PETITION OF DIXON MARQUETTE CEMENT COMPANY FOR ADJUSTED STANDARD FROM: 35 ILL. ADM. CODE PARTS 811 & 814

EXHIBITS 1-5

March 15, 2001

Prepared by:

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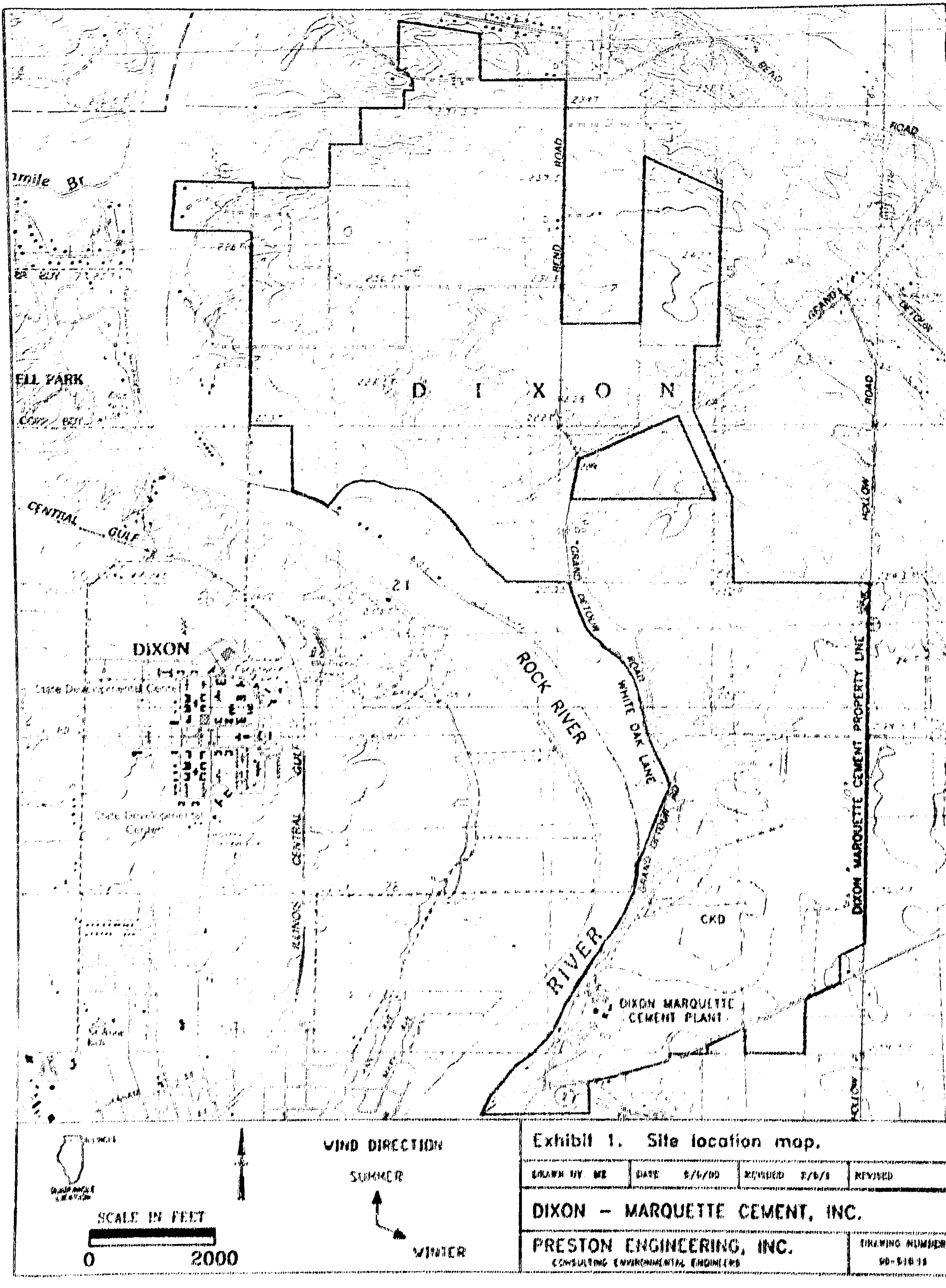

Exhibit 1. Site location map.

DRAWN BY: MR	DATE: 8/6/00	REVISED 3/6/1	REVISED

DIXON – MARQUETTE CEMENT, INC.

PRESTON ENGINEERING, INC.
CONSULTING ENVIRONMENTAL ENGINEERS

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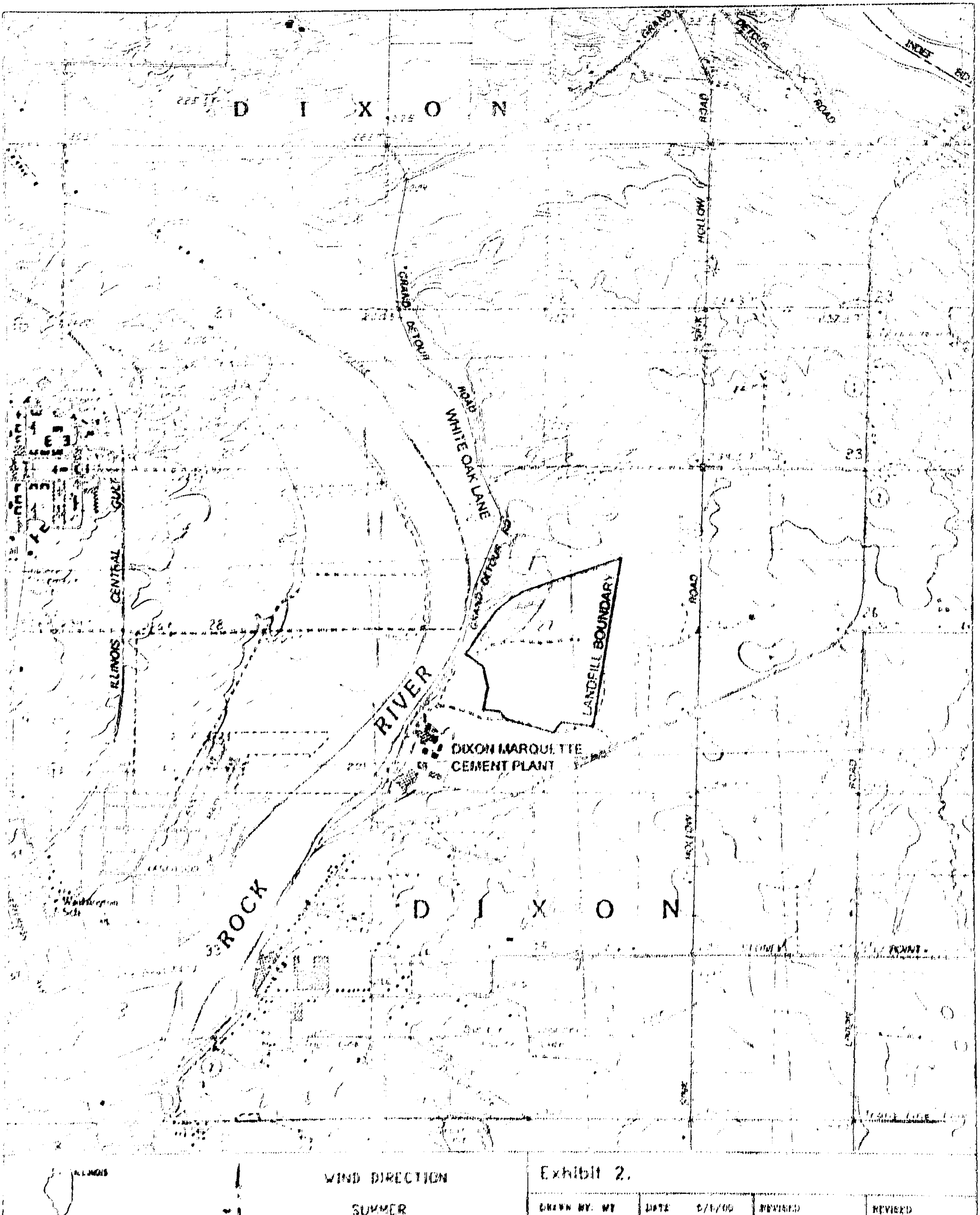

Exhibit 2.

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DIXON – MARQUETTE CEMENT, INC.

PRESTON ENGINEERING, INC.
CONSULTING ENVIRONMENTAL ENGINEERS

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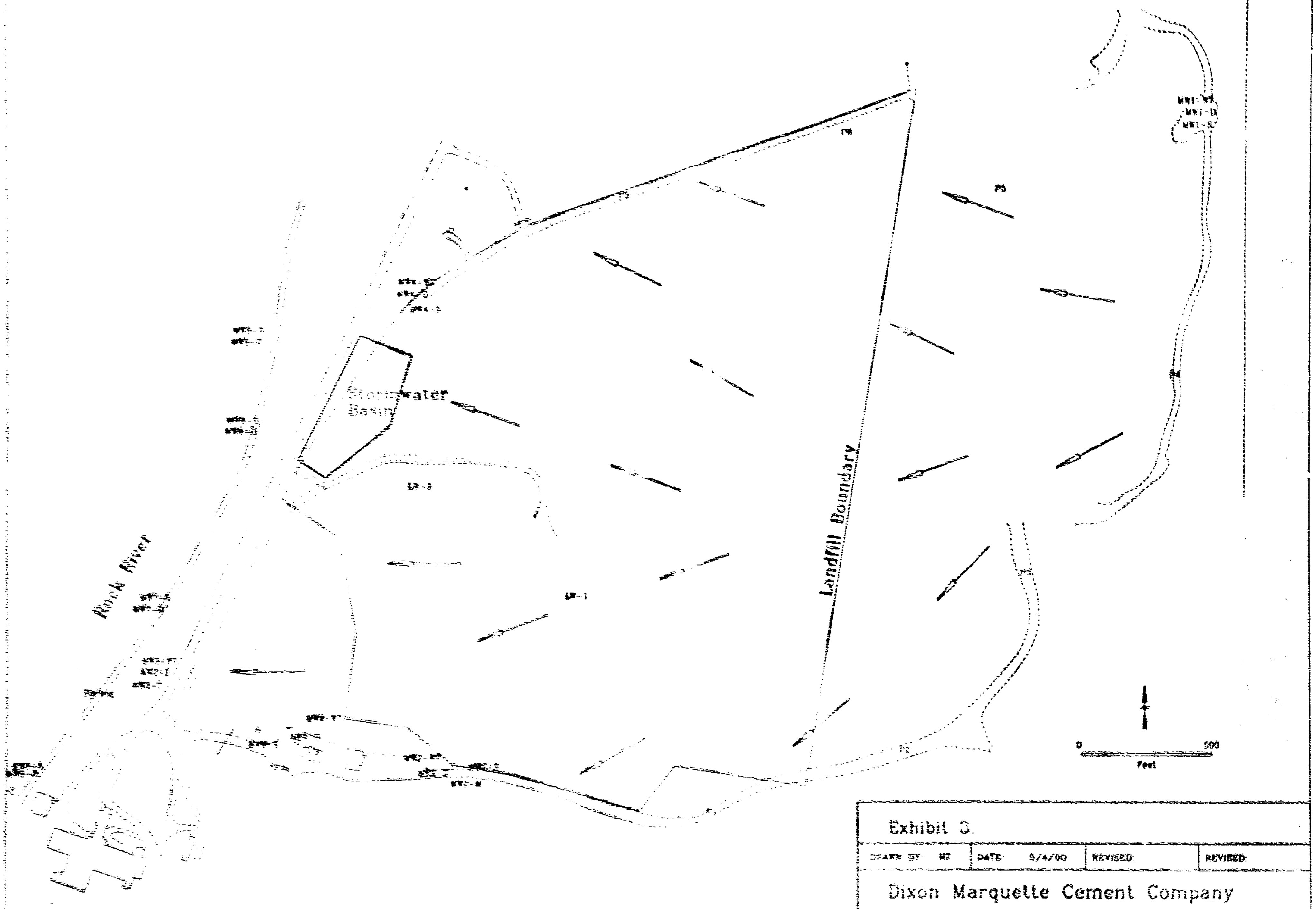


Arrows show groundwater flow direction in the Pecatonica Formation.

Exhibit 3			
DRAWN BY: MT	DATE: 5/4/00	REVISED:	REVISED:
Dixon Marquette Cement Company			
PRESTON ENGINEERING, INC. CONSULTING ENVIRONMENTAL ENGINEERS			DRAWING NUMBER 95-51610

Exhibit 4

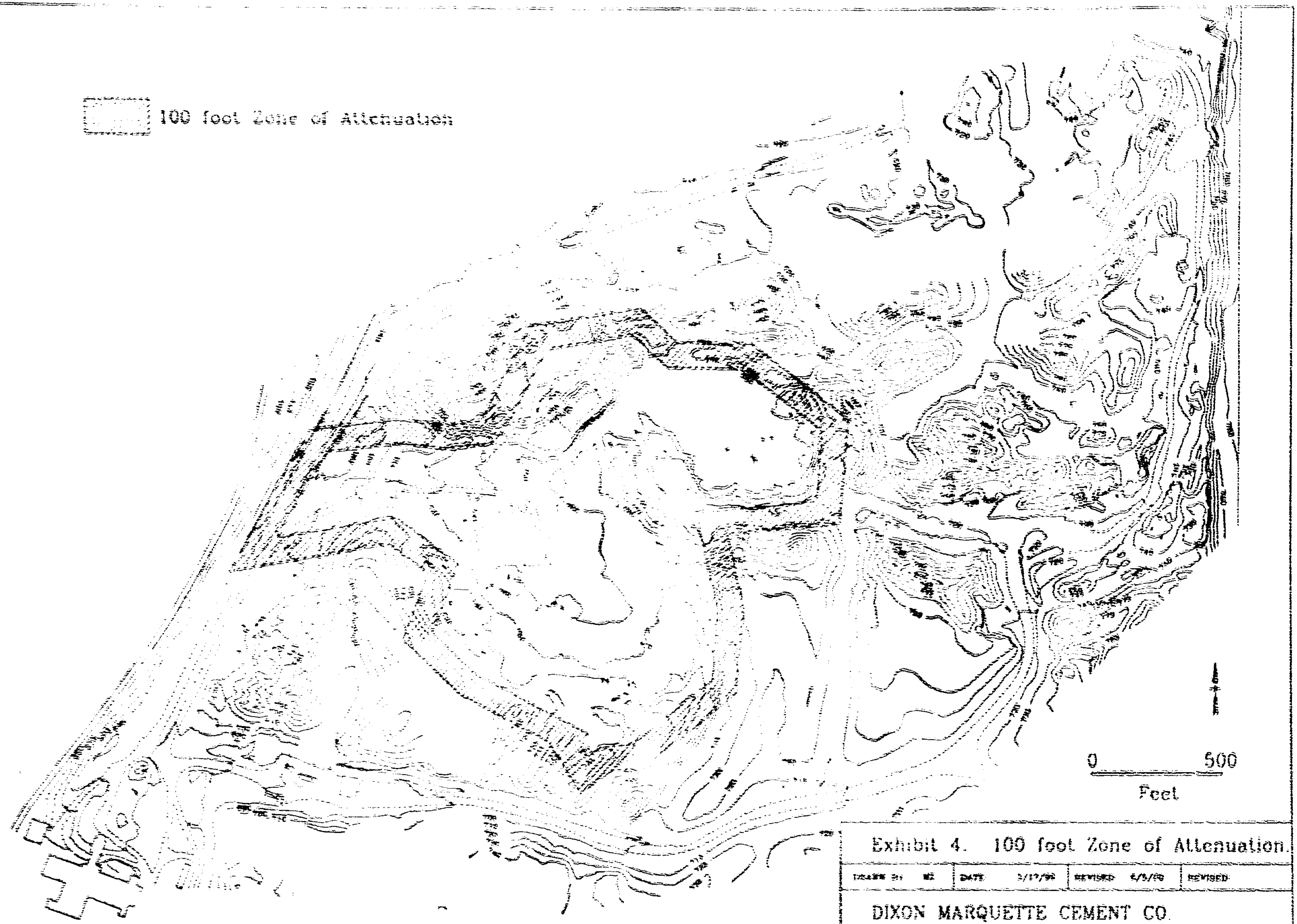


Exhibit 4. 100 foot Zone of Attenuation.

DRAWN BY | DATE | REVISED | REVISED

DIXON MARQUETTE CEMENT CO.

PRESTON ENGINEERING, INC.
CONSULTING ENVIRONMENTAL ENGINEERS

DRAWING NUMBER

Exhibit 5

Hydrogeologic Report

Dixon Marquette Cement

March 2001

Prepared by

Preston Engineering, Inc.

4436 N. Brady Street, Davenport, Iowa

Mark W. Zell

Mark W. Zell

Licensed Professional Geologist in Illinois #[illegible]

License expires March 31, 2003

CONTENTS

ATTACHMENTS

1.0 Introduction

This report describes the geologic and hydrologic conditions at the Dixon Marquette Cement Company site near Dixon, Illinois, and the surrounding area. Information from published material and from field studies at the site that were completed by Preston Engineering, Inc. and Versar, Inc. was used. Wells and piezometers were installed in and around the landfill. The wells and the Rock River were sampled to establish the chemical characteristics of the groundwater and surface water. Hydraulic conductivity tests were conducted on the monitoring wells. A study of bedrock structure and joint patterns was completed. The information from the published sources and from the site investigation is presented and interpreted in this report.

2.0 Geologic Setting

2.1 Regional Geology

The area within 10 miles of Dixon has Ordovician age bedrock near the surface, with exposures along the Rock River. The bedrock includes (in order of increasing age) the Maquoketa, Galena, Platteville, Ancell, and Prairie du Chien Groups, and is mostly limestone, dolomite, sandstone, and some shale. The Maquoketa and Galena Groups consist of shale, limestone, and dolomite, and they outcrop to the southwest of Dixon. The Platteville Group consists of limestone and dolomite, and it outcrops in the Dixon area. It is primarily limestone of the Mifflin Formation in the Platteville Group that is mined at the Dixon Marquette Cement plant. To the northeast of Dixon, sandstone of the Ancell Group and dolomite of the Prairie du Chien Group outcrop. Locally, Pennsylvanian shale occurs in fissures and sinkholes in the Platteville Group.

The sequence of rocks shows increasing age from southwest to northeast, and the rocks dip to the southwest. The rocks lie on the flank of the Ashton Arch and at the southern end of the Wisconsin Arch. The rocks dip away from the center of the Ashton Arch, which trends northwest to southeast in the area east of Dixon. Paralleling the arch is the Sandwich fault zone, which runs from near Oregon to near Manhattan. On the upthrown southwestern side of the fault, Cambrian rocks have been brought to the surface. The fault zone is 0.5 to 2 miles wide and is about 85 miles long. The greatest cumulative displacement along the zone is about 800 feet.

The Rock River flows to the southwest near Dixon, and it has cut into the bedrock. The St. Peter sandstone is exposed along the river near Grand Detour, and the Platteville Group is exposed near Dixon. The river makes a sharp horseshoe-shaped meander near Grand Detour, possibly as a consequence of joint systems in the bedrock.

Unconsolidated Holocene deposits consist of alluvium in the Rock River valley, glacial till deposits, and wind-blown loess.

2.2 Site Geology

The surface material has been disturbed in and near the CKD disposal area. Overlying the bedrock are two types of material: soil and rock spoil from mining operations, typically placed in windrows on top of the Pecatonica Formation, and cement kiln dust, clinker, and other debris, typically placed on top of the Pecatonica Formation and the spoil. The thickness of the spoil reaches 80 to 90 feet in the western part of the landfill. The thickness of the CKD reaches about 60 feet near the center of the landfill.

A description of the stratigraphic column at the Dixon Marquette Cement plant was published in the Illinois State Geological Survey Circular 502 (Willman and Kolata, 1978). In the circular, the Grand Detour, Mifflin, and Pecatonica Formations are described as they appear in outcrop. These three formations are exposed at the site, and are described below based on descriptions by Willman and Kolata, field observations of outcrops by Preston Engineering, Inc., and examination of rock cores from holes drilled for monitoring wells.

The Grand Detour Formation is approximately 32 feet thick, and consists of the Forreston member (12 feet thick) and the Stillman member (20 feet thick). The Forreston member is a gray argillaceous fossiliferous limestone, and the Stillman member is a gray limestone with dolomite mottling. There are shaly partings in both members. The Grand Detour Formation is exposed in cliffs on the west side of Sink Hollow Road where it and the underlying Mifflin Formation have been mined.

The Mifflin Formation is the primary source of the limestone used by Dixon Marquette in the manufacture of Portland cement. It consists of about 18 feet of gray and yellow argillaceous fossiliferous limestone with shale partings. There is a 4 to 6 inch thick layer of dolomitic shale at the top, underlain by a layer of bentonite that is usually less than 0.5 inch thick. The Mifflin Formation has thin wavy bedding, usually 0.5 to 3 inches thick, and has numerous vertical joints. The limestone within the Mifflin Formation typically has five percent or less magnesium carbonate. It is exposed on the west side of Sink Hollow Road, on the east side of White Oak Lane, and in outliers in the mined areas around the landfill where the rock was not suitable for use in cement manufacturing or not accessible.

The Pecatonica Formation consists of about 34 feet of limestone and dolomite. Four members are present at the site: the Medusa member, a dolomite-mottled limestone with a corrosion surface at the top; the New Glarus member, consisting of dolomite and dolomite-mottled limestone with a thin shaly bed at the top; the Dane member, a limestone; and the Chana member, a sandy dolomite. The bedding is thicker than in the Mifflin Formation, and is about 2 to 12 inches thick. It has wavy shaly bedding in places, and some stylolites, suggesting that some carbonate has been dissolved. The lower Pecatonica is vuggy in places, which increases the porosity of the rock. The dolomite in the Pecatonica Formation typically has between 5 and 25 percent magnesium carbonate. The top of the Pecatonica is exposed in much of the area around the CKD landfill at Dixon Marquette, and probably directly underlies most of the landfill. It is also exposed along the Rock River west of the landfill. The Pecatonica was exposed around the landfill as a result of mining of the overlying Mifflin Formation. Dixon Marquette uses the Pecatonica Formation as a source of construction aggregate.

The Platteville Group rocks have numerous joints, and some can be traced on horizontal surfaces for several hundred feet. The joints are enlarged in places, which provide local areas of extremely high permeability. The dominant bearing of the joints is between N80°E and N80°W. There is a secondary trend with bearings between N10°W and N10°E. Over 90 percent of the joints are within 5° of vertical.

in most areas in and immediately around the landfill the rock overlying the Pecatonica Formation has been mined. The mined rock was blasted prior to removal. The blasting procedure consisted of drilling vertical holes from the surface to the top of the Pecatonica Formation, and detonating explosives in the holes. The holes were horizontally spaced about 10 feet apart. The rock overlying the Pecatonica was fractured by the blasting and was hauled to the plant. The blasting was designed to allow removal of the Mifflin Formation without significant damage to the Pecatonica Formation. The top of the Pecatonica Formation has been used as a work surface by heavy equipment to load and haul the blasted rock, and it remains largely intact today. The effects of blasting can be seen in the Pecatonica Formation, however. Numerous circular potholes, roughly 3 to 4 feet in diameter, mark the top of the rock. The holes are usually no deeper than about 0.5 foot, and are spaced about 10 feet apart. Fractures radiate in a spoke-like pattern from many of the holes, and intersect fractures from neighboring holes. The potholes originated at the base of blast holes made in the overlying formations, and the fractures resulted from the blasting. The vertical extent of the blast fractures was not observed.

The removal of the Mifflin Formation in the mined areas has revealed the structure on top of the Pecatonica Formation. The Pecatonica Formation dips gently westward, but locally there are high spots or small domes. The domes range from about 50 feet to several hundred feet in diameter, and have up to about 10 feet of relief in the larger domes. Typically the Mifflin Formation above the domes is extensively jointed and has a chemical composition that makes it unsuitable for cement production.

Underlying the Pecatonica and not exposed at the site is the Ancell Group, which consists of the Glenwood and St. Peter Formations. The Glenwood Formation consists of 8 to 10 feet of gray fine quartz sandstone and gray siltstone. The sandstone is mottled and well cemented. The quartz grains are poorly sorted and range in size from 0.1 mm to 0.5 mm. The poor sorting distinguishes the sandstone from the underlying St. Peter Formation, which is well sorted and has sand grains of about 0.5 mm. Within the Glenwood Formation sandstone are two siltstone layers that are 1 to 2 feet thick. The upper siltstone layer is sandy at the top. The siltstone separates easily along bedding planes, and is more friable than the sandstone. Outcrops of the Glenwood in the area are rare, probably because of its thickness and because the siltstone is easily eroded. The elevation of the top of the Glenwood Formation was determined at four monitoring well locations around the landfill, and it was found that the rock strikes N 5° W and has a dip of 0.9° to the west.

The St. Peter Formation is a uniform nearly pure quartz sandstone. A water supply well drilled at the Dixon Marquette site in 1992 encountered 359 feet of sandstone of the St. Peter Formation. It consists almost entirely of fine to medium, well sorted, well rounded, poorly cemented quartz grains. There are some shaly layers and carbonate-cemented layers near the top of the formation.

Cross sections of the site are included in this report. A description of geologic materials at the monitoring well locations is also included.

3.0 Hydrologic Setting

3.1 Regional Hydrology

Surface water drainage in the area around Dixon is dominated by the Rock River and its tributaries. The Rock River in Illinois flows to the southwest from north of Rockford to Rock Island. Tributaries flowing from the upland areas create a dendritic drainage pattern. There is a maximum of about 190 feet of relief within 3 miles of downtown Dixon.

The important aquifers in the area are the St. Peter Formation and the Mt. Simon Formation, both of which are sandstone. The St. Peter Formation is exposed to the northeast of Dixon, in the area around Grand Detour. The exposed area is probably a recharge zone for the aquifer. The rock dips gently to the southwest. The Mt. Simon Formation consists of about 1500 feet of sandstone with some shale, with the top of the formation found at about 1000 feet deep in the Dixon area. The City of Dixon maintains several water supply wells one to two miles from the landfill. They have a total depth of 1260 to 1870 feet, and obtain water from the St. Peter, Eminence, and Mt. Simon Formations.

3.2 Site Hydrology

Prior to mining, the area of the landfill was hilly with a northwest-trending valley leading to the Rock River. There was 80 to 100 feet of relief. The extreme west side of the landfill was used for railroad sidings. The Mifflin Formation may have been thin or absent on the former valley floor on the northwest side of the landfill, and possibly no rock was mined in that area. Mining probably progressed up the dip of the rocks to the east and northeast to aid in draining the work area.

Currently, surficial drainage consists of small streams that parallel roads around the landfill. The configuration of mined and filled areas around the landfill prevents good drainage, and small ponds have formed. On the east side of the landfill groundwater exits the rock faces near Sink Hollow Road and forms ponds. Some of the ponds have outlets to ephemeral streams, and others do not appear to have an outlet. Those with no outlet must drain through evaporation and infiltration. In 1999, a storm water basin was constructed on the west side of the landfill. The basin was designed to restrict storm water runoff from flowing directly into the Rock River and decrease the amount of solids being discharged.

The Pecatonica Formation is exposed at the surface or underlies most of the fill material in the landfill. The rock is extensively jointed, and surface water and groundwater can seep into the rock via the joints. The vertical extent of the joints was not determined during the field investigation. On the east side of the landfill along a road, water was observed to be flowing into an opening in the rock. The flow rate into the opening during a period of rain in May 1998 was estimated at 10 to 20 gallons per minute. The water entering the hole was turbid and pale yellow.

The Pecatonica is exposed along the Rock River to the west of the landfill. Springs occur along the exposures, and the water flows into the river. The largest of the springs in this area, located along White Oak Lane east-southeast of the landfill, exits a joint in the rock in the upper part of the Pecatonica Formation, about 5 feet below the contact with the overlying Mifflin Formation. The flow during several days in March 1998 was estimated at 100 gallons per minute, or about 160 acre-feet per year. The flow approximately doubled shortly after a period of heavy rain in May 1998. The water flowing from the spring was observed to be clear on several occasions in March, and was turbid and pale yellow on two occasions in May. Because of the fluctuations in discharge and changes in turbidity that are apparently associated with precipitation, it is thought that there exist connections between surface water and the joint from which the spring issues.

In some places the Pecatonica Formation contains shaly or clay layers that impede the vertical migration of groundwater. Groundwater was observed to be discharging immediately above a thin clay layer in the Pecatonica Formation on the east side of the coal storage area north of the landfill. This clay layer was similar in appearance and thickness to the bentonite layer that occurs near the top of the Mifflin Formation. Groundwater was also observed to be exiting the rock above the bentonite layer in the Mifflin Formation near Sink Hollow Road. The groundwater discharges at these points indicates that layers of clay less than 0.5 inch thick can be effective in redirecting the vertical flow of groundwater in the Platteville Group.

The uppermost aquifer at the site is almost entirely contained within the Pecatonica Formation. The top of the aquifer is most commonly about one to five feet below the top of the Pecatonica Formation, or what remains of the formation in areas where the top portion of it was removed during mining. In areas with thick CKD deposits the top of the aquifer is about five feet above the Pecatonica Formation, and is within the CKD. The bottom of the aquifer coincides with the contact between the Pecatonica Formation and the underlying Glenwood Formation. The depth of this contact ranges from about 34 to 100 feet. The Glenwood Formation consists of sandstone and shale, and it acts as an aquitard. The depth of the top of the aquifer ranges from about zero to 90 feet at the facility. The thickness of the aquifer ranges from about 30 to 43 feet, and is thickest where it underlies the CKD disposal area.

Quarterly measurements of the water table elevation in the uppermost aquifer at four monitoring well locations around the CKD disposal area were made from April 1998 to November 2000. The measurements indicated that the water table had a gradient of about 0.02, and was flowing west and southwest toward the Rock River. The difference between the highest and lowest measured elevation of the water table at the easternmost well, MW1-S, was 0.13 feet. At the westernmost well, MW3-S, the difference was 2.35 feet. The potentiometric surface map included in this report shows a slight mound of water beneath the CKD landfill. If groundwater is mounded in the CKD area, the flow direction should be slightly northwest and southwest, as well as west, from the CKD area. The water table and the direction of groundwater flow in the uppermost aquifer appear to be stable throughout the year, based on the quarterly measurements. Short term temporal variations in the elevation of the water table have not been investigated.

Quarterly measurements of the potentiometric surface were also made in wells screened in the St. Peter Sandstone. Data from the four deep wells indicated that the water table has a westward gradient. The most fluctuation over one year of measurements was at well MW3-D, located on the west side of the landfill. The fluctuation was 2.33 feet. The water table and the direction of groundwater flow in the St. Peter aquifer appear to be stable throughout the year, based on the quarterly measurements. Short term temporal variations in the elevation of the potentiometric surface have not been investigated.

The potentiometric surface in both deep and shallow wells apparently dropped by about 1 to 3 feet between Spring 1998 and Summer 1998. The water levels had not recovered to Spring 1998 conditions by February 1999. It is not known if the fluctuation is correlated to a seasonal effect such as water uptake by vegetation or wet and dry periods.

The hydraulic conductivity of the area around the well screens at 22 on site monitoring wells was measured by means of slug tests. Tests were conducted by positioning a pressure transducer beneath the water in the well, quickly submersing a solid slug, and recording water level changes in response. After the water level stopped falling and was at or near the initial static water level, the slug was quickly removed and the response of the water level was recorded again. An In-Situ pressure transducer and data logger were used to record the test data. The data was evaluated using the method of Bouwer and Rice. The data for the test at well MW5-S did not have sufficient resolution to conduct an adequate analysis. The following table shows the calculated hydraulic conductivity at each of the other wells.

Table 1. Hydraulic Conductivity at Dixon Marquette Cement Company Monitoring Wells

Well	K (feet/minute)	K (centimeters/second)
MW1-S	0.00735	0.0037
MW2-S	0.0000228	0.000012
MW3-S	0.000155	0.000079
MW4-S	0.00195	0.00099
MW6-S	0.0089	0.0045
MW7-S	0.015	0.0078
MW8-S	0.014	0.0073
MW9-S	0.000045	0.000023
MW1-D	0.00024	0.00012
MW2-D	0.0108	0.0055
MW3-D	0.00061	0.00031
MW4-D	0.000817	0.00042
MW5-D	0.031	0.016
MW6-D	0.0061	0.0031
MW7-D	0.0030	0.0015
MW8-D	0.0024	0.0012
MW9-D	0.0028	0.0014
MW2-M	0.000000833	0.00000042
MW2-WT	0.0037	0.0019
MW3-WT	0.00013	0.000066
MW9-WT	0.0089	0.0045

The permeability of the Pecatonica Formation varies greatly both horizontally and vertically, and is probably dependent on the proximity of joints. Tests on monitoring wells installed at the base of the Pecatonica Formation showed that the highest measured hydraulic conductivity was about 300 times more than the lowest conductivity.

Based on the measured hydraulic conductivity and gradient, and estimates of the porosity of the rock, the groundwater flow velocity in the Pecatonica Formation ranges from 0.001 to 38 feet per day. Actual flow rates may be several orders of magnitude higher in areas with large fractures.

The St. Peter Formation underlies the Glenwood Formation, and consists of uniform fine to medium quartz sandstone. It is an important aquifer in the area. Tests on monitoring wells completed in the formation on site (the deep wells) show that the conductivity of the sandstone varies from 0.00024 to 0.031 feet per minute. The water in the St. Peter Formation may be artesian on the west side of the disposal area.

Between the Pecatonica Formation and the St. Peter Formation is sandstone and siltstone of the Glenwood Formation. Injection tests were conducted in the formation at the time of monitoring well installation to determine the permeability of the shale within the Glenwood Formation. The test apparatus consisted of a double packer that was used to isolate the interval of the formation to be tested, a water pump capable of increasing the water pressure between the packers, a pressure gauge that measured the water pressure between the packers, and a flow meter that measured the amount of water moving into the formation. After sealing the packers, the water pressure was increased in increments and then held steady for 30 minutes. At well MW2-D some flow was measured during the test, but it could not be determined if both packers had properly sealed against the borehole wall. Because the bottom packer may have leaked and the water flowed into a more permeable underlying formation, the validity of the injection test at well MW2-D is in doubt. The test apparatus was modified for tests on other wells by removing the bottom packer, and drilling only to the bottom of the section of rock to be tested. No leakage was seen around the single packer during these tests, and any flow should have been into the rock below the packer. Because no flow was measured during the tests, the calculated conductivities represent an estimated maximum conductivity based on the sensitivity of the flow meter that was used and the pressure that was applied. The results of aquifer tests on the Glenwood Formation are summarized in the following table.

Table 2. Hydraulic Conductivity of the Glenwood Formation*

Well	Hydraulic Conductivity (feet/minute)	Hydraulic Conductivity (cm/second)
MW1-D	$<5.83 \times 10^{-7}$	$<2.96 \times 10^{-7}$
MW2-M	8.33×10^{-7}	4.2×10^{-7}
MW3-D	$<4.12 \times 10^{-7}$	$<2.09 \times 10^{-7}$
MW4-D	$<5.27 \times 10^{-7}$	$<2.67 \times 10^{-7}$
MW7-D	1.3×10^{-4}	6.68×10^{-5}
MW8-S	4.4×10^{-7}	2.22×10^{-7}
MW9	1.4×10^{-7}	6.86×10^{-7}

*Because no flow into the rock was measured during injection tests at wells MW1-D, MW3-D, and MW4-D, the resulting hydraulic conductivities represent a maximum value based on the sensitivity of the flow measuring device. The hydraulic conductivity at well MW2-M was measured with a slug test. The hydraulic conductivity at wells MW7-D, MW8-S, and MW9 was determined by laboratory analysis of rock core samples

No evidence of vertical fractures was seen in core samples from the formation. A monitoring well was installed in the Glenwood Formation (MW2-M), and a slug test was conducted. The hydraulic conductivity was calculated to be 8.3×10^{-7} feet per minute, or about 300 to 9000 times less than the overlying dolomite.

There are additional sandstone formations underlying the St. Peter Formation that serve as aquifers, but because of their depth and isolation from the surficial activities at the landfill, they are not discussed here.

Maps of the site showing the potentiometric surface of the aquifers in the Pecatonica and St. Peter Formations are included in this report.

3.3 Climatic Conditions

Information on the climate at Dixon was obtained from the Midwest Climate Center in Springfield, Illinois. Between 1961 and 1990 the average annual temperature was 48.1°F, the average annual maximum was 58.7°, and the average annual minimum was 37.5°. Extreme temperatures from 1893 to 1996 were -27° and 110°. The average annual precipitation between 1961 and 1990 was 35.58 inches, and between 1893 and 1996 it ranged from 18.49 inches in 1994 to 47.53 inches in 1965. Ten-year 24-hour rainfall events produce between 4.5 and 5.0 inches of rain. The number of days per year with a base temperature of 32° or more averaged 168. Wind speed and direction for Rockford, Illinois (30 miles northeast of Dixon) averaged 9.8 miles per hour, and the average direction was from the west-northwest during the winter and from the south at other times.

4.0 Monitoring Well Installation

During March and April 1998, nine monitoring wells were installed around the CKD disposal site. The wells were installed in pairs at three sites, and three wells were installed at one site. Additional wells were installed along White Oak Lane and south of the landfill in June 1999. Wells with screens at or near the water table were installed around the landfill in July 1999.

The IEPA defines the zone of attenuation (ZA) around a landfill as being that area within 100 feet from the edge of the landfill and extending from the ground surface to the bottom of the uppermost aquifer, excluding the volume occupied by the waste. None of the monitoring wells at the facility are within this regulatory ZA. The downgradient wells range from 320 to 610 feet from the ZA, and the background wells are about 1670 feet from the ZA. It has been demonstrated that groundwater that has been affected by leachate has migrated beyond the regulatory ZA. Practically, the zone of attenuation is a swath between the waste and the Rock River. A map showing this existing ZA is attached. Well placement was determined based on the existing ZA, rather than the regulatory definition of ZA.

Well locations were specified based on the location of the potential source of contaminants (the CKD landfill), the assumed groundwater flow direction, and accessibility. The width of any potential contaminant plume downgradient from the landfill was established as the maximum width of the area containing CKD, normal to the groundwater flow direction. The groundwater flow direction was assumed to be from the landfill toward the Rock River, i.e., in a west-southwest direction. The maximum width of the landfill perpendicular to this direction, and the width of any contaminant plume, was estimated to be 1550 feet wide. One set of wells, MW1-S and MW1-D, was located north-northeast of the landfill in the assumed upgradient location. These wells were intended to access groundwater that would be likely to travel beneath the landfill, but that had not yet been influenced by any potential leachate from the landfill. Wells MW2-S and MW2-D were located near the southern edge of the potential plume, and wells MW4-S and MW4-D were located near the northern edge of the potential plume. Wells MW3-S and MW3-D were located downgradient of the landfill and near the centerline of the potential plume, and they are in the existing zone of attenuation. Wells along White Oak Lane (MW5-S, MW5-D, MW6-S, MW6-D, MW7-S, MW7-D, MW8-S, and MW8-D) and between wells MW2 and MW3 were installed to better define the extent of groundwater affected by leachate. Wells screened at the water table were added to give a more complete three-dimensional picture of the groundwater quality.

Wells at each location are screened at different depths and formations. Wells designated with the suffix WT are screened at or near the water table, which is within the Pecatonica Formation near the landfill. Wells with the suffix S are screened in alluvium along White Oak Lane, or at the base of the Pecatonica elsewhere. Wells designated D are screened in the St. Peter Formation. One well with a suffix M was screened in the Glenwood Formation.

The St. Peter wells near the landfill were constructed by first drilling to the top of the first shale layer within the Glenwood Formation, and installing a 6-inch steel casing from the shale to the surface. The casing was grouted in place with high solids bentonite grout. This effectively sealed the base of the casing and prevented leakage of groundwater to lower aquifers. Drilling then proceeded inside the steel casing through the remaining Glenwood Formation and into the St. Peter Formation. Potable water was used for drilling fluid.

In all but one well, a 10 foot long PVC screen with 0.010-inch slots was used at the base of the borehole. The exception was well MW2-M, which has a 2 foot long screen. Centralizers were used on the screens in the deep wells to insure that the filter pack was of uniform thickness. Sand was placed around the screens up to a point 2 feet above the screens. About 3 feet of bentonite pellets were then placed above the sand, and bentonite grout was tremied from the top of the pellets to the surface.

Well construction reports were completed for the monitoring wells on forms provided by the Illinois Department of Public Health (IDPH). These forms were submitted to IDPH, and copies are attached to this report.

The surveyed elevations of the wells and the static water levels are presented in the following tables.

Table 3. Monitoring well and piezometer data.
(all elevations are in feet above mean sea level)

Well	Easting	Northing	Elevation of the top of casing	Ground surface elevation	Top of screen elevation	Bottom of well elevation	Depth to water from the top of casing (11/89)	Water level elevation (03/90)
MW1-S	5605.2	11026.0	759.93	756.26	708.8	697.9	3.80	756.13
MW1-D	5809.4	11060.0	759.26	75[illegible].64	668.8	658.8	71.44	668.42
MW1-WT	56[illegible]	11[illegible]	759.26	756.56	758.8	728.8	6.65	752.69
MW2-S	2557.5	11022.6	692.65	690.60	66[illegible].2	561.2	7.82	685.66
MW2-D	5556.0	12005.6	692.84	690.52	669.0	646.7	8.52	684.58
MW2-D	5[illegible].0	11982.0	692.[illegible]	690.[illegible]	66[illegible].5	655.7	30.36	658.57
MW2-WT	5557.8	11972.2	693.10	690.59	687.7	677.2	10.20	682.90
MW3-S	5[illegible].0	9[illegible].8	690.20	687.50	66[illegible].8	658.8	24.00	665.20
MW3-D	[illegible]	[illegible]	699.26	696.26	656.2	656.2	46.29	656.87
MW3-WT	5706.8	9[illegible]	696.09	696.00	[illegible]	[illegible]	28.60	6[illegible]
MW4-S	[illegible]	11[illegible]	698.79	692.60	[illegible]	[illegible]	20.02	678.[illegible]
MW4-D	[illegible]	11[illegible]	695.00	692.00	[illegible]	651.0	46.[illegible]	658.[illegible]
MW4-WT	5[illegible].7	11[illegible]	690.80	692.40	[illegible]	[illegible]	20.50	[illegible]
MW5-S	[illegible]	11[illegible]	666.50	65[illegible]	660.0	650.0	7.65	660.69
MW5-D	[illegible]	11[illegible]	658.50	65[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MW6-S	[illegible]	11[illegible]	652.77	65[illegible]	661.2	638.2	[illegible]	[illegible]
MW6-D	[illegible]	[illegible]	6[illegible]	655.6	[illegible]	[illegible]	[illegible]	[illegible]
MW7-S	5[illegible]	[illegible]	[illegible]	653.88	650.8	[illegible]	[illegible]	6[illegible]
MW7-D	[illegible]	[illegible]	[illegible]	659.20	6[illegible]	[illegible]	[illegible]	[illegible]
MW8-S	[illegible]	[illegible]	65[illegible]	650.20	660.6	[illegible]	[illegible]	6[illegible]
MW8-D	[illegible]	11[illegible]	[illegible]	6[illegible]	620.0	[illegible]	7.26	[illegible]
MW9-S	[illegible]	11[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	677.[illegible]
MW9-D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	28.[illegible]	[illegible]
MW9-WT	[illegible]	11[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.[illegible]	[illegible]
MW10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MW11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
P1	[illegible]	[illegible]	[illegible]				[illegible]	[illegible]
P2	[illegible]	[illegible]	[illegible]				1.[illegible]	[illegible]
P3	[illegible]	[illegible]	[illegible]				[illegible]	[illegible]
P4	[illegible]	[illegible]	[illegible]				[illegible]	[illegible]
P5	[illegible]	[illegible]	[illegible]				[illegible]	[illegible]
P6	[illegible]	[illegible]	[illegible]				[illegible]	[illegible]
P7	[illegible]	[illegible]	[illegible]				[illegible]	690.07

Table 4. Elevations of the potentiometric surface in monitoring wells.
(all elevations are in feet above mean sea level)

Well	30-April-98	07-May-98	17-Jun-98	24-Jul-98	26-Oct-98	16-Feb-99
MW1-S	736.19	736.20	736.09	736.10	736.23	736.23
MW1-D	668.59	668.97	668.60	668.12	668.02	668.61
MW2-S	689.19	689.45	687.56	686.93	688.44	689.19
MW2-Ss	688.14	685.57	688.26	686.90	687.86	
MW2-D	662.46	662.44	661.01	660.08	660.44	661.44
MW3-S	669.49	669.26	668.24	667.14	667.65	667.63
MW3-D	647.92	647.60	645.56	645.59	646.01	646.23
MW4-S	683.87	683.63	680.59	677.35	682.10	682.33
MW4-D	657.85	657.70	655.03	653.24	655.30	655.82
LW-1			703.51	703.36	703.27	703.60

Potentiometric surface maps for the St. Peter and Pecatonica formations are included in Attachment 6 of this document.

5.0 Groundwater Sampling

Prior to sampling, three well volumes of water were purged from each well with dedicated PVC bailers. The groundwater samples were collected within 24 hours of purging the well. The samples were placed directly into the proper laboratory containers, and placed in a cooler with ice. During the 1998 and 1999 events, samples to be analyzed for dissolved metals were filtered in the field with single-use 0.45 µm filters. A turbidity requirement was implemented during the third quarter of 2000. If the turbidity of the sample for metal analysis was greater than 5 NTU, two samples, one filtered and one not filtered, were collected. Samples that were filtered were identified by the suffix "F" after the well name.

In 1998 and 1999, the monitoring wells were sampled for volatile, semi-volatile, and inorganic compounds. Most of the volatile and all of the semi-volatile compounds were not detected in the background, downgradient, and leachate wells. If the compound was not detected in all of the wells after two rounds of sampling, it was eliminated from the list of sampling. Currently there are thirty-four inorganic constituents, five volatile compounds, and pH that are being analyzed in the groundwater, leachate, and surface water.

6.0 Groundwater Quality Standards

The groundwater quality standard for any constituent is the concentration of that constituent in the background groundwater. Wells MW1-WT, MW1-S, and MW1-D, screened at the water table in the uppermost aquifer (in the Pecatonica Formation), the base of the Pecatonica Formation, and the St. Peter Formation, respectively, are located upgradient from the landfill and are not expected to be influenced by leachate from the landfill. Concentrations of constituents in the waters from these three wells represent background conditions, and were used to determine the groundwater quality standards.

Statistical tests were used on data from background water samples for the list of compounds that were analyzed at Dixon Marquette Cement Company. For most parameters there were four to fourteen sets of analytical data. The sampling frequency has not been great enough to establish if short term fluctuations in water quality occur, such as those that might occur because of rapid surface water influx, nor has it been long enough to show if variations recur seasonally. The population distribution was assumed to be normal.

Because of the small sample sizes, Student's *t* distribution was applied to sample sets where all the data were above the detection limit. In cases where 15 percent or less of the data was below the detection limit, the values below the detection limit were replaced with one-half of the detection limit. Student's *t* test was then applied. In cases where between 15 and 50 percent of the data was below the detection limit, Cohen's adjustment to the mean and variance was applied before Student's *t* test was applied. If 50 percent or more of the data was below the detection limit, a test of proportion will be used to determine if a downgradient well differs from the background well. For semi-volatile and volatile compounds, any detection is considered to be an increase above the background concentrations.

The concentrations of constituents that exceed the background concentrations at a level of significance of 0.01 were determined. In cases where none of the constituent was detected in the background well in any of the samples, any detection of the constituent in downgradient wells will be an exceedance of the background concentration. The following tables show each constituent and the minimum concentration that exceeds the background concentration, determined as described above, for the upper part of the uppermost aquifer (MW1-WT), the lower part of the uppermost aquifer (MW1-S), and the aquifer in the St. Peter Formation (MW1-D). Data in tables in Attachment 4 show which constituents in groundwater around the landfill exceed the background concentrations. Wells LW-1 and LW-3 were compared to well MW1-WT, and alluvial wells were compared to well MW1-S.

Table 5. Minimum Concentrations of Volatile Organic Compounds that Exceed Background Concentrations, in µg/l. *

Parameter	Water Table	Base of Pecatonica	Top of St. Peter
Acetone	50	50	50
Acrolein	50	50	50
Acrylonitrile	50	50	50
Benzene	5	5	5
Bromobenzene	5	5	5
Bromochloromethane	5	5	5
Bromodichloromethane	5	5	5
Bromoform	5	5	5
Bromomethane	10	10	10
n-butylbenzene	10	10	10
sec-butylbenzene	10	10	10
tert-butylbenzene	10	10	10
Carbon disulfide	10	10	10
Carbon tetrachloride	5	5	5
Chlorobenzene	5	5	5
Chlorodibromomethane	5	5	5
Chloroethane	10	10	10
Chloroform	5	5	5
Chloromethane	10	10	10
2-chlorotoluene	5	5	5
4-chlorotoluene	5	5	5
Dibromomethane	5	5	5
1,2-dichlorobenzene	5	5	5
1,3-dichlorobenzene	5	5	5
1,4-dichlorobenzene	5	5	5
Dichlorodifluoromethane	10	10	10
1,2-dichloroethane	5	5	5
1,1-dichloroethane	5	5	5
1,1-dichloroethene	5	5	5
cis-1,2-dichloroethene	5	5	5
trans-1,2-dichloroethene	5	5	5
trans-1,4-dichloro-2-butene	10	10	10
1,2-dichloropropane	5	5	5
1,3-dichloropropane	5	5	5
2,2-dichloropropane	5	5	5
1,1-dichloropropene	5	5	5
1,3-dichloropropene	10	10	10
cis-1,3-dichloropropene	5	5	5
trans-1,3-dichloropropene	5	5	5

Table 5. Minimum Concentrations of Volatile Organic Compounds that Exceed Background Concentrations, in µg/l. *

Parameter	Water Table	Base of Pecatonica	Top of St. Peter
Ethylbenzene	5	5	5
2-hexanone	5	5	5
Hexachlorobutadiene	10	10	10
Iodomethane	10	10	10
Isopropylbenzene	10	10	10
p-isopropyltoluene	10	10	10
Methylene chloride	5	5	5
Methyl ethyl ketone	10	10	10
4-methyl-2-pentanone	5	5	5
Tetrahydrofuran	5	5	5
Vinyl acetate	10	10	10
n-propylbenzene	10	10	10
Styrene	5	5	5
1,1,1,2-tetrachloroethane	5	5	5
1,1,2,2-tetrachloroethane	5	5	5
Tetrachloroethene	5	5	5
Toluene	5	5	5
1,2,3-trichlorobenzene	5	5	5
1,2,4-trichlorobenzene	5	5	5
1,1,1-trichloroethane	5	5	5
1,1,2-trichloroethane	5	5	5
Trichloroethylene	5	5	5
Trichlorofluoromethane	10	10	10
1,2,3-trichloropropane	5	5	5
1,2,4-trimethylbenzene	10	10	10
1,3,5-trimethylbenzene	10	10	10
Vinyl chloride	10	10	10
o-xylene	10	10	10
m and p xylene	5	5	5
Xylenes, total	5	5	5

* Note: Any detection of a VOC is considered to be an exceedance of the background concentration.

Table 6. Minimum Concentrations of Inorganic Compounds that Exceed Background Concentrations, in mg/l.

Parameter	Water Table	Base of Pecatonica	Top of St. Peter
Aluminum	0.454	0.04	(0.44)
Antimony	0.001	(0.11)	0.001
Arsenic	0.003	(0.10)	(0.18)
Barium	0.227	0.091	0.051
Beryllium	0.001	0.001	0.001
Boron	(0.43)	(0.30)	(0.20)
Cadmium	0.001	0.001	0.001
Calcium	126.1	109	91.8
Chromium	0.002	0.002	(0.36)
Cobalt	0.008	0.003	(0.30)
Copper	0.012	0.005	0.006
Iron	0.9	0.465	0.819
Lead	0.006	0.001	(0.18)
Magnesium	50.5	53.9	73.9
Manganese	2.69	0.045	0.098
Mercury	(0.14)	0.0002	0.0002
Nickel	0.023	0.007	0.003
Potassium	4.0	(0.50)	2.3
Selenium	(0.28)	0.004	0.005
Silver	0.001	0.001	0.001
Sodium	53.7	12.8	3.85
Thallium	(0.28)	(0.11)	(0.11)
Vanadium	0.007	(0.44)	0.003
Zinc	0.014	0.058	0.023
Alkalinity, total	342	253	346
Alkalinity, bicarbonate	334	250	343
Ammonia nitrogen	(0.14)	(0.20)	(0.22)
BOD, 5-day	54.5	(0.5)	(0.5)
Chloride	25.4	30.8	4.1
COD	(0.43)	5.0	5.0
Cyanide	0.1	0.005	0.005
Fluoride	0.76	(0.19)	0.19
Nitrate	(0.14)	11.07	0.21
Oil and Grease	(0.25)	(0.143)	0.1
Sulfate	242.8	178.3	44.2
Total dissolved solids	488	540	383
TOC	17	4.5	5.1

(Values in parentheses are the ratios of samples with detectable concentrations to the total number of samples, and are not background concentrations.)

Table 6. Minimum Concentrations of Inorganic Compounds that Exceed Background Concentrations, in mg/l.

Parameter	Water Table	Base of Pecatonica	Top of St. Peter
Aluminum	0.454	0.04	(0.44)
Antimony	0.001	(0.11)	0.001
Arsenic	0.003	(0.10)	(0.18)
Barium	0.227	0.091	0.051
Beryllium	0.001	0.001	0.001
Boron	(0.43)	(0.30)	(0.20)
Cadmium	0.001	0.001	0.001
Calcium	126.1	109	91.8
Chromium	0.002	0.002	(0.36)
Cobalt	0.008	0.003	(0.30)
Copper	0.012	0.005	0.006
Iron	0.9	0.465	0.819
Lead	0.006	0.001	(0.18)
Magnesium	50.5	53.9	73.9
Manganese	2.69	0.045	0.098
Mercury	(0.14)	0.0002	0.0002
Nickel	0.023	0.007	0.003
Potassium	4.0	(0.50)	2.3
Selenium	(0.28)	0.004	0.005
Silver	0.001	0.001	0.001
Sodium	53.7	12.8	3.85
Thallium	(0.28)	(0.11)	(0.11)
Vanadium	0.007	(0.44)	0.003
Zinc	0.014	0.058	0.023
Alkalinity, total	342	253	346
Alkalinity, bicarbonate	334	250	343
Ammonia nitrogen	(0.14)	(0.20)	(0.22)
BOD, 5-day	54.5	(0.5)	(0.5)
Chloride	25.4	30.8	4.1
COD	(0.43)	5.0	5.0
Cyanide	0.1	0.005	0.005
Fluoride	0.76	(0.19)	0.19
Nitrate	(0.14)	11.07	0.21
Oil and Grease	(0.25)	(0.143)	0.1
Sulfate	242.8	178.3	44.2
Total dissolved solids	488	540	383
TOC	17	4.5	5.1

(Values in parentheses are the ratios of samples with detectable concentrations to the total number of samples, and are not background concentrations.)

Table 7. Minimum Concentrations of Semivolatile Compounds that Exceed Background Concentrations, in µg/l. *

Parameter	Water Table	Base of Pecatonica	Top of St. Peter
Alachlor	1	1	1
Atrazine	1	1	1
Bis(2-ethylhexyl)phthalate	1	1	1
Bis(2-chloromethyl)ether	1	1	1
Di-n-butylphthalate	1	1	1
Diethyl phthalate	1	1	1
Dimethyl phthalate	1	1	1
Isophorone	1	1	1
Naphthalene	1	1	1
p-cresol	1	1	1
Parathion	1	1	1
Pentachlorophenol	1	1	1
Phenol	1	1	1
Aldrin	0.034	0.034	0.034
gamma-BHC	0.025	0.025	0.025
Chlordane	0.037	0.037	0.037
4,4'-DDT	0.091	0.091	0.091
Dieldrin	0.044	0.044	0.044
Endrin	0.039	0.039	0.039
Heptachlor	0.040	0.040	0.040
Heptachlor Epoxide	0.032	0.032	0.032
Methoxychlor	0.176	0.176	0.176
Toxaphene	0.086	0.086	0.086
PCB-1016	0.050	0.050	0.050
PCB-1221	0.054	0.054	0.054
PCB-1232	0.065	0.065	0.065
PCB-1242	0.065	0.065	0.065
PCB-1248	0.090	0.090	0.090
PCB-1254	0.100	0.100	0.100
PCB-1260	0.100	0.100	0.100
PCB-1268	0.100	0.100	0.100
2,4-D	0.29	0.29	0.29
Silvex(2,4,5-TP)	0.34	0.34	0.34
Aldicarb	0.5	0.5	0.5
Carbofuran	5	5	5
1,2-dibromo-3-chloropropane	0.1	0.1	0.1
Ethylene dibromide	0.1	0.1	0.1

* Note: A detection of a semivolatile compound in the downgradient monitoring wells is considered to be an exceedance of the background concentration.

7.0 Summary of Laboratory Analysis of Groundwater and Leachate

On May 7, 1998 the groundwater in the four shallow wells (MW 1-S through 4-S) and the four deep wells (MW 1-D through 4-D) was sampled. On June 16, July 24, and October 26, 1998, and February 1999, the groundwater in the same wells, and at a leachate well in the CKD landfill were sampled. In July, September, and November 1999 all wells except MW2-M were sampled, along with the spring near White Oak Lane. In 2000, sampling occurred in March, June, September, and November. The same locations were sampled in 2000 as in 1999.

The groundwater in the upgradient wells (MW1-S, MW1-D, and MW1-WT) had low concentrations of chloride, sulfate, potassium, and sodium. Dissolved solids were between 320 and 580 mg/l, which corresponds closely to values in Visocky et al. (1985) for the Galena-Platteville and Ancell Groups. The sample from the shallow aquifer had 8.2 μg/l toluene on July 24, 1998. The source of the toluene was not identified. In October 1998 and February 1999 no toluene was detected in MW1-S above 1 μg/l. Because toluene has not been confirmed in the well, its detection in the sample from July 1998 is considered to be sporadic, and toluene is not actually present in the well.

The leachate samples collected from LW1 and LW3 have elevated concentrations of calcium, potassium, sodium, chloride, sulfate, and total dissolved solids. In addition, the concentration of magnesium, manganese, iron are elevated when compared to the water table background concentrations of these parameters. Additional parameters that are slightly greater than the background concentrations include arsenic, boron, chromium, cobalt, copper, and lead. The leachate samples had low concentrations of benzene, 1,1-dichloroethane, and toluene.

The downgradient wells MW3-S and MW3-WT are located southwest of the landfill. The groundwater at this location has a pale yellow color and a high pH (>10). The analytical results show that the groundwater in both of these wells has elevated concentrations of chloride, sulfate, potassium, and dissolved solids when compared to the respective background concentration. In addition, elevated levels of sodium and alkalinity were seen in the shallow and water table wells at this location. Organic compounds were detected in these two wells (MW3-S and MW3-WT).

In MW3-S, three samples during 1998 had detected concentrations of 1,1-dichloroethane, the highest was 0.004 mg/L. The highest concentration of 1,1,1-trichloroethane in this well was 0.015 mg/L (15 μg/L) on May 7, 1998. In MW3-WT, 1,1-dichloroethane, 1,1-dichloroethene, and 1,1,1-trichloroethane were detected. The greatest concentration were 0.0081, 0.0079, and 0.010 mg/L, respectively.

Monitoring well 7-S is located along White Oak Lane, north of MW3. Groundwater at well MW7-S had a high pH, dissolved solids, potassium, sodium, chloride, and sulfate, which indicate contamination by leachate. For some sampling events the shallow wells along White Oak Lane exceeded the background concentrations of aluminum, arsenic, barium, boron, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium, vanadium, chloride, sulfate, dissolved solids, and alkalinity. The organic compounds 1,1-dichloroethane, 1,1-dichloroethene, and 1,1,1-trichloroethane were detected in MW7-S. The highest concentrations of the three compounds were 0.0639, 0.0082, and 0.006 mg/L, respectively.

The deep wells in this area (MW3-D and MW7-D) had elevated concentrations of barium, calcium, iron, manganese, nickel, potassium, sodium, alkalinity, and chloride exceeded the background concentrations. However, no organic compounds were detected during the sampling events.

Monitoring wells 5, 6 and 8 are also located along White Oak Lane, east of the landfill. In the shallow wells, elevated concentrations of aluminum, boron, calcium, copper, iron, manganese, potassium, sodium, alkalinity, chloride, sulfate and total dissolved solids were observed in these three locations. The groundwater in the St. Peter aquifer in this location is similar in composition.

The downgradient monitoring wells 2-S and 2-D, located south of the CKD landfill, had groundwater similar to the upgradient well. However, concentrations of barium, copper, magnesium, potassium, and alkalinity were slightly greater than the background concentration for these parameters in the shallow well.

Monitoring wells 9-S, 9-WT, and 9-D are located east of MW2 and south of the CKD landfill. In MW9-S and MW9-WT concentrations of aluminum, arsenic, calcium, magnesium, nickel, potassium, sodium, alkalinity, chloride, sulfate, and total dissolved solids consistently exceed the respective background concentrations.

Groundwater in the St. Peter aquifer at this location (MW2-D and MW9-D) has concentrations of barium, iron, manganese, potassium, chloride and sodium that are slightly greater than the background concentration in MW1-D. No organic compounds were detected in these monitoring wells.

The downgradient monitoring wells 4-S and 4-D, located northwest of the landfill, had groundwater with qualities intermediate between the upgradient well and the leachate well. The pH of the groundwater is 7.2. It had elevated concentrations of potassium, chloride, and sulfate, and somewhat elevated concentrations of sodium and dissolved solids. The current CKD waste disposal area is not directly upgradient from MW4-S, and there may be other waste disposal sites at the facility that have affected the groundwater at MW4-S. Previously there was a settling pond immediately north of MW4-S that received slurry and wastewater from a wet process in the #4 kiln. The #4 kiln was constructed in 1960. The exact dates of operation of the settling pond are not known, but a cover was being applied to it by 1977. Although this pond no longer exists, the disposal of process waste in it may have affected the groundwater.

Summary tables of the laboratory results have been included in attachment 4. The original laboratory reports are available from Preston Engineering, Inc. and will be provided on request.

8.0 Adjusted Groundwater Standards

Because the concentrations of several parameters in downgradient wells exceed the background concentrations and Section 620 class I groundwater standards, Dixon Marquette Cement Company is requesting adjusted groundwater standards. The following table lists the requested standards and the Class I groundwater standard.

Table 8. Requested Groundwater Standards
all values in mg/L

	Class I Standard	Requested Adjusted Standard
Aluminum		2.522
Antimony	0.006	0.006
Arsenic	0.05	0.141
Barium	2	2
Beryllium	0.004	0.004
Boron	2	2
Cadmium	0.005	0.005
Calcium		420
Chromium	0.1	0.1
Cobalt	1	1
Copper	0.65	0.65
Lead	0.0075	0.012
Iron	5	6.4
Magnesium		171.5
Manganese	0.15	3.3
Mercury	0.002	0.002
Nickel	0.1	0.1
Potassium		2309
Selenium	0.05	0.05
Sodium		140.5
Thallium	0.002	0.004
Vanadium		0.02
Zinc	5	5
Alkalinity, total		1699
Alkalinity, phenol.		1121
Alkalinity, bicarb		977
Ammonia nitrogen		1.25
Chloride	200	241
COD		187
Fluoride	4	4.4
Nitrate as N	10	11.1
pH (stnd units)		10.9
Sulfate	400	1245
TOC		29
Dissolved Solids	1200	4338
Benzene	0.005	0.005
1,1-dichloroethane		0.7
1,1-dichloroethene	0.007	35
Toluene	1	1
1,1,1-trichloroethane	0.2	0.2

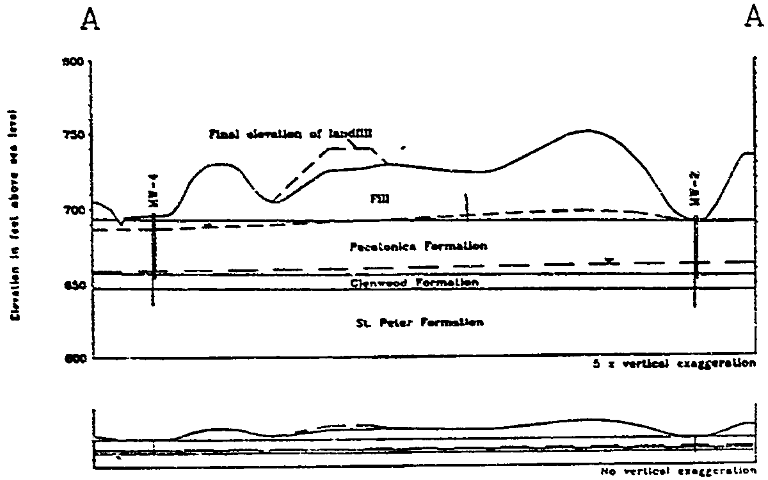
9.0 Abandonment of Borings and Monitoring Wells

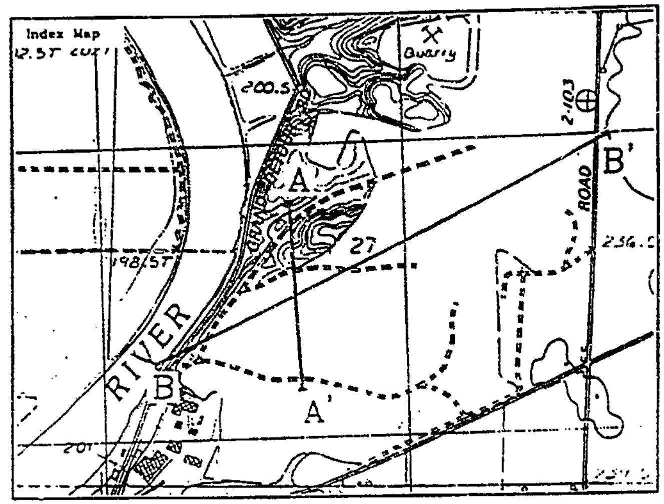
All borings made during the hydrogeologic investigation were converted to monitoring wells immediately following drilling. No borings have required abandonment.

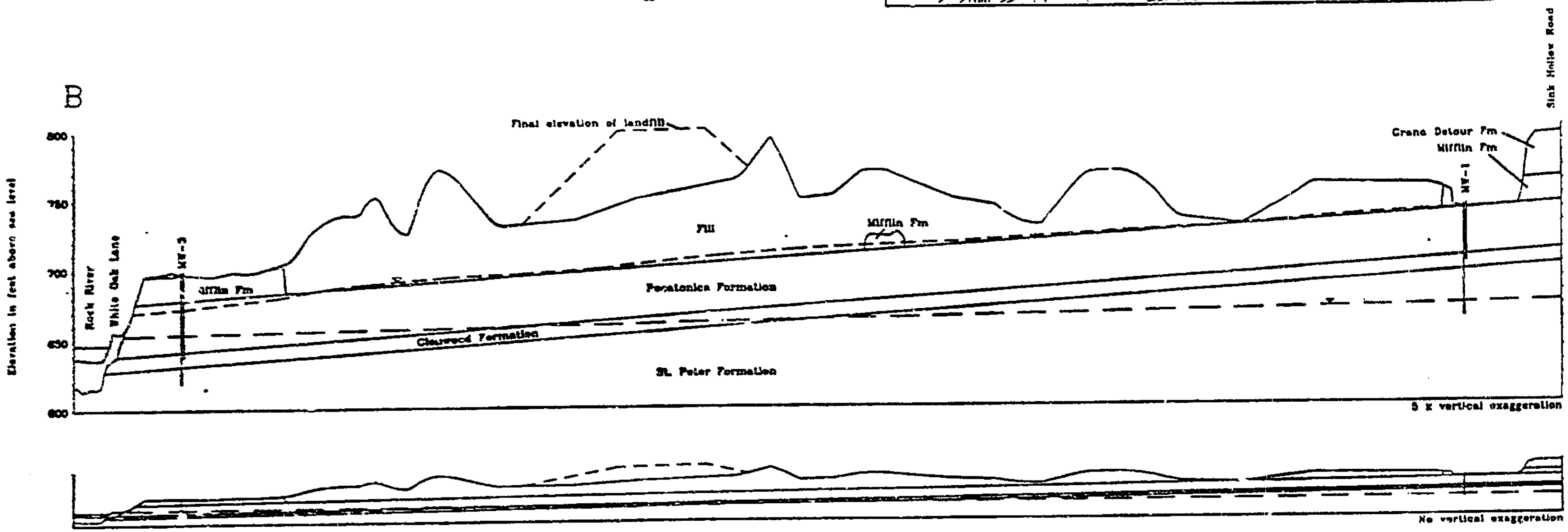
Future borings that are not sealed or plugged immediately will be covered to prevent injury. Borings and wells that will be abandoned in the future will be filled with bentonite chips or pellets, or will have high-solids bentonite grout tremied into them. During tremie operations, the base of the tremie pipe will remain submerged in grout as the hole is being filled. Bentonite chips will be screened to remove fine material before being used. Bentonite and bentonite grout are compatible with the groundwater, leachate, soil, and CKD that are found at the site. Well casings that extend above the surface will be removed. All excess drilling mud, drill cuttings, and contaminated materials uncovered during or created by drilling will be disposed of in the on site landfill. Areas around the borings will be restored to conditions acceptable to Dixon Marquette Cement.

Attachment 1

Cross Sections Through CKD Landfill



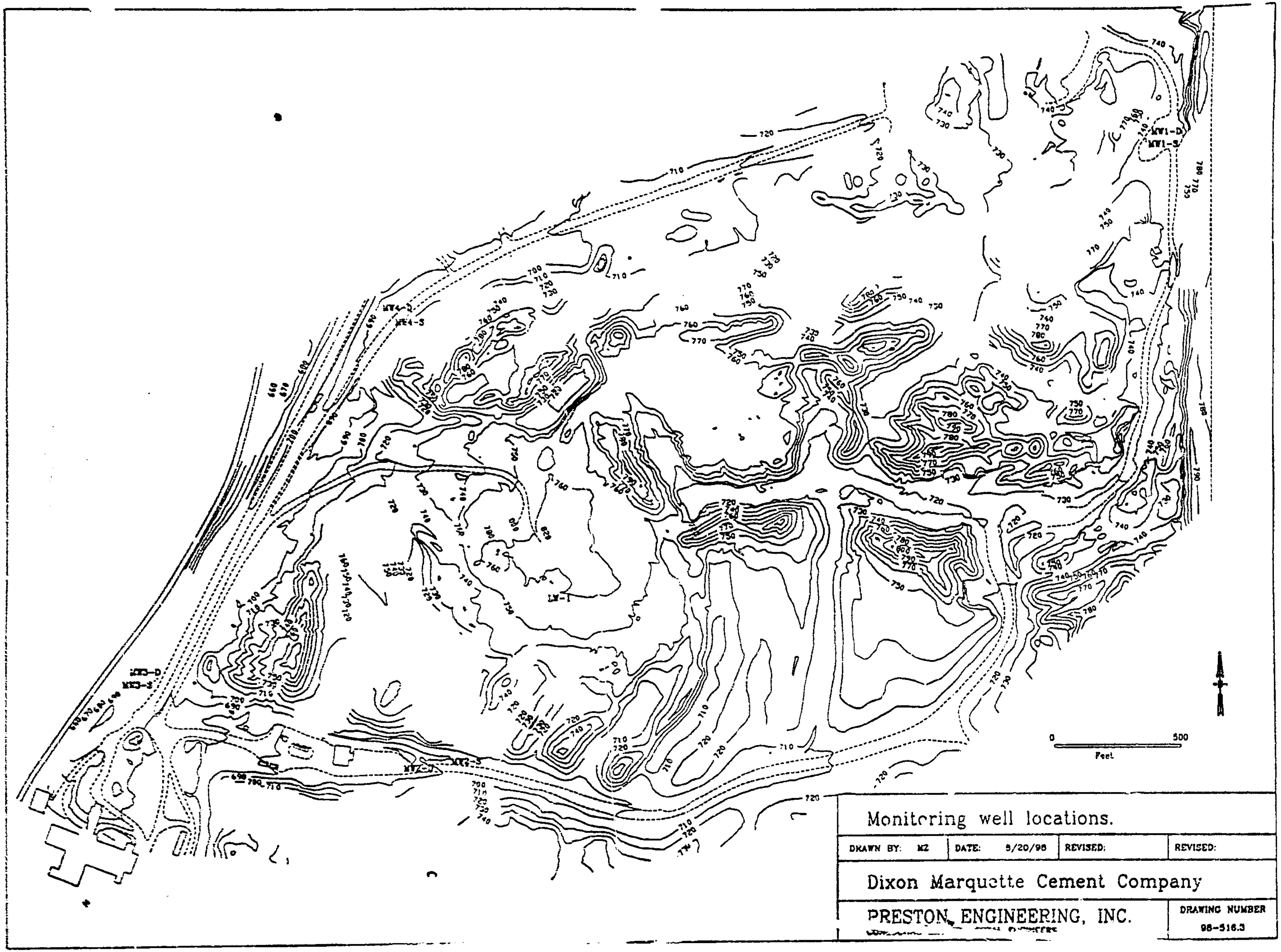




\- - - - - - Potentiometric surface based on water levels in wells screened in the Pecatonica Formation.

— — — — Potentiometric surface based on water levels in wells screened in the St. Peter Formation.

Cross Sections through CKD landfill			
DRAWN BY: MZ	DATE 4/24/98	REVISED:	REVISED:
DIXON MARQUETTE CEMENT COMPANY			
PRESTON ENGINEERING, INC. CONSULTING ENVIRONMENTAL ENGINEERS			DRAWING NUMBER 95-516.6



Monitoring well locations.				
DRAWN BY: MZ	DATE: 9/20/96	REVISED:	REVISED:	
Dixon Marquette Cement Company				
PRESTON ENGINEERING, INC.			DRAWING NUMBER 96-516.3	

Attachment 2

Well Construction Reports

WELL CONSTRUCTION REPORT

Date 5-5-98

TYPE OR PRESS FIRMLY WITH BLACK INK PEN, THIS FORM MUST BE COMPLETED WITHIN 30 DAYS OF COMPLETION AND SENT TO THE APPROPRIATE HEALTH DEPARTMENT

1. Date Well Completed 3-20-98
2. Use: [ ] Domestic [ ] Irrigation [ ] Commercial [ ] Livestock [X] Monitoring [ ] Other
3. Type of Well:
   a. Bored Well: Hole Diameter ____ in. Depth ____ ft. Casing Diameter ____ in. Buried Slab: [ ]Yes [ ]No
   b. Driven Well: Drive Pipe Diameter ____ in. Depth ____ ft.
   c. Drilled Well: Well Diameter 2 in. Depth ____ ft. Casing Diameter 2 in. Type PVC Joint ____

Casing Grout:

Kind	Oversized Drill Hole(in)	From(ft)	To(ft)
Bentonite	6	26	2

Finished In: Unconsolidated [ ] Rock [X] Gravel Pack: [X]Yes [ ]No Grain Size med. sand

4. Well Disinfected? [ ]Yes [X]No
5. Date Permanent Pump Installed none
6. Licensed Pump Contractor ____ License Number ____
7. Pitless Adapter Installed? [ ]Yes [X]No Manufacturer ____ Model ____ Attached to Casing - How? [ ] Screwed On [ ] Welded [ ] Compression
8. Type of Well Cap ____
9. Tank Working Cycle ____ gallons Captive Air: [ ]Yes [ ]No
10. Pump and Equipment Disinfected? [ ]Yes [ ]No

General Comments: (If dry hole, fill out log & indicate how hole was sealed.)

Illinois Department of Public Health
Division of Environmental Health - 525 W. Jefferson
Springfield, IL 62761

IMPORTANT NOTICE. This State Agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. Disclosure of this information is mandatory. This form has been approved by the Forms Management Center.

IL 482-0126

GEOLOGICAL AND WATER SURVEY WELL RECORD

11. Permit Number ____ Date Issued ____
12. Property Owner Dixon Marquette Cement Co. Well # MW1-S
13. Drilling Company Name Geotechnical Services, Inc.
14. Name of Person who drilled the well Matt White
15. Well Site Address 1914 White Oak Lane, Dixon, IL
16. Twnshp Name Dixon Land ID# ____
17. Subdivision Name ____ Lot ____ Elevation 739 ft.
18. Location: Cnty Lee Sect 27 Twnshp 22N Range 9E NE Quarter of the SE Quarter of the NE Quarter
19. Casing and Liner Pipe:

Dia (In.)	Type	From(ft)	To (ft)
2 in	PVC	28	?

20. Screen: Diameter 2 in. Length 10 ft. Slot Size 0.010 Material PVC

21. Water from Pecatonica Fm at depth 28 ft. to 38 ft.
22. Static Level 3.74 ft. below casing top which is 38 in. above ground level. Pumping Level ____ ft. Pumping ____ gpm for ____ hours.
23. Earth Materials Passed Through

Earth Materials Passed Through	Depth Top(ft)	Depth Bottom(ft)
Pecatonica dolomite	0	34
Glenwood sandstone	34	38

Continue on back of sheet if necessary

Licensed Contractor Signature ____ License Number ____

11/95

(SEE REVERSE SIDE FOR ADDITIONAL INFORMATION)

WELL CONSTRUCTION REPORT

Date 5-5-98

TYPE OR PRESS FIRMLY WITH BLACK INK PEN, THIS FORM MUST BE COMPLETED WITHIN 30 DAYS OF COMPLETION AND SENT TO THE APPROPRIATE HEALTH DEPARTMENT

1. Date Well Completed 3-20-98
2. Use: [ ] Domestic [ ] Irrigation [ ] Commercial [ ] Livestock [X] Monitoring [ ] Other ____
3. Type of Well:
   a. Bored Well: Hole Diameter ____ in. Depth ____ ft. Casing Diameter ____ in. Buried Slab: [ ]Yes [ ]No
   b. Driven Well: Drive Pipe Diameter ____ in. Depth ____ ft.
   c. Drilled Well: Well Diameter 2 in. Depth ____ ft. Casing Diameter 2 in. Type PVC Joint ____

Casing Grout:

Kind	Oversized Drill Hole(In)	From(ft)	To(ft)
Bentonite	5.25	66	2

Finished In: Unconsolidated [ ] Gravel Pack: [X]Yes [ ]No
Rock [X] Grain Size med. Sand

4. Well Disinfected? [ ]Yes [X]No
5. Date Permanent Pump Installed none
6. Licensed Pump Contractor ____
   License Number ____
7. Pitless Adapter Installed? [ ]Yes [X]No
   Manufacturer ____ Model ____
   Attached to Casing - How? [ ] Screwed On [ ] Welded [ ] Compression
8. Type of Well Cap ____
9. Tank Working Cycle ____ gallons Captive Air: [ ]Yes [ ]No
10. Pump and Equipment Disinfected? [ ]Yes [ ]No

General Comments: (If dry hole, fill out log & indicate how hole was sealed.)

Illinois Department of Public Health
Division of Environmental Health - 525 W. Jefferson
Springfield, IL 62761

IMPORTANT NOTICE. This State Agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. Disclosure of this information is mandatory. This form has been approved by the Forms Management Center.

GEOLOGICAL AND WATER SURVEY WELL RECORD

11. Permit Number ____ Date Issued ____
12. Property Owner Dixon Marquette Cement Co. Well # MW1-D
13. Drilling Company Name Geotechnical Services Inc.
14. Name of Person who drilled the well Matt White
15. Well Site Address 1914 White Oak Lane, Dixon, IL
16. Twnshp Name Dixon Land ID# ____
17. Subdivision Name ____ Lot ____ Elevation 739 ft.
18. Location: Cnty Lee Sect 27 Twnshp 22 N Range 9E
    NE Quarter of the SE Quarter of the NE Quarter
19. Casing and Liner Pipe:

Dia (In.)	Type	From(ft)	To (ft)
2 in.	PVC	68	0

20. Screen:
    Diameter 2 in.
    Length 10 ft.
    Slot Size 0.010
    Material PVC
21. Water from St. Peter Fm at depth 68 ft. to 78 ft.
22. Static Level 70.67 ft. below casing top which is 29 in. above ground level.
    Pumping Level ____ ft. Pumping ____ gpm for ____ hours.
23.

Earth Materials Passed Through	Depth Top(ft)	Depth Bottom(ft)
Pecatonica dolomite	0	34
Glenwood sandstone	34	44.5
St. Peter sandstone	44.5	78

Continue on back of sheet if necessary

Licensed Contractor Signature ____ License Number ____

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(SEE REVERSE SIDE FOR ADDITIONAL INFORMATION)

Geologic Descriptions

Monitoring Well MW-1D (northeast side of CKD landfill)

(All measurements in feet)

Depth of Top	Thickness	Unit	Description
		Pecatonica Formation	
0	34		Limestone and dolomite
		Glenwood Formation	
34	44.5		Sandstone and siltstone
		St. Peter Formation	
44.5	78		Sandstone, quartz

WELL CONSTRUCTION REPORT

Date 5-5-98

TYPE OR PRESS FIRMLY WITH BLACK INK PEN, THIS FORM MUST BE COMPLETED WITHIN 30 DAYS OF COMPLETION AND SENT TO THE APPROPRIATE HEALTH DEPARTMENT

1. Date Well Completed 3-20-98
2. Use: [ ] Domestic [ ] Irrigation [ ] Commercial [ ] Livestock [X] Monitoring [ ] Other
3. Type of Well:
   a. Bored Well: Hole Diameter ____ in. Depth ____ ft.
   Casing Diameter ____ in. Buried Slab: [ ]Yes [ ]No
   b. Driven Well: Drive Pipe Diameter ____ in. Depth ____ ft.
   c. Drilled Well: Well Diameter 2 in. Depth ____ ft.
   Casing Diameter ____ in. Type ____ Joint ____

Casing Grout:

Kind	Oversized Drill Hole(In)	From(ft)	To(ft)
Bentonite	6	27.5	2

Finished In: Unconsolidated [ ] Rock [X] Gravel Pack: [X]Yes [ ]No Grain Size med sand

4. Well Disinfected? [ ]Yes [X]No
5. Date Permanent Pump Installed ____
6. Licensed Pump Contractor ____
   License Number ____
7. Pitless Adapter Installed? [ ]Yes [X]No
   Manufacturer ____ Model ____
   Attached to Casing - How? [ ] Screwed On [ ] Welded [ ] Compression
8. Type of Well Cap ____
9. Tank Working Cycle ____ gallons Captive Air: [ ]Yes [ ]No
10. Pump and Equipment Disinfected? [ ]Yes [ ]No

General Comments: (If dry hole, fill out log & indicate how hole was sealed.)

Illinois Department of Public Health
Division of Environmental Health - 525 W. Jefferson
Springfield, IL 62761

IMPORTANT NOTICE. This State Agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. Disclosure of this information is mandatory. This form has been approved by the Forms Management Center.

GEOLOGICAL AND WATER SURVEY WELL RECORD

11. Permit Number ____ Date Issued ____
12. Property Owner Dixon Marquette Cement Co. Well # MW2-S
13. Drilling Company Name Geotechnical Services Inc.
14. Name of Person who drilled the well Matt White
15. Well Site Address 1914 White Oak Lane, Dixon, IL
16. Twnshp Name Dixon Land ID# ____
17. Subdivision Name ____ Lot ____ Elevation 692 ft.
18. Location: Cnty Lee Sect 27 Twnshp 22N Range 9E
    NE Quarter of the SE Quarter of the SW Quarter
19. Casing and Liner Pipe:

Dia (In.)	Type	From(ft)	To (ft)
2 in.	PVC	29.5	0

20. Screen:
    Diameter 2 in.
    Length 10 ft.
    Slot Size 0.010
    Material PVC
21. Water from Pecatonica Fm at depth 39.5 ft. to 29.5 ft.
22. Static Level 3.81 ft. below casing top which is 28 in. above ground level.
    Pumping Level ____ ft. Pumping ____ gpm for ____ hours.
23.

Earth Materials Passed Through	Depth Top(ft)	Depth Bottom(ft)
Pecatonica dolomite	0	36.5
Glenwood sandstone	36.5	39.5

Continue on back of sheet if necessary

Licensed Contractor Signature ____ License Number ____

11/95

(SEE REVERSE SIDE FOR ADDITIONAL INFORMATION)

WELL CONSTRUCTION REPORT

Date 5-5-98

TYPE OR PRESS FIRMLY WITH BLACK INK PEN, THIS FORM MUST BE COMPLETED WITHIN 30 DAYS OF COMPLETION AND SENT TO THE APPROPRIATE HEALTH DEPARTMENT

1. Date Well Completed 3-20-98
2. Use: [ ] Domestic [ ] Irrigation [ ] Commercial [ ] Livestock [X] Monitoring [ ] Other ____
3. Type of Well:
   a. Bored Well: Hole Diameter ____ in. Depth ____ ft.
      Casing Diameter ____ in. Buried Slab: [ ]Yes [ ]No
   b. Driven Well: Drive Pipe Diameter ____ in. Depth ____ ft.
   c. Drilled Well: Well Diameter 2 in. Depth 43.5 ft.
      Casing Diameter 2 in. Type PVC Joint ____

Casing Grout:

Kind	Oversized Drill Hole(In)	From(ft)	To(ft)
Bentonite	4.25	40	0

Finished In: Unconsolidated [ ] Gravel Pack: [X]Yes [ ]No
Rock [X] Grain Size med. sand

4. Well Disinfected? [ ]Yes [X]No
5. Date Permanent Pump Installed ____
6. Licensed Pump Contractor ____
   License Number ____
7. Pitless Adapter Installed? [ ]Yes [X]No
   Manufacturer ____ Model ____
   Attached to Casing - How? [ ] Screwed On [ ] Welded [ ] Compression
8. Type of Well Cap ____
9. Tank Working Cycle ____ gallons Captive Air: [ ]Yes [ ]No
10. Pump and Equipment Disinfected? [ ]Yes [ ]No

General Comments: (If dry hole, fill out log & indicate how hole was sealed.)

Illinois Department of Public Health
Division of Environmental Health - 525 W. Jefferson
Springfield, IL 62761

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IL 482-0126

GEOLOGICAL AND WATER SURVEY WELL RECORD

11. Permit Number ____ Date Issued ____
12. Property Owner Dixon Marquette Cement Co. Well # MW2-M
13. Drilling Company Name Geotechnical Services Inc
14. Name of Person who drilled the well Matt White
15. Well Site Address 1914 White Oak Lane, Dixon, IL
16. Twnshp Name Dixon Land ID# ____
17. Subdivision Name ____ Lot ____ Elevation ____ ft.
18. Location: Cnty Lee Sect 27 Twnshp 22N Range 9E
    NE Quarter of the SE Quarter of the SW Quarter
19. Casing and Liner Pipe:

Dia (In)	Type	From(ft)	To (ft)
2 in	PVC	41.5	0

20. Screen:
    Diameter 2 in.
    Length 2 ft.
    Slot Size 0.010
    Material PVC

21. Water from Glenwood Fm at depth 41.5 ft. to 43.5 ft.
22. Static Level 8.71 ft. below casing top which is 28 in. above ground level.
    Pumping Level ____ ft. Pumping ____ gpm for ____ hours.
23. Earth Materials Passed Through

Earth Materials Passed Through	Depth Top(ft)	Depth Bottom(ft)
Pecatonica dolomite	0	36.5
Glenwood sandstone	36.5	43.5

Continue on back of sheet if necessary

Licensed Contractor Signature ____ License Number ____

11/95

(SEE REVERSE SIDE FOR ADDITIONAL INFORMATION)

WELL CONSTRUCTION REPORT

Date 5-5-98

TYPE OR PRESS FIRMLY WITH BLACK INK PEN, THIS FORM MUST BE COMPLETED WITHIN 30 DAYS OF COMPLETION AND SENT TO THE APPROPRIATE HEALTH DEPARTMENT

1. Date Well Completed 3-20-98
2. Use: [ ] Domestic [ ] Irrigation [ ] Commercial [ ] Livestock [X] Monitoring [ ] Other
3. Type of Well:
   a. Bored Well: Hole Diameter ____ in. Depth ____ ft. Casing Diameter ____ in. Buried Slab: [ ]Yes [ ]No
   b. Driven Well: Drive Pipe Diameter ____ in. Depth ____ ft.
   c. Drilled Well: Well Diameter 2 in. Depth 60 ft. Casing Diameter 2 in. Type PVC Joint ____

Casing Grout:

Kind	Oversized Drill Hole(In)	From(ft)	To(ft)
Bentonite	5.25	48	2

Finished In: Unconsolidated [ ] Gravel Pack: [X]Yes [ ]No
Rock [X] Grain Size med. sand

4. Well Disinfected? [ ]Yes [X]No
5. Date Permanent Pump Installed ____
6. Licensed Pump Contractor ____
   License Number ____
7. Pitless Adapter Installed? [ ]Yes [X]No
   Manufacturer ____ Model ____
   Attached to Casing - How? [ ] Screwed On [ ] Welded [ ] Compression
8. Type of Well Cap ____
9. Tank Working Cycle ____ gallons Captive Air: [ ]Yes [ ]No
10. Pump and Equipment Disinfected? [ ]Yes [ ]No

General Comments: (If dry hole, fill out log & indicate how hole was sealed.)

Illinois Department of Public Health
Division of Environmental Health - 525 W. Jefferson
Springfield, IL 62761

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GEOLOGICAL AND WATER SURVEY WELL RECORD

11. Permit Number ____ Date Issued ____
12. Property Owner Dixon Marquette Cement Co Well # MW2-D
13. Drilling Company Name Geotechnical Services, Inc.
14. Name of Person who drilled the well Matt White
15. Well Site Address 1914 White Oak Lane, Dixon IL
16. Twnshp Name Dixon Land ID# ____
17. Subdivision Name ____ Lot ____ Elevation 692 ft.
18. Location: Cnty Lee Sect 27 Twnshp 22N Range 9E
    NE Quarter of the SE Quarter of the SW Quarter
19. Casing and Liner Pipe:

Dia (In)	Type	From(ft)	To (ft)
2 in	PVC	50	0

20. Screen:
    Diameter 2 in.
    Length 10 ft.
    Slot Size 0.010
    Material PVC

21. Water from St. Peter Fm at depth 50 ft. to 60 ft.
22. Static Level 30.45 ft. below casing top which is 27 in. above ground level.
    Pumping Level ____ ft. Pumping ____ gpm for ____ hours.
23. Earth Materials Passed Through

Earth Materials Passed Through	Depth Top(ft)	Depth Bottom(ft)
Pecatonica dolomite	0	36.5
Glenwood sandstone	36.5	47
St. Peter sandstone	47	60

Continue on back of sheet if necessary

Licensed Contractor Signature ____ License Number ____

11/95

(SEE REVERSE SIDE FOR ADDITIONAL INFORMATION)

[redacted]32-[redacted]

Geologic Descriptions

Monitoring Well MW-2D (south side of CKD landfill)

(All measurements in feet)

Depth of Top	Thickness	Unit	Description
0	1.5		Fill material, crushed rock
		Pecatonica Formation	
		Medusa member	
1.5	4.5		Limestone, yellow with gray dolomitic mottling, rare brachiopod
		New Glarus member	
6	1		Limestone, yellow with dark yellow mottling
7	4.5		Limestone, yellow with gray dolomitic mottling, some brachiopods, gastropods, crinoids
11.5	4.5		Limestone, yellow and gray, stylolites at 12 feet
		Dane member	
16	7.5		Limestone, yellow with large dolomitic or shaly mottling, some brachiopods, pyritic at 19.5 feet, calcite in vug at 22 feet
23.5	4		Dolomite, gray, sandy, vuggy from 25 to 26 feet and 27 to 27.5 feet, calcite in vug at 24 feet, some pyrite
27.5	1.5		Limestone, yellow and gray with dolomitic mottling
		Chana member	
29	7.5		Dolomite, gray, sandy, pyritic, vuggy at 32 to 35.5 feet
		Glenwood Formation	
36.5	2.5		Sandstone, fine grained quartz, some pyrite
39	0.5		Siltstone, sandy, gray, some pyrite
39.5	1.5		Siltstone, gray, fissile
41	2		Sandstone, quartz, some pyrite
43	1		Siltstone, gray, fissile
44	3		Sandstone, quartz, mottled, some pyrite
		St. Peter Formation	
47	2.5		Sandstone, quartz, poorly cemented, pyritic at 47 feet
49.5	10		Sandstone, quartz

WELL CONSTRUCTION REPORT

Date 5-5-98

TYPE OR PRESS FIRMLY WITH BLACK INK PEN, THIS FORM MUST BE COMPLETED WITHIN 30 DAYS OF COMPLETION AND SENT TO THE APPROPRIATE HEALTH DEPARTMENT

1. Date Well Completed 3-20-98
2. Use: [ ] Domestic [ ] Irrigation [ ] Commercial [ ] Livestock [X] Monitoring [ ] Other ____
3. Type of Well:
   a. Bored Well: Hole Diameter ____ in. Depth ____ ft. Casing Diameter ____ in. Buried Slab: [ ]Yes [ ]No
   b. Driven Well: Drive Pipe Diameter ____ in. Depth ____ ft.
   c. Drilled Well: Well Diameter 2 in. Depth ____ ft. Casing Diameter ____ in. Type ____ Joint ____

Casing Grout:

Kind	Oversized Drill Hole(In)	From(ft)	To(ft)
Bentonite	6	47	2

Finished In: Unconsolidated [ ] Rock [X] Gravel Pack: [X]Yes [ ]No Grain Size med. sand

4. Well Disinfected? [ ]Yes [X]No
5. Date Permanent Pump Installed ____
6. Licensed Pump Contractor ____ License Number ____
7. Pitless Adapter Installed? [ ]Yes [X]No Manufacturer ____ Model ____ Attached to Casing - How? [ ] Screwed On [ ] Welded [ ] Compression
8. Type of Well Cap ____
9. Tank Working Cycle ____ gallons Captive Air: [ ]Yes [ ]No
10. Pump and Equipment Disinfected? [ ]Yes [ ]No

General Comments: (If dry hole, fill out log & indicate how hole was sealed.)

Illinois Department of Public Health
Division of Environmental Health - 525 W. Jefferson
Springfield, IL 62761

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GEOLOGICAL AND WATER SURVEY WELL RECORD

11. Permit Number ____ Date Issued ____
12. Property Owner Dixon Marquette Cement Co. Well # MW3-S
13. Drilling Company Name Geotechnical Services Inc
14. Name of Person who drilled the well Matt White
15. Well Site Address 1914 White Oak Lane, Dixon IL
16. Twnshp Name Dixon Land ID# ____
17. Subdivision Name ____ Lot ____ Elevation 697 ft.
18. Location: Cnty Lee Sect 27 Twnshp 22N Range 9E SE Quarter of the NW Quarter of the SW Quarter
19. Casing and Liner Pipe:

Dia (In)	Type	From(ft)	To (ft)
2 in	PVC	50	0

20. Screen: Diameter 2 in. Length 10 ft. Slot Size 0.010 Material PVC
21. Water from Pecatonica Fm at depth 59 ft. to 49 ft.
22. Static Level 26.80 ft. below casing top which is 28 in. above ground level. Pumping Level ____ ft. Pumping ____ gpm for ____ hours.
23. Earth Materials Passed Through

Earth Materials Passed Through	Depth Top(ft)	Depth Bottom(ft)
Soil	0	1.5
Mifflin dolomite	1.5	18.5
Pecatonica dolomite	18.5	55
Glenwood sandstone	55	59

Continue on back of sheet if necessary

Licensed Contractor Signature ____ License Number ____

11/95

(SEE REVERSE SIDE FOR ADDITIONAL INFORMATION)

WELL CONSTRUCTION REPORT

Date 5-5-98

TYPE OR PRESS FIRMLY WITH BLACK INK PEN, THIS FORM MUST BE COMPLETED WITHIN 30 DAYS OF COMPLETION AND SENT TO THE APPROPRIATE HEALTH DEPARTMENT

1. Date Well Completed 3-20-98
2. Use: [ ] Domestic [ ] Irrigation [ ] Commercial [ ] Livestock [X] Monitoring [ ] Other ______
3. Type of Well:
   a. Bored Well: Hole Diameter ______ in. Depth ______ ft. Casing Diameter ______ in. Buried Slab: [ ]Yes [ ]No
   b. Driven Well: Drive Pipe Diameter ______ in. Depth ______ ft.
   c. Drilled Well: Well Diameter 2 in. Depth 78 ft. Casing Diameter 2 in. Type PVC Joint ______

Casing Grout:

Kind	Oversized Drill Hole(In)	From(ft)	To(ft)
Bentonite	5.25	66	2

Finished In: Unconsolidated [ ] Rock [X] Gravel Pack: [X]Yes [ ]No Grain Size med. sand

4. Well Disinfected? [ ]Yes [X]No
5. Date Permanent Pump Installed ______
6. Licensed Pump Contractor ______ License Number ______
7. Pitless Adapter Installed? [ ]Yes [X]No Manufacturer ______ Model ______ Attached to Casing - How? [ ] Screwed On [ ] Welded [ ] Compression
8. Type of Well Cap ______
9. Tank Working Cycle ______ gallons Captive Air: [ ]Yes [ ]No
10. Pump and Equipment Disinfected? [ ]Yes [ ]No

General Comments: (If dry hole, fill out log & indicate how hole was sealed.)

Illinois Department of Public Health
Division of Environmental Health - 525 W. Jefferson
Springfield, IL 62761

GEOLOGICAL AND WATER SURVEY WELL RECORD

11. Permit Number ______ Date Issued ______
12. Property Owner Dixon Marquette Cement Co Well # MW3-D
13. Drilling Company Name Geotechnical Services Inc
14. Name of Person who drilled the well Matt White
15. Well Site Address 1914 White Oak Lane, Dixon, IL
16. Twnshp Name Dixon Land ID# ______
17. Subdivision Name ______ Lot ______ Elevation ______ ft.
18. Location: Cnty Lee Sect 27 Twnshp 22N Range 9E SE Quarter of the NW Quarter of the SW Quarter
19. Casing and Liner Pipe:

Dia (In.)	Type	From(ft)	To (ft)
2 in	PVC	68	0

20. Screen: Diameter 2 in. Length 10 ft. Slot Size 0.010 Material PVC

21. Water from St. Peter Fm at depth 68 ft. to 78 ft.
22. Static Level 44.84 ft. below casing top which is 30 in. above ground level. Pumping Level ______ ft. Pumping ______ gpm for ______ hours.
23. Earth Materials Passed Through

Earth Materials Passed Through	Depth Top(ft)	Depth Bottom(ft)
Soil	0	1.5
Mifflin dolomite	1.5	18.5
Pecatonica dolomite	18.5	55
Glenwood sandstone	55	66
St. Peter sandstone	66	78

Continue on back of sheet if necessary

Licensed Contractor Signature ______ License Number ______

11/95

(SEE REVERSE SIDE FOR ADDITIONAL INFORMATION)

Geologic Descriptions

Monitoring Well MW-3D (southwest side of CKD landfill)

(All measurements in feet)

Depth of Top	Thickness	Unit	Description
0	1.5		Fill material, crushed rock
		Mifflin Formation	
1.5	18.5		Limestone
		Pecatonica Formation	
18.5	55		Limestone and dolomite
		Glenwood Formation	
55	66		Sandstone and siltstone
		St. Peter Formation	
66	78		Sandstone, quartz

WELL CONSTRUCTION REPORT

Date 5-5-98

TYPE OR PRESS FIRMLY WITH BLACK INK PEN, THIS FORM MUST BE COMPLETED WITHIN 30 DAYS OF COMPLETION AND SENT TO THE APPROPRIATE HEALTH DEPARTMENT

1. Date Well Completed 3-20-98
2. Use: [ ] Domestic [ ] Irrigation [ ] Commercial [ ] Livestock [X] Monitoring [ ] Other
3. Type of Well:
   a. Bored Well: Hole Diameter ____ in. Depth ____ ft. Casing Diameter ____ in. Buried Slab: [ ]Yes [ ]No
   b. Driven Well: Drive Pipe Diameter ____ in. Depth ____ ft.
   c. Drilled Well: Well Diameter ~~4.25~~ 2 in. Depth 42 ft. Casing Diameter 2 in. Type PVC Joint ____

Casing Grout:

Kind	Oversized Drill Hole(In)	From(ft)	To(ft)
Bentonite	4.25	30	2

Finished In: Unconsolidated [ ] Rock [X] Gravel Pack: [X]Yes [ ]No Grain Size med. sand

4. Well Disinfected? [ ]Yes [X]No
5. Date Permanent Pump Installed none
6. Licensed Pump Contractor ____ License Number ____
7. Pitless Adapter Installed? [ ]Yes [X]No Manufacturer ____ Model ____ Attached to Casing - How? [ ] Screwed On [ ] Welded [ ] Compression
8. Type of Well Cap ____
9. Tank Working Cycle ____ gallons Captive Air: [ ]Yes [ ]No
10. Pump and Equipment Disinfected? [ ]Yes [ ]No

General Comments: (If dry hole, fill out log & indicate how hole was sealed.)

Illinois Department of Public Health
Division of Environmental Health - 525 W. Jefferson
Springfield, IL 62761

IMPORTANT NOTICE. This State Agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. Disclosure of this information is mandatory. This form has been approved by the Forms Management Center.

GEOLOGICAL AND WATER SURVEY WELL RECORD

11. Permit Number ____ Date Issued ____
12. Property Owner Dixon Marquette Cement Co. Well # MW4-S
13. Drilling Company Name Geotechnical Services Inc.
14. Name of Person who drilled the well Matt White
15. Well Site Address 1914 White Oak Lane, Dixon, IL
16. Twnshp Name Dixon Land ID# ____
17. Subdivision Name ____ Lot ____ Elevation 696 ft.
18. Location: Cnty Lee Sect 27 Twnshp 22N Range 9E SE Quarter of the SE Quarter of the NW Quarter
19. Casing and Liner Pipe:

Dia (In.)	Type	From(ft)	To (ft)
2 in.	PVC	32	0

20. Screen: Diameter 2 in. Length 10 ft. Slot Size 0.010 Material PVC

21. Water from Pecatonica Fm at depth 32 ft. to 42 ft.
22. Static Level 10.90 ft. below casing top which is 28 in. above ground level. Pumping Level ____ ft. Pumping ____ gpm for ____ hours.
23.

Earth Materials Passed Through	Depth Top(ft)	Depth Bottom(ft)
Soil	0	8.5
Pecatonica dolomite	8.5	38.5
Glenwood sandstone	38.5	42

Continue on back of sheet if necessary

Licensed Contractor Signature ____ License Number ____

11/95

(SEE REVERSE SIDE FOR ADDITIONAL INFORMATION)

WELL CONSTRUCTION REPORT

Date 5-5-98

TYPE OR PRESS FIRMLY WITH BLACK INK PEN, THIS FORM MUST BE COMPLETED WITHIN 30 DAYS OF COMPLETION AND SENT TO THE APPROPRIATE HEALTH DEPARTMENT

1. Date Well Completed 3-20-98
2. Use: [ ] Domestic [ ] Irrigation [ ] Commercial [ ] Livestock [X] Monitoring [ ] Other ______
3. Type of Well:
   a. Bored Well: Hole Diameter ______ in. Depth ______ ft. Casing Diameter ______ in. Buried Slab: [ ]Yes [ ]No
   b. Driven Well: Drive Pipe Diameter ______ in. Depth ______ ft.
   c. Drilled Well: Well Diameter 2 in. Depth 60.5 ft. Casing Diameter 2 in. Type PVC Joint ______

Casing Grout:

Kind	Oversized Drill Hole(In)	From(ft)	To(ft)
Bentonite	5.25	48.5	2

Finished In: Unconsolidated [ ] Rock [X] Gravel Pack: [X]Yes [ ]No Grain Size med. sand

4. Well Disinfected? [ ]Yes [X]No
5. Date Permanent Pump Installed none
6. Licensed Pump Contractor ______ License Number ______
7. Pitless Adapter Installed? [ ]Yes [X]No Manufacturer ______ Model ______ Attached to Casing - How? [ ] Screwed On [ ] Welded [ ] Compression
8. Type of Well Cap ______
9. Tank Working Cycle ______ gallons Captive Air: [ ]Yes [ ]No
10. Pump and Equipment Disinfected? [ ]Yes [ ]No

General Comments: (If dry hole, fill out log & indicate how hole was sealed.)

Illinois Department of Public Health
Division of Environmental Health - 525 W. Jefferson
Springfield, IL 62761

IMPORTANT NOTICE: This State Agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. Disclosure of this information is mandatory. This form has been approved by the Forms Management Center.

GEOLOGICAL AND WATER SURVEY WELL RECORD

11. Permit Number ______ Date Issued ______
12. Property Owner Dixon Marquette Cement Co. Well # MW4-D
13. Drilling Company Name Geotechnical Services, Inc.
14. Name of Person who drilled the well Matt White
15. Well Site Address 1914 White Oak Lane, Dixon, IL
16. Twnshp Name Dixon Land ID# ______
17. Subdivision Name ______ Lot ______ Elevation 696 ft.
18. Location: Cnty Lee Sect 27 Twnshp 22N Range 9E SE Quarter of the SE Quarter of the NW Quarter
19. Casing and Liner Pipe:

Dia (In)	Type	From(ft)	To (ft)
2 in.	PVC		

20. Screen: Diameter 2 in. Length 10 ft. Slot Size 0.010 Material PVC
21. Water from St. Peter Fm. at depth 50.5 ft. to 60.5 ft.
22. Static Level 37.26 ft. below casing top which is 29 in. above ground level. Pumping Level ______ ft. Pumping ______ gpm for ______ hours.
23. Earth Materials Passed Through

Earth Materials Passed Through	Depth Top(ft)	Depth Bottom(ft)
Soil	0	8.5
Pecatonica dolomite	8.5	38.5
Glenwood sandstone	38.5	48.5
St. Peter sandstone	48.5	60.5

Continue on back of sheet if necessary

Licensed Contractor Signature ______ License Number ______

11/95

(SEE REVERSE SIDE FOR ADDITIONAL INFORMATION)

[redacted]82-[redacted]

Attachment 3

Aquifer Test Data

GS
Geotechnical
Services Inc.

June 12, 1998

Mr. Mark Zell
Preston Engineering
4436 N. Brady Street
Davenport, Iowa 52806-4009

RE: PACKER TEST RESULTS
DIXON MARQUETTE CEMENT COMPANY
DIXON, ILLINOIS

Dear Mr. Zell:

Geotechnical Services, Inc. (GSI) has completed the analysis of the packer tests conducted at the above referenced facility. The results are presented in the attachments to this letter. The following equation was used for calculating the hydraulic conductivity of the test intervals.

$$K := \frac{Q}{2 \cdot \pi \cdot L \cdot H} \cdot \operatorname{asinh}\left(\frac{L}{2 \cdot r}\right)$$

(Based on equation from Earth Manual, US Dept. of Interior, Bureau of Reclamation)

K = hydraulic conductivity
Q = constant rate of flow into the portion of borehole
L = length of portion of the borehole tested
H_g = head due to gravity
H_p = head as applied pressure
H = differential head of water
r = radius of hole tested
$\sinh^{-1}$ = inverse hyperbolic sine

Please note that on three of the tests, MW-1, MW-3 and MW-4) no flow was measured during the packer tests. To provide a maximum hydraulic conductivity estimate, the flow meter minimum detection of 0.0017 gpm was used as the flow rate for these tests. This allows for a maximum hydraulic conductivity estimate to be calculated.

258 EAST 90TH STREET
DAVENPORT, IOWA 52806-7341
(319) 285-8541 • FAX (319) 285-8545

If you have any questions please call.

Sincerely,
GEOTECHNICAL SERVICES, INC.

Joel P. Zirkle, ICGP, RG
Senior Geologist

cc: File 26Q0026

Attachments

GS

Attachment A

Date Test Conducted: March 31, 1998
Location: MW-1
Depth of Test Interval: 42.5 ft. to 43.5 ft.

$$r := \frac{1.5\,in}{12 \cdot \frac{in}{ft}}$$

$$Q := 0.0017 \frac{gal}{min} \cdot 0.13368 \frac{ft^3}{gal}$$

$$Hg := 49 \cdot ft$$

$$Hp := 35 \cdot psi \cdot 2.31 \cdot \frac{ft}{psi}$$

$$H := Hg + Hp$$

$$L := 1 \cdot ft$$

$$K := \frac{Q}{2 \cdot \pi \cdot L \cdot H} \cdot asinh\left(\frac{L}{2 \cdot r}\right)$$

$$K = 5.83 \cdot 10^{-7} \cdot \frac{ft}{min}$$

$$K = 2.96 \cdot 10^{-7} \cdot \frac{cm}{sec}$$

GS

Attachment B

Date Test Conducted: March 24, 1998
Location: MW-2
Depth of Test Interval: 42.0 ft. to 43.5 ft.

$$r := \frac{1.5\,in}{12 \cdot \frac{in}{ft}}$$

$$Q := 0.230\,\frac{gal}{min} \cdot 0.13368\,\frac{ft^3}{gal}$$

$$Hg := 48.5\,ft$$

$$Hp := 20\,psi \cdot 2.31 \cdot \frac{ft}{psi}$$

$$H := Hg + Hp$$

$$L := 1.5\,ft$$

$$K := \frac{Q}{2 \cdot \pi \cdot L \cdot H} \cdot \operatorname{asinh}\left(\frac{L}{2 \cdot r}\right)$$

$$K = 8.58 \cdot 10^{-5} \cdot \frac{ft}{min}$$

$$K = 4.36 \cdot 10^{-5} \cdot \frac{cm}{sec}$$

GS

Attachment C

Date Test Conducted: March 27, 1998
Location: MW-3
Depth of Test Interval: 62.0 ft. to 63.0 ft.

$$r := \frac{1.5\,\text{in}}{12 \cdot \frac{\text{in}}{\text{ft}}}$$

$$Q := 0.0017\frac{\text{gal}}{\text{min}} \cdot 0.13368\frac{\text{ft}^3}{\text{gal}}$$

$$Hg := 68.5\,\text{ft}$$

$$Hp := 50\,\text{psi} \cdot 2.31 \cdot \frac{\text{ft}}{\text{psi}}$$

$$H := Hg + Hp$$

$$L := 1.0\,\text{ft}$$

$$K := \frac{Q}{2 \cdot \pi \cdot L \cdot H} \cdot \text{asinh}\left(\frac{L}{2 \cdot r}\right)$$

$$K = 4.12 \cdot 10^{-7} \cdot \frac{\text{ft}}{\text{min}}$$

$$K = 2.09 \cdot 10^{-7} \cdot \frac{\text{cm}}{\text{sec}}$$

GS

Attachment D

Date Test Conducted: April 3, 1998
Location: MW-4
Depth of Test Interval: 45.0 ft. to 46.0 ft.

$$r := \frac{1.5\,in}{12 \cdot \frac{in}{ft}}$$

$$Q := 0.0017\frac{gal}{min} \cdot 0.13368\frac{ft^3}{gal}$$

$$Hg := 51.5\,ft$$

$$Hp := 40\,psi \cdot 2.31 \cdot \frac{ft}{psi}$$

$$H := Hg + Hp$$

$$L := 1 \cdot ft$$

$$K = \frac{Q}{2 \cdot \pi \cdot L \cdot H} \cdot asinh\left(\frac{L}{2 \cdot r}\right)$$

$$K = 5.27 \cdot 10^{-7} \cdot \frac{ft}{min}$$

$$K = 2.67 \cdot 10^{-7} \cdot \frac{cm}{sec}$$

Slug Test Results

Title: Slug out
Client: DMC
Job Number: 98-516
Well Number: MW-1 Shallow

Well Geometry
H: 38.45
Le: 12.
Lw: 38.45
rc: .083
rw: 3.

filter pack porosity: 0.0
effective radius: 8.33E-2

Bouwer Rice Coefficients
Le/rw: 4.
A: 1.705
B: .201
C: .71
ln(Re/rw): 1.643

Hvorslev
F: 52.228

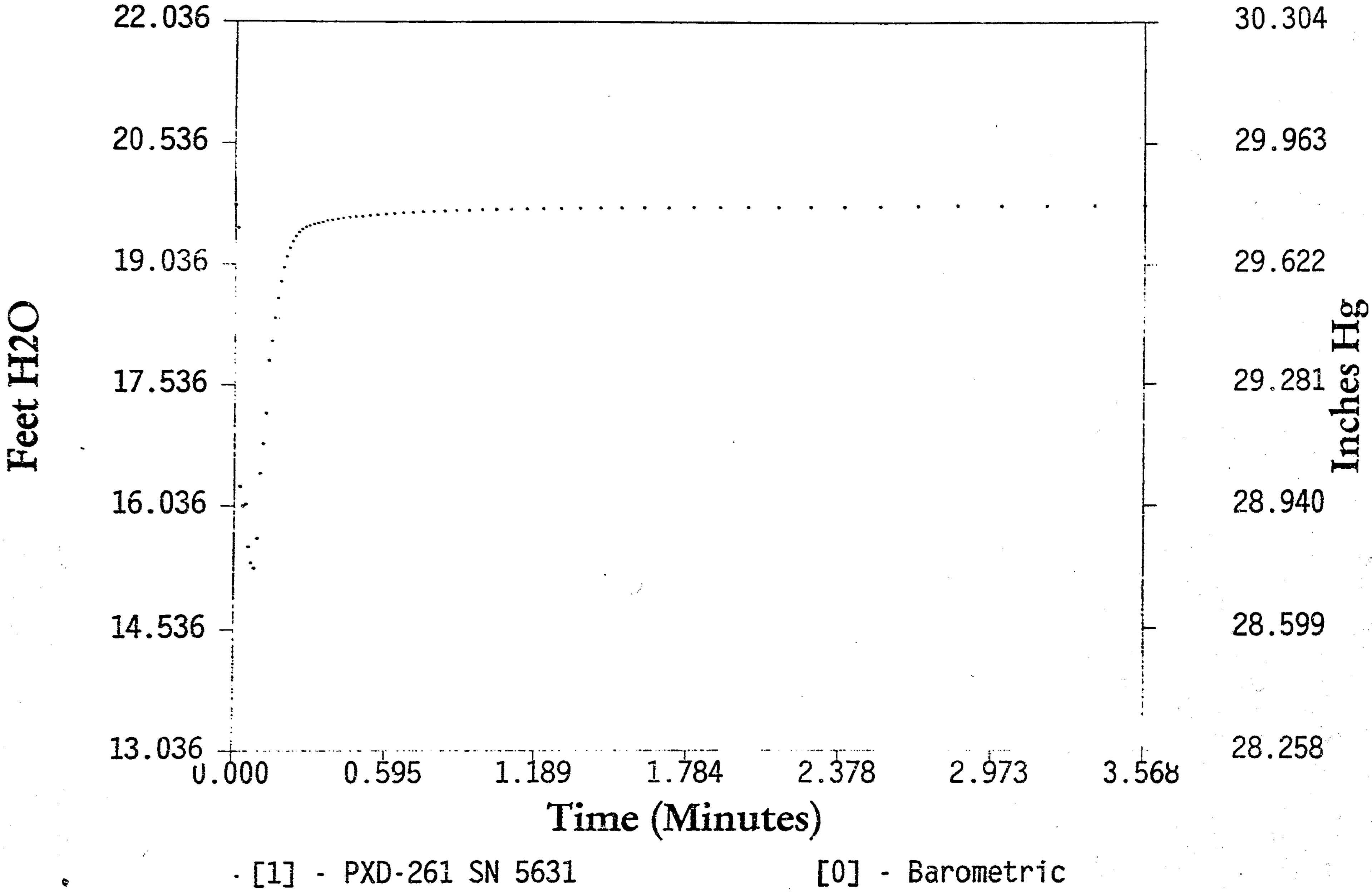
Least Squares Fit
slope: -1.55E+1
intercept: 1.57E+0

Hydraulic Conductivity
Bouwer-Rice: 7.35E-3
Hvorslev: 6.46E-3

Recovery Data and Fit

time	y	weight	fitted
0.00	4.50	1.00	4.74
0.01	4.14	1.00	4.05
0.02	3.35	1.00	3.41
0.03	2.98	1.00	2.86
0.04	2.60	1.00	2.41
0.06	1.95	1.00	2.03
0.07	1.69	1.00	1.71
0.08	1.41	1.00	1.44

1S OUT


22.036
20.536
19.036
17.536
16.036
14.536
13.036
Feet H2O
30.304
29.963
29.622
29.281
28.940
28.599
28.258
Inches Hg
0.000
0.595
1.189
1.784
2.378
2.973
3.568
Time (Minutes)
[1] - PXD-261 SN 5631
[0] - Barometric

Slug Test Results

Title: Slug out
Client: DMC
Job Number: 98-516
Well Number: MW-1 Deep

Well Geometry
H: 300.
Le: 12.
Lw: 10.01
rc: .083
rw: 2.625

filter pack porosity: 0.0
effective radius: 8.33E-2

Bouwer Rice Coefficients
Le/rw: 4.571
A: 1.721
B: .205
C: .738
ln(Re/rw): .71

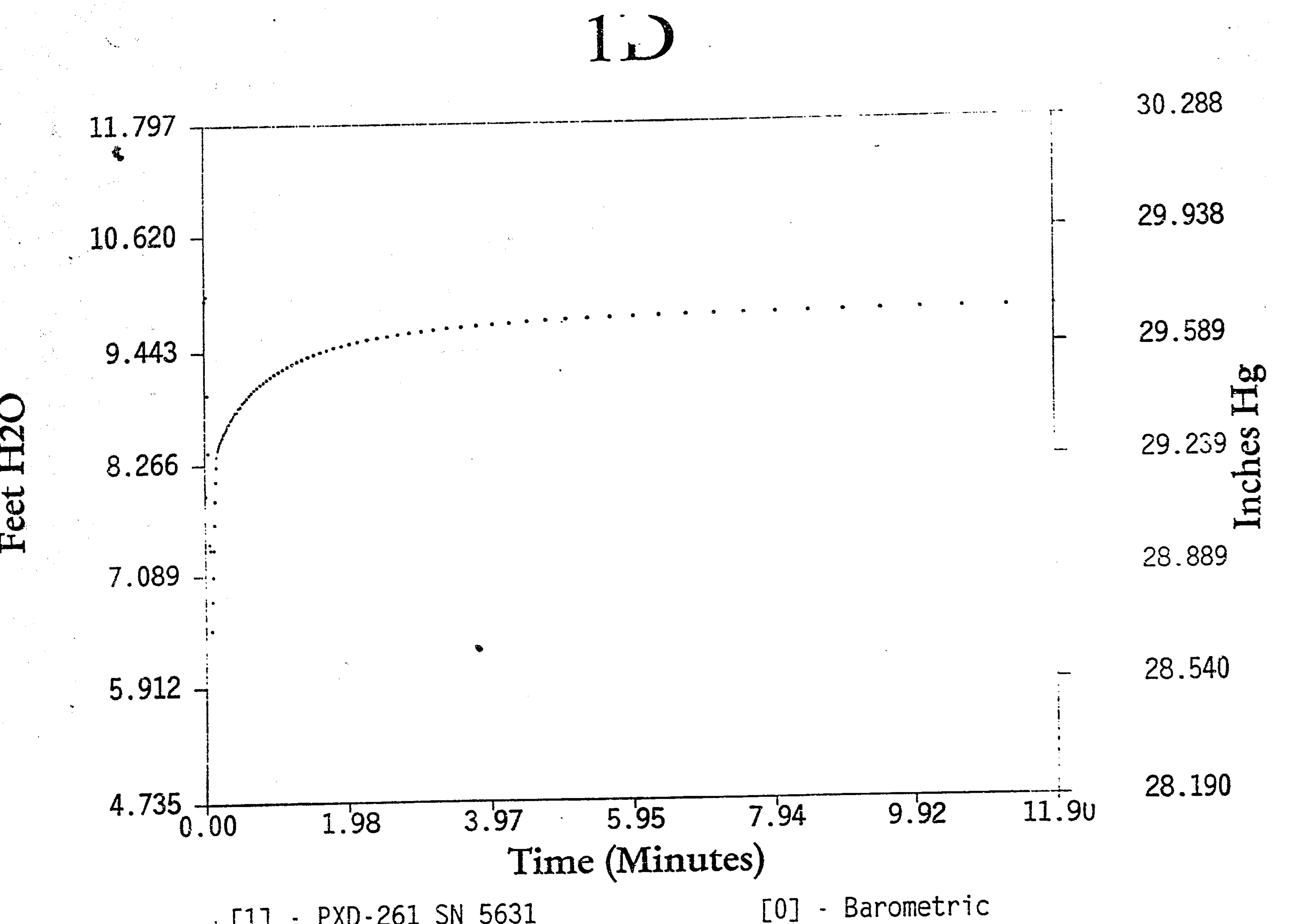
Hvorslev
F: 48.131

Least Squares Fit
slope: -1.17E+0
intercept: 4.35E-1

Hydraulic Conductivity
Bouwer-Rice: 2.4E-4
Hvorslev: 5.3E-4

Recovery Data and Fit

time	y	weight	fitted
0.00	1.56	1.00	1.54
0.01	1.53	1.00	1.53
0.02	1.51	1.00	1.51
0.03	1.48	1.00	1.49
0.04	1.47	1.00	1.47
0.06	1.44	1.00	1.45
0.07	1.43	1.00	1.43
0.08	1.39	1.00	1.40
0.10	1.38	1.00	1.38
0.11	1.36	1.00	1.36
0.13	1.33	1.00	1.33
0.14	1.30	1.00	1.31
0.16	1.28	1.00	1.28
0.18	1.25	1.00	1.25
0.20	1.23	1.00	1.22
0.22	1.20	1.00	1.19



1D
Feet H2O
11.797
10.620
9.443
8.266
7.089
5.912
4.735
Inches Hg
30.288
29.938
29.589
29.239
28.889
28.540
28.190
0.00
1.98
3.97
5.95
7.94
9.92
11.90
Time (Minutes)
[1] - PXD-261 SN 5631
[0] - Barometric

Slug Test Results

Title: Slug in
Client: DMC
Job Number: 98-516
Well Number: MW-2 Shallow

Well Geometry
H: 38.17
Le: 12.
Lw: 38.17
rc: .083
rw: 3.

filter pack porosity: 0.0
effective radius: 8.33E-2

Bouwer Rice Coefficients
Le/rw: 4.
A: 1.705
B: .201
C: .71
ln(Re/rw): 1.639

Hvorslev
F: 52.228

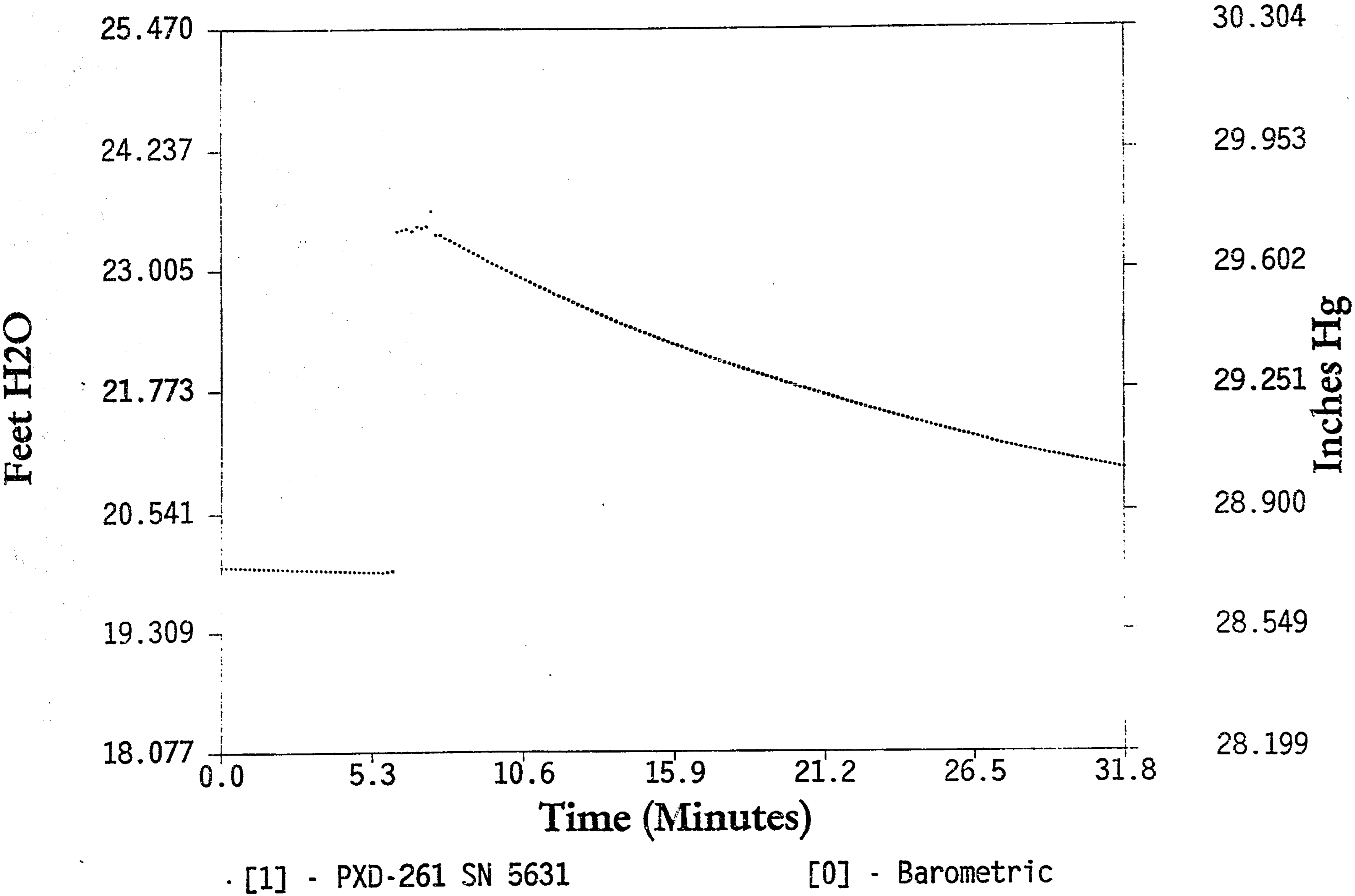
Least Squares Fit
slope: -4.8E-2
intercept: 1.24E+0

Hydraulic Conductivity
Bouwer-Rice: 2.28E-5
Hvorslev: 2.E-5

Recovery Data and Fit

time	y	weight	fitted
0.00	3.45	1.00	3.45
0.17	3.42	1.00	3.42
0.33	3.40	1.00	3.39
0.50	3.37	1.00	3.37
0.67	3.34	1.00	3.34
0.83	3.31	1.00	3.31

DMC MW-2 Shallow



Slug Test Results

Title:	Slug in
Client:	DMC
Job Number:	98-516
Well Number:	MW-2 Deep

Well Geometry

H:	300.
Le:	12.
Lw:	31.94
rc:	.083
rw:	2.625

filter pack porosity:	0.0
effective radius:	8.33E-2

Bouwer Rice Coefficients

Le/rw:	4.571
A:	1.721
B:	.205
C:	.738
ln(Re/rw):	.977

Hvorslev

F:	48.191

Least Squares Fit

slope:	-3.71E+1
intercept:	1.24E+0

Hydraulic Conductivity

Bouwer-Rice:	1.05E-2
Hvorslev:	1.68E-2

Recovery Data and Fit

time	y	weight	fitted
0.00	3.43	1.00	3.31
0.01	2.19	1.00	2.28
0.02	1.48	1.00	1.50
0.03	1.02	1.00	0.99

Slug Test Results

Title: Slug out
Client: DMC
Job Number: 98-516
Well Number: MW-2 Deep

Well Geometry
H: 300.
Le: 12.
Lw: 31.94
rc: .083
rw: 2.625

filter pack porosity: 0.0
effective radius: 8.33E-2

Bouwer Rice Coefficients
Le/rw: 4.571
A: 1.721
B: .205
C: .738
ln(Re/rw): .977

Hvorslev
F: 48.191

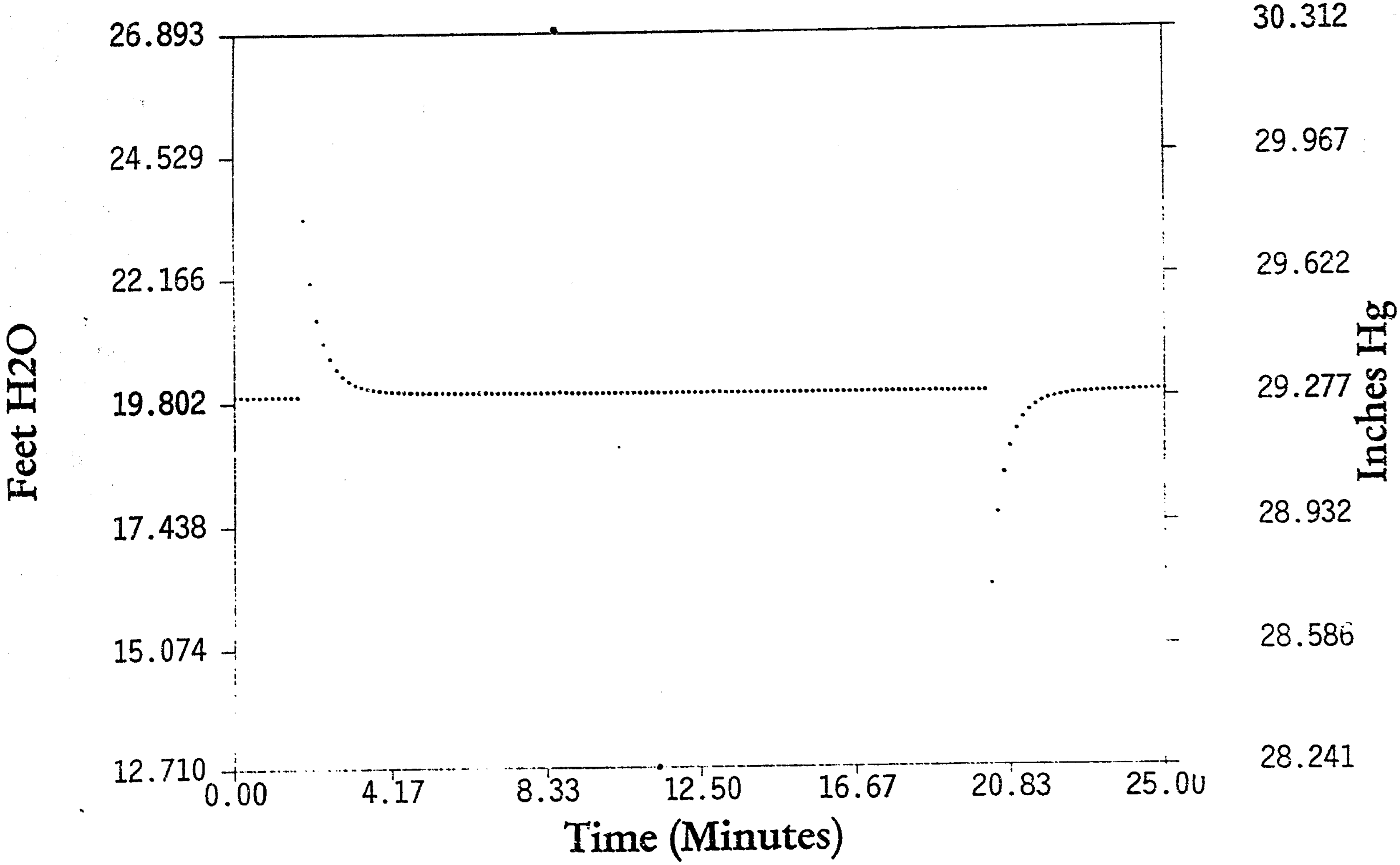
Least Squares Fit
slope: -3.84E+1
intercept: 1.31E+0

Hydraulic Conductivity
Bouwer-Rice: 1.08E-2
Hvorslev: 1.74E-2

Recovery Data and Fit

time	y	weight	fitted
0.00	3.68	1.00	3.56
0.01	2.33	1.00	2.42
0.02	1.55	1.00	1.57
0.03	1.05	1.00	1.02

DMC MW-2 Deep



[1] - PXD-261 SN 5631 [0] - Barometric

Slug Test Results

Title:	Slug in
Client:	DMC
Job Number:	98-516
Well Number:	MW-3 Shallow

Well Geometry

H:	34.79
Le:	12.
Lw:	34.79
rc:	.083
rw:	3.

filter pack porosity:	0.0
effective radius:	8.33E-2

Bouwer Rice Coefficients

Le/rw:	4.
A:	1.705
B:	.201
C:	.71
ln(Re/rw):	1.597

Hvorslev

F:	52.228

Least Squares Fit

slope:	-3.33E-1
intercept:	1.34E+0

Hydraulic Conductivity

Bouwer-Rice:	1.54E-4
Hvorslev:	1.39E-4

Recovery Data and Fit

time	y	weight	fitted
0.00	3.90	1.00	3.83
0.17	3.61	1.00	3.62
0.33	3.39	1.00	3.43
0.50	3.20	1.00	3.24
0.67	3.04	1.00	3.07
0.83	2.90	1.00	2.90
1.00	2.79	1.00	2.74

Slug Test Results

Title: Slug out
Client: DMC
Job Number: 98-516
Well Number: MW-3 Shallow

Well Geometry
H: 34.79
Le: 12.
Lw: 34.79
rc: .083
rw: 3.

filter pack porosity: 0.0
effective radius: 8.33E-2

Bouwer Rice Coefficients
Le/rw: 4.
A: 1.705
B: .201
C: .71
ln(Re/rw): 1.597

Hvorslev
F: 52.228

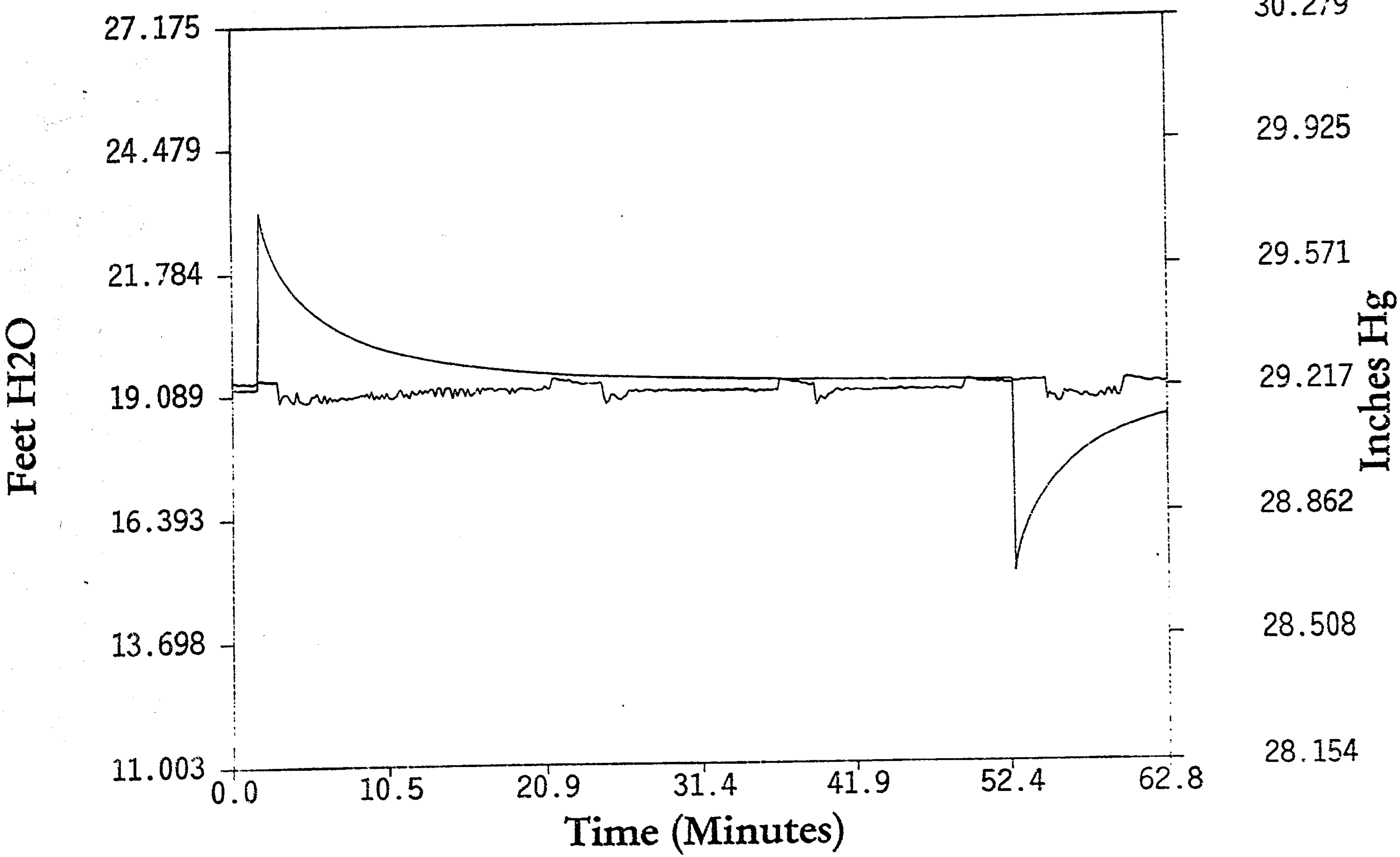
Least Squares Fit
slope: -3.35E-1
intercept: 1.41E+0

Hydraulic Conductivity
Bouwer-Rice: 1.55E-4
Hvorslev: 1.4E-4

Recovery Data and Fit

time	y	weight	fitted
0.00	4.20	1.00	4.10
0.17	3.86	1.00	3.88
0.33	3.62	1.00	3.67
0.50	3.43	1.00	3.47
0.67	3.26	1.00	3.28
0.83	3.11	1.00	3.11
1.00	2.98	1.00	2.94

DMC MW-3 Shallow



[1] - PXD-261 SN 5631

[0] - Barometric

Slug Test Results

Title:	Slug in
Client:	DMC
Job Number:	98-516
Well Number:	MW-3 Deep

Well Geometry

H:	300.
Le:	12.
Lw:	35.9
rc:	.083
rw:	2.625

filter pack porosity:	0.0
effective radius:	8.33E-2

Bouwer Rice Coefficients

Le/rw:	4.571
A:	1.721
B:	.205
C:	.738
ln(Re/rw):	.997

Hvorslev

F:	48.191

Least Squares Fit

slope:	-2.12E+0
intercept:	9.47E-1

Hydraulic Conductivity

Bouwer-Rice:	6.1E-4
Hvorslev:	9.58E-4

Recovery Data and Fit

time	y	weight	fitted
0.00	2.61	1.00	2.57
0.17	1.78	1.00	1.81
0.33	1.25	1.00	1.27
0.50	0.91	1.00	0.90

Slug Test Results

Title:	Slug out
Client:	DMC
Job Number:	98-516
Well Number:	MW-3 Deep

Well Geometry

H:	300.
Le:	12.
Lw:	35.9
rc:	.083
rw:	2.625

filter pack porosity:	0.0
effective radius:	8.33E-2

Bouwer Rice Coefficients

Le/rw:	4.571
A:	1.721
B:	.205
C:	.738
ln(Re/rw):	.997

Hvorslev

F:	48.191

Least Squares Fit

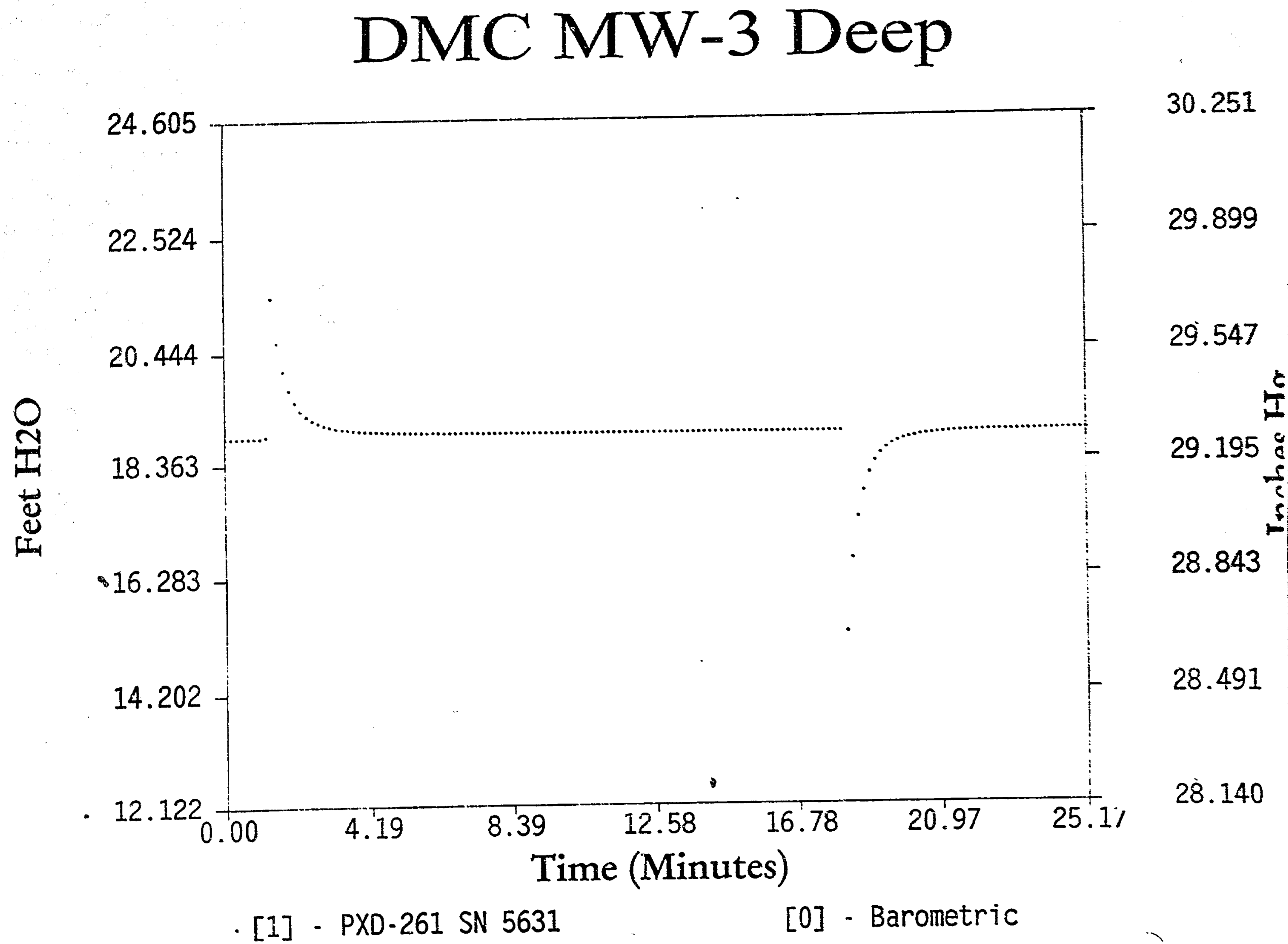
slope:	-2.42E+0
intercept:	1.28E+0

Hydraulic Conductivity

Bouwer-Rice:	6.98E-4
Hvorslev:	1.1E-3

Recovery Data and Fit

time	y	weight	fitted
0.00	3.66	1.00	3.58
0.17	2.34	1.00	2.39
0.33	1.57	1.00	1.60
0.50	1.09	1.00	1.07


DMC MW-3 Deep
Feet H2O
24.605
22.524
20.444
18.363
16.283
14.202
12.122
0.00
4.19
8.39
12.58
16.78
20.97
25.17
Time (Minutes)
30.251
29.899
29.547
29.195
28.843
28.491
28.140
[1] - PXD-261 SN 5631
[0] - Barometric

Slug Test Results

Title:	Slug in
Client:	DMC
Job Number:	98-516
Well Number:	MW-4 Shallow

Well Geometry

H:	29.93
Le:	12.
Lw:	29.93
rc:	.083
rw:	2.125

filter pack porosity:	0.0
effective radius:	8.33E-2

Bouwer Rice Coefficients

Le/rw:	5.647
A:	1.749
B:	.211
C:	.792
ln(Re/rw):	1.798

Hvorslev

F:	42.813

Least Squares Fit

slope:	-3.74E+0
intercept:	1.33E+0

Hydraulic Conductivity

Bouwer-Rice:	1.95E-3
Hvorslev:	1.91E-3

Recovery Data and Fit

time	y	weight	fitted
0.01	3.57	1.00	3.64
0.17	2.06	1.00	2.03
0.33	1.12	1.00	1.09
0.50	0.57	1.00	0.58

Slug Test Results

Title: Slug out
Client: DMC
Job Number: 98-516
Well Number: MW-4 Shallow

Well Geometry
H: 29.93
Le: 12.
Lw: 29.93
rc: .083
rw: 2.125

filter pack porosity: 0.0
effective radius: 8.33E-2

Bouwer Rice Coefficients
Le/rw: 5.647
A: 1.749
B: .211
C: .792
ln(Re/rw): 1.798

Hvorslev
F: 42.813

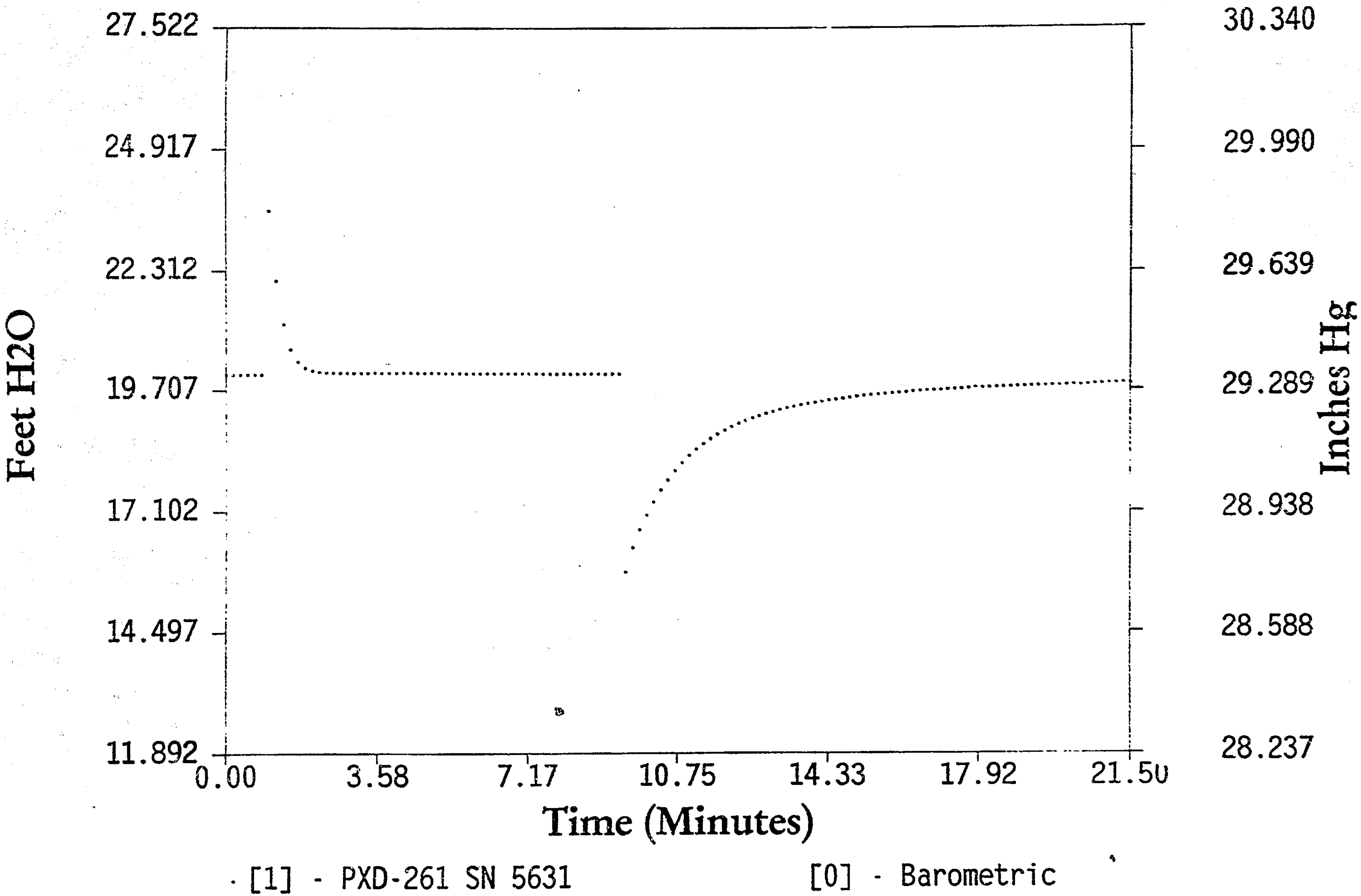
Least Squares Fit
slope: -6.4E-1
intercept: 1.44E+0

Hydraulic Conductivity
Bouwer-Rice: 3.33E-4
Hvorslev: 3.26E-4

Recovery Data and Fit

time	y	weight	fitted
0.01	4.26	1.00	4.18
0.17	3.75	1.00	3.79
0.33	3.36	1.00	3.40
0.50	3.04	1.00	3.06
0.67	2.75	1.00	2.75
0.83	2.50	1.00	2.47

DMC MW-4 Shallow



Slug Test Results

Title:	Slug in
Client:	DMC
Job Number:	98-516
Well Number:	MW-4 Deep

Well Geometry

H:	300.
Le:	12.
Lw:	26.03
rc:	.083
rw:	2.625

filter pack porosity:	0.0
effective radius:	8.33E-2

Bouwer Rice Coefficients

Le/rw:	4.571
A:	1.721
B:	.205
C:	.738
ln(Re/rw):	.94

Hvorslev

F:	48.191

Least Squai Fit

slope:	-3.E+0
intercept:	5.24E-1

Hydraulic Conductivity

Bouwer-Rice:	8.17E-4
Hvorslev:	1.36E-3

Recovery Data and Fit

time	y	weight	fitted
0.01	2.52	1.00	2.44
0.17	1.48	1.00	1.53
0.33	0.90	1.00	0.93
0.50	0.58	1.00	0.56

Slug Test Results

Title:	Slug out
Client:	DMC
Job Number:	98-516
Well Number:	MW-4 Deep

Well Geometry

H:	300.
Le:	12.
Lw:	26.03
rc:	.083
rw:	2.625

filter pack porosity:	0.0
effective radius:	8.33E-2

Bouwer Rice Coefficients

Le/rw:	4.571
A:	1.721
B:	.205
C:	.738
ln(Re/rw):	.94

Hvorslev

F:	48.191

Least Squares Fit

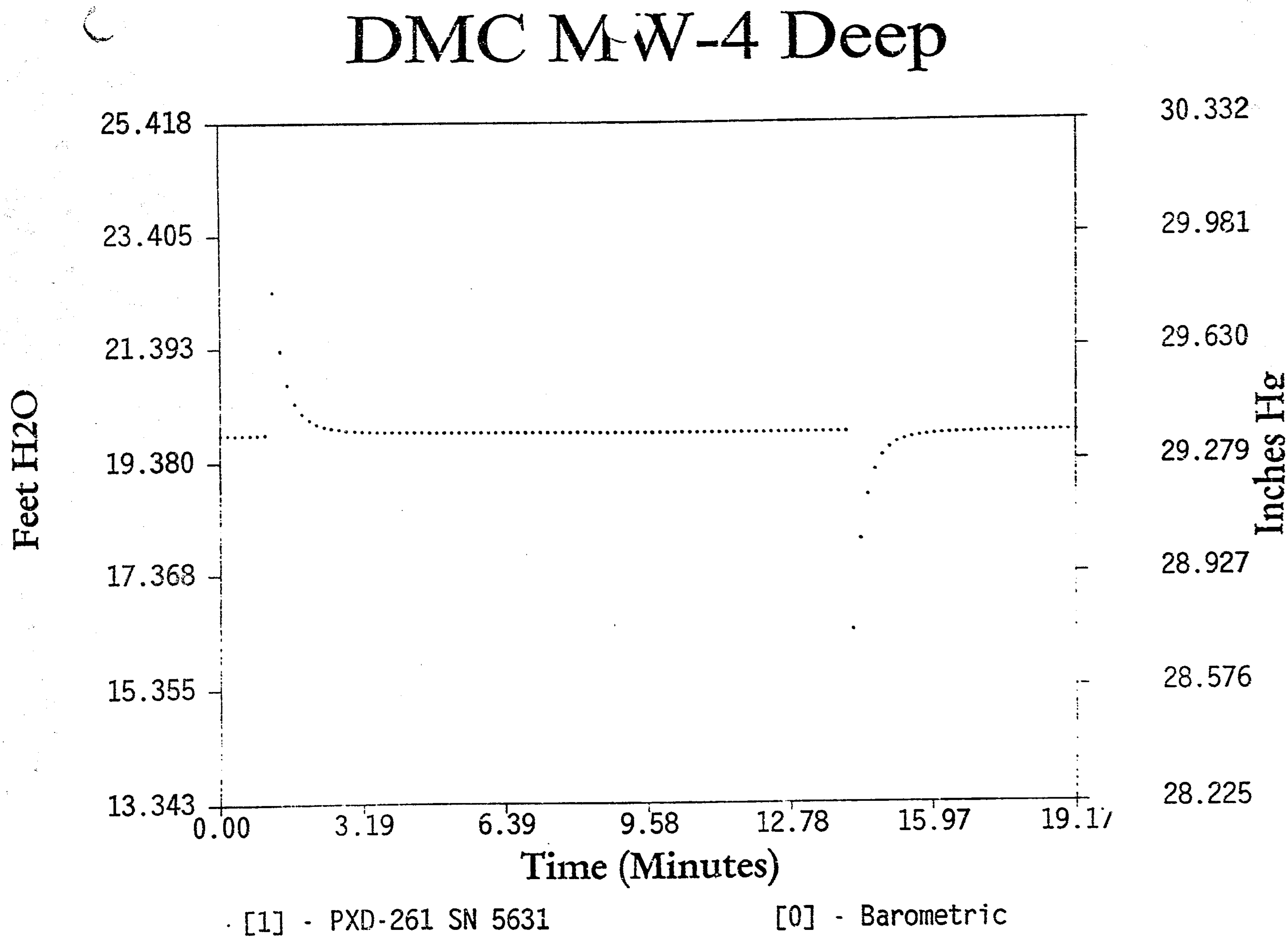
slope:	-3.35E+0
intercept:	1.26E+0

Hydraulic Conductivity

Bouwer-Rice:	9.1E-4
Hvorslev:	1.52E-3

Recovery Data and Fit

time	y	weight	fitted
0.01	3.54	1.00	3.40
0.17	1.93	1.00	2.01
0.33	1.12	1.00	1.15
0.50	0.68	1.00	0.66


DMC MW-4 Deep
Feet H2O
25.418
23.405
21.393
19.380
17.368
15.355
13.343
Inches Hg
30.332
29.981
29.630
29.279
28.927
28.576
28.225
0.00
3.19
6.39
9.58
12.78
15.97
19.17
Time (Minutes)
[1] - PXD-261 SN 5631
[0] - Barometric

Slug Test Results

Title: Slug in
Client: DMC
Job Number: 98-516
Well Number: MW-2 Mid

Well Geometry
H: 39.03
Le: 3.5
Lw: 39.03
rc: .083
rw: 2.125

filter pack porosity: 0.0
effective radius: 8.33E-2

Bouwer Rice Coefficients
Le/rw: 1.647
A: .
B: .
C: .
ln(Re/rw): 2.646

Hvorslev
F: 29.285

Least Squares Fit
slope: -3.17E-4
intercept: 1.86E+0

Hydraulic Conductivity
Bouwer-Rice: 8.33E-7
Hvorslev: 2.36E-7

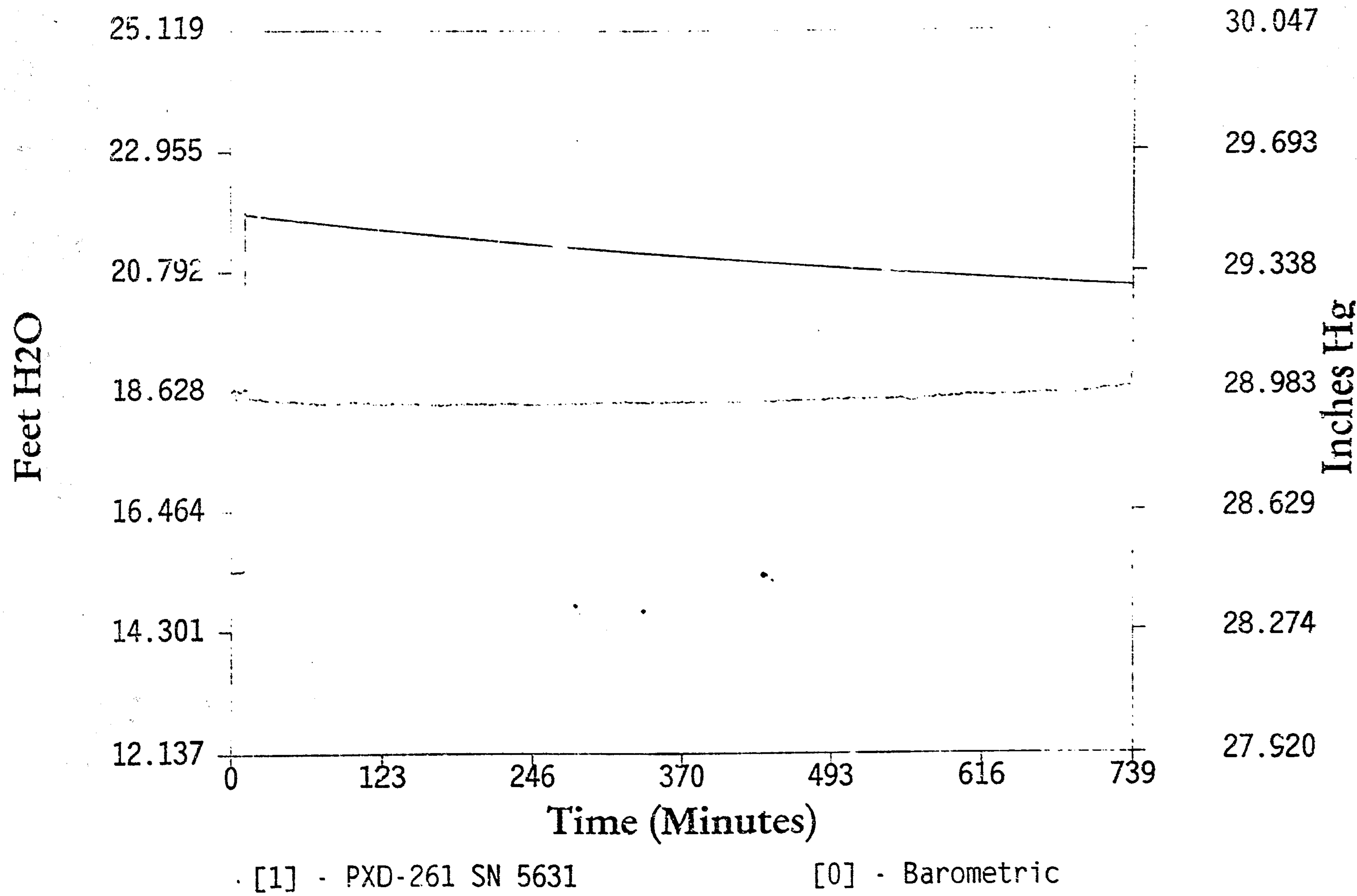
Recovery Data and Fit

time	y	weight	fitted
0.00	5.35	0.00	6.40
0.17	6.45	1.00	6.39
0.33	6.41	1.00	6.39
0.50	6.41	1.00	6.39
0.83	6.41	1.00	6.39
1.50	6.41	1.00	6.39

2.00	6.40	1.00	6.39
2.50	6.40	1.00	6.39
3.50	6.40	1.00	6.39
4.50	6.40	1.00	6.39
5.50	6.40	1.00	6.38
6.00	6.39	1.00	6.38
6.50	6.39	1.00	6.38
7.50	6.39	1.00	6.38
8.00	6.39	1.00	6.38
8.50	6.39	1.00	6.38
9.50	6.38	1.00	6.38
10.50	6.38	1.00	6.37
11.33	6.38	1.00	6.37
11.50	6.38	1.00	6.37
12.50	6.38	1.00	6.37
13.17	6.37	1.00	6.37
13.50	6.37	1.00	6.37
14.50	6.37	1.00	6.37
14.67	6.37	1.00	6.37
15.50	6.37	1.00	6.36
16.50	6.36	1.00	6.36
16.67	6.36	1.00	6.36
17.50	6.36	1.00	6.36
18.39	6.36	1.00	6.36
18.50	6.36	1.00	6.36
19.50	6.35	1.00	6.36
20.33	6.35	1.00	6.35
20.50	6.35	1.00	6.35
21.50	6.35	1.00	6.35
22.50	6.35	1.00	6.35
23.50	6.34	1.00	6.35
24.50	6.34	1.00	6.35
24.67	6.34	1.00	6.35
25.50	6.34	1.00	6.34
26.50	6.34	1.00	6.34
27.33	6.33	1.00	6.34
27.50	6.33	1.00	6.34
28.50	6.33	1.00	6.34
29.50	6.33	1.00	6.34
39.67	6.33	1.00	6.32
30.50	6.33	1.00	6.33
72.00	6.25	1.00	6.25
102.00	6.18	1.00	6.19
132.00	6.11	1.00	6.13

162.00	6.05	1.00	6.07
191.33	5.99	1.00	6.02
222.00	5.93	1.00	5.96
251.17	5.87	1.00	5.91
282.00	5.81	1.00	5.85
312.00	5.76	1.00	5.79
341.50	5.71	1.00	5.74
372.00	5.65	1.00	5.68
401.50	5.61	1.00	5.63
432.00	5.55	1.00	5.58
462.00	5.51	1.00	5.52
492.00	5.46	1.00	5.47
522.00	5.41	1.00	5.42
552.00	5.37	1.00	5.37
581.83	5.32	1.00	5.32
611.50	5.28	1.00	5.27
641.83	5.24	1.00	5.22
672.00	5.20	1.00	5.17
702.00	5.15	1.00	5.12
731.17	5.12	1.00	5.07

DMC MW-2 Mid



Feet H2O
25.119
22.955
20.792
18.628
16.464
14.301
12.137
Inches Hg
30.047
29.693
29.338
28.983
28.629
28.274
27.920
0
123
246
370
493
616
739
Time (Minutes)
[1] - PXD-261 SN 5631
[0] - Barometric

Attachment 4

Summary Of Analytical Data

Rev 3/14/01

Summary of Analytical Results for Volatile Organic Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in ug/l)

Compound	MW1-S 5/7/98	MW1-S 7/24/98	MW1-S 10/26/98	MW1-S 2/16/99	MW1-S 7/26/99	MW1-S 9/9/99	MW1-S 11/1/99	MW1-S 3/2/00	MW1-S 6/23/00	MW1-S 9/29/00	MW1-S 11/30/00	MW2-S 5/7/98	MW2-S 7/24/98	MW2-S 10/26/98	MW2-S 7/26/99
Acetone	<20	<20	<20		<50	<50	<50					<20			<50
Acrolein	<50	<10	<50		<50	<50	<50					<50			<50
Acrylonitrile	<5.0	<10	<10		<50	<50	<50					<5.0			<50
Benzene	<1.0	<0.5	<0.5	<0.5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1.0	<0.5	<0.5	<5.0
Bromobenzene	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
Bromochloromethane	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
Bromodichloromethane	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
Bromoform	<1.0	<2.0	<2.0	<2.0	<5.0	<5.0	<5.0					<1.0			<5.0
Bromomethane	<1.0	<4.0	<4.0	<4.0	<10.0	<10.0	<10.0					<1.0			<10.0
n-butylbenzene	<1.0	<1.0	<1.0	<1.0	<10.0	<10.0	<10.0					<1.0			<10.0
sec-butylbenzene	<1.0	<1.0	<1.0	<1.0	<10.0	<10.0	<10.0					<1.0			<10.0
tert-butylbenzene	<1.0	<1.0	<1.0	<1.0	<10.0	<10.0	<10.0					<1.0			<10.0
Carbon disulfide	<20	<1.0	<1.0		<10.0	<10.0	<10.0					<20			<10.0
Carbon tetrachloride	<1.0	<1.0	<0.3	<0.3	<5.0	<5.0	<5.0					<1.0			<5.0
Chlorobenzene	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
Chlorodibromomethane	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
Chloroethane	<1.0	<4.0	<4.0	<4.0	<10.0	<10.0	<10.0					<1.0			<10.0
Chloroform	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
Chloromethane	<1.0	<1.0	<1.0	<1.0	<10.0	<10.0	<10.0					<1.0			<10.0
o-chlorotoluene	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
p-chlorotoluene	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
1,2-dibromo-3-chloropropane	<1.0	<10	<10	<10								<1.0			
1,2-dibromoethane	<1.0	<10	<10	<10								<1.0			
Dibromomethane	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
1,2-dichlorobenzene	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
1,3-dichlorobenzene	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
p-dichlorobenzene	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
Dichlorofluoromethane	<1.0	<10	<10												
Dichlorodifluoromethane	<1.0	<3.0	<3.0	<3.0	<10.0	<10.0	<10.0					<1.0			<10.0
1,2-dichloroethane	<1.0	<1.0	<1.0	<0.4	<5.0	<5.0	<5.0					<1.0			<5.0
1,1-dichloroethane	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1.0		<1.0	<5.0
1,1-dichloroethene	<1.0	<2.0	<2.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1.0	<2.0		<5.0
cis-1,2-dichloroethene	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
trans-1,2-dichloroethene	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
trans-1,4-dichloro-2-butene	<1.0	<10	<10	<10	<10.0	<10.0	<10.0								<10.0
di-isopropylether	<1.0	<1.0	<1.0												
1,2-dichloropropane	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
1,3-dichloropropane	<1.0	<1.5	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
2,2-dichloropropane	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
1,1-dichloropropene	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
1,3-dichloropropene					<10.0	<10.0	<10.0								<10.0
cis-1,3-dichloropropene	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
trans-1,3-dichloropropene	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
Ethylbenzene	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
Heptane		<1.0													
2-hexanone	<20	<10	<10		<5.0	<5.0	<5.0					<20			<5.0
Hexachlorobutadiene	<1.0	<5.0	<5.0		<10.0	<10.0	<10.0					<1.0			<10.0
Iodomethane	<1.0	<10	<10	<10	<10.0	<10.0	<10.0					<1.0			<10.0
Isopropylbenzene	<1.0	<1.0	<1.0	<1.0	<10.0	<10.0	<10.0					<1.0			<10.0
p-isopropyltoluene	<1.0	<1.0	<1.0	<1.0	<10.0	<10.0	<10.0					<1.0			<10.0
Methylene chloride	<10	<10	<5.0	<10	<5.0	<5.0	<5.0					<1.0			<5.0
Methyl ethyl ketone	<20	<10	<10		<10.0	<10.0	<10.0					<20			<10.0
MTBE		<1.0	<1.0												
Methyl isobutyl ketone		<10	<10												
4-methyl-2-pentanone	<20				<5.0	<5.0	<5.0					<20			<5.0
Tetrahydrofuran	<50	<50	<50		<5.0	<5.0	<5.0					<50			<5.0
Naphthalene	<1.0	<5.0	<10	<10								<1.0			
n-propylbenzene	<1.0	<1.0	<1.0	<1.0	<10.0	<10.0	<10.0					<1.0			<10.0
Styrene	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
1,1,1,2-tetrachloroethane	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
1,1,2,2-tetrachloroethane	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
Tetrachloroethene	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
Toluene	<1.0	8.2	<1.0	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1.0	<1.0	<1.0	<5.0
1,2,3-trichlorobenzene	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0					<1.0			<5.0
1,2,4-trichlorobenzene	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0								<5.0
1,1,1-trichloroethane	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<3.0	<5.0	<5.0	<5.0	<5.0	<1.0	<1.0	<1.0	<5.0
1,1,2-trichloroethane	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0								<5.0
Trichloroethene	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0
Trichlorofluoromethane	<5.0	<4.0	<4.0	<4.0	<10.0	<10.0	<10.0					<5.0			<10.0
1,2,3-trichloropropane	<1.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0					<1.0			<5.0
1,2,4-trimethylbenzene	<1.0	<1.0	<1.0	<1.0	<10.0	<10.0	<10.0					<1.0			<10.0
1,3,5-trimethylbenzene	<1.0	<1.0	<1.0	<1.0	<10.0	<10.0	<10.0					<1.0			<10.0
Vinyl acetate	<5.0		<10		<10.0	<10.0	<10.0					<5.0			<10.0
Ethyl acetate												<1.0			
Vinyl chloride	<1.0	<1.0	<1.0	<1.0	<10.0	<10.0	<10.0					<1.0			<10.0
2-chloroethylvinyl ether	<1.0											<1.0			
Ethyl methacrylate	<5											<5			
o-xylene	<1.0				<10.0	<10.0	<10.0					<1.0			<10.0
m and p xylene	<1.0				<5.0	<5.0	<5.0					<1.0			<5.0
Xylenes, total	<1.0	<3.0	<3.0	<3.0	<5.0	<5.0	<5.0					<1.0			<5.0

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Volatile Organic Compounds at Dixon Marquette Cement Company, 1998-2000
(all values in ug/l)

Compound	MW2-S 9/9/99	MW2-S 11/1/99	MW2-S 3/2/00	MW2-S 6/23/00	MW2-S 9/29/00	MW2-S 11/30/00	MW2-S 11/30/00	MW3-S 5/7/98	MW3-S 6/17/98	MW3-S 7/24/98	MW3-S 10/26/98	MW3-S 7/26/99	MW3-S 9/8/99	MW3-S 11/1/99	MW3-S 3/2/00
Acetone	<50	<50						<20				<50	<50	<50	
Acrolein	<50	<50						<50				<50	<50	<50	
Acrylonitrile	<50	<50						<5.0				<50	<50	<50	
Benzene	<5.0	<5.0	<5.0	<5.0	<5.0		<5.0	<1.0		<0.5	<0.5	<5.0	<5.0	<5.0	<5.0
Bromobenzene	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
Bromochloromethane	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
Bromodichloromethane	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
Bromoform	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
Bromomethane	<10.0	<10.0						<1.0				<10.0	<10.0	<10.0	
n-butylbenzene	<10.0	<10.0						<1.0				<10.0	<10.0	<10.0	
sec-butylbenzene	<10.0	<10.0						<1.0				<10.0	<10.0	<10.0	
tert-butylbenzene	<10.0	<10.0						<1.0				<10.0	<10.0	<10.0	
Carbon disulfide	<10.0	<10.0						<20				<10.0	<10.0	<10.0	
Carbon tetrachloride	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
Chlorobenzene	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
Chlorodibromomethane	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
Chloroethane	<10.0	<10.0						<1.0				<10.0	<10.0	<10.0	
Chloroform	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
Chloromethane	<10.0	<10.0						<1.0				<10.0	<10.0	<10.0	
o-chlorotoluene	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
p-chlorotoluene	<5.0	<5.0										<5.0	<5.0	<5.0	
1,2-dibromo-3-chloropropane								<1.0							
1,2-dibromoethane								<1.0							
Dibromomethane	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
1,2-dichlorobenzene	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
1,3-dichlorobenzene	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
p-dichlorobenzene	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
Dichlorofluoromethane															
Dichlorodifluoromethane	<10.0	<10.0						<1.0				<10.0	<10.0	<10.0	
1,2-dichloroethane	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
1,1-dichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0		<5.0	***2.9***	***2.0***		***4.0***	<5.0	<5.0	<5.0	<5.0
1,1-dichloroethene	<5.	<5.0	<5.0	<5.0	<5.0		<5.0	<1.0		<2.0		<5.0	<5.0	<5.0	<5.0
cis-1,2-dichloroethene	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
trans-1,2-dichloroethene	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
trans-1,4-dichloro-2-butene	<10.0	<10.0										<10.0	<10.0	<10.0	
di-isopropylether															
1,2-dichloropropane	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
1,3-dichloropropane	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
2,2-dichloropropane	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
1,1-dichloropropene	<5.0	<5.0										<5.0	<5.0	<5.0	
1,3 dichloropropene	<10.0	<10.0										<10.0	<10.0	<10.0	
cis-1,3-dichloropropene	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
trans-1,3-dichloropropene	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
Ethylbenzene	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
Heptane															
2-hexanone	<5.0	<5.0						<20				<5.0	<5.0	<5.0	
Hexachlorobutadiene	<10.0	<10.0						<1.0				<10.0	<10.0	<10.0	
Iodomethane	<10.0	<10.0						<1.0				<10.0	<10.0	<10.0	
Isopropylbenzene	<10.0	<10.0						<1.0				<10.0	<10.0	<10.0	
p-isopropyltoluene	<10.0	<10.0						<1.0				<10.0	<10.0	<10.0	
Methylene chloride	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
Methyl ethyl ketone	<10.0	<10.0						<20				<10.0	<10.0	<10.0	
MTBE															
Methyl isobutyl ketone															
4-methyl-2-pentanone	<5.0	<5.0						<20				<5.0	<5.0	<5.0	
Tetrahydrofuran	<5.0	<5.0						<50				<5.0	<5.0	<5.0	
Naphthalene								<1.0							
n-propylbenzene	<10.0	<10.0						<1.0				<10.0	<10.0	<10.0	
Styrene	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
1,1,1,2-tetrachloroethane	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
1,1,2,2-tetrachloroethane	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
Tetrachloroethene	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
Toluene	<5.0	<5.0	<5.0	<5.0	<5.0		<5.0	<1.0		<1.0	<1.0	<5.0	<5.0	<5.0	<5.0
1,2,3-trichlorobenzene	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
1,2,4-trichlorobenzene	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
1,1,1-trichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0		<5.0	***15***	***12.0***	***12.2***	***11.4***	<5.0	***6.80***	***6.4***	<5.0
1,1,2-trichloroethane	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
Trichloroethene	<5.0	<5.0						<1.0		<1.0	<1.0	<5.0	<5.0	<5.0	
Trichlorofluoromethane	<10.0	<10.0						<5.0				<10.0	<10.0	<10.0	
1,2,3-trichloropropane	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
1,2,4-trimethylbenzene	<10.0	<10.0						<1.0				<10.0	<10.0	<10.0	
1,3,5-trimethylbenzene	<10.0	<10.0						<1.0				<10.0	<10.0	<10.0	
Vinyl acetate	<10.0	<10.0						<5.0				<10.0	<10.0	<10.0	
Ethyl acetate								<1.0							
Vinyl chloride	<10.0	<10.0						<1.0				<10.0	<10.0	<10.0	
2-chloroethylvinyl ether								<1.0							
Ethyl methacrylate								<5							
o-xylene	<10.0	<10.0						<1.0				<10.0	<10.0	<10.0	
m and p xylene	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	
Xylenes, total	<5.0	<5.0						<1.0				<5.0	<5.0	<5.0	

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Volatile Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in μg/l)

Compound	MW3-S 11/1/99	MW3-S 3/2/00	MW3-S 6/23/00	MW3-S 9/29/00	MW3-S 11/30/00	MW4-S 5/7/98	MW4-S 7/24/98	MW4-S 10/26/98	MW4-S 7/26/99	MW4-S 9/9/99	MW4-S 11/1/99	MW4-S 3/2/00	MW4-S 6/23/00	MW4-S 9/29/00
Acetone	<50					<20			<50	<50	<50			
Acrolein	<50					<50			<50	<50	<50			
Acrylonitrile	<50					<5.0			<50	<50	<50			
Benzene	<5.0	<5.0	<5.0	<5.0	<5.0	<1.0	<0.5	<0.5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Bromobenzene	<5.0					<1.0			<5.0	<5.0	<5.0			
Bromochloromethane	<5.0					<1.0			<5.0	<5.0	<5.0			
Bromodichloromethane	<5.0					<1.0			<5.0	<5.0	<5.0			
Bromoform	<5.0					<1.0			<5.0	<5.0	<5.0			
Bromomethane	<10.0					<1.0			<10.0	<10.0	<10.0			
n-butylbenzene	<10.0					<1.0			<10.0	<10.0	<10.0			
sec-butylbenzene	<10.0					<1.0			<10.0	<10.0	<10.0			
tert-butylbenzene	<10.0					<1.0			<10.0	<10.0	<10.0			
Carbon disulfide	<10.0					<20			<10.0	<10.0	<10.0			
Carbon tetrachloride	<5.0					<1.0			<5.0	<5.0	<5.0			
Chlorobenzene	<5.0					<1.0			<5.0	<5.0	<5.0			
Chlorodibromomethane	<5.0					<1.0			<5.0	<5.0	<5.0			
Chloroethane	<10.0					<1.0			<10.0	<10.0	<10.0			
Chloroform	<5.0					<1.0			<5.0	<5.0	<5.0			
Chloromethane	<10.0					<1.0			<10.0	<10.0	<10.0			
o-chlorotoluene	<5.0					<1.0			<5.0	<5.0	<5.0			
p-chlorotoluene	<5.0					<1.0			<5.0	<5.0	<5.0			
1,2-dibromo-3-chloropropane						<1.0								
1,2-dibromoethane						<1.0								
Dibromomethane	<5.0					<1.0			<5.0	<5.0	<5.0			
1,2-dichlorobenzene	<5.0					<1.0			<5.0	<5.0	<5.0			
1,3-dichlorobenzene	<5.0					<1.0			<5.0	<5.0	<5.0			
p-dichlorobenzene	<5.0					<1.0			<5.0	<5.0	<5.0			
Dichlorofluoromethane														
Dichlorodifluoromethane	<10.0					<1.0			<10.0	<10.0	<10.0			
1,2-dichloroethane	<5.0					<1.0			<5.0	<5.0	<5.0			
1,1-dichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<1.0		<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1-dichloroethene	<5.0	<5.0	<5.0	<5.0	<5.0	<1.0	<2.0		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
cis-1,2-dichloroethene	<5.0					<1.0			<5.0	<5.0	<5.0			
trans-1,2-dichloroethene	<5.0					<1.0			<5.0	<5.0	<5.0			
trans-1,4-dichloro-2-butene	<10.0								<10.0	<10.0	<10.0			
di-isopropylether														
1,2-dichloropropane	<5.0					<1.0			<5.0	<5.0	<5.0			
1,3-dichloropropane	<5.0					<1.0			<5.0	<5.0	<5.0			
2,2-dichloropropane	<5.0					<1.0			<5.0	<5.0	<5.0			
1,1-dichloropropene	<5.0					<1.0			<5.0	<5.0	<5.0			
1,3-dichloropropene	<10.0								<10.0	<10.0	<10.0			
cis-1,3-dichloropropene	<5.0					<1.0			<5.0	<5.0	<5.0			
trans-1,3-dichloropropene	<5.0					<1.0			<5.0	<5.0	<5.0			
Ethylbenzene	<5.0					<1.0			<5.0	<5.0	<5.0			
Heptane														
2-hexanone	<5.0					<20			<5.0	<5.0	<5.0			
Hexachlorobutadiene	<10.0					<1.0			<10.0	<10.0	<10.0			
Iodomethane	<10.0					<1.0			<10.0	<10.0	<10.0			
Isopropylbenzene	<10.0					<1.0			<10.0	<10.0	<10.0			
p-isopropyltoluene	<10.0					<1.0			<10.0	<10.0	<10.0			
Methylene chloride	<5.0					<10			<5.0	<5.0	<5.0			
Methyl ethyl ketone	<10.0					<20			<10.0	<10.0	<10.0			
MTBE														
Methyl isobutyl ketone						<20								
4-methyl-2-pentanone	<5.0					<20			<5.0	<5.0	<5.0			
Tetrahydrofuran	<5.0					<50			<5.0	<5.0	<5.0			
Naphthalene						<1.0								
n-propylbenzene	<10.0					<1.0			<10.0	<10.0	<10.0			
Styrene	<5.0					<1.0			<5.0	<5.0	<5.0			
1,1,1,2-tetrachloroethane	<5.0					<1.0			<5.0	<5.0	<5.0			
1,1,2,2-tetrachloroethane	<5.0					<1.0			<5.0	<5.0	<5.0			
Tetrachloroethene	<5.0					<1.0			<5.0	<5.0	<5.0			
Toluene	<5.0	<5.0	<5.0	<5.0	<5.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2,3-trichlorobenzene	<5.0					<1.0			<5.0	<5.0	<5.0			
1,2,4-trichlorobenzene	<5.0					<1.0			<5.0	<5.0	<5.0			
1,1,1-trichloroethane	***6.4***	<5.0	<5.0	<5.0	<5.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,2-trichloroethane	<5.0					<1.0			<5.0	<5.0	<5.0			
Trichloroethene	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0			
Trichlorofluoromethane	<10.0					<5.0			<10.0	<10.0	<10.0			
1,2,3-trichloropropane	<5.0					<1.0			<5.0	<5.0	<5.0			
1,2,4-trimethylbenzene	<10.0					<1.0			<10.0	<10.0	<10.0			
1,3,5-trimethylbenzene	<10.0					<1.0			<10.0	<10.0	<10.0			
Vinyl acetate	<10.0					<5.0			<10.0	<10.0	<10.0			
Ethyl acetate						<1.0								
Vinyl chloride	<10.0					<1.0			<10.0	<10.0	<10.0			
2-chloroethylvinyl ether						<1.0								
Ethyl methacrylate						<5								
o-xylene	<10.0					<1.0			<10.0	<10.0	<10.0			
m and p xylene	<5.0					<1.0			<5.0	<5.0	<5.0			
Xylenes, total	<5.0					<1.0			<5.0	<5.0	<5.0			

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Volatile Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in µg/l)

Compound	MW4-S 11/30/00	MW5-S 7/26/99	MW5-S 9/9/99	MW5-S 11/1/99	MW5-S 3/2/00	MW5-S 6/23/00	MW5-S 9/29/00	MW5-S 11/30/00	MW6-S 7/26/99	MW6-S 9/9/99	MW6-S 11/1/99	MW6-S 3/2/00	MW6-S 6/23/00	MW6-S 9/29/00
Acetone		<50	<50	<50					<50	<50	<50			
Acrolein		<50	<50	<50					<50	<50	<50			
Acrylonitrile		<50	<50	<50					<50	<50	<50			
Benzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Bromobenzene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Bromochloromethane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Bromodichloromethane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Bromoform		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Bromomethane		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
n-butylbenzene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
sec-butylbenzene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
tert-butylbenzene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
Carbon disulfide		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
Carbon tetrachloride		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Chlorobenzene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Chlorodibromomethane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Chloroethane		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
Chloroform		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Chloromethane		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
o-chlorotoluene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
p-chlorotoluene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,2-dibromo-3-chloropropane														
1,2-dibromoethane														
Dibromomethane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,2-dichlorobenzene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,3-dichlorobenzene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
p-dichlorobenzene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Dichlorofluoromethane														
Dichlorodifluoromethane		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
1,2-dichloroethane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,1-dichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1-dichloroethene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
cis-1,2-dichloroethene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
trans-1,2-dichloroethene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
trans-1,4-dichloro-2-butene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
di-isopropylether														
1,2-dichloropropane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,3-dichloropropane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
2,2-dichloropropane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,1-dichloropropene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,3-dichloropropene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
cis-1,3-dichloropropene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
trans-1,3-dichloropropene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Ethylbenzene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Heptane														
2-hexanone		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Hexachlorobutadiene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
Iodomethane		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
Isopropylbenzene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
p-isopropyltoluene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
Methylene chloride		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Methyl ethyl ketone		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
MTBE														
Methyl isobutyl ketone														
4-methyl-2-pentanone		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Tetrahydrofuran		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Naphthalene														
n-propylbenzene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
Styrene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,1,1,2-tetrachloroethane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,1,2,2-tetrachloroethane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Tetrachloroethene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Toluene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2,3-trichlorobenzene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,2,4-trichlorobenzene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,1,1-trichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,2-trichloroethane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Trichloroethene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Trichlorofluoromethane		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
1,2,3-trichloropropane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,2,4-trimethylbenzene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
1,3,5-trimethylbenzene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
Vinyl acetate		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
Ethyl acetate														
Vinyl chloride		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
2-chloroethylvinyl ether														
[illegible]yl methacrylate														
[illegible]ne		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
m and p xylene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Xylenes, total		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Volatile Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in µg/l)

Compound	MW6-S 11/30/00	MW7-S 7/26/99	MW7-S 9/9/99	MW7-S 11/1/99	MW7-S 3/2/00	MW7-S 6/23/00	MW7-S 9/29/00	MW7-S 11/30/00	MW8-S 7/26/99	MW8-S 9/9/99	MW8-S 11/1/99	MW8-S 3/2/00	MW8-S 6/23/00	MW8-S 9/29/00
Acetone		<50	<50	<50					<50	<50	<50			
Acrolein		<50	<50	<50					<50	<50	<50			
Acrylonitrile		<50	<50	<50					<50	<50	<50			
Benzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Bromobenzene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Bromochloromethane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Bromodichloromethane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Bromoform		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Bromomethane		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
n-butylbenzene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
sec-butylbenzene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
tert-butylbenzene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
Carbon disulfide		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
Carbon tetrachloride		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Chlorobenzene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Chlorodibromomethane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Chloroethane		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
Chloroform		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Chloromethane		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
o-chlorotoluene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
p-chlorotoluene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,2-dibromo-3-chloropropane														
1,2-dibromoethane														
Dibromomethane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,2-dichlorobenzene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,3-dichlorobenzene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
p-dichlorobenzene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Dichlorofluoromethane														
Dichlorodifluoromethane		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
1,2-dichloroethane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,1-dichloroethane	<5.0	<5.0	<5.0	***38.9***	***13***	***25.2***	***63.9***	***58.1***	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1-dichloroethene	<5.0	<5.0	***6.1***	<5.0	<5.0	<5.0	***6.1***	***8.20***	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
cis-1,2-dichloroethene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
trans-1,2-dichloroethene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
trans-1,4-dichloro-2-butene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
di-isopropylether														
1,2-dichloropropane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,3-dichloropropane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
2,2-dichloropropane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,1-dichloropropene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,3-dichloropropene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
cis-1,3-dichloropropene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
trans-1,3-dichloropropene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Ethylbenzene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Heptane														
2-hexanone		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Hexachlorobutadiene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
Iodomethane		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
Isopropylbenzene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
p-isopropyltoluene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
Methylene chloride		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Methyl ethyl ketone		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
MTBE														
Methyl isobutyl ketone														
4-methyl-2-pentanone		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Tetrahydrofuran		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Naphthalene														
n-propylbenzene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
Styrene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,1,1,2-tetrachloroethane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,1,2,2-tetrachloroethane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Tetrachloroethene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Toluene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2,3-trichlorobenzene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,2,4-trichlorobenzene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,1,1-trichloroethane	<5.0	***6***	<5.0	<5.0	<5.0	***5.7***	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,2-trichloroethane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Trichloroethene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Trichlorofluoromethane		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
1,2,3-trichloropropane		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
1,2,4-trimethylbenzene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
1,3,5-trimethylbenzene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
Vinyl acetate		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
Ethyl acetate														
Vinyl chloride		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
2-chloroethylvinyl ether														
Ethyl methacrylate														
o-xylene		<10.0	<10.0	<10.0					<10.0	<10.0	<10.0			
m and p xylene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			
Xylenes, total		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0			

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Volatile Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in µg/l)

Compound	MW8-S 11/30/00	MW9-S 7/26/99	MW9-S 9/9/99	MW9-S 11/1/99	MW9-S 3/2/00	MW9-S 6/23/00	MW9-S 9/29/00	MW9-S 11/30/00	MW1-D 7/24/98	MW1-D 10/26/98	MW1-D 2/16/99	MW1-D 7/26/99	MW1-D 9/9/99	MW1-D 11/1/99
Acetone		<50	<50	<50					<20	<20		<50	<50	<50
Acrolein		<50	<50	<50					<10	<50		<50	<50	<50
Acrylonitrile		<50	<50	<50					<10	<10		<50	<50	<50
Benzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.5	<0.5	<0.5	<5.0	<5.0	<5.0
Bromobenzene		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Bromochloromethane		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Bromodichloromethane		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Bromoform		<5.0	<5.0	<5.0					<2.0	<2.0	<2.0	<5.0	<5.0	<5.0
Bromomethane		<10.0	<10.0	<10.0					<4.0	<4.0	<4.0	<10.0	<10.0	<10.0
n-butylbenzene		<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
sec-butylbenzene		<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
tert-butylbenzene		<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
Carbon disulfide		<10.0	<10.0	<10.0					<1.0	<1.0		<10.0	<10.0	<10.0
Carbon tetrachloride		<5.0	<5.0	<5.0					<1.0	<0.3	<0.3	<5.0	<5.0	<5.0
Chlorobenzene		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Chlorodibromomethane		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Chloroethane		<10.0	<10.0	<10.0					<4.0	<4.0	<4.0	<10.0	<10.0	<10.0
Chloroform		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Chloromethane		<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
o-chlorotoluene		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
p-chlorotoluene		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,2-dibromo-3-chloropropane									<10	<10	<10			
1,2-dibromoethane									<10	<10	<10			
Dibromomethane		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,2-dichlorobenzene		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,3-dichlorobenzene		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
p-dichlorobenzene		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Dichlorofluoromethane									<10	<10				
Dichlorodifluoromethane		<10.0	<10.0	<10.0					<3.0	<3.0	<3.0	<10.0	<10.0	<10.0
1,2-dichloroethane		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,1-dichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1.0	<5.0	<1.0	<5.0	<5.0	<5.
1,1-dichloroethene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<2.0	<2.0	<2.0	<5.0	<5.0	<5.0
cis-1,2-dichloroethene		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
trans-1,2-dichloroethene		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
trans-1,4-dichloro-2-butene		<10.0	<10.0	<10.0					<10	<10	<10	<10.0	<10.0	<10.0
di-isopropylether									<1.0	<1.0				
1,2-dichloropropane		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,3-dichloropropane		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
2,2-dichloropropane		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,1-dichloropropene		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,3-dichloropropene		<10.0	<10.0	<10.0								<10.0	<10.0	<10.0
cis-1,3-dichloropropene		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
trans-1,3-dichloropropene		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Ethylbenzene		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Heptane									<1.0					
2-hexanone		<5.0	<5.0	<5.0					<10	<10		<5.0	<5.0	<5.0
Hexachlorobutadiene		<10.0	<10.0	<10.0					<5.0	<5.0		<10.0	<10.0	<10.0
Iodomethane		<10.0	<10.0	<10.0					<10	<10		<10.0	<10.0	<10.0
Isopropylbenzene		<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
p-isopropyltoluene		<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
Methylene chloride		<5.0	<5.0	<5.0					<10	<5.0	<10	<5.0	<5.0	<5.0
Methyl ethyl ketone		<10.0	<10.0	<10.0					<10	<10		<10.0	<10.0	<10.0
MTBE									<1.0	<1.0				
Methyl isobutyl ketone									<10	<10				
4-methyl-2-pentanone		<5.0	<5.0	<5.0								<5.0	<5.0	<5.0
Tetrahydrofuran		<5.0	<5.0	<5.0					<50	<50		<5.0	<5.0	<5.0
Naphthalene									<5.0	<10	<1.0			
n-propylbenzene		<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
Styrene		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,1,1,2-tetrachloroethane		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,1,2,2-tetrachloroethane		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Tetrachloroethene		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Toluene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,2,3-trichlorobenzene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2,4-trichlorobenzene		<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,1-trichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,1,2-trichloroethane		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Trichloroethene		<5.0	<5.0	<5.0					<4.0	<1.0	<1.0	<5.0	<5.0	<5.0
Trichlorofluoromethane		<10.0	<10.0	<10.0					<1.0	<4.0	<4.0	<10.0	<10.0	<10.0
1,2,3-trichloropropane		<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,2,4-trimethylbenzene		<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
1,3,5-trimethylbenzene		<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
Vinyl acetate		<10.0	<10.0	<10.0					<10	<10		<10.0	<10.0	<10.0
Ethyl acetate														
Vinyl chloride		<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
2-chloroethylvinyl ether														
Ethyl methacrylate														
o-xylene		<10.0	<10.0	<10.0								<10.0	<10.0	<10.0
m and p xylene		<5.0	<5.0	<5.0								<5.0	<5.0	<5.0
Xylenes, total		<5.0	<5.0	<5.0					<3.0	<3.0	<3.0	<5.0	<5.0	<5.0

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Volatile Compounds at Dixon Marquette Cement Company, 1998-2000
(all values in µg/l)

Compound	MW1-D 3/2/00	MW1-D 6/23/00	MW1-D 9/29/00	MW1-D 11/30/00	MW2-D 7/24/98	MW2-D 10/26/98	MW2-D 7/26/99	MW2-D 9/9/99	MW2-D 11/1/99	MW2-D 3/2/00	MW2-D 6/23/00	MW2-D 9/29/00	MW2-D 11/30/00	MW3-D 7/24/98
Acetone							<50	<50	<50					
Acrolein							<50	<50	<50					
Acrylonitrile							<50	<50	<50					
Benzene	<5.0	<5.0	<5.0	<5.0	<0.5	<0.5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.5
Bromobenzene							<5.0	<5.0	<5.0					
Bromochloromethane							<5.0	<5.0	<5.0					
Bromodichloromethane							<5.0	<5.0	<5.0					
Bromoform							<5.0	<5.0	<5.0					
Bromomethane							<10.0	<10.0	<10.0					
n-butylbenzene							<10.0	<10.0	<10.0					
sec-butylbenzene							<10.0	<10.0	<10.0					
tert-butylbenzene							<10.0	<10.0	<10.0					
Carbon disulfide							<10.0	<10.0	<10.0					
Carbon tetrachloride							<5.0	<5.0	<5.0					
Chlorobenzene							<5.0	<5.0	<5.0					
Chlorodibromomethane							<5.0	<5.0	<5.0					
Chloroethane							<10.0	<10.0	<10.0					
Chloroform							<5.0	<5.0	<5.0					
Chloromethane							<10.0	<10.0	<10.0					
o-chlorotoluene							<5.0	<5.0	<5.0					
p chlorotoluene							<5.0	<5.0	<5.0					
1,2-dibromo-3-chloropropane														
1,2-dibromoethane														
Dibromomethane							<5.0	<5.0	<5.0					
1,2-dichlorobenzene							<5.0	<5.0	<5.0					
1,3-dichlorobenzene							<5.0	<5.0	<5.0					
p-dichlorobenzene							<5.0	<5.0	<5.0					
Dichlorofluoromethane														
Dichlorodifluoromethane							<10.0	<10.0	<10.0					
1,2-dichloroethane							<5.0	<5.0	<5.0					
1,1-dichloroethane	<5.0	<5.0	<5.0	<5.0			<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	
1,1-dichloroethene	<5.0	<5.0	<5.0	<5.0	<2.0			<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<2.0
cis-1,2-dichloroethene								<5.0	<5.0					
trans-1,2-dichloroethene								<5.0	<5.0					
trans-1,4-dichloro-2-butene								<10.0	<10.0					
di-isopropylether														
1,2-dichloropropane								<5.0	<5.0					
1,3-dichloropropane								<5.0	<5.0					
2,2-dichloropropane								<5.0	<5.0					
1,1-dichloropropene								<5.0	<5.0					
1,3-dichloropropene								<10.0	<10.0					
cis-1,3-dichloropropene								<5.0	<5.0					
trans-1,3-dichloropropene								<5.0	<5.0					
Ethylbenzene								<5.0	<5.0					
Heptane														
2-hexanone								<5.0	<5.0					
Hexachlorobutadiene								<10.0	<10.0					
Iodomethane								<10.0	<10.0					
Isopropylbenzene								<10.0	<10.0					
p-isopropyltoluene								<10.0	<10.0					
Methylene chloride								<5.0	<5.0					
Methyl ethyl ketone								<10.0	<10.0					
MTBE														
Methyl isobutyl ketone														
4-methyl-2-pentanone								<5.0	<5.0					
Tetrahydrofuran								<5.0	<5.0					
Naphthalene														
n-propylbenzene								<10.0	<10.0					
Styrene								<5.0	<5.0					
1,1,1,2-tetrachloroethane								<5.0	<5.0					
1,1,2,2-tetrachloroethane								<5.0	<5.0					
Tetrachloroethene								<5.0	<5.0					
Toluene	<5.0	<5.0	<5.0	<5.0	<1.0	<1.0		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1.0
1,2,3-trichlorobenzene								<5.0	<5.0					
1,2,4-trichlorobenzene								<5.0	<5.0					
1,1,1-trichloroethane	<5.0	<5.0	<5.0	<5.0	<1.0	<1.0		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1.0
1,1,2-trichloroethane								<5.0	<5.0					
Trichloroethene						<1.0		<5.0	<5.0					<1.0
Trichlorofluoromethane								<10.0	<10.0					
1,2,3-trichloropropane								<5.0	<5.0					
1,2,4-trimethylbenzene								<10.0	<10.0					
1,3,5-trimethylbenzene								<10.0	<10.0					
Vinyl acetate								<10.0	<10.0					
Ethyl acetate														
Vinyl chloride								<10.0	<10.0					
2-chloroethylvinyl ether														
Ethyl methacrylate														
o-xylene								<10.0	<10.0					
m and p xylene								<5.0	<5.0					
Xylenes, total								<5.0	<5.0					

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Volatile Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in µg/l)

Compound	MW3-D 10/26/98	MW3-D 7/26/99	MW3-D 9/9/99	MW3-D 11/1/99	MW3-D 3/2/00	MW3-D 6/23/00	MW3-D 9/29/00	MW3-D 11/30/00	MW4-D 7/24/98	MW4-D 10/26/98	MW4-D 7/26/99	MW4-D 9/9/99	MW4-D 11/1/99	MW4-D 3/2/00
Acetone		<50	<50	<50					<50		<50	<50	<50	
Acrolein		<50	<50	<50					<50		<50	<50	<50	
Acrylonitrile		<50	<50	<50					<50		<50	<50	<50	
Benzene	<0.5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<0.5	<5.0	<5.0	<5.0	<5.0
Bromobenzene		<5.0	<5.0	<5.0					<5.0		<5.0	<5.0	<5.0	
Bromochloromethane		<5.0	<5.0	<5.0					<5.0		<5.0	<5.0	<5.0	
Bromodichloromethane		<5.0	<5.0	<5.0					<5.0		<5.0	<5.0	<5.0	
Bromoform		<5.0	<5.0	<5.0					<5.0		<5.0	<5.0	<5.0	
Bromomethane		<10.0	<10.0	<10.0					<10.0		<10.0	<10.0	<10.0	
n-butylbenzene		<10.0	<10.0	<10.0					<10.0		<10.0	<10.0	<10.0	
sec-butylbenzene		<10.0	<10.0	<10.0					<10.0		<10.0	<10.0	<10.0	
tert-butylbenzene		<10.0	<10.0	<10.0					<10.0		<10.0	<10.0	<10.0	
Carbon disulfide		<10.0	<10.0	<10.0					<10.0		<10.0	<10.0	<10.0	
Carbon tetrachloride		<5.0	<5.0	<5.0					<5.0		<5.0	<5.0	<5.0	
Chlorobenzene		<5.0	<5.0	<5.0					<5.0		<5.0	<5.0	<5.0	
Chlorodibromomethane		<5.0	<5.0	<5.0					<5.0		<5.0	<5.0	<5.0	
Chloroethane		<10.0	<10.0	<10.0					<10.0		<10.0	<10.0	<10.0	
Chloroform		<5.0	<5.0	<5.0					<5.0		<5.0	<5.0	<5.0	
Chloromethane		<10.0	<10.0	<10.0					<10.0		<10.0	<10.0	<10.0	
o-chlorotoluene		<5.0	<5.0	<5.0					<5.0		<5.0	<5.0	<5.0	
p-chlorotoluene		<5.0	<5.0	<5.0					<5.0		<5.0	<5.0	<5.0	
1,2-dibromo-3-chloropropane														
1,2-dibromoethane														
Dibromomethane		<5.0	<5.0	<5.0					<5.0		<5.0	<5.0	<5.0	
1,2-dichlorobenzene		<5.0	<5.0	<5.0					<5.0		<5.0	<5.0	<5.0	
1,3-dichlorobenzene		<5.0	<5.0	<5.0					<5.0		<5.0	<5.0	<5.0	
p-dichlorobenzene		<5.0	<5.0	<5.0					<5.0		<5.0	<5.0	<5.0	
Dichlorofluoromethane														
Dichlorodifluoromethane		<10.0	<10.0	<10.0					<10.0		<10.0	<10.0	<10.0	
1,2-dichloroethane		[illegible]	<5.0	<5.0					<5.0		<5.0	<5.0	<5.0	
1,1-dichloroethane	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		<1.0	<5.0	<5.0	<5.0	<5.
1,1-dichloroethene		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<2.0		<5.0	<5.0	<5.0	<5.
cis-1,2-dichloroethene		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
trans-1,2-dichloroethene		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
trans-1,4-dichloro-2-butene		<10.0	<10.0	<10.0							<10.0	<10.0	<10.0	
di-isopropylether														
1,2-dichloropropane		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
1,3-dichloropropane		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
2,2-dichloropropane		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
1,1-dichloropropene		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
1,3-dichloropropene		<10.0	<10.0	<10.0							<10.0	<10.0	<10.0	
cis-1,3-dichloropropene		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
trans-1,3-dichloropropene		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
Ethylbenzene		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
Heptane														
2-hexanone		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
Hexachlorobutadiene		<10.0	<10.0	<10.0							<10.0	<10.0	<10.0	
Iodomethane		<10.0	<10.0	<10.0							<10.0	<10.0	<10.0	
Isopropylbenzene		<10.0	<10.0	<10.0							<10.0	<10.0	<10.0	
p-isopropyltoluene		<10.0	<10.0	<10.0							<10.0	<10.0	<10.0	
Methylene chloride		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
Methyl ethyl ketone		<10.0	<10.0	<10.0							<10.0	<10.0	<10.0	
MTBE														
Methyl isobutyl ketone														
4-methyl-2-pentanone		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
Tetrahydrofuran		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
Naphthalene														
n-propylbenzene		<10.0	<10.0	<10.0							<10.0	<10.0	<10.0	
Styrene		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
1,1,1,2-tetrachloroethane		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
1,1,2,2-tetrachloroethane		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
Tetrachloroethene		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
Toluene	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1.0	<1.0	<5.0	<5.0	<5.0	<5.
1,2,3-trichlorobenzene		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
1,2,4-trichlorobenzene		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
1,1,1-trichloroethane	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1.0	<1.0	<5.0	<5.0	<5.0	<5.
1,1,2-trichloroethane		<5.0	<5.0	<5.0							<5.0	<5.0	<6.0	
Trichloroethene	<1.0	<5.0	<5.0	<5.0					<1.0	<1.0	<5.0	<5.0	<5.0	
Trichlorofluoromethane		<10.0	<10.0	<10.0							<10.0	<10.0	<10.0	
1,2,3-trichloropropane		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
1,2,4-trimethylbenzene		<10.0	<10.0	<10.0							<10.0	<10.0	<10.0	
1,3,5-trimethylbenzene		<10.0	<10.0	<10.0							<10.0	<10.0	<10.0	
Vinyl acetate		<10.0	<10.0	<10.0							<10.0	<10.0	<10.0	
Ethyl acetate														
Vinyl chloride		<10.0	<10.0	<10.0							<10.0	<10.0	<10.0	
2-chloroethylvinyl ether														
Ethyl methacrylate														
o-xylene		<10.0	<10.0	<10.0							<10.0	<10.0	<10.0	
m and p xylene		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	
Xylenes, total		<5.0	<5.0	<5.0							<5.0	<5.0	<5.0	

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Volatile Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in µg/l)

Compound	MW4-D 6/23/00	MW4-D 9/29/00	MW4-D 11/30/00	MW5-D 7/26/99	MW5-D 9/9/99	MW5-D 11/1/99	MW5-D 3/2/00	MW5-D 6/23/00	MW5-D 9/29/00	MW5-D 11/30/00	MW6-D 7/26/99	MW6-D 9/9/99	MW6-D 11/1/99	MW6-D 3/2/00
Acetone				<50	<50	<50					<50	<50	<50	
Acrolein				<50	<50	<50					<50	<50	<50	
Acrylonitrile				<50	<50	<50					<50	<50	<50	
Benzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Bromobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Bromochloromethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Bromodichloromethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Bromoform				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Bromomethane				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
n-butylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
sec-butylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
tert-butylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
Carbon disulfide				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
Carbon tetrachloride				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Chlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Chlorodibromomethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Chloroethane				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
Chloroform				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Chloromethane				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
o-chlorotoluene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
p-chlorotoluene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,2-dibromo-3-chloropropane														
1,2-dibromoethane														
Dibromomethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,2-dichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,3-dichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
p-dichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Dichlorofluoromethane														
Dichlorodifluoromethane				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
1,2-dichloroethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,1-dichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.
1,1-dichloroethene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.
cis-1,2-dichloroethene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
trans-1,2-dichloroethene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
trans-1,4-dichloro-2-butene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
di-isopropylether														
1,2-dichloropropane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,3-dichloropropane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
2,2-dichloropropane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,1-dichloropropene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,3-dichloropropene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
cis-1,3-dichloropropene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
trans-1,3-dichloropropene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Ethylbenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Heptane														
2-hexanone				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Hexachlorobutadiene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
Iodomethane				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
Isopropylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
p-isopropyltoluene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
Methylene chloride				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Methyl ethyl ketone				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
MTBE														
Methyl isobutyl ketone														
4-methyl-2-pentanone				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Tetrahydrofuran				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Naphthalene														
n-propylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
Styrene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,1,1,2-tetrachloroethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,1,2,2-tetrachloroethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Tetrachloroethene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Toluene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.
1,2,3-trichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,2,4-trichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,1,1-trichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5,
1,1,2-trichloroethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Trichloroethene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Trichlorofluoromethane				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
1,2,3-trichloropropane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,2,4-trimethylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
1,3,5-trimethylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
Vinyl acetate				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
Ethyl acetate														
Vinyl chloride				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
2-chloroethylvinyl ether														
Ethyl methacrylate														
o-xylene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
m and p xylene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Xylenes, total				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Volatile Compounds at Dixon Marquette Cement Company, 1998-2000

(all values in µg/l)

Compound	MW6-D 6/23/00	MW6-D 9/29/00	MW6-D 11/30/00	MW7-D 7/26/99	MW7-D 9/9/99	MW7-D 11/1/99	MW7-D 3/2/00	MW7-D 6/23/00	MW7-D 9/29/00	MW7-D 11/30/00	MW8-D 7/26/99	MW8-D 9/9/99	MW8-D 11/1/99	MW8-D 3/2/00
Acetone				<50	<50	<50					<50	<50	<50	
Acrolein				<50	<50	<50					<50	<50	<50	
Acrylonitrile				<50	<50	<50					<50	<50	<50	
Benzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Bromobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Bromochloromethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Bromodichloromethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Bromoform				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Bromomethane				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
n-butylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
sec-butylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
tert-butylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
Carbon disulfide				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
Carbon tetrachloride				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Chlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Chlorodibromomethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Chloroethane				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
Chloroform				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Chloromethane				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
o-chlorotoluene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
p-chlorotoluene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,2-dibromo-3-chloropropane														
1,2-dibromoethane														
Dibromomethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,2-dichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,3-dichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
p-dichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Dichlorofluoromethane														
Dichlorodifluoromethane				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
1,2-dichloroethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,1-dichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.
1,1-dichloroethene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.
cis-1,2-dichloroethene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
trans-1,2-dichloroethene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
trans-1,4-dichloro-2-butene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
di-isopropylether														
1,2-dichloropropane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,3-dichloropropane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
2,2-dichloropropane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,1-dichloropropene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,3-dichloropropene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
cis-1,3-dichloropropene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
trans-1,3-dichloropropene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Ethylbenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Heptane														
2-hexanone				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Hexachlorobutadiene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
Iodomethane				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
Isopropylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
p-isopropyltoluene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
Methylene chloride				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Methyl ethyl ketone				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
MTBE														
Methyl isobutyl ketone														
4-methyl-2-pentanone				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Tetrahydrofuran				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Naphthalene														
n-propylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
Styrene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,1,1,2-tetrachloroethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,1,2,2-tetrachloroethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Tetrachloroethene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Toluene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.
1,2,3-trichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,2,4-trichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,1,1-trichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.
1,1,2-trichloroethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Trichloroethene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Trichlorofluoromethane				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
1,2,3-trichloropropane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
1,2,4-trimethylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
1,3,5-trimethylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
Vinyl acetate				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
Ethyl acetate														
Vinyl chloride				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
2-chloroethylvinyl ether														
Ethyl methacrylate														
o-xylene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	
m and p xylene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	
Xylenes, total				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Volatile Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in µg/l)

Compound	MW8-D 6/23/00	MW8-D 9/29/00	MW8-D 11/30/00	MW9-D 7/26/99	MW9-D 9/9/99	MW9-D 11/1/99	MW9-D 3/2/00	MW9-D 6/23/00	MW9-D 9/29/00	MW9-D 11/30/00	MW1-WT 7/26/99	MW1-WT 9/9/99	MW1-WT 11/1/99	MW1-WT 3/2/00
Acetone				<50	<50	<50					<50	<50	<50	<50
Acrolein				<50	<50	<50					<50	<50	<50	<50
Acrylonitrile				<50	<50	<50					<50	<50	<50	<50
Benzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Bromobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Bromochloromethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Bromodichloromethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Bromoform				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Bromomethane				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
n-butylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
sec-butylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
tert-butylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
Carbon disulfide				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
Carbon tetrachloride				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Chlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Chlorodibromomethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Chloroethane				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
Chloroform				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Chloromethane				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
o-chlorotoluene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
p-chlorotoluene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
1,2-dibromo-3-chloropropane														
1,2-dibromoethane														
Dibromomethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
1,2-dichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
1,3-dichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
p-dichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Dichlorofluoromethane														
Dichlorodifluoromethane				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
1,2-dichloroethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
1,1-dichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.
1,1-dichloroethene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
cis-1,2-dichloroethene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
trans-1,2-dichloroethene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
trans-1,4-dichloro-2-butene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
di-isopropylether														
1,2-dichloropropane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
1,3-dichloropropane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
2,2-dichloropropane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
1,1-dichloropropene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
1,3-dichloropropene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
cis-1,3-dichloropropene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
trans-1,3-dichloropropene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Ethylbenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Heptane														
2-hexanone				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Hexachlorobutadiene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
Iodomethane				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
Isopropylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
p-isopropyltoluene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
Methylene chloride				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Methyl ethyl ketone				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
MTBE														
Methyl isobutyl ketone														
4-methyl-2-pentanone				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Tetrahydrofuran				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Naphthalene														
n-propylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
Styrene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
1,1,1,2-tetrachloroethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
1,1,2,2-tetrachloroethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Tetrachloroethene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Toluene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2,3-trichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
1,2,4-trichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
1,1,1-trichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,2-trichloroethane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Trichloroethene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Trichlorofluoromethane				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
1,2,3-trichloropropane				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
1,2,4-trimethylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
1,3,5-trimethylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
Vinyl acetate				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
Ethyl acetate														
Vinyl chloride				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
2-chloroethylvinyl ether														
Ethyl methacrylate														
o-xylene				<10.0	<10.0	<10.0					<10.0	<10.0	<10.0	<10.0
m and p xylene				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0
Xylenes, total				<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304 124 thru 304 126

Summary of Analytical Results for Volatile Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in µg/l)

Compound	MW1-WT 6/23/00	MW1-WT 9/29/00	MW1-WT 11/30/00	MW2-WT 7/26/99	MW2-WT 9/9/99	MW2-WT 11/1/99	MW2-WT 3/2/00	MW2-WT 6/23/00	MW2-WT 9/29/00	MW2-WT 11/30/00	MW3-WT 7/26/99	MW3-WT 9/9/99
Acetone				<50	<50	<50					<50	<50
Acrolein				<50	<50	<50					<50	<50
Acrylonitrile				<50	<50	<50					<50	<50
Benzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Bromobenzene				<5.0	<5.0	<5.0					<5.0	<5.0
Bromochloromethane				<5.0	<5.0	<5.0					<5.0	<5.0
Bromodichloromethane				<5.0	<5.0	<5.0					<5.0	<5.0
Bromoform				<5.0	<5.0	<5.0					<5.0	<5.0
Bromomethane				<10.0	<10.0	<10.0					<10.0	<10.0
n-butylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0
sec-butylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0
tert-butylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0
Carbon disulfide				<10.0	<10.0	<10.0					<10.0	<10.0
Carbon tetrachloride				<5.0	<5.0	<5.0					<5.0	<5.0
Chlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0
Chlorodibromomethane				<5.0	<5.0	<5.0					<5.0	<5.0
Chloroethane				<10.0	<10.0	<10.0					<10.0	<10.0
Chloroform				<5.0	<5.0	<5.0					<5.0	<5.0
Chloromethane				<10.0	<10.0	<10.0					<10.0	<10.0
o-chlorotoluene				<5.0	<5.0	<5.0					<5.0	<5.0
p-chlorotoluene				<5.0	<5.0	<5.0					<5.0	<5.0
1,2-dibromo-3-chloropropane												
1,2-dibromoethane												
Dibromomethane				<5.0	<5.0	<5.0					<5.0	<5.0
1,2-dichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0
1,3-dichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0
p-dichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0
Dichlorofluoromethane												
Dichlorodifluoromethane				<10.0	<10.0	<10.0					<10.0	<10.0
1,2-dichloroethane				<5.0	<5.0	<5.0					<5.0	<5.0
1,1-dichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.
1,1-dichloroethene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	***7.90***
cis-1,2-dichloroethene				<5.0	<5.0	<5.0					<5.0	<5.0
trans-1,2-dichloroethene				<5.0	<5.0	<5.0					<5.0	<5.0
trans-1,4-dichloro-2-butene				<10.0	<10.0	<10.0					<10.0	<10.0
di-isopropylether												
1,2-dichloropropane				<5.0	<5.0	<5.0					<5.0	<5.0
1,3 dichloropropane				<5.0	<5.0	<5.0					<5.0	<5.0
2,2-dichloropropane				<5.0	<5.0	<5.0					<5.0	<5.0
1,1-dichloropropene				<5.0	<5.0	<5.0					<5.0	<5.0
1,3-dichloropropene				<10.0	<10.0	<10.0					<10.0	<10.0
cis-1,3-dichloropropene				<5.0	<5.0	<5.0					<5.0	<5.0
trans-1,3-dichloropropene				<5.0	<5.0	<5.0					<5.0	<5.0
Ethylbenzene				<5.0	<5.0	<5.0					<5.0	<5.0
Heptane												
2-hexanone				<5.0	<5.0	<5.0					<5.0	<5.0
Hexachlorobutadiene				<10.0	<10.0	<10.0					<10.0	<10.0
Iodomethane				<10.0	<10.0	<10.0					<10.0	<10.0
Isopropylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0
p-isopropyltoluene				<10.0	<10.0	<10.0					<10.0	<10.0
Methylene chloride				<5.0	<5.0	<5.0					<5.0	<5.0
Methyl ethyl ketone				<10.0	<10.0	<10.0					<10.0	<10.0
MTBE												
Methyl isobutyl ketone												
4-methyl-2-pentanone				<5.0	<5.0	<5.0					<5.0	<5.0
Tetrahydrofuran				<5.0	<5.0	<5.0					<5.0	<5.0
Naphthalene												
n-propylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0
Styrene				<5.0	<5.0	<5.0					<5.0	<5.0
1,1,1,2-tetrachloroethane				<5.0	<5.0	<5.0					<5.0	<5.0
1,1,2,2-tetrachloroethane				<5.0	<5.0	<5.0					<5.0	<5.0
Tetrachloroethene				<5.0	<5.0	<5.0					<5.0	<5.0
Toluene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2,3-trichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0
1,2,4-trichlorobenzene				<5.0	<5.0	<5.0					<5.0	<5.0
1,1,1-trichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	***40***	<5.0
1,1,2-trichloroethane				<5.0	<5.0	<5.0					<5.0	<5.0
Trichloroethene				<5.0	<5.0	<5.0					<5.0	<5.0
Trichlorofluoromethane				<10.0	<10.0	<10.0					<10.0	<10.0
1,2,3-trichloropropane				<5.0	<5.0	<5.0					<5.0	<5.0
1,2,4-trimethylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0
1,3,5-trimethylbenzene				<10.0	<10.0	<10.0					<10.0	<10.0
Vinyl acetate				<10.0	<10.0	<10.0					<10.0	<10.0
Ethyl acetate												
Vinyl chloride				<10.0	<10.0	<10.0					<10.0	<10.0
2-chloroethylvinyl ether												
Ethyl methacrylate												
o-xylene				<10.0	<10.0	<10.0					<10.0	<10.0
m and p xylene				<5.0	<5.0	<5.0					<5.0	<5.0
Xylenes, total				<5.0	<5.0	<5.0					<5.0	<5.0

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304 124 thru 304 126

Summary of Analytical Results for Volatile Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in µg/l)

Compound	MW3-WT 11/1/99	MW3-WT 3/2/00	MW3-WT 6/23/00	MW3-WT 9/29/00	MW3-WT 11/30/00	MW4-WT 7/26/99	MW4-WT 9/9/99	MW4-WT 11/1/99	MW4-WT 3/2/00	MW4-WT 6/23/00	MW4-WT 9/29/00	MW4-WT 11/30/00
Acetone	<50					<50	<50	<50				
Acrolein	<50					<50	<50	<50				
Acrylonitrile	<50					<50	<50	<50				
Benzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Bromobenzene	<5.0					<5.0	<5.0	<5.0				
Bromochloromethane	<5.0					<5.0	<5.0	<5.0				
Bromodichloromethane	<5.0					<5.0	<5.0	<5.0				
Bromoform	<5.0					<5.0	<5.0	<5.0				
Bromomethane	<10.0					<10.0	<10.0	<10.0				
n-butylbenzene	<10.0					<10.0	<10.0	<10.0				
sec-butylbenzene	<10.0					<10.0	<10.0	<10.0				
tert-butylbenzene	<10.0					<10.0	<10.0	<10.0				
Carbon disulfide	<10.0					<10.0	<10.0	<10.0				
Carbon tetrachloride	<5.0					<5.0	<5.0	<5.0				
Chlorobenzene	<5.0					<5.0	<5.0	<5.0				
Chlorodibromomethane	<5.0					<5.0	<5.0	<5.0				
Chloroethane	<10.0					<10.0	<10.0	<10.0				
Chloroform	<5.0					<5.0	<5.0	<5.0				
Chloromethane	<10.0					<10.0	<10.0	<10.0				
o-chlorotoluene	<5.0					<5.0	<5.0	<5.0				
p-chlorotoluene	<5.0					<5.0	<5.0	<5.0				
1,2-dibromo-3-chloropropane												
1,2-dibromoethane												
Dibromomethane	<5.0					<5.0	<5.0	<5.0				
1,2-dichlorobenzene	<5.0					<5.0	<5.0	<5.0				
1,3-dichlorobenzene	<5.0					<5.0	<5.0	<5.0				
p-dichlorobenzene	<5.0					<5.0	<5.0	<5.0				
Dichlorofluoromethane												
Dichlorodifluoromethane	<10.0					<10.0	<10.0	<10.0				
1,2-dichloroethane	<5.0					<5.0	<5.0	<5.0				
1,1-dichloroethane	***8.1***	<5.0	<5.0	***8***	***6.50***	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1-dichloroethene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
cis-1,2-dichloroethene	<5.0					<5.0	<5.0	<5.0				
trans-1,2-dichloroethene	<5.0					<5.0	<5.0	<5.0				
trans-1,4-dichloro-2-butene	<10.0					<10.0	<10.0	<10.0				
di-isopropylether												
1,2-dichloropropane	<5.0					<5.0	<5.0	<5.0				
1,3-dichloropropane	<5.0					<5.0	<5.0	<5.0				
2,2-dichloropropane	<5.0					<5.0	<5.0	<5.0				
1,1-dichloropropene	<5.0					<5.0	<5.0	<5.0				
1,3-dichloropropene	<10.0					<10.0	<10.0	<10.0				
cis-1,3-dichloropropene	<5.0					<5.0	<5.0	<5.0				
trans-1,3-dichloropropene	<5.0					<5.0	<5.0	<5.0				
Ethylbenzene	<5.0					<5.0	<5.0	<5.0				
Heptane												
2-hexanone	<5.0					<5.0	<5.0	<5.0				
Hexachlorobutadiene	<10.0					<10.0	<10.0	<10.0				
Iodomethane	<10.0					<10.0	<10.0	<10.0				
Isopropylbenzene	<10.0					<10.0	<10.0	<10.0				
p-isopropyltoluene	<10.0					<10.0	<10.0	<10.0				
Methylene chloride	<5.0					<5.0	<5.0	<5.0				
Methyl ethyl ketone	<10.0					<10.0	<10.0	<10.0				
MTBE												
Methyl isobutyl ketone												
4-methyl-2-pentanone	<5.0					<5.0	<5.0	<5.0				
Tetrahydrofuran	<5.0					<5.0	<5.0	<5.0				
Naphthalene												
n-propylbenzene	<10.0					<10.0	<10.0	<10.0				
Styrene	<5.0					<5.0	<5.0	<5.0				
1,1,1,2-tetrachloroethane	<5.0					<5.0	<5.0	<5.0				
1,1,2,2-tetrachloroethane	<5.0					<5.0	<5.0	<5.0				
Tetrachloroethene	<5.0					<5.0	<5.0	<5.0				
Toluene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2,3-trichlorobenzene	<5.0					<5.0	<5.0	<5.0				
1,2,4-trichlorobenzene	<5.0					<5.0	<5.0	<5.0				
1,1,1-trichloroethane	***35.6***	***18***	***19.7***	***34.1***	***22.0***	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,2-trichloroethane	<5.0					<5.0	<5.0	<5.0				
Trichloroethene	<5.0					<5.0	<5.0	<5.0				
Trichlorofluoromethane	<10.0					<10.0	<10.0	<10.0				
1,2,3-trichloropropane	<5.0					<5.0	<5.0	<5.0				
1,2,4-trimethylbenzene	<10.0					<10.0	<10.0	<10.0				
1,3,5-trimethylbenzene	<10.0					<10.0	<10.0	<10.0				
Vinyl acetate	<10.0					<10.0	<10.0	<10.0				
Ethyl acetate												
Vinyl chloride	<10.0					<10.0	<10.0	<10.0				
2-chloroethylvinyl ether												
Ethyl methacrylate												
o-xylene	<10.0					<10.0	<10.0	<10.0				
m and p xylene	<5.0					<5.0	<5.0	<5.0				
Xylenes, total	<5.0					<5.0	<5.0	<5.0				

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Volatile Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in µg/l)

Compound	MW9-WT 7/26/99	MW9-WT 9/9/99	MW9-WT 11/1/99	MW9-WT 3/2/00	MW9-WT 6/23/00	MW9-WT 9/29/00	MW9-WT 11/30/00	LW-1 6/17/98	LW-1 7/24/98	LW-1 10/26/98	LW-1 7/26/99	LW-1 9/9/99	LW-1 11/1/99
Acetone	<50	<50	<50					<20	<20	<20	<50	<50	<50
Acrolein	<50	<50	<50						<10	<50	<50	<50	<50
Acrylonitrile	<50	<50	<50						<10	<10	<50	<50	<50
Benzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	***1.4***	<0.5	<0.5	<5.0	<5.0	<5.0
Bromobenzene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Bromochloromethane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Bromodichloromethane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Bromoform	<5.0	<5.0	<5.0					<2.0	<2.0	<2.0	<5.0	<5.0	<5.0
Bromomethane	<10.0	<10.0	<10.0					<4.0	<4.0	<4.0	<10.0	<10.0	<10.0
n-butylbenzene	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
sec-butylbenzene	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
tert-butylbenzene	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
Carbon disulfide	<10.0	<10.0	<10.0						<1.0	<1.0	<10.0	<10.0	<10.0
Carbon tetrachloride	<5.0	<5.0	<5.0					<1.0	<1.0	<0.3	<5.0	<5.0	<5.0
Chlorobenzene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Chlorodibromomethane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Chloroethane	<10.0	<10.0	<10.0					<4.0	<4.0	<4.0	<10.0	<10.0	<10.0
Chloroform	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Chloromethane	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
o-chlorotoluene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
p-chlorotoluene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,2-dibromo-3-chloropropane								<10	<10	<1.0			
1,2-dibromoethane								<10	<10	<10			
Dibromomethane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,2-dichlorobenzene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,3-dichlorobenzene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
p-dichlorobenzene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Dichlorofluoromethane									<10	<3.0			
Dichlorodifluoromethane	<10.0	<10.0	<10.0					<3.0	<3.0	<3.0	<10.0	<10.0	<10.0
1,2-dichloroethane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,1-dichloroethane	<5.0	***8.30***	***5.3***	***13.2***	***8.5***	***10.4***	***8.3***	***1.3***	<1.0	***1.3***	<5.0	<5.0	<5.
1,1-dichloroethene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<2.0	<2.0	<2.0	<5.0	<5.0	<5.0
cis-1,2-dichloroethene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
trans-1,2-dichloroethene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
trans-1,4-dichloro-2-butene	<10.0	<10.0	<10.0					<1.0	<10	<10	<10.0	<10.0	<10.0
di-isopropylether									<1.0	<1.0			
1,2-dichloropropane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,3-dichloropropane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
2,2-dichloropropane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,1-dichloropropene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,3-dichloropropene	<10.0	<10.0	<10.0								<10.0	<10.0	<10.0
cis-1,3-dichloropropene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
trans-1,3-dichloropropene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Ethylbenzene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Heptane									<1.0				
2-hexanone	<5.0	<5.0	<5.0						<10	<10	<5.0	<5.0	<5.0
Hexachlorobutadiene	<10.0	<10.0	<10.0					<5.0	<5.0	<5.0	<10.0	<10.0	<10.0
Iodomethane	<10.0	<10.0	<10.0						<10	<10	<10.0	<10.0	<10.0
Isopropylbenzene	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
p-isopropyltoluene	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
Methylene chloride	<5.0	<5.0	<5.0					<10	<10	<5.0	<5.0	<5.0	<5.0
Methyl ethyl ketone	<10.0	<10.0	<10.0					<10	<10	<10	<10.0	<10.0	<10.0
MTBE								<1.0	<1.0	<1.0			
Methyl isobutyl ketone									<10	<10			
4-methyl-2-pentanone	<5.0	<5.0	<5.0								<5.0	<5.0	<5.0
Tetrahydrofuran	<5.0	<5.0	<5.0						<50	<50	<5.0	<5.0	<5.0
Naphthalene								<5.0	<5.0	<5.0			
n-propylbenzene	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
Styrene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,1,1,2 tetrachloroethane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,1,2,2-tetrachloroethane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Tetrachloroethene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Toluene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	***1.2***	<1.0	<1.0	<5.0	<5.0	<5.0
1,2,3 trichlorobenzene	<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2,4 trichlorobenzene	<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,1-trichloroethane	***8***	<5.0	***9.5***	***41.3***	***10.6***	***11.3***	***15.3***	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,1,2 trichloroethane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Trichloroethene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Trichlorofluoromethane	<10.0	<10.0	<10.0					<4.0	<4.0	<4.0	<10.0	<10.0	<10.0
1,2,3 trichloropropane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,2,4 trimethylbenzene	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
1,3,5 trimethylbenzene	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
Vinyl acetate	<10.0	<10.0	<10.0						<10	<10	<10.0	<10.0	<10.0
Ethyl acetate													
Vinyl chloride	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
2-chloroethylvinyl ether													
Ethyl methacrylate													
o-xylene	<10.0	<10.0	<10.0								<10.0	<10.0	<10.0
m and p xylene	<5.0	<5.0	<5.0								<5.0	<5.0	<5.0
Xylenes, total	<5.0	<5.0	<5.0					<3.0	<3.0	<3.0	<5.0	<5.0	<5.0

Values in bold italics exceed the background concentration

Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Volatile Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in µg/l)

Compound	MW9-WT 7/26/99	MW9-WT 9/9/99	MW9-WT 11/1/99	MW9-WT 3/2/00	MW9-WT 6/23/00	MW9-WT 2/29/00	MW9-WT 11/30/00	LW-1 6/17/98	LW-1 7/24/98	LW-1 10/26/98	LW-1 7/26/99	LW-1 9/9/99	LW-1 11/1/99
Acetone	<50	<50	<50					<20	<20	<20	<50	<50	<50
Acrolein	<50	<50	<50						<10	<50	<50	<50	<50
Acrylonitrile	<50	<50	<50						<10	<10	<50	<50	<50
Benzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	***1.4***	<0.5	<0.5	<5.0	<5.0	<5.0
Bromobenzene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Bromochloromethane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Bromodichloromethane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Bromoform	<5.0	<5.0	<5.0					<2.0	<2.0	<2.0	<5.0	<5.0	<5.0
Bromomethane	<10.0	<10.0	<10.0					<4.0	<4.0	<4.0	<10.0	<10.0	<10.0
n-butylbenzene	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
sec-butylbenzene	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
tert-butylbenzene	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
Carbon disulfide	<10.0	<10.0	<10.0						<1.0	<1.0	<10.0	<10.0	<10.0
Carbon tetrachloride	<5.0	<5.0	<5.0					<1.0	<1.0	<0.3	<5.0	<5.0	<5.0
Chlorobenzene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Chlorodibromomethane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Chloroethane	<10.0	<10.0	<10.0					<4.0	<4.0	<4.0	<10.0	<10.0	<10.0
Chloroform	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Chloromethane	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
o-chlorotoluene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
p-chlorotoluene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,2-dibromo-3-chloropropane								<10	<10	<1.0			
1,2-dibromoethane								<10	<10	<10			
Dibromomethane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,2 dichlorobenzene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,3-dichlorobenzene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
p-dichlorobenzene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Dichlorofluoromethane									<10	<3.0			
Dichlorodifluoromethane	<10.0	<10.0	<10.0					<3.0	<3.0	<3.0	<10.0	<10.0	<10.0
1,2-dichloroethane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,1-dichloroethane	<5.0	***8.30***	***5.3***	***13.2***	***8.5***	***10.4***	***8.3***	***1.3***	<1.0	***1.3***	<5.0	<5.0	<5.
1,1-dichloroethene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<2.0	<2.0	<2.0	<5.0	<5.0	<5.0
cis-1,2-dichloroethene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
trans-1,2-dichloroethene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
trans-1,4-dichloro-2-butene	<10.0	<10.0	<10.0					<1.0	<10	<10	<10.0	<10.0	<10.0
di-isopropylether									<1.0	<1.0			
1,2-dichloropropane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,3-dichloropropane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
2,2-dichloropropane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,1-dichloropropene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,3-dichloropropene	<10.0	<10.0	<10.0								<10.0	<10.0	<10.0
cis-1,3-dichloropropene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
trans-1,3-dichloropropene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Ethylbenzene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Heptane									<1.0				
2-hexanone	<5.0	<5.0	<5.0						<10	<10	<5.0	<5.0	<5.0
Hexachlorobutadiene	<10.0	<10.0	<10.0					<5.0	<5.0	<5.0	<10.0	<10.0	<10.0
Iodomethane	<10.0	<10.0	<10.0						<10	<10	<10.0	<10.0	<10.0
Isopropylbenzene	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
p-isopropyltoluene	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
Methylene chloride	<5.0	<5.0	<5.0					<10	<10	<5.0	<5.0	<5.0	<5.0
Methyl ethyl ketone	<10.0	<10.0	<10.0					<10	<10	<10	<10.0	<10.0	<10.0
MTBE								<1.0	<1.0	<1.0			
Methyl isobutyl ketone									<10	<10			
4-methyl-2-pentanone	<5.0	<5.0	<5.0								<5.0	<5.0	<5.0
Tetrahydrofuran	<5.0	<5.0	<5.0						<50	<50	<5.0	<5.0	<5.0
Naphthalene								<5.0	<5.0	<5.0			
n-propylbenzene	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
Styrene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,1,1,2 tetrachloroethane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,1,2,2-tetrachloroethane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Tetrachloroethene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Toluene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	***1.2***	<1.0	<1.0	<5.0	<5.0	<5.0
1,2,3 trichlorobenzene	<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2,4-trichlorobenzene	<5.0	<5.0	<5.0					<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,1-trichloroethane	***8***	<5.0	***9.5***	***41.3***	***10.6***	***11.3***	***15.3***	<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,1,2 trichloroethane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Trichloroethene	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
Trichlorofluoromethane	<10.0	<10.0	<10.0					<4.0	<4.0	<4.0	<10.0	<10.0	<10.0
1,2,3 trichloropropane	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0	<5.0	<5.0	<5.0
1,2,4 trimethylbenzene	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
1,3,5 trimethylbenzene	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
Vinyl acetate	<10.0	<10.0	<10.0						<10	<10	<10.0	<10.0	<10.0
Ethyl acetate													
Vinyl chloride	<10.0	<10.0	<10.0					<1.0	<1.0	<1.0	<10.0	<10.0	<10.0
2-chloroethylvinyl ether													
Ethyl methacrylate													
o-xylene	<10.0	<10.0	<10.0								<10.0	<10.0	<10.0
m and p xylene	<5.0	<5.0	<5.0								<5.0	<5.0	<5.0
Xylenes, total	<5.0	<5.0	<5.0					<3.0	<3.0	<3.0	<5.0	<5.0	<5.0

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Volatile Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in µg/l)

Compound	LW-1 3/2/00	LW-1 6/23/00	LW-1 9/29/00	LW-1 11/30/00	LW-3 7/26/99	LW-3 9/9/99	LW-3 11/1/99	LW-3 6/23/00	LW-3 9/29/00	LW-3 11/30/00	SPRING 7/26/99	SPRING 9/9/99	SPRING 11/1/99	SPRING 3/2/00
Acetone					<50	<50	<50				<50	<50	<50	
Acrolein					<50	<50	<50				<50	<50	<50	
Acrylonitrile					<50	<50	<50				<50	<50	<50	
Benzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Bromobenzene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Bromochloromethane					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Bromodichloromethane					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Bromoform					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Bromomethane					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
n-butylbenzene					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
sec-butylbenzene					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
tert-butylbenzene					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
Carbon disulfide					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
Carbon tetrachloride					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Chlorobenzene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Chlorodibromomethane					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Chloroethane					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
Chloroform					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Chloromethane					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
o-chlorotoluene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
p-chlorotoluene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
1,2-dibromo-3-chloropropane														
1,2-dibromoethane														
Dibromomethane					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
1,2-dichlorobenzene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
1,3-dichlorobenzene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
p-dichlorobenzene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Dichlorofluoromethane														
Dichlorodifluoromethane					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
1,2-dichloroethane					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
1,1-dichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.
1,1-dichloroethene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.
cis-1,2-dichloroethene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
trans-1,2-dichloroethene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
trans-1,4-dichloro-2-butene					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
di-isopropylether														
1,2-dichloropropane					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
1,3-dichloropropane					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
2,2-dichloropropane					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
1,1-dichloropropene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
1,3-dichloropropene					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
cis-1,3-dichloropropene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
trans-1,3-dichloropropene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Ethylbenzene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Heptane														
2-hexanone					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Hexachlorobutadiene					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
Iodomethane					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
Isopropylbenzene					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
p-isopropyltoluene					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
Methylene chloride					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Methyl ethyl ketone					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
MTBE														
Methyl isobutyl ketone														
4-methyl-2-pentanone					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Tetrahydrofuran					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Naphthalene														
n-propylbenzene					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
Styrene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
1,1,1,2-tetrachloroethane					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
1,1,2,2-tetrachloroethane					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Tetrachloroethene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Toluene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.
1,2,3-trichlorobenzene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
1,2,4-trichlorobenzene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
1,1,1-trichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.
1,1,2-trichloroethane					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Trichloroethene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Trichlorofluoromethane					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
1,2,3-trichloropropane					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
1,2,4-trimethylbenzene					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
1,3,5-trimethylbenzene					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
Vinyl acetate					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
Ethyl acetate														
Vinyl chloride					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
2-chloroethylvinyl ether														
Ethyl methacrylate														
o-xylene					<10.0	<10.0	<10.0				<10.0	<10.0	<10.0	
m and p xylene					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	
Xylenes, total					<5.0	<5.0	<5.0				<5.0	<5.0	<5.0	

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Volatile Compounds at Dixon Marquette Cement Company, 1998-2000
(all values in µg/l)

Compound	SPRING 6/23/00	SPRING 9/29/00	SPRING 11/30/00	RRUS 3/2/00	RRUS 6/23/00	RRUS 9/29/00	RRUS 11/30/00	RRDS 3/2/00	RRDS 6/23/00	RRDS 9/29/00	RRDS 9/29/00	RRDS 11/30/00
Acetone												
Acrolein												
Acrylonitrile												
Benzene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0
Bromobenzene												
Bromochloromethane												
Bromodichloromethane												
Bromoform												
Bromomethane												
n-butylbenzene												
sec-butylbenzene												
tert-butylbenzene												
Carbon disulfide												
Carbon tetrachloride												
Chlorobenzene												
Chlorodibromomethane												
Chloroethane												
Chloroform												
Chloromethane												
o-chlorotoluene												
p-chlorotoluene												
1,2-dibromo-3-chloropropane												
1,2-dibromoethane												
Dibromomethane												
1,2-dichlorobenzene												
1,3-dichlorobenzene												
p-dichlorobenzene												
Dichlorofluoromethane												
Dichlorodifluoromethane												
1,2-dichloroethane												
1,1-dichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0
1,1-dichloroethene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0
cis-1,2-dichloroethene												
trans-1,2-dichloroethene												
trans-1,4-dichloro-2-butene												
di-isopropylether												
1,2-dichloropropane												
1,3-dichloropropane												
2,2-dichloropropane												
1,1-dichloropropene												
1,3-dichloropropene												
cis-1,3-dichloropropene												
trans-1,3-dichloropropene												
Ethylbenzene												
Heptane												
2-hexanone												
Hexachlorobutadiene												
Iodomethane												
Isopropylbenzene												
p-isopropyltoluene												
Methylene chloride												
Methyl ethyl ketone												
MTBE												
Methyl isobutyl ketone												
4-methyl-2-pentanone												
Tetrahydrofuran												
Naphthalene												
n-propylbenzene												
Styrene												
1,1,1,2-tetrachloroethane												
1,1,2,2-tetrachloroethane												
Tetrachloroethene												
Toluene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0
1,2,3-trichlorobenzene												
1,2,4-trichlorobenzene												
1,1,1-trichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0
1,1,2-trichloroethane												
Trichloroethene												
Trichlorofluoromethane												
1,2,3-trichloropropane												
1,2,4-trimethylbenzene												
1,3,5-trimethylbenzene												
Vinyl acetate												
Ethyl acetate												
Vinyl chloride												
2-chloroethylvinyl ether												
Ethyl methacrylate												
o xylene												
m and p xylene												
Xylenes, total												

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in mg/l)

Parameter	MW1-S 5/7/98	MW1-S-F 5/7/98	MW1-S 6/17/98	MW1-S 7/24/98	MW1-S-F 7/24/98	MW1-S 10/26/98	MW1-S 2/16/99	MW1-S 7/26/99	MW1-S 9/9/99	MW1-S 11/1/99	MW1-S 3/2/00	MW1-S 6/23/00	MW1-S 9/29/00	MW1-S 11/30/00
Aluminum				<0.10	<0.10	<0.10		<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Antimony				<0.10	<0.10	<0.10		<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Arsenic	<0.0050	<0.0050		<0.080	<0.080	<0.080	<0.080	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Barium	0.067	0.07		0.064	0.067	0.056	0.069	0.072	0.067	0.066	0.075	0.052	0.069	***0.135***
Beryllium				<0.010	<0.010	<0.010	<0.010	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron				<0.1	<0.050	<0.050	<0.050	<0.05	0.05	<0.05	0.078	<0.05	<0.05	0.048
Cadmium	<0.005	<0.010		<0.020	<0.020	<0.020	<0.020	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	95	100		100	***120***	91	100	***117***	98.3	103	***112***	100	106	104
Chromium	<0.040	<0.040		<0.020	<0.020	<0.020	<0.020	0.001	<0.001	0.001	0.001	0.001	0.001	***0.003***
Cobalt				<0.020	<0.020	<0.020	<0.020	0.001	0.001	0.001	***0.004***	<0.001	0.001	0.001
Copper				<0.020	<0.020	<0.020	<0.020	0.002	0.002	0.002	0.005	<0.001	0.001	0.004
Iron	<0.050	<0.050	<0.10	<0.10	<0.10	<0.10	<0.10	0.258	0.298	0.153	0.200	0.201	0.220	***1.01***
Lead	<0.0050	<0.0050		<0.10	<0.10	<0.10	<0.10	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Magnesium				48	***56***	45	49	***59.7***	48.0	50.7	52.3	49.5	51.5	48.5
Manganese	0.031	0.031	0.029	0.029	***0.046***	0.025	0.03	0.045	0.039	0.044	0.028	<0.001	0.032	0.063
Mercury				<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel				<0.058	<0.050	<0.050	<0.050	0.005	0.005	0.006	0.003	0.004	0.005	***0.010***
Potassium	<1.0	1.1	<2.0	<2.0	***5.5***	<2.0	<2.0	1.04	.89	1.81	1.80	1.13	2.20	<0.05
Selenium	<0.0050	<0.0050		<0.15	<0.15	<0.15	<0.15	0.004	0.003	0.003	<0.001	0.002	<0.001	***0.012***
Silver				<0.020	<0.020	<0.020	<0.020	<0.001	<0.001	<0.001				
Sodium		12	***11***	11	12	10	11	12.5	11.3	11.8	12.8	***14.5***	12.5	11.1
Thallium				<1.0	<1.0	<1.0		<0.001	<0.001	<0.001	<0.001	<0.001	0.005	<0.001
Vanadium				<0.050	<0.050	<0.050		0.001	<0.001	<0.001	<0.001	0.002	0.002	0.008
Zinc				***0.08***	0.028	<0.020	0.039	0.034	0.032	0.037	0.019	0.007	0.036	***0.087***
Alkalinity, phenol.				<5.0	<5.0	<5.0					4.0	<1.0	<1.0	<1.0
Alkalinity, total	***256***	248		240	***260***	250		188	216	242	240	240.0	230	246
Alkalinity, bicarbonate	***256***	248		240	***260***	250		170	201	230	228	227.0	226	238
Ammonia nitrogen				<0.20		<0.20	<0.20	<0.10	0.27	<0.10	<0.10	<0.10	0.23	<0.10
BOD, 5-day				<5.0	<5.0	<5.0		1.0	2.9	3.0				
Chloride	***31***	***31***	[illegible]	***31***	***38***	30	***31***	29.6	27.5	27.9	28.1	29.2	29.9	29.1
COD				<5.0	<5.0	<5.0	<5.0	<20	<20	<20	<20	<20	<20	<20
Cyanide				<0.0050	<0.0050	<0.0050	<0.0050	<.10	<0.10	<0.10				
Fluoride				<0.20	<0.20	<0.21	<0.20	0.18	0.15	0.16	0.13	0.17	0.17	0.18
Nitrate as N	<1.0		6.9	6.9	<0.020	9.7	7.5	6.03	6.89	6.24	3.54	5.49	6.42	6.91
Oil and Grease				<1.5	<1.5	3.1	<5.0	<.10	<0.10	<0.10				
pH (standard pH units)	7.41		7.3	7.1	7.3	7.4	7.4	7.8	8.2	7.7	7.2	7.5	7.3	8.1
Sulfate	150	***240***	170	***180***	***190***	150	***180***	169	178	178	***179***	171	165	169
Phenols		<0.020		<0.020	<0.020	<0.020	<0.020							
Phosphorus, Total			<0.10											
TOC				3.9		1	5	***6.09***	2.32	1.45	3.16	2.73	0.57	0.61
Total Dissolved Solids	***574***	***597***	***550***	***550***	***550***	***580***	***550***	428	440	435	435	422	420	422
Turbidity (nephalometric turbidity units)		0.2	<1									1.37	0.99	

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in mg/l)

Parameter	MW2-S 5/7/98	MW2-S-F 5/7/98	MW2-S 6/17/98	MW2-S 7/24/98	MW2-S 10/26/98	MW2-S 2/16/99	MW2-S 7/26/99	MW2-S 9/9/99	MW2-S 11/1/99	MW2-S 3/7/00	MW2-S 6/23/00	MW2-S 9/29/00	MW2-S 11/30/00	MW3-S 5/7/98
Aluminum							<0.04	<0.04	<0.04	<0.04	<0.04	0.051	0.019	
Antimony							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Arsenic	<0.0050	<0.0050					0.003	0.003	0.003	0.002	<0.001	0.002	0.002	0.0178
Barium	0.161	0.166		0.145	0.153		0.172	0.153	0.138	0.165	0.143	0.184	0.118	0.064
Beryllium							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Boron							<0.05	<0.05	<0.05	0.064	<0.05	<0.05	0.015	
Cadmium	<0.005	<0.010					<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005
Calcium	81	79		83	86		96.3	88.3	85.6	93.9	86.4	91	82.6	0.9
Chromium	<0.040	<0.040					0.001	<0.001	0.001	<0.001	0.001	0.002	<0.003	<0.040
Cobalt							0.003	0.003	0.003	0.002	0.001	0.003	0.002	
Copper							<0.001	0.002	<0.001	0.003	0.004	0.008	<0.001	
Iron	0.198	0.251	0.49	0.2	<0.10		0.568	0.529	0.436	0.371	0.371	0.783	0.190	1.46
Lead	<0.0050	<0.0050					<0.001	0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.0050
Magnesium							46.4	41.7	40.9	42.0	40.4	41.7	37.6	
Manganese	0.131	0.131	0.062	0.048	0.057		0.055	0.049	0.056	0.050	<0.001	0.088	0.062	0.051
Mercury							<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	
Nickel							0.004	0.005	0.004	0.003	0.008	0.005	0.003	
Potassium	1.4	1.7	<2.0	<2.0	2.5	<2.0	1.47	1.20	2.80	2.13	6.50	0.920	<0.05	1,400
Selenium	<0.0050	<0.0050					<0.004	<0.001	<0.001	0.002	<0.001	0.002	0.002	<0.0050
Silver							<0.001	<0.001	<0.001					
Sodium	4.2	4.6	4.8	4.3	5.3	4.7	5.15	4.87	4.52	5.30	5.91	5.20	3.40	67
Thallium							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Vanadium							0.002	<0.001	0.001	<0.001	0.003	0.003	<0.001	
Zinc							0.015	0.017	0.014	0.014	0.047	0.100	0.014	
Alkalinity, phenol.				<5.0	<5.0					<1.0	<1.0	<1.0	<1.0	
Alkalinity, total	344	344		350	350		281	268	326	339	335.0	332	346	680
Alkalinity, bicarbonate	344	344		350	350		255	255	318	328	331.0	330	323	240
Ammonia nitrogen							<0.10	0.14	<0.10	<0.10	<0.10	<0.10	<0.10	
BOD, 5-day							1.1	12.7	1.2					
Chloride	<5	<5	<5.0	<5.0	7.7	<5	24.0	1.89	2.16	2.73	2.71	2.92	2.65	137
COD							<20	<20	<20	<20	205	77.1	<20	
Cyanide							<.10	<0.10	<0.10					
Fluoride							0.23	0.10	0.12	0.10	0.12	0.12	0.14	
Nitrate as N	6.1		<1.0	<1.0	<1.0		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<1.0
Oil and Grease							<.10	<0.10	<0.10					
pH (standard pH units)	7.21		7.2	7.1	7.2	7.5	7.9	8.2	7.8	7.0	7.3	7.1	7.8	10.2
Sulfate	37	48	45	45	35	37	100	35.1	34.0	34.4	40.5	40.5	39.4	680
Phenols														
Phosphorus, Total			<0.10											
TOC							6.73	1.15	1.05	2.73	3.19	0.63	0.56	
Total Dissolved Solids	395	407	380	370	380	370	328	340	327	337	334	334	332	2,060
Turbidity (nephelometric turbidity units)		2.5	<1		<1.0						3.49	9.00		

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in mg/l)

Parameter	MW3-S-F 5/7/98	MW3-S 6/17/98	MW3-S 7/24/98	MW3-S-F 7/24/98	MW3-S 10/26/98	MW3-S 2/16/99	MW3-S 7/26/99	MW3-S 9/9/99	MW3-S 11/1/99	MW3-S 3/2/00	MW3-S 6/23/00	MW3-S 9/29/00	MW3-S 11/30/00
Aluminum							0.29	0.39	0.837	0.406	0.071	0.233	0.028
Antimony							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Arsenic	0.0304				0.0304		0.131	0.079	0.091	0.065	0.060	0.097	0.175
Barium	0.059		0.049		0.036		0.054	0.046	0.051	0.042	0.034	0.042	0.089
Beryllium							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron							0.05	0.15	0.062	0.184	<0.05	0.052	0.204
Cadmium	<0.010				<0.010		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Calcium	8.5		4.4		3		4.44	3.71	5.34	2.40	3.53	6.10	1.30
Chromium	<0.040				<0.040		0.003	<0.001	0.003	0.001	0.003	0.003	0.018
Cobalt							<0.001	0.002	0.003	<0.001	<0.001	<0.001	<0.001
Copper							0.011	0.013	0.014	0.009	0.006	0.045	0.022
Iron	<0.050	<1.0	1		<0.10		0.484	0.399	0.861	0.180	0.152	0.291	0.409
Lead							<0.001	0.002	0.002	0.001	<0.001	<0.001	0.001
Magnesium							4.07	2.80	3.43	1.10	2.91	3.50	0.60
Manganese	0.028	<0.100	0.073		0.031		0.101	0.173	0.328	0.106	<0.001	0.058	0.041
Mercury							<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0015
Nickel							0.014	0.013	0.015	0.008	0.008	0.013	0.038
Potassium	1,200	1,600	1,600	2,000	1,900	2,900	2314	2010	2170	2120	1980	218	2120
Selenium	<0.0050						0.008	0.005	0.007	0.004	0.004	0.005	0.016
Silver							<0.001	<0.001	<0.001				
Sodium	96	100	98	120	120	120	145	138	134	130	130	138	129
Thallium							<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001
Vanadium							0.015	<0.001	0.011	0.003	0.010	0.016	0.029
Zinc							0.008	0.012	0.014	0.012	<0.001	0.014	0.015
Alkalinity, phenol.			640		650					662	1155.0	710.0	746
Alkalinity, total	650		1,400		1,500		1590	1600	1472	1540	1507.0	1630.0	1660
Alkalinity, bicarbonate	350		120		200		1450	250	800	293	328.0	807.0	774
Ammonia nitrogen							<0.10	1.60	<0.10	<0.10	<0.10	0.61	<0.10
BOD, 5-day							<1.0	2.9	4.2				
Chloride	918	130	160	170	140	170	181	163	151	160	231	202	203
COD							<20	35	<20	36.4	242	68.8	55.9
Cyanide							<.10	<0.10	<0.10				
Fluoride							3.97	4.00	4.44	3.47	3.11	3.02	3.20
Nitrate as N		<1.0	<1.0		<1.0		<0.10	<0.10	0.16	<0.10	<0.10	<0.10	<0.10
Oil and Grease							<0.10	<0.10	<0.10				
pH (standard pH units)		10.4	10.5	10.4	10.4	10.4	10.9	11.2	10.5	10.8	10.8	10.4	10.7
Sulfate	520	1,200	1,400	1100	980	1100	980	1054	1009	931	1153	1170	1242
Phenols													
Phosphorus, Total		1.6											
TOC							12.9	22.7	17.0	27.2	17.9	9.28	14.3
Total Dissolved Solids	2,130	3,700	3,900	4,300	4,200	4,300	3776	3462	4350	3980	3160	4400	4390
Turbidity (nephelometric turbidity units)	75	1.57			1.8						8.10	22.10	

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000

(all values in mg/l)

Parameter	MW3-SF 11/30/00	MW4-S 5/7/98	MW4-S-F 5/7/98	MW4-S 6/17/98	MW4-S 7/24/98	MW4-S 10/26/98	MW4-S 2/16/99	MW4-S 7/26/99	MW4-S 9/9/99	MW4-S 11/1/99	MW4-S 3/2/00	MW4-S 5/23/00	MW4-S 6/29/00	MW4-S 11/30/00
Aluminum	0.176							0.87	0.96	0.631	0.065	<0.04	0.101	0.017
Antimony	<0.001							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	0.106	<0.0050	<0.0050					0.003	0.007	0.003	0.001	<0.001	0.001	<0.001
Barium	0.070	0.099	0.094		0.084	0.096		0.106	0.094	0.089	0.105	0.068	0.107	0.098
Beryllium	<0.001							<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.135							1.27	1.10	1.14	1.03	0.08	1.30	0.895
Cadmium	<0.001	<0.005	<0.010					<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	0.9[illegible]	150	160		150	150		177	163	155	166	137	156	150
Chromium	0.007	<0.040	<0.040					0.003	<0.001	0.002	0.002	0.001	0.002	0.001
Cobalt	<0.001							0.004	0.005	0.002	0.002	<0.001	0.001	0.001
Copper	0.016							0.007	0.010	0.005	0.007	<0.001	0.008	0.002
Iron	0.366	0.845	<0.050	<0.10	<0.10	<0.10		2.09	5.39	1.77	0.879	0.323	1.15	0.648
Lead	<0.001	<0.0050	<0.0050					0.007	0.033	0.006	<0.001	<0.001	0.001	<0.001
Magnesium	0.40							69.9	60.8	58.1	64.1	52.7	59.3	56.2
Manganese	0.055	0.359	0.357	0.518	0.670	0.665		0.832	0.952	0.746	0.758	0.407	0.886	0.810
Mercury	<0.0002							<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0002	<0.0002
Nickel	0.021							0.010	0.012	0.006	0.005	0.003	0.007	0.005
Potassium	2160	250	250	210	200	270	330	234	238	251	214	180	238	233
Selenium	0.012	<0.0050	<0.0050					0.001	0.002	0.002	0.003	<0.001	0.003	0.002
Silver								<0.001	<0.001	<0.001				
Sodium	133	25	28	22	20	24	28	27.3	30.3	27.5	24.8	21.0	25.4	24.0
Thallium	<0.001							<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Vanadium	0.016							0.004	<0.001	0.002	0.002	0.004	0.003	0.002
Zinc	0.005							0.037	0.070	0.039	0.021	<0.001	0.060	0.019
Alkalinity, phenol.					<5.0	<5.0					<1.0	<1.0	<1.0	<1.0
Alkalinity, total		332	328		360	390		356	320	384	352	322.0	378.0	380
Alkalinity, bicarbonate		332	328		360	390		340	310	320	332	320.0	350.0	360
Ammonia nitrogen								<0.10	0.23	<0.10	<0.10	<0.10	<0.10	<0.10
BOD, 5-day								4.3	4.0	<1.0				
Chloride		116	115	84	83	90	120	81.0	92.8	99.2	96.1	73.6	88.3	94.8
COD								<20	<20	<20	<20	52.6	57.1	58.8
Cyanide								<0.10	<0.10	<0.10				
Fluoride								0.29	0.22	0.22	0.16	0.24	0.25	0.28
Nitrate as N		<1.0		<1.0	<1.0	<1.0		<0.10	0.11	<0.10	<0.10	<0.10	<0.10	<0.10
Oil and Grease								<0.10	<0.10	<0.10				
pH (standard pH units)		7.16		7.3	7.2	7.3	7.3	7.6	8.0	7.5	7.1	7.4	7.3	7.9
Sulfate		530	550	530	510	520	630	397	463	502	455	375	443	441
Phenols														
Phosphorus, Total				<0.10										
TOC								11.9	3.31	4.55	8.38	9.01	2.40	2.58
Total Dissolved Solids		1,420	1,410	1,300	1,200	1,400	1,700	852	843	985	863	683	882	888
Turbidity (nephelometric turbidity units)			<0.1	< 1		<1.0						4.29	18.10	

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in mg/l)

Parameter	MW4-SF 11/30/00	MW5-S 7/26/99	MW5-S 9/9/99	MW5-S 11/1/99	MW5-S 3/2/00	MW5-S 6/23/00	MW5S-F 6/23/00	MW5-S 9/29/00	MW5-S 11/30/00	MW5-SF 11/30/00	MW6-S 7/26/99	MW6-S 9/9/99	MW6-S 11/1/99	MW6-S 3/2/00
Aluminum	<0.04	0.17	0.17	0.161	0.286	0.041	<0.04	0.151	0.195	<0.04	3.01	0.08	0.116	0.166
Antimony	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	<0.001	0.001	<0.001	0.002	0.005	<0.001	<0.001	0.001	<0.001	<0.001	0.004	<0.001	0.001	0.003
Barium	0.095	0.199	0.069	0.095	0.307	0.078	0.086	0.131	0.087	.082	0.350	0.331	0.271	0.276
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Boron	0.979	0.52	0.55	0.527	0.700	<0.05	<0.05	0.572	0.328	0.300	0.51	0.63	0.688	0.431
Cadmium	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Calcium	143	274	291	279	278	204	218	177	175	172	345	24.6	232	398
Chromium	0.002	0.004	0.001	0.003	0.006	0.002	0.003	0.004	0.002	0.001	0.007	<0.001	0.002	0.005
Cobalt	0.001	<0.001	<0.001	<0.001	0.006	<0.001	<0.001	<0.001	<0.001	<0.001	0.020	0.008	0.009	0.030
Copper	0.001	0.004	0.006	0.007	0.017	<0.001	<0.001	0.003	0.004	0.004	0.024	0.006	0.004	0.022
Iron	0.398	0.913	0.816	0.718	2.24	0.351	0.381	0.604	0.644	0.354	5.34	0.693	1.06	5.55
Lead	<0.001	0.001	0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.015	<0.001	<0.001	<0.001
Magnesium	53.6	59.0	34.6	101	202	28.9	58.3	58.7	62.1	52.7	78.0	31.4	51.9	99.2
Manganese	0.700	0.081	0.064	0.047	1.25	<0.001	<0.001	0.044	0.117	0.083	3.11	0.694	2.44	2.13
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	0.006	0.005	0.004	0.003	0.021	0.001	0.002	0.002	0.002	0.002	0.033	0.017	0.017	0.038
Potassium	222	23.5	61.9	59.5	341	23.9	221	74.5	17.7	145	64.6	70.2	68.8	59.8
Selenium	0.004	0.003	0.001	0.004	0.008	<0.001	<0.001	0.001	0.001	<0.001	0.003	0.001	0.002	0.005
Silver		<0.001	<0.001	<0.001							<0.001	<0.001	<0.001	
Sodium	22.6	22.8	78.5	55.3	34.0	47.2	33.0	18.6	9.	17.1	35.1	55.0	27.3	33.4
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Vanadium	0.002	0.007	<0.001	0.005	0.023	0.005	0.007	0.007	0.003	0.002	0.023	<0.001	0.003	0.002
Zinc	0.020	0.011	0.020	0.012	0.047	<0.001	<0.001	0.009	0.016	0.009	0.041	0.010	0.011	0.003
Alkalinity, phenol.					<1.0	<1.0		<1.0	<1.0					<1.0
Alkalinity, total		324	372	586	386	432.0		490.0	502		369	354	390	388
Alkalinity, bicarbonate		314	350	540	377	427.9		375.0	479		360	325	350	379
Ammonia nitrogen		<0.10	<0.10	<0.10	<0.10	<0.10		0.19	<0.10		<0.10	<0.10	<0.10	<0.10
BOD, 5-day		4.6	1.6	<1.0							5.3	2.2	<1.0	
Chloride		21.6	111	95.5	125	36.9		25.2	23.9		187	142	105	133
COD		<20	26	<20	<20	57.9		25.7	203		<20	<20	<20	<20
Cyanide		<0.10	<0.10	<0.10							<0.10	<0.10	<0.10	
Fluoride		0.13	0.06	0.09	0.06	0.13		0.13	0.12		0.29	0.17	0.22	0.19
Nitrate as N		1.31	6.24	2.00	<0.10	<0.10		<0.10	0.10		0.10	<0.10	<0.10	<0.10
Oil and Grease		<0.10	<0.10	<0.10							<0.10	<0.10	<0.10	
pH (standard pH units)		7.6	7.5	7.6	6.9	7.1	7.3	7.3	7.7		7.4	7.9	7.8	7.8
Sulfate		220	571	578	650	278		198	203		214	332	314	242
Phenols														
Phosphorus, Total														
TOC		21.6	29.0	17.9	<0.50	9.86		1.41	1.46		21.1	13.2	5.59	13.7
Total Dissolved Solids		668	1090	1016	121?	654		633	646		867	865	820	789
Turbidity (nephelometric turbidity units)						3.62		180.00						

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000
(all values in mg/l)

Parameter	MW6-S 8/23/00	MW6-S 9/29/00	MW6-S 11/30/00	MW6-SF 11/30/00	MW7-S 7/26/99	MW7-S 9/9/99	MW7-S 11/1/99	MW7-S 3/2/00	MW7-S 6/23/00	MW7-S 9/29/00	MW7-S 11/30/00	MW8-S 7/26/99	MW8-S 9/9/99	MW8-S 11/1/99
Aluminum	<0.04	***0.127***	***1.74***	***0.101***	***.83***	***0.30***	***0.443***	***0.662***	<0.04	***0.292***	***0.090***	***0.51***	***0.29***	***0.665***
Antimony	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	***0.003***	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	<0.001	0.001	0.003	0.003	***0.028***	***0.025***	***0.044***	***0.017***	***0.007***	0.013	0.026	0.001	<0.001	0.001
Barium	***0.143***	***0.251***	***0.181***	***0.190***	0.045	0.047	0.046	0.055	0.033	0.044	0.025	***0.073***	0.066	0.056
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	<0.05	0.292	0.364	0.437	0.25	0.19	0.216	1.95	<0.05	0.204	0.195	0.25	0.25	0.225
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	***149***	***233***	***258***	***235***	23.9	14.7	11.9	43.4	40.8	29.0	14.2	***265***	***226***	***223***
Chromium	0.002	***0.003***	***0.003***	0.002	***0.004***	0.002	0.002	***0.005***	0.002	0.001	0.002	***0.004***	***0.003***	***0.006***
Cobalt	<0.001	***0.007***	***0.011***	***0.005***	0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.002	0.002	0.002
Copper	0.001	***0.012***	***0.020***	0.005	0.005	***0.007***	***0.008***	***0.009***	<0.001	***0.006***	0.004	***0.015***	***0.014***	***0.011***
Iron	0.284	0.770	***4.86***	***0.759***	***1.98***	***0.789***	***0.629***	***1.32***	0.109	***0.683***	0.142	***1.60***	***1.19***	***1.67***
Lead	<0.001	<0.001	***0.008***	<0.001	***0.003***	***0.002***	***0.002***	<0.001	<0.001	0.001	<0.001	***0.003***	***0.004***	***0.003***
Magnesium	20.3	***47.7***	***57.6***	47.3	10.6	5.80	4.55	13.6	15.1	10.6	4.60	***110***	***94.4***	***94.3***
Manganese	***0.094***	***1.61***	***1.79***	***1.67***	***0.154***	***0.133***	***0.065***	***0.157***	0.002	***0.103***	0.024	***0.363***	***0.233***	***0.255***
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	0.003	***0.009***	***0.023***	***0.012***	***0.012***	***0.014***	***0.014***	0.007	0.002	***0.011***	***0.009***	***0.010***	***0.010***	***0.008***
Potassium	***31.2***	49.5	39.7	43.1	***656***	***717***	***793***	***503***	***406***	***629***	***727***	***265***	***263***	***265***
Selenium	<0.001	0.003	0.004	0.003	0.001	0.002	0.002	***0.005***	<0.001	0.003	0.002	0.003	0.003	0.003
Silver	<0.001				<0.001	<0.001	<0.001					<0.001	<0.001	<0.001
Sodium	***53.6***	***64.9***	***55.6***	***57.8***	***37.8***	***42.9***	***49.9***	***37.4***	***25.8***	***44.2***	***48.8***	8.2	***39.8***	***40.1***
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	0.005	0.006	0.013	0.001	0.016	0.012	0.022	0.015	0.007	0.013	0.006	0.003	<0.001	0.003
Zinc	<0.001	0.013	0.023	0.004	0.027	0.015	0.016	0.027	<0.001	0.023	<0.001	0.044	0.027	0.042
Alkalinity, phenol.	<0.001	<1.0	<1.0					41	<1.0	92.0	160			
Alkalinity, total	***417.0***	***384.0***	***420***		***396***	***466***	***534***	***348***	***341.0***	***334.0***	***486***	***271***	***270***	***314***
Alkalinity, bicarbonate	***410.0***	***350.0***	***357***		***285***	***265***	***475***	154	***333.0***	***254.0***	***297***	***265***	***265***	***306***
Ammonia nitrogen	<0.10	<0.10	<0.10		<0.10	<0.10	<0.10	<0.10	<0.10	0.94	<0.10	<0.10	<0.10	<0.10
BOD, 5-day					3.1	3.8	<1.0					3.1	1.1	<1.0
Chloride	***71.1***	***246***	***188***		***70.1***	***90.2***	***97.7***	***56.3***	***48.8***	***105***	***110***	***119***	***121***	***113***
COD	***100***	***123***	***94.1***		<20	<20	<20	<20	***10.5***	***34.3***	<20	<20	<20	<20
Cyanide					<0.10	<0.10	<0.10					<0.10	<0.10	<0.10
Fluoride	***0.41***	***0.27***	***0.30***		***1.64***	***1.95***	***2.43***	***0.80***	0.65	***1.30***	***1.84***	***0.26***	0.16	0.19
Nitrate as N	<0.10	<0.10	<0.10		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	2.73	2.47	2.88
Oil and Grease					<0.10	<0.10	<0.10					<0.10	<0.10	<0.10
pH (standard pH units)	7.1	7.1	7.8		10.0	10.2	9.8	9.4	8.9	9.4	10.2	7.8	8.3	7.8
Sulfate	106	***186***	***254***		***401***	***475***	***494***	***345***	***336***	***648***	***474***	***618***	***818***	***753***
Phenols														
Phosphorus, Total														
TOC	***13.2***	2.01	2.53		***17.2***	***10.7***	***15.2***	***14.4***	***18.0***	***7.00***	***11.3***	***9.80***	***5.86***	***9.8***
Total Dissolved Solids	***566***	***842***	***830***		***1047***	***1294***	***1423***	***901***	***802***	***1156***	***1308***	***1135***	***1190***	***1191***
Turbidity (nephelometric turbidity units)	2.69	200.00	.						0.68	23.00				

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds
at Dixon Marquette Cement Company, 1998-2000
(all values in mg/l)

Parameter	MW8-S 3/2/00	MW8-S 6/23/00	MW8-S 9/29/00	MW8-S 11/30/00	MW8-SF 11/30/00	MW9-S 7/26/99	MW9-S 9/9/99	MW9-S 11/1/99	MW9-S 3/2/00	MW9-S 6/23/00	MW9-S 9/29/00	MW9-S 11/30/00
Aluminum	***0.435***	<0.04	***0.109***	***0.233***	<0.04	***0.52***	***0.03***	***0.369***	***0.698***	<0.04	***0.149***	0.019
Antimony	<0.001	<0.001	<0.001	<0.001	<0.001	***0.003***	***0.002***	<0.001	***0.002***	<0.001	<0.001	<0.001
Arsenic	***0.005***	<0.001	0.001	<0.001	<0.001	***0.013***	***0.005***	***0.008***	***0.009***	***0.004***	0.003	0.002
Barium	***0.172***	0.044	0.055	0.057	0.056	***0.086***	0.065	0.060	0.058	0.047	0.041	0.033
Beryllium	***0.002***	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.253	<0.05	0.199	0.232	0.211	<0.05	0.15	0.067	0.070	<0.05	0.032	0.075
Cadmium	***0.003***	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	***268***	***224***	***234***	***222***	***218***	***175***	***118***	***394***	***207***	108	***110***	97.4
Chromium	***0.040***	***0.007***	***0.005***	***0.008***	***0.004***	***0.004***	<0.001	0.002	***0.007***	0.002	0.002	<0.003
Cobalt	***0.035***	<0.001	<0.001	<0.001	<0.001	0.004	0.002	0.003	***0.004***	<0.001	0.001	<0.001
Copper	***0.113***	<0.001	***0.007***	***0.097***	0.004	***0.019***	***0.012***	***0.034***	***0.036***	0.003	***0.013***	***0.010***
Iron	***5.30***	0.415	***0.549***	***0.853***	0.210	***2.00***	***0.582***	***1.29***	***5.10***	0.231	***0.827***	0.134
Lead	***0.004***	<0.001	<0.001	***0.002***	<0.001	***0.008***	***0.002***	***0.007***	<0.001	<0.001	<0.001	<0.001
Magnesium	***125***	***92.4***	***93.3***	***91.1***	***85.4***	***86.8***	***72.2***	***81.2***	***104***	***72.3***	***73.5***	***86.2***
Manganese	***4.30***	<0.001	0.024	***0.187***	***0.065***	***0.472***	***0.202***	***0.212***	***0.224***	0.040	***0.192***	***0.101***
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	***0.0003***	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	***0.058***	0.002	0.003	0.005	0.004	***0.020***	***0.016***	***0.010***	***0.012***	0.003	0.007	0.005
Potassium	***217***	***174***	254	280	274	***364***	***378***	***384***	***477***	***428***	445	427
Selenium	***0.014***	0.001	0.002	***0.006***	0.003	0.002	0.001	0.004	***0.009***	0.003	0.004	***0.005***
Silver						<0.001	<0.001	<0.001				
Sodium	***43.1***	***43.4***	***52.4***	***51.4***	***50.7***	***89.2***	***88.0***	***91.9***	***103***	***101***	***97.8***	***93.7***
Thallium	***0.002***	<0.001	0.005	0.001	0.001	<0.001	<0.001	<0.001	<0.001	***0.003***	<0.001	<0.001
Vanadium	<0.001	0.004	0.003	0.003	0.001	0.004	<0.001	0.002	0.002	0.005	0.004	0.001
Zinc	***0.363***	<0.001	0.025	0.021	0.018	0.029	0.014	0.025	0.050	<0.001	0.015	0.007
Alkalinity, phenol.	<1.0	<1.0	<1.0	<1.0					<1.0	<1.0	<1.0	<1.0
Alkalinity, total	***284***	***316.0***	***274.0***	***278***		***405***	***398***	236	***334***	***459.0***	***458.0***	***476***
Alkalinity, bicarbonate	***271***	***314.0***	***282.9***	***257***		***391***	***355***	220	***287***	***423.0***	***375.0***	***458***
Ammonia nitrogen	<0.10	<0.10	<0.10	<0.10		0.30	0.51	<0.10	<0.10	<0.10	0.53	<0.10
BOD, 5-day						2.9	4.4	1.2				
Chloride	***162***	***181***	***179***	***198***		***78.9***	***90.1***	***109***	***129***	***152***	***106***	***110***
COD	***30.3***	***158***	<20	<20		<20	<20	<20	<20	***216***	<20	<20
Cyanide						<0.10	<0.10	<0.10				
Fluoride	0.14	***0.28***	***0.22***	***0.21***		0.31	0.23	0.26	0.16	0.35	***0.31***	***0.34***
Nitrate as N	1.68	2.95	3.01	1.86		0.10	<0.10	<0.10	0.14	0.12	<0.10	<0.10
Oil and Grease						<0.10	<0.10	<0.10				
pH (standard pH units)	7.1	7.2	7.3	7.9		7.9	8.2	8.0	7.3	7.4	7.4	7.8
Sulfate	***832***	***686***	***847***	***865***		***575***	***640***	***668***	***622***	703	717	***681***
Phenols												
Phosphorus, Total												
TOC	***14.4***	***15.1***	2.05	2.50		***7.72***	4.10	***10.2***	***8.46***	***9.90***	1.90	2.25
Total Dissolved Solids	***1161***	***1125***	***1200***	***1252***		***1064***	***1173***	***1257***	***1365***	***1333***	***1250***	***1278***
Turbidity (nephelometric turbidity units)		3.03	21.00							2.26	18.20	

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in mg/l)

Parameter	MW1-D 5/7/98	MW1-D-F 5/7/98	MW1-D 6/17/98	MW1-D 7/24/98	MW1-D-F 7/24/98	MW1-D 10/26/98	MW1-D 2/16/99	MW1-D 7/28/99	MW1-D 9/9/99	MW1-D 11/1/99	MW1-D 3/2/00	MW1-D 6/23/00	MW1-D 9/29/00
Aluminum			<0.04	<0.10	<0.10	<0.10		<0.04	0.08	0.109	0.111	<0.04	0.048
Antimony			<0.001	<0.10	<0.10	<0.10		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	<0.0050	<0.0050	<0.001	<0.080	<0.080	<0.080	<0.080	<0.001	<0.001	<0.001	0.001	<0.001	0.001
Barium	0.063	0.049	<0.001	0.044	0.051	0.047	0.046	0.047	0.053	0.047	0.055	0.030	0.046
Beryllium			<0.001	<0.010	<0.010	<0.010	<0.010	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron			<0.05	<0.1	<0.050	<0.050	<0.050	<0.05	<0.05	<0.05	0.051	<0.05	<0.05
Cadmium	<0.005	<0.010	<0.001	<0.020	<0.020	<0.020	<0.020	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	93	71	<0.05	80	100	86	79	92.3	87.6	84.9	89.4	51.8	82.4
Chromium	<0.040	<0.040	<0.003	<0.020	<0.020	<0.020	<0.020	.002	<0.001	0.002	0.001	<0.001	0.002
Cobalt			<0.001	<0.020		<0.020	<0.020	<0.001	0.004	0.003	0.007	<0.001	<0.001
Copper			<0.001	<0.020	<0.020	<0.020	<0.020	0.002	0.003	0.004	0.003	<0.001	0.007
Iron	0.372	<0.050	<0.005	<0.10	<0.10	<0.10	<0.10	.273	0.568	0.519	1.18	0.132	0.214
Lead	<0.0050	<0.0050	<0.001	<0.10	<0.10	<0.10	<0.010	<0.001	0.001	<0.001	0.002	<0.001	<0.001
Magnesium			<0.005	39	46	44	41	49.7	45.5	44.0	121	36.2	43.7
Manganese	0.071	<0.010	<0.001	<0.010	<0.010	<0.010	<0.010	0.007	0.050	0.053	0.219	<0.001	0.002
Mercury			<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel			<0.001	<0.050	<0.050	<0.050	<0.050	0.002	0.003	0.003	0.003	<0.001	0.002
Potassium	1.5	1.4	<0.05	<2.0	8.5	<2.0	<2.0	1.57	1.34	1.89	2.90	1.20	1.90
Selenium	<0.0050	<0.0050	<0.001	<0.15	<0.15	<0.15	<0.15	<0.004	0.001	0.001	0.004	0.001	0.006
Silver				<0.020	<0.020	<0.020	<0.020	<0.001	<0.001	<0.001			
Sodium	3.1	3.2	<0.001	3.1	3.4	4.2	3.3	3.65	3.57	3.90	3.80	3.00	3.60
Thallium			<0.001	<1.0	<1.0	<1.0		<0.001	<0.001	<0.001	0.002	<0.001	0.003
Vanadium			<0.001	<0.050	<0.050	<0.050	<0.020	0.002	<0.001	0.002	0.001	0.002	0.004
Zinc			<0.001	<0.020	<0.020	<0.020	<1.0	0.011	0.013	0.018	0.017	<0.001	0.020
Alkalinity, phenol.			<1.0	<5.0	<5.0	<5.0					<1.0	<1.0	<1.0
Alkalinity, total	348	336	<1.0	350	350	350		282	268	320	314	325.0	312.0
Alkalinity, bicarbonate	348	336	<1.0	350	350	350		250	260	310	296	308.0	310.0
Ammonia nitrogen			<0.10	[illegible]	<0.20	<0.20		<0.10	0.11	<0.10	<0.10	<0.10	0.29
BOD, 5-day				<5.0	<5.0	<5.0		2.5	3.7	2.4			
Chloride	<5	<5	<0.05		<5.0	<5.0	<5.0	2.23	1.91	2.55	2.58	4.86	2.61
COD			<20	<5.0	<5.0	<8.3	<5.0	<20	<20	<20	<20	52.6	43.7
Cyanide				<0.0050	<0.0050	<0.0050	<0.0050	<.10	<0.10	<0.10			
Fluoride			<0.05	<0.20	<0.20	<0.21	<0.20	0.18	0.13	0.14	0.11	0.14	0.13
Nitrate as N	<1.0		<0.10	<1.0	<1.0	<1.0		0.20	0.18	0.19	0.14	0.13	0.20
Oil and Grease				<1.5	<1.5	<2.7	<5.0	<.10	<0.10	<0.10			
pH (standard pH units)	7.31			7.1	7.3	7.4	7.3	8.1	8.1	7.7	7.2	7.4	7.2
Sulfate	37	43	<0.10	56	39	35	37	37.7	37.0	37.6	35.6	40.7	40.2
Phenols				<0.020	<0.020	<0.020	<0.020						
Phosphorus, Total													
TOC			<0.50	1.5	2.3	<1.0	6.0	4.13	2.79	3.92	4.59	3.10	<0.50
Total Dissolved Solids	396	390	<1.0	400	390	400	370	333	338	326	322	323	317
Turbidity (nephelometric turbidity units)		<0.1										0.00	2.70

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in mg/l)

Parameter	MW1-D 11/30/00	MW2-D 5/7/98	MW2-D-F 5/7/98	MW2-D 6/17/98	MW2-D 7/24/98	MW2-D 10/26/98	MW2-D 2/16/99	MW2-D 7/26/99	MW2-D 9/9/99	MW2-D 11/1/99	MW2-D 3/2/00	MW2-D 6/23/00	MW2-D 9/29/00
Aluminum	<0.04							<0.04	<0.04	<0.04	0.040	<0.04	0.053
Antimony	<0.001							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	<0.001	0.0101	0.0111					0.015	0.011	0.015	0.010	0.005	0.011
Barium	0.036	*0.131*	*0.141*		*0.147*	*0.162*		*0.179*	*0.157*	*0.160*	*0.185*	*0.151*	*0.160*
Beryllium	<0.001							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.009							<0.05	<0.05	<0.05	0.059	<0.05	<0.05
Cadmium	<0.001	<0.005	<0.010					<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	69.1	*92*	*92*		*100*	*99*		*115*	*97.2*	*113*	*111*	*106*	*104*
Chromium	<0.003	<0.040	<0.040					0.002	<0.001	0.001	0.001	0.001	0.001
Cobalt	<0.001							0.004	0.003	0.003	0.002	0.001	0.001
Copper	0.001							0.001	0.002	0.001	0.005	0.001	0.003
Iron	0.217	0.764	0.752	*1.1*	*1.5*	*1.6*		*2.50*	*2.47*	*2.41*	*2.17*	*1.07*	*2.15*
Lead	<0.001	<0.0050						0.002	<0.001	<0.001	<0.001	0.001	<0.001
Magnesium	38.5							51.0	42.1	45.2	48.3	45.6	44.9
Manganese	0.001	*0.615*	*0.668*	*0.545*	*0.616*	*0.578*		*0.287*	*0.264*	*0.298*	*0.199*	*0.104*	*0.164*
Mercury	<0.0002							<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	0.001							0.003	0.003	0.002	0.003	*0.005*	0.002
Potassium	<0.05	1.4	1.7	<2.0	<2.0	<2.0	<2.0	1.38	0.92	1.40	2.40	1.72	2.30
Selenium	0.004	<0.0050	<0.0050					<0.004	<0.001	<0.001	<0.001	<0.001	<0.001
Silver								<0.001	<0.001	<0.001			
Sodium	2.40	*12*	*12*	*9.7*	*9.2*	*9.7*	*9.8*	*10.8*	*9.64*	*10.1*	*11.0*	*11.1*	*11.1*
Thallium	<0.001							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	0.001							0.003	<0.001	0.001	<0.001	0.003	*0.004*
Zinc	0.004							*0.032*	0.012	0.010	0.013	0.023	0.023
Alkalinity, phenol.	<1.0				<5.0	<5.0					<1.0	<1.0	<1.0
Alkalinity, total	328	*404*	*404*		*400*	*400*		316	324	*382*	344	*376.0*	*366.0*
Alkalinity, bicarbonate	315	*404*	*404*		*400*	*400*		310	320	*350*	329	*357.0*	*355.0*
Ammonia nitrogen	<0.10							<0.10	0.10	<0.10	<0.10	<0.10	<0.10
BOD, 5-day								<1.0	6.3	<1.0			
Chloride	2.46	*19*	*19*	*23*	*22*	*22*	*22*	*20.1*	*19.8*	*18.9*	*20.3*	*21.9*	*31.9*
COD	<20							<20	<20	<20	<20	*68.4*	*160*
Cyanide								<.10	<0.10	<0.10			
Fluoride	0.17							*.21*	0.16	0.17	0.12	0.19	0.17
Nitrate as N	0.18	<1.0		<1.0	<1.0	<1.0		<0.10	<0.10	*0.34*	<0.10	<0.10	<0.10
Oil and Grease								<.10	<0.10	<0.10			
pH (standard pH units)	8.0	7.15		7.2	7.2	7.3	7.4	7.8	8.2	7.7	7.2	7.3	7.2
Sulfate	39.9	38	40	37	38	29	30	29.6	26.2	30.6	26.7	29.2	30.4
Phenols													
Phosphorus, Total				<0.10									
TOC	0.28							*8.71*	*6.11*	1.05	*6.95*	*10.1*	<0.50
Total Dissolved Solids	316	*434*	*472*	*470*	*420*	*450*	*440*	*388*	*398*	*390*	*393*	*1301*	*390*
Turbidity (nephelometric turbidity units)			7.0	<1		<1.0						3.93	9.1

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in mg/l)

Parameter	MW2-D 11/30/50	MW2-DF 11/30/00	MW2-DF 2/14/01	MW3-D 5/7/98	MW3-D-F 5/7/98	MW3-D 6/17/98	MW3-D 7/24/98	MW3-D 10/26/98	MW3-D 2/16/99	MW3-D 7/26/99	MW3-D 9/9/99	MW3-D 11/1/99	MW3-D 3/2/00
Aluminum	<0.04	<0.04	<0.04							<0.04	0.055	<0.04	0.050
Antimony	<0.001	<0.001	<0.001							<0.001	<0.001	<0.001	<0.001
Arsenic	0.008	0.005	0.013	0.0080	0.0101					0.019	0.006	0.022	0.011
Barium	***0.239***	***0.140***	0.160	***0.134***	***0.133***		***0.139***	***0.139***		***0.163***	***0.053***	***0.134***	***0.159***
Beryllium	<0.001	<0.001	<0.001							<0.001	<0.001	<0.001	<0.001
Boron	0.022	0.011	<0.05							<0.05	<0.05	<0.05	0.076
Cadmium	<0.001	<0.001	<0.001	<0.005	<0.10					<0.001	<0.001	<0.001	<0.001
Calcium	***100***	***100***	79.4	***93***	8.6		***99***	9.5		***112***	41.8	***98.9***	***104***
Chromium	0.004	0.001	<0.001	<0.040	<0.040					0.002	<0.001	0.002	<0.001
Cobalt	0.002	0.001	0.001							0.002	0.002	0.003	0.001
Copper	0.002	0.0010	0.002							0.001	0.002	0.002	0.002
Iron	***2.55***	***1.59***	2.24	***0.919***	0.560	0.80	***0.90***	***1.1***		***1.79***	***0.830***	***2.03***	***1.57***
Lead	<0.001	<0.001	<0.001							<0.001	<0.001	<0.001	<0.001
Magnesium	42.5	42.4	43.8	0.904	0.846	0.547	0.504	0.477		***49.2***	17.3	41.7	42.6
Manganese	***0.300***	***0.170***	0.136							***0.314***	0.087	***0.282***	***0.172***
Mercury	<0.0002	<0.0002	<0.0002							<0.0002	<0.0002	<0.0002	<0.0002
Nickel	0.003	0.002	0.002							***0.004***	0.001	***0.004***	0.003
Potassium	1.30	1.80	1.68	1.8	1.9	<2.0	***4.1***	***2.6***	***2.9***	***3.68***	***2.30***	***3.82***	***2.90***
Selenium	***0.007***	0.002	<0.003	<0.0050	<0.0050					<0.004	<0.001	<0.001	0.001
Silver										<0.001		<0.001	
Sodium	***9.50***	***9.60***	6.92	***8.9***	***8.4***	***9.6***	***9.1***	***7.4***	***6.6***	***6.76***	2.90	***6.43***	***6.90***
Thallium	<0.001	<0.001	<0.001							<0.001	<0.001	<0.001	<0.001
Vanadium	***0.009***	0.001	<0.001							0.003	0.001	0.002	<0.001
Zinc	0.013	***0.059***	0.007							0.009	0.006	***0.025***	0.009
Alkalinity, phenol.	<1.0						<5.0	<5.0					<1.0
Alkalinity, total	***396***			***384***	316		***380***	***380***		310	***364***	***366***	***360***
Alkalinity, bicarbonate	***380***			***384***	316		***380***	***380***		295	***348***	***345***	***347***
Ammonia nitrogen	<0.10									<0.10	0.14	<0.10	<0.10
BOD, 5-day										2.5	5.5	<1.0	
Chloride	<0.05			***7***	***7***	***8.5***	***8.8***	***8.3***	***8.6***	***7.27***	***7.78***	***7.13***	***7.81***
COD	***35.3***									<20	137	<20	<20
Cyanide										<.10	<0.10	<0.10	
Fluoride	***0.20***									***0.28***	***0.22***	***0.20***	0.17
Nitrate as N	<0.10			<1.0		<1.0	<1.0	<1.0		<0.10	<0.10	<0.10	<0.10
Oil and Grease										<.10	<0.10	<0.10	
pH (standard pH units)	7.9			7.24		7.1	7.1	7.3	7.3	8.1	7.2	7.8	7.0
Sulfate	30.6			39	37	42	36	28	30	27.5	30.9	23.6	27.0
Phenols													
Phosphorus, Total						<0.10							
TOC	0.74									***10.6***	0.61	1.56	2.63
Total Dissolved Solids	***306***			***432***	***431***	***450***	***420***	***410***	400	359	353	357	362
Turbidity (nephelometric turbidity units)					4.0	<1		<1.0					

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in mg/l)

Parameter	MW3-D 6/23/00	MW3-D 9/29/00	MW3-D 11/30/00	MW3-DF 11/30/00	MW4-D 5/7/98	MW4-D-F 5/7/98	MW4-D 6/17/98	MW4-D 7/24/98	MW4-D-F 7/24/98	MW4-D 2/16/99	MW4-D 7/26/99	MW4-D 9/9/99	MW4-D 11/1/99
Aluminum	<0.04	<0.04	<0.04	<0.04							<0.04	0.06	<0.04
Antimony	<0.001	<0.001	<0.001	<0.001							<0.001	<0.001	<0.001
Arsenic	0.009	<0.001	0.015	0.016	0.0053	<0.0050					0.004	0.003	0.004
Barium	***0.118***	<0.001	***0.127***	***0.120***	***0.125***	***0.126***		***0.099***	***0.088***		***0.086***	***0.081***	***0.076***
Beryllium	<0.001	<0.001	<0.001	<0.001							<0.001	<0.001	<0.001
Boron	<0.05	<0.05	0.023	0.020							1.10	0.75	0.957
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.005	<0.010					<0.001	<0.001	<0.001
Calcium	***95.3***	<0.05	***99.4***	***96.8***	***160***	***160***		***200***	***180***		***222***	***177***	***191***
Chromium	0.001	<0.001	<0.003	<0.003	<0.040	<0.040					0.002	<0.001	0.001
Cobalt	0.001	<0.001	0.002	<0.001							0.003	0.002	0.002
Copper	<0.001	<0.001	<0.001	<0.001							0.004	0.003	0.004
Iron	***1.32***	<0.005	***1.46***	***2.84***	***1.12***	***1.08***	0.64	0.49	0.39		***0.957***	.02	0.607
Lead	<0.001	<0.001	<0.001	<0.001	<0.0050	<0.0050					<0.001	<0.001	<0.001
Magnesium	40.1	<0.005	40.6	40.5							***85.7***	21.0	73.4
Manganese	***0.119***	<0.001	***0.157***	***0.138***	***2.74***	***2.78***	***1.4***	***1.1***	***0.907***		***1.13***	***1.16***	***1.09***
Mercury	<0.0002	<0.0002	<0.0002	<0.0002							<0.0002	<0.0002	<0.0002
Nickel	0.002	<0.001	0.002	0.003							***0.017***	***0.013***	***0.018***
Potassium	***4.92***	<0.05	***6.00***	***5.50***	***180***	***160***	***160***	***150***	***160***	***180***	***214***	***193***	***209***
Selenium	<0.001	<0.001	<0.001	<0.001	<0.0050	<0.0050					<0.001	0.001	0.001
Silver											<0.001	<0.001	<0.001
Sodium	***6.12***	<0.001	***6.10***	***5.80***	***27***	***28***	***22***	***21***	***21***	***22***	***24.3***	***67.4***	***23.2***
Thallium	<0.001	<0.001	<0.001	<0.001							0.001	0.001	<0.001
Vanadium	***0.004***	<0.001	<0.001	<0.001							0.003	<0.001	0.002
Zinc	<0.001	<0.001	<0.001	<0.001							***0.142***	***0.079***	***0.166***
Alkalinity, phenol.	<1.0	<1.0	<1.0					<5.0	<5.0				
Alkalinity, total	***360.0***	<1.0	***364***		***404***	***404***		***390***	***410***		***413***	***400***	***400***
Alkalinity, bicarbonate	***345.0***	<1.0	327		***404***	***404***		***390***	***410***		***390***	***375***	***370***
Ammonia nitrogen	<0.10	<0.10	<0.10								<0.10	<0.10	<0.10
BOD, 5-day											6.3	6.5	<1.0
Chloride	***8.56***	<0.05	***8.42***		***93***	***93***	***71***	***76***	***76***	***88***	***93.8***	***101***	***84.8***
COD	***232***	<20	<20								<20	<20	<20
Cyanide											<.10	<0.10	<0.10
Fluoride	0.17	<0.05	***0.20***								***0.36***	0.19	***0.24***
Nitrate as N	<0.10	<0.10	<0.10		<1.0		<1.0	<1.0	<1.0		0.10	<0.10	<0.10
Oil and Grease											<0.10	<0.10	<0.10
pH (standard pH units)	7.2		7.9		6.93		7.0	6.9	7.2	7.1	7.8	8.3	7.4
Sulfate	28.7	<0.10	32.3		***520***	***510***	***530***	***550***	***390***	***550***	***514***	***537***	***484***
Phenols													
Phosphorus, Total							0.13						
TOC	***5.89***	<0.50	1.36								***8.79***	***11.1***	<0.50
Total Dissolved Solids	357	<1.0	357		***1,330***	***1,320***	***1,300***	***1,200***	***1,300***	***1,400***	***966***	***1034***	***950***
Turbidity (nephelometric turbidity units)	3.46	1.40				10	<1		<1.0				

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.121 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in mg/l)

Parameter	MW4-D 3/2/00	MW4-D 6/23/00	MW4-D 9/29/00	MW4-D 11/30/00	MW5-D 7/26/99	MW5-D 9/9/99	MW5-D 11/1/99	MW5-D 3/2/00	MW5-D 6/23/00	MW5-D 9/29/00	MW5-D 11/30/00	MW6-D 7/26/99	MW6-D 8/3/99
Aluminum	<0.04	<0.04	0.198	0.012	0.06	0.06	0.050	0.080	<0.04	0.195	0.023	0.11	0.05
Antimony	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	0.003	0.001	0.002	0.002	0.002	<0.001	0.002	0.003	<0.001	0.002	0.001	0.005	0.002
Barium	***0.082***	***0.066***	***0.080***	***0.089***	***0.121***	***0.062***	***0.053***	***0.087***	0.043	***0.052***	0.050	***0.096***	***0.062***
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	1.17	0.06	1.13	0.960	0.45	0.40	0.360	0.407	<0.05	0.390	0.468	0.56	0.40
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	***205***	***182***	***206***	***186***	***235***	***213***	***214***	***247***	***205***	***224***	***216***	***193***	***167***
Chromium	0.002	0.001	0.002	0.001	0.004	<0.001	0.002	0.004	0.001	0.004	0.001	0.003	<0.001
Cobalt	0.002	0.001	0.001	0.002	0.015	0.008	0.008	0.044	0.004	0.007	0.008	0.007	0.002
Copper	0.004	<0.001	***0.030***	0.003	***0.028***	***0.011***	***0.007***	***0.033***	<0.001	***0.013***	0.004	***0.037***	0.006
Iron	0.618	0.355	***1.06***	0.386	***0.893***	0.544	0.385	***2.24***	0.383	0.496	0.307	***1.43***	0.410
Lead	<0.001	<0.001	0.006	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.010	<0.001
Magnesium	***77.1***	70.8	***76.3***	72.6	***85.5***	30.3	***76.9***	***82.7***	71.3	***79.2***	73.1	66.6	56.3
Manganese	***1.29***	***0.533***	***0.979***	***0.804***	***0.475***	***0.213***	***0.242***	***0.70***	0.094	***0.215***	***0.284***	***0.378***	***0.103***
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	***0.017***	***0.012***	***0.017***	***0.019***	***0.013***	***0.007***	***0.006***	***0.020***	***0.004***	***0.005***	***0.006***	***0.008***	***0.004***
Potassium	***248***	***198***	***233***	***204***	***456***	***449***	***416***	***438***	***401***	***389***	***361***	***184***	***173***
Selenium	***0.006***	<0.001	0.002	0.004	0.004	0.002	0.003	0.004	<0.001	0.004	0.004	0.002	<0.001
Silver					<0.001	<0.001	<0.001					<0.001	<0.001
Sodium	***25.5***	***23.6***	***28.2***	***22.2***	***22.1***	***75.0***	***31.4***	***33.4***	***30.3***	***31.2***	***28.9***	***20.7***	***18.4***
Thallium	0.001	0.002	0.001	0.003	0.003	0.001	0.002	<0.001	0.001	<0.001	0.001	<0.001	<0.001
Vanadium	0.002	***0.005***	***0.005***	0.003	***0.005***	<0.001	0.002	***0.005***	***0.004***	***0.004***	0.001	0.003	<0.001
Zinc	***0.137***	***0.122***	***0.218***	***0.284***	***0.032***	0.015	0.016	***0.058***	<0.001	0.021	0.004	***0.036***	0.012
Alkalinity, phenol.	<1.0	<1.0	<1.0	<1.0				<1.0	<1.0	<1.0	<1.0		
Alkalinity, total	***400***	***398.0***	***378.0***	***398***	339	338	348	***408***	338.0	334.0	***350***	303	170
Alkalinity, bicarbonate	***385***	***388.0***	***365.0***	***377***	323	330	325	***385***	332.0	320.0	340	290	165
Ammonia nitrogen	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	<0.10	<0.10	1.07
BOD, 5-day					2.3	2.5	1.2					3.0	<1.0
Chloride	***118***	***108***	***107***	***110***	***159***	***148***	***150***	***164***	***164***	***157***	***160***	***93.2***	***80.8***
COD	<20	***168***	***94.3***	<20	<20	<20	<20	<20	***31.6***	***114***	<20	<20	<20
Cyanide					<0.10	<0.10	<0.10					<0.10	<0.10
Fluoride	0.15	***0.35***	***0.27***	***0.35***	0.16	0.09	0.11	0.08	0.13	0.13	0.13	0.18	0.12
Nitrate as N	<0.10	<0.10	<0.10	<0.10	***1.07***	***1.11***	***1.18***	***0.59***	***1.09***	***0.80***	***1.66***	***1.63***	***1.78***
Oil and Grease					<0.10	<0.10	<0.10					<0.10	<0.10
pH (standard pH units)	7.2	7.1	7.1	7.5	7.9	8.4	7.8	7.0	7.2	7.4	7.5	7.9	8.4
Sulfate	***549***	***516***	***561***	***531***	***871***	***830***	***881***	***850***	***915***	***873***	***834***	***533***	***497***
Phenols													
Phosphorus, Total													
TOC	***7.91***	***10.8***	1.70	2.24	***10.8***	4.34	4.03	***7.76***	***10.8***	1.29	2.19	2.69	2.85
Total Dissolved Solids	***1032***	***971***	***986***	***986***	***1376***	***1383***	***1384***	***1360***	***1322***	***1270***	***1271***	***873***	***878***
Turbidity (nephelometric turbidity units)		1.20	40.00						1.37	5.40			

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000

(all values in mg/l)

Parameter	MW6-D 11/1/99	MW6-D 3/2/00	MW6-D 6/23/00	MW6D-F 6/23/00	MW6-D 9/29/00	MW6-D 11/30/00	MW7-D 7/26/99	MW7-D 9/9/99	MW7-D 11/1/99	MW7-D 3/2/00	MW7-D 6/23/00	MW7D-F 6/23/00	MW7-D 9/29/00
Aluminum	<0.04	0.063	<0.04	<0.04	0.097	<0.04	<0.04	<0.04	0.045	<0.04	<0.04	<0.04	0.040
Antimony	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	0.004	0.013	<0.001	<0.001	0.003	0.001	0.004	0.011	0.017	0.012	0.007	0.005	0.008
Barium	***0.059***	***0.076***	0.046	0.043	***0.058***	0.049	***0.091***	***0.160***	***0.141***	***0.174***	0.033	***0.113***	***0.131***
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.449	0.540	<0.05	<0.05	0.499	0.394	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	***174***	***188***	***180***	***180***	***214***	***201***	***106***	90.4	***93.5***	***103***	***93.5***	***94.3***	89.9
Chromium	0.002	0.005	0.002	0.002	0.002	<0.003	0.001	<0.001	0.002	0.005	03002	0.001	0.001
Cobalt	0.003	0.027	<0.001	<0.001	0.003	0.001	0.004	0.002	0.002	0.002	<0.001	<0.001	<0.001
Copper	0.003	***0.039***	<0.001	<0.001	***0.010***	0.003	***0.009***	0.004	0.004	0.002	<0.001	<0.001	0.003
Iron	0.352	***4.56***	0.344	0.310	***0.913***	0.183	0.206	***2.41***	***2.19***	***3.81***	***1.37***	***1.68***	***1.88***
Lead	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001
Magnesium	59.9	61.8	58.3	60.0	***74.0***	69.2	47.2	39.0	40.6	42.1	39.9	40.7	37.7
Manganese	***0.113***	***0.278***	<0.001	<0.001	0.056	0.061	***0.600***	***0.310***	***0.689***	***0.290***	0.087	0.090	***0.140***
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	***0.004***	***0.011***	0.002	0.002	***0.004***	0.003	***0.008***	***0.005***	***0.005***	***0.005***	0.001	0.001	0.002
Potassium	***152***	***166***	***229***	***235***	***181***	***137***	***2.43***	2.21	***3.37***	1.10	1.81	***3.90***	***3.50***
Selenium	0.001	***0.006***	<0.001	<0.001	0.002	0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001
Silver	<0.001						<0.001	<0.001	<0.001				
Sodium	***18.3***	***19.5***	***18.8***	***21.4***	***21.8***	***18.3***	***8.2***	***6.98***	***6.57***	***6.90***	***5.70***	***6.00***	***5.70***
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	0.002	***0.005***	0.003	***0.004***	***0.004***	0.001	0.003	<0.001	0.002	<0.001	***0.004***	0.001	0.003
Zinc	0.012	***0.048***	0.013	0.007	0.020	<0.001	0.018	***0.028***	0.016	***0.030***	<0.001	<0.001	0.013
Alkalinity, phenol		<1.0	<1.0		<1.0	<1.0				<1.0	<1.0		<1.0
Alkalinity, total	330	280	276.0		304.0	318	326	***374***	***376***	***362***	***364.0***		***354.0***
Alkalinity, bicarbonate	300	266	274.0		287.0	297	308	335	***350***	***345***	***347.0***		342.0
Ammonia nitrogen	<0.10	<0.10	<0.10		<0.10	<0.10	<0.10	0.11	<0.10	<0.10	<0.10		0.16
BOD, 5-day	<1.0						3.3	3.7	<1.0				
Chloride	***85.6***	***83.8***	***125***		***126***	***119***	3.71	***4.42***	***4.72***	***5.47***	***5.69***		***5.58***
COD	<20	<20	***78.9***		<20	***124***	<20	<20	<20	<20	<20		<20
Cyanide	<0.10						<0.10	<0.10	<0.10				
Fluoride	0.13	0.12	0.18		0.16	0.15	***0.23***	0.19	***0.20***	0.16	0.19		0.15
Nitrate as N	***1.72***	***1.70***	***1.75***		***0.97***	***0.66***	<0.10	<0.10	<0.10	<0.10	<0.10		<0.10
Oil and Grease	<0.10						<0.10	<0.10	<0.10				
pH (standard pH units)	7.4	7.0	7.3	7.3	7.2	7.8	8.0	8.1	7.7	7.0	7.3		7.3
Sulfate	***487***	***485***	***517***		***582***	***534***	20.7	18.6	18.6	20.0	20.2		21.2
Phenols													
Phosphorus, Total													
TOC	1.62	***5.79***	***11.6***		1.43	1.42	***9.26***	4.64	4.4	3.20	***13.7***		0.67
Total Dissolved Solids	***852***	***837***	***943***		***939***	***887***	348	355	353	347	350		344
Turbidity (nephelometric turbidity units)			4.85		11.00						18.6		11.0

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in mg/l)

Parameter	MW7-D 11/30/00	MW7-DF 11/30/00	MW8-D 7/28/99	MW8-D 9/9/99	MW8-D 11/1/99	MW8-D 3/2/00	MW8-D 6/23/00	MW8D-F 6/23/00	MW8-D 9/29/00	MW8-D 11/30/00	MW8-DF 11/30/00	MW9-D 7/26/99	MW9-D [illegible]
Aluminum	0.004	0.033	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.087	<0.04	<0.04	<0.04	<0.04
Antimony	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	0.011	0.010	0.016	0.017	0.024	0.019	[illegible]	0.010	0.013	0.011	0.007	<0.001	0.010
Barium	0.131	[illegible]	0.175	0.245	0.230	0.265	0.135	0.214	0.253	0.238	0.215	0.140	0.186
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.017	0.026	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.030	0.27	<0.05	<0.05
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	90.2	88.5	[illegible]	92.1	93.8	95.8	91.8	90.0	97.3	92.2	90.5	108	92.4
Chromium	0.001	0.005	0.002	0.008	0.001	[illegible]	0.001	0.002	0.001	0.004	<0.001	0.001	<0.001
Cobalt	<0.001	<0.001	0.004	0.004	0.003	0.002	<0.001	<0.001	<0.001	0.001	0.001	0.003	0.001
Copper	0.002	0.001	0.015	0.005	0.003	0.004	<0.001	<0.001	0.003	0.003	<0.001	0.002	0.005
Iron	1.80	1.72	1.13	3.70	3.46	3.45	1.30	2.27	2.37	1.83	1.37	0.239	5.43
Lead	<0.001	<0.001	0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Magnesium	37.7	36.2	45.9	39.3	40.1	40.4	33.2	38.1	42.3	38.0	36.7	46.8	40.8
Manganese	0.152	[illegible]	1.31	0.613	1.21	0.602	0.202	0.222	0.281	0.296	0.287	1.49	[illegible]
Mercury	<0.0002	<0.0002	<0.0002	0.0010	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	0.002	0.003	0.009	0.012	0.065	0.005	0.002	0.001	0.004	0.009	0.005	0.010	0.007
Potassium	4.00	4.00	2.12	2.12	1.83	2.30	3.00	4.54	2.05	1.10	<0.05	7.09	4.12
Selenium	0.003	0.002	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	0.002	0.001	0.002	<0.001	<0.001
Silver			<0.001	<0.001	<0.001				<0.001			<0.001	<0.001
Sodium	4.90	5.10	9.64	9.15	7.87	7.22	6.70	6.20	6.80	6.00	5.49	7.16	6.76
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	0.002	0.003	0.002	<0.001	0.002	<0.001	0.004	0.005	0.004	0.002	0.002	0.003	<0.001
Zinc	0.005	0.008	0.016	0.012	0.021	0.015	<0.001	<0.001	0.014	<0.001	0.005	0.011	0.010
Alkalinity, phenol	<1.0					6	<1.0		<1.0	<1.0			
Alkalinity, total	362		341	362	380	364	376.0		374.0	378		310	302
Alkalinity, bicarbonate	341		323	335	360	341	359.0		354.0	359		295	285
Ammonia nitrogen	<0.10		<0.10	<0.10	<0.10	<0.10	<0.10		<0.10	<0.10		<0.10	0.23
BOD, 5-day			4.9	2.2	1.8							3.8	7.0
Chloride	5.92		1.04	1.07	1.90	1.66	1.73		1.57	1.70		3.26	3.65
COD	47.1		<20	<20	<20	<20	163		<20	<20		<20	22
Cyanide			<0.10	<0.10	<0.10							<0.10	<0.10
Fluoride	0.20		0.27	0.21	0.22	0.19	0.24		0.22	0.25		0.23	0.17
Nitrate as N	<0.10		<0.10	<0.10	<0.10	<0.10	<0.10		<0.10	<0.10		0.33	<0.10
Oil and Grease			<0.10	<0.10	<0.10							<0.10	<0.10
pH (standard pH units)	8.0		8.1	8.2	7.7	8.0	7.3		7.2	7.7		7.9	8.2
Sulfate	20.3		9.15	9.59	10.7	10.6	8.81		9.29	9.83		12.4	13.0
Phenols													
Phosphorus, Total													
TOC	0.66		10.0	11.1	<0.50	2.31	15.3		0.89	0.83		7.90	8.40
Total Dissolved Solids	344		347	354	353	342	340		339	340		357	356
Turbidity (nephelometric turbidity units)							14.7		19.00				

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company. 1998-2000 (all values in mg/l)

Parameter	MW9-D 11/1/99	MW9-D 3/2/00	MW9-D 6/23/00	MW9-D 9/29/00	MW9-D 11/30/00	MW9-DF 11/30/00
Aluminum	1.77	0.510	<0.04	1.20	0.045	0.004
Antimony	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	0.029	0.008	0.005	0.015	0.008	0.006
Barium	***0.215***	***0.188***	***0.136***	***0.225***	***0.157***	***0.161***
Beryllium	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Boron	<0.05	<0.05	<0.05	<0.05	0.021	0.019
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	3.10	***102***	***94.0***	***113***	***92.3***	***93.5***
Chromium	0.013	0.006	0.002	0.006	<0.003	<0.003
Cobalt	0.003	0.001	<0.001	0.01	<0.001	<0.001
Copper	0.004	0.002	<0.001	0.003	0.002	0.001
Iron	***10.3***	***5.16***	***2.09***	***8.63***	***2.23***	***2.13***
Lead	0.006	<0.001	<0.001	0.013	0.002	<0.001
Magnesium	42.6	42.8	39.7	43.7	38.7	38.7
Manganese	***0.574***	***0.554***	0.057	***0.225***	***0.124***	***0.127***
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	***0.018***	***0.006***	0.001	***0.008***	0.001	0.001
Potassium	***3.10***	1.50	***3.10***	***3.40***	***3.60***	***2.80***
Selenium	0.001	0.003	<0.001	0.002	0.003	0.001
Silver	<0.001			<0.001		
Sodium	***6.87***	***7.10***	***6.63***	7.50	***6.10***	***5.90***
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	***0.007***	0.003	***0.004***	***0.007***	0.001	0.001
Zinc	***0.123***	***0.046***	<0.001	***0.076***	0.008	0.008
Alkalinity, phenol.		<1.0	<1.0	<1.0	<1.0	
Alkalinity, total	***370***	352	***371.0***	***378.0***	***378***	
Alkalinity, bicarbonate	***360***	339	***365.0***	332.0	***367***	
Ammonia nitrogen	<0.10	<0.10	<0.10	0.30	<0.10	
BOD, 5-day	3.6					
Chloride	3.22	***4.29***	***4.92***	***4.62***	***4.25***	
COD	<20	<20	***616***	<20	***23.6***	
Cyanide	<0.10					
Fluoride	***0.20***	0.17	0.18	0.19	***0.21***	
Nitrate as N	<0.10	<0.10	<0.10	<0.10	<0.10	
Oil and Grease	<0.10					
pH (standard pH units)	7.9	7.0	7.2	7.8	7.6	
Sulfate	15.5	17.5	15.2	25.0	15.9	
Phenols						
Phosphorus, Total						
TOC	***7.09***	***8.54***	***12.1***	0.82	0.73	
Total Dissolved Solids	356	348	347	351	347	
Turbidity (nephelometric turbidity units)			3.83			

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in mg/l)

Parameter	MW1-WT 7/26/99	MW1-WT 9/9/99	MW1-WT 11/1/99	MW1-WT 3/2/00	MW1-WT 6/23/00	MW1-WT 9/29/00	MW1-WT 11/30/00	MW1-WTF 11/30/00	MW2-WT 7/26/99	MW2-WT 9/9/99	MW2-WT 11/1/99	MW2-WT 3/2/00	MW2-WT 6/23/00
Aluminum	0.27	<0.04	<0.04	<0.04	0.080	0.226	0.074	<0.04	0.31	0.16	0.275	0.312	<0.04
Antimony	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	0.003	0.002	0.001	0.002	0.002	0.001	<0.001	<0.001	0.002	0.002	0.002	0.001	<0.001
Barium	0.122	0.155	0.140	0.183	***0.250***	0.202	0.142	0.079	0.106	0.087	0.067	0.070	0.049
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	<0.05	<0.05	0.061	0.078	<0.05	<0.05	0.031	0.016	<0.05	<0.05	<0.05	0.080	<0.05
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	97.7	107	99.1	110	96.4	***129***	125	120	***328***	***282***	***238***	***415***	***174***
Chromium	0.002	<0.001	0.001	0.001	0.001	0.001	<0.003	<0.003	***0.004***	<0.001	0.002	***0.003***	0.002
Cobalt	0.007	0.008	0.001	0.004	0.004	0.005	0.005	0.002	0.002	0.002	0.002	0.005	<0.001
Copper	0.012	0.011	0.005	0.005	0.001	0.008	0.004	<0.001	0.008	0.012	0.008	0.008	0.001
Iron	0.730	0.501	0.175	***0.966***	0.304	0.620	0.582	0.048	***1.40***	***1.09***	0.844	***1.55***	0.346
Lead	0.003	0.004	<0.001	<0.001	0.001	0.001	<0.001	<0.001	0.006	0.004	0.002	0.002	<0.001
Magnesium	18.2	32.7	35.7	39.6	38.8	49.4	46.8	45.8	***121***	***107***	***91.3***	***121***	***64.4***
Manganese	2.04	2.64	0.912	2.23	1.88	1.78	2.36	1.25	0.223	0.181	0.286	0.089	<0.001
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	0.023	0.016	0.009	0.010	0.022	0.018	0.017	0.008	0.013	0.009	0.010	***0.045***	0.003
Potassium	2.43	3.06	3.63	1.90	3.30	4.00	3.30	3.90	***1370***	***1480***	***1010***	***816***	***488***
Selenium	<0.004	<0.001	<0.001	<0.001	<0.001	0.005	0.002	<0.001	0.005	0.008	0.008	0.005	0.002
Silver	<0.001	<0.001	<0.001	<0.001					<0.001	<0.001	<0.001		
Sodium	***64.9***	***38.5***	35.1	34.4	26.2	31.5	26.1	26.9	***59.3***	***62.4***	48.7	44.3	31.4
Thallium	<0.001	<0.001	<0.001	0.002	<0.001	0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001
Vanadium	0.005	<0.001	0.002	0.002	0.007	0.007	0.004	<0.001	0.005	<0.001	0.002	0.004	0.004
Zinc	0.010	0.011	0.008	0.012	<0.001	0.014	0.006	0.001	0.013	0.012	0.012	***0.017***	<0.001
Alkalinity, phenol.					<1.0	<1.0	<1.0					<1.0	<1.0
Alkalinity, total	201	***346***	322	215	270.0	290.0	280		***384***	***362***	***398***	308	***478.0***
Alkalinity, bicarbonate	198	330	320	188	265.0	276.0	272		***365***	***355***	***390***	298	***471.0***
Ammonia nitrogen	<0.10	<0.10	<0.10	<0.10	<0.10	0.14	<0.10		<0.10	<0.10	<0.10	<0.10	<0.10
BOD, 5-day	2.2	35.9	1.8	9.4					3.1	6.6	<1.0		
Chloride	1.55	22.1	17.9	18.8	18.2	19.6	18.6		***297***	***678***	***464***	***383***	***131***
COD	<20	44	<20	25.6	<20	42.9	<20		<20	<20	<20	<20	353
Cyanide	<.10	<0.10	<0.10	<0.10					<.10	<0.10	<0.10		
Fluoride	0.13	***1.13***	0.12	0.10	0.13	0.13	0.15		0.23	0.09	0.11	0.06	0.24
Nitrate as N	<0.10	<0.10	0.12	<0.10	<0.10	<0.10	<0.10		0.55	0.85	1.59	1.40	0.20
Oil and Grease	<.10	<0.10	<0.10	0.121					<.10	<0.10	<0.10		
pH (standard pH units)	7.5	8.3	7.8	8.0	7.4	7.1	7.6		7.6	8.1	7.7	7.2	7.2
Sulfate	80.6	86.1	95.7	120	***175***	238	***253***		***1121***	***1619***	***1300***	***1150***	***771***
Phenols													
Phosphorus, Total													
TOC	8.06	***22.3***	4.04	7.44	10.4	1.28	1.43		10.9	12.7	14.0	***17.9***	6.65
Total Dissolved Solids	320	430	407	390	420	485	471		***3168***	***3412***	***2910***	***1968***	***1407***
Turbidity (nephelometric turbidity units)					8.50	3.00							2.54

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.128

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in mg/l)

Parameter	MW2-WT 9/23/00	MW2-WT 11/30/00	MW2-WTF 11/30/00	MW3-WT 7/26/99	MW3-WT 9/9/99	MW3-WT 11/1/99	MW3-WT 3/2/00	MW3-WT 6/23/00	MW3-WT 9/29/00	MW3-WT 11/30/00	MW3-WTF 11/30/00	MW4-WT 7/26/99
Aluminum	0.190	0.060	0.060	0.25	0.16	0.091	0.149	0.041	0.069	0.047	0.042	<0.04
Antimony	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	<0.001	<0.001	***0.003***	<0.001	<0.001
Arsenic	0.001	0.001	0.001	***0.006***	***0.009***	***0.008***	***0.004***	0.002	0.002	***0.020***	***0.007***	0.003
Barium	0.088	0.114	0.103	0.114	0.045	0.041	0.018	0.032	0.055	0.142	0.048	0.158
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	<0.05	0.056	0.060	0.11	0.12	0.112	0.156	<0.05	0.066	0.452	0.129	1.57
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	***269***	***299***	***300***	86.7	16.5	11.9	2.20	9.10	18.0	15.2	3.50	***440***
Chromium	0.002	0.002	0.002	***0.007***	0.001	***0.003***	0.002	***0.003***	0.001	***0.014***	0.002	0.002
Cobalt	0.002	<0.001	<0.001	0.002	0.002	0.001	<0.001	<0.001	<0.001	0.002	<0.001	***0.010***
Copper	0.006	0.007	0.006	***0.014***	0.011	0.011	0.006	0.007	0.009	***0.022***	0.012	0.003
Iron	***0.946***	0.352	0.263	***1.03***	0.228	0.131	.220	0.097	0.152	0.407	0.106	***1.87***
Lead	0.003	<0.001	<0.001	0.006	0.002	<0.001	0.002	0.002	0.001	<0.001	<0.001	<0.001
Magnesium	***96.9***	***109***	***111***	26.9	11.7	7.72	1.40	10.7	17.4	12.4	12.2	***71.1***
Manganese	0.435	0.031	0.027	0.228	0.151	0.158	0.056	<0.001	0.091	0.095	0.110	2.20
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	***0.0009***	<0.0002	<0.0002
Nickel	0.010	0.008	0.007	0.010	0.010	0.006	0.002	0.006	0.003	0.026	0.010	0.019
Potassium	***669***	***783***	***956***	***892***	***1210***	***1080***	***767***	***675***	***560***	***1050***	***1090***	***261***
Selenium	0.006	0.006	0.007	0.015	0.006	0.009	0.003	0.005	0.005	0.023	0.005	0.002
Silver				<0.001	<0.001	<0.001						<0.001
Sodium	33.7	51.2	51.0	***75.7***	***85.5***	***78.8***	***63.7***	***81.0***	***63.6***	***95.4***	***94.8***	21.3
Thallium	0.002	0.002	0.001	<0.001	<0.001	<0.001	0.003	<0.001	0.005	<0.001	<0.001	<0.001
Vanadium	0.006	0.001	0.001	***0.014***	***0.018***	***0.019***	***0.009***	0.007	0.005	***0.064***	***0.014***	0.005
Zinc	***0.018***	0.011	0.012	0.012	0.007	0.005	0.003	***0.015***	0.013	***0.016***	0.006	***0.035***
Alkalinity, phenol.	<1.0	<1.0					***160***	<1.0	***52.0***	***300***		
Alkalinity, total	***376.0***	***430***		***507***	***922***	***852***	***530***	***437.0***	***368.0***	***760***		***363***
Alkalinity, bicarbonate	***360.0***	***422***		***433***	245	***790***	168	***428.0***	***355.0***	***420***		***350***
Ammonia nitrogen	<0.10	<0.10		<0.10	***0.46***	<0.10	<0.10	<0.10	<0.10	<0.10		<0.10
BOD, 5-day				3.0	5.0	<1.0						6.3
Chloride	***276***	***563***		***128***	***131***	***108***	***133***	***195***	***169***	***163***		***71.5***
COD	180	85.3		<20	65	<20	<20	232	51.4	<20		<20
Cyanide				<.10	<0.10	<0.10						<0.10
Fluoride	0.17	0.15		1.06	***1.74***	1.37	0.63	***0.82***	0.65	***1.32***		0.31
Nitrate as N	1.36	2.72		0.87	0.30	1.79	0.60	0.65	0.65	0.23		<0.10
Oil and Grease				<0.10	<0.10	<0.10						<0.10
pH (standard pH units)	7.1	7.5		9.3	10.4	9.7	10.2	9.8	8.8	10.0		7.6
Sulfate	***1095***	***1667***		***598***	***677***	***566***	***402***	***411***	***666***	***726***		***412***
Phenols												
Phosphorus, Total												
TOC	2.58	4.86		7.46	***49.3***	14.0	15.1	10.1	5.11	8.34		6.63
Total Dissolved Solids	***1770***	***3240***		***1459***	***2204***	***1859***	***1349***	***2301***	***1590***	***1893***		***848***
Turbidity (nephelometric turbidity units)	8.50							9.44	6.70			

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in mg/l)

Parameter	MW4-WT 9/9/99	MW4-WT 11/1/99	MW4-WT 3/2/00	MW4-WT 6/23/00	MW4-WT 9/29/00	MW4-WT 11/30/00	MW4-WTF 11/30/00	MW9-WT 7/26/99	MW9-WT 9/9/99	MW9-WT 11/1/99	MW9-WT 3/2/00	MW9-WT 6/23/00	MW9-WT 9/29/00
Aluminum	.33	***0.715***	***1.30***	<0.04	0.205	0.104	0.055	***0.92***	***1.51***	***1.65***	***0.781***	<0.04	***0.456***
Antimony	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	0.003	0.003	***0.006***	0.002	0.002	***0.004***	<0.001	***0.005***	***0.007***	***0.011***	***0.006***	***0.004***	0.003
Barium	0.149	0.123	0.117	0.063	0.122	0.190	0.057	0.110	0.214	0.098	0.081	0.047	0.051
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	1.05	1.21	1.53	0.11	1.78	2.14	0.232	0.09	0.08	0.094	<0.05	<0.05	<0.05
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	***175***	***180***	***261***	***125***	***164***	***155***	***222***	***262***	***424***	***279***	***205***	104	66.7
Chromium	0.001	0.002	0.002	0.002	0.002	***0.005***	***0.006***	***0.004***	***0.005***	***0.005***	***0.004***	0.002	0.001
Cobalt	0.007	0.006	0.007	<0.001	0.002	***0.011***	<0.001	0.004	***0.020***	***0.012***	0.007	0.001	0.002
Copper	0.004	0.008	0.011	<0.001	0.008	0.009	0.007	0.008	***0.013***	***0.037***	***0.025***	<0.001	0.009
Iron	***3.92***	***2.60***	***7.97***	***1.08***	***2.23***	***3.80***	***0.953***	***2.84***	***7.57***	***3.64***	***2.62***	0.032	0.772
Lead	0.002	0.003	<0.001	<0.001	0.001	0.002	0.002	0.005	***0.014***	***0.011***	<0.001	<0.001	0.004
Magnesium	22.0	***62.0***	***69.7***	40.1	***51.6***	49.7	***91.1***	***93.4***	***113***	***91.2***	***75.3***	***51.9***	26.5
Manganese	0.368	1.67	1.07	0.171	0.520	***2.88***	0.167	1.36	1.66	2.59	1.32	<0.001	0.448
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	***0.0004***
Nickel	0.025	0.015	0.012	0.003	0.009	0.025	0.005	0.012	***0.094***	***0.057***	***0.052***	0.011	0.008
Potassium	***243***	***267***	***201***	***172***	***228***	***220***	***280***	***558***	***520***	***1000***	***621***	***527***	***313***
Selenium	0.002	0.002	<0.001	<0.001	0.002	0.006	0.002	0.002	0.003	0.009	0.007	<0.001	0.003
Silver	<0.001	<0.001						<0.001	<0.001	<0.001			
Sodium	***55.2***	25.4	23.2	13.8	25.4	21.0	22.4	38.8	***96.6***	***74.2***	***59.5***	47.9	35.3
Thallium	<0.001	<0.001	<0.001	0.002	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Vanadium	<0.001	0.006	0.006	0.004	0.005	***0.009***	<0.001	0.007	***0.010***	***0.011***	<0.001	0.006	0.004
Zinc	***0.038***	***0.021***	***0.022***	<0.001	***0.022***	0.008	0.008	***0.032***	***0.068***	***0.050***	***0.028***	<0.001	0.014
Alkalinity, phenol.			<1.0	<1.0	<1.0	<1.0					<1.0	<1.0	<1.0
Alkalinity, total	***364***	***380***	306	296.0	***356.0***	***370***		***418***	***420***	***540***	***480***	***500.0***	550.0
Alkalinity, bicarbonate	***345***	***360***	297	279.0	***350.0***	***360***		***391***	***400***	***505***	***398***	***480.0***	***376.0***
Ammonia nitrogen	***0.34***	<0.10	<0.10	<0.10	0.32	<0.10		<0.10	***0.28***	<0.10	<0.10	<0.10	0.31
BOD, 5-day	3.4	<1.0						2.9	4.1	3.0			
Chloride	***87.1***	***96.9***	***77.3***	***42.9***	***76.2***	***88.2***		***164***	***306***	***373***	***219***	***145***	***191***
COD	25	<20	<20	200	22.9	67.6		<20	<20	<20	<20	447	<20
Cyanide	<0.10	<0.10						<0.10	<0.10	<0.10			
Fluoride	0.23	0.24	0.16	0.28	0.29	0.31		0.52	0.21	0.42	0.30	0.71	0.75
Nitrate as N	<0.10	<0.10	<0.10	0.40	0.10	<0.10		<0.10	0.19	1.33	0.11	<0.10	<0.10
Oil and Grease	<0.10	<0.10						<0.10	<0.10	<0.10			
pH (standard pH units)	8.2	7.7	7.1	7.3	7.2	7.7		7.8	8.2	7.8	7.5	7.9	7.6
Sulfate	***424***	***487***	***472***	***365***	***410***	***432***		***690***	***986***	***1080***	***959***	***506***	***717***
Phenols													
Phosphorus, Total													
TOC	***27.6***	3.58	9.05	9.27	2.35	3.07		16.9	5.82	16.8	13.1	11.4	3.08
Total Dissolved Solids	***969***	***978***	***853***	***683***	***832***	***876***		***1379***	***1876***	***3120***	***1500***	***1260***	***1470***
Turbidity (nephelometric turbidity units)				28.6	65.00							3.40	66.20

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in mg/l)

Parameter	MW9-WT 11/30/00	MW9-WTF 11/30/00	LW-1 6/17/98	LW-1 7/24/98	LW-1 10/26/98	LW-1 2/16/98	LW-1 7/26/99	LW-1 9/9/99	LW-1 11/1/99	LW-1 3/2/00	LW-1 6/23/00	LW-1 9/29/00	LW-1 11/30/00
Aluminum	0.180	0.008		7.3	3.3		2.45	2.02	4.57	0.610	<0.04	0.305	0.009
Antimony	<0.001	<0.001		<0.50	<0.20		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Arsenic	0.008	0.006		<0.400	<0.160		0.008	0.009	0.021	0.010	0.007	0.013	0.021
Barium	0.070	0.070		0.190	0.156		0.096	0.109	0.076	0.081	0.054	0.070	0.265
Beryllium	<0.001	<0.001	<0.150	<0.050	<0.020		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.114	0.110		0.22	<0.50		0.20	0.27	0.276	0.233	<0.05	0.176	0.825
Cadmium	<0.001	<0.001		<0.100	<0.040		<0.001	0.001	0.003	0.003	<0.001	<0.001	0.007
Calcium	117	104		620	600		758	635	673	581	397	529	623
Chromium	0.002	0.002		<0.020	<0.040		0.009	0.007	0.022	0.010	0.005	0.008	0.028
Cobalt	0.001	0.001	<0.300	<0.020	<0.040		0.023	0.035	0.043	0.028	0.007	0.016	0.048
Copper	0.009	0.005	<0.300	<0.020	<0.040		0.038	0.048	0.111	0.043	0.018	0.048	0.103
Iron	0.375	0.298	48	6.9	6.5		8.48	7.35	10.1	6.41	1.00	4.44	3.42
Lead	0.001	<0.001		<0.50	<0.020		0.015	0.016	0.019	0.002	<0.001	0.002	<0.001
Magnesium	59.5	60.0		220	220		287	228	30.5	216	115	168	136
Manganese	0.657	0.609	7.9	8.0	8.2		8.17	2.32	12.6	[illegible]	3.59	5.76	29.2
Mercury	<0.0002	<0.0002	0.0002	<0.0002	<0.00020		<0.0002	0.0004	<0.0002	<0.0002	<0.0002	0.0006	0.0034
Nickel	0.010	0.011		<0.250	<0.100		0.043	0.055	0.082	0.044	0.017	0.037	0.079
Potassium	909	893	5,100	4,300	5,500	5,900	6,512	6080	6074	7080	6220	6920	7420
Selenium	0.004	0.004		<0.75	<0.30		0.021	0.027	0.074	0.037	0.030	0.050	0.104
Silver				<0.100	<0.040		<0.001	<0.001	<0.001				
Sodium	87.1	86.4	320	280	330	320	195	366	379	396	337	387	388
Thallium	0.001	<0.001		<5.0	<2.0		<0.001	<0.001	0.002	0.002	0.001	0.003	0.017
Vanadium	0.005	0.003		<0.250	<0.100		0.016	0.008	0.024	0.013	0.005	0.007	0.033
Zinc	0.009	0.009		<0.100	<0.040		0.021	0.022	0.077	0.030	<0.001	0.028	0.029
Alkalinity, phenol.	<1.0			<5.0	<5.0					<1.0	<1.0	<1.0	<1.0
Alkalinity, total	638			310	330		295	242	308	254	310.0	276.0	280
Alkalinity, bicarbonate	599			310	330		287	240	270	198	300.0	354.0	259
Ammonia nitrogen	<0.10			5.2	7.7		5.61	4.53	2.31	3.66	6.09	13.7	1.40
BOD, 5-day				<5.0	<5.0		2.7	4.6	24				
Chloride	293		1,600	1,900	2,000	1,700	1,445	2121	3090	2200	3096	3890	3588
COD	23.5			66	66		<20	42	<20	25	542	257	26.5
Cyanide				<0.0050	<0.0050		<0.10	<0.10	<0.10				
Fluoride	1.12			0.40	0.48		0.31	0.44	0.22	0.82	0.86	<0.05	0.30
Nitrate as N	0.17		21	13	12		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Oil and Grease				<1.5	3.1		2.2	<0.10	<0.10				
pH (standard pH units)	8.3		7.4	7.2	7.4	7.4	7.7	8.2	7.8	7.1	7.5	7.3	7.8
Sulfate	915		6,200	5,800	5,900	6,300	4,444	6731	6740	6400	6441	7339	7830
Phenols				<0.020	<0.020								
Phosphorus, Total			1.3										
TOC	5.76			16	22		23.8	24.1	30.8	81.3	22.1	13.8	17.4
Total Dissolved Solids	1894		13,000	14,000	11,000	16,000	13,200	13120	1326	14840	7115	15100	15180
Turbidity (nephelometric turbidity units)			<1								2.85	21.00	

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in mg/l)

Parameter	LW-1F 11/30/00	LW-3 7/26/99	LW-3 9/9/99	LW-3 11/1/99	LW-3 6/23/00	LW-3 9/29/00	LW-3 11/30/00	LW-3F 11/30/00	SPRING 7/26/99	SPRING 9/9/99	SPRING 11/1/99	SPRING 3/2/00	SPRING 6/23/00	SPRING 9/29/00
Aluminum	<0.04	0.13	0.59	2.28	<0.04	0.231	0.404	<0.04	0.08	0.10	0.131	0.027	<0.04	0.031
Antimony	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	0.016	0.001	0.002	0.057	<0.001	0.008	<0.001	<0.001	<0.001	<0.001	0.002	0.001	0.007	<0.001
Barium	0.122	0.196	0.297	0.061	0.067	0.109	0.091	0.090	0.066	0.033	0.066	0.085	0.053	0.079
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.375	0.09	0.13	0.284	<0.05	0.132	0.159	0.169	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	0.002	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	485	1025	768	715	271	309	387	286	150	73.3	143	139	112	134
Chromium	0.012	0.005	0.001	0.069	0.003	0.008	0.001	0.001	0.002	<0.001	0.002	0.003	0.005	0.004
Cobalt	0.029	0.006	0.025	0.018	0.002	0.007	0.003	0.004	<0.001	<0.001	<0.001	<0.001	0.007	<0.001
Copper	0.056	0.002	0.005	0.053	<0.001	0.003	0.007	0.002	0.002	0.015	0.003	0.005	0.017	0.002
Iron	4.92	2.53	4.39	7.97	0.848	15.7	0.876	0.434	0.254	0.144	0.373	0.230	1.00	<0.005
Lead	<0.001	<0.001	0.004	0.009	<0.001	0.002	0.004	0.002	<0.001	0.006	<0.001	<0.001	<0.001	0.301
Magnesium	133	109	128	106	83.4	93.7	90.6	85.1	67.6	32.7	63.4	53.3	49.5	59.6
Manganese	13.0	2.61	1.93	9.19	0.830	186	1.06	1.59	0.041	0.027	0.053	0.025	3.59	0.042
Mercury	0.0013	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	0.046	0.023	0.065	0.048	0.008	0.019	0.014	0.012	0.001	0.004	0.003	0.002	0.016	0.002
Potassium	7250	60.6	58.4	44.9	60.5	58.0	71.9	68.3	134	71.5	164	77.3	55.8	138
Selenium	0.062	0.005	0.005	0.023	<0.001	<0.001	0.002	<0.001	0.002	<0.001	0.003	0.006	0.030	0.001
Silver		<0.001	<0.001	<0.001					<0.001	<0.001	<0.001			
Sodium	383	9.30	8.47	9.61	7.24	9.10	8.40	8.50	23.4	15.7	26.6	30.4	18.6	24.8
Thallium	0.005	0.002	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Vanadium	0.009	0.013	<0.001	0.029	0.008	0.009	0.002	<0.001	0.003	<0.001	0.002	0.004	0.005	0.004
Zinc	0.020	0.013	0.016	0.200	<0.001	0.318	0.018	0.026	0.005	0.069	0.012	0.010	<0.001	0.008
Alkalinity, phenol.					<1.0	<1.0	<1.0					<1.0	<1.0	<1.0
Alkalinity, total		367	328	564	579.0	516.0	546		254	342	354	320	318.0	340.0
Alkalinity, bicarbonate		360	310	515	570.0	332.0	497		245	330	310	297	310.0	320.0
Ammonia nitrogen		<0.10	0.25	<0.10	<0.10	104	<0.10		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
BOD, 5-day		2.9	36.6	24					2.6	<1.0	<1.0			
Chloride		21.0	18.1	35.1	37.3	74.7	62.7		82.8	95.9	114	98.4	54.6	99.8
COD		<20	45	<20	<20	51.4	<20		<20	<20	<20	<20	421	<20
Cyanide		<0.10	<0.10	<0.10					<0.10	<0.10	<0.10			
Fluoride		0.21	0.20	0.20	0.26	0.22	0.25		0.21	0.16	0.17	0.13	0.17	0.17
Nitrate as N		<0.10	<0.10	<0.10	<0.10	0.16	0.41		11.3	13.0	11.1	4.75	10.8	9.42
Oil and Grease		<0.10	<0.10	<0.10					<0.10	<0.10	<0.10			
pH (standard pH units)		7.3	7.7	7.4	6.8	6.8	8.2		8.1	8.3	7.7	7.0	7.3	7.1
Sulfate		429	416	403	431	474	471		210	235	503	198	137	255
Phenols														
Phosphorus, Total														
TOC		12.8	9.36	11.8	13.4	2.57	3.94		10.7	8.48	5.06	6.00	6.70	1.17
Total Dissolved Solids		783	858	867	867	860	898		682	730	825	638	533	722
Turbidity (nephelometric turbidity units)					17.2								0.15	0.15

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Inorganic Compounds at Dixon Marquette Cement Company, 1998-2000 (all values in mg/l)

Parameter	SPRING 11/30/00	RRUS 3/2/00	RRUS 6/23/00	RRUS 9/29/00	RRUS 11/30/00	RRDS 3/2/00	RRDS 6/23/00	RRDS 9/29/00	RRDS 11/30/00
Aluminum	<0.04	0.191	0.179	0.435	<0.04	0.172	0.163	0.535	<0.04
Antimony	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	<0.001	0.002	<0.001	0.001	<0.001	0.002	<0.001	<0.001	<0.001
Barium	0.065	0.064	0.064	0.078	0.046	0.063	0.063	0.079	0.041
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.035	<0.05	<0.05	<0.05	0.042	<0.05	<0.05	<0.05	0.036
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	135	66.1	66.6	71.8	75.8	65.8	64.3	74.1	73.0
Chromium	<0.003	0.002	0.001	0.001	<0.003	0.002	0.002	0.001	<0.003
Cobalt	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	0.002	0.005	0.001	0.005	<0.001	0.005	<0.001	0.004	0.001
Iron	0.072	0.463	0.481	0.800	0.046	0.345	0.476	0.947	0.038
Lead	<0.001	<0.001	0.002	0.002	<0.001	<0.001	0.002	0.003	<0.001
Magnesium	59.6	32.2	31.6	37.3	40.9	32.0	31.4	38.6	41.2
Manganese	0.033	0.068	0.055	0.146	0.025	0.063	0.044	0.153	0.04
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	0.001	0.003	0.006	0.002	0.001	0.002	0.001	0.002	0.001
Potassium	178	5.55	7.00	6.70	3.20	5.13	7.23	3.80	2.80
Selenium	<0.001	0.008	<0.001	0.001	<0.001	0.005	<0.001	0.002	<0.001
Silver									
Sodium	25.2	20.2	11.3	18.2	20.5	20.0	12.4	18.7	21.0
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.001	0.004	0.006	0.005	<0.001	0.004	0.006	0.005	<0.001
Zinc	<0.001	0.021	<0.001	0.025	<0.001	0.014	<0.001	0.019	<0.001
Alkalinity, phenol.	<1.0	<1.0	<1.0	16.0	16	<1.0	<1.0	<1.0	16
Alkalinity, total	338	200	210.0	242.0	272	197	213.0	230.0	270
Alkalinity, bicarbonate	319	139	185.0	187.0	231	109	207.0	216.0	227
Ammonia nitrogen	<0.10	<0.10	<0.10	0.37	<0.10	<0.10	<0.10	0.13	<0.10
BOD, 5-day									
Chloride	112	41.4	28.6	39.5	44.5	40.6	28.9	46.3	50.1
COD	<20	<20	<20	31.4	29.4	<20	126	<20	<20
Cyanide									
Fluoride	0.21	0.14	0.14	0.14	0.15	0.18	0.14	0.13	0.14
Nitrate as N	8.75	5.69	5.76	4.27	4.55	5.71	5.85	4.12	3.85
Oil and Grease									
pH (standard pH units)	7.7	7.6	8.1	8.1	8.7	7.8	8.1	8.0	8.7
Sulfate	320	30.3	29.1	33.6	39.9	30.4	28.0	35.3	33.5
Phenols									
Phosphorus, Total									
TOC	1.95	9.94	9.14	3.87	4.67	9.25	10.9	4.00	4.47
Total Dissolved Solids	805	304	280	308	360	306	281	314	357
Turbidity (nephelometric turbidity units)			33.00	45.00			39.60	45.00	

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Semivolatile Compounds, Pesticides, Herbicides, and PCB's at Dixon Marquette Cement Company, 1998-2000 (all values in ug/l)

Parameter	MW1-S 7/24/98	MW1-S 10/26/98	MW1-S 2/16/99	MW1-S 7/26/99	MW1-S 9/9/99	MW1-S 11/1/99	MW2-S 7/26/99	MW2-S 9/9/99	MW2-S 11/1/99	MW3-S 7/26/99	MW3-S 9/9/99	MW3-S 11/1/99
Acenaphthene	<21	<10										
Acenaphthylene	<21	<10										
Alachlor (lasso)	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Atrazine	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	<21	<10										
Benzidine	<210	<100										
Benzo(a)anthracene	<21	<10										
Benzo(b)fluoranthene	<21	<10										
Benzo(k)fluoranthene	<21	<10										
Benzo(a)pyrene	<21	<10										
Benzo(g,h,i)perylene	<21	<10										
Benzyl alcohol	<21	<10										
Benzy' butyl phthalate	<21	<10										
Bis(2-chloroethyl) ether	<21	<10										
Bis(2-chlorethoxy)methane	<21	<10										
Bis(2-ethylhexyl)phthalate	<21	<10		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(chloromethyl)ether				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroisopropyl)ether	<21	<10										
4-Bromophenyl phenyl ether	<21	<10										
4-Chloroaniline	<21	<10										
2-Chloronaphthalene	<21	<10										
4-Chlorophenylphenyl ether	<21	<10										
Chrysene	<21	<10										
Dibenzo(a,h) anthracene	<21	<10										
Di-n-butylphthalate	<21	<10		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	<21	<10										
1,3-Dichlorobenzene	<21	<10										
1,4-Dichlorobenzene	<21	<10										
3,3-Dichlorobenzidine	<100	<50										
Diethyl phthalate	<21	<10		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dimethyl phthalate	<21	<10		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dinitrotoluene	<21	<10										
2,6-Dinitrotoluene	<21	<10										
Di-n-octylphthalate	<21	<10										
Fluoranthene	<21	<10										
Fluorene	<21	<10										
Hexachloro-1,3-butadiene	<21	<10	<10									
Hexachlorocyclopentadiene	<42	<20										
Hexachloroethane	<21	<10										
Indeno(1,2,3-cd)pyrene	<21	<10										
Isophorone	<21	<10		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylnaphthalene	<21	<10										
Naphthalene	<21	<10	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Nitroaniline	<21	<10										
3-Nitroaniline	<21	<10										
4-Nitroaniline	<21	<10										
Nitrobenzene	<21	<10										
N-Nitrosodimethylamine	<21	<10										
N-Nitrosodiphenylamine	<21	<10										
N-Nitrosodi-n-propylamine	<21	<10										
Phenanthrene	<21	<10										
Pyrene	<21	<10										
Pyridine	<21	<10										
1,2,4-Trichlorobenzene	<21	<10	<5.0									
Benzoic Acid	<42	<20										
4-Chloro-3-methylphenol	<21	<10										
2-Chlorophenol	<21	<10										
p-Cresol				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cresols,Total	<21	<10										
2,4-Dichlorophenol	<21	<10										
2,4-Dimethylphenol	<21	<10										
2,4-Dinitrophenol	<21	<10										

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Semivolatile Compounds, Pesticides, Herbicides, and PCB's at Dixon Marquette Cement Company, 1998-2000 (all values in ug/l)

Parameter	MW1-S 7/24/98	MW1-S 10/26/98	MW1-S 2/16/99	MW1-S 7/26/99	MW1-S 9/9/99	MW1-S 11/1/99	MW2-S 7/26/99	MW2-S 9/9/99	MW2-S 11/1/99	MW3-S 7/26/99	MW3-S 9/9/99	MW3-S 11/1/99
2-Methyl-4,6-dinitrophenol	<21	<10										
2-Nitrophenol	<21	<10										
4-Nitrophenol	<21	<10										
Parathion	<0.5	<0.5		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	<21	<10	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phenol	<21	<10		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4,5-Trichlorophenol	<21	<10										
2,4,6-Trichlorophenol	<21	<10										
Aldrin	<0.05	<0.10		<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034
alpha-BHC	<0.05	<0.10										
beta-BHC	<0.05	<0.10										
gamma-BHC	<0.05	<0.10	<0.10	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
delta-BHC	<0.05	<0.10										
Chlordane	<0.2	<1.0	<1.0	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037
4,4'-DDD	<0.05	<0.10										
4,4'-DDE	<0.05	<0.10										
4,4'-DDT	<0.05	<0.20		<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091
Dieldrin	<0.05	<0.10		<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044
Endosulfan I	<0.05	<0.05										
Endosulfan II	<0.05	<0.20										
Endosulfan Sulfate	<0.05	<0.10										
Endrin	<0.05	<0.10	<0.10	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039
Endrin Aldehyde	<0.05	<0.10	<0.10									
Heptachlor	<0.05	<0.10	<0.10	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Heptachlor Epoxide	<0.05	<0.10	<0.10	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032
Methoxychlor	<0.05	<1.0	<1.0	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176
Toxaphene	<1.0	<2.0	<2.0	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086
Aroclor-1016				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Aroclor-1221				<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054
Aroclor-1232				<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065
Aroclor-1242				<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065
Aroclor-1248				<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090
Aroclor-1254				<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Aroclor-1260				<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Aroclor-1268				<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
PCB-1016/1242	<0.05	<1.0	<1.0									
PCB-1221	<0.05	<1.0	<1.0									
PCB-1232	<0.05	<1.0	<1.0									
PCB-1248	<0.05	<1.0	<1.0									
PCB-1254	<0.05	<1.0	<1.0									
PCB-1260	<0.05	<1.0	<1.0									
PCB-1268			<1.0									
2,4-D	<2.0	<2.0	<2.0	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29
Silvex(2,4,5-TP)	<2.0	<2.0	<2.0	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34
Aldicarb	<10	<10	<10	<0.50	<.50	<.50	<0.50	<.50	<.50	<0.50	<.50	<.50
Carbofuran	<10	<10	<10	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-Dibromo-3-Chloropropane				<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Ethylene dibromide				<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Trifluralin			<5									

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Semivolatile Compounds, Pesticides, Herbicides, and PCB's at Dixon Marquette Cement Company, 1998-2000 (all values in ug/l)

Parameter	MW4-S 7/26/99	MW4-S 9/9/99	MW4-S 11/1/99	MW5-S 7/26/99	MW5-S 9/9/99	MW5-S 11/1/99	MW6-S 7/26/99	MW6-S 9/9/99	MW6-S 11/1/99	MW7-S 7/26/99	MW7-S 9/9/99	MW7-S 11/1/99
Acenaphthene												
Acenaphthylene												
Alachlor (lasso)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Atrazine	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene												
Benzidine												
Benzo(a)anthracene												
Benzo(b)fluoranthene												
Benzo(k)fluoranthene												
Benzo(a)pyrene												
Benzo(g,h,i)perylene												
Benzyl alcohol												
Benzyl butyl phthalate												
Bis(2-chloroethyl) ether												
Bis(2-chlorethoxy)methane												
Bis(2-ethylhexyl)phthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(chloromethyl)ether	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroisopropyl)ether												
4-Bromophenyl phenyl ether												
4-Chloroaniline												
2-Chloronaphthalene												
4-Chlorophenylphenyl ether												
Chrysene												
Dibenzo(a,h) anthracene												
Di-n-butylphthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene												
1,3-Dichlorobenzene												
1,4-Dichlorobenzene												
3,3-Dichlorobenzidine												
Diethyl phthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dimethyl phthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dinitrotoluene												
2,6-Dinitrotoluene												
Di-n-octylphthalate												
Fluoranthene												
Fluorene												
Hexachloro-1,3-butadiene												
Hexachlorocyclopentadiene												
Hexachloroethane												
Indeno(1,2,3-cd)pyrene												
Isophorone	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylnaphthalene												
Naphthalene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Nitroaniline												
3-Nitroaniline												
4-Nitroaniline												
Nitrobenzene												
N-Nitrosodimethylamine												
N-Nitrosodiphenylamine												
N-Nitrosodi-n-propylamine												
Phenanthrene												
Pyrene												
Pyridine												
1,2,4-Trichlorobenzene												
Benzoic Acid												
4-Chloro-3-methylphenol												
2-Chlorophenol												
p-Cresol	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cresols,Total												
2,4-Dichlorophenol												
2,4-Dimethylphenol												
2,4-Dinitrophenol												

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.121 thru 304.126

Summary of Analytical Results for Semivolatile Compounds, Pesticides, Herbicides, and PCB's at Dixon Marquette Cement Company, 1998-2000
(all values in ug/l)

Parameter	MW4-S 7/26/99	MW4-S 9/9/99	MW4-S 11/1/99	MW5-S 7/26/99	MW5-S 9/9/99	MW5-S 11/1/99	MW6-S 7/26/99	MW6-S 9/9/99	MW6-S 11/1/99	MW7-S 7/26/99	MW7-S 9/9/99	MW7-S 11/1/99
2-Methyl-4,6-dinitrophenol												
2-Nitrophenol												
4-Nitrophenol												
Parathion	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phenol	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4,5-Trichlorophenol												
2,4,6-Trichlorophenol												
Aldrin	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034
alpha-BHC												
beta-BHC												
gamma-BHC	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
delta-BHC												
Chlordane	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037
4,4'-DDD												
4,4'-DDE												
4,4'-DDT	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091
Dieldrin	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044
Endosulfan I												
Endosulfan II												
Endosulfan Sulfate												
Endrin	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039
Endrin Aldehyde												
Heptachlor	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Heptachlor Epoxide	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032
Methoxychlor	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176
Toxaphene	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086
Aroclor-1016	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Aroclor-1221	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054
Aroclor-1232	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065
Aroclor-1242	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065
Aroclor-1248	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090
Aroclor-1254	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Aroclor-1260	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Aroclor-1268	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
PCB-1016/1242												
PCB-1221												
PCB-1232												
PCB-1248												
PCB-1254												
PCB-1260												
PCB-1268												
2,4-D	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29
Silvex(2,4,5-TP)	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34
Aldicarb	<0.50	<.50	<.50	<0.50	<.50	<.50	<0.50	<.50	<.50	<0.50	<.50	<.50
Carbofuran	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-Dibromo-3-Chloropropane	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Ethylene dibromide	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Trifluralin												

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Semivolatile Compounds, Pesticides, Herbicides, and PCB's at Dixon Marquette Cement Company, 1998-2000
(all values in ug/l)

Parameter	MW8-S 7/26/99	MW8-S 9/9/99	MW8-S 11/1/99	MW9-S 7/26/99	MW9-S 9/9/99	MW9-S 11/1/99	MW1-D 7/24/98	MW1-D 10/26/98	MW1-D 2/16/99	MW1-D 7/26/99	MW1-D 9/9/99	MW1-D 11/1/99
Acenaphthene							<19	<10				
Acenaphthylene							<19	<10				
Alachlor (lasso)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<0.5		<1.0	<1.0	<1.0
Atrazine	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<0.5		<1.0	<1.0	<1.0
Anthracene							<19	<10				
Benzidine							<190	<100				
Benzo(a)anthracene							<19	<10				
Benzo(b)fluoranthene							<19	<10				
Benzo(k)fluoranthene							<19	<10				
Benzo(a)pyrene							<19	<10				
Benzo(g,h,i)perylene							<19	<10				
Benzyl alcohol							<19	<10				
Benzyl butyl phthalate							<19	<10				
Bis(2-chloroethyl) ether							<19	<10				
Bis(2-chlorethoxy)methane							<19	<10				
Bis(2-ethylhexyl)phthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<19	<10		<1.0	<1.0	<1.0
Bis(chloromethyl)ether	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0				<1.0	<1.0	<1.0
Bis(2-chloroisopropyl)ether							<19	<10				
4-Bromophenyl phenyl ether							<19	<10				
4-Chloroaniline							<19	<10				
2-Chloronaphthalene							<19	<10				
4-Chlorophenylphenyl ether							<19	<10				
Chrysene							<19	<10				
Dibenzo(a,h) anthracene							<19	<10				
Di-n-outylphthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<19	<10		<1.0	<1.0	<1.0
1,2-Dichlorobenzene							<19	<10				
1,3-Dichlorobenzene							<19	<10				
1,4-Dichlorobenzene							<19	<10				
3,3-Dichlorobenzidine							<95	<50				
Diethyl phthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<19	<10		<1.0	<1.0	<1.0
Dimethyl phthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<19	<10		<1.0	<1.0	<1.0
2,4-Dinitrotoluene							<19	<10				
2,6-Dinitrotoluene							<19	<10				
Di-n-octylphthalate							<19	<10				
Fluoranthene							<19	<10				
Fluorene							<19	<10				
Hexachloro-1,3-butadiene							<19	<10	<1(			
Hexachlorocyclopentadiene							<38	<20				
Hexachloroethane							<19	<10				
Indeno(1,2,3-cd)pyrene							<19	<10				
Isophorone	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<19	<10		<1.0	<1.0	<1.0
2-Methylnaphthalene							<19	<10				
Naphthalene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<19	<10	<10	<1.0	<1.0	<1.0
2-Nitroaniline							<19	<10				
3-Nitroaniline							<19	<10				
4-Nitroaniline							<19	<10				
Nitrobenzene							<19	<10				
N-Nitrosodimethylamine							<19	<10				
N-Nitrosodiphenylamine							<19	<10				
N-Nitrosodi-n-propylamine							<19	<10				
Phenanthrene							<19	<10				
Pyrene							<19	<10				
Pyridine							<19	<10				
1,2,4-Trichlorobenzene							<19	<10				
Benzoic Acid							<38	<20				
4-Chloro-3-methylphenol							<19	<10				
2-Chlorophenol							<19	<10				
p-Cresol	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0				<1.0	<1.0	<1.0
Cresols, Total							<19	<10				
2,4-Dichlorophenol							<19	<10				
2,4-Dimethylphenol							<19	<10				
2,4-Dinitrophenol							<19	<10				

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Semivolatile Compounds, Pesticides, Herbicides, and PCB's at Dixon Marquette Cement Company, 1998-2000 (all values in ug/l)

Parameter	MW8-S 7/26/99	MW8-S 9/9/99	MW8-S 11/1/99	MW9-S 7/26/99	MW9-S 9/9/99	MW9-S 11/1/99	MW1-D 7/24/98	MW1-D 10/26/98	MW1-D 2/16/99	MW1-D 7/26/99	MW1-D 9/9/99	MW1-D 11/1/99
2-Methyl-4,6-dinitrophenol							<19	<10				
2-Nitrophenol							<19	<10				
4-Nitrophenol							<19	<10				
Parathion	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<0.5		<1.0	<1.0	<1.0
Pentachlorophenol	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<19	<10	<10	<1.0	<1.0	<1.0
Phenol	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<19	<10		<1.0	<1.0	<1.0
2,4,5-Trichlorophenol							<19	<10				
2,4,6-Trichlorophenol							<19	<10				
Aldrin	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.05	<0.10		<0.034	<0.034	<0.034
alpha-BHC							<0.05	<0.10				
beta-BHC							<0.05	<0.10				
gamma-BHC	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.05	<0.10	<0.10	<0.025	<0.025	<0.025
delta-BHC							<0.05	<0.10				
Chlordane	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.2	<1.0	<1.0	<0.037	<0.037	<0.037
4,4'-DDD							<0.05	<0.10				
4,4'-DDE							<0.05	<0.10				
4,4'-DDT	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.05	<0.20		<0.091	<0.091	<0.091
Dieldrin	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.05	<0.10		<0.044	<0.044	<0.044
Endosulfan I							<0.05	<0.05				
Endosulfan II							<0.05	<0.20				
Endosulfan Sulfate							<0.05	<0.10				
Endrin	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.05	<0.10	<0.10	<0.039	<0.039	<0.039
Endrin Aldehyde							<0.05	<0.10				
Heptachlor	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.05	<0.10	<0.10	<0.040	<0.040	<0.040
Heptachlor Epoxide	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.05	<0.10		<0.032	<0.032	<0.032
Methoxychlor	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.05	<1.0	<1.0	<0.176	<0.176	<0.176
Toxaphene	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<1.0	<2.0	<2.0	<0.086	<0.086	<0.086
Aroclor-1016	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050				<0.050	<0.050	<0.050
Aroclor-1221	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054				<0.054	<0.054	<0.054
Aroclor-1232	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065				<0.065	<0.065	<0.065
Aroclor-1242	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065				<0.065	<0.065	<0.065
Aroclor-1248	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090				<0.090	<0.090	<0.090
Aroclor-1254	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100				<0.100	<0.100	<0.100
Aroclor-1260	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100				<0.100	<0.100	<0.100
Aroclor-1268	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100				<0.100	<0.100	<0.100
PCB-1016/1242							<0.05	<1.0	<1.0			
PCB-1221							<0.05	<1.0	<1.0			
PCB-1232							<0.05	<1.0	<1.0			
PCB-1248							<0.05	<1.0	<1.0			
PCB-1254							<0.05	<1.0	<1.0			
PCB-1260							<0.05	<1.0	<1.0			
PCB-1268									<1.0			
2,4-D	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<2.0	<2.0	<2.0	<0.29	<0.29	<0.29
Silvex(2,4,5-TP)	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<2.0	<2.0	<2.0	<0.34	<0.34	<0.34
Aldicarb	<0.50	<.50	<.50	<0.50	<.50	<.50	<10	<10	<10	<0.50	<.50	<.50
Carbofuran	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	<5.0	<5.0	<5.0
1,2-Dibromo-3-Chloropropane	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10				<0.10	<0.10	<0.10
Ethylene dibromide	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10				<0.10	<0.10	<0.10
Trifluralin												

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Semivolatile Compounds, Pesticides, Herbicides, and PCB's at Dixon Marquette Cement Company, 1996-2000 (all values in ug/l)

Parameter	MW2-D 7/26/99	MW2-D 9/9/99	MW2-D 11/1/99	MW3-D 7/26/99	MW3-D 9/9/99	MW3-D 11/1/99	MW4-D 7/26/99	MW4-D 9/9/99	MW4-D 11/1/99	MW5-D 9/9/99	MW5-D 11/1/99	MW6-D 7/26/99
Acenaphthene												
Acenaphthylene												
Alachlor (lasso)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Atrazine	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene												
Benzidine												
Benzo(a)anthracene												
Benzo(b)fluoranthene												
Benzo(k)fluoranthene												
Benzo(a)pyrene												
Benzo(g,h,i)perylene												
Benzyl alcohol												
Benzyl butyl phthalate												
Bis(2-chloroethyl) ether												
Bis(2-chlorethoxy)methane												
Bis(2-ethylhexyl)phthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(chloromethyl)ether	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroisopropyl)ether												
4-Bromophenyl phenyl ether												
4-Chloroaniline												
2-Chloronaphthalene												
4-Chlorophenylphenyl ether												
Chrysene												
Dibenzo(a,h) anthracene												
Di-n-butylphthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene												
1,3-Dichlorobenzene												
1,4-Dichlorobenzene												
3,3-Dichlorobenzidine												
Diethyl phthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dimethyl phthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dinitrotoluene												
2,6-Dinitrotoluene												
Di-n-octylphthalate												
Fluoranthene												
Fluorene												
Hexachloro-1,3-butadiene												
Hexachlorocyclopentadiene												
Hexachloroethane												
Indeno(1,2,3 cd)pyrene												
Isophorone	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylnaphthalene												
Naphthalene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Nitroaniline												
3-Nitroaniline												
4-Nitroaniline												
Nitrobenzene												
N-Nitrosodimethylamine												
N-Nitrosodiphenylamine												
N-Nitrosodi-n-propylamine												
Phenanthrene												
Pyrene												
Pyridine												
1,2,4-Trichlorobenzene												
Benzoic Acid												
4-Chloro-3-methylphenol												
2-Chlorophenol												
p-Cresol	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cresols,Total												
2,4-Dichlorophenol												
2,4-Dimethylphenol												
2,4-Dinitrophenol												

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

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Summary of Analytical Results for Semivolatile Compounds, Pesticides, Herbicides, and PCB's at Dixon Marquette Cement Company, 1998-2000
(all values in ug/l)

Parameter	MW2-D 7/26/99	MW2-D 9/9/99	MW2-D 11/1/99	MW3-D 7/26/99	MW3-D 9/9/99	MW3-D 11/1/99	MW4-D 7/26/99	MW4-D 9/9/99	MW4-D 11/1/99	MW5-D 9/9/99	MW5-D 11/1/99	MW6-D 7/26/99
2-Methyl-4,6-dinitrophenol												
2-Nitrophenol												
4-Nitrophenol												
Parathion	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phenol	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4,5-Trichlorophenol												
2,4,6-Trichlorophenol												
Aldrin	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034
alpha-BHC												
beta-BHC												
gamma-BHC	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
delta-BHC												
Chlordane	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037
4,4'-DDD												
4,4'-DDE												
4,4'-DDT	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091
Dieldrin	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044
Endosulfan I												
Endosulfan II												
Endosulfan Sulfate												
Endrin	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039
Endrin Aldehyde												
Heptachlor	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Heptachlor Epoxide	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032
Methoxychlor	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176
Toxaphene	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086
Aroclor-1016	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Aroclor-1221	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054
Aroclor-1232	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065
Aroclor-1242	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065
Aroclor-1248	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090
Aroclor-1254	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Aroclor-1260	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Aroclor-1268	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
PCB-1016/1242												
PCB-1221												
PCB-1232												
PCB-1248												
PCB-1254												
PCB-1260												
PCB-1268												
2,4-D	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29
Silvex(2,4,5-TP)	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34
Aldicarb	<0.50	<.50	<.50	<0.50	<.50	<.50	<0.50	<.50	<.50	<.50	<.50	<0.50
Carbofuran	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-Dibromo-3-Chloropropane	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Ethylene dibromide	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Trifluralin												

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable ... to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Semivolatile Compounds, Pesticides, Herbicides, and PCB's at Dixon Marquette Cement Company, 1998-2000 (all values in ug/l)

Parameter	MW6-D 9/9/99	MW6-D 11/1/99	MW7-D 7/26/99	MW7-D 9/9/99	MW7-D 11/1/99	MW8-D 7/26/99	MW8-D 9/9/99	MW8-D 11/1/99	MW9-D 7/26/99	MW9-D 9/9/99	MW9-D 11/1/99	MW1-WT 7/26/99
Acenaphthene												
Acenaphthylene												
Alachlor (lasso)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Atrazine	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene												
Benzidine												
Benzo(a)anthracene												
Benzo(b)fluoranthene												
Benzo(k)fluoranthene												
Benzo(a)pyrene												
Benzo(g,h,i)perylene												
Benzyl alcohol												
Benzyl butyl phthalate												
Bis(2-chloroethyl) ether												
Bis(2-chlorethoxy)methane												
Bis(2-ethylhexyl)phthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(chloromethyl)ether	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroisopropyl)ether												
4-Bromophenyl phenyl ether												
4-Chloroaniline												
2-Chloronaphthalene												
4-Chlorophenylphenyl ether												
Chrysene												
Dibenzo(a,h) anthracene												
Di-n-butylphthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene												
1,3-Dichlorobenzene												
1,4-Dichlorobenzene												
3,3-Dichlorobenzidine												
Diethyl phthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dimethyl phthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dinitrotoluene												
2,6-Dinitrotoluene												
Di-n-octylphthalate												
Fluoranthene												
Fluorene												
Hexachloro-1,3-butadiene												
Hexachlorocyclopentadiene												
Hexachloroethane												
Indeno(1,2,3-cd)pyrene												
Isophorone	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylnaphthalene												
Naphthalene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Nitroaniline												
3-Nitroaniline												
4-Nitroaniline												
Nitrobenzene												
N-Nitrosodimethylamine												
N-Nitrosodiphenylamine												
N-Nitrosodi-n-propylamine												
Phenanthrene												
Pyrene												
Pyridine												
1,2,4-Trichlorobenzene												
Benzoic Acid												
4-Chloro-3-methylphenol												
2-Chlorophenol												
p-Cresol	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cresols, Total												
2,4-Dichlorophenol												
2,4 Dimethylphenol												
2,4-Dinitrophenol												

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Semivolatile Compounds, Pesticides, Herbicides, and PCB's at Dixon Marquette Cement Company, 1998-2000
(all values in ug/l)

Parameter	MW6-D 9/9/99	MW6-D 11/1/99	MW7-D 7/26/99	MW7-D 9/9/99	MW7-D 11/1/99	MW8-D 7/26/99	MW8-D 9/9/99	MW8-D 11/1/99	MW9-D 7/26/99	MW9-D 9/9/99	MW9-D 11/1/99	MW1-WT 7/26/99
2-Methyl-4,6-dinitrophenol												
2-Nitrophenol												
4-Nitrophenol												
Parathion	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phenol	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4,5-Trichlorophenol												
2,4,6-Trichlorophenol												
Aldrin	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034
alpha-BHC												
beta-BHC												
gamma-BHC	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
delta-BHC												
Chlordane	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037
4,4'-DDD												
4,4'-DDE												
4,4'-DDT	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091
Dieldrin	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044
Endosulfan I												
Endosulfan II												
Endosulfan Sulfate												
Endrin	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039
Endrin Aldehyde												
Heptachlor	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Heptachlor Epoxide	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032
Methoxychlor	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176
Toxaphene	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086
Aroclor-1016	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Aroclor-1221	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054
Aroclor-1232	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065
Aroclor-1242	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065
Aroclor-1248	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090
Aroclor-1254	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Aroclor-1260	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Aroclor-1268	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
PCB-1016/1242												
PCB-1221												
PCB-1232												
PCB-1248												
PCB-1254												
PCB-1260												
PCB-1268												
2,4-D	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29
Silvex(2,4,5-TP)	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34
Aldicarb	<.50	<.50	<0.50	<.50	<.50	<0.50	<.50	<.50	<0.50	<.50	<.50	<0.50
Carbofuran	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-Dibromo-3-Chloropropane	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Ethylene dibromide	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Trifluralin												

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Semivolatile Compounds, Pesticides, Herbicides, and PCB's at Dixon Marquette Cement Company, 1998-2000 (all values in ug/l)

Parameter	MW1-WT 9/9/99	MW1-WT 11/1/99	MW2-WT 3/2/00	MW2-WT 7/26/99	MW2-WT 9/9/99	MW2-WT 11/1/99	MW3-WT 7/26/99	MW3-WT 9/9/99	MW3-WT 11/1/99	MW4-WT 7/26/99	MW4-WT 9/9/99	MW4-WT 11/1/99
Acenaphthene												
Acenaphthylene												
Alachlor (lasso)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Atrazine	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene												
Benzidine												
Benzo(a)anthracene												
Benzo(b)fluoranthene												
Benzo(k)fluoranthene												
Benzo(a)pyrene												
Benzo(g,h,i)perylene												
Benzyl alcobol												
Benzyl butyl phthalate												
Bis(2-chloroethyl) ether												
Bis(2-chlorethoxy)methane												
Bis(2-ethylhexyl)phthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(chloromethyl)ether	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroisopropyl)ether												
4-Bromophenyl phenyl ether												
4-Chloroaniline												
2-Chloronaphthalene												
4-Chlorophenylphenyl ether												
Chrysene												
Dibenzo(a,h) anthracene												
Di-n-butylphthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene												
1,3-Dichlorobenzene												
1,4-Dichlorobenzene												
3,3-Dichlorobenzidine												
Diethyl phthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dimethyl phthalate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dinitrotoluene												
2,6-Dinitrotoluene												
Di-n-octylphthalate												
Fluoranthene												
Fluorene												
Hexachloro-1,3-butadiene												
Hexachlorocyclopentadiene												
Hexachloroethane												
Indeno(1,2,3-cd)pyrene												
Isophorone	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylnaphthalene												
Naphthalene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Nitroaniline												
3-Nitroaniline												
4-Nitroaniline												
Nitrobenzene												
N-Nitrosodimethylamine												
N-Nitrosodiphenylamine												
N-Nitrosodi-n-propylamine												
Phenanthrene												
Pyrene												
Pyridine												
1,2,4-Trichlorobenzene												
Benzoic Acid												
4-Chloro-3-methylphenol												
2-Chlorophenol												
p-Cresol	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cresols, Total												
2,4-Dichlorophenol												
2,4-Dimethylphenol												
2,4-Dinitrophenol												

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Semivolatile Compounds, Pesticides, Herbicides, and PCB's at Dixon Marquette Cement Company, 1998-2000 (all values in ug/l)

Parameter	MW1-WT 9/9/99	MW1-WT 11/1/99	MW1-WT 3/2/00	MW2-WT 7/26/99	MW2-WT 9/9/99	MW2-WT 11/1/99	MW3-WT 7/26/99	MW3-WT 9/9/99	MW3-WT 11/1/99	MW4-WT 7/26/99	MW4-WT 9/9/99	MW4-WT 11/1/99
2-Methyl-4,6-dinitrophenol												
2-Nitrophenol												
4-Nitrophenol												
Parathion	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phenol	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4,5-Trichlorophenol												
2,4,6-Trichlorophenol												
Aldrin	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034
alpha-BHC												
beta-BHC												
gamma-BHC	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
delta-BHC												
Chlordane	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037
4,4'-DDD												
4,4'-DDE												
4,4'-DDT	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091
Dieldrin	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044
Endosulfan I												
Endosulfan II												
Endosulfan Sulfate												
Endrin	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039
Endrin Aldehyde												
Heptachlor	<0.040	<0.040	<0.340	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Heptachlor Epoxide	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032
Methoxychlor	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176
Toxaphene	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086
Aroclor-1016	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Aroclor-1221	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054
Aroclor-1232	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065
Aroclor-1242	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065
Aroclor-1248	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090
Aroclor-1254	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Aroclor-1260	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Aroclor-1268	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
PCB-1016/1242												
PCB-1221												
PCB-1232												
PCB-1248												
PCB-1254												
PCB-1260												
PCB-1268												
2,4-D	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29
Silvex(2,4,5-TP)	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34
Aldicarb	<.50	<.50	<.50	<0.50	<.50	<.50	<0.50	<.50	<.50	<0.50	<.50	<.50
Carbofuran	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-Dibromo-3-Chloropropane	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Ethylene dibromide	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Trifluralin												

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Semivolatile Compounds, Pesticides, Herbicides, and PCB's at Dixon Marquette Cement Company, 1998-2000 (all values in ug/l)

Parameter	MW9-WT 7/26/99	MW9-WT 9/9/99	MW9-WT 11/1/99	LW-1 7/24/98	LW-1 10/26/98	LW-1 7/26/99	LW-1 9/9/99	LW-1 11/1/99	LW-3 7/26/99	LW-3 9/9/99	LW-3 11/1/99	SPRING 7/26/99
Acenaphthene				<20	<10							
Acenaphthylene				<20	<10							
Alachlor (lasso)	<1.0	<1.0	<1.0	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Atrazine	<1.0	<1.0	<1.0	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene				<20	<10							
Benzidine				<200	<100							
Benzo(a)anthracene				<20	<10							
Benzo(b)fluoranthene				<20	<10							
Benzo(k)fluoranthene				<20	<10							
Benzo(a)pyrene				<20	<10							
Benzo(g,h,i)perylene				<20	<10							
Benzyl alcohol				<20	<10							
Benzyl butyl phthalate				<20	<10							
Bis(2-chloroethyl) ether				<20	<10							
Bis(2-chlorethoxy)methane				<20	<10							
Bis(2-ethylhexyl)phthalate	<1.0	<1.0	<1.0	<20	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(chloromethyl)ether	<1.0	<1.0	<1.0			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bis(2-chloroisopropyl)ether				<20	<10							
4-Bromophenyl phenyl ether				<20	<10							
4-Chloroaniline				<20	<10							
2-Chloronaphthalene				<20	<10							
4-Chlorophenylphenyl ether				<20	<10							
Chrysene				<20	<10							
Dibenzo(a,h) anthracene				<20	<10							
Di-n-butylphthalate	<1.0	<1.0	<1.0	<20	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene				<20	<10							
1,3-Dichlorobenzene				<20	<10							
1,4-Dichlorobenzene				<20	<10							
3,3-Dichlorobenzidine				<100	<50							
Diethyl phthalate	<1.0	<1.0	<1.0	<20	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dimethyl phthalate	<1.0	<1.0	<1.0	<20	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dinitrotoluene				<20	<10							
2,6-Dinitrotoluene				<20	<10							
Di-n-octylphthalate				<20	<10							
Fluoranthene				<20	<10							
Fluorene				<20	<10							
Hexachloro-1,3-butadiene				<20	<10							
Hexachlorocyclopentadiene				<40	<20							
Hexachloroethane				<20	<10							
Indeno(1,2,3-cd)pyrene				<20	<10							
Isophorone	<1.0	<1.0	<1.0	<20	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylnaphthalene				<20	<10							
Naphthalene	<1.0	<1.0	<1.0	<20	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Nitroaniline				<20	<10							
3-Nitroaniline				<20	<10							
4-Nitroaniline				<20	<10							
Nitrobenzene				<20	<10							
N-Nitrosodimethylamine				<20	<10							
N-Nitrosodiphenylamine				<20	<10							
N-Nitrosodi-n-propylamine				<20	<10							
Phenanthrene				<20	<10							
Pyrene				<20	<10							
Pyridine				<20	<10							
1,2,4-Trichlorobenzene				<20	<10							
Benzoic Acid				<40	<20							
4-Chloro-3-methylphenol				<20	<10							
2-Chlorophenol				<20	<10							
p-Cresol	<1.0	<1.0	<1.0			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cresols, Total				<20	<10							
2,4-Dichlorophenol				<20	<10							
2,4-Dimethylphenol				<20	<10							
2,4-Dinitrophenol				<20	<10							

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Semivolatile Compounds, Pesticides, Herbicides, and PCB's at Dixon Marquette Cement Company, 1998-2000 (all values in ug/l)

Parameter	MW9-WT 7/26/99	MW9-WT 9/9/99	MW9-WT 11/1/99	LW-1 7/24/98	LW-1 10/26/98	LW-1 7/26/99	LW-1 9/9/99	LW-1 11/1/99	LW-3 7/26/99	LW-3 9/9/99	LW-3 11/1/99	SPRING 7/26/99
2-Methyl-4,6-dinitrophenol				<20	<10							
2-Nitrophenol				<20	<10							
4-Nitrophenol				<20	<10							
Parathion	<1.0	<1.0	<1.0	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	<1.0	<1.0	<1.0	<20	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phenol	<1.0	<1.0	<1.0	<20	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4,5-Trichlorophenol				<20	<10							
2,4,6-Trichlorophenol				<20	<10							
Aldrin	<0.034	<0.034	<0.034	<0.10	<0.10	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034	<0.034
alpha-BHC				<0.10	<0.10							
beta-BHC				<0.10	<0.10							
gamma-BHC	<0.025	<0.025	<0.025	<0.10	<0.10	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
delta-BHC				<0.10	<0.10							
Chlordane	<0.037	<0.037	<0.037	<0.4	<1.0	<0.037	<0.037	<0.037	<0.057	<0.037	<0.037	<0.037
4,4'-DDD				<0.10	<0.10							
4,4'-DDE				<0.10	<0.10							
4,4'-DDT	<0.091	<0.091	<0.091	<0.10	<0.20	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091	<0.091
Dieldrin	<0.044	<0.044	<0.044	<0.10	<0.10	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044
Endosulfan I				<0.10	<0.05							
Endosulfan II				<0.10	<0.20							
Endosulfan Sulfate				<0.10	<0.10							
Endrin	<0.039	<0.039	<0.039	<0.10	<0.10	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039
Endrin Aldehyde				<0.10	<0.10							
Heptachlor	<0.040	<0.040	<0.040	<0.10	<0.10	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Heptachlor Epoxide	<0.032	<0.032	<0.032	<0.10	<0.10	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032	<0.032
Methoxychlor	<0.176	<0.176	<0.176	<0.10	<1.0	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176	<0.176
Toxaphene	<0.086	<0.086	<0.086	<2.0	<2.0	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086	<0.086
Aroclor-1016	<0.050	<0.050	<0.050			<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Aroclor-1221	<0.054	<0.054	<0.054			<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054
Aroclor-1232	<0.065	<0.065	<0.065			<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065
Aroclor-1242	<0.065	<0.065	<0.065			<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065
Aroclor-1248	<0.090	<0.090	<0.090			<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090
Aroclor-1254	<0.100	<0.100	<0.100			<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Aroclor-1260	<0.100	<0.100	<0.100			<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Aroclor-1268	<0.100	<0.100	<0.100			<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
PCB-1016/1242				<1.0	<1.0							
PCB-1221				<1.0	<1.0							
PCB-1232				<1.0	<1.0							
PCB-1248				<1.0	<1.0							
PCB-1254				<1.0	<1.0							
PCB-1260				<1.0	<1.0							
PCB-1268												
2,4-D	<0.29	<0.29	<0.29	<2.0	<2.0	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29
Silvex(2,4,5-TP)	<0.34	<0.34	<0.34	<2.0	<2.0	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34
Aldicarb	<0.50	<.50	<.50	<10	<10	<0.50	<.50	<.50	<0.50	<.50	<.50	<0.50
Carbofuran	<5.0	<5.0	<5.0	<10	<10	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-Dibromo-3-Chloropropane	<0.10	<0.10	<0.10			<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Ethylene dibromide	<0.10	<0.10	<0.10			<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Trifluralin												

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.123

Summary of Analytical Results for Semivolatile Compounds, Pesticides, Herbicides, and PCB's at Dixon Marquette Cement Company, 1998-2000 (all values in ug/l)

Parameter	SPRING 9/9/99	SPRING 11/1/99
Acenaphthene		
Acenaphthylene		
Alachlor (lasso)	<1.0	<1.0
Atrazine	<1.0	<1.0
Anthracene		
Benzidine		
Benzo(a)anthracene		
Benzo(b)fluoranthene		
Benzo(k)fluoranthene		
Benzo(a)pyrene		
Benzo(g,h,i)perylene		
Benzyl alcohol		
Benzyl butyl phthalate		
Bis(2-chloroethyl) ether		
Bis(2-chlorethoxy)methane		
Bis(2-ethylhexyl)phthalate	<1.0	<1.0
Bis(chloromethyl)ether	<1.0	<1.0
Bis(2-chloroisopropyl)ether		
4-Bromophenyl phenyl ether		
4-Chloroaniline		
2-Chloronaphthalene		
4-Chlorophenylphenyl ether		
Chrysene		
Dibenzo(a,h) anthracene		
Di-n-butylphthalate	<1.0	<1.0
1,2-Dichlorobenzene		
1,3-Dichlorobenzene		
1,4-Dichlorobenzene		
3,3-Dichlorobenzidine		
Diethyl phthalate	<1.0	<1.0
Dimethyl phthalate	<1.0	<1.0
2,4-Dinitrotoluene		
2,6-Dinitrotoluene		
Di-n-octylphthalate		
Fluoranthene		
Fluorene		
Hexachloro-1,3-butadiene		
Hexachlorocyclopentadiene		
Hexachloroethane		
Indeno(1,2,3-cd)pyrene		
Isophorone	<1.0	<1.0
2-Methylnaphthalene		
Naphthalene	<1.0	<1.0
2-Nitroaniline		
3-Nitroaniline		
4-Nitroaniline		
Nitrobenzene		
N-Nitrosodimethylamine		
N-Nitrosodiphenylamine		
N-Nitrosodi-n-propylamine		
Phenanthrene		
Pyrene		
Pyridine		
1,2,4-Trichlorobenzene		
Benzoic Acid		
4-Chloro-3-methylphenol		
2-Chlorophenol		
p-Cresol	<1.0	<1.0
Cresols, Total		
2,4-Dichlorophenol		
2,4-Dimethylphenol		
2,4-Dinitrophenol		

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Summary of Analytical Results for Semivolatile Compounds, Pesticides, Herbicides, and PCB's at Dixon Marquette Cement Company, 1998-2000 (all values in ug/l)

Parameter	SPRING 9/9/99	SPRING 11/1/99
2-Methyl-4,6-dinitrophenol		
2-Nitrophenol		
4-Nitrophenol		
Parathion	<1.0	<1.0
Pentachlorophenol	<1.0	<1.0
Phenol	<1.0	<1.0
2,4,5-Trichlorophenol		
2,4,6-Trichlorophenol		
Aldrin	<0.034	<0.034
alpha-BHC		
beta-BHC		
gamma-BHC	<0.025	<0.025
delta-BHC		
Chlordane	<0.037	<0.037
4,4'-DDD		
4,4'-DDE		
4,4'-DDT	<0.091	<0.091
Dieldrin	<0.044	<0.044
Endosulfan I		
Endosulfan II		
Endosulfan Sulfate		
Endrin	<0.039	<0.039
Endrin Aldehyde		
Heptachlor	<0.040	<0.040
Heptachlor Epoxide	<0.032	<0.032
Methoxychlor	<0.176	<0.176
Toxaphene	<0.086	<0.086
Aroclor-1016	<0.050	<0.050
Aroclor-1221	<0.054	<0.054
Aroclor-1232	<0.065	<0.065
Aroclor-1242	<0.065	<0.065
Aroclor-1248	<0.090	<0.090
Aroclor-1254	<0.100	<0.100
Aroclor-1260	<0.100	<0.100
Aroclor-1268	<0.100	<0.100
PCB-1016/1242		
PCB-1221		
PCB-1232		
PCB-1248		
PCB-1254		
PCB-1260		
PCB-1268		
2,4-D	<0.29	<0.29
Silvex(2,4,5-TP)	<0.34	<0.34
Aldicarb	<.50	<.50
Carbofuran	<5.0	<5.0
1,2-Dibromo-3-Chloropropane	<0.10	<0.10
Ethylene dibromide	<0.10	<0.10
Trifluralin		

Values in bold italics exceed the background concentration
Shaded values exceed the maximum allowable in effluent to surface water as per section 304.124 thru 304.126

Attachment 5

Boring Logs

Boring Log
Dixon Marquette Cement Company
Monitoring Well MW1-D (east side of CKD landfill)
Drilled 19-March-98 by Geotechnical Services, Inc., Davenport, Iowa
Continuous rock core sampling (2 inch diameter by 5 feet long) with 4.25 inch air hammer
Total depth 78 feet
Geologic descriptions are from rock core samples, logged by Mark Zell of Preston Engineering, Inc. (All measurements in feet)

Depth of Top	Thickness	Unit	Description
		Pecatonica Formation	
		Medusa member	
0	4		Limestone, yellow with gray dolomitic mottling, rare brachiopod
		New Glarus member	
4	9		Limestone, yellow with dark yellow mottling, some brachiopods, gastropods
		Dane member	
15	4		Limestone, yellow with large dolomitic or shaly mottling, some brachiopods, pyritic at 19 feet
19	8.5		Dolomite, gray, sandy, vuggy from 19 to 29 feet
		Chana member	
27.5	8		Dolomite, gray, sandy, pyritic
		Glenwood Formation	
35.5	3		Sandstone, fine grained quartz, pyritic
38.5	4		Siltstone, gray, fissile
42.5	1.5		Sandstone, quartz, some pyrite
		St. Peter Formation	
44			Sandstone, quartz, poorly cemented

Boring Log
Dixon Marquette Cement Company
Monitoring Well MW2-D (south side of CKD landfill)
Drilled 16-March-98 by Geotechnical Services, Inc., Davenport, Iowa
Continuous rock core sampling (2 inch diameter by 5 feet long) with 4.25 inch air hammer
Total depth 60 feet
Geologic descriptions are from rock core samples, logged by Mark Zell of Preston Engineering, Inc. (All measurements in feet)

Depth of Top	Thickness	Unit	Description
0	1.5		Fill material, crushed rock
		Pecatonica Formation	
		Medusa member	
1.5	4.5		Limestone, yellow with gray dolomitic mottling, rare brachiopod
		New Glarus member	
6	1		Limestone, yellow with dark yellow mottling
7	4.5		Limestone, yellow with gray dolomitic mottling, some brachiopods, gastropods, crinoids
11.5	4.5		Limestone, yellow and gray, stylolites at 12 feet
		Dane member	
16	7.5		Limestone, yellow with large dolomitic or shaly mottling, some brachiopods, pyritic at 19.5 feet, calcite in vug at 22 feet
23.5	4		Dolomite, gray, sandy, vuggy from 25 to 26 feet and 27 to 27.5 feet, calcite in vug at 24 feet, some pyrite
27.5	1.5		Limestone, yellow and gray with dolomitic mottling
		Chana member	
29	7.5		Dolomite, gray, sandy, pyritic, vuggy at 32 to 35.5 feet
		Glenwood Formation	
36.5	2.5		Sandstone, fine grained quartz, some pyrite
39	0.5		Siltstone, sandy, gray, some pyrite
39.5	1.5		Siltstone, gray, fissile
41	2		Sandstone, quartz, some pyrite
43	1		Siltstone, gray, fissile
44	3		Sandstone, quartz, mottled, some pyrite
		St. Peter Formation	
47	2.5		Sandstone, quartz, poorly cemented, pyritic at 47 feet
49.5	10		Sandstone, quartz

Revised 5-March-01

Boring Log
Dixon Marquette Cement Company
Monitoring Well MW3-D (west side of CKD landfill)
Drilled 17-March-98 by Geotechnical Services, Inc., Davenport, Iowa
Continuous rock core sampling (2 inch diameter by 5 feet long) with 4.25 inch air hammer
Total depth 78 feet
Geologic descriptions are from rock core samples, logged by Mark Zell of Preston Engineering, Inc. (All measurements in feet)

Depth of Top	Thickness	Unit	Description
0	1.5		Fill material, crushed rock
		Mifflin Formation	
1.5	8.5		Limestone, yellow, fossiliferous, brachiopods
10	8.5		Limestone, yellow, mottled
		Pecatonica Formation	
		Medusa member	
18.5	4.5		Limestone, yellow with gray dolomitic mottling, rare brachiopod
		New Glarus member	
23	11.5		Limestone, yellow with dark yellow mottling, some brachiopods, and gastropods
		Dane member	
34.5	13		Limestone, yellow with large dolomitic or shaly mottling, some brachiopods, pyritic at 19.5 feet, calcite in vug at 22 feet
		Chana member	
47.5	7.5		Dolomite, gray, sandy, pyritic
		Glenwood Formation	
55	2.5		Sandstone, fine grained quartz, some pyrite
57.5	1.5		Siltstone, gray, fissile
59	2		Sandstone, quartz, some pyrite
61	2		Siltstone, gray, fissile
63	3		Sandstone, quartz, mottled, some pyrite
		St. Peter Formation	
66			Sandstone, quartz, poorly cemented

Boring Log
Dixon Marquette Cement Company
Monitoring Well MW4-D (northwest side of CKD landfill)
Drilled 18-March-98 by Geotechnical Services, Inc., Davenport, Iowa
Continuous rock core sampling (2 inch diameter by 5 feet long) with 4.25 inch air hammer
Total depth 60.5 feet
Geologic descriptions are from rock core samples, logged by Mark Zell of Preston Engineering, Inc. (All measurements in feet)

Depth of Top	Thickness	Unit	Description
0	8.5		Fill material, crushed rock
		Pecatonica Formation	
8.5	20.5		Limestone, yellow and gray with dolomitic mottling
		Chana member	
29	7.5		Dolomite, gray, sandy, pyritic, vuggy
		Glenwood Formation	
38.5	2.5		Sandstone, fine grained quartz, some pyrite
41.5	4.5		Siltstone, gray, fissile
46	2		Sandstone, quartz, mottled, some pyrite
		St. Peter Formation	
48			Sandstone, quartz, poorly cemented

Boring Log
Dixon Marquette Cement Company
Leachate Well LW-3
Drilled 07-July-99 by Geotechnical Services, Inc., Davenport, Iowa
Hollow stem auger to 18 feet deep. 4.25 inch air hammer to 42 feet deep.
Total depth 42 feet
Geologic descriptions are from drill cuttings, logged by Mark Zell of Preston Engineering, Inc.
(All measurements in feet)

Depth of Top	Thickness	Unit	Description
0	15		Brown moist rocky soil
		Mifflin?	
15	3		Rock, difficult drilling
		Pecatonica Formation	
32	10		Yellow brown dolomite, wet

Boring Log
Dixon Marquette Cement Company
Monitoring Well MW5-D (west of CKD landfill along White Oak Lane)
Drilled 1-June-99 by Geotechnical Services, Inc., Davenport, Iowa
Continuous rock core sampling (2 inch diameter by 5 feet long) with 4.25 inch air hammer
Total depth 49.5 feet
Geologic descriptions are from rock core samples, logged by Elizabeth McMahon of Preston Engineering, Inc. (All measurements in feet)

Depth of Top	Thickness	Unit	Description
0	1		Top soil, brown, organic material
1	1		Fill material
2	1		Brown clay, trace silt, dry
3	3		Red (brick color) clay, crumbles easily
6	2		Light brown silt w/ trace sand, moist, gray mottles, red/rust stains
8	2		Brown to gray sandy silt some limestone chips
10	12		Brown sand trace gravel
22	4		Well graded brown soil, poorly sorted
26	7		Brown sand with trace gravel
33	1	St. Peter Formation	Gray, clayey sandstone
34	5		Gray sandstone with brown mottling
39	5		Gray to yellow/white sandstone
44	5.5		Yellow to gray/green sandstone

Revised 5-March-01

Boring Log
Dixon Marquette Cement Company
Monitoring Well MW6-D (west of CKD landfill along White Oak Lane)
Drilled 7-June-99 by Geotechnical Services, Inc., Davenport, Iowa
Continuous rock core sampling (2 inch diameter by 5 feet long) with 4.25 inch air hammer
Total depth 40 feet
Geologic descriptions are from rock core samples, logged by Elizabeth McMahon of Preston Engineering, Inc. (All measurements in feet)

Depth of Top	Thickness	Unit	Description
0	1		Top soil, brown, organic material
1	1		Brown clay with organic material
2	2.75		Brown clay with trace sand with rust and yellow mottles
4.75	7.75		Brown sand with limestone chips, and trace silts
12.5	0.5		Gray sediment/silty material
13	9		Brown sand with trace gravel, brown, fine. trace silt
22	0.5		River Rock
22.5	4		Brown sand with gravel and trace silt
26.5	0.5		Light brown clay
27.5	6.5	St. Peter Formation	Light gray to gray sandstone with sand lens, stains, and brown mottling
34	6		Gray to green sandstone with brown mottling

Boring Log
Dixon Marquette Cement Company
Monitoring Well MW7-D (west of CKD landfill along White Oak Lane)
Drilled 9-June-99 by Geotechnical Services, Inc., Davenport, Iowa
Continuous rock core sampling (2 inch diameter by 5 feet long) with 4.25 inch air hammer
Total depth 34.5 feet
Geologic descriptions are from rock core samples, logged by Elizabeth McMahon of Preston Engineering, Inc. (All measurements in feet)

Depth of Top	Thickness	Unit	Description
0	0.5		Top soil, brown, organic material
		Pecatonica Formation	
0.5	1.5		Gray to light brown limestone with brown mottles
3	6		Brown to gray limestone with fossils
9	4		Gray to dark gray limestone signs of dolomite
13	2		Light brown limestone with rust stains
		Glenwood Formation	
15	6		Dark gray shale with greasy feel Fracture noted from 15.5' to 16.5'
		St. Peter Formation	
21	13.5		Green to gray sandstone

Boring Log
Dixon Marquette Cement Company
Monitoring Well MW8-D (west of CKD landfill along White Oak Lane)
Drilled 11-June-99 by Geotechnical Services, Inc., Davenport, Iowa
Continuous rock core sampling (2 inch diameter by 5 feet long) with 4.25 inch air hammer
Total depth 39.5 feet
Geologic descriptions are from rock core samples, logged by Elizabeth McMahon of Preston Engineering, Inc. (All measurements in feet)

Depth of Top	Thickness	Unit	Description
0	1		Top soil, brown, organic material with white limestone chips
		Pecatonica Formation	
1	4		White limestone with brown mottles and fossilized material
5	6		Brown limestone with gray to dark gray mottles
11	1		Quartz or dolomite material with silica traces
12	1		Fossils observed in stone
13	2		Limestone, gray exterior with brown interior
15	3		White limestone with reddish brown mottles
18	2		Transition zone: alternating layers of Glenwood shale and Pecatonica limestone.
20	1		Clay with rust mottles
21	0.5		Blue/gray greasy clay
21.5	3		Dark gray shale
24.5	2.5		No recovery from boring
		St. Peter Formation	
27	0		Sandstone observed from cuttings
34	3		Friable sandstone
37	2.5		Solid sandstone

Illinois Environmental Protection Agency — Field Boring Log

Site File No.:
County: Lee
Boring No. MW1-S
Monitor Well No. MW1-S

Site File Name: Dixon Marquette Cement Co.
Surface Elevation: 736.76
Completion Depth: 38 ft

Fed. ID. No.
Auger Depth
Rotary Depth

Quadrangle: Dixon East — Sec. 27 T. 22N R. 9E
Date: Start
Finish: 3-20-98

UTM (or State Plane) Coord. N.(X) E.(Y)

Latitude ° ' " Longitude ° ' "

Boring Location: E side of landfill

Drilling Equipment: 4 1/4" air hammer

SAMPLES	Personnel
	G - Mark Zell
	D - Matt White
	H - Gary Kimler
	H -

Elev.	DESCRIPTION OF MATERIALS	Graphic Log	Depth in feet	Sample No.	Sample Type	Sample Recovery (%)	Penetrometer	N Values (Blow Counts)	OVA or HNU Readings	REMARKS
	Limestone, yellow with gray dolomitic mottling, rare brachiopod									
	Limestone, yellow with dark yellow mottling, some brachiopods, gastropods									Continuous core
726.76			10							
	Limestone, yellow with large dolomitic or shaly mottling, some brachiopods, pyritic at 19 feet									
716.76	Dolomite, gray, sandy, vuggy from 19 to 29 feet		20							
	Dolomite, gray, sandy, pyritic									
706.76			30							
	Sandstone, fine grained quartz, pyritic									
696.76			40							

(WSC226)

Illinois Environmental Protection Agency — Field Boring Log

Page 1 of 1

Site File No.:
County: Lee
Boring No.: MW1-D
Monitor Well No.: MW1-D

Site File Name: Dixon Marquette Cement Co.
Surface Elevation: 736.84
Completion Depth: 78 ft

Fed. ID. No.:
Auger Depth:
Rotary Depth:

Quadrangle: Dixon East
Sec. 27 T. 22N R. 9E
Date: Start:
Finish: 3-19-98

UTM (or State Plane) Coord. N.(X):
E(Y):

Latitude:
Longitude:

Boring Location: E side of landfill

Drilling Equipment: 4¼" air hammer

Personnel
G - Mark Zell
D - Matt White
H - Gary Kimler
H -

Elev.	DESCRIPTION OF MATERIALS	Depth in feet	SAMPLE NO.	SAMPLE TYPE	SAMPLE RECOVERY (%)	PENETROMETER	N VALUES (BLOW COUNTS)	OVA or HNU READINGS	REMARKS
	Limestone, yellow with gray dolomitic mottling, rare brachiopod								
	Limestone, yellow with dark yellow mottling, some brachiopods, gastropods								Continuous core
726.84		10							
	Limestone, yellow with large dolomitic or shaly mottling, some brachiopods, pyritic at 19 feet								
716.84	Dolomite, gray, sandy, vuggy from 19 to 29 feet	20							
	Dolomite, gray, sandy, pyritic								
706.84		30							
	Sandstone, fine grained quartz, pyritic								
	Siltstone, gray, fissile								
696.84		40							
	Sandstone, quartz, some pyrite								
	Sandstone, quartz, poorly cemented								
686.84		50							
676.84		60							
666.84		70							
656.84		80							

(IL532-0226)

Revised 28-May-99

Illinois Environmental Protection Agency — Field Boring Log

Site File No.: ______ County: Lee Boring No. MW2-S Monitor Well No. MW2-S

Site File Name: Dixon Marquette Cement Co. Surface Elevation: 690.67 Completion Depth: 39.5 ft.

Fed. ID. No.: ______ Auger Depth: ______ Rotary Depth: ______

Quadrangle: Dixon East Sec. 27 T. 22N R. 9E Date: Start ______ Finish: 3-20-98

UTM (or State Plane) Coord. N.(X) ______ E(Y) ______

Latitude ______ Longitude ______

Boring Location: S of landfill

Drilling Equipment: 4¼" air hammer

Personnel
G - Mark Zell
D - Matt White
H - Gary Kinler
H -

Elev.	DESCRIPTION OF MATERIALS	Depth in feet	REMARKS
	Fill material, crushed rock.		
	Limestone, yellow with gray dolomitic mottling		
	Limestone, yellow with dark yellow mottling		
680.67	Limestone, yellow with gray dolomitic mottling, some brachiopods, gastropods, crinoids	10	Continuous core
	Limestone, yellow and gray, stylolites at 12 feet		
670.67	Limestone, yellow with large dolomitic or shaly mottling, some brachiopods, pyritic at 19.5 feet	20	
	Dolomite, gray, sandy, vuggy, some pyrite		
	Limestone, yellow and gray with dolomitic mottling		
660.67	Dolomite, gray, sandy, pyritic, vuggy at 32 to 35.5 feet	30	
	Sandstone, fine grained quartz, some pyrite		
650.67	Siltstone, sandy, gray, some pyrite	40	

SAMPLES: Sample No. | Sample Type | Sample Recovery (%) | Penetrometer | N Values (Blow Counts) | OVA or HNU Readings — (no entries)

(850220)

Illinois Environmental Protection Agency — Field Boring Log

Site File No.:
County: Lee
Boring No.: MW2-D
Monitor Well No.: MW2-D

Site File Name: Dixon Marquette Cement Co.
Surface Elevation: 690.66
Completion Depth: 60

Fed. ID. No.:
Auger Depth:
Rotary Depth:

Quadrangle: Dixon East Sec. 27 T. 22N R. 9E
Date: Start:
Finish: 3-20-98

UTM (or State Plane) Coord. N.(X): E.(Y):

Latitude: ° ' " Longitude: ° ' "

Boring Location: S of landfill

Drilling Equipment: 4¼" air hammer

SAMPLES: Sample No. | Sample Type | Sample Recovery (%) | Penetrometer | N Values (Blow Counts) | OVA or HNU Readings

Personnel
- G - Mark Zell
- D - Matt White
- H - Gary Kinler
- H -

Elev.	DESCRIPTION OF MATERIALS	Depth in feet
	Fill material, crushed rock.	
	Limestone, yellow with gray dolomitic mottling	
	Limestone, yellow with dark yellow mottling	
680.66	Limestone, yellow with gray dolomitic mottling, some brachiopods, gastropods, crinoids	10
	Limestone, yellow and gray, stylolites at 12 feet	
670.66	Limestone, yellow with large dolomitic or shaly mottling, some brachiopods, pyritic at 19.5 feet	20
	Dolomite, gray, sandy, vuggy, some pyrite	
	Limestone, yellow and gray with dolomitic mottling	
660.66	Dolomite, gray, sandy, pyritic, vuggy at 32 to 35.5 feet	30
	Sandstone, fine grained quartz, some pyrite	
650.66	Siltstone, sandy, gray, some pyrite	40
	Sandstone, quartz, some pyrite	
	Siltstone, gray, fissile	
	Sandstone, quartz, mottled, some pyrite	
	Sandstone, quartz, poorly cemented, pyritic at 47 feet	
640.66	Sandstone, quartz	50
630.66		60

REMARKS

Continuous core

(950226)

Illinois Environmental Protection Agency — Field Boring Log

Page 1 of 1

Site File No.:	County: Lee	Boring No.: MW3-S	Monitor Well No.: MW3-S
Site File Name: Dixon Marquette Cement Co.		Surface Elevation: 693.96	Completion Depth: 59 ft
Fed. ID. No.:		Auger Depth:	Rotary Depth:
Quadrangle: Dixon East	Sec. 27 T. 22N R. 9E	Date: Start	Finish: 3-20-98
UTM (or State Plane) Coord. N.(X)	E.(Y)		
Latitude: ° ' "	Longitude: ° ' "		
Boring Location: W side of landfill			
Drilling Equipment: 4¼" air hammer			

Personnel
G - Mark Zell
D - Matt White
H - Gary Kimler
H -

Elev.	DESCRIPTION OF MATERIALS	Graphic Log	Depth in feet	Sample No.	Sample Type	Sample Recovery (%)	Penetrometer	N Values (Blow Counts)	OVA or HNU Readings	REMARKS
	Fill material, crushed rock Limestone, yellow, fossiliferous, brachiopods									Continuous core
683.96	Limestone, yellow, mottled		10							
673.96	Limestone, yellow with gray dolomitic mottling, rare brachiopod Limestone, yellow with dark yellow mottling, some brachiopods, and gastropods		20							
663.96			30							
	Limestone, yellow with large dolomitic or shaly mottling, some brachiopods, pyritic at 19.5 feet, calcite in vug at 22 feet									
653.96			40							
	Dolomite, gray, sandy, pyritic									
643.96			50							
	Sandstone, fine grained quartz, some pyrite Siltstone, gray, fissile									
633.96			60							

Illinois Environmental Protection Agency — Field Boring Log

Page 1 of 1

Site File No.: ______ County: Lee

Boring No.: MW3-D Monitor Well No.: MW3-D

Site File Name: Dixon Marquette Cement Co.

Surface Elevation: 690.26 Completion Depth: 78 ft

Fed. ID. No.: ______ Auger Depth: ______ Rotary Depth: ______

Quadrangle: Dixon East Sec. 27 T. 22N R. 9E Date: Start ______ Finish: 3-20-98

UTM (or State Plane) Coord. N.(X) ______ E.(Y) ______

Latitude ° ' " Longitude ° ' "

Boring Location: W side of landfill

Drilling Equipment: 4¼" air hammer

Personnel:
G - Mark Zell
D - Matt White
H - Gary Kimler
H -

SAMPLES: Sample No. | Sample Type | Sample Recovery (%) | Penetrometer | N Values (Blow Counts) | OVA or HNU Readings

Elev.	DESCRIPTION OF MATERIALS	Depth in feet	REMARKS
	Fill material, crushed rock		
	Limestone, yellow, fossiliferous, brachiopods		Continuous core
680.26	Limestone, yellow, mottled	10	
670.26	Limestone, yellow with gray dolomitic mottling, rare brachiopod	20	
	Limestone, yellow with dark yellow mottling, some brachiopods, and gastropods		
660.26		30	
	Limestone, yellow with large dolomitic or shaly mottling, some brachiopods, pyritic at 19.5 feet, calcite in vug at 22 feet		
650.26		40	
	Dolomite, gray, sandy, pyritic		
640.26		50	
	Sandstone, fine grained quartz, some pyrite		
	Siltstone, gray, fissile		
630.26	Sandstone, quartz, some pyrite	60	
	Siltstone, gray, fissile		
	Sandstone, quartz, mottled, some pyrite		
	Sandstone, quartz, poorly cemented		
620.26		70	
610.26		80	

(050228)

Revised 28-May-99

Illinois Environmental Protection Agency — Field Boring Log — Page 1 of 1

Site File No.: County: Lee Boring No.: MW4-S Monitor Well No.: MW4-S

Site File Name: Dixon Marquette Cement Co. Surface Elevation: 692.44 Completion Depth: 42 ft

Fed. ID. No.: Auger Depth: Rotary Depth:

Quadrangle: Dixon East Sec. 27 T. 22N R. 9E Date: Start: Finish: 3-20-98

UTM (or State Plane) Coord. N.(X) E(Y)

Latitude . . . Longitude . . .

Boring Location: NW of landfill

Drilling Equipment: 4¼" air hammer

Personnel:
G - Mark Zell
D - Matt White
H - Gary Kimler
H -

Elev.	DESCRIPTION OF MATERIALS	Graphic Log	Depth In feet	SAMPLE NO.	SAMPLE TYPE	SAMPLE RECOVERY (%)	PENETROMETER	N VALUES (BLOW COUNTS)	OVA or HNU READINGS	REMARKS
	Fill material, crushed rock									Continuous core
682.44	Limestone, yellow and gray with dolomitic mottling		10							
672.44			20							
662.44	Dolomite, gray, sandy, pyritic, vuggy		30							
652.44	Sandstone, fine grained quartz, some pyrite Siltstone, gray, fissile		40							
642.44			50							

(93C226)

Illinois Environmental Protection Agency — Field Boring Log

Page 1 of 1

Site File No.:		County	Lee	Boring No.	MW4-D
Site File Name	Dixon Marquette Cement Co.			Monitor Well No.	MW4-D
Fed. ID. No.		Surface Elevation	692.69	Completion Depth	60.5 ft
Quadrangle	Dixon East	Sec. 27 T. 22N R. 9E		Auger Depth	
Rotary Depth		Date: Start		Finish	3-20-98
UTM (or State Plane) Coord. N.(X)		E.(Y)			
Latitude		Longitude			
Boring Location	NW of landfill				
Drilling Equipment	4¼" air hammer				

Personnel
G - Mark Zell
D - Matt White
H - Gary Kinder
H -

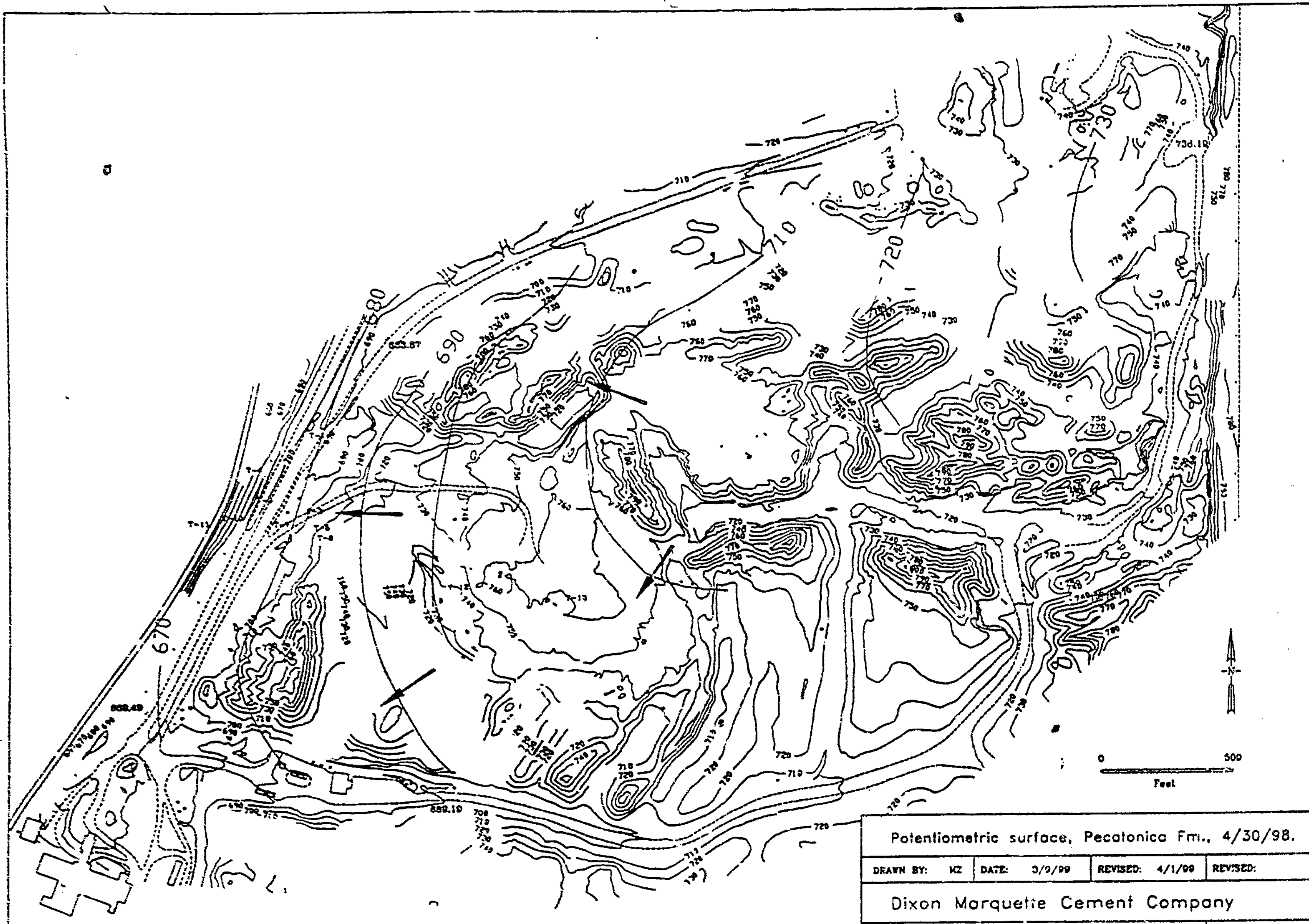
Elev.	DESCRIPTION OF MATERIALS	Depth in feet	Sample No.	Sample Type	Sample Recovery (x)	Penetrometer	N Values (Blow Counts)	OVA or HNU Readings	REMARKS
	Fill material, crushed rock								Continuous core
682.69	Limestone, yellow and gray with dolomitic mottling	10							
672.69		20							
662.69	Dolomite, gray, sandy, pyritic, vuggy	30							
652.69	Sandstone, fine grained quartz, some pyrite								
	Siltstone, gray, fissile	40							
	Sandstone, quartz, mottled, some pyrite								
642.69	Sandstone, quartz, poorly cemented	50							
632.69		60							

(95C226)

Revised 28-May-99

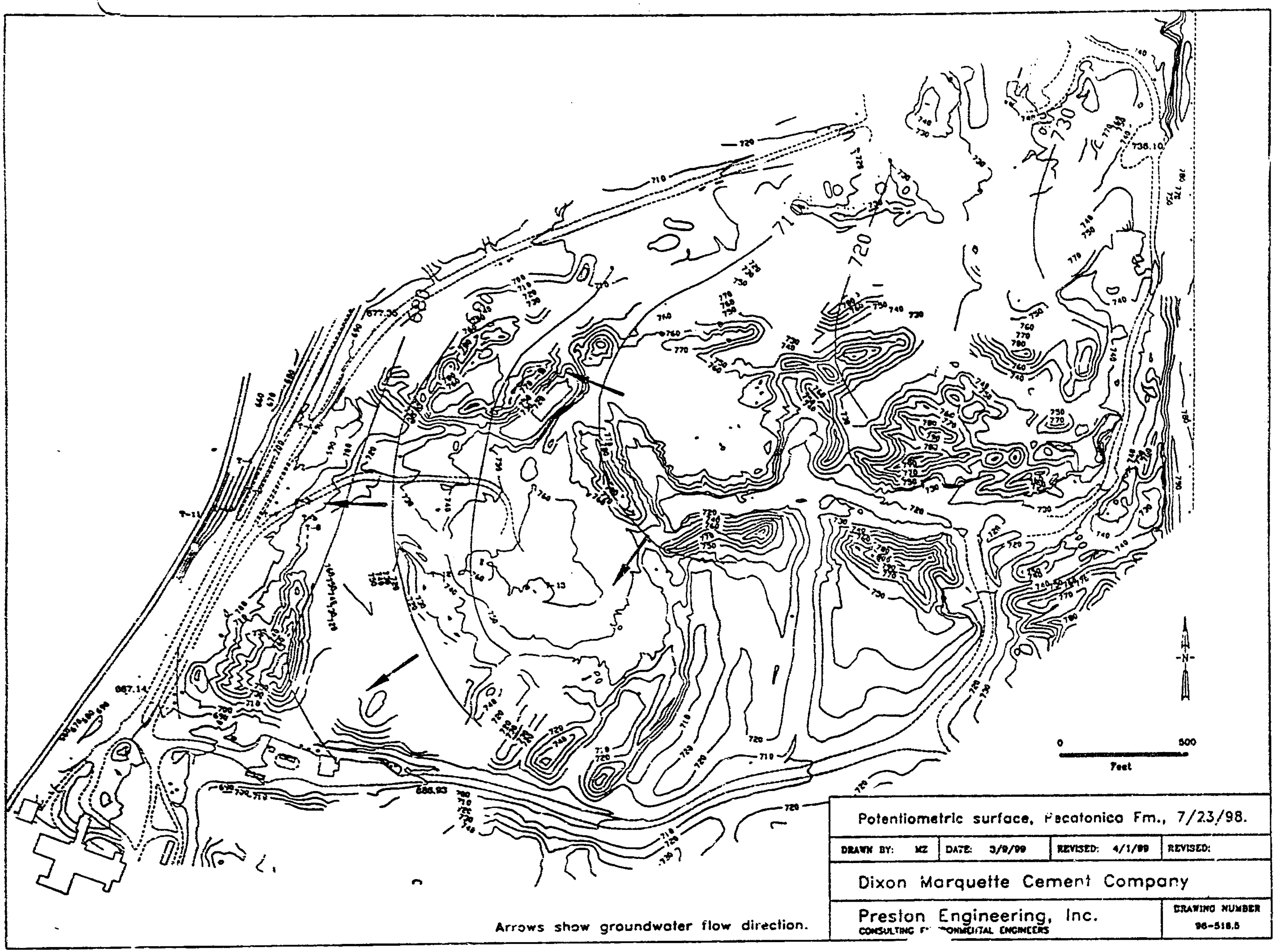
Attachment 6

Potentiometric Surface Maps



Arrows show groundwater flow direction.

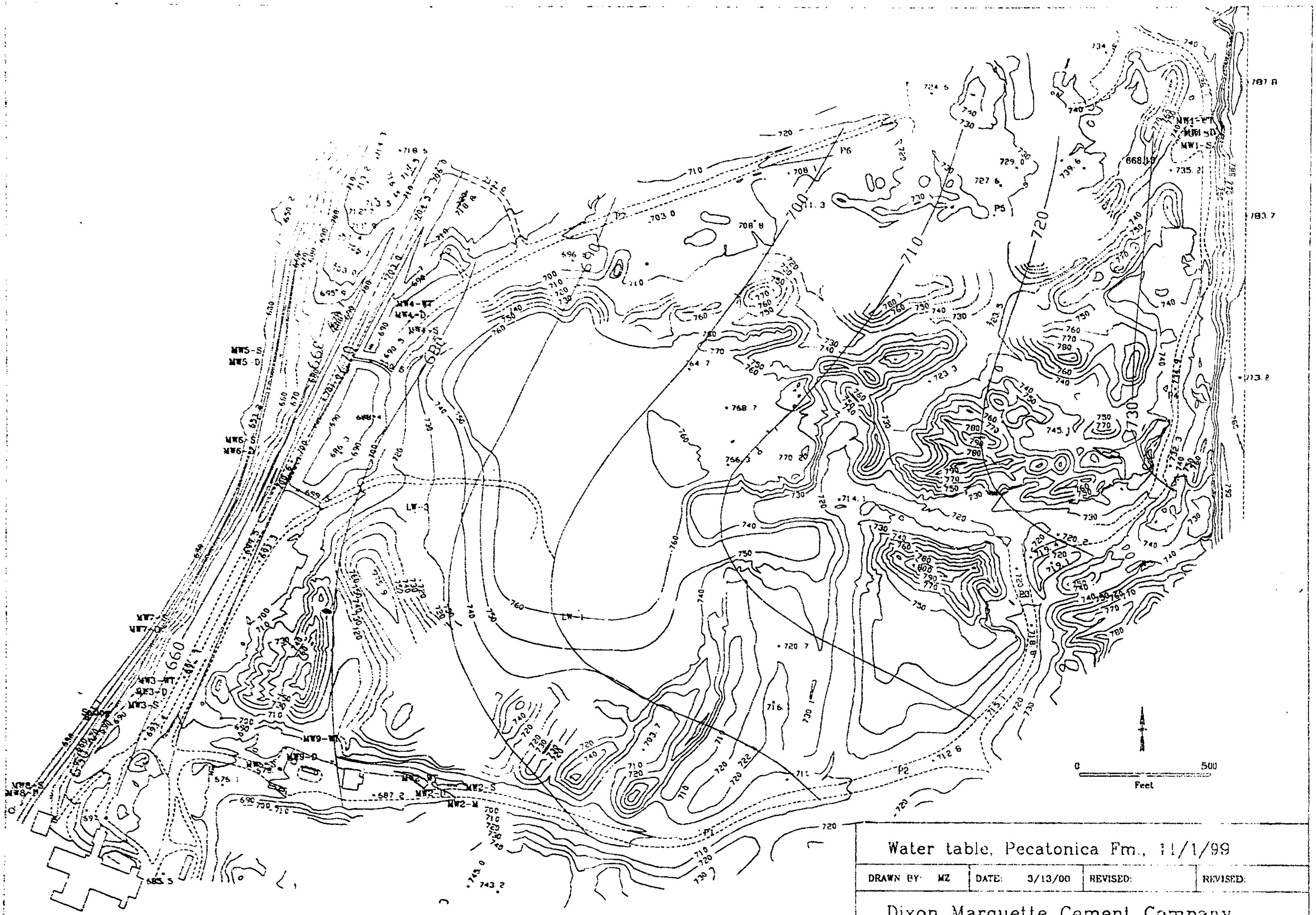
Potentiometric surface, Pecatonica Fm., 4/30/98.			
DRAWN BY: MZ	DATE: 3/2/99	REVISED: 4/1/99	REVISED:
Dixon Marquette Cement Company			
Preston Engineering, Inc. CONSULTING ENVIRONMENTAL ENGINEERS			DRAWING NUMBER 98-516.5


Potentiometric surface, Pecatonica Fm., 7/23/98.
DRAWN BY: MZ
DATE: 3/9/99
REVISED: 4/1/99
REVISED:
Dixon Marquette Cement Company
Preston Engineering, Inc.
CONSULTING ENVIRONMENTAL ENGINEERS
DRAWING NUMBER 96-518.5
Arrows show groundwater flow direction.
0
500
Feet
N

Revised 1-April-99

Arrows show groundwater flow direction.

Potentiometric surface, Pecatonica Fm., 2/16/99.			
DRAWN BY: MZ	DATE: 3/9/99	REVISED: 4/1/99	REVISED:
Dixon Marquette Cement Company			
Preston Engineering, Inc. CONSULTING ENVIRONMENTAL ENGINEERS			DRAWING NUMBER 98-516.5

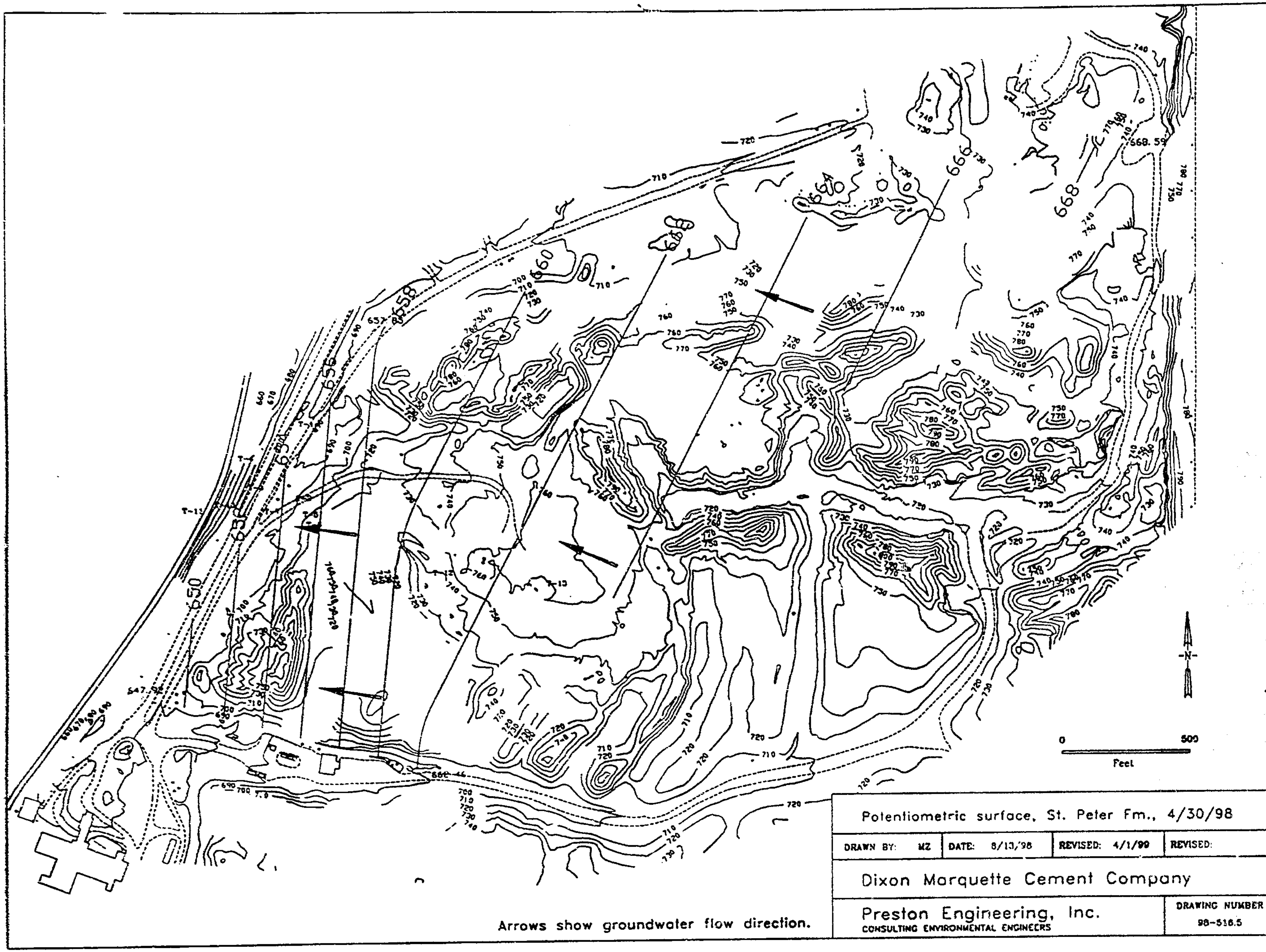


Water table, Pecatonica Fm., 11/1/99			
DRAWN BY: MZ	DATE: 3/13/00	REVISED:	REVISED:

Dixon Marquette Cement Company

PRESTON ENGINEERING, INC.
CONSULTING ENVIRONMENTAL ENGINEERS

DRAWING NUMBER 98-518.9



Arrows show groundwater flow direction.

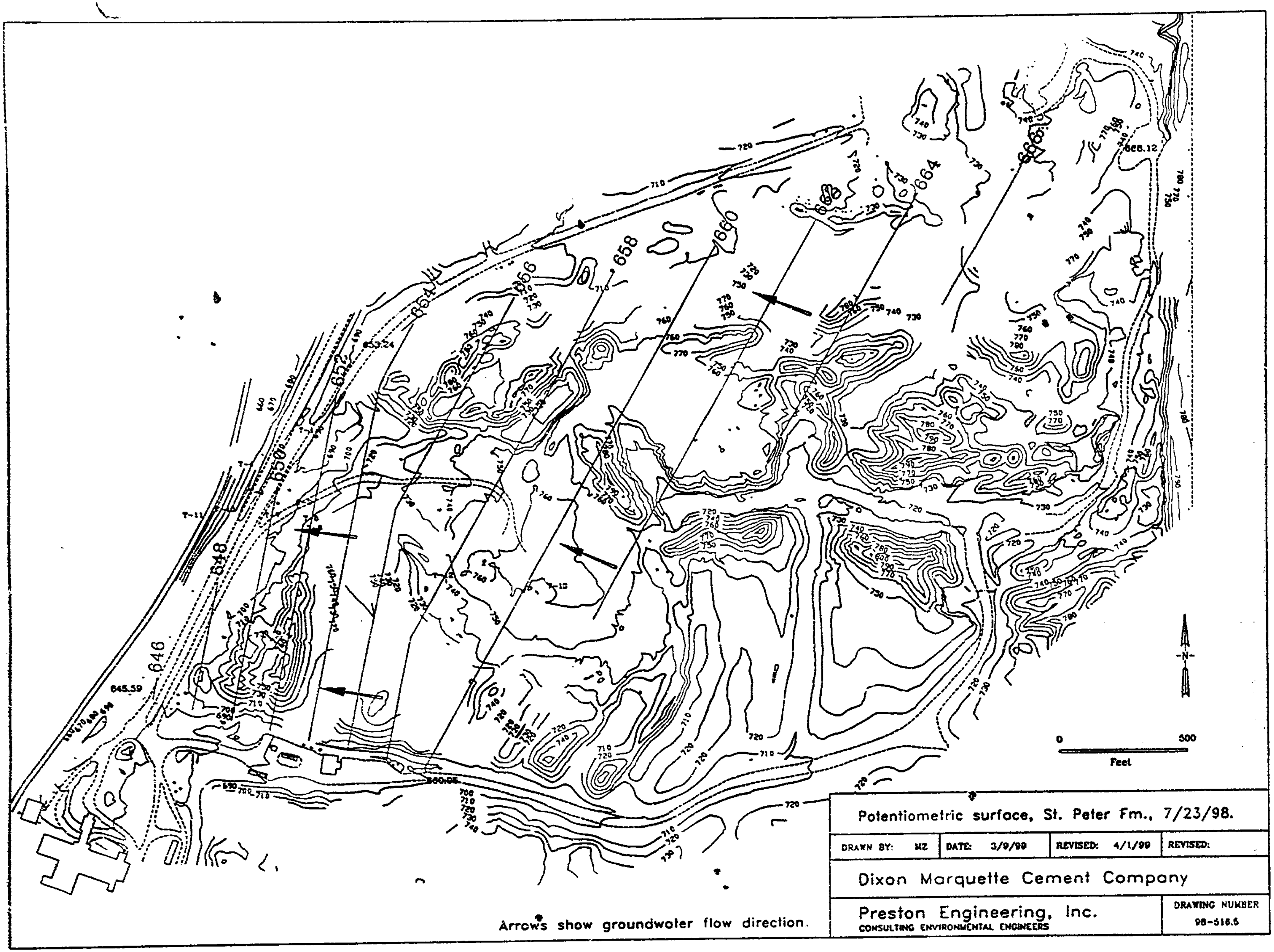
Potentiometric surface, St. Peter Fm., 4/30/98

DRAWN BY: MZ	DATE: 8/13/98	REVISED: 4/1/99	REVISED:

Dixon Marquette Cement Company

Preston Engineering, Inc.
CONSULTING ENVIRONMENTAL ENGINEERS

DRAWING NUMBER
98-516.5



Arrows show groundwater flow direction.

Potentiometric surface, St. Peter Fm., 7/23/98.

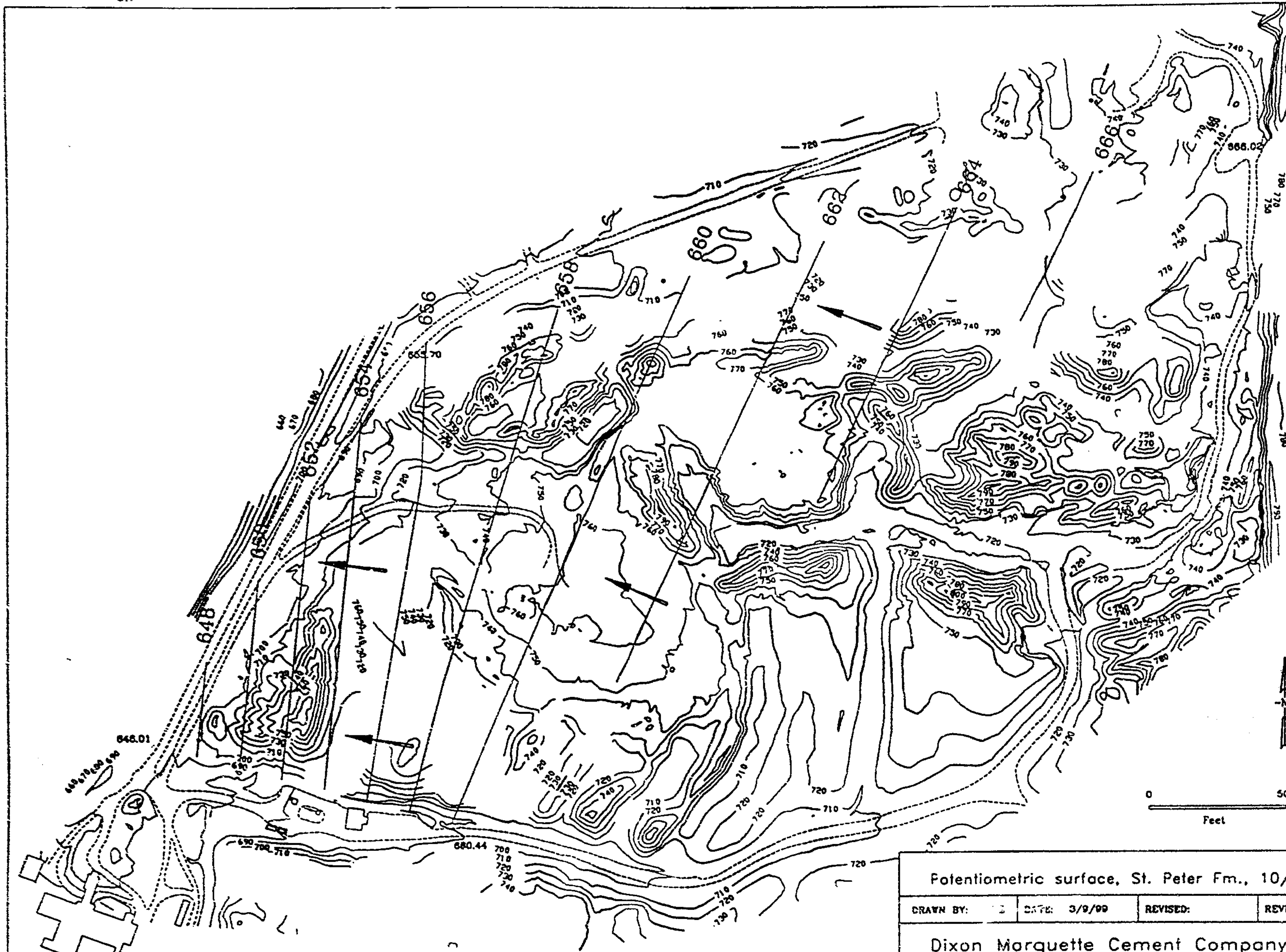
DRAWN BY: MZ	DATE: 3/9/99	REVISED: 4/1/99	REVISED:

Dixon Marquette Cement Company

Preston Engineering, Inc.
CONSULTING ENVIRONMENTAL ENGINEERS

DRAWING NUMBER
98-518.6

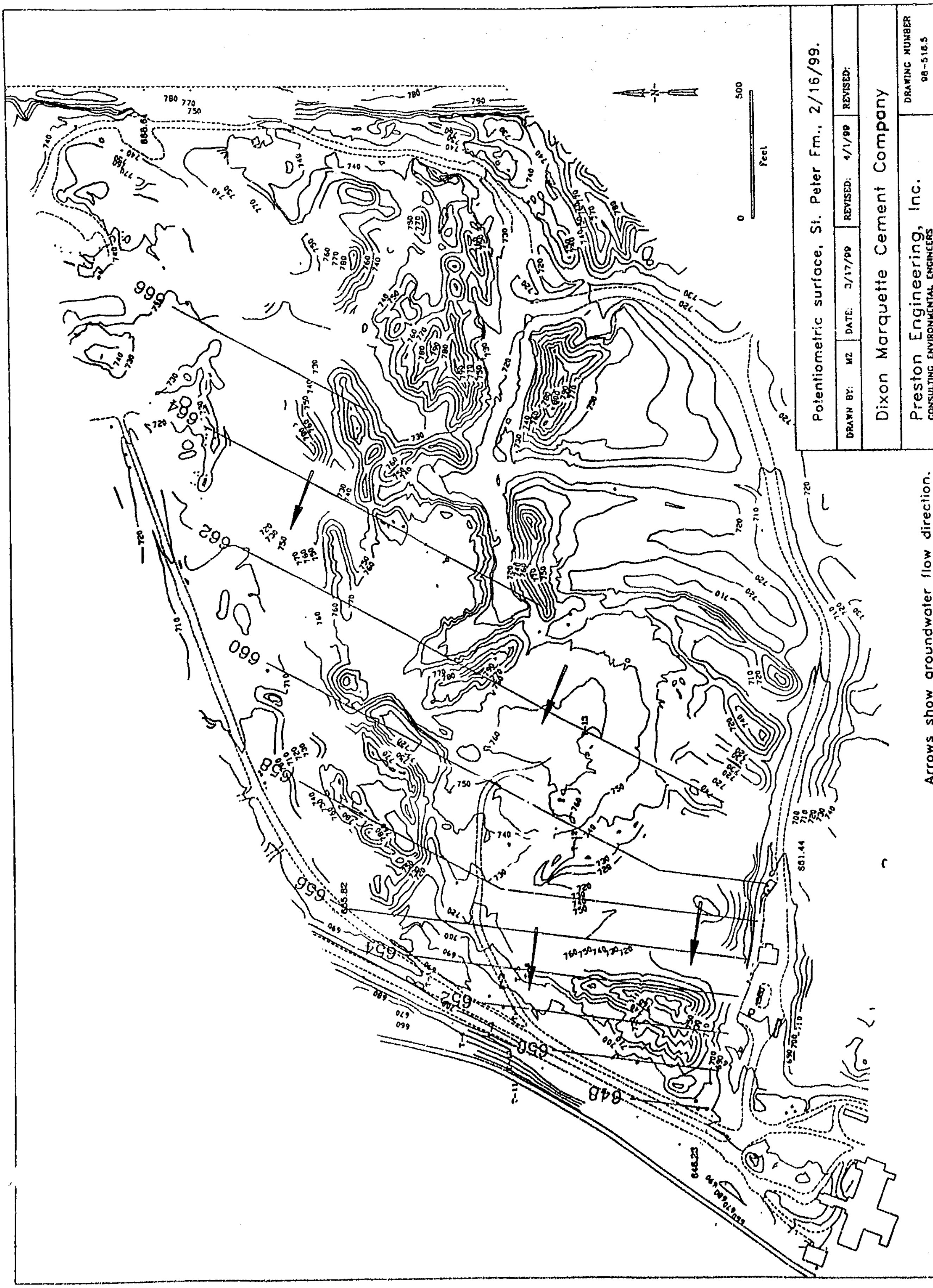
Revised 1-April-99

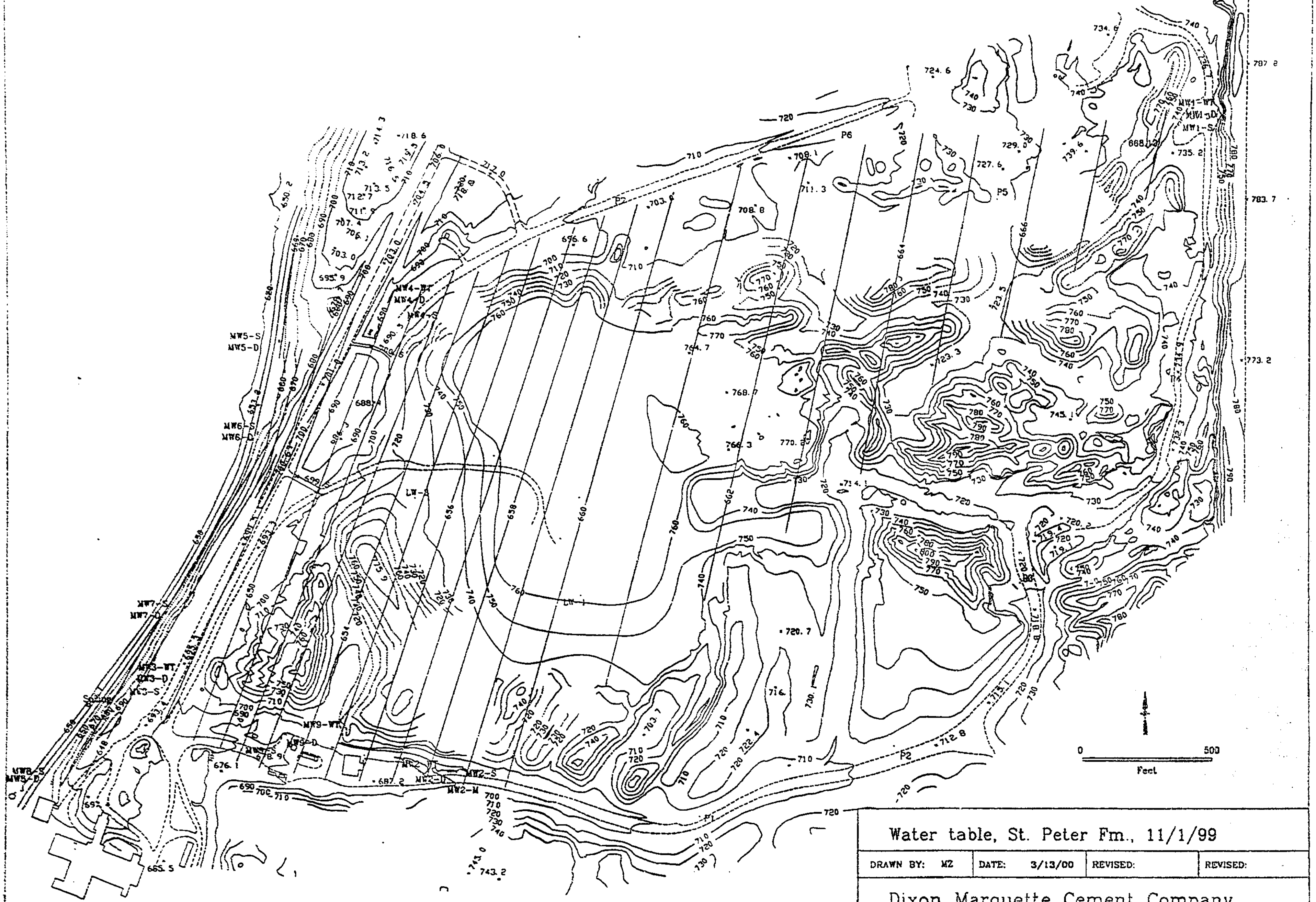


Arrows show groundwater flow direction.

Potentiometric surface, St. Peter Fm., 10/26/98			
DRAWN BY:	DATE: 3/9/99	REVISED:	REVISED:
Dixon Marquette Cement Company			
Preston Engineering, Inc. CONSULTING ENVIRONMENTAL ENGINEERS			DRAWING NUMBER 98-518.5

Revised 1-April-99

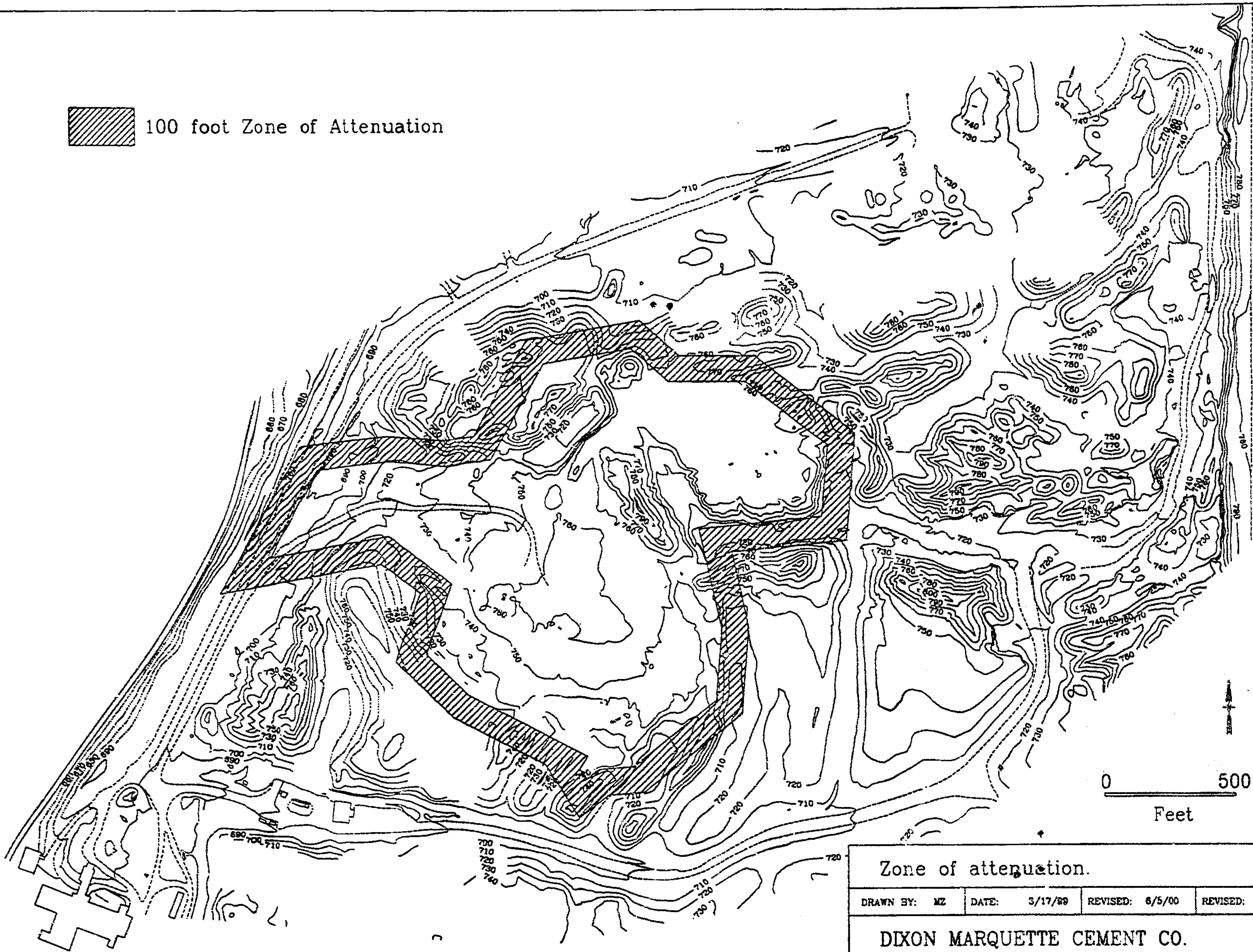

Potentiometric surface, St. Peter Fm., 2/16/99.
DRAWN BY: MZ
DATE: 3/17/99
REVISED: 4/1/99
REVISED:
Dixon Marquette Cement Company
Preston Engineering, Inc.
CONSULTING ENVIRONMENTAL ENGINEERS
DRAWING NUMBER
98-518.5
Arrows show groundwater flow direction.
0
500
Feet
N



Water table, St. Peter Fm., 11/1/99			
DRAWN BY: MZ	DATE: 3/13/00	REVISED:	REVISED:
Dixon Marquette Cement Company			
PRESTON ENGINEERING, INC. CONSULTING ENVIRONMENTAL ENGINEERS			DRAWING NUMBER 98-516.9

Attachment 7

Zone Of Attenuation



Zone of attenuation.					
DRAWN BY: MZ	DATE: 3/17/89	REVISED: 6/5/00	REVISED:		
DIXON MARQUETTE CEMENT CO.					
PRESTON ENGINEERING, INC. CONSULTING ENVIRONMENTAL ENGINEERS			DRAWING NUMBER 98-516.1		

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Preston Engineering, Inc.

environmental consultants

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Corporate Office
4436 N. Brady St. • Davenport, IA 52806
Ph. 319/388/8288 • Fax 319/388/9003

www.prestonengineering.com

Regional Office
5650 N.W. Johnston Dr. Ste. G • Johnston, IA 50131
Ph. 515/727/9195 • Fax 515/727/9198

PETITION OF DIXON MARQUETTE CEMENT COMPANY FOR ADJUSTED STANDARD FROM: 35 ILL. ADM. CODE PARTS 811 & 814

EXHIBITS 6–10

March 15, 2001

Prepared by:

Preston Engineering, Inc.
4436 North Brady Street
Davenport, Iowa 52806
(319) 388-8288- phone
(319) 388-9003- fax

Exhibit 6

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276

217/782-0610 THOMAS V. SKINNER, DIRECTOR

September 13, 1999

Dixon-Marquette Cement Company
1914 White Oak Lane
Post Office Box 467
Dixon, Illinois 61021

Re: Dixon-Marquette Cement Company
Dixon Plant
NPDES Permit No. IL0003514
Modification of NPDES Permit (After Public Notice)

Gentlemen:

The Illinois Environmental Protection Agency has reviewed the request for modification of the above-referenced NPDES Permit and issued a public notice based on that request. The final decision of the Agency is to modify the Permit as follows:

Outfall 003A has been redesignated Outfall 015.

Internal Outfalls 001A, 001B, 001C, 002A, 002B, 002C, 002D, 002E, 003A, 003B, 004A and 004B have been designated.

Outfall 014 has been added to the permit.

Outfalls 007, 008 and 009 have been removed from the permit due to coverage under NPDES Permit ILG840104.

Enclosed is a copy of the modified Permit. You have the right to appeal this modification to the Illinois Pollution Control Board within a 35 day period following the modification date shown on the first page of the permit.

Should you have any question or comments regarding the above, please contact David Ginder of my staff.

Very truly yours,

Thomas G. McSwiggin, P.E.
Manager, Permit Section
Division of Water Pollution Control

TGM:BJY:DPG:98030407.dlk

Attachment: Modified Permit

cc: Records
Compliance Assurance Section; Willet, Hoffman & Associates

NPDES Permit No. IL0003514

Illinois Environmental Protection Agency

Division of Water Pollution Control

1021 North Grand Avenue East

Post Office Box 19276

Springfield, Illinois 62794-9276

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

Modified (NPDES) Permit

Expiration Date: November 30, 2000

Issue Date: December 4, 1995
Modification Date: September 13, 1999

Name and Address of Permittee:

Dixon-Marquette Cement Company
1914 White Oak Lane
Post Office Box 467
Dixon, Illinois 61021

Facility Name and Address:

Dixon Plant
1914 White Oak Lane
Dixon, Illinois 61021
(Lee County)

Discharge Number and Name:		Receiving Waters
001A	Internal Outfall	
001B	Internal Outfall	
001C	Internal Outfall	
001	Combined flows from Outfalls 001A - 001C, and Storm Water	Rock River
002A	Internal Outfall	
002B	Internal Outfall	
002C	Internal Outfall	
002D	Internal Outfall	
002E	Internal Outfall	
002	Combined flows from Outfalls 002A - 002E, and Storm Water	Rock River
003A	Internal Outfall	
003B	Internal Outfall	
003	Combined flows from 003A - 003B, and Storm Water	Rock River
004A	Internal Outfall	
004B	Internal Outfall	
004	Combined flows from Outfalls 004A - 004B, and Storm Water runoff from an Inactive Limestone Mining Area and Cement Kiln Dust Landfill	Unnamed Tributary to the Rock River
005	Storm Water Runoff from Inactive Limestone Mining Area, Aggregate Wash Plant Sedimentation Pond Overflow and Coal Stock Pile Runoff	Rock River
006	Storm Water Runoff	
014	Storm Water Runoff from an Inactive Limestone Mining Area	Rock River
	and Cement Kiln Dust Landfill	Rock River
015	Sewage Treatment Plant Effluent	
		Rock River

In compliance with the provisions of the Illinois Environmental Protection Act, Title 35 of Ill. Adm. Code, Subtitle C and/or Subtitle D, Chapter 1, and the Clean Water Act (CWA), the above-named permittee is hereby authorized to discharge at the above location to the above-named receiving stream in accordance with the standard conditions and attachments herein.

Permittee is not authorized to discharge after the above expiration date. In order to receive authorization to discharge beyond the expiration date, the permittee shall submit the proper application as required by the Illinois Environmental Protection Agency (IEPA) not later than 180 days prior to the expiration date.

Thomas G. McSwiggin, P.E.
Manager, Permit Section
Division of Water Pollution Control

TGM:DPG:98030407.dlk

NPDES Permit No. IL0003514

Effluent Limitations and Monitoring

PARAMETER	LOAD LIMITS lbs/day DAF (DMF) 30 DAY AVERAGE	LOAD LIMITS lbs/day DAF (DMF) DAILY MAXIMUM	CONCENTRATION LIMITS mg/l 30 DAY AVERAGE	CONCENTRATION LIMITS mg/l DAILY MAXIMUM	SAMPLE FREQUENCY	SAMPLE TYPE

1. From the modification date of this permit until the expiration date, the effluent of the following discharge(s) shall be monitored and limited at all times as follows:

Outfalls: 001 and 003

Flow					1/Month	Single Reading
pH	See Special Condition 2				1/Month	Grab
Temperature*	See Special Condition 5				1/Month	Single Reading
Total Suspended Solids			15	30	1/Month	Grab
Total Dissolved Solids	Monitor Only				1/Month	Grab
Sulfate	Monitor Only				1/Month	Grab

*At the time of each effluent sampling event, a grab sample of the cooling water intake for each outfall shall be collected and a temperature reading shall be taken and reported on the DMR form.

NPDES Permit No. IL0003514

Effluent Limitations and Monitoring

PARAMETER	LOAD LIMITS lbs/day DAF (DMF) 30 DAY AVERAGE	DAILY MAXIMUM	CONCENTRATION LIMITS mg/l 30 DAY AVERAGE	DAILY MAXIMUM	SAMPLE FREQUENCY	SAMPLE TYPE

1. From the modification date of this permit until the expiration date, the effluent of the following discharge(s) shall be monitored and limited at all times as follows:

Outfall: 002

PARAMETER	LOAD LIMITS 30 DAY AVERAGE	LOAD LIMITS DAILY MAXIMUM	CONCENTRATION 30 DAY AVERAGE	CONCENTRATION DAILY MAXIMUM	SAMPLE FREQUENCY	SAMPLE TYPE
Flow					1/Month	Single Reading
pH	See Special Condition 2				1/Month	Grab
Temperature*	See Special Condition 5				1/Month	Single Reading
Total Suspended Solids	18.6**				1/Month	Grab
Iron	Monitor Only		3.5	7.0	1/Month	Grab
Total Dissolved Solids	Monitor Only				1/Month	Grab
Manganese	Monitor Only				1/Month	Grab
Sulfate	Monitor Only				1/Month	Grab

*At the time of each effluent sampling event, a grab sample of the cooling water intake for each outfall shall be collected and a temperature reading shall be taken and reported on the DMR form.

**See Special Condition 13

NPDES Permit No. IL0003514

Effluent Limitations and Monitoring

PARAMETER	LOAD LIMITS lbs/day DAF (DMF) 30 DAY AVERAGE	LOAD LIMITS lbs/day DAF (DMF) DAILY MAXIMUM	CONCENTRATION LIMITS mg/l 30 DAY AVERAGE	CONCENTRATION LIMITS mg/l DAILY MAXIMUM	SAMPLE FREQUENCY	SAMPLE TYPE

1. From the modification date of this permit until the expiration date, the effluent of the following discharge(s) shall be monitored and limited at all times as follows:

Outfalls: 002C, 004A, 004B and 014

Flow					1/Month	Single Reading
pH	See Special Condition 2				1/Month	Grab
Total Suspended Solids			15	30	1/Month	Grab
Total Dissolved Solids**	Monitor Only				1/Month	Grab
Sulfate**	Monitor Only.				1/Month	Grab

**Total Dissolved Solids and Sulfate Monitoring required for Outfall 014 only.

Effluent Limitations and Monitoring

PARAMETER	LOAD LIMITS lbs/day DAF (DMF) 30 DAY AVERAGE	DAILY MAXIMUM	CONCENTRATION LIMITS mg/l 30 DAY AVERAGE	DAILY MAXIMUM	SAMPLE FREQUENCY	SAMPLE TYPE

1. From the modification date of this permit until the expiration date, the effluent of the following discharge(s) shall be monitored and limited at all times as follows:

Outfall: 004

PARAMETER	LOAD 30 DAY AVERAGE	LOAD DAILY MAXIMUM	CONC. 30 DAY AVERAGE	CONC. DAILY MAXIMUM	SAMPLE FREQUENCY	SAMPLE TYPE
Flow					1/Month	Single Reading
pH	See Special Condition 2				1/Month	Grab
*Temperature	See Special Condition 5				1/Month	Single Reading
Total Suspended Solids**			15	30	1/Month	Grab
Total Dissolved Solids	Monitor Only				1/Month	Grab
Sulfate	Monitor Only				1/Month	Grab

*At the time of each effluent sampling event, a grab sample of the cooling water intake for each outfall shall be collected and a temperature reading shall be taken and reported on the DMR form.
**See Special Condition 13.

Outfall: 002A and 005

PARAMETER	LOAD 30 DAY AVERAGE	LOAD DAILY MAXIMUM	CONC. 30 DAY AVERAGE	CONC. DAILY MAXIMUM	SAMPLE FREQUENCY	SAMPLE TYPE
Flow					1/Month	Single Reading
pH	See Special Condition 2				1/Month	Grab
Total Suspended Solids			15	30	1/Month	Grab
Iron**			2.0	4.0	1/Month	Grab
Manganese**			1.0	2.0	1/Month	Grab

*Effluent sampling for flow shall be continuous if hardware allows otherwise it shall be once a month single reading.
**Iron and Manganese monitoring for Outfall 005 shall be Monitor only.

Outfalls: 006

PARAMETER	LOAD 30 DAY AVERAGE	LOAD DAILY MAXIMUM	CONC. 30 DAY AVERAGE	CONC. DAILY MAXIMUM	SAMPLE FREQUENCY	SAMPLE TYPE
Flow					1/Month	*
pH	See Special Condition 2				1/Month	Grab
Total Suspended Solids			35	70	1/Month	Grab

*Effluent sampling for flow shall be continuous if hardware allows otherwise it shall be once a month single reading.

NPDES Permit No. IL0003514

Effluent Limitations and Monitoring

PARAMETER	LOAD LIMITS lbs/day DAF (DMF) 30 DAY AVERAGE	LOAD LIMITS lbs/day DAF (DMF) DAILY MAXIMUM	CONCENTRATION LIMITS mg/l 30 DAY AVERAGE	CONCENTRATION LIMITS mg/l DAILY MAXIMUM	SAMPLE FREQUENCY	SAMPLE TYPE

1. From the modification date of this permit until the expiration date, the effluent of the following discharge(s) shall be monitored and limited at all times as follows:

Outfall: 015 - Sewage Treatment Plant Effluent

PARAMETER	30 DAY AVERAGE (lbs/day)	DAILY MAXIMUM (lbs/day)	30 DAY AVERAGE (mg/l)	DAILY MAXIMUM (mg/l)	SAMPLE FREQUENCY	SAMPLE TYPE
Flow					1/Month	
pH	See Special Condition 2				1/Month	Grab
Total Suspended Solids			30	60	1/Month	Grab
BOD_5			30	60	1/Month	Grab
Fecal Coliform	See Special Condition 1					

Special Conditions

SPECIAL CONDITION 1. The daily maximum fecal coliform count shall not exceed 400 per 100 ml.

SPECIAL CONDITION 2. The pH shall be in the range 6.0 to 9.0. The monthly minimum and monthly maximum values shall be reported on the DMR form.

SPECIAL CONDITION 3. Within 180 days of the modification date of this permit, the permittee shall provide written information to the Illinois EPA on any biocides used in the Powerhouse Cooling Towers. Such information shall include the name of the chemical(s) used, active ingredients, dosage concentration, anticipated concentration in the discharge from Outfall 001A and Outfall 001, and aquatic toxicity data. The Illinois EPA may modify this permit during its term based on information provided under this Special Condition. Such modification shall follow Public Notice and opportunity for hearing.

SPECIAL CONDITION 4. Sampling at Outfalls 001, 002 and 003 shall be performed during dry weather periods (when no stormwater is present in the discharges).

SPECIAL CONDITION 5. Discharge of wastewater from Outfalls 001, 002, 003, and 004 must not alone or in combination with other sources cause the receiving stream to violate the following thermal limitations at the edge of the mixing zone which is defined by Section 302.211, Illinois Administration Code, Title 35, Chapter 1, Subtitle C, as amended:

A. Maximum temperature rise above natural temperature must not exceed 5°F (2.8°C).

B. Water temperature at representative locations in the main river shall not exceed the maximum limits in the following table during more than one (1) percent of the hours in the 12-month period ending with any month. Moreover, at no time shall the water temperature at such locations exceed the maximum limits in the following table by more than 3°F (1.7°C). (Main river temperatures are temperatures of those portions of the river essentially similar to and following the same thermal regime as the temperatures of the main flow of the river.)

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
°F	60	60	60	90	90	90	90	90	90	90	90	60
°C	16	16	16	32	32	32	32	32	32	32	32	16

C. The monthly maximum value shall be reported on the DMR form.

SPECIAL CONDITION 6. For the purpose of this permit, Outfalls 001A-001C, 001, 002A-002E, 002, 003A-003B, 003, 004A-B, 004, 005, and 014 are designated as follows:

Outfall Number	Description
001A	Non-contact cooling water from the Powerhouse Cooling Towers
001B	Old Clay Storage Building compressor cooling water
001C	Raw Mills and Raw Mill compressor cooling water
001	Flows Tributary to Outfalls 001A, 001B, 001C and storm water
002A	Coal Pile Runoff
002B	Plant Air compressors cooling water
002C	Coal Mill cooling water
002D	Precipitator compressors cooling water, Preheater Fans cooling water, Analyzer water, Dracco Baghouse Fan cooling water, Homogenizing Silos compressors cooling water, #1, 2, 3 Kiln Piers Discharge End cooling water
002E	#1, 2, 3 Finish Mills cooling water, cement coolers, #1, 2, 3 Finish Mill compressor cooling water, #4 Finish Mill cooling water, #4 Finish Mill compressor cooling water, B Pump compressors cooling water
002	Flows tributary to Outfalls 002A - 002E, and storm water

Special Conditions

003A	Packhouse compressors "A" Pump cooling water
003B	Packhouse compressors Instrument Air cooling water
003	Flows tributary to 003A and 003B, and storm water
004A	#1, 2, 3, Kiln Piers Feed End cooling water, #4 Piers Discharge End cooling water
004B	#4 Kiln compressors cooling water, Wheelabrator Baghouse Fan Motor Bearings cooling water, #4 Kiln Piers Feed End cooling water
004	Flows Tributary to Outfall 004A and 004B, and storm water runoff from an Inactive Limestone Mining Area and Cement Kiln Dust Landfill
005	Storm water runoff from Inactive Limestone Mining Area, Aggregate Wash Plant Sedimentation Pond Overflow and Coal Stock Pile Runoff.
014	Storm Water Runoff from an Inactive Limestone Mining Area and Cement Kiln Dust Landfill

SPECIAL CONDITION 7. Samples taken in compliance with the effluent monitoring requirements shall be taken at a point representative of the discharge, but prior to entry into the receiving stream.

SPECIAL CONDITION 8. The permittee shall record monitoring results on Discharge Monitoring Report forms using one such form for each discharge each month. The completed Discharge Monitoring Report form shall be submitted monthly to IEPA, no later than the 15th of the following month, unless otherwise specified by the Agency, to the following address:

Illinois Environmental Protection Agency
Bureau of Water
Compliance Assurance Section
1021 North Grand Avenue East
Post Office Box 19276
Springfield, Illinois 62794-9276

Flows shall be reported as a monthly average on the Discharge Monitoring Report form.

SPECIAL CONDITION 9. The permittee shall notify the Agency in writing by certified mail within thirty days of abandonment, cessation, or suspension of active mining for thirty days or more unless caused by a labor dispute. During cessation or suspension of active mining, whether caused by a labor dispute or not, the permittee shall provide whatever interim impoundment, drainage diversion, and wastewater treatment is necessary to avoid violations of the Act or Subtitle D, Chapter 1.

SPECIAL CONDITION 10. The Agency has determined that the effluent limitations in this permit constitute BAT/BAC for storm water which is treated in the existing treatment facilities for purposes of this permit issuance, and no pollution prevention plan will be required for such storm water. In addition to the chemical specific monitoring required elsewhere in this permit, the permittee shall conduct an annual inspection of the facility site to identify areas contributing to a storm water discharge associated with mining or industrial activities and determine whether any facility modifications have occurred which result in previously-treated storm water discharges no longer receiving treatment. If any such discharges are identified the permittee shall request a modification of this permit within 30 days after the inspection. Records of the annual inspection shall be retained by the permittee for the term of this permit and be made available to the Agency upon request.

SPECIAL CONDITION 11. Mining excavation operations shall maintain a minimum setback of 200 feet from the two private potable wells located in Sections 15 and 22, identified as wells 13, 17, 18 and 113 in the permit application, pursuant to section 14.2 of the Illinois Environmental Protection Act.

SPECIAL CONDITION 12. The use or operation of this facility shall be by or under the supervision of a Certified Class K operator.

SPECIAL CONDITION 13. The Outfall 002C Total Suspended Solids (TSS) loading rate shall be subtracted from the TSS loading rate determined for Outfall 002 when verifying compliance with the 18.6 lbs/day TSS load limit placed in the permit.

Additionally, when river water is used as a source of cooling water for Outfalls 002 and 004, a grab sample of the river water at the river water intake shall be taken and analyzed for TSS and the result shall be reported on the Discharge Monitoring Report (DMR) in mg/l. The background river TSS loading rate may be subtracted from the TSS loading rate for Outfalls 002 and 004 when verifying compliance with the TSS limits placed in the Effluent Limitations and Monitoring portion of the permit. If the TSS background river value is subtracted from the TSS results reported on the DMR for Outfalls 002 and/or 004, calculations shall be provided that demonstrate how the reported TSS values were determined.

Construction Authorization

Authorization is hereby granted to the above designee to construct the mine and mine refuse area described as follows:

The facility is an existing, approximately 802 acre inactive limestone quarry, aggregate processing area and wash plant, and cement processing plant, designated as the Dixon-Marquette Company, Dixon Plant, located in Sections 22, 27, 33 and 34, T22N, R9E of the 4th P.M. in Lee County, Illinois in Dixon. Facility operations include the crushing and stockpiling of limestone aggregate which is processed through a rotary kiln for the production of Portland Cement. Plant operation results in an average discharge of 0.06 MGD of noncontact cooling water from the powerhouse cooling towers from outfall 001A, 0.005 MGD of compressor cooling water from the Old Clay Storage Building from outfall 001B, 0.009 MGD of raw mills and raw mill compressor cooling water from outfall 001C, 0.074 MGD of combined flows from outfalls 001A, 001B, 001C and storm water from outfall 001, 0.004 MGD of coal pile runoff from outfall 002A, 0.008 MGD of plant air compressors cooling water from outfall 002B, 0.028 MGD of coal mill cooling water from outfall 002C, 0.132 MGD of precipitator compressors cooling water, preheater fans cooling water, analyzer water, Dracco baghouse fan cooling water, homogenizing silos compressors cooling water, #1,2,3 kiln piers discharge end cooling water from outfall 002D, 0.314 MGD of #1,2,3 finish mills cooling water, cement coolers, #1,2,3 finish mill compressor cooling water, #4 finish mill cooling water, #4 finish mill compressor cooling water, B pump compressors cooling water from outfall 002E, 0.48 MGD of combined flows from outfalls 002A-002E, and storm water from outfall 002, 0.008 MGD of packhouse compressors "A" pump cooling water from outfall 003A, 0.006 MGD of packhouse compressors instrument air cooling water from outfall 003B, 0.014 MGD of combined flows from outfalls 003A and 003B and storm water from outfall 003, 0.05 MGD of #1,2,3 kiln piers feed end cooling water, #4 kiln piers discharge end cooling water from outfall 004A, 0.10 MGD of #4 kiln compressors cooling water, wheelabrator baghouse fan motor bearings cooling water, #4 kiln piers feed end cooling water from outfall 004B, 0.15 MGD of combined flows from outfalls 004A and 004B and storm water runoff from an inactive limestone mining area and cement kiln dust landfill from outfall 004, storm water runoff on an intermittent basis from an inactive limestone mining area, aggregate wash plant sedimentation pond overflow and coal stock pile runoff from outfall 005, an intermittent discharge of storm water runoff from an inactive mining area and mine processing area from outfall 006, 0.229 MGD of storm water runoff from an inactive limestone mining area and cement kiln dust landfill from outfall 014 and 0.013 MGD of sewage treatment plant effluent from outfall 015. Sedimentation ponds will be constructed prior to outfalls 002A and 014. Outfalls 001, 002, 003, 005, 006, 014 and 015 and the flows tributary to these outfalls discharge to the Rock River. Outfall 004 and the flows tributary to outfall 004 discharge to an unnamed tributary of the Rock River.

The abandonment plan submitted with the application May 22, 1995 shall be executed and completed in accordance with Section 405.109 of Subtitle D: Mine Related Water Pollution.

This Authorization is issued subject to the following Special Condition(s). If such Special Conditions require additional or revised facilities, satisfactory engineering plan documents must be submitted to this Agency for review and approval.

If any statement or representation in the application is found to be incorrect, this permit may be revoked and the permittee thereupon waives all rights thereunder.

The issuance of this permit (a) shall not be considered as in any manner affecting the title of the premises upon which the mine or mine refuse area is to be located; (b) does not release the permittee from any liability for damage to person or property caused by or resulting from the installation, maintenance or operation of the proposed facilities; (c) does not take into consideration the structural stability of any units or parts of the project; and (d) does not release the permittee from compliance with other applicable statutes of the State of Illinois, or with applicable local laws, regulations or ordinances.

This permit may not be assigned or transferred. Any subsequent operator shall obtain a new permit from the Illinois Environmental Protection Agency.

There shall be no deviations from the approved plans and specifications unless revised plans, specifications and application shall first have been submitted to the Illinois Environmental Protection Agency and a supplemental permit issued.

The permit holder shall notify the Illinois Environmental Protection Agency (217/782-3637) immediately of an emergency at the mine or mine refuse area which causes or threatens to cause a sudden discharge of contaminants into the waters of Illinois and shall immediately undertake necessary corrective measures as required by Rule 405.111 under Chapter 1, Subtitle D: Mine Related Water Pollution of Illinois Pollution Control Board Rules and Regulations.

Final plans, specifications, application and supporting documents as submitted and approved shall constitute part of this permit and are identified in the records of the Illinois Environmental Protection Agency, by the permit number designated in the heading of this Section.

BY:DPG\98030407.DLK

Attachment H

Standard Conditions

Definitions

Act means the Illinois Environmental Protection Act, 415 ILCS 5 as Amended.

Agency means the Illinois Environmental Protection Agency.

Board means the Illinois Pollution Control Board.

Clean Water Act (formerly referred to as the Federal Water Pollution Control Act) means Pub. L 92-500, as amended. 33 U.S.C. 1251 et seq.

NPDES (National Pollutant Discharge Elimination System) means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 402, 318 and 405 of the Clean Water Act.

USEPA means the United States Environmental Protection Agency.

Daily Discharge means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurements, the "daily discharge" is calculated as the average measurement of the pollutant over the day.

Maximum Daily Discharge Limitation (daily maximum) means the highest allowable daily discharge.

Average Monthly Discharge Limitation (30 day average) means the highest allowable average of daily discharges over a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month.

Average Weekly Discharge Limitation (7 day average) means the highest allowable average of daily discharges over a calendar week, calculated as the sum of all daily discharges measured during a calendar week divided by the number of daily discharges measured during that week.

Best Management Practices (BMPs) means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the State. BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Aliquot means a sample of specified volume used to make up a total composite sample.

Grab Sample means an individual sample of at least 100 milliliters collected at a randomly-selected time over a period not exceeding 15 minutes.

24 Hour Composite Sample means a combination of at least 8 sample aliquots of at least 100 milliliters, collected at periodic intervals during the operating hours of a facility over a 24-hour period.

8 Hour Composite Sample means a combination of at least 3 sample aliquots of at least 100 milliliters, collected at periodic intervals during the operating hours of a facility over an 8-hour period.

Flow Proportional Composite Sample means a combination of sample aliquots of at least 100 milliliters collected at periodic intervals such that either the time interval between each aliquot or the volume of each aliquot is proportional to either the stream flow at the time of sampling or the total stream flow since the collection of the previous aliquot.

(1) **Duty to comply.** The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action, permit termination, revocation and reissuance, modification, or for denial of a permit renewal application. The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

(2) **Duty to reapply.** If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. If the permittee submits a proper application as required by the Agency no later than 180 days prior to the expiration date, this permit shall continue in full force and effect until the final Agency decision on the application has been made.

(3) **Need to halt or reduce activity not a defense.** It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

(4) **Duty to mitigate.** The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

(5) **Proper operation and maintenance.** The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up, or auxiliary facilities, or similar systems only when necessary to achieve compliance with the conditions of the permit.

(6) **Permit actions.** This permit may be modified, revoked and reissued, or termina[ted] for cause by the Agency pursuant to 40 CFR 122.62. The filing of a request by [the] permittee for a permit modification, revocation and reissuance, or termination, [or a] notification of planned changes or anticipated noncompliance, does not stay [any] permit condition.

(7) **Property rights.** This permit does not convey any property rights of any sort, or [any] exclusive privilege.

(8) **Duty to provide information.** The permittee shall furnish to the Agency withi[n a] reasonable time, any information which the Agency may request to determine whe[ther] cause exists for modifying, revoking and reissuing, or terminating this permit, o[r to] determine compliance with the permit. The permittee shall also furnish to the Ager[ncy] upon request, copies of records required to be kept by this permit.

(9) **Inspection and entry.** The permittee shall allow an authorized representative of [the] Agency, upon the presentation of credentials and other documents as may be requi[red] by law, to:

(a) Enter upon the permittee's premises where a regulated facility or activit[y is] located or conducted, or where records must be kept under the conditions of [this] permit;

(b) Have access to and copy, at reasonable times, any records that must be k[ept] under the conditions of this permit;

(c) Inspect at reasonable times any facilities, equipment (including monitoring [and] control equipment), practices, or operations regulated or required under [this] permit; and

(d) Sample or monitor at reasonable times, for the purpose of assuring pe[rmit] compliance, or as otherwise authorized by the Act, any substances or parame[ters] at any location.

(10) **Monitoring and records.**

(a) Samples and measurements taken for the purpose of monitoring shall [be] representative of the monitored activity.

(b) The permittee shall retain records of all monitoring information, including calibration and maintenance records, and all original strip chart recordings [for] continuous monitoring instrumentation, copies of all reports required by [this] permit, and records of all data used to complete the application for this permit, [for] a period of at least 3 years from the date of this permit, measurement, repor[t or] application. This period may be extended by request of the Agency at any ti[me].

(c) Records of monitoring information shall include:

(1) The date, exact place, and time of sampling or measurements;

(2) The individual(s) who performed the sampling or measurements;

(3) The date(s) analyses were performed;

(4) The individual(s) who performed the analyses;

(5) The analytical techniques or methods used; and

(6) The results of such analyses.

(d) Monitoring must be conducted according to test procedures approved under [40] CFR Part 136, unless other test procedures have been specified in this per[mit]. Where no test procedure under 40 CFR Part 136 has been approved, [the] permittee must submit to the Agency a test method for approval. The permi[ttee] shall calibrate and perform maintenance procedures on all monitoring [and] analytical instrumentation at intervals to ensure accuracy of measurements.

(11) **Signatory requirement.** All applications, reports or information submitted to [the] Agency shall be signed and certified.

(a) **Application.** All permit applications shall be signed as follows:

(1) For a corporation: by a principal executive officer of at least the leve[l of] vice president or a person or position having overall responsibility [for] environmental matters for the corporation;

(2) For a partnership or sole proprietorship: by a general partner or [the] proprietor, respectively; or

(3) For a municipality, State, Federal, or other public agency: by eithe[r a] principal executive officer or ranking elected official.

(b) **Reports.** All reports required by permits, or other information requested by [the] Agency shall be signed by a person described in paragraph (a) or by a d[uly] authorized representative of that person. A person is a duly authoriz[ed] representative only if:

(1) The authorization is made in writing by a person described in paragraph ([a]); and

(2) The authorization specifies either an individual or a position responsible [for] the overall operation of the facility, from which the discharge originates, su[ch] as a plant manager, superintendent or person of equivalent responsibili[ty]; and

(3) The written authorization is submitted to the Agency.

(c) **Changes of Authorization.** If an authorization under (b) is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of (b) must be submitted to the Agency prior to or together with any reports, information, or applications to be signed by an authorized representative.

(12) **Reporting requirements.**

(a) **Planned changes.** The permittee shall give notice to the Agency as soon as possible of any planned physical alterations or additions to the permitted facility.

(b) **Anticipated noncompliance.** The permittee shall give advance notice to the Agency of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

(c) **Compliance schedules.** Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date.

(d) **Monitoring reports.** Monitoring results shall be reported at the intervals specified elsewhere in this permit.

(1) Monitoring results must be reported on a Discharge Monitoring Report (DMR).

(2) If the permittee monitors any pollutant more frequently than required by the permit, using test procedures approved under 40 CFR 136 or as specified in the permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR.

(3) Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Agency in the permit.

(e) **Twenty-four hour reporting.** The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and time; and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance. The following shall be included as information which must be reported within 24 hours:

(1) Any unanticipated bypass which exceeds any effluent limitation in the permit;

(2) Violation of a maximum daily discharge limitation for any of the pollutants listed by the Agency in the permit to be reported within 24 hours.

The Agency may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

(f) **Other noncompliance.** The permittee shall report all instances of noncompliance not reported under paragraphs (12)(c), (d), or (e), at the time monitoring reports are submitted. The reports shall contain the information listed in paragraph (12)(e).

(g) **Other information.** Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application, or in any report to the Agency, it shall promptly submit such facts or information.

(13) **Transfer of permits.** A permit may be automatically transferred to a new permittee if:

(a) The current permittee notifies the Agency at least 30 days in advance of the proposed transfer date;

(b) The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage and liability between the current and new permittees; and

(c) The Agency does not notify the existing permittee and the proposed new permittee of its intent to modify or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement.

(14) All manufacturing, commercial, mining, and silvicultural dischargers must notify the Agency as soon as they know or have reason to believe:

(a) That any activity has occurred or will occur which would result in the discharge of any toxic pollutant identified under Section 307 of the Clean Water Act which is not limited in the permit, if that discharge will exceed the highest of the following notification levels:

(1) One hundred micrograms per liter (100 ug/l);

(2) Two hundred micrograms per liter (200 ug/l) for acrolein and acrylonitrile; five hundred micrograms per liter (500 ug/l) for 2,4-dinitrophenol and for 2-methyl-4,6 dinitrophenol; and one milligram per liter (1 mg/l) for antimony.

(3) Five (5) times the maximum concentration value reported for that pollutant in the NPDES permit application; or

(4) The level established by the Agency in this permit.

(b) That they have begun or expect to begin to use or manufacture as an intermedi or final product or byproduct any toxic pollutant which was not reported NPDES permit application.

(15) All Publicly Owned Treatment Works (POTWs) must provide adequate notice to t Agency of the following:

(a) Any new introduction of pollutants into that POTW from an indirect disc which would be subject to Sections 301 or 306 of the Clean Water Act if it directly discharging those pollutants; and

(b) Any substantial change in the volume or character of pollutants being introdu into that POTW by a source introducing pollutants into the POTW at the ti issuance of the permit.

(c) For purposes of this paragraph, adequate notice shall include information on the quality and quantity of effluent introduced into the POTW, and (ii) a anticipated impact of the change on the quantity or quality of effluent discharged from the POTW.

(16) If the permit is issued to a publicly owned or publicly regulated treatment works, t permittee shall require any industrial user of such treatment works to comply w federal requirements concerning:

(a) User charges pursuant to Section 204(b) of the Clean Water Act, and appl regulations appearing in 40 CFR 35;

(b) Toxic pollutant effluent standards and pretreatment standards pursuant to Sect 307 of the Clean Water Act; and

(c) Inspection, monitoring and entry pursuant to Section 308 of the Clean Wate

(17) If an applicable standard or limitation is promulgated under Section 301(b)(2)(C) a (D), 304(b)(2), or 307(a)(2) and that effluent standard or limitation is more stri than any effluent limitation in the permit, or controls a pollutant not limited permit, the permit shall be promptly modified or revoked, and reissued to conf that effluent standard or limitation.

(18) Any authorization to construct issued to the permittee pursuant to 35 Ill. Adm. C 309.154 is hereby incorporated by reference as a condition of this permit.

(19) The permittee shall not make any false statement, representation or certification i application, record, report, plan or other document submitted to the Agency or t USEPA, or required to be maintained under this permit.

(20) The Clean Water Act provides that any person who violates a permit con implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Clean Wat is subject to a civil penalty not to exceed $10,000 per day of such violation. A person who willfully or negligently violates permit conditions implementing Sectio 301, 302, 306, 307, or 308 of the Clean Water Act is subject to a fine of not less $2,500 nor more than $25,000 per day of violation, or by imprisonment for not than one year or both.

(21) The Clean Water Act provides that any person who falsifies, tampers with, knowingly renders inaccurate any monitoring device or method required to maintained under permit shall, upon conviction, be punished by a fine of not more $10,000 per violation, or by imprisonment for not more than 6 months per violati by both.

(22) The Clean Water Act provides that any person who knowingly makes any fal statement, representation, or certification in any record or other document subm or required to be maintained under this permit shall, including monitoring repo reports of compliance or non-compliance shall, upon conviction, be punished by of not more than $10,000 per violation, or by imprisonment for not more than 6 mont per violation, or by both.

(23) Collected screening, slurries, sludges, and other solids shall be disposed of in a manner as to prevent entry of those wastes (or runoff from the wastes) into w of the State. The proper authorization for such disposal shall be obtained from Agency and is incorporated as part hereof by reference.

(24) In case of conflict between these standard conditions and any other conditi included in this permit, the other condition(s) shall govern.

(25) The permittee shall comply with, in addition to the requirements of the permit, applicable provisions of 35 Ill. Adm. Code, Subtitle C, Subtitle D, Subtitle E, and applicable orders of the Board.

(26) The provisions of this permit are severable, and if any provision of this permit, o application of any provision of this permit is held invalid, the remaining provisions this permit shall continue in full force and effect.

(Rev. 3-13-98)

Exhibit 7

Buchanan Consulting, Inc.

VEGETATION ASSESSMENT REPORT
SHORELINE AND BLUFF AREAS
DIXON-MARQUETTE CEMENT KILN DUST LANDFILL

Prepared for:

Versar, Inc.

July 1999

Buchanan Consulting, Inc.

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Mr. Gordon M. Stevens, P.G.
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Versar, Inc.
Green Brook Executive Center
200 West 22nd Street, Suite 250
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22 July 1999

Re: Vegetation Assessment Report
Shoreline and Bluff Areas Adjoining Dixon-Marquette Cement Kiln Dust Landfill
Dixon, IL

Dear Mr. Stevens:

Buchanan Consulting Inc. (**BCI**) is pleased to submit this report as a deliverable from its services to Versar, Inc. to perform a vegetation assessment adjacent to the Dixon-Marquette Cement Kiln Dust (CKD) landfill located near Dixon, Illinois (Figure 1) as an indication if leachate from the CKD landfill operation is having an impact on the local terrestrial or shoreline ecosystem. The scope of work was completed in accordance with Schedule A of Versar's purchase order #07045 (corresponding to **BCI's** proposal dated 25 June 1999).

Understanding of the Project

BCI's understanding of this project is that the CKD landfill at the Dixon-Marquette Cement Company facility is undergoing regulatory scrutiny. It has been deemed prudent and proactive to perform a vegetation assessment in the areas down-gradient from the CKD landfill to see if groundwater leachate and/or runoff from the CKD landfill is adversely impacting the bluff and shoreline environment adjacent to the Rock River. Assessing the vegetation adjacent to and down-gradient from the CKD landfill operation is being used as an environmental indicator because vegetation is a prominent component of the base of the ecological food chain, is dependent on and reflective of the immediate physical environment, and, therefore, will exhibit observable patterns in composition and form if influenced by contamination. The use of vegetation to indicate environmental contamination is a commonly used standard practice for property assessments (ASTM Standard E1527-94, "Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process"). This assessment is voluntary and not regulatory driven.

BCI understands that its services and work product are confidential and are the property of Versar, Inc. for use by its client.

Scope and Approach

BCI performed the following tasks to complete this assessment:

Collect Background Information - To ensure that the scope and approach was appropriate and accurate, BCI visited the site 23 June 1999 with Versar, Inc., met with the client, and performed a preliminary walkdown to identify appropriate locations for a representative vegetation assessment.

BCI reviewed literature on similar assessments of vegetation in river-side areas in Central Illinois and texts on regional flora to develop a context for what represents "normal" floristic composition. BCI also collected information on the physical setting, soil types, disturbance history, etc. to ensure that comparisons between the observations made in the "potential impact zone" and the "control zone" are valid.

Perform Site Investigation - BCI visited the site 6 July 1999 and established four transects (i.e., linear observation routes through the representative vegetation communities), two transects in each of two types of vegetation communities (Figure 2). Within the area northwest of the CKD landfill, between the CKD landfill and the Rock River, are two primary vegetation types: the wooded bluff vegetation community and the river shoreline community. BCI established a transect in each of these two vegetation types within the potential impact zone adjacent to the CKD landfill and compared the observations to those taken from two similar transects in the control zone located north (up-gradient) outside the area of potential influence of the CKD landfill.

Per discussions with Versar (Mr. Gordon Stevens, personal communication, 23 June 1999), it is understood that groundwater travels toward the river through highly fractured dolomite/limestone, which forms the bluffs. The groundwater emerges at some points as active springs and also seeps into the river along the shoreline. A permitted surface water discharge also drains the landfill, traverses the bluff, and enters the river as a point discharge. If contamination is present in this groundwater and surface water at levels that could impact vegetation, these impacts would manifest themselves in the form of unusual vegetation species composition, or visible stress such as discoloration or odd growth forms.

BCI observed the vegetation along the designated transects and recorded the species composition of all existing strata (i.e., groundlayer, shrub, understory, and overstory).

These strata are defined as follows:

Groundlayer = all herbaceous (non-woody) species and seedlings of woody shrubs and trees growing on the ground;

Shrub stratum = woody shrubs, vines, and tree seedlings or young saplings growing above the groundlayer;

Understory = Woody species larger than 1" diameter but smaller than 4" diameter.

Overstory = Woody species larger than 4" diameter.

An indicator of abundance was recorded for each species in each stratum by ranking the species as: 1 - abundant and widespread; 2 - common; or 3 - infrequent or local. Qualitative observations of the condition of the vegetation were also recorded. Standard quantitative sampling methodologies were not employed for this assessment because the inherent variability of quantitative sampling methodologies renders them statistically invalid for comparing control and experimental vegetation transects in this manner. Qualitative observations by a trained plant ecologist have been adopted here as a more reliable means of detecting any abnormalities that might be due to operations at the subject facility.

The observations are summarized on data sheets for each stratum along each of the four transects. In addition, observations of wildlife or other evidence indicative of the health of the ecosystem were noted.

Results

Setting - The assessment areas are located on the eastern shoreline and bluffs of the Rock River, just north of Dixon, Lee County, Illinois. This area forms the border of two principal geographical biotic divisions in Illinois: the Grand Prairie Division and Western Division (Jones 1963). The specific sampling transects are strongly influenced by very site-specific physical conditions that create a combination of soils, moisture regime and microclimate. In addition, the land traversed by the sampling transects has a history of human disturbance that also is manifested in the composition and distribution of the vegetation.

The two shoreline transects (Figures 3 and 4) were located between the Rock River waterway and the river frontage road (White Oak Road formerly Grand Detour Road) along a narrow strip of river bank. The soils are a combination of alluvial deposits and eroded silt-loams at the foot of the river bank grading into fractured limestone/dolomite and scree (loose rock pieces) overlain by a thin silt loam soil at the crest of the river bank. Slopes range from 15% in isolated areas where surface water outfalls from the bluffs have deposited an alluvial delta to 80% in the most severely eroded river cuts. Generally, the banks slope 30% to 50%. Most of the length of the upper river bank in this area is occasionally mowed and maintained as roadside. This results in a component of the vegetation being reflective of early-successional disturbed sites close to the roadside. The lower river bank is occasionally subject to flooding and erosion/deposition. This influence is also reflected in certain components of the vegetation. A few scattered trees provide some shaded areas, especially along the up-gradient control transect, but most of the shoreline is in full sun and west-facing. At regular intervals are seeps and surface discharges from the fractured limestone/dolomite bluffs above and east of the river. The moisture regime, due to contributions from both the river and the seeps and springs, is wet to mesic.

The two wooded bluff transects (Figures 5 and 6) were located east of the river frontage road and beneath the crest of the bluff. The soils here are quite thin in most places, overlying fractured limestone/dolomite and scree near or at the surface in many places. Soil development is most advanced in level areas or depressed pockets within the bluffs, but generally the prevalent landform is steep scree slopes, 30% to 90%, and occasional bare limestone/dolomite escarpment. The predominance of limestone/dolomite contributes to a highly calcareous (calcium-rich) soil chemistry. The moisture regime varies from somewhat dry, as might be expected on a west-facing scree slope, to mesic in the vicinity of springs and seeps.

Vegetation Survey Results - The results of the qualitative surveys of each vegetation transect are presented in Tables 1 through 4 and can be summarized as follows:

Transect #1 Shoreline Transect Adjacent and Down-gradient from CKD Landfill Area

Table 1 shows the results for this transect. The most prominent species in the ground layer are a mix of typical central Illinois floodplain species (orange jewelweed and Virginia creeper) and weedy invasive and non-native species reflective of physical disturbances (reed canarygrass and black mustard). A total of 30 groundlayer species were observed, indicating a reasonably diverse vegetation matrix. In the shrub stratum, the dominant species (indigo bush, Virginia creeper, and riverbank grape) are all typical native Illinois floodplain and riparian residents. A total of 16 species of shrubs and tree seedlings were observed, almost all of which were typical native species for this situation. Only a few large scattered trees occur along the shoreline, consisting of white ash and cottonwood. Again, these are typical of this type of vegetation community. Per Swink and Wilhelm (1979) *Plants of the Chicago Region*, the association of species found here are generally reflective of other similar plant associations found elsewhere in north-central and northeast Illinois.

All of the vegetation strata were vigorous, healthy, and showed no signs of stress, such as discoloration, malformation, or necrosis.

Transect #2 Shoreline Transect Up-gradient from CKD Landfill Area

This transect was selected as a background or control area outside of the influence of the CKD landfill area. Table 2 presents the observations from this transect. To make the comparison of the vegetation of this transect with that of the down-gradient transect, it is important to note that there were a few significant physical differences between transects. First, the up-gradient transect is shorter in length, due to the fact that its northern end abuts cropland and a camping/recreational area so that sampling beyond that point was untenable. Second, portions of the up-gradient transect are shaded by trees more than the down-gradient transect, and the ground layer composition is influenced somewhat by this shade.

Even so, the composition of the up-gradient transect is quite similar to the down-gradient transect. The two dominant species in the groundlayer are orange jewelweed and reed canarygrass, similar to the down-gradient composition. Species diversity was almost identical, with 29 groundlayer species recorded, of which 24 were also recorded in the down-gradient transect. Of the five species that were found in the up-gradient transect not found in the down-gradient, four are shade-loving. The shrub stratum also matches quite closely between the up-gradient transect and down-gradient transect. Both transects include Virginia creeper and riverbank grape as dominants. The notable difference between the two transects in shrub composition is that indigo bush is prominent in the down-gradient transect and lacking in the up-gradient. Indigo bush is not particularly shade tolerant, which might explain its absence in the up-gradient transect. This does not indicate that the down-gradient transect is relatively impacted or degraded; in fact, to the contrary, indigo bush is a fairly conservative species (Quality Rating of 6 by Swink and Wilhelm 1979) which means that it is fairly intolerant of disturbance. In a similar vein, the existence in both transects of glade mallow, a very high quality species intolerant of disturbance, underscores this point.

Again, the vegetation in the up-gradient transect was healthy, vigorous, and showed no signs of adverse environmental impacts.

Transect #3 Bluff Woods Transect Adjacent and Down-gradient from CKD Landfill Area

The observations of species in the various strata in this survey transect are presented in Table 3. The groundlayer was quite diverse, with white snakeroot, Virginia creeper, and poison ivy the most prevalent species. A total of 32 species were observed in the groundlayer, indicating a fairly high diversity. Almost all of these species are native and typical of a calcareous river bluff woodland. The shrub stratum was also fairly diverse, with honeysuckle and choke cherry dominant, and a total of 12 species of tree reproduction and shrubs observed. The understory was composed of 10 species of tree saplings and understory trees, of which hackberry was most widespread. The overstory was dominated by boxelder and contained a total of 14 tree species; however, both the understory and overstory had a fairly even mix of tree species, indicating good balance and healthy reproduction. Nearly all of the species, with the exception of white mulberry which is a non-native adventive species, are typical native residents of river-side slopes in this part of Illinois. All strata appeared healthy and vigorous.

Transect #4 Bluff Woods Transect Up-gradient from CKD Landfill Area

Table 4 presents the observations of species in this transect. Again, for comparative purposes, this transect was not quite as long as Transect #3 adjoining the CKD landfill area due to changes in topography that limited the survey length. However, the results indicate the composition and structure of the two transects are similar and, therefore, underscore the validity of the comparisons. In fact, all of the 25 species observed in the groundlayer of the up-gradient transect, also appear in the adjoining transect. The shrub stratum was dominated by honeysuckle, as was the adjoining transect, and in general, all strata were similarly composed. The slightly lower diversity in the up-gradient transect probably simply reflects the smaller sampling area due to the aforementioned topographic limitations on the transect placement. All strata appeared healthy and vigorous.

Discussion and Conclusions - In general, the vegetation both within and outside of the potential zone of influence of the CKD landfill operation appear quite similar and in excellent condition. No evidence of impacts from the CKD landfill operation was observed, and no discernible differences in composition, form, or health were observed between the up-gradient transects and those adjoining or down-gradient from the CKD landfill.

The shoreline transects both contain a mix of plant species reflective of some amount of physical disturbance, which is to be expected in this setting with the periodic flooding and road construction/maintenance. The wooded bluff transects reflect a fairly high quality river-side woods in all strata. All transects support a species composition and structure that are quite typical of this location and physical setting. When comparing the results of the survey to other similar reports from the Illinois River valley (Buchanan 1975), the Sangamon River basin (Jones and Bell 1974), and the typical associations reported by Swink and Wilhelm (1979) for the north-central and northeast Illinois region, this conclusion is strongly supported.

The differences that exist between the up-gradient sampling transects and the adjoining or down-gradient transects are easily attributable to microclimate, topography and natural diversity. Many of the species found in both transects, but most notably in the transects adjoining or down-gradient from the landfill operation, are conservative species intolerant to disturbance. The bluff woods in particular are fairly high quality in terms of vegetation. While a few invasive species such as common buckthorn and white mulberry occur, they are not dominant as in other degraded woodlands throughout the region. Relatively few exotic non-native species were observed in any transect. Numerous species observed in both the shoreline and bluff woods survey transects are assigned quality ratings by Swink and Wilhelm of 5 or higher (on a scale of 0 - 10). If these shoreline and woodland communities were being significantly and adversely impacted by the landfill operations, such conservative species would probably not occur.

Corollary observations were made of wildlife usage as an indication of ecosystem health. While certainly not exhaustive or complete, the presence of such higher level consumers as hawks and turtles, the abundance of frogs, fish hatchlings in the outfall points of the springs from the bluffs, and nesting birds are suggestive of a healthy functioning ecosystem.

Thank you very much for the opportunity to serve you. Please contact BCI with any questions or comments.

Respectfully submitted,

Warren J. Buchanan

Warren J. Buchanan
President

References Cited

1. Buchanan, W. J. 1975. Vegetation monitoring. IN Terrestrial monitoring program for the construction phase of the LaSalle County Station 1975. Second Annual Report to Commonwealth Edison Company, Chicago. Chapter 1. 66 pages.
2. Jones, A. G. and D. T. Bell. 1974. Vascular plants of the Sangamon River Basin: annotated checklist and ecological summary. Univ. Il. College of Ag. Ag. Expt. Sta. Bull. 746. 77 pages.
3. Jones, G. N. 1963. Flora of Illinois. Third ed. American Midland Naturalist: Monograph No. 7. 401 pages.
4. Swink, F. and G. Wilhelm. 1979. Plants of the Chicago Region. Third ed. The Morton Arboretum, Lisle, IL. 922 pages.

FIGURES

Mr. Gordon M. Stevens, P.G. : Versar, Inc.
Vegetation Assessment, Dixon-Marquette Cement, Dixon, IL
22 July 1999

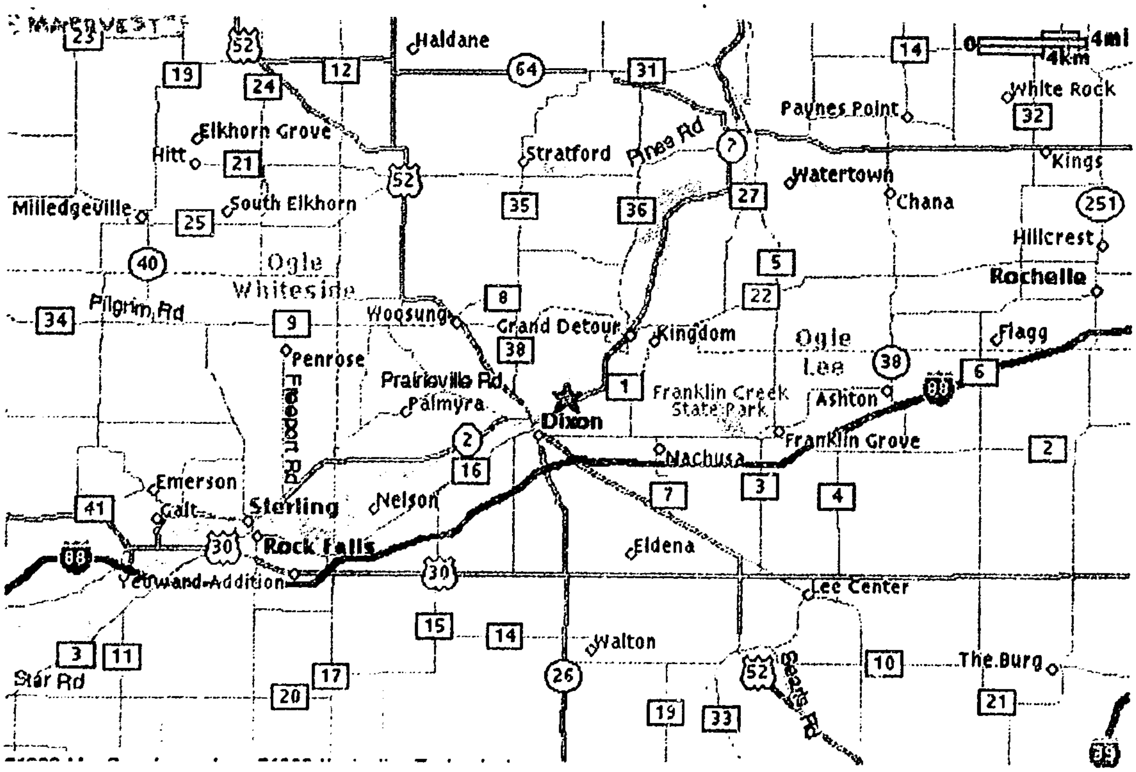

Figure 1. Site location

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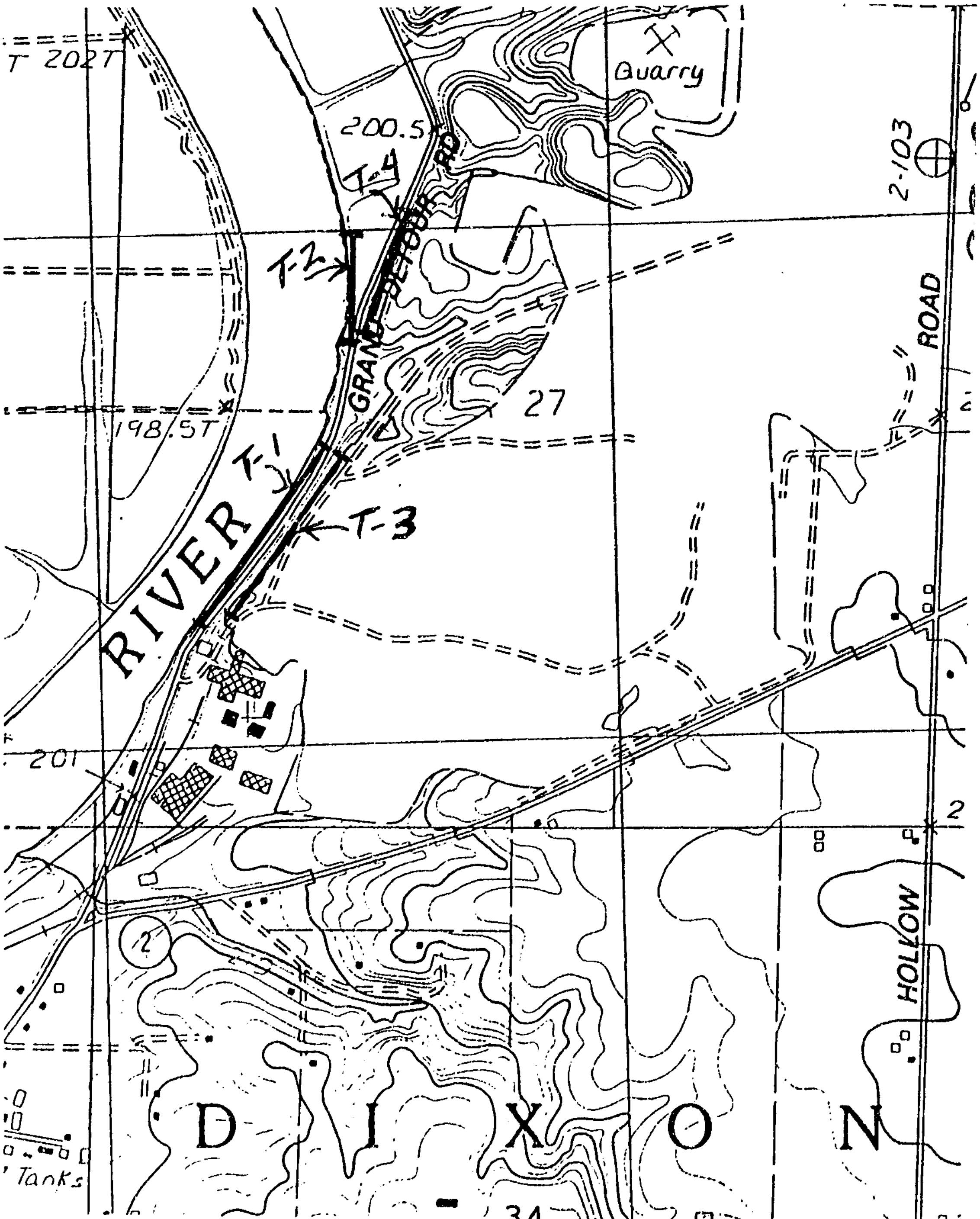

Figure 2. Location of Vegetation Transects

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Figure 3. Shoreline Vegetation Transect #1
Adjacent to and Down-Gradient from CKD Landfill

**Figure 4. Shoreline Vegetation Transect #2
Up-Gradient from CKD Landfill**

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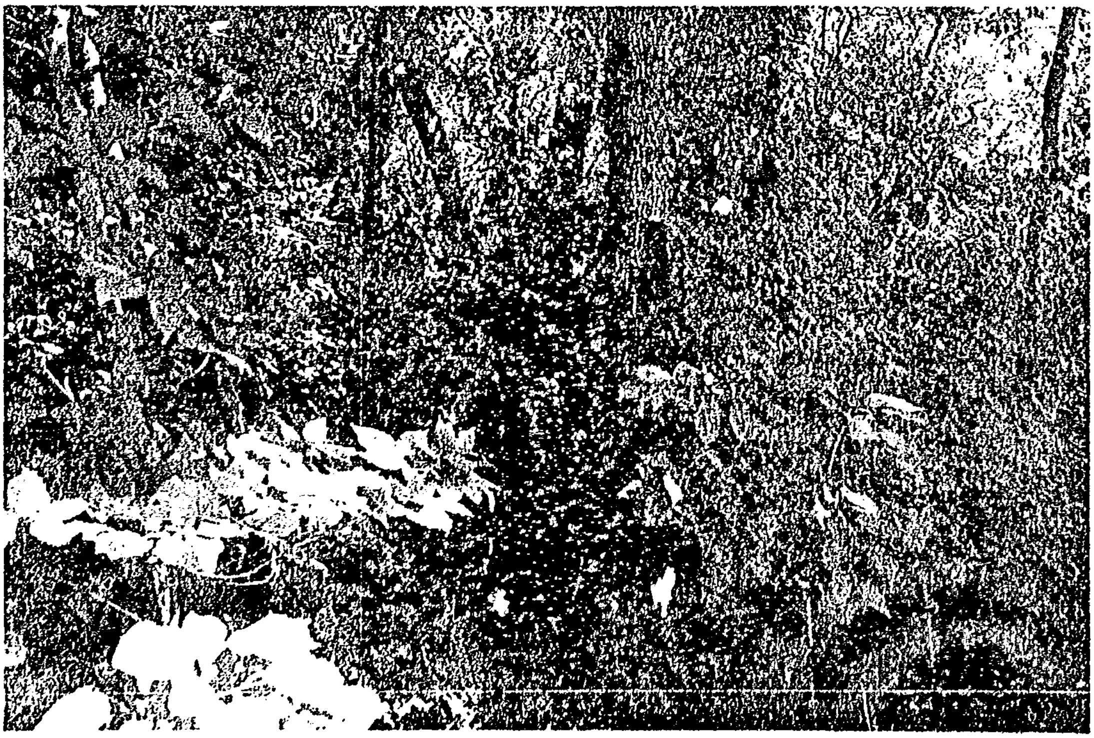
Figure 5. Bluff Woods Vegetation Transect #3
Adjacent to and Down-Gradient from CKD Landfill



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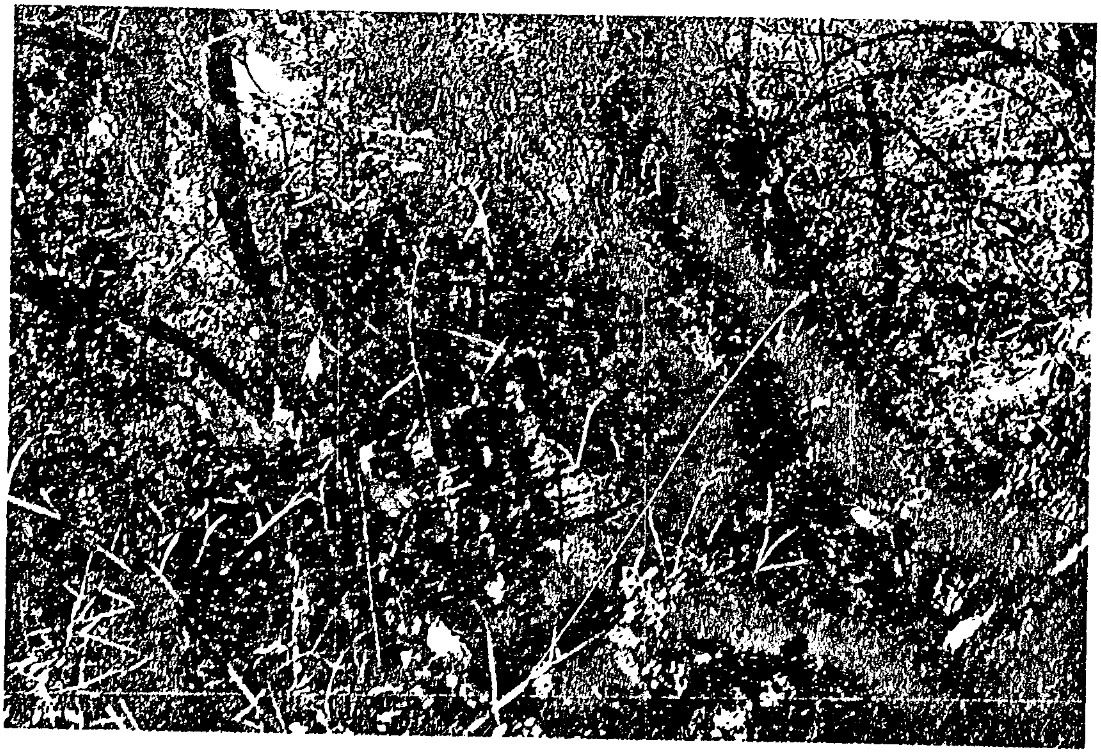
22 July 1999

Figure 6. Bluff Woods Vegetation Transect #4
Up-Gradient from CKD Landfill



TABLES

Table 1. List of Species and Abundance Index for Transect #1 Shoreline Transect Adjacent to Landfill Area

(*Note: 1=abundant, widespread; 2=common; 3=infrequent, local)

Groundlayer

Scientific Name	Common Name	Abundance*
Brassica nigra	Black mustard	1
Impatiens capensis	Orange jewelweed	1
Parthenocissus quinquefolia	Virginia creeper	1
Phalaris arundinacea	Reed canarygrass	1
Bromus inermis	Smooth brome	2
Convolvulus sepium	Hedge bindweed	2
Erigeron philadelphicus	Marsh fleabane	2
Heliopsis helianthoides	False sunflower	2
Napaea dioica	Glade mallow	2
Nepeta cataria	Catnip	2
Oenothera biennis	Common evening primrose	2
Rhus radicans	Poison ivy	2
Rudbeckia laciniata	Wild golden glow	2
Silphium perfoliatum	Cup plant	2
Urtica gracilis	Tall nettle	2
Vitis riparia	Riverbank grape	2
Apocynum cannabinum	Dogbane	3
Asclepias incarnata	Marsh milkweed	3
Asclepias syriaca	Common milkweed	3
Aster sp.	Aster species	3
Cicuta maculata	Water hemlock	3
Eupatorium rugosum	White snakeroot	3
Heracleum maximum	Cow parsnip	3
Ipomoea purpurea	Common morning glory	3
Menispermum canadense	Moonseed	3
Polygonatum biflorum	Solomon's seal	3
Smilax tamnoides hispida	Bristly catbrier	3
Solidago altissima	Tall goldenrod	3
Teucrium canadense	Germander or wood sage	3
Thalictrum polygamum	Meadow rue	3

Shrub Stratum

Scientific Name	Common Name	Abundance
Amorpha fruticosa	Indigo bush	1
Parthenocissus quinquefolia	Virginia creeper	1

Table 1. (continued) List of Species and Abundance Index for Transect #1
Shoreline Transect Adjacent to Landfill Area

(*Note: 1=abundant, widespread; 2=common; 3=infrequent, local)

Shrub Stratum (continued)

Scientific Name	Common Name	Abundance*
Vitis riparia	Riverbank grape	1
Acer negundo	Boxelder	2
Acer saccharinum	Silver maple	2
Fraxinus americana	White ash	2
Rhus radicans	Poison ivy	2
Celtis occidentalis	Hackberry	3
Cornus racemosa	Gray dogwood	3
Lonicera prolifera	Honeysuckle	3
Morus alba	White mulberry	3
Rosa multiflora	Multiflora rose	3
Prunus virginiana	Choke cherry	3
Sambucus canadensis	Elderberry	3
Tilia americana	Basswood	3
Ulmus rubra	Slippery elm	3

Tree Stratum (few scattered trees)

Scientific Name	Common Name	Abundance
Fraxinus americana	White ash	3
Populus deltoides	Cottonwood	3

Table 2. List of Species and Abundance Index for Transect #2
Shoreline Transect Upgradient from Landfill Area

(*Note: 1=abundant, widespread; 2=common; 3=infrequent, local)

Groundlayer

Scientific Name	Common Name	Abundance*
Impatiens capensis	Orange jewelweed	1
Phalaris arundinacea	Reed canarygrass	1
Brassica nigra	Black mustard	2
Bromus inermis	Smooth brome	2
Convolvulus sepium	Hedge bindweed	2
Heliopsis helianthoides	False sunflower	2
Napaea dioica	Glade mallow	2
Parthenocissus quinquefolia	Virginia creeper	2
Rhus radicans	Poison ivy	2
Rudbeckia laciniata	Wild golden glow	2
Silphium perfoliatum	Cup plant	2
Teucrium canadense	Germander or wood sage	2
Vitis riparia	Riverbank grape	2
Actinomeris alternifolia	Wingstem	3
Asclepias incarnata	Marsh milkweed	3
Asclepias syriaca	Common milkweed	3
Aster sp.	Aster species	3
Elymus virginicus	Virginia wildrye	3
Heracleum maximum	Cow parsnip	3
Laportea canadensis	Wood nettle	3
Menispermum canadense	Moonseed	3
Oenothera biennis	Common evening primrose	3
Polygonatum biflorum	Solomon's seal	3
Sanguinaria canadensis	Bloodroot	3
Silene cucubalus	Bladder campion	3
Smilax tamnoides hispida	Bristly catbrier	3
Solidago altissima	Tall goldenrod	3
Thalictrum polyganum	Meadow rue	3
Urtica gracilis	Tall nettle	3

Shrub Stratum

Scientific Name	Common Name	Abundance
Parthenocissus quinquefolia	Virginia creeper	1
Vitis riparia	Riverbank grape	1
Rhus radicans	Poison ivy	2

Table 2. (continued) List of Species and Abundance Index for Transect #2
Shoreline Transect Upgradient from Landfill Area

(*Note: 1=abundant, widespread; 2=common; 3=infrequent, local)

Shrub Stratum (continued)

Scientific Name	Common Name	Abundance*
Celtis occidentalis	Hackberry	3
Cornus racemosa	Gray dogwood	3
Lonicera prolifera	Honeysuckle	3
Morus alba	White mulberry	3
Rosa multiflora	Multiflora rose	3
Sambucus canadensis	Elderberry	3
Staphylea trifolia	Bladdernut	3
Tilia americana	Basswood	3
Ulmus rubra	Slippery elm	3
Viburnum opulus	Highbush cranberry	3

Tree Stratum (few scattered trees)

Scientific Name	Common Name	Abundance
Acer negundo	Boxelder	3
Acer saccharinum	Silver maple	3
Fraxinus americana	White ash	3
Ulmus americana	American elm	3

Table 3. List of Species and Abundance Index for Transect #3
Bluff Woods Transect Adjacent to Landfill Area

(*Note: 1=abundant, widespread; 2=common; 3=infrequent, local)

Groundlayer

Scientific Name	Common Name	Abundance*
Eupatorium rugosum	White snakeroot	1
Parthenocissus quinquefolia	Virginia creeper	1
Rhus radicans	Poison ivy	1
Alliaria officinalis	Garlic mustard	2
Aster shortii	Short's aster	2
Campanula americana	Tall bellflower	2
Carex laxiflora	Wood sedge	2
Hepatica acutiloba	Sharp-lobed hepatica	2
Sanguinaria canadensis	Bloodroot	2
Sanicula gregaria	Black snakeroot	2
Smilacina racemosa	False Solomon's seal	2
Smilax tamnoides hispida	Bristly catbrier	2
Anemone virginiana	Thimble flower	3
Aquilegia canadensis	Columbine	3
Arabis laevigata	Smooth bank cress	3
Celtis occidentalis	Hackberry	3
Circaea quadrisulcata	Enchanter's nightshade	3
Desmodium glutinosum	Pointed tick-trefoil	3
Elymus villosus	Silky wildrye	3
Galium concinnum	Shining bedstraw	3
Geum canadense	White avens	3
Helianthus strumosus	Woodland sunflower	3
Hydrophyllum virginianum	Virginia waterleaf	3
Impatiens capensis	Orange jewelweed	3
Menispermum canadense	Moonseed	3
Osmorhiza claytoni	Sweet cicely	3
Physalis heterophylla	Clammy ground cherry	3
Polygonatum biflora	Solomon's seal	3
Prenanthes alba	Lion's foot	3
Sanguinaria canadensis	Bloodroot	3
Solidago flexicaulis	Zigzag goldenrod	3
Trillium recurvatum	Prairie wake robin	3

Table 3. (continued) List of Species and Abundance Index for Transect #3 Bluff Woods Transect Upgradient from Landfill Area

(*Note: 1=abundant, widespread; 2=common; 3=infrequent, local)

Shrub Stratum (continued)

Scientific Name	Common Name	Abundance*
Vitis riparia	Riverbank grape	2
Celtis occidentalis	Hackberry	3
Fraxinus quadrangulata	Blue ash	3
Physocarpus opulifolius	Ninebark	3

Understory Stratum

Scientific Name	Common Name	Abundance
Celtis occidentalis	Hackberry	1
Fraxinus americana	White ash	2
Fraxinus quadrangulata	Blue ash	2
Acer negundo	Boxelder	3
Acer saccharum	Sugar maple	3
Juglans nigra	Black walnut	3
Ostrya virginiana	Hop hornbeam	3
Ulmus rubra	Slippery elm	3

Overstory Stratum

Scientific Name	Common Name	Abundance
Celtis occidentalis	Hackberry	2
Fraxinus quadrangulata	Blue ash	2
Quercus macrocarpa	Burr oak	2
Tilia americana	Basswood	2
Fraxinus americana	White ash	3
Juglans nigra	Black walnut	3
Populus deltoides	Cottonwood	3
Ulmus rubra	Slippery elm	3

Table 4. List of Species and Abundance Index for Transect #4
Bluff Woods Transect Upgradient from Landfill Area

(*Note: 1=abundant, widespread; 2=common; 3=infrequent, local)

Groundlayer

Scientific Name	Common Name	Abundance*
Parthenocissus quinquefolia	Virginia creeper	1
Aster shortii	Short's aster	2
Eupatorium rugosum	White snakeroot	2
Osmorhiza claytoni	Sweet cicely	2
Prenanthes alba	Lion's foot	2
Rhus radicans	Poison ivy	2
Sanguinaria canadensis	Bloodroot	2
Sanicula gregaria	Black snakeroot	2
Alliaria officinalis	Garlic mustard	3
Anemone virginiana	Thimble flower	3
Aquilegia canadensis	Columbine	3
Arabis laevigata	Smooth bank cress	3
Campanula americana	Tall bellflower	3
Carex laxiflora	Wood sedge	3
Celtis occidentalis	Hackberry	3
Elymus villosus	Silky wildrye	3
Galium concinnum	Shining bedstraw	3
Geum canadense	White avens	3
Hydrophyllum virginianum	Virginia waterleaf	3
Impatiens capensis	Orange jewelweed	3
Menispermum canadense	Moonseed	3
Smilacina racemosa	False Solomon's seal	3
Smilax tamnoides hispida	Bristly catbrier	3
Solidago flexicaulis	Zigzag goldenrod	3
Trillium recurvatum	Prairie wake robin	3

Shrub Stratum

Scientific Name	Common Name	Abundance
Lonicera prolifera	Honeysuckle	1
Fraxinus americana	White ash	2
Prunus virginiana	Choke cherry	2
Rhamnus cathartica	Common buckthorn	2
Ribes missouriense	Missouri gooseberry	2
Smilax tamnoides hispida	Bristly catbrier	2
Staphylea trifolia	Bladdernut	2

Table 4. (continued) List of Species and Abundance Index for Transect #4 Bluff Woods Transect Adjacent to Landfill Area

(*Note: 1=abundant, widespread; 2=common; 3=infrequent, local)

Shrub Stratum

Scientific Name	Common Name	Abundance
Lonicera prolifera	Honeysuckle	1
Prunus virginiana	Choke cherry	1
Rhamnus cathartica	Common buckthorn	2
Rhus radicans	Poison ivy	2
Smilax tamnoides hispida	Bristly catbrier	2
Staphylea trifolia	Bladdernut	2
Vitis riparia	Riverbank grape	2
Acer negundo	Boxelder	3
Juglans nigra	Black walnut	3
Physocarpus opulifolius	Ninebark	3
Rhus glabra	Smooth sumac	3
Ribes missouriense	Missouri gooseberry	3

Understory Stratum

Scientific Name	Common Name	Abundance
Celtis occidentalis	Hackberry	1
Acer negundo	Boxelder	2
Fraxinus americana	White ash	2
Ostrya virginiana	Hop hornbeam	2
Staphylea trifoliata	Bladdernut	2
Acer saccharum	Sugar maple	3
Fraxinus quadrangulata	Blue ash	3
Juglans nigra	Black walnut	3
Morus alba	White mulberry	3
Quercus macrocarpa	Burr oak	3

Overstory Stratum

Scientific Name	Common Name	Abundance
Acer negundo	Boxelder	1
Celtis occidentalis	Hackberry	2
Fraxinus americana	White ash	2
Fraxinus quadrangulata	Blue ash	2

Table 4. (continued) List of Species and Abundance Index for Transect #4
Bluff Woods Transect Adjacent to Landfill Area

(*Note: 1=abundant, widespread; 2=common; 3=infrequent, local)

Overstory Stratum (continued)

Scientific Name	Common Name	Abundance
Quercus borealis	Red oak	2
Quercus macrocarpa	Burr oak	2
Acer saccharum	Sugar maple	3
Juglans nigra	Black walnut	3
Morus alba	White mulberry	3
Morus rubra	Red mulberry	3
Ostrya virginiana	Hop hornbeam	3
Populus deltoides	Cottonwood	3
Tilia americana	Basswood	3
Ulmus rubra	Slippery elm	3

Exhibit 8

DETECTION MONITORING PROGRAM

for

Dixon Marquette Cement Company

Dixon, Illinois

January 2001

Prepared by

Preston Engineering, Inc.

4436 North Brady Street

Davenport, IA 52806

319/388-8288

1.0 INTRODUCTION

During March and April 1998, nine monitoring wells (MW1-S, MW1-D, MW2-S, MW2-D, MW2-M, MW3-S, MW3-D, MW4-S, and MW4-D) were installed around the CKD disposal site at the Dixon Marquette Cement plant in Dixon, Illinois. The wells were installed in pairs at three sites, and three wells were installed at one site. Each well was assigned a number designating which well cluster it was in, and a letter designating the location of the screened interval. Letter designations were S and D, which designated screened intervals at the base of the Pecatonica Formation and the top of the St. Peter Formation, respectively. One well, completed in the Glenwood Formation, was designated MW2-M, and was used solely for conducting hydraulic conductivity testing. Each well, except for MW2-M, has a 10 foot long, 2 inch diameter screen at its base.

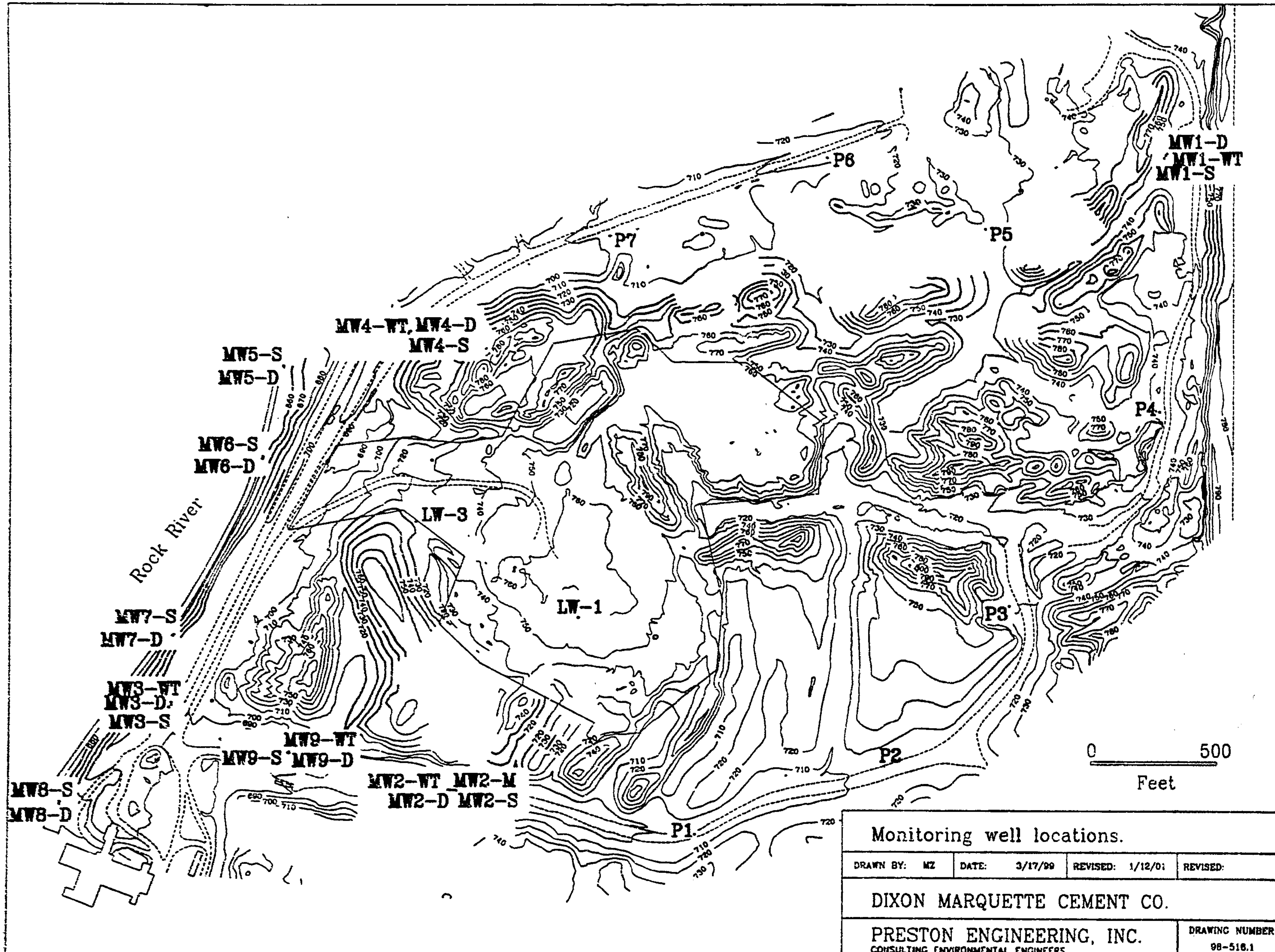
In May 1998 two leachate wells were installed in the CKD disposal area. The wells were designated LW-1 and LW-2. The base of the screen in both wells was positioned at the contact between CKD and the underlying Pecatonica Formation. One of the wells, LW-2, was dry and was later abandoned. Well LW-1 has consistently had several feet of water in it. The water in the well is assumed to have been in contact with the surrounding CKD and is considered to be leachate. An additional leachate well, LW-3, was installed in the CKD disposal area in July 1999. No groundwater was noted in the CKD during drilling. Groundwater was found in the uppermost part of the Pecatonica Formation, which was directly under the CKD.

In June 1999 four pairs of wells were installed along White Oak Lane on the west side of Dixon Marquette property. In each pair, one well is screened across the water table, and one is screened at the top of the St. Peter Formation. The wells were designated MW5-S, MW5-D, MW6-S, MW6-D, MW7-S, MW7-D, MW8-S, and MW8-D.

In June 1999 a pair of wells was installed south of the CKD disposal area between wells MW2 and MW3. They were designated MW9-S and MW9-D. The screen in well MW9-S was placed at the base of the Pecatonica Formation, and the screen in MW9-D was placed at the top of the St. Peter Formation.

In July 1999 wells were added that were screened across the potentiometric surface, or as close to it as practical, at five locations. These wells were designated MW1-WT, MW2-WT, MW3-WT, MW4-WT, and MW9-WT.

Seven piezometers (P1 through P7) were added southeast, east, and north of the landfill. They are narrow diameter PVC pipes that run from just above the surface to about 15 feet deep. They are used to measure the potentiometric surface near the top of the uppermost aquifer, and they are not included in the sampling program. Figure 1 is a map of the site with the well and piezometer locations shown, and Table 1 lists well data.



Monitoring well locations.			
DRAWN BY: MZ	DATE: 3/17/99	REVISED: 1/12/01	REVISED:
DIXON MARQUETTE CEMENT CO.			
PRESTON ENGINEERING, INC. CONSULTING ENVIRONMENTAL ENGINEERS			DRAWING NUMBER 98-516.1

Table 1. Monitoring well data.

Well	Total Depth (ft from top of casing)	Formation screened
MW1-S	42.05	Pecatonica
MW1-D	80.5	St. Peter
MW1-WT	15.5	Pecatonica
MW2-S	41.85	Pecatonica
MW2-D	62.25	St. Peter
MW2-M	46.20	Glenwood
MW2-WT	15.5	Pecatonica
MW3-S	61.5	Pecatonica
MW3-D	80.6	St. Peter
MW3-WT	37.5	Pecatonica
MW4-S	44.1	Pecatonica
MW4-D	63.2	St. Peter
MW4-WT	25	Pecatonica
MW5-S	15	Alluvium*
MW5-D	47.5	St. Peter
MW6-S	15	Alluvium*
MW6-D	40	St. Peter
MW7-S	15	Pecatonica
MW7-D	34.5	St. Peter
MW8-S	18	Pecatonica
MW8-D	40	St. Peter
MW9-S	37.5	Pecatonica
MW9-D	59.5	St. Peter
MW9-WT	15.5	Pecatonica
LW-1	65	CKD fill
LW-3	44.5	Pecatonica
Spring	not applicable	emanates from Pecatonica

*The Pecatonica Formation has been eroded at this location and replaced with alluvium of the Rock River.

The groundwater in and around the CKD disposal area will be monitored quarterly. The sampling plan is designed to detect changes in groundwater quality that result from contamination by leachate derived from the landfill.

Groundwater flow beneath the landfill is roughly east to west, or toward the Rock River. One well triplet (MW1-S, MW1-D, and MW1-WT) was placed on the east, or upgradient side of the landfill. These wells monitor the groundwater quality in an area that has not been affected by CKD disposal. Data from the upgradient wells will be used in comparisons with data from other wells to determine if leachate has affected the groundwater quality.

Wells at MW2, MW3, MW4, and MW9 are used to detect leachate in the groundwater in areas close to the CKD and downgradient from it. Well pairs at MW5, MW6, MW7, and MW8 are used to determine if leachate has affected the groundwater near the Rock River, and to determine if the groundwater quality may affect the surface water quality in the river.

Two wells, LW-1 and LW-3, are used to characterize groundwater beneath the landfill. Groundwater in these wells may have been in contact with the CKD. Data from these wells will be used to determine which parameters should be monitored in other wells.

Water elevations in all of the wells and piezometers will be measured before each sampling event. The data can be used to create potentiometric maps of the groundwater. Maps will be made from data from groups of wells that are screened at the same depth in the same formation.

2.0 SAMPLING METHODOLOGY

Prior to field activities, arrangements will be made with a commercial laboratory that is certified in the State of Illinois. The lab will provide sample containers and will place the proper preservative in each container prior to shipping. A list of the container types and preservatives is presented in Table 2.

The following information from each well will be recorded at the time of sampling:

Date and time of sampling

Depth to water from the top of the casing prior to purging

The volume of water that was purged prior to sampling

The appearance of the water

The temperature, pH, conductivity, and turbidity of the groundwater at the time of sampling

Wells MW1-S, MW1-D, MW1-WT, MW2-S, MW2-D, MW2-WT, MW3-S, MW3-D, MW3-WT, MW4-S, MW4-D, MW4-WT, MW5-S, MW5-D, MW6-S, MW6-D, MW7-S, MW7-D, MW8-S, MW8-D, MW9-S, MW9-D, MW9-WT, LW-1, LW-3, the Rock River (two locations), and the spring that is west of MW-3 will be sampled. Wells will be purged prior to sampling. Sampling will take place within 24 hours of purging. The water will be field tested for turbidity. If the turbidity is 5 NTU or less, samples will not be field filtered for metals. If the turbidity exceeds 5 NTU, two samples for metals will be collected: one that is unfiltered, and one that is field filtered through a filter with a pore size of 0.45 µm or less prior to preservation. All of the samples will be kept on ice in the field and during delivery to the lab. Samples will be packed in coolers with ice, sealed, and delivered to the laboratory by overnight courier. A chain of custody form will accompany the shipment. An example chain of custody form is attached. This form, or an equivalent form supplied by the laboratory, will be used.

Sampling of the Rock River will take place quarterly. Sampling will consist of collection of river water from a location upgradient from the landfill (about 1000 feet upriver from MW5) and from a location downgradient from the landfill (near MW8). Sampling will take place from the shore on the left bank. The river water will be analyzed for the same parameters as the groundwater. Samples will first be collected from the upstream location, then the samples from the downstream location will be collected. Field measurements of temperature, pH, and specific conductivity will be made. The river samples for dissolved iron will be passed through a filter with a pore size of 0.45 µm or less prior to preservation.

In addition to monitoring for compounds that exceed the background concentrations, the list of organic chemicals in 40 CFR 141.40, and any other organic chemical for which a groundwater quality standard or criterion has been adopted pursuant to Section 14.4 of the Act or Section 8 of the Illinois Groundwater Protection Act, will be analyzed biennially.

Table 2. Chemical Parameters to be Analyzed.

Parameter	Method	Container	Preservative	Holding Time
Volatile organics	8260	2 40 ml glass vials	HCl, 4°C	14 days
Metals	200.8	125 ml HDPE	HNO_3, 4°C	6 months
pH	4500	250 ml HDPE	4°C	immediate
Calcium, Potassium, Sodium, Chloride, Fluoride, Nitrate, Sulfate, Alkalinity, Ammonia, Dissolved solids, TOC	200.8, 4110, 2320, 2540C, 4500, 5310	250 ml HDPE	4°C	14 days

3.0 ANALYTES

Quarterly samples from all 28 locations will be analyzed for the following. Practical quantitation limits will be those specified by USEPA SW846 laboratory methods.

Benzene
1,1-dichloroethane
1,1-dichloroethene
1,1,1-trichloroethane
Toluene
Aluminum
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Mercury
Nickel
Potassium
Selenium
Sodium
Thallium
Vanadium
Zinc
Ammonia nitrogen
Chloride
COD
Fluoride
Nitrate as N
Sulfate
Alkalinity, phenol.
Alkalinity, bicarbonate
Alkalinity, total
Total organic carbon
Total dissolved solids
pH

These parameters have been previously detected in downgradient wells at concentrations exceeding the background concentrations.

4.0 QUALITY CONTROL

Additional samples for quality control will be submitted to the laboratory. Split samples will be collected from wells MW1-S and MW3-S (both screened in the Pecatonica Formation), and MW7-S. The samples will be labeled as split samples, but no well numbers will identify them. The split samples will be analyzed for the same parameters as the other samples from the same wells. These samples will be used as a check on sampling procedures and reproducibility at the laboratory.

A trip blank consisting of pure water will be prepared by the laboratory and analyzed for organic compounds by Method 8260 and metals by Method 200.8. The trip blank will be used as a check on contamination of the samples.

The laboratory will be certified by the State of Illinois, and will adhere to a quality control program that meets specifications in 35 IAC 186, which governs the certification of laboratories. Samples will be analyzed by standard methods according to USEPA SW-846 Test Methods for Evaluating Solid Waste. Quality control procedures listed in SW-846 for the methods that are used will be used by the laboratory.

Exhibit 9

FEASIBILITY AND COST ANALYSIS

OF

REMEDIAL ALTERNATIVES

MARCH 13, 2001

Dixon Marquette Cement Company
Dixon, Illinois

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EXECUTIVE SUMMARY

Sixty four remediation technologies listed on the federal remediation technology roundtable were screened for applicability to Dixon Marquette Cement Company's landfill. Eleven technologies were considered theoretically feasible and were evaluated for installation at the landfill.

Installation of a RCRA Subtitle D Cap with Cap Enhancement was determined to be technically feasible. This type of technology would have a capital cost of $2,000,000 to $4,000,000.

No other technologies were feasible.

TABLE OF CONTENTS

I. INTRODUCTION

The Dixon Marquette Cement Plant (DMC) has disposed of waste cement kiln dust in an onsite landfill since 1984. The landfill appears to have been used as early as 1959 by previous plant owners. It is located in a portion of an old surface mine. The landfill is approximately 300 feet east of the Rock River at its closest point.

DMC desires to continue to use the landfill for disposal of waste cement kiln dust (CKD). However, because of inherent siting and design factors it is not technically or economically feasible to comply with all current landfill regulations. Therefore, it was necessary to evaluate alternatives that could be included in adjusted standards. Numerous sources were used to evaluate the costs and feasibility of various alternatives to the landfill regulations.

USEPA publication 540-R-00-002 "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" was used as a reference. The Federal Remediation Technology Roundtable website was used to screen various alternatives. A more detailed cost analysis was done for favorable alternatives.

The general alternatives considered were closing the landfill and hauling all new waste to the local landfill, hauling all new and previously disposed waste to the local landfill, and operating the landfill with adjusted standards. Options for collecting groundwater, treating groundwater, and hydraulic control were evaluated for the operating with adjusted standards alternative.

II. PRELIMINARY FEASIBILITY ANALYSIS

The Federal Remediation Technology Roundtable website (www.frtr.gov) contains a treatment technology screening matrix for many alternatives for treating waste, soil and groundwater. Table 3-2: Treatment Technologies Screening Matrix is included in the Appendix A. The inorganic contaminant column was selected because the CKD waste is inorganic and the leachate contaminants were primarily inorganic. The array of treatment technologies is rated by effectiveness. Technologies rated better for inorganic contaminants were selected for additional consideration. Background information was reviewed to determine if a technology could be used for the DMC site.

Many of the technologies rated better for inorganic technologies were determined to be ineffective, unproven, or expensive after review of background information. The following technologies were determined to be infeasible and were eliminated from further consideration. Technology descriptions are included in Appendix B.

4.6 Electrokinetic Separation
4.8 Soil Flushing
4.10 Solidification/Stabilization
4.17 Chemical Extraction
4.18 Chemical Reduction/Oxidation
4.20 Separation
4.21 Soil Washing
4.24 Solidification/Stabilization
4.40 Hydrofracturing
4.46 Passive/Reactive Treatment Walls
5.57 Deep Well Injection

The following technologies were determined to be theoretically feasible and were evaluated further to determine the site specific feasibility and cost at this facility. Technology descriptions are located in Appendix C.

4.30 Landfill Cap (Soil Containment Remediation)
4.31 Landfill Cap Enhancement (Soil Containment Remediation)
4.32 Excavation, Retrieval, and Off-Site Disposal (Soil Remediation)
4.36 Phytoremediation (In Situ Groundwater Remediation)
4.48 Constructed Wetlands (Ex Situ Groundwater Remediation)
4.49 Adsorption/Absorption (Ex Situ Groundwater Remediation)
4.52 Ion Exchange (Ex Situ Groundwater Remediation)
4.53 Precipitation/Coagulation/Flocculation (Ex Situ Groundwater Remediation)
4.40 Directional Wells (In Situ Groundwater Remediation)
4.58 Groundwater Pumping (Groundwater Containment)
4.59 Slurry Walls (In Situ Groundwater Remediation)

III. FEASIBILITY ANALYSIS OF SELECTED TECHNOLOGIES

Eleven technologies that were theoretically feasible were evaluated in more detail. The effectiveness at addressing all of the contaminants associated with the landfill as well as the cost was considered.

4.30 Landfill Cap

The purpose of a cap is to prevent direct contact with waste, prevent wind blown transport of the waste, and to reduce the volume of precipitation that infiltrates through the waste and becomes leachate. The most common cap is a soil layer that has been compacted to former a barrier layer, which is then covered with a protective layer that supports vegetation. Two types of designs which are common are a RCRA Subtitle C Cap and a RCRA Subtitle D Cap.

A RCRA Subtitle D Cap is required for non-hazardous waste landfills. The Illinois regulation for Subtitle D landfills (811.314 Final Cover System) calls for a low permeability layer that has a minimum thickness of three feet and a permeability of less than 10^{-7} cm/sec. A final protective cover is required that is three feet thick and is capable of supporting vegetation. Based on the technology summary, the rough industry cost is $175k/acre acre for a RCRA Subtitle D. This works out to be a total cost of $4,025,000 dollars for a 23-acre cap. However, because DMC has equipment to move soil it is anticipated the cost for a cap that meets Illinois requirements would cost less than $2,000,000 if onsite soils can be used for the cap. A preliminary construction cost estimate for a landfill cap is included in Appendix D. The estimated cost for a landfill cap was $1,852,000.

A RCRA Subtitle C Cap is a multilayered landfill cap that is suggested for use in RCRA hazardous waste applications. These caps have at least one synthetic liner in addition to the provisions of the Subtitle D cap. The synthetic liner will further reduce infiltration of water into the waste. The drawback is increased difficulty in construction and increased cost. The rough industry guideline cost is $225k/acre. This would be a total of $5,175,000 for a 23-acre cap. DMC does not have the ability to construct this type of cover and would need to use a landfill contractor. Therefore, the industry average is a reasonable estimate.

Construction of Subtitle D Cap installed in accordance with the IEPA rule 811.314 when the landfill is closed is a technologically feasible option.

4.31 Landfill Cap Enhancements

The purpose of landfill cover enhancement is to reduce or eliminate percolation. Water harvesting increases runoff. Vegetation cover reduces soil moisture via plant uptake and evapotranspiration.

The anticipated design is likely to have at least a 20% slope which will result in a substantial amount of runoff. In addition, the landfill cap will need to be seeded with vegetation to control wind and water erosion of the soil cover. Landfill cap enhancements are anticipated as part of a normal soil cap construction and will not increase the cost of a Subtitle D cap.

Inclusion of landfill cap enhancements such as vegetation is a feasible and appropriate technology to apply to the anticipated Subtitle D cap.

4.32 Excavation, Retrieval, and Off-Site Disposal

Contaminated material is removed and transported to permitted off-site treatment and disposal facilities. The technology guide provides a cost estimate of $270 to $460 per ton for disposal at a RCRA permitted facility.

The CKD landfill is estimated to contain 650,000 tons of waste. Disposal costs at the local permitted Subtitle D landfill are $38/ton. The total cost would be $24,700,000 for disposal. There would be an additional cost of approximately $300,000 for site restoration. The total cost for this technology is $25,000,000.

The cost of offsite disposal is economically infeasible.

4.36 Phytoremediation

Phytoremediation is a set of processes that uses plants to remove, transfer, stabilize and destroy organic/inorganic contamination in groundwater, surface water, and leachate. These mechanisms include enhanced rhizosphere biodegradation, hydraulic control, phyto-degradation, phyto-volatilization, phyto-accumulation, and phyto-stabilization.

The DMC site poses significant constraints on this technology. The primary contaminants are inorganic and thus are not amenable to biodegradation or volatilization. Much of the contamination is deep and in bedrock where roots are not likely to penetrate. Plants could pump shallow groundwater and accumulate contaminants in the shallow water near the Rock River. Planting trees along the river was investigated. However, there is very little area between the bluff overlooking the river and the river to plant trees. Currently, there is a lush stand of trees and vegetation along the bluff face that may very well attenuate contaminants in the shallow water table.

This technology was determined to be infeasible for this site because of site constraints.

4.48 Constructed Wetlands

The constructed wetlands-based treatment technology uses natural geochemical and biological processes inherent in an artificial wetland ecosystem to accumulate and remove metals, explosives, and other contaminants from influent waters. The process can use a filtration or degradation process.

Although the technology incorporates principal components of wetland ecosystems, including organic soils, microbial fauna, algae and vascular plants, microbial activity is responsible for most of the remediation. Metals are removed through ion exchange, adsorption, absorption, and precipitation with geochemical and microbial oxidation and reduction. Ion exchange occurs as metals in the water contact humic or other organic substances in the wetland. Wetlands constructed for this purpose often have little or no soil instead they have straw, manure or compost. Oxidation and reduction reactions catalyzed by bacteria that occur in the aerobic and anaerobic zones play a major role in precipitating metals as hydroxides and sulfides. Precipitated and adsorbed metals settle in quiescent ponds or are filtered out as water percolates through the medium or the plants.

The performance of wetland systems is not easily predicted nor is the cost. One estimate from the technical document is $1.36 per thousand gallons. Up to three million gallons per day of contaminated groundwater is discharged. The cost for treating this volume of water would be $4,080 per day or about $1.5 million dollars per year.

This technology is not economically feasible and the technical feasibility is dubious.

4.49 Adsorption/Absorption

In liquid absorption, solutes concentrate at the surface of the sorbent, thereby reducing their concentration in the bulk liquid phase. The most common adsorbent is granular activated carbon. Other adsorbents include activated alumina, forage sponge, lignin adsorption, sorption clays, and synthetic resins.

Adsorption does not work well for water soluble compounds and small molecules. Therefore, it would not be a good choice for inorganic contaminants such as dissolved solids. Cost estimates range from $280/1000 gallons to $340/1000 gallons. At three million gallons per day of contaminated groundwater, the cost could be over $1,000,000 per day.

This technology will not work well for the dissolved constituents found in the groundwater at this site and the cost is prohibitory.

4.52 Ion Exchange

Ion exchange removes ions from the aqueous phase by exchange with counter ions on the exchange medium. Ion exchange can remove dissolved metals from aqueous solutions. However, the ions removed are replaced with other ions with little change is dissolved solids content. Wastewater is also produced when the unit is regenerated. The cost is typically $0.30 to $0.80 per 1000 gallons treated. For three million gallons per day of contaminated groundwater, the cost would be $900 to $2,400 per day.

This technology would not significantly decrease the level of dissolved solids and the expense is significant.

4.53 Precipitation/Coagulation/Flocculation

This process transforms dissolved contaminants into an insoluble solid, facilitating the contaminant's subsequent removal from the liquid phase by sedimentation or filtration. The process usually uses pH adjustment, addition of a chemical precipitant, and flocculation.

Precipitation of metals has long been the primary method of treating metal-laden industrial wastewaters. This involves the conversion of soluble heavy metal salts to insoluble salts that will precipitate. The precipitate can be removed from the treated water by physical methods such as clarification (settling) and/or filtration. The precipitate or sludge must then be disposed in a landfill unless they have sufficient commercial value to allow recycling.

Cost for this process may be from $0.30 to $0.70 per 1,000 gallons plus $0.50 per 1,000 gallons for sludge disposal. For a three million gallon per day system, the cost ranges from $2,400 per day to $3,750 per day.

This is a poor technology for treating groundwater under the DMC landfill. The groundwater has low heavy metal contamination. Adding chemicals will raise the dissolved solids content of the groundwater, which already has elevated levels. The annual cost is from $876,000 to $1,365,000 per year.

The technology is eliminated because of the high cost and questionable benefit.

4.40 Directional Wells

Drilling techniques are used to position wells horizontally, or at an angle, to reach contaminants not accessible by direct vertical drilling.

Use of the technology may be limited by the potential for wells to collapse, requirement of specialized technology, difficulty in precisely locating wells, cost, and depths limited to 50 feet.

Cost estimates in the technology guide are $20 to $75 per foot. However, these costs appear to be for unconsolidated formations. Typically drilling in rock increase costs by a factor of 10. An analysis of leachate collection systems is included in Appendix E. The preliminary cost estimate for a horizontal well 2000 foot long is $695,000 or $350 per foot.

This technology appears feasible although there i some uncertainty of the percent of capture because of the variability of jointing in the bedrock.

4.58 Groundwater Pumping

Groundwater pumping is a commonly used groundwater remediation technology at contaminated sites. Possible objectives of groundwater pumping include removal of dissolved contaminants from the subsurface, and containment of contaminated groundwater to prevent migration.

Limitations of the technology include the length of time necessary to meet the remediation goal, the systems often fail to contain the contaminant plume, the cost of installation and operation is high, and biofouling of wells is common.

The cost for this type of system depends on the specific design and site conditions. A preliminary design is included in Appendix E. A system of 100 wells, 30 feet deep at DMC would cost over $600,000 for construction. Operating costs were estimated to be $100,000 per year.

This technology is feasible, although the actual capture of groundwater will depend on how effectively major joints are intersected. The location of major joints is difficult to predict, making the percent of groundwater capture uncertain.

4.59 Slurry Walls

These subsurface barriers consist of vertically excavated trenches filled with slurry. The slurry, usually a mixture of bentonite and water, hydraulically shores the trench to prevent collapse and retards ground water flow. Slurry walls are used to contain contaminated ground water, divert uncontaminated groundwater flow, and/or provide a barrier for the groundwater treatment system.

Slurry walls are typically placed at depths up to 100 feet and are generally 2 to 4 feet thick. The most effective application of a slurry wall for site remediation is to key the slurry wall 2 to 3 feet into a low permeability layer such as clay or bedrock. This keying-in provides for an effective foundation with minimum leakage potential.

The cost for a soil-bentonite wall in a soft to medium soil range is $5 to $7 per square foot. A recent bid for a local landfill resulted in a construction cost of approximately $7 per square foot. These costs are based on excavation in soil. At the DMC site the slurry wall would have to be constructed in fractured dolomite and keyed into the Glenwood shale unit. Bedrock excavation is typically a factor of 10 higher than soil excavation. To circle the landfill with a 40-foot deep slurry wall would require a minimum of 160,000 square feet of slurry wall. At $50 a square foot, the cost would be $8,000,000.

The cost and difficulty in installing a slurry wall in 40 foot of rock makes this alternative infeasible.

APPENDIX A

Treatment Technologies
Screening Matrix

Table 3-2: Treatment Technologies Screening Matrix

Rating Codes ■ - Better; ○ - Average; △ - Worse. ◆ - See Definition in Table 3-1a. Y - Yes; N - No. F - Full; P - Pilot. S - Solid; L - Liquid; V - Vapor. NA - Not Applicable I - Inadequate. O&M - Operation & Maintenance; Cap - Capital; B - Both	Development Status	Treatment Train (excludes off-gas treatment)	Residuals Produced	O&M or Capital Intensive	Availability	System Reliability/ Maintainability	Cleanup Time	Overall Cost	Nonhalogenated VOCs	Halogenated VOCs	Nonhalogenated SVOCs	Halogenated SVOCs	Fuels	Inorganics	Radionuclides	Explosives
Soil, Sediment, and Sludge																
3.1 In Situ Biological Treatment																
4.1 Bioventing	F	N	N	N	◆	◆	◆	■	■	◆	◆	◆	■	△	◆	I
4.2 Enhanced Bioremediation □□ Aerobic □□ Anaerobic	F	N	N	O&M	◆	◆	◆	◆	■	■	◆	◆	■	◆	◆	■
4.3 Land Treatment	F	N	N	N	◆	◆	◆	◆	■	■	◆	◆	■	△	◆	◆
4.4 Natural Attenuation	F	N	N	O&M	◆	◆	△	◆	■	◆	◆	◆	◆	◆	◆	◆
4.5 Phytoremediation □□ Enhanced Rhizosphere Biodegradation □□ Phyto-accumulation □□ Phyto-degradation □□ Phyto-stabilization	P	N	N	N	△	○	△	■	○	○	○	○	■	△	△	■
3.2 In Situ Physical/Chemical Treatment																
4.6 Electrokinetic Separation	F	Y	L	O&M	■	○	○	○	○	○	○	○	△	■	○	△
4.7 Fracturing □□ Blast-Enhanced □□ Lasagna Process □□ Pneumatic Fracturing	F	Y	N	O&M	△	○	○	○	○	○	○	○	○	○	△	○
4.8 Soil Flushing □□ Cosolvents Enhancement	F	N	L	O&M	■	○	△	△	■	■	○	○	○	■	△	△
4.9 Soil Vapor Extraction	F	N	L	O&M	■	■	○	■	■	■	○	○	■	△	△	△
4.10 Solidification /Stabilization □□ In Situ Vitrification	F	N	S	B	○	○	○	○	■	■	■	■	△	■	■	△
3.3 In Situ Thermal Treatment																

4.11 Thermally Enhanced Soil Vapor Extraction □□ Electrical Resistance Heating □□ Radio Frequency/ Electromagnetic Heating □□ Hot Air Injection	P	N	N	N	△	■	△	■	○	○	■	■	■	△	△	△
3.4 Ex Situ Biological Treatment (assuming excavation)																
4.12 Biopiles	F	N	N	N	■	■	○	■	■	■	◆	◆	■	◆	△	■
4.13 Composting	F	N	N	N	■	■	○	■	■	■	◆	◆	■	◆	△	■
4.14 Fungal Biodegradation □□ White Rot Fungus	F	N	N	O&M	△	△	△	■	◆	◆	◆	◆	◆	△	△	■
4.15 Landfarming	F	N	N	N	■	■	△	■	■	■	◆	◆	■	◆	△	◆
4.16 Slurry Phase Biological Treatment	F	N	N	B	○	○	○	○	■	■	◆	◆	■	◆	△	■
3.5 Ex Situ Physical/Chemical Treatment (assuming excavation)																
4.17 Chemical Extraction □□ Acid Extraction □□ Solvent Extraction	F	Y	L	B	○	○	△	△	○	○	■	■	○	■	○	■
4.18 Chemical Reduction/Oxidation	F	Y	S	N	■	■	■	○	○	○	○	○	○	■	△	△
4.19 Dehalogenation □□ Base-Catalyzed Decomposition □□ Glycolate/Alkaline Polyethylene Glycol (A/PEG)	F	N	V	B	△	△	△	△	○	○	○	○	△	△	△	△
4.20 Separation □□ Gravity Separation □□ Magnetic Separation □□ Sieving/Physical Separation	F	Y	S	O&M	■	○	■	○	○	○	○	○	■	■	△	△
4.21 Soil Washing	F	Y	S L	B	■	○	■	○	○	○	■	■	■	■	△	■
4.22 Soil Vapor Extraction	F	N	L	N	■	■	○	■	■	■	○	○	○	△	△	△
4.23 Solar Detoxification	P	N	N	Cap.	○	○	○	■	■	■	■	■	■	△	△	■
4.24 Solidification /Stabilization □□ Bituminization □□ Emulsified Asphalt □□ Modified Sulfur Cement □□ Polyethylene Extrusion □□ Pozzolan/Portland Cement □□ Radioactive Waste Solidification □□ Sludge Stabilization □□ Soluble Phosphates □□ Vitrification/Molten Glass	F	N	S	Cap.	■	■	■	○	△	△	○	○	△	■	■	△
3.6 Ex Situ Thermal Treatment (assuming excavation)																
4.25 Hot Gas Decontamination	P	N	N	B	○	■	■	■	△	△	△	△	△	△	△	■

4.26 Incineration □□ Circulating Bed Combustor □□ Fluidized Bed □□ Infrared Combustion □□ Rotary Kiln	F	N	L S V	B	■	○	■	△	■	■	■	■	■	△	△	■
4.27 Open Burn/Open Detonation	F	N	S	B	■	■	■	■	△	△	△	△	△	△	△	■
4.28 Pyrolysis □□ Fluidized Bed □□ Molten Salt Destruction □□ Rotary Kiln	F	N	L S	B	△	I	■	△	○	○	■	■	○	△	△	I
4.29 Thermal Desorption □□ High Temperature □□ Low Temperature	F	Y	L S	B	■	○	■	○	■	■	■	■	■	△	△	■
3.7 Containment																
4.30 Landfill Cap □□ Asphalt/Concrete Cap □□ RCRA Subtitle C Cap □□ RCRA Subtitle D Cap	NA	N	NA	N	■	■	△	■	○	○	○	○	○	○	△	○
4.31 Landfill Cap Enhancements □□ Water Harvesting □□ Vegetative Cover	NA	N	NA	N	■	■	△	■	○	○	○	○	○	○	△	○
3.8 Other Treatment																
4.32 Excavation, Retrieval, and Off-Site Disposal	NA	N	NA	N	■	■	■	△	○	○	○	○	○	○	△	○
Ground Water, Surface Water, and Leachate																
3.9 In Situ Biological Treatment																
4.33 Co-metabolic Treatment	P	N	N	O&M	△	◆	◆	◆	■	◆	■	◆	◆	△	△	○
4.34 Enhanced Biodegradation □□ Nitrate Enhancement □□ Oxygen Enhancement with Air Sparging □□ Oxygen Enhancement with Hydrogen Peroxide	F	N	N	O&M	■	◆	◆	◆	■	◆	■	◆	■	△	△	○
4.35 Natural Attenuation	F	N	N	O&M	■	◆	◆	◆	◆	◆	◆	◆	◆	△	△	△
4.36 Phytoremediation □□ Enhanced Rhizosphere Biodegradation □□ Hydraulic Control □□ Phyto-Degradation □□ Phyto-Volatilization	P	N	N	N	○	■	△	■	○	○	○	○	○	■	△	■
3.10 In Situ Physical/Chemical Treatment																
4.37 Aeration	F	Y	V	N	■	○	■	■	■	■	○	○	■	△	△	△
4.38 Air Sparging	F	Y	V	N	■	■	■	■	■	■	△	△	■	△	△	△
4.39 Bioslurping	F	Y	L V	N	■	○	○	■	○	○	■	■	■	△	△	○

4.40 Directional Wells (enhancement)	F	N	NA	Cap.	△	○	■	I	○	○	○	○	○	○	△	○
4.41 Dual Phase Extraction	F	Y	L V	O&M	■	○	○	○	■	■	△	△	■	△	△	△
4.42 Fluid/Vapor Extraction	F	Y	L V	O&M	■	○	○	○	■	■	○	○	■	△	△	△
4.43 Hot Water or Steam Flushing/Stripping	P	Y	L V	Cap.	■	△	■	○	○	○	■	■	■	△	△	△
4.44 Hydrofracturing	P	Y	N	N	I	■	■	○	○	○	○	○	○	○	△	○
4.45 In-Well Air Stripping □□ Circulating Wells	P	Y	L V	Cap.	■	■	○	○	■	■	○	○	■	I	△	△
4.46 Passive /Rreactive Treatment Walls □□ Funnel and Gate □□ Iron Treatment Wall	F	N	S	Cap.	■	I	△	I	■	■	■	■	○	■	△	■
3.11 Ex Situ Biological Treatment																
4.47 Biorcactors	F	N	S	Cap.	■	○	○	■	■	■	■	◈	■	△	△	■
4.48 Constructed Wetlands	F	N	S	Cap.	△	◈	◈	○	○	○	○	◈	○	■	△	■
3.12 Ex Situ Physical/Chemical Treatment (assuming pumping)																
4.49 Adsorption/ Absorption □□ Activated Alumina □□ Forager Sponge □□ Lignin Adsorption/ Sorptive Clays □□ Synthetic Resins	P	N	S	I	○	I	I	△	○	○	○	○	△	■	◈	△
4.50 Air Stripping	F	N	L V	O&M	■	■	○	■	■	■	○	○	○	△	△	△
4.51 Granulated Activated Carbon (GAC)/Liquid Phase Carbon Adsorption	F	N	S	O&M	■	■	■	◈	■	■	■	■	○	△	△	△
4.52 Ion Exchange	F	Y	S	N	■	■	○	■	△	△	△	△	△	■	○	△
4.53 Precipitation/ Coagulation /Flocculation □□ Coagulants and Flocculation	F	Y	S	N	■	■	○	■	△	△	△	△	△	■	○	I
4.54 Separation □□ Distillation □□ Filtration/ Ultrafiltration /Microfiltration □□ Freeze Crystallization □□ Membrane Pervaporation □□ Reverse Osmosis	F	Y	S	B	■	■	■	△	■	■	■	■	■	◈	◈	△
4.55 Sprinkler Irrigation □□ Trickling Filter	F	Y	S L	N	■	○	○	■	■	■	■	■	■	△	△	△
4.56 UV Oxidation □□ UV Photolysis	F	N	N	B	■	△	NA	○	■	■	■	■	■	△	△	■
3.13 Containment																

4.57 Deep Well Injection	F	N	S L	N	■	○	NA	■	○	○	○	○	○	○	○	○
4.58 Ground Water Pumping □□ Surfactant Enhanced Recovery □□ Drawdown Pumping	F	N	L	B	■	■	NA	△	○	○	○	○	○	○	△	○
4.59 Slurry Walls	F	N	NA	Cap.	■	■	■	■	○	○	○	○	○	○	△	○
3.14 Air Emissions/Off-Gas Treatment																
4.60 Biofiltration	F	NA	S L	N	○	◆	■	■	■	◆	◆	◆	■	△	NA	◆
4.61 High Energy Destruction □□ High Energy Corona □□ Tunable Hybrid Plasma Reactor	P	NA	N	I	△	△	NA	○	■	■	■	■	■	○	NA	△
4.62 Membrane Separation	P	NA	N	I	△	△	NA	○	■	■	○	○	○	△	NA	○
4.63 Oxidation □□ Catalytic Oxidation □□ Internal Combustion Engine Oxidation □□ Thermal Oxidation □□ Ultraviolet Oxidation	F	NA	N	N	■	■	NA	■	■	■	■	■	■	△	NA	○
4.64 Vapor Phase Carbon Adsorption □□ VOC Recovery and Recycle	F	NA	S	N	■	■	NA	■	■	■	■	■	■	○	NA	■

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APPENDIX B

Infeasible Technologies

4.6 Electrokinetic Separation

(In Situ Soil Remediation Technology)

Technology	Description
Soil, Sediment, and Sludge	
3.2 In Situ Physical/Chemical Treatment	
4.6 Electrokinetic Separation	The Electrokinetic Remediation (ER) process removes metals and organic contaminants from low permeability soil, mud, sludge, and marine dredging. ER uses electrochemical and electrokinetic processes to desorb, and then remove, metals and polar organics. This in situ soil processing technology is primarily a separation and removal technique for extracting contaminants from soils.

Description:

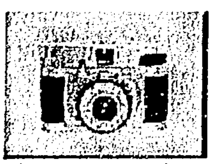

Figure 4-6: Typical In Situ Electrokinetic Separation System

The principle of electrokinetic remediation relies upon application of a low-intensity direct current through the soil between ceramic electrodes that are divided into a cathode array and an anode array. This mobilizes charged species, causing ions and water to move toward the electrodes. Metal ions, ammonium ions, and positively charged organic compounds move toward the cathode. Anions such as chloride, cyanide, fluoride, nitrate, and negatively charged organic compounds move toward the anode. The current creates an acid front at the anode and a base front at the cathode. This generation of acidic condition in situ may help to mobilize sorbed metal contaminants for transport to the collection system at the cathode.

The two primary mechanisms transport contaminants through the soil towards one or the other electrodes: electromigration and electroosmosis. In electromigration, charged particles are transported through the substrate. In contrast, electroosmosis is the movement of a liquid containing ions relative to a stationary charged surface. Of the two, electromigration is the main mechanism for the ER process. The direction and rate of movement of an ionic species will depend on its charge, both in magnitude and polarity, as well as the magnitude of the electroosmosis-induced flow velocity. Non-ionic species, both inorganic and organic, will also be transported along with the electroosmosis induced water flow.

Two approaches are taken during electrokinetic remediation: "Enhanced Removal" and "Treatment without Removal".

"Enhanced Removal" is achieved by electrokinetic transport of contaminants toward the polarized electrodes to concentrate the contaminants for subsequent removal and ex-situ treatment. Removal of contaminants at the electrode may be accomplished by several means among which are: electroplating at the electrode; precipitation or co-precipitation at the electrode; pumping of water near the electrode; or complexing with ion exchange resins. Enhanced removal is widely used on remediation of soils contaminated metals.

"Treatment without Removal" is achieved by electro-osmotic transport of contaminants through treatment zones placed between electrodes. The polarity of the electrodes is reversed periodically, which reverses the direction of the contaminants back and forth through treatment zones. The frequency with which electrode polarity is reversed is determined by the rate of transport of contaminants through the soil. This approach can be used on in-situ remediation of soils contaminated with organic species.

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Synonyms:

Electrokinetics; Electromigration.

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Applicability:

Targeted contaminants for electrokinetics are heavy metals, anions, and polar organics in soil, mud, sledge, and marine dredging. Concentrations that can be treated range from a few parts per million (ppm) to tens of thousands ppm. Electrokinetics is most applicable in low permeability soils. Such soils are typically saturated and partially saturated clays and silt-clay mixtures, and are not readily drained.

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Limitations:

Factors that may limit the applicability and effectiveness of this process include:

- Effectiveness is sharply reduced for wastes with a moisture content of less than 10 percent. Maximum effectiveness occurs if the moisture content is between 14 and 18 percent.
- The presence of buried metallic or insulating material can induce variability in the electrical conductivity of the soil, therefore, the natural geologic spatial variability should be delineated. Additionally, deposits that exhibit very high electrical conductivity, such as ore deposits, cause the technique to be inefficient.
- Inert electrodes, such as carbon, graphite, or platinum, must be used so that no residue will be introduced into the treated soil mass. Metallic electrodes may dissolve as a result of electrolysis and introduce corrosive products into the soil mass.
- Electrokinetics is most effective in clays because of the negative surface charge of clay particles. However, the surface charge of the clay is altered by both charges in the pH of the pore fluid and the adsorption of contaminants. Extreme pH at the electrodes and reduction-oxidation changes induced by the process electrode reactions many inhibit ER's effectiveness, although acidic conditions (i.e., low pH) may help to remove metals.
- Oxidation/reduction reactions can form undesirable products (e.g., chlorine gas).

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Data Needs:

A detailed discussion of data elements is provided in Subsection 2.2.1 (Data Requirements for Soil, Sediment and Sludge).

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Performance Data:

There have been few, if any, commercial applications of electrokinetic remediation in the United States. The electrokinetic technology has been operated for test and demonstration purposes at the pilot scale and at full scale at the following sites: (1) Louisiana State University, (2) Electrokinetics, Inc., (3) Geokinetics International, Inc., and (4) Battelle Memorial Institute. Geokinetics International, Inc.(GII) has successfully demonstrated the in situ electrokinetic remediation process in five field sites in Europe.

In 1996, a comprehensive demonstration study of lead extraction at a U.S.Army firing range in Louisiana was conducted by DoD's Small Business Innovative Research Program and

Electrokinetics, Inc. The EPA taking part in independent assessments of the results, found pilot-scale studies have demonstrated that concentrations of lead decreased to less than 300 mg/kg in 30 weeks of electrokinetic processing when the soils where originally contaminated as high as 4,500 mg/kg of lead.

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Cost:

Costs will vary with the amount of soil to be treated, the conductivity of the soil, the type of contaminant, the spacing of electrodes, and the type of process design employed. Ongoing pilot-scale studies using "real-world" soils indicate that the energy expenditures in extraction of metals from soils may be 500 kWh/m^3 or more at electrode spacing of 1.0m to 1.5m. Direct costs estimates of about \$15/m^3 for a suggested energy expenditure of \$0.03 per kilowatt hours, together with the cost of enhancement, could result in direct costs of \$50/m^3 or more. If no other efficient in situ technology is available to remediate fine-grained and heterogeneous subsurface deposits contaminated with metals, this technique would remain potentially competitive.

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References:

EPA, 1996. ***Recent Development for In Situ Treatment of Metal Contaminated Soil***. EPA Office of Solid Waste & Emergency Response. Technology Innovative Office. Washington, DC.

USAEC, 1997. **"In-situ Electrokinetic Remediation for Metal Contaminated Soils"** in *Innovative Technology Demonstration, Evaluation and Transfer Activities, FY 96 Annual Report*, Report No. SFIM-AEC-ET-CR-97013, pp. 87-88.

U.S. DOE, 1995. **"Electrokintic Remediation of Heavy Metals and Radionuclides,"** in *Technology Catalogue, Second Edition*, Office of Environmental Management Office of Technology Development, DOE/EM-0235, pp. 201-203.

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Site Information:

- **Army Demo**, U.S. Army Waterways Experiment Station, Baton Rouge Louisiana
- An Underground Storage Tank Spill
- **DOE Demo**, Oak Ridge K-25 facility, Tennessee
- **DOE Demo**: Sandia National Laboratories Chemical Waste Landfill
- **EPA/DOE Demo**: DOE Gaseous Diffusion Plant, Paducah, Kentucky
- **DOE Demo**, Old TNX Basin, Savannah River Site, South Carolina
- **U.S. Army**, firing range, LA
- Additional site information on the FRTR web site

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Points of Contact:

General FRTR Agency Contacts

Technology Specific Web Sites:

Government Web Sites

Non-Government Web Sites

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Vendor Information:

A list of vendors offering In Situ Physical/Chemical Soil Treatment is available from the Vendor Information System for Innovative Treatment Technologies (VISITT) developed by U.S. Environmental Protection Agency (EPA).

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Health and Safety:.

To be added

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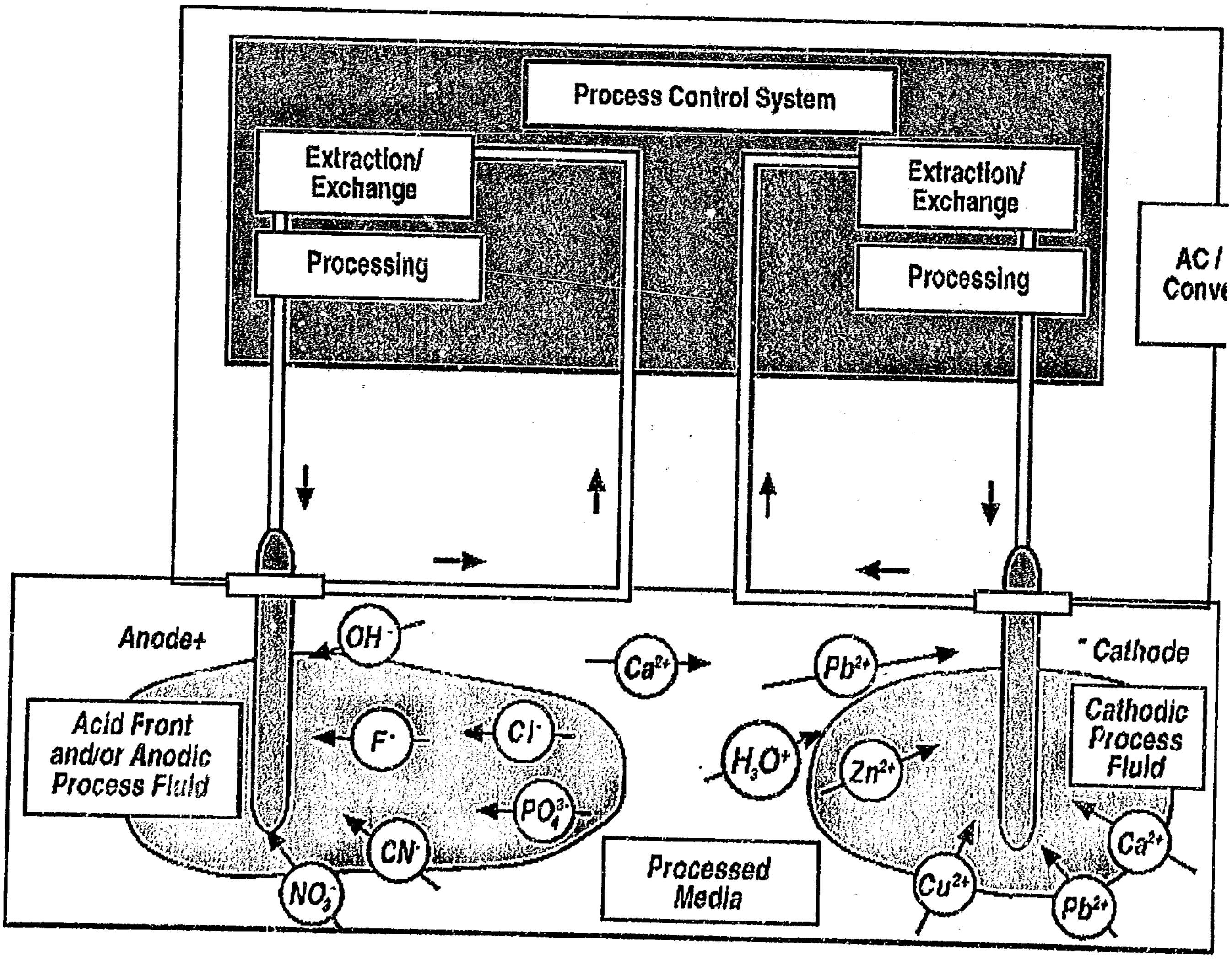

Process Control System
Extraction/ Exchange
Processing
Extraction/ Exchange
Processing
AC /
Conve
Anode+
Cathode
Acid Front and/or Anodic Process Fluid
Cathodic Process Fluid
Processed Media

4.8 Soil Flushing

(In Situ Soil Remediation Technology)

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Description | Synonyms | Applicability | Limitations
Data Needs | Performance | Cost | References
Site Information | Points of Contact | Vendor Information | Health & Safety

Technology	Description
Soil, Sediment, and Sludge	
3.2 In Situ Physical/Chemical Treatment	
4.8 Soil Flushing	Water, or water containing an additive to enhance contaminant solubility, is applied to the soil or injected into the ground water to raise the water table into the contaminated soil zone. Contaminants are leached into the ground water, which is then extracted and treated.

Description:

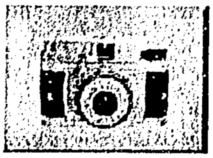

Figure 4-8:
Typical Soil Flushing System

In situ soil flushing is the extraction of contaminants from the soil with water or other suitable aqueous solutions. Soil flushing is accomplished by passing the extraction fluid through in-place soils using an injection or infiltration process. Extraction fluids must be recovered from the underlying aquifer and, when possible, they are recycled.

➤ ***Cosolvent Enhancement***

Cosolvent flushing involves injecting a solvent mixture (e.g., water plus a miscible organic solvent such as alcohol) into either vadose zone, saturated zone, or both to extract organic contaminants. Cosolvent flushing can be applied to soils to dissolve either the source of contamination or the contaminant plume emanating from it. The cosolvent mixture is normally injected upgradient of the contaminated area, and the solvent with dissolved contaminants is extracted downgradient and treated above ground.

Recovered ground water and flushing fluids with the desorbed contaminants may need treatment to meet appropriate discharge standards prior to recycle or release to local, publicly owned wastewater treatment works or receiving streams. To the maximum extent practical, recovered fluids should be reused in the flushing process. The separation of surfactants from recovered flushing fluid, for reuse in the process, is a major factor in the cost of soil flushing. Treatment of the recovered fluids results in process sludges and residual solids, such as spent carbon and spent ion exchange resin, which must be appropriately treated before disposal. Air emissions of volatile contaminants from recovered flushing fluids should be collected and treated, as appropriate, to meet applicable regulatory standards. Residual flushing additives in the soil may be a concern and should be evaluated on a site-specific basis.

The duration of soil flushing process is generally short- to medium-term.

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Synonyms:

DSERTS Code: M12 (Soil Flushing).

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Applicability:

The target contaminant group for soil flushing is inorganics including radioactive contaminants. The technology can be used to treat VOCs, SVOCs, fuels, and pesticides, but it may be less cost-effective than alternative technologies for these contaminant groups. The addition of environmentally compatible surfactants may be used to increase the effective solubility of some organic compounds; however, the flushing solution may alter the physical/chemical properties of the soil system. The technology offers the potential for recovery of metals and can mobilize a wide range of organic and inorganic contaminants from coarse-grained soils.

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Limitations:

Factors that may limit the applicability and effectiveness of the process include:

- Low permeability or heterogeneous soils are difficult to treat.
- Surfactants can adhere to soil and reduce effective soil porosity.
- Reactions of flushing fluids with soil can reduce contaminant mobility.
- The potential of washing the contaminant beyond the capture zone and the introduction of surfactants to the subsurface concern regulators. The technology should be used only where flushed contaminants and soil flushing fluid can be contained and recaptured.
- Aboveground separation and treatment costs for recovered fluids can drive the economics of the process.

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Data Needs:

A detailed discussion of these data elements is provided in Subsection 2.2.1 (Data Requirements for Soil, Sediment, and Sludge). Treatability tests are required to determine the feasibility of the specific soil-flushing process being considered. Physical and chemical soil characterization parameters that should be established include soil permeability, soil structure, soil texture, soil porosity, moisture content, total organic carbon (TOC), cation exchange capacity (CEC), pH, and buffering capacity.

Contaminant characteristics that should be established include concentration, solubility, partition coefficient, solubility products, reduction potential, and complex stability constants. Soil and contaminant characteristics will determine the flushing fluids required, flushing fluid compatibility, and changes in flushing fluids with changes in contaminants.

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Performance Data:

Soil flushing is a developing technology that has had limited use in the United States. Typically, laboratory and field treatability studies must be performed under site-specific conditions before soil flushing is selected as the remedy of choice. To date, the technology has been selected as part of the source control remedy at 12 Superfund sites. This technology is currently operational at only one Superfund site; a second was scheduled to begin operation in 1991. EPA completed construction of a mobile soil-flushing system, the In Situ Contaminant/Treatment Unit, in 1988. This mobile soil-flushing system is designed for use at spills and uncontrolled hazardous waste sites. There has been very little commercial success with this technology.

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Cost:

The cost of soil flushing depends greatly on the type and concentration of surfactants used, if they are used at all. Rough estimates ranging from $25 to $250 per cubic yard have been reported.

Additional cost information can be found in the Hazardous, Toxic, and Radioactive Wastes (HTRW) Historical Cost Analysis System (HCAS) developed by Environmental Historical Cost Committee of Interagency Cost Estimation Group.

Go to HCAS

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References:

AATDF, 1997. *Technology Practices Manual for Surfactants and Cosolvents*, Technical Report, Document No. TR-97-2.

EPA, 1991. ***In Situ Soil Flushing***, Engineering Bulletin, EPA/540/2-91/021.

EPA, 1994. ***In Situ Remediation Technology Status Report: Cosolvent***, Engineering Bulletin, EPA/542/K-94/006.

EPA, 1996. ***A Citizen's Guide to In Situ Soil Flushing***, Technology Fact Sheet, EPA/542/F-96/006.

EPA, 1997. ***Best Management Practices (BMPs) for Soil Treatment Technologies: Suggested Operational Guidelines to Prevent Cross-media Transfer of Contaminants During Clean-UP Activities***, EPA OSWER, EPA/530/R-97/007.

Nash J., R.P. Traver, and D.C. Downey, 1986. "Surfactant-Enhanced In Situ Soils Washing", USAF Engineering and Services Laboratory, Florida. ESL-TR-97-18, Available from NTIS, Springfield, VA, Order No. ADA188066.

Sturges, S.G., Jr., P. McBeth, Jr., R.C. Pratt, 1992. "Performance of Soil Flushing and Groundwater Extraction at the United Chrome Superfund Site," ***Journal of Hazardous Materials***, El Savior Science Pub., B.V., Amsterdam, Vol. 29, pp. 59-78.

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Site Information:

- Laramie Tie Plant, WY

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Points of Contact:

General FRTR Agency Contacts

Technology Specific Web Sites:

Government Web Sites

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Vendor Information:

A list of vendors offering In Situ Physical/Chemical Soil Treatment is available from the Vendor Information System for Innovative Treatment Technologies (VISITT) developed by U.S. Environmental Protection Agency (EPA).

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Health and Safety:

HTRW Hazard Analysis

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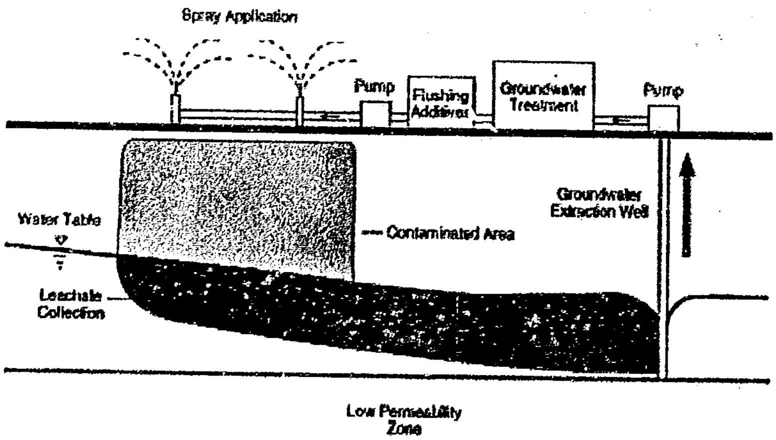

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4.10 Solidification/Stabilization

(In Situ Soil Remediation Technology)

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Description | Synonyms | Applicability | Limitations
Data Needs | Performance | Cost | References
Site Information | Points of Contact | Vendor Information | Health & Safety

Technology	Description
Soil, Sediment, and Sludge	
3.2 In Situ Physical/Chemical Treatment	
4.10 In Situ Solidification/ Stabilization	Contaminants are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization).

Description:

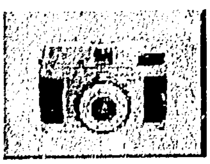

Figure 4-10a:
Typical Auger/Caisson and Reagent/Injector Head Systems

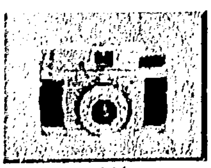

Figure 4-10b:
Typical In Situ Vitrification System

Solidification/stabilization (S/S) reduces the mobility of hazardous substances and contaminants in the environment through both physical and chemical means. Unlike other remedial technologies, S/S seeks to trap or immobilize contaminants within their "host" medium (i.e., the soil, sand, and/or building materials that contain them), instead of removing them through chemical or physical treatment. Leachability testing is typically performed to measure the immobilization of contaminants. S/S techniques can be used alone or combined with other treatment and disposal methods to yield a product or material suitable for land disposal or, in other cases, that can be applied to beneficial use. These techniques have been used as both final and interim remedial measures.

Auger/caisson systems and injector head systems are techniques used in soil S/S. They apply S/S agents to soils to trap or immobilize contaminants.

Bottom barriers are horizontal subsurface barriers that prevent vertical migration by providing a floor of impermeable material beneath the waste. The installation of a grout injection bottom barrier involves directional drilling with forced grout injection. Implementation of this technology is highly dependent on the physical properties of soil.

➤ ***In Situ Vitrification (ISV)***

In situ vitrification (ISV) is another in situ S/S process which uses an electric current to melt soil or other earthen materials at extremely high temperatures (1,600 to 2,000 °C or 2,900 to 3,650 °F) and thereby immobilize most inorganics and destroy organic pollutants by pyrolysis. Inorganic pollutants are incorporated within the vitrified glass and crystalline mass. Water vapor and organic pyrolysis combustion products are captured in a hood, which draws the contaminants into an off-gas treatment system that removes particulates and other pollutants from the gas. The vitrification product is a chemically stable, leach-resistant, glass and crystalline material similar to obsidian or basalt rock. The process destroys and/or removes organic materials. Radionuclides and heavy metals are retained within the molten soil.

The timeframe for in situ S/S is short- to medium-term, while in situ ISV process is typically short-term.

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Synonyms:

DSERTS Codes: M13 (Vitrification).
N11 (Solidification/Stabilization)

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Applicability:

The target contaminant group for in situ S/S is generally inorganics (including radionuclides).

The Auger/Caisson and Reagent/Injector Head Systems have limited effectiveness against SVOCs and pesticides and no expected effectiveness against VOCs; however, systems designed to be more effective in treating organics are being developed and tested.

The ISV process can destroy or remove organics and immobilize most inorganics in contaminated soils, sludge, or other earthen materials. The process has been tested on a broad range of VOCs and SVOCs, other organics including dioxins and PCBs, and on most priority pollutant metals and radionuclides.

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Limitations:

Factors that may limit the applicability and effectiveness of the in situ S/S include:

- Depth of contaminants may limit some types of application processes.
- Future usage of the site may "weather" the materials and affect ability to maintain immobilization of contaminants.
- Some processes result in a significant increase in volume (up to double the original volume).
- Certain wastes are incompatible with variations of this process. Treatability studies are generally required.
- Reagent delivery and effective mixing are more difficult than for ex situ applications.
- Like all in situ treatments, confirmatory sampling can be more difficult than for ex situ treatments.
- The solidified material may hinder future site use.
- Processing of contamination below the water table may require dewatering.

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Data Needs:

A detailed discussion of these data elements is provided in Subsection 2.2.1 (Data Requirements for Soil, Sediment, and Sludge). Data needs include particle size, Atterberg limits, moisture content, metal concentrations, sulfate content, organic content, density, permeability, unconfined compressive strength, leachability, pH, and microstructure analysis. For ISV, a minimum alkali content in soil (sodium and potassium oxides) of 1.4 wt% is necessary to form glass. The composition of most soils is well within the range of processability.

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Performance Data:

Auger/Caisson and Reagent/Injector Head Systems processes are well demonstrated, can be applied to the most common site and waste types, require conventional materials handling equipment, and are available competitively from a number of vendors. Most reagents and additives are also widely available and relatively inexpensive industrial commodities.

Auger/Caisson and Reagent/Injector Head Systems processes have demonstrated the capability to reduce the mobility of contaminated waste by greater than 95%. The effects, over the long term, of weathering (e.g., freeze-thaw cycles, acid precipitation, and wind erosion), ground water infiltration, and physical disturbance associated with uncontrolled future land use can significantly affect the integrity of the stabilized mass and contaminant mobility in ways that cannot be predicted by laboratory tests.

There have been few, if any, commercial applications of ISV. The ISV process has been operated for test and demonstration purposes at the pilot scale and at full scale at the following sites: (1) Geosafe Corporation's test site, (2) DOE's Hanford Nuclear Reservation, (3) DOE's Oak Ridge National Laboratory, and (4) DOE's Idaho National Engineering Laboratory. More than 170 tests at various scales have been performed on a broad range of waste types in soils and sludge. A demonstration will take place at the Parsons/ETM site in Grand Ledge, Michigan, where the process is currently operating.

Process depths up to 6 meters (19 ft) have been achieved in relatively homogeneous soils. The achievable depth is limited under certain heterogeneous conditions.

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Cost:

Costs for Auger/Caisson and Reagent/Injector Head Systems processes vary widely according to materials or reagents used, their availability, project size, and chemical nature of contaminants (e.g., types and concentration levels for shallow applications). The in situ soil mixing/auger techniques average $50 to $80 per cubic meter ($40 to $60 per cubic yard) for the shallow applications and $190 to $330 per cubic meter ($150 to $250 per cubic yard) for the deeper applications.

The shallow soil mixing technique processes 36 to 72 metric tons (40 to 80 tons) per hour on average, and the deep soil mixing technique averages 18 to 45 metric tons (20 to 50 tons) per hour.

The major factor driving the selection process beyond basic waste compatibility is the availability of suitable reagents. Auger/Caisson and Reagent/Injector Head Systems processes require that potentially large volumes of bulk reagents and additives be transported to project sites. Transportation costs can dominate project economics and can quickly become uneconomical in cases where local or regional material sources are unavailable.

The cost for grout injection varies depending on site-specific conditions. Costs for drilling can range from $50 to $150/ft and grouting from $50 to $75/ft, not including mobilization, wash disposal, or adverse site condition expenses.

For ISV, average costs for treatability tests (all types) are $25K plus analytical fees; for PCBs and dioxins, the cost is $30K plus analytical. Equipment mobilization and demobilization costs are $200K to $300K combined. Vitrification operation cost varies with electricity costs, quantity of water, and depth of process.

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References:

California Base Closure Environmental Committee (CBCEC), 1994. ***Treatment Technologies Applications Matrix for Base Closure Activities, Revision 1***, Technology Matching Process Action Team, November, 1994.

DOE, 1992. ***In Situ Vitrification***, Technology Transfer Bulletin, prepared by Battelle's Pacific Northwest Laboratories for DOE, Richland, WA.

DOE, January 1992. "**ISV Planning and Coordination,**" *FY92 Technical Task Plan and Technical Task Description*, TTP Reference No. RL-8568-PT.

DOE, July 1992. "**116-B-6A Crib ISV Demonstration Project,**" *FY92 Technical Task Plan and*

Technical Task Description, TTP Reference No. RL-8160-PT.

DOE, April 1995. ***Technology Catalogue****, Second Edition*, Office of Environmental Management & Office of Technology Development, DOE/EM-0235.

EPA, 1989. ***Chemfix Technologies, Inc. Chemical Fixation/Stabilization***, EPA RREL, series includes Technology Evaluation, Vol. I, EPA/540/5-89/011a, PB91-127696, and Technology Evaluation, Vol. II, EPA/540/5-89/011b, PB90-274127.

EPA, 1989. ***Hazcon Solidification***, EPA RREL, series includes Technology Evaluation, Vol. I, EPA/540/5-89/001a, PB89-158810; Technology Evaluation, Vol. II, EPA/540/5-89/001b, PB89-158828; Applications Analysis, EPA/540/A5-89/001; and Technology Demonstration Summary, EPA/540/S5-89/001.

EPA, 1989. ***IWT/GeoCon In-Situ Stabilization***, EPA RREL, series includes Technology Evaluation, Vol. I, EPA/540/5-89/004a; Technology Evaluation, Vol. II, EPA/540/5-89/004b, PB89-194179; Technology Evaluation, Vol. III, EPA/540/5-89/004c, PB90-269069; Technology Evaluation, Vol. IV, EPA/540/5-89/004d, PB90-269077; Applications Analysis, EPA/540/A5-89/004; Technology Demonstration Summary, EPA/540/S5-89/004; Technology Demonstration Summary Update Report, EPA/540/S5-89/004a; and Demonstration Bulletin, EPA/540/M5-89/004.

EPA, 1989. ***SITE Program Demonstration Test International Waste Technologies In Situ Stabilization/Solidification Hialeah, Florida***, Technology Evaluation Report, EPA RREL, Cincinnati, OH, EPA/540/5-89/004a.

EPA, 1989. ***Soliditech, Inc. Solidification***, EPA RREL, series includes Technology Evaluation, Vol. I, EPA/540/5-89/005a; Technology Evaluation, Vol. II, EPA/540/5-89/005b, PB90-191768; Applications Analysis, EPA/540/A5-89/005; Technology Demonstration Summary, EPA/540/S5-89/005; and Demonstration Bulletin, EPA/540/M5-89/005.

EPA, 1989. ***Stabilization/Solidification of CERCLA and RCRA Wastes: Physical Tests, Chemical Testing Procedures, Technology Screening, and Field Activities***, EPA, CERL, Cincinnati, OH, EPA/625/6-89/022.

EPA, 1990. ***International Waste Technologies/Geo-Con In Situ Stabilization/Solidification***, Applications Report, EPA, ORD, Washington, DC, EPA/540/A5-89/004.

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EPA, 1995. ***Remediation Case Studies: Thermal Desorption, Soil Washing, and In Situ Vitrification***, Federal Remediation Technologies Roundtable, Report, EPA/542/R-95/005.

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EPA, 1997. ***Technology Alternatives for the Remediation of Soils Contaminated with As, Cd, Cr, Hg, and Pb***, Engineering Bulletin, EPA540/R-97/008.

Federal Remediation Technologies Roundtable, 1995. ***Remediation Case Studies: Thermal Desorption, Soil Washing, and In Situ Vitrification***, EPA/542/R-95/005.

- In Situ Vitrification at the Parsons Chemical/ETM Enterprises Superfund Site Grand Ledge, Michigan (interim results)

Federal Remediation Technologies Roundtable, 1997. ***Remediation Case Studies: Bioremediation and Vitrification***, EPA/542/R-97/008.

- In Situ Vitrification at the Parsons Chemical/ETM Enterprises Superfund Site, Grand Ledge, Michigan
- In Situ Vitrification, U.S. Department of Energy, Hanford Site, Richland, Washington; Oak Ridge National Laboratory WAG 7; and Various Commercial Sites.

Rumer, R. and J.K., Mitchell (eds.), 1995. ***Assessment of Barrier Containment Technologies - a Comprehensive Treatment for Environmental Remediation Applications***, International Containment Technology Workgroup, Baltimore.

Wiles, C.C., 1991. ***Treatment of Hazardous Waste with Solidification/Stabilization***, EPA Report EPA/600/D-91/061.

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Site Information:

- EPA *SITE* Demo: Hialeah, FL
- EPA Demo: Geosafe Test Site, WA; Hanford Nuclear Reservation, WA
- DOE Demo: Hanford Reservation, WA
- EPA Demo: Douglassville, PA
- Parsons Chemical/ETM Enterprises Superfund Site, Grand Ledge, MI (interim report)
- Parsons Chemical/ETM Enterprises Superfund Site, Grand Ledge, MI (final report)
- Hanford Site, Richland, WA; Oak Ridge National Lab WAG 7
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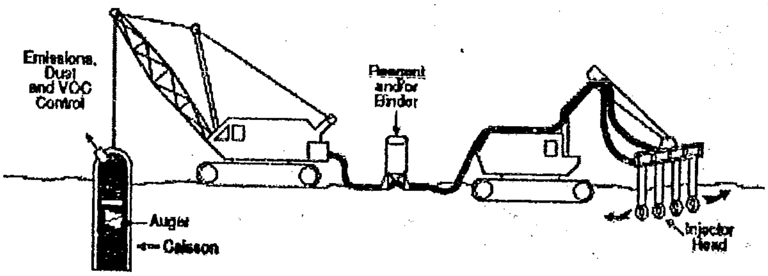

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4.17 Chemical Extraction

(Ex Situ Soil Remediation Technology)

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Description | Synonyms | Applicability | Limitations
Data Needs | Performance | Cost | References
Site Information | Points of Contact | Vendor Information | Health & Safety

Technology	Description
Soil, Sediment, and Sludge	
3.5 Ex Situ Physical/Chemical Treatment (assuming excavation)	
4.17 Chemical Extraction	Waste contaminated soil and extractant are mixed in an extractor, dissolving the contaminants. The extracted solution is then placed in a separator, where the contaminants and extractant are separated for treatment and further use.

Description:

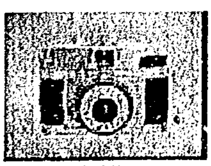

Figure 4-17: Typical Solvent Extraction Process

Chemical extraction does not destroy wastes but is a means of separating hazardous contaminants from soils, sludges, and sediments, thereby reducing the volume of the hazardous waste that must be treated. The technology uses an Extracting chemical and differs from soil washing, which generally uses water or water with wash-improving additives. Commercial-scale units are in operation. They vary in regard to the Chemical employed, type of equipment used, and mode of operation.

Physical separation steps are often used before chemical extraction to grade the soil into coarse and fine fractions, with the assumption that the fines contain most of the contamination. Physical separation can also enhance the kinetics of extraction by separating out particulate heavy metals, if these are present in the soil.

➤ *Acid Extraction*

Acid can also be used as the extractant. Acid extraction uses hydrochloric acid to extract heavy metal contaminants from soils. In this process, soils are first screened to remove coarse solids. Hydrochloric acid is then introduced into the soil in the extraction unit. The residence time in the unit varies depending on the soil type, contaminants, and contaminant concentrations, but generally ranges between 10 and 40 minutes. The soil-extractant mixture is continuously pumped out of the mixing tank, and the soil and extractant are separated using hydrocyclones.

When extraction is complete, the solids are transferred to the rinse system. The soils are rinsed with water to remove entrained acid and metals. The extraction solution and rinse waters are regenerated using comercially available precipitants, such as sodium hydroxide, lime, or other proprietary formulations, along with a flocculent that removes the metals and reforms the acid. The heavy metals are concentrated in a form potentially suitable for recovery. During the final step, the soils are dewatered and mixed with lime and fertilizer to neutralize any residual acid.

➤ ***Solvent Extraction***

Solvent extraction is a common form of chemical extraction using organic solvent as the extractant. It is commonly used in combination with other technologies, such as solidification/stabilization, incineration, or soil washing, depending upon site-specific conditions. Solvent extraction also can be used as a stand alone technology in some instances. Organically bound metals can be extracted along with the target organic contaminants, thereby creating residuals with special handling requirements. Traces of solvent may remain within the treated soil matrix, so the toxicity of the solvent is an important consideration. The treated media are usually returned to the site after having met Best Demonstrated Available Technology (BDAT) and other standards.

The duration of operations and maintenance for chemical extraction is medium-term.

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Synonyms:

DSERTS Codes: N16 (Acid Extraction)
N17 (Solvent Extraction)

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Applicability:

Solvent extraction has been shown to be effective in treating sediments, sludges, and soils containing primarily organic contaminants such as PCBs, VOCs, halogenated solvents, and petroleum wastes. The process has been shown to be applicable for the separation of the organic contaminants in paint wastes, synthetic rubber process wastes, coal tar wastes, drilling muds, wood-treating wastes, separation sludges, pesticide/insecticide wastes, and petroleum refinery oily wastes.

Acid extraction is suitable to treat sediments, sludges, and soils contaminated by heavy metals.

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Limitations:

Factors that may limit the applicability and effectiveness of the process include:

- Some soil types and moisture content levels will adversely impact process performance.
- Higher clay content may reduce extraction efficiency and require longer contact times.
- Organically bound metals can be extracted along with the target organic pollutants, which restricts handling of the residuals.
- The presence of detergents and emulsifiers can unfavorably influence the extraction performance.
- Traces of solvent may remain in the treated solids; the toxicity of the solvent is an important consideration.
- Solvent extraction is generally least effective on very high molecular weight organic and very hydrophilic substances.
- After acid extraction, any residual acid in treated soil needs to be neutralized.
- Capital costs can be relatively high and the technology may be more economical at larger sites.
- Meeting highly stringent heavy metals criteria (e.g., passing the California WET test) may prove uneconomical.

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Data Needs:

A detailed discussion of these data elements is provided in Subsection 2.2.1 (Data Requirements for Soil, Sediment, and Sludge). It is important to determine whether mass transfer or equilibrium will be controlling. The controlling factor is critical to the design of the unit and to the determination of whether the technology is appropriate for the waste.

Soil properties that should be determined include particle size; pH; partition coefficient; cation exchange capacity; organic content; TCLP; moisture content; and the presence of metals, volatiles, clays, and complex waste mixtures.

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Performance Data:

The performance data currently available are mostly from Resource Conservation Company (RCC). The ability of RCC's full-scale B.E.S.T.^{TM} process to separate oily feedstock into product fractions was evaluated by EPA at the General Refining Superfund site near Savannah, Georgia, in February 1987. The treated soils from this unit were backfilled to the site, product oil was recycled as a fuel oil blend, and the recovered water was pH-adjusted and transported to a local industrial wastewater treatment facility.

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Cost:

Cost estimates for this technology range from $110 to $440 per metric ton ($100 to $400 per ton), depending on the volume of soil treated.

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References:

California Base Closure Environmental Committee (CBCEC), 1994. ***Treatment Technologies Applications Matrix for Base Closure Activities, Revision 1***, Technology Matching Process Action Team, November, 1994.

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Federal Remediation Technologies Roundtable, 1998. ***Remediation Case Studies: Ex Situ Soil Treatment Technologies (Bioremediation, Solvent Extraction, Thermal Desorption)***, EPA/542/R-98/011.

- Solvent Extraction at the Sparrevohn Long Range Radar Station, Alaska

Raghavan, R., D.H. Dietz, and E. Coles, 1988. *Cleaning Excavated Soil Using Extraction Agents: A State-of-the-Art Review*, EPA Releases Control Branch, Edison, NJ, EPA Report EPA 600/2-89/034.

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Site Information:

- EPA Removal Action: Traband Warehouse PCBs, OK
- EPA Removal Action: Stanford Pesticide Site No. 1, AZ
- EPA Remedial Action: Palmetto Wood Preserving, SC
- EPA Removal Action: PBM Enterprises, MI
- EPA Removal Action: Zhiegner Refining Company
- **EPA Demo:** Midwest, California, Australia
- **EPA Demo:** Grand Calumet River Site, IL
- **EPA SITE Demo:** Research Facility, Edison, NJ
- United Creosoting, Conroe, TX
- DOE pilot-scale test, Idaho National Engineering Laboratory
- SUPERFUND Remedial Action, Arrowhead Refinery Co.
- **EPA SITE Demo:** Naval Air Station North Island Site 4, San Diego, CA
- EPA Removal Action: General Refining Company, GA
- EPA Removal Action: Vineland Chemical Company, NJ
- EPA Removal Action: Avtex Fibers, VA
- **EPA & Navy Demo:** EPA Lab, NJ
- **EPA Demo:** Douglassville, PA
- **EPA Demo**
- Star Enterprise, Port Arthur, TX
- EPA Demo: New Bedford Harbor, MA & O'Connor Site, ME
- Sparrevohn Long Range Radar Station, AK
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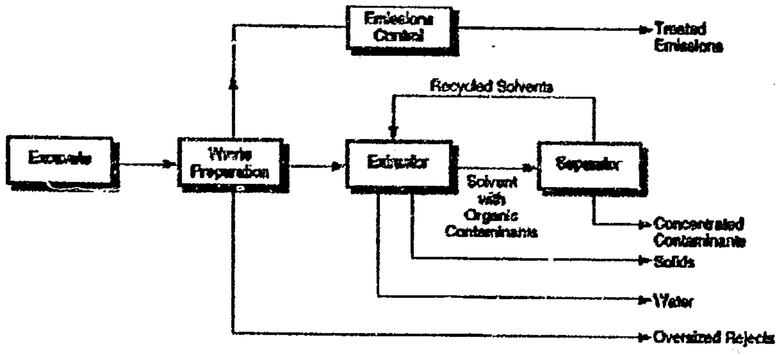

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4.18 Chemical Reduction/Oxidation

(Ex Situ Soil Remediation Technology)

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Description	Synonyms	Applicability	Limitations
Data Needs	Performance	Cost	References
Site Information	Points of Contact	Vendor Information	Health & Safety

Technology	Description
Soil, Sediment, and Sludge	
3.5 Ex Situ Physical/Chemical Treatment (assuming excavation)	
4.18 Chemical Reduction/Oxidation	Reduction/oxidation chemically converts hazardous contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. The oxidizing agents most commonly used are ozone, hydrogen peroxide, hypochlorites, chlorine, and chlorine dioxide.

Description:

Reduction/oxidation (Redox) reactions chemically convert hazardous contaminants to nonhazardous or less toxic compounds that are more stable, less mobile, and/or inert. Redox reactions involve the transfer of electrons from one compound to another. Specifically, one reactant is oxidized (loses electrons) and one is reduced (gains electrons). The oxidizing agents most commonly used for treatment of hazardous contaminants are ozone, hydrogen peroxide, hypochlorites, chlorine, and chlorine dioxide. Chemical redox is a full-scale, well-established technology used for disinfection of drinking water and wastewater, and it is a common treatment for cyanide wastes. Enhanced systems are now being used more frequently to treat contaminants in soils.

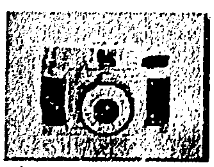

Figure 4-18: Typical Chemical Reduction/Oxidation Process

Chemical reduction/oxidation is a short- to medium-term technology.

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Synonyms:

DSERTS Code: N13 (Chemical Reduction/Oxidation).

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Applicability:

The target contaminant group for chemical redox is inorganics. The technology can be used but may be less effective against nonhalogenated VOCs and SVOCs, fuel hydrocarbons, and pesticides.

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Limitations:

Factors that may limit the applicability and effectiveness of the process include:

- Incomplete oxidation or formation of intermediate contaminants may occur depending upon the contaminants and oxidizing agents used.
- The process is not cost-effective for high contaminant concentrations because of the large amounts of oxidizing agent required.
- Oil and grease in the media should be minimized to optimize process efficiency.

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Data Needs:

A detailed discussion of these data elements is provided in Subsection 2.2.1 (Data Requirements for Soil, Sediment, and Sludge). Treatability tests should be conducted to identify parameters such as water, alkaline metals, and humus content in the soils; the presence of multiple phases; and total organic halides that could affect processing time and cost.

Performance Data:

Chemical redox is a full-scale, well-established technology used for disinfection of drinking water and wastewater, and it is a common treatment for cyanide (oxidation) and chromium (reduction of Cr (VI) to Cr (III) prior to precipitation) wastes. Enhanced systems are now being used more frequently to treat hazardous wastes in soils.

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Cost:

Estimated costs range from $190 to $660 per cubic meter ($150 to $500 per cubic yard).

Additional cost information can be found in the Hazardous, Toxic, and Radioactive Wastes (HTRW) Historical Cost Analysis System (HCAS) developed by Environmental Historical Cost Committee of Interagency Cost Estimation Group.

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References:

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Mayer, G., W. Bellamy, N. Ziemba, and L.A. Otis, 15-17 May 1990. "Conceptual Cost Evaluation of Volatile Organic Compound Treatment by Advanced Ozone Oxidation," *Second Forum on Innovative Hazardous Waste Treatment Technologies: Domestic and International*, Philadelphia, PA, EPA, Washington, DC, EPA Report EPA/2-90/010.

USAEC, 1997. "Catalyzed Hydrogen Peroxide Treatment of 2, 4, 6-Trinitrotoluene in Soils" in *Innovative Technology Demonstration, Evaluation and Transfer Activities, FY 96 Annual Report*, Report No. SFIM-AEC-ET-CR-97013, pp. 77-78.

USAEC, 1997. "Remediation of Chemical Agent Contaminated Soils Using Peroxysulfate" in *Innovative Technology Demonstration, Evaluation and Transfer Activities, FY 96 Annual Report*, Report No. SFIM-AEC-ET-CR-97013, pp. 93-94.

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Site Information:

- EPA Demo: Coleman-Evans Site, FL
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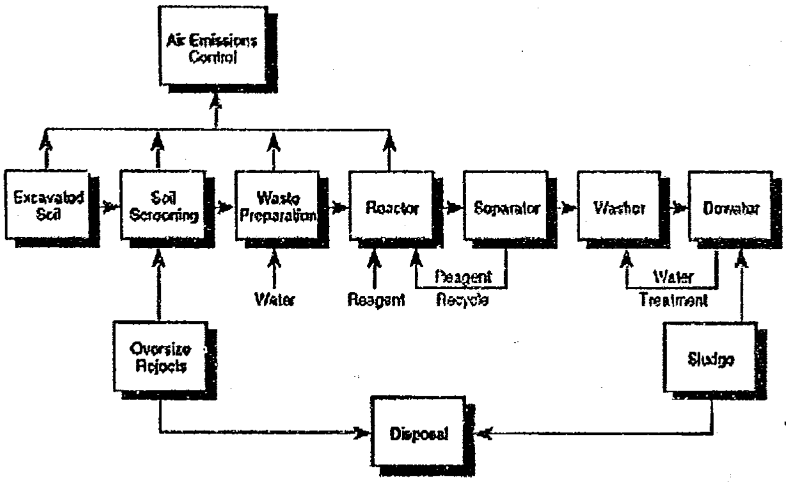

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4.20 Separation

(Ex Situ Soil Remediation Technology)

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Technology	Description
Soil, Sediment, and Sludge	
3.5 Ex Situ Physical/Chemical Treatment	
4.20 Separation	Separation techniques concentrate contaminated solids through physical and chemical means. These processes seek to detach contaminants from their medium (i.e., the soil, sand, and/or binding material that contains them).

Description:

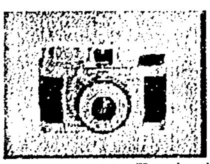

Figure 4-20: Typical Gravity Separation System

Ex situ separation can be performed by many processes. Gravity separation and sieving/physical separation are two well-developed processes that have long been primary methods for treating municipal wastewaters. Magnetic separation, on the other hand, is a much newer separation process that is still being tested.

➤ ***Gravity Separation***

Gravity separation is a solid/liquid separation process, which relies on a density difference between the phases. Equipment size and effectiveness of gravity separation depends on the solids settling velocity, which is a function of the particles size, density difference, fluid viscosity, and particle concentration (hindered settling). Gravity separation is also used for removing immiscible oil phases, and for classification where particles of different sizes are separated. It is often preceded by coagulation and flocculation to increase particle size, thereby allowing removal of fine particles.

➤ ***Magnetic Separation***

Magnetic separation is used to extract slightly magnetic radioactive particles from host materials such as water, soil, or air. All uranium and plutonium compounds are slightly magnetic while most host materials are nonmagnetic. The process operates by passing contaminated fluid or slurry through a magnetized volume. The magnetized volume contains a magnetic matrix material such as steel wool that extracts the slightly magnetic contamination particles from the slurry.

➤ ***Sieving/Physical Separation***

Sieving and physical separation processes use different size sieves and screens to effectively concentrate contaminants into smaller volumes. Physical separation is based on the fact that most organic and inorganic contaminants tend to bind, either chemically or physically, to the fine (i.e., clay and silt) fraction of a soil. The clay and silt soil particles are, in turn, physically bound to the coarser sand and gravel particles by compaction and adhesion. Thus, separating the fine clay and silt particles from the coarser sand and gravel soil particles would effectively concentrate the contaminants into a smaller volume of soil that could then be further treated or disposed.

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Synonyms:

NA

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Applicability:

The target contaminant groups for ex situ separation processes are SVOCs, fuels, and inorganics (including radionuclides). The technologies can be used on selected VOCs and pesticides. Magnetic separation is specifically used on heavy metals, radionuclides, and magnetic radioactive particles, such as uranium and plutonium compounds.

Physical separation often precedes chemical extraction treatment based on the assumption that most of the contamination is tied to the finer soil fraction, which alone may need to be treated. Separation is also useful when heavy metal contaminants occur as particulates (e.g., in small-arms ranges). One advantage of physical separation processes is that high throughputs can be achieved with relatively small equipment.

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Limitations:

Factors that may limit the applicability and effectiveness of these processes include:

- High clay and moisture content will increase treatment cost.
- Gravity separation processes rely on a difference in the solids and liquid phase densities. Specific gravity of particles will effect settling rate and process efficiency. Additionally, settling velocity is dependent on the viscosity of the suspending fluid, which must be known to estimate process efficiency and to size equipment.
- Special measures may be required to mitigate odor problems, resulting from organic sludge that undergoes septic conditions.

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Data Needs:

A detailed discussion of data elements is provided in Subsection 2.2.1 (Data Requirements for Soil, Sediment, and Sludge). In addition, particle size distribution; soil type, physical form, handling properties, and moisture content; contaminant type and concentration; texture; and organic content need to be investigated.

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Performance Data:

Gravity separation and sieving/physical separation are full-scale, well-established technologies used mostly for treatment of wastewater and contaminated soil, sediment, and sludge. Magnetic separation is a promising new technique used to remove radioactive contaminants from soils. It has recently been tested at the bench-scale level at DOE sites.

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Cost:

NA

Additional cost information can be found in the Hazardous, Toxic, and Radioactive Wastes (HTRW) Historical Cost Analysis System (HCAS) developed by Environmental Historical Cost Committee of Interagency Cost Estimation Group.

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Coyne Prenger, 1995. ***High Gradient Magnetic Separation (HGMS),*** Los Alamos National Laboratory (LANL), LALP-94-264.

DOE, April 1995. ***Technology Catalogue, Second Edition***, Office of Environmental Management & Office of Technology Development, DOE/EM-0235.

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Site Information:

- Los Alamos National Laboratory (LANL)
- **DOE Demo:** INEL, ID
- **EPA Demo:** Iron Mountain Mine Site, CA
- Twin Cities AAP, New Brighton, MN
- Additional site information on the FRTR web site

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Points of Contact:

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Technology Specific Web Sites:

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Vendor Information:

A list of vendors offering Ex Situ Physical/Chemical Soil Treatment is available from the Vendor Information System for Innovative Treatment Technologies (VISITT) developed by U.S. Environmental Protection Agency (EPA).

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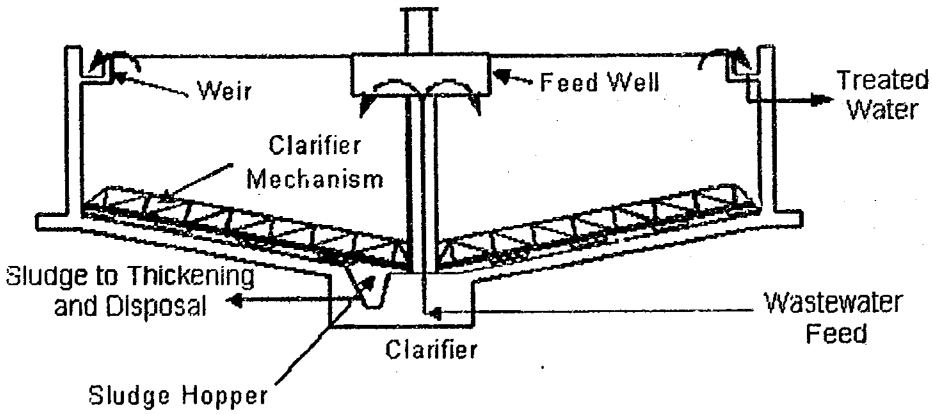

Weir
Feed Well
Treated Water
Clarifier Mechanism
Sludge to Thickening and Disposal
Wastewater Feed
Clarifier
Sludge Hopper

4.21 Soil Washing

(Ex Situ Soil Remediation Technology)

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Description | Synonyms | Applicability | Limitations
Data Needs | Performance | Cost | References
Site Information | Points of Contact | Vendor Information | Health & Safety

Technology	Description
Soil, Sediment, and Sludge	
3.5 Ex Situ Physical/Chemical Treatment (assuming excavation)	
4.21 Soil Washing	Contaminants sorbed onto fine soil particles are separated from bulk soil in an aqueous-based system on the basis of particle size. The wash water may be augmented with a basic leaching agent, surfactant, pH adjustment, or chelating agent to help remove organics and heavy metals.

Description:

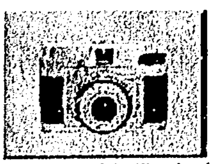
Figure 4-21: Typical Soil Washing Process

Soil washing is a water-based process for scrubbing soils ex situ to remove contaminants. The process removes contaminants from soils in one of two ways:

- By dissolving or suspending them in the wash solution (which can be sustained by chemical manipulation of pH for a period of time).
- By concentrating them into a smaller volume of soil through particle size separation, gravity separation, and attrition scrubbing (similar to those techniques used in sand and gravel operations).

Soil washing systems incorporating most of the removal techniques offer the greatest promise for application to soils contaminated with a wide variety of heavy metal, radionuclides, and organic contaminants. Commercialization of the process, however, is not yet extensive.

The concept of reducing soil contamination through the use of particle size separation is based on the finding that most organic and inorganic contaminants tend to bind, either chemically or physically, to clay, silt, and organic soil particles. The silt and clay, in turn, are attached to sand and gravel particles by physical processes, primarily compaction and adhesion. Washing processes that separate the fine (small) clay and silt particles from the coarser sand and gravel soil particles effectively separate and concentrate the contaminants into a smaller volume of soil that can be further treated or disposed of. Gravity separation is effective for removing high or low specific gravity particles such as heavy metal-containing compounds (lead, radium oxide, etc.). Attrition scrubbing removes adherent contaminant films from coarser particles. However, attrition washing can increase the fines in soils processed. The clean, larger fraction can be returned to the site for continued use.

Complex mixture of contaminants in the soil (such as a mixture of metals, nonvolatile organics, and SVOCs) and heterogeneous contaminant compositions throughout the soil mixture make it difficult to formulate a single suitable washing solution that will consistently and reliably remove all of the different types of contaminants. for these cases, sequential washing, using different wash formulations and/or different soil to wash fluid ratios, may be required.

Soil washing is generally considered a media transfer technology. The contaminated water generated from soil washing are treated with the technology(s) suitable for the contaminants.

The duration of soil washing is typically short- to medium-term.

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Synonyms:

DSERTS Code: N15 (Soil Washing).

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Applicability:

The target contaminant groups for soil washing are SVOCs, fuels, and heavy metals. The technology can be used on selected VOCs and pesticides. The technology offers the ability for recovery of metals and can clean a wide range of organic and inorganic contaminants from coarse-grained soils.

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Limitations:

Factors that may limit the applicability and effectiveness of the process include:

- Complex waste mixtures (e.g., metals with organics) make formulating washing fluid difficult.
- High humic content in soil may require pretreatment.
- The aqueous stream will require treatment at demobilization.
- Additional treatment steps may be required to address hazardous levels of washing solvent remaining in the treated residuals.
- It may be difficult to remove organics adsorbed onto clay-size particles.

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Data Needs:

A detailed discussion of these data elements is provided in Subsection 2.2.1 (Data Requirements for Soil, Sediment, and Sludge). Particle size distribution (0.24 to 2 mm optimum range); soil type, physical form, handling properties, and moisture content; contaminant type and concentration; texture; organic content; cation exchange capacity; pH and buffering capacity. A complete bench scale treatability study should always be completed before applying this technology as a remedial solution.

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Performance Data:

At the present time, soil washing is used extensively in Europe but has had limited use in the United States. During 1986-1989, the technology was one of the selected source control remedies at eight Superfund sites.

Soil washing provides a cost effective and environmentally proactive alternative to stabilization and landfilling. Two pilot scale demonstrations were carried out at Fort Polk, Louisiana in 1996. These employed commercially available unit processes - physical separation/acid leaching systems. The system employed acetic acid as the leaching agent, and the other, hydrochloric acid. Input soil had a lead content of approximately 3500 mg/kg. The hydrochloric acid system was most effective. Processed soil had total lead concentration of 200 mg/kg and TCLP levels for lead of approximately 2 mg/L. The through put rate was approximately 6 tons per hour. Choice of acid leaching agent is a function of specific soil chemistry and degree of solubility required.

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Cost:

The average cost for use of this technology, including excavation, is approximately $170 per ton, depending on site specific conditions and the target waste quantity and concentration.

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References:

Battelle, 1997. ***Physical Separation and Acid Leaching: A Demonstration of Small-Arms Range Remediation at Fort Polk, Louisiana.*** Final report prepared for Naval Facilities Engineering Service Center (NFESC) and U.S. Army Environmental Center under contract with NFESC, Port Hueneme, CA.

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BDM, 1997. ***Demonstration of Physical Separation/Leaching Methods for the Remediation of Heavy Metals-Contaminated Soils at Small-Arms Range Worldwide Search Report.*** Prepared for U.S. Army Environmental Center (USAEC) and Naval Facilities Engineering Service Center under contract with USAEC, Aberdeen Proving Ground, MD.

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EPA, 1990. ***Soil Washing Treatment***, Engineering Bulletin, EPA, OERR, Washington, DC, EPA/540/2-90/017. Available from NTIS, Springfield, VA, Order No. PB91-228056.

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EPA, 1993. ***Bescorp Soil Washing System Battery Enterprises Site Brice Environmental Services, Inc.***, EPA RREL, Demonstration Bulletin, EPA/540/MR-93/503.

EPA, 1993. ***Biogenesis Soil Washing Technology***, EPA RREL, series includes Demonstration Bulletin, EPA/540/MR-93/510; Innovative Technology Evaluation Report, EPA/540/R-93/510; and

Site Technology Capsule, EPA/540/SR-93/510.

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- Soil Washing at the King of Prussia Technical Corporation Superfund Site, Winslow Township, New Jersey

Raghavan, R., D.H. Dietz, and E. Coles, 1988. ***Cleaning Excavated Soil Using Extraction Agents: A State-of-the-Art Review***, EPA Report EPA 600/2-89/034.

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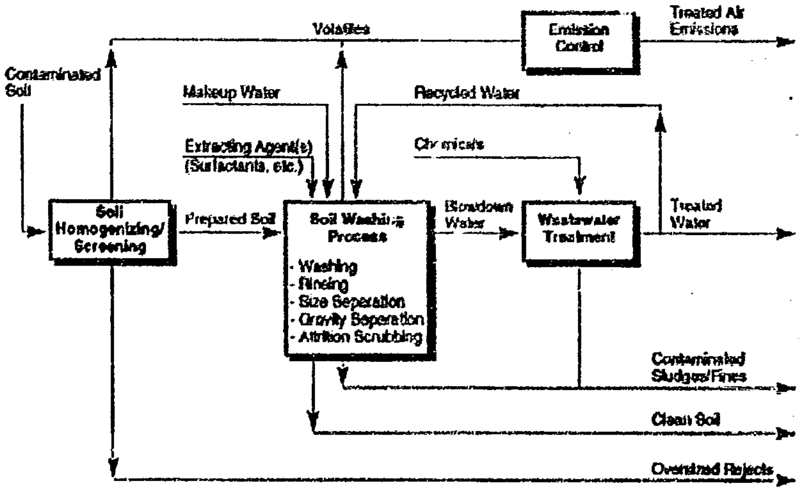
Site Information:

- Ft. Polk, LA
- Twin Cities AAP, New Brighton, MN
- **EPA Demo:** Santa Maria, CA
- Army Saginaw Bay Confined Disposal Facility, MI
- **DOE Demo:** Clemson Technical Center, SC
- **EPA & DOE Demo:** Montclair, West Orange & Glen Ridge Sites, NJ
- **EPA Demo:** Toronto Port Industrial District, Canada
- **Army Demo:** Sacramento Army Depot, CA
- **DOE Demo:** Fernald Site, OH
- **EPA Demo:** Alaska Battery Enterprises Superfund Site, AK
- **EPA Demo:** MacGil



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4.24 Solidification/Stabilization

(Ex Situ Soil Remediation Technology)

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Description | Synonyms | Applicability | Limitations
Data Needs | Performance | Cost | References
Site Information | Points of Contact | Vendor Information | Health & Safety

Technology	Description
Soil, Sediment, and Sludge	
3.5 Ex Situ Physical/Chemical Treatment (assuming excavation)	
4.24 Solidification/ Stabilization (Ex Situ)	Contaminants are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization).

Description:

As for in situ solidification/stabilization (S/S) (see Technology Profile No. 4.10), ex situ S/S contaminants are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization). Ex situ S/S, however, typically requires disposal of the resultant materials. Under CERCLA material can be replaced on site.

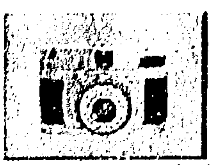

Figure 4-24: Typical Ex Situ Solidification/ stabilization Process Flow Diagram

There are many innovations in the stabilization and solidification technology. Most of the innovations are modifications of proven processes and are directed to encapsulation or immobilizing the harmful constituents and involve processing of the waste or contaminated soil. Nine distinct innovative processes or groups of processes include: (1) bituminization, (2) emulsified asphalt, (3) modified sulfur cement, (4) polyethylene extrusion, (5) pozzolan/Portland cement, (6) radioactive waste solidification, (7) sludge stabilization, (8)soluble phosphates, and (9) vitrification/molten glass.

Typical ex situ S/S is a short- to medium-term technology.

➤ ***Bituminization***

In the bituminization process, wastes are embedded in molten bitumen and encapsulated when the bitumen cools. The process combines heated bitumen and a concentrate of the waste material, usually in slurry form, in a heated extruder containing screws that mix the bitumen and waste. Water is evaporated from the mixture to about 0.5% moisture. The final product is a homogenous mixture of extruded solids and bitumen.

➤ *Emulsified Asphalt*

Asphalt emulsions are very fine droplets of asphalt dispersed in water that are stabilized by chemical emulsifying agents. The emulsions are available as either cationic or anionic emulsions. The emulsified asphalt process involves adding emulsified asphalts having the appropriate charge to hydrophilic liquid or semiliquid wastes at ambient temperature. After mixing, the emulsion breaks, the water in the waste is released, and the organic phase forms a continuous matrix of hydrophobic asphalt around the waste solids. In some cases, additional neutralizing agents, such as lime or gypsum, may be required. After given sufficient time to set and cure, the resulting solid asphalt has the waste uniformly distributed throughout it and is impermeable to water.

➤ ***Modified Sulfur Cement***

Modified sulfur cement is a commercially-available thermoplastic material. It is easily melted (127° to 149° C (260° to 300° F)) and then mixed with the waste to form a homogenous molten slurry which is discharged to suitable containers for cooling, storage, and disposal. A variety of common mixing devices, such as, paddle mixers and pug mills, can be used. The relatively low temperatures used limit emissions of sulfur dioxide and hydrogen sulfide to allowable threshold values.

➤ ***Polyethylene Extrusion***

The polyethylene extrusion process involves the mixing of polyethylene binders and dry waste materials using a heated cylinder containing a mixing/transport screw. The heated, homogenous mixture exits the cylinder through an output die into a mold, where it cools and solidifies. Polyethylene's properties produce a very stable, solidified product. The process has been tested on nitrate salt wastes at plant-scale, establishing its viability, and on various other wastes at the bench and pilot scale.

➤ ***Pozzolan/Portland Cement***

Pozzolan/Portland cement process consists primarily of silicates from pozzolanic-based materials like fly ash, kiln dust, pumice, or blast furnace slag and cement-based materials like Portland cement. These materials chemically react with water to form a solid cementious matrix which improves the handling and physical characteristics of the waste. They also raise the pH of the water which may help precipatate and immobilize some heavy metal contaminants. Pozzolanic and cement-based binding agents are typically appropriate for inorganic contaminants. The effectiveness of this binding agent with organic contaminants varies.

➤ ***Radioactive Waste Solidification***

In radioactive waste solidification (Grouting/Other) treatment, solidification additives are used to form a uniform and stable matrix to encapsulate radioactive waste materials. Assemblies include pumps for liquids or slurries, conveyors for sludges or solids, storage silos, weigh feeders, piping, mixers and disposal or storage.

➤ ***Sludge Stabilization***

The sludge stabilization process is the addition of a reagent, either slags or cementitious materials, to sludge to transform the material so that the hazardous constituents are in their least mobile or toxic form. Sludges which leach heavy metals or other contaminants are often stabilized to immobilize the hazardous constituents.

➤ ***Soluble Phosphates***

The soluble phosphates process involves the addition of various forms of phosphate and alkali for control of pH as well as for formation of complex metal molecules of low-solubility to immobilize (insolubilize) the metals over a wide pH range. Unlike most other stabilization processes, soluble phosphate processes do not convert the waste into a hardened, monolithic mass. One application of soluble phosphates and lime is in stabilizing fly ash by immobilizing the lead and cadmium in the ash.

➤ ***Vitrification/Molten Glass***

Vitrification, or molten glass, processes are solidification methods that employ heat up to 1,200° C to melt and convert waste materials into glass or other glass and crystalline products. The high temperatures destroy any organic constituents with very few byproducts. Materials, such as heavy metals and radionuclides, are actually incorporated into the glass structure which is, generally, a relatively strong, durable material that is resistant to leaching. In addition to solids, the waste materials can be liquids, wet or dry sludges, or combustible materials. Borosilicate and soda-lime are the principal glass formers and provide the basic matrix of the vitrified product.

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Synonyms: **DSERTS Code:** M13 (Vitrification)
N11 (Solidification/Stabilization)

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Applicability: The target contaminant group for ex situ S/S is inorganics, including radionuclides. Most S/S technologies have limited effectiveness against organics and pesticides, except vitrification which destroys most organic contaminants.

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Limitations: Factors that may limit the applicability and effectiveness of the process include:

- Environmental conditions may affect the long-term immobilization of contaminants.
- Some processes result in a significant increase in volume (up to double the original volume).
- Certain wastes are incompatible with different processes. Treatability studies are generally required.
- Organics are generally not immobilized.
- Long-term effectiveness has not been demonstrated for many contaminant/process combinations.

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Data Needs: A detailed discussion of these data elements is provided in Subsection 2.2.1 (Data Requirements for Soil, Sediment, and Sludge). Soil parameters that must be determined include particle size, Atterberg limits, moisture content, metal concentrations, sulfate content, organic content, density, permeability, unconfined compressive strength, leachability, microstructure analysis, and physical and chemical durability.

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Performance Data: The performance of ex situ S/S is dependent on the type of S/S process used.

DOE has demonstrated the Polyethylene Encapsulation of Radionuclides and Heavy Metals (PERM) process at the bench scale. The process is a waste treatment and stabilization technology for high-level mixed waste. Specific targeted contaminants include radionuclides (e.g., cesium, strontium, and cobalt), and toxic metals (e.g., chromium, lead, and cadmium). Scale-up from bench-scale tests has demonstrated the feasibility to process waste at approximately 2,000 lb/hr. The scale-up feasibility tests have successfully demonstrated the potential to encapsulate at least 60 wt% nitrate salt in polyethylene. Polyethylene waste forms have been demonstrated to exceed Nuclear Regulatory Commission, EPA, and Department of Transportation waste form criteria. Waste forms containing up to several thousand ppm of toxic-metal contaminants have passed the EPA's TCLP.

DOE also demonstrated the arc melter vitrification process, which is capable of melting soil and metals, pyrolizing or oxidizing residual organics, melting structural metals from melted slag (silica and metal oxides), and partitioning transuranic (TRU) waste into slag phase. Durability tests with the resultant slag showed an approximately order of magnitude reduction in leachability when compared with high-level borosilicate glass.

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Cost:

Ex situ solidification/stabilization processes are among the most mature remediation technologies. Representative overall costs from more than a dozen vendors indicate an approximate cost of under $110 per metric ton ($100 per ton), including excavation.

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References:

Battelle Memorial Institute, 1995. ***ReOpt. V3.1***, by Battelle Memorial Institute for DOE under Contract DE/AC06/76RLO 1830.

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Site Information:

- EPA *SITE* Demo: Robins AFB, Macon, GA
- EPA *SITE* Demo: Selma Pressure Treating Selma, CA
- EPA *SITE* Demo: Portable Equip. Salvage Co. Clackamas, OR
- Navy Demo: Naval Const. Battalion Ctr. Port Hueneme, CA
- Imperial Oil Co./Champion Chemical Co. Superfund Site Morganville, NJ
- Small Arms Range, Naval Air Station Mayport, FL
- Davis-Monthan AFB
- DOI Demo: Salt Lake City Research Center
- DOI Demo: Albany Metallurgy Research Center, OR
- EPA & DOE Demo: Component Development & Integration Facility, MT
- NEL Demo: NAS North Island Installation Restoration (IR) Site 11, CA
- Envirocare of Utah, Inc., Salt Lake City, Utah
- DOE's Portsmouth Gaseous Diffusion Plant, X-231B Unit, Piketon, OH
- Additional site information on the FRTR web site

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Vendor Information:

A list of vendors offering Ex Situ Physical/Chemical Soil Treatment is available from the Vendor Information System for Innovative Treatment Technologies (VISITT) developed by U.S. Environmental Protection Agency (EPA).

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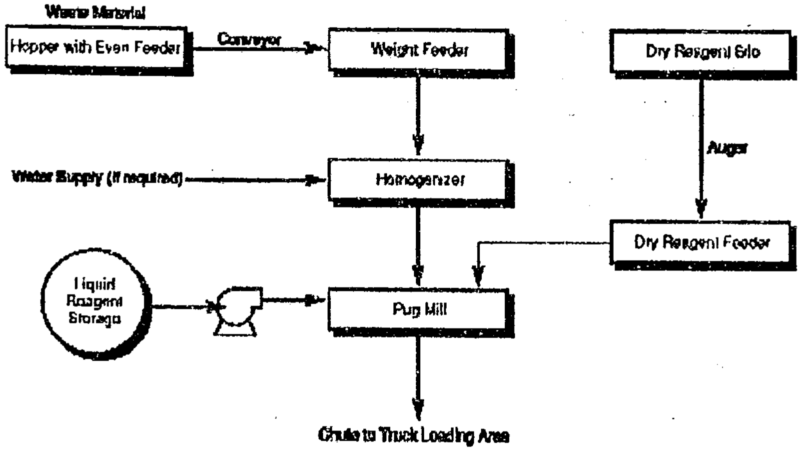

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4.44 Hydrofracturing

(In Situ Ground Water Remediation Technology)

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Description	Synonyms	Applicability	Limitations
Data Needs	Performance	Cost	References
Site Information	Points of Contact	Vendor Information	Health & Safety

Technology	Description
Ground Water, Surface Water, and Leachate	
3.10 In Situ Physical/Chemical Treatment	
4.44 Hydrofracturing (enhancement)	Injection of pressurized water through wells cracks low permeability and over-consolidated sediments. Cracks are filled with porous media that serve as substrates for bioremediation or to improve pumping efficiency.

Description:

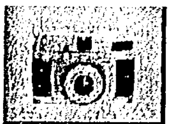
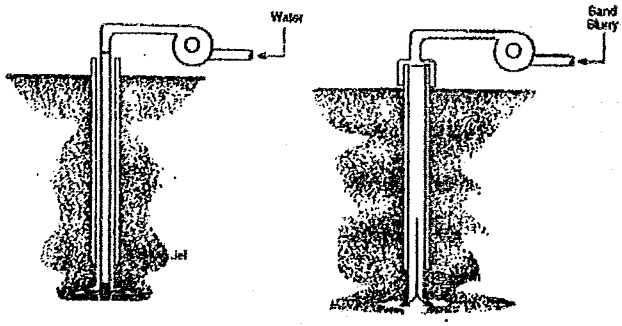


Figure 4-44: Typical Sequence of Operations for Creating Hydraulic Fractures

Hydrofracturing is a pilot-scale technology in which pressurized water is injected to increase the permeability of consolidated material or relatively impermeable unconsolidated material. Fissures created in the process are filled with a porous medium that can facilitate bioremediation and/or improve extraction efficiency. Fractures promote more uniform delivery of treatment fluids and accelerated extraction of mobilized contaminants. Typical applications are linked with soil vapor extraction, in situ bioremediation, and pump-and-treat systems.

The fracturing process begins with the injection of water into a sealed borehole until the pressure of the water exceeds the overburden pressure and a fracture is created. A slurry composed of a coarse-grained sand and guar gum gel or a similar substitute is then injected as the fracture grows away from the well. After pumping, the sand grains hold the fracture open while an enzyme additive breaks down the viscous fluid. The thinned fluid is pumped from the fracture, forming a permeable subsurface channel suitable for delivery or recovery of a vapor or liquid.

The hydraulic fracturing process can be used in conjunction with soil



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vapor extraction technology to enhance recovery. Hydraulically-induced fractures are used to deliver fluids, substrates and nutrients for in situ bioremediation applications.

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Synonyms: **DSERTS Code**: F17 (Hydrofracturing - enhancement)

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Applicability: Hydrofracturing is applicable to a wide range of contaminant groups with no particular target group.

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Limitations: Factors that may limit the applicability and effectiveness of the process include:

- The technology should not be used in bedrock susceptible to seismic activity.
- Investigation of possible underground utilities, structures, or trapped free product is required.
- The potential exists to open new pathways leading to the unwanted spread of contaminants (e.g., DNAPLs).
- Pockets of low permeability may still remain after using this technology.
- There is an inability to control the final location or size of the fractures that are created.
- Fractures are anticipated to collapse due to over burden pressure.

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Data Needs: A detailed discussion of these data elements is provided in Subsection 2.2.2. (Data Requirements for Ground Water, Surface Water, and Leachate).

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Performance Data: The technology has had widespread use in the petroleum and water-well construction industries but is an innovative method for remediating hazardous waste sites.

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Cost: The cost per fracture is estimated to be $1,000 to $1,500, based on creating four to six fractures per day. This cost (including equipment rental, operation, and monitoring) is small compared to the benefits of enhanced remediation and the reduced number of wells needed to complete the remediation. A number of factors affect the estimated costs of creating hydraulic fractures at a site. These factors include physical site conditions such as site accessibility and degree of soil consolidation; degree of soil saturation; and geographical location, which affects availability of services and supplies. The first two factors also affect the effectiveness of hydraulic fracturing.

The costs presented in this analysis are based on conditions found at the Xerox Oak Brook site. A full-scale demonstration was not conducted for this technology. Because operating costs were not independently monitored during the pilot-scale demonstrations at the Xerox Oak Brook and Dayton sites, all costs presented in this section were provided by Xerox and University of Cincinnati Center Hill.

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References:

EPA, 1991. ***Feasibility of Hydraulic Fracturing of Soil to Improve Remedial Actions***, EPA/600/S2-91/012.

EPA, 1993. ***Hydraulic Fracturing Technology***, EPA/600/R-93/505.

EPA, 1993. ***Hydraulic Fracturing of Contaminated Soil***, series includes Demonstration Bulletin, EPA/540/MR-93/505; Technology Evaluation and Applications Analysis Combined, EPA/540/R-93/505; and Technology Demonstration Summary, EPA/540/SR-93/505.

EPA, 1994. ***In Situ Remediation Technology Status Report: Hydrofracturing/Pneumatic Fracturing***, EPA/542/K-94/005.

EPA, 1997. ***Analysis of Selected Enhancements for Soil Vapor Extraction***, EPA OSWER, EPA/542/R-97/007.

Federal Remediation Technologies Roundtable, 1997. ***Remediation Case Studies: Soil Vapor Extraction and Other In Situ Technologies***, EPA/542/R-97/009.

- Hydraulic and Pneumatic Fracturing at the U.S. Department of Energy's Portsmouth Gaseous Diffusion Plant, Ohio; Department of Defense; and Commercial Sites.

Hubbert, M.K and D.G. Willis, 1957. **"Mechanics of Hydraulic Fracturing,"** *Petroleum Transactions AIME*, Vol. 210, pp. 153 through 168.

Murdoch, L.C., 1990. **"A Field Test of Hydraulic Fracturing in Glacial Till,"** in *Proceedings of the Research Symposium*, Ohio, EPA Report, EPA/600/9-90/006.

Murdoch, L.C., 1993. **"Hydraulic Fracturing of Soil During Laboratory Experiments, Part I: Methods and Observations; Part II: Propagation; Part III: Theoretical Analysis"**, *Geotechnique*, Vol. 43, No. 2, Institution of Civil Engineers, London, pp. 255 to 287.

University of Cincinnati (UC), 1991. **"Work Plan for Hydraulic Fracturing at the Xerox Oak Brook Site in Oak Brook, Illinois"**.

Wolf, A. and L.C. Murdoch, 1992. **"The Effect of Sand-Filled Hydraulic Fractures on Subsurface Air Flow: Summary of SVE Field Tests Conducted at the Center Hill Research Facility"**, UC Center Hill Facility, Unpublished Report.

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Site Information:

- Xerox Facility Oak Brook, IL
- UST site, Dayton, OH
- DOE's Portsmouth Gaseous Diffusion Plant, OH

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Points of Contact:

General FRTR Agency Contacts

Technology Specific Web Sites:

Non-Government Web Sites

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Vendor Information:

A list of vendors offering In Situ Physical/Chemical Water Treatment is available from the Vendor Information System for Innovative Treatment Technologies (VISITT) developed by U.S. Environmental Protection Agency (EPA).

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Health and Safety:

To be added

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4.46 Passive/Reactive Treatment Walls

(In Situ Ground Water Remediation Technology)

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Description | Synonyms | Applicability | Limitations
Data Needs | Performance | Cost | References
Site Information | Points of Contact | Vendor Information | Health & Safety

Technology	Description
Ground Water, Surface Water, and Leachate	
3.10 In Situ Physical/Chemical Treatment	
4.46 Passive/Reactive Treatment Walls	These barriers allow the passage of water while causing the degradation or removal of contaminants.

Description:

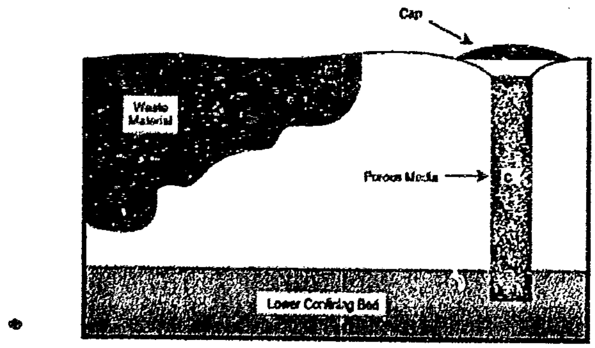
Figure 4-46: Typical Passive Treatment Wall (Cross-Section)

A permeable reaction wall is installed across the flow path of a contaminant plume, allowing the water portion of the plume to passively move through the wall. These barriers allow the passage of water while prohibiting the movement of contaminants by employing such agents as zero-valent metals, chelators (ligands selected for their specificity for a given metal), sorbents, microbes, and others.

The contaminants will either be degraded or retained in a concentrated form by the barrier material. The wall could provide permanent containment for relatively benign residues or provide a decreased volume of the more toxic contaminants for subsequent treatment.

➤ ***Funnel and Gate***

Modifications to the basic passive treatment walls may involve a funnel-and-gate system or an iron treatment wall. The funnel-and-gate system for in situ treatment of contaminated plumes consists of low hydraulic conductivity (e.g., 1E-6 cm/s) cutoff walls (the funnel) with a gate that contains in situ reaction zones. Ground water primarily flows through high conductivity gaps (the gates). The type of cutoff walls most likely to be used in the current practice are slurry walls or sheet piles. Innovative methods such as deep soil mixing and jet grouting are also being considered for funnel walls.



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➤ *Iron Treatment Wall*

An iron treatment wall consists of iron granules or other iron bearing minerals for the treatment of chlorinated contaminants such as TCE, DCE, and VC. As the iron is oxidized, a chlorine atom is removed from the compound by one or more reductive dechlorination mechanisms, using electrons supplied by the oxidation of iron . The iron granules are dissolved by the process, but the metal disappears so slowly that the remediation barriers can be expected to remain effective for many years, possibly even decades.

Barrier and post-closure monitoring tests are being conducted by the USAF, U.S. Navy, and DOE in field-scale demonstration plots and are being designed for actual contaminated sites. The range of materials available for augmenting existing barrier practice is broad. Two types of barriers have been the focus of initial efforts of this program, i.e., permeable reactive barriers and in-place bioreactors.

Passive treatment walls are generally intended for long-term operation to control migration of contaminants in ground water.

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Synonyms: Permeable reactive barrier; In place bioreaction; In-situ chemical filters.
DSERTS Code: F16 (Passive Treatment Walls)

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Applicability: Target contaminant groups for passive treatment walls are VOCs, SVOCs, and inorganics. The technology can be used, but may be less effective, in treating some fuel hydrocarbons.

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Limitations: Factors that may limit the applicability and effectiveness of the process include:

- Passive treatment walls may lose their reactive capacity, requiring replacement of the reactive medium.
- Passive treatment wall permeability may decrease due to precipitation of metal salts
- Depth and width of barrier.
- Limited to a subsurface lithology that has a continous aquitard at a depth that is within the vertical limits of trenching equipment.
- Volume cost of treatment medium.
- Biological activity or chemical precipitation may limit the permeability of the passive treatment wall.

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Data Needs:

A detailed discussion of these data elements is provided in Subsection 2.2.2. (Data Requirements for Ground Water, Surface Water, and Leachate).

Data needs include hydraulic gradient; contaminant characteristics (depth, areal extent, type, and concentration); depth to ground water, including range of anticipated fluctuations; depth to impermeable barrier key-in; site stratigraphy; ground water hydrology; water quality, flow rate, and direction; soil permeability; and buffering capacity.

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Performance Data:

Data has been developed by the USAF, the University of Waterloo, and Enviromental Technologies, Inc.

Several full-scale and demonstration scale walls have been installed for remediation of ground water contaminated with chlorinated aliphatic hydrocarbons. These sites include Lowry AFB and Moffett Field NAS. Several more sites are currently being evaluated or have passive treatment walls scheduled for installation.

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Cost:

Complete cost data are still not available because most sites have been demonstration scale and may have been overdesigned for a safety margin. However, costs are decreasing as the price of reactive iron media declines and cost per unit of contaminant removed is a function of the concentrations in ground water.

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References:

California Base Closure Environmental Committee (CBCEC), 1994. ***Treatment Technologies Applications Matrix for Base Closure Activities, Revision 1***, Technology Matching Process Action Team, November, 1994.

EPA, 1995. ***In Situ Remediation Technology Status Report: Treatment Walls***, Office of Solid Waste and Emergency Response, EPA/540/K-94/004.

EPA, 1997. ***Permeable Reactive Subsurface Barriers for the Interception and remediation of Chlorinated Hydrocarbon and Chromium(VI) Plumes in Ground Water***, EPA/600/F-97/008.

DOE, 1993. ***Technical Name: Barriers and Post-Closure Monitoring***, Technology Information Profile (Rev. 2), DOE Protech Database, TTP No. AL-1211-25.

DOE, 1994. ***Technology Catalogue***, First Edition. February.

Federal Remediation Technologies Roundtable, 1998. ***Remediation Case Studies: Innovative Groundwater Treatment Technologies***, EPA/542/R-98/015.

- Pump and Treat and Permeable Reactive Barrier to Treat Contaminated Groundwater at the Former Intersil, Inc. Site, Sunnyvale, California
- Permeable Reactive Barrier to Treat Contaminated Groundwater at Moffett Federal Airfield, Mountain View, California
- In Situ Permeable Reactive Barrier for Treatment of Contaminated Groundwater at the U.S. Coast Guard Support Center, Elizabeth City, North Carolina

Hansen, W., et al., 1992. **"Barriers and Post-Closure Monitoring"**, Briefing Chart, Los Alamos National Laboratory, Los Alamos, NM, TTP No. AL-1212-25.

USAF, 1997. ***Design Guidance for Application of Permeable Barriers to Remediate Dissolved Chlorinated Solvents***, prepared by Battelle under contract to Environics Directorate, Armstrong Laboratory.

Vidic, R.D. and F.G. Pohland. **"Technology Evaluation Report: Treatment Walls"**, GWRTAC Series TE-96-01.

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Site Information:

- Tonolli Corporation, PA
- Lowry Air Force Base, CO
- Somersworth Sanitary Landfill Site, NH
- Moffett Field NAS, CA
- Brown's Battery Breaking Site, OU 2, PA
- Canadian Forces Base, Canada
- Borden Aquifer, Canada
- Air Force Demo Hill AFB, UT
- Los Alamos National Laboratory
- Former Intersil, Inc. Site, Sunnyvale, CA
- Moffett Federal Airfield, Mountain View, CA
- The U.S. Coast Guard Support Center, Elizabeth City, NC
- Additional site information on the FRTR web site

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A list of vendors offering In Situ Physical/Chemical Water Treatment is available from the Vendor Information System for Innovative Treatment Technologies (VISITT) developed by U.S. Environmental Protection Agency (EPA).

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HTRW Hazard Analysis

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4.57 Deep Well Injection

(Ground Water Containment Remediation Technology)

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Description | Synonyms | Applicability | Limitations
Data Needs | Performance | Cost | References
Site Information | Points of Contact | Vendor Information | Health & Safety

Technology	Description
Ground Water, Surface Water, and Leachate	
3.13 Containment	
4.57 Deep Well Injection	Deep well injection is a liquid waste disposal technology. This alternative uses injection wells to place treated or untreated liquid waste into geologic formations that have no potential to allow migration of contaminants into potential potable water aquifers.

Description:

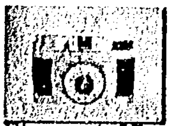

Figure 4-57: Typical Deep Well Injection System

A typical injection well consists of concentric pipes, which extend several thousand feet down from the surface level into highly saline, permeable injection zones that are confined vertically by impermeable strata. The outermost pipe or surface casing, extends below the base of any underground sources of drinking water (USDW) and is cemented back to the surface to prevent contamination of the USDW. Directly inside the surface casing is a long string casing that extends to and sometimes into the injection zone. This casing is filled in with cement all the way back to the surface in order to seal off the injected waste from the formations above the injection zone back to the surface. The casing provides a seal between the wastes in the injection zone and the upper formations. The waste is injected through the injection tubing inside the long string casing either through perforations in the long string or in the open hole below the bottom of the long string. The space between the string casing and the injection tube, called the annulus, is filled with an inert, pressurized fluid, and is sealed at the bottom by a removable packer preventing injected wastewater from backing up into the annulus.

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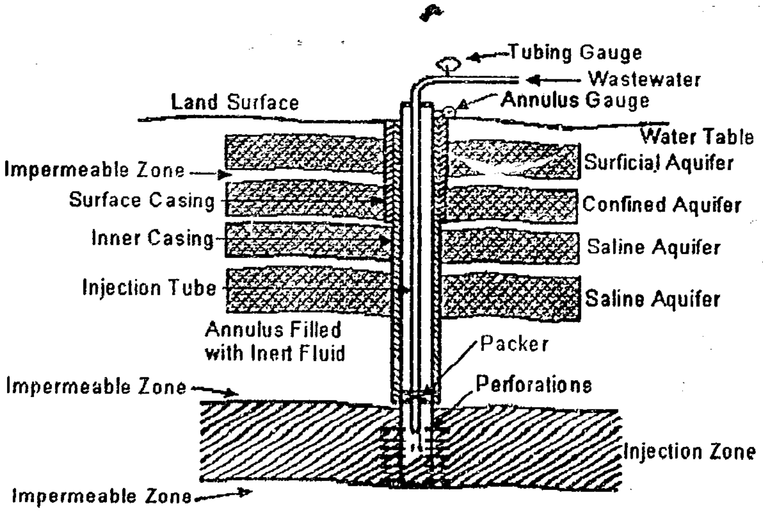
Tubing Gauge
Wastewater
Annulus Gauge
Land Surface
Water Table
Impermeable Zone
Surficial Aquifer
Surface Casing
Confined Aquifer
Inner Casing
Saline Aquifer
Injection Tube
Saline Aquifer
Annulus Filled with Inert Fluid
Packer
Impermeable Zone
Perforations
Injection Zone
Impermeable Zone

Synonyms: Subsurface injection, Underground injection, Class I injection wells.

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Applicability: The target contaminant groups for deep well injection are VOCs, SVOCs, fuels, explosives, and pesticides. However, existing permitted deep well injection facilities are limited to a narrow range of specific wastes. Success at expanding existing permits to manage hazardous wastes seems unlikely.

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Limitations: Factors that may limit the applicability and effectiveness of these processes include:

- Injection will not be used for hazardous waste disposal in any areas where seismic activity could potentially occur.
- Injected wastes must be compatible with the mechanical components of the injection well system and the natural formation water. The waste generator may be required to perform physical, chemical, biological, or thermal treatment for removal of various contaminants or constituents from the waste to modify the physical and chemical character of the waste to assure compatibility.
- High concentrations of suspended solids (typically >2 ppm) can lead to plugging of the injection interval.
- Corrosive media may react with the injection well components, with injection zone formation, or with confining strata with very undesirable results. Wastes should be neutralized.
- High iron concentrations may result in fouling when conditions alter the valence state and convert soluble to insoluble species.
- Organic carbon may serve as an energy source for indigenous or injected bacteria resulting in rapid population growth and subsequent fouling.
- Waste streams containing organic contaminants above their solubility limits may require pretreatment before injection into a well.
- Site assessment and aquifer characterization are required to determine suitability of site for wastewater injection.
- Extensive assessments must be completed prior to receiving approval from regulatory authority.

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Data Needs: A detailed discussion of data elements is provided in Subsection 2.2.2 (Data Requirements for Ground Water, Surface Water, and Leachate).

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Performance Data: Injection wells have been used for the disposal of industrial and hazardous wastes since the 1950s, so the equipment and methodology are readily available and well known; however the use of them today is continuing under very strict regulatory control.

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Cost: NA

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References:

EPA, 1985. ***Report to Congress on Injection of Hazardous Waste***, EPA, Office of Drinking Water, EPA/9-85-003.

Reeder et al., 1977. ***Review and Assessment of Deep Well Injection of Hazardous Waste, Volume I***, EPA/600/2-77/029a.

Warner and J.H.Lehr, 1977. ***An Introduction to the Technology of Subsurface Wastewater Injection***, EPA/600/2-77/240.

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Site Information:

- **DOI Demo** Bureau of Mines Tuscaloosa Research Center, AL

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Points of Contact:

General FRTR Agency Contacts

Technology Specific Web Sites:

NA

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Vendor Information:

A list of vendors offering Water Containment Treatment is available from the Vendor Information System for Innovative Treatment Technologies (VISITT) developed by U.S. Environmental Protection Agency (EPA).

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Health and Safety:

To be added

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APPENDIX C

Theoretically Feasible Technologies

4.48 Constructed Wetlands

(Ex Situ Ground Water Remediation Technology)

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Description | Synonyms | Applicability | Limitations
Data Needs | Performance | Cost | References
Site Information | Points of Contact | Vendor Information | Health & Safety

Technology	Description
Ground Water, Surface Water, and Leachate	
3.11 Ex Situ Biological Treatment (assuming pumping)	
4.48 Constructed Wetlands	The constructed wetlands-based treatment technology uses natural geochemical and biological processes inherent in an artificial wetland ecosystem to accumulate and remove metals, explosives, and other contaminants from influent waters. The process can use a filtration or degradation process.

Description:

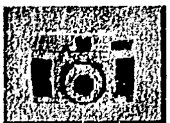
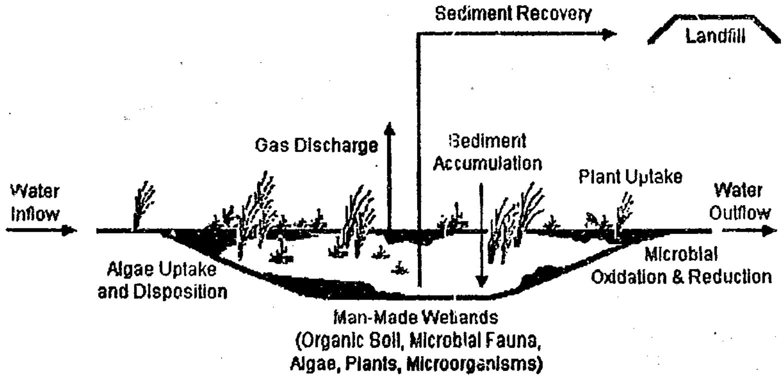


Figure 4-48: Typical Constructed Wetlands System

Although the technology incorporates principal components of wetland ecosystems, including organic soils, microbial fauna, algae, and vascular plants, microbial activity is responsible for most of the remediation.

Influent waters with high metal concentrations and low pH flow through the aerobic and anaerobic zones of the wetland ecosystem. Metals are removed through ion exchange, adsorption, absorption, and precipitation with geochemical and microbial oxidation and reduction. Ion exchange occurs as metals in the water contact humic or other organic substances in the wetland. Wetlands constructed for this purpose often have little or no soil instead they have straw, manure or compost. Oxidation and reduction reactions catalyzed by bacteria that occur in the aerobic and anaerobic zones, respectively, play a major role in precipitating metals as hydroxides and sulfides. Precipitated and adsorbed metals settle in quiescent ponds or are filtered out as water percolates through the medium or the plants.

Influent water with explosive residues or other contaminants flows through and beneath the gravel surface of a gravel-based wetland. The


Sediment Recovery
Landfill
Gas Discharge
Sediment Accumulation
Plant Uptake
Water Inflow
Water Outflow
Algae Uptake and Disposition
Microbial Oxidation & Reduction
Man-Made Wetlands (Organic Soil, Microbial Fauna, Algae, Plants, Microorganisms)

wetland, using emergent plants, is a coupled anaerobic-aerobic system. The anaerobic cell uses plants in concert with natural microbes to degrade the contaminant. The aerobic, also known as the reciprocating, cell further improves water quality through continued exposure to the plants and the movement of water between cell compartments.

Wetland treatment is a long-term technology intended to operate continously for years.

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Synonyms: NA

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Applicability: Constructed wetlands have most commonly been used in wastewater treatment for controlling organic matter; nutrients, such as nitrogen and phosphorus; and suspended sediments. The wetlands process is also suitable for controlling trace metals, and other toxic materials. Additionally, the treatment has been used to treat acid mine drainage generated by metal or coal mining activities. These wastes typically contain high metals concentrations and are acidic. The process can be adapted to treat neutral and basic tailings solutions.

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Limitations: The wetlands remediation technology must be adjusted to account for differences in geology, terrain, trace metal composition, and climate in the metal mining regions of the western United States.

The following factors may limit the applicability and effectiveness of the process:

- The long-term effectiveness of constructed wetlands is not well known. Wetland aging may be a problem which may contribute to a decrease in contaminant removal rates over time.
- The cost of building an artificial wetland varies considerably from project and may not be financially viable for many sites.

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Data Needs: A detailed discussion of data elements is provided in Subsection 2.2.2 (Data Requirements for Ground Water, Surface Water, and Leachate).

Performance Data: This technology was accepted into the Emerging Technology Program in 1988; the project was completed in 1991. The purpose of the project was to build, operate, monitor, and assess the effectiveness of a constructed wetlands in treating a portion of acid mine drainage from the Big Five Tunnel site near Idaho Springs, Colorado. The Final Report (EPA/540/R-93/523) is available from NTIS (Order No. PB93-233914). The Summary (EPA/540/SR-93/523) and Bulletin (EPA/540/F-92/001) are available from EPA.

Study results indicated that heavy metal removal efficiency can approach the removal efficiency of chemical precipitation treatment plants. Some of the optimum results from the 3 years of operation are listed below.

- pH was raised from 2.9 to 6.5.
- Dissolved aluminum, cadmium, chromium, copper, and zinc concentrations were reduced by 99 percent or more.
- Iron was reduced by 99 percent.
- Lead was reduced by 94 percent or more.
- Nickel was reduced by 84 percent or more.
- Manganese removal was relatively low, with reduction between 9 and 44 percent.
- Biotoxicity to fathead minnows and water fleas was reduced by factors of 4 to 20.

Because wetland removal processes are primarily microbial, the technology can be developed with traditional process engineering approaches. Laboratory studies can indicate whether remediation is possible, while bench-scale experiments can determine the proper loading and reactor design. Using this approach, five laboratory proof-of-principle studies and three bench-scale studies have been performed, and at least four successful demonstration reactors have been built to remove heavy metals from different types of water.

A final project goal was to develop a manual that discusses design and operating criteria for constructing a full-scale wetland to treat acid mine discharges. The "Wetland Designs for Mining Operations" manual is available from the National Technical Information Service.

Based on the results from the SITE Emerging Technology Program, this technology was selected to participate in the SITE Demonstration Technology Program. Under the Demonstration Program, EPA is evaluating the effectiveness of biogeochemical processes at the Burleigh Tunnel mine site, near Silver Plume, Colorado. Treatment of Burleigh Tunnel discharge is part of the remedy for the Clear Creek/Central City Superfund site. Construction of a pilot-scale system began in summer 1993 and was completed in October 1993. For more information on this project, refer to the Colorado Department of Health profile in the Demonstration Program section (ongoing projects).

The USAEC is demonstrating a gravel based wetland system at Milan Army Ammunition Plant through the ESTCP. The gravel-based system has been effective at degrading TNT and RDX, with a total nitrobody concentration of 10,000 ppb. Analyses indicate degradation due to the rise and fall of daughter products. TNT is reduced to less than 2 ppb. The demonstration had been operational since June 1996.

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Cost:

Studies at Milan Army Ammunition Plant conducted by USAEC and Tennessee Valley Authority (TVA) indicate that plants with nitroreductase, in concert with microbes, can degrade explosive residues. It is estimated that amortizing the capital costs of wetland treatment over a 10 year period results in a cost of $1.36/Kgal; over a 30 years period, the cost is $0.45/Kgal.

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References:

EPA, 1993. ***Constructed Wetlands-Based Treatment***, EPA/540/R-93/523.

EPA, 1995. ***Colorado School of Mines profile in the Emerging Technology Program.***

Lefave, J.P., 1997. ***Constructed Wetlands for Treatment of NPS Pollution***, NFESC.

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Site Information:

- Burleigh Tunnel Silver Plume, CO
- EPA Demo Burleigh Tunnel, CO
- Big Five Tunnel, CO
- Bear Creek, Oak Ridge, TN
- Naval Amphibious Base in Little Creek, Virginia

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Technology Specific Web Sites:

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Vendor Information:

A list of vendors offering Ex Situ Biological Water Treatment is available from the Vendor Information System for Innovative Treatment Technologies (VISITT) developed by U.S. Environmental Protection Agency (EPA).

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To be added

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4.49 Adsorption/Absorption

(Ex Situ Ground Water Remediation Technology)

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Description | Synonyms | Applicability | Limitations
Data Needs | Performance | Cost | References
Site Information | Points of Contact | Vendor Information | Health & Safety

Technology	Description
Ground Water, Surface Water, and Leachate	
3.12 Ex Situ Physical/Chemical Treatment	
4.49 Adsorption/ Absorption	In liquid adsorption, solutes concentrate at the surface of a sorbent, thereby reducing their concentration in the bulk liquid phase.

Description:

Figure 4-49 Typical Adsorption/ Absorption System

Adsorption mechanisms are generally categorized as either physical adsorption, chemisorption, or electrostatic adsorption. Weak molecular forces, such as Van der Waals forces, provide the driving force for physical adsorption, while a chemical reaction forms a chemical bond between the compound and the surface of the solid in chemisorption. Electrostatic adsorption involves the adsorption of ions through Coulombic forces, and is normally referred to as ion exchange, which is addressed separately in the ion exchange modules. In liquids, interactions between the solute and the solvent also play an important role in establishing the degree of adsorption.

The most common adsorbent is granulated activated carbon (GAC) (Technology Profile No. 4.51). Other natural and synthetic adsorbents include: activated alumina, forage sponge, lignin adsorption, sorption clays, and synthetic resins.

➤ *Activated Alumina*

Activated alumina is a filter media made by treating aluminum ore so that it becomes porous and highly adsorptive. Activated alumina will remove variety of contaminants, including excessive fluoride, arsenic, and selenium. The medium requires periodic cleaning with an appropriate regenerant such as alum or acid in order to remain effective.

➤ ***Forage Sponge***

Forage sponge is an open-celled cellulose sponge incorporating an amine-containing chelating polymer that selectively absorbs dissolved heavy metals. The polymer is intimately bonded to the cellulose so as to minimize physical separation from the supporting matrix. The functional groups in the polymer (i.e. amine and carboxyl groups) provide selective affinity for heavy metals in both cationic and anionic states, preferentially forming complexes with transition-group heavy metals.

➤ ***Lignin Adsorption/Sorptive Clay***

Lignin adsorption/sorptive clays are used to treat aqueous waste streams with organic, inorganic and heavy metals contamination. The waste stream is treated due to the molecular adhesion of the contaminants to an adsorptive surface.

➤ ***Synthetic Resins***

Synthetic resins are more expensive than GAC, but can be designed to achieve higher degrees of selectivity and adsorption capacity for certain compounds than activated carbon. Resins are typically regenerated using acids, bases, or organic solvents, instead of thermal methods, so they are better suited for thermally unstable compounds such as explosives, and are resistant to deactivation due to the adsorption of dissolved solids. Additionally, resins tend to be more resistant to abrasion than activated carbon, increasing their service life.

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Synonyms: Liquid phase adsorption.

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Applicability: The target contaminants groups for adsorption/absorption processes are most organic contaminants and selected inorganic contaminants from liquid and gas streams. Activated alumina can remove fluoride and heavy metals. The forager sponge is specifically used to remove heavy metals. Lignin adsorption/sorptive clays treat organic, inorganic and heavy metals contamination within aqueous waste streams. Synthetic resins are better suited for thermally unstable compounds such as explosives than GAC, due to the resins' non-thermal regeneration requirements.

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Limitations: Factors that may limit the applicability and effectiveness of these processes include:

- Water-soluble compounds and small molecules are not adsorbed well.
- Costs are high if used as the primary treatment on waste streams with high contaminant concentration lev is.
- Not applicable to sites having high levels of oily substances.
- Not practical where the content of the absorbable hazardous substance is so high that very frequent replacement of the absorbent unit is necessary.
- Contaminated media often require treatment/disposal as hazardous wastes, if they can't be regenerated.

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Data Needs: A detailed discussion of data elements is provided in Subsection 2.2.2 (Data Requirements for Ground Water, Surface Water, and Leachate).

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Performance Data: Adsorption/absorption processes have a long history of use as treatment for municipal, industrial, and hazardous waste streams. The concepts, theory, and engineering aspects of the technologies are well developed. They are proven technologies with documented performance data.

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Cost: The cost to treat heavy metal contaminated ground water over a one year period with the Forager Sponge technology is estimated at $340/1000 gallons, assuming the sponges are not regenerated and are replaced upon saturation; or $238/1000 gallons, assuming the sponges are regenerated twice providing for three useful treatment cycles. Costs for other adsorbent processes are not available.

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References:

Battelle Memorial Institute, 1995. "**ReOpt V3.1 User Documentation**", for DOE under contract DE/AC06/76RLO 1830.

Rainer, N., 1995. "**Forager Sponge, Technology Description**", Dynaphone, Inc.

Water Quality Association, 1994. "**Treating the Water We Drink, When and Where We Drink It.**", *WaterReview Technical Brief*, Vol. 9, No. 4.

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Site Information:

- **EPA Demo** National Lead Industry, NJ
- Pease Air Force Base, Newington, NH
- **Superfund Site**: Western Processing, WA

- **Superfund Site:** Rocky Mountain Arsenal, OU 17, CO
- **Superfund Site:** Vally Wood Preserving, Inc., Turlock, CA
- **Superfund Site:** Motor Wheel, Lansing TWP, MI
- **Superfund Site:** Perham Arsenic, Perham, MN
- Additional site information on the FRTR web site

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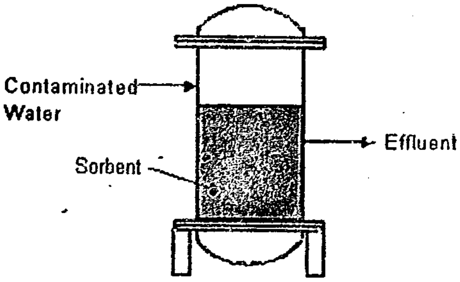
Contaminated Water
Sorbent
Effluent

4.52 Ion Exchange

(Ex Situ Ground Water Remediation Technology)

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Description | Synonyms | Applicability | Limitations
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Technology	Description
Ground Water, Surface Water, and Leachate	
3.12 Ex Situ Physical/Chemical Treatment (assuming pumping)	
4.52 Ion Exchange	Ion exchange removes ions from the aqueous phase by exchange with counter ions on the exchange medium.

Description:

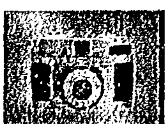

Figure 4-52: Typical Ion Exchange and Adsorption Equipment Diagram

Ion exchange removes ions from the aqueous phase by the exchange of cations or anions between the contaminants and the exchange medium. Ion exchange materials may consist of resins made from synthetic organic materials that contain ionic functional groups to which exchangeable ions are attached. They also may be inorganic and natural polymeric materials. After the resin capacity has been exhausted, resins can be regenerated for re-use.

The duration of ion exchange technology is typically short- to medium-term depending on the factors discussed in Data Needs.

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Synonyms: NA

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Applicability: Ion exchange can remove dissolved metals and radionuclides from aqueous solutions. Other compounds that have been treated include nitrate, ammonia nitrogen, and silicate.

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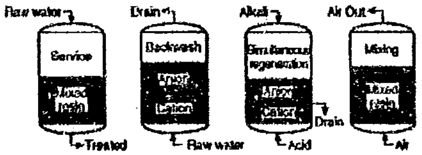

Principle of mixed-bed ion exchange: *(a)* Service period. *(b)* Backwash period. *(c)* Simultaneous regeneration. (Illinois Water Treatment Co.)

Source: *Chemical Engineer's Handbook*, Perry & Chilton (5th Edition)

4-46 94P-3318 9/19/94

Limitations:

Factors that may affect the applicability and effectiveness of this process include:

- Oil and grease in the ground water may clog the exchange resin.
- Suspended solids content greater than 10 ppm may cause resin blinding.
- The pH of the influent water may affect the ion exchange resin selection.
- Oxidants in ground water may damage the ion exchange resin.
- Wastewater is generated during the regeneration step and will require additional treatment and disposal.

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Data Needs:

A detailed discussion of these data elements is provided in Subsection 2.2.2 (Data Requirements for Ground Water, Surface Water, and Leachate).

Factors affecting the design of an ion exchange system include the presence of oil and grease, contaminant concentration, exchange capacity of the resin, suspended solids, metals, oxidant content, inorganic ions in ground water; and pH of the ground water.

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Performance Data:

DOE has developed compact processing units (CPUs), or "modular waste treatment units," which are relatively small mobile equipment modules. They perform unit chemical process operations. The CPUs allow rapid deployment of technologies for the treatment of radioactive wastes in underground storage tanks. The modules would be manufactured off-site by commercial vendors and moved into place using trucks or special transports. The concept of having standardized modules is based on the notion that various radioactive waste treatment subsystems could be standardized to match the CPU hardware package, leading to more rapid, cost-effective deployment. The cost benefits are realized even when multiple units are deployed to achieve greater processing rates. The modular design concept will also allow for reuse of CPU components for different unit processes or process deployments.

The ion-exchange CPU will pump undiluted liquid tank waste from an underground storage tank or receive liquid waste from a waste retrieval system for treatment. DOE Northwest Laboratories developed the CPU concept in FY91. Development of a cesium ion-exchange CPU technology is scheduled for 1996. A radioactive waste treatment demonstration is scheduled for FY97.

Another DOE technology, the resorcinol-formaldehyde ion exchange (ReFIX) resin, is being developed for prototype demonstration at the Hanford site in FY97. ReFIX resin is applicable to high-level wastestreams containing cesium-supernate salt solutions.

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Cost:

The cost for a typical ion exchange system ranges from $0.08 to $0.21 per 1,000 liters ($0.30 to $0.80 per 1,000 gallons) treated. Key cost factors include:

- Pretreatment requirements.
- Discharge requirements and resin utilization.
- Regenerant used and efficiency.

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References:

California Base Closure Environmental Committee (CBCEC), 1994. ***Treatment Technologies Applications Matrix for Base Closure Activities, Revision 1***, Technology Matching Process Action Team, November, 1994.

DOE, 1993. ***Technology Name: Cesium Removal by Compact Processing Units for Radioactive Waste Treatment***, Technology Information Profile (Rev. 2) for ProTech, DOE ProTech Database, TTP Reference No.: RL-321221.

DOE, 1993. ***Technology Name: Resorcinol-Formaldehyde Ion Exchange Resin for Elutable Ion Exchange in the Compact Portable Units (CPUs) Proposed at Hanford***, Technology Information Profile (Rev. 2) for ProTech, DOE ProTech Database, TTP Reference No.: SR-1320-02.

DOE, 1994. ***Technology Catalogue***, First Edition. February.

EPA, 1990. ***Innovative and Alternative Technology Assessment Manual***, EPA, Office of Water Program Operations, EPA/430/9-78/009.

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Site Information:

- **EPA Demo** Kerr-McGee Chemical Corp., WI
- **Army Demo** USACE-WES, MS
- Additional site information on the FRTR web site

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4.53 Precipitation/Coagulation/Flocculation

(Ex Situ Ground Water Remediation Technology)

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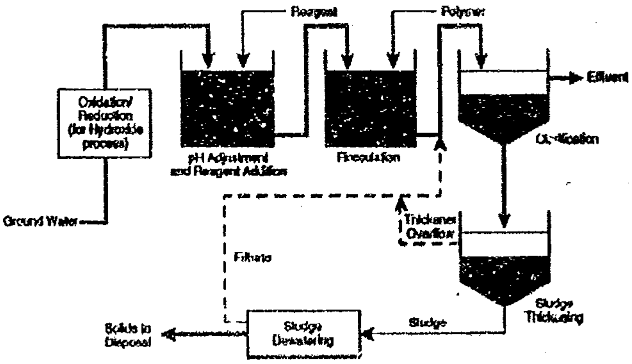
Technology	Description
Ground Water, Surface Water, and Leachate	
3.12 Ex Situ Physical/Chemical Treatment (assuming pumping)	
4.53 Precipitation/ Coagulation/ Flocculation	This process transforms dissolved contaminants into an insoluble solid, facilitating the contaminant's subsequent removal from the liquid phase by sedimentation or filtration. The process usually uses pH adjustment, addition of a chemical precipitant, and flocculation.

Description:

Figure 4-53: Typical Metals Precipitation Process

Precipitation of metals has long been the primary method of treating metal-laden industrial wastewaters. As a result of the success of metals precipitation in such applications, the technology is being considered and selected for use in remediating ground water containing heavy metals, including their radioactive isotopes. In ground water treatment applications, the metal precipitation process is often used as a pretreatment for other treatment technologies (such as chemical oxidation or air stripping) where the presence of metals would interfere with the other treatment processes.

Metals precipitation from contaminated water involves the conversion of soluble heavy metal salts to insoluble salts that will precipitate. The precipitate can then be removed from the treated water by physical methods such as clarification (settling) and/or filtration. The process usually uses pH adjustment, addition of a chemical precipitant, and flocculation. Typically, metals precipitate from the solution as hydroxides, sulfides, or carbonates. The solubilities of the specific metal contaminants and the required cleanup standards will dictate the process used. In some cases, process design will allow for the generation of sludges that can be sent to recyclers for metal recovery.



4-40 94P-2726 8/25/94 Source: Arthur D. Little, Inc.

➤ ***Coagulants and Flocculation***

In the precipitation process, chemical precipitants, coagulants, and flocculantation are used to increase particle size through aggregation. The precipitation process can generate very fine particles that are held in suspension by electrostatic surface charges. These charges cause clouds of counter-ions to form around the particles, giving rise to repulsive forces that prevent aggregation and reduce the effectiveness of subsequent solid-liquid separation processes. Therefore, chemical coagulants are often added to overcome the repulsive forces of the particles. The three main types of coagulants are inorganic electrolytes (such as alum, lime, ferric chloride, and ferrous sulfate), organic polymers, and synthetic polyelectrolytes with anionic or cationic functional groups. The addition of coagulants is followed by low-sheer mixing in a flocculator to promote contact between the particles, allowing particle growth through the sedimentation phenomenon called flocculant settling.

Flocculant settling refers to a rather dilute suspension of particles that coalesce, or flocculate, during the sedimentation operation. As coalescence or flocculation occurs, the particles increase in mass and settle at a faster rate. The amount of flocculation that occurs depends on the opportunity for contact, which varies with the overflow rate, the depth of the basin, the velocity gradients in the system, the concentration of particles, and the range of particles sizes. The effects of these variables can only be accomplished by sedimentation tests.

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Synonyms: NA.

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Applicability: Precipitation is used mainly to convert dissolved ionic species into solid-phase particulates that can be removed from the aqueous phase by coagulation and filtration. Remedial application of this technology usually involve removal of dissolved toxic metals and radionuclides. Depending on the process design, sludges may be amenable to metal recovery.

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Limitations: Disadvantages of metals precipitation may include:

- As with any pump and treat process, if the source of contamination is not removed (as in metals absorbed to soil), treatment of the ground water may be superfluous.
- The presence of multiple metal species may lead to removal difficulties as a result of amphoteric natures of different compounds (i.e., optimization on one metal species may prevent removal of another).
- As discharge standards become more stringent, further treatment may be required.
- Metal hydroxide sludges must pass TCLP prior to land

disposal.
- Soluble hexavalent chrome requires extra treatment prior to coagulaation and flocculation.
- Reagent addition must be carefully controlled to preclude unacceptable concentrations in treatment effluent.
- Efficacy of the system relies on adequate solids separation techniques (e.g., clarification, flocculation, and/or filtration).
- Process may generate toxic sludge requiring proper disposal.
- Process can be costly, depending on reagents used, required system controls, and required operator involvement in system operation.
- Dissolved salts are added to the treated water as a result of pH adjustment.
- Polymer may need to be added to the water to achieve adequate settling of solids.
- Treated water will often require pH adjustment.
- Metals held in solution by complexing agents (e.g., cyanide or EDTA) are difficult to precipitate.

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Data Needs: A detailed discussion of these data elements is provided in Subsection 2.2.2 (Data Requirements for Ground Water, Surface Water, and Leachate).

Bench-scale treatability tests should be conducted to determine operating parameters and characteristics [i.e., reagent type and dosage, optimum pH, retention time, flow rate, temperature, mixing requirements, flocculent (polymer) selection, suspended solids, precipitate settling and filtration rates, and sludge volume and characteristics].

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Performance Data: Precipitation of heavy metals as the metal hydroxides or sulfides has been practiced as the prime method of treatment for heavy metals in industrial wastewater for many years. More recently, precipitation (usually as the metal hydroxides) has been used in the electronics and electroplating industries as a pretreatment technology for wastewater discharge to a publicly owned treatment works (POTW). Metals precipitation is widely used to meet NPDES requirements for the treatment of heavy metal-containing wastewaters.

Because of its success in meeting requirements for discharge of treated wastewater, metals precipitation is recognized as a proven process for use in remedial activities such as ground water treatment. Precipitation (combined with sedimentation, and/or flocculation and filtration) is becoming the most widely selected means for heavy metals removal from ground water in pump and treat operations.

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Cost:

The primary capital cost factor is design flow rate. Capital costs for 75- and 250-liters-per-minute (20-gpm and 65-gpm) packaged metals precipitation systems are approximately $85,000 and $115,000, respectively.

The primary factors affecting operating costs are labor and chemical costs. Operating costs (excluding sludge disposal) are typically in a range from $0.08 to $0.18 per 1,000 liters ($0.30 to $0.70 per 1,000 gallons) of ground water containing up to 100 mg/L of metals.

For budgetary purposes, sludge disposal may be estimated to increase operating costs by approximately $0.13 per 1,000 liters ($0.50 per 1,000 gallons) of ground water treated. Actual sludge disposal costs (including fixation and transportation) have been estimated at approximately $330 per metric ton ($300 per ton) of sludge.

Costs for performing a laboratory treatability study for metals precipitation may range from $5,000 to $20,000. Depending on the degree of uncertainty or other requirements, a pilot or field demonstration may be needed. Associated costs may range from $50,000 to $250,000 (depending on scale, analytical requirements, and duration).

Additional cost information can be found in the Hazardous, Toxic, and Radioactive Wastes (HTRW) Historical Cost Analysis System (HCAS) developed by Environmental Historical Cost Committee of Interagency Cost Estimation Group.

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References:

Balaso, C.A., et al., 1986. **"Soluble Sulfide Precipitation Study"**, Arthur D. Little, Inc., Final Report to USATHAMA, Report No. AMXTH-TE-CR-87106.

Battelle Memorial Institute, 1995. **"ReOpt. V3.1"**, by Battelle Memorial Institute for DOE under Contract DE/AC06/76RLO 1830.

Bricka, R. Mark, 1988. **"Investigation and Evaluation of the Performance of Solidified Cellulose and Starch Xanthate Heavy Metal Sludges"**, USACE-WES Technical Report EL-88-5.

EPA, 1980. ***Control and Treatment Technology for the Metal Finishing Industry: Sulfide Precipitation***, EPA/625/8-80/003.

EPA, 1990. ***Innovative and Alternative Technology Assessment Manual***, EPA, Office of Water Program Operations, EPA/430/9-78/009.

Federal Remediation Technologies Roundtable, 1998. ***Remediation Case Studies: Innovative Groundwater Treatment Technologies***, EPA/542/R-98/015.

- Coagulation/Flocculation/Dissolved Air Flotation and Oleofiltration™ at the Coastal Systems Station, AOC 1, Panama City, Florida

NEESA, 1993. ***Precipitation of Metals from Ground Water.*** NEESA Document Number 20.2-051.6, Naval Energy and Environmental Support Activity, Port Hueneme, CA.

Tchobanoglous, G. and F.L. Burton, 1991. "**Wastewater Engineering - Treatment, Disposal and Reuse,**" Third Edition. Metcalf & Eddy, Inc.

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Site Information:

- **EPA Demo** Palangana Uranium Mine Site, TX
- Coakley Landfill New Hampshire
- Stringfellow Acid Pit Site CA
- Winthrop Landfill Winthrop, ME
- EPA Removal Action Crown Plating, MO
- Coastal Systems Station, AOC 1, Panama City, FL
- Additional site information on the FRTR web site

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4.40 Directional Wells

(In Situ Ground Water Remediation Technology)

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Technology	Description
Ground Water, Surface Water, and Leachate	
3.10 In Situ Physical/Chemical Treatment	
4.40 Directional Wells	Drilling techniques are used to position wells horizontally, or at an angle, to reach contaminants not accessible by direct vertical drilling.

Description:

Figure 4-40: Typical Diagram of In Situ Air Stripping with Horizontal Wells

Drilling techniques are used to position wells horizontally, or at an angle, to reach contaminants not accessible by direct vertical drilling. Directional drilling may be used to enhance other in-situ or in-well technologies such as ground water pumping, bioventing, SVE, soil flushing, and in-well air stripping.

Hardware used for directional boring includes wireline coring rigs, hydraulic thrust systems, electric cone penetrometers, steering tracking hardware, sonic drilling, and push coring systems. Hydraulically activated thrust equipment capable of exerting more than 40 tons of thrust is used to push the directional boring heads into the earth. Directional control is obtained by proper positioning of the face of the nonsymmetric boring head. Slow rotation of the boring head will cut and compact the geologic material into the borehole wall. Thrusting a boring head that is not rotating wil cause a directional change. The machinery is capable of initiating a borehole, steering down to a desired horizontal depth, continuing at that depth, and then steering back to the surface at a downrange location.

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Synonyms: Horizontal Wells.

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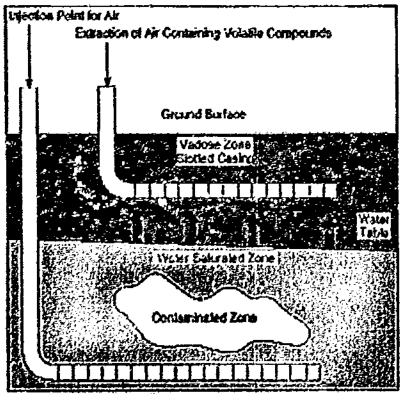
Injection Point for Air
Extraction of Air Containing Volatile Compounds
Ground Surface
Vadose Zone
Slotted Casing
Water Table
Water Saturated Zone
Contaminated Zone

Applicability:

Directional well technology is applicable to the complete range of contaminant groups with no particular target group. It is particularly useful when existing structures interfere with placement of vertical wells.

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Limitations:

Factors that may limit the applicability and effectiveness of the process include:

- The potential exists for the wells to collapse.
- Specialized equipment is required.
- Wells are difficult to position precisely.
- Installation of horizontal wells is typically costly.
- Currently, the technology is limited to depths of less than 50 feet.

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Data Needs:

A detailed discussion of these data elements is provided in Subsection 2.2.2. (Data Requirements for Ground Water, Surface Water, and Leachate).

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Performance Data:

Testing was performed as part of the Mixed Waste Landfill Integrated Demonstration at Sandia National Laboratories, Albuquerque, NM. Several directional holes were drilled; a depth of 12 meters (40 feet) was achieved with a maximum horizontal extent of 174 meters (570 feet).

A DOE field demonstration at the Savannah River site was performed in FY90 for in situ air stripping (ISAS), a mass transfer process that uses horizontal injection and vacuum extraction wells to remediate sites contaminated with VOCs within the vadose zone and soil/ground water in the saturated zone. Air is injected into the saturated zone through horizontal injection wells placed below the water table. As the air passes through the contaminant plume, it volatilizes the chemical constituents. This process performs best in homogeneous soil conditions, while heterogeneities such as formations, fractures, clay layers, and partial clay lenses hinder performance. Clay layers often have high contaminant concentrations, while stratigraphy can cause preferential flow paths and limit the process efficiency. ISAS has been shown to be effective when some interbedded, thin, and/or discontinuous clays are present. A full-scale demonstration, including 4% methane enhancement as a bioremediation nutrient in the injection well, was conducted during FY92, with results to be available in FY93. Better underground transport modeling and bioremediation modeling are needed. The technology was also used successfully in the DOE VOCs in the Non-Arid Soils Integrated Demonstration in Savannah River, South Carolina. Testing of directional boring for monitoring equipment installation was performed in an actual contamination zone during the summer of 1992.

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Cost: Estimated costs are about \$60 to \$250 per meter (\$20 to \$75 per foot) for hydraulic bi-directional thrust drilling. Sonic drilling can be as much as \$330 per meter (\$100 per foot).

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References:

DOE, 1991. ***Horizontal Hybrid Directional Boring***, FY92 Technical Task Plan, TTP Reference No.: AL-ZU23-J2.

DOE, 1991. ***SRS Integrated Demonstration: Directional Drilling***, FY92 Technical Task Plan, TTP Reference No.: SR-1211-01.

DOE, 1992. ***Directional Sonic Drilling***, FY93 Technical Task Plan, TTP Reference No.: AL-2311-05.

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DOE, 1994. ***Technology Catalogue***, First Edition. February.

DOE, 1993. ***Technology Name: Slant-Angle Sonic Drilling, Technology Information Profile (Rev. 2)***, DOE ProTech Database, TTP Reference No.: AL2310-05.

EPA, 1994. ***Manual: Alternative Methods for Fluid Delivery and Recovery***, Prepared by: Murdoch, L., and Wilson, D.D. EPA/625/R-94/003.

EPA, 1997. ***Analysis of Selected Enhancements for Soil Vapor Extraction***, EPA OSWER, EPA/542/R-97/007.

Kaback, D., and Oakley, D. 1996. "**Horizontal Environmental Wells in the United States: A Catalogue**," Colorado Center for Environmental Management (CCEM).

Wilson, D.D., and Kaback, D.S., 1993. "**Industry Survey for Horizontal Wells**", Westinghouse Savannah River Company (DOE), Aiken, SC. WSRC-TR-93-511.

Wilson, D.D., 1996. "**Use of Horizontal Drilling In Environmental Remediation: A Horizontal Well Case Study**", Water Well Journal, February.

Wilson, D.D., 1996, "**Horizontal Well Development Made Easy**", Water Well Journal, October.

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Site Information:

- **DOE Demo** Savannah River Site, SC

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4.58 Ground Water Pumping

(Ground Water Containment Remediation Technology)

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Data Needs | Performance | Cost | References
Site Information | Points of Contact | Vendor Information | Health & Safety

Technology	Description
Ground Water, Surface Water, and Leachate	
3.13 Containment	
4.58 Ground Water Pumping	Ground water pumping is a component of many pump-and-Treat processes, which are some of the most commonly used ground water remediation technologies at contaminated sites.

Description:

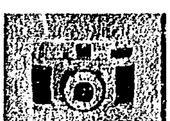

Figure 4-58: Typical Ground Water Pumping System

Possible objectives of ground water pumping include removal of dissolved contaminants from the subsurface, and containment of contaminated ground water to prevent migration.

The first step of any remediation project consists of defining the remedial action objectives to be accomplished at the site. This involves gathering enough background site information and field data to make assessments of remedial requirements and possible cleanup levels. The first determination is whether cleanup or containment will be the most appropriate remedial action. If cleanup is chosen, the level of cleanup must be determined. If containment is chosen, ground water pumping is used as a hydraulic barrier to prevent off-site migration of contaminant plumes.

The next component consists of the design and implementation of the ground water pumping system based on data evaluated in setting the goals and objectives. The criteria for well design, pumping system, and treatment are dependent on the physical site characteristics and contaminant type. Actual treatment may include the design of a train of processes such as gravity segregation, air strippers, carbon systems tailored to remove specific contaminants.

Another component of any ground water extraction system is a ground water monitoring program to verify its effectiveness. Monitoring the remedial with wells and piezometers allows the operator to make iterative adjustments to the system in response to changes in subsurface conditions caused by the remediation.

The final component is determining the termination requirements. Termination requirements are based on the cleanup objectives defined in the initial stage of the remedial process. The termination criteria are also dependent on the specific site aspects revealed during remedial operations.

Although pumping for containment implies no treatment the following treatments usually follow pumping in pump and treat systems. These are briefly described below and in detail in technology profiles 4.47 through 4.55:

4.47 Bioreactors:
Contaminants in extracted ground water are put into contact with microorganisms in attached or suspended growth biological reactors. In suspended systems, such as activated sludge, contaminated ground water is circulated in an aeration basin. In attached systems, such as rotating biological contractors and trickling filters, microorganisms are established on an inert support matrix.

4.48 Constructed wetlands:
The constructed wetlands-based treatment technology uses natural geochemical and biological processes inherent in an artificial wetland ecosystem to accumulate and remove metals and other contaminants from influent waters.

4.49 Adsorption/Absorption:
In liquid adsorption, solutes concentrate at the surface of a sorbent, thereby reducing their concentration in the bulk liquid phase. The most common adsorbent is granulated activated carbon (GAC) (see Technology Profile No. 4.51). Other natural and synthetic adsorbents include: forage sponge, lignin adsorption, sorption clays, and synthetic resins.

4.50 Air Stripping:
Volatile organics are partitioned from ground water by increasing the surface area of the contaminated water exposed to air. Aeration methods include packed towers, diffused aeration, tray aeration, and spray aeration.

4.51 Granulated Activated Carbon (GAC)/Liquid Phase Carbon Adsorption:
Ground water is pumped through a series of canisters or columns containing activated carbon to which dissolved organic contaminants adsorb. Periodic replacement or regeneration of saturated carbon is required.

4.52 Ion Exchange:
Ion exchange removes ions from the aqueous phase by the exchange of cations or anions between the contaminants and the exchange medium. Ion exchange materials may consist of resins made from synthetic organic materials that contain ionic functional groups to which exchangeable ions are attached. They also may be inorganic and natural polymeric materials. After the resin capacity has been exhausted, resins can be regenerated for re-use.

4.53 Precipitation/Coagulation/ Flocculation:
This process transforms dissolved contaminants into an insoluble solid, facilitating the contaminant's subsequent removal from the liquid phase by sedimentation or filtration. The process usually uses pH adjustment, addition of a chemical precipitant, and flocculation.

4.54 Separation:
Separation processes seek to detach contaminants from their medium (i.e., ground water and/or binding material that contain them). Ex situ separation of waste stream can be performed by many processes: (1) distillation, (2) filtration/ultrafiltration/microfiltration, (3) freeze crystallization, (4) membrane pervaporation and (5) reverse osmosis.

4.55 Sprinkler Irrigation:
Wastewater is distributed over the top of the filter bed through which wastewater is trickled. The organic contaminants in wastewater are degraded by the microorganisms attached to the filter medium.

➤ ***Surfactant Enhanced Recovery***

The application of surfactants micelles or steam to the ground water can facilitate the ground water pumping process by increasing the mobility and solubility of the contaminants sorbed to the soil matrix. This material can also facilitate the entrainment of hydrophobic contaminants to allow removal and assures that multi-phase contaminants can be effectively removed. Thu[s] it can increase the contaminant mass removal per pore volume of ground water flushing through the contaminated zone.

The implementation of surfactant-enhanced recovery requires the injection of surfactants into a contaminated aquifer. Typical systems utilize a pump to extract ground water at some distance away from the injection point. The extracted ground water is treated ex situ to separate the injected surfactants from the contaminants and ground water. In order to be cost-effective, the design of the surfactant-enhanced recovery system is critical. Once the surfactants have separated from the ground water they can be re-injected into the subsurface. Contaminants must be separated from the ground water and treated prior to discharge of the extracted ground water.

➤ ***Drawdown Pumping***

Pump drawdown nonaqueous-phase liquid (NAPL) recovery systems are designed to pump NAPL and ground water from recovery wells or trenches. Pumping removes water and lowers the water table near the extraction area to create a cone of depression. The cone of depression in the vicinity of the extraction well produces a gravity head that pushes flow of NAPL toward the well and increases the thickness of the NAPL layer in the well. Each foot of ground water depression provides a driving head equivalent to a pressure difference of 0.45 psi. In most cases, the production of a cone of depression will increase NAPL recovery rates.

Pumping may be accomplished with one or two pumps. In the single-pump configuration, one pump withdraws both water and NAPL. The dual-pump configuration uses one pump located below the water table to remove water and a second located in the NAPL layer to recover NAPL. A single-pump system reduces capital and operating costs and allows simpler control systems and operation, but produces a stream of mixed water and NAPL that must then be separated.

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Synonyms:

Pump and treat.
DSERTS Code: Q1 (Waste Removal - Liquids)

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Applicability:

The first step in determining whether ground water pumping is an appropriate remedial technology is to conduct a site characterization investigation. Site characteristics, such as hydraulic conductivity, will determine the range of remedial options possible. Chemical properties of the site and plume need to be determined to characterize transport of the contaminant and evaluate the feasibility of ground water pumping. To determine if ground water pumping is appropriate for a site, one needs to know the history of the contamination event, the properties of the subsurface, and the biological and chemical contaminant characteristics. Identifying the chemical and physical site characteristics, locating the ground water contaminant plume in three dimensions, and determining aquifer and soil properties are necessary in designing an effective ground water pumping strategy.

Surfactant-enhanced recovery are most applicable for contaminated sites with enhanced light, nonaqueous-phase liquids (LNAPLs) and dense, nonaqueous-phase liquids (DNAPLs).

Drawdown pumping is effective for NAPL recovery when the aquifer has moderate to high hydraulic conductivity and a thick layer of low-viscosity NAPL. An aquifer with high hydraulic conductivity gives less flow resistance of NAPL into the well. A thick layer of NAPL allows the pumping system to collect a high proportion of NAPL in relation to the amount of ground water. For best operation, the NAPL thickness should be sufficient to completely cover the pump suction port.

Drawdown pumping is a commercially available technology that can be easily implemented with conventional pumps in wells or trenches. System installation costs are low to moderate, but the cost per amount of NAPL recovered varies greatly.

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Limitations:

The following factors may limit the applicability and effectiveness of ground water pumping as part of the remedial process:

- The potentially long time necessary to achieve the remediation goal
- System designs fail to contain the contaminant as predicted, allowing the plume to migrate and failure of the pumping equipment.
- Residual saturation of the contaminant in the soil pores cannot be removed by ground water pumping. Contaminants tend to be sorbed in the soil matrix. Ground water pumping is not applicable to contaminants with high residual saturation, contaminants with high sorption capabilities, and homogeneous aquifers with hydraulic conductivity less than 10^{-5} cm/sec.
- The cost of permitting procuring and operating treatment systems is high. Additional cost may also be attributed to the disposal of spend carbon and other treatment residuals and wastes.
- Biofouling of the extraction wells and associated treatment stream is a common problem which can severely affect system performance. The potential for this problem should be evaluated prior to the installation.

The following factors may limit the applicability and effectiveness of surfactant-enhanced recovery:

- Subsurface heterogeneities, as with most ground water remediation technologies, present challenges to the successful implementation of surfactant-enhanced recovery
- Potential toxic effects of residual surfactants in the subsurface
- Off-site migration of contaminants due to the increase solubility achieved with surfactant injection Obtaining regulatory approval to inject surfactants into an aquifer.

The following factors may limit the applicability and effectiveness of drawdown pumping:

- Drawdown pumping generally produces large volumes of water in the process of recovering the free product.

- The production of a cone depression in the water table can smear the free product or trap the fuel in the saturated zone when the water table returns to its original level.

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Data Needs:

Collecting as much background site data as possible, obtaining accurate information on the type of contaminants present, and determining the hydrogeological nature of the site are essential. Contaminant information needed consists of: 1) source characterization, including the volume released, the area infiltrated, and duration of release; 2) concentration distribution of contaminants and naturally occurring chemicals in the ground water and soil; and 3) processes affecting plume development, such as chemical and biological reactions influencing contaminant mobility. Hydrogeologic information include determining the size of the contaminated aquifer, depth to water table, hydraulic conductivity of the surrounding aquifer material, impermeable units and confining layers, ground water flow direction and velocity, recharge and discharge areas, seasonal variations of ground water conditions, and local ground water use. Methods for determining aquifer properties include a slug test, pump test, and a borehole flowmeter test. The pump test consists of pumping one well and measuring the water level response of surrounding wells. A slug test measures the rate at which water level in one well returns to its initial state after inducing a rapid water level change by introducing or with drawing a volume of water. The borehole flowmeter test measures flow direction and rate in a borehole.

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Performance Data:

DOE has developed and tested many pump and treat technologies for hazardous waste removal over the past twenty years. Performance data on some of the most recent DOE sites can be in the Technology Application Analyses and site information below.

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Cost:

Cost data varies from site to site for ground water pump and treat technology. Recent cost data on a few of DOE's sites can be found below in the links to the Technology Application Analyses and in the site information.

Additional cost information can be found in the Hazardous, Toxic, and Radioactive Wastes (HTRW) Historical Cost Analysis System (HCAS) developed by Environmental Historical Cost Committee of Interagency Cost Estimation Group.

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DOE, 1994. ***Technology Application Analysis: Pump and Treat of Contaminated Groundwater at U.S. Department of Energy, Lawrence Livermore National Laboratory, Livermore Site, Livermore, California,*** prepared by Stone & Webster Environmental Technology & Services.

DOE, 1994. ***Technology Application Analysis: Pump and Treat of Contaminated Groundwater at Operable Unit B/C, McClellan Air Force Base, California,*** prepared by Stone & Webster Environmental Technology & Services.

DOE, 1994. ***Technology Application Analysis: Pump and Treat of Contaminated Groundwater at Operable Unit D, McClellan Air Force Base, California***, prepared by Stone & Webster Environmental Technology & Services.

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- Pump and Treat System at Commencement Bay, South Tacoma Channel (Well 12A), Phase 2, Tacoma, Washington
- Recovery of Free Petroleum Product at Fort Drum, Fuel Dispensing Area 1595, Watertown, New York
- Pump and Treat of Contaminated Groundwater at IRP Site 4, Langley Air Force Base, Virginia
- Pump and Treat of Contaminated Groundwater at Operable Unit B/C, McClellan Air Force Base, California
- Pump and Treat of Contaminated Groundwater at the Twin Cities Army Ammunition Plant, New Brighton, Minnesota
- Pump and Treat of Contaminated Groundwater at the U.S. Department of Energy's Kansas City Plant, Kansas City, Missouri
- Pump and Treat of Contaminated Groundwater at the U.S. Department of Energy's Savannah River Site, A/M Area, Aiken, South Carolina

Federal Remediation Technologies Roundtable, 1998. ***Remediation Case Studies: Groundwater Pump and Treat (Chlorinated Solvents),*** EPA/542/R-98/013

- Pump and Treat of Contaminated Groundwater at the Des Moines TCE Superfund Site, OU 1, Des Moines, Iowa
- Pump and Treat of Contaminated Groundwater at the Former Firestone Facility Superfund Site, Salinas, California
- Pump and Treat of Contaminated Groundwater at the JMT Facility RCRA Site, Brockport, New York
- Pump and Treat of Contaminated Groundwater at the Keefe Environmental Services Superfund Site, Epping, New Hampshire
- Groundwater Pump and Treat and Soil Vapor Extraction at DOE's Lawrence Livermore National Laboratory, Site 300,

GSA OU, Livermore, California
- Pump and Treat of Contaminated Groundwater at the Mystery Bridge at Hwy 20 Superfund Site, Dow/DSI Facility, Evansville, Wyoming
- Groundwater Containment at Site LF-12, Offutt AFB, Nebraska
- Pump and Treat of Contaminated Groundwater at the Old Mill Superfund Site, Rock Creek, Ohio
- Pump and Treat of Contaminated Groundwater at the SCRDI Dixiana Superfund Site, Cayce, South Carolina
- Groundwater Containment at Site OT-16B, Shaw AFB, South Carolina
- Groundwater Containment at Site SD-29 and ST-30, Shaw AFB, South Carolina
- Pump and Treat of Contaminated Groundwater at the Sol Lynn/Industrial Transformers Superfund Site, Houston, Texas
- Pump and Treat of Contaminated Groundwater at the Solid State Circuits Superfund Site, Republic, Missouri
- Pump and Treat of Contaminated Groundwater with Containment Wall at the Solvent Recovery Services of New England, Inc. Superfund Site, Southington, Connecticut

Federal Remediation Technologies Roundtable, 1998. ***Remediation Case Studies: Groundwater Pump and Treat (Nonchlorinated Solvents)***, EPA/542/R-98/014

- Pump and Treat of Contaminated Groundwater at the Baird and McGuire Superfund Site, Holbrook, Massachusetts
- Pump and Treat of Contaminated Groundwater at the City Industries Superfund Site, Orlando, Florida
- Pump and Treat of Contaminated Groundwater at the King of Prussia Technical Corporation Superfund Site, Winslow Township, New Jersey
- Pump and Treat of Contaminated Groundwater at the LaSalle Electrical Superfund Site, LaSalle, Illinois
- Pump and Treat of Contaminated Groundwater at the Mid-South Wood Products Superfund Site, Mena, Arkansas
- Pump and Treat of Contaminated Groundwater at the Odessa Chromium I Superfund Site, OU 2, Odessa, Texas
- Pump and Treat of Contaminated Groundwater at the Odessa Chromium IIS Superfund Site, OU 2, Odessa, Texas
- Groundwater Containment at Site FT-01, Pope AFB, North Carolina
- Groundwater Containment at Site SS-07, Pope AFB, North Carolina
- Pump and Treat and Containment of Contaminated Groundwater at the Sylvester/Gilson Road Superfund Site, Nashua, New Hampshire
- Pump and Treat of Contaminated Groundwater at the United Chrome Superfund Site, Corvallis, Oregon
- Pump and Treat of Contaminated Groundwater at the U.S. Aviex Superfund Site, Niles, Michigan
- Pump and Treat of Contaminated Groundwater at the Western Processing Superfund Site, Kent, Washington

Federal Remediation Technologies Roundtable, 1998. ***Remediation Case Studies: Innovative Groundwater Treatment Technologies***, EPA/542/R-98/015.

- Pump and Treat and Permeable Reactive Barrier to Treat Contaminated Groundwater at the Former Intersil, Inc. Site, Sunnyvale, California
- Pump and Treat and In Situ Bioremediation of Contaminated Groundwater at the French Ltd. Superfund Site, Crosby, Texas
- Pump and Treat and Air Sparging of Contaminated Groundwater at the Gold Coast Superfund Site, Miami, Florida
- Pump and Treat and In Situ Bioremediation of Contaminated Groundwater at the Libby Groundwater Superfund Site, Libby, Montana
- Pump and Treat, In Situ Bioremediation, and In Situ Air Sparging of Contaminated Groundwater at Site A, Long Island, New York

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Site Information:

- Lawerence Livermore Nat'l Lab (LLNL), Livermore, CA
- McClellan Air Force Base, Operable Unit (OU) D, CA
- FAA Technical Center, NJ
- Former Intersil, Inc. Site, Sunnyvale, CA
- Amoco Petroleum Pipeline, Constantine, MI
- Baird and McGuire Superfund Site, Holbrook, MA
- City Industries Superfund Site, Orlando, FL
- Commencement Bay, South Tacoma Channel (Well 12A), Phase 2, Tacoma, WA
- Des Moines TCE Superfund Site, OU 1, Des Moines, IO
- Former Firestone Facility Superfund Site, Salinas, CA
- Fort Drum, Fuel Dispensing Area 1595, Watertown, NY
- French Ltd. Superfund Site, Crosby, TX
- Gold Coast Superfund Site, Miami, FL
- JMT Facility RCRA Site, Brockport, NY
- Keefe Environmental Services Superfund Site, Epping, NH
- King of Prussia Technical Corporation Superfund Site, Winslow Township, NJ
- Langley Air Force Base, IRP Site 4, Langley, VA
- LaSalle Electrical Superfund Site, LaSalle, IL
- DOE's Lawrence Livermore National Laboratory, Site 300, GSA OU, Livermore, CA
- Libby Groundwater Superfund Site, Libby, MT
- McClellan Air Force Base, Operable Unit (OU) B/C,CA
- Mid-South Wood Products Superfund Site, Mena, AR
- Mystery Bridge at Hwy 20 Superfund Site, Dow/DSI Facility, Evansville, WY
- Odessa Chromium I Superfund Site, OU 2, Odessa, TX
- Odessa Chromium IIS Superfund Site, OU 2, Odessa, TX
- Site LF-12, Offutt AFB, NB
- Old Mill Superfund Site, Rock Creek, OH

- Site FT-01, Pope AFB, NC
- Site SS-07, Pope AFB, NC
- SCRDI Dixiana Superfund Site, Cayce, SC
- Site OT-16B, Shaw AFB, SC
- Site SD-29 and ST-30, Shaw AFB, SC
- Site A, Long Island, NY
- Sol Lynn/Industrial Transformers Superfund Site, Houston, TX
- Solid State Circuits Superfund Site, Republic, MO
- Solvent Recovery Services of New England, Inc. Superfund Site, Southington, CT
- Sylvester/Gilson Road Superfund Site, Nashua, NH
- Twin City Army Ammunition Plant, New Brighton, MN
- United Chrome Superfund Site, Corvallis, OR
- U.S. Aviex Superfund Site, Niles, MI
- U.S. DOE's Kansas City Plant, Kansas City, MO
- U.S. DOE's Savannah River Site A/M Area, Aiken, SC
- Western Processing Superfund Site, Kent, WA
- Additional site information on the FRTR web site

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Points of Contact:

General FRTR Agency Contacts

Technology Specific Web Sites:

Government Web Sites

Non-Government Web Sites

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Vendor Information:

A list of vendors offering Water Containment Treatment is available from the Vendor Information System for Innovative Treatment Technologies (VISITT) developed by U.S. Environmental Protection Agency (EPA).

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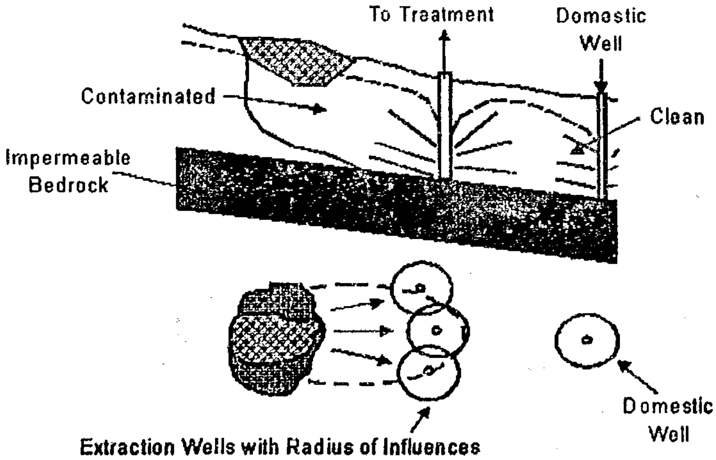
To Treatment
Domestic Well
Contaminated
Clean
Impermeable Bedrock
Domestic Well
Extraction Wells with Radius of Influences

4.59 Slurry Walls

(Ground Water Containment Remediation Technology)

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Description | Synonyms | Applicability | Limitations
Data Needs | Performance | Cost | References
Site Information | Points of Contact | Vendor Information | Health & Safety

Technology	Description
Ground Water, Surface Water, and Leachate	
3.13 Containment	
4.59 Slurry Walls	These subsurface barriers consist of vertically excavated trenches filled with slurry. The slurry, usually a mixture of bentonite and water, hydraulically shores the trench to prevent collapse and retards ground water flow.

Description:

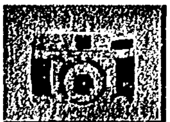

Figure 4-59: Typical Keyed-In Slurry Wall (Cross-Section)

Slurry walls are used to contain contaminated ground water, divert contaminated ground water from the drinking water intake, divert uncontaminated ground water flow, and/or provide a barrier for the ground water treatment system.

These subsurface barriers consist of a vertically excavated trench that is filled with a slurry. The slurry hydraulically shores the trench to prevent collapse and forms a filter cake to reduce ground water flow. Slurry walls often are used where the waste mass is too large for treatment and where soluble and mobile constituents pose an imminent threat to a source of drinking water.

Slurry walls are a full-scale technology that have been used for decades as long-term solutions for controlling seepage. They are often used in conjunction with capping. The technology has demonstrated its effectiveness in containing greater than 95% of the uncontaminated ground water; however, in contaminated ground water applications, specific contaminant types may degrade the slurry wall components and reduce the long-term effectiveness.

Most slurry walls are constructed of a soil, bentonite, and water mixture. The bentonite slurry is used primarily for wall stabilization during trench excavation. A soil-bentonite backfill material is then placed into the trench (displacing the slurry) to create the cutoff wall. Walls of this composition provide a barrier with low permeability and chemical resistance at low cost. Other wall compositions, such as cement/bentonite, pozzolan/bentonite, attapulgite, organically modified bentonite, or slurry/geomembrane composite, may be used if greater structural strength is required or if chemical incompatibilities between bentonite and site contaminants exist.

Slurry walls are typically placed at depths up to 30 meters (100 feet) and are generally 0.6 to 1.2 meters (2 to 4 feet) in thickness. Installation depths over 30 m (100 ft) are implementable using clam shell bucket excavation, but the cost perunit area of wall increases by about a factor of three. The most effective application of the slurry wall for site remediation or pollution control is to base (or key) the slurry wall 0.6 to 0.9 meters (2 to 3 feet) into a low permeability layer such as clay or bedrock, as shown in the preceding figure. This "keying-in" provides for an effective foundation with minimum leakage potential. An alternate configuration for slurry wall installation is a "hanging" wall in which the wall projects into the ground water table to block the movement of lower density or floating contaminants such as oils, fuels, or gases. Hanging walls are used less frequently than keyed-in walls.

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Synonyms:

Vertical cutoff walls; Hydrodynamic barriers; Slurry Trenches.
DSERTS Code: I2 (Slurry Walls/Underground Barriers)

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Applicability:

Slurry walls contain the ground water itself, thus treating no particular target group of contaminants. They are used to contain contaminated ground water, divert contaminated ground water from drinking water intake, divert uncontaminated ground water flow, and/or provide a barrier for the ground water treatment system.

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Limitations:

Factors that may limit the applicability and effectiveness of the process include:

- Most of the approaches involve a large amount of heavy construction.
- The technology only contains contaminants within a specific area.
- Soil-bentonite backfills are not able to withstand attack by strong acids, bases, salt solutions, and some organic chemicals. Other slurry mixtures can be developed to resist specific chemicals.
- There is the potential for the slurry walls to degrade or deteriorate over time.
- Use of this technology does not guarantee that further remediation in the future may not be necessary.

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Data Needs:

A detailed discussion of these data elements is provided in Subsection 2.2.2. (Data Requirements for Ground Water, Surface Water, and Leachate).

The following factors, at a minimum, must be assessed prior to designing effective soil-bentonite slurry walls: maximum allowable permeability, anticipated hydraulic gradients, required wall strength, availability and grade of bentonite to be used, boundaries of contamination, compatibility of wastes and contaminants in contact with slurry wall materials, characteristics (i.e., depth, permeability, and continuity) of substrate into which the wall is to be keyed, characteristics of backfill material (e.g., fines content), and site terrain and physical layout.

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Performance Data:

Slurry walls have been used for decades, so the equipment and methodology are readily available and well known; however, the process of designing the proper mix of wall materials to contain specific contaminants is less well developed. Excavation and backfilling of the trench is critical and requires experienced contractors.

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Cost:

Costs likely to be incurred in the design and installation of a standard soil-bentonite wall in soft to medium soil range from $540 to $750 per square meter ($5 to $7 per square foot) (1991 dollars). These costs do not include variable costs required for chemical analyses, feasibility, or compatibility testing. Testing costs depend heavily on site-specific factors.

Factors that have the most significant impact on the final cost of soil-bentonite slurry wall installation include:

- Type, activity, and distribution of contaminants.
- Depth, length, and width of wall.
- Geological and hydrological characteristics.
- Distance from source of materials and equipment.
- Requirements for wall protection and maintenance.
- Type of slurry and backfill used.
- Other site-specific requirements as identified in the initial site assessment (e.g., presence of contaminants or debris).
- Planning, permitting, regulatory interaction, and site restoration.

Additional cost information can be found in the Hazardous, Toxic, and Radioactive Wastes (HTRW) Historical Cost Analysis System (HCAS) developed by Environmental Historical Cost Committee of Interagency Cost Estimation Group.

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Zappi, M.E., R.A. Shafer, and D.D. Adrian, 1990. **"Compatibility of Ninth Avenue Superfund Site Ground Water with Two Soil-Bentonite Slurry Wall Backfill Mixtures"**, WES Report No. EL-90-9.

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Site Information:

- Hazardous Waste Landfill
- Sanitary Landfill
- Coal Tar Disposal Pond
- Sylvester/Gilson Road Superfund Site, Nashua, NH

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Points of Contact:

General FRTR Agency Contacts

Technology Specific Web Site:

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Vendor Information:

A list of vendors offering In Situ Physical/Chemical Water Treatment is available from the Vendor Information System for Innovative Treatment Technologies (VISITT) developed by U.S. Environmental Protection Agency (EPA).

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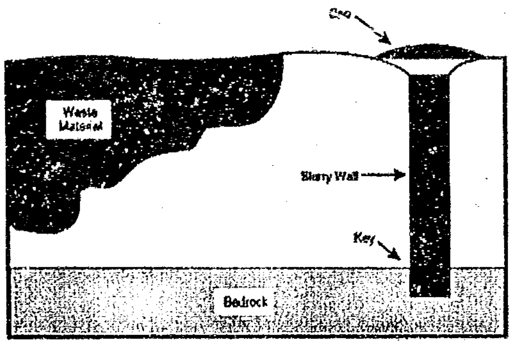

4-41 94P-2350 8/26/94

4.30 Landfill Cap

(Soil Containment Remediation Technology)

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Description | Synonyms | Applicability | Limitations
Data Needs | Performance | Cost | References
Site Information | Points of Contact | Vendor Information | Health & Safety

Technology	Description
Soil, Sediment, and Sludge	
3.7 Containment	
4.30 Landfill Cap	Landfill caps are used for contaminant source control.

Description: Landfill caps can be used to:

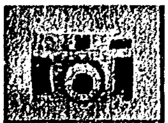
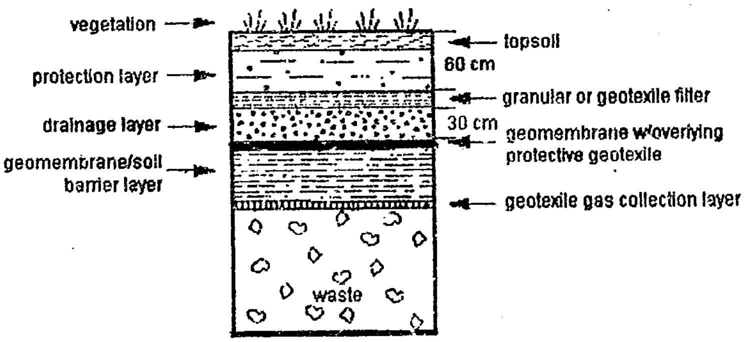


Figure 4-30: Typical RCRA Subtitle C Landfill Cap System

- Caps can minimize exposure on the surface of the waste facility.
- Prevent vertical infiltration of water into wastes that would create contaminated leachate.
- Contain waste while treatment is being applied.
- Control gas emissions from underlying waste.
- Create a land surface that can support vegetation and/or be used for other purposes.

Landfill Capping is the most common form of remediation because it is generally less expensive than other technologies and effectively manages the human and ecological risks associated with a remediation site.

The design of landfill caps is site specific and depends on the intended functions of the system. Landfill Caps can range from a one-layer system of vegetated soil to a complex multi-layer system of soils and geosynthetics. In general, less complex systems are required in dry climates and more complex systems are required in wet climates. The material used in the construction of landfill caps include low-permeability and high-permeability soils and low-permeability geosynthetic products. The low-permeability materials divert water


vegetation
protection layer
drainage layer
geomembrane/soil barrier layer
topsoil
60 cm
granular or geotexile filter
30 cm
geomembrane w/overlying protective geotexile
geotexile gas collection layer
waste

and prevent its passage into the waste. The high permeability materials carry water away that percolates into the cap. Other materials may be used to increase slope stability.

The most critical components of a landfill cap are the barrier layer and the drainage layer. The barrier layer can be low-permeability soil (clay) and/or geosynthetic clay liners (GCLs). A flexible geomembrane liner is placed on top of the barrier layer. Geomembranes are usually supplied in large rolls and are available in several thickness (20 to 140 mil), widths (15 to 100 ft), and lengths (180 to 840 ft). The candidate list of polymers commonly used is lengthy, which includes polyvinyl chloride (PVC), polyethylenes of various densities, reinforced chlorosulfonated polyethylene (CSPE-R), polypropylene, ethylene interpolymer alloy (EIA), and many newcomers. Soils used as barrier materials generally are clays that are compacted to a hydraulic conductivity no greater than 1×10^{-6} cm/sec. Compacted soil barriers are generally installed in 6-inch minimum lifts to achieve a thickness of 2 feet or more. A composite barrier uses both soil and a geomembrane, taking advantage of the properties of each. The geomembrane is essentially impermeable, but, if it develops a leak, the soil component prevents significant leakage into the underlying waste.

For facilities on top of putrescible wastes, the collection and control of methane and carbon dioxide, potent greenhouse gases, must be part of facility design and operation.

➢ ***Asphalt/Concrete Cap***

The most effective single-layer caps are composed of concrete or bituminous asphalt. It is used to form a surface barrier between landfill and the environment. An asphalt concrete cap would reduce leaching through the landfill into an adjacent aquifer.

➢ ***RCRA Subtitle C Cap***

The RCRA C multilayered landfill cap is a baseline design that is suggested for use in RCRA hazardous waste applications. These caps generally consist of an upper vegetative (topsoil) layer, a drainage layer, and a low permeability layer which consists of a synthetic liner over 2 feet of compacted clay. The compacted clay liners are effective if they retain a certain moisture content but are susceptible to cracking if the clay material is desiccated. As a result alternate cap designs are usually considered for arid environments.

➢ ***RCRA Subtitle D Cap***

RCRA Subtitle D requirements are for non-hazardous waste landfills. The design of a landfill cover for a RCRA Subtitle D facility is generally a function of the bottom liner system or natural subsoils present. The cover must meet the following specifications:

- the material must have a permeability no greater than 1 x 10-5 cm/s, or equivalent permeability of any bottom liner or natural subsoils present, whichever is less.
- The infiltration layer must contain at least 45 cm of earthen material.
- The erosion control layer must be at least 15 cm of earthen material capable of sustaining native plant growth.

Alternative design can be considered, but must be of equivalent performance as the specifications outlined above. All covers should be designed to prevent the "bathtub" effect. The bathtub effect occurs when a more permeable cover is placed over a less permeable bottom liner or natural subsoil. The landfill then fills up like a bathtub.

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Synonyms: Cap; Landfill cover; Surface cover.

DSERTS Codes: I0 (Containment)
I1 (Capping)

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Applicability: Landfill Caps may be temporary or final. Temporary caps can be installed before final closure to minimize generation of leachate until a better remedy is selected. They are usually used to minimize infiltration when the underlying waste mass is undergoing settling. A more stable base will thus be provided for the final cover, reducing the cost of the post-closure maintenance. Landfill caps also may be applied to waste masses that are so large that other treatment is impractical. At mining sites for example, caps can be used to minimize the infiltration of water to contaminated tailings piles and to provide a suitable base for the establishment of vegetation. In conjunction with water diversion and detention structures, landfill caps may be designed to route surface water away from the waste area while minimizing erosion.

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Limitations: Landfilling does not lessen toxicity, mobility, or volume of hazardous wastes, but does mitigate migration. Landfill caps are most effective where most of the underlying waste is above the water table. A cap, by itself, cannot prevent the horizontal flow of ground water through the waste, only the vertical entry of water into the waste. In many cases landfill caps are used in conjunction with vertical walls to minimize horizontal flow and migration. The effective life of landfill components (including cap) can be extended by long-term inspection and maintenance. Vegetation, which has a tendency for deep root penetration, must be eliminated from the cap area. In addition, precautions must be taken to assume that the integrity of the cap is not compromised by land use activities.

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Data Needs:

A detailed discussion of these data elements is provided in Subsection 2.2.1 (Data Requirements for Soil, Sediment, and Sludge). Many laboratory tests are needed to ensure that the materials being considered for each of the landfill cap components are suitable. Tests to determine the suitability of soil include grain size analysis, Atterberg limits, and compaction characteristics. Landfill instability can be solved by understanding interface friction properties between all material layers, natural or synthetic. The major engineering soil properties that must be defined are the shear strength and hydraulic conductivity. Shear strength may be determined with the unconfined compression test, direct shear test, or triaxial compression test. Hydraulic conductivity of soils may be measured in the laboratory by the constant head permeability test or the falling head permeability test. Field hydraulic conductivity tests on test pads are generally recommended prior to actual cover construction to ensure that the low-permeability requirements can actually be met under construction conditions.

Laboratory tests are also needed to ensure that geosynthetic materials will meet the cap requirements, For example, geosynthetics in caps may be subjected to tensile stresses caused by subsidence and by the gravitational tendency of a geomembrane or material adjacent to it to slide or be pulled down slopes.

Since facility performance is a function of quality construction more so than selection of materials, construction quality assurance of caps are critical. EPA has generated a technical guidance document on this subject. The technical guidance should be strictly followed during design and construction.

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Performance Data:

Previously installed caps are hard to monitor for performance. Monitoring well systems or infiltration monitoring systems can provide some information, but it is often not possible to determine whether the water or leachate originated as surface water or ground water. Performance can be monitored much more effectively by including pan lysimeter in future caps.

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Cost:

Landfill caps are generally the least expensive way to manage the human health and ecological risks effectively. Rough industry cost are $175k/acre for RCRA Subtitle D, and $225k/acre for RCRA Subtitle C.

Additional cost information can be found in the Hazardous, Toxic, and Radioactive Wastes (HTRW) Historical Cost Analysis System (HCAS) developed by Environmental Historical Cost Committee of Interagency Cost Estimation Group.

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EPA, 1987. ***Geosynthetic Design Guidance for Hazardous Waste Landfill Cells and Surface Impoundments***, EPA/600/2-87/025.

EPA, 1988. ***Technology Screening Guide for Treatment of CERCLA Soil and Sludge***, EPA/540/288/004.

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EPA, 1991. ***Compilation of Information on Alternative Barriers for Liner and Cover Systems***, EPA/600/2-91/002.

EPA, 1991. ***Inspection Techniques for the Fabrication of Geomembrane Field Seams***, Technical Guidance Document, EPA/530/SW-91/051.

EPA, 1993. ***Construction Quality Control and Quality Assurance at Waste Containment Facilities***, Technical Guidance Document, Office of Research and Development, RREL, Cincinnati, OH, EPA/600/R-93/182.

EPA, 1993. ***Engineering Bulletin: Landfill Covers***, EPA/540/S-93/500.

EPA, 1995. ***RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfills***, Office of Research and Development, NRMRL, Cincinnati, OH, EPA/600/R-95/051.

EPA, 1995. ***Report of 1995 Workshop on Geosynthetic Clay Liners***, Office of Research and Development, NRMRL, Cincinnati, OH, EPA/600/R-96/149.

EPA, 1997. ***Best Management Practices (BMPs) for Soil Treatment Technologies: Suggested Operational Guidelines to Prevent Cross-media Transfer of Contaminants During Clean-UP Activities***, EPA OSWER, EPA/530/R-97/007.

EPA, 1997. ***Technology Alternatives for the Remediation of Soils Contaminated with As, Cd, Cr, Hg, and Pb***, Engineering Bulletin, EPA540/R-97/008.

EPA, 1998. ***Evaluation of Subsurface Engineered Barriers at Waste Sites***, Technology Report, EPA/542/R-98/005.

Federal Remediation Technologies Roundtable, 1998. ***Remediation***

Case Studies: In Situ Soil Treatment Technologies (Soil Vapor Extraction, Thermal Processes), EPA/542/R-98/012

- Soil Vapor Extraction at the Seymour Recycling Corporation Superfund Site, Seymour, Indiana

Federal Remediation Technologies Roundtable, 1998. ***Remediation Case Studies: Groundwater Pump and Treat (Nonchlorinated Solvents)***, EPA/542/R-98/014

- Pump and Treat and Containment of Contaminated Groundwater at the Sylvester/Gilson Road Superfund Site, Nashua, New Hampshire

Federal Remediation Technologies Roundtable, 1998. ***Remediation Case Studies: Debris and Surface Cleaning Technologies, and Other Miscellaneous Technologies***, EPA/542/R-98/017.

- Lawrence Livermore National Laboratory (LLNL) Site 300 - Pit 6 Landfill Operable Unit (OU), Livermore, CA.

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Site Information:

- AFCEE action, Fairchild AFB, WA
- DOE Oak Ridge, TN facility
- Lawrence Livermore National Laboratory, Site 300, Coast Ranges, CA
- **DOE Demo**, Lee Acres landfill, Farmington, NM
- Lawrence Livermore National Laboratory, Site 300, Pit 6 Landfill OU, Livermore, CA
- Seymour Recycling Corporation Superfund Site, Seymour, IN
- Sylvester/Gilson Road Superfund Site, Nashua, NH

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Vendor Information:

A list of vendors offering Soil Containment Treatment is available from the Vendor Information System for Innovative Treatment Technologies (VISITT) developed by U.S. Environmental Protection Agency (EPA).

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HTRW Hazard Analysis

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4.31 Landfill Cap Enhancements

(Soil Containment Remediation Technology)

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Data Needs | Performance | Cost | References
Site Information | Points of Contact | Vendor Information | Health & Safety

Technology	Description
Soil, Sediment, and Sludge	
3.7 Containment	
4.31 Landfill Cover Enhancements	The purpose of landfill cover enhancement is to reduce or eliminate contaminant migration (e.g. percolation). Water harvesting and vegetative cover are two ways for landfill cover enhancements. Water harvesting uses runoff enhancement to manage landfill site water balance. Vegetative cover reduces soil moisture via plant uptake and evapotranspiration.

Description:

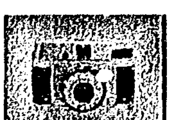


Figure 4-31: Typical Water Harvesting Enhancement

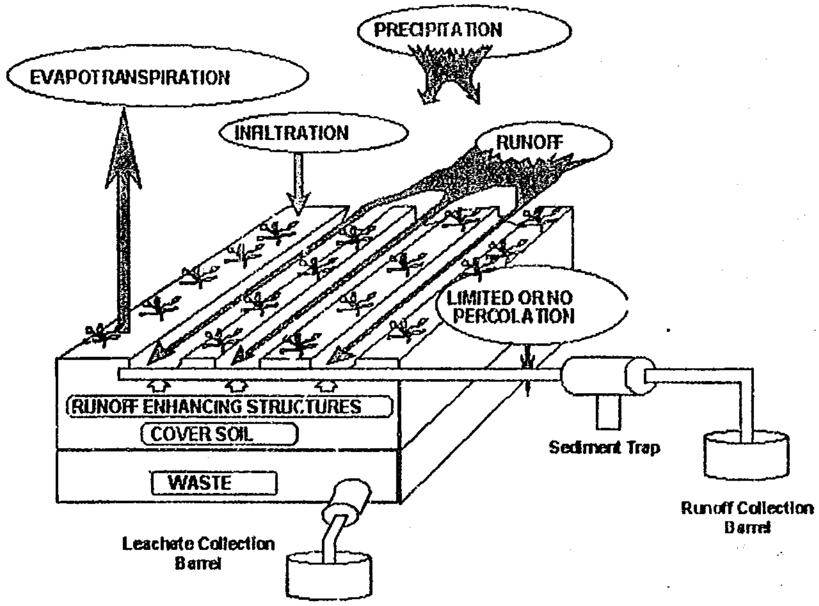
The precipitation to the landfill cover is balanced by the combination of following effects: run-off, cumulating in soil, evapotranspiration, and percolation. For a given amount of precipitation, in order to reduce or eliminate percolation, the effects of run-off and/or evapotranspiration need to be enhanced.

➢ ***Water Harvesting***

Water harvesting uses runoff enhancement to manage landfill site water balance. This enhancement can be achieved by simply covering landfill cover surface with metal rain gutter placed parallel to the slope. The percentage of runoff increases when gutter coverage increases. However, too much coverage (> 40%) has little effect on runoff enhancement.

➢ ***Vegetative Cover***

Vegetative cover reduces soil moisture via plant uptake and evapotranspiration. Plant cover also limits soil erosion. Vegetative



PRECIPITATION
EVAPOTRANSPIRATION
INFILTRATION
RUNOFF
LIMITED OR NO PERCOLATION
RUNOFF ENHANCING STRUCTURES
COVER SOIL
WASTE
Sediment Trap
Runoff Collection Barrel
Leachate Collection Barrel

cover is more stable because it emphasizes use of natural materials and configurations, which implies longevity.

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Synonyms: NA

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Applicability: Landfill cover enhancement is applicable for traditional landfills, surface impoundment's, waste piles, sludges, and some mine tailings. It may prove to be less costly than a conventional barrier because it uses simple structure or local resources. It is simple in design, easy to install over an existing landfill cover, and easy to remove if other uses for the land emerge in the future.

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Limitations: Factors that may limit the applicability and effectiveness of these processes include:

- Proper site evaluation is required.
- Plant coverage is seasonal.
- Too much gutter coverage (> 40%) has little effect on runoff enhancement.

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Data Needs: A detailed discussion of data elements is provided in Subsection 2.2.1 (Data Requirements for Soil, Sediment, and Sludge).

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Performance Data: Landfill cover enhancement is a fairly new technology that is still being tested and demonstrated.

Naval Facilities Engineering Services Center initiated a demonstration project at Marine Corp Base Hawaii to evaluate infiltration control cover design. Metal rain gutters were placed on the ground surface and parallel to the slope. Remaining surface was seeded with 6 native grasses and shrubs. After 9 months of operation, it was found that plots with runoff enhancement had 2 to 5 times more runoff, and 2 to 3 times less percolation.

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Cost: The simple configuration of landfill cover enhancement should result better containment with little increase in costs. These costs are currently determined on a case-by-case basis because of construction material availability and design requirements at various site locations.

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References:

Dwyer, S., 1997. ***Alternative Landfill Cover Demonstration.*** Sandia National Laboratories, U.S. DOE Environmental Management, Office of Science and Technology.

EPA, 1993. ***Evaluation of Subsurface Engineered Barriers at Waste Sites***, Technology Report, EPA/542/R-98/005.

Finley, R., 1997. ***Demonstrate Capillary Barrier Design Tools.*** Sandia National Laboratories, U.S. DOE Environmental Management, Office of Science and Technology.

Hakonson, T.E., L. Karr, and B. Harre, 1997. ***A Water Balance Study of Infiltration Control Landfill Cover Design at Marine Corp Base Hawaii***, Technical paper, Naval Facilities Engineering Services Center, Port Hueneme, CA.

Murphy B., 1995. ***Demonstration project may lead to more effective hazardous waste landfill covers.*** Sandia National Laboratories, U.S. DOE Environmental Management, Office of Science and Technology.

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Site Information:

- **DOE Demonstration**, Sandia National Laboratories
- MCAS Kaneohe Bay

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Points of Contact:

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A list of vendors offering Soil Containment Treatment is available from the Vendor Information System for Innovative Treatment Technologies (VISITT) developed by U.S. Environmental Protection Agency (EPA).

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4.32 Excavation, Retrieval, and Off-Site Disposal

(Other Soil Remediation Technology)

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Description | Synonyms | Applicability | Limitations
Data Needs | Performance | Cost | References
Site Information | Points of Contact | Vendor Information | Health & Safety

Technology	Description
Soil, Sediment, and Sludge	
3.7 Other Treatment	
4.32 Excavation, Retrieval, and Off-Site Disposal	Contaminated material is removed and transported to permitted off-site treatment and disposal facilities. Pretreatment may be required.

Description:

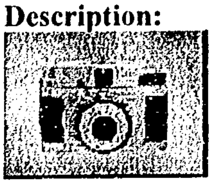

Figure 4-32: Typical Contaminated Soil Excavation Diagram

Contaminated material is removed and transported to permitted off-site treatment and/or disposal facilities. Some pretreatment of the contaminated media usually is required in order to meet land disposal restrictions.

Confined disposal facilities (CDFs) are engineered structure enclosed by dikes and designed to retain dredged materials. A CDF may have a large cell for material disposal, and adjoining cells for retention and decantation of turbid, supernatant water. A variety of linings have been used to prevent seepage through the dike walls. The most effective are clay or bentonite-cement slurries, but sand, soil, and sediment linings have also been used.

Location and design are two important CDF consideration. Terms to consider in the location of a CDF are the physical aspects (size, proximity to a navigable waterway), the design/construction (geology/hydrology), and the environmental (current use of the area, environmental value, and environmental effects). The primary goal of a CDF design is minimization of contaminant loss. Caps are the most effective way to minimize contaminant loss from CDFs, but selection of proper liner material is also an important control on CDFs. Finally, CDFs require continuous monitoring to ensure structural integrity.

Operation and maintenance duration lasts as long as the life of the facility.

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Synonyms:

DSERTS Codes:
E0 (Removal)
E1 (Waste Removal-Soils)
R1 (Waste Removal-Sludges)
S1 (Waste Removal-Non-soil Solids)

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Applicability:

Excavation and off-site disposal is applicable to the complete range of contaminant groups with no particular target group. Excavation and off-site by relocating the waste to a different (and presumably safer) site.

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Limitations:

Factors that may limit the applicability and effectiveness of the process include:

- Generation of fugitive emissions may be a problem during operations.
- The distance from the contaminated site to the nearest disposal facility with the required permit(s) will affect cost.
- Depth and composition of the media requiring excavation must be considered.
- Transportation of the soil through populated areas may affect community acceptability.
- Disposal options for certain waste (e.g., mixed waste or transuranic waste) may be limited. There is currently only one licensed disposal facility for radioactive and mixed waste in the United States.
- Contaminants can potentially migrate from CDF from several pathways, including effluent discharge to surface water, rainfall surface runoff, leachate into ground water, volatilization to the atmosphere, and dike uptake.
- CDFs can develop odor problems as well as mosquito and insect problems without proper design and maintenance.

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Data Needs:

A detailed discussion of these data elements is provided in Subsection 2.2.1 (Data Requirements for Soil, Sediment, and Sludge).

The type of contaminant and its concentration will impact off-site disposal requirements. Soil characterization as dictated by land disposal restrictions (LDRs) are required. Most hazardous wastes must be treated to meet either RCRA or non-RCRA treatment standards prior to land disposal. Radioactive wastes would have to meet disposal facility waste form requirements based on waste classification.

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Performance Data:

Excavation and off-site disposal is a well proven and readily implementable technology. Prior to 1984, excavation and off-site disposal was the most common method for cleaning up hazardous waste sites. Excavation is the initial component in all ex situ treatments.

The rate of excavation depends on a number of factors, including the number of loaders and trucks operating. The excavation of 18,200 metric tons (20,000 tons) of contaminated soil would typically require about 2 months. Disposal of the contaminated media is dependent upon the availability of adequate containers to transport the hazardous waste to a permitted facility.

CERCLA includes a statutory preference for treatment of contaminants, and excavation and off-site disposal is now less acceptable than in the past. The disposal of hazardous wastes is governed by RCRA (40 CFR Parts 261-265), and the U.S. Department of Transportation (DOT) regulates the transport of hazardous materials (49 CFR Parts 172-179, 49 CFR Part 1387, and DOT-E 8876).

DOE has demonstrated a cryogenic retrieval of buried waste system, which uses liquid nitrogen (LN2) to freeze soil and buried waste to reduce the spread of contamination while the buried material is retrieved with a series of remotely operated tools. Other excavation/retrieval systems that DOE is currently developing include a remote excavation system, a hydraulic impact end effector, and a high pressure waterjet dislodging and conveyance end effector using confined sluicing.

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Cost:

Cost estimates for excavation and disposal range from \$300 to \$510 per metric ton (\$270 to \$460 per ton) depending on the nature of hazardous materials and methods of excavation. These estimates include excavation/removal, transportation, and disposal at a RCRA permitted facility. Additional cost of treatment at disposal facility may also be required. Excavation and off-site disposal is a relatively simple process, with proven procedures. It is a labor-intensive practice with little potential for further automation. Additional costs may include soil characterization and treatment to meet land ban requirements.

Additional cost information can be found in the Hazardous, Toxic, and Radioactive Wastes (HTRW) Historical Cost Analysis System (HCAS) developed by Environmental Historical Cost Committee of Interagency Cost Estimation Group.

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Church, H.K., 1981. ***Excavation Handbook***, McGraw Hill Book Co., New York, NY.

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EPA, 1992. ***McColl Superfund Site Demonstration of a Trial Excavation***, EPA RREL, series include Technology Evaluation EPA/S40/R-92/015, PB92-226448; Applications Analysis, EPA/540/AR-92/015; and Technology Demonstration. Summary, EPA/540/SR/-92/015.

EPA, 1997. ***Best Management Practices (BMPs) for Soil Treatment Technologies: Suggested Operational Guidelines to Prevent Cross-media Transfer of Contaminants During Clean-UP Activities***, EPA OSWER, EPA/530/R-97/007.

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Site Information:

- **EPA Demo**: Carter Industrial, MI; Shaver's Farm, GA; Hopkinsville, KY
- **EPA Demo**:IN, MI, OH, SD, VA, WI
- **DOE Integrated Demo**: (1,2) Chemical and Mixed Waste Landfills, Albuquerque, NM; (3) Mixed Waste Landfill at Kirkland AFB, NM
- **DOE Integrated Demo**: Fernald Environmental Project Cincinnati, OH

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Vendor Information:

A list of vendors offering Soil Excavation, Retrieval, and Off-Site Disposal Treatment is available from the Vendor Information System for Innovative Treatment Technologies (VISITT) developed by U.S. Environmental Protection Agency (EPA).

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4.36 Phytoremediation

(In Situ Ground Water Remediation Technology)

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Description | Synonyms | Applicability | Limitations
Data Needs | Performance | Cost | References
Site Information | Points of Contact | Vendor Information | Health & Safety

Technology	Description
Ground Water, Surface Water, and Leachate	
3.9 In Situ Biological Treatment	
4.36 Phytoremediation	Phytoremediation is a set of processes that uses plants to remove, transfer, stabilize and destroy organic/inorganic contamination in ground water, surface water, and leachate.

Description:

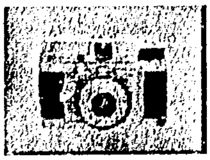

Figure 4-36 Typical In Situ Phytoremediation System

Phytoremediation is a set of processes that uses plants to clean contamination in ground water and surface water. The treatment of metals or other inorganic contamination has been discussed in Section 4.5 (Phytoremediation for Soil). There are several ways plants can be used for the phytoremediation. These mechanisms include enhanced rhizosphere biodegradation, hydraulic control, phyto-degradation and phyto-volatilization.

➤ ***Enhanced Rhizosphere Biodegradation***

Enhanced rhizosphere biodegradation takes place in the soil surrounding plant roots. Natural substances released by plant roots supply nutrients to microorganisms, which enhances their ability to biodegrade organic contaminants. Plant roots also loosen the soil and then die, leaving paths for transport of water and aeration. This process tends to pull water to the surface zone and dry the lower saturated zones.

➤ ***Hydraulic Control***

Depending on the type of trees, climate, and season, trees can act as organic pumps when their roots reach down towards the water table and establish a dense root mass that takes up large quantities of water.

➤ ***Phyto-degradation***

Phyto-degradation is the metabolism of contaminants within plant tissues. Plants produce enzymes, such as dehalogenase and oxygenase, that help catalyze degradation. Investigations are proceeding to determine if both aromatic and chlorinated aliphatic compounds are amenable to phyto-degradation.

➤ ***Phyto-volatilization***

Phyto-volatilization occurs as plants take up water containing organic contaminants and release the contaminants into the air through their leaves. Plants can also break down organic contaminants and release breakdown products into air through leaves.

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Synonyms: Vegetation-enhanced bioremediation.

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Applicability: Phytoremediation can be used to clean up organic contaminants from surface water, ground water, leachate, and municipal and industrial wastewater.

Plants also produce enzymes, such as dehalogenase and oxygenase, which help catalyze degradation.

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Limitations:

There are a number of limitations to phytoremediation

- It is limited to shallow soils, streams, and ground water.
- High concentrations of hazardous materials can be toxic to plants.
- It involves the same mass transfer limitations as other biotreatments.
- Climatic or seasonal conditions may interfere or inhibit plant growth, slow remediation efforts, or increase the length of the treatment period.
- It can transfer contamination across media, e.g., from soil to air.
- It is not effective for strongly sorbed (e.g., PCBs) and weakly sorbed contaminants.
- Phytoremediation will likely require a large surface area of land for remediation.
- The toxicity and bioavailability of biodegradation products is not always known. Products may be mobilized into ground water or bioaccumulated in animals. More research is needed to determine the fate of various compounds in the plant metabolic cycle to ensure that plant droppings and products manufactured by plants do not contribute toxic or harmful chemicals into the food chain or increase risk exposure to the general public.

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Data Needs:

A detailed discussion of these data elements is provided in Subsection 2.2.2. (Data Requirements for Ground Water, Surface Water, and Leachate).

In addition, detailed information is needed to determine the kinds of soil used for phytoremediation projects. Water movement, reductive oxygen concentrations, root growth, and root structure all affect the growth of plants and should be considered when implementing phytoremediation.

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Performance Data:

The U.S. Air Force used poplar trees to contain a ground water TCE plume. TCE was shown to be degraded in the tissues of the poplar trees. The trees pumped a sufficient amount of water to produce a cone of depression limiting the spread of the TCE plume.

In Iowa, EPA demonstrated the usage of phytoremediation by planting poplar trees along a stream bank between a corn field and the stream. These trees acted as natural pumps to keep toxic herbicides, pesticides, and fertilizers out of the streams and ground water. After three years, while the nitrate concentration in ground water at the edge of the corn field was measured at 150 mg/L, the ground water among the poplar trees along the stream bank had nitrate concentration of only 3 mg/L.

USAEC is also leading the team of experts from EPA, Tennessee Valley Authority (TVA) and the Waterways Experimental Station (WES) to successfully demonstrate phytoremediation of explosive contaminated sites in Milan Army Ammunition Plant in Milan, TN.

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Cost:

Construction estimates for phytoremediation are $200K/acre and $20K/acre for operations and maintenance.

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References:

Boyajian, G. E. and Devedjian, D. L., 1997. "**Phytoremediation: It Grows on You**", *Soil & Groundwater Cleanup*, February/March, pp. 22-26.

California Base Closure Environmental Committee (CBCEC), 1994. ***Treatment Technologies Applications Matrix for Base Closure Activities, Revision 1***, Technology Matching Process Action Team, November, 1994.

EPA, 1998. ***A Citizen's Guide to Phytoremediation***, Technology Fact Sheet, EPA NCEPI, EPA/542/F-98/011.

EPA, 1996. ***A Citizen's Guide to Bioremediation***, Technology Fact Sheet, EPA NCEPI, EPA/542/F-96/007.

EPA, 1996. ***A Citizen's Guide to Phytoremediation***, Technology Fact Sheet, EPA NCEPI, EPA/542/F-96/014.

EPA, 1996. ***Recent Developments for In Situ Treatment of Metal Contaminated Soils***, EPA/542/R-96/008.

USAEC, 1997. ***Phytoremediation of Explosives in Groundwater Using Constructed Wetlands in Innovative Technology Demonstration, Evaluation and Transfer Activities, FY 96 Annual Report***, Report No. SFIM-AEC-ET-CR-97013, pp. 155-156.

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Site Information:

- Aberdeen, MD
- Ogden, UT
- U.S Air Force Facility, Fort Worth, TX
- Milan Army Ammunition Plant (USAEC), TN
- **DOE**, Bear Creek, Oak Ridge National Laboratory, TN

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Points of Contact:

General FRTR Agency Contacts

Technology Specific Web Sites:

Government Web Sites

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Vendor Information:

A list of vendors offering In Situ Biological Treatment is available from the Vendor Information System for Innovative Treatment Technologies (VISITT) developed by U.S. Environmental Protection Agency (EPA).

Government Disclaimer

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Health and Safety:

To be added

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4.5 Phytoremediation

(In Situ Soil Remediation Technology)

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Description | Synonyms | Applicability | Limitations
Data Needs | Performance | Cost | References
Site Information | Points of Contact | Vendor Information | Health & Safety

Technology	Description
Soil, Sediment, and Sludge	
3.1 In Situ Biological Treatment	
4.5 Phytoremediation	Phytoremediation is a process that uses plants to remove, transfer, stabilize, and destroy contaminants in soil and sediment. Contaminants may be either organic or inorganic.

Description:

Phytoremediation is a process that uses plants to remove, transfer, stabilize, and destroy contaminants in soil and sediment. The mechanisms of phytoremediation include enhanced rhizosphere biodegradation, phyto-extraction (also called phyto-accumulation), phyto-degradation, and phyto-stabilization.

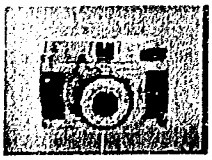

Figure 4-5: Typical In Situ Phytoremediation System

➤ *Enhanced Rhizosphere Biodegradation*

Enhanced rhizosphere biodegradation takes place in the soil immediately surrounding plant roots. Natural substances released by plant roots supply nutrients to microorganisms, which enhances their biological activities. Plant roots also loosen the soil and then die, leaving paths for transport of water and aeration. This process tends to pull water to the surface zone and dry the lower saturated zones.

➤ *Phyto-accumulation*

Phyto-accumulation is the uptake of contaminants by plant roots and the translocation/accumulation (phytoextraction) of contaminants into plant shoots and leaves.

➤ ***Phyto-degradation***

Phyto-degradation is the metabolism of contaminants within plant tissues. Plants produce enzymes, such as dehalogenase and oxygenase, that help catalyze degradation. Investigations are proceeding to determine if both aromatic and chlorinated aliphatic compounds are amenable to phyto-degradation.

➤ ***Phyto-stabilization***

Phyto-stabilization is the phenomenon of production of chemical compounds by plant to immobilize contaminants at the interface of roots and soil.

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Synonyms: Vegetation-enhanced bioremediation.

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Applicability: Phytoremediation may be applicable for the remediation of metals, pesticides, solvents, explosives, crude oil, PAHs, and landfill leachates.

Some plant species have the ability to store metals in their roots. They can be transplanted to sites to filter metals from wastewater. As the roots become saturated with metal contaminants, they can be harvested.

Hyper-accumulator plants may be able to remove and store significant amount of metallic contaminants.

Currently, trees are under investigation to determine their ability to remove organic contaminants from ground water, translocate and transpiration, and possibly metabolize them either to CO_2 or plant tissue.

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Limitations: There are a number of limitations to phytoremediation in soil.

- The depth of the treatment zone is determined by plants used in phytoremediation. In most cases, it is limited to shallow soils.
- High concentrations of hazardous materials can be toxic to plants.
- It involves the same mass transfer limitations as other biotreatments.
- It may be seasonal, depending on location.
- It can transfer contamination across media, e.g., from soil to air.
- It is not effective for strongly sorbed (e.g., PCBs) and weakly sorbed contaminants.
- The toxicity and bioavailability of biodegradation products is not always known.
- Products may be mobilized into ground water or bioaccumulated in animals.
- It is still in the demonstration stage.

- It is unfamiliar to regulators.

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Data Needs:

A detailed discussion of these data elements is provided in Subsection 2.2.1 (Data Requirements for Soil, Sediment, and Sludge). In addition, detailed information is needed to determine the kinds of soil used for phytoremediation projects. Water movement, reductive oxygen concentrations, root growth, and root structure all affect the growth of plants and should be considered when implementing phytoremediation.

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Performance Data:

Currently, the Superfund Innovative Technology Evaluation (SITE) Program is attempting to demonstrate and evaluate the efficacy and cost of phytoremediation in the field at sites in Oregon, Utah, Texas, and Ohio.

USAEC is also leading the team of experts from EPA, Tennessee Valley Authority (TVA) and the Waterways Experimental Station (WES) to successfully demonstrate phytoremediation of explosive contaminated sites in Milan Army Ammunition Plant in Milan, TN.

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Cost:

US AEC estimated that the cost for phytoremediation of one acre of lead-contaminated soil to a depth of 50 cm was $60,000 to $100,000, whereas excavating and landfilling the same soil volume was $400,000 to $1,700,000.

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References:

Boyajian, G. E. and Devedjian, D. L., 1997. "**Phytoremediation: It Grows on You**", *Soil & Groundwater Cleanup*, February/March, pp. 22-26.

EPA, 1998. ***A Citizen's Guide to Phytoremediation***, Technology Fact Sheet, EPA NCEPI, EPA/542/F-98/011.

EPA, 1996. ***A Citizen's Guide to Phytoremediation***, Technology Fact Sheet, EPA NCEPI, EPA/542/F-96/014.

EPA, 1996. ***Recent Developments for In Situ Treatment of Metal Contaminated Soils***, EPA/542/R-96/008.

Schnoor, J.L., L.A. Licht, S.C. McCutcheon, N.L. Wolfe, and L.H. Carreira. 1995. "**Phytoremediation of organic and nutrient contaminants,**" *Environ. Sci. Technol.* 29:318A-323A.

USAEC, 1997. "**Phytoremediation of Lead**" in *Innovative Technology Demonstration, Evaluation and Transfer Activities, FY 96 Annual Report*, Report No. SFIM-AEC-ET-CR-97013, pp. 89-92.

U.S. DOE, 1995. "**Bioremediation of High Explosives by Plants,**" in *Technology Catalogue, Second Edition*, Office of Environmental Management Office of Technology Development, DOE/EM-0235, pp. 169-

172.

A comprehensive list of 850 references on phytoremediation are available at Remediation Technologies Development Forum (RTDF) Phytoremediation Action Team Web Site. Click to access

RTDF Phytoremediation Bibliography

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Site Information:

- McCormick & Baxter **SUPERFUND Site**, Portland, OR (Wood treatment site)
- Argonne National Laboratory
- Craney Island Fuel Terminal, U.S. Navy, Portsmouth, VA
- **EPA S.I.T.E. Program**, Ogden, Utah
- Ohio (Former metal plating site)
- **DOE Demo**: Savannah River Site , SC
- DOE Savannah River Site, SC

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Health and Safety:

To be added

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APPENDIX D

Preliminary Cost Estimate
CKD landfill Cap

Geotechnical
Services Inc.

June 28, 1999

Preston Engineering Inc.
4436 N. Brady Street
Davenport, Iowa

ATTN: Mr. Morris Preston, P.E.

RE: **GSI No. 993181**
Preliminary Construction Cost Estimate
CKD Landfill Cap
Dixon Marquette Cement Company
Dixon, Illinois 61021

Dear Mr. Preston:

Geotechnical Services, Inc. (GSI) is pleased to provide this preliminary cost estimate for the construction of the CKD Landfill Cap. As requested in our telephone conversation of June 25, 1999, and June 28, 1999 the following information presents our preliminary cost estimate for the construction of a three (3) foot thick low permeability cap with hydroseeded vegetative layer for the Cement Kiln Dust (CKD) Landfill to be located at the Dixon Marquette Cement Company in Dixon, Illinois.

For estimating purposes the following data has been utilized:

1. Landfill cap: 24 acre area, capped with a 3 foot recompacted low permeability layer without drainage layer. A six inch vegetative layer will be placed over the recompacted low permeability cap. Hydroseeding will be utilized to seed the vegetative layer.
2. On site sandy clay soil will be amended and utilized for the cap borrow material, borrow transport distance will be 2,000 feet or less.
3. On site sandy clay borrow does not meet required permeability (k) of 1×10^{-7} cm/sec or less.
4. Prior to construction, geotechnical laboratory testing will be performed to identify optimum soil amendment quantities to achieve required permeability value based on Standard Proctor compaction criteria.
5. Construction QA/QC will be performed by an independent testing laboratory.
6. Bentonite soil amendment will be utilized to achieve recompacted soil layer permeability (k) of 1×10^{-7} cm/sec or less for the cap.

GEOTECHNICAL, MATERIALS ENGINEERING & ENVIRONMENTAL CONSULTANTS

258 EAST 90TH STREET
DAVENPORT, IOWA 52806-7341
(319) 285-8541 • FAX (319) 285-8545

OFFICES LOCATED THROUGHOUT IOWA, KANSAS, MISSOURI & NEBRASKA

GSI

7. On site water will be used for moisture conditioning at no charge to the contractor.
8. On site sandy clay borrow will be mixed/amended at a rate of approximately 2 pounds bentonite /cu.ft. of borrow, moisture conditioned in 8 inch loose lifts and compacted with sheeps foot roller with appropriate lift bonding.
9. Construction equipment consisting of CMI or Caterpillar recycler/pulverizer, tank truck with spray bar, earth moving pans, grader, and sheeps foot compactor – self propelled.
10. Off site contractor will provide equipment operators and manual labor for the addition of the bentonite amendment and construction of the cap.
11. Bentonite amendment to be supplied by Bentonite Performance Minerals, delivered by truck, 100# bags on pallets.
12. Estimated construction completion: 4 months.

Based on the above information, the following preliminary cost estimate for the landfill cap has been developed:

Item	Material (Per Acre)	Labor (Per Acre)	Cost/Acre (M & L)	Total Cost
Hydroseed	$ 900	$ 600	$ 1,500	$ 36,000
Vegetative Layer, 6"	$ 9,700	$ 2,400	$12,100	$290,400
Bentonite Amendment	$15,700	$ 2,100	$17,800	$427,200
Haul/Place Borrow		$ 8,700	$ 8,700	$208,800
Mixing & Compaction		$21,000	$21,000	$504,000
Construction QA/QC		$ 3,000	$ 3,000	$ 72,000
Amendment Lab Testing		$ 200	$ 200	$ 4,800

GS

Total Estimated Cost	$1,543,200
Estimated Cost/Acre	$ 64,300
Total Estimated Cost (w/20% Contingency)	$1,851,840

If you have any questions or require additional information concerning the above information, material and labor rates and the estimated cost for the construction of this landfill cap, please call me at 319-285-8541.

Sincerely,
GEOTECHNICAL SERVICES, INC.

George D. Komisarek, P.E., P.G.
Vice President

cc: file

Mr. Neil DeRynck
Dixon Marquette Cement Company
1914 White Oak Lane
Dixon, Illinois 61021

APPENDIX E

Leachate Collection System

Dixon Marquette Cement
98-516

Proposed Leachate Collection System
January 27, 2000

The CKD landfill at Dixon Marquette Cement generates leachate that enters the bedrock beneath the landfill and travels downgradient toward the Rock River. To meet State of Illinois requirements, a leachate collection system must be installed.

The CKD directly overlies the Pecatonica Formation, a highly jointed dolomite about 35 feet thick. The joints in the rock are essentially vertical, and run in two preferred directions, roughly north and south, and east to west. Groundwater flow beneath the landfill is probably primarily along the joints. Consequently, any effective and efficient leachate collection system should be designed to intercept groundwater in the joints.

Traditional dewatering systems use multiple vertical wells. This type of system would work as a leachate collection system at the site, but only if wells could be placed so that the screens would intersect the joints. Because the number of and locations of the joints are not known, well placement becomes a problem. One way to solve the problem is to install a large number of vertical wells in the hope that some percentage of them will coincide with joints. This becomes a trial-and-error method that potentially wastes a lot of money in exploratory drilling.

The geologic conditions are very suitable, on the other hand, for horizontal wells. A single horizontal well, drilled at some angle to the planes of the joints, will intersect the joints. Each horizontal well can replace dozens of vertical wells. There are cost savings that come with using horizontal wells. Vertical wells would need a pump placed in each well, with electricity delivered to each pump. Surface piping connecting the wells would need to be trenched in for hundreds of feet. The multiplicity of recovery pumps, and the cost of maintaining them, would be many times more than the single pump in a horizontal well. Electrical costs in operating a single well would also be less. The saving in operation and maintenance increases as the duration of the project increases.

Unless a large number (hundreds?) of vertical wells are drilled, the probability of failure of vertical wells to capture the leachate is high. The recommended collection system, therefore, is one that uses a horizontal well.

The proposed system consists of one horizontal well. It will run east of and parallel to the haul road on the west side of the landfill. It will be about 8 to 10 inches in diameter, and be located near the base of the Pecatonica Formation. This location should allow the well to capture a large majority of the groundwater in the uppermost aquifer that has traveled beneath the landfill. It should also dewater the Pecatonica enough so that groundwater is no longer in contact with CKD at the base of the landfill.

The horizontal well could be drilled from either the north or south end. The drill stem will enter the ground at a shallow angle and be rotated so it becomes horizontal at a depth of about 30 feet. At the other end, the drill stem will again be rotated, this time upward, to exit at a point about 2000 feet from the entry. A well screen will then be pulled into the hole as the drill is backed out.

A single large capacity submersible pump will be used in the well to recover groundwater, which will be transferred to a holding basin before treatment and discharge to the Rock River.

PRESTON ENGINEERING, INC.

PROJECT ESTIMATE for:	*Leachate system, 1 horizontal well*
Project #:	*98-516*
Location:	*Dixon Marquette*
Date of Estimate:	*19-Dec 00*

DESCRIPTION	QUANTITY	UNIT	RATE	TOTAL		
PERSONNEL						
Principal	16	hour	$100.00	$1,600	management	
Principal	16	hour	$100.00	$1,600	4 site visits	
Level 3 Scientist	40	hour	$70.00	$2,800	design	
Level 3 Scientist	130	hour	$70.00	$9,100	travel, 54 trips	
Level 3 Scientist	192	hour	$70.00	$13,440	install well	
Level 3 Scientist	0	hour	$70.00	$0	manifolding, trenching	
Level 3 Scientist	40	hour	$70.00	$2,800	startup	
Level 3 Scientist	0	hour	$70.00	$0		
Level 3 Scientist	0	hour	$70.00	$0		
Level 3 Scientist	0	hour	$70.00	$0		
Level 2 Technician	8	hour	$49.00	$392		
						$31,732
TRAVEL						
Mileage	7560	mile	$0.38	$2,873		
Tolls, parking	54	each	$0.60	$32		
Per Diem	0	day	$40.00	$0		
Lodging	0	day	$50.00	$0		
EQUIPMENT AND SUPPLIES						
Surveying equipment	1	day	$25.00	$25		
Submersible pumps and contr	1	each	$10,000.00	$10,000		
Equipment sheds	1	each	$3,000.00	$3,000		
Computer drafting	4	hour	$10 00	$40		
						$15,970
DRILLING SUBCONTRACTORS						
Mobilization	1	each	$500.00	$500		
Bedrock drilling	2000	feet	$200.00	$400,000		
Well installation (PVC)	2000	feet	$50.00	$100,000		
Flush mount covers	0	each	$125.00	$0		
Well development	10	hour	$125.00	$1,250		
Decontamination	0	hour	$100.00	$0		
Per diem	23	day	$150.00	$3,450		
EXCAVATOR SUBCONTRACTOR						
Backhoe	0	hour	$75.00	$0		
ELECTRICAL SUBCONTRACTOR						
Connect pump	16	hour	$75.00	$1,200		
SUBCONTRACTOR HANDLING	10	percent	$506,400	$50,640		
CONTINGENCY	15	percent	$604,7[illegible]	$90,711		
TOTAL				$695,454		

PRESTON ENGINEERING, INC.

PROJECT ESTIMATE for:	*Leachate system, 100 vertical wells*
Project #:	*98-516*
Location:	*Dixon Marquette*
Date of Estimate:	*28-Jan-00*

DESCRIPTION	QUANTITY	UNIT	RATE	TOTAL		
PERSONNEL						
Principal	16	hour	$100.00	$1,600	management	
Principal	16	hour	$100.00	$1,600	4 site visits	
Level 3 Scientist	40	hour	$70.00	$2,800	design	
Level 3 Scientist	130	hour	$70.00	$9,100	travel, 54 trips	
Level 3 Scientist	272	hour	$70.00	$19,040	install wells	
Level 3 Scientist	160	hour	$70.00	$11,200	manifolding, trenching	
Level 3 Scientist	80	hour	$70.00	$5,600	startup	
Level 3 Scientist	0	hour	$70.00	$0		
Level 3 Scientist	0	hour	$70.00	$0		
Level 3 Scientist	0	hour	$70.00	$0		
Level 2 Technician	8	hour	$49.00	$392		
					$51,332	
TRAVEL						
Mileage	7560	mile	$0.38	$2,873		
Tolls, parking	54	each	$0.60	$32		
Per Diem	0	day	$40.00	$0		
Lodging	0	day	$50.00	$0		
EQUIPMENT AND SUPPLIES						
Surveying equipment	1	day	$25.00	$25		
Submersible pumps and controll	100	each	$3,000.00	$300,000		
Equipment sheds	3	each	$3,000.00	$9,000		
Computer drafting	8	hour	$10.00	$80		
					$312,010	
DRILLING SUBCONTRACTORS						
Mobilization	1	each	$500.00	$500	GSI	
Bedrock drilling	3000	feet	$25.00	$75,000		
Well installation (PVC)	3000	feet	$11.00	$33,000		
Flush mount covers	100	each	$125.00	$12,500		
Well development	50	hour	$125.00	$6,250		
Decontamination	0	hour	$100.00	$0		
Per diem	34	day	$150.00	$5,100		
EXCAVATOR SUBCONTRACTOR						
Backhoe	80	hour	$75.00	$6,000		
ELECTRICAL SUBCONTRACTOR						
Connect 100 pumps	200	hour	$75.00	$15,000		
SUBCONTRACTOR HANDLING	10	percent	$153,350	$15,335		
CONTINGENCY	15	percent	$532,027	$79,804		
TOTAL				$611,831		

Exhibit 10

FEBRUARY 27, 2001

REQUEST FOR ADJUSTED GROUNDWATER STANDARDS

DIXON MARQUETTE CEMENT COMPANY
DIXON, ILLINOIS

PREPARED BY PRESTON ENGINEERING, INC
4436 NORTH BRADY AVENUE
DAVENPORT, IOWA 52806
TELEPHONE: (319) 388-8288
FAX: (319) 388-9003

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ATTACHMENTS

I. INTRODUCTION

Groundwater samples have been collected from wells around the Dixon Marquette Cement (DMC) landfill for several years. This information from wells (MW5-S, MW6-S, MW7-S, and MW8-S) at the boundary of the proposed zone of attenuation (ZOA) indicate values for some chemical parameters that exceed the background concentration established for the background wells (MW 1-WT, MW 1-S). A statistical analysis was performed on the data covering thirty-nine (39) parameters.

The background concentration was evaluated by establishing the 99% confidence level for each parameter. Levels in downgradient wells that are higher than this confidence interval indicates a statistically significant increase over background.

The concentration of parameters in downgradient wells was examined using statistical methods. The 99.5% confidence level was established for each parameter. A trend analysis was also performed to determine if the level in each well appeared to be increasing or decreasing over time. The data, trend line, and 99.5% confidence level were plotted for each well and each parameter.

A narrative discussion of each parameter was provided.

Groundwater criteria were established for each parameter. Levels were selected that could be met at monitoring wells MW 5-S, MW 6-S, MW 7-S and MW 8-S. The criteria selected was the higher of the Section 620 groundwater standards or the 99.5% confidence interval. Higher levels were set for some parameters where it appeared there was an increasing trend and where levels where higher at MW 3-S which is upgradient. In these cases the 99.5 % confidence level for MW 3-S was used as a criteria.

II. BACKGROUND CONCENTRATIONS

Statistical analysis was performed on three background monitoring wells, MW 1-WT, 1-S, and 1-D. Six methods were used to calculate the upper limit concentration to compare the downgradient monitoring wells with the background.

- *Student's T Distribution:* When the parameter was detected in all of the sample results, this method was used to calculate the upper limit concentration. The student's t distribution is used for a small data set, less than 30 samples, and assumes that the sample set is normal.
- *Detection Limit Divided by 2 (DL/2):* In cases where 15 percent or less of the data was below the detection limit, the values below the detection limit were replaced with one-half of the detection limit. Student's t test was then applied.
- *Cohen's Method:* When less than 50% of the samples were reported as below the detection limit, the upper background limit concentration was calculated using this method. Cohen's method provides estimates of the mean and standard deviation when there are observations less than the detection limit. The method assumes that the sample set is normally distributed and the detection limit remains the same through the sampling period.
- *Test of Proportions:* When more than 50% of the samples were reported as below the detection limit, a test of proportions was performed on the downgradient monitoring well. This procedure does not establish a background concentration since it is a comparison of two sampling sets. Using the sample sizes and the number of samples that were below the detection limit in each sample set, the test indicates if the downgradient concentration is statistically different than the background concentrations.
- *Lowest Non Detect:* When the concentration was below detection limits during the entire sampling period, the lowest non-detect was used as the upper limit.
- *Method Detection Limit:* The method detection limit was established as the upper limit for volatile and semi-volatile compounds. However, any detection is considered to be an exceedance of the background concentration.

Using data from only one monitoring well, the 99th percentile was calculated for the upper limit in the student's t distribution and the Cohen methods. The two sided 99th percentile confidence interval was used to calculate background levels for pH. This was performed in accordance to Title 35 of Illinois Administrative Code, Section 811.320.e, entitled: "Statistical Analysis of Groundwater Monitoring Data."

The sampling results of MW 1-S, 1-WT, and 1-D, and the statistical analysis is summarized in the section entitled "BACKGROUND TABLES."

III. STATISTICAL APPROACH OF DOWNGRADIENT MONITORING WELLS

The arithmetic mean and standard deviation were calculated for each parameter and each well. When the result was reported as below the detection limit, the detection limit was used in the calculations. These results are denoted in the tables by italicizing the value.

The data set was compared to the average plus one standard deviation and the average plus two standard deviations. Those that were greater than the average plus one standard deviation were represented with bold characters in the tables. The results that were greater than the average plus two standard deviations were highlighted in the tables.

The one sided 99.5% confidence interval was calculated for each parameter and each of the four downgradient monitoring wells (5-S through 8-S). For pH, the two-sided 99% confidence interval was calculated. Since there were less than 30 sampling events, the student's t distribution was used to calculate the interval. The four intervals were compared, and the maximum value was chosen to represent the results of the four downgradient monitoring wells.

Sampling data and statistical analysis for each well is located in the section of this document entitled "DOWNGRADIENT TABLES." Summaries of the confidence intervals, background concentrations, and the Class I Groundwater Standards are found in the section entitled "SUMMARY TABLES."

The data was graphed with the 99.5% confidence interval and the Class I Groundwater Standard, when applicable. The standards are published in Title 35 of the Illinois Administrative Code Section 620.410 entitled Groundwater Quality Standards for Class I: Potable Resource Groundwater. A trend line was added to each of the wells for each parameter. Since the results did not indicate a clear trend, a linear trend or the best-fit line was chosen to represent the data.

The graphs of each parameter are found in the section entitled "GRAPHS" of this document.

IV. GROUNDWATER IMPACT– INORGANIC COMPOUNDS

In the following sections, each inorganic compound in MW 5-S through 8-S is discussed with respect to the background concentrations. When comparing these wells to background concentrations, both MW 1-WT and 1-S were used since the groundwater is shallow near White Oak Lane. Since MW 1-D monitors the upgradient groundwater in the Saint Peter Formation, the levels were not compared to the MW 5-S through 8-S.

Aluminum

The upper limit in the background MW 1-WT was calculated to be 0.454 mg/L using Cohen's method. The upper limit in MW 1-S was set at 0.04 mg/L, the lowest non-detectable limit. All but three results were greater than the MW 1-S background limit. All concentrations in MW 5-S were below the background concentration in 1-WT. In MW 6-S, two values, 1.74 and 3.01 mg/L, were significantly higher than the 1-WT background concentration. There were two results in MW 7-S that were slightly greater than the 1-WT background. These were 0.88 mg/L on July 26, 1999 and 0.662 on March 2, 2000. In the July and November 1999 samplings, the results in the MW 8-S were also slightly greater than the 1-WT background. These values were 0.51 and 0.665 mg/L, respectively.

The average concentrations of aluminum in the four downgradient monitoring wells were below the background concentration in MW 1-WT. Each, however, were greater than upper limit of 0.04 mg/L in MW 1-S.

Antimony

Since antimony was not detected in the background well 1-WT, the upper limit was set to be 0.001 mg/L, the lowest not detectable limit. Antimony was detected only once during the monitoring period in one of the wells. The parameter was detected in MW 7-S at 0.003 mg/L on March 2, 2000.

To determine if there is a difference between the background MW 1-S and the four downgradient wells, a test of proportions was performed. The test of proportions indicates that the result was not different than the background MW 1-S. Therefore, the landfill has had very little affect on this parameter in the groundwater.

Arsenic

The upper limit background concentration was calculated to be 0.003 in MW 1-WT using the student's t distribution. The concentration of arsenic ranged from 0.001 to 0.005 mg/L in MW 5-S, 0.001 to 0.004 in MW 6-S, 0.0017 to 0.044 mg/L in MW 7-S and 0.001 to 0.005 mg/L in MW 8-S. A total of four sample results, one from each well, were greater than the upper limit concentration in MW 1-WT.

A test of proportions was performed to indicate whether or not the arsenic concentrations in the downgradient wells were significantly different than the concentrations in MW 1-S. Although arsenic was detected in all four of the downgradient monitoring wells, the concentrations were not considered to be significantly different than MW 1-S except for MW 5-S. The landfill has had very little affect on this parameter in the groundwater.

Barium

The background concentration of barium was calculated to be 0.227 and 0.091 mg/L in the MW 1–WT and 1-S, respectively. These limits were calculated using the student's t 99% confidence interval. Barium was detected in all four of the downgradient monitoring wells. The concentrations ranged from 0.025 to 0.35 mg/L. Four of the samples were greater than 0.091 mg/L in MW 5-S, however only 1 was greater than 0.227 mg/L. All seven results were greater than the MW 1-S background limit in MW 6-S. Two of the results were greater than the 1-WT background limit. There were no results that were greater the background concentrations in MW 7-S, and only 1 that was greater than the MW 1-WT background concentration in MW 8-S.

The average concentration of barium in MW 5-S through 8-S was 0.138, 0.258, 0.042, and 0.075 mg/L, respectively. Monitoring well 6-S was the only average that was greater than the background concentration of 0.227 mg/L. Therefore, the landfill has had very little affect on this parameter in the groundwater.

Beryllium

Since beryllium was not detected in the background monitoring wells, 1-S or 1-WT, the upper background limit is 0.001 mg/L, the lowest non-detectable limit. On March 2, 2000, beryllium was detected in MW 8-S. This was the only time that the parameter was detected in the four shallow wells along the Rock River. Therefore, the landfill has had very little affect on this parameter in the groundwater.

Boron

To determine if the downgradient wells are significantly different than the background monitoring wells, a test of proportions was performed. The tests indicated that only MW 8-S was significantly different than the background MW 1-WT. All of the wells were significantly different than MW 1-S.

The concentration of boron ranged from 0.05 to 1.95 mg/L in the four downgradient monitoring wells. The average concentration of boron in MW 5-S through 8-S was 0.464, 0.424, 0.436, and 0.208 mg/L, respectively. This parameter in the groundwater has been significantly impacted by the landfill.

Cadmium

Since cadmium was not detected in the background monitoring wells 1-WT or 1-S, the upper background limit is 0.001 mg/L, the lowest non-detectable limit for each. Cadmium was detected in MW 5-S, 6-S, and 8-S during the March 2000 sampling event only. The average concentration for each of the four downgradient monitoring wells was 0.001 mg/L, the detection limit. Therefore, the landfill has had very little affect on the concentrations of cadmium in the groundwater.

Calcium

The background concentration of calcium was calculated to be 109 mg/L in the MW 1-S and 126 mg/L in MW 1-WT using the upper limit of the student's t 99% confidence interval. The concentration of calcium in monitoring wells 5-S, 6-S, and 8-S were consistently greater than the background limits during the entire sampling period. The concentrations ranged from 24.6 to 345 mg/L. The average concentrations of calcium in these three wells were 240, 234, and 237 mg/L, respectively. Calcium concentrations in MW 7-S were consistently below the background concentrations ranging from 11.9 to 43.4 mg/L with an average of 35 mg/L. The concentration of calcium in the groundwater has been significantly impacted by the landfill.

Chromium

The background concentrations were calculated to be 0.002 mg/L in both MW 1-WT and 1-S using Cohen's method. Chromium was detected in all four of the downgradient monitoring wells 5-S through 8-S. The maximum concentration was found in MW 8-S during the March 2000 sampling event. The concentration was found to be 0.04 mg/L. The average concentration of chromium in MW 5-S through 7-S was found to be 0.003 mg/L. The average concentration in MW 8-S was calculated to be 0.010 mg/L. Concentrations of chromium in the groundwater have been slightly affected by the landfill.

Cobalt

Using Cohen's method, the upper limit of the 99% confidence interval was calculated to be 0.003 mg/L in MW 1-S. In MW 1-WT, the background limit was calculated to be 0.008 mg/L using the student's t distribution. Cobalt was detected in all four of the downgradient monitoring wells 5-S through 8-S during the sampling period. Most of the concentrations were below the 0.008 mg/L background level. Three of the exceedances were in MW 6-S. In the March 2000 sampling event, MW 8-S also exceed the background concentration, having a result of 0.035 mg/L.

The average concentration of cobalt in MW 5-S through 8-S is 0.002, 0.012, 0.001, and 0.006 mg/L. The landfill has had a small affect on the concentration of cobalt in the groundwater.

Copper

The background concentration was calculated to be 0.012 mg/L in MW 1-WT using student's t distribution and 0.008 mg/L with Cohen's method in MW 1-S. Copper was detected in all four of the monitoring wells. The concentrations ranged from below the detection limit to 0.113 mg/L. In MW 5-S there was one result that was greater than the 1-WT background limit. The rest were below 0.008 mg/L. In MW 6-S, there were three results that were greater than 0.012 mg/L and three that were below 0.008 mg/L. All of the sampling results were less than or equal to 0.008 mg/L in MW 7-S. In MW 8-S, there were three results greater than 0.012 mg/L and one that was greater than 0.008 mg/L.

The average concentration of copper in the four downgradient monitoring wells 5-S through 8-S is 0.006, 0.013, 0.005, and 0.024 mg/L, respectively. The concentration of copper has been affected slightly due to the landfill.

Lead

Since lead was not detected in the background MW 1-S, the upper background limit is 0.001 mg/L, the lowest non-detectable limit. In MW 1-WT, the background concentration was calculated to be 0.006 mg/L. In MW 5-S, lead was detected in two of the samples and was reported at the detection limit. The average lead concentration in this monitoring well was calculated to be 0.001 mg/L. In MW 6-S, there were two sample events that had detectable concentrations. The concentration of these detected concentrations were 0.015 and 0.008 mg/L and were greater than the Class I Groundwater Standard of 0.0075 mg/L. The average concentration was calculated to be 0.004 mg/L. Four out of the seven sample sets in MW 7-S had levels that were detected. These were less than 0.006 mg/L. In MW 8-S, five of the sample had levels of lead that were detectable. The concentrations were below 0.006 mg/L.

Of all of the sampling events, two sample results in MW 6-S were greater than the MW 1-S upper limit background concentration. These concentrations were also greater than the Class I Groundwater Standard. Lead concentrations in the downgradient monitoring wells has been slightly affected by the landfill.

Iron

The background concentration was calculated to be 0.465 mg/L in MW 1-S using Cohen's method and 0.891 in MW 1-WT using student's t distribution. Iron was detected in all of the sample locations during all of the sample events. The average concentrations were calculated to be 0.898, 2.665, 0.805, and 1.654 for MW 5-S through 8-S, respectively. The concentration of iron in the groundwater has been significantly impacted by the landfill.

Magnesium

The background concentration was calculated to be 53.9 and 50.5 mg/L in the MW 1-S and 1-WT, respectively. Both of these confidence intervals were calculated using the upper limit of the student's t distribution. The average concentrations were calculated to be 82.3, 55.16, 9.3, and 100.1 mg/L for monitoring wells 5-S through 8-S, respectively. Approximately 72% of the samples were greater than the MW 1-WT background concentration in MW 5-S. Four of the seven sampling events had concentrations greater than 50.478 mg/L. The concentration of magnesium was greater than 50.478 mg/L in MW 8-S. In MW 7-S, the greatest concentration was 15.1 mg/L. The concentration of magnesium in the groundwater has been significantly impacted by the landfill.

Manganese

The background concentration was calculated to be 0.045 mg/L in the MW 1-S and 2.687 mg/L in MW 1-WT using the upper limit of the student's t 99% confidence interval. Two concentrations in the four downgradient wells had concentrations that were greater than 2.687 mg/L. Monitoring well 6-S had a manganese concentration of 3.11 mg/L during the July 1999 sampling event. Monitoring well 8-S had a manganese concentration of 4.3 mg/L during the March 2000 sampling event. The average concentrations were 0.229, 1.695, 0.094, and 0.763 in the four respective monitoring wells, 5-S through 8-S. Therefore, the landfill has had very little affect on the concentration of manganese in the groundwater.

Mercury

Since mercury was not detected in the background MW 1-S, the upper background limit is 0.0002 mg/L, the lowest non-detectable limit. A test of proportions showed that the wells were not significantly Mercury was not detected in the four shallow wells near the Rock River during the monitoring period. There has been very little affect on the concentration of mercury from the landfill.

Nickel

The background concentration was calculated to be 0.007 mg/L in MW 1-S using Cohen's method. In MW 1-WT the 99% confidence interval was calculated to be 0.023 mg/L using student's t distribution. There were three sampling results that were greater than the 1-WT background concentration in the four downgradient monitoring wells 5-S through 8-S. Two concentrations, 0.033 and 0.038 mg/L, were in the sampling data from MW 6-S. During the March 2000 sampling event, MW 8-S had a nickel concentration of 0.058 mg/L. The average concentration of nickel in MW 5-S through 8-S were 0.005, 0.020, 0.010, and 0.014 mg/L, respectively. The landfill has had a small affect on the concentration of nickel in the groundwater.

Potassium

Since the data had 50% of non-detects in the background well, MW 1-S, a test of proportions was performed to determine if the downgradient wells were significantly different. Each of the four downgradient wells had levels of potassium that was detected during all of the seven sampling events. The test of proportions proved that the downgradient and upgradient wells were significantly different.

The upper limit of the 99 percentile background concentration in MW 1-WT was calculated to be 4.0 mg/L, using the student's t distribution. Each of the four downgradient wells was significantly higher than the background. The average concentrations in monitoring wells 5-S and 6-S were calculated to be 86.0, and 55.0 mg/L. Monitoring wells 7-S and 8-S were higher with averages of 632.6 and 245 mg/L, respectively. The concentration of potassium in the groundwater has been significantly impacted by the landfill.

Selenium

The 99th percentile was calculated to be 0.004 mg/L in background well 1-S. In MW 5-S, concentrations ranged from below detection limits to 0.006 mg/L. The average concentration was 0.002 mg/L in this well. Monitoring well 6-S and MW 7-S had an average selenium concentration of 0.003 and 0.002 mg/L, respectively. The range for each of these wells was from below detection limits to 0.005 mg/L. Monitoring well 8-S was significantly different than the background monitoring well. The average concentration in this well was calculated to be 0.005 mg/L and the data ranged from 0.001 to 0.014 mg/L.

A test of proportions was performed to determine if the downgradient wells were considered to be significantly different than the background well 1-WT. In the downgradient monitoring wells 5-S through 8-S, there were 6 to 7 samples that had levels of selenium that was detected. The test of proportions confirmed that the downgradient wells were significantly different than MW 1-WT. Comparing both background concentrations to the four downgradient monitoring wells, the landfill has affected the concentration of selenium.

Sodium

The background concentration was calculated to be 12.8 mg/L in the MW 1-S using the upper limit of the student's t 99% confidence interval. In MW 1-WT, the 99th percentile was calculated to be 53.7 mg/L. In MW 5-S, the concentrations ranged from 9 to 78.5 mg/L with an average sodium concentration of 37.9 mg/L. The average concentration of sodium in MW 6-S was calculated to be 46.4 mg/L. The sample results ranged from 27.3 to 64.9 mg/L. In MW 7-S, the sampling results ranged from 25.8 to 49.9 mg/L with an average of 40.9 mg/L. In MW 8-S, the average was calculated to be 39.7 mg/L and the sample result ranged from 8.2 to 52.4 mg/L. Sodium concentration in the groundwater has been significantly affected by the landfill.

Thallium

To determine if the downgradient monitoring results were significantly different than MW 1-S and MW 1-WT, tests of proportions were performed. The results of these tests indicated that there was no significant difference between the background, MW 1-S and MW 1-WT, and the downgradient monitoring wells, 5-S through 8-S. Thallium was detected once during the monitoring period in MW 6-S at the detection limit, 0.001 mg/L. In MW 8-S, there were two sampling events in which the parameter was detected. The results were 0.002 and 0.005 mg/L. The average thallium concentration for this monitoring well was calculated to be 0.002 mg/L. The landfill has had very little affect on this parameter in the groundwater.

Vanadium

The upper limit of the 99th percentile was found to be 0.007 mg/L in the background MW 1-WT using the student's t distribution. In MW 5-S, there was one concentration that exceeded the background. The concentration was reported during the March 2000 sampling event and had a concentration of 0.023 mg/L. The average vanadium concentration was calculated to be 0.007 mg/L. Results of MW 6-S were similar to MW 5-S. There was only one sample result, 0.023 mg/L, that was greater than the background concentration. The average vanadium concentration for this well is 0.008 mg/L. The sampling results in MW 7-S ranged from 0.006 to 0.022 mg/L. The average concentration was calculated to be 0.013 mg/L. All of the results were less than the background concentration in MW 8-S. The average concentration was calculated to be 0.003 mg/L.

A test of proportions was performed on the data to determine if the results were significantly different than the background MW 1-S. The test of proportions found that only MW 7-S is considered to be different than the results of the background MW 1-S. The landfill has had a small impact affect on the concentration of vanadium in the groundwater.

Zinc
The background concentration was calculated to be 0.058 and 0.014 mg/L in the MW 1-S and 1-WT, respectively. Each of these concentrations was calculated using the upper limit of the student's t 99% confidence interval. There was one sample result in the four monitoring wells, 5-S through 8-S that was greater than the background concentration of 0.058 mg/L. The concentration, 0.363 mg/L was reported in the March 2000 sampling event in MW 8-S. The average zinc concentrations for MW 5-S through 8-S are: 0.017, 0.015, 0.016, and 0.075, respectively. The landfill has had very little affect on this parameter in the groundwater.

Total Alkalinity
The background concentration was calculated to be 253 and 342 mg/L in the MW 1-S and 1-WT, respectively Each of these concentrations was calculated using the upper limit of the student's t 99% confidence interval. In MW 5-S through 8-S, the alkalinity was consistently higher than the background concentrations. Only one value was less than the MW 1-WT background concentration at 324 mg/L in MW 5-S. The average concentrations for the four downgradient wells were 442, 389, 396, and 287 mg/L. The concentration of total alkalinity in the groundwater has been significantly impacted by the landfill.

Phenol Alkalinity
Phenol alkalinity was not detected in the three samples of MW 1-WT, thus the upper limit of the background concentration was set at 1.0 mg/L, the lowest detection limit.

To determine if the downgradient monitoring wells were significantly different than the background concentrations in MW 1-S, a test of proportions was performed on each downgradient well. Monitoring well 7-S has the only detectable levels of phenol alkalinity. The test of proportions indicates that this is not significantly different than the background. However, the concentrations range from below the detection limit to 160 mg/L. The average concentration of phenol alkalinity was calculated to be 73.5 mg/L.

Bicarbonate Alkalinity
The background concentrations were calculated to be 250 and 334 mg/L in the MW 1-S and 1-WT using the upper limit of the student's t 99% confidence interval. Sample results ranged from 314 to 540 mg/L in MW 5-S. The average concentration was calculated to be 410 mg/L. In MW 6-S, results ranged in concentration from 325 to 410 mg/L. The average concentration in this well was calculated to be 366 mg/L. Bicarbonate alkalinity in MW 7-S ranged from 154 to 475 mg/L and had an average concentration of 366 mg/L. In MW 8-S, all of the results were less than the background concentration of 334.029 mg/L. Th average was calculated to be 276 mg/L in MW 8-S. The concentration of bicarbonate alkalinity has been slightly impacted due to the landfill.

Ammonia Nitrogen

Since there were more than 50% of samples that had non-detectable results in the background monitoring wells 1-S and 1-WT; a test of proportions was performed on each downgradient monitoring well. The test showed that there was no significant difference in concentrations between the both of the background concentrations and the concentrations in the four downgradient monitoring wells. There were a total of two sample results that had detectable levels of ammonia nitrogen in the downgradient wells. These were in MW 5-S and 7-S with values of 0.19 and 0.94 mg/L, respectively. Therefore, the landfill has had very little affect on this parameter in the groundwater.

Chloride

The background concentration was calculated to be 30.8 and 25.4 mg/L in MW 1-S and 1-WT, respectively, using the upper limit of the student's t 99% confidence interval. In MW 5-S, the concentration of chloride ranged from 21.6 to 125 mg/L with an average of 62.7 mg/L. In MW 6-S, the sampling results ranged from 71.1 to 246 mg/L. The average concentration of chloride was calculated to be 152.9 mg/L. The average chloride concentration in MW 7-S was found to be 82.6 mg/L, the data ranged from 48.8 to 110 mg/L. The concentration of chloride ranged from 113 to 198 in MW 8-S. The average was calculated to be 153 mg/L. The concentration of chloride in the groundwater has been significantly impacted by the landfill.

Chemical Oxygen Demand (COD)

Since the chemical oxygen demand was not detected in the background MW 1-S, the upper background limit is 5.0 mg/L, the lowest non-detectable limit. When detected, the sample results were greater than 5 mg/L in each of the four downgradient monitoring wells.

A test of proportions was performed to determine if there was a significant difference between the COD concentrations in the background monitoring well, 1-WT. The background well had three of the seven samples that were detected. The concentrations were 44, 25.6, and 42.9 mg/L. Although, the test of proportions indicated that there was no difference in the data, it appears that there is a difference in three of the downgradient monitoring wells. The four detected concentrations in MW 5-S were 26, 57.9, 25.7, and 203 mg/L. Monitoring well 6-S had three detected concentrations. The results are 100, 123, and 94.1 mg/L. Two sample events had quantitative results in MW 8-S. The results were 30.3 and 158 mg/L. Monitoring well 7-S had two detected results, which were 10.5 and 34.3 mg/L. There has been an impact on the concentration of COD in the groundwater due to the landfill.

Fluoride

The background concentration was calculated to be 0.193 mg/L in MW 1-S using Cohen's method. The student's t distribution was used to calculate the upper limit in MW 1-WT. This concentration was found to be 0.757 mg/L. Of the four downgradient monitoring wells, only MW 7-S has had a significant change from the background concentrations. Monitoring well 5-S had concentrations that were less than 0.13 mg/L. The average concentration was calculated to be 0.10 mg/L in this monitoring well. The concentration of fluoride in MW 6-S ranged from 0.17 to 0.41 mg/L. The average concentration was calculated to be 0.26 mg/L. The results in MW 8-S were all below the 1-WT upper limit concentration of 0.757 mg/L. The data ranged from 0.14 to 0.26 mg/L with an average of 0.21 mg/L. There is a significant variation between the background concentrations and MW 7-S. The results ranged from 0.64 to 2.43 mg/L with an average concentration of 1.52 mg/L. The concentration of fluoride in the groundwater has been slightly impacted.

pH

The limits calculated for pH range from 7.16 to 8.14 in MW 1-WT and 7.22 to 7.82 in MW 1-S. In the downgradient monitoring wells, pH ranged from 6.9 to 7.8 in MW 5-S, 7.1 to 7.9 in MW 6-S, 8.9 to 10.2 in MW 7-S an7.1 to 8.3 in MW 8-S.

Nitrate as N

The background concentration was calculated to be 11.07 mg/L in MW 1-S using Cohen's method. Monitoring well 5-S and 8-S had quantitative results for nitrate concentrations. In monitoring well 5-S, the three results were 1.31, 6.24, and 2.00 mg/L. Using the detection limit to calculate the average concentration for this well, the result was 1.42 mg/L. Data ranged from 1.68 to 3.01 mg/L in MW 8-S. The average concentration was calculated to be 2.48 mg/L.

A test of proportions was used to determine if there was a difference between the background MW 1-WT and the four downgradient monitoring wells, 5-S through 8-S. Nitrate was detected in three of the sample events in MW 5-S and all seven of the events in MW 8-S. The test of proportions indicated that there was no significant difference between MW 5-S and 1-WT. Monitoring well 8-S was determined to be significantly different than the background concentration.

The groundwater has been affected only slightly by the landfill with regards to nitrate concentrations.

Sulfate

The background concentration was calculated to be 178 mg/L in the MW 1-S and 243 mg/L in MW 1-WT using the upper limits of the student's t 99% confidence intervals. In MW 5-S, the concentrations of sulfate ranged from 196 to 650 mg/L with an average of 385 mg/L. In MW 6-S, the average of sulfate was 235 mg/L, where the data ranged from 106 to 332 mg/L. The concentration of sulfate ranged from 336 to 494 mg/L in MW 7-S with an average concentration of 425 mg/L. The average sulfate concentration in

MW 8-S was calculated to be 803 mg/L. The results ranged from 686 to 865 mg/L. The concentration of sulfate in the groundwater has been significantly impacted by the landfill.

Total Organic Carbon (TOC)

The background concentrations were calculated to be 4.5 and 17.1 mg/L in the MW 1-S and 1-WT using the upper limits of the student's t 99% confidence intervals. The concentration of TOC in MW 5-S ranged from below detection limits to 29 mg/L. The average concentration was calculated to be 11.7 mg/L. In MW 6-S, the data ranged from 2.01 to 13.7 mg/L. The average concentration in this well was calculated to be 10.2 mg/L. The range of TOC concentration in MW 7-S was 7 to 18 mg/L and the average was 13.4 mg/L. In MW 8-S, the results ranged from 2.05 to 14.4 mg/L with an average of 8.5 mg/L. Therefore, the landfill has had very little affect on this parameter in the groundwater.

Total Dissolved Solids (TDS)

The background concentrations were calculated to be 540 and 488 mg/L in the MW 1-S and 1-WT, respectively, using the upper limits of the student's t 99% confidence intervals. The concentration of TDS in MW 5-S ranged from 633 to 1213 mg/L with an average concentration of 846 mg/L. In MW 6-S, results ranged from 566 to 867 mg/L with an average concentration of 797 mg/L. The range and average of TDS concentrations in MW 7-S were 802 to 1423 mg/L and 1133 mg/L, respectively. In MW 8-S, the results ranged from 1125 to 1252 mg/L. The average concentration was calculated to be 1179 mg/L for MW 8-S. The concentration of dissolved solids in the groundwater has been significantly impacted by the landfill.

V. GROUNDWATER IMPACT– VOLATILE ORGANIC COMPOUNDS

All of the monitoring wells have been scanned for volatile organic compounds during the sampling period. Compounds have been eliminated from the list when all of the downgradient and upgradient monitoring results are below detection limit for two sampling events.

Currently there are five volatile compounds that are being analyzed for in the monitoring wells at Dixon Marquette Cement Company. These are benzene, 1,1-dichloroethane, 1,1-dichloroethene, toluene, and 1,1,1-trichloroethane. Of these compounds, benzene, 1,1-dichloroethene, toluene, and 1,1,1-trichloroethane have class I groundwater standards.

In the following sections, these five compounds are discussed with respect to the background concentrations, and the concentrations in the downgradient monitoring wells: 5-S through 8-S.

Benzene
The compound was not detected in the background monitoring wells MW 1-WT and 1-S. The upper background concentration limit was found to be 0.005 mg/L, the method detection limit. Benzene was not detected in the downgradient monitoring wells 5-S and 8-S.

1,1-Dichloroethane
The compound was not detected in the background monitoring wells MW 1-WT and 1-S. The upper background concentration limit was found to be 0.005 mg/L. In the downgradient monitoring wells 5-S through 8-S, the compound was detected in only 7-S. Seven of the eleven samples had quantitative results in MW 7-S. The average concentration was calculated to be 0.0299 mg/L.

1,1-Dichloroethene
The compound was not detected in the background monitoring wells MW 1-WT and 1-S. The upper background concentration limit was found to be 0.005 mg/L, the method detection limit. In the downgradient monitoring wells, 5-S through 8-S, the compound was detected in MW 7-S only. Three of the seven samples had quantitative results. The average concentration was calculated to be 0.0058 mg/L.

Toluene
The sample from the shallow aquifer had 0.0082 mg/l toluene on July 24, 1998. The source of the toluene was not identified. There have been no other sampling events in whic toluene was detected in MW1-S above 0.005 mg/l. Because toluene was not confirmed in the well, its detection in the sample from July 1998 is considered to be sporadic, and toluene is not actually present in the well. Toluene was not detected in MW 1-WT, thus the upper background concentration limit is 0.005 mg/L, the method

detection limit. In the four downgradient monitoring wells, 5-S through 8-S, toluene was not detected during all of the sampling events and is not considered to be different than the background concentration.

1,1,1-Trichloroethane

The compound was not detected in MW 1-WT and 1-S. The upper background concentration limit was found to be 0.005 mg/L, the method detection limit. In MW 7-S, two of the sample events had results that were detected. The average concentration of 1,1,1-trichloroethane was calculated to be 0.0052 mg/L. There were no detected concentrations of 1,1,1-trichlorethane in MW 5-S, 6-S, and 8-S.

VI. GROUNDWATER STANDARDS

In the foll wing sections, the maximum 99.5% confidence interval of MW 5-S through 8-S is discussed with respect to the Class I Groundwater Standard. In addition, the best fit lines and trends of the sampling data are presented.

Aluminum

There is no Class I Groundwater Standard for this parameter. The maximum 99.5% confidence interval for MW 5-S through MW 8-S was calculated to be 2.522 mg/L.

Linear trend lines for each of the four monitoring wells indicate a decreasing slope for the data. Results from other downgradient monitoring wells indicate that the 99.5% confidence interval would be met in the future at Dixon Marquette Cement Company.

Antimony

The Class I Groundwater Standard for this parameter is 0.006 mg/L. The 99.5 % confidence interval was calculated to be 0.002 mg/L using data from MW 7-S.

Since the parameter was not detected in the other three wells, the trend line was steady, without a slope. The trend line for MW 7-S was negative, representing a decreasing trend. The parameter was not detected in two downgradient wells, MW 3-S, and MW 4-S.

Arsenic

The Class I Groundwater Standard for this parameter is 0.05 mg/L. The maximum 99.5% confidence interval was calculated to be 0.041 mg/L using data from MW 7-S.

The linear trend lines indicate a decreasing slope for each of the four monitoring wells. Although the trend lines indicate a decreasing slope for each of the monitoring wells, it is expected that the concentrations of arsenic is expected to rise to levels that exceed the standard since MW 3-S has consistently exceeded the standard.

Barium

The Class I Groundwater Standard for this parameter is 2.0 mg/L. The maximum 99.5% confidence interval for the four downgradient wells, 5-S through 8-S was calculated to be 0.371 mg/L.

Each of the four trend lines has a negative slope, indicating a decreasing trend in the concentrations over time. Using data from MW 3-S and 4-S and the trend lines for the four monitoring wells, the concentration of barium is not expected to rise to concentrations greater than the standard.

Beryllium

The Class I Groundwater Standard is 0.004 mg/L for beryllium. The maximum 99.5% confidence interval was calculated to be 0.002 mg/L using the data from MW 8-S.

Since the parameters were not detected in the other three wells, the trend lines were steady, without slopes. The trend line for MW 8-S was negative, representing a decreasing trend. The monitoring data from MW 3-S and 4-S indicate that there should not be an increase in the concentrations of this parameter.

Boron

The Class I Groundwater Standard is 2.0 mg/L. The maximum 99.5% confidence interval was calculated to be 1.452 mg/L from the sampling data at MW 7-S.

All of the trend lines for the four downgradient monitoring wells are negative, indicating a decreasing trend. Using the trend lines, and monitoring data from other downgradient wells, it is not expected that the concentration of boron would exceed this standard.

Cadmium

The Class I Groundwater Standard for this parameter is 0.005 mg/L. The 99.5% confidence interval was calculated to be 0.002 mg/L for the four downgradient monitoring wells.

The slopes of the trend lines indicate a that the concentrations are steady with a slight decrease in the concentration over time. Since cadmium was not detected in MW 3-S and 4-S, the landfill has had very little affect on the groundwater for this parameter.

Calcium

There is no Class I Groundwater Standard for this parameter. The maximum 99.5% confidence interval was calculated to be 420 mg/L for the four downgradient wells.

The linear trend lines have a positive slope for MW 6-S and 7-S indicating a slightly increasing trend over time. The results from MW 3-S do not indicate an increase in the parameter. Values were below 10 mg/L in MW 3-S.

Chromium—

The maximum 99.5% confidence interval was calculated to be 0.030 mg/L, this is significantly lower than the Class I Groundwater Standard of 0.1 mg/L.

The trends indicate that the concentration of chromium slightly is decreasing in MW 5-S through 7-S. There is a small increasing trend in MW 8-S. There is very little difference between the concentrations of MW 5-S through 8-S and the chromium concentrations in MW 3-S.

Cobalt

The 99.5% confidence interval for the four downgradient wells was calculated to be 0.027 mg/L. This is significantly lower than the Class I Groundwater Standard of 1 mg/L.

All of the trend lines for the four monitoring wells indicate that the cobalt concentrations are remaining steady with a slight decrease over time. The data from MW 3-S indicate that the landfill is having very little affect on this parameter, and one would not expect a significant increase over time.

Copper

The 99.5% confidence interval for the four monitoring wells 5-S through 8-S was calculated to be 0.084 mg/L. This is significantly lower the Class I Groundwater Standard of 0.65 mg/L.

Except for MW 6-S, the trends indicate a slightly decreasing slope. The slope for MW 6-S indicates an increasing trend over time. This, however, is a very shallow slope.

Lead

The maximum 99.5% confidence interval was calculated to be 0.012 using data from MW 6-S. This is approximately 60% higher than the class I groundwater standard.

The linear trends for the four monitoring wells have negative slopes, indicating a decreasing trend. Concentrations of lead in MW 3-S were below 0.002 mg/L, which indicate that the landfill has not had a significant affect on this parameter.

Iron

The maximum 99.5% confidence interval for the four downgradient wells was calculated to be 6.399 mg/L using the data from MW 6-S. This is approximately 128% increase from the Class I Groundwater Standard of 5 mg/L.

The four best-fit lines have negative slopes, representing a decreasing trend. Concentrations of iron in MW 3-S are less than 1 mg/L, whereas the concentrations of MW 4-S range from 0.323 to 5.39 mg/L.

Magnesium

There is no Class I Groundwater Standard for this parameter. The maximum 99.5 % confidence interval was calculated to be 171.5 mg/L using data from MW 5-S.

The best fit line for the sampling data in MW 5-S, 7-S and 8-S indicate an increasing trend for this parameter. Monitoring well 3-S has concentrations that are significantly less than the 1-WT background concentration.

Manganese

The Class I Groundwater Standard is 0.15 mg/L for this parameter. The maximum 99.5% confidence interval was calculated to be 3.251 mg/L using data from MW 6-S.

Only MW 8-S was represented by a positive slope during trend analysis. This indicates that the concentration manganese is increasing in this monitoring well.

Mercury

The class I ground water standard for this parameter is 0.002 mg/L. Since the parameter was not detected, the lowest non-detectable limit, 0.0002 mg/L was found to be the maximum 99.5% confidence interval.

Nickel

The 99.5% confidence interval was calculated to be 0.044 mg/L, this is significantly lower than 0.1, the Class I Groundwater Standard. The best fit lines four each of the four monitoring wells indicate a slightly decreasing trend in the data.

Potassium

There is no class I ground water standard for this parameter. The maximum 99.5% confidence interval was calculated to be 838.1 mg/L.

Although the four best-fit lines that represent the data have negative slopes, or decreasing trends, it is unlikely that the concentration in these wells will decrease. Data from MW 3-S suggest that the concentration will increase as the average concentration in this well is 1636 mg/L.

Selenium

The maximum 99.5% confidence interval was calculated to be 0.011 mg/L. There is approximately 355% difference between the confidence interval and the Class I Groundwater Standard of 0.05 mg/L.

Three of the four best-fit lines have a positive slope, indicating an increasing trend. The trend line for MW 5-S is negative. Data from MW 3-S indicate that there may be an increase in the concentrations of selenium over time.

Sodium

There is no Class I Groundwater Standard for this parameter. The maximum 99.5% confidence interval was calculated to be 74.4 mg/L using the data from MW 5-S.

Three of the four trend lines indicate that the concentration of sodium is increasing over time. Data from MW 3-S further indicate that sodium concentrations are being affected by the landfill and the concentration will increase in the four downgradient monitoring wells. The average concentration in MW 3-S is 122.1 mg/L.

Thallium

The Class I Groundwater Standard for thallium is 0.002 mg/L. The 99.5% confidence interval was calculated to be 0.004 mg/L using data from MW 8-S.

There were no trend lines for the monitoring wells 5-S through 7-S. The best-fit line for MW 8-S has a positive slope, indicating an increasing trend. Data from MW 3-S indicate that an increase in thallium is unlikely to occur.

Vanadium

There is no Class I Groundwater Standard for this parameter. The maximum 99.5% confidence interval was calculated to be 0.021 mg/L using the data from MW 7-S.

Three of the four slopes of the best-fit lines were negative, indicating a decreasing trend. The slope on the trend line for MW 8-S was positive. Data from MW 3-S indicate that there is a slight increase in vanadium concentrations over time, as the average concentration in this well is 0.012 mg/L.

Zinc

The 99.5% confidence interval was calculated to be 0.268 mg/L, this is significantly lower than the groundwater standard of 5 mg/L.

The trend lines for the four monitoring wells indicate a decrease in concentration of zinc over time. Data from MW 3-S indicate that the landfill has had little affect on the zinc concentrations, as the average is 0.011 mg/L.

Total Alkalinity

There is no Class I Groundwater Standard for this parameter. The 99.5% confidence interval was calculated to be 578 mg/L, using data from MW 5-S.

The best fit lines for the four downgradient wells, 5-S through 8-S, were positive, indicating an increase in the concentration of total alkalinity over time. Data from MW 3-S indicates that the alkalinity in these wells will continue to rise as the average concentration in this well is 1488 mg/L.

Phenol Alkalinity

There is no Class I Groundwater Standard for this parameter. The 99.5% confidence interval was calculated to be 305 mg/L using data from MW 7-S.

The slope of the best-fit line for the results in MW 7-S indicates a positive increase in concentration of phenol alkalinity over time. In addition, MW 3-S has concentrations that average 765 mg/L.

Bicarbonate Alkalinity

There is no Class I Groundwater Standard for this parameter. The 99.5% confidence interval was calculated to be 528 mg/L using data from MW 5-S.

The best-fit lines for MW 5-S and 6-S have positive slopes, indicating an increase in concentration over time. Data from MW 3-S also indicates that there will be a steady increase in the bicarbonate alkalinity as the range of sampling data is 120 to 1450 mg/L and the average concentration is 523 mg/L.

Ammonia Nitrogen

There is no Class I Groundwater Standard for this parameter. The 99.5% confidence interval was calculated to be 0.70 mg/L, using data from MW 7-S.

The trends for MW 5-S and MW 7-S indicate an increase in ammonia nitrogen over time. Data from MW 3-S had two sampling events with detectable concentrations. The results were 1.60 and 0.61 mg/L.

Chloride

The Class I Groundwater Standard is 200 mg/L, whereas the 99.5% confidence interval was calculated to be 241 mg/L for the four downgradient monitoring wells, 5-S through 8-S. This is a 17% difference.

Only the best fit line for the MW 5-S sampling data indicates a decreasing trend over time. Chloride concentrations are expected to continue to rise in the four downgradient monitoring wells. Monitoring well 3-S has chloride concentrations that range from 130 to 231 mg/L, the average was calculated to be 169.0 mg/L.

Chemical Oxygen Demand (COD)

There is no Class I Groundwater Standard for COD. The maximum 99.5% confidence interval was calculated to be 155.3 mg/L using data from MW 5-S.

All four best-fit lines indicated that the concentration of COD would increase over time. Monitoring well 3-S also indicates that the concentration of COD will increase in the four downgradient monitoring wells. The concentration of COD ranged from below detection limits to 242 mg/L.

Fluoride

The Class I Groundwater Standard for fluoride is 4 mg/L. The maximum 99.5% confidence interval was calculated to be 2.48 mg/L using data from MW 7-S.

The best fit lines indicate that the concentration of fluoride is increasing in all of the monitoring wells except for MW 7-S. In addition, the concentration of fluoride in MW 3-S ranged from 3.02 to 4.44 mg/L with an average concentration of 3.60 mg/L. This further indicates that there will be an increase in the fluoride concentration in the four downgradient monitoring wells.

Nitrate as N

The Class I Groundwater Standard for nitrate is 10 mg/L. The 99.5% confidence interval was calculated to be 4.84 mg/L. There is approximately 107% difference between the two values.

The trend lines showed a decreasing slope for MW 5-S and an increasing one for MW 8-S. Since the concentrations in MW 3-S are similar to the MW 5-S, the concentration of nitrate is not expected to increase.

pH

The two sided 99% confidence interval was calculated to be 7.0 to 10.4 for the four downgradient monitoring wells 5-S through 8-S. Although the linear trends indicate a decreasing pH, values greater than 10 were reported in MW 7-S.

Sulfate

The Class I Groundwater Standard for sulfate is 400 mg/L. The 99.5% confidence interval was calculated to be 897 mg/L from the MW 8-S data.

The best-fit lines indicate that sulfate is increasing in MW 8-S only. Results from MW 3-S indicate that the concentration of sulfate will increase. The average concentration was calculated to be 1076 mg/L in MW 3-S.

Total Organic Carbon (TOC)

There is no Class I Groundwater Standard for total organic carbon. The maximum 99.5% confidence interval was calculated to be 28.9 mg/L.

All of the best-fit lines indicate a decreasing trend in concentration over time. Data from MW 3-S indicates that the concentration of TOC will increase as the average concentration is 17.32 mg/L.

Total Dissolved Solids (TDS)

The Class I Groundwater Standard for this parameter is 1200 mg/L. The maximum 99.5% confidence interval for the four downgradient monitoring wells was calculated using results from MW 7-S. The result is 1478 mg/L.

The best-fit line for MW 8-S indicates an increasing trend for the concentration of TDS over time. The other three have a negative slope, indicating a decrease in concentration. Data from MW 3-S indicates that the concentration of TDS will increase instead of decrease. The average concentration is 3843 mg/L.

Benzene

The class I groundwater standard for this compound is 0.005 mg/L. The maximum 99.5% confidence interval could not be calculated for monitoring wells 5-S through 8-S since benzene was not detected during the sampling events. All of the trend lines are represented by horizontal lines that have no slope.

1,1-Dichloroethane

There is no class I groundwater standard for this parameter. The maximum 99.5% confidence interval was calculated to be 0.0669 mg/L using data from MW 7-S. Since the compound was not detected in MW 5-S, 6-S, and 8-S, the trend lines are horizontal without a slope. The best fit line in MW 7-S was represented by a positive slope representing an increasing trend.

1,1-Dichloroethene

The class I groundwater standard for this parameter is 0.007 mg/L. The maximum 99.5% confidence interval was calculated to be 0.0076 mg/L using data from MW 7-S. Since the 1,1-dichloroethene was not detected in MW 5-S, 6-S, and 8-S, the trend lines are horizontal without a slope. The best fit line in MW 7-S was represented by a positive slope representing an increasing trend.

Toluene

The class I groundwater standard for this compound is 1 mg/L. The maximum 99.5% confidence interval could not be calculated for monitoring wells 5-S through 8-S since toluene was not detected during the sampling events. All of the trend lines are represented by horizontal lines that have no slope.

1,1,1-Trichloroethane

The class I groundwater standard for this compound is 0.2 mg/L. The maximum 99.5% confidence interval was calculated to be 0.0059 mg/L using data from MW 7-S. Since the 1,1,1-trichloroethane was not detected in MW 5-S, 6-S, and 8-S, the trend lines are horizontal without a slope. The best fit line in MW 7-S was represented by a negative slope representing a decreasing trend.

VII. ADJUSTED GROUNDWATER STANDARDS

In the following table, the Class I Groundwater Standards, the maximum 99.5% Confidence Interval of MW 5-S through 8-S, the upper limits of the 99th percentile for MW 1-WT and 1-S, and the calculated 99.5% confidence interval for MW 3-S are given. The requested adjusted groundwater standard is listed. All concentrations are given in mg/L, unless noted otherwise.

	Class I Standard	MW 5S - 8S Max 99.5% CI	MW 1-S Upper Limit	MW 1-WT Upper limit	MW 3-S 99.5% CI	Requested Adjusted Standard
Aluminum		*2.522*	0.04	0.454	0.730	2.522
Antimony	*0.006*	0.002	Tst of Prop	0.001	0.001	0.006
Arsenic	0.05	0.041	Tst of Prop	0.003	*0.141*	0.141
Barium	*2*	0.371	0.091	0.227	0.068	2
Beryllium	*0.004*	0.002	0.001	0.001	0.001	0.004
Boron	*2*	1.452	Tst of Prop	Tst of Prop	0.212	2
Cadmium	*0.005*	0.002	0.001	0.001	0.006	0.005
Calcium		*420*	109	126	6.6	420
Chromium	*0.1*	0.030	0.002	0.002	0.032	0.1
Cobalt	*1*	0.027	0.003	0.008	0.003	1
Copper	*0.65*	0.084	0.005	0.012	0.037	0.65
Lead	0.0075	*0.012*	0.001	0.006	0.004	0.012
Iron	5	*6.399*	0.465	0.891	1.017	6.4
Magnesium		*171.5*	53.9	50.4	4.6	171.5
Manganese	0.15	*3.251*	0.045	2.687	0.186	3.3
Mercury	*0.002*	0.0002	0.0002	Tst of Prop	0.0011	0.002
Nickel	*0.1*	0.044	0.007	0.023	0.031	0.1
Potassium		838	Tst of Prop	4.004	*2309*	2309
Selenium	*0.05*	0.011	0.004	Tst of Prop	0.012	0.05
Sodium		74.4	12.8	53.7	*140.5*	140.5
Thallium	0.002	*0.004*	Tst of Prop	Tst of Prop	0.002	0.004
Vanadium		*0.021*	Tst of Prop	0.007	0.026	0.02
Zinc	*5*	0.268	0.058	0.014	0.018	5
Alkalinity, total		578	253	342	*1699*	1699
Alkalinity, phenol.		305.0	Tst of Prop	1.0	*1121*	1121
Alkalinity, bicarb		578	250.036	334.029	*977*	977
Ammonia nitrogen		0.70	Tst of Prop	Tst of Prop	*1.25*	1.25
Chloride	200	*241*	30.8	25.4	197	241
COD		155	5.0	Tst of Prop	*187*	187
Fluoride	4	2.48	0.19	0.76	*4.42*	4.4
Nitrate as N	10	4.84	*11.07*	Tst of Prop	0.88	11.1
pH (stnd units)		*7.0* to 10.4	7.22 to 7.82	7.16 to 8.14	9.0 to *10.9*	7.0 to 10.9
Sulfate	400	897	178	243	*1245*	1245
TOC		*28.9*	4.5	17.1	26.51	29
Ttl Dis Solids	1200	1478	540	488	*4338*	4338

	Class I Standard	MW 5S - 8S Max 99.5% CI	MW 1-S Upper Limit	MW 1-WT Upper limit	MW 3-S 99.5% CI	Requested Adjusted Standard
Benzene	0.005	NA	0.005	0.005	NA	0.005
1,1-dichloroethane		0.0669	0.005	0.005	5.4 mg/L	0.7 *
1,1-dichloroethene	0.007	0.0076	0.005	0.005	NA	0.035 **
Toluene	1	NA	0.005	0.005	NA	1
1,1,1-trichloroethane	0.2	0.0059	0.005	0.005	12.0	0.2

NA– Concentrations for all sampling events were below detection limits. The 99.5% confidence interval was not calculated for this parameter.

* The Class I groundwater remediation objective from Section 742 was used because a groundwater standard is not available.

** The Class II 620 groundwater standard is proposed.

Due to the concentrations in monitoring well 3-S, some of the parameters are expected to increase above the maximum confidence interval of 5-S through 8-S. These parameters include: arsenic, potassium, sodium, alkalinity, sulfate, and total dissolved solids. In these instances, the 99.5% confidence interval of 3-S was requested as the adjusted standard. In the following paragraphs, each of these parameters is explained with respect to the concentrations in MW 3-S and the maximum 99.5% confidence interval of MW 5-S through 8-S.

Arsenic– The class I groundwater standard is 0.05 mg/L, which is significantly higher than the 99.5% confidence interval calculated for monitoring wells 5-S through 8-S. Seven of the nine sample results in MW 3-S were greater than the standard of 0.05 mg/L. The average concentration was calculated to be 0.083 mg/L.

Potassium– The maximum 99.5% confidence interval of MW 5-S through 8-S is 838 mg/L. Potassium concentrations in MW 3-S ranged from 200 to 2314 mg/L with an average concentration of 2010 mg/L.

Sodium– The maximum 99.5% confidence interval of MW 5-S through 8-S is 74.4 mg/L. This concentration is significantly lower than the average concentration of sodium in MW 3-S. Sodium ranged from 82 to 145 mg/L with an average of 122.1 mg/L in this downgradient well.

Total Alkalinity– The maximum 99.5% confidence interval of MW 5-S through 8-S is 578 mg/L. In monitoring well 3-S, total alkalinity peaked at 1660 mg/L on November 29, 2000. The concentration of total alkalinity has been consistently rising in this well. The average was calculated to be 1488 mg/L.

Phenol Alkalinity– The average concentration in MW 3-S was calculated to be 765 mg/L, however the peak concentration of phenol alkalinity was measured to be 1155 mg/L during the June 2000 sampling event. The maximum 99.5% confidence interval of MW 5-S through 8-S is 305 mg/L.

Bicarbonate Alkalinity– The average concentration of bicarbonate alkalinity in MW 3-S is 523 mg/L, this is lower than the maximum 99.5% confidence interval of MW 5-S through 8-S, 528 mg/L. Since the maximum concentration in MW 3-S is 1450 mg/L, the four downgradient monitoring wells are expected to exceed the adjusted groundwater standard.

Sulfate– The maximum 99.5% confidence interval of MW 5-S through 8-S is 897 mg/L. This is significantly lower then the average concentration in MW 3-S. The average concentration was calculated to be 1076 mg/L and the peak concentration in this well was 1400 mg/L.

Total Dissolved Solids– The maximum 99.5% confidence interval is 1478 mg/L in MW 5-S through 8-S. This concentration is significantly lower than the average concentration, 3843 mg/L, in MW 3-S. Concentrations of total dissolved solids have been increasing in MW 3-S over time. The peak concentration was 4400 mg/L during the September 2000 sampling event.

Since there were exceedances of the requested adjusted groundwater standard in MW 3-S, the following parameters are also considered to be of future concern.

Vanadium– During the sampling period, there was one MW 3-S concentration of vanadium that was greater than the 99.5% confidence interval of 0.021 mg/L. This occurred during the November 2000 sampling event and the concentration was 0.029 mg/L.

Ammonia Nitrogen– Two of the seven sample results had concentrations of ammonia nitrogen in MW 3-S. The concentrations were 1.60 and 0.61 mg/L. The requested adjusted standard for this parameter is 0.70 mg/L. Thus one sample was significantly greater than the standard.

Chemical Oxygen Demand– Although the average concentration of COD in MW 3-S is less than the requested standard, there is some concern with future results. During the June 2000 sampling event, the concentration of COD peaked at 242 mg/L.

Fluoride– In monitoring well 3-S, one concentration was greater than the Class I Groundwater Standard. The concentration was 4.44 mg/L, a 110% increase above the standard.

SUMMARY TABLES

Dixon Marquette Cement Comp
99.5% CIs Summary

Parameter	MW 5-S	MW 6-S	MW 7-S	MW 8-S	Class I GroundWater Stnd	Maximum Value
Aluminum	0.277	2.522	0.844	0.664		2.522
Antimony	0.001	0.001	0.002	0.001	0.006	0.002
Arsenic	0.004	0.004	0.041	0.004	0.05	0.041
Barium	0.269	0.371	0.057	0.141	2	0.371
Beryllium	0.001	0.001	0.001	0.002	0.004	0.002
Boron	0.786	0.751	1.452	0.318	2	1.452
Cadmium	0.002	0.001	0.001	0.002	0.005	0.002
Calcium	318	420	45	268		420
Chromium	0.006	0.006	0.005	0.030	0.1	0.030
Cobalt	0.005	0.027	0.001	0.025	1	0.027
Copper	0.014	0.027	0.009	0.084	0.65	0.084
Lead	0.001	0.012	0.003	0.004	0.0075	0.012
Iron	1.834	6.399	1.806	4.186	5	6.399
Magnesium	171.5	95.8	15.9	119.3		171.5
Manganese	0.913	3.251	0.187	3.133	0.15	3.251
Mercury	0.0002	0.0002	0.0002	0.0002	0.002	0.0002
Nickel	0.016	0.039	0.016	0.044	0.1	0.044
Potassium	259.6	77.6	838.1	302		838
Selenium	0.005	0.005	0.004	0.011	0.05	0.011
Sodium	74.4	68.0	53.5	62.2		74.4
Thallium	0.001	0.001	0.001	0.004	0.002	0.004
Vanadium	0.018	0.019	0.021	0.004		0.021
Zinc	0.039	0.035	0.033	0.268	5	0.268
Alkalinity, total	578	425	534	317		578
Alkalinity, phenol.	1	2.4	305	1.0		305.0
Alkalinity, bicarb	528	409	441.57	309		528
Ammonia nitrogen	0.16	0.10	0.7	0.10		0.70
Chloride	132.0	241	119.32	206	200	241
COD	155.3	127	31.24	119		155
Fluoride	0.15	0.39	2.48	0.28	4	2.48
Nitrate as N	4.84	0.10	0.10	3.27	10	4.84
pH Upper Limit (stnd units)	7.9	8.1	10.4	8.3		10.4
pH Lower Limit (stnd units)	7.0	7.0	9.0	7.0		7.0
Sulfate	694	352	523	897	400	897
TOC	28.89	20.83	19.3	16.5		28.9
Ttl Dis Solids	1225	957	1478	1245	1200	1478
Benzene	NA	NA	NA	NA	0.005	NA
1,1-dichloroethane	NA	NA	0.0669	NA		0.0669
1,1-dichloroethene	NA	NA	0.0076	NA	0.007	0.0076
Toluene	NA	NA	NA	NA	1	NA
1,1,1-trichloroethane	NA	NA	0.0059	NA	0.2	0.0059

All values in mg/L unless noted otherwise.

Dixon Marquette Cement Comp
99.5% CIs Summary with MW 3-S

Parameter	MW 3-S	MW 5-S	MW 6-S	MW 7-S	MW 8-S	Class I GroundWater Stnd	Maximum Value
Aluminum	0.730	0.277	2.522	0.844	0.664		2.522
Antimony	0.001	0.001	0.001	0.002	0.001	0.006	0.002
Arsenic	0.141	0.004	0.004	0.041	0.004	0.05	0.141
Barium	0.068	0.269	0.371	0.057	0.141	2	0.371
Beryllium	0.001	0.001	0.001	0.001	0.002	0.004	0.002
Boron	0.212	0.786	0.751	1.452	0.318	2	1.452
Cadmium	0.006	0.002	0.001	0.001	0.002	0.005	0.006
Calcium	6.6	318	420	45	268		420
Chromium	0.032	0.006	0.006	0.005	0.030	0.1	0.032
Cobalt	0.003	0.005	0.027	0.001	0.025	1	0.027
Copper	0.037	0.014	0.027	0.009	0.084	0.65	0.084
Lead	0.004	0.001	0.012	0.003	0.004	0.0075	0.012
Iron	1.017	1.834	6.399	1.806	4.186	5	6.399
Magnesium	4.6	171.5	95.8	15.9	119.3		171.5
Manganese	0.186	0.913	3.251	0.187	3.133	0.15	3.251
Mercury	0.0011	0.0002	0.0002	0.0002	0.0002	0.002	0.0011
Nickel	0.031	0.016	0.039	0.016	0.044	0.1	0.044
Potassium	2309	259.6	77.6	838.1	302		2309
Selenium	0.012	0.005	0.005	0.004	0.011	0.05	0.012
Sodium	140.5	74.4	68.0	53.5	62.2		140.5
Thallium	0.002	0.001	0.001	0.001	0.004	0.002	0.004
Vanadium	0.026	0.018	0.019	0.021	0.004		0.026
Zinc	0.018	0.039	0.035	0.033	0.268	5	0.268
							0.000
							0.00
Alkalinity, total	1699	578	425	534	317		1699
Alkalinity, phenol.	1120.8	1	2.4	305	1.0		1121
Alkalinity, bicarb	977	528	409	441.57	309		977
Ammonia nitrogen	1.25	0.16	0.10	0.7	0.10		1.25
Chloride	197.5	132.0	241	119.32	206	200	241
COD	187.4	155.3	127	31.24	119		187
Fluoride	4.42	0.15	0.39	2.48	0.28	4	4.42
Nitrate as N	0.88	4.84	0.10	0.10	3.27	10	4.84
pH Upper Limit (stnd units)	10.9	7.9	8.1	10.4	8.3		10.9
pH Lower Limit (stnd units)	10.3	7.0	7.0	9.0	7.0		7.0
Sulfate	1245	694	352	523	897	400	1245
TOC	26.51	28.89	20.83	19.3	16.5		28.9
Ttl Dis Solids	4338	1225	957	1478	1245	1200	4338
Benzene	NA	NA	NA	NA	NA	5	NA
1,1-dichloroethane	0.005	NA	NA	0.0669	NA		0.0669
1,1-dichloroethene	NA	NA	NA	0.0076	NA	7	0.0076
Toluene	NA	NA	NA	NA	NA	1000	NA
1,1,1-trichloroethane	0.012	NA	NA	0.0059	NA	200	0.012

All values in mg/L unless noted otherwise.

Dixon Marquette Cement Comp
Requested Groundwater Standards Summary

	Class I Grndwtr Standard	MW 5S to 8S Max 99.5% CI	MW 1-S Upper Limit	MW 1-WT Upper limit	MW 3-S 99.5% CI	Requested Adjusted Groundwater Stnd
Aluminum		2.522	0.04	0.454	0.730	2.522
Antimony	0.006	0.002	Tst of Prop	0.001	0.001	0.006
Arsenic	0.05	0.041	Tst of Prop	0.003	0.141	0.141
Barium	2	0.371	0.091	0.227	0.068	2
Beryllium	0.004	0.002	0.001	0.001	0.001	0.004
Boron	2	1.452	Tst of Prop	Tst of Prop	0.212	2.000
Cadmium	0.005	0.002	0.001	0.001	0.006	0.005
Calcium		420	109	126	6.6	420
Chromium	0.1	0.030	0.002	0.002	0.032	0.1
Cobalt	1	0.027	0.003	0.008	0.003	1
Copper	0.65	0.084	0.005	0.012	0.037	0.65
Lead	0.0075	0.012	0.001	0.006	0.004	0.012
Iron	5	6.399	0.465	0.891	1.017	6.399
Magnesium		171.5	53.903	50.478	4.6	171.5
Manganese	0.15	3.251	0.045	2.687	0.186	3.251
Mercury	0.002	0.0002	0.0002	Tst of Prop	0.0011	0.002
Nickel	0.1	0.044	0.007	0.023	0.031	0.1
Potassium		838	Tst of Prop	4.004	2309	2309
Selenium	0.05	0.011	0.004	Tst of Prop	0.012	0.05
Sodium		74.4	12.8	53.7	140.5	140.5
Thallium	0.002	0.004	Tst of Prop	Tst of Prop	0.002	0.004
Vanadium		0.021	Tst of Prop	0.007	0.026	0.026
Zinc	5	0.268	0.058	0.014	0.018	5
Alkalinity, total		578	253	342	1699	1699
Alkalinity, phenol.		305.0	Tst of Prop	1.0	1121	1121
Alkalinity, bicarb		528	250.036	334.029	977	977
Ammonia nitrogen		0.70	Tst of Prop	Tst of Prop	1.25	1.25
Chloride	200	241	30.8	25.4	197	241
COD		155	5.0	Tst of Prop	187.4	187
Fluoride	4	2.48	0.19	0.76	4.42	4.42
Nitrate as N	10	4.84	11.07	Tst of Prop	0.88	11.07
pH Upper Limit (stnd units)		10.4	7.82	8.14	10.9	10.9
pH Lower Limit (stnd units)		7.0	7.22	7.16	10.3	7.0
Sulfate	400	897	178	243	1245	1245
TOC		28.9	4.5	17.1	26.51	28.9
Ttl Dis Solids	1200	1478	540	488	4338	4338
Benzene	0.005	NA	0.005	0.005	NA	0
1,1-dichloroethane		0.0669	0.005	0.005	0.005	0.7*
1,1-dichloroethene		0.0076	0.005	0.005	NA	0.35**
Toluene	1	NA	0.005	0.005	NA	1
1,1,1-trichloroethane	0.2	0.0059	0.005	0.005	0.012	0.2

All values in mg/L unless noted otherwise.

* The Class I groundwater remediation objective from Section 742 was used because a groundwater standard is not available.

** The Class II 620 groundwater standard is proposed.

Dixon Marquette Cement Comp
Summary

	MW 3-S AVE	MW 5-S AVE	MW 6-S AVE	. MW 7-S AVE	MW 8-S AVE	Class I Grndwtr Standard	MW 5S to 8S Max 99.5% CI	MW 1-S Upper Limit	MW 1-WT Upper limit
Aluminum	0.322	0.168	0.754	0.387	ι.326		2.522	0.04	0.454
Antimony	0.001	0.001	0.001	0.001	0.001	0.006	0.002	Tst of Prop	0.001
Arsenic	0.083	0.002	0.002	0.023	0.002	0.05	0.041	Tst of Prop	0.003
Barium	0.051	0.138	0.258	0.042	0.075	2	0.371	0.091	0.227
Beryllium	0.001	0.001	0.001	0.001	0.001	0.004	0.002	0.001	0.001
Boron	0.107	0.464	0.424	0.436	0.208	2	1.452	Tst of Prop	Tst of Prop
Cadmium	0.002	0.001	0.001	0.001	0.001	0.005	0.002	0.001	0.001
Calcium	4.3	240	234	25	237		420	109	126
Chromium	0.012	0.003	0.003	0.003	0.010	0.1	0.030	0.002	0.002
Cobalt	0.001	0.002	0.012	0.001	0.006	1	0.027	0.003	0.008
Copper	0.017	0.006	0.013	0.005	0.024	0.65	0.084	0.005	0.012
Lead	0.002	0.001	0.004	0.002	0.003	0.0075	0.012	0.001	0.006
Iron	0.576	0.898	2.665	0.805	1.654	5	6.399	0.465	0.891
Magnesium	2.6	82.3	55.2	9.3	100.1		171.5	53.9	50.5
Manganese	0.096	0.229	1.695	0.094	0.763	0.15	3.251	0.045	2.687
Mercury	0.0004	0.0002	0.0002	0.0002	0.0002	0.002	0.0002	0.0002	Tst of Prop
Nickel	0.016	0.005	0.020	0.010	0.014	0.1	0.044	0.007	0.023
Potassium	1636	86.0	54.8	632.6	245		838	Tst of Prop	4.0
Selenium	0.007	0.002	0.003	0.002	0.005	0.05	0.011	0.004	Tst of Prop
Sodium	122.1	37.9	46.4	40.9	39.7		74.4	12.8	53.7
Thallium	0.001	0.001	0.001	0.001	0.002	0.002	0.004	Tst of Prop	Tst of Prop
Vanadium	0.012	0.007	0.008	0.013	0.003		0.021	Tst of Prop	0.007
Zinc	0.011	0.017	0.015	0.016	0.075	5	0.268	0.058	0.014
Alkalinity, total	1488	442	389	422	287		578	253	342
Alkalinity, phenol.	765.2	1.0	0.8	74	1.0		305.0	Tst of Prop	1.0
Alkalinity, bicarb	523	410	366	294.71	276		528	250	334
Ammonia nitrogen	0.39	0.11	0.10	0.2	0.10		0.70	Tst of Prop	Tst of Prop
Chloride	169.0	62.7	153	82.59	153	200	241	31	25
COD	68.3	53.2	57	20.69	41		155	5.0	Tst of Prop
Fluoride	3.60	0.10	0.26	1.52	0.21	4	2.48	0.19	0.76
Nitrate as N	0.43	1.42	0.10	0.10	2.48	10	4.84	11.07	Tst of Prop
pH Upper Limit (stnd units)	10.6	7.4	7.6	9.7	7.6		10.4	7.82	8.14
pH Lower Limit (stnd units)	10.6	7.4	7.6	9.7	7.6		7.0	7.22	7.16
Sulfate	1076	385	235	425	803	400	897	178	243
TOC	17.32	11.68	10.19	13.4	8.5		28.9	4.5	17.1
Ttl Dis Solids	3843	846	797	1133	1179	1200	1478	540	488
Benzene	NA	NA	NA	NA	NA	0.005	NA	0.005	0.005
1,1-dichloroethane	0.0045	NA	NA	0.0299	NA		0.0669	0.005	0.005
1,1-dichloroethene	NA	NA	NA	0.0058	NA	0.007	0.0075	0.005	0.005
Toluene	NA	NA	NA	NA	NA	1	NA	0.005	0.005
1,1,1-trichloroethane	0.0081	NA	NA	0.0052	NA	0.2	0.0059	0.005	0.005

All values in mg/L unless noted otherwise.

BACKGROUND TABLES

Dixon Marquette Cement Comp
Background MW1-S
Statistical Analysis

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Aluminum	<0.1	<0.1	<0.04	<0.04	<0.04	<0.04
Antimony	<0.1	<0.1	<0.001	<0.001	<0.001	<0.001
Arsenic	<0.005	<0.08	<0.08	<0.08	<0.001	<0.001
Barium	0.067	0.064	0.056	0.069	0.072	0.067
Beryllium	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001
Boron	<0.1	<0.05	<0.05	<0.05	0.05	<0.05
Cadmium	<0.005	<0.02	<0.02	<0.02	<0.001	<0.001
Calcium	95	91	100	100	117	98.3
Chromium	0.001	0.001	0.001	0.001	0.001	0.003
Cobalt	0.001	0.001	0.001	0.004	0.001	0.001
Copper	0.002	0.002	0.002	0.005	0.001	0.004
Lead	<0.005	<0.1	<0.1	<0.1	<0.001	<0.001
Iron	0.258	0.298	0.153	0.2	0.201	0.22
Magnesium	48	45	49	59.7	48	50.7
Manganese	0.031	0.029	0.025	0.03	0.029	0.045
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	0.005	0.006	0.006	<0.058	<0.05	<0.05
Potassium	1.04	0.89	1.81	1.8	1.13	2.2
Selenium	0.004	0.003	0.003	<0.005	<0.15	<0.15
Sodium	11	10	11	11	12.5	11.3
Thallium		<1	<1	<0.001	<0.001	<0.001
Vanadium	<0.05	<0.05	0.001	<0.001	<0.001	<0.001
Zinc	0.08	0.039	0.034	0.032	0.037	0.01
Alkalinity, total	256	240	250	188	216	242
Alkalinity, phenol.		<5	<5	4	<1.0	<1
Alkalinity, bicarbonate	256	240	250	170	201	230
Ammonia nitrogen	<.2	<.2	<.2	<.1	0.27	<0.1
Chloride	31	30	31	31	32	29.6
COD		<5	<5	<5	<20	<20
Fluoride	0.18	0.15	0.16	<0.2	<0.2	<0.21
Nitrate	6.9	6.9	9.7	7.5	6.03	6.89
pH Upper Limit	7.41	7.3	7.1	7.4	7.4	7.8
pH Lower Limit						
Sulfate	160	180	150	180	170	169
TOC	3.9	1	5	6.09	2.32	1.45
TDS	574	550	580	550	550	428
Benzene	<0.0010	<0.0005	<0.0005	<0.0005	<0.0050	<0.0050
1,1-dichloroethane	<0.0010	<0.0010	<0.0010	<0.0010	<0.0050	<0.0050
1,1-dichloroethene	<0.0010	<0.0020	<0.0020	<0.0020	<0.0050	<0.0050
Toluene	<0.0010	0.0082	<0.0010	<0.0010	<0.0050	<0.0050
1,1,1-trichloroethane	<0.0010	<0.0010	<0.0010	<0.0010	<0.0050	<0.0050

All concentrations in mg/L.

Dixon Marquette Cement Comp
Background MW1-S
Statistical Analysis

	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12	Sample 13
Aluminum	<0.04	<0.04	<0.04				
Antimony	<0.001	0.001	<0.001				
Arsenic	<0.001	<0.001	<0.001	0.001	<0.001		
Barium	0.066	0.075	0.062	0.069	0.135		
Beryllium	<0.001	<0.001	<0.001	<0.001			
Boron	<0.05	0.078	<0.05	0.048			
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001		
Calcium	103	112	100	106	104		
Chromium	<0.04	<0.02	<0.02	<0.02	<0.001		
Cobalt	<0.02	<0.02	<0.02	<0.001			
Copper	<0.02	<0.02	<0.02	<0.001			
Lead	<0.001	<0.001	<0.001	<0.001	<0.001		
Iron	1.01	<0.05	<0.1	<0.1	<0.1	<0.1	
Magnesium	52.3	49.5	51.5	48.5			
Manganese	0.039	0.044	0.028	0.032	0.063	0.0005	
Mercury	<0.0002	<0.0002	<0.0002	<0.0002			
Nickel	0.003	0.004	0.005	0.01			
Potassium	<2	<2	<1	<2	<2	<0.05	
Selenium	<0.15	0.002	<0.001	0.007	0.012		
Sodium	11.8	12.6	14.5	12.5	11.1		
Thallium	<0.001	<0.001	0.005	<0.001			
Vanadium	0.002	0.002	0.008				
Zinc	0.019	0.007	0.036	0.067			
Alkalinity, total	240	240	230	246			
Alkalinity, phenol.	<1						
Alkalinity, bicarbonate	228	227	226	238			
Ammonia nitrogen	<0.10	<0.1	0.23	<0.1			
Chloride	27.5	27.9	28.1	29.2	29.9	28.1	
COD	<20	<20	<20	<20	<20		
Fluoride	0.13	0.17	0.17	0.18			
Nitrate	6.24	3.54	5.49	6.42	5.91	<1	<0.02
pH Upper Limit	8.2	7.7	7.2	7.5	7.3	8.1	7.3
pH Lower Limit							
Sulfate	178	178	179	171	165	169	
TOC	3.16	2.73	0.57	0.61			
TDS	440	435	435	422	420	422	
Benzene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050		
1,1-dichloroethane	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050		
1,1-dichloroethene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050		
Toluene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050		
1,1,1-trichloroethane	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050		

All concentrations in mg/L.

Dixon Marquette Cement Comp
Background MW1-S
Statistical Analysis

	Sample 14	Mean	Stnd. dev.	Deg of Freedom	99 Percentile	Upper limit	Method
Aluminum						0.040	Lowest non-detect
Antimony							Test of proportions
Arsenic							Test of proportions
Barium		0.073	0.021	10	2.76	0.091	Student's t
Beryllium						0.001	Lowest non-detect
Boron							Test of proportions
Cadmium						0.001	Lowest non-detect
Calcium		102	7	10	2.76	109	Student's t
Chromium		0.001	0.001	5	3.36	0.002	Cohen
Cobalt		0.002	0.001	5	3.36	0.003	Cohen
Copper		0.003	0.002	5	3.36	0.005	Cohen
Lead						0.001	Lowest non-detect
Iron		0.236	0.075	2	3.36	0.465	Cohen
Magnesium		50.2	3.9	9	2.82	53.9	Student's t
Manganese		0.033	0.015	11	2.72	0.045	Student's t
Mercury						0.0002	Lowest non-detect
Nickel		0.003	0.003	5	3.36	0.007	Cohen
Potassium							Test of proportions
Selenium		0.002	0.002	5	3.36	0.004	Cohen
Sodium		11.8	1.2	10	2.76	12.8	Student's t
Thallium							Test of proportions
Vanadium							Test of proportions
Zinc		0.036	0.023	9	2.82	0.058	Student's t
Alkalinity, total		235	20	9	2.82	253	Student's t
Alkalinity, phenol.							Test of proportions
Alkalinity, bicarbonate		227	25	9	2.82	250	Student's t
Ammonia nitrogen							Test of proportions
Chloride		29.6	1.5	11	2.72	30.8	Student's t
COD						5.0	Lowest non-detect
Fluoride		0.08	0.09	5	3.36	0.19	Cohen
Nitrate		7.32	1.26	5	3.36	11.07	Cohen
pH Upper Limit		7.516	0.338	12	3.06	7.82	Student's t
pH Lower Limit		7.52	0.338	12	3.06	7.22	Student's t
Sulfate		170.8	9.2	11	2.72	178.3	Student's t
TOC		2.7	1.9	9	2.82	4.5	Student's t
TDS		484	69	11	2.72	540	Student's t
Benzene						0.005	Method Detection Limit
1,1-dichloroethane						0.005	Method Detection Limit
1,1-dichloroethene						0.005	Method Detection Limit
Toluene						0.005	Method Detection Limit
1,1,1-trichloroethane						0.005	Method Detection Limit

All concentrations in mg/L.

Dixon Marquette Cement Comp
MW1-S
Test of Proportions

	Monitoring Well 1-WT		Monitoring Well 5-S		Zd	Monitoring Well 6-S		Zd	Monitoring Well 7-S		Zd	Monitoring Well 8-S		Zd
	Samples Detected	Sample Size	Samples Detected	Sample Size		Samples Detected	Sample Size		Samples Detected	Sample Size		Samples Detected	Sample Size	
Antimony	1	9	0	7	0.91	0	7	0.91	1	7	0.19	0	7	0.91
Arsenic	1	10	2	7	0.99	5	7	2.61	7	7	3.66	4	7	2.10
Boron	3	10	6	7	2.27	6	7	2.27	6	7	2.27	7	7	2.89
Potassium	6	12	7	7	2.26	7	7	2.26	7	7	2.26	7	7	2.26
Thallium	1	9	0	7	0.91	1	7	0.19	0	7	0.91	3	7	1.45
Vanadium	4	9	6	7	1.69	6	7	1.69	7	7	2.38	5	7	1.08
Alkalinity, phenol.	1	6	0	4	0.86	0	4	0.86	3	4	1.84	0	4	0.86
Ammonia nitrogen	2	10	1	7	0.30	1	7	0.30	1	7	0.30	0	7	1.26
Toluene	1	11	0	7	0.82	0	7	0.82	0	7	0.82	0	7	0.82

If Zd > 1.96, then sample set is significantly different than background

Dixon Marquette Cement Comp
Background MW1-WT
Statistical Analysis

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7
Aluminum	0.27	0.08	0.226	0.074	<0.04	<0.04	<0.04
Antimony	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	0.003	0.002	0.001	0.002	0.002	0.001	0.0005
Barium	0.122	0.155	0.14	0.183	0.25	0.202	0.142
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	<0.05	<0.05	0.061	0.078	<0.05	<0.05	0.031
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	97.7	107	99.1	110	96.4	129	125
Chromium	0.002	0.001	0.001	0.001	0.001	<0.001	<0.001
Cobalt	0.007	0.008	0.001	0.004	0.004	0.005	0.005
Copper	0.012	0.011	0.005	0.005	0.001	0.008	0.004
Lead	0.003	0.004	0.001	0.001	<0.001	<0.001	<0.001
Iron	0.73	0.501	0.175	0.966	0.304	0.62	0.582
Magnesium	18.2	32.7	35.7	39.6	38.8	49.4	46.8
Manganese	2.04	2.64	0.912	2.23	1.88	1.78	2.36
Mercury	<0.0002	<0.0002	<0.0002	<0 0002	<0.0002	0.0002	<0.0002
Nickel	0.023	0.016	0.009	0.01	0.022	0.018	0.017
Potassium	2.43	3.06	3.63	1.9	3.3	4	3.3
Selenium	<0.004	<0.001	<0.001	<0.001	<0.001	0.005	0.002
Sodium	64.9	38.5	35.1	34.4	26.2	31.5	26.1
Thallium	<0.001	<0.001	<0.001	0.002	<0.001	0.001	<0.001
Vanadium	0.005	0.002	0.002	0.007	0.004	0.007	0.0005
Zinc	0.01	0.011	0.008	0.012	0.001	0.014	0.006
Alkalinity, total	201	346	322	215	270	290	280
Alkalinity, phenol	<1.0	<1.0	<1.0				
Alkalinity, bicarbonate	198	330	320	188	265	276	272
Ammonia nitrogen	<0.1	<0.1	<0.1	<0.1	<0.1	0.14	<0.01
Chloride	1.55	22.1	17.9	18.8	18.2	19.6	18.6
COD	<20	44	<20	25.6	<20	42.9	<20
Fluoride	0.13	1.13	0.12	0.1	0.13	0.13	0.15
Nitrate	<0.1	<0.1	0.12	<0.1	<0.1	<0.1	<0.1
pH Upper Limit	7.5	8.3	7.8	8	7.4	7.1	7.6
pH Lower Limit							
Sulfate	83.8	86.1	95.7	120	175	238	253
TOC	8.06	22.3	4.04	7.44	10.4	1.28	1.43
TDS	320	430	407	390	420	485	471
Benzene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,1-dichloroethane	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,1-dichloroethene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Toluene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,1,1-trichloroethane	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

All concentrations in mg/L.

Dixon Marquette Cement Comp
Background MW1-WT
Statistical Analysis

	Mean	Stnd. dev.	Deg of Freedom	99 Percentile	Upper limit	Method
Aluminum	0.163	0.100	3	4.54	0.454	Cohen
Antimony					0.001	Lowest non-detect
Arsenic	0.002	0.001	6	3.14	0.003	Student's t
Barium	0.171	0.044	6	3.14	0.227	Student's t
Beryllium					0.001	Lowest non-detect
Boron						Test of proportions
Cadmium					0.0	Lowest non-detect
Calcium	109.2	13.2	6	3.14	126.1	Student's t
Chromium	0.001	0.000	4	3.75	0.002	Cohen
Cobalt	0.005	0.002	6	3.14	0.008	Student's t
Copper	0.007	0.004	6	3.14	0.012	Student's t
Lead	0.002	0.002	3	4.54	0.006	Cohen
Iron	0.6	0.3	6	3.14	0.9	Student's t
Magnesium	37.3	10.3	6	3.14	50.5	Student's t
Manganese	1.98	0.55	6	3.14	2.69	Student's t
Mercury						Test of proportions
Nickel	0.0	0.0	6	3.14	0.0	Student's t
Potassium	3.1	0.7	6	3.14	4.0	Student's t
Selenium						Test of proportions
Sodium	36.7	13.3	6	3.14	53.7	Student's t
Thallium						Test of proportions
Vanadium	0.004	0.003	6	3.14	0.007	Student's t
Zinc	0.009	0.004	6	3.14	0.014	Student's t
Alkalinity, total	275	53	6	3.14	342	Student's t
Alkalinity, phenol					1	Lowest non-detect
Alkalinity, bicarbonate	264	55	6	3.14	334	Student's t
Ammonia nitrogen						Test of proportions
Chloride	16.7	6.8	6	3.14	25.4	Student's t
COD						Test of proportions
Fluoride	0.27	0.38	6	3.14	0.76	Student's t
Nitrate						Test of proportions
pH Upper Limit	7.65	0.37	7	3.5	8.14	Student's t
pH Lower Limit	7.65	0.37	7	3.5	7.16	Student's t
Sulfate	150.2	72.2	6	3.14	242.8	Student's t
TOC	8	7	6	3.14	17	Student's t
TDS	418	55	6	3.14	488	Student's t
Benzene					0.005	Method Detection Limit
1,1-dichloroethane					0.005	Method Detection Limit
1,1-dichloroethene					0.005	Method Detection Limit
Toluene					0.005	Method Detection Limit
1,1,1-trichloroethane					0.005	Method Detection Limit

All concentrations in mg/L.

Dixon Marquette Cement Comp
MW1-WT
Test of Proportions

	Monitoring Well 1-WT		Monitoring Well 5-S		Zd	Monitoring Well 6-S		Zd	Monitoring Well 7-S		Zd	Monitoring Well 8-S		Zd
	Samples Detected	Sample Size	Samples Detected	Sample Size		Samples Detected	Sample Size		Samples Detected	Sample Size		Samples Detected	Sample Size	
Boron	3	7	6	7	1.67	6	7	1.67	6	7	1.67	7	7	2.37
Mercury	1	7	0	7	1.04	6	7	1.04	0	7	1.04	0	7	1.04
Selenium	2	7	6	7	2.16	6	7	2.16	6	7	2.16	7	7	2.79
Thallium	2	7	0	7	1.53	1	7	0.65	0	7	1.53	3	7	0.56
Ammonia nitrogen	1	7	1	7	0.00	1	7	0.00	1	7	0.00	0	7	1.04
COD	3	7	4	7	0.53	3	7	0.00	2	7	0.56	2	7	0.56
Nitrate	1	7	3	7	1.18	[illegible]	7	1.04	0	7	1.04	7	7	3.24

If Zd > 1.96, then sample set is significantly different than background

Dixon Marquette Cement Comp
Background MW1-D
Statistical Analysis

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Aluminum	0.08	0.109	<0.1	<0.1	<0.04	0.111
Antimony	<0.1	<0.1	<0.001	<0.001	<0.001	<0.001
Arsenic	<0.005	<0.08	<0.08	<0.08	<0.001	<0.001
Barium	0.063	0.044	0.047	0.046	0.047	0.053
Beryllium	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001
Boron	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	<0.005	<0.02	<0.02	<0.02	<0.02	<0.001
Calcium	93	80	86	79	92.3	87.6
Chromium	0.002	0.002	<0.04	<0.02	<0.02	<0.02
Cobalt	0.004	0.003	<0.02	<0.02	<0.02	<0.001
Copper	0.002	0.003	0.004	0.003	0.007	0.001
Lead	<0.005	<0.1	<0.1	<0.01	<0.001	<0.001
Iron	0.872	0.79	0.273	0.568	0.519	1.19
Magnesium	39	44	41	49.7	45.5	44
Manganese	0.071	0.066	0.007	0.058	0.053	0.001
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	0.002	0.003	0.003	0.003	0.002	0.001
Potassium	1.5	1.4	1.57	1.34	1.89	2.9
Selenium	0.001	.0.001	0.004	0.001	0.006	0.004
Sodium	3.1	3.8	3.1	4.2	3.3	3.65
Thallium	<1	<1	<0.001	<0.001	<0.001	0.002
Vanadium	0.002	0.002	0.001	0.002	0.004	0.001
Zinc	0.011	0.013	0.018	0.017	0.02	0.004
Alkalinity, total	348	350	350	282	268	320
Alkalinity, phenol.	<5	<5	<1	<1	<1	<1
Alkalinity, bicarbonate	348	350	350	250	260	310
Ammonia	<0.2	<0.2	<0.1	<0.1	0.11	<0.1
Chloride	2.23	1.91	2.55	2.58	4.86	2.61
COD	<5	<5	<8.3	<20	<20	<20
Fluoride	0.18	0.13	0.14	0.11	0.14	0.13
Nitrate	0.2	0.18	0.19	0.14	0.13	0.2
pH Upper Limit	7.31	7.1	7.3	7.4	7.5	8.1
pH Lower Limit						
Sulfate	37	42	56	35	37	37.7
TOC	3.92	1.5	6	4.13	2.79	4.59
TDS	396	400	400	400	370	333
Benzene	<0.0005	<0.0005	<0.0005	<0.0050	<0.0050	<0.0050
1,1-dichloroethane	<0.0010	<0.0050	<0.0010	<0.0050	<0.0050	<0.0050
1,1-dichloroethene	<0.0020	<0.0020	<0.0020	<0.0050	<0.0050	<0.0050
Toluene	<0.0010	<0.0010	<0.0010	<0.0050	<0.0050	<0.0050
1,1,1-trichloroethane	<0.0010	<0.0010	<0.0010	<0.0050	<0.0050	<0.0050

All concentrations in mg/L.

Dixon Marquette Cement Comp
Background MW1-D
Statistical Analysis

	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12	Sample 13	Sample 14
Aluminum	<0.04	0.048	<0.04					
Antimony	<0.001	<0.001	<0.001					
Arsenic	<0.001	0.001	<0.001	.0.001	<0.001			
Barium	0.047	0.055	0.03	0.046	0.036			
Beryllium	<0.001	<0.001	<0.001	<0.001				
Boron	0.051	<0.05	<0.05	0.009				
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Calcium	84.9	89.4	51.8	82.4	69.1			
Chromium	<0.001	0.001	<0.001	0.002	<0.001			
Cobalt	0.007	<0.001	<0.001	<0.001				
Copper	<0.02	<0.02	<0.02	<0.001				
Lead	<0.001	0.001	0.002	<0.001	<0.001			
Iron	0.132	0.214	0.217	<0.1	<0.1	<0.1		
Magnesium	121	36.2	43.7	38.5				
Manganese	0.219	0.002	0.001	<0.01	<0.01	<0.01	<0.01	<0.01
Mercury	<0.0002	<0.0002	<0.0002	<0.0002				
Nickel	<0.05	<0.05	<0.05	<0.001				
Potassium	1.2	1.9	<2	<2	<2	<2	<0.05	
Selenium	<0.005	<0.15	<0.15	<0.15	<0.004			
Sodium	3.57	3.9	3.8	3	3.6	2.4		
Thallium	<0.001	0.003	<0.001					
Vanadium	<0.05	<0.05	<0.02	<0.001				
Zinc	<0.02	<0.02	<1	<0.001				
Alkalinity, total	314	325	312	328				
Alkalinity, phenol.								
Alkalinity, bicarbonate	296	308	310	315				
Ammonia	<0.1	0.29	<0.1					
Chloride	2.46	<5	<5	<5	<5			
COD	<20	52.6	45.7	<20				
Fluoride	0.17	<0.2	<0.2	<0.21				
Nitrate	0.18	<1	<1	<1	<1			
pH Upper Limit	8.1	7.7	7.2	7.4	7.2	8		
pH Lower Limit								
Sulfate	37	37.6	35.6	40.7	40.2	39.9		
TOC	3.16	0.28	<1	<0.5				
TDS	338	326	322	323	317	316		
Benzene	<0.0050	<0.0050	<0.0050	<0.0050				
1,1-dichloroethane	<0.0050	<0.0050	<0.0050	<0.0050				
1,1-dichloroethene	<0.0050	<0.0050	<0.0050	<0.0050				
Toluene	<0.0050	<0.0050	<0.0050	<0.0050				
1,1,1-trichloroethane	<0.0050	<0.0050	<0.0050	<0.0050				

All concentrations in mg/L.

Dixon Marquette Cement Comp
Background MW1-D
Statistical Analysis

	Mean	Stnd. dev.	Deg of Freedom	99 Percentile	Upper limit	Method
Aluminum						Test of proportions
Antimony					0.001	Lowest non-detect
Arsenic						Test of proportions
Barium	0.043	0.009	10	2.76	0.051	Student's t
Beryllium					0.001	Lowest non-detect
Boron						Test of proportions
Cadmium					0.001	Lowest non-detect
Calcium	81.4	11.9	10	2.76	91.8	Student's t
Chromium						Test of proportions
Cobalt						Test of proportions
Copper	0.003	0.002	5	3.36	0.006	Cohen
Lead						Test of proportions
Iron	0.531	0.361	8	2.9	0.819	Cohen
Magnesium	50.3	25.2	9	2.82	73.9	Student's t
Manganese	0.053	0.069	8	2.9	0.098	Cohen
Mercury					0.0002	Lowest non-detect
Nickel	0.002	0.001	5	3.36	0.003	Cohen
Potassium	1.7	0.5	7	3	2.3	Cohen
Selenium	0.003	0.002	5	3.36	0.005	Cohen
Sodium	3.45	0.49	11	2.72	3.85	Student's t
Thallium						Test of proportions
Vanadium	0.002	0.001	5	3.36	0.003	Cohen
Zinc	0.014	0.006	5	3.36	0.023	Cohen
Alkalinity, total	320	28	9	2.82	346	Student's t
Alkalinity, phenol.					1.000	Lowest non-detect
Alkalinity, bicarbonate	310	35	9	2.82	343	Student's t
Ammonia						Test of proportions
Chloride	2.74	0.97	6	3.14	4.1	Cohen
COD					5.0	Test of proportions
Fluoride	0.14	0.02	6	3.14	0.19	Cohen
Nitrate	0.17	0.03	6	3.14	0.21	Cohen
pH Upper Limit	7.526	0.362	11	3.11	7.86	Student's t
pH Lower Limit	7.53	0.362	11	3.11	7.19	Student's t
Sulfate	39.6	5.6	11	2.72	44.2	Student's t
TOC	3.3	1.8	7	3	5.1	Cohen
TDS	353	36	11	2.72	383	Student's t
Benzene					0.005	Method Detection Limit
1,1-dichloroethane					0.005	Method Detection Limit
1,1-dichloroethene					0.005	Method Detection Limit
Toluene					0.005	Method Detection Limit
1,1,1-trichloroethane					0.005	Method Detection Limit

All concentrations in mg/L.

DOWNGRADIENT TABLES

Dixon Marquette Cement Company

Monitoring Well 3S

Parameter	MW3-S 07-May-98	MW3-S 17-Jun-98	MW3-S 24-Jul-98	MW3-S 26-Oct-98	MW3-S 16-Feb-99	MW3-S 26-Jul-99
Aluminum						0.29
Antimony						*0.001*
Arsenic	0.0176			0.0304		0.131
Barium	0.064		0.049	0.036		0.054
Beryllium						*0.001*
Boron						0.05
Cadmium	*0.005*			*0.01*		*0.001*
Calcium	8.9		4.4	3		4.44
Chromium	*0.04*			*0.04*		0.003
Cobalt						*0.001*
Copper						0.011
Lead	*0.005*					*0.001*
Iron	1.46	*1.0*	1.0	*0.1*		0.484
Magnesium						4.07
Manganese	0.051	*0.1*	0.073	0.031		0.101
Mercury						*0.0002*
Nickel						0.014
Potassium	1400	1600	1600	1900	200	2314
Selenium	*0.005*					0.006
Sodium	82	100	98	120	120	145
Thallium						*0.001*
Vanadium						0.015
Zinc						0.008
Alkalinity, total	980		1400	1500		1590
Alkalinity, phenol.			640	650		
Alkalinity, bicarb	240		120	200		1450
Ammonia nitrogen						*0.10*
Chloride	137	130	160	140	170	181
COD						*20*
Fluoride						3.97
Nitrate as N	*1.0*	*1.0*	*1.0*	*1.0*		*0.10*
pH Upper Limit (stnd units)	10.2	10.4	10.5	10.4	10.4	10.9
pH Lower Limit (stnd units)						
Sulfate	690	1200	1400	980	1100	980
TOC						12.9
Ttl Dis Solids	2960	3700	3900	4200		3776
Benzene	*0.001*		*0.0005*	*0.0005*		*0.005*
1,1-dichloroethane	0.0029	0.003		0.004		*0.005*
1,1-dichloroethene	*0.001*		*0.002*			*0.005*
Toluene	*0.001*		*0.001*	*0.001*		*0.005*
1,1,1-trichloroethane	0.015	0.0126	0.0122	0.0114		*0.005*

All values in mg/L unless noted otherwise

XXX Non detected Concentration

XXX Concentration > Average + 1 Standard Deviation

XXX Concentration > Average + 2 Standard Deviation

Dixon Marquette Cement Company

Monitoring Well 3S

Parameter	MW3-S	MW3-S	MW3-S	MW3-S	MW3-S	99.5% CI*
	09-Sep-99	01-Nov-99	02-Mar-00	23-Jun-00	29-Sep-00	29-Nov-00
Aluminum	0.39	0.837	0.406	0.071	0.233	0.028
Antimony	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	0.001
Arsenic	0.079	0.091	0.065	0.06	0.097	0.175
Barium	0.046	0.051	0.042	0.034	0.042	0.089
Beryllium	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
Boron	0.15	0.062	0.184	*0.05*	0.052	0.204
Cadmium	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	0.001
Calcium	3.71	5.34	2.4	3.53	6.1	1.3
Chromium	*0.001*	0.003	0.001	0.003	0.003	0.018
Cobalt	0.002	0.003	*0.001*	*0.001*	*0.001*	*0.001*
Copper	0.013	0.014	0.009	0.006	0.045	0.022
Lead	0.002	0.002	0.001	*0.001*	*0.001*	0.001
Iron	0.399	0.861	0.18	0.152	0.291	0.409
Magnesium	2.8	3.43	1.1	2.91	3.5	0.6
Manganese	0.173	0.328	0.106	*0.001*	0.056	0.041
Mercury	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	0.0015
Nickel	0.013	0.015	0.008	0.008	0.013	0.038
Potassium	2010	2170	2120	1980	218	2120
Selenium	0.005	0.007	0.004	0.004	0.005	0.016
Sodium	139	134	130	130	138	129
Thallium	*0.001*	*0.001*	*0.001*	*0.001*	0.002	*0.001*
Vanadium	*0.001*	0.011	0.003	0.01	0.016	0.029
Zinc	0.012	0.014	0.012	*0.001*	0.014	0.015
Alkalinity, total	1600	1472	1540	1507	1630	1660
Alkalinity, phenol.			662	1155	710	774
Alkalinity, bicarb	250	800	293	328	807	746
Ammonia nitrogen	1.60	*0.10*	*0.10*	*0.10*	0.61	*0.10*
Chloride	163	151	160	231	202	203
COD	35	*20*	36.4	242	68.6	55.9
Fluoride	4	4.44	3.47	3.11	3.02	3.2
Nitrate as N	*0.10*	0.16	*0.10*	*0.10*	*0.10*	*0.10*
pH Upper Limit (stnd units)	11.2	10.5	10.8	10.8	10.4	10.7
pH Lower Limit (stnd units)						
Sulfate	1054	1009	931	1153	1170	1242
TOC	22.7	17	27.2	17.9	9.26	14.3
Ttl Dis Solids	3462	4350	3980	3150	4400	4390
Benzene	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
1,1-dichloroethane	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
1,1-dichloroethene	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Toluene	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
1,1,1-trichloroethane	0.0068	0.0064	*0.005*	*0.005*	*0.005*	*0.005*

All values in mg/L unless noted otherwise

XXX Non detected Concentration

XXX Concentration > Average + 1 Standard Deviation

XXX Concentration > Average + 2 Standard Deviation

Dixon Marquette Cement Company
Monitoring Well 3S

Parameter	Average	Stnd Dev	Average + 1 Stnd Dev	Average + 2 Stnd Dev	99.5% CI*	Ave + 99.5% CI*
	30-Mar-01	30-Mar-01	30-Mar-01	30-Mar-01	30-Mar-01	30-Mar-01
Aluminum	0.322	0.269	0.591	0.861	0.408	0.730
Antimony	0.001	0.000	0.001	0.001	0.000	0.001
Arsenic	0.083	0.049	0.132	0.180	0.058	0.141
Barium	0.051	0.016	0.067	0.083	0.017	0.068
Beryllium	0.001	0.000	0.001	0.001	0.000	0.001
Boron	0.107	0.069	0.177	0.246	0.105	0.212
Cadmium	0.002	0.003	0.006	0.009	0.004	0.006
Calcium	4.3	2.1	6.4	8.6	2.3	6.6
Chromium	0.012	0.016	0.029	0.045	0.020	0.032
Cobalt	0.001	0.001	0.002	0.003	0.001	0.003
Copper	0.017	0.013	0.030	0.044	0.020	0.037
Lead	0.002	0.001	0.003	0.005	0.002	0.004
Iron	0.576	0.440	1.016	1.456	0.441	1.017
Magnesium	2.6	1.3	3.9	5.2	2.0	4.6
Manganese	0.096	0.090	0.186	0.276	0.090	0.186
Mercury	0.0004	0.0005	0.0009	0.0014	0.0007	0.0011
Nickel	0.016	0.010	0.026	0.036	0.016	0.031
Potassium	1636	718	2354	3072	673	2309
Selenium	0.007	0.004	0.010	0.014	0.005	0.012
Sodium	122.1	19.2	141.3	160.5	18.4	140.5
Thallium	0.001	0.000	0.002	0.002	0.001	0.002
Vanadium	0.012	0.009	0.021	0.031	0.014	0.026
Zinc	0.011	0.005	0.016	0.021	0.007	0.018
Alkalinity, total	1488	195	1683	1878	211	1699
Alkalinity, phenol.	765.2	197.3	962.5	1159.8	355.6	1120.8
Alkalinity, bicarb	523	419	942	1361	454	977
Ammonia nitrogen	0.39	0.57	0.95	1.52	0.86	1.25
Chloride	169.0	30.4	199.4	229.7	28.5	197.5
COD	68.3	78.7	146.9	225.6	119.1	187.4
Fluoride	3.60	0.54	4.14	4.68	0.82	4.42
Nitrate as N	0.43	0.45	0.88	1.33	0.45	0.88
pH Upper Limit (stnd units)	10.6	0.3	10.9	11.2	0.3	10.9
pH Lower Limit (stnd units)						10.3
Sulfate	1076	180	1256	1436	169	1245
TOC	17.32	6.06	23.39	29.45	9.18	26.51
Ttl Dis Solids	3843	495	4337	4832	496	4338
Benzene	NA	NA	NA	NA	NA	NA
1,1-dichloroethane	0.0045	0.001	0.005	0.006	0.0009	0.0054
1,1-dichloroethene	NA	NA	NA	NA	NA	NA
Toluene	NA	NA	NA	NA	NA	NA
1,1,1-trichloroethane	0.0081	0.0038	0.012	0.016	0.0039	0.012

All values in mg/L unless noted otherwise
NA All sampling events below detection limit
* 95% CI computed for all parameter except pH. A two sided 99% CI was computed.

Dixon Marquette Cement Company
Monitoring Well 5S

Parameter	MW5-S	MW5-S	MW5-S	MW5-S	MW5-S	MW5-S	MW5-S
	26-Jul-99	09-Sep-99	01-Nov-99	02-Mar-00	23-Jun-00	29-Sep-00	29-Nov-00
Aluminum	0.17	0.17	0.161	0.286	0.041	0.151	0.195
Antimony	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
Arsenic	0.001	0.001	0.002	0.005	*0.001*	0.001	*0.001*
Barium	0.199	0.069	0.095	0.307	0.078	0.131	0.087
Beryllium	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
Boron	0.52	0.55	0.527	0.700	*0.05*	0.572	0.328
Cadmium	*0.001*	*0.001*	*0.001*	0.002	*0.001*	*0.001*	*0.001*
Calcium	274	291	279	278	204	177	175
Chromium	0.004	0.001	0.003	0.006	0.002	0.004	0.002
Cobalt	*0.001*	*0.001*	*0.001*	0.006	*0.001*	*0.001*	*0.001*
Copper	0.004	0.006	0.007	0.017	*0.001*	0.003	0.004
Lead	0.001	0.001	*0.001*	0.001	*0.001*	*0.001*	0.001
Iron	0.913	0.816	0.718	2.24	0.351	0.604	0.646
Magnesium	89	34.6	101	202	28.9	58.7	62.1
Manganese	0.081	0.064	0.047	1.25	*0.001*	0.044	0.117
Mercury	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*
Nickel	0.005	0.004	0.003	0.021	0.001	0.002	0.002
Potassium	23.5	61.9	59.5	341	23.9	74.5	17.7
Selenium	0.003	0.001	0.004	0.006	*0.001*	0.001	0.001
Sodium	22.8	78.5	55.3	34	47.2	18.6	9
Thallium	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
Vanadium	0.007	*0.001*	0.005	0.023	0.005	0.007	0.003
Zinc	0.011	0.02	0.012	0.047	*0.001*	0.009	0.016
Alkalinity, total	324	372	586	386	432	490	502
Alkalinity, phenol.				*1.0*	*1.0*	*1.0*	*1.0*
Alkalinity, bicarb	314	360	540	377	427	375	479
Ammonia nitrogen	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	0.19	*0.10*
Chloride	21.6	111	95.5	125	36.9	25.2	23.9
COD	*20*	26	*20*	*20*	57.9	25.7	203
Fluoride	0.13	0.06	0.09	0.06	0.13	0.13	0.12
Nitrate as N	1.31	6.24	2.00	*0.10*	*0.10*	*0.10*	0.10
pH Upper Limit (stnd units)	7.6	7.8	7.6	6.9	7.1	7.3	7.7
pH Lower Limit (stnd units)							
Sulfate	220	571	578	650	278	196	203
TOC	21.6	29	17.9	*0.50*	9.86	1.41	1.46
Ttl Dis Solids	668	1090	1016	1213	654	633	646
Benzene	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
1,1-dichloroethane	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
1,1-dichloroethene	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Toluene	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
1,1,1-trichloroethane	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*

All values in mg/L unless noted otherwise

XXX Non detected Concentration

XXX Concentration > Average + 1 Standard Deviation

XXX Concentration > Average + 2 Standard Deviation

Dixon Marquette Cement Company
Monitoring Well 5S

Parameter	Average	Stnd Dev	Average + 1 Stnd Dev	Average + 2 Stnd Dev	99.5% CI*	Ave + 99.5% CI*	Slope of Trend
	30-Mar-01	30-Mar-01	30-Mar-01	30-Mar-01	30-Mar-01	30-Mar-01	26-Jan-01
Aluminum	0.168	0.072	0.240	0.312	0.109	0.277	-0.00005
Antimony	0.001	0.000	0.001	0.001	0.000	0.001	
Arsenic	0.002	0.001	0.003	0.005	0.002	0.004	-0.0000008
Barium	0.138	0.087	0.225	0.311	0.131	0.269	-0.00008
Beryllium	0.001	0.000	0.001	0.001	0.000	0.001	
Boron	0.464	0.213	0.677	0.889	0.322	0.786	-0.0004
Cadmium	0.001	0.000	0.002	0.002	0.001	0.002	-5E-08
Calcium	240	52	292	344	79	318	-0.25505
Chromium	0.003	0.002	0.005	0.006	0.003	0.006	-0.0000002
Cobalt	0.002	0.002	0.004	0.005	0.003	0.005	-0.0000003
Copper	0.006	0.005	0.011	0.016	0.008	0.014	-0.000006
Lead	0.001	0.000	0.001	0.001	0.000	0.001	
Iron	0.898	0.618	1.516	2.134	0.936	1.834	-0.0007
Magnesium	82.3	58.9	141.2	200.1	89.2	171.5	-0.0531
Manganese	0.229	0.452	0.681	1.132	0.684	0.913	-0.00005
Mercury	0.0002	0.0000	0.0002	0.0002	0.0000	0.0002	
Nickel	0.005	0.007	0.012	0.019	0.011	0.016	-0.000007
Potassium	86.0	114.7	200.7	315.3	173.6	259.6	-0.0304
Selenium	0.002	0.002	0.004	0.006	0.003	0.005	-0.000004
Sodium	37.9	24.1	62.0	86.1	36.5	74.4	-0.0749
Thallium	0.001	0.000	0.001	0.001	0.000	0.001	
Vanadium	0.007	0.007	0.015	0.022	0.011	0.018	-0.0000002
Zinc	0.017	0.015	0.031	0.046	0.022	0.039	-0.00001
Alkalinity, total	442	90	532	622	136	578	*0.205*
Alkalinity, phenol.	1.0	0	1.0	1.0	0	1	
Alkalinity, bicarb	410	77	488	565	117	528	*0.1217*
Ammonia nitrogen	0.11	0.03	0.15	0.18	0.05	0.16	*0.00008*
Chloride	62.7	45.7	108.5	154.2	69.3	132.0	-0.1106
COD	53.2	67.4	120.6	188.0	102.1	155.3	*0.23*
Fluoride	0.10	0.03	0.14	0.17	0.05	0.15	*0.001*
Nitrate as N	1.42	2.26	3.68	5.93	3.42	4.84	-0.0075
pH Upper Limit (stnd units)	7.4	0.3	7.8	8.1	0.4	7.9	-0.0005
pH Lower Limit (stnd units)						7.0	
Sulfate	385	204	589	793	309	694	-0.5407
TOC	11.68	11.37	23.04	34.41	17.2	28.89	-0.0496
Ttl Dis Solids	846	251	1096	1347	380	1225	-0.6478
Benzene	NA	NA	NA	NA	NA	NA	
1,1-dichloroethane	NA	NA	NA	NA	NA	NA	
1,1-dichloroethene	NA	NA	NA	NA	NA	NA	
Toluene	NA	NA	NA	NA	NA	NA	
1,1,1-trichloroethane	NA	NA	NA	NA	NA	NA	

All values in mg/L unless noted otherwise

NA All sampling events below detection limit

* 95% CI computed for all parameter except pH. A two sided 99% CI was computed.

Dixon Marquette Cement Company

Monitoring Well 6S

Parameter	MW6-S	MW6-S	MW6-S	MW6-S	MW6-S	MW6-S	MW6-S
	26-Jul-99	09-Sep-99	01-Nov-99	02-Mar-00	23-Jun-00	29-Sep-00	29-Nov-00
Aluminum	**3.01**	0.08	0.116	0.166	*0.04*	0.127	1.74
Antimony	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
Arsenic	**0.004**	*0.001*	0.001	0.003	*0.001*	0.001	0.003
Barium	**0.350**	0.331	0.271	0.276	0.143	0.251	0.181
Beryllium	*0.001*	*0.001*	*0.001*	0.001	*0.001*	*0.001*	*0.001*
Boron	0.510	0.630	**0.688**	0.431	*0.05*	0.292	0.364
Cadmium	*0.001*	*0.001*	*0.001*	0.001	*0.001*	*0.001*	*0.001*
Calcium	345	24.6	232	**398**	149	233	256
Chromium	**0.007**	*0.001*	**0.002**	**0.005**	0.002	**0.003**	**0.003**
Cobalt	0.02	0.008	0.009	**0.030**	*0.001*	0.007	0.011
Copper	0.024	0.006	0.004	0.022	0.001	0.012	0.02
Lead	**0.015**	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	0.008
Iron	**5.34**	0.693	1.06	**5.55**	0.284	0.77	4.96
Magnesium	**78**	31.4	51.9	**99.2**	20.3	**47.7**	57.6
Manganese	**3.11**	0.694	2.44	2.13	0.094	1.61	1.79
Mercury	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*
Nickel	**0.033**	0.017	**0.017**	0.038	0.003	0.009	0.023
Potassium	64.6	**70.2**	68.6	59.8	3[illegible].2	49.5	39.7
Selenium	0.003	0.001	0.002	**0.005**	*0.001*	**0.003**	**0.004**
Sodium	35.1	55	27.3	33.4	53.6	**64.9**	55.6
Thallium	*0.001*	*0.001*	*0.001*	0.001	*0.001*	*0.001*	*0.001*
Vanadium	0.023	*0.001*	0.003	0.002	0.005	0.006	0.013
Zinc	**0.041**	0.010	0.011	0.003	*0.001*	0.013	0.023
Alkalinity, total	369	354	390	388	**417**	384	420
Alkalinity, phenol.				*1.0*	*0.001*	*1.0*	*1.0*
Alkalinity, bicarb	360	325	350	379	**410**	350	387
Ammonia nitrogen	0.10	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*
Chloride	187	142	105	133	71.1	**246**	186
COD	*20*	*20*	*20*	*20*	100	**123**	94.1
Fluoride	0.29	0.17	0.22	0.19	**0.41**	0.27	0.3
Nitrate as N	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*
pH Upper Limit (stnd units)	7.4	7.9	7.8	7.8	7.1	7.1	7.8
pH Lower Limit (stnd units)							
Sulfate	214	**332**	314	242	106	186	254
TOC	21.1	13.2	5.59	13.7	13.2	2.01	2.53
Ttl Dis Solids	[illegible]67	865	820	789	566	842	830
Benzene	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
1,1-dichloroethane	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
1,1-dichloroethene	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Toluene	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
1,1,1-trichloroethane	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*

All values in mg/L unless noted otherwise

XXX Non detected Concentration

XXX Concentration > Average + 1 Standard Deviation

XXX Concentration > Average + 2 Standard Deviation

Dixon Marquette Cement Company
Monitoring Well 6S

Parameter	Average	Stnd Dev	Average + 1 Stnd Dev	Average + 2 Stnd Dev	99.5% CI*	Ave + 99.5% CI*	Slope of Trend
	30-Mar-01	30-Mar-01	30-Mar-01	30-Mar-01	30-Mar-01	30-Mar-01	26-Jan-01
Aluminum	0.75	1.17	1.921	3.088	1.768	2.522	-0.0011
Antimony	0.001	0.000	0.001	0.001	0.000	0.001	
Arsenic	0.002	0.001	0.003	0.005	0.002	0.004	-0.0000009
Barium	0.258	0.075	0.332	0.407	0.113	0.371	-0.0003
Beryllium	0.001	0.000	0.001	0.001	0.000	0.001	
Boron	0.424	0.216	0.640	0.856	0.327	0.751	-0.0008
Cadmium	0.001	0.000	0.001	0.001	0.000	0.001	
Calcium	233.9	123.0	357	480	186	420	*0.0385*
Chromium	0.003	0.002	0.005	0.007	0.003	0.006	-0.000002
Cobalt	0.012	0.010	0.022	0.032	0.015	0.027	-0.00001
Copper	0.013	0.009	0.022	0.031	0.014	0.027	*0.000001*
Lead	0.004	0.006	0.010	0.015	0.008	0.012	-6.00E-06
Iron	2.665	2.465	5.131	7.596	3.734	6.399	-0.0004
Magnesium	55.16	26.81	82.0	108.8	40.6	95.8	-0.0237
Manganese	1.695	1.027	2.722	3.749	1.555	3.251	-0.0018
Mercury	0.0002	0.0000	0.0002	0.0002	0.0000	0.0002	
Nickel	0.020	0.012	0.032	0.045	0.019	0.039	-0.00002
Potassium	55	15	69.9	84.9	22.8	77.6	-0.0643
Selenium	0.003	0.001	0.004	0.006	0.002	0.005	0.000002
Sodium	46.4	14.2	60.6	74.9	21.5	68.0	0.0046[illegible]
Thallium	0.001	0.000	0.001	0.001	0.000	0.001	
Vanadium	0.008	0.008	0.015	0.023	0.012	0.019	-0.000004
Zinc	0.015	0.014	0.028	0.042	0.021	0.035	
Alkalinity, total	389	24	413	436	36	425	*0.0394*
Alkalinity, phenol.	0.8	0.5	1.2	1.7	1.7	2.4	
Alkalinity, bicarb	366	28	394	422	43	409	*0.0792*
Ammonia nitrogen	0.10	0.00	0.10	0.10	0.00	0.10	
Chloride	152.9	58.3	211	270	88	241	*0.0876*
COD	56.7	46.6	103	150	71	127	*0.241*
Fluoride	0.26	0.08	0.35	0.43	0.12	0.39	*0.0002*
Nitrate as N	0.10	0.00	0.10	0.10	0.00	0.10	
pH Upper Limit (stnd units)	7.6	0.4	7.9	8.3	0.5	8.1	-0.0006
pH Lower Limit (stnd units)						7.0	
Sulfate	235	77	312	389	117	352	-0.1863
TOC	10.2	7.0	17.22	24.24	10.64	20.83	-0.026
Ttl Dis Solids	797	105	902	1008	160	957	-0.1683
Benzene	NA	NA	NA	NA	NA	NA	
1,1-dichloroethane	NA	NA	NA	NA	NA	NA	
1,1-dichloroethene	NA	NA	NA	NA	NA	NA	
Toluene	NA	NA	NA	NA	NA	NA	
1,1,1-trichloroethane	NA	NA	NA	NA	NA	NA	

All values in mg/L unless noted otherwise

NA All sampling events below detection limit

* 95% CI computed for all parameter except pH. A two sided 99% CI was computed.

Dixon Marquette Cement Company

Monitoring Well 7S

Parameter	**MW7-S**	**MW7-S**	**MW7-S**	**MW7-S**	**MW7-S**	**MW7-S**	**MW7-S**
	26-Jul-99	**09-Sep-99**	**01-Nov-99**	**02-Mar-00**	**23-Jun-00**	**29-Sep-00**	**29-Nov-00**
Aluminum	**0.88**	0.30	0.443	0.662	*0.04*	0.292	0.09
Antimony	*0.001*	*0.001*	*0.001*	**0.003**	*0.001*	*0.001*	*0.001*
Arsenic	0.028	0.025	**0.044**	0.017	0.007	0.013	0.026
Barium	0.045	0.047	0.046	**0.055**	0.033	0.044	0.025
Beryllium	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
Boron	0.25	0.19	0.216	1.95	*0.05*	0.204	0.195
Cadmium	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
Calcium	23.9	14.7	11.9	**43.4**	40.8	29	14.2
Chromium	0.004	0.002	0.002	**0.005**	0.002	0.001	0.002
Cobalt	0.001	*0.001*	*0.001*	0.001	*0.001*	*0.001*	*0.001*
Copper	0.005	0.007	0.008	0.006	*0.001*	0.006	0.004
Lead	**0.003**	**0.002**	**0.002**	*0.001*	***0.001***	0.001	*0.001*
Iron	**1.98**	0.789	0.629	1.32	0.109	0.663	0.142
Magnesium	10.8	5.8	4.55	13.6	**15.1**	10.6	4.6
Manganese	0.154	0.133	**0.085**	**0.157**	0.002	0.103	0.024
Mercury	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*
Nickel	0.012	0.014	0.014	0.007	0.002	0.011	0.009
Potassium	656	717	**793**	503	406	626	727
Selenium	0.001	0.002	0.002	**0.005**	*0.001*	0.003	0.002
Sodium	37.6	42.9	**49.9**	37.4	25.8	44.2	48.8
Thallium	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
Vanadium	0.016	0.012	**0.022**	0.015	0.007	0.013	0.006
Zinc	0.027	0.015	0.016	**0.027**	*0.001*	**0.023**	*0.001*
Alkalinity, total	396	466	**534**	348	**341**	384	486
Alkalinity, phenol.				41	*1.0*	92	160
Alkalinity, bicarb	285	265	**475**	154	333	254	297
Ammonia nitrogen	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	0.94	*0.10*
Chloride	70.1	90.2	97.7	56.3	48.8	105	**110**
COD	*20*	*20*	*20*	*20*	10.5	**34.3**	*20*
Fluoride	1.64	1.95	**2.43**	0.8	0.65	1.3	1.84
Nitrate as N	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*
pH Upper Limit (stnd units)	10	10.2	9.8	9.4	8.9	9.4	10.2
pH Lower Limit (stnd units)							
Sulfate	401	475	494	345	336	448	474
TOC	17.2	**10.7**	**15.2**	14.4	**18**	**7**	11.3
Ttl Dis Solids	1047	1294	**1423**	901	802	1156	1308
Benzene	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
1,1-dichloroethane	***0.005***	*0.005*	0.0389	0.013	**0.0252**	**0.0639**	**0.0581**
1,1-dichloroethene	*0.005*	**0.0061**	*0.005*	*0.005*	*0.005*	0.0061	**0.0082**
Toluene	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
1,1,1-trichloroethane	0.006	*0.005*	*0.005*	*0.005*	**0.0057**	*0.005*	*0.005*

All values in mg/L unless noted otherwise

XXX Non detected Concentration

XXX Concentration > Average + 1 Standard Deviation

XXX Concentration > Average + 2 Standard Deviation

Dixon Marquette Cement Company

Monitoring Well 7S

Parameter	Average	Stnd Dev	Average + 1 Stnd Dev	Average + 2 Stnd Dev	99.5% CI*	Ave + 99.5% CI*	Slope of Trend
	30-Mar-01	30-Mar-01	30-Mar-01	30-Mar-01	30-Mar-01	30-Mar-01	26-Jan-01
Aluminum	0.387	0.302	0.689	0.991	0.457	0.844	-0.0011
Antimony	0.001	0.001	0.002	0.003	0.001	0.002	-0.0000001
Arsenic	0.023	0.012	0.035	0.047	0.018	0.041	-0.00003
Barium	0.042	0.010	0.052	0.062	0.015	0.057	-0.00003
Beryllium	0.001	0.000	0.001	0.001	0.000	0.001	
Boron	0.436	0.670	1.107	1.777	1.015	1.452	-0.0002
Cadmium	0.001	0.000	0.001	0.001	0.000	0.001	
Calcium	25	13	38	51	20	45	*0.0147*
Chromium	0.003	0.001	0.004	0.005	0.002	0.005	-0.000003
Cobalt	0.001	0.000	0.001	0.001	0.000	0.001	
Copper	0.005	0.002	0.008	0.010	0.003	0.009	-0.000006
Lead	0.002	0.001	0.002	0.003	0.001	0.003	-0.000003
Iron	0.805	0.661	1.466	2.126	1.001	1.806	-0.0023
Magnesium	9.3	4.3	13.6	18.0	6.6	15.9	*0.0023*
Manganese	0.094	0.061	0.155	0.217	0.093	0.187	-0.002
Mercury	0.0002	0.0000	0.0002	0.0002	0.0000	0.0002	
Nickel	0.010	0.004	0.014	0.018	0.007	0.016	-0.00001
Potassium	632.6	135.7	768.3	904.0	205.5	838.1	-0.1819
Selenium	0.002	0.001	0.004	0.005	0.002	0.004	*0.000001*
Sodium	40.9	8.3	49.2	57.5	12.5	53.5	*0.0018*
Thallium	0.001	0.000	0.001	0.001	0.000	0.001	
Vanadium	0.013	0.005	0.018	0.024	0.008	0.021	-0.00002
Zinc	0.016	0.011	0.027	0.038	0.017	0.033	-0.00003
Alkalinity, total	422.14	73.86	496.00	569.87	111.87	534.01	*0.0687*
Alkalinity, phenol.	7[illegible].5	69	142.1	210.8	231	305	*0.453*
Alkalinity, bicarb	294.71	96.96	391.68	488.64	146.86	441.57	-0.081
Ammonia nitrogen	0.2	0.3	0.5	0.9	0.5	0.7	*0.0007*
Chloride	82.59	24.25	106.84	131.09	36.73	119.32	*0.0354*
COD	20.69	6.97	27.66	34.62	10.56	31.24	*0.0084*
Fluoride	1.52	0.64	2.16	2.79	0.97	2.48	-0.0012
Nitrate as N	0.10	0.00	0.10	0.10	0.0	0.10	
pH Upper Limit (stnd units)	9.7	0.5	10.2	10.7	0.7	10.4	-0.0008
pH Lower Limit (stnd units)						9.0	
Sulfate	425	65	489	554	98	523	-0.0167
TOC	13.4	3.9	17.3	21.3	5.9	19.3	-0.0088
Ttl Dis Solids	1133	228	1361	1589	345	1478	-0.1319
Benzene	NA	NA	NA	NA	NA	NA	
1,1-dichloroethane	0.0299	0.0244	0.054	0.0787	0.037	0.0669	*0.1027*
1,1-dichloroethene	0.0058	0.0012	0.007	0.0082	0.002	0.0076	*0.0038*
Toluene	NA	NA	NA	NA	NA	NA	
1,1,1-trichloroethane	0.0052	0.0004	0.006	0.0061	0.001	0.0059	-0.0007

All values in mg/L unless noted otherwise

NA All sampling events below detection limit

* 95% CI computed for all parameter except pH. A two sided 99% CI was computed.

Dixon Marquette Cement Company

Monitoring Well 8S

Parameter	MW8-S	MW8-S	MW8-S	MW8-S	MW8-S	MW8-S	MW8-S
•	26-Jul-99	09-Sep-99	01-Nov-99	02-Mar-00	23-Jun-00	29-Sep-00	29-Nov-00
Aluminum	0.51	0.29	**0.665**	0.435	*0.04*	0.109	0.233
Antimony	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
Arsenic	0.001	*0.001*	0.001	0.005	*0.001*	0.001	*0.001*
Barium	0.073	0.066	0.056	0.172	0.044	0.055	0.057
Beryllium	*0.001*	*0.001*	*0.001*	0.002	*0.001*	*0.001*	*0.001*
Boron	0.25	0.25	0.225	0.253	0.05	0.199	0.232
Cadmium	*0.001*	*0.001*	*0.001*	**0.003**	*0.001*	*0.001*	*0.001*
Calcium	265	226	223	268	224	234	222
Chromium	0.004	0.003	0.006	0.04	0.007	0.005	0.006
Cobalt	0.002	0.002	0.002	0.035	*0.001*	*0.001*	*0.001*
Copper	0.015	0.014	0.011	0.113	*0.001*	0.007	0.007
Lead	0.003	0.004	0.003	0.004	*0.001*	*0.001*	0.002
Iron	1.6	1.19	1.57	5.3	0.415	0.549	0.953
Magnesium	110	94.4	94.3	125	92.4	93.3	91.1
Manganese	0.363	0.233	0.255	4.3	*0.001*	0.024	0.167
Mercury	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*
Nickel	0.010	0.010	0.008	0.058	0.002	0.003	0.005
Potassium	265	263	265	217	174	254	280
Selenium	0.003	0.003	0.003	0.014	**0.001**	0.002	0.006
Sodium	8.2	39.6	40.1	43.1	43.4	52.4	51.4
Thallium	*0.001*	*0.001*	*0.001*	0.002	*0.001*	**0.005**	0.001
Vanadium	0.003	*0.001*	0.003	*0.001*	0.004	0.003	0.003
Zinc	0.044	0.027	0.042	0.363	*0.001*	0.025	0.021
Alkalinity, total	271	270	314	284	316	274	278
Alkalinity, phenol.				*1.0*	*1.0*	*1.0*	*1.0*
Alkalinity, bicarb	265	265	300	271	314	262	257
Ammonia nitrogen	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*
Chloride	119	121	113	162	181	179	**198**
COD	*20*	*20*	*20*	30.3	158	*20*	*20*
Fluoride	**0.26**	0.16	0.19	0.14	0.26	0.22	0.21
Nitrate as N	2.73	2.47	2.68	1.68	2.95	**3.01**	1.86
pH Upper Limit (stnd units)	7.8	8.3	7.8	7.1	7.2	7.3	7.9
pH Lower Limit (stnd units)							
Sulfate	818	818	753	852	686	847	865
TOC	9.8	5.86	9.8	**14.4**	15.1	2.05	2.5
Ttl Dis Solids	1135	1190	1191	1161	1125	1200	**1252**
Benzene	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
1,1-dichloroethane	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
1,1-dichloroethene	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Toluene	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
1,1,1-trichloroethane	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*

All values in mg/L unless noted otherwise

XXX Non detected Concentration

XXX Concentration > Average + 1 Standard Deviation

XXX Concentration > Average + 2 Standard Deviation

Dixon Marquette Cement Company

Monitoring Well 8S

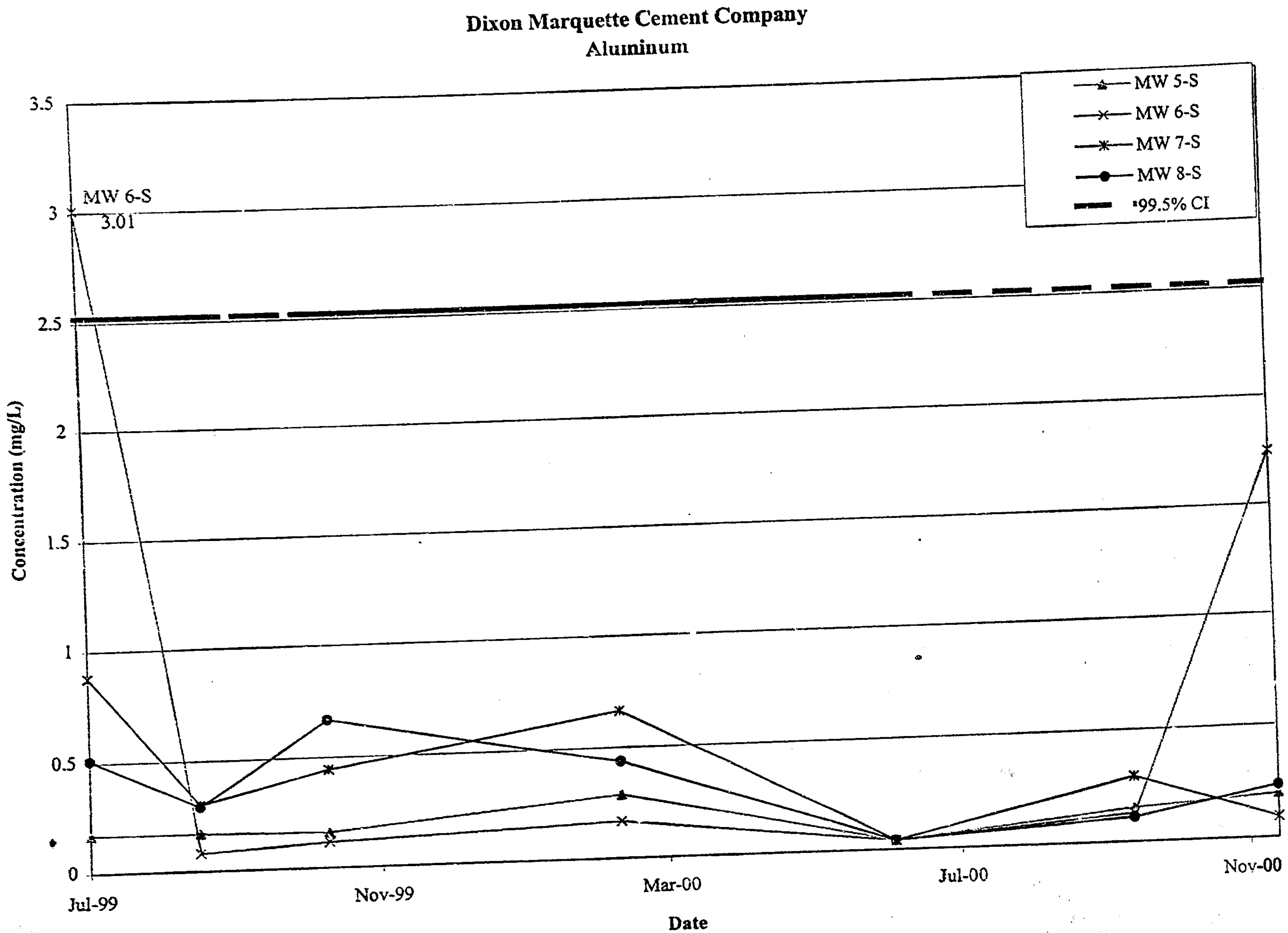
Parameter	Average	Stnd Dev	Average + 1 Stnd Dev	Average + 2 Stnd Dev	99.5% CI*	Ave + 99.5% CI*	Slope of Trend
	30-Mar-01	30-Mar-01	30-Mar-01	30-Mar-01	30-Mar-01	30-Mar-01	26-Jan-01
Aluminum	0.326	0.223	0.549	0.773	0.338	0.664	-0.0008
Antimony	0.001	0.000	0.001	0.001	0.000	0.001	
Arsenic	0.002	0.002	0.003	0.005	0.002	0.004	-0.0000002
Barium	0.075	0.044	0.119	0.162	0.066	0.141	-0.00004
Beryllium	0.001	0.000	0.002	0.002	0.001	0.002	-5E-08
Boron	0.208	0.072	0.281	0.353	0.110	0.318	-0.0001
Cadmium	0.001	0.001	0.002	0.003	0.001	0.002	-0.0000001
Calcium	237	20	258	278	31	268	-0.039
Chromium	0.010	0.013	0.023	0.037	0.020	0.030	*0.000002*
Cobalt	0.006	0.013	0.019	0.032	0.019	0.025	-0.000004
Copper	0.024	0.040	0.064	0.103	0.060	0.084	-0.00002
Lead	0.003	0.001	0.004	0.005	0.002	0.004	-0.000005
Iron	1.654	1.672	3.325	4.997	2.532	4.186	-0.0021
Magnesium	100.1	12.7	112.8	125.5	19.3	119.3	*0.0233*
Manganese	0.763	1.565	2.328	3.893	2.370	3.133	*0.0007*
Mercury	0.0002	0.0000	0.0002	0.0002	0.0000	0.0002	
Nickel	0.014	0.020	0.034	0.053	0.030	0.044	-0.00002
Potassium	245	37	283	320	56	302	-0.0296
Selenium	0.005	0.004	0.009	0.013	0.007	0.011	*0.000001*
Sodium	39.7	14.8	54.6	69.4	22.4	62.2	*0.0587*
Thallium	0.002	0.001	0.003	0.005	0.002	0.004	*0.000004*
Vanadium	0.003	0.001	0.004	0.005	0.002	0.004	*0.000002*
Zinc	0.075	0.128	0.203	0.331	0.194	0.268	-0.00006
Alkalinity, total	287	20	307	326	30	317	*0.0058*
Alkalinity, phenol.	1.0	0	1.0	1.0	0.0	1.0	
Alkalinity, bicarb	276	22	298	320	33	309	-0.0109
Ammonia nitrogen	0.10	0.00	0.10	0.10	0.00	0.10	
Chloride	153	35	188	223	53	206	*0.1731*
COD	41	52	93	144	78	119	*0.0621*
Fluoride	0.21	0.05	0.25	0.30	0.07	0.28	*0.00004*
Nitrate as N	2.48	0.52	3.00	3.52	0.8	3.27	*0.004*
pH Upper Limit (stnd units)	7.6	0.4	8.1	8.5	0.7	8.3	-0.001
pH Lower Limit (stnd units)						7.0	
Sulfate	803	62	865	927	94	897	*0.0585*
TOC	8.5	5.3	13.8	19.0	8.0	16.5	-0.0099
Ttl Dis Solids	1179	43	1222	1266	65	1245	*0.1091*
Benzene	NA	NA	NA	NA	NA	NA	
1,1-dichloroethane	NA	NA	NA	NA	NA	NA	
1,1-dichloroethene	NA	NA	NA	NA	NA	NA	
Toluene	NA	NA	NA	NA	NA	NA	
1,1,1-trichloroethane	NA	NA	NA	NA	NA	NA	

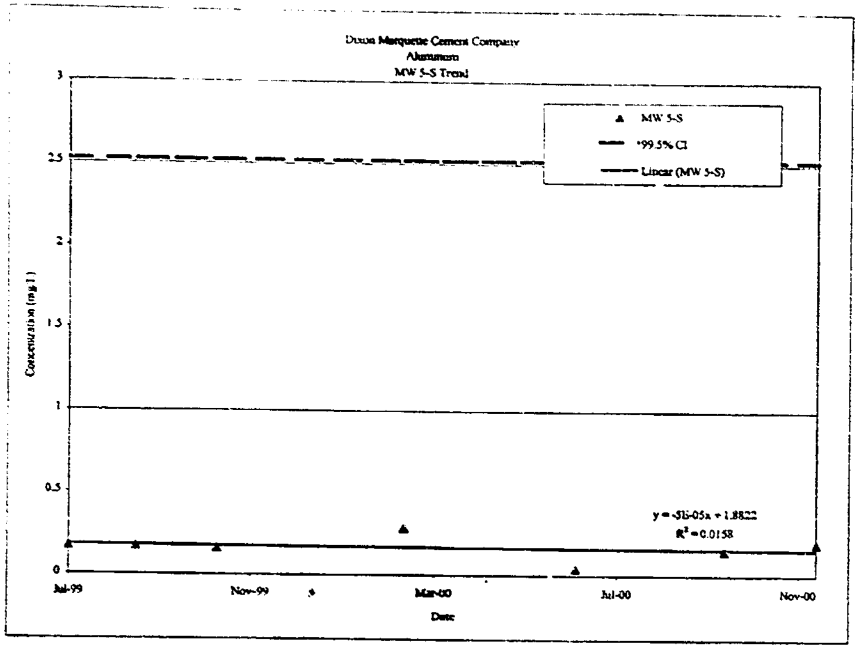
All values in mg/L unless noted otherwise

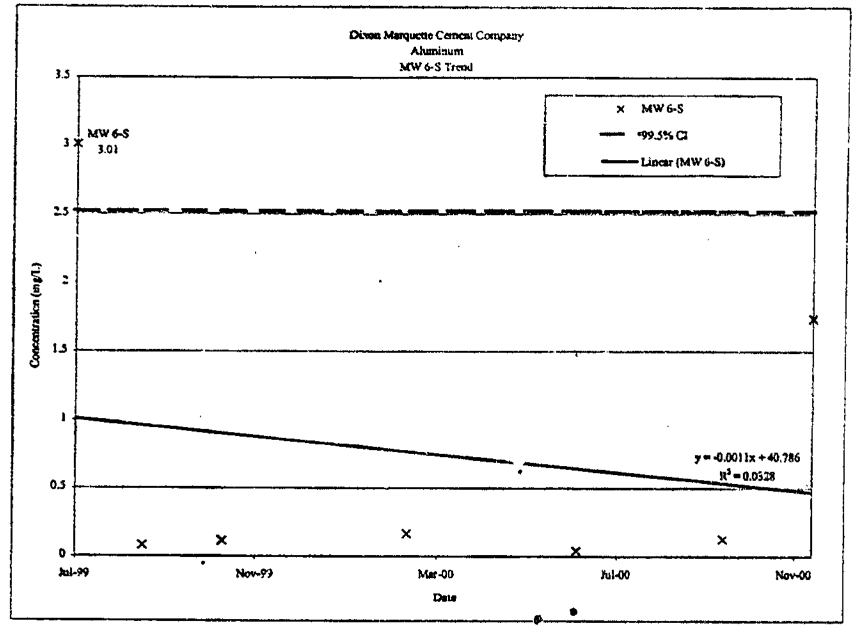
NA All sampling events below detection limit

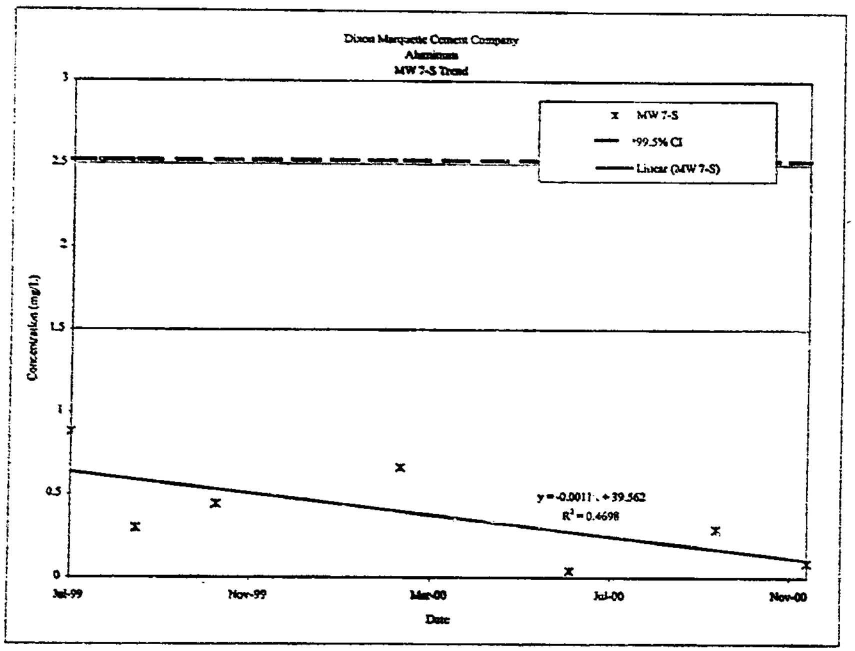
* 95% CI computed for all parameter except pH. A two sided 99% CI was computed.

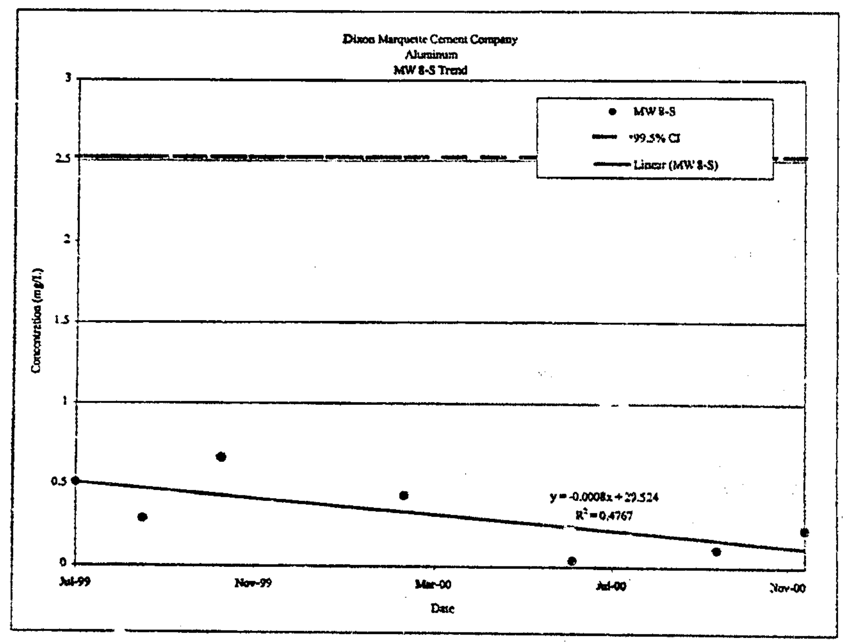
GRAPHS


Dixon Marquette Cement Company
Aluminum
MW 5-S
MW 6-S
MW 7-S
MW 8-S
99.5% CI
MW 6-S
3.01
3.5
3
2.5
2
1.5
1
0.5
0
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
Aluminum
MW 5-S Trend
MW 5-S
*99.5% CI
Linear (MW 5-S)
y = -5E-05x + 1.8822
R^2 = 0.0158
Concentration (mg/l)
3
2.5
2
1.5
1
0.5
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

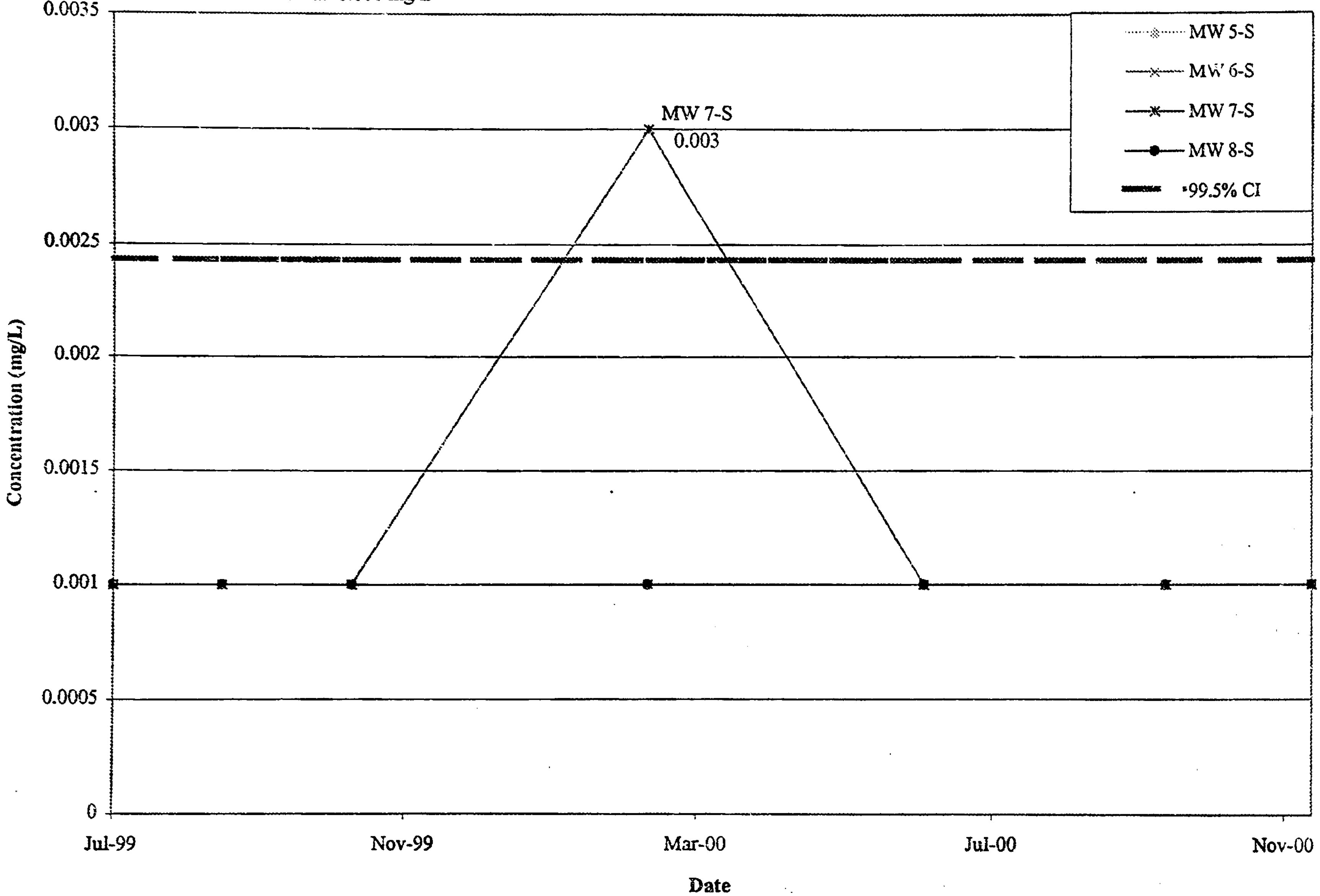

Dixon Marquette Cement Company
Aluminum
MW 6-S Trend
MW 6-S
*99.5% CI
Linear (MW 6-S)
MW 6-S
3.01
y = -0.0011x + 40.786
R^2 = 0.0528
Concentration (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

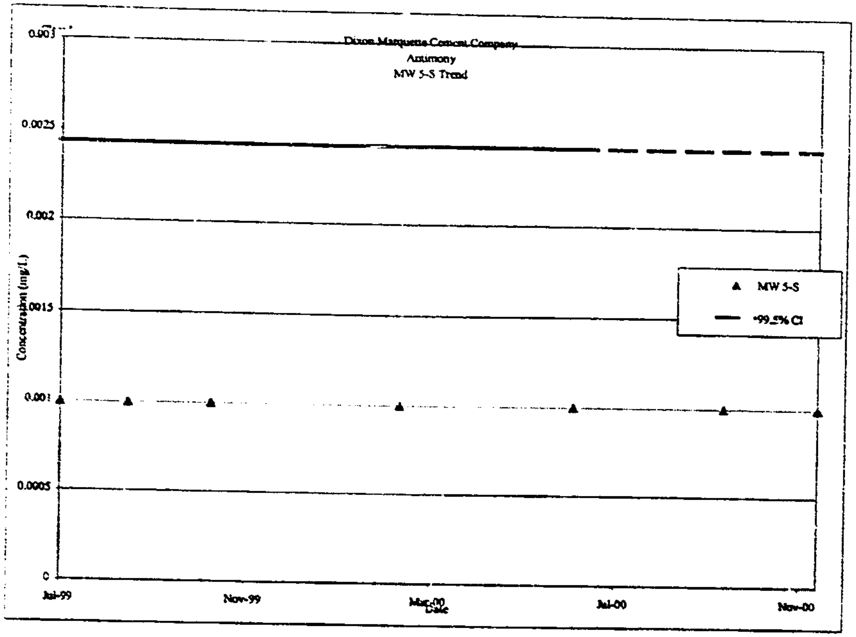

Dixon Marquette Cement Company
Aluminum
MW 7-S Trend
MW 7-S
*99.5% CI
Linear (MW 7-S)
y = -0.0011x + 39.562
R^2 = 0.4698
Concentration (mg/L)
3
2.5
2
1.5
1
0.5
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

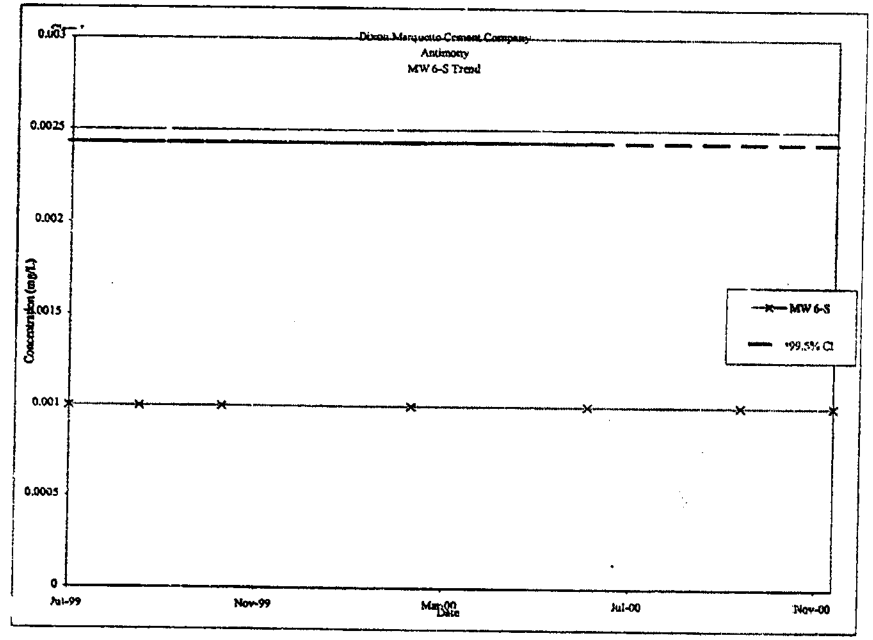

Dixon Marquette Cement Company
Aluminum
MW 8-S Trend
MW 8-S
*99.5% CI
Linear (MW 8-S)
y = -0.0008x + 29.524
R^2 = 0.4767
Concentration (mg/L)
3
2.5
2
1.5
1
0.5
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

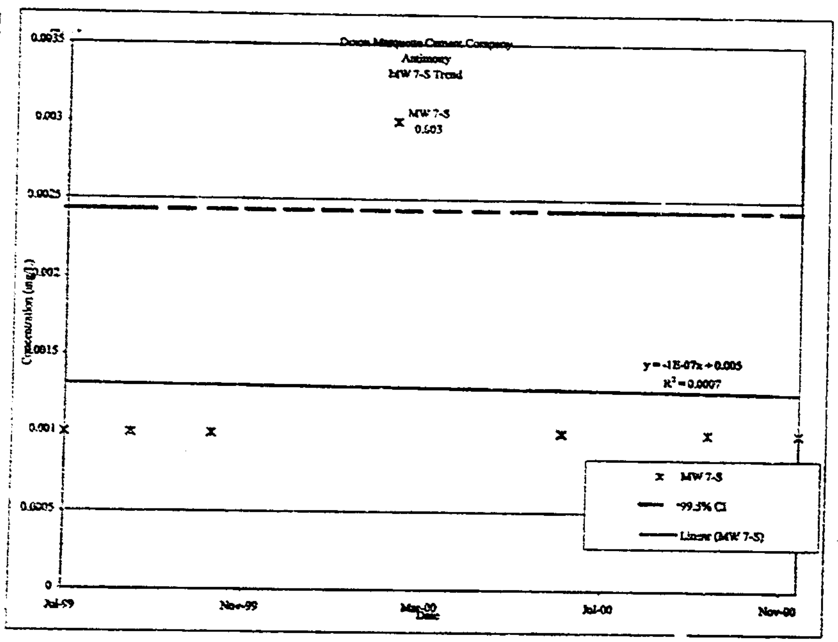
Dixon Marquette Cement Company
Antimony

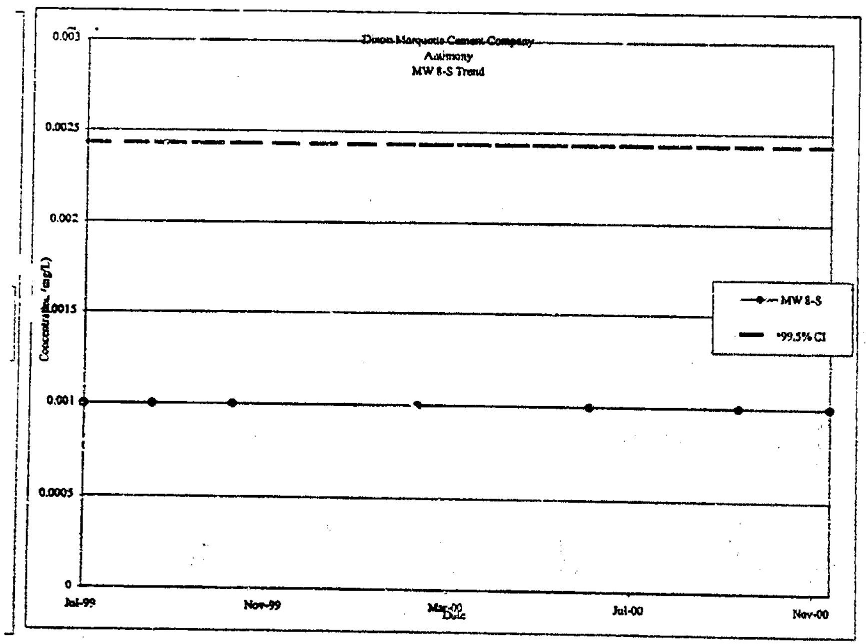
Class I H2O Standard: 0.006 mg/L

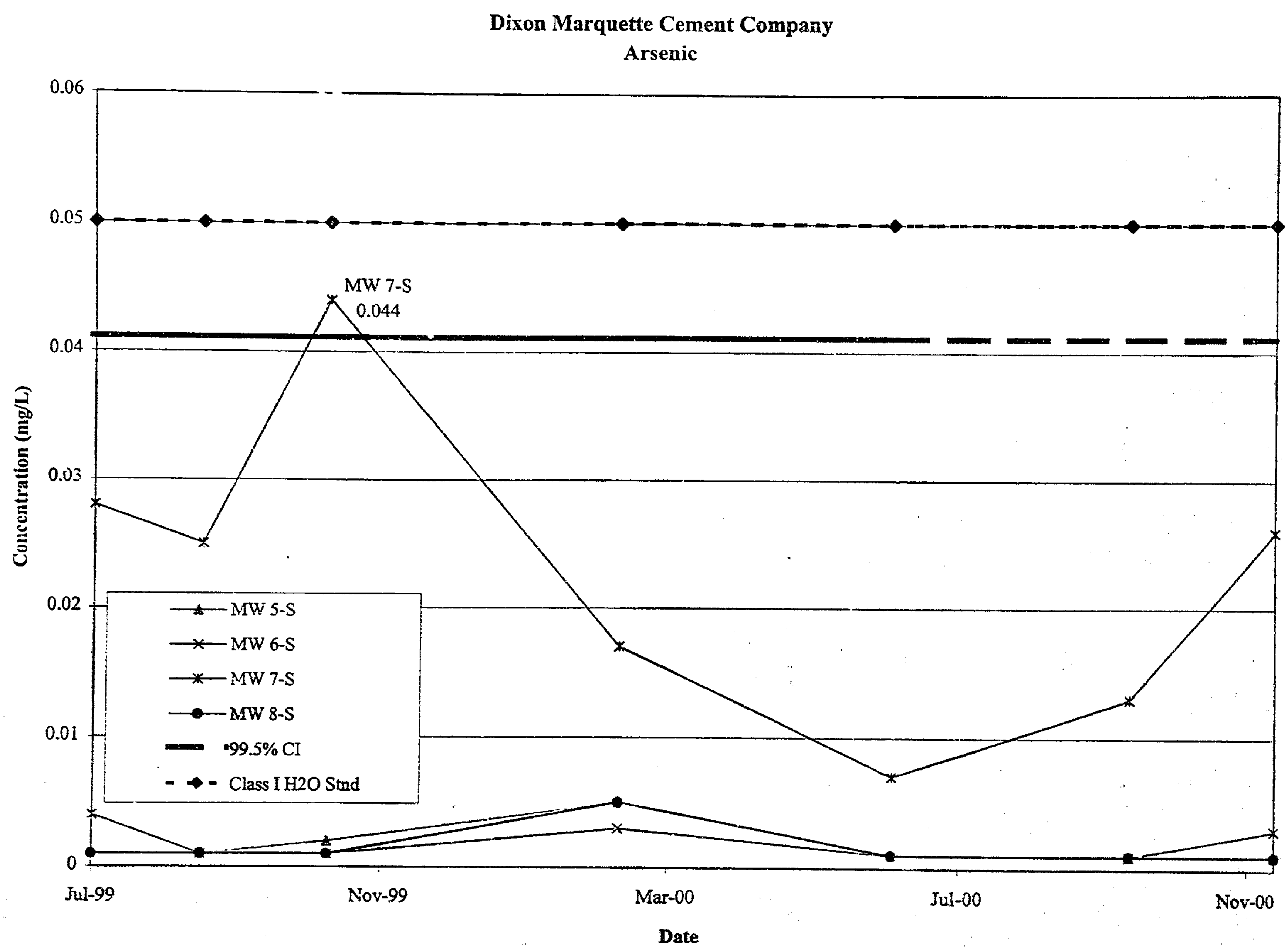


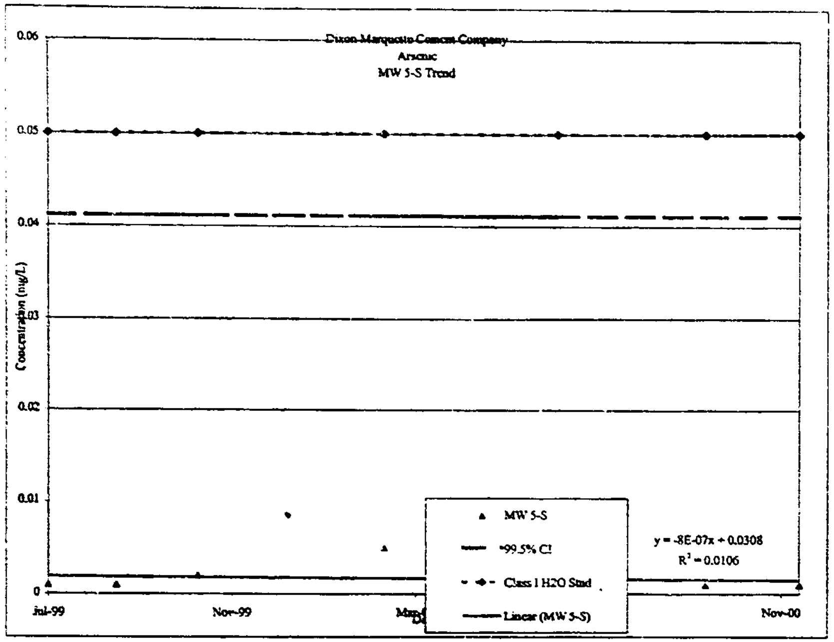

Dixon Marquette Cement Company
Antimony
MW 5-S Trend
Concentration (mg/L)
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 5-S
*99.5% CI

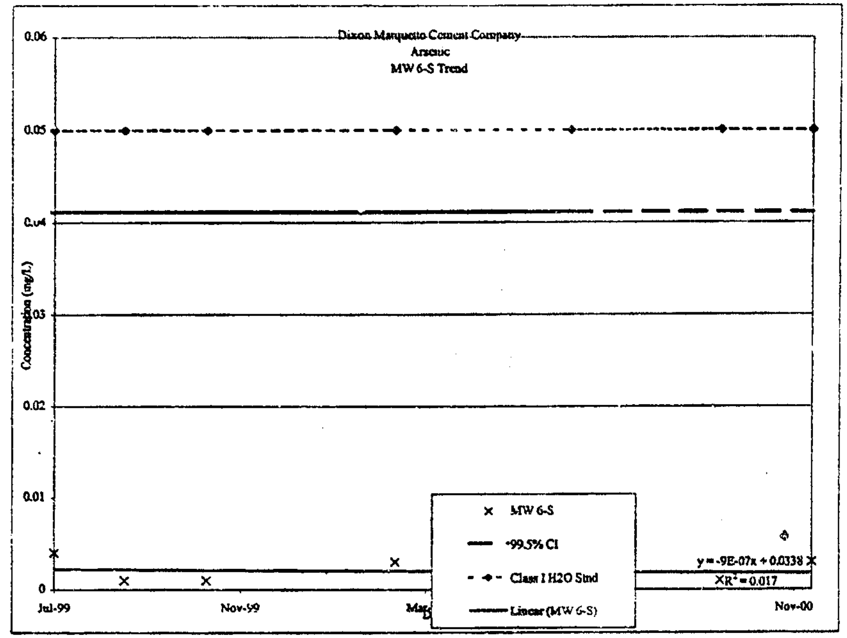

Dixon Marquette Cement Company
Antimony
MW 6-S Trend
Concentration (mg/L)
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 6-S
*99.5% CI

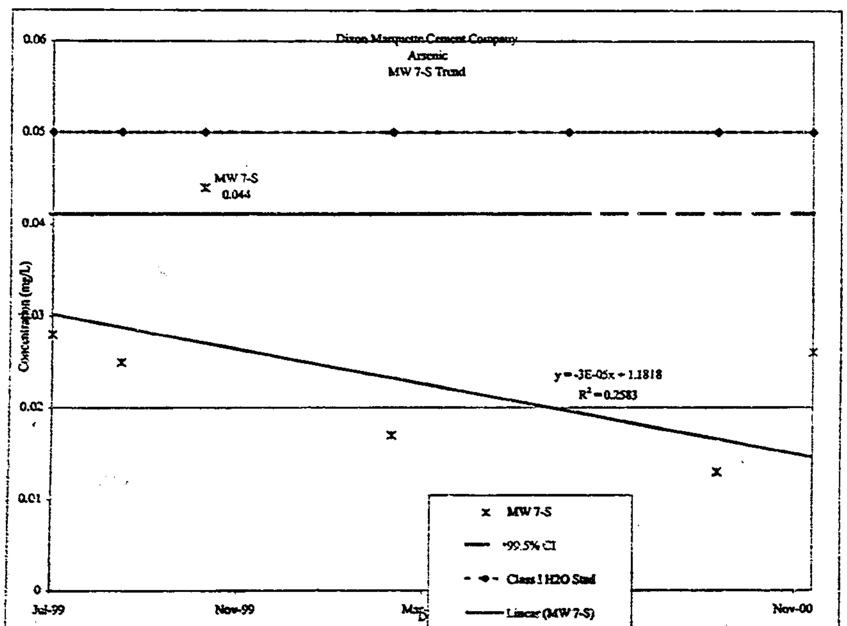

Dixon Marquette Cement Company
Antimony
MW 7-S Trend
MW 7-S
0.003
Concentration (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
y = -1E-07x + 0.005
R² = 0.0007
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 7-S
*99.5% CI
Linear (MW 7-S)

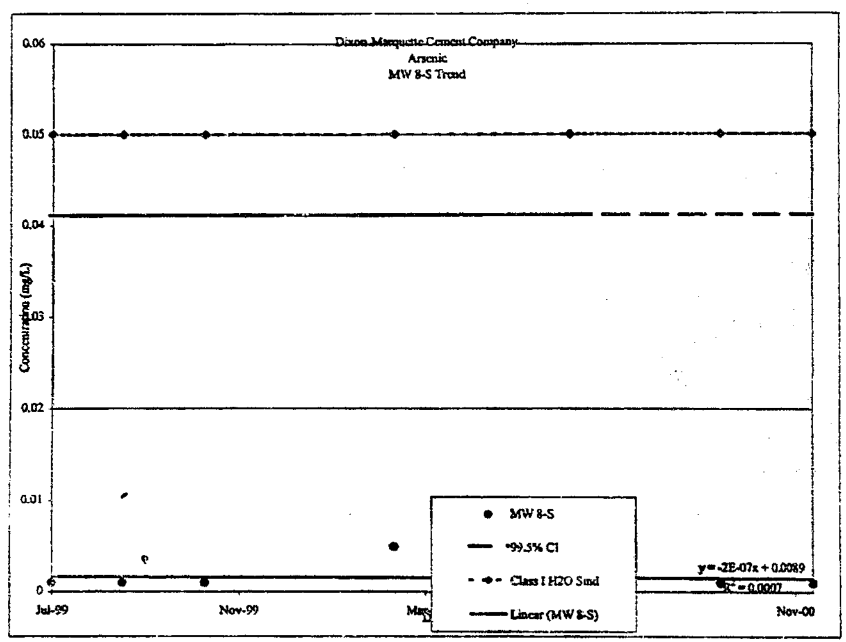

Dixon Marquette Cement Company
Antimony
MW 8-S Trend
Concentration (mg/L)
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 8-S
*99.5% CI

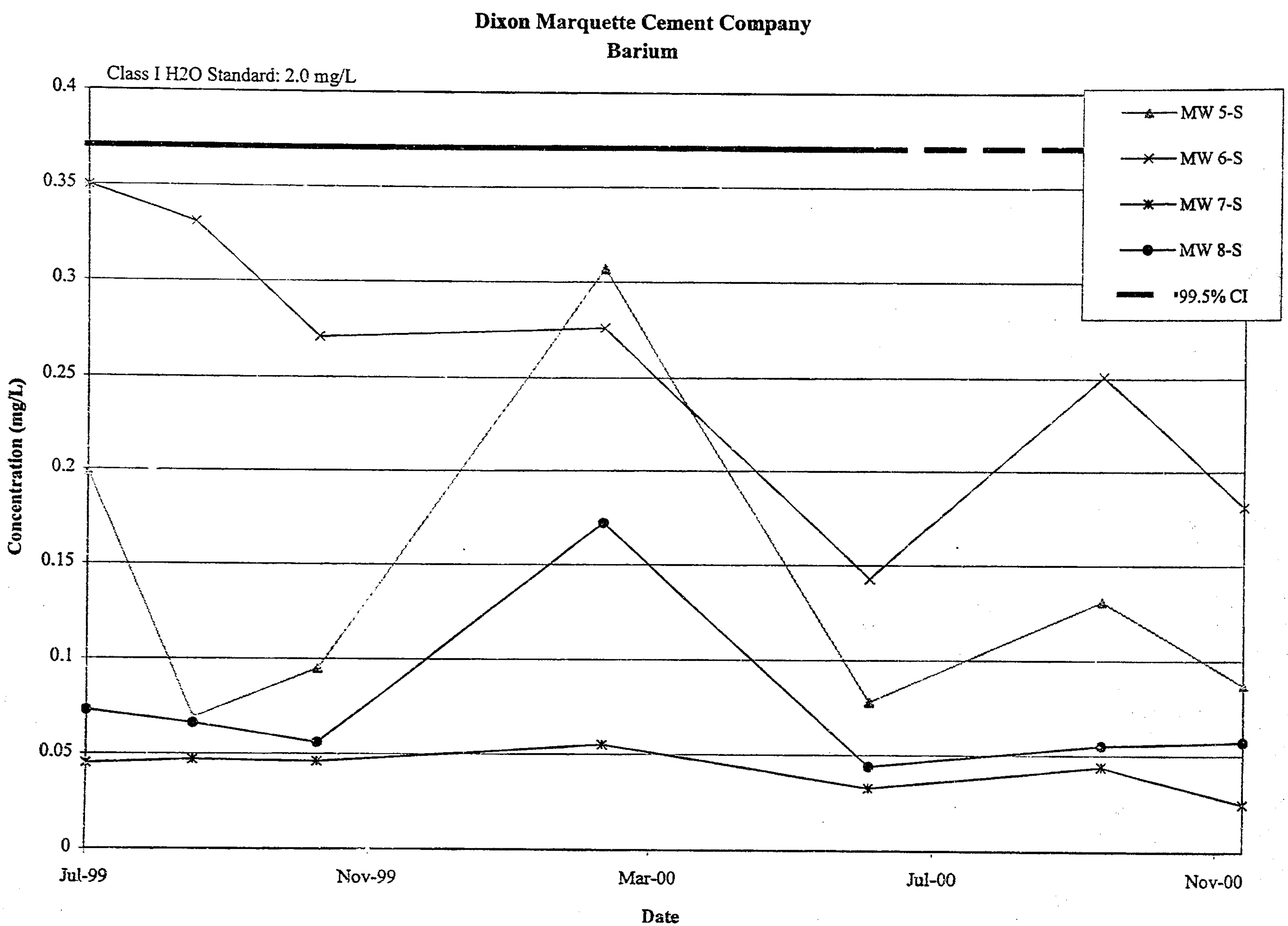

Dixon Marquette Cement Company
Arsenic
0.06
0.05
0.04
0.03
0.02
0.01
0
Concentration (mg/L)
MW 7-S
0.044
MW 5-S
MW 6-S
MW 7-S
MW 8-S
*99.5% CI
Class I H2O Stnd
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
Arsenic
MW 5-S Trend
Concentration (mg/L)
0.06
0.05
0.04
0.03
0.02
0.01
0
Jul-99
Nov-99
Nov-00
MW 5-S
+99.5% CI
Class I H2O Stnd
Linear (MW 5-S)
y = -8E-07x + 0.0308
R² = 0.0106

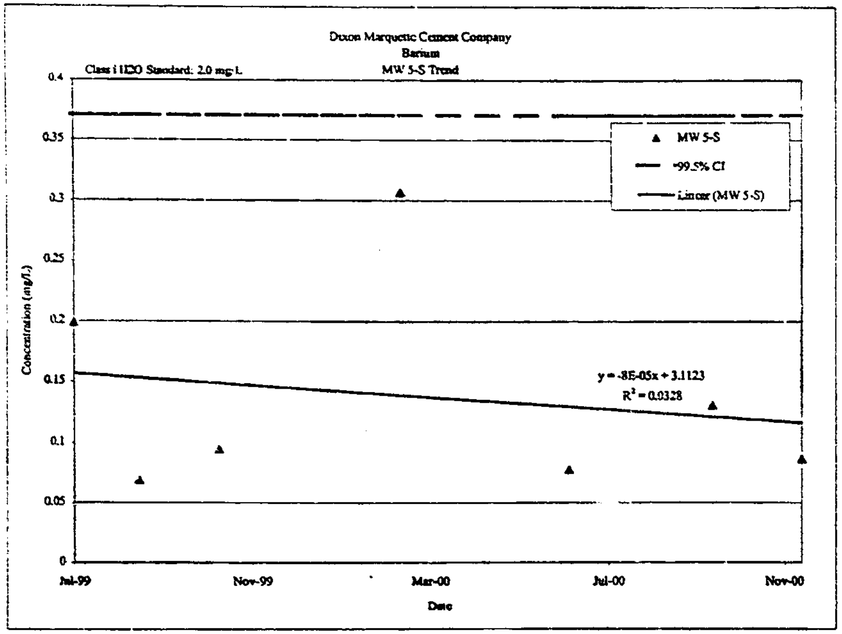

Dixon Marquette Cement Company
Arsenic
MW 6-S Trend
Concentration (mg/L)
0.06
0.05
0.04
0.03
0.02
0.01
0
Jul-99
Nov-99
Nov-00
MW 6-S
+99.5% CI
Class I H2O Stnd
Linear (MW 6-S)
y = -9E-07x + 0.0338
R² = 0.017

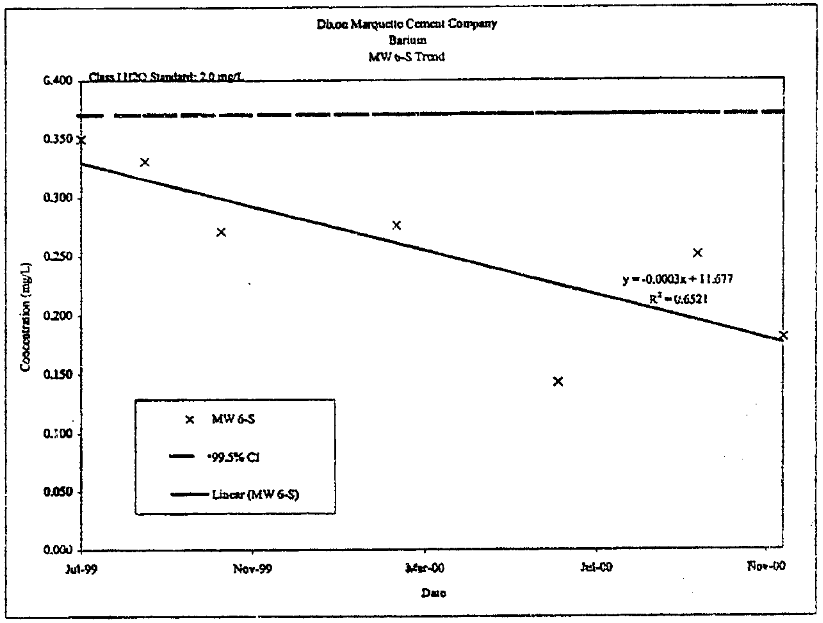

Dixon Marquette Cement Company
Arsenic
MW 7-S Trend
Concentration (mg/L)
0.06
0.05
0.04
0.03
0.02
0.01
0
Jul-99
Nov-99
Nov-00
MW 7-S
0.044
y = -3E-05x + 1.1818
R² = 0.2583
MW 7-S
+99.5% CI
Class I H2O Stnd
Linear (MW 7-S)

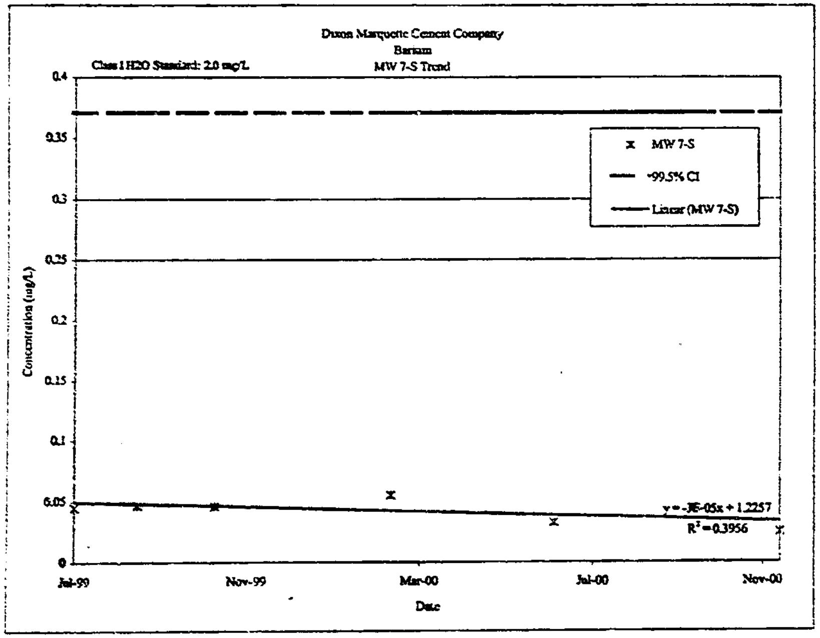

Dixon Marquette Cement Company
Arsenic
MW 8-S Trend
Concentration (mg/L)
0.06
0.05
0.04
0.03
0.02
0.01
0
Jul-99
Nov-99
Nov-00
MW 8-S
+99.5% CI
Class I H2O Stnd
Linear (MW 8-S)
y = -2E-07x + 0.0089
R² = 0.0007

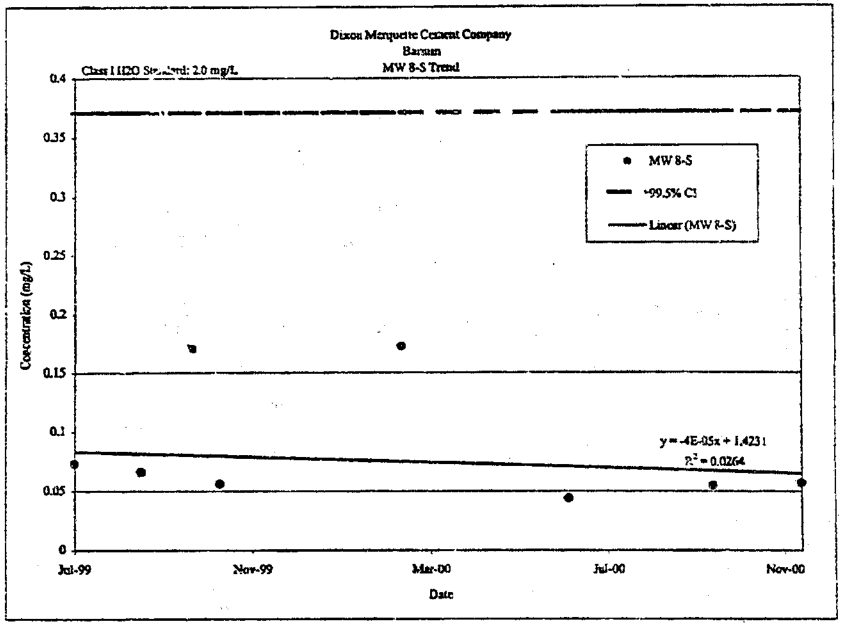


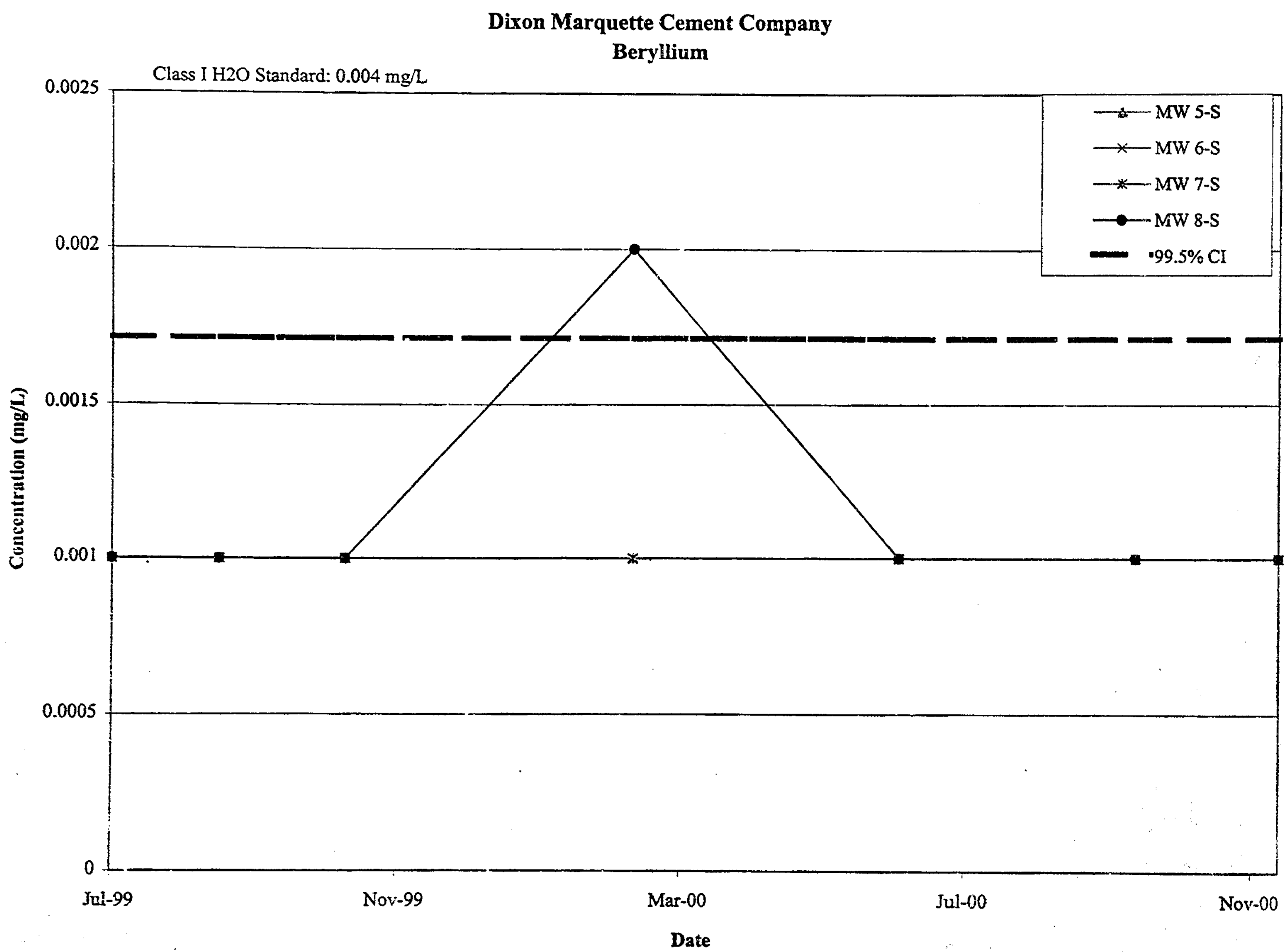
Dixon Marquette Cement Company
Barium
Class I H2O Standard: 2.0 mg/L
Concentration (mg/L)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 5-S
MW 6-S
MW 7-S
MW 8-S
'99.5% CI


Dixon Marquette Cement Company
Barium
MW 5-S Trend
Class I H2O Standard: 2.0 mg/L
MW 5-S
+99.5% CI
Linear (MW 5-S)
y = -8E-05x + 3.1123
R² = 0.0328
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

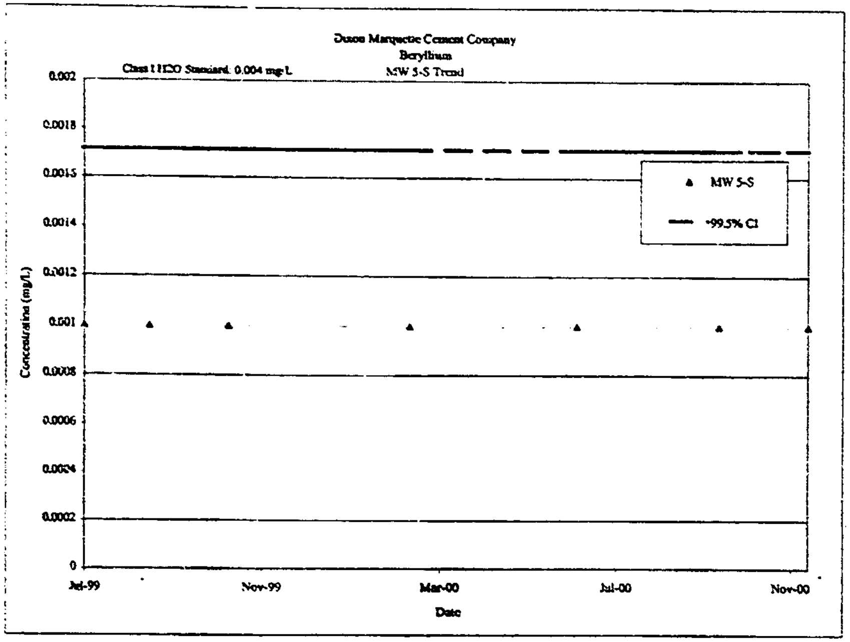

Dixon Marquette Cement Company
Barium
MW 6-S Trend
Class I H2O Standard: 2.0 mg/L
MW 6-S
+99.5% CI
Linear (MW 6-S)
y = -0.0003x + 11.677
R² = 0.6521
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

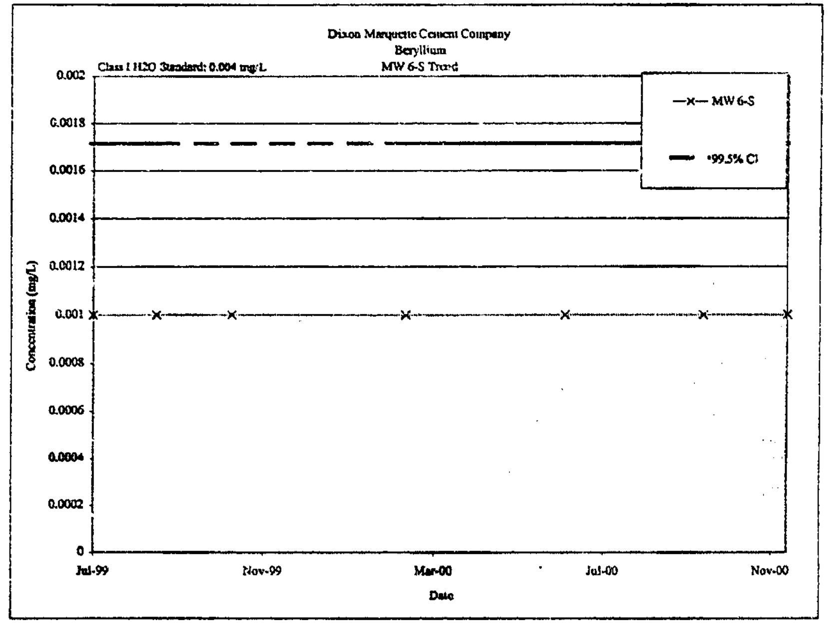

Dixon Marquette Cement Company
Barium
MW 7-S Trend
Class I H2O Standard: 2.0 mg/L
MW 7-S
+99.5% CI
Linear (MW 7-S)
y = -3E-05x + 1.2257
R² = 0.3956
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

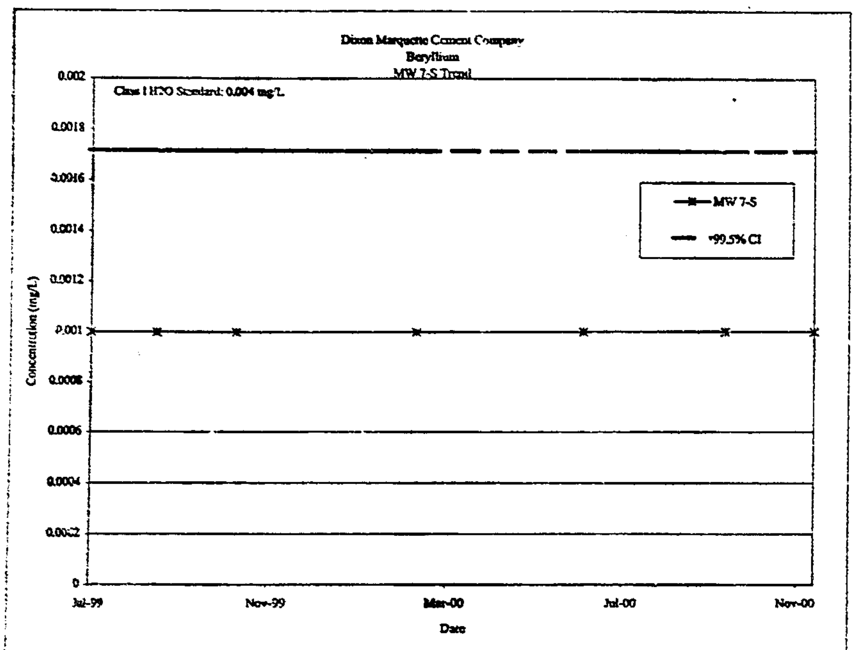

Dixon Marquette Cement Company
Barium
MW 8-S Trend
MW 8-S
+99.5% CI
Linear (MW 8-S)
y = -4E-05x + 1.4231
R² = 0.0264
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

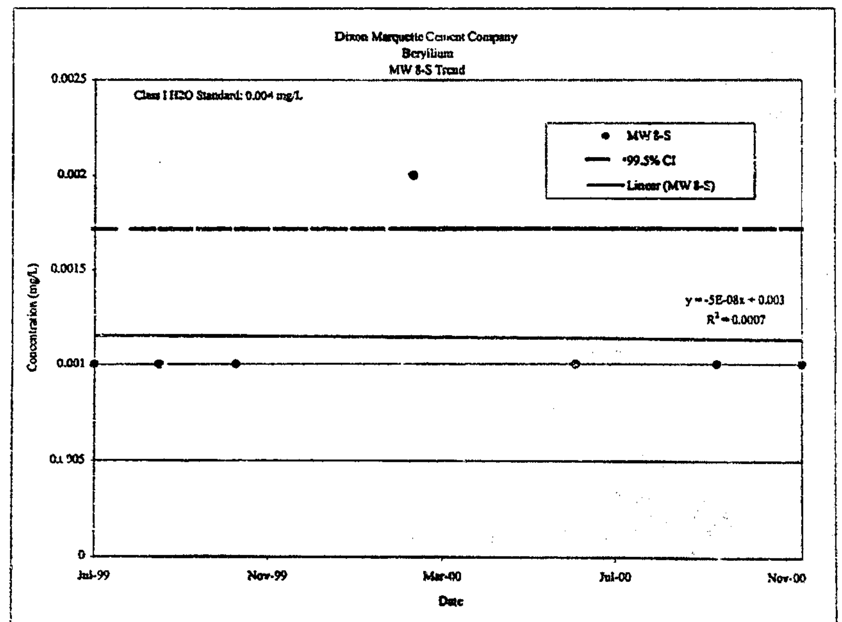


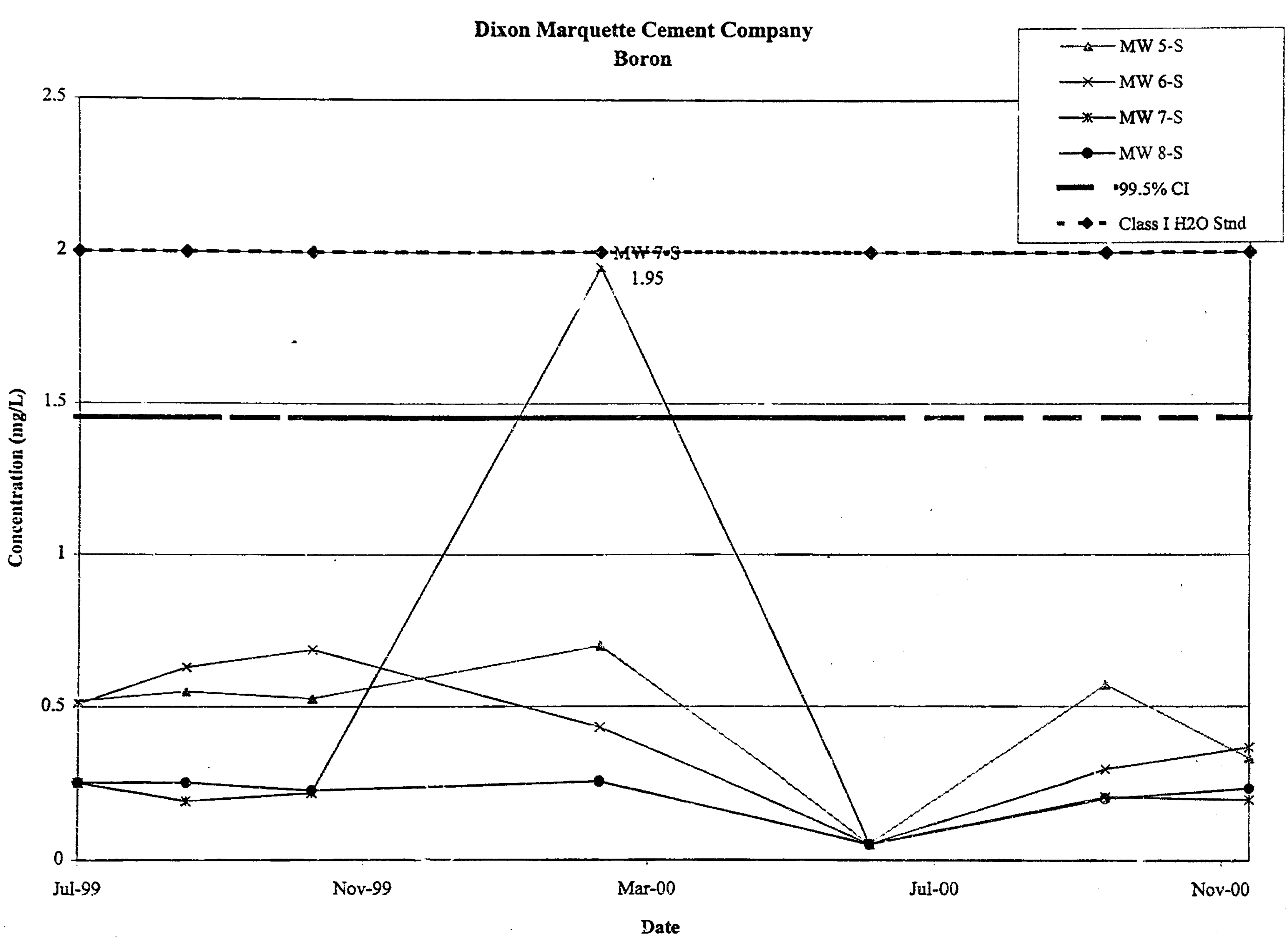
Dixon Marquette Cement Company
Beryllium
Class I H2O Standard: 0.004 mg/L
0.0025
0.002
0.0015
0.001
0.0005
0
Concentration (mg/L)
MW 5-S
MW 6-S
MW 7-S
MW 8-S
99.5% CI
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
Beryllium
MW 5-S Trend
Class I H2O Standard: 0.004 mg/L
Concentration (mg/L)
Date
MW 5-S
+99.5% CI
0.002
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

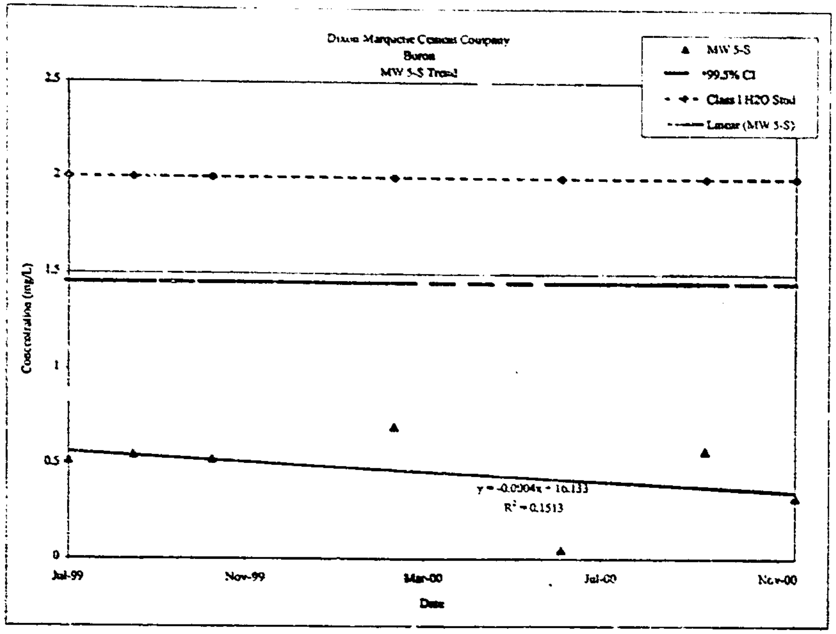

Dixon Marquette Cement Company
Beryllium
MW 6-S Trend
Class I H2O Standard: 0.004 mg/L
Concentration (mg/L)
Date
MW 6-S
+99.5% CI
0.002
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00


Dixon Marquette Cement Company
Beryllium
MW 7-S Trend
Class I H2O Standard: 0.004 mg/L
Concentration (mg/L)
Date
MW 7-S
+99.5% CI
0.002
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

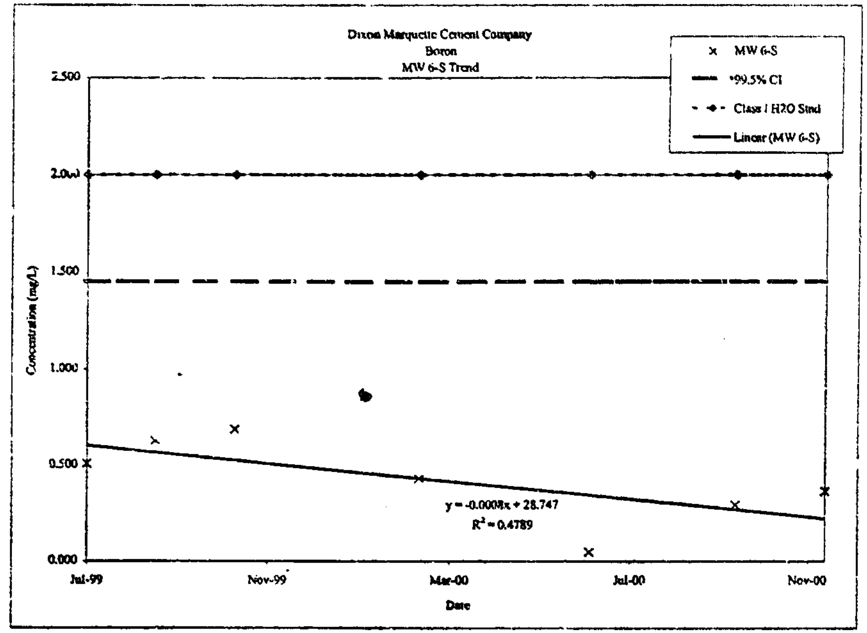

Dixon Marquette Cement Company
Beryllium
MW 8-S Trend
Class I H2O Standard: 0.004 mg/L
Concentration (mg/L)
Date
MW 8-S
+99.5% CI
Linear (MW 8-S)
y = -5E-08x + 0.003
R² = 0.0007
0.0025
0.002
0.0015
0.001
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00



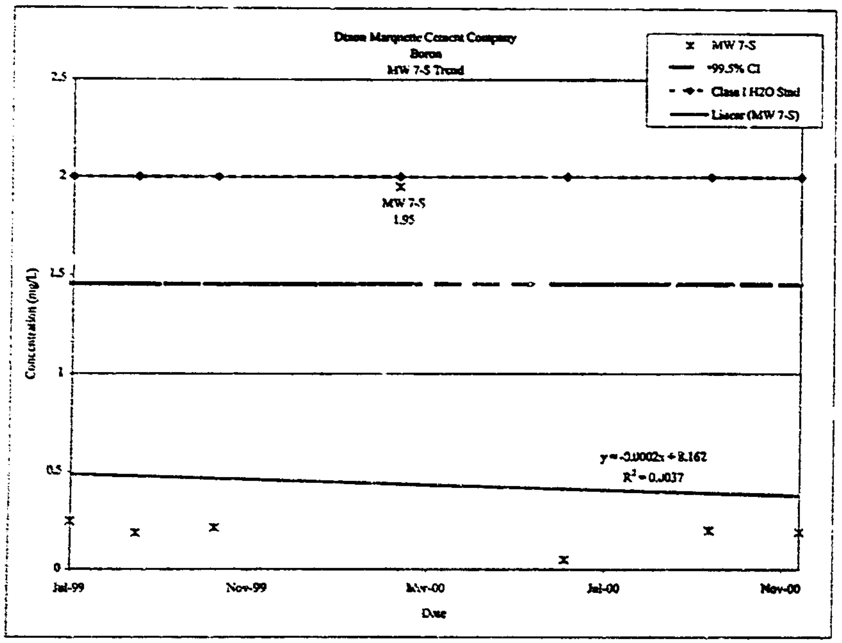
Dixon Marquette Cement Company
Boron
MW 5-S
MW 6-S
MW 7-S
MW 8-S
99.5% CI
Class I H2O Stnd
MW 7-S
1.95
2.5
2
1.5
1
0.5
0
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date



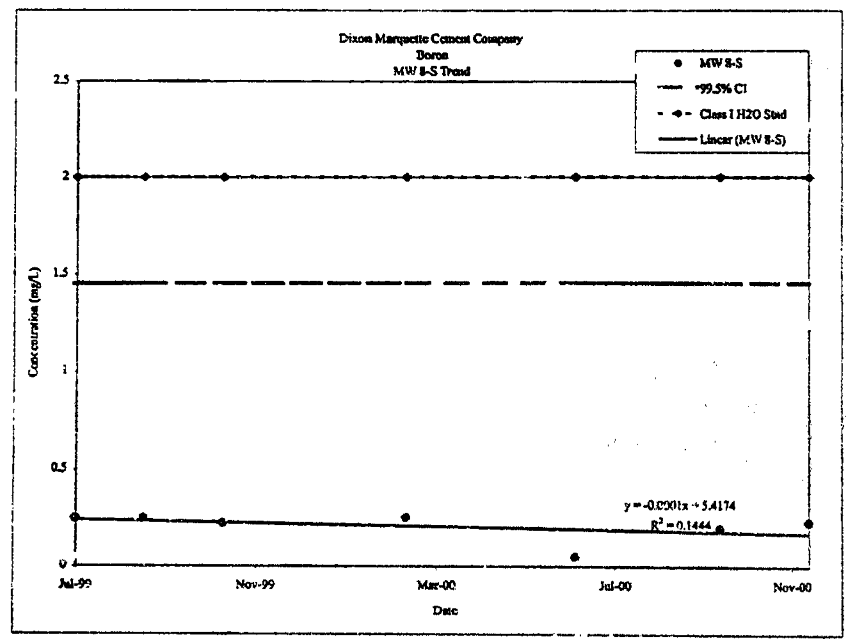
Dixon Marquette Cement Company
Boron
MW 5-S Trend
MW 5-S
*99.5% CI
Class I H2O Std
Linear (MW 5-S)
y = -0.0004x + 16.133
R² = 0.1513
Concentration (mg/L)
2.5
2
1.5
1
0.5
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date



Dixon Marquette Cement Company
Boron
MW 6-S Trend
MW 6-S
*99.5% CI
Class I H2O Std
Linear (MW 6-S)
y = -0.0008x + 28.747
R² = 0.4789
Concentration (mg/L)
2.500
2.000
1.500
1.000
0.500
0.000
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

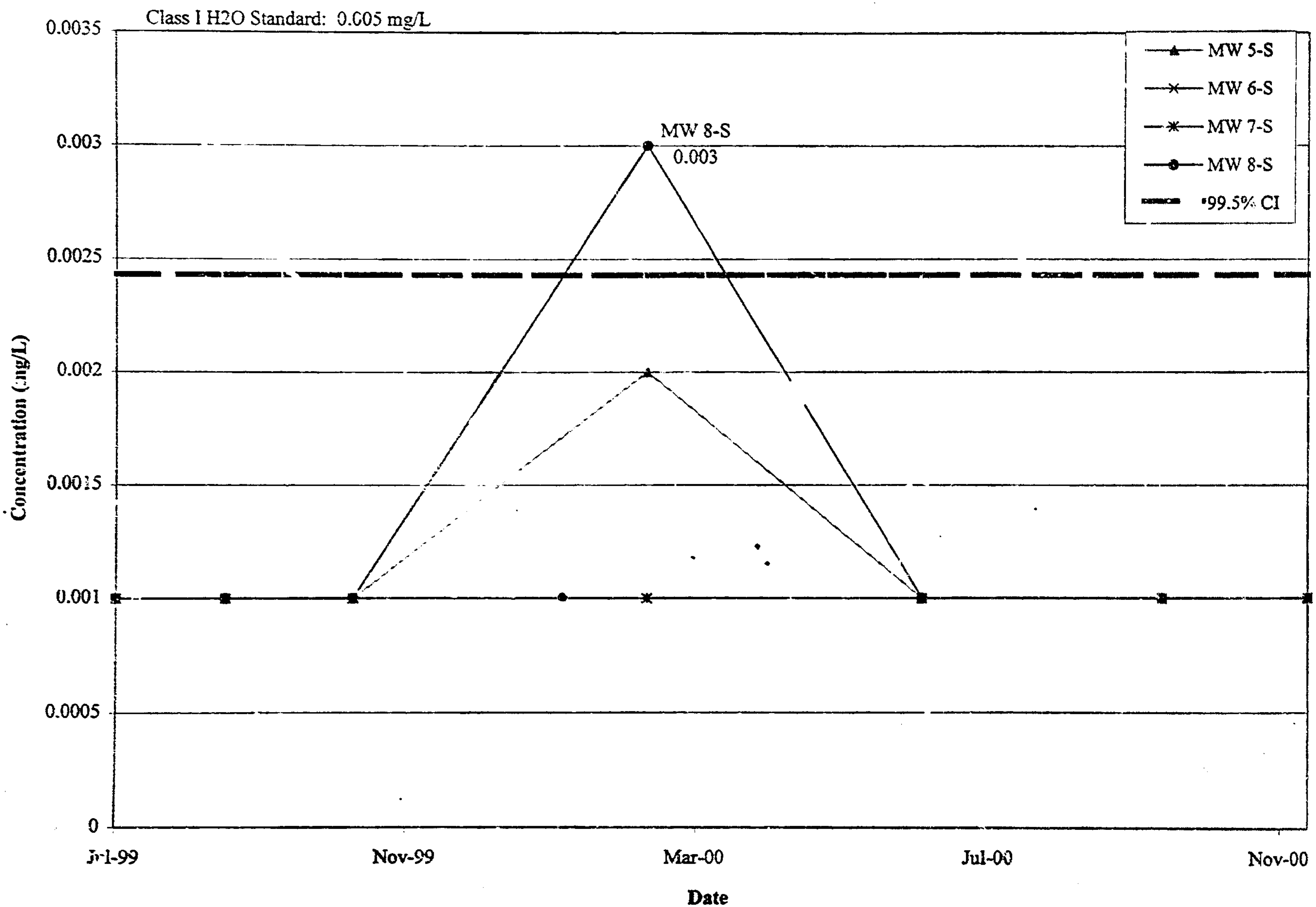


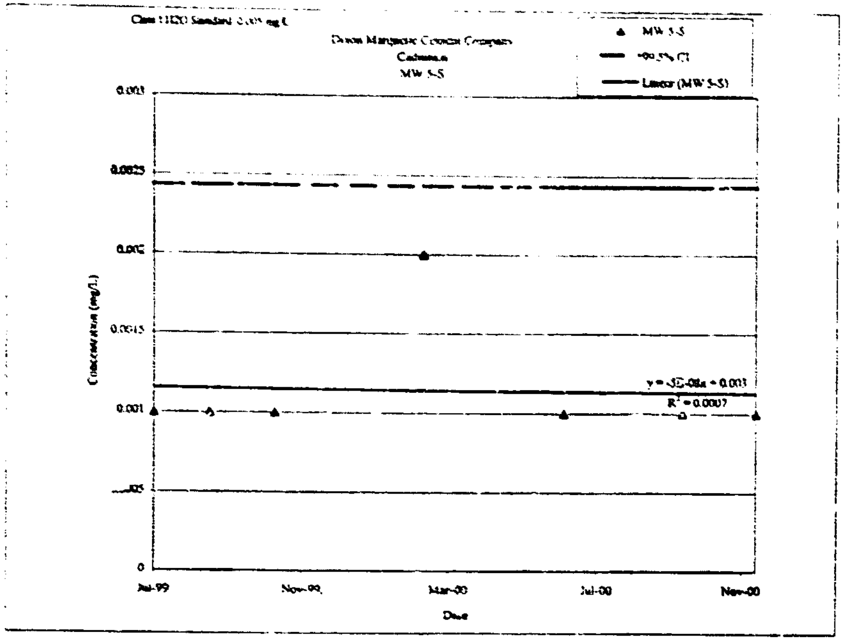
Dixon Marquette Cement Company
Boron
MW 7-S Trend
MW 7-S
*99.5% CI
Class I H2O Std
Linear (MW 7-S)
MW 7-S
1.95
y = -0.0002x + 8.162
R² = 0.0037
Concentration (mg/L)
2.5
2
1.5
1
0.5
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

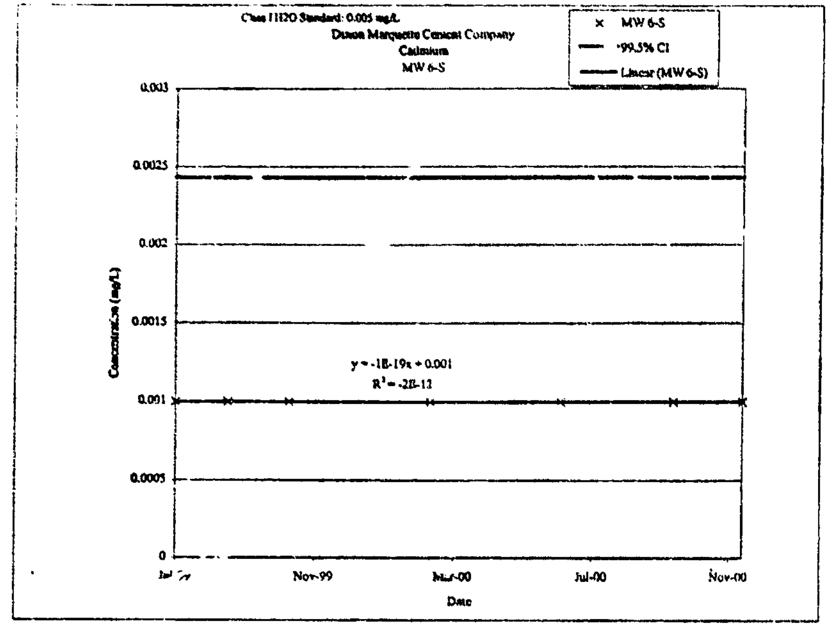


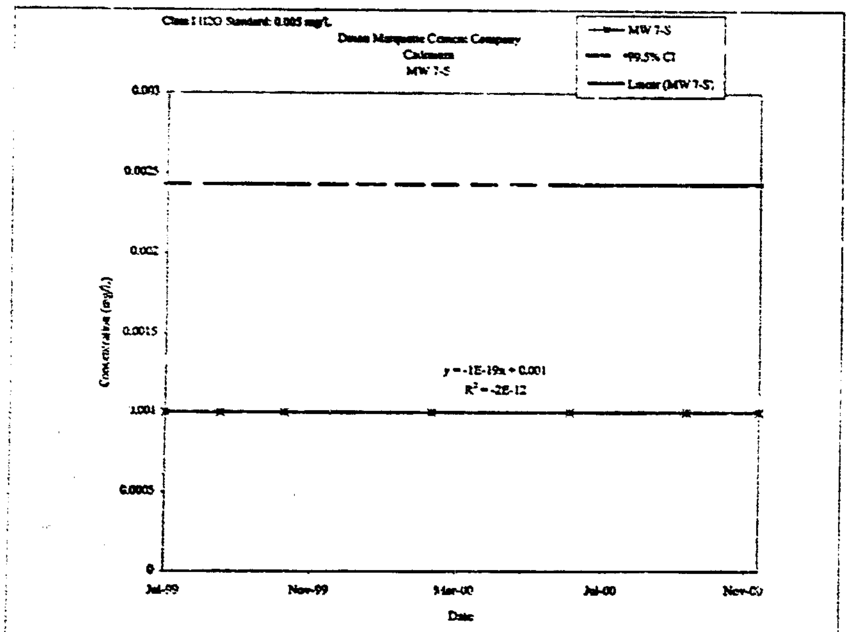
Dixon Marquette Cement Company
Boron
MW 8-S Trend
MW 8-S
*99.5% CI
Class I H2O Std
Linear (MW 8-S)
y = -0.0001x + 5.4174
R² = 0.1444
Concentration (mg/L)
2.5
2
1.5
1
0.5
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

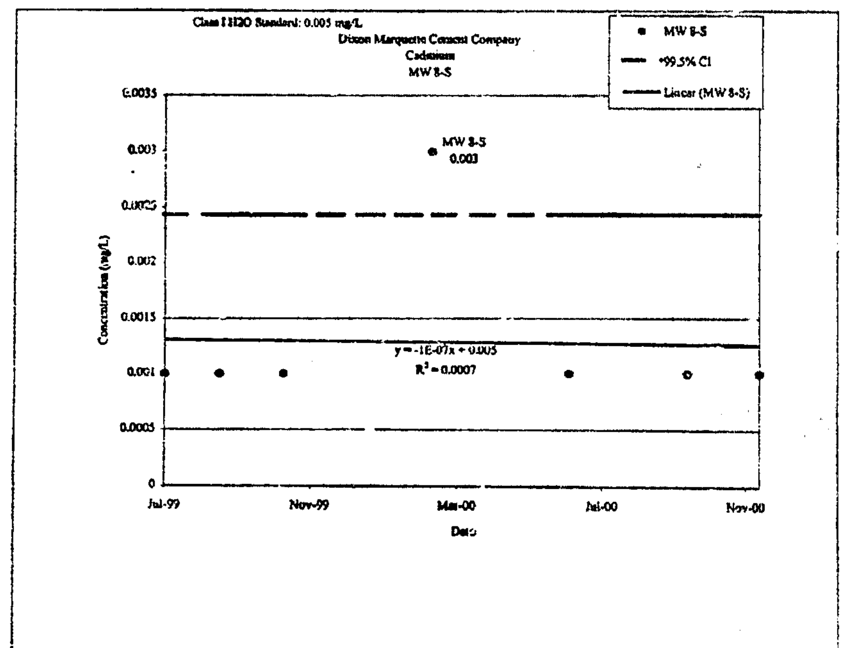
Dixon Marquette Cement Company
Cadmium



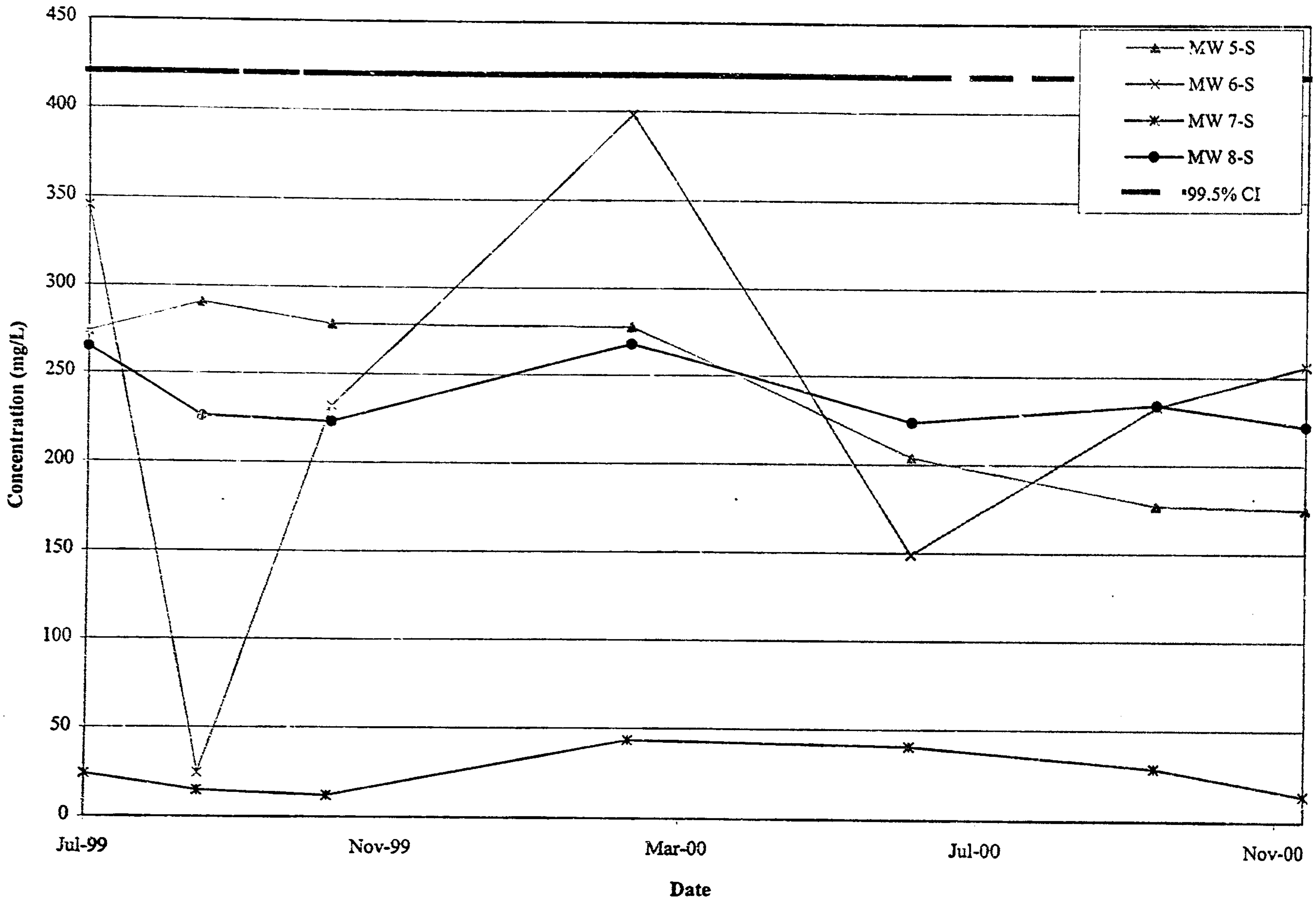

Class I H2O Standard: 0.005 mg/L
Dixon Marquette Cement Company
Cadmium
MW 5-S
MW 5-S
+99.5% CI
Linear (MW 5-S)
y = -3E-08x + 0.003
R² = 0.0007
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

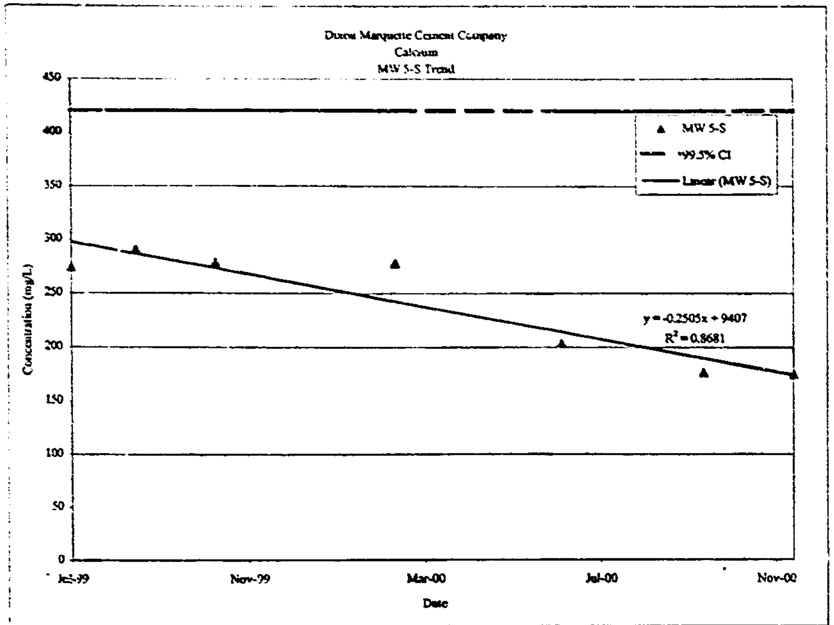

Class I H2O Standard: 0.005 mg/L
Dixon Marquette Cement Company
Cadmium
MW 6-S
MW 6-S
+99.5% CI
Linear (MW 6-S)
y = -1E-19x + 0.001
R² = -2E-12
Concentration (mg/L)
Date
Nov-99
Mar-00
Jul-00
Nov-00


Class I H2O Standard: 0.005 mg/L
Dixon Marquette Cement Company
Cadmium
MW 7-S
MW 7-S
+99.5% CI
Linear (MW 7-S)
y = -1E-19x + 0.001
R² = -2E-12
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00

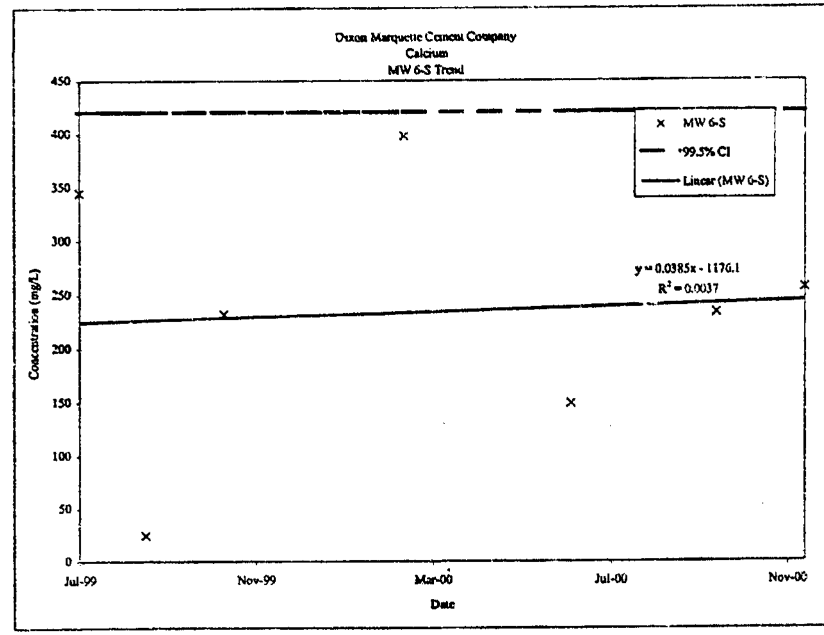

Class I H2O Standard: 0.005 mg/L
Dixon Marquette Cement Company
Cadmium
MW 8-S
MW 8-S
+99.5% CI
Linear (MW 8-S)
MW 8-S
0.003
y = -1E-07x + 0.005
R² = 0.0007
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

Dixon Marquette Cement Company
Calcium

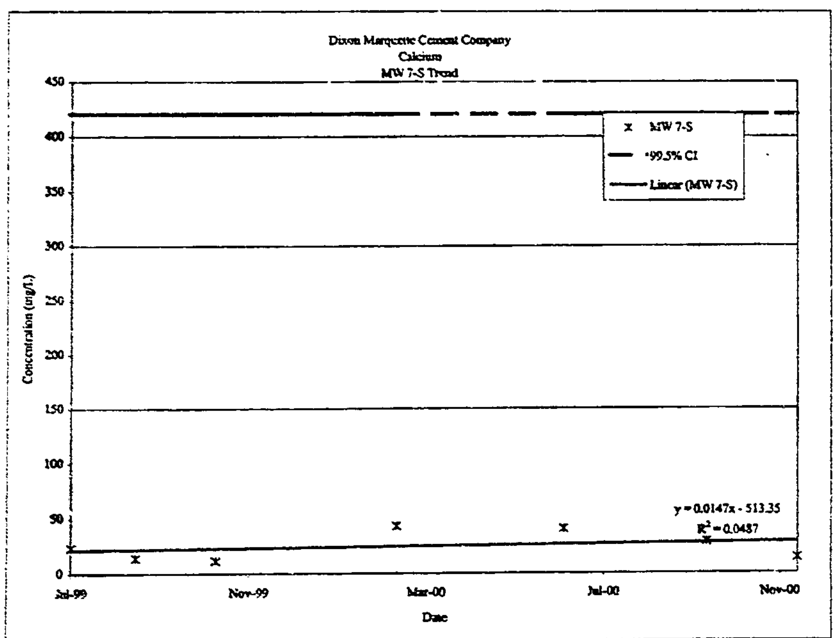




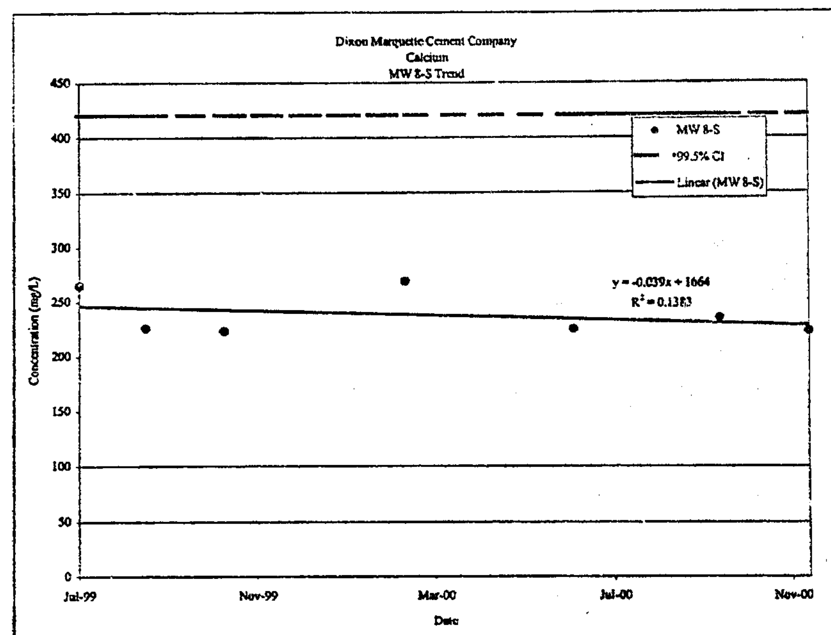
Dixon Marquette Cement Company
Calcium
MW 5-S Trend
Concentration (mg/L)
Date
MW 5-S
*99.5% CI
Linear (MW 5-S)
y = -0.2505x + 9407
R² = 0.8681
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00



Dixon Marquette Cement Company
Calcium
MW 6-S Trend
Concentration (mg/L)
Date
MW 6-S
*99.5% CI
Linear (MW 6-S)
y = 0.0385x - 1176.1
R² = 0.0037
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

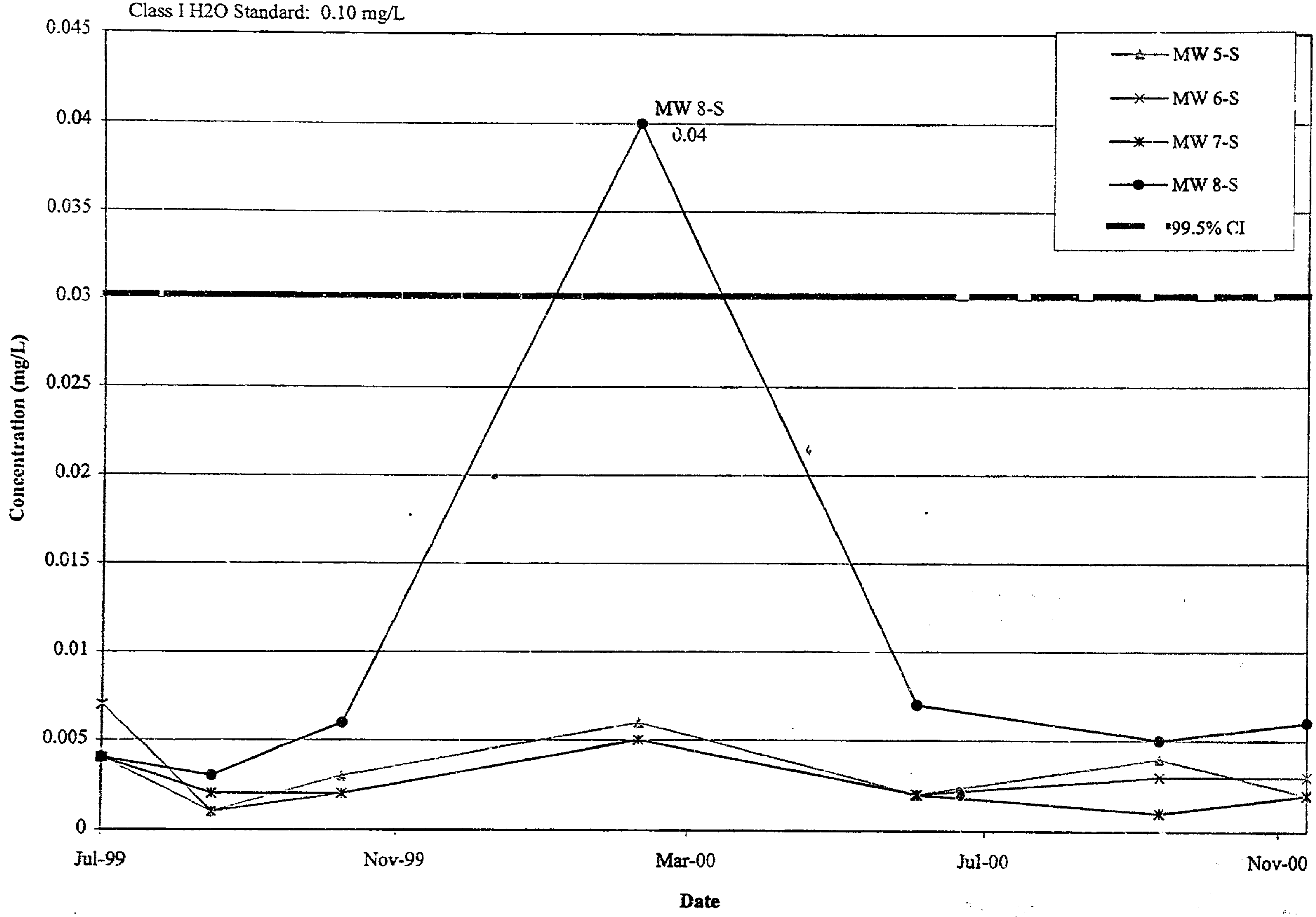


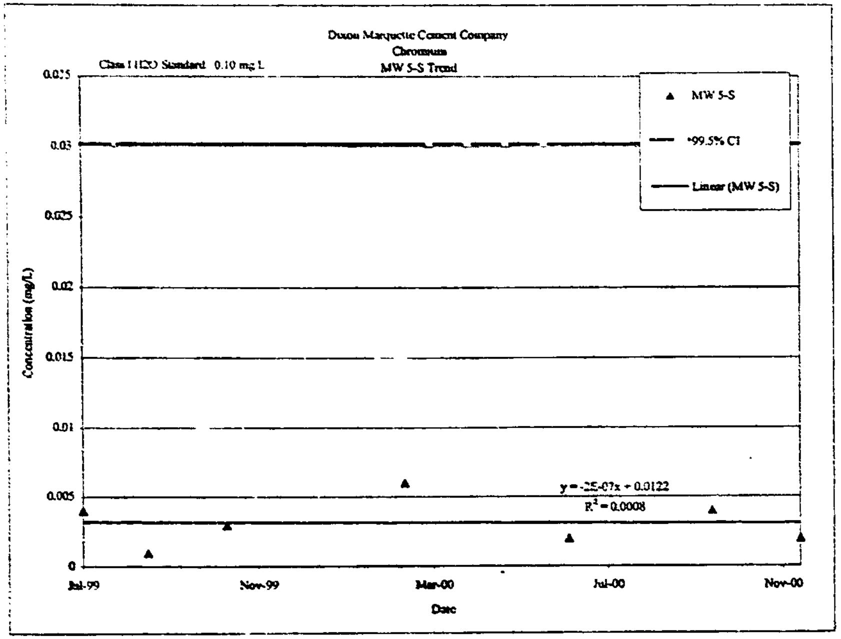
Dixon Marquette Cement Company
Calcium
MW 7-S Trend
Concentration (mg/L)
Date
MW 7-S
*99.5% CI
Linear (MW 7-S)
y = 0.0147x - 513.35
R² = 0.0487
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

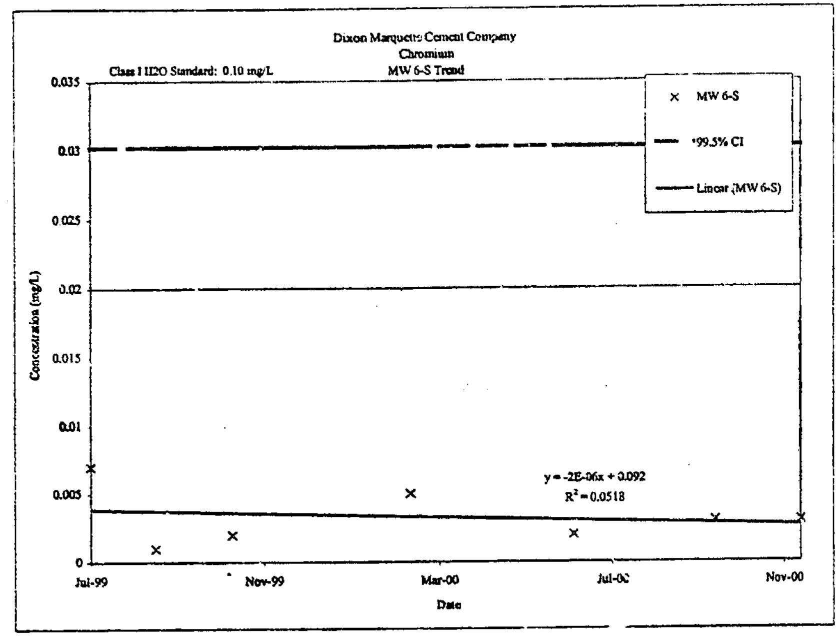


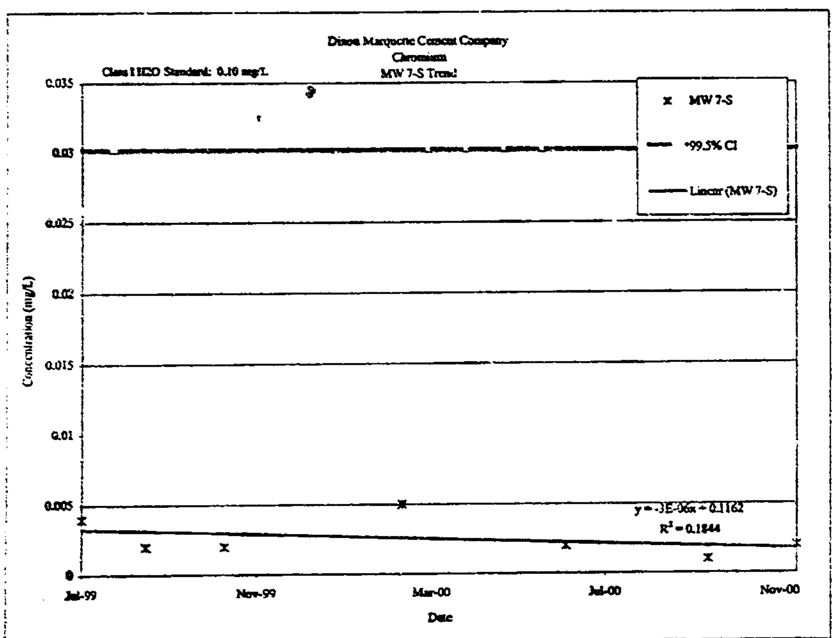
Dixon Marquette Cement Company
Calcium
MW 8-S Trend
Concentration (mg/L)
Date
MW 8-S
*99.5% CI
Linear (MW 8-S)
y = -0.039x + 1664
R² = 0.1383
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

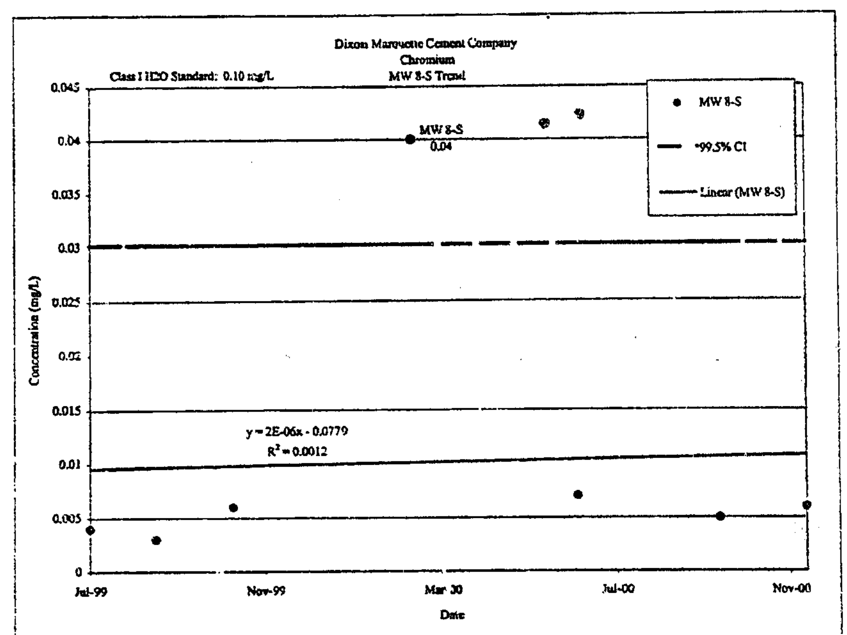
Dixon Marquette Cement Company
Chromium

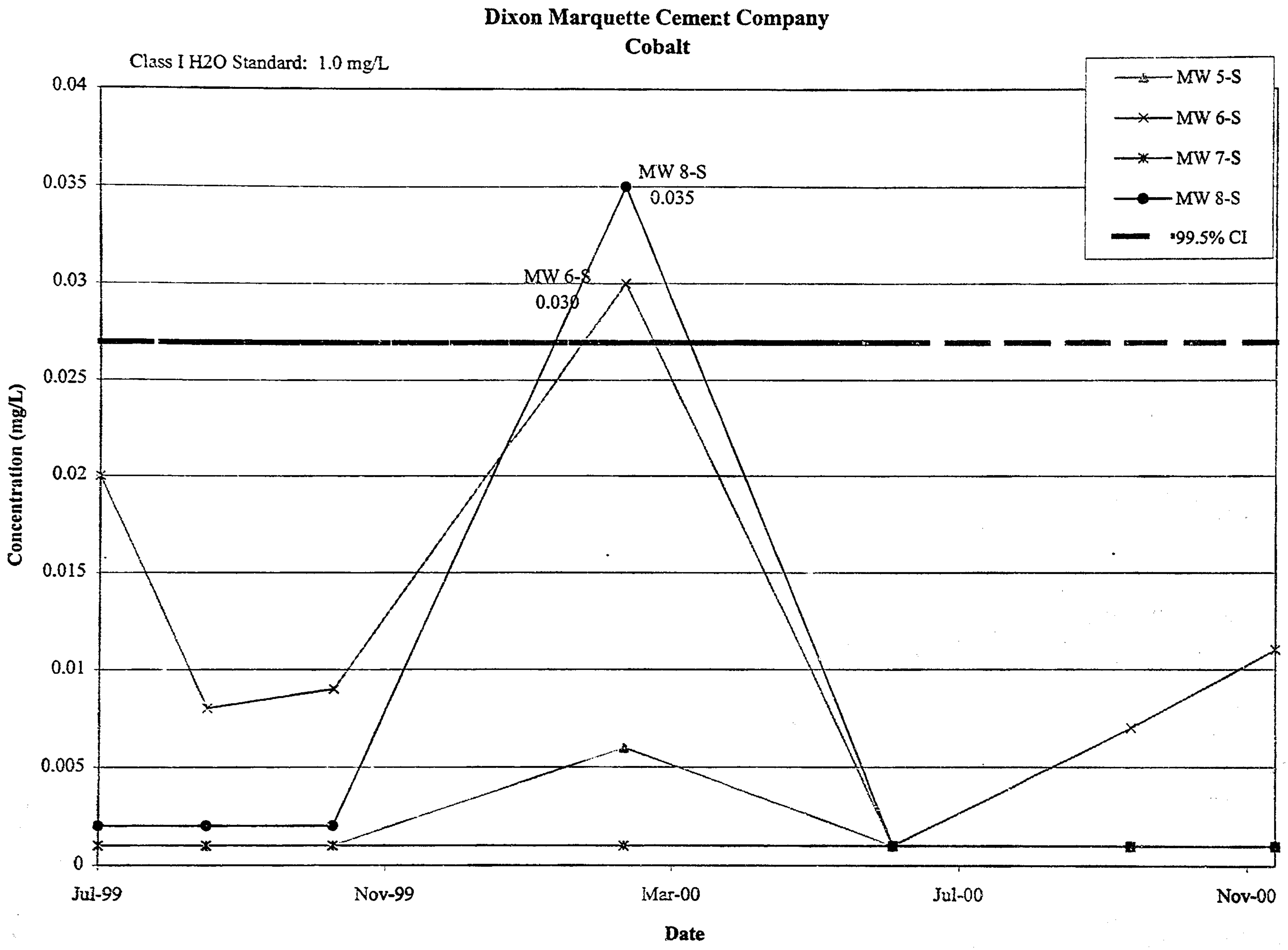


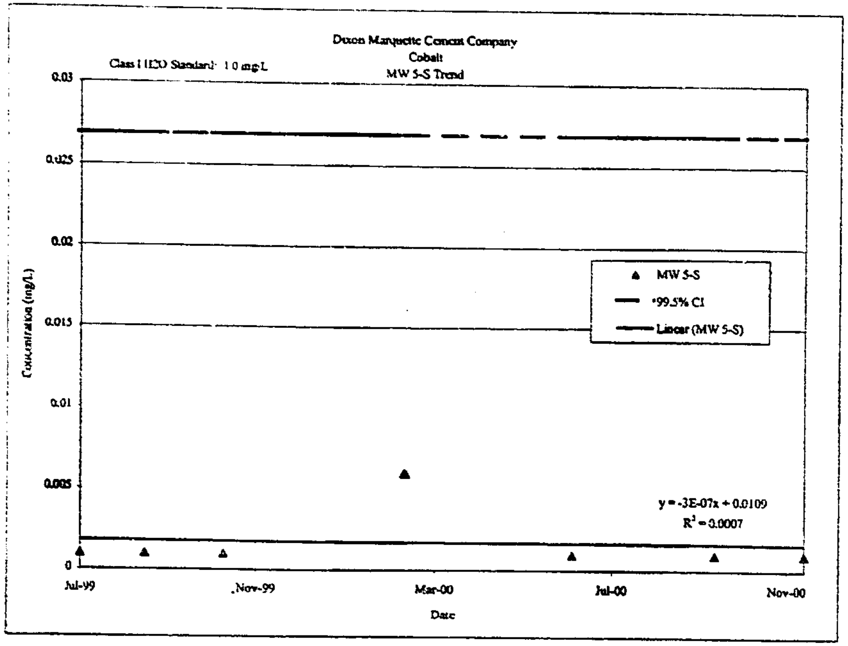

Dixon Marquette Cement Company
Chromium
MW 5-S Trend
Class I H2O Standard: 0.10 mg/L
MW 5-S
+99.5% CI
Linear (MW 5-S)
y = -2E-07x + 0.0122
R² = 0.0008
Concentration (mg/L)
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

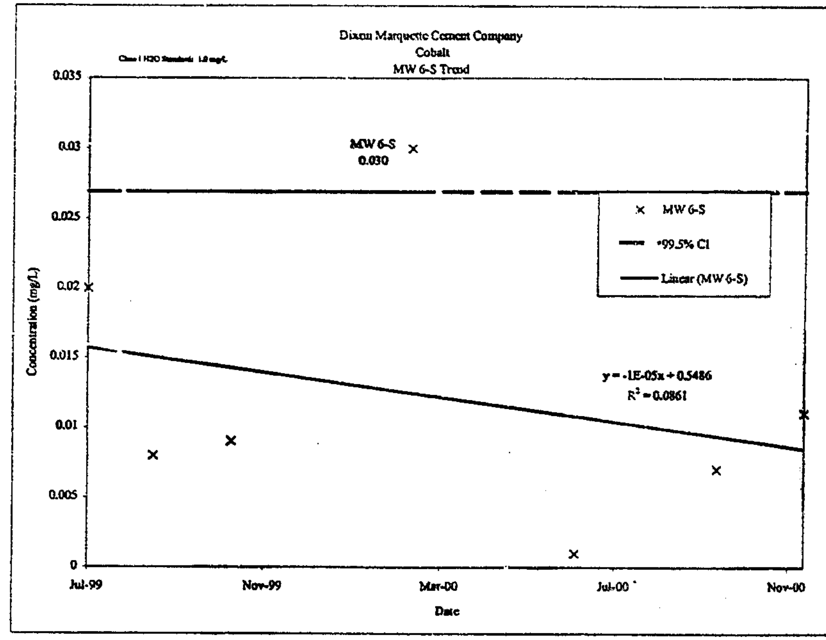

Dixon Marquette Cement Company
Chromium
MW 6-S Trend
Class I H2O Standard: 0.10 mg/L
MW 6-S
+99.5% CI
Linear (MW 6-S)
y = -2E-06x + 0.092
R² = 0.0518
Concentration (mg/L)
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

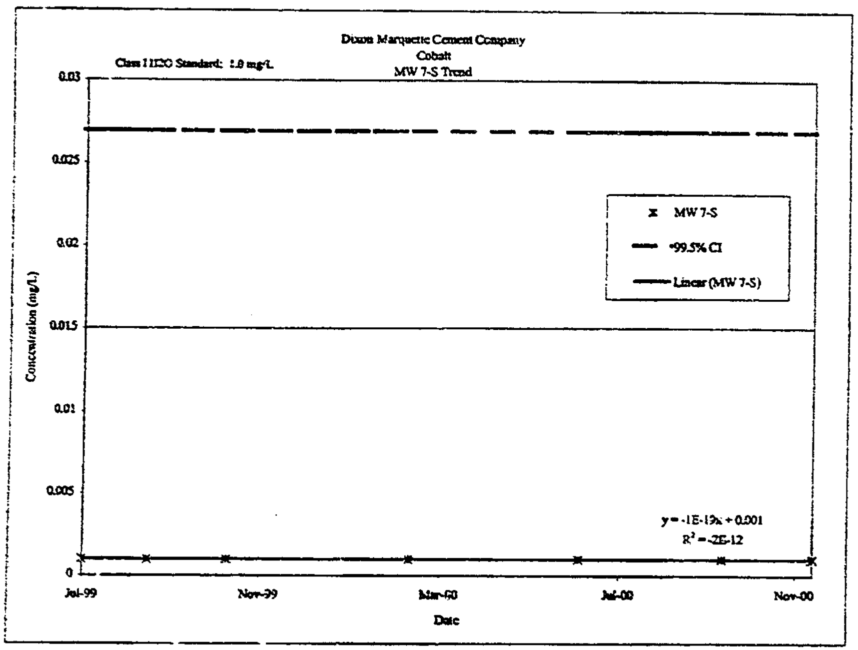

Dixon Marquette Cement Company
Chromium
MW 7-S Trend
Class I H2O Standard: 0.10 mg/L
MW 7-S
+99.5% CI
Linear (MW 7-S)
y = -3E-06x + 0.1162
R² = 0.1844
Concentration (mg/L)
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

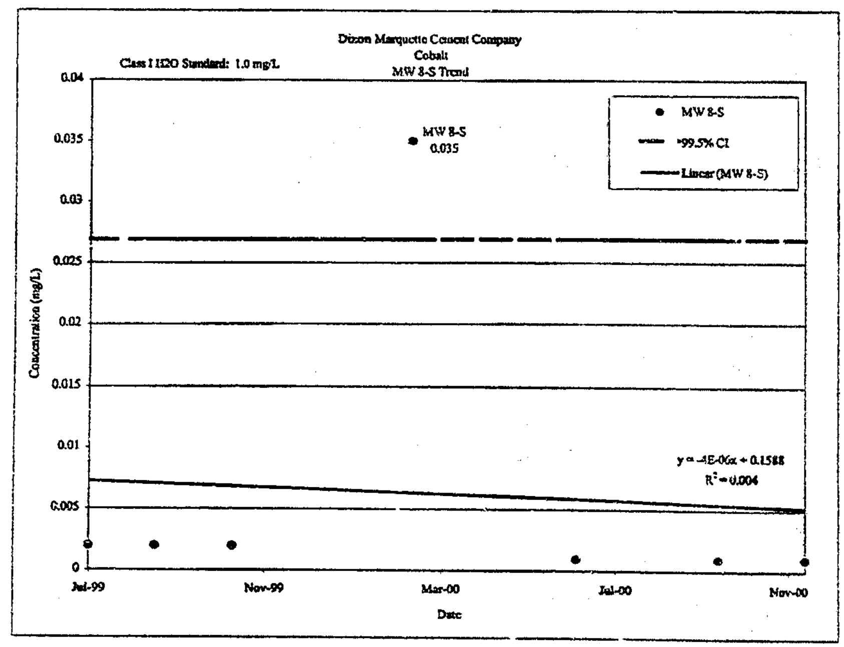

Dixon Marquette Cement Company
Chromium
MW 8-S Trend
Class I H2O Standard: 0.10 mg/L
MW 8-S
+99.5% CI
Linear (MW 8-S)
MW 8-S
0.04
y = 2E-06x - 0.0779
R² = 0.0012
Concentration (mg/L)
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04
0.045
Jul-99
Nov-99
Mar 30
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
Cobalt
Class I H2O Standard: 1.0 mg/L
MW 5-S
MW 6-S
MW 7-S
MW 8-S
*99.5% CI
MW 8-S
0.035
MW 6-S
0.030
Concentration (mg/L)
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
Cobalt
MW 5-S Trend
Class I H2O Standard: 1.0 mg/L
Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
MW 5-S
*99.5% CI
Linear (MW 5-S)
y = -3E-07x + 0.0109
R² = 0.0007
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

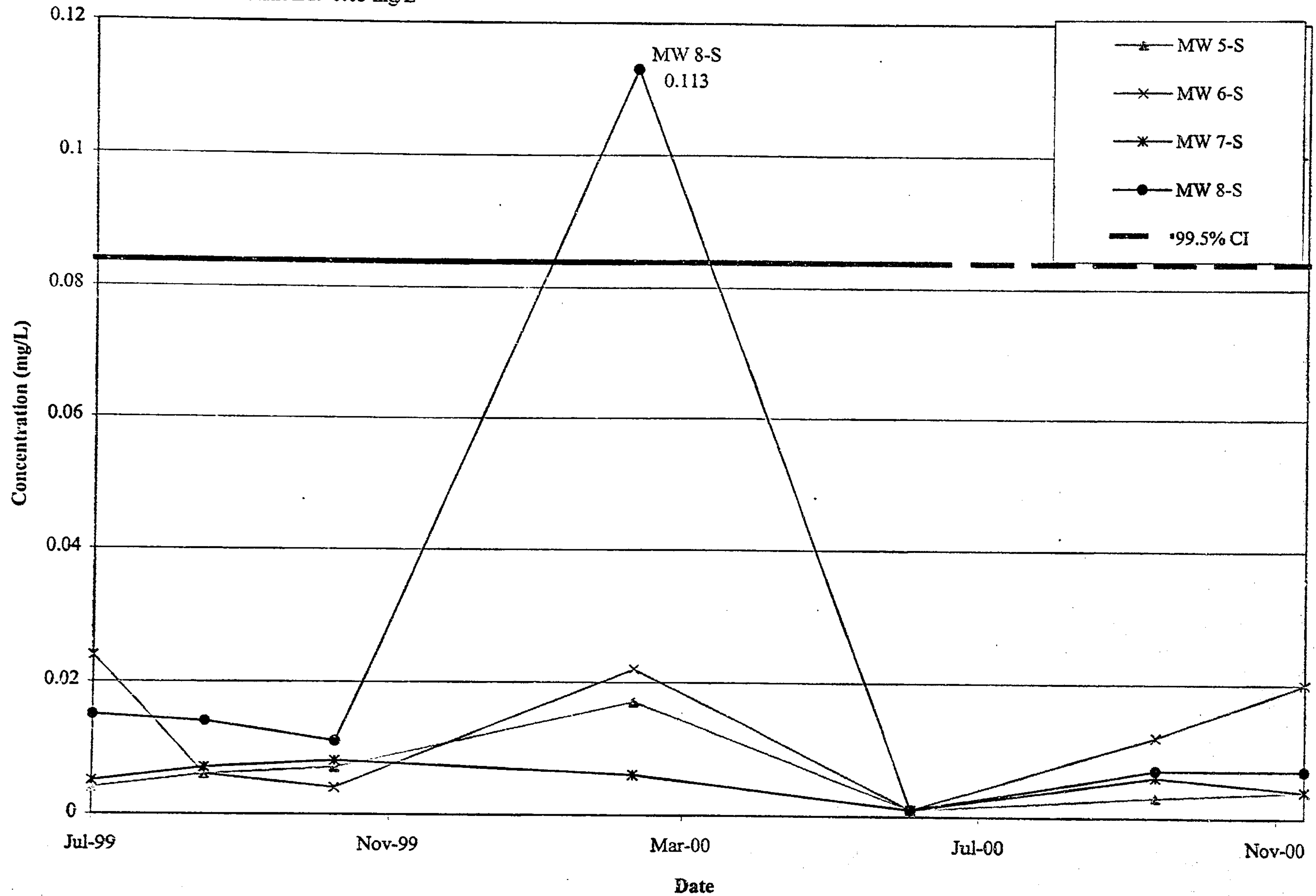

Dixon Marquette Cement Company
Cobalt
MW 6-S Trend
Class I H2O Standard: 1.0 mg/L
Concentration (mg/L)
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
MW 6-S
0.030
MW 6-S
*99.5% CI
Linear (MW 6-S)
y = -1E-05x + 0.5486
R² = 0.0861
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

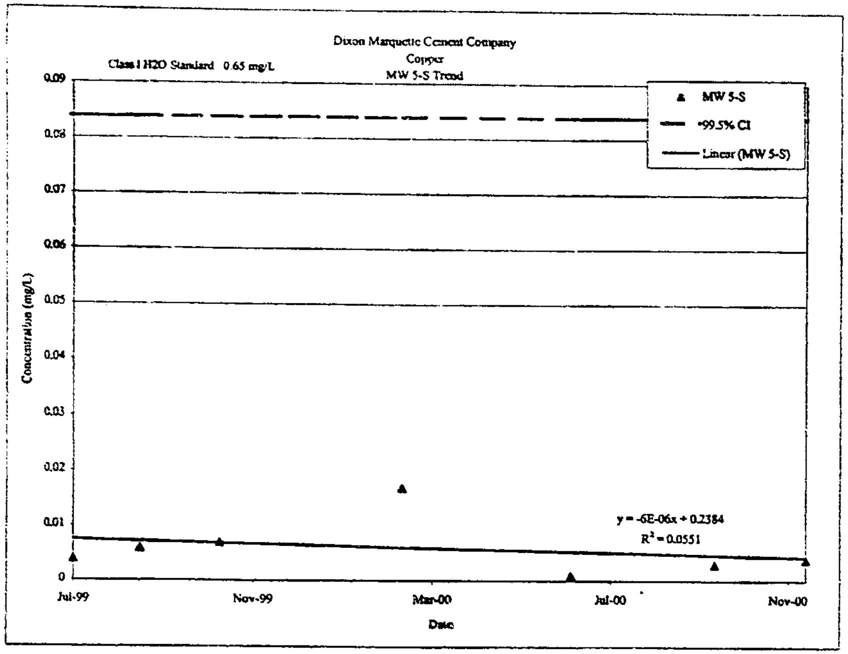

Dixon Marquette Cement Company
Cobalt
MW 7-S Trend
Class I H2O Standard: 1.0 mg/L
Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
MW 7-S
*99.5% CI
Linear (MW 7-S)
y = -1E-19x + 0.001
R² = -2E-12
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
Cobalt
MW 8-S Trend
Class I H2O Standard: 1.0 mg/L
Concentration (mg/L)
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
MW 8-S
0.035
MW 8-S
*99.5% CI
Linear (MW 8-S)
y = -4E-06x + 0.1588
R² = 0.004
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

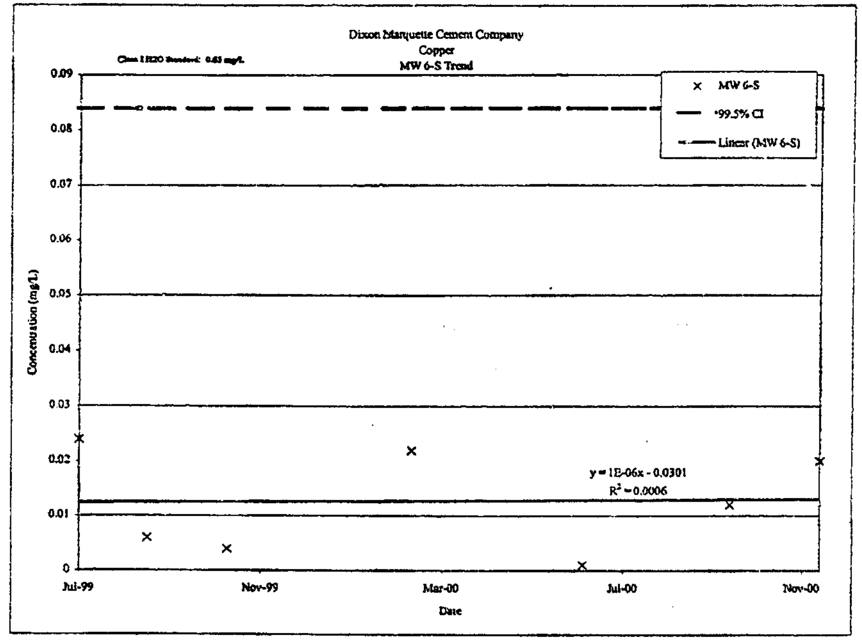
Dixon Marquette Cement Company
Copper

Class I H2O Standard: 0.65 mg/L

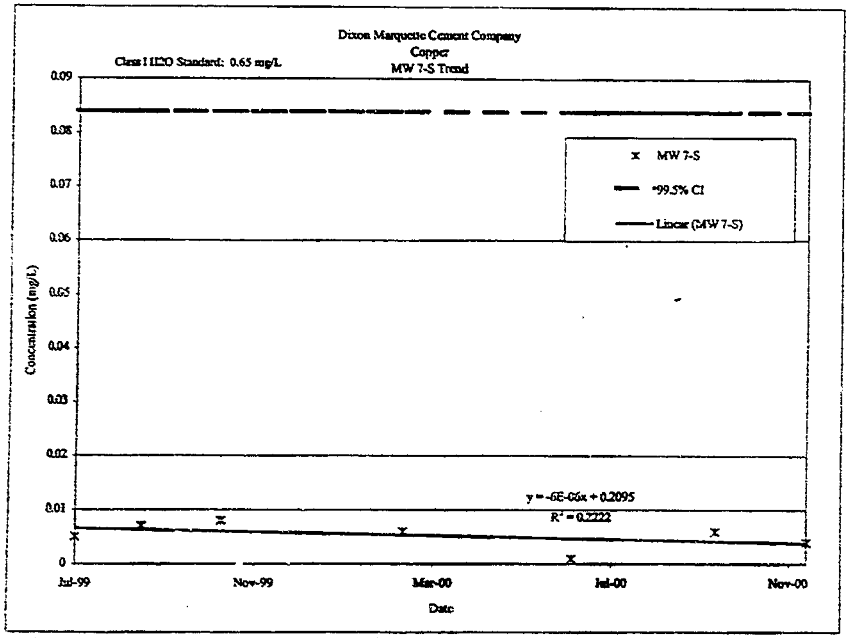




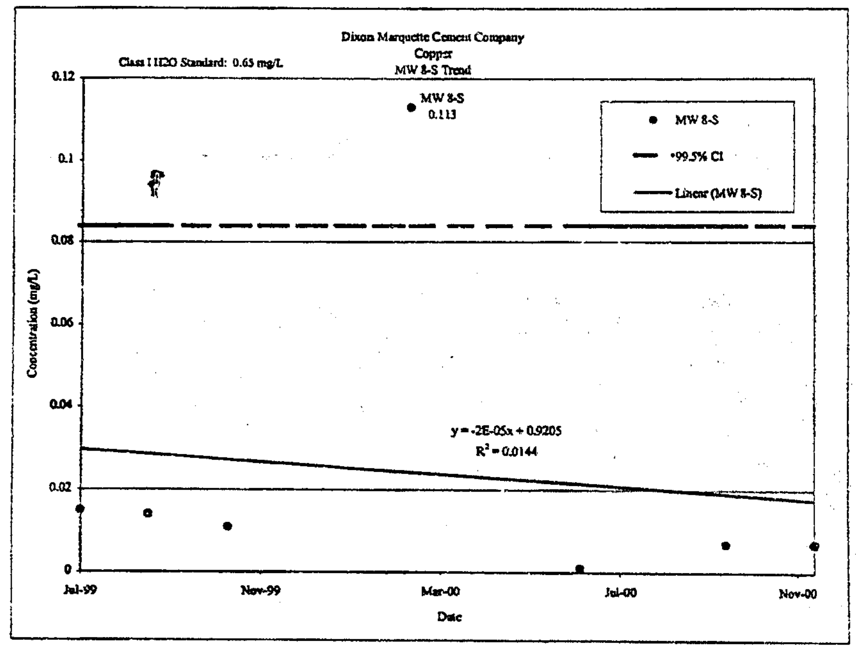
Dixon Marquette Cement Company
Copper
MW 5-S Trend
Class I H2O Standard 0.65 mg/L
MW 5-S
*99.5% CI
Linear (MW 5-S)
y = -6E-06x + 0.2384
R² = 0.0551
Concentration (mg/L)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date



Dixon Marquette Cement Company
Copper
MW 6-S Trend
MW 6-S
*99.5% CI
Linear (MW 6-S)
y = 1E-06x - 0.0301
R² = 0.0006
Concentration (mg/L)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

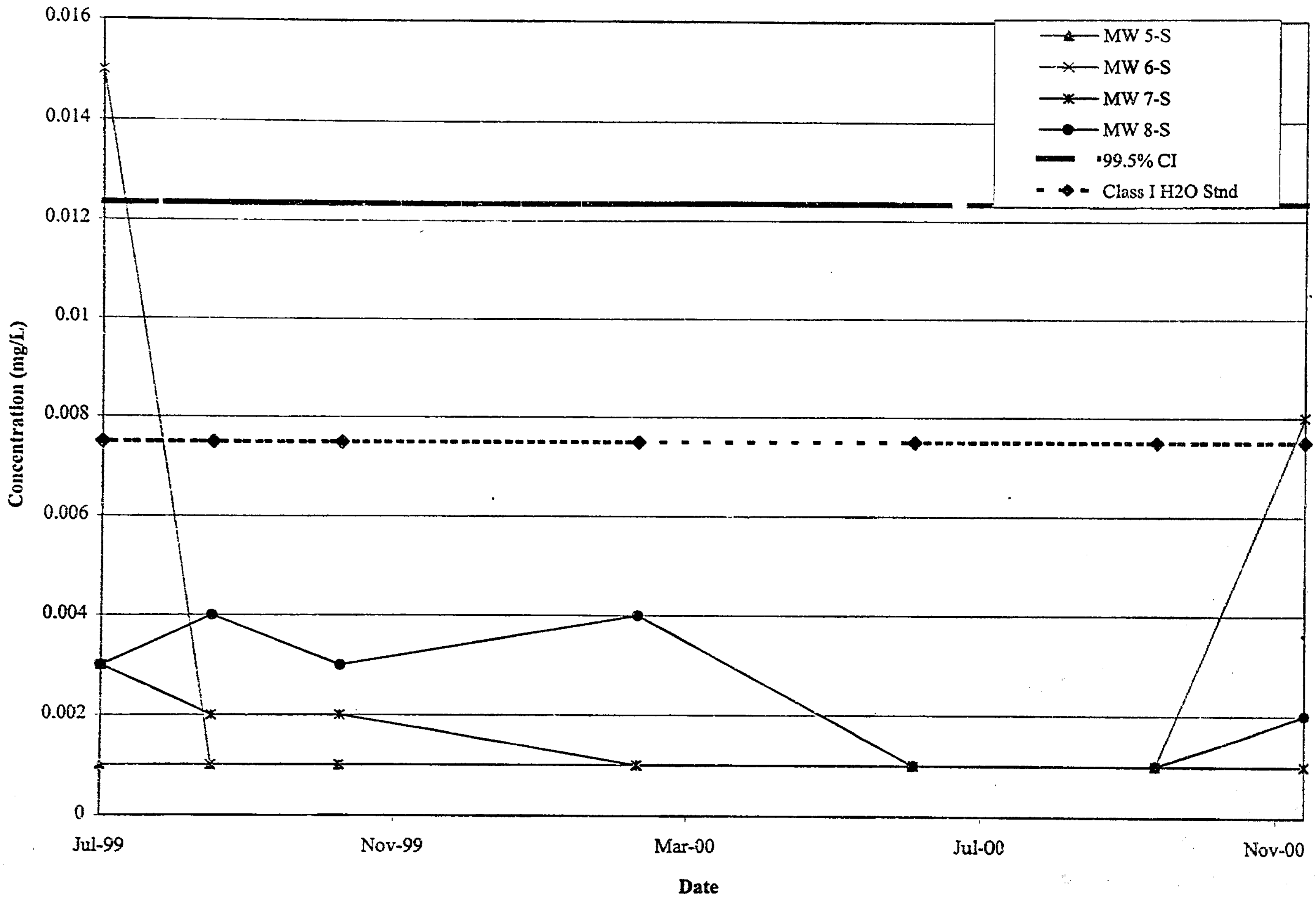


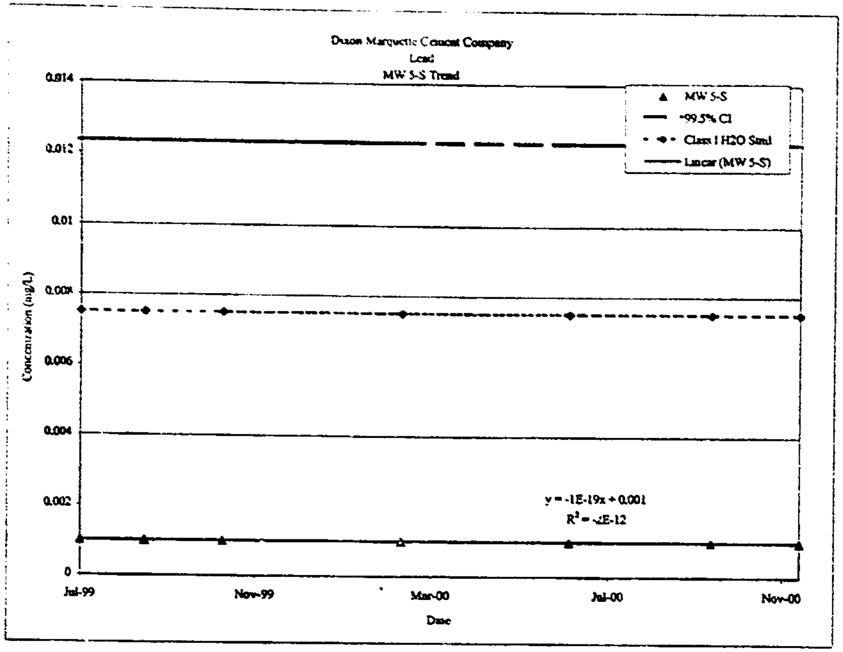
Dixon Marquette Cement Company
Copper
MW 7-S Trend
Class I H2O Standard: 0.65 mg/L
MW 7-S
*99.5% CI
Linear (MW 7-S)
y = -6E-06x + 0.2095
R² = 0.2222
Concentration (mg/L)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

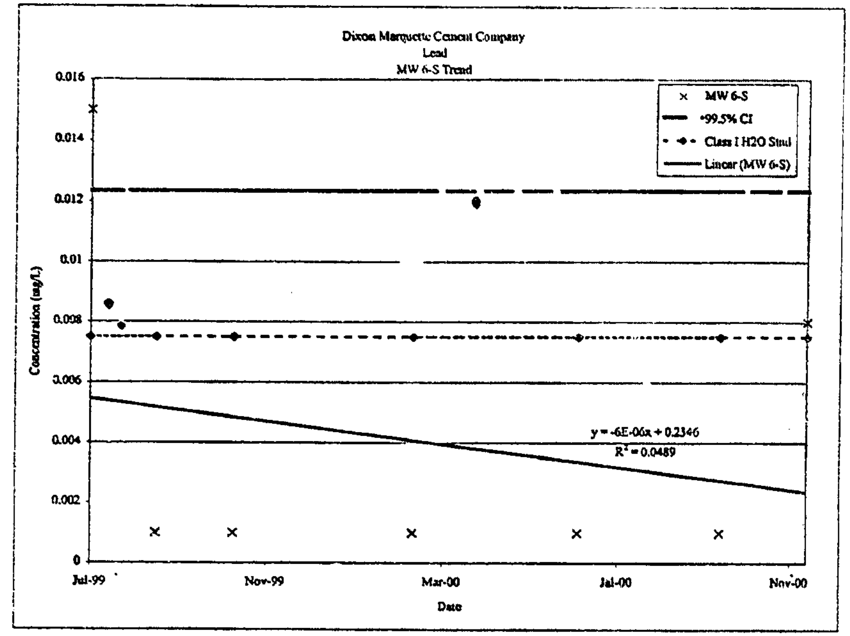


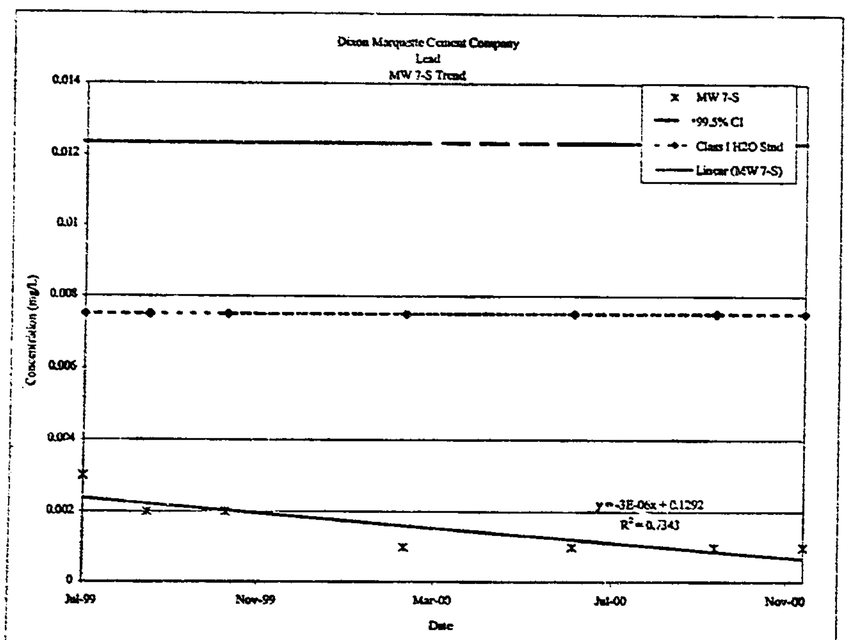
Dixon Marquette Cement Company
Copper
MW 8-S Trend
Class I H2O Standard: 0.65 mg/L
MW 8-S
0.113
MW 8-S
*99.5% CI
Linear (MW 8-S)
y = -2E-05x + 0.9205
R² = 0.0144
Concentration (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

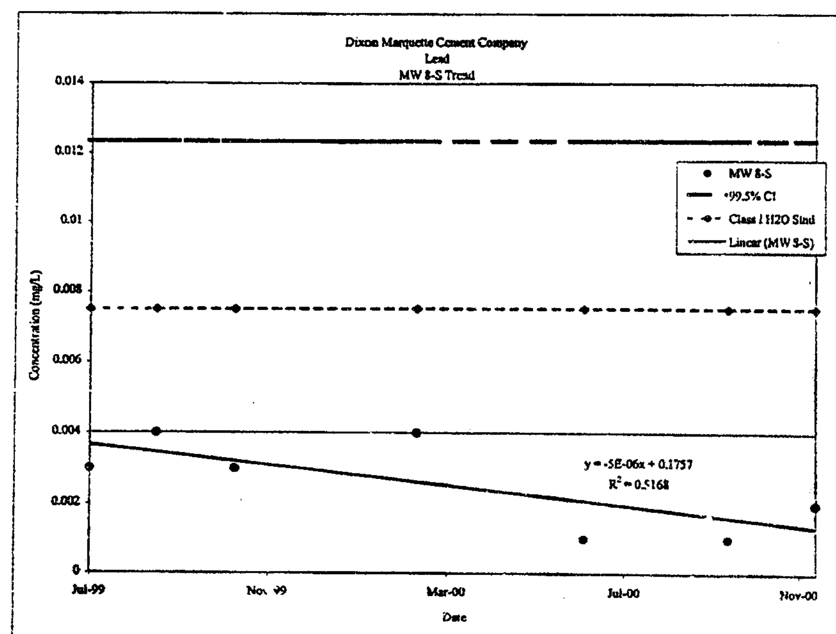
Dixon Marquette Cement Company
Lead



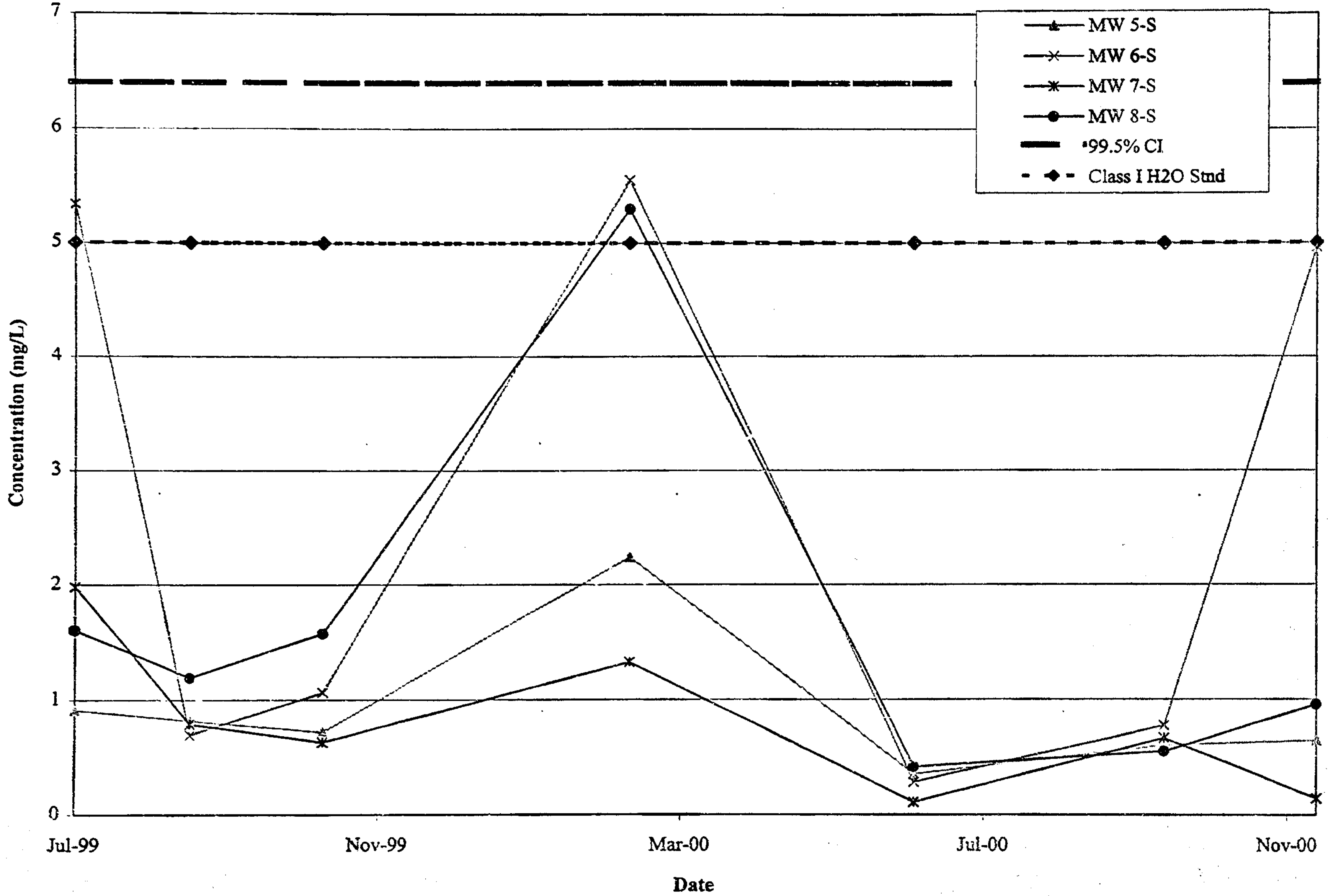

Dixon Marquette Cement Company
Lead
MW 5-S Trend
MW 5-S
+99.5% CI
Class I H2O Stnd
Linear (MW 5-S)
y = -1E-19x + 0.001
R² = -2E-12
Concentration (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

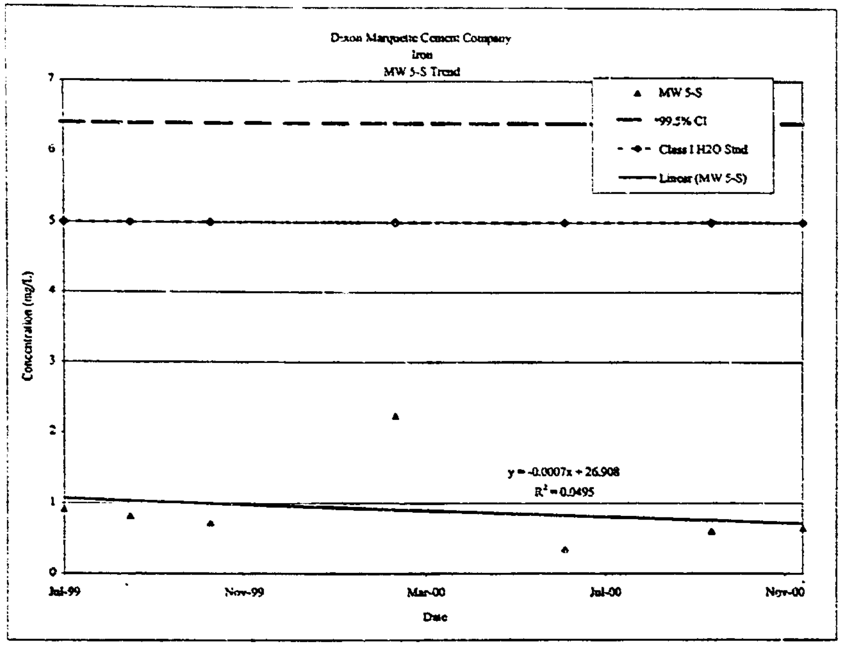

Dixon Marquette Cement Company
Lead
MW 6-S Trend
MW 6-S
+99.5% CI
Class I H2O Stnd
Linear (MW 6-S)
y = -6E-06x + 0.2346
R² = 0.0489
Concentration (mg/L)
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

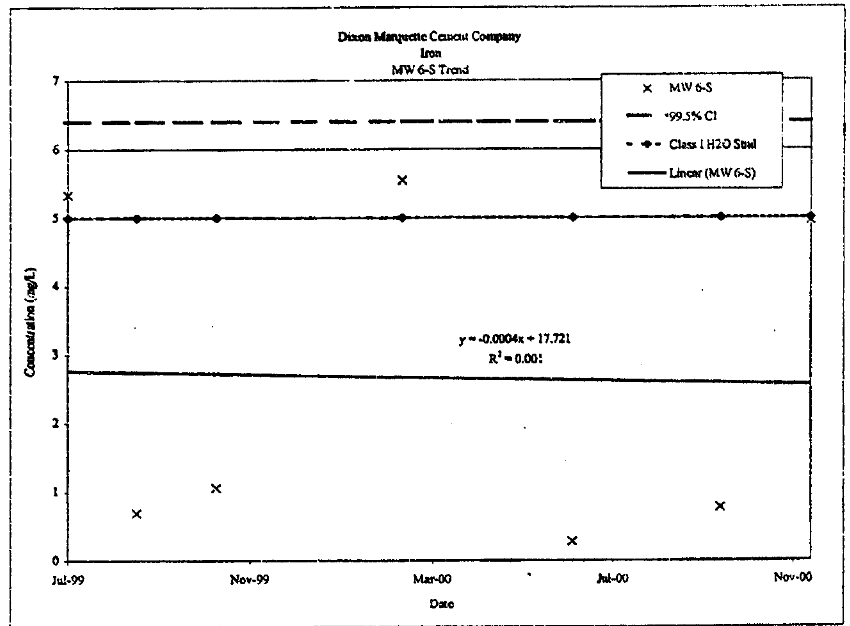

Dixon Marquette Cement Company
Lead
MW 7-S Trend
MW 7-S
+99.5% CI
Class I H2O Stnd
Linear (MW 7-S)
y = -3E-06x + 0.1292
R² = 0.7343
Concentration (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

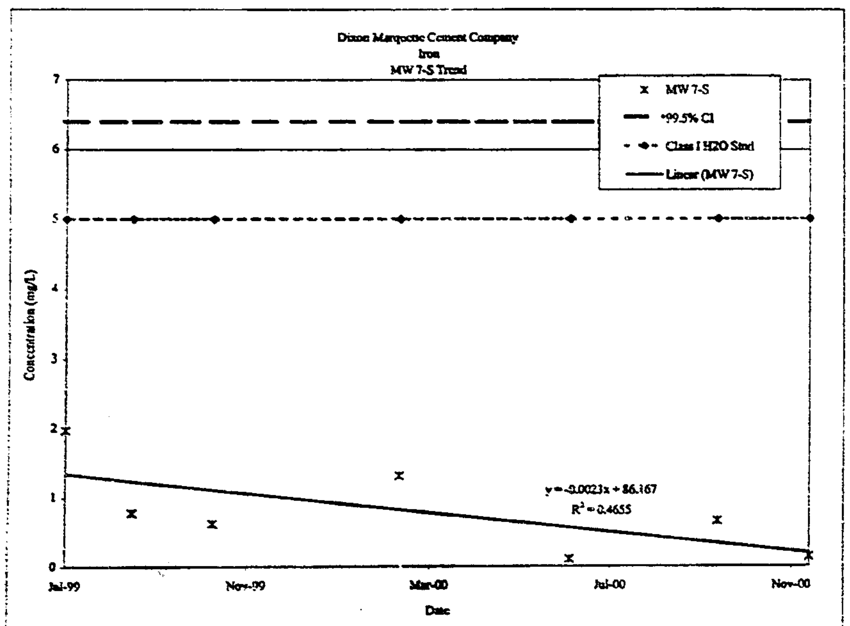

Dixon Marquette Cement Company
Lead
MW 8-S Trend
MW 8-S
+99.5% CI
Class I H2O Stnd
Linear (MW 8-S)
y = -5E-06x + 0.1757
R² = 0.5168
Concentration (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

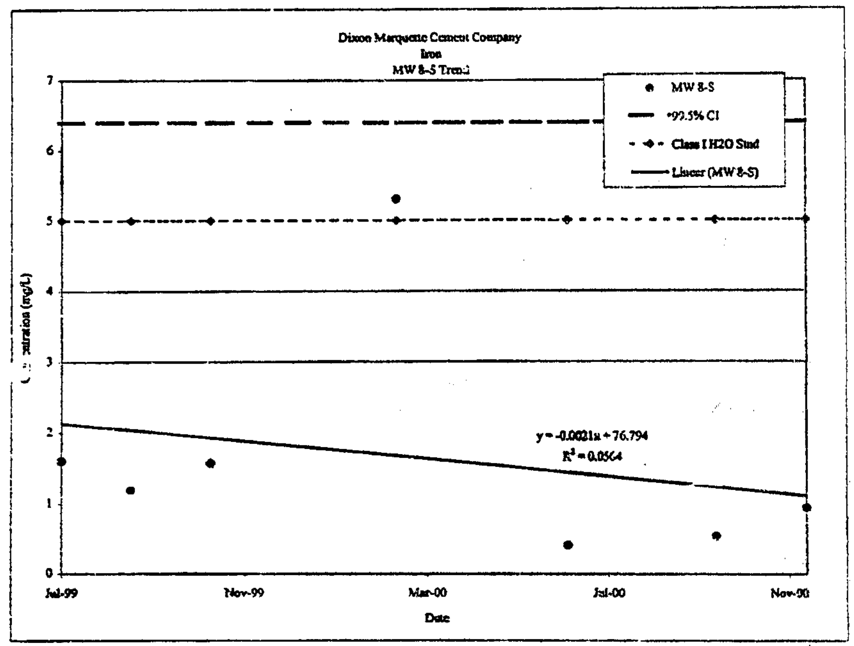
Dixon Marquette Cement Company
Iron



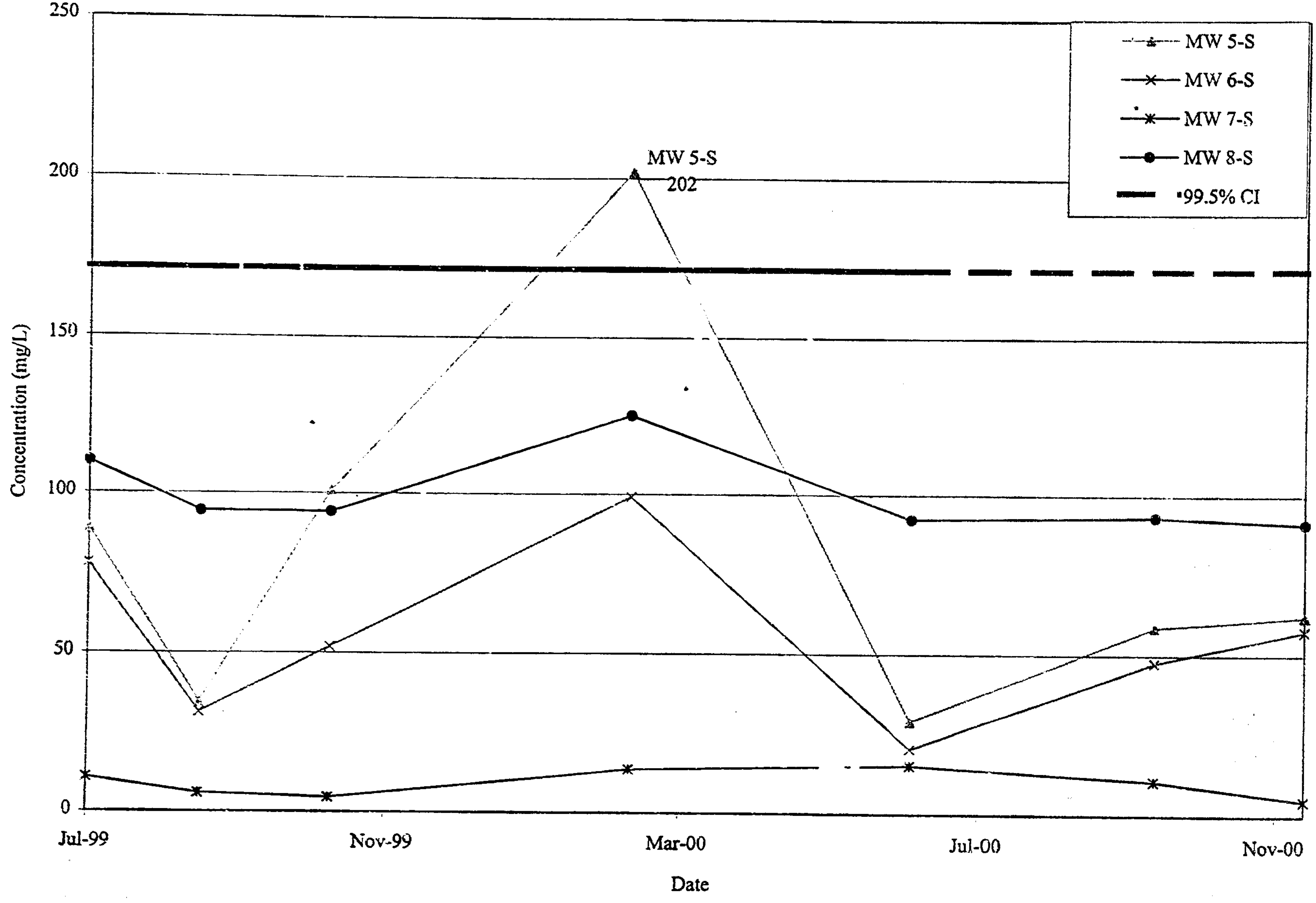

Dixon Marquette Cement Company
Iron
MW 5-S Trend
MW 5-S
+99.5% CI
Class I H2O Std
Linear (MW 5-S)
y = -0.0007x + 26.908
R² = 0.0495
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

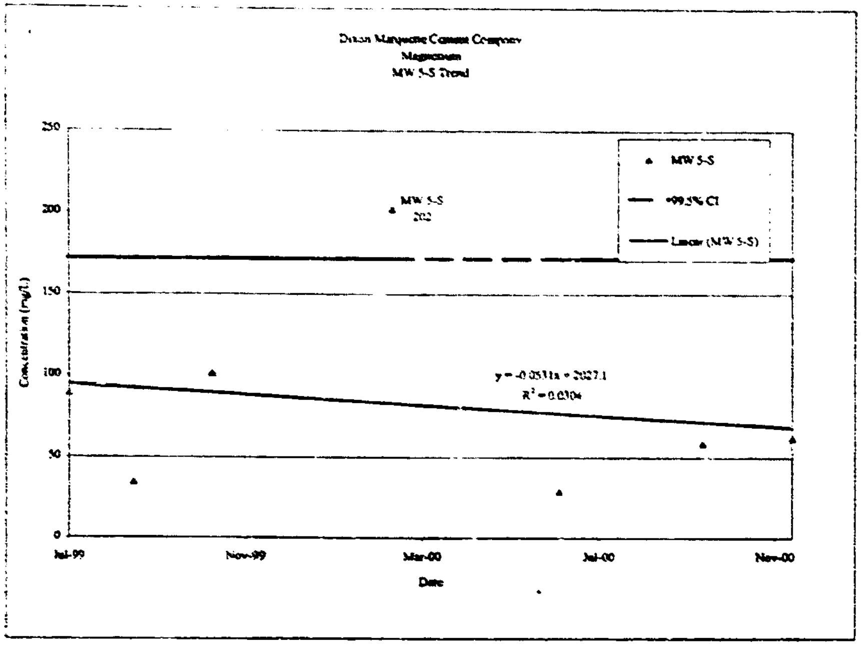

Dixon Marquette Cement Company
Iron
MW 6-S Trend
MW 6-S
+99.5% CI
Class I H2O Std
Linear (MW 6-S)
y = -0.0004x + 17.721
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

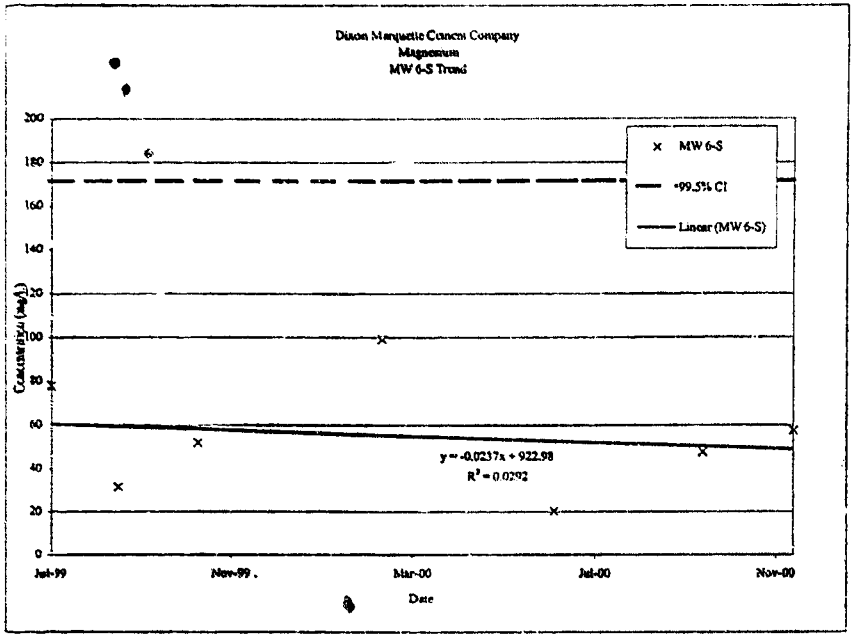

Dixon Marquette Cement Company
Iron
MW 7-S Trend
MW 7-S
+99.5% CI
Class I H2O Std
Linear (MW 7-S)
y = -0.0023x + 86.167
R² = 0.4655
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

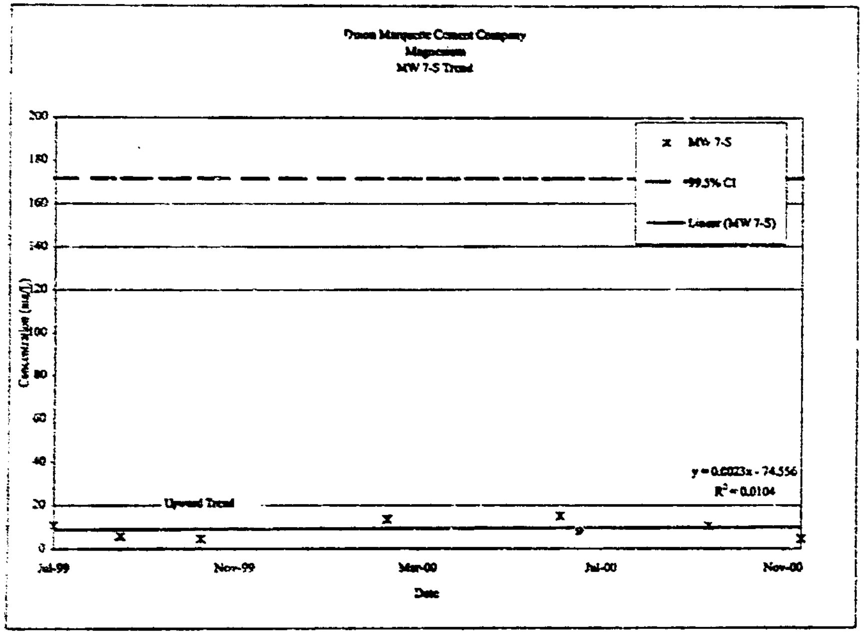

Dixon Marquette Cement Company
Iron
MW 8-S
+99.5% CI
Class I H2O Std
Linear (MW 8-S)
y = -0.0021x + 76.794
R² = 0.0564
Date
Jul-99
Nov-99
Mar-00
Jul-00

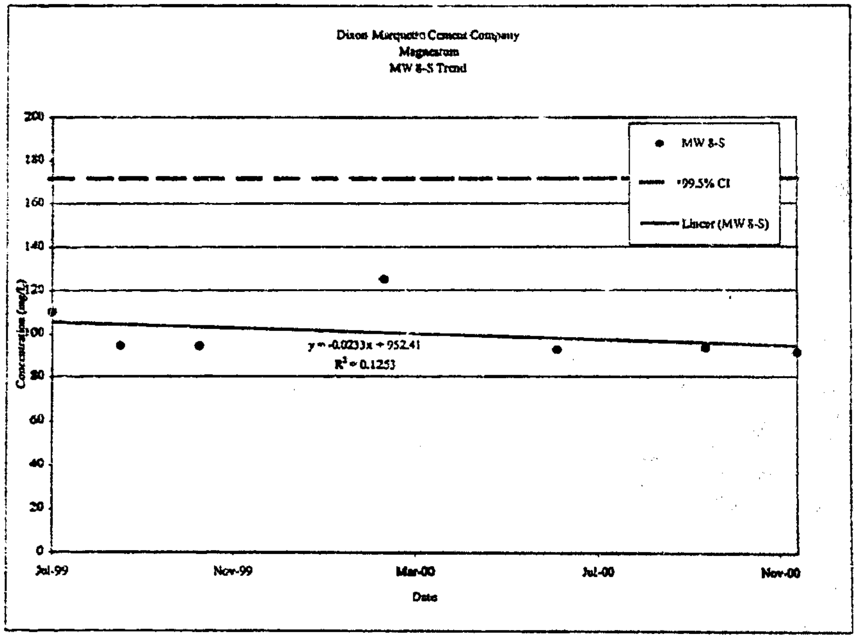
Dixon Marquette Cement Company
Magnesium

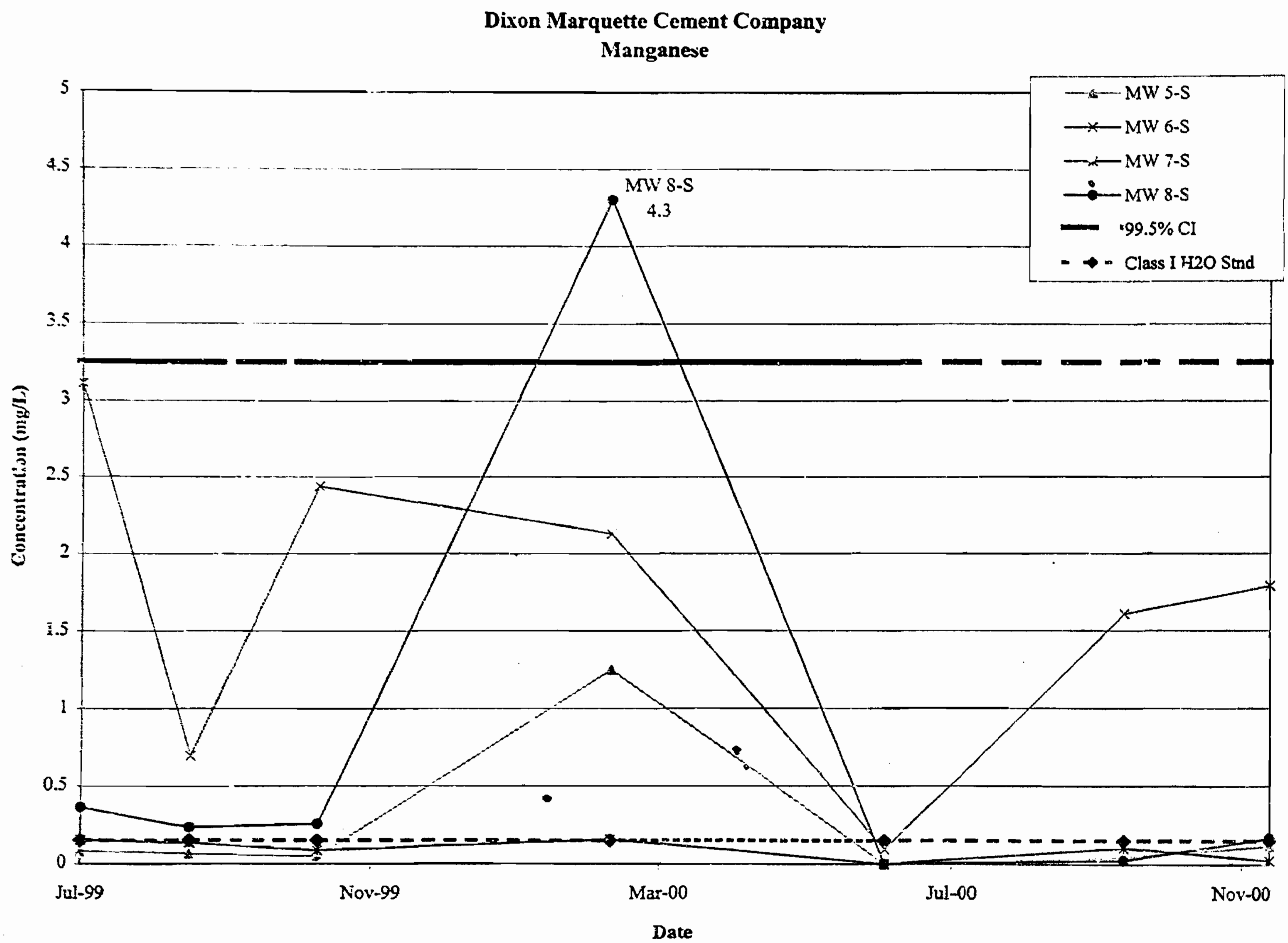



Dixon Marquette Cement Company
Magnesium
MW 5-S Trend
MW 5-S
+99.5% CI
Linear (MW 5-S)
MW 5-S
202
y = -0.0531x + 2027.1
R² = 0.0304
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

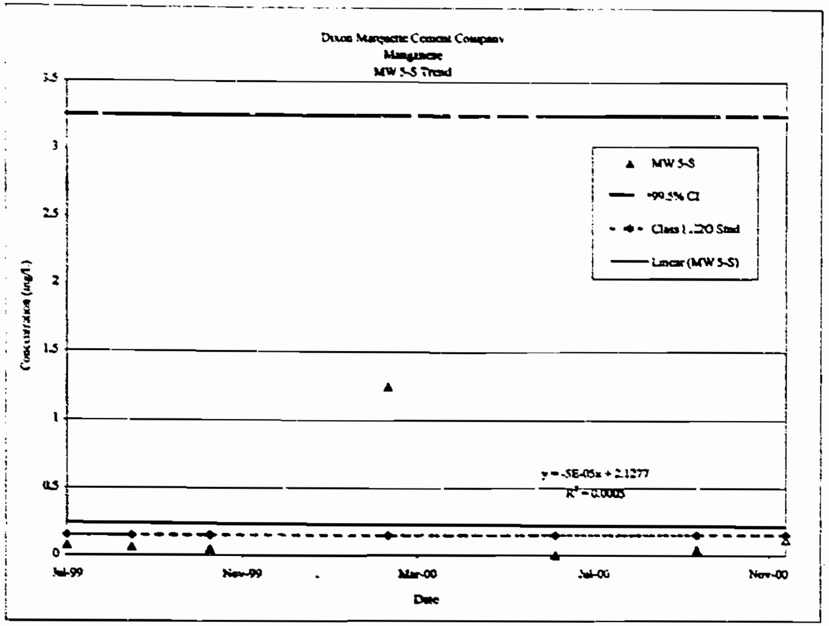

Dixon Marquette Cement Company
Magnesium
MW 6-S Trend
MW 6-S
+99.5% CI
Linear (MW 6-S)
y = -0.0237x + 922.98
R² = 0.0292
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

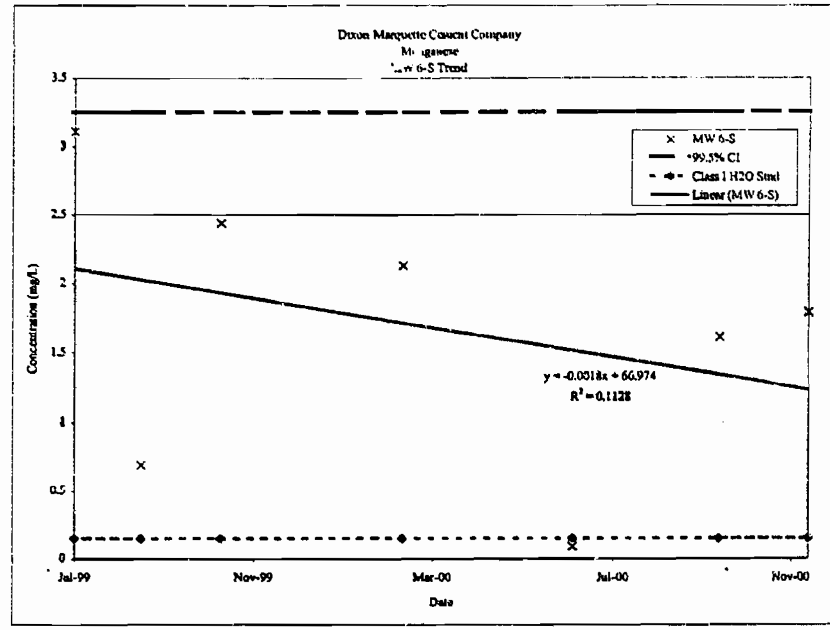

Dixon Marquette Cement Company
Magnesium
MW 7-S Trend
MW 7-S
+99.5% CI
Linear (MW 7-S)
y = 0.0023x - 74.556
R² = 0.0104
Upward Trend
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

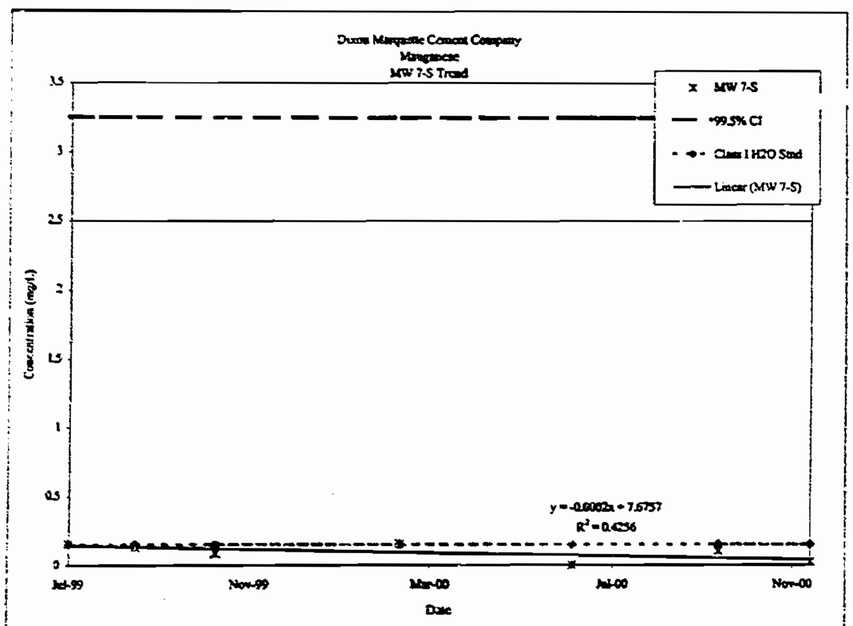

Dixon Marquette Cement Company
Magnesium
MW 8-S Trend
MW 8-S
+99.5% CI
Linear (MW 8-S)
y = -0.0233x + 952.41
R² = 0.1253
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

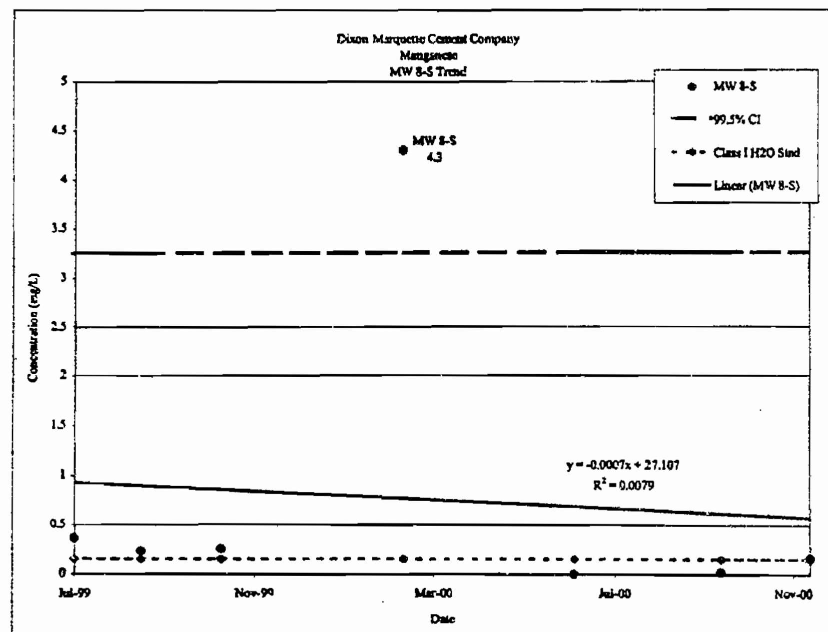


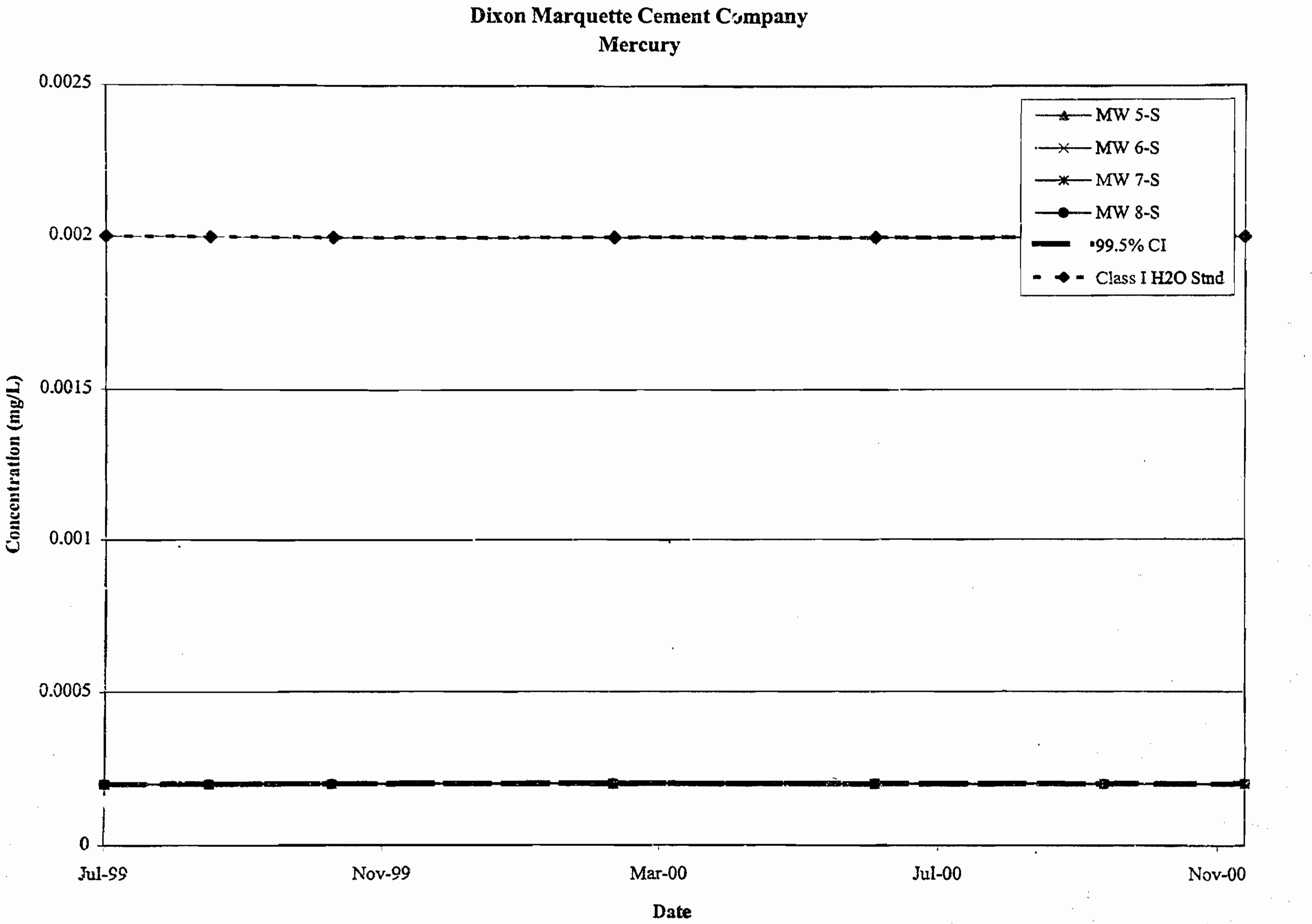
Dixon Marquette Cement Company
Manganese
MW 5-S
MW 6-S
MW 7-S
MW 8-S
99.5% CI
Class I H2O Stnd
MW 8-S
4.3
Concentration (mg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
Manganese
MW 5-S Trend
MW 5-S
+99.5% CI
Class I H2O Stnd
Linear (MW 5-S)
y = -5E-05x + 2.1277
R² = 0.0005
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

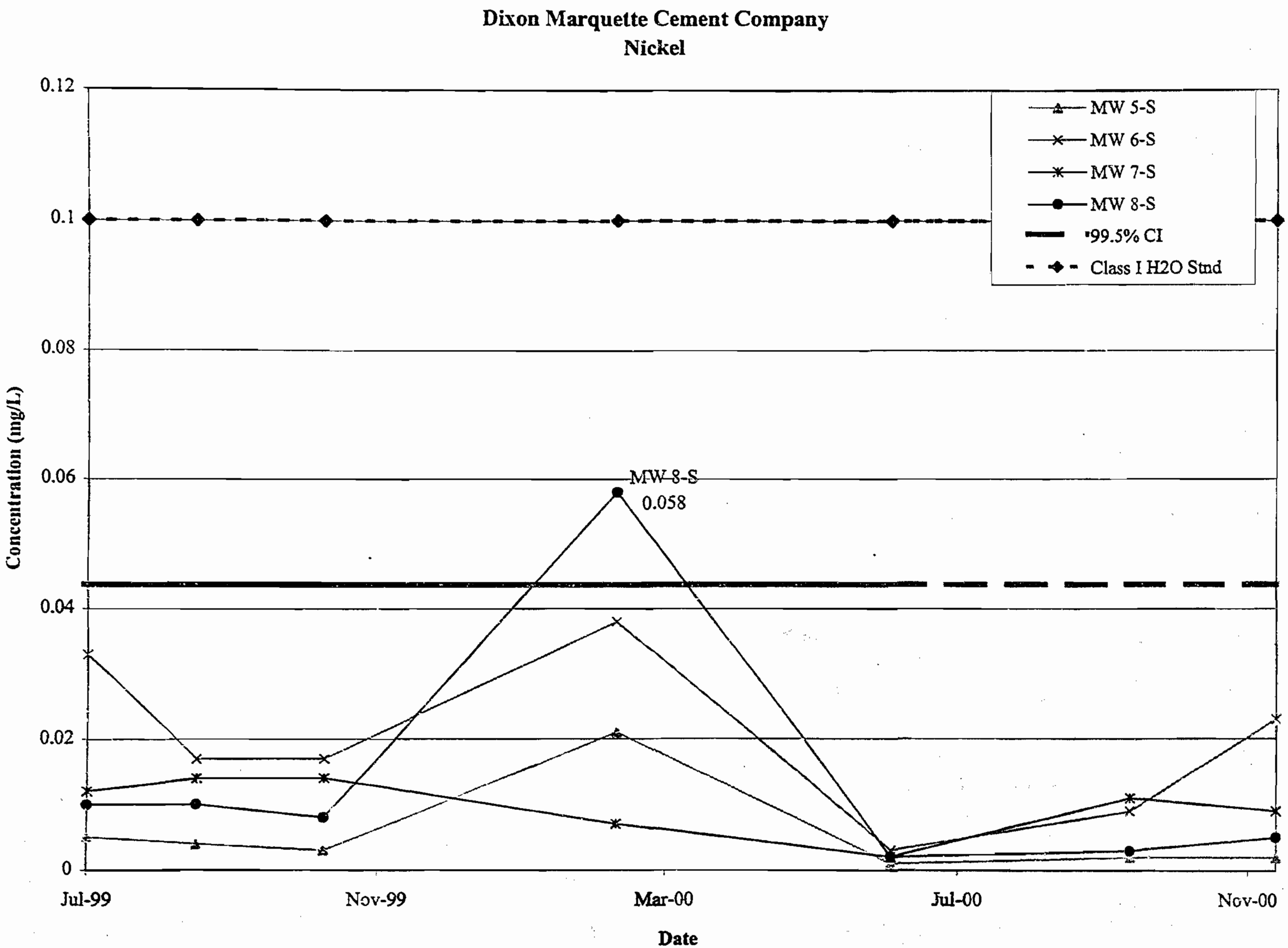

Dixon Marquette Cement Company
MW 6-S Trend
MW 6-S
+99.5% CI
Class I H2O Stnd
Linear (MW 6-S)
y = -0.0018x + 66.974
R² = 0.1128
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
Manganese
MW 7-S Trend
MW 7-S
+99.5% CI
Class I H2O Stnd
Linear (MW 7-S)
y = -0.0002x + 7.6757
R² = 0.4256
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

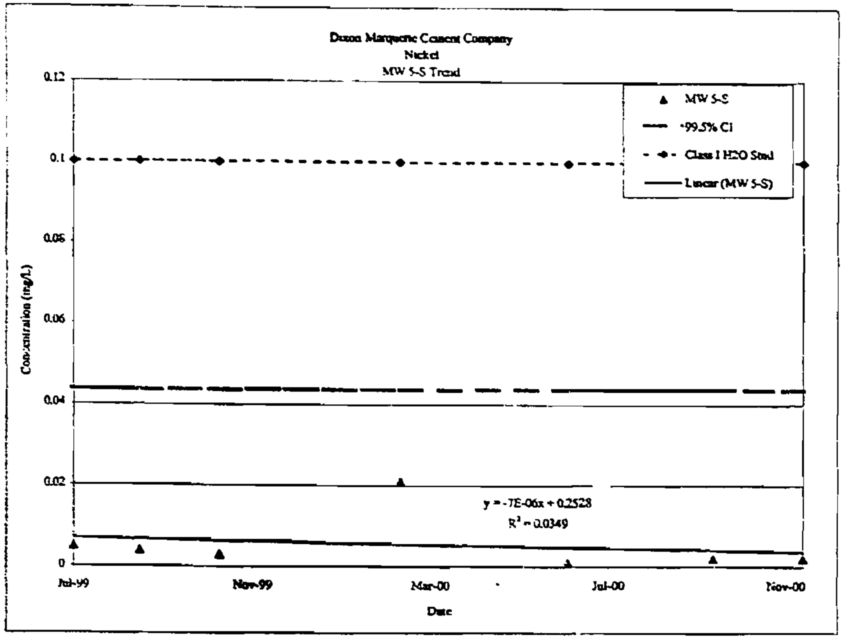

Dixon Marquette Cement Company
Manganese
MW 8-S Trend
MW 8-S
+99.5% CI
Class I H2O Stnd
Linear (MW 8-S)
MW 8-S
4.3
y = -0.0007x + 27.107
R² = 0.0079
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

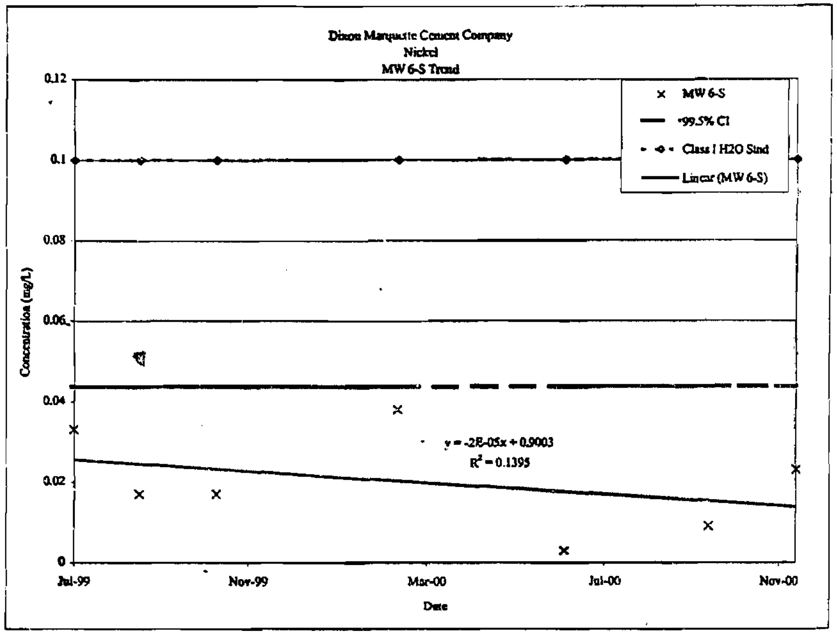


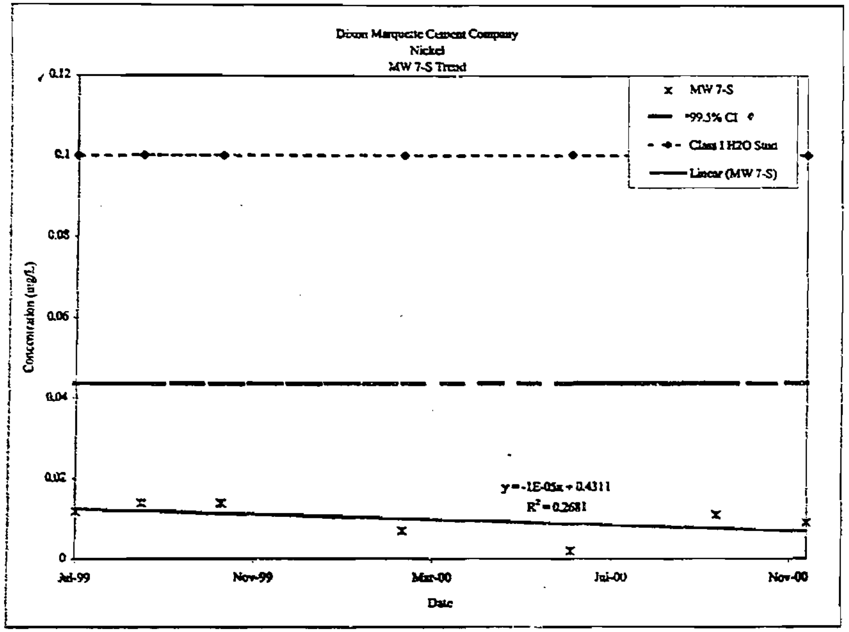
Dixon Marquette Cement Company
Mercury
0.0025
0.002
0.0015
0.001
0.0005
0
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 5-S
MW 6-S
MW 7-S
MW 8-S
99.5% CI
Class I H2O Stnd

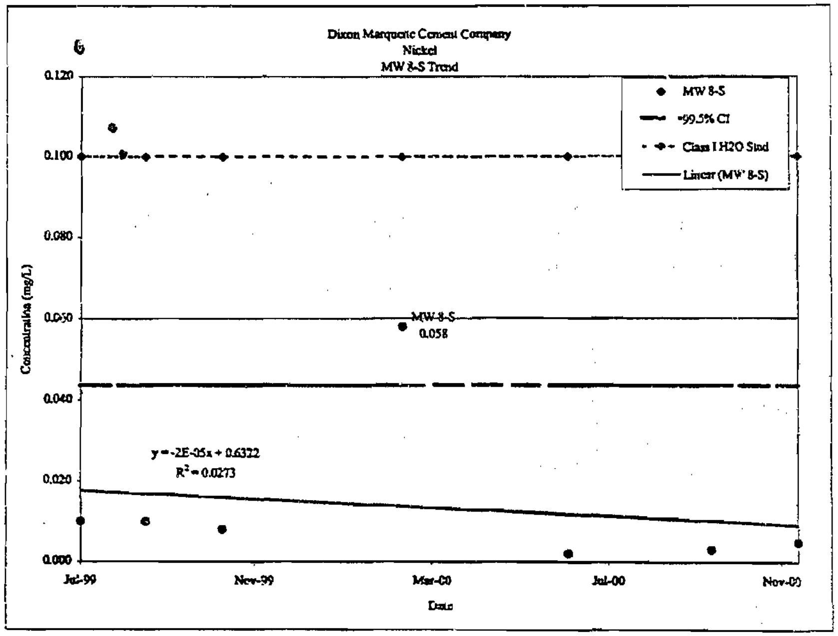


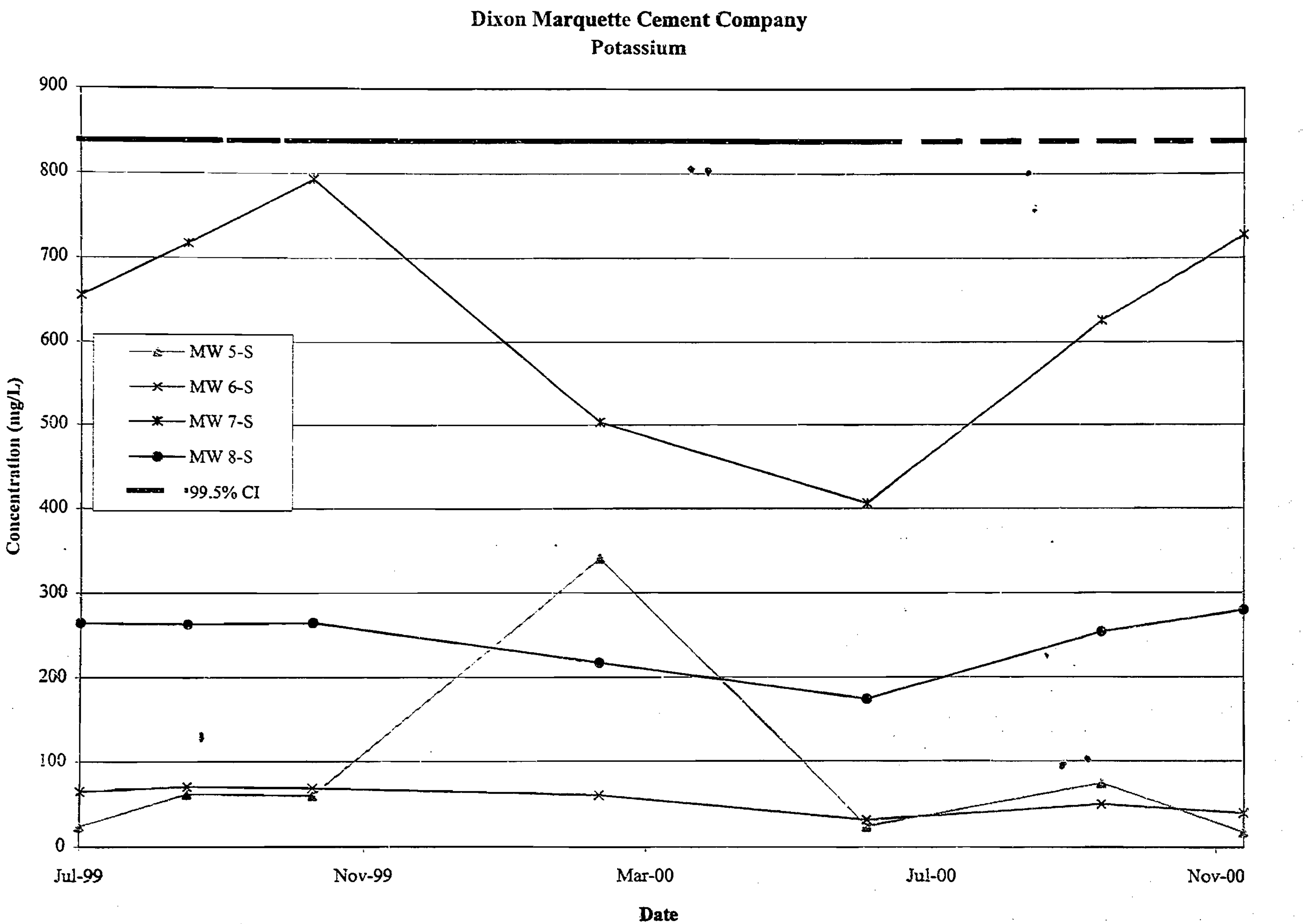
Dixon Marquette Cement Company
Nickel
Concentration (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
MW 5-S
MW 6-S
MW 7-S
MW 8-S
99.5% CI
Class I H2O Stnd
MW 8-S
0.058
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
Nickel
MW 5-S Trend
Concentration (mg/L)
Date
MW 5-S
+99.5% CI
Class I H2O Stnd
Linear (MW 5-S)
y = -7E-06x + 0.2528
R² = 0.0349
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

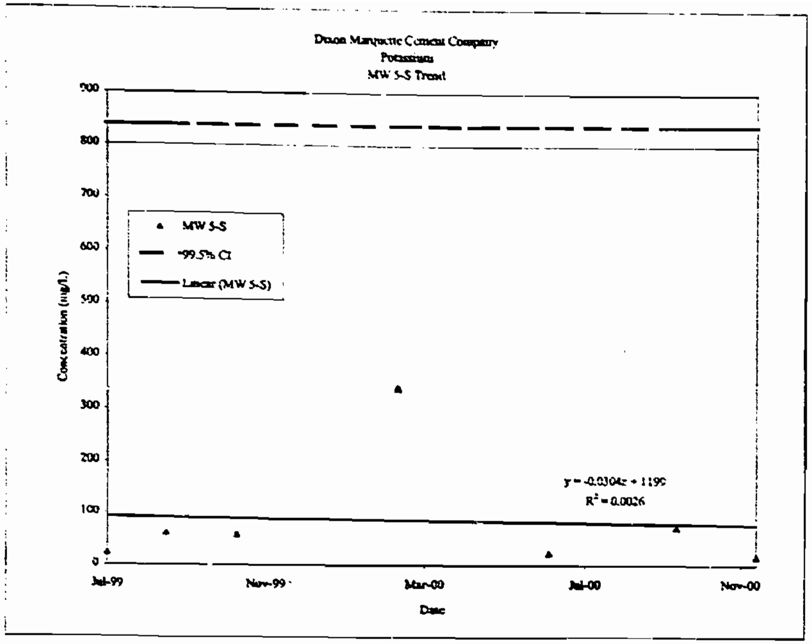

Dixon Marquette Cement Company
Nickel
MW 6-S Trend
Concentration (mg/L)
Date
MW 6-S
+99.5% CI
Class I H2O Stnd
Linear (MW 6-S)
y = -2E-05x + 0.9003
R² = 0.1395
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

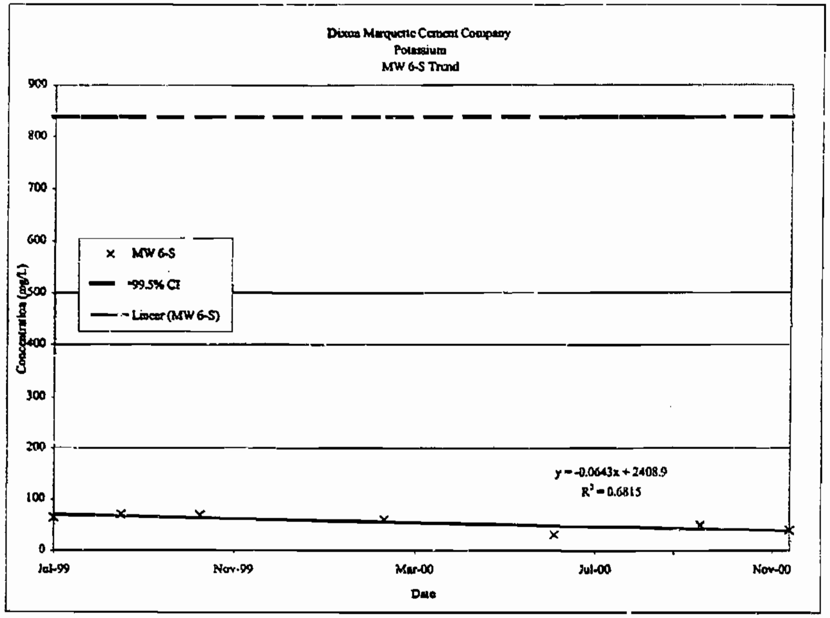

Dixon Marquette Cement Company
Nickel
MW 7-S Trend
Concentration (mg/L)
Date
MW 7-S
+99.5% CI
Class I H2O Stnd
Linear (MW 7-S)
y = -1E-05x + 0.4311
R² = 0.2681
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

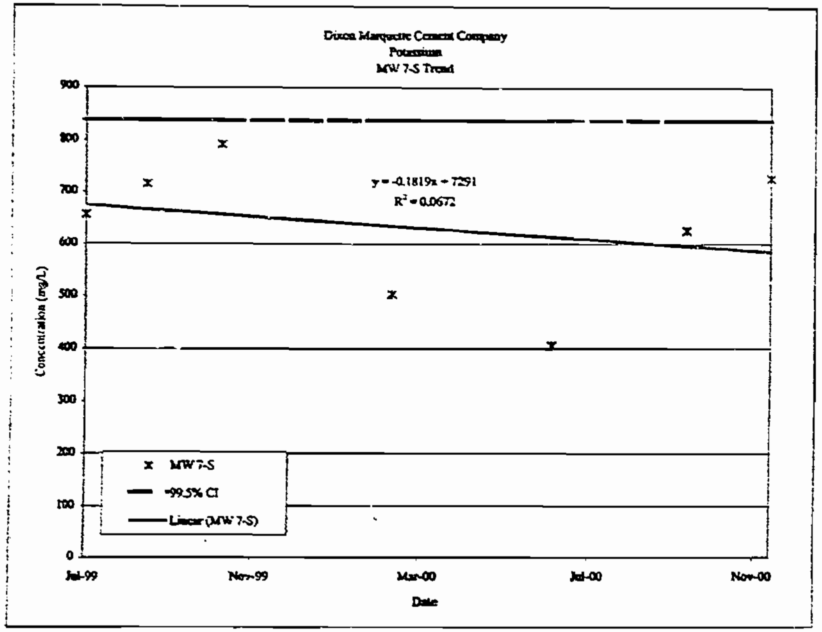

Dixon Marquette Cement Company
Nickel
MW 8-S Trend
Concentration (mg/L)
Date
MW 8-S
+99.5% CI
Class I H2O Stnd
Linear (MW 8-S)
MW 8-S
0.058
y = -2E-05x + 0.6322
R² = 0.0273
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

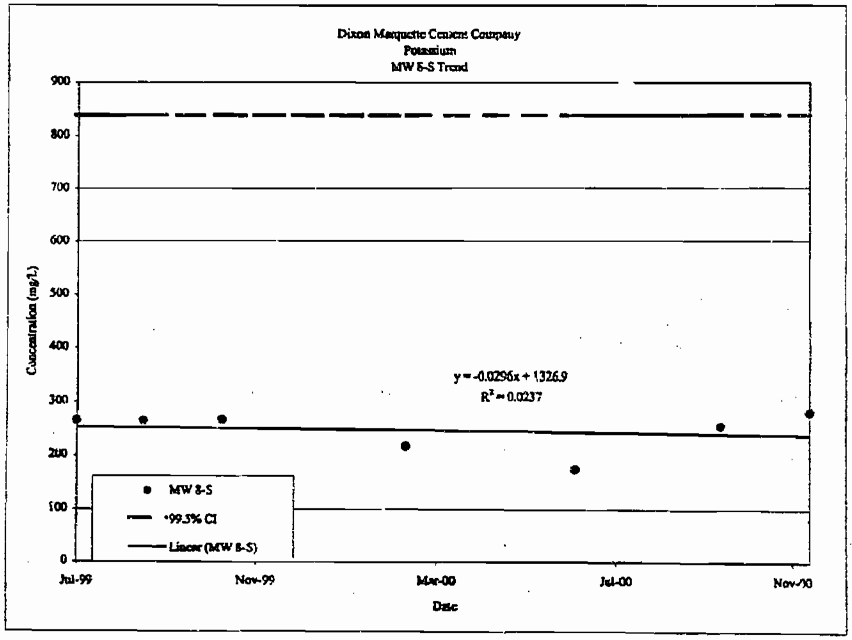


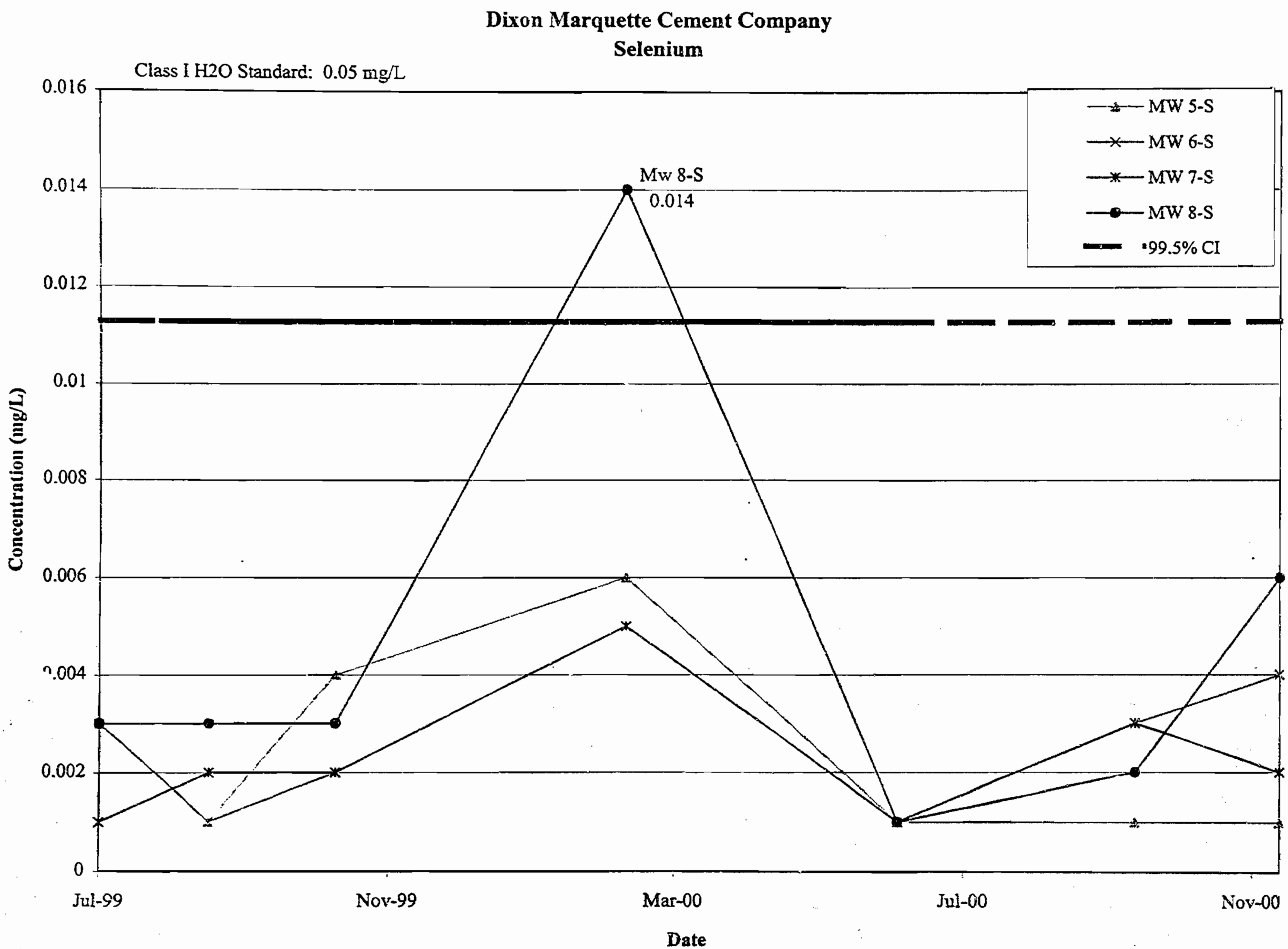
Dixon Marquette Cement Company
Potassium
900
800
700
600
500
400
300
200
100
0
Concentration (mg/L)
MW 5-S
MW 6-S
MW 7-S
MW 8-S
99.5% CI
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
Potassium
MW 5-S Trend
Concentration (mg/L)
Date
MW 5-S
99.5% CI
Linear (MW 5-S)
y = -0.0304x + 1190
R^2 = 0.0026
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

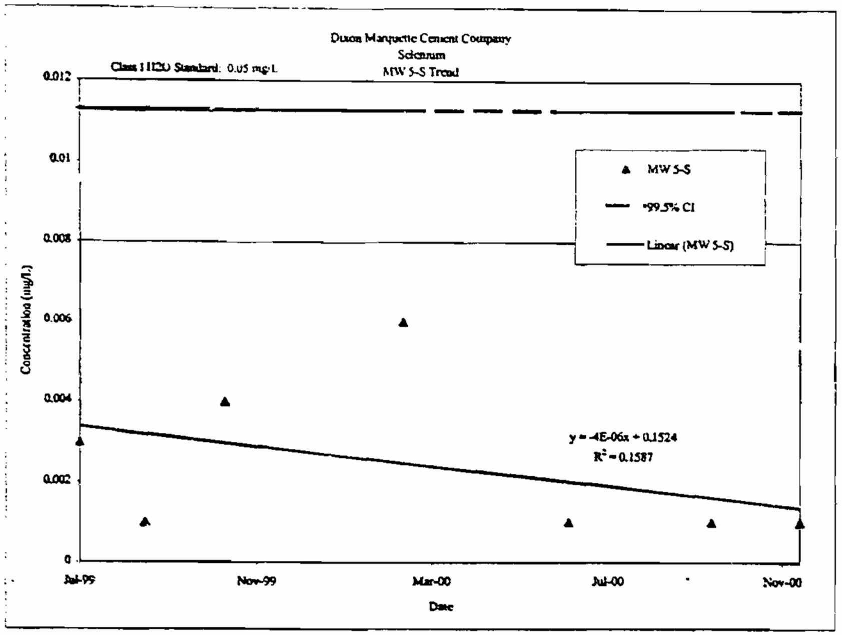

Dixon Marquette Cement Company
Potassium
MW 6-S Trend
Concentration (mg/L)
Date
MW 6-S
99.5% CI
Linear (MW 6-S)
y = -0.0643x + 2408.9
R^2 = 0.6815
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

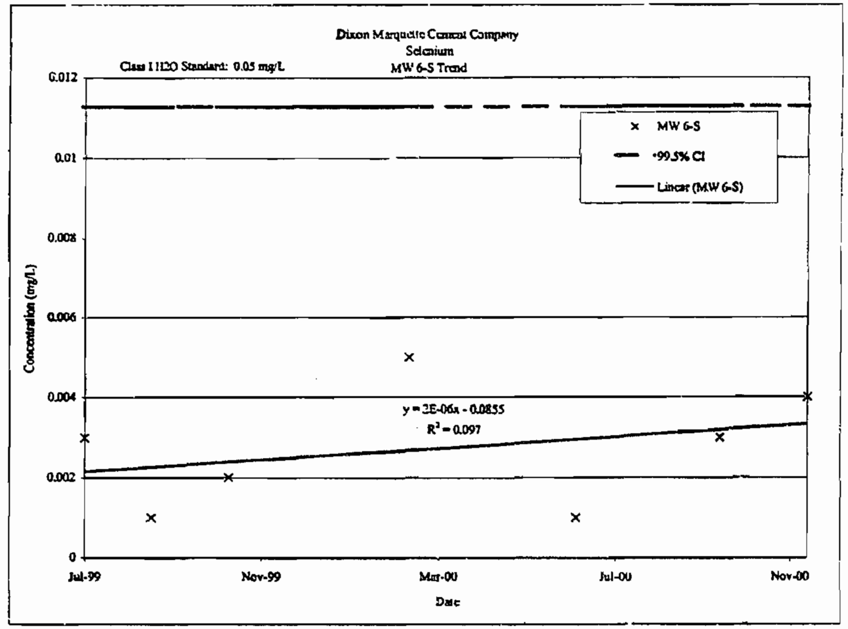

Dixon Marquette Cement Company
Potassium
MW 7-S Trend
Concentration (mg/L)
Date
MW 7-S
99.5% CI
Linear (MW 7-S)
y = -0.1819x + 7291
R^2 = 0.0672
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

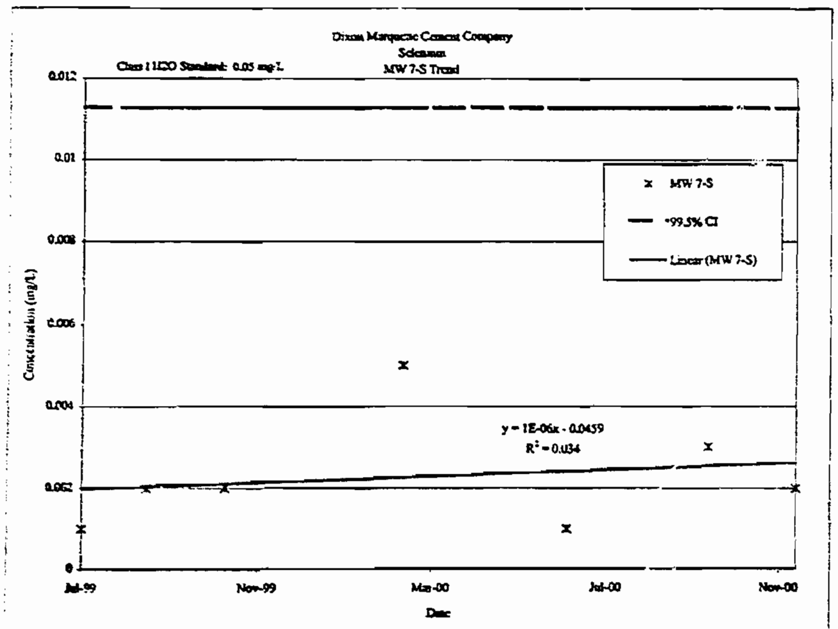

Dixon Marquette Cement Company
Potassium
MW 8-S Trend
Concentration (mg/L)
Date
MW 8-S
99.5% CI
Linear (MW 8-S)
y = -0.0296x + 1326.9
R^2 = 0.0237
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

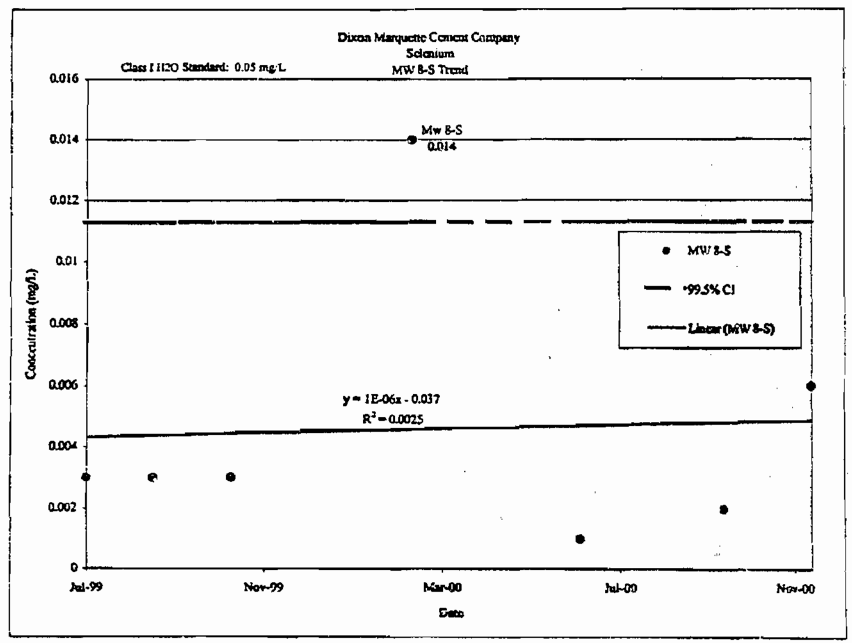


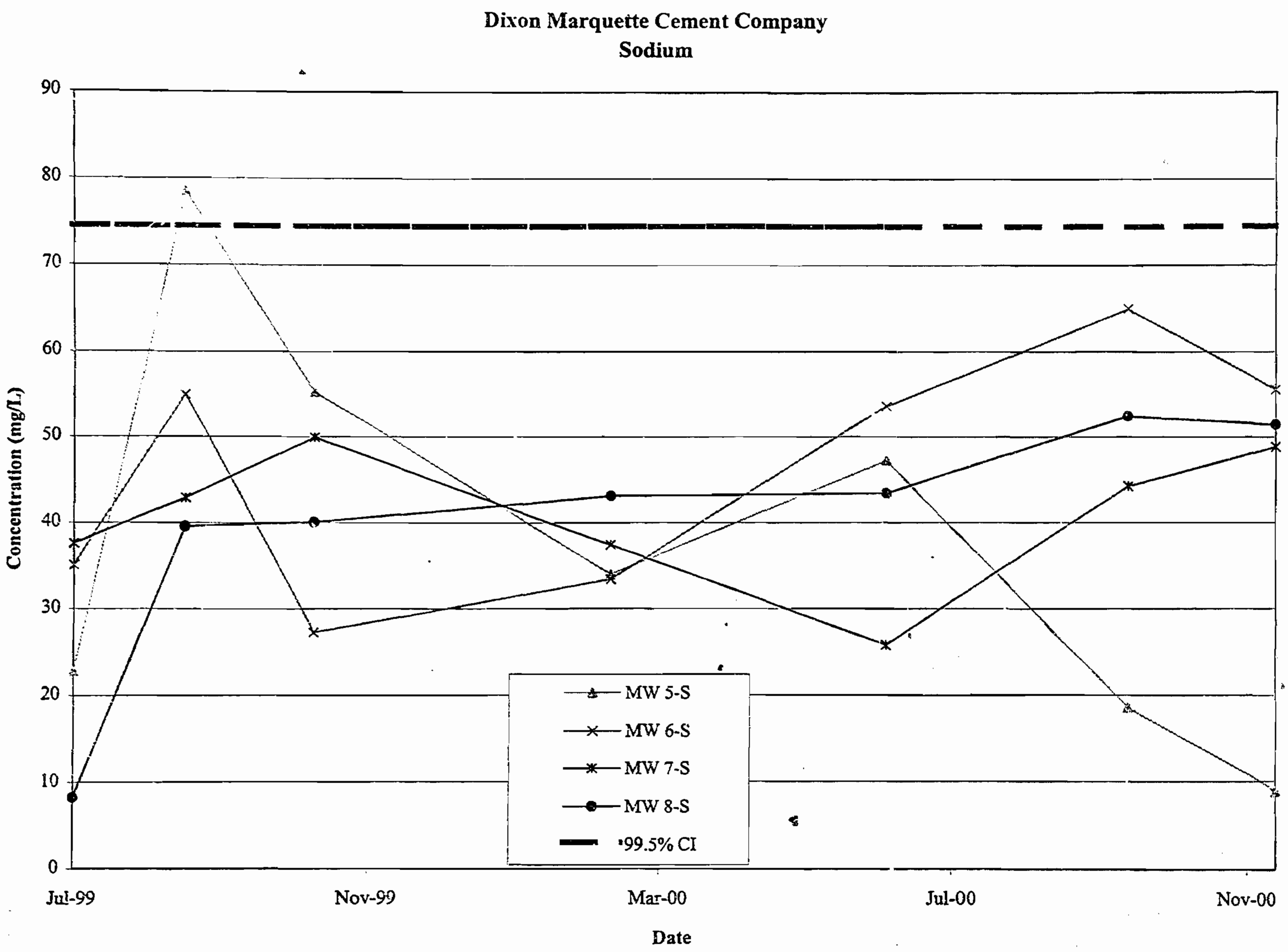
Dixon Marquette Cement Company
Selenium
Class I H2O Standard: 0.05 mg/L
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Concentration (mg/L)
Mw 8-S
0.014
MW 5-S
MW 6-S
MW 7-S
MW 8-S
99.5% CI
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
Selenium
MW 5-S Trend
Class I H2O Standard: 0.05 mg/L
MW 5-S
+99.5% CI
Linear (MW 5-S)
y = -4E-06x + 0.1524
R^2 = 0.1587
Concentration (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

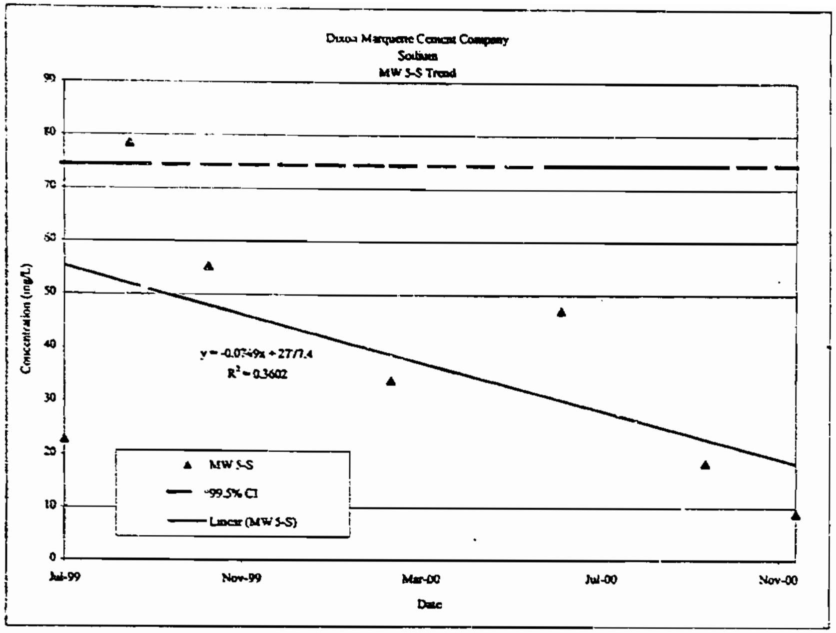

Dixon Marquette Cement Company
Selenium
MW 6-S Trend
Class I H2O Standard: 0.05 mg/L
MW 6-S
+99.5% CI
Linear (MW 6-S)
y = 2E-06x - 0.0855
R^2 = 0.097
Concentration (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

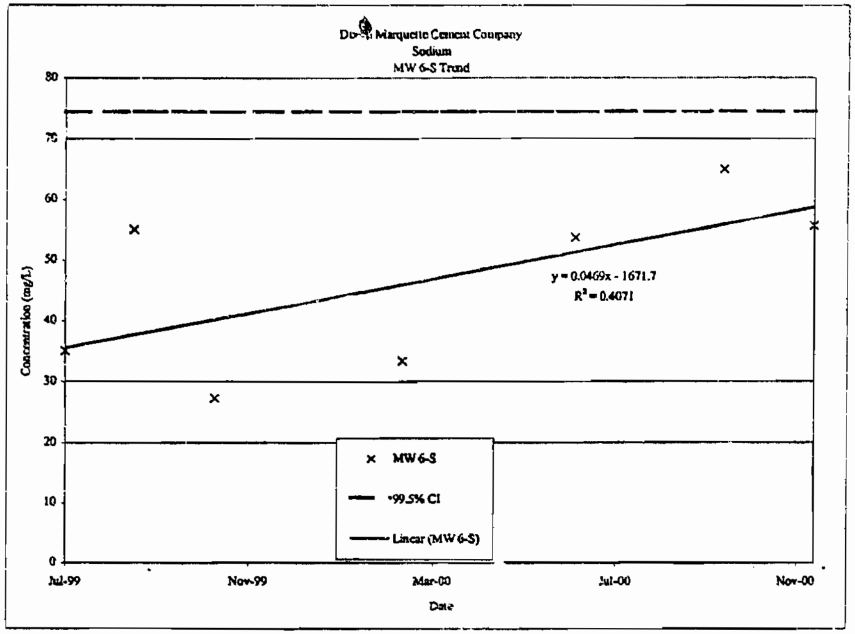

Dixon Marquette Cement Company
Selenium
MW 7-S Trend
Class I H2O Standard: 0.05 mg/L
MW 7-S
+99.5% CI
Linear (MW 7-S)
y = 1E-06x - 0.0459
R^2 = 0.034
Concentration (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

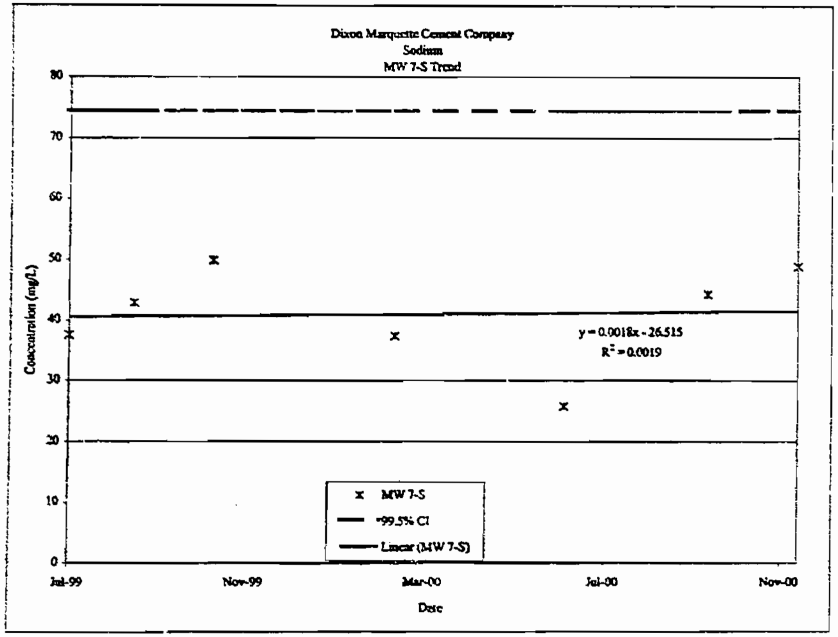

Dixon Marquette Cement Company
Selenium
MW 8-S Trend
Class I H2O Standard: 0.05 mg/L
Mw 8-S
0.014
MW 8-S
+99.5% CI
Linear (MW 8-S)
y = 1E-06x - 0.037
R^2 = 0.0025
Concentration (mg/L)
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

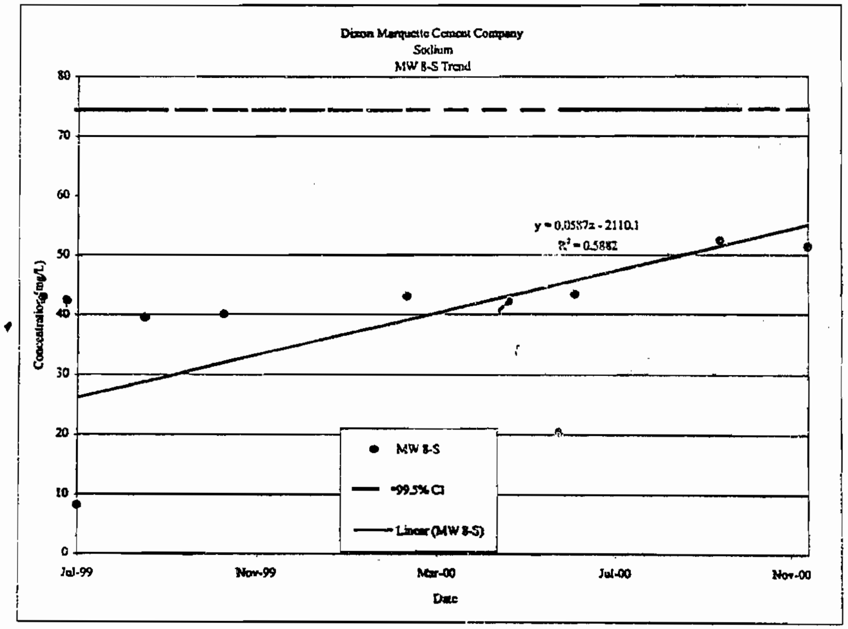


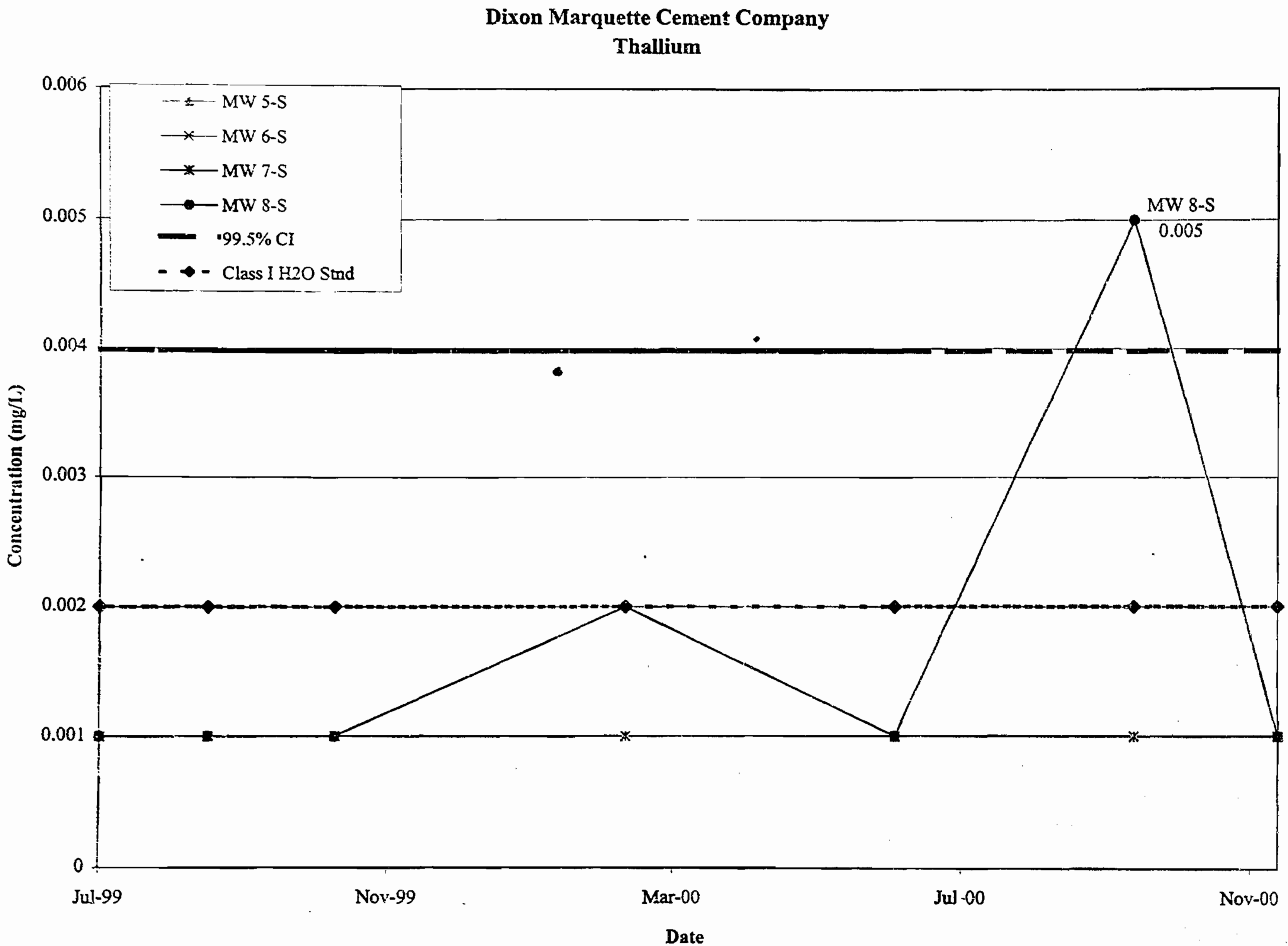
Dixon Marquette Cement Company
Sodium
Concentration (mg/L)
90
80
70
60
50
40
30
20
10
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 5-S
MW 6-S
MW 7-S
MW 8-S
99.5% CI


Dixon Marquette Cement Company
Sodium
MW 5-S Trend
Concentration (mg/L)
y = -0.0749x + 2777.4
R^2 = 0.3602
MW 5-S
+99.5% CI
Linear (MW 5-S)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

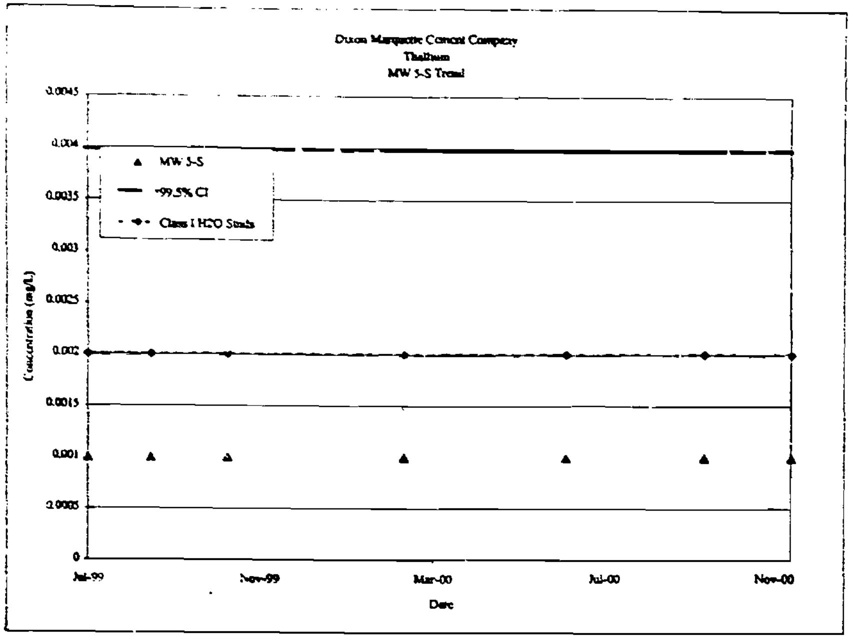

Marquette Cement Company
Sodium
MW 6-S Trend
Concentration (mg/L)
y = 0.0469x - 1671.7
R^2 = 0.4071
MW 6-S
+99.5% CI
Linear (MW 6-S)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

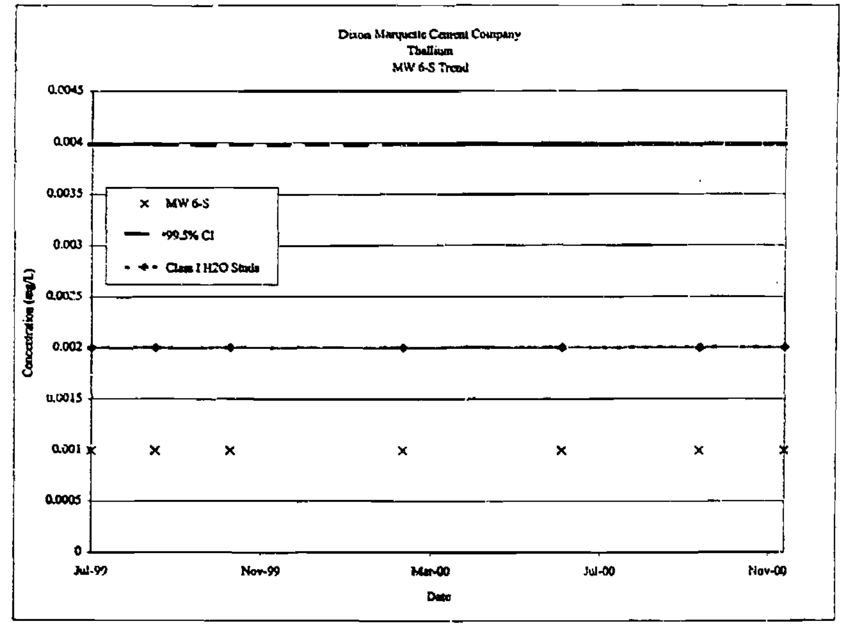

Dixon Marquette Cement Company
Sodium
MW 7-S Trend
Concentration (mg/L)
y = 0.0018x - 26.515
R^2 = 0.0019
MW 7-S
+99.5% CI
Linear (MW 7-S)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

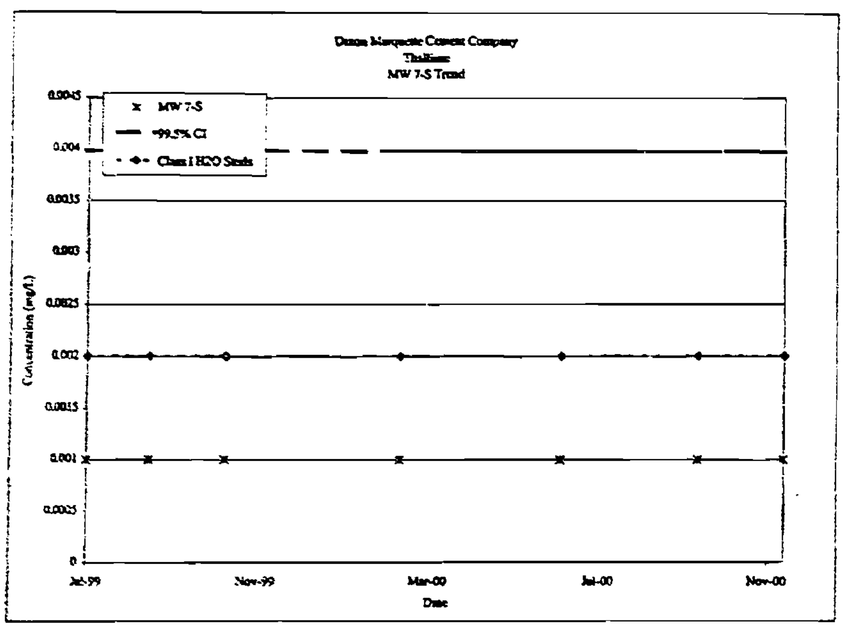

Dixon Marquette Cement Company
Sodium
MW 8-S Trend
Concentration (mg/L)
y = 0.0587x - 2110.1
R^2 = 0.5882
MW 8-S
+99.5% CI
Linear (MW 8-S)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

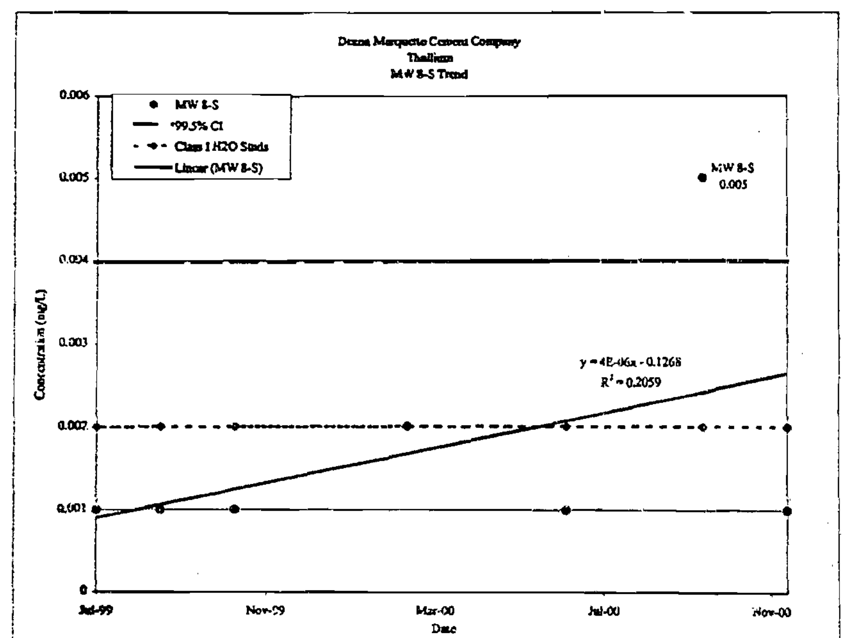


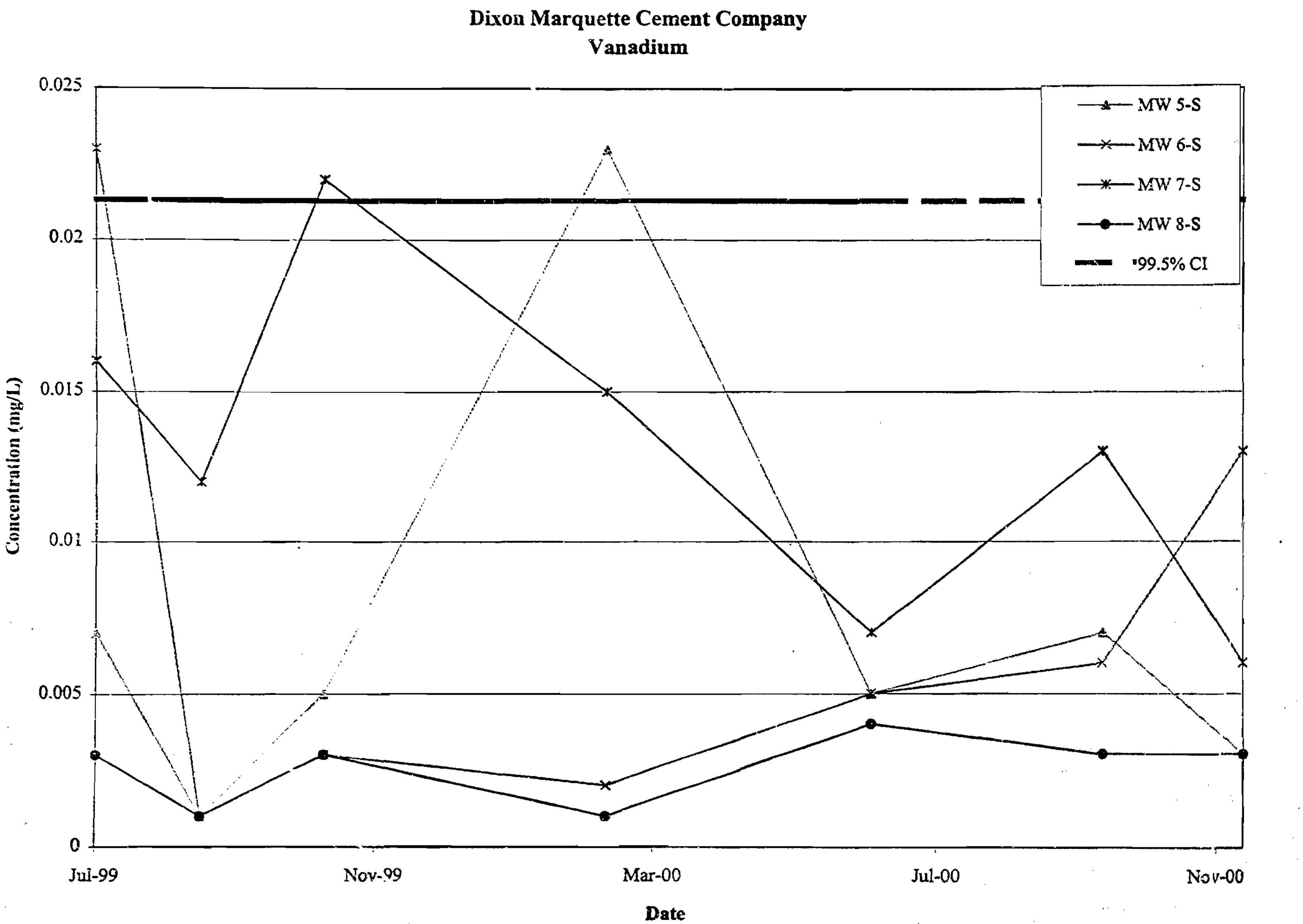
Dixon Marquette Cement Company
Thallium
MW 5-S
MW 6-S
MW 7-S
MW 8-S
99.5% CI
Class I H2O Stnd
MW 8-S
0.005
0.006
0.005
0.004
0.003
0.002
0.001
0
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
Thallium
MW 5-S Trend
MW 5-S
+99.5% CI
Class I H2O Stnds
Concentration (mg/L)
0
0.0005
0.001
0.0015
0.002
0.0025
0.003
0.0035
0.004
0.0045
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

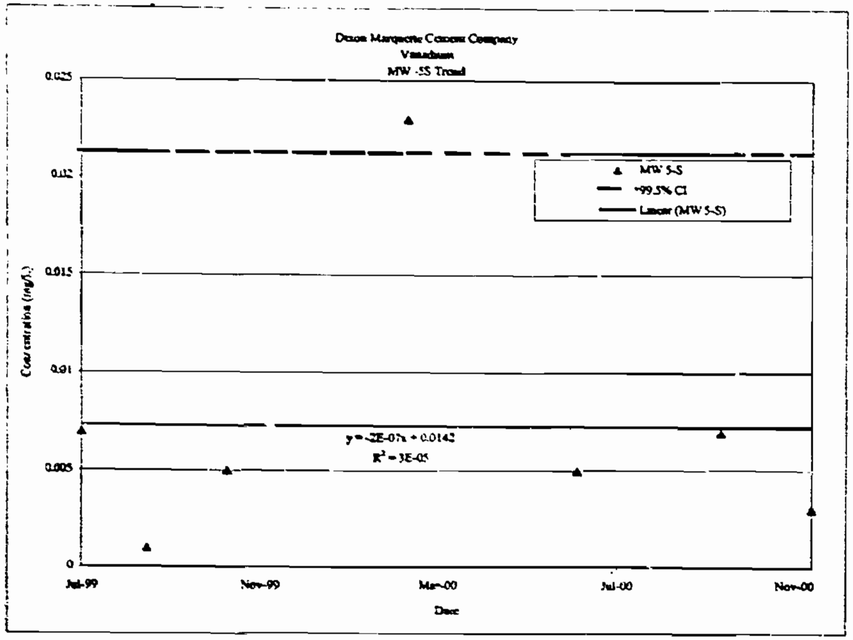

Dixon Marquette Cement Company
Thallium
MW 6-S Trend
MW 6-S
+99.5% CI
Class I H2O Stnds
Concentration (mg/L)
0
0.0005
0.001
0.0015
0.002
0.0025
0.003
0.0035
0.004
0.0045
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

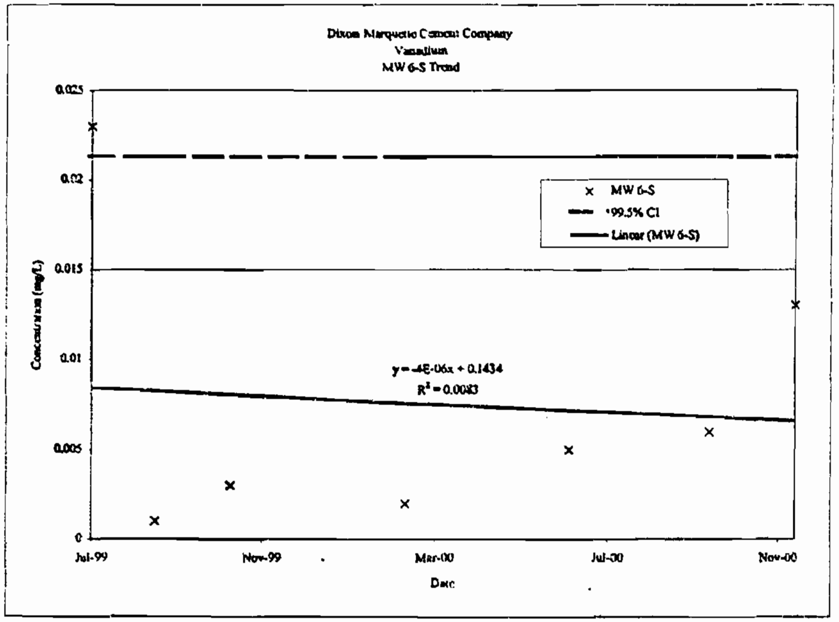

Dixon Marquette Cement Company
Thallium
MW 7-S Trend
MW 7-S
+99.5% CI
Class I H2O Stnds
Concentration (mg/L)
0
0.0005
0.001
0.0015
0.002
0.0025
0.003
0.0035
0.004
0.0045
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

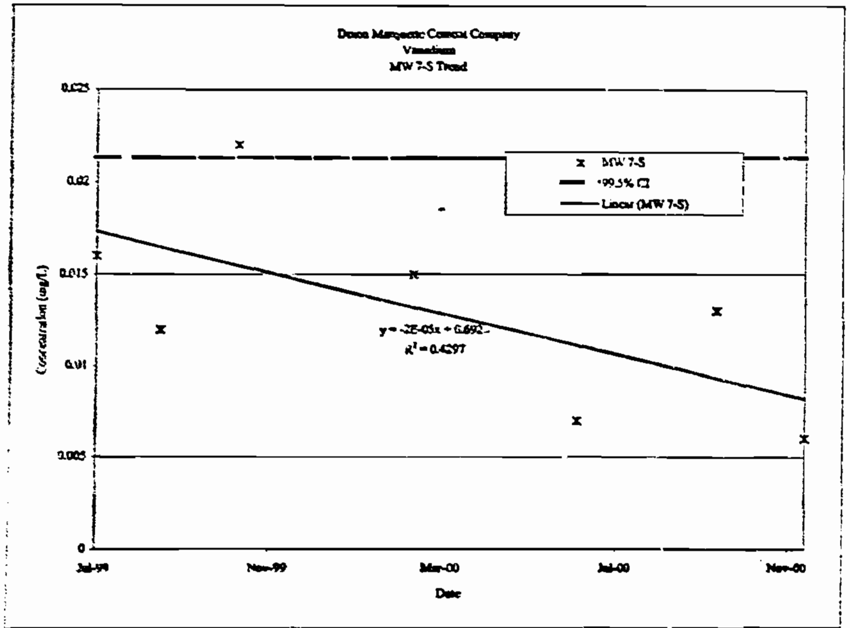

Dixon Marquette Cement Company
Thallium
MW 8-S Trend
MW 8-S
+99.5% CI
Class I H2O Stnds
Linear (MW 8-S)
MW 8-S
0.005
y = 4E-06x - 0.1268
R² = 0.2059
Concentration (mg/L)
0
0.001
0.002
0.003
0.004
0.005
0.006
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

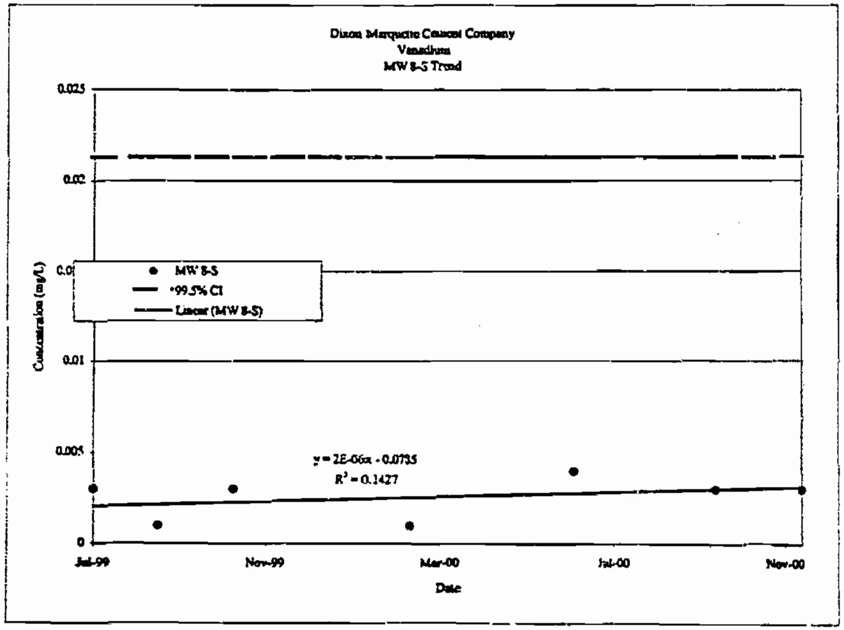


Dixon Marquette Cement Company
Vanadium
Concentration (mg/L)
0.025
0.02
0.015
0.01
0.005
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 5-S
MW 6-S
MW 7-S
MW 8-S
99.5% CI

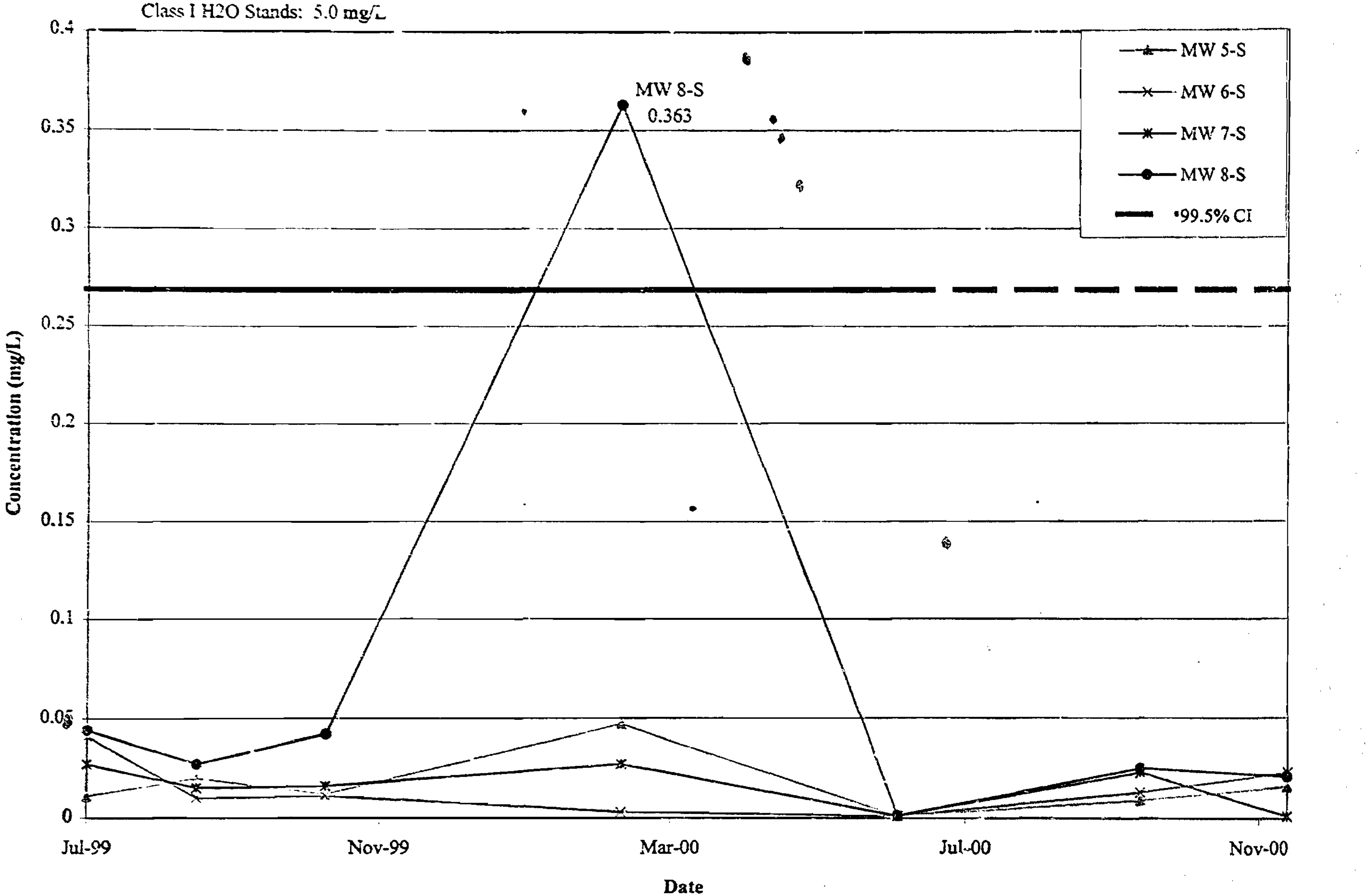

Dixon Marquette Cement Company
Vanadium
MW -5S Trend
MW 5-S
+99.5% CI
Linear (MW 5-S)
y = -2E-07x + 0.0142
R² = 3E-05
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

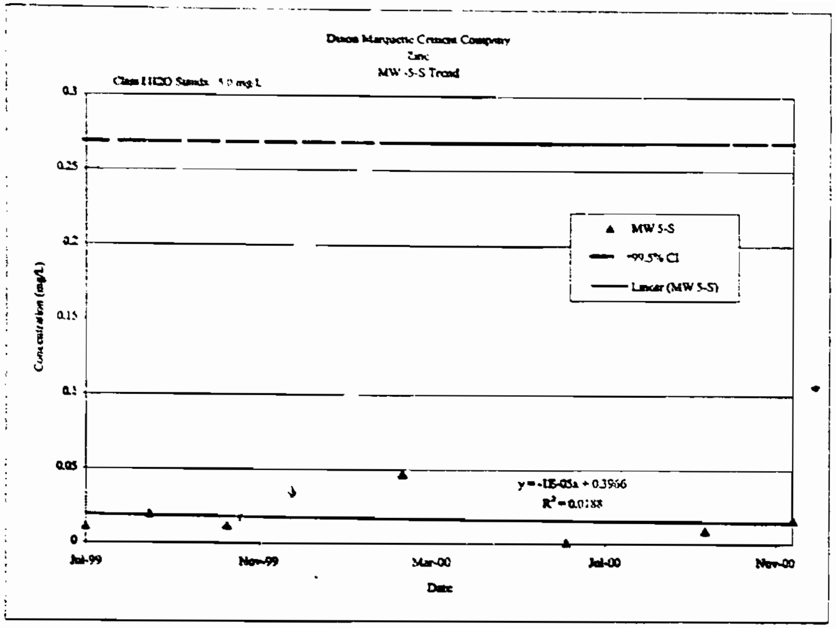

Dixon Marquette Cement Company
Vanadium
MW 6-S Trend
MW 6-S
+99.5% CI
Linear (MW 6-S)
y = -4E-06x + 0.1434
R² = 0.0083
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

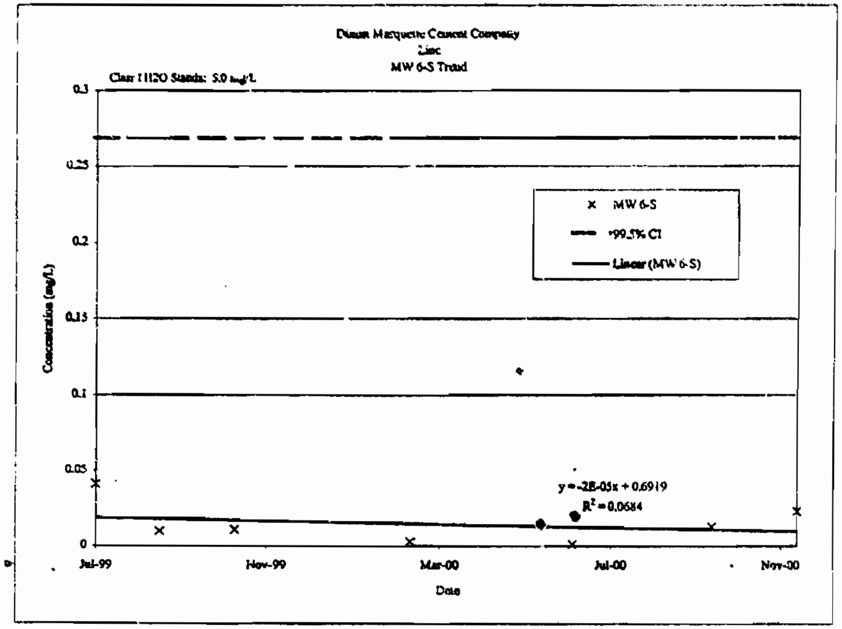

Dixon Marquette Cement Company
Vanadium
MW 7-S Trend
MW 7-S
+99.5% CI
Linear (MW 7-S)
y = -2E-05x + 0.692
R² = 0.4297
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

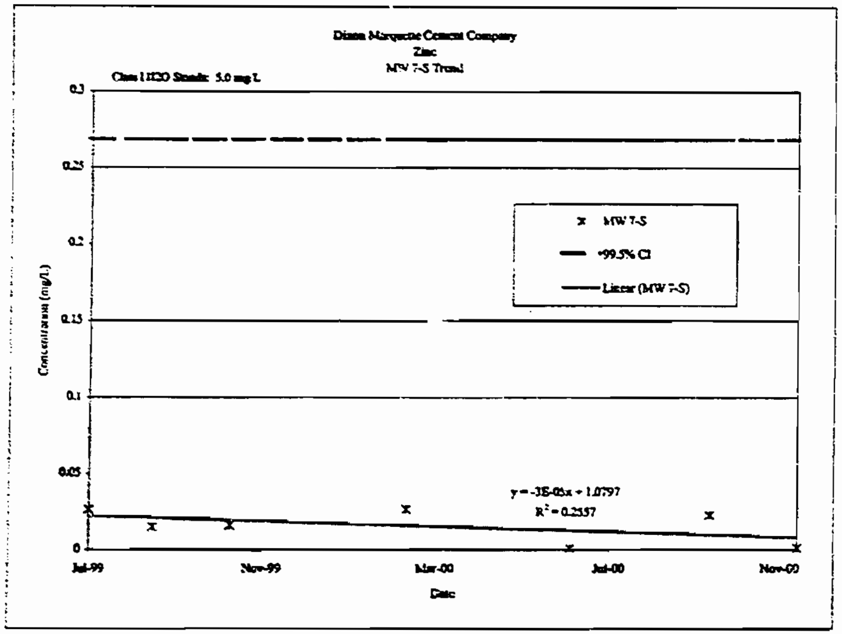

Dixon Marquette Cement Company
Vanadium
MW 8-S Trend
MW 8-S
+99.5% CI
Linear (MW 8-S)
y = 2E-06x - 0.0735
R² = 0.1427
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

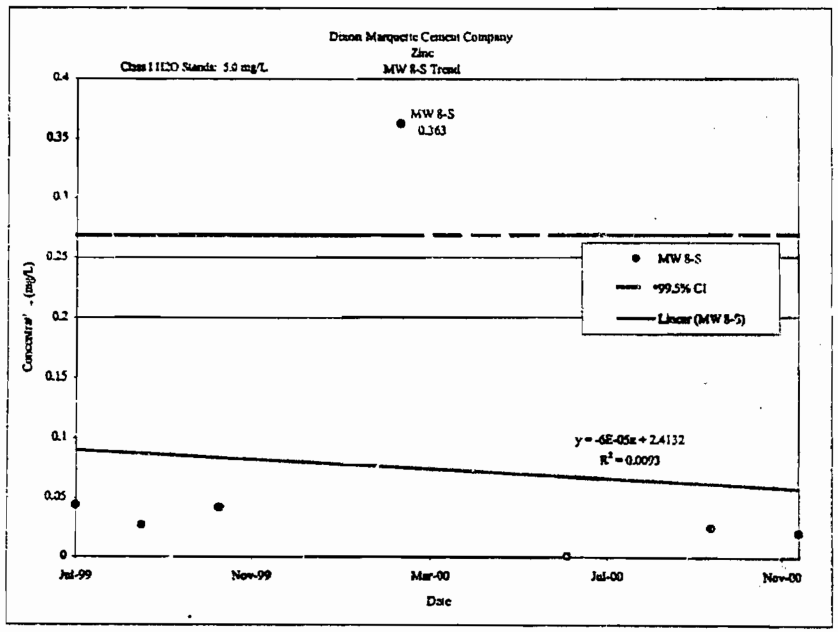
Dixon Marquette Cement Company
Zinc

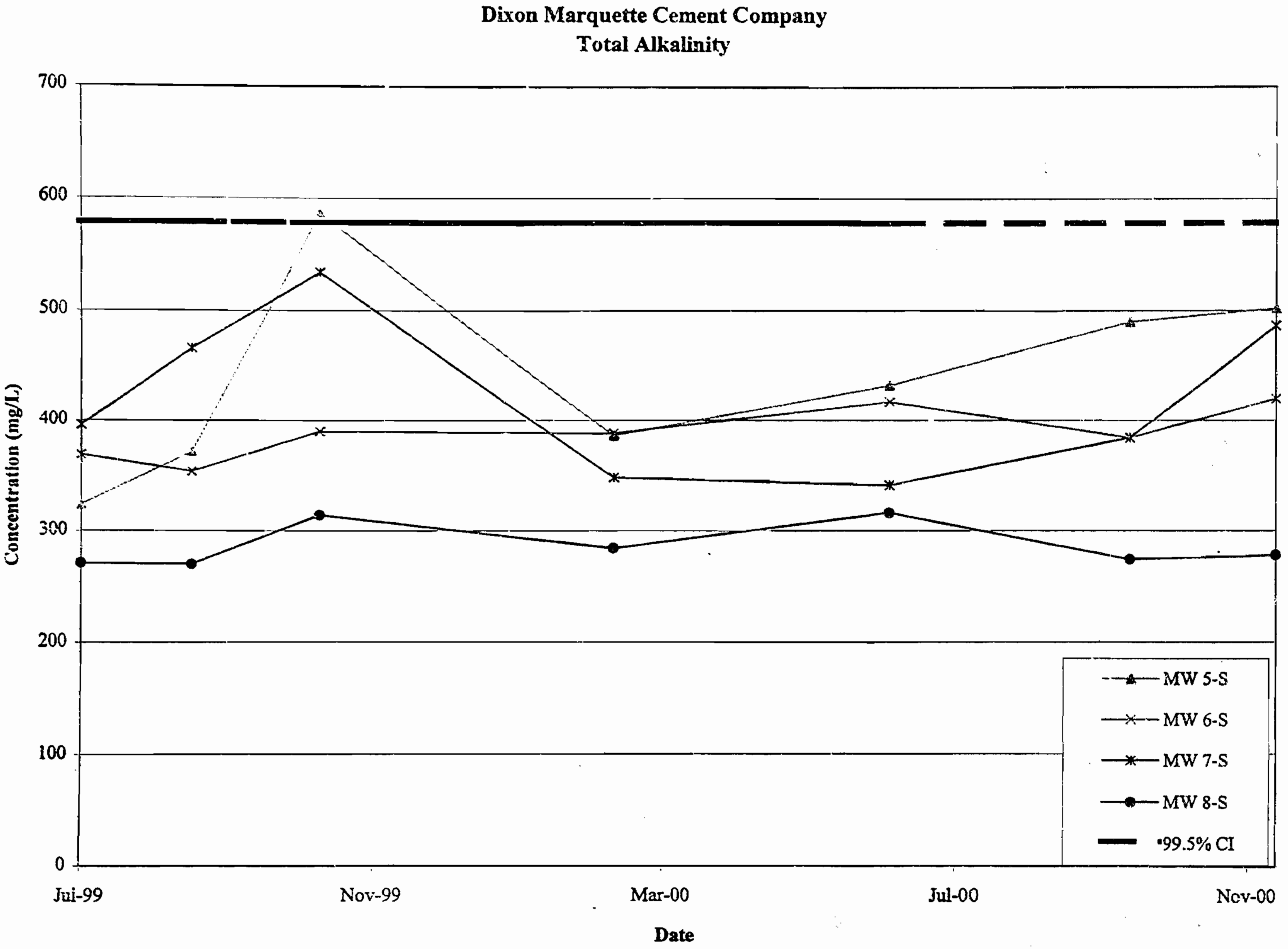


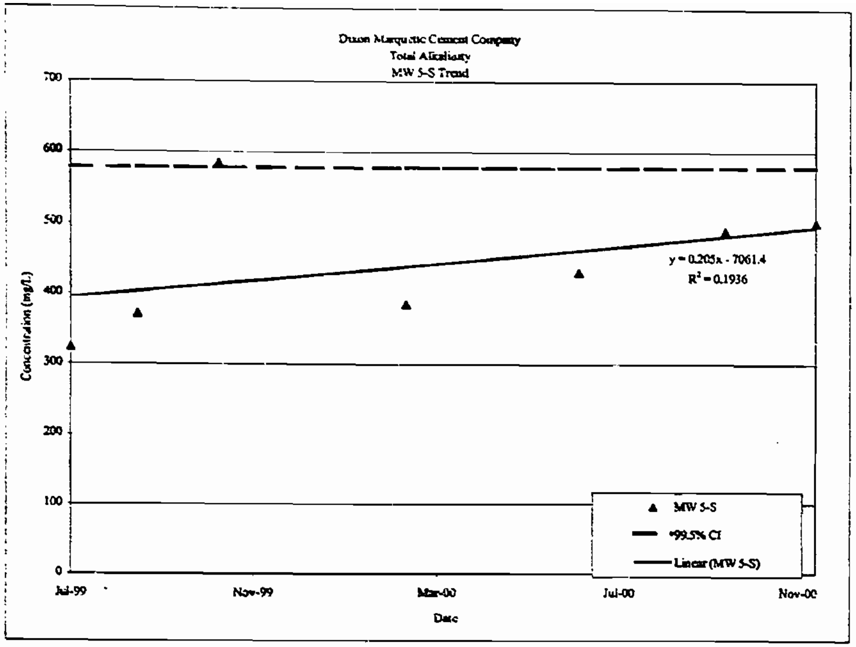

Dixon Marquette Cement Company
Zinc
MW 5-S Trend
Class I H2O Stands: 5.0 mg/L
MW 5-S
+99.5% CI
Linear (MW 5-S)
y = -1E-05x + 0.3966
R² = 0.0188
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

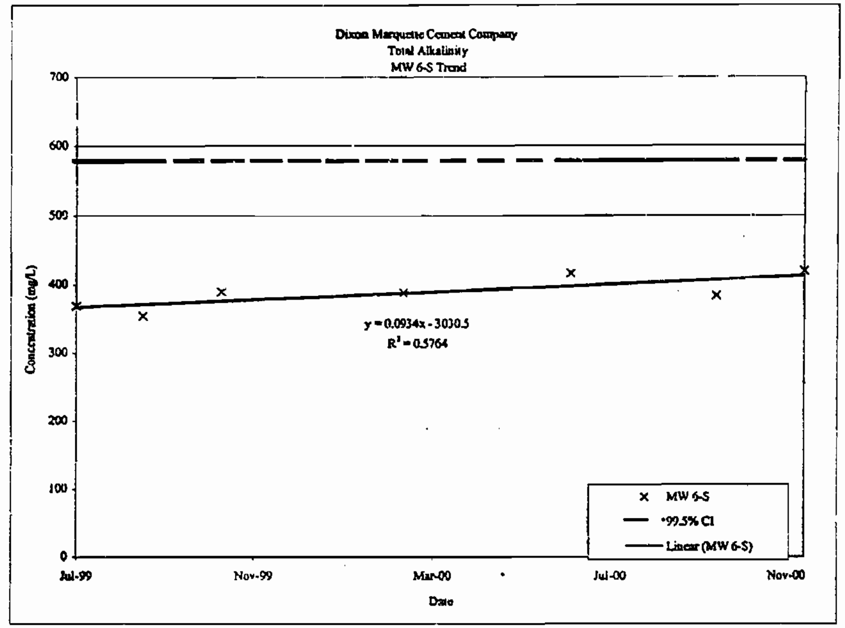

Dixon Marquette Cement Company
Zinc
MW 6-S Trend
Class I H2O Stands: 5.0 mg/L
MW 6-S
+99.5% CI
Linear (MW 6-S)
y = -2E-05x + 0.6919
R² = 0.0684
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

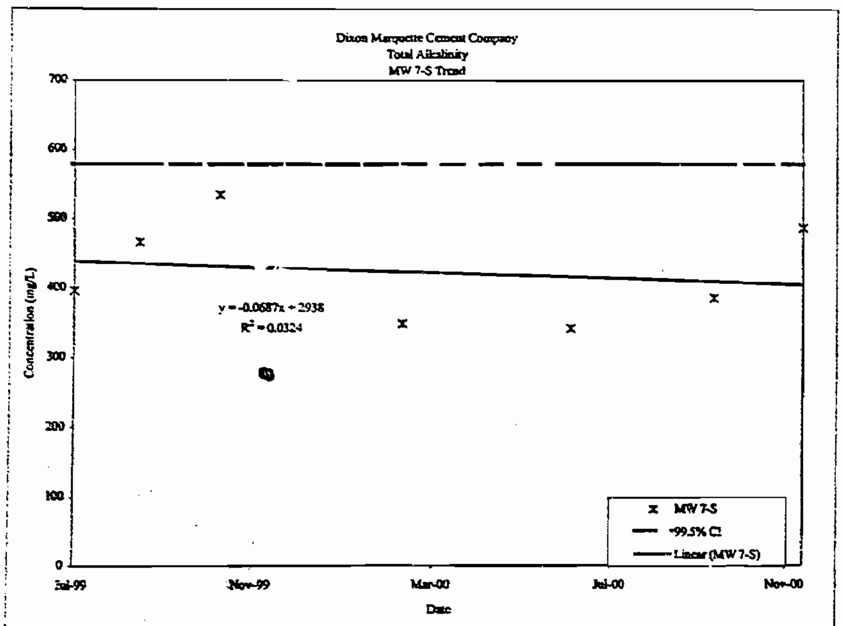

Dixon Marquette Cement Company
Zinc
MW 7-S Trend
Class I H2O Stands: 5.0 mg/L
MW 7-S
+99.5% CI
Linear (MW 7-S)
y = -3E-05x + 1.0797
R² = 0.2357
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

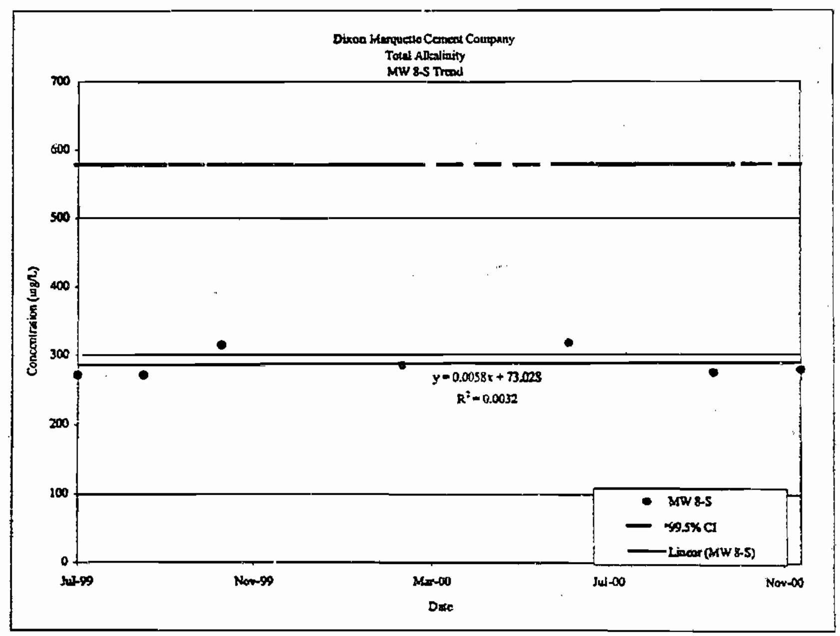

Dixon Marquette Cement Company
Zinc
MW 8-S Trend
Class I H2O Stands: 5.0 mg/L
MW 8-S
0.363
+99.5% CI
Linear (MW 8-S)
y = -6E-05x + 2.4132
R² = 0.0093
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

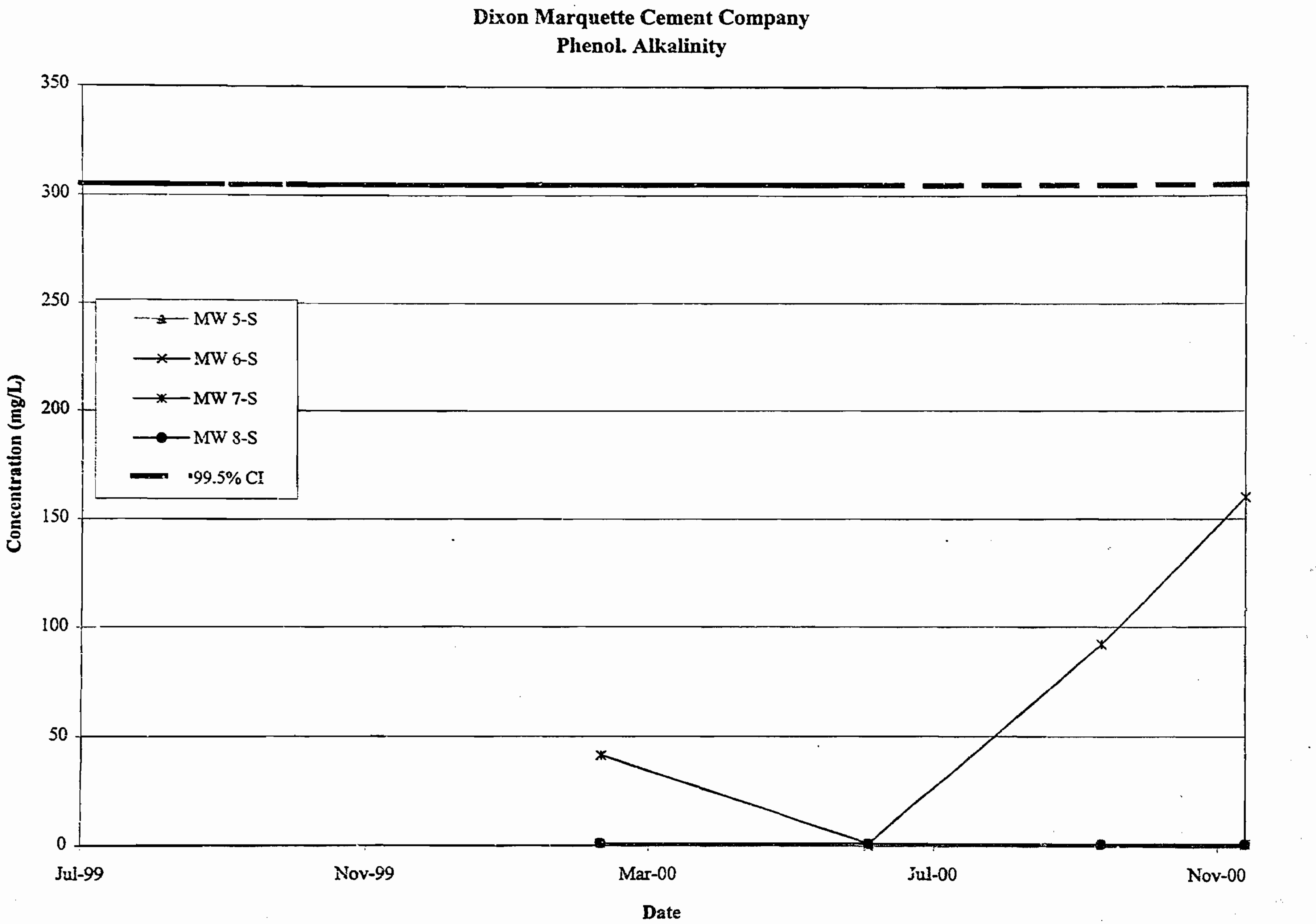

Dixon Marquette Cement Company
Total Alkalinity
700
600
500
400
300
200
100
0
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 5-S
MW 6-S
MW 7-S
MW 8-S
99.5% CI

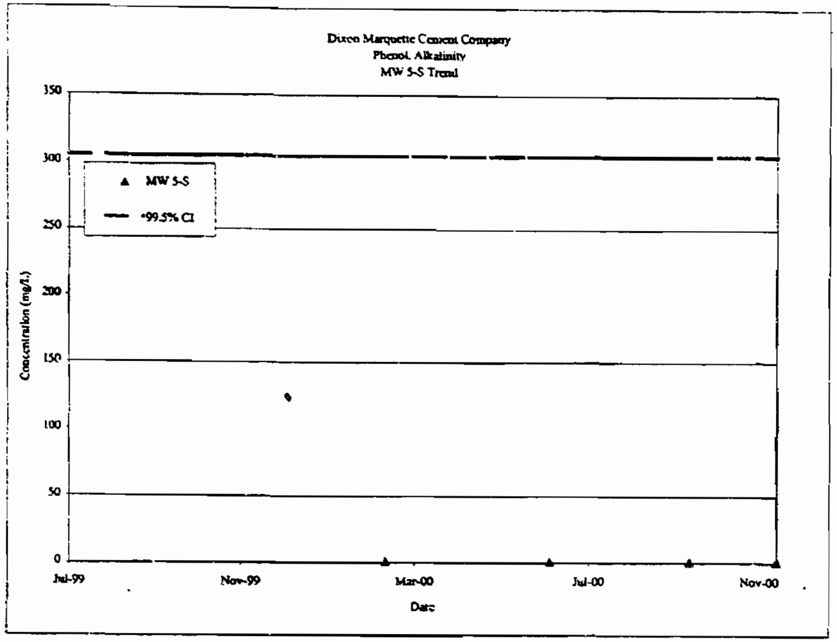

Dixon Marquette Cement Company
Total Alkalinity
MW 5-S Trend
Concentration (mg/L)
700
600
500
400
300
200
100
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
y = 0.205x - 7061.4
R^2 = 0.1936
MW 5-S
*99.5% CI
Linear (MW 5-S)


Dixon Marquette Cement Company
Total Alkalinity
MW 6-S Trend
Concentration (mg/L)
700
600
500
400
300
200
100
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
y = 0.0934x - 3030.5
R^2 = 0.5764
MW 6-S
*99.5% CI
Linear (MW 6-S)

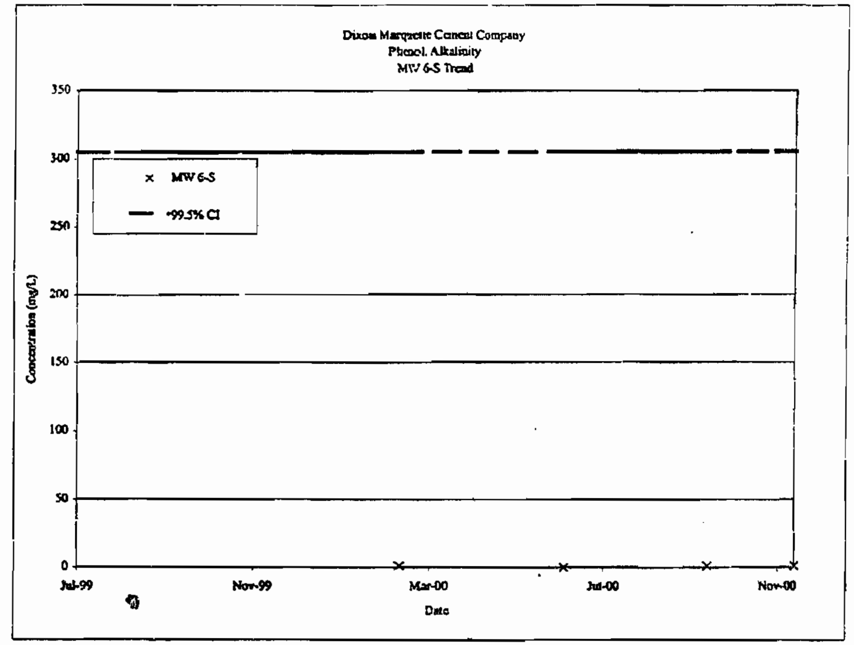

Dixon Marquette Cement Company
Total Alkalinity
MW 7-S Trend
Concentration (mg/L)
700
600
500
400
300
200
100
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
y = -0.0687x + 2938
R^2 = 0.0324
MW 7-S
*99.5% CI
Linear (MW 7-S)


Dixon Marquette Cement Company
Total Alkalinity
MW 8-S Trend
Concentration (ug/L)
700
600
500
400
300
200
100
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
y = 0.0058x + 73.028
R^2 = 0.0032
MW 8-S
*99.5% CI
Linear (MW 8-S)

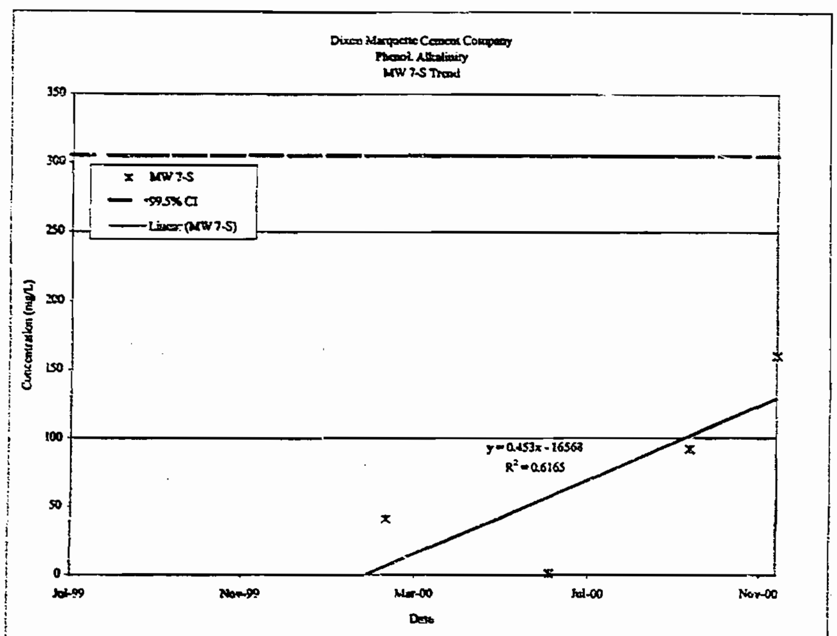

Dixon Marquette Cement Company
Phenol. Alkalinity
Concentration (mg/L)
350
300
250
200
150
100
50
0
MW 5-S
MW 6-S
MW 7-S
MW 8-S
99.5% CI
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date



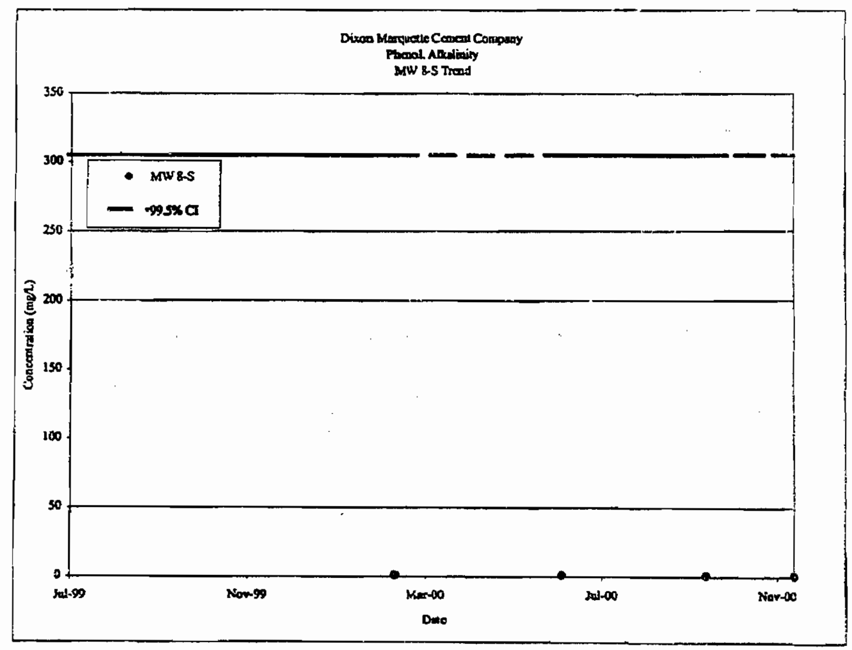
Dixon Marquette Cement Company
Phenol. Alkalinity
MW 5-S Trend
MW 5-S
+99.5% CI
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00



Dixon Marquette Cement Company
Phenol. Alkalinity
MW 6-S Trend
MW 6-S
+99.5% CI
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

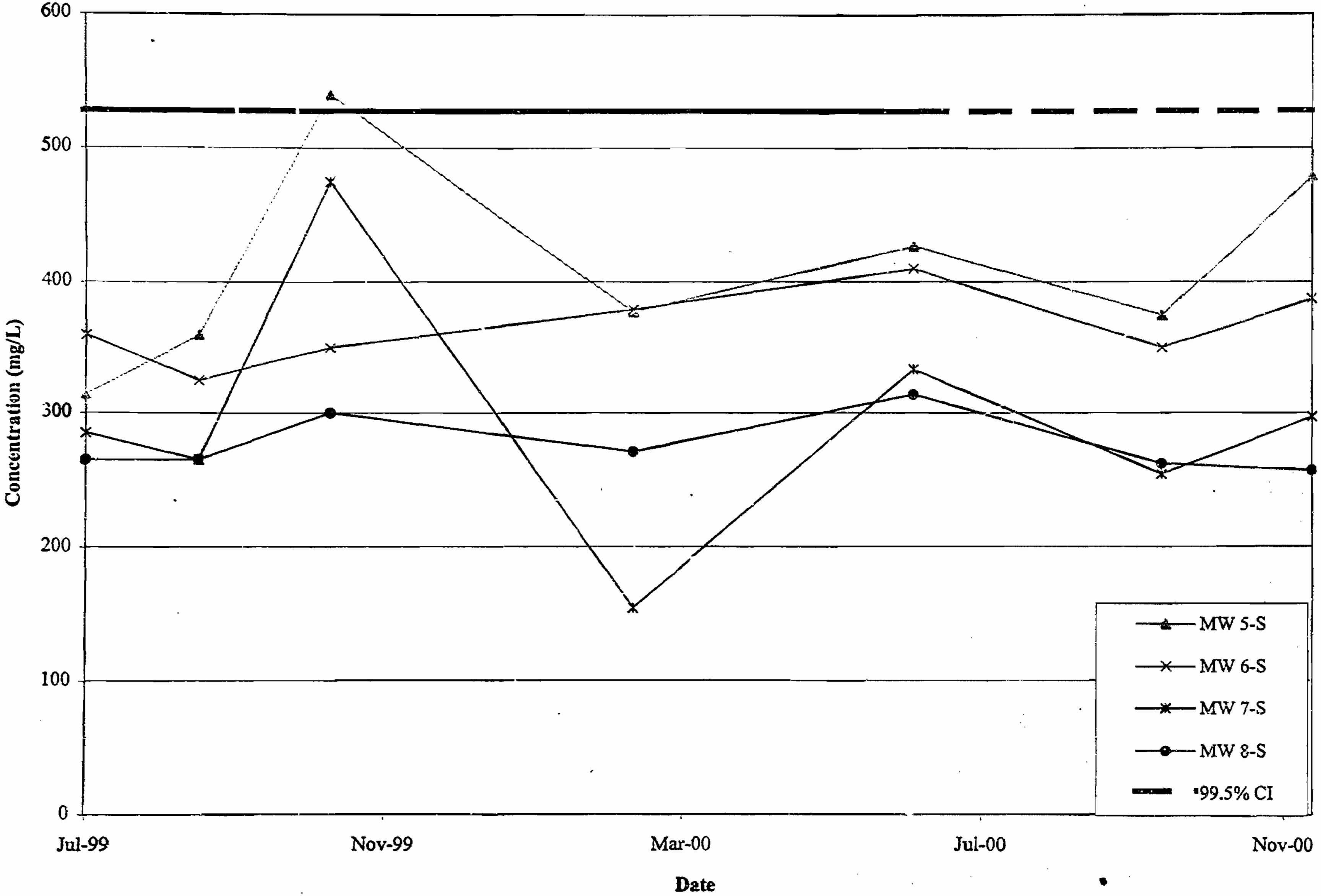


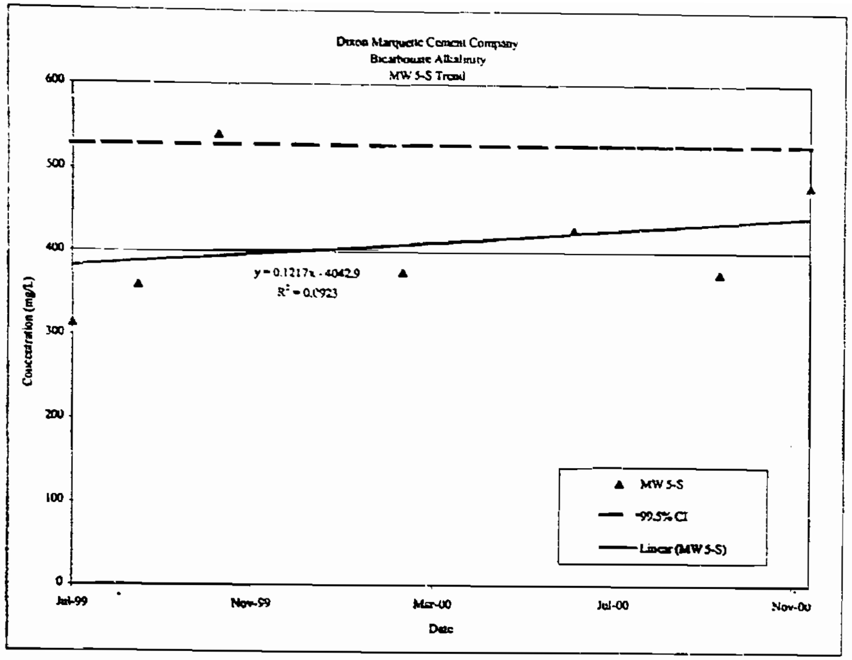
Dixon Marquette Cement Company
Phenol. Alkalinity
MW 7-S Trend
MW 7-S
+99.5% CI
Linear (MW 7-S)
y = 0.453x - 16568
R² = 0.6165
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

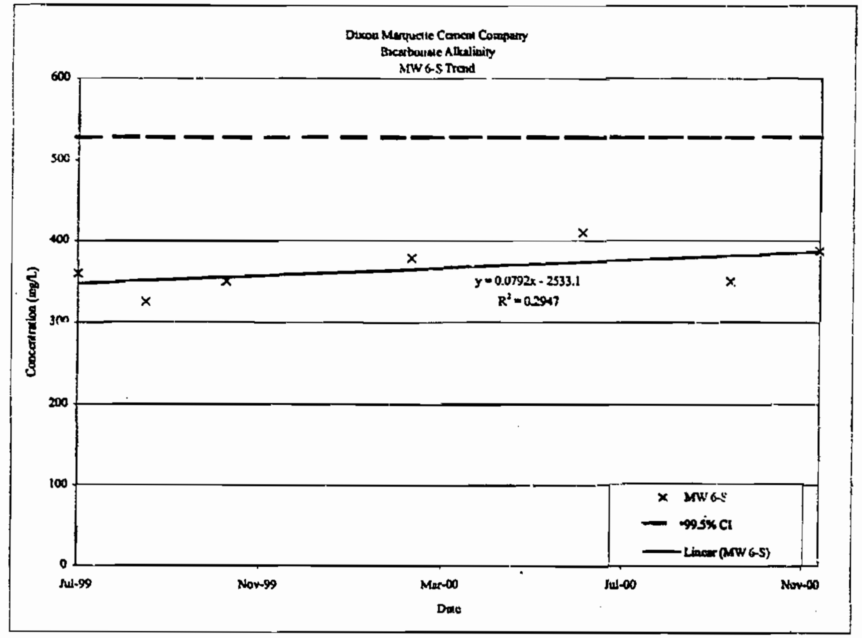


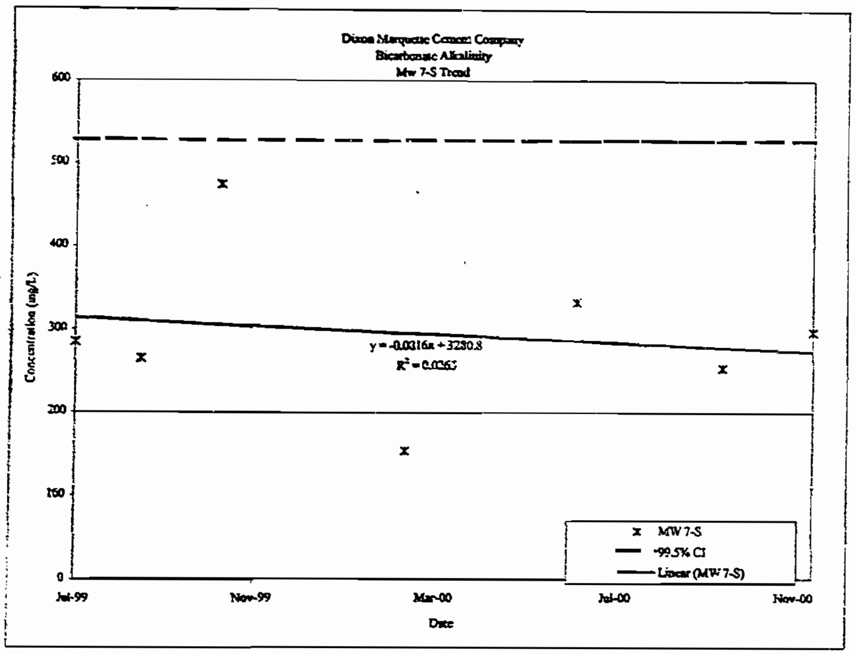
Dixon Marquette Cement Company
Phenol. Alkalinity
MW 8-S Trend
MW 8-S
+99.5% CI
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

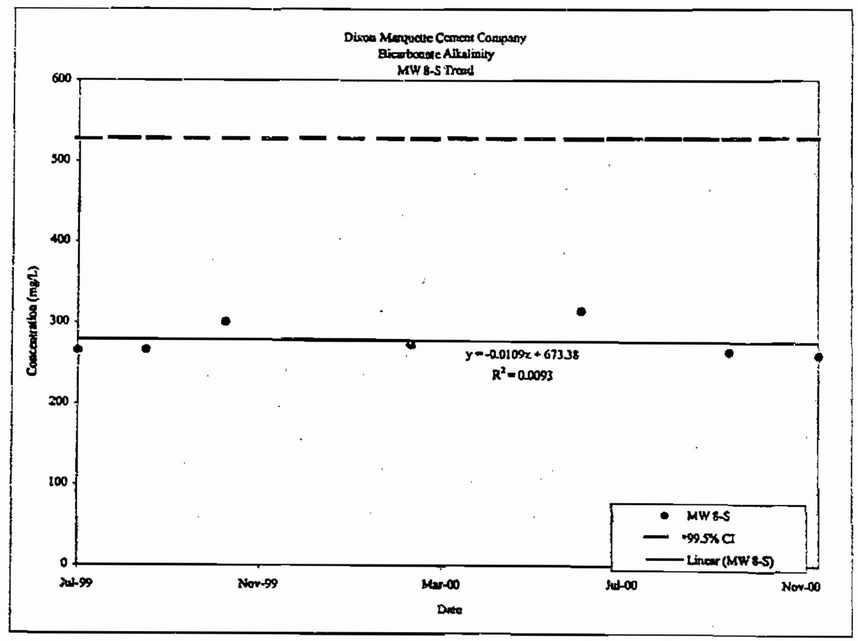
Dixon Marquette Cement Company
Bicarbonate Alkalinity



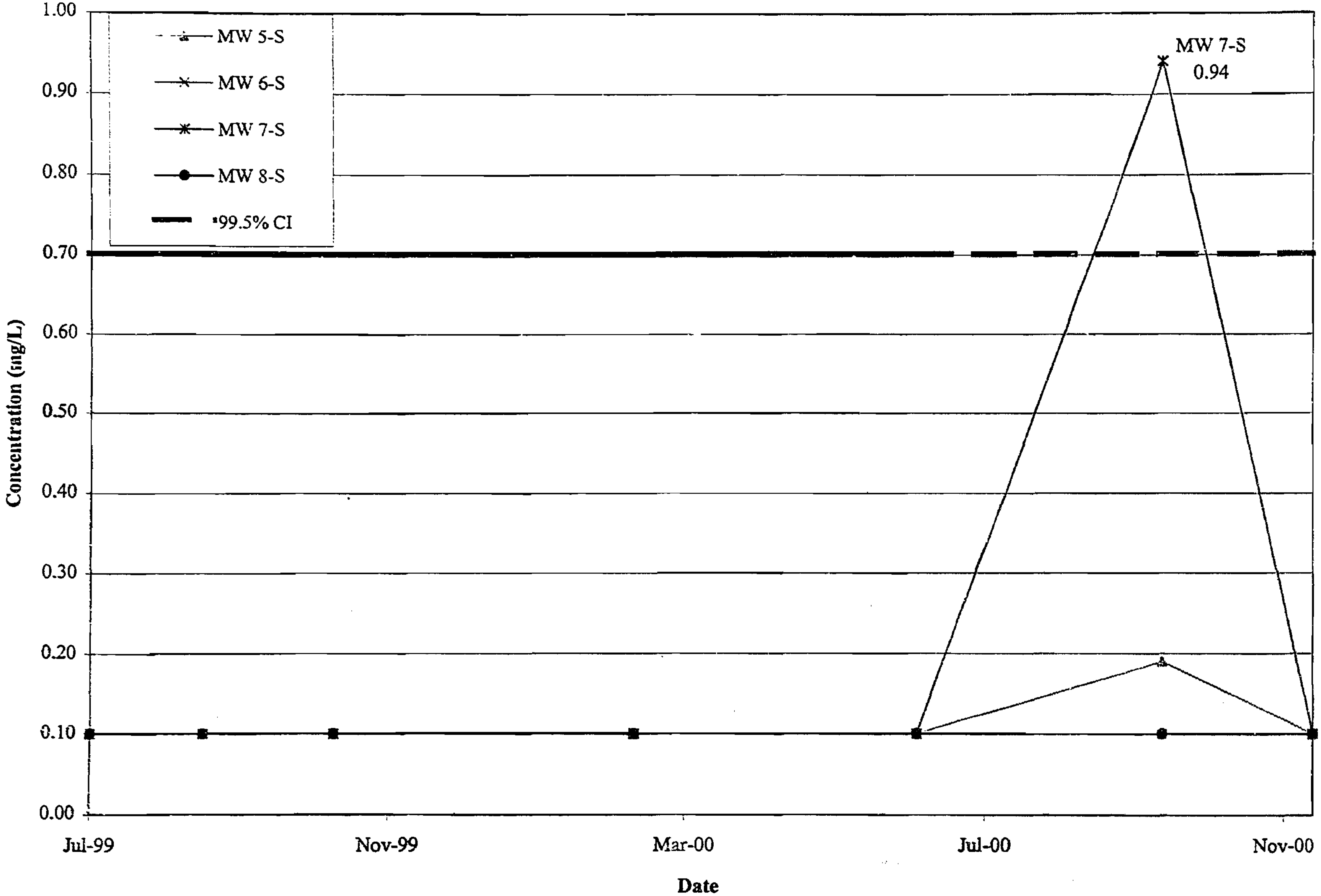

Dixon Marquette Cement Company
Bicarbonate Alkalinity
MW 5-S Trend
y = 0.1217x - 4042.9
R² = 0.0923
Concentration (mg/L)
0
100
200
300
400
500
600
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 5-S
+99.5% CI
Linear (MW 5-S)

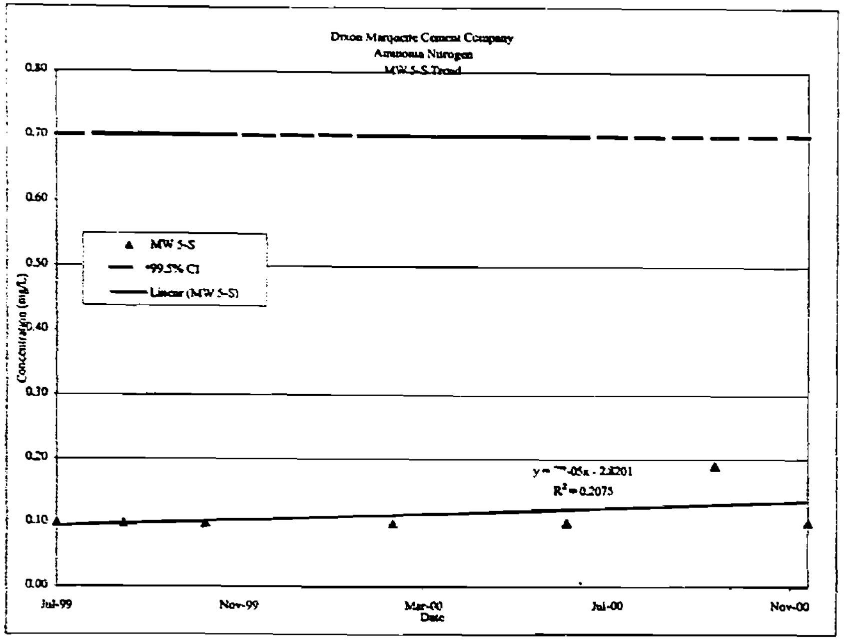

Dixon Marquette Cement Company
Bicarbonate Alkalinity
MW 6-S Trend
y = 0.0792x - 2533.1
R² = 0.2947
Concentration (mg/L)
0
100
200
300
400
500
600
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 6-S
+99.5% CI
Linear (MW 6-S)

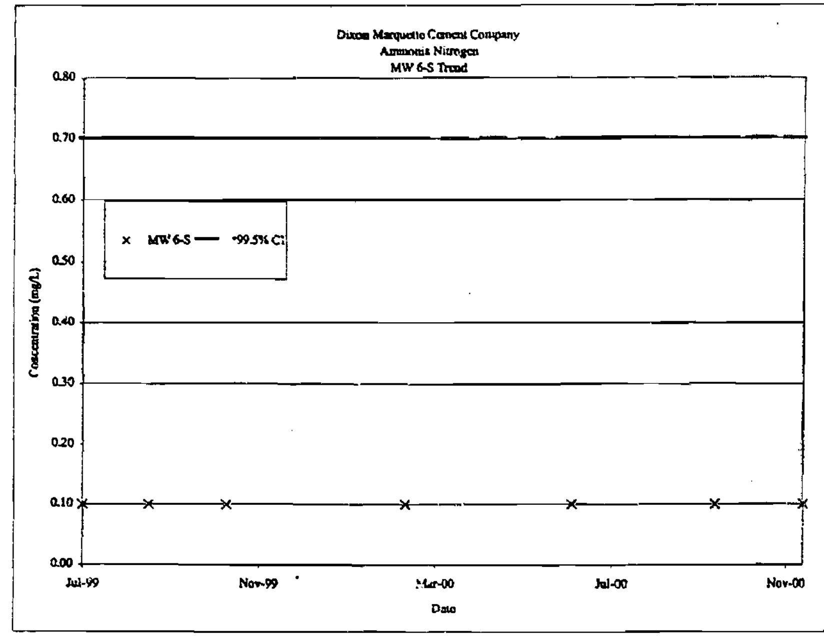

Dixon Marquette Cement Company
Bicarbonate Alkalinity
Mw 7-S Trend
y = -0.0316x + 3280.8
Concentration (mg/L)
0
100
200
300
400
500
600
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 7-S
+99.5% CI
Linear (MW 7-S)

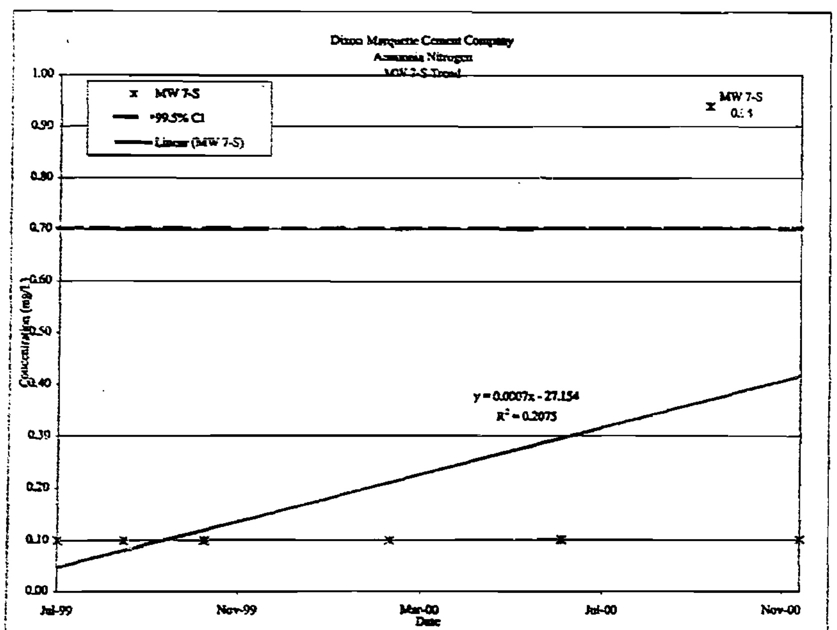

Dixon Marquette Cement Company
Bicarbonate Alkalinity
MW 8-S Trend
y = -0.0109x + 673.38
R² = 0.0093
Concentration (mg/L)
0
100
200
300
400
500
600
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 8-S
+99.5% CI
Linear (MW 8-S)

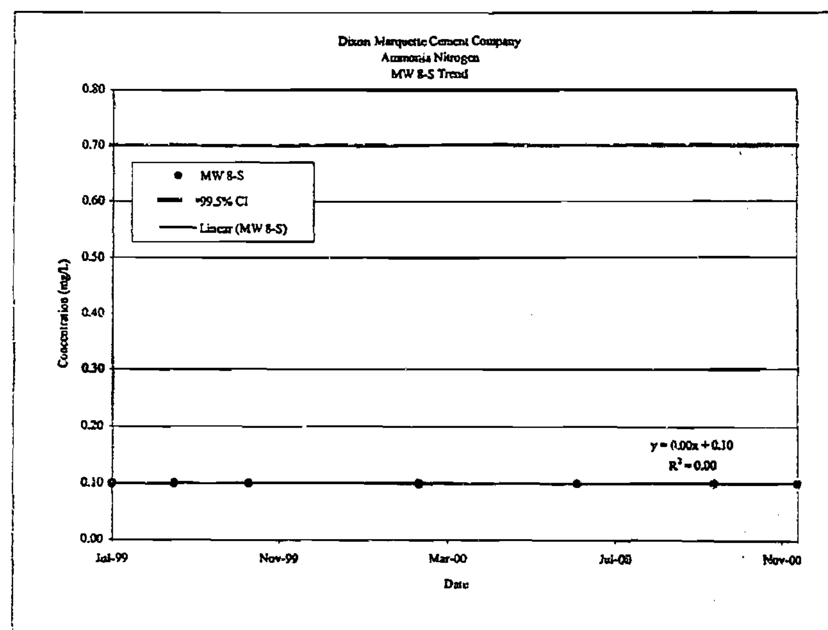
Dixon Marquette Cement Company
Ammonia Nitrogen

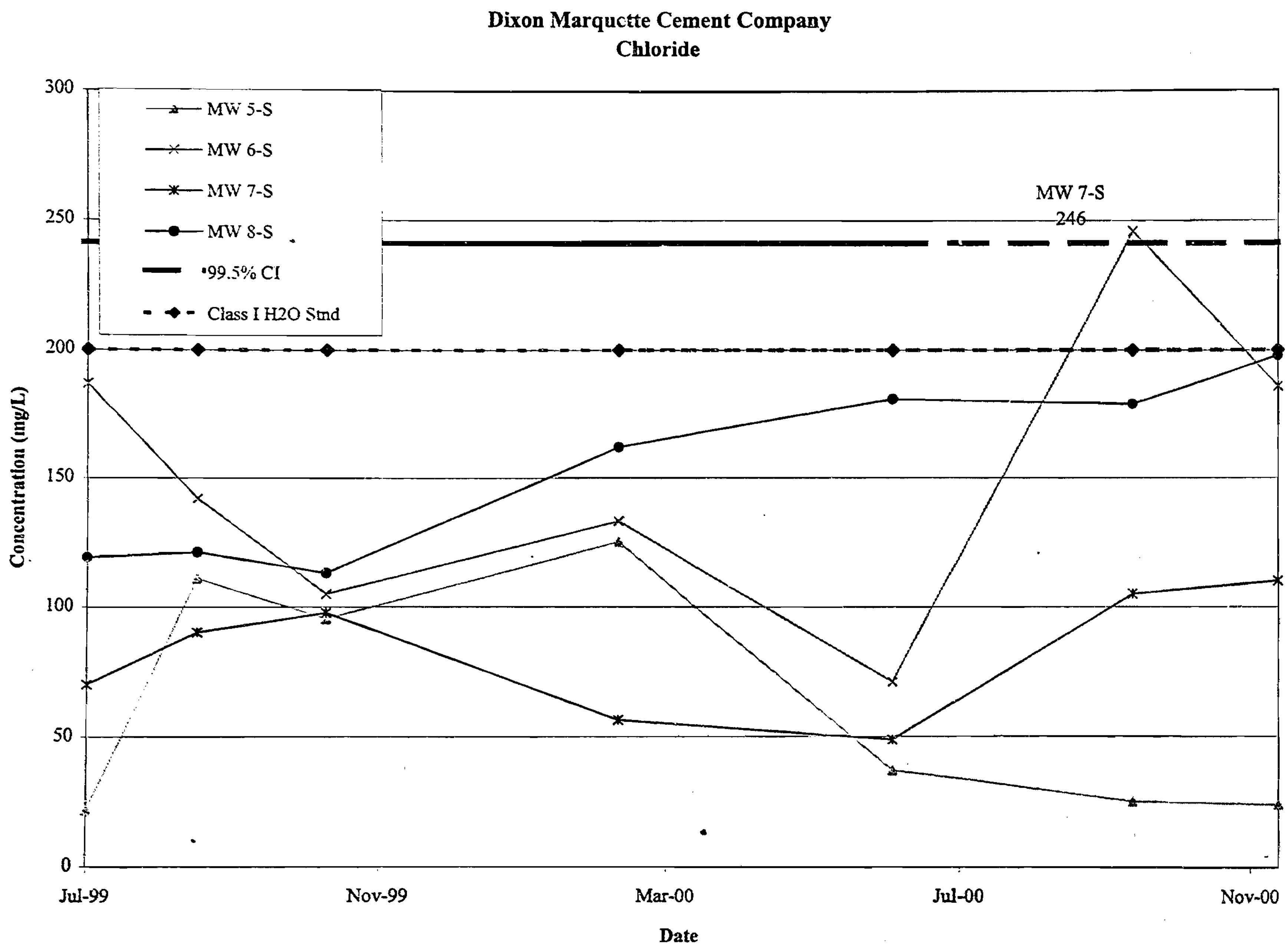



Dixon Marquette Cement Company
Ammonia Nitrogen
MW 5-S Trend
MW 5-S
*99.5% CI
Linear (MW 5-S)
Concentration (mg/L)
R² = 0.2075
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

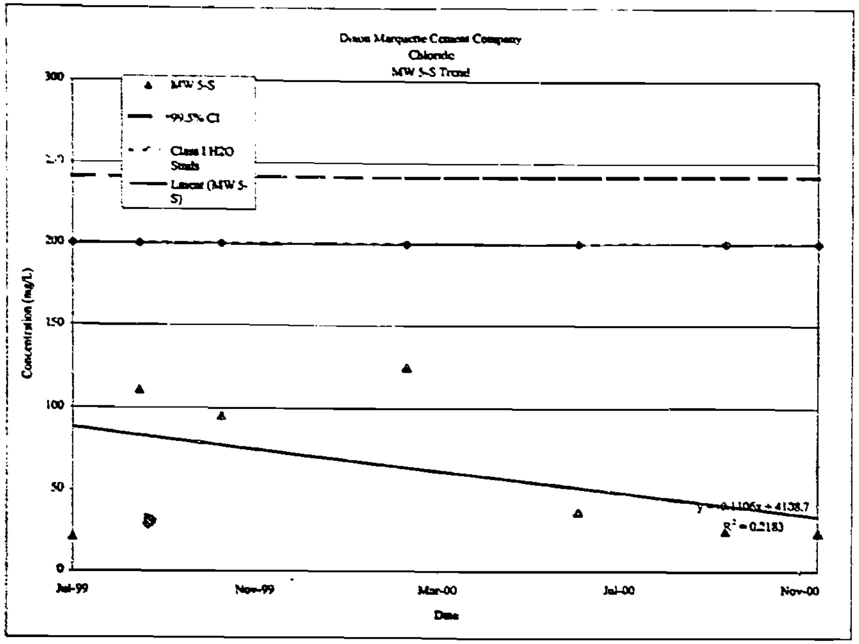

Dixon Marquette Cement Company
Ammonia Nitrogen
MW 6-S Trend
MW 6-S
*99.5% CI
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
Ammonia Nitrogen
MW 7-S
*99.5% CI
Linear (MW 7-S)
y = 0.0007x - 27.154
R² = 0.2075
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

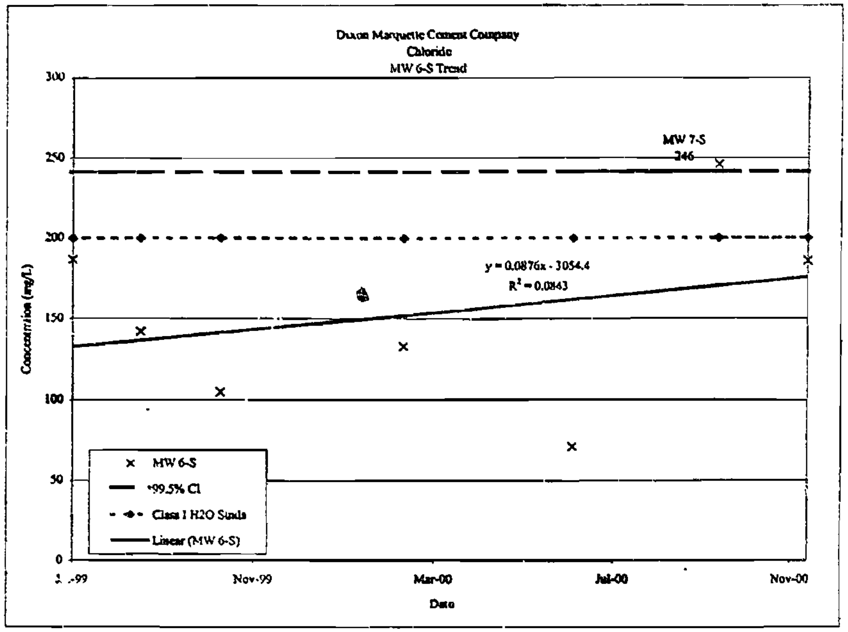

Dixon Marquette Cement Company
Ammonia Nitrogen
MW 8-S Trend
MW 8-S
*99.5% CI
Linear (MW 8-S)
y = 0.00x + 0.10
R² = 0.00
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Nov-00
Date



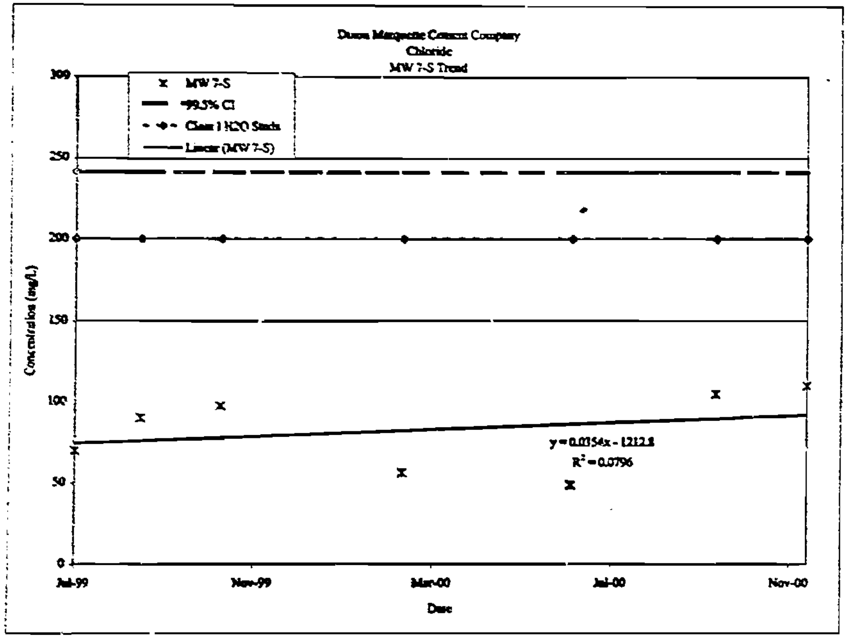
Dixon Marquette Cement Company
Chloride
MW 5-S
MW 6-S
MW 7-S
MW 8-S
99.5% CI
Class I H2O Stnd
MW 7-S
246
300
250
200
150
100
50
0
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date



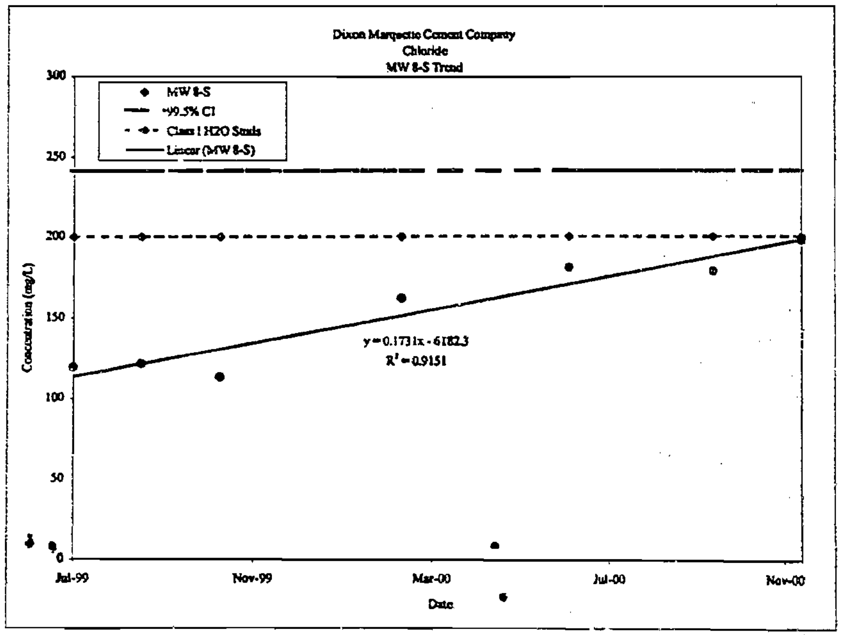
Dixon Marquette Cement Company
Chloride
MW 5-S Trend
MW 5-S
+99.5% CI
Class I H2O Stnds
Linear (MW 5-S)
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
R² = 0.2183



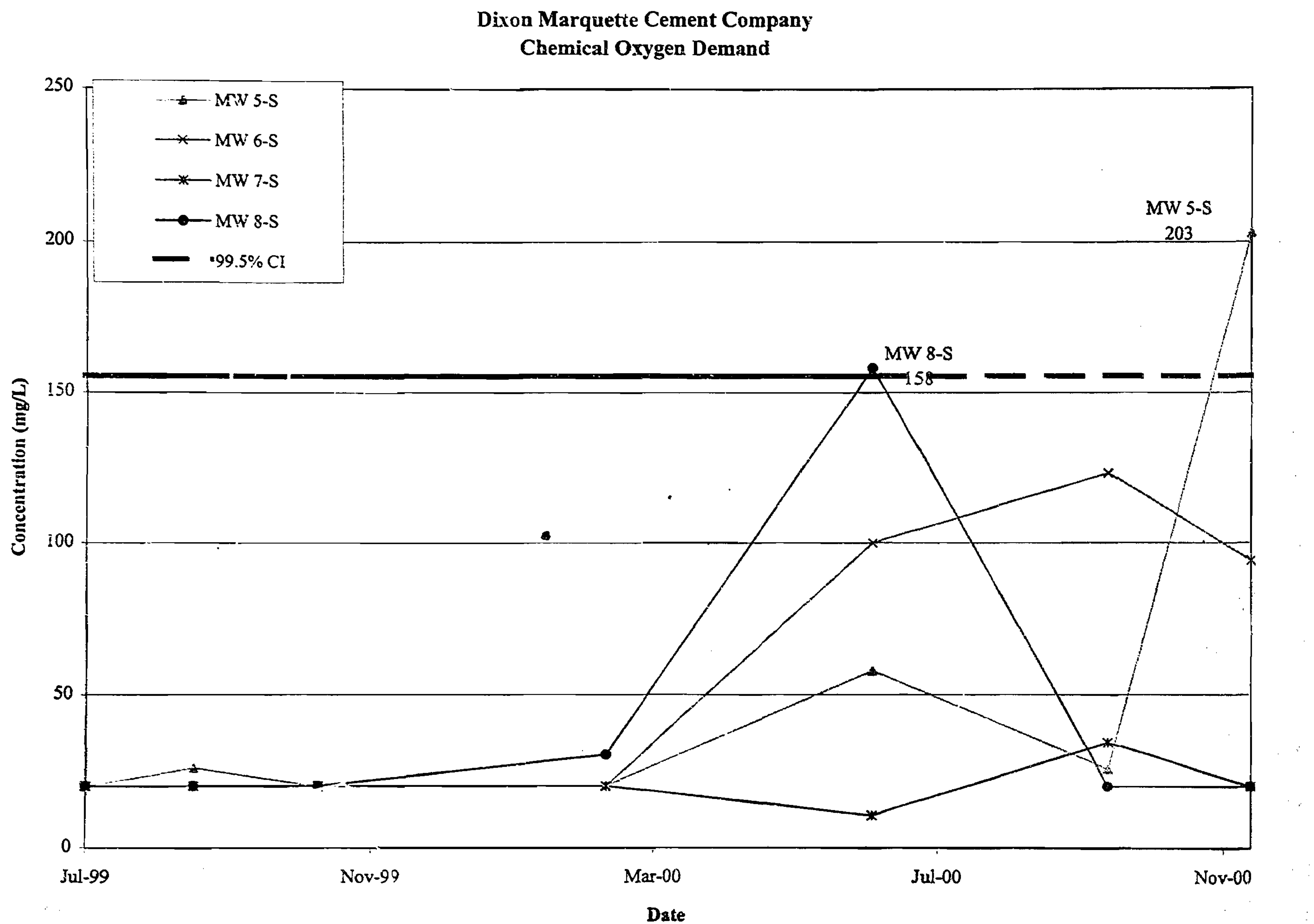
Dixon Marquette Cement Company
Chloride
MW 6-S Trend
MW 7-S
246
y = 0.0876x - 3054.4
R² = 0.0843
MW 6-S
+99.5% CI
Class I H2O Stnds
Linear (MW 6-S)
Concentration (mg/L)
Date
Nov-99
Mar-00
Jul-00
Nov-00



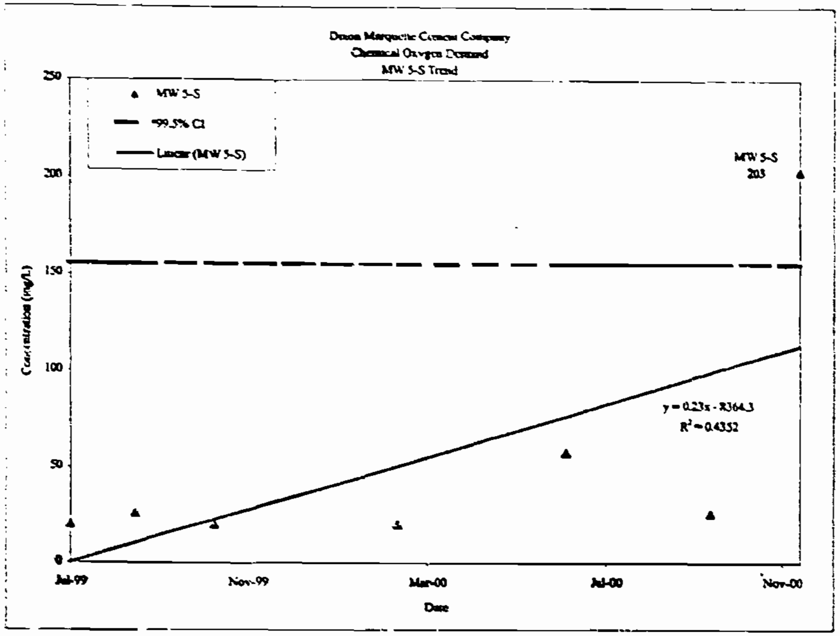
Dixon Marquette Cement Company
Chloride
MW 7-S Trend
MW 7-S
+99.5% CI
Class I H2O Stnds
Linear (MW 7-S)
y = 0.0354x - 1212.8
R² = 0.0796
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

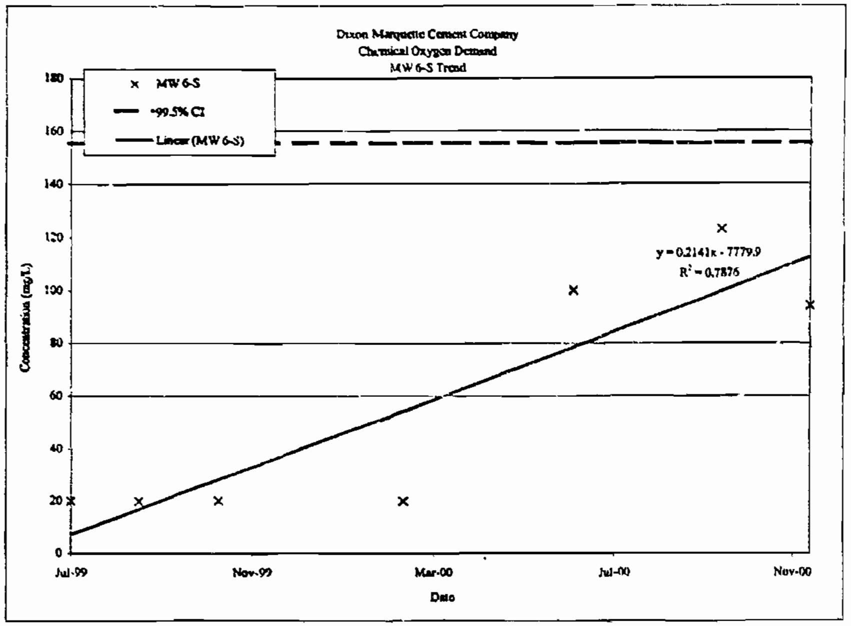


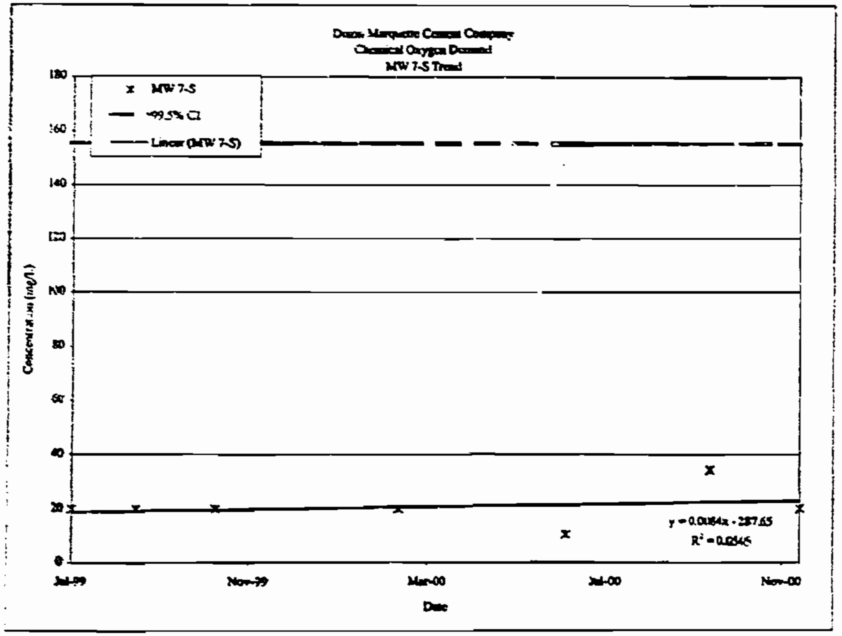
Dixon Marquette Cement Company
Chloride
MW 8-S Trend
MW 8-S
+99.5% CI
Class I H2O Stnds
Linear (MW 8-S)
y = 0.1731x - 6182.3
R² = 0.9151
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

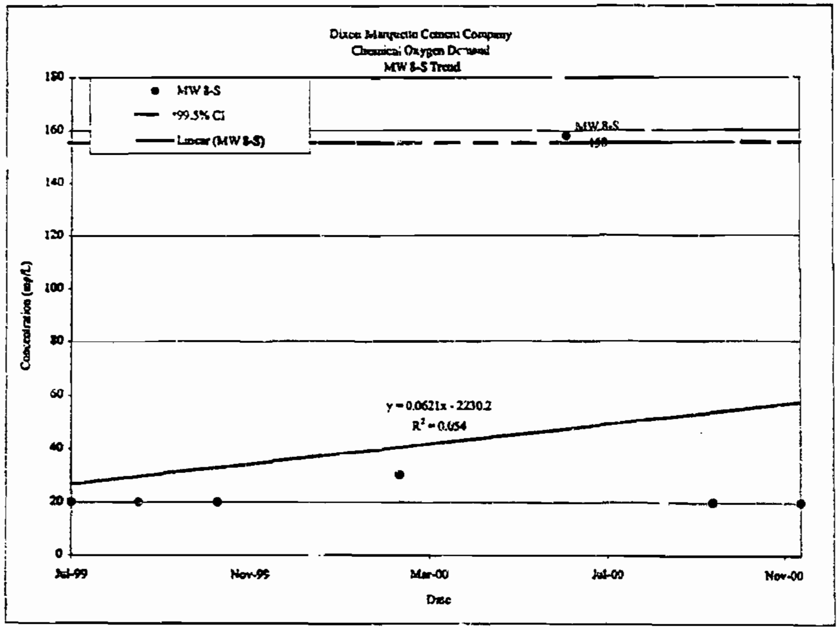


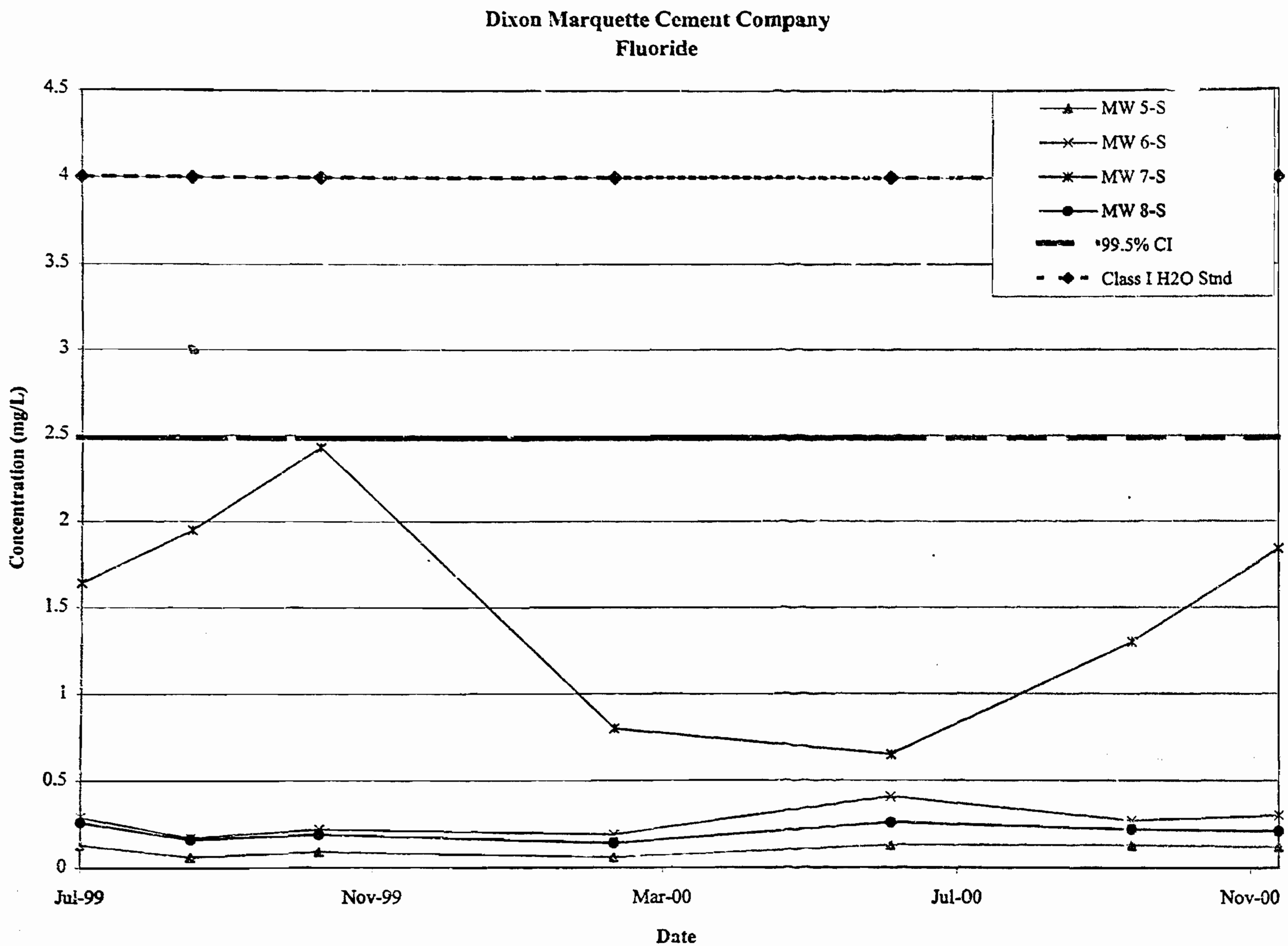
Dixon Marquette Cement Company
Chemical Oxygen Demand
MW 5-S
MW 6-S
MW 7-S
MW 8-S
99.5% CI
MW 5-S
203
MW 8-S
158
Concentration (mg/L)
250
200
150
100
50
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
Chemical Oxygen Demand
MW 5-S Trend
MW 5-S
+99.5% CI
Linear (MW 5-S)
MW 5-S
203
y = 0.23x - 8364.3
R^2 = 0.4352
Concentration (mg/L)
250
200
150
100
50
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

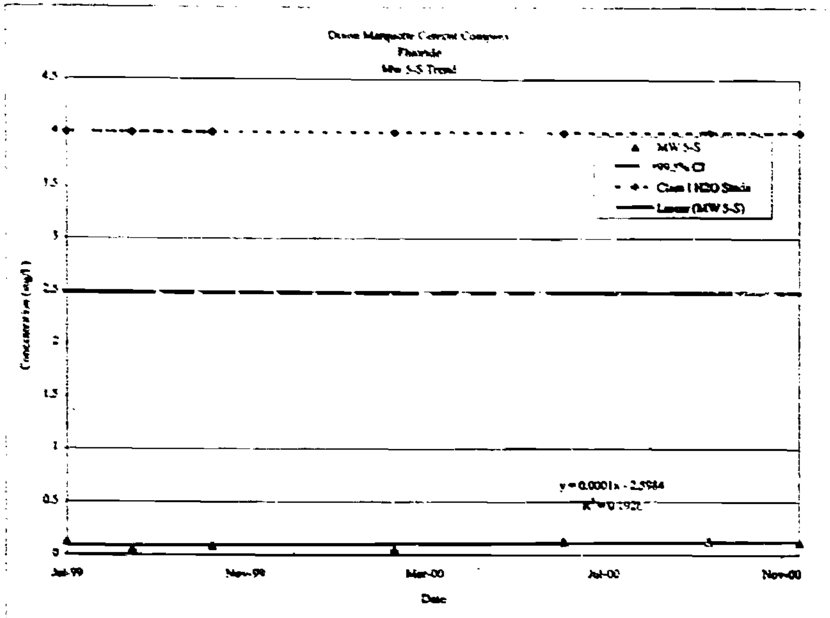

Dixon Marquette Cement Company
Chemical Oxygen Demand
MW 6-S Trend
MW 6-S
+99.5% CI
Linear (MW 6-S)
y = 0.2141x - 7779.9
R^2 = 0.7876
Concentration (mg/L)
180
160
140
120
100
80
60
40
20
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
Chemical Oxygen Demand
MW 7-S Trend
MW 7-S
+99.5% CI
Linear (MW 7-S)
y = 0.0084x - 287.65
R^2 = 0.0545
Concentration (mg/L)
180
160
140
120
100
80
60
40
20
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

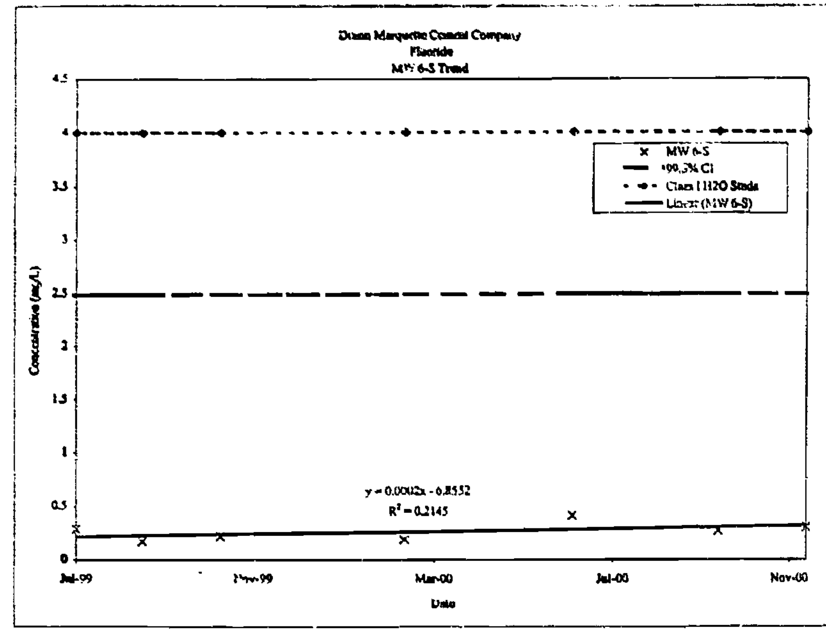

Dixon Marquette Cement Company
Chemical Oxygen Demand
MW 8-S Trend
MW 8-S
+99.5% CI
Linear (MW 8-S)
MW 8-S
y = 0.0621x - 2230.2
R^2 = 0.654
Concentration (mg/L)
180
160
140
120
100
80
60
40
20
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date



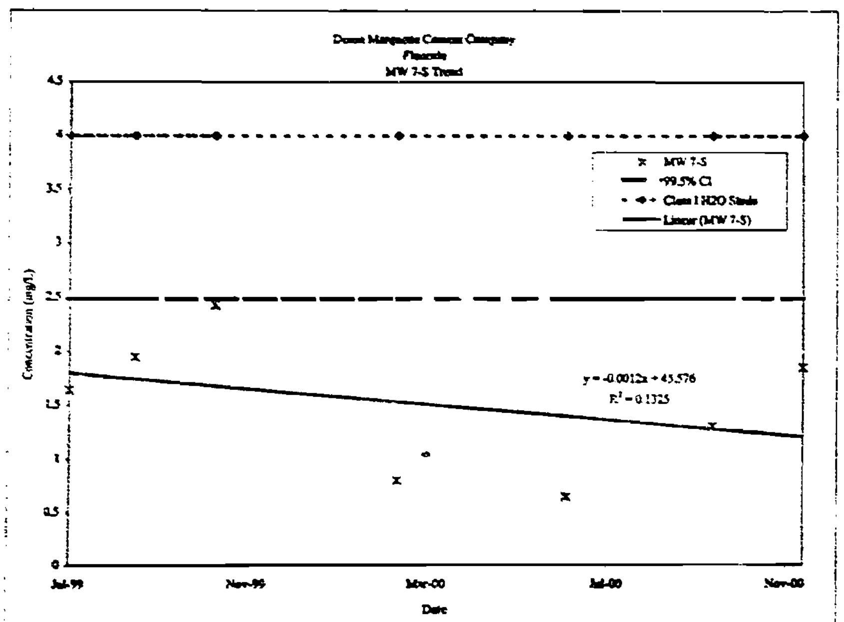
Dixon Marquette Cement Company
Fluoride
Concentration (mg/L)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 5-S
MW 6-S
MW 7-S
MW 8-S
99.5% CI
Class I H2O Stnd



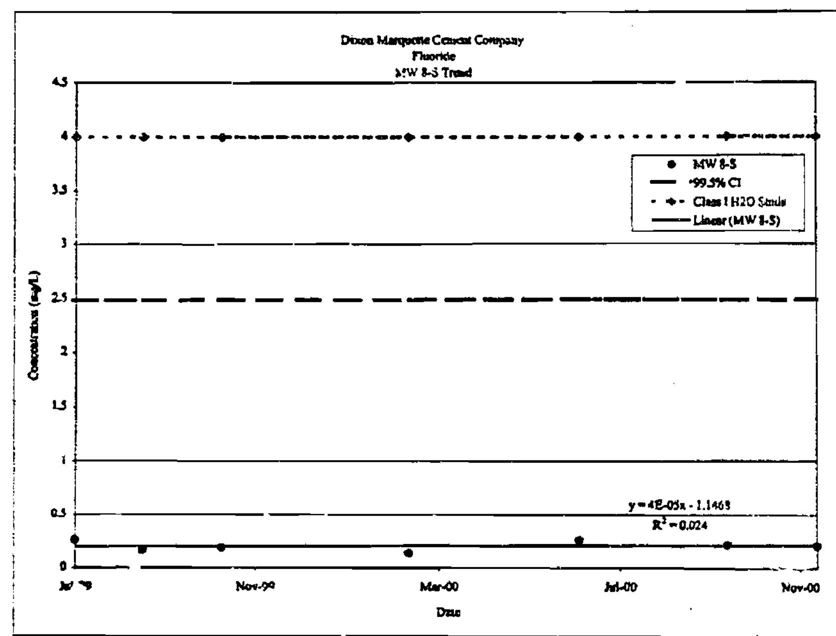
Dixon Marquette Cement Company
Fluoride
MW 5-S Trend
MW 5-S
+99.5% CI
Class I H2O Stnds
Linear (MW 5-S)
y = 0.0001x - 2.5984
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00



Dixon Marquette Cement Company
Fluoride
MW 6-S Trend
MW 6-S
+99.5% CI
Class I H2O Stnds
Linear (MW 6-S)
y = 0.0002x - 6.8552
R^2 = 0.2145
Concentration (mg/L)
Date
Jul-99
Mar-00
Jul-00
Nov-00

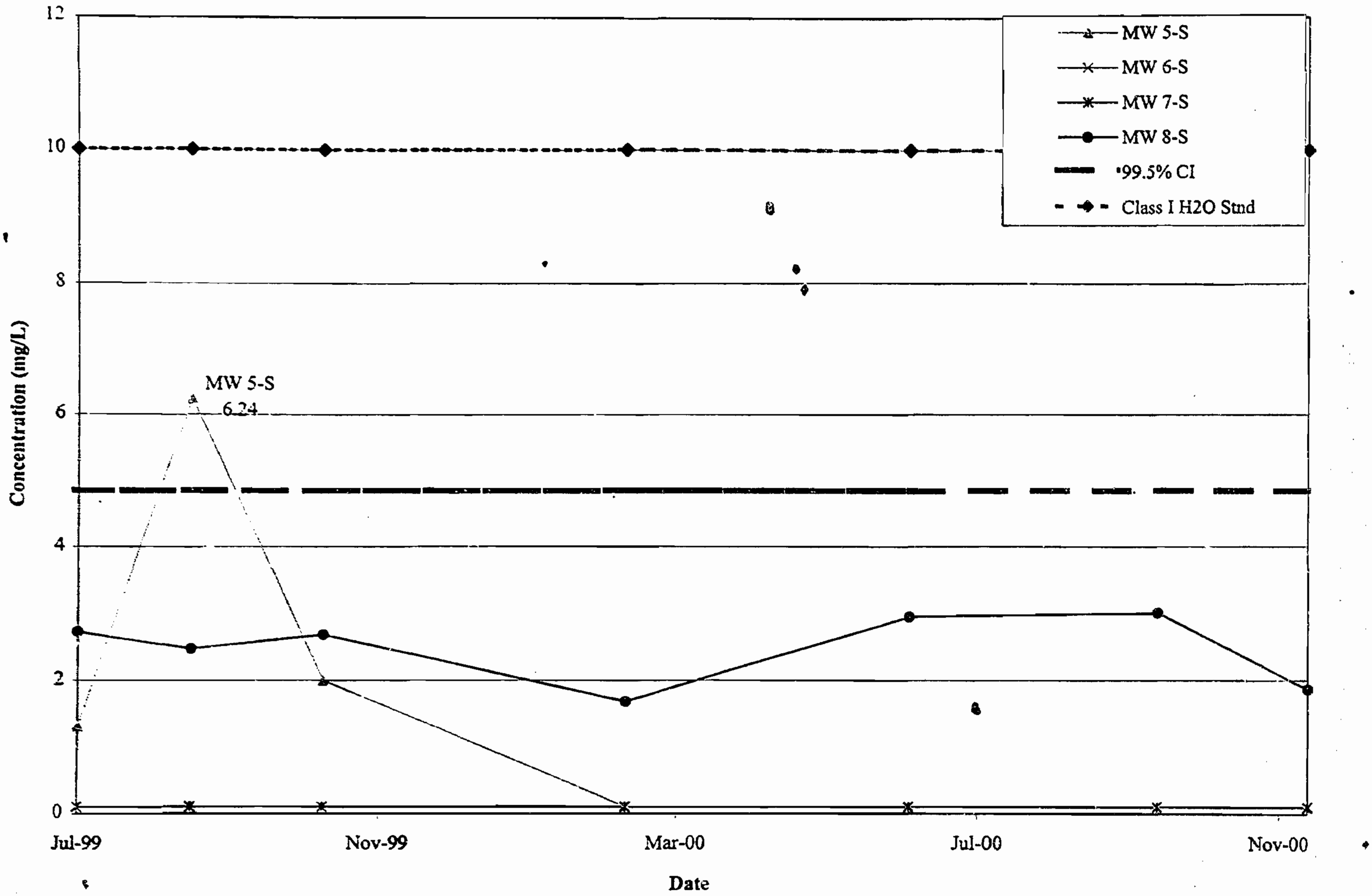


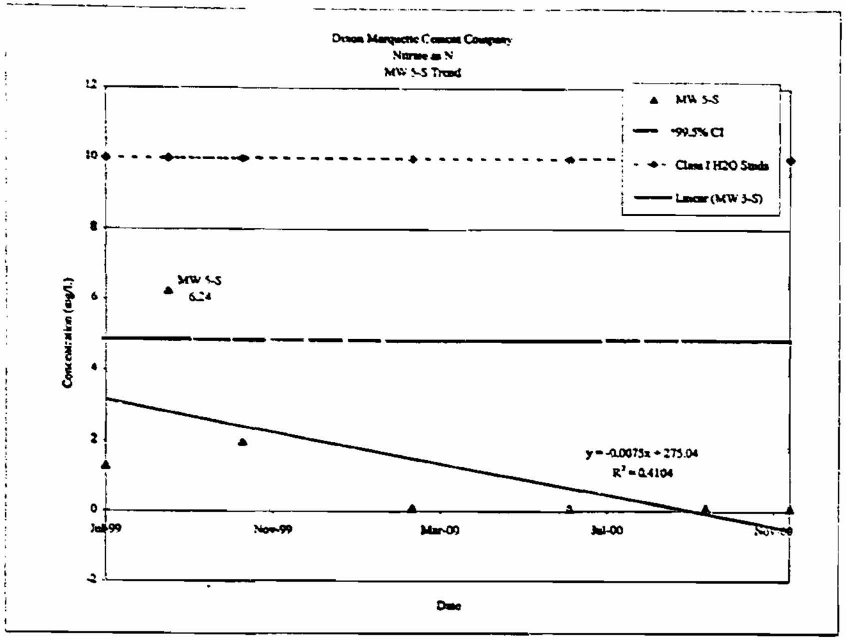
Dixon Marquette Cement Company
Fluoride
MW 7-S Trend
MW 7-S
+99.5% CI
Class I H2O Stnds
Linear (MW 7-S)
y = -0.0012x + 45.576
R^2 = 0.1325
Concentration (mg/L)
Date
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

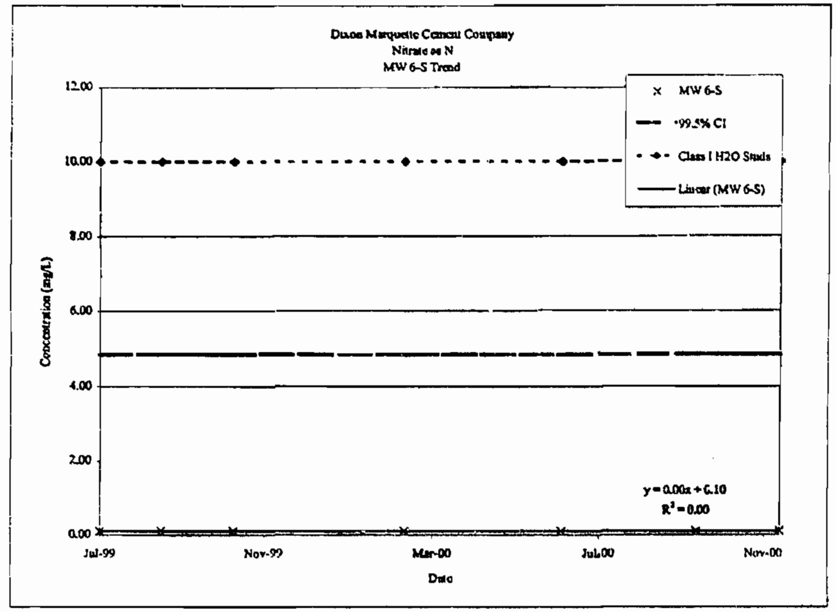


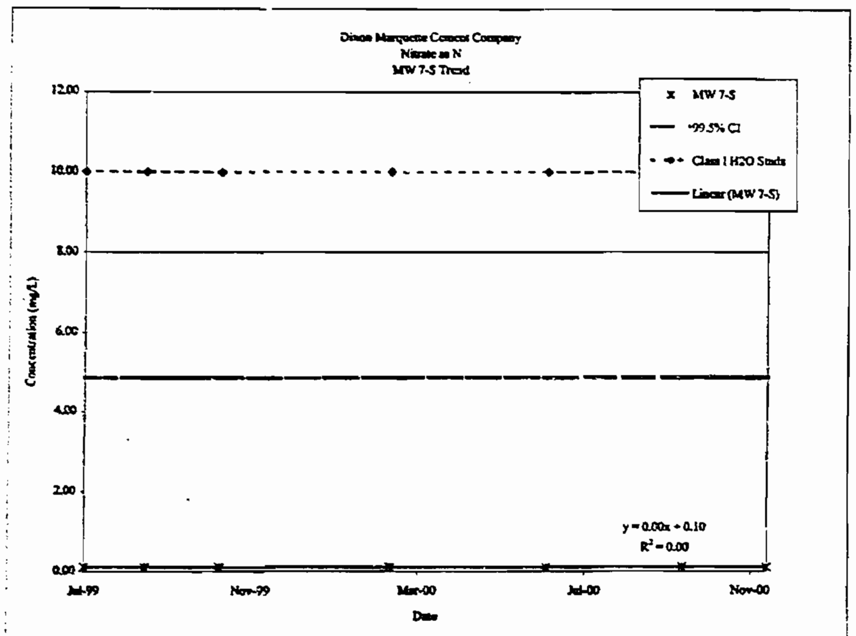
Dixon Marquette Cement Company
Fluoride
MW 8-S Trend
MW 8-S
+99.5% CI
Class I H2O Stnds
Linear (MW 8-S)
y = 4E-05x - 1.1463
R^2 = 0.024
Concentration (mg/L)
Date
Nov-99
Mar-00
Jul-00
Nov-00

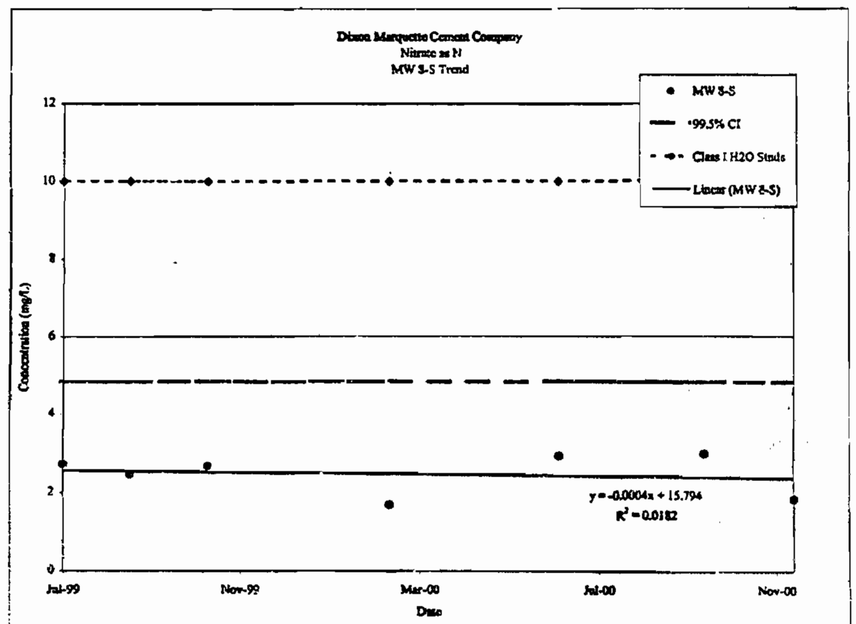
Dixon Marquette Ceme... Company
Nitrate as N

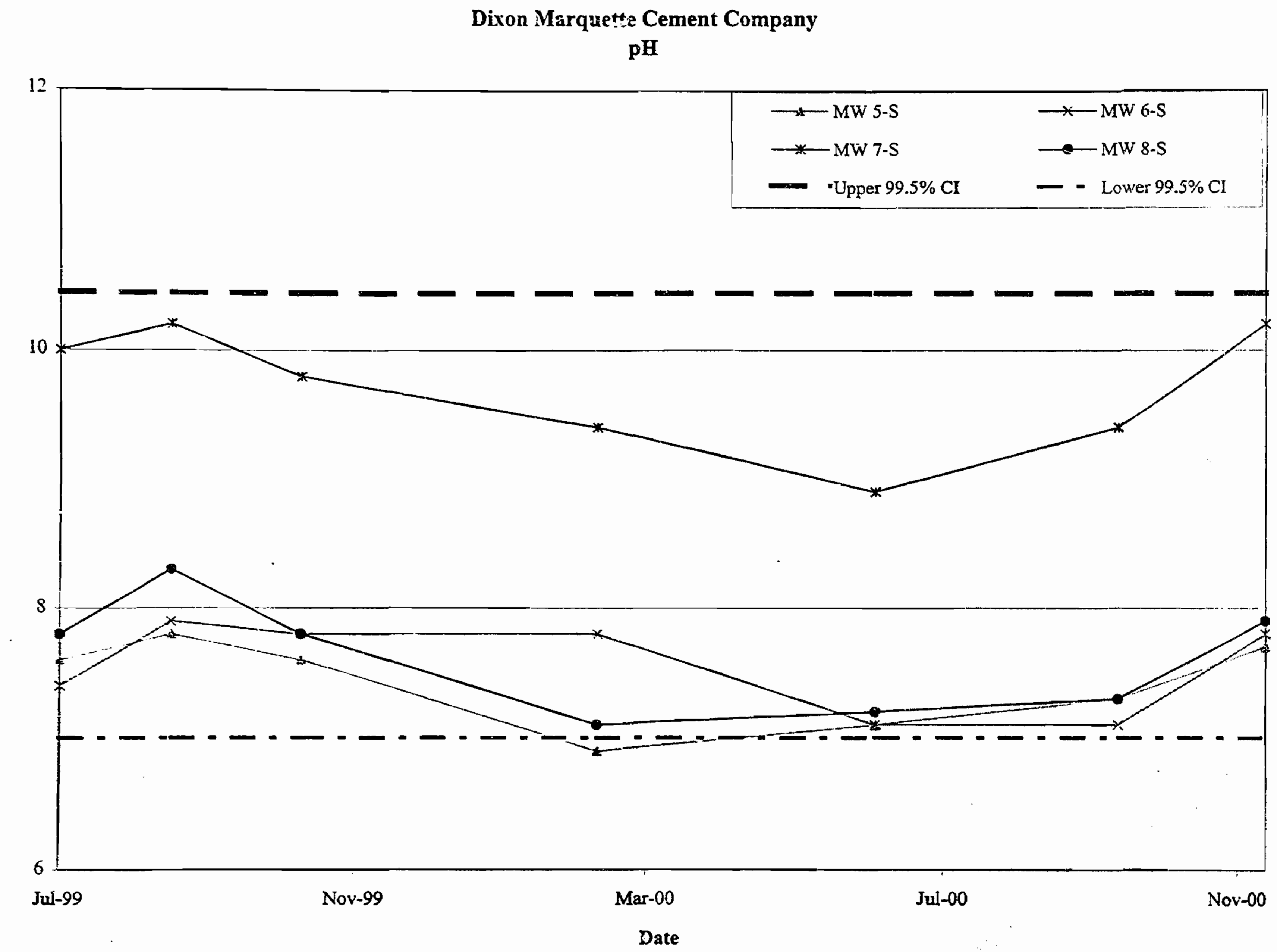


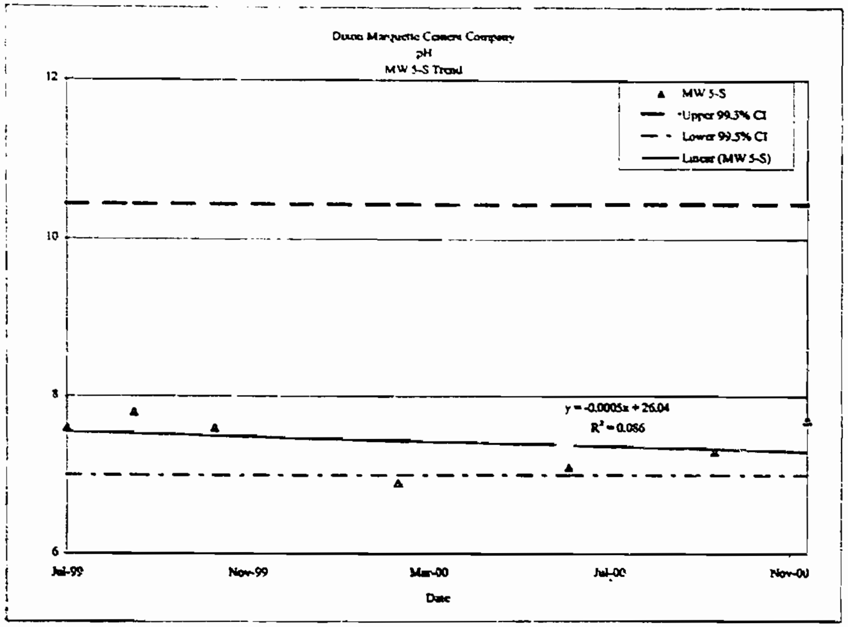

Dixon Marquette Cement Company
Nitrate as N
MW 5-S Trend
MW 5-S
*99.5% CI
Class I H2O Stnds
Linear (MW 5-S)
MW 5-S
6.24
y = -0.0075x + 275.04
R^2 = 0.4104
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

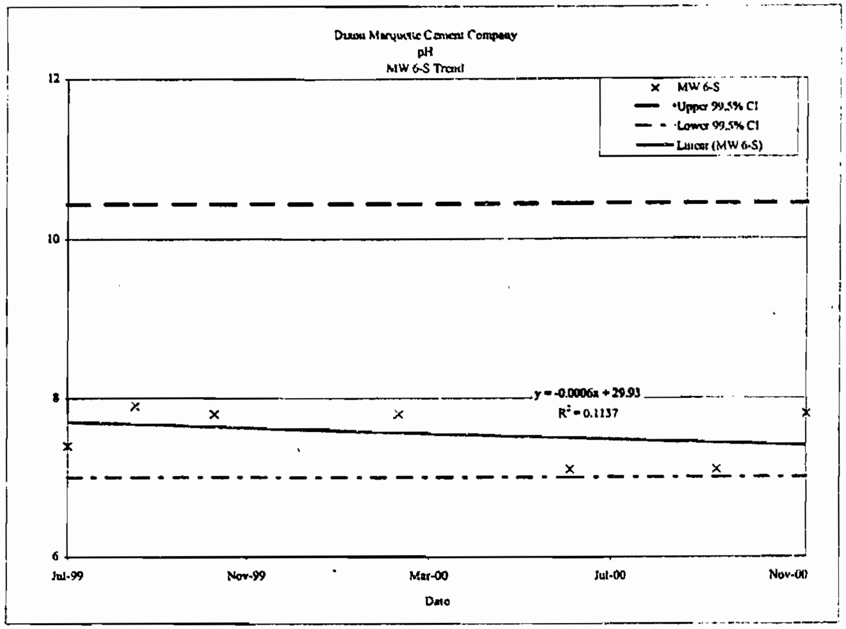

Dixon Marquette Cement Company
Nitrate as N
MW 6-S Trend
MW 6-S
*99.5% CI
Class I H2O Stnds
Linear (MW 6-S)
y = 0.00x + 0.10
R^2 = 0.00
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

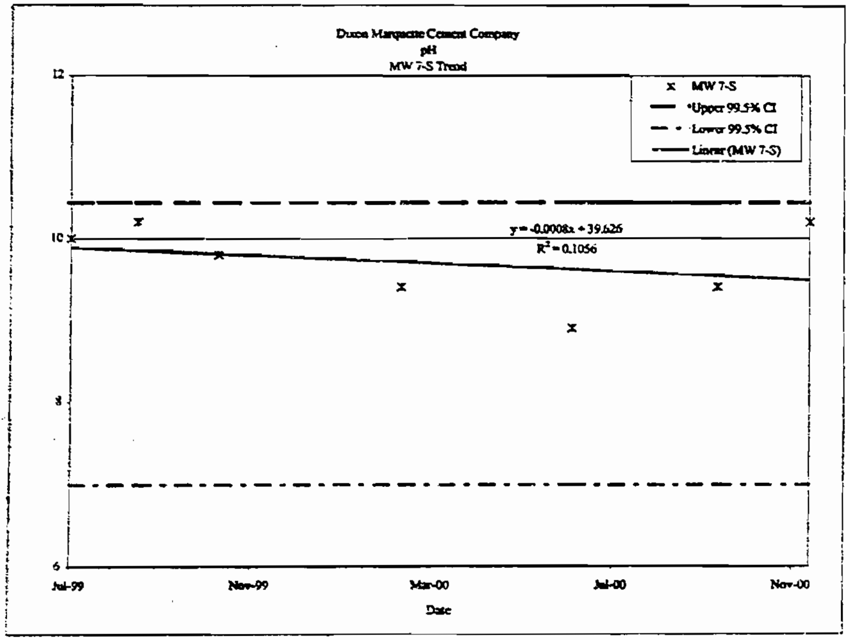

Dixon Marquette Cement Company
Nitrate as N
MW 7-S Trend
MW 7-S
*99.5% CI
Class I H2O Stnds
Linear (MW 7-S)
y = 0.00x + 0.10
R^2 = 0.00
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

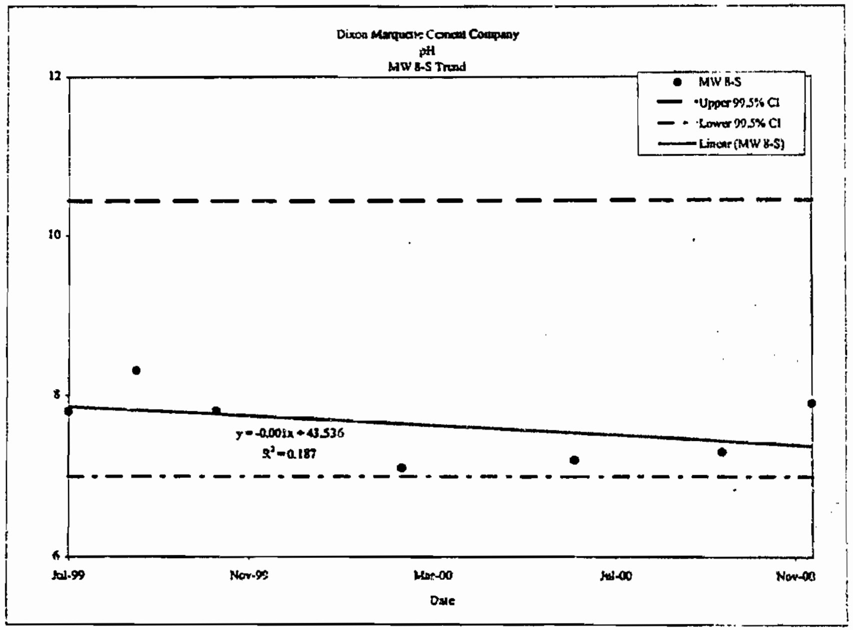

Dixon Marquette Cement Company
Nitrate as N
MW 8-S Trend
MW 8-S
*99.5% CI
Class I H2O Stnds
Linear (MW 8-S)
y = -0.0004x + 15.794
R^2 = 0.0182
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

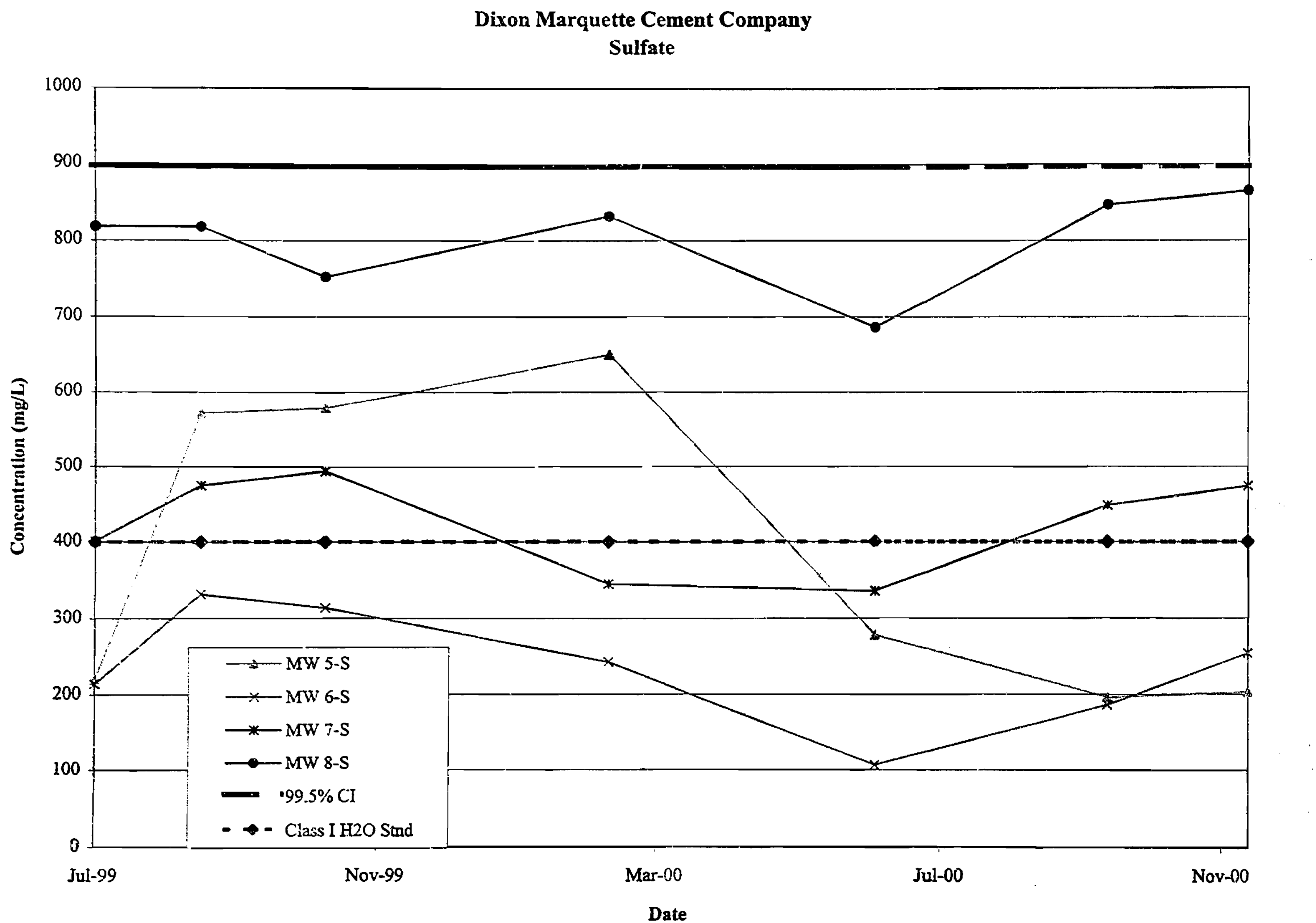

Dixon Marquette Cement Company
pH
12
10
8
6
MW 5-S
MW 6-S
MW 7-S
MW 8-S
Upper 99.5% CI
Lower 99.5% CI
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
pH
MW 5-S Trend
MW 5-S
Upper 99.5% CI
Lower 99.5% CI
Linear (MW 5-S)
y = -0.0005x + 26.04
R² = 0.086
Date

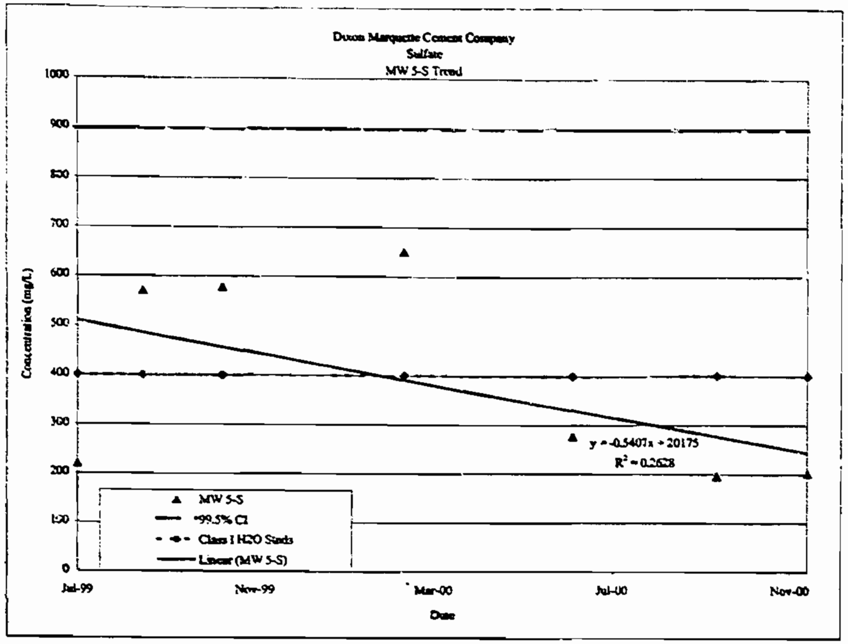

Dixon Marquette Cement Company
pH
MW 6-S Trend
MW 6-S
Upper 99.5% CI
Lower 99.5% CI
Linear (MW 6-S)
y = -0.0006x + 29.93
R² = 0.1137
Date

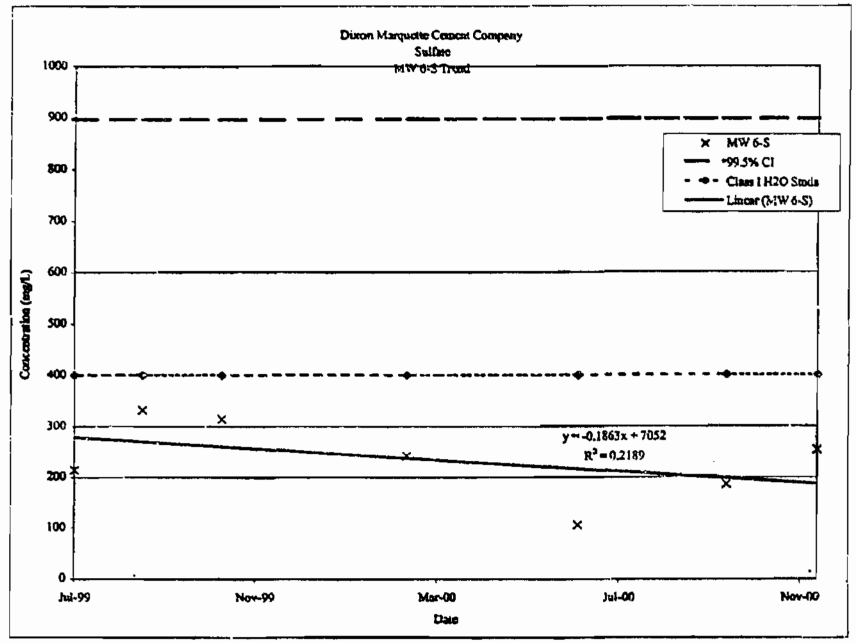

Dixon Marquette Cement Company
pH
MW 7-S Trend
MW 7-S
Upper 99.5% CI
Lower 99.5% CI
Linear (MW 7-S)
y = -0.0008x + 39.626
R² = 0.1056
Date

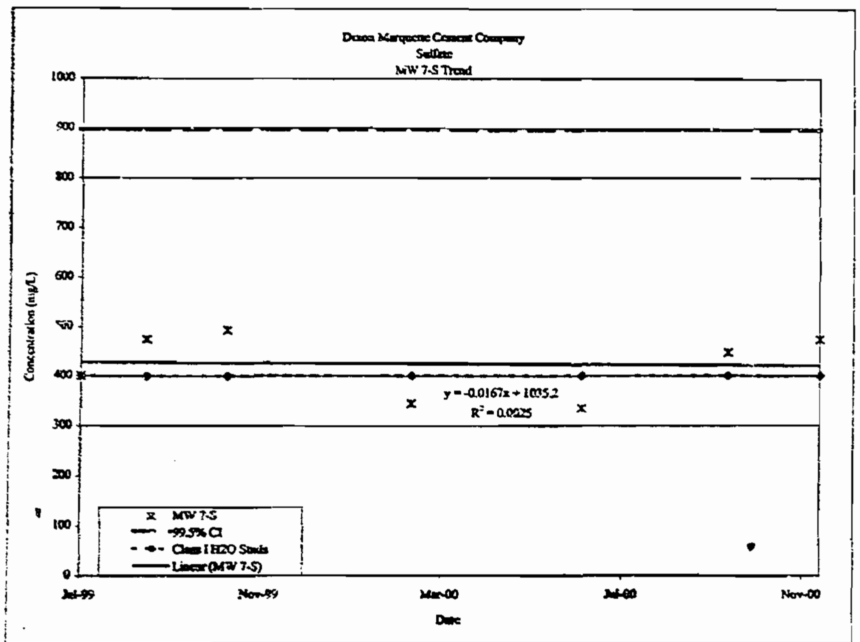

Dixon Marquette Cement Company
pH
MW 8-S Trend
MW 8-S
Upper 99.5% CI
Lower 99.5% CI
Linear (MW 8-S)
y = -0.001x + 43.536
R² = 0.187
Date

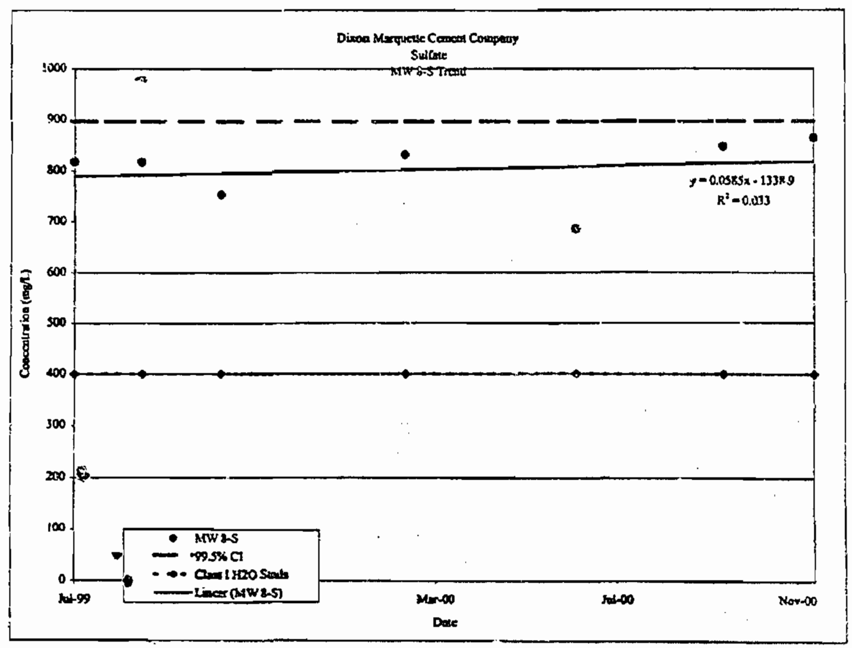


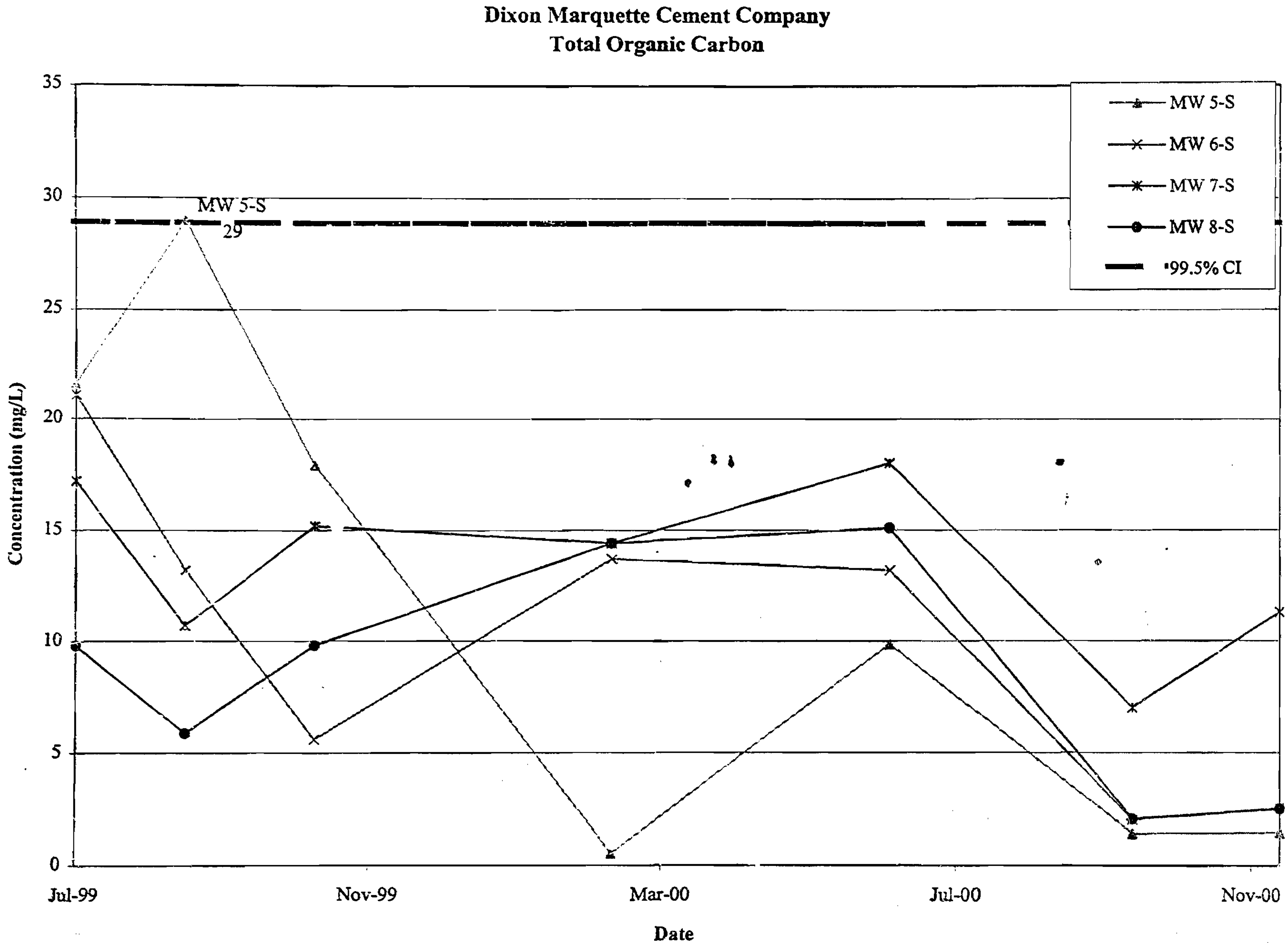
Dixon Marquette Cement Company
Sulfate
Concentration (mg/L)
1000
900
800
700
600
500
400
300
200
100
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 5-S
MW 6-S
MW 7-S
MW 8-S
99.5% CI
Class I H2O Stnd

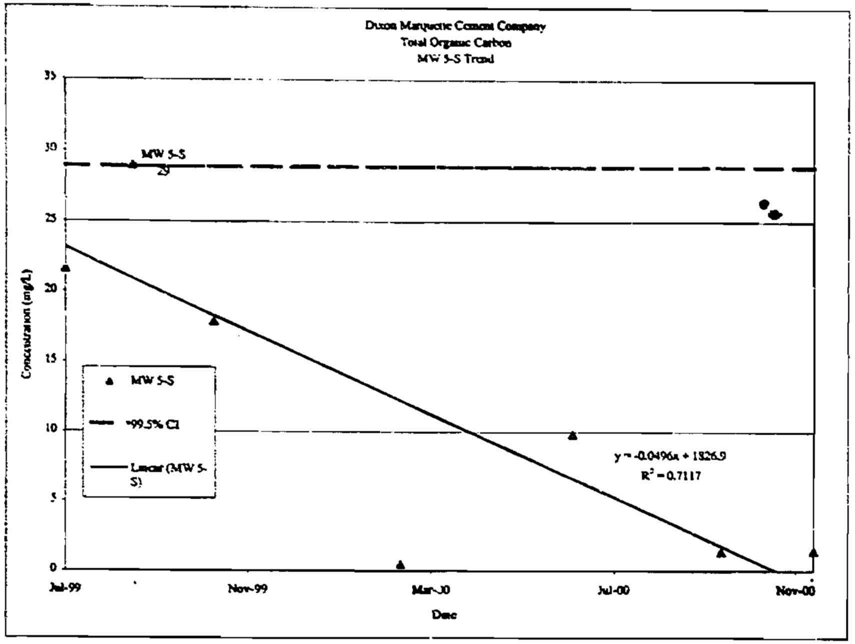

Dixon Marquette Cement Company
Sulfate
MW 5-S Trend
Concentration (mg/L)
Date
y = -0.5407x + 20175
R^2 = 0.2628
MW 5-S
*99.5% CI
Class I H2O Stnds
Linear (MW 5-S)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00


Dixon Marquette Cement Company
Sulfate
MW 6-S Trend
Concentration (mg/L)
Date
MW 6-S
*99.5% CI
Class I H2O Stnds
Linear (MW 6-S)
y = -0.1863x + 7052
R^2 = 0.2189
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

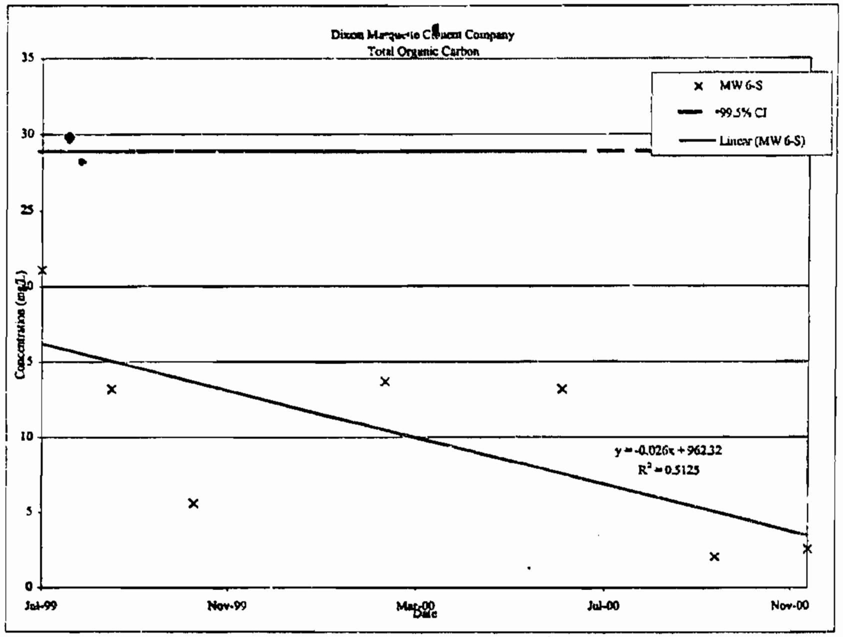

Dixon Marquette Cement Company
Sulfate
MW 7-S Trend
Concentration (mg/L)
Date
y = -0.0167x + 1035.2
R^2 = 0.0225
MW 7-S
*99.5% CI
Class I H2O Stnds
Linear (MW 7-S)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00


Dixon Marquette Cement Company
Sulfate
MW 8-S Trend
Concentration (mg/L)
Date
y = 0.0585x - 1338.9
R^2 = 0.033
MW 8-S
*99.5% CI
Class I H2O Stnds
Linear (MW 8-S)
Jul-99
Mar-00
Jul-00
Nov-00

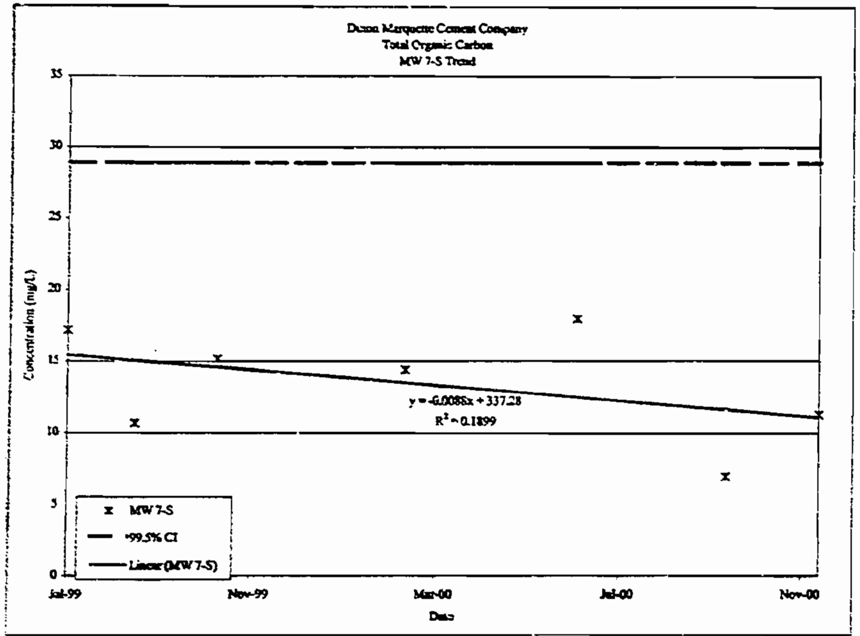

Dixon Marquette Cement Company
Total Organic Carbon
MW 5-S
MW 6-S
MW 7-S
MW 8-S
99.5% CI
MW 5-S
29
Concentration (mg/L)
35
30
25
20
15
10
5
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date



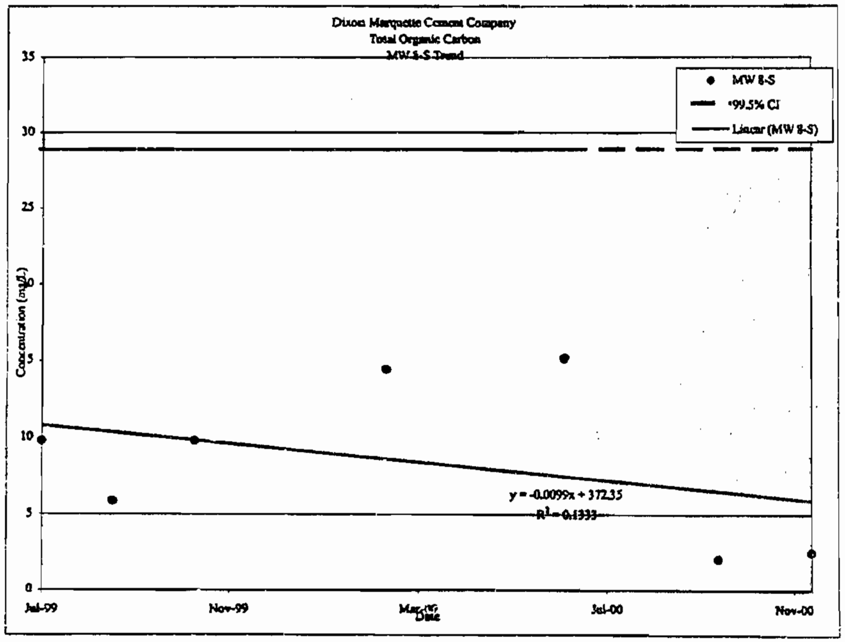
Dixon Marquette Cement Company
Total Organic Carbon
MW 5-S Trend
MW 5-S
29
y = -0.0496x + 1826.9
R^2 = 0.7117
MW 5-S
+99.5% CI
Linear (MW 5-S)
Concentration (mg/L)
Date
Jul-99
Nov-99
Jul-00
Nov-00



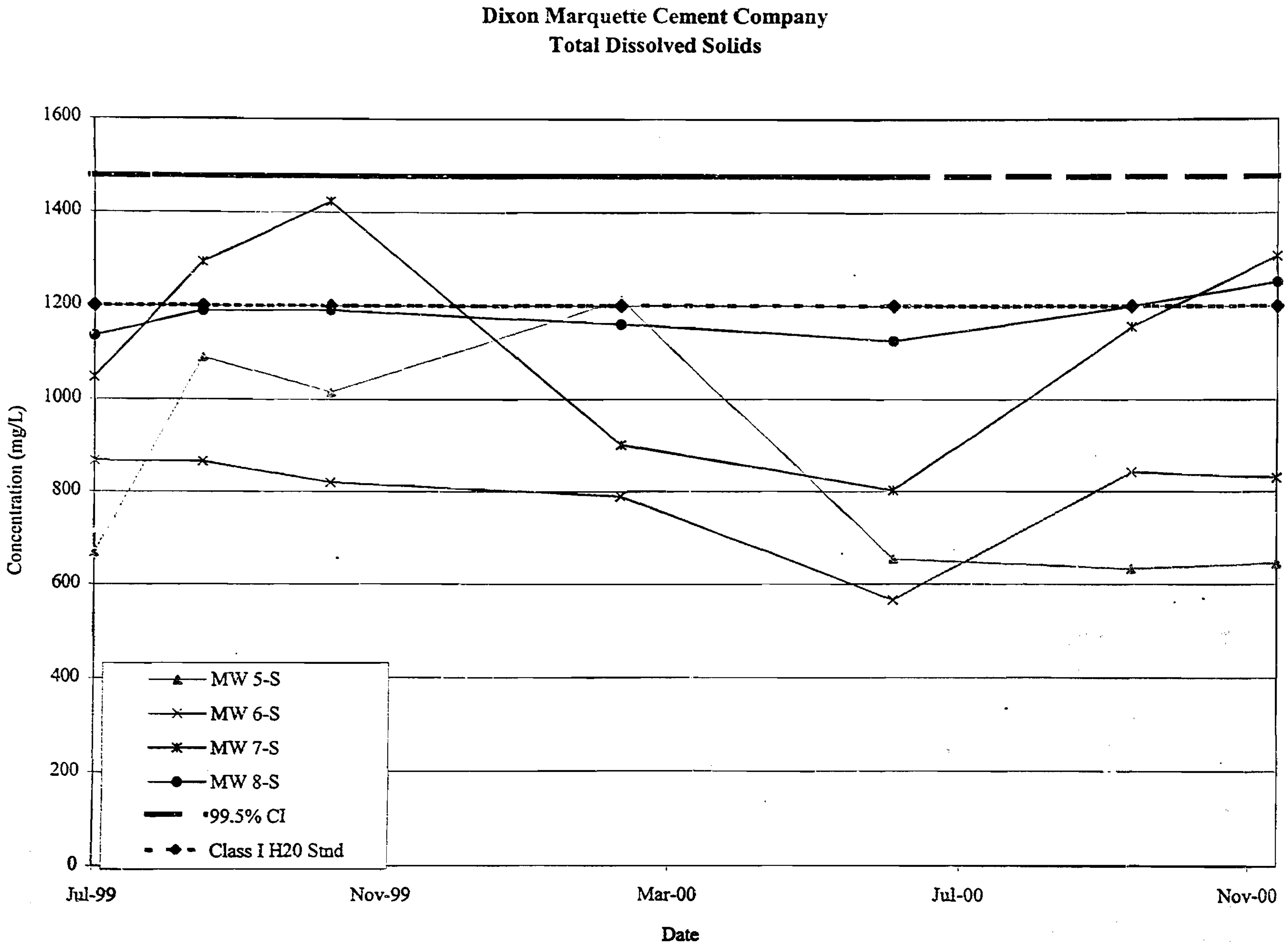
Dixon Marquette Cement Company
Total Organic Carbon
MW 6-S
+99.5% CI
Linear (MW 6-S)
y = -0.026x + 962.32
R^2 = 0.5125
Concentration (mg/L)
Jul-99
Nov-99
Jul-00
Nov-00

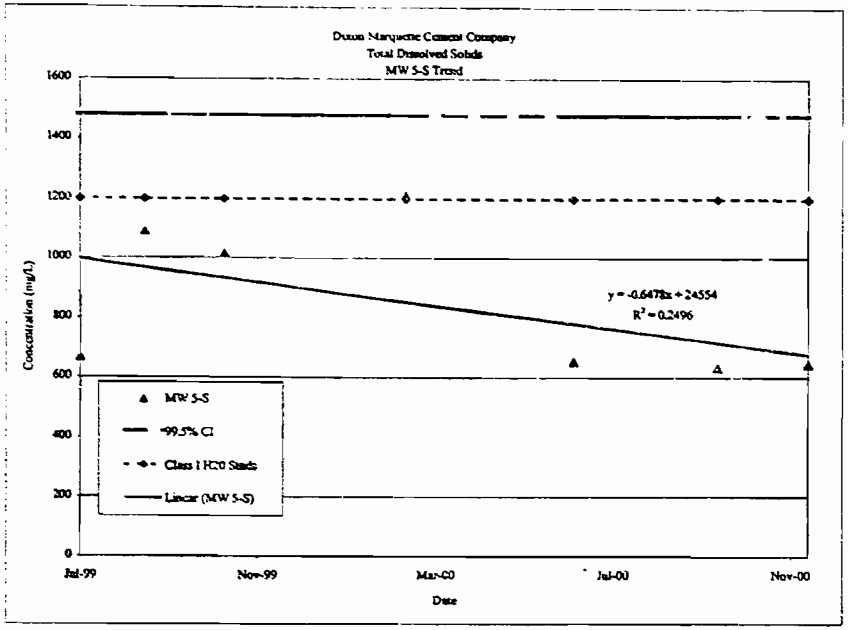


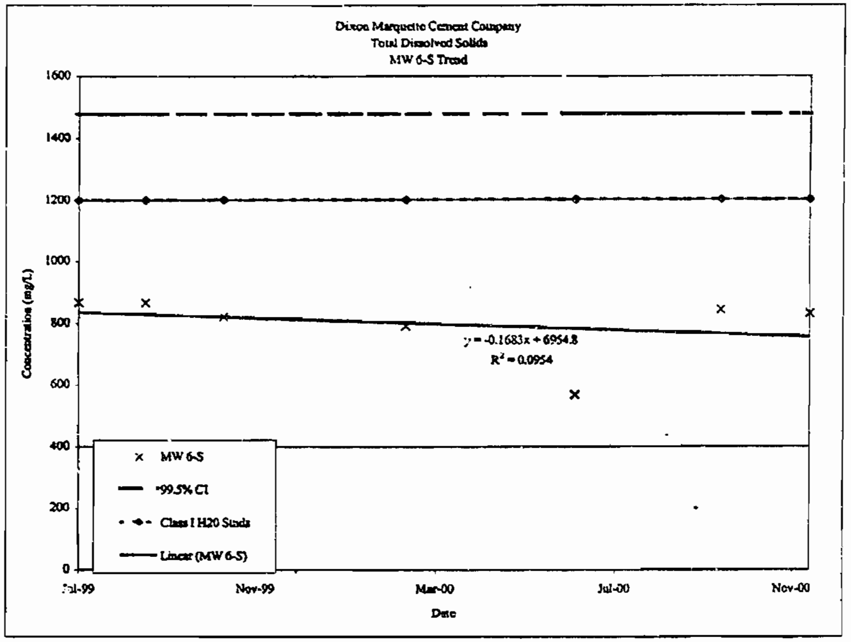
Dixon Marquette Cement Company
Total Organic Carbon
MW 7-S Trend
y = -0.0088x + 337.28
R^2 = 0.1899
MW 7-S
+99.5% CI
Linear (MW 7-S)
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

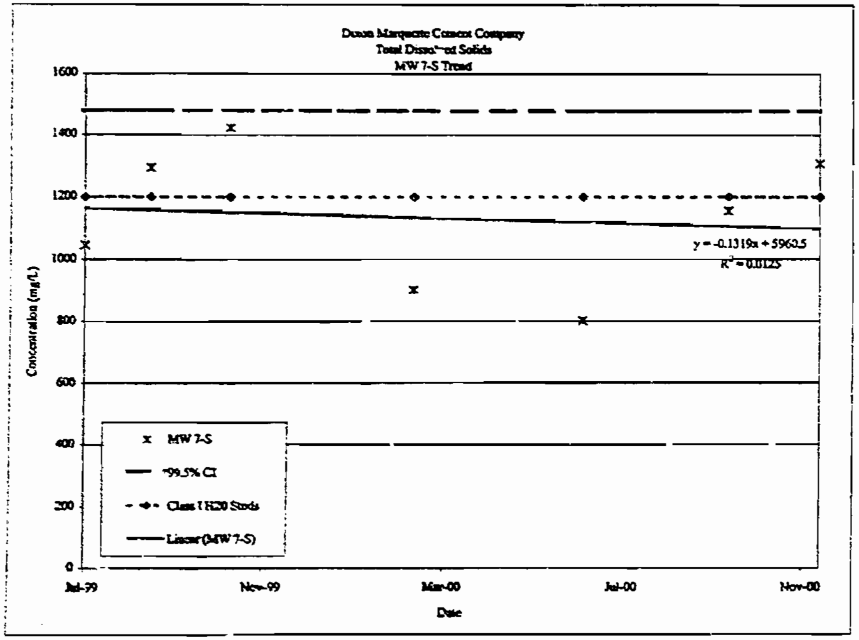


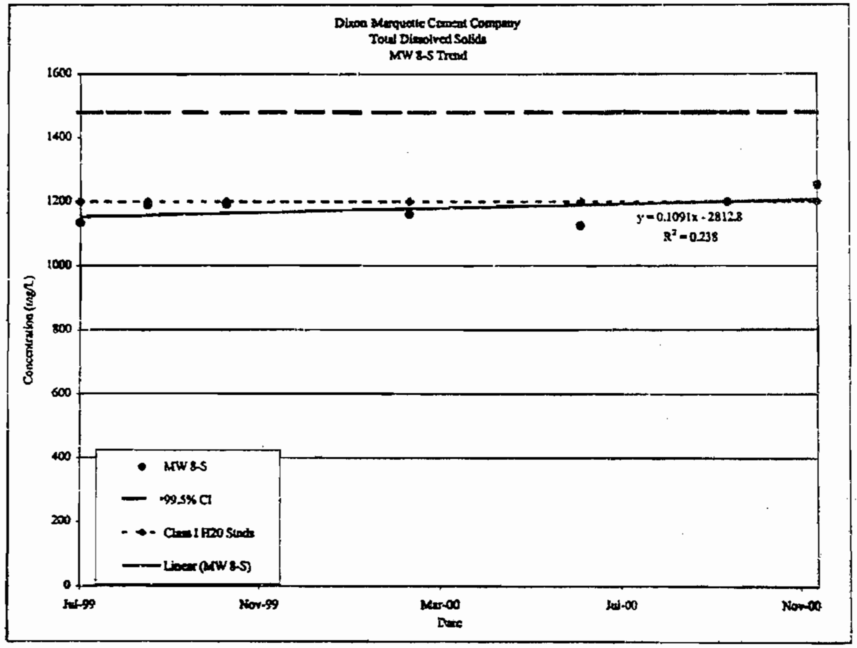
Dixon Marquette Cement Company
Total Organic Carbon
MW 8-S
+99.5% CI
Linear (MW 8-S)
y = -0.0099x + 372.35
Concentration (mg/L)
Jul-99
Nov-99
Jul-00
Nov-00

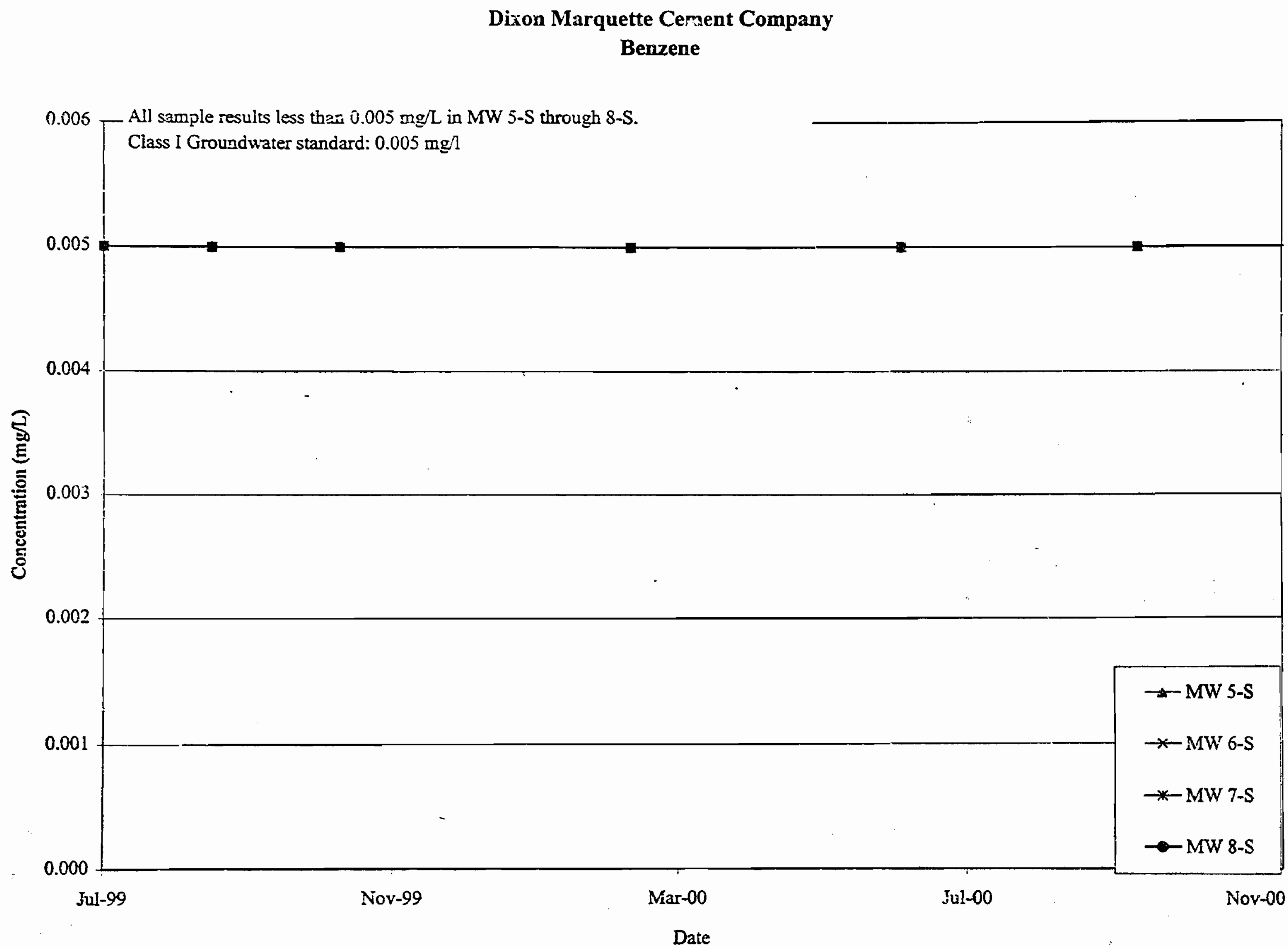

Dixon Marquette Cement Company
Total Dissolved Solids
1600
1400
1200
1000
800
600
400
200
0
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 5-S
MW 6-S
MW 7-S
MW 8-S
•99.5% CI
Class I H20 Stnd


Dixon Marquette Cement Company
Total Dissolved Solids
MW 5-S Trend
Concentration (mg/L)
Date
y = -0.6478x + 24554
R² = 0.2496
MW 5-S
99.5% CI
Class I H20 Stnds
Linear (MW 5-S)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00


Dixon Marquette Cement Company
Total Dissolved Solids
MW 6-S Trend
Concentration (mg/L)
Date
y = -0.1683x + 6954.8
R² = 0.0954
MW 6-S
99.5% CI
Class I H20 Stnds
Linear (MW 6-S)
Nov-99
Mar-00
Jul-00
Nov-00

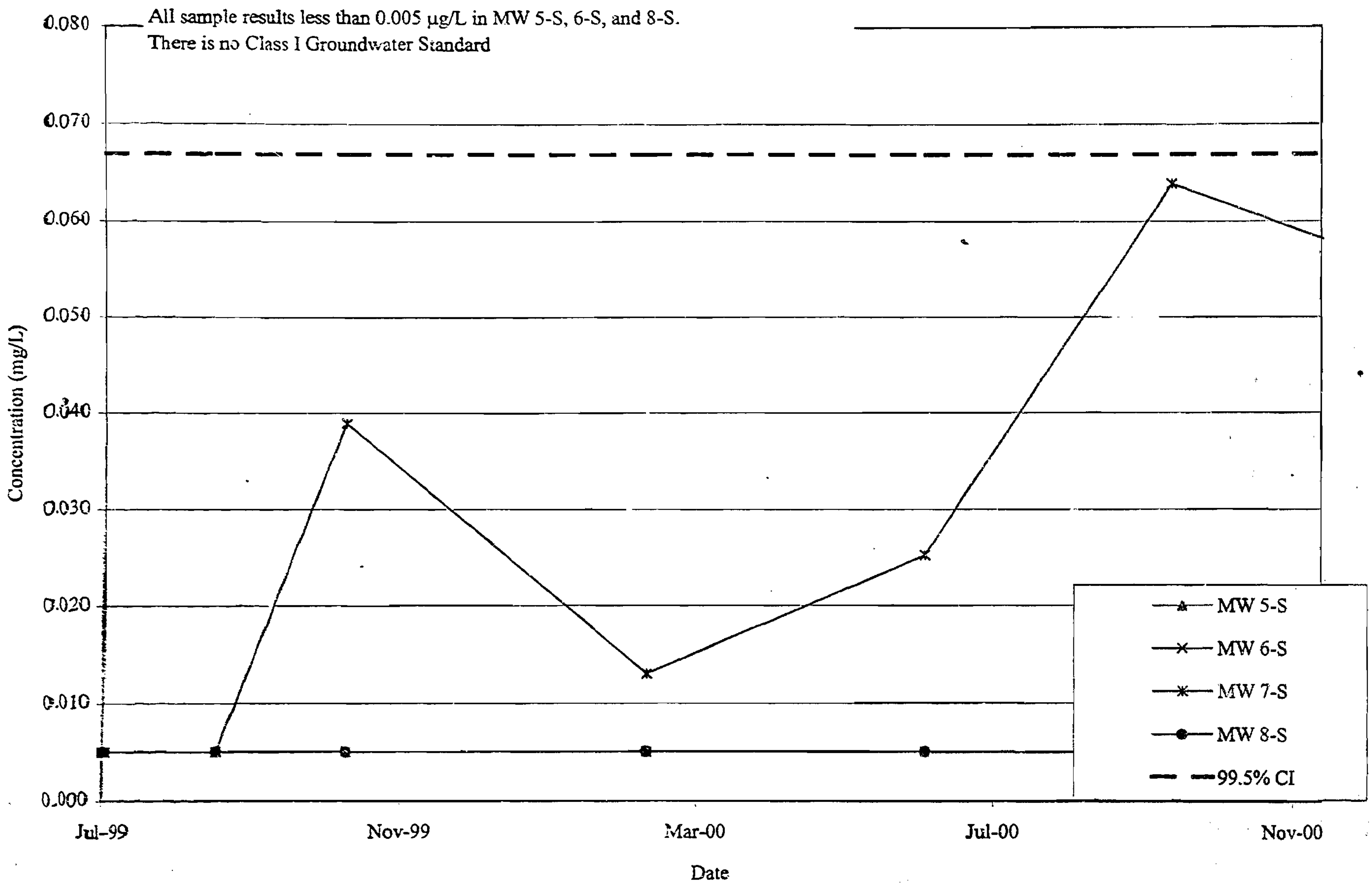

Dixon Marquette Cement Company
MW 7-S Trend
Concentration (mg/L)
Date
y = -0.1319x + 5960.5
MW 7-S
99.5% CI
Class I H20 Stnds
Linear (MW 7-S)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00

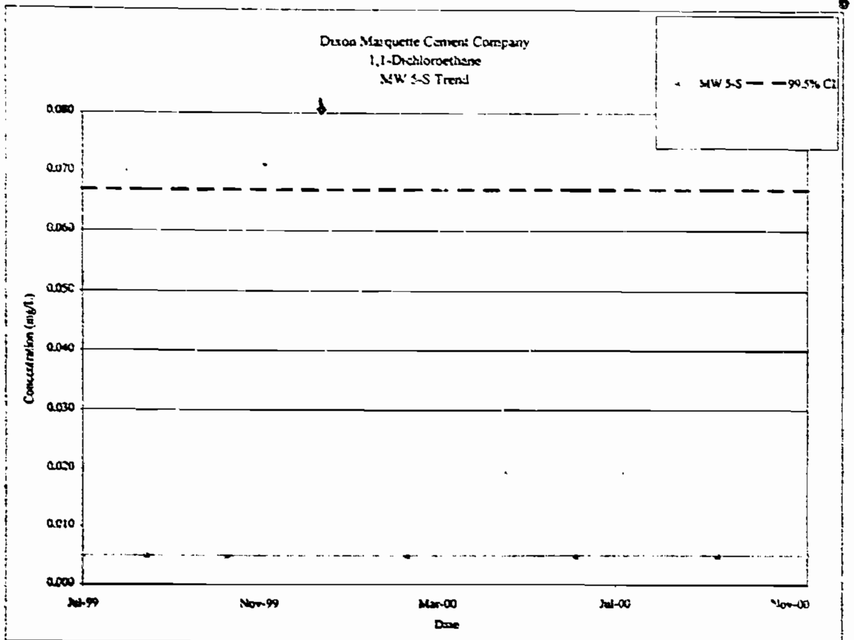

Dixon Marquette Cement Company
Total Dissolved Solids
MW 8-S Trend
Concentration (mg/L)
Date
y = 0.1091x - 2812.8
R² = 0.238
MW 8-S
99.5% CI
Class I H20 Stnds
Linear (MW 8-S)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00



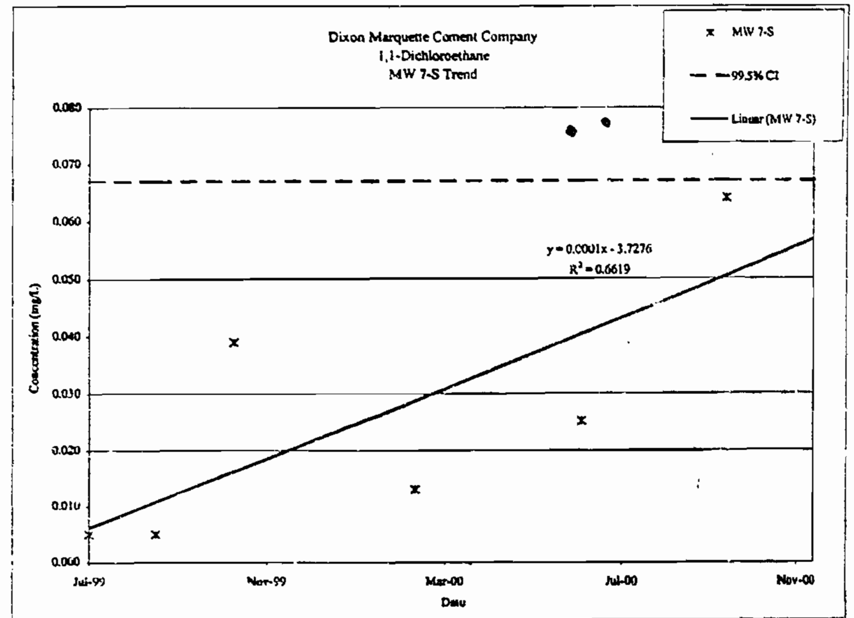
Dixon Marquette Cement Company
Benzene
All sample results less than 0.005 mg/L in MW 5-S through 8-S.
Class I Groundwater standard: 0.005 mg/l
0.006
0.005
0.004
0.003
0.002
0.001
0.000
Concentration (mg/L)
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 5-S
MW 6-S
MW 7-S
MW 8-S

Dixon Marquette Cement Company
1,1-Dichloroethane

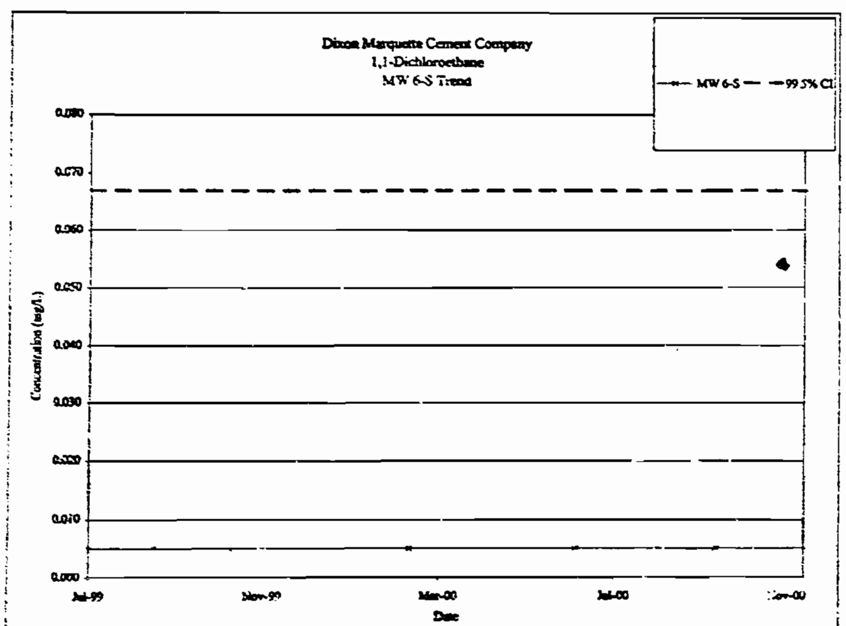




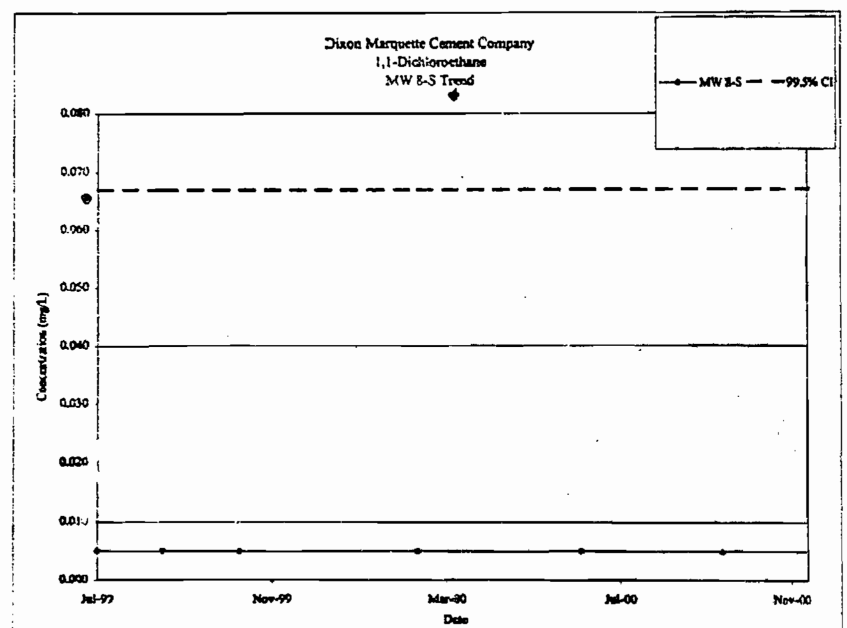
Dixon Marquette Cement Company
1,1-Dichloroethane
MW 5-S Trend
MW 5-S
99.5% CI
Concentration (mg/L)
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date



Dixon Marquette Cement Company
1,1-Dichloroethane
MW 7-S Trend
MW 7-S
99.5% CI
Linear (MW 7-S)
y = 0.0001x - 3.7276
R² = 0.6619
Concentration (mg/L)
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

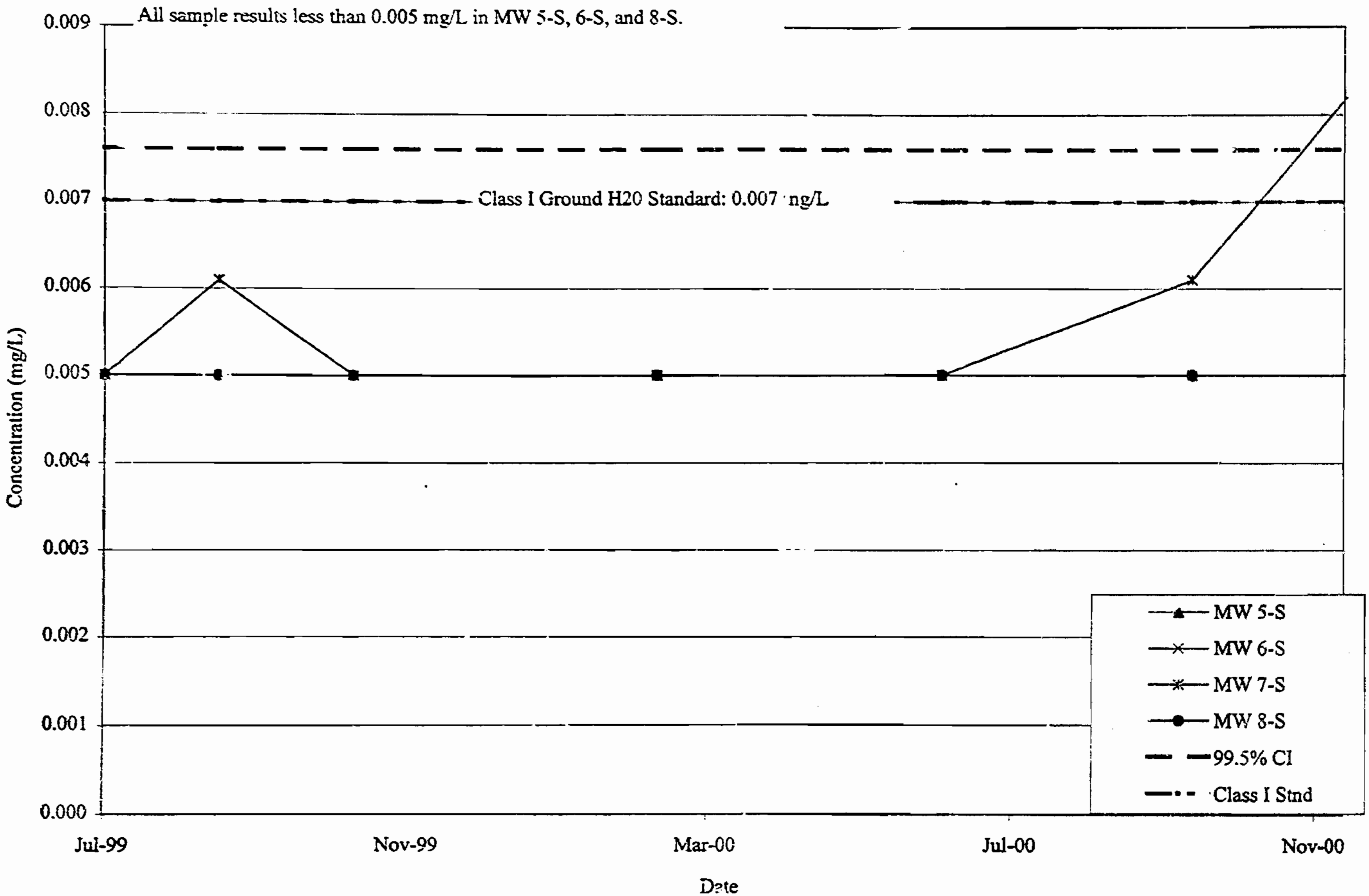


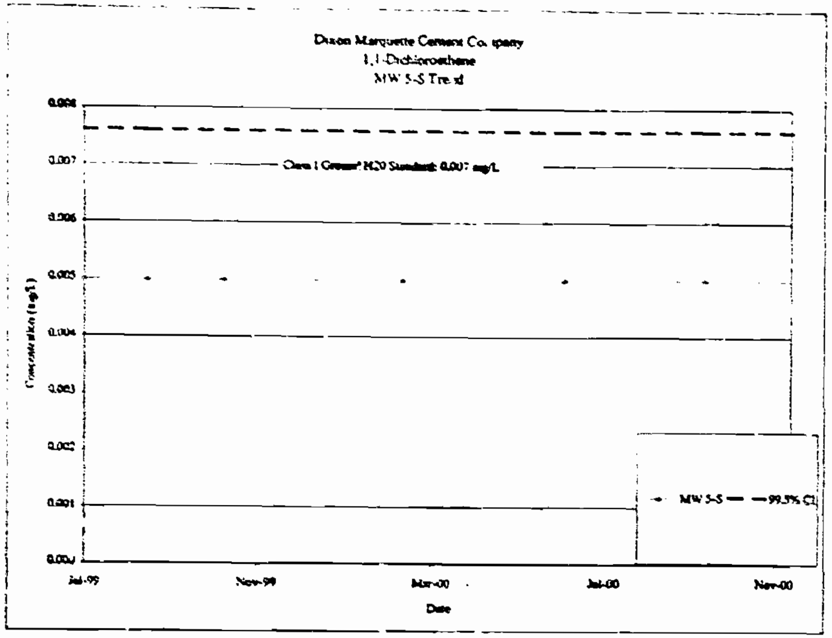
Dixon Marquette Cement Company
1,1-Dichloroethane
MW 6-S Trend
MW 6-S
99.5% CI
Concentration (mg/L)
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

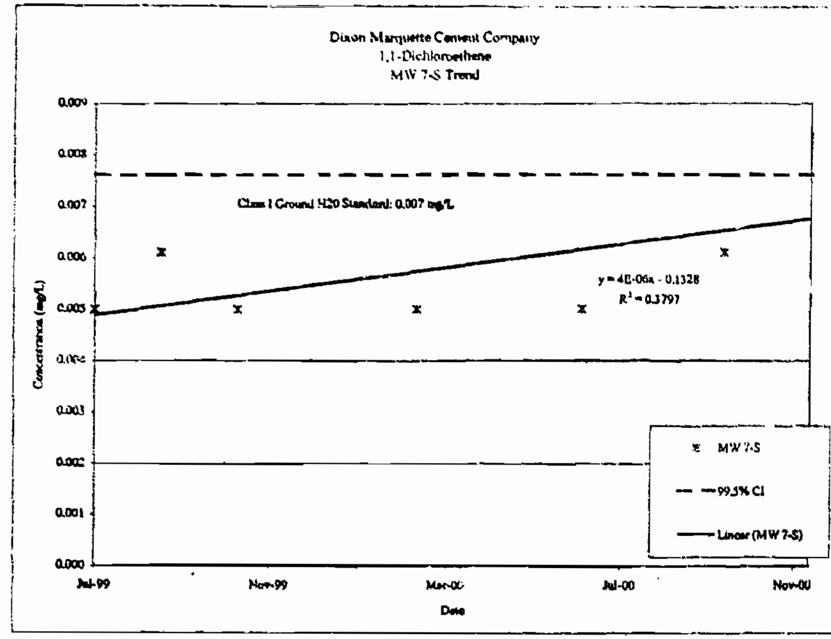


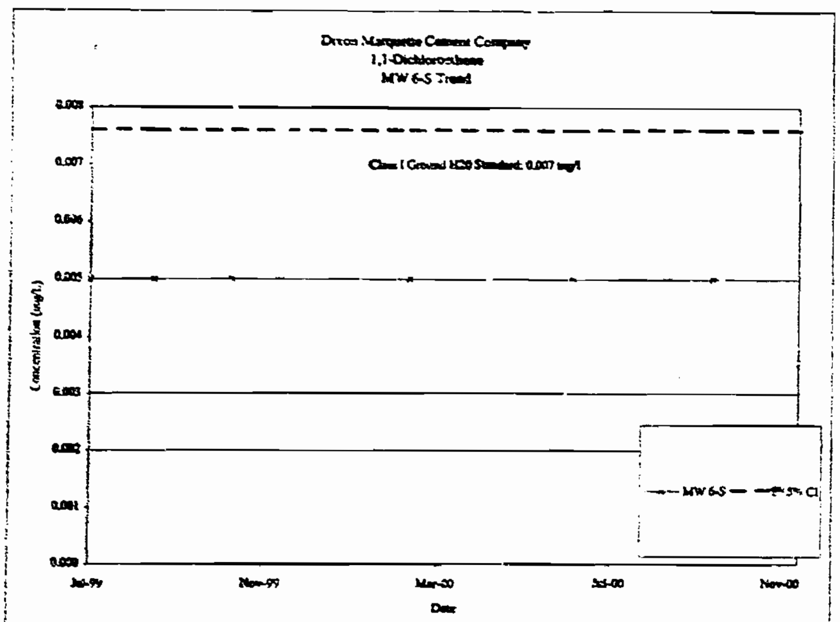
Dixon Marquette Cement Company
1,1-Dichloroethane
MW 8-S Trend
MW 8-S
99.5% CI
Concentration (mg/L)
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

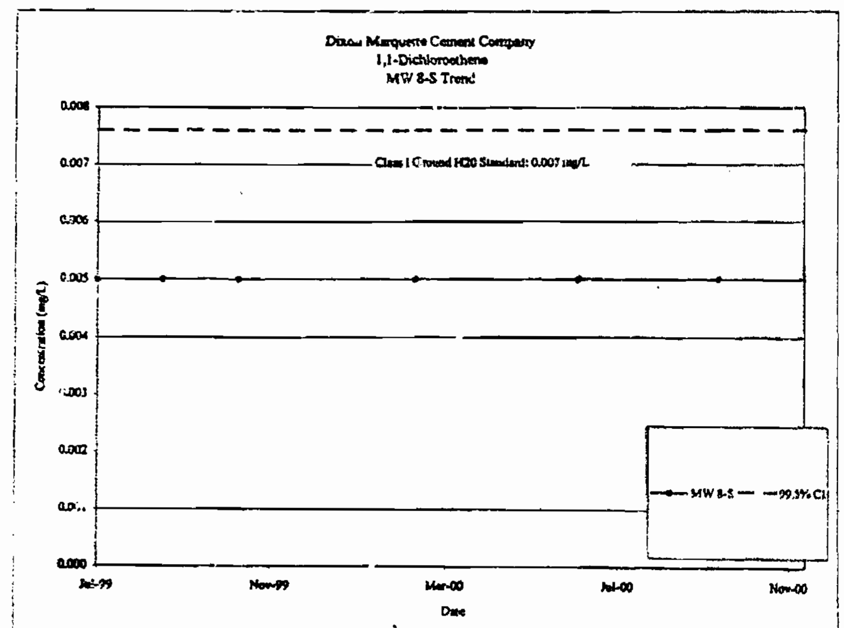
Dixon Marquette Cement Company
1,1-Dichloroethene



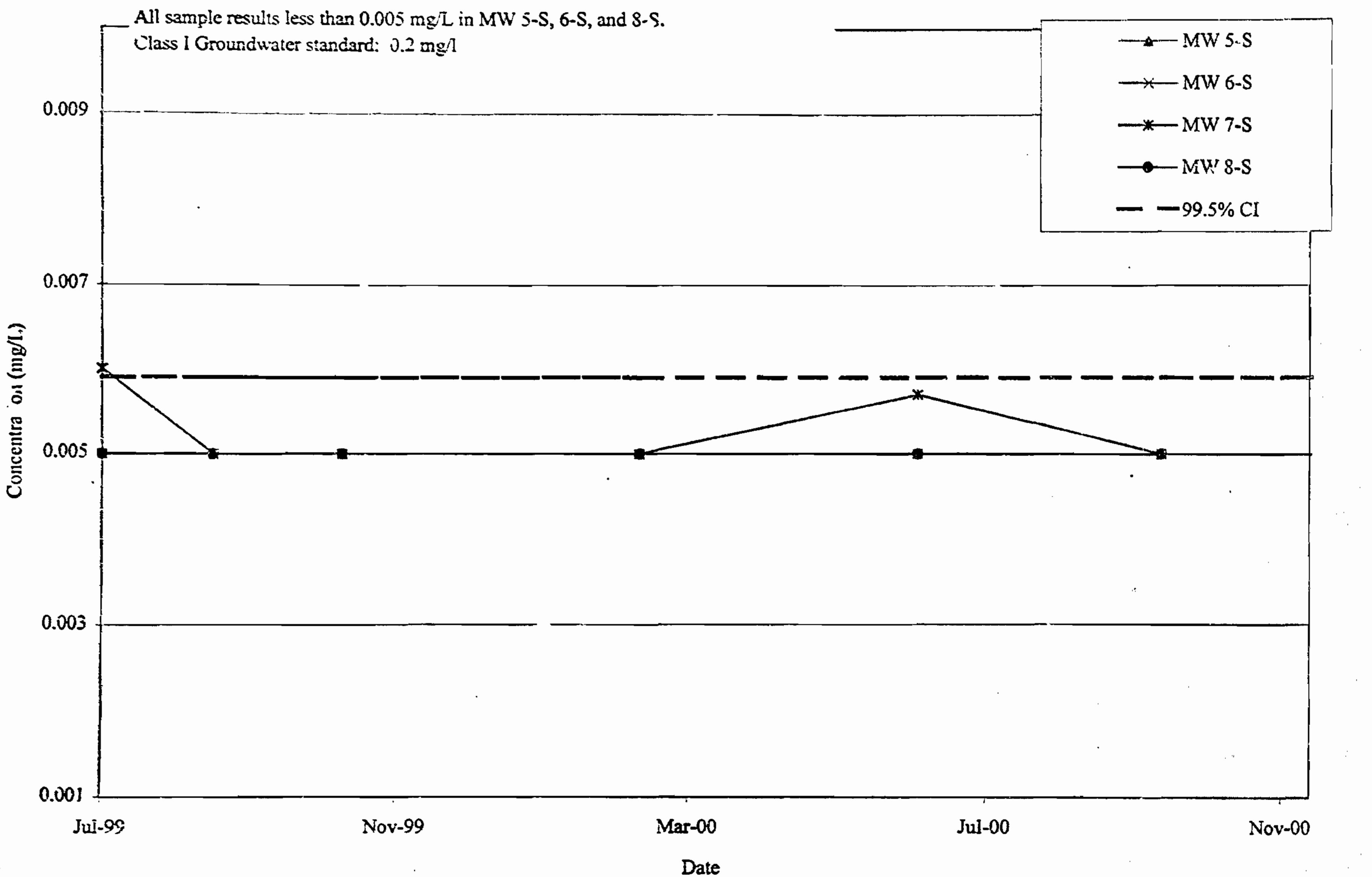

Dixon Marquette Cement Company
1,1-Dichloroethene
MW 5-S Trend
Class I Ground H20 Standard: 0.007 mg/L
Concentration (mg/L)
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 5-S
99.5% CI

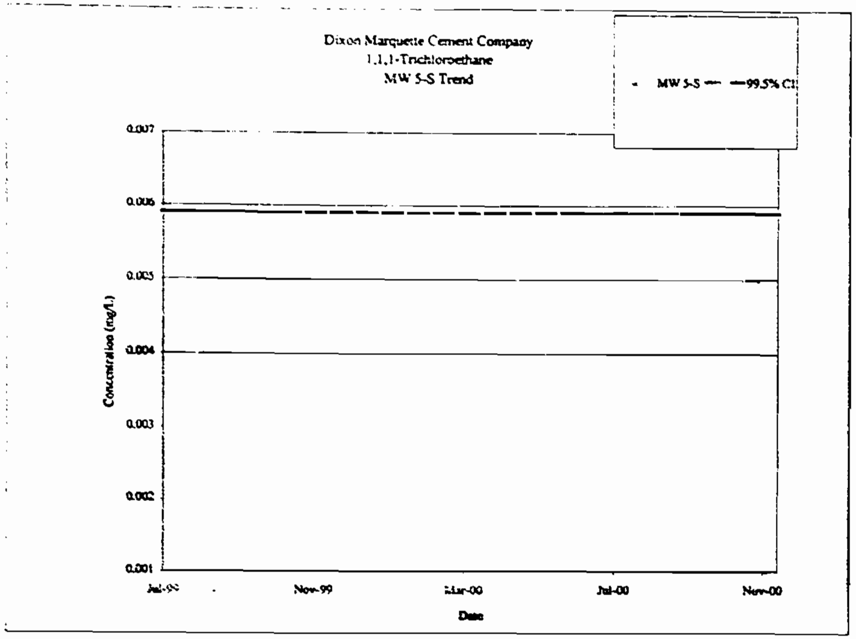

Dixon Marquette Cement Company
1,1-Dichloroethene
MW 7-S Trend
Class I Ground H20 Standard: 0.007 mg/L
y = 4E-06x - 0.1328
R² = 0.3797
Concentration (mg/L)
0.009
0.008
0.007
0.006
0.005
0.003
0.002
0.001
0.000
Jul-99
Nov-99
Jul-00
Nov-00
Date
MW 7-S
99.5% CI
Linear (MW 7-S)

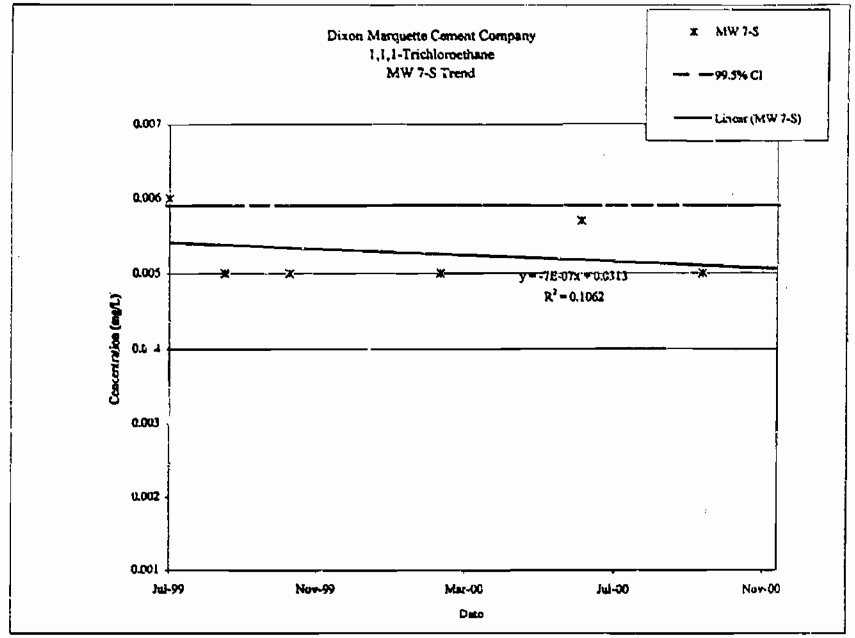

Dixon Marquette Cement Company
1,1-Dichloroethene
MW 6-S Trend
Class I Ground H20 Standard: 0.007 mg/l
Concentration (mg/L)
0.008
0.007
0.005
0.004
0.003
0.002
0.001
0.000
Jul-99
Nov-99
Mar-00
Nov-00
Date
MW 6-S

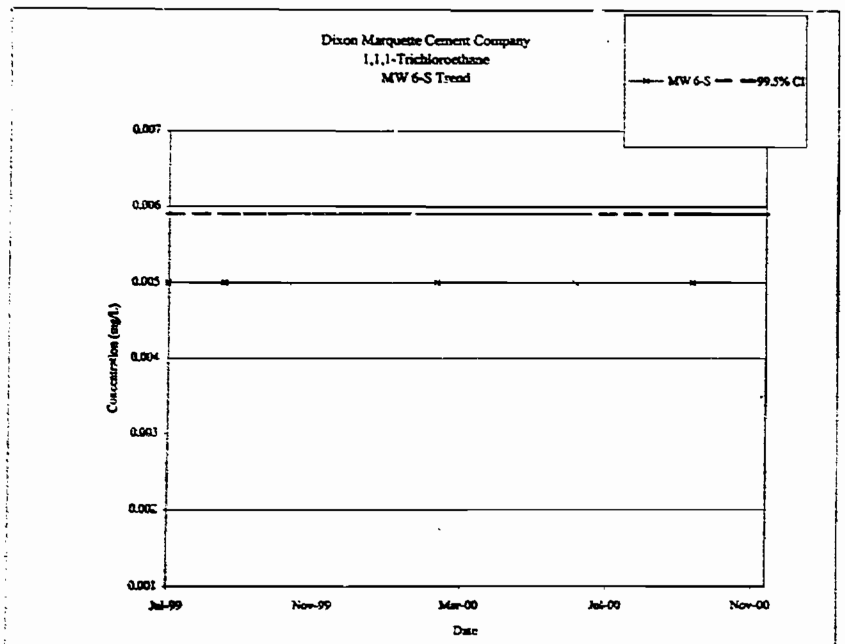

Dixon Marquette Cement Company
1,1-Dichloroethene
MW 8-S Trend
Class I Ground H20 Standard: 0.007 mg/L
Concentration (mg/L)
0.008
0.007
0.006
0.005
0.004
0.002
0.000
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date
MW 8-S
99.5% CI

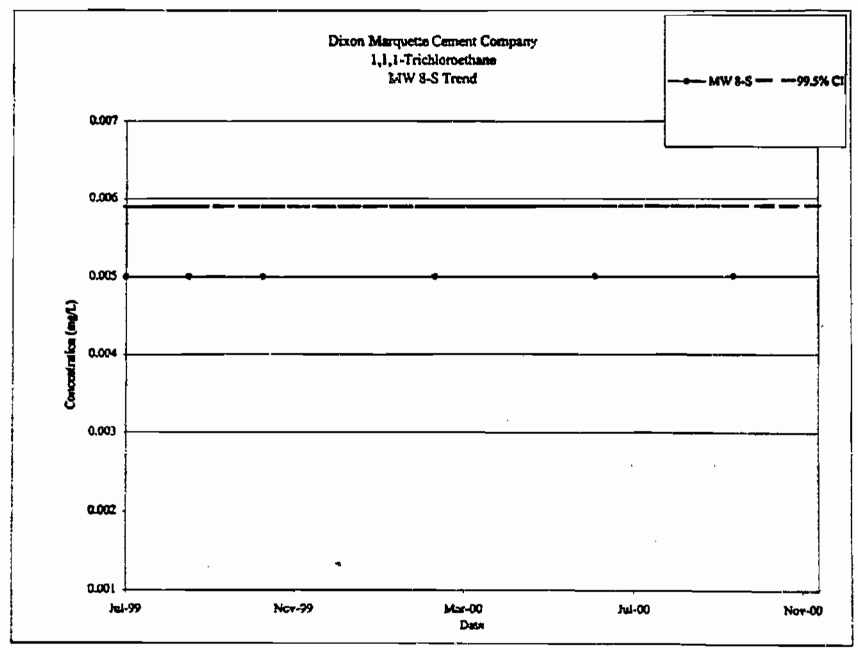
Dixon Marquette Cement Company
1,1,1-Trichloroethane




Dixon Marquette Cement Company
1,1,1-Trichloroethane
MW 5-S Trend
MW 5-S
99.5% CI
Concentration (mg/L)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
Nov-99
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
1,1,1-Trichloroethane
MW 7-S Trend
MW 7-S
99.5% CI
Linear (MW 7-S)
Concentration (mg/L)
0.007
0.006
0.005
0.003
0.002
0.001
R² = 0.1062
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
1,1,1-Trichloroethane
MW 6-S Trend
MW 6-S
99.5% CI
Concentration (mg/L)
0.007
0.006
0.005
0.004
0.003
0.001
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date


Dixon Marquette Cement Company
1,1,1-Trichloroethane
MW 8-S Trend
MW 8-S
99.5% CI
Concentration (mg/L)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Date

Dixon Marquette Cement Company
Toluene