GROUNDWATER MONITORING SYSTEM AND SAMPLING AND ANALYSIS PROGRAM

CCR LANDFILL

MUSCATINE POWER AND WATER
Muscatine County, Iowa

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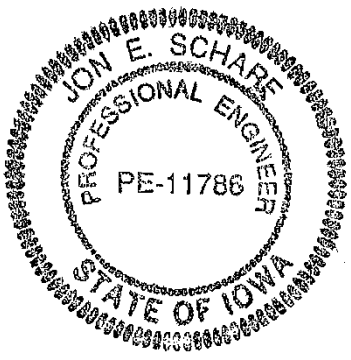
Prepared For:
Muscatine Power and Water

Prepared By:

CERTIFICATION



I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

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I. INTRODUCTION

The Muscatine Power and Water (MP&W) Coal Combustion Residue (CCR) Landfill is located in the Southwest ½ of Section 16, Township 76 North, Range 3 West, in Muscatine County, Iowa (Figure I-1).

The landfill opened in December 1985 as a monofill that receives only CCR produced by the MP&W power generating process. The CCR is a mixture of gypsum (~75%), fly ash (~20%), and bottom ash, and slag (~5%).

The total permitted fill area is about 33.5 acres, including the original Phase I (19 acres) which was the sole fill area between December 1985 and November 2012, Phase II (4.5 acres) which was added in November 2012, and the future expansion Phases III and IV (~10 acres) (Figure I-2).

The specific intent of this document is to satisfy the groundwater monitoring and corrective action requirements of the Federal CCR Rule Part 257.90-98 cited below. Section III of this document follows the outline of the federal rule to allow easy comparison of this document and the rule.

A. REGULATIONS

The landfill is regulated by both Federal and State of Iowa CCR rules, as follows:

The EPA regulates the landfill under the Federal CCR Rule 40 CFR Part 257 Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities (EPA, 2015).

The State of Iowa's Department of Natural Resources (IDNR) regulates the landfill under Iowa Administrative Code [567] Chapter 103 – Coal Combustion Residue. The facility is designed and operated in accordance with the IDNR-approved engineering plans and specifications (HR Green 2012; MP&W 2008, 2009, and 2010; and GES 1991 and 1993) which are incorporated into the current Landfill Operating Permit No. 70-SDP-06-82P.

State Permit No. 70-SDP-06-82P was issued on August 9, 2010 and expires on August 9, 2020, with the following permit amendments:

Amendment	Date	Purpose
#1	03/23/11	- Incorporate Plugging Record for MW-16.
#2	02/13/12	- Incorporate field tile slope drain extension-2011. - Authorization to construct Phase II expansion.
#3	05/08/12	- Incorporate Plugging Records for MW-15, MW-18, MW-19, MW-20. - Work plan requirement to replace these wells.
#4	10/24/12	- Incorporate Construction Documentation Report for Phase II Development. - Authorization to place CCR in Phase II area.

		- Incorporate Plugging Record for MW-14. - Incorporate construction documentation for MW-14A, MW-15A, and MW-18A. - Revise Permit Special Provision #3a pertaining to the HMSP.
Unnumbered	05/22/13	- Deleting the requirement for submittal of a Semiannual Water Quality Report to DNR.
#5	07/29/13	- Incorporate the Updated HMSP.
#6	09/04/15	- Revise Special Provision #3d relating to monitoring requirements. - Revise Special Provision #3e relating to Method Detection Limits.

The following variances to the permit have also been issued:

Variance	Date	Purpose
#1	01/25/93	- From having a certified landfill operator on duty during all hours of operation.
#2	07/08/94	- From methane monitoring and reporting requirements incorporated in Permit X.2.j.

This facility is also regulated under IDNR National Pollutant Discharge Elimination System (NPDES) Permit No. 7000109 which was issued on January 19, 2010 and expired on January 18, 2015. An application for permit renewal was submitted to DNR on July 18, 2014. This permit requires monitoring of specified constituents in discharge from a pond that receives water from two groundwater interceptor drains and storm water runoff from the CCR landfill and area agricultural land.

The facility has been developed in accordance with the Landfill Development, Plans and Specifications, and Reports, as referenced:

Date	Title
11/01/91	-Closure/Post Closure Plan. Iowa rule original date 11/01/91, revised January 1996, and December 2009; and Federal CCR rule October 17, 2016.
11/21/91	-Supporting Documentation Plans and Specifications (DOPS).
01/29/93	-Supplemental Plan Sheet 16.
Various	-Supplemental information dated 10/02/08, 12/17/09, and 03/30/10.
1/17/12	-CCR Landfill Cell Development – Phase II
11/24/14	-Annual Groundwater and Surface Water Monitoring Report
11/24/14	-Leachate Control System Performance Evaluation Report
10/19/15	-CCR Fugitive Dust Prevention and Control Plan and Annual Updates
10/17/16	-Run-On and Run-Off Control System Plan; Federal CCR rule

B. SITE DEVELOPMENT

The landfill has been in continuous operation since December 1985 beginning with the Phase I area. Construction of the lined Phase II area was completed in 2012. The clay material for a compacted low permeability clay liner was taken from the Phase II development area and from the future Phase III development area. The 4 foot thick compacted clay liner was installed and a 1 foot thick sand drainage layer was placed over the liner to allow for leachate to flow to the leachate collection system. The leachate collection system for Phase II was tied into the existing leachate conveyance system for Phase I. The sand was then covered with

approximately 3 feet of CCR to protect this drainage layer. A piezometer, PZ-5, was installed in the northeast corner of the Phase II development. Authorization to place CCR in the Phase II area was granted by the IDNR on October 24, 2012.

The leachate collection system serves both the Phase I and Phase II areas of the landfill. The system consists of three 6-inch diameter perforated pipe laterals that tie into a 6-inch diameter header line that empties into Lift Station "A" located along the haul road at the northwest end of the runoff containment pond (near monitoring well MW-13). Piping material installed in Phase I is Schedule 80 PVC and piping material in Phase 2 is HDPE SDR11.

A storm water interceptor ditch runs along the north and west site perimeters and routes runoff around the site to a discharge point at a downstream farm pond. A buried groundwater cut-off drain runs along the east and south landfill boundaries, where liquid collected along the east boundary flows north to a discharge point at the storm water interceptor ditch and the liquid collected along the south boundary flows west to a discharge point at a small pond.

C. CURRENT WATER QUALITY MONITORING – IAC CHAPTER 103

The current water quality monitoring program is implemented under the IDNR-approved Hydrologic Monitoring System Plan (HMSP) and is compliant with Iowa Administrative Code (IAC) [567] Chapter 103 – Coal Combustion Residue.

The HMSP includes upgradient monitoring wells MW-8, MW-10, and MW-21[1] and downgradient wells MW-4A, MW-5B, MW-6A, MW-13, MW-14A, MW-15A, and MW-18A; and upstream surface water point SW-22 and downstream points SW-23, SW-24, SW-25, and SW-26 (farm pond). A Water Quality Report (AWQR) due annually to IDNR by November 30 summarizes the surface and groundwater quality conditions of the site (MP&W, November 25, 2015) and the leachate conditions of the site (MP&W, November 25, 2015).

All monitoring points are routinely sampled for parameters specified in current IAC Chapter 103.1(2)f, including arsenic, barium, beryllium, cobalt, copper, iron, lead, magnesium, manganese, selenium, zinc, chlorides, and sulfate; plus under Permit Amendment #6 aluminum, calcium, boron, fluoride, molybdenum, nickel, strontium, and vanadium. Analytical results have historically been reported as dissolved metals in accordance with Chapter 103. Recently, both dissolved and total metals have been reported in accordance with Permit Amendment #6.

Groundwater level measurement points include each of the above-listed HMSP wells plus several others retained as measurement points, including MW-9, MW-11, MW-12, MW-17 and CCR piezometers PZ-1, PZ-2, PZ-3, PZ-4 and PZ-5.

[1] MW-21 will be transitioned to a downgradient monitoring point beginning in 2016.

II. SUBSURFACE CONDITIONS AT THE CCR LANDFILL

MP&W completed its Iowa DNR-approved Hydrogeologic Investigation Work Plan (GES, June 1990) and follow-on Hydrogeologic Evaluation (GES, October 1991) as requirements of the State's landfill permitting process. The Hydrogeologic Evaluation incorporated and referenced all subsurface exploration and testing performed at the landfill site beginning in 1981 through October 1991. It presented a description of the field and laboratory investigation procedures employed and it defined the subsurface conditions of the site, including the geologic setting, bedrock units, surficial deposits, and soils. It also provided the site-specific documentation of the geology, hydrogeologic units (aquifers and confining units), and groundwater flow paths, gradients, and rates. These documents are referenced herein for comprehensive description and documentation of subsurface conditions.

The summary discussion below is presented in context of the 2015 Federal CCR Rule requirements for groundwater monitoring systems. For example, the existing wells and hydrogeologic conditions of the uppermost aquifer and underlying confining aquitard are emphasized because it is the uppermost aquifer that is the required unit for groundwater quality monitoring under the Federal CCR rule. To supplement the discussion some material from the above documents is included in Appendix A for easy reference, including (1) a geologic cross section of the storage pond dam area (Figure 5 taken from GES, June 1990), and (2) geologic and vertical groundwater flow cross sections of the site (Figures 4, 5, 6, and 7 taken from GES, October 1991).

The subsurface conditions of the MP&W CCR landfill site are summarized as follows.

A. SURFICIAL DEPOSITS

The shallow stratigraphy and lithology of the Pleistocene sediments at the landfill include, in ascending order, (1) clay-rich glacial till, (2) an interval characterized by lenses of sand, silt, and clay, and (3) loess, or clayey silt (i.e., a windblown deposit). In places, paleosols (i.e., ancient soil) are preserved at the top of the glacial till. In other areas, discontinuous lenses of fine- to medium-grained sand as much as 9 feet thick separate the glacial till from the loess. Elsewhere, discontinuous lenses of fine-grained sand as much as 4 feet thick separate the glacial till from overlying silt. Some of the fine-grained, lenticular sands may be aeolian (windblown) deposits that mark the base of the loess sequence. Other sand lenses are enclosed by glacial till and represent ancient glacial outwash (meltwater) deposits. A geologic cross section drawn along a line of borings drilled as an aid in construction of the pond dam shown in Figure I-2 depicts the complexity of the shallow deposits (see Figure 5 from GES June 1990 in Appendix A).

B. HYDROGEOLOGIC UNITS

The uppermost aquifer and underlying confining unit control groundwater flow and the potential for CCR-impacted groundwater migration at the site. A description of the uppermost aquifer and the underlying confining unit follows.

Uppermost Aquifer

This aquifer represents the unit in possible hydrologic connection with the CCR waste and, as such, the unit through which potential landfill impacts, if any, may be observed via groundwater monitoring.

This aquifer is comprised of a sequence of weathered, mottled, oxidized brown to medium gray glacial till, sand, and clayey silt (loess), which collectively constitute the uppermost continuous aquifer beneath the site. The upper limit of this aquifer is the seasonally fluctuating groundwater table. Saturated thickness is variable dependent upon landscape position and seasonal variation in the water table. No perched saturated (water table) zones have been observed. The lower limit of this aquifer is an underlying un-weathered, low permeability glacial till lower confining unit.

This uppermost aquifer is generally defined by hydraulic conductivity values on the order of 1.0E-5 to 1.0E-4 centimeters per second (cm/sec), which is two to three orders of magnitude greater than the underlying confining unit, and by decreasing permeability at greater depth. The field permeability data affirm that the assemblage of shallow silts, paleosols, sands, and weathered glacial till deposits at depths of less than about 50 feet function hydrologically as the uppermost continuous aquifer beneath the site. Groundwater flow will preferentially occur in the shallow assemblage of deposits due to their greater permeability and effective porosities relative to the deeper less permeable glacial till confining unit. The encompassed sand lenses that are present appear laterally discontinuous between borings and thus do not track as a single unit across the entire site; rather they are part of the assemblage comprising the upper aquifer.

Lower Confining Unit

This confining unit represents a natural hydrogeologic barrier (i.e., aquitard) to the vertical flow of groundwater. As a whole, the deeper un-weathered, un-oxidized, medium to dark gray/green, clay-rich glacial till functions as a lower (underlying) confining unit due to its low permeability and effective porosity. This unit exhibits a field hydraulic conductivity value on the order of 1.0E-6 to 1.0E-7 cm/sec which is characteristic of un-weathered and un-oxidized clay-rich glacial till. The top of this confining unit is estimated about 50± feet deep based on descriptive notations and field permeability results noted on the geologic boring logs (Appendix D).

This confining unit overlies bedrock, which is about 335 feet deep at site's maintenance shop water well and composed of Devonian age carbonate rock (limestone, dolomite, shale).

The one sand lens that may/may not be laterally continuous is greater than 50 feet deep and has a relative low field hydraulic conductivity of 1.0E-6 cm/sec. This lens appears confined within the un-weathered glacial till confining unit as evidenced by artesian water pressure with a corresponding upward hydraulic flow gradient.

C. GROUNDWATER FLOW

Local and intermediate groundwater flow systems control groundwater movement at the site-level, including recharge along upland topographic ridges and discharge to the original stream valley. The pre-landfill groundwater flow direction in the uppermost aquifer was dominantly horizontal from the east/southeast toward the west/northwest with natural convergence along an ephemeral stream that formally drained the site (i.e., where the pond is now). This dominant flow pattern persists under present-day conditions but with localized variation introduced by the hydrologic discontinuity created upon placement of CCR waste. Seasonal fluctuations in groundwater levels may slightly modify the flow rates but the overall groundwater flow directions remain constant.

The vertical flow components are recharge (downward) in the upland area of the southeast corner of the site (MW-8/9); discharge (upward) in the lowland areas along the drainage way in the northeast corner of the site (MW-10/11/12); and variable (recharge/discharge/neutral) downstream of the pond (MW-4a/MW-17). Seasonal fluctuations in groundwater levels, particularly the water table level, result in changes to the magnitude of the vertical gradient but not the direction (i.e., recharge or discharge).

Review of the current water table map (see Figure I-2) shows equipotential lines and groundwater flow lines which show the continued dominance of horizontal movement relative to vertical movement. Under current conditions the dominant flow direction remains the same as the pre-landfill condition except that convergence is now toward the pond and low area located west of the landfill, which has replaced the original stream. In addition, a radial flow component was created by the deposition of CCR waste.

Radial flow is controlled by the: (1) landfill's bottom/sidewall cut-and-fill configuration in the southeast/east area where the landfill was cut into the pre-existing topographic ridge below the water table, (2) constructed perforated cutoff drains along the east and south perimeters which are installed to an elevation lower than the bottom elevation of the waste, (3) bypass ditch north of the fill area, and (4) presence of some accumulated leachate within Phase I CCR waste (i.e., leachate mounding).

Radial flow control is illustrated, for example, in the southeast corner of the site at MW-8/MW-9 where the groundwater elevation contours bend at nearly right angles and are very closely spaced. Flow discontinuity is not apparent but flow heterogeneities are present due to the permeability contrasts between the uppermost aquifer, waste, and drains. This means the cut-off drains may form a groundwater divide, as designed, between the liquid within the CCR and the native water table.

MP&W is in process of evaluating the leachate conditions and is striving to reduce the accumulation of leachate, either by reduced infiltration or improved performance of the leachate collection system.

III. GROUNDWATER MONITORING AND CORRECTIVE ACTION – FEDERAL CCR RULE §257.90 THROUGH §257.98

MP&W owns and operates an existing Coal Combustion Residuals (CCR) landfill located in the Southwest ½ of Section 16, Township 76 North, Range 3 West, in Muscatine County, Iowa. MP&W intends to comply with the rules promulgated by the U.S. Environmental Protection Agency (EPA) pertaining to Disposal of CCR from Electric Utilities published in 40 CFR Part 257 on April 17, 2015 in Federal Register, Volume 80, No. 74; and with the Technical Amendments published on July 2, 2015 in Federal Register, Volume 80, No. 127.

This document specifically addresses the sub rules pertaining to Groundwater Monitoring and Corrective Action under sections Applicability (§257.90), Groundwater Monitoring Systems (§257.91), Groundwater Sampling and Analysis Requirements (§257.93), Detection Monitoring Program (§257.94), Assessment Monitoring Program (§257.95), Assessment of Corrective Measures (§257.96), Selection of Remedy (§257.97), and Implementation of the Corrective Action Program (§257.98).

A. APPLICABILITY – §257.90

Owners of existing CCR landfills (disposal units) are required to install groundwater monitoring systems, develop a sampling and analysis program to include statistical procedures to be used for evaluating monitoring data, and initiate detection monitoring and evaluation of data for “statistically significant increases (SSI)” over background levels for selected constituents. If detected constituents are measured at a "statistically significant level (SSL)” over the established background level the Owner must conduct assessment monitoring, and if necessary, initiate corrective action responses to control the release.

The Owner must make available an annual groundwater monitoring and corrective action report, the first of which is due no later than January 31, 2018. The report must document the status the groundwater monitoring and corrective action program, summarize actions completed, describe problems encountered, and identify activities for the upcoming year. The content of the report is prescribed in §257.90(e). The report must be placed in the facility’s operating record and comply with the recordkeeping requirements in §257.105(h), notification requirements in §257.106(h), and internet requirements in §257.107(h).

B. GROUNDWATER MONITORING SYSTEMS – §257.91

The rule for Groundwater Monitoring Systems (GMS) is a performance standard (§257.91(a)), where the system must consist of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that: (1) accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit, and (2) accurately represent the quality of groundwater passing the waste boundary of the CCR unit to monitor potential contaminant pathways in the uppermost aquifer.

Under §257.91(b-c) the number, spacing, and depths of the monitoring system have been determined based upon site-specific technical information to meet the rule's performance standard, including the subsurface conditions observed at the site as summarized in Section II of this document. This includes a characterization of the uppermost aquifer (e.g., saturated thickness and hydrologic properties such as hydraulic conductivity and porosity, groundwater flow rate, direction and seasonal fluctuations, and the bounding geologic units. The approximate spacing of downgradient monitoring wells is less than 300 feet and their locations take into consideration the natural (pre-landfill) and current convergence of groundwater flow paths. The wells are located as close as feasible to the downgradient CCR waste boundary as based on topography, cell development, and operations.

Section §257.91(d) does not apply because this is not a multi CCR unit facility.

Under §257.91(e) the GMS monitoring wells are cased in a manner that maintains the integrity of the monitoring well and borehole, where all wells were installed under the then current Iowa Administrative Code rules for monitoring well construction standards. All monitoring well installations were documented in the Hydrogeologic Evaluation (GES, October 1991) or, for later wells, submitted to IDNR by MP&W. For easy reference, well construction standard and records are included in Appendix D. Abandoned borings, wells or piezometers also complied with then current Iowa Administrative Code rules relating to the sealing of nonfunctional wells and/or boreholes. All drilling and well construction is completed under the direct supervision of a well contractor certified under [567] Iowa Administrative Code Chapter 82, which became effective in January 1993.

Under §257.91(f) this engineer-sealed document by HR Green certifies that this GMS is designed and constructed to meet the requirements of §257.91.

The GMS monitoring points are shown in Figure I-2 (Appendix A) and summarized in Table III-1 (Appendix B) and consist of the following monitoring wells:

Background Quality – §257.91(1)

Two (2) monitoring wells are representative of background (ambient) groundwater quality conditions of the uppermost aquifer, including MW-8 and MW-10. These wells accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit.

- Monitoring well MW-8 is located in an upgradient, side slope landscape position (elevation 744.4 feet) along a pre-landfill topographic ridge located in the southeast area. The well screen elevation (704.4 to 714.4 feet) is below the bottom invert elevation of the cut-off drains (719 to 720 feet in the southeast area). This well monitors the upgradient quality of the uppermost aquifer, including weathered glacial till.

- Monitoring well MW-10 is located in a background, lowland streambank position (elevation 716.3 feet) located in the northeast area where a native intermittent stream still enters the site. The well screen elevation (698.3 to 708.3 feet) monitors the background quality of the uppermost aquifer including the interface of alluvial silt and weathered glacial till along the margin of the stream as it enters the site. This well is not upgradient of the CCR waste in a hydrologic sense but it is located on available MP&W property where it provides representative background groundwater quality, as allowed under §257.91(a)(1)ii.

Downgradient Quality - §257.91(2)

Eight (8) monitoring wells are representative of downgradient quality conditions in the uppermost aquifer, including MW-4A, MW-5B, MW-6A, MW-13, MW-14A, MW-15A, MW-18A, and MW-21. The locations and depths of these wells accurately represent the quality of groundwater passing the waste boundary of the CCR unit and reasonably make possible the detection of groundwater contamination in the uppermost aquifer.

- Monitoring wells MW-13 (loess/weathered till/sand), MW-14A (water table, sand/loess/weathered till), MW-15A (water table, loess/weathered till), and MW-18A (water table, loess/weathered till) are located within about 40 to 60 feet of the west edge of the Phase I and Phase II fill areas. The uppermost aquifer groundwater monitored by these wells ultimately discharges horizontally into the landfill runoff control pond.

- Monitoring wells MW-4A (weathered till/silt), MW-5B (silt/weathered till), MW-6A (sand/weathered till), and MW-21 are located downgradient of the southwest corner of the Phase II and future fill areas and adjacent to the runoff control pond. These wells are situated along the course of the original stream that drained the pre-landfill site. The uppermost aquifer groundwater monitored by these wells ultimately discharges to a downstream farm pond.

C. GROUNDWATER SAMPLING AND ANALYSIS REQUIREMENTS – §257.93

Under §257.93(a) the Groundwater Monitoring Program (GMP) includes consistent sampling and analysis procedures to provide accurate representation of groundwater quality. Reference is made to HR Green's "*Procedure For Groundwater and Surface Water Sampling*" (May 2016), which is adopted herein as standard protocol. This document addresses sample collection, preservation and shipment, analytical procedures, chain of custody, quality assurance, quality control, and other topics. Several general notes from the Procedure include (1) the upgradient/background wells will be sampled first, (2) a low flow sampling methodology will be applied, (3) one field quality control sample will be collected per event (i.e., 10%), (4) groundwater samples will not be field-filtered prior to laboratory analysis of total

recoverable metals; and (5) a certified laboratory will be used for the analytical analysis. This document is available for review upon request.

Under §257.93(b) the GMP includes the constituents listed in Appendices III and IV of Part 257 of the CCR rule. For detection monitoring these constituents include boron, calcium, chloride, fluoride, pH, sulfate, and total dissolved solids from Appendix III Part 257 (Table III-2); and for assessment monitoring these constituents include antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, fluoride, lead, lithium, mercury, molybdenum, selenium, thallium, and radium 226 & 228 combined from Appendix IV Part 257 (Table III-3). All constituents are analyzed as total recoverable, where samples are not field filtered.

Under §257.93(c) groundwater levels will be measured in each GMS well immediately prior to purging, each time groundwater is sampled. Other wells may be retained as water level measurement points. Levels will be measured to the nearest 0.01 feet (1/100 hundredth) and used to determine rate and direction of groundwater flow each time groundwater is sampled. For each well a qualitative comparison will be made between the current event's water level readings and the historical water level range of the uppermost aquifer as established in the *Annual Groundwater and Surface Monitoring Report* (MP&W, November 25, 2015). Variation within the documented historical range will indicate that flow rate and direction are consistent within normal seasonal fluctuations. In addition, a water table map for the uppermost aquifer will be generated using the measured water levels obtained from each sampling event, except that not more than semi-annual maps will be produced during initial period when sampling events are being conducted frequently (e.g., 2-3 months apart) to establish background conditions. The contours on these maps will allow for a quantitative assessment of flow rate and direction. Measurements of well depths will also be obtained during each sampling event to verify that the wells are physically intact and not filling with sediment, except where such measurements are not possible due to the presence of dedicated sampling equipment in the well.

Under §257.93(d) the background groundwater quality will be established for each of the constituents listed in Appendices III and IV of Part 257 (see Tables III-2 and III-3) by using the upgradient and background wells described under §257.91(a)(1), as applicable for detection (§257.94(a)) or assessment (§257.95(a)) monitoring requirements. The upgradient and background wells include MW-8 and MW-10.

Under §257.93(e) the number of samples collected under detection and assessment monitoring (for both downgradient and background wells) will be consistent with the statistical procedures selected under §257.93(f) and the performance standard under §257.93(g). The sampling procedures will be as specified under §257.94(b-d) for detection monitoring and §257.95(b-d) for assessment monitoring, and §257.96(b) for corrective action.

Under §257.93(f) the selected statistical method to be used during detection monitoring in evaluating groundwater monitoring data for each constituent is the

Prediction Interval Procedure under §257.93(f)(3). For this procedure an interval for each constituent is established from the distribution of the background data and then the level of each constituent in each compliance well (i.e., well/constituent) is compared to the upper prediction limit to assess if a statistically significant increase (SSI) over background has occurred.

Under §257.93(f)(6) this engineer-sealed document with narrative description of the selected statistical method certifies the prediction interval procedure during detection monitoring is appropriate for evaluating for quality changes in the data and that this method will comply with the performance standards under §257.93(g), including:

(1) §257.93(g)(1) addressing the distribution of constituents where normal distributions will use parametric methods and non-normal distributions will use non-parametric methods.

(2) §257.93(g)(4) addressing the effectiveness of this approach by considering the number of samples in the background database, the data distribution, and the range of concentrations values for each constituent of concern.

(3) §257.93(g)(5) establishing the practical quantitation limit as the lowest concentration level that can be reliably achieved during routine laboratory operating conditions.

(4) §257.93(g)(6) allowing for the correction of seasonal and spatial variability as well as temporal correlation in the data.

Tables III-4 and III-5 depict eligible methodologies to screen background data and establish background constituent levels (i.e., interwell and intrawell comparisons). Tables III-6 and III-7 depict the corresponding methodologies for use in computing prediction limits during detection monitoring to determine SSI.

The selected statistical approach, that is, either the interwell or intrawell prediction limit method, will be determined based on evaluation of actual sampling data and will be selected to be effective in detecting changes in groundwater quality (EPA, Unified Guidance, 2009). The statistically calculated prediction limits will be used during detection monitoring to statistically analyze detected inorganic constituents at each monitoring well (i.e., well/constituents) to determine under §257.93(h) whether or not there is a statistically significant increase (SSI) over background values. The SSI determination(s) will be completed within 90 days of completing sampling and analysis, where under §257.93(h)(2)(i) analysis is for total recoverable metals of non-field filtered samples. Volatile organic compounds and synthetic compounds are not applicable to this CCR site. Inorganic well/constituent pairs with confirmed SSI (i.e., interwell or intrawell prediction limit exceedances) will then be placed into the Assessment Monitoring Program under §257.95 where the methodology for constructing confidence intervals depicted in Table III-8 will be applied (Appendix B).

D. DETECTION MONITORING PROGRAM – §257.94

Under §257.94(a) the Detection Monitoring Program will include, at a minimum, groundwater monitoring for all constituents listed in Appendix III to Part 257, including boron, calcium, chloride, fluoride, pH, sulfate, and total dissolved solids (TDS). The long-term monitoring frequency for the Appendix III constituents under §257.94(b) will be semiannual during the active life of the CCR unit and the post-closure period.

Under §257.94(b) to initiate detection monitoring for this existing landfill eight (8) independent samples will be collected from each background and downgradient well and analyzed for the constituents listed Appendix III to Part 257 including boron, calcium, chloride, fluoride, pH, sulfate, and total dissolved solids (TDS); and for the constituents listed in Appendix IV to Part 257 including antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, fluoride, lead, lithium, mercury, molybdenum, selenium, thallium, and radium 226 & 228 combined.

Under §257.94(b) the anticipated schedule for the initial 8 independent sampling events will be completed by October 17, 2017, including June, August, October, and December 2016, and February, April, June, and August 2017. Such a schedule will capture seasonal variability in quality and groundwater flow conditions, if present.

Under §257.94(c) the number of samples collected and analyzed will be consistent with the sampling and statistical procedures referenced in §257.93(e) and will account for any unique characteristics of the site.

Under §257.94(d) the owner may consider an alternative monitoring frequency for repeated sampling and analysis for constituents listed in Appendix III of Part 257 during the active life and the post-closure period based on the availability of groundwater. Such a proposal may be considered upon completion of the initial 8 independent sampling events and would include documentation requirements under §257.94(d)(1-3).

Under §257.94(e) if the owner determines pursuant to §257.93(h) that there is a statistically significant increase (SSI) over background levels for one or more of the constituents listed in Appendix III to Part 257 at any monitoring well the owner will within 90 days of this determination establish an assessment monitoring program meeting the requirements of §257.95 and prepare a notification for the facilities operating record stating that an assessment monitoring program has been established. Such a determination for SSI will occur under the Detection Monitoring Program after completion of the initial 8 independent sampling events and the initial statistical evaluation using the selected methodologies from Tables III-4 through III-7. As applicable, the owner may also demonstrate that a source other than the CCR unit caused the SSI, or that the SSI was the result of error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The demonstration

must be in writing and completed within 90 days of detecting the SSI. If the demonstration is successful then detection monitoring may continue.

E. ASSESSMENT MONITORING PROGRAM – §257.95

Under §257.95(a) assessment monitoring is required whenever a SSI has been detected during detection monitoring for one or more of the constituents in Appendix III of Part 257.

Under §257.95(b) within 90 days of triggering an assessment monitoring program, and annually thereafter, the owner must sample and analyze the groundwater for all constituents listed in Appendix IV to Part 257.

Under §257.95(c) an alternative monitoring frequency may be considered if documented under the requirements of §257.95(c).

Under §257.95(d) after obtaining the results from the initial and subsequent sampling events required under §257.95(b) the owner must within 90 days of obtaining the results, and on at least a semiannual basis thereafter, resample all wells that were installed pursuant to §257.91 and conduct analyses for all constituents in Appendix III and for those constituents in Appendix IV to Part 257 that are detected and then place the results in the operating record. Groundwater Protection Standards (GWPS) will be established for all constituents detected pursuant to §257.95(b or d) and in accordance with the requirements of §257.95(h). These activities and results will be summarized in the annual groundwater monitoring and corrective action report required under §257.90(e).

Under §257.95(e) if the concentration of all constituents listed in Appendix III and Appendix IV of Part 257 are shown to be at or below background values, using the statistical procedures in §257.93(g), for two consecutive sampling events, the owner may return to the detection monitoring and place notification in the operating record.

Under §257.95(f) if the concentrations of any constituent in Appendix III and Appendix IV to Part 257 are above background values, but all concentrations are below the GWPS the owner must continue assessment monitoring.

Under §257.95(g) if one or more constituents in Appendix IV to Part 257 are detected at statistically significant levels (SSL) above the GWPS the owner must place notification in the operating record and proceed to characterize the nature and extent of the release and any relevant site conditions that may affect the remedy ultimately selected. The characterization must meet the requirements of §257.95(g)(1) and the public notification the requirements of §257.95(g)(2). Under §257.95(g)(3) within 90 days of finding that any of the constituents listed in Appendix IV to Part 257 have been detected at a SSL exceeding the GWPS the owner must either initiate an assessment of corrective measures under §257.96, or demonstrate an error in any such determination.

Under §257.95(h) the owner must establish a GWPS for each constituent in Appendix IV to Part 257 detected in the groundwater. The GWPS shall be: (1) for constituents for which a maximum contaminant level (MCL) has been established, the MCL for that constituent, or (2) for constituents for which an MCL has not been established, the background concentration for the constituent established from wells in accordance with §257.91, or (3) for constituents for which the background level is higher than the MCL identified under §257.95(h)(1), the background concentration.

Table III-8 depicts the methodology for constructing confidence intervals during assessment monitoring to determine statistically significant level (SSL) exceedances (Appendix B). The well/constituent will be considered to be present at a SSL only when the entire confidence interval exceeds the applicable GWPS (Unified Guidance, 2009).

F. ASSESSMENT OF CORRECTIVE MEASURES – §257.96

Under §257.96(a) within 90 days of a finding that any constituent listed in Appendix IV of Part 257 has been detected at a SSL exceeding the GWPS, or immediately upon detection of a release, the owner must initiate an assessment of corrective measures to prevent further releases, to remediate releases, and to restore the affected area to original conditions. The assessment must be completed within 90 days unless a time extension of not more than 60 days is needed to complete the assessment, as demonstrated by the owner and attested to by a qualified professional engineer. The owner will include any such demonstration in the annual groundwater monitoring and corrective action report required under §257.90(e).

Under §257.96(b) the CCR unit will continue to monitor groundwater in accordance with the Assessment Monitoring Program during the assessment of corrective measures.

Under §257.96(c) the assessment of corrective measures will evaluate the effectiveness of potential corrective measures in meeting the requirements and objectives of the remedy as described under §257.97, including performance, reliability, ease of implementation, impacts, exposure, time required, permitting, etc.

Under §257.96(d-f) the owner must place the completed assessment of corrective measures in the operating record; discuss the results of the corrective measures assessment in a public meeting at least 30 days prior to the selection of a remedy under §257.97; and meet recordkeeping, notification, and internet requirements.

Table III-9 depicts the methodology for evaluating the effectiveness of corrective measures (Appendix B).

G. SELECTION OF REMEDY – §257.97

Under §257.97(a) the owner will, if needed based on the results of the assessment of corrective measures, select a remedy as soon as feasible that meets the standards listed in §257.97(b), including being protective of human health and environment, attain the GWPS, control the source(s) of release so as to reduce or eliminate, to the extent feasible, further releases on constituents in Appendix IV of Part 257, remove from the environment as much of the contaminated material as feasible, and comply with standards for management of wastes under §257.98(d). In selecting the remedy the owner will consider the requirements of §257.97(c) and establish a schedule for implementing and completing remedial activities under §257.97(d).

H. IMPLEMENTATION OF THE CORRECTIVE ACTION PROGRAM – §257.98

Under §257.98(a) within 90 days of selecting the remedy the owner will initiate remedial activities. Based on the schedule established under §257.97(d) for implementation and completion of remedial activities the owner must establish and implement a corrective action groundwater monitoring program that meets the requirements of an assessment monitoring program under §257.95, implement the corrective action remedy selected under §257.97, and address any interim measures that might be needed to reduce the contaminants leaching from the CCR unit.

Under §257.98(b) if at any time the owner determines that compliance with the requirements of §257.97(b) is not being achieved through the remedy selected the owner will implement other methods or techniques that could feasibly achieve compliance.

Under §257.98(c) the remedy will be considered complete when compliance with the GWPS has been achieved at all points within the plume of contamination that lie beyond the groundwater monitoring well system and concentrations of constituents listed in Appendix IV of Part 257 have not exceeded the GWPS for a period of three consecutive years. Table III-7 depicts the methodology for corrective action, where the effectiveness of the remedial actions will be evaluated based on the confidence intervals constructed for applicable well/constituent pairs as compared to a specified clean-up standard which is the GWPS. When the entire interval is determined to be below the standard under §257.98(c) for three consecutive years that well/constituent pair will be declared to be in compliance, and inorganic well/constituent pairs will be moved back into detection monitoring and appropriate limit-based statistics will resume.

Under §257.98(d) all CCR units managed pursuant to a remedy required under §257.97 will be managed in a way that complies with applicable RCRA requirements.

Under §257.98(e) upon completion of the remedy the owner will prepare a notification stating that the remedy has been completed and obtain a certification from a qualified professional engineer.

IV. RECORDKEEPING, NOTIFICATION, AND POSTING OF INFORMATION – FEDERAL RULE §257.105 THROUGH §257.107

A. RECORDKEEPING REQUIREMENTS – §257.105

Muscatine Power and Water, as owner of an existing CCR landfill unit, will maintain files in its operating record as required under §257.105(h) – groundwater monitoring and corrective action – for a period of no less than five years. This includes the (1) annual groundwater monitoring report, (2) documentation pertaining to monitoring wells, (3) groundwater monitoring certification, (4) selection of statistical method certification, (5) notification within 30 days of establishing an assessment monitoring program, (6) analytical results of Appendices III and IV to Part 257, (7) notification within 30 days of returning to a detection monitoring program, (8) notification within 30 days of detecting of constituents in Appendix IV of Part 257 at statistically significant levels above the groundwater protection standard, (9) notification within 30 days of initiating the assessment of corrective measures, (10) the completed assessment of corrective measures, (11) documentation recording the public meeting for the corrective measures assessment, (12) the semiannual report describing the progress in selecting and designing the remedy and the selection of remedy report, and (13) notification within 30 days of completing the remedy.

B. NOTIFICATION REQUIREMENTS – §257.106

Notifications required under §257.106(h) – groundwater monitoring and corrective action – will be sent to the relevant regulatory authority, including for (1) availability of the annual groundwater report, (2) availability of the groundwater monitoring system certification, (3) selection of a statistical method certification, (4) that an assessment monitoring program has been established, (5) that the CCR unit is returning to a detection monitoring program, (6) that constituent(s) in Appendix IV to Part 257 have been detected at statistically significant levels above the groundwater protection standard and notifications to landowners, (7) that an assessment of corrective measures has been initiated, (8) availability of assessment of corrective measures, (9) the availability of the semiannual report describing the progress in selecting and designing the remedy and the selection of remedy report, and (10) completion of the remedy.

C. PUBLICALY ACCESSIBLE INTERNET SITE REQUIREMENTS – §257.107

Muscatine Power and Water will maintain a publicly accessible Internet site (CCR website) containing the information specified in §257.107(h) – groundwater monitoring and corrective action. The link to the website *CCR Rule Compliance Data and Information* is: https://www.mpw.org/utilities/ccr-rule.

V. REFERENCES CITED

Green Environmental Services (GES), November 21, 1991. Coal Combustion Residue Landfill Development Plans and Supporting Documentation, Muscatine Power and Water; and Supplemental Plan Sheets 16 and 18 dated January 29, 1993.

Green Environmental Services (GES), October 25, 1991. Hydrogeologic Evaluation of the Muscatine Power and Water Coal Combustion Residue Landfill.

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U.S. Environmental Protection Agency (EPA), 2015. Published in Federal Register Volume 80, No. 74 published on April 17, 2015, *Final Rule 40 CFR Part 257 Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities*; and *Technical Amendments* (correcting the effective date) published in Federal Register Volume 80, No. 127 on July 2, 2015.

APPENDIX A

FIGURES

Figure I-1 Location Map

Figure I-2 Site Map

Supplemental Information From:

Hydrogeologic Investigation Work Plan (GES, June 1990)

Figure 5: Geological Cross Section, Storage Pond Dam

Hydrogeologic Evaluation (GES, October 1991)

Figure 4: Cross Section A-A'

Figure 5: Cross Section B-B'

Figure 6: Cross Section C-C'

Figure 7: Cross Section D-D'

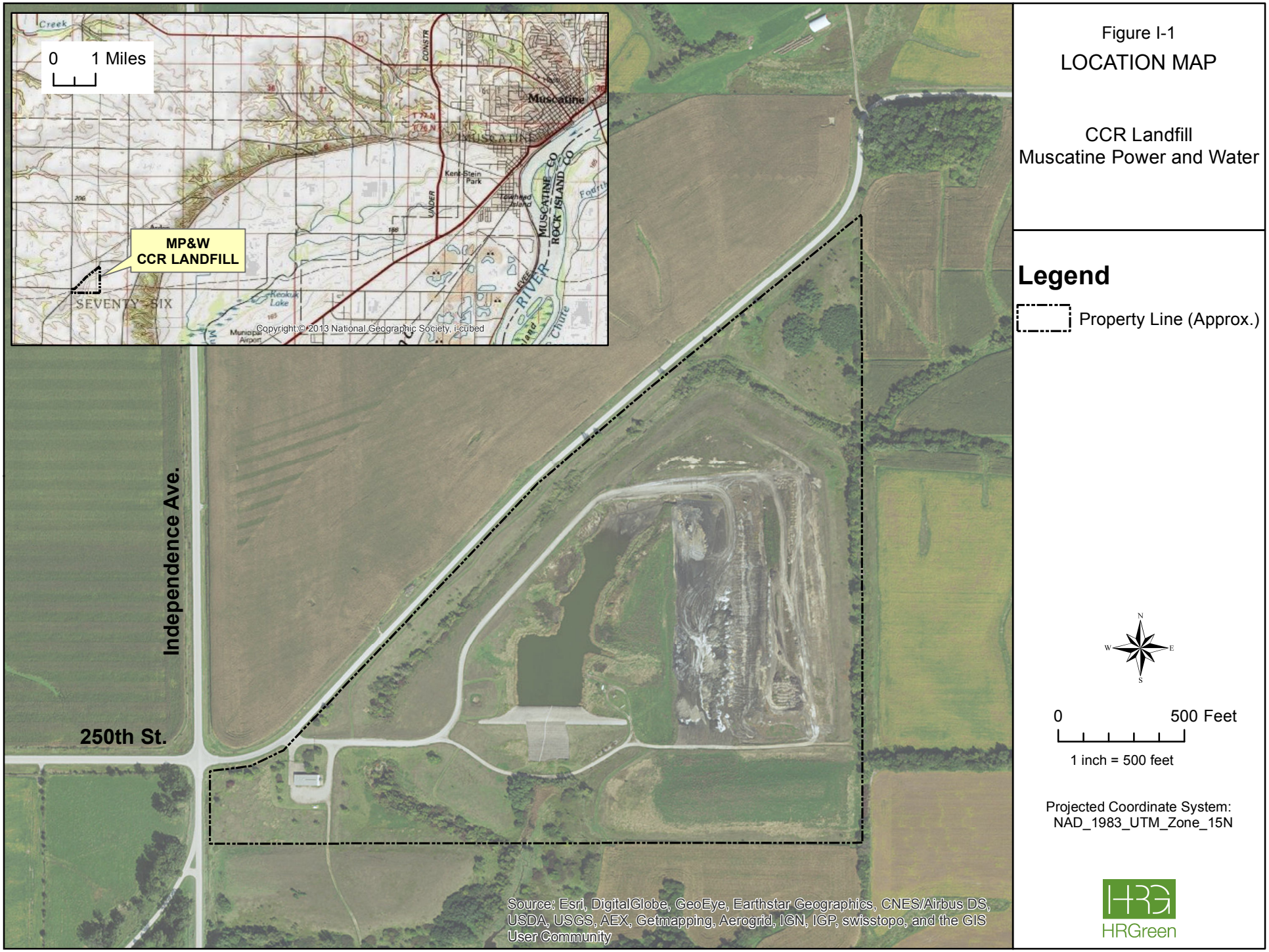


Figure I-1

LOCATION MAP

CCR Landfill
Muscatine Power and Water

Legend

Property Line (Approx.)

N
W E
S

0 500 Feet

1 inch = 500 feet

Projected Coordinate System:
NAD_1983_UTM_Zone_15N

HRGreen

HRG PLOT: 1/18/2016 FILE: \\HRGCRNAS\Data\10100095.03\GIS\Figl-1-LocationMap.mxd

Figure I-2

SITE MAP

CCR Landfill
Muscatine Power and Water

Legend

- Monitoring Wells
- Piezometers
- Abandoned Wells
- Water Supply Well
- Water Table (8/17/2015)
- Geologic Cross Sections
- Leachate Collection System
- Perforated Cut-Off Drain
- Phase II (2012)
- Permitted Fill Area
- Property Line (Approx.)
- Water Table Flow Direction

N
W E
S

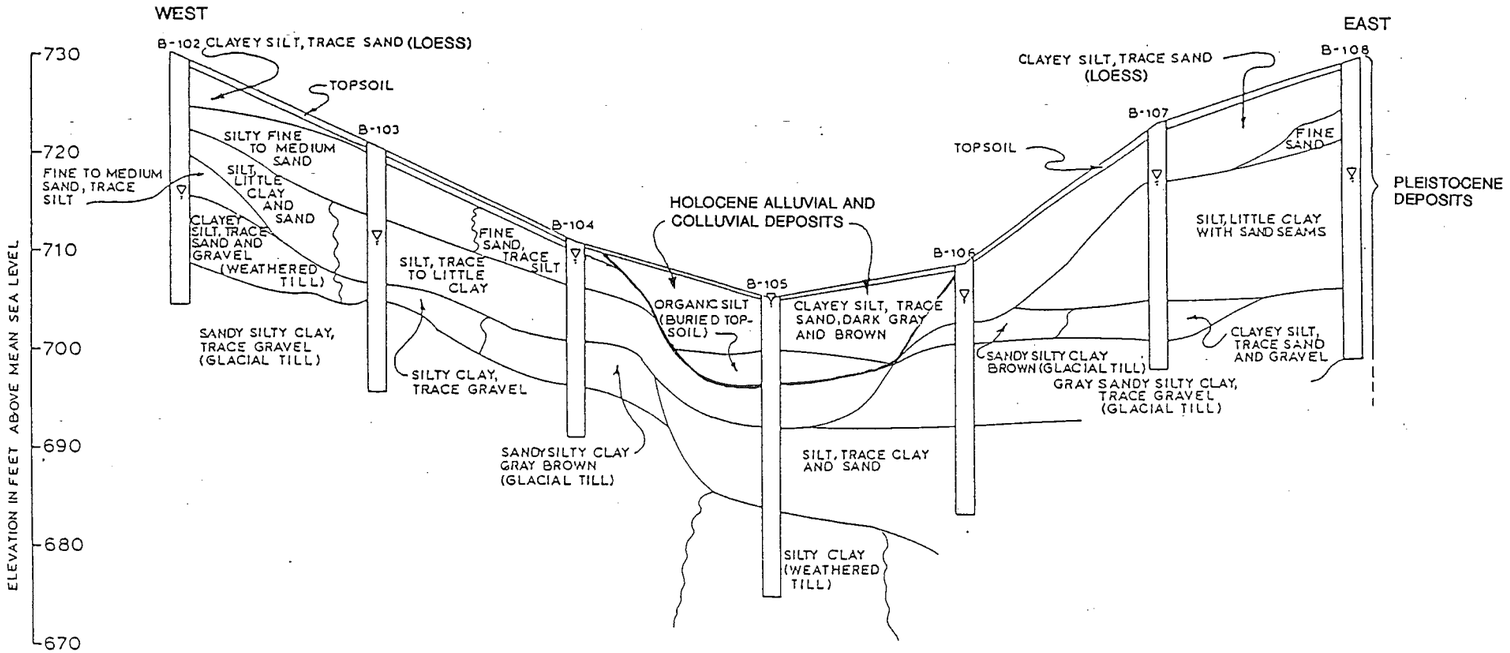
0 200 Feet

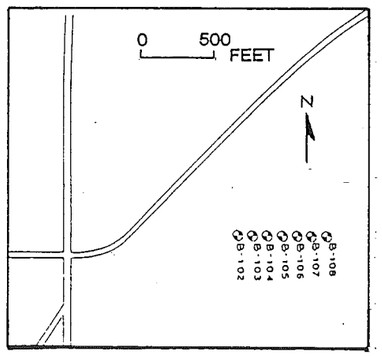
1 inch = 200 feet

Projected Coordinate System:
NAD 1983 StatePlane Iowa_South

HRGreen

HRG PLOT: 5/11/2016 FILE: \\HRGCRNAS\Data\10100095.03\GIS\Figure I-2-SiteMap.mxd





LOCATION IN SW 1/4 sec.16 AND NW 1/4 sec. 21, T.76N., R.3W

0 10 FEET
HORIZONTAL SCALE

529823

FIGURE 5

GEOLOGICAL CROSS SECTION, STORAGE POND DAM, MUSCATINE POWER AND WATER COAL-COMBUSTION-RESIDUE LANDFILL, MUSCATINE, IOWA

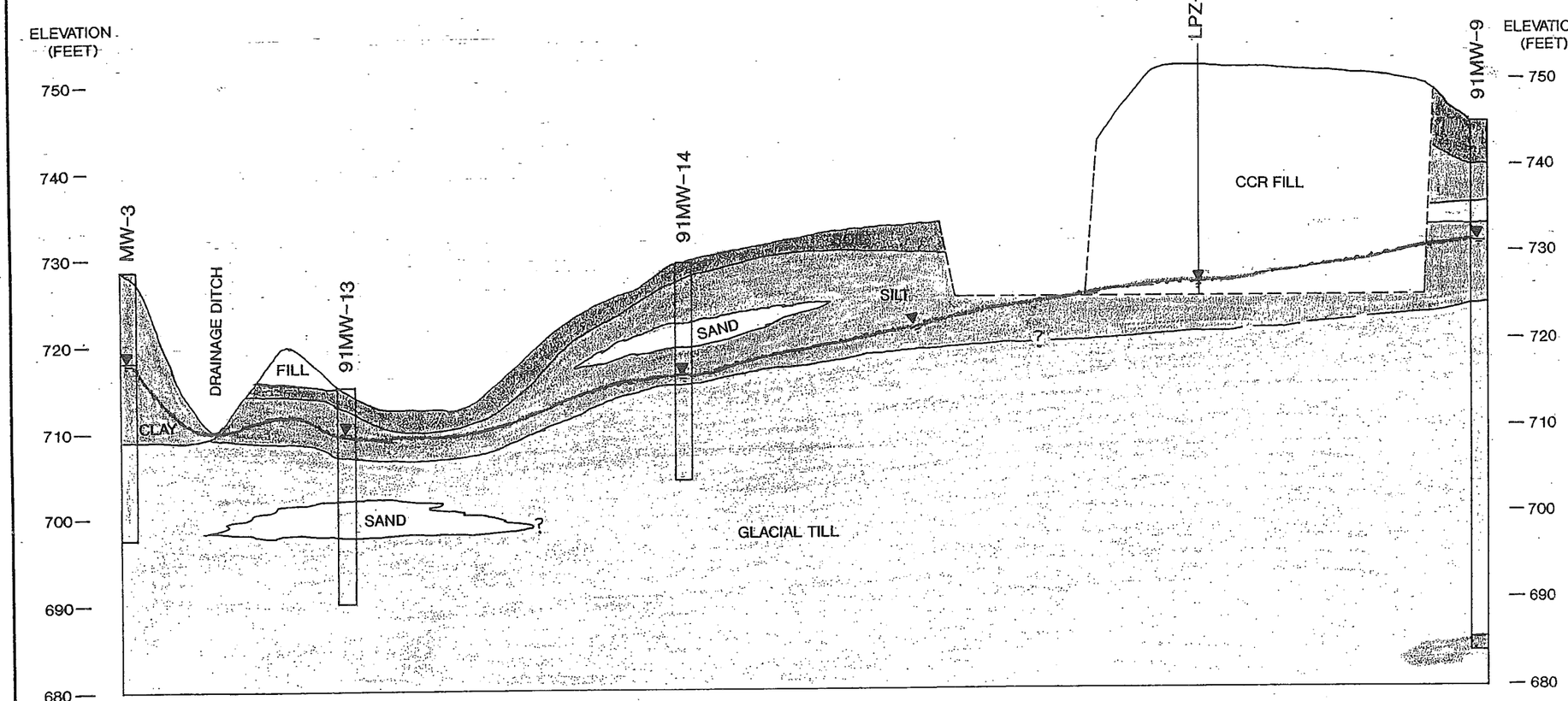
ADAPTED FROM TERRACON CONSULTANTS, 1981b

Green Environmental Services, Inc.

705911

NORTHEAST
A

SOUTHWEST
A'



LEGEND

- SOIL
- CLAY
- SILT
- SAND
- GLACIAL TILL
- WATER TABLE
- WASTE BOUNDARIES

WATER LEVELS MEASURED 10/8/1991
LEACHATE LEVELS MEASURED 09/11/1991

0 100' 200'
HORIZONTAL SCALE

5458S7

FIGURE 4

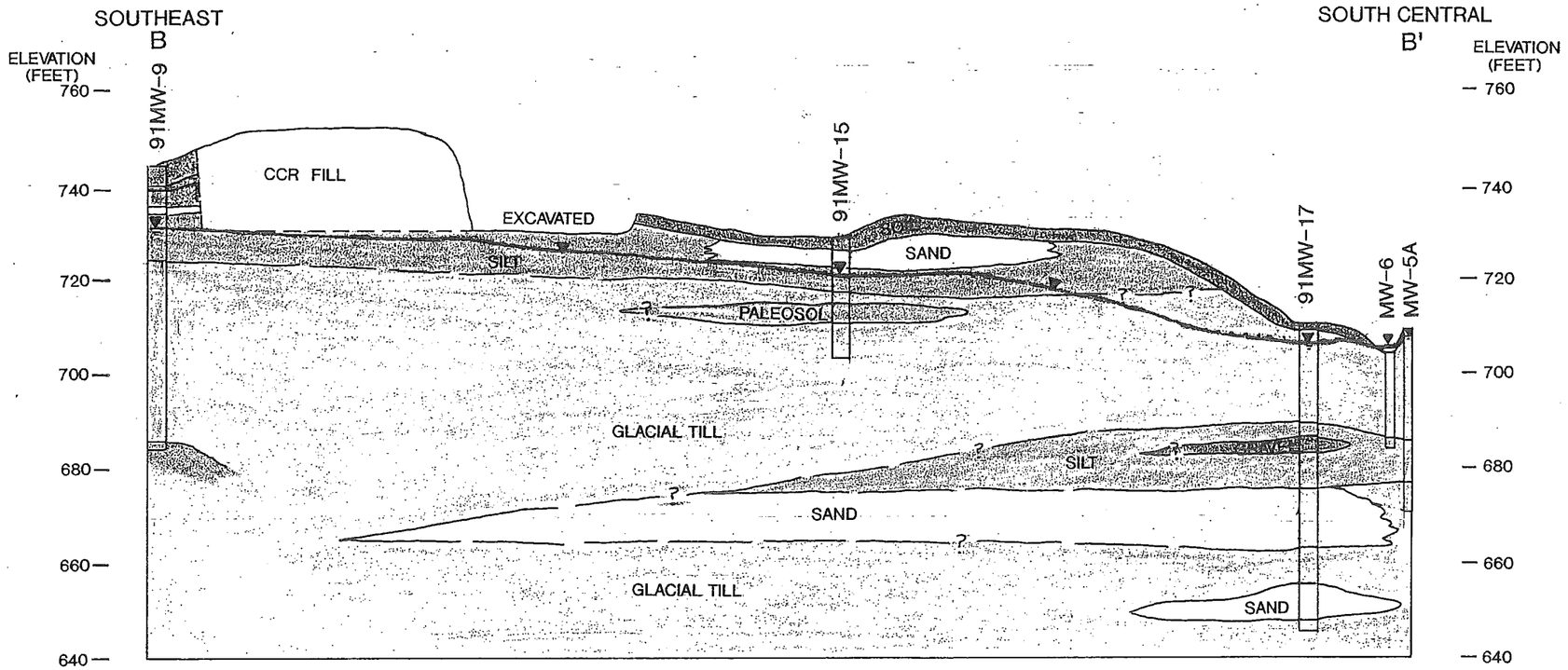
GEOLOGIC CROSS SECTION A - A'

MUSCATINE
POWER & WATER
CCR LANDFILL

OCTOBER, 1991

Green
Environmental
Services Inc.

DCK 705910J



LEGEND

- SOIL
- SILT
- SAND
- GRAVEL
- PALEOSOL
- GLACIAL TILL
- WATER TABLE
- WASTE BOUNDARIES

WATER LEVELS MEASURED 10/8/1991

0 100' 200'
HORIZONTAL SCALE

545857

FIGURE 5

GEOLOGIC CROSS SECTION B - B'

MUSCATINE
POWER & WATER
CCR LANDFILL

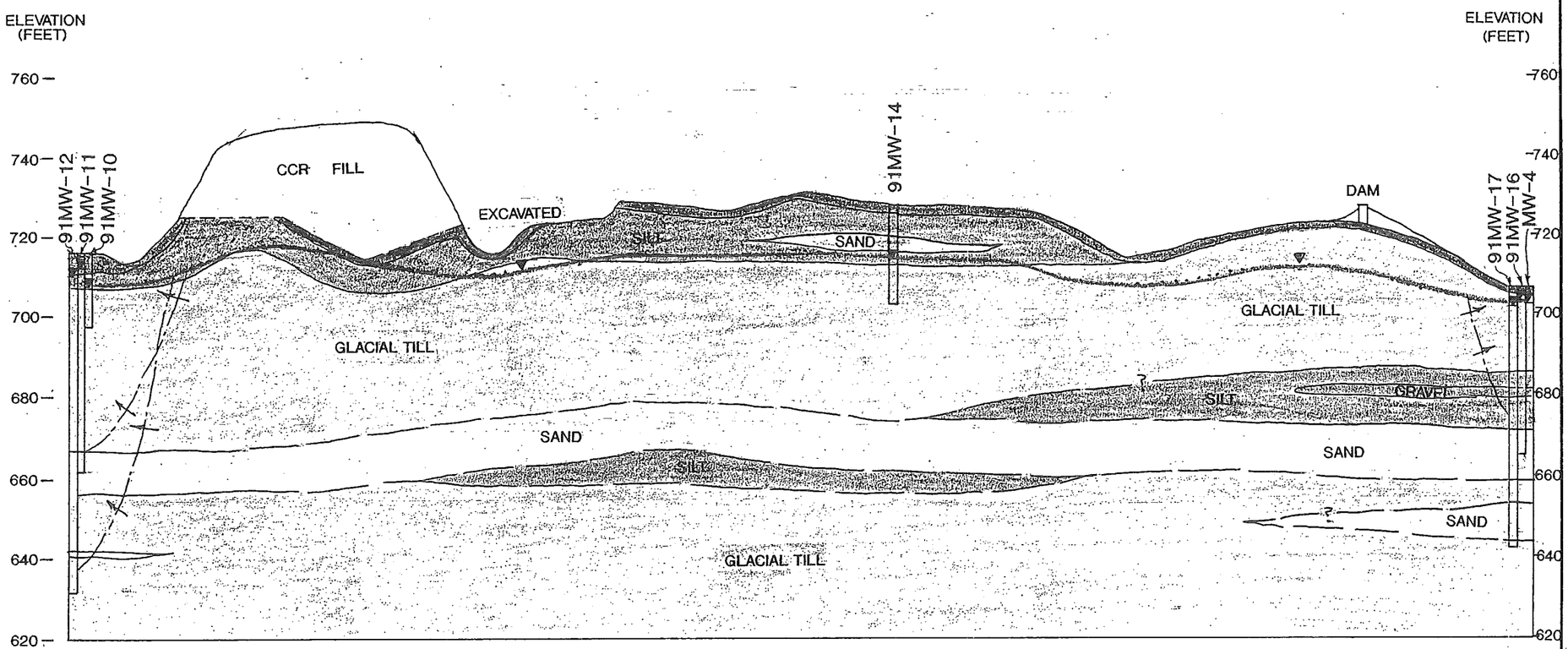
OCTOBER, 1991

Green
Environmental
Services, Inc.

DCK 705910J

C
NORTHEAST

C'
SOUTH CENTRAL



LEGEND

- SOIL
- SILT
- SAND
- GRAVEL
- GLACIAL TILL
- WATER TABLE
- APPROXIMATE WASTE BOUNDARIES
- EQUIPOTENTIAL LINES
- GROUNDWATER FLOW DIRECTIONS

WATER LEVELS MEASURED 10/8/1991
LEACHATE LEVELS MEASURED 09/11/1991

0 100' 200'
HORIZONTAL SCALE

545857

FIGURE 6

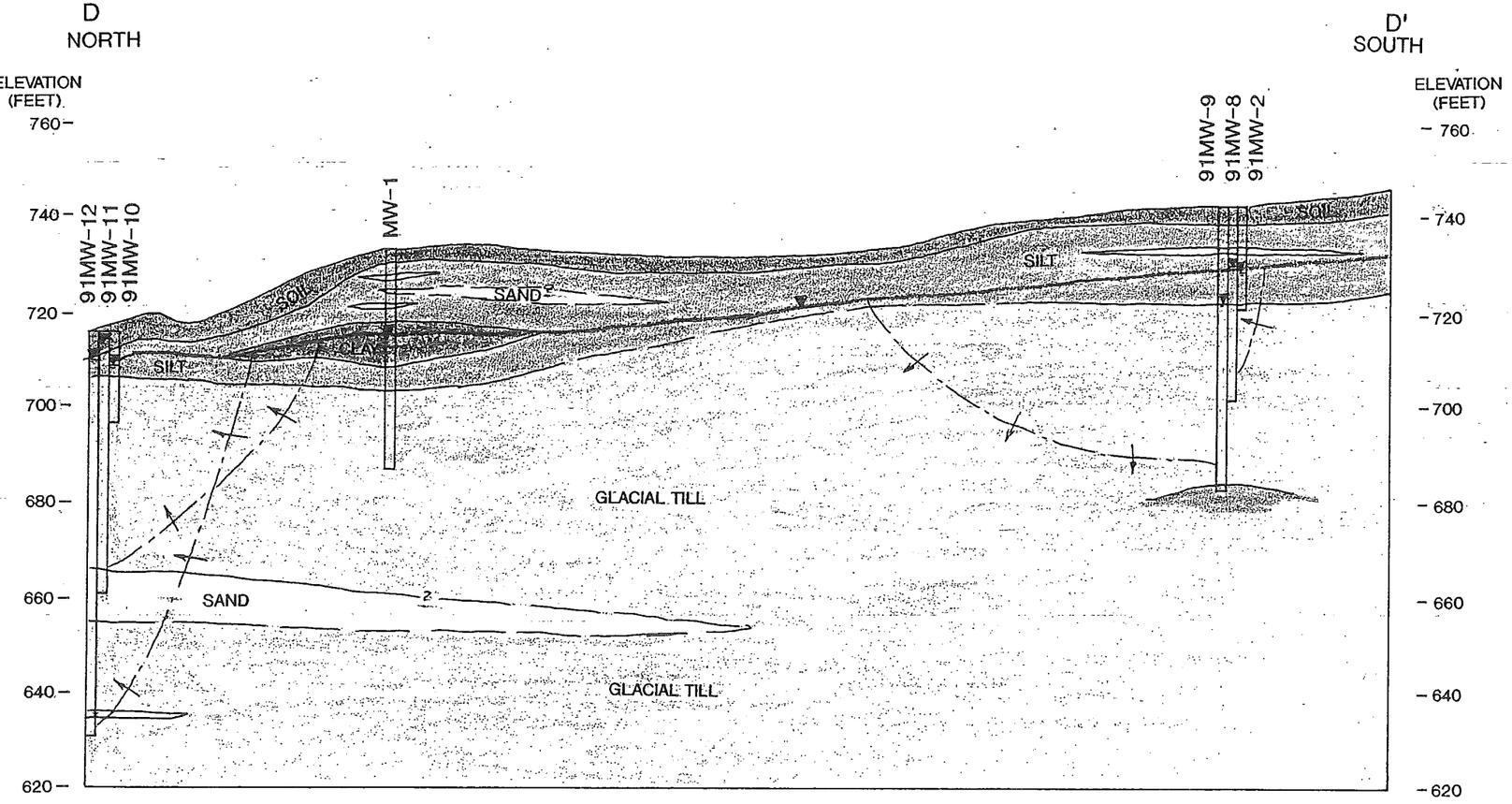
GEOLOGIC AND VERTICAL FLOW CROSS SECTION C - C'

MUSCATINE
POWER & WATER
CCR LANDFILL

OCTOBER, 1991

Green
Environmental
Services, Inc.

DCK 705910J



LEGEND

- SOIL
- SILT
- SAND
- CLAY
- GLACIAL TILL
- WATER TABLE
- EQUIPOTENTIAL LINES
- GROUNDWATER FLOW DIRECTIONS

WATER LEVELS MEASURED 10/8/1991

0 100' 200'
HORIZONTAL SCALE

545857

FIGURE 7

GEOLOGIC AND VERTICAL FLOW CROSS SECTION D - D'

MUSCATINE
POWER & WATER
CCR LANDFILL

OCTOBER, 1991

Green
Environmental
Services, Inc.

DCK 705910J

APPENDIX B

TABLES

Table III-1
Summary of Monitoring Wells and Piezometers
Muscatine Power and Water

	WELL COORDINATES[1]				WELL CONSTRUCTION							
	Site System [2]		State Plane[3]		Elevation[4]							
Well ID	Northing	Easting	Northing	Easting	Top of Well Casing	Ground	Well Depth[4]	Screen Length	Screened Lithology	Function	Hydrogeologic Unit	Water Table Elevation (8/17/15)
PZ-1	11,209	3,071	511,728	2,269,506	749.71	749	37.00	30	CCR	Piezometer	CCR	731.22
PZ-2	11,208	3,305	511,736	2,269,740	747.16	744	36.00	30	CCR	Piezometer	CCR	732.80
PZ-3	10,851	3,402	511,377	2,269,851	763.83	761	27.00	20	CCR	Piezometer	CCR	732.50
PZ-4	10,434	3,397	510,967	2,269,843	765.45	762	27.00	20	CCR	Piezometer	CCR	732.05
PZ-5	10,970	3,050	511,495	2,269,505	729.63	721	10.00	5	CCR	Piezometer	CCR	719.67
MW-4A	9,964	2,510	510,481	2,268,964	713.45	711.18	25.00	10	Clay, Silt	Monitoring	Uppermost Aquifer	707.47
MW-5B	9,969	2,323	510,485	2,268,777	709.10	706.73	25.00	10	Silt, Clay	Monitoring	Uppermost Aquifer	706.03
MW-6A	9,966	2,417	510,482	2,268,871	708.92	706.49	25.00	10	Silt, Sand	Monitoring	Uppermost Aquifer	705.47
MW-8	10,103	3,615	510,639	2,270,068	747.36	744.37	43.04	10	Till	Monitoring	Uppermost Aquifer	733.69
MW-9	10,110	3,616	510,646	2,270,068	747.12	744.40	58.74	10	Till	Piezometer	Uppermost Aquifer	726.36
MW-10	11,312	3,625	511,846	2,270,058	718.51	716.32	19.99	10	Silt, Till	Monitoring	Uppermost Aquifer	713.89
MW-11	11,306	3,624	511,840	2,270,058	718.34	716.00	55.97	10	Till, Sand	Piezometer	Uppermost Aquifer	716.47
MW-12	11,299	3,624	511,833	2,270,057	717.75	715.40	86.42	5	Till	Piezometer	Lower Confining Unit	716.36
MW-13	10,962	2,621	511,481	2,269,061	717.63	715.44	18.97	10	Silt, Till, Sand	Monitoring	Uppermost Aquifer	711.83
MW-14A	10,500	2,845	511,035	2,269,301	729.00	726.19	20.00	10	Silt, Till, Clay	Monitoring	Uppermost Aquifer	717.02
MW-15A	10,230	2,850	510,748	2,269,291	729.99	727.12	20.00	10	Silt, Clay	Monitoring	Uppermost Aquifer	719.88
MW-17	9,957	2,516	510,475	2,268,971	714.27	711.10	67.43	10	Till, Sand	Piezometer	Lower Confining Unit	Damaged
MW-18A	10,790	2,840	511,304	2,269,303	729.13	726.06	23.00	10	Clay, Silt	Monitoring	Uppermost Aquifer	714.80
MW-21	10,280	2,200	510,779	2,268,668	725.75	722.81	21.91	10	Silt, Clay	Monitoring	Uppermost Aquifer	716.20

(1) The SW corner of T77N, R3W, Sec 16 (intersection Independence Ave. & 250th St.) is common coordinate: Site System (10,000, 1,000) and State Plane (510,509, 2,267,433).
(2) Site System coordinates from MP&W site map (File 74, Drawing ELF0080K) dated 10/22/15.
(3) State Plane coordinates from MP&W in email dated 1/20/16.
(4) DNR Sampling Forms 542-1322 from September 2015.
(5) Wells MW-9, MW-11, MW-12, and MW-17 are water level measuring points only. PZ-1 through PZ-5 are leachate head measureing points only.

Table III-2
Constituents for Detection Monitoring
Appendix III to Part 257 CCR Rule

Boron
Calcium
Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids (TDS)

Table III-3
Constituents for Assessment Monitoring
Appendix IV to Part 257 CCR Rule

Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228, combined

* All metals as Total.

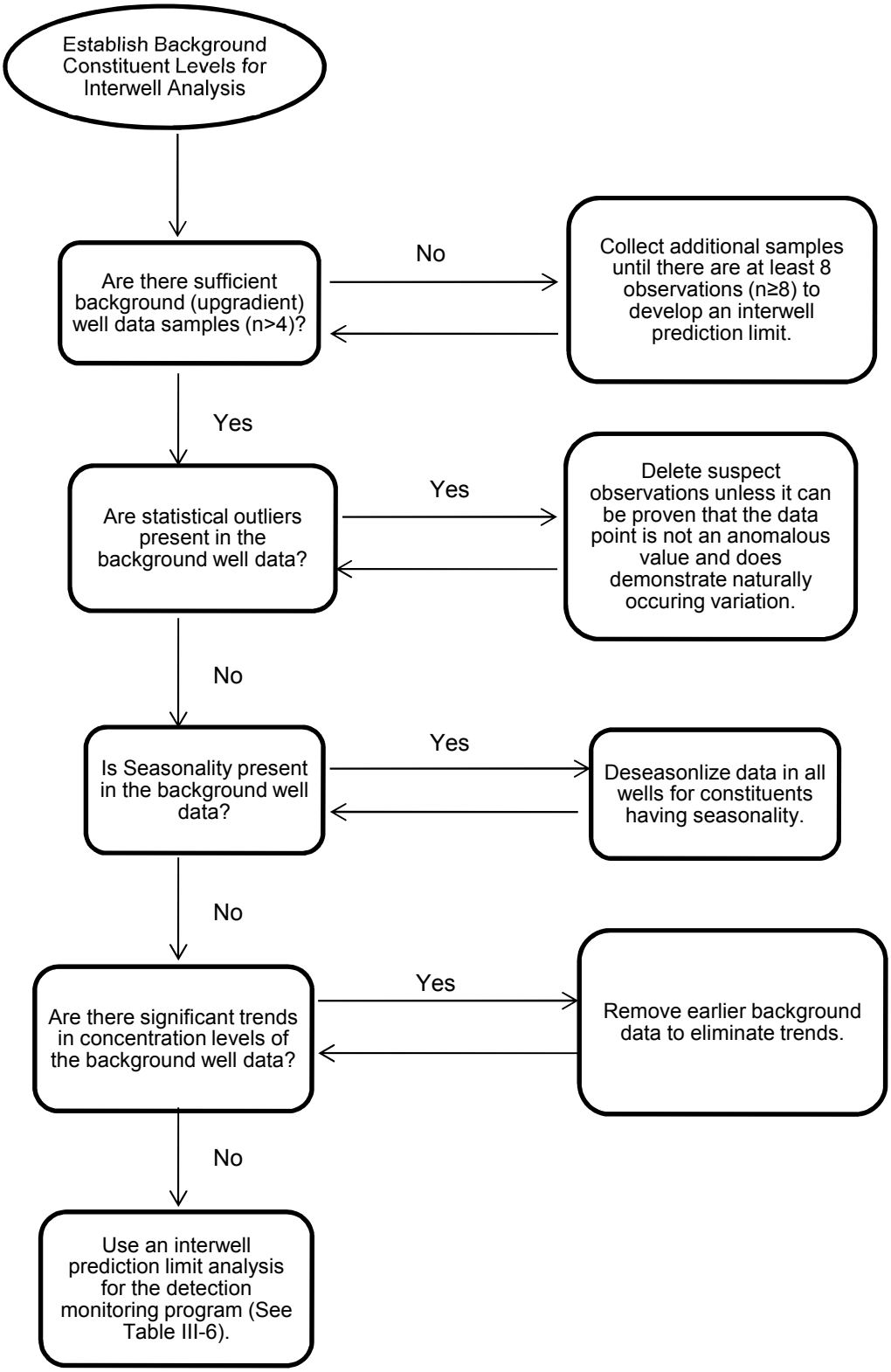


Table III-4: Methodology to Screen Background Data for Interwell Limits and Establish Background Constituent Levels

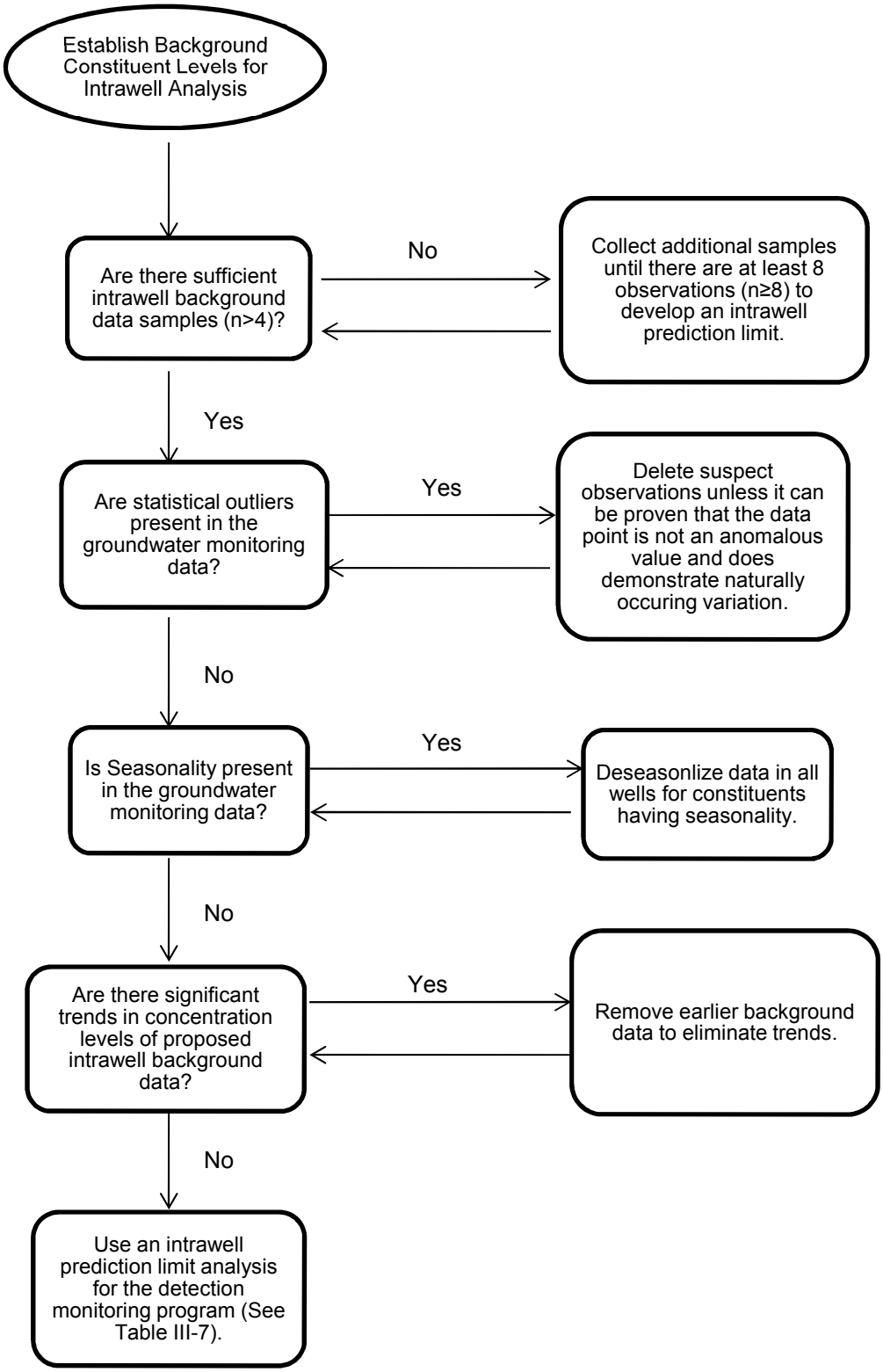


Table III-5: Methodology to Screen Background Data for Intrawell Limits and Establish Background Constituent Levels

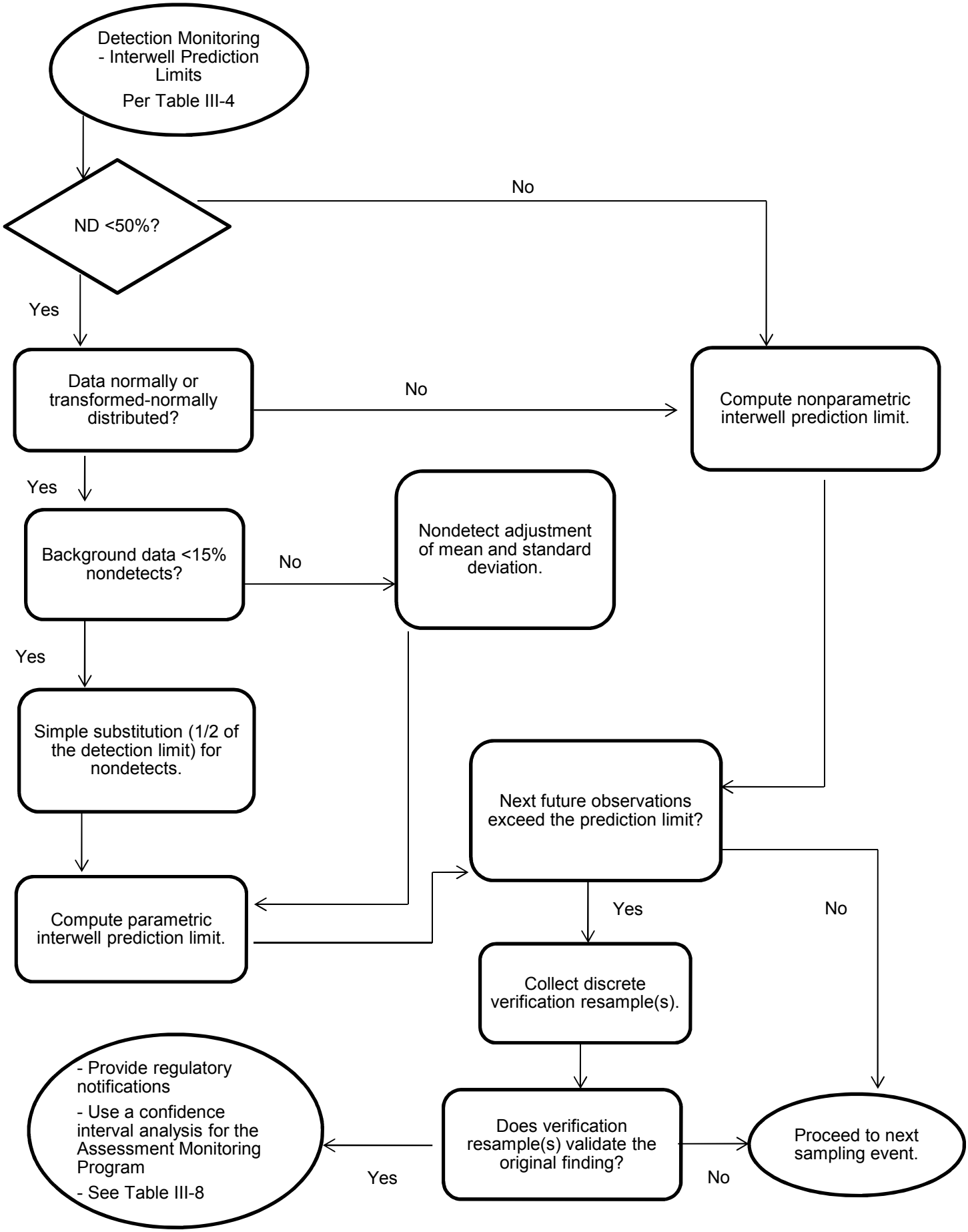


Table III-6: Methodology for Detection Monitoring - Computing Interwell Prediction Limits

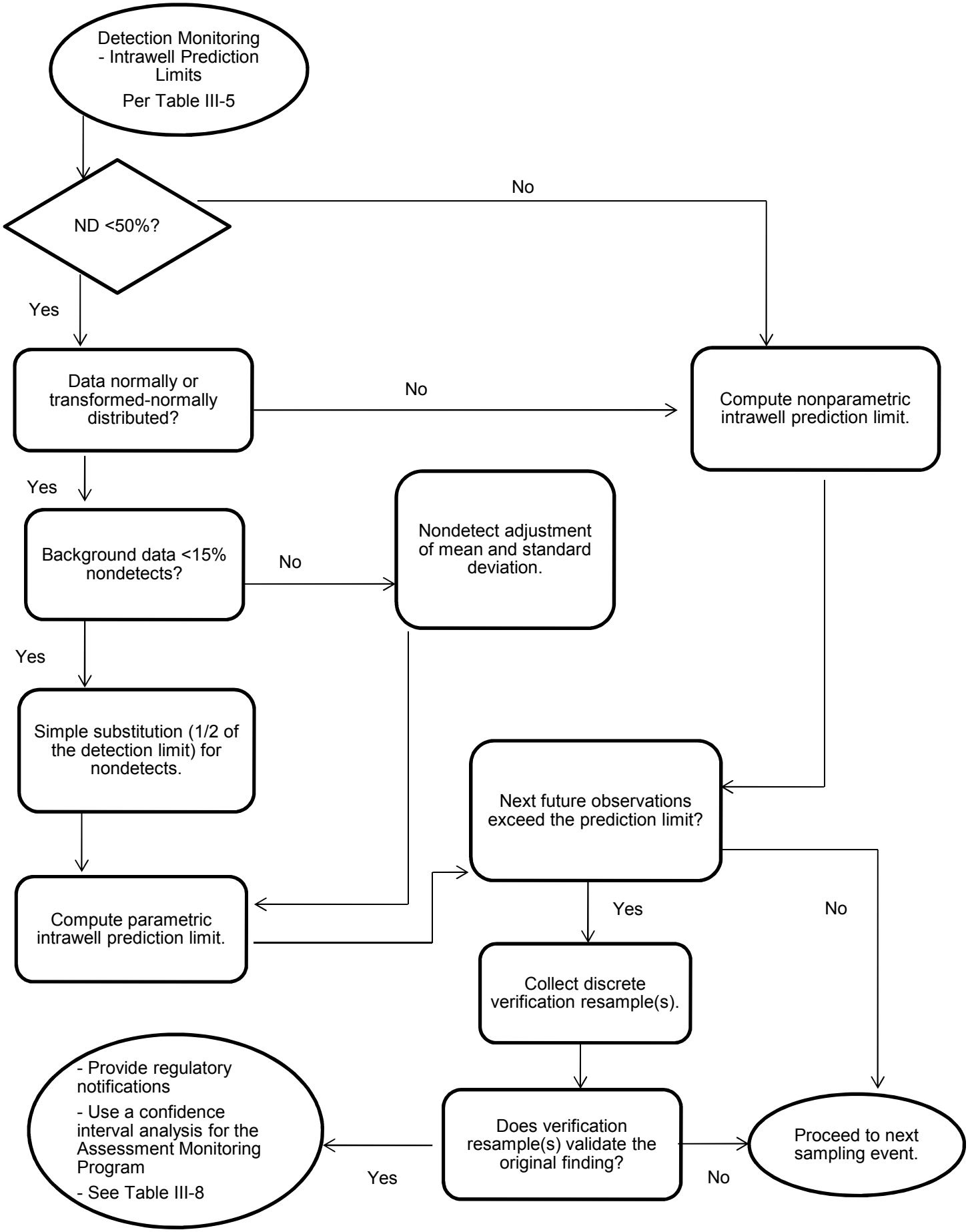


Table III-7: Methodology for Detection Monitoring - Computing Intrawell Prediction Limits

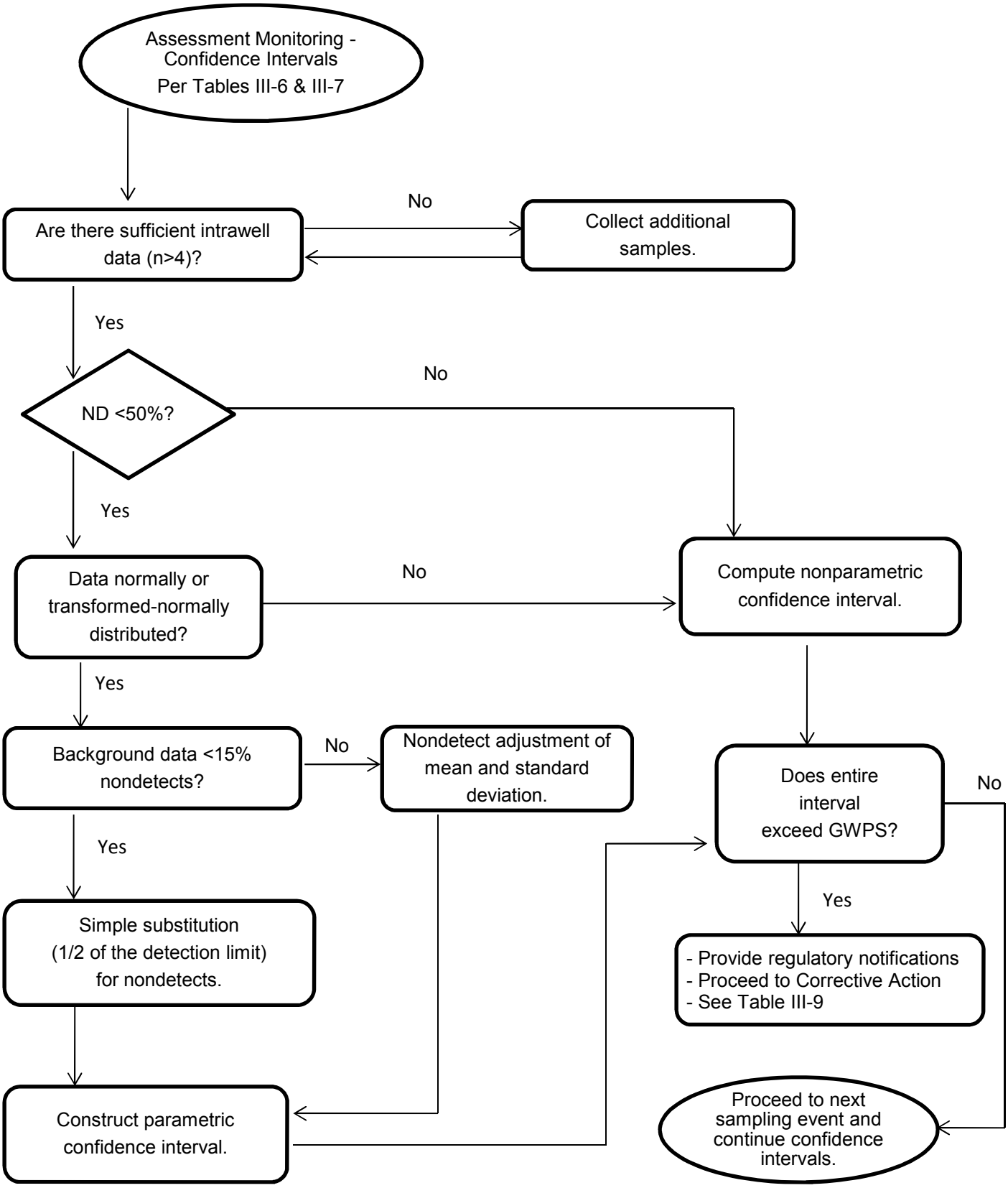


Table III-8: Methodology for Assessment Monitoring – Constructing Confidence Intervals

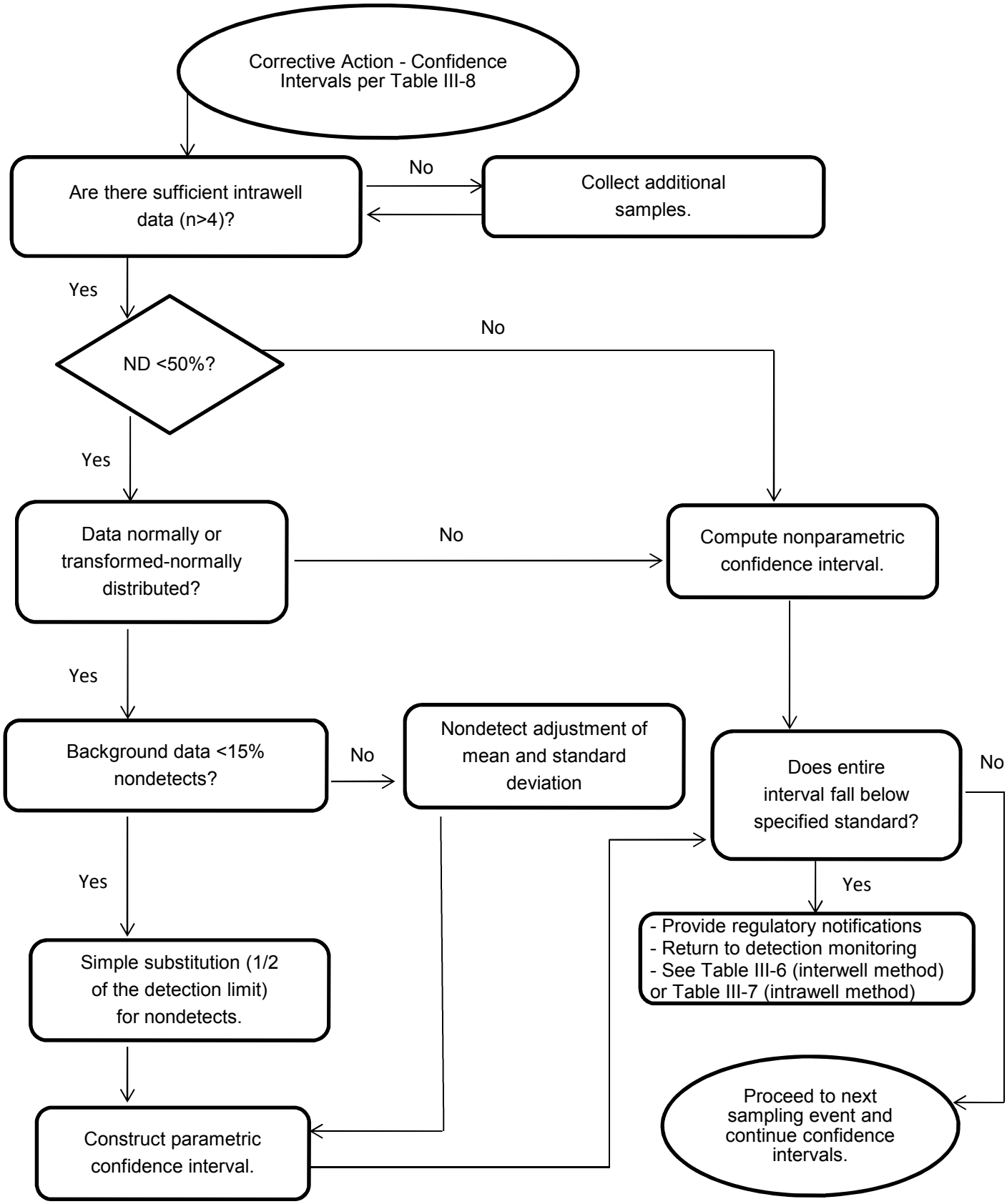


Table III-9: Methodology for Corrective Action

APPENDIX C

REGULATIONS

Code of Federal Regulations (CFR) Part 257:
Criteria for Classification of Solid Waste Disposal Facilities and Practice

- §257.53 – Definitions
- §257.90-98 – Groundwater Monitoring and Corrective Action
- §257.105-107 – Recordkeeping, Notification, and Posting to the Internet
- Appendix III to Part 257 – Constituents for Detection Monitoring.
- Appendix IV to Part 257 – Constituents for Assessment Monitoring

THE FOLLOWING IS FEDERAL CODE PERTAINING TO:
"GROUNDWATER MONITORING AND CORRECTIVE ACTION" AT CCR UNITS

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Part II

Environmental Protection Agency

40 CFR Parts 257 and 261
Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule

available and applicable voluntary consensus standards.

This rulemaking involves technical standards. EPA has decided to use the following technical standards in this rule: (1) RCRA Subpart D, Section 257.70 liner design criteria for new CCR landfills and any lateral expansion of a CCR landfill includes voluntary consensus standards developed by ASTM International and EPA test methods such as SW–846, (2) Section 257.71 liner design criteria for existing CCR surface impoundments include voluntary consensus standards developed by ASTM International and EPA test methods such as SW–846, (3) Section 257.72 liner design criteria for new CCR surface impoundments and any lateral expansion of a CCR surface impoundment include voluntary consensus standards developed by ASTM International and EPA test methods such as SW–846, and (4) Section 257.73 structural stability standards for new and existing surface impoundments use the ASTM D 698 and 1557 standards for embankment compaction.

J. Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations

Executive Order (E.O.) 12898 (59 FR 7629, Feb. 16, 1994) establishes federal executive policy on environmental justice. Its main provision directs federal agencies, to the greatest extent practicable and permitted by law, to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations in the United States.

EPA has determined that this final rule will not have disproportionately high and adverse human health or environmental effects on minority or low-income populations because it increases the level of environmental protection for all affected populations without having any disproportionately high and adverse human health or environmental effects on any population, including any minority or low-income population.

EPA's risk assessment for this action did not separately evaluate either minority or low income populations. However, to evaluate the demographic characteristics of communities that may be affected by the CCR rule, the RIA compares the demographic characteristics of populations surrounding coal-fired electric utility plants with broader population data for two geographic areas: (1) One-mile radius from CCR management units (*i.e.,* landfills and impoundments) likely to be affected by groundwater releases from both landfills and impoundments; and (2) watershed catchment areas downstream of surface impoundments that receive surface water run-off and releases from CCR impoundments and are at risk of being contaminated from CCR impoundment discharges (*e.g.,* unintentional overflows, structural failures, and intentional periodic discharges).

For the population as a whole 24.8% belong to a minority group and 11.3% falls below the Federal Poverty Level. For the population living within one mile of plants with surface impoundments 16.1% belong to a minority group and 13.2% live below the Federal Poverty Level. These minority and low-income populations are not disproportionately high compared to the general population. The percentage of minority residents of the entire population living within the catchment areas downstream of surface impoundments is disproportionately high relative to the general population, *i.e.,* 28.7%, versus 24.8% for the national population. Also, the percentage of the population within the catchment areas of surface impoundments that is below the Federal Poverty Level is disproportionately high compared with the general population, *i.e.,* 18.6% versus 11.3% nationally.

Comparing the population percentages of minority and low income residents within one mile of landfills to those percentages in the general population, EPA found that minority and low-income residents make up a smaller percentage of the populations near landfills than they do in the general population, *i.e.,* minorities comprised 16.6% of the population near landfills versus 24.8% nationwide and low-income residents comprised 8.6% of the population near landfills versus 11.3% nationwide. In summary, although populations within the catchment areas of plants with surface impoundments appear to have disproportionately high percentages of minority and low-income residents relative to the nationwide average, populations surrounding plants with landfills do not. Because landfills are less likely than impoundments to experience surface water run-off and releases, catchment areas were not considered for landfills.

Because the CCR rule is risk-reducing, with reductions in risk occurring largely within the surface water catchment zones around, and groundwater beneath, coal-fired electric utility plants, the rule will not result in new disproportionate risks to minority or low-income populations.

K. Congressional Review Act

The Congressional Review Act, 5 U.S.C. 801 *et seq.,* as added by the Small Business Regulatory Enforcement Fairness Act of 1996, generally provides that before a rule may take effect, the agency promulgating the rule must submit a rule report, which includes a copy of the rule, to each House of the Congress and to the Comptroller General of the United States. EPA will submit a report containing this rule and other required information to the U.S. Senate, the U.S. House of Representatives, and the Comptroller General of the United States prior to publication of the rule in the **Federal Register**. A Major rule cannot take effect until 60 days after it is published in the **Federal Register**. This action is a ''major rule'' as defined by 5 U.S.C. 804(2). This rule will be effective 180 days after its publication in the **Federal Register**.

List of Subjects

40 CFR Part 257

Environmental protection, Beneficial use, Coal combustion products, Coal combustion residuals, Coal combustion waste, Disposal, Hazardous waste, Landfill, Surface impoundment.

40 CFR Part 261

Environmental protection, Hazardous waste, Recycling, Reporting and recordkeeping requirements.

Dated: December 19, 2014.

Gina McCarthy,

Administrator.

For the reasons set out in the preamble, title 40, chapter I, of the Code of Federal Regulations is amended as follows:

PART 257—CRITERIA FOR CLASSIFICATION OF SOLID WASTE DISPOSAL FACILITIES AND PRACTICES

■ 1. The authority citation for part 257 continues to read as follows:

Authority: 42 U.S.C. 6907(a)(3), 6912(a)(1), 6944(a); 33 U.S.C. 1345(d) and (e).

■ 2. Section 257.1 is amended by:

■ a. Adding a sentence at the end of paragraph (a) introductory text;

■ b. Revising paragraphs (a)(1) and (2); and

■ c. Adding paragraph (c)(12).

The revisions and additions read as follows:

§ 257.1 Scope and purpose.

(a) * * * Unless otherwise provided, the criteria in §§ 257.50 through 257.107 are adopted for determining which CCR landfills and CCR surface impoundments pose a reasonable probability of adverse effects on health or the environment under sections 1008(a)(3) and 4004(a) of the Act.

(1) Facilities failing to satisfy any of the criteria in §§ 257.1 through 257.4 or §§ 257.5 through 257.30 or §§ 257.50 through 257.107 are considered open dumps, which are prohibited under section 4005 of the Act.

(2) Practices failing to satisfy any of the criteria in §§ 257.1 through 257.4 or §§ 257.5 through 257.30 or §§ 257.50 through 257.107 constitute open dumping, which is prohibited under section 4005 of the Act.

* * * * *

(c) * * *

(12) Except as otherwise specifically provided in subpart D of this part, the criteria in subpart A of this part do not apply to CCR landfills, CCR surface impoundments, and lateral expansions of CCR units, as those terms are defined in subpart D of this part. Such units are instead subject to subpart D of this part.

■ 3. Section 257.2 is amended by adding in alphabetical order definitions for ''CCR landfill'' and ''CCR surface impoundment'' to read as follows:

§ 257.2 Definitions.

* * * * *

CCR landfill means an area of land or an excavation that receives CCR and which is not a surface impoundment, an underground injection well, a salt dome formation, a salt bed formation, an underground or surface coal mine, or a cave. For purposes of this subpart, a CCR landfill also includes sand and gravel pits and quarries that receive CCR, CCR piles, and any practice that does not meet the definition of a beneficial use of CCR.

CCR surface impoundment means a natural topographic depression, man-made excavation, or diked area, which is designed to hold an accumulation of CCR and liquids, and the unit treats, stores, or disposes of CCR.

* * * * *

■ 4. Part 257 is amended by:

■ a. Adding and reserving subpart C; and

■ b. Adding subpart D.

The additions read as follows:

Subpart C—[Reserved]

Subpart D—Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments

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Subpart D—Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments

§ 257.50 Scope and purpose.

(a) This subpart establishes minimum national criteria for purposes of determining which solid waste disposal facilities and solid waste management practices do not pose a reasonable probability of adverse effects on health or the environment under sections 1008(a)(3) and 4004(a) of the Resource Conservation and Recovery Act.

(b) This subpart applies to owners and operators of new and existing landfills and surface impoundments, including any lateral expansions of such units that dispose or otherwise engage in solid waste management of CCR generated from the combustion of coal at electric utilities and independent power producers. Unless otherwise provided in this subpart, these requirements also apply to disposal units located off-site of the electric utility or independent power producer. This subpart also applies to any practice that does not meet the definition of a beneficial use of CCR.

(c) This subpart also applies to inactive CCR surface impoundments at active electric utilities or independent power producers, regardless of the fuel currently used at the facility to produce electricity.

(d) This subpart does not apply to CCR landfills that have ceased receiving CCR prior to October 19, 2015.

(e) This subpart does not apply to electric utilities or independent power producers that have ceased producing electricity prior to October 19, 2015.

(f) This subpart does not apply to wastes, including fly ash, bottom ash, boiler slag, and flue gas desulfurization materials generated at facilities that are not part of an electric utility or independent power producer, such as manufacturing facilities, universities, and hospitals. This subpart also does not apply to fly ash, bottom ash, boiler slag, and flue gas desulfurization materials, generated primarily from the combustion of fuels (including other fossil fuels) other than coal, for the purpose of generating electricity unless the fuel burned consists of more than fifty percent (50%) coal on a total heat input or mass input basis, whichever results in the greater mass feed rate of coal.

(g) This subpart does not apply to practices that meet the definition of a beneficial use of CCR.

(h) This subpart does not apply to CCR placement at active or abandoned underground or surface coal mines.

(i) This subpart does not apply to municipal solid waste landfills that receive CCR.

§ 257.51 Effective date of this subpart.

The requirements of this subpart take effect on October 19, 2015.

§ 257.52 Applicability of other regulations.

(a) Compliance with the requirements of this subpart does not affect the need for the owner or operator of a CCR landfill, CCR surface impoundment, or lateral expansion of a CCR unit to comply with all other applicable federal, state, tribal, or local laws or other requirements.

(b) Any CCR landfill, CCR surface impoundment, or lateral expansion of a CCR unit continues to be subject to the requirements in §§ 257.3–1, 257.3–2, and 257.3–3.

§ 257.53 Definitions.

The following definitions apply to this subpart. Terms not defined in this section have the meaning given by RCRA.

Acre foot means the volume of one acre of surface area to a depth of one foot.

Active facility or *active electric utilities or independent power producers* means any facility subject to the requirements of this subpart that is in operation on October 14, 2015. An electric utility or independent power producer is in operation if it is generating electricity that is provided to electric power transmission systems or to electric power distribution systems on or after October 14, 2015. An off-site disposal facility is in operation if it is accepting or managing CCR on or after October 14, 2015.

Active life or *in operation* means the period of operation beginning with the initial placement of CCR in the CCR unit and ending at completion of closure activities in accordance with § 257.102.

Active portion means that part of the CCR unit that has received or is receiving CCR or non-CCR waste and that has not completed closure in accordance with § 257.102.

Aquifer means a geologic formation, group of formations, or portion of a formation capable of yielding usable quantities of groundwater to wells or springs.

Area-capacity curves means graphic curves which readily show the reservoir water surface area, in acres, at different elevations from the bottom of the reservoir to the maximum water surface, and the capacity or volume, in acre-feet, of the water contained in the reservoir at various elevations.

Areas susceptible to mass movement means those areas of influence (*i.e.,* areas characterized as having an active or substantial possibility of mass movement) where, because of natural or human-induced events, the movement of earthen material at, beneath, or adjacent to the CCR unit results in the downslope transport of soil and rock material by means of gravitational influence. Areas of mass movement include, but are not limited to, landslides, avalanches, debris slides and flows, soil fluctuation, block sliding, and rock fall.

Beneficial use of CCR means the CCR meet all of the following conditions:

(1) The CCR must provide a functional benefit;

(2) The CCR must substitute for the use of a virgin material, conserving natural resources that would otherwise need to be obtained through practices, such as extraction;

(3) The use of the CCR must meet relevant product specifications, regulatory standards or design standards when available, and when such standards are not available, the CCR is not used in excess quantities; and

(4) When unencapsulated use of CCR involving placement on the land of 12,400 tons or more in non-roadway applications, the user must demonstrate and keep records, and provide such documentation upon request, that environmental releases to groundwater, surface water, soil and air are comparable to or lower than those from analogous products made without CCR, or that environmental releases to groundwater, surface water, soil and air will be at or below relevant regulatory and health-based benchmarks for human and ecological receptors during use.

Closed means placement of CCR in a CCR unit has ceased, and the owner or operator has completed closure of the CCR unit in accordance with § 257.102 and has initiated post-closure care in accordance with § 257.104.

Coal combustion residuals (CCR) means fly ash, bottom ash, boiler slag, and flue gas desulfurization materials generated from burning coal for the purpose of generating electricity by electric utilities and independent power producers.

CCR fugitive dust means solid airborne particulate matter that contains or is derived from CCR, emitted from any source other than a stack or chimney.

CCR landfill or landfill means an area of land or an excavation that receives CCR and which is not a surface impoundment, an underground injection well, a salt dome formation, a salt bed formation, an underground or surface coal mine, or a cave. For purposes of this subpart, a CCR landfill also includes sand and gravel pits and quarries that receive CCR, CCR piles, and any practice that does not meet the definition of a beneficial use of CCR.

CCR pile or pile means any non-containerized accumulation of solid, non-flowing CCR that is placed on the land. CCR that is beneficially used off-site is not a CCR pile.

CCR surface impoundment or impoundment means a natural topographic depression, man-made excavation, or diked area, which is designed to hold an accumulation of CCR and liquids, and the unit treats, stores, or disposes of CCR.

CCR unit means any CCR landfill, CCR surface impoundment, or lateral expansion of a CCR unit, or a combination of more than one of these units, based on the context of the paragraph(s) in which it is used. This term includes both new and existing units, unless otherwise specified.

Dike means an embankment, berm, or ridge of either natural or man-made materials used to prevent the movement of liquids, sludges, solids, or other materials.

Displacement means the relative movement of any two sides of a fault measured in any direction.

Disposal means the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste as defined in section 1004(27) of the Resource Conservation and Recovery Act into or on any land or water so that such solid waste, or constituent thereof, may enter the environment or be emitted into the air or discharged into any waters, including groundwaters. For purposes of this subpart, disposal does not include the storage or the beneficial use of CCR.

Downstream toe means the junction of the downstream slope or face of the CCR surface impoundment with the ground surface.

Encapsulated beneficial use means a beneficial use of CCR that binds the CCR into a solid matrix that minimizes its mobilization into the surrounding environment.

Existing CCR landfill means a CCR landfill that receives CCR both before and after October 14, 2015, or for which construction commenced prior to October 14, 2015 and receives CCR on or after October 14, 2015. A CCR landfill has commenced construction if the owner or operator has obtained the federal, state, and local approvals or permits necessary to begin physical

construction and a continuous on-site, physical construction program had begun prior to October 14, 2015.

Existing CCR surface impoundment means a CCR surface impoundment that receives CCR both before and after October 14, 2015, or for which construction commenced prior to October 14, 2015 and receives CCR on or after October 14, 2015. A CCR surface impoundment has commenced construction if the owner or operator has obtained the federal, state, and local approvals or permits necessary to begin physical construction and a continuous on-site, physical construction program had begun prior to October 14, 2015.

Facility means all contiguous land, and structures, other appurtenances, and improvements on the land, used for treating, storing, disposing, or otherwise conducting solid waste management of CCR. A facility may consist of several treatment, storage, or disposal operational units (*e.g.,* one or more landfills, surface impoundments, or combinations of them).

Factor of safety (Safety factor) means the ratio of the forces tending to resist the failure of a structure to the forces tending to cause such failure as determined by accepted engineering practice.

Fault means a fracture or a zone of fractures in any material along which strata on one side have been displaced with respect to that on the other side.

Flood hydrograph means a graph showing, for a given point on a stream, the discharge, height, or other characteristic of a flood as a function of time.

Freeboard means the vertical distance between the lowest point on the crest of the impoundment dike and the surface of the waste contained therein.

Free liquids means liquids that readily separate from the solid portion of a waste under ambient temperature and pressure.

Groundwater means water below the land surface in a zone of saturation.

Hazard potential classification means the possible adverse incremental consequences that result from the release of water or stored contents due to failure of the diked CCR surface impoundment or mis-operation of the diked CCR surface impoundment or its appurtenances. The hazardous potential classifications include high hazard potential CCR surface impoundment, significant hazard potential CCR surface impoundment, and low hazard potential CCR surface impoundment, which terms mean:

(1) *High hazard potential CCR surface impoundment* means a diked surface impoundment where failure or mis-operation will probably cause loss of human life.

(2) *Low hazard potential CCR surface impoundment* means a diked surface impoundment where failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the surface impoundment owner's property.

(3) *Significant hazard potential CCR surface impoundment* means a diked surface impoundment where failure or mis-operation results in no probable loss of human life, but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns.

Height means the vertical measurement from the downstream toe of the CCR surface impoundment at its lowest point to the lowest elevation of the crest of the CCR surface impoundment.

Holocene means the most recent epoch of the Quaternary period, extending from the end of the Pleistocene Epoch, at 11,700 years before present, to present.

Hydraulic conductivity means the rate at which water can move through a permeable medium (*i.e.,* the coefficient of permeability).

Inactive CCR surface impoundment means a CCR surface impoundment that no longer receives CCR on or after October 14, 2015 and still contains both CCR and liquids on or after October 14, 2015.

Incised CCR surface impoundment means a CCR surface impoundment which is constructed by excavating entirely below the natural ground surface, holds an accumulation of CCR entirely below the adjacent natural ground surface, and does not consist of any constructed diked portion.

Indian country or *Indian lands* means:

(1) All land within the limits of any Indian reservation under the jurisdiction of the United States Government, notwithstanding the issuance of any patent, and including rights-of-way running throughout the reservation;

(2) All dependent Indian communities within the borders of the United States whether within the original or subsequently acquired territory thereof, and whether within or without the limits of the State; and

(3) All Indian allotments, the Indian titles to which have not been extinguished, including rights of way running through the same.

Indian Tribe or *Tribe* means any Indian tribe, band, nation, or community recognized by the Secretary of the Interior and exercising substantial governmental duties and powers on Indian lands.

Inflow design flood means the flood hydrograph that is used in the design or modification of the CCR surface impoundments and its appurtenant works.

In operation means the same as *active life.*

Karst terrain means an area where karst topography, with its characteristic erosional surface and subterranean features, is developed as the result of dissolution of limestone, dolomite, or other soluble rock. Characteristic physiographic features present in karst terranes include, but are not limited to, dolines, collapse shafts (sinkholes), sinking streams, caves, seeps, large springs, and blind valleys.

Lateral expansion means a horizontal expansion of the waste boundaries of an existing CCR landfill or existing CCR surface impoundment made after October 14, 2015.

Liquefaction factor of safety means the factor of safety (safety factor) determined using analysis under liquefaction conditions.

Lithified earth material means all rock, including all naturally occurring and naturally formed aggregates or masses of minerals or small particles of older rock that formed by crystallization of magma or by induration of loose sediments. This term does not include man-made materials, such as fill, concrete, and asphalt, or unconsolidated earth materials, soil, or regolith lying at or near the earth surface.

Maximum horizontal acceleration in lithified earth material means the maximum expected horizontal acceleration at the ground surface as depicted on a seismic hazard map, with a 98% or greater probability that the acceleration will not be exceeded in 50 years, or the maximum expected horizontal acceleration based on a site-specific seismic risk assessment.

New CCR landfill means a CCR landfill or lateral expansion of a CCR landfill that first receives CCR or commences construction after October 14, 2015. A new CCR landfill has commenced construction if the owner or operator has obtained the federal, state, and local approvals or permits necessary to begin physical construction and a continuous on-site, physical construction program had begun after October 14, 2015. Overfills are also considered new CCR landfills.

New CCR surface impoundment means a CCR surface impoundment or lateral expansion of an existing or new CCR surface impoundment that first receives CCR or commences construction after October 14, 2015. A

new CCR surface impoundment has commenced construction if the owner or operator has obtained the federal, state, and local approvals or permits necessary to begin physical construction and a continuous on-site, physical construction program had begun after October 14, 2015.

Operator means the person(s) responsible for the overall operation of a CCR unit.

Overfill means a new CCR landfill constructed over a closed CCR surface impoundment.

Owner means the person(s) who owns a CCR unit or part of a CCR unit.

Poor foundation conditions mean those areas where features exist which indicate that a natural or human-induced event may result in inadequate foundation support for the structural components of an existing or new CCR unit. For example, failure to maintain static and seismic factors of safety as required in §§ 257.73(e) and 257.74(e) would cause a poor foundation condition.

Probable maximum flood means the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the drainage basin.

Qualified person means a person or persons trained to recognize specific appearances of structural weakness and other conditions which are disrupting or have the potential to disrupt the operation or safety of the CCR unit by visual observation and, if applicable, to monitor instrumentation.

Qualified professional engineer means an individual who is licensed by a state as a Professional Engineer to practice one or more disciplines of engineering and who is qualified by education, technical knowledge and experience to make the specific technical certifications required under this subpart. Professional engineers making these certifications must be currently licensed in the state where the CCR unit(s) is located.

Recognized and generally accepted good engineering practices means engineering maintenance or operation activities based on established codes, widely accepted standards, published technical reports, or a practice widely recommended throughout the industry. Such practices generally detail approved ways to perform specific engineering, inspection, or mechanical integrity activities.

Retrofit means to remove all CCR and contaminated soils and sediments from the CCR surface impoundment, and to ensure the unit complies with the requirements in § 257.72

Representative sample means a sample of a universe or whole (*e.g.,* waste pile, lagoon, and groundwater) which can be expected to exhibit the average properties of the universe or whole. See EPA publication SW–846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Chapter 9 (available at *http://www.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm*) for a discussion and examples of representative samples.

Run-off means any rainwater, leachate, or other liquid that drains over land from any part of a CCR landfill or lateral expansion of a CCR landfill.

Run-on means any rainwater, leachate, or other liquid that drains over land onto any part of a CCR landfill or lateral expansion of a CCR landfill.

Sand and gravel pit or quarry means an excavation for the extraction of aggregate, minerals or metals. The term sand and gravel pit and/or quarry does not include subsurface or surface coal mines.

Seismic factor of safety means the factor of safety (safety factor) determined using analysis under earthquake conditions using the peak ground acceleration for a seismic event with a 2% probability of exceedance in 50 years, equivalent to a return period of approximately 2,500 years, based on the U.S. Geological Survey (USGS) seismic hazard maps for seismic events with this return period for the region where the CCR surface impoundment is located.

Seismic impact zone means an area having a 2% or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10 g in 50 years.

Slope protection means engineered or non-engineered measures installed on the upstream or downstream slope of the CCR surface impoundment to protect the slope against wave action or erosion, including but not limited to rock riprap, wooden pile, or concrete revetments, vegetated wave berms, concrete facing, gabions, geotextiles, or fascines.

Solid waste management or management means the systematic administration of the activities which provide for the collection, source separation, storage, transportation, processing, treatment, or disposal of solid waste.

State means any of the fifty States in addition to the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands.

State Director means the chief administrative officer of the lead state agency responsible for implementing the state program regulating disposal in CCR landfills, CCR surface impoundments, and all lateral expansions of a CCR unit.

Static factor of safety means the factor of safety (safety factor) determined using analysis under the long-term, maximum storage pool loading condition, the maximum surcharge pool loading condition, and under the end-of-construction loading condition.

Structural components mean liners, leachate collection and removal systems, final covers, run-on and run-off systems, inflow design flood control systems, and any other component used in the construction and operation of the CCR unit that is necessary to ensure the integrity of the unit and that the contents of the unit are not released into the environment.

Unstable area means a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity, including structural components of some or all of the CCR unit that are responsible for preventing releases from such unit. Unstable areas can include poor foundation conditions, areas susceptible to mass movements, and karst terrains.

Uppermost aquifer means the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural ground surface to which the aquifer rises during the wet season.

Waste boundary means a vertical surface located at the hydraulically downgradient limit of the CCR unit. The vertical surface extends down into the uppermost aquifer.

Location Restrictions

§ 257.60 Placement above the uppermost aquifer.

(a) New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must be constructed with a base that is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high water table). The owner or operator must demonstrate by the dates specified in paragraph (c) of this section

following the date of initial receipt of CCR in the CCR unit.

(4) *Frequency of inspections.* (i) Except as provided for in paragraph (b)(4)(ii) of this section, the owner or operator of the CCR unit must conduct the inspection required by paragraphs (b)(1) and (2) of this section on an annual basis. The date of completing the initial inspection report is the basis for establishing the deadline to complete the first subsequent inspection. Any required inspection may be conducted prior to the required deadline provided the owner or operator places the completed inspection report into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing subsequent inspection reports is based on the date of completing the previous inspection report. For purposes of this section, the owner or operator has completed an inspection when the inspection report has been placed in the facility's operating record as required by § 257.105(g)(6).

(ii) In any calendar year in which both the periodic inspection by a qualified professional engineer and the quinquennial (occurring every five years) structural stability assessment by a qualified professional engineer required by §§ 257.73(d) and 257.74(d) are required to be completed, the annual inspection is not required, provided the structural stability assessment is completed during the calendar year. If the annual inspection is not conducted in a year as provided by this paragraph (b)(4)(ii), the deadline for completing the next annual inspection is one year from the date of completing the quinquennial structural stability assessment.

(5) If a deficiency or release is identified during an inspection, the owner or operator must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.

(c) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

§ 257.84 Inspection requirements for CCR landfills.

(a) *Inspections by a qualified person.* (1) All CCR landfills and any lateral expansion of a CCR landfill must be examined by a qualified person as follows:

(i) At intervals not exceeding seven days, inspect for any appearances of actual or potential structural weakness and other conditions which are disrupting or have the potential to disrupt the operation or safety of the CCR unit; and

(ii) The results of the inspection by a qualified person must be recorded in the facility's operating record as required by § 257.105(g)(8).

(2) *Timeframes for inspections by a qualified person*—(i) *Existing CCR landfills.* The owner or operator of the CCR unit must initiate the inspections required under paragraph (a) of this section no later than October 19, 2015.

(ii) *New CCR landfills and any lateral expansion of a CCR landfill.* The owner or operator of the CCR unit must initiate the inspections required under paragraph (a) of this section upon initial receipt of CCR by the CCR unit.

(b) *Annual inspections by a qualified professional engineer.* (1) Existing and new CCR landfills and any lateral expansion of a CCR landfill must be inspected on a periodic basis by a qualified professional engineer to ensure that the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering standards. The inspection must, at a minimum, include:

(i) A review of available information regarding the status and condition of the CCR unit, including, but not limited to, files available in the operating record (*e.g.,* the results of inspections by a qualified person, and results of previous annual inspections); and

(ii) A visual inspection of the CCR unit to identify signs of distress or malfunction of the CCR unit.

(2) *Inspection report.* The qualified professional engineer must prepare a report following each inspection that addresses the following:

(i) Any changes in geometry of the structure since the previous annual inspection;

(ii) The approximate volume of CCR contained in the unit at the time of the inspection;

(iii) Any appearances of an actual or potential structural weakness of the CCR unit, in addition to any existing conditions that are disrupting or have the potential to disrupt the operation and safety of the CCR unit; and

(iv) Any other change(s) which may have affected the stability or operation of the CCR unit since the previous annual inspection.

(3) *Timeframes for conducting the initial inspection*—(i) *Existing CCR landfills.* The owner or operator of the CCR unit must complete the initial inspection required by paragraphs (b)(1) and (2) of this section no later than January 18, 2016.

(ii) *New CCR landfills and any lateral expansion of a CCR landfill.* The owner or operator of the CCR unit must complete the initial annual inspection required by paragraphs (b)(1) and (2) of this section no later than 14 months following the date of initial receipt of CCR in the CCR unit.

(4) *Frequency of inspections.* The owner or operator of the CCR unit must conduct the inspection required by paragraphs (b)(1) and (2) of this section on an annual basis. The date of completing the initial inspection report is the basis for establishing the deadline to complete the first subsequent inspection. Any required inspection may be conducted prior to the required deadline provided the owner or operator places the completed inspection report into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing subsequent inspection reports is based on the date of completing the previous inspection report. For purposes of this section, the owner or operator has completed an inspection when the inspection report has been placed in the facility's operating record as required by § 257.105(g)(9).

(5) If a deficiency or release is identified during an inspection, the owner or operator must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.

(c) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

Groundwater Monitoring and Corrective Action

§ 257.90 Applicability.

(a) Except as provided for in § 257.100 for inactive CCR surface impoundments, all CCR landfills, CCR surface impoundments, and lateral expansions of CCR units are subject to the groundwater monitoring and corrective action requirements under §§ 257.90 through 257.98.

(b) *Initial timeframes*—(1) *Existing CCR landfills and existing CCR surface impoundments.* No later than October 17, 2017, the owner or operator of the CCR unit must be in compliance with the following groundwater monitoring requirements:

(i) Install the groundwater monitoring system as required by § 257.91;

(ii) Develop the groundwater sampling and analysis program to include selection of the statistical

procedures to be used for evaluating groundwater monitoring data as required by § 257.93;

(iii) Initiate the detection monitoring program to include obtaining a minimum of eight independent samples for each background and downgradient well as required by § 257.94(b); and

(iv) Begin evaluating the groundwater monitoring data for statistically significant increases over background levels for the constituents listed in appendix III of this part as required by § 257.94.

(2) *New CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units.* Prior to initial receipt of CCR by the CCR unit, the owner or operator must be in compliance with the groundwater monitoring requirements specified in paragraph (b)(1)(i) and (ii) of this section. In addition, the owner or operator of the CCR unit must initiate the detection monitoring program to include obtaining a minimum of eight independent samples for each background well as required by § 257.94(b).

(c) Once a groundwater monitoring system and groundwater monitoring program has been established at the CCR unit as required by this subpart, the owner or operator must conduct groundwater monitoring and, if necessary, corrective action throughout the active life and post-closure care period of the CCR unit.

(d) In the event of a release from a CCR unit, the owner or operator must immediately take all necessary measures to control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of contaminants into the environment. The owner or operator of the CCR unit must comply with all applicable requirements in §§ 257.96, 257.97, and 257.98.

(e) *Annual groundwater monitoring and corrective action report.* For existing CCR landfills and existing CCR surface impoundments, no later than January 31, 2018, and annually thereafter, the owner or operator must prepare an annual groundwater monitoring and corrective action report. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, the owner or operator must prepare the initial annual groundwater monitoring and corrective action report no later than January 31 of the year following the calendar year a groundwater monitoring system has been established for such CCR unit as required by this subpart, and annually thereafter. For the preceding calendar year, the annual report must document the status of the groundwater monitoring and corrective action program for the CCR unit, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year. For purposes of this section, the owner or operator has prepared the annual report when the report is placed in the facility's operating record as required by § 257.105(h)(1). At a minimum, the annual groundwater monitoring and corrective action report must contain the following information, to the extent available:

(1) A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;

(2) Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;

(3) In addition to all the monitoring data obtained under §§ 257.90 through 257.98, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;

(4) A narrative discussion of any transition between monitoring programs (*e.g.,* the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels); and

(5) Other information required to be included in the annual report as specified in §§ 257.90 through 257.98.

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the internet requirements specified in § 257.107(h).

§ 257.91 Groundwater monitoring systems.

(a) *Performance standard.* The owner or operator of a CCR unit must install a groundwater monitoring system that consists of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that:

(1) Accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit. A determination of background quality may include sampling of wells that are not hydraulically upgradient of the CCR management area where:

(i) Hydrogeologic conditions do not allow the owner or operator of the CCR unit to determine what wells are hydraulically upgradient; or

(ii) Sampling at other wells will provide an indication of background groundwater quality that is as representative or more representative than that provided by the upgradient wells; and

(2) Accurately represent the quality of groundwater passing the waste boundary of the CCR unit. The downgradient monitoring system must be installed at the waste boundary that ensures detection of groundwater contamination in the uppermost aquifer. All potential contaminant pathways must be monitored.

(b) The number, spacing, and depths of monitoring systems shall be determined based upon site-specific technical information that must include thorough characterization of:

(1) Aquifer thickness, groundwater flow rate, groundwater flow direction including seasonal and temporal fluctuations in groundwater flow; and

(2) Saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer, and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including, but not limited to, thicknesses, stratigraphy, lithology, hydraulic conductivities, porosities and effective porosities.

(c) The groundwater monitoring system must include the minimum number of monitoring wells necessary to meet the performance standards specified in paragraph (a) of this section, based on the site-specific information specified in paragraph (b) of this section. The groundwater monitoring system must contain:

(1) A minimum of one upgradient and three downgradient monitoring wells; and

(2) Additional monitoring wells as necessary to accurately represent the quality of background groundwater that has not been affected by leakage from the CCR unit and the quality of groundwater passing the waste boundary of the CCR unit.

(d) The owner or operator of multiple CCR units may install a multiunit groundwater monitoring system instead of separate groundwater monitoring systems for each CCR unit.

(1) The multiunit groundwater monitoring system must be equally as capable of detecting monitored constituents at the waste boundary of

the CCR unit as the individual groundwater monitoring system specified in paragraphs (a) through (c) of this section for each CCR unit based on the following factors:

(i) Number, spacing, and orientation of each CCR unit;

(ii) Hydrogeologic setting;

(iii) Site history; and

(iv) Engineering design of the CCR unit.

(2) If the owner or operator elects to install a multiunit groundwater monitoring system, and if the multiunit system includes at least one existing unlined CCR surface impoundment as determined by § 257.71(a), and if at any time after October 19, 2015 the owner or operator determines in any sampling event that the concentrations of one or more constituents listed in appendix IV to this part are detected at statistically significant levels above the groundwater protection standard established under § 257.95(h) for the multiunit system, then all unlined CCR surface impoundments comprising the multiunit groundwater monitoring system are subject to the closure requirements under § 257.101(a) to retrofit or close.

(e) Monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole. This casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of groundwater samples. The annular space (*i.e.,* the space between the borehole and well casing) above the sampling depth must be sealed to prevent contamination of samples and the groundwater.

(1) The owner or operator of the CCR unit must document and include in the operating record the design, installation, development, and decommissioning of any monitoring wells, piezometers and other measurement, sampling, and analytical devices. The qualified professional engineer must be given access to this documentation when completing the groundwater monitoring system certification required under paragraph (f) of this section.

(2) The monitoring wells, piezometers, and other measurement, sampling, and analytical devices must be operated and maintained so that they perform to the design specifications throughout the life of the monitoring program.

(f) The owner or operator must obtain a certification from a qualified professional engineer stating that the groundwater monitoring system has been designed and constructed to meet the requirements of this section. If the groundwater monitoring system includes the minimum number of monitoring wells specified in paragraph (c)(1) of this section, the certification must document the basis supporting this determination.

(g) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the internet requirements specified in § 257.107(h).

§ 257.92 [Reserved]

§ 257.93 Groundwater sampling and analysis requirements.

(a) The groundwater monitoring program must include consistent sampling and analysis procedures that are designed to ensure monitoring results that provide an accurate representation of groundwater quality at the background and downgradient wells required by § 257.91. The owner or operator of the CCR unit must develop a sampling and analysis program that includes procedures and techniques for:

(1) Sample collection;

(2) Sample preservation and shipment;

(3) Analytical procedures;

(4) Chain of custody control; and

(5) Quality assurance and quality control.

(b) The groundwater monitoring program must include sampling and analytical methods that are appropriate for groundwater sampling and that accurately measure hazardous constituents and other monitoring parameters in groundwater samples. For purposes of §§ 257.90 through 257.98, the term *constituent* refers to both hazardous constituents and other monitoring parameters listed in either appendix III or IV of this part.

(c) Groundwater elevations must be measured in each well immediately prior to purging, each time groundwater is sampled. The owner or operator of the CCR unit must determine the rate and direction of groundwater flow each time groundwater is sampled. Groundwater elevations in wells which monitor the same CCR management area must be measured within a period of time short enough to avoid temporal variations in groundwater flow which could preclude accurate determination of groundwater flow rate and direction.

(d) The owner or operator of the CCR unit must establish background groundwater quality in a hydraulically upgradient or background well(s) for each of the constituents required in the particular groundwater monitoring program that applies to the CCR unit as determined under § 257.94(a) or § 257.95(a). Background groundwater quality may be established at wells that are not located hydraulically upgradient from the CCR unit if it meets the requirements of § 257.91(a)(1).

(e) The number of samples collected when conducting detection monitoring and assessment monitoring (for both downgradient and background wells) must be consistent with the statistical procedures chosen under paragraph (f) of this section and the performance standards under paragraph (g) of this section. The sampling procedures shall be those specified under § 257.94(b) through (d) for detection monitoring, § 257.95(b) through (d) for assessment monitoring, and § 257.96(b) for corrective action.

(f) The owner or operator of the CCR unit must select one of the statistical methods specified in paragraphs (f)(1) through (5) of this section to be used in evaluating groundwater monitoring data for each specified constituent. The statistical test chosen shall be conducted separately for each constituent in each monitoring well.

(1) A parametric analysis of variance followed by multiple comparison procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's mean and the background mean levels for each constituent.

(2) An analysis of variance based on ranks followed by multiple comparison procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's median and the background median levels for each constituent.

(3) A tolerance or prediction interval procedure, in which an interval for each constituent is established from the distribution of the background data and the level of each constituent in each compliance well is compared to the upper tolerance or prediction limit.

(4) A control chart approach that gives control limits for each constituent.

(5) Another statistical test method that meets the performance standards of paragraph (g) of this section.

(6) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the selected statistical method is appropriate for evaluating the groundwater monitoring data for the CCR management area. The certification must include a narrative description of the statistical method selected to evaluate the groundwater monitoring data.

(g) Any statistical method chosen under paragraph (f) of this section shall comply with the following performance standards, as appropriate, based on the statistical test method used:

(1) The statistical method used to evaluate groundwater monitoring data shall be appropriate for the distribution of constituents. Normal distributions of data values shall use parametric methods. Non-normal distributions shall use non-parametric methods. If the distribution of the constituents is shown by the owner or operator of the CCR unit to be inappropriate for a normal theory test, then the data must be transformed or a distribution-free (non-parametric) theory test must be used. If the distributions for the constituents differ, more than one statistical method may be needed.

(2) If an individual well comparison procedure is used to compare an individual compliance well constituent concentration with background constituent concentrations or a groundwater protection standard, the test shall be done at a Type I error level no less than 0.01 for each testing period. If a multiple comparison procedure is used, the Type I experiment wise error rate for each testing period shall be no less than 0.05; however, the Type I error of no less than 0.01 for individual well comparisons must be maintained. This performance standard does not apply to tolerance intervals, prediction intervals, or control charts.

(3) If a control chart approach is used to evaluate groundwater monitoring data, the specific type of control chart and its associated parameter values shall be such that this approach is at least as effective as any other approach in this section for evaluating groundwater data. The parameter values shall be determined after considering the number of samples in the background data base, the data distribution, and the range of the concentration values for each constituent of concern.

(4) If a tolerance interval or a predictional interval is used to evaluate groundwater monitoring data, the levels of confidence and, for tolerance intervals, the percentage of the population that the interval must contain, shall be such that this approach is at least as effective as any other approach in this section for evaluating groundwater data. These parameters shall be determined after considering the number of samples in the background data base, the data distribution, and the range of the concentration values for each constituent of concern.

(5) The statistical method must account for data below the limit of detection with one or more statistical procedures that shall at least as effective as any other approach in this section for evaluating groundwater data. Any practical quantitation limit that is used in the statistical method shall be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility.

(6) If necessary, the statistical method must include procedures to control or correct for seasonal and spatial variability as well as temporal correlation in the data.

(h) The owner or operator of the CCR unit must determine whether or not there is a statistically significant increase over background values for each constituent required in the particular groundwater monitoring program that applies to the CCR unit, as determined under § 257.94(a) or § 257.95(a).

(1) In determining whether a statistically significant increase has occurred, the owner or operator must compare the groundwater quality of each constituent at each monitoring well designated pursuant to § 257.91(a)(2) or (d)(1) to the background value of that constituent, according to the statistical procedures and performance standards specified under paragraphs (f) and (g) of this section.

(2) Within 90 days after completing sampling and analysis, the owner or operator must determine whether there has been a statistically significant increase over background for any constituent at each monitoring well.

(i) The owner or operator must measure ''total recoverable metals'' concentrations in measuring groundwater quality. Measurement of total recoverable metals captures both the particulate fraction and dissolved fraction of metals in natural waters. Groundwater samples shall not be field-filtered prior to analysis.

(j) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

§ 257.94 Detection monitoring program.

(a) The owner or operator of a CCR unit must conduct detection monitoring at all groundwater monitoring wells consistent with this section. At a minimum, a detection monitoring program must include groundwater monitoring for all constituents listed in appendix III to this part.

(b) Except as provided in paragraph (d) of this section, the monitoring frequency for the constituents listed in appendix III to this part shall be at least semiannual during the active life of the CCR unit and the post-closure period. For existing CCR landfills and existing CCR surface impoundments, a minimum of eight independent samples from each background and downgradient well must be collected and analyzed for the constituents listed in appendix III and IV to this part no later than October 17, 2017. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, a minimum of eight independent samples for each background well must be collected and analyzed for the constituents listed in appendices III and IV to this part during the first six months of sampling.

(c) The number of samples collected and analyzed for each background well and downgradient well during subsequent semiannual sampling events must be consistent with § 257.93(e), and must account for any unique characteristics of the site, but must be at least one sample from each background and downgradient well.

(d) The owner or operator of a CCR unit may demonstrate the need for an alternative monitoring frequency for repeated sampling and analysis for constituents listed in appendix III to this part during the active life and the post-closure care period based on the availability of groundwater. If there is not adequate groundwater flow to sample wells semiannually, the alternative frequency shall be no less than annual. The need to vary monitoring frequency must be evaluated on a site-specific basis. The demonstration must be supported by, at a minimum, the information specified in paragraphs (d)(1) and (2) of this section.

(1) Information documenting that the need for less frequent sampling. The alternative frequency must be based on consideration of the following factors:

(i) Lithology of the aquifer and unsaturated zone;

(ii) Hydraulic conductivity of the aquifer and unsaturated zone; and

(iii) Groundwater flow rates.

(2) Information documenting that the alternative frequency will be no less effective in ensuring that any leakage from the CCR unit will be discovered within a timeframe that will not materially delay establishment of an assessment monitoring program.

(3) The owner or operator must obtain a certification from a qualified

professional engineer stating that the demonstration for an alternative groundwater sampling and analysis frequency meets the requirements of this section. The owner or operator must include the demonstration providing the basis for the alternative monitoring frequency and the certification by a qualified professional engineer in the annual groundwater monitoring and corrective action report required by § 257.90(e).

(e) If the owner or operator of the CCR unit determines, pursuant to § 257.93(h) that there is a statistically significant increase over background levels for one or more of the constituents listed in appendix III to this part at any monitoring well at the waste boundary specified under § 257.91(a)(2), the owner or operator must:

(1) Except as provided for in paragraph (e)(2) of this section, within 90 days of detecting a statistically significant increase over background levels for any constituent, establish an assessment monitoring program meeting the requirements of § 257.95.

(2) The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The owner or operator must complete the written demonstration within 90 days of detecting a statistically significant increase over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report. If a successful demonstration is completed within the 90-day period, the owner or operator of the CCR unit may continue with a detection monitoring program under this section. If a successful demonstration is not completed within the 90-day period, the owner or operator of the CCR unit must initiate an assessment monitoring program as required under § 257.95. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

(3) The owner or operator of a CCR unit must prepare a notification stating that an assessment monitoring program has been established. The owner or operator has completed the notification when the notification is placed in the facility's operating record as required by § 257.105(h)(5).

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

§ 257.95 Assessment monitoring program.

(a) Assessment monitoring is required whenever a statistically significant increase over background levels has been detected for one or more of the constituents listed in appendix III to this part.

(b) Within 90 days of triggering an assessment monitoring program, and annually thereafter, the owner or operator of the CCR unit must sample and analyze the groundwater for all constituents listed in appendix IV to this part. The number of samples collected and analyzed for each well during each sampling event must be consistent with § 257.93(e), and must account for any unique characteristics of the site, but must be at least one sample from each well.

(c) The owner or operator of a CCR unit may demonstrate the need for an alternative monitoring frequency for repeated sampling and analysis for constituents listed in appendix IV to this part during the active life and the post-closure care period based on the availability of groundwater. If there is not adequate groundwater flow to sample wells semiannually, the alternative frequency shall be no less than annual. The need to vary monitoring frequency must be evaluated on a site-specific basis. The demonstration must be supported by, at a minimum, the information specified in paragraphs (c)(1) and (2) of this section.

(1) Information documenting that the need for less frequent sampling. The alternative frequency must be based on consideration of the following factors:

(i) Lithology of the aquifer and unsaturated zone;

(ii) Hydraulic conductivity of the aquifer and unsaturated zone; and

(iii) Groundwater flow rates.

(2) Information documenting that the alternative frequency will be no less effective in ensuring that any leakage from the CCR unit will be discovered within a timeframe that will not materially delay the initiation of any necessary remediation measures.

(3) The owner or operator must obtain a certification from a qualified professional engineer stating that the demonstration for an alternative groundwater sampling and analysis frequency meets the requirements of this section. The owner or operator must include the demonstration providing the basis for the alternative monitoring frequency and the certification by a qualified professional engineer in the annual groundwater monitoring and corrective action report required by § 257.90(e).

(d) After obtaining the results from the initial and subsequent sampling events required in paragraph (b) of this section, the owner or operator must:

(1) Within 90 days of obtaining the results, and on at least a semiannual basis thereafter, resample all wells that were installed pursuant to the requirements of § 257.91, conduct analyses for all parameters in appendix III to this part and for those constituents in appendix IV to this part that are detected in response to paragraph (b) of this section, and record their concentrations in the facility operating record. The number of samples collected and analyzed for each background well and downgradient well during subsequent semiannual sampling events must be consistent with § 257.93(e), and must account for any unique characteristics of the site, but must be at least one sample from each background and downgradient well;

(2) Establish groundwater protection standards for all constituents detected pursuant to paragraph (b) or (d) of this section. The groundwater protection standards must be established in accordance with paragraph (h) of this section; and

(3) Include the recorded concentrations required by paragraph (d)(1) of this section, identify the background concentrations established under § 257.94(b), and identify the groundwater protection standards established under paragraph (d)(2) of this section in the annual groundwater monitoring and corrective action report required by § 257.90(e).

(e) If the concentrations of all constituents listed in appendices III and IV to this part are shown to be at or below background values, using the statistical procedures in § 257.93(g), for two consecutive sampling events, the owner or operator may return to detection monitoring of the CCR unit. The owner or operator must prepare a notification stating that detection monitoring is resuming for the CCR unit. The owner or operator has completed the notification when the notification is placed in the facility's operating record as required by § 257.105(h)(7).

(f) If the concentrations of any constituent in appendices III and IV to this part are above background values, but all concentrations are below the groundwater protection standard

established under paragraph (h) of this section, using the statistical procedures in § 257.93(g), the owner or operator must continue assessment monitoring in accordance with this section.

(g) If one or more constituents in appendix IV to this part are detected at statistically significant levels above the groundwater protection standard established under paragraph (h) of this section in any sampling event, the owner or operator must prepare a notification identifying the constituents in appendix IV to this part that have exceeded the groundwater protection standard. The owner or operator has completed the notification when the notification is placed in the facility's operating record as required by § 257.105(h)(8). The owner or operator of the CCR unit also must:

(1) Characterize the nature and extent of the release and any relevant site conditions that may affect the remedy ultimately selected. The characterization must be sufficient to support a complete and accurate assessment of the corrective measures necessary to effectively clean up all releases from the CCR unit pursuant to § 257.96. Characterization of the release includes the following minimum measures:

(i) Install additional monitoring wells necessary to define the contaminant plume(s);

(ii) Collect data on the nature and estimated quantity of material released including specific information on the constituents listed in appendix IV of this part and the levels at which they are present in the material released;

(iii) Install at least one additional monitoring well at the facility boundary in the direction of contaminant migration and sample this well in accordance with paragraph (d)(1) of this section; and

(iv) Sample all wells in accordance with paragraph (d)(1) of this section to characterize the nature and extent of the release.

(2) Notify all persons who own the land or reside on the land that directly overlies any part of the plume of contamination if contaminants have migrated off-site if indicated by sampling of wells in accordance with paragraph (g)(1) of this section. The owner or operator has completed the notifications when they are placed in the facility's operating record as required by § 257.105(h)(8).

(3) Within 90 days of finding that any of the constituents listed in appendix IV to this part have been detected at a statistically significant level exceeding the groundwater protection standards the owner or operator must either:

(i) Initiate an assessment of corrective measures as required by § 257.96; or

(ii) Demonstrate that a source other than the CCR unit caused the contamination, or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Any such demonstration must be supported by a report that includes the factual or evidentiary basis for any conclusions and must be certified to be accurate by a qualified professional engineer. If a successful demonstration is made, the owner or operator must continue monitoring in accordance with the assessment monitoring program pursuant to this section, and may return to detection monitoring if the constituents in appendices III and IV to this part are at or below background as specified in paragraph (e) of this section. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

(4) If a successful demonstration has not been made at the end of the 90 day period provided by paragraph (g)(3)(ii) of this section, the owner or operator of the CCR unit must initiate the assessment of corrective measures requirements under § 257.96.

(5) If an assessment of corrective measures is required under § 257.96 by either paragraph (g)(3)(i) or (g)(4) of this section, and if the CCR unit is an existing unlined CCR surface impoundment as determined by § 257.71(a), then the CCR unit is subject to the closure requirements under § 257.101(a) to retrofit or close. In addition, the owner or operator must prepare a notification stating that an assessment of corrective measures has been initiated.

(h) The owner or operator of the CCR unit must establish a groundwater protection standard for each constituent in appendix IV to this part detected in the groundwater. The groundwater protection standard shall be:

(1) For constituents for which a maximum contaminant level (MCL) has been established under §§ 141.62 and 141.66 of this title, the MCL for that constituent;

(2) For constituents for which an MCL has not been established, the background concentration for the constituent established from wells in accordance with § 257.91; or

(3) For constituents for which the background level is higher than the MCL identified under paragraph (h)(1) of this section, the background concentration.

(i) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

§ 257.96 Assessment of corrective measures.

(a) Within 90 days of finding that any constituent listed in appendix IV to this part has been detected at a statistically significant level exceeding the groundwater protection standard defined under § 257.95(h), or immediately upon detection of a release from a CCR unit, the owner or operator must initiate an assessment of corrective measures to prevent further releases, to remediate any releases and to restore affected area to original conditions. The assessment of corrective measures must be completed within 90 days, unless the owner or operator demonstrates the need for additional time to complete the assessment of corrective measures due to site-specific conditions or circumstances. The owner or operator must obtain a certification from a qualified professional engineer attesting that the demonstration is accurate. The 90-day deadline to complete the assessment of corrective measures may be extended for no longer than 60 days. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

(b) The owner or operator of the CCR unit must continue to monitor groundwater in accordance with the assessment monitoring program as specified in § 257.95.

(c) The assessment under paragraph (a) of this section must include an analysis of the effectiveness of potential corrective measures in meeting all of the requirements and objectives of the remedy as described under § 257.97 addressing at least the following:

(1) The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to any residual contamination;

(2) The time required to begin and complete the remedy;

(3) The institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy(s).

(d) The owner or operator must place the completed assessment of corrective measures in the facility's operating record. The assessment has been completed when it is placed in the facility's operating record as required by § 257.105(h)(10).

(e) The owner or operator must discuss the results of the corrective measures assessment at least 30 days prior to the selection of remedy, in a public meeting with interested and affected parties.

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

§ 257.97 Selection of remedy.

(a) Based on the results of the corrective measures assessment conducted under § 257.96, the owner or operator must, as soon as feasible, select a remedy that, at a minimum, meets the standards listed in paragraph (b) of this section. This requirement applies to, not in place of, any applicable standards under the Occupational Safety and Health Act. The owner or operator must prepare a semiannual report describing the progress in selecting and designing the remedy. Upon selection of a remedy, the owner or operator must prepare a final report describing the selected remedy and how it meets the standards specified in paragraph (b) of this section. The owner or operator must obtain a certification from a qualified professional engineer that the remedy selected meets the requirements of this section. The report has been completed when it is placed in the operating record as required by § 257.105(h)(12).

(b) Remedies must:

(1) Be protective of human health and the environment;

(2) Attain the groundwater protection standard as specified pursuant to § 257.95(h);

(3) Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in appendix IV to this part into the environment;

(4) Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems;

(5) Comply with standards for management of wastes as specified in § 257.98(d).

(c) In selecting a remedy that meets the standards of paragraph (b) of this section, the owner or operator of the CCR unit shall consider the following evaluation factors:

(1) The long- and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful based on consideration of the following:

(i) Magnitude of reduction of existing risks;

(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy;

(iii) The type and degree of long-term management required, including monitoring, operation, and maintenance;

(iv) Short-term risks that might be posed to the community or the environment during implementation of such a remedy, including potential threats to human health and the environment associated with excavation, transportation, and re-disposal of contaminant;

(v) Time until full protection is achieved;

(vi) Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment;

(vii) Long-term reliability of the engineering and institutional controls; and

(viii) Potential need for replacement of the remedy.

(2) The effectiveness of the remedy in controlling the source to reduce further releases based on consideration of the following factors:

(i) The extent to which containment practices will reduce further releases; and

(ii) The extent to which treatment technologies may be used.

(3) The ease or difficulty of implementing a potential remedy(s) based on consideration of the following types of factors:

(i) Degree of difficulty associated with constructing the technology;

(ii) Expected operational reliability of the technologies;

(iii) Need to coordinate with and obtain necessary approvals and permits from other agencies;

(iv) Availability of necessary equipment and specialists; and

(v) Available capacity and location of needed treatment, storage, and disposal services.

(4) The degree to which community concerns are addressed by a potential remedy(s).

(d) The owner or operator must specify as part of the selected remedy a schedule(s) for implementing and completing remedial activities. Such a schedule must require the completion of remedial activities within a reasonable period of time taking into consideration the factors set forth in paragraphs (d)(1) through (6) of this section. The owner or operator of the CCR unit must consider the following factors in determining the schedule of remedial activities:

(1) Extent and nature of contamination, as determined by the characterization required under § 257.95(g);

(2) Reasonable probabilities of remedial technologies in achieving compliance with the groundwater protection standards established under § 257.95(h) and other objectives of the remedy;

(3) Availability of treatment or disposal capacity for CCR managed during implementation of the remedy;

(4) Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy;

(5) Resource value of the aquifer including:

(i) Current and future uses;

(ii) Proximity and withdrawal rate of users;

(iii) Groundwater quantity and quality;

(iv) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to CCR constituents;

(v) The hydrogeologic characteristic of the facility and surrounding land; and

(vi) The availability of alternative water supplies; and

(6) Other relevant factors.

(e) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

§ 257.98 Implementation of the corrective action program.

(a) Within 90 days of selecting a remedy under § 257.97, the owner or operator must initiate remedial activities. Based on the schedule established under § 257.97(d) for implementation and completion of remedial activities the owner or operator must:

(1) Establish and implement a corrective action groundwater monitoring program that:

(i) At a minimum, meets the requirements of an assessment monitoring program under § 257.95;

(ii) Documents the effectiveness of the corrective action remedy; and

(iii) Demonstrates compliance with the groundwater protection standard pursuant to paragraph (c) of this section.

(2) Implement the corrective action remedy selected under § 257.97; and

(3) Take any interim measures necessary to reduce the contaminants leaching from the CCR unit, and/or potential exposures to human or ecological receptors. Interim measures must, to the greatest extent feasible, be consistent with the objectives of and contribute to the performance of any remedy that may be required pursuant to § 257.97. The following factors must be considered by an owner or operator in determining whether interim measures are necessary:

(i) Time required to develop and implement a final remedy;

(ii) Actual or potential exposure of nearby populations or environmental receptors to any of the constituents listed in appendix IV of this part;

(iii) Actual or potential contamination of drinking water supplies or sensitive ecosystems;

(iv) Further degradation of the groundwater that may occur if remedial action is not initiated expeditiously;

(v) Weather conditions that may cause any of the constituents listed in appendix IV to this part to migrate or be released;

(vi) Potential for exposure to any of the constituents listed in appendix IV to this part as a result of an accident or failure of a container or handling system; and

(vii) Other situations that may pose threats to human health and the environment.

(b) If an owner or operator of the CCR unit, determines, at any time, that compliance with the requirements of § 257.97(b) is not being achieved through the remedy selected, the owner or operator must implement other methods or techniques that could feasibly achieve compliance with the requirements.

(c) Remedies selected pursuant to § 257.97 shall be considered complete when:

(1) The owner or operator of the CCR unit demonstrates compliance with the groundwater protection standards established under § 257.95(h) has been achieved at all points within the plume of contamination that lie beyond the groundwater monitoring well system established under § 257.91.

(2) Compliance with the groundwater protection standards established under § 257.95(h) has been achieved by demonstrating that concentrations of constituents listed in appendix IV to this part have not exceeded the groundwater protection standard(s) for a period of three consecutive years using the statistical procedures and performance standards in § 257.93(f) and (g).

(3) All actions required to complete the remedy have been satisfied.

(d) All CCR that are managed pursuant to a remedy required under § 257.97, or an interim measure required under paragraph (a)(3) of this section, shall be managed in a manner that complies with all applicable RCRA requirements.

(e) Upon completion of the remedy, the owner or operator must prepare a notification stating that the remedy has been completed. The owner or operator must obtain a certification from a qualified professional engineer attesting that the remedy has been completed in compliance with the requirements of paragraph (c) of this section. The report has been completed when it is placed in the operating record as required by § 257.105(h)(13).

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the internet requirements specified in § 257.107(h).

Closure and Post-Closure Care

§ 257.100 Inactive CCR surface impoundments.

(a) Except as provided by paragraph (b) of this section, inactive CCR surface impoundments are subject to all of the requirements of this subpart applicable to existing CCR surface impoundments.

(b) An owner or operator of an inactive CCR surface impoundment that completes closure of such CCR unit, and meets all of the requirements of either paragraphs (b)(1) through (4) of this section or paragraph (b)(5) of this section no later than April 17, 2018, is exempt from all other requirements of this subpart.

(1) *Closure by leaving CCR in place.* If the owner or operator of the inactive CCR surface impoundment elects to close the CCR surface impoundment by leaving CCR in place, the owner or operator must ensure that, at a minimum, the CCR unit is closed in a manner that will:

(i) Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere;

(ii) Preclude the probability of future impoundment of water, sediment, or slurry;

(iii) Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system; and

(iv) Minimize the need for further maintenance of the CCR unit.

(2) The owner or operator of the inactive CCR surface impoundment must meet the requirements of paragraphs (b)(2)(i) and (ii) of this section prior to installing the final cover system required under paragraph (b)(3) of this section.

(i) Free liquids must be eliminated by removing liquid wastes or solidifying the remaining wastes and waste residues.

(ii) Remaining wastes must be stabilized sufficient to support the final cover system.

(3) The owner or operator must install a final cover system that is designed to minimize infiltration and erosion, and at a minimum, meets the requirements of paragraph (b)(3)(i) of this section, or the requirements of an alternative final cover system specified in paragraph (b)(3)(ii) of this section.

(i) The final cover system must be designed and constructed to meet the criteria specified in paragraphs (b)(3)(i)(A) through (D) of this section.

(A) The permeability of the final cover system must be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1×10^{-5} centimeters/second, whichever is less.

(B) The infiltration of liquids through the CCR unit must be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.

(C) The erosion of the final cover system must be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

(D) The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.

(ii) The owner or operator may select an alternative final cover system design, provided the alternative final cover system is designed and constructed to meet the criteria in paragraphs (b)(3)(ii)(A) through (C) of this section.

(A) The design of the final cover system must include an infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraphs (b)(3)(i)(A) and (B) of this section.

(B) The design of the final cover system must include an erosion layer that provides equivalent protection from wind or water erosion as the erosion layer specified in paragraph (b)(3)(i)(C) of this section.

cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the final cover;

(2) If the CCR unit is subject to the design criteria under § 257.70, maintaining the integrity and effectiveness of the leachate collection and removal system and operating the leachate collection and removal system in accordance with the requirements of § 257.70; and

(3) Maintaining the groundwater monitoring system and monitoring the groundwater in accordance with the requirements of §§ 257.90 through 257.98.

(c) *Post-closure care period.* (1) Except as provided by paragraph (c)(2) of this section, the owner or operator of the CCR unit must conduct post-closure care for 30 years.

(2) If at the end of the post-closure care period the owner or operator of the CCR unit is operating under assessment monitoring in accordance with § 257.95, the owner or operator must continue to conduct post-closure care until the owner or operator returns to detection monitoring in accordance with § 257.95.

(d) *Written post-closure plan*—(1) *Content of the plan.* The owner or operator of a CCR unit must prepare a written post-closure plan that includes, at a minimum, the information specified in paragraphs (d)(1)(i) through (iii) of this section.

(i) A description of the monitoring and maintenance activities required in paragraph (b) of this section for the CCR unit, and the frequency at which these activities will be performed;

(ii) The name, address, telephone number, and email address of the person or office to contact about the facility during the post-closure care period; and

(iii) A description of the planned uses of the property during the post-closure period. Post-closure use of the property shall not disturb the integrity of the final cover, liner(s), or any other component of the containment system, or the function of the monitoring systems unless necessary to comply with the requirements in this subpart. Any other disturbance is allowed if the owner or operator of the CCR unit demonstrates that disturbance of the final cover, liner, or other component of the containment system, including any removal of CCR, will not increase the potential threat to human health or the environment. The demonstration must be certified by a qualified professional engineer, and notification shall be provided to the State Director that the demonstration has been placed in the operating record and on the owners or operator's publicly accessible Internet site.

(2) *Deadline to prepare the initial written post-closure plan*—(i) *Existing CCR landfills and existing CCR surface impoundments.* No later than October 17, 2016, the owner or operator of the CCR unit must prepare an initial written post-closure plan consistent with the requirements specified in paragraph (d)(1) of this section.

(ii) *New CCR landfills, new CCR surface impoundments, and any lateral expansion of a CCR unit.* No later than the date of the initial receipt of CCR in the CCR unit, the owner or operator must prepare an initial written post-closure plan consistent with the requirements specified in paragraph (d)(1) of this section.

(iii) The owner or operator has completed the written post-closure plan when the plan, including the certification required by paragraph (d)(4) of this section, has been placed in the facility's operating record as required by § 257.105(i)(4).

(3) *Amendment of a written post-closure plan.* (i) The owner or operator may amend the initial or any subsequent written post-closure plan developed pursuant to paragraph (d)(1) of this section at any time.

(ii) The owner or operator must amend the written closure plan whenever:

(A) There is a change in the operation of the CCR unit that would substantially affect the written post-closure plan in effect; or

(B) After post-closure activities have commenced, unanticipated events necessitate a revision of the written post-closure plan.

(iii) The owner or operator must amend the written post-closure plan at least 60 days prior to a planned change in the operation of the facility or CCR unit, or no later than 60 days after an unanticipated event requires the need to revise an existing written post-closure plan. If a written post-closure plan is revised after post-closure activities have commenced for a CCR unit, the owner or operator must amend the written post-closure plan no later than 30 days following the triggering event.

(4) The owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the initial and any amendment of the written post-closure plan meets the requirements of this section.

(e) *Notification of completion of post-closure care period.* No later than 60 days following the completion of the post-closure care period, the owner or operator of the CCR unit must prepare a notification verifying that post-closure care has been completed. The notification must include the certification by a qualified professional engineer verifying that post-closure care has been completed in accordance with the closure plan specified in paragraph (d) of this section and the requirements of this section. The owner or operator has completed the notification when it has been placed in the facility's operating record as required by § 257.105(i)(13).

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(i), the notification requirements specified in § 257.106(i), and the Internet requirements specified in § 257.107(i).

Recordkeeping, Notification, and Posting of Information to the Internet

§ 257.105 Recordkeeping requirements.

(a) Each owner or operator of a CCR unit subject to the requirements of this subpart must maintain files of all information required by this section in a written operating record at their facility.

(b) Unless specified otherwise, each file must be retained for at least five years following the date of each occurrence, measurement, maintenance, corrective action, report, record, or study.

(c) An owner or operator of more than one CCR unit subject to the provisions of this subpart may comply with the requirements of this section in one recordkeeping system provided the system identifies each file by the name of each CCR unit. The files may be maintained on microfilm, on a computer, on computer disks, on a storage system accessible by a computer, on magnetic tape disks, or on microfiche.

(d) The owner or operator of a CCR unit must submit to the State Director and/or appropriate Tribal authority any demonstration or documentation required by this subpart, if requested, when such information is not otherwise available on the owner or operator's publicly accessible Internet site.

(e) *Location restrictions.* The owner or operator of a CCR unit subject to this subpart must place the demonstrations documenting whether or not the CCR unit is in compliance with the requirements under §§ 257.60(a), 257.61(a), 257.62(a), 257.63(a), and 257.64(a), as it becomes available, in the facility's operating record.

(f) *Design criteria.* The owner or operator of a CCR unit subject to this subpart must place the following

information, as it becomes available, in the facility's operating record:

(1) The design and construction certifications as required by § 257.70(e) and (f).

(2) The documentation of liner type as required by § 257.71(a).

(3) The design and construction certifications as required by § 257.72(c) and (d).

(4) Documentation prepared by the owner or operator stating that the permanent identification marker was installed as required by §§ 257.73(a)(1) and 257.74(a)(1).

(5) The initial and periodic hazard potential classification assessments as required by §§ 257.73(a)(2) and 257.74(a)(2).

(6) The emergency action plan (EAP), and any amendment of the EAP, as required by §§ 257.73(a)(3) and 257.74(a)(3), except that only the most recent EAP must be maintained in the facility's operating record irrespective of the time requirement specified in paragraph (b) of this section.

(7) Documentation prepared by the owner or operator recording the annual face-to-face meeting or exercise between representatives of the owner or operator of the CCR unit and the local emergency responders as required by §§ 257.73(a)(3)(i)(E) and 257.74(a)(3)(i)(E).

(8) Documentation prepared by the owner or operator recording all activations of the emergency action plan as required by §§ 257.73(a)(3)(v) and 257.74(a)(3)(v).

(9) The history of construction, and any revisions of it, as required by § 257.73(c), except that these files must be maintained until the CCR unit completes closure of the unit in accordance with § 257.102.

(10) The initial and periodic structural stability assessments as required by §§ 257.73(d) and 257.74(d).

(11) Documentation detailing the corrective measures taken to remedy the deficiency or release as required by §§ 257.73(d)(2) and 257.74(d)(2).

(12) The initial and periodic safety factor assessments as required by §§ 257.73(e) and 257.74(e).

(13) The design and construction plans, and any revisions of it, as required by § 257.74(c), except that these files must be maintained until the CCR unit completes closure of the unit in accordance with § 257.102.

(g) *Operating criteria.* The owner or operator of a CCR unit subject to this subpart must place the following information, as it becomes available, in the facility's operating record:

(1) The CCR fugitive dust control plan, and any subsequent amendment of the plan, required by § 257.80(b), except that only the most recent control plan must be maintained in the facility's operating record irrespective of the time requirement specified in paragraph (b) of this section.

(2) The annual CCR fugitive dust control report required by § 257.80(c).

(3) The initial and periodic run-on and run-off control system plans as required by § 257.81(c).

(4) The initial and periodic inflow design flood control system plan as required by § 257.82(c).

(5) Documentation recording the results of each inspection and instrumentation monitoring by a qualified person as required by § 257.83(a).

(6) The periodic inspection report as required by § 257.83(b)(2).

(7) Documentation detailing the corrective measures taken to remedy the deficiency or release as required by §§ 257.83(b)(5) and 257.84(b)(5).

(8) Documentation recording the results of the weekly inspection by a qualified person as required by § 257.84(a).

(9) The periodic inspection report as required by § 257.84(b)(2).

(h) *Groundwater monitoring and corrective action.* The owner or operator of a CCR unit subject to this subpart must place the following information, as it becomes available, in the facility's operating record:

(1) The annual groundwater monitoring and corrective action report as required by § 257.90(e).

(2) Documentation of the design, installation, development, and decommissioning of any monitoring wells, piezometers and other measurement, sampling, and analytical devices as required by § 257.91(e)(1).

(3) The groundwater monitoring system certification as required by § 257.91(f).

(4) The selection of a statistical method certification as required by § 257.93(f)(6).

(5) Within 30 days of establishing an assessment monitoring program, the notification as required by § 257.94(e)(3).

(6) The results of appendices III and IV to this part constituent concentrations as required by § 257.95(d)(1).

(7) Within 30 days of returning to a detection monitoring program, the notification as required by § 257.95(e).

(8) Within 30 days of detecting one or more constituents in appendix IV to this part at statistically significant levels above the groundwater protection standard, the notifications as required by § 257.95(g).

(9) Within 30 days of initiating the assessment of corrective measures requirements, the notification as required by § 257.95(g)(5).

(10) The completed assessment of corrective measures as required by § 257.96(d).

(11) Documentation prepared by the owner or operator recording the public meeting for the corrective measures assessment as required by § 257.96(e).

(12) The semiannual report describing the progress in selecting and designing the remedy and the selection of remedy report as required by § 257.97(a), except that the selection of remedy report must be maintained until the remedy has been completed.

(13) Within 30 days of completing the remedy, the notification as required by § 257.98(e).

(i) *Closure and post-closure care.* The owner or operator of a CCR unit subject to this subpart must place the following information, as it becomes available, in the facility's operating record:

(1) The notification of intent to initiate closure of the CCR unit as required by § 257.100(c)(1).

(2) The annual progress reports of closure implementation as required by § 257.100(c)(2)(i) and (ii).

(3) The notification of closure completion as required by § 257.100(c)(3).

(4) The written closure plan, and any amendment of the plan, as required by § 257.102(b), except that only the most recent closure plan must be maintained in the facility's operating record irrespective of the time requirement specified in paragraph (b) of this section.

(5) The written demonstration(s), including the certification required by § 257.102(e)(2)(iii), for a time extension for initiating closure as required by § 257.102(e)(2)(ii).

(6) The written demonstration(s), including the certification required by § 257.102(f)(2)(iii), for a time extension for completing closure as required by § 257.102(f)(2)(i).

(7) The notification of intent to close a CCR unit as required by § 257.102(g).

(8) The notification of completion of closure of a CCR unit as required by § 257.102(h).

(9) The notification recording a notation on the deed as required by § 257.102(i).

(10) The notification of intent to comply with the alternative closure requirements as required by § 257.103(c)(1).

(11) The annual progress reports under the alternative closure requirements as required by § 257.103(c)(2).

(12) The written post-closure plan, and any amendment of the plan, as required by § 257.104(d), except that only the most recent closure plan must be maintained in the facility's operating record irrespective of the time requirement specified in paragraph (b) of this section.

(13) The notification of completion of post-closure care period as required by § 257.104(e).

(j) *Retrofit criteria.* The owner or operator of a CCR unit subject to this subpart must place the following information, as it becomes available, in the facility's operating record:

(1) The written retrofit plan, and any amendment of the plan, as required by § 257.102(k)(2), except that only the most recent retrofit plan must be maintained in the facility's operating record irrespective of the time requirement specified in paragraph (b) of this section.

(2) The notification of intent that the retrofit activities will proceed in accordance with the alternative procedures in § 257.103.

(3) The annual progress reports required under the alternative requirements as required by § 257.103.

(4) The written demonstration(s), including the certification in § 257.102(f)(2)(iii), for a time extension for completing retrofit activities as required by § 257.102(k)(3).

(5) The notification of intent to initiate retrofit of a CCR unit as required by § 257.102(k)(5).

(6) The notification of completion of retrofit activities as required by § 257.102(k)(6).

§ 257.106 Notification requirements.

(a) The notifications required under paragraphs (e) through (i) of this section must be sent to the relevant State Director and/or appropriate Tribal authority before the close of business on the day the notification is required to be completed. For purposes of this section, *before the close of business* means the notification must be postmarked or sent by electronic mail (email). If a notification deadline falls on a weekend or federal holiday, the notification deadline is automatically extended to the next business day.

(b) If any CCR unit is located in its entirety within Indian Country, the notifications of this section must be sent to the appropriate Tribal authority. If any CCR unit is located in part within Indian Country, the notifications of this section must be sent both to the appropriate State Director and Tribal authority.

(c) Notifications may be combined as long as the deadline requirement for each notification is met.

(d) Unless otherwise required in this section, the notifications specified in this section must be sent to the State Director and/or appropriate Tribal authority within 30 days of placing in the operating record the information required by § 257.105.

(e) *Location restrictions.* The owner or operator of a CCR unit subject to the requirements of this subpart must notify the State Director and/or appropriate Tribal authority that each demonstration specified under § 257.105(e) has been placed in the operating record and on the owner or operator's publicly accessible internet site.

(f) *Design criteria.* The owner or operator of a CCR unit subject to this subpart must notify the State Director and/or appropriate Tribal authority when information has been placed in the operating record and on the owner or operator's publicly accessible internet site. The owner or operator must:

(1) Within 60 days of commencing construction of a new CCR unit, provide notification of the availability of the design certification specified under § 257.105(f)(1) or (3). If the owner or operator of the CCR unit elects to install an alternative composite liner, the owner or operator must also submit to the State Director and/or appropriate Tribal authority a copy of the alternative composite liner design.

(2) No later than the date of initial receipt of CCR by a new CCR unit, provide notification of the availability of the construction certification specified under § 257.105(f)(1) or (3).

(3) Provide notification of the availability of the documentation of liner type specified under § 257.105(f)(2).

(4) Provide notification of the availability of the initial and periodic hazard potential classification assessments specified under § 257.105(f)(5).

(5) Provide notification of the availability of emergency action plan (EAP), and any revisions of the EAP, specified under § 257.105(f)(6).

(6) Provide notification of the availability of documentation prepared by the owner or operator recording the annual face-to-face meeting or exercise between representatives of the owner or operator of the CCR unit and the local emergency responders specified under § 257.105(f)(7).

(7) Provide notification of documentation prepared by the owner or operator recording all activations of the emergency action plan specified under § 257.105(f)(8).

(8) Provide notification of the availability of the history of construction, and any revision of it, specified under § 257.105(f)(9).

(9) Provide notification of the availability of the initial and periodic structural stability assessments specified under § 257.105(f)(10).

(10) Provide notification of the availability of the documentation detailing the corrective measures taken to remedy the deficiency or release specified under § 257.105(f)(11).

(11) Provide notification of the availability of the initial and periodic safety factor assessments specified under § 257.105(f)(12).

(12) Provide notification of the availability of the design and construction plans, and any revision of them, specified under § 257.105(f)(13).

(g) *Operating criteria.* The owner or operator of a CCR unit subject to this subpart must notify the State Director and/or appropriate Tribal authority when information has been placed in the operating record and on the owner or operator's publicly accessible internet site. The owner or operator must:

(1) Provide notification of the availability of the CCR fugitive dust control plan, or any subsequent amendment of the plan, specified under § 257.105(g)(1).

(2) Provide notification of the availability of the annual CCR fugitive dust control report specified under § 257.105(g)(2).

(3) Provide notification of the availability of the initial and periodic run-on and run-off control system plans specified under § 257.105(g)(3).

(4) Provide notification of the availability of the initial and periodic inflow design flood control system plans specified under § 257.105(g)(4).

(5) Provide notification of the availability of the periodic inspection reports specified under § 257.105(g)(6).

(6) Provide notification of the availability of the documentation detailing the corrective measures taken to remedy the deficiency or release specified under § 257.105(g)(7).

(7) Provide notification of the availability of the periodic inspection reports specified under § 257.105(g)(9).

(h) *Groundwater monitoring and corrective action.* The owner or operator of a CCR unit subject to this subpart must notify the State Director and/or appropriate Tribal authority when information has been placed in the operating record and on the owner or operator's publicly accessible internet site. The owner or operator must:

(1) Provide notification of the availability of the annual groundwater

monitoring and corrective action report specified under § 257.105(h)(1).

(2) Provide notification of the availability of the groundwater monitoring system certification specified under § 257.105(h)(3).

(3) Provide notification of the availability of the selection of a statistical method certification specified under § 257.105(h)(4).

(4) Provide notification that an assessment monitoring programs has been established specified under § 257.105(h)(5).

(5) Provide notification that the CCR unit is returning to a detection monitoring program specified under § 257.105(h)(7).

(6) Provide notification that one or more constituents in appendix IV to this part have been detected at statistically significant levels above the groundwater protection standard and the notifications to land owners specified under § 257.105(h)(8).

(7) Provide notification that an assessment of corrective measures has been initiated specified under § 257.105(h)(9).

(8) Provide notification of the availability of assessment of corrective measures specified under § 257.105(h)(10).

(9) Provide notification of the availability of the semiannual report describing the progress in selecting and designing the remedy and the selection of remedy report specified under § 257.105(h)(12).

(10) Provide notification of the completion of the remedy specified under § 257.105(h)(13).

(i) *Closure and post-closure care.* The owner or operator of a CCR unit subject to this subpart must notify the State Director and/or appropriate Tribal authority when information has been placed in the operating record and on the owner or operator's publicly accessible Internet site. The owner or operator must:

(1) Provide notification of the intent to initiate closure of the CCR unit specified under § 257.105(i)(1).

(2) Provide notification of the availability of the annual progress reports of closure implementation specified under § 257.105(i)(2).

(3) Provide notification of closure completion specified under § 257.105(i)(3).

(4) Provide notification of the availability of the written closure plan, and any amendment of the plan, specified under § 257.105(i)(4).

(5) Provide notification of the availability of the demonstration(s) for a time extension for initiating closure specified under § 257.105(i)(5).

(6) Provide notification of the availability of the demonstration(s) for a time extension for completing closure specified under § 257.105(i)(6).

(7) Provide notification of intent to close a CCR unit specified under § 257.105(i)(7).

(8) Provide notification of completion of closure of a CCR unit specified under § 257.105(i)(8).

(9) Provide notification of the deed notation as required by § 257.105(i)(9).

(10) Provide notification of intent to comply with the alternative closure requirements specified under § 257.105(i)(10).

(11) The annual progress reports under the alternative closure requirements as required by § 257.105(i)(11).

(12) Provide notification of the availability of the written post-closure plan, and any amendment of the plan, specified under § 257.105(i)(12).

(13) Provide notification of completion of post-closure care specified under § 257.105(i)(13).

(j) *Retrofit criteria.* The owner or operator of a CCR unit subject to this subpart must notify the State Director and/or appropriate Tribal authority when information has been placed in the operating record and on the owner or operator's publicly accessible Internet site. The owner or operator must:

(1) Provide notification of the availability of the written retrofit plan, and any amendment of the plan, specified under § 257.105(j)(1).

(2) Provide notification of intent to comply with the alternative retrofit requirements specified under § 257.105(j)(2).

(3) The annual progress reports under the alternative retrofit requirements as required by § 257.105(j)(3).

(4) Provide notification of the availability of the demonstration(s) for a time extension for completing retrofit activities specified under § 257.105(j)(4).

(5) Provide notification of intent to initiate retrofit of a CCR unit specified under § 257.105(j)(5).

(6) Provide notification of completion of retrofit activities specified under § 257.105(j)(6).

§ 257.107 Publicly accessible Internet site requirements.

(a) Each owner or operator of a CCR unit subject to the requirements of this subpart must maintain a publicly accessible Internet site (CCR Web site) containing the information specified in this section. The owner or operator's Web site must be titled ''CCR Rule Compliance Data and Information.''

(b) An owner or operator of more than one CCR unit subject to the provisions of this subpart may comply with the requirements of this section by using the same Internet site for multiple CCR units provided the CCR Web site clearly delineates information by the name or identification number of each unit.

(c) Unless otherwise required in this section, the information required to be posted to the CCR Web site must be made available to the public for at least five years following the date on which the information was first posted to the CCR Web site.

(d) Unless otherwise required in this section, the information must be posted to the CCR Web site within 30 days of placing the pertinent information required by § 257.105 in the operating record.

(e) *Location restrictions.* The owner or operator of a CCR unit subject to this subpart must place each demonstration specified under § 257.105(e) on the owner or operator's CCR Web site.

(f) *Design criteria.* The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) Within 60 days of commencing construction of a new unit, the design certification specified under § 257.105(f)(1) or (3).

(2) No later than the date of initial receipt of CCR by a new CCR unit, the construction certification specified under § 257.105(f)(1) or (3).

(3) The documentation of liner type specified under § 257.105(f)(2).

(4) The initial and periodic hazard potential classification assessments specified under § 257.105(f)(5).

(5) The emergency action plan (EAP) specified under § 257.105(f)(6), except that only the most recent EAP must be maintained on the CCR Web site irrespective of the time requirement specified in paragraph (c) of this section.

(6) Documentation prepared by the owner or operator recording the annual face-to-face meeting or exercise between representatives of the owner or operator of the CCR unit and the local emergency responders specified under § 257.105(f)(7).

(7) Documentation prepared by the owner or operator recording any activation of the emergency action plan specified under § 257.105(f)(8).

(8) The history of construction, and any revisions of it, specified under § 257.105(f)(9).

(9) The initial and periodic structural stability assessments specified under § 257.105(f)(10).

(10) The documentation detailing the corrective measures taken to remedy the

deficiency or release specified under § 257.105(f)(11).

(11) The initial and periodic safety factor assessments specified under § 257.105(f)(12).

(12) The design and construction plans, and any revisions of them, specified under § 257.105(f)(13).

(g) *Operating criteria.* The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The CCR fugitive dust control plan, or any subsequent amendment of the plan, specified under § 257.105(g)(1) except that only the most recent plan must be maintained on the CCR Web site irrespective of the time requirement specified in paragraph (c) of this section.

(2) The annual CCR fugitive dust control report specified under § 257.105(g)(2).

(3) The initial and periodic run-on and run-off control system plans specified under § 257.105(g)(3).

(4) The initial and periodic inflow design flood control system plans specified under § 257.105(g)(4).

(5) The periodic inspection reports specified under § 257.105(g)(6).

(6) The documentation detailing the corrective measures taken to remedy the deficiency or release specified under § 257.105(g)(7).

(7) The periodic inspection reports specified under § 257.105(g)(9).

(h) *Groundwater monitoring and corrective action.* The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The annual groundwater monitoring and corrective action report specified under § 257.105(h)(1).

(2) The groundwater monitoring system certification specified under § 257.105(h)(3).

(3) The selection of a statistical method certification specified under § 257.105(h)(4).

(4) The notification that an assessment monitoring programs has been established specified under § 257.105(h)(5).

(5) The notification that the CCR unit is returning to a detection monitoring program specified under § 257.105(h)(7).

(6) The notification that one or more constituents in appendix IV to this part have been detected at statistically significant levels above the groundwater protection standard and the notifications to land owners specified under § 257.105(h)(8).

(7) The notification that an assessment of corrective measures has been initiated specified under § 257.105(h)(9).

(8) The assessment of corrective measures specified under § 257.105(h)(10).

(9) The semiannual reports describing the progress in selecting and designing remedy and the selection of remedy report specified under § 257.105(h)(12), except that the selection of the remedy report must be maintained until the remedy has been completed.

(10) The notification that the remedy has been completed specified under § 257.105(h)(13).

(i) *Closure and post-closure care.* The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The notification of intent to initiate closure of the CCR unit specified under § 257.105(i)(1).

(2) The annual progress reports of closure implementation specified under § 257.105(i)(2).

(3) The notification of closure completion specified under § 257.105(i)(3).

(4) The written closure plan, and any amendment of the plan, specified under § 257.105(i)(4).

(5) The demonstration(s) for a time extension for initiating closure specified under § 257.105(i)(5).

(6) The demonstration(s) for a time extension for completing closure specified under § 257.105(i)(6).

(7) The notification of intent to close a CCR unit specified under § 257.105(i)(7).

(8) The notification of completion of closure of a CCR unit specified under § 257.105(i)(8).

(9) The notification recording a notation on the deed as required by § 257.105(i)(9).

(10) The notification of intent to comply with the alternative closure requirements as required by § 257.105(i)(10).

(11) The annual progress reports under the alternative closure requirements as required by § 257.105(i)(11).

(12) The written post-closure plan, and any amendment of the plan, specified under § 257.105(i)(12).

(13) The notification of completion of post-closure care specified under § 257.105(i)(13).

(j) *Retrofit criteria.* The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The written retrofit plan, and any amendment of the plan, specified under § 257.105(j)(1).

(2) The notification of intent to comply with the alternative retrofit requirements as required by § 257.105(j)(2).

(3) The annual progress reports under the alternative retrofit requirements as required by § 257.105(j)(3).

(4) The demonstration(s) for a time extension for completing retrofit activities specified under § 257.105(j)(4).

(5) The notification of intent to retrofit a CCR unit specified under § 257.105(j)(5).

(6) The notification of completion of retrofit activities specified under § 257.105(j)(6).

■ 5. Amend part 257 by adding ''Appendix III to Part 257'' and ''Appendix IV to Part 257'' to read as follows:

Appendix III to Part 257—Constituents for Detection Monitoring

Common name [1]
Boron
Calcium
Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids (TDS)

[1] Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

Appendix IV to Part 257—Constituents for Assessment Monitoring

Common name [1]
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228 combined

[1] Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

PART 261—IDENTIFICATION AND LISTING OF HAZARDOUS WASTE

■ 6. The authority citation for part 261 continues to read as follows:

Authority: 42 U.S.C. 6905, 6912(a), 6921, 6922, 6924(y) and 6938.

■ 7. Section 261.4 is amended by revising paragraph (b)(4) to read as follows:

APPENDIX D

WELL CONSTRUCTION STANDARDS

STANDARDS

- Construction Documentation Form (#542-1277)
- Water Well Abandonment Plugging Record Form (#542-1226)
- Monitoring Well Construction Specifications

RECORDS

- Construction Documentation Forms and Well Logs

MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal Site Name Muscatine Power & Water Permit #70-SDP-06-82P-CCR
Well or Piezometer #_____ Date Started_____ Date Completed_____

A. Surveyed Locations and Elevations

Locations (0.5 ft.):
The reference system is NAD 1927 State Plane Iowa South FIPS 1402 (feet).
Location of this well is:
Northing:_____
Easting:_____

Elevations (±0.01 ft. MSL):
Ground surface_____
Top of protective casing_____
Top of well casing_____
Benchmark elevation_____
Benchmark description_____

B. Soil Boring Information

Name and address of construction company

_____
Name of driller _____
Drilling method_____
Drilling fluid_____
Bore hole diameter_____
Soil sampling method_____
Depth of boring_____

C. Monitoring Well Installation

Casing material_____
Length of casing_____
Outside casing diameter_____
Inside casing diameter_____
Casing joint type_____
Casing/screen joint type_____
Screen material_____
Screen opening size_____
Screen length_____
Depth of well_____

Well Installation, continued:

Filter pack:
Material_____
Grain size_____
Volume_____

Seal (minimum 3 ft. length above filter pack):
Material_____
Placement method_____
Volume_____

Backfill (if different from seal):
Material_____
Placement Method_____
Volume_____

Surface seal design:
Material of protective casing:

_____
Material of grout between protective casing and well casing:_____

_____
Protective cap:
Material_____
Vented? Y/N_____ Locking? Y/N

Well cap:
Material_____
Vented? Y/N_____

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing)_____
Stabilization time_____
Well development method_____

_____

_____
Upgradient or downgradient well?_____
Average depth of frost line_____

Attachments: Driller's log. Pipe schedules and grouting schedules.
8-1/2 X 11 inch map showing location of all monitoring wells and piezometers.

Form #542-1277

IOWA DEPARTMENT OF NATURAL RESOURCES

Abandoned Water Well Plugging Record

1. **Owner:**

Name: _____ Phone: _____

Address: _____

City: _____ State: _____ Zip: _____

If this was a Public Water Supply Well, please provide:

PWSID Name: _____ PWSID Number: _____

2. **Location of Well (Cistern):**

_____ ¼ of, _____ ¼ of, _____ ¼ of, Section _____ , T _____ N, R _____ ☐ East ☐ West

County: _____ Describe well location on property: _____

GPS Well Location: Latitude: _____ Longitude: _____

3. **Well Description:**

Well depth: _____ ft

Depth to water _____ ft.

Casing depth: _____ ft. Casing Material: ☐ Steel ☐ Plastic ☐ Concrete ☐ Clay ☐ Brick ☐ Stone

Casing diameter: _____ in.

Year or decade constructed: _____ Type of Construction: ☐ Drilled ☐ Driven ☐ Bored ☐ Augured ☐ Dug

Is this a Monitoring Well? ☐ Yes ☐ No Well ID: _____

Check if Cistern ☐ Depth: _____ ft. Diameter: _____ ft.

I certify this well has been plugged as required by rule 567-39.8 of the Iowa Administrative Code (IAC). I agree to provide any additional information the county or department may need concerning this well.

Signature of Owner _____ Date Plugged: _____

If plugged by certified well contractor, complete this box:

I have plugged this well as required by rule 567-39.8 of the Iowa Administrative Code (IAC).

Signature of Contractor: _____ Cert No: _____

OR, If plugged by well owner, complete this box:

The property owner has plugged this well following requirements in rule 567-39.8 of the Iowa Administrative Code (IAC) with the oversight and assistance of the designated county agent.

Signature of County Agent: _____ Date Approved: _____

Eligible for Grants-to-Counties cost share: ☐ Yes ☐ No (Determined by County Agent)

Complete one form for each well plugged and submit within 30 days to the local county agent:

OR, only if no county agent is available, to:

Water Supply Section
Iowa Department of Natural Resources
502 E 9th St
Des Moines IA 50319-0034

AQUAGUARD®

One-Sack Borehole Grouting Material

Description

AQUAGUARD is a single-sack grout containing granular Wyoming sodium bentonite blended with inorganic additives. The grout is designed for sealing the annular space around monitor or water well casing.

Applications/Functions

- Grout plastic and steel casings in monitor or water wells
- Seal downhole instruments in test and observation holes
- Aid in sealing of cathodic protection installations

Note: Not recommended for use as a cement additive

Advantages

- Does not contain any polymers
- Easy, one-sack, dust-free mixing
- Develops a 30% solids slurry weighing 10.1 lb/gal (1.21 g/cm^3) with a hydrostatic gradient of 0.525 psi/ft (11.88 kPa/meter)
- Flexible seal providing low permeability that prevents commingling of aquifers and entry of surface contaminants
- No heat of hydration, no damage to plastic casing due to temperature elevations
- NSF/ANSI Standard 60 certified

Typical Properties

Appearance	Tan to gray granules
Specific gravity	2.5
Slurry pH (8%)	8.0
Electrical Resistivity, ohms-meter	0.5
Yield Volume gal/sack (liters/sack)	16.3 (61.7)
Permeability (30% solids grout)	3.0 x 10^{-8} cm/sec (in fresh water)

Recommended Treatment

Add one 50-lb (22.7 kg) sack of AQUAGUARD into 14 gallons (53 liters) of circulating fresh water over a 20 to 30 second interval to make a 30% active solids slurry with slurry density of 10.1 lb/gal, or 1.21 g/cm^3. After adding AQUAGUARD, the slurry is ready to be placed, even though it may contain suspended, unyielded bentonite granules. Do not over mix and do not use a centrifugal pump. Immediately tremie the grout into place to allow the bentonite granules to hydrate and swell in situ.

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Additional Information

- The grouting method selected will depend upon, and you should carefully consider, all prevailing geological and hydrological factors and any existing regulatory requirements. The grouting process may not be complete until the grout is static at the desired level.

- The subsurface environment that the respective bentonite sealing material or grout is to be placed into should always be taken into consideration when selecting the appropriate material to compose the well seal. If the formation water chemistry has a total hardness of greater than or equal to 500 parts per million and/or a chloride content of greater than or equal to 1500 parts per million the use of a bentonite material may not be appropriate for this environment. In the event that questions regarding subsurface environments arise it is always best to consult your local Baroid IDP representative to determine if the Baroid product of choice is appropriate for the given conditions.

Packaging

AQUAGUARD® is packaged in 50-lb (22.7 kg) multiwall paper bags containing 0.7 ft^3 (0.02 m^3).

Availability

AQUAGUARD can be purchased through any Baroid Industrial Drilling Products Distributor. To locate the Baroid IDP distributor nearest you contact the Customer Service Department in Houston or your area IDP Sales Representative.

Baroid Industrial Drilling Products
Product Service Line, Halliburton
3000 N. Sam Houston Pkwy E.
Houston, TX 77032

Customer Service	(800) 735-6075 Toll Free	(281) 871-4612
Technical Service	(877) 379-7412 Toll Free	(281) 871-4613

BENSEAL®

Sealing and Plugging Agent

Description

BENSEAL is a granular (8-mesh), natural Wyoming sodium bentonite for use in sealing and grouting well casings and earthen structures. BENSEAL is not recommended for use as a drilling mud.

Applications/Functions

- Seal or grout plastic or steel casings in monitor and water well construction
- Seal or plug any earthen borehole
- Seal leaking ponds, ditches and dams
- Soil stabilization
- Prepare BENSEAL/EZ-MUD® and AQUA-GROUT™/BENSEAL grouting systems
- Prepare a dry grout of BENSEAL and sand, one-to-one ratio by volume, admixture

Advantages

- High swelling capacity to create a tight seal
- Granular, dust free, single-sack product
- No heat of hydration
- Prevents commingling of aquifers and contamination from surface
- Forms a flexible seal to protect casing from corrosive contaminants
- Allows for hole re-entry
- ANSI/NSF Standard 60 certified

Typical Properties

Appearance	Bluish to gray granules
Dry screen analysis	85% of 8 mesh
Bulk density, lb/ft^3	73.4 (as packaged)
Moisture, %	8 to 10
Specific gravity	2.6
Permeability	less than 1×10^{-8} cm/sec (in fresh water)

Recommended Treatment

As a casing drill and drive operation:

1. Dig a cone-shaped depression around casing. Depression should be 6 - 8 inches (152-203 mm) larger than the outside diameter of the casing and 2 - 3 feet (60-75 cm) deep.
2. Keep cone-shaped depression filled with dry BENSEAL while driving the casing.

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Recommended Treatment (continued)

Note:

When drilling and driving a 4" (102mm) pipe, expect to use 2.5 pounds of BENSEAL per foot of hole or 3.7 kilograms of BENSEAL per meter of hole.

BENSEAL/sand grout:

1. Combine BENSEAL and sand at a ratio of one-to-one by volume. Mix well.
2. This mixture can be poured from the top into holes not over 100 feet (30.5 meters) deep, and through 50 feet (15.3 meters) or less of standing water in the hole.

BENSEAL/sand is often used to set shallow casing, heat pumps, etc.

Note:
Sand particle size should be approximately equal to BENSEAL.

Sealing earthen structures:

1. Work BENSEAL into the top six inches (152 mm) of soil and compact it, completely covering the area that will be under water.

Normal treatment is between 3 to 5 pounds per square foot (14.5–24.5 kg/m^2), depending on the type of soil. If the leaking area can be identified and isolated, an attempt can be made to broadcast BENSEAL uniformly into the water over the area in question.

Lost returns (moderate):

1. Begin with the pit full of mud.
2. Raise the pump suction off bottom and place a shovel next to it and slightly under suction.
3. Pour dry BENSEAL slowly into the space between shovel and suction.
4. Pump it down the hole.

Packaging

BENSEAL is packaged in 50-lb (22.7 kg) multiwall paper bags, containing 0.7 ft^3 (0.02 m^3).

Availability

BENSEAL can be purchased through any Baroid Industrial Drilling Products Distributor. To locate the Baroid IDP distributor nearest you contact the Customer Service Department in Houston or your area IDP Sales Representative.

Baroid Industrial Drilling Products,
A Product and Service Line of Halliburton Energy Services, Inc.
3000 N. Sam Houston Pkwy. E.
Houston, TX 77032

Customer Service	(800) 735-6075 Toll Free	(281) 871-4612
Technical Service	(877) 379-7412 Toll Free	(281) 871-4613

R.W.SIDLEY THOMPSON SCALE

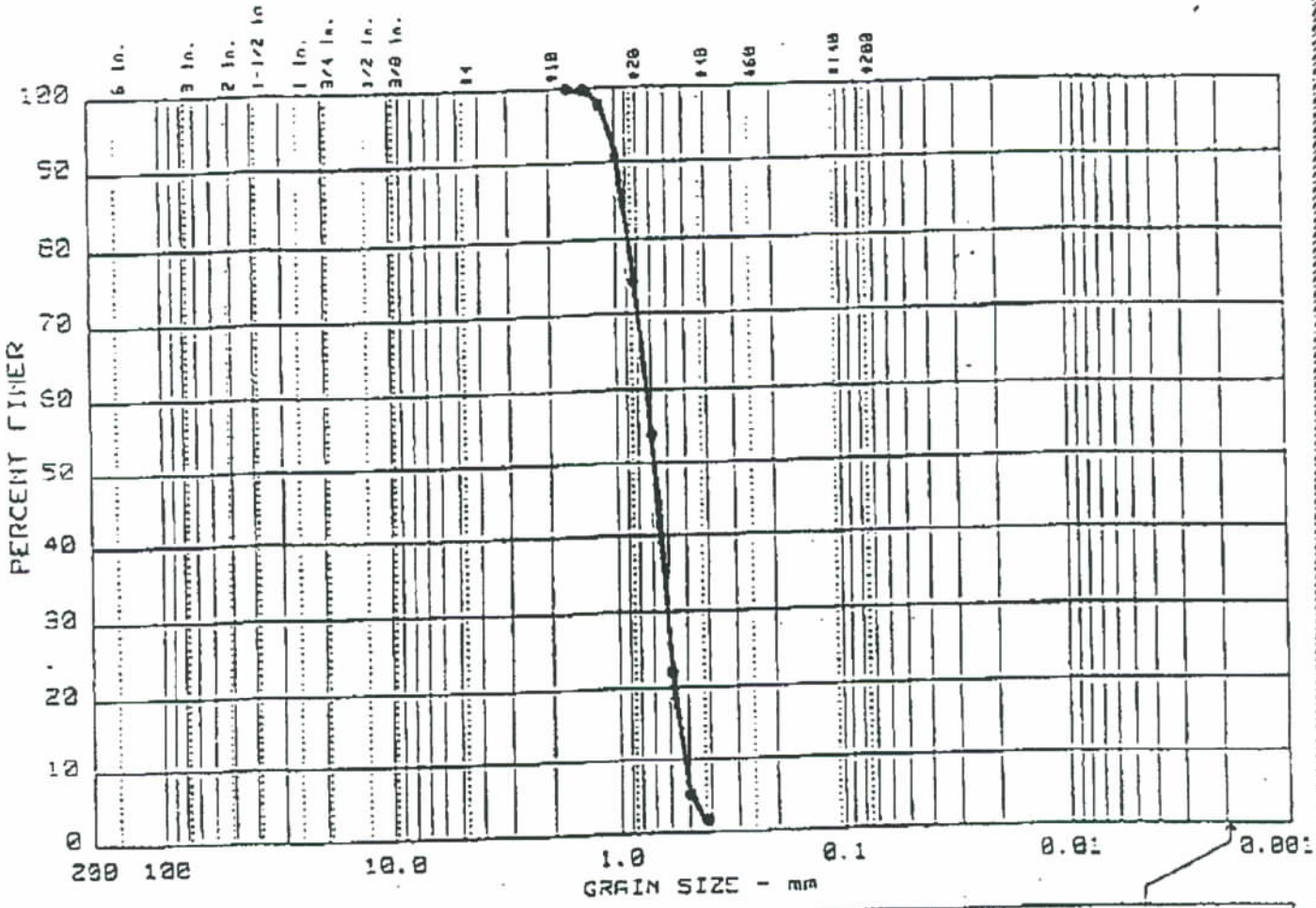
R. W. Sidley, Inc.

Typical #7 Well Pack Sand

Effective Size .5 mm (.45-.55)

20/40

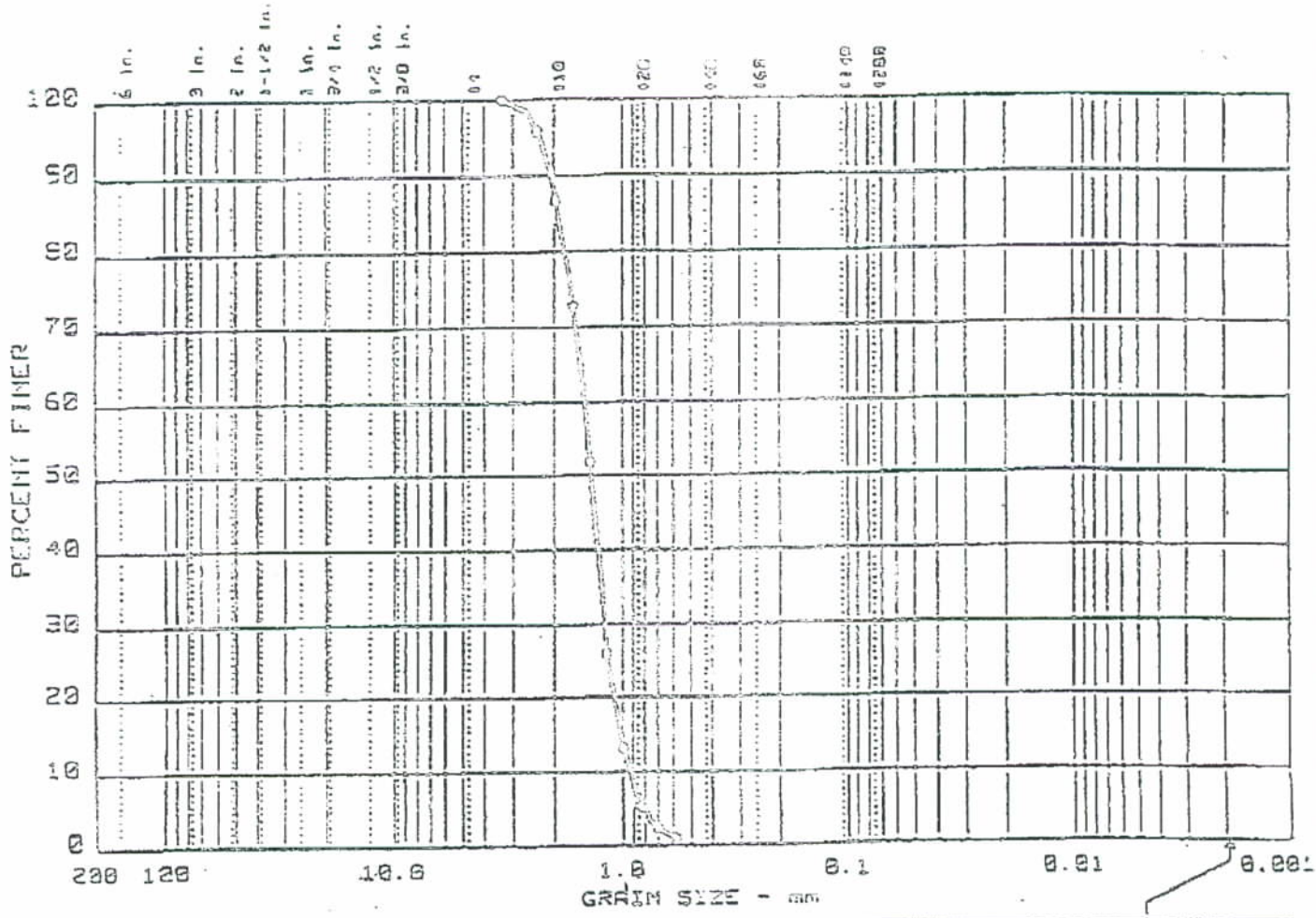
Grain Size Distribution Test



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
• 20	0.0	0.0	100.0		

Typical #5 Well Pack Sand
Effective Size 1.0 mm
Grain Size Distribution Test

1020 Sand



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
15	0.0	13.1	85.9		

R. W. Sidley, Inc. ○ P.O. Box 150 ○ 436 Casement Avenue ○ Painesville, Ohio
Local: 216-352-9343 ○ Cleveland: 216-951-5030 ○ Toll Free: 1-800-536-9343

Compliments of IES Drilling Supply
ASTM 5092

Recommended (Achievable) Filter Pack Characteristics for Common Screen Slot Sizes

Size of Screen Opening, mm (in)	Slot No.	Sand Pack Mesh Size Name(s)	1% Passing Size (D-1), mm	Effective Size (D-10), mm	30% Passing Size (D-30), mm	Range of Uniformity Coefficient	Roundness (Powers Scale)
0.125 (0.005)	5*	100	0.09 to 0.12	0.14 to 0.17	0.17 to 0.21	1.3 to 2.0	2 to 5
0.25 (0.010)	10	20 to 40	0.25 to 0.35	0.4 to 0.5	0.5 to 0.6	1.1 to 1.6	3 to 5
0.50 (0.020)	20	10 to 20	0.7 to 0.9	1.0 to 1.2	1.2 to 1.5	1.1 to 1.6	3 to 6
0.75 (0.030)	30	10 to 20	0.7 to 0.9	1.0 to 1.2	1.2 to 1.5	1.1 to 1.6	3 to 6
1.0 (0.040)	40	8 to 12	1.2 to 1.4	1.6 to 1.8	1.7 to 2.0	1.1 to 1.6	4 to 6
1.5 (0.060)	60	6 to 9	1.5 to 1.8	2.3 to 3.0	2.5 to 3.0	1.1 to 1.7	4 to 6
2.0 (0.080)	80	4 to 8	2.0 to 2.4	2.4 to 3.0	2.6 to 3.1	1.1 to 1.7	4 to 6

* A 5-slot (0.152-mm) opening is not currently available in slotted PVC but is available in Vee wire PVC and Stainless; 6-slot opening may be substituted in these cases.

6.3 Primary Filter Pack:

6.3.1 Materials—The primary filter pack (gravel pack) consists of a granular material of known chemistry and selected grain size and gradation that is installed in the annulus between the screen and the borehole wall. The filter pack is usually selected to have a 30% finer (d-30) grain size that is about 4 to 10 times greater than the 30% finer (d-30) grain size of the hydrologic unit being filtered. Usually, the filter is selected to have a low (that is, less than 2.5) uniformity coefficient. The grain size and gradation of the filter are selected to stabilize the hydrologic unit adjacent to the screen and permit only the finest soil grains to enter the screen during development. Thus, after development, a correctly filtered monitoring well is relatively turbid-free. *Note 3—When installing a monitoring well in Karst or highly fractured bedrock, the borehole configuration of void spaces within the formation surrounding the borehole is often unknown. Therefore, the installation of a filter pack becomes difficult and may not be possible.*

6.3.2 Gradation—The filter pack should be uniformly graded and comprised of hard durable siliceous particles washed and screened with a particle size distribution derived by multiplying the d-30 size of the finest-grained screened stratum by a factor between 4 and 10. Use a number between four and six as the multiplier if the stratum is fine and uniform; use a factor between six and ten where the material has highly nonuniform gradation and includes silt-sized particles. The grain-size distribution of the filter pack is then plotted using the d-30 size as the control point on the graph. The selected filter pack should have a uniformity coefficient of approximately 2.5 or less. *Note 4—This practice presents a design for monitoring wells that will be effective in the majority of aquifers. Applicable state guidance may differ from the designs contained in this practice. Note 5—Because the well screen slots have uniform openings, the filter pack should be composed of particles that are as uniform in size as is practical. Ideally, the uniformity coefficient (the quotient of the 60% passing, D-60 size divided by the 10% passing D-10 size {effective size}) of the filter pack should be 1.0 (that is, the D-60% and the D-10% sizes should be identical). However, a more practical and consistently achievable uniformity coefficient for all ranges of filter pack sizes is 2.5. This value of 2.5 should represent a maximum value, not an ideal. Note 6—Although not recommended as standard practice, often a project requires drilling and installing the well in one phase of work. Therefore, the filter pack materials must be ordered and delivered to the drill site before soil samples can be collected. In these cases the suggested well screen slot size and filter pack materials are presented in the table above.*

HOLEPLUG®

Graded Sodium Bentonite

Description

HOLEPLUG size-graded bentonite is a naturally occurring Wyoming sodium bentonite clay used to seal and plug earthen boreholes. HOLEPLUG is mined from specially selected ore bodies, which exhibit a high swelling capability. HOLEPLUG will fall through a standing column of water in the hole and reach the bottom with delayed hydration without bridging to the wall of the borehole. Complete fill of the annular space can be achieved, and bridging of the particles in the upper hole is minimized. Complete fill of the annular space is necessary to form an effective, long-term plug in compliance with environmental regulatory requirements.

HOLEPLUG is available in two particle size grades:

- HOLEPLUG 3/4" (100% of particles pass through 3/4" screen; all particles retained on 3/8" screen)
- HOLEPLUG 3/8" (100% of particles pass through 3/8" screen; all particles retained on 1/4" screen)

Applications/Functions

- Highly recommended for use in grouting annulus in all types of wells, particularly environmental monitoring well applications
- Seal above gravel packs
- Plug decommissioned boreholes
- Seal abandoned earthen cavities
- Seal around conductor pipe
- Seal lost circulation zones
- Shut off artesian flow

Advantages

- Prevents entry of surface water into boreholes
- High swelling potential
- In situ swelling to provide a superior seal with excellent casing stabilization
- Easier to apply than pellets
- Cost effective
- Simple to apply, mixing not required
- Prevents vertical movement of fluids in the hole between porous zones
- Forms a permanent, flexible downhole seal
- Allows hole reentry
- Rehydratable
- ANSI/NSF Standard 60 certified

Rev. 8/2000 · IDP 006

Typical Properties

Bulk density, lb/ft^3	
HOLEPLUG 3/4"	71.8 (as packaged)
HOLEPLUG 3/8"	68.8 (as packaged)
Volume of 50-lb (22.7 kg) sack	
HOLEPLUG 3/4"	0.73 ft^3 or 0.027 yd^3 or 0.021 m^3
HOLEPLUG 3/8"	0.70 ft^3 or 0.026 yd^3 or 0.020 m^3
Moisture	17%
Permeability	1.5 x 10^{-9} cm/sec (in fresh water)
Appearance	Beige to tan chips
Specific gravity	2.6

Recommended Treatment

Plugging and Stemming Drill Holes

Due to shipping and handling, a small amount of fine bentonite particles may be present. For optimum results, HOLEPLUG should be poured over a mesh or screen with ¼" (6.4 mm) openings to "sift out" the smaller particles. The screen should be large enough (approx.1 yd^2 or 1m^2) to be folded into a "V" shape to allow sifting while the product is being poured into the hole. Also, HOLEPLUG should be poured slowly. Allow approximately two minutes to pour a 50-lb
(22.7 kg) bag.

1. Position the screen with the lower end placed over the borehole
2. Slowly pour HOLEPLUG down the "V" so that fine particles fall through the screen before the larger particles fall into the borehole
3. Fill hole as required (above static water level or to ground level)
4. Observe all regulatory specifications

Stopping loss of circulation and stabilizing unconsolidated formations

1. Pull drill pipe out of hole
2. Pour HOLEPLUG into hole to fill above problem zone
3. Drill ahead slowly with reduced pump pressure

Plugging flowing wells

Pour HOLEPLUG into hole until water flow subsides or hole is filled to surface.

Application Amounts

Amounts of HOLEPLUG Required for Plugging Applications				
Hole Diameter (inches)	Hole Volume (ft^3/ft)	Pounds HOLEPLUG Needed to Fill One Foot	Feet Filled by One Bag HOLEPLUG	Bags HOLEPLUG Needed to Fill 100 ft
2	0.022	1.6	32.6	3.2
2.5	0.034	2.4	20.5	5.0
3	0.049	3.5	14.3	7.0
3.5	0.067	4.8	10.4	9.6
4	0.087	6.3	7.9	12.6
4.5	0.110	7.9	6.3	15.8
5	0.136	9.8	5.1	19.6
5.5	0.165	11.9	4.2	23.8
6	0.196	14.1	3.5	28.2
6.5	0.230	16.6	3.0	33.2
7	0.267	19.2	2.6	38.4
7.5	0.307	22.1	2.3	44.2
8	0.349	25.1	2.0	50.2
8.5	0.394	28.4	1.8	56.8
9	0.442	31.8	1.6	63.6
9.5	0.492	35.4	1.4	70.8
10	0.545	39.2	1.3	78.4
11	0.660	47.5	1.1	95.0
12	0.785	56.5	0.89	113.0
15	1.227	88.3	0.57	176.6
18	1.767	127.2	0.39	254.4
20	2.182	157.1	0.32	314.2
25	3.409	245.4	0.20	490.8
30	4.909	353.4	0.14	706.8

Application Amounts (metric equivalents)

Amounts of HOLEPLUG Required for Plugging Applications				
Hole Diameter (mm)	Hole Volume (m^3/m)	Kilograms HOLEPLUG Needed to Fill One Meter	Meters Filled by One Bag HOLEPLUG	Bags HOLEPLUG Needed to Fill 10 meters
51	0.002	2.3	9.87	1.0
64	0.003	3.6	6.31	1.6
76	0.005	5.2	4.38	2.3
89	0.006	7.0	3.22	3.1
102	0.008	9.2	2.47	4.1
114	0.010	11.6	1.95	5.1
127	0.013	14.4	1.58	6.3
140	0.015	17.4	1.30	7.7
152	0.018	20.7	1.10	9.1
165	0.021	24.3	0.93	10.7
178	0.025	28.2	0.81	12.4
191	0.029	32.4	0.70	14.3
203	0.032	36.8	0.62	16.2
216	0.037	41.6	0.55	18.2
229	0.041	46.6	0.49	20.5
241	0.046	51.9	0.44	22.9
254	0.051	57.5	0.39	25.3
279	0.061	69.6	0.33	30.7
305	0.073	82.8	0.27	36.5
381	0.114	129.4	0.18	57.0
457	0.164	186.4	0.12	82.1
508	0.203	230.1	0.10	101.4
635	0.317	359.5	0.06	158.4
762	0.456	517.7	0.04	228.1

Packaging

HOLEPLUG graded bentonite is packaged in 50-lb (22.7 kg) multiwall paper bags.

Availability

HOLEPLUG can be purchased through any Baroid Industrial Drilling Products Distributor. To locate the Baroid IDP distributor nearest you contact the Customer Service Department in Houston or your area IDP Sales Representative.

Baroid, a Halliburton Company
Industrial Drilling Products
3000 N. Sam Houston Pkwy E.
Houston, TX 77032

Customer Service	(800) 735-6075 Toll Free	(281) 871-4612
Technical Service	(877) 379-7412 Toll Free	(281) 871-4613

PVC PIPE SPECIFICATIONS

PVC Schedule 40

Nominal Pipe Size (in.)	O.D.	Average I.D.	Min. Wall	Nominal Wt./ft.	Max. W./P. PSI*
1/8	.405	.261	.068	.045	810
1/4	.540	.354	.088	.081	780
3/8	.675	.483	.091	.109	620
1/2	.840	.608	.109	.161	600
3/4	1.050	.810	.113	.214	480
1	1.315	1.033	.133	.315	450
1 1/4	1.660	1.364	.140	.426	370
1 1/2	1.900	1.592	.145	.509	330
2	2.375	2.049	.154	.682	280
2 1/2	2.875	2.445	.203	1.076	300
3	3.500	3.042	.216	1.409	260
3 1/2	4.000	3.520	.226	1.697	240
4	4.500	3.998	.237	2.006	220
5	5.563	5.017	.258	2.726	190
6	6.625	6.031	.280	3.535	180
8	8.625	7.943	.322	5.305	160
10	10.750	9.976	.365	7.532	140
12	12.750	11.890	.406	9.949	130
14	14.000	13.072	.437	11.810	130
16	16.000	14.940	.500	15.416	130
18	18.000	16.809	.562	20.112	130
20	20.000	18.743	.593	23.624	120
24	24.000	22.544	.687	32.873	120

PVC Schedule 80

Nominal Pipe Size (in.)	O.D.	Average I.D.	Min. Wall	Nominal Wt./ft.	Max. W./P. PSI*
1/8	.405	.203	.095	.058	1230
1/4	.540	.288	.119	.100	1130
3/8	.675	.407	.126	.138	920
1/2	.840	.528	.147	.202	850
3/4	1.050	.724	.154	.273	690
1	1.315	.935	.179	.402	630
1 1/4	1.660	1.256	.191	.554	520
1 1/2	1.900	1.476	.200	.673	470
2	2.375	1.913	.218	.932	400
2 1/2	2.875	2.289	.276	1.419	420
3	3.500	2.864	.300	1.903	370
3 1/2	4.000	3.326	.318	2.322	350
4	4.500	3.786	.337	2.782	320
5	5.563	4.767	.375	3.867	290
6	6.625	5.709	.432	5.313	280
8	8.625	7.565	.500	8.058	250
10	10.750	9.492	.593	11.956	230
12	12.750	11.294	.687	16.437	230
14	14.000	12.410	.750	19.790	220
16	16.000	14.214	.843	25.430	220
18	18.000	16.014	.937	31.830	220
20	20.000	17.814	1.031	40.091	220
24	24.000	21.418	1.218	56.882	210

PVC Schedule 120

Nominal Pipe Size (in.)	O.D.	Average I.D.	Min. Wall	Nominal Wt./ft.	Max. W./P. PSI*
1/2	.84	.480	.170	.223	1010
3/4	1.050	.690	.170	.295	770
1	1.315	.891	.200	.440	720
1- 1/4	1.660	1.204	.215	.614	600
1 -1/2	1.900	1.423	.225	.744	540
2	2.375	1.845	.250	1.052	470
2 -1/2	2.875	2.239	.300	1.529	470
3	3.500	2.758	.350	2.184	440
4	4.500	3.572	.437	3.516	430
6	6.625	5.434	.562	6.759	370

SDR 21 - W.P. 200 PSI (Water @ 73.4°F.)

Nominal Pipe Size (in.)	O.D.	Average I.D.	Min. Wall	Nominal Wt./ft.
3/4	1.050	.910	.060	.129
1	1.315	1.169	.063	.170
1 1/4	1.660	1.482	.079	.263
1 1/2	1.900	1.700	.090	.339
2	2.375	2.129	.113	.521
2 1/2	2.875	2.581	.137	.754
3	3.500	3.146	.167	1.106
3 1/2	4.000	3.596	.190	1.443
4	4.500	4.046	.214	1.825
5	5.563	5.001	.265	2.792
6	6.625	5.955	.316	3.964
8	8.625	7.755	.410	6.679

SDR 26 - W.P. 160 PSI (Water @ 73.4°F.)

Nominal Pipe Size (in.)	O.D.	Average I.D.	Min. Wall	Nominal Wt./ft.
1	1.315	1.175	.060	.164
1 1/4	1.660	1.512	.064	.221
1 1/2	1.900	1.734	.073	.284
2	2.375	2.173	.091	.432
2 1/2	2.875	2.635	.110	.622
3	3.500	3.210	.135	.915
3 1/2	4.000	3.672	.154	1.183
4	4.500	4.134	.173	1.494
5	5.563	5.109	.214	2.288
6	6.625	6.085	.255	3.228
8	8.625	7.921	.332	5.468
10	10.750	9.874	.413	8.492
12	12.750	11.710	.490	11.956
14	14.000	12.860	.538	14.430
16	16.000	14.696	.615	18.810
18	18.000	16.534	.692	23.860
20	20.000	18.370	.769	29.470
24	24.000	22.043	.923	42.520

CLEAR PVC Schedule 40

Nominal Pipe Size (in.)	O.D.	Average I.D.	Min. Wall	Nominal Wt./ft.	Max. W./P. PSI*
1/4	.540	.354	.088	.081	390
3/8	.675	.483	.091	.109	310
1/2	.840	.608	.109	.161	300
3/4	1.050	.810	.113	.214	240
1	1.315	1.033	.133	.315	220
1 1/4	1.660	1.364	.140	.429	180
1 1/2	1.900	1.592	.145	.509	170
2	2.375	2.049	.154	.682	140
2 1/2	2.875	2.445	.203	1.076	150
3	3.500	3.042	.216	1.409	130
3 1/2	4.000	3.520	.226	1.697	120
4	4.500	3.998	.237	2.006	110
6	6.625	6.031	.280	3.535	90
6 x 1/8	6.625	6.355	.125	1.647	45
8	8.625	7.943	.322	5.305	80

*** Note:** All pressure ratings are for water at 73.4° with solvent cemented joints.

Bell and Gasket PVC Pipe is available in Schedules 40, 80, 120 and SDR's 21, 26, 35, 41 and C-900.
Compounds used in the manufacture of PVC and CPVC Pipe meet ASTM Standard D-1784.
Schedules 40, 80 and 120 PVC Pipe meet ASTM Standard D-1785.
Pressure Rated (SDR Series) PVC Pipe meets ASTM Standard D-2241.
ASTM Standard D-1784 classification equivalents:
PVC Normal Impact = Type I Grade I = PVC 1120 = Cell Classification 12454-B
For more complete information, request "Condensed Catalog HPB-103-A&B"

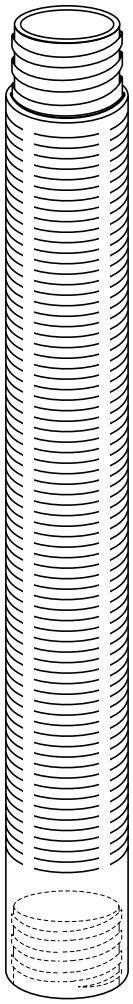
FLUSH THREAD PVC SCREEN AND CASING

- ✓ Monoflex CNC computer lathed flush threads follow ASTM F-480 recommendations for reliable, consistent results on the job site.
- ✓ Our close tolerances provide a strong connection while retaining ease of assembly.
- ✓ Manufactured from quality PVC pipe; Monoflex flush thread screens and casings are available in diameters of 1/2" through 12" with 2, 4, or 8 threads per inch stocked in schedules 40 & 80. Other schedules and SDR's are available in PVC and high density polyethylene.
- ✓ Laying length is standard for 2" and 4" schedule 40 PVC. Other sizes are end to end length. Custom lengths are available in all diameters.
- ✓ All standard Monoflex PVC threads are compatible with other materials threaded to ASTM F-480 recommendations, with the same TPI.
- ✓ All standard screens provide maximum net open area. A wide variety of slot sizes and spacings are available to adapt to various site conditions and applications.
- ✓ 2" and 4" schedules 40 and 80 screens and casings are supplied with Buna-N O-rings at no additional charge. Buna-N O-rings are available for all other sizes for a nominal charge.
- ✓ All flush thread screens and casings are Enviro-wrapped and hermetically sealed at both ends as a standard practice.

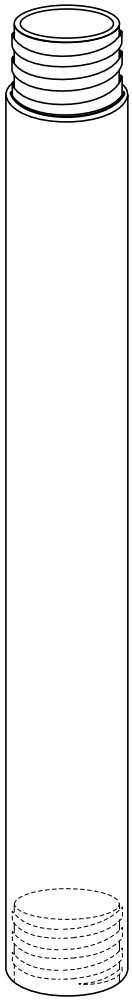
PLEASE SPECIFY PART NUMBER WHEN ORDERING.

The following pages list flush thread PVC screens and casings along with the appropriate Buna-N O-rings, and flush thread caps, plugs, and points.

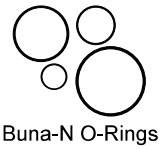
Custom lengths, threads and adapters available.



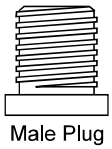
Flush Thread Screen



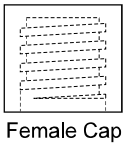
Flush Thread Casing



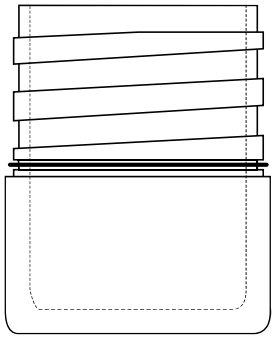
Buna-N O-Rings



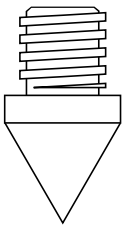
Male Plug (solid)



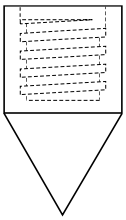
Female Cap (solid)



Male Plug (molded)



Male Point (solid)



Female Point (solid)

ENGINEERING SPECIFICATIONS

PVC FLUSH THREAD MONITOR WELL SCREENS AND CASINGS

1. All PVC well screens and casings used on this project shall be manufactured by Monoflex and conform to ASTM F-480: "Standard Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80."
2. PVC materials used to produce the raw PVC pipe shall meet ASTM Standard D-1784: "Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds for PVC Normal Impact, Type I Grade I (1120), cell classification 12454-B."
3. The finished schedules 40, 80, and 120 raw pipe shall meet the requirements of ASTM Standard D-1785: "Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120." In addition, both the raw material and the finished raw pipe shall be approved by the National Sanitation Foundation (NSF) for use in potable water applications.
4. The PVC pipe used to produce the well screens and casings shall be made from virgin plastic produced by the original compounder.
5. The pipe shall be homogeneous throughout and essentially uniform in color, opacity and density. The inside and outside surfaces shall be glossy in appearance and free of chalking, sticky or tacky material and visually free of oils, grease, dust and marks imparted as a result of the manufacturing process. In addition the pipe walls shall be free of cracks, holes, blisters, voids, foreign inclusion, or other defects that are visible to the naked eye and that may affect the wall integrity. Machined slots or holes deliberately placed in the pipe are acceptable.
6. The outside diameters, wall thicknesses and out of roundness tolerances shall fall within the guidelines of Tables 1 & 2 of the ASTM F-480 Standard Specification when measured in accordance with Test Method D-2122.
7. All flush thread materials must be slotted and threaded without the use of any type of liquid coolant. Air is the only acceptable coolant.
8. Well screens 1/2" through 5" are to be slotted on 1/8" spacing. Well screens 6" and larger are to be slotted on 1/4" spacing unless otherwise specified. ALL well screens .040 slot and larger will be slotted on 1/4" spacing unless otherwise specified.
9. All screens and casings shall be nominal length except for 2" and 4" schedule 40 which shall be laying length. The term "laying length" refers to the overall length less the length required to complete the assembly. Nominal length + the length of the exposed male thread (pin) = laying length.
10. The threads per inch for the various diameters and schedules of flush thread materials shall be the same as that produced by Monoflex, Largo, Florida or approved equal.
11. All screens and casings shall be supplied in individual polyethylene bags hermetically sealed at BOTH ends. Said products shall be shipped in cardboard boxes with properly secured ends. Each box shall display a color coded label containing a full description of the product inside. Said label must indicate the number pieces per box, the threads per inch, the date of packaging, the signatures of the packer and QC inspector and show a drawing of the product.

MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name Muscatine P & W CCR Landfill Permit # 70 -SDP-6- 82 P
Well or Piezometer # 91MW-8 Date started 07-16-91 Date completed 07-16-91

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site SW-Sect. 16
distance and direction
along boundary
10,103 feet north
Distance and direction
from boundary to well
3,615 feet east

Elevations (±0.01 ft. MSL):
Ground surface 744.37
* Top of protective casing 747.76
Top of well casing 747.41
Benchmark elevation 747.23
Benchmark description BM-2
RR Spike in Hollow Tree

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
R.R. 2, Box 18
Iowa City, IA 52242
Name of driller Joel Johnson
Drilling method Hollow Stem Auger
Drilling fluid N/A
Bore hole diameter 9"
Soil sampling method Laskey-Continuous
Depth of boring 41.0 feet

C. Monitoring Well Installation

Casing material Schedule 40 PVC
Length of casing 32.5 feet
Outside casing diameter 2.375"
Inside casing diameter 2.00"
Casing joint type Flush Threaded
Casing/screen joint type Flush threaded
Screen material Schedule 40 PVC
Screen opening size 0.010"
Screen length 10.0 feet
Depth of well 42.5 feet

Well Installation, continued:

Filter pack:
Material Muscatine #1 Sand Pack
Grain size 0.093"
Volume 5.125 cu. ft.
Seal (minimum 3 ft. length above filter pack):
Material Benseal grout
Placement method Tremie Tube
Volume 9.635 cu. ft.

Backfill (if different from seal):
Material None
Placement Method
Volume

Surface seal design:
Material of protective casing:
Steel (set in concrete)
Material of grout between protective casing and well casing:
Granular Bentonite
Protective cap:
Material Steel (not airtight)
Vented? Y/N Locking? Y/N Y
Well cap:
Material PVC, Neoprene, Stainless
Vented? Y/N N steel

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing)
Stabilization time
Well development method Pnuematic bailer, used until water is clear

Upgradient or downgradient well? (see piezometric map from Hydrogeologic study)
Average depth of frostline 30.0"

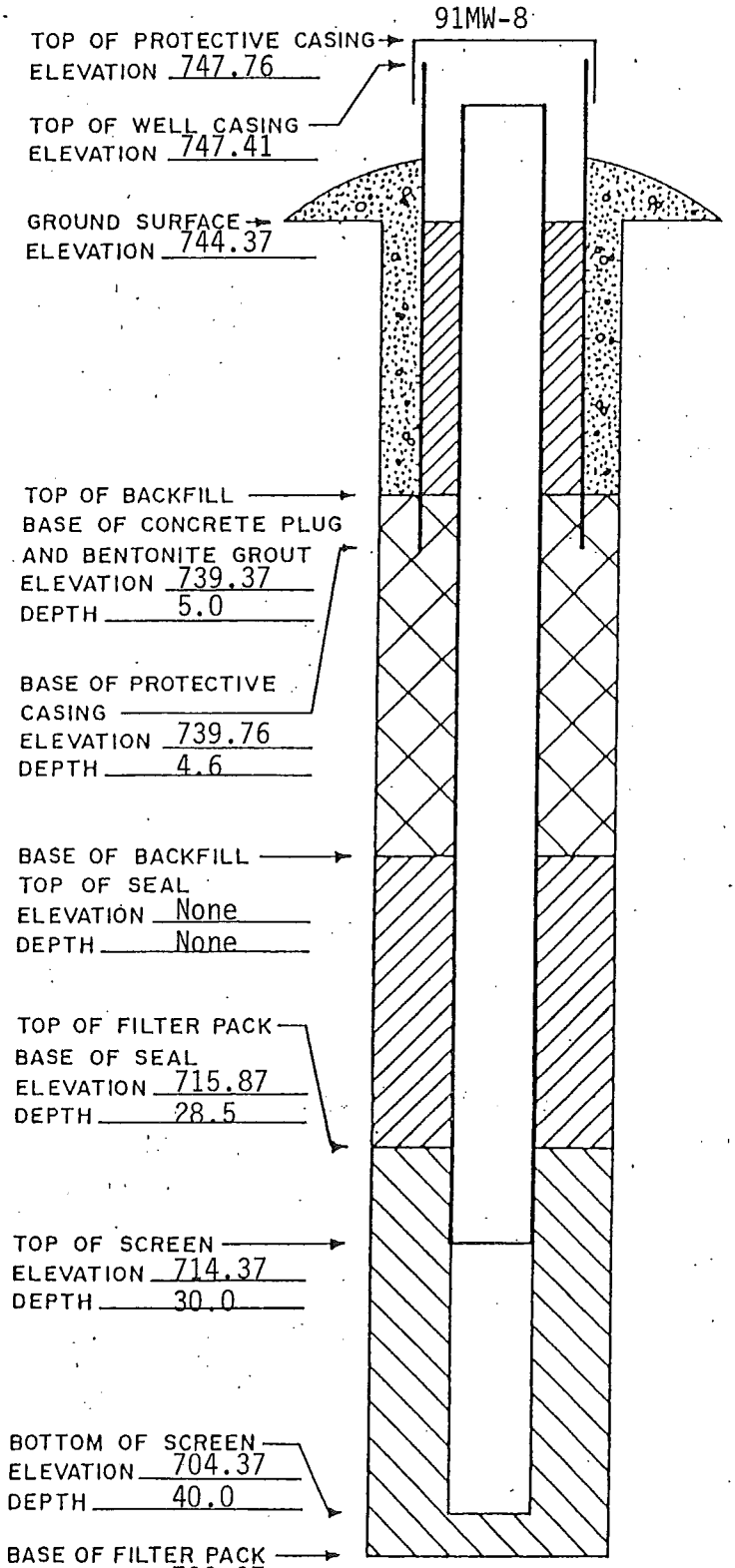
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring wells and piezometers.

Form #542-1277

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTER\



MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name Muscatine P & W CCR Landfill Permit # 70 -SDP-6- 82 P
Well or Piezometer # 91MW-9 Date started 07-15-91 Date completed 07-16-91

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site SW-Sect. 16
distance and direction
along boundary
10,110 feet north
Distance and direction
from boundary to well
3,616 feet east

Elevations (±0.01 ft. MSL):
Ground surface 744.44
* Top of protective casing 747.50
Top of well casing 747.18
Benchmark elevation 747.23
Benchmark description BM-2
RR Spike in Hollow Tree

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
R.R. 2, Box 18
Iowa City, IA 52242
Name of driller Joel Johnson
Drilling method Hollow Stem Auger
Drilling fluid N/A
Bore hole diameter 9"
Soil sampling method Laskey-Continuous
Depth of boring 60.0 feet

C. Monitoring Well Installation

Casing material Schedule 40 PVC
Length of casing 48.5 feet
Outside casing diameter 2.375"
Inside casing diameter 2.00"
Casing joint type Flush Threaded
Casing/screen joint type Flush threaded
Screen material Schedule 40 PVC
Screen opening size 0.010"
Screen length 10.0 feet
Depth of well 58.5 feet

Well Installation, continued:

Filter pack:
Material Muscatine #1 Sand Pack
Grain size 0.093"
Volume 5.125 cu. ft.
Seal (minimum 3 ft. length above filter pack):
Material Benseal grout
Placement method Tremie Tube
Volume 16.195 cu. ft.

Backfill (if different from seal):
Material None
Placement Method
Volume

Surface seal design:
Material of protective casing:
Steel (set in concrete)
Material of grout between protective casing and well casing:
Granular Bentonite
Protective cap:
Material Steel (not airtight)
Vented? Y/N Locking? Y/N Y
Well cap:
Material PVC, Neoprene, Stainless
Vented? Y/N N steel

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing)
Stabilization time
Well development method Pnuematic bailer, used until water is clear

Upgradient or downgradient well? (see piezometric map from Hydrogeologic study)
Average depth of frostline 30.0"

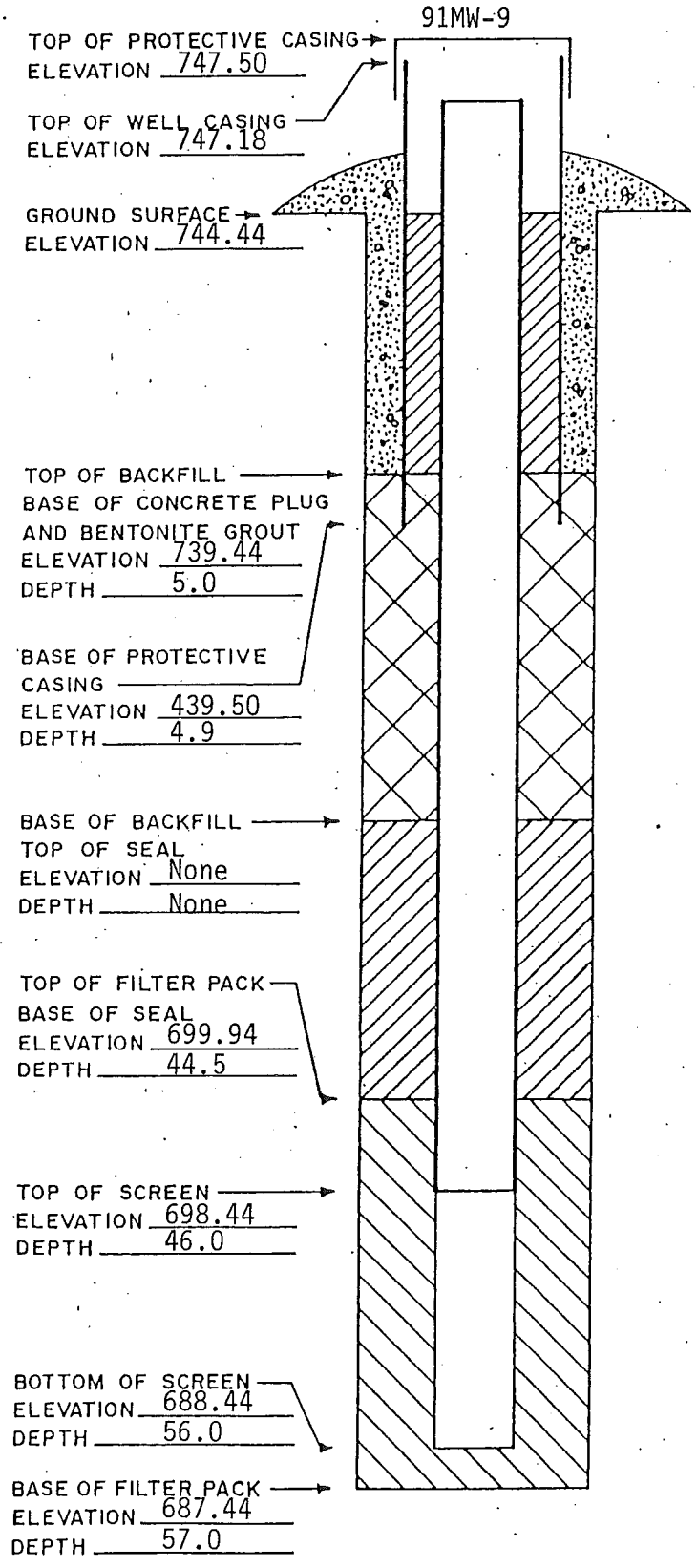
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring wells and piezometers.

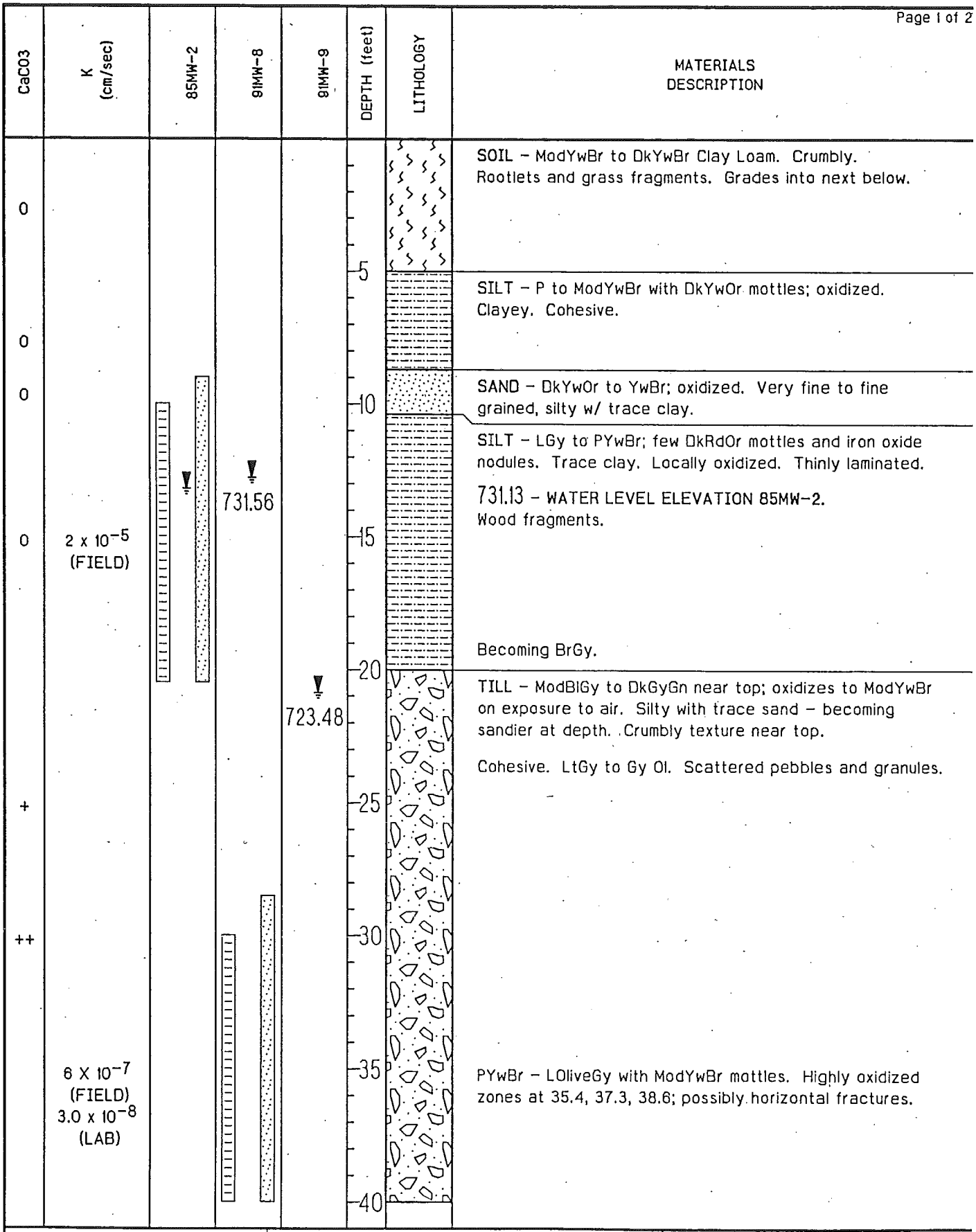
Form #542-1277

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTER\





Green Environmental Services, Inc.

PROJECT Muscatine P&W CCR Landfill

PROJECT NUMBER 705910

SURFACE ELEVATION 744.44 Feet MSL

TOTAL DEPTH OF HOLE 60.0 Feet

LOG OF MW-2, MW-8, MW-9

WATER LEVELS ON October 8, 1991

GEOLOGIST S. Leimkuehler

CaCO3	K (cm/sec)	85MW-2	91MW-8	91MW-9	DEPTH (feet)	LITHOLOGY	MATERIALS DESCRIPTION
++	1×10^{-6} (FIELD)				45, 50, 55, 60, 65, 70, 75, 80		LBrGy to Med LGy; completely unoxidized.
++							SILT - LtGy. Clayey, unoxidized, thinly laminated.
							Bottom of boring.

Green Environmental Services, Inc.

PROJECT Muscatine P&W CCR Landfill

PROJECT NUMBER 705910

SURFACE ELEVATION 744.44 Feet MSL

TOTAL DEPTH OF HOLE 60.0 Feet

LOG OF MW-2, MW-8, MW-9

WATER LEVELS ON October 8, 1991

GEOLOGIST S. Leimkuehler

MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name Muscatine P & W CCR Landfill Permit # 70 -SDP-6- 82 P
Well or Piezometer # 91MW-10 Date started 07-15-91 Date completed 07-15-91

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site SW-Sect. 16
distance and direction
along boundary
11,312 feet north
Distance and direction
from boundary to well
3,625 feet east

Elevations (±0.01 ft. MSL):
Ground surface 716.32
* Top of protective casing 718.69
Top of well casing 718.31
Benchmark elevation 728.72
Benchmark description BM-1
RR Spike in Oak Tree

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
R.R. 2, Box 18
Iowa City, IA 52242
Name of driller Joel Johnson
Drilling method Hollow Stem Auger
Drilling fluid N/A
Bore hole diameter 9"
Soil sampling method Laskey-Continuous
Depth of boring 19.0 feet

C. Monitoring Well Installation

Casing material Schedule 40 PVC
Length of casing 10.0 feet
Outside casing diameter 2.375"
Inside casing diameter 2.00"
Casing joint type Flush Threaded
Casing/screen joint type Flush threaded
Screen material Schedule 40 PVC
Screen opening size 0.010"
Screen length 10.0 feet
Depth of well 20.0 feet

Well Installation, continued:

Filter pack:
Material Muscatine #1 Sand Pack
Grain size 0.093"
Volume 5.125 cu. ft.
Seal (minimum 3 ft. length above filter pack): *Exception granted*
Material Benseal grout
Placement method Poured
Volume 0.615 cu. ft.

Backfill (if different from seal):
Material None
Placement Method
Volume

Surface seal design:
Material of protective casing:
Steel (set in concrete)
Material of grout between protective casing and well casing:
Granular Bentonite
Protective cap:
Material Steel (not airtight)
Vented? Y/N Locking? Y/N Y
Well cap:
Material PVC, Neoprene, Stainless
Vented? Y/N N steel

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing)
Stabilization time
Well development method Pnuematic bailer, used until water is clear

Upgradient or downgradient well? (see piezometric map from Hydrogeologic study)
Average depth of frostline 30.0"

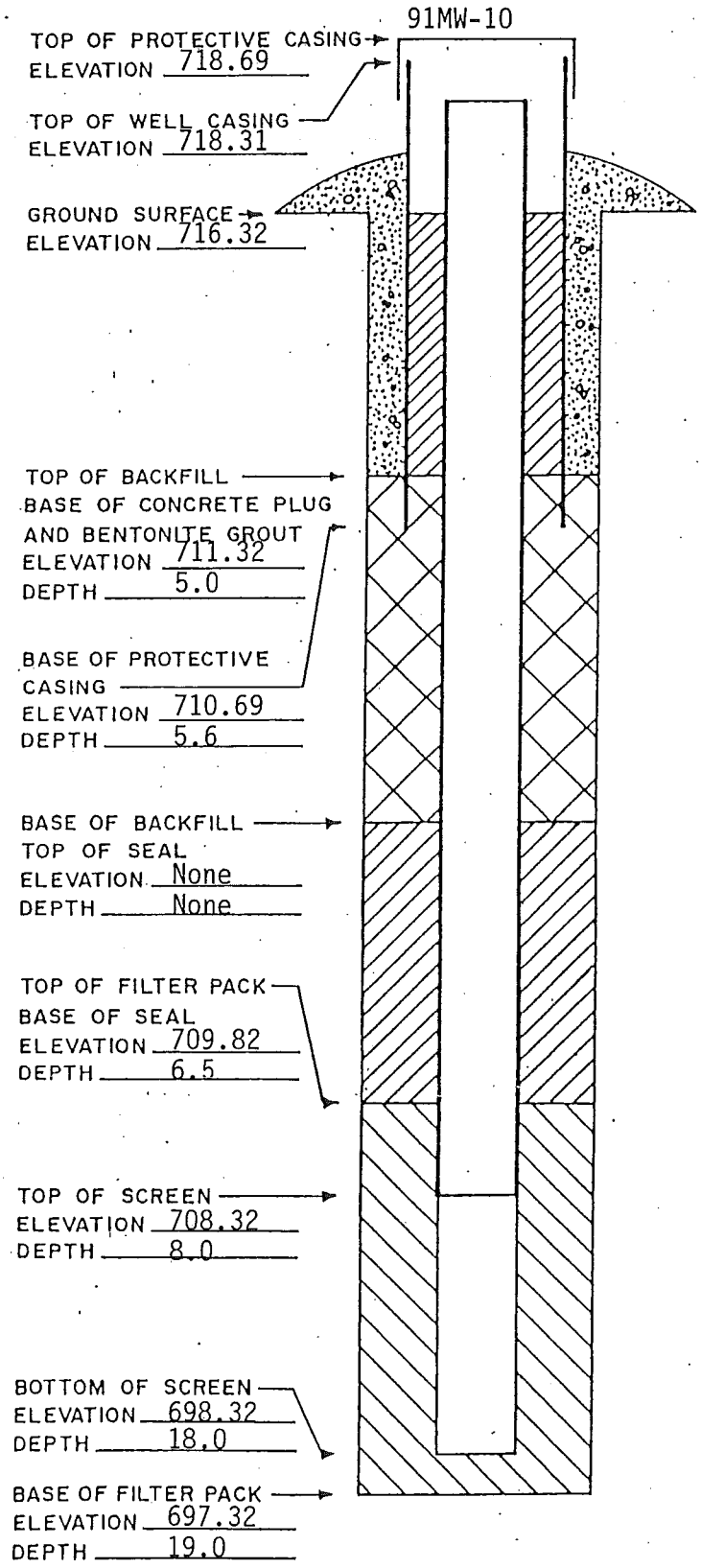
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring wells and piezometers.

Form #542-1277

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTER'



MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name Muscatine P & W CCR Landfill Permit # 70 -SDP-6- 82 P
Well or Piezometer # 91MW-11 Date started 07-12-91 Date completed 07-12-91

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site SW-Sect. 16
distance and direction
along boundary
11,306 feet north
Distance and direction
from boundary to well
3,624 feet east

Elevations (±0.01 ft. MSL):
Ground surface 716.02
* Top of protective casing 718.63
Top of well casing 718.29
Benchmark elevation 728.72
Benchmark description BM-1
RR Spike in Oak Tree

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
R.R. 2, Box 18
Iowa City, IA 52242
Name of driller Joel Johnson
Drilling method Hollow Stem Auger
Drilling fluid N/A
Bore hole diameter 9"
Soil sampling method Laskey-Continuous
Depth of boring 55.0 feet

C. Monitoring Well Installation

Casing material Schedule 40 PVC
Length of casing 45.0 feet
Outside casing diameter 2.375"
Inside casing diameter 2.00"
Casing joint type Flush Threaded
Casing/screen joint type Flush threaded
Screen material Schedule 40 PVC
Screen opening size 0.010"
Screen length 10.0 feet
Depth of well 56.5 feet

Well Installation, continued:

Filter pack:
Material Muscatine #1 Sand Pack
Grain size 0.093"
Volume 4.715 cu. ft.
Seal (minimum 3 ft. length above filter pack):
Material Benseal grout
Placement method Tremie Tube
Volume 5.125 cu. ft.

Backfill (if different from seal):
Material None
Placement Method
Volume

Surface seal design:
Material of protective casing:
Steel (set in concrete)
Material of grout between protective casing and well casing:
Granular Bentonite
Protective cap:
Material Steel (not airtight)
Vented? Y/N Locking? Y/N Y
Well cap:
Material PVC, Neoprene, Stainless
Vented? Y/N N steel

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing)
Stabilization time
Well development method Pnuematic bailer, used until water is clear

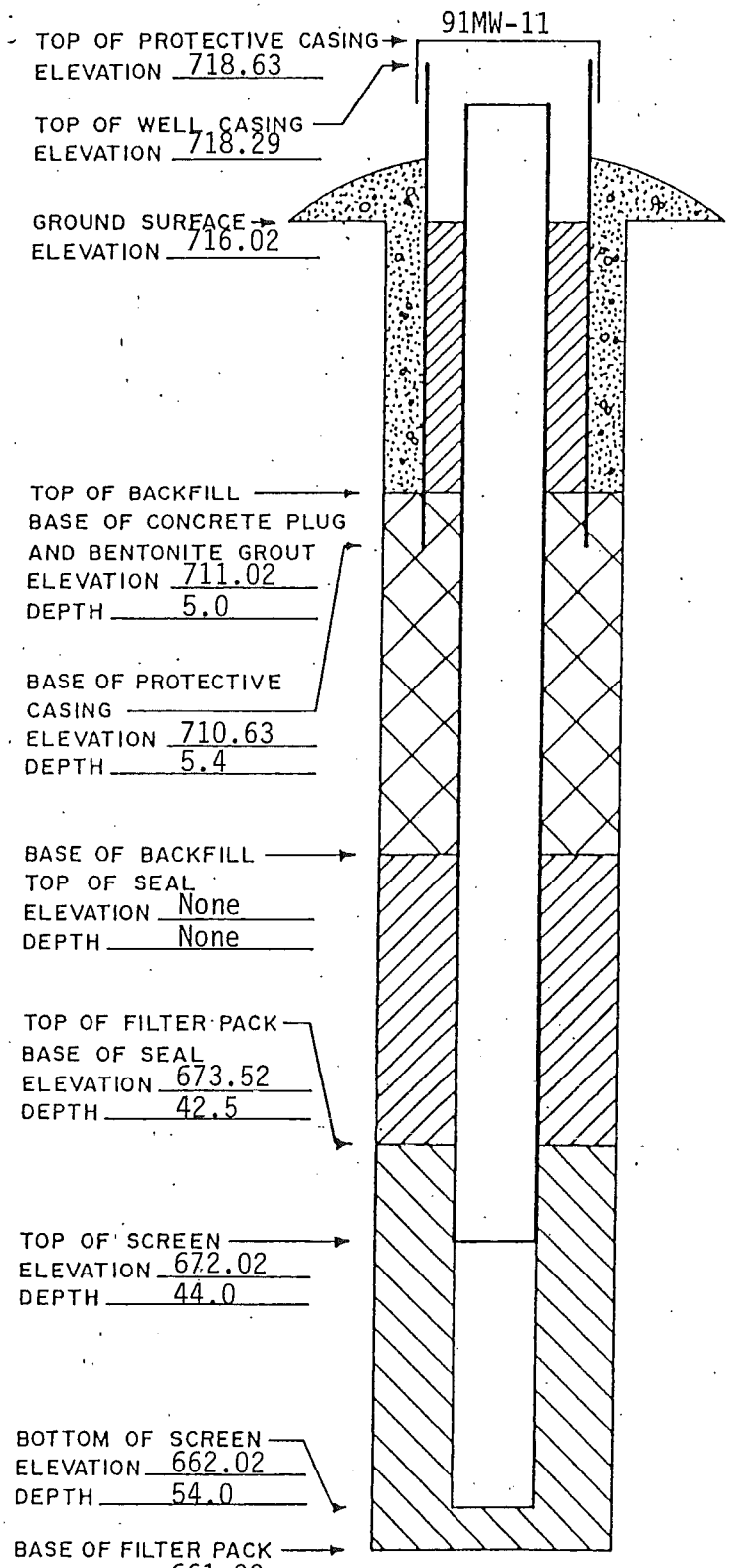
Upgradient or downgradient well? (see piezometric map from Hydrogeologic study)
Average depth of frostline 30.0"

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring wells and piezometers.

Form #542-1277

ELEVATIONS: ± 0.01 FT. MSL
DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTER'



MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name Muscatine P & W CCR Landfill Permit # 70 -SDP-6- 82 P
Well or Piezometer # 91MW-12 Date started 07-11-91 Date completed 07-12-91

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site SW-Sect. 16
distance and direction
along boundary
11,299 feet north
Distance and direction
from boundary to well
3,624 feet east

Elevations (±0.01 ft. MSL):
Ground surface 715.36
* Top of protective casing 718.13
Top of well casing 717.78
Benchmark elevation 728.72
Benchmark description BM-1
RR Spike in Oak Tree

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
R.R. 2, Box 18
Iowa City, IA 52242
Name of driller Joel Johnson
Drilling method Hollow Stem Auger
Drilling fluid N/A
Bore hole diameter 9"
Soil sampling method Laskey-Continuous
Depth of boring 85.0 feet

C. Monitoring Well Installation

Casing material Schedule 40 PVC
Length of casing 81.5 feet
Outside casing diameter 2.375"
Inside casing diameter 2.00"
Casing joint type Flush Threaded
Casing/screen joint type Flush threaded
Screen material Schedule 40 PVC
Screen opening size 0.010"
Screen length 5.0 feet
Depth of well 86.5 feet

Well Installation, continued:

Filter pack:
Material Muscatine #1 Sand Pack
Grain size 0.093"
Volume 3.075 cu. ft.
Seal (minimum 3 ft. length above filter pack):
Material Benseal grout
Placement method Tremie Tube
Volume 29.725 cu. ft.

Backfill (if different from seal):
Material None
Placement Method
Volume

Surface seal design:
Material of protective casing:
Steel (set in concrete)
Material of grout between protective casing and well casing:
Granular Bentonite
Protective cap:
Material Steel (not airtight)
Vented? Y/N Locking? Y/N Y
Well cap:
Material PVC, Neoprene, Stainless
Vented? Y/N N steel

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing)
Stabilization time
Well development method Pnuematic bailer, used until water is clear

Upgradient or downgradient well? (see piezometric map from Hydrogeologic study)
Average depth of frostline 30.0"

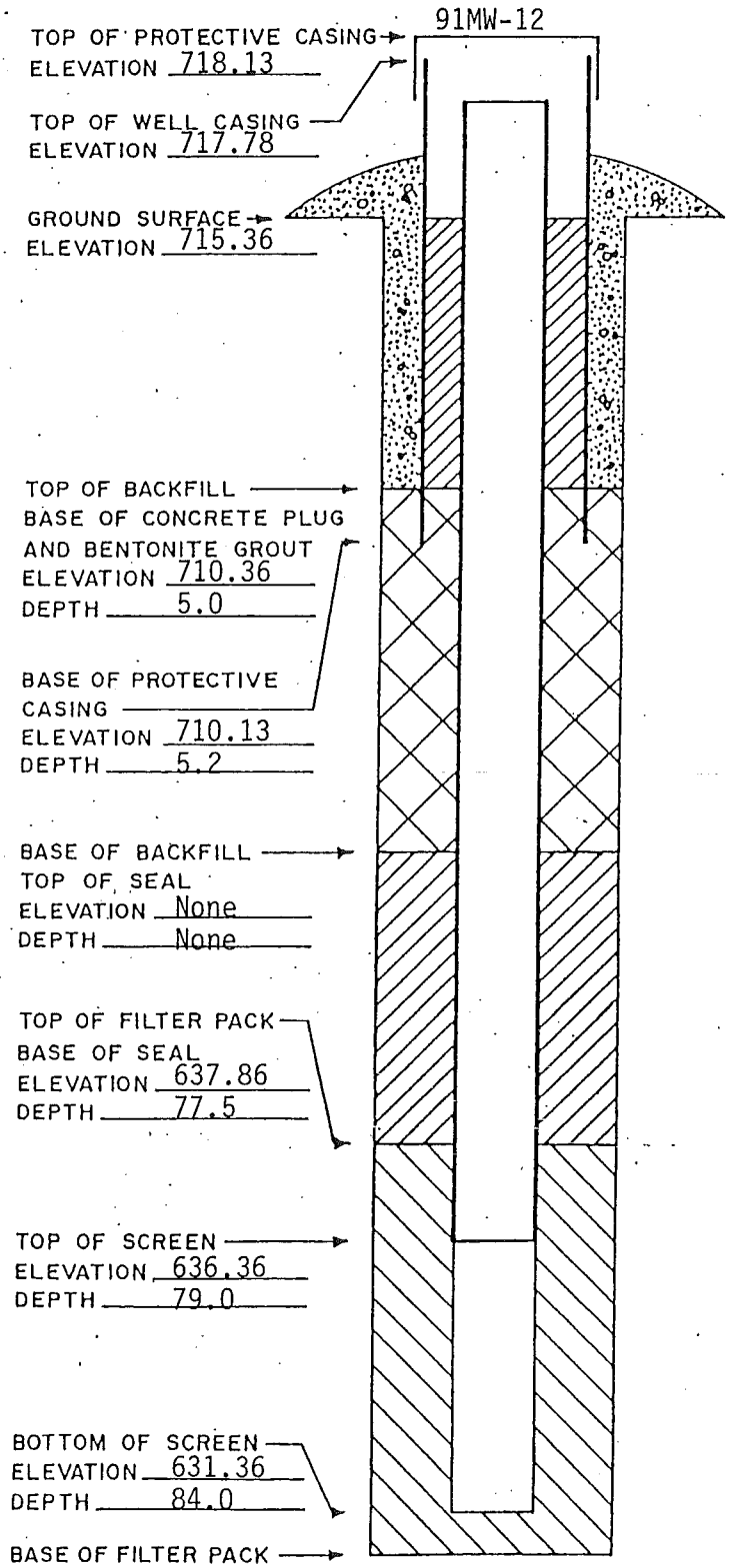
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring wells and piezometers.

Form #542-1277

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERV



CaCO3	K (cm/sec)	91MW-10	91MW-11	91MW-12	DEPTH (feet)	LITHOLOGY	MATERIALS DESCRIPTION
0			714.06				SOIL – PModYwBr; oxidized. Silt Loam. Crumbly texture. Rootlets and grass fragments.
		710.21		712.34	5		SILT – BrBlk to VLGy with ModYwBr mottles; oxidized. thinly laminated.
0							
0					10		TILL – MedGy to DkYwOr; oxidized. Sandy and silty. Saturated. Cohesive.
++	Well recharged too fast to measure.						MedGy; unoxidized. Sandy and silty, with high percentage of rounded granules and pebbles (1/2 – 1" size). Cohesive.
					15		
++					20		
					25		
++							TILL – MedGy; few ModBlGy mottles. Sandy, silty, with granules and occ. pebbles. Extremely plastic when wet.
					30		
++					35		
	1.5×10^{-8} (LAB)						High silt content to from 38.7 to 39.0 feet.
					40		Small horizontal fracture at 39.3 feet. Oxidized.

Green Environmental Services, Inc.

PROJECT Muscatine P&W CCR Landfill

PROJECT NUMBER 705910

SURFACE ELEVATION 716.02 Feet MSL

TOTAL DEPTH OF HOLE 85.0 Feet

LOG OF MW-10, MW-11, MW-12

WATER LEVELS ON October, 8, 1991

GEOLOGIST S. Leimkuehler

CaCO3	K (cm/sec)	91MW-10	91MW-11	91MW-12	DEPTH (feet)	LITHOLOGY	MATERIALS DESCRIPTION
++					45		No recovery to 47.0 feet.
							Till, as above. Slightly crumbly texture.
++	3×10^{-4} (FIELD)				50		No recovery to 54.5 feet.
0					55		SAND – DkYwOr. V. Fine – Medium grained. Moderately well sorted. Silty, clayey.
++					60		TILL – ModBlGy to DkGnGy; unoxidized. Silty, sandy, with granules and pebbles. Extremely plastic when wet.
							MedGy.
++					65		
					70		
++							
+					75		SAND – PYwBr. V. fine to fine grained; trace clay. Well sorted.
++							TILL – Med to MedDkGy; unoxidized. Silty, sandy, with granules and pebbles.
					80		High sand content from 79.5 to 81.0 feet.

Green Environmental Services, Inc.

PROJECT Muscatine P&W CCR Landfill
PROJECT NUMBER 705910
SURFACE ELEVATION 716.02 Feet MSL
TOTAL DEPTH OF HOLE 85.0 Feet

LOG OF MW-10, MW-11, MW-12
WATER LEVELS ON October 8, 1991
GEOLOGIST S. Leimkuehler

CaCO3	K (cm/sec)	91MW-10	91MW-11	91MW-12	DEPTH (feet)	LITHOLOGY	MATERIALS DESCRIPTION
++	1×10^{-7} (FIELD)				85		Bottom of boring.
					90		
					95		
					100		
					105		
					110		
					115		
					120		

Green Environmental Services, Inc.

PROJECT Muscatine P&W CCR Landfill

PROJECT NUMBER 705910

SURFACE ELEVATION 716.02 Feet MSL

TOTAL DEPTH OF HOLE 85.0 Feet

LOG OF MW-10, MW-11, MW-12

WATER LEVELS ON October 8, 1991

GEOLOGIST S. Leimkuehler

MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name Muscatine P & W CCR Landfill Permit # 70 -SDP-6- 82 P
Well or Piezometer # 91MW-13 Date started 07-10-91 Date completed 07-10-91

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site SW-Sect. 16
distance and direction
along boundary
10,962 feet north
Distance and direction
from boundary to well
2,621 feet east

Elevations (±0.01 ft. MSL):
Ground surface 715.44
* Top of protective casing 717.82
Top of well casing 717.41
Benchmark elevation 726.24
Benchmark description BM-3
Spike in Large Stump

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
R.R. 2, Box 18
Iowa City, IA 52242
Name of driller Joel Johnson
Drilling method Hollow Stem Auger
Drilling fluid N/A
Bore hole diameter 9"
Soil sampling method Laskey-Continuous
Depth of boring 25.0 feet

C. Monitoring Well Installation

Casing material Schedule 40 PVC
Length of casing 9.5 feet
Outside casing diameter 2.375"
Inside casing diameter 2.00"
Casing joint type Flush Threaded
Casing/screen joint type Flush threaded
Screen material Schedule 40 PVC
Screen opening size 0.010"
Screen length 10.0 feet
Depth of well 19.5 feet

Well Installation, continued:

Filter pack:
Material Muscatine #1 Sand Pack
Grain size 0.093"
Volume 5.125 cu. ft.
Seal (minimum 3 ft. length above filter pack): *Exception granted*
Material Holeplug
Placement method Poured
Volume 0.205 cu. ft.

Backfill (if different from seal):
Material None
Placement Method
Volume

Surface seal design:
Material of protective casing:
Steel (set in concrete)
Material of grout between protective casing and well casing:
Granular Bentonite
Protective cap:
Material Steel (not airtight)
Vented? Y/N Locking? Y/N Y
Well cap:
Material PVC, Neoprene, Stainless
Vented? Y/N N steel

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing)
Stabilization time
Well development method Pnuematic bailer, used until water is clear

Upgradient or downgradient well? (see piezometric map from Hydrogeologic study)
Average depth of frostline 30.0"

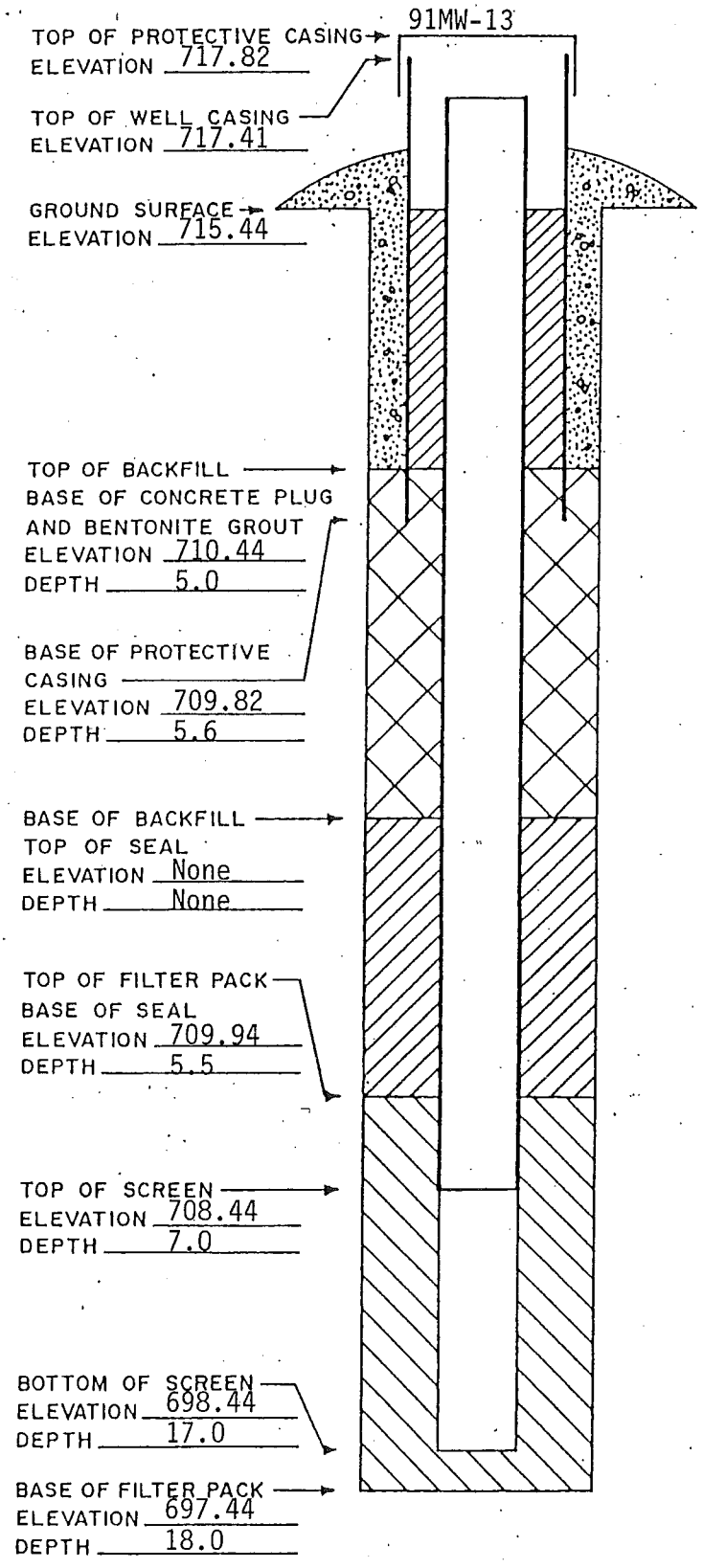
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring wells and piezometers.

Form #542-1277

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTER\



CaCO3	K (cm/sec)		91MW-13		DEPTH (feet)	LITHOLOGY	MATERIALS DESCRIPTION
0							SOIL – PYwBr; oxidized. Clay loam. Crumbly ped to powdery texture. Root fragments. Loess-derived?
0			709.58		5		SILT – P to Dk YwBr/YwOr/LtGy; oxidized; mottled. Clayey, with some fine to v. fine sand. Rootlets. Sandy above and clayey below.
0	4×10^{-5} (FIELD)				10		TILL – PBr with DkYwBr mottles; oxidized. V. fine sand and silt, scarce pebbles. Slightly crumbly texture to 11.0 feet.
							YwBr. Increasing sand and granule content. Saturated. Grades into next below.
++					15		SAND – YwBr. Fine grained with granules and pebbles. Silty, with trace clay.
++	4.4×10^{-8} (LAB)				20		TILL – DkGy/DkGnGy; unoxidized. Sandy and silty with pebbles and granules.
							LtGy with few GnGy mottles. Fewer granules and pebbles.
					25		NO SAMPLE Driller reported "Grey sandy silty clay with trace gravel" (Till).
							Bottom of boring.
					30		
					35		
					40		

Green Environmental Services, Inc.

PROJECT Muscatine P&W CCR Landfill

PROJECT NUMBER 705910

SURFACE ELEVATION 715.44 Feet MSL

TOTAL DEPTH OF HOLE 25.0 Feet

LOG OF MW-13

WATER LEVELS ON October 8, 1991

GEOLOGIST S. Leimkuehler

MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name Muscatine P & W CCR Landfill Permit # 70 -SDP-6- 82 P
Well or Piezometer # 91MW-14 Date started 07-10-91 Date completed 07-10-91

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site SW-Sect. 16
distance and direction
along boundary
10,645 feet north
Distance and direction
from boundary to well
2,853 feet east

Elevations (±0.01 ft. MSL):
Ground surface 729.41
* Top of protective casing 732.39
Top of well casing 732.02
Benchmark elevation 726.24
Benchmark description BM-3
Spike in Large Stump

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
R.R. 2, Box 18
Iowa City, IA 52242
Name of driller Joel Johnson
Drilling method Hollow Stem Auger
Drilling fluid N/A
Bore hole diameter 9"
Soil sampling method Laskey-Continuous
Depth of boring 25.0 feet

C. Monitoring Well Installation

Casing material Schedule 40 PVC
Length of casing 9.5 feet
Outside casing diameter 2.375"
Inside casing diameter 2.00"
Casing joint type Flush Threaded
Casing/screen joint type Flush threaded
Screen material Schedule 40 PVC
Screen opening size 0.010"
Screen length 10.0 feet
Depth of well 19.5 feet

Well Installation, continued:

Filter pack:
Material Muscatine #1 Sand Pack
Grain size 0.093"
Volume 5.125 cu. ft.
Seal (minimum 3 ft. length above filter pack): *Exception granted*
Material Holeplug
Placement method Poured
Volume 0.205 cu. ft.

Backfill (if different from seal):
Material None
Placement Method
Volume

Surface seal design:
Material of protective casing:
Steel (set in concrete)
Material of grout between protective casing and well casing:
Granular Bentonite
Protective cap:
Material Steel (not airtight)
Vented? Y/N Locking? Y/N Y
Well cap:
Material PVC, Neoprene, Stainless
Vented? Y/N N steel

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing)
Stabilization time
Well development method Pnuematic bailer, used until water is clear

Upgradient or downgradient well? (see piezometric map from Hydrogeologic study)
Average depth of frostline 30.0"

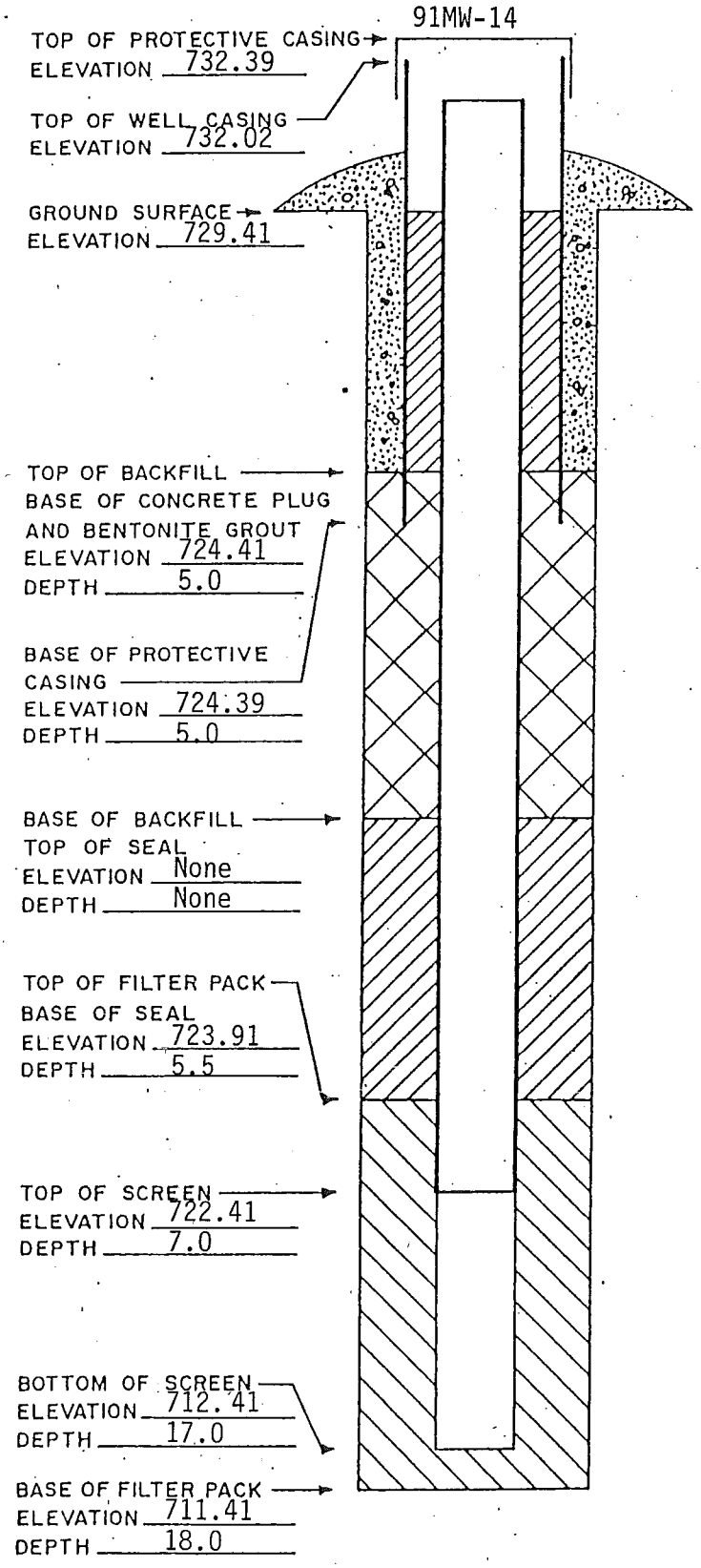
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring wells and piezometers.

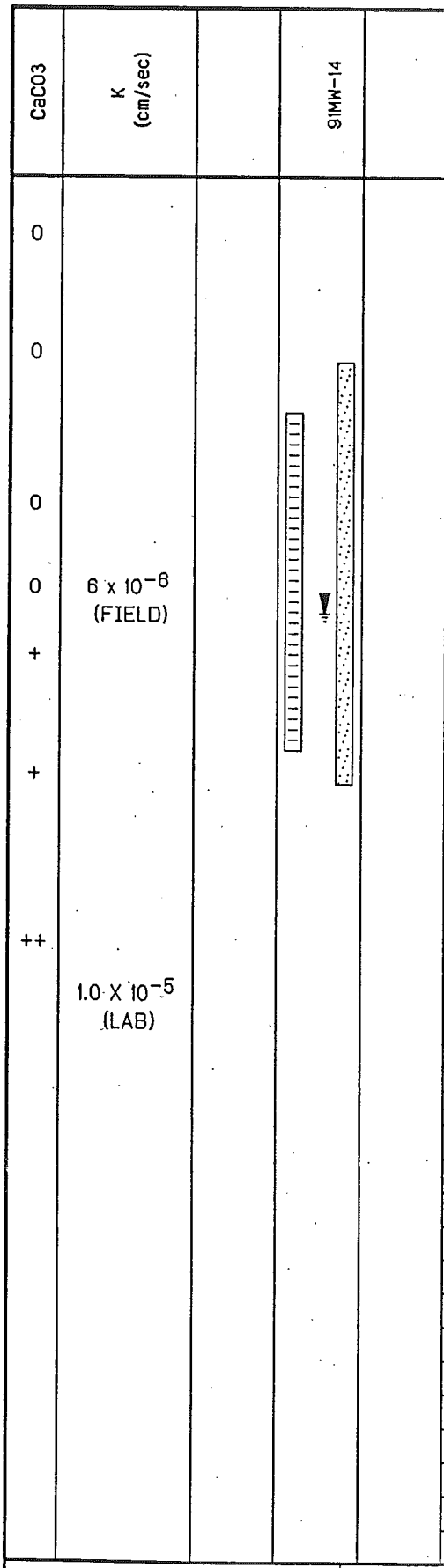
Form #542-1277

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTER\





MATERIALS DESCRIPTION

SOIL – V. DkYwBr; oxidized. Silt Loam. Crumbly texture. Root and grass fragments.

SILT – P to ModYwBr/DkYwOr; oxidized; mottled. Clayey, with trace sand. Some thin laminations. Crumbly texture from 2.5–3.5 and 6.2–7.4 feet.

SILTY SAND – DkYwOr to ModYwBr; oxidized. Fine to medium grained; trace clay.

Saturated.

SILT – VPYwBr with DkYwOr mottles; oxidized. Clayey with increasing sand content below 13.0 feet. Occ. 3–5mm sand seams.

716.34 – WATER LEVEL ELEVATION 91MW-14.

TILL – P to ModYwBr with DkYwOr mottles; oxidized. Sandy and silty with granules and pebbles. Crumbly ped-like texture above 19.0 feet.

ModYwBr. Cohesive.

GyOrPk to POlive from 23.5 to 24.0 feet.

Bottom of boring.

Green Environmental Services, Inc.

PROJECT Muscatine P&W CCR Landfill

PROJECT NUMBER 705910

SURFACE ELEVATION 729.41 Feet MSL

TOTAL DEPTH OF HOLE 25.0 Feet

LOG OF MW-14

WATER LEVELS ON October 8, 1991

GEOLOGIST S. Leimkuehler

MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name Muscatine P & W CCR Landfill Permit # 70 -SDP-6- 82 P
Well or Piezometer # 91MW-15 Date started 07-10-91 Date completed 07-10-91

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site SW-Sect. 16
distance and direction
along boundary
10,271 feet north
Distance and direction
from boundary to well
2,901 feet east

Elevations (±0.01 ft. MSL):
Ground surface 728.22
* Top of protective casing 731.12
Top of well casing 730.74
Benchmark elevation 726.24
Benchmark description BM-3
Spike in Large Stump

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
R.R. 2, Box 18
Iowa City, IA 52242
Name of driller Joel Johnson
Drilling method Hollow Stem Auger
Drilling fluid N/A
Bore hole diameter 9"
Soil sampling method Laskey-Continuous
Depth of boring 25.0 feet

C. Monitoring Well Installation

Casing material Schedule 40 PVC
Length of casing 9.5 feet
Outside casing diameter 2.375"
Inside casing diameter 2.00"
Casing joint type Flush Threaded
Casing/screen joint type Flush threaded
Screen material Schedule 40 PVC
Screen opening size 0.010"
Screen length 10.0 feet
Depth of well 19.5 feet

Well Installation, continued:

Filter pack:
Material Muscatine #1 Sand Pack
Grain size 0.093"
Volume 5.125 cu. ft.
Seal (minimum 3 ft. length above filter pack): *Exception granted*
Material Holeplug
Placement method Poured
Volume 0.205 cu. ft.

Backfill (if different from seal):
Material None
Placement Method
Volume

Surface seal design:
Material of protective casing:
Steel (set in concrete)
Material of grout between protective casing and well casing:
Granular Bentonite
Protective cap:
Material Steel (not airtight)
Vented? Y/N Locking? Y/N Y
Well cap:
Material PVC, Neoprene, Stainless
Vented? Y/N N steel

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing)
Stabilization time
Well development method Pnuematic bailer, used until water is clear

Upgradient or downgradient well? (see piezometric map from Hydrogeologic study)
Average depth of frostline 30.0"

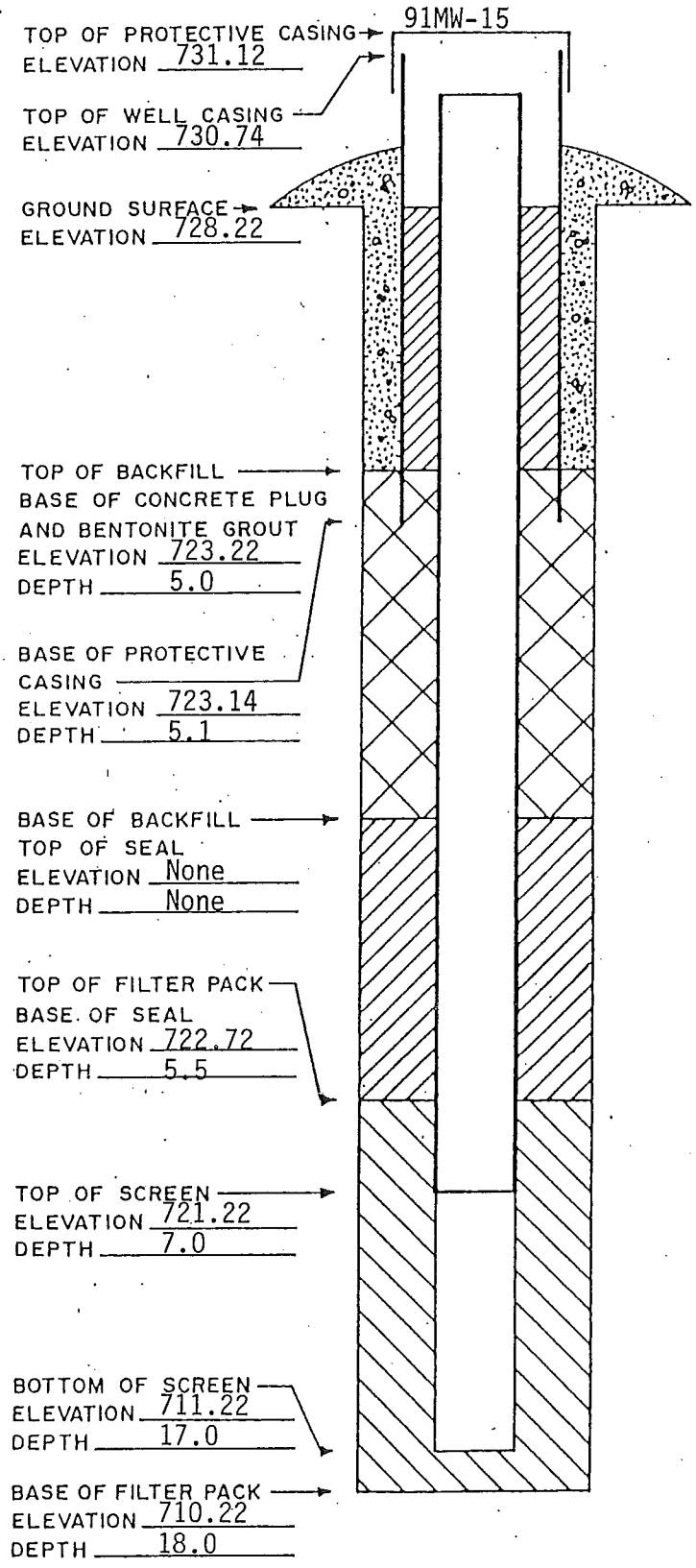
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring wells and piezometers.

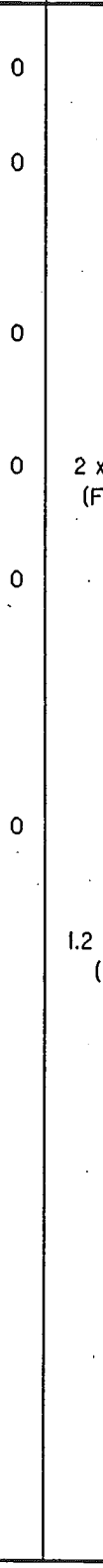
Form #542-1277

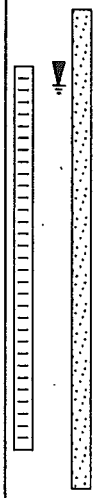
ELEVATIONS: ± 0.01 FT. MSL

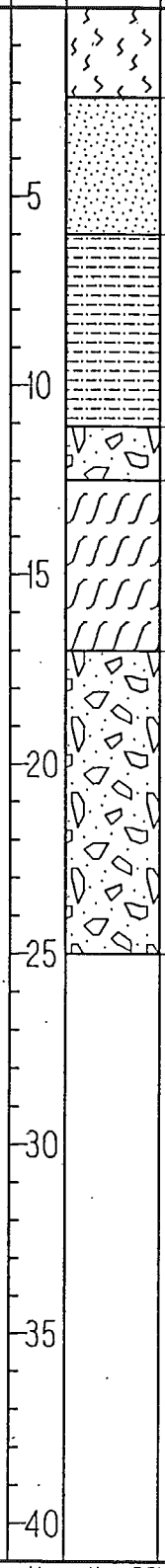
DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERV









MATERIALS DESCRIPTION

SOIL – YwBr; oxidized. Silty Clay Loam. Crumbly texture. Grass fragments and rootlets.

SAND – DkYwOr. V. Fine to Fine (occ. medium) grained; trace silt and clay. Very well sorted.

SILT – LtGy to YwBr with few DkYwOr mottles; oxidized. Some v. fine sand; trace clay; occ 1" sand seams. Occ. thin laminations. Saturated.

720.64 – WATER LEVEL 91MW-15.

PBr with YwBr mottles.

TILL – PBr/ModYwBr with DkYwOr mottles; oxidized. Silty; sandy; with granules and occ. pebbles.

PALEOSOL – PBr/ModYwBr with ModRdBr peds; oxidized. Silty; sandy; with granules and occ. pebbles. Crumbly ped texture. Till-derived.

TILL – PBr with DkYwOr mottles; oxidized. Silty; sandy; with granules and pebbles. Stiff.

Wood fragments. Crumbly texture from 21.1 to 21.4 feet and 28.7 to 24.1 feet.

LtOliveGy/MedGy; unoxidized.

Bottom of boring.

Green Environmental Services, Inc.

PROJECT Muscatine P&W CCR Landfill
PROJECT NUMBER 705910
SURFACE ELEVATION 728.22 Feet MSL
TOTAL DEPTH OF HOLE 25.0 Feet

LOG OF MW-15

WATER LEVELS ON October 8, 1991
GEOLOGIST S. Leimkuehler

MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name Muscatine P & W CCR Landfill Permit # 70 -SDP-6- 82 P
Well or Piezometer # 91MW-16 Date started 07-09-91 Date completed 07-09-91

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site SW-Sect. 16
distance and direction
along boundary
9,953 feet north
Distance and direction
from boundary to well
2,505 feet east

Elevations (±0.01 ft. MSL):
Ground surface 710.45
* Top of protective casing 713.05
Top of well casing 712.71
Benchmark elevation 723.98
Benchmark description BM-4
Top of concrete W. end of Spillway

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
R.R. 2, Box 18
Iowa City, IA 52242
Name of driller Joel Johnson
Drilling method Hollow Stem Auger
Drilling fluid N/A
Bore hole diameter 9"
Soil sampling method Laskey-Continuous
Depth of boring 42.0 feet

C. Monitoring Well Installation

Casing material Schedule 40 PVC
Length of casing 33.5 feet
Outside casing diameter 2.375"
Inside casing diameter 2.00"
Casing joint type Flush Threaded
Casing/screen joint type Flush threaded
Screen material Schedule 40 PVC
Screen opening size 0.010"
Screen length 10.0 feet
Depth of well 43.5 feet

Well Installation, continued:

Filter pack:
Material Muscatine #1 Sand Pack
Grain size 0.093"
Volume 5.125 cu. ft.
Seal (minimum 3 ft. length above filter pack):
Material Benseal grout
Placement method Tremie Tube
Volume 10.045 cu. ft.

Backfill (if different from seal):
Material None
Placement Method
Volume

Surface seal design:
Material of protective casing:
Steel (set in concrete)
Material of grout between protective casing and well casing:
Granular Bentonite
Protective cap:
Material Steel (not airtight)
Vented? Y/N Locking? Y/N Y
Well cap:
Material PVC, Neoprene, Stainless
Vented? Y/N N steel

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing)
Stabilization time
Well development method Pnuematic bailer, used until water is clear

Upgradient or downgradient well? (see piezometric map from Hydrogeologic study)
Average depth of frostline 30.0"

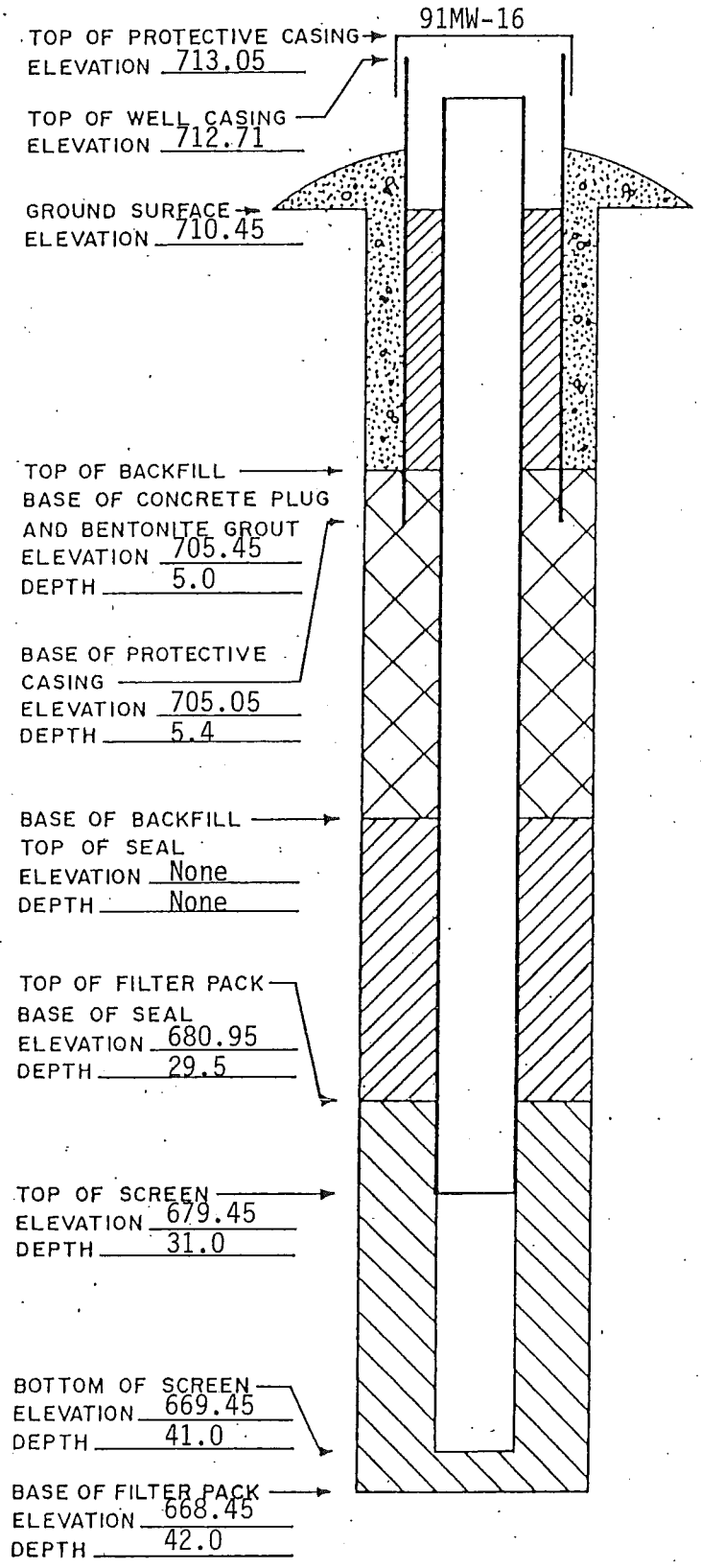
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring wells and piezometers.

Form #542-1277

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERV



MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name Muscatine P & W CCR Landfill Permit # 70 -SDP-6- 82 P
Well or Piezometer # 91MW-17 Date started 07-08-91 Date completed 07-08-91

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site SW-Sect. 16
distance and direction
along boundary
9,957 feet north
Distance and direction
from boundary to well
2,516 feet east

Elevations (±0.01 ft. MSL):
Ground surface 711.10
* Top of protective casing 713.85
Top of well casing 713.53
Benchmark elevation 723.98
Benchmark description BM-4
Top of concrete W. end of Spillway

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
R.R. 2, Box 18
Iowa City, IA 52242
Name of driller Joel Johnson
Drilling method Hollow Stem Auger
Drilling fluid N/A
Bore hole diameter 9"
Soil sampling method Laskey-Continuous
Depth of boring 65.5 feet

C. Monitoring Well Installation

Casing material Schedule 40 PVC
Length of casing 57.5 feet
Outside casing diameter 2.375"
Inside casing diameter 2.00"
Casing joint type Flush Threaded
Casing/screen joint type Flush threaded
Screen material Schedule 40 PVC
Screen opening size 0.010"
Screen length 10.0 feet
Depth of well 67.5 feet

Well Installation, continued:

Filter pack:
Material Muscatine #1 Sand Pack
Grain size 0.093"
Volume 4.715 cu. ft.
Seal (minimum 3 ft. length above filter pack):
Material Benseal grout
Placement method Tremie Tube
Volume 19.885 cu. ft.

Backfill (if different from seal):
Material None
Placement Method
Volume

Surface seal design:
Material of protective casing:
Steel (set in concrete)
Material of grout between protective casing and well casing:
Granular Bentonite
Protective cap:
Material Steel (not airtight)
Vented? Y/N Locking? Y/N Y
Well cap:
Material PVC, Neoprene, Stainless
Vented? Y/N N steel

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing)
Stabilization time
Well development method Pnuematic bailer, used until water is clear

Upgradient or downgradient well? (see piezometric map from Hydrogeologic study)
Average depth of frostline 30.0"

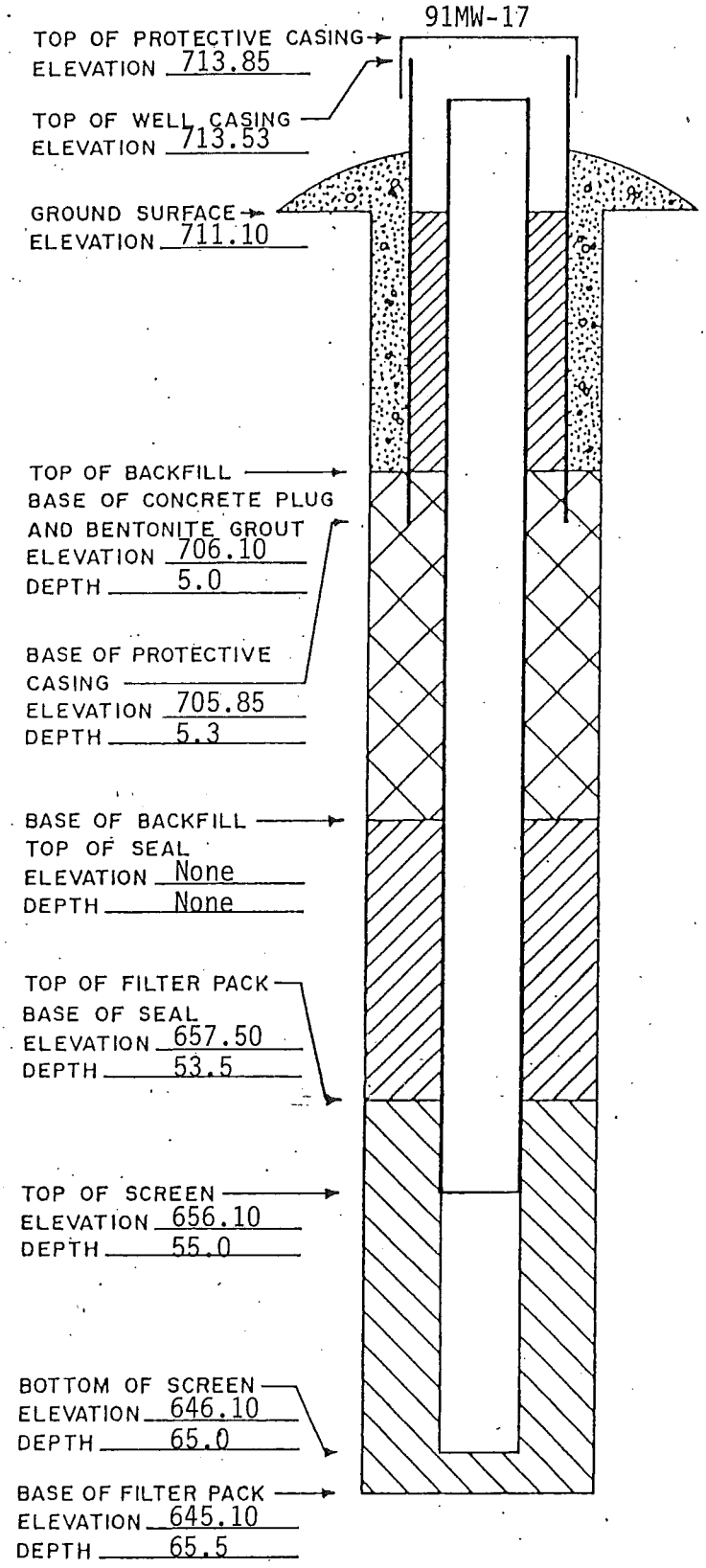
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring wells and piezometers.

Form #542-1277

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTER\



CaCO3	K (cm/sec)	85MW-4	91MW-16	91MW-17	DEPTH (feet)	LITHOLOGY	MATERIALS DESCRIPTION
0							SOIL – PGyYwOr; oxidized. Clay loam. Crumbly ped texture. Loess-derived?
+		706.34	707.08	705.75	5		TILL – VDkYwOr/PYwBr with DkYwOr mottles & streaks; oxidized; top more weathered than below. Clayey above; silty and sandy below; scattered granules & pebbles, including carbonate debris. Stiff. Carbonized rootlets near top.
++							TILL – MedGy; dries VPYwBr. Indistinctly laminated. Sandy; silty; scarce granules; scarce pebbles near base.
++					10		
	5.1×10^{-5} (LAB)				15		
++							GyYwBr. Silty – VF sandy zone. 0.2 feet thick.
	2×10^{-5} (FIELD)				20		
							SILT – VL to LtGy (damp). Clayey. Laminated to thinly laminated. Locally wet.
					25		GRAVEL – GyBr. Granule – 5 mm. VWell sorted with infiltrated clay – V Fine sand.
							SILT – LtGy to VLtGy. Clayey. Lenticular to contorted laminations. Wet.
					30		SILT – Rich in organic matter. BrBk to PYwBr or LtBrGy. Clayey. Carbonized twigs & other plant debris. Laminated. Except for organic matter, similar to silt above.
0							SILT – DkYwGy/MedGy with DkYwBr mottles. Somewhat silty to sandy. Plastic; locally wet. Crumbly ped texture in upper 2 feet; indistinctly laminated below.
					35		
+	5×10^{-4} (FIELD)						SILTY SAND – MedGy to VLtGy/DskyYw. Clay-rich to less clayey. Laminated to indistinctly laminated. Moderately well sorted in lower parts.
++							SAND – LtGy/PYwBr. Fine to medium grained with 15–20% carbonate grains; some up to granules; clayey and silty. Semi-consolidated.
					40		

Green Environmental Services, Inc.

PROJECT Muscatine P&W CCR Landfill

PROJECT NUMBER 705910

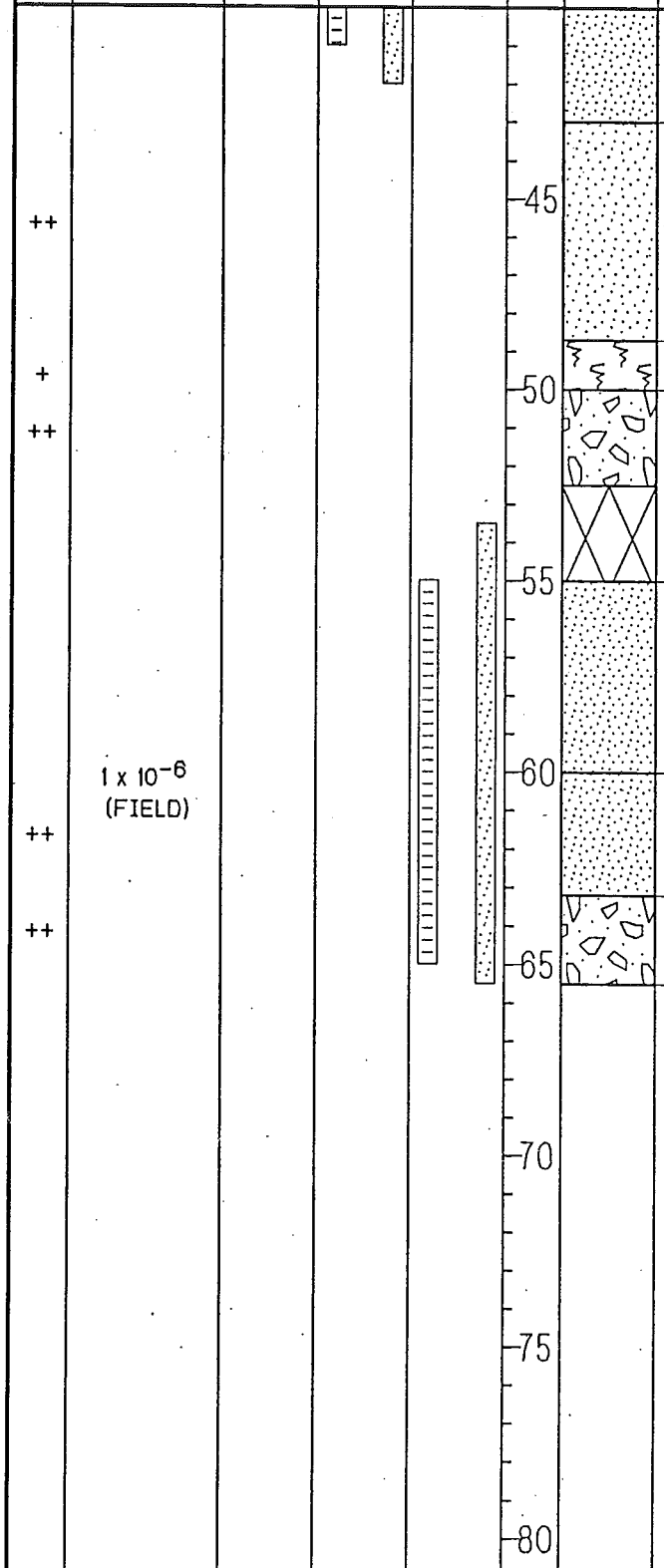
SURFACE ELEVATION 710.45 Feet MSL

TOTAL DEPTH OF HOLE 65.5 Feet

LOG OF MW-4, MW-16, MW-17

WATER LEVELS ON October 8, 1991

GEOLOGIST P. Franks, S. Leimkuehler



MATERIALS DESCRIPTION

SAND, as above.

SAND – MedGy with Olive overtones; oxidized GyYwOr on outside of core. Fine to medium and medium to coarse and very coarse grained; sparse carbonate granules. Bedding not seen. Wet. Probably contains interstitial clay like below.

TILL – GyOl to ModYwOr/GyOlGn; top 0.5 feet stained by "lim". Sandy and silty. Indistinctly laminated. Plastic when wet. Glacial till lacking pebbles.

TILL – MedDkGy with Ol overtones. Silty and sandy with scattered limestone pebbles ≤ 4 cm long; pebbles concentrated at top of core (stone line?). Indistinctly laminated. Plastic when wet.

No recovery from 52.5 to 55.0. Driller reported "Grey sandy silty clay with trace gravel" (Till).

SAND – MedYwBr/DkGyBlGn oxidized YwBr on outside of core. Grain size variable; medium to coarse toward top; fine toward bottom of core; clayey and silty. Bedding not apparent. Wet.

SAND – PYwBr. Fine to medium grained. Moderately well sorted. Bedding not apparent. Wet.

TILL – MedDkGy with Br overtones. Silty and sandy with granules and pebbles ≤ 1 cm long; many non-carbonate pebbles and carbonate pebbles. Indistinctly laminated. Top 0.5 feet wet and plastic; still below.

Bottom of boring.

Green Environmental Services, Inc.

PROJECT Muscatine P&W CCR Landfill
PROJECT NUMBER 705910
SURFACE ELEVATION 710.45 Feet MSL
TOTAL DEPTH OF HOLE 65.5 Feet

LOG OF MW-4, MW-16, MW-17

WATER LEVELS ON October 8, 1991
GEOLOGIST P. Franks, S. Leimkuehler

MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name MP&W CCR Landfill Permit # 70 -SDP-6 -82 P
Well or Piezometer # MW-4A Date started 12/17/01 Date completed 12/19/01

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site SW-Sect. 16
Distance and direction along boundary 9.964 feet north
Distance and direction from boundary to well 2,510 feet east

Elevations (± 0.01 ft. MSL):
Ground surface 711.18
Top of protective casing 713.78
Top of well casing 713.45
Benchmark elevation 723.99
Benchmark description Chiseled X on concrete spillway

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
717 E 2nd Ave.
Coralville, IA 52241
Name of driller Jay R. Joslyn
Drilling method HSA
Drilling fluid NA
Bore hole diameter 8 1/4"
Soil sampling method Laskey continuous
Depth of boring 23'

C. Monitoring Well Installation

Casing material Sch 40 PVC
Length of casing 15.0'
Outside casing diameter 2.375"
Inside casing diameter 2.067"
Casing joint type Threaded
Casing/screen joint type Threaded
Screen material Sch. 40 PVC
Screen opening size 0.010"
Screen length 10.0'
Depth of well 22.5'

Well Installation, continued:

Filter pack:
Material Sand
Grain size 20-40
Volume 4.6 c.f.

Seal (minimum 3 ft. length above filter pack):
Material Bentonite chips (holeplug)
Placement method Gravity
Volume 1.9 c.f.

Backfill (if different from seal):
Material included above
Placement Method "
Volume "

Surface seal design:
Material of protective casing: Aluminum
Material of grout between protective casing and well casing: Sand and holeplug
Protective cap:
Material Aluminum
Vented? Y/N Y Locking? Y/N Y
Well cap:
Material PVC
Vented? Y/N N

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing)
Stabilization time
Well development method Pump and surge
Upgradient or downgradient well? (see piezometric map from Hydrogeologic study) downgradient
Average depth of frostline

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring wells and piezometers.

Form #542-1277

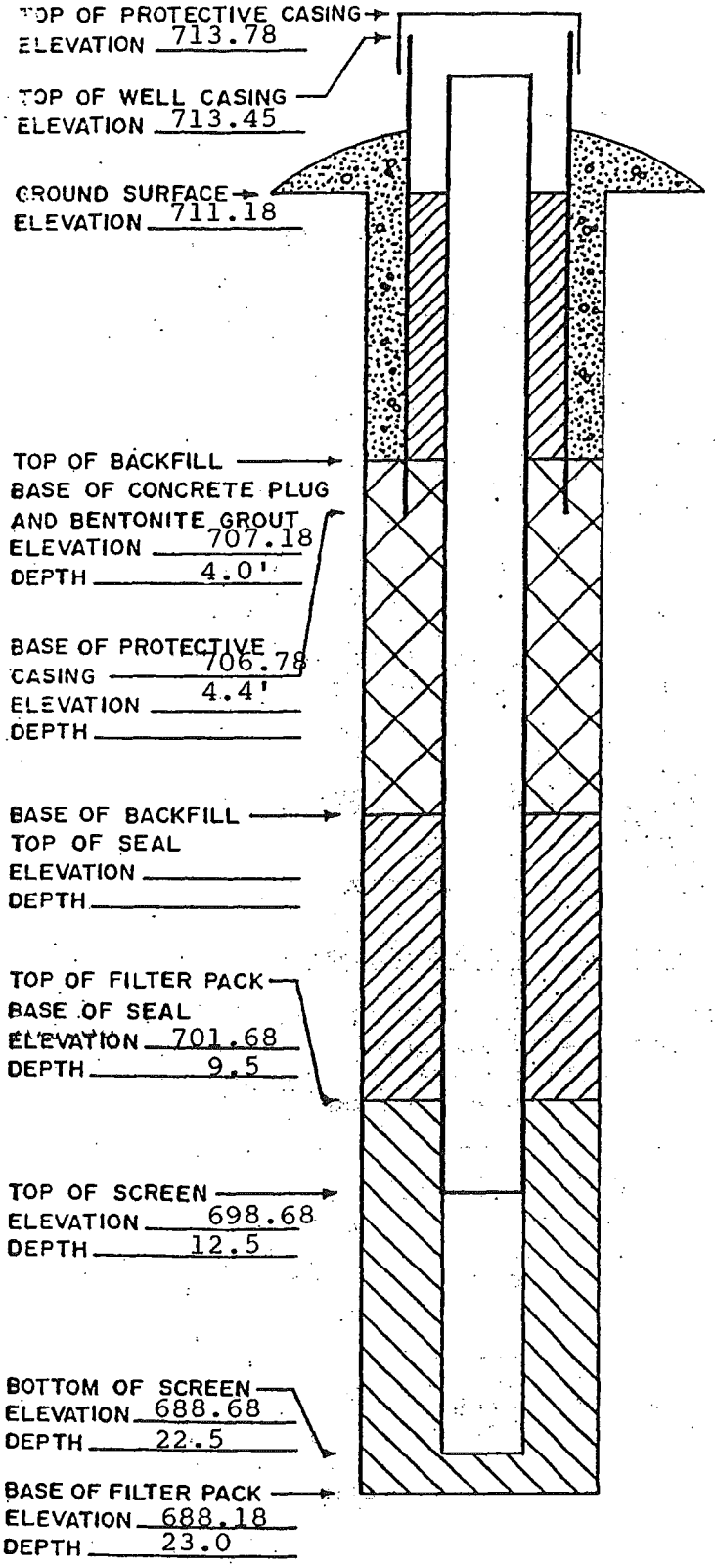
Printed on Recycled Paper

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL).

MW-4A



0'-4' Darkbrown silty clay
trace organics
4'-6' Light brown silty clay
6'-10' Light gray brown
mottled silty clay
10'-16' Gray clayey silt
16'-20' Gray sandy clayey silt
20'-23' Brown organic clayey
silt

MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name MPW CCR Landfill Permit # 70-SDP-6-82 P
Well or Piezometer # MW-5B Date started 12/18/01 Date completed 12/19/01

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site SW-Sect 16
Distance and direction along boundary 9,969 feet north

Distance and direction from boundary to well 2,323 feet east

Elevations (± 0.01 ft. MSL):
Ground surface 706.73
Top of protective casing 709.49
Top of well casing 709.10
Benchmark elevation 723.99
Benchmark description Chiseled X on concrete spillway

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
717 E. 2nd Ave.
Coralville, IA 52241
Name of driller Jay R. Joslyn
Drilling method HSA
Drilling fluid NA
Bore hole diameter 8-1/4"
Soil sampling method Laskey continuous
Depth of boring 23.0'

C. Monitoring Well Installation

Casing material Sch 40 PVC
Length of casing 15.0'
Outside casing diameter 2.375"
Inside casing diameter 2.067"
Casing joint type Threaded
Casing/screen joint type Threaded
Screen material Sch 40 PVC
Screen opening size 0.010"
Screen length 10.0'
Depth of well 22.5'

Well Installation, continued:

Filter pack:
Material Sand
Grain size 20-40
Volume 4.6 c.f.

Seal (minimum 3 ft. length above filter pack):
Material Bentonite chips (holeplug)
Placement method Gravity
Volume 1.9 c.f.

Backfill (if different from seal):
Material included above
Placement Method "
Volume "

Surface seal design:
Material of protective casing: Aluminum
Material of grout between protective casing and well casing: Sand and holeplug
Protective cap:
Material Aluminum
Vented? Y/N Y Locking? Y/N Y
Well cap:
Material PVC
Vented? Y/N N

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing)
Stabilization time
Well development method Pump and surge

Upgradient or downgradient well? (see piezometric map from Hydrogeologic study) downgradient
Average depth of frostline

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring wells and piezometers.

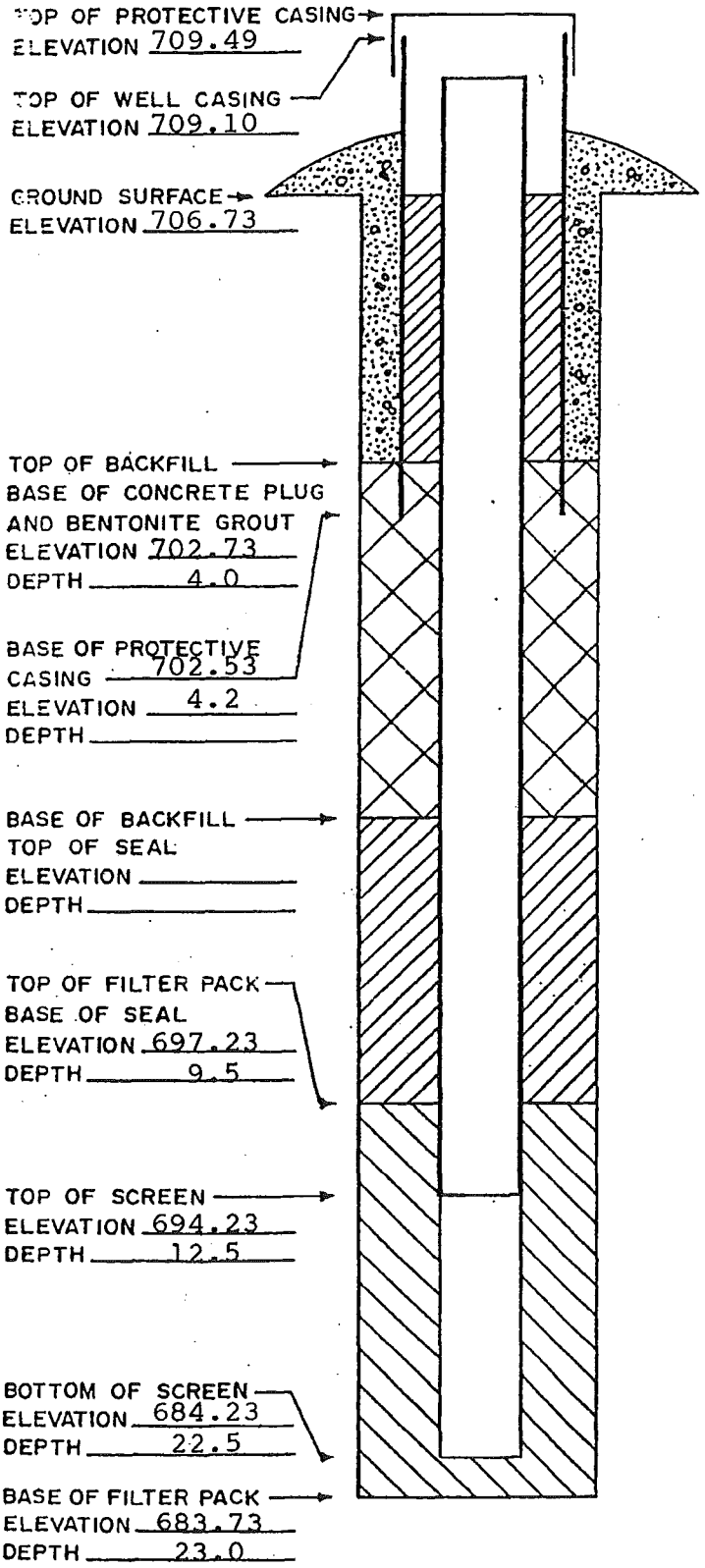
Form #542-1277

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL).

MW-5B



0' - 9.5' Dark brown silty clay
Tr. organics to 2'

9.5'-12.0' Brown sandy silty clay
w/ sand lenses

12.0'-15.5' Gray sandy silty clay

15.5'-20.0' Gray silt w/fine sand

20.0'-23.0' Dark brown organic
silt tr. clay

MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name MPW CCR Landfill Permit # 70 -SDP-6 -82 P
Well or Piezometer # MW-6A Date started 12/18/01 Date completed 12/19/01

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site SW-Sect. 16
Distance and direction along boundary 9.966 feet north
Distance and direction from boundary to well 2,417 feet east

Elevations (± 0.01 ft. MSL):
Ground surface 706.49
Top of protective casing 709.31
Top of well casing 708.92
Benchmark elevation 723.99
Benchmark description Chiseled X on concrete spillway

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
717 E. 2nd Ave.
Coralville, IA 52241
Name of driller Jay R. Joslyn
Drilling method HSA
Drilling fluid NA
Bore hole diameter 8 1/4"
Soil sampling method Laskey continuous
Depth of boring 23.0'

C. Monitoring Well Installation

Casing material Sch 40 PVC
Length of casing 15.0'
Outside casing diameter 2.375"
Inside casing diameter 2.067"
Casing joint type Threaded
Casing/screen joint type Threaded
Screen material PVC
Screen opening size 0.010"
Screen length 10.0'
Depth of well 22.5'

Well Installation, continued:

Filter pack:
Material Sand
Grain size 20-40
Volume 4.6 c.f.

Seal (minimum 3 ft. length above filter pack):
Material Bentonite chips (Holeplug)
Placement method Gravity
Volume 1.9 c.f.

Backfill (if different from seal):
Material Included above
Placement Method "
Volume "

Surface seal design:
Material of protective casing: Aluminum
Material of grout between protective casing and well casing: Sand and holeplug
Protective cap:
Material Aluminum
Vented? Y/N Y Locking? Y/N Y
Well cap:
Material PVC
Vented? Y/N N

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing)
Stabilization time
Well development method Pump and Surge

Upgradient or downgradient well? (see piezometric map from Hydrogeologic study) Downgradient
Average depth of frostline

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring wells and piezometers.

Form #542-1277

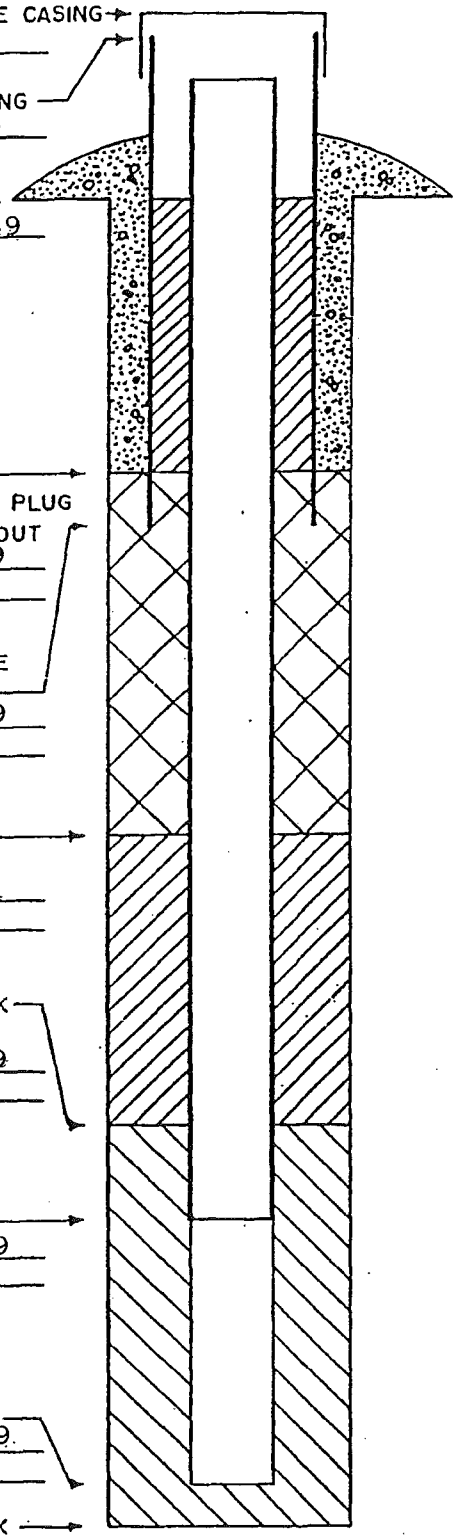
Printed on Recycled Paper

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL).

MW-6A



TOP OF PROTECTIVE CASING
ELEVATION 709.31

TOP OF WELL CASING
ELEVATION 708.92

GROUND SURFACE
ELEVATION 706.49

TOP OF BACKFILL
BASE OF CONCRETE PLUG AND BENTONITE GROUT
ELEVATION 702.49
DEPTH 40

BASE OF PROTECTIVE CASING
ELEVATION 702.29
DEPTH 4.2

BASE OF BACKFILL
TOP OF SEAL
ELEVATION
DEPTH

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 696.99
DEPTH 9.5

TOP OF SCREEN
ELEVATION 693.99
DEPTH 12.5

BOTTOM OF SCREEN
ELEVATION 683.99
DEPTH 22.5

BASE OF FILTER PACK
ELEVATION 683.49
DEPTH 23.0

0'-0.5'	Dark brown silty clay w/organics
0.5'-6.0'	Light brown silty clay
6.0'-11.0'	Light gray brown mottled silty clay tr. sand
11.0'-20.0'	Gray silty clay tr. sand
20.0'-23.0'	Lt. gray silt tr.fine sand

Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES

MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: Muscatine Power & Water Permit No.:

Well or Piezometer No: MW14A

Dates Started: 09/10/2012 Date Completed: 09/10/2012

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):

Specify corner of site:

Distance & direction along boundary:

Distance & direction from boundary to wall:

Elevations (± 0.01 ft MSL):

Ground Surface: 726.19 ft. ASL

Top of protective casing:

Top of well casing: 729.00 ft. ASL

Benchmark elevation: 722.24 ft. ASL

Benchmark description: Rim of lift station manhole

B. SOIL BORING INFORMATION

Name & Address of Construction Company:
GeoSource, Inc.
15331 130th Ave
Monticello, IA 52310

Name of Driller: Kent Helgens No. 7717

Drilling Method: 3 1/4 in. Hollow Stem Auger

Drilling Fluid:

Bore Hole Diameter: 7 in.

Soil Sampling Method: Split Spoon

Depth of Boring: 17 ft.

C. MONITORING WELL INSTALLATION

Casing material: PVC

Length of casing: 10 ft.

Outside casing diameter: 2 3/8 in.

Inside casing diameter: 2 in.

Casing joint type: N/A

Casing/screen joint type: Flush threaded

Screen material: Slotted PVC

Screen opening size: .010

Screen length: 10 ft.

Depth of well: 17 ft. below grade

Filter Pack:

Material: Sand pack

Grain size: 60-80 mesh

Volume: 250 lbs.

Seal (minimum 3 ft length above filter pack):

Material: 3/8 in. Hole Plug

Placement method: Gravity

Volume: 125 lbs.

Backfill (if different from seal):

Material:

Placement method:

Volume:

Surface seal design:

Material of protective casing: Aluminum

Material of grout between protective casing and well casing: 3/8 in. Hole plug

Protective cap:

Material: Hinged aluminum

Vented: ☐ Yes ☐ No Locking: ☑ Yes ☐ No

Well Cap:

Material: 2 in. expansion plug

Vented: ☐ Yes ☑ No

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 15.96 ft. below top of casing Stabilization Time: Greater than 24 hours

Well development method: Hand bailed well dry with one liter polyethylene bailer

Average depth of frostline: 4 feet

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

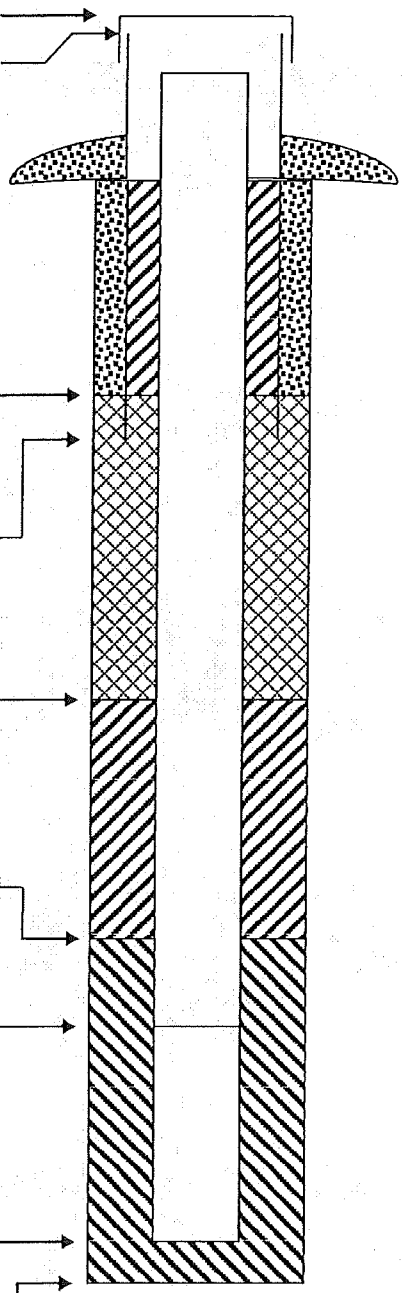
Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)

14A



TOP OF PROTECTIVE CASING
ELEVATION _____

TOP OF WELL CASING
ELEVATION 729.00 ft. ASL

GROUND SURFACE
ELEVATION 726.19 ft. ASL

TOP OF BACKFILL
BASE OF CONCRETE PLUG
AND BENTONITE GROUT
ELEVATION 725.19 ft. ASL
DEPTH 1 ft.

BASE OF PROTECTIVE CASING
ELEVATION 725.19 ft. ASL
DEPTH 1 ft.

BASE OF BACKFILL
TOP OF SEAL
ELEVATION 725.19 ft. ASL
DEPTH 1 ft.

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 720.00 ft. ASL
DEPTH 6 ft.

TOP OF SCREEN
ELEVATION 719.00 ft. ASL
DEPTH 7 ft.

BOTTOM OF SCREEN
ELEVATION 709.00 ft. ASL
DEPTH 17 ft.

BASE OF FILTER PACK
ELEVATION 708.50 ft. ASL
DEPTH 17.5 ft.

SOIL BORING LOG AND MONITORING WELL CONSTRUCTION DIAGRAM

Boring / Well Number: MW14A	Facility Name: Muscatine Power & Water	Facility Address:
Boring Depth (ft) X Diameter (in): 17 ft. X 7 in.		Drilling Method: 3.25" HSA
Well Contractor Name: Kent Helgens		Logged By: Scott Behrends
Registration Number: 7717		
Ground Surface Elevation (ASL): 726.19'		Top of Casing Elevation (ASL): 729.00'
Date: 09/10/12 Start Time: 1115	Date: 09/10/12 End Time: 1215	UST Number: / LUST Number:

Depth (feet)	Well Construction Details	Blow Count if applicable	Sample No.	Sample Depth	Sample Type	PID/FID Reading	Rock Formations , Soil, Color and Classifications
+ 4	Protective Casing						
--							
+ 2							
--							
0	Concrete						--------Grass^---------
--							
2							Silty Sand, fine grained brown (SM)
--	10 ft of 2 in PVC Riser						
4	Bentonite						
--							
6							----------
--							Clayey Silt, mottled light gray & reddish brown (CL-ML)
8							
--							----------
10	10 ft of 2 in 010 Slotted PVC						Silty Clay w/ a little sand light gray (CL-ML)
--							
12	Sand						----------
--							Sandy Clay w/ a little gravel brown to medium gray (till) (CL)
14	V						
--							
16							----------
--							End of Boring @ 17 ft. bg
18							
--							
20							
--							
22							
--							
24							
--							
26							

*SS (split spoon) HSA (hollow stem auger)

Observations	Date:	09/11/12								
Water Levels (ASL)	Level:	713.04'								
Static Water Level Symbol v	Time:	1315								

DNR FORM 542-1392

Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES

MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: Muscatine Power & Water Permit No.:

Well or Piezometer No: MW15A

Dates Started: 09/10/2012 Date Completed: 09/10/2012

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):

Specify corner of site:

Distance & direction along boundary:

Distance & direction from boundary to wall:

Elevations (± 0.01 ft MSL):

Ground Surface: 727.12 ft. ASL

Top of protective casing:

Top of well casing: 729.99 ft. ASL

Benchmark elevation: 722.24 ft. ASL

Benchmark description: Rim of lift station manhole

B. SOIL BORING INFORMATION

Name & Address of Construction Company:
GeoSource, Inc.
15331 130th Ave
Monticello, IA 52310

Name of Driller: Kent Helgens No. 7717

Drilling Method: 3 1/4 in. Hollow Stem Auger

Drilling Fluid:

Bore Hole Diameter: 7 in.

Soil Sampling Method: Split Spoon

Depth of Boring: 17 ft.

C. MONITORING WELL INSTALLATION

Casing material: PVC

Length of casing: 10 ft.

Outside casing diameter: 2 3/8 in.

Inside casing diameter: 2 in.

Casing joint type: N/A

Casing/screen joint type: Flush threaded

Screen material: Slotted PVC

Screen opening size: .010

Screen length: 10 ft.

Depth of well: 17 ft. below grade

Filter Pack:

Material: Sand pack

Grain size: 60-80 mesh

Volume: 250 lbs.

Seal (minimum 3 ft length above filter pack):

Material: 3/8 in. Hole Plug

Placement method: Gravity

Volume: 125 lbs.

Backfill (if different from seal):

Material:

Placement method:

Volume:

Surface seal design:

Material of protective casing: Aluminum

Material of grout between protective casing and well casing: 3/8 in. Hole plug

Protective cap:

Material: Hinged aluminum

Vented: ☐ Yes ☐ No Locking: ☒ Yes ☐ No

Well Cap:

Material: 2 in. expansion plug

Vented: ☐ Yes ☒ No

D. WATER LEVEL MEASUREMENT (feet below top of inner well)

Water level: Dry Stabilization Time: Greater than 24 hours

Well development method: None

Average depth of frostline: 4 feet

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

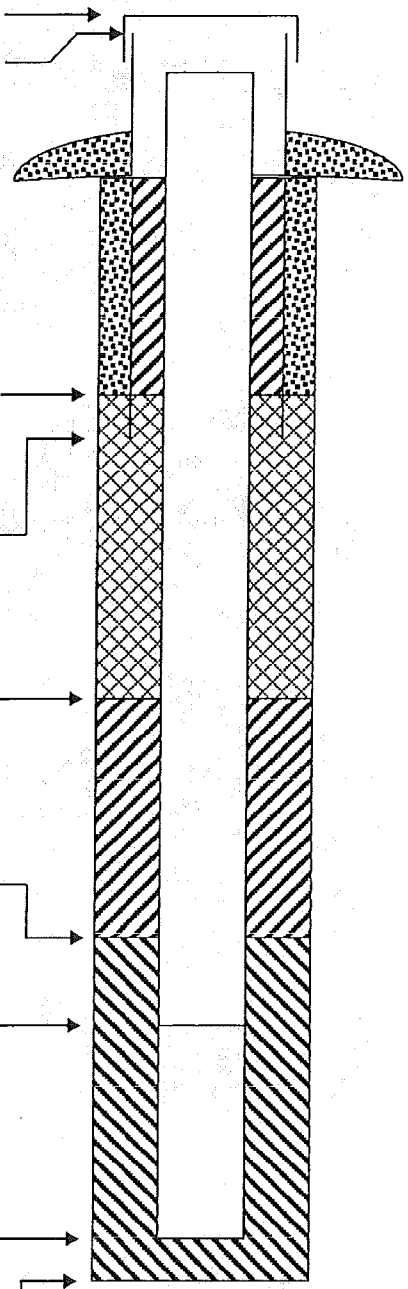
Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)

15A



TOP OF PROTECTIVE CASING ELEVATION _____

TOP OF WELL CASING ELEVATION 729.99 ft. ASL

GROUND SURFACE ELEVATION 727.12 ft. ASL

TOP OF BACKFILL
BASE OF CONCRETE PLUG AND BENTONITE GROUT
ELEVATION 726.12 ft. ASL
DEPTH 1 ft.

BASE OF PROTECTIVE CASING
ELEVATION 726.12 ft. ASL
DEPTH 1 ft.

BASE OF BACKFILL
TOP OF SEAL
ELEVATION 726.12 ft. ASL
DEPTH 1 ft.

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 720.99 ft. ASL
DEPTH 6 ft.

TOP OF SCREEN
ELEVATION 719.99 ft. ASL
DEPTH 7 ft.

BOTTOM OF SCREEN
ELEVATION 709.99 ft. ASL
DEPTH 17 ft.

BASE OF FILTER PACK
ELEVATION 709.49 ft. ASL
DEPTH 17.5 ft.

SOIL BORING LOG AND MONITORING WELL CONSTRUCTION DIAGRAM

Boring / Well Number:	Facility Name:	Facility Address:
MW15A	Muscatine Power & Water	
Boring Depth (ft) X Diameter (in):	17 ft. X 7 in.	Drilling Method: 3.25" HSA
Well Contractor Name:	Kent Helgens	Logged By:
Registration Number:	7717	Scott Behrends
Ground Surface Elevation (ASL):	727.12'	Top of Casing Elevation (ASL): 729.99'
Date: 09/10/12	Date: 09/10/12	UST Number: / LUST Number:
Start Time: 1230	End Time: 1325	

Depth (feet)	Well Construction Details	Blow Count if applicable	Sample No.	Sample Depth	Sample Type	PID/FID Reading	Rock Formations , Soil, Color and Classifications
+ 4							
--	Protective Casing						
+ 2							
--							
0	Concrete						--------Grass^---------
--							
2							Sand, fine grained brown (SW-SM)
--	10 ft of 2 in PVC Riser						
4							
--	Bentonite						----------
6							Clayey Silt, mottled brown & gray, stiff (CL-ML)
--							----------
8							
--							
10	10 ft of 2 in 010 Slotted PVC						Silty Clay , gray to dark green (CL-ML)
--							----------
12	Sand						Sandy Clay w/ a little gravel mottled gray & brown dense (CL)
--							
14							
--							
16							
--							
18							End of Boring @ 17 ft. bg
--							
20							
--							
22							
--							
24							
--							
26							

*SS (split spoon) HSA (hollow stem auger)

Observations	Date:	09/11/12							
Water Levels (ASL)	Level:	Dry							
Static Water Level Symbol v	Time:	1330							

Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES

MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: Muscatine Power & Water Permit No.:

Well or Piezometer No: MW18A

Dates Started: 09/10/2012 Date Completed: 09/10/2012

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):

Specify corner of site:

Distance & direction along boundary:

Distance & direction from boundary to wall:

Elevations (± 0.01 ft MSL):

Ground Surface: 726.06 ft. ASL

Top of protective casing:

Top of well casing: 729.13 ft. ASL

Benchmark elevation: 722.24 ft. ASL

Benchmark description: Rim of lift station manhole

B. SOIL BORING INFORMATION

Name & Address of Construction Company:
GeoSource, Inc.
15331 130th Ave
Monticello, IA 52310

Name of Driller: Kent Helgens No. 7717

Drilling Method: 3 1/4 in. Hollow Stem Auger

Drilling Fluid:

Bore Hole Diameter: 7 in.

Soil Sampling Method: Split Spoon

Depth of Boring: 20 ft.

C. MONITORING WELL INSTALLATION

Casing material: PVC

Length of casing: 13 ft.

Outside casing diameter: 2 3/8 in.

Inside casing diameter: 2 in.

Casing joint type: N/A

Casing/screen joint type: Flush threaded

Screen material: Slotted PVC

Screen opening size: .010

Screen length: 10 ft.

Depth of well: 20 ft. below grade

Filter Pack:

Material: Sand pack

Grain size: 60-80 mesh

Volume: 250 lbs.

Seal (minimum 3 ft length above filter pack):

Material: 3/8 in. Hole Plug

Placement method: Gravity

Volume: 175 lbs.

Backfill (if different from seal):

Material:

Placement method:

Volume:

Surface seal design:

Material of protective casing: Aluminum

Material of grout between protective casing and well casing: 3/8 in. Hole plug

Protective cap:

Material: Hinged aluminum

Vented: ☐ Yes ☐ No Locking: ☒ Yes ☐ No

Well Cap:

Material: 2 in. expansion plug

Vented: ☐ Yes ☒ No

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 16.91 ft. below top of casing Stabilization Time: Greater than 24 hours

Well development method: Hand bailed well dry with one liter polyethylene bailer

Average depth of frostline: 4 feet

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

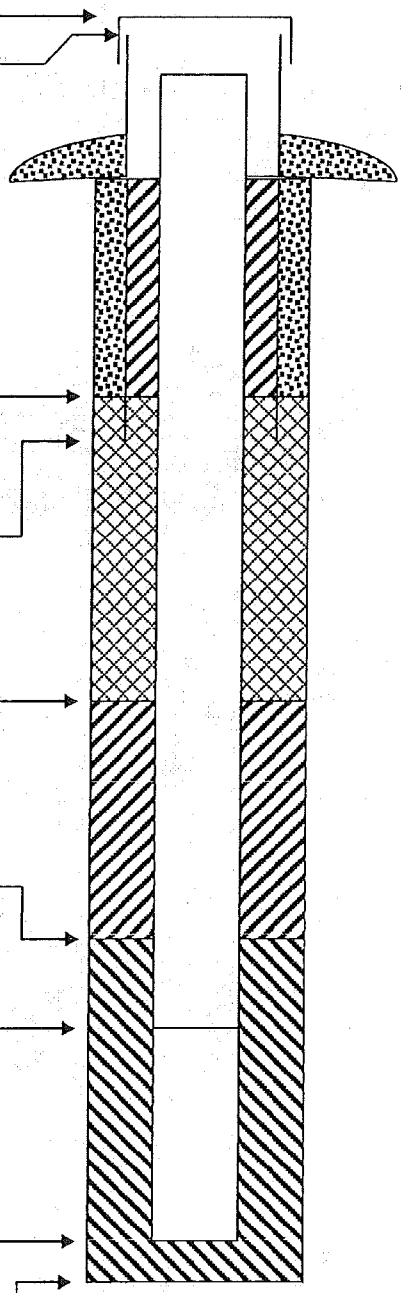
Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)

18A



TOP OF PROTECTIVE CASING
ELEVATION _____
TOP OF WELL CASING
ELEVATION 729.13 ft. ASL

GROUND SURFACE
ELEVATION 726.06 ft. ASL

TOP OF BACKFILL
BASE OF CONCRETE PLUG
AND BENTONITE GROUT
ELEVATION 725.06 ft. ASL
DEPTH 1 ft.

BASE OF PROTECTIVE CASING
ELEVATION 725.06 ft. ASL
DEPTH 1 ft.

BASE OF BACKFILL
TOP OF SEAL
ELEVATION 725.06 ft. ASL
DEPTH 1 ft.

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 717.13 ft. ASL
DEPTH 9 ft.

TOP OF SCREEN
ELEVATION 716.13 ft. ASL
DEPTH 10 ft.

BOTTOM OF SCREEN
ELEVATION 706.13 ft. ASL
DEPTH 20 ft.

BASE OF FILTER PACK
ELEVATION 705.63 ft. ASL
DEPTH 20.5 ft.

SOIL BORING LOG AND MONITORING WELL CONSTRUCTION DIAGRAM

Boring / Well Number: MW18A	Facility Name: Muscatine Power & Water	Facility Address:	
Boring Depth (ft) X Diameter (in):	20 ft. X 7 in.	Drilling Method:	3.25" HSA
Well Contractor Name:	Kent Helgens	Logged By:	
Registration Number:	7717	Scott Behrends	
Ground Surface Elevation (ASL):	726.06'	Top of Casing Elevation (ASL):	729.13'
Date: 09/10/12	Date: 09/10/12	UST Number:	LUST Number:
Start Time: 930	End Time: 1100		

Depth (feet)	Well Construction Details	Blow Count if applicable	Sample No.	Sample Depth	Sample Type	PID/FID Reading	Rock Formations , Soil, Color and Classifications
+ 4							
--	Protective Casing						
+ 2							
--							
0	Concrete						--------Grass^---------
--							
2							Silt & Clayey Silt
--							w/ organic matter
4	13 ft of						light brown to dark gray
--	2 in PVC	Bentonite					(OL)
6	Riser						
--							-- mixed clayey silt & fine
8							grained sand, brown
--							----------
10							
--							Silty Clay w/ interbedded
12							fine grained sand
--	10 ft of						light gray, soft
14	2 in	Sand					(CL-ML)
--	010 Slotted						
16	PVC						----------
--							Silty Clay w/ a little sand
18							dark gray, till
--							(CL-ML)
20							----------
--							End of Boring @ 20 ft. bg
22							
--							
24							
--							
26							

*SS (split spoon) HSA (hollow stem auger)

Observations	Date:	09/11/12								
Water Levels (ASL)	Level:	712.22'								
Static Water Level Symbol v	Time:	1300								

DNR FORM 542-1392

MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name MPW CCR Landfill, Letts, IA Permit # 70-SDP-6-82 P
Well or Piezometer #MW-21 Date started 5/24/93 Date completed 5/24/93

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site S.W.-Sect. 16
Distance and direction along boundary
10,280 ft. North
Distance and direction from boundary to well
2,200 ft. East

Elevations (± 0.01 ft. MSL):
Ground surface 722.81
Top of protective casing 726.00
Top of well casing 725.72
Benchmark elevation 723.98
Benchmark description
Chiseled X on concrete spillway

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
717 E. 2nd Ave.
Coralville, IA 52241
Name of driller Joel J. Johnson
Drilling method HSA
Drilling fluid None
Bore hole diameter 8.25"
Soil sampling method Laskey
Depth of boring 19.5'

C. Monitoring Well Installation

Casing material Schedule 40 PVC
Length of casing 12 ft.
Outside casing diameter 2.375"
Inside casing diameter 2.067"
Casing joint type "O" ring/threads
Casing/screen joint type Same
Screen material Schedule 40 PVC
Screen opening size 0.010"
Screen length 10 ft.
Depth of well 19 ft.

Well Installation, continued:

Filter pack:
Material Northern Gravel well pack
Grain size "Coarse 0"
Volume 4.3 c.f.

Seal (minimum 3 ft. length above filter pack):
Material Bentonite chips
Placement method Hand placed
Volume 0.7 c.f.

Backfill (if different from seal):
Material Portland cement concrete
Placement Method Hand placed
Volume 1.7 c.f.

Surface seal design:
Material of protective casing:
Extruded aluminum
Material of grout between protective casing and well casing:
Bentonite chips
Protective cap:
Material Same as casing
Vented? Y/N Y Locking? Y/N Y
Well cap:
Material Steel and plastic
Vented? Y/N N

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing)
Stabilization time
Well development method Pneumatic bailer - pumped visibly clean
Upgradient or downgradient well? (see piezometric map from Hydrogeologic study) See below *
Average depth of frostline 30.0"

* Downgradient of leachate storage

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring wells and piezometers.

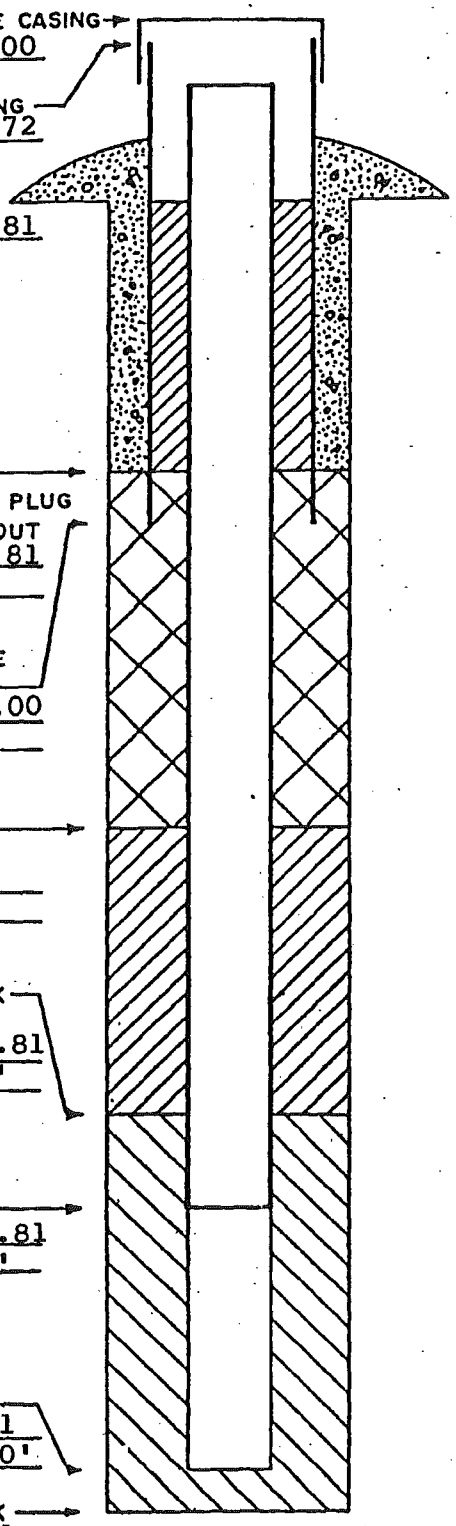
Form #542-1277

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL

21



TOP OF PROTECTIVE CASING
ELEVATION 726.00

TOP OF WELL CASING
ELEVATION 725.72

GROUND SURFACE
ELEVATION 722.81

TOP OF BACKFILL

BASE OF CONCRETE PLUG AND BENTONITE GROUT
ELEVATION 717.81
DEPTH 5.0'

BASE OF PROTECTIVE CASING
ELEVATION 718.00
DEPTH 4.8'

BASE OF BACKFILL
TOP OF SEAL
ELEVATION N/A
DEPTH N/A

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 715.81
DEPTH 7.0'

TOP OF SCREEN
ELEVATION 713.81
DEPTH 9.0'

BOTTOM OF SCREEN
ELEVATION 703.81
DEPTH 19.0'

BASE OF FILTER PACK
ELEVATION 703.31
DEPTH 19.5'

field boring log

Project MUSKINGUM RIVER Flyash LANDFILL

Boring No. MW-21 Date Started 5-24-93 Date Complete 5-24-93

Drilled by Jobl Logged by Jobl Rig CME-75

subsurface stratigraphy

☐ 4" Flight Augers ☒ 4¼" ID H.S. ☐ 6¼" ID H.S.

From	To	Description
0.0	3.0	yellow BRN Silty Clay
3.0	10.0	yellow BRN. Silt w/TR. Sand
		More Sand w/Depth
10.0	13.0	yellow BRN silty Sand.
13.0		yellow BRN Silty Clay

Bottom of Boring 19.5

water levels

10.0' While Drilling

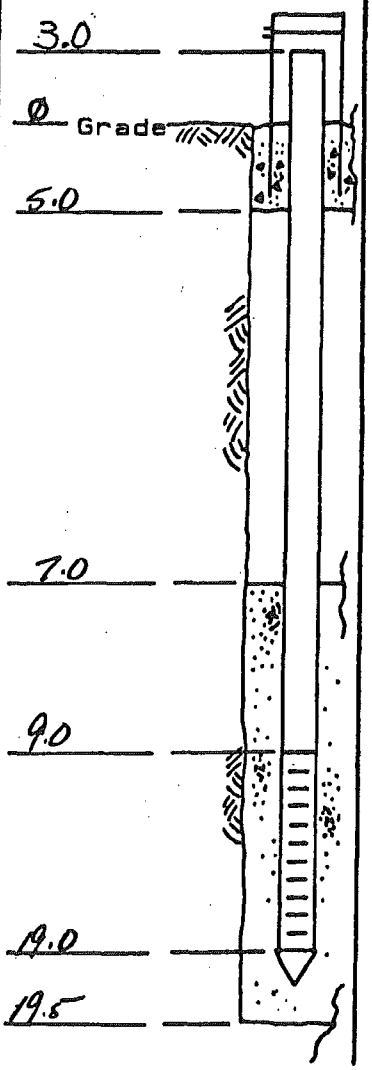
___ 0 Hours A.B.

___ ___ Hr. A.B.

well details

☒ Stick-up Cover

☐ Flush Cover



sample data

Depth	Number/Type	Depth	Number/Type

CS = Continuous Sampler AS = Auger Sample

aquadrill