

**SOURCE WATER PROGRAM**

**SITE ASSESSMENT RESULTS ADDENDUM No. 02  
(MARSH SAMPLING)**

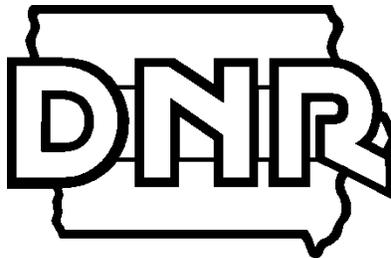
For

**CITY OF ELLIOTT MUNICIPAL WATER SUPPLY  
MUNICIPAL WELL #1 (DNR Well ID # 1419)**

**ELLIOTT, MONTGOMERY COUNTY, IOWA**

**February 4, 2011**

**IOWA DEPARTMENT OF NATURAL RESOURCES**



Prepared by

**Daniel Cook  
Environmental Specialist Senior  
IDNR Project Manager  
Contaminated Sites Section**

Iowa Department of Natural Resources Contaminated Sites Section staff collected three additional groundwater samples for the City of Elliott Source Water Protection Site Assessment to determine if the existing marsh area northeast of the City of Elliot was causing denitrification of the groundwater as the groundwater passed underneath. As noted in the December 22, 2008 Site Assessment Results and Addendum 01 the level of nitrate in the groundwater samples were found in the 7 to 8 mg/L range north of the marsh and less than 1 mg/L south of the marsh. The results of this sampling event were used to determine if the marsh was removing nitrate from the groundwater as the nitrate impacted groundwater migrated under the marsh. IDNR staff members traveled to the site on January 20, 2011 to install the wells and then collect samples on January 21<sup>st</sup>. Samples remained in IDNR custody until either submitted to SHL for analysis or analyzed with IDNR equipment.

Three temporary monitoring wells were placed in and just south of the marsh to a depth of 24 feet and were be screened from 19 to 24 feet deep (Figure 1). The wells were purged of 5 gallons of groundwater to remove as much fine silt and sand as possible. The wells were also surveyed in with the measurements used to determine the groundwater flow direction.

The following morning the groundwater heads were be measured in each well and samples were collected for nitrates, dissolved oxygen (DO), dissolved organic carbon (DOC), and total organic carbon (TOC). The wells were then properly plugged according to IAC-567-39, *Requirements for Properly Plugging Abandoned Wells*. DO samples will confirm the existence of hydric soils (oxygen depleted soils) and the DOC and TOC samples will confirm the existence of a carbon source that is required for the denitrification process to take place. TOC is a measurement of dissolved and suspended carbon in the groundwater whereas the DOC sample is filtered therefore measuring only the dissolved carbon.

Nitrate and DO testing was completed on site with IDNR's HACH DR 2800 Spectrophotometer using HACH Method 10206 for the nitrates and HACH Method 8166 for the DO DOC and TOC samples were sent the State Hygienic Laboratory (SHL) for analysis using Method SM-5310B.

Sample analysis indicate the denitrification process is taking place, earlier testing showed the groundwater migrating towards the marsh was impacted with nitrates and leaving the marsh area at very low levels, sample results from this addendum help to explain why. Table 1 shows low levels of DO and DOC in MW-02 and MW-03 which were collected directly under the marsh (where denitrification should be taking place). Low levels of DOC but higher levels of TOC indicate that as the carbon dissolves it is being used up by the biological denitrification process in anaerobic conditions (low DO).

Higher levels of DO and DOC were recorded at MW-01 which was located 400 feet to the southwest of the marsh where the demand for oxygen isn't as strong

because the nitrate level is very low and aerobic conditions exist. Normal groundwater contains DO at 5.4 to 14.8 mg/L depending on the temperature; groundwater is normally around 55° F at which pure water is saturated with oxygen at 10.6mg/L. Fish can survive in water with DO levels greater then 2mg/L.

Elliott SWP Site Assessment Addendum No. 02  
Marsh Sampling Results  
Table 1

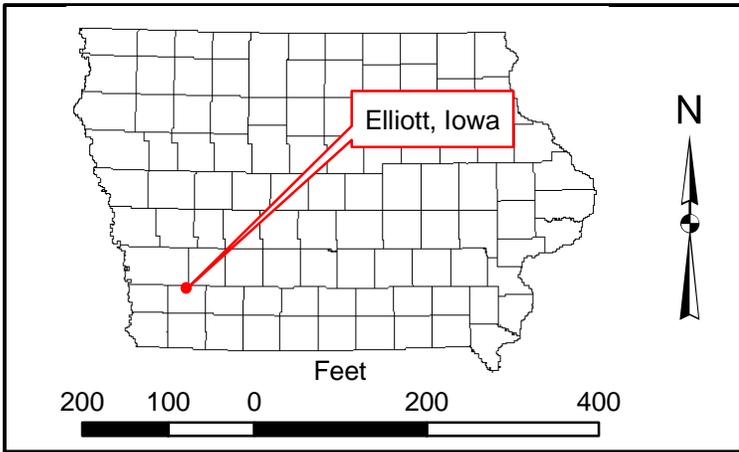
	Nitrate (mg/L)	Oxygen (mg/L)	Carbon (Total) (mg/L)	Carbon (Dissolved) (mg/L)
MW-01	0.47	4.9	5.9	0.7
MW-02	0.42	0.36	3.1	< 0.5
MW-03	< 0.32	0.28	3.3	< 0.5

Samples collected January 21, 2011

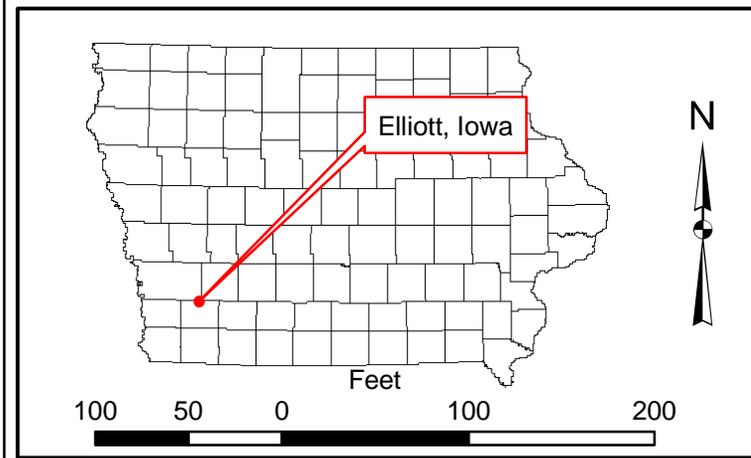
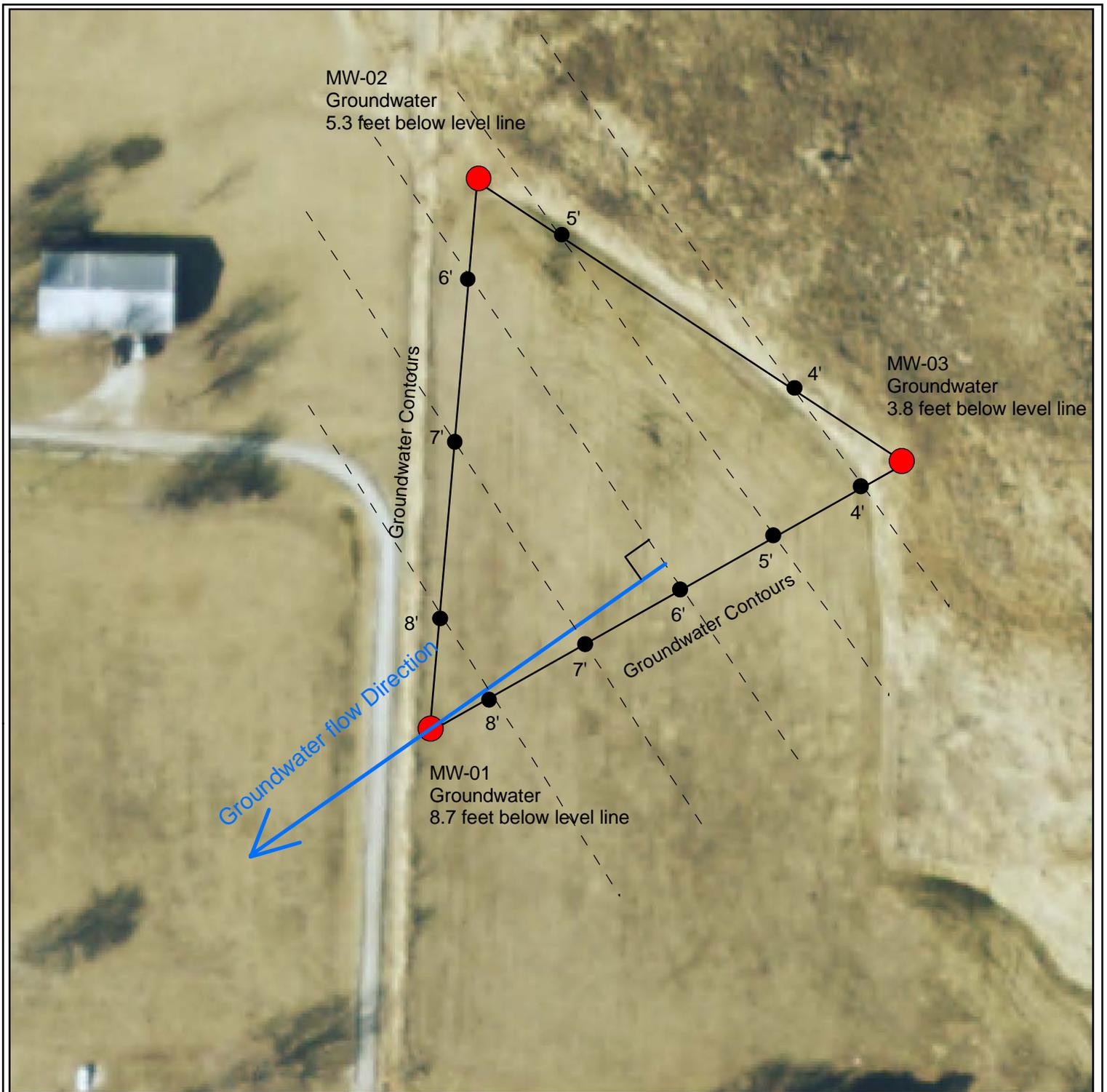
The conversion of ammonium to nitrate is performed primarily by soil-living bacteria and other nitrifying bacteria. The primary stage of nitrification, the oxidation of ammonium (NH<sub>4</sub><sup>+</sup>) is performed by bacteria such as the Nitrosomonas species, which converts ammonia to nitrites (NO<sub>2</sub><sup>-</sup>). Other bacterial species, such as the Nitrobacter, are responsible for the oxidation of the nitrites into nitrates (NO<sub>3</sub><sup>-</sup>). It is important for the nitrites to be converted to nitrates because accumulated nitrites are toxic to plant life.

Denitrification is a microbial facilitated process of nitrate reduction that may ultimately produce molecular nitrogen (N<sub>2</sub>) through a series of intermediate gaseous nitrogen oxide products. This respiratory process reduces oxidized forms of nitrogen in response to the oxidation of an electron donor such as organic matter (carbon). The preferred nitrogen electron acceptors in order of most to least thermodynamically favorable include nitrate (NO<sub>3</sub><sup>-</sup>), nitrite (NO<sub>2</sub><sup>-</sup>), nitric oxide (NO), and nitrous oxide (N<sub>2</sub>O). In terms of the general nitrogen cycle, denitrification completes the cycle by returning N<sub>2</sub> to the atmosphere.

Overall, sample results indicate denitrification is taking place in the groundwater under the marsh due to anaerobic conditions and high levels of dissolved carbon caused by the natural decay process of plant matter in the surface waters of the marsh. As the oxygen depleted zone, along with the carbon, migrates down through the water column the microbes switch from oxygen to nitrate as the primary electron acceptor rapidly denitrifying the groundwater.



Iowa Department of Natural Resources	
City of Elliott SWP Site Assessment Elliott, Montgomery County, Iowa	
	Sampling Locations Figure 1



<p>Iowa Department of Natural Resources</p>
<p>City of Elliott SWP Site Assessment Elliott, Montgomery County, Iowa</p>
<p>Groundwater Flow Direction Figure 2</p>

Sample Collection Field Sheet  
Iowa Department of Natural Resources  
Des Moines, Iowa

Project Name: Elliott SWP	Project Manager: Dan Cook
Address: (Marsh Area)	Program: SWP
City, State: Elliott, Iowa 51532	

Sample Number: <u>MW-01</u>	Sample Matrix: <u>Groundwater</u>
Latitude: <u>41° 09' 01.41" N</u>	Collection Date: <u>January 21, 2011</u>
Longitude: <u>95° 09' 34.26" W</u>	Collection Time: <u>8:40am</u>

Container: <u>1 - #74 250ml Plastic Bottle (w/HCl)</u>	Analysis: <u>Total Organic Carbon (SM-5310B)</u>
<u>1 - #74 250ml Plastic Bottle (w/HCl)</u>	<u>Dissolved Organic Carbon (SM-5310B)</u>

Collection Notes: January 20, 2011  
 Arrived on site at 11:35 AM, the weather was clear calm and 63°F (10°F). Checked utility locates and all 3 proposed boring locations were clear of any underground utilities. Set up Casprobe to place MW-01. Pushed the 2 1/4" rods down to 24 feet deep and inserted 5 feet of screen and 20 feet of riser. Pulled the Casprobe rods and sealed the new well with bentonite. Purged 5 gallons of groundwater. Measured groundwater head and found it 7.06 feet below top of casing. Sampled well for nitrates and found level at 0.45 mg/L (HACH Method 10206 - TNT plus 835)  
 Left the monitoring well in place and moved to MW-02

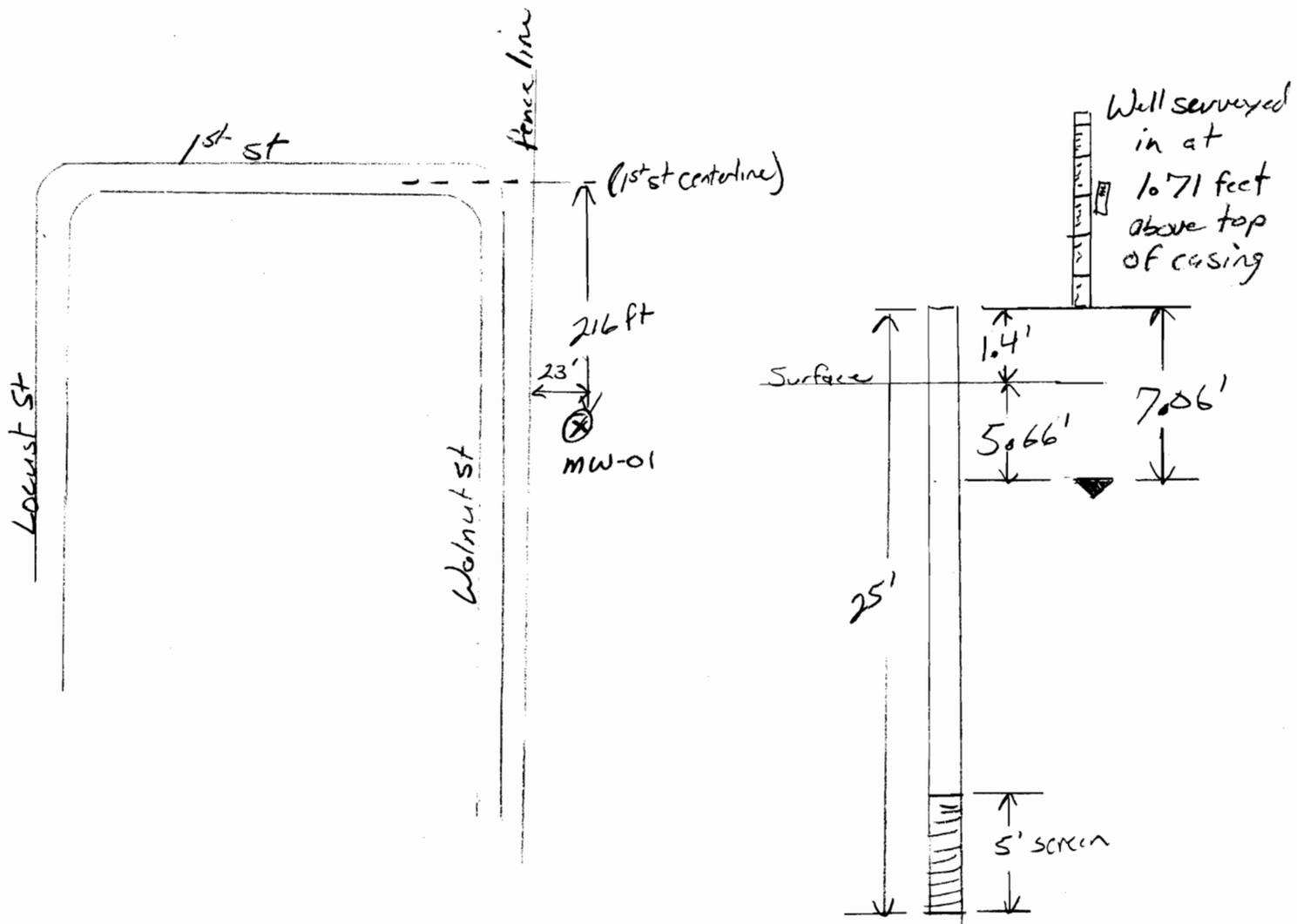
January 21, 2011 8:00am - 0°F with snow showers  
 Returned to MW-01 after leaving it set overnight and measured the head and found no change from previous day (7.06 feet below top of casing). Purged an additional 5 gallons of ground water and collected samples for dissolved organic carbon and total organic carbon. DOC was field filtered with a



MW-01 continued.

0.45 um filter before placing in sample bottle. Nitrate was sampled again and found at 0.47 mg/L. Dissolved oxygen was sampled for using HACH method 8166 AccuVac Ampuls HR and found at 4.9 mg/L.

Head was measured one more time and found at 7.06 feet above the top of casing again indicating a very fast recovering well. The monitoring well was then pulled and plugged with bentonite. all equipment was loaded and moved to MW-02.



Sample Collection Field Sheet  
Iowa Department of Natural Resources  
Des Moines, Iowa

Project Name: Elliott SWP	Project Manager: Dan Cook
Address: (Marsh Area)	Program: SWP
City, State: Elliott, Iowa 51532	

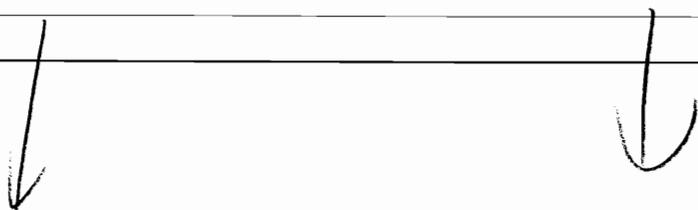
Sample Number: MW-02	Sample Matrix: Groundwater
Latitude: 41° 09' 05.62" N	Collection Date: January 21, 2011
Longitude: 95° 09' 33.98" W	Collection Time: 9:20 AM

Container: 1 - #74 250ml Plastic Bottle (w/HCl)	Analysis: Total Organic Carbon (SM-5310B)
1 - #74 250ml Plastic Bottle (w/HCl)	Dissolved Organic Carbon (SM-5310B)

Collection Notes:

January 20, 2011 Set up Geoprobe to bore MW-02 and pushed the 2 1/4" rod down to 24 ft deep. Placed 5 feet of screen and 20 feet of riser (All 1" OD PVC) and removed Geoprobe rods. Placed a bentonite plug in annular space. Measured head at 2.06 feet below top of casing. Purged 5 gallons of groundwater then collected sample to measure nitrates. Using HACH method 10206 the nitrate level was found at 0.36 mg/L. The well was then surveyed in then we moved to the next monitoring well location.

January 21, 2011 9:10 am  
Returned to MW-02 and measured head at 2.05 feet below the top of casing. Then we purged 5 gallons of groundwater and collected samples for total organic carbon and dissolved organic carbon. The DOC was field filtered through a 0.45um filter before placing in sample bottle. MW-02d was collected as a TOC duplicate.

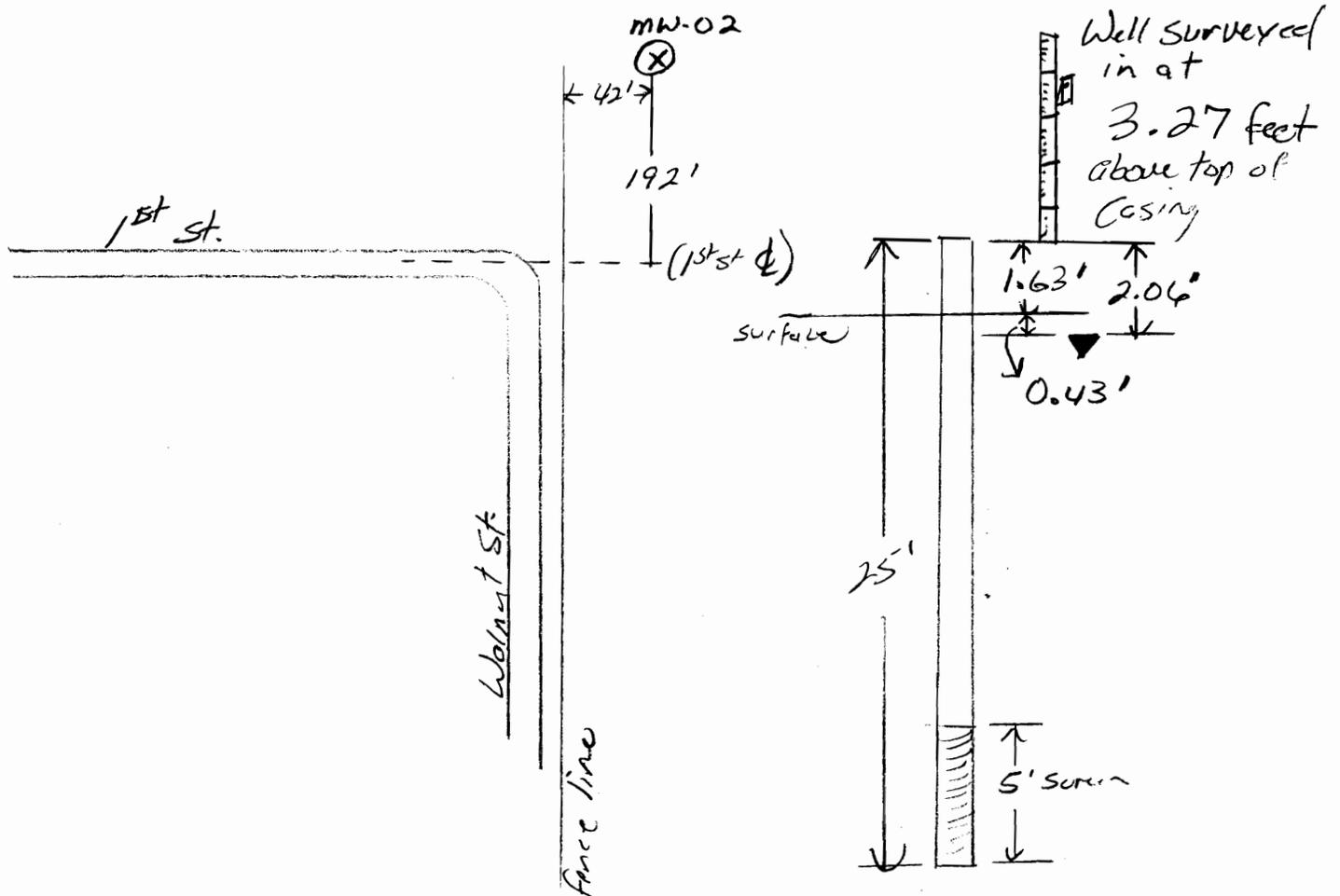


MW-02 continued.

Nitrate levels were checked again and found at 0.32 mg/L. Dissolved oxygen was sampled for using HACH Method 8166 High Range AccuVac Ampuls and the level was found at 0.37 mg/L. This level was close to the Lower detection limit of the method so another sample was measured using HACH Method 8316 - Low Range AccuVac Ampuls and the dissolved oxygen level was found at 357 µg/L or 0.357 mg/L.

The head was measured one more time and found at 2.86 feet below top of casing.

The monitoring well was pulled and the hole plugged with bentonite.



Sample Collection Field Sheet  
Iowa Department of Natural Resources  
Des Moines, Iowa

Project Name: Elliott SWP  
Address: (Marsh Area)  
City, State: Elliott, Iowa 51532

Project Manager: Dan Cook  
Program: SWP

Sample Number: MW-03

Sample Matrix: Groundwater

Latitude: 41° 09' 02.98" N

Collection Date: January 21, 2011

Longitude: 95° 09' 30.40" W

Collection Time: 10:10am

Container: 1 - #74 250ml Plastic Bottle (w/HCl)

Analysis: Total Organic Carbon (SM-5310B)

1 - #74 250ml Plastic Bottle (w/HCl)

Dissolved Organic Carbon (SM-5310B)

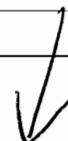
Collection Notes:

January 20, 2011 Set up Geoprobe to bore MW-03, pushed the 2" 1/4" geoprobe rods down to 24 feet deep. Place 5 feet of 1" pvc screen and 20 feet of riser down the geoprobe rods. Removed the Geoprobe rods leaving the pvc well in place, filled the annular space around the pvc with bentonite.

Purged 5 gallons of water from the well then collected sample to test for nitrates using HACH method 20206. Nitrates were measured at less than 0.23 mg/L (below the method detection limit). Measured ground water head in the well and found it at 1.46 feet below the top of the casing. The casing is 1.66 feet above the surface so the head is 0.2 feet above the surface.

January 21, 2011

Purged 5 more gallons of water from the well and collected samples for total organic carbon and dissolved organic carbon. The DOC was field filtered with a 0.45 µm filter. MW-03d is a duplicate for DOC.



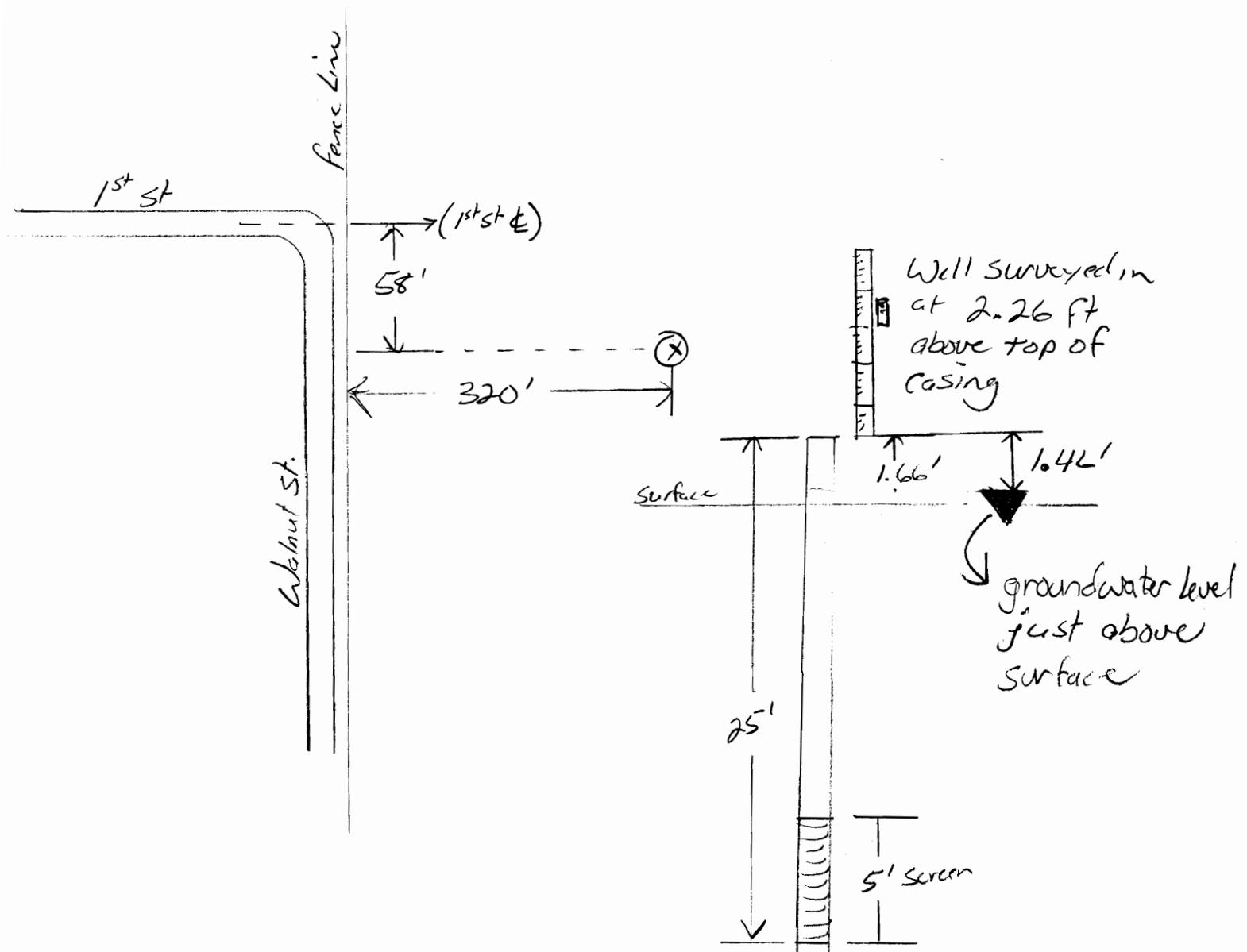
# MW-03 Continued

The nitrate level was checked again and was still below the method detection limit of 0.23 mg/L. Dissolved oxygen was test for using HACH Method 8316 for Low Range and the level was at 276 mg/L or 0.276 mg/L.

The head was measured again and it was still at 1.46 feet below the top of the casing or just above the surface elevation.

The monitoring well was pulled and the hole plugged with bentonite.

Stowed all equipment in the truck and finished for the day (12:45pm)









# State Hygienic Laboratory

The University of Iowa

Date of report: 02-07-2011

.....  
DAN COOK  
IDNR CONTAMINATED SITES  
502 EAST NINTH STREET  
  
DES MOINES IA 50319-0034

Sample Number 2011002281  
Date Received 01-21-2011  
Project WMSF  
Date Collected 01-21-2011 09:20  
Collection Site mw-02d  
Collection Town  
Description water  
Reference ELLIOTT MARSH  
Collector COOK DAN  
Phone (515) 281-4171  
Purchase Order WMSF

**Comments**

Upon arrival, sample met container and preservation requirements for the analysis requested. Please review carefully your sample results for additional analyte comments or method exceptions.

**Additional Information**

DNR Project Code (Circle One):

Not provided

## Preliminary Results of Analyses

**Total Organic Carbon**

Analyte	Concentration mg/L	Quantitation Limit mg/L
Total Organic Carbon	3.0	0.5

Date Analyzed: 02-04-2011

Analyzed at: Ankeny

Analyst: LD/AB

Method: SM 5310 B

Verified: BW

**Description of units used within this report**

mg/L - Milligrams per Liter

Quant Limit - Lowest concentration reliably measured

The results of this report relate only to the items analyzed. This report shall not be reproduced except in full without the written approval of the laboratory.

Iowa Environmental Laboratory IDs are: Ankeny #397, Iowa City #027, Lakeside #393.

If you have any questions please call Client Services at 800/421-IOWA (4692) or 319/335-4500. Thank you.



