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REMEDIAL DESIGN WORK PLAN
FOR THE
LEHIGH PORTLAND CEMENT COMPANY SITE
MASON CITY, IOWA

Prepared for:
LEHIGH PORTLAND CEMENT COMPANY
MASON CITY, IOWA

Prepared by:
LAYNE GEOSCIENCES, INC.
A SUBSIDIARY OF LAYNE, INC.

LGI

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1.0 INTRODUCTION

In compliance with the Administration Order (AO)(VII-F-92-0031) for site remedial design and remedial action issued on September 29, 1992, Layne GeoSciences, Inc. (LGI), on behalf of the Lehigh Portland Cement Company (Lehigh), has prepared this Remedial Design Work Plan (RDWP) to present data acquisition activities and protocols planned for the Lehigh Mason City site. The data derived from the investigative efforts outlined in this plan will be used to develop subsequent design plan submittals. The implementation of the remedial action at the Lehigh site requires a thorough remedial design phase which translates conceptual feasibility study stage designs into executable plans and specifications. The remedial action for the site was developed and presented in the document entitled: *"Remedial Investigation/Feasibility Study (RI/FS) for the Lehigh Portland Cement Company Plant, Mason City, Iowa"* submitted to the United States Environmental Protection Agency (EPA) in April 1991.

This RDWP has been prepared to address the elements set forth in Section IV ("Work To Be Performed") of the site AO. The primary elements of this RDWP include:

- A discussion of site background and planned remedial efforts;
- Additional data requirements;
- The composition of the design team;
- The schedule for the remedial design effort;
- A permitting requirements plan;
- A standard composition work plan for the characterization of the CKD present at the site;
- A quality assurance project plan for data collection; and
- A health and safety plan for field activities.

2.0 SITE BACKGROUND AND SUMMARY OF THE REMEDIAL ACTION

The Lehigh site is comprised of two separate areas. Area one, referred to as the "Plant Area", constitutes portions of the Lehigh property to the west of U.S. Hwy. 65. Area two, referred to as the "LCNC Area", lies to the east of U.S. Hwy. 65 and is comprised of portions of the Lime Creek Nature Center (LCNC), a county-owned natural area formerly owned by Lehigh. The site, which is comprised of the two aforementioned areas, is depicted in Drawing 1 (provided in document map pocket).

The environmental situation at the Lehigh site centers on degraded groundwater and surface water quality brought about through interaction with waste cement kiln dust (CKD), a by-product of the cement manufacturing process. CKD had historically been deposited in several areas around the site. In some areas, including former limestone quarries, the CKD is present below the current watertable where contact with groundwater may be continuous. In other areas, the CKD was deposited above the watertable surface, where it only comes into contact with meteoric waters which percolate through the surficial deposits. When water comes into contact with CKD, soluble compound species are leached. The result of the interaction is a water quality with elevated total dissolved solids concentrations and pH levels.

A two-phased remediation approach aimed at the isolation of the CKD from groundwater, surface water and meteoric waters was presented in the site RI/FS, and later approved by the U.S. Environmental Protection Agency (EPA). Isolation of the CKD present at the site, as proposed in the RI/FS, will be done through consolidation and capping. The applicable site quarries will then be drained and the water treated and discharged under a National Pollution Discharge Elimination (NPDES) permit. Draining of the site quarries will result in the removal of waters affected by the CKD and is intended to lower the elevation of the watertable to a point below the base of the CKD deposits. The effort, as presented in the FS, is the most readily applicable, practical, and cost-effective alternative for site remediation. The remedial activities planned for both site areas are detailed in the following sections.

2.1 Remedial Action at the Lehigh Plant Site

The remediation of the Plant Area will be accomplished through the sequential implementation of water pumping and capping efforts. The initial remedial action, the draining of Blue Waters, Area "C" and Arch Ponds may require a time frame of 1-2 years, dependent upon the influx of waters to the ponds, and the maintenance of the 300 to 500 gpm pumping and treatment rate. However, the time estimate is preliminary, as precipitation rate has a significant effect on the rate of water volume reduction. Initial pumping efforts will use the existing Blue Waters Pond floating pump assembly. Later pumping will be from a sump to be excavated in the base of Arch Pond. Based on past experience, the pumping of Blue Waters Pond will be effective in draining the Area C quarry. The pumped water will be treated using acid neutralization due to its inherent simplicity and effectiveness. The treated water will then be discharged to the Winnebago River in quantities adjusted to maintain the resultant stream TDS concentration below the 750 mg/L limit per a pending NPDES permit. Maintenance of the 750 mg/L TDS limit will necessitate the installation of a gaging facility on the discharge stream. Based on preliminary discussions with the Iowa Department of Natural Resources (IDNR), an existing United States Geological Survey (USGS) gage located downstream of the proposed discharge may be used for stream flow calculations. As per the site AO and draft NPDES permit, stream and discharge effluent will be monitored for pH, total suspended solids (TSS), TDS, arsenic, lead and chromium.

Following drainage of the ponds, drainageways will be excavated in the base of Blue Waters and Area "C" Ponds. These drainageways will route any runoff and seeps that are collected in the drained quarries to a sump which will be excavated in the base of Arch Pond following sediment dredging (Drawing 1). With pond drainage, the local shallow groundwater gradients will reverse toward the quarries. The reversal of groundwater flow will result in the removal of waters from the shallow groundwater system while simultaneously eliminating the potential for off-site migration of such waters.

Placement of an engineered clay cap over the CKD Reclamation Area will be initiated concurrent to the drainage of the ponds. The objectives of CKD capping are to minimize the infiltration of water through the kiln dust, thereby reducing the production of elevated pH/elevated TDS leachate; to prevent the release of kiln dust to the air and local surface water bodies; to promote effective surface drainage off the cap; to reduce the amount of groundwater which may potentially be required for extraction for treatment; to separate the CKD from plant roots and animals; and to prevent direct human contact with kiln dust. The design for the cap will include obtaining appropriate low permeability clay material and engineering a proper thickness and surface slope. The cap will be covered with a layer of topsoil designed to prevent erosion and degradation of the low permeability cap, while promoting vegetation growth and surface drainage away from the kiln dust.

The soil cap has been tentatively established to consist of 18" of compacted clay with an in field permeability in the range of 5×10^{-8} cm/sec overlain by 12" of clayey soil and a surficial 2" topsoil mantle with final slopes which do not exceed a 1.5 slope failure safety factor. The surface caps will also be engineered so as to maintain topsoil losses at less than 2 tons/acre/year. Finalization of the cap parameters will be accomplished through the implementation of a test pad program during which infiltrometer testing will be performed to determine permeability, and through geotechnical analysis of the site CKD and capping materials. The test pad protocols and geotechnical testing efforts will be addressed later in this RDWP. The cap will be graded so that runoff will be directed to the Arch Pond sump to allow blending of surface water with water derived from groundwater seeps into the drained quarries.

The CKD present in the Area "C" quarry and the sediment from the former Blue Waters Pond and Arch Pond will be consolidated in the drained Area "C" quarry and covered with an engineered clay cap also meeting the aforementioned cap specifications. The clay required for capping will be supplied by Lehigh and installed by a contractor.

The installation of a french drain groundwater seep collection trench to the west of Arch Pond will also be implemented during the initial stages of site remediation. The water collected in the drain will be directed to the Arch Pond sump. The goal of the trench is to intercept seepage occurring along the haul road located to the north of the Lehigh manufacturing plant. The drain should also be effective in lowering the watertable in the CKD Reclamation Area.

Three additional monitoring wells will be installed around the CKD Reclamation Area. These wells will be used to assess groundwater quality and additionally characterize the hydrogeology of the area. The determination of whether the CKD in the Reclamation Area is saturated is an important factor in the area hydrogeologic characterization. The new wells will be used in the assessment of CKD saturation. The wells will also be used to assess the effectiveness of the pumping of the Arch Pond sump and the french drain. If the base of the CKD in the Reclamation Area is found to remain saturated following the drainage of the site ponds and installation of the french drain, other dewatering scenarios will be considered.

The net result of the Plant Area remedial action will be the isolation of the CKD from interaction with meteoric and groundwater, and the removal and treatment of impacted water which presently exists in the site ponds and in the shallow bedrock section.

2.2 Remedial Action in the LCNC Area

The CKD present in the LCNC Area was primarily deposited in two areas. These areas include what is referred to as the "Badlands" and "Quarry Lake" areas (Drawing 1). The majority of the LCNC area CKD deposits currently exist in an unsaturated state situated above the watertable, however, a portion of the CKD deposits in the Quarry Lake area are in direct contact with the surface water of Quarry Lake. Because of the similarity in conditions to the Plant Area, a similar CKD isolation plan was presented for the LCNC Area in the RI/FS.

Because all of the CKD in the Badlands area was deposited above watertable grade, CKD isolation in the Badlands area will simply entail consolidation and soil capping using the same capping parameters established for the Plant Area. However, some of the CKD deposits in and around Quarry Lake are in direct contact with surface water. In order to isolate the CKD present at Quarry Lake, the western portion of the pond will have to be drained and the CKD excavated and moved to an above groundwater grade location and capped. The existing above groundwater grade quarry located adjacent to the railroad right-of-way which is located to the east of the Quarry Lake has been selected as the repository for the CKD (Drawing 1). Following CKD transfer, the former quarry will be capped with drainage directed to the southern portion of Quarry Lake. Drainage of the southern portion of the lake will necessitate the construction of a dike in the channel which connects the two water bodies which comprise Quarry Lake (Drawing 1). Once the dike is in place, the water present in the smaller southern portion of the Lake will be pumped to the northern water body. Once the below watertable grade CKD has been removed, the temporary dam will be removed and the drained portion of the lake allowed to refill.

Although some slightly elevated TDS and pH values were noted in the water samples collected at Quarry Lake and the badlands area monitoring well 14S, groundwater removal and treatment is not considered necessary at the LCNC. The decision for not extracting groundwater is based on the lack of any significant groundwater impact at the site, and the natural dilution and buffering occurring in the bedrock aquifer. Periodic groundwater monitoring will also be performed in the LCNC area.

The result of the remedial action in the LCNC area will be the removal of CKD from contact with site surface water and groundwater and, through the capping of the CKD deposits, minimization of the production of leachate.

2.3 Operation of a Water Treatment System

As discussed above, water pumped from the site ponds and the eventual Arch Pond collection sump will have to be treated prior to discharge. As a preliminary form of treatment, runoff from the capped CKD Reclamation Area and capped Area C quarry will be directed to the Arch Pond sump. This dilution water may also result in the precipitation of less soluble compounds from solution. Subsequent treatment will entail pH adjustment utilizing hydrochloric acid (HCl) followed by blending into the Winnebago River under the guidelines set forth in an NPDES permit. Operation of the treatment system, and consequently portions of the site remedial action (capping of the Area C CKD deposits), directly hinges on the installation of the discharge pipeline to the Winnebago River. In addition, operation of the system under the pending NPDES permit is dependent on the performance of a stream characterization study. This study, which includes investigations of the stream's biological and water chemistry attributes, is tentatively scheduled for Spring, 1993. Once the Arch Pond collection sump is operational and groundwater levels are lowered beneath the site CKD deposits (if necessary), subsequent water treatment may no longer be necessary.

3.0 ACQUISITION OF DESIGN DATA

In order to prepare subsequent design plans for the remediation effort, several predesign data acquisition tasks will need to be completed. Some of these data collection tasks are currently underway. The data collection tasks necessary for subsequent design efforts include:

- A site survey to determine the present topography of the site*;
- Laboratory geotechnical testing of the capping materials to be used for the low permeability clay cap*;
- Geotechnical slope stability analysis*;
- The installation of monitoring wells;
- Groundwater, surface water, and effluent collection and analysis;
- Channel geometry characterization for the design of a temporary dam; and
- Design, installation and testing of clay cap test pads*.

"*"-data collection effort currently underway.

A discussion of the objectives and implementation protocols of the above investigative tasks is presented in the following sections. In addition, a discussion of design methodologies is also presented.

3.1 Site Survey

Accurate topographic control is prerequisite to the preparation of accurate grading plans. Site topographic surveying of the planned capping areas and drainage areas (Badlands, Quarry Lake, CKD Reclamation Area, Area C quarry, and the eventual Arch Pond sump area) was initiated in October, 1992. The surveying efforts, supervised by a registered land surveyor, are being performed relative to a nearby USGS benchmark. The field work is anticipated to be completed, weather permitting, by the end of 1992, while the site maps are to be generated from these notes during the first quarter of 1993. The results of the site survey will be used to determine appropriate CKD base grades on which the clay cap will be placed. The difference in the existing topography and base grade topography will be used to calculate soil cut-and-fill volumes. The legal description of the Lehigh site is also currently being prepared by the contracted surveying firm.

3.2 Clay Characterization

To prevent surface water from infiltrating through the kiln dust, a low permeability barrier will be placed on the surface of the kiln dust. The low permeability barrier will consist of a layer of locally occurring clay. The clay proposed for construction of the cap is accessible in the Lehigh clay pit located approximately ¼ mile west of the Plant Area. Based on preliminary assessments, the Lehigh clay source is suitable for capping and present in sufficient quantities for site capping activities.

The suitability of the clay as a capping material has been assessed through laboratory geotechnical analyses including:

- grain size analysis including hydrometer;
- moisture-density relations (standard proctor) tests;
- Atterburg limits (liquid limit and plastic limit);
- falling head permeability tests; and
- natural moisture content.

Based upon the analysis of two samples, the clay to be used for capping is texturally very fine with 95%-99% by weight passing a P200 sieve. The results of standard proctor analysis range from 110-113 pounds/ft^3 at moisture content values of 17.5% and 15%, respectively. Natural moisture content at the time of sampling was 17.4%. The liquid limit for the clay averaged 47 and the plastic limit ranged from 22-25. Based on these Atterberg limit values, the clay may be generally classified as having a moderate swell potential. The permeability of the recompacted clay averaged 1.4 x 10^{-8} cm/s at a 96% of maximum standard proctor compaction density. An additional sample will be collected and analyzed during the site test pad program.

3.3 Slope Stability Analysis

Due to physical limitations at the Lehigh site, slopes greater than those generally recommended by the US EPA with IDNR guidance. Because slope failure is a concern with steeper slopes, clay and CKD samples have been collected for geotechnical characterization for slope stability analysis. This analysis, using the slope stability testing, will result in the determination of the maximum stable cap slope. A 1.5 safety factor will then be applied to the calculated maximum slope angle to give the design slope angle for the capped CKD deposits.

Based on conceptual grading plans, two slope stability conditions are being considered. The first stability scenario, which is only applicable to the CKD Reclamation Area, centers on the determination of the strength of *in situ* CKD and the potential for shear failure between the in-place CKD and the clay cap. To address the failure concerns, clay and undisturbed CKD samples have been submitted for Atterberg analyses, standard proctor analyses, textural analysis, consolidated and unconsolidated undrained triaxial shear tests, and direct shear testing. The second stability scenario is common to all of the site capping areas including the Reclamation Area, and involves the determination of the strength of recompacted CKD and the clay cap which shall overlie it. The geotechnical testing associated with the second scenario will include gradations, standard proctor analysis, undrained triaxial shear testing, in place density, water content, and direct shear measurements. Both slope failure scenarios will be modeled using the computer models PCSTABL4 and BISTAT.

3.4 Monitoring Wells

The addition of three watertable monitoring wells to the existing monitoring well array (well nest LPC-MW90-2S and 2D and wells LPC-MW90-3S, 4S, 5S, 6D, 7S, 8D, 9S, 10S, 11S, 12S, 12D, 13S and 14S) will be necessary in order to refine the current interpretation of the area hydrogeology beneath the CKD Reclamation Area (Drawing 2-Provided in document map pocket). The specific data collection objectives of the installation of the monitoring wells include:

- Determination of area stratigraphy;
- Determination of the depth to groundwater;
- Determination of groundwater flow direction and gradient;
- Assessment of groundwater quality;
- Determining whether the CKD in the Reclamation Area is saturated;
- Determining the effects of pond draining on the groundwater system;
- Determining the physical characteristics of the aquifer; and
- Assessing the effectiveness of the engineered cap.

The primary goal in acquiring the above data will be the determination of whether the CKD in the Reclamation Area is saturated. As discussed in the site feasibility study, Arch Pond will be converted into a site sump which will be pumped to lower the watertable proximal to the sump. The effectiveness of the pumping will be assessed by noting water level fluctuations in the new and existing wells. If the CKD is found to be saturated and pumping is not totally effective in addressing the problem, the area will be modeled using the groundwater flow model MODFLOW and incorporating the hydrogeologic data derived from the new and existing wells in an effort to determine the best method of addressing the situation.

The wells will be rotary drilled using air or air/water circulation techniques and will be completed in accordance with the regulations set forth by the Iowa Department of Natural Resources (IDNR). The specific well construction parameters will include:

- Well screen: Two-inch diameter factory slotted PVC screen; slot size shall be .010", screen length shall be ten feet
- Well riser: Two-inch diameter flush joint, threaded, PVC
- Four-inch diameter PVC slip caps
- Sand pack material
- Bentonite slurry
- Pelletized bentonite
- Neat portland cement
- Protective casing: six-inch steel locking well boxes will be grouted into the boring.

An LGI hydrogeologist will log the borings as well as supervise well construction. The wells will be developed by bailing, pumping, or air lifting to ensure good hydraulic connection with the surrounding formation. Water levels will be allowed to equilibrate over a suitable time period before measurements of static water levels are taken. Elevations of tops of well casing for all new wells will be surveyed to the nearest one hundredth of a foot and location to the nearest one tenth of a foot.

3.5 Water Quality Monitoring and Analysis

The temporal assessment of groundwater and surface water quality at the site will be used to assess the effectiveness of the remedial action. Important to the design process will be the sampling and analysis of the groundwater in the CKD Reclamation Area. Results from the on-going data collection will be used to evaluate the proposed design activities. Therefore, following installation of the three new wells, the entire site monitoring well array, including the new and existing wells, will be sampled and analyzed for the site parameters for groundwater as presented in the AO are pH and the metals chromium, lead and arsenic. Field parameters including pH, specific conductance, and temperature will also be measured during the sampling event. The collected data will be used as a baseline to assess the effectiveness of subsequent remedial activities. The wells will be sampled on a quarterly basis during the remedial action and for two years after its completion.

As part of the discharge pipeline/treatment facility permitting process, effluent water samples (from the existing emergency discharge facility) will have to be collected and analyzed for total suspended solids (TSS). Should the TSS concentrations be found to exceed a daily maximum of 45 mg/l, a more effective settling procedure will be designed and constructed to attain discharge limitations.

All sampling and sample shipment will be performed in accordance with the protocols set forth in the Remedial Design Quality Assurance Project Plan included as Appendix A of RDWP. All analytical work will be performed by an EPA approved CLP laboratory. In addition, the sampling team(s) will adhere to the safety protocols presented in the Remedial Design Health and Safety Plan provided in Appendix B of this RDWP.

3.6 Channel Characterization

Installation of a temporary dike across the Quarry Lake channel will necessitate a channel depth/geometry survey. Although water depth is less than 5', the hydrostatic force to be endured will be evaluated to ensure adequate construction. Channel geometry and water depth will be determined by direct measurement.

3.7 Clay Cap Test Pads

A clay cap test pad effort is proposed in order to gather the geotechnical and specific construction data. The test pad data, including installation criteria, geotechnical aspects, and in-field infiltration information, will prove necessary for subsequent remedial design efforts.

The test pad will be installed to the north of the Lehigh facility and immediately west of the reclamation area CKD deposit (Figure 1). The finished pad will measure approximately 60' x 100' and will be comprised of both an underlying CKD layer and a clay cap. The pad will be divided into four individual approximate 15' x 100' longitudinal strips. In an effort to determine optimum placement parameters, factors including compactive effort and soil moisture content will be varied between the four strips.

Initial site activities will include surface clearing, grubbing and leveling of the test pad area as directed by an on site LGI representative. Cap dimensions will be established by contracted surveyors. Once cleared, approximately 700 yds^3 of CKD from the nearby reclamation area will be transferred to the pad area. The CKD will be used to create a platform approximately 2' thick. In addition to qualitative assessment, density and moisture testing of the CKD will also be performed for comparison to optimum laboratory attained values. The in-field density testing will be accomplished using a nuclear density gauge.

The clay used for the test pad will be obtained from the Lehigh clay pit located approximately ¼ mile to the west of the test pad site (Figure 1). This clay has already been submitted for geotechnical characterization. As part of the testing, standard proctor analyses were performed

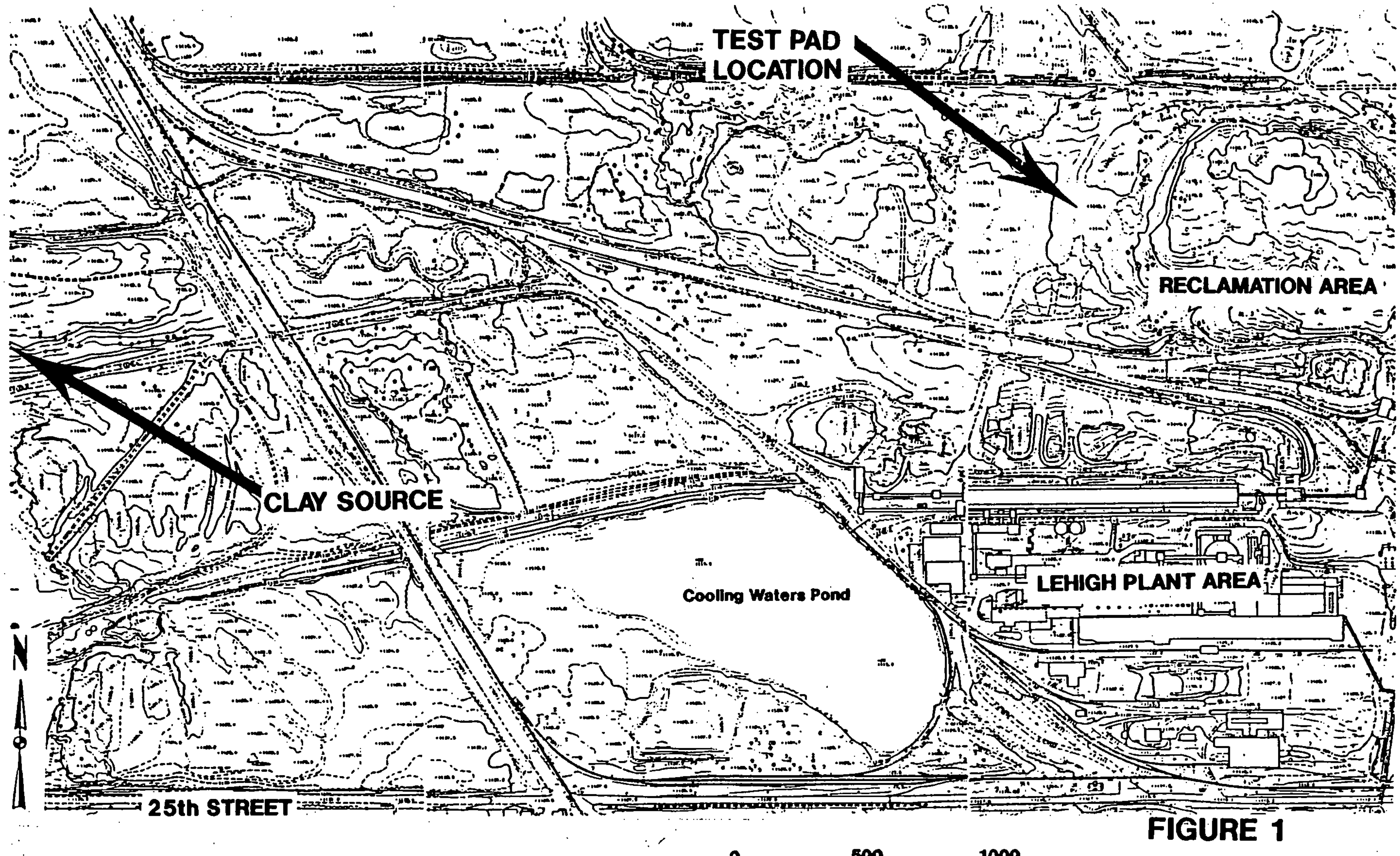

FIGURE 1

TEST PAD AND CLAY SOURCE LOCATIONS, LEHIGH SITE, MASON CITY, IOWA

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on several samples and density/moisture conditions determined. The standard density values for the clay ranged from 110-113 pcf at moisture contents of 17.5% and 15.0%, respectively. The clay installation parameters will be varied until at least 95% of standard optimum proctor soil densities have been achieved. Clay with 0%-4% greater than optimum water content will be placed in order to minimize permeability. Representative clay samples will be collected for confirmatory proctor analysis.

The total engineered clay thickness will be 18". In attaining the 18" total thickness, compacted 9" lifts will be placed as part of the test pad process. Compaction will be accomplished using a sheepsfoot roller. As with the CKD platform, density and moisture testing of the engineered clay will be done on a 10' staggered grid on each installed lift using a calibrated probe-equipped nuclear density meter. Clay samples will also be collected for laboratory moisture content analysis.

Once optimum density has been achieved on one of the test strips, the surface will be scraped to remove a 3" veneer of less dense clay and two infiltrometers will be installed. Because the determination of the single dimensional (vertically downward) flux through the clay barrier is the goal of the program, double-ring infiltrometers have been selected in order to minimize the problem of lateral flow beneath a single ring unit. Two infiltrometers have been proposed so that the data collected from one unit can be corroborated with those from the adjacent unit. The infiltrometers will be constructed and installed following ASTM testing method D 5093-90 as well as the guidance presented in the document entitled: *"Field Measurement of Infiltration Rates Using a Sealed Double-Ring Infiltrometer"* written by Stephen Trautwein of the University of Texas at Austin (attached). The infiltrometers to be used for the testing will adhere to the ASTM standard testing method D5093-90. As presented in the guidance document, the double-ring infiltrometers will be teamed with tensiometers to measure the depth to the wetting front. LGI proposes to install six tensiometers in each infiltrometer to provide the data acquisition redundancy necessary to confirm the testing results. The tensiometers will be installed at depths of 5", 10" and 15" beneath the ground surface adjacent to the inner ring (Figure 2). The test will be conducted until steady state conditions are achieved. The data will be recorded on the

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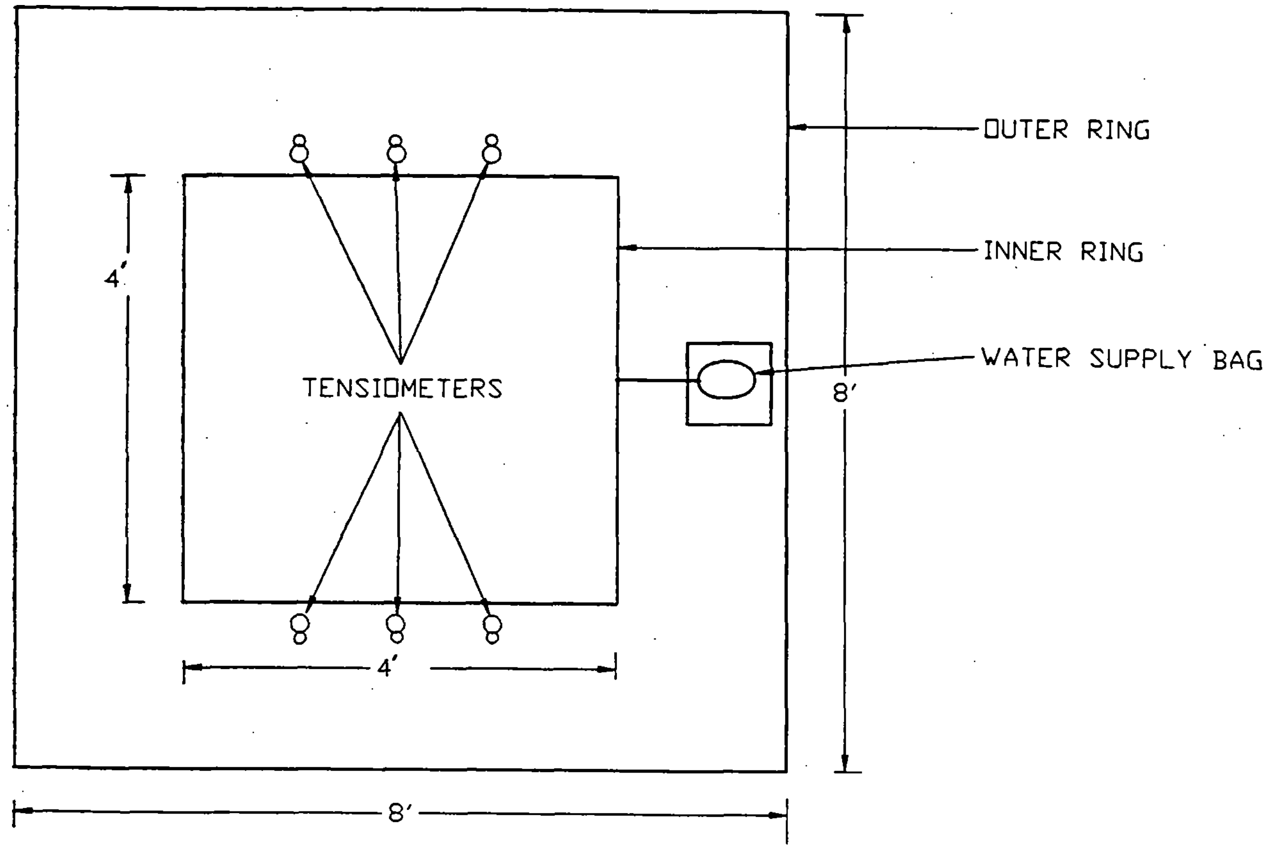
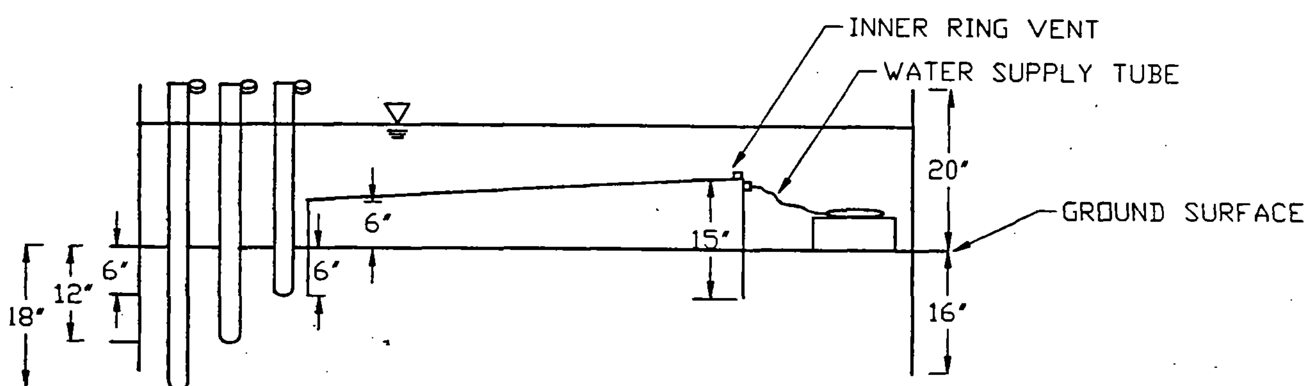


PLAN VIEW



PROFILE VIEW

FIGURE 2

PLAN AND PROFILE
OF THE
PROPOSED DOUBLE-RING
INFILTROMETERS
LEHIGH TEST PAD

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forms provided in the testing procedures attachment. For comparison and confirmatory purposes, three shelby tube samples will be collected from the tested clay strip and submitted for laboratory falling head permeability testing as well as cap thickness confirmation.

A benchmark will be established at the test pad so that lift thickness and infiltrometer elevations can be recorded during the tests. The infiltrometer elevation data is made necessary due to the swelling capacity of the clays to be used. Once the wetting front reaches the base of the inner ring, the ring may rise due to the effect of swelling clays, however, based on Atterberg limit values, swelling should not be significant. The elevation data will serve as input data for the calculation of hydraulic conductivity. Temperature changes can also affect the quality of data obtained during an infiltrometer test. In order to minimize significant water temperature fluctuations, the infiltrometers will be wrapped with insulation (straw) and covered with an insulated wooden/insulation framework.

The health and safety practices to be followed during the test pad effort are addressed in the Remedial Design Health and Safety Plan provided in Appendix B of this RDWP.

4.0 PROPOSED REMEDIAL DESIGN SCHEDULE

A proposed schedule for the investigative efforts outlined in this RDWP, as well as all subsequent submittals, is provided as Drawing 3 (Provided in document map pocket). As indicated on the schedule, most of the required design data will tentatively be acquired during the first quarter of 1993. However, weather conditions may delay the efforts. Perhaps the most weather dependent element of the data collection tasks is the construction of the clay cap test pad. Should weather conditions delay the installation of the pad, design efforts will be delayed accordingly, because site cut and fill plans can not be prepared until the thickness of the clay cap is finalized. Other timetable elements which are tentative include the construction of the discharge pipeline and the commencement of pumping. The construction of the pipeline is directly dependent on the acquisition of an easement from Cerro Gordo County and a construction permit from the IDNR. Use of the pipeline is dependent on the acquisition of an NPDES permit and the performance of stream study on the Winnebago River. Subsequent remedial design and construction activities including the capping of the Area C CKD deposit and excavation of the surface water drainageways in the former quarries directly hinge on the pumping effort. In addition, the necessity of some elements provided on the schedule including groundwater modeling and design of the french drain are contingent on the drainage of the quarries and construction of the Arch Pond sump.

5.0 COMPOSITION OF THE DESIGN TEAM

Remedial design efforts will be performed by LGI personnel while maintaining continual communication with the Lehigh project coordinator and his staff. LGI attempts to maintain personnel continuity throughout the project. Therefore, although the scope of the effort is shifting from one of investigation to remedial engineering, Mr. Mark Borucki will continue as the Project Manager. The design team will be comprised of individuals experienced in the disciplines of engineering, hydrogeology, and construction management/data quality control as specifically applies to CKD disposal sites. The specific individuals assigned to the Lehigh remedial design project include:

Project Manager

Mark K. Borucki- Project Manager/Hydrogeologist

As the project manager from the preparation of the Lehigh RI/FS to present, Mr. Borucki has gained the site familiarity necessary to direct remedial system engineering efforts. He has also established a working relationship with Lehigh, US EPA and IDNR personnel. Mr. Borucki's familiarity with the site, combined with his experience in hydrogeology, site remediation, construction management, and earthworking projects, will ensure that the system engineering is efficiently managed.

Project Engineering Team

A. James Kelly, P.E.- Sr. Project Engineer

Mr. Kelly is a professional engineer in environmental engineering with over 12 years of experience. His experience has included system, process, civil and remedial design as well as subsurface characterization. Mr. Kelly will be responsible for all engineering associated with the Lehigh remedial action design.

Lance W. Parve- Project Engineer

Mr. Parve's extensive experience in site civil engineering work and remedial actions will be utilized during the Lehigh remedial engineering. Mr. Parve also offers extensive experience in CADD survey preparation.

Donald Pionek- Project Engineer

Mr. Pionek offers over 20 years of experience in civil engineering and the preparation of site grading plans. Mr. Pionek will be responsible for preparing all site capping area cut-and-fill plans.

Project Hydrogeology Team

Bernard G. Fenelon- Sr. Project Hydrogeologist

Mr. Fenelon has over 7 years of experience in hydrogeological interpretation and application. Mr. Fenelon will coordinate all of the site hydrogeologic investigations outlined in this RDWP. He will also interact with the project manager and design engineers.

Wenbin Yuan- Project Hydrogeologist

Mr. Yuan will be called upon to perform all necessary groundwater modeling efforts associated with system design. His extensive experience in groundwater and surface water chemistry will also prove beneficial in assessing the assessing the effect

Project Quality Assurance/Construction Management Team

John T. Bruskewitz- Project Hydrogeologist

Mr. Bruskewitz has broad experience in the fields of hydrogeology, surface hydrology, and construction management. In addition, Mr. Bruskewitz will manage the collection of all field data and ensure that quality assurance protocols are followed during the remedial design process.

Christopher J. Macek- Geologist

Mr. Macek, through his experience in geology and construction management, will serve as one of the on site data coordinators.

Technical Advisory Team

John C. Osborne- Sr. Project Hydrogeologist

Mr. Osborne's experience with the remedial design and subsequent construction management of a similar site will prove invaluable to the engineering of the Lehigh remediation system.

James Bridgforth, P.E.- Sr. Engineer

As an experienced design engineer in the civil and hydraulic engineering fields for over 25 years, Mr. Bridgforth will provide support to the technical design team on an as needed basis.

Carl Nuzman, P.E.- Chief Hydrologist

As a professional engineer and chief hydrologist, Mr. Nuzman has over 20 years of experience in the design and construction of numerous groundwater recovery and dewatering systems in a variety of hydrogeologic settings. He also has extensive experience in water treatment engineering.

6.0 PERMITTING PLAN

Some of the remedial actions planned for the Lehigh site will require the procurement of various permits from local and state agencies. Although no permits should be required during the remedial design data collection and submittal period, several permits will be necessary prior to the implementation of remedial efforts. The anticipated permits and easements associated with the Lehigh site remediation include:

Pipeline and Operation of the water treatment system-

- Easement from Cerro Gordo County (LCNC)**;
- Easement from Iowa Traction Railroad*;
- Permission to use the USGS gage on Winnebago River;
- Permit from IDNR for construction of gaging station on Calmus Creek;
- NPDES permit from IDNR for discharge to the Winnebago River**;
- Iowa DOT permit for construction beneath US Hwy 65*;
- IDNR Construction Permit**;
    - Pipeline
    - Treatment Facility

Remedial Actions in the Lehigh Plant Area-

- Groundwater extraction (if necessary) permit from IDNR;
- Stormwater runoff permit(s)(as necessary);

Remedial Actions in the LCNC Area-

- Easement from Cerro Gordo County**;
- Iowa DOT permit for US Hwy 65 equipment crossing (controlled intersection?);
- IDNR permit for the construction of the dike in Quarry Lake and pumping of water from the western portion of the Lake to the eastern;
- Stormwater runoff (as necessary).

Permit/Easement Status
"*"- Acquired
"**"- Pending

The acquisition of all necessary permits will be performed through a coordinated effort involving Lehigh and their agents, LGI, and all applicable subcontractors. All permits will be acquired before any actions are initiated.

7.0 CKD STANDARD COMPOSITION WORKPLAN

This standard composition workplan for CKD addresses two functions, differentiation and characterization, with respect to the Remedial Design. Each function has a separate purpose and requires the determination of different CKD qualities. Differentiation addresses the issue of distinguishing CKD from natural soils at the site, a necessary process to ensure all the CKD is properly disposed and to minimize the moving and capping of non-CKD materials. Characterization addresses the requirement of defining the chemical composition of CKD with the purpose of describing the CKD to be consolidated and capped at the Site. The health and safety plan and data quality assurance plans associated with these tasks are included in the as appendices to this document.

The following subsections address sampling plans and statistical requirements for CKD differentiation from locally occurring soils, CKD characterization, and sampling requirements.

7.1 Differentiation

7.1.1 Area Soils

Data for this section comes from the USDA Soil Conservation Service (SCS) report: Soil Survey of Cerro Gordo County/Iowa published in 1981. Much of the Lehigh site at the time of the survey was covered by water filled quarries, limestone quarry pits, clay pits, and loamy orthents (soils which have been reshaped or relocated by man's activities). In these areas, the material exposed after possible reshaping will be difficult to predict. The general soil complex overlaying the area of the site is the Rockton-Sogan-Mottland Association described as well drained and somewhat excessively drained soil that formed in loamy sediment over limestone bedrock on stream benches and uplands. The following soils listed by map symbol number are indigenous to the Lehigh site:

41C - Sparta Loamy Fine Sand

This soil is excessively drained and is typically very dark brown loamy fine sand at the surface, grading to a very dark grayish-brown loamy, fine sand in the subsurface, to a dark yellowish-brown, friable loamy, fine sand or a yellowish-brown loose fine sand at depth in the substratum. The soil is generally acidic in the upper layer and contains about 1 percent organic matter.

135 - Coland Clay Loam

This poorly drained soil is located on bottomlands and is typically a black clay loam at the surface and in the subsurface and grades to olive-gray and very dark gray in the substratum. The soil is neutral or slightly acidic with about 7 percent organic matter.

177 - Saude Loam

This is a well-drained soil which is typically a very dark brown loam at the surface and subsurface, which in the subsoil and substratum varies between dark yellowish-brown, friable loam; dark yellowish-brown, very friable sandy loam and dark yellowish-brown loamy sand and gravelly coarse sand. The soil varies from neutral to strongly acidic with about 3 percent organic matter.

178B - Waukee Loam

This well-drained soil is typically a very dark brown loam at the surface, grading to a dark brown loam in the subsurface, and brown and dark yellowish-brown and brown, loamy coarse sand and coarse sand with gravel in the substratum. The soil ranges from neutral to strongly acidic with about 4 percent organic matter.

213 - Rockton Loam

This soil is well-drained and is usually located where bedrock is within 3' at the surface. Typically, the surface is a very dark brown loam becoming grayish in the subsurface. The subsoil is a brown, friable clay loam becoming reddish and sandy with depth. This soil is generally acidic and contains approximately 4 percent organic matter.

214 - Rockton Loam, 214B - Rockton Loam

This soil is typically located about 2 feet above limestone bedrock and well- drained. The description is generally the same as above, except at depth it becomes a brown, firm clay. It is acidic and has about 4 percent organics.

225 - Lawler Loam, 226 - Lawler Loam

This is a somewhat poorly drained soil located about 2 to 2½ feet above sand and gravel. At the surface it is a black loam grading to a very dark brown loam (subsurface); to a dark grayish-brown, friable loam changing to grayish-brown, light olive brown, and light brownish gray (subsoil); and finally, to a light olive brown and yellowish-brown gravelly coarse sand at depth (substratum). The soil is generally acidic and contains approximately 5 percent organic matter.

354 - Aquolls and Histosols

No one pedon is typical of Aquolls and Histosols. Included in these soils are Okoboji, Palms, Houghton, Faxon, and Tilfer soils. They are poorly to very poorly drained soils subject to flooding and ponding. They range from mildly acidic to mildly alkaline with the organic content of Aquolls ranging between 9 and 18 percent and in Histosols between 35 and 60 percent. Commonly, the Aquolls are black clay loam, silty clay loam, or mucky silt loam grading in the subsurface to black and very dark gray clay loam or mottled silty clay loam, and dark gray to bluish-gray clay loam, silty clay loam, or loam in the substratum. Typical Histosols are black sapric or hemic material at the surface and subsurface, grading to a very dark or dark gray silty clay loam, silt loam, clay loam, or loam in the substratum.

412C - Sogan Loam

This is an excessively drained soil typically consisting of an 8-inch thick dark brown loam at the surface and brown to dark brown loam in a 3-inch thick subsurface layer. Hard, shattered, level-bedded limestone bedrock underlies the soil. The soil ranges from slightly acidic to moderately (7.9 to 8.4 pH) alkaline and contains about 3 percent organic matter.

412E - Sogan Loam

Same as above except the 3-inch subsurface layer is absent.

559 - Talcot Clay Loam

This poorly drained soil is located about 3 feet above sand and gravel. Typically, the surface and the subsurface layer is black clay loam, the subsoil grades from a dark gray and olive, friable, clay loam to an olive gray and olive, friable loam, and the substratum is a yellowish-gray gravelly sand. The soil is moderately (7.9 to 8.4 pH) alkaline and contains about 6 percent organic matter.

936 -Coland - Hanlon Complex

This complex consists of poorly to moderately well-drained floodplain soils. Typically, the Coland surface and subsurface soil is black clay loam grading to an olive gray loam to a very dark gray and dark gray loamy sand in the substratum. Typically, the Hanlon surface soil is a black fine sandy loam grading in the subsurface to a very dark gray fine, sandy loam and into a very dark grayish-brown sandy loam in the substratum. These soils are neutral to slightly acidic with about 7 percent organics in the Coland and 4 percent in the Hanlon.

7.1.2 CKD Description

The CKD observed at the Lehigh site, for the most part, was white to light tan with some grading to a medium tan and yellow tan. Based on the results of the testing of a grab sample, CKD when mixed with an equal volume of tap water resulted in a solution pH in excess of 10 units following a ½ hour period. Nearly one-hundred percent of CKD will pass a number 200 sieve.

7.1.3 CKD Differentiation

Based on preliminary observations, CKD should be differentiable from *in situ* soils based on color, pH and texture. All the area soils are dark in color with the exception of the Lawler and Talcot loams which can display a light olive brown or light brownish-gray.

Additionally, with the exception of Sogan and Talcot loams, all site soils exhibited acid, neutral, or mildly alkaline pH and none displayed a pH over 9.0. A standard testing method will be developed to test the solution pH of collected soil/CKD samples. The method will entail the placement of a fixed volume of soil/CKD/soil-CKD mixture in a beaker into which a comparable volume of tap water will be added and the resulting solution pH measured. At this time, LGI anticipates that the test will involve adding approximately 400 ml of tap water to approximately 100 cm^3 of soil/CKD/soil-CKD, however, these volumes would be finalized on-site during initial testing activities.

Unless a clay deposit is discovered in the remediation area, the texture of the CKD should be readily distinguishable from the native soils. To ensure these observations are valid, samples of on-site, *in situ* soils will be compared to CKD samples gathered from several areas of the site. The CKD sample collection sites will vary aerially and with depth, and specific sites will be selected based on noted differences in CKD color and texture.

7.2 Characterization

7.2.1 Historical CKD Characterization

The U.S. Bureau of Mines (USBM) and the Portland Cement Association (PCA) have been active in the study and characterization of CKD for many years. The PCA published a document[1] in 1992 which summarizes work by the USBM[2] and by Construction Technology Laboratories, Inc. (CTL) for the PCA[3] among others.

[1]PCA's Kiln Dust Task Group, 1992, "An Analysis of Selected Trace Metals in Cement and Kiln Dust," Portland Cement Association, Skokie, IL.

[2]Haynes, B.W. and G.W. Kramer, 1982. "Characterization of U.S. Cement Kiln Dust," Bureau of Mines Information Circular 8885, Bureau of Mines, Avondale, MD.

[3]Delles, J.B., H.M. Kanare, S.J. Padiyara, and D.J. Broton, 1991, "Trace metals in Cement and Kiln Dust from North American Cement Plants," a report for PCA by Construction Technologies Laboratories, Inc.

The purpose of the 1982 USBM study was to characterize CKD which was normally produced by American cement plants. The mineralogy and chemical composition for 113 CKD samples from 102 plants were determined for 28 elements, 7 anions, CO_2, noncarbonate carbon, and chemically bound water. Hazardous potential was assessed by the EPA EP toxicity test. All but one sample, which slightly exceeded the criterion for lead, were in compliance with the EP toxicity test. It should be noted that no portland cement plants were included in this study. The typical CKD composition resulting from this study is given in Table 1.

Table 1. Typical Composition of CKD (1982).

Constituent	% by Weight
$CaCO_3$	55.5
SiO_2	13.6
CaO	8.1
K_2SO_4	5.9
$CaSO_4$	5.2
Al_2O_3	4.5
Fe_2O_3	2.1
KCl	1.4
MgO	1.3
Na_2SO_4	1.3
KF	0.4
other	0.7
TOTAL	100.0

The second CKD study was undertaken to update and expand upon the findings of the 1982 study. During the study, which was released in 1992, CKD was collected and analyzed CKD samples from 79 plants operating in the United States (71% of U.S. plants represented) and Canada (including portland cement plants). The emphasis of this study was 12 trace metals (including the 8 RCRA regulated metals). Extractable metals were analyzed following the US EPA toxicity characteristic leaching procedure (TCLP) and total recoverable metals. Over 99 percent of the CKD samples were below RCRA limits. Comparison of data for trace metals in the 1982 and 1992 studies show remarkable consistency.

The exhaustive work performed by the USBM (1982) and CTL (1991) studies sufficiently characterize the CKD and further work in this area is not warranted.

7.3 Statistical Sampling Requirements[4]

If sampling is required, then sampling will be done in a statistically acceptable manner. Statistics, the science of collecting, organizing, and summarizing data in such a manner that valid conclusions can be made, makes the quality estimation of the total field of CKD (population) valid by the quality estimation of the number of samples taken throughout the population. The overall quantity of material is capable of being estimated using the sampling data. A statistical population can then be derived which can be put to practical use in the field. For example, statistical lot sizes of portland cement are not to be larger than 125 tons, by ASTM C-917, paragraph 5.3. The same idea can be carried over to the CKD, where, for instance, the maximum lot size might be 100 cubic yards. Thus, a field sample(s) can be taken of any portion of the 100 cubic yards as the CKD is consolidated. The characterizations of the CKD can be determined by rapid field tests for color, texture, and pH.

The following key characteristics and terms are commonly used in sampling strategies:

- **Data type.** Attribute data, such as defective or acceptable, are the primary information recorded for sampling units when the major concern is the percentage of sample units that are defective. Measurement data are collected when the goal is to compute summary statistics, such as means, variances, and ranges. Selection of the type of sampling strategy is a design function. Since there is no "unacceptable CKD", attribute data has no meaning here. Measurement data would be required, but the data is needed and the acceptable range is within tolerance is subjective.

- **Acceptance/Rejection Criteria.** When percentage unacceptable is the statistic of concern, acceptance/rejection criteria are based on the maximum percentage of unacceptable units that can be tolerated. When summary measurements are of concern, these criteria are based on the nominal level (e.g., mean, variance) that is considered satisfactory for a specified measurement. Selection of the appropriate acceptance/rejection criteria is a design function.

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[4]EPA, 1986, "Construction Quality Assurance for Hazardous Wasteland Disposal Facilities," Environmental Protection Agency, Technical Guidance Document, EPA/530-SW-86-031.

- **Sampling Units or Blocks.** Sampling units or blocks are definite isolated quantities of material constant in composition and produced by a uniform process, that are eligible for selection into a sample. Each unit may contain one or more element that can be further selected for measurement.

- **Sampling Units and Measurements per Unit.** These numbers may be selected on the basis of judgment or determined by statistical methods. A subsequent topic of discussion.

- **Location(s) of Sampling Units and/or Measurements Within Units.** Locations for individual sampling units and/or measurements may be selected on the basis of judgment or on a random basis.

- **Treatment of Outliers.** Criteria for identifying and rejecting measurements that may be in error, or atypical, may be based on judgment or on statistical methods.

- **Corrective Measures.** When a sample fails to satisfy the acceptance criteria or a measurement is identified as an outlier by the prespecified criteria, some corrective action must be taken. The actual physical means of correction should be specified by the designer. In this case, any CKD is acceptable.

The term "sampling unit" or "block," refers to a definite, isolated quantity of material, such as soil, of constant composition and produced by essentially the same process, that is presented for inspection, acceptance, and/or measurement. It is characteristic of a block that all variation among measured properties within it is assumed to be random, with no underlying differences between locations in the block. The block may be characterized by a block mean and variance or as acceptable or unacceptable for each measured characteristic. Block size is established on the basis of judgment of uniformity of materials and construction and on economics of inspection.

For measurement purposes, a sampling unit or block is usually subdivided into a number of sample units or batches. A sample element is that portion of material removed from each selected sample unit or batch. A sample is a collection of sample elements, such as truck loads. Each element in the sample is independent from the other elements in the sample, and data are collected for each sample element.

The establishment of sampling methods and of sampling and testing frequency may be based on either judgment or on probablistic methods using statistical theory. Judgmental methods are subject to biases and sampling errors dependent on the knowledge, capability, and experience of the CQA inspection personnel. These factors cannot be easily evaluated and documented. Statistical methods are more rational, calculable, and documentable than judgmental methods and are usually recommended where feasible and applicable. Whether judgmental or statistical sampling is to be used, it is imperative that the procedure used is specified clearly and completely and is an accepted approach to sampling.

7.3.1 100-Percent Inspection

The ideal situation is that where the quality of all of the material used for a particular component of a storage site can be assessed by an objective observation or test procedure. Clearly, these procedures are limited to observations and nondestructive tests that are relatively inexpensive in terms of resource and time requirements. A less than optimum, but necessary, situation is where the quality of a material is assessed by subjective evaluation, usually visual inspection, of all material.

7.3.2 Judgmental Sampling

Judgmental sampling refers to any sampling strategy where decisions concerning sample size, selection scheme, and/or locations are based on other than probable considerations. The objective may be to select typical sample elements to represent a whole process or to identify zones of suspected poor quality. Sampling frequency is often specified by the designer and may be a function of the confidence in the CQA personnel. Selection of the sampling location(s) is often left up to CQA inspection personnel making the entire process dependent on the validity of his judgment.

There can be no standardized rules for judgmental sampling simply because such sampling depends on the judgment of the designer. Because judgmental sampling strategies are based on the experience and opinions of the CQA personnel, sample estimates (e.g., mean, variance, or relationship among variables) may be biased and hence may not represent accurately the overall material or process. There is no practical way to test for or to quantify these inherent biases nor to estimate the level of confidence associated with the sample estimates.

7.3.3 Statistical Sampling

There is an inherent, or natural, variability in measurement data for any specified quality characteristic of most materials and components used in construction, including the materials and processes used to construct a storage site. This variability may be attributed to variability in material quality, construction operations, measurement techniques and instrumentation, as well as the overall capabilities of the CQA personnel.

Statistical sampling methods are based on the principles of probability theory and are used to estimate selected characteristics (e.g., mean, variance, percent defective) of the overall material or process (population). The primary differences between these methods and those based on judgment are that sample selection is by an objective random process that reduces the likelihood of selection bias (i.e., every sampling unit has a known likelihood of selection) and provides a means of assessing the magnitude of potential error in the sample estimate (i.e., variability in sample group estimates that would be observed if multiple groups of independent sample elements were selected or the likelihood that the sample estimate does not deviate from the overall characteristic to be estimated by more than some specified amount). However, it should be realized that there is a need for experienced judgment in the selection of appropriate statistical techniques and in the evaluation of data generated by these techniques.

In statistical sampling, a sample unit refers to entities that are enumerated for purposes of sample selection and may or may not be the items that are measured. The underlying requirement for a statistical (or random) sample is that all of the units selected into the sample must have a known probability (chance) of selection into the sample.

There are many variations in random sampling strategies that can be used. Some examples are:

- **Stratified Sampling**
  If the CKD is known to vary across the site, independent samples might be selected from each area and the results combined by a weighing scheme depending on some property of the differentiating characteristic.

- **Two-Stage Sampling Strategy**
If it is impractical to enumerate all possible sample items, it may be possible to select a small number of large sample units and then select a sample of measurable elements from each unit.

- **Systematic Sampling**
If many loads of CKD are being hauled to a site and it is reasonable to assume that the loads are homogeneous relative to a particular characteristic, it may be desirable to examine every *nth* load after starting with a randomly selected start less than 'n'.

- **Grid Sampling**
If the goal is to assess some characteristic of an area, it may be desirable to overlay the site with a grid pattern and to select grid sections for sampling by randomly selecting coordinates. In this situation, if each section has an equal chance of selection, the plan would be classified as simple random sampling. If instead the plan specified that the selection probabilities be in proportion to some known characteristic such as area of grid section, it would be classified as a proportionate sampling. This will ensure that the probability of selection per unit area is the same for all grids and is equivalent to the situation in which all grids are equal and have an equal probability of being selected. The primary caution is that selection probabilities be known in advance or be equal for all units in an area, and that an accepted statistical technique be used for selection of random numbers.

7.3.4 Discussion

The plan used for each evaluation should be tailored to the particular situation and types of sample estimates desired. If the goal is to estimate some characteristic of a completed component or process, a simple random sample design or some modification such as a stratified or two-stage sampling plan should be used. If the goal is to monitor an ongoing operation such as placement of soils by trucks, a systematic sampling strategy may be used, where every *nth* truck would be examined after a random start. The reason for this selection is that the latter design does not require complete enumeration of the potential sampling units whereas some such enumeration scheme is usually necessary for the other designs. Once the data have been collected from a particular sampling strategy, they must be summarized, analyzed, and presented in a way that is tailored to the sample design that was used. All statistical sampling designs are based on the principles of simple random sampling.

Except for judgmental sampling, a basic assumption is that a probability of a known event, a standard deviation, or variance of the data is known. In this instance for CKD, that is not the case. Nor is there established limits on an acceptable range of values or rejection criteria. Therefore, if characterization sampling is required, a systematic sampling method based on truck or scraper loads for hauled CKD and random augering for *in situ* CKD will be used. For differentiation sampling, judgmental sampling is inherently required. The strategy will be established at a preconstruction meeting between Lehigh and the US EPA, if needed.

7.4 Recommendations

LGI believes that CKD can be differentiated from locally occurring soils using color, CKD/water solution pH and texture. Field testing will be performed to confirm this assumption.

LGI recommends that the data from existing national CKD characterization studies be adopted as the character of the CKD being capped at the Lehigh site, with no additional testing being required. It is further recommended that judgmental sampling be used for differentiation; and if required, a systematic sampling method based on CKD loads be utilized as discussed in detail in Section 7.3.3.

APPENDIX A

REMEDIAL DESIGN QUALITY ASSURANCE PROJECT PLAN

REMEDIAL DESIGN QUALITY ASSURANCE PROJECT PLAN
FOR THE
LEHIGH PORTLAND CEMENT COMPANY
PRE-REMEDIAL DESIGN DATA ACQUISITION PHASE

MASON CITY, IOWA

Prepared for:

LEHIGH PORTLAND CEMENT COMPANY
Mason City, Iowa

Prepared by:

LAYNE GEOSCIENCES, INC.
A Subsidiary of Layne Inc.

Project No. 61.2940
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LGI

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1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) details the procedures to be followed during acquisition of data necessary for the preparation of the Remedial Design Workplan (RDWP) for the Lehigh Portland Cement Company (Lehigh), Mason City, Iowa. The QAPP is necessary to ensure adherence to an optimal level of quality and reliability during the collection of the necessary data during this phase of data acquisition. The QAPP also details the policies, objectives, functional activities and specific quality assurance and control procedures that will be used by Layne GeoSciences, Inc. (LGI). All contracted and subcontracted firms performing work at the Lehigh site will abide by all operating quality assurance stipulations set forth by Lehigh and LGI. In addition, contracted and subcontracted firms will operate under the conditions presented in the document entitled: *"Standard General Conditions of the Construction Contract"* prepared by the Engineers' Joint Contract Documents Committee. and the Standard Specifications and Conditions of the Lehigh Portland Cement Company.

To meet the specifications of data acquisition activities set forth in the RDWP field inspecting, testing, sampling, and monitoring will be performed. Specifically, these activities will include the geotechnical monitoring of the clay cap test pad installation, the inspection and supervision of the construction of the new monitoring wells, the sampling of groundwater, pond water, treated effluent, and cement kiln dust (CKD). The tasks associated with each of the above inspection activities are detailed in the sections below.

The QAPP adheres to the guidelines specified in the U.S. Environmental Protection Agency (EPA) documents entitled; *"Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans"*, MS-005/80, 1980; *"NEIC Policies and Procedures"*, EPA 330-9/78-001-R, Revised 1986; *"Standard Operating Procedure-Review of Quality Assurance Related Documents"*, No. DQ310C, 1991; *"Construction Quality Assurance for Hazardous Waste Land Disposal Facilities"*, EPA/530-SW-86-031, 1986; *"Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA"*, Interim Final, EPA/540/G-89/004, 1988; and *"Data Quality Objectives for Remedial Response Activities, Development Process"*, EPA/504/G-87/003, 1987.

2.0 UPGRADING OF SITE MONITORING WELL ARRAY

The monitoring well array will be supplemented with three new wells. The three new wells will be drilled and constructed to a depth of approximately 20 feet into rock.

Installation of the monitoring wells will necessitate oversight by an LGI hydrogeologist. The hydrogeologist's activities associated with the wells will include siting, geologic logging, the supervision and direction of well construction, and well development and sampling. The hydrogeologist will maintain complete records of the well installation process, and will prepare well logs and well construction diagrams.

3.0 WATER QUALITY MONITORING

A necessary element of the remedial design phase of the RDWP will include the collection of groundwater, pond water, effluent samples and CKD samples. The water sample results will be used so that the treatment facility can be adequately designed, whereas the CKD samples will provide proper characterization of the CKD. The present monitoring well array will be increased with three additional monitoring points. Representative data will be acquired during the remedial design phase through the use of appropriate sampling procedures.

The various aspects which will be addressed in this section will include:

- Pre-sampling orientation of the sample collection crew;
- Description of sampling techniques or guidelines;
- Sampling methods with procedures outlined for each sample matrix;
- Sample handling procedures with descriptions of the sample containers, procedures, reagents, etc., used for sample collection, preservation, transport, and storage;
- Sampling equipment decontamination procedures to avoid sample contamination;
- Field documentation procedures; and
- Custody procedures for sample shipment

The objectives of the project are to minimize water contact with the CKD and to meet discharge requirements as defined in the NPDES permit and Administrative Order. These limits as presented in Table 1 constitute the project Applicable or Relevant and Appropriate Requirements ARARs.

TABLE 1

Discharge Limits

Water Source	Constituent	Limit or Range	Source
Groundwater	pH	6.5 - 8.5	AO
	chromium	0.050 mg/l	AO
	lead	0.050 mg/l	AO
	arsenic	0.050 mg/l	AO
Discharge to River	pH	6.0-9.0	NPDES
	TSS	30(ave)-45(max) mg/l	NPDES
	TDS	750 mg/l daily	NPDES

During the two year interim period, a 750 mg/l limit for TDS applies to the end of the 2000 foot mixing zone. An extension of the time period for the interim limits can be granted. After the interim period, the TDS limit will be determined by the algebraic equation listed in the NPDES permit and the 7Q10.

The need for treatment is expected to diminish after the CKD is hydrological isolated to the point at which the treatment is no longer required. The groundwater quality, at this point, will allow the water to be discharged directly to the Winnwbago River.

3.1 Pre-Sampling Orientation

A pre-sampling orientation meeting will be conducted to inform the sample collection crew of site health and safety protocol and the sampling methods to be used during the investigation. The meeting will serve to familiarize the sampling crew with the overall scope of the study, the sampling procedures, and the methodology for the use of the sampling equipment.

The objectives of the meeting, in particular, will be to familiarize the sampling crew with the following:

- Sample material characteristics, sampling equipment, and safety procedures;
- Location and number of sampling and/or monitoring points;
- Equipment operation and calibration procedures;
- Sample collection procedures and frequency;
- Field and trip blank collection procedures;
- Sample preservation, storage, and shipping;
- Documentation and record keeping procedures; and
- Decontamination materials and equipment decontamination procedures.
- Disposal of the water generated during purging of the wells and equipment decontamination.

3.2 Sampling Methods

Representative samples will be collected by using sampling guidelines recommended by the US EPA and the Iowa DNR. These procedures are outlined for each sample matrix in the ensuing subsections.

3.2.1 Cement Kiln Dust

Cement Kiln Dust samples will be collected directly into 500 ml glass containers. The bottles will be filled as full as possible to limit interaction with the atmosphere. The bottles will then be marked and labeled for shipment to the laboratory. Chain of custody forms will accompany the samples during shipment to the laboratory and will serve as documentation of sample handling history. All sampling equipment will be decontaminated between sampling locations.

3.2.2 Groundwater

A water level survey will be conducted at the beginning of each sampling event. Water levels will be measured in each monitoring well to be sampled to the nearest 0.01 of a foot and will be taken in order progressing from the least known contaminated well to the greatest known contaminated well. The general condition of the well and wellhead will be recorded. Should the well casing be damaged in any way, the well will be inspected for possible contamination and for casing integrity. In addition, the top of the casing will be resurveyed to determine if the elevation needs to be updated.

Groundwater sampling will progress from the least known contaminated location to the worst known contaminated location. Before extracting a sample from the monitoring wells, the wells will be purged so that representative samples are obtained. Purging will be accomplished using either a check valve type pump, PVC bailer or teflon bailer. A minimum of four well volumes will be removed from each well or the well will be evacuated to dryness. Purging will continue until the pH and/or the conductance stabilizes to within $\pm 10\%$ over two consecutive well volumes to ensure a representative sample.

Upon collection of a sample, field measurements of temperature, pH and specific conductance will be taken and recorded. The samples will then be bottled, marked and packaged for transferral to the laboratory in a cooler and maintained at 4°C. Chain of custody forms will accompany the samples during transferral to the laboratory and will serve as documentation of sample handling history. In addition, a random duplicate sample will be taken, one field blank will be prepared, and a trip blank will also be provided. The samples will be transferred to a qualified CLP laboratory for analysis of pH and total metals analysis for chromium, lead, and arsenic on a quarterly basis. All sampling instrumentation and equipment will be decontaminated between sampling locations and the water transferred to the site collection sump for subsequent treatment.

3.2.3 General Groundwater Sampling Procedure

The general sampling procedures are outlined below:

- The pH meter and conductivity meter will be calibrated according to manufacturer's specifications. The pH meter will be calibrated using buffers of pH 7.00 and pH 10.00.
- The well head and/or surface seal will be examined to check for integrity and recorded in the field log book. If damage is found, the condition will be assessed to determine if contamination could have entered the well from the surface, if not the well will be bailed to determine if it will accept a bailer and will still recharge. If surface contamination could have entered the well, the well will be repaired or abandoned.
- The depth to static water level in the well will be measured from the top of the PVC casing and recorded in the field log book.
- A bottom-emptying, teflon bailer will be lowered down the well and a water sample withdrawn to test water temperature, pH, and conductivity. The values will be recorded in the field log book.
- Well volumes will be evacuated using a Keck submersible pump and decontaminated between sampling points.
- The above step will be repeated until the pH and/or the conductivity stabilized to within (±) 10% over two (2) successive volume increments. This will be done to ensure the water extracted from the well was representative of the surrounding formation. Wells which are pumped dry will be allowed to recover prior to obtaining the sample.
- After recording the stable pH, conductivity and temperature reading, a sample of the groundwater will be collected.
- The samples will be labeled and a chain of custody document will be completed for the samples. Sample information will be recorded in the field log book.
- The samples will be placed in insulated coolers, cooled to 4°C and transported to the analytical laboratory.
- All sampling equipment will be decontaminated before moving to the next sampling point.

Water samples analyzed for metals will be filtered and acidified. The sample will be pumped through a 0.45 micron disposable filter utilizing a peristaltic or submersible Keck pump. The metals samples are filtered because of the possible presence of sediment in the groundwater. Because the samples will be acidified, filtering the samples rather than dissolving the constituents within the suspended sediment will allow for a more accurate representation of groundwater quality. Standard protocols for inorganic contaminant will be followed during all sampling events. Chain of custody forms will accompany the sample transferrals to the laboratory and served as documentation of sample handling history.

3.2.4 Effluent

Effluent water samples will be collected to demonstrate compliance with the water quality stipulations set forth under the site NPDES permit. Field measurements of temperature, pH, and specific conductance will be taken and recorded. The effluent water samples will then be collected directly into the appropriate-sized bottles. The samples will be analyzed for total dissolved solids, pH, and total suspended solids on a weekly basis, and for phenols on a monthly basis. The samples will be packaged in a cooler and maintained at 4°C for transferral to the laboratory. Chain of custody forms will accompany the samples during transferral to the laboratory and will serve as documentation of sample handling history. All sampling instrumentation and equipment will be decontaminated between sampling locations.

3.2.5 Surface Water

The elevations of the four surface water bodies to be sampled (Blue Waters Pond, Area "C" Pond, Quarry Lake and Arch Pond if not dry) will be taken as part of the water level survey conducted in conjunction with groundwater sampling. At a specific location in each of surface water bodies, field measurements of temperature, pH, and specific conductance will be taken and recorded. The surface water samples will then be collected directly into the appropriate containers. The samples will be labeled and placed in a cooler and maintained at 4°C for transferral to the laboratory.

3.3 Sample Handling

Several types of sample bottles with proper preservation will be required for each water sampling location. The required sample bottles and preservatives are detailed below:

Effluent from Treatment Facility:

Sample bottle:	1-liter plastic
Preservation:	none
Filtering:	none
Laboratory analysis	TDS, pH, TSS

Groundwater:

Sample bottle:	1-liter plastic
Preservation:	Nitric acid
Filtering:	none
Laboratory analysis:	As, Cr, Pb

Groundwater:

Sample bottle:	1-liter plastic
Preservation:	none
Filtering:	none
Laboratory analysis:	lab pH

After the bottles are appropriately filled, the lids will be hand-tightened. The sample bottles will then be secured with tape, and placed in an ice chest for transport to the laboratory. Any remaining space in the ice chest will be filled with styrofoam blocks or ice packing. The inside temperature of the ice chest will be maintained at 4°C using ice. Samples will be transported to the laboratory for analysis within 24 hours after collection and the analyses will be performed within permissible holding times (2 days for total dissolved solids, 7 days for total suspended solids and specific conductance, and 6 months for metals). If samples cannot be shipped on the same day that they are collected, packaging of the samples in coolers will be delayed until the following morning so that the samples can be shipped with a full load of ice. The samples will be stored on ice in coolers, and kept in a secure area.

3.4 Decontamination Procedures

All sampling equipment will be thoroughly decontaminated prior to any sampling activity to avoid contamination. The decontamination procedure will entail the following procedure:

1. Wash with non-phosphate detergent;
2. Rinse with tap water; and
3. Rinse with organic free, deionized/distilled water

As previously discussed, sampling will proceed from the least known contaminated location to the location with the greatest known contamination.

Field instrumentation used to measure pH, temperature, specific conductance, and water levels will be decontaminated between measurements by rinsing with organic free, deionized/distilled water.

The drill rig (and support vehicles if needed) will be decontaminated at a designated area using high pressure water and steam prior to the drilling of the monitoring wells and after the last boring. The following items will be decontaminated using high pressure water and steam between each boring:

- All down-hole drilling and sampling equipment
- Any piece of drilling equipment that comes in contact with CKD during the drilling operation
- Any hand tools used in the drilling process that come in contact with the down-hole drilling and sampling equipment
- All well development and purging equipment, including bailers, pumps, surge blocks and jetting tools. All the pumps and hoses will be flushed with clean tap water between borings
- Any support vehicle, water or pick-up truck, that becomes excessively soiled during the drilling or well development activities.

3.5 Documentation

A sample numbering system will be used to identify each sample. The numbering system will provide a tracking procedure to allow retrieval of information about a particular sample and assure that each sample is uniquely numbered. The sample identification numbers will be composed of four components:

1) A three letter designation to identify the project for which the sample is collected. (For this project it will be LEH)

2) A code to identify its type as follows:

    - MW- Groundwater Monitoring Well

- EF- Treated Effluent
- SF- Surface Waters

3) For the monitoring wells, a two-digit number will be used to indicate the specific monitoring well. The treatment facility effluent will be identified as "EFF". The surface water bodies will be identified as:

Blue Waters Pond	BWP
Area "C" Pond	ACP
Quarry Lake	QL
Arches Pond	ARCHP

4) A two-digit number to consecutively number sequential samples taken at a specific sampling location.

Examples of complete sample identification numbers:

- LEH-MW01-01: Lehigh- Mason City Plant - MW-1 - Sample Number 01
- LEH-EFF-03: Lehigh - Mason City Plant - Effluent Sample Number 03
- LEH-BWP-02: Lehigh - Mason City Plant - Blue Waters Pond - Sample Number 02

Sample labels will contain sufficient information to uniquely identify the sample in the absence of other documentation. The labels will include:

- Project number;
- Unique sample number (detailed above);
- Sample location (and depth, if applicable);
- Sampling date and time;
- Sampler's name;
- Preservation method employed; and
- Filtered/Unfiltered

The sample label will always be directly affixed to the sample container and will always be completed using indelible ink.

All information for water sampling will be recorded on field sampling data forms (Form 3-1) and in a field sampling log book. A copy of Form 3-1 is presented in Appendix A. This information will include sample type(s) taken, sample identification number, project name, project location, analyses requested, sample container(s), preservative(s), label identification (if applicable), all field measurements, casing volume calculations, the date, sampling location, well identification, starting time for well evacuation pumping, ending time for well evacuation pumping, pumping volume, general well condition, weather, time of sampling, field samplers' names (with identification of leader), and comments.

Pertinent observations, such as groundwater sampling field parameters (i.e., temperatures, specific conductance and pH), instrument adjustments (calibrations) performed in the field, and statements pertaining to any problems encountered, will be noted in the field log book. A sample analysis request form and a chain-of-custody form will be completed before transport or shipment. A complete description of sample custody is discussed in the next subsection.

If any color slides, photographs, or other related evidence is collected in the field, information on time, date, site location, and the name or signature of the photographer will be noted in the field log book.

3.6 Custody Procedures

As part of standard operating procedures, a chain-of-custody will be maintained for routine control of sample exchange. The chain of custody includes a field log book, a sample label, a sample analysis request form, and a chain-of-custody record. The sample custody will be maintained for both field sampling and laboratory operations.

After completing all field documentation procedures, the ice chest containing the samples will be addressed, identified, and placarded as appropriate. The ice chest will be hand-carried or shipped to the designated laboratory under proper custody documentation procedures.

4.0 CLAY CAP TEST PAD TESTING PROCEDURES

Certain testing protocols will be followed during the construction of the Lehigh clay cap test pad. The tests applicable to the test pad include:

- Surveying of lift thicknesses and infiltrometer elevations;
- Nuclear density and moisture content testing;
- Infiltrometer testing;
- Shelby tube clay sampling and permeability testing; and
- Moisture content sampling.

4.1 Surveying

A registered land surveyor will be used to ascertain the thickness of individual lifts as well as the elevations of the installed infiltrometers. The surveying team will be on site during the test pad construction.

4.2 Nuclear Density/Moisture Testing

A licensed operator shall perform the nuclear density and moisture content testing during the test pad program. The nuclear gauge will be calibrated to standards at the beginning and mid-point of each work day. Each lift will be tested in probe mode in order to minimize the lower density top layer effect. The tests will be performed on a staggered approximate 10' spacing as depicted Figure 4-1 located in Appendix B. The collected data will be recorded on prepared forms (Form 4-1). A copy of this form is presented in Appendix B.

4.3 Infiltrometer Testing

The analytical methodology presented in ASTM method D5093-90 will be followed during the installation and operation of the dual-ring infiltrometers. The saturation depth will be determined through the installation of six tensiometers per infiltrometer. Relevant data will be recorded on test pad infiltrometer data forms (Form 4-2). A copy of this form is presented in Appendix B.

4.4 Shelby Tube Sampling/Permeability Testing

Two clay samples will be collected using shelby tubes from the test strip on which the infiltrometers are installed. In order to correlate infiltrometer data to the permeability obtained for shelby tube samples, the samples will be submitted for laboratory falling-head permeability testing.

4.5 Soil Moisture Testing

Although the nuclear gauge to be used calculates soil moisture content, confirmatory samples (obtained from the shelby tube samples discussed above) will be collected and submitted for laboratory quantification.

5.0 QUALITY ASSURANCE OBJECTIVES

The data quality objectives established for each construction and water quality monitoring measurement parameter are based on prior knowledge of the measurement system employed, method validation studies using one or a combination of factors such as duplicates, spikes, standards, calibrations, recovery studies, etc., and the requirements of this project. The precision, accuracy, completeness, representativeness, and comparability objectives for the Lehigh site remedial action are discussed in the following sections; along with the procedures which will be employed to achieve these objectives. The ARARs were presented in tabular format in Section 3.0 - WATER QUALITY MONITORING AND METHOD DETECTION LIMITS (MDLs) are discussed in Section 6.0 - ANALYTICAL PROCEDURES. The MDLs are below the ARARs for all parameters.

5.1 Precision

Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Various measures of precision exist depending upon the "prescribed similar conditions". Precision goals for the Lehigh site investigation will be in accordance with the standards set by the American Society of Testing Materials (ASTM) and US EPA Contract Laboratory Program (CLP) laboratory requirements. All construction testing and laboratory analytical work will be performed following established protocols to ensure precision and comparability.

Earthen materials compaction testing is a critical element of the construction phase of the site remediation requiring significant data collection. The attainment of data precision goals in the density testing of these materials will be ensured by adhering to an acceptance value of 95% of the laboratory standard proctor value for these materials. Should the 95% value not be attained, the CQA Officer will notify the grading contractor and additional compaction efforts will be employed until the acceptance value is attained. The compactive effort will be recorded as the number of passes of the compaction equipment required to attain the 95% standard proctor density.

Water quality analytical precision will be assured through adhering to quality assurance protocols. The analytical laboratory will run a control standard at the beginning of each sample set and record the readings on a control chart form. In addition, appropriate instrument checks and calibration will be conducted (discussed in later sections) and duplicate, trip blank, and field blank samples will also be submitted. The blanks and duplicates will be treated as separate samples for identification, logging and shipping. Analytical results for the blanks and duplicates will be filed with the appropriate field sample data. These procedures will determine if particular analytical data would be reproducible for a specific sample.

A field blank is prepared by running deionized water through the sampling equipment and then transferring the water into sample bottles to evaluate for contamination that might be a result of contact with the sampling equipment. One field blank will be prepared for each sampling set during the Lehigh groundwater and surface water monitoring program. During groundwater sampling, if dedicated bailers are used, the field blank will be prepared using the bailer in the least known contaminated well before it is sampled. If dedicated bailers are not used, the field blank will be prepared at the end of the day after decontamination is completed. This process will provide data to evaluate the effectiveness of the decontamination procedures. To minimize the possibility of cross-contamination, locations will be sampled from least known contamination to greatest known contamination.

A duplicate is an additional sample taken from one of the same locations in the sampling set. For the Lehigh monitoring program, two duplicate samples (one subsurface and one surface water) will be collected for each set. The duplicate sample will be labeled as a separate sample and submitted for analysis. The results for the duplicate are then compared with results from the other sample taken from the same location to verify the degree of precision. Duplicate readings must be within 20% relative difference.

5.2 Accuracy

Accuracy is the degree of agreement between a measurement and an accepted reference or true value that can be expressed as a difference, percentage, or ratio as follows:

Difference = X-T
Percentage = (X-T)/T x 100
Ratio = X/T
where: X = a measurement
T = an accepted reference or true value.

Accuracy will be achieved for this project by the application of ASTM and US EPA CLP laboratory quality control standards and guidelines.

5.2.1 Soil Density Meter Calibration

The accuracy of the earthen material density readings will require daily calibration of the soil density/moisture meter. The calibration procedures are made necessary due to the minuscule decrease in the amount of radiation emitted from the radiation sources caused by natural decay.

5.2.2 Laboratory Water Analysis Calibration

Laboratory analytical accuracy will entail the running of at least one sample spike for each set of samples. Results will be recorded on control charts and have an upper limit of 125% and a lower limit of 75% of the known spike concentration. Results of the spike analysis will be reported with the appropriate field sample data. Detailed information on laboratory accuracy will be available in the Laboratory QA/QC manual after a laboratory has been selected.

5.2.3 Field Water Analysis Calibration

Water sample temperature, pH, and conductivity will be measured in the field on each sample taken. The manufacturers accuracy of each instrument will be noted in the field notes. Thermometers will not be calibrated separate from the manufacturers calibration. The pH meter will be field calibrated with pH buffer solutions of pH 7.00 and pH 10.00. The conductivity meter is internally calibrated based on a known resistance. Conductivity and pH field readings will be compared to lab results as a further check.

5.3 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. The completeness objective for the Lehigh site remedial activities and water quality monitoring is 90%. The degree of completeness will be determined by evaluating the data in conjunction with precision and accuracy requirements.

5.4 Representativeness

Representativeness is the degree to which the data accurately and precisely represents a characteristic of population, parameter variations at a sampling point, a process condition, or an environmental condition. For the Lehigh program, representativeness will be achieved by following appropriate sampling procedures as suggested in US EPA and Iowa DNR guidance documents. These procedures are outlined in Section 3.0. Adherence to these procedures will result in the collection of representative samples when, analyzed in conjunction with accuracy and precision requirements, will meet the representativeness objectives for the project.

5.5 Comparability

Comparability expresses the confidence with which one data set can be compared to another. Comparability will be achieved by maintaining, whenever possible and applicable, the units of measurement for the sample data consistent with those currently in use by the federal, state, and local agencies. For instance, soil density will be expressed in pounds per cubic foot (lbs/ft^3), temperature in degrees celsius, contaminant concentration in micrograms per liter (mg/liter) or parts per billion (ppb) for liquids. All data will be calculated and reported in units consistent with other organizations reporting similar data to allow comparability of data bases among organizations.

5.6 Historical Precision and Accuracy

Precision is a measure of the variability in repeated measurements of the same sample compared to the average value. Accuracy was discussed in Section 5.2 - Accuracy. Both Precision and Accuracy will be measured for each sampling round by the laboratory. For more details in this area see the appropriate laboratory QA/QC manual. Some historical data is available to assist in selecting analytical methods and as an indication of the usefulness of an analysis for the various parameters.

Precision is reported as Percent Relative Standard Deviation (%RSD.) The lower the %RSD, the more precise the data. %RSD is calculated for a pair of repeated analyses by the following:

$$\%RSD=[2|x_1-x_2|/(x_1+x_2)](100/\sqrt{2})$$

Accuracy is reported as %Bias; as %Bias approached zero, accuracy increases. %Bias is calculated by:

$$\%Bias= (x-y/y)(100)$$

where: Y is the true value and x is the reported value.

This method measures the systematic error within an analytical technique.

6.0 ANALYTICAL PROCEDURES

Only a US EPA CLP certified laboratory or a laboratory using a CLP equivalent QA/QC program will be used for sample analysis so as to assure that approved protocols will be followed. Samples collected in the field will be analyzed in the laboratory for selected parameters using standard guidelines and regulatory test procedures.

Specific analytical methods are chosen based on the ability of the method to meet detection limit requirements versus cost effectiveness. The detection limits are set for each parameter based on maximum concentrations allowed under primary and secondary regulations for drinking water and the reasonable achievable limits for the technique. The test methods, analytical equipment, and Method Detection Limits (MDL) for the required parameters are outlined in Table 3.

TABLE 2

Laboratory Water Analytical Methods

Parameter	Test Method	Equipment	Detection Limit
pH[1]	EPA 150.1	Corning pH meter	0.01 Units
spec. Conductance[2]	EPA 120.1	Wheat stone bridge	5 μmhos/cm
chromium (total)	EPA 218.2	P&E 5000 AAS-Furnace	0.001 mg/l
Lead	EPA 239.2	P&E 5000 AAS-Furnace	0.004 mg/l
Arsenic	EPA 206.2	P&E 5000 AAS-Furnace	0.010 mg/l
Total Dissolved Solids			

(2) Lab Confirmation for Field tests

The field parameters will be measured in the field with an instrument or equipment which has been inspected and calibrated. All data will be immediately recorded in the appropriate documents.

6.1 Calibration

Field instruments, such as pH meters and conductivity meters, will be calibrated whenever the instrument is turned on by following manufacturer's specifications. All calibrations performed

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(2) Lab confirmation for field tests

in the field will be recorded in the field notebook.

Laboratory instruments will be calibrated according to the intervals and techniques specified by the manufacturer for each instrument. If these are not available, the intervals will be established based on the stability and degree of usage of the test equipment, the degree of accuracy required, and regulatory requirements. A file will be kept for each piece of equipment to record results of the calibration and a label will be placed on the instrument indicating when the calibration was performed and when the next calibration is due. Any equipment past due for calibration shall not be used until calibration has been completed.

6.2 Data Reduction and Validation

One of the most important aspects of sample evaluation is the data reduction, validation, and reporting. This task will be performed by experienced personnel to ensure that only quality and representative data is reported for the selected parameters.

To validate the data, results are reviewed for consistency with previous results including the same number of significant figures and detection limits. The data should also be presented in reports of similar appearance and format. The results are then visually scanned for unusually high or low values based on prior data. If such a value is found, the results are checked to assure that the value was accurately read, calculated, and transcribed and that the instrument was functioning properly. The appropriate corrective action will be taken based on the results of this check (eg. instrument repaired, data recalculated, sample rerun).

6.3 Preventative Maintenance

Preventative maintenance will be performed for all field instruments according to manufacturer specifications. The instruments and equipment will be decontaminated and calibrated as needed. Spare parts or other accessories needed for routine maintenance will be kept with the instruments and equipment for immediate use. All field instruments and equipment will be promptly returned to their protective containers after use.

Laboratory equipment will be maintained according to the intervals and tasks specified by the manufacturer. Preventative maintenance items will include:

- A schedule of preventative maintenance tasks
- A list of any critical spare parts that should be on hand
- A label for each piece of equipment indicating when the maintenance was performed and when the next maintenance is due.

Equipment that is past due for maintenance can be used provided it is still in calibration.

7.0 PERFORMANCE AND SYSTEM AUDITS

The system audit consists of evaluation of all components of the measurement systems to determine their proper selection and use. This audit includes a careful evaluation of both field and laboratory quality control procedures incorporated into the sampling and analysis program to maintain quality control. Quality control checks will be accomplished by ensuring that proper field calibration, construction testing procedures, surface water and groundwater sampling, transporting, analytical, and documentation procedures are followed. An audit will be performed by the Project Quality Assurance (PQA) Manager after completion of each sampling round. The audit will be conducted in accordance with the following checklist:

- Complete Documentation?
  sampling date, sampling team, sampling location, sample collection method, sample preservation, calibration techniques and results, presentation of QC data

- Proper Sample Handling?
  decontamination procedures, sample storage conditions, sample containers, collection equipment, field custody noted in logbook, samples hand delivered to laboratory, transfer of custody documented, laboratory custody documented

- Appropriate Analysis?
  date of analysis within holding time, sample preparation, analytical method, detection limit, analysis of a trip blank, field blank, field duplicate, laboratory blank, laboratory replicate, and laboratory spike at a frequency of at least 1 per 20 samples for each matrix, compatibility between field and laboratory measurements

The findings of the audit will be fully documented and included in the quality assurance reports for review and corrective actions as necessary. The analytical lab will also perform system audits in accordance with established checklists and CLP requirements.

7.1 Routine Procedures to Assess Data Precision, Accuracy and Completeness

Precision, accuracy, and completeness will be checked by performing system audits and evaluating quality assurance data (eg. duplicates, blanks and spikes). In addition, the analyzing laboratory will evaluate the water quality data in accordance with CLP requirements using the appropriate statistical procedures that include:

- Central tendency and dispersion
  - Arithmetic mean
  - Range
  - Standard deviation
  - Relative standard deviation
  - Pooled standard deviation
  - Geometric mean

- Measures of variability
  - Accuracy
  - Bias
  - Precision; within laboratory and between laboratories

- Significance test
  - u-test
  - t-test
  - F-test
  - Chi-square test

- Confidence limits

- Testing for outliers

APPENDIX A

FORM 3-1 Field Sampling Data Sheet

IN-FIELD SAMPLING DOCUMENT

FACILITY NAME: ______________________________ DATE: __________

SAMPLING TEAM: ______________________________

LOCATION					
Protective Casing?					
Protective Casing Cap?					
Locked?					
Well Cap?					
Concrete Seal?					
Visual Damage?					
Pipe Top Elevation:					
Depth to Water:					
Volume Water in Well:					
Time Begin Purging:					
Volume Purged:					
Purged Dry?					
Problems Purging?					
Temperature:					
Field Conductivity:					
Field pH:					
Color/Odor:					
Turbidity:					
Sample Filtered?					
TOTAL DEPTH (TOC)					

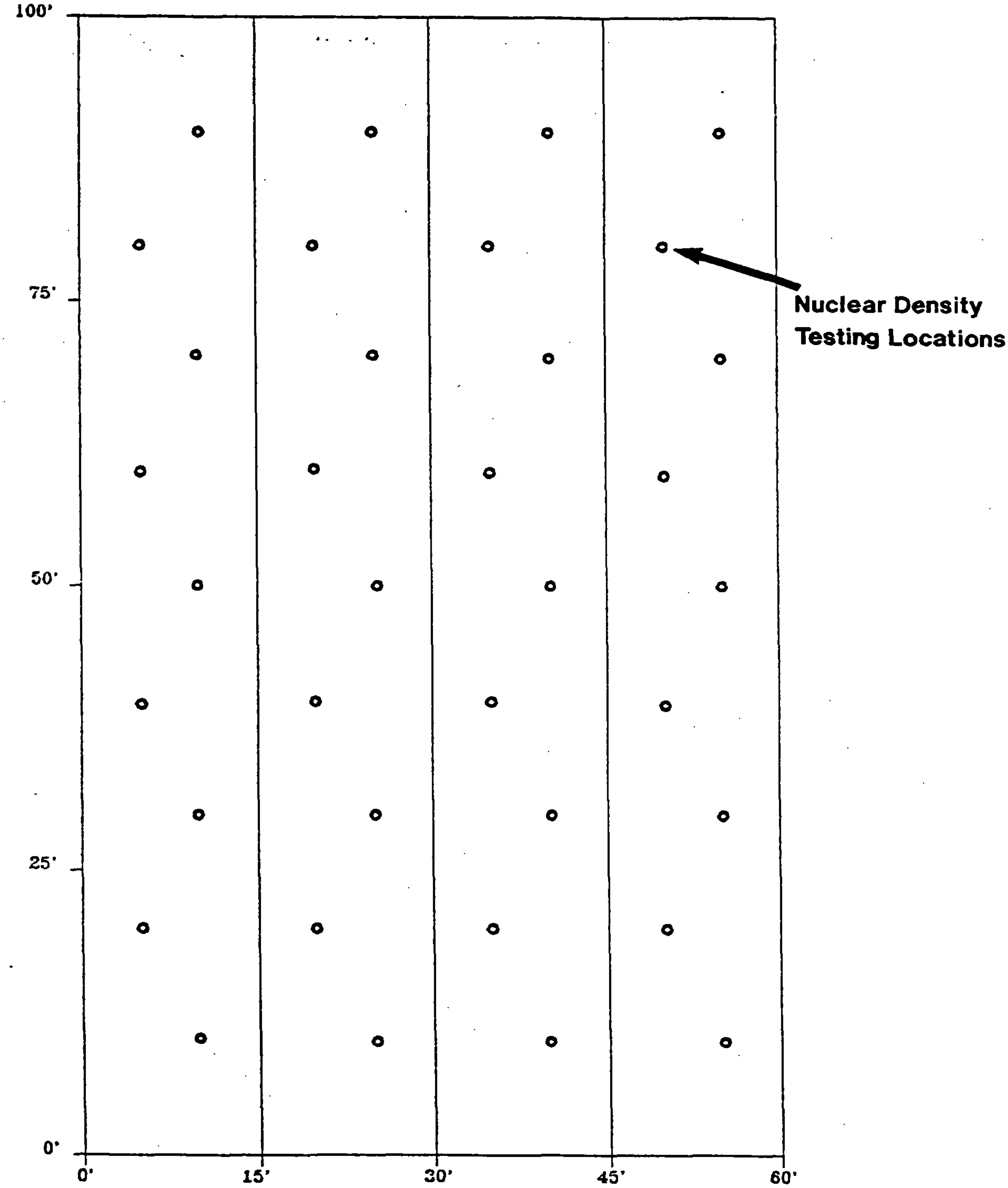
APPENDIX B

Figure 4-1 Lehigh Test Pad Details

Form 4-1 Field Density Test Form

Form 4-2 Test Pad Infiltrometer Data Form

BADGER BLUEPRINT CO. 557549



Layne GeoSciences, Inc.
A Subsidiary of LAYNE-WESTERN COMPANY, INC.

FIGURE 4–1
Lehigh Test Pad Details

Drawn by:	JB	Checked by: / Approved by:	JLB	11/92	Drawing number

FORM 4-1

Date ______

LGI Job No ______

Project Name ______

Technician ______

Page ____ of ______

LGI

FIELD DENSITY TESTS
(ASTM D 2922)

Unit ______ Density Std. ______ Moisture Std. ______

Test No.										
Soil Type										
Proctor										
Opt. Moisture										
Qp (TSF)										
Lift Elev.										
Test Depth										
Density Count										
Moisture Count										
Wet Density										
Dry Density										
Moisture										
% Moisture										
% Pr; % Dry										
cation										

emarks: ______

Location Diagram

Show North Arrow

LEHIGH TEST PAD INFILTROMETER DATA

DATE	TIME
WEIGHT	INSTRUMENT
TENSIOMETER READINGS IN CENTIBARS	
1	2
3	4
5	6
COMMENTS	

DATE	TIME
WEIGHT	INSTRUMENT
TENSIOMETER READINGS IN CENTIBARS	
1	2
3	4
5	6
COMMENTS	

DATE	TIME
WEIGHT	INSTRUMENT
TENSIOMETER READINGS IN CENTIBARS	
1	2
3	4
5	6
COMMENTS	

DATE	TIME
WEIGHT	INSTRUMENT
TENSIOMETER READINGS IN CENTIBARS	
1	2
3	4
5	6
COMMENTS	

APPENDIX B

REMEDIAL DESIGN PHASE HEALTH AND SAFETY PLAN

REMEDIAL DESIGN PHASE HEALTH AND SAFETY PLAN
LEHIGH PORTLAND CEMENT COMPANY

Prepared for:

LEHIGH PORTLAND CEMENT COMPANY
Mason City, Iowa

Prepared by:

LAYNE GEOSCIENCES, INC.
A Subsidiary of Layne, Inc.

Project No. 61.2940
November 1992

TABLE OF CONTENTS

1.0 INTRODUCTION

This Health and Safety Plan contains the requirements for protection of all personnel during the collection of data at the Lehigh Portland Cement Company (Lehigh), Mason City, Iowa. The acquisition of this data is necessary for the completion of the Lehigh remedial design workplan.

It is written with the intent of developing the awareness of site personnel with regards to health and safety hazards which may exist. Earth-moving, construction, well installation of contaminated material requires strict adherence to procedures in order to prevent injury, loss of life, or health hazard to site personnel or to the public.

The objective of this health and safety plan is to assure that safe working conditions exist at the site. The following organization and procedures have been established based on an analysis of potential hazards and personnel protection measures have been selected in response to these risks.

All work will be performed in accordance with applicable Layne GeoSciences, Inc. (LGI), Iowa Department of Natural Resources, U.S. Environmental Protection Agency, and Mine Safety and Health Administration (MSHA) policies and regulations as well as the health and safety guidance set forth in Lehigh specifications Section 37.

2.0 RESPONSIBILITIES

2.1 Project Manager

The project manager will direct the site investigation and operation. The project manager has the primary responsibility for:

- Assuring that all personnel are aware of the potential hazards of the site and the proper procedures for handling those hazards should they occur, including all health and safety provisions and standards in this plan.

- Assuring that the proper personal protection equipment is available and utilized properly by all site personnel.

- Monitoring the safety performance of personnel to ensure that mandatory health and safety procedures are adequate and correcting any performances that do not comply with the Health and Safety Plan.

- Consulting with Health and Safety Officer and/or personnel.

- Preparation and submittal of any and all project reports including progress, accident, incident and contractual.

2.2 Site Health and Safety Officer

After the project starts and the Health and Safety officer has had time to evaluate the potential for hazardous site conditions, he or she may determine that a member of the project team may assume the duties of site health and safety officer. The primary responsibilities of the Site Safety Officer (SSO) are:

- Advise the project manager on all health and safety related matters involved at the site.

- Direct and ensure that the health and safety procedures are being correctly followed in the field, including the proper use of personal protective and site monitoring equipment.

- Ensure that the field crews observe the appropriate work practices and decontamination procedures.

- Report on safety violations to the project manager.

2.3 Safety Supervisor

The safety supervisor for the drill crew will in most cases be the drill rig operator: for other activities, it will be the senior member of the crew by position.

- The Safety Supervisor should consider the "responsibility" for safety and the "authority" to enforce safety to be a matter of first importance.

- The Safety Supervisor should be the leader in using proper personal safety gear and set an example in following the rules that are being enforced on others.

- The Safety Supervisor should enforce the use of proper safety equipment and take appropriate corrective action when proper personal protective safety equipment is not being used.

- The Safety Supervisor should understand that proper maintenance of tools and equipment and general "housekeeping" will provide the environment to promote and enforce safety.

- Before drilling is started with a particular drill, the safety Supervisor must be assured that the operator (who may also be the safety Supervisor) has had adequate training and is thoroughly familiar with the drill rig, its controls and its capabilities.

- The Safety Supervisor should inspect the drill rig and equipment at least daily for structural damage, loose bolts and nuts, proper tension in chain drives, loose or missing guards or protective covers, fluid leaks, damaged houses and/or damaged pressure gauges and pressure relief valves.

- The Safety Supervisor should check and test all safety devices such as emergency shut-down switches at least daily and preferable at the start of a drilling shift. Drilling should not be permitted until all emergency shut-down and waning systems are working correctly. Do not wire around, bypass or remove an emergency device.

- The Safety Supervisor should check that all gauges, warning lights and control levers are functioning properly and listen for unusual sounds on each starting of an engine.

- The Safety Supervisor should assure that all new drill rig workers or field personal are informed of safe operating practices and should provide each new worker with a copy of the safety manual, and when appropriate the drill rig manufacturer's operations and maintenance manual. The safety Supervisor should assure that each new employee reads and understands the safety manual.

- The Safety Supervisor should assure that there is a first-aid kit on each drill rig and a fire extinguisher on each drill rig and on each additional vehicle and assure that they are properly maintained.

- The Safety Supervisor (and as many crew members as possible) should be well trained and capable of using first-aid kits, fire extinguishers and all other safety devices and equipment.

- The Safety Supervisor should maintain a list of addresses and telephone numbers of emergency assistance units (ambulance services, police, hospitals, etc.) and inform other members of the crew of the existence and location of the list.

- The Safety Supervisor should carefully instruct a new worker in safety and observe the new worker's progress towards understanding safe operating practices.

- The Safety Supervisor should observe the mental, emotional and physical capability of each worker to perform the assigned work in a proper and safe manner. The safety supervisor should dismiss any worker from the site whose mental and physical capabilities might cause injury to the worker or co-workers.

2.4 Drilling Crew and Other Field Personnel

These individuals will be those employees involved in field work. All field personnel engaged in site activities are required to become thoroughly familiar with, and to conform to, the provisions of this manual, and such other safety directives as may be considered appropriate by Project Managers, Safety Officers, and Supervisors. Personnel are encouraged to offer ideas, suggestions or recommendations regarding any operational condition, procedure or practice, that may enhance the safety of affected personnel or the public. Their primary responsibilities will be:

- Perform all required work safely.

- Familiarize themselves with and understand the site Health and Safety Plan, including proper use of personal protection equipment.

- Report any unsafe conditions to supervisory personnel.

- Be aware of signs and symptoms of potential exposure to site contaminants and thermal stress.

3.0 HAZARDS ANALYSIS

3.1 Hazard Evaluation

Based on the project description, it is possible that on-site personal may encounter hazards associated with sampling and drilling activities. These hazards are typically physical in nature, i.e., overhead hazards, being bumped into, tripping, and falling because of unlevel terrain.

Based on hazards assumed to be present at Lehigh, it is possible for on-site personal to be exposed to chemically corrosive ground water and fugitive dust that could be caustic when combined with mucus membranes or perspiration on exposed dermal area.

3.2 Risk Assessment

With regards to the physical hazards, it is believed that these can be minimized and prevented through employee education, protective equipment, and preventing access to the work site for unauthorized personnel.

Previous sampling events at Lehigh indicate high pH groundwater could be encountered. Exposure to the known contaminants can cause irritation to both the skin and respiratory system. To protect against this hazard, Level D protection will be worn on site which consists of steel toed boots, hard hats, safety glasses, gloves, and coveralls or Tyvek suits or as deemed appropriate by the SSO.

3.3 Overhead and Buried Utilities

The use of a drill rig on a site or project within the vicinity of electrical power lines and other utilities requires that special precautions be taken by both supervisors and the members of the exploration crew. Electricity can shock, burn, and cause death.

- Overhead and buried utilities should be located, noted and emphasized on all boring location plans and boring assignment sheets.
- When overhead electrical lines exist at or near a drilling site or project, consider all wires to be alive and dangerous.

- Watch for sagging poser lines before entering a site. Do not lift power lines to gain entrance. Call the utility and ask them to raise the power lines or de-energize (turn off) the power.

- Before raising the drill rig mast (derrick) on a site in the vicinity of power lines, walk completely around the drill rig. Determine what the minimum distance from any point on the drill rig to the nearest power line will be when the mast is raised and/or being raised. Do not raise the mast or operate the drill rig if this distance is less than 20 feet (6m), or if known, the minimum clearance stipulated by federal, state and local regulations.

4.0 PERSONAL PROTECTION

4.1 Overview

Protective clothing and respiratory protection help prevent on-site workers from coming in contact with contaminants. It is imperative that personal protective equipment be appropriate to protect against the known potential hazards for each investigation and each work site. The selection of protective equipment will be based upon the types, concentrations, and routes of personal exposure that may be encountered. The appropriate level of protection for initial site entry will be based upon a conservative assessment of the best available site contamination information.

Protective clothing must be worn by all assigned personnel while on site, until sufficient data has been acquired to enable the Health and Safety Officer to make an informed judgement regarding possible downgrading. The Project Manager must weigh the fact that fatigue and alertness on the part of the team members is a significant safety factor. Protective clothing is cumbersome, hastens the on-set of fatigue, and limits stay-time. In the absence of clear indications that work can proceed safely without protective clothing, required items include chemical-resistant pants and jacket, rubber or leather boots, protective gloves, hard hat or head cover, dust mask, and chemical goggles or a full face respirator.

Disposable and reusable clothing is available, however, disposable clothing is fragile, easily torn, and especially vulnerable during cold weather. The "bootees" that are furnished with this clothing are highly vulnerable and are of limited value on rough ground or for walking through snagging objects.

There are four (4) levels of personal protection recommended by the Environmental Protection Agency. They range from Level D, (used when the least amount of contamination is known), upgrading to Level C when contamination levels require protection from bodily contact and the filtering of breathing air; up to Level B when contamination requires protection from bodily contact and the use of a supplied breathable air source is necessary; up to Level A, which is used when the contamination levels require the highest available protection from bodily contact, respiratory and eye irritation. Following are descriptions of the levels of personal protection and criteria for their selection.

4.2 Respiratory Protection - General

- Only properly cleaned, maintained, NIOSH/MSA approved respirators shall be used on-site.
- Selection of respirators, as well as any decisions regarding upgrading or downgrading of respiratory protection will be made by the Health and Safety Officer.
- Air purifying cartridges shall be replaced when load up, or breakthrough occur or when needed.
- Only employees who have had pre-issue qualitative fit tests and semi-annual fit tests thereafter, shall be allowed to work in atmospheres where respirators are required.
- No employee shall be assigned to tasks requiring the use of respirators if, based upon the most recent examination, a physician determines that the employee will be unable to function normally wearing a respirator or that the safety or health of the employee or other employees will be impaired by use of respirator.
- All physical approved employees that are able to wear a respirator will receive training and fit testing with the respirator.
- Contact lenses are not to be worn.
- Air supplied respirators shall be assembled per manufacturer's specifications regarding hose length, couplings, valves regulators, manifolds, etc. Use of air line respirators will probably not be required at the Lehigh site.
- Excessive facial hair (e.g. beards) prohibits proper face fit and effectiveness of air purifying respirators. Persons required to wear respiratory protection must not have beards, etc. All personnel will be required to be clean shaven prior to each day's shift.
- Regular eyeglasses cannot be worn with full face respirators (breaks the face-piece seal). Inserts must be utilized.
- The respiratory protection utilized on-site will be in compliance with OSHA, 29 CFR 1910.134.

4.3 Respiratory Protection - Specific

On-site personnel will not be required to wear full face respirators. Any upgrading of protection will be after consultation with the Health and Safety personnel.

4.4 Task Specification Protection

Based on evaluation of potential hazards, the following levels of personal protection have been designated for field activities at the Lehigh site. For monitoring well installation and groundwater sampling, Level D protection consisting of the following equipment will be required:

- Chemical resistant boots with steel toes and shank.
- Coveralls, Tyvek suits, or long sleeve shirts.
- Hard Hats.
- Safety glasses with protective side shields (as deemed necessary by the On-site Safety Coordinator).
- Work gloves.
- Latex or vinyl, surgical-type gloves (as deemed necessary by the On-Site Safety Coordinator).

4.5 Communication Procedures

The following standard hand signals will be used on-site:

- Hand gripping throat......Out of air, can't breathe
- Gripping partner's wrist or put both hands around partner's wrist....Leave area immediately.
- Hands on top of head.....Need assistance
- Thumbs up............OK, I am all right, I understand
- Thumbs down...........No, negative

5.0 HEALTH AND SAFETY PROCEDURES

5.1 Unsafe Situations

- All employees are directed to bring to the attention of the most readily accessible Supervisor any unsafe condition, practice, or circumstance associated with or resulting from site investigations.

- In case of immediate hazard to employees or the public, any employee on the scene should take all practicable steps to eliminate or neutralize the hazard; this may include leaving the site. Follow-up consultation with the Project Manager or Supervisor must then be made at the first opportunity. In such circumstances, the Project Manager or Supervisor must take, or cause to be taken, the necessary steps to ensure that the investigation can be completed safely. Such steps may include changes in procedure, removal or neutralization of a hazard or consultation with appropriate experts. In cases where the hazard is not immediate, the employee should consult the Supervisor management regarding appropriate corrective measures. Application of this rule requires exercising good judgement and common sense by all employees.

5.2 Personal Precautions

- Eating, drinking, chewing gum or tobacco, smoking, or any practices that increase the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated as contaminated.

- Hands and face must be thoroughly washed upon leaving the work area.

- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.

- Contact with contaminated or suspected contaminated surfaces should be avoided. Whenever possible, do not walk through puddles, leachate, or discolored surfaces; or lean, sit, or place equipment on drums, containers, or on soil suspected of being contaminated.

- Medicine and alcohol can exacerbate the effect from exposure to toxic chemicals. Prescribed drugs should not be taken by personnel on response operation where the potential for absorption, inhalation, or ingestion of toxic substances exists unless specifically approved by a qualified physician. Alcoholic beverages may not be consumed on-site.

5.3 On-Site Personnel Requirements

- All personnel going on-site must be thoroughly briefed on anticipated hazards, and trained on equipment to be worn, safety procedures to be followed, emergency procedures, and communications.

- Personnel on site must use the buddy system when wearing respiratory protective equipment.

- Visual contact must be maintained between crew teams on-site and site safety personnel. Drilling crew members should remain close together to assist each other during emergencies.

- All field personnel should make full use of their senses to alert themselves to potentially dangerous situations which they should avoid, e.g., presence of strong and irritating or nauseating odors.

- Personnel should practice unfamiliar field procedures prior to operations.

- Field personnel shall be familiar with the physical characteristics of the site, including:

    - wind direction in relation to contamination zones;
    - accessibility to associates, equipment, and vehicles;
    - communications;
    - operation zones;
    - site access; and
    - nearest water sources.

- Personnel and equipment in a contaminated area should be kept to a minimum, consistent with effective site operations.

- Procedures for leaving a contaminated area must be planned and implemented prior to going on-site in accordance with the Site Health and Safety Plan.

- All visitors to the job-site must comply with the Health and Safety Plan procedures. Personal protection equipment may be modified for visitors depending on the situation. Any modifications must be approved by the Site Health and Safety Officer.

- The nearest hospital or medical care facility shall be located (Figure A-1). Emergency phone numbers (police, fire, hospital, ambulance, poison center) shall be available on-site in case of incident.

5.4 General Work Practices

A number of general work practices shall be followed at the Lehigh site. The practices include:

- At least one copy of this procedure shall be available at each job work site.
- Contaminated protective equipment, such as respirators, hoses, boots, etc., shall not be removed from the regulated area until it has been cleaned, or properly packaged and labeled.
- Legible and understandable precautionary labels shall be affixed prominently to containers of contaminated scrap, waste, debris, and clothing.
- Removal of contaminated soil from protective clothing or equipment by blowing, shaking, or any other means which disperse contaminants into the air is prohibited.
- Transportation and disposal of contaminated materials shall comply with all applicable local, state, and federal regulations. These items will be addressed by the transporter and disposer.
- Contaminated materials shall be stored in tightly closed containers in well ventilated areas.
- Containers shall be moved only with the proper equipment and shall be secured to prevent dropping or loss of control during transport.
- All trenching, shoring, and excavation work must comply with all federal OSHA rules.
- Disposable equipment, such as protective clothing, shall be disposed of in containers labeled in accordance with appropriate state and federal standards.
- Sealed and sterile water shall be available near the work activities for emergency flushing of eyes. Clean water will be available for the surficial flushing of body parts.

5.5 Moisture Density Gauges

The following information is a brief outline of the hazards of the safety practices with nuclear density gauges. For more in depth information on the gauge, refer to the owners manual. To insure the safe handling of the gauge, the operator will have attended a class for the safe use of the equipment. A small amount of radioactive material is contained in the density and the moisture test equipment. The material is usually Cesium-137 and Americium 241: Beryllium. The amount of radiation emitted from the two sources is insignificant when the equipment is handled according to the manufacturers recommendations, but as a precaution the operator will wear a radiation monitoring badge to insure his safety while operating the test equipment.

6.0 MEDICAL SURVEILLANCE PROGRAM

6.1 Medical Monitoring - General

All on-site personnel shall have successfully completed an examination by an occupational physician in accordance with the Layne, Inc. Medical Surveillance Program. This program meets or exceeds the requirements as specified in 29 CFR 1910.120.

6.2 Surveillance Program - Environmental Physics

The following tests are performed for all personnel both on a pre-employment and periodic/update basis:

- Complete physical exam
- Chest x-rays (P/A and lateral)
- Electrocardiogram for initial physical, for workers over age 40 and each year thereafter
- Pulmonary function (FEVI, FVC)
- Audiometry (500 to 8,000 Hz)
- Visual
- Urinalysis
- SMAC-21 or equivalent
- Drug and alcohol screening

7.0 WORKER TRAINING PROGRAM

All personnel shall complete the Layne Environmental Training Program or a similar course which meets the 40-hour requirement as well as content specified in 29 CFR 1910.120.

8.0 THERMAL EXPOSURE

8.1 Overview

Adverse weather conditions are important considerations in planning and conducting site operations. Extremes in hot and cold weather can cause physical discomfort, loss of efficiency and personal injury.

8.2 Heat Stress

Heat stress can result when the protective clothing decreases natural body ventilation even when temperatures are moderate. Working under various levels of personal protection may require the wearing of low permeability disposable suits, gloves and boots. This clothing will prevent most natural body ventilation. Discomfort due to increased sweating and body temperature (heat stress) may be expected at the work site.

Recommendations to reduce heat stress include:

- Drink plenty of fluids (to replace loss through sweating).
- Wear cotton undergarments to act as a wick to absorb moisture.
- Make adequate shelter available for taking rest breaks to cool off.

For extremely warm weather, follow these additional recommendations:

- Wear cooling devices to aid in ventilation (the additional weight may affect efficiency).
- Install portable showers or hose down facilities to cool clothing and body.
- Shift working hours to early morning and early evening, avoiding the hottest time of the day.
- Rotate crews wearing the protective clothing.

8.3 Cold Exposure

Cold Exposure can occur in temperatures at or below freezing. If prolonged exposure to cold occurs without proper protection, the effects of cold exposure can happen in temperatures above freezing. Exposure to cold can cause severe injury (frostbite) or overall drop in body temperature. Fingers, toes, and ears are the most susceptible to frostbite.

Both the outdoor temperature and the wind velocity play a part in cold injuries. Wind chill is used to describe the chilling effect of moving air in combination with low temperatures. Cold exposure can be a serious threat to on-site personnel that remove protective clothing and expose perspiration soaked underclothing to the cool air. The water conducts heat 240 times faster than air - thus rapidly cooling the body and wet clothing. Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperatures - its symptoms are usually seen in five stages:

- Shivering
- Apathy, listlessness, sleepiness and rapid body cooling
- Unconsciousness, glassy stare, slow pulse and
- Freezing of the extremities (most sensitive to freezing first are the fingers, toes and ears)
- Death.

Recommended actions to avoid suffering the effects of cold exposure:

- Wear cotton undergarments to absorb perspiration from the body.
- Wear additional layers of light clothing as needed for warmth. The layering effect hold in air, trapping body heat and some layers could be removed as the temperature rises during the work day.
- Pay close attention to body signals and feelings, especially on high surface area to volume ratios of the body - ears, fingers, toes and take the appropriate action to correct any problem indications (such as break from work activity and move to rest area to warm up, add additional clothing).
- Install a wind break to block the cold winds from blowing directly at the crew.
- Provide a sheltered rest break area to retreat to for resting and warming up.

9.0 EMERGENCY INFORMATION

9.1 Emergency Situations

All site activities present a potential risk to on-site personnel. During routine operations, risk is minimized by establishing good work practices, staying alert, and using proper personal protective equipment. Unpredictable events such as physical injury, chemical exposure, or fire may occur and must be anticipated.

Emergency conditions are considered to exist if:

- Any member of the field crew is involved in an accident or experiences any adverse effects or symptoms of exposure while on-site; or
- A condition is discovered that suggests the existence of a situation more hazardous than anticipated.

9.2 Emergency Procedures

9.2.1 Overview

The following emergency procedures should be followed:

In the event of emergency, the contacts identified in the Section 10.0 shall be notified. This list should be posted conspicuously at the site.

- Personnel on-site should use the "buddy system (teams).
- Buddies should pre-arrange hand signals or other means of emergency signals for communications in case of being out of hearing range.
- Visual contact should be maintained between "teams" on-site with other field personnel remaining in close proximity in order to assist each other in case of emergencies.
- In the event that any member of the field crew experiences any adverse effects or symptoms of exposure while on the scene, the entire crew should immediately halt work and act according to the instructions provided by the Project Manager or Site Health and Safety Officer.

9.2.2 Personal Injury

In case of personal injury at the site, the following procedures should be followed:

- Any on-site personnel trained in first aid can administer treatment to an injured worker.

- The victim should be transported to the nearest hospital or medical center. If necessary, an ambulance should be called to transport the victim. A map of the most direct route to hospital from the Lehigh site can be found in Figure B-1.

9.2.3 Contact With Caustic Solutions

The cement kiln dust (CKD) and water in the West Quarry, the treatment plant, and some of the monitoring wells is potentially caustic. Care must be taken when handling the CKD and water due to the possibility of burns to the eyes and skin. Alkali burns of the eye are progressive injuries. An eye that first appears to have only slight surface injuries, may develop deep inflammation and tissue destruction and sight may be lost. If alkali water comes into contact with the eye the following procedures should be followed:

- Flood the eye thoroughly with water for 15 minutes.

- If the victim is lying down, turn the head to the side. Hold the lids open and pour the water from the inner corner outward.

- Do not irrigate with soda solution.

- Immobilize the eye by covering it with a dry pad or protective dressing

- Seek immediate medical aid.

For Contact with the skin:

- Wash away the contaminant with large amounts of water as quickly as possible and for at least 15 minutes. Remove the victim's clothing from the areas involved.

- Apply a dressing bandage and get medical aid.

9.2.4 Contact With Electricity

If a drill rig makes contact with electrical wires, it may or may not be insulated from the ground by the tires of the carrier. Under either circumstance the human body, if it simultaneously comes in contact with the drill rig and the ground, will provide a conductor of the electricity to the ground. Death or serious injury can be the result. If a drill rig or a drill rig carrier makes contact with overhead or underground electrical lines:

- Under most circumstances, the operator and other personnel on the seat of the vehicle should remain seated and not leave the vehicle. Do not move or touch any part, particularly a metallic part, of the vehicle or the drill rig.

- If it is determined that the drill rig should be vacated, then all personnel should jump clear and as far as possible from the drill. Do not step off - jump off, and do not hang on to the vehicle or any part of the drill when jumping clear.

- If you are on the ground, stay away from the vehicle and the drill rig, do not let others get near the vehicle and the drill rig and seek assistance from local emergency personnel, such as the police or a fire department.

- When an individual is injured and in contact with the drill rig or with power lines, attempt rescue with extreme caution. If a rescue is attempted, use a long, dry unpainted piece of wood or a long, dry, clean rope. Keep as far away from the victim as possible and do not touch the victim until he is completely clear of the drill rig or electrical lines.

- When the victim is completely clear of the electrical source and is unconscious and a heart beat (pulse) cannot be detected, begin cardiopulmonary resuscitation (CPR) immediately.

9.2.5 Chemical Exposure

If a member of the field crew is exposed to chemicals, the procedures outlined below should be followed:

- Another crew member (buddy) should remove the individual from the immediate area of contamination.

- Precautions should be taken to avoid exposure of other individuals to the chemicals.

- If the chemical is on the individual's clothing, first rinse the clothing if possible, and then the clothing should be removed it is safe to do so.

- If the chemical has contacted the skin, the skin should be washed with large amounts of water, for at least 15 minutes.

- In case of eye contact, an emergency eye wash should be used. Eyes should be washed for at least 15 minutes.

- If necessary, the victim should be transported to the nearest hospital or medical center. The nature of the injury may require that an ambulance be called to transport the victim.

- All chemical exposure incidents must be reported in writing by the Project Manager on an Accident Report Form.

10.0 SITE SPECIFIC INFORMATION

The nearest hospital to the Lehigh site is indicated on the map in Figure B-1.

First Aid Instructions

Eye - irrigate immediately for 15 minutes
Skin - soap wash promptly
Inhalation - move to fresh air
Ingestion - get medical attention

List of emergency phone numbers:

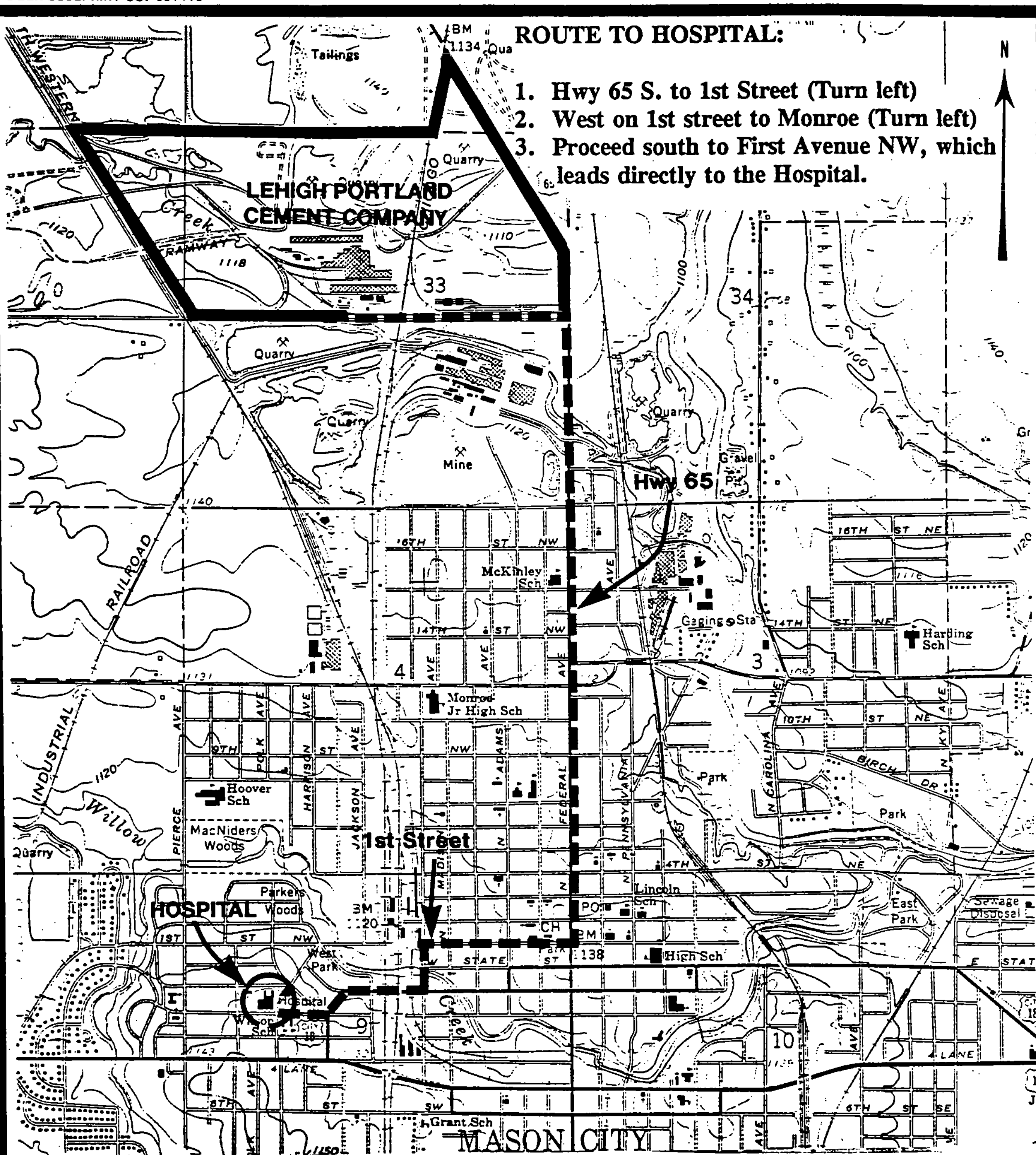
Agency/Facility	Phone Number
Ambulance/Local Service	911
Hospital/Hospital	911
Police/Mason City Police	911

Personnel to be notified in the case of an emergency.

Layne GeoSciences, Inc.
4140 DuPlainville Road
Pewaukee, WI 53072
(414) 691-2662

Corporate Industrial Hygiene Group
1900 Shawnee Mission Parkway
Mission Woods, KS 66205
(913) 362-0510

BADGER BLUEPRINT CO. 551415



SCALE 1:24 000

1 ½ 0 1 MILE

IOWA

QUADRANGLE LOCATION

▬ ▬ ▬ ▬ – ROUTE TO HOSPITAL

▬▬▬▬▬ – LEHIGH SITE BOUNDARY

LGI **Layne GeoSciences, Inc.**

A Subsidiary of LAYNE-WESTERN COMPANY, INC.

FIGURE B–1

HOSPITAL LOCATION MAP

Drawn by:	Cm 11/4	Checked by:			Drawing number
		Approved by:	LB	11/92	

PROPOSED SCHEDULE FOR THE LEHIGH PORTLAND CEMENT COMPANY
REMEDIAL DESIGN ACTIVITIES AND SUBSEQUENT SUBMITTALS

NOV., 92	DEC., 92	JAN., 93	FEB., 93	MAR., 93	APR., 93	MAY, 93	JUN., 93	JUL., 93	AUG., 93	SEP., 93	OCT., 93	NOV., 93	DEC., 93	JAN., 94	FEB., 94	MAR., 94
R.D.W.P SUBMITTED →	EPA REVIEW			STREAM STUDY PERFORMED →	→	→	→	STREAM STUDY REPORT SUBMITTED								
TEST PAD** CONSTRUCTED →	INFILTROMETER** DATA COLLECTION															
SOIL/CKD GEOTECHNICAL TESTING	SLOPE STABILITY ANALYSIS COMPLETED					PRELIMINARY DESIGN PLAN SUBMITTED (30%) →	EPA REVIEW		PREFINAL DESIGN PLAN SUBMITTED →	EPA REVIEW	FINAL DESIGN PLAN SUBMITTED →	EPA REVIEW	REMEDIAL DESIGN WORK PLAN SUBMITTED →	EPA REVIEW	BID DOCUMENTS PREPARED CONTRACTORS SELECTED	SITE REMEDIAL ACTION INITIATED
FIELD SURVEYING EFFORT COMPLETED →	→	SURVEY DATA REDUCTION & MAP GENERATION	SITE GRADING PLANS INITIATED													
		MONITORING WELLS INSTALLED, DEVELOPED & SLUG TESTED	MONITORING WELL SAMPLING EVENT													
									GROUNDWATER MODELING* DESIGN OF FRENCH DRAIN*							
	←	DISCHARGE PIPELINE*** CONSTRUCTED (?) →	→	→	POND PUMPING AND WATER TREATMENT DISCHARGE INITIATED UNDER NPDES PERMIT*** →	→	POND DRAINAGE →	→	→	→	→	→	→	→	→	CONTINUES →

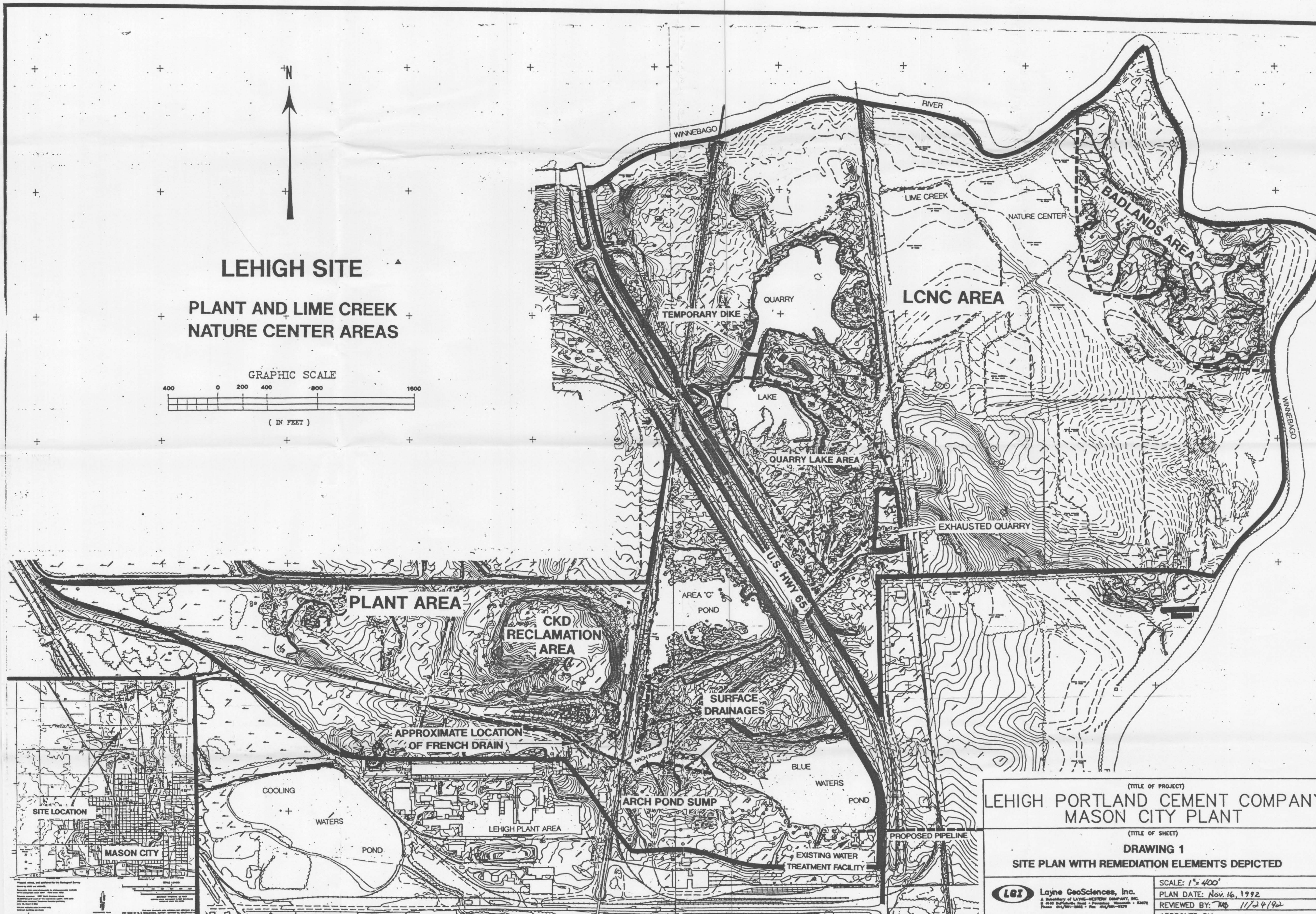
NOTES:

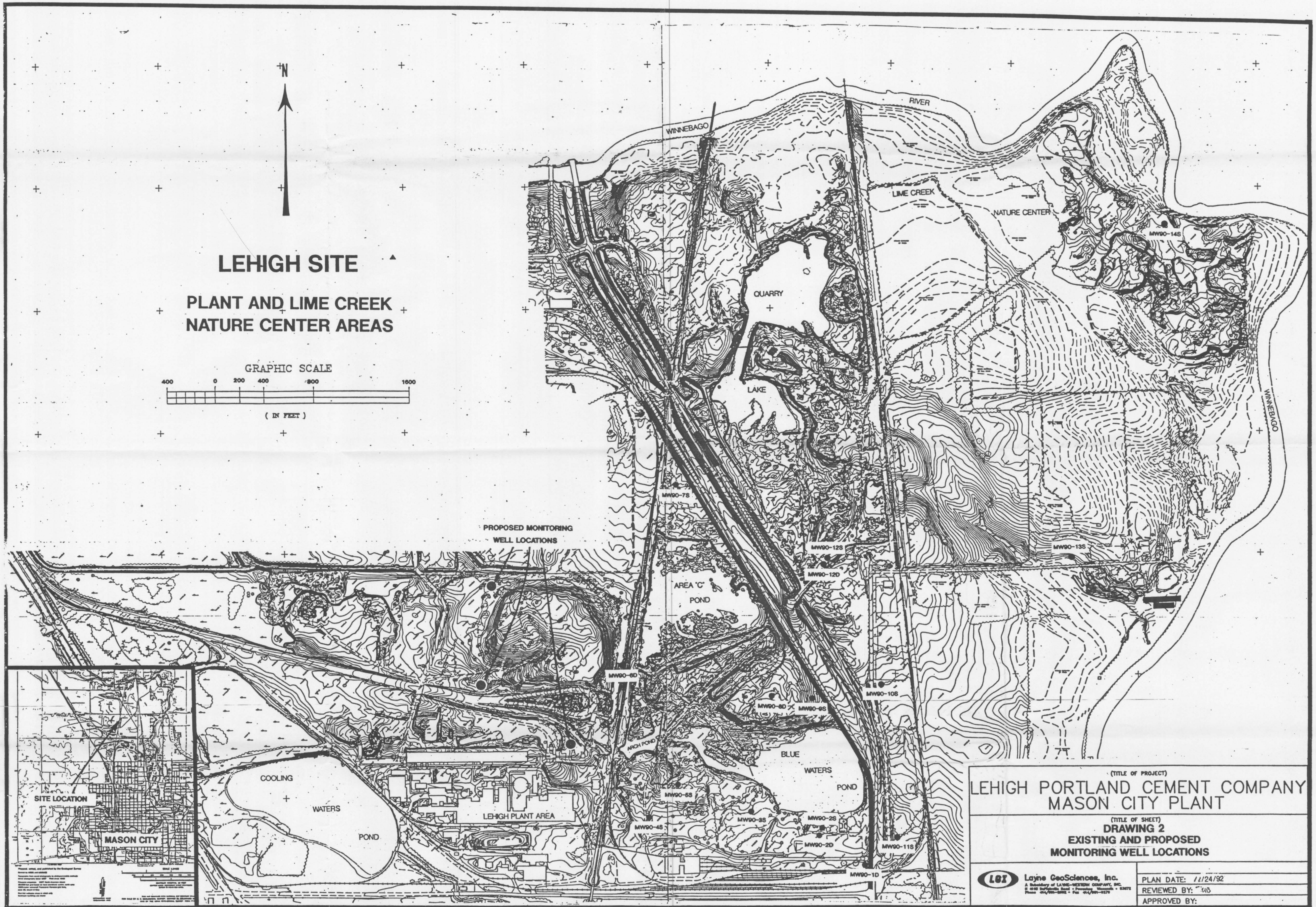
* - CONTINGENCY EFFORT BASED ON FINDINGS OF CKD RECLAMATION AREA INVESTIGATION

** - WEATHER DEPENDENT TIMETABLE. IF DELAYED UNTIL SPRING, SUBSEQUENT DESIGN EFFORTS AND SUBMITTALS WILL BE DELAYED ACCORDINGLY.

*** - TIME FRAMES CONTINGENT ON ACQUISITION OF EASEMENT(S).

LGI Layne GeoSciences, Inc.		
SCALE: / DATE: 11/12/92	APPROVED BY: M.K.B.	DRAWN BY W.Y / REVISED 11/24/92
REMEDIAL DESIGN ACTIVITIES SCHEDULE		
		DRAWING NUMBER


N
LEHIGH SITE
PLANT AND LIME CREEK
NATURE CENTER AREAS
GRAPHIC SCALE
400 0 200 400 800 1600
(IN FEET)
WINNEBAGO
RIVER
LIME CREEK
NATURE CENTER
BADLANDS AREA
LCNC AREA
QUARRY
TEMPORARY DIKE
LAKE
QUARRY LAKE AREA
EXHAUSTED QUARRY
WINNEBAGO
U.S. HWY 65
PLANT AREA
AREA "C"
POND
CKD
RECLAMATION
AREA
SURFACE
DRAINAGES
APPROXIMATE LOCATION
OF FRENCH DRAIN
ARCH POND
BLUE
WATERS
POND
COOLING
WATERS
POND
LEHIGH PLANT AREA
ARCH POND SUMP
EXISTING WATER
TREATMENT FACILITY
PROPOSED PIPELINE
SITE LOCATION
MASON CITY
(TITLE OF PROJECT)
LEHIGH PORTLAND CEMENT COMPANY
MASON CITY PLANT
(TITLE OF SHEET)
DRAWING 1
SITE PLAN WITH REMEDIATION ELEMENTS DEPICTED
LGI
Layne GeoSciences, Inc.
SCALE: 1"= 400'
PLAN DATE: Nov. 16, 1992
REVIEWED BY: 11/24/92
APPROVED BY:



N
LEHIGH SITE
PLANT AND LIME CREEK
NATURE CENTER AREAS
GRAPHIC SCALE
400
0
200
400
800
1600
(IN FEET)
WINNEBAGO
RIVER
LIME CREEK
NATURE CENTER
QUARRY
LAKE
MW90-14S
MW90-7S
MW90-12S
MW90-12D
MW90-13S
PROPOSED MONITORING
WELL LOCATIONS
AREA "C"
POND
MW90-6D
MW90-10S
MW90-8D
MW90-9S
ARCH POND
BLUE
WATERS
POND
COOLING
WATERS
POND
LEHIGH PLANT AREA
MW90-5S
MW90-4S
MW90-3S
MW90-2S
MW90-2D
MW90-11S
MW90-1D
SITE LOCATION
MASON CITY
(TITLE OF PROJECT)
LEHIGH PORTLAND CEMENT COMPANY
MASON CITY PLANT
(TITLE OF SHEET)
DRAWING 2
EXISTING AND PROPOSED
MONITORING WELL LOCATIONS
Layne GeoSciences, Inc.
PLAN DATE: 11/24/92
REVIEWED BY:
APPROVED BY: