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Corrective Action Plan

Kuhlman Electric Corporation Facility
Crystal Springs, Mississippi

15 March 2011

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Kuhlman Electric Corporation Facility
Crystal Springs, Mississippi

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AS	Air Sparge
bgs	Below Ground Surface
CAP	Corrective Action Plan
CoC	Chemical of Concern
CSM	Conceptual Site Model
CT	Carbon Tetrachloride
ft/day	feet per day
ft/ft	foot per foot
ft/year	feet per year
HASP	Health and Safety Plan
ISCO	In-situ Chemical Oxidation
KEC	Kuhlman Electric Corporation
K_{oc}	Organic Carbon-to-Water Partitioning Coefficient
K_{ow}	Octanol-to-Water Partitioning Coefficient
MDEQ	Mississippi Department of Environmental Quality
MNA	Monitored Natural Attenuation
O&M	Operations and Maintenance
PCB	Polychlorinated Biphenyls
PLC	Programmable Logic Control
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
ROI	Radius/Radii of Influence
SIM	Selected Ion Method
SVE	Soil Vapor Extraction
TRG	Target Remediation Goal
µg/L	Micrograms per Liter
USEPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Constituent/Compound

1. Introduction

This Corrective Action Plan (CAP) describes activities to remediate groundwater impacts from the Kuhlman Electric Corporation (KEC) facility (the site) located in Crystal Springs, Mississippi (Figure 1). The KEC facility was constructed in the 1950s and has operated as an electric transformer manufacturing plant since that time. The future of the property is expected to remain industrial. This CAP was prepared on behalf of KEC in response to the Mississippi Commission on Environmental Quality Order No. 4449-02, issued to KEC on July 23, 2002. A preliminary groundwater assessment was performed at the KEC facility in 2004 (Martin & Slagle 2004) and was followed by a comprehensive assessment completed in 2009 (Martin & Slagle 2009). The assessments found that polychlorinated biphenyls (PCBs) were not migrating to groundwater but that certain volatile organic compounds and degradation products (VOCs) associated with the manufacturing processes were, notably, 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethene (1,1-DCE), and 1,4-dioxane. The assessments identified a VOC plume extending southwest from the KEC site. This CAP addresses a proposal for remediation of the source area and the VOC impacts to groundwater.

1.1 Objectives/Rationale

As described in the groundwater assessment report (Martin & Slagle 2009), the source of groundwater contamination at the KEC site has been identified beneath the southwest corner of the KEC manufacturing building (Figure 2). Soil beneath the floor slab in this area contains the following chemicals of concern (CoCs): 1,1,1-TCA, 1,1-DCE, 1,4-dioxane, and carbon tetrachloride (CT). The approximate extent of soil impacts is shown on Figure 3. Contaminants have migrated downward through unconsolidated sediments to groundwater. Contaminant migration has continued via the groundwater flow pathway off the facility property to the southwest with a portion of the plume also moving south (Figure 4). The 1,1-DCE plume extends approximately 2,800 feet southwest and 2,600 feet south of the KEC property boundary (Figure 5). The smaller 1,4-dioxane plume is contained within the limits of the 1,1-DCE plume.

The general objective of corrective action for VOC impacts to groundwater at the KEC site is to mitigate the risk of any potential CoC exposure to human and environmental receptors above risk-based standards. Specific objectives are the following:

1. Ensure CoC concentrations in soil and groundwater in the contaminant source area beneath the KEC manufacturing building are at levels protective of site workers.

2. Reduce CoC concentrations in soil in the contaminant source area beneath the KEC manufacturing building to the extent that remaining concentrations no longer contribute to, or exacerbate, CoC concentrations in off-site groundwater.

3. Reduce CoC concentrations in off-site groundwater to levels protective of downgradient groundwater receptors.

To achieve these objectives, this CAP proposes to design, construct, and operate an air sparging (AS) and soil vapor extraction (SVE) system in the contaminant source area beneath the KEC manufacturing building to reduce CoC concentrations in on-site soil and groundwater. Monitored natural attenuation (MNA) is proposed for the off-site groundwater contaminant plume to track the expected decrease in CoC concentrations in groundwater resulting from the reduction of CoCs in the contaminant source area beneath the KEC manufacturing building. This CAP also includes contingencies for expanding active treatment into the off-site plume, as necessary, to ensure MNA is viable.

2. Conceptual Design

An adaptable remedy is proposed that will be designed to meet the risk based clean up objectives for the source area beneath the KEC manufacturing building and groundwater plume in a reliable and cost effective manner. This section of the CAP provides an overview of the proposed remedy's conceptual design. In order to better understand the design basis for the proposed remedy, a concise summary of the Conceptual Site Model (CSM) is provided in Section 2.1. The CSM has been used to define the extent of soils and groundwater that will be subject to treatment by the proposed remedy (Section 2.2). The anticipated effectiveness of applicable remediation technologies considered for addressing soil and groundwater impacts will be further discussed in Section 2.3. An overview of the proposed remedial approach, developed based on current understanding of site conditions and technology effectiveness expectations, is provided in Section 2.4. A discussion of the pre-design activities that will be performed in order to validate the viability of the proposed approach and guide the subsequent installation and implementation requirements is presented in Section 2.5.

2.1 Conceptual Site Model

In order to understand how the proposed remedial approach will be used to meet the closure objectives for this project, it is important to understand how the current extent of CoC impacts has evolved in light of site-specific conditions. The CSM provides a basis for understanding the nature and extent of CoC fate and transport, and identifies how these impacts can potentially affect receptors. It depicts the site and its environment(s) and delineates potential chemical sources, chemical release and transport mechanisms, affected media, migration routes, and potential human and ecological receptors. Ultimately the CSM provides a framework for problem definition and aids in the identification of data gaps. More importantly, it identifies key exposure pathways and associated media on which to focus assessment and remediation activities. Those elements of the CSM considered most applicable to understanding the extent of cleanup and establishing the basis for the proposed remedy are discussed below. This information has been condensed from the investigation data. The information provided in this report is the basis for this short data summary and the conceptual site model descriptions below.

2.1.1 Site Geology and Hydrogeology

The geology of the site consists of unconsolidated sediments to approximately 111 feet below ground surface (bgs). Silts and clays of low plasticity occupy the upper horizons (2 to 16 feet bgs) and are underlain by interbedded fine sands, sandy gravel, silty sand, and thin layers of plastic clay.

The water table at the site exists at approximately 62 feet bgs in the unconsolidated sediments. Groundwater flow is to the southwest and south with an average hydraulic gradient of 0.0032 foot/foot (ft/ft). Hydraulic conductivities range from 7.5 to 44 feet per day (ft/day) with an average of 27 ft/day based on slug tests. Vertical gradients are minimal.

The City of Crystal Springs has five municipal wells screened in the upper, unconsolidated aquifer and located 2,400 feet to 7,200 feet south and southwest of the KEC site. Pumping of these municipal wells does affect the groundwater flow direction within the study area. Two other municipal water supply wells are located farther to the southeast and are screened in the lower aquifer. These two deeper municipal wells do not appear to influence the groundwater flow in the upper aquifer.

2.1.2 Nature and Extent of Contamination

A series of site assessments was conducted between 2004 and 2008 to define the nature and extent of contamination in the study area. The assessments included soil, groundwater, and soil gas sampling. The impacts identified are related primarily to the use of 1,1,1-TCA at the KEC site.

Compounds detected in soils above unrestricted Mississippi Department of Environmental Quality (MDEQ) Target Remediation Goals (TRGs) are limited to the source area located beneath the KEC facility and are the following: 1,1,1-TCA, 1,1-DCE, 1,4-dioxane, and CT.

1,1-DCE is a breakdown product of 1,1,1-TCA and 1,4-dioxane is a compound that was commonly used as a stabilizer in 1,1,1-TCA. The primary source compound, 1,1,1-TCA, has attenuated to concentrations below TRGs in both soil and groundwater. Figure 3 depicts the approximate lateral extent of all CoC impacts in soil above TRGs. The extents are based primarily on 1,1-DCE concentrations, because 1,4-dioxane and CT are limited to detections in individual direct push borings contained within the bounds of the 1,1-DCE delineation.

The soil vapor survey results generally correlate with the vadose zone soil results and supplement the delineation of potential soil sources that could result in vapor intrusion or soil-to-groundwater contaminant migration.

Compounds detected in groundwater above TRGs beneath the KEC facility are the following: 1,1-DCE, 1,4-dioxane, 1,1,2-trichloroethane (1,1,2-TCA), and 1,2-dichloroethane (1,2-DCA).

Figure 4 depicts the approximate lateral extent of all groundwater impacts to groundwater exceeding TRGs within the study area. The impacts are based primarily on 1,1-DCE and 1,4-dioxane concentrations, because the 1,1,2-TCA and 1,2-DCA constituents attenuate in groundwater to concentrations below TRGs prior to reaching the property boundary. The only compounds currently off site above TRGs in groundwater are 1,1-DCE and 1,4-dioxane. The 1,1-DCE plume extends from the KEC property west approximately 2,800 feet and southwest approximately 2,600 feet, whereas the 1,4-dioxane plume generally resides within the limits of the 1,1-DCE plume (Figure 5). Groundwater is impacted to depths of 85 to 100 feet bgs.

Previous investigations have determined that the average total porosity of the unconsolidated aquifer sediments is 43% (Martin & Slagle 2009). Groundwater flow and advective contaminant transport occurs through the migratory, interconnected pore spaces, commonly termed the mobile or effective porosity. During plume advancement, dissolved VOCs migrating in groundwater through the interconnected mobile pore spaces diffuse into the immobile pore spaces. No site-specific data for mobile porosity have been collected, but based on the lithology types encountered, it is reasonable to assume the average (mobile or effective) porosity, indicative of groundwater transport, likely ranges between 10 and 20%. The average groundwater flow velocity, based on average hydraulic conductivity, gradient, and anticipated mobile porosity values, is approximately 250 feet per year (ft/year). Actual dissolved contaminant plume velocities are typically much less, depending on a variety of fate and transport mechanisms (e.g., adsorption, retardation, biodegradation, and diffusion) governed in part by site conditions and chemical characteristics. For this study area, 1,1-DCE plume is migrating at a much slower rate than natural flow rate of the groundwater. 1,4-Dioxane, on the other hand is miscible in water, and has a relatively low partitioning coefficient (K_{oc}), so it does not exhibit significant sorption to organic matter in the aquifer matrix. Moreover, 1,4-dioxane does not biodegrade significantly under natural conditions; consequently, its primary attenuation mechanisms in groundwater are dispersion and dilution. As a result of these characteristics, the 1,4-dioxane plume, while also slower moving than groundwater, is likely advancing at a faster rate than the 1,1-DCE plume.

The highest core concentrations of 1,1-DCE and 1,4-dioxane are currently located off site, approximately 400 to 600 feet downgradient in the vicinity of Monitor Wells MW-11A/B and MW-15A/B. Concentrations of 1,1-DCE are approximately 7 to 15 times the TRG of 7 micrograms per liter (µg/L) in this core while concentrations of 1,4-dioxane are generally only 2 times the TRG of 6.09 µg/L. Concentrations in the KEC site source area and at the toe of the plume are generally stable to decreasing; however, the core of the mass appears to be moving within the study area.

1,1-DCE and 1,4-dioxane were detected in the Crystal Springs municipal Well No. 7 in November 2005. Well No. 7 was subsequently shut down and the remaining municipal wells and combined influent water supply flow to the municipal treatment plant have been monitored monthly since that time. Over the course of the monthly monitoring program, 1,1-DCE and 1,4-dioxane have been detected at concentrations below laboratory reporting limits in groundwater from Well No. 1. The detections in Well No. 1 have all been below the 1,1-DCE and 1,4-dioxane TRGs. No 1,1-DCE or 1,4-dioxane has ever been detected in the combined influent water supply line to the water treatment plant. The CoC concentrations in sentinel Monitor Wells MW-25 and MW-27, installed upgradient of the water supply wells, have been declining or non-detect since shutting down Well No. 7. Sampling of sentinel Well MW-26 identified CoC detections below laboratory reporting limits (and below TRGs) in this well in 2009 and 2010. The CoC concentrations in this well have historically been below laboratory detection limits. In response to the apparent rise in CoC concentrations, sentinel Wells MW-28 and MW-29 were installed in 2009. Sampling of these two sentinel wells has not identified detectable CoCs in groundwater at these locations. Based on the evaluation of spatial and temporal CoC trends in the sentinel wells to date, there is likely a contributing source to 1,1-DCE and 1,4-dioxane groundwater impacts located between the off-site groundwater plume originating from the KEC site and the municipal well field. Trends from these wells will be evaluated during the initial period of performance. If additional data warrant further investigation of a potential source unrelated to the KEC plume, this investigation will need to be conducted by MDEQ or the third party (or parties) responsible for this source.

During the previous groundwater assessments, petroleum hydrocarbons (benzene and naphthalene) were detected above their TRGs in groundwater from MW-19 and in Waterloo Profiler samples collected at/near the intersection of U.S. Highway 51 and West Georgetown Street. The petroleum hydrocarbon detections are likely attributable to the present and historical commercial gasoline stations located in the vicinity of these sample locations and are not associated with the KEC plant activities. Further investigation and/or remediation of these petroleum impacts will need to be conducted by MDEQ or the parties responsible for these impacts.

2.1.3 Exposure Pathway Considerations

Exposure can occur only when the potential exists for a receptor to directly contact released constituents or when a mechanism exists for the released constituents to be transported to a receptor. Without exposure, there is no risk. All potential exposure pathways for the site have been combined into an integrated and dynamic exposure model. The exposure pathway evaluation presented on Figure 5 indicates potentially complete and incomplete pathways and represents the cumulative information needed to evaluate whether exposure pathways warrant further consideration. Complete pathways are designated by a solid dot, while an open space designates incomplete or minor pathways. The exposure pathway evaluation is based on site-specific information that combines information on primary sources of constituents, constituent release mechanisms, transport media, potential receptors, exposure routes, and potentially complete exposure pathways.

The VOC impacts in the upper groundwater aquifer of Crystal Springs, which are the subject of this CAP, stem from releases associated with the KEC manufacturing facility. The groundwater isoconcentration maps plainly show the beginning of the plume of VOCs starting at the southwest corner of the KEC manufacturing facility. The VOCs migrated downward through the sands beneath the KEC manufacturing facility until they reached the upper groundwater aquifer. Migration continued via the groundwater flow path to the southwest.

2.2 Extent of Cleanup

Corrective action is proposed based on the current understanding of impacts and in a manner that is consistent with the CAP objectives. The approximate extent of aggregated soil and groundwater impacts subject to this CAP are presented on Figures 3 and 4. From a geographic perspective, a remediation strategy is proposed that will satisfy (1) on-site objectives related to treatment of the source area impacts to soil and groundwater beneath the KEC manufacturing facility floor, and (2) off-site objectives pertinent to mitigation of groundwater impacts related to the KEC site. These objectives are further explained in Section 1.1 and Section 5.

2.3 Proposed Technologies

In support of developing this CAP, ARCADIS screened a range of applicable remediation technologies for treatment of the CoCs in question. There are multiple remediation technologies involving treatment via physical, chemical, and biological processes that could be employed to meet anticipated remediation objectives for the study area. However, given the relative magnitude and extent of impacts, physical constraints posed by the source location, and the subsurface geology, many of these technologies are either less desirable or cost-prohibitive relative to others capable of delivering comparable results. The relative distribution and extent of 1,4-dioxane impacts beneath the KEC manufacturing facility floor are of note due to the physical and chemical characteristics of 1,4-dioxane, which is a relatively recalcitrant compound to treat. As a result, many of the individual technologies, which would otherwise be capable of addressing the source area CoCs at the KEC site and the off-site 1,1-DCE plume, may have limited applicability toward treating the 1,4-dioxane. Implementation of multiple technologies may be necessary in order to achieve all of the CAP objectives.

Technologies aimed at addressing the source area will be designed to address both soil and groundwater as an aggregate media, with performance objectives based on achieving the restricted Tier 1 TRGs (for industrial sites). The source area soils will be treated to the extent required to ensure the numerical groundwater standards can be met, and reliably maintained following treatment, at the KEC property boundary. The technologies aimed at addressing the off-site groundwater impacts will be designed to meet the numerical groundwater standards for Tier 1 unrestricted TRGs as described in Section 5.

Specific technologies are best suited for meeting the CAP objectives. The following provides an overview of how and why these technologies are being proposed for this project.

2.3.1 Soil Vapor Extraction (SVE)

SVE is proposed for purposes of direct physical treatment of the source area (impacted, unsaturated zone soils) beneath the KEC manufacturing facility building, as well as air sparging as a complementary technology. It is anticipated that the underlying soils are amenable to successful and effective application of this technology. This technology is also well suited to treat the majority of the CoCs that are either directly, or indirectly affecting groundwater quality beneath and downgradient from the KEC manufacturing facility building, with 1,4-dioxane being the possible exception. Further considerations are summarized as follows:

- Application of SVE to treat the source area will have an immediate impact on reducing the concentrations of 1,1-DCE and CT in soils.

- The 1,1,1-TCA soil concentrations do not presently exceed the Tier 1 TRGs for soil; however, its daughter products (1,1,2-TCA and 1,2-DCA) are currently exceeding the Tier 1 TRGs for groundwater on site. One of its daughter products, 1,1-DCE, also exceeds Tier 1 TRGs for groundwater off site. The 1,1,1-TCA is also highly susceptible to treatment by SVE. Accordingly, the SVE technology will further reduce any residual 1,1,1-TCA concentrations, and will likely have an immediate indirect impact on the ability to achieve the on-site treatment objectives for 1,1,2-TCA and 1,2-DCA, as well as the off-site treatment objectives for 1,1-DCE.

- SVE is expected to have a moderate to high impact on removing 1,4-dioxane from the soils beneath the KEC manufacturing facility building. This CoC typically migrates through soil and enters groundwater rapidly because it has a relatively high solubility and boiling point, and a low octanol-to-water partitioning coefficient (i.e., Log K_{ow}) and Henry's Law constant. When it is present in soil, however, its physical properties indicate that it is volatile enough to be removed in situ using SVE, even though its vapor pressure is lower than many other VOCs. The observed extent of 1,4-dioxane in soils above the Tier 1 TRG is limited to one borehole location. Given the magnitude and extent of 1,4-dioxane impacts in the source area (unsaturated zone soils), use of this technology to remediate the other VOCs (i.e., 1,1-TCA, 1,1-DCE, 1,1,2-TCA, and 1,2-DCA), will also mitigate the residual 1,4-dioxane concentrations in the unsaturated zone soils such that the qualitative risk-based treatment objective for 1,4-dioxane can be achieved.

2.3.2 Monitored Natural Attenuation

MNA should play an instrumental role in this project. Given the current size of – and relatively low concentrations within – the off-site plume, to the extent MNA can be demonstrated to be reliable; it may prove more desirable than a more aggressive, active treatment technology. Further considerations are summarized as follows:

- Typically MNA relies upon one or more of several naturally occurring physical processes, including advection, dispersion, dilution, diffusion, volatilization, sorption/desorption, as well as naturally occurring biodegradation or chemical transformation reactions.

- The off-site 1,1-DCE plume appears to be stable at this time. Predominant mechanisms for further reducing concentrations of 1,1-DCE will be the physical MNA processes, although to a lesser extent biological degradation to vinyl chloride and chemical transformation to carbon dioxide may continue to play a role in the natural attenuation of this CoC. The proposed remedy will entail collection and evaluation of geochemical data during the initial monitoring period for purposes of qualifying the relative significance of biodegradation on plume fate and transport.

- The off-site 1,4-dioxane plume appears to be unstable at this time. This CoC is not particularly susceptible to biological degradation. Therefore, the MNA strategy for 1,4-dioxane will require reduction of the source area concentrations to meet the objectives of the cleanup goal. This will in turn reduce the potential for ongoing contributions to the off-site plume. Absent an ongoing source, the off-site 1,4-dioxane plume is expected to stabilize, followed by declining magnitude and extent of impact over time.

- Ultimately whether or not more active off-site treatment is warranted will depend upon (1) the ability of the source area remedy to reduce concentrations of the source area CoCs to the extent the off-site plumes become stable, and (2) once determined stable, whether or not naturally occurring processes are able to continue to reduce the overall footprint of the plumes over a reasonable time period. Even if active treatment of the off-site plumes is warranted, MNA will still play a critical role in reducing the scale/scope of any off-site in-situ remedy.

2.3.3 Air Sparging (AS)

In-situ AS is proposed for purposes of direct physical treatment of dissolved phase CoC impacts beneath the KEC manufacturing facility building, with potential expansion, as necessary, to help treat selected areas of the off-site CoC plumes. Aquifer impacts at the site appear to be amenable to successful and effective application of this technology. It is also well suited to treat the majority of the CoCs that are currently exceeding the TRGs for groundwater, both on and off site, with 1,4-dioxane being the possible exception. Further considerations are summarized as follows:

- Application of AS beneath the KEC manufacturing facility building will have a direct and immediate impact on reducing the concentrations of 1,1-DCE, 1,1,2-TCA, and 1,2-DCA.

- The AS technology will have limited to moderate impact on the dissolved phase 1,4-dioxane concentrations. Once 1,4-dioxane becomes dissolved in water it is relatively difficult to treat. This CoC has only recently come under scrutiny and evaluation by regulatory agencies; as a result, the track record for in-situ treatment within the environmental industry is relatively limited. Ongoing studies by the environmental industry as a whole tend to suggest there are few technologies available to effectively and consistently remediate 1,4-dioxane in situ.

- Nonetheless, some studies have shown moderate success at treatment by AS. ARCADIS has actually been able to demonstrate significant reductions (between 50 and 80%) in dissolved phase 1,4-dioxane concentrations at other sites by using this technology. Ultimately, we expect that the successful application of AS to treat the 1,4-dioxane will be constrained by site-specific considerations. At this time it is reasonable to assume that AS could prove successful at reducing the source area concentrations to the extent that off-site MNA is sustainable and CAP objectives can be met.

2.4 Remedial Approach

During the technology screening process, those technologies which were determined to be potentially effective were grouped and sequenced in a manner designed to meet the project objectives. The proposed grouping, sequence, and implementation of multiple technologies are considered as remediation alternatives. ARCADIS also evaluated several alternatives, based primarily on their relative ability to reliably satisfy all CAP objectives. Supplemental evaluation criteria were also considered, namely:

1. Relative short-term and long-term treatment effectiveness of the individual technologies and the overall reliability of the aggregate alternatives.

2. Relative complexity of implementation with respect to physical access, site-specific constraints, stakeholder limitations, and regulatory considerations.

3. Relative cost considerations as they relate to overall lifecycle cost, capital expenditure, operation, maintenance, and monitoring costs, technology contingency costs, and potential cost uncertainty.

Ultimately the remedial alternatives evaluation was used to refine the technical basis and rationale for the proposed remedial approach set forth in this CAP. A risk-based, adaptive approach is proposed to remediate the source area beneath the KEC manufacturing facility building and the off-site groundwater impacts. The remainder of this CAP provides the framework for how the proposed approach would be implemented, including an overview of the anticipated schedule, pre-design requirements, performance monitoring expectations, and a discussion of key project milestones and the decision process used to make implementation or operation decisions (e.g., whether or not contingency plans warrant implementation).

As stated in Section 2.3, all of the proposed technologies have limitations in application or efficiency. Therefore, knowing the advantages and limitations to a particular technology and using them selectively or in sequence is crucial. Technology sequencing will prove to be a critical component to the overall strategy of meeting closure objectives for this project. The overriding strategy would be to apply and sequence remediation technologies in a manner that maximizes the treatment efficiency and focuses primarily on treating the CoCs and hydrostratigraphic units that are contributing to off-site risks, while balancing remedy costs over the lifetime of the project.

The two primary drivers for off-site risk are 1,1-DCE and 1,4-dioxane. The off-site 1,1-DCE plume appears to be stable. The off-site 1,4-dioxane plume, while less extensive in area than the 1,1-DCE plume, appears to be increasing in size/extent. It is important to reiterate that the 1,4-dioxane plume concentrations are only slightly above the Tier 1 TRG. Given the current state, extent, and configuration of the off-site plumes, a relatively aggressive approach toward remediation of the source area impacts is suggested, coupled with an adaptive MNA approach for the off-site plumes.

The proposed approach is outlined as follows:

1. Design, install, and operate an AS/SVE system to treat soil and groundwater impacts in the source areas beneath the KEC facility building and on the KEC property.

   - The primary treatment objective of this technology will be to treat the VOC-impacted source area beneath the building responsible for the off-site 1,1-DCE plume.

   - This technology may only have a limited impact on reducing the 1,4-dioxane concentrations in the source area. However, given that downgradient 1,4-dioxane concentrations are only slightly exceeding the Tier 1 TRGs, AS/SVE in the source area may mitigate future 1,4-dioxane contributions to the off-site plume.

   - The source area AS/SVE system will be designed, constructed, and operated in a manner designed to achieve aggressive treatment goals. The SVE remedy component will target a minimum pore volume exchange rate throughout the source area soils of approximately one pore volume per day. The AS component will target complete/overlapping treatment of the impacted extent of the saturated zone in the upper aquifer.

2. In the event more aggressive source area treatment is needed to control/mitigate the off-site CoC contributions to groundwater, implementation of a contingency treatment technology in the source area to further treat any recalcitrant CoCs (e.g., 1,4-dioxane may be appropriate). Source area in-situ chemical oxidation (ISCO) may be considered as a contingency technology, implementation of which will be dictated or refined based on the success of the physical (i.e., AS/SVE) treatment efforts.

3. Rely on MNA initially for the off-site plumes.

   - The success of the overall remedy will depend largely on how the off-site plume responds to aggressive source area treatment. During the initial period of performance, off-site monitoring will be used to further assess whether or not CoC concentrations stabilize (in the case of 1,4-dioxane), remain stable (in the case of 1,1-DCE), and/or demonstrate an appreciable decline in concentration in response to the on-site efforts.

   - This monitoring period would also be used to evaluate and further assess how pumping operations by the Crystal Springs water system are affecting plume migration.

4. In the event off-site MNA is not a viable long-term solution, expand the in-situ technologies to treat off-site groundwater. In-situ treatment of the off-site plumes would be considered a contingency alternative; actual implementation of AS/SVE and/or an alternative technology would depend in part on technology demonstration/performance in the source area.

5. The need for off-site treatment would likely be determined based on the stability of the 1,4-dioxane plume as source area treatment with AS/SVE progresses. If it turns out the 1,4-dioxane plume is not stabilizing in a manner amenable to long-term MNA, in-situ measures would be considered to treat the off-site plume to the extent necessary to ensure MNA viability.

2.5 Pre-design Requirements

As will be discussed in Section 5, the proposed remediation objectives are based primarily on achieving unrestricted Tier 1 TRGs in groundwater, with the expectation that on-site soil treatment will be performed to the extent groundwater objectives can be met. While it is anticipated that unrestricted Tier 1 TRGs for soils will be readily met during implementation of this remedy, it is likely that more thorough risk evaluation is necessary to definitively rule out the need for quantitative, numerical cleanup goals for soils. Following MDEQ's approval of this CAP, a more thorough Tier 2 risk evaluation should be performed to develop site-specific, restricted TRGs for soils.

As discussed in Section 2.4, the proposed approach relies upon aggressive source area in-situ treatment using AS/SVE. In order to adequately design and implement these technologies, a pilot study is proposed for purposes of refining the design criteria that will be used to determine AS/SVE well placement, injection and extraction flow requirements, mechanical and electrical component needs, and other operational considerations. The AS/SVE pilot study would entail installation of an AS/SVE well pair and several pilot observation wells. Short-term step testing, using temporary skid mounted equipment, would be used to estimate achievable AS treatment extents (i.e., radii of influence [ROIs]) at a range of pressures and flows. Step testing would also be used to determine achievable vacuum ROIs under a range of applied vacuums and extraction flow rates from the SVE well. The vacuum observations would be used to estimate pneumatic conductivity of the vadose zone soils. The pneumatic conductivity would be used, in turn, to model extraction flow requirements, and refine full-scale SVE well placement, in order to achieve optimal pore volume exchange rates throughout the source area treatment extents. The pilot test would also be used to conservatively assess potential VOC emission rates during full-scale operation of the AS/SVE system. These data would be used to assess emission permit requirements in context of allowable thresholds and to determine if and how emission controls need to be factored in to the full-scale design.

3. System Components

A general description of system components is provided in the subsections below. The actual construction details, and the extent to which these components are installed, will be refined. Additional consideration will need to be given to access constraints posed by installation in an active manufacturing facility.

3.1 AS Wells

Source area treatment of groundwater is proposed using in-situ AS. While the exact placement and number of AS wells required in the source areas is subject to pilot test determinations and KEC facility constraints, a source area remedy would require installation of approximately 23 AS wells, as shown on Figure 6. AS wells will be constructed with 2-foot long, machine slotted, screen intervals, installed to an approximate total depth of 90 feet bgs, and will target treatment of the impacted extent of the saturated unconsolidated sediments. Wells will be spaced in a manner designed to achieve overlapping AS treatment ROIs throughout the entire source area when operating under the optimal flow rates, as will be determined by the pilot test. Preliminary expectations are that the source area AS wells would be spaced approximately 35 to 40 feet apart, and that well locations/spacing would need to be adjusted to minimize obstructions to KEC manufacturing operations. The wells will be constructed using a combination of 1-inch and 2-inch diameter, Schedule 40 polyvinyl chloride (PVC) materials, and the annular borehole space above the well screens will be sealed using a compressed bentonite product with a high expansion ratio.

As described in Section 2.4 and Section 9, this remedy may require future expansion of AS treatment into off-site areas. In the event AS treatment is required downgradient, any AS wells installed in support of this type of expansion would be drilled and constructed similarly to the source area wells. However, these wells would likely be installed in a transect fashion, as opposed to the grid approach that is planned for the source area beneath the KEC manufacturing facility building. The transect orientation would entail placement of a line, or curtain, of AS treatment wells in a manner designed to intersect plume migration through areas (e.g., zones, depths) of preferential migration where the off-site contaminant mass flux is greatest.

3.2 SVE Wells

Source area treatment of residual soil impacts is proposed using SVE. The SVE will also be used to capture vapors from the AS system. The exact placement and number of SVE wells required in the source areas would be subject to pilot test determinations and KEC facility constraints; however, at this time ARCADIS anticipates the source area remedy would entail installation of approximately 10 SVE wells, as shown on Figure 6. SVE wells will be constructed with 50- to 70-foot long, 2-inch diameter, stainless steel wire-wrapped well screen intervals and will be installed into the saturated reach of the upper aquifer, to an approximate total depth up to 80 feet bgs.

Extending the screens into the saturated zone will ensure the wells are able to directly influence soils in the capillary fringe, as well as any adsorbed phase impacts that are periodically exposed during periods of low water table elevation. Based on a preliminary evaluation of the anticipated range of vacuum and flow requirements and the anticipated open screen area, it does not appear that submerging the lower screen interval would present a significant entrainment concern at this site. If during pilot testing it appears that submerging the lower end of the screen interval could prove problematic, appropriate adjustments to the anticipated construction details would be made.

Wells will be spaced in a manner designed to achieve overlapping SVE treatment ROIs throughout the entire source area when operating under the optimal flow rates, as will be determined by the pilot test. Preliminary expectations are that the source area SVE wells would be spaced approximately 70 to 80 feet apart, and that well locations/spacing would need to be adjusted to minimize obstructions to KEC manufacturing operations.

As described in Section 2.4 and Section 9, this remedy may require future expansion of AS/SVE treatment into off-site areas. In the event AS treatment is required downgradient of the KEC plant property, SVE wells would be installed as warranted to manage the collection of AS vapors. Any SVE wells required for this purpose would likely be drilled and constructed in a manner similar to the source area SVE wells.

Given the anticipated number of SVE wells, ARCADIS believes that vertical wells are the most desirable means for treating impacted soils, and collecting AS vapors.

However, we also recognize that targeting treatment beneath the existing KEC facility building may present a number of physical implementation constraints. Evaluation of horizontal or directionally drilled wells are a more cost-effective and less intrusive means for accomplishing the AS/SVE treatment objectives may be appropriate.

3.3 Engineered Treatment Systems

The AS/SVE system proposed by this CAP will entail forced air delivery and extraction using above grade electrical and mechanical systems. A design effort would fully evaluate how these systems can be installed within and/or beneath the active manufacturing facility without obstructing manufacturing operations. Well field piping systems would optimally be installed overhead or above grade on pipe rack systems. AS distribution and SVE conveyance piping would be sized in a manner to minimize pressure and vacuum losses at the anticipated flow rates; centralized flow control and monitoring manifolds would distribute/collect air from the AS/SVE well field. The flow control manifolds would be co-located with the mechanical systems and individual well piping runs would be extended throughout the plant and connected to the individual wells.

The AS/SVE manifolds will be capable of monitoring, adjusting, and distributing flow from the entire SVE well network. The AS manifold will be equipped with automated pulsing capabilities. The SVE manifold will be capable of manually operated selective extraction in the event focused SVE extraction or cycling is warranted. The SVE equipment will collect extracted vapors from the manifold and convey them through a level controlled liquid separator and inlet filter installed prior to the blower inlet.
A separate filter/silencer will be installed on the discharge side of the SVE blower and extracted vapors will be routed through a discharge stack. At this time, no emission control technologies are expected to be necessary. The size and type of blower used will also be determined based on pilot test determinations. The SVE blower would be sized in a manner to ensure adequate capacity for expansion should the need arise. The blower motor will be equipped with a variable speed drive, and the SVE control systems will be interlocked using process logic control (PLC) based programming.

The AS treatment system would be installed using a skid mounted compressed air package. The size and type of compressor used will be determined during the ensuing design effort, and will be specified in a manner to ensure the system is capable of providing higher flow in the event future expansion of the well field is necessary. Depending on the type of compressor used, the system will be equipped with coalescing filters, heat exchangers, and receiver tank components, as warranted, to ensure delivery of oil-free, clean, dry air to the AS injection manifold. The AS equipment operation, and well field pulsing controls, will be integrated into the SVE control panel. The AS/SVE control systems will be equipped with remote monitoring capabilities for purposes of communicating system status, alarm conditions, and basic real-time operating conditions. Collection, control, and mitigation of fugitive vapors merit critical consideration during the design, installation, and operation of the AS/SVE systems. The control systems will include instrumentation and interlocks designed to monitor fugitive vapor concerns within occupied areas and shut down the system in the event fugitive vapors are detected at levels that pose a risk to worker health and safety. ARCADIS will also include pertinent provisions in the Health and Safety Plan (HASP).

4. Schedule

A Gantt chart showing the proposed project schedule is provided in Appendix A. All activities listed in Appendix A are contingent on MDEQ approval of this CAP. The intent will be to adhere to the approved pre-design, design, and construction schedule for the initial AS/SVE and monitor well installations as closely as feasible.

Following installation of the AS/SVE system, periodic operation, maintenance, and performance monitoring on the source area systems would be required. The performance monitoring program would be used to assess AS/SVE performance, which would in turn be used to (1) identify opportunities for optimization of the installed systems, and (2) determine if implementation of the contingency treatment measures are necessary. The operation, maintenance, and monitoring period will continue through the duration of active treatment, until such time the treatment objectives for these systems have been met.

The initial schedule provided in Appendix A includes anticipated periods of performance for active treatment using AS/SVE, as well as potential timeframes for deploying contingency installations. However, it should be noted that given the adaptive nature of this remedial approach, many of the post-construction elements of the schedule will be tied largely to remedy performance. The intent is to rely on assessment of performance monitoring data to determine if the initial schedule projections are reliable and if adjustments to schedule expectations are warranted. Once the initial systems are installed, treatment is underway, and a body of remedy performance data is established, the schedule should be re-assessed. Periodic schedule adjustments may be necessary.

5. Remedial Goals

MDEQ has established risk-based soil and groundwater standards known as Tier 1 TRGs. VOC contamination in soil above the groundwater table is confined to the contaminant source area beneath the KEC manufacturing building. Maximum concentrations of 1,1-DCE, 1,4-dioxane, and CT detected in soil exceed unrestricted TRGs (Martin & Slagle 2009). Maximum concentrations of 1,1-DCE and CT also exceed restricted TRGs. Corrective action objectives for soil remediation in the contaminant source area (Section 1.1) include both reducing CoC concentrations to reduce any potential on-site worker exposures and reducing CoC concentrations to the extent that remaining concentrations no longer contribute to or exacerbate CoC concentrations in off-site groundwater.

The KEC facility continues to operate and the site is expected to remain industrial in the future. Consequently, Tier 1 restricted TRGs may be appropriate for soil remediation in the contaminant source area to address any potential for worker exposure. Concentrations of CoCs in soil that are protective of off-site groundwater have not been established. At this time, soil remediation to Tier 1 restricted TRGs is proposed as protective of both on-site workers and off-site groundwater. However, additional site-specific risk evaluation may be warranted to establish more appropriate remedial goals for soil in the contaminant source area at the KEC facility.

Concentrations of 1,1-DCE, 1,4-dioxane, 1,1,2-TCA, and 1,2-DCA in on-site groundwater beneath the contaminant source area currently exceed Tier 1 TRGs (Martin & Slagle 2009). However, only 1,1-DCE and 1,4-dioxane concentrations currently exceed Tier 1 TRGs in off-site groundwater. The corrective action objective for groundwater remediation in the on-site contaminant source area is to reduce CoC concentrations to address any potential for on-site worker exposure (Section 1.1). The objective for off-site groundwater remediation is to reduce CoC concentrations to address any potential downgradient groundwater receptors.

Currently, groundwater from the impacted upper, unconfined aquifer downgradient of the KEC facility is pumped for municipal use. Consequently, remediation to Tier 1 TRGs for off-site groundwater is appropriate. Remediation to Tier 1 TRGs may also be appropriate for on-site groundwater due to the close proximity of the contaminant source area to the property boundary. At this time, remediation to Tier 1 TRGs for on-site groundwater is proposed, although additional site-specific risk evaluation may be warranted to establish more appropriate remedial goals for on-site groundwater at the KEC facility. The initial AS/SVE implementation phase and quarterly monitoring period should be complete before cleanup standards for groundwater on site are established.

6. Operation and Maintenance (O&M) Plan

A Proposed O&M plan for all AS/SVE treatment equipment would be prepared during the design of the treatment system. In addition to detailing system operating instructions, the O&M plan will detail equipment maintenance requirements. The level of detail will be sufficient for ensuring proper and efficient treatment throughout the life of the project. The proposed O&M plan will include a system maintenance schedule, detailing manufacturer recommended mechanical and electrical maintenance requirements based on equipment hours of operation, and will also document equipment make, model, troubleshooting, and manufacturer contact information for all treatment system components. A copy of the O&M plan will be provided to MDEQ prior to the initiation of startup and full-scale operation of the AS/SVE system.

In the event supplemental treatment using ISCO is warranted, the O&M plan would be amended as appropriate to detail O&M requirements for the various ISCO components. The need for ISCO system O&M amendments would be re-assessed and prepared during the design of this remedy expansion and, if necessary, an amended O&M plan would be provided to MDEQ prior to initiation of ISCO activities.

7. Performance Monitoring Plan

The primary objective of AS/SVE operation is to remove as much CoC mass from the subsurface as effectively as possible, thereby reducing or eliminating source loading to groundwater. Physical removal of CoCs from the subsurface can be expected to progress in an asymptotic manner, with maximum removal rates observed during the initial treatment period, followed by decline to a lower threshold level that may or may not include detectable CoC concentrations. Moreover, the rate of decline is expected to decrease over time. The AS/SVE system effectiveness will be determined by (1) the rate and magnitude of this decline, (2) the ability to obtain low-level or non-detectable CoC concentrations in extracted vapors, and (3) the ability to reduce or eliminate residual CoC source loading to groundwater.

Performance monitoring of the AS/SVE system is proposed on a monthly basis for the first quarter of operations in order to (1) evaluate system operating characteristics, and (2) identify treatment optimization opportunities. Performance monitoring will entail measurement of individual SVE well extraction and AS well injection flow rates; separator liquid collection rates; system-wide extraction vacuum and temperature; system-wide injection pressure and temperature; individual SVE well emissions; and total SVE system emissions. Vapor samples will be collected from the SVE emission stack for laboratory analysis on a quarterly basis to track VOC air emission discharge rates and the cumulative mass of CoCs removed. The treatment system will also be inspected to ensure reliable operation and performance in accordance with performance-based design specifications. Following the first three months of system operations, performance monitoring will be conducted on a quarterly basis.

Groundwater monitoring is proposed to be conducted to evaluate AS/SVE system performance. Groundwater performance monitoring will at a minimum use existing Well MW-10A and two new wells to be constructed: MW-30 and MW-31 (Figure 7). As shown on Figure 7, these wells will be located near the downgradient boundary of AS/SVE system operation. New Wells MW-30 and MW-31 will be constructed similarly to existing on-site groundwater monitor wells. That is, these wells will be constructed with 15-foot-long screened intervals located across the uppermost portions of the aquifer. The placement of additional performance monitor wells may be evaluated. Additional performance monitor wells may be needed within the AS/SVE treatment zone and in the area immediately downgradient from the treatment zone, upgradient of MW-10A/B/C. As indicated during groundwater assessment activities (Martin & Slagle 2009), CoC detections in groundwater occur near the top of the saturated zone near the contaminant source area. Groundwater monitoring for AS/SVE performance assessment will be coordinated with compliance monitoring as described in Section 8.

Performance monitoring data would primarily be used to verify that the AS/SVE system is performing properly. A comprehensive system performance evaluation would be performed semiannually in order to assess treatment progress toward meeting cleanup objectives. This semiannual evaluation will consider all data collected to date, estimate the total mass of CoCs removed, and ultimately determine if AS/SVE is achieving cleanup objectives in a timely and cost-effective manner. Data collected monthly/quarterly will be evaluated and used to optimize system operational parameters during subsequent operation, maintenance, and monitoring events to maintain optimal system performance.

The AS/SVE system will be operated continuously until asymptotic mass removal rates have been achieved, or until groundwater cleanup objectives have been met. MDEQ approval would be requested before shutting down the AS/SVE system for rebound evaluation purposes. Post treatment monitoring would continue in order to assess rebound, and if additional treatment is necessary, either the system will be turned back on or technology enhancements subject to MDEQ approval may be implemented as appropriate.

8. Compliance Monitoring Plan

The goal of the Compliance Monitoring Plan is to demonstrate that groundwater with CoC concentrations greater than the MDEQ Tier 1 TRGs is not migrating from the KEC property. This would be measured by sampling the groundwater at regularly scheduled intervals from the existing monitoring well network. A description of the monitoring network, the proposed sampling and analysis plan, and associated reporting effort is provided in the following subsections.

8.1 Monitor Well Network

The existing groundwater monitor well network of 38 wells shown on Figure 2 was installed during previous groundwater assessment efforts (Martin & Slagle 2009). The existing network includes nine nested well locations for assessing the vertical distribution of CoCs in the upper aquifer. Based on a review of the well network, groundwater monitoring results to date, and the remedial measures presented in this CAP, none of the existing wells are proposed for abandonment. Table 1 summarizes construction details for all existing monitoring network wells. The existing monitoring network will be augmented through the addition of at least five new monitor wells.

It is proposed that the monitoring network be expanded to include:

- Installation of two additional monitor wells (MW-30 and MW-31) near the KEC facility boundary for purposes of evaluating AS/SVE performance. Additional performance monitor wells are anticipated on site. The exact number and placement of additional wells, subject to MDEQ approval, will be determined after pilot testing and during the design of the full-scale AS/SVE well network.

- Installation of an additional well (MW-32) along Independence Street at the presumed leading edge of the 1,4-dioxane plume.

- Installation of an additional well (MW-33) in between existing Wells MW-19 and MW-22, along or near Marion Drive, in order to evaluate groundwater beyond the apparent distal edge of the western lobe of the 1,1-DCE plume.

- Installation of an additional well (MW-34) between MW-23A and the Crystal Springs water treatment facility. This well will be used to monitor the distal portion of the southern lobe of the KEC 1,1-DCE plume and will be used to further qualify whether or not the KEC plume is contributing to the low-level detections (below TRGs) that have been recently observed in municipal Wells CSW-WA1 and CSW-WA2.

Existing monitor wells located hydraulically upgradient of the contaminant source area that have not previously detected CoC concentrations exceeding TRGs that may serve as background wells are (see Table 1 and Figure 7): MW-05, MW-07, MW-08, and MW-12.

Wells interior to the existing contaminant plume that may be used to assess changes in the plume as attenuation proceeds are (see Table 1 and Figure 7): MW-02, MW-03, MW-04, MW-06, MW-10A, -10B, and -10C, MW-11A and -11B, MW-15A and -15B, MW-17A and -17B, MW-18A and -18B, MW-20A and -20B, MW-21A and -21B, and MW-23A and -23B. Proposed new AS/SVE performance monitor wells, MW-30 and MW-31, and the proposed Well MW-32 would be sampled as in-plume wells with the list identified above.

Wells peripheral to the existing contaminant plume that may be used as sentinel Wells to detect the migration of CoCs outside the predicted area of containment are (see Table 1 and Figure 7): MW-09, MW-13, MW-14A and -14B, MW-16, MW-19, MW-22, MW-24, MW-25, MW-26, MW-27, MW-28, and MW-29. Proposed new Wells MW-33 and MW-34 would be sampled as sentinel Wells with the list identified above.

8.2 Sample Parameters and Schedule

Previous groundwater sampling has detected 1,1-DCE and 1,4-dioxane in off-site monitor wells at concentrations exceeding Tier 1 TRGs. Background and in-plume wells will be sampled to evaluate contaminants and breakdown products to evaluate natural attenuation progress. Sentinel wells will be sampled to detect the migration of CoCs outside the predicted area of containment. Samples will be analyzed for VOCs using U.S. Environmental Protection Agency (USEPA) Method 8260B with analysis for 1,4-dioxane using the USEPA Method 8270C selected ion monitoring (SIM).

All background, in-plume, and sentinel monitor wells will be sampled quarterly for a minimum of 1 year (four events). In order to further evaluate the significance of biodegradation in the attenuation of CoCs, geochemical indicator parameters would be collected and analyzed during the quarterly monitoring program. The supplemental geochemical data will include analyses of methane, ethane, and ethene by Method AM20GAX, carbon dioxide by Method AM20GAX, total organic carbon by USEPA Method 9060A, Nitrate by USEPA Method 300.1, sulfate by USEPA Method 300.1, total and dissolved iron by USEPA Method 200.7, alkalinity by USEPA Method 310.1, chloride by USEPA Method 300.1, and field analysis of dissolved oxygen and oxidation reduction potential.

Following the initial four quarters of monitoring, the compliance monitoring program will be reviewed and adjustments may be proposed, including the reduction or addition of monitor wells and potentially changes in the monitoring frequency to semiannual or annual sampling.

8.3 Compliance Reporting

Groundwater data collected during the performance and compliance monitoring programs will be summarized and reported to MDEQ within 60 days of receiving all off-site analytical laboratory results from any individual compliance monitoring event. Proposed compliance monitoring reports will include the following information as a minimum:

- A summary of data collection performed and treatment system operations during the associated period, including details on methods and procedures used to collect and evaluate data;

- A discussion of AS/SVE performance monitoring results, including evaluation of vapor data, mass removal rates, and a summary of cumulative mass removed;

- A discussion of the groundwater compliance monitoring and geochemical data, including evaluation of spatial and temporal CoC trends, and an assessment of whether or not the geochemical data indicate biodegradation is occurring;

- Tabular summaries of AS/SVE performance monitoring data, vapor data, water level and groundwater field parameter data, and groundwater analytical results;

- Figures depicting potentiometric surface of the upper aquifer, CoC plume maps, and spatial geochemical trends;

- Graphs depicting AS/SVE performance trends, water level and CoC trends, and geochemical data trends as appropriate; and

- Appendices that include copies of AS/SVE O&M and monitoring logs, field notes, groundwater sampling logs, and copies of laboratory data reports.

As the body of performance and compliance monitoring data grows, remedy performance, the conceptual site model, and implementation of contingency plans would be reviewed.

9. Contingency Plan

Previous sections of this CAP have discussed contingency technologies and/or treatment expansion considerations in the event the proposed source area AS/SVE and off-site MNA strategy require augmentation. Technology sequencing will prove to be a critical component of the overall strategy of meeting closure objectives for this project. The initial treatment methods would primarily focus on physical treatment of CoC mass in source area soils and groundwater. The proposed remedial approach anticipates contingencies for (1) expansion of physical treatment extents, and/or (2) implementation of a chemical or enhanced biodegradation technology if necessary. The suggested "triggers" for implementing these contingencies will entail both quantitative and subjective evaluation of several factors, including:

- Ongoing evaluation of spatial and temporal CoC concentration trends in near-vicinity, downgradient monitor wells;
- Whether or not the observed percent reductions in soil, vapor, and or groundwater concentrations are sufficient to sustain MNA and project closure objectives;
- Results of periodic rebound testing and evaluation; and
- Periodically updated projections for when cleanup goals or intermediate milestones may be met.

The proposed performance and compliance monitoring programs described in Sections 7 and 8 will provide the framework for evaluating how the proposed remedy is performing. Data from the performance monitoring program will be assessed primarily for purposes of determining if the as-built AS/SVE systems are meeting the on-site treatment objectives for soil and groundwater. These data will be used first and foremost to identify opportunities for optimizing or enhancing the on-site AS/SVE system. Maximizing treatment benefits from the existing systems would be appropriate before expansion is considered. If AS/SVE expansion beyond the source area is warranted, the data from the performance monitoring and compliance monitoring programs would be used to identify the likely areas where mass flux contributions to the off-site plume are located. Additional well installations and delineation may also be used to refine the extent to which these systems should be expanded.

Use of an additional in-situ treatment technology in the source area, following AS/SVE, or to treat off-site groundwater may be also required at some point during this project. The performance and compliance monitoring programs would be used to assess whether or not supplemental treatment using a contingency technology is necessary. Supplemental pilot testing and/or bench scale treatability testing may be proposed to evaluate how and where such a technology will be most effectively applied in order to meet the CAP objectives.

Beyond whether or not the final cleanup goals have been met, it is difficult to define appropriate intermediate and/or quantitative milestones for purposes of triggering the implementation of contingency plans. A conclusions and recommendations section would be included in the compliance monitoring reports that will be regularly submitted to MDEQ. These reports will address contingency planning determinations as and when appropriate.

10. Quality Assurance Project Plan (QAPP)

ARCADIS has submitted a proposed QAPP for MDEQ review and consideration as part of this CAP (Appendix B). The QAPP provides a description of all data quality objectives and procedures that will be associated with sample collection, laboratory analysis, monitor and treatment well installations, installation of AS/SVE system components, treatment system O&M, and quality assurance responsibilities associated with this project. The QAPP has been prepared in accordance with the requirements and guidelines established by the USEPA and MDEQ for data collection, analysis, and management, and integrates quality assurance/quality control procedures for all field and laboratory activities. All project personnel and subcontractors shall strictly adhere to it throughout the course of remedy implementation. ARCADIS anticipates periodic amendments will be provided as necessary to account for adjustment to the sampling program and remedy enhancements over the course of the project.

11. Health and Safety Plan

ARCADIS has submitted a proposed project-specific HASP for MDEQ review and consideration as part of this CAP (Appendix C). All project personnel and subcontractors must strictly adhere to it throughout the course of remedy implementation. The HASP will be periodically reviewed and amended as necessary prior to construction events or other events that can have an adverse impact on human health or the environment. Any revisions to the HASP will be reviewed, and subject to approval, by MDEQ before changes are implemented in the field.

12. References

Martin & Slagle. 2004. "Preliminary Groundwater Assessment Report; Kuhlman Electric Corporation, Crystal Springs, Mississippi." Prepared for BorgWarner Inc., by Martin & Slagle GeoEnvironmental Associates, LLC.

Martin & Slagle. 2009. "Groundwater Assessment Report; Kuhlman Electric Corporation, Crystal Springs, Mississippi." Prepared for BorgWarner Inc., by Martin & Slagle GeoEnvironmental Associates, LLC. April 2009.

Table

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Table 1. Monitor Well Network Summary, Corrective Action Plan for the KEC Facility, Crystal Springs, Mississippi.

Well No.	Date Installed	Screen Length (ft)	Screen Interval (ft bgs)	Depth of Surface Casing (ft bgs)	Ground Surface Elevation (ft msl)	Top of Casing Elevation (ft msl)	Monitoring Objective
MW-1	3/11/2004	15	58-73	•	467.76	467.47	Well abandoned March 2005
MW-2	3/16/2004	15	57-72	•	465.59	465.23	Interior Plume Trends
MW-3	3/18/2004	15	59-74	•	458.70	458.32	Interior Plume Trends
MW-4	3/17/2004	15	55-70	•	465.82	465.67	Interior Plume Trends
MW-5	3/18/2004	15	18-33	•	457.02	456.55	Perched Water Zone, Upgradient/Background
MW-6	3/25/2004	15	43-58	•	457.61	457.28	Interior Plume Trends
MW-7	3/24/2004	15	51-66	•	463.00	462.70	Upgradient/Background
MW-8	3/26/2004	15	47-62	•	455.04	454.46	Upgradient/Background
MW-9	3/3/2005	15	61-76	•	470.21	470.03	Sentinel Well
MW-10A	7/7/2007	10	62-72	•	471.25	470.95	AS/SVE Performance, Interior Plume Trends
MW-10B	7/7/2007	5	76-81	•	471.25	470.78	Interior Plume Trends
MW-10C	7/17/2007	5	94-99	90	471.25	470.97	Interior Plume Trends
MW-11A	7/5/2007	10	75-85	•	470.46	470.08	Interior Plume Trends
MW-11B	7/18/2007	5	100-105	95	470.46	470.01	Interior Plume Trends
MW-12	6/4/2007	10	65-75	•	465.65	465.35	Upgradient/Background
MW-13	7/7/2007	10	62-72	•	465.38	465.12	Sentinel Well
MW-14A	6/8/2007	10	69.5-79.5	•	464.20	464.03	Sentinel Well
MW-14B	6/11/2007	5	97-102	•	464.20	463.99	Sentinel Well
MW-15A	6/18/2007	10	65-75	•	467.53	467.29	Interior Plume Trends
MW-15B	6/20/2007	5	86-91	•	467.53	467.29	Interior Plume Trends
MW-16	6/5/2007	10	55-65	•	460.51	460.24	Sentinel Well
MW-17A	6/28/2007	10	60-70	•	460.31	460.02	Interior Plume Trends
MW-17B	6/28/2007	5	83-88	•	460.31	460.04	Interior Plume Trends
MW-18A	6/25/2007	10	62-72	•	459.95	459.46	Interior Plume Trends
MW-18B	6/26/2007	5	80-85	•	459.95	459.67	Interior Plume Trends
MW-19	6/6/2007	10	85.5-95.5	•	454.38	454.02	Sentinel Well
MW-20A	6/22/2007	10	57-67	•	462.41	462.12	Interior Plume Trends
MW-20B	6/21/2007	5	100-105	•	462.41	462.00	Interior Plume Trends
MW-21A	7/2/2007	10	58-68	•	459.00	458.72	Interior Plume Trends
MW-21B	7/16/2007	5	88-93	85	459.00	458.65	Interior Plume Trends
MW-22	6/12/2007	10	85.5-95.5	•	447.92	447.54	Sentinel Well
MW-23A	6/15/2007	10	35-45	•	440.61	440.12	Interior Plume Trends
MW-23B	6/14/2007	5	79-84	•	440.61	440.41	Interior Plume Trends
MW-24	7/5/2007	5	77-82	•	433.41	433.14	Sentinel Well
MW-25	7/13/2007	10	98-108	•	451.26	450.95	Sentinel Well
MW-26	6/13/2007	10	92-102	•	459.61	459.37	Sentinel Well
MW-27	7/17/2007	10	99-109	•	433.48	433.56	Sentinel Well
MW-28	11/2/2009	30	80-110	•	463.10	462.82	Sentinel Well
MW-29	11/3/2009	25	81-106	•	460.47	459.82	Sentinel Well
MW-30	Installation Pending	•	•	•	•	•	AS/SVE Performance, Interior Plume Trends
MW-31	Installation Pending	•	•	•	•	•	AS/SVE Performance, Interior Plume Trends
MW-32	Installation Pending	•	•	•	•	•	Interior Plume Trends
MW-33	Installation Pending	•	•	•	•	•	Sentinel Well
MW-34	Installation Pending	•	•	•	•	•	Sentinel Well

Notes:
ft = feet
ft bgs = feet below ground surface
ft msl = elevation in feet above mean sea level
• = information does not exist or is not applicable under the defined parameters

Figures

CITY: MIDLAND-TX DIV/GROUP: ENV DB: H.CLARDY LD: H.CLARDY PIC: PM: G.CRAMER TM: K.SZYMPRUCH LYR: ON=*;OFF=*REF*
G:\ENVCAD\MIDLAND\ACT\LA002889\0001\00001\CAP PROPOSAL-VOLUME 1\DWG\02889B01.DWG LAYOUT: 1 SAVED: 10/29/2010 1:53 PM ACADVER: 18.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 10/29/2010 1:57 PM BY: CLARDY, HERB

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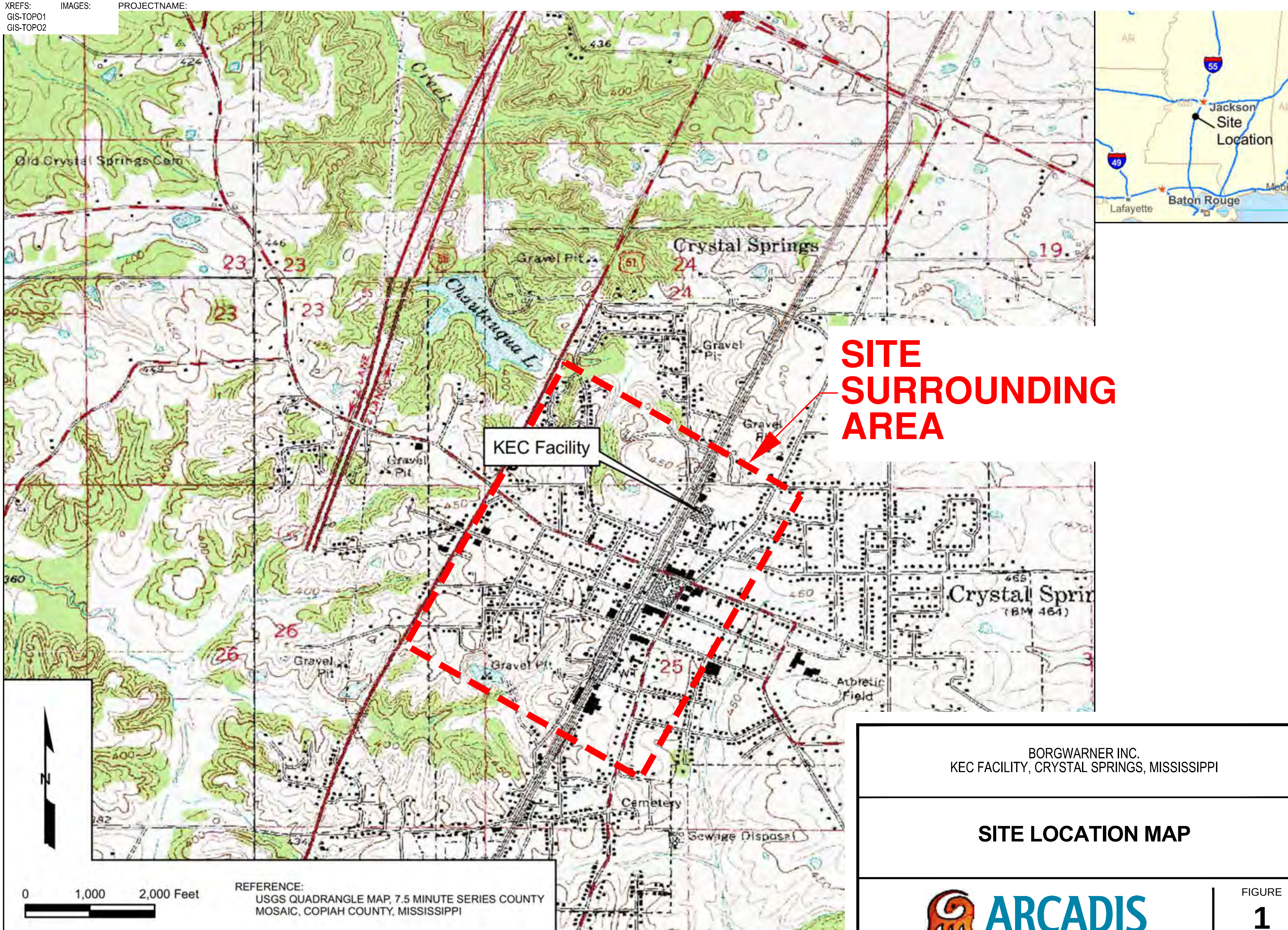


0 1,000 2,000 Feet

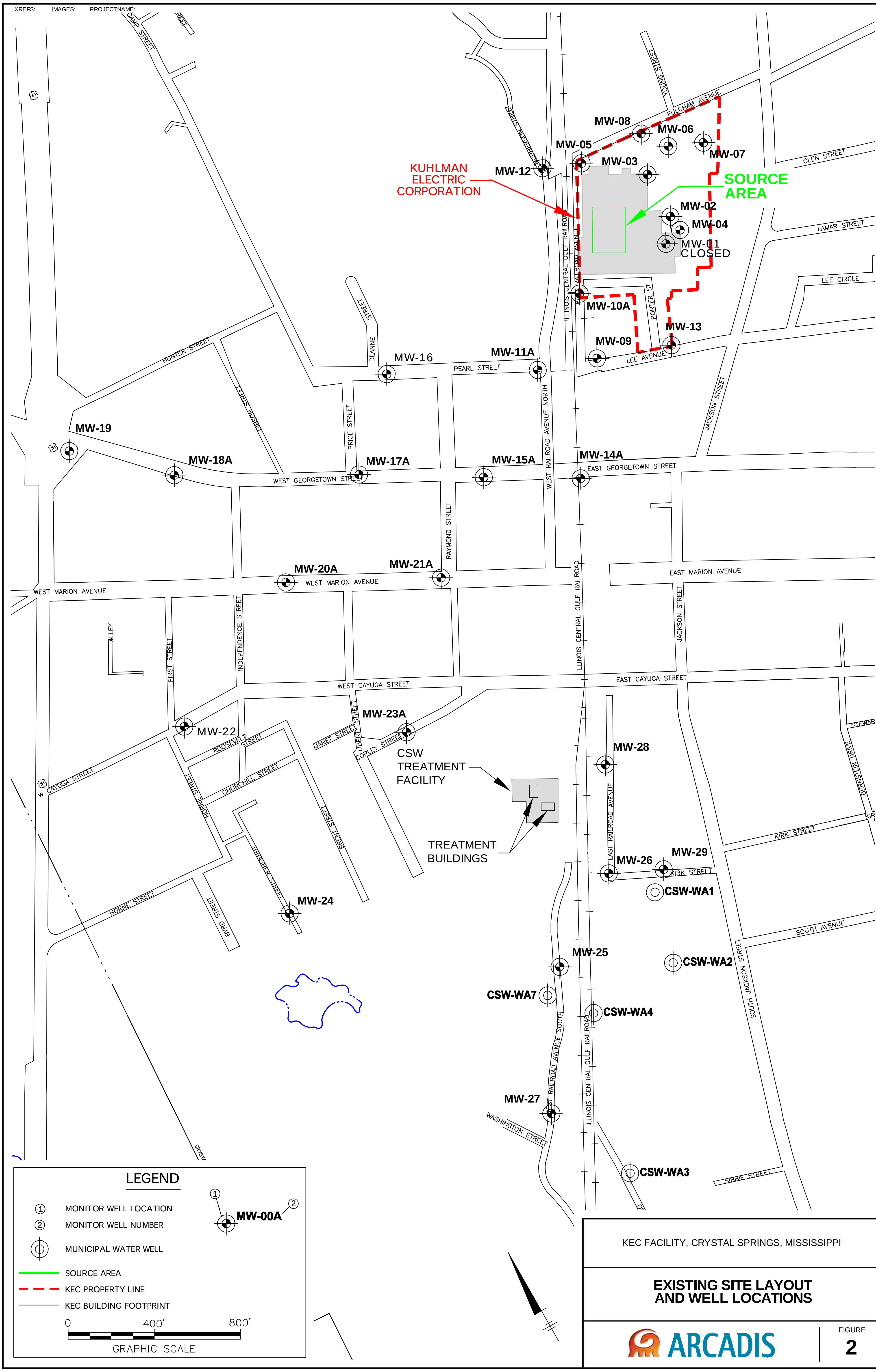
REFERENCE:
USGS QUADRANGLE MAP, 7.5 MINUTE SERIES COUNTY MOSAIC, COPIAH COUNTY, MISSISSIPPI

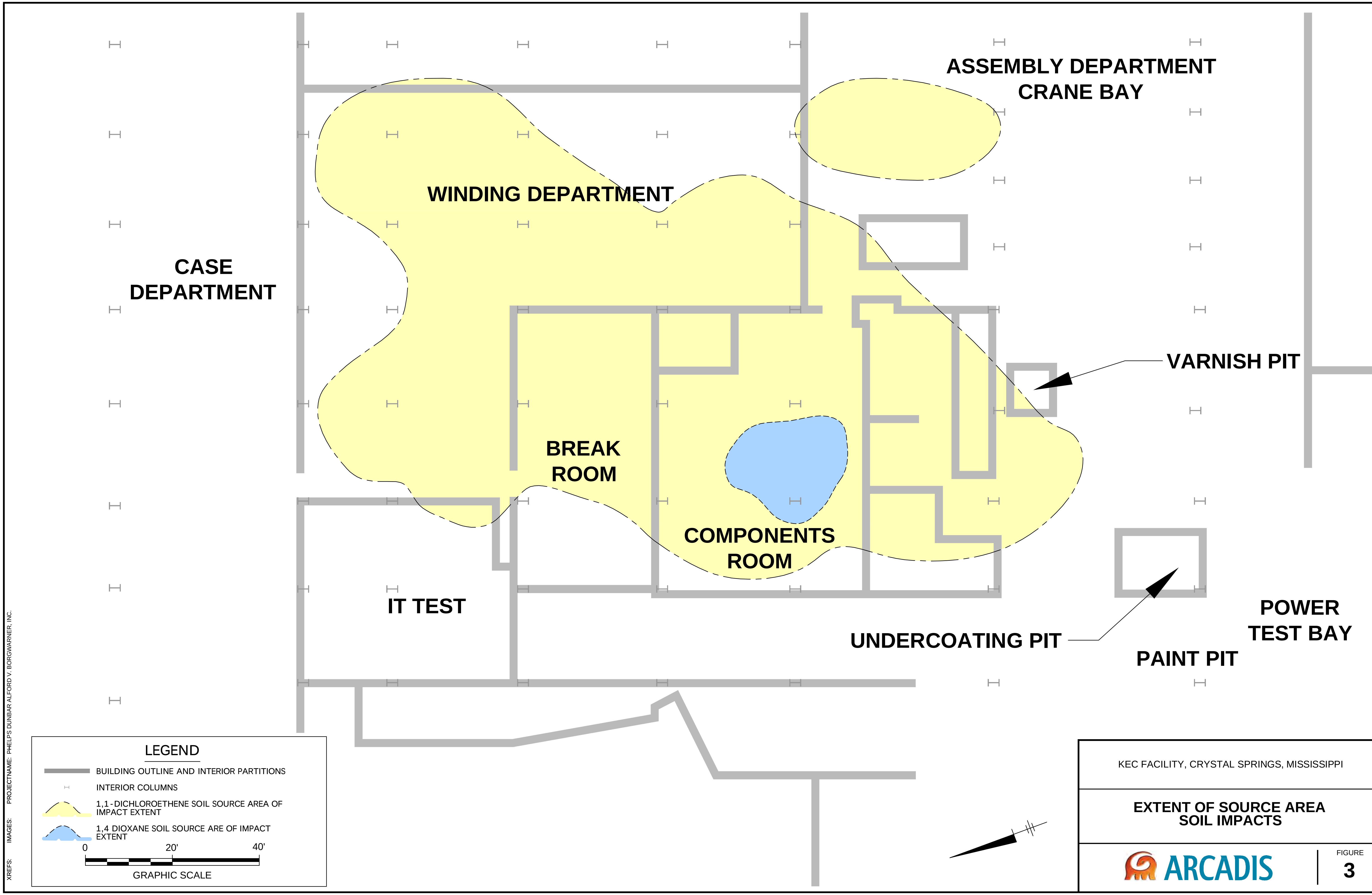
BORGWARNER INC.
KEC FACILITY, CRYSTAL SPRINGS, MISSISSIPPI

SITE LOCATION MAP

ARCADIS

FIGURE
1


XREFS: IMAGES: PROJECTNAME:
KUHLMAN ELECTRIC CORPORATION
SOURCE AREA
MW-01 CLOSED
MW-02
MW-03
MW-04
MW-05
MW-06
MW-07
MW-08
MW-09
MW-10A
MW-11A
MW-12
MW-13
MW-14A
MW-15A
MW-16
MW-17A
MW-18A
MW-19
MW-20A
MW-21A
MW-22
MW-23A
MW-24
MW-25
MW-26
MW-27
MW-28
MW-29
CSW-WA1
CSW-WA2
CSW-WA3
CSW-WA4
CSW-WA7
CSW TREATMENT FACILITY
TREATMENT BUILDINGS
FULGHAM AVENUE
YOUNG STREET
GLEN STREET
LAMAR STREET
LEE CIRCLE
LEE AVENUE
PORTER ST
PEARL STREET
DEANNE STREET
HUNTER STREET
PRICE STREET
WEST GEORGETOWN STREET
EAST GEORGETOWN STREET
RAYMOND STREET
WEST RAILROAD AVENUE NORTH
ILLINOIS CENTRAL GULF RAILROAD
JACKSON STREET
WEST MARION AVENUE
EAST MARION AVENUE
INDEPENDENCE STREET
FIRST STREET
ALLEY
WEST CAYUGA STREET
EAST CAYUGA STREET
W CAYUGA STREET
ROOSEVELT STREET
JANET STREET
LIBERTY STREET
COPLEY STREET
CHURCHILL STREET
HORNE STREET
BYRD STREET
THRASHER STREET
BRENT STREET
EAST RAILROAD AVENUE
KIRK STREET
SOUTH AVENUE
SOUTH JACKSON STREET
BERNSTEIN DRIVE
STEWART
WEST RAILROAD AVENUE SOUTH
WASHINGTON STREET
CAMP STREET
LEGEND
1 MONITOR WELL LOCATION
2 MONITOR WELL NUMBER
MUNICIPAL WATER WELL
SOURCE AREA
KEC PROPERTY LINE
KEC BUILDING FOOTPRINT
MW-00A
0 400' 800'
GRAPHIC SCALE
KEC FACILITY, CRYSTAL SPRINGS, MISSISSIPPI
EXISTING SITE LAYOUT AND WELL LOCATIONS
ARCADIS
FIGURE 2

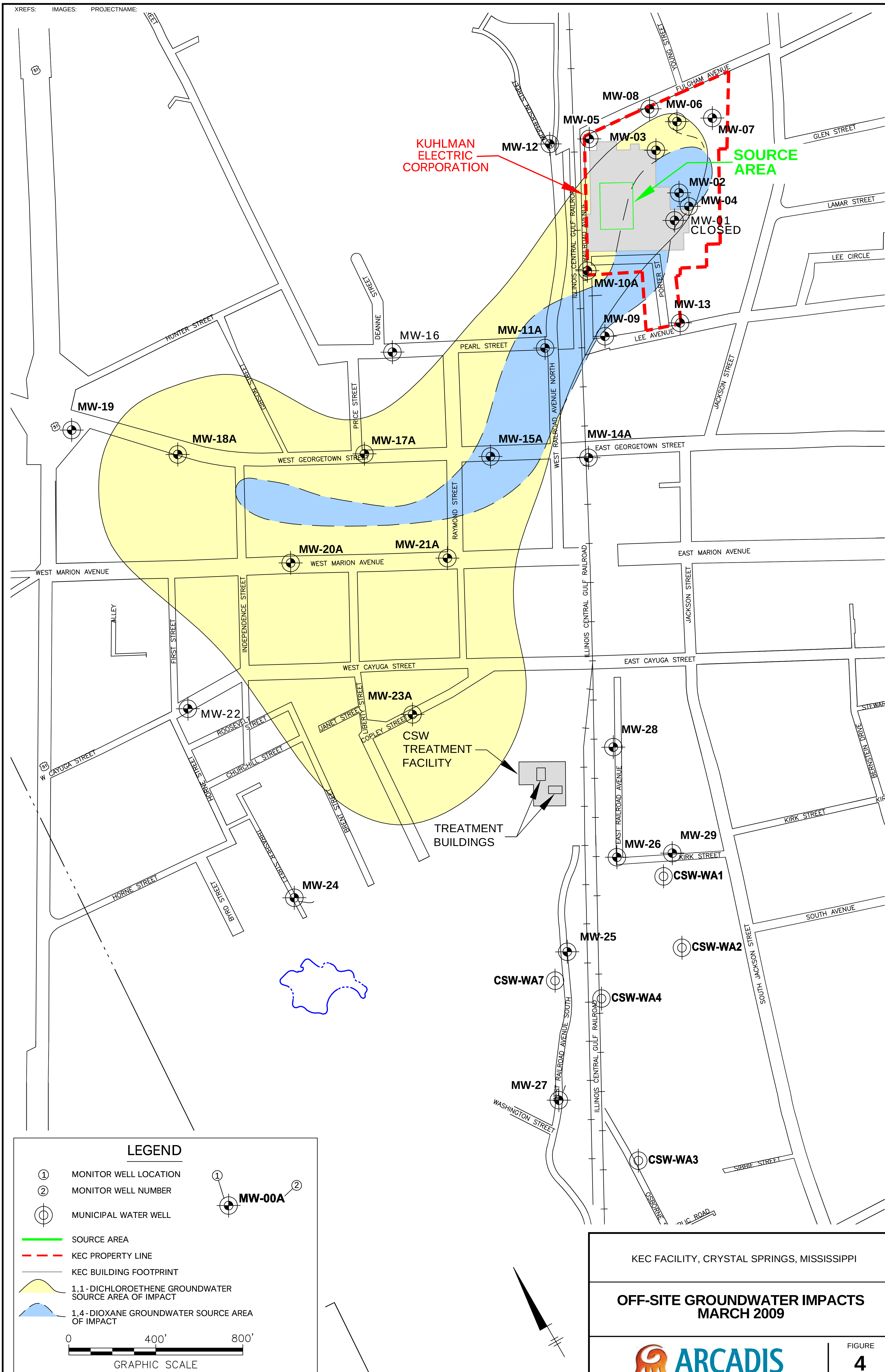


KEC FACILITY, CRYSTAL SPRINGS, MISSISSIPPI

EXTENT OF SOURCE AREA SOIL IMPACTS

ARCADIS

FIGURE 3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SOURCE AREA
MW-01 CLOSED
MW-02
MW-03
MW-04
MW-05
MW-06
MW-07
MW-08
MW-09
MW-10A
MW-11A
MW-12
MW-13
MW-14A
MW-15A
MW-16
MW-17A
MW-18A
MW-19
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CSW-WA1
CSW-WA2
CSW-WA3
CSW-WA4
CSW-WA7
CSW TREATMENT FACILITY
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FULGHAM AVENUE
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LEE CIRCLE
LEE AVENUE
PORTER ST
JACKSON STREET
HUNTER STREET
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EAST GEORGETOWN STREET
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WEST RAILROAD AVENUE NORTH
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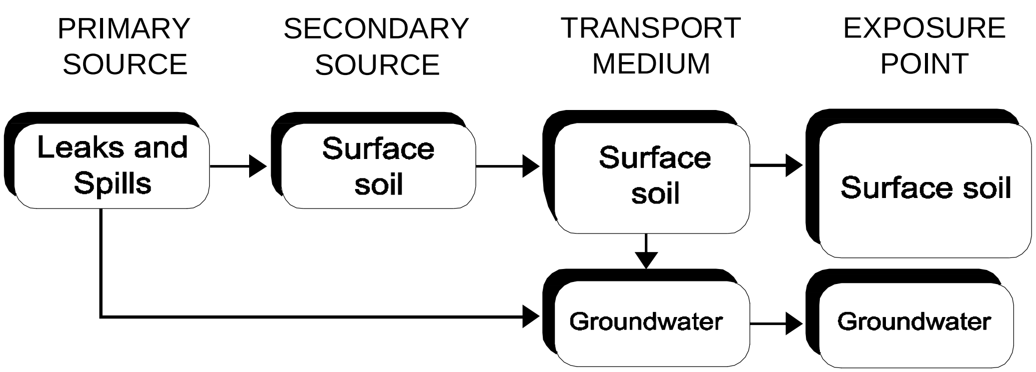
WEST RAILROAD AVENUE SOUTH
WASHINGTON STREET
KIRK STREET
SOUTH AVENUE
SOUTH JACKSON STREET
BERNSTEIN DRIVE
SIBBIE STREET
OSBORNE
YOUNG STREET
LEGEND
1 MONITOR WELL LOCATION
2 MONITOR WELL NUMBER
MW-00A
MUNICIPAL WATER WELL
SOURCE AREA
KEC PROPERTY LINE
KEC BUILDING FOOTPRINT
1,1-DICHLOROETHENE GROUNDWATER SOURCE AREA OF IMPACT
1,4-DIOXANE GROUNDWATER SOURCE AREA OF IMPACT
0 400' 800'
GRAPHIC SCALE
KEC FACILITY, CRYSTAL SPRINGS, MISSISSIPPI
OFF-SITE GROUNDWATER IMPACTS
MARCH 2009
ARCADIS
FIGURE
4

XREFS: IMAGES: PROJECTNAME:

EXPLANATION

● Current or Hypothetical Future Complete Exposure Pathway
○ Incomplete Exposure Pathway



POTENTIAL RECEPTORS

Exposure Point	Exposure Route	HUMAN – CURRENT: SITE WORKER	HUMAN – CURRENT: RESIDENTIAL RECEPTOR	HUMAN – FUTURE: SITE WORKER	HUMAN – FUTURE: OFF-SITE RESIDENTIAL RECEPTOR	BIOTA: TERRESTRIAL	BIOTA: AQUATIC
Surface soil	Oral	●	○	●	●	○	○
Surface soil	Dermal	●	○	●	●	○	○
Surface soil	Inhalation	●	○	●	●	○	○
Groundwater	Oral	○	○	○	●	○	○
Groundwater	Dermal	○	○	○	●	○	○
Groundwater	Inhalation	●	○	●	●	○	○

KEC FACILITY, CRYSTAL SPRINGS, MISSISSIPPI

PRELIMINARY EXPOSURE PATHWAY ASSESSMENT

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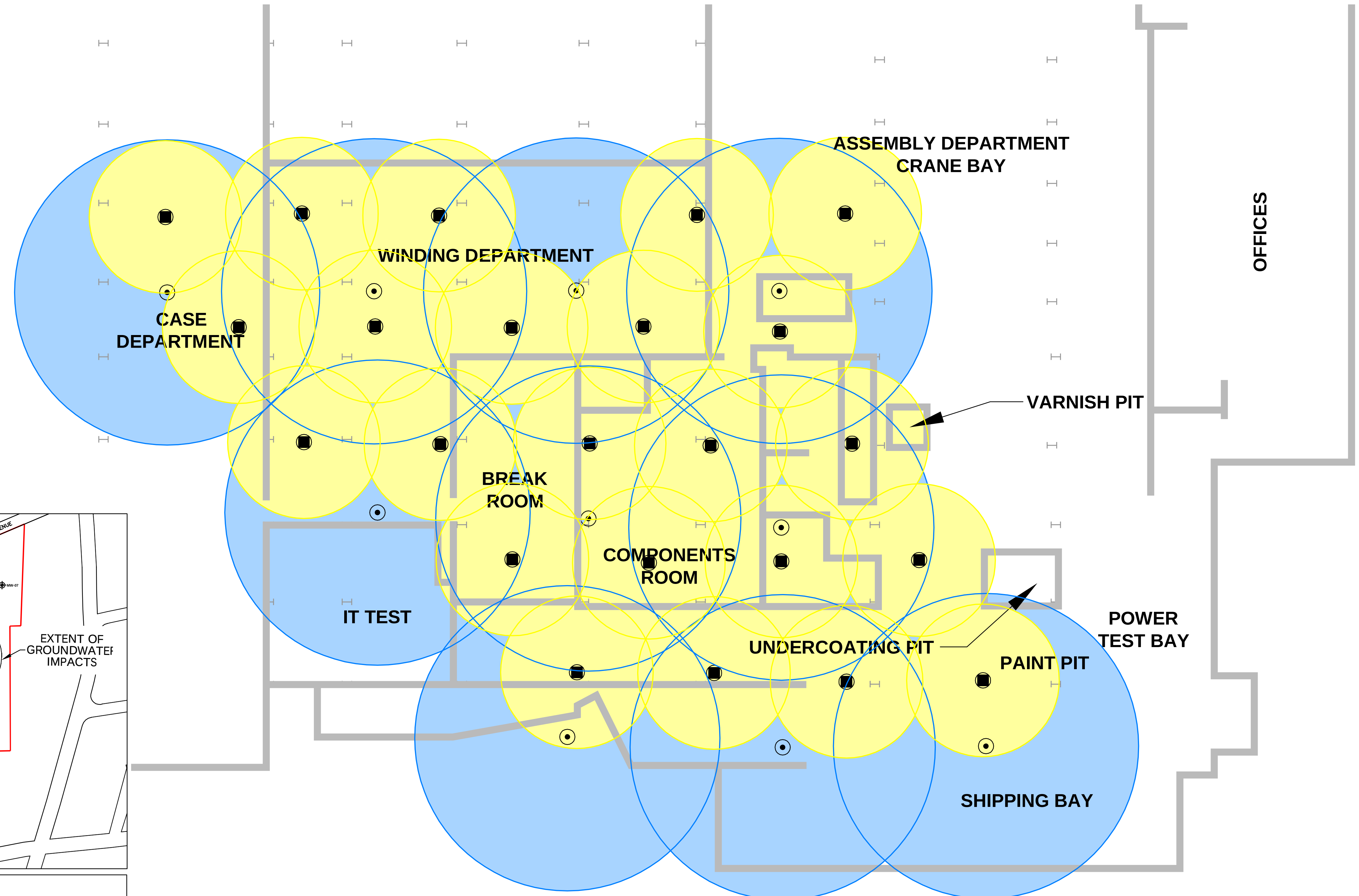
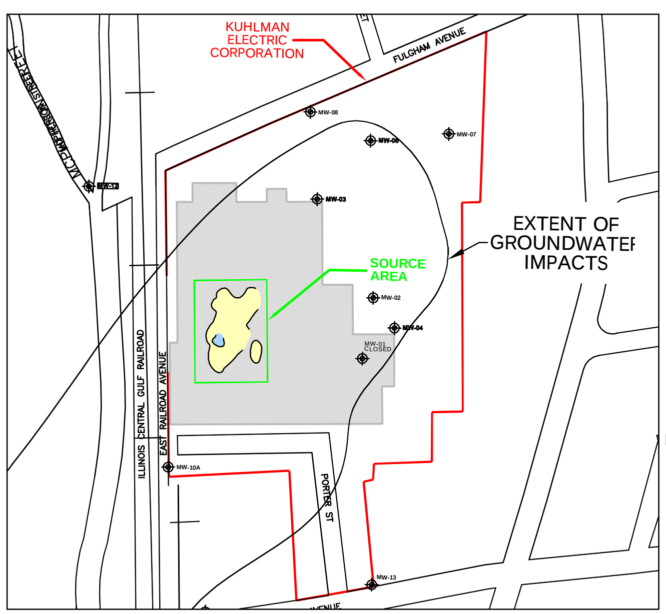
FIGURE 5





LEGEND

- BUILDING OUTLINE AND INTERIOR PARTITIONS
- INTERIOR COLUMNS
- SOIL VAPOR EXTRACTION WELL
- AIR SPARGE WELL
- SVE WELL RADIUS-OF-INFLUENCE (40')
- AIR SPARGE WELL RADIUS-OF-INFLUENCE (20')

0 30' 60'
GRAPHIC SCALE

FLOOR PLAN - KEC PLANT

NOTE:
THE TREATMENT OBJECTIVE IS TO COMPLETE COVERAGE OVER THE SOURCE AREA WITH OVERLAPPING AS/SVE TREATMENT ROIs. THE WELL LOCATIONS AND SPACINGS DEPICTED ON THIS FIGURE ARE CONCEPTUAL. ACTUAL WELL LOCATIONS WILL BE DETERMINED DURING THE DESIGN. OFFSET LOCATIONS AND DIRECTIONAL OR HORIZONTAL DRILLING METHODS MAY BE NECESSARY IN ORDER TO OVERCOME ACCESS CONSTRAINTS AND MINIMIZE OBSTRUCTIONS TO ACTIVE MANUFACTURING OPERATIONS.

KEC FACILITY, CRYSTAL SPRINGS, MISSISSIPPI

CONCEPTUAL LAYOUT FOR AS AND SVE WELL INSTALLATIONS

ARCADIS

FIGURE
6

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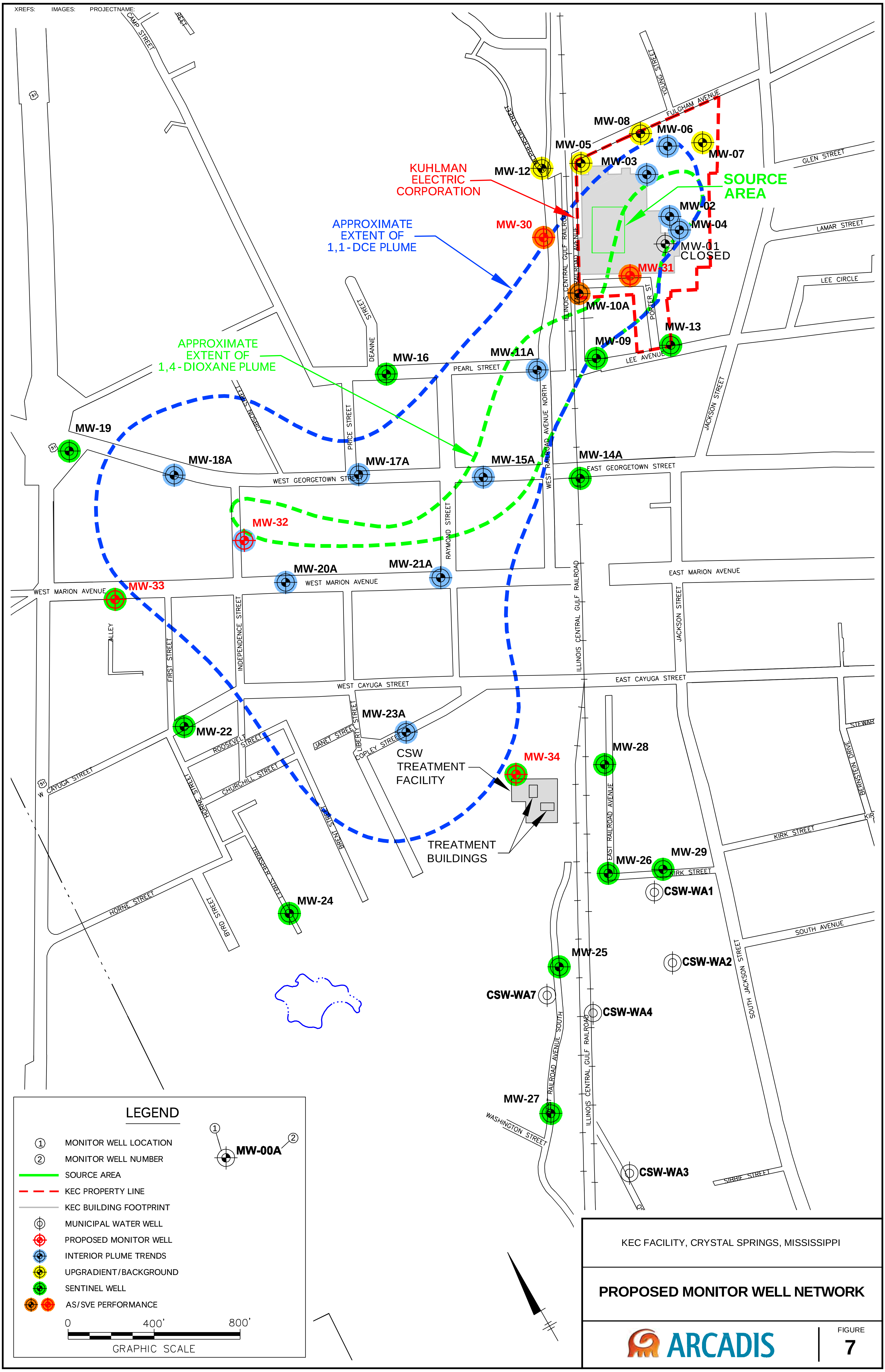

KEC FACILITY, CRYSTAL SPRINGS, MISSISSIPPI

PROPOSED MONITOR WELL NETWORK

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FIGURE 7

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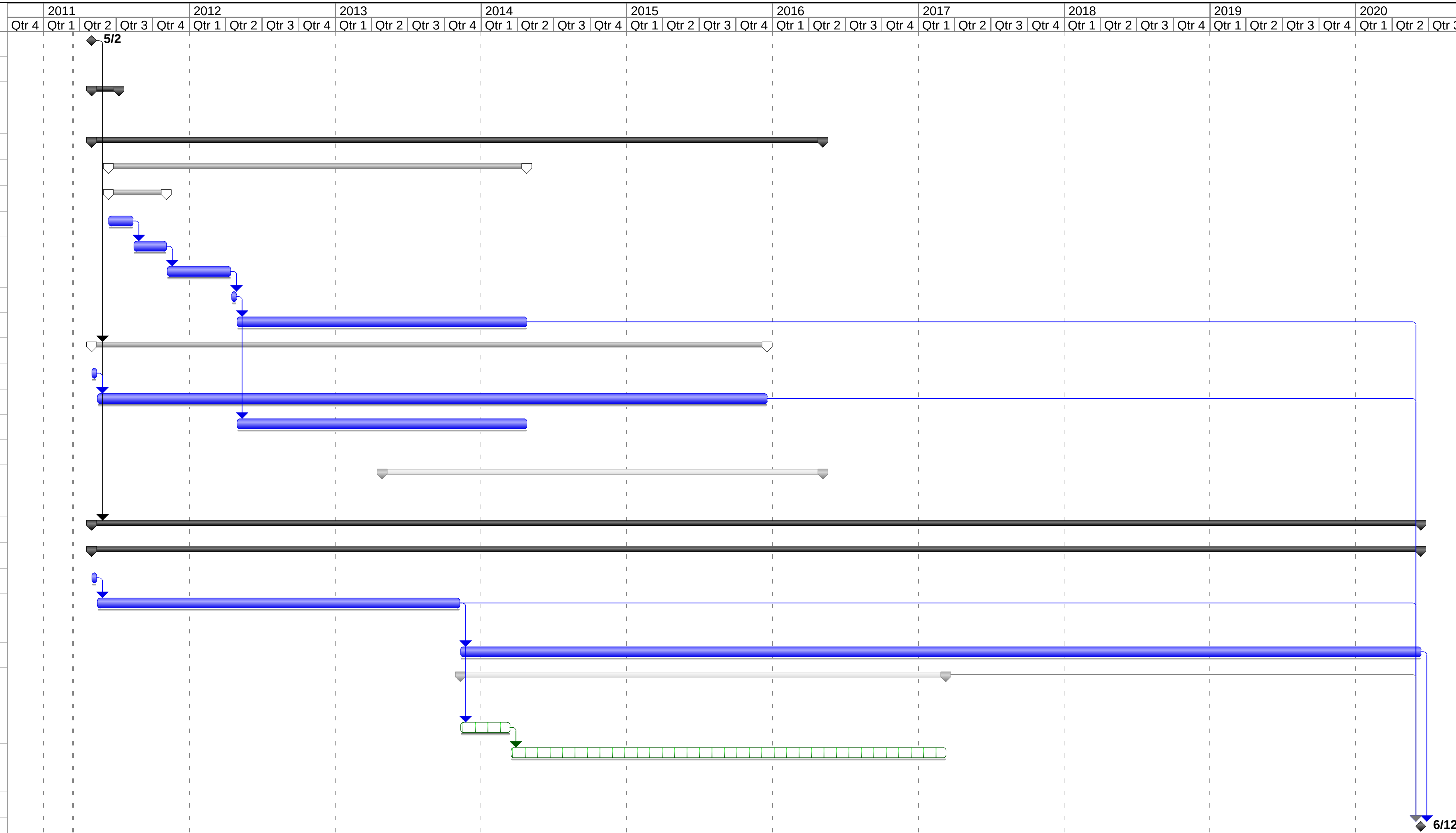
Appendix A

Project Schedule

Appendix A
Generalized Implementation Schedule for Proposed Conceptual Approach

ID	Task Name
1	CAP Approval
2	
3	**Pre-Design Activities**
7	
8	**Source Area**
9	**AS/SVE**
10	**Design**
11	Conceptual Draft (60%)
12	Draft Final (90%)
13	Procurement/Construction
14	Startup & Optimization
15	O&M
16	**Performance Monitoring**
17	Monitoring Well Installations
18	Property Boundary Monitoring
19	AS/SVE Monitoring
20	
21	**Contingency Treatment**
27	
28	**Offsite Plumes**
29	**Monitored Natural Attenuation**
30	Monitoring Well Installations
31	Initial Period of Demonstration and Evaluation
32	Long Term Monitoring
33	**In Situ Treatment (Contingencies)**
34	Refine Offsite In Situ Approach
35	Implement in Situ Treatment Offsite
36	
37	Tentative Project Closure



Client: BorgWarner, Inc.
Project: KEC Groundwater Remediation
Location: Crystal Springs, MS

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Appendix B

Quality Assurance Project Plan

Imagine the result

Quality Assurance Project Plan

Kuhlman Electric Corporation Facility
Crystal Springs, Mississippi

15 March 2011

ARCADIS

Julia Daigle
Scientist

Lance W. Fontenot, Ph.D.
Principal Scientist/Toxicologist

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Associate Vice President/Principal Hydrogeologist

Quality Assurance Project Plan
Kuhlman Electric Corporation Facility
Crystal Springs, Mississippi

Prepared for:
Mississippi Department of Environmental Quality

Prepared by:
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Fax 225 218 9677

Our Ref.:
LA002889.0001.00001

Date:
15 March 2011

Table of Contents

Tables

Figures

Appendices

Acronyms and Abbreviations

1,1-DCE	1,1-Dichloroethene
1,1-TCA	1,1,1-Trichloroethane
AS	Air Sparge
ASTM	ASTM International
BGS	Below Ground Surface
CAP	Corrective Action Plan
C	Celsius
CFR	Code of Federal Regulations
CoC	Chemical of Concern
DOT	Department of Transportation
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
EISOPQAM	Environmental Investigations Standard Operating Procedures and Quality Assurance Manual
EQuIS	Environmental Quality Information Systems
ft/day	Feet Per Day
GS/MS	Gas Chromatography/Mass Spectrometry
GIS	Geographic Information System
HASP	Health and Safety Plan
ID	Identification
IDW	Investigation-Derived Waste
KEC	Kuhlman Electric Corporation
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LIMS	Laboratory Information Management System
LTO	Laboratory Task Order
MCL	Maximum Contaminant Level
MDEQ	Mississippi Department of Environmental Quality
MDL	Method Detection Limit
MNA	Monitored Natural Attenuation

Acronyms and Abbreviations (continued)

MS	Matrix Spike
MSD	Matrix Spike Duplicate
NELAP	National Environmental Laboratory Accreditation Program
NFG	National Functional Guidelines
NTU	Nephelometric Turbidity Unit
OVA	Organic Vapor Analyzer
OVM	Organic Vapor Meter
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PPE	Personal Protective Equipment
PSA	Professional Services Agreement
PT	Performance Testing
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAM	Quality Assurance Manual
QAPP	Quality Assurance Project Plan
QC	Quality Control
%R	Percent Recovery
RL	Reporting Limit
ROI	Radius of Influence
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
SVE	Soil Vapor Extraction
TRG	Target Remediation Goal
USEPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compound

Title and Approval Page

Quality Assurance Project Plan
Facility Remediation Program
Kuhlman Electric Corporation Facility
Crystal Springs, Mississippi

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Prepared by:
Julia Daigle and Lance Fontenot
10352 Plaza Americana Drive, Baton Rouge, Louisiana 70816
Telephone: (225) 292-1004

Project Manager: ______________________________
Signature

TBD
Printed Name/Date

Project QA Officer: ______________________________
Signature

TBD
Printed Name/Date

Distribution List

Tony Russell
Office of Pollution Control
Mississippi Department of Environmental Quality
Post Office Box 2261
Jackson, Mississippi 39225

1. Project Organization and Responsibility

The project organization for the activities to be conducted during remedial operations is presented within the following section. The project activities are being performed under the direction of the Mississippi Department of Environmental Quality (MDEQ) for the mitigation of environmental impacts at the Kuhlman Electric Corporation (KEC) facility site. The project activities are being conducted on behalf of KEC in response to the Mississippi Commission on Environmental Quality Order No. 4449-02, issued to KEC on July 23, 2002.

The project organizational chart is provided as Appendix A. Contact information for key project team members is presented in Table 1.

This document was prepared using the U.S. Environmental Protection Agency (USEPA) Region 4 *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, November 2001 (EISOPQAM) as specified by MDEQ. The Region 4 EISOPQAM will be used to reference procedures associated with the activities described within this Quality Assurance Project Plan (QAPP).

1. Background Information

The following document presents a site-wide summary Sampling and Analysis Plan (SAP) within the QAPP to conduct additional site assessment to define releases associated with the past activities formerly associated with the KEC site. The QAPP includes a summary of the site history, current site information, and general activities which may be performed to attain the project objectives. Additionally, the SAP includes a summary of the anticipated remediation activities to be conducted at the site (Section 10).

1.1 Site Description

The KEC facility (the site) is located at 101 Kuhlman Drive, Crystal Springs, Copiah County, Mississippi, at Latitude N 31° 15’ 20” and Longitude W 90° 21’ 20”. The plant site is located within the town limits of Crystal Springs. The town center is located south of the plant approximately 0.25 mile (Martin & Slagle 2004) (Figure 1). The KEC facility was constructed in the 1950s and has operated as an electric transformer manufacturing plant since that time. The future use of the property is expected to remain industrial.

The geology of the site consists of unconsolidated sediments to approximately 111 feet below ground surface (bgs). Silts and clays of low plasticity occupy the upper horizons (2 to 16 feet bgs) and are underlain by interbedded fine sands, sandy gravel, silty sand, and thin layers of plastic clay.

The water table at the site exists at approximately 62 feet bgs in the unconsolidated sediments. Groundwater flow is to the southwest and south with an average hydraulic gradient of 0.0032 foot per foot. Hydraulic conductivities range from 7.5 to 44 feet per day (ft/day) with an average of 27 ft/day based on slug tests. Vertical gradients are minimal.

The City of Crystal Springs has five municipal wells screened in the upper, unconsolidated aquifer and located 2,400 feet to 7,200 feet south and southwest of the KEC site. Pumping of these municipal wells does affect the groundwater flow direction within the study area. Two other municipal water supply wells are located farther to the southeast and are screened in the lower aquifer. These two deeper municipal wells do not appear to influence the groundwater flow in the upper aquifer.

Previous investigations have determined that the average total porosity of the unconsolidated aquifer sediments is 43 percent (Martin & Slagle 2009). Groundwater flow and advective contaminant transport occurs through the migratory, interconnected pore spaces, commonly termed the mobile or effective porosity. During plume advancement, dissolved volatile organic compounds (VOCs) migrating in groundwater through the interconnected mobile pore spaces diffuse into the immobile pore spaces. No site-specific data for mobile porosity have been collected, but based on the lithology types encountered, it is reasonable to assume the average (mobile or effective) porosity, indicative of groundwater transport, likely ranges between 10 and 20 percent. The average groundwater flow velocity, based on average hydraulic conductivity, gradient, and anticipated mobile porosity values, is approximately 250 feet per year. Actual dissolved contaminant plume velocities are typically much less, depending on a variety of fate and transport mechanisms (e.g., adsorption, retardation, biodegradation, and diffusion) governed in part by site conditions and chemical characteristics. For this study area, the velocity of the 1,1-dichloroethene (1,1-DCE) plume is migrating at a much slower rate than groundwater. 1,4-Dioxane, on the other hand, is miscible in water and has a relatively low partitioning coefficient; therefore, it does not exhibit significant sorption to organic matter in the aquifer matrix. Moreover, 1,4-dioxane does not biodegrade significantly under natural conditions; consequently, its primary attenuation mechanisms in groundwater are dispersion and dilution. As a result of these characteristics, the 1,4-dioxane plume, while also slower than groundwater, is likely advancing at a faster rate than the 1,1-DCE plume.

1.2 Site History

This QAPP was prepared in response to the Mississippi Commission on Environmental Quality Order No. 4449-02, issued to KEC on July 23, 2002. A preliminary groundwater assessment was performed at the KEC facility in 2004 (Martin & Slagle 2004) and was followed by a comprehensive assessment completed in 2009 (Martin & Slagle 2009). The assessments found that polychlorinated biphenyls were not migrating to groundwater but that certain VOCs associated with the manufacturing processes were, notably, 1,1,1-trichloroethane (1,1,1-TCA), 1,1-DCE, and 1,4-dioxane. The assessments identified a VOC plume extending southwest from the KEC site. The Corrective Action Plan (CAP) addresses remediation of the source area and the VOC impacts to groundwater.

A series of site assessments were conducted between 2004 and 2008 to define the nature and extent of contamination in the study area. The assessments included soil, groundwater, and soil gas sampling. The impacts identified are related primarily to the use of 1,1,1-TCA at the KEC site.

Compounds detected in soils above unrestricted MDEQ Target Remediation Goals (TRGs) are limited to the source area located beneath the KEC facility and are the following: 1,1,1-TCA, 1,1-DCE, 1,4-dioxane, and carbon tetrachloride.

2. Problem Definition

2.1 Project Objective

The remediation services will include an initial baseline assessment, implementation of a groundwater remediation plan and soil action plan, establishment of institutional controls, and other work as directed by MDEQ. Remedial actions will be employed until corrective objectives are satisfied.

2.2 Data Quality Objectives (DQOs)

DQOs established for this QAPP are presented in Table 2. As listed in Table 2, the Problem Definition is based upon the following DQO:

Problem statement: Past industrial operations have contributed to residual contamination at the site. The project goal is to employ remedial actions until corrective action objectives are satisfied. To achieve this goal, additional assessments of groundwater shall be performed. A groundwater remediation plan shall be developed and implemented. Remediation will be complete when the corrective action objectives have been fulfilled.

The QAPP defines the quality assurance procedures necessary to meet the general objective of corrective action for VOC impacts to groundwater at the KEC site and to mitigate the risk of any potential chemical of concern (CoC) exposure to human and environmental receptors above risk-based standards. Specific objectives are the following:

1. Ensure CoC concentrations in soil and groundwater in the contaminant source area beneath the KEC manufacturing building are at levels protective of site workers.

2. Reduce CoC concentrations in soil in the contaminant source area beneath the KEC manufacturing building to the extent that remaining concentrations no longer contribute to, or exacerbate, CoC concentrations in off-site groundwater.

3. Reduce CoC concentrations in off-site groundwater to be protective of downgradient groundwater receptors.

To achieve these objectives, the CAP proposes to design, construct, and operate an air sparging (AS) and soil vapor extraction (SVE) system in the contaminant source area beneath the KEC manufacturing building to reduce CoC concentrations in on-site soil and groundwater. Monitored natural attenuation (MNA) is proposed for the off-site groundwater contaminant plume to track the expected decrease in CoC concentrations in groundwater resulting from the reduction of CoCs in the contaminant source area beneath the KEC manufacturing building. This CAP also includes contingencies for expanding active treatment into the off-site plume, as necessary, to ensure MNA is viable.

Other general project DQOs include precision, accuracy, representativeness, comparability, and completeness (PARCC). Brief descriptions of the PARCC parameters are presented below.

2.2.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average value, usually stated in terms of standard deviation or coefficient of variation. It also may be measured as the relative percent difference (RPD) between two values. Precision includes the interrelated concepts of instrument or method detection limits (MDLs) and multiple field sample variance. Sources of this variance are sample heterogeneity, sampling error, and analytical error.

2.2.2 Accuracy

Accuracy measures the bias of the measurement system. Sources of this error are the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analysis. Data interpretation and reporting may also be significant sources of error. Typically, analytical accuracy is assessed through the analysis of spiked samples and may be stated in terms of percent recovery or the average (arithmetic mean) of the percent recovery. Blank samples are also analyzed to assess sampling and analytical bias (e.g.)., sample contamination). Background measurements similarly assess measurement bias.

2.2.3 Representativeness

Representativeness expresses the degree to which data represent a characteristic of a population, a parameter variation at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with proper design of the measurement program. Sample/measurement locations may be biased (judgmental) or unbiased (random or systematic). For unbiased schemes, the sampling must be designed not only to collect samples that represent conditions at a sample location, but also to select sample locations that represent the total area to be sampled.

2.2.4 Completeness

Completeness is defined as the percentage of measurements performed which are judged to be valid. Although a quantitative goal must be specified, the completeness goal is the same for all data uses: that a sufficient amount of **valid** data be generated. It is important that critical samples are identified and plans made to ensure that valid data are collected for them.

2.2.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set may be compared to another. Sample data should be comparable with other measurement data for similar samples and sample conditions. This goal is achieved through the use of standard techniques to collect and analyze samples including the use of USEPA-approved analytical methods.

3. Project Description

The purpose of this project is to remediate residual contaminants above the MDEQ Tier 1 TRGs as identified during previous site investigations. The TRGs for select chemical compounds are shown in Table 3.

During the technology screening process, those technologies which were determined to be potentially effective were grouped and sequenced in a manner designed to meet the project objectives. The proposed grouping, sequence, and implementation of multiple technologies are considered as remediation alternatives. Several alternatives were evaluated, based primarily on their relative ability to reliably satisfy all of the CAP objectives. Supplemental evaluation criteria were also considered, namely:

1. Relative short-term and long-term treatment effectiveness of the individual technologies and the overall reliability of the aggregate alternatives.

2. Relative complexity of implementation with respect to physical access, site-specific constraints, stakeholder limitations, and regulatory considerations.

3. Relative cost considerations as they relate to overall lifecycle cost; capital expenditure; operation, maintenance, and monitoring costs; technology contingency costs; and potential cost uncertainty.

A risk-based, adaptive approach to remediation of the source area beneath the KEC manufacturing facility building and the off-site groundwater impacts is proposed. The CAP provides the framework for how the proposed approach will be implemented, including an overview of the anticipated schedule, pre-design requirements, performance monitoring expectations, and a discussion of key project milestones and the decision process used to make implementation or operation decisions (e.g., whether or not contingency plans warrant implementation).

All of the proposed technologies have limitations in application or efficiency. Therefore, knowing the advantages and limitations to a particular technology and using them selectively or in sequence is crucial. Technology sequencing will prove to be a critical component to the overall strategy of meeting closure objectives for this project. The overriding strategy will be to apply and sequence remediation technologies in a manner that maximizes the treatment efficiency and focuses primarily on treating the CoCs and hydrostratigraphic units that are contributing to off-site risks, while balancing remedy costs over the lifetime of the project.

The two primary drivers for off-site risk are 1,1-DCE and 1,4-dioxane. The off-site 1,1-DCE plume appears to be stable. The off-site 1,4-dioxane plume, while less extensive in area than the 1,1-DCE plume, appears to be increasing in size/extent. It is important to reiterate that the 1,4-dioxane plume concentrations are only slightly above the Tier 1 TRG. Given the current state, extent, and configuration of the off-site plumes, a relatively aggressive approach toward remediation of the source area impacts is proposed, coupled with an adaptive MNA approach for the off-site plumes.

The proposed approach is outlined as follows:

2. Design, install, and operate an AS/SVE system to treat soil and groundwater impacts in the source areas beneath the KEC facility building and on the KEC property.

   – The primary treatment objective of this technology will be to treat the VOC-impacted source area beneath the building responsible for the off-site 1,1-DCE plume.

   – This technology may only have a limited impact on reducing the 1,4-dioxane concentrations in the source area. However, given that downgradient 1,4-dioxane concentrations are only slightly exceeding the Tier 1 TRGs, AS/SVE in the source area may mitigate future 1,4-dioxane contributions to the off-site plume.

   – The source area AS/SVE system will be designed, constructed, and operated in a manner designed to achieve aggressive treatment goals. The SVE remedy component will target a minimum pore volume exchange rate throughout the source area soils of approximately one pore volume per day. The AS component will target complete/overlapping treatment of the impacted extent of the saturated zone in the upper aquifer.

3. If more aggressive source area treatment is needed to control/mitigate the off-site CoC contributions to groundwater, implementation of a contingency treatment technology in the source area would be recommended to further treat any recalcitrant CoCs (e.g., 1,4-dioxane). Source area in-situ chemical oxidation may be considered as a contingency technology, implementation of which will be dictated or refined based on the success of the physical (i.e., AS/SVE) treatment efforts.

4. Rely on MNA initially for the off-site plumes.

   – The success of the overall remedy will depend largely on how the off-site plume responds to aggressive source area treatment. During the initial period of performance, off-site monitoring will be used to further assess whether or not CoC concentrations stabilize (in the case of 1,4-dioxane), remain stable (in the case of 1,1-DCE), and/or demonstrate an appreciable decline in concentration in response to the on-site efforts.

   – This monitoring period will also be used to evaluate and further assess how pumping operations by the Crystal Springs water system are affecting plume migration.

5. If off-site MNA is not a viable long-term solution, expand the in-situ technologies to treat off-site groundwater. In-situ treatment of the off-site plumes will be considered a contingency alternative; actual implementation of AS/SVE and/or an alternate technology will depend in part on technology demonstration/performance in the source area.

6. The need for off-site treatment will likely be determined based on the stability of the 1,4-dioxane plume as source area treatment with AS/SVE progresses. If it turns out the 1,4-dioxane plume is not stabilizing in a manner amenable to long-term MNA, in-situ measures will be considered to treat the off-site plume to the extent necessary to ensure MNA viability.

4. Initial Baseline Assessment

The remediation objectives are based primarily on achieving unrestricted Tier 1 TRGs in groundwater, with the expectation that on-site soil treatment will be performed to the extent groundwater objectives can be met. It is anticipated that unrestricted Tier 1 TRGs for soils will be readily met during implementation of this remedy, but also expected that it will be necessary to conduct a more thorough risk evaluation in order to definitively rule out the need for quantitative, numerical cleanup goals for soils. Following MDEQ's approval of the CAP, a more thorough Tier 2 risk evaluation will be performed to develop site-specific, restricted TRGs for soils. Preliminary expectations are that any restricted Tier 2 soil TRGs developed during this evaluation will be higher than the current concentrations observed on site.

The recommended approach relies upon aggressive source area in-situ treatment using AS/SVE. In order to adequately design and implement these technologies, a pilot study is proposed for purposes of refining the design criteria that will be used to determine AS/SVE well placement, injection and extraction flow requirements, mechanical and electrical component needs, and other operational considerations. The AS/SVE pilot study will entail installation of an AS/SVE well pair and several pilot observation wells. Short-term step testing, using temporary skid-mounted equipment, will be used to estimate achievable AS treatment extents (i.e., radii of influence [ROIs]) at a range of pressures and flows. Step testing will also be used to determine achievable vacuum ROIs under a range of applied vacuums and extraction flow rates from the SVE well. The vacuum observations will be used to estimate pneumatic conductivity of the vadose zone soils. The pneumatic conductivity will be used, in turn, to model extraction flow requirements and refine full-scale SVE well placement, in order to achieve optimal pore volume exchange rates throughout the source area treatment extents. The pilot test will also be used to conservatively assess potential VOC emission rates during full-scale operation of the AS/SVE system. These data will be used to assess emission permit requirements in context of allowable thresholds and to determine if and how emission controls need to be factored in to the full-scale design.

Baseline sampling will be conducted on selected existing groundwater monitor wells. The existing wells were installed during previous assessment activities and may require redevelopment prior to the collection of samples. In addition to the sampling of existing wells, additional soil borings may be advanced to further define "hot spot" concentrations and/or the boundaries of impacted areas. Some of the soil borings may be converted to temporary wells for the collection of groundwater samples.

As an overview, the assessment program to determine present site conditions will include:

- Collection of soil and groundwater samples at selected locations surrounding known areas of contamination. Locations may deviate from those proposed within this document based upon review of analytical data and approval by MDEQ;
- Soil and groundwater samples will be collected at proposed locations based on field conditions and the use of appropriate tools that may include manual hand augers, a Geoprobe® device, and/or a drilling rig;
- Groundwater samples will be collected from permanent and/or temporary monitor wells. Temporary monitor wells will be plugged and abandoned upon completion of the assessment or will be converted to permanent monitor wells;
- Soil samples will be field-screened using an Organic Vapor Analyzer (OVA) or an Organic Vapor Meter (OVM) and samples will be selected for volatile chemical analyses based upon vapor measurement results or by visual observations; and
- Chemical analyses will be performed on soil and groundwater samples for the site-specific CoC as described in Section 10 (General Project Sampling Requirements). Based on the type of potential impacts identified, the subcontract off-site environmental laboratory will perform analyses to determine the concentrations of applicable chemical parameters

5. Groundwater Remediation

Groundwater concentrations in excess of TRGs at the site will be addressed through AS/SVE within the source area and MNA for off-site plumes.

5.1 Air Sparge Wells

Source area treatment of groundwater using in-situ AS is proposed. While the exact placement and number of AS wells required in the source areas is subject to pilot test determinations and KEC facility constraints, the anticipated source area remedy will require installation of approximately 23 AS wells. This remedy may require future expansion of AS treatment into off-site areas. If AS treatment is required downgradient, any AS wells installed in support of this type of expansion will be drilled and constructed similarly to the source area wells. However, these wells will likely be installed in a transect fashion, as opposed to the grid approach that is planned for the source area beneath the KEC manufacturing facility building. The transect orientation will entail placement of a line, or curtain, of AS treatment wells in a manner designed to intersect plume migration through areas (e.g., zones, depths) of preferential migration where the off-site contaminant mass flux is greatest.

5.2 Soil Vapor Extraction Wells

Source area treatment of residual soil impacts using SVE is proposed. The SVE will also be used to capture vapors from the AS system. The exact placement and number of SVE wells required in the source areas will be subject to pilot test determinations and KEC facility constraints; however, at this time the anticipated source area remedy will entail installation of approximately 10 SVE wells. SVE wells will be constructed with 50- to 70-foot long, 2-inch diameter, stainless steel wire-wrapped well screen intervals and will be installed into the saturated reach of the upper aquifer, to an approximate total depth up to 80 feet bgs. Wells will be spaced in a manner designed to achieve overlapping SVE treatment ROIs throughout the entire source area when operating under the optimal flow rates, as will be determined by the pilot test. Preliminary expectations are that the source area SVE wells will be spaced approximately 70 to 80 feet apart and that well locations/spacing will need to be adjusted to minimize obstructions to KEC manufacturing operations.

This remedy may require future expansion of AS/SVE treatment into off-site areas. If AS treatment is required downgradient of the KEC plant property, SVE wells will be installed as warranted to manage the collection of AS vapors. Any SVE wells required for this purpose will likely be drilled and constructed in a manner similar to the source area SVE wells.

Given the proposed number of SVE wells, it is anticipated that vertical wells are the most desirable means for treating impacted soils and collecting AS vapors. However, it also is recognized that targeting treatment beneath the existing KEC facility building may present a number of physical implementation constraints. Upon the culmination of the pilot testing effort, and during the ensuing design, it may be necessary to re-evaluate whether or not horizontal or directionally drilled wells are a more cost-effective and less intrusive means for accomplishing the AS/SVE treatment objectives.

5.3 Engineered Treatment Systems

The AS/SVE system will entail forced air delivery and extraction using above-grade electrical and mechanical systems. The anticipated design effort will fully evaluate how these systems can be installed within and/or beneath the active manufacturing facility without obstructing manufacturing operations. To the extent practicable, the well field piping systems will be installed overhead or above grade on pipe rack systems. AS distribution and SVE conveyance piping will be sized in a manner to minimize pressure and vacuum losses at the anticipated flow rates. Centralized flow control and monitoring manifolds will be used to distribute/collect air from the AS/SVE well field. The flow control manifolds will be co-located with the mechanical systems and individual well piping runs will be extended throughout the plant and connected to the individual wells.

The AS/SVE manifolds will be capable of monitoring, adjusting, and distributing flow from the entire SVE well network. The AS manifold will be equipped with automated pulsing capabilities. The SVE manifold will be capable of manually operated selective extraction if focused SVE extraction or cycling is warranted. The SVE equipment will collect extracted vapors from the manifold and convey them through a level controlled liquid separator and inlet filter installed prior to the blower inlet. A separate filter/silencer will be installed on the discharge side of the SVE blower and extracted vapors will be routed through a discharge stack. At this time, no emission control technologies are expected to be necessary; however, this will be further assessed during pilot testing and full-scale design of the AS/SVE system. The size and type of blower used will also be determined based on pilot test determinations. The SVE blower should be sized in a manner that will ensure adequate capacity for expansion should the need arise. The blower motor will be equipped with a variable speed drive, and the SVE control systems will be interlocked using process logic control (PLC) based programming.

The AS treatment system will be installed using a skid-mounted compressed air package. The size and type of compressor used will be determined during the ensuing design effort and will be specified in a manner to ensure the system is capable of providing higher flow if future expansion of the well field is necessary. Depending on the type of compressor used, the system will be equipped with coalescing filters, heat exchangers, and receiver tank components, as warranted, to ensure delivery of oil-free, clean, dry air to the AS injection manifold. The AS equipment operation and well field pulsing controls will be integrated into the SVE control panel. The AS/SVE control systems will be equipped with remote monitoring capabilities for purposes of communicating system status, alarm conditions, and basic real-time operating conditions.

6. Institutional Controls

Based on the results of historical and baseline sampling, institutional controls may be employed as a part of site remediation activities. The purpose of institutional controls is to reduce or eliminate potential exposure pathways to known CoC remaining. Institutional controls will be implemented as the remediation progresses under MDEQ Brownfields restricted Tier 1 TRGs.

7. Sample Design

This section includes descriptions of work to be performed, media to be sampled, CoC, and an overview of field quality assurance/quality control (QA/QC) procedures. The site CoCs are presented in Table 4. At a minimum, these CoC will be analyzed by the laboratory. However, the laboratory will also report additional volatile and semivolatile constituents that are in the laboratory's standard operating procedure (SOP) for the SW-846 Method. This list will be confirmed in future work plans and after the laboratory is selected. The proposed locations and numbers of analytical and geotechnical sample collection points will be presented in future work plans developed for each area.

It should be noted that the sampling design described within this section allows for flexibility in relocating, adding, or removing sample locations, based on site observations identified during the field investigations. The sample locations will be identified in subsequent media-specific work plans to adequately identify, characterize, and delineate the site conditions. Modifications to the list of CoC may be warranted if observed conditions indicate the existence of potential CoC not listed in this QAPP.

8. Field Operations

Field policies and SOPs will be employed to ensure personnel safety, consistency in procedures, and the collection of representative samples. As required, new policies or SOPs will be developed to encompass additional or different field procedures to address the project objectives. Changes to existing policies will be reviewed and approved by the project QA Manager.

8.1 Field Documentation

Field documentation will include a field logbook and/or daily logs, field sampling logs, instrument calibration logs, and data forms to provide sufficient information to allow review of field conditions and sample collection, evaluate potential impacts to sample and data integrity, and enable reconstruction of events that occurred during the field operations when necessary. Daily logs will also document any deviations from the work plan, the QAPP, or other applicable planning document and describe the rationale for such changes.

All entries will be made in waterproof ink, and the time of the entry will be recorded. The top of each page of the field documents will contain the date that the entries on that page were recorded. No pages will be removed from a bound logbook for any reason. Corrections will be made according to the procedures given later in this section.

The daily logs and/or sample logs will include, as applicable:

- Name of the person making the entry (signature);
- Names of team members, subcontractors, and visitors on site;
- Levels of personal protective equipment (PPE): level of protection originally used; changes in protection, if required; and reasons for changes;
- Drilling information, including method employed; diameter of borehole and well casing; materials used; depth of borehole; and well construction, if appropriate;
- Documentation for samples collected, including, as applicable, sampling location; sampling depth for subsurface soil and surface water samples; sample identification number; sample collection method; sampling date, time, and personnel; sample matrix; sample sequence (order in which samples were collected); equipment used (including the use of fuel-powered units/motors during surface water sampling); type of sample (e.g., grab, composite); quantity of each aliquot if sample is a composite; and sample preservation;
- Types of field QC samples, including when and where they were collected. The description of sample collection equipment should be included for equipment blanks and the actual field samples collected with that equipment prior to collection of the rinsate;
- Samples split with oversight agencies, if applicable;

- Information regarding well purging, including depth to water and total well depth, calculations used for volume purged, volume purged, equipment used, field measurements, length of purge time, and date and time well was purged;
- Drum sampling: type of drum; description of contents; and description of layers sampled;
- Field equipment used, equipment identification numbers, and calibration information;
- On-site measurement data;
- Field observations and remarks;
- Weather conditions and wind direction;
- Equipment decontamination procedures;
- Unusual circumstances or difficulties; and
- Initials or signature of person recording the information.

All recorded field documentation associated with field activities will be retained in the project files.

8.2 Corrections to Field Documentation

As with all bound data logbooks, no pages will be removed for any reason. If corrections are necessary on any field documentation, they will be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside it. The correction must be initialed and dated. Where necessary, corrected errors will include a footnote explaining the correction.

8.3 Photographs

Photographs will be taken as directed by the team leader. Documentation by a photograph will ensure the validity as a visual representation of an existing situation. A log will be developed to track the media on which the photos are filed (e.g., compact disc, floppy disk). Photographs, as developed or transferred to electronic media, shall be compiled into a photographic log and information recorded in field notebooks added to the log with appropriate photographs. The following information will be noted in the log for digital or non-digital photographs as applicable to the media used for preservation:

- Date, time, location, and direction photograph was taken;
- Description of the photograph taken;
- Reasons why the photograph was taken;
- Sequential number of the photograph and the film roll number or electronic media identification; and
- Camera lens system used.

8.4 Field Sampling Equipment Procedures

Field supplies and equipment will be obtained from a reputable and reliable distribution company. The Field Operations Manager will inspect all supplies and equipment upon receipt at the site to verify that the correct materials were received. A program for maintaining field equipment should be used to ensure that the equipment is available in good working order when and where it is needed consists of the following elements:

- A list is maintained of reputable and reliable equipment rental suppliers to provide equipment or specialized instrumentation as necessary to meet project requirements;
- An equipment manual library is maintained and field personnel are trained in the proper use and care of equipment on an as-needed basis. Equipment manuals will be kept on site during field activities as a guide to calibration and maintenance;
- Field instrument SOPs are followed. New SOPs are prepared, as necessary, to encompass appropriate field activities;
- The Field Operations Manager is responsible to ensure that the equipment is tested, cleaned, charged, and calibrated in accordance with the manufacturer's instructions before use at the job site;

- A calibration/maintenance log is maintained for each piece of equipment. The log may be used to identify drift in the calibration over time, which might indicate the need for replacement of sensors or factory calibration; and

- The maintenance log or daily logs documents all repairs, adjustments, and calibrations and is retained in the project file. The field equipment logbooks will clearly document the date, description of the problems, corrective action taken, result, and person who performed the work.

Equipment will be rented as necessary to complete field operations and acquire the necessary data. All equipment will be inspected upon receipt to ensure that it is in working order. Supplier, type of instrument, and instrument identification numbers will be recorded in the field documentation. Calibration of all rental equipment will be verified.

Some of the standard field instrument calibration procedures described in Table 5 will be used to test and/or evaluate the instrument's performance. Field equipment will be inspected daily before use to ensure that no visual defects are present. In the event of major equipment failure in the field, a back-up instrument will be available or a replacement unit can be at the field site within 24 hours or less.

8.5 Field Equipment Decontamination

Sampling methods and equipment are chosen to minimize decontamination requirements and the possibility of cross contamination. Equipment or supplies that cannot be effectively decontaminated (e.g., sample tubing or rope) will be disposed of after sampling. Investigation/sampling equipment will be cleaned at the site prior to use, between sampling locations, and prior to transport back to the storage facility. Decontamination of field equipment, such as monitoring equipment, stainless steel sampling equipment, and drilling equipment, will be noted in the project logbook. Decontamination will consist of hand-washing with phosphate-free soap and a water rinse. Additionally, equipment may be steam cleaned with phosphate-free soap and high-pressure hot water as an alternative to hand-washing. If it is necessary to make decontamination procedure changes in the field, the changes will be noted in the logbook. Otherwise, a notation will be made each day that decontamination was conducted as specified in the project documents. Decontamination procedures will be conducted in accordance with those specified in the QAPP and also presented in the EISOPQAM.

Equipment blanks will be collected to verify the effectiveness of the decontamination procedures. If equipment blanks indicate poor techniques, the Project Chemist and Field Operations Manager/Field Coordinator will ensure techniques are modified and samplers trained appropriately to completely clean equipment prior to use. Evaluation of sampling techniques will be conducted in accordance with the procedures outlined in Section 9.12.3.

8.6 Sample Collection Protocols

Project technical personnel will review the project requirements and determine the best technology to obtain the samples and information required for achieving the stated goals. Investigation methodologies; sample collection procedures; sample types, numbers, and locations; and sampling equipment will be in accordance with intended use of the data and quality protocols established in the site QAPP.

The primary CoC at the KEC site are VOCs and 1,4-dioxane. The QAPP also lists other potential analytical methods which may be required to support the remedial objectives and waste characterization necessary for disposal of investigation-derived waste (IDW).

In general, sampling at each location will progress from clean areas to contaminated areas. This practice lowers the potential for cross contamination of samples and, subsequently, eliminates data anomalies or misinterpretation of the extent of contamination. The order of sample collection at a specific location normally proceeds as follows:

1. VOCs;

2. 1,4-Dioxane; and

3. Other parameters such as anions/cations and general chemistry parameters.

This sequence helps maintain the integrity of the samples and minimize the potential loss of volatile constituents. If soil sampling is required, samples requiring determination of VOCs will primarily be collected in accordance with SW-846 Method 5035 (USEPA 1997) protocols

using the Encore® sampling device. The Encore® capsule will be shipped to the laboratory for preservation in accordance with protocols established in SW-846 Method 5035. Alternatives to the Encore® device may be used which include a commercially available tool designed to capture 5 grams or 25 grams of sample for field preservation in laboratory pre-weighed vials containing sodium bisulfate or methanol. Vials will then be re-weighed by the laboratory to determine exact sample weight. Where collection of discrete 5- or 25-gram samples is inappropriate (i.e., rocky or unconsolidated material such as sludge or sediment), a 2- or 4-ounce wide-mouth glass jar will be packed full and as tightly as possible and will then be shipped to the laboratory for analysis.

If sufficient sample volume is unavailable to perform all desired parameters, the preferred parameters will be identified on a case-by-case basis.

Overall, the Field Operations Manager will be responsible for ensuring the correct sample collection methods are employed, documenting any problems and verifying required corrective actions. The Project Manager will approve any necessary corrective actions associated with sample collection. Corrective actions will be documented in field logs or addenda to field logs. Any changes to the sampling program, including sample locations, will be approved by the Project Manager.

8.7 Field Sample Identification Protocols

Each sample will be identified by a unique sample identification number in the logbook and on the chain-of-custody record using an alphanumeric code. Geographic location will be determined for field samples as necessary for report preparation and data display. Field samples will be identified using the following convention in the order presented below:

- Groundwater and soil sample identifications (IDs) will end with the date (in “mmddyy” format).
- For existing groundwater monitor wells, the current well ID will be incorporated into the sample ID.
- Soil samples will end with the depth interval (in feet).
- Blind duplicate samples will be labeled sequentially, starting at 1, in the form A#DUP01[location type code](yymmdd).

Following are some examples:

- Groundwater Sample 1 taken on October 6, 2011, would be: GW001(100611).

- Surface Soil Sample 4 taken from 0 to 6 inches would be: SS004(0-0.5).

The location type codes that will be used in the sample IDs are listed below:

- MW – monitor well;

- TW – temporary well;

- SB – soil boring (by drilling);

- GP – soil by direct push (or Geoprobe®);

- SS – surface soil by trowel or other hand collection method;

- IDW – investigation-derived waste; and

- PS – pilot study.

Equipment rinsate blanks will be identified using the sample type code (i.e., EB) followed by the date as MMDDYY as a parenthetical statement. If more than one equipment blank is generated for a single day, an alphanumeric character will be added to differentiate the blanks.

For trip blanks, the sample code of "TB" will be followed by the cooler identification number. For example, the trip blank associated with Cooler Number 3-121406 submitted on December 12, 2011, would be identified as TB3-121406.

8.8 Sample Containers

The volumes and containers required for the sampling activities are listed in Table 6. The laboratory will provide new, pre-cleaned sample containers. The laboratory shall use an approved specialty container supplier that prepares the containers in accordance with USEPA bottle preparation procedures. The laboratory must maintain a record of all sample bottle lot numbers shipped in the event of a contamination problem.

Sample container lids will not be mixed. All sample lids must stay with the original containers as provided by the supplier. Bottle lids (with any associated bottle) exhibiting cracks, splits, or chips shall be appropriately discarded.

8.9 Sample Container Labels

Sample labels affixed to the sample container will be used to properly identify all samples collected in the field. Each sample container will be marked in ink with the following information:

- Unique identification number for each sample in accordance with Section 9.7;
- Date and time of sample collection;
- Preservative/filtration used;
- Required analysis; and
- Sampler's initials.

8.10 Sample Preservation and Holding Times

Sample containers with appropriate preservatives will be obtained from the laboratory. Reagents used for preservation will be reagent-grade chemicals supplied by the laboratory. The laboratory shall maintain traceability records for all preservatives in the event of potential contamination of samples. The laboratory must ensure that preservatives used in containers supplied for sample collection will not expire within the anticipated time of sample collection completion. Each bottle received from the laboratory must be clearly labeled with the type of chemical preservative. Sample containers will not be stored at the site for longer than 30 days. Sample preservatives are listed in Table 6.

If samples must be preserved in the field, samples will be preserved at the time of collection using the following procedure. Preservatives will be supplied by the laboratory and will be properly labeled and include the expiration dates. A clean, disposable pipette or a pre-measured, single-use, glass ampoule/vial will be used to transfer liquid preservatives to the sample container. Care will be taken to avoid contact between the pipette or ampoule and the sample or sample container. Solid preservatives will be transferred to the sample container using a clean, stainless steel spoon. After preservation, the sample will be gently shaken to mix the preservative, and a small amount of the sample will be poured into a clean cup and tested with pH paper to determine whether a sufficient amount of preservative has been used. The field personnel will record the manual addition of preservatives (type and volume) in the field logbook.

Sample container orders will be submitted to the laboratory 5 working days prior to commencement of field operations to allow supplies of clean, fresh containers and preservatives to be shipped to the facility. Residual preservatives will be returned to the laboratory or appropriately disposed. No preservatives will be used beyond the expiration date.

Sample preservation will be verified on receipt at the laboratory with the exception of aqueous VOC samples. VOC sample preservation shall be verified prior to analysis. The preservation or pH check will be recorded on the sample receipt form or other appropriate logbook. If the samples are improperly preserved, a corrective action form will be submitted to the laboratory project manager for follow-up action. The laboratory will notify the project Field Coordinator or Project Chemist to implement corrective actions in the field to ensure sufficient preservative is added at the time of sample collection.

Sample holding times will be based on published USEPA guidance and will be calculated for the date and time of collection. A list of preservatives and holding times for each type of analysis is presented in Table 6. Additional preservation requirements and holding times for non-target analyses are listed in 40 Code of Federal Regulations (CFR) Part 136.

8.11 Sample Handling and Custody Requirements

Field and laboratory personnel will, at all times, be aware of the need to maintain all samples, whether in the field or in the laboratory, under strict chain-of-custody protocols and in a manner to retain physical properties and chemical composition. The following sections detail sample handling and sample custody requirements from collection to ultimate disposal.

8.11.1 Sample Handling

The transportation and handling of samples will be accomplished in a manner that not only protects the integrity of the sample, but also documents sample custody.

Regulations for the packaging, marking, labeling, and shipping of hazardous materials are promulgated by the U.S. Department of Transportation (DOT) in 49 CFR 171 through 177.

8.11.2 Sample Packaging

Samples will be packaged carefully to avoid breakage or cross contamination and will be shipped to the laboratory at proper temperatures. The following sample packaging guidelines will be followed:

- The sample bottles will be placed in the cooler in a manner to minimize potential cross contamination;
- Sample bottles from specific sampling locations will be placed in the same cooler where possible;
- In cases where samples for volatile analysis will be shipped in several coolers on a single day, VOC vials may be consolidated into a single cooler to minimize the number of required trip blanks;
- Wet ice will be used to cool samples during shipping. Ice will not be used as a substitute for packing materials;
- Shipping coolers will be filled with packing materials (e.g., bubble wrap). Packing material may be placed between or wrapped around glass containers to prevent the bottles from shifting and to minimize potential breakage during shipping;
- Temperature blanks will be included in each cooler to allow the laboratory to check cooler/sample transportation upon receipt. Temperature blanks will consist of a 250-milliliter plastic bottle filled with deionized water. Temperature blanks may be provided by the laboratory or prepared in the field prior to sealing coolers;
- Under no circumstances will packing material such as sawdust or sand be used;
- A chain-of-custody record will be placed in a sealable plastic bag and taped to the inside of the cooler lid;

- Custody seals will be affixed to the sample cooler in such a way as to indicate any tampering during shipment and then dated and initialed; and

- All sample containers will generally be segregated according to sample matrix and expected contaminant concentration where possible. Soil samples will not be shipped with water samples, and low-concentration samples will not be shipped with medium- and high-concentration samples.

8.11.3 Shipping Containers

Environmental samples will be properly packaged and labeled for transport and dispatched to the analytical laboratory. A separate chain-of-custody record will be prepared for each shipping container. Sample shipping containers will generally be commercially purchased coolers (e.g., Coleman, Igloo). Any water spouts must be sealed with tape to prevent leaking of melted water or samples from broken bottles. Each shipping container will be custody-sealed for shipment as appropriate. The container custody seal will consist of packing tape wrapped around the package at least twice and custody seals affixed in such a way that access to the container can be gained only by cutting the tape and breaking a seal. Field personnel will make arrangements for transportation of samples to the laboratory. In most cases, samples will be shipped using an overnight express carrier (e.g., Federal Express). Field personnel will provide the laboratory with a shipment schedule and notify them of deviations from planned activities. The field personnel will notify the laboratory no later than 3 p.m. (Central Time) on Thursday prior to scheduling samples for Saturday delivery.

Sample coolers will be identified with a unique number that will incorporate the cooler number and the date shipped to the laboratory. Cooler Number 1 for samples shipped on December 14, 2011, would be would be identified as 1-121411. The chain-of-custody record included in this cooler will carry the same number as the cooler.

8.11.4 Sample Custody

Formal sample custody procedures begin when sample collection is initiated. Sample identification documents will be carefully prepared so that sample identification, chain of custody, and integrity are maintained and sample disposition controlled. Sample identification documents include:

- Field notebooks;
- Sample labels;
- Custody seals;
- Chain-of-custody records; and
- Disposal records.

The primary objective of the chain-of-custody procedures is to provide an accurate, traceable record of the possession and handling of a sample from collection through completion of all required analyses and final disposal. A sample is in custody if it is:

- In a sampling team member's physical possession;
- In a sampling team member's view;
- Locked in a vehicle;
- In a custody-sealed container during shipment via commercial courier; or
- Held in a secured area that is restricted to authorized personnel.

The laboratory must follow internal written and approved procedures for shipping, receiving, logging, and internally transferring samples.

8.11.4.1 Field Sample Chain-of-Custody Procedures

All sample transfers will be documented under complete chain-of-custody procedures. An example of a chain-of-custody form is presented within Appendix B.

As part of the chain-of-custody procedures, all sample containers will be labeled with sample identification, date and time collected, initials of sample collector, and the test parameters required. The field supervisor will be responsible for the custody and care of collected samples until the containers have been transferred to the laboratory or commercial shipping company. After sample collection, the containers will be placed in a cooler with wet ice and custody seals affixed to the cooler exterior to prevent tampering.

The field sample collection team will ensure that the sample containers are in the sampler's physical possession, in view at all times, or are stored in a locked area to prevent tampering. The completed chain-of-custody form will be sealed inside the cooler if shipment to the laboratory is via commercial carrier. If samples are directly transferred to the laboratory courier or sample custodian, the chain-of-custody form will be signed by the field supervisor (or his designee) at the time of physical transfer.

When a commercial courier service is used, the field supervisor (or designee) will sign the chain-of-custody form and retain a copy for the field records prior to sealing the cooler. When the samples have been delivered to the laboratory, the laboratory sample receipt personnel will sign the chain-of-custody form. The fully executed original chain-of-custody form will be included in the analytical report. The analytical laboratory has internal standard operating procedures described within the Quality Assurance Manual (QAM) for receipt of samples, maintenance of custody, sample security, tracking the analyses of samples, and assembling the completed data.

The following sampling guidelines will be followed to ensure that appropriate chain-of-custody protocols are employed:

- Use as few people as possible to handle samples;
- Coolers or boxes containing cleaned bottles should be maintained in a clean, secure environment;
- In cases where samples for volatile analysis will be shipped in several coolers on a single day, VOC vials may be consolidated into a single cooler to minimize the number of required trip blanks;
- The field supervisor has ultimate responsibility for the care and custody of the samples collected until they are transferred or dispatched to the laboratory;
- When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the chain-of-custody form;
- Samples will be packaged properly for shipment and delivered to the laboratory for analyses without breakage or leaking;

- All deliveries will be accompanied by the chain-of-custody form identifying its contents. The original form will accompany the shipment, and a copy will be retained by the Project Manager; and

- All coolers used for sample shipment will be sealed with a custody seal (example in Appendix B).

8.11.4.2 Chain-of-Custody Form

The chain-of-custody form must be completed by the technical staff designated by the Field Operations Manager/Field Coordinator as responsible for sample shipment to the appropriate laboratory for analysis. In addition, if samples are known to require rapid turnaround in the laboratory because of project time constraints or analytical concerns (e.g., extraction time or sample retention period limitations), the person completing the chain-of-custody form should note these constraints in the “Remarks” section of the chain-of-custody form. The chain-of-custody form should also indicate any special preservation techniques necessary or whether the samples need to be filtered and clearly indicate field QC samples for matrix spike/matrix spike duplicate (MS/MSD), trip blanks, and equipment blanks. The original signed chain-of-custody form accompanies the samples from the field to the laboratory where receipt is documented by appropriate signatures and dates. Copies of the chain-of-custody form are maintained with the project file. The original, fully executed chain-of-custody record will be included in the hard copy report.

Each chain-of-custody form will include the cooler number which identify the chain of custody for sample tracking purposes. A copy of the chain-of-custody form will be retained with the field records. If samples are shipped by commercial carrier, the shipping records will be maintained in the project files with the field records.

8.11.4.3 Custody Seals

Custody seals are preprinted, adhesive-backed seals with security slots designed to break if the seals are disturbed. Custody seals are applied to each DOT-approved sample shipping container to ensure security. Two seals will be used per cooler. Seals are signed and dated upon use. Upon receipt at the laboratory, the custodian checks the custody seal for tampering and documents on a cooler receipt form that seals on shipping coolers/boxes are intact.

8.12 Field Quality Control Samples

The field QC samples listed below will be collected and analyzed at the frequency listed in Table 7.

8.12.1 Field Duplicate Samples

Field duplicate samples provide insight as to the homogeneity of the sample matrix and enable consideration of variations in contaminant concentrations present in the matrix. Duplicate sample data establish a degree of confidence that the sample is representative of site conditions. Duplicate samples will be collected at the rate of 1 duplicate per every 20 project samples of similar matrix. For VOC analyses, duplicate soil samples will be prepared by collecting equal aliquots from the same sample source and placing them in separate sample collection devices, preserved vials, or sample bottles. For all other methods, soil from the desired sample interval/location will be placed in a stainless steel bowl and thoroughly mixed prior to filling necessary sample containers for the primary sample and field duplicate. Duplicate water samples will be prepared by equally distributing water collected among all sample bottles to be filled for both the field sample and the field duplicate sample. Duplicate samples will be shipped with the samples they represent and will be analyzed in the same manner. Duplicate samples will be labeled so as to be blind to the laboratory. The RPD between the concentration in the original and duplicate sample measures the overall precision of the field sampling and analytical method. Field duplicate RPDs will be calculated after receipt of the analytical data. The RPD will be calculated as follows:

$$RPD = \left(\frac{PR - DR}{\frac{1}{2}(PR + DR)} \right) \times 100$$

Where:

PR = primary sample result

DR = duplicate sample result

The precision of field duplicates is evaluated by using approximately two times the laboratory QC criteria for duplicates (i.e., RPDs of 40 percent for water and 70 percent for soils). If all other laboratory QC criteria are met, RPD results outside control limits indicate potential matrix effects or non-homogeneity of samples. Significant deviations in the RPD results of field duplicates are assessed to evaluate whether data met all DQOs for the project. Results for duplicates that exceed the above criteria may be qualified as estimated. Professional judgment will be used to determine the applicability and extent of qualification to other field samples.

8.12.2 Trip Blanks

Trip blanks are collected to establish that the transport of sample containers to and samples from the field does not result in the contamination of the sample from external sources. Trip blanks will be included in all coolers containing samples requiring VOC determination. Trip blanks will be prepared by the laboratory by filling 40-milliliter vials with analyte-free water, sealed, and labeled in a clean area. A set of two or three analyte-free water-filled VOC vials prepared by the laboratory will constitute a trip blank. The above protocol for trip blanks applies to both aqueous and non-aqueous samples. Trip blanks will be treated in the same manner as the VOC samples they represent.

If contamination is present in the trip blank, the sample results will be qualified as non-detect at the value reported when the sample concentrations are less than five times the level found in the trip blank. If constituent levels in the sample are greater than five times the levels in the trip blank, no qualification will be necessary unless the compounds reported are considered common laboratory contaminants. Concentrations of common laboratory contaminants detected in the trip blank and reported in samples at less than ten times the trip blank concentration will be qualified as non-detect at the value reported. If trip blank contaminants also are present in the method blank or are not present in the project samples, then no further action is required. All other sources of contamination must be investigated as part of the corrective action process.

8.12.3 Equipment Rinsate Blanks

Equipment rinsate blanks (equipment blanks) are designed to demonstrate that sampling equipment has been properly prepared and cleaned before field use and that cleaning procedures between samples are sufficient to minimize cross contamination. Equipment blanks will be prepared in the field using a contaminant-free (deionized or distilled water) water source. The field equipment blank will be preserved, documented, shipped, and analyzed in the same manner as the samples it represents.

Equipment blanks will be collected at a rate of 1 per 20 field samples of similar matrix. The location and equipment used to collect this blank shall be clearly documented on the Field Sampling Logs. Samples collected with dedicated or disposable equipment will not require equipment blank samples at the 1 per 20 sample frequency. One equipment blank will be collected per sampling event or one per lot where single use or dedicated equipment is used, as appropriate. Examples of single use or dedicated equipment include acetate sleeves for direct push soil samples, disposable bailers, or dedicated bailers.

If low-level contamination is present in the equipment blank, the sample results should be greater than five times the level found in the blank. The equipment blank will be linked to samples collected the same day, using similar equipment. If contaminant levels in the sample are less than five times the levels in the equipment blank, the sample results will be qualified as non-detect at an elevated reporting limit. Sources of contamination will be investigated as part of the corrective action process. If blank contamination results in qualification of data as non-detect at levels above the applicable screening standard, resampling may be necessary. Sample results that do not meet DQOs after qualification may require resampling. The QA Manager, Project Chemist, and Field Operations Manager/Field Coordinator will determine potential changes in the field procedures to eliminate contamination sources prior to resampling.

8.12.4 Miscellaneous Field QC Samples

Miscellaneous QC samples may also include the analysis of source water and filters. Because the water supply source is used in decontamination and well drilling activities, it may be necessary to determine the possibility for the introduction of outside contaminants. Filters may be used to evaluate dissolved constituents in groundwater. Filter blanks will be prepared to evaluate the potential contribution of CoC to the samples. Filter blanks will be collected, preserved, and analyzed in the same manner as the field samples that they represent.

8.13 Investigation-Derived Waste

Any IDW generated during field activities will be handled in a manner consistent with USEPA guidance for managing IDW associated with site sample collection (USEPA 1992) and applicable federal and state regulations. IDW includes disposable equipment and PPE, purge and development waters, drilling fluids, soil cuttings, and decontamination fluids. IDW will be managed and disposed in accordance with state and federal regulations. Visual contamination or analytical results of site samples may indicate the need for analysis of IDW. Method references for toxicity characteristic leaching procedure, toxicity, corrosively, ignitability, and reactivity analyses that may be used to characterize IDW are included in Table 6.

9. General Project Sampling Requirements

The activities described in this section will serve as the general SAP for the initial assessment to be performed. The initial assessment activities are designed to collect additional data where data gaps exist and to finalize CoC delineation. The Project Manager will serve as the individual responsible for implementing corrective action for problems or inconsistencies associated with the project sampling requirements. Descriptions of field procedures and analytical programs that will be used during the investigation are included in the following subsections.

As summarized in Table 2, the project sampling and analyses program has been developed to meet the project DQOs:

Develop the decision rule: If soil and groundwater quality data indicate concentrations above Tier 1 Evaluation TRG, the affected media will be addressed by the inclusion of these areas in the remedial actions set forth in this QAPP.

Specify limits on decision errors: Because the assessment includes a biased sampling design (judgment based), a statistical evaluation of decision error is not possible. The use of biased sampling prevents the results of the investigation from being used to evaluate areas beyond the immediate study area boundaries. Data quality and usability will be determined in accordance with the criteria set forth in the QAPP. Rejected data will not be used for decision-making purposes.

9.1 Field Program

During the field program, site activities will be conducted in accordance with procedures described within Section 5 (Sampling Design and Quality Assurance Procedures) of the EISOPQAM and as described in this QAPP. These procedures include the decontamination process implemented between sample collection locations and proper collection of field samples and QA/QC samples. The Health and Safety Plan (HASP) for the field sampling protocol will be provided as a separate document.

9.2 Soil Boring/Sampling Geoprobe® Device

If soil sampling is required, soil borings will be advanced with a Geoprobe® device (where possible) in order to collect undisturbed subsoil samples as presented in future work plans. No drilling fluids (i.e., bentonite-based drilling mud) will be used as part of this drilling method for shallow zone monitor wells.

Samples will be obtained using a disposable 1.5-inch diameter clear acetate sample collection tube within the Geoprobe® device. The sample tube will be placed at the desired depth and hydraulically advanced the length of the tube (4.0 feet) in one continuous movement. Following retrieval, the sample will be removed from the Geoprobe® device.

Upon retrieval of soil samples, the top and bottom ends of the soil samples may be discarded because they are potentially disturbed. Visual inspection and lithologic characterization will precede the collection of a discrete soil sample from the soil core. A qualified geologist or hydrogeologist will describe all samples and all relevant data will be recorded onto the Sample/Core Log (i.e., soil type, color, physical characteristics, texture, mineralogy, moisture content, and any observed evidence of contamination). Appendix B includes an example of a Sample/Core Log that will be used to record lithologic characteristics during the assessment.

During the soil sampling program, each collected sample will be segmented with clean stainless-steel spoons or knives for field and laboratory analysis. Duplicate sets of soil samples from each cored interval may be removed from the interior portion of the core with a stainless-steel sampling device and placed directly into separate containers designated for field screening and potential submission to the laboratory for analysis. If sufficient volume is unavailable to generate a duplicate set of samples, an additional soil boring will be advanced within a 3-foot radius of the initial boring. Soil samples will be sent to the laboratory from selected intervals determined by the “headspace” analysis described below. Samples held for possible confirmatory analyses will be maintained in coolers at approximately 4 degrees Celsius (°C) until shipped to the laboratory or discarded. The container designated for field screening will be sealed with aluminum foil and set aside to allow volatilization of site contaminants within the “headspace” of the sample container. All soil samples will be field-screened with either an OVA or an OVM. Disposable chemically resistant gloves will be used during the entire process and discarded after each sample collection to eliminate the possibility of cross contamination of samples.

After a minimum of 5 minutes, "headspace" in the container will be tested for the presence of organic vapors by inserting the instrument probe through the septum (typically an aluminum foil seal) of the sample container. All measured vapor concentrations will be recorded on Sample/Core Logs by the site geologist or hydrogeologist. All instruments will be operated and calibrated according to manufacturer's instructions. Recalibration of the instrument will be performed, at a minimum, prior to use each work day and at the end of each work day. All calibration events will be recorded by the site geologist or hydrogeologist on instrument calibration forms.

Samples will be retained from subsurface intervals that appear to be the most highly contaminated and from intervals exhibiting a change in lithology. If no contamination is indicated by the field screening, at least one sample per borehole will be sent to the laboratory for determination of the suspected CoC. The sample will be selected from the interval within the borehole that has the highest probability of being contaminated (i.e., first permeable layer), as determined by the on-site geologist or hydrogeologist. The analytical methods, sample volumes, and preservation requirements are summarized in Table 6. After collection, samples will be immediately placed on wet ice and maintained at 4°C until received by the laboratory. Samples will be forwarded to the laboratory under complete chain-of-custody procedures. Samples will be stored in the receiving laboratory at approximately 4°C until the analyses are performed.

9.3 Soil Sampling – Hand Auger

If required, surficial soil samples will be collected with the use of a stainless-steel hand auger. In order to minimize the potential for cross-contamination between sample locations, the hand auger will be decontaminated as described in Section 9.5 (Field Equipment Decontamination). Once surficial soil samples are collected, the field hydrogeologist will record sample collection times and soil characteristics (e.g., sample color, lithology, presence of natural organic material) on a Soil/Sediment Sampling Log. Appendix B presents a Soil/Sediment Sampling Log that will be used to document surficial soil samples collected with a hand auger. Surficial soil samples will be containerized, stored in a cooler with ice, and transported to the laboratory under strict chain-of-custody procedures.

9.4 Temporary Monitor Well Installation Program

If needed for the remediation program, this section describes the methods for the installation of temporary monitor wells. Upon completion of the soil sampling activities, selected soil boring sites will be converted into temporary monitor wells to collect groundwater samples. Prepackaged monitor wells will be placed within the boreholes using the Geoprobe® device. Construction details for monitor wells installed during the investigation will be recorded on the Well Construction Logs shown in Appendix B.

The monitor wells will be installed with the screened interval to intersect the top of the water table. The monitor wells will be installed using a Geoprobe® direct-push rig to minimize the generation of soil cuttings and provide minimal disturbance to the surrounding area. The monitor well installation process will begin by initially driving and/or hydraulically pushing the Geoprobe® 3.25-inch outside diameter (2.65-inch inside diameter) drill rods into the subsurface to the desired depth. The drill rod will be equipped with an expendable stainless-steel drive point/monitor well anchor assembly. Upon retraction of the drive unit, a Geoprobe® 5-foot long by 1.5-inch diameter Schedule 40 polyvinyl chloride (PVC) well screen, encased within a 2.5-inch diameter stainless-steel 0.011-inch mesh, pre-packed filter, will be inserted inside the drive casing. The well screen will be threaded to the appropriate length of PVC riser pipe, and the well assembly will be lowered into the drill casing. The 3.25-inch diameter drill rods will then be retracted, leaving the drive point, well screen, and riser in place.

To complete the monitor well installation, the annulus of the well surrounding the well screen will be filled to the extent possible with 20/40 grade silica sand or equivalent to a height approximately 1 to 2 feet above the top of the well screen. An approximately 2-foot thick bentonite seal will be poured above the sand pack using pelleted bentonite. The bentonite pellets will be hydrated with water and allowed to swell for 24 hours to create an appropriate well seal. Upon hydration, the remainder of the well annulus will be filled using an approximately 95 percent neat cement/5 percent bentonite slurry mixture pumped into the well annulus to the surface using the Tremie method. Because the property is largely inactive and no traffic is anticipated over the site area, approximately 3 feet of riser pipe (“stickup”) will remain above the ground surface to provide access to the monitor wells. Colored flagging will be tied to the well and/or nearby vegetation as necessary to aid in field location.

Each temporary well will be developed using a bailer or low-flow purging and sampling procedures via a peristaltic pump equipped with new silicon pump-head tubing and Teflon® or Teflon-lined sample collection tubing for each well location. During development of each well, the on-site hydrogeologist will collect representative samples of discharge water and record measurements of field parameters (i.e., pH, specific conductivity, and temperature) of these samples within field logs. Development at each well site will proceed until corresponding field measurements stabilize and until the discharge water is clear and free of suspended particles. Purging will continue until turbidity is less than 10 Nephelometric Turbidity Units (NTUs). Where 10 NTUs cannot be achieved, both total and dissolved metals will be collected to evaluate the potential impact of solids on the actual concentrations of metals. Total suspended solids and total dissolved solids will also be determined at the locations where total and dissolved metals samples are collected.

Purged water will be containerized during development of each monitor well. An off-site treatment/disposal determination will be made upon receipt of groundwater analytical data.

Upon completion of groundwater sampling, water level measurements will be collected for the newly installed wells. The top elevation of each monitor well casing will be surveyed. The resulting data will be used to evaluate groundwater flow patterns beneath the site. The temporary wells will be removed from probeholes (preferred), or abandoned in-place if depths negate their removal. Probeholes and/or the monitor wells will be encapsulated by backfilling the borehole with a cement-bentonite slurry mix in accordance with ASTM International (ASTM) procedures using the Tremie method.

9.5 Permanent Monitor Well Installation

Permanent monitor wells will be installed by a water well contractor licensed by the State of Mississippi. All wells will be installed in accordance with the July 1, 2005, *Minimum Specifications for Drilling Services* document (Appendix C).

9.6 Groundwater Sampling Procedures

Groundwater samples will be collected from the temporary monitor wells during one sampling event. Monitor wells will be purged of three to five well volumes with a bailer, or through the use of low-flow purging methods, prior to sampling. Low-flow monitor well sampling procedures entail purging and sampling the monitor well at flow rates between 0.1 and 0.5 liter per minute, to achieve a drawdown of not more than 0.1 meter during the sampling process (this drawdown is considered a “goal” because the actual drawdown is dependent upon geologic factors).

The groundwater purged from the well is monitored via an in-line flow cell with appropriate water quality instrumentation to evaluate when various water quality field parameters (pH, temperature, dissolved oxygen, specific conductance, oxidation reduction potential, and turbidity) stabilize. Upon stabilization, the water in the well is deemed representative of the formation water within the aquifer and samples are collected at the same low flow rates in laboratory-supplied containers. All field measurements, purge volumes, and water level measurements will be recorded at the time of sample collection on Water Sampling Logs by the field technician. Appendix B presents a copy of a Water Sampling Log that may be used during the assessment.

The purging and sampling procedure for each well will be performed using a bailer or peristaltic pump equipped with new silicon pump-head tubing and Teflon® or Teflon®-lined tubing. This process will eliminate the necessity for field decontamination of pumping equipment between each well. Purging will continue until turbidity is less than 10 NTUs. Purge water and used tubing, along with other solid materials generated during the investigation, will be collected as part of the solid waste generated in the project and will be properly disposed as IDW.

Clean laboratory-provided sample containers with appropriate preservative will be used for sample collection. The sample parameters, sample volumes, and preservation requirements are summarized in Table 6. After collection, samples will be immediately placed on ice and maintained at a temperature of approximately 4°C until they are received by the laboratory. Samples will be shipped to the laboratory using complete chain-of-custody procedures described within Section 9.11.4.1 (Field Sample Chain-of-Custody Procedures). Samples will be stored in the receiving laboratory at 4°C until the analyses are performed.

10. Special Training Requirements/Certification

Workers who participate in the types of activities defined in the Occupational Safety and Health Administration requirements under CFR 1910.120 must have completed the 40-hour health and safety training program. Each employee must successfully complete a minimum of 8 hours of refresher training annually to maintain the certification. Employee training records should be maintained in the office where the employee resides. Current HAZWOPER training certificates will be maintained for all personnel performing work where 40-hour training is required.

All analytical chemistry laboratories performing analyses on samples collected will be required to maintain current National Environmental Laboratory Accreditation Program (NELAP) accreditation for the parameters of interest if accreditation is available. Accreditation certificates, audit reports, and performance testing data will be reviewed by the Project Chemist to ensure that laboratory capabilities meet or exceed project requirements. Laboratories must also maintain internal training records for technical staff in accordance with standard laboratory practices and certification requirements. The laboratory will provide the applicable training records, including Initial Demonstration of Competence documentation, for review, as deemed necessary, by the Project Chemist.

All subcontractors and their employees will have current and applicable performance and certifications required to perform the assigned scope of work. Subcontract agreements will include the specific training and certification requirements and applicable records will be reviewed as appropriate. Subcontractor training and certification documentation will be maintained at the subcontractors' offices.

11. Laboratory Analytical Program

11.1 Analytical Laboratories

Independent environmental analytical laboratories will be subcontracted as appropriate for the various project requirements including contaminant delineation, confirmation sampling, routine monitoring, and pilot/bench-scale studies. Analytical chemistry laboratories shall be accredited, under NELAP, for the analytical parameters required for the project for which accreditation is available through the primary accrediting state. The laboratory QA programs will be reviewed by the Project Chemist. The laboratory will assign an experienced Project Manager to coordinate analytical support for field operations with the Field Manager and Project Chemist. The laboratory staff will include a qualified QA Manager/Coordinator, who reports directly to laboratory management independently of the technical operations of the laboratory, to oversee technical adherence to the laboratory QA programs and the QAPP. The specific duties of the laboratory Project Manager and QA Manager/Coordinator include:

- Reviewing the QAPP and any applicable site-specific work plans to verify that analytical operations will meet project requirements as defined in the project documents;

- Documenting and implementing project-specific QA/QC requirements in the laboratory and reviewing analytical data (minimum 10 percent review by laboratory QA Officer) to verify the requirements were met;

- Reviewing receipt of all sample shipments and notifying the Field Operations Manager/Field Coordinator and Project Chemist of any discrepancies within 1 day of receipt;

- Conducting internal laboratory audits to assess implementation of the laboratory QAM and procedures and providing written records of those audits;

- Rapidly notifying the Field Operations Manager and Project Chemist regarding laboratory nonconformance with the QAPP or analytical QA/QC problems affecting project samples; and

- Coordinating with project and laboratory management to implement corrective actions as required by the QAPP and internal laboratory QAM.

The laboratory QAM is incorporated by reference into this QAPP and will be included as Appendix D when the laboratory subcontract is executed. The primary analytical laboratory will provide all off-site analytical support for work performed under a specified scope of work and contractual agreement. All off-site laboratories contracted will maintain current accreditation under NELAP encompassing the appropriate parameters/methods required to meet investigation, monitoring, assessment, and remediation activities. The laboratory reporting, detection, and quality control limits will be used to evaluate data quality and will be incorporated into this QAPP when the laboratory is selected. Laboratory SOPs will be evaluated by the project chemist as appropriate to ensure method performance is acceptable. Data will be uploaded to an electronic project database to facilitate data evaluation and report preparation.

An on-site mobile laboratory may be used for “hot spot” evaluation. The laboratory selected will exhibit sufficient experience in the parameters required to ensure reliability in the data generated and the associated decisions. On-site laboratory data will be considered quantitative if the methodologies employed closely follow USEPA-approved methods. If screening methods are used, only qualitative data will be generated.

At a minimum, site-specific parameters listed in Table 4 will be analyzed during the investigations and remedial actions. Additional VOCs and semivolatile organic compounds (SVOCs) may be added to individual task work plans, if requested by MDEQ. The primary analytical methods to be used by the laboratory include:

- VOCs by SW-846 Method 8260B; and

- 1,4-Dioxane by SW-846 Method 8270C (selected ion monitoring).

In order to further evaluate the significance of biodegradation in the attenuation of CoCs, geochemical indicator parameters will be collected and analyzed during the quarterly monitoring program. The supplemental geochemical data will include analyses of methane, ethane, and ethene by Method AM20GAX, carbon dioxide by Method AM20GAX, total organic carbon by USEPA Method 9060A, nitrate by USEPA Method 300.1, sulfate by USEPA Method 300.1, total and dissolved iron by USEPA Method 200.7, alkalinity by USEPA Method 310.1, chloride by USEPA Method 300.1, and field analysis of dissolved oxygen and oxidation reduction potential.

It should be noted that modifications to the analytical program may be required if any conditions are encountered during the field program that would warrant modification. Changes in the program will be recommended and addendums to the QAPP will be made as appropriate and supplemental documents will be prepared if warranted.

11.2 Geotechnical Laboratories

Geotechnical laboratories will be selected based on project need.

11.3 Analytical Quality Assurance Program

The following section describes QA procedures that will ensure data usability. These protocols are established to ensure that analytical data generated during field and laboratory operations are usable for the intended purpose. Appropriate field QC samples as described in Table 7 will be collected/prepared and analyzed to provide information regarding sample collection techniques, matrix effects, and laboratory performance. Laboratory QC samples are prepared and analyzed to provide information relative to laboratory performance, instrument calibration, and matrix impacts on the usability of data. The analytical data are reviewed against defined criteria to ensure that data of known and acceptable quality are available to assist with project decisions and verification of attainment of project goals. Laboratory Quality Control Sample Analysis Guidelines are shown in Table 8. The compliance with data quality criteria will yield consistent results that are representative of the media and conditions measured and useful for meeting the intended project objectives. Analytical precision and accuracy are QA criteria used for evaluation of potential data bias associated with sample collection or analysis and matrix or non-homogeneity impacts to reproducibility.

11.3.1 Laboratory Quality Assurance Analyses

Analytical performance is monitored through various QC samples and spikes, such as laboratory method blanks, surrogate spikes, laboratory control sample (LCS), MS, MSD, and replicate samples. All QC samples are performed on the basis of a laboratory batch. Two basic types of batches are used: the preparation batch and the analytical batch. The preparation batch includes all samples processed as a unit during organic sample preparation, metals digestion, or wet chemistry preparation. Preparation batches will not exceed 20 samples excluding associated QC samples. The analytical batch consists of all samples analyzed together in the actual analytical sequence and is also limited to a maximum of 10 or 20 samples based on the method. The QC samples associated with sample preparation include method blanks, LCS, MS, and duplicates. Surrogates are introduced into samples during preparation for extractable organic constituents or prior to purging for VOCs. For some analyses, such as volatile organics, the analytical batch is equivalent to the preparation batch. The analytical sequence includes calibration standards, instrument blanks, and reference standards.

Instances may arise where elevated concentrations of target analytes/compounds, non-homogeneous samples, or matrix interferences preclude achieving the detection limits or associated QC target criteria in a specific sample. In such instances, data will be examined on a case-by-case basis during the data validation process to determine the usability of the reported values. The laboratory will report the reason for deviations from these detection limits or noncompliance with QC criteria in the case narrative. The laboratory QC samples listed below will be collected and analyzed at the frequency listed in Table 8.

11.3.1.1 Laboratory Method Blank

A laboratory method blank is an analyte-free material of similar matrix processed in the same manner, in the same analytical batch, and at the same time as a project sample. The blank is prepared using ASTM Type II water when analyzing water samples and, where practicable, pre-cleaned sand or other solid material, such as sodium sulfate, when analyzing solid samples. The laboratory method blank sample is prepared in the same batch with the project samples at a frequency of 1 laboratory method blank per batch of 20 (or fewer) project samples for the given matrix type. The laboratory method blanks serve to demonstrate a contamination-free environment in the laboratory, reagents, and glassware used in sample preparation and analysis. The goal is for method blanks to be free of contamination or at a maximum less than the reporting limit. Low-level contamination may be present, but must be less than reporting limits for undiluted samples. If contaminants are present in the method blank but not in project samples, no further action is required. Where blank contamination exceeds general method guidance criteria, the laboratory shall re-prepare and re-analyze the samples or shall contact the Project Chemist for determination of appropriate corrective action. Qualification of constituents detected in method blanks and in associated field samples will be based on the criteria set forth in the validation section of this QAPP. All sources of contamination that are not common laboratory contaminants as defined in the method SOPs must be investigated as part of the corrective action process.

Qualification criteria for samples associated with contaminated blanks are listed in Section 17.5.

11.3.1.2 Surrogate Standards

For certain organic methods, all samples, including the method blanks and QC samples, are spiked with a set of specific surrogate standards to monitor the accuracy of the analytical determination. Surrogate spikes are added at the start of the laboratory preparation process. Surrogate compounds are not typically found in environmental samples. QC criteria for surrogate recoveries are method- and matrix-specific. Surrogate recoveries must be within QC limits for method blanks and LCS samples to demonstrate acceptable method performance. If surrogate recoveries are outside QC criteria for method blanks or LCS samples, corrective action is required and the Project Chemist should be notified. The percent recovery of surrogates in a specific sample provides an indication of the total accuracy of the analytical method in that specific sample only. Surrogate recoveries that are outside QC criteria for a sample indicate a potential matrix effect. Matrix effects must be verified based on review of recoveries in the method blank or LCS, sample reanalysis, or evaluation of interfering compounds. Sample cleanup procedures required by the laboratory SOPs must be implemented to alleviate potential matrix problems. Surrogate recoveries are calculated using the following formula:

$$\%R = \frac{SR}{SA} \times 100$$

Where:

%R = % Recovery

SR = Sample Result

SA = Surrogate Concentration Added

The QC criteria for surrogate recoveries will be as established in the analytical laboratory QA Program. The QC limits will be listed for each laboratory.

11.3.1.3 Laboratory Control Samples

An LCS or LCS Duplicate (LCSD) consists of ASTM Type II water and, where practicable, pre-cleaned sand or sodium sulfate for solid matrices, or a purchased performance testing sample. Type II water is defined (D1193-91- Standard Specification for Reagent Water) by ASTM as “water that has greater than 1 megaohm-cm resistivity”. The referenced ASTM method covers requirements for water suitable for use in methods of chemical analysis and physical testing. The source of the chemicals used for LCS spiking will be from a different supply source than the calibration standards. Where second source standards are not available, the LCS must be spiked with materials from a separate manufacturing lot of the standard. The analytical laboratory will maintain complete records of standards tracking and preparation which will be available for review as necessary. Any deviation from the utilization of second source standards will be approved by the Project Chemist.

The LCS is generally spiked with all of the analytes of interest near the mid-point of the calibration range as defined by the method. In some instances, spiking with a subset of the target compounds will be acceptable for the LCS where permissible in the SW-846 method protocol and with approval of the Project Chemist. The LCS is processed under the same sample preparation, surrogate and internal standards addition, and analytical protocols as the project samples. LCSs are analyzed at the frequency of 1 per batch of 20 samples or fewer of similar matrixes. The recovery of target analytes in the LCS provides an evaluation of method performance and accuracy. Method control may be established based on the subset of compounds listed in the method. LCSDs are analyzed with some methods but are not required QA components. LCSDs are prepared and analyzed by the same protocols as the LCS. LCSD analyses provide precision evaluation of the method performance in addition to the accuracy information.

Laboratory QC criteria for LCSs and LCSDs are established for each method and matrix. Control limits for the laboratories performing analyses will be determined. The laboratory will update the QC limits annually. The LCS recovery of the method-specific control compounds/analytes must be within the laboratory-established control limits to demonstrate acceptable method performance. If the LCS recoveries are outside QC criteria for more than a few target analytes, recoveries are significantly low (<10 percent) and corrective action is required. After corrective action is complete, sample re-analysis is required for the failed parameters. If LCS recoveries exceed the QC criteria, and that parameter is not detected in any of the samples, re-analysis is not necessary. For any other deviations from the LCS control limits that cannot be resolved by sample re-analysis within holding times, the Project Chemist must be notified immediately. If critical samples are affected, the Field Operations Manager/Field Coordinator may determine that resampling is required.

11.3.1.4 Matrix Spike Sample

The MS sample consists of a project sample split into two parts and processed as two separate samples. Additional sample volume will be collected in the field, identified on the chain-of-custody form, and provided to the laboratory for use as the MS sample. In addition to the regular monitoring standards (internal standards, surrogate), spiking analytes are added to the second sample aliquot. Generally, all method target analytes, if compatible, are added. A subset of target analytes may be used if indicated in the method SOP and approved by the Project Chemist. An MS sample will be prepared for every batch of 20 samples (or fewer) for a given matrix unless sufficient sample volume is not available. Where site-specific MSs cannot be performed, the laboratory shall include a batch MS or blank spike for additional evaluation of method performance in accordance with SW-846 method and SOP protocols. Percent recoveries for batch-specific MSs will be used only to evaluate method performance. Site samples will not be qualified based solely on the spike recoveries in matrices from other locations where the batch LCS is in control. Equipment and trip blanks must not be used for MS evaluation. MS recoveries are a measure of the performance of the method on the matrices of samples being analyzed. MS recoveries outside the control limits for batches where the LCS is demonstrated to be in control indicate potential matrix effects. Sample cleanup procedures may be warranted for samples with severe matrix effects. The laboratory shall notify the

Project Chemist of instances of extreme matrix effects on the analytical data to determine appropriate corrective action. The percent recovery (%R) formula is as follows:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

Where:

SSR = Spike Sample Result

SR = Sample Result

SA = Spike Added

Matrix spike recoveries for the project will be based on laboratory-established control limits for the methods performed. The Project Chemist will review the laboratory control limits prior to approval for use for project samples.

11.3.1.5 Matrix Spike Duplicate Sample

The MSD sample is prepared in conjunction with the MS sample for organic methods and, as applicable, for inorganic methods (e.g., metals, cyanide). The MSD is prepared and analyzed from a third portion of the same site sample as the MS. Acceptable method performance may be exhibited by acceptable recoveries for both the MS and MSD if the batch LCS fails for specific compounds. The spike recoveries are calculated and reported the same as the matrix spike. The RPD between the spiked compound concentrations detected in the MS and MSD provides an indication of the precision of the analytical method on the actual site samples of similar matrix. The RPD is calculated by the laboratory using the following formula.

$$RPD = \left(\frac{PR - DR}{\frac{1}{2}(PR + DR)} \right) \times 100$$

Where:

PR = Primary Sample Result

DR = Duplicate Sample Result

The laboratory-derived advisory control limit for RPD will be used for evaluation of precision for MS pairs.

11.3.1.6 Laboratory Replicate Sample

A laboratory replicate consists of a second aliquot selected by the laboratory from the same project sample. Selection of replicate samples from a heterogeneous matrix requires homogenization to ensure that representative portions are analyzed. Note that samples to be analyzed for volatile compounds shall not be homogenized. One sample per batch of 20 samples or fewer per matrix is analyzed in lieu of an MSD. The duplicate is prepared for methods that typically show concentrations of target analytes above MDLs, such as wet chemistry methods. The RPDs, between the recoveries in the original and duplicate, measure the precision of the analytical method on the actual project samples. These limits will be used to evaluate laboratory precision for replicate samples prepared in the laboratory for methods where MSDs are not appropriate. If all other QC criteria are met, RPD results outside control limits indicate potential matrix effects and non-homogeneity of the sample. The laboratory shall investigate significant deviations in the RPD results by observing the sample to determine any visual heterogeneity or reviewing sample data for matrix interference. If visual observation does not indicate a potential problem, the sample may be re-analyzed. Potential matrix effects are reported and discussed in the case narrative. The RPD is calculated using the same formula as the RPD for the MS/MSD.

11.3.1.7 Instrument Blanks

Instrument or reagent blanks are analyzed in the laboratory to assess laboratory instrument procedures as possible sources of sample contamination and establish background levels in the analytical system. If method blanks show contamination or the analysts suspect carryover from a high concentration sample, an instrument blank will be used to determine the appropriate corrective action. Instrument blank results are included in the analytical report.

11.3.1.8 Calibration Verification Standards

A standard is obtained from a different source or, at a minimum, a different lot from that of the calibration standard. A check standard result is used to verify an existing calibration or calibration curve. The check standard provides information on the accuracy of the instrumental analytical method independent of various sample matrices. Calibration verification standards are analyzed with each analytical batch as applicable to the analytical method and SOP.

11.3.1.9 Method-Specific Quality Control Samples

The laboratory will follow all specific quality processes as defined by the analytical method and laboratory SOP. Method-specific QC samples may include analysis of other QC samples or standards identified in the specific method SOP. Method-specific QC samples or standards include internal standards for gas chromatography (GC) and/or GC/mass spectroscopy (GC/MS) methods.

11.3.1.10 Performance Checks

The laboratory will perform analyses of performance testing (PT) samples as required to maintain NELAP and other applicable accreditations. The Project Chemist will review laboratory PT sample results on a semiannual basis. If the laboratory fails any PT parameters that impact the project samples, the laboratory will immediately notify the Project Chemist to identify appropriate corrective action implementation and to determine if any project data have been impacted.

11.4 Laboratory Instrument/Equipment Testing, Inspection, and Maintenance Requirements

All laboratory instruments and equipment used for sample analysis will be serviced and maintained only by qualified personnel. Procedures will be implemented to ensure that instruments are operating properly and that calibrations are correct prior to analysis and reporting of any sample parameters.

11.4.1 Laboratory Equipment Maintenance

The laboratory must maintain an adequate stock of spare parts and consumables for all analytical equipment. Routine preventive maintenance procedures should be documented in the laboratory SOPs and/or QAM. Maintenance performed on each piece of equipment must be documented in a maintenance logbook. Daily checks of the laboratory deionized water and other support systems will be performed. The laboratory will have backup instrumentation or a process in place for most of the analytical equipment to minimize potential adverse impacts on data quality due to instrument malfunction. For example, the laboratory should have duplicate instrumentation and/or maintain service agreements for rapid response with the manufacturer of major laboratory instruments (e.g., GC/MS). Laboratory instrument maintenance procedures will be evaluated during the laboratory selection process and during the project, as necessary, to verify that there will no impacts on analyses of project samples due to instrument malfunction.

11.4.2 Instrument Calibration and Frequency

All instruments and equipment used during sampling and analysis will be operated, calibrated, and maintained according to the manufacturer's guidelines and recommendations, as well as criteria set forth in the applicable analytical methodologies and SOPs. The laboratory QAM will provide brief descriptions of instrument calibration procedures to be performed by the analytical laboratories. Personnel properly trained in these procedures will perform operation, calibration, and maintenance of all instruments. Documentation of all routine and special maintenance and calibration information will be maintained in an appropriate logbook or reference file and will be available for inspection. All laboratory instrument calibration is set forth in analytical method SOPs.

Field instrument calibration will be performed in accordance with applicable policy. Table 5 lists typical monitoring equipment used during fieldwork with general calibration information. This equipment is representative of instruments typically required for site groundwater and field sampling operations. All field personnel receive annual refresher training on the field operation of all health and safety related equipment, which includes calibration procedures. All equipment calibration performed in the field must be recorded on the field instrument calibration forms. The forms will be retained in the project file.

Qualitative field methods may be used to evaluate remedial action performance prior to collection and submission of samples to the off-site analytical laboratory for quantitative evaluation.

11.5 Inspection/Acceptance Requirements for Supplies and Consumables

Acquisition and/or purchase of material, equipment, and services will be prepared, reviewed, and approved in accordance with the requirements set forth in appropriate subcontracting procedures.

11.5.1 Standard Reagent Receipt and Traceability

For analytical laboratory operations, all standards are obtained directly from USEPA or through a reliable commercial supplier with a proven record for quality, traceable standards. All commercially supplied standards must be traceable to USEPA or National Institute of Standards and Technology reference standards, and appropriate documentation will be obtained from the supplier. The certificates will be kept on file in a central location. When standards are received, they will be documented with the following: date received, chemical, lot number, concentration, and date opened or expiration date. When standards are prepared from these source materials, information will be included in a logbook with date of preparation, lot source, amount used, final volumes, resulting concentration, and preparer’s initials. Laboratory SOPs and standards/reagent records will be reviewed during laboratory audits or if QC problems arise to ensure traceability requirements are met.

For field operations, standards are primarily applicable to chemical preservatives as described in Table 6 and field instrument calibration solutions for pH, conductivity, and turbidity. Chemical preservatives are typically obtained from the laboratory that is responsible for maintaining the traceability records. Field instrument calibration standards are obtained from chemical suppliers and maintained records by project management.

12. Data Documentation and Data Management

All field records and laboratory analytical data will be maintained and managed in accordance with procedures described in Section 3.5 (Field Records) and Section 3.6 (Documents Control) of EISOPQAM and as further defined in this QAPP. A field logbook, with sequentially numbered pages, will be used during fieldwork to document field activities and sample collection.

12.1 Documentation and Records

The primary documentation for the project includes field records, analytical data packages, and summary and closure reports. All documentation generated in support of the monitoring and remedial actions will be retained for a period of at least 6 years.

Requirements for retention of field records are presented in previous sections. Requirements for analytical data packages activities are described in the following sections. The work plans will provide additional requirements for any associated field and analytical documentation.

12.2 Laboratory Report Content

Analytical reports prepared by the laboratory will be defined as Level II data packages and will include the information listed in this section. The Level II data packages will include a fully executed chain-of-custody form, sample receipt checklist, cross-reference table of field samples that identifies laboratory and sample number preparation and analytical batch numbers, analytical results, collection and analysis dates, reporting limits, dilution factors, surrogate recoveries, method blank data, LCSs, MSs, laboratory replicates, laboratory control limits, and explanation of data flags, as well as a case narrative and fully executed chain-of-custody form. The hard copy report shall include a laboratory sample receipt checklist that documents sample condition as well as nonconformances at the time the laboratory receives the samples.

The reports also will include the laboratory control limits with appropriate data flags identifying any QC result reported outside control limits and an explanation of all data flags applied by the laboratory. The report-specific case narrative will present an explanation of all QC results reported outside control limits and samples analyzed at dilutions where all results are non-detect. The case narrative shall include discussions of any observations during sample preparation and analysis which could impact data quality. The laboratory report will include copies of any nonconformance or corrective action forms associated with data generation.

Laboratory reports will not include calibration information or raw data.

Soils will be reported on a dry weight basis. The reporting limits (RLs) and MDLs will be corrected for percent moisture (soils only) and all dilution factors. Any compounds found less than the RL, but greater than the MDL, should be reported and qualified with a “J” flag as estimated.

The laboratory will provide an electronic data deliverable (EDD) that matches all data reported on the hard copy analytical report. Electronic data report requirements are described in Section 13.4.2.

12.3 Laboratory Record Retention

All records related to the analytical effort will be maintained at the laboratory in access-controlled areas for at least 1 year. All records will then be retained by the laboratory in a secure location for a period of 6 years after the final report is issued. Types of records to be maintained in addition to the analytical report include the following:

- Complete chain-of-custody forms from sample receipt to destruction. Sample destruction records must contain information on the manner of final disposal;
- Supporting documentation for any nonconformance or corrective action forms supplied in the analytical report or related to the analysis of project samples;
- Computer records on disk with magnetic tape backup of cost information, scheduling, raw data, Laboratory Information Management System (LIMS) data, and laboratory management records;
- All laboratory notebooks including raw data such as readings, calibration details, and QC results;
- Hard copies or scanned images of data system printouts (e.g., chromatograms, mass spectra, and inductively coupled plasma data files);
- Sample receipt documentation; and
- Hard copy analytical reports or scanned electronic images.

Electronic data and media retention policies will correlate with hard copy data retention at the laboratories as well as other points of electronic data generation. Additionally, electronic data must be subject to backup routines that will enable recovery of data that may become corrupted or lost due to instrument, computer, and/or power failures. Electronic media will be stored in climate-controlled areas to minimize potential for degradation. Storage areas will be access limited.

12.4 Electronic Data Management

Electronic data management provides the ability to track samples and results from work plan implementation to the final report. The field data include approved work planning tables, labels, field sampling forms, chain-of-custody forms, and logbooks. The surveyor will provide coordinates for all sample locations in hard copy and electronic format. The Field Operations Manager/Field Coordinator will review all field data for accuracy. Field data not provided by the laboratory will be manually entered into a database or spreadsheet.

A Microsoft® Access database will be used to handle environmental data for the remediation project. Use of electronic data storage will allow access to the data for efficient data evaluation, display, and reporting.

12.4.1 Field Data

Field data such as pH, turbidity, conductivity, oxidation reduction potential, temperature, and dissolved oxygen will be incorporated into the database by manual input.

Spatial data (geographic coordinates) for each sampling location will be collected as necessary and incorporated into the database for display via the geographic information system (GIS). Consistent units for the x, y, and z coordinates will be used.

12.4.2 Laboratory Electronic Data Deliverables

A standard Microsoft® Excel spreadsheet will be used for the laboratory EDD. The laboratory will prepare the spreadsheet directly from the LIMS that is used for generating the hard copy report. The following information shall be included in the spreadsheet:

- Sample ID;
- Date and time sampled;
- Date and time analyzed;
- Matrix;

- Parameter;
- Chemical Abstract Number;
- Results with appropriate units;
- Method performed;
- Applicable laboratory qualifiers;
- Laboratory name;
- Sample Delivery Group or Laboratory Project Number;
- RL;
- Dilution Factor; and
- MDL.

The Project Chemist or designee will review 5 percent of electronic laboratory and field data to verify the results against the hard copy and check for transcription errors. A greater than 15 percent discrepancy rate in two consecutive data sets will require additional review and verification. Electronic data will match the hard copy data for all results including significant figures. The results will be transferred to the centralized Environmental Quality Information Systems (EQuIS) database. The Project Chemist will add any data qualifiers and the Data Manager will create data tables for the data report. The Project Chemist and Field Operations Manager will resolve discrepancies between the planned activities and actual data collected and document the findings in a summary report. The central database will be stored in a secure area with access limited to data management specialists designated by the Project Manager. The central database will allow direct linking to GIS/computer-aided design systems, risk assessment programs, and other final data user models and statistical programs. Data users may enter additional electronic data such as risk-based criteria for comparison of the results. This data will be stored in separate tables in the database and linked to the actual results. Any data from outside sources will include a description of the data, a reference to the source, and the date updated. The outside data will be checked prior to use in order to verify that the most current values are used.

13. Laboratory Measurements and Data Acquisition

This section of the QAPP contains descriptions of all aspects of the implementation of field, laboratory, and data handling procedures to meet the requirements of KEC activities. The site-wide QAPP provides the basis for ensuring that appropriate methods are used and thoroughly documented. These procedures will be adapted, as appropriate, to meet the objectives of the project.

13.1 Laboratory Custody Procedures

Internal laboratory custody protocols must maintain a system that provides for and identifies custody during sample log in, sample analysis, data storage and reporting, and sample disposal. These procedures must ensure continuous documentation of sample custody from receipt to disposal. Laboratories must complete a cooler or sample receipt form documenting the temperature and condition of the samples on receipt. The form must be included in the laboratory data package.

13.2 Analytical Method Requirements

The primary analytical methods anticipated to be used for samples collected are listed in Table 4. Analytes/compounds that may be reported for samples collected are listed in Table 4. All methods will be USEPA-approved unless nonstandard methods are required to evaluate the presence of unanticipated or unusual compounds. The Project Chemist will review performance data with the laboratory for any nonstandard method prior to utilization of the procedure for determination of any analytical parameters. Additional USEPA-approved methods that may be used are published in references listed in Section 14.3. Specific performance criteria, including QA protocols, for each analytical method are documented in the published methods and laboratory SOPs and the laboratory QAM. The QAM for each analytical laboratory performing work will be reviewed as part of the procurement process and laboratory SOPs will be examined during on-site audits or as necessary. “QAM” is a generic term for the laboratory quality assurance document that describes the laboratory program to ensure data of known quality are generated. The primary laboratory QAM will be included as Appendix D when the laboratory is selected.

13.3 Standard Laboratory Analytical Procedures

All standard analytical methods performed in conjunction with remedial activities will be USEPA approved. The analytical methods are referenced in:

- *Test Methods for Evaluating Solid Waste, Physical Chemical Methods*, 3rd edition, SW-846 (1997);
- 40 CFR Part 136, *Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act*; and
- *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, Revised March 1983.

The primary laboratory and any subcontract laboratories shall be accredited under NELAP for the parameters and methods applicable to investigations where accreditation is available through the primary accrediting authority under which accreditation is maintained by the laboratory. The laboratory will perform all methods in accordance with the appropriate USEPA-approved methods and the laboratory-specific SOPs for compliance with this QAPP and other project-specific requirements. The laboratory shall have method-specific SOPs for all methods performed. The SOPs will detail method set-up, calibration, performance, and reporting criteria in accordance with SOP preparation under NELAP guidance and requirements. Method performance will be in strict compliance with the SOP and referenced method. Laboratory SOPs will include any modifications to the published method and will indicate actual performance protocols performed by the laboratory. The laboratory will update SOPs in accordance with NELAP requirements. The Project Chemist must approve any changes to the method performance acceptance criteria. Laboratory SOPs may be reviewed during on-site laboratory audits, as appropriate. Determination of any parameters by methods other than those identified in this QAPP or the work plan will require approval prior to application to KEC samples.

The laboratory RLs for all target analytes/compounds will be compared to the health-based screening values (e.g., MDEQ Tier 1 TRGs) or drinking water maximum contaminant levels that are anticipated to be used as screening values and/or cleanup goals for remedial actions. Any RLs that exceed the proposed screening values are flagged with an asterisk. The flagged analytes will be evaluated as part of the preparation of the work plan to determine whether it is critical for the parameters to meet the screening values. The work plan will indicate the most current reporting and detection limits for the analytical methods required for the specific location or project if the limits differ from the site-wide QAPP. The laboratory must notify the Project Chemist of any updated or revised RLs prior to initiation of field operations. Required sample or extract dilutions to complete the analyses within method performance criteria may also impact RLs. All required sample dilutions will be noted in the analytical report and explained in the case narrative. The laboratory shall make every effort to report all compounds/analytes at the lowest technically achievable limit to meet the risk screening standard requirements. The changes/elevations in RLs will be evaluated to determine potential impact on DQOs or risk evaluation. Any additional methods required for future projects will be specified in the work plan. A notification addendum to the QAPP will be prepared annually to provide a current listing of laboratory RLs and control limits. The addendum will also include summaries of any significant changes to laboratory method SOPs. Significant changes may include deletion of a method, changes in calibration ranges, and new SOPs for detection and quantitation of CoC.

13.4 Nonstandard Laboratory Analytical Procedures

The laboratory may be required to develop, validate, and use nonstandard analytical techniques for specific purposes. These methods may be proposed to meet specific data needs for the project or where it can be shown that substantial cost or timesaving can be achieved in comparison to standard procedures. In these instances, the laboratory will provide a method performance package including initial precision and accuracy data, MDL studies, and an SOP. Any nonstandard performance-based methods and supporting documentation will be incorporated as addenda to the QAPP.

13.5 Mobile Laboratory

A mobile laboratory may be used to provide rapid screening during “hot spot” identification and delineation. Method performance will adhere to the current standard operating procedure developed specifically for the application. Calibration verification and method blanks will be analyzed daily. Calibrations will be performed as necessary to ensure that data are reliable and representative of the site characteristics. Calibration verification will be based on the SOP, which includes monitoring of response factors and retention time windows.

Data generated by the field laboratory will be used for screening purposes only. Approximately 10 percent of the samples collected will also be submitted to the contract laboratory for verification of field screening data and to provide definitive data, if necessary. The contract laboratory will utilize SW-846 methods or modified equivalents. Additional details will be amended to the QAPP if a mobile laboratory is contracted to support “hot spot” evaluations at the site.

13.6 Field Screening Methods

OVAs or OVMs will be used to screen soil cores to select the interval with the highest potential for elevated contaminant concentrations. The instruments will be calibrated in accordance with manufacturer's specifications. Calibration verification will be performed as described in Table 5.

In general, method performance will be in accordance with the applicable screening kit or method manufacturing guidance. Deviations from the guidance or USEPA-approved method will be identified in a method-specific SOP as necessary or in the field notes.

14. Assessment and Oversight

Assessment and oversight procedures will be implemented in accordance with this QAPP. The QAPP outlines general roles and responsibilities for the project team. Additional procedures will be developed as necessary to meet the DQOs and presented in an addendum to or a revision of the QAPP.

Upon completion of field activities and analytical data validation, the project draft and final reports will be prepared. The draft and final reports will contain descriptions of all field activities, data validation reports, results of data evaluations, copies of field records, copies of analytical data packages, and supporting figures and data summary tables. The final report will be sealed by a Mississippi-registered geologist.

14.1 Assessments and Response Actions

Assessment activities include management and assessments, technical systems audits, and performance evaluations. Management assessments include routinely scheduled meetings and conference calls to evaluate staff utilization. Assignment of qualified personnel, maintenance of schedules and budgets, and quality of project deliverables are verified as part of these assessments. Performance evaluations are used to ensure that trained and qualified staff is used for the project. Technical assessment activities applicable to Site activities include peer review, data quality reviews, and technical system audits (i.e., laboratory and field). Technical systems audits include review and evaluation of field and laboratory performance to assess the implementation of quality programs and directives specifically for Site activities. Procedures for assessment and audits of data quality are described in Section 17 (Data Validation) of this QAPP. Procedures for peer review and technical assessments are summarized briefly below. Both the overall and direct technical assessment activities may result in the need for corrective action. The procedure for implementing a corrective action response program for both field and laboratory situations are summarized briefly below.

14.2 Peer Review

All project deliverables including work plans, QAPPs, draft and final reports, and technical memoranda will be peer reviewed. The peer review process provides for a critical evaluation of the deliverable by an individual or team to determine whether the deliverable will meet the established criteria, DQOs, technical standards, and contractual obligations. The Project Manager or Remediation Task Manager will assign peer reviewers, depending on the nature and complexity of the project, when the publications schedule is established. The Project Manager will be responsible for ensuring all peer reviewers participate in the review process and approve all final deliverables. For technical memoranda and other project documents, the Remediation Task Manager will be responsible for obtaining principal review and approval. The QA Manager is responsible for verifying that project documents are generated in accordance with the project requirements.

14.3 Technical Systems Assessments

The entire project team is responsible for ongoing assessment of the technical work performed by the team, identification of nonconformance with the project objectives, and initiation, implementation, and documentation of corrective action. Independent performance and systems audits are technical assessments that also are an integral part of the overall QA/QC program for Site activities. The following describes the types of audits conducted, the frequency of these audits, and the personnel responsible for conducting the audits.

14.3.1 Field Audits

Field audits for specific project will be conducted as necessary during the project to ensure compliance with all project requirements. Field audits are performed under the direction of the QA Manager. The field audit report will be prepared and submitted to management.

14.3.2 Field Inspections

The Field Operations Manager will be responsible for inspecting all field activities to verify compliance of the activities with the project plans.

14.3.3 Laboratory Audits

The primary laboratory and any subcontracting laboratory must implement a comprehensive program of internal audits to verify the compliance of their analytical and management systems with the SOPs and QAMs. The laboratory may be requested to perform a project-specific audit to verify compliance with project requirements. The laboratory must be accredited and maintain current accreditation for methods and parameters where accreditation is available through the primary accrediting authority.

The Project Chemist may also audit laboratories. These audits are typically performed to verify the laboratory capabilities and implementation of any complex project requirements or in response to a QC nonconformance identified as part of the data review process.

14.4 Corrective Action

Corrective actions will be implemented as determined by project reviews, data quality assessments, and other procedural evaluations. In conjunction with the QA Manager and Project Chemist, the Field Operations Manager/Field Coordinator is responsible for initiating and implementing corrective action in the field. The Project Manager and/or Remediation Task Manager are responsible for implementing, as necessary, corrective action in office settings. The laboratory Project Manager, in conjunction with the laboratory technical staff and QA Manager, is responsible for implementing corrective action in the laboratory. It is their combined responsibility to ensure that all analytical procedures are followed as specified and that the data generated meet the prescribed acceptance criteria. Specific corrective actions necessary will be clearly documented in the logbooks or analytical reports.

14.4.1 Field Corrective Action Scenarios

The need for corrective action in the field may be determined by technical assessments or by more direct means such as equipment malfunction. Once a problem has been identified, it may be addressed immediately or an audit report may serve as notification to project management staff that corrective action is necessary. Immediate corrective actions taken in the field will be documented in the project logbook. Corrective actions may include, but are not limited to:

- Correcting equipment decontamination or sample handling procedures if field blanks indicate contamination;
- Recalibrating field instruments and checking battery charge;
- Training field personnel in correct sample handling or collection procedures; and
- Accepting data with an acknowledged level of uncertainty.

After a corrective action has been implemented, its effectiveness will be verified. If the action does not resolve the problem, appropriate personnel will be assigned to investigate and effectively remedy the problem.

14.4.2 Laboratory Corrective Action Scenarios

Out-of-control QC data, laboratory audits, or outside data review may determine the need for corrective action in the laboratory. Corrective actions may include, but are not limited to:

- Reanalyzing samples, if holding times permit;
- Correcting laboratory procedures;
- Recalibrating instruments using freshly prepared standards;
- Replacing solvents or other reagents that give unacceptable blank values;
- Training additional laboratory personnel in correct sample preparation and analysis procedures; and
- Accepting data with an acknowledged level of uncertainty.

Specific laboratory corrective actions for analytical deficiencies must be consistent with the analytical method. The laboratory corrective actions must be defined in analytical SOPs. Any deviations from the analytical SOP require corrective actions and documentation with approval of the Project Chemist. Whenever the Project Chemist deems corrective action necessary, the laboratory Project Manager will ensure that the following steps are taken:

- The cause of the problem is investigated and identified;
- Appropriate corrective action is determined;
- Corrective action is implemented and the effectiveness verified by the laboratory QA Officer; and
- Documentation of the corrective action verification is provided to the Project Chemist in a timely manner.

15. Project Reports

Following receipt of all analytical data and upon completion of the data evaluation and validation process, a project summary report will be prepared. The draft and final reports will include summaries of all project activities, analytical data packages, data validation reports, and data evaluations. Conclusions and recommendations will also be presented within the summary reports. Supporting figures, interpretations of the geophysical survey, copies of logs, data validation forms, chain-of-custody forms, and the chemical analytical report(s) will also be included within the project reports. The final report will be sealed by a Mississippi-registered geologist.

15.1 Quality Assurance Reports

The following reports may be prepared for management as applicable for activities conducted at the Site. These reports will be retained in the project files.

Field Reports - The Field Operations Manager/Field Coordinator will prepare summary reports at the end of each sampling week. The reports will document field progress and any concerns in the field. Adjustments to the field scope of work and other problems will be reported immediately. The report will be provided to the Field Operations Manager and Project Manager.

Audit Reports - Audit reports will be prepared by the audit team leader immediately after completion of the audit. The report will list findings and recommendations and will be provided to the Project Manager, Remediation Task Manager, and Project Chemist.

Data Validation Reports - Data validation reports will be completed by the Project Chemist as soon as possible after receipt of the data from the laboratory (i.e., the goal is within 4 weeks). Impacts on the usability of the data will be tracked by adding qualifiers to individual data points as described in Section 17.

16. Data Validation

Data generated will be reviewed for conformance with the QAPP, corrective action plan, and project requirements. QA information provided by the laboratory will be evaluated relative to the methods performed, the laboratory SOPs, the laboratory QAM, chain-of-custody requests, Laboratory Task Orders (LTOs) or similar directive document, and QAPP, as appropriate. The laboratory will be responsible for internal review of all calibrations, raw data, and calculations. The final analytical report will be reviewed by the laboratory Project Manager and other appropriate laboratory management personnel for compliance with the above listed documents including peer and supervisory review prior to releasing data to the Project Manager..

The Project Chemistry Team will perform additional verification and validation of laboratory data as well as review field documentation and data. Data verification will include completeness, correctness, and conformance evaluations against project requirements set forth in the site-wide QAPP, work plans, LTOs, laboratory QAM, and analytical methods. Data validation will be performed to assess the quality and usability of the data generated.

Field record review will include instrument calibration logs, sampling logs, chain-of-custody forms, field notes, and field parameter results. The field information assessment will evaluate the potential for impact to sample integrity and chemical data quality.

16.1 Verification and Validation Methods

The data review scheme for analytical results from the receipt of the analytical data through the validated report is described below. The laboratory is responsible for performing internal data review. The data review by the analytical laboratory will include 100 percent analyst review, 100 percent peer review, and 100 percent review by the laboratory Project Manager to verify that all project-specific requirements are met. The laboratory QA Officer will perform a review on 10 percent of the data packages. All levels of laboratory review will be fully documented and available for review if requested or if a laboratory audit is performed.

After receipt from the laboratory, project data will be verified and validated using the following steps.

16.2 Validation Reports

Data validation reports will be generated for each data package to record the results of the validation effort. The data validation reports will identify all deficiencies and the impact on the results. The Database Manager will amend qualifiers generated during the validation process to the EQuIS database and a summary table of the data qualifiers will be included with the analytical report.

General procedures for data validation and usability are described below. These procedures will be adapted, if necessary, to meet project-specific or activity-specific requirements. Data validation and usability criteria set forth in this QAPP shall be followed unless otherwise amended in the work plan. The work plans will also address any modifications to data review criteria not included in this QAPP.

Review of completed laboratory reports will be conducted by the laboratory prior to submission for validation. The review of the laboratory report by the laboratory Project Manager will be performed to ensure that all applicable laboratory procedures have been conducted in accordance with USEPA-approved methodologies and the KEC QAPP.

The Project Chemist or qualified designee will review the analytical report case narratives and perform a cursory review of laboratory reports for completeness and compliance with project objectives. Chemical analytical data collected in support of the remedial and monitoring programs will be reviewed and qualified using guidelines established in the USEPA National Functional Guidelines (NFGs; USEPA 2002a) modified to incorporate method- and project-specific requirements. For samples collected in support of remedial decisions, 10 percent of the data will undergo KEC project Level II data verification and validation. If no significant deficiencies are identified, additional data validation will not be performed. If deficiencies are identified that warrant further evaluation of the analytical data, the Project Chemist and the Project Manager will determine additional verification protocols to ensure data usability. Samples collected in support of long-term operations and maintenance of selected remedies, pilot or bench-scale studies, wastewater discharge and storm water compliance, or waste disposal will not be validated. The Level II validation components are presented in Section 17.3.

Method performance evaluation will be based on the laboratory method control criteria presented in the laboratory QAM or associated documentation as well as the validation protocols presented in the USEPA NFG. A review of field records and chain-of-custody logs will also be included in the validation procedure.

16.3 Level II Validation Components

Project Level II data validation includes a review of all sample documentation. Sample documentation includes sample collection logs and chain-of-custody forms. The analytical report will be reviewed for completeness and for compliance with chain-of-custody requests, LTOs, and the corrective action plan. The following parameters will be evaluated:

- Blank contamination
  - Method blanks
  - Trip blanks
  - Equipment blanks;
- MS and MSD recoveries;
- MS/MSD precision;
- LCS and LCSD recoveries;
- LCS/LCSD RPDs (when available);
- Surrogate recoveries;
- Field duplicate precision;
- Reporting limits relative to the project requirements;
- Holding time compliance;
- Data package completeness;

- Sample receipt information;
- Fully executed chain-of-custody documentation;
- Report completeness and conformance with chain of custody, LTO, QAPP, work plan, and other project requirements; and
- Case narrative describing any out-of-control events and summarizing analytical observation or non-conformances.

If the data package is incomplete, the Project Chemist will contact the laboratory, which must provide all missing information within a reasonable timeframe (i.e., 1 to 2 days). Based upon a review of the data, the quality (usability) of the data will be determined as described within Section 18 (Data Usability).

16.4 Field Data Review

Field data are generated from in-field measurements, which may include geophysical surveys, well development, groundwater sampling, and surface water sampling. The quality objective for the in-field measurement activities is to obtain accurate measurements of sample characteristics, including pH, conductivity, temperature, turbidity, dissolved oxygen, and/or oxygen reduction potential, using appropriate equipment. Data are recorded in field logbooks or on field sampling sheets and instrument calibration logs. Calibration logs will be reviewed with other field documentation to identify any potential impacts to data quality and usability. Field logbooks are reviewed as part of the QC inspections, audits, and data validation. Field data are typically provided as an appendix to final reports. Field and laboratory data are generally assessed against specific criteria determined to be applicable for the project. All criteria must be evaluated prior to the assessment to verify the current values and applicability of the guidance. Regulatory and other guidance that may be used for risk comparisons are presented in the references section of this QAPP. Field data packages will be reviewed by the Project QA Manager and Project Manager for completeness and accuracy. The validation of the field data package will consist of the following:

- A review of field data contained in notebooks, Sample/Core Logs, Soil/Sediment Sampling Logs, Water Sampling Logs, and Well Construction Logs for completeness;

- A verification that equipment blanks, field blanks, field replicates, and trip blanks were properly prepared, identified, and analyzed;

- A check on field analyses for equipment calibration and instrument condition; and

- A review of chain-of-custody forms for proper completion, signatures, and dates. These records will be reviewed in conjunction with the sample receipt forms completed by the laboratory to ensure adequate sample transfer procedures.

16.5 Data Qualification

Based on the Level II validation, the following qualifiers will be applied as applicable to the analytical data.

Data Qualifier	Definition of Data Qualifier
J	Estimated value below laboratory quantitative reporting limit but detected above the method detection limit or estimated value due to quality assurance deficiency.
UB	Parameter is considered non-detect at the reported value due to associated blank contamination.
UJ	Parameter is non-detect but the value is considered estimated due to quality assurance deficiency.
U	Not detected above laboratory quantitative reporting limit.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte may not be verified. This flag may be used to designate samples with high or low surrogate recovery.

Serious analytical problems will be reported immediately to the Project Chemist by the laboratory Project Manager. The Project Chemist will notify the Field Operations Manager/Field Coordinator and Project Manager to evaluate the necessity for resampling or additional sample collection. Time and type of corrective action (if needed) will depend on the severity of the problem and will be related to the overall project importance of the data points. Corrective actions may include altering procedures in the field, conducting an audit, resampling, or modifying laboratory protocol.

17. Data Usability

The objective of this project is to delineate soil and groundwater impacted by release of CoC during previous site activities and to achieve site remediation. Analytical data generated in accordance with USEPA SW-846 or other USEPA-approved methodologies will be considered definitive and quantitative based upon completion of the validation processes.

Data, qualified during validation, will be used in the final site assessment based upon the following criteria:

Data Qualifier	Definition of Qualifier	Criteria for Data Usability
U or UJ	Analyte not detected above the laboratory Quantitative Reporting Limit.	Data usable for intended purposes and parameter is considered not present at the listed value.
J	Estimated value either below the laboratory Quantitative Reporting Limit or Estimated due to minor data quality deficiency.	Data will be used as valid for risk evaluation.
UB	Analyte is not present in sample above listed value based on associated blank contamination.	Data will be used as quantitative for risk evaluation.
R	Sample result is considered unusable due to serious deficiencies in method performance. The presence or absence of the analyte cannot be verified.	Data may not be used for decision-making purposes.

17.1 Reconciliation with Data Usability Requirements

For routine assessments of data quality, the data validation procedures described in Section 17 will be used and appropriate data qualifiers will be assigned to indicate limitations on the data. The Project Chemist will be responsible for evaluating precision, accuracy, representativeness, comparability, and completeness of the data using procedures described in Section 3.2 of this site-wide QAPP. Any deviations from the analytical DQOs for the project will be documented in the data validation memorandum provided to the data users for the project. The Project Chemist will work with the final users of the data in performing data quality assessments. The data quality assessment may include some or all the following steps:

- Data that are determined to be incomplete or not usable for the project will be discussed with the project team. If critical data points are involved which impact the ability to complete the project objectives, the data users will report immediately to the Field Operations Manager/Field Coordinator. The Field Operations Manager/Field Coordinator will discuss the resolution of the issue with the Project Manager and implement the necessary corrective actions (e.g., resampling);

- Data that are nondetect but have RLs elevated due to blank contamination or matrix interference will be compared to screening values (see Table 3). If reporting limits exceed the screening values, then the results will be handled as appropriate for data use; and

- Data qualified as estimated will be used if it is determined that the data are useable for their intended purpose. If an estimated result is close to a screening value, then there is uncertainty in any conclusions as to whether the result exceeds the screening value. The data user must evaluate the potential uncertainty in developing recommendations for the site. If estimated results become critical data points in making final decisions on the site, the Field Operations Manager/Field Coordinator should evaluate the use of the results and may consider the data point incomplete.

The ultimate data assessment process involves comparing analytical results to screening values and background concentrations to determine whether the contamination present is site related (i.e., above background levels) or significant (i.e., above screening values).

18. References

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USEPA. 2002b. Guidance for Quality Assurance Project Plans, EPA QA/G-5. Office of Environmental Information, EPA/240/R-02/009. December.

Tables

Table 1. Remediation Technical Team Members, Kuhlman Electric Corp. Facility, Quality Assurance Project Plan, Crystal Springs, Mississippi.

Name and Contact Information	Telephone/E-Mail	Project Function
Tony Russell Mississippi Department of Environmental Quality (MDEQ)	Phone: 601-961-5654 Fax: 601-961-5300	MDEQ Chief Assessment & Remediation Branch
TBD		

Table 2. Data Quality Objectives, Kuhlman Electric Corp. Facility, Quality Assurance Project Plan, Crystal Springs, Mississippi.

Data Quality Objective	Project Specific Action
Problem statement	Past industrial operations at KEC have contributed to residual contamination at the site. The project goal is to employ remedial actions until corrective action objectives are satisfied.. To achieve this goal, additional assessments of groundwater shall be performed. A groundwater remediation plan shall be developed and implemented. Remediation will be complete when the corrective objectives have been fulfilled.
Identify the decisions	1. Ensure CoC concentrations in soil and groundwater in the contaminant source area beneath the KEC manufacturing building are at levels protective of site workers. 2. Reduce CoC concentrations in soil in the contaminant source area beneath the KEC manufacturing building to the extent that remaining concentrations no longer contribute to, or exacerbate, CoC concentrations in off-site groundwater. 3. Reduce CoC concentrations in off-site groundwater to be protective of downgradient groundwater receptors.
Identify the inputs to the decision	Compare CoC data to MDEQ TRG (performance data to design data)
Define the boundary of the property	The extent of remedial action will be limited to areas previously assessed and any areas requiring remedial action based on the results of the historical and additional baseline assessment.
Develop the decision rule	If soil and groundwater quality data indicate concentrations above Tier 1 Evaluation TRG, the affected media will be addressed by the inclusion of these areas in the remedial actions set forth in this QAPP.
Specify limits on decision errors	Data quality and usability will be determined in accordance with the criteria set forth in the QAPP. Rejected data will not be used for decision-making purposes.

CoC Chemical of Concern.
MDEQ Mississippi Department of Environmental Quality.
QAPP Quality Assurance Project Plan.
SWMU Solid Waste Management Unit.
TRG Target Remediation Goal.
KEC Kuhlman Electric Corp. Facility.

Table 3. Mississippi Department of Environmental Quality Tier 1 Target Remediation Goals, Kuhlman Electric Corp. Facility, Quality Assurance Project Plan, Crystal Springs, Mississippi.

Chemical of Concern	Soil Tier 1 TRG Restricted (mg/kg)	Soil Tier 1 TRG Unrestricted (mg/kg)	Groundwater Tier 1 TRG (µg/L)
1,1-Dichloroethene	1.18E-01	7.72E-02	7 (MCL)
1,1-Dichloroethane	1.16E+02	4.06E-01	7.98E+02
1,2-Dichloroethane	6.21E-01	4.06E-01	5 (MCL)
1,1,1-Trichloroethane	1.19E+03	1.19E+03	200 (MCL)
1,1,2-Trichloroethane	1.67	1.09	5 (MCL)
Chloroform	4.78E-01	3.12E-01	1.55E-01
Trichloroethene	7.92	5.17	5 (MCL)
Toluene	3.80E+01	3.80E+01	1000 (MCL)
1,4-Dioxane	5.20E+02	5.81E+01	6.09E+00

mg/kg Milligram per kilogram.
MCL Maximum contaminant level.
MDEQ Mississippi Department of Environmental Quality.
TRG Target Remediation Goal as of February 28, 2002.
µg/L Microgram per liter.

Table 4. Compound and Analyte List, Kuhlman Electric Corp. Facility, Quality Assurance Project Plan, Crystal Springs, Mississippi.

Parameter	Analytical Method	Chemical of Concern
Volatile Organic Compounds	Method 8260B	1,1-Dichloroethene
		1,1-Dichloroethane
		1,2-Dichloroethane
		1,1,1-Trichloroethane
		1,1,2-Trichloroethane
		Chloroform
		Trichloroethene
		Toluene
Semivolatile Organic Compounds	Method 8270C (selected ion monitoring)	1,4-Dioxane

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Table 5. General Field Equipment and Calibration Procedures, Kuhlman Electric Corp. Facility, Quality Assurance Project Plan, Crystal Springs, Mississippi.

Instrument or Equipment	Description	Field Calibration Procedure	Performance Criteria	Responsible Personnel
pH/Conductivity, Temperature Meter	Meter designed for field use with battery operation. Range pH: 0 to 14 s.u. Range conductivity: 0 to 2,000 µS	Instruments are factory-calibrated and automatically compensate for temperature. Calibration of the meters for pH will be completed each day immediately prior to use in accordance with the manufacturer's recommendations. In general, pH meter calibration will include two pH buffers bracketing expected pH range of samples to be measured (i.e., 7.00 and 4.00) with a verification of the slope using a third buffer (4.00 or 10.00). The electrode will be rinsed between buffers and stored in the manufacturer-recommended solutions between field measurements. Conductivity calibrations are conducted similar to the pH calibration utilizing two calibration standards and adjusting the meter to the appropriate values. Calibrations will be verified with a pH buffer at least every 4 hours and at the end of the sampling day.	pH: ± 0.01 s.u. Conductivity: at ± 2% FSD The instrument will be checked with a pH buffer every 4 hours and at the end of the sampling day. If the response is greater than ± 0.2 s.u. from the standard, complete re-calibration will be conducted. Conductivity will be checked every 4 hours.	Sample Collection Personnel
pH/Conductivity, Temperature, DO, ORP Meter	YSI Model 600 XL probe with YSI Model 610-D display instrumentation or the QED FC4000. Units must automatically correct for salinity at low DO readings by estimating salinity from temperature and conductivity measurements, then internally adjusting the DO reading. The probes must contain separate pH, temperature, conductivity, DO, and ORP probes in one unit.	Each day prior to use, the pH, specific conductance, DO, and ORP probes will be calibrated or tested for responsiveness in accordance with the manufacturer's recommendations. The pH probe will be calibrated utilizing two buffers (pH 7.00, then pH 4.00), and a verification buffer. The ORP probe is then calibrated with the ORP standard solution (Zobell), and the DO probe is checked with saturated air in accordance with the manufacturer's guidance. The probes should be rinsed with deionized water between each calibration solution and following calibration. Used calibration solution is to be discarded. Finally, the conductivity probe is checked with a solution of known conductivity.	Turbidity and DO: ± 10% pH: ± 0.01 s.u. Conductivity: at ± 2% FSD The instrument calibration will be verified every 4 hours and at the end of the sampling day. For pH, if the calibration check is greater than ± 0.2 s.u. from the true value, complete calibration will be conducted.	Project Geologist, Sample Collection Personnel

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Table 5. General Field Equipment and Calibration Procedures, Kuhlman Electric Corp. Facility, Quality Assurance Project Plan, Crystal Springs, Mississippi.

Instrument or Equipment	Description	Field Calibration Procedure	Performance Criteria	Responsible Personnel
Turbidimeter	Nephelometer designed for field use with battery operation. Range 0.01 to 1,000 Nephelometric Turbidity Units.	The unit is factory calibrated. Unit responsiveness will be checked prior to use each day with appropriate standards provided by the supplier. The responsiveness is checked on the 0 to 10 range, 0 to 100 range, and 0 to 1000 range.	± 10%	Sample Collection Personnel
PID	Photoionization detector that is a portable, non-destructive trace gas analyzer. Units must be Class I, Division 2, Grade A, B, C, or D. Unit must have rechargeable battery, a range of 0 to 2,000 ppm, and a 11.7 eV lamp. Calibration check gas (e.g., isobutylene must be provided with unit).	Instrument is calibrated internally prior to shipment from the warehouse or every 6 months, whichever is more frequent. In the field, PIDs will be calibrated at the start of each day in accordance with manufacturer's instructions. If a significant change in weather occurs during the day (i.e., change in humidity or temperature) or if the unit is turned off for an extended period, the instrument will be recalibrated prior to use. When a PID is used to screen samples in the field, periodic ambient readings will also be recorded in the log book. The general calibration procedures include: • Turn unit on and allow for 5-minute warm-up; • Set span control for probe being used (11.7); • Set function switch to standby position and adjust to zero using zero adjust knob; • Set function switch to the 0 to 200 ppm range; • Connect the analyzer to the regulator and calibration gas cylinder; • Open the regulator valve and allow the meter reading to stabilize; and • Using the span knob, adjust the meter to the concentration indicated on the calibration gas cylinder.	Meter must be able to adjust properly using the span knob or the lamp may require cleaning.	Site Safety Officer

µS Micro Siemens
DO Dissolved oxygen
eV electron volts
FSD Full scale deflection
ORP Oxidation/Reduction Potential
PID Photoionization detector
ppm parts per million
s.u. Standard units
SOP Standard Operating Procedure

Table 6. Summary of Methods, Containers, Preservatives, and Holding Times, Kuhlman Electric Corp. Facility, Quality Assurance Project Plan, Crystal Springs, Mississippi.

Parameter	Matrix	Preparation Method	Analytical Method [(a)]	Container [(b)]	Preservative	Holding Time [(c)]
General Parameters						
VOCs	Water	5030, 5032	8260/624	3 x 40-mL vial with Teflon-lined septum	pH< 2 with HCl, Cool 4°C	14 days
	Water	5030, 5032	8260/624	3 x 40-mL vial with Teflon-lined septum	If effervescence is observed, eliminate HCl preservative and Cool 4°C	7 days
	Solid	5035	8260	3 x Encore™ OR 2 x Sodium Bisulfate vial and 1 x Methanol vial	Cool 4°C	48 hours to preservation for Encore™, then 14 days to analysis
1,4-Dioxane	Water	3510, 3520 [(d)]	8270 (Low Level)/625	2 x 1-L amber G	Cool 4°C [(e)]	7 days to extraction and 40 days to analysis
	Solid	3540, 3550 [(d)]	8270 (Low Level)	1 x 4-oz or 8-oz G	Cool 4°C	14 days to extraction and 40 days to analysis
Waste Characterization Parameters						
TCLP Metals [(f)] (including Mercury)	Solid Waste Material	1311 for Leach/ 3005, 3010	6010 and 7470 (for Leachate)	1 x 8-oz wide-mouth G	Cool 4°C	28 days from collection to Leach; 28 days to analysis of Leachate
TCLP VOCs [(f)]	Solid Waste Material	1311 for Leach/ 5030	8260 for Leachate	1 x 4-oz G packed full	Cool 4°C	14 days from collection to Leach; 14 days to analysis of Leachate when preserved with HCl to pH< 2
TCLP SVOCs [(f)]	Solid Waste Material	1311 for Leach/ 3510, 3520	8270 for Leachate	1 x 8-oz wide-mouth G	Cool 4°C	14 days from collection to Leach; 40 days to analysis of Leachate
Ignitability	Aqueous Waste	NA	1010	500 mL G	NA	NA
	Solid Waste Material	NA	1010	1 x 8-oz wide-mouth G	NA	NA

Table 6. Summary of Methods, Containers, Preservatives, and Holding Times, Kuhlman Electric Corp. Facility, Quality Assurance Project Plan, Crystal Springs, Mississippi.

Parameter	Matrix	Preparation Method	Analytical Method [(a)]	Container [(b)]	Preservative	Holding Time [(c)]
Reactivity	Aqueous Waste	NA	USEPA Region 4 Guidance for Sulfide	500 mL HDPE	pH> 9 with 2 mL ZnAc and NaOH, Cool 4°C	7 days
	Aqueous Waste	NA	9010/9012/9014 for Cyanide	1 x 1-L HDPE	pH> 12 with NaOH	14 days
	Solid Waste Material	NA	USEPA Region 4 Guidance for Sulfide	1 x 8-oz wide-mouth G	Cool 4°C	7 days
	Solid Waste Material	NA	9010/9012/9014 for Cyanide	1 x 1-L HDPE	Cool 4°C	Sulfide 7 days
Corrosivity (pH)	Aqueous Waste	NA	9040	250 mL HDPE	NA	24 hours
	Solid Waste Material	NA	9045	1 x 8-oz wide-mouth G	NA	24 hours
General Chemistry Parameters						
Alkalinity	Water	NA	310.1	250 mL HDPE	Cool 4°C	14 days
Carbon dioxide			AM20GAX			
Chloride	Water	NA	300.1	250 mL HDPE/ 2 x 40 mL vial	Cool 4°C	28 days
Ferrous Iron	Water	NA	200.7	250 mL HDPE/ 2 x 40 mL vial for 7199 Modified	Cool 4°C for SM3500/ pH< 2 with HCl for 7199 Modified	Analyze ASAP/ 48 hours for 7199 Modified
Methane Ethane Ethene			AM20GAX			
Nitrate	Water	NA	300.1	250 mL HDPE/ 2 x 40 mL vial	Cool 4°C	2 days
Sulfate	Water	NA	300.1	250 mL HDPE/ 2 x 40 mL vial	Cool 4°C	28 days
Total Organic Carbon (TOC)	Water	NA	9060A	250 mL amber G	pH< 2 with HCl or H_2SO_4, Cool 4°C	28 days

(a) The 8000 series methods will be used for assessment and remediation; the 600 series methods will be used only for wastewater or storm water analyses performed in accordance with discharge permits.
(b) Sample volumes may be combined for MNA parameters where preservatives are the same and adequate sample volume is supplied to the laboratory. Volumes listed are based on sample containers and not minimum volumes required for some of the General Chemistry Parameters listed under the MNA heading only. All other volumes are minimum volumes required to be submitted to the laboratory.
(c) Maximum holding time allowed from date of collection.
(d) Cleanup methods may be applicable if matrix interference is encountered. Cleanup methods may include alumina (Method 3610), florisil (Method 3620), silica gel (Method 3630), gel permeation chromatography (GPC) (Method 3640), and sulfur (Method 3660). Selection of appropriate method is based on nature of interference and target compounds.
(e) If residual chlorine is present, requires sodium thiosulfate in each sample container.
(f) Waste Characterization addresses solid (soils, sludge, waste) material analysis for waste disposal purposes. Liquid (aqueous or organic) wastes will be characterized using the appropriate methods for determination of total constituent concentrations in accordance with waste disposal requirements under the Resource Conservation and Recovery Act (RCRA). TCLP analyses will be performed as required on wastes containing > 0.5% solids in accordance with RCRA waste characterization and disposal requirements.
(g) This holding time is a contractual holding time that has been established by ARCADIS and is established in the USEPA Region 4 Laboratory Operations and Quality Assurance Manual.

°C – Degrees Centigrade.
G – Glass.
H_2SO_4 – Sulfuric acid.
HCl – Hydrochloric acid.
HDPE – High Density Polyethylene.
HNO_3 – Nitric acid.
L – Liter.
mL – Milliliter.
MNA – Monitored Natural Attenuation.
NA – Not Applicable.
NaOH – Sodium hydroxide.
SVOCs – Semivolatile Organic Compounds.
TAL – Target Analyte List.
TCL – Target Compound List.
TCLP – Toxicity Characteristic Leaching Procedure.
VOCs – Volatile Organic Compounds.
ZnAc – Zinc acetate.

Table 7. Field Quality Control Sample Collection Guidelines, Kuhlman Electric Corp. Facility, Quality Assurance Project Plan, Crystal Springs, Mississippi.

QC Sample	Description
Field Duplicate	One per matrix per 20 samples for each analysis.
Equipment Rinsate Blank	One per equipment set per 20 samples collected for each analysis. Only equipment sets that are dedicated or disposed of do not require equipment blanks.
Trip Blank	One per shipment for each cooler in which samples for volatile analysis are shipped. Trip blanks are analyzed for all volatile methods designated for the samples. Trip blanks are shipped for both solid and aqueous matrices.

Table 8. Laboratory Quality Control Sample Analysis Guidelines, Kuhlman Electric Corp. Facility, Quality Assurance Project Plan, Crystal Springs, Mississippi.

QC Sample	Description
Method Blank	One per matrix per preparation batch for each analysis.
Lab Replicate	One per matrix per preparation batch for each analysis.
Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD)	One LCS per matrix per preparation batch for each analysis. LCSD performance is optional.
Surrogate Spiking	All samples analyzed for organic methods as method and Standard Operating Procedure (SOP) appropriate.
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One pair per matrix per preparation batch for each analysis. The spike solution must contain a broad range of the analytes of concern at Vicksburg Chemical. The overall frequency of MS/MSD on the project samples must be at least 1 set per 20 samples.

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Figures

CITY: MIDLAND-TX DIV/GROUP: ENV DB: H.CLARDY LD: H.CLARDY PIC: PM: G.CRAMER TM: K.SZYMPRUCH LYR: ON=*;OFF=*REF*
G:\ENVCAD\MIDLAND\ACT\LA002889\0001\00001\CAP PROPOSAL-VOLUME 1\DWG\02889B01.DWG LAYOUT: 1 SAVED: 10/29/2010 1:53 PM ACADVER: 18.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 10/29/2010 1:57 PM BY: CLARDY, HERB

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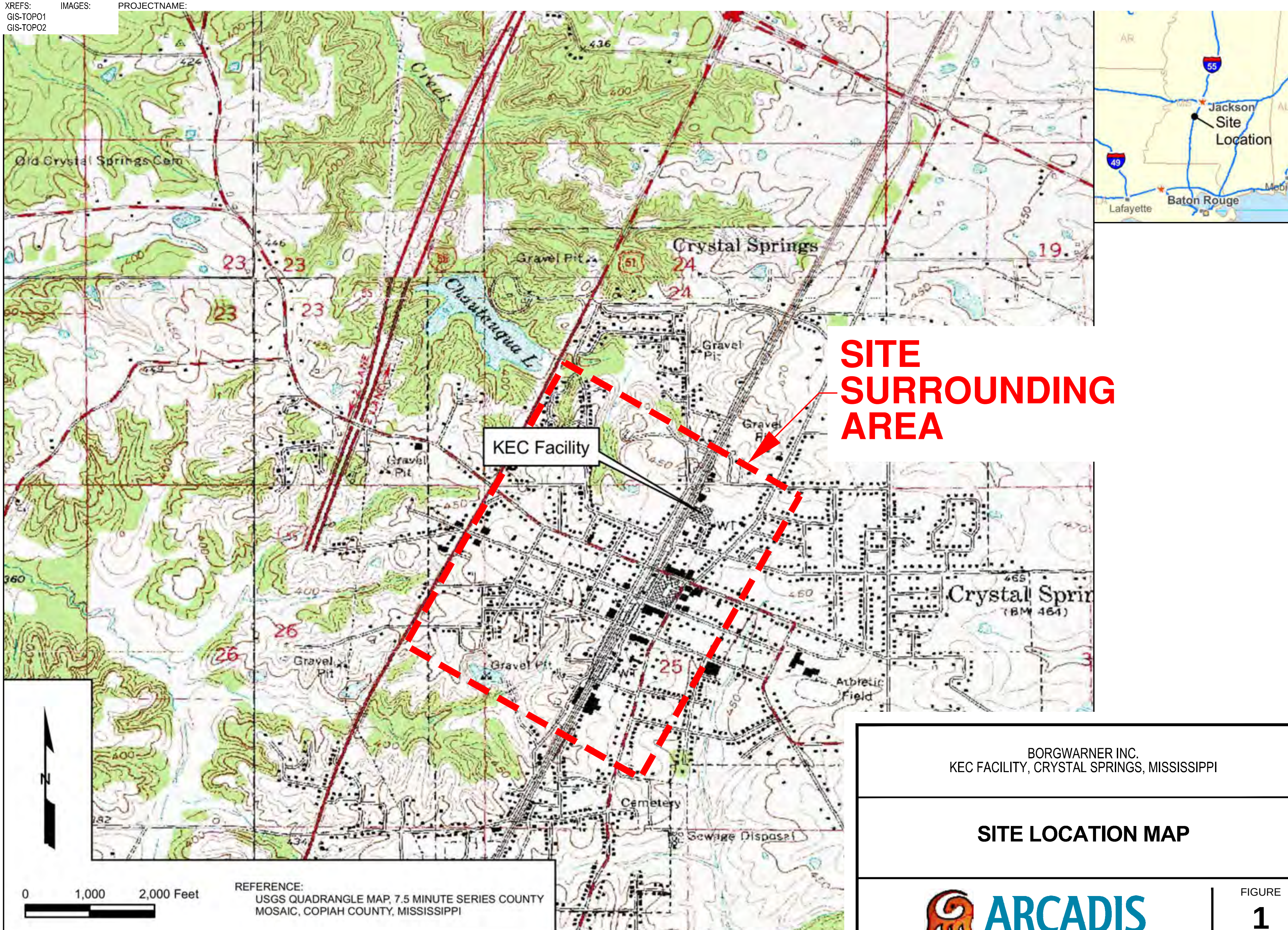

REFERENCE:
USGS QUADRANGLE MAP, 7.5 MINUTE SERIES COUNTY MOSAIC, COPIAH COUNTY, MISSISSIPPI

BORGWARNER INC.
KEC FACILITY, CRYSTAL SPRINGS, MISSISSIPPI

SITE LOCATION MAP

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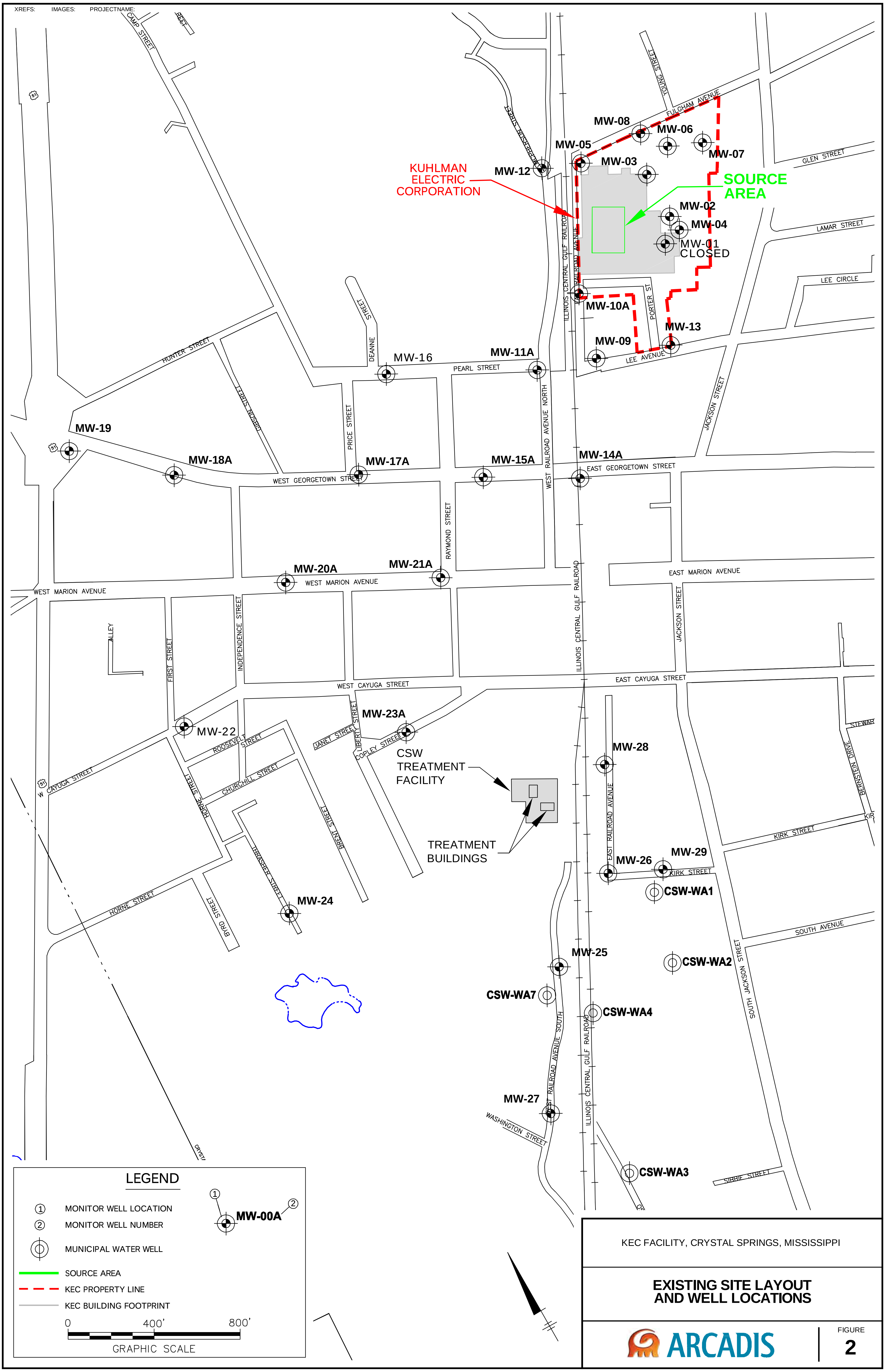
FIGURE 1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KUHLMAN ELECTRIC CORPORATION
SOURCE AREA
MW-01 CLOSED
MW-02
MW-03
MW-04
MW-05
MW-06
MW-07
MW-08
MW-09
MW-10A
MW-11A
MW-12
MW-13
MW-14A
MW-15A
MW-16
MW-17A
MW-18A
MW-19
MW-20A
MW-21A
MW-22
MW-23A
MW-24
MW-25
MW-26
MW-27
MW-28
MW-29
CSW-WA1
CSW-WA2
CSW-WA3
CSW-WA4
CSW-WA7
CSW TREATMENT FACILITY
TREATMENT BUILDINGS
FULGHAM AVENUE
GLEN STREET
LAMAR STREET
LEE CIRCLE
LEE AVENUE
PORTER ST
YOUNG STREET
PEARL STREET
DEANNE STREET
HUNTER STREET
PRICE STREET
WEST GEORGETOWN STREET
EAST GEORGETOWN STREET
RAYMOND STREET
WEST RAILROAD AVENUE NORTH
ILLINOIS CENTRAL GULF RAILROAD
JACKSON STREET
WEST MARION AVENUE
EAST MARION AVENUE
ALLEY
FIRST STREET
INDEPENDENCE STREET
WEST CAYUGA STREET
EAST CAYUGA STREET
W CAYUGA STREET
ROOSEVELT STREET
JANET STREET
LIBERTY STREET
COPLEY STREET
CHURCHILL STREET
HORNE STREET
BYRD STREET
THRASHER STREET
BRENT STREET
EAST RAILROAD AVENUE
KIRK STREET
SOUTH AVENUE
SOUTH JACKSON STREET
BERNSTEIN DRIVE
WEST RAILROAD AVENUE SOUTH
WASHINGTON STREET
CAMP STREET
LEGEND
① MONITOR WELL LOCATION
② MONITOR WELL NUMBER
MW-00A
MUNICIPAL WATER WELL
SOURCE AREA
KEC PROPERTY LINE
KEC BUILDING FOOTPRINT
0 400' 800'
GRAPHIC SCALE
KEC FACILITY, CRYSTAL SPRINGS, MISSISSIPPI
EXISTING SITE LAYOUT AND WELL LOCATIONS
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FIGURE 2

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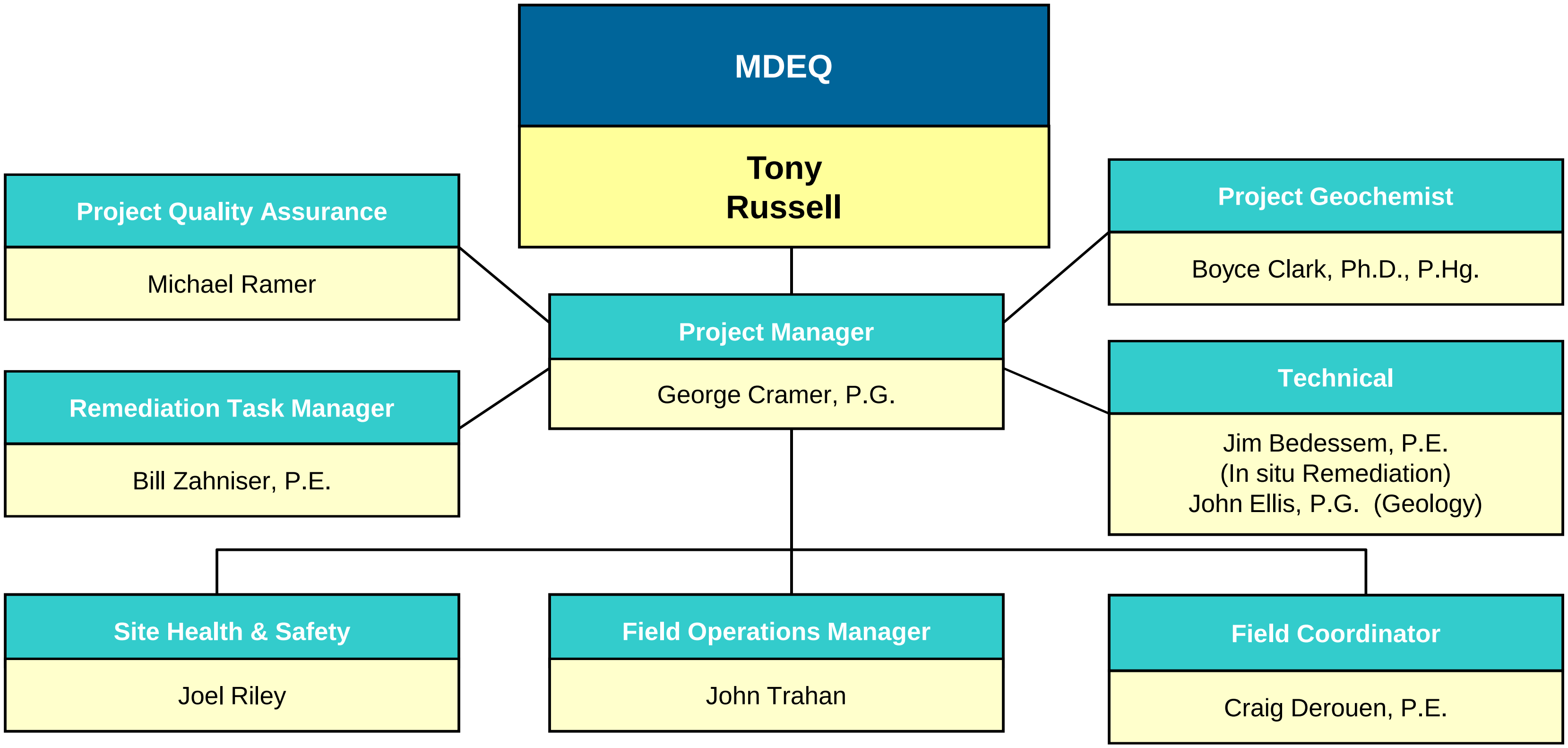
Appendix A

Organizational Structure

Kuhlman Electric Corp. Facility Remediation Project
Organizational Structure



PhelpsDunbar/2889.1/M/4/kp

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Appendix B

Typical Field Forms

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infrastructure, environment, buildings

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page ___ of ___

Lab Work Order #

Send Results to:

Contact & Company Name:	Telephone
Address:	Fax:
City State Zip	E-mail Address:
Project Name/Location (City, State):	Project #:
Sampler's Printed Name:	Sampler's Signature:

Preservative							
Filtered (✓)							
# of Containers							
Container Information							

PARAMETER ANALYSIS & METHOD

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: ______
G. Other: ______
H. Other: ______

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: ______
10. Other: ______

Matrix Key:
SO - Soil
W - Water
T - Tissue
SE - Sediment
SL - Sludge
A - Air
NL - NAPL/Oil
SW - Sample Wipe
Other: ______

Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix								REMARKS

Special Instructions/Comments:

☐ **Special QA/QC Instructions(✓):**

Laboratory Information and Receipt		Relinquished By	Received By	Relinquished By	Laboratory Received By
Lab Name:	Cooler Custody Seal (✓)	Printed Name:	Printed Name:	Printed Name:	Printed Name:
☐ Cooler packed with ice (✓)	☐ Intact ☐ Not Intact	Signature:	Signature:	Signature:	Signature:
Specify Turnaround Requirements:	Sample Receipt:	Firm:	Firm/Courier:	Firm/Courier:	Firm:
Shipping Tracking #:	Condition/Cooler Temp: ______	Date/Time:	Date/Time:	Date/Time:	Date/Time:

Distribution: **WHITE – Laboratory returns with results** **YELLOW – Lab copy** **PINK – Retained by ARCADIS**

CHAIN-OF-CUSTODY SEAL • CHAIN-OF-CUSTODY SEAL

ARCADIS ARCADIS

CHAIN-OF-CUSTODY SEAL • CHAIN-OF-CUSTODY SEAL

ARCADIS
10352 Plaza Americana Drive
Baton Rouge, LA 70816

SAMPLE / CORE LOG

ring/Well: ____ Project No.: ____

Site Location: ____ Drilling Started: ____ Drilling Completed: ____

Land-Surface Elev.: ____ Surveyed: ____ Estimated: ____ Datum: ____

Drilling Fluid: ____ Drilling Method Used: ____

Drilling Contractor: ____ Driller: ____ Helper: ____

Prepared By: ____ Hammer Weight: ____ Hammer Drop (inches): ____

Fill | Silty Clay | Silt | Sandy Silt | Silty Sand | Shelby Tube | Water First Encountered

Clay | Sandy Clay | Clayey Silt | Sand | Clayey Sand | Split Spoon | Water Level After 10 Minutes

SAMPLE DEPTH (ft)	SAMPLE TYPE	RECOVERY (ft)	SYMBOL	VISUAL DESCRIPTION	USCS (LL/PL/PI)	PP H V	OVM (wo/F) (ppm)	REMARKS
0								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
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14								
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SOIL/SEDIMENT SAMPLING LOG

PROJECT NAME: ____________________

PROJECT NUMBER: ____________________ DATE: __________

SITE LOCATION: ____________________

SAMPLE ID NUMBER: __________ CODED/REPLICATE NO.: __________

TIME SAMPLING BEGAN: __________ ENDING: __________

WEATHER: ____________________

SITE DESCRIPTION: ____________________

SAMPLING DATA

COLLECTION METHOD: ____________________

DEPTH: __________ MOISTURE CONTENT: __________

COLOR: __________ ODOR: __________

DESCRIPTION: ____________________

ANALYSES REQUIRED	CONTAINER DESCRIPTION FROM LAB: X OR ARCADIS:

SAMPLING MONITORING (TIP, OVA, HNU, etc.) __________

REMARKS: ____________________

SAMPLING PERSONNEL: ____________________

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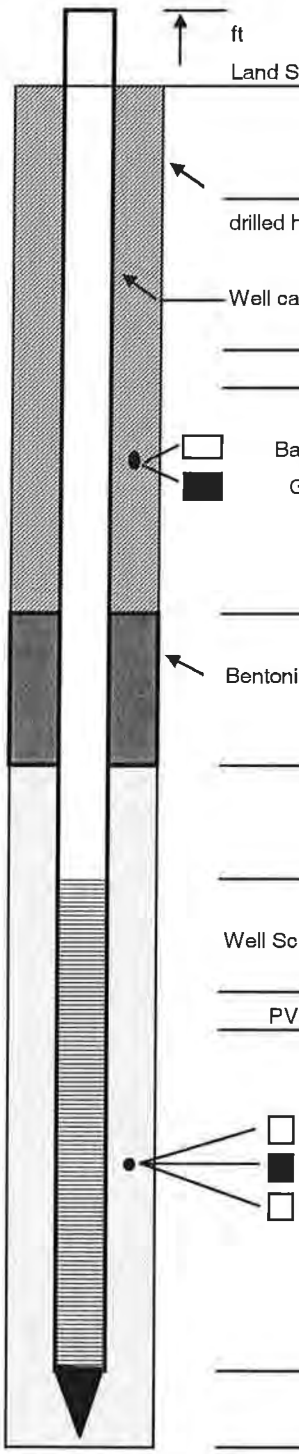
WELL CONSTRUCTION LOG



_____ ft

Land Surface

_____ inch diameter drilled hole

Well casing, _____ inch diameter, PVC

Backfill

Grout cement

_____ ft*

Bentonite

slurry

pellets

_____ ft*

_____ ft*

Well Screen, _____ inch diameter PVC, 0.010 slot

Gravel Pack

Sand Pack

Formation Collapse

_____ ft*

_____ ft*

Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project _____ Well _____

Town/City _____

County/Parish _____ State _____

Permit Number _____

Land-Surface Elevation and Datum _____ feet X Surveyed Estimated

_____

Installation Date(s) _____

Drilling Method _____

Drilling Contractor _____

Drilling Fluid _____

_____

Development Technique(s) and Date(s)

_____

_____

_____

_____

Fluid Loss During Drilling _____ gallons

Water Removed During Development _____ gallons

Static Depth to Water _____ feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose Monitor Well

_____

_____

Remarks _____

_____

_____

_____

_____

_____

Prepared by _____

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WATER SAMPLING LOG

Project ____________________ Project No. ____________________

Site Location ____________________ Date: ____________

Site/Well No. ____________ Replicate No. ____________ Code No. ____________

Weather ____________ Sampling Time: Begin ____________ End ____________

Evacuation Data

Measuring Point ____________

MP Elevation (ft) ____________

Land Surface Elevation (ft) ____________

Sounded Well Depth (ft bmp) ____________

Depth To Water (ft bmp) ____________

Water Level Elevation (ft) ____________

Water Column In Well (ft) ____________

Casing Diameter/Type ____________

Gallons In Well ____________

Gallons Pumped/Bailed Prior To Sampling ____________

Sample Pump Intake Setting (ft bmp) ____________

Purge Time Begin: ______ End ______

Pumping Rate (gpm) ____________

Evacuation Method ____________

Field Parameters

Color ____________

Odor ____________

Appearance ____________

pH (s.u.) ____________

Conductivity (mS/cm) ____________

Conductivity (µmhos/cm) ____________

Turbidity (NTU) ____________

Temperature (^{o}C/ ^{o}F) ____________

Dissolved Oxygen (mg/L) ____________

ORP (mV) ____________

Sampling Method ____________

Remarks ____________

Constituents Sampled	Container Description	Number	Preservative

Sampling Personnel ____________

Well Casing Volumes

Gal./Ft.	1" = 0.04	1 - 1/2" = 0.09	2 - 1/2" = 0.26	3 - 1/2" = 0.50	6" = 1.47
	1 - 1/4" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65	

bmp	Below measuring point	ml	Milliliter	NTU	Nephelometric Turbidity Units
^{o}C/^{o}F	Degrees Celsius/Fahrenheit	mS/cm	Millisiemens per centimeter	PVC	Polyvinyl chloride
ft	Feet	msl	Mean sea level	s.u.	Standard units
gpm	Gallons per minute	NA	Not Applicable	µmhos/cm	Micromhos per centimeter
mg/L	Milligrams per liter	NR	Not Recorded	VOC	Volatile Organic Compounds
ppt	Parts per thousand	CS	Carbon steel	SS	Stainless steel

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MONITOR WELL INSPECTION CHECKLIST

Project Name: ______________________ Project Number: ______________________

Inspectors Name: ______________________ Inspection Date: ______________________

Monitor Well ID: ______________________ Site Location: ______________________

Type of Well:

☐ Flush Mounted ☐ Above Grade

A. Condition of protective casing: ______________________

B. Condition of concrete pads (note cracks, breaks, slope direction): ______________________

____

C. Condition of guard posts: ______________________

D. Is the well locked? ______________________

E. Is well identification number clearly marked? ______________________

F. Is the TOC elevation mark clearly visible on the well ? ______________________

G. Condition of well casing: ______________________

H. Condition of well cap: ______________________

I. Condition of surrounding grounds (i.e., overgrowth, is the well accessible, etc.): ______________________

J. Does water adequately drain from the well site?: ______________________

K. Total depth of well (properly decon tape between wells). ______________________

____

L. Depth to top of grout from protective casing - length of protective casing above concrete pad: ______________________

M. Comments/Recommendations: ______________________

____

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FIELD PARAMETER FORM

Well Identification Number:

Job Name/Number: ______________________ Date: ____________

Water Level (TOC): ______________________ Total Depth: ____________

OVM Reading: ______________________ 3 Well Volumes: ____________

Start Time: ______________________ Total Volumes Removed: ____________

Time	Water Level (ft gmp)	Temp (°F)	Spc. Cond. (µmhos/cm)	Salinity (ppt)	DO (%)	DO (mg/L)	pH (s.u.)	REDOX/ORP (mv)

Observations/Comments:

Ferrous Iron: ____________ Sulfide: ____________

Project Name / Number:			Sample ID:
Matrix:	Collection:	Preservative:	
Analysis:			Date:
Sampler(s):			Time:

FIELD INSTRUMENT CALIBRATION LOG

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Date:

ARCADIS Project Name: Project Number:

Field Calibration by: Instrument Source

Type of Instrument	Manufacturer	Model Number	Time	Standard Concentration	Calibrated Reading	Remarks
pH Meter				4.00 s.u.		
				7.00 s.u.		
				10.00 s.u.		
				4.00 s.u.		
				7.00 s.u.		
				10.00 s.u.		
				4.00 s.u.		
				7.00 s.u.		
				10.00 s.u.		
Conductivity Meter				3,000 μmhos/cm		
				5,000 μmhos/cm		
				30,000 μmhos/cm		
				3,000 μmhos/cm		
				5,000 umhos/cm		
				30,000 μmhos/cm		
				3,000 μmhos/cm		
				5,000 μmhos/cm		
				30,000 μmhos/cm		
Dissolved Oxygen Calibrate to Water-Saturated Air				mm Hg		
				mm Hg		
				mm Hg		
Turbidimeter				NTU		
				NTU		
				NTU		
ORP				150 MV		
				150 MV		
				150 MV		

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Appendix C

MDEQ Minimum Specifications for Drilling Services

Mississippi Department of Environmental Quality
Minimum Specifications for Drilling Services
July 1, 2005

ITEM 1 - MOBILIZATION AND DEMOBILIZATION

The driller should leave the site as clean as when he arrived which includes soil disposal, if necessary.

ITEM 2 - DECONTAMINATION

Prior to mobilization any part of the drill rig and/or equipment that comes in contact with the borehole will be thoroughly cleaned to remove all oil, grease, mud, tar, etc. This cleaning process will consist of scrubbing the equipment with a detergent and tap water then using a high-pressure hot water rinse.

Before drilling each boring, the augers, drilling bits, etc. shall be cleaned by at least using a high-pressure hot water rinse. Special attention should be given to the threaded section of the casing. Petroleum based lubricants shall not be used to prevent binding.

Before taking Shelby tube or split-spoon samples, this and associated equipment shall be minimally decontaminated using the following protocol:

(1) Cleaned thoroughly with detergent and tap water,
(2) Rinsed thoroughly with isopropyl alcohol or methanol, and
(3) Then rinsed thoroughly with distilled water.

ITEMS 3 AND 4 - DRILLING OF BOREHOLES, SPLIT-SPOON SAMPLING, AND ABANDONMENT

Subsurface samples will be collected at five-foot intervals with a cleaned split-spoon or equivalent. Sampling will be carried out to the required depth while using standard ASTM protocols to recover the samples. Borehole abandonment will require grouting by the tremie method (95% Portland cement and 5% bentonite by weight) to begin at the bottom of the boring and proceeds to land surface. The patch at the land surface shall be the same material surrounding the borehole (i.e. asphalt, concrete, etc.).

ITEMS 5, 6, AND 7 - INSTALLATION OF MONITORING WELLS

All monitoring wells shall be at least PVC schedule 40 with 0.010-inch factory slotted screen openings and drilled using hollow stem technology. Each screen will be continuously slotted and at least 10 foot in length. The well will consist of a least a schedule 40 (ASTM) body with threaded flush joints. No solvents or lubricating compounds will be used to aid pipe connection. PVC plugs will be threaded onto the bottom of each well screen to prevent the intrusion of filter material. The driller will place the threaded caps onto the well pipe opening at the surface. The well caps shall be watertight and lockable. If the wells are to be less than/greater than standard 4" inside diameter, prior approval from the MDEQ must be granted *before* the wells are installed.

The annular space between the monitoring well and the borehole wall shall be at least 2.0 inches and will be backfilled with a clean medium to coarse grain sand (20/40 sand) to a level approximately 1.0 foot above the top of the screen.

A two-foot bentonite seal of bentonite pellets will be placed immediately above the sand and firmly tamped in place.

The remainder of the annular space should be grouted to land surface with a grout mixture (95% Portland cement and 5% bentonite by weight) to approximately land surface.

ITEM 8 - WELL DEVELOPMENT

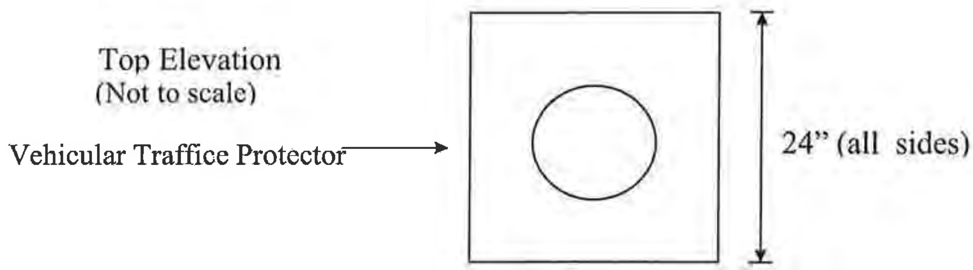
Upon completion of the monitoring well installation, the well should be developed by bailing, pumping, surge block, etc. At least three to five well volumes should be pumped or the well should be pumped dry. The final water from the well should not be turbid. The engineering firm's field geologist or engineer shall determine the decision as to when the well is properly developed.

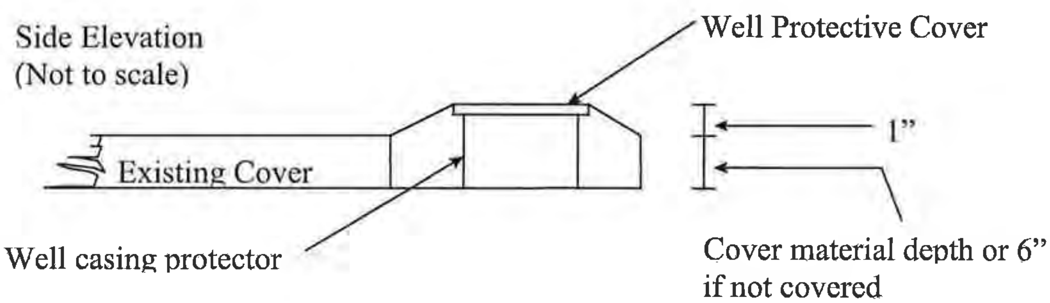
ITEM 9 - FABRICATION/INSTALLATION OF MONITOR WELL HEAD PROTECTION

In most cases the site will utilize concrete or asphalt as a covering material. Before installation of monitor well head protection, the engineer shall review the attached drawing to assure proper excavation prior to the pouring of concrete, which forms the vehicular traffic protector. If the location of the monitor well is within a covered area (asphalt or concrete), the existing surface about the monitor well must be removed utilizing either mechanical sawing or pneumatic hammer equipment to a depth of existing cover and the width and length as specified on the drawing. Loose materials on the exposed earthen surface shall be removed or compacted to assure a smooth surface upon which to pour the concrete mixture. If the monitor well is to be located outside a covered area, the earthen material should be removed using a shovel or pickaxe to a depth of six inches and a width and length as specified on the attached drawing. The monitor well should then be cut to the proper height so that the security casing cover will extend 2 inches above the well casing considering the requirements as outlined in the attached drawing and the security casing set.

The concrete mixture to be used as the vehicular traffic protector shall consist of the addition of five (5) pounds of Portland cement to each 80-pound bag of "Quickcrete" or other commercially available brand concrete mixture when the poured material is to be derived from bagged dry mix. Water should be added to the mixture in an amount necessary for desired consistency before the concrete is poured. If the poured material is to be delivered from a concrete supplier by truck, 2500 psi concrete should be specified. The concrete surface of the protector should then be trialed so that the surface of the concrete on any side of the security casing is flush with the monitor well security casing well cap and mating cover material. A flush mounted protective cover should be installed on the well casing protector to protect the monitoring wells against damage from site activities. The words "Monitoring Well" or a similar designation should be *embossed* on the protective cap.

MONITORING WELLHEAD PROTECTION





Mississippi Commission on Environmental Quality
Regulation LW-3

LICENSING OF WATER WELL CONTRACTORS REGULATIONS

Adopted by the Mississippi Commission on Environmental Quality June 24, 2004

TABLE OF CONTENTS

Licensing of Water Well Contractors Regulations (LW-3)

I. DEFINITIONS

The words and phrases used in this regulation, shall have the following meanings:

A. Annular Space — The space between the borehole wall and the well casing or screen, or the space between a casing pipe and a liner pipe or between two strings of casing.

B. Applicant — Any person who submits an application to obtain a water well contractor's license.

C. Aquifer — a geologic formation, hydraulically connected group of formations, or part of a formation that can yield water to a well or spring.

1. Confined Aquifer (Commonly referred to as artesian aquifers) – a permeable geologic layer or zone saturated with groundwater isolated from the atmosphere by impermeable confining layers. The groundwater in confined aquifers is subjected to pressures higher than atmospheric pressure so that water in a well penetrating the aquifer will rise to some level above the actual top of the aquifer.

2. Unconfined Aquifer (Commonly referred to as water table aquifers) – a permeable geologic layer or zone saturated with groundwater at atmospheric pressure. These aquifers are generally not overlain by impermeable confining layers and may be vulnerable to contamination from surface activities or events that discharge pollutants on the ground.

D. Artesian — Groundwater under sufficient hydrostatic pressure to rise above the aquifer containing it.

E. Beneficial use — The application of water, excluding waste of water, to a purpose that produces economic or other tangible or intangible benefits to the state and its citizens. Such uses include, but are not limited to, diversions or withdrawals for public, industrial, or agricultural use.

F. Board or Permit Board – The Mississippi Environmental Quality Permit Board.

G. Certificate of Insurance – Proof of coverage under Contractors Liability Insurance.

H. Commission –The Mississippi Commission on Environmental Quality, or its designee.

I. Committee – The Water Well Driller's Advisory Committee.

J. Days — Calendar days, unless specifically indicated otherwise in the body of this regulation.

K. Decommissioning — The complete and permanent sealing of a well bore to prevent contamination of the aquifer.

L. Department or MDEQ – The Mississippi Department of Environmental Quality.

M. Dewatering – The temporary lowering of the groundwater level to facilitate installation of underground utilities, construction of foundations, and various other purposes.

N. Domestic use — The use of water for ordinary household purposes, the watering of farm livestock, poultry, and domestic animals, and the irrigation of home gardens and lawns.

O. Filter Pack — Smooth, uniform, clean sand or gravel placed in the annular space between the borehole wall and well screen to prevent sediments from entering the screen.

P. Fresh water — Water having a Total Dissolved Solids (TDS) concentration of less than 1,000 parts per million (ppm).

Q. Geotechnical Boring — A hole constructed for the purpose of sampling, measuring, or testing the strata encountered for scientific, engineering, geological or regulatory purposes.

R. Groundwater — Water occurring beneath the surface of the ground.

S. Grout — A fluid mixture of neat cement and water, with additives such as sand, bentonite, or hydrated lime, or a mixture of bentonite and water, capable of producing a water-tight seal, that can be forced through a pipe or placed in an annular space, as required for sealing a well or an annular space to protect against intrusion of contamination.

T. Halliburton Method---A method of grouting casing in which the slurry is forced down the casing and into the annular space until slurry returns are obtained at the ground surface.

U. Inactive Status – The status assigned to a license by the Commission to indicate that the licensee may not practice well drilling and/or pump installation until the licensee has met the requirements of this regulation regarding renewal or reinstatement of the license.

V. Incompetency – An action or inaction by a licensee which demonstrates a general lack of knowledge or ability to practice water well drilling and/or pump installation.

W. Landowner — The person, or entity, holding legal title to the surface of the land upon which a withdrawal or diversion of water is located.

X. Licensee – Any individual who holds a valid Water Well Contractor's License issued by the state, or any company or corporation engaged in the business of water well contracting under a license duly issued to a designated principal, or key employee, in the company or corporation. Licenses will only be issued to individuals, and a company will be deemed to be licensed only if it has a principal or key employee who is licensed.

1. Restricted Licensee – An individual holding a Water Well Contractor's License who is restricted to performance of only such activities as may be specified in the conditions of the license. Typically, restrictions will be placed on the licenses of individuals who:

   a. only engage in specialized well or borehole construction such as drilling geotechnical boreholes, constructing environmental monitoring wells, or constructing geo-thermal systems; or

   b. only engage in limited aspects of the water well construction business such as pump and well equipment installation and service.

2. Unrestricted Licensee – An individual holding a Water Well Contractor's License who is thereby authorized to engage, to the full extent allowed by this regulation, in the business of constructing, maintaining, and repairing water wells; installing and servicing pumps and related water well equipment; drilling special purpose boreholes; constructing monitoring wells; or any other work involving drilling, grouting, plugging, abandoning, or decommissioning water wells and boreholes. Companies, corporations, or other business entities, that are not individuals, will be deemed to have met the licensing requirement if a principal in the firm, or other key employee authorized to act for the firm, holds an unrestricted water well contractor's license.

Y. Misconduct– A willful or intentional action or inaction by a licensee that is contrary to the standard or accepted practice of the industry that would be applied by competent professionals, under the same circumstances.

Z. Municipal use — The use of water by a municipal government to promote the life, safety, health, comfort, and business pursuits of its people. The term does not include irrigation of crops that may be planted within the corporate boundaries.

AA. Office or OLWR--- the Office of Land and Water Resources of MDEQ.

BB. Permitted use —

1. The use of a specific amount of water at a specific time and at a specific place, authorized and allotted by the Board for a designated beneficial use within specific limits as to quantity, time, place, and rate of diversion or withdrawal; or

2. The right to the use of water as specified in the permit, subject to the provisions of Mississippi Code Annotated Section 51-3-5, including the construction of waterworks or other related facilities.

CC. Person — The state or other agency or institution thereof, any municipality, political subdivision, public or private corporation, individual, partnership, association or other entity, and including any officer or governing or managing body of any municipality, political subdivision, or public or private corporation, or the United States or any officer or employee thereof.

DD. Plugging — See "Decommissioning".

EE. Potable Water — Water that is suitable for human consumption and meets all primary drinking water standards (Primary Maximum Contaminant Levels) set by the United States Environmental Protection Agency (EPA).

FF. Potential Sources of Contamination – Sites or facilities that use, store, and/or dispose of substances (on site) that, due to their quantity, toxicity, and/or mobility, could impact the water quality of aquifers used for potable water supply. Examples of such sources include, but are not limited to, failing or inadequate individual sewage treatment and disposal systems, tanks used for bulk storage of petroleum products, Class V injection wells, container and drum storage sites, etc.

GG. Public Water System –A system that provides potable water to the public through pipes or, after August 5, 1998, other conveyances if such system has at least fifteen service connections or regularly serves an average of at least twenty-five individuals daily at least 60 days out of the year. **Note: This duplicates a Mississippi State Department of Health definition. It is included in this regulation to serve as a reminder that wells exempted from regulation by MDEQ because the surface casing diameter is less than six (6) inches, may still be regulated by the Mississippi State Department of Health if they are part of a Public Water System.**

HH. Pump Installation – The installation of pumps or pumping equipment for water wells, including the removal and re-installation of pumps or pumping equipment for service, repairs, or replacement.

II. Pumps or Pumping Equipment – Any equipment or materials utilized or intended for use in withdrawing or obtaining water from water wells or surface water diversion points.

JJ. Repair of Water Wells – Work on any water well involving re-drilling, deepening, changing casing and screen depths, re-screening, cleaning by use of chemicals, and re-development; or removing and re-installing pumps, pumping equipment, or any related equipment intended to draw water from the well.

KK. State Well Report – A report documenting information related to the drilling of a well or borehole and the development and completion of a water well together with any other data or information required by MDEQ, reported on forms provided by the MDEQ.

LL. Surface casing — That string of casing in any water well having the greatest outside diameter, regardless of whether it is located at or below ground level.

MM. Suspended Status – The status assigned to a license by the Commission to indicate that the licensee has willfully violated provisions of State law or of this regulation so as to endanger himself, others, the environment, and/or the public health.

NN. Test Boring and Coring – the removal and collection of soil samples from the earth by means of augers, core-barrels, spoons, wash casing and bailers for the purpose of obtaining geologic and hydrologic information.

OO. Tremie pipe — a device, usually a small-diameter pipe, that carries grout or other material to the bottom of a borehole or casing and that allows pressure grouting from the bottom up without introduction of air pockets.

PP. Well or "water well" — a hole that is drilled, driven, bored, excavated, or otherwise penetrated into the ground to access, evaluate and/or withdraw ground water. For purposes of this regulation, this definition does not pertain to wells constructed for the purpose of disposal of fluids or other materials, but does include:

1. Abandoned Well— a well that has not been used within the preceding twelve month period, or one that has had the pump disconnected and/or removed for reasons other than maintenance, repair, or replacement.

2. Dewatering Well— a well used for temporary removal of surface water or groundwater to facilitate construction or mining operations, or for permanent protection of a structure or activity from the effects of surface water or groundwater.

3. Monitoring Well— a well used to obtain data on the quality of water in an aquifer system or at specified depths and locations related to a potential source of pollutant.

4. Observation Well--- a well used primarily for measuring the water level in an aquifer.

5. Recovery Well— a well constructed for the purpose of recovering undesirable groundwater for treatment or removal of contaminants.

6. Relief Well— a well constructed to provide pressure relief from an artesian aquifer or from excessive head differentials in water table aquifers.

7. Replacement Well— a well drilled to replace an existing well that has become unusable, provided the new well meets the requirements set forth in these regulations.

8. Standby Well--- a well that can be placed in operation to withdraw water but is only used when water is temporarily unavailable from the primary source or sources because of mechanical failure, maintenance, or power failure.

9. Test Well ---a well drilled to explore for groundwater for a water supply well.

10. Underground Discharge Well --- a well in which the top of the casing terminates at a discharge head located below the frostline.

QQ. Well Completion — term used collectively to refer to both the drilling and developing phases of well construction. For the purpose of reporting requirements established in this regulation, a distinction is made between completion of drilling and completion of well development:

1. Completion of drilling -- the date that drilling is completed and the drill rig is no longer required at the site.

2. Completion of well development – the date that the well is fully functional and ready to provide water for its designated beneficial use, including having met any applicable water testing requirements.

II. APPLICABILITY

A. Any person, or any company, corporation, or other business entity engaging in a business or occupation that involves drilling of water wells or drilling boreholes that may penetrate water bearing strata (including constructing water wells, constructing geo-thermal systems, constructing environmental monitoring wells, conducting geotechnical investigations, conducting seismic exploration, or similar activities) or installing pumps or other equipment in water wells must first obtain the appropriate license or license renewal required pursuant to this regulation. A license is not transferrable or assignable, and MDEQ will maintain a current register of licensees.

B. Any person, or any company, corporation, or other business entity engaged in the practice of water well service and pump installation as of the effective date of this regulation may be issued a Restricted License, without examination, provided a properly completed license application is submitted to MDEQ, with the license fee, within sixty (60) days after the effective date of this regulation. If the applicant is a company,corporation, or other business entity that is not an individual, the application shall include the name of the designated individual who will hold the license for the company. A company will be deemed to be licensed only if it has a designated principal or other key employee who is licensed. The application shall be accompanied by a notarized affidavit signed by the applicant certifying that the individual applicant or the company's designee has a minimum of three (3) years qualifying experience in the practice for which the license is being sought. Any application received after the sixty (60) day time limit will be subject to the examination requirement of this regulation before any license will be issued; and the application will have to be accompanied by notarized affidavits from three (3) licensed water well contractors, as required by statute, certifying that the applicant has a minimum of three (3) years qualifying experience in the limited practice for which the license is being sought.

C. Exemptions – For the purposes of these regulations, a person who owns or leases property in the state; or who otherwise owns a property interest allowing the drilling of a water well on, and the use of water under, property in the state may drill a water well on that property without having a Water Well Contractor's license provided:

1. The well will be used only to supply water for domestic use to a single family dwelling which is the owner's or lessee's permanent residence; and/or to water livestock on the owner's or lessee's farm; and

2. The owner or lessee complies with applicable well construction standards contained in this regulation and the applicable regulations promulgated by the Mississippi State Department of Health.

D. Either a licensed water well contractor or an employee certified by the licensee in accordance with paragraph II. E. of this regulation must be on site and personally supervising operations during all critical stages of the drilling and completion of a potable water well including, but not limited to, collecting sand samples, logging the hole, setting the casing, grouting the well, setting the screen, placing the filter pack, developing and testing the well, and installing the pump.

E. Licensed water well contractors who have the capability to conduct simultaneous operations on multiple construction sites within the state may certify the competency of employees who will be in responsible charge of all on-site operations in the absence of the licensee. Within sixty (60) days after the effective date of this regulation, the licensee shall furnish MDEQ a list of the designated employees and a written certification that the listed employees are competent to perform and supervise all critical stages of drilling and completion of potable water wells. The list shall be updated and recertified by the licensee annually and submitted to MDEQ with the annual request for license renewal.

F. Neither these regulations, nor any permit issued thereunder, creates or includes any property right in favor of the permittee.

III. **<u>MINIMUM REQUIREMENTS FOR LICENSING</u>** --An applicant for a license, as defined in this regulation, must submit a completed application on the form provided by MDEQ; and meet or comply with the requirements set forth below:

A. <u>Water Well Contractor (Unrestricted License)</u>

1. Be at least twenty-one (21) years of age; and

2. Be of good moral character; and

3. If not previously licensed by the state, demonstrate, to the satisfaction of the Commission, a reasonable knowledge of state water laws, regulations, water well and borehole drilling practices, and pump and well equipment installation practices by passing such examinations as may be prescribed by the Commission, or its designee; and

4. Provide proof that the applicant possesses, or has unrestricted access to, the necessary tools and equipment to engage in all aspects of the business of water well contracting;

5. Provide evidence of at least three (3) years qualifying experience, i.e. experience in on-site supervision and being in responsible charge of all

aspects of water well and borehole construction gained while working under the personal supervision of a water well contractor holding an unrestricted license, or its equivalent; and

6. If not previously licensed by the state, provide notarized affidavits, as required by statute, from three (3) licensed water well contractors certifying that the applicant has the necessary qualifications and experience to meet the state's licensing standards at the level for which he is applying.

B. Water Well Contractor (Restricted License)

1. Be at least twenty-one (21) years of age; and

2. Be of good moral character; and

3. Demonstrate, to the satisfaction of the Commission, a reasonable knowledge of state water laws, regulations, and the specific practices for which the restricted license is being sought by passing such examinations as may be prescribed by the Commission, or its designee;

4. Provide written certification that they will only engage in the limited practice for which they are seeking the restricted license, such as constructing irrigation wells in the Mississippi River Valley Alluvial Aquifer (MRVA), constructing domestic wells less than six (6) inches in diameter, drilling geotechnical boreholes, constructing environmental monitoring wells, constructing geo-thermal systems, or installing and servicing pumps and related well equipment;

5. Provide evidence of at least three (3) years of qualifying experience, i.e. experience gained while working under the direct supervision of a licensee engaged in the business or practice for which the license is being sought; and

6. If not previously licensed by the state, provide notarized affidavits, as required by statute, from three (3) licensed water well contractors certifying that the applicant has the necessary qualifications and experience to meet the state's licensing standards at the level for which he is applying.

IV. EXAMINATION

A. A license applicant shall be required to take such examinations as may be prescribed by MDEQ. Three examinations will normally be administered to test: (1) general knowledge of groundwater resources and wells, (2) specialized knowledge in equipment, techniques, and practices appropriate to the license being sought, and (3) specific knowledge of state laws, regulations, and construction standards. Upon receipt of a completed application form and supporting documentation as set forth in paragraph III., MDEQ will contact the applicant to schedule the examinations. At that time, MDEQ will advise the applicant as to the types of examinations that will be administered, the general content of the examinations, and the availability of study materials.

B. The examinations will be taken at a time and place designated by MDEQ.

C. If the applicant fails to pass the examination(s), the examination(s) may be taken again upon written request, but not sooner than 30 days after the previous examination. If the applicant does not request re-examination within one (1) year, the application for license will be nullified and discarded.

D. MDEQ may waive a portion of the examination requirement for an applicant with a valid license from another state having license requirements substantially the same as those contained in this regulation. However, all applicants will be required to pass the examination on state laws, regulations and construction standards.

V. FEES

A. License Fee--Upon passing the examination, the annual license fee of one hundred dollars ($100.00) must be paid before the license will be issued. The fee must be paid by check, money order, or electronic payment directed to MDEQ. **Do not send cash.**

B. Renewal Fee —An annual renewal fee of one hundred dollars ($100.00) must be paid to MDEQ with the request for renewal of a license.

C. Late Fees--A late fee of ten dollars ($10.00) per month, or any fraction thereof, will be assessed for renewal or reinstatement requests received after the expiration date of the last valid license.

VI. LICENSE RENEWAL

A. All licenses expire on June 30 and must be renewed annually. The licensee shall submit a completed renewal request form, provide by MDEQ, along with the appropriate fee to MDEQ prior to June 30. Re-examination is not required for timely renewal of a license.

B. Receipt of the renewal form and fee by MDEQ prior to June 30 shall have the effect of extending the old license until the new license and ID is issued, or until the applicant is notified that the request for renewal has been denied. If the request for renewal is not properly filed by June 30, the license will expire and the licensee shall cease all work for which a valid license is required until such time as the license has been reinstated.

C. A licensee may request that an expired license be re-instated by submitting to MDEQ the required renewal form and paying the appropriate fee plus accumulated late fees. Failure to request re-instatement within one (1) year after the expiration date may be deemed a forfeiture of the reinstatement option. Any request for reinstatement submitted thereafter may require submittal of a new application and be subject to the examination requirement.

D. Restricted licensees requesting renewal must submit a written certification that they will continue to work only in accordance with the conditions of the restricted license.

VII. EQUIPMENT

All drilling rigs, water trucks, service vehicles and other vehicles used in the normal drilling, construction, completion, or reworking of wells and boreholes, and/or the installation of pumping equipment must have the name of the licensee (person, firm, or corporation), and the letters "MS Lic." with the appropriate license number prominently and legibly displayed on both sides of the vehicle. The letters and numerals shall be not less than two (2) inches in height and be placed on a background of contrasting color. Drill rigs shall be registered with MDEQ, for identification purpose only, by completing and submitting forms provided by MDEQ for that purpose.

VIII. STATE WELL REPORTS -- The State Well Report will include sections for a driller's log, a well completion report, and a well modification report. The driller's log portion of the report shall be completed by the licensed contractor and submitted to MDEQ for all drilled wells and boreholes that penetrate water bearing strata. Water well contractors drilling irrigation wells into the Mississippi River Valley Alluvial Aquifer (MRVA) shall furnish a copy of the driller's log to the YMD Joint Water Management District (YMD) at the same time the original report is submitted to MDEQ. Driller's logs will not be required for geo-technical boreholes less than twenty-five (25) feet in depth that do not encounter water bearing strata; environmental monitoring wells less than twenty-five (25) in depth that are regulated under other state and federal environmental programs; or small diameter wells or sampling holes less than fifty (50) feet in depth that are established with direct push (geo-probe) equipment. If a water well is developed and completed by a water well contractor immediately upon completion of drilling, both sections of the form shall be completed by the contractor and the report submitted to MDEQ within thirty (30) days after completion of the well. If for any reason a well is not developed and completed immediately upon completion of drilling, the following procedure shall be followed:

A. The driller's log section of the well report form provided by MDEQ shall be completed by the water well contractor who constructed the well or borehole and submitted to MDEQ within thirty (30) days after completion of drilling. For all water wells and boreholes, the driller's log section of the report must be signed by an appropriately licensed water well contractor. The driller's log entries on the report form shall be true, accurate, and complete. Portions of the form that may not be applicable shall contain an entry to that effect. Incomplete or inaccurate submittals will be returned to the licensee for completion or correction, but the 30-day filing period will not be extended. If the properly-executed form is not on file with MDEQ by the end of the 30-day period, the licensee will be deemed to be in non-compliance and may be subject to penalties as prescribed by statute and this regulation. The water well contractor filing the report shall keep a copy of the submittal and provide a copy to the owner of the well or borehole. For geotechnical investigations, the licensee may submit boring logs generated for a site report in lieu of the MDEQ form, provided the logs include all required information.

B. If a water well is completed by someone other than the water well contractor who constructed the well, the owner of the well shall be responsible for providing a copy of the state well report form containing the previously completed driller's log to the licensee responsible for completion of the well.

C. The licensee who develops and completes the well shall fill out the well completion section of the well report on the copy of the form containing the previously submitted driller's log and submit the completed report to MDEQ within thirty (30) days after completion of the well. For all water wells, the well completion section of the report must be signed by an appropriately licensed water well contractor. The entries on the report form relating to well completion shall be true, accurate, and complete. Portions of the form that may not be applicable shall contain an entry to that effect. Incomplete or inaccurate submittals will be returned to the responsible licensee for completion or correction, but the 30-day filing period will not be extended. If the properly-executed form is not on file with MDEQ by the end of the 30-day period, the licensee will be deemed to be in non-compliance and may be subject to penalties as prescribed by statute and this regulation. The water well contractor filing the report shall keep a copy of the submittal and provide a copy to the owner of the well.

D. The well modification report shall be filed with MDEQ by the licensed water well contractor within thirty (30) days after any major modification to, or rehabilitation of, an existing well six (6) inches or greater in diameter. The report shall include the water use permit number associated with the well and a detailed description of the work performed. When a well that does not comply with current construction standards requires major modifications or rehabilitation, the work shall include items necessary to bring the well up to current minimum standards set forth in paragraphs XI.A.1.(b.), (c.) and (d.)

IX. SUSPENSION / REVOCATION OF LICENSE

A. Grounds for the suspension or revocation of a license are as follows:

1. Providing false information in an application for a license or any affidavit required in the licensing process;

2. Violating any provision of Miss. Code Ann. Sections 55-5-1 et seq. or this regulation;

3. Attempting to obtain a license by fraud or misrepresentation;

4. Participating in fraudulent, deceptive, or dishonest business practices;

5. Demonstrated incompetency as a driller and/or pump installer;

6. Failure or refusal to file accurate and timely reports as required by this regulation; or

7. Failure to obey Orders, Rules and Regulations of the Commission, including refusal to accept or receive official correspondence from the Commission or its designee.

X. HEARINGS AND APPEALS

Procedures for hearings and appeals of Commission decisions are set forth in Miss. Code Annotated, Sections 51-5-7 and 51-5-9.

XI. DESIGN CRITERIA AND CONSTRUCTION STANDARDS -- The Licensee shall be responsible for compliance with all applicable state and federal statutes and regulations.

A. Water Wells and Boreholes Penetrating Aquifers In General Use For Domestic and PublicWater Supply -- The standards contained herein are the minimum construction standards considered necessary for the protection of the state's high-quality groundwater resources. Other regulatory programs may be applicable and additional standards may be required for certain types of facilities, such as Mississippi State Department of Health regulations governing public supply wells. If a water well contractor encounters geologic formations or unusual circumstances that appear to dictate a deviation from the standards, the contractor shall consult with MDEQ staff regarding proposed construction procedures for the water well or borehole in question.

1. Construction Standards – The following construction standards apply to wells and boreholes penetrating water bearing strata including but not

limited to, potable water wells, irrigation wells, monitoring wells, observation wells, underground discharge wells, dewatering wells, saline or brackish water withdrawal wells, contaminant recovery wells, heat pump water supply holes and vertical closed-loop system holes, industrial supply wells, cathodic protection wells, rig supply wells and geotechnical boreholes:

a. All water wells and boreholes covered under this section shall be constructed by a licensed water well contractor unless specifically exempted by statute.

b. Well casing shall terminate not less than twelve (12) inches above natural ground elevation or, where practicable, above the 100-year flood elevation. However, if flood levels around the well routinely exceed a reasonable height for an extended casing above the twelve (12) inch minimum, then the well shall be fully sealed with a Braden Casing Head, or approved equivalent, to prevent the flow of flood waters into the casing. The casing head shall contain a screw-in plug with a minimum diameter of one-half (1/2) inch to provide access for water level measurements. If the casing is not covered with a recorder box or pump housing, then it must have a locked, overlapping cover or other suitable cover capable of preventing unauthorized access to the casing head and access plug.

c. All wells shall have a check valve installed in the discharge line to prevent the intentional or accidental introduction of contaminants into the well. All new unmetered wells larger than six (6) inches in diameter shall have a minimum of four (4) feet of straight pipe installed between the casing head and the check valve, and all other equipment, valves, pressure relief valves, vacuum breakers, and distribution systems shall be connected on the discharge side of the check valve.

d. All wells, except approved underground discharge wells as specified in paragraph o. below, shall be constructed in such a manner that the finished ground elevations around the casing are sloped to drain away from the casing. Equipment such as engines, pressure tanks, or fuel tanks to be installed shall be placed on pre-cast concrete blocks or pads to prevent differential settlement that could result in damage to the pump and the well.

e. The annular space on all wells covered by this section of the regulation shall be grouted from a depth of at least ten (10) feet below the surface to the surface, except as specified in paragraphs f, h, i, j, k, l, n, and o below.

f. Wells located within one hundred (100) feet of a potential source of pollution such as sewers, septic tanks, landfills, and waste and raw material piles shall be grouted from a depth of at least fifty (50) feet below the land surface to the surface, except as specified in paragraphs h, i, j, k, l, n, and o below

g. Potable water wells shall not be constructed within 100 feet of any potential source of pollution.

h. Wells located within one-quarter mile of a known existing area of contaminated aquifer shall be grouted from the top of the water bearing stratum to the ground surface, or the top of the casing for underground discharge wells.

i. Outer casing for wells serving public water supply systems shall be grouted from the top of the target water bearing stratum to the ground surface.

j. Monitoring wells shall be grouted from the top of the seal or filter pack to the ground surface, unless a more stringent requirement is mandated by other applicable regulatory programs. Specifics of monitoring well construction shall follow the most stringent requirements of the applicable regulatory programs.

k. Cathodic protection wells shall be grouted from a depth of fifty (50) feet below ground surface to the ground surface. Wells constructed with granular material such as gravel from the top of the anodes to near the surface are prohibited. If wells are no longer used, the vent pipe, casing or other non-grouted openings shall be grouted from a depth of at least ten (10) feet below the ground surface to the ground surface.

l. For continuous lengths of grout not separated by multiple screens, grout shall be introduced in one continuous operation from the top of the water bearing stratum to the ground surface.

m. Grout for all holes covered under this section shall consist of either neat cement, cement grout, cement-bentonite mixture (5-8% bentonite), or bentonite. Bentonite pellets or bentonite chips may be added under free-fall conditions for depths not exceeding twenty-five (25) feet. Free-fall addition of any other type grout from the surface is prohibited. Granulated or pelletized bentonite may be placed to greater depths only if introduced through a tremie pipe.

n. All wells, regardless of size, which are drilled through or into aquifers containing chloride concentrations in excess of 250 milligrams per liter (mg/l) and/or total dissolved solids (TDS) concentrations in excess of

1000 milligrams per liter (mg/l), must be completed using metal casing. Furthermore, all such wells shall be completed using only the casing method of grouting (Halliburton method) to grout thoroughly the annular space from the bottom of the casing to ground surface or to the top of the casing for underground discharge wells.

o. Outer casing for underground discharge domestic wells shall be grouted from a depth of at least ten (10) feet below the top of the casing at the underground discharge head, or pitless adapter, to the top of the casing.

2. Disinfection

a. All water used in the drilling or construction process and in well development shall be clean and free of impurities that could contaminate water bearing sands penetrated by the well or borehole. For construction and development of a potable water well, water shall be obtained from a groundwater source of proven quality such as a domestic well or a public water supply system. If the water is obtained from a local public water supply distribution system, it need not have additional chlorine added during the drilling and/or construction process; otherwise, the water shall be chlorinated. A residual of free chlorine of not less than 5 parts per million (ppm) shall be maintained in any water used for well development.

b. Gravel to be placed in potable water wells shall be disinfected with a solution of at least 50 mg/l free chlorine. (Clean pre-packaged gravel is exempt from this requirement.)

c. Upon completion of drilling potable water wells, the well and adjacent aquifer shall be disinfected using a solution of at least 50 mg/l free chlorine applied for at least 24 hours. The procedure shall meet or exceed the American Water Works Association (AWWA) Standard current at the time of the activity.

d. After disinfection, the potable water well shall be pumped until a chlorine free sample is collected from the well. The sample also must be free of coliform bacteria. Samples shall be collected, submitted, and analyzed in accordance with applicable Mississippi State Department of Health requirements.

B. Water Wells and Boreholes Constructed in the Mississippi River Valley Alluvial Aquifer (MRVA) – The MRVA is a uniquely situated shallow aquifer used almost exclusively for agricultural irrigation with very little potential of increased demand for domestic or public water supply. Because of the unconsolidated nature of the material and the predominant agricultural water use, the drilling technique in general use for large diameter irrigation wells in the MRVA is reverse circulation rotary drilling. Consequently the standards for construction and disinfection have been modified slightly to reflect the water usage and drilling practices in the MRVA. If a water well contractor encounters geologic formations or unusual circumstances that appear to dictate a deviation from the standards, the contractor shall consult with MDEQ staff regarding proposed construction procedures for the water well or borehole in question.

1. Construction Standards -- The following construction standards apply to irrigation wells screened and completed in the MRVA and to boreholes that do not penetrate the base of the MRVA, including but not limited to, irrigation wells, monitoring wells, observation wells, and geotechnical boreholes:

   a. All water wells and boreholes covered under this section shall be constructed by a licensed water well contractor unless specifically exempted by statute.

   b. Well casing shall terminate not less than twelve (12) inches above natural ground elevation or, where practicable, above the 100-year flood elevation. However, if flood levels around the well routinely exceed a reasonable height for an extended casing above the twelve (12) inch minimum, then the well shall be fully sealed with a Braden Casing Head, or approved equivalent, to prevent the flow of flood waters into the casing. The casing head shall contain a screw-in plug with a minimum diameter of one-half (1/2) inch to provide access for water level measurements. If the casing is not covered with a recorder box or pump housing, then it must have a locked, overlapping cover or other suitable cover capable of preventing unauthorized access to the casing head and access plug.

   c. All wells shall have a check valve installed in the discharge line to prevent the intentional or accidental introduction of contaminants into the well. All new unmetered wells larger than six (6) inches in diameter shall have a minimum of four (4) feet of straight pipe installed between the casing head and the check valve, and all other equipment, valves, pressure relief valves, vacuum breakers, and distribution systems shall be connected on the discharge side of the check valve.

   d. All wells, except approved underground discharge wells, shall be constructed in such a manner that the finished ground elevations around the casing are sloped to drain away from the casing. Equipment such as engines, pressure tanks, or fuel tanks to be installed shall be placed on pre-cast concrete blocks or pads to prevent differential settlement that could result in damage to the pump and the well.

e. The annular space on all wells covered by this section of the regulation shall be grouted or sealed with bentonite from the lowest level of disturbed earth immediately adjacent to the casing down to a depth of at least ten (10) feet below that level, except as specified in paragraphs f. and g. below.

f. Wells located within one hundred (100) feet of a potential source of pollution such as sewers, septic tanks, landfills, and waste and raw material piles shall be grouted from the lowest level of disturbed earth immediately adjacent to the casing down to a depth of at least fifty (50) feet below that level, except as specified in paragraph g. below.

g. Wells located within one-quarter mile of a known existing area of contaminated aquifer shall be grouted from the lowest level of disturbed earth immediately adjacent to the casing to the top of the water bearing stratum.

h. Grout for all holes covered under this section shall consist of either neat cement, cement grout, cement-bentonite mixture (5-8% bentonite), or bentonite. Bentonite pellets or bentonite chips may be added under free-fall conditions for depths not exceeding twenty-five (25) feet.Free-fall addition of any other type grout from the surface is prohibited. Granulated or pelletized bentonite may be placed to greater depths only if introduced through a tremie pipe.

2. Drilling Fluids and Disinfection

A. All water used in the drilling or construction process and in well development for non-potable water wells in the MRVA shall be dosed to a minimum concentration of fifty parts per million (50 ppm) of chlorine, i.e., two (2) gallons of sodium hypochlorite (laundry bleach, approximately five percent (5%) available chlorine) per one thousand (1000) gallons of drilling water.

B. The licensee shall denote on the driller's log portion of the State Well Report the location of the source of any surface water used as well as the method of dosing and the volume of chlorine used in the drilling and development of a non-potable water well in the MRVA.

C. Equipment used in the transport, storage, or circulation of surface water during the drilling and development of a non-potable water well in the MRVA shall not be used thereafter in the drilling and development of a potable water well without having first been disinfected with a solution of at least fifty parts per million (50 ppm) free chlorine for a minimum contact time of twenty-four (24) hours.

XII. Maintenance and Service Criteria for Potable Water Wells

A. General – Installation of pumps and well equipment shall be in accordance with the manufacturer's recommendation and this regulation. All pumps and well equipment shall be designed and installed so as to prevent contamination of the well.

1. Licensing -- Pump installation shall be performed either by a Water Well Contractor holding an unrestricted license or by a restricted licensee who specializes in pump installation and well service.

2. Location of pressure tanks and switches -- Pressure tanks and switches located above ground shall be on a concrete slab or preformed pad or blocks. Tanks and switches installed below grade shall be in a concrete pit or basement designed to be adequately drained, unless approved for direct burial. A pressure tank may be buried provided the tank is designed for that type installation. Tanks to be installed inside the bore of a water well must be designed for that purpose and approved by the Commission.

2. Temporary seal -- If the pump and well equipment are not installed immediately upon completion of drilling, all openings to the well must be closed to prevent pollution or vandalism. After pump installation, all open spaces must be sealed off to prevent contamination of the ground water.

3. Drop pipe, wire, etc. -- All drop pipe, wire, pumps, and other pumping equipment to be installed in the well shall either be new or be disinfected with a solution of at least 50 mg/l free chlorine; and it shall be installed in such a manner as to permit removal and repair of all equipment. If equipment or tools are lost in the well and not recovered, a statement describing the item or items lost shall be attached to the well completion report submitted to MDEQ.

4. Prevention of contamination -- Pumping equipment shall be installed in such a manner as to prevent the entrance of contamination into the ground water. Discharge pipes shall be fitted with devices which will prevent the entrance of small animals.

5. Check valves -- Pumping equipment installed and used in conjunction with Chemigation, which is the practice of injecting agricultural chemicals into irrigation lines in order to mix and distribute the chemicals with the water flowing through the irrigation system, shall have either two check valves, or other means of backflow prevention as may be approved by MDEQ, installed between the well head and the point of introduction of any chemicals.

B. Submersible pump installation

1. Check valves -- Submersible Pumps shall have no less than 2 check valves installed. One check valve must be installed above ground.

2. Wire -- Wire shall be secured to the drop pipe in a manner which will support the weight of the wire and keep the wire close to the pipe.

3. Clamps -- All clamps used shall be all stainless steel.

C. Jet pump installation

1. Check valves -- Jet Pumps shall have a check valve installed on the discharge side of the pressure tank.

2. Clamps -- All clamps used shall be all stainless steel.

D. Turbine pump installation

1. Steel column pipe for line shaft turbine pumps – Steel column pipe for turbine pump irrigation wells shall be standard weight flanged or threaded steel pipe.

2. Plastic column pipe may be used for turbine pump installation provided the pipe is designed and manufactured for that purpose.

E. Pressure systems -- All pressure systems will have a pressure relief valve installed between the well seal and pressure switch.

F. Power and control wiring -- Licensees may run power and control wiring from a disconnect box to water well equipment. A license issued pursuant to this regulation does not authorize the licensee to alter the existing electrical service to any building or structure or perform any other electrical work covered by the National Electric Code (NEC) or local building codes.

XIII. Decommissioning of Abandoned or Unused Water Wells and Boreholes

A. Applicability

1. Except as stated in paragraph B. below, the standards for decommissioning abandoned or unused water wells and boreholes apply to all abandoned water wells and to all boreholes that penetrate water bearing

strata or are greater than twenty-five (25) feet in depth including potable water wells, agricultural wells, monitoring wells, observation wells, dewatering wells, relief wells, saline or brackish water withdrawal wells, contaminant recovery wells, heat pump water supply wells and closed-loop system holes, industrial supply wells, rig supply wells, geotechnical boreholes, cathodic protection wells and pilot boreholes.

2. All wells and boreholes that penetrate water bearing stratum with a depth of 25 feet, or greater, below land surface must properly be decommissioned by a water well contractor licensed by MDEQ. Water wells less than 25 feet in depth below land surface may be plugged by someone other than a licensed water well contractor. However, the same procedures and reporting requirements apply regardless of who plugs the well.

3. If approved and accepted in writing by MDEQ, properly cased and sealed wells may be provided with a locking cover capable of preventing the entrance of contaminants and used as monitoring wells or observation wells in lieu of abandonment. If the use of an observation or monitoring well is later discontinued by MDEQ, the landowner/permittee shall be responsible for having the well properly decommissioned by a licensed water well contractor .

B. <u>Exemptions</u>

1. Exemption from this regulation does not relieve the owner of the responsibility for identifying and complying with other applicable local, state, and federal regulations. The following types of wells and boreholes are exempt from decommissioning requirements set forth in this regulation:

   a. Saline water wells associated with enhanced oil and gas recovery operation, brine withdrawal wells, and other types of on-site oil and gas well holes, including Class II wells regulated under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. Sections 6901 et seq.;

   b. Class I, III, IV and V injection wells regulated under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. Sections 6901 et seq.; and

   c. Geotechnical boreholes less than twenty-five (25) feet in depth that do not penetrate water bearing strata and boreholes drilled in planned roadbed construction areas where the natural overburden will be removed to within twenty-five (25) feet of the bottom of the hole.

C. Types of Abandoned or Unused Wells--A water well may be considered by MDEQ to have been abandoned if its use has been permanently discontinued; if the well has not been used in the preceding 12 months (except for established rotations of pumping equipment between wells related to crop irrigation and instances where the owner has notified MDEQ of an anticipated longer period of nonuse after which the well will be placed back in service.); if the pumping equipment has been removed (except for established rotations of pumping equipment between wells related to crop irrigation); or if the well cannot be repaired. Rig supply holes, geotechnical boreholes, pilot holes, and dewatering holes are considered abandoned immediately upon completion of the project phase for which they are drilled, unless the well is an integral part of the continued operation of the project, such as a pressure relief well or a permanently used dewatering well.

D. Time allowed for plugging --Rig supply wells, pilot holes, and geotechnical boreholes shall be plugged within 30 days after abandonment or cessation of use. All other holes shall be plugged within 180 days after abandonment or cessation of use.

E. Decommissioning forms -- Abandonment and plugging of water wells and boreholes shall be reported on a decommissioning form approved by and made available from MDEQ. The person or contractor who plugs an abandoned water well or borehole shall submit the decommissioning form to MDEQ within 30 days after completion of the plugging. For irrigation wells located in the MRVA, a copy of the form shall be submitted to YMD at the same time the original is submitted to MDEQ. Reporting the abandonment and plugging of multiple water wells and/or boreholes on one form may be permissable, with prior approval from MDEQ, provided the same decommissioning procedure was used and the location of each water well and/or borehole is clearly identified.

F. Decommissioning Procedures – The following procedures shall be followed in the decommissioning of any water well or borehole for which decommissioning is required under this regulation:

1. Grout for all holes shall consist of neat cement, cement grout, cement-bentonite mixture (5-8% bentonite), or bentonite. Bentonite pellets may be added under free-fall conditions for depths not exceeding twenty-five (25) feet, providing pellets are placed in layers not more than five (5) feet deep and tamped into place after addition of each layer. Granulated or pelletized bentonite may be placed to greater depths if introduced through a tremie pipe. Free-fall addition of other types of grout from the surface is prohibited;

2. Obstructions shall be removed from the well casing;

3. If there is reason to question the physical integrity of the well casing because of the age of the well or the material used for the casing, or there are no records to indicate that the annular space was grouted properly during construction of the well, the driller shall consult with MDEQ before plugging the well. In such instances, MDEQ may require that the casing be perforated to allow the introduction of grout into cavities or voids that may have formed outside the casing; or may require that the casing be removed from the hole prior to grouting;

4. For abandoned water wells in agricultural fields, the casing shall be cut off and removed down to a minimum depth of three feet below land surface. After grouting, the excavation shall be filled with compacted soil. In other areas, the casing shall be cut off and removed at least down to the ground surface elevation. MDEQ may authorize alternate methods of abandonment and/or abandonment by other than a licensed water well contractor, provided the results will meet the intent of the regulations. Only detailed written requests to utilize an alternate method of abandonment or to abandon a well without utilizing a licensed water well contractor shall be considered for approval. If approved, MDEQ will provide written authorization to the requestor.

5. Abandoned water wells or boreholes shall be sealed from the bottom of the hole to ground surface using a grout as described in paragraph 1. above.

6. MDEQ may authorize alternate methods of abandonment and/or abandonment by other than a licensed water well contractor, provided the results will meet the intent of the regulations. Only detailed written requests to utilize an alternate method of abandonment or to abandon a well without utilizing a licensed water well contractor shall be considered for approval. If approved, MDEQ will provide written authorization to the requestor.

XIV. <u>ENFORCEMENT</u>

Enforcement of these regulations shall be governed by Miss. Code Ann. Sections 51-5-7 and 51-5-17, and Sections 49-17-31 through 49-17-43.

XV. <u>CORRESPONDENCE AND ADEQUACY OF NOTICE</u>

A. <u>General</u> -- All permittees and licensees shall inform MDEQ of any address changes within fifteen (15) days of any change of address, and must readily accept all mail sent to them from the Commission, MDEQ, or the Permit Board.

B. Registered or certified mail -- Registered or Certified Mail sent with proper postage and to the last address provided to MDEQ by the permittee or licensee shall be considered adequate notification of notice served if MDEQ is notified that the mail was delivered and accepted or if the mail is returned as rejected or unclaimed by the addressee.

C. Refusal to accept mail -- Refusal to accept mail from the Commission, the Permit Board, the Department, or its designee, shall be considered a violation of this regulation.

XVI. CONFIDENTIAL INFORMATION

Procedures for declaring submitted information confidential and for agency handling of such information are found in Miss. Code Ann., Section 49-17-39, Section 51-3-44, and the Commission's Regulations Regarding the Review and Reproduction of Public Records (MCEQ-2).

ARCADIS

Appendix D

Laboratory QAM

The laboratory Quality Assurance Manual (QAM) will be provided when the analytical laboratory is selected.

ARCADIS

Appendix C

Site-Specific Health and Safety Plan

ARCADIS

Infrastructure · Water · Environment · Buildings

Imagine the result

Proposed Site-Specific Health and Safety Plan

Kuhlman Electric Corporation Facility

15 March 2011

ARCADIS

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Environmental Scientist II
Designated H&S Plan Writer

Kimberly A. Golden
Principal Scientist
Designated H&S Plan Reviewer

George H. Cramer
Associate Vice President/Principal Hydrogeologist
Project Manager

Site-Specific Health and Safety Plan

Kuhlman Electric Corporation Facility

Prepared by:
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Our Ref.:
LA002889.0001.00001

Date:
15 March 2011

ARCADIS

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Tables

Appendices

1. Emergency Contact Information and Procedures

Local Police Crystal Springs Police Department *108 W Railroad Avenue South, Crystal Springs, MS*	911 and (601) 892-2121
Local Ambulance Hazelhurst Ambulance Service *233 Magnolia Street, Hazelhurst, MS*	911 and (601) 894-2222
Local Fire Department Crystal Springs Fire Department *200 West Marion Avenue, Crystal Springs, MS*	911 and (601) 892-1313
Local Hospital Hardy Wilson Memorial Hospital *233 Magnolia Street, Hazelhurst, MS*	911 and (601) 894-4541
Local Weather Data	Weather.com
Poison Control	(800) 332-3073
National Response Center (all spills in reportable quantities)	(800) 424-8802
U.S. Coast Guard (spills to water)	(800) 424-8802
Project Manager –	TBD
Project H&S Manager –	TBD
Client Contact –	TBD
WorkCare	1 (800) 455-6155

Directions to Hardy Wilson Memorial Hospital

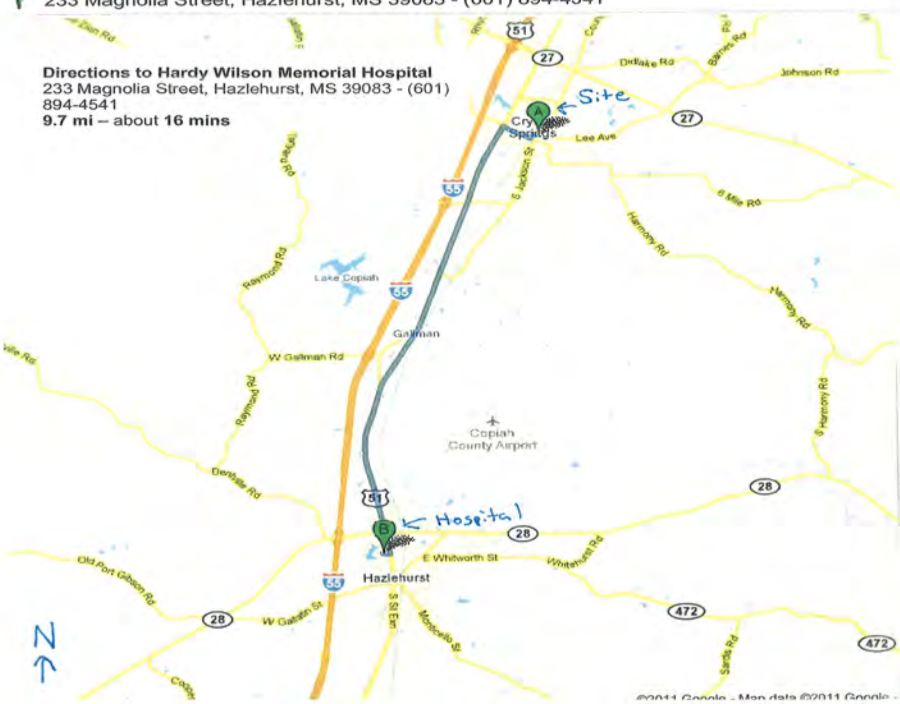
Medical Facility:	Hardy Wilson Memorial Hospital
Address:	233 Magnolia Street, Hazelhurst, MS
Phone Number:	(601) 894-4541

Hospital Route

A 101 Kuhlman Dr, Crystal Springs, MS 39059

1.	Head **west** on **Lee Ave** toward **E Railroad Ave**	go 328 ft total 328 ft
2.	Turn left at **E Railroad Ave**	go 479 ft total 0.2 mi
3.	Take the 1st right onto **W Georgetown St** About 1 min	go 0.5 mi total 0.6 mi
4.	Turn left at **US-51 S** About 13 mins	go 8.9 mi total 9.6 mi
5.	Turn right at **Magnolia St**	go 0.1 mi total 9.7 mi

B **Hardy Wilson Memorial Hospital**
233 Magnolia Street, Hazlehurst, MS 39083 - (601) 894-4541



Emergency Notification Procedure for the project:

Step 1: Dial 911 (if necessary) and/or Hospital/Work Care
Step 2: Project Manager: TBD
Step 3: Project H&S
Step 4: Client H&S Contact: TBD

Emergency Supplies and Equipment List

Emergency Supplies and Equipment (check all that apply)	**Location on Project Site**
☒ First Aid Kit (type):	Office, vehicles
☒ Fire Extinguisher	Vehicles, office, treatment units
☒ Mobile Phone ☐ Satellite Phone	On person
☒ Traffic Cones	To be used as needed when conducting work near roadways
☐ Walkie Talkies	
☒ Water or Other Fluid Replenishment	Vehicle, office
☒ Eye Wash/Quick Drench Station	Project trailer, office
☒ Eye Wash Bottle	Vehicle
☒ Wash and Dry Towelettes	Optional
☒ Sunscreen (SPF 15 or higher)	optional
☒ Insect Repellant	TBD/ needs PM approval if
☒ Chemical Spill Kit	Project storage
☒ *Other (specify):OVA, Summa® canisters, Dräger Tubes and Pump*	Project trailer or Site Safety Officer

2. Introduction

All work on this project will be carried out in compliance with ARCADIS U.S., Inc.'s (ARCADIS') Health and Safety Standards and the Occupational Safety and Health Administration's Hazardous Waste Operations and Emergency Response regulation. The design of this Health and Safety Plan (HASP) conforms to the requirements of the ARC HSFS010-H&S Plan Standard. Specific health and safety (H&S) information for the project is contained in this HASP. All personnel working on hazardous operations or in the area of hazardous operations shall read and be familiar with this HASP before doing any work. All project personnel shall sign the certification page acknowledging that they have read and understand this HASP.

Subcontractors will be given copies of this plan and will be required, at a minimum, to follow the procedures described herein. Subcontractors will also be required to develop more extensive HASPs for the activities for which they are responsible. The subcontractor's HASP shall meet at a minimum this HASP. The subcontractor shall review this HASP and in the event that there are any inconsistencies, deviations, or other differences between the subcontractor's plan and this HASP, such inconsistencies, deviations, or other differences shall be identified by the subcontractor. Site Safety Officer (SSO) shall review the subcontractor's plan. However, such review or failure to object to the subcontractor's plan shall not in any manner be a representation that the subcontractor's plan is sufficient for the subcontractor's work.

To the extent possible, all contractors and subcontractors and the Project H&S staff will work together to develop adequate procedures where inconsistencies, deviations, or other differences occur prior to the initiation of that activity. ARCADIS claims no responsibility for the use of this HASP by others although other subcontractors working at the site may use this HASP as a guidance document. In any event, ARCADIS does not guarantee the health and/or safety of any person entering this site. Strict adherence to the H&S guidelines provided herein will reduce, but not eliminate, the potential for injury at this site. To this end, H&S becomes the inherent responsibility of personnel working at the site.

This proposed HASP has been prepared to obtain project approval from the State of Mississippi Department of Environmental Quality (MDEQ) and the client. After final approval is given, the proposed Corrective Action Plan (CAP) states a pilot study will be conducted to gather the necessary information for a full-scale design of the remedial system. This proposed HASP will be revised to include the detailed design information, prior to initiating work on the pilot study or the full-scale remediation project.

Changes in the scope of the project or introduction of new hazards to the project shall require revision of the HASP by the HASP writer and reviewer and approval by the Project Manager. The HASP Addendum Form and log table are included as Appendix A.

3. Project Site History and Requirements

3.1 Site Background

The Kuhlman Electric Corporation (KEC) facility was constructed in the 1950s and has operated as an electric transformer manufacturing plant since that time. The future use of the property is expected to remain industrial. This is a transformer manufacturing facility that, in the past, used polychlorinated biphenyls (PCBs) as a temperature control agent in the transformer oil. In 1999, Borg Warner Inc. (BW) acquired the Kuhlman Corporation, including its KEC subsidiary located in Crystal Springs, Mississippi. In April 2000, it was determined that PCBs had been released from the Crystal Springs KEC facility. BW sold KEC, including the KEC Crystal Springs facility, 7 months after purchasing and prior to the discovery of PCB-impacted soil. On behalf of KEC, BW has been engaged in extensive remediation at the site since the discovery of the PCB impacts under the direction of MDEQ with input from the U.S. Environmental Protection Agency.

A CAP was prepared in response to the Mississippi Commission on Environmental Quality Order No. 4449-02, issued to KEC on July 23, 2002. A preliminary groundwater assessment was performed at the KEC facility in 2004 (Martin & Slagle 2004) and was followed by a comprehensive assessment completed in 2009 (Martin & Slagle 2009). The assessments found that PCBs were not migrating to groundwater but that certain volatile organic compounds (VOCs) associated with the manufacturing processes were (notably, 1,1,1-trichloroethane [1,1,1-TCA], 1,1-dichloroethene [1,1-DCE], and 1,4-dioxane). The assessments identified a VOC plume extending southwest from the KEC facility.

As described in the groundwater assessment report (Martin & Slagle 2009), the source of groundwater contamination at the KEC site has been identified beneath the southwest corner of the KEC manufacturing building. Soil beneath the floor slab in this area contains the following chemicals of concern (CoCs): 1,1,1-TCA, 1,1-DCE, 1,4-dioxane, and PCBs. It appears that the PCBs have remained directly underneath the slab and have not migrated with the 1,1,1-TCA, 1,1-DCE and 1,4-dioxane plume. Contaminants have migrated downward through unconsolidated sediments to groundwater. Contaminant migration has continued via the groundwater flow pathway off the facility property to the southwest with a portion of the plume also moving south. The 1,1-DCE plume extends approximately 2,800 feet southwest and 2,600 feet south of the KEC property boundary. The smaller 1,4-dioxane and 1,1,1-TCA plumes are contained within the limits of the 1,1-DCE plume.

3.2 Site Description

Site Type: (Check as many as applicable)

X	Active	X	Secure	X	Industrial		Landfill		Service station
	Inactive		Unsecured		Commercial		Well field		Water work
			Uncontrolled		Residential		Railroad		Undeveloped
Other specify: Transformer Manufacturing Plant									

The KEC plant is located at 101 Kuhlman Drive, Crystal Springs, Copiah County, Mississippi 39059, at Latitude N 31° 15' 20" and Longitude W 90° 21' 20". The site is located within the town limits of Crystal Springs. The town center is located south of the plant approximately 0.25 mile.

The KEC property is bordered to the south by commercial businesses and residences located across Lee Street. The property is bordered to the west by a railroad line and residences. To the northwest is a vacant lot formerly occupied by an icehouse, and residences are located to the northeast. East of the plant and abutted to the property are residences and one funeral home. The residences are all single-family dwellings with individual yards. The single-family dwellings extend for several blocks in all directions except north. At least one church and a public swimming pool are located within two blocks of the site to the east. The predominant land uses in the surrounding area are commercial, former industrial, institutional, and residential.

The KEC property consists of a manufacturing plant building situated on about 15 acres of land. The site ground cover consists of grass, concrete, and asphalt pavement.

The primary CoCs on this project are:

Known Compounds	Source (soil/water/drum, etc.)	Known Concentration Range (µg/L)	
		Lowest	Highest
1,1,1-Trichloroethane	Groundwater	1.1	20
1,1-Dichloroethene	Groundwater	1.1	240
1,4-Dioxane	Groundwater	1.2	68
Polychlorinated Biphenyls	Groundwater	N/A	N/A

N/A Not available.
µg/L Microgram per liter.

3.3 List of Proposed Project Tasks and Scope of Work

Task 1 – Pre-construction Activities: Soil Vapor Extraction (SVE) and Air Sparging (AS) remediation systems to remediate groundwater conditions at the KEC site will be installed. Pre-construction activities include initial personnel mobilization, project kick-off meetings, site boundary delineation, establishing communication protocol, work zone design, equipment delivery, utility locates, and other activities that facilitate the start-up phase of the project. Project management will initiate and complete the above tasks prior to starting any project setup activities. Management will ensure a General Storm Water Construction Permit is obtained during this phase of the project. Air permits may be required for the operation of the SVE/AS system. Project management will facilitate the acquisition of the required air permit or, if applicable, an exemption from the state;

Task 2 – Proposed Project Setup: Site setup activities will be coordinated with key KEC facility personnel. Initial setup activities include the delineation of the remedial system work zone and constructing the support, contamination reduction, and exclusion zones. Prior to any grading or construction activities, the work zone will be set up so site access is controlled by appropriate personnel. The site will be designed so that all persons entering and exiting the remedial system work zone do so through one entrance. The project team will determine how to track associates on site, but at a minimum, a sign-in and sign-out sheet will be used to track associates working inside the SVE and AS remedial system work zone. When site control is established, the project will begin construction tasks to prepare the work zone for the SVE and AS system installation. The ground surface will be cleared of any debris or obstructions inside the area designated as the footprint for the SVE and AS system. If needed, the surface will be graded around the SVE and AS system to ensure stability and adequate storm water runoff. Erosion controls measures will be installed, (i.e., silt fencing, straw waddling, hay bales, turbidity curtain), if deemed necessary, depending on construction techniques. Considerable amounts of surface alterations can expose surface water runoff at the KEC facility to increased concentrations of suspend solids. In turn, elevated suspended solids can negatively affect the storm water discharging from KEC and ultimately to waters of the state. Routine site inspections will ensure erosion control measures are adequately managing runoff from the SVE and AS system work zone during setup activities. Project management will ensure that all setup activities are complete prior to starting the remedial system installation;

Task 3 – SVE and AS System Installation: SVE and AS remedial systems will be installed to treat the CoCs in groundwater at the KEC site. Installation of the SVE and

AS system will include documenting project progression, completing “as built” drawings, and developing an operation and maintenance plan.

Site conditions have inherent hazards associated with the CoCs identified in groundwater at the KEC site. Project manager and/or SSO will conduct air monitoring activities during the installation of the SVE and AS system to ensure both project and plant personnel are not exposed to VOC concentrations above the American Conference of Government Industrial Hygienists established time weighted averages (TWAs). Air monitoring activities will dictate personal protective equipment (PPE) usage and upgrades to ensure both project and plant personnel are not exposed to VOC levels above regulated action levels and do not approach conditions near established short-term exposure levels, or conditions immediately dangerous to life and health. Air monitoring on site will also use five-gas meters, which have the ability to monitor the lower explosive limit (LEL) and oxygen (O_2) levels. Five-gas meters will be used to clear any confined spaces, excavations, and/or structures that have the potential to collect flammable or combustible vapors prior to entry.

Air monitoring activities during installation of the SVE and AS system will use both personal and area air monitoring techniques. Personal air monitoring activities will ensure project personnel performing the SVE and AS system installation are not exposed to VOC concentrations above established TWAs. Area air monitoring efforts will confirm that no VOCs are migrating from the remediation site into KEC work zones. Air monitoring efforts at the KEC remediation site will use a combination of passive, active, personal, and area air monitoring techniques to ensure site conditions are properly monitored.

Passive personal air monitoring will be conducted with organic vapor badges. A representative number of associates working on the installation activities will wear the organic vapor badges. The representative number of associates wearing organic vapor badges will be based on information derived from the pilot study and full-scale design. The Project Manager and/or SSO will determine what tasks are to be conducted daily. At a minimum, one organic vapor badge will be used for each task that has the potential for VOC vapors. The Project Manager and/or SSO will prepare an air monitoring schedule. Project management will submit the organic vapor badges to an accredited laboratory for analysis. Based on the analytical results, project management may decide to reduce or increase both the frequency of usage and/or the percentage of associates wearing organic vapor badges during the installation phase.

Active area air monitoring activities will be conducted by the Project Manager and/or SSO. Although the instrument of choice may vary depending on project preferences, at a minimum a portable Organic Vapor Analyzer (OVA) will be used. Portable OVA monitors such as a photoionization detector (PID) or flame ionization detector will be selected by project management. Portable OVAs will be used daily, focusing on areas surrounding the installation activities. If the OVA indicate atmospheric conditions on site have VOC concentrations above the project established action level, Stop Work Authority (SWA) will be used immediately and all site personnel will clear the area. SWA will remain in effect until the Project Manager and/or the SSO clears the site for work to continue. Prior to continuing work, the SSO will use an OVA to determine if the area is clear or if PPE needs to be upgraded to the next level. All PPE upgrades will be based on the constituent with the lowest action level.

If the project team chooses to use air monitoring equipment that can differentiate the specific atmospheric concentration of each constituent separately (i.e., Dragger tubes), the SSO will base site PPE usage on the atmospheric concentrations of each individual constituent determined present on site. If Dragger tubes are used at the site, the SSO will ensure the chemical-specific tubes are used to determine precise atmospheric concentrations of specific constituents identified at the KEC site. If Dragger tubes or a like product are not used, the OVA monitor will be calibrated to site-specific CoCs.

During the installation of the SVE and AS remediation system, it is important to ensure KEC plant personnel are not exposed to VOC concentrations above the established TWAs. In order to ensure KEC personnel are not exposed to harmful levels of VOCs, area and personnel air monitoring will be conducted at the KEC site. Air monitoring activities will be designed to identify VOC concentrations inside KEC work zones which migrated from the remediation site. Area air monitoring locations and schedule will be determined by the Project Manager and/or SSO.

To conduct the necessary active area air monitoring, Summa® canisters or long-term real time monitors will be used. Summa® canisters will accurately determine whether VOCs are migrating from the work site into KEC work zones. However, because of the design and nature of Summa® canisters, turnaround on analytical results can vary from laboratory to laboratory. The project team may decide to use a combination of both real-time perimeter monitors and strategically placed Summa® canisters for optimal coverage.

If key project personnel determine that another method of personnel and/or area air monitoring is preferable, the HASP will be amended and the project will continue with the newly selected monitoring methods. After an established pattern of air monitoring data is available and evaluated, project personnel may decide to increase or reduce the number and/or frequency or personnel and areas monitored. However, any changes in project air monitoring must be approved by the project management team, the KEC facility, and, if applicable, MDEQ.

Task 4 – SVE and AS System Operation and Maintenance*:* At the completion of the SVE and AS remedial system installation, all unnecessary tools, equipment, and project personnel will be demobilized. Appropriate staff will manage, operate, and maintain the SVE and AS remedial system at the KEC facility. All necessary maintenance activities to ensure the SVE and AS system continues to operate optimally, safely, and efficiently will be conducted. Periodic sampling of KEC groundwater conditions will be conducted at a frequency determined by project management and MDEQ to determine the effectiveness of the remedial system. The SVE and AS remedial system will continue to operate at the KEC facility until site groundwater conditions are deemed to have VOC concentrations below regulated action levels and/or established project remediation goals.

Task 5 – SVE and AS System Decommissioning: When project management, KEC, and MDEQ determine all project goals have been met, the SVE and AS remedial system will be decommissioned. All equipment will be removed from the KEC facility and the work zone will be returned to its original state. When project management and KEC facility staff determine all decommissioning tasks have been completed, the field portion of the project will be closed out. The H&S risks associated with this task are not covered by this HASP. An addendum to this HASP or a new HASP would be prepared prior to decommissioning the system.

4. Project Organization and Responsibilities

4.1 All Personnel

Each person is responsible for completing tasks safely and reporting any unsafe acts or conditions to their supervisor. No person may work in a manner that conflicts with these procedures. Prior to initiating site activities, all personnel will receive training in accordance with applicable regulations and be familiar with the requirements and standards referenced in this HASP. In addition, all personnel will attend daily safety meetings (tailgate meetings) to discuss site-specific hazards prior to beginning each day's work. Every employee, subcontractor, and client representative at the site has the responsibility to stop the work of a coworker or subcontractor if the working conditions or behaviors are considered unsafe.

4.2 Project Manager/Task Manager

The Project Manager is responsible for verifying that project activities are completed in accordance with the requirements of this HASP. The Project Manager is responsible for confirming that the project has the equipment, materials, and qualified personnel to fully implement the safety requirements of this HASP and/or that subcontractors assigned to this project meet these requirements. It is also the responsibility of the Project Manager to:

- Review all applicable H&S Standards, and ensure that project activities conform to all requirements;
- Obtain client-specific H&S information and communicate with the client on H&S issues;
- Communicate with the SSO on H&S issues;
- Allocate resources for correction of identified unsafe work conditions;
- Ensure all site workers have all training necessary for the project;
- Ensure air monitoring is conducted and documented correctly; and
- Report all injuries, illnesses, and near-misses to the client representative, lead incident investigations, and ensure that any recommendations made are implemented.

4.3 Site Safety Officer

The SSO has overall responsibility for the technical H&S aspects of the project. Inquiries regarding project H&S standards, project procedures, and other technical or regulatory issues should be addressed to this individual. It is also the responsibility of the SSO to:

- Review and work in accordance with the components of this HASP;

- Ensure that work is performed in a safe manner and has authority to stop work when necessary to protect workers and/or the public;
- Ensure that this HASP is available to and reviewed by all site personnel including subcontractors;
- Ensure that necessary site-specific training is performed (both initial and “tailgate” safety briefings);
- Ensure site visitors have been informed of the hazards related to project work;
- Coordinate activities during emergency situations;
- Conduct area and personal air monitoring with calibrated equipment following a documented air monitoring schedule;
- Communicate with the PM on H&S issues;
- Report all injuries, illnesses, and near-misses to the PM; and
- Ensure that necessary safety equipment is maintained and used at the site.

The SSO will contact an H&S professional for assistance in establishing the respiratory cartridge change schedule as required.

5. Project Hazards and Control Measures

5.1 Hazard Analysis

Table 1. Hazard Ranking Chart

	Consequence		Probability				
	Property Damage	Injury	Frequent	Likely	Occasional	Seldom	Unlikely
Severity	> $100,000	Fatality	H	H	H	H	M
	> $10,000	Injury Requiring Hospitalization	H	H	H	M	L
	> $1000	Injury Requiring Medical Treatment Beyond First Aid	H	M	M	L	L
	< $1000	Injury Requiring First Aid	M	L	L	L	L

H High.
M Medium.
L Low.

☐ Hazards are ranked using the ARCADIS Hazard Ranking Chart Process: ARC HSMS002

Biological		***Mechanical***		***Chemical/Radiation***	
M	Biting/stinging insects	M	Cuts on equipment/tools		Not applicable
	Biting animals	M	Pinch points on equipment	M	General
	Poisonous plants	L	Burns from equipment		Dusts, toxic
	Phys. damaging plants	M	Struck by equipment	M	Dusts, nuisance
L	Bacteria				Chemicals, project use
Driving		***Motion***			Chemicals, corrosive
	Night driving	M	Lifting/awkward body positions	M	Chemicals, explosive
L	Off-road driving	M	Struck by vehicle/traffic	M	Chemicals, flammable
M	Urban driving				Chemicals, oxidizing
	All terrain vehicle	***Personal Safety***		M	Chemicals, toxic
	Boat		Working late/night		Chemicals, reactive
			Working alone		Radiation, ionizing
Electrical			High crime area		Radiation, non-ionizing
M	Wet environments				
M	Electrical panels	***Pressure***		***Compound Specific***	
M	Electric utilities	M	Utilities (gas, water, etc)		Asbestos
M	Electric power tools	L	Compressed gas cylinders		Benzene
		TBD	Compressed air/aerosols		Cadmium
Environment		M	Hydraulic systems		Hydrogen sulfide
M	Heat				Lead
L	Cold	***Sound***			Silica

L	Lightning	M	Equipment noise		
M	Inclement weather	L	Tool noise	***Gravity***	
L	High wind	L	Traffic noise (vehicle/train/etc)	M	Slip, trip, fall
					Fall from height
					Ladders or scaffolds
					Struck by falling object

TBD To be determined.
H High.
M Medium.
L Low.

5.2 Job Loss Analyses (JLAs), H&S Standards, and Personal Protective Equipment

At the time the project is initiated, the SSO will develop JLAs for each safety critical task and will include them in Appendix B. The SSO will determine the project's JLA needs and will develop JLAs on an as-needed basis. An example JLA has been included in Appendix B.

Hazards identified in the table above will be addressed specifically in the JLAs as well as control methods to protect employees and property from hazards. The JLA also lists the type of PPE required for the completion of the project. A detailed list of PPE for the project is located in Appendix C.

Project H&S Standards are listed below. These standards should be reviewed by the project manager, task manager, and site personnel. The Client H&S Resource should be contacted with any questions concerning the standards.

- Control of Hazardous Energy (Lockout/Tagout);
- Excavation and Trenching;
- Equipment Safety – including hand tools;
- HAZWOPER Work;
- Signs, Signals, and Barricades;
- Utility Location Procedures;
- Concrete and Masonry Construction;

- Demolition;
- Excavation and Trenching;
- Heavy and Mechanized Equipment;
- Power Transmission and Distribution;
- Underground Construction, Compressed Air; and
- Welding, Cutting, and Other Hot Work.

5.3 Field Health & Safety Handbook

The Field H&S Handbook (FHSHB) is a document containing information about topic-specific H&S requirements for the field. This handbook contains relevant general topics and is used as part of the overall HASP process. To aid in the consistency of the HASP process, the handbook will be used as an informational source in conjunction with this HASP.

The following handbook sections are required reading for this project:

- Section II: Title E – Hazard Identifications, Risk Assessment and Risk Control Process;
- Section II: Title F – Incident Reporting and Investigation;
- Section II: Title G – Near-Loss/Miss Reporting;
- Section II: Title H – Stop-Work Authority;
- Section II: Title L – Emergency Action Planning;
- Section II: Title P – Recordkeeping and Postings;
- Section III: Title A – Daily Safety Meetings/Tailgates;
- Section III: Title B – DOT - Hazardous Materials Transportation/Dangerous Goods;

- Section III: Title C – First Aid/Cardiopulmonary Resuscitation;
- Section III: Title E – General H&S Rules and Safe Work Permits;
- Section III: Title F – General Housekeeping, Personal Hygiene and Field Sanitation;
- Section III: Title G – Site Security, Work Zones and Decontamination for HAZWOPER Sites;
- Section III: Title J – Fire Prevention;
- Section III: Title L – Noise;
- Section III: Title N – Biological Hazards;
- Section III: Title R – Personal Protective Equipment;
- Section III: Title Z – Control of Hazardous Energy;
- Section III: Title AA – Electrical Safety;
- Section III: Title HH – Compressed Gas Cylinder Handling, Storage and Use
- Section III: Title KK – Signs, Signals and Barricades;
- Section III: Title MM – Utility Location;
- Section IV: Title D – Excavation/Trenching;
- Section IV: Title E – Heavy Equipment;
- Section IV: Title H – Concrete;
- Section IV: Title I – Demolition;
- Section IV: Title K – Welding and Cutting;

- Section IV: Title P – Power Distribution;
- Section IV: Title Q – Permit to Work;
- Section V: Title H – Process Safety Management; and
- Section V: Title D – Industrial Hygiene and Monitoring Equipment.

5.4 Project-Specific Hazards

5.4.1 Soil Vapor Extraction Hazards

There are multiple safety concerns and hazards associated with SVE systems. The hazards associated with SVE systems are physical, chemical, and biological. The information below breaks down the hazards in separate categories to highlight the necessary steps that must be taken to safely operate SVE remedial systems.

Physical hazards associated with SVE systems include:

- During the excavation of trenches and installation of horizontal piping systems, workers may be seriously injured or killed by heavy equipment such as front-end loaders and scrapers operating in their work areas. This equipment may also generate excessive noise during operation. Heavy equipment should be equipped with a backup alarm that alerts workers. When approaching operating equipment, the approach should be made from the front and within view of the operator, preferably making eye contact and using hand signals. Hearing protection should be used.

- Fire or explosion hazards may exist should excavation equipment rupture an underground utility such as electrical or gas lines during installation of the system. To control utility contact hazards, identify the location of all below- and above-ground utilities. Contact local utilities and public works personnel to determine the locations of utilities. In addition, sound policy requires, at least two other methods of locating underground utilities are required to have three lines of evidence needed prior to excavation. These may include contracting a third party to conduct a utility survey, probing with a metal rod or hand-excavating to determine the exact location of utilities prior to drilling, potholing with air, using high-pressure water, or using other acceptable locating methods. Once utilities are located, careful excavation by backhoe may be allowed.

- During the transfer of flammable gas from the extraction wells or subsurface piping systems to the treatment unit, a fire or explosion hazard may exist. The gas may be ignited by improperly selected or installed equipment. Verify that the hazardous area classifications, as defined in National Fire Protection Agency (NFPA) 70-500-1 through 500-10, are indicated on the drawings. All controls, wiring, and equipment should be in conformance with the requirements of NFPA 70 for the identified hazard areas. Equipment should be grounded and/or provided with ground fault circuit interrupter (GFCI) protection if required by NFPA 70. The atmosphere around the area should be periodically monitored with a combustible gas monitor. If the concentration of explosive gas reaches 10 percent of the LEL or greater, the system should be inspected for leaks and emission points. All sources of VOC emissions should be controlled to prevent the release of flammable gas. A permanent explosion level meter/alarm may also be needed.

- Thermally enhanced SVE systems may incorporate the use of steam to heat soils to be treated. Pressure caused by plugged steam lines may cause a rupture or an explosion in the system. Controls to prevent an explosion hazard include operating the steam generator within its design parameters and the use of emergency pressure relief valves. Steam lines should be periodically flushed to remove any accumulated scale or deposits.

- The surface temperature of uninsulated steam generators and piping systems may reach several hundred degrees and pose a burn hazard to workers. Catalytic oxidation system components can be quite hot, and also pose a burn hazard. Controls to help prevent burn hazards include properly insulating surfaces, including hazard warning signs on the equipment, and providing physical covers to prevent contact.

- High levels of noise may be generated by blowers and compressors and may result in hearing loss. Unprotected blowers and fans may entangle workers' clothing and cause injury. Equipment noise should be controlled with the use of insulation materials, barriers, proper lubrication, and proper maintenance of equipment. The use of personal hearing protection should be required when working in areas of elevated noise levels. All moving and rotating equipment should be guarded and workers informed that all such equipment be operated only with guards in place. Equipment must be shut down and locked and tagged out before maintenance is performed on that equipment.

- During drilling operations, heavy equipment such as augers and pipes is periodically raised overhead and placed into or above the well. Workers may be exposed to swinging equipment during lifting, or may be exposed to crushing hazards if the equipment falls. Cables used to raise and lower equipment may also become entangled in loose clothing or other equipment. Direct push drilling methods using hydraulic pressure to advance a soil boring may pose a crushing hazard to hands and/or feet. When raising a drill mast, always have an observer to the side to observe and supervise. Do not move the drilling rig with the mast raised. Controls to help prevent workers from becoming entangled with the revolving augers include securing all loose clothing, using low-profile auger pins, and using long-handled shovels to remove soil cuttings from the borehole. Cable systems should be used with caution and inspected regularly for loose strands or frayed wires that may become entangled in loose clothing and that may be indicative of weakening of the cable

- Electrocution or fire hazards may exist when using hollow-stemmed auger, direct push, or other drilling methods if the drilling mast contacts overhead electric lines or piping systems containing flammable chemicals. To control potential electrocution or fire hazards associated with overhead lines or piping systems, inform all workers as to the location of overhead utilities. Drill in an alternate location if possible. All lifting equipment, such as cranes, forklifts, and drilling rigs, should remain at least 10 feet from the power line according to Occupational Safety and Health Administration (OSHA), 29 Code of Federal Regulations (CFR) 1926.550. When raising a drill mast, always have a worker observe and supervise. Operate the mast at its lowest height; different drill rigs will have different mast elevations and may be operated at different heights.

- Operation of temporary and permanent electrical equipment, such as lights, generators and heated SVE system components, may cause electrical hazards. Verify that the hazardous area classifications, as defined in NFPA 70-500-1 through 500-10, are indicated on the drawings. All controls, wiring, and equipment should be in conformance with the requirements of NFPA 70 for the identified hazardous areas. Equipment should be grounded and/or provided with GFCI protection if required by NFPA 70 requirements. Only qualified and approved electricians or associates trained in electrical safety will be permitted to work on electrical systems. In addition, lockout tagout procedures will be followed prior to performing any electrical work.

- If the project team decides to use compressed air cylinders, site associates must be aware of the inherent hazards associated with compressed cylinders. Improper storage and use of cylinders of compressed gases in some SVE systems may cause explosive or projectile hazards. Cylinders of compressed gases should be stored upright, capped when not in use, and secured to prevent movement. Extreme temperatures should be avoided.

- Steam pressure washing of equipment may expose workers to thermal or burn hazards, eye hazards due to flying projectiles dislodged during pressure washing, slip hazards from wet surfaces, and noise hazards. Thermal burns may be prevented by using insulated gloves (e.g., silica fabric gloves). Eye injuries and hearing loss may be prevented by wearing safety goggles and hearing protection during pressure washing activities. Slip hazards may be controlled by workers wearing slip-resistant boots and draining water away from the decontamination operation into a tank or pit. Walking surfaces should be drained and free of standing liquids or mud.

- Manual lifting of heavy objects may expose workers to back, arm, and shoulder injuries. Workers should not be required to lift heavy loads manually. Some loads may require two people. Proper lifting techniques include stretching, bending at the knees, and bringing the load close to the body. Mechanical lifting equipment, such as forklifts, should be used to lift or to move loads.

Chemicals hazards associated with SVE systems include:

- Biological degradation of certain organic compounds may produce toxic intermediate products. Workers may be exposed to degradation products during operation or maintenance of the system. To minimize exposure, include ventilation of the affected area. Air-supplied respiratory protection may also be required to be used on monitoring. Remediation designers should understand and anticipate the generation and management of general and specific process products and design for their management.

- During installation of the wells and system operations and maintenance, workers may be exposed to dermal or inhalation hazards associated with waste chemicals, such as airborne dusts and particulates, and VOC emissions resulting from off gassing or leaks. During installation, workers may need to apply water or surfactant-amended water solution to the area to help control generation of airborne dusts, particulates, and VOCs. During installation and operation, proper ventilation and PPE should be used (e.g., an air-purifying respirator with organic vapor cartridges). Closed systems, such as SVE, should be routinely checked for leaks of the off-gas treatment system with PIDs, air samples, O_2 meters, leak detection fluids, explosive gas meters, or specific gas tests with chemical-specific detector tubes. Leaks should be repaired immediately. Vent stack heights should be adequate to disperse off gas. Designers should anticipate byproducts and products and be certain that technologies selected for treatment (e.g., activated carbon, condensation, catalytic oxidation) of off-gas residuals are both effective and safe.

- Air injection may cause the migration of VOCs to low areas, such as basements, sewers, and other areas. Accumulated VOCs can cause flammable conditions and/or chemical exposure to occupants. The pilot test and full-scale design will fully identify the potential hazards. Periodic air testing will be done to ensure safe levels in areas where VOCs may migrate.

- Workers and plant personnel could be exposed to VOCs as they are discharged from the blower vent. Emission controls, such as activated carbon canisters, will be installed on the blower vent discharge and will be periodically monitored to prevent contaminated carbon or other removal media, vapors, and catalysts from being released.

- Fire and/or explosion or chemical release (inhalation/ingestion/asphyxiation) hazards may exist when using hollow-stemmed auger, direct push, or other drilling methods if the drilling bit or bucket ruptures underground utilities or tanks/piping systems (overhead chemical feed lines) containing hazardous chemicals. Perform a utility survey, probe with a metal rod prior to excavation, or hand excavate to determine the exact location of underground lines prior to drilling. During design, locate overhead hazards and design so that installations using erect equipment are not necessary in that area, if possible.

Biological hazards associated with SVE systems include:

- Workers may be exposed to a wide array of biological hazards, including snakes, bees, wasps, ticks, hornets, and rodents, during any phase of remediation. The symptoms of exposure vary from mild irritation to anaphylactic shock and death. Exposure to deer ticks may cause Lyme disease. Periodic inspections of the site should be performed to identify stinging insect nests and for the presence of snakes. Professional exterminating companies should be consulted for removal.

Certain tick and insect repellents may be used for exposure control. However, workers should check their skin and clothing for ticks periodically throughout the work day.

5.4.2 Air Sparging Hazards

There are multiple safety concerns and hazards associated with AS systems. Most of the physical, chemical, and biological hazards associated with AS systems are also associated with SVE system hazards, which are covered above. The following identifies hazards specific to AS systems and hazards mentioned above will also apply to AS systems:

Physical hazards associated with AS systems include:

- Due to the presence of high levels of oxygen in an enhanced air sparge system, there may be an increased risk of starting a fire. Oxygen delivery systems should be regularly inspected for leaks and all sources of ignition.

Chemical hazards associated with AS systems include:

- The use of oxygen or ozone enhancement may create an increased flammability potential or toxic (ozone) exposure. Adequately ventilate the affected area, and regularly inspect piping systems for leaks.

- During well installation, workers may be exposed to contaminants, such as VOCs, dusts, and metals, in soil and development water through the inhalation/ingestion/dermal contact routes. During well installation, workers may need to apply water or amended water solutions to the area to help control the generation of airborne dusts, particulates, and VOCs. Workers may also use respiratory protection including the use of approved filter/cartridges (e.g., high-efficiency particulate air [N100, R100, P100] filters for particulates, organic vapor cartridges for vapors, or combination filter/cartridges for dual protection). Personal exposure may be controlled by the use of PPE. An analysis of the work tasks and potential for chemical exposure should be performed to determine the correct PPE and/or respirator cartridge(s), if needed. The analysis should include a chemical profile on the waste materials to help ensure the equipment specified will be appropriate for the respective chemical hazard.

- Injection (sparging) wells may cause migration of VOCs into subsurface structures, such as basements and sewers. The VOCs may be toxic and/or flammable, resulting in chemical exposure or the potential for a fire or explosion. The system designer should determine the pressure range of the system and install hazard warning alarms to prevent over-pressurization. Periodic air testing should be performed in basements and other areas where VOCs may migrate to ensure safe levels.

- During entry into confined space, such as a manhole to collect condensate samples, workers may be exposed to airborne chemical hazards if the atmosphere in the confined space contains a toxic chemical or is oxygen deficient. A confined-space entry program, which includes worker training and air testing procedures, should be implemented prior to entering confined space. All atmospheres of confined space should be tested prior to and during entry. If a hazardous atmosphere is determined to exist, confined space should be ventilated and the hazards abated.

- Biological degradation of certain chlorinated organic compounds may produce toxic intermediate products including vinyl chloride. Vinyl chloride exists as a gas and may accumulate to higher levels in boreholes or in the system. Workers may be exposed to intermediate products during operation or maintenance of the system. Controls to minimize exposure include local ventilation of the affected area. If ventilation or other engineering controls are not sufficient to maintain exposures to less than the OSHA permissible exposure limit (PEL), then select the proper respirator according to 29 CFR 1910.1017 or 29 CFR 1910.134 for other intermediate products. Check with the respirator manufacturer to ensure use in atmospheres containing vinyl chloride. The full-scale design will further identify potential biological degradation and the HASP will be revised to include additional hazards identified during the full-scale design process.

6. Hazard Communication (HazCom)

All project-required chemicals must be handled in accordance with the pertinent HazCom Standard and the requirements outlined in the FHSHB. The table below lists all chemicals that will be brought, used, and/or stored on the site. Material Safety Data Sheets for chemicals brought on site will be included in Appendix D after the full-scale design is complete.

List the chemicals anticipated to be used on this project subject to HazCom requirements.

	Acids/Bases	Qty		Decontamination	Qty		Calibration	Qty.
☐			☐	Not applicable		☒	To be determined	
☐	Hydrochloric acid	<500 mL	☒	Alconox	• 5 lbs	☐	Isobutylene/air	1 cyl
☐	Nitric acid	<500 mL	☐	Liquinox	• 1 gal	☐	Methane/air	1 cyl
☐	Sulfuric acid	<500 mL	☐	Acetone	• 1 gal	☐	Pentane/air	1 cyl
☐	Sodium hydroxide	<500 mL	☐	Methanol	• 1 gal	☐	Hydrogen/air	1 cyl
☐	Zinc acetate	<500 mL	☐	Hexane	• 1 gal	☐	Propane/air	1 cyl
☐	Ascorbic acid	<500 mL	☐	Isopropyl alcohol	• 4 gal	☐	Hydrogen sulfide/air	1 cyl
☐	Acetic acid	<500 mL	☐	Nitric acid	• 1 L	☐	Carbon monoxide/air	1 cyl
☒	Other: To be determined		☐	Other:		☒	pH standards (4,7,10)	• 1 gal
						☒	Conductivity standards	• 1 gal
						☒	Other: Oxygen	

	Fuels	Qty.		Kits	Qty.
☐	Not applicable		☐	Not applicable	
☒	Gasoline	• 5 gal	☐	Hach (specify):	1 kit
☒	Diesel	• 5 gal	☐	DTECH (specify):	1 kit
☐	Kerosene	• 5 gal	☐	EPA 5035 Soil (specify kit):	1 kit
☐	Propane	1 cyl	☒	Other: Dräger tubes	
☐	Other:				

	Remediation	Qty.		Other:	Qty.
☒	1,1,1-trichloroethane	TBD	☒	Lubricating oil	
☒	1,1-dichloroethene	TBD	☒	Spray paint	• 6 cans
☒	1,4-dioxane	TBD	☒	WD-40	• 1 can
☒	Polychlorinated biphenyls	TBD	☒	Pipe cement	• 1 can
			☒	Pipe primer	• 1 can
			☐	Mineral spirits	• 1 gal

Material safety data sheets (MSDSs) must be available to field staff. Manufacturer-supplied MSDSs are preferred, however, if the manufacturer's MSDS cannot be located, use the source provided below. Indicate below how MSDS information will be provided:

- ☐ Not applicable
- ☐ Printed copy in company vehicle
- ☒ Printed copy in the project trailer/office
- ☐ Printed copy attached
- ☐ Electronic copy on field computer

Find an MSDS	
Source:	www.hz.genium.com
Username:	TBD
Password:	TBD

Bulk quantities of the following materials will be stored:

Contact the project H&S contact for information in determining code and regulatory requirements associated with bulk storage of materials.

6.1 Chemical Hazards

Air monitoring will be conducted as outlined in this HASP to collect exposure data for CoCs or for chemicals brought on site for use. Table 2 lists the properties of chemicals that will be encountered at the site.

Table 2. Chemical Hazard Information

Chemical Name	IP (eV)	Odor Threshold (ppm)	Routes of Entry/ Exposure Symptoms	8-hr TWA[1] (ppm)	IDLH (NIOSH) (ppm)	STEL (ppm)	Source TLV/PEL
1,1-Dichloroethene	10.00	2,000	Inhalation/ingestion/ penetration/ absorption	5	N/A	N/A	ACGIH
1,4-Dioxane	9.41	620	Inhalation/ingestion/ penetration/ absorption	20	500	360	ACGIH
1,1,1-Trichloroethane	11.00	44	Inhalation/ingestion/ penetration/ absorption	350	700	450	OSHA
Polychlorinated Biphenyls	7.86	5	Inhalation/ingestion/ penetration/ absorption	1 (skin)	5	N/A	OSHA

[1]The TLV from the ACGIH is listed unless the PEL, designated by OSHA, is lower.

ACGIH	American Conference on Government Industrial Hygienists.
eV	Electron volt.
IDLH	Immediately Dangerous to Life and Health.
IP	Ionization Potential.
N/A	Not Applicable.
NIOSH	National Institute for Occupational Safety and Health.
OSHA	Occupational Safety and Health Administration.
PEL	Permissible Exposure Limit.
ppm	Parts per million.
STEL	Short-Term Exposure Limit.
TVL	Threshold Limit Value.
TWA	Time-weighted average.

See Section 8 for information on air monitoring requirements.

7. Tailgate Meetings

Tailgate safety briefings must be conducted at least once daily and should be conducted twice daily (at the start of the job and after mid-day meal break), or as tasks/hazards change. Each tailgate safety briefing must be documented on the form included in Appendix E and maintained with the project files. The tailgate safety briefing will serve as a final review for hazard identification and controls to be used. JLAs and FHSHB controls should be reviewed as part of the briefing to ensure hazard controls are adequate for planned work.

8. Personal Exposure Monitoring and Respiratory Protection

Personal and area exposure monitoring will be documented on the Real Time Exposure Monitoring Data Collection Form provided in Appendix E. All monitoring equipment will be maintained and calibrated in accordance with manufacturer's recommendations. All pertinent monitoring data will be logged on the form and maintained on site for the duration of project activities. Calibration of all monitoring equipment will be conducted daily and logged on the same form.

Table 3 lists exposure monitoring requirements and associated action levels for site exposure hazards (e.g., chemical, noise, radiation). Action levels have been developed for exposure monitoring with real-time air monitoring instruments as specified in the table.

Action levels at the KEC facility will be based on the constituent with the lowest TWA. If selected monitoring devices can differentiate and identify each specific constituent of concern (i.e., Dräger tubes), the site may use action levels based on each individual constituent. The constituent with the lowest 8-hour TWA at the KEC facility is 1,1-dichloroethene, with an 8-hour ACGIH TWA of 5 parts per million. Action levels at the KEC family will be recognized as one-half of the ACGIH TWA. If concentrations of this level are observed, PPE will be upgraded accordingly. PPE requirements at the KEC facility will be based on real-time air monitoring concentrations of 1,1-dichloroethene (constituent with lowest TWA) or concentrations specifically correlating with each constituent if real-time air monitoring can distinguish the atmospheric concentrations of each constituent separately. Real-time air monitoring data will determine the required respiratory protection levels at the site during scheduled intrusive activities. The action levels are based on sustained readings indicated by the instrument(s). Air monitoring will be performed and recorded at up to 30-minute intervals.

If elevated concentrations are indicated, the monitoring frequency will be increased, as appropriate. If sustained measurements are observed during this time, the following actions will be instituted, and the Project Manager and Project H&S Manager will be notified. For purposes of this HASP, sustained readings are defined as the average airborne concentration maintained for a period of 1 minute.

Table 3. Exposure Monitoring Requirements

Task 1 – Is exposure monitoring required for the completion of this task? ☐ YES ☒ NO If yes, complete the following:				
Exposure Hazard	**Monitoring Equipment**	**Monitoring Frequency**	**Action Level**	**Required Action**
N/A	N/A	N/A	N/A	N/A
Task 2 – Is exposure monitoring required for the completion of this task? ☐ YES ☒ NO If yes, complete the following:				
Exposure Hazard	**Monitoring Equipment**	**Monitoring Frequency**	**Action Level**	**Required Action**
N/A	N/A	N/A	N/A	N/A
Task 3 – Is exposure monitoring required for the completion of this task? ☒ YES ☐ NO If yes, complete the following:				
Exposure Hazard	**Monitoring Equipment**	**Monitoring Frequency**	**Action Level (ppm)**	**Required Action**
1,1-Dichloroethene	PID / FID / Dräger Tube	Continuous	2.5	Level C (full face)
1,1-dichloroethene	PID / FID / Dräger Tube	Continuous	250	Level B
1,4-Dioxane	PID / FID / Dräger Tube	Continuous	10	Level C (full face)
1,4-Dioxane	PID / FID / Dräger Tube	Continuous	1,000	Level B
1,1,1-Trichloroethane	PID / FID / Dräger Tube	Continuous	175	Level C (full face)
1,1,1-Trichloroethane	PID / FID / Dräger Tube	Continuous	1,750	Level B
Polychlorinated Biphenyls	N/A	Continuous	0.5 (skin)	Level C (full face)

Task 4 – Is exposure monitoring required for the completion of this task? ☒ YES ☐ NO If yes, complete the following:				
Exposure Hazard	**Monitoring Equipment**	**Monitoring Frequency**	**Action Level**	**Required Action**
1,1-Dichloroethene	PID / FID / Dräger Tube	Continuous	2.5	Level C (full face)
1,1-Dichloroethene	PID / FID / Dräger Tube	Continuous	250	Level B
1,4-Dioxane	PID / FID / Dräger Tube	Continuous	10	Level C (full face)
1,4-Dioxane	PID / FID / Dräger Tube	Continuous	1,000	Level B
1,1,1-Trichloroethane	PID / FID / Dräger Tube	Continuous	175	Level C (full face)
1,1,1-Trichloroethane	PID / FID / Dräger Tube	Continuous	1,750	Level B
Polychlorinated Biphenyls	N/A	Continuous	0.5 (skin)	Level C (full face)
Task 5 – Is exposure monitoring required for the completion of this task? ☐ YES ☒ NO If yes, complete the following:				
Exposure Hazard	**Monitoring Equipment**	**Monitoring Frequency**	**Action Level**	**Required Action**
N/A	N/A	N/A	N/A	N/A

PID/FID Photoionization Detector/Flame Ionization Detector.

8.1 Respirator Cartridge Change Schedule

Respirators will be stored in clean containers (i.e., self-sealing bag) when not in use. If respirators are required to be worn based on the action levels established above, respirator cartridges will be replaced in accordance with the following change-out schedule.

Type of Cartridge	Cartridge Change-out Schedule
Particulate (i.e., high-efficiency particulate air) / Sorbent (i.e., organic vapor) combination filter.	At least weekly or whenever the employee detects an increase in breathing resistance. This will occur as the filter becomes loaded with particulate matter. At the end of each day's use or sooner, if the respirator manufacturer change-out schedule software program dictates otherwise. The Project H&S Manager or the Project Manager must be consulted regarding gas/vapor cartridge change-out schedule.

Personnel who wear air-purifying respirators (APRs) must be trained in their use, must have successfully passed a qualitative respiratory fit test within the last 12 months, and must have medical clearance for APR use.

With the exception of protection against particulates*, if the action plan outlined above calls for an upgrade to APR (for protection against organic vapors and other gaseous chemicals), the following will apply:

- The respirator cartridge will be equipped with an end-of-service-life indicator (ESLI) certified by the National Institute for Occupational Safety and Health for the contaminant; or
- If there is no ESLI appropriate for a contaminant, the project will implement a change schedule for cartridges to ensure that they are changed before the end of their service life.

**Note – A Cartridge Change Schedule is not necessary for cartridges used in the protection against particulates provided that the cartridges are changed out when there is a perceived resistance in breathing experienced by the user.*

9. Medical Surveillance

All medical surveillance requirements must be completed and site personnel medically cleared before being permitted on the project site.

10. General Site Access and Control

The Project Manager and/or SSO will coordinate access and control security at the work site. As the work dictates, the SSO will establish a work area perimeter. The size of the perimeter will be based on the daily task activities and will be discussed with all project personnel during the tailgate meeting and then documented on the tailgate meeting form. Control zones for Level C or above will be demarcated by either visual or physical devices and will be monitored for effectiveness by the SSO.

Only authorized personnel will be allowed beyond the perimeter. Other site workers and visitors to the site should be kept out of the work site. If visitors need access to the site, the SSO will escort the visitor at all times. All visitors will log in and out with the SSO. The visitor log sheet is included in Appendix E.

10.1 Sanitation at Temporary Workplaces

10.1.1 Potable Water

An adequate supply of potable water must be provided on the site. Portable containers used to dispense drinking water shall be capable of being tightly closed and equipped with a tap. Water shall not be dipped from containers. Any container used to distribute drinking water shall be clearly marked as to the nature of its contents and not used for any other purpose. Where single service cups (to be used but once) are supplied, both a sanitary container for the unused cups and a receptacle for disposing of the used cups shall be provided.

10.1.2 Toilet Facilities

Under temporary field conditions, the SSO will make provisions so that no less than one toilet facility is available. Use of a nearby toilet facility is an acceptable arrangement for mobile crews having transportation readily available.

11. Decontamination Control Zones and Procedures

The decontamination procedures outlined in the FHSHB are provided for typical Level D and Level C ensembles.

The zones for Level C and above will be designated by traffic cones, barricades, signs, caution tape, or other means effective in identifying the different areas. The SSO will establish control boundaries for the exclusion zone, contamination reduction zone, and the support zone. The zones will be identified by the SSO during tailgate meetings and documented on the meeting form. Entrance and exit to the exclusion zone will only be through controlled access points established for each work area.

Level B or Level A decontamination procedures are detailed in the below table:

Table 4. Level A/B Decontamination Steps

Level A Decontamination Steps		Level B Decontamination Steps	
EZ-1	Segregated Equipment Drop	EZ-1	Segregated Equipment Drop
EZ-2	Boot Cover and Glove Wash	EZ-2	Boot Cover and Glove Wash
EZ-3	Boot Cover and Glove Rinse	EZ-3	Boot Cover and Glove Rinse

Level A Decontamination Steps		Level B Decontamination Steps	
EZ-4	Tape Removal	EZ-4	Tape Removal
EZ-5	Boot Cover Removal	EZ-5	Boot Cover Removal
EZ-6	Outer Glove Removal	EZ-6	Outer Glove Removal
CRZ-7	Suit/Safety Boot Wash	CRZ-7	Outer Glove Removal
CRZ-8	Suit/Safety Boot Rinse	CRZ-8	Suit/SCBA/Boot/Glove Rinse
CRZ-9	Encapsulated Suit Partial Removal/Tank Change	CRZ-9	Tank Change
CRZ-9a	Redress-return to EZ	CRZ-9a	Redress-return to EZ
CRZ-10	Safety Boot Removal	CRZ-10	Safety Boot Removal
CRZ-11	Encapsulated Suit Removal	CRZ-11	SCBA Removal
CRZ-12	SCBA Removal	CRZ-12	Splash Suit Removal
CRZ-13	Inner Glove Wash	CRZ-13	Inner Glove Wash
CRZ-14	Inner Glove Rinse	CRZ-14	Inner Glove Rinse
CRZ-15	Face-piece Removal	CRZ-15	Face-piece Removal
CRZ-16	Inner Glove Removal	CRZ-16	Inner Glove Removal
CRZ-17	Inner Clothing Removal	CRZ-17	Inner Clothing Removal
SZ-18	Field Wash	SZ-18	Field Wash
SZ-19	Redress	SZ-19	Redress

CRZC Contamination Reduction Zone.
EZ Exclusion Zone.
SCBA Self-Contained Breathing Apparatus.
SZ Support Zone.

It is not anticipated that Level A protection will be required. If Level A is contemplated, work will be stopped and the SSO will consult with the Project Manager and Corporate Health and Safety.

12. Emergency Action Plan (EAP)

In the event that an injury, over-exposure, or spill has occurred, an EAP will be implemented. All employees working on this project must be shown the location and proper use of all emergency equipment prior to beginning work on the project.

In the event of any emergency situation, site personnel will immediately notify the SSO who will initiate emergency response actions. The SSO will determine the need for off-site emergency response assistance. If the SSO determines that on-site personnel can adequately respond and control the situation, the SSO will oversee the response and ensure site personnel are properly protected and use proper procedures. If not, the SSO will contact appropriate emergency response personnel per the phone list and other personnel as required by the client for assistance. Personal injury or heat/cold exposure requiring immediate medical help, personal medical emergency, or hazardous chemical exposure situations will require the SSO to immediately call the appropriate emergency number for medical assistance (see the emergency phone list in Section 1).

Potential emergencies may include:

- Spills of and exposure to chemicals used during mixing;
- Personal injury;
- Personal exposure;
- Fire;
- Vehicle accidents;
- Severe weather; and
- Heat stress.

The SSO will conduct regular site inspections to identify any potential emergency situations for the purposes of avoiding those emergency situations.

13. Client-Specific Health and Safety Requirements

All project personnel must comply with the client's specific H&S requirements at all times. Additional client-specific H&S requirements will be added to this HASP on an as-needed basis and after the full-scale design has been completed.

14. Ground or Air Shipments of Hazardous Materials (HazMat)

All samples, electronic equipment with batteries, powders, gases, liquids, magnetized materials, or radioactive materials being shipped by air or ground transport will be evaluated using a shipping determination process to determine if the material or equipment being shipped is hazardous for transport. All materials identified as HazMat will be shipped according to applicable Department of Transportation (DOT) and International Air Transport Association regulations and requirements as prescribed by a DOT Program.

All employees collecting samples, preparing HazMat packages, or offering HazMat to a third party carrier such as Federal Express will have current HazMat training. Shipping forms are provided in Appendix E.

15. Subcontractors

A copy of this HASP is to be provided to all subcontractors prior to the start of work so that the subcontractor is informed of the hazards at the site. All Subcontractors should be required to adopt this HASP. The **"Subcontractor Acknowledgement Memo" must be signed and dated by the subcontractor's management and placed in the project file.** Once the signed memo is received by the project manager, an electronic version of this HASP can be submitted to the subcontractor to use as their own. Subcontractors working at the site will need to have this plan with them and will also need to sign the Subcontractor HASP receipt signature page of this (Appendix E). Subcontractors are responsible for the H&S of their employees at all times and have the authority to halt work if unsafe conditions arise.

The Project/Task Manager and SSO (or authorized representative) has the authority to halt the subcontractor's operations and to remove the subcontractor or subcontractor's employee(s) from the site for failure to comply with established H&S procedures or for operating in an unsafe manner.

16. Project Personnel HASP Certification

All site project personnel will sign the certification signature page provided in Appendix E of this HASP.

17. Roadway Work Zone Safety

All project work performed in a public or private roadway, regardless of work duration, will require either a written Traffic Control Plan (TCP) or a Site Traffic Awareness and Response Plan. Projects having work activities on both public and private roadways will operate under a TCP approved by an employee designated with Engineering Judgment.

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Appendix A

HASP Addendum Pages and Log Table

Addendum Page

This form should be completed for new tasks associated with the project. The project manager and/or task manager should revise the Project Hazard Analysis Worksheet with the new task information and attach to this addendum sheet. JLAs should be developed for any new tasks and attached as well.

Review the addendum with all site staff, including subcontractors, during the daily tailgate briefing, and complete the tailgate briefing form as required. Attach a copy of the addendum to all copies of the HASP including the site copy, and log in the Addendum Log Table A-1 on the next page.

Addendum Number: ____________________ Project Number: ____________________

Date of Changed Conditions: ____________________ Date of Addendum: ____________________

Description of Change that Results in Modifications to HASP:

Signed: ______________________________
Project Manager

Signed: ______________________________
SSO

Signed: ______________________________
H&S Plan Writer

Signed: ______________________________
H&S Plan Reviewer

Addendum Log Table

Addendums are to be added to every copy of the HASP and logged on Table A-1 to verify that all copies of the HASP are current:

Table A-1 Addendum Log Table

Addendum Number	Date of Addendum	Reason for Addendum	Person Completing Addendum
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

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Appendix B

Job Loss Analyses

Job Loss Analysis

General

Client Name	
JSA ID	TBD
Job Name	Construction-Heavy equipment operation
Task Description	Heavy Equipment for Groundwater Treatment Construction
Project Number	TBD
Project Name	TBD
PIC Name	TBD
Project Manager	George H. Cramer
Status	
Creation Date	
Auto Closed	

User Roles

Role	Employee	Due Date	Completed	Approve	Supervisor	Active
Created By	Riley, Joel					

Job Steps

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
1	Loading and Unloading Equipment from transport vehicles.	1	Stake or impact hazards from moving equipment	Stand clear of equipment loading or unloading from transport vehicles	FHSHB Section IV (E); ARCHSF019, FHSHB Section III(MM)
		2	Equipment damage from improper removal or placement on vehicle	Ensure any ramps used are rated for weight and properly placed and secure prior to moving equipment across, ensure trailers being loaded or unloaded are properly secured against movement.	FHSHB Section IV (E); ARCHSF019, FHSHB Section III(MM)
		3	Overhead utility contact for equipment with booms or extensions	Plan position of transport vehicle to maintain safe distance (>20 ft) from all overhead lines and structures. Use spotters since operator focus may be on vehicle alignment with ramps or other ground level distractions.	FHSHB Section IV (E); ARCHSF019, FHSHB Section III(MM)
		4	Ascending/Descending equipment cab.	Do not hurry through task, wear footwear with good tread and ankle support, maintain 3 points of contact while accessing or egress equipment, no jumping off trailers or truck beds. Use spotters and ensure assoicates remain clear of blind spots.	FHSHB Section IV (E); ARCHSF019, FHSHB Section III(MM)
2	Pre-operation Inspection	1	Pinch hazards to hands	Wear gloves appropriate for hazard while maintaining dexterity. Keep hand in field of vision and watch for and keep hands clear of obvious hazards like door or cover closures. Do not hurry during the removal or placement of covers or equipment components.	
		2	Head injury from striking equipment covers or components	Wear hard hat, stay focused on surroundings, avoid standing or raising up suddenly especially if door cover is overhead.	
		3	Exposure to engine fluids or lubricants	Wear protective gloves, ensure MSDS is available for engine fluids and lubricants, promptly wash exposed skin, contact WorkCare immediately for any situation where diesel is injected under the skin.	

		4	Awkward body positions and twisting	Plan inspection activity and do not hurry through task, stretch before crawling or squatting. Avoid overreaching.	
		5	Entanglement in equipment components.	Do not circumvent protective guards or shields, ensure equipment is not operational (LOTO if necessary) when accessing engine compartment if intrusion required.	
3	Equipment operation	1	Strike or impact hazards with other workers, equipment or structures.	Keep eyes moving and watch for unanticipated worker movement. Keep workers 15 ft from any extendable area of the equipment, Maintain 360 degrees of awareness and ensure adequate communication method with	
		2	Utility contact (subsurface or above ground)	Follow utility clearance procedure prior to any intrusive work with equipment. Immediately stop work if any unusual or unanticipated condition encountered.	
		3	Rollovers on slopes or from improper usage	Follow equipment manufacturer instructions for use on slopes or load capacities, wear seatbelt at all times, Ensure all outriggers, if equipped are properly deployed on stable surface.	
		4	Noise from engine or work activity	Wear hearing protection as required, keep equipment well maintained.	
		5	Slips and falls from accessing or egress from equipment	Maintain 3 points of contact when access or egress equipment, keep any ladder or steps on equipment clean and dry to extent practical, ensure equipment doors, if present, are in good working order.	
		6	Exposure to tools and metal edges and damaged metal resulting in cuts lacerations to hands during maintenance	Wear protective gloves that allow for good dexterity. Mitigate sharp surfaces to extent practical.	
		7	Pinch/crush hazards to hands from doors or covers	Wear gloves appropriate for hazard while maintaining dexterity, Watch for and keep hands clear of obvious hazards like door or cover closures. Do not hurry during the removal or placement of covers or equipment components.	
		8	Contact stress to knees and hands	Use padding or knee pads if kneeling on hard surfaces for an extended period of time. Avoid placing weight on hands for extended periods of time.	
4	Maintenance	1	Awkward body positions and twisting	Plan inspection activites and do not hurry through task, stretch before crawling or squatting. Avoid overreaching.	
		2	Excessive force turning bolts or lifting heavy components, decontamination activities.	Use automated methods to loosen tight bolts, do not use excessive force or torque when using hand tools. Do not use "cheater bars"	

		3	Contact with engine fluids or lubricants	Wear protective gloves, ensure MSDS is available for engine fluids and lubricants, promptly wash exposed skin, contact WorkCare immediately for any situation where diesel is injected under the skin.	
		4	Flying debris during gross decontamination or cleaning activities	Wear adequate eye and face protection when removing soils or solid media form tracks, buckets, or other component of equipment using pressure washer.	
		5	Entanglement in equipment components.	Do not circumvent protective guards or shields, ensure equipment is not operational (LOTO if necessary) when accessing engine compartment if intrusion required. Use lockout tag out procedure when performing maintenance on vehicles, equipment and remedial system.	
		6	Exposure of hands and arms to hot engine components	Take the time to allow the engine to cool, wear protective gloves and forearm protection.	
		7	Struck by moving equipment or boom extensions	Keep at least 15 ft from any extendable area of the equipment, if entering within 15 ft, establish and maintain contact with equipment operator, ear high visibility clothing or work vest.	
5	Working in proximity to heavy equipment	1	Equipment damage from moving equipment	Keep other equipment not required for work outside of heavy equipment work area in all directions. Flag or mark with high visibility markings, cones, etc., any required equipment near the ground. Do not stand under suspended loads, stay within line of vision of equipment operator. Use hand signals and eye contact at all times.	
		2	Noise hazards from equipment operation	Wear hearing protection and increase distance if work activity permits.	

Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	work gloves (specify type)	Leather, nitrile if handling chemicals	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs	as needed	Recommended

Supplies

Type	Supply	Description	Required
Miscellaneous	fire extinguisher	ABC	Required
Miscellaneous	first aid kit		Required
Personal	eye wash (specify type)		Required

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Appendix C

PPE Checklists

PPE CHECKLIST

R = Equipment required to be present on the site. **O** = Optional equipment. Subcontractors must have the same equipment listed here as a minimum.

Description (Put Specific Material or Type in Box)	Level Of Protection		
	D	C	B
Body			
Coveralls			
Chemical Protective Suit	O	R	R
Splash Apron	O	O	O
Rain Suit			
Traffic Safety Vest (reflective)	As needed	As needed	As needed
Head			
Hard Hat (if does not create other hazard)	R	R	R
Head Warmer (depends on temperature and weather			
Eyes & Face			
Safety Glasses (incorporate sun protection as necessary)	R	O	O
Goggles (based on hazard)	O	O	O
Splash Guard (based on hazard)	O	O	O
Ears			
Ear Plugs	R	R	R
Ear Muffs	O	O	O
Hands and Arms			
Outer Chemical Resistant Gloves	O	R	R
Inner Chemical Resistant Gloves	O	R	R
Insulated Gloves	O	O	O
Work Gloves	R		
Foot			
Safety Boots (steel toe and shank)	R	R	R
Rubber, Chemical Resistant Boots	O	R	R
Rubber Boots	O		
Disposable Boot Covers	O	R	R
Respiratory Protection			
1/2 Mask Air-Purifying Respirator			
Full Face Air-Purifying Respirator		R	
Dust Protection			
Powered Air-Purifying Respirator			
Self-Contained Breathing Apparatus			
Air Line			R

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Appendix D

Material Safety Data Sheets

TO BE PROVIDED AFTER FULL-SCALE DESIGN IS COMPLETE

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Appendix E

HASP Forms

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Document Control Number:TGM - ____________________
TGM + *project number plus date as follows: xxxxxxxx.xxxx.xxxxx - dd/mm/year*

TAILGATE HEALTH & SAFETY MEETING FORM

This form documents the tailgate meeting conducted in accordance with the Project HASP. Personnel who perform work operations on-site during the day are required to attend this meeting and to acknowledge their attendance, at least daily.

Project Name:			**Project Location:**
Date:	**Time:**	**Conducted by:**	**Signature/Title:**
Client:		**Client Contact:**	**Subcontractor companies:**

TRACKing the Tailgate Meeting

Think through the Tasks (list the tasks for the day):

1 ____________ 3 ____________ 5 ____________
2 ____________ 4 ____________ 6 ____________

Other Hazardous Activities - Check the box if there are any other ARCADIS, Client or other party activities that may pose hazards to ARCADIS operations ☐ If there are none, write "None" here: ______

If yes, describe them here: ____________

How will they be controlled? ____________

Prework Authorization - check activities to be conducted that require permit issuance or completion of a checklist or similar before work begins:

	Doc #		Doc #		Doc #
☐ Not applicable		☐ Working at Height	______	☐ Confined Space	______
☐ Energy Isolation (LOTO)	______	☐ Excavation/Trenching	______	☐ Hot Work	______
☐ Mechanical Lifting Ops	______	☐ Overhead & Buried Utilities	______	☐ Other permit	______

Discuss following questions (for some review previous day's post activities). **Check if yes :** ☐ Topics from Corp H&S to cover?

☐ Incidents from day before to review?	☐ Lessons learned from the day before?	☐ Any Stop Work Interventions yesterday?
☐ Any corrective actions from yesterday?	☐ Will any work deviate from plan?	☐ If deviations, notify PM & client
☐ JLAs or procedures are available?	☐ Field teams to "dirty" JLAs, as needed?	☐ All equipment checked & OK?
☐ Staff has appropriate PPE?	☐ Staff knows Emergency Plan (EAP)?	☐ Staff knows gathering points?

Comments: ____________

Recognize the hazards (check all those that are discussed) (Examples are provided) and **Assess** the Risks (Low, Medium, High - circle risk level) - Provide an overall assessment of hazards to be encountered today and briefly list them under the hazard category.

☐ Gravity (i.e., ladder, scaffold, trips) (L M H)	☐ Motion (i.e., traffic, moving water) (L M H)	☐ Mechanical (i.e., augers, motors) (L M H)
☐ Electrical (i.e., utilities, lightning) (L M H)	☐ Pressure (i.e., gas cylinders, wells) (L M H)	☐ Environment (i.e., heat, cold, ice) (L M H)
☐ Chemical (i.e., fuel, acid, paint) (L M H)	☐ Biological (i.e., ticks, poison ivy) (L M H)	☐ Radiation (i.e., alpha, sun, laser) (L M H)
☐ Sound (i.e., machinery, generators) (L M H)	☐ Personal (i.e. alone, night, not fit) (L M H)	☐ Driving (i.e. car, ATV, boat, dozer) (L M H)

Continue TRACK Process on Page 2

TAILGATE HEALTH & SAFETY MEETING FORM - Pg. 2

Control the hazards (Check all and discuss those methods to control the hazards that will be implemented for the day): Review the HASP, applicable JLAs, and other control processes. Discuss and document any additional control processes.

- [x] **STOP WORK AUTHORITY** (Must be addressed in every Tailgate meeting - (*See statements below*)

☐ Elimination	☐ Substitution	☐ Isolation
☐ Engineering controls	☐ Administrative controls	☐ Monitoring
☐ General PPE Usage	☐ Hearing Conservation	☐ Respiratory Protection
☐ Personal Hygiene	☐ Exposure Guidelines	☐ Decon Procedures
☐ Emergency Action Plan (EAP)	☐ Fall Protection	☐ Work Zones/Site Control
☐ JLA to be developed/used ***(specify)***	☐ LPO conducted ***(specify job/JLA)***	☐ Traffic Control
☐	☐	☐ Other ***(specify)***
☐	☐	☐

Signature and Certification Section - Site Staff and Visitors

Name/Company/Signature	Initial & Sign In Time	Initial & Sign out Time	I have read and understand the HASP

Important Information and Numbers

All site staff should arrive fit for work. If not, they should report to the supervisor any restrictions or concerns.

In the event of an injury, employees will call WorkCare at 1.800.455.6155 and then notify the field supervisor who will, in turn, notify Corp H&S at 1.720.344.3844.

In the event of a motor vehicle accident, employees will notify the field supervisor who will then notify Corp H&S at 1.720.344.3844 and then Corp Legal at 1.720.344.3756.

In the event of a utility strike or other damage to property of a client or 3rd party, employees will immediately notify the field supervisor, who will then immediately notify Corp Legal at 1.678.373.9556 and Corp H&S at 1.720.344.3500

Visitor Name/Co - not involved in work

Visitor Name/Co	In	Out

I will STOP the job any time anyone is concerned or uncertain about health & safety or if anyone identifies a hazard or additional mitigation not recorded in the site, project, job or task hazard assessment.

I will be alert to any changes in personnel, conditions at the work site or hazards not covered by the original hazard assessments.

If it is necessary to **STOP THE JOB**, I will perform **TRACK**; and then amend the hazard assessments or the HASP as needed.

I will not assist a subcontractor or other party with their work unless it is absolutely necessary and then only after I have done TRACK and I have thoroughly controlled the hazard.

Post Daily Activities Review - Review at end of day or before next day's work (Check those applicable and explain:)

- [ ] Lessons learned and best practices learned today: ______
- [ ] Incidents that occurred today: ______
- [ ] Any Stop Work interventions today? ______
- [ ] Corrective/Preventive Actions needed for future work: ______
- [ ] Any other H&S issues: ______

Keep H&S 1st in all things

WorkCare - 1.800.455.6155
Near Loss Hotline - 1.866.242.4304

Real Time Exposure Monitoring Data Collection Form

Document all air monitoring conducted on the Site below. Keep this form with the project file.

Site Name: ______________________ Date: __________

Instrument: __________ Model: __________ Serial #: __________

Calibration Method: (Material used settings, etc.)	
Calibration Results:	
Calibrated By:	

Activity Being Monitored	Compounds/Hazards Monitored	Time	Reading	Action Required? Y/N

Describe Any Actions Taken as a Result of this Air Monitoring and Why

____

____

Subcontractor Acknowledgement: Receipt of HASP Signature Form

ARCADIS claims no responsibility for the use of this HASP by others although subcontractors working at the site may use this HASP as a guidance document. In any event, ARCADIS does not guarantee the health and/or safety of any person entering this site. Strict adherence to the health and safety guidelines provided herein will reduce, but not eliminate, the potential for injury at this site. To this end, health and safety becomes the inherent responsibility of personnel working at the site.

Printed Name	Company	Signature	Date

Visitor Acknowledgement and Acceptance of HASP Signature Form

By signing below, I waive, release and discharge the owner of the site and ARCADIS and their employees from any future claims for bodily and personal injuries which may result from my presence at, entering, or leaving the site and in any way arising from or related to any and all known and unknown conditions on the site.

Name	Company	Reason for Visit	Date/Time On Site	Date/Time Off Site

Employee Signature Form

I certify that I have read, understand, and will abide by the safety requirements outlined in this HASP.

Printed Name	Signature	Date

Hazardous Materials Transportation Form

	Vehicle (place X in box)	Type (pick-up, car, box truck, etc.)
Personal		
Rental		
ARCADIS owned/leased		
Government owned		
Trailer		
Materials Transported	**Quantity**	**Storage/Transport Container**

List Trained Drivers:

____

____

Hazardous Materials Shipment Form

Material Description and Proper Shipping Name (per DOT or IATA)	Shipment Quantity	DOT Hazard Classification	Shipment Method (air/ground)

List Shipper (i.e., who we are offering the shipment to):

____

____

List Trained Employee(s):

____

____