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DOCUMENTATION REPORT FOR RCRA CLOSURE OF OLD CALCIUM CARBIDE DESULFURIZATION SLAG TREATMENT UNIT

PREPARED FOR
GENERAL MOTORS CORPORATION
CENTRAL FOUNDRY DIVISION
SAGINAW NODULAR IRON PLANT
SAGINAW, MICHIGAN

OCTOBER 1991

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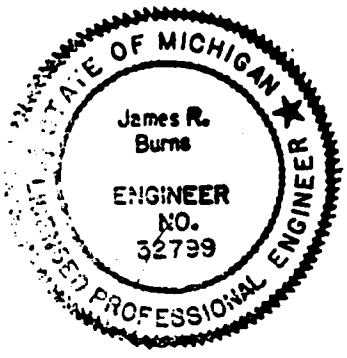
CERTIFICATION OF CLOSURE

The information submitted in this report is to the best of my knowledge and belief, true, accurate, and complete, and the closure activities for these units have been conducted in conformance with the approved closure plan.



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1. INTRODUCTION

1.1 Background

The General Motors Corporation Central Foundry Division, Saginaw Nodular Iron (GMC-CFD-SNI) plant manufactured nodular iron castings. During the manufacturing process, GMC-CFD-SNI added calcium carbide to reduce the sulfur content in the molten iron. This step was necessary to produce ductile iron with appropriate metallurgical properties. The slag generated by this process was known as calcium carbide desulfurization slag, and contained small quantities (one to three percent) of unreacted calcium carbide. When unreacted calcium carbide in the slag came into contact with water, a combustible (acetylene) gas was formed as a reaction product. Therefore, calcium carbide desulfurization slag was a potential hazardous waste by the characteristic of reactivity (D003).

The treatment technique used to render the slag nonhazardous involved eliminating the ability of the slag to generate acetylene gas. This was accomplished by placing the waste in a waste pile and spraying the waste with water. To the best of our knowledge potassium permanganate and surfactant were not used at this old calcium carbide desulfurization slag treatment unit.

The GMC-CFD-SNI plant began preparing a closure plan for old calcium carbide desulfurization slag treatment unit in mid-1987 and submitted the closure plan to the Michigan Department of Natural Resources (MDNR) in December 1987. The closure plan described the activities, tests, and closure performance standards used to document the closure of the bunker in accordance with Michigan Public Act 64. The following documents relate to the submittal, modification, and approval of the closure plan for the old calcium carbide desulfurization slag treatment unit:

- Interim Status Closure Plan for Old Calcium Carbide Desulfurization Slag Treatment Unit, December 1987.
- Addenda for RCRA Closure Plans, May 1988.
- Closure of Four RCRA Units March 1989 Meeting with the MDNR, March 1989.

- Ground Water Monitoring Program for RCRA Closure of Two Calcium Carbide Desulfurization Slag Waste Management Units, November 1990.

Appendix A contains MDNR correspondence related to these documents.

1.2 Purpose and Scope

The purpose of this report is to describe the MDNR-approved closure activities performed by GMC-CFD-SNI to document that soils at depths of 0-4 feet below ground surface containing "above background" concentrations of the constituents of concern have been removed from the unit. These closure activities were proposed to MDNR in the previously listed reports, and were subsequently approved by MDNR.

This report also includes a summary of the ground water monitoring aspects of the approved closure activities.

The scope of this report includes the following:

- A description of the closure performance standard and specifications.
- A description of the previous treatment removal and disposal of the calcium carbide desulfurization slag waste.
- A description of the impacts of the calcium carbide desulfurization slag treatment on the underlying soils by means of establishing background concentrations, sampling and analyzing soils within and adjacent to the hazardous waste management unit and the evaluation of those results.
- A description of the removal of concrete and a monitoring well.
- A description of the excavation of the impacted soils, depth determinations and methods to prevent track-out.
- A description of final decontamination of equipment.
- A description of the backfill and final cover procedures.
- A description of the post-excavation sampling activities and analytical results.
- A discussion of ground water monitoring results.

The scope of RMT's involvement in the closure process has included the following:

- Assist GMC-CFD-SNI in the development of a closure plan for the old calcium carbide desulfurization slag treatment unit.
- Collect and analyze soil samples from background locations for the parameters defined in the approved closure plan.
- Observe the removal of existing concrete and decontamination of excavation equipment.
- Observe the removal and disposal of the impacted soils.
- Collect and analyze soil samples from the excavation area sidewalls for the parameters defined in the approved closure plan.
- Observe the backfill and final cover operation.
- Review ground water data provided by GMC-CFD-SNI and interpret the data in accordance with the November 1990 ground water plan.

2. CLOSURE PERFORMANCE STANDARD AND SPECIFICATIONS

The closure performance standard specified in the MDNR approved closure plan is detailed below:

1. Minimization of further maintenance.

2. Control, minimize, or eliminate to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous waste constituents, leachate, contaminated rainfall, or waste decomposition products to ground or surface waters or to the atmosphere.

The closure of the old calcium carbide desulfurization slag treatment unit consisted of the following elements:

1. Evaluation of underlying soils
2. Removal of concrete
3. Excavation of impacted soils
4. Evaluation of remaining sidewall soils
5. Decontamination of equipment
6. Backfill and compaction of excavation

This closure documentation report details how closure activities were conducted at the site to achieve the above referenced closure performance standard for the "non groundwater-related" aspects of the approved closure activities. The ground water monitoring program has been evaluated and is also discussed in this document.

3. DOCUMENTATION OF CLOSURE ACTIVITIES

3.1 Treatment and Removal of the Hazardous Waste

The slag generated during the manufacturing process of nodular iron is known as calcium carbide desulfurization slag, which contains small quantities of unreacted calcium carbide. The calcium carbide becomes reactive with water and forms acetylene as a reaction product. Therefore, the slag was a hazardous waste by the characteristic of reactivity (D003).

The treatment technique used to render the slag nonhazardous involved eliminating the ability of the slag to generate acetylene gas. This was accomplished by placing the waste in a waste pile, spraying the waste with a mixture of water.

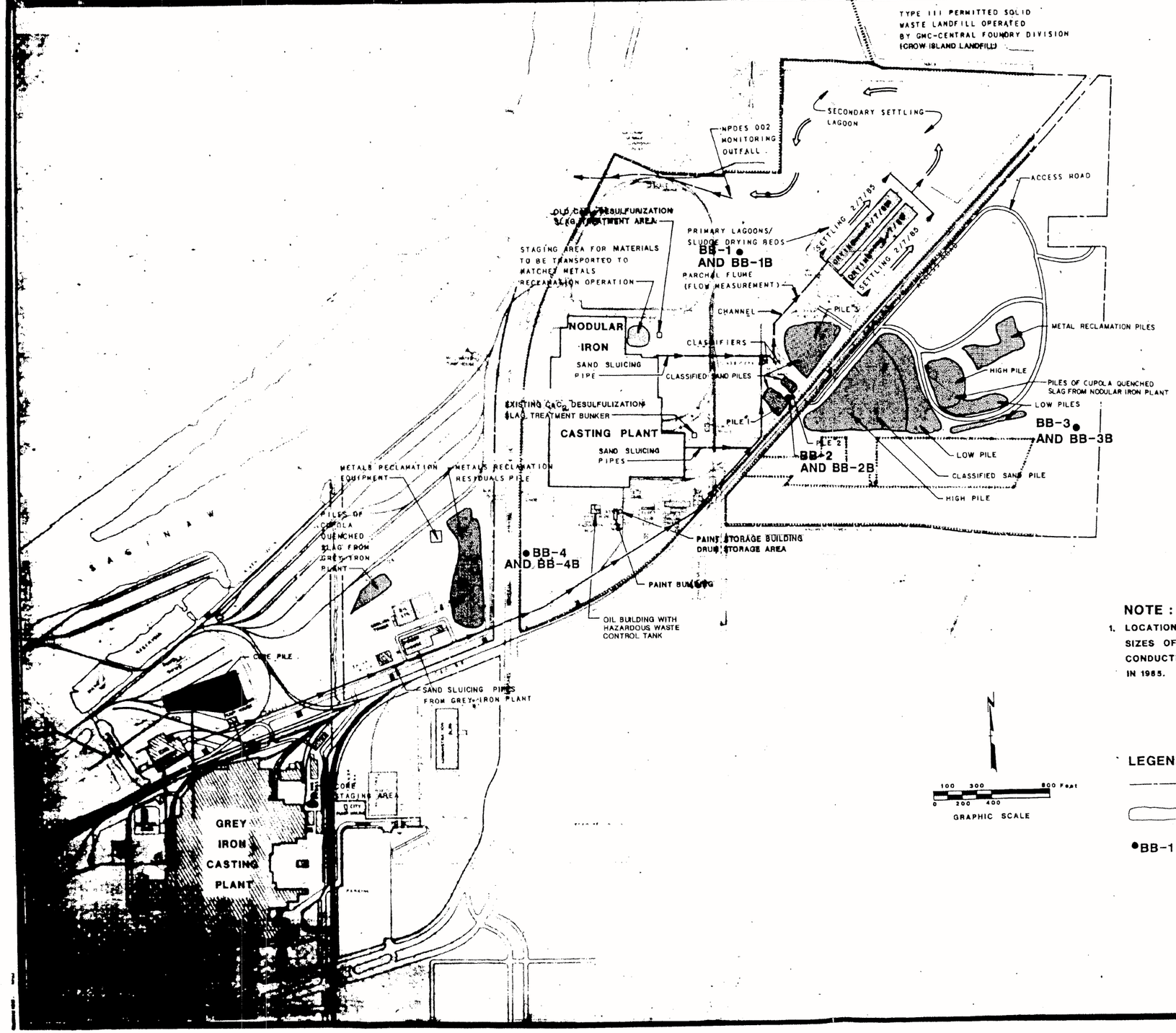
During the active life of the Old Calcium Carbide Desulfurization Slag Treatment Unit, the reacted slag, which is classified as nonhazardous.

3.2 Evaluation of Impacts of Old Calcium Carbide Desulfurization Slag Treatment Unit on the Underlying Soils

To determine the impacts of the old calcium carbide desulfurization slag treatment unit on the underlying soils, a soil sampling plan was developed. (Interim Status Closure Plan For Old Calcium Carbide Desulfurization Slag Treatment Unit). The background sampling and analysis plan was conducted during September 1987 and July 1988 and is summarized in Section 3.2.1. The underlying soil sampling and analysis plan was conducted in 1987 and 1988, and is summarized in Section 3.2.2. The specific methods and procedures are described in the reports listed in Section 1.1.

3.2.1 Establishment of Background Conditions

Prior to beginning on-site closure activities, soil samples were collected from four background soil borings located in areas believed to be unaffected by desulfurization slag handling, treatment, storage and disposal. The locations of the four background borings are detailed in Figure 3-1. The analytical results of the soil samples from these background borings



NOTE :

1. LOCATIONS, DESCRIPTIONS AND APPROXIMATE SIZES OF PILES ARE BASED ON AN INVENTORY CONDUCTED BY RMT AND CFD STAFF MEMBERS IN 1985.

LEGEND

——— APPROXIMATE CFD PROPERTY LINE

STOCKPILE

●BB-1 BACKGROUND BORING LOCATION AND NUMBER

NO	BY	DATE	REVISION	APP'D

PROJECT
CLOSURE DOCUMENTATION REPORT FOR EXISTING C&C2 DESULFURIZATION SLAG TREATMENT BUNKER GM-CFD SAGINAW, MICHIGAN

SHEET TITLE :
BACKGROUND SAMPLE LOCATIONS

DRAWN BY DRB	SCALE AS SHOWN	PROJ. NO. 1128.22
CHECKED BY		DRWG. NO.
APPROVED BY	DATE PRINTED	SHEET OF
DATE AUGUST, 1989		FIGURE 3-1

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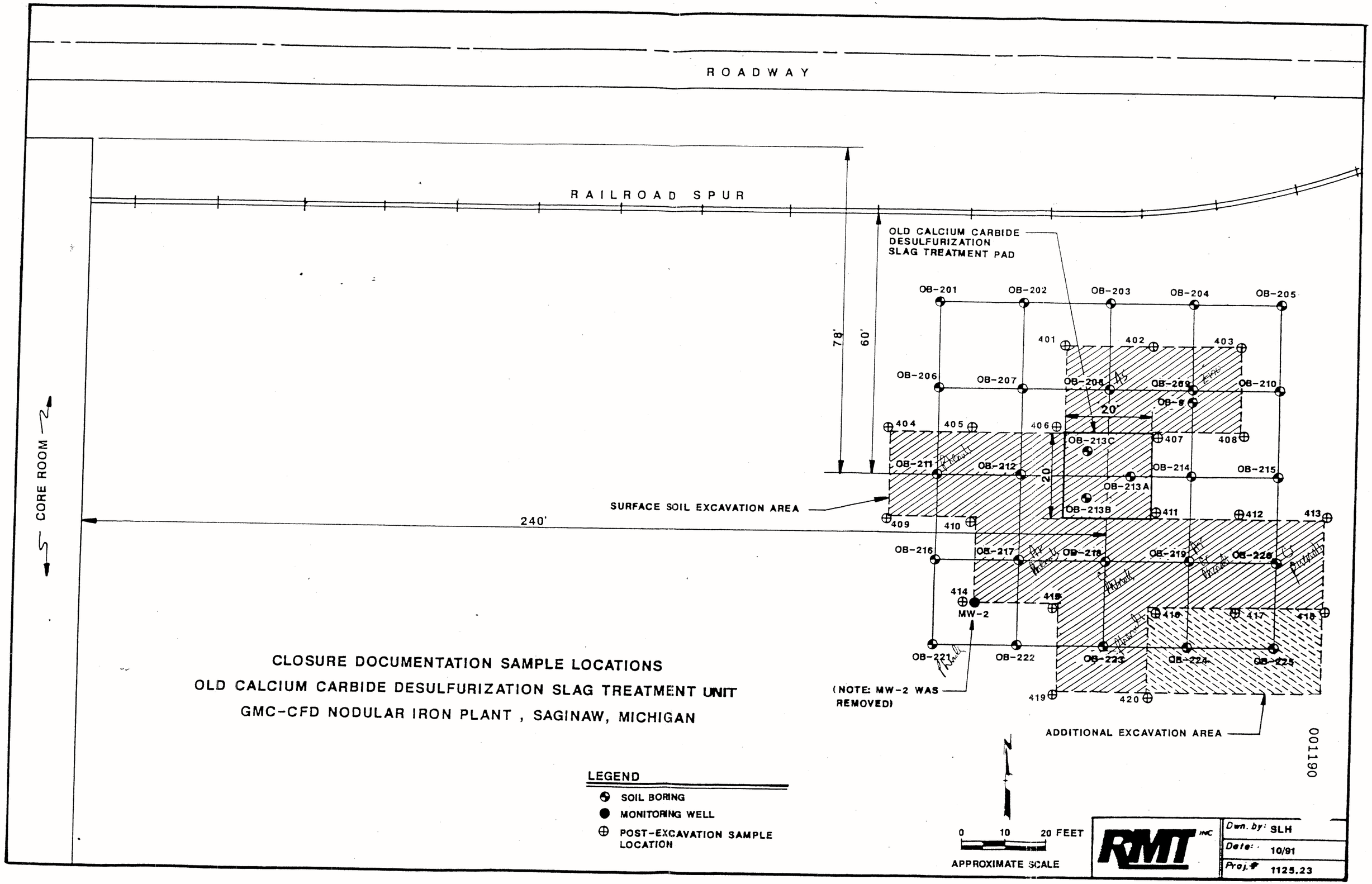

CLOSURE DOCUMENTATION SAMPLE LOCATIONS

OLD CALCIUM CARBIDE DESULFURIZATION SLAG TREATMENT UNIT

GMC-CFD NODULAR IRON PLANT , SAGINAW, MICHIGAN

LEGEND

- SOIL BORING
- MONITORING WELL
- POST-EXCAVATION SAMPLE LOCATION

RMT INC

Dwn. by: SLH

Date: 10/91

Proj.# 1125.23

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FIGURE 3-2

TABLE 3-2

GMC - CFD - SAGINAW NODULAR IRON PLANT
Compositional Analytical Results for Soil Samples of
Old Calcium Carbide Desulfurization Slag Treatment Unit

CHEMICAL PARAMETER	UNITS	Background 99% Prediction Limit	Sampling Location and Depth (feet)											
			OB-201 0-2	OB-201 6-8	OB-201 12-14	OB-202 0-2	OB-202 6-8	OB-202 10-12	OB-203 0-2	OB-203 6-8	OB-203 12-14	OB-204 0-2	OB-204 8-10	OB-204 12-14
Arsenic	mg/kg	16	1.7	1.9	3.5	7.0	4.9	4.5	3.5	1.4	2.6	2.1	2.2	2.4
Cadmium	mg/kg	1.8	<0.5	<0.6	<0.6	<0.5	<0.6	<0.6	<0.5	<0.6	<0.6	<0.6	<0.6	<0.6
Chromium	mg/kg	178	12	18	11	29	17	13	29	8	12	13*	35	11
Fluoride	mg/kg	10,300	200	100	230	750	180	170	330	99	210	730	48	100
Lead	mg/kg	138	<11	<12	<12	<11	<12	<12	<11	<12	<11	<11	<11	<11
Phenols	mg/kg	3.3	<1.3	<1.4	2.9	<1.4	<1.4	<1.5	<1.4	<1.5	<1.4	<1.4	<1.4	<1.4
Selenium	mg/kg	1.5	<0.6	<0.7	<0.7	<0.7	<0.7	<0.7	<0.6	<0.7	<0.7	<0.6	<0.7	<0.7
Zinc	mg/kg	1050	24*	18	18	330	18	20	160	11	22	86	15	18
Calcium Carbide** Reactivity	mg/kg													

NOTES: * Indicates sample matrix inteferences.
** Per March 10, 1989 agreement with MDNR, it was agreed that this parameter did not need to be analyzed.

TABLE 3-2 (cont'd)

GMC – CFD – SAGINAW NODULAR IRON PLANT
Compositional Analytical Results for Soil Samples of
Old Calcium Carbide Desulfurization Slag Treatment Unit

CHEMICAL PARAMETER	UNIT	Background 99% Prediction Limit	Sampling Location and Depth (feet)											
			OB-205 0-2	OB-205 6-8	OB-205 12-14	OB-206 0-2	OB-206 8-10	OB-206 10-12	OB-207(a) 0-2	OB-207(a) 8-8	OB-207 10-12	OB-208 0-2	OB-208 6-8	OB-208 12-14
Arsenic	mg/kg	16	5.3*	3.0	<0.7	1.8	1.9	1.4	6.4	3.9	8.2	41	3.9	2.5
Cadmium	mg/kg	1.8	0.5	<0.6	<0.6	<0.6	<0.6	<0.6	<1.0	<1.0	<0.6	<0.6	<0.6	<0.6
Chromium	mg/kg	178	31	55	14*	12	17*	12	52	25	12	14	52	11
Fluoride	mg/kg	10,300	460	180	88	180	160	280	390	950	190	180	970	120
Lead	mg/kg	138	<11	<12	<11	<11	<12	<12	<10	24	<11	<11	15	<11
Phenols	mg/kg	3.3	<1.4	<1.5	<1.4	<1.4	<1.5	<1.5	3.1	<1.5	<1.4	<1.4	<1.6	<1.4
Selenium	mg/kg	1.5	<0.6	<0.7	<0.7	<0.6	<0.7	<0.7	<0.60	<0.60	<0.7	<0.6	<0.7	<0.7
Zinc	mg/kg	1050	170	25	19	92	21*	20	290*	21	26	150	28	23
Calcium Carbide** Reactivity	mg/kg													

NOTES: * Indicates sample matrix inteferences.
** Per March 10, 1989 agreement with MDNR, it was agreed that this parameter did not need to be analyzed.

TABLE 3-2 (cont'd)

GMC – CFD – SAGINAW NODULAR IRON PLANT
Compositional Analytical Results for Soil Samples of
Old Calcium Carbide Desulfurization Slag Treatment Unit

CHEMICAL PARAMETER	UNIT	Background 99% Prediction Limit	Sampling Location and Depth (feet)											
			OB-209(a) 0-2	OB-209(a) 6-8	OB-209 10-12	OB-210 0-2	OB-210 6-8	OB-210 12-14	OB-211 0-2	OB-211 6-8	OB-211 10-12	OB-212 0-2	OB-212 6-8	OB-212 12-14
Arsenic	mg/kg	16	9.1	8.3	1.8	10	6.0*	1.6	2.5	1.5	1.0	18	2.7	1.6
Cadmium	mg/kg	1.8	<1.0	<1.0	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Chromium	mg/kg	178	52	40	11	25	44	12	28*	16	13	48	27	8
Fluoride	mg/kg	10,300	5700	96	150	800	290	160	190	240	20	610	190	130
Lead	mg/kg	138	23	13.0	<11	<11	<12	<11*	<11	<12	<11	<12	<12	<11
Phenols	mg/kg	3.3	1.4	<1.5	<1.4	<1.4	<1.5	<1.4	4.5	3.6	<1.4	<1.5	2.7	<1.4
Selenium	mg/kg	1.5	<0.60	<0.60	<0.7	<0.6	<0.7	<0.6	<0.6	<0.7	<0.7	<0.7	<0.7	<0.6
Zinc	mg/kg	1050	1300	22	25	180	23	24	370*	8	16	190	11	16
Calcium Carbide** Reactivity	mg/kg													

NOTES: * Indicates sample matrix inteferences.
** Per March 10, 1989 agreement with MDNR, it was agreed that this parameter did not need to be analyzed.

TABLE 3-2 (cont'd)

GMC – CFD – SAGINAW NODULAR IRON PLANT
Compositional Analytical Results for Soil Samples of
Old Calcium Carbide Desulfurization Slag Treatment Unit

CHEMICAL PARAMETER	UNITS	Background 99% Prediction Limit	Sampling Location and Depth (feet)											
			OB-213(b) 0-2	OB-213(b) 6-8	OB-213 10-12	OB-214 0-2	OB-214 4-6	OB-214 10-12	OB-215 0-2	OB-215 6-8	OB-215 12-14	OB-216 0-2	OB-216 6-8	OB-216 10-12
Arsenic	mg/kg	16	4.2	4.9	2.1	2.5	3.2	1.3	1.3	1.3	1.8	1.4	0.9*	0.9*
Cadmium	mg/kg	1.8	<0.60	<0.60	<0.58	<0.5	<0.7	<0.6	<0.5	0.6	<0.6	<0.5	<0.6	<0.6
Chromium	mg/kg	178	58*	38	11	46	42	11	11	13	14	20	11	7*
Fluoride	mg/kg	10,300	180	400	240	400	1500	430	110	180	190	820	57	220
Lead	mg/kg	138	11	9.6	14	<11	<13	<11	<11	15	<11	<11*	<12	<11*
Phenols	mg/kg	3.3	<1.5	<1.6	<1.5	<1.4	<1.6	<1.4	2.7	<1.5	<1.4	<1.3	<1.5	<1.4
Selenium	mg/kg	1.5	<0.96	<1.0	<0.93	<0.6	<0.8	<0.6	<0.7	<0.7	<0.7	<0.6	<0.7	<0.6
Zinc	mg/kg	1050	20	16	18	14	29	16	810	12	38	7	5	20
Calcium Carbide** Reactivity	mg/kg													

NOTES: * Indicates sample matrix inteferences.
** Per March 10, 1989 agreement with MDNR, it was agreed that this parameter did not need to be analyzed.

TABLE 3-2 (cont'd)

GMC – CFD – SAGINAW NODULAR IRON PLANT
Compositional Analytical Results for Soil Samples of
Old Calcium Carbide Desulfurization Slag Treatment Unit

CHEMICAL PARAMETER	UNITS	Background 90% Prediction Limit	Sampling Location and Depth (feet)											
			OB-217(a) 0-2	OB-217 6-8	OB-217 10-12	OB-218 0-2	OB-218 6-8	OB-218 10-12	OB-219(a) 0-2	OB-219(a) 6-8	OB-219 12-14	OB-220 0-2	OB-220 6-8	OB-220 12-14
Arsenic	mg/kg	16	7.8	19	1.9	7.9*	3.0*	1.1	16	15	0.9	1.8	2.6	2.3
Cadmium	mg/kg	1.8	<1.0	<0.6	<0.6	<0.6	<0.6	<0.6	<1.0	<1.0	<0.6	<0.6	<0.6	<0.6
Chromium	mg/kg	178	41	17	12	41*	23	9	64	160	10	81	27	15
Fluoride	mg/kg	10,300	3200	630	220	1000	89	220	370	1500	270	170	550	160
Lead	mg/kg	138	<10	<12	<12	<11	<12	<11	10	14	<11	13	<12	14
Phenols	mg/kg	3.3	5.9	2.7	3.4	11	2.4	3.1	11	2.6	<1.4	4.2	6.2	5.4
Selenium	mg/kg	1.5	<0.60	<0.7	<0.7	<0.6	<0.7	<0.7	<0.60	<0.60	<0.7	<0.7	<0.7	<0.7
Zinc	mg/kg	1050	53	12	20	180	12	16	89	27	26	160	16	24
Calcium Carbide** Reactivity	mg/kg													

NOTES: * Indicates sample matrix inteferences.
** Per March 10, 1989 agreement with MDNR, it was agreed that this parameter did not need to be analyzed.

TABLE 3-2 (cont'd)

GMC – CFD – SAGINAW NODULAR IRON PLANT
Compositional Analytical Results for Soil Samples of
Old Calcium Carbide Desulfurization Slag Treatment Unit

CHEMICAL PARAMETER	UNITS	Background 99% Prediction Limit	Sampling Location and Depth (feet)										
			OB-221 0-2	OB-221 4-6	OB-221 8-10	OB-222 0-2	OB-222 4-6	OB-222 12-14	OB-223 0-2	OB-223 4-6	OB-223 10-12	OB-224 0-2	OB-224 6-8	OB-224 10-12
Arsenic	mg/kg	16	1.6	2.0	2.7	6.5	3.6	3.4	7.7	2.2	1.5	2.9	2.0*	2.0
Cadmium	mg/kg	1.8	<0.5	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.7	<0.6
Chromium	mg/kg	178	20	35	11	25	62	12	32	52	12	17	25	17
Fluoride	mg/kg	10,300	320	600	160	2500	1500	250	1400	100	150	440	2700	210
Lead	mg/kg	138	<11	<12	13	15	38	<11	19	24	<11	15	23	19
Phenols	mg/kg	3.3	1.9	3.8	<1.4	2.0	2.9	<1.4	3.4	4.8	<1.4	3.2	2.5	1.5
Selenium	mg/kg	1.5	<0.6	<0.7	<1.4*	<0.7	0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.8	<0.7
Zinc	mg/kg	1050	10	14	14	33	23	21	120	15	17	120	20	25
Calcium Carbide** Reactivity	mg/kg													

NOTES: * Indicates sample matrix inteferences.
** Per March 10, 1989 agreement with MDNR, it was agreed that this parameter did not need to be analyzed.

TABLE 3-2 (cont'd)

GMC - CFD - SAGINAW NODULAR IRON PLANT
Compositional Analytical Results for Soil Samples of
Old Calcium Carbide Desulfurization Slag Treatment Unit

CHEMICAL PARAMETER	UNITS	Background 90% Prediction Limit	Sampling Location and Depth (feet)											
			OB-225 0-2	OB-225 4-6	OB-225 8-10									
Arsenic	mg/kg	16	3.2	3.0	3.1									
Cadmium	mg/kg	1.8	<0.6	<0.6	<0.6									
Chromium	mg/kg	178	17	28	23									
Fluoride	mg/kg	10,300	1100	1600	350									
Lead	mg/kg	138	12	15	23									
Phenols	mg/kg	3.3	<1.4	2.4	<1.6									
Selenium	mg/kg	1.5	<0.7	<0.7	<1.5									
Zinc	mg/kg	1050	14	19	38									
Calcium Carbide** Reactivity	mg/kg													

NOTES: * Indicates sample matrix inteferences.
** Per March 10, 1989 agreement with MDNR, it was agreed that this parameter did not need to be analyzed.

Four of the soil samples exceeded the background upper 99% prediction limit for arsenic. These samples were located in the following areas:

Boring Location	Sample Depth (feet)
OB-208	(0-2)
OB-212	(0-2)
OB-217	(6-8)
OB-219	(0-2)

Twelve of the soil samples exceeded the background upper 99% prediction limit for phenols. These samples were located in the following areas:

Boring Location	Sample Depth (feet)
OB-211	(0-2), (6-8)
OB-217	(0-2), (10-12)
OB-218	(0-2)
OB-219	(0-2)
OB-220	(0-2), (6-8), (12-14)
OB-221	(4-6)
OB-223	(0-2), (4-6)

One of the soil samples exceeded the background upper 99% prediction limit for zinc. This sample was located at OB-209 at the 0-2 feet depth interval.

3.2.4 Identification of Impacted Soils

The results of the soil sampling program indicated that soils underlying and adjacent to the old calcium carbide desulfurization slag treatment unit were impacted by the use of the unit. The MDNR approved closure plan for this area specified removal of impacted soils to the saturated zone.

The locations of impacted soils to be excavated were defined from the statistical comparison previously described. The limits of the areas to be excavated were identified as midway between the impacted soil sample and nearest unimpacted sample. Figure 3-2 defines the area of impacted soils which would be excavated. As approved by MDNR, the soils below the ground water table which had parameter levels higher than the background upper 99%

prediction limit were not excavated due to the difficulties associated with removing soil below the ground water table.

3.3 Removal of Structures

3.3.1 Concrete Removal

Impacted soil removal was designated by diagonal lines as shown on Figure 3-2. Concrete covers approximately 35% of the area where impacted soils were designated for removal. The concrete in these areas initially was cut to create a fracture line. A backhoe with a jack hammer attachment then broke the concrete into removable sized pieces.

A bucket was placed on the backhoe. The concrete was excavated using the backhoe, loaded into trucks, weighed using GMC-CFD-SNI truck scales and then transported to GMC's Crow Island Landfill for disposal. The concrete was removed in stages so the trucks were loaded on the concrete whenever possible. The total amount of concrete removed was 40 tons.

3.3.2 Monitoring Well Removal

The monitoring wells were protected whenever possible. Wells were abandoned only in the event that the limits of the excavation include a well. Monitoring well MW-2 was in the limits of the old calcium carbide desulfurization slag treatment unit excavation and had to be removed in the following manner:

- All structures were removed, such as guarding.
- The well casing was removed.
- The hole was then filled with grout.

After the well was abandoned, the area surrounding and including the well was excavated.

3.4 Excavation of Impacted Soil

3.4.1 Impacted Soil Removal

After the concrete was removed, the excavation of the impacted soil began. The soil was excavated using a backhoe and loaded into trucks for transportation to GMC's Crow Island Landfill for disposal.

Prior to disposal in the landfill the excavated material was weighed using the GMC-CFD-SNI truck scale. The weigh tickets were then collected and the quantities tallied at the completion of each workday. The total amount of soil excavated and disposed was approximately 1100 tons.

3.4.2 Depth of Excavation

As approved by MDNR, the soils were not removed below the ground water table because of the difficulties associated with the removal of saturated soils. It was previously determined through ground water elevation monitoring that soils would be excavated to a depth of 5 feet below grade or until ground water was reached. In general, the ground water depth was approximately 4 feet below grade.

3.4.3 Methods to Prevent Track-Out of Soils

When possible, the trucks remained on pavement to prevent track-out of soils. When it was not possible to stay on the pavement, a plastic pad was constructed for loading. Soils spilled while loading were brushed off the truck and onto the loading pad before leaving the site. The loading pad was then swept, and the soils were returned to the excavation.

3.5 Decontamination

3.5.1 Decontamination of Equipment

When both excavations (at the existing calcium carbide desulfurization slag treatment bunker discussed in a separate closure documentation report and the old calcium carbide desulfurization slag treatment unit) were completed, the equipment was steam-cleaned before leaving the facility. A plastic decontamination pad was constructed for this purpose. A steam cleaner was used to clean the equipment. The water collected from the steam-cleaning operation was vacuumed by the tanker truck. The water was then taken to GMC-CFD, Saginaw Grey Iron Wastewater Treatment Plant for treatment.

3.6 Backfill and Cover

After the post excavation soil analyses were evaluated, GMC-CFD-SNI met with MDNR on August 8, 1989, to review the data. It was concluded at this meeting that since sampling locations 416 and 417 were above the 99% prediction limit for phenols, further excavation was warranted (See Section 4, Post Excavation Soil Sampling).

Following completion of excavation activities, the area was backfilled with 1450 tons of sand which was compacted with a bulldozer.

3.7 Photographic Documentation of Closure Activities

The closure activities are pictorially documented in Appendix B.

001204

4. POST-EXCAVATION SOIL SAMPLING

4.1 Sampling Locations

After excavation of the impacted soils was completed, 20 samples were collected and analyzed to document that soils which remained on the outside wall of the excavation did not contain background concentrations of constituents of concern. The samples were collected on the outside wall of the excavation on a 20-foot grid interval approved in the closure plan. The MDNR-approved sample locations are shown on Figure 3-2.

4.2 Sampling Methods

The soil samples were collected using a plastic hand trowel for arsenic and zinc and a metal hand trowel for phenols to scrape the unexcavated side wall throughout the entire depth of the sampling location. For each location, an individual sample was mixed in a plastic container for arsenic and zinc and a glass container for phenols to generate a composite sample for laboratory analysis, and shipped overnight to the RMT laboratory in Madison, Wisconsin. Analytical methods used are summarized in Table 4-1.

4.3 Sampling Analysis

The samples from each sampling location were tested for the parameter(s) (arsenic, phenol, or zinc) at that particular location that were in excess of the background upper prediction limit. For example, because sample OB-208 contained an "above background" concentration for arsenic, the surrounding soil was excavated and samples 401, 402, 406 and 407 were tested for arsenic. Analytical results from these samples are reported in Table 4-2 and the laboratory data

TABLE 4-1

ANALYTICAL METHODS FOR SOIL COMPOSITIONAL ANALYSIS

Parameter	Analytical[1] Method	Practical Quantitation Limit
Arsenic	7060	0.6 mg/kg
Total Phenols (4AAP)	9066	2.5 mg/kg
Zinc	7950	2 mg/kg

1 - Approved method according to the 3rd Edition of USEPA document SW 846 "Test Methods for Evaluating Solid Wastes, November 1986.

TABLE 4-2

GMC-CFD - SAGINAW NODULAR IRON
SOIL SAMPLE RESULTS FOR THE RCRA CLOSURE
OF OLD CALCIUM CARBIDE DESULFURIZATION SLAG TREATMENT UNIT

CHEMICAL PARAMETER	BACKGROUND 99% PREDICTION LIMIT	SAMPLING LOCATIONS 401	402	403	404	405	406	407	408	409	410
ARSENIC	16 mg/kg	<3.3	4.8	NS	NS	<3.9	4.9	<3.6	NS	NS	<3.4
PHENOLS	3.3 mg/kg	NS	NS	NS	<2.0	NS	NS	NS	NS	<1.4	<1.4
ZINC	1050 mg/kg	NS	31	47	NS	NS	NS	19	28	NS	NS
CHEMICAL PARAMETER	BACKGROUND 99% PREDICTION LIMIT	SAMPLING LOCATIONS 411	412	413	414	415	416	417	418	419	420
ARSENIC	16 mg/kg	<3.2	<3.7	NS	NS	NS	4.7	NS	NS	NS	NS
PHENOLS	3.3 mg/kg	<1.3	<1.5	<1.7	2.1	2.3	3.8	5.7	<1.4	<1.4	<1.8
ZINC	1050 mg/kg	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NOTE: Concentrations in mg/kg dry weight
Samples composited from a depth of 0-5 feet
NS = Soil in these locations was not analyzed for this parameter based upon previous agreement with MDNR letter dated April 3, 1989.

sheets are contained in Appendix C. Two of the samples exceeded the background upper 99% prediction limit for phenols. Therefore, further excavation was necessary for the old calcium carbide desulfurization slag treatment unit. During an August 8, 1989, meeting with GMC-CFD-SNI, the MDNR approved the additional excavation of soils surrounding sample locations 416 and 417 as detailed in Figure 3-2 and agreed that no further post-excavation sampling would be necessary. Following excavation, this area was backfilled with sand and compacted with a bulldozer.

5. POST EXCAVATION GROUND WATER MONITORING

5.1 Ground Water Monitoring Program

Analysis of soil samples collected from the Old Calcium Carbide Desulfurization Slag Treatment Unit showed that constituents of concern (COC) were still present in the soils indicating the necessity of instituting a ground water monitoring program. RMT prepared a ground water monitoring plan entitled Ground Water Monitoring Program for RCRA Closure of Two Calcium Carbide Desulfurization Slag Waste Management Units; this plan was presented to GMC-CFD-SNI in November, 1990 who in turn had it submitted to MDNR.

The scope of the ground water monitoring program included the following:

- Installation of ground water monitoring wells around the old calcium carbide desulfurization slag treatment unit location.
- Collection of four distinct rounds of ground water samples and water level data.
- Analysis of the ground water samples for COCs detected in the soils at the site.
- Statistical analysis of the ground water analytical data to determine if statistically significant impacts to the ground water had occurred.
- Compilation of a report documenting the actions at the site.

GMC-CFD-SNI having substantially completed the monitoring well installation (Appendix D) and ground water sampling provided the data to RMT for interpretation. The monitoring wells were installed at the locations indicated on the map in Appendix D. The analytical results from the ground water sampling and analysis are included in Appendix E. Table 5-1 is a tabulated summary of the water level data collected over the six rounds of sampling.

5.2 Statistical Analysis

Six rounds of water level data were provided to RMT by GMC-CFD-SNI. This data was used to construct ground water contour maps from which upgradient and downgradient wells were defined. The contours at the site fluctuate over time such that only two wells, MW-2 and

TABLE 5-1

DATA FROM WELLS AT OLD CALCIUM CARBIDE DESULFURIZATION SLAG TREATMENT UNIT
CALCULATION OF GROUND WATER ELEVATIONS FROM DATA SUPPLIED BY GMC/CFD-SNI

WELL ID.	REFERENCE ELEVATION	11/19 DEPTH TO WATER	11/19 WATER TBL ELEVATION	12/17 DEPTH TO WATER	12/17 WATER TBL ELEVATION	1/28 DEPTH TO WATER	1/28 WATER TBL ELEVATION	2/13 DEPTH TO WATER	2/13 WATER TBL ELEVATION	8/7 DEPTH TO WATER	8/7 WATER TBL ELEVATION	8/19 DEPTH TO WATER	8/19 WATER TBL ELEVATION
MW-1	593.10	4.60	588.50	3.95	589.15	5.62	587.48	5.10	588.00	7.20	587.22	6.08	587.02
MW-2	594.42	5.63	588.79	4.83	589.59	6.92	587.50	6.40	588.02	7.16	587.26	7.30	587.12
MW-7A	594.78	6.86	587.92	6.20	588.58	7.74	587.04	7.33	587.45	7.99	586.79	8.17	586.61
MW-13	594.60	6.10	588.50	5.58	589.02	7.10	587.50	6.77	587.83	7.39	587.21	7.64	586.96
MW-14	593.89	5.34	588.55	4.41	589.48	6.53	587.36	5.76	588.13	6.69	587.20	6.86	587.03
MW-15	594.56	5.86	588.70	5.25	589.31	7.03	587.53	6.54	588.02	7.28	587.28	7.47	587.09
MW-16	594.84	6.94	587.90	5.70	589.14	7.23	587.61	6.83	588.01	7.60	587.24	7.81	587.03

Hydraulically

no cax dd

MW-15 were consistently upgradient of the former location of the bunker. These two wells were designated as upgradient wells for the statistical analyses. A ground water contour map representative of conditions at the site is included in Appendix F.

The statistical methods used to analyze the ground water monitoring data are from the guidance document Statistical Analysis of Ground Water Monitoring Data at RCRA Facilities-Interim Final Guidance. Due to the high proportion of non-detects in the data, a Test of Proportions was selected as the most appropriate method of analysis. No statistical analysis was conducted for parameters where all results were below detection limits. It was felt that this represented *prima facia* evidence that no statistically significant impacts to the ground water had occurred for that parameter.

Statistical analyses were performed on the arsenic and phenols data. A tabulated summary of the data is included in Table 5-2 and the statistical analyses are contained in Appendix G. The statistical analyses indicate that there have been no statistically significant impacts to the ground water at this site from phenols. It should be noted that even though the statistical method used (Test of Proportions) is designed to analyze heavily censored (large number of non-detects) data the number of non-detects is so high that the distributional assumptions for the method are technically violated. The test of proportion is a fairly robust (broadly applicable) method; consequently the strict failure is probably not catastrophic. The failure may introduce a greater likelihood of a Type II (false negative) error occurring.

The statistical analysis for arsenic, which was performed using a Test of Proportions method, indicates that statistically significant impacts to the ground water have occurred. The same violation of assumptions occurs for the arsenic data; however, since impacts were indicated to have occurred this is not a concern for this data.

TABLE 5-2

OLD CALCIUM CARBIDE DESULFURIZATION SLAG TREATMENT UNIT
GROUND WATER QUALITY DATA

	DATE	UNITS	ARSENIC	CADMIUM	CHROMIUM	LEAD	SELENIUM	PHENOLS
UPGRADIENT WELLS					MW-2			
	20-Nov-90	mg/l	0.013	<0.010	<0.010	<0.010	<0.010	0.330
	18-Dec-90	mg/l	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	29-Jan-91	mg/l	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	14-Feb-91	mg/l	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
					MW-15			
	20-Nov-90	mg/l	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	18-Dec-90	mg/l	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	29-Jan-91	mg/l	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	14-Feb-91	mg/l	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
DOWNGRADIENT WELLS					MW-16			
	20-Nov-90	mg/l	0.049	<0.010	<0.010	<0.010	<0.010	<0.010
	18-Dec-90	mg/l	0.041	<0.010	<0.010	<0.010	<0.010	<0.010
	29-Jan-91	mg/l	0.043	<0.010	<0.010	<0.010	<0.010	<0.010
	14-Feb-91	mg/l	0.038	<0.010	<0.010	<0.010	<0.010	<0.010
					MW-7A			
	20-Nov-90	mg/l	0.011	<0.010	<0.010	<0.010	<0.010	<0.010
	18-Dec-90	mg/l	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	29-Jan-91	mg/l	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	14-Feb-91	mg/l	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
					MW-1			
	20-Nov-90	mg/l	0.017	<0.010	<0.010	<0.010	<0.010	0.310
	18-Dec-90	mg/l	0.012	<0.010	<0.010	<0.010	<0.010	0.240
	29-Jan-91	mg/l	0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	14-Feb-91	mg/l	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
					MW-13			
	20-Nov-90	mg/l	0.015	<0.010	<0.010	<0.010	<0.010	<0.010
	18-Dec-90	mg/l	0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	29-Jan-91	mg/l	0.011	<0.010	<0.010	<0.010	<0.010	<0.010
	14-Feb-91	mg/l	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
					MW-14			
	20-Nov-90	mg/l	0.011	<0.010	<0.010	<0.010	<0.010	<0.010
	18-Dec-90	mg/l	0.011	<0.010	<0.010	<0.010	<0.010	<0.010
	29-Jan-91	mg/l	0.017	<0.010	<0.010	<0.010	<0.010	<0.010
	14-Feb-91	mg/l	0.010	<0.010	<0.010	<0.010	<0.010	<0.010

Note: Metals analyses represent dissolved metals.

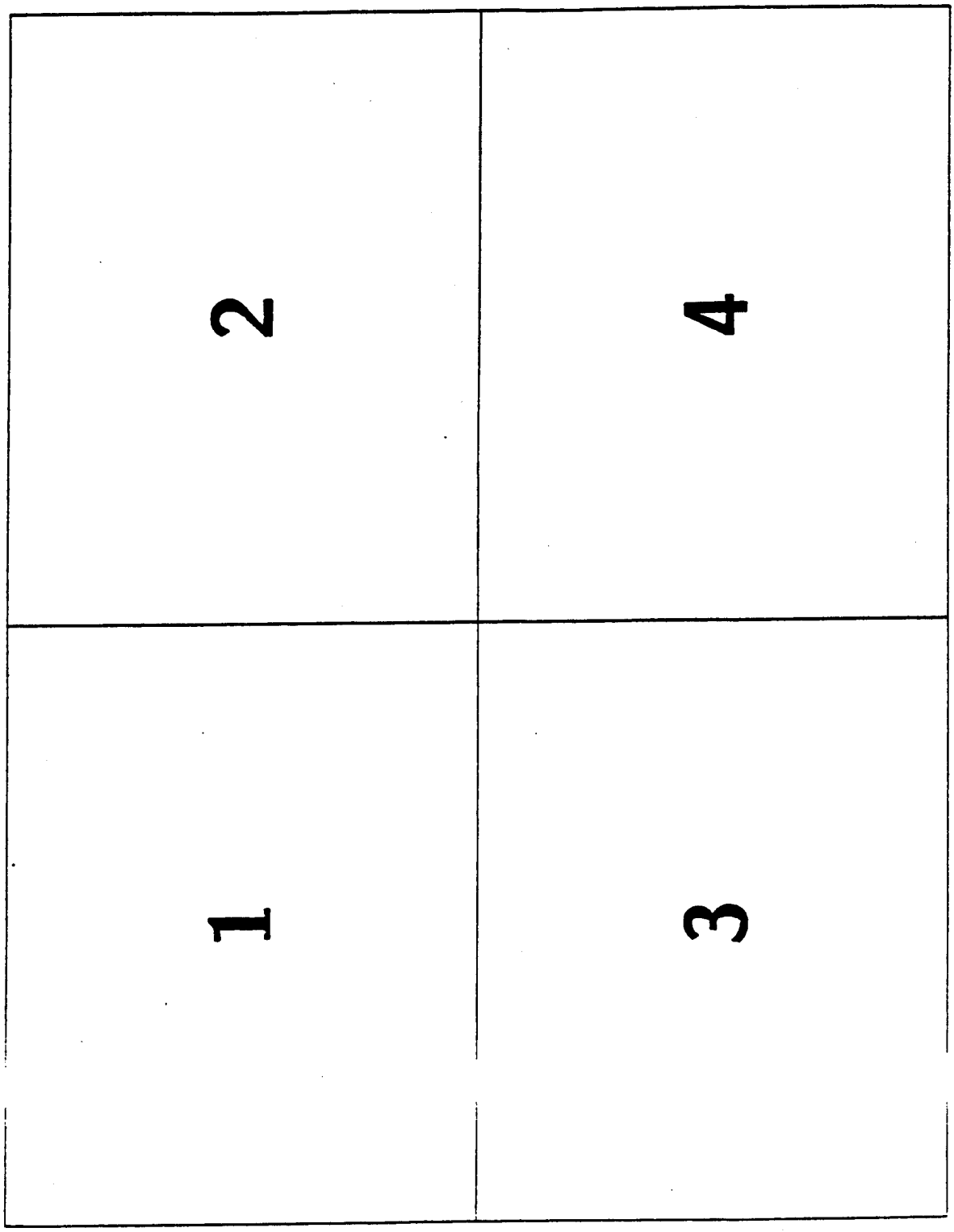
APPENDIX A

MDNR CORRESPONDENCE

APPENDIX B

PHOTOGRAPHIC DOCUMENTATION OF CLOSURE ACTIVITIES

PHOTOGRAPH ORIENTATION



001243

1) Breaking the concrete with jackhammer.

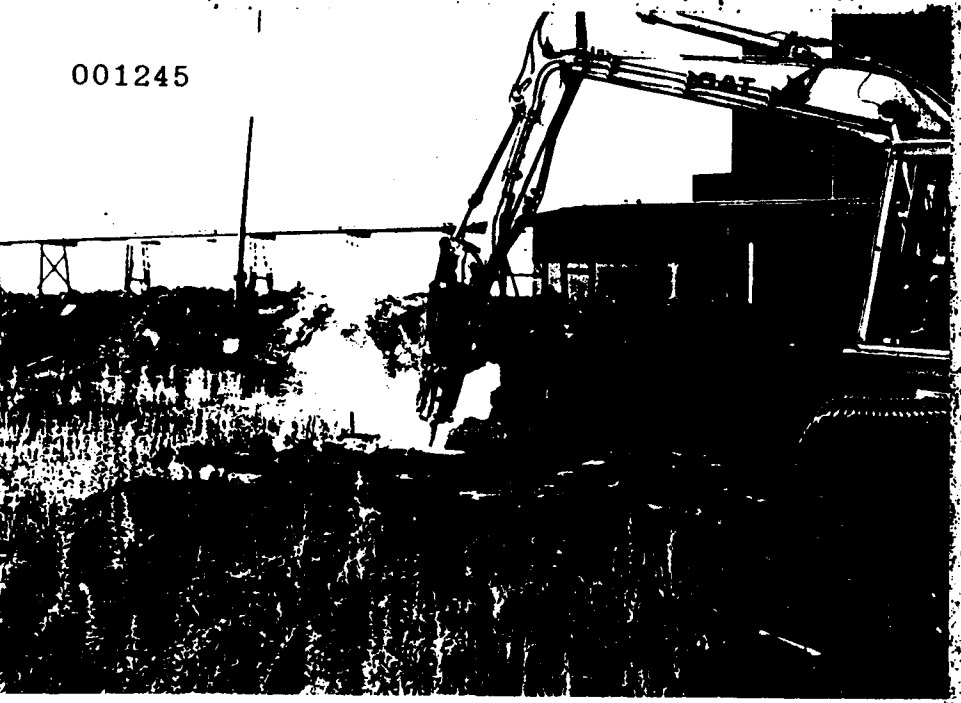
2) Breaking the concrete with jackhammer.

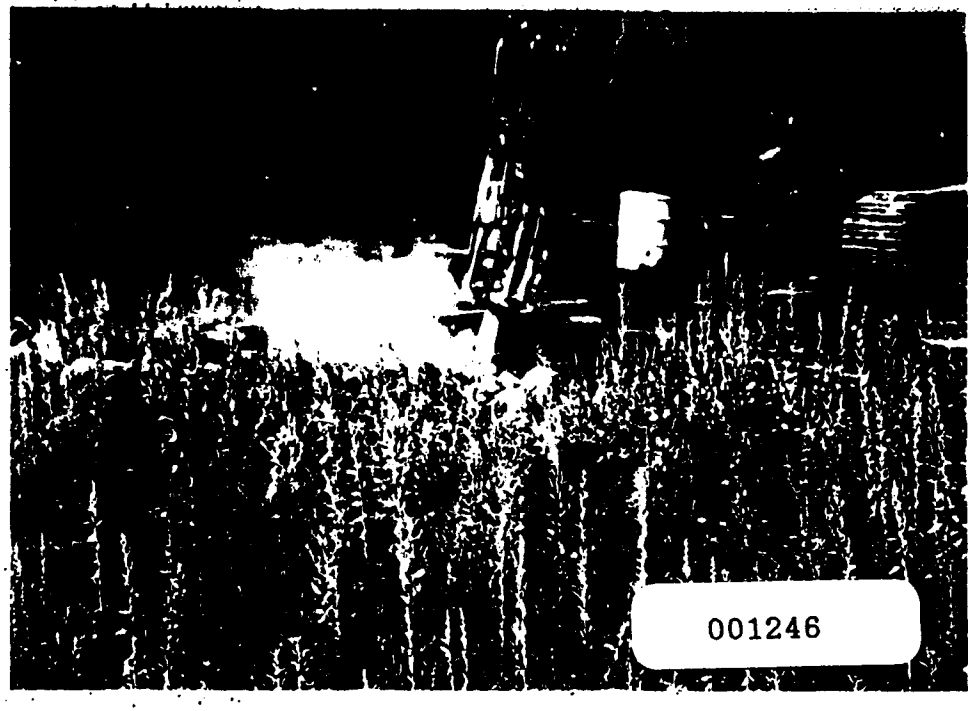
3) The old calcium carbide desulfurization treatment pad broken.

4) Removing the concrete.

G-LINE #5258-I
35MM PRINTS

001245

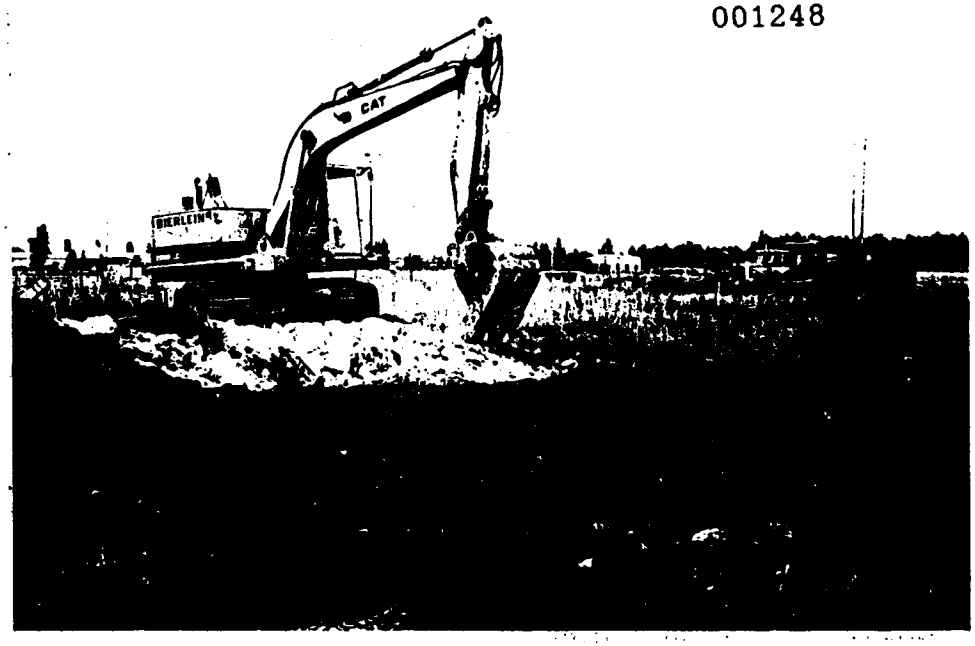




001246

001247

001248



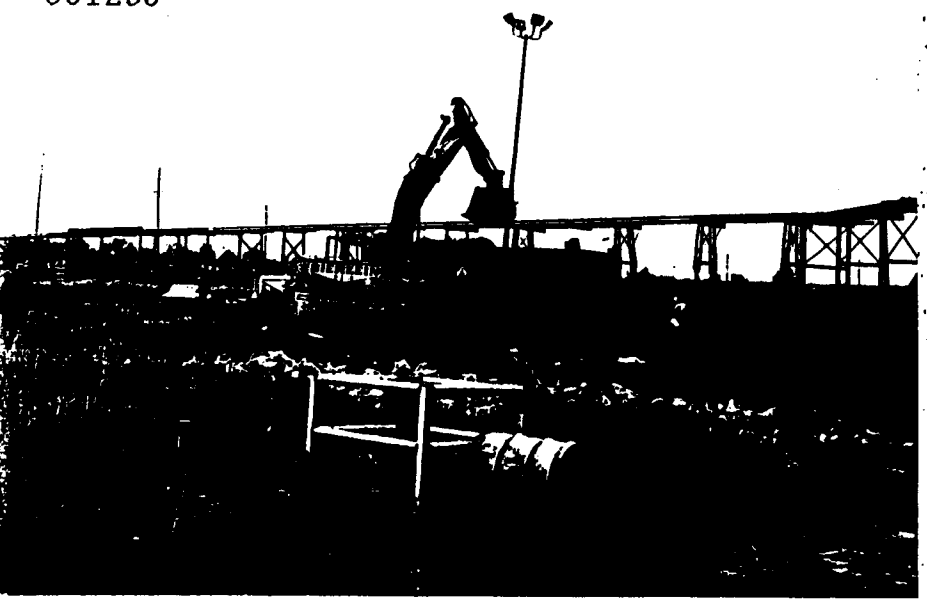
1) Loading soil into trucks.

2) Truck being loaded on plastic pad.

3) Truck being loaded on plastic pad.

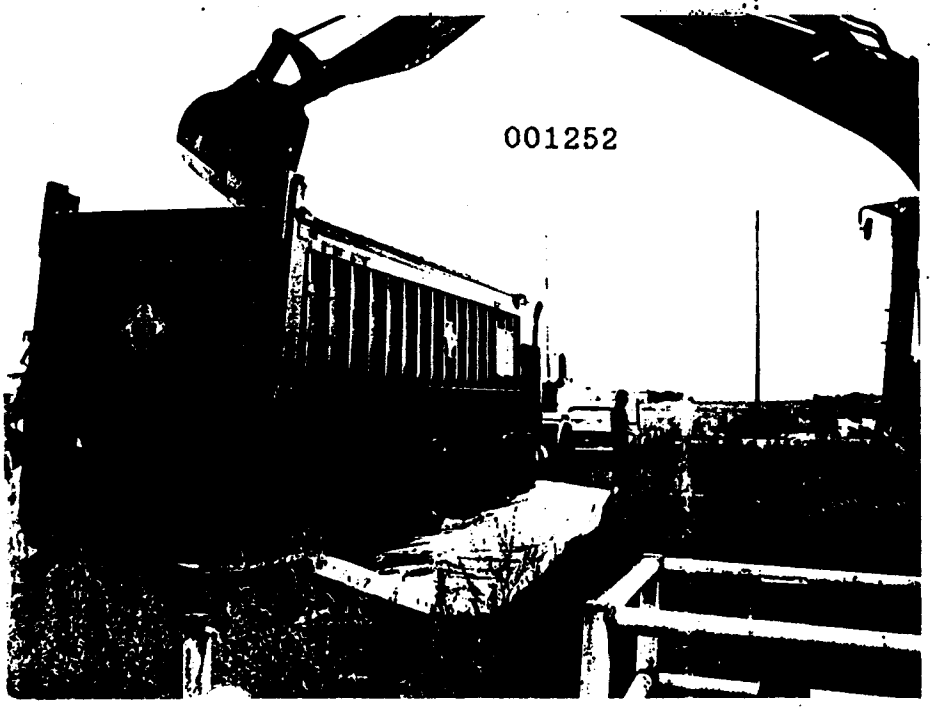
4) Excavating soil.

001250



001251

001252



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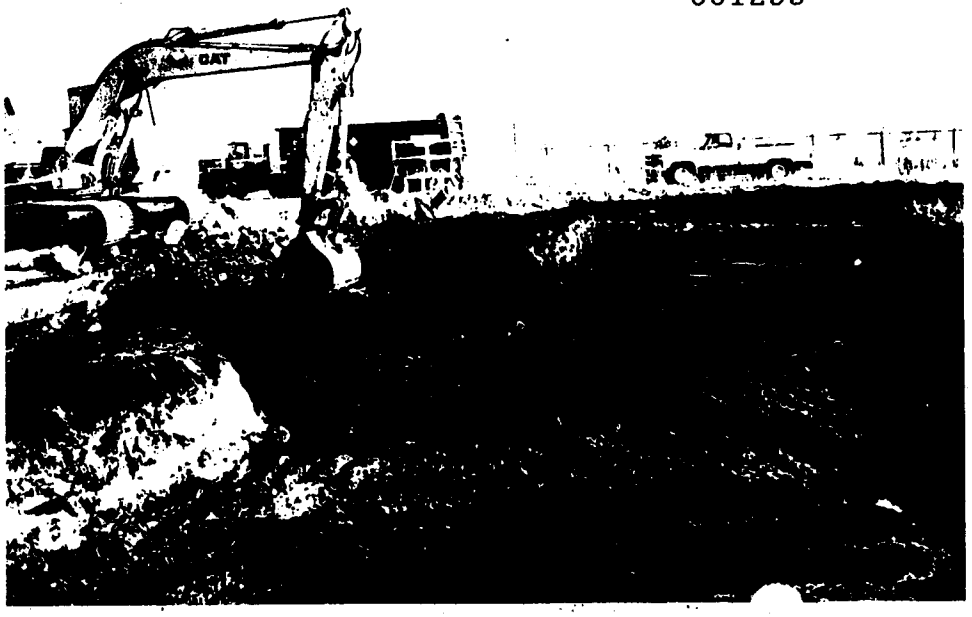
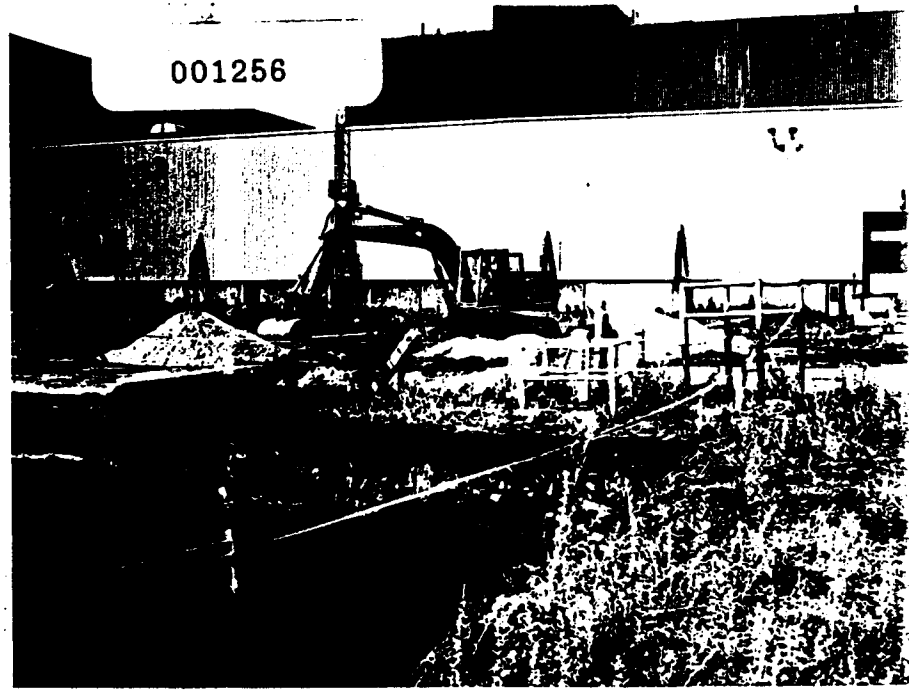


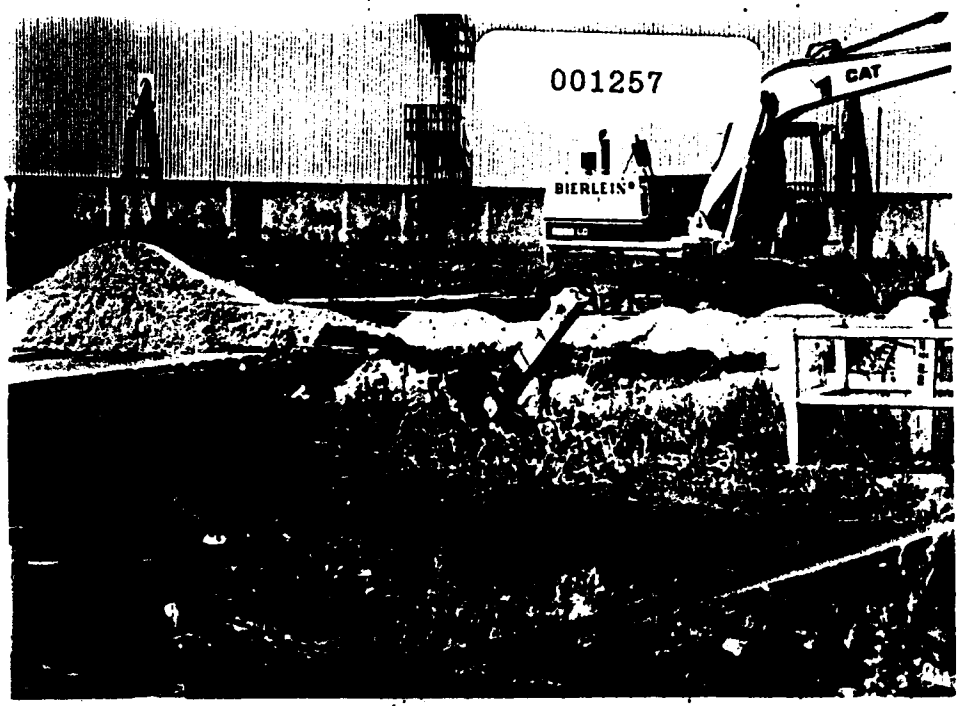
1) Building dike with sand to divert runoff.

2) Building dike with sand to divert runoff.

3) Building dike with sand to divert runoff.

C-LINE #52584
35MM PRINTS





Note: Photos on this sheet show decontamination of equipment after excavation at existing calcium carbide desulfurization slag treatment bunker and old calcium carbide desulfurization treatment unit.

1) Final decontamination of backhoe track before leaving the facility.

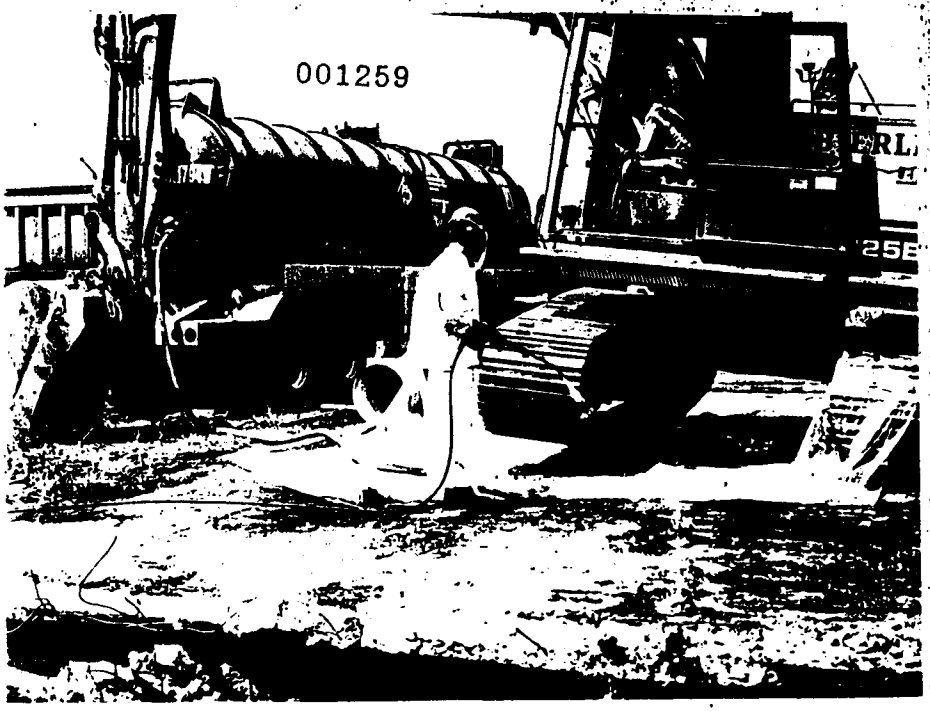
2) Final decontamination of backhoe track before leaving the facility.

3) Final decontamination of backhoe bucket before leaving the facility.

4) Final decontamination of truck before leaving the facility.

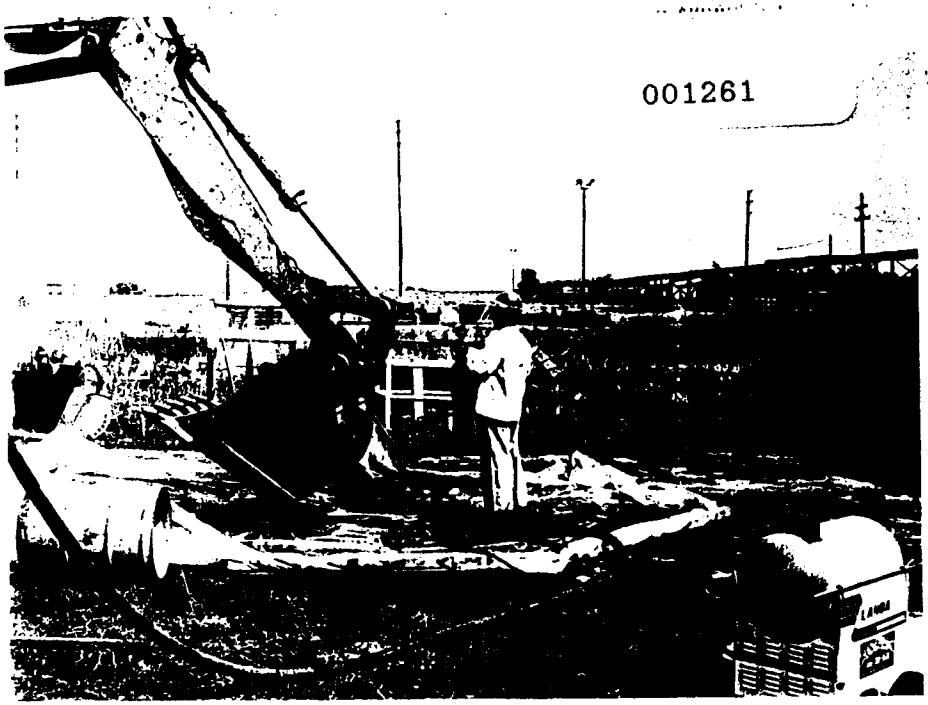
C-LINE #5258
35MM PRINTS

001259



001260

001261



001262

1) Additional excavation to remove impacted soils.

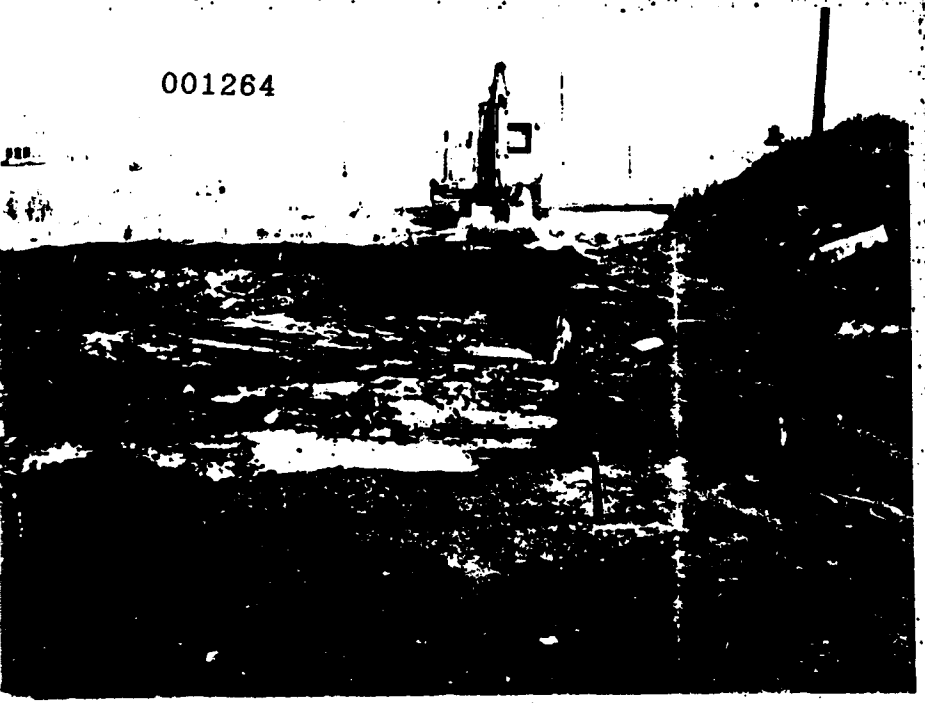
2) Additional excavation to remove impacted soils.

3) Additional excavation to remove impacted soils.

4) Additional excavation to remove impacted soils.

C-LINE #52584
35MM PRINTS

001264



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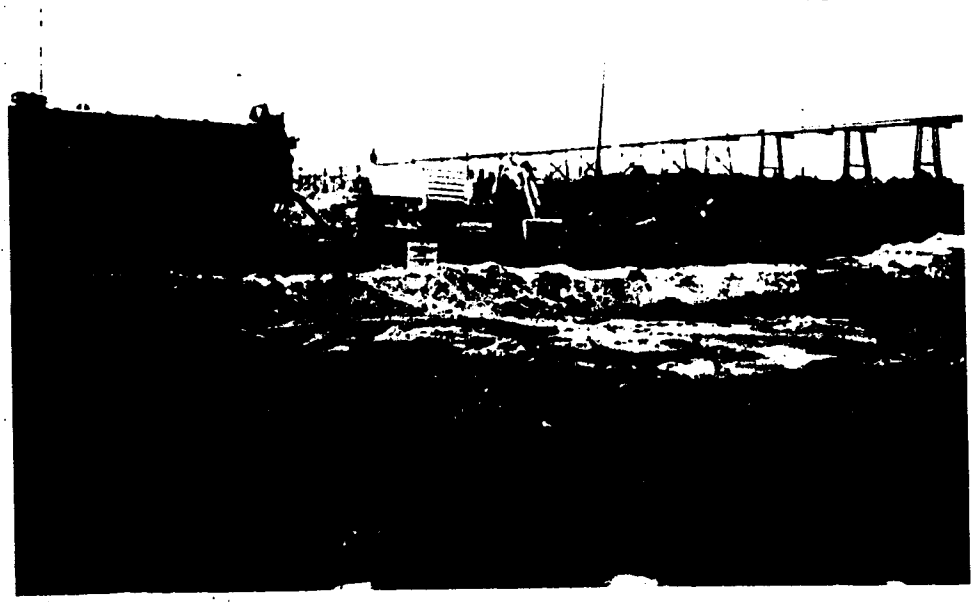

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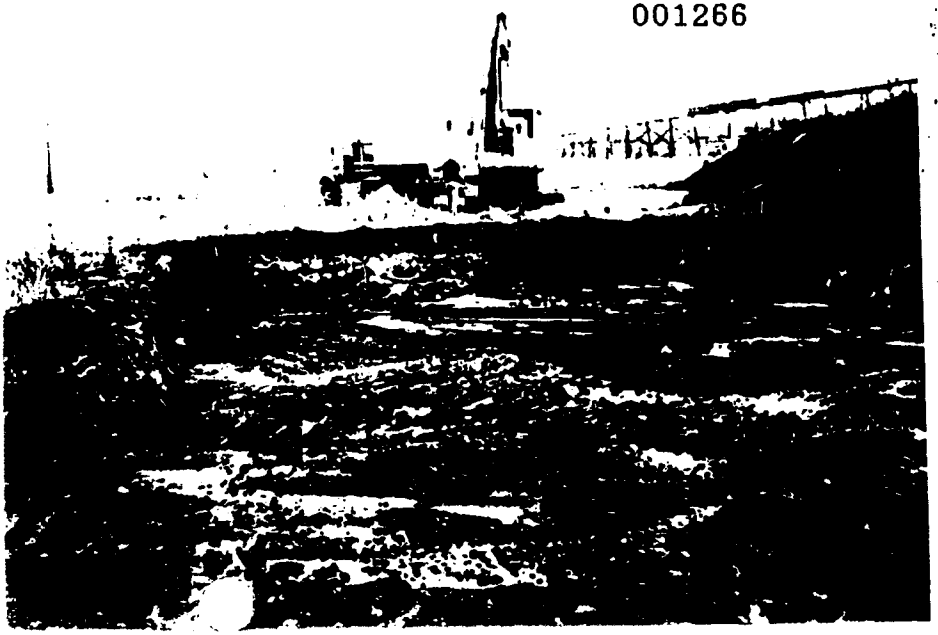
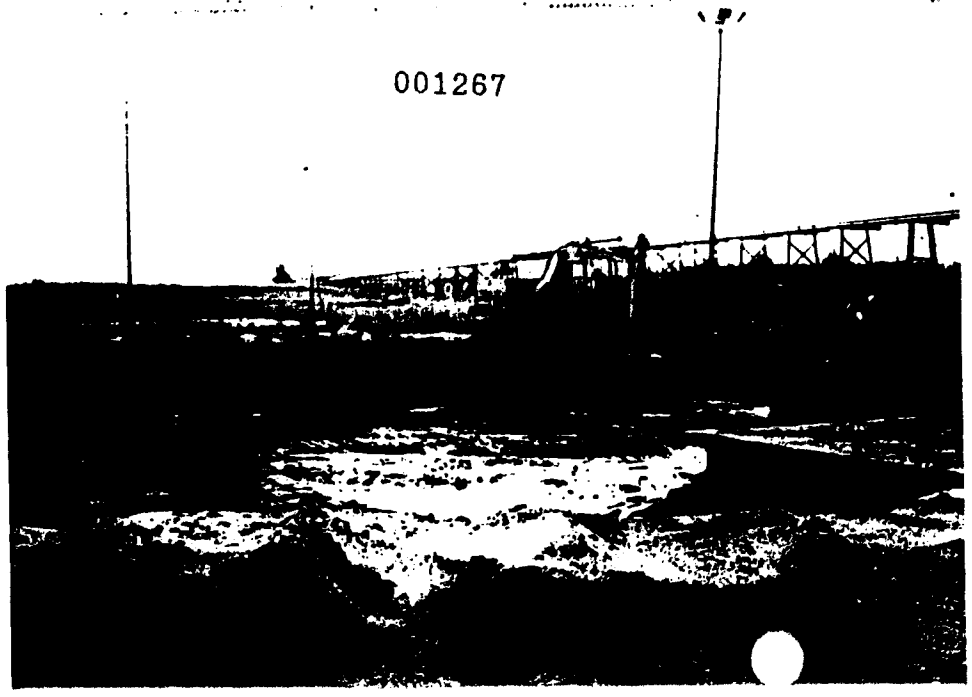


001267



1) Completion of excavation after first round of soil removal.

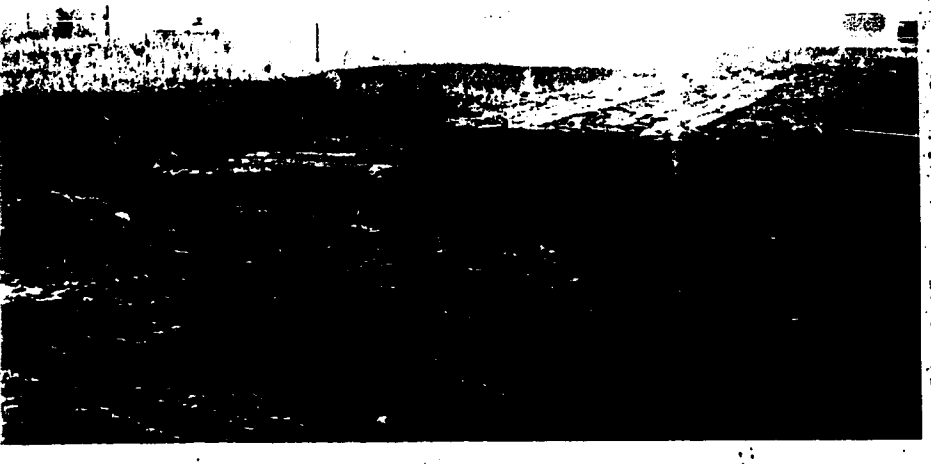
2) Elevated view after final excavation.

3) Backfilling.

4) Completed backfill and final cover.

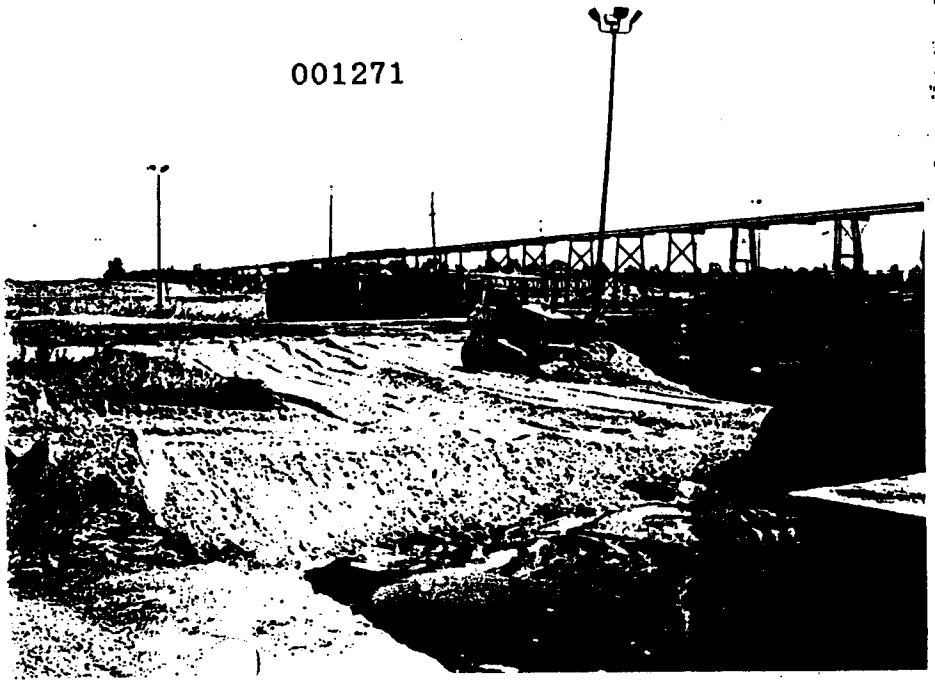
C-LINE #52584
35MM PRINTS

001269

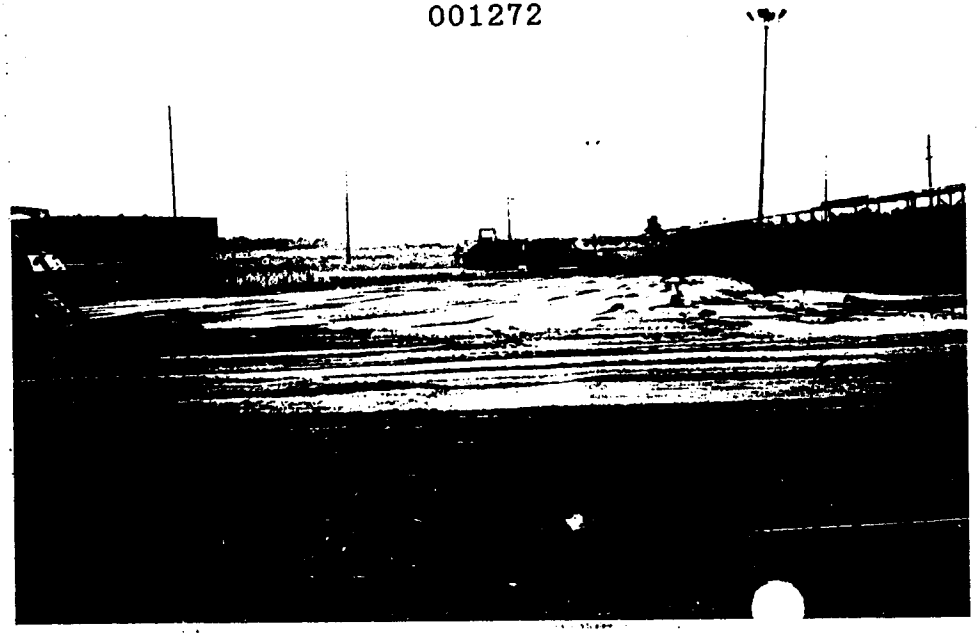


001270

001271



001272



APPENDIX C

LABORATORY DATA SHEETS FOR POST-EXCAVATION SAMPLES

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41034
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529
REPORT DATE: 08/03/89
COLLECTION DATE: 07/24/89
STATION ID: 401
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Solids, Total	92	%
Arsenic, Total	<3.3	mg/kg dry wt.

Alan Doughty, Ph.D., Laboratory Director

001275

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41035
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529
REPORT DATE: 08/03/89
COLLECTION DATE: 07/24/89
STATION ID: 402
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Solids, Total	94	%
Arsenic, Total	4.8	mg/kg dry wt.
Zinc, Total	31	mg/kg dry wt.

Alan Doughty, Ph.D., Laboratory Director

001276

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41036
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529
REPORT DATE: 08/03/89
COLLECTION DATE: 07/24/89
STATION ID: 403
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Solids, Total	96	%
Zinc, Total	47	mg/kg dry wt.

Alan Doughty, Ph.D., Laboratory Director

001277

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41037
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529
REPORT DATE: 08/02/89
COLLECTION DATE: 07/24/89
STATION ID: 404
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Phenols	<2.0	mg/kg dry wt.
Solids, Total	63	%

Alan Doughty, Ph.D., Laboratory Director

001278

RMT, INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41038
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529

REPORT DATE: 08/03/89
COLLECTION DATE: 07/24/89
STATION ID: 405
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Phenols	<1.6	mg/kg dry wt.
Solids, Total	77	%
Arsenic, Total	<3.9	mg/kg dry wt.

Alan Doughty, Ph.D., Laboratory Director

001279

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41039
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529
REPORT DATE: 08/03/89
COLLECTION DATE: 07/24/89
STATION ID: 406
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Solids, Total	95	%
Arsenic, Total	4.9	mg/kg dry wt.

Alan Doughty, Ph.D., Laboratory Director

001280

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41040
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529
REPORT DATE: 08/03/89
COLLECTION DATE: 07/24/89
STATION ID: 407
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Solids, Total	84	%
Arsenic, Total	<3.6	mg/kg dry wt.
Zinc, Total	19*	mg/kg dry wt.

* Estimated value-precision QC fails due to non homogeneous sample matrix.

Alan Doughty, Ph.D., Laboratory Director

001281

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41041
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529

REPORT DATE: 08/03/89
COLLECTION DATE: 07/24/89
STATION ID: 408
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Solids, Total	96	%
Zinc, Total	28	mg/kg dry wt.

001282

Alan Doughty, Ph.D. / Laboratory Director

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41042
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529
REPORT DATE: 08/02/89
COLLECTION DATE: 07/24/89
STATION ID: 409
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Phenols	<1.4	mg/kg dry wt.
Solids, Total	92	%

001283

Alan Doughty, Ph.D., Laboratory Director

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41043
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529
REPORT DATE: 08/03/89
COLLECTION DATE: 07/24/89
STATION ID: 410
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Phenols	<1.4	mg/kg dry wt.
Solids, Total	88	%
Arsenic, Total	<3.4	mg/kg dry wt.

Alan Doughty, Ph.D., Laboratory Director

001284

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41044
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529
REPORT DATE: 08/03/89
COLLECTION DATE: 07/24/89
STATION ID: 411
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Phenols	<1.3	mg/kg dry wt.
Solids, Total	95	%
Arsenic, Total	<3.2	mg/kg dry wt.

Alan Doughty, Ph.D., Laboratory Director

001285

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41045
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529
REPORT DATE: 08/03/89
COLLECTION DATE: 07/24/89
STATION ID: 412
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Phenols	<1.5	mg/kg dry wt.
Solids, Total	82	%
Arsenic, Total	<3.7	mg/kg dry wt.

Alan Doughty, Ph.D., Laboratory Director

001286

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41046
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529
REPORT DATE: 08/02/89
COLLECTION DATE: 07/24/89
STATION ID: 413
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Phenols	<1.7	mg/kg dry wt.
Solids, Total	72	%

Alan Doughty, Ph.D., Laboratory Director

001287

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41047
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529
REPORT DATE: 08/02/89
COLLECTION DATE: 07/24/89
STATION ID: 414
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Phenols	2.1	mg/kg dry wt.
Solids, Total	82	%

Alan Doughty, Ph.D., Laboratory Director

001288

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41048
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529

REPORT DATE: 08/02/89
COLLECTION DATE: 07/24/89
STATION ID: 415
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Phenols	2.3	mg/kg dry wt.
Solids, Total	87	%

Alan Doughty, Ph.D., Laboratory Director

001289

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41049
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529
REPORT DATE: 08/03/89
COLLECTION DATE: 07/24/89
STATION ID: 416
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Phenols	3.8	mg/kg dry wt.
Solids, Total	79	%
Arsenic, Total	4.7	mg/kg dry wt.

Alan Doughty, Ph.D., Laboratory Director

001290

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41050
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529
REPORT DATE: 08/02/89
COLLECTION DATE: 07/24/89
STATION ID: 417
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Phenols	5.7	mg/kg dry wt.
Solids, Total	79	%

Alan Doughty, Ph.D., Laboratory Director

001291

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41051
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529
REPORT DATE: 08/02/89
COLLECTION DATE: 07/24/89
STATION ID: 418
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Phenols	<1.4	mg/kg dry wt.
Solids, Total	88	%

Alan Doughty, Ph.D., Laboratory Director

001292

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41052
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529
REPORT DATE: 08/02/89
COLLECTION DATE: 07/24/89
STATION ID: 419
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Phenols	<1.4	mg/kg dry wt.
Solids, Total	87	%

Alan Doughty, Ph.D., Laboratory Director

001293

RMT INC.
LABORATORIES

CLIENT: GMC CFD SAGINAW NODULAR IRON
SAMPLE #: 41053
PROJECT #: 01125.29
WORK ORDER #: 072689-0112529
REPORT DATE: 08/02/89
COLLECTION DATE: 07/24/89
STATION ID: 420
SAMPLE COLLECTOR: MK

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Phenols	<1.8	mg/kg dry wt.
Solids, Total	70	%

Alan Doughty, Ph.D., Laboratory Director

001294

APPENDIX D

GROUND WATER MONITORING WELL LOCATIONS, WELL LOGS AND BORING LOGS

SCHLEEDE
HAMPTON
ASSOCIATES INC
CONSULTING ENGINEERS

August 23, 1991

Central Foundry Division
Divisional Offices
77 W. Center Street
Saginaw, Michigan 48605-5073

Attn: Mr. G.K. West
Senior Engineering - Environmental Activities
Manufacturing Administration

Regarding: Monitoring Well Installation Project
Saginaw Nodular Iron Plant
Calcium Carbide Storage Areas
SHA Project Number 30240

Gentlemen:

The purpose of this letter is to document that the monitoring wells installed as part of this project (MW-2, MW-2A, MW-13, MW-14, MW-15, MW-16, MW-17, and MW-18) were constructed in accordance with instructions and specifications for the closure plan provided by CFD. I was present during construction of all of the wells, and I attest to their proper installation.

Sincerely,
Schleede-Hampton Associates, Inc.

James Berry, P.E.
Project Manager

001297

2254 COLE STREET
BIRMINGHAM, MICHIGAN 48009
313-540-3044

SCHLEEDE
HAMPTON
ASSOCIATES INC
CONSULTING ENGINEERS

December 5, 1990

Central Foundry Division
Divisional Offices
77 W. Center Street
P.O. Box 5073
Saginaw, Michigan 48605-5073

Attn: Mr. G. Keith West
Senior Engineer - Environmental Activities

Regarding: Monitoring Well Installation Project
Calcium Carbide Storage Areas
Saginaw Nodular Iron Plant
SHA Project Number 30240

Gentlemen:

We have completed the groundwater monitoring well installation project at the Saginaw Nodular Iron Plant. The project consisted of installing a total of eight monitoring wells at both of the former calcium carbide yards storage areas at the plant. This report presents a discussion the project including methods and materials, soil boring logs, and monitoring well installation logs.

The scope of this project included soil drilling, sampling, and the installation of eight groundwater monitoring wells at two sites. Six wells were installed at the old slag treatment area located southeast of the plant. These wells were designated MW-2, MW-2A, MW-13, MW-14, MW-15, MW-16. Two wells were installed at the existing slag treatment bunker located south of the plant. These wells were designated MW-17 and MW-18.

The monitoring well locations were marked in the field by representatives of Central Foundry Division before the field work started.

The wells were drilled using truck mounted rotary head drilling equipment. Standard penetration tests were performed and split barrel samples were recovered at 2 1/2 foot intervals to the full depth of each boring.

Well screens and riser casing were installed in the borehole at completion of the drilling and sampling operations. Washed, graded, sand backfill was placed around the screen, and an annular seal of bentonite pellets was installed near the surface. A locking protective steel cover was grouted into place over the top of the casing at completion.

2254 COLE STREET
BIRMINGHAM, MICHIGAN 48009
313-540-3044

The boreholes were extended to depths greater than the eventual depth of well screen placement in some cases. Washed sand backfill was used to seat the screen in the upper sand soils at these locations.

A Field Engineer from Schleede-Hampton Associates, Inc. supervised and monitored the drilling and sampling procedures at all times.

After the wells were constructed, they were purged using hand bailers. Well development continued until the water was clear and pH, temperature, and conductivity field meter readings had stabilized.

Well rim elevations were determined by conventional differential leveling. A site benchmark was selected with an assumed elevation of 100.00 feet. This benchmark consisted of the plant floor surface at the center line of the overhead door immediately north of the existing treatment bunker.

A summary of well construction data is shown in table 1. Soil boring logs and well construction details for each well are contained in the appendix of this report.

If you have any questions regarding the project, please feel free to contact us at your convenience.

Sincerely,
Schleede-Hampton Associates, Inc.

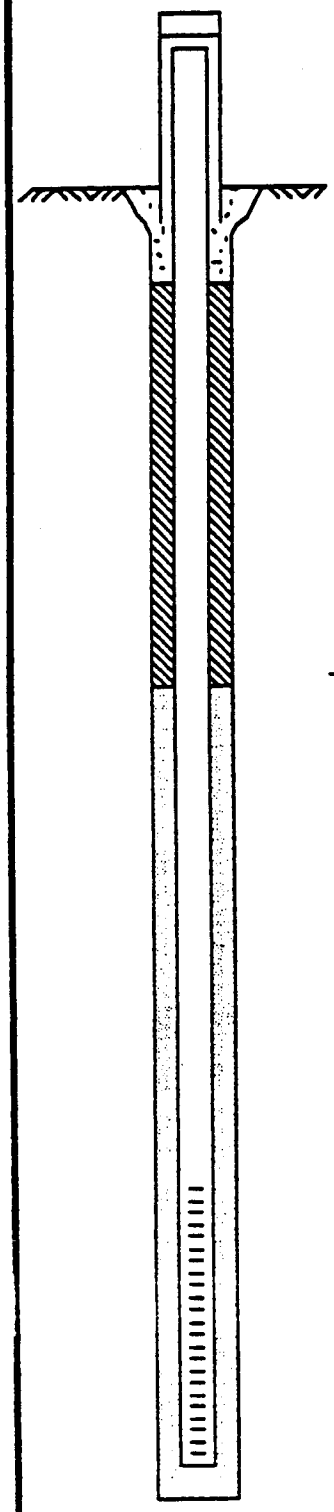
James Berry, P.E.
Senior Project Manager

TABLE I

SUMMARY OF WELL CONSTRUCTION DATA

Well Number	Construction Material	Well Diameter (IN.)	Rim Elevation	Total Length (FT.-IN.)	Stick Up Height (in.)	Well Tip Elevation	Well Screen Interval
MW-2	PVC	4	102.33	15-5	40	86.9	86.9 - 96.9
MW-2A	PVC	4	102.80	17-7	42	85.3	85.3 - 95.3
MW-13	PVC	4	102.70	15-1	43	87.6	87.6 - 97.6
MW-14	PVC	4	101.98	15-5	40	86.6	86.6 - 96.6
MW-15	PVC	4	102.60	15-5	45	87.2	87.2 - 97.2
MW-16	PVC	4	102.83	16-2	42	86.7	86.7 - 96.7
MW-17	PVC	4	102.03	17-8	43	84.4	84.4 - 94.4
MW-18	PVC	4	102.23	18-3	40	84.0	84.0 - 94.0

ELEVATION	WELL CONSTRUCTION DETAIL MW - 2	REMARKS
		DATE OF INSTALLATION 10/29/90
102.33	TOP OF CASING (RIM)	
99.0	GROUND SURFACE	ANNULAR SEAL BENTONITE TABLETS
98.0	TOP OF ANNULAR SEAL	TOTAL RISER LENGTH 5 FT. 5 IN.
		SCREEN 10 FT.
97.0	TOP OF GRANULAR BACKFILL	PERVIOUS BACKFILL WASHED SAND
		TOTAL WELL LENGTH 15 FT. 5 IN.
		STICK UP HEIGHT 40 IN.
96.9	TOP OF SCREEN	LOCK ID. MASTER # 3753
86.9	BOTTOM OF PLUG (TIP)	



001301

SCHLEEDE-HAMPTON ASSOCIATES, INC. • CONSULTING ENGINEERS

RECORD OF SUBSURFACE EXPLORATION

BORING MW-2 PAGE 1 OF 1

PROJECT NAME SNI Monitoring Well Installation Project
SHA PROJECT NO. 30240
SITE LOCATION Old Calcium Carbide Treatment Area

DATE STARTED 10/29/90
DATE COMPLETED 10/29/90
DRILLER RD BORING METHOD HSA
GW ENCOUNTERED WHILE DRILLING 5½'
GROUND WATER, AT COMPLETION -
GROUND WATER, AFTER - DAYS -
HOLE CAVED, - AT -

ELEV.	DESCRIPTION	DEPTH	SAMPLE	N	Qu	Qp	Wc	REMARKS
	Moist to wet, dense to slightly dense, black, fine SAND Trace silt, trace concrete debris		SS-1	44				
			SS-2	50				
		5						
			SS-3	12				
			SS-4	4				
		10						
			SS-5	26				
	Moist, very stiff, brown, mottled, grey CLAY		SS-6	25				
		15						
	End of Boring							

SYMBOLS
- N: STANDARD PENETRATION, BLOWS/FT.
- Qu: UNCONFINED COMPRESSIVE STRENGTH, TONS/SQ. FT.
- Wc: WATER CONTENT, %
- LL: LIQUID LIMIT, %
- PI: PLASTICITY INDEX, %
- Dd: NATURAL DRY DENSITY, LBS./CU. FT.
- Qp: HAND PENETROMETER, TONS/SQ. FT.
- GW: GROUND WATER

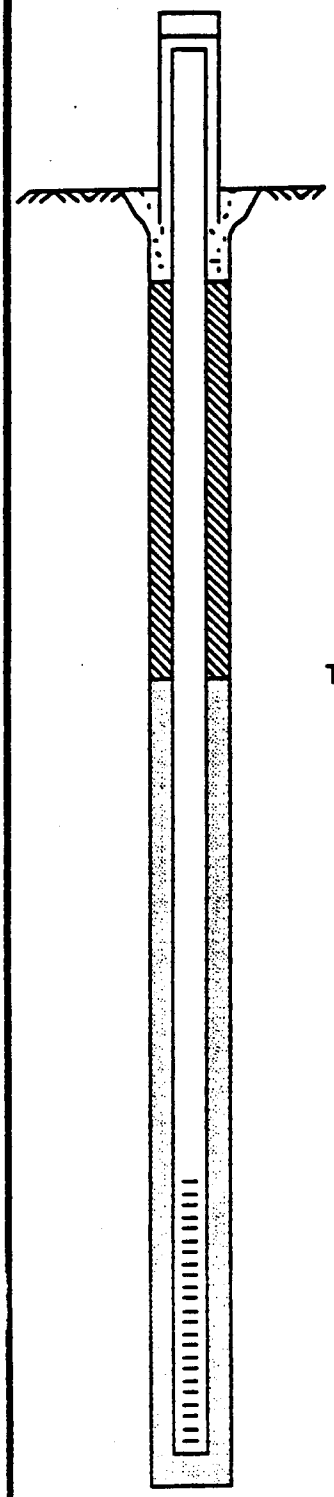
SAMPLE DESIGNATION
- SS— DRIVEN SPLIT SPOON 1 3/8" I.D., 2" O.D.
- ST— PRESSED SHELBY TUBE
- AU— AUGER SAMPLE
- RC— ROCK CORE - NXM

BORING METHOD
- HSA— HOLLOW STEM AUGERS
- CFA— CONTINUOUS FLIGHT AUGERS
- C— CASING
- MD— MUD DRILLING

NOTE: The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

001302

ELEVATION	WELL CONSTRUCTION DETAIL MW - 2A	REMARKS
		DATE OF INSTALLATION 10/29/90
102.80	TOP OF CASING (RIM)	
99.3	GROUND SURFACE	ANNULAR SEAL BENTONITE TABLETS
98.2	TOP OF ANNULAR SEAL	
		TOTAL RISER LENGTH 7 FT. 7 IN.
		SCREEN LENGTH 10 FT.
96.8	TOP OF GRANULAR BACKFILL	PERVIOUS BACKFILL WASHED SAND
		TOTAL WELL LENGTH 17 FT. 7 IN.
		STICK UP HEIGHT 42 IN.
95.3	TOP OF SCREEN	LOCK ID. MASTER # 3753
85.3	BOTTOM OF PLUG (TIP)	



001303

SCHLEEDE-HAMPTON ASSOCIATES, INC. • CONSULTING ENGINEERS

RECORD OF SUBSURFACE EXPLORATION

BORING MW-2A PAGE 1 OF 1

PROJECT NAME SNI Monitoring Well Installation Project
SHA PROJECT NO. 30242
SITE LOCATION Old Calcium Carbide Treatment Area

DATE STARTED 10/29/90
DATE COMPLETED 10/29/90
DRILLER RD BORING METHOD HSA
GW ENCOUNTERED WHILE DRILLING 7'
GROUND WATER, AT COMPLETION 7'
GROUND WATER, AFTER - DAYS -
HOLE CAVED, - AT -

ELEV.	DESCRIPTION	DEPTH	SAMPLE	N	Qu	Qp	Wc	REMARKS
	Moist, medium dense, black, fine SAND Trace silt, trace wood debris		SS-1	16				
	Variegated, grey, silty CLAY	5	SS-2	16				
	Moist to wet, medium dense, black, fine SAND Trace silt, trace wood debris		SS-3	12				
			SS-4	8				
		10						
			SS-5	8				
	Moist, stiff, brown, mottled, grey, silty CLAY		SS-6	19				
		15						
	End of Boring							

SYMBOLS
- N: STANDARD PENETRATION, BLOWS/FT.
- Qu: UNCONFINED COMPRESSIVE STRENGTH, TONS/SQ. FT.
- Wc WATER CONTENT, %
- LL: LIQUID LIMIT, %
- PI: PLASTICITY INDEX, %
- Dd: NATURAL DRY DENSITY, LBS./CU. FT.
- Qp: HAND PENETROMETER, TONS/SQ. FT.
- GW: GROUND WATER

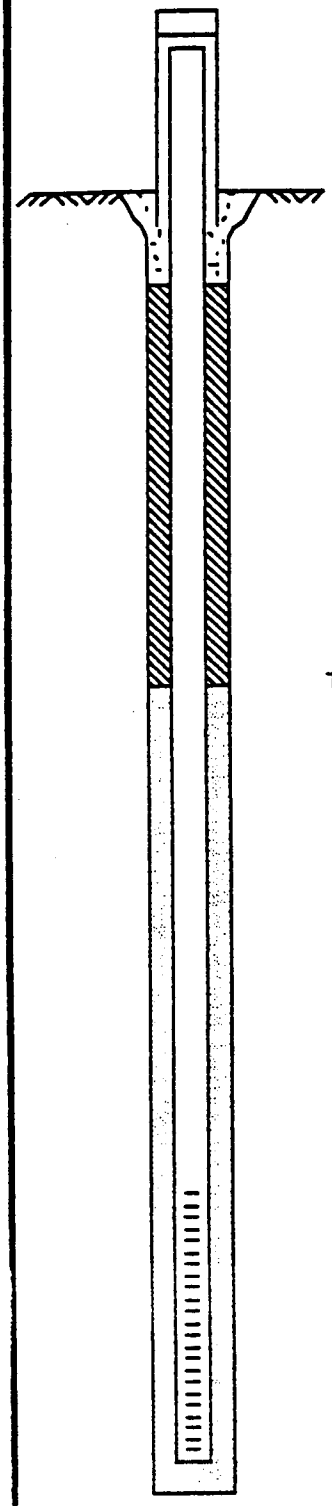
SAMPLE DESIGNATION
- SS— DRIVEN SPLIT SPOON 1 3/8" I.D., 2" O.D.
- ST— PRESSED SHELBY TUBE
- AU— AUGER SAMPLE
- RC— ROCK CORE - NXM

BORING METHOD
- HSA—HOLLOW STEM AUGERS
- CFA—CONTINUOUS FLIGHT AUGERS
- C— CASING
- MD— MUD DRILLING

NOTE: The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

001304

ELEVATION	WELL CONSTRUCTION DETAIL MW - 13	REMARKS
		DATE OF INSTALLATION 10/29/90
102.70	TOP OF CASING (RIM)	
99.1	GROUND SURFACE	ANNULAR SEAL BENTONITE TABLETS
98.5	TOP OF ANNULAR SEAL	
		TOTAL RISER LENGTH 5 FT. 1 IN.
		SCREEN LENGTH 10 FT.
97.8	TOP OF GRANULAR BACKFILL	PERVIOUS BACKFILL WASHED SAND
		TOTAL WELL LENGTH 15 FT. 1 IN.
		STICK UP HEIGHT 43 IN.
97.6	TOP OF SCREEN	LOCK ID. MASTER # 3753
87.6	BOTTOM OF PLUG (TIP)	



001305

SCHLEEDE-HAMPTON ASSOCIATES, INC. • CONSULTING ENGINEERS

RECORD OF SUBSURFACE EXPLORATION

BORING MW-13 PAGE 1 OF 1

PROJECT NAME SNI Monitoring Well Installation Project
SHA PROJECT NO. 30240
SITE LOCATION Old Calcium Carbide Treatment Area

DATE STARTED 10/30/90
DATE COMPLETED 10/30/90
DRILLER RD BORING METHOD HSA
GW ENCOUNTERED WHILE DRILLING 6'
GROUND WATER, AT COMPLETION -
GROUND WATER, AFTER - DAYS -
HOLE CAVED, - AT -

ELEV.	DESCRIPTION	DEPTH	SAMPLE	N	Qu	Qp	Wc	REMARKS
	Brown, fine SAND							
	Moist to wet, medium dense to slightly dense, black, fine SAND Trace silt		SS-1	23				
			SS-2	7				
		5						
			SS-3	14				
			SS-4	6				
	Variegated, silty CLAY	10						
	Moist, stiff, brown, mottled, grey, silty CLAY		SS-5	18				
	End of Boring	15						

SYMBOLS
N: STANDARD PENETRATION, BLOWS/FT.
Qu: UNCONFINED COMPRESSIVE STRENGTH, TONS/SQ. FT.
Wc WATER CONTENT, %
LL: LIQUID LIMIT, %
PI: PLASTICITY INDEX, %
Dd: NATURAL DRY DENSITY, LBS./CU. FT.
Qp: HAND PENETROMETER, TONS/SQ. FT.
GW: GROUND WATER

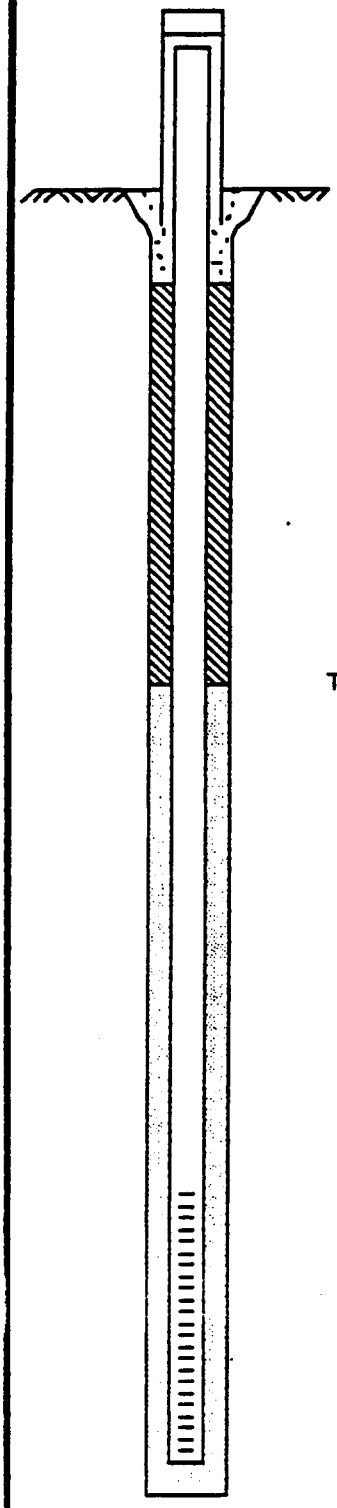
SAMPLE DESIGNATION
SS— DRIVEN SPLIT SPOON 1 3/8" I.D., 2" O.D.
ST— PRESSED SHELBY TUBE
AU— AUGER SAMPLE
RC— ROCK CORE - NXM

BORING METHOD
HSA—HOLLOW STEM AUGERS
CFA—CONTINUOUS FLIGHT AUGERS
C— CASING
MD— MUD DRILLING

NOTE: The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

001306

ELEVATION	WELL CONSTRUCTION DETAIL MW - 14	REMARKS
		DATE OF INSTALLATION 10/29/90
101.98	TOP OF CASING (RIM)	
98.6	GROUND SURFACE	ANNULAR SEAL BENTONITE TABLETS
97.6	TOP OF ANNULAR SEAL	
		TOTAL RISER LENGTH 5 FT. 5 IN.
		SCREEN LENGTH 10 FT.
96.6	TOP OF GRANULAR BACKFILL	PERVIOUS BACKFILL WASHED SAND
		TOTAL WELL LENGTH 15 FT. 5 IN.
		STICK UP HEIGHT 40 IN.
96.6	TOP OF SCREEN	LOCK ID. MASTER # 3753
86.6	BOTTOM OF PLUG (TIP)	



001307

SCHLEEDE-HAMPTON ASSOCIATES, INC. • CONSULTING ENGINEERS

RECORD OF SUBSURFACE EXPLORATION

BORING MW-14 **PAGE** 1 **OF** 1

PROJECT NAME SNI Monitoring Well Installation Project
SHA PROJECT NO. 30240
SITE LOCATION Old Calcium Carbide Treatment Area

DATE STARTED 10/29/90
DATE COMPLETED 10/29/90
DRILLER RD **BORING METHOD** HSA
GW ENCOUNTERED WHILE DRILLING 6'
GROUND WATER, AT COMPLETION -
GROUND WATER, AFTER - **DAYS** -
HOLE CAVED, - **AT** -

ELEV.	DESCRIPTION	DEPTH	SAMPLE	N	Qu	Qp	Wc	REMARKS
	Moist to wet, medium dense, black, fine SAND Trace silt, occasional layers of variegated clay		SS-1	28				
		5	SS-2	45				
			SS-3	14				
			SS-4	8				
	Variegated, silty CLAY	10						
	Moist, brown, mottled, grey, silty CLAY		SS-5	25				
	End of Boring	15						

SYMBOLS
N: STANDARD PENETRATION, BLOWS/FT.
Qu: UNCONFINED COMPRESSIVE STRENGTH, TONS/SQ. FT.
Wc WATER CONTENT, %
LL: LIQUID LIMIT, %
PI: PLASTICITY INDEX, %
Dd: NATURAL DRY DENSITY, LBS./CU. FT.
Qp: HAND PENETROMETER, TONS/SQ. FT.
GW: GROUND WATER

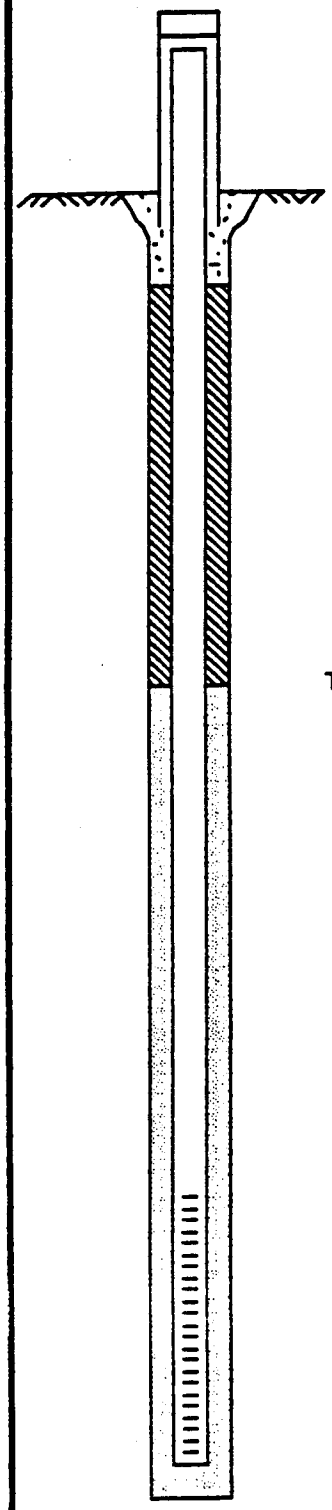
SAMPLE DESIGNATION
SS— DRIVEN SPLIT SPOON 1 3/8" I.D., 2" O.D.
ST— PRESSED SHELBY TUBE
AU— AUGER SAMPLE
RC— ROCK CORE - NXM

BORING METHOD
HSA— HOLLOW STEM AUGERS
CFA— CONTINUOUS FLIGHT AUGERS
C— CASING
MD— MUD DRILLING

NOTE: The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

001308

ELEVATION	WELL CONSTRUCTION DETAIL MW - 15	REMARKS
		DATE OF INSTALLATION 10/29/90
102.60	TOP OF CASING (RIM)	
98.9	GROUND SURFACE	ANNULAR SEAL BENTONITE TABLETS
97.7	TOP OF ANNULAR SEAL	TOTAL RISER LENGTH 5 FT. 5 IN.
		SCREEN LENGTH 10 FT.
96.9	TOP OF GRANULAR BACKFILL	PERVIOUS BACKFILL WASHED SAND
		TOTAL WELL LENGTH 15 FT. 5 IN.
		STICK UP HEIGHT 45 IN.
97.2	TOP OF SCREEN	LOCK ID. MASTER # 3753
87.2	BOTTOM OF PLUG (TIP)	



001309

SCHLEEDE-HAMPTON ASSOCIATES, INC. ● CONSULTING ENGINEERS

RECORD OF SUBSURFACE EXPLORATION

BORING MW-15 PAGE 1 OF 1

PROJECT NAME SNI Monitoring Well Installation Project
SHA PROJECT NO. 30240
SITE LOCATION Old Calcium Carbide Treatment Area

DATE STARTED 10/29/90
DATE COMPLETED 10/29/90
DRILLER RD BORING METHOD HSA
GW ENCOUNTERED WHILE DRILLING 3'
GROUND WATER, AT COMPLETION -
GROUND WATER, AFTER - DAYS -
HOLE CAVED, - AT -

ELEV.	DESCRIPTION	DEPTH	SAMPLE	N	Qu	Qp	Wc	REMARKS
	Moist to wet, loose, light brown, fine SAND Trace silt		SS-1	4				
	Wet, medium dense to slightly dense, black, fine SAND Trace silt	5	SS-2	22				
			SS-3	22				
		10	SS-4	6				
	Moist, stiff, brown, mottled grey, silty CLAY		SS-5	18				
	End of Boring	15						

SYMBOLS
N: STANDARD PENETRATION, BLOWS/FT.
Qu: UNCONFINED COMPRESSIVE STRENGTH, TONS/SQ. FT.
Wc WATER CONTENT, %
LL: LIQUID LIMIT, %
PI: PLASTICITY INDEX, %
Dd: NATURAL DRY DENSITY, LBS./CU. FT.
Qp: HAND PENETROMETER, TONS/SQ. FT.
GW: GROUND WATER

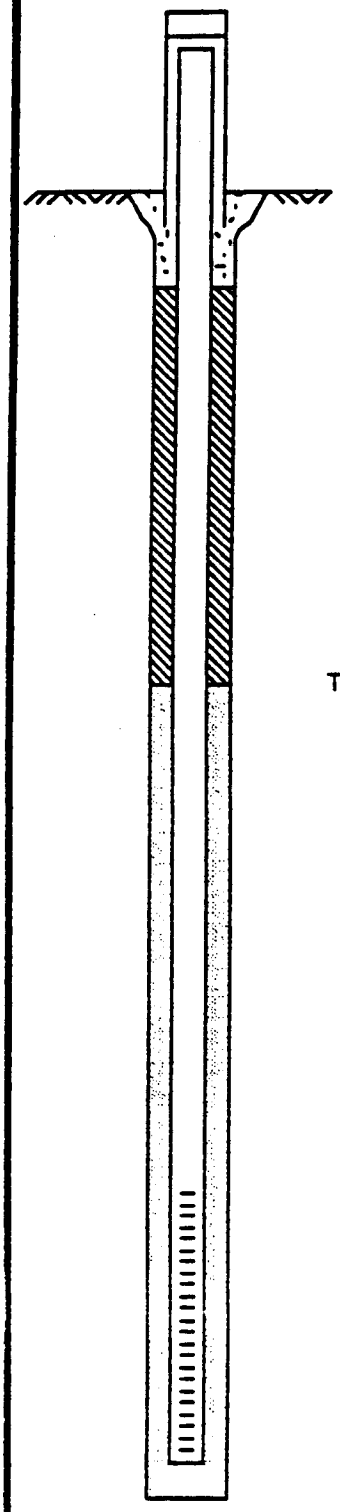
SAMPLE DESIGNATION
SS— DRIVEN SPLIT SPOON 1 3/8" I.D., 2" O.D.
ST— PRESSED SHELBY TUBE
AU— AUGER SAMPLE
RC— ROCK CORE - NXM

BORING METHOD
HSA—HOLLOW STEM AUGERS
CFA—CONTINUOUS FLIGHT AUGERS
C— CASING
MD— MUD DRILLING

NOTE: The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

001310

ELEVATION	WELL CONSTRUCTION DETAIL MW - 16	REMARKS
		DATE OF INSTALLATION 10/30/90
102.83	TOP OF CASING (RIM)	
99.3	GROUND SURFACE	ANNULAR SEAL BENTONITE TABLETS
98.3	TOP OF ANNULAR SEAL	
		TOTAL RISER LENGTH 6 FT. 2 IN.
		SCREEN LENGTH 10 FT.
97.7	TOP OF GRANULAR BACKFILL	PERVIOUS BACKFILL WASHED SAND
		TOTAL WELL LENGTH 16 FT. 2 IN.
		STICK UP HEIGHT 42 IN.
96.7	TOP OF SCREEN	LOCK ID. MASTER # 3753
86.7	BOTTOM OF PLUG (TIP)	



001311

SCHLEEDE-HAMPTON ASSOCIATES, INC. • CONSULTING ENGINEERS

RECORD OF SUBSURFACE EXPLORATION

BORING MW-16 **PAGE** 1 **OF** 1

PROJECT NAME SNI Monitoring Well Installation Project
SHA PROJECT NO. 30240
SITE LOCATION Old Calcium Carbide Treatment Area

DATE STARTED 10/30/90
DATE COMPLETED 10/30/90
DRILLER RD **BORING METHOD** HSA
GW ENCOUNTERED WHILE DRILLING 6'
GROUND WATER, AT COMPLETION -
GROUND WATER, AFTER - **DAYS** -
HOLE CAVED, - **AT** -

ELEV.	DESCRIPTION	DEPTH	SAMPLE	N	Qu	Qp	Wc	REMARKS
	Moist to wet, medium dense to loose, black, fine SAND Trace silt, trace brick and slag fragments		SS-1	34				
			SS-2	7				
		5						
			SS-3	14				
			SS-4	2				
		10						
	Brown, mottled, grey, silty CLAY		SS-5	24				
	End of Boring	15						

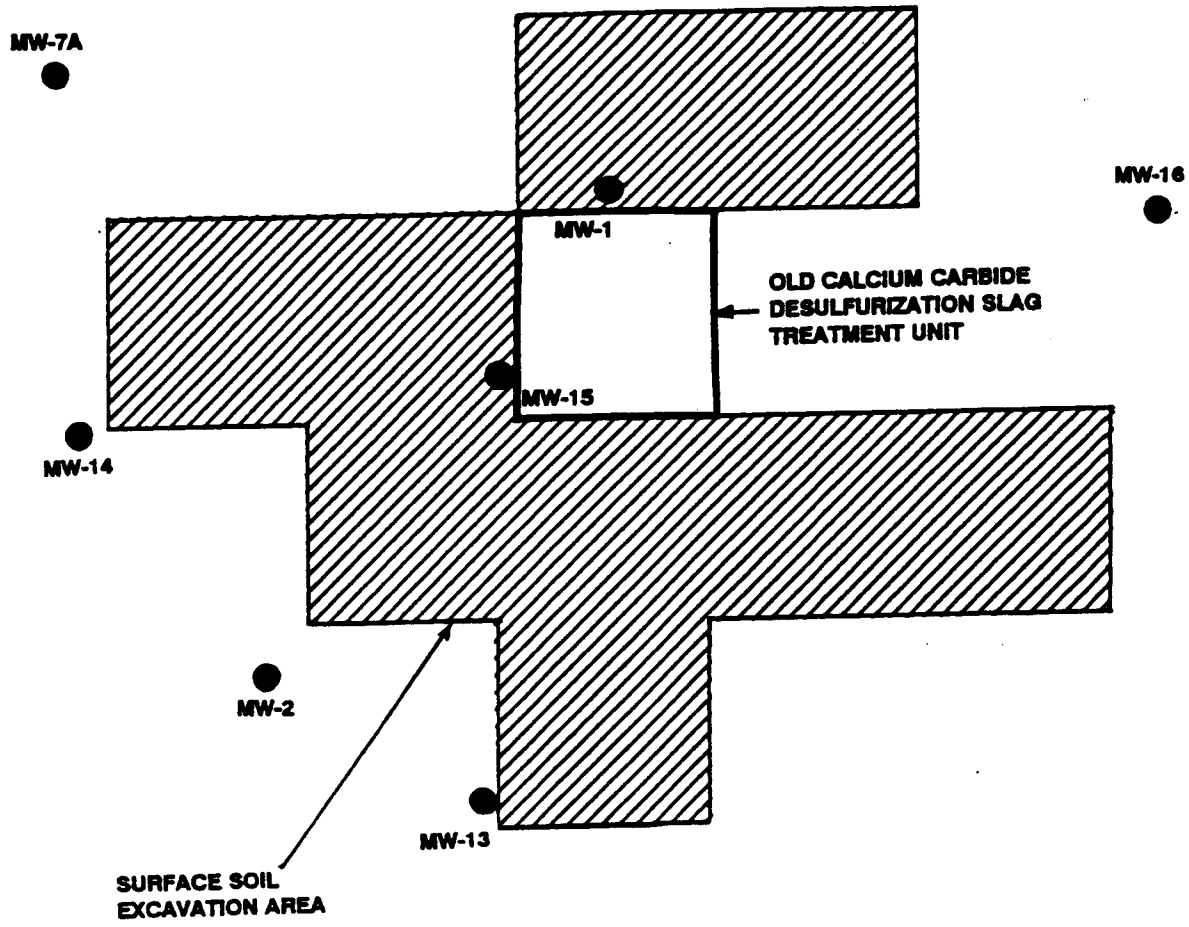
SYMBOLS
- N: STANDARD PENETRATION, BLOWS/FT.
- Qu: UNCONFINED COMPRESSIVE STRENGTH, TONS/SQ. FT.
- Wc: WATER CONTENT, %
- LL: LIQUID LIMIT, %
- PI: PLASTICITY INDEX, %
- Dd: NATURAL DRY DENSITY, LBS./CU. FT.
- Qp: HAND PENETROMETER, TONS/SQ. FT.
- GW: GROUND WATER

SAMPLE DESIGNATION
- SS— DRIVEN SPLIT SPOON 1 3/8" I.D., 2" O.D.
- ST— PRESSED SHELBY TUBE
- AU— AUGER SAMPLE
- RC— ROCK CORE - NXM

BORING METHOD
- HSA—HOLLOW STEM AUGERS
- CFA—CONTINUOUS FLIGHT AUGERS
- C— CASING
- MD— MUD DRILLING

NOTE: The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

001312



GMC-CFD-SNI OLD CALCIUM CARBIDE DESULFURIZATION SLAG TREATMENT UNIT GROUND WATER MONITORING WELL LOCATION MAP

LEGEND

- MONITORING WELLS FOR RCRA CLOSURE
- GROUND WATER CONTOUR (11/19/90)

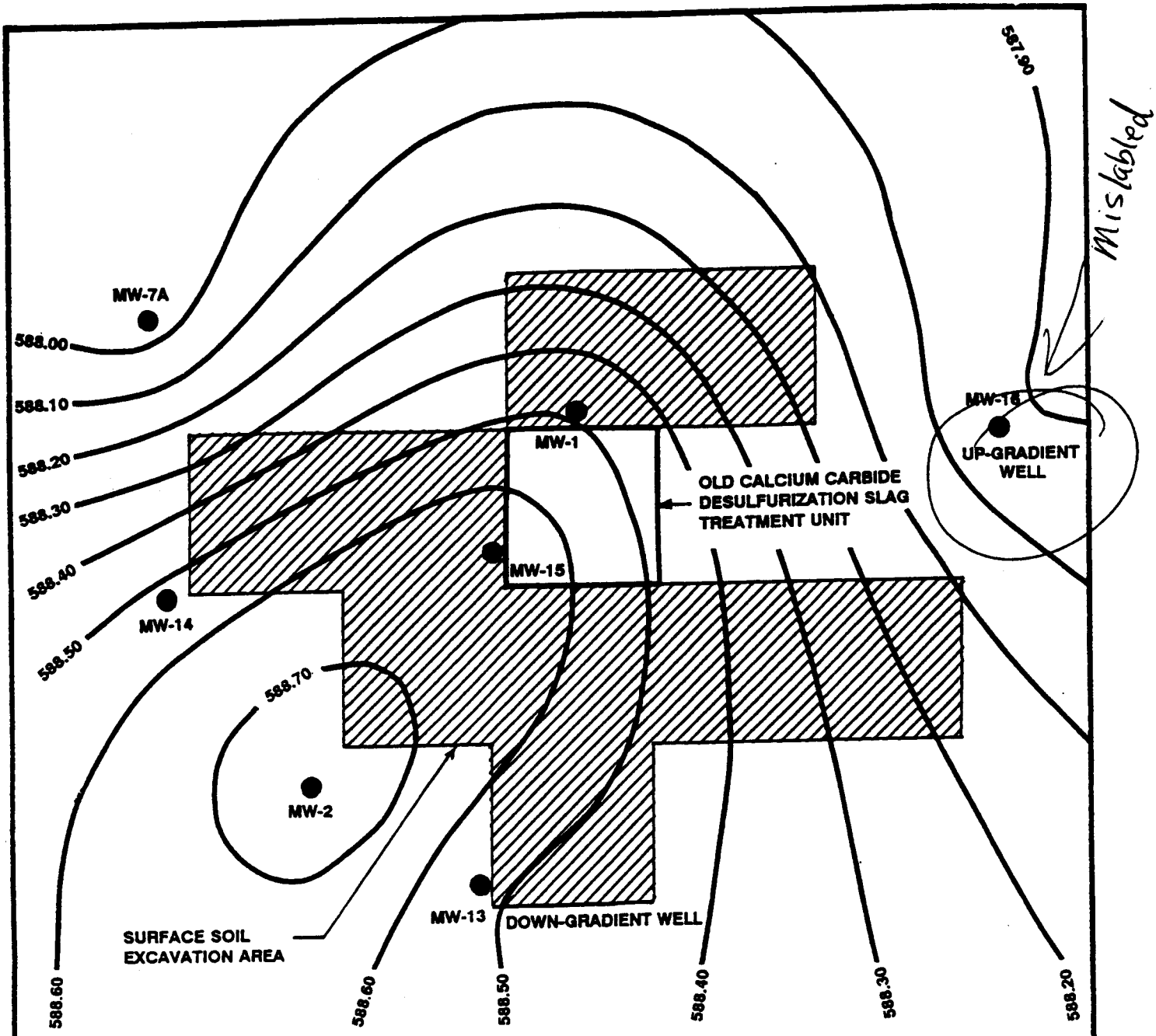
NORTH

APPROXIMATE SCALE: 1" = 20'

RMT INC.

Dwn. by:	CMS
Date:	10/91
Proj.#	1125.23

001313



GMC-CFD-SNI OLD CALCIUM CARBIDE DESULFURIZATION SLAG TREATMENT UNIT GROUND WATER MONITORING WELL LOCATIONS AND GROUND WATER CONTOUR MAP

LEGEND

- MONITORING WELLS FOR RCRA CLOSURE
- GROUND WATER CONTOUR (11/19/90)

NORTH

APPROXIMATE SCALE: 1" = 20'

RMT INC	Dwn. by: CMS
	Date: 10/91
	Proj #: 1125.23

001314

APPENDIX E

GROUND WATER ANALYTICAL RESULTS

WW Engineering & Science, Inc.
5555 Glenwood Hills Parkway SE • PO Box 874 • Grand Rapids, MI 49588-0874 • (616) 942-0800 Fax (616) 942-6459

October 14, 1991

Mr. Keith West
GM Central Foundries Division
Divisional Offices
77 W. Center Street
P.O. Box 5073
Saginaw, MI 48605-5073

RE: Groundwater Monitoring

Dear Mr. West:

WW Engineering & Science (WWES) collected and analyzed groundwater samples from your Saginaw Nodular Iron Plant during the period of November 1990 through January 1991.

All work was completed in accordance with the calcium carbide closure plan for the old and existing area of the plant, outlined in Section F (Groundwater Monitoring Program) as supplied to WWES by the General Motors Corporation.

Thank you for the opportunity to be of service. Please do not hesitate to contact me if you have any questions or need additional information for your summary report.

Sincerely,

WW ENGINEERING & SCIENCE
ENVIRONMENTAL LABORATORY DIVISION

Shar Hopp
Marketing Director

001317

FEB 2 . 1991

WW Engineering & Science, Inc.
5555 Glenwood Hills Parkway SE • P.O. Box 874 • Grand Rapids, Michigan 49588-0874 • PH(616)942-9600 FX(616)942-0499

February 26, 1991

NEEDED FOR
OH
AM

Mr. Keith West
GM Central Foundry
Divisional Offices
77 W. Center St.
P.O. Box 5073
Saginaw, MI 48605

Dear Mr. West:

I recently had a discussion with Shar Hopp in which your concerns regarding the Saginaw closure monitoring well reports were addressed. Accordingly, I have compiled spread sheets for each individual well as well as field reports for your review. Please make note of the following:

1. Data for each well has been entered with regards to your detection limit requirements rather than our achievable limits. Therefore, values our analytical reports that were positive above our detection limit but below your required detection limit are entered as "less than" your required limit.
2. All units have been converted to mg/l for consistency.
3. MW 2A and MW 7A refer to the same well. MW 7A has been designated as the well I.D. for consistency.
4. The computer software program used to compile the spread sheets assigns a value of zero for data points entered as "less than" for purposes of calculating averages.
5. MW 14 and its duplicate from the November sampling were reanalyzed for manganese due to the difference in their originally reported values. The values obtained were 0.007 mg/l and 0.009 mg/l respectively. The data point entered on the spread sheet reflects this 0.007 value.
6. The nitrate value in our analytical report for MW 3 from the November sampling was in error. The value should have read 0.20 mg/l rather than 0.02 mg/l. The spread sheet reflects this correction.

001318

You will also find enclosed a memorandum from Dr. Richard Rediske addressing your concerns about differences in phosphorus and chloride results for field duplicates. I hope this will clarify matters on this issue.

If you have any questions or require any further information at this time, do not hesitate to contact either Shar or myself.

Sincerely,

WW ENGINEERING & SCIENCE
ENVIRONMENTAL LABORATORY DIVISION

Ron Hamilton
Project Chemist

GM CENTRAL FOUNDRY
PROJECT #25744
CFD-SAGINAW CLOSURE

MW: #1

PARAMETERS	11/20/90 (mg/l)	12/18/90 (mg/l)	1/29/91 (mg/l)	2/14/91 (mg/l)	REQUIRED LIMITS (mg/l)	AVERAGE (mg/l)
pH (FIELD)	10.99	11.16	10.76	11.65	---	11.14
TOC	20	15	12	14	1.0	15
ALKALINITY, TOTAL	136	119	109	120	20	121
CHLORIDE	6.0	<1.0	2.7	4.5	1.0	3.3
FLUORIDE	15	14	17	15	0.1	15
NITROGEN,NITRATE	0.46	0.14	0.67	0.31	0.05	0.40
PHENOL, TOTAL	0.31	0.24	<0.10	<0.10	0.10	0.14
PHOSPHORUS, TOTAL	0.11	0.14	<0.10	<0.10	0.10	0.06
ARSENIC, DISSOLVED	0.017	0.012	0.010	<0.010	0.010	0.010
CADMIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
CALCIUM, DISSOLVED	47	52	48	45	0.03	48
CHROMIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
IRON, DISSOLVED	0.03	<0.01	<0.01	0.01	0.01	0.01
LEAD, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
MAGNESIUM, DISSOLVED	<0.30	<0.30	<0.30	<0.30	0.30	0
MANGANESE, DISSOLVED	<0.005	<0.005	<0.005	<0.005	0.005	0
POTASSIUM, DISSOLVED	8.0	6.3	5.1	6.0	0.5	6.4
SELENIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
SODIUM, DISSOLVED	41	31	22	27	0.3	30
ZINC, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0

001320

GM CENTRAL FOUNDRY
PROJECT #25744
FD-SAGINAW CLOSURE

MW: #2

PARAMETERS	11/20/90 (mg/l)	12/18/90 (mg/l)	1/29/91 (mg/l)	2/14/91 (mg/l)	REQUIRED LIMITS (mg/l)	AVERAGE (mg/)
pH (FIELD)	10.91	11.13	10.49	11.71	---	11.06
TOC	8.4	5.9	3.8	3.7	1.0	5.5
ALKALINITY, TOTAL	100	97	84	96	20	94
CHLORIDE	6.5	1.5	3.6	3.2	1.0	3.7
FLUORIDE	15	14	15	12	0.1	14
NITROGEN,NITRATE	0.06	<0.05	<0.05	<0.05	0.05	0.02
PHENOL, TOTAL	0.33	<0.10	<0.10	<0.10	0.10	0.08
PHOSPHORUS, TOTAL	0.29	0.32	0.19	0.12	0.10	0.23
ARSENIC, DISSOLVED	0.013	<0.010	<0.010	<0.010	0.010	0.003
CADMIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
CALCIUM, DISSOLVED	38	46	43	44	0.03	43
CHROMIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
IRON, DISSOLVED	0.05	0.02	0.02	0.01	0.01	0.03
LEAD, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
MAGNESIUM, DISSOLVED	<0.30	<0.30	<0.30	<0.30	0.30	0
MANGANESE, DISSOLVED	<0.005	<0.005	<0.005	<0.005	0.005	0
POTASSIUM, DISSOLVED	6.5	5.5	4.6	4.9	0.5	5.4
SELENIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
SODIUM, DISSOLVED	36	24	15	15	0.3	23
ZINC, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0

GM CENTRAL FOUNDRY
PROJECT #25744
FD-SAGINAW CLOSURE

MW: #7A

PARAMETERS	11/20/90 (mg/l)	12/18/90 (mg/l)	1/29/91 (mg/l)	2/14/91 (mg/l)	REQUIRED LIMITS (mg/l)	AVERAGE (mg/l)
pH (FIELD)	10.40	11.09	10.67	11.88	---	11.01
TOC	13	10	8.1	8.2	1.0	9.8
ALKALINITY, TOTAL	72	108	105	112	20	99
CHLORIDE	7.1	<1.0	2.7	3.3	1.0	3.3
FLUORIDE	16	12	14	11	0.1	13
NITROGEN,NITRATE	<0.05	<0.05	<0.05	<0.05	0.05	0
PHENOL, TOTAL	<0.10	<0.10	<0.10	<0.10	0.10	0
PHOSPHORUS, TOTAL	1.0	0.16	<0.10	<0.10	0.10	0.29
ARSENIC, DISSOLVED	0.011	<0.010	<0.010	<0.010	0.010	0.003
CADMIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
CALCIUM, DISSOLVED	30	53	50	47	0.03	45
CHROMIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
IRON, DISSOLVED	0.05	0.02	0.01	<0.01	0.01	0.02
LEAD, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
MAGNESIUM, DISSOLVED	0.79	<0.30	<0.30	<0.30	0.30	0.20
MANGANESE, DISSOLVED	<0.005	<0.005	<0.005	<0.005	0.005	0
POTASSIUM, DISSOLVED	4.1	5.3	4.7	4.8	0.5	4.7
SELENIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
SODIUM, DISSOLVED	27	19	16	14	0.3	19
ZINC, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0

001322

3M CENTRAL FOUNDRY
PROJECT #25744
CFD-SAGINAW CLOSURE

MW: #13

PARAMETERS	11/20/90 (mg/l)	12/18/90 (mg/l)	1/29/91 (mg/l)	2/14/91 (mg/l)	REQUIRED LIMITS (mg/l)	AVERAGE (mg/l)
pH (FIELD)	10.98	11.10	10.92	12.15	---	11.29
TOC	14	9.9	7.2	6.3	1.0	9.4
ALKALINITY, TOTAL	99	61	128	120	20	102
CHLORIDE	18	22	5.8	6.5	1.0	13.1
FLUORIDE	20	14	17	15	0.1	17
NITROGEN,NITRATE	<0.05	<0.05	<0.05	0.07	0.05	0.02
PHENOL, TOTAL	<0.10	<0.10	<0.10	<0.10	0.10	0
PHOSPHORUS, TOTAL	<0.10	0.25	<0.10	<0.10	0.10	0.06
ARSENIC, DISSOLVED	0.015	0.010	0.011	<0.010	0.010	0.009
CADMIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
CALCIUM, DISSOLVED	77	88	74	72	0.03	78
CHROMIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
IRON, DISSOLVED	0.01	<0.01	<0.01	<0.01	0.01	0.00
LEAD, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
MAGNESIUM, DISSOLVED	0.96	2.1	<0.30	0.54	0.30	0.90
MANGANESE, DISSOLVED	<0.005	<0.005	<0.005	<0.005	0.005	0
POTASSIUM, DISSOLVED	4.6	4.3	3.3	4.0	0.5	4.1
SELENIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
SODIUM, DISSOLVED	43	48	18	24	0.3	33
ZINC, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0

001323

GM CENTRAL FOUNDRY
PROJECT #25744
CFD-SAGINAW CLOSURE

MW: #14

PARAMETERS	11/20/90 (mg/l)	12/18/90 (mg/l)	1/29/91 (mg/l)	2/14/91 (mg/l)	REQUIRED LIMITS (mg/l)	AVERAGE (mg/l)
pH (FIELD)	10.01	10.45	10.20	11.36	---	10.51
TOC	6.6	5.4	4.9	3.8	1.0	5.2
ALKALINITY, TOTAL	65	75	70	76	20	72
CHLORIDE	12	4.9	7.4	6.1	1.0	7.6
FLUORIDE	20	21	27	21	0.1	22
NITROGEN,NITRATE	<0.05	<0.05	<0.05	0.15	0.05	0.04
PHENOL, TOTAL	<0.10	<0.10	<0.10	<0.10	0.10	0
PHOSPHORUS, TOTAL	0.22	0.18	<0.10	0.10	0.10	0.13
ARSENIC, DISSOLVED	0.011	0.011	0.017	0.010	0.010	0.012
CADMIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
CALCIUM, DISSOLVED	30	30	36	31	0.03	32
CHROMIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
IRON, DISSOLVED	0.37	0.02	<0.01	0.01	0.01	0.10
LEAD, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
MAGNESIUM, DISSOLVED	2.5	1.4	0.53	0.38	0.30	1.2
MANGANESE, DISSOLVED	0.007	<0.005	<0.005	<0.005	0.005	0.002
POTASSIUM, DISSOLVED	4.5	4.1	3.9	4.2	0.5	4.2
SELENIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
SODIUM, DISSOLVED	41	44	42	46	0.3	43
ZINC, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0

001324

GM CENTRAL FOUNDRY
PROJECT #25744
CFD-SAGINAW CLOSURE

MW: #15

PARAMETERS	11/20/90 (mg/l)	12/18/90 (mg/l)	1/29/91 (mg/l)	2/14/91 (mg/l)	REQUIRED LIMITS (mg/l)	AVERAGE (mg/l)
pH (FIELD)	9.87	9.48	9.53	9.84	---	9.68
TOC	10	7.6	4.3	3.4	1.0	6.3
ALKALINITY, TOTAL	74	66	56	64	20	65
CHLORIDE	2.5	<1.0	<1.0	3.4	1.0	1.5
FLUORIDE	6.3	2.0	4.9	1.3	0.1	3.6
NITROGEN,NITRATE	0.18	0.16	<0.05	0.72	0.05	0.27
PHENOL, TOTAL	<0.10	<0.10	<0.10	<0.10	0.10	0
PHOSPHORUS, TOTAL	<0.10	<0.10	<0.10	<0.10	0.10	0
ARSENIC, DISSOLVED	<0.010	<0.010	<0.010	<0.010	0.010	0
CADMIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
CALCIUM, DISSOLVED	21	17	21	23	0.03	21
CHROMIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
IRON, DISSOLVED	0.30	0.08	0.02	0.07	0.01	0.12
LEAD, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
MAGNESIUM, DISSOLVED	1.2	1.9	2.0	3.4	0.30	2.1
MANGANESE, DISSOLVED	0.007	<0.005	<0.005	<0.005	0.005	0.002
POTASSIUM, DISSOLVED	3.4	5.0	4.0	1.9	0.5	3.6
SELENIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
SODIUM, DISSOLVED	14	11	7.2	4.3	0.3	9.1
ZINC, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0

001325

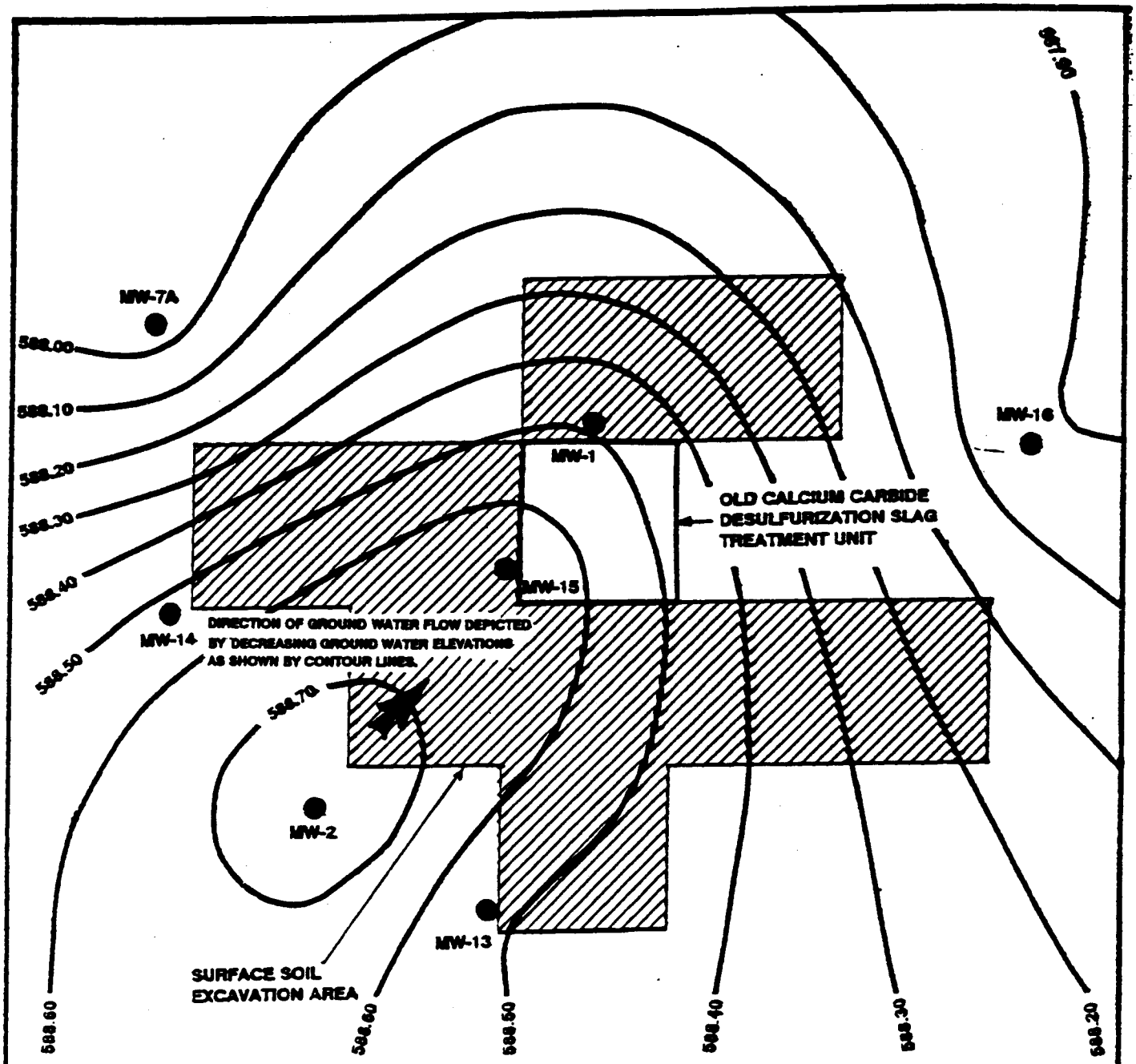
GM CENTRAL FOUNDRY
PROJECT #25744
FD-SAGINAW CLOSURE

MW: #16

PARAMETERS	11/20/90 (mg/l)	12/18/90 (mg/l)	1/29/91 (mg/l)	2/14/91 (mg/l)	REQUIRED LIMITS (mg/l)	AVERAGE (mg/l)
pH (FIELD)	8.46	8.62	8.57	9.18	---	8.71
TOC	25	18	13	14	1.0	18
ALKALINITY, TOTAL	68	230	210	200	20	177
CHLORIDE	51	39	36	39	1.0	41
FLUORIDE	21	19	19	19	0.1	20
NITROGEN,NITRATE	0.20	<0.05	0.31	0.22	0.05	0.18
PHENOL, TOTAL	<0.10	<0.10	<0.10	<0.10	0.10	0
PHOSPHORUS, TOTAL	<0.10	<0.10	0.32	0.11	0.10	0.11
ARSENIC, DISSOLVED	0.049	0.041	0.043	0.038	0.010	0.043
CADMIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
CALCIUM, DISSOLVED	33	29	27	25	0.03	29
CHROMIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
IRON, DISSOLVED	0.85	0.14	0.14	0.12	0.01	0.31
LEAD, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
MAGNESIUM, DISSOLVED	6.9	6.4	5.7	5.8	0.30	6.2
MANGANESE, DISSOLVED	0.141	0.098	0.094	0.073	0.005	0.102
POTASSIUM, DISSOLVED	10	8.8	7.7	7.8	0.5	8.6
SELENIUM, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0
SODIUM, DISSOLVED	186	166	152	150	0.3	164
ZINC, DISSOLVED	<0.01	<0.01	<0.01	<0.01	0.01	0

APPENDIX F

GROUND WATER FLOW DIRECTION CONTOUR MAP



GMC-CFD-SNI OLD CALCIUM CARBIDE DESULFURIZATION SLAG TREATMENT UNIT GROUND WATER MONITORING WELL LOCATIONS AND GROUND WATER CONTOUR MAP

LEGEND

- MONITORING WELLS FOR RCRA CLOSURE
- GROUND WATER CONTOUR (11/19/90)

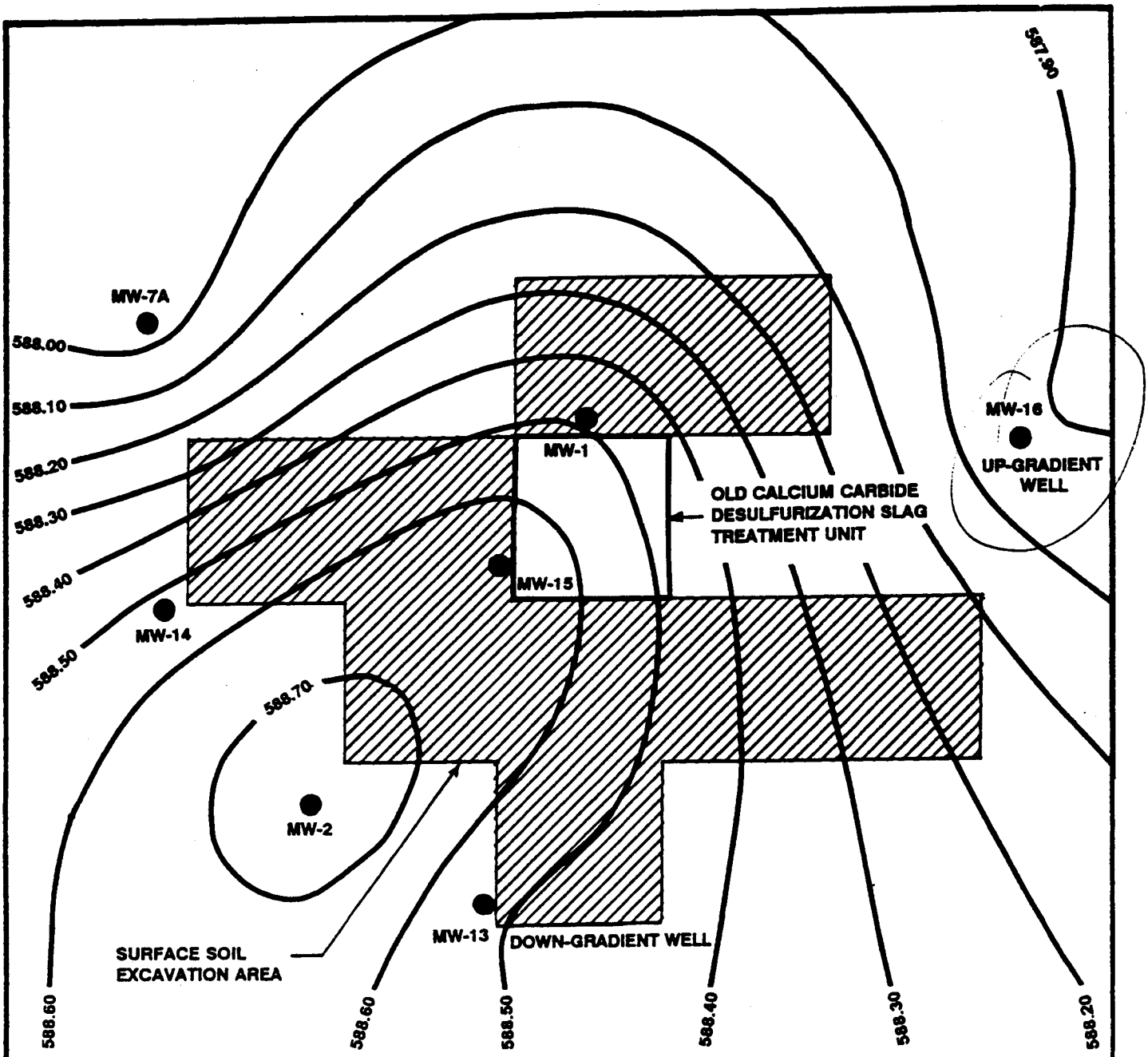
NORTH

APPROXIMATE SCALE: 1" = 20'

RMT INC.

Dwn. by:	CMS
Date:	10/91
Proj.#	1125.23

001329



GMC-CFD-SNI OLD CALCIUM CARBIDE DESULFURIZATION SLAG TREATMENT UNIT GROUND WATER MONITORING WELL LOCATIONS AND GROUND WATER CONTOUR MAP

LEGEND

- MONITORING WELLS FOR RCRA CLOSURE
- GROUND WATER CONTOUR (11/19/90)

NORTH

APPROXIMATE SCALE: 1" = 20'

RMT INC.

Dwn. by:	CMS
Date:	10/91
Proj. #	1125.23

001330

APPENDIX G

STATISTICAL ANALYSIS OF GROUND WATER MONITORING DATA

TEST OF PROPORTIONS FOR ARSENIC DATA AT OLD
CALCIUM CARBIDE DESULFERIZATION SLAG TREATMENT AREA

TABLE CURRENT AS OF
10/25/91
02:41 PM EST

UPGRADIENT WELLS		BACKGROUND WELLS		ALL WELLS	
MW-2		n=	8	n=	28
20-Nov-90	0.013	P=	0.875	P=	0.571
18-Dec-90 <	0.010	n(p)=	7	n(p)=	16
29-Jan-91 <	0.010	n(1-P)=	1	n(1-P)=	12
14-Feb-91 <	0.010				
MW-15					
20-Nov-90 <	0.010	X=	1	, where X is number of detections in background samples	
18-Dec-90 <	0.010	n=	8	, where n is total number of background samples analyzed	
29-Jan-91 <	0.010	Pu=	0.125	, where Pu is proportion of detects in background samples	
14-Feb-91 <	0.010	Y=	15	, where Y is number of detections in compliance samples	
DOWN GRADIENT WELLS		m=	20	, where m is total number of compliance samples analyzed	
MW-16		Pd=	0.750	, where Pd is proportion of detects in compliance samples	
20-Nov-90	0.049	SD=	0.207	, where SD is standard error of diff. in proportions, calc. is	
18-Dec-90	0.041			SD = SQRT([(x+y) / (n+m)] [1 - (x+y) / (n+m)] [1 /n + 1/m])	
29-Jan-91	0.043	Z=	-3.019	, where Z is the test statistic calculated by this formula,	
14-Feb-91	0.038			Z = (Pu - Pd)/SD	
MW-7A					
20-Nov-90	0.011				
18-Dec-90 <	0.010				
29-Jan-91 <	0.010				
14-Feb-91 <	0.010				
MW-1					
20-Nov-90	0.017				
18-Dec-90	0.012				
29-Jan-91	0.010				
14-Feb-91 <	0.010				
MW-13					
20-Nov-90	0.015				
18-Dec-90	0.010				
29-Jan-91	0.011				
14-Feb-91 <	0.010				
MW-14					
20-Nov-90	0.011				
18-Dec-90	0.011				
29-Jan-91	0.017				
14-Feb-91	0.010				

THE ABSOLUTE VALUE OF Z (3.019) IS GREATER THAN THE 97.5th PERCENTILE OF THE STANDARD NORMAL DISTRIBUTION (1.96), THUS THERE IS

EVIDENCE OF STATISTICALLY SIGNIFICANT IMPACT TO THE GROUND WATER FOR THIS DATA THE ASSUMPTIONS CONCERNING THE PROPORTIONS OF DETECTED VALUES IS INVALID, THIS INDICATES THAT THERE IS A HIGHER THAN ACCEPTABLE LIKELYHOOD OF A TYPE II ERROR (FAILURE TO DETECT IMPACTS), HOWEVER SINCE STATISTICALLY SIGNIFICANT IMPACTS ARE INDICATED TO BE PRESENT THIS IS PROBABLY NOT A CONCERN AT THIS SITE.

TEST OF PROPORTIONS FOR PHENOLS DATA AT OLD
CALCIUM CARBIDE DESULFERIZATION SLAG TREATMENT AREA

DATE	PHENOLS
UPGRADIENT WELLS	
MW-2	
20-Nov-90	0.330
18-Dec-90	< 0.010
29-Jan-91	< 0.010
14-Feb-91	< 0.010
MW-15	
20-Nov-90	< 0.010
18-Dec-90	< 0.010
29-Jan-91	< 0.010
14-Feb-91	< 0.010
DOWN GRADIENT WELLS	
MW-16	
20-Nov-90	< 0.010
18-Dec-90	< 0.010
29-Jan-91	< 0.010
14-Feb-91	< 0.010
MW-7A	
20-Nov-90	< 0.010
18-Dec-90	< 0.010
29-Jan-91	< 0.010
14-Feb-91	< 0.010
MW-1	
20-Nov-90	0.310
18-Dec-90	0.240
29-Jan-91	< 0.010
14-Feb-91	< 0.010
MW-13	
20-Nov-90	< 0.010
18-Dec-90	< 0.010
29-Jan-91	< 0.010
14-Feb-91	< 0.010
MW-14	
20-Nov-90	< 0.010
18-Dec-90	< 0.010
29-Jan-91	< 0.010
14-Feb-91	< 0.010

BACKGROUND WELLS		ALL WELLS	
n=	8	n=	28
P=	0.875	P=	0.107
n(P)=	7	n(p)=	3
n(1-P)=	1	n(1-P)=	25

X=	1	, where X is number of detections in background samples
n=	8	, where n is total number of background samples analyze
Pu=	0.125	, where Pu is proportion of detects in background sampl
Y=	2	, where Y is number of detections in compliance samples
m=	20	, where m is total number of compliance samples analyze
Pd=	0.100	, where Pd is proportion of detects in compliance sampl
SD=	0.129	, where SD is standard error of diff. in proportions, c
		SD = SQRT([(x+y) / (n+m)] [1 - (x+y) / (n+m)] [1 /n +
Z=	0.193	, where Z is the test statistic calculated by this form
		Z = (Pu - Pd)/SD

THE ABSOLUTE VALUE OF Z (.193) IS LESS THAN THE 97.5th PERCENTILE

OF THE STANDARD NORMAL DISTRIBUTION (1.96), THUS THERE IS NO EVIDENCE OF STATISTICALLY SIGNIFICANT IMPACTS TO THE GROUND WATER HOWEVER, THE n(P) AND n(1-P) TESTS INDICATE THAT THE DATA ARE NOT APPROPRIATELY DISTRIBUTED AND THAT CONSEQUENTLY THE TEST MAY FAIL TO INDICATE CONTAMINATION WHEN IT IS PRESENT