GEOLOGIC INVESTIGATION AND WELL INSTALLATION WORK PLAN

Prepared For:

EL DORADO

El Dorado Chemical Company

Prepared By:

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1.0 INTRODUCTION

This Work Plan documents the planned approach for conducting an investigation to further characterize the geology and hydrogeology of the El Dorado Chemical Company (EDC) facility in El Dorado Arkansas. The field activities will consist of the advancement and logging of eleven (11) borings and the installation of four (4) monitor wells. A map of the site is presented as Figure 1.

1.1 OBJECTIVES

The objectives of this investigation are to:

- Further characterize the shallow site stratigraphy with borings that penetrate through to the confining clay unit (Cook Mountain Clay); and
- Install additional wells to further define ground water flow and quality.

1.2 BACKGROUND

A Phase II site investigation of the EDC facility was conducted in June 1996. Eighteen monitor wells were installed within the shallow Cockfield Formation during the Phase II investigation. Boring logs containing the detailed lithologic descriptions and geotechnical data were generated and published the *Phase II Ground Water Investigation Report*. Four cross sections were constructed to illustrate the shallow geology beneath the facility and presented in the *2001 Annual Ground Water Report*. The 18 monitor wells were sampling during the Phase II investigation and again in May and November 2001, June, October and December 2002 and in May, June and September 2003.

1.3 CONSTITUENTS OF CONCERN

Ground water analytical results indicate the constituents of concern for this site are ammonia as N, nitrate as N, sulfate and minor amounts of chromium and lead. These constituents have

typically been detected north of the Production Area and on the north and southeast sides of Lake Kildeer. All constituents are non-volatile and are not expected to present any hazard to investigation personnel.

2.0 SITE SETTING

The regional shallow geology consists of the Claiborne Group, with two units that crop out in Union County: the Cockfield Formation and the Cook Mountain Formation. The Cockfield Formation, locally referred to as the "lignite sand", is generally characterized by fine sand, interbedded silty clay and lignite becoming more massive and containing less silt and clay with depth. Beneath the Cockfield Formation lies the Cook Mountain Formation. The Cook Mountain is 50 to 200 feet thick and is composed of clay and silty clay containing minor amounts of localized very fine to silty sand. These clays serve as a confining unit between the more permeable overlying Cockfield Formation and the underlying aquifer. The Cook Mountain is uniformly underlain by the Greensand Aquifer of the Sparta Sand.

The shallow subsurface consists of interbedded sand, silty sand, silt and clay. Site boring logs indicate a clay/sand/clay/sand sequence with more clay in the northern area of the property and more sand to the south. However, the most of the borings drilled at the site do not extend into the upper part of the Cook Mountain Formation; therefore, the Cockfield Formation is not fully defined. The purpose of this additional investigation is to further define this unit both vertically and horizontally.

3.0 FIELD OPERATIONS

The planned field investigation procedures are described in the following sections. Should adjustments to any of the sampling rationale and/or locations become necessary during the course of the investigation for reasons as yet undetermined, EMS will coordinate the changes with EDC personnel prior to implementing the altered plan.

Prior to sampling, EMS will communicate with EDC personnel to locate underground utilities. No underground utilities in the sampling areas are anticipated.

3.1 SOIL SAMPLING

The following sections detail the methodology employed to further characterize the geology at the EDC site.

3.1.1 Soil Sampling Scope of Work

The field operation will consist of drilling and logging eleven (11) soil borings. The total depth will be approximately 30 feet, until the top of the Cook Mountain Formation (clay unit) is encountered. Figure 1 depicts the location of the proposed borings. Techniques used to characterize the soil conditions during this investigation include soil conductivity profiling; and soil collection for physical description and conductivity profile correlation. The methodology used for soil sample collection will consist of Geoprobe collection devices and probes.

3.1.2 Soil Sampling Equipment and Procedures

The site allows access in most areas to small (pickup) truck-mounted or track-mounted drilling equipment. Therefore, where accessible, a Geoprobe® Model 540 UD (pickup truck mounted) or Model 66 DT (posi-track mounted) direct-push sampling system will be used to collect soil samples for site characterization. Appropriate safety and operational considerations will be utilized in the sample collection efforts as described in the Site Specific Health and Safety Plan which will be prepared prior to mobilization to the site and is available upon request. All sampling equipment will be thoroughly cleaned prior to mobilization to the site.

Soil samples will be collected using a Geoprobe Macro-core 48-inch long, 2-inch diameter soil sampling probe equipped with a disposable 1.5-inch diameter clear PVC sample collection tube within the probe. Several decontaminated, pre-assembled soil probes are typically used in a Geoprobe soil boring effort to streamline the time necessary to acquire soil samples from a borehole location. Soil samples will be collected continuously, from ground surface to the

termination depth of each boring. Upon completion of each 4-foot soil "push", the sample collection tube will be retrieved and split open, and the soil will be visually described and logged by the field geologist or hydrogeologist in accordance with the Unified Soil Classification System. All soil descriptions and other pertinent observations will be recorded on dedicated soil boring logs for each location. Soil cores collected will not be discarded; rather, they will be stored on site.

3.2 WELL INSTALLATION

Each monitor well will be installed using the Geoprobe's direct-push capability driving 1.5-inch inside-diameter probe rod equipped with an expendable stainless-steel drive point. Once the desired depth is reached, the well will be installed within the probe rod and the rod extracted, leaving the temporary well and expendable drive point in place. Pre-packed screens or slotted screens with a filter pack may be used. If slotted screens are used, sufficient filter pack is installed to fully cover the screened interval plus two feet or more to provide a buffer against possible grout infiltration. The filter pack is placed in six-inch increments, as the 2.125-inch casing is pulled up in six-inch increments. The filter pack is placed in this manner to minimize the amount of open formation exposed and thus minimize the possibility for formation collapse. Following placement of the filter pack to at least two feet above the top of the screen, a grout seal is installed. The grout will consist of a mixture of bentonite, Portland cement and water in accordance with applicable Arkansas (Arkansas Water Well Construction Commission Rules and Regulations) and U.S. Environmental Protection Agency (*Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, USEPA, Region IV, Science and Ecosystem Support Division, November 2001) guidelines. To provide a minimal but appropriate level of security and access, an inside-threaded, countersunk plug, PVC "cleanout coupling" will be placed over the pipe and cemented in place using neat cement grout. Each well pipe will be equipped with a PVC slip-cap containing an approximately 1/8-inch hole drilled in the top of the slip-cap for ventilation. A depiction of the well construction detail is presented as Figure 2.

3.3 BORING ABANDONMENT

Borehole abandonment will be accomplished in accordance with applicable Arkansas (Arkansas Water Well Construction Commission Rules and Regulations) and U.S. Environmental Protection Agency (*Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, USEPA, Region IV, Science and Ecosystem Support Division, November 2001) guidelines. In general, borehole abandonment will be accomplished by pressure grouting the borehole using a tremie tube inserted through the Geoprobe drill rods to the bottom of the borehole and filling it from the bottom up as the drill rods and tremie tube are retracted. The solution used to abandon each borehole will consist of Portland Type I cement in 80lb. bags mixed with not more than 5-8% sodium bentonite powder by weight, and not more than 5 gallons of water per bag of cement. The solution will be mixed to a smooth consistency and pumped using the Geoprobe Model GS1000 grout pump or equivalent.

In soil sampling boreholes using the Geoprobe Macro-core sampler, upon completion of the soil sampling the borehole will be filled by pumping the bentonite grout mixture through the drill rods (minus the sample probe) from the bottom up. Upon filling the borehole and allowing some time for any settling of the grout solution in the borehole, the top of each abandoned borehole will be filled with like materials of the surface drilled (concrete, asphalt, etc.).

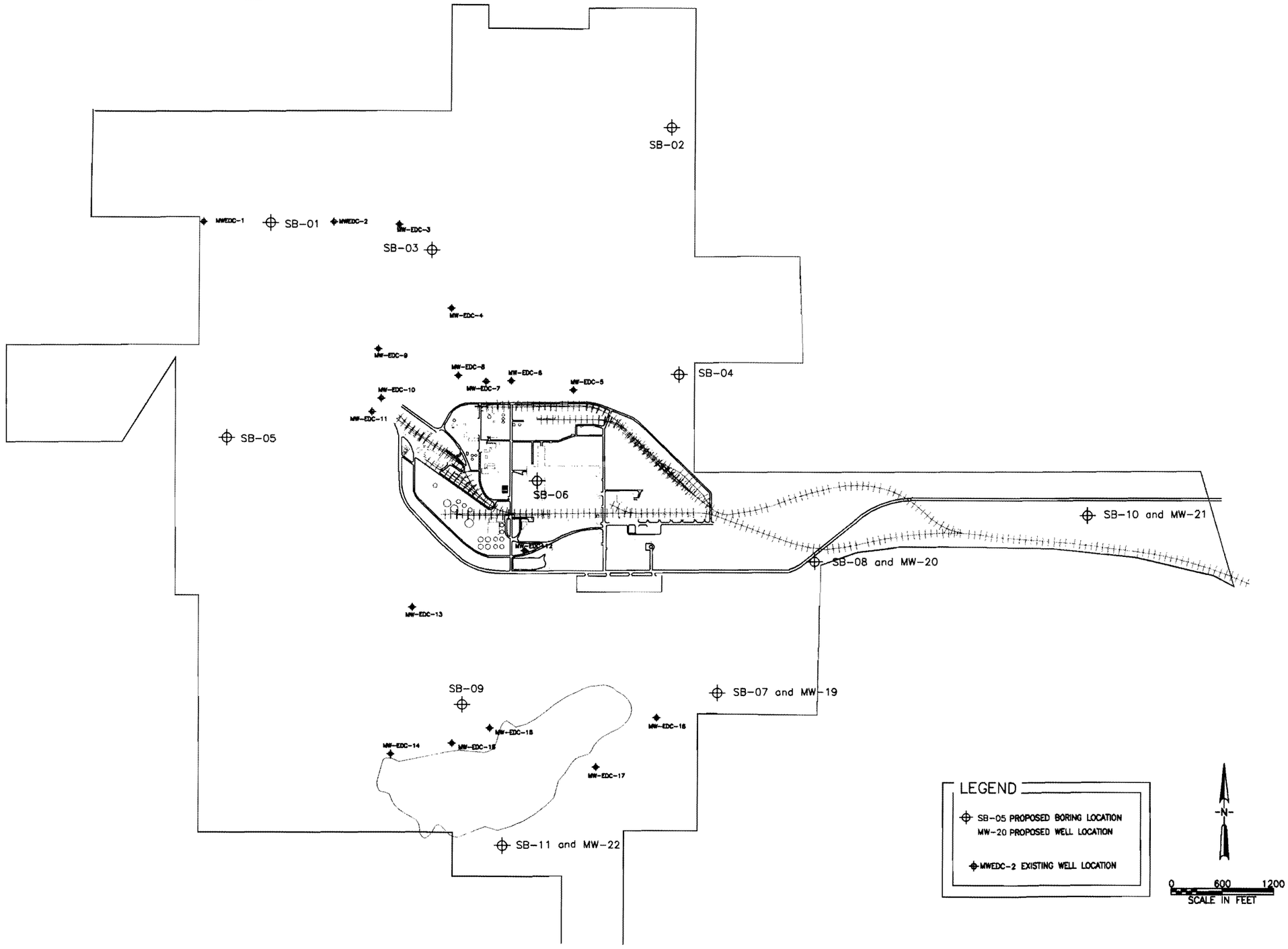
3.4 SURVEYING

The location and ground elevation and/or top of casing of each boring or well installed will be surveyed to provide accurate location data. Surveying will be accomplished throughout the project to establish a surveyed location of other borings, wells, site topography, and other points of interest as necessary.

4.0 REPORTING

Upon completion of field activities, a report documenting field activities and findings will be prepared. The report will include:

- Short description of drilling activities;
- Soil boring and well construction logs;
- Maps illustrating surveyed locations of new borings and wells;
- Geologic cross-sections; and
- An updated discussion on site geologic and ground water conditions.



ELDORADO ENVIRONMENTAL MANAGEMENT SERVICES, INC.

PROJECT NO: 2EC0100 CROSS SECTION FIGURE1.DWG	
DRAFTED BY: KK/LM	DATE: 02/18/02
APPROVED: BY:	DATE:

PROPOSED BORING AND MONITOR WELL LOCATION MAP

EL DORADO CHEMICAL COMPANY
EL DORADO, ARKANSAS

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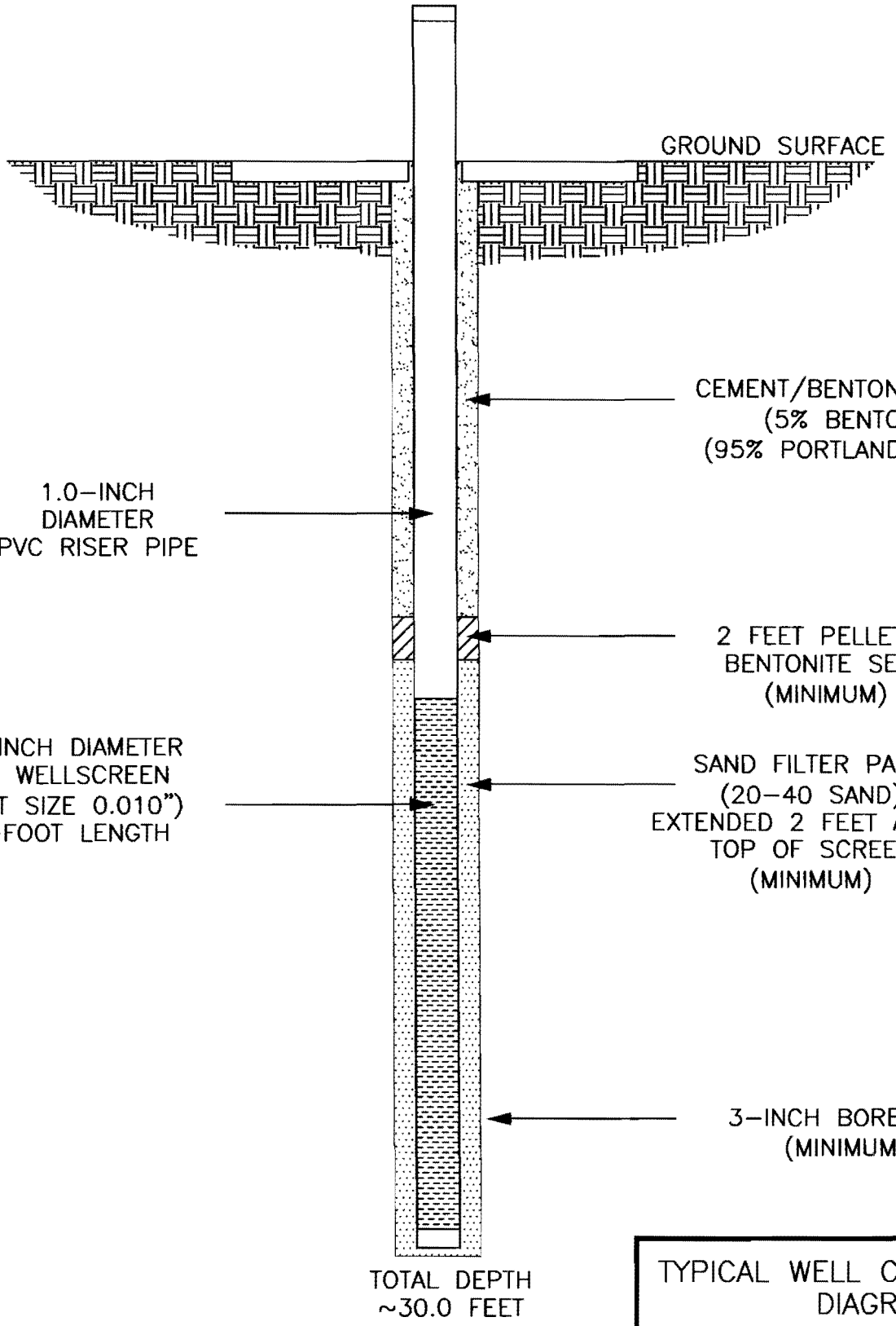

TYPICAL WELL CONSTRUCTION DIAGRAM

DATE: 02/25/03	APPROVED: BY: ____ DATE: ____	DRAWN BY: KRK
SCALE: N.T.S.		CAD NO. MON WELL DETAIL 01

ENVIRONMENTAL MANAGEMENT SERVICES, INC.