# WEST JEFFERSON NORTH FACILITY: MONITORING WELL CLUSTER LOCATION PLAN

**A LIMITED FIELD INVESTIGATION TO ADDRESS CURRENT UNCERTAINTIES IN THE FLOW SYSTEM AND WATER QUALITY**

**BATTELLE--INTERNALLY SPONSORED STUDY**

**June 26, 2006**

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## Introduction

**The Battelle Memorial Institute (BMI) West Jefferson Facility is located just south of Interstate 70, 15 miles west of Columbus, Ohio (Figure 1). At the location BMI owns several hundreds of acres of land adjacent to and on the west side of Big Darby Creek. In the past the West Jefferson North Facility (labeled Jefferson North on Figure 1) housed research involving radioactive materials. This focused groundwater study has been designed to determine whether any potential contamination of groundwater caused by the research activities conducted in the North Facility could potentially migrate across the Battelle property boundaries. Additionally, wells will be drilled within the fenced-in area in order further study the water quality and hydrostratigraphy.**

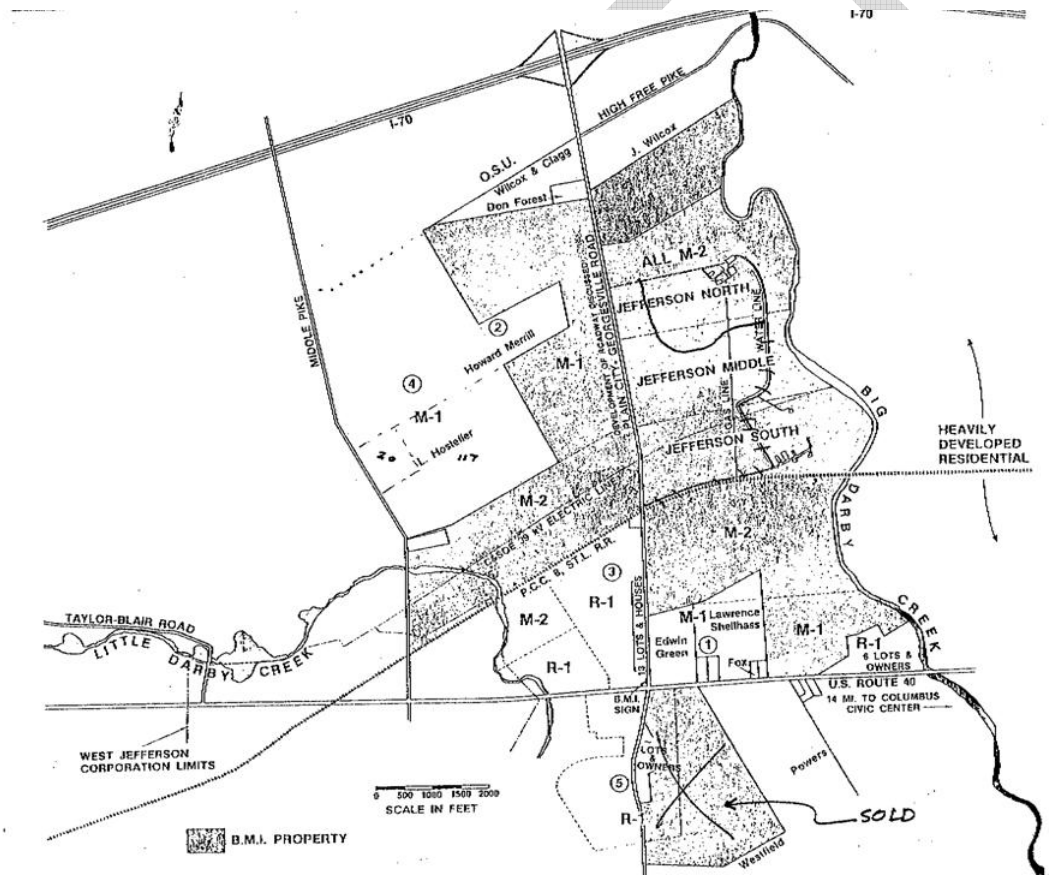


**Figure 1. Property owned by Battelle near West Jefferson is shaded.**

## Hydrogeological Background

**In summary, from land surface downward there are 6 unconsolidated hydrostratigraphic units above the bedrock: 1) the near-surface water table till unit (containing the water table), 2) the 885 sand layer, 3) dense till, 4) the 855 sand layer, 5) dense till, and 6) the basal sand. The basal sand directly overlies the limestone bedrock and is in hydraulic communication with that regional aquifer. Lateral groundwater flow occurs in hydrostratigraphic unit numbers 1, 2, 4, and 6, as well as the regional aquifer. Figure 2 identifies the location of the stratigraphic cross-section presented in Figure 3. The cross-section shows the relationship of the layers at the North Facility.**

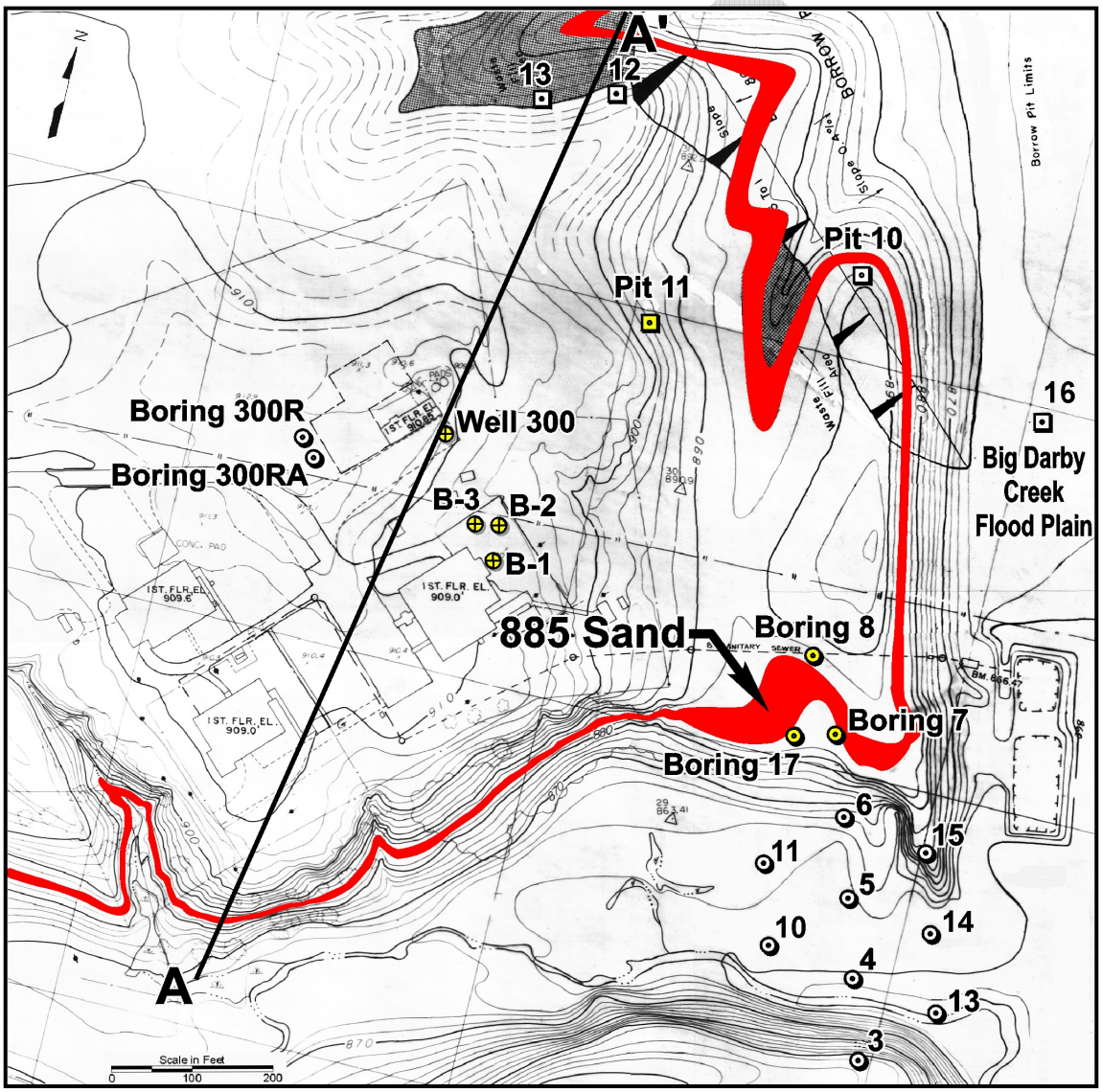


**Figure 2. Detailed topographic map of the North Facility prepared prior to damming Silver Creek and location of cross-section A-A'.**

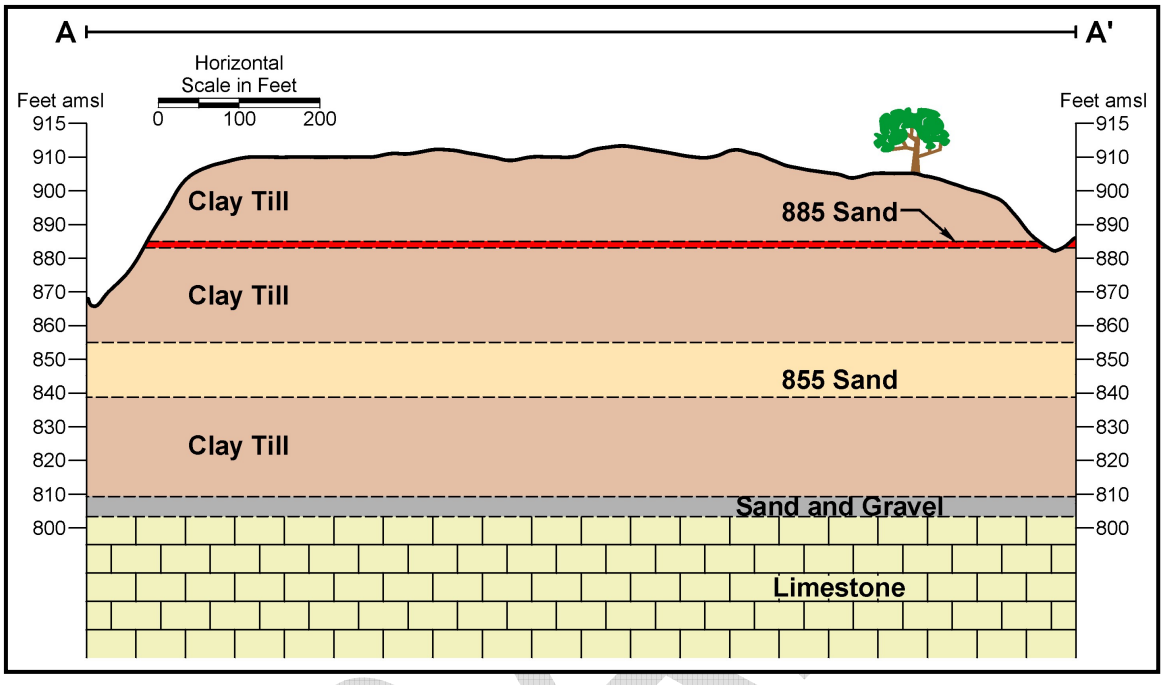


**Figure 3. Stratigraphic cross-section from A to A'.**

**In 2002-2003 three monitoring wells were constructed in each of the three sand layers above the bedrock, the 885 sand, the 855 sand and the basal sand. The purpose was to triangulate the water level measurements in order to determine the direction of lateral groundwater flow in the units. All of the wells in that study were constructed within the fenced in area and well spacing for triangulations was on the order of 400-600 feet (Figure 4). The water level data were collected from all wells over a period of one day during each measurement event. The time interval between measurement events varied from one month to daily over the period, August 2002 to May 2003. Measurements taken over that period indicated that lateral groundwater flow in the 885 sand layer was toward the west-northwest, that flow in the 855 sand layer was toward the northwest, and that flow in the basal sand was toward the northeast. Please note that the wells completed in the 3 layers were not installed in clusters in the previous study in order to maximize the coverage of the stratigraphic data. Determination of the continuity of the layers was a goal of the earlier work.**

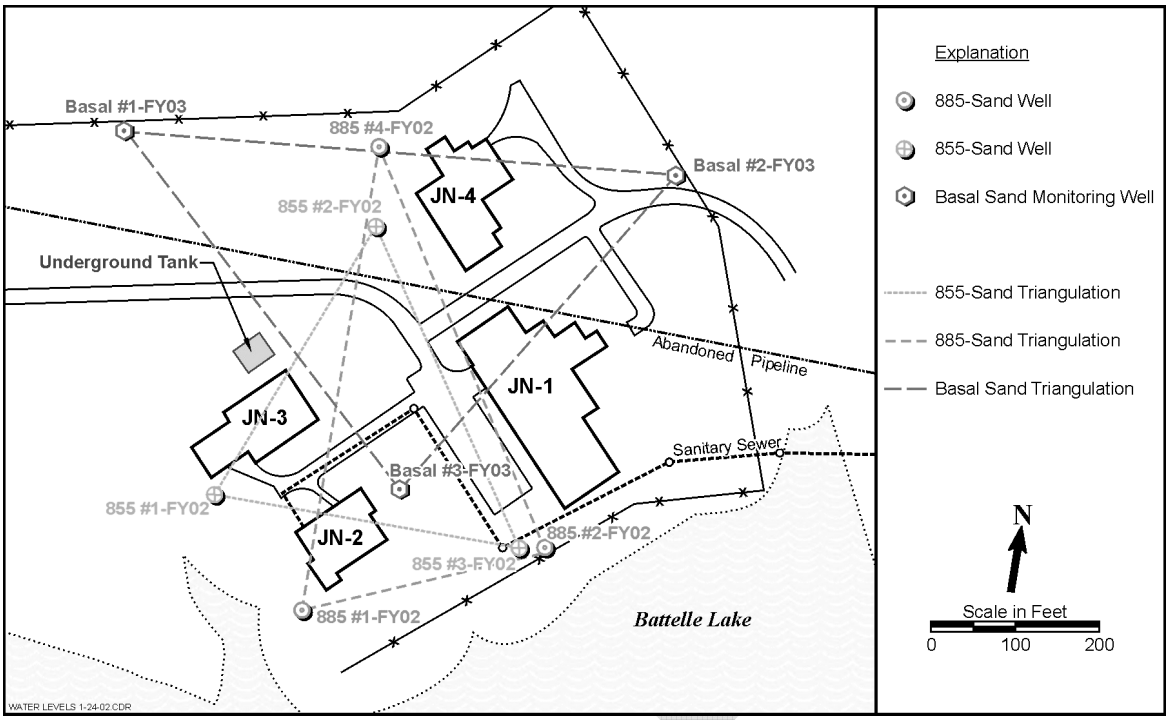


**Figure 4. Locations of previous wells (2002/3) completed in the three transmissive layers.**

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## Groundwater Flow

**The water table under the facility exists at about 5 feet below land surface and groundwater movement through the near-surface, dense till occurs by gravity drainage to the nearby lake to the south and lowlands toward the east. This has been documented for several years through water level measurements taken during surveillance monitoring (Figure 5).**

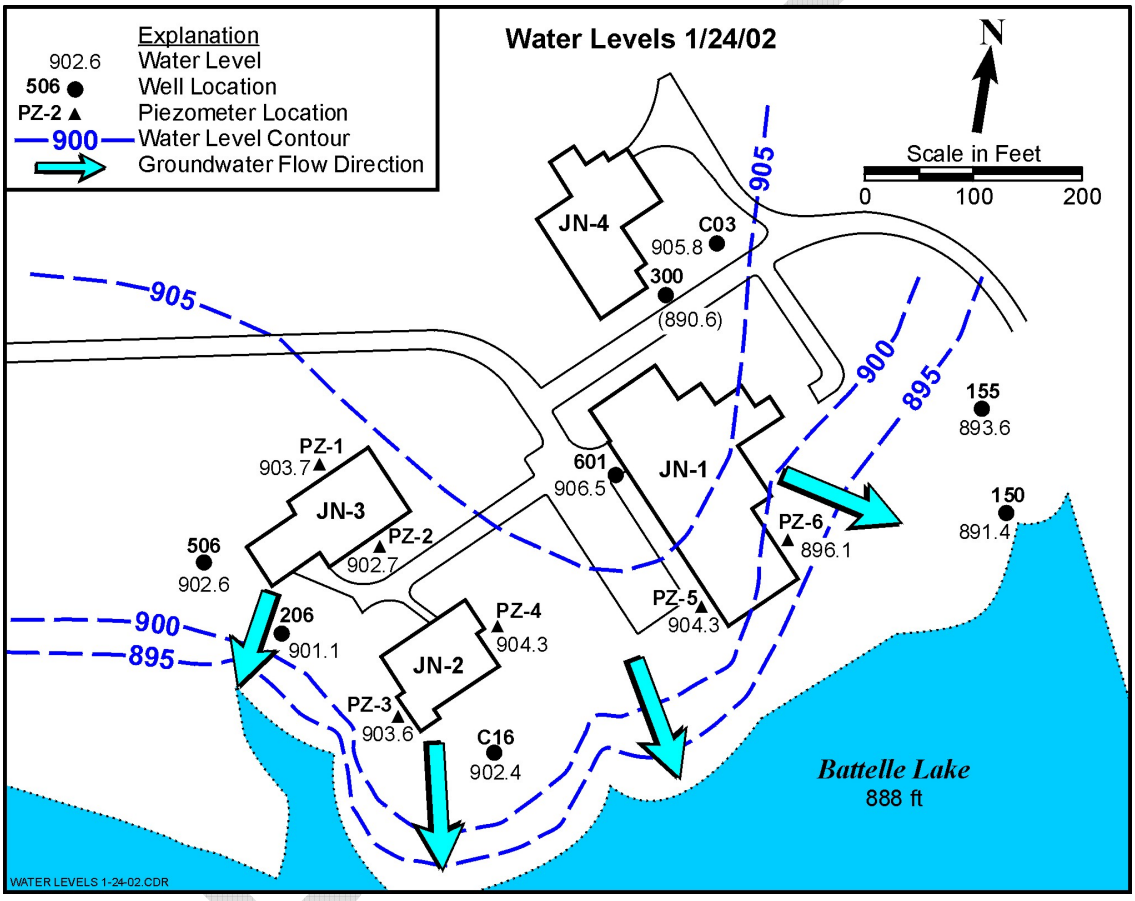


**Figure 5. Groundwater flow directions at the water table.**

**A deeper drilling program was initiated in 2002 that identified three thin sand layers in the 100-180 feet of till under the facility. The flow systems in the three sands below unit #1 behave differently. Groundwater flow directions within the 3 sand/silt layers are shown on Figure 6**

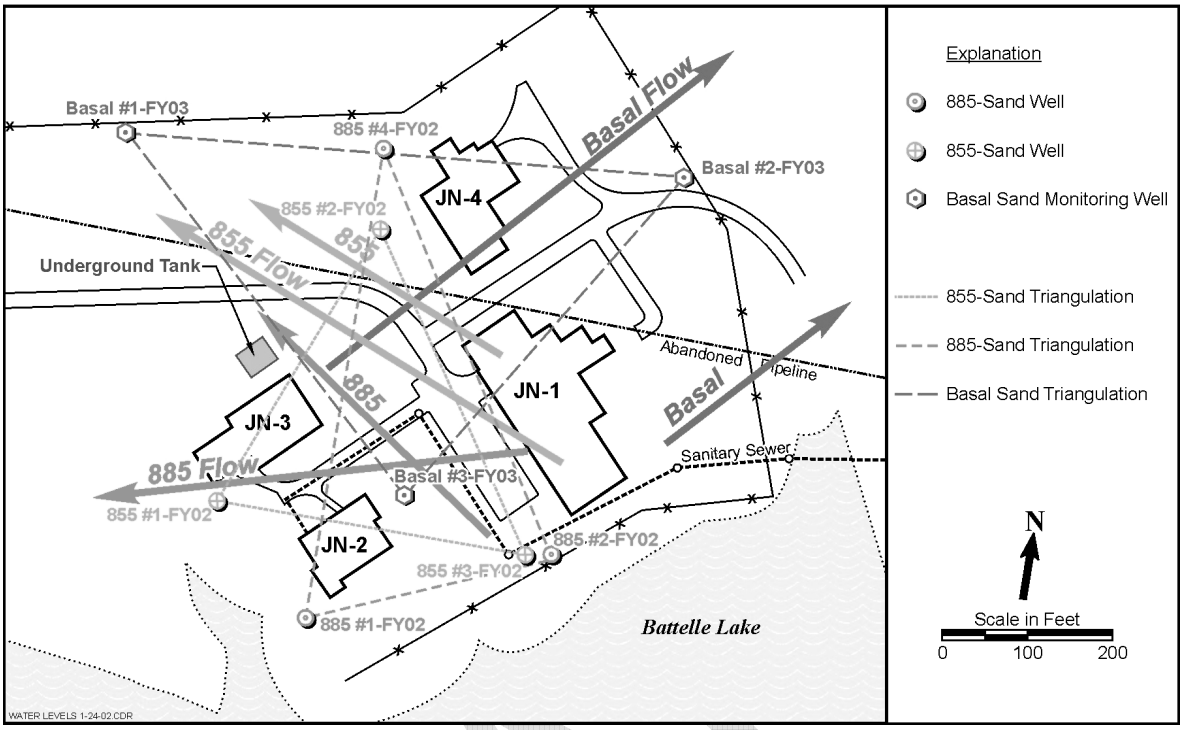


**Figure 6. Groundwater directions in the 885 Sand, 855 Sand and 805 Sand under the North Facility.**

**Based on the elevation of the bottom of Silver Creek Valley and flow directions it is likely that the lake is hydraulically connected to both the 885 and 855 sands. The higher hydraulic head (~889-890 feet in elevation during 2002-2003) in the lake regulates the groundwater flow in the 885 and 855 sand layers away from it, toward the north and northwestern directions. As a result, groundwater flow in these two layers does not appear to be moving toward and discharging in natural discharge locations in the valley. Prior to damming the valley and filling the lake it's likely that both the 885 and 855 sands discharged as seeps along the former northern slope of the valley that now contains the lake. Seeps were identified on topographic maps and through interviews with retired employees in 2002.**

**Nowadays, based on the 2002/3 water level measurements in the 885 sand layer, shallow groundwater appears to be flowing in a west to northwest direction. This unit is complicated by the fact that water level measurements appear to be hybrids with the water levels in the water table unit above. Over the years the shallower wells from the water quality monitoring well network indicate a natural groundwater flow system onsite, since they monitor groundwater at the water table (approximately 5 feet below land surface). That is, groundwater levels are highest near the center of the facility where the ground surface elevation is the highest and**

**the water table becomes lower southward toward the lake and eastward toward Big Darby Creek. As a result, the 885 sand layer and shallow (water table) groundwater flow system is complicated by the presence of the lake, but the flow system is very local. Groundwater from the shallow groundwater flow system likely discharges on Battelle property. It would discharge into the lake toward the south and as seeps toward the east.**

**Based on the flow direction estimated from water levels measurements made in onsite wells the groundwater discharge location for the 855 sand layer appears to be northward of the facility, however, that area encompasses flat till plain. A potential discharge location in the area would be the Big Darby Creek Valley toward the northeast where the till plain has been dissected.**

**Groundwater in the basal sand flows toward the Big Darby Creek Valley. The valley is a regional discharge area for groundwater flow. However, the depth of the basal sand logged in the 3 onsite wells was highly variable. The depth of the basal sand under the valley floor is likely variable, as well.**

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## Locations of "Discharge Area" Monitoring Well Clusters

**The purpose of installing additional monitoring wells at this time is to determine whether contaminated groundwater is present near the property boundaries in the 885, 855 and basal sand layers. The area under consideration is between the North Facility and Big Darby Creek.**

**The Big Darby Creek valley is both a regional and local discharge location for groundwater. The area around the North Facility is fairly flat and the Big Darby Creek and its tributaries are by far the dominant topographic features in the area. Even with the local modification of the flow system caused by the Lake the groundwater in the 3 sand layers would ultimately discharge to the Big Darby Creek valley.**

**Well cluster locations were selected using the following criteria.**

**The wells will be located:**

1. **on Battelle property**
2. **close to the Big Darby Creek valley**
3. **where the sand layers are present**
4. **down-gradient of the North Facility**
5. **with reasonable spacing between them given the flow system**
6. **within a reasonable distance toward the northeast in order to allow groundwater flowing locally toward the north [because of the presence of the Lake] to divert eastward toward the Big Darby valley**

**Tentative monitoring well locations are shown in Figure 7.**

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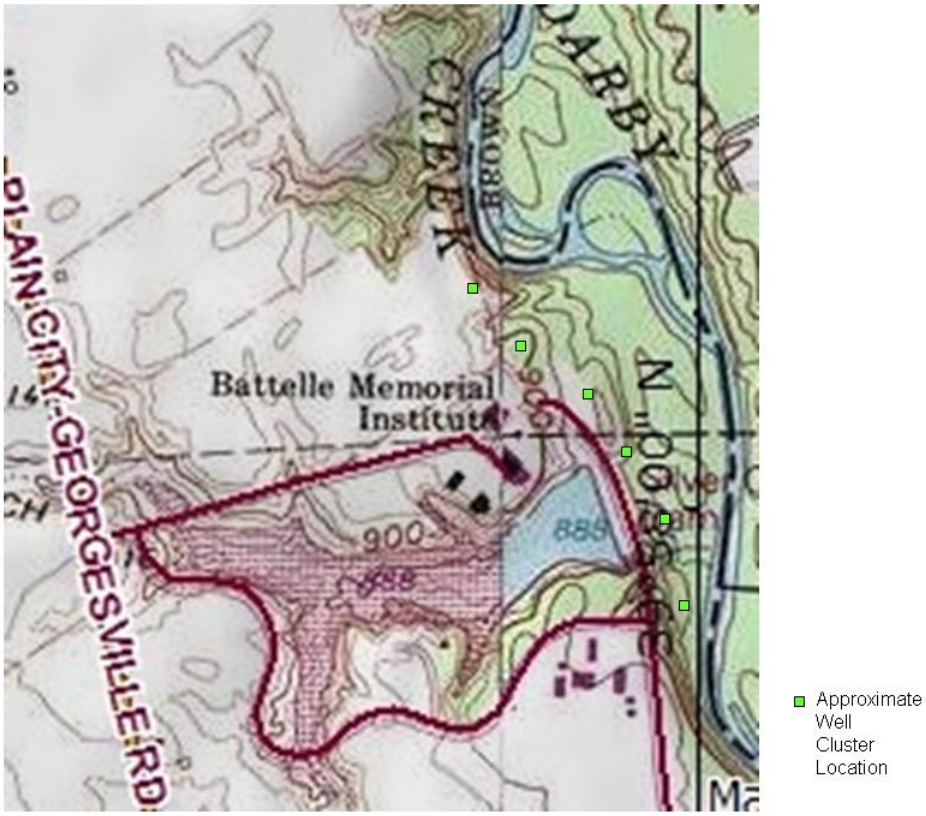


**Figure 7. Tentative locations of "discharge area" monitoring well clusters.**

**At each drilling location the basal sand well will be drilled first so that the 885 and 855 sand depths can be identified during logging. If either or both of the shallower sand are present those wells will be installed nearby the basal sand well without logging or sampling during drilling. Each well will be screened in only one sand layer and when more than one unit is present at a drilling location wells will be completed in clusters of 2 or 3 (if all 3 layers are present).**

## Locations of "Source Area" Monitoring Well Clusters

**In addition to the six clusters planned for the groundwater discharge area toward the east, three clusters are planned within the fenced-in area. These clusters will be positioned near to the North Pumping Well and potential former sources of contamination with highest gross beta readings identified in the 805/855/and 885 layers during the 2002-2003 site groundwater flow studies. The tentative locations are shown of Figure 8.**

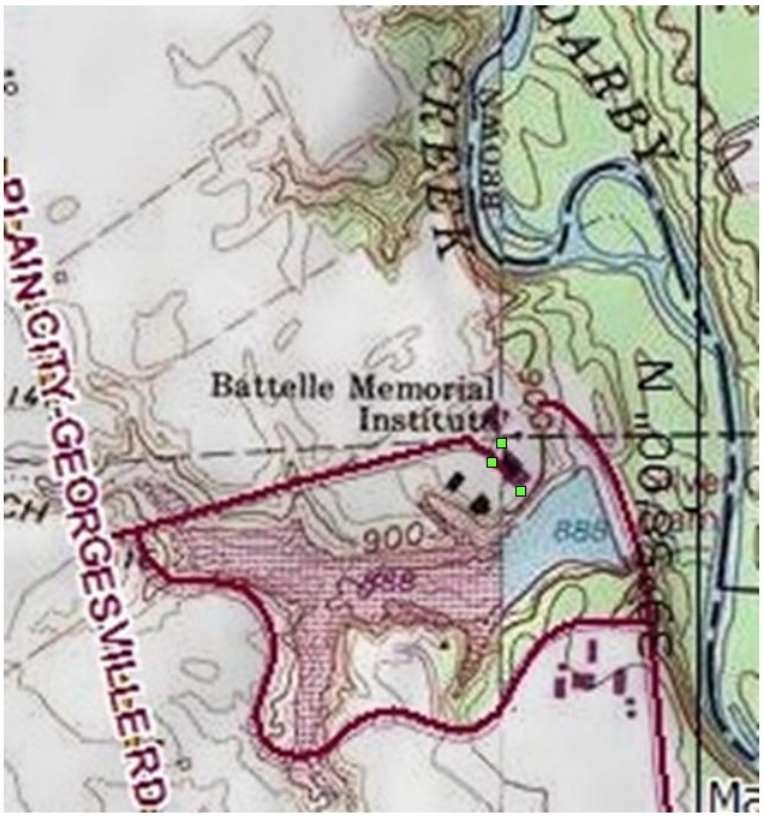


**Figure 8. Tentative locations of "source area" monitoring well clusters.**