IN-SITU HYDRAULIC CONDUCTIVITY TESTING
and
GROUND WATER SAMPLING
PROTOCOLS

CLIFF'S-DOW DISPOSAL AREA
Marquette, Michigan

Period of Activity
July 24 - 26, 1985

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Introduction

The following presents the methods and procedures to be employed in completing the in-situ hydraulic conductivity (K) tests on recently installed ground water monitor wells at the Cliffs-Dow Disposal Area. The purpose of the tests is to obtain estimates of aquifer permeability which in turn will be used to estimate ground water flow velocity.

A Quality Control/Quality Assurance (QA/QC) program for the K-tests has also been formulated and is presented herein. This document serves to append the previously submitted Quality Assurance Project Plan and Site Safety Plan to provide task specific descriptions and protocols.

Testing Methods and Procedures

Potential Hydraulic Difference Creation:

To complete an in-situ hydraulic conductivity (K) test, a potential hydraulic difference must be created between the well being monitored and the surrounding aquifer. At the Cliffs-Dow site, this will be accomplished by rapidly inserting a solid piece of one-inch (1") diameter PVC into the water column in the well, thereby displacing the water column upward in the well and creating a potential for flow from the well to the surrounding aquifer. The rate of decline of the water level in the well will be monitored as it again comes into equilibrium with the aquifer.

Subsequent to the well water level approaching the pre-induced hydraulic head static level, the displacing rod will be removed. This will result in a water level in the well that is lower than the surrounding aquifer and therefore will create a potential for flow from the aquifer into the well. This recovery will also be monitored until the static level is approached.

Groundwater Level Monitoring Equipment and Time Sequence:

Groundwater levels during the tests will be monitored using an Enviro-Labs Data Logging System which employs a conventional analog signal generating pressure transducer that directly measures feet of hydraulic head to the one-hundredth (0.01) of a foot.
During the tests, groundwater level (hydraulic head) data will be collected for both the head decline and recovery periods according to the following time schedule:

<table>
<thead>
<tr>
<th>Time After Potential Difference Induced</th>
<th>Time Between Water Level Readings</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 1 minutes</td>
<td>2 secs</td>
</tr>
<tr>
<td>1 - 3 minutes</td>
<td>5 secs</td>
</tr>
<tr>
<td>3 - 5 minutes</td>
<td>15 secs</td>
</tr>
<tr>
<td>5 -10 minutes</td>
<td>30 secs</td>
</tr>
<tr>
<td>10 -30 minutes</td>
<td>60 secs</td>
</tr>
</tbody>
</table>

Note: It is anticipated that the well's water level will be near the pre-test measured static level after thirty (30) minutes.

Step by Step Testing Procedure:

1. Install pressure transducer and couple to data logging unit, noting depth installed.
2. Measure and record static groundwater level in well to be tested.
3. Insert displacing rod.
4. Monitor water level declines to static level.
5. Remove displacing rod.
6. Monitor water level recovery.

Equipment Decontamination

Following each respective test, equipment coming in contact with groundwater will be decontaminated. This will be accomplished using a control source water rinse, followed by an isopropanol rinse, followed by a distilled water rinse.

Quality Assurance/Quality Control Program

The objective of the Quality Assurance/Quality Control program is to ensure that the in-situ hydraulic conductivity (K) test data is of known and acceptable quality. This will be accomplished by completing the following:

1. daily manufacturer-specified pressure transducer and data logging instrument calibration,
2. replicate data gathering; two tests will be performed on each well, and
3. periodic physical ground water level measurements collected at five (5) minute intervals during the test to cross check pressure transducer readings.

Task Specific Safety Plan
All wells to be tested exist outside the site boundaries. Exposure to airborne compounds is therefore not anticipated. Direct contact of ground water during the test completion will be avoided by wearing disposable chemical resistant coveralls and rubber gloves.

Data Analysis
Values of hydraulic conductivity will be calculated from the change in head versus change in time data using Hvorselv's formulae.
CLIFFS-DOW DISPOSAL AREA

Ground Water Sampling Procedure

General

Ground water quality samples will be collected from the six (6) newly installed monitor wells and existing monitor wells numbers 3, 3A and 3B. These nine (9) wells represent all the ground water monitor wells at the site that are constructed of stainless steel materials.

Sampling Procedure

All ground water samples will be collected prior to performance of the K-testing using a stainless steel bailer attached to polypropylene line. To ensure a representative portion of ground water is contained in the well, between three and five times the volume initially contained in the well will be purged prior to sample collection. Purging will be accomplished by bailing the wells by use of the stainless steel bailer. All well purge (evacuation) discharge will be contained at the well location and disposed within the site boundaries.

Equipment Decontamination

Subsequent to each respective well sampling, the bailer and polypropylene line will be decontaminated using a control source water rinse, followed by an isopropanol rinse, followed by distilled water rinse. A new length of polypropylene line will be used for each well. All decontamination fluids and used lengths of polypropylene line will be disposed of inside the site boundaries.

Sample Analysis

All collected ground water samples will be analyzed for the following parameters:

Field Measurements

pH
Conductivity
Temperature
### Purgeable Priority Pollutants

<table>
<thead>
<tr>
<th>Metals</th>
<th>Purgeable Priority Pollutants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>Lead</td>
</tr>
<tr>
<td>Chromium</td>
<td>Mercury</td>
</tr>
<tr>
<td>Copper</td>
<td>Nickel</td>
</tr>
<tr>
<td>Zinc</td>
<td></td>
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<td></td>
<td></td>
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</tbody>
</table>

### Base Neutral Compounds

<table>
<thead>
<tr>
<th>Phenols</th>
<th>Base Neutral Compounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenol</td>
<td>Naphthalene</td>
</tr>
<tr>
<td>2-Methylphenol</td>
<td>2-Methylnaphthalene</td>
</tr>
<tr>
<td>4-Methylphenol</td>
<td>Dibenzofuran</td>
</tr>
<tr>
<td>2,4-Dimethylphenol</td>
<td>Phenanthrene</td>
</tr>
<tr>
<td></td>
<td>Pyrene</td>
</tr>
<tr>
<td></td>
<td>Fluorene</td>
</tr>
</tbody>
</table>

The analyses are to be performed using the following USEPA-approved methods:

- **Method 206.3** Total Arsenic
- **Method 218.1** Total Chromium
- **Method 220.1** Total Copper
- **Method 239.1** Total Lead
- **Method 245.1** Total Mercury
- **Method 249.1** Total Nickel
- **Method 289.1** Total Zinc
- **Method 601** Purge and trap gas chromatographic technique for purgeable priority pollutants
- **Method 604** Capillary gas chromatographic flame ionization detection technique for phenols
- **Method 610** Capillary gas chromatographic flame ionization technique for polynuclear aromatic hydrocarbons.

In addition to the nine (9) ground water samples, five samples will be collected as part of the Quality Assurance/Qaulity Control program. The quality control samples will consist of one duplicate well water sample collected from a select monitor well; two water samples collected in duplicate from a select monitor well for matrix spiking; one sample of the control water used for decontamination; and one field blank prepared by pouring distilled water into the decontaminated bailer. The samples will be collected in the following order: 85-1, 85-3, 85-2, and existing Well Nest 3.