INTERIM REPORT FOR THE OLIN BUFFALO AVENUE PLANT RCRA FACILITY INVESTIGATION

VOLUME I

Prepared for:
Olin Chemicals
Lower River Road
Charleston, Tennessee 37310
February 1992

Woodward-Clyde

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February 7, 1992
90C2030-5

Mr. James C. Brown
Olin Chemicals
Lower River Road
Charleston, Tennessee 37310

Re: Interim Report for the Olin Buffalo Avenue Plant
RCRA Facility Investigation (RCRA-89-3013-0208)

Dear Mr. Brown:

Woodward-Clyde Consultants (WCC) is pleased to submit this Interim Report for the RCRA Facility Investigation being conducted at Olin's Buffalo Avenue Plant in Niagara Falls, New York. The Interim Report was prepared in accordance with the Work Plan approved by the U.S. Environmental Protection Agency for the project.

If you have any questions or comments concerning this report, please contact the undersigned. We appreciate the opportunity to work with Olin on this project.

Sincerely,

Kelly R. McIntosh

Kelly R. McIntosh, P.E.
Associate

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cc: S. D'Angelo
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EXECUTIVE SUMMARY

The purpose of this Interim Report, conducted by Woodward-Clyde Consultants (WCC) is to assess the adequacy of the soils sampling and groundwater monitoring programs for the Olin RCRA Facility Investigation (RFI), and to present a preliminary evaluation of the potential for off-site contaminant migration via underground man-made passageways.

The Interim Report is based on the following data:

1. One round of analytical data for groundwater.

2. Available hydraulic head measurements.

3. Analytical results from soil sampling.

4. Available sewer maps and elevation data.

All of these data are included in, or appended to, this report. The conclusions of the Interim Report are as follows:

Adequacy of the Soil Sampling Program: Mercury has been found in soil samples obtained from throughout the Plant as part of environmental studies and construction projects. The RFI, which focussed on Solid Waste Management Units (SWMUs), provided results similar to the past sampling programs, indicating that the mercury contamination at the Plant is primarily a result of emissions and effluents occurring over nearly 100 years of mercury cell operation at the facility. The Current Conditions Report (CCR) and the data collected for the RFI indicate that organic chemical contamination in soil is a potential concern primarily in the area of the Plant between Alundum Road and Gill Creek (the ARGC area). This is believed to be a result of the Plant's pesticide production activities from 1950 through 1956. In 1956, the facility exploded and the operations were terminated. The explosion was probably a cause of chemical release to the soil along with routine emissions and effluents.

The Olin Plant is largely paved and access is completely controlled. Therefore, the major route of potential exposure to soil contamination is via leaching to groundwater. Additional soils data will not be required to assess this pathway. Therefore, no additional soil sampling is recommended for the RFI.

Adequacy of Monitoring Well Network:

To improve the characterization of off-site migration of contaminants in groundwater, WCC recommends installation of eight additional monitoring wells. To allow further investigation of potential seepage to Gill Creek, two shallow (A-zone) wells are recommended to be installed on either side of Gill Creek at the southern boundary of the Plant. To evaluate potential off-site migration to the north, a monitoring well cluster is recommended to be located across Buffalo Avenue from approximately the center of Plant 2. Finally, a cluster of three monitoring wells is recommended for the northwest corner of Plant 1, to evaluate the production well impacts in this area.

Man-Made Passageways:

Four underground sewer lines (one on-Plant, three off-Plant) were identified as having the potential to cause preferential groundwater migration. These are:

Plant 2 7S System (on-Plant)
Chemical Road Sewer (off-Plant)
Buffalo Avenue Diversion Sewer (off-Plant)
Buffalo Avenue Sanitary Sewers (off-Plant)

However, based on pipe and installation trench elevations, the on-Plant groundwater hydraulic head distribution, and the chemical quality of groundwater in the vicinity of these sewers, they appear to represent little potential for enhancing off-Plant contaminant migration.

1.0
INTRODUCTION

Olin Corporation (Olin) has entered into an Administrative Consent Order (Index No. RCRA-89-3013-0208) with the U.S. Environmental Protection Agency (EPA) which provides for performance of a RCRA Facility Investigation (RFI) at Olin's Buffalo Avenue Plant in Niagara Falls, New York (Figure 1-1). The Consent Order was issued while Olin was in the process of conducting a voluntary groundwater investigation at the Plant. This groundwater study included installation of 24 groundwater monitoring wells. During discussions with EPA regarding the scope-of-work for the RFI, it was decided that an Interim Report would be prepared based on one round of groundwater analyses and the soils analytical results. In accordance with the Work Plan prepared for the project by Woodward-Clyde Consultants (dated February 20, 1990), and the Addendum to the Work Plan (dated August 9, 1991), the objectives of the Interim Report are as follows:

1. To assess the adequacy of the current monitoring well network.
2. To assess the adequacy of the soils sampling program.
3. To identify underground man-made passageways and present a preliminary evaluation of the potential for contaminant migration along these conduits.
4. Available sewer location and elevation data.

The Interim Report is based on the following data:

1. One round of analytical data for groundwater.
2. Available hydraulic head measurements.
3. Analytical results from soil sampling.

The Interim Report is organized in twelve sections. Section 2.0 contains a brief presentation of the Plant history and project background for the reader unfamiliar with the reports and work plans previously submitted pursuant to the RFI. Section 3.0 presents a brief overview of the work performed for this Interim Report. Section 4.0 presents a characterization of regional and site geology. The results of the hydraulic testing program are presented in Section 5.0. The results of soils and groundwater analyses are presented and discussed in Sections 6.0 and 7.0, respectively. Section 8.0 presents a preliminary assessment of the potential for contaminant migration along underground utilities. In Section 9.0, the adequacy of the soils sampling program and the current groundwater monitoring well network at the Plant is assessed. Conclusions and recommendations are presented in Section 10.0, and limitations are discussed in Section 11.0. References are listed in Section 12.0.

2.0 BACKGROUND

The Olin Corporation (Olin), under its present name, and earlier as the Olin-Mathieson Chemical Corporation, the Mathieson Chemical Company, and the Castner Electrolytic Company, has manufactured chemical products in Niagara Falls, New York, since 1897. Production has occurred at two plant sites located south of Buffalo Avenue, approximately 1000 feet north of the Upper Niagara River (see Figure 1-1).

A map showing the two plants in more detail is presented as Figure 2-1. The smaller (6-acre) eastern site (Plant 1) is separated from Plant 2 by Chemical Road and by 300 feet of property owned by E.I. Du Pont de Nemours and Company (Du Pont). Plant 2 (16-acres) is divided into two sections by Alundum Road (private). In this report, Plant 1 and Plant 2 are collectively referred to as the Plant. Only when these facilities are discussed individually are the numeric designations used.

The Plant is located in an industrial community. Plant 1 is bounded on the west and south by former production facilities owned by Carborundum Corporation. Plant 2 property is bounded on the east by the 3163 Buffalo Avenue Site, a former chemical plant and disposal site currently being investigated by a group of Potentially Responsible Parties (PRPs) under a NYSDEC Consent Order. Adjacent to Plant 2 to the south is the Du Pont Niagara Plant, which has also conducted hydrogeologic investigations and remedial actions pursuant to a NYSDEC Consent Order.

Olin's principal business in Niagara Falls has centered around the electrolytic production of chlorine and caustic soda from rock salt (sodium chloride) using various modifications of the mercury-cell/chlor-alkali process. Mercury cells were once operated on both plant sites, but have been confined to Plant 2 for the past 30 years. Plant 1 has been largely inactive since the shutdown of calcium hypochlorite (HTH™) production in September 1982, and is presently used only for warehousing and groundwater treatment. In 1991, all mercury cell/chlor-alkali operations at the Plant were discontinued and decommissioned.

Despite the historical predominance of inorganic chemical production, several organic chemicals, including trichlorobenzene, trichlorophenol, and BHC (hexachlorocyclohexane), were manufactured in the section of Plant 2 between Alundum Road and Gill Creek between 1950 and 1956.

Investigations conducted by Olin since 1978 have documented the presence of mercury and a variety of organic chemicals at parts-per-billion (ppb) to parts-per-million (ppm) concentrations in soils and shallow groundwater at Plant 2, and in cooling water produced from deeper wells at Plant 1. Since May 1984, Olin has treated groundwater withdrawn from the bedrock production wells using activated carbon. Du Pont entered into an agreement with Olin in February 1985 under which Olin's production wells and treatment system are operated as part of Du Pont's groundwater remediation program.

In the early 1980s, the EPA commissioned an effort to estimate individual facility chemical contributions to the Niagara River directly, and via groundwater infiltration to the Falls Street Tunnel (Koszalka, et. al., 1985). Both this study and a more recent one conducted for the City of Niagara Falls (O'Brien and Gere, 1987) have claimed a potential for off-site chemical migration in groundwater from the Olin Buffalo Avenue Plant.

These assertions were made based on a very limited review of available data. In 1988, Olin contracted Woodward-Clyde Consultants (WCC) to review all existing data related to soil and groundwater contamination at the Buffalo Avenue Plant and to assess the need for further action on the matter. WCC's findings were presented in the Groundwater Assessment Report (August, 1988). The Groundwater Assessment Report identified the eastern portion of Plant 2, between Alundum Road and Gill Creek, as an area for which additional information was needed to characterize groundwater flow and contaminant transport conditions. Of particular importance is the effectiveness of the Olin production wells in controlling off-site migration in this area. Based on this recommendation, Olin Corporation contracted WCC to design and perform a study to further investigate soil and groundwater contamination. The major components of the study included soil sampling near active or former solid waste management units (SWMUs), installation and sampling of groundwater monitoring wells, and hydraulic testing. The elements of this investigation were presented in the Field Operations Plan

(FOP) for the project (June, 1989). Monitoring well installations were nearly complete by the time Olin Corporation was notified (in September 1989) of EPA's intention to initiate an RFI pursuant to RCRA Section 3013.

Since that notification, the following documents have been prepared and submitted to EPA pursuant to the Consent Order:

Current Conditions Report (CCR)
Project Management Plan (PMP)
Data Management Plan (DMP)
Health and Safety Plan (HASP)
Community Relations Plan (CRP)
Data Collection Quality Assurance Plan (DCQAP)
RFI Work Plan (Work Plan)
Addendum to the RFI Work Plan (Addendum)

The purpose of the RFI is to determine the nature and extent of releases of hazardous waste or hazardous waste constituents from SWMUs, and other source areas at the facility. This will be achieved through characterization of soil and groundwater contamination with respect to the potential for off-site transport and environmental impact. As such, its major components will be sampling and analysis of groundwater, supplemental soil sampling and analysis, and contaminant transport evaluation. Surface water and sediments are being investigated jointly with a neighboring facility in a separate program with the New York State Department of Environmental Conservation (Gill Creek Study).

The RFI consists of the following tasks:

1. Monitoring well installation
2. Groundwater sampling and analysis
3. Hydraulic head monitoring
4. Hydraulic testing
5. Soil sampling and analysis
6. Man-made passageways evaluation

7. Preparation of an Interim Report
8. Additional well installations based on Interim Report, if necessary
9. Source characterization
10. Potential receptor identification
11. Preparation of the RFI Report

The requirements for each task are presented in detail in the Work Plan and the Addendum. Tasks 1, 2 (one round), 3, 4, and 5 have been completed and form the basis for this Interim Report. These tasks are described in the following section.

3.0
WORK PERFORMED

This section describes the work performed as a basis for this Interim Report.

3.1 GROUNDWATER MONITORING WELL INSTALLATION (TASK 1)

The Project Management Plan (PMP) for the Olin RFI describes the technical approach and reasoning for the placement of monitoring wells for this study. A total of 24 groundwater monitoring wells have been installed at the Buffalo Avenue Plant under the direction of WCC. The wells were installed in clusters of three at eight locations as shown on Figure 3-1.

Five of the clusters are located in the Plant 2 area west of Gill Creek, two clusters are located on Olin property east of Gill Creek, and one cluster is located along the southern boundary of Plant 1. Each cluster contains a top-of-bedrock well and two deeper bedrock wells to monitor the first three water bearing zones from ground surface to a depth of approximately 50 feet. The top-of-bedrock wells, termed A-zone wells for this study, were installed to evaluate flow conditions and water quality at the interface between the overburden and the fractured bedrock. The deeper bedrock wells were installed to monitor flow conditions and water quality within the two uppermost major water-bearing bedrock fracture zones within the Lockport Formation. The uppermost water-bearing fracture zone is termed the B-zone for this study. Monitoring wells penetrating the lower water-bearing fracture zone are termed C-wells for this study. All drilling and well installation procedures are presented in detail in the Work Plan. The A-zone wells are constructed using a 5 foot length of screen and sandpack with a bentonite and grout annular seal. The B-zone and C-zone wells are completed as open 3-7/8 inch diameter rock holes spanning the water-bearing fracture zone and sealed using a 4-1/2 inch O.D. steel casing and a cement/bentonite grout annular seal. Well completion diagrams are included in Appendix A. Soil boring and rock core descriptive logs are included in Appendix B.

3.2 GROUNDWATER SAMPLING AND ANALYSIS (TASK 2)

The Work Plan specifies quarterly collection of groundwater samples from the 24 newly installed monitoring wells, the operating Olin production well (prior to treatment), and previously installed wells (Harza wells) capable of yielding meaningful results. Two Harza wells, BH-1 and BH-3, are included in the sampling program. All other Harza wells have been damaged and decommissioned except BH-9. BH-9 was not sampled because it is at approximately the same location as new well cluster OBA-5.

In accordance with the Work Plan, one round of groundwater samples was collected for the Interim Report. The samples were collected for the fourth quarter 1991 period. The next round of samples will be collected during the first quarter of 1992.

Groundwater samples were collected as described in the Work Plan and Addendum. Groundwater samples were analyzed by Recra Environmental, Inc. of Amherst, New York for the Project Analyte List (PAL). The PAL (Table 3-1) was developed to characterize groundwater contaminants potentially present from on-site and off-site sources. It is a comprehensive list, developed by taking the Contract Laboratory Program (CLP) Target Compound List (TCL) and adding additional chemicals as described in the Work Plan. Groundwater analyses were conducted in accordance with the DCQAP.

3.3 HYDRAULIC HEAD MONITORING (TASK 3)

The hydraulic head monitoring program was designed to evaluate temporal variations in groundwater elevations and the influence of the Olin Production wells and Gill Creek on local flow conditions. The monitoring program had two separate elements: (1) monthly monitoring well water level measurement and, (2) a continuous (hourly) water level monitoring program in selected monitoring wells, Gill Creek, and the Niagara River.

3.3.1 Monthly Measurements

Groundwater hydraulic heads were measured in all new monitoring wells (plus BH-1 and

BH-3) monthly for 12 consecutive months (October 1990 through September 1991). Measurements were obtained over a period of less than 4 hours as described in the Work Plan.

3.3.2 Continuous (Hourly) Measurements

A 7-day continuous water level monitoring program was conducted in accordance with the Work Plan. Well clusters monitored were OBA-8, OBA-7, OBA-5, and OBA-4. These well clusters are located at increasing distances from the Olin Production Well and on both sides of Gill Creek so that data concerning the relative effects of both hydrologic features could be collected.

At each selected monitoring well cluster, two 2-channel or one 4-channel Hermit™ data logger and three pressure transducers were used to collect and record hourly water level measurements. Each transducer was calibrated and used in accordance with the Work Plan. Water levels were also measured within Gill Creek during the monitoring program using a stilling well and continuous monitoring equipment. Water levels in the Niagara River were obtained from the New York Power Authority monitoring point at the Robert Moses Intakes and from the Ontario Hydro monitoring point at the Canadian Intake. The river water elevations are routinely measured by the power authorities at 60 minute intervals.

Following completion of the 7-day monitoring program, Gill Creek and two top-of-bedrock monitoring wells, OBA-4A and OBA-7A, were selected for 30 days of additional monitoring to evaluate effects of precipitation events. In addition, OBA-4B was continuously monitored to provide data on the interaction between Gill Creek and the upper bedrock fracture zone. During the 30-day period, water levels were continuously monitored at Gill Creek and obtained from the power authorities for the Niagara River.

3.4 HYDRAULIC TESTING (TASK 4)

The response of the water-bearing zones to hydraulic stress was investigated through single well permeability testing and a pumping study using the Olin production well. The purpose of the single well tests was to estimate the transmissivity in the vicinity of each monitoring well. The purpose of the pumping study was to evaluate the hydraulic impact of the Olin production well on groundwater flow beneath the Plant in the A-, B-, and C-zones. Single well test results are presented in Section 5.1, and pumping test results are presented in Section 5.2.

3.4.1 Single-Well Permeability Testing

Slug tests were performed on all newly installed site monitoring wells. The purpose of these tests was to estimate the transmissivity in the near-well vicinity. The slug tests were performed by inserting (falling head) or withdrawing (rising head) a slug of known volume from the well and monitoring the response of the water level in the well. Both falling and rising head tests were performed.

Water level responses were monitored in the wells using pressure transducers and battery-powered Hermit™ data loggers. The data logger was programmed to take water level measurements in a logarithmic progression (i.e., 10 measurements in the first 10 seconds, 10 measurements in the next 100 seconds, etc.). The following methodology was used to collect the slug test data.

1. Measure depth to water and depth to the bottom of the well. Note the depth of the zone being tested, well construction details, and volume of slug being used.

2. Insert transducer into well and perform initial calibration by raising and lowering transducer a known distance and recording the resultant data logger response. Secure transducer at a depth of approximately 10 feet below the water surface (if possible).

3. Insert or withdraw slug rapidly but smoothly from the water column and begin recording the water level response.

4. Continue monitoring the water level response until 90 percent recovery is observed.

5. Decontaminate all equipment between wells using procedures described in the RFI Work Plans.

3.4.2 Olin Production Well Pumping Study

A pumping study was conducted to determine the areal extent of the hydraulic depression associated with the Olin Production Wells. Groundwater was pumped from the South Production Well and the hydraulic response was monitored at each of the 24 monitoring wells installed for the RFI and in selected Du Pont monitoring wells. The test was conducted in steps as follows:

Pre-test: For approximately 48 hours the pumping rate was maintained at approximately 600 gpm. All monitoring wells were monitored at lease twice a day during this period (pre-test monitoring).

Step 1: The pumping test was initiated after the pre-test monitoring by shutting the pump down and monitoring recovery at each observation well for a period of 94 hours (recovery test).

Step 2: After 94 hours of recovery, the South Production Well was pumped at a rate generally between 400 and 500 gpm. The pumping system was somewhat unsteady at this flow rate, which was lower than its normal operating rate. In addition, the pumping rate was in excess of 1000 gpm for a few minutes at the start of the test prior to a buildup of water pressure in the treatment system. The duration of Step 2 was 70 hours.

Step 3: After 70 hours of pumping (Step 2), the pumping rate was increased to approximately 1000 gpm for a period of 118 hours.

Step 4: After pumping at approximately 1000 gpm for 118 hours (Step 3), the pumping rate was increased to the maximum system capacity (pump, piping and water treatment), which ranged between approximately 1300-1500 gpm. The pumping rate was maintained in this range for 48 hours.

The pumping schedule for the test is summarized on Table 3-2. Figure 3-2 shows a graph of pumping rate versus time for the duration of the test.

Continuous monitoring devices were used to automatically monitor hydraulic head in 17 monitoring wells (Table 3-3).

3.5 SOIL SAMPLING (TASK 5)

Soil sampling was performed as part of the RFI to assess any soil contamination resulting from potential hazardous waste constituents releases at selected Olin SWMUs and other areas of the Plant. Figure 3-3 shows the locations of SWMUs at the Plant. Information regarding potential hazardous waste constituents releases from SWMUs at the Olin Plant is included in the RCRA 3004u questionnaire submitted to USEPA on September 20, 1989. The Olin RFI Workplan and Addendum Letter (dated August 9, 1991) describe the rationale for the placement of soil sampling locations and analysis parameters for this study. A total of 18 soil borings were advanced and soil sampling performed as shown on Figure 3-4. Figure 3-4 also includes a summary of the particular SWMU or feature being investigated and the depth to refusal for each boring.

All borings were advanced using hollow-stem auger drilling techniques with continuous soil sampling using split-spoon samplers. Borings were advanced and sampling performed until auger refusal was reached. All drilling equipment and split-spoon samplers were decontaminated in accordance with the RFI Work Plan. Boring logs are included in Appendix B.

Analyses of soil samples was in accordance with the Work Plan and Addendum. The soil sampling program is summarized below:

SWMU or Location	Soil Borings	Analyses
LD-2	9	Total and extractable mercury
TK-1	1	Total and extractable mercury
WWT-1	1	Total and extractable mercury
LA-1	1	Total and extractable mercury
LA-2	1	Total and extractable mercury
LA-3	1	Total and extractable mercury
LA-4	1	Total and extractable mercury
North of Building 17	1	Total and extractable mercury
BHC Storage Area	1	Organic analytes on the PAL except methanol
Building 97 Area	1	Inorganic and organic analyses on the PAL except methanol

3.6 PRELIMINARY MAN-MADE PASSAGEWAYS EVALUATION (TASK 6)

Past and present underground man-made passageways at the Olin Plant were identified based on available utility drawings. The locations and depths of these structures were evaluated with respect to groundwater potentiometric surfaces and the distribution of soil and groundwater contamination. Based on this assessment, potential preferential pathways for contaminant migration were identified.

4.0
GEOLOGIC CONDITIONS

4.1 REGIONAL GEOLOGY

A complex sequence of geologic events has resulted in the placement of two sedimentary units of very different ages, origins, and characteristics in direct contact in the Niagara Falls area. A veneer of unconsolidated Pleistocene glacial till and fine-grained lake bottom sediments less than 20,000 years old overlie 80 to 158 feet of dolomite bedrock (Lockport Dolomite) deposited as limestone in the Middle Silurian period (350 million years before present (BP)). Water moves through the glacial deposits at rates determined by the local texture of the unconsolidated sediment matrix. The Lockport Dolomite, however, is of very low permeability except where dissolution channels have developed along horizontal bedding planes or through vertical fractures and joints. A 60-foot thick sequence of impermeable calcareous shale, the Rochester Formation, underlies the Lockport, and separates lower-lying formations from the Lockport Dolomite. Exclusive of man-emplaced fill, the Pleistocene glacial deposits and the Lockport Dolomite are the only two units of potential interest with respect to contaminant migration at the Olin Plant. The thickness, lithology, and hydraulic characteristics of the deposits underlying the Niagara Falls area have been extensively studied by the USGS (Maslia and Johnston, 1982) and through a number of hydrogeologic investigations conducted by Olin, Du Pont, and Occidental Chemical Company, among others, throughout the Niagara Falls region. A more complete discussion of regional geology is presented in the CCR.

4.2 SITE GEOLOGY

4.2.1 Soils

Overburden materials observed during advancement of 18 soil borings and installation of 24 monitoring wells during the Olin RFI can be grouped into two classes: 1) man emplaced fill materials associated with excavation and construction of the Olin Plant; and 2) pleistocene glacial materials deposited during the most recent Wisconsin glacial advance and subsequent retreat approximately 12,000 years BP. Descriptive logs for the monitoring well installations and soil borings are included in Appendix B. The glacial deposits, where observed, typically consist of a fine-grained silty clay unit related to deposition within ancestral glacial Lake Tonawanda throughout the period of ice margin retreat. However, some coarser-grained glacial till and stratified sand and gravel deposits were observed in limited quantities. The till deposits are generally unsorted, unstratified, glacially transported materials, while the stratified sand and gravel units are associated with the reworking of till materials in glacial outwash streams prior to glacial retreat.

The thickness of unconsolidated overburden materials varies from 5.1 to 14.3 feet across the Plant. As illustrated in the top-of-bedrock elevation contour map and the overburden isopach map (Figures 4-1 and 4-2), the Plant lies above an isolated northwest-southeast trending bedrock ridge. The apex of the ridge appears to be centered beneath the caustic unloading/storage area at Plant 2 and has a N60°W orientation. Regionally, this local bedrock ridge is situated on the western flank of a broad north-south trending buried valley (CCR).

In general, the thickest sequences of natural glacial deposits are found in areas of the Plant furthest radially from the apex of the bedrock ridge (i.e., where overburden thickness is the greatest) and in the northerly portions of the Plant away from the ancestral northern bank of the Upper Niagara River which existed directly south of the Olin Plant prior to reclamation in the last century. As is illustrated in a glacial deposits isopach map (Figure 4-3), the most significant accumulation of glacial deposits (greater than 3 feet) are found, in order of decreasing thickness, at well clusters OBA-3, OBA-8, OBA-2, soil boring OSB-5, and well cluster OBA-1. Regarding well cluster OBA-3, it appears that these wells were installed within a roughly north-south trending erosional swale, possibly an ancestral path of Gill Creek or a buried outwash channel, which was subsequently filled with glaciolacustrine materials. The strongest evidence for the existence of this buried valley includes: 1) the notably thicker accumulation of lacustrine sediments observed at cluster OBA-3; 2) a sharp decrease in overburden thickness to the west and east of the OBA-3 cluster; and 3) the first bedrock water-bearing zone (B-zone) was observed at approximately 16 feet below ground surface (BGS) at clusters OBA-4 and OBA-3. Since water-bearing zones in the Lockport Dolomite are associated with bedding planes which are locally relatively flat in orientation and fairly continuous, the observed difference in the depth to bedrock but similarity in depth to the B-zone for clusters OBA-3 and OBA-4 suggests that the buried valley, and the bedrock ridge that the Plant overlies, are erosional remnants.

All unconsolidated sediments have been classified, in order of occurrence from ground surface, into four material types: 1) fill; 2) alluvium; 3) glaciolacustrine; and 4) till. As discussed earlier, the man-emplaced fill and to a lesser extent the glaciolacustrine sediments volumetrically dominate the overburden materials observed at the Plant.

Fill materials encountered across the Plant are quite variable in thickness and nature. These include gray shot rock, cinder, mixtures of reworked sand, silt and clay, brick debris, slag, and lesser amounts of brine mud, fly ash, and lime sludge. Fill materials were most prevalent at: 1) the most southerly portions of the Plant where reclamation of low lying marsh areas near the ancestral northern bank of the Upper Niagara River has occurred (i.e., cluster OBA-5); 2) areas where bedrock is closest to the surface (i.e., the bedrock ridge apex/axis); 3) Plant process areas where intense excavation, construction and infilling have occurred (i.e., most recent cell room area, process areas situated between Alundum Road and Gill Creek); and 4) areas adjacent to Gill Creek (i.e., remediation areas, past channel modification).

Alluvium deposits, believed to have been emplaced during late stage evolution of glacial Lake Tonawanda, typically consist of a fine silty sand sometimes with interspersed wood and peat stringers. A thin layer of alluvium was observed only at cluster OBA-8, suggesting it is very limited in volume and areal extent beneath the Plant. Alluvium deposits would most likely be observed only in areas where the overburden is relatively thick and further toward the Niagara Falls sewage treatment plant, approximately 1000 feet west of the Plant, where the unit was first described (Calkin and Brett, 1978).

The glaciolacustrine deposits generally consist of a mottled brown/red/gray clay and silty clay with a small sand component. The clay is typically very firm, cohesive, relatively impermeable and has high plasticity. Subrounded rock clasts are usually present and increase in abundance close to the bedrock interface. The lacustrine clay was observed in varying thicknesses at well clusters OBA-1, OBA-2, OBA-3, OBA-6, and OBA-8 and in soil borings OSB-3, OSB-5, OSB-6 and OSB-18.

Like the alluvial deposits, glacial till, composed of brown to gray silty clay with abundant rock fragments and sand, was not often observed and, where present, was very limited in thickness. The till often resembles the lacustrine clay with a larger component of rock clasts and sand.

The only natural material encountered at cluster OBA-5 was a thin bed of black, organic rich, marsh deposits. This occurrence again illustrates the fact that the former north bank of the Upper Niagara River was situated just south of Olin Plant, very close to OBA-5 cluster location.

4.2.2 Bedrock

The Olin Niagara Plant is underlain by the Lockport Formation of Middle Silurian Age (320-350 million years old). Lithologically the Lockport Formation is a dolomite and is generally brown-gray in color, medium-grained, displays medium to massive bedding, carbonaceous partings, vugs, and stylolites and is fossiliferous in sections. The approximately 200-foot section of the Lockport Formation in the Niagara Falls vicinity is divided into five members: 1) the Oak Orchard; 2) Eramosa; 3) Goat Island; 4) Gasport; and 5) Decew. The portion of the Lockport Formation which immediately underlies the Plant is the Oak Orchard member.

As discussed earlier, the Olin Plant lies above a northwest-southeast trending bedrock ridge. This isolated bedrock ridge appears to be located on the western flank of a longer regional north-south trending buried valley (CCR).

The Lockport Dolomite supplies non-contact cooling water for the Olin Plant but is not used for potable water supply due to naturally high levels of dissolved solids. Groundwater movement in the Lockport Dolomite occurs through near horizontal bedding plane fractures, vertical joints and solution cavities. As described below, bedding plane fractures, further enhanced by groundwater solutioning, are the primary route of groundwater transport. The most significant bedding plane fracture frequency occurs within the upper 25 to 30 feet of the formation, as it has been subjected to weathering and flexure during tectonic events and glacial rebound. Distinct water-bearing fracture zones in the Lockport have been identified and intensively examined in the past few decades by numerous investigators. At a given location, distinct water-bearing zones appear to be locally laterally continuous and occur at fairly uniform depths.

Numerous vertical joints have also been observed within the Lockport Dolomite in exposed rock faces but were originally described as tight and do not appear to transmit water readily. However, since vertical joints provide vertical pathways for contaminants and cross-communication between water-bearing zones they must be considered significant. This is a consideration for the Plant area as it has been suggested that exceptional well yields from the Olin production wells may be a result of an enhanced east-northeasterly set of vertical joints related to deep basin faulting (Yager and Kappel, 1987).

Descriptive rock logs for the 24 monitoring wells are included in Appendix B.

4.3 GROUNDWATER HYDROLOGY

4.3.1 Water-Bearing Zones

As discussed above, the overburden at the Olin Plant is relatively thin, in general less than 10 feet in thickness. Saturated conditions (i.e., the water table) were generally encountered during drilling within the lower 2 feet of soil above the top-of-bedrock. The upper most water-bearing zone is therefore defined as the lower 2 feet of overburden and the weathered bedrock surface. This will be referred to as the A-zone.

The water-bearing properties of the Lockport Dolomite have been extensively studied at the adjacent Du Pont Niagara Plant and 3163 Buffalo Avenue Site, and elsewhere in the vicinity. These studies have shown that groundwater flow within the bedrock occurs primarily within dissolution channels which have developed along horizontal bedding planes and through vertical fractures and joints. The horizontal bedding plane fracture zones can be considered to be leaky confined water-bearing zones, with vertical leakage occurring through vertical fractures and joints.

During drilling for well installation, water-bearing fracture zones are identified by drilling water loss to the formation, core inspection and sudden changes in the drilling mechanics (such as a drill rod dropping or vibration). Two major water-bearing fracture zones were encountered at the Plant. Using terminology consistent with that used for the hydrogeologic assessments performed at the adjacent Du Pont facility, these zones are referred to as the B- and CD-zones. A less widespread water-bearing fracture zone was encountered during the drilling of three wells (OBA-1C, OBA-7C and OBA-4C). This minor water-bearing zone corresponds to the C-zone identified in the Du Pont studies and is located between the B- and CD-zones. The B-zone is located between 16 and 21 feet below ground surface. The CD-zone is located between 45 and 50 feet below the ground surface. When present, the C-zone was encountered between 25 and 35 feet below ground surface.

4.3.2 Groundwater Flow

4.3.2.1 Regional Influences on Groundwater Flow

Major regional influences on groundwater flow in the region near the Olin Plant are the Niagara River and Niagara Gorge, the water diversion structures of the Niagara Power Project, and the Falls Street Tunnel. Figure 4-4 shows the approximate locations of these features.

The Niagara Power Project was constructed in the early 1960s and is operated by the New York Power Authority (NYPA). The NYPA diversion structures potentially affecting groundwater flow at the Olin Plant are the twin buried conduits which carry water from the upper Niagara River north to the Robert Moses Power Plant, and the Forebay Canal, an L-shaped excavation in the bedrock linking the conduits with the Robert Moses Power Plant. The Olin Plant is located approximately 2000 feet west of the twin buried conduits and approximately 4 miles southeast of the Forebay Canal. The upper Niagara River is located approximately 1000 feet south of the Olin Plant.

For a detailed account of the effect of the Niagara Power Project on groundwater flow within the Lockport Dolomite in the Niagara Falls area, refer to U.S. Geological Survey Water-Resources Investigations Report 86-4130. Very briefly, the present understanding of the hydraulic impact of these structures is as follows. The unlined Forebay Canal is cut directly into and entirely through the Lockport Dolomite. The Forebay Canal is in hydraulic communication with the twin buried conduits and with the drain system along the outside of the conduits. The communication is via gently southward dipping water-bearing bedding plane fractures that are exposed in the walls of the Forebay Canal. The conduit drain system has been described as being highly efficient at transmitting hydraulic pressure charges from the Forebay Canal southward (Miller and Kappel, 1987).

The water level in the Forebay Canal is a hydraulic low point. Since there is close hydraulic connection between the Forebay Canal and the conduit drain system, the hydraulic head in the drains is lower than that in the surrounding upper Lockport Formation and groundwater discharges to the drains. The conduit drains therefore act as a line sink for groundwater discharge.

Forebay Canal water levels typically vary over a 24-hour cycle, with highs occurring in the evening and lows occurring in the morning. The magnitude of these fluctuations is greatest during the tourist season, which begins on April 1, when less water is diverted to the power project during daylight hours. After November 1, however, levels are typically lower and the magnitude of the fluctuations is less.

The Falls Street Tunnel (FST) is an unlined 7-foot by 9-foot tunnel within the upper Lockport. The FST carries stormwater from east to west beneath Falls Street, approximately 1500 feet north of the Olin Plant. The FST likely receives groundwater infiltration throughout its length, however the location where it crosses above the conduits (approximately 3.6 miles south of the Forebay Canal) is known to be a major infiltration point into the FST due to leakage from the conduit drain system.

Groundwater infiltration at the FST/conduit crossing contributes to head loss in the conduit drain system. The high rate of infiltration apparently is a contributing factor causing the conduit system to be a consistent discharge boundary. In 1989, the City of Niagara Falls undertook a project to seal the FST at the conduit crossing. Although seepage was substantially reduced, the general location remains an area of major groundwater infiltration (W. Kappel, USGS, Personal Communication). The Niagara River flows from east to west approximately 1000 feet south of the Plant. The river level in the vicinity of the plant is also affected by the NYPA diversions. NYPA regulates the flow of diverted water in part by closing a gated structure in the Niagara River downstream of the Olin Plant, which partially obstructs flow in the river and increases the diversion flow. Therefore, the river level rises during periods of high rates of diverted flow and falls during periods of low rates of diverted flow. The change in river level is approximately 1.5 feet.

4.3.2.2 A-Zone Groundwater Flow

Figures 4-5 through 4-16 present potentiometric surface maps constructed for the A-zone based on the monthly measurements from October 1990 through September 1991. These maps show that the A-zone potentiometric surface mimics the top-of-bedrock surface (see Figure 4-1) with radial flow occurring in all directions from the bedrock high located in the western part of Plant 2. A-zone groundwater flowing to the north may be seeping into the Buffalo Avenue Diversion Sewer, which is a 48-inch sewer excavated into the bedrock (invert elevation north of the Plant is approximately 555 feet).

Some A-zone groundwater flowing toward the east may seep into Gill Creek. Projected hydraulic heads to near the creek suggest that the Gill Creek water level and A-zone hydraulic head are approximately the same. East of Gill Creek (OBA-4A) the hydraulic head is substantially less than Gill Creek. This indicates that A-zone groundwater either flows beneath Gill Creek (in which case Gill Creek would be an influent stream) or that some seepage into Gill Creek occurs from the A-zone along the western bank, and some leakage from Gill Creek to the subsurface system occurs along the eastern bank.

A-zone flow westward and southward from the bedrock high could eventually discharge to the Niagara River or Gill Creek. However, it is more likely that the primary direction of groundwater flow is downward to the more transmissive bedding plane fracture zones. Two factors, consistently observed for each of the 12 monthly measurement rounds, suggest downward leakage is occurring. First, the low hydraulic head at OBA-8A suggests that the Olin production well cone-of-depression has induced leakage downward from the overlying A-zone. Second, the elevated A-zone hydraulic heads associated with the bedrock high cause an impressed area of high hydraulic head in the B-zone bedding plane fracture zone (as described below).

4.3.2.3 B-Zone Groundwater Flow

The production well water level is incorporated into the potentiometric surface maps for the bedrock water-bearing zones. Prior to February 1991 no direct measurements were obtained from the production well. Access to the well for hydraulic head measurements was obtained for the pumping study (and later measurements). To estimate production well water levels for earlier months, measurements obtained subsequent to February 1991 were plotted versus the pumping rate at the time of measurement (Figure 4-17). The resulting plot fits a straight line over the range of measurements. For the months prior to the installation of the access hole, the best fit line shown on Figure 4-17 was used to estimate the water level in the production well based on the measured pumping rate.

Monthly potentiometric surface maps for the B-zone are presented in Figures 4-18 through 4-29. Although the production wells are not open directly to the B-zone interval, a cone-of-depression resulting from induced leakage downward to the C- and/or CD-zones appears to extend throughout the Plant 1 area to near the center of Plant 2, where there is a radial flow component due to the impressed hydraulic head from the overlying A-zone hydraulic mound (at the bedrock high). Leakage from Gill Creek may also be causing a hydraulic mound in the underlying B-zone. Only to the east of Gill Creek does there appear to be a north or northeasterly component to groundwater flow, possibly toward the NYPA Conduits or Falls Street Tunnel. Vertical gradients between the A- and B-zones are without exception downward and represent a substantial driving force for downward vertical groundwater flow from the A-zone. Horizontal hydraulic gradients between Chemical Road and Gill Creek are extremely low.

4.3.2.4 C-Zone Groundwater Flow

The potentiometric surface maps for the C-zone are presented in Figures 4-30 through 4-41. The Olin production wells are open directly to the C-zone interval. The cone-of-depression appears to extend approximately to Gill Creek for each of the monthly measurement ~~rounds~~. The effects of the production wells are further discussed in Section 5.0.

? may not! could work like B zone but not enough data points to tell

4.3.2.5 CD-Zone Groundwater Flow

Figures 4-42 through 4-53 present the potentiometric surface maps for the CD-zone. The Olin production wells are open directly to the CD-zone interval. The cones-of-depression appear to extend throughout the Plant approximately to Gill Creek. The effects of the production wells are further discussed in Section 5.0.

4.3.2.6 Deeper Water-Bearing Fracture Zones

Hydrogeologic studies at the adjacent Du Pont facility and at the 3163 Buffalo Avenue Site provide ample evidence that an upward vertical hydraulic gradient exists between deeper water-bearing bedding plane fracture zones in the Lockport Dolomite and the overlying C- and CD-zones. Du Pont has installed monitoring well clusters including deeper bedrock (termed D- and F-zones by Du Pont) wells at locations both south and north of the Olin Plant. These well clusters (14, 15, 19 and 22) show a consistent upward vertical gradient between the D- or F-zones and the C/CD-zone. Du Pont studies also indicate substantial cones-of-depression in the D- and F-fracture as a result of pumping from the production well.

4.3.3 Results of Continuous Monitoring Study

4.3.3.1 Seven-Day Study

Hydraulic head versus time plots were prepared based on the 7-day continuous monitoring at well clusters OBA-4, OBA-5, OBA-7, OBA-8 and the Niagara River. The Gill Creek stilling well was also continuously monitored. The 7-day continuous monitoring at well cluster OBA-4 began approximately 3 days after the other wells due to a data logger malfunction. Figure 4-54 shows the Gill Creek and Niagara River stage throughout the monitoring period. Figure 4-55 shows hydraulic head versus time plots for A-zone wells. A-zone hydraulic heads varied less than approximately 0.3 feet during the period, showing little direct hydraulic communication with the river. Hydraulic head versus time plots are presented on Figure 4-56 for the B-zone wells monitored. As with the A-zone wells, the B-zone shows little variation in hydraulic head (less than a few tenths of a foot). C- and CD-zone water levels (Figure 4-57) show more variation in general, and appear to show an increase in hydraulic head (of 0.3 to 0.5 feet) nearly concurrent with the approximate one foot increase in Niagara River level that occurred on January 31, 1991. Monitoring at OBA-4C was not begun in time to monitor this change, but OBA-4C showed little or no variation in hydraulic head during the days it was monitored. For OBA-5C, OBA-7C and OBA-8C, the rise in hydraulic head associated with the river stage increases occurred over approximately the same time period in each well (i.e., there was no substantial lag time between the well responses on one side of the Plant versus the other). The fluctuations measured in OBA-8C on January 30 and February 6 were apparently a result of surges in the production well pumping system, which have been noted to occur occasionally. Monitoring well OBA-8C responds almost immediately to changes in the production well pumping rate.

Daily precipitation records obtained from the Niagara Falls Airport Weather Station during the 7-day study indicate only trace levels of daily precipitation (0.1 inch or less), and 2 inches of snowmelt during the study period. Therefore, there were no substantial precipitation effects on groundwater during the 7-day study.

4.3.3.2 Thirty-Day Study

The Gill Creek stilling well and monitoring wells OBA-7A, OBA-4A and OBA-4B were continuously (hourly measurements) monitored for a period of 30 days. Substantial precipitation events occurred twice during the 30-day monitoring period. Between March 2 and March 7, a total of approximately 2.7 inches of precipitation (including snowmelt) occurred. Later in the month, on March 18, 0.63 inches of rainfall were recorded. Gill Creek stage elevations versus time are plotted on Figure 4-58.

Figures 4-59 and 4-60 show each of the two precipitation events and their corresponding Gill Creek stage hydrographs. The Niagara Falls International Airport Weather Station records total precipitation every 6 hours. Therefore, the precipitation histogram time intervals are 6 hours. Hydraulic head versus time curves for the three monitoring wells continuously monitored are presented on Figures 4-61 through 4-63. Each of the monitoring wells responded rather quickly to precipitation indicating that some recharge is occurring near these wells. The monitoring well hydrographs show a shorter lag-to-peak hydraulic head than the Gill Creek hydrograph. This suggests that the hydraulic head increase is due to recharge rather than the increase in stage in Gill Creek.

5.0 HYDRAULIC TESTING

5.1 SLUG TESTS

5.1.1 Solution Methods

Transmissivity or hydraulic conductivity was estimated from the slug test results by the methods of Cooper et. al. (1967), and Bower and Rice (1976), respectively. The Bower and Rice solution is applicable to unconfined aquifers and was used to interpret the test data from A-zone monitoring wells. The parameter estimated for unconfined conditions is hydraulic conductivity$^{(k)}$. The solution is as follows:

$$\ln S_o - \ln S_t = \frac{2\,K\,L\,t}{r_c^2\,\ln(r_e/r_w)}$$

where:

S_o = initial drawdown in well due to instantaneous removal of water from well, dimensions of length [L]

S_t = drawdown in well at time t [L]

L = length of well screen [L]

r_c = radius of well casing [L]

$\ln(r_e/r_w)$ = empirical "shape factor" determined from tables provided in Bower and Rice (1976)

r_e = equivalent radius over which head loss occurs [L]

K = hydraulic conductivity $[Lt^{-1}]$

r_w = radius of well (including gravel pack) [L]

H = static height of water in well [L]

b = saturated thickness of aquifer [L]

This equation is solved through use of semilog plots of impressed head or drawdown (logscale) versus time (arithmetic scale). Hydraulic conductivity is estimated by fitting a straight line to the semilog plot, calculating the slope, and solving for K.

The Cooper et. al. (1967) method is applicable for confined aquifers and was used to estimate transmissivities(T) from the B-zone and C-zone test data. Cooper et. al. have developed a family of type curves based on solution of the partial differential equation for drawdown in a well using the Laplace Transform. The type curves are semilog plots of H/H_o versus time, where H is the hydraulic head at time t and H_o is the initial head in the well due to slug injection or extraction. By matching the field data to the type curve, transmissivity can be estimated.

WCC used the software package AQTESOLV to reduce the slug test data using the appropriate solution technique.

5.1.2 Slug Test Results

Table 5-1 presents the results of the slug tests conducted on A-zone monitoring wells. Since in all A-zone wells the static water level was below the depth of the top of the sandpack, the hydraulic conductivity of the sandpack is likely to significantly impact resulting hydraulic conductivity estimates. Therefore, when evaluating the hydraulic conductivity of the A-zone, the slug test results should be considered together with the response of the wells to purging and the soil texture characteristics observed during well installation. Slug test results for the A-zone wells are presented graphically for each well tested in Appendix C.

Table 5-2 presents the results of slug tests conducted on the B-zone and C-zone wells. Estimated transmissivity values for B-zone wells ranged from 4.9×10^{-4} ft^2/min to 2.9 ft^2/min, with a logarithmic mean of 2.1×10^{-1} ft^2/min. Estimated transmissivity values for the C-zone wells ranged from 6.6×10^{-3} ft^2/min to 86.5 ft^2/min, with a logarithmic mean of 1.2×10^{-1} ft^2/min. Since the B-zone and C-zone monitoring wells are completed as open holes, the results of the slug tests are not impacted by sandpack. However, use of the estimated transmissivity values is limited by the basic assumption of porous media flow conditions required to use either solution method. Therefore, some of the slug test curves (Appendix C) do not match the standard type curves well. All hydraulic conductivity and transmissivity estimates should be considered of order-of-magnitude accuracy.

5.2 PUMPING STUDY RESULTS

5.2.1 Pre-Test Monitoring

The pre-test hydraulic head monitoring showed that A-zone and B-zone hydraulic heads varied less than approximately 0.3 feet (except for an 0.38 foot variation at OBA-7B) and C- and CD-zone hydraulic heads fluctuated less than 0.4 feet during the 48 hours prior to the initiation of the pumping study. Potentiometric surface maps prepared from data collected near the end of the pre-test monitoring period are presented on Figures 5-1 through 5-4.

5.2.2 Recovery Test: Unstressed (No Pumping) Conditions

Hydraulic head measurements were obtained from all observation wells toward the end of the recovery test (Step 1). At the time of measurement, the pump had been off for approximately 90 hours. Figures 5-5 through 5-8 present the potentiometric surface maps prepared from these measurements for each water-bearing zone. The maps show potentiometric surfaces under conditions where no pumping of groundwater occurs. The A-zone potentiometric surface shows a groundwater high near the center of Plant 2, with outward radial groundwater flow. This groundwater high appears to be approximately coincident with the bedrock high described in Section 4.0. The relatively low water level at OBA-8A suggests that the hydraulic regime had not completely recovered from drawdown due to induced leakage downward under pumping conditions even though the pump had been off for nearly 4 days. This finding suggests that in this area the A-zone is behaving as an unconfined, low hydraulic conductivity unit and/or it is not well connected to the bedrock water-bearing zones (i.e., vertical hydraulic conductivity is low compared to horizontal hydraulic conductivity in the bedrock). As described in Section 4.0, some A-zone groundwater may be discharging to Gill Creek from the west. Based on observations during well installation, the low hydraulic head measured at OBA-3A appears to be related to a narrow north-south trending buried valley located in this area.

The B-zone hydraulic regime (Figure 5-6), under conditions of no pumping, is characterized by extremely low hydraulic gradients. The groundwater flow direction appears to be primarily northward. Although less pronounced than observed in the A-zone, the B-zone exhibits a hydraulic low near cluster OBA-8, suggesting a residual drawdown due to induced leakage during pumping conditions. Gill Creek does not appear to be substantially impacting groundwater flow in the B-zone, although the marginally elevated level at OBA-4B could be caused by leakage of Gill Creek water through the crushed stone stream bed which directly overlies the bedrock in this area. West of Gill Creek, hydraulic heads in the B-zone were generally 4 to 8 feet lower than in the A-zone indicating strong downward vertical hydraulic gradients. East of Gill Creek, hydraulic heads in the B-zone were less than two feet lower than in the A-zone.

The C-zone potentiometric surface, under conditions of no pumping, is characterized by extremely low horizontal hydraulic gradients (Figure 5-7). The gradient is so small that groundwater flow direction is unclear from the hydraulic head measurements. Hydraulic heads in the C-zone were approximately one foot lower than in the B-zone.

Similar to the other bedrock water-bearing zones, the CD-zone potentiometric surface (Figure 5-8), under conditions of no pumping, is characterized by extremely low horizontal hydraulic gradients. The one exception is the rather low hydraulic head (about 1.5 feet less than elsewhere) measured in well OBA-2C. The cause of this hydraulic low has not been determined, however, the low slug test result (6.1×10^{-3} ft^2/min) and lack of fractures encountered in this well suggest that it may be slower to respond to pumping changes than other C/CD-zone wells. Except at cluster OBA-2, hydraulic heads measured in the CD-zone were less than 2 feet lower than in the B-zone.

5.2.3 500 GPM Pumping Step

Figures 5-9 through 5-12 present potentiometric surface maps based on measurements taken after approximately 70 hours of pumping at approximately 500 gpm. Figure 5-9 shows that the A-zone at this time was not substantially impacted by the pumping. As evidenced by the residual drawdown observed at OBA-8A after 90 hours of recovery, any pumping impacts caused by induced downward leakage would be manifested very slowly and would not be discernable during the timeframe of this pumping study.

As shown on Figure 5-10, the cone-of-depression in the B-zone due to downward leakage extends to the center of Plant 2 (near well cluster OBA-7B). Figure 5-11 presents the potentiometric surface map for the C-zone, showing a cone-of-depression extending easterly throughout Plant 2 to the vicinity of Gill Creek. The CD-zone potentiometric surface shows a similar cone-of-depression (Figure 5-12) which extends easterly to Gill Creek.

5.2.4 1000 GPM Pumping Step

Figures 5-13 through 5-16 present potentiometric surface maps prepared from measurements taken after approximately 100 hours of pumping at approximately 1000 gpm. Figure 5-13 shows that the A-zone had not yet been impacted by the pumping. The B-zone potentiometric surface map (Figure 5-14) shows a more pronounced cone-of-depression (compared to 500 gpm), due to induced leakage near the production well but no discernable increase in the radius of influence. The C-zone and CD-zone potentiometric surface maps for this step (Figures 5-15 and 5-16) both show increased hydraulic gradients toward the production well. The radius of influence to the east slightly increased, but still extends to Gill Creek.

5.2.5 1500 GPM Pumping Step

Figures 5-17 through 5-20 present potentiometric surface maps prepared from measurements taken after approximately 48 hours of pumping at approximately 1300 to

1500 gpm. As shown on Figure 5-17, the A-zone potentiometric surface still showed little or no response to pumping. In the B-zone, the increase in the pumping rate did not result in a significant increase in the radius of influence east of the production well (Figure 5-18). The C-zone and CD-zone potentiometric surface, shown on Figures 5-19 and 5-20, again shows an increase in hydraulic gradient toward the production well within the cone-of-depression, but no significant increase in the radius of influence toward the east.

not much change from pre-stressed condition over most of E ½ of plant.

6.0
SOIL CONTAMINATION

The soil sampling and analytical program for the Olin RFI is described in Section 3.5. Appendix D presents WCC's Quality Assurance review of the data. A summary of all laboratory analytical data is included in Appendix E. Analytical results are discussed below.

6.1 MERCURY

Tabulated analytical results from total mercury and TCLP mercury analyses conducted on soil samples are presented in Table 6-1. These results are plotted on Figures 6-1 and 6-2. Mercury contamination is relatively widespread at the Plant. Low concentrations of 2.3 mg/kg or less were reported for OSB-3 located north of Buffalo Avenue in an area where brine mud was used for pothole repair. Concentrations reported for OSB-2, also a location of brine mud deposition, were 6.5 mg/kg or less. Total mercury concentrations in soil were in the range of 1 to 100 mg/kg at OSB-4, OSB-5, OSB-6, OSB-7, OSB-8, OSB-12 and OSB-16. Levels of total mercury exceeding 100 mg/kg were reported for OSB-1, OSB-9, OSB-10, OSB-13, OSB-14 and OSB-15.

Total mercury concentrations were generally highest in the upper 4 feet of soil with the notable exception of OSB-1 in which the 8 to 10-foot interval showed the highest total mercury levels. Small beads of elemental mercury were noted in the sample obtained from the bottom of the 6 to 8-foot interval in this boring and the analyzed total mercury concentrations from the 6 to 8-foot and 8 to 10-foot intervals were the highest levels reported in any of the soil borings. The TCLP extract concentration was 8.6 ug/L, indicating low potential to leach.

Soil samples were also analyzed for mercury using the Toxicity Characteristic Leaching Procedure (TCLP). All TCLP mercury results were less than the regulatory level of 200 ug/L. The maximum TCLP mercury result obtained during the program was 31.7 ug/L from the 0 to 2 foot interval in boring OSB-11. Other soil borings with samples yielding TCLP mercury concentrations higher than 10 ug/L were OSB-10, OSB-11, and OSB-12.

TCLP mercury results for all soil samples from the remaining soil borings were less than 10 ug/L.

6.2 ORGANIC CHEMICALS

Soil samples obtained from soil borings OSB-17 and OSB-18 were analyzed for the organic chemicals on the Project Analyte List (PAL). Table 6-1 presents the results of soil analyses for the PAL organic chemicals (see Section 3.5). Figure 3-4 shows the locations of OSB-17 and OSB-18.

6.2.1 Volatile Organic Chemicals

The following volatile organic chemicals were detected in soil samples from OSB-17 and OSB-18:

- Methylene chloride
- Acetone
- Chloroform
- Trichloroethene
- Benzene
- Tetrachloroethene
- Toluene
- Chlorobenzene
- Total xylenes

These chemicals were generally detected at trace levels. A few results were in the 0.010 mg/kg range and no reported concentrations exceeded 0.050 mg/kg. The results are tabulated in Table 6-1.

6.2.2 Semivolatile Organic Chemicals

Analytical results for all semivolatile organic chemicals detected in soil samples from OSB-17 and OSB-18 are tabulated in Table 6-1. A total of 35 semivolatile compounds were detected in at least one of the soil samples. Neither chlorinated benzene compounds nor chlorinated phenol compounds were measured above 10 mg/kg in samples from OSB-17. 4-methylphenol was quantified in one sample from OSB-17 (6 to 8 feet) at 25 mg/kg. The semivolatiles present at the highest concentrations in soil samples from OSB-17 were the polyaromatic hydrocarbon compounds (PAHs). Individual PAH compounds were measured at levels ranged up to 59 mg/kg in the intervals between 0 and 6 feet. In the lowermost interval of soil (6 to 8 feet) PAH concentrations were much higher. Nine PAH compounds were measured in this interval at levels exceeding 1,000 mg/kg. The elevated PAH levels in OSB-17 apparently are related to the type of fill used in the area. The lowermost split-spoon sample obtained from OSB-17 was noted to contain a black granular fill. This material could possibly contain flyash or weathered asphalt.

In soil boring OSB-18, dichlorobenzene compounds were measured above 10 mg/kg in one sample (4 to 6 feet interval). The levels were 17 mg/kg for 1,3-dichlorobenzene and 24 mg/kg for 1,2-dichlorobenzene. 2,4,5-Trichlorobenzene was present in all four samples from OSB-18 at levels ranging from 210 mg/kg to 1,900 mg/kg. Hexachlorobenzene was present in two samples from OSB-18 at 5.8 mg/kg (2 to 4 feet) and 25 mg/kg (0 to 2 feet). No other semivolatile compounds were quantified above 10 ppm in soil samples from OSB-18.

6.2.3 Pesticides/PCB

Results for all chemicals detected in the pesticide/PCB analyses of soil samples from OSB-17 and OSB-18 are tabulated in Table 6-1. No PCB compounds were detected. Of the 15 pesticides detected in at least one sample, only alpha-BHC, beta-BHC and gamma-BHC were quantified above 10 mg/kg. The maximum pesticide concentration in samples from OSB-17 was 44 mg/kg for beta-BHC (2 to 4 feet). The maximum pesticide concentration for OSB-18 was 23 mg/kg of alpha-BHC (4 to 6 feet).

7.0
GROUNDWATER CONTAMINATION

A Quality Assurance review of all results of the groundwater analyses conducted as described in Section 3.2 is presented in Appendix D. All analytical results are tabulated in Appendix E. All detected compounds are tabulated on Table 7-1. The results of the groundwater analyses are summarized below.

7.1 MERCURY

Mercury concentrations in A-zone groundwater samples are plotted on Figure 7-1. The highest concentrations (approximately 200 ug/L) occur in the southeast section of Plant 2. This is southeast of the historic mercury source area at Plant 2 and may be indicative of migration down the slope of the top-of-bedrock. Elsewhere, mercury concentrations were approximately 10 ug/L or less. In the B-zone samples (Figure 7-2), the highest mercury levels (greater than 100 ug/L) were quantified in samples from OBA-1B and OBA-7B, located in the western portion of Plant 2. In B-zone wells east of Gill Creek, levels were reported to be less than 1 ug/L. Mercury results for C- and CD-zone wells are plotted on Figure 7-3. Only one well showed a concentration of greater than 1 ug/L (7.9 ug/L at OBA-7C).

7.2 ORGANIC CHEMICALS

7.2.1 Non-Aqueous Phase Liquid

A denser than water non-aqueous phase liquid (DNAPL) has been observed to collect in the bottom of well OBA-2C, located near Buffalo Avenue. The DNAPL was sampled and analyzed for the PAL. Compounds detected were chlorinated aliphatic volatile compounds (total of 29.8 percent), semivolatile organic chemicals (total of 4.7 percent) and pesticides (total of 0.06 percent). Concentrations of compounds quantified in the DNAPL sample are listed in Table 7-2. The predominance of volatile aliphatic organic compounds, which have not been used at the Plant in substantial quantities and were not found at high levels in soil samples, suggests an off-site source. The fact that the only observation of NAPL was in a deep monitoring well also suggests an off-site source. This is the only observation of NAPL in Olin monitoring wells to date.

7.2.2 Aqueous Contamination

7.2.2.1 Volatile Organic Chemicals

Concentrations of volatile organic chemicals detected in any groundwater sample are tabulated in Table 7-1. In general, the contaminants present at the highest concentrations in groundwater beneath the Olin Plant are the volatile organics, particularly the chlorinated aliphatic (i.e., non-aromatic) hydrocarbons. These chemicals have not been produced, or used to any substantial extent in production, at the Olin Plant. Figure 7-4 shows the distribution of total chlorinated aliphatic volatile organic compounds in A-zone groundwater. Levels are highest (3,000 to 5,000 ug/L) in the southeastern portion of Plant 2 and at OBA-3A. Figure 7-5 shows the distribution of total chlorinated aliphatic volatile organic compounds in the B-zone. Concentrations are highest (greater than 200,000 ug/L) along the south boundary of the Olin Plant. Figure 7-6 shows the distribution of total chlorinated aliphatic volatile organic compounds in the C- and CD-zone groundwater samples. The highest concentration was reported for the sample from OBA-2C (563,800 ug/L). As described in Section 7.2.1, this well contained several inches of NAPL. Levels exceeding 100,000 ug/L were also reported for the samples from OBA-1C and OBA-6C.

The only volatile organic compounds which are thought to be potentially associated with Olin activities at the plant are the aromatic compounds benzene and monochlorobenzene. Figure 7-7 shows the distribution of benzene in A-zone groundwater. Elevated benzene concentrations were reported for BH-3 (49,000 ug/L), OBA-3A (4,900 ug/L) and OBA-5A (76 ug/L). B-zone benzene concentrations are plotted on Figure 7-8. The highest concentrations were reported for samples from OBA-3B (7,100 ug/L) and OBA-5B (6,300 ug/L). C- and CD-zone benzene concentrations are plotted on Figure 7-9. Concentrations are below 1,000 ug/L except for OBA-3C (9,700 ug/L). Monochlorobenzene is discussed with other chlorinated benzene compounds in the following subsection.

7.2.2.2 Chlorinated Benzene Compounds

Concentrations of chlorinated benzene compounds (chlorobenzenes) detected in at least one groundwater sample are presented in Table 7-1. Chlorobenzenes were used or produced at the Olin Plant from 1950 through 1956. Chlorobenzenes were also used or produced by Solvent Chemical (3163 Buffalo Avenue Site) to the east. Figure 7-10 presents the distribution of total chlorinated benzene compounds (including monochlorobenzene, dichlorobenzenes, trichlorobenzenes and hexachlorobenzene) in A-zone groundwater samples. As with benzene, an elevated A-zone concentration is reported for BH-3. However, the highest concentration of chlorobenzenes is reported for OBA-3A. B-zone total chlorobenzenes are plotted on Figure 7-11. The highest concentration is again reported for cluster OBA-3B (17,730 ug/L). Concentrations in the eastern portion of Plant 2 range from 1,382 ug/L (OBA-2B) to 7,100 ug/L (OBA-5B). Figure 7-12 presents the C- and CD-zone distribution of total chlorobenzenes. The highest concentration of total chlorobenzenes is reported for OBA-3C (33,740 ug/L). Total concentrations elsewhere were reported to be less than 1,000 ug/L.

7.2.2.3 Chlorinated Phenols

Concentrations of chlorinated phenols measured above detection limits in at least one well are presented in Table 7-1. Chlorinated phenol compounds were produced or used at the Olin Plant from 1954-1956. Figure 7-13 presents the total chlorinated phenol concentrations for the A-zone wells. Chlorinated phenols were detected in three wells: OBA-3A (68 ug/L), BH-3 (47 ug/L) and OBA-7A (7 ug/L). Total chlorinated phenol concentrations are plotted for B-zone wells on Figure 7-14. The highest concentrations were reported for OBA-6B (646 ug/L), OBA-5B (279 ug/L) and OBA-2B (150 ug/L). Total chlorinated phenol concentrations for C- and CD-zone wells are plotted on Figure 7-15. The highest total concentration was present at OBA-7C (577 ug/L) with lesser levels at OBA-6C (130 ug/L).

7.2.2.4 Pesticides/PCBs

Concentrations of Pesticides/PCBs measured in any well above detection limits are presented in Table 7-1. BHC was produced in the section of Plant 2 between Alundum

Road and Gill Creek (ARGC area) from 1950 through 1956. BHC compounds were the only pesticides consistently detected in groundwater at the Plant. A-zone total BHC concentrations are plotted on Figure 7-16. The highest concentrations were reported for wells BH-3 (1,274 ug/L) and OBA-5A (422.9 ug/L). Figure 7-17 presents total BHC concentrations for B-zone monitoring wells. The highest total concentration in B-zone samples of 275 ug/L was reported for OBA-5B. C- and CD- zone total BHC concentrations are presented on Figure 7-18. The highest concentrations were reported for OBA-6C (42.32 ug/L) and OBA-4C (39.3 ug/L).

No PCB compounds were detected in any sample.

7.2.2.5 Methanol

Methanol was used at the Olin plant from 1941 until 1990. Methanol concentrations in groundwater samples are presented in Table 7-1. Concentrations exceeding 10 mg/L were limited to monitoring wells OBA-5B (68 mg/L), OBA-6A (1,570 mg/L), OBA-6B (161 mg/L) and OBA-8B (75 mg/L).

7.3 CONTAMINANT MIGRATION

Of the chemicals detected in groundwater, the following appear to have sources potentially related to the Olin Plant operations:

Mercury
Benzene
Chlorinated benzene compounds
Chlorinated phenol compounds
BHC compounds
Methanol

The highest concentrations of mercury occur in the southeast portion of Plant 2 in the A-zone, but at the western portion of Plant 2 for the B-zone and C/CD-zone. This suggests that mercury-containing groundwater has migrated southeasterly from the source areas located in the north section of Plant 2, probably down the slope of the bedrock ridge. Within the B-zone and C/CD-zone, migration appears to be westerly toward the production wells.

The organic chemicals listed above were used or produced over a period of several years in the area of Plant 2 between Gill Creek and Alundum Road (ARGC area). Chlorinated phenol levels in the A-zone are relatively low in the ARGC area, but show an order-of-magnitude increase in the B-zone samples. This is consistent with the presence of relatively distinct source areas in the overburden with little horizontal migration (and therefore lack of widespread contamination) in the A-zone. Rather, leakage and subsequent migration within the B-zone occurs. A similar pattern is observed for the BHC compounds, except that the highest levels are encountered in the A-zone, perhaps due to the lower mobility of BHCs or proximity of samples to the source area.

Benzene and chlorinated benzene levels are elevated in the ARGC area within the A- and B-zones with some westerly migration toward the production wells occurring in the B- and C/CD-zones.

Benzene and chlorinated benzene compounds were present at very high concentrations in all wells at well cluster OBA-3, probably due to an off-site source. Cluster OBA-3 is adjacent to a facility currently being investigated under a NYSDEC Consent Order. This site, referred to as the 3163 Buffalo Avenue Site, is located approximately 200 feet east of well cluster OBA-3 and has been documented to contain chlorinated benzene contamination in both aqueous and non-aqueous phases. According to the Remedial Investigation (RI) conducted for the Site, contaminant migration is in the direction of well cluster OBA-3.

But it doesn't explain the presence of BHC's

Volatile aliphatic hydrocarbons have not been used at the Olin Plant in substantial quantity. The distribution of contamination (e.g., highest levels in the deeper bedrock) is consistent with that which would be associated with an off-site source.

8.0
PRELIMINARY MAN-MADE PASSAGEWAYS ASSESSMENT

In this section major plant sewer systems are assessed with respect to their potential for acting as preferential pathways for off-site migration of contaminated groundwater. The primary characteristic used to determine if a sewer is a potentially significant preferential pathway for groundwater contaminant migration is its location relative to the top-of-bedrock. As described in Section 4.3, the first major water-bearing zone for groundwater flow beneath the Plant is the interval spanning the lower two feet of overburden and the weathered upper bedrock. Pipes and/or backfill above bedrock will not create a substantial hydraulic depression, even if susceptible to infiltration, because the saturated zone in the overburden is so thin. For example, Figure 8-1 shows a plot of the subtraction of the A-zone potentiometric surface for July 1991 from the top-of-bedrock surface. While this does not necessarily present an accurate portrayal of the overburden saturated thickness because of potential head loss or increase due to penetration of the weathered bedrock, it does provide an approximation if one assumes that there is not a major permeability contrast between the two units. The overburden saturated zone estimated in this manner ranged from approximately zero to three feet. Therefore, for a permeable conduit to cause a substantial hydraulic depression it must be constructed several feet into the bedrock.

look in vicinity of OB1A-4 drawdown is not likely due to sewer inflow

Other factors evaluated in assessing potential for preferential transport along storm sewers were the groundwater potentiometric surfaces and the distribution of contaminants. The potentiometric surface plots were examined to located hydraulic depressions which could be related to infiltration to sewers (or backfill). The distribution of chemical contaminants was evaluated with respect to any linearity of concentrated zones which could be related to preferential contaminant migration.

There are seven sewer systems in the Plant 1 area and six sewer systems in the Plant 2 area. Appendix F presents a compilation of surface elevation, bottom elevation and pipe dimensions along each sewer system. These data were evaluated with respect to the top-of-bedrock surface, the groundwater potentiometric surfaces and the chemical contaminant distributions in groundwater.

Figures 8-2 and 8-3 show the locations of the sewer systems located within Plant 1 and Plant 2, respectively. Each system is evaluated below.

8.1 PLANT 1 SEWER SYSTEMS

8.1.1 Clear Water Sewer Systems

In the Plant 1 area, there are two clear water sewer systems (designated 1CW and 2CW) which discharge to the Buffalo Avenue Diversion Sewer. The Buffalo Avenue Diversion Sewer carries stormwater and permitted discharges to the Niagara River. In the vicinity of the Plant 2 connections, the Buffalo Avenue Diversion Sewer is a 60-inch pipe excavated into the bedrock. Its potential impact on groundwater flow is further discussed in Section 8.3.

The 1CW sewer system runs south to north in the western portion of Plant 1. The pipes are above bedrock except in the immediate vicinity of the connection with the Buffalo Avenue Diversion Sewer (manholes 94 and 96). Therefore, the 1CW system does not represent a substantial potential for causing preferential off-site groundwater flow and contaminant migration.

The 2CW system, portions of which have been abandoned and plugged, runs south to north in the eastern portion of Plant 1. The 2CW system is also above the bedrock at all locations except in the immediate vicinity of its connection with the Buffalo Avenue Diversion Sewer. Therefore the 2CW system does not represent a substantial potential for causing preferential off-site groundwater flow and contaminant migration.

8.1.2 Sanitary Sewer Systems

There are four sanitary systems which have been used in Plant 1. These are the 1S, 2S, 3S and 9S systems. Each of these connects to a city sanitary sewer which runs down Buffalo Avenue (Buffalo Avenue Sanitary Sewer) to the city wastewater treatment plant. Each of these sanitary sewer systems appears to be located above the bedrock except in the immediate vicinity of the connections with the Buffalo Avenue Sanitary Sewer, which is excavated into bedrock along the section of Buffalo Avenue north of Plant 1. These systems therefore do not appear to present a major potential for preferential off-site groundwater flow and contaminant migration. The Buffalo Avenue Sanitary Sewer is further discussed in Section 8.3.

8.2 PLANT 2 SEWER SYSTEMS

8.2.1 Clear Water Sewer Systems

There are two clear water sewer systems located at Plant 2. Both run south to north and connect to the Buffalo Avenue diversion sewer, which is a 48-inch pipe excavated into bedrock near Plant 2. Both these systems, 3CW and 4CW, are above bedrock on-site and do not present a substantial preferential pathway for off-site groundwater flow and contaminant migration.

8.2.2 Sanitary Sewer Systems

There are four sanitary sewer systems in the Plant 2 area: 5S, 6S, 7S and 8S. Each discharges directly or via the Chemical Road sewer to a sanitary sewer along Buffalo Avenue. The sanitary sewer beneath Buffalo Avenue adjacent to Plant 2 flows west to east from Chemical Road to 27th Street where it connects to a sewer running northward under 27th Street to the Southside Interceptor Tunnel. From the eastern boundary of Plant 2, the sanitary sewer runs east to west to the connection at 27th Street. These sanitary sewers are excavated into bedrock.

The 5S system is above grade until the vicinity of its connection to the Sanitary Sewer on Buffalo Avenue and as such does not represent a substantial potential for causing preferential groundwater flow.

The 6S and 8S sewer systems are located in the southwest portion of Plant 2 and connect to a sanitary sewer running south to north under Chemical Road (Du Pont property). These systems are above bedrock on Olin property, except possibly in the immediate vicinity of the Chemical Road connections. The invert elevations at manholes 108 (6S) and 88 (8S) are very close, but probably not below, the interpolated top-of-bedrock elevation. Therefore, these sewer systems do not appear to be potential conduits for preferential off-site groundwater flow and contaminant migration. Manhole 109 on the Chemical Road Sewer is below the interpolated top-of-bedrock elevation. The Chemical Road Sewer is discussed further in Section 8.3.

The 7S sewer system is excavated into bedrock throughout most of the length of its main trunk which runs south to north under Alundum Road. As such, it represents a potential pathway for preferential off-site groundwater flow and contaminant migration.

8.3 OFF-SITE SEWERS

Three nearby off-site sewers were identified to be excavated into bedrock and therefore represent a potential concern with respect to preferential groundwater migration. These include:

Chemical Road Sewer
Buffalo Avenue Diversion Sewer
Buffalo Avenue Sanitary Sewers

Adams Ave Sewer especially along Gill Creek
O/C

The Buffalo Avenue sewers are approximately 10 feet or less below the top-of-bedrock. The Chemical Road sewer probably penetrates bedrock to a lesser extent (based on elevation data from the Olin systems connecting to it), however no invert elevation data was obtained for the main trunk of the Chemical Road Sewer. South of the Plant, along Adams Avenue, there is a sewer running east-west. Although there are no current connections with the Olin Plant systems, because of its proximity to the Plant, an attempt will be made to obtain or measure invert elevations along this sewer. / yes

8.4 SUMMARY AND PRELIMINARY CONCLUSIONS

Four sewers on or near the Plant were found to represent a substantial potential for causing preferential flow. These were:

Plant 2 7S system (on-plant)
Chemical Road Sewer (off-plant)
Buffalo Avenue Diversion Sewer (off-plant)

Buffalo Avenue Sanitary Sewers (off-plant)

Each of these sewers/excavations was identified as having a potential for receiving groundwater discharge. In order for substantial groundwater infiltration to occur, the installation trench must either physically penetrate the water-bearing zone, or be in close hydraulic connection via vertical fractures. If a fracture zone is not directly penetrated, or in close hydraulic connection, it would take a relatively high upward hydraulic gradient to induce water flow out of the water-bearing fractures, which are of very high hydraulic conductivity.

The main trunk of the 7S sewer system is excavated approximately 5 to 6 feet into bedrock along its traverse across Plant 2. This indicates that the bottom of the installation trench is about 4 to 5 feet above the B-zone bedding plane fractures. The hydraulic head at monitoring well OBA-6B (558 feet to 559 feet), located adjacent to the main trunk of the 7S system, is below the invert elevation of the sewer along that stretch (559 feet). Leakage upward from the B-zone into the 7S system is not occurring in this vicinity. The inverts of the 7S system are below the measured water levels in the A-zone. The potentiometric surface maps do not show a depression in the A-zone hydraulic head near the sewers, indicating that if infiltration is occurring, it is not widespread. Therefore, the 7S system does not likely represent a substantial pathway for off-site migration of contaminants with sources on the Olin Plant. However, based on the high downward vertical gradient between the A- and B-zones, contaminants in the pipe or trench could leak downward to the B-zone.

must factor in sewer bedding too

The Chemical Road Sewer is probably similar in elevation to the main trunk of the 7S system, based on invert elevations of connecting pipes and its destination. The property owner will be contacted to determine if elevation data are available for this sewer. If these data are unavailable, Olin will request permission to measure invert elevations as part of the RFI.

The sewers along Buffalo Avenue are located in an installation trench excavated approximately 6 to 10 feet into the bedrock. Therefore the A-zone groundwater is directly intercepted. The projected B-zone elevations are generally a foot or more below the installation trench elevation. However, the B-zone is in closer proximity than for the

NOT according to Golder

Recycled Paper

other sewers and is likely closely connected hydraulically to the installation trench.

Hydraulic heads measured at well cluster OBA-2 indicate that the overburden and upper few feet of bedrock are dewatered in the vicinity of Buffalo Avenue. The CCR reports similar conditions occurring along the section of Buffalo Avenue between Gill Creek and Alundum Road (based on the Harza study in 1979). The potentiometric surface maps show a depression in the A-zone groundwater along Buffalo Avenue, although this may also be the natural direction of A-zone groundwater flow. The B-zone shows no discernable hydraulic impact of the Buffalo Avenue Sewers.

Vertical hydraulic gradients are strongly downward from the A- through CD-zones in the vicinity of the Buffalo Avenue Sewers. If the installation trench has exposed or enhanced vertical fracturing, leakage out of the pipe and/or trench could impact on-site B- and C/CD-zone groundwater. Elevated levels of contamination measured in samples from wells OBA-2C and OBA-1C could be related to leakage of contaminated water out of the sewer line or its installation trench.

In summary, the on-Plant hydraulic impact of each of the identified sewers appears to be limited to the A-zone. However, the impacts are not widespread and since A-zone contaminant levels near these structures are generally very low, there does not appear to be a major potential for off-plant migration of groundwater contamination via these conduits. The remaining three rounds of groundwater samples will provide more data concerning groundwater quality near the sewers. Additional data will also be generated from the expansion of the groundwater monitoring program described in Section 9.2. Invert elevations will be obtained for the Chemical Road Sewer and Adams Avenue Sewer and included in the RFI.

9.0
ADEQUACY OF SAMPLING PROGRAMS

The Work Plan states that soil and groundwater contamination will be characterized to form the basis for an evaluation (in the RFI Report) of the potential for off-site transport and environmental impact. The adequacy of the soil sampling program and monitoring well network with respect to providing sufficient data for this evaluation is discussed below.

9.1 SOILS

9.1.1 Mercury Contamination

Mercury has been (and is) routinely analyzed for in excavations (for determination of soil handling procedures) at the Olin Plant. These data indicate that some level of mercury contamination is present in soils throughout the historic operating plant areas. A total of 40 soil samples located near former Solid Waste Management Units (SWMUs) within the Plant 2 area were collected for the RFI and analyzed for total mercury. Analytical results ranged from not detected (at 0.1 mg/kg) to 626 mg/kg and averaged 91.2 mg/kg. In the early to mid 1980s, soil borings were performed for construction purposes at 12 locations in Plant 2, without regard to the plant operating history (as described in the CCR). Mercury concentrations ranged from not detected to 204 mg/kg and averaged 50 mg/kg. These numbers are comparable to those collected for the RFI to investigate SWMUs. Considering the low mobility of mercury, if the SWMUs were the source of the widespread mercury contamination one would generally expect much higher levels closer to the units. This is clearly not the case for most SWMUs. The mercury distribution at the plant is more characteristic of emission and effluents occurring over nearly 100 years of mercury cell operation at the facility. As such, additional soil sampling for mercury analyses at locations throughout the historically operating plant areas would be expected to yield levels in the ranges described above.

any pre plant point

including liquid Hg?! Not

There was one observation of elemental mercury beads during the field investigations.

Several small beads of elemental mercury were noted in the sample obtained from the 6 to 8 foot interval in soil boring OSB-1. The TCLP mercury analytical result for this sample (8.6 ug/L) indicates a relatively low potential for leaching and causing aqueous groundwater contamination. Relatively low mercury concentrations measured at well cluster OBA-8 (see Figures 7-1, 7-2 and 7-3), located approximately 200 feet to the west of OSB-1, support this assertion.

The Plant is almost entirely paved and access will be restricted for the foreseeable future. Unless these conditions are changed, the primary route of off-site migration of mercury soil contamination involves leaching to groundwater and subsequent groundwater transport. Additional soil sampling for mercury analysis is therefore not needed for the RFI, since groundwater sampling will address the primary potential migration pathway.

they have sampled the lower bottom of the former cells?

9.1.2 Organic Chemical Contamination

In contrast to the mercury distribution in soil, data presented in the CCR indicate that concentrations of BHC and chlorinated benzene compounds are higher near the former BHC production and storage areas. A major source was when the production facility exploded and was destroyed in 1956. The first round of groundwater analyses collected for the RFI show that elevated levels of potential Olin contaminants (BHC, chlorinated benzene and phenol compounds) are limited primarily to the ARGC area in the A- and B-zones. These data support the conclusion that the on-plant sources of organic chemicals are the soils near the former production and storage areas.

As discussed in Section 7.0, there appear to be off-plant sources for aliphatic volatile organic chemicals and both on-plant and off-plant sources of chlorinated benzene compounds.

The AGRC area is largely paved, and access is completely controlled. The primary route of potential off-site migration of organic soil contaminants is via leaching and subsequent groundwater migration. Therefore, the focus of the RFI is primarily on groundwater contaminant migration. Additional soil sampling and analyses for organic chemicals will not substantively add to the investigation.

In summary, additional soil sampling and analyses for mercury and/or organic chemicals is not required for completion of the RFI.

9.2 GROUNDWATER

9.2.1 Vertical Extent of Groundwater Contamination

probably want some off-site deeper wells or wells on limit of well 2 capture zone

Monitoring wells are not needed deeper than the C- and CD-zone wells currently installed for the Olin RFI. Although some contamination has reached the C- and CD-zones, groundwater flow in these zones is toward the production wells and treatment system. Furthermore, as described in Section 4.3, groundwater hydraulic head data from investigations of deeper bedrock water bearing zones show that the vertical hydraulic gradients are upward from lower bedrock fracture zones to the C- and CD-zones. Du Pont studies also show that within the next two lower water-bearing fracture zones in the Lockport Dolomite (termed the D- and F-zones by Du Pont), the production wells effect a cone-of-depression extending approximately to Gill Creek. Therefore, leakage from the C- and CD-zones to deeper bedrock water-bearing fracture zones does not present a major pathway for off-site solute transport in groundwater.

9.2.2 Horizontal Extent of Contamination

Potential off-site groundwater flow and contaminant migration is not sufficiently characterized using the current monitoring well network at the following areas:

1. Southeast corner of the ARGC area of Plant 2, with respect to potential seepage of shallow groundwater into Gill Creek.

2. North of Plant 2 across Buffalo Avenue.

3. Northwestern Plant 1.

Each location is discussed in more detail below.

It is unclear whether seepage of contaminated groundwater is occurring from the A-zone to Gill Creek in the southeastern portion of the ARGC area. Installation and monitoring of two A-zone wells, one adjacent to each streambank would provide data concerning whether seepage to Gill Creek is occurring and, if so, the chemical quality of the seepage.

North of Buffalo Avenue, a well cluster (A-, B- and C/CD-zone wells) is needed to determine whether contamination has migrated past sanitary sewers on Buffalo Avenue and the Buffalo Avenue Diversion Sewer. This cluster would also provide data concerning the production well cone-of-depression in this area. It is possible that existing wells used for the Industrial Welding Site Remedial Investigation (RI) could be incorporated into this cluster.

A monitoring well cluster (A-, B- and C/CD-zone wells) located near the northwestern corner of Plant 1 would provide data required to investigate the following:

1. The production well cone-of-depression in this area.

2. Chemical contamination levels in groundwater close to the Buffalo Avenue Sewers at this location.

3. Groundwater hydraulic heads compared to the Buffalo Avenue Sewers.

In total, eight additional monitoring wells are recommended to be installed and sampled during the last two quarterly sampling events. The approximate locations of these wells are shown on Figure 9-1. RFI schedule impacts associated with installation and sampling of additional wells will depend upon USEPA's response or approval of this Interim Report.

10.0 CONCLUSIONS AND RECOMMENDATIONS

10.1 SOIL SAMPLING

As described in Section 9.1, Plant soils have been sufficiently characterized for the Olin RFI. No further soil sampling is recommended.

10.2 GROUNDWATER MONITORING WELL NETWORK

For the reasons described in Section 9.2, eight additional monitoring wells are recommended to be installed and sampled prior to completion of the RFI. These wells will generate data concerning potential seepage to Gill Creek, off-site groundwater flow to the north and the production well cone-of-influence in the northwestern portion of Plant 1.

10.3 MAN-MADE PASSAGEWAYS

Four underground sewer lines (one on-Plant, three off-plant) were identified as having the potential to cause preferential groundwater migration. These are:

Plant 2 7S system (on-Plant)
Chemical Road Sewer (off-Plant)
Buffalo Avenue Diversion Sewer (off-Plant)
Buffalo Avenue Sanitary Sewers

However, based on pipe or installation trench elevation, the on-Plant groundwater hydraulic head distribution and the chemical quality of groundwater in the vicinity of these sewers, they appear to represent little potential for enhancing off-Plant contaminant migration.

11.0
LIMITATIONS

WCC's work is in accordance with our understanding of professional practice and environmental standards existing at the time the work was performed. Professional judgements presented are based on our evaluation of technical information gathered and on our understanding of site conditions and site history. Our analyses, interpretations, and judgements rendered are consistent with professional standards of care and skill ordinarily exercised by the consulting community and reflect the degree of conservatism WCC deems proper for this project at this time. Methods are constantly changing and it is recognized that standards may subsequently change because of improvements in the state of the practice.

The information used for this investigation is presented in this report and includes boring logs, water level elevations, and soil and water quality analyses. Boring logs reflect subsurface conditions at the indicated locations. WCC has endeavored to collect soil and water samples which are representative of site conditions. Soil and water quality samples, however, can only represent a small portion of the subsurface conditions in the area, both in volume and through time. The interpretations made in this report are based on the assumption that subsurface conditions do not deviate appreciably from those found during our field investigations.

12.0
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Tables

TABLE 3-1

PROJECT ANALYTE LIST

TCL VOLATILES

Chloromethane
Bromomethane
Vinyl Chloride
Chloroethane
Methylene Chloride
Acetone
Carbon Disulfide
1,1-Dichloroethene
1,1-Dichloroethane
1,2-Dichloroethene
Chloroform
1,2-Dichloroethane
2-Butanone
1,1,1-Trichloroethane
Carbon Tetrachloride
Vinyl Acetate
Bromodichloromethane
1,2-Dichloropropane
cis-1,3-Dichloropropene
Trichloroethene
Dibromochloromethane
1,1,2-Trichloroethane
Benzene
trans-1,3-Dichloropropene
Bromoform
4-Methyl-2-pentanone
2-Hexanone
Tetrachloroethene
Toluene
1,1,2,2-Tetrachloroethane
Chlorobenzene
Ethyl Benzene
Styrene
Xylenes

TABLE 3-1 (continued)

PROJECT ANALYTE LIST

NON-TCL VOLATILES

Methanol

TCL SEMI-VOLATILES

Phenol
bis(2-Chloroethyl)ether
2-Chlorophenol
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Benzyl alcohol
1,2-Dichlorobenzene
2-Methylphenol
bis(2-Chloroisopropyl)ether
4-Methylphenol
N-Nitroso-di-n-propylamine
Hexachloroethane
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol
Benzoic acid
bis(2-Chloroethoxy)methane
2,4-Dichlorophenol
1,2,4-Trichlorobenzene
Naphthalene
4-Chloroaniline
Hexachlorobutadiene
4-Chloro-3-methylphenol(para-chloro-meta-cresol)
2-Methylnaphthalene
Hexachlorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
2-Chloronaphthalene
2-Nitroaniline
Dimethylphthalate

TABLE 3-1 (continued)

PROJECT ANALYTE LIST

TCL SEMI-VOLATILES (continued)

Acenaphthylene
2,6-Dinitrotoluene
3-Nitroaniline
Acenaphthene
2,4-Dinitrophenol
4-Nitrophenol
Dibenzofuran
2,4-Dinitrotoluene
Diethylphthalate
4-Chlorophenyl-phenyl ether
Fluorene
4-Nitroaniline
4,6-Dinitro-2-methylphenol
N-nitrosodiphenylamine
4-Bromophenyl-phenylether
Hexachlorobenzene
Pentachlorophenol
Phenanthrene
Anthracene
Di-n-butylphthalate
Fluoranthene
Pyrene
Butylbenzylphthalate
3,3'-Dichlorobenzidine
Benzo(a)anthracene
Chrysene
bis(2-Ethylhexyl)phthalate
Di-n-octylphthalate
Benzo(b)fluoranthene

TABLE 3-1 (continued)

PROJECT ANALYTE LIST

NON-TCL SEMI-VOLATILES

Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenz(a,h)anthracene
Benzo(g,h,i)perylene
3-Chlorophenol
4-Chlorophenol
2,3-Dichlorophenol
2,5-Dichlorophenol
3,4-Dichlorophenol
3,5-Dichlorophenol
2,3,4-Trichlorophenol
2,3,5-Trichlorophenol
2,3,6-Trichlorophenol
3,4,5-Trichlorophenol
2,3,4,5-Tetrachlorophenol
2,3,5,6-Tetrachlorophenol
2,3,4,6-Tetrachlorophenol

PESTICIDES/PCBs

alpha-BHC
beta-BHC
delta-BHC
gamma-BHC (Lindane)
Heptachlor
Aldrin
Heptachlor epoxide
Endosulfan I
Dieldrin
4,4'-DDE
Endrin
Endosulfan II
4,4'-DDD
Endosulfan sulfate
4,4'-DDT

TABLE 3-1 (continued)

PROJECT ANALYTE LIST

PESTICIDES/PCBs (continued)

Methoxychlor
Endrin ketone
alpha-Chlordane
gamma-Chlordane
Toxaphene
Aroclor-1016
Aroclor-1221
Aroclor-1232
Aroclor-1242
Aroclor-1248
Aroclor-1254
Aroclor-1260

TAL INORGANICS

Mercury

TABLE 3-2

SUMMARY OF PUMPING RATES: PRODUCTION WELL PUMPING STUDY
OLIN NIAGARA FALLS PLANT RFI

Step	Date/Time Started	Date/Time Ended	Approximate Pumping Rate
Step 1	2/7/91 1:00PM	2/11/91 11:36AM	0 gpm (Recovery)
Step 2	2/11/91 11:36AM	2/14/91 1:00PM	400-500 gpm
Step 3	2/14/91 1:00PM	2/19/91 11:00AM	1000 gpm
Step 4	2/19/91 11:00AM	2/21/91 11:00AM	1300-1600 gpm

TABLE 3-3

PRODUCTION WELL PUMP TEST: OBSERVATION WELLS
OLIN NIAGARA FALLS PLANT RFI

Observation Well	Measurement Method
OBA-1A	Manual
OBA-2A	Manual
OBA-3A	Manual
OBA-4A	Manual
OBA-5A	Manual
OBA-6A	Manual
OBA-7A	Manual
OBA-8A	Manual
OBA-1B	Continuous
OBA-2B	Manual
OBA-3B	Manual
OBA-4B	Manual
OBA-5B	Manual
OBA-6B	Manual
OBA-7B	Continuous
OBA-8B	Continuous
OBA-1C	Continuous
OBA-2C	Manual
OBA-3C	Manual
OBA-4C	Manual
OBA-5C	Manual
OBA-6C	Manual
OBA-7C	Continuous
OBA-8C	Continuous
BH-1	Manual

TABLE 3-3 (continued)

PRODUCTION WELL PUMP TEST: OBSERVATION WELLS
OLIN NIAGARA FALLS PLANT RFI

Observation Well	Measurement Method
BH-3	Manual
Gill Creek	Continuous
North Well	Continuous
South Well	Manual
OBA-14A	Continuous
OBA-14C	Continuous
OBA-15A	Continuous
OBA-15C	Continuous
OBA-15CD	Continuous
OBA-19A	Continuous
OBA-19B	Continuous
OBA-19C	Continuous
OBA-19CD1	Continuous
OBA-19CD2	Manual
OBA-20A	Manual
OBA-20B	Continuous
OBA-22A	Manual
OBA-22B	Manual
OBA-22C	Manual
OBA-26C	Manual/Continuous
OBA-26CD	Manual/Continuous

TABLE 5-1

RESULTS OF SLUG TESTS: A-ZONE MONITORING WELLS
OLIN NIAGARA FALLS PLANT RFI

		Estimated Hydraulic Conductivity (ft/min)[1]	
Well	**Date Tested**	**Falling Head Test**	**Rising Head Test**
OBA-1A	1/22/91	$5.9x10^{-5}$ [2]	$1.4x10^{-4}$ [2]
OBA-2A	(3)	-----	-----
OBA-3A	1/25/91	$2.3x10^{-2}$	$2.6x10^{-2}$
OBA-4A	(3)	-----	-----
OBA-5A	1/24/91	$1.3x10^{-2}$	$1.2x10^{-2}$
OBA-6A	1/23/91	$2.3x10^{-4}$ [2]	$1.9x10^{-4}$ [2]
OBA-7A	1/24/91	$9.7x10^{-4}$ [2]	$8.4x10^{-4}$ [2]
OBA-8A	1/22/91	$2.0x10^{-5}$ [2]	$5.0x10^{-5}$ [2]

(1) - Method of Bower and Rice (1976) used to estimate hydraulic conductivity
(2) - Test results likely impacted by sandpack
(3) - Insufficient volume of water in well to perform slug test

TABLE 5-2

RESULTS OF SLUG TESTS: B-ZONE AND C-ZONE MONITORING WELLS
OLIN NIAGARA FALLS PLANT RFI

Well	Date Tested	Estimated Transmissivity Falling Head Test	(ft^2/min)(1) Rising Head Test
OBA-1B	1/22/91	$8.5x10^{-1}$	$8.3x10^{-1}$
OBA-2B	1/24/91	2.9	-----(2)
OBA-3B	1/25/91	$1.6x10^{-3}$	$4.9x10^{-4}$
OBA-4B	1/23/91	$1.1x10^{-2}$	$1.3x10^{-2}$
OBA-5B	1/24/91	$3.2x10^{-1}$	$4.7x10^{-1}$
OBA-6B	1/23/91	$5.7x10^{-1}$	$9.7x10^{-1}$
OBA-7B	1/24/91	$1.6x10^{-1}$	$4.3x10^{-1}$
OBA-8B	1/22/91	1.1	1.6
OBA-1C	1/22/91	$1.2x10^{-1}$	$1.0x10^{-1}$
OBA-2C	1/24/91	$6.6x10^{-3}$	$6.1x10^{-3}$
OBA-3C	1/25/91	$1.8x10^{-2}$	$1.6x10^{-2}$
OBA-4C	1/23/91	86.5	-----(2)
OBA-5C	1/24/91	$3.1x10^{-1}$	$5.2x10^{-2}$
OBA-6C	1/23/91	$3.8x10^{-3}$	$3.4x10^{-3}$
OBA-7C	1/24/91	$4.6x10^{-1}$	1.6
OBA-8C	1/22/91	6.0	1.1

(1) - Method of Cooper et. al. (1967) used to estimate transmissivity
(2) - Response too rapid for accurate measurement

TABLE 6-1

OLIN NIAGARA PLANT RFI
SUBSURFACE SOIL INVESTIGATION
MERCURY RESULTS

BORING ID		TOTAL Hg(mg/kg)	TCLP Hg (ug/L)
OSB-1	0'-2'	0.40	ND0.2
	2'-4'	458	1.6
	4'-6'	167	0.6
	6'-8'	624	8.6
	8'-10'	1210	2.9
OSB-2	0'-2'	6.5	ND0.2
	4'-6'	0.41	0.2
OSB-3	0'-2'	2.3	0.2
	2'-4'	0.77	ND0.2
	4'-6'	0.44	ND0.2
Dup	4'-6'	0.98	ND0.2
	6'-8'	ND0.10	ND0.2
OSB-4	0'-2'	56.9	0.4
	2'-4'	2.9	2.4
OSB-5	0'-2'	11.4	0.2
	2'-4'	35.4	0.9
	4'-6'	1.3	ND0.2
OSB-6	0'-2'	78.6	3.7
Dup	0'-2'	65.6	3.2
	3'-5'	55.0	6.6
	5'-7'	6.5	ND0.2
	7'-9'	1.7	0.8
OSB-7	0'-2'	21.1J	1.3J
	2'-4'	7.8J	ND0.2
OSB-8	0'-2'	29.8J	1.3J
	2'-4'	18.5J	0.3J
OSB-9	0'-2'	23.7J	ND0.2
	2'-4'	112J	4.6J
OSB-10	0'-2'	250J	13.2J
	2'-4'	626J	14.2J
Dup	2'-4'	1920J	10.7J
OSB-11	0'-2'	588J	31.7J
	2'-4'	165J	2.5J
OSB-12	0'-2'	50	3.2
	2'-4'	63	16.3
OSB-13	0'-2'	418	8.6
	2'-4'	95.4	1.5
OSB-14	0'-2'	113	1.1
	2'-4'	95.2	1.4

TABLE 6-1 (continued)

OLIN NIAGARA PLANT RFI (continued)
SUBSURFACE SOIL INVESTIGATION
MERCURY RESULTS

BORING ID		TOTAL Hg(mg/kg)	TCLP Hg (ug/L)
OSB-15	0'-2'	27.5	1.2
	2'-4'	104	0.3
OSB-16	0'-2'	8.3	ND0.2
	2'-4'	5.2	0.2
Dup	2'-4'	4.0	ND0.2
	4'-6'	15.7	ND0.2
	6'-8'	No Result[1]	ND0.2
OSB-17	0'-2'	Not Analyzed[2]	Not Analyzed[2]
	2'-4'	Not Analyzed	Not Analyzed
	4'-6'	Not Analyzed	Not Analyzed
	6'-8'	Not Analyzed	Not Analyzed
OSB-18	0'-2'	404	4.0
Dup	0'-2'	464	6.5
	2'-4'	161	5.1
	4'-6'	1.7	0.5
	6'-8'	11.9	1.3

Rinsate Blanks	Total Hg(ug/L)
RB-1	0.2
RB-2	57.7
RB-3	ND0.2
RB-4	0.7
RB-5	ND0.2

NS - Not sampled
ND - Not detected, applicable detection limit listed
J - Indicates an estimated value due to outlying QC criteria and/or indicates detection above the method detection limit (MDL) but less than the practical quantitation limit (PQL).
E - Compound whose concentration exceeds the calibration range of the GC/MS instrument but was diluted below the instrument detection limit on subsequent dilution runs.
R - Data found to be unusable as a result of outlying QC criteria.
U - The material was analyzed for but was not detected. The numerical value is the sample quantitation limit and has been adjusted to reflect contamination from laboratory or field activities.
UJ - Estimated quantitation limit

Notes:

(1) - Total mercury analysis not performed due to laboratory error
(2) - Total and TCLP mercury analysis not performed as per RFI Work Plan

TABLE 6-2

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI SOIL SAMPLES
NIAGARA FALLS, NEW YORK

Sample ID	OSB-17 0'-2'	OSB-17 2'-4'	OSB-17 4'-6'	OSB-17 6'-8'	OSB-18 0'-2'	Dup OSB-18 0'-2'	OSB-18 2'-4'	OSB-18 4'-6'
Sample Date	10/18/91	10/18/91	10/18/91	10/18/91	10/18/91	10/18/91	10/18/91	10/18/91
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Compounds								
<u>TCL - VOAS</u>								
Methylene chloride	0.002J	0.0005J	0.001J	0.001J	ND0.006	ND0.006	ND0.006	ND0.006
Acetone	ND0.011	ND0.010	0.008J	0.012J	0.016J	0.034J	0.034J	0.045J
Chloroform	0.006	0.007	0.004J	0.009	0.016	0.017	0.008	0.001
1,2-dichloropropane	ND0.006	ND0.005	ND0.006	ND0.006	ND0.006	ND0.006	ND0.006	ND0.006
Trichloroethene	0.002J	0.002J	0.0007J	0.002J	0.0009J	0.001J	0.0009J	ND0.006
Benzene	0.003J	0.002J	ND0.006	0.003J	0.003	0.003J	0.003J	0.002J
Tetrachloroethene	0.002J	0.002J	0.002J	0.003J	0.008	0.007	0.015	0.009
Toluene	0.0005J	ND0.005	ND0.006	0.0006J	0.001J	ND0.006	ND0.006	ND0.006
Chlorobenzene	0.003J	0.002J	0.002J	0.003J	0.002J	ND0.006	0.020	22
Total xylenes	ND0.006	ND0.005	ND0.006	ND0.006	ND0.006	ND0.006	ND0.006	ND0.006

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TABLE 6-2 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI SOIL SAMPLES
NIAGARA FALLS, NEW YORK

Sample ID	OSB-18 6'-8'	RB-5 Rinsate
Sample Date	10/18/91	10/18/91
Units	mg/kg	ug/L
Compounds		
TCL - VOAS		
Methylene chloride	ND0.006	ND5
Acetone	ND0.012	ND10
Chloroform	0.003J	ND5
1,2-dichloropropane	ND0.006	3J
Trichloroethene	ND0.006	ND5
Benzene	0.002J	ND5
Tetrachloroethene	0.009	ND5
Toluene	0.001J	ND5
Chlorobenzene	0.015J	4J
Total xylenes	0.003J	ND5

NS - Not sampled
ND - Not detected, applicable detection limit listed
J - Indicates an estimated value due to outlying QC criteria and/or indicates detection above the method detection limit (MDL) but less than the practical quantitation limit (PQL).
E - Compound whose concentration exceeds the calibration range of the GC/MS instrument but was diluted below the instrument detection limit on subsequent dilution runs.
R - Data found to be unusable as a result of outlying QC criteria.
U - The material was analyzed for but was not detected. The numerical value is the sample quantitation limit and has been adjusted to reflect contamination from laboratory or field activities.
UJ - Estimated quantitation limit

TABLE 6-2 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI SOIL SAMPLES
NIAGARA FALLS, NEW YORK

Sample ID	OSB-17 0'-2'	OSB-17 2'-4'	OSB-17 4'-6'	OSB-17 6'-8'	OSB-18 0'-2'	Dup OSB-18 0'-2'	OSB-18 2'-4'	OSB-18 4'-6'
Sample Date	10/18/91	10/18/91	10/18/91	10/18/91	10/18/91	10/18/91	10/18/91	10/18/91
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Compounds								
<u>Semi-Volatiles</u>								
1,3-dichlorobenzene	0.36J	0.52J	0.077J	ND24	1.7	2.3	1.1	17E
1,4-dichlorobenzene	1.0	1.7	ND0.75	ND24	ND0.80	ND0.79	0.69J	2.0
1,2-dichlorobenzene	0.57J	0.85	0.15J	ND24	0.89	1.3	3.4	24
2-methylphenol	ND0.71	ND0.73	ND0.75	7.5J	ND0.80	ND0.79	ND0.80	ND0.82
4-methylphenol	ND0.71	0.13J	ND0.75	25	ND0.80	ND0.79	ND0.80	ND0.82
2,4-dimethylphenol	ND0.71	ND0.73	ND0.75	5.9J	ND0.80	ND0.79	ND0.80	ND0.82
2,4-dichlorophenol	ND0.71	ND0.73	ND0.75	ND24	ND0.80	ND0.79	0.15J	ND0.82
1,2,4-trichlorobenzene	4.4	6.4	1.1	ND24	330	270	210	1,900
Naphthalene	2.0	2.4	1.4	1,400	ND0.80	ND0.79	ND0.80	ND0.82
2-methylnaphthalene	0.38J	0.57J	0.46J	140J	0.46J	0.44J	0.19J	ND0.82UJ
2,4,6-trichlorophenol	0.085J	0.15J	ND0.75	ND24	ND0.80	ND0.79	ND0.80	ND0.82
2,4,5-trichlorophenol	0.42J	0.43J	ND3.6	ND110	1.7J	2.2J	ND3.9	6.5
Acenaphthylene	0.93	0.82	ND0.75	ND24	ND0.80	ND0.79	0.17J	ND0.82
Acenaphthene	ND0.71	2.4	2.7	1,000	ND0.80	ND0.79	0.14J	ND0.82
Dibenzofuran	2.0	1.7	2.1	650	0.31J	0.36J	0.14J	ND0.82
Fluorene	2.4	3.1	3.8	920	ND0.80	ND0.79	0.13J	ND0.82
Hexachlorobenzene	0.14J	0.15J	ND0.75	ND24	25	29J	5.8	ND0.82
Phenanthrene	26	47	59	4,600	1.6	1.8	1.8	0.28J
Anthracene	3.8	6.5	5.7	1,300	ND0.80	ND0.79	0.29J	ND0.82
Fluoranthene	43	50	51	3,500	2.5	2.9	3.9	0.39J
Pyrene	25	33	31	2,800	1.7	1.9	4.7	0.30
Benzo(a)anthracene	18	24	20	1,600	0.83	0.97	1.4	0.17J
Chrysene	18	25	23	1,400	1.6	1.8	1.8	0.20J
Bis(2-ethylhexyl)phthalate	0.91	0.91	0.85	ND24	1.4	1.7	1.5	0.35J
Benzo(b)fluoranthene	18	29	25	1.4	2.1	2.6	3.1	0.21J
Benzo(k)fluoranthene	6.1	7.6	6.0	260	0.76J	0.98	1.4	0.11J
Benzo(a)pyrene	12E	23	10	1,200	0.18J	0.21J	1.8	0.13J
Indeno(1,2,3-cd)pyrene	0.063J	5.8	ND0.75	310	0.83	0.87	1.3	0.12J

TABLE 6-2 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI SOIL SAMPLES
NIAGARA FALLS, NEW YORK

Sample ID	OSB-17 0'-2'	OSB-17 2'-4'	OSB-17 4'-6'	OSB-17 6'-8'	OSB-18 0'-2'	Dup OSB-18 0'-2'	OSB-18 2'-4'	OSB-18 4'-6'
Sample Date	10/18/91	10/18/91	10/18/91	10/18/91	10/18/91	10/18/91	10/18/91	10/18/91
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Compounds								
Semi-Volatiles								
Dibenzo(a,h)anthracene	1.3	1.2	0.33J	65	ND0.80	ND0.79	ND0.80	ND0.82
Benzo(g,h,i)perylene	0.062J	1.1	2.3	82	0.59J	0.59J	0.87	0.10J
3,4-dichlorophenol	ND0.71	ND0.73	ND0.75	ND24	ND0.80	ND0.79	0.13J	ND0.82
2,3,6-trichlorophenol	ND0.71	ND0.73	ND0.75	ND24	ND0.80	ND0.79	2.6	ND0.82
3,4,5-trichlorophenol	ND0.71	ND0.73	ND0.75	ND24	0.31J	0.57J	ND0.80	ND0.82
2,3,4,5-tetrachlorophenol	ND0.71UJ	ND0.73UJ	ND0.75UJ	ND24UJ	0.16J	0.45J	0.46J	ND0.82
2,3,4,6-tetrachlorophenol	ND0.71R	ND0.73R	ND0.75R	ND24R	0.096J	ND0.79R	ND0.80R	0.31J

TABLE 6-2 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI SOIL SAMPLES
NIAGARA FALLS, NEW YORK

Sample ID	OSB-18 6'-8'	RB-5 Rinsate
Sample Date	10/18/91	10/18/91
Units	mg/kg	ug/L
Compounds		
<u>Semi-Volatiles</u>		
1,3-dichlorobenzene	2.3	ND10
1,4-dichlorobenzene	0.42J	ND10
1,2-dichlorobenzene	4.3	ND10
2-methylphenol	ND0.73	ND10
4-methylphenol	ND0.73	ND10
2,4-dimethylphenol	ND0.73	ND10
2,4-dichlorophenol	ND0.73	ND10
1,2,4-trichlorobenzene	340	ND10
Naphthalene	ND0.73	ND10
2-methylnaphthalene	ND0.73UJ	ND10
2,4,6-trichlorophenol	ND0.73	ND10
2,4,5-trichlorophenol	2.9J	ND50
Acenaphthylene	ND0.73	ND10
Acenaphthene	ND0.73	ND10
Dibenzofuran	ND0.73	ND10
Fluorene	ND0.73	ND10
Hexachlorobenzene	ND0.73	ND10
Phenanthrene	0.18J	ND10
Anthracene	ND0.73	ND10
Fluoranthene	0.28J	ND10
Pyrene	0.22J	ND10
Benzo(a)anthracene	0.12J	ND10
Chrysene	0.17J	ND10
Bis(2-ethylhexyl)phthalate	3.7	ND10
Benzo(b)fluoranthene	0.21J	ND10
Benzo(k)fluoranthene	0.079J	ND10
Benzo(a)pyrene	0.072J	ND10
Indeno(1,2,3-cd)pyrene	0.11J	ND10

TABLE 6-2 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI SOIL SAMPLES
NIAGARA FALLS, NEW YORK

Sample ID	OSB-18 6'-8'	RB-5 Rinsate
Sample Date	10/18/91	10/18/91
Units	mg/kg	ug/L
Compounds		
<u>Semi-Volatiles</u>		
Dibenzo(a,h)anthracene	0.036J	ND10
Benzo(g,h,i)perylene	0.11J	ND10
3,4-dichlorophenol	ND0.73	ND10
2,3,6-trichlorophenol	ND0.73	ND10
3,4,5-trichlorophenol	ND0.73	ND10
2,3,4,5-tetrachlorophenol	ND0.73	ND10
2,3,4,6-tetrachlorophenol	ND0.73R	ND10R

NS - Not sampled
ND - Not detected, applicable detection limit listed
J - Indicates an estimated value due to outlying QC criteria and/or indicates detection above the method detection limit (MDL) but less than the practical quantitation limit (PQL).
E - Compound whose concentration exceeds the calibration range of the GC/MS instrument but was diluted below the instrument detection limit on subsequent dilution runs.
R - Data found to be unusable as a result of outlying QC criteria.
U - The material was analyzed for but was not detected. The numerical value is the sample quantitation limit and has been adjusted to reflect contamination from laboratory or field activities.
UJ - Estimated quantitation limit

TABLE 6-2 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI SOIL SAMPLES
NIAGARA FALLS, NEW YORK

Sample ID	OSB-17 0'-2'	OSB-17 2'-4'	OSB-17 4'-6'	OSB-17 6'-8'	OSB-18 0'-2'	Dup OSB-18 0'-2'	OSB-18 2'-4'	OSB-18 4'-6'
Sample Date	10/18/91	10/18/91	10/18/91	10/18/91	10/18/91	10/18/91	10/18/91	10/18/91
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Compounds								
<u>Pesticides</u>								
alpha-BHC	10	18	2.6	1.6	1.0J	1.6	18	23
beta-BHC	27	44	3.5	0.56	19	30	9.5	0.94
delta-BHC	5.5	9.8	0.94	0.58	ND0.19	ND0.19	0.16J	0.19J
gamma-BHC	8.3	13	1.0	0.46	ND0.19	ND0.19	0.35J	0.39J
Heptachlor	ND0.34	ND0.70	0.051	0.0057	ND0.19	ND0.19	ND0.39	ND0.40
Aldrin	ND0.34	ND0.70	ND0.036	0.096	ND0.19	ND0.19	ND0.39	ND0.40
Heptachlor epoxide	ND0.34	ND0.70	ND0.036	ND0.037	ND0.19	0.03J	ND0.39	ND0.40
Dieldrin	ND0.69	ND1.4	0.083	1.1	ND0.39	ND0.38	ND0.78	ND0.81
Endrin	ND0.69	ND1.4	ND0.072	1.3	ND0.39	ND0.38	ND0.78	ND0.81
Endosulfan II	ND0.69	ND1.4	0.015J	0.01J	ND0.39	0.05J	ND0.78	ND0.81
4,4'-DDD	ND0.69	ND1.4	ND0.072	0.029J	ND0.39	ND0.38	ND0.78	ND0.81
4,4'-DDT	ND0.69	ND1.4	0.085	0.0087J	ND0.39	ND0.38	ND0.78	ND0.81
Methoxychlor	ND3.4	ND7.0	ND0.36	0.17J	ND1.9	ND1.9	ND3.9	ND4.0
Alpha-chlordane	ND3.4	ND7.0	0.36U	0.37U	ND1.9	ND1.9	ND3.9	ND4.0
Gamma-chlordane	ND3.4	ND7.0	ND0.36	ND0.37	ND1.9	0.065J	ND3.9	ND4.0

TABLE 6-2 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI SOIL SAMPLES
NIAGARA FALLS, NEW YORK

Sample ID	OSB-18 6'-8'	RB-5 Rinsate
Sample Date	10/18/91	10/18/91
Units	mg/kg	ug/L
Compounds		
Pesticides		
alpha-BHC	5.0	0.14
beta-BHC	1.6	0.063
delta-BHC	ND0.088	0.12
gamma-BHC	0.091	0.041
Heptachlor	ND0.088	ND0.062
Aldrin	ND0.088	ND0.062
Heptachlor epoxide	ND0.088	ND0.062
Dieldrin	ND0.18	ND0.12
Endrin	ND0.18	ND0.12
Endosulfan II	ND0.18	ND0.12
4,4'-DDD	ND0.18	ND0.12
4,4'-DDT	ND0.18	ND0.12
Methoxychlor	ND0.88	ND0.62
Alpha-chlordane	ND0.88	ND0.62
Gamma-chlordane	ND0.88	ND0.62

NS - Not sampled
ND - Not detected, applicable detection limit listed
J - Indicates an estimated value due to outlying QC criteria and/or indicates detection above the method detection limit (MDL) but less than the practical quantitation limit (PQL).
E - Compound whose concentration exceeds the calibration range of the GC/MS instrument but was diluted below the instrument detection limit on subsequent dilution runs.
R - Data found to be unusable as a result of outlying QC criteria.
U - The material was analyzed for but was not detected. The numerical value is the sample quantitation limit and has been adjusted to reflect contamination from laboratory or field activities.
UJ - Estimated quantitation limit

TABLE 7-1

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	Olin Production Well	OBA-1A	OBA-1B	OBA-1C	OBA-2B	OBA-2C	OBA-3A
Sample Date	9/23/91	9/17/91	9/17/91	9/17/91	9/23/91	10/4/91	9/23/91
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Compounds							
TCL - VOCS							
vinyl chloride	150	ND10	51	840EJ	69	2800	1300
methylene chloride	97J	ND5	330J	39,000J	ND5R	300J	ND500R
acetone	ND10UJ	ND10	21	ND10UJ	ND10UJ	ND1000	ND1000UJ
carbon disulfide	ND5	ND5	ND5	6J	ND5	490J	ND500
1,1-dichloroethene	2J	ND5	9	360J	ND5	120J	ND500
1,1-dichloroethane	ND5	ND5	1J	24J	ND5	ND500	ND500
1,2-dichloroethene (total)	340	ND5	340	16,000	170	16,000	2200
chloroform	390	3J	19	98,000	33	6400	ND500
1,2-dichloroethane	ND5	ND5	ND5	68J	ND5	ND500	ND500
1,1,1-trichloroethane	2J	ND5	ND5	320EJ	ND5	ND500	ND500
carbon tetrachloride	10	ND5	ND5	37J	ND5	1600	ND500
bromodichloromethane	ND5	ND5	ND5	ND5UJ	ND5	ND500	ND500
1,2-dichloropropane	ND5	ND5	ND5	ND5UJ	ND5	ND500	ND500
cis-1,3-dichloropropene	ND5	ND5	ND5	2J	ND5	ND500	ND500
trichloroethene	460	9	2700	150,000	140	380,000	ND500
1,1,2-trichloroethane	ND5	ND5	ND5	1700J	ND5	580	ND500
benzene	2J	6	18	920J	7	140J	4900
tetrachloroethene	210	7	3000	20,000	85	82,000	ND500
1,1,2,2-tetrachloroethane	84J	4J	ND5	ND5UJ	ND5	74,000	ND500
toluene	ND5	ND5	2J	5J	ND5	66J	ND500
chlorobenzene	0.9J	5U	27	190J	9	57J	16,000
ethyl benzene	ND5	ND5	ND5	ND5UJ	ND5	ND500	ND500
total xylenes	ND5	ND5	ND5	4J	ND5	ND500	ND500

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID **Sample Date** **Units**	Dup OBA-3A 9/23/91 ug/L	OBA-3B 9/23/91 ug/L	OBA-3C 10/4/91 ug/L	OBA-4A 9/20/91 ug/L	OBA-4B 9/18/91 ug/L	OBA-4C 9/18/91 ug/L	OBA-5A 9/20/91 ug/L
Compounds							
<u>TCL - VOCS</u>							
vinyl chloride	1500	1700	2900	ND10	35	110J	11J
methylene chloride	ND500	ND500R	ND1000	ND5	ND5	160J	6J
acetone	ND1000	ND1000	ND2000	ND10	ND10	ND250	99
carbon disulfide	ND500	ND500	ND1000	ND5	ND5	ND120	ND25
1,1-dichloroethene	ND500	ND500	ND1000	ND5	0.8J	ND120	ND25
1,1-dichloroethane	ND500	ND500	ND1000	ND5	ND5	ND120	ND25
1,2-dichloroethene (total)	2400	2400	8400	3J	150	1300	270
chloroform	ND500	ND500	ND1000	5	ND5	850	530J
1,2-dichloroethane	ND500	ND500	ND1000	ND5	ND5	ND120	ND25
1,1,1-trichloroethane	ND500	ND500	ND1000	ND5	ND5	ND120	11J
carbon tetrachloride	ND500	ND500	ND1000	ND5	ND5	ND120	5J
bromodichloromethane	ND500	ND500	ND1000	ND5	ND5	ND120	ND25
1,2-dichloropropane	ND500	ND500	ND1000	ND5	ND5	ND120	ND25
cis-1,3-dichloropropene	ND500	ND500	ND1000	ND5	ND5	ND120	ND25
trichloroethene	ND500	ND500	500J	48	32	6900	870J
1,1,2-trichloroethane	ND500	ND500	ND1000	ND5	ND5	ND120	ND25
benzene	5400	7100	9700	ND5	25	25J	76
tetrachloroethene	ND500	ND500	190J	22	14	4900	830
1,1,2,2-tetrachloroethane	ND500	ND500	840J	ND5	ND5	1400J	ND25
toluene	ND500	ND500	ND1000	ND5	ND5	ND120	ND25
chlorobenzene	17,000	13,000	22,000	ND5	22	47J	160
ethyl benzene	ND500	ND500	ND1000	ND5	ND5	ND120	ND25
total xylenes	ND500	ND500	ND1000	ND5	ND5	ND120	ND25

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	Dup OBA-5A	OBA-5B	OBA-5C	OBA-6A	OBA-6B	OBA-6C	OBA-7A
Sample Date	9/20/91	9/20/91	10/7/91	9/20/91	9/19/91	9/19/91	9/19/91
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Compounds							
<u>TCL - VOCS</u>							
vinyl chloride	10J	1300	100J	12	83J	250J	ND10
methylene chloride	9J	30,000	ND100	ND5	1100	ND500	ND5
acetone	130	ND1000	ND200	33	ND400	ND1000	ND10
carbon disulfide	ND50	290J	ND100	ND5	ND200	ND500	ND5
1,1-dichloroethene	ND50	1200	18J	ND5	21J	ND500	ND5
1,1-dichloroethane	ND50	ND500	ND100	ND5	ND200	ND500	ND5
1,2-dichloroethene (total)	270	17,000	2100	88	1400	5800	24
chloroform	540J	74,000J	34J	ND5	83J	190J	14
1,2-dichloroethane	ND50	ND500	ND100	ND5	ND200	ND500	ND5
1,1,1-trichloroethane	10J	750	ND100	ND5	ND200	ND500	ND5
carbon tetrachloride	ND50	240J	ND100	ND5	ND200	110J	ND5
bromodichloromethane	ND50	ND500	ND100	ND5	ND200	ND500	ND5
1,2-dichloropropane	ND50	ND500	ND100	ND5	ND200	ND500	ND5
cis-1,3-dichloropropene	ND50	ND500	ND100	ND5	ND200	ND500	ND5
trichloroethene	1100J	310,000J	1800	28J	5100J	39,000J	11U
1,1,2-trichloroethane	ND50	ND500	120	ND5	ND200	ND500	ND5
benzene	75	6300	420	3J	1100	230J	ND5
tetrachloroethene	830	30,000	110	35	3100	56,000	9U
1,1,2,2-tetrachloroethane	ND50	ND500	47J	ND5	ND200	ND500	ND5
toluene	ND50	ND500	ND100	4J	ND200	ND500	ND5
chlorobenzene	160	2100	ND100	2J	220	81J	3J
ethyl benzene	ND50	ND500	ND100	0.6J	ND200	ND500	ND5
total xylenes	ND50	ND500	ND100	4J	ND200	ND500	2J

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID Sample Date Units	OBA-7B 9/19/91 ug/L	OBA-7C 10/7/91 ug/L	Dup OBA-7C 10/7/91 ug/L	OBA-8A 9/19/91 ug/L	OBA-8B 9/18/91 ug/L	Dup OBA-8B 9/18/91 ug/L	OBA-8C 9/18/91 ug/L
Compounds							
<u>TCL - VOCS</u>							
vinyl chloride	ND100	290	380	ND10	1600J	1300	ND50
methylene chloride	1000	130	160	6	30,000J	24,000J	ND25
acetone	ND100	ND200	ND200	ND10	ND100UJ	ND1000	ND50
carbon disulfide	ND50	ND100	ND100	ND5	250J	ND500	ND25
1,1-dichloroethene	ND50	18J	24J	ND5	190J	120J	ND25
1,1-dichloroethane	ND50	ND100	ND100	3J	20J	ND500	ND25
1,2-dichloroethene (total)	ND50	1600	2100	1J	15,000	14,000	58
chloroform	ND50	340	340	780J	93,000	76,000	6J
1,2-dichloroethane	ND50	ND100	ND100	ND5	71J	ND500	ND25
1,1,1-trichloroethane	ND50	ND100	ND100	ND5	460J	240J	ND25
carbon tetrachloride	ND50	ND100	ND100	ND5	8J	ND500	ND25
bromodichloromethane	ND50	ND100	ND100	0.7J	ND50UJ	ND500	ND25
1,2-dichloropropane	ND50	ND100	ND100	ND5	ND50UJ	ND500	ND25
cis-1,3-dichloropropene	ND50	ND100	ND100	ND5	ND50UJ	ND500	ND25
trichloroethene	50U	2700	2800	9	62,000	48,000	620
1,1,2-trichloroethane	ND50	ND100	ND100	ND5	260J	190J	ND25
benzene	7J	58J	77J	ND5	200J	180J	ND25
tetrachloroethene	50U	1200	1300	7	13,000	12,000	850
1,1,2,2-tetrachloroethane	ND50	ND100	ND100	4J	9500J	11,000J	57J
toluene	ND50	ND100	ND100	ND5	ND50UJ	ND500	ND25
chlorobenzene	ND50	ND100	100U	ND5	56U	ND500	3J
ethyl benzene	ND50	ND100	ND100	ND5	ND50UJ	ND500	ND25
total xylenes	ND50	ND100	ND100	ND5	ND50UJ	ND500	ND25

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID Sample Date Units	BH-1 9/18/91 ug/L	BH-3 9/18/91 ug/L	NAPL OBA-2C 9/20/91 mg/kg	Rinsate 1 9/18/91 ug/L	Rinsate 2 9/20/91 ug/L	Rinsate 3 10/7/91 ug/L	Trip Blank 1 9/18/91 ug/L
Compounds							
TCL - VOCS							
vinyl chloride	3J	ND1000	ND6200	ND10	ND10	ND10	ND10
methylene chloride	ND5	76J	ND3100	ND5	0.6J	ND5	ND5
acetone	ND10	610J	ND6200	ND10	ND10	ND10	ND10
carbon disulfide	ND5	ND500	ND3100	ND5	ND5	ND5	ND5
1,1-dichloroethene	ND5	ND500	ND3100	ND5	ND5	ND5	ND5
1,1-dichloroethane	ND5	ND500	ND3100	ND5	ND5	ND5	ND5
1,2-dichloroethene (total)	23	280J	380J	ND5	ND5	ND5	ND5
chloroform	0.7J	2800	600J	ND5	2J	ND5	ND5
1,2-dichloroethane	ND5	ND500	ND3100	ND5	ND5	ND5	ND5
1,1,1-trichloroethane	ND5	ND500	ND3100	ND5	ND5	ND5	ND5
carbon tetrachloride	ND5	ND500	2300J	ND5	ND5	ND5	ND5
bromodichloromethane	ND5	ND500	ND3100	ND5	ND5	ND5	ND5
1,2-dichloropropane	ND5	ND500	ND3100	1J	0.9J	ND5	ND5
cis-1,3-dichloropropene	ND5	ND500	ND3100	ND5	ND5	ND5	ND5
trichloroethene	18	1600	130,000	ND5	62	3J	ND5
1,1,2-trichloroethane	ND5	ND500	ND3100	ND5	ND5	ND5	ND5
benzene	2J	49,000	ND3100	ND5	ND5	ND5	ND5
tetrachloroethene	4J	250J	130,000	ND5	15	ND5	ND5
1,1,2,2-tetrachloroethane	3J	390J	35,000	ND5	ND5	ND5	ND5
toluene	0.5J	ND500	ND3100	ND5	ND5	ND5	ND5
chlorobenzene	5U	9800	ND3100	2J	2J	ND5	ND5
ethyl benzene	ND5	ND500	ND3100	ND5	ND5	ND5	ND5
total xylenes	ND5	ND500	ND3100	ND5	ND5	ND5	ND5

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	Trip Blank 2	Field Blank 1	Field Blank 2
Sample Date	9/20/91	9/18/91	10/7/91
Units	ug/L	ug/L	ug/L
Compounds			
<u>TCL - VOCS</u>			
vinyl chloride	ND10	ND10	ND10
methylene chloride	ND5	ND5	ND5
acetone	ND10	ND10	ND10
carbon disulfide	ND5	ND5	ND5
1,1-dichloroethene	ND5	ND5	ND5
1,1-dichloroethane	ND5	ND5	ND5
1,2-dichloroethene (total)	ND5	ND5	ND5
chloroform	ND5	ND5	ND5
1,2-dichloroethane	ND5	ND5	ND5
1,1,1-trichloroethane	ND5	ND5	ND5
carbon tetrachloride	ND5	ND5	ND5
bromodichloromethane	ND5	ND5	ND5
1,2-dichloropropane	ND5	1J	ND5
cis-1,3-dichloropropene	ND5	ND5	ND5
trichloroethene	ND5	ND5	28
1,1,2-trichloroethane	ND5	ND5	ND5
benzene	ND5	ND5	ND5
tetrachloroethene	ND5	ND5	4J
1,1,2,2-tetrachloroethane	ND5	ND5	ND5
toluene	ND5	ND5	2J
chlorobenzene	ND5	2J	1J
ethyl benzene	ND5	ND5	ND5
total xylenes	ND5	ND5	ND5

NS - Not sampled
ND - Not detected, applicable detection limit listed
J - Indicates an estimated value due to outlying QC criteria and/or indicates detection above the method detection limit (MDL) but less than the practical quantitation limit (PQL).
E - Compound whose concentration exceeds the calibration range of the GC/MS instrument but was diluted below the instrument detection limit on subsequent dilution runs.
R - Data found to be unusable as a result of outlying QC criteria.
U - The material was analyzed for but was not detected. The numerical value is the sample quantitation limit and has been adjusted to reflect contamination from laboratory or field activities.
UJ - Estimated quantitation limit

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	Olin Production Well	OBA-1A	OBA-1B	OBA-1C	OBA-2B	OBA-2C	OBA-3A
Sample Date	9/23/91	9/19/91	9/17/91	9/17/91	9/23/91	10/4/91	9/23/91
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Compounds							
TCL-BNAs							
phenol	ND10	ND12	10J	ND12	ND10	11J	ND10
2-chlorophenol	ND10	ND12	ND12	ND12	ND10	ND12	16
1,3-dichlorobenzene	ND10	ND12	ND12	18	48	26	730
1,4-dichlorobenzene	ND10	ND12	ND12	19	9J	84	2700
benzyl alcohol	ND10	ND12	ND12	ND12	ND10	13	ND10
1,2-dichlorobenzene	ND10	ND12	5J	44	16	450	3600
2-methylphenol	ND10	ND12	ND12	ND12	ND10	ND12	ND10
4-methylphenol	ND10	ND12	5J	ND12	ND10	ND12	ND10
hexachloroethane	ND10	ND12	ND12	5J	ND10	440	ND10
2,4-dimethylphenol	ND10	ND12	ND12	ND12	ND10	ND12	ND10
benzoic acid	ND50	ND59	23J	ND62	ND50	2200J	ND52
2,4-dichlorophenol	ND10	ND12	ND12	ND12	ND10	ND12	ND10
1,2,4-trichlorobenzene	2J	ND12	37	8J	1300	56	520
napthalene	ND10	ND12	ND12	ND12	ND10	ND12	ND10
4-chloroanaline	ND10	ND12	ND12	ND12	ND10	ND12	4J
hexachlorobutadiene	ND10	ND12	ND12	ND12	ND10	23	ND10
2,4,6-trichlorophenol	ND10	ND12	ND12	ND12	110	ND12	ND10
2,4,5-trichlorophenol	ND50	ND59	10J	34J	ND50	ND62	ND52
hexachlorobenzene	ND10	ND12	ND12	ND12	ND10	ND12	ND10
pentachlorophenol	ND50	ND59	ND62	ND62	ND50	ND62	ND52
phenanthrene	ND10	ND12	ND12	ND12	ND10	ND12	ND10
anthracene	ND10	ND12	ND12	ND12	ND10	ND12	ND10
fluoranthene	ND10	ND12	ND12	ND12	ND10	ND12	ND10
pyrene	ND10	ND12	ND12	ND12	ND10	ND12	ND10
bis(2-ethylhexyl)phthalate	ND10	ND12	ND12	ND12	ND10	ND12	ND10
benzo(b)fluoranthene	ND10	ND12	ND12	ND12	ND10	ND12	ND10
2,3-dichlorophenol	ND10	ND12	ND12	ND12	ND10	ND12	3J
2,5-dichlorophenol	ND10	ND12	ND12	ND12	ND10	ND12	5J

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	Olin Production Well	OBA-1A	OBA-1B	OBA-1C	OBA-2B	OBA-2C	OBA-3A
Sample Date	9/23/91	9/19/91	9/17/91	9/17/91	9/23/91	10/4/91	9/23/91
Units	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L
Compounds							
<u>TCL-BNAs</u>							
3,4-dichlorophenol	ND10	ND12	ND12	11J	26	ND12	4J
2,3,6-trichlorophenol	ND10	ND12	ND12	ND12	ND10	ND12	ND10
2,3,4,5-tetrachlorophenol	ND10UJ	ND12	ND12	ND12	ND10UJ	ND12	ND10UJ
3-chlorophenol	ND10	ND12	ND12	ND12	7J	ND12	20
4-chlorophenol	ND10	ND12	ND12	ND12	7J	ND12	20

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID **Sample Date** **Units**	Dup OBA-3A 9/23/91 ug/L	OBA-3B 9/23/91 ug/L	OBA-3C 10/4/91 ug/L	OBA-4A 9/23/91 ug/L	OBA-4B 9/18/91 ug/L	OBA-4C 9/18/91 ug/L	OBA-5A 9/20/91 ug/L
Compounds							
TCL-BNAs							
phenol	ND12	ND11	ND12	ND12	ND12	ND12	ND12R
2-chlorophenol	20	8J	15	ND12	ND12	ND12	ND12R
1,3-dichlorobenzene	370J	540	1000	ND12	ND12	12	280J
1,4-dichlorobenzene	1400J	1700	4400	ND12	ND12	43	110
benzyl alcohol	ND12	40	ND12	ND12	ND12	ND12	ND12R
1,2-dichlorobenzene	1700J	2300	5900	ND12	ND12	58	370J
2-methylphenol	ND12	ND11	ND12	ND12	ND12	ND12	ND12R
4-methylphenol	ND12	ND11	ND12	ND12	ND12	ND12	ND12R
hexachloroethane	ND12	ND11	ND12	ND12	ND12	24	ND12R
2,4-dimethylphenol	ND12	ND11	ND12	ND12	ND12	ND12	ND12R
benzoic acid	ND59	ND56	ND62	ND62	ND58	ND58	64J
2,4-dichlorophenol	7J	ND11	ND12	ND12	ND12	ND12	ND12R
1,2,4-trichlorobenzene	320J	190	440J	ND12	ND12	170	4600
napthalene	ND12	ND11	ND12	ND12	ND12	ND12	6J
4-chloroanaline	9J	ND11	ND12	ND12	ND12	ND12	ND12
hexachlorobutadiene	ND12	ND11	ND12	ND12	ND12	32	ND12
2,4,6-trichlorophenol	ND12	ND11	ND12	ND12	ND12	ND12	ND12R
2,4,5-trichlorophenol	ND59	ND56	ND62	ND62	ND58	ND58	ND58R
hexachlorobenzene	ND12	ND11	ND12	ND12	ND12	ND12	ND12
pentachlorophenol	ND59	ND56	ND62	ND62	ND58	ND58	ND58R
phenanthrene	ND12	ND11	ND12	ND12	ND12	ND12	8J
anthracene	ND12	ND11	ND12	ND12	ND12	ND12	ND12
fluoranthene	ND12	ND11	ND12	ND12	ND12	ND12	10J
pyrene	ND12	ND11	ND12	ND12	ND12	ND12	7J
bis(2-ethylhexyl)phthalate	ND12	ND11	ND12	ND12	ND12	15	ND12
benzo(b)fluoranthene	ND12	ND11	ND12	ND12	ND12	ND12	7J
2,3-dichlorophenol	ND12	ND11	ND12	ND12	ND12	ND12	ND12R
2,5-dichlorophenol	ND12	ND11	6J	ND12	ND12	ND12	ND12R

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID **Sample Date** **Units**	Dup OBA-3A 9/23/91 ug/L	OBA-3B 9/23/91 ug/L	OBA-3C 10/4/91 ug/L	OBA-4A 9/23/91 ug/L	OBA-4B 9/18/91 ug/L	OBA-4C 9/18/91 ug/L	OBA-5A 9/20/91 ug/L
Compounds							
<u>TCL-BNAs</u>							
3,4-dichlorophenol	5J	5J	5J	ND12	ND12	ND12	ND12R
2,3,6-trichlorophenol	ND12	ND11	ND12	ND12	ND12	ND12	ND12R
2,3,4,5-tetrachlorophenol	ND12UJ	ND11UJ	ND12	ND12	ND12UJ	ND12	ND12R
3-chlorophenol	25	9J	24	ND12	ND12	ND12	ND12R
4-chlorophenol	ND12	9J	ND12	ND12	ND12	ND12	ND12R

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	Dup OBA-5A	OBA-5B	OBA-5C	OBA-6A	OBA-6B	OBA-6C	OBA-7A
Sample Date	9/20/91	9/20/91	10/7/91	9/20/91	9/19/91	9/19/91	9/19/91
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Compounds							
TCL-BNAs							
phenol	30J	11J	ND12	85	15	ND12	ND12
2-chlorophenol	ND12R	ND11	ND12	ND11	ND11	ND12	ND12
1,3-dichlorobenzene	220	260	ND12	ND11	200	13	4J
1,4-dichlorobenzene	62	190	ND12	ND11	57	9J	3J
benzyl alcohol	ND12R	ND11	ND12	ND11	ND11	ND12	ND12
1,2-dichlorobenzene	250	450	ND12	ND11	150	32	ND12
2-methylphenol	ND12R	ND11	ND12	4J	3J	ND12	ND12
4-methylphenol	ND12R	ND11	ND12	24	11J	ND12	ND12
hexachloroethane	ND12	27	ND12	ND11	ND11	220	ND12
2,4-dimethylphenol	ND12R	ND11	ND12	ND11	ND11	ND12	ND12
benzoic acid	ND60R	42J	ND62	19J	47J	ND62UJ	ND62
2,4-dichlorophenol	ND12R	ND11	ND12	ND11	ND11	ND12	ND12
1,2,4-trichlorobenzene	2800	4100	ND12	ND11	5700	360	3J
napthalene	ND12	2J	ND12	ND11	4J	ND12	ND12
4-chloroanaline	ND12	ND11	ND12	ND11	ND11	ND12	ND12
hexachlorobutadiene	ND12	ND11	ND12	ND11	ND11	35	ND12
2,4,6-trichlorophenol	ND12R	5J	ND12	ND11	620	130	ND12
2,4,5-trichlorophenol	ND60R	ND56	ND62	ND56	ND56	ND62	ND62
hexachlorobenzene	ND12	ND11	ND12	ND11	ND11	ND12	ND12
pentachlorophenol	ND60R	ND56	ND62	ND56	ND56	ND62	7J
phenanthrene	5J	ND11	ND12	ND11	ND11	ND12	ND12
anthracene	ND12	ND11	ND12	ND11	ND11	ND12	ND12
fluoranthene	7J	ND11	ND12	ND11	ND11	ND12	ND12
pyrene	5J	ND11	ND12	ND11	ND11	ND12	ND12
bis(2-ethylhexyl)phthalate	ND12	ND11	ND12	ND11	ND11	ND12	ND12
benzo(b)fluoranthene	98J	ND11	ND12	ND11	ND11	ND12	ND12
2,3-dichlorophenol	ND12R	ND11	ND12	ND11	ND11	ND12	ND12
2,5-dichlorophenol	ND12R	ND11	ND12	ND11	ND11	ND12	ND12

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	Dup OBA-5A	OBA-5B	OBA-5C	OBA-6A	OBA-6B	OBA-6C	OBA-7A
Sample Date	9/20/91	9/20/91	10/7/91	9/20/91	9/19/91	9/19/91	9/19/91
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Compounds							
TCL-BNAs							
3,4-dichlorophenol	ND12R	8J	ND12	ND11	13	ND12	ND12
2,3,6-trichlorophenol	ND12R	260	ND12	ND11	13	ND12	ND12
2,3,4,5-tetrachlorophenol	ND12R	3J	ND12	ND11UJ	ND11UJ	ND12UJ	ND12UJ
3-chlorophenol	ND12R	3J	ND12	ND11	ND11	ND12	ND12
4-chlorophenol	ND12R	ND11	ND12	ND11	ND11	ND12	ND12

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	OBA-7B	OBA-7C	Dup OBA-7C	OBA-8A	OBA-8B	Dup OBA-8B	OBA-8C
Sample Date	9/19/91	10/7/91	10/7/91	9/19/91	9/18/91	9/18/91	9/18/91
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Compounds							
TCL-BNAs							
phenol	12	7J	4J	ND12	ND12	ND11	ND12
2-chlorophenol	ND12	ND12	ND11	ND12	ND12	ND11	ND12
1,3-dichlorobenzene	11J	3J	2J	ND12	95	91	ND12
1,4-dichlorobenzene	ND12	2J	2J	ND12	10J	9J	ND12
benzyl alcohol	9J	ND12	ND11	ND12	ND12	ND11	ND12
1,2-dichlorobenzene	11J	12U	11U	ND12	ND12	ND11	ND12
2-methylphenol	2J	ND12	ND11	ND12	ND12	ND11	ND12
4-methylphenol	5J	3J	2J	ND12	ND12	ND11	ND12
hexachloroethane	ND12	ND12	ND11	ND12	ND12	ND11	ND12
2,4-dimethylphenol	ND12	ND12	ND11	ND12	ND12	ND11	ND12
benzoic acid	ND58	ND62	ND56	ND60	ND59	ND57	ND62
2,4-dichlorophenol	ND12	14	13	ND12	ND12	ND11	ND12
1,2,4-trichlorobenzene	130	8J	9J	ND12	ND12	ND11	33
napthalene	ND12	ND12	ND11	ND12	ND12	ND11	ND12
4-chloroanaline	ND12	ND12	ND11	ND12	ND12	ND11	ND12
hexachlorobutadiene	ND12	ND12	ND11	ND12	ND12	ND11	ND12
2,4,6-trichlorophenol	ND12	6J	7J	ND12	ND12	ND11	ND12
2,4,5-trichlorophenol	ND58	200	200	ND60	4J	2J	12J
hexachlorobenzene	ND12	ND12	ND11	ND12	ND12	ND11	ND12
pentachlorophenol	ND58	ND62	ND56	ND60	ND59	ND57	ND62
phenanthrene	ND12	ND12	ND11	ND12	ND12	ND11	ND12
anthracene	ND12	ND12	ND11	ND12	ND12	ND11	ND12
fluoranthene	ND12	ND12	ND11	ND12	ND12	ND11	ND12
pyrene	ND12	ND12	ND11	ND12	ND12	ND11	ND12
bis(2-ethylhexyl)phthalate	ND12	ND12	10J	ND12	ND12	ND11	4J
benzo(b)fluoranthene	ND12	ND12	ND11	ND12	ND12	ND11	ND12
2,3-dichlorophenol	ND12	ND12	ND11	ND12	ND12	ND11	ND12
2,5-dichlorophenol	ND12	ND12	ND11	ND12	ND12	ND11	ND12

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	OBA-7B	OBA-7C	Dup OBA-7C	OBA-8A	OBA-8B	Dup OBA-8B	OBA-8C
Sample Date	9/19/91	10/7/91	10/7/91	9/19/91	9/18/91	9/18/91	9/18/91
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Compounds							
<u>TCL-BNAs</u>							
3,4-dichlorophenol	ND12	330	390	ND12	ND12	ND11	ND12
2,3,6-trichlorophenol	ND12	ND12	ND11	ND12	ND12	ND11	ND12
2,3,4,5-tetrachlorophenol	ND12UJ	22J	20J	ND12UJ	ND12	ND11	ND12
3-chlorophenol	ND12	5J	4J	ND12	ND12	ND11	ND12
4-chlorophenol	ND12	ND12	ND11	ND12	ND12	ND11	ND12

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	BH-1	BH-3	NAPL OBA-2C	Rinsate Blank 1	Rinsate Blank 2	Rinsate Blank 3	Trip Blank 1
Sample Date	9/19/91	9/18/91	9/20/91	9/18/91	9/20/91	10/7/91	-----
Units	ug/L	ug/L	mg/kg	ug/L	ug/L	ug/L	ug/L
Compounds							
TCL-BNAs							
phenol	ND12	44	ND90	ND12	ND11	ND12	NS
2-chlorophenol	ND12	20	ND90	ND12	ND11	ND12	
1,3-dichlorobenzene	ND12	700	410	ND12	ND11	ND12	
1,4-dichlorobenzene	ND12	390J	1200	ND12	ND11	ND12	
benzyl alcohol	ND12	ND12	ND90	ND12	ND11	ND12	
1,2-dichlorobenzene	ND12	1600	6,000	ND12	ND11	ND12	
2-methylphenol	ND12	ND12	ND90	ND12	ND11	ND12	
4-methylphenol	ND12	ND12	ND90	ND12	ND11	ND12	
hexachloroethane	ND12	ND12	25,000	ND12	ND11	ND12	
2,4-dimethylphenol	ND12	ND12	ND90	ND12	ND11	ND12	
benzoic acid	ND61	630J	ND440UJ	ND58	ND56	ND60	
2,4-dichlorophenol	ND12	ND12	ND90	ND12	ND11	ND12	
1,2,4-trichlorobenzene	ND12	4900	2800	ND12	ND11	ND12	
napthalene	ND12	ND12	ND90	ND12	ND11	ND12	
4-chloroanaline	ND12	ND12	ND90	ND12	ND11	ND12	
hexachlorobutadiene	ND12	ND12	9600	ND12	ND11	ND12	
2,4,6-trichlorophenol	ND12	9J	ND90	ND12	ND11	ND12	
2,4,5-trichlorophenol	ND61	ND62	ND440	ND58	ND56	ND60	
hexachlorobenzene	ND12	ND12	360	ND12	ND11	ND12	
pentachlorophenol	ND61	ND62	ND440	ND58	ND56	ND60	
phenanthrene	ND12	2J	ND90	ND12	ND11	ND12	
anthracene	ND12	2J	ND90	ND12	ND11	ND12	
fluoranthene	ND12	ND12	ND90	ND12	ND11	ND12	
pyrene	ND12	ND12	ND90	ND12	ND11	ND12	
bis(2-ethylhexyl)phthalate	ND12	ND12	2100	ND12	ND11	ND12	
benzo(b)fluoranthene	ND12	ND12	ND90	ND12	ND11	ND12	
2,3-dichlorophenol	ND12	ND12	ND90	ND12	ND11	ND12	
2,5-dichlorophenol	ND12	4J	ND90	ND12	ND11	ND12	

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	BH-1	BH-3	NAPL OBA-2C	Rinsate Blank 1	Rinsate Blank 2	Rinsate Blank 3	Trip Blank 1
Sample Date	9/19/91	9/18/91	9/20/91	9/18/91	9/20/91	10/7/91	-----
Units	ug/L	ug/L	mg/kg	ug/L	ug/L	ug/L	ug/L
Compounds							
TCL-BNAs							
3,4-dichlorophenol	ND12	ND12	ND90	ND12	ND11	ND12	NS
2,3,6-trichlorophenol	ND12	ND12	ND90	ND12	ND11	ND12	
2,3,4,5-tetrachlorophenol	ND12	4J	ND90UJ	ND12	ND11	ND12	
3-chlorophenol	ND12	10J	ND90	ND12	ND11	ND12	
4-chlorophenol	ND12	ND12	ND90	ND12	ND11	ND12	

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	Trip Blank 2	Field Blank 1	Field Blank 2
Sample Date	-----	-----	-----
Units	ug/L	ug/L	ug/L
Compounds			
<u>TCL-BNAs</u>			
phenol	NS	NS	NS
2-chlorophenol			
1,3-dichlorobenzene			
1,4-dichlorobenzene			
benzyl alcohol			
1,2-dichlorobenzene			
2-methylphenol			
4-methylphenol			
hexachloroethane			
2,4-dimethylphenol			
benzoic acid			
2,4-dichlorophenol			
1,2,4-trichlorobenzene			
napthalene			
4-chloroanaline			
hexachlorobutadiene			
2,4,6-trichlorophenol			
2,4,5-trichlorophenol			
hexachlorobenzene			
pentachlorophenol			
phenanthrene			
anthracene			
fluoranthene			
pyrene			
bis(2-ethylhexyl)phthalate			
benzo(b)fluoranthene			
2,3-dichlorophenol			
2,5-dichlorophenol			

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

	Trip Blank 2	Field Blank 1	Field Blank 2
Well ID			
Sample Date	-----	-----	-----
Units	ug/L	ug/L	ug/L
Compounds			
TCL-BNAs			
3,4-dichlorophenol	NS	NS	NS
2,3,6-trichlorophenol			
2,3,4,5-tetrachlorophenol			
3-chlorophenol			
4-chlorophenol			

NS - Not sampled
ND - Not detected, applicable detection limit listed
J - Indicates an estimated value due to outlying QC criteria and/or indicates detection above the method detection limit (MDL) but less than the practical quantitation limit (PQL).
E - Compound whose concentration exceeds the calibration range of the GC/MS instrument but was diluted below the instrument detection limit on subsequent dilution runs.
R - Data found to be unusable as a result of outlying QC criteria.
U - The material was analyzed for but was not detected. The numerical value is the sample quantitation limit and has been adjusted to reflect contamination from laboratory or field activities.
UJ - Estimated quantitation limit

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	Olin Production Well	OBA-1A	OBA-1B	OBA-1C	OBA-2B	OBA-2C	OBA-3A
Sample Date	9/23/91	9/20/91	9/17/91	9/17/91	9/23/91	10/4/91	9/23/91
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Compounds							
TCL - Pesticide/PCBs							
alpha-BHC	0.65	8.5	ND0.062	ND0.062	20	2.8	5.4
beta-BHC	ND0.056	21	0.32	ND0.062	0.66	1.1	0.95
delta-BHC	ND0.056	ND0.28	ND0.062	ND0.062	ND0.25	0.89	1.6
gamma-BHC	0.27	ND0.28	ND0.062	0.14	3.7	2.0	0.92
Heptachlor	ND0.056	ND0.28	ND0.062	ND0.062	ND0.25	0.47	ND0.23
Aldrin	ND0.056	ND0.28	ND0.062	ND0.062	ND0.25	0.094J	ND0.23
Heptachlor epoxide	ND0.056	ND0.28	ND0.062	ND0.062	ND0.25	ND0.12	ND0.23
4,4'-DDE	ND0.11	ND0.57	ND0.12	ND0.12	ND0.50	ND0.25	ND0.46
Endrin	ND0.11	ND0.57	ND0.12UJ	ND0.12	ND0.50	ND0.25	ND0.46
Endosulfan sulfate	0.51	ND0.57	ND0.12	ND0.12	ND0.50	0.062J	ND0.46
4,4'-DDT	ND0.11	ND0.57	ND0.12	ND0.12	ND0.50	ND0.25	ND0.46
alpha-Chlordane	ND0.56	ND2.8	ND0.62	ND0.62	ND2.5	ND1.2	ND2.3
gamma-Chlordane	ND0.56	ND2.8	ND0.62	ND0.62	ND2.5	ND1.2	ND2.3

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	Dup OBA-3A	OBA-3B	OBA-3C	OBA-4A	OBA-4B	OBA-4C	OBA-5A
Sample Date	9/23/91	9/23/91	10/4/91	9/20/91	9/18/91	9/18/91	9/20/91
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Compounds							
TCL - Pesticide/PCBs							
alpha-BHC	5.2	2.6	1.5	ND0.062	0.56	21	190
beta-BHC	0.93	0.70	1.2	0.22	0.84	1.8	130
delta-BHC	1.6	0.41	0.28	ND0.062	0.036J	4.5	4.9
gamma-BHC	0.64	ND0.056	0.18	ND0.062	ND0.055	12	98
Heptachlor	ND0.22	ND0.056	ND0.062	ND0.062	ND0.055	ND0.29	ND0.62
Aldrin	ND0.22	ND0.056	ND0.062	ND0.062	ND0.055	ND0.29	ND0.62
Heptachlor epoxide	ND0.22	ND0.056	ND0.062	ND0.062	ND0.055	ND0.29	ND0.62
4,4'-DDE	ND0.44	ND0.11	ND0.12	ND0.12	ND0.11	ND0.58	ND1.2
Endrin	ND0.44	ND0.11	ND0.12	ND0.12	ND0.11	ND0.58	ND1.2
Endosulfan sulfate	ND0.44	ND0.11	ND0.12	ND0.12	ND0.11	1.3	ND1.2
4,4'-DDT	ND0.44	ND0.11	ND0.12	ND0.12	ND0.11	ND0.58	ND1.2
alpha-Chlordane	ND2.2	ND0.56	ND0.62	ND0.62	ND0.55	ND2.9	ND6.2
gamma-Chlordane	ND2.2	ND0.56	ND0.62	ND0.62	ND0.55	ND2.9	ND6.2

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	Dup OBA-5A	OBA-5B	OBA-5C	OBA-6A	OBA-6B	OBA-6C	OBA-7A
Sample Date	9/20/91	9/20/91	10/7/91	9/20/91	9/19/91	9/19/91	9/19/91
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Compounds							
TCL - Pesticide/PCBs							
alpha-BHC	180	120	ND0.062	ND0.062	3.7	39	0.066
beta-BHC	98	42	ND0.062	0.10	7.7	2.1	5.8
delta-BHC	4.3	3.0	ND0.062	ND0.062	ND0.12	0.22J	ND0.062
gamma-BHC	93	110	ND0.062	ND0.062	ND0.12	1.0	ND0.062
Heptachlor	ND0.62	ND0.62	ND0.062	ND0.062	ND0.12	ND0.62	ND0.062
Aldrin	ND0.62	ND0.62	ND0.062	ND0.062	ND0.12	ND0.62	0.028J
Heptachlor epoxide	ND0.62	ND0.62	ND0.062	ND0.062	ND0.12	ND0.62	0.071
4,4'-DDE	ND1.2	ND1.2	ND0.12	ND0.12	ND0.25	ND1.2	ND0.12
Endrin	ND1.2	ND1.2	ND0.12	ND0.12	ND0.25	ND1.2	ND0.12
Endosulfan sulfate	ND1.2	ND1.2	0.15	ND0.12	ND0.25	ND1.2	ND0.12
4,4'-DDT	ND1.2	ND1.2	ND0.12	ND0.12	1.0	ND1.2	ND0.12
alpha-Chlordane	ND6.2	ND6.2	ND0.62	ND0.62	ND1.2	ND6.2	ND0.62
gamma-Chlordane	ND6.2	ND6.2	ND0.62	ND0.62	ND1.2	ND6.2	ND0.62

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID Sample Date Units	OBA-7B 9/19/91 ug/L	OBA-7C 10/7/91 ug/L	Dup OBA-7C 10/7/91 ug/L	OBA-8A 9/19/91 ug/L	OBA-8B 9/18/91 ug/L	Dup OBA-8B 9/18/91 ug/L	OBA-8C 9/18/91 ug/L
Compounds							
TCL - Pesticide/PCBs							
alpha-BHC	ND0.062	ND0.062	ND0.056	0.10	8.4	6.9	1.2
beta-BHC	0.43	0.31	0.26	0.93	0.80	0.70	0.021J
delta-BHC	ND0.062	ND0.062	ND0.056	ND0.062	ND0.28	ND0.28	ND0.058
gamma-BHC	ND0.062	ND0.062	ND0.056	ND0.062	0.56	0.53	ND0.058
Heptachlor	ND0.062	0.90	1.0	ND0.062	ND0.28	ND0.28	ND0.058
Aldrin	ND0.062	ND0.062	ND0.056	0.065	ND0.28	ND0.28	ND0.058
Heptachlor epoxide	ND0.062	ND0.062	ND0.056	ND0.062	ND0.28	ND0.28	ND0.058
4,4'-DDE	ND0.12	ND0.12	ND0.11	ND0.12	ND0.56	ND0.55	ND0.058
Endrin	ND0.12	ND0.12	ND0.11	ND0.12	ND0.56	ND0.55	ND0.12
Endosulfan sulfate	ND0.12	ND0.12	ND0.11	ND0.12	ND0.56	ND0.55	ND0.12
4,4'-DDT	ND0.12	0.21	ND0.11	ND0.12	ND0.56	ND0.55	ND0.12
alpha-Chlordane	ND0.62	ND0.62	ND0.56	ND0.62	ND2.8	ND2.8	ND0.12
gamma-Chlordane	ND0.62	ND0.62	ND0.56	ND0.62	ND2.8	ND2.8	ND0.58

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	BH-1	BH-3	NAPL OBA-2C	Rinsate 1	Rinsate 2	Rinsate 3	Trip Blank 1
Sample Date	9/18/91	9/18/91	9/20/91	9/18/91	9/20/91	10/7/91	-----
Units	ug/L	ug/L	mg/kg	ug/L	ug/L	ug/L	ug/L
Compounds							
<u>TCL - Pesticide/PCBs</u>							
alpha-BHC	ND0.062	610	70	ND0.058	ND0.062	ND0.058	NS
beta-BHC	0.38	64	71	ND0.058	ND0.062	ND0.058	
delta-BHC	0.027J	170	170	ND0.058	ND0.062	ND0.058	
gamma-BHC	ND0.062	430	50	ND0.058	ND0.062	ND0.058	
Heptachlor	ND0.062	ND2.5	7.6	ND0.058	ND0.062	ND0.058	
Aldrin	ND0.062	ND2.5	ND4.9	ND0.058	ND0.062	ND0.058	
Heptachlor epoxide	ND0.062	ND2.5	5.2	ND0.058	ND0.062	ND0.058	
4,4'-DDE	ND0.12	ND5.0	9.0J	ND0.12	ND0.12	ND0.12	
Endrin	ND0.12	ND5.0	130	ND0.12	ND0.12	ND0.12	
Endosulfan sulfate	ND0.12	ND5.0	200	ND0.12	ND0.12	ND0.12	
4,4'-DDT	ND0.12	ND5.0	ND9.8	ND0.12	ND0.12	ND0.12	
alpha-Chlordane	ND0.62	ND25	1.8J	ND0.58	ND0.62	ND0.58	
gamma-Chlordane	ND0.62	ND25	3.9J	ND0.58	ND0.62	ND0.58	

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	Trip Blank 2	Field Blank 1	Field Blank 2
Sample Date	-----	-----	-----
Units	ug/L	ug/L	ug/L
Compounds			
<u>TCL - Pesticide/PCBs</u>			
alpha-BHC	NS	NS	NS
beta-BHC			
delta-BHC			
gamma-BHC			
Heptachlor			
Aldrin			
Heptachlor epoxide			
4,4'-DDE			
Endrin			
Endosulfan sulfate			
4,4'-DDT			
alpha-Chlordane			
gamma-Chlordane			

NS - Not sampled
ND - Not detected, applicable detection limit listed
J - Indicates an estimated value due to outlying QC criteria and/or indicates detection above the method detection limit (MDL) but less than the practical quantitation limit (PQL).
E - Compound whose concentration exceeds the calibration range of the GC/MS instrument but was diluted below the instrument detection limit on subsequent dilution runs.
R - Data found to be unusable as a result of outlying QC criteria.
U - The material was analyzed for but was not detected. The numerical value is the sample quantitation limit and has been adjusted to reflect contamination from laboratory or field activities.
UJ - Estimated quantitation limit

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID **Sample Date** **Units**	Olin Production Well 9/23/91 ug/L	OBA-1A 9/17/91 ug/L	OBA-1B 9/17/91 ug/L	OBA-1C 9/17/91 ug/L	OBA-2B 9/23/91 ug/L	OBA-2C 10/4/91 ug/L	OBA-3A 9/23/91 ug/L
Compound							
Methanol	ND1000	ND1000	2100	1800	ND1000	ND1000	ND1000
Sample Date **Units**	9/23/91 ug/L	9/20/91 ug/L	9/17/91 ug/L	9/17/91 ug/L	9/23/91 ug/L	10/4/91 ug/L	9/23/91 ug/L
Mercury	0.3	1.8	166	0.2	30.6	0.9	6.3J

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	Dup OBA-3A	OBA-3B	OBA-3C	OBA-4A	OBA-4B	OBA-4C	OBA-5A
Sample Date	9/23/91	9/23/91	10/4/91	9/20/92	9/18/91	9/18/91	9/20/91
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Compound							
Methanol	ND1000	ND1000	ND1000	ND1000	ND1000	ND1000	1400
Sample Date	9/23/91	9/23/91	10/4/91	9/23/91	9/18/91	9/18/91	9/20/91
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Mercury	0.3J	0.2	0.5	ND0.2	ND0.2	ND0.2	202

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	Dup OBA-5A	OBA-5B	OBA-5C	OBA-6A	OBA-6B	OBA-6C	OBA-7A
Sample Date	9/20/91	9/20/91	10/7/91	9/20/91	9/19/91	9/19/91	9/19/91
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Compound							
Methanol	1500	68,000	ND1000	1,570,000	161,000	1500	ND1000
Sample Date	9/20/91	9/20/91	10/7/91	9/20/91	9/19/91	9/19/91	9/19/91
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Mercury	194	7.0	ND0.2	10.6	47.7	0.7	2.8

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	OBA-7B	OBA-7C	Dup OBA-7C	OBA-8A	OBA-8B	Dup OBA-8B	OBA-8C
Sample Date	9/19/91	10/7/91	10/7/91	9/19/91	9/18/91	9/18/91	9/18/91
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Compound							
Methanol	2300	ND1000	ND1000	ND1000	75,000J	6300J	ND1000
Sample Date	9/19/91	10/7/91	10/7/91	9/19/91	9/18/91	9/18/91	9/18/91
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Mercury	108	7.9	6.2	13.1	1.3	2.0	0.3

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	BH-1	BH-3	OBA-2C NAPL	Rinsate 1	Rinsate 2	Rinsate 3	Trip Blank 1
Sample Date	9/18/91	9/18/91	9/20/91	9/18/91	9/20/91	10/7/91	9/18/91
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Compound							
Methanol	ND1000	3000	ND100,000 UJ	ND1000	ND1000	ND1000	ND1000
Sample Date	9/20/91	9/18/91	9/20/91	9/18/91	9/20/91	10/7/91	-----
Units	ug/L	ug/L	mg/kg	ug/L	ug/L	ug/L	ug/L
Mercury	ND0.2	223	ND0.14	ND0.2	ND0.2	ND0.2	NS

TABLE 7-1 (continued)

SUMMARY OF DETECTED COMPOUNDS
OLIN RFI GROUNDWATER SAMPLES
NIAGARA FALLS, NEW YORK

Well ID	Trip Blank 2	Field Blank 1	Field Blank 2
Sample Date	9/20/91	9/18/91	10/7/91
Units	ug/L	ug/L	ug/L
Compound			
Methanol	ND1000	ND1000	ND1000
Sample Date	-----	-----	-----
Units	ug/L	ug/L	ug/L
Mercury	NS	NS	NS

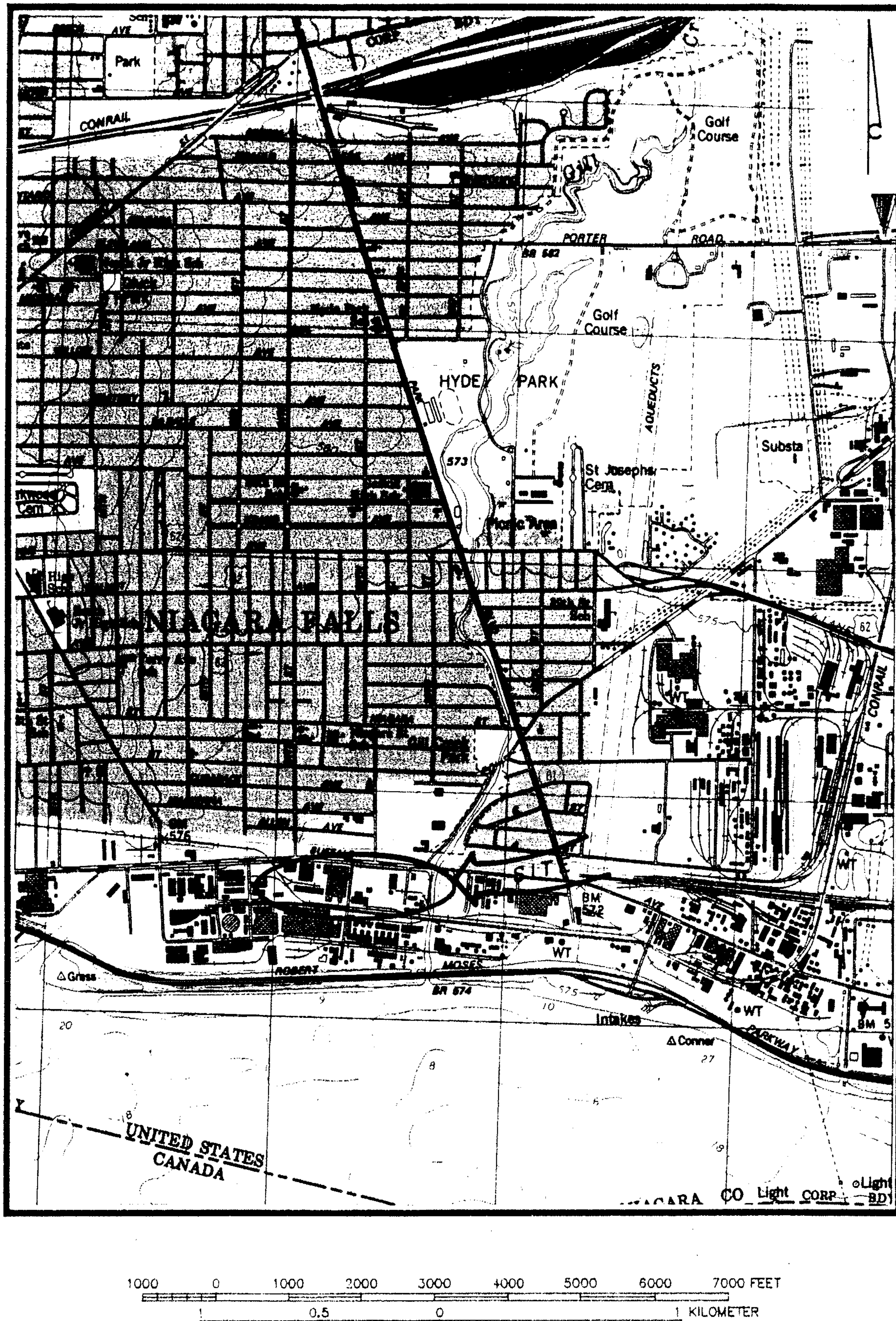
NS - Not sampled
ND - Not detected, applicable detection limit listed
J - Indicates an estimated value due to outlying QC criteria and/or indicates detection above the method detection limit (MDL) but less than the practical quantitation limit (PQL).
E - Compound whose concentration exceeds the calibration range of the GC/MS instrument but was diluted below the instrument detection limit on subsequent dilution runs.
R - Data found to be unusable as a result of outlying QC criteria.
U - The material was analyzed for but was not detected. The numerical value is the sample quantitation limit and has been adjusted to reflect contamination from laboratory or field activities.
UJ - Estimated quantitation limit

TABLE 7-2

DETECTED CHEMICALS IN WELL OBA-2C DNAPL
OLIN BUFFALO AVENUE PLANT RFI

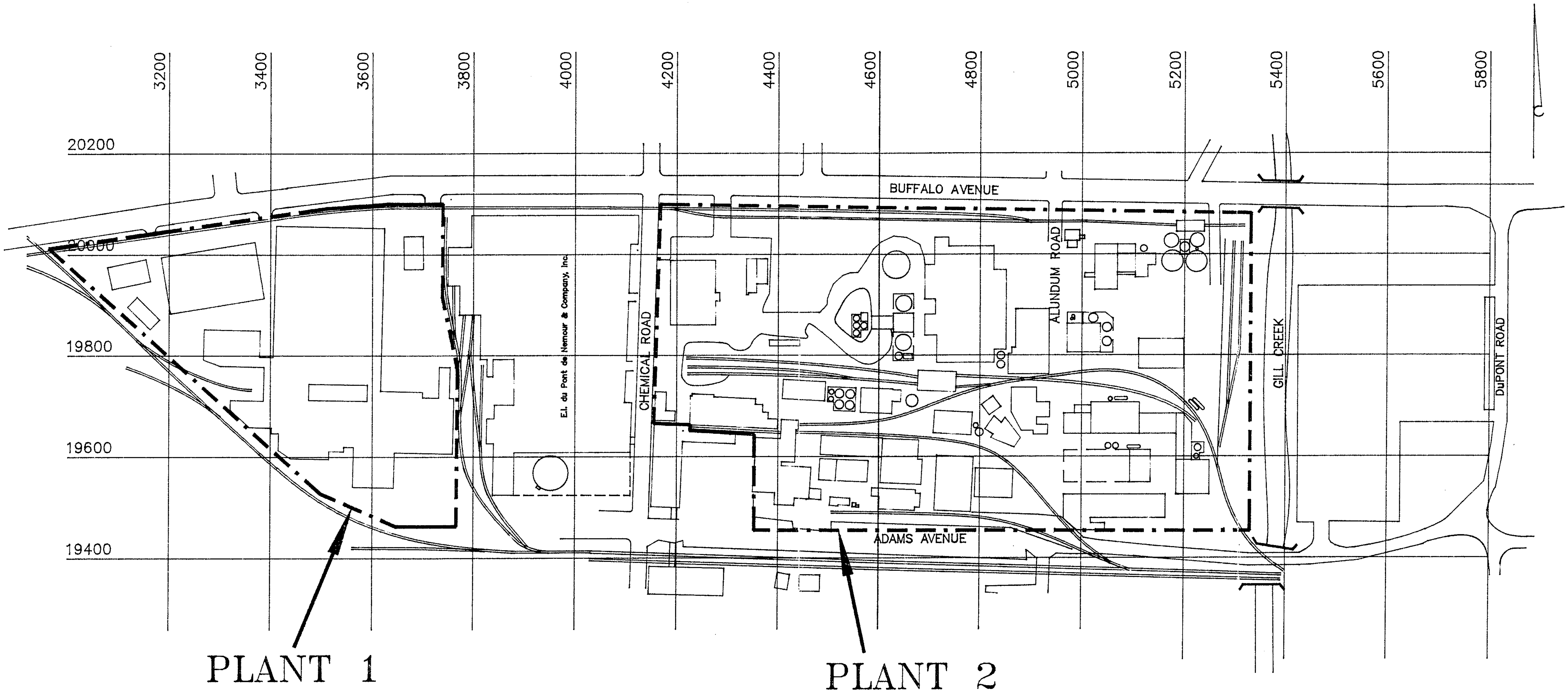
Chemical	Concentration (mg/kg)
Volatile Organic Compounds	
1,2-Dichloroethene (total)	380
Chloroform	600
Carbon tetrachloride	2,300
Trichloroethene	130,000
Tetrachloroethene	130,000
1,1,2,2-Tetrachloroethane	35,000
	Subtotal: 298,280 mg/kg (29.8%)
Semivolatile Organic Compounds	
1,3-Dichlorobenzene	410
1,4-Dichlorobenzene	1,200
1,2-Dichlorobenzene	6,000
1,2,4-Trichlorobenzene	2,800
Hexachlorobutadiene	9,600
Hexachlorobenzene	360
bis(2-Ethylhexyl)phthalate	2,100
Hexachloroethane	25,000
	Subtotal: 47,470 mg/kg (4.7%)
Pesticide/PCB	
alpha-BHC	70
beta-BHC	71
delta-BHC	130
gamma-BHC	50
Heptachlor	7.6
Heptachlor epoxide	5.2
Endrin	130
Endosulfan sulfate	130
alpha-Chlordane	1.8
gamma-Chlordane	3.9
4,4'-DDE	9.0
	Subtotal: 608.5 mg/kg (0.06%)

Figures

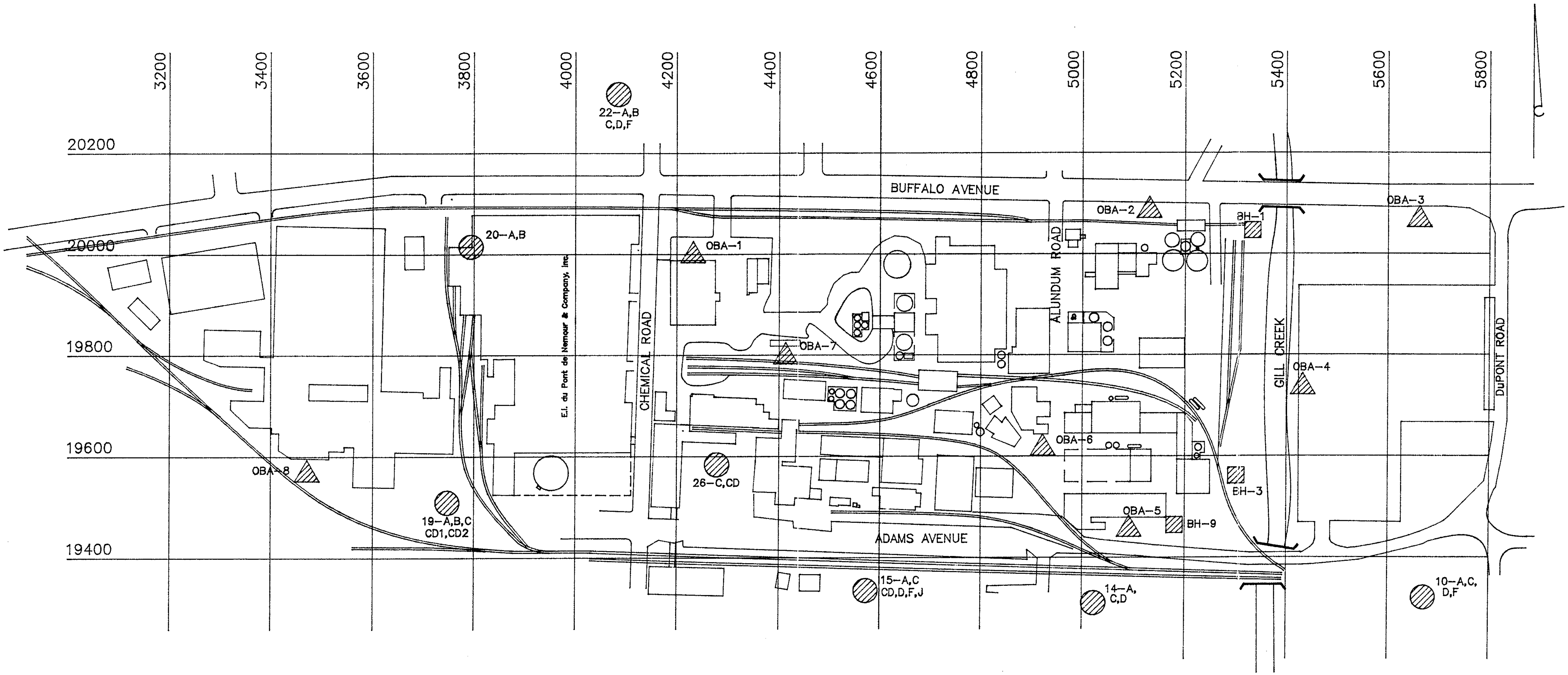


REGIONAL LOCATION PLAN

Figure 1–1



OLIN CHEMICALS NIAGARA PLANT RCRA FACILITY INVESTIGATION		
WOODWARD–CLYDE CONSULTANTS Consulting Engineers, Geologists and Environmental Scientists		
SITE LOCATION PLAN		
Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 2–1
Scale: 0 200 Feet		



LEGEND:

HBH–1 EXISTING HARZA MONITORING WELLS

OBA–1 OLIN MONITORING WELL LOCATIONS

20–A,B DuPONT MONITORING WELLS

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD–CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

MONITORING WELL LOCATION PLAN

Job No.: 88C2346–12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 3–1
Scale: 0 200 Feet		

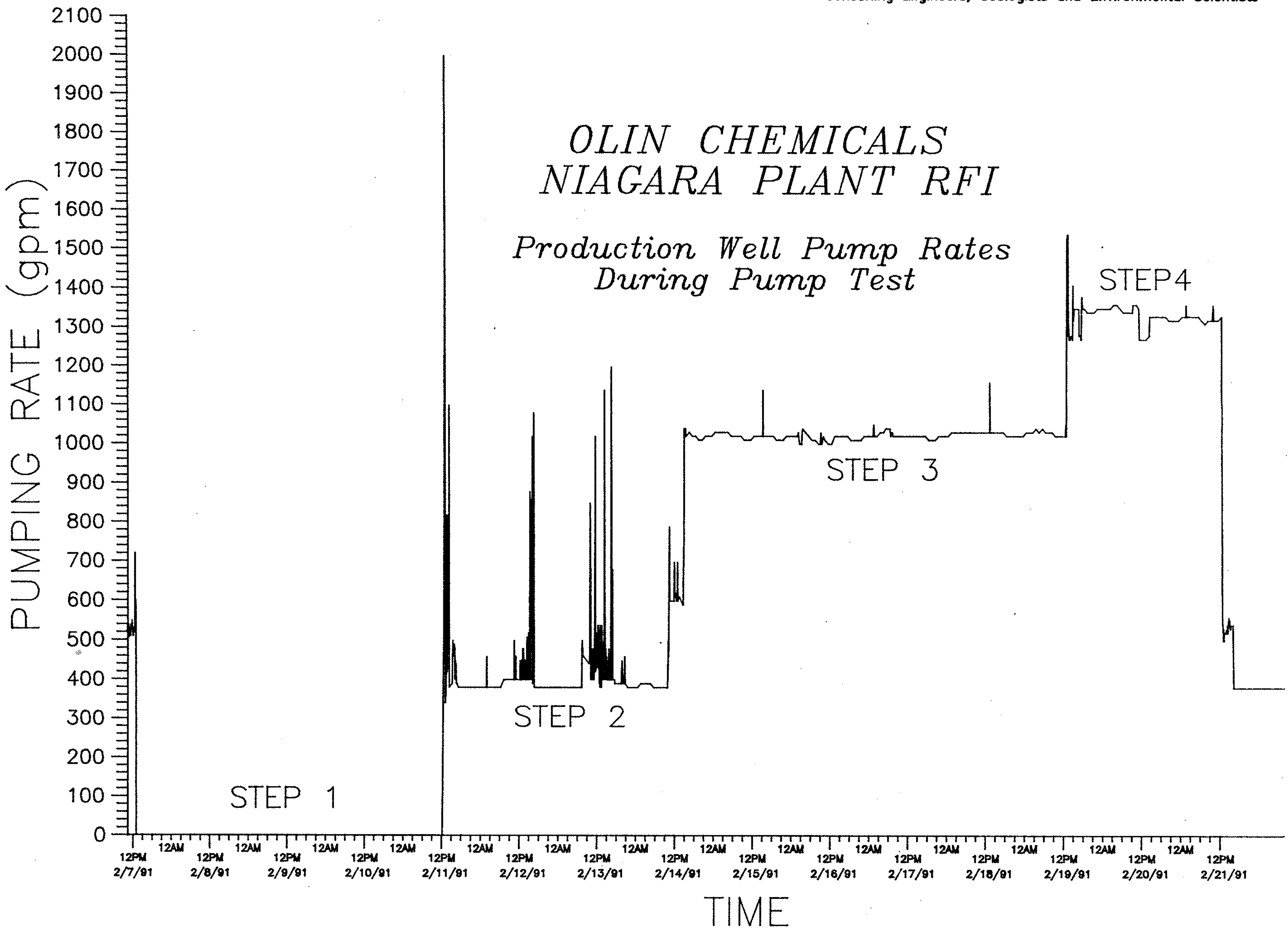
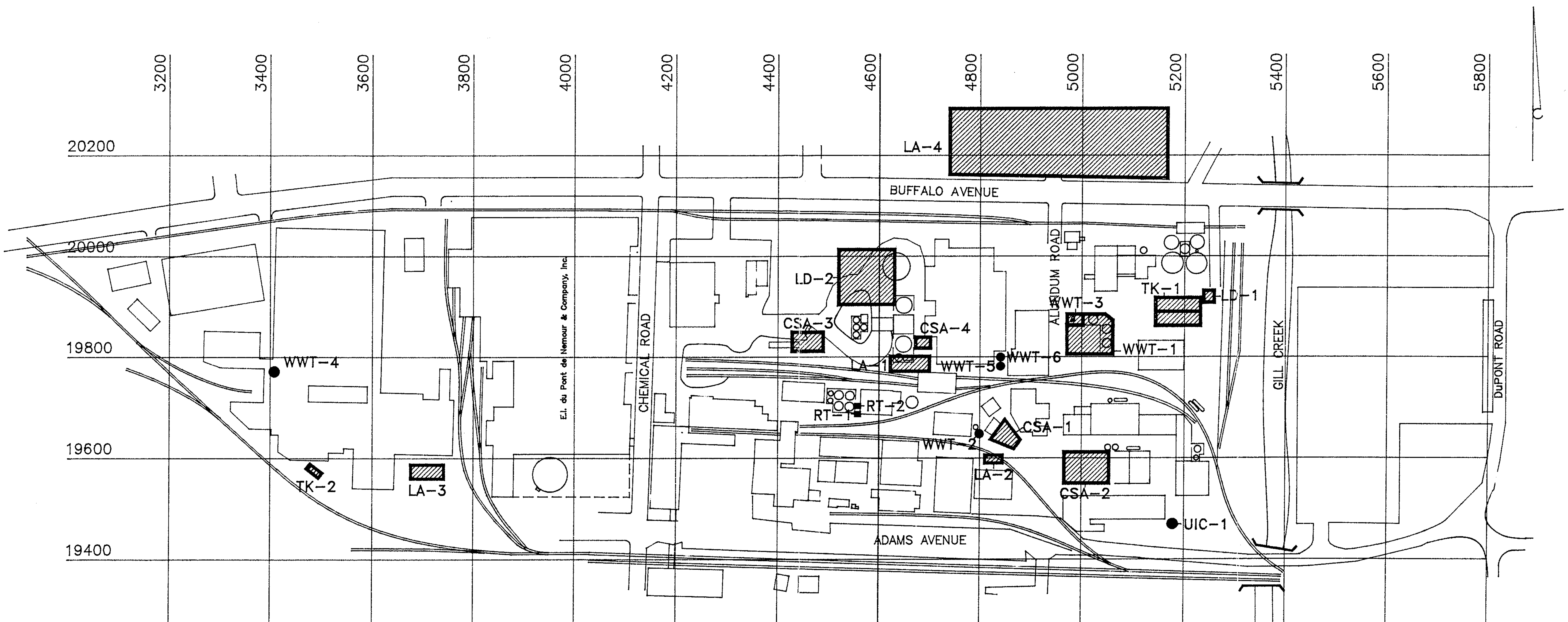

OLIN CHEMICALS
NIAGARA PLANT RFI
Production Well Pump Rates
During Pump Test
PUMPING RATE (gpm)
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
STEP 1
STEP 2
STEP 3
STEP4
12PM 2/7/91
12AM
12PM 2/8/91
12AM
12PM 2/9/91
12AM
12PM 2/10/91
12AM
12PM 2/11/91
12AM
12PM 2/12/91
12AM
12PM 2/13/91
12AM
12PM 2/14/91
12AM
12PM 2/15/91
12AM
12PM 2/16/91
12AM
12PM 2/17/91
12AM
12PM 2/18/91
12AM
12PM 2/19/91
12AM
12PM 2/20/91
12AM
12PM 2/21/91
TIME

Figure 3-2



UNIT	USAGE	STATUS (as of 2/90)	UNIT	USAGE	STATUS (as of 2/90)
CSA-1	Drum Storage Area	Active	WWT-6	Treatment Tank: Sodium Hypochlorite Decomposition	Inactive
CSA-2	Drum Storage Area	Inactive	TK-1	Concrete Lined Brine Mud Treatment Tank	Inactive (RCRA Closure)
CSA-3	Drum Storage Area	Inactive (RCRA Closure)	TK-2	Concrete Lined Waste Calcium Hypochlorite Settling Tank	Inactive (RCRA Closure)
CSA-4	Drum Storage Area	Inactive	LA-1	Brine Mud Application for Road Repairs	Inactive
LD-1	Brine Mud Waste Pile	Inactive (RCRA Closure)	LA-2	Brine Mud Application for Road Repairs	Inactive
LD-2	Cooling Water Surface Impoundment	Inactive	LA-3	Brine Mud Application to Fill Topographic Low Area	Inactive
WWT-1	Treatment Tank: Hg Removal from Wastewater	Active	LA-4	Brine Mud Application for Road Repairs	Inactive
WWT-2	Treatment Tank: Sodium Hypochlorite Decomposition	Active	UIC-1	Bedrock Injection Well	Inactive
WWT-3	Treatment Tank: pH Adjustment of Wastewater	Active	RT-1	Thermal Treatment of Mercury Sludge	Active
WWT-4	Treatment Tank: Chlorine Removal from Wastewater	Inactive	RT-2	Thermal Treatment of Mercury Sludge (Backup for RT-1)	Active
WWT-5	Treatment Tank: Sodium Hypochlorite Decomposition	Inactive			

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

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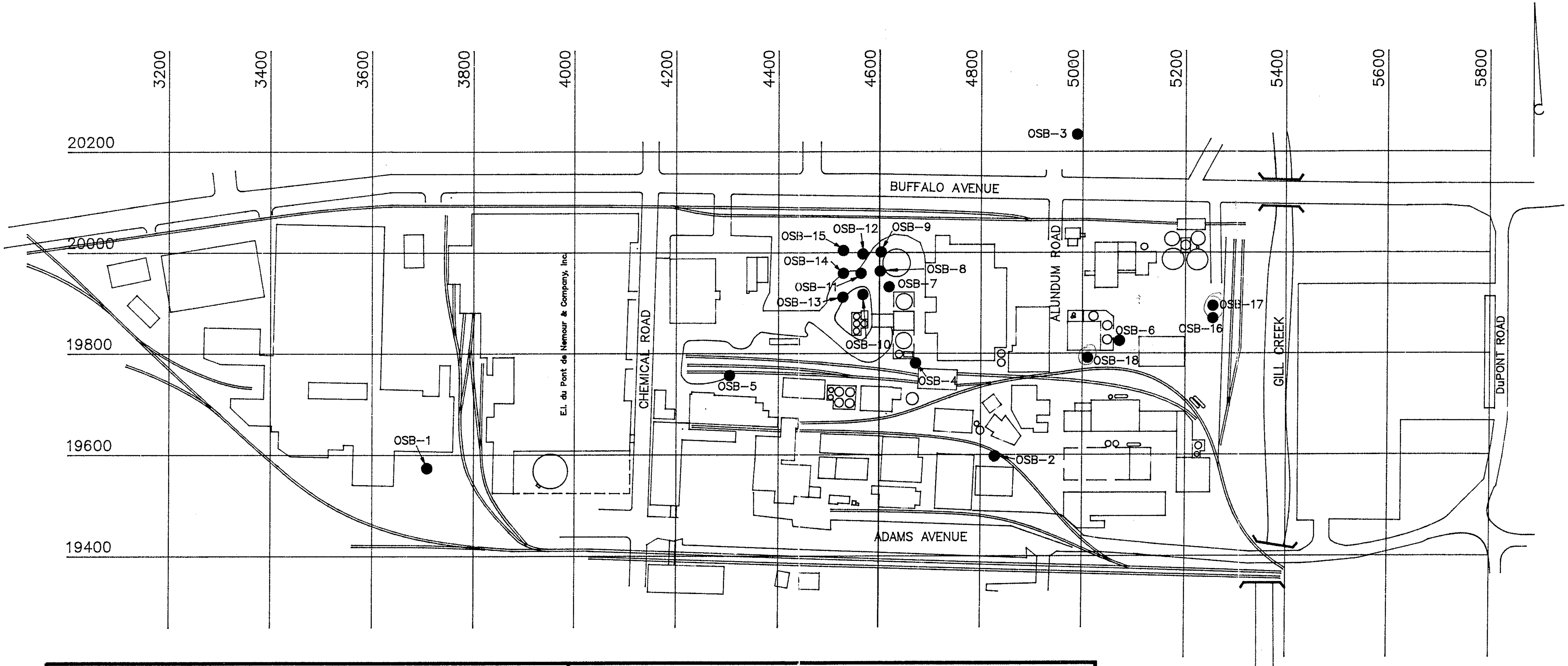
OLIN SOLID WASTE MANAGEMENT UNITS (SWMUs)

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 3-3
Scale: 0 200 Feet		



BORING	SWMU INVESTIGATED	DEPTH TO REFUSAL	NATURE OF REFUSAL
OSB-1	LA-3	9.1'	Bedrock
OSB-2	LA-2	4.6'	Bedrock
OSB-3	LA-4	6.9'	Bedrock
OSB-4	LA-1	2.5'	Old Foundation
OSB-5	North of Building 17	6.5'	Bedrock
OSB-6	WWT-1	8.2'	Bedrock
OSB-7	LD-2	5.3'	Bedrock
OSB-8	LD-2	3.2'	Old Foundation
OSB-9	LD-2	3.2'	Old Foundation
OSB-10	LD-2	4'	Old Foundation
OSB-11	LD-2	2.5'	Old Foundation
OSB-12	LD-2	3'	Old Foundation
OSB-13	LD-2	3.4'	Old Foundation
OSB-14	LD-2	2.8'	Old Foundation
OSB-15	LD-2	2.6'	Old Foundation
OSB-16	TK-1	6.7'	Bedrock
OSB-17	BHC Storage Pile	7'	Bedrock
OSB-18	Building 97	6.7'	Bedrock

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

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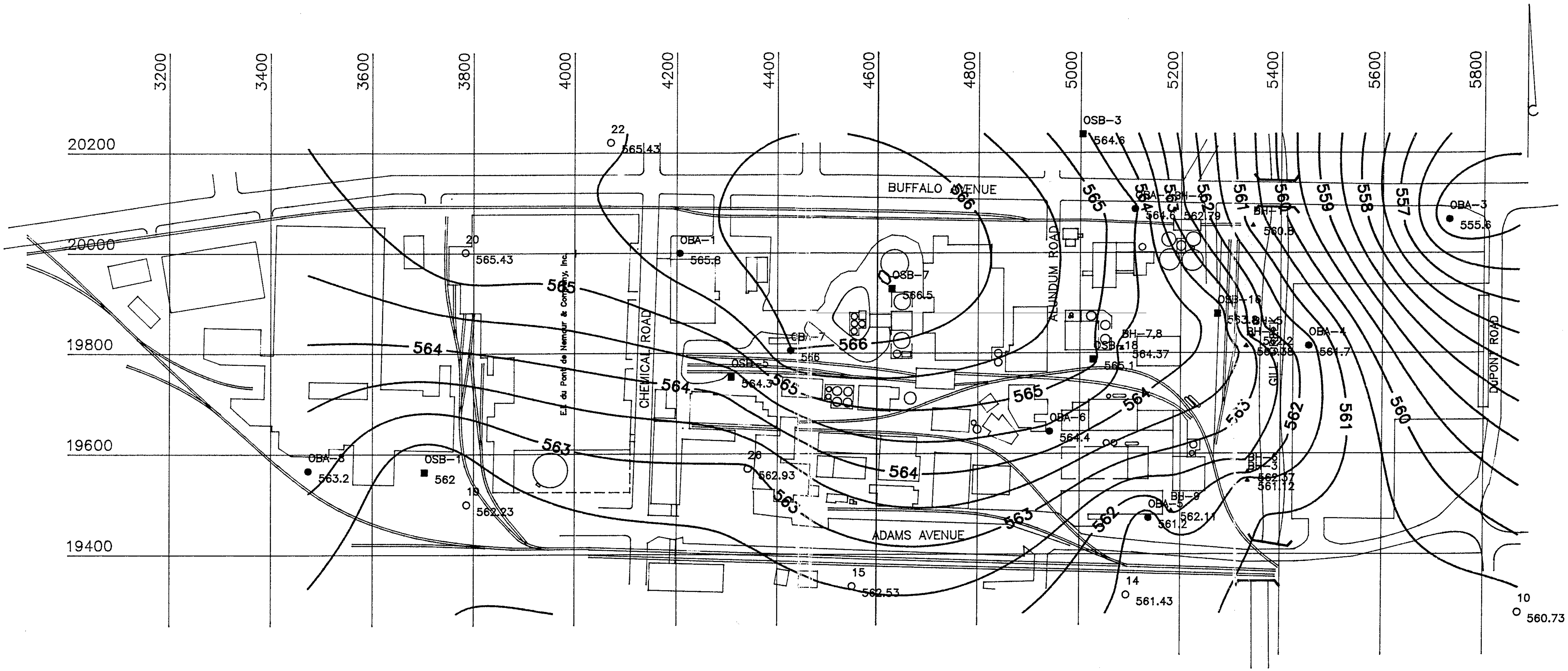
SOIL BORING LOCATIONS

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 3-4
Scale: 0 — 200 Feet		



OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

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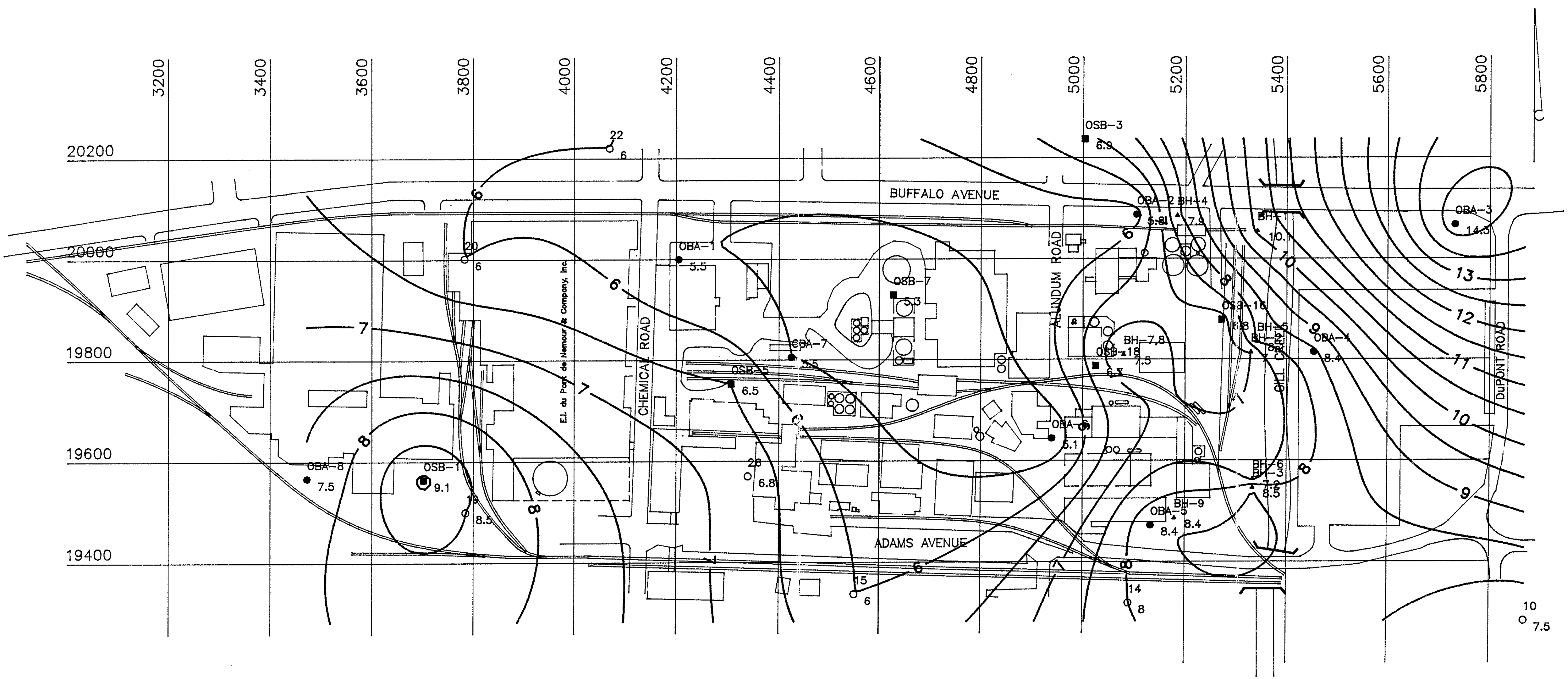
TOP OF BEDROCK ELEVATION
CONTOUR MAP

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	
Scale: 0 — 200 Feet		Figure 4-1

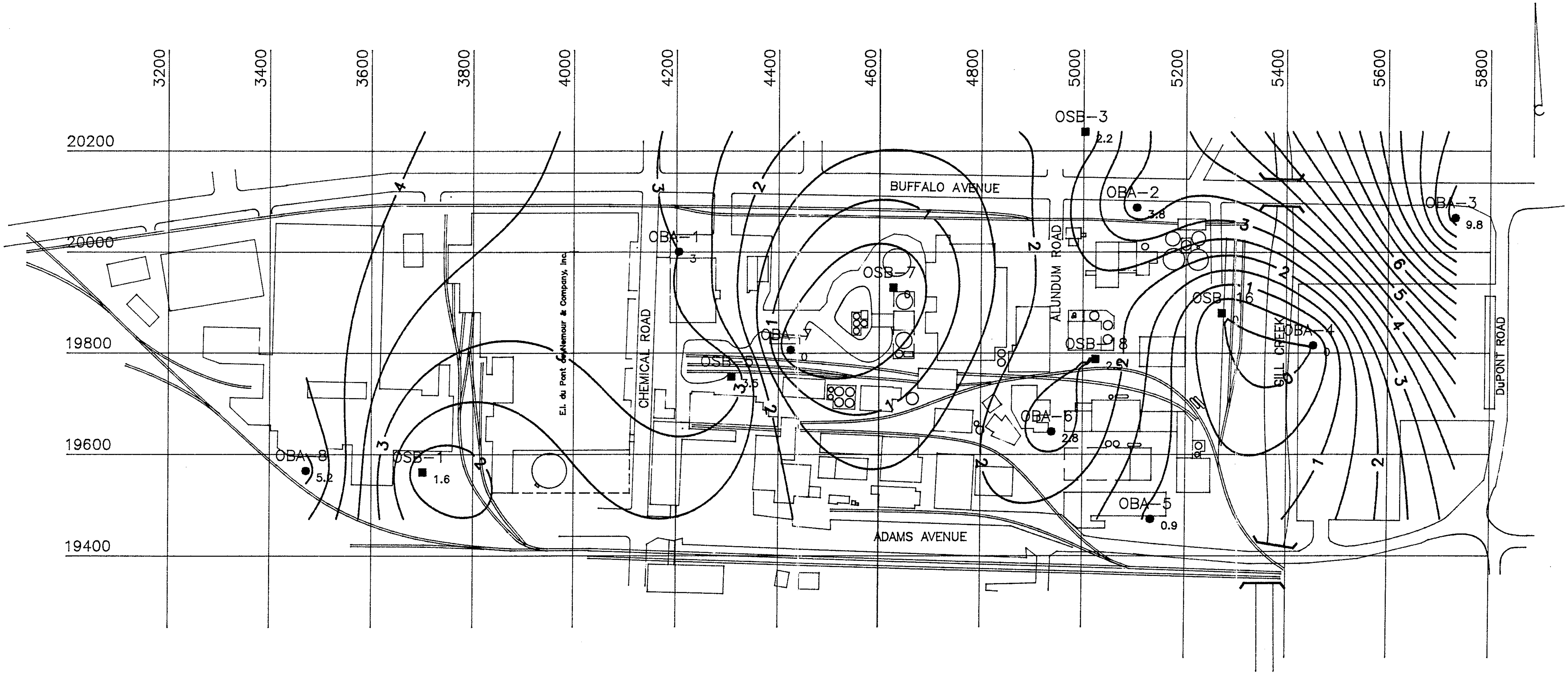


OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

OVERBURDEN ISOPACH CONTOUR MAP

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	
Scale: 0 — 200 Feet		Figure 4-2



OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
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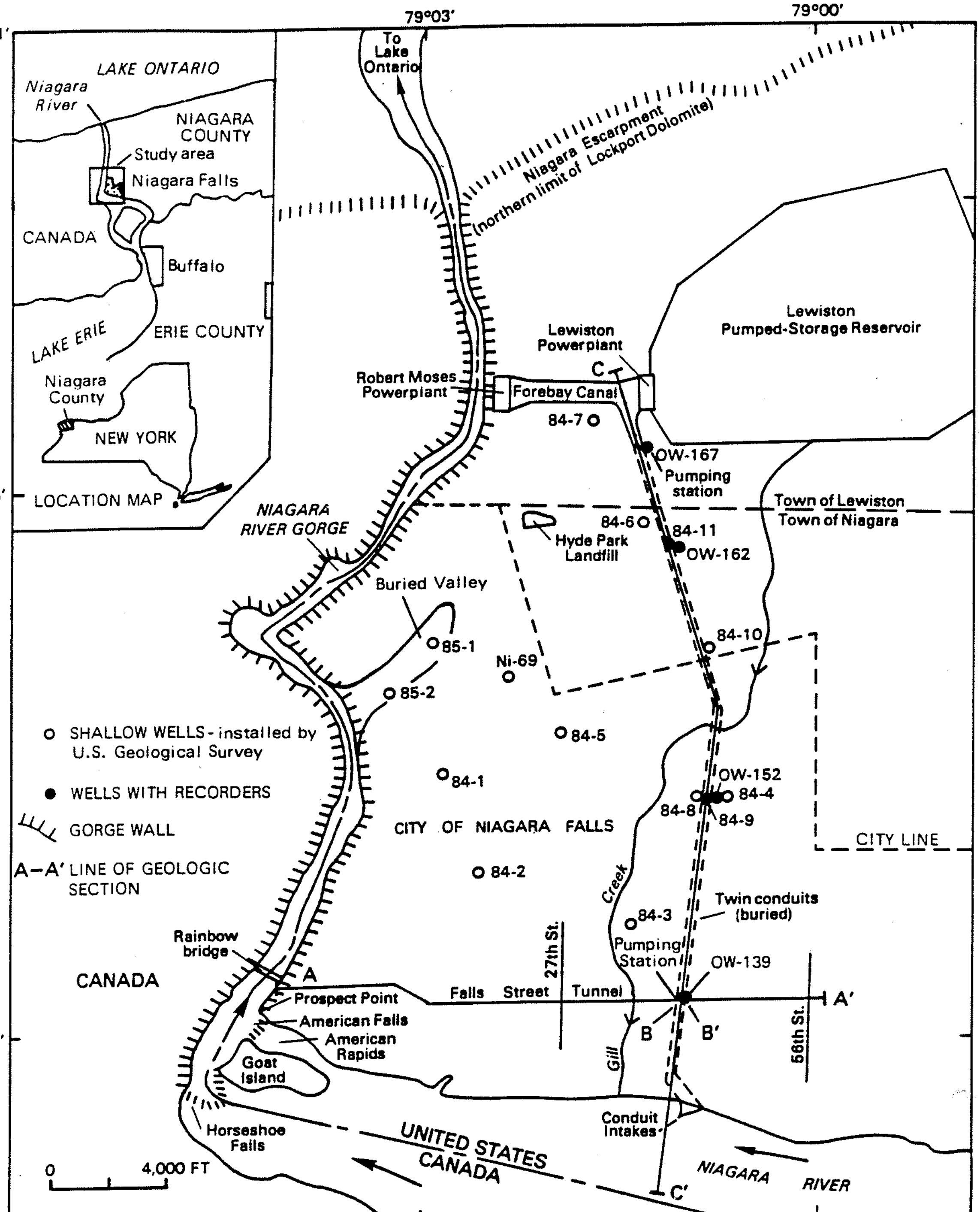
GLACIAL DEPOSITS ISOPACH
CONTOUR MAP

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-3
Scale: 0 — 200 Feet		



Base from U.S. Geological Survey
Lewiston, 1965, and Niagara Falls, 1965, 1:24,000

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

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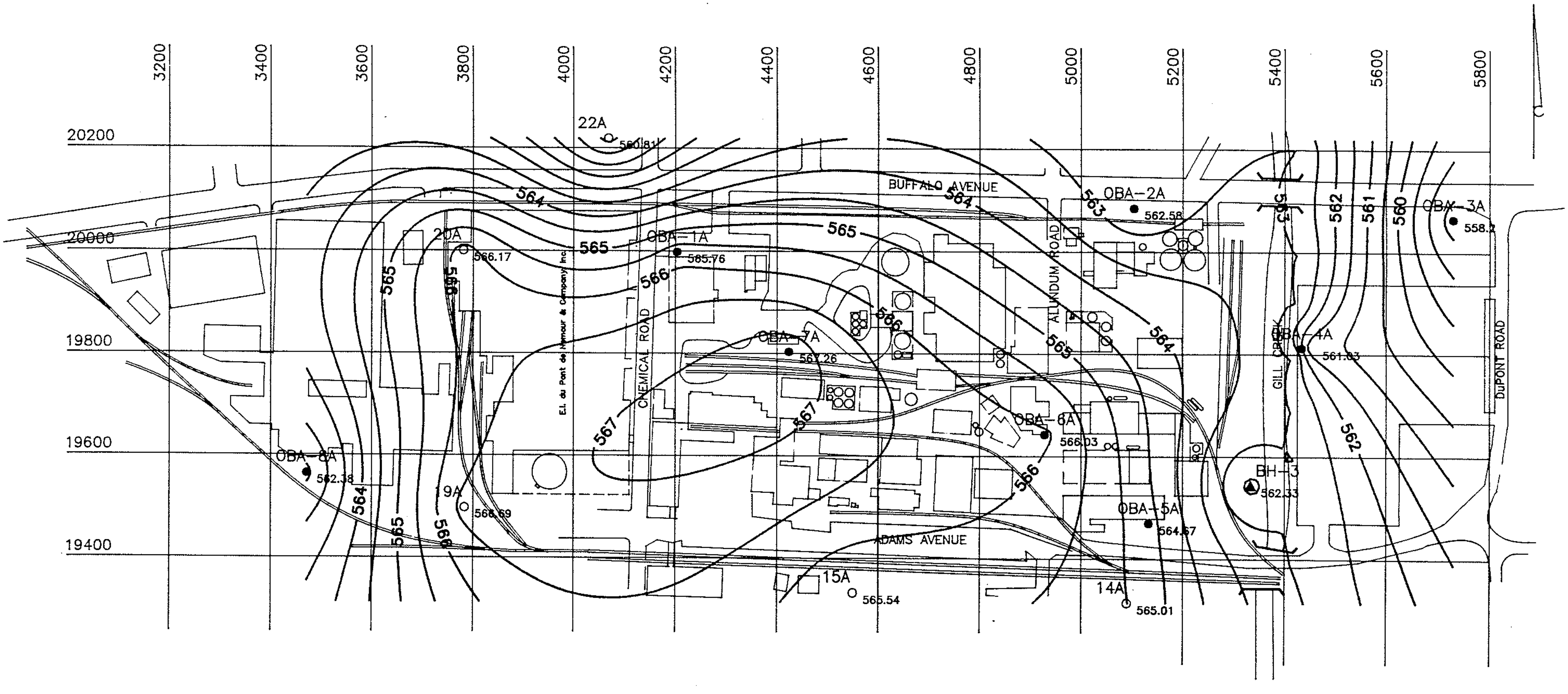
REGIONAL INFLUENCES ON
GROUNDWATER FLOW
NIAGARA FALLS, NEW YORK

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	
Scale:		Figure 4-4



STATIC WATER LEVEL AT GILL CREEK: 563.00

DATE OF MEASUREMENT: 10/25/90

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
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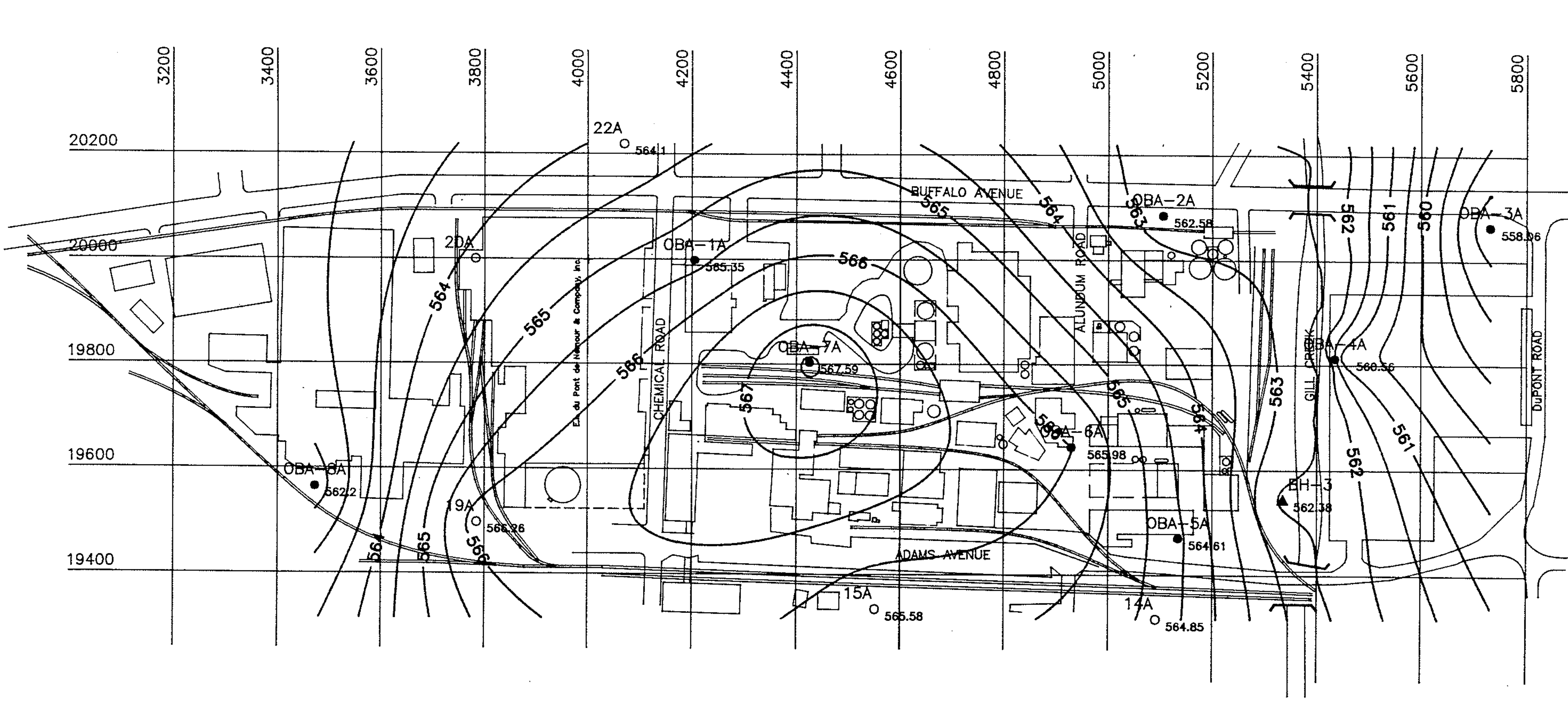
POTENTIOMETRIC SURFACE CONTOUR MAP
A-ZONE
OCTOBER, 1990

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-5
Scale: 0 200 Feet		



STATIC WATER LEVEL AT GILL CREEK: 562.44

DATE OF MEASUREMENT: 11/27/90

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

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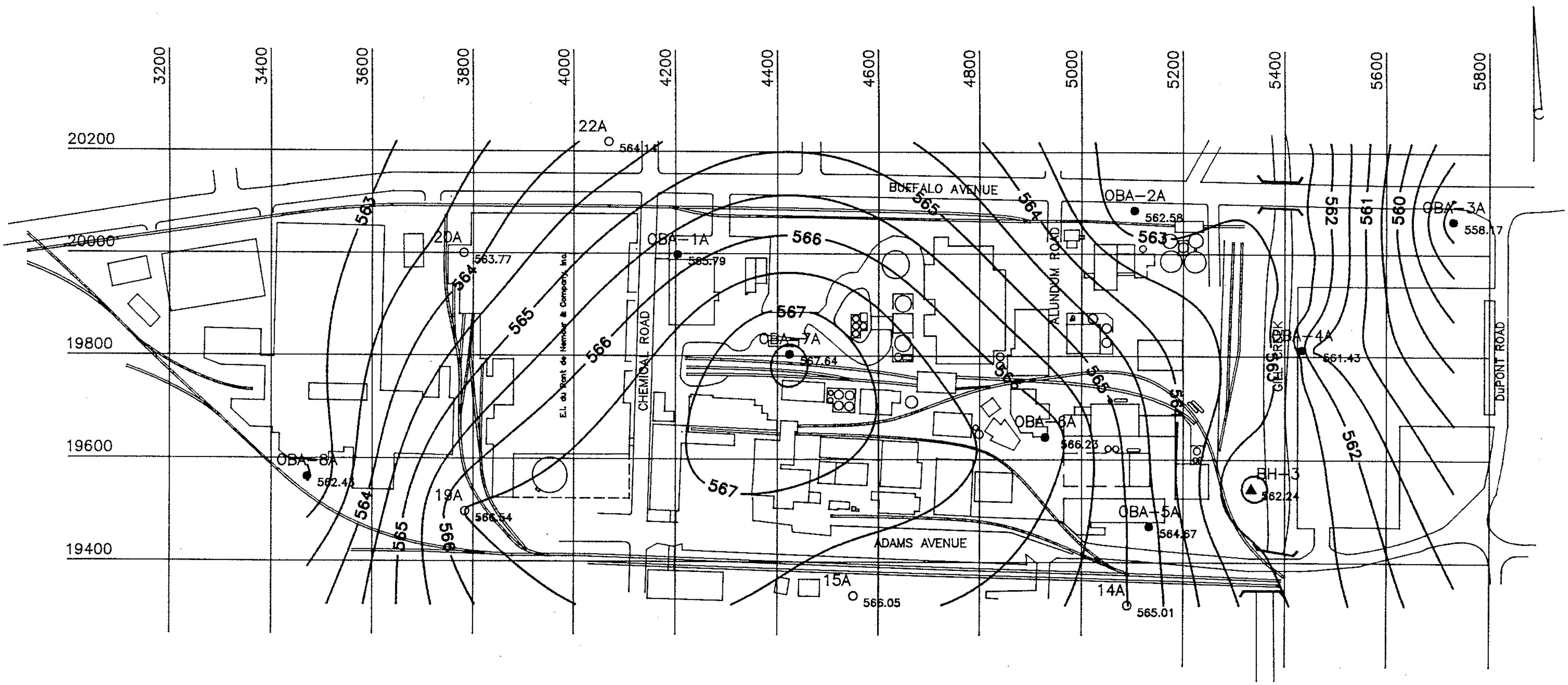
POTENTIOMETRIC SURFACE CONTOUR MAP
A-ZONE
NOVEMBER, 1990

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	
Scale: 0 200 Feet		Figure 4-6



STATIC WATER LEVEL AT GILL CREEK: 562.85

DATE OF MEASUREMENT: 12/7/90

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
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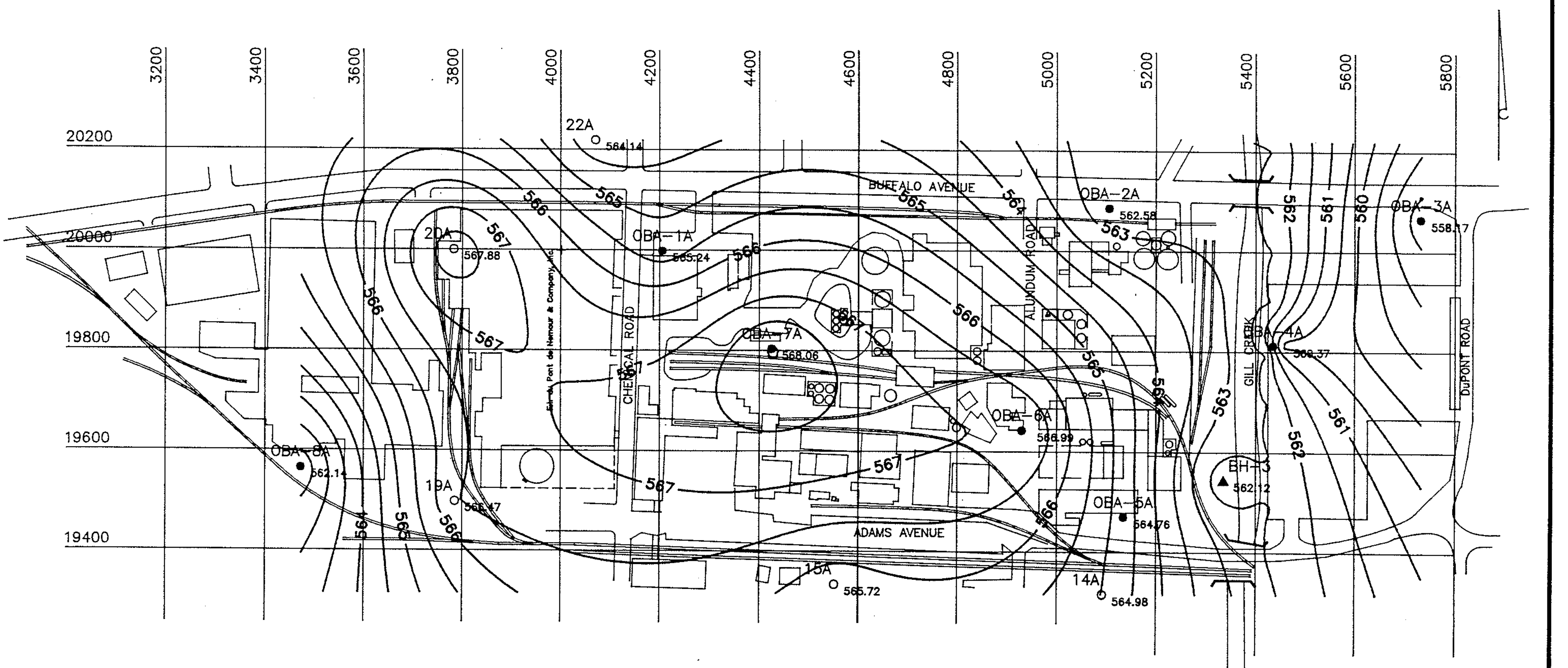
POTENTIOMETRIC SURFACE CONTOUR MAP
A-ZONE
DECEMBER, 1990

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-7
Scale: 0 200 Feet		



STATIC WATER LEVEL AT GILL CREEK: 562.53

DATE OF MEASUREMENT: 1/16/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

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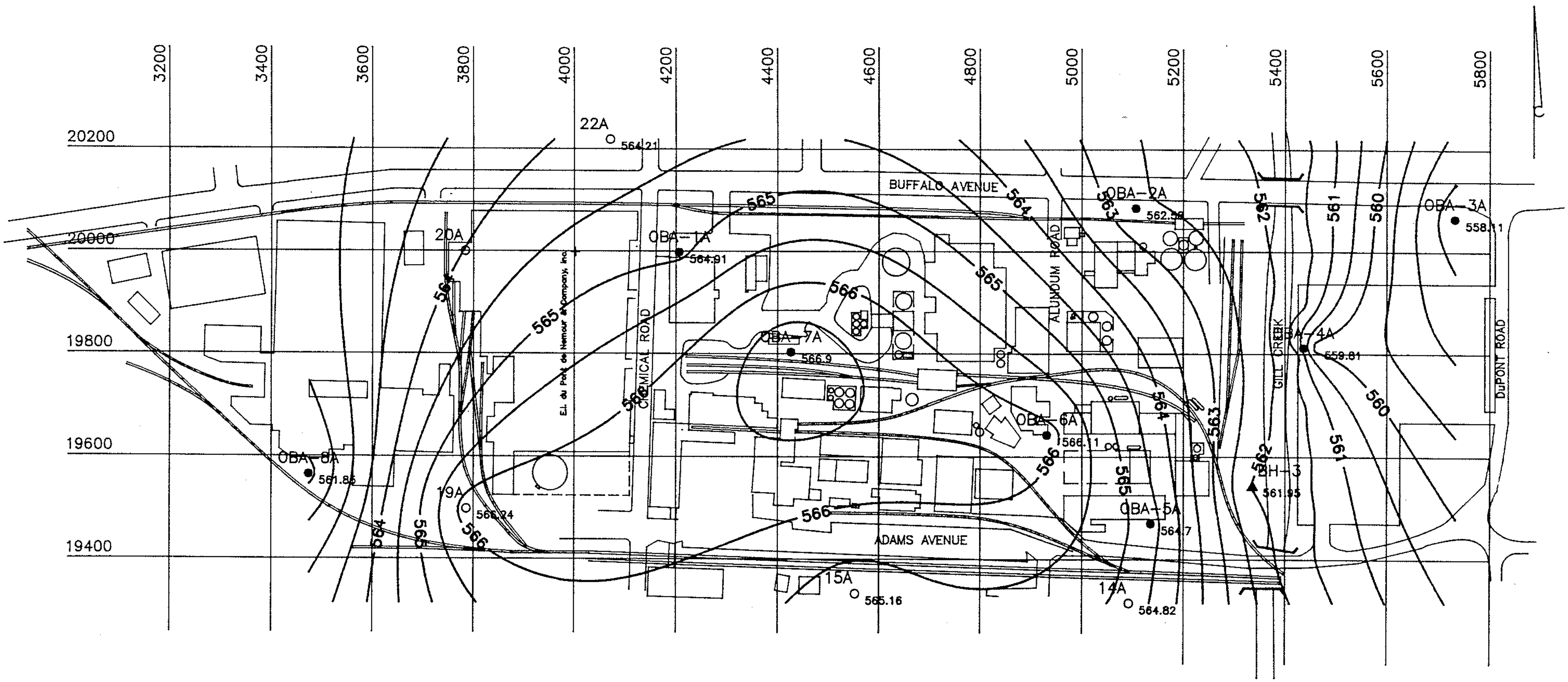
POTENTIOMETRIC SURFACE CONTOUR MAP
A-ZONE
JANUARY, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-8
Scale: 0 — 200 Feet		



STATIC WATER LEVEL AT GILL CREEK: 561.73

DATE OF MEASUREMENT: 2/6/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

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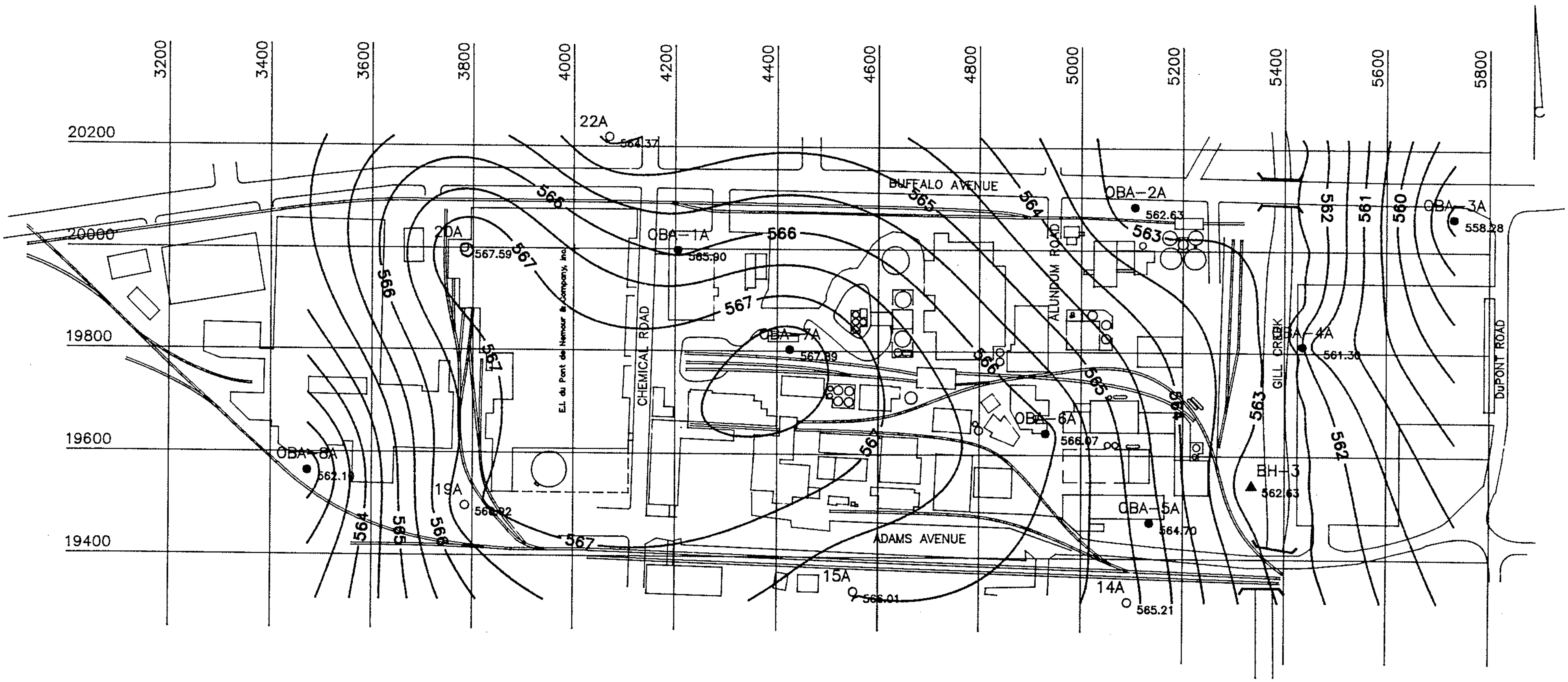
POTENTIOMETRIC SURFACE CONTOUR MAP
A-ZONE
FEBRUARY, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-9
Scale: 0 200 Feet		



STATIC WATER LEVEL AT GILL CREEK: 562.68

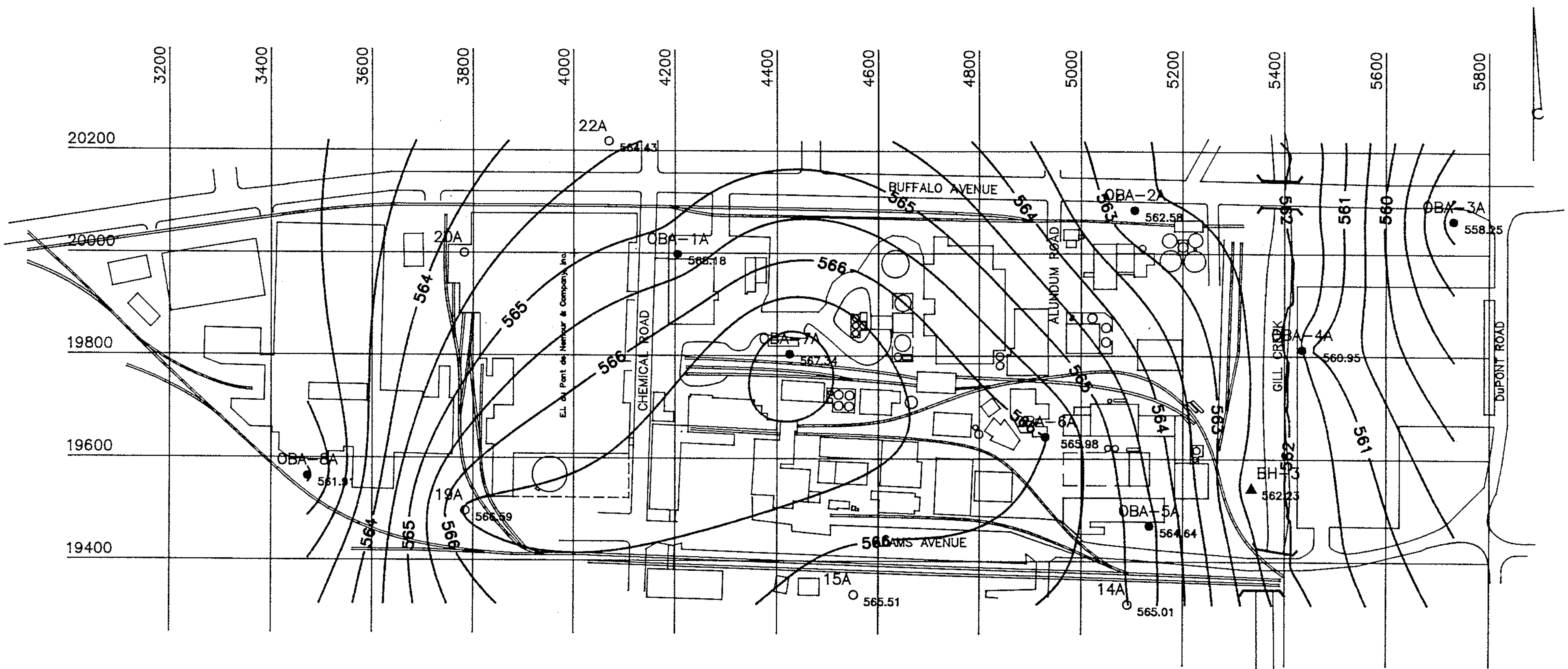
DATE OF MEASUREMENT: 3/25/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
A-ZONE
MARCH, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-10
Scale: 0 — 200 Feet		



STATIC WATER LEVEL AT GILL CREEK: 561.99

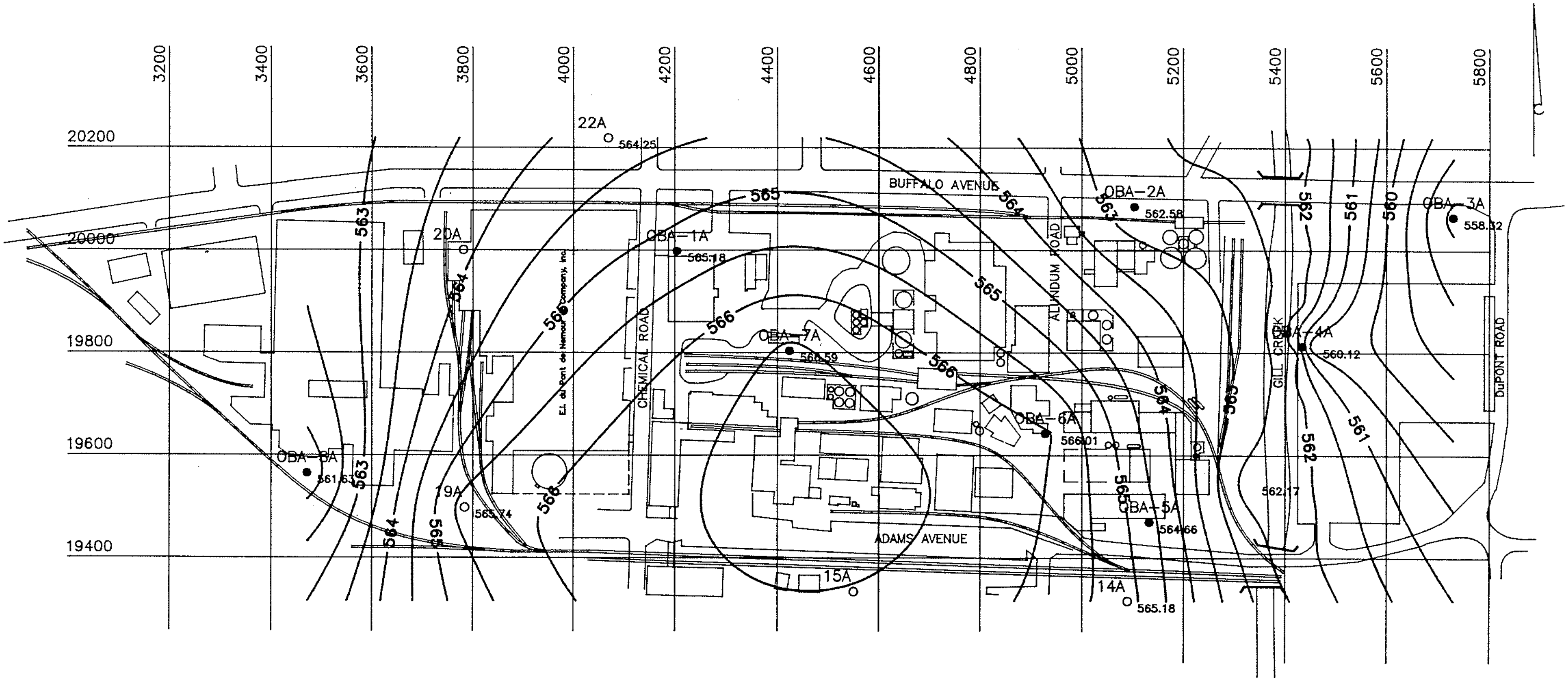
DATE OF MEASUREMENT: 4/8/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
A-ZONE
APRIL, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-11
Scale: 0 200 Feet		



STATIC WATER LEVEL AT GILL CREEK: 562.24

DATE OF MEASUREMENT: 5/13/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
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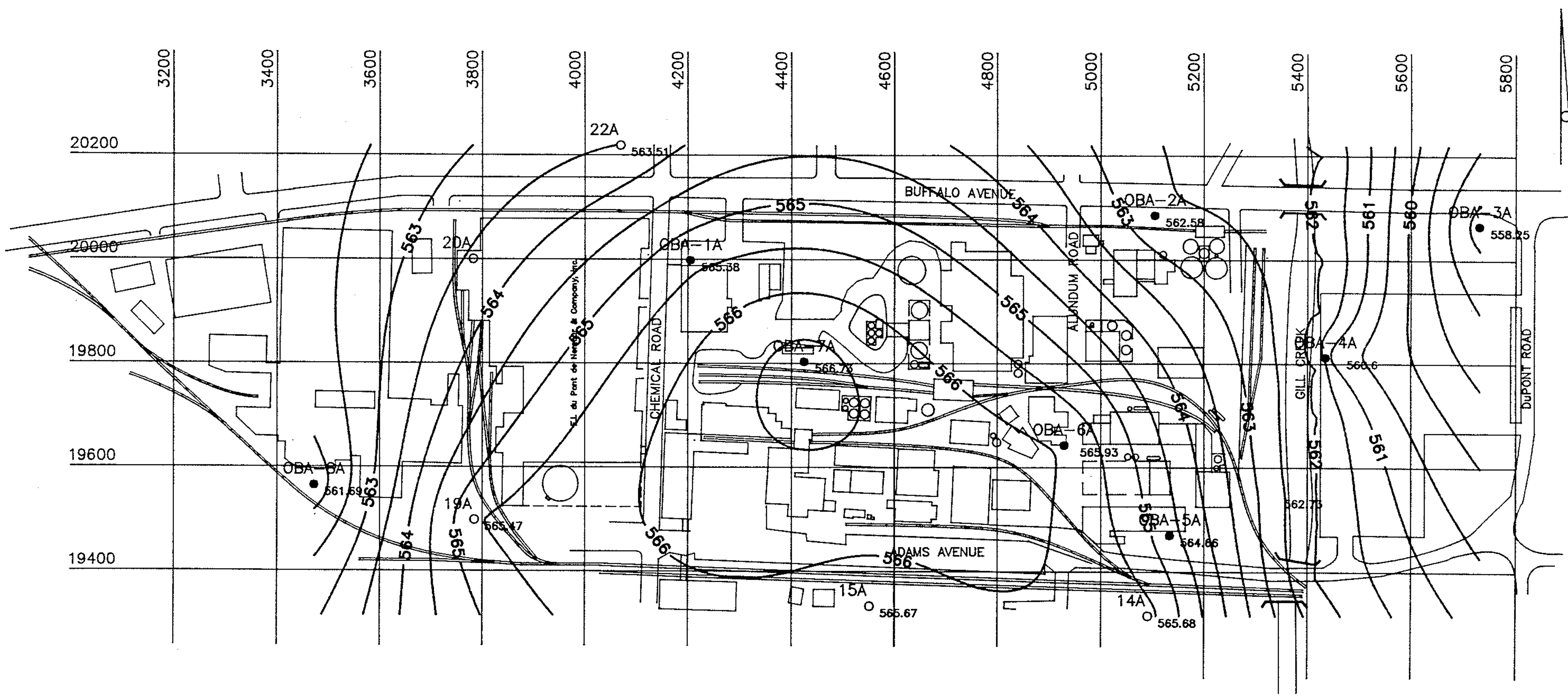
POTENTIOMETRIC SURFACE CONTOUR MAP
A-ZONE
MAY, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	
Scale: 0 200 Feet		Figure 4-12



STATIC WATER LEVEL AT GILL CREEK: 562.01

DATE OF MEASUREMENT: 6/6/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
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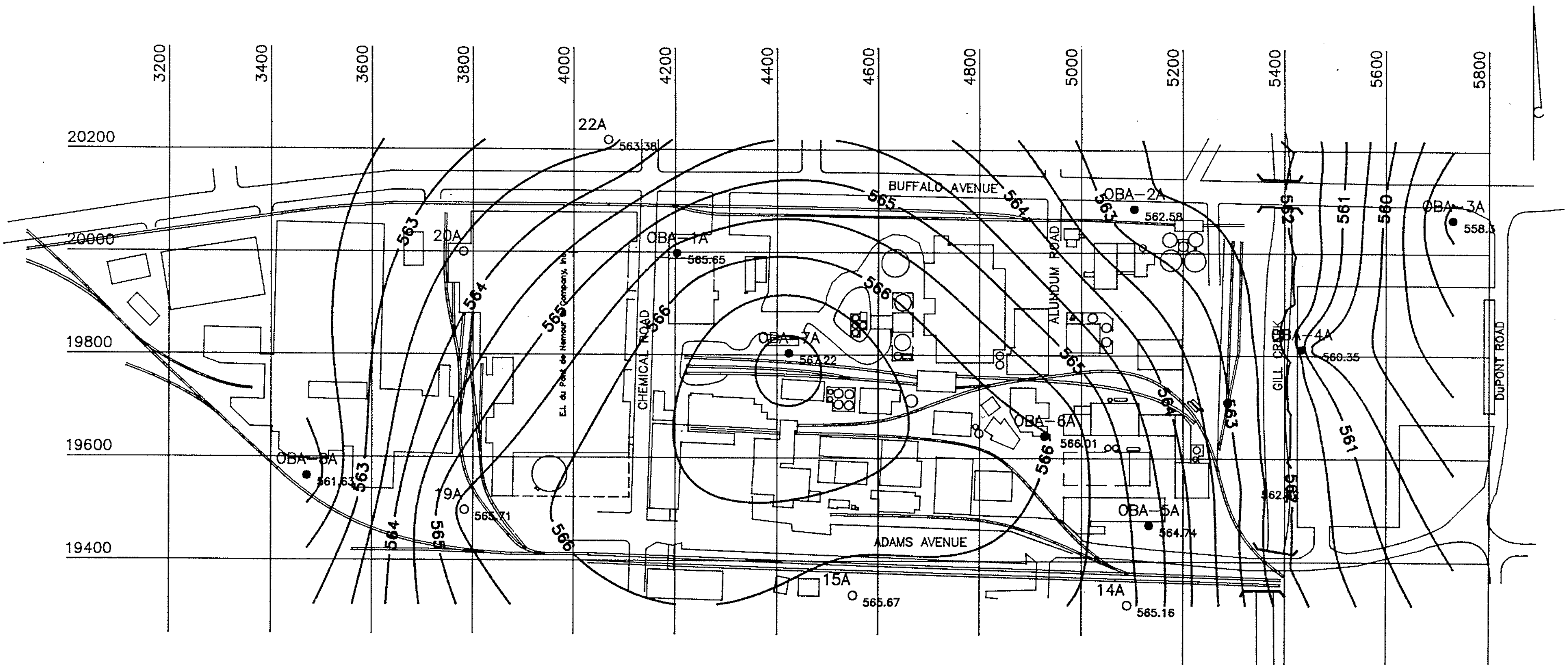
POTENTIOMETRIC SURFACE CONTOUR MAP
A-ZONE
JUNE, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	
Scale: 0 — 200 Feet		Figure 4-13



STATIC WATER LEVEL AT GILL CREEK: 562.00

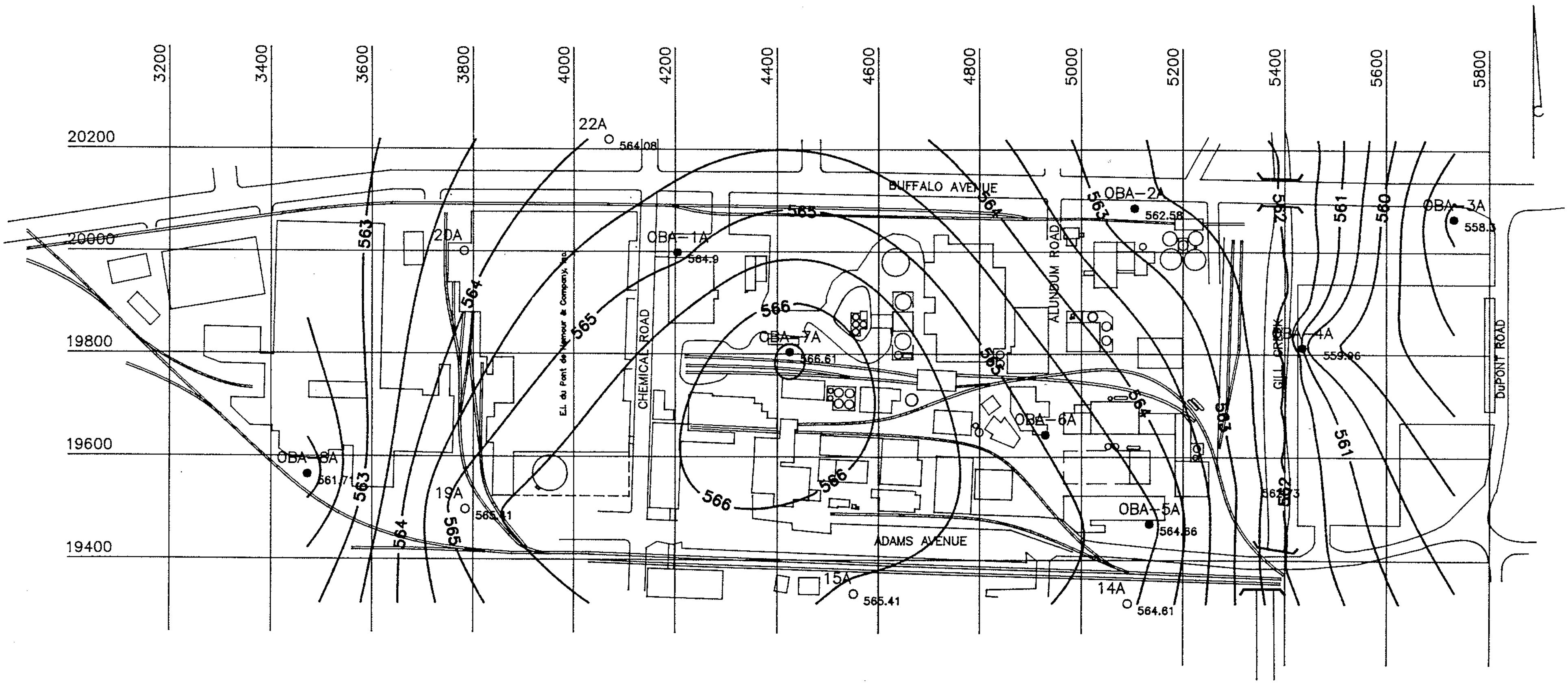
DATE OF MEASUREMENT: 7/9/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
A-ZONE
JULY, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-14
Scale: 0 200 Feet		



STATIC WATER LEVEL AT GILL CREEK: 561.91

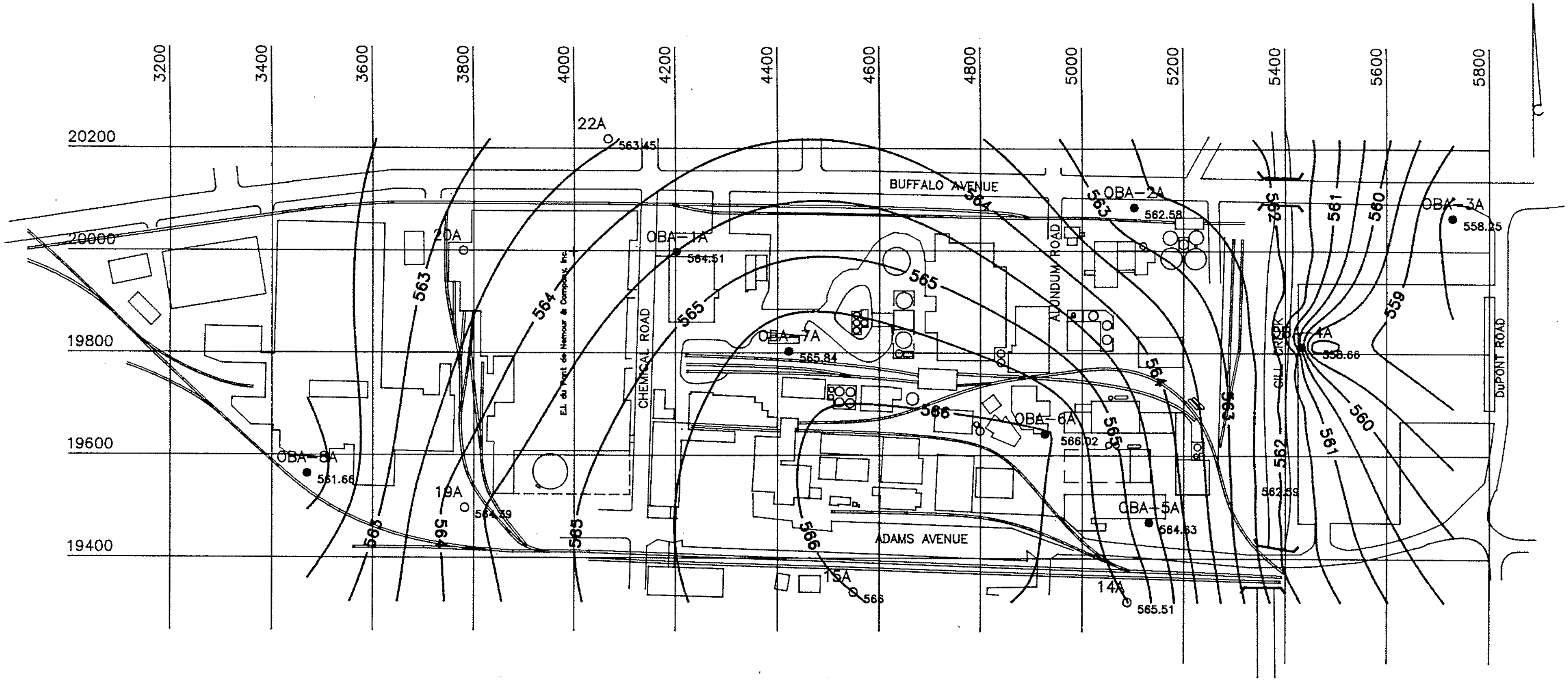
DATE OF MEASUREMENT: 8/19/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
A-ZONE
AUGUST, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-15
Scale: 0 200 Feet		



STATIC WATER LEVEL AT GILL CREEK: 561.83

DATE OF MEASUREMENT: 9/4/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
A-ZONE
SEPTEMBER, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-16
Scale: 0 200 Feet		

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

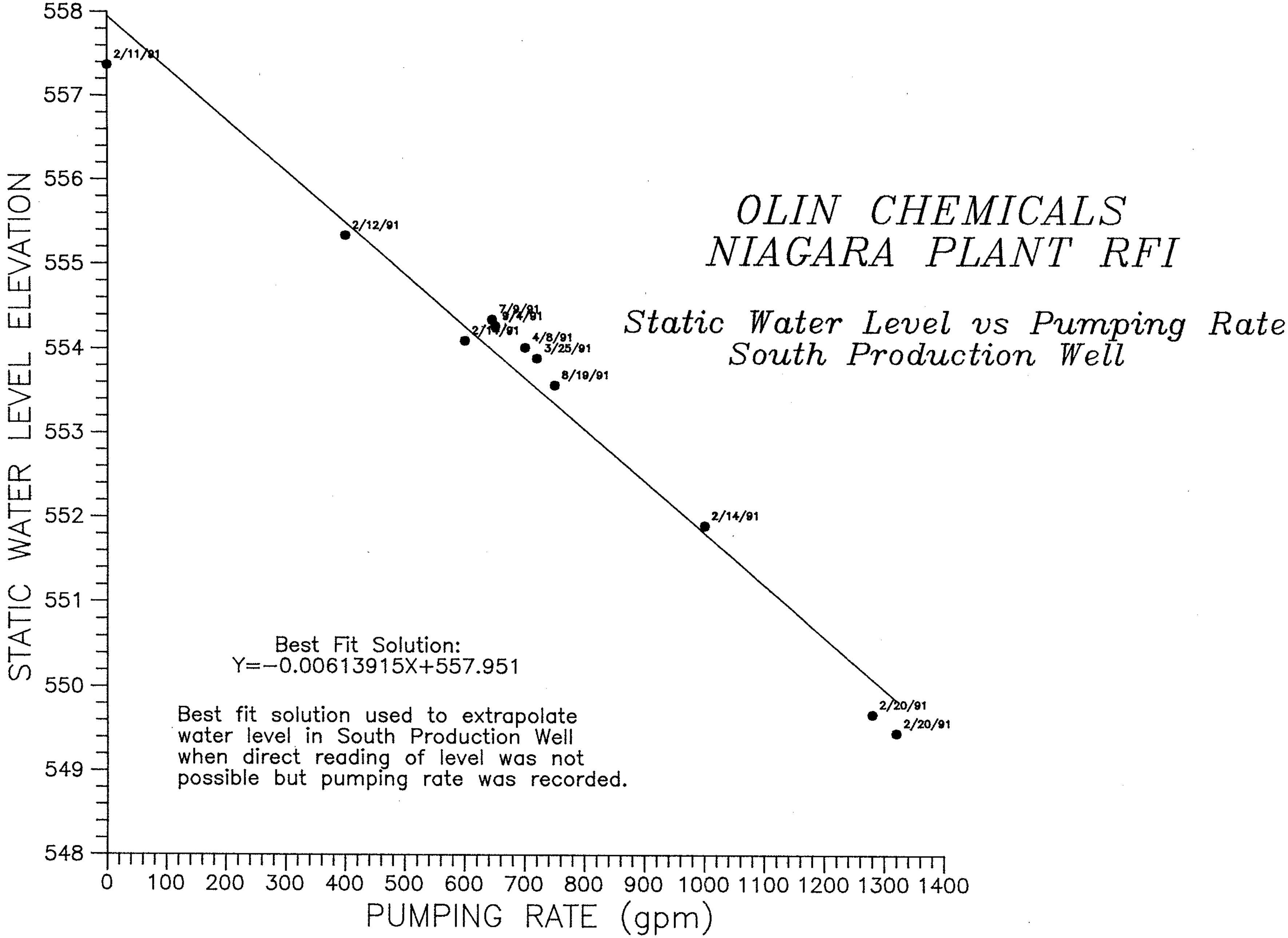
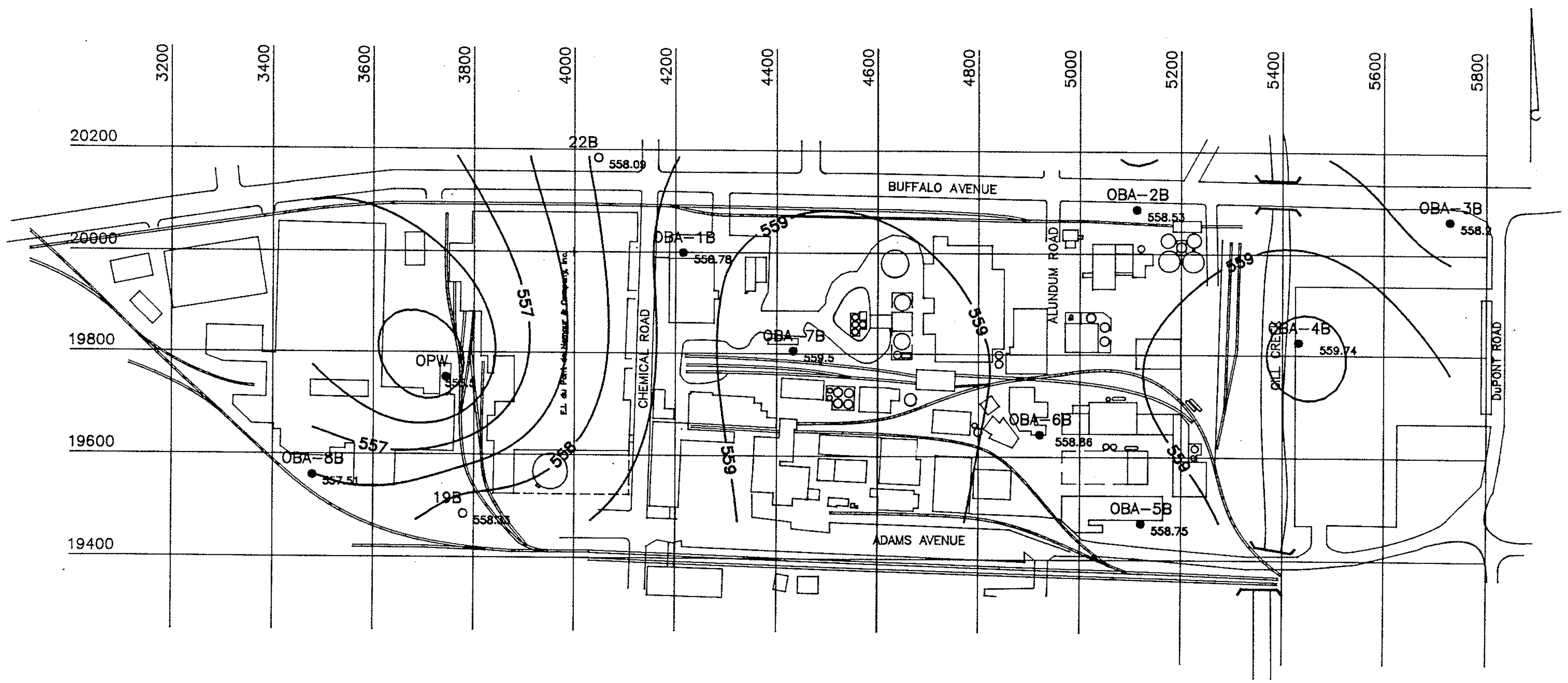


Figure 4-17



PRODUCTION WELL PUMPING RATE: 370 gpm

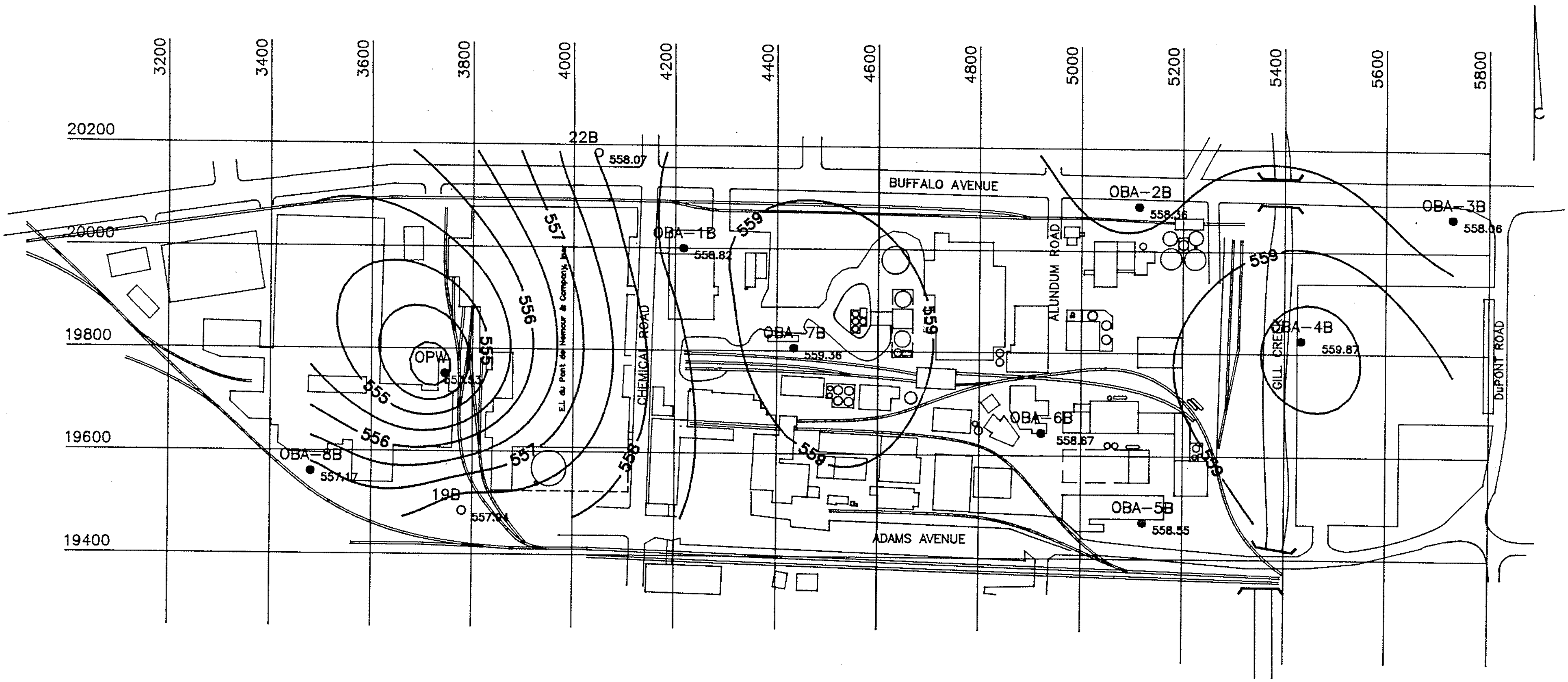
DATE OF MEASUREMENT: 10/25/90

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
B-ZONE
OCTOBER, 1990

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-18
Scale: 0 200 Feet		



PRODUCTION WELL PUMPING RATE: 720 gpm

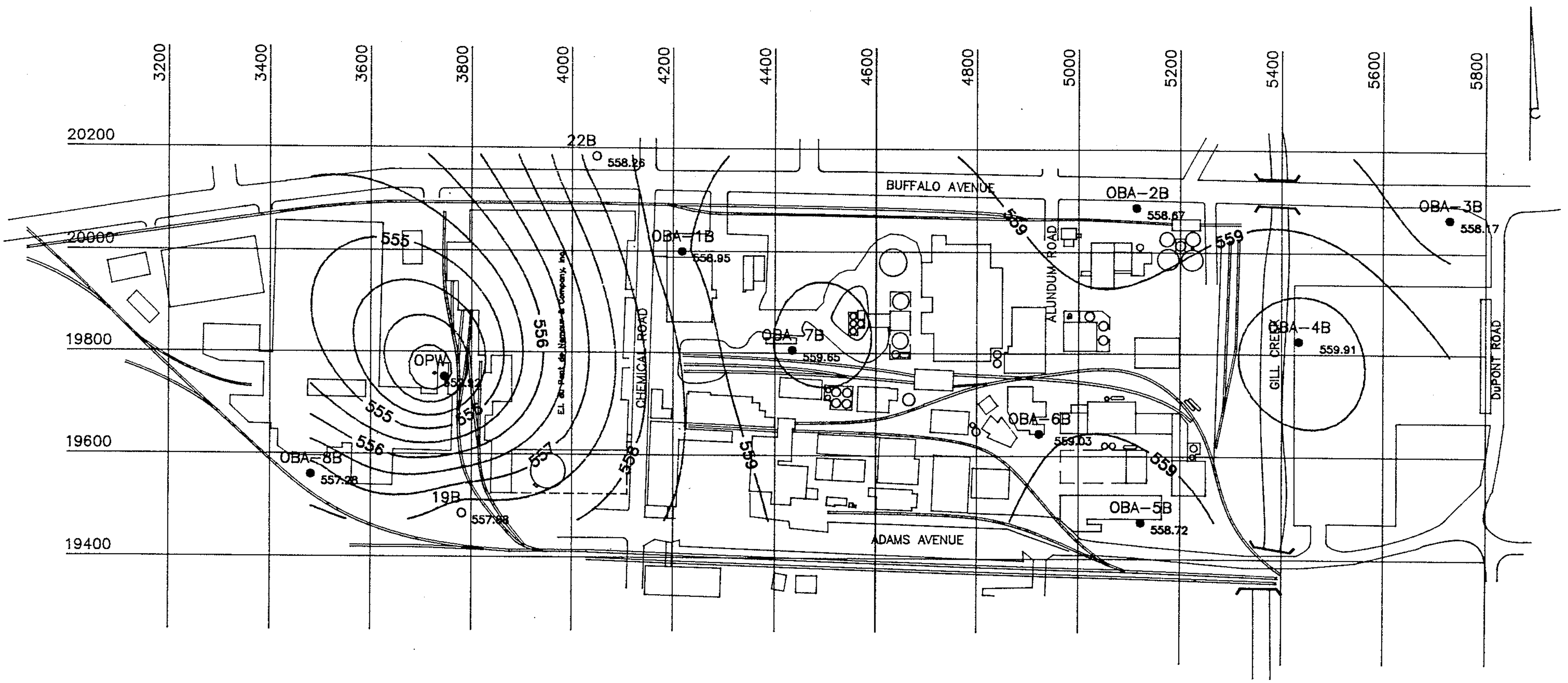
DATE OF MEASUREMENT: 11/27/90

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD–CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
B–ZONE
NOVEMBER, 1990

Job No.: 88C2346–12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4–19
Scale: 0 — 200 Feet		



PRODUCTION WELL PUMPING RATE: 820 gpm

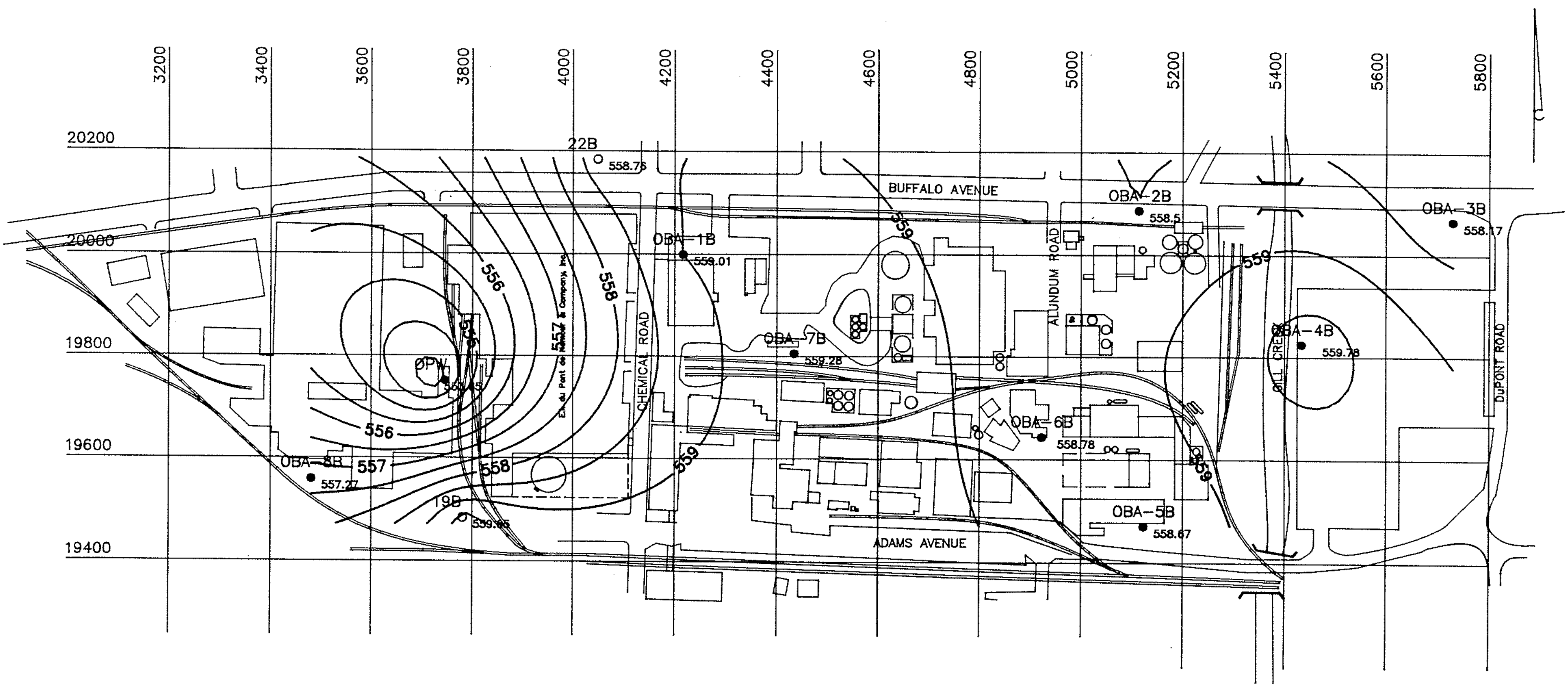
DATE OF MEASUREMENT: 12/7/90

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
B-ZONE
DECEMBER, 1990

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-20
Scale: 0 — 200 Feet		



PRODUCTION WELL PUMPING RATE: 700 gpm

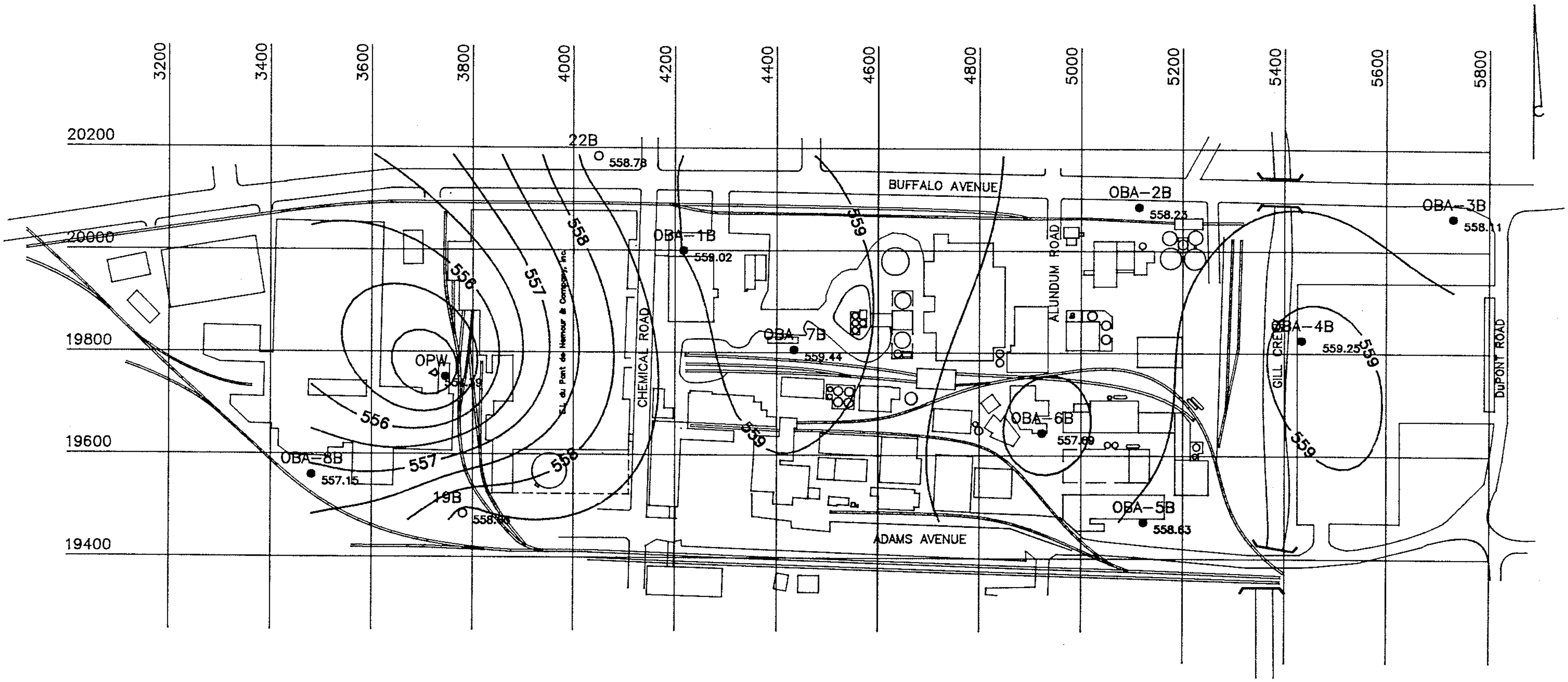
DATE OF MEASUREMENT: 1/16/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
B-ZONE
JANUARY, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	
Scale: 0 200 Feet		Figure 4-21



PRODUCTION WELL PUMPING RATE: 580 gpm

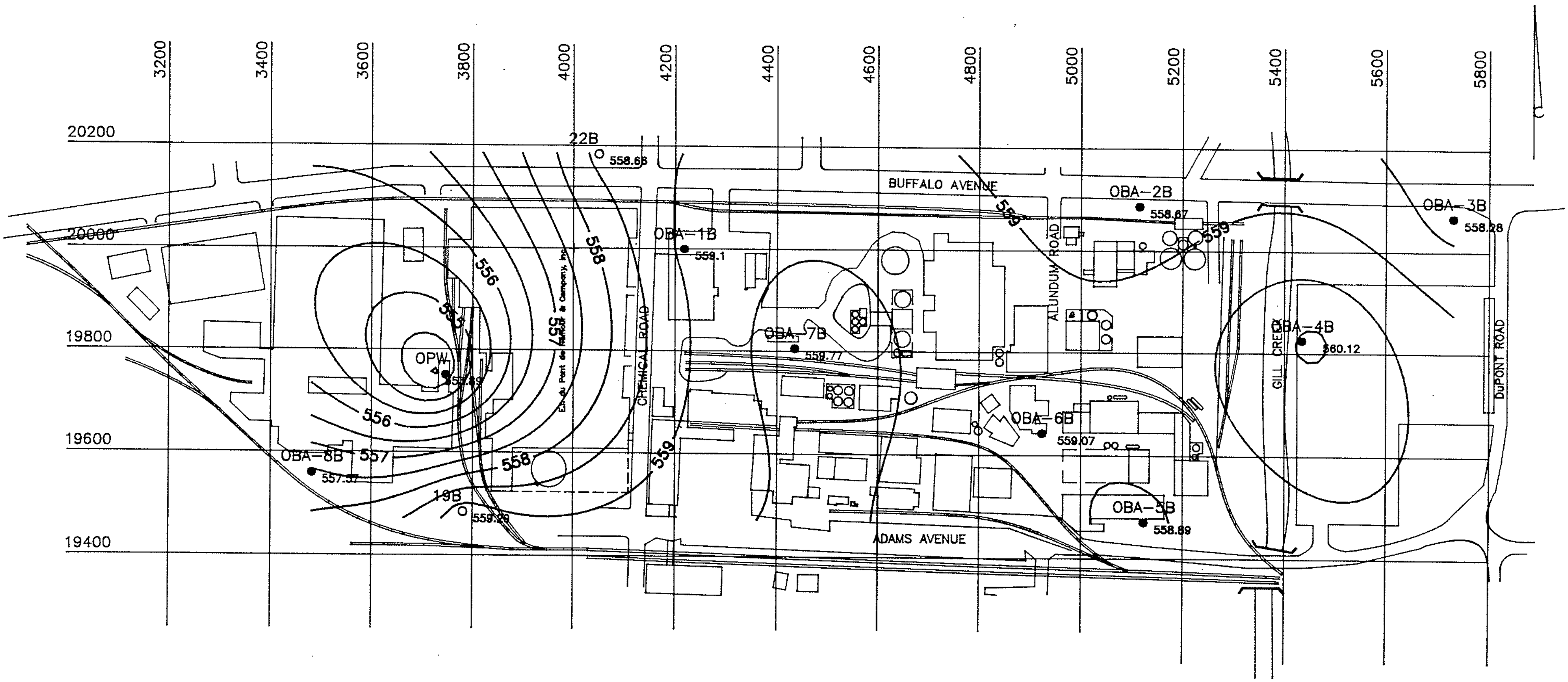
DATE OF MEASUREMENT: 2/6/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
B-ZONE
FEBRUARY, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-22
Scale: 0 200 Feet		



PRODUCTION WELL PUMPING RATE: 720 gpm

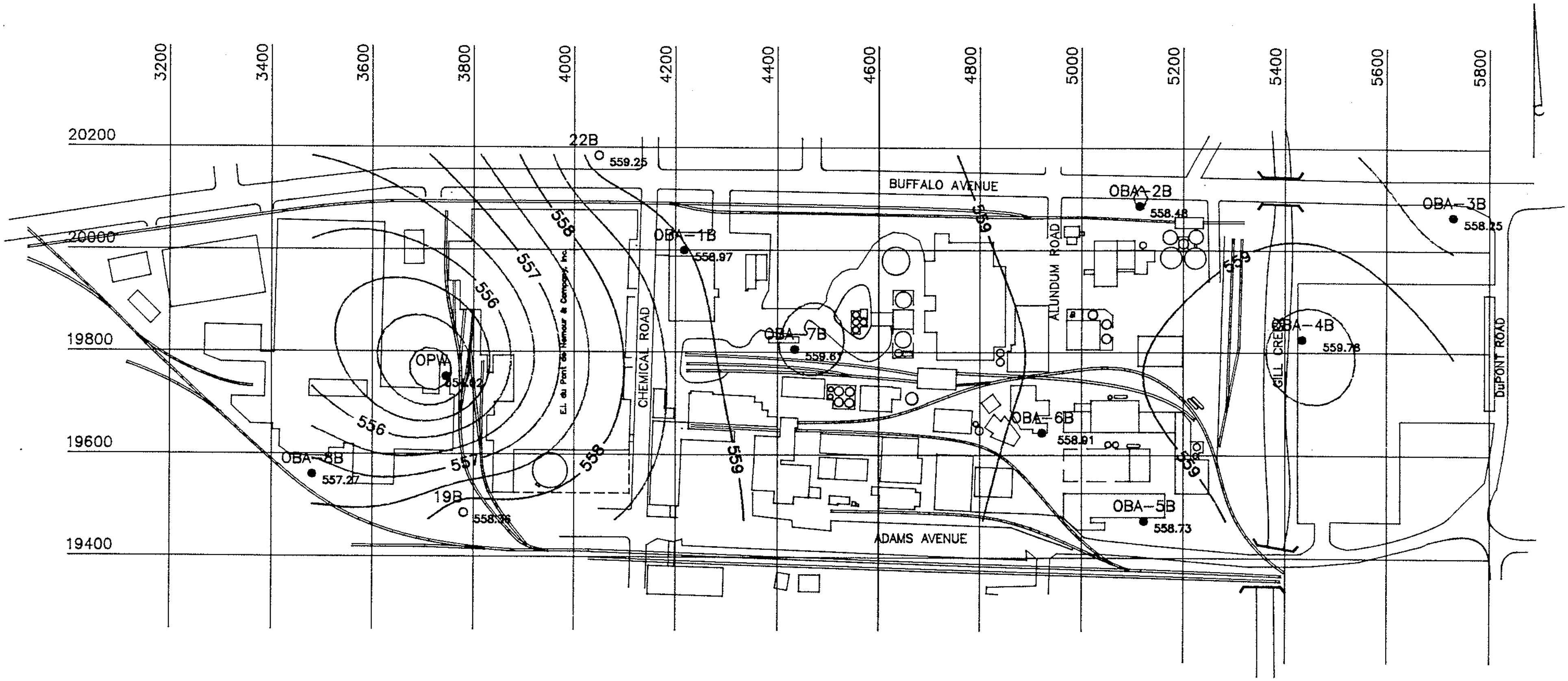
DATE OF MEASUREMENT: 3/25/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
B-ZONE
MARCH, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-23
Scale: 0 200 Feet		



PRODUCTION WELL PUMPING RATE: 700 gpm

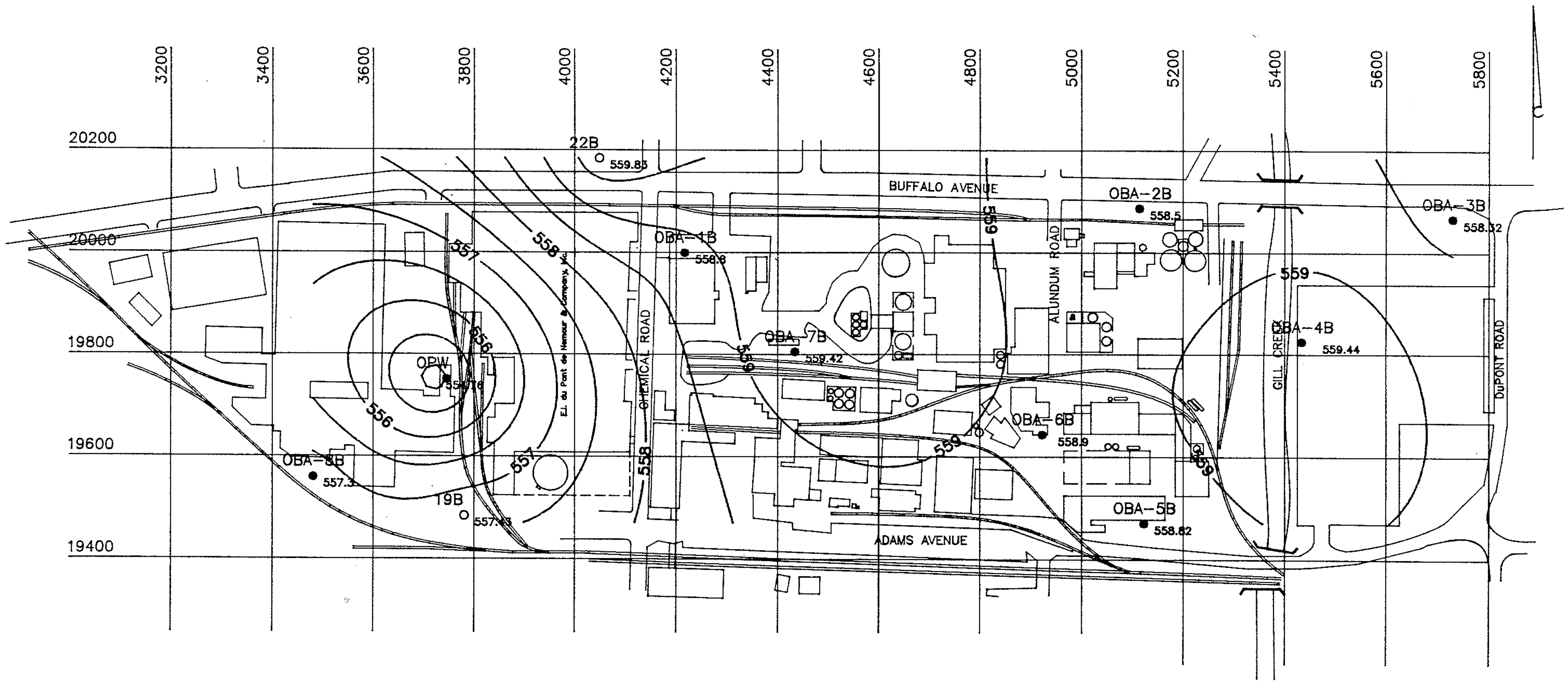
DATE OF MEASUREMENT: 4/8/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
B-ZONE
APRIL, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	
Scale: 0 200 Feet		Figure 4-24



PRODUCTION WELL PUMPING RATE: 520 gpm

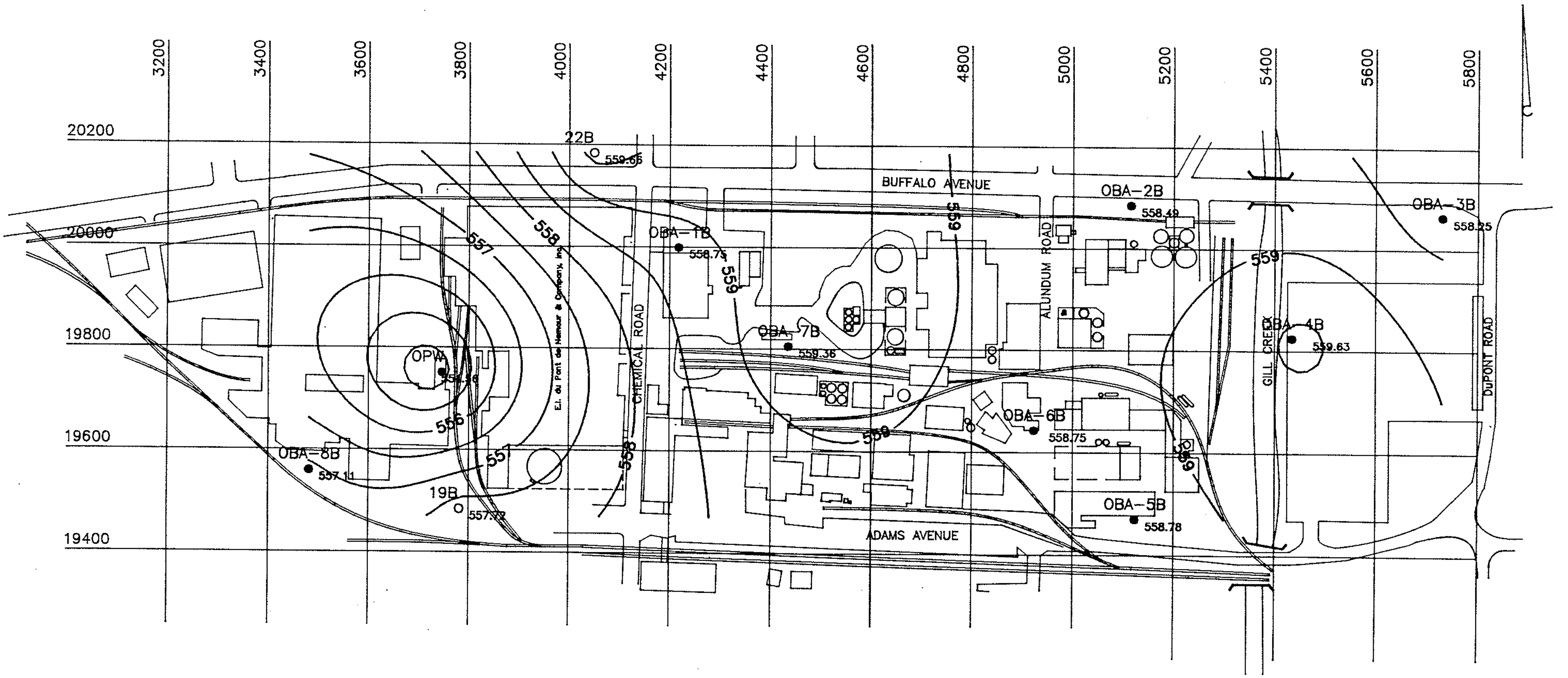
DATE OF MEASUREMENT: 5/13/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
B-ZONE
MAY, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	
Scale: 0 — 200 Feet		Figure 4-25



PRODUCTION WELL PUMPING RATE: 600 gpm (average)

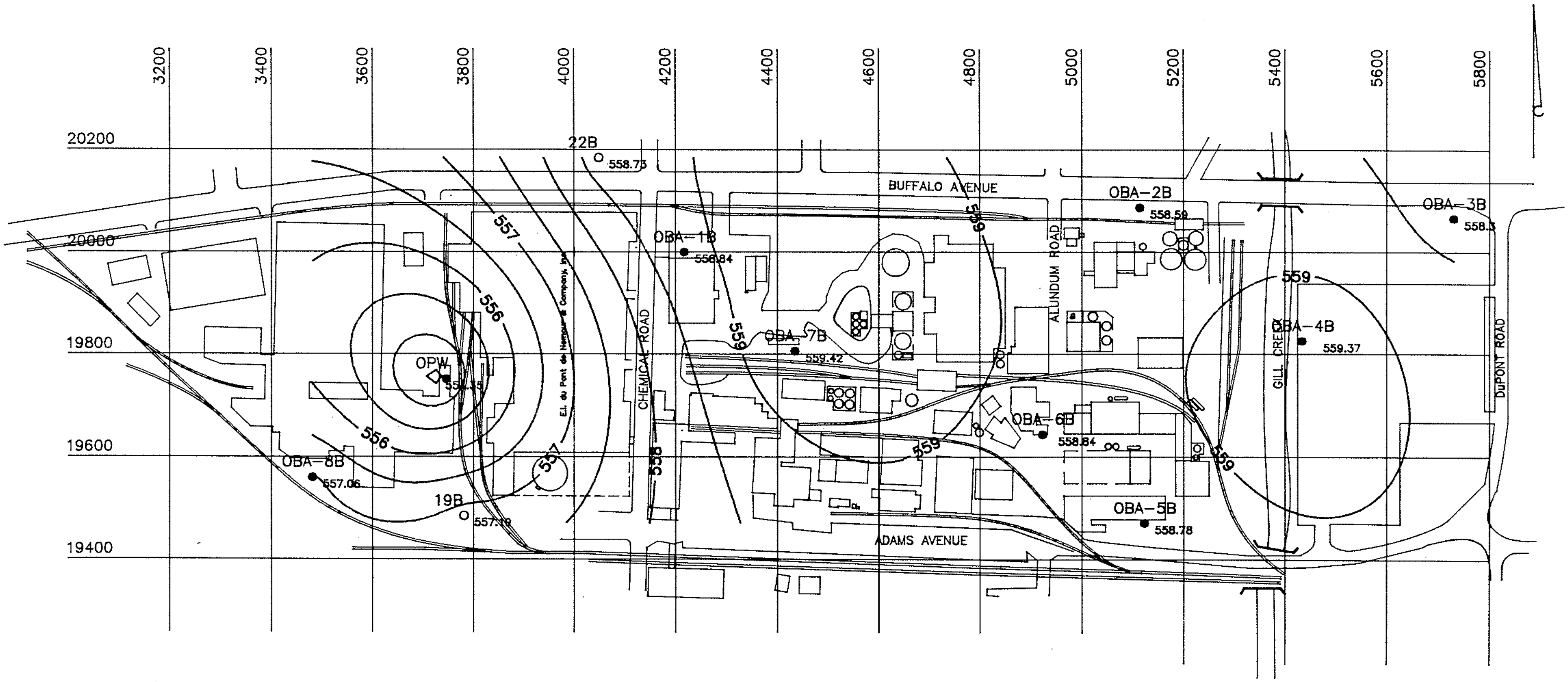
DATE OF MEASUREMENT: 6/6/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
B-ZONE
JUNE, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-26
Scale: 0 200 Feet		



PRODUCTION WELL PUMPING RATE: 645 gpm

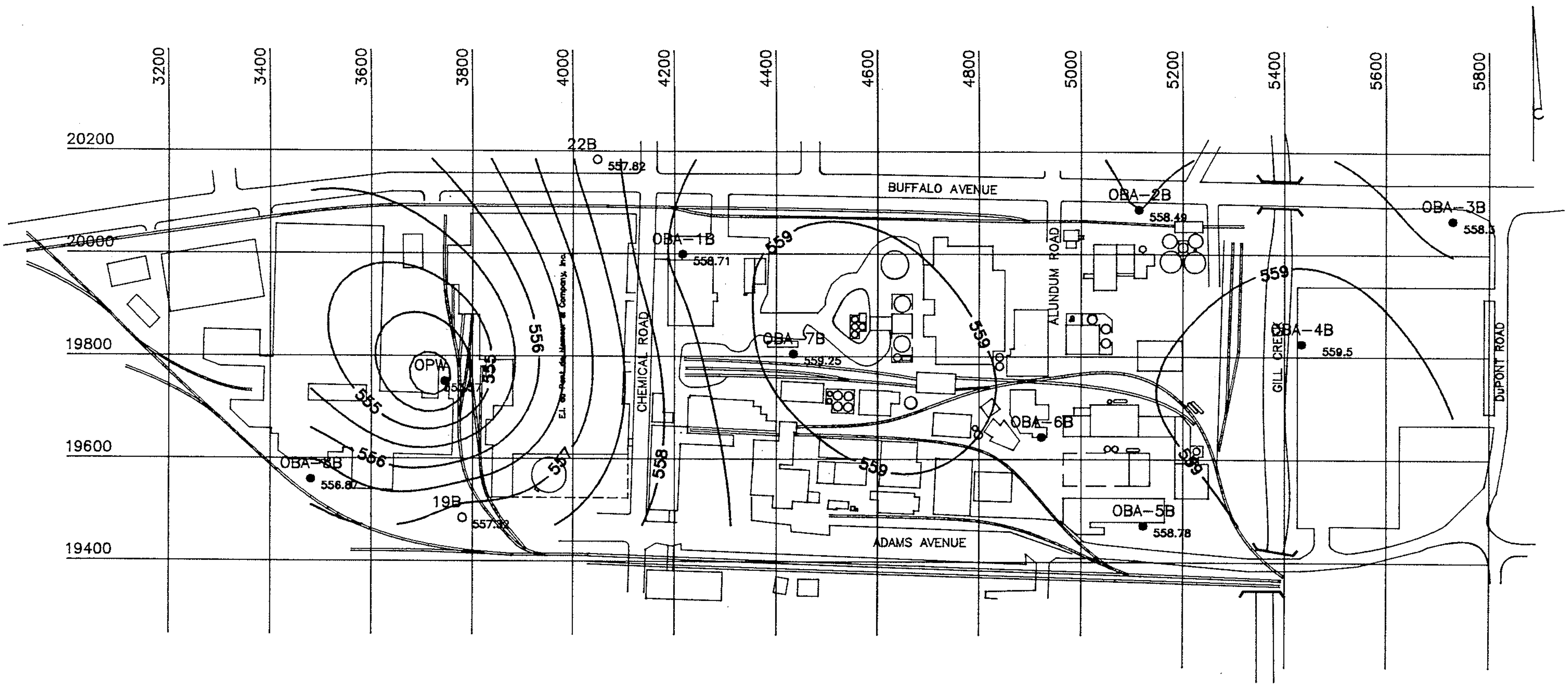
DATE OF MEASUREMENT: 7/9/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
B-ZONE
JULY, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	
Scale: 0 200 Feet		Figure 4-27



PRODUCTION WELL PUMPING RATE: 750 gpm

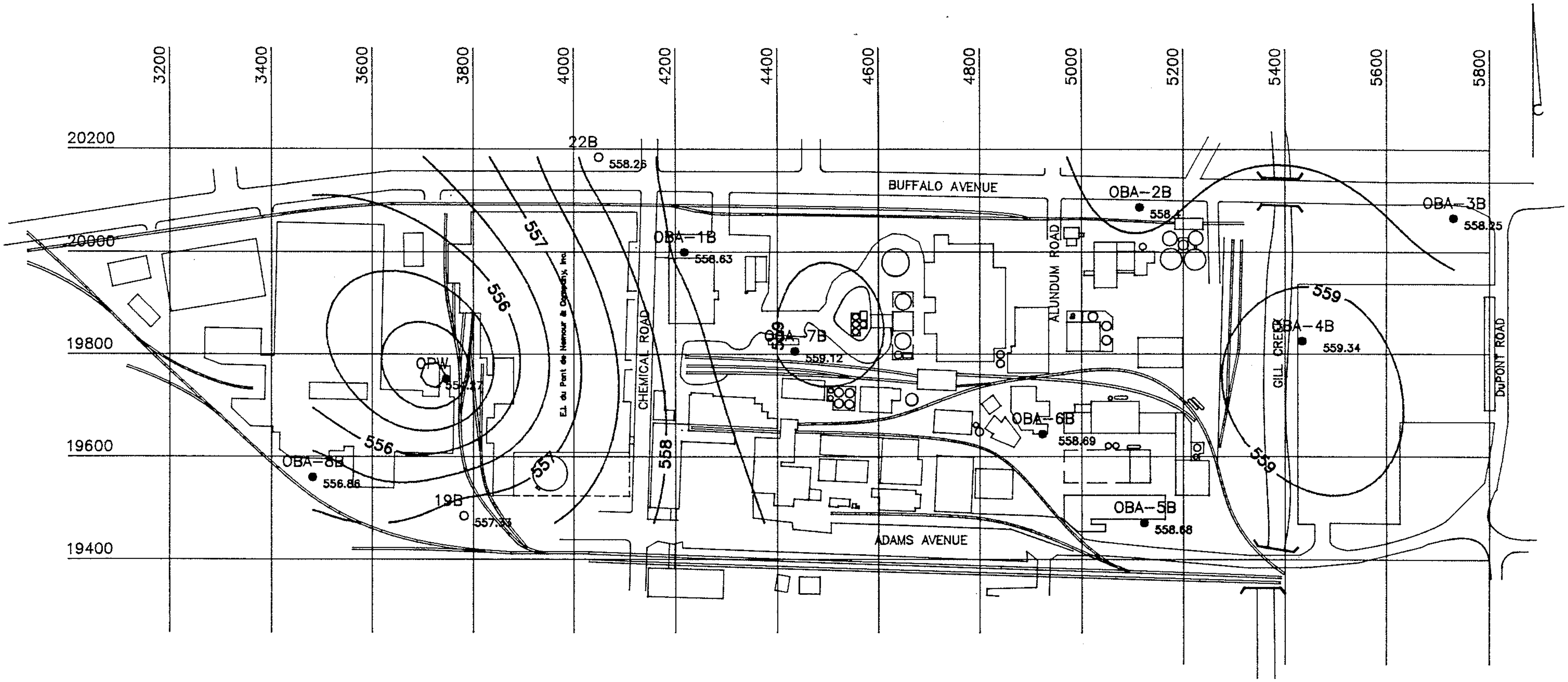
DATE OF MEASUREMENT: 8/19/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD–CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
B–ZONE
AUGUST, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4–28
Scale: 0 200 Feet		



PRODUCTION WELL PUMPING RATE: 650 gpm

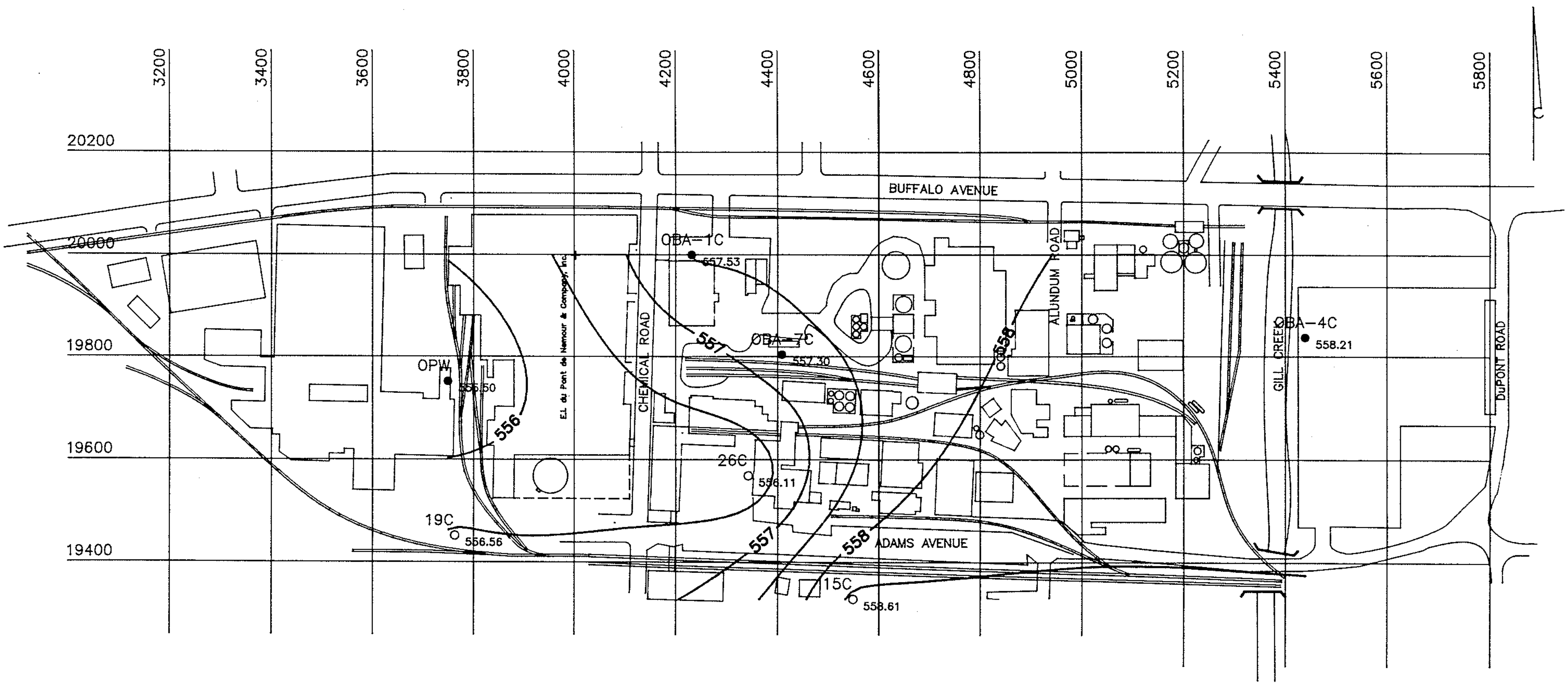
DATE OF MEASUREMENT: 9/4/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
B-ZONE
SEPTEMBER, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-29
Scale: 0 — 200 Feet		



PRODUCTION WELL PUMPING RATE: 370 gpm

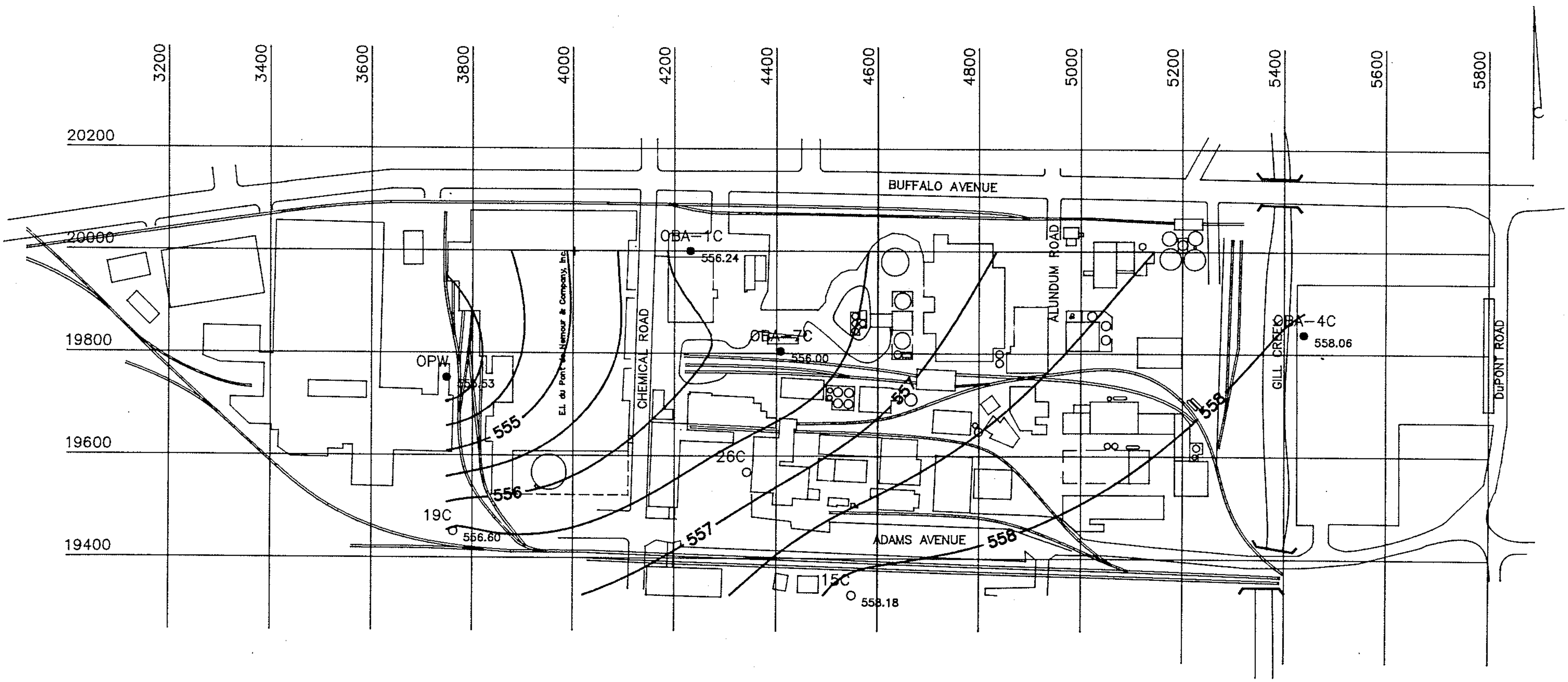
DATE OF MEASUREMENT: 10/25/90

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
C-ZONE
OCTOBER, 1990

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-30
Scale: 0 — 200 Feet		



PRODUCTION WELL PUMPING RATE: 720 gpm

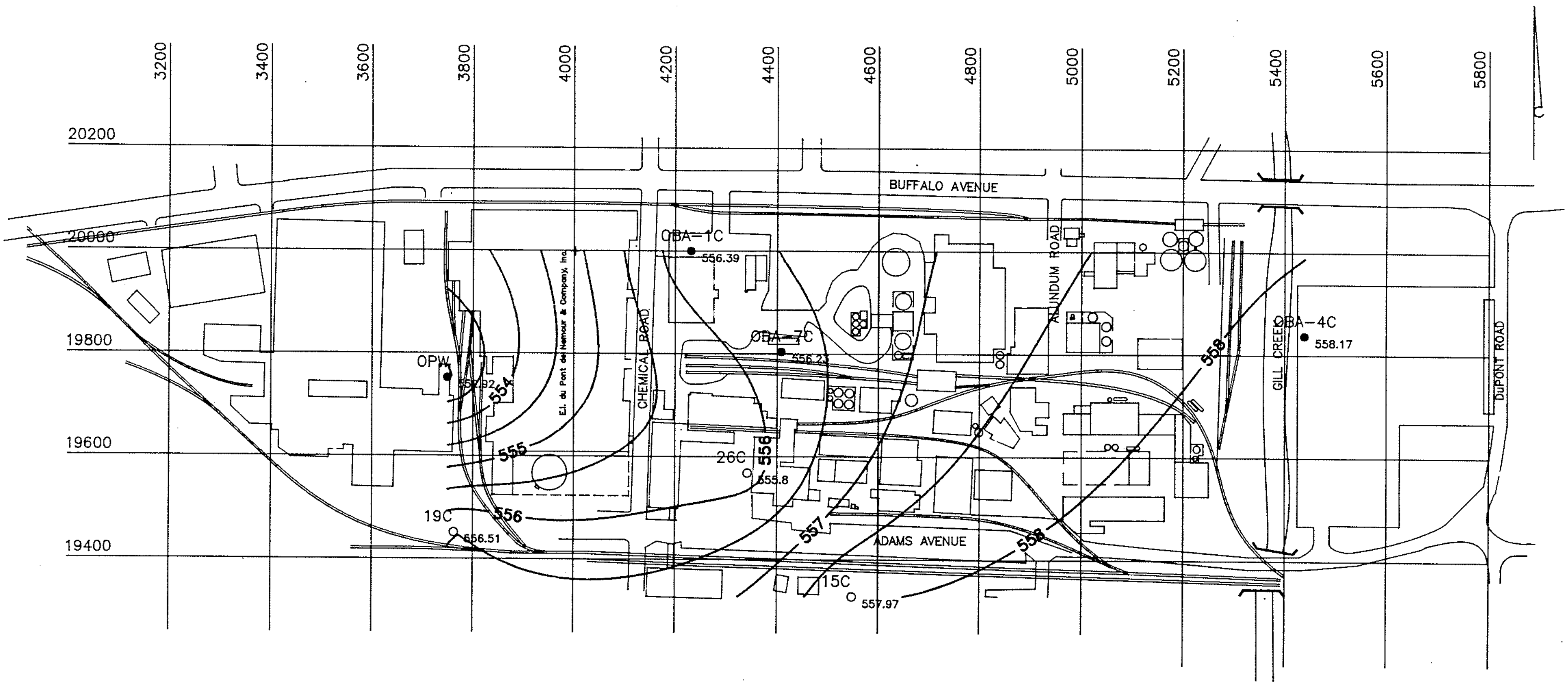
DATE OF MEASUREMENT: 11/27/90

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
C-ZONE
NOVEMBER, 1990

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-31
Scale: 0 200 Feet		



PRODUCTION WELL PUMPING RATE: 820 gpm

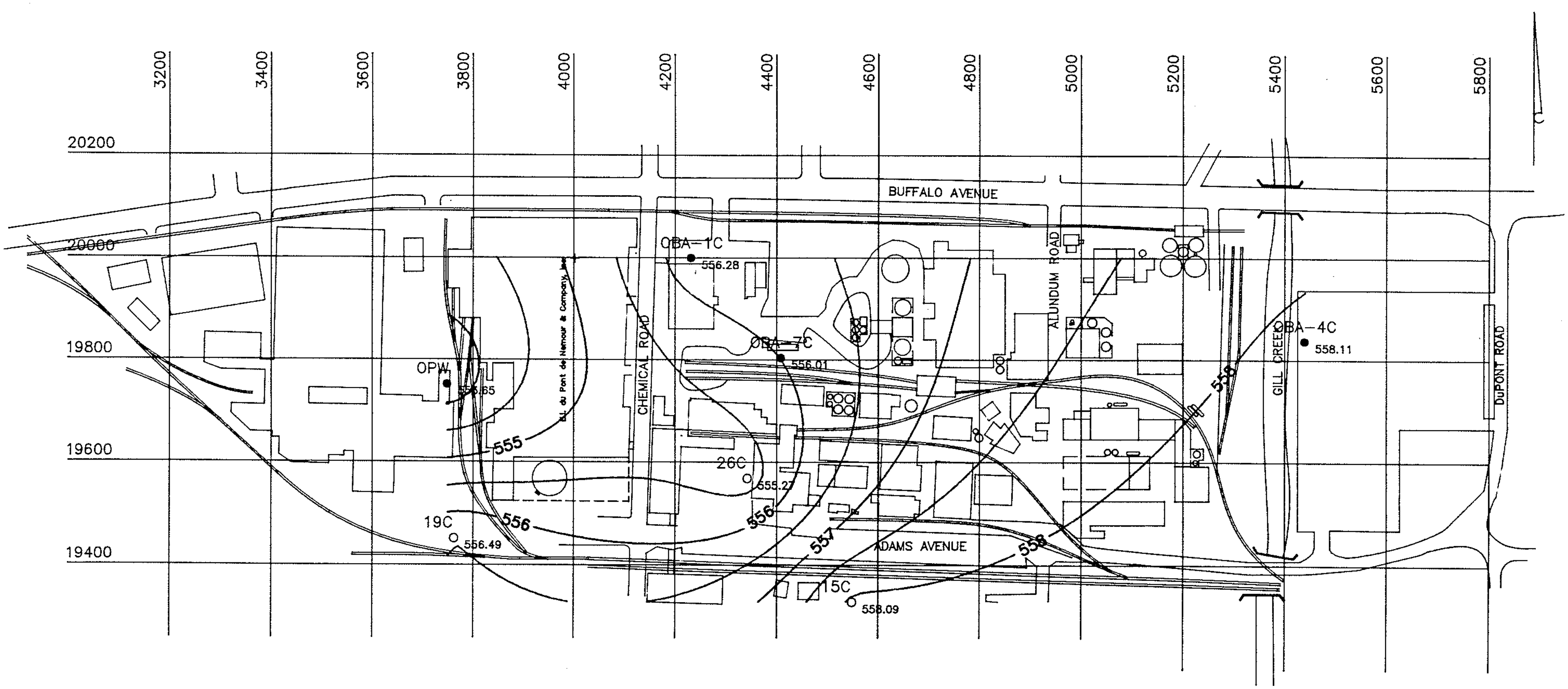
DATE OF MEASUREMENT: 12/7/90

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
C-ZONE
DECEMBER, 1990

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-32
Scale: 0 200 Feet		



PRODUCTION WELL PUMPING RATE: 700 gpm

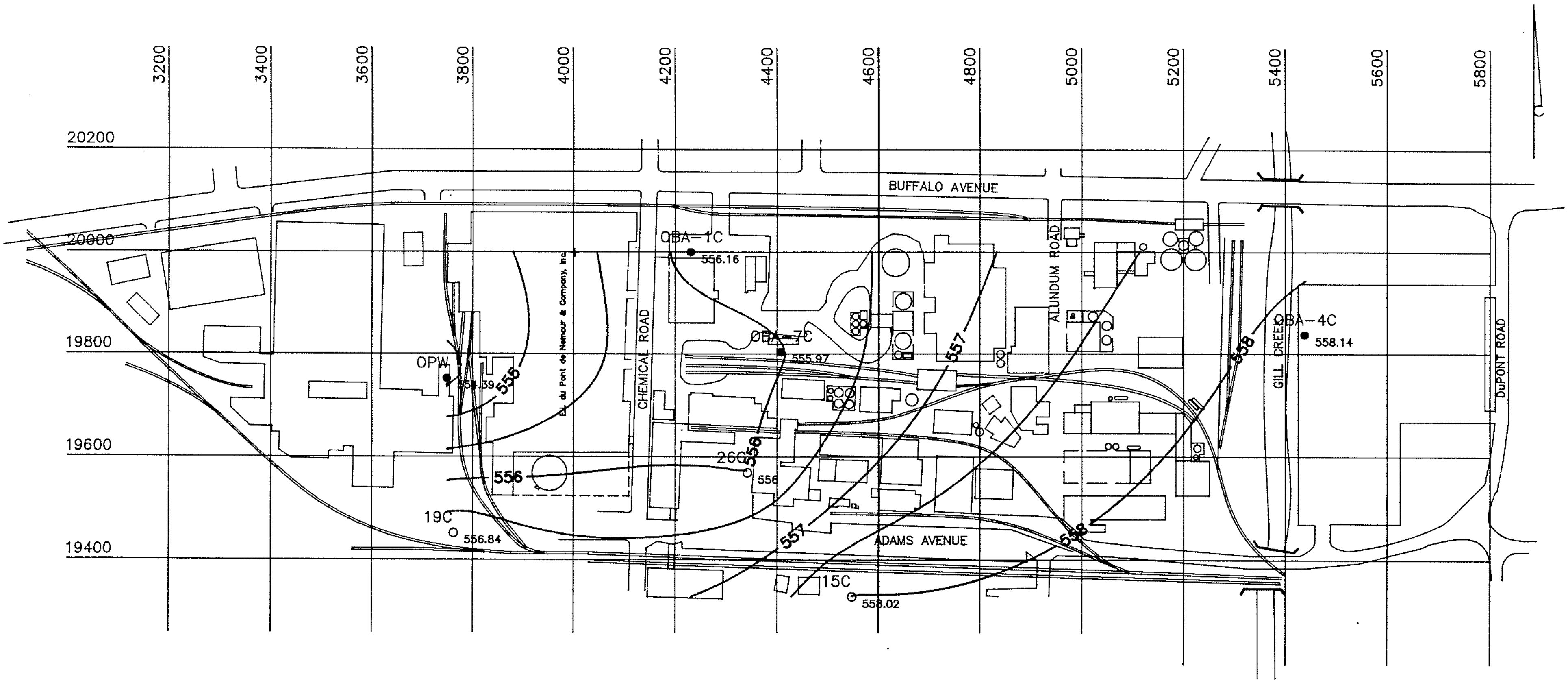
DATE OF MEASUREMENT: 1/16/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
C-ZONE
JANUARY, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-33
Scale: 0 200 Feet		



PRODUCTION WELL PUMPING RATE: 580 gpm

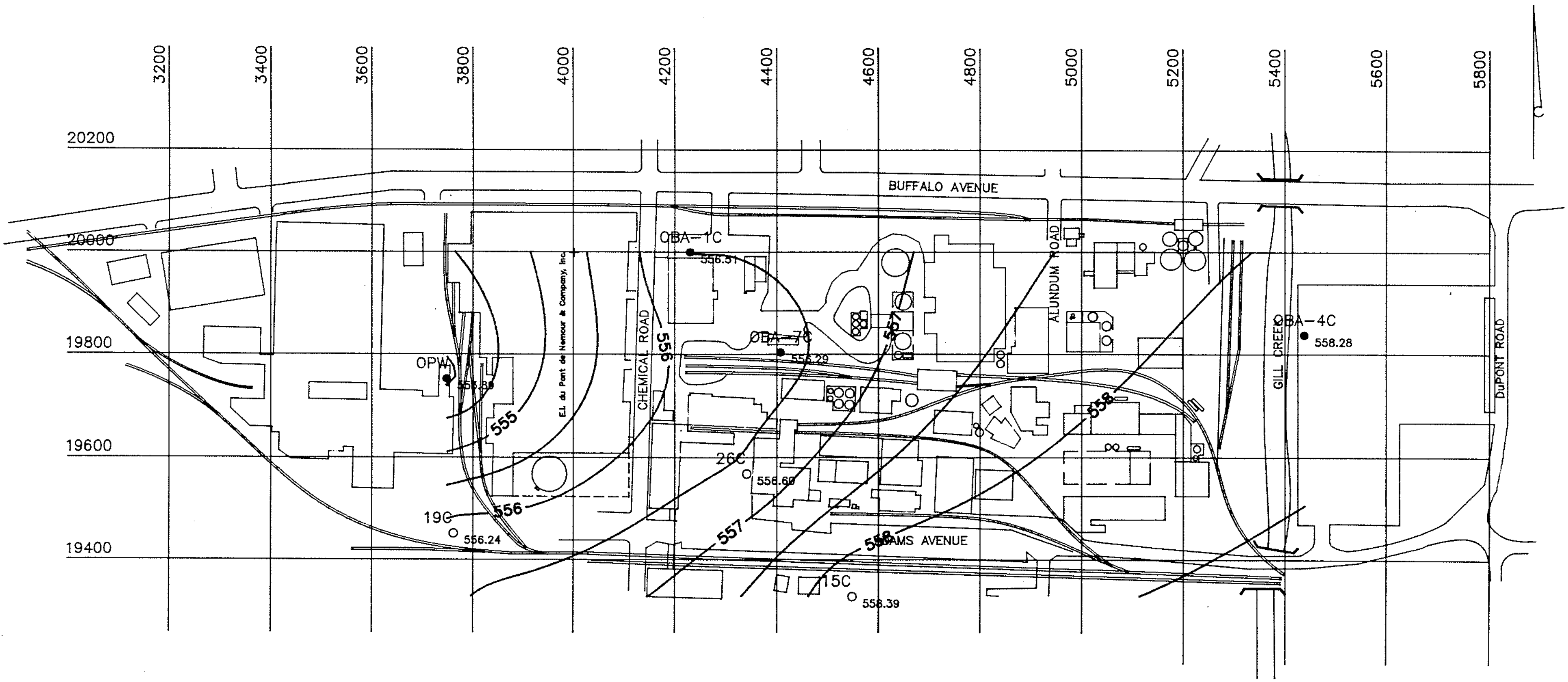
DATE OF MEASUREMENT: 2/6/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
C-ZONE
FEBRUARY, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-34
Scale: 0 200 Feet		



PRODUCTION WELL PUMPING RATE: 720 gpm

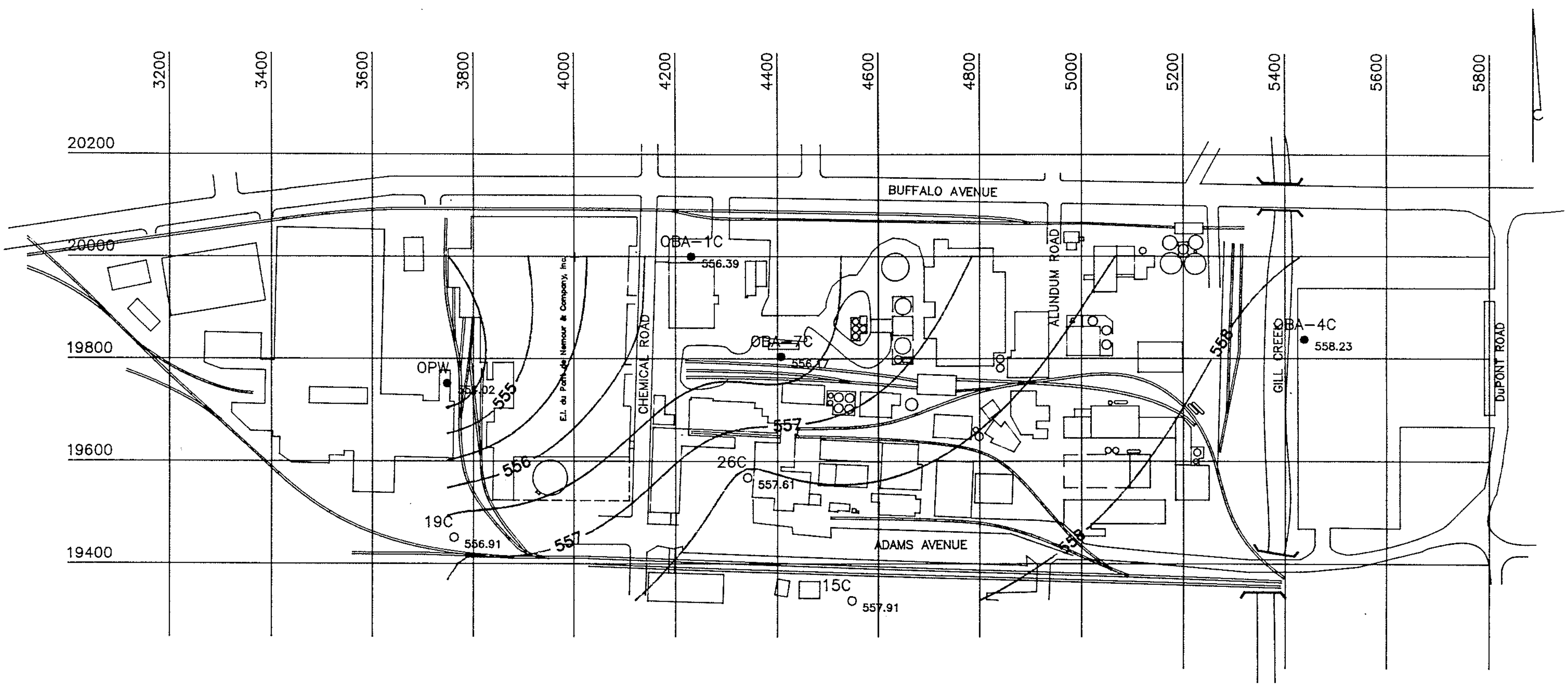
DATE OF MEASUREMENT: 3/25/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
C-ZONE
MARCH, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-35
Scale: 0 — 200 Feet		



PRODUCTION WELL PUMPING RATE: 700 gpm

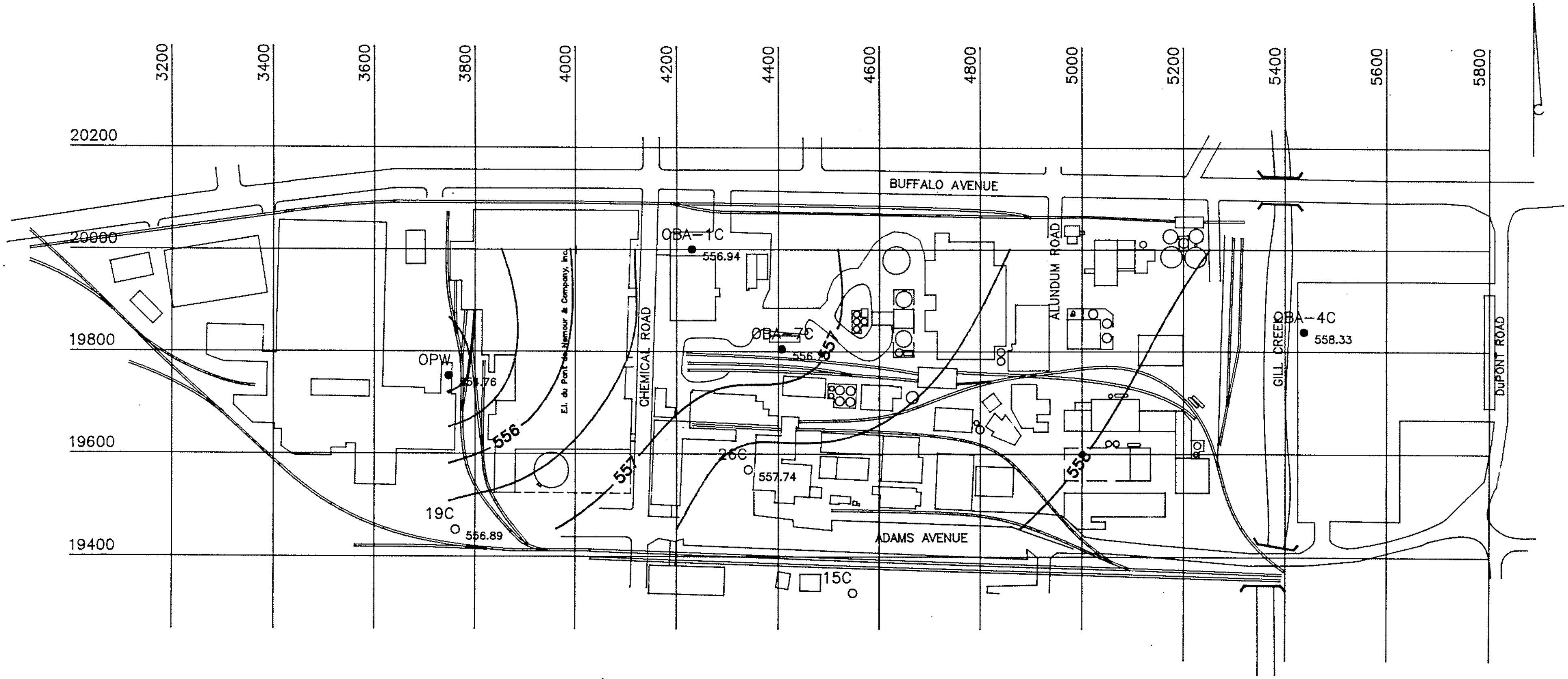
DATE OF MEASUREMENT: 4/8/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
C-ZONE
APRIL, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	
Scale: 0 — 200 Feet		Figure 4-36



PRODUCTION WELL PUMPING RATE: 520 gpm

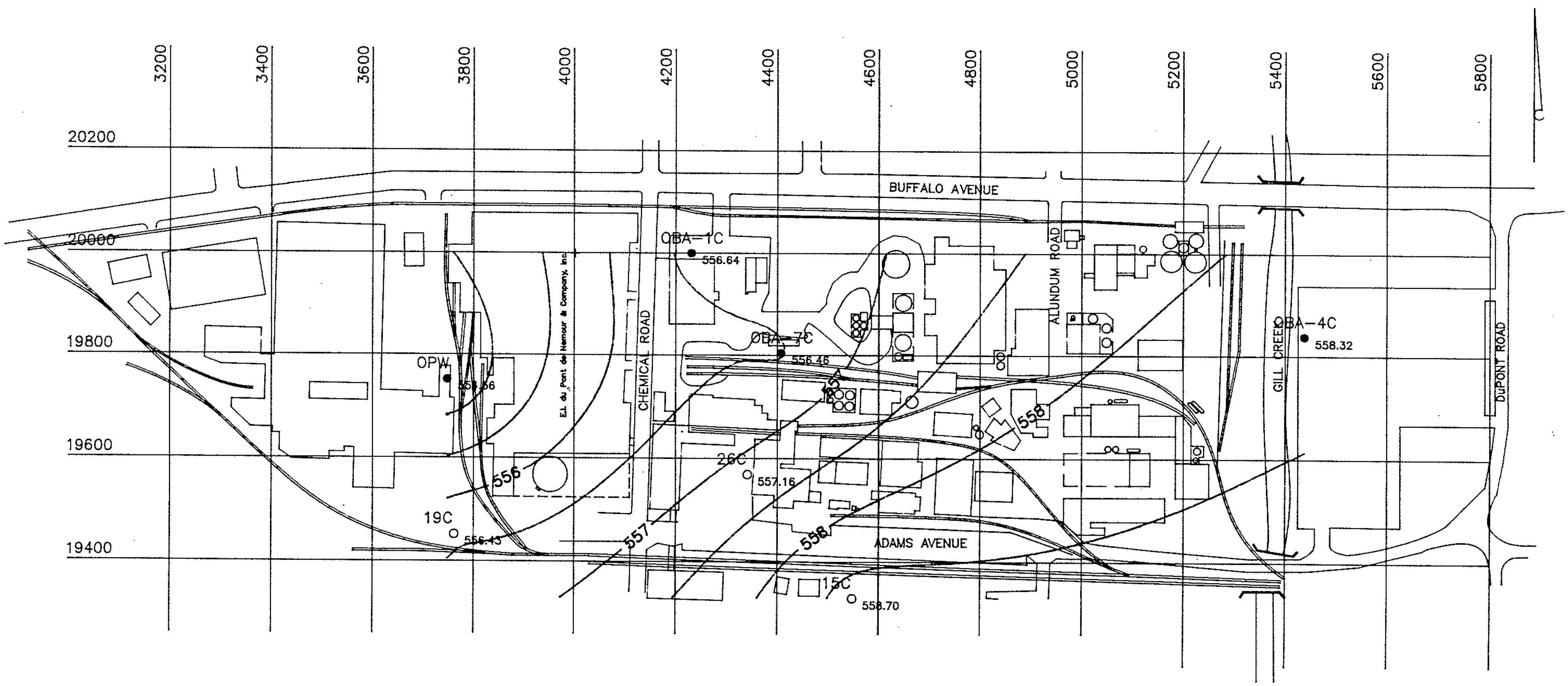
DATE OF MEASUREMENT: 5/13/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
C-ZONE
MAY, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-37
Scale: 0 200 Feet		



PRODUCTION WELL PUMPING RATE: 600 gpm (average)

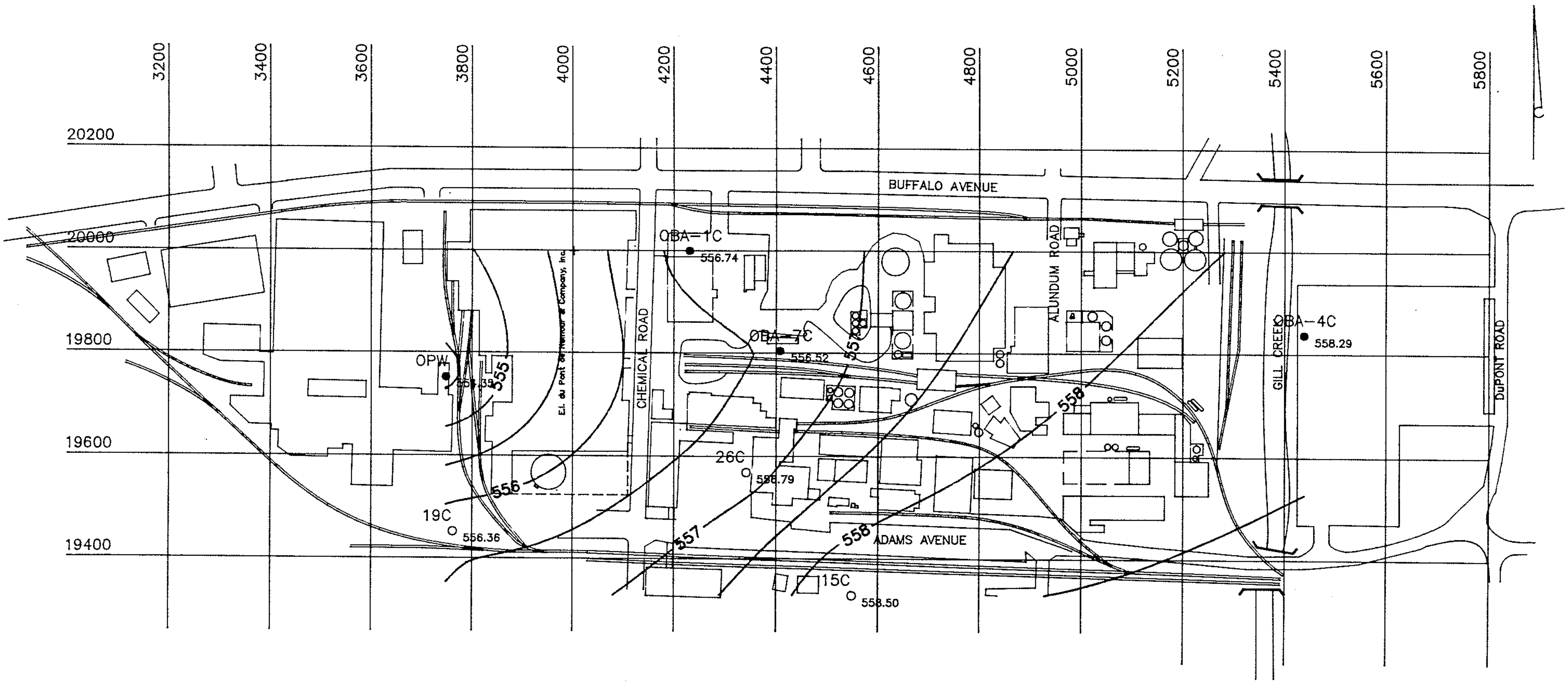
DATE OF MEASUREMENT: 6/6/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
C-ZONE
JUNE, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	
Scale: 0 — 200 Feet		Figure 4-38



PRODUCTION WELL PUMPING RATE: 645 gpm

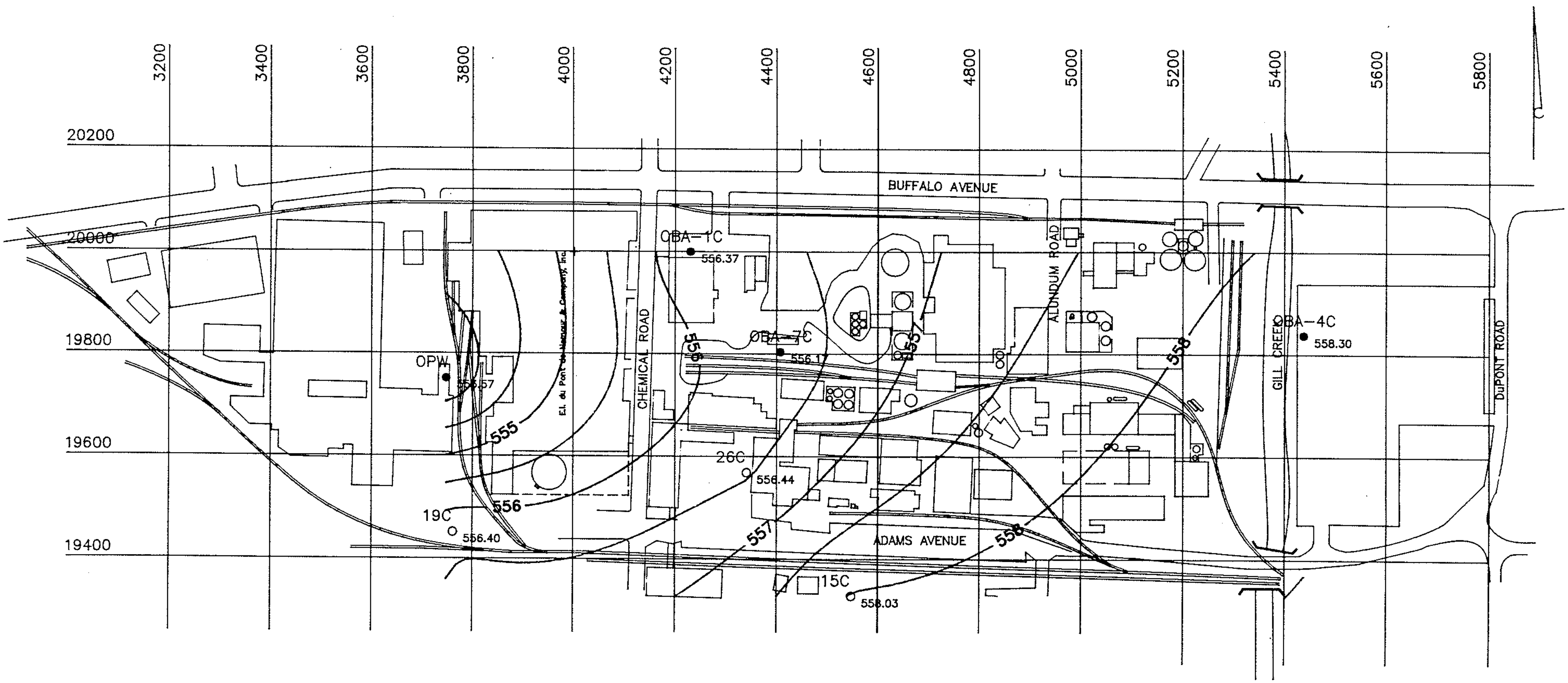
DATE OF MEASUREMENT: 7/9/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
C-ZONE
JULY, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-39
Scale: 0 200 Feet		



PRODUCTION WELL PUMPING RATE: 750 gpm

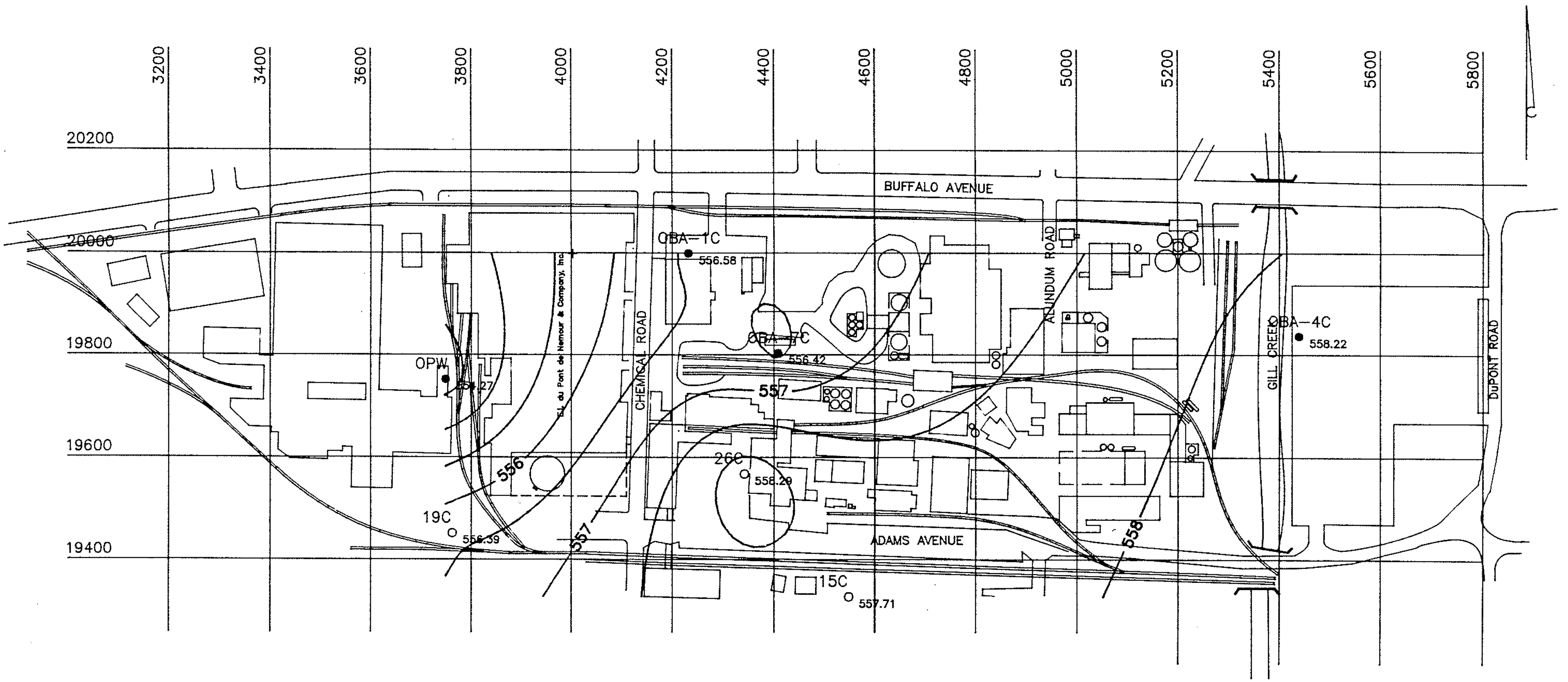
DATE OF MEASUREMENT: 8/19/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
C-ZONE
AUGUST, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-40
Scale: 0 — 200 Feet		



PRODUCTION WELL PUMPING RATE: 650 gpm

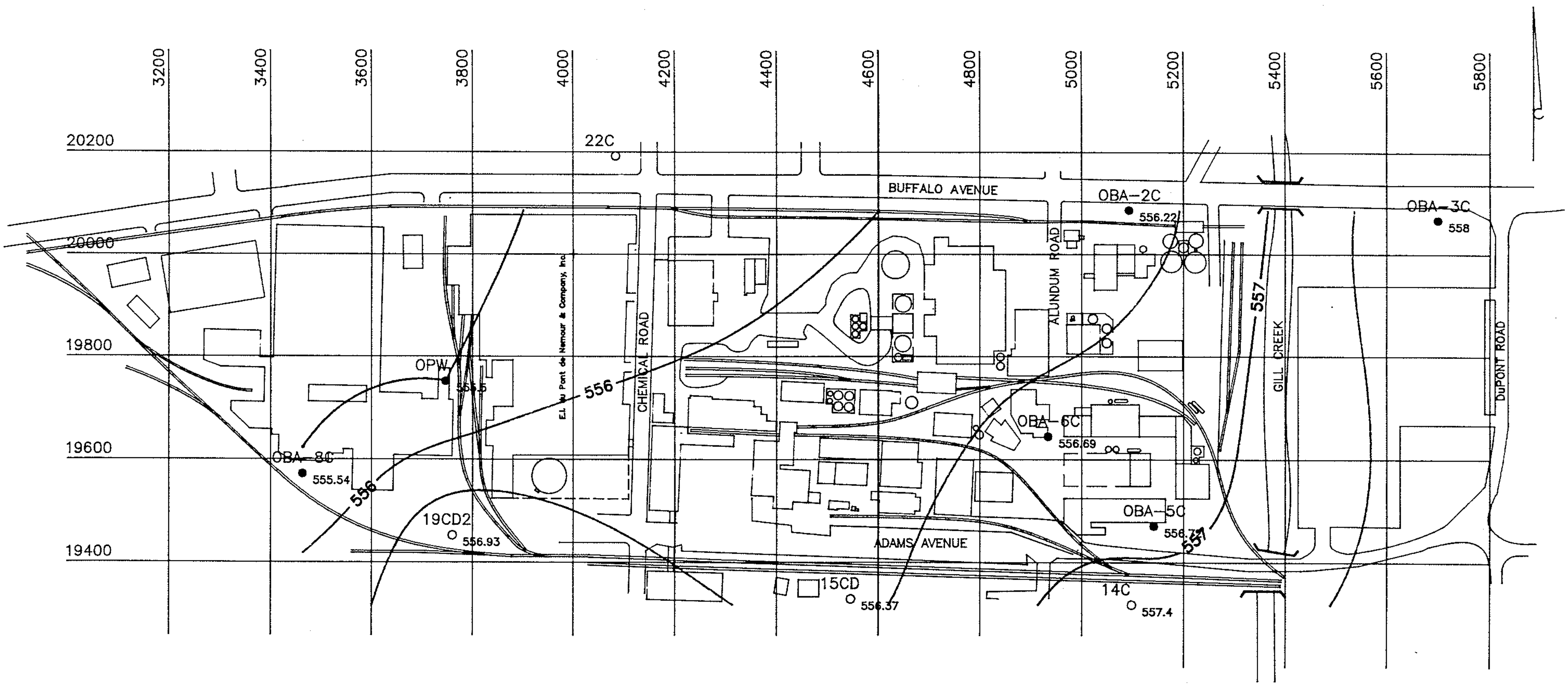
DATE OF MEASUREMENT: 9/4/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
C-ZONE
SEPTEMBER, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-41
Scale: 0 — 200 Feet		



PRODUCTION WELL PUMPING RATE: 370 gpm

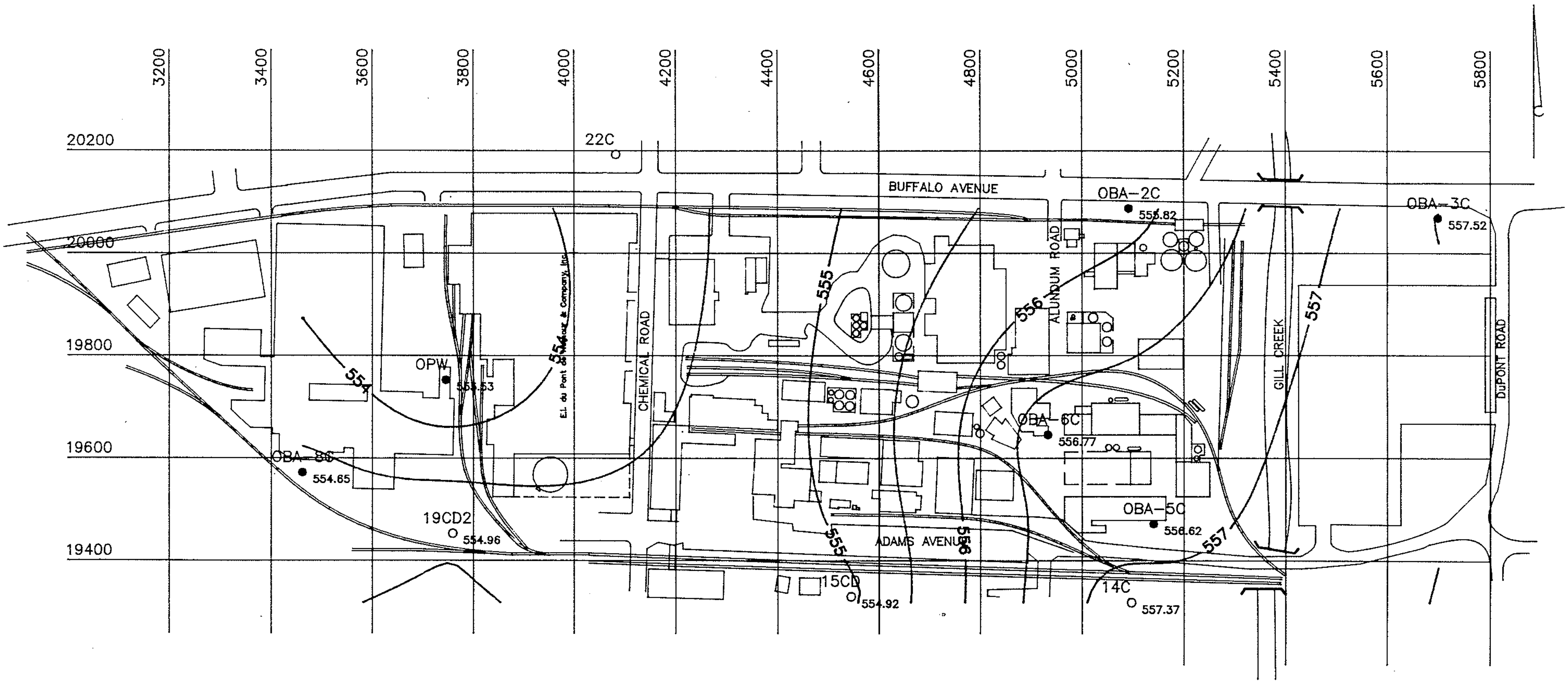
DATE OF MEASUREMENT: 10/25/90

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
CD-ZONE
OCTOBER, 1990

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-42
Scale: 0 — 200 Feet		



PRODUCTION WELL PUMPING RATE: 720 gpm

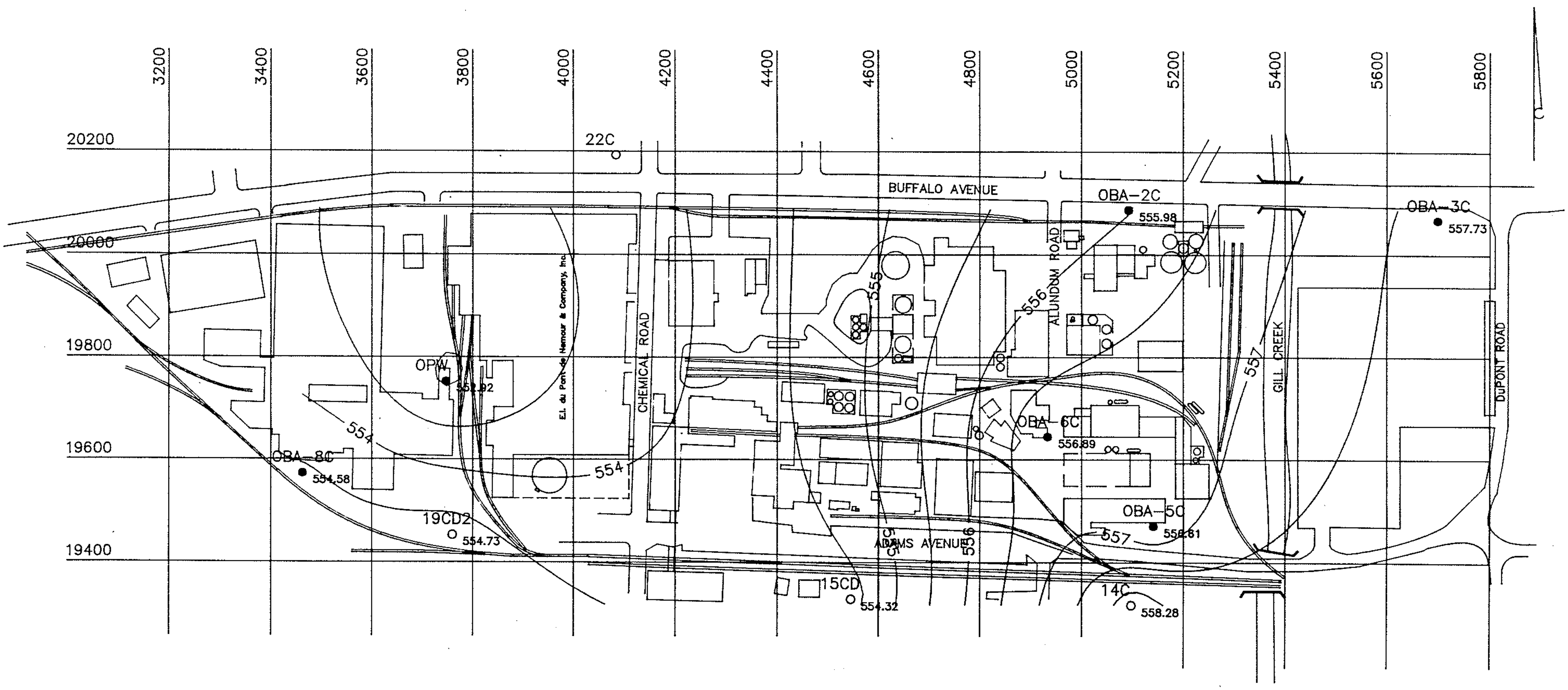
DATE OF MEASUREMENT: 11/27/90

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
CD-ZONE
NOVEMBER, 1990

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-43
Scale: 0 200 Feet		



PRODUCTION WELL PUMPING RATE: 820 gpm

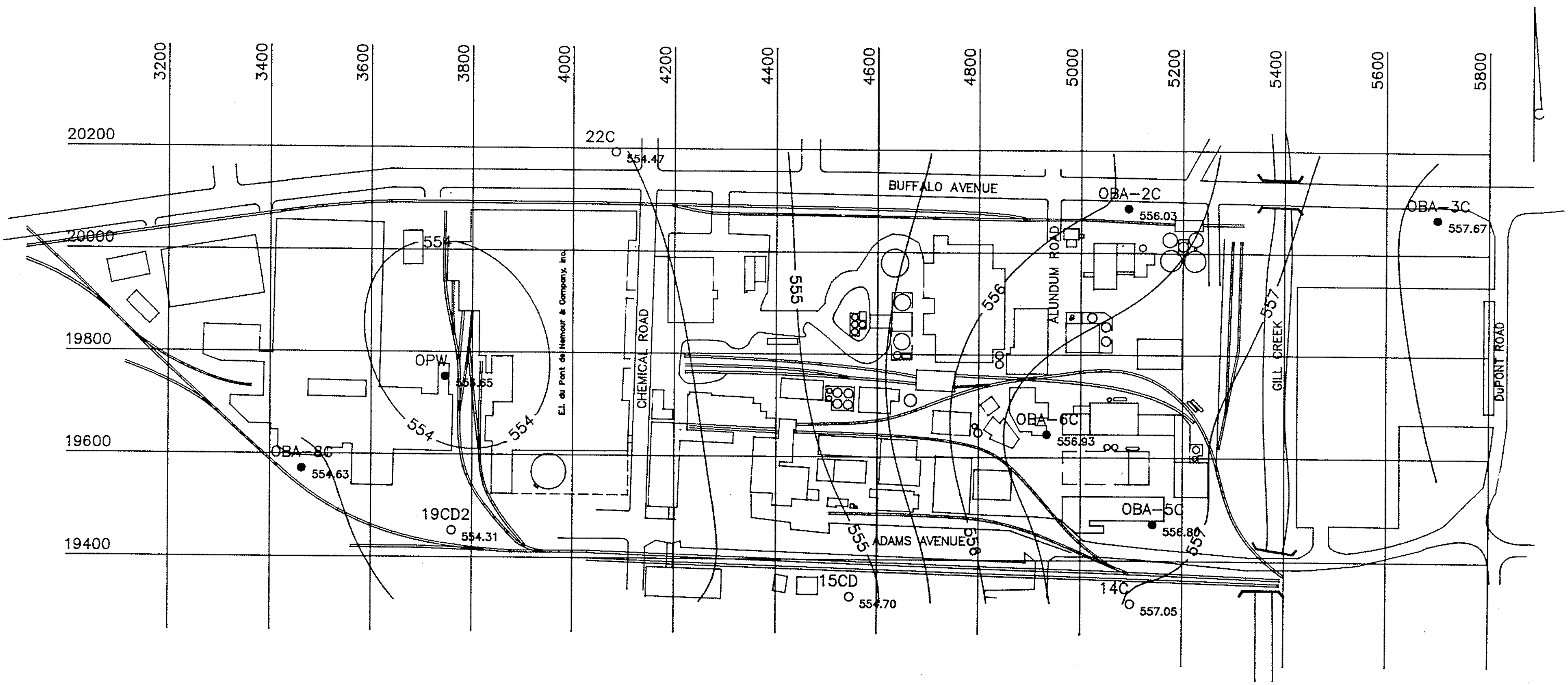
DATE OF MEASUREMENT: 12/7/90

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
CD-ZONE
DECEMBER, 1990

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-44
Scale: 0 200 Feet		



PRODUCTION WELL PUMPING RATE: 700 gpm

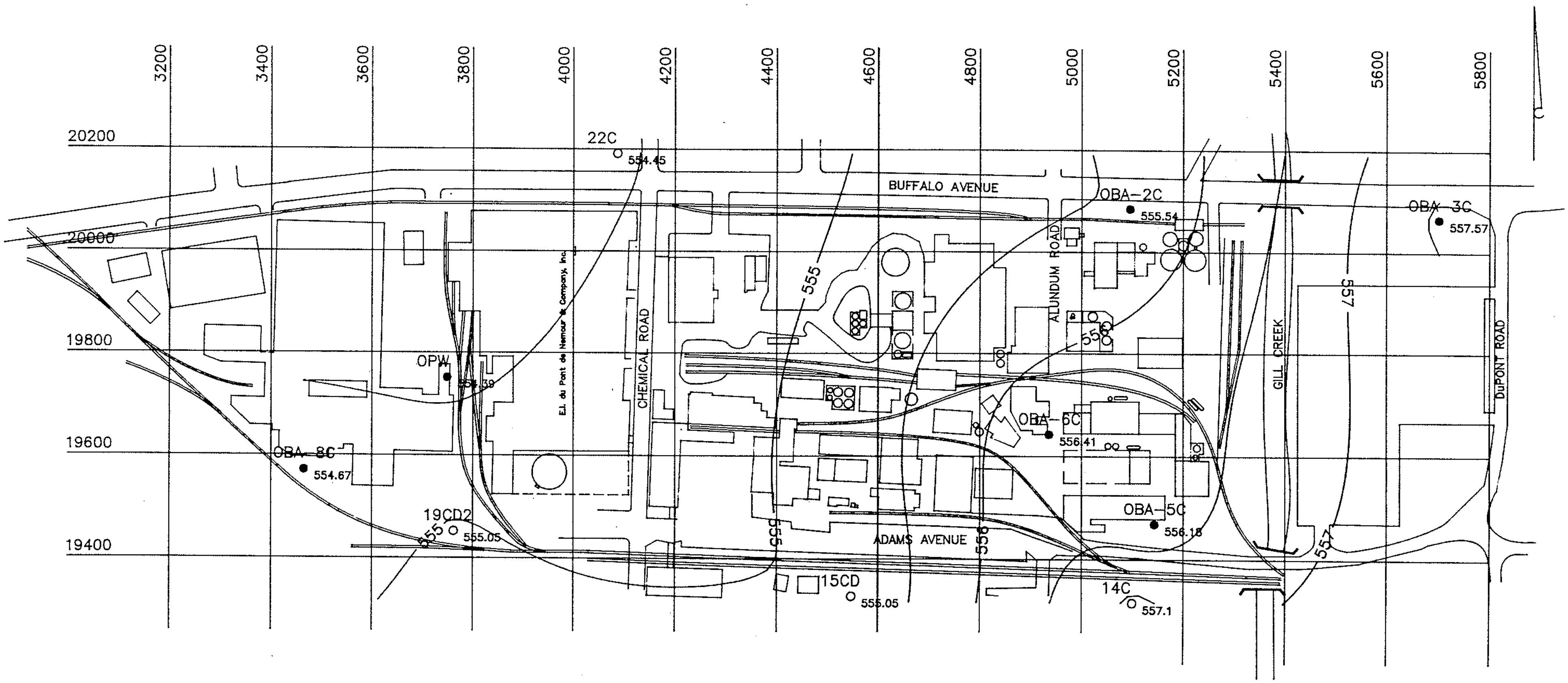
DATE OF MEASUREMENT: 1/16/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
CD-ZONE
JANUARY, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-45
Scale: 0 — 200 Feet		



PRODUCTION WELL PUMPING RATE: 580 gpm

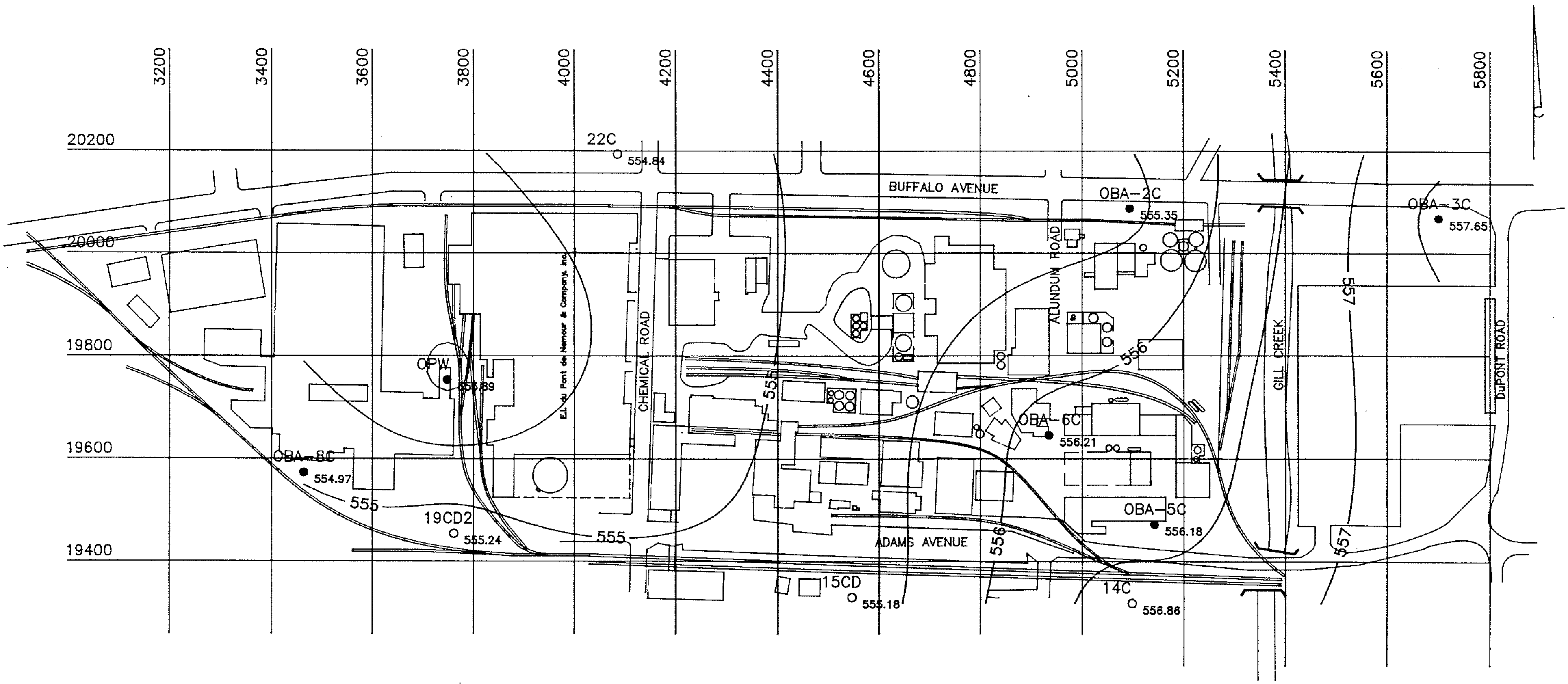
DATE OF MEASUREMENT: 2/6/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
CD-ZONE
FEBRUARY, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-46
Scale: 0 — 200 Feet		



PRODUCTION WELL PUMPING RATE: 720 gpm

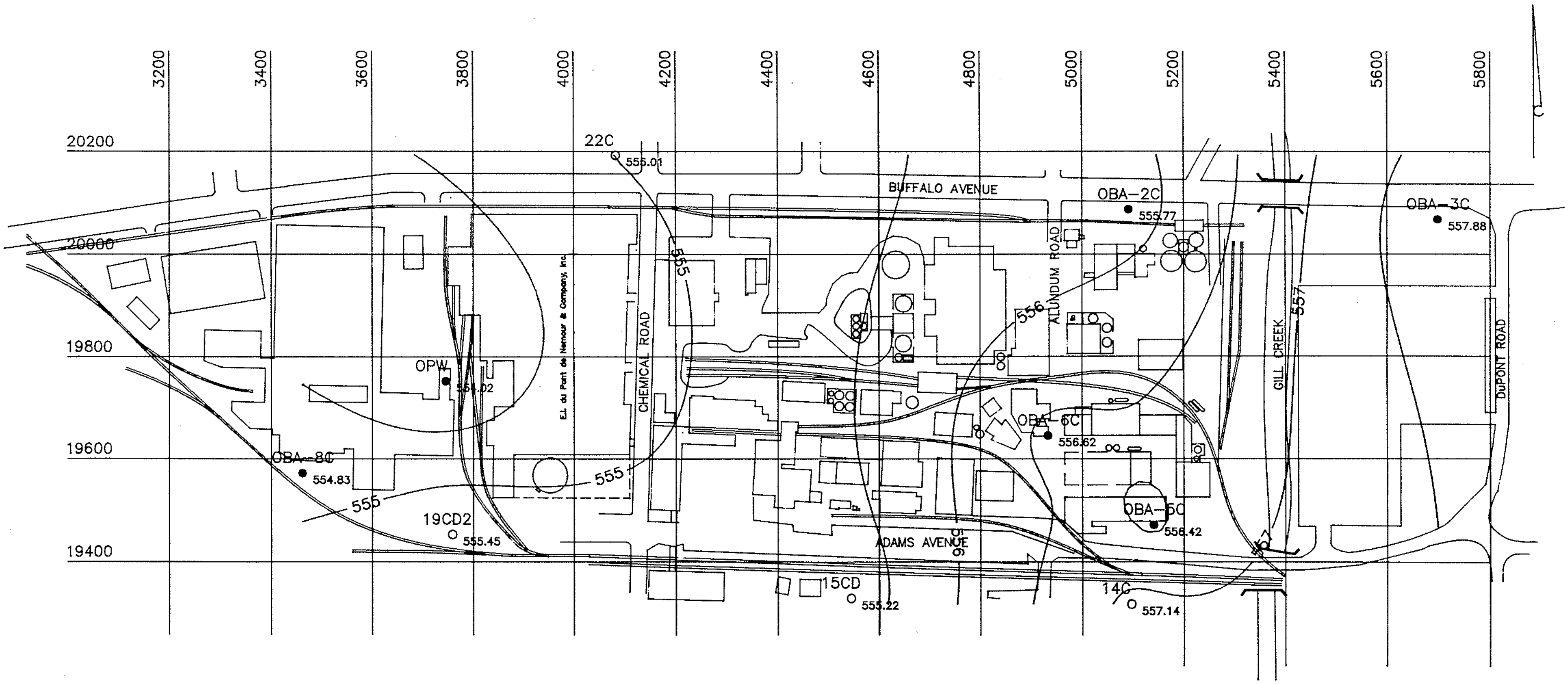
DATE OF MEASUREMENT: 3/25/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
CD-ZONE
MARCH, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-47
Scale: 0 200 Feet		



PRODUCTION WELL PUMPING RATE: 700 gpm

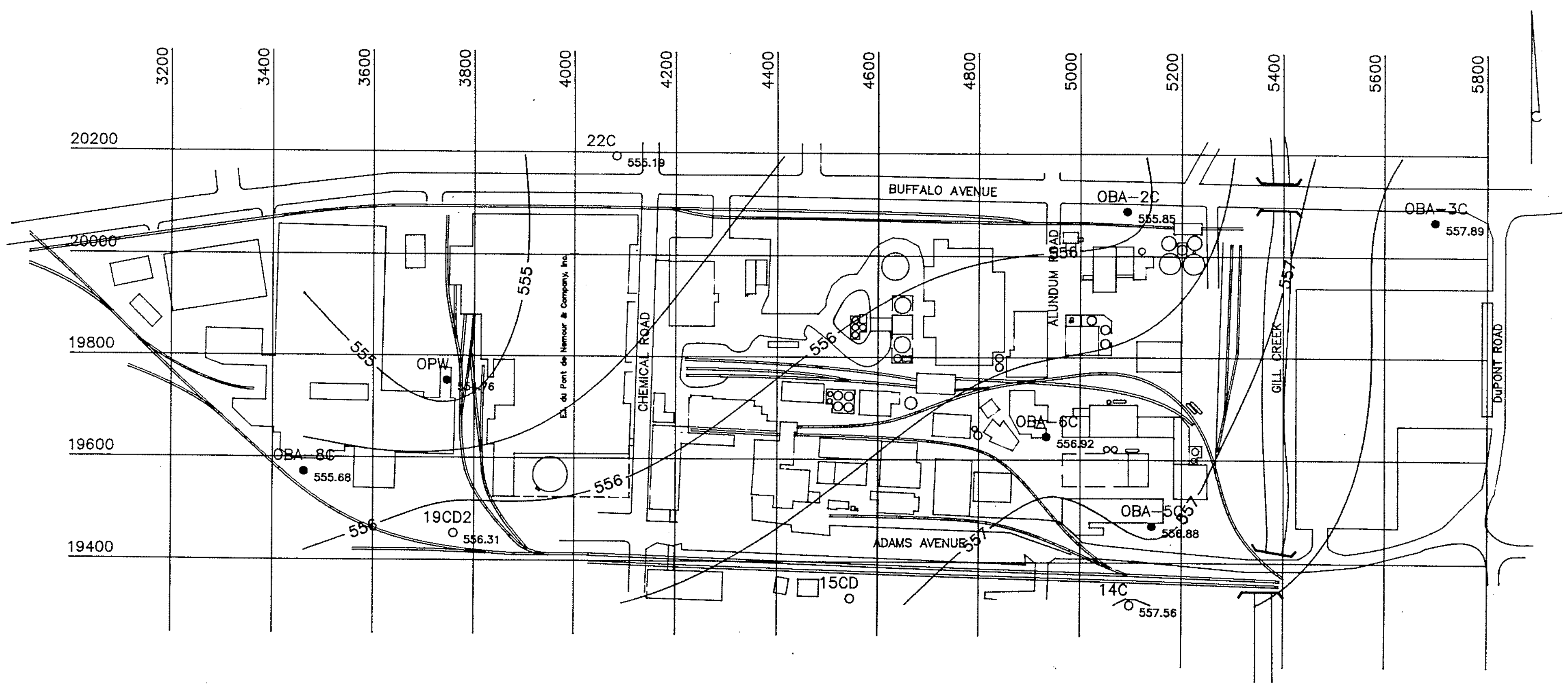
DATE OF MEASUREMENT: 4/8/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD–CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
CD–ZONE
APRIL, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4–48
Scale: 0 200 Feet		



PRODUCTION WELL PUMPING RATE: 520 gpm

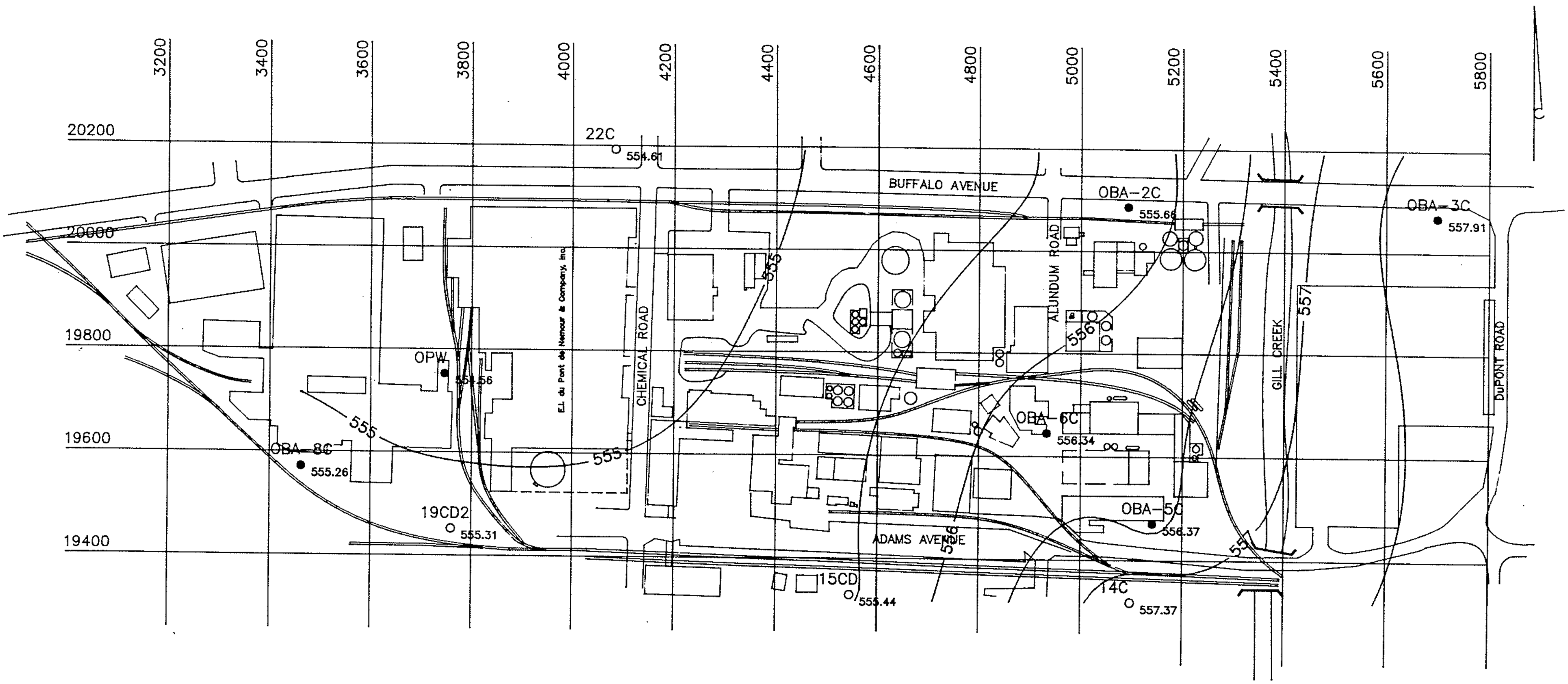
DATE OF MEASUREMENT: 5/13/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
CD-ZONE
MAY, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-49
Scale: 0 200 Feet		



PRODUCTION WELL PUMPING RATE: 600 gpm (average)

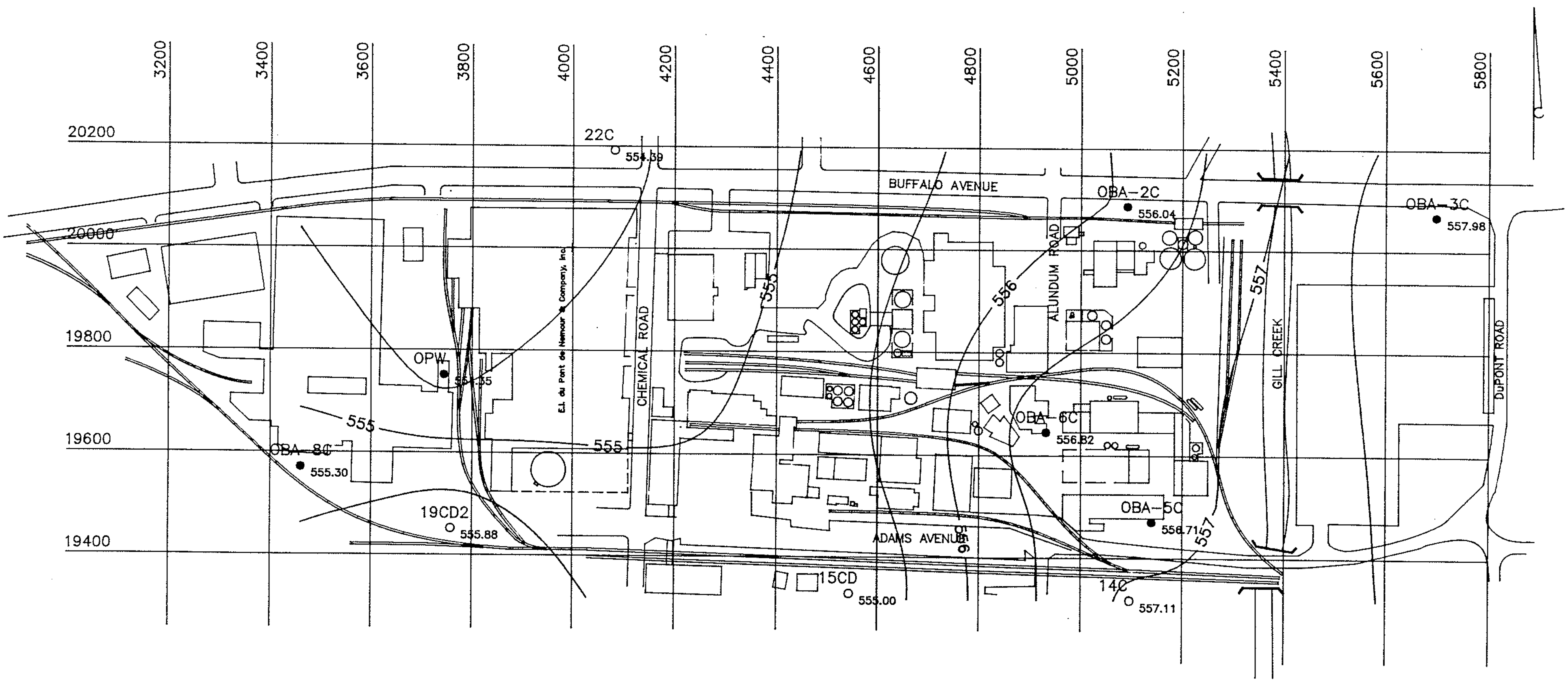
DATE OF MEASUREMENT: 6/6/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
CD-ZONE
JUNE, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-50
Scale: 0 — 200 Feet		



PRODUCTION WELL PUMPING RATE: 645 gpm

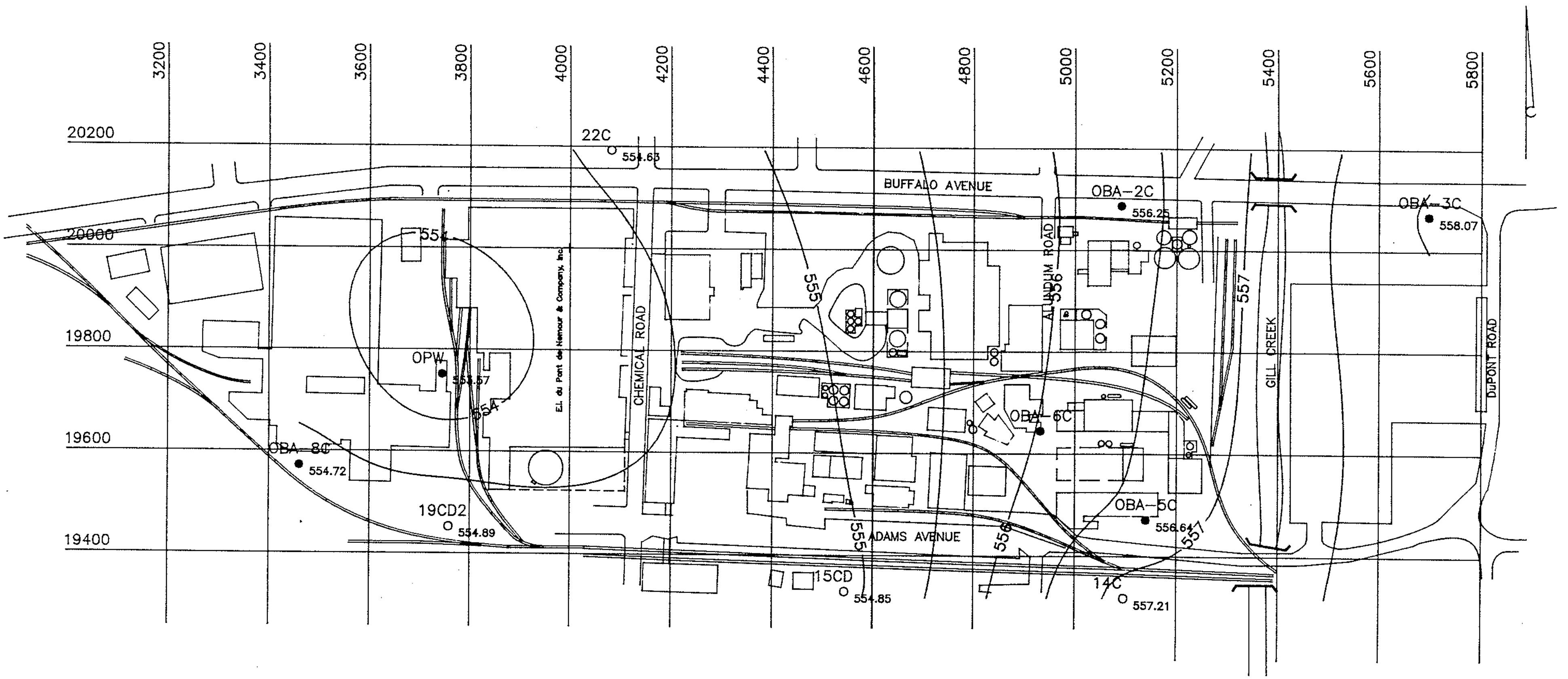
DATE OF MEASUREMENT: 7/9/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
CD-ZONE
JULY, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-51
Scale: 0 — 200 Feet		



PRODUCTION WELL PUMPING RATE: 750 gpm

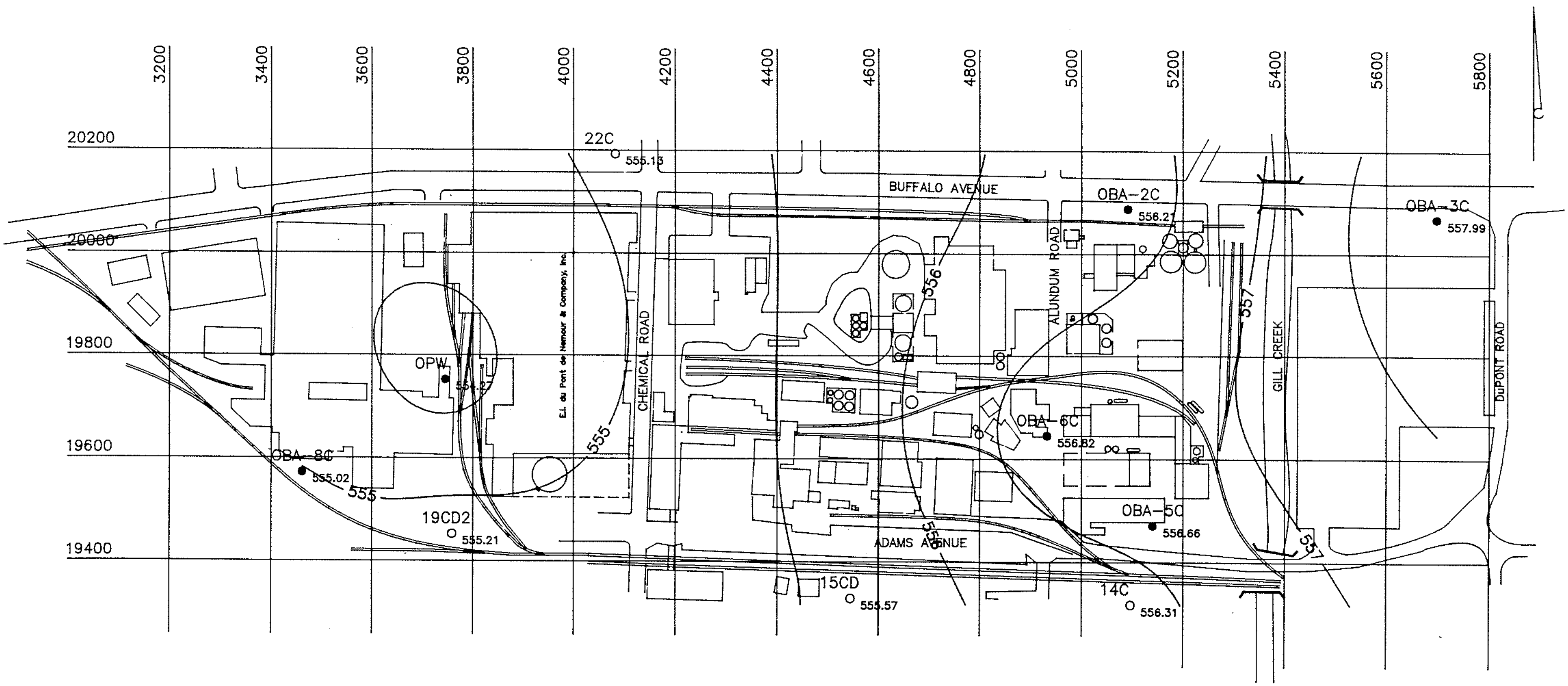
DATE OF MEASUREMENT: 8/19/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
CD-ZONE
AUGUST, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	
Scale: 0 200 Feet		Figure 4-52



PRODUCTION WELL PUMPING RATE: 650 gpm

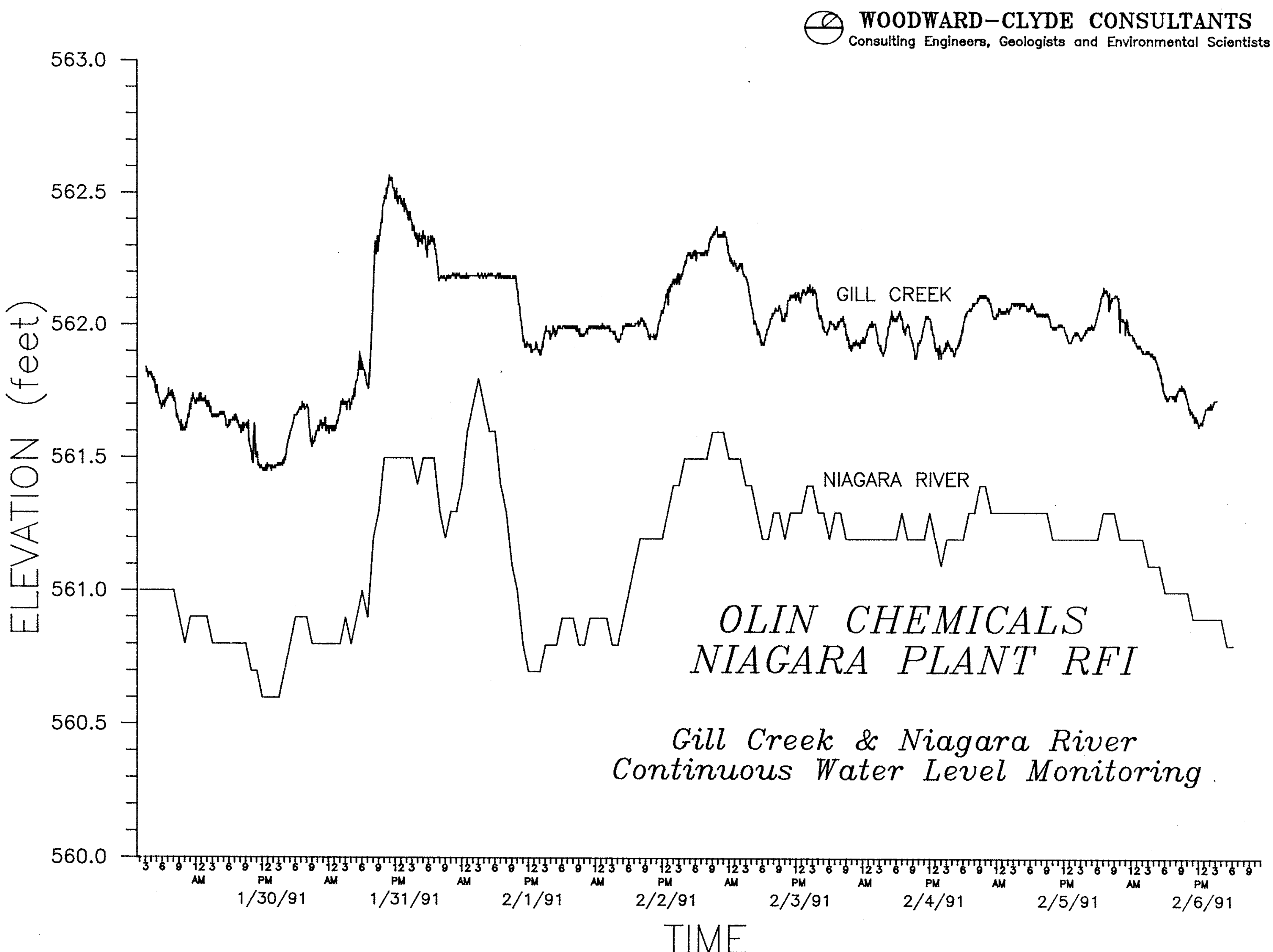
DATE OF MEASUREMENT: 9/4/91

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

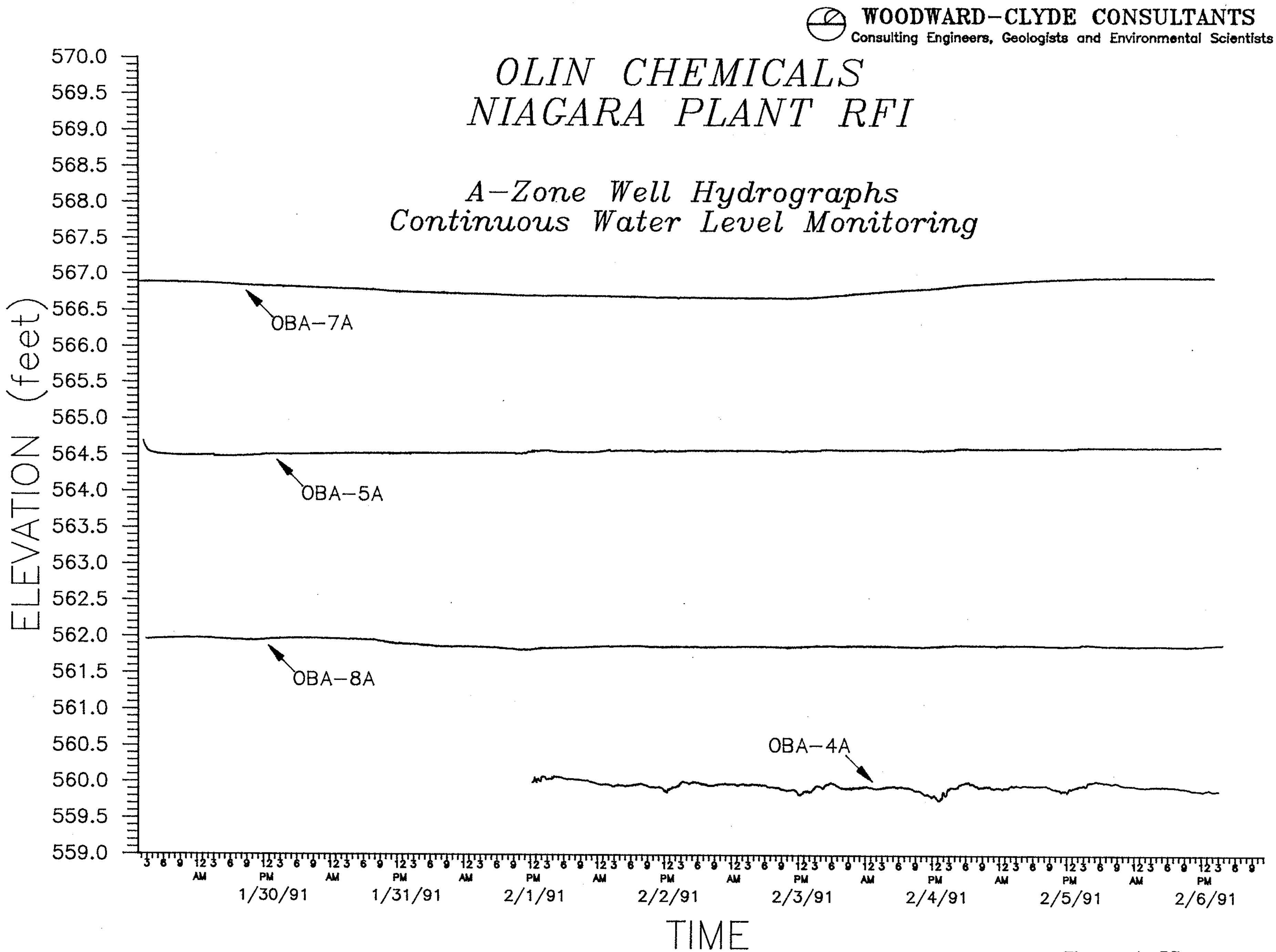
POTENTIOMETRIC SURFACE CONTOUR MAP
CD-ZONE
SEPTEMBER, 1991

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 4-53
Scale: 0 200 Feet		



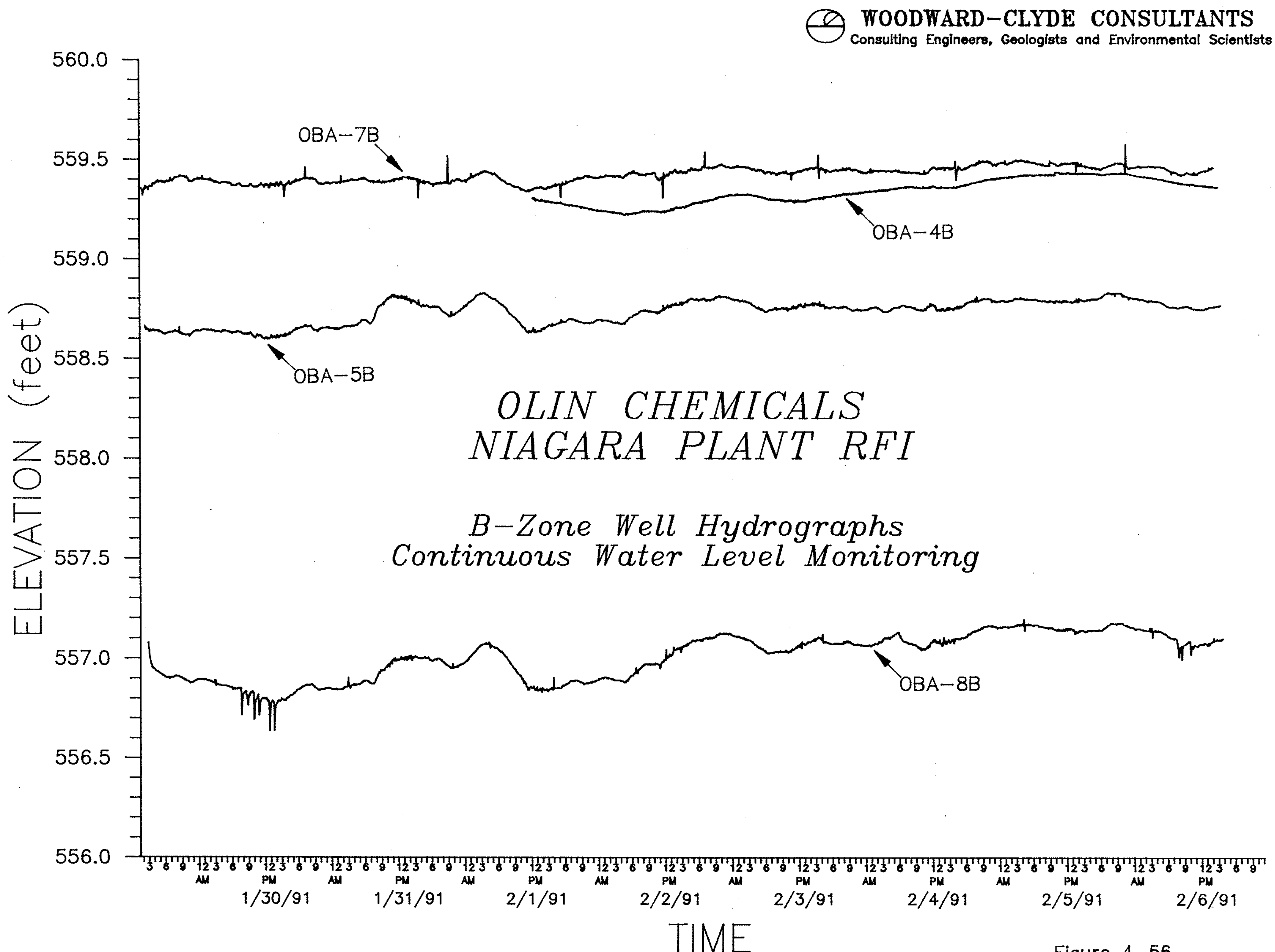
WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists
ELEVATION (feet)
563.0
562.5
562.0
561.5
561.0
560.5
560.0
GILL CREEK
NIAGARA RIVER
OLIN CHEMICALS
NIAGARA PLANT RFI
Gill Creek & Niagara River
Continuous Water Level Monitoring
1/30/91
1/31/91
2/1/91
2/2/91
2/3/91
2/4/91
2/5/91
2/6/91
TIME

Figure 4-54



WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists
OLIN CHEMICALS
NIAGARA PLANT RFI
A-Zone Well Hydrographs
Continuous Water Level Monitoring
ELEVATION (feet)
570.0
569.5
569.0
568.5
568.0
567.5
567.0
566.5
566.0
565.5
565.0
564.5
564.0
563.5
563.0
562.5
562.0
561.5
561.0
560.5
560.0
559.5
559.0
OBA-7A
OBA-5A
OBA-8A
OBA-4A
1/30/91
1/31/91
2/1/91
2/2/91
2/3/91
2/4/91
2/5/91
2/6/91
AM
PM
TIME

Figure 4-55



WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists
OLIN CHEMICALS
NIAGARA PLANT RFI
B-Zone Well Hydrographs
Continuous Water Level Monitoring
OBA-7B
OBA-4B
OBA-5B
OBA-8B
ELEVATION (feet)
560.0
559.5
559.0
558.5
558.0
557.5
557.0
556.5
556.0
TIME
1/30/91
1/31/91
2/1/91
2/2/91
2/3/91
2/4/91
2/5/91
2/6/91

Figure 4-56

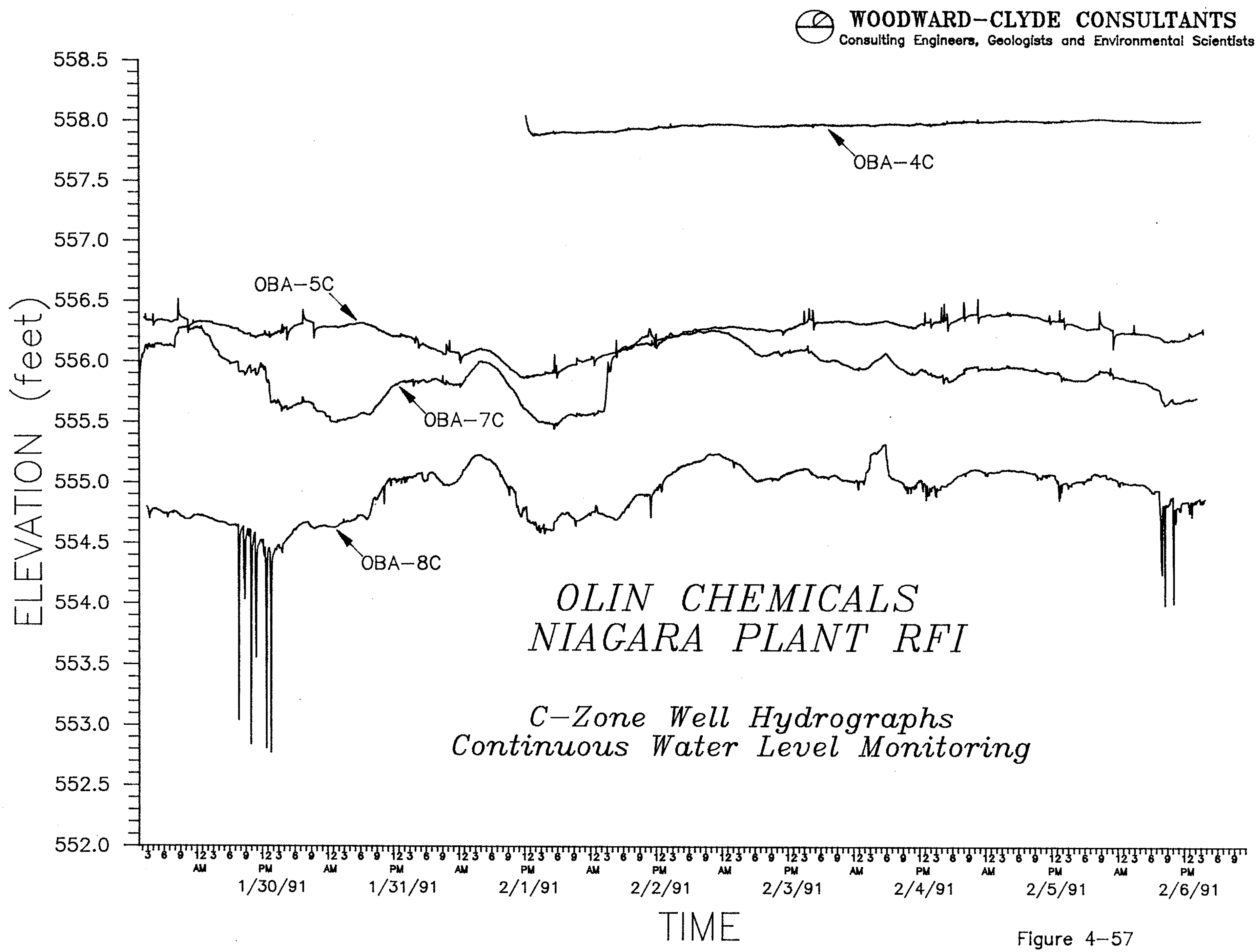
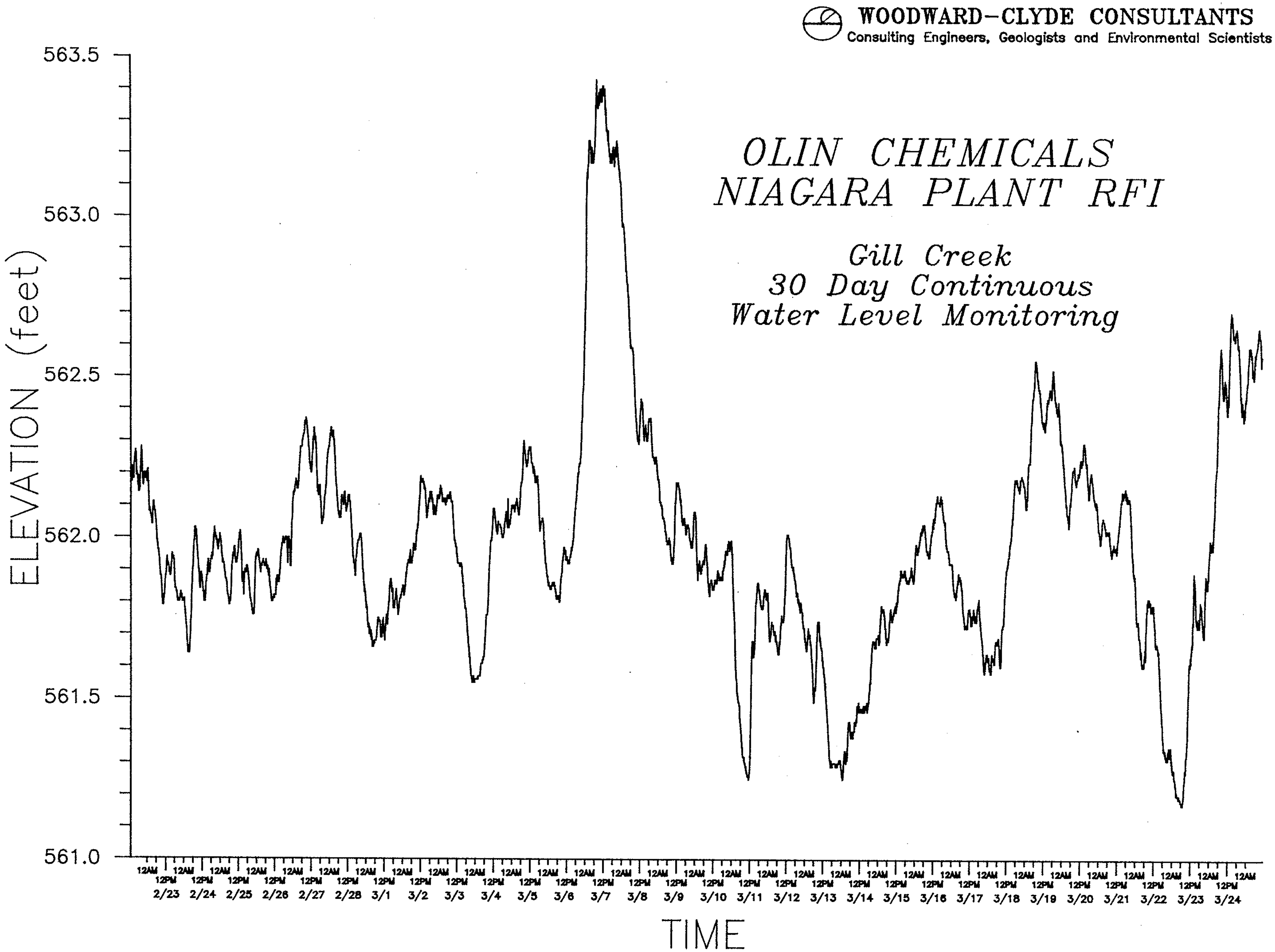
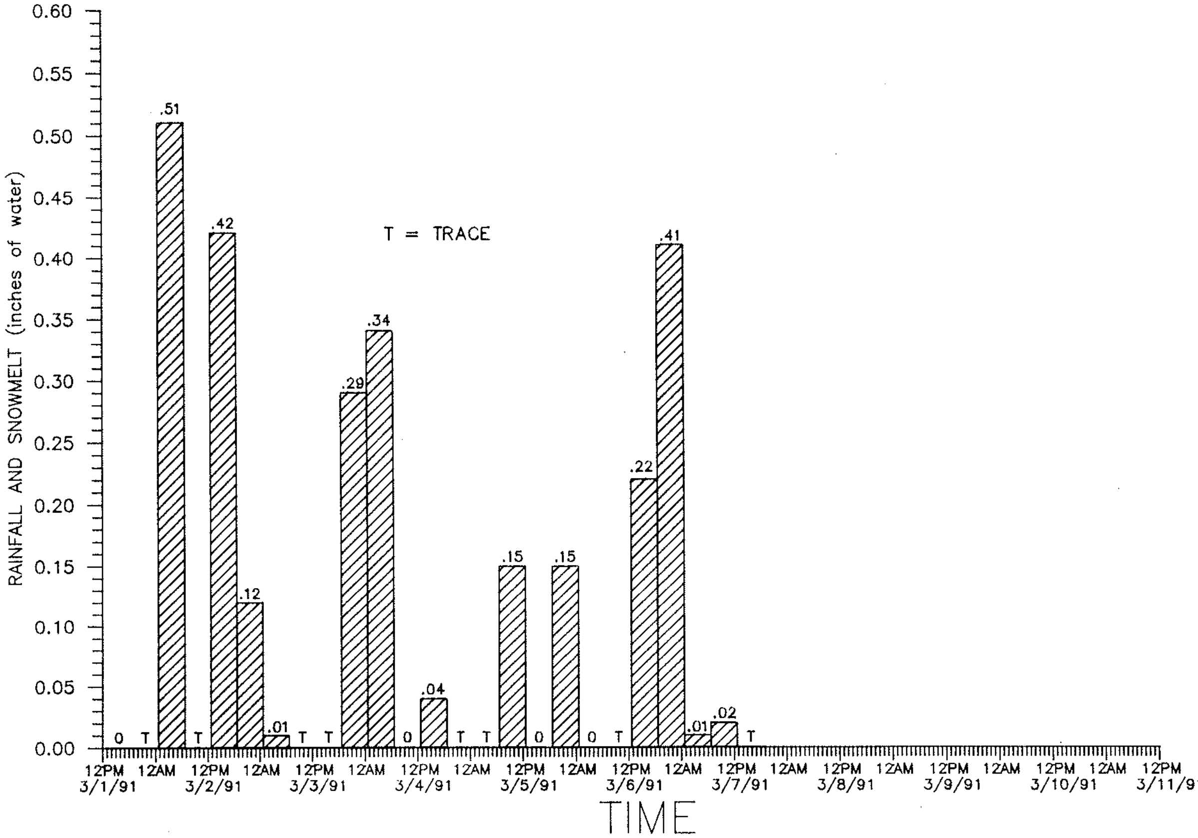

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists
558.5
558.0
557.5
557.0
556.5
556.0
555.5
555.0
554.5
554.0
553.5
553.0
552.5
552.0
ELEVATION (feet)
OBA-4C
OBA-5C
OBA-7C
OBA-8C
OLIN CHEMICALS
NIAGARA PLANT RFI
C-Zone Well Hydrographs
Continuous Water Level Monitoring
AM
PM
1/30/91
1/31/91
2/1/91
2/2/91
2/3/91
2/4/91
2/5/91
2/6/91
TIME

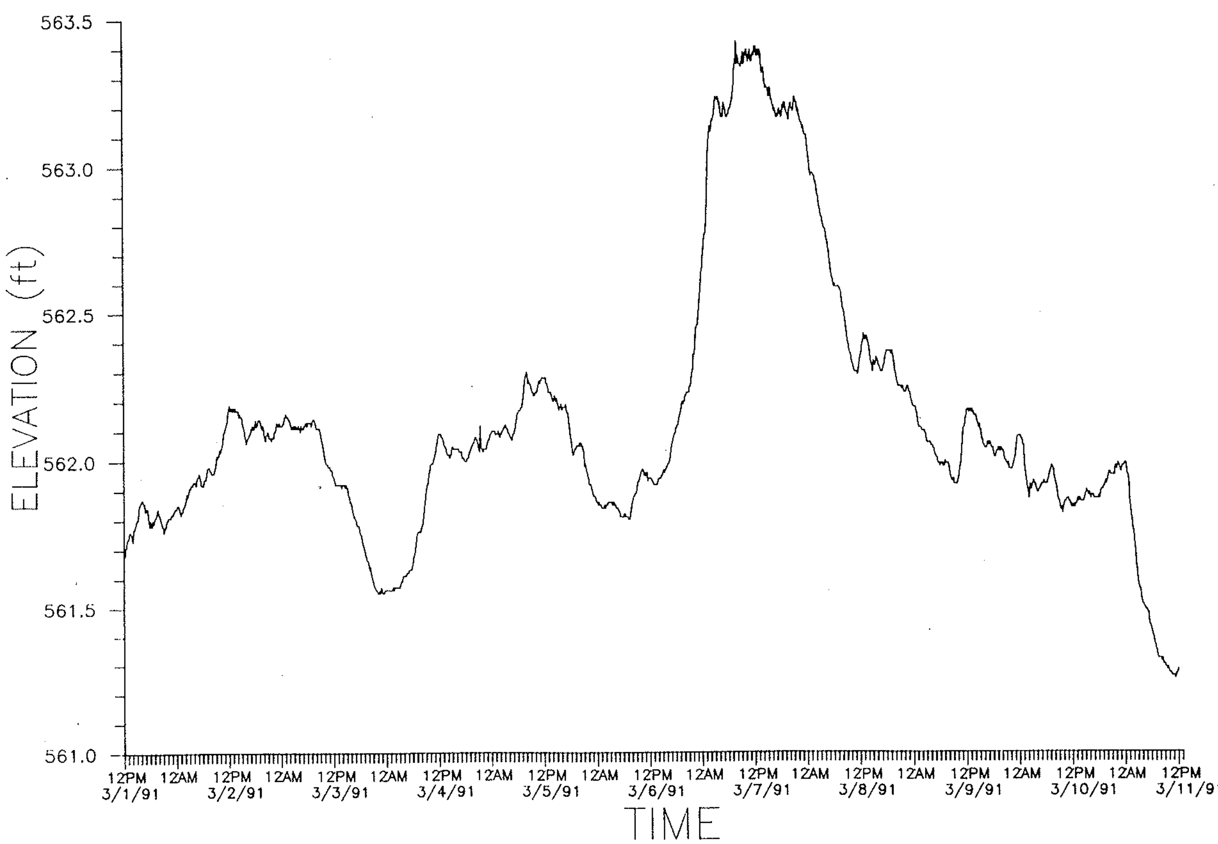
Figure 4-57



WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists
OLIN CHEMICALS
NIAGARA PLANT RFI
Gill Creek
30 Day Continuous
Water Level Monitoring
ELEVATION (feet)
563.5
563.0
562.5
562.0
561.5
561.0
TIME
12AM
12PM
2/23 2/24 2/25 2/26 2/27 2/28 3/1 3/2 3/3 3/4 3/5 3/6 3/7 3/8 3/9 3/10 3/11 3/12 3/13 3/14 3/15 3/16 3/17 3/18 3/19 3/20 3/21 3/22 3/23 3/24

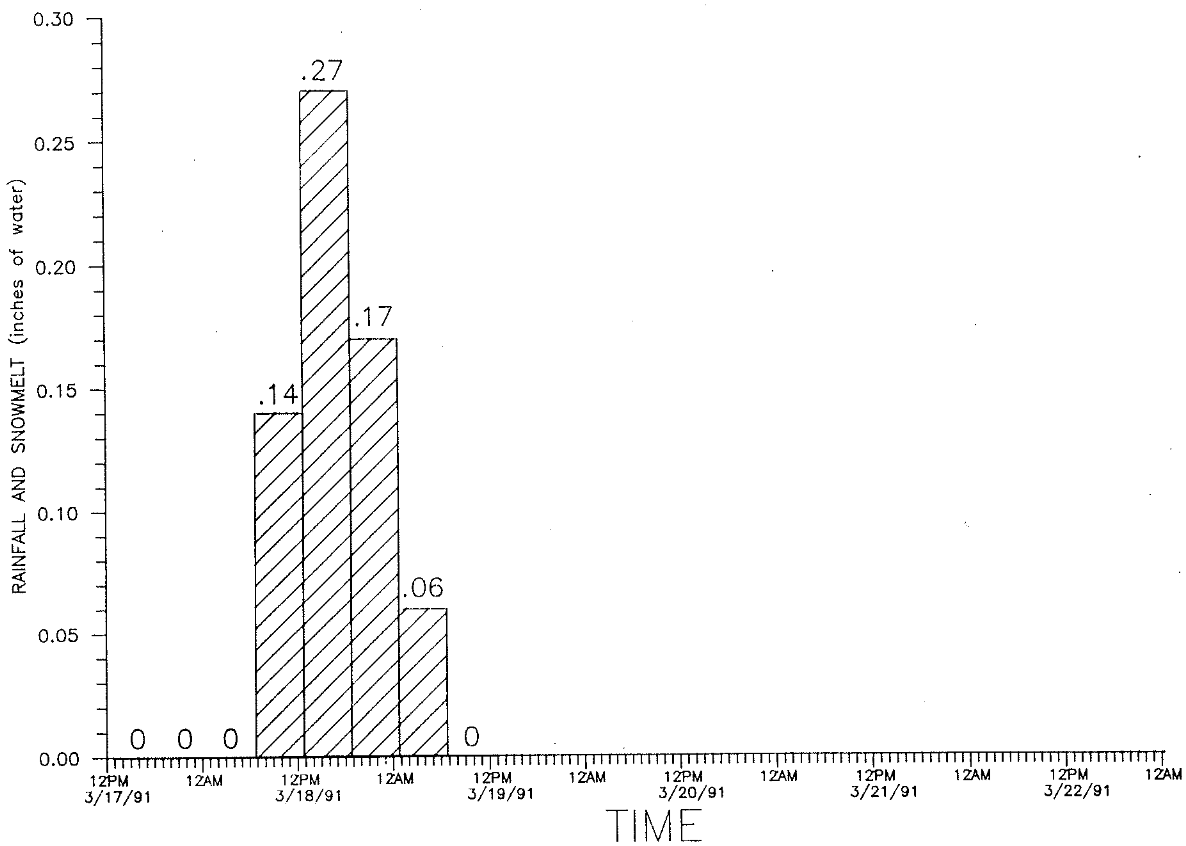
Figure 4-58

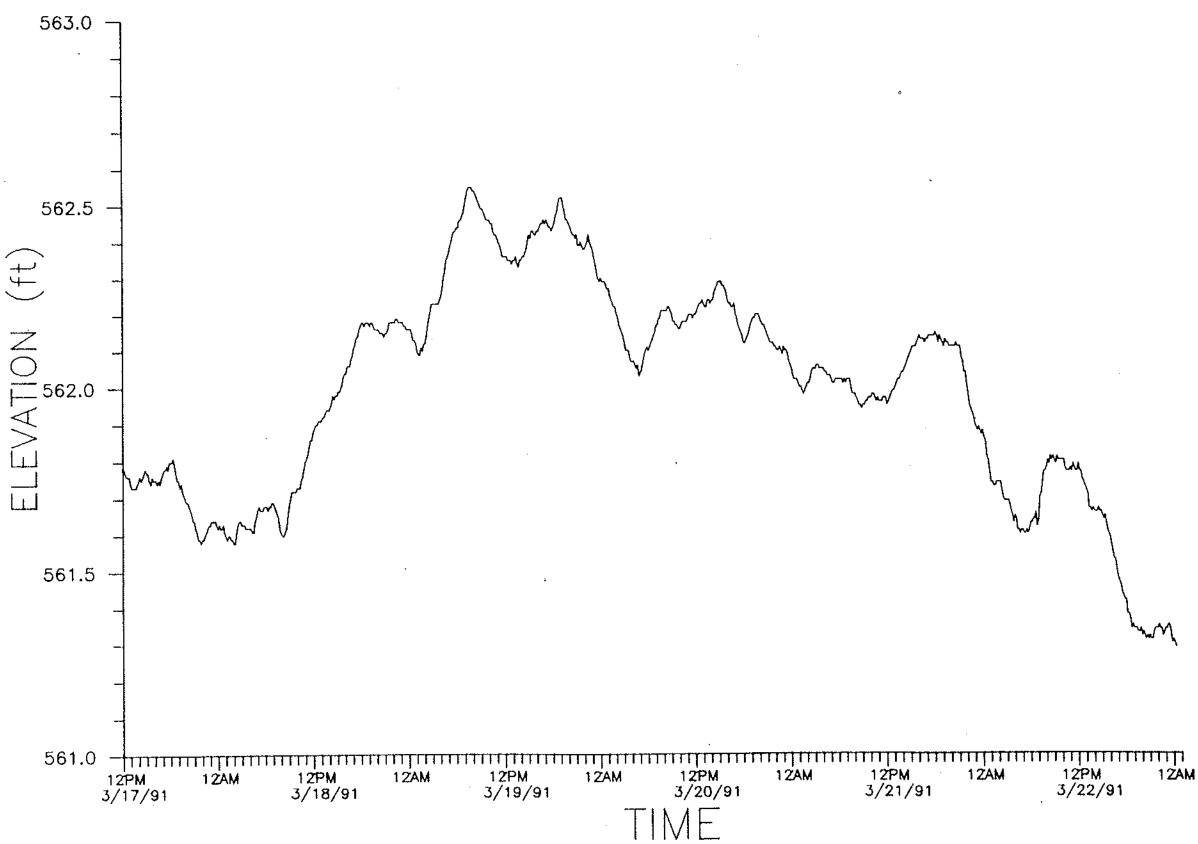




Gill Creek Stage Hydrograph:
March 1 through March 11, 1991

Figure 4–59





Gill Creek Stage Hydrograph:
March 17 through March 22, 1991

Figure 4-60

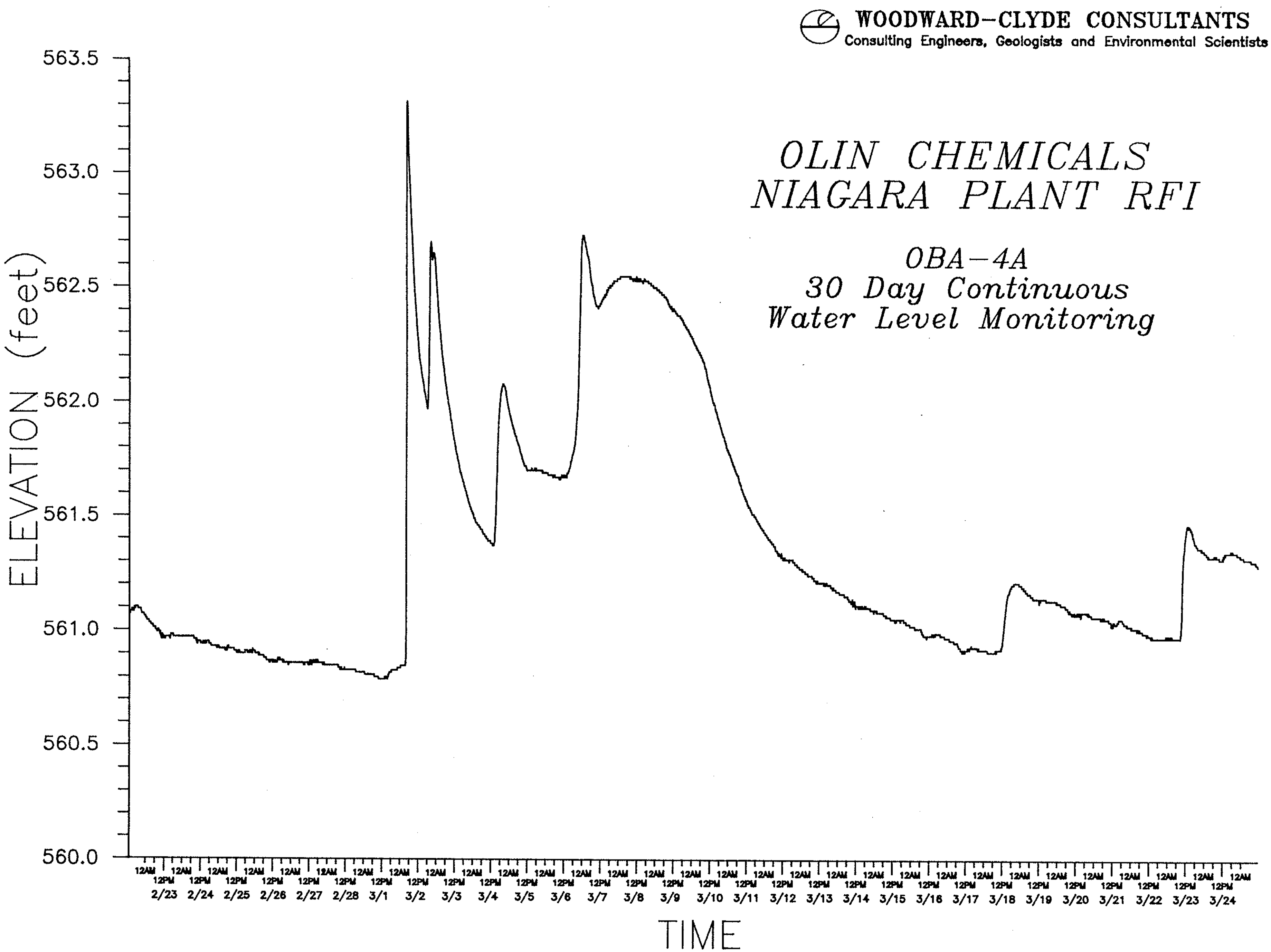
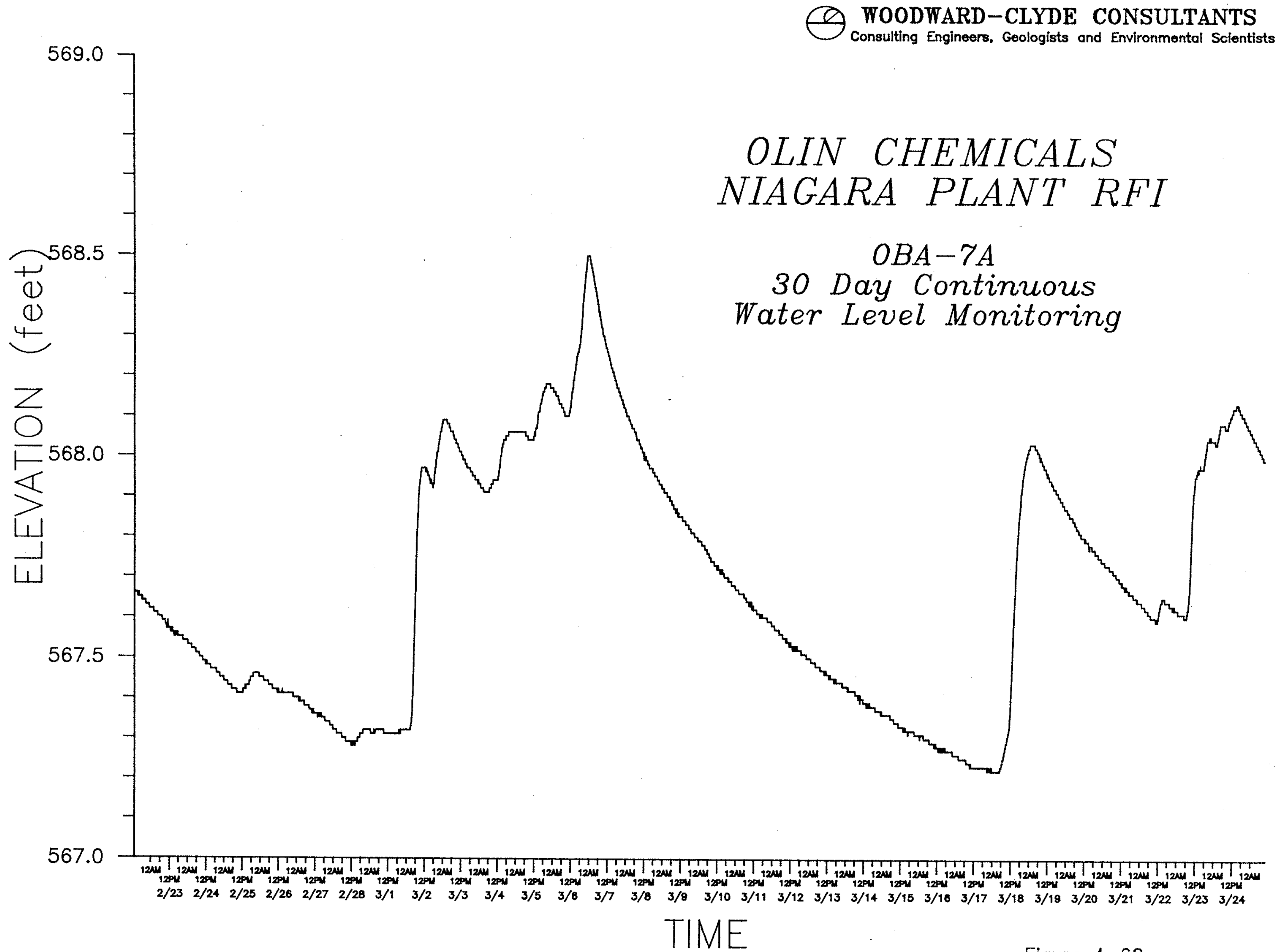

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists
OLIN CHEMICALS
NIAGARA PLANT RFI
OBA-4A
30 Day Continuous
Water Level Monitoring
ELEVATION (feet)
563.5
563.0
562.5
562.0
561.5
561.0
560.5
560.0
TIME
2/23 2/24 2/25 2/26 2/27 2/28 3/1 3/2 3/3 3/4 3/5 3/6 3/7 3/8 3/9 3/10 3/11 3/12 3/13 3/14 3/15 3/16 3/17 3/18 3/19 3/20 3/21 3/22 3/23 3/24

Figure 4-61



WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists
OLIN CHEMICALS
NIAGARA PLANT RFI
OBA-7A
30 Day Continuous
Water Level Monitoring
ELEVATION (feet)
569.0
568.5
568.0
567.5
567.0
12AM
12PM
2/23 2/24 2/25 2/26 2/27 2/28 3/1 3/2 3/3 3/4 3/5 3/6 3/7 3/8 3/9 3/10 3/11 3/12 3/13 3/14 3/15 3/16 3/17 3/18 3/19 3/20 3/21 3/22 3/23 3/24
TIME

Figure 4-62

WOODWARD–CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

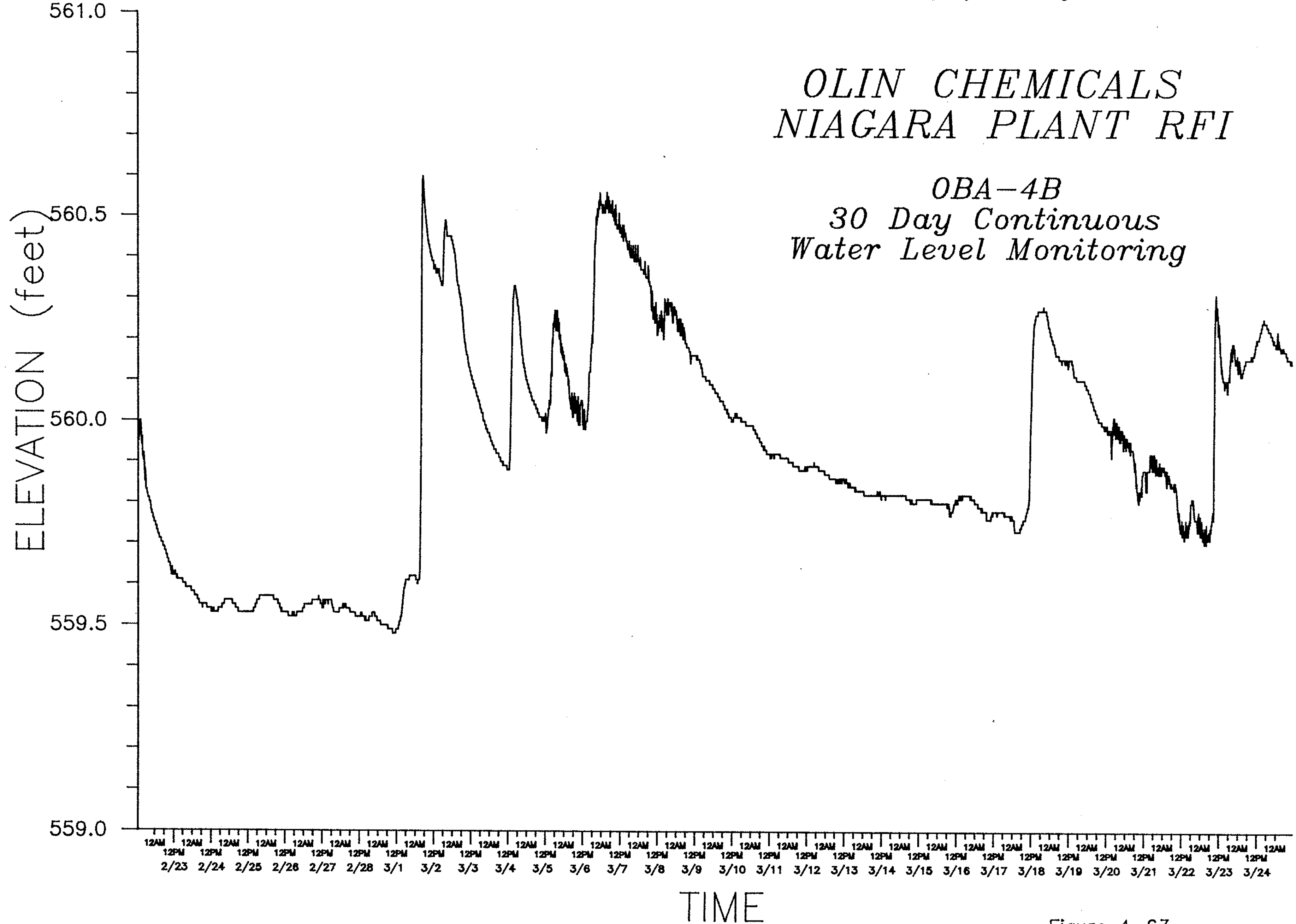
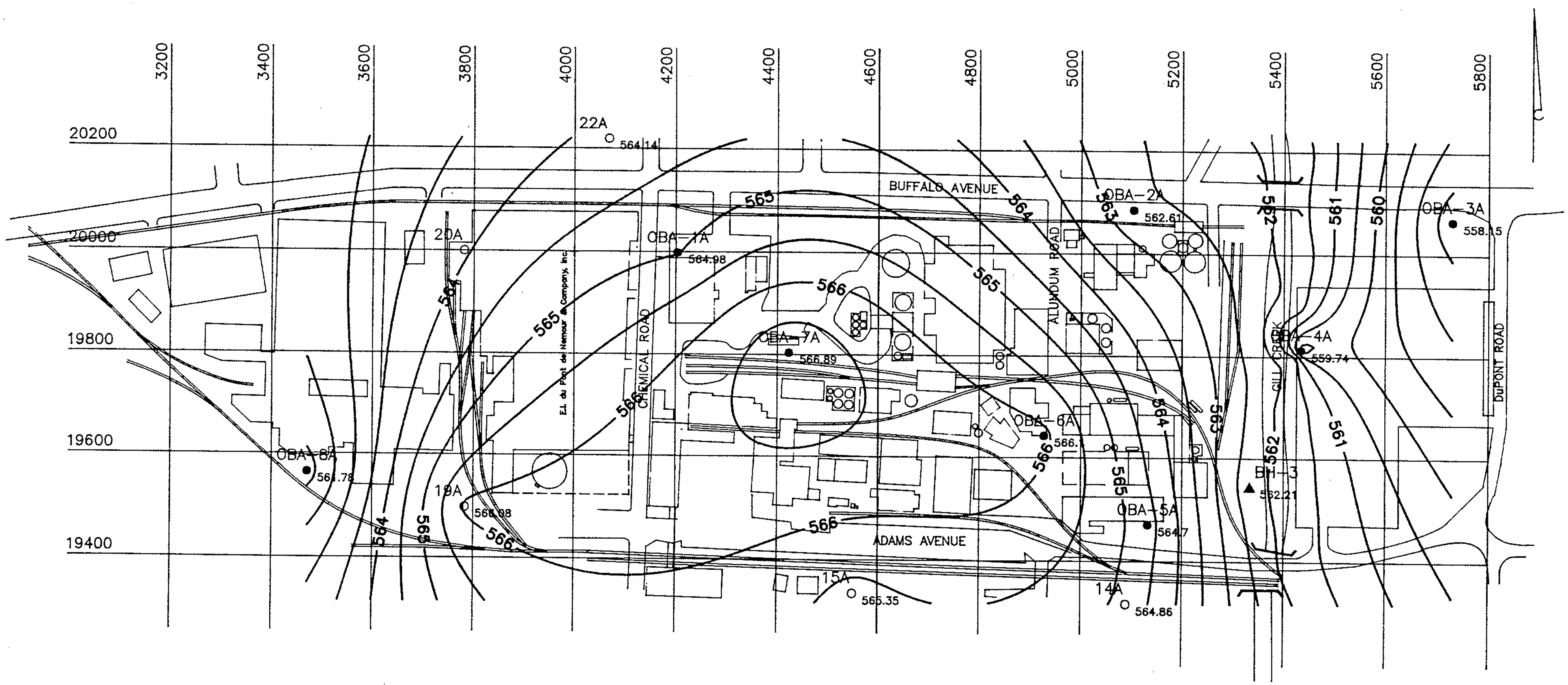


Figure 4–63



DATE/TIME OF MEASUREMENT: 2/6/91, 1500 hours

ELAPSED TIME FROM START OF PUMP TEST: Not applicable

STATIC WATER LEVEL AT GILL CREEK: 561.82

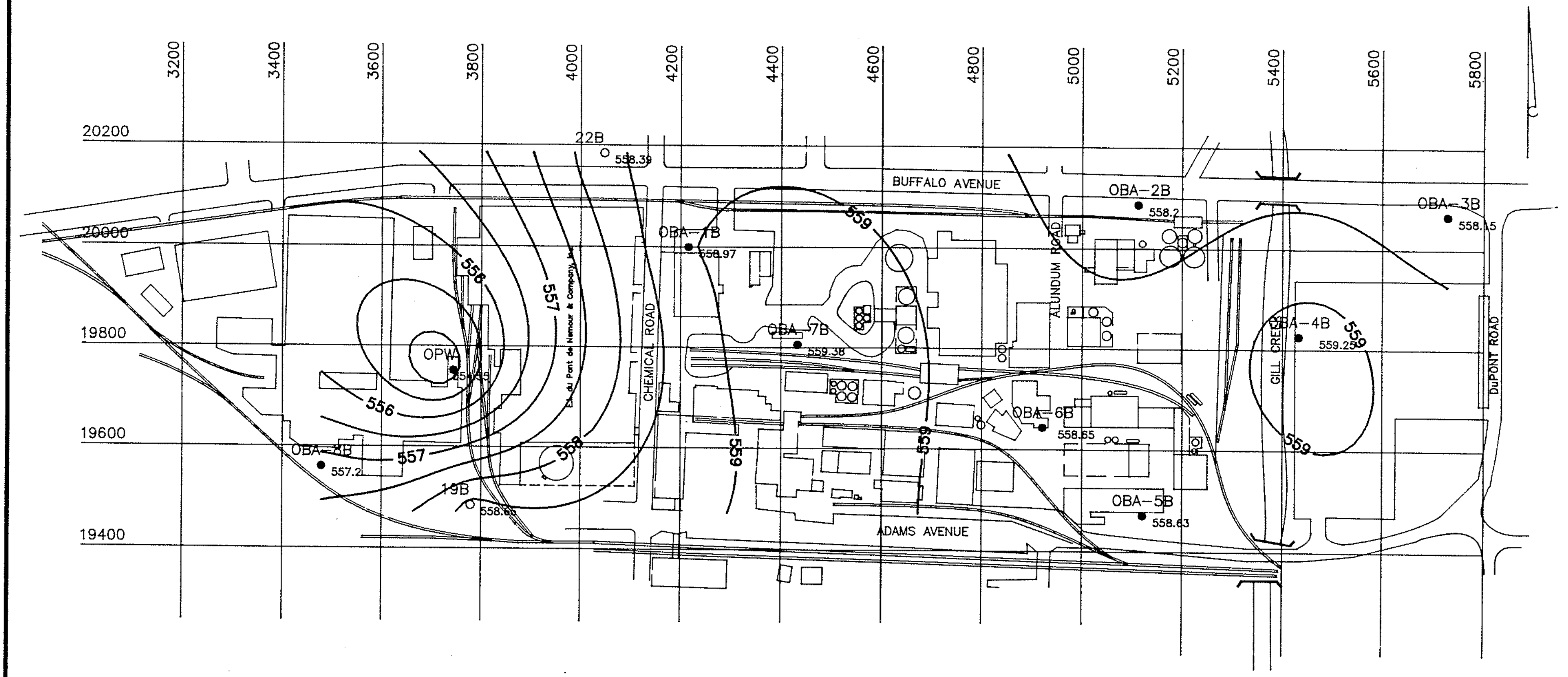
PRODUCTION WELL PUMPING RATE: 570 gpm

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
A-ZONE
PRE-PUMP TEST MONITORING

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5-1
Scale: 0 — 200 Feet		



DATE/TIME OF MEASUREMENT: 2/6/91, 1500 hours

ELAPSED TIME FROM START OF PUMP TEST: Not applicable

STATIC WATER LEVEL AT GILL CREEK: 561.82

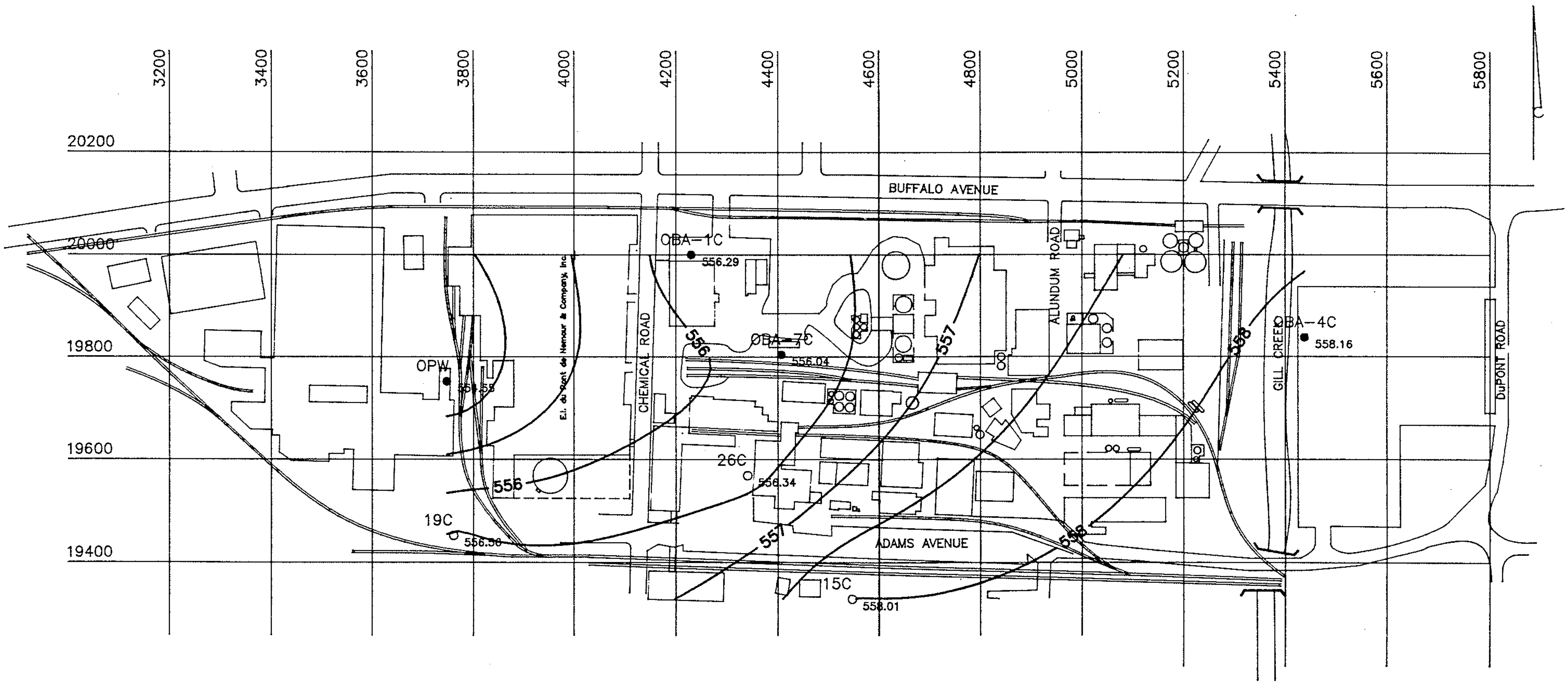
PRODUCTION WELL PUMPING RATE: 570 gpm

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
B-ZONE
PRE-PUMP TEST MONITORING

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5-2
Scale: 0 — 200 Feet		



DATE/TIME OF MEASUREMENT: 2/6/91, 1500 hours

ELAPSED TIME FROM START OF PUMP TEST: Not applicable

STATIC WATER LEVEL AT GILL CREEK: 561.82

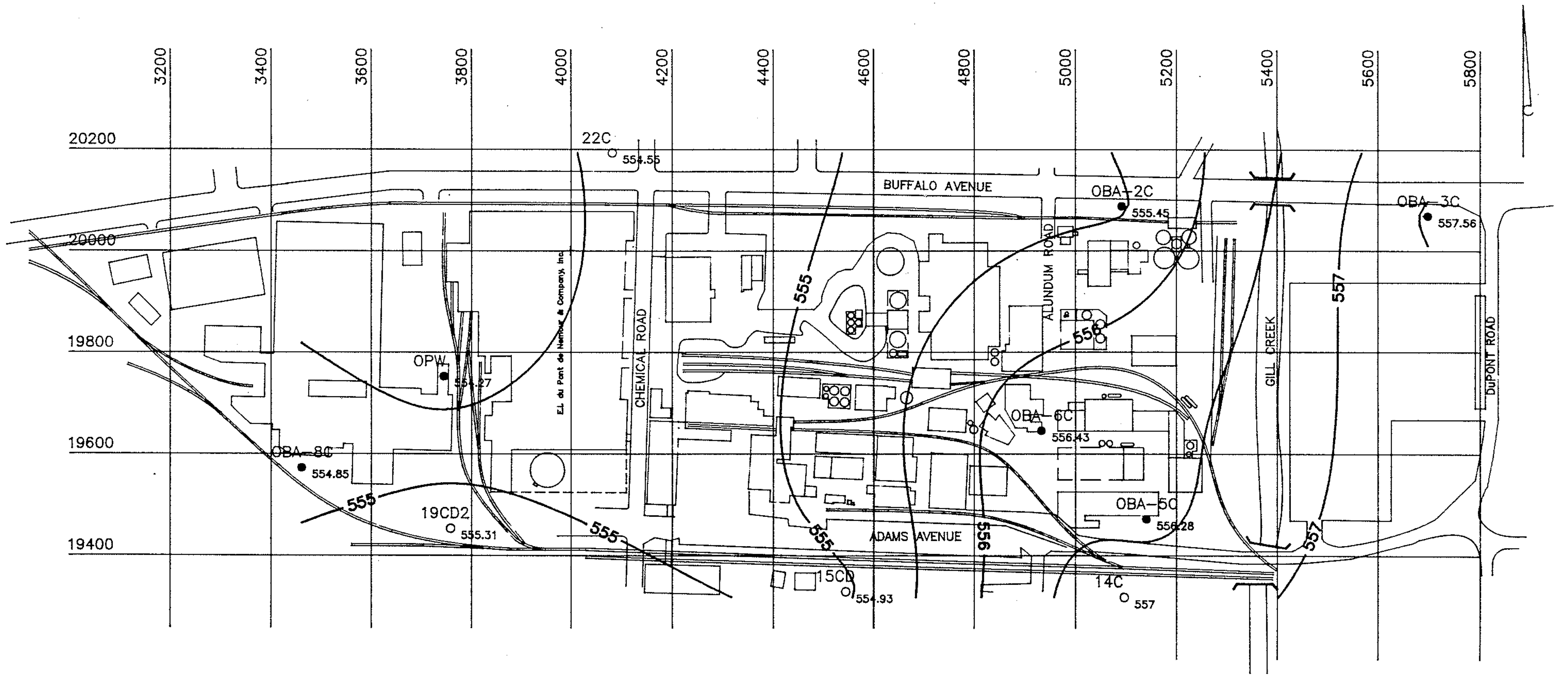
PRODUCTION WELL PUMPING RATE: 570 gpm

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
C-ZONE
PRE-PUMP TEST MONITORING

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5-3
Scale: 0 200 Feet		



DATE/TIME OF MEASUREMENT: 2/6/91, 1500 hours

ELAPSED TIME FROM START OF PUMP TEST: Not applicable

STATIC WATER LEVEL AT GILL CREEK: 561.82

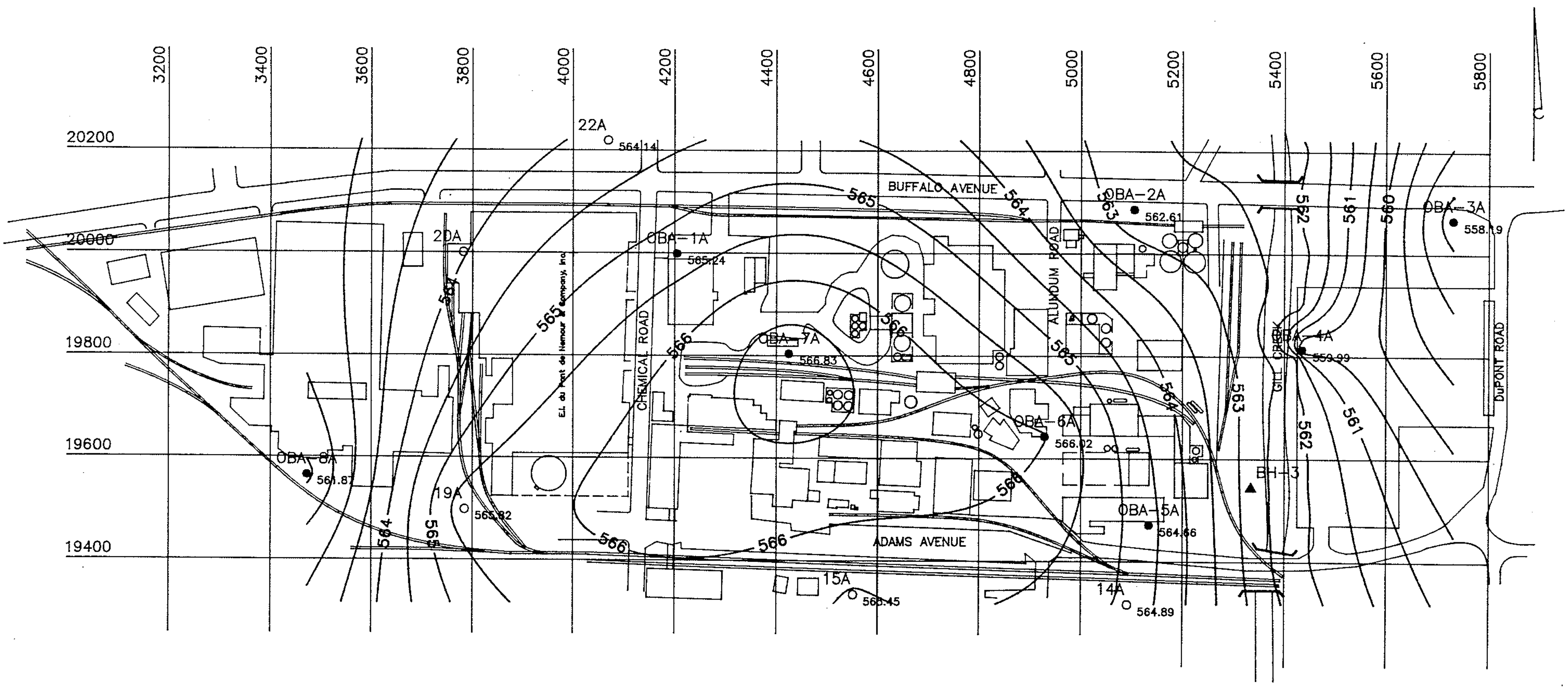
PRODUCTION WELL PUMPING RATE: 570 gpm

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
CD-ZONE
PRE-PUMP TEST MONITORING

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5-4
Scale: 0 200 Feet		



DATE/TIME OF MEASUREMENT: 2/11/91, 1030 hours

ELAPSED TIME FROM START OF PUMP TEST: 93.5 hours

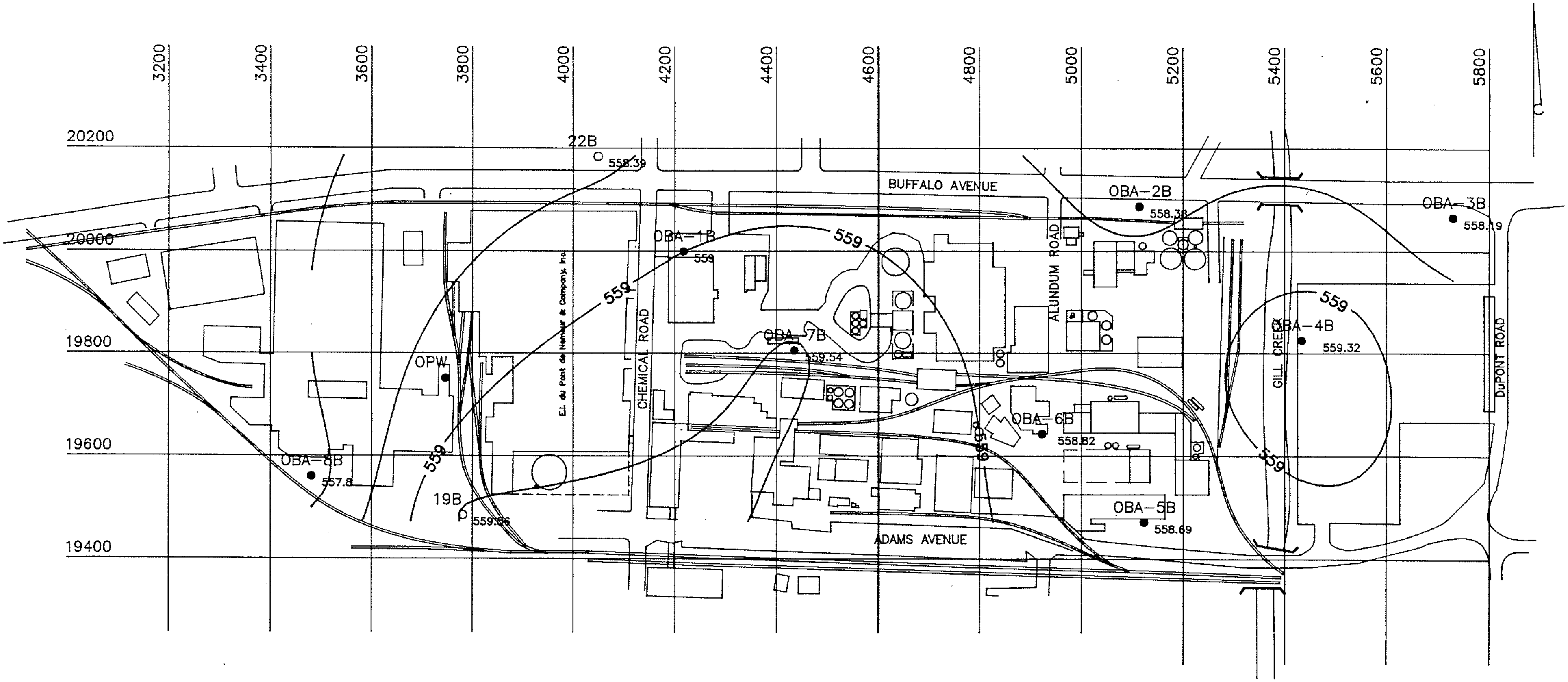
STATIC WATER LEVEL AT GILL CREEK: 562.20

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
A-ZONE
RECOVERY STEP (UNSTRESSED CONDITIONS)

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5-5
Scale: 0 — 200 Feet		



DATE/TIME OF MEASUREMENT: 2/11/91, 1030 hours

ELAPSED TIME FROM START OF PUMP TEST: 93.5 hours

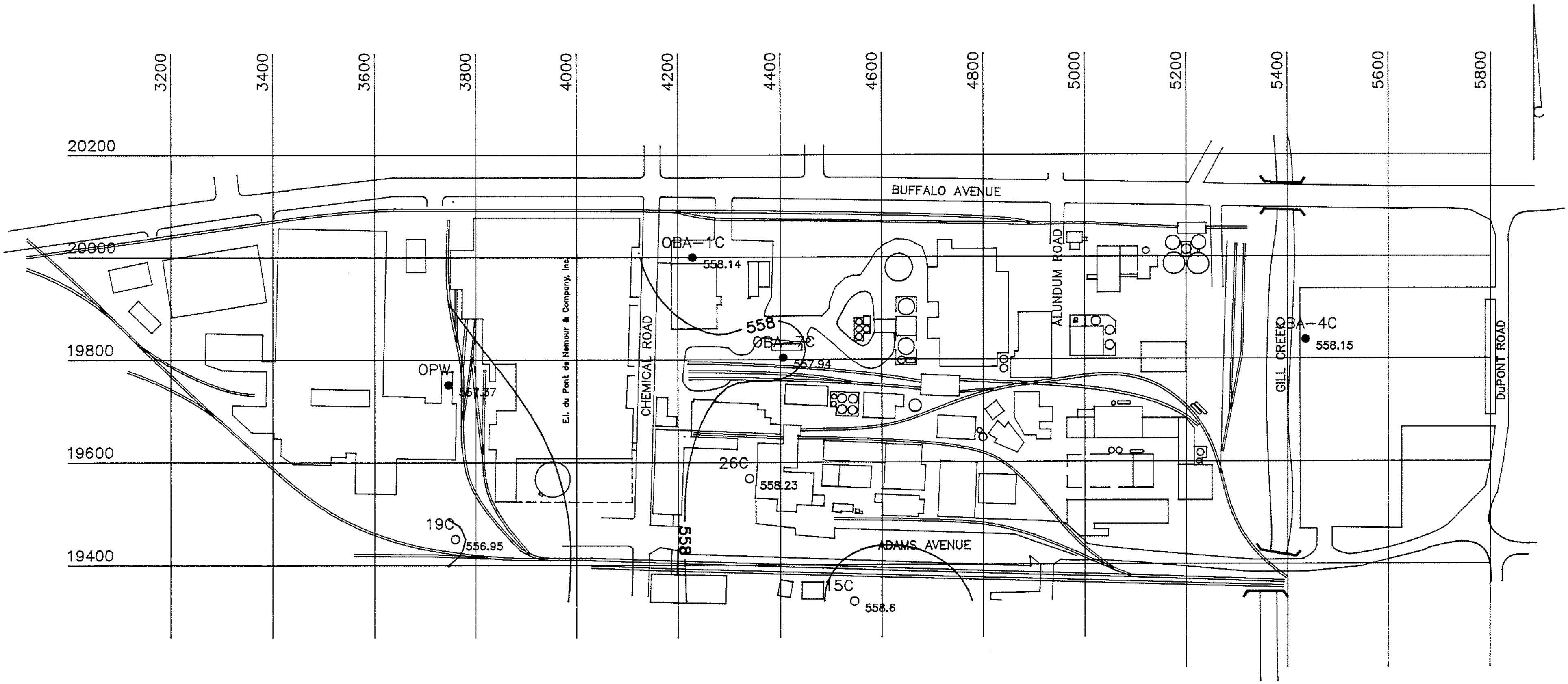
STATIC WATER LEVEL AT GILL CREEK: 562.20

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
B-ZONE
RECOVERY STEP (UNSTRESSED CONDITIONS)

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5-6
Scale: 0 200 Feet		



DATE/TIME OF MEASUREMENT: 2/11/91, 1030 hours

ELAPSED TIME FROM START OF PUMP TEST: 93.5 hours

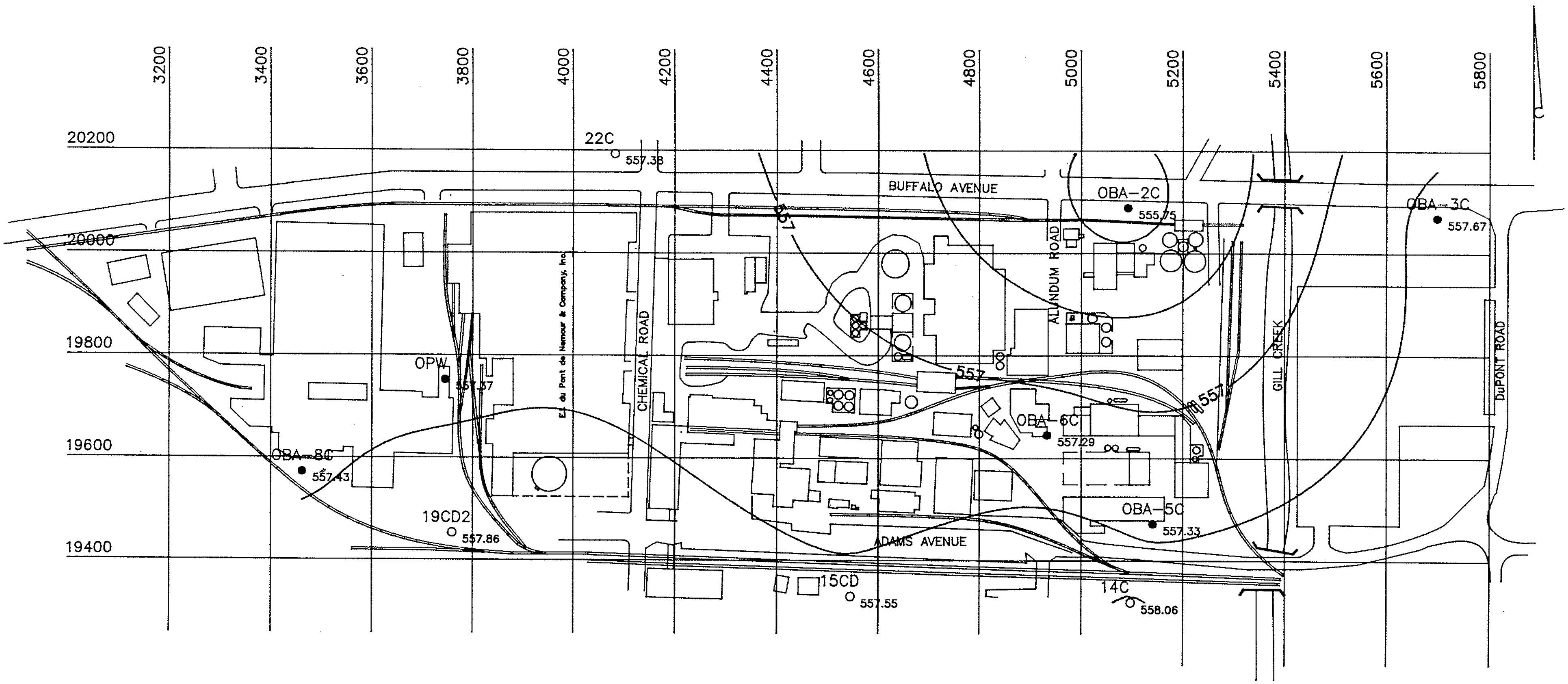
STATIC WATER LEVEL AT GILL CREEK: 562.20

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
C-ZONE
RECOVERY STEP (UNSTRESSED CONDITIONS)

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5-7
Scale: 0 200 Feet		

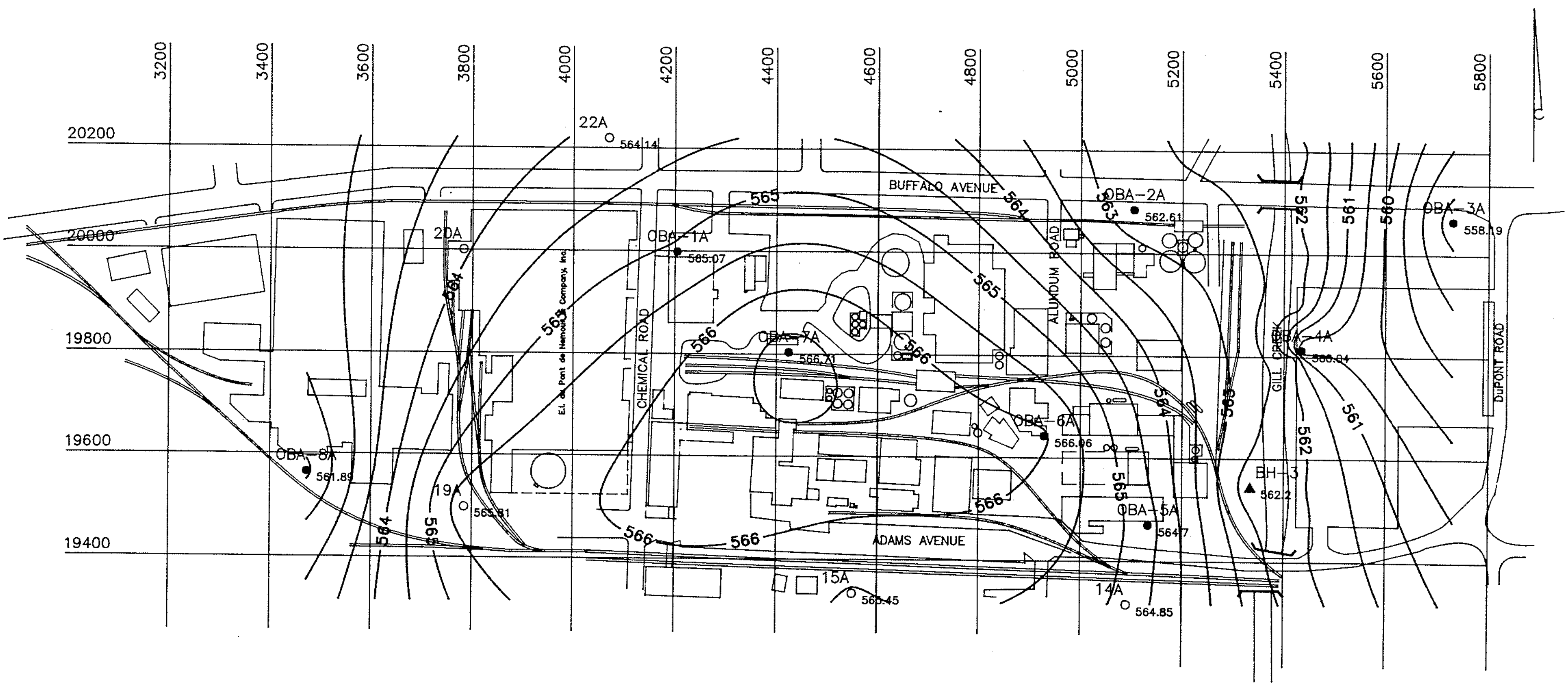


DATE/TIME OF MEASUREMENT: 2/11/91, 1030 hours

ELAPSED TIME FROM START OF PUMP TEST: 93.5 hours

STATIC WATER LEVEL AT GILL CREEK: 562.20

OLIN CHEMICALS NIAGARA PLANT RCRA FACILITY INVESTIGATION		
WOODWARD-CLYDE CONSULTANTS Consulting Engineers, Geologists and Environmental Scientists		
POTENTIOMETRIC SURFACE CONTOUR MAP CD-ZONE RECOVERY STEP (UNSTRESSED CONDITIONS)		
Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5-8
Scale: 0 200 Feet		



DATE/TIME OF MEASUREMENT: 2/14/91, 1130 hours

ELAPSED TIME FROM START OF PUMP TEST: 166.5 hours

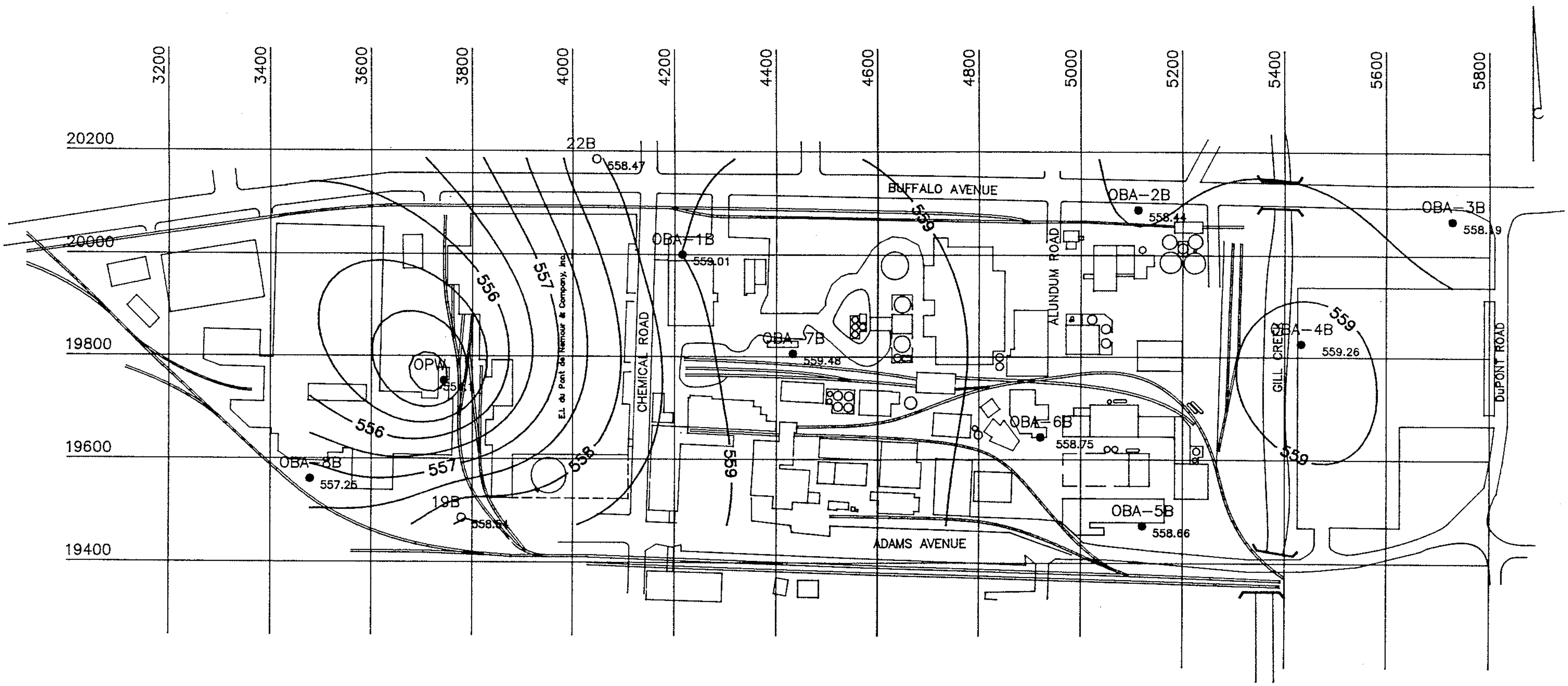
STATIC WATER LEVEL AT GILL CREEK: 562.18

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
A-ZONE
500 GPM PUMPING STEP: STEP2

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5-9
Scale: 0 200 Feet		

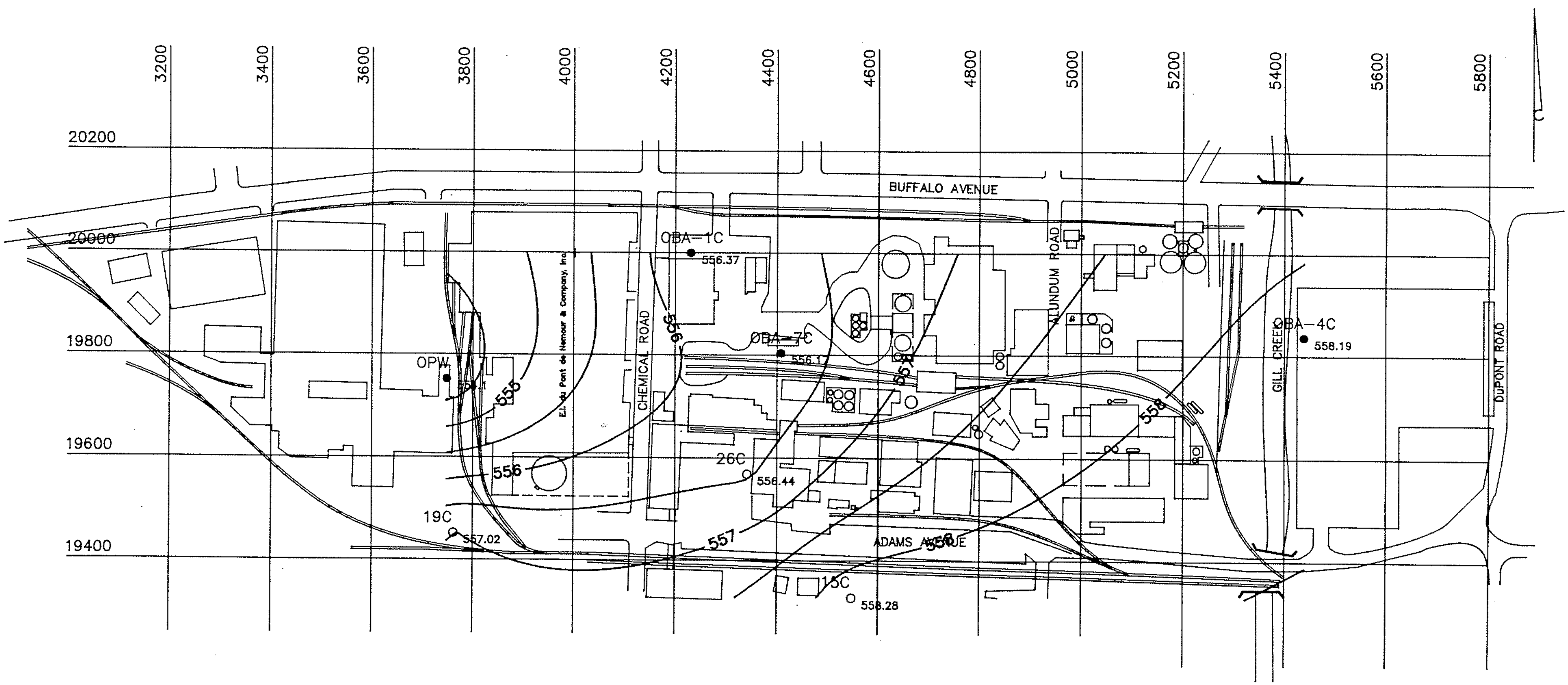


DATE/TIME OF MEASUREMENT: 2/14/91, 1130 hours

ELAPSED TIME FROM START OF PUMP TEST: 166.5 hours

STATIC WATER LEVEL AT GILL CREEK: 562.18

OLIN CHEMICALS NIAGARA PLANT RCRA FACILITY INVESTIGATION		
WOODWARD–CLYDE CONSULTANTS Consulting Engineers, Geologists and Environmental Scientists		
POTENTIOMETRIC SURFACE CONTOUR MAP B–ZONE 500 GPM PUMPING STEP: STEP2		
Job No.: 88C2346–12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5–10
Scale: 0 200 Feet		



DATE/TIME OF MEASUREMENT: 2/14/91, 1130 hours

ELAPSED TIME FROM START OF PUMP TEST: 166.5 hours

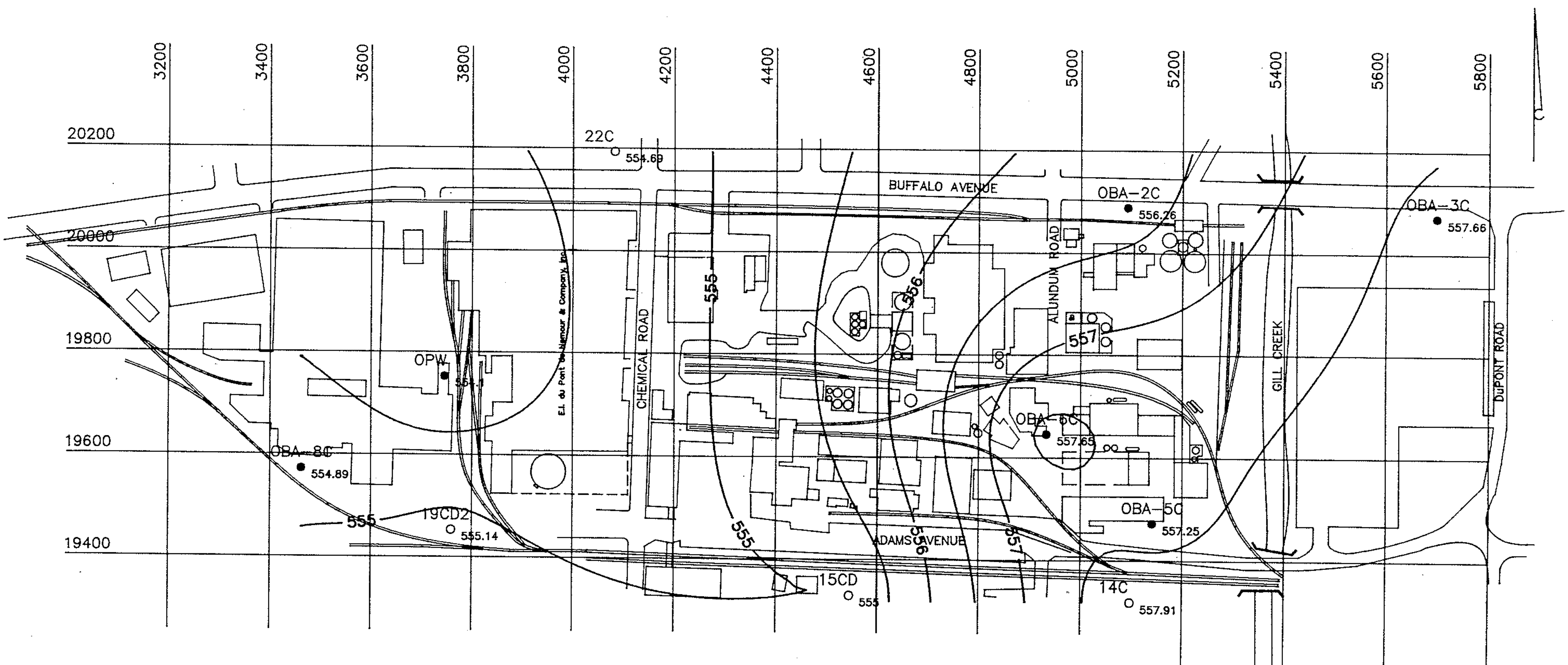
STATIC WATER LEVEL AT GILL CREEK: 562.18

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
C-ZONE
500 GPM PUMPING STEP: STEP2

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5-11
Scale: 0 — 200 Feet		



DATE/TIME OF MEASUREMENT: 2/14/91, 1130 hours

ELAPSED TIME FROM START OF PUMP TEST: 166.5 hours

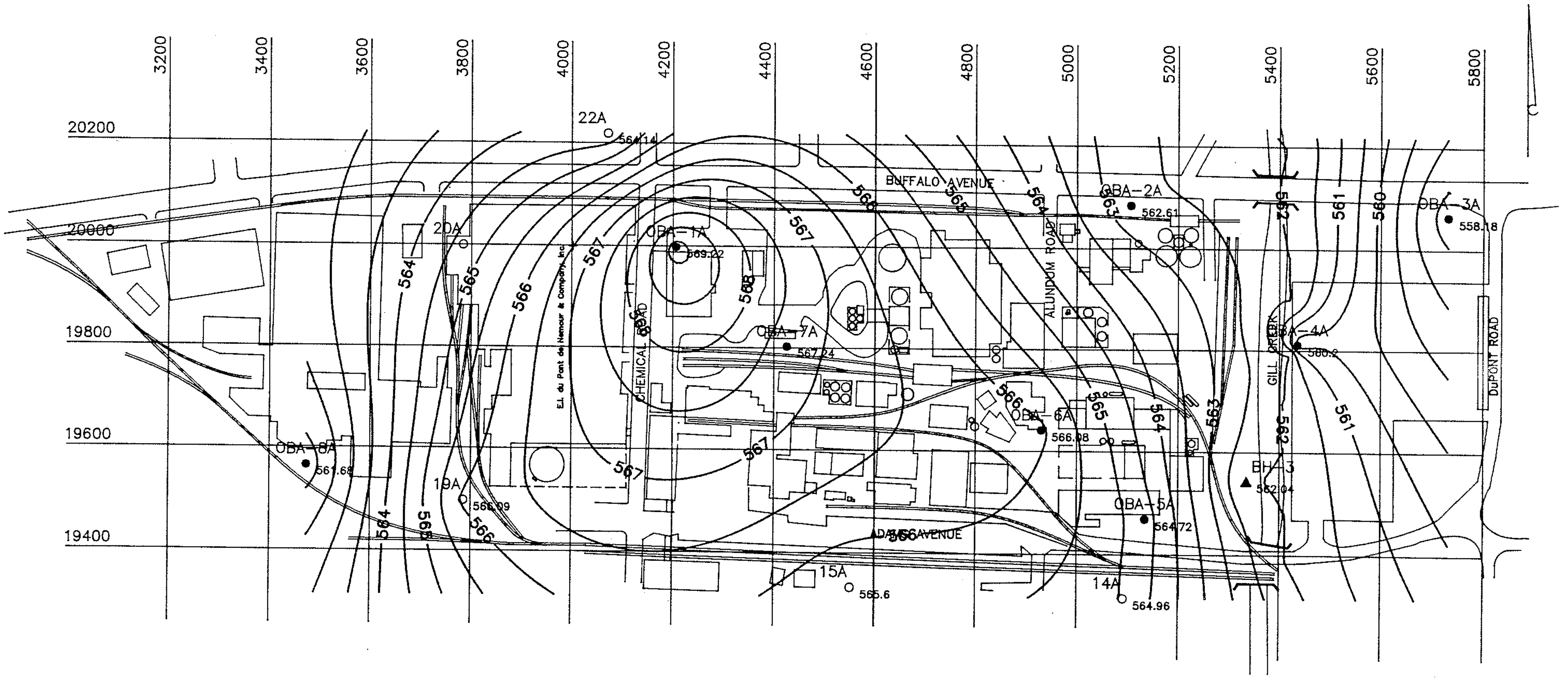
STATIC WATER LEVEL AT GILL CREEK: 562.18

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
CD-ZONE
500 GPM PUMPING STEP: STEP2

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5-12
Scale: 0 200 Feet		



DATE/TIME OF MEASUREMENT: 2/19/91, 1000 hours

ELAPSED TIME FROM START OF PUMP TEST: 285 hours

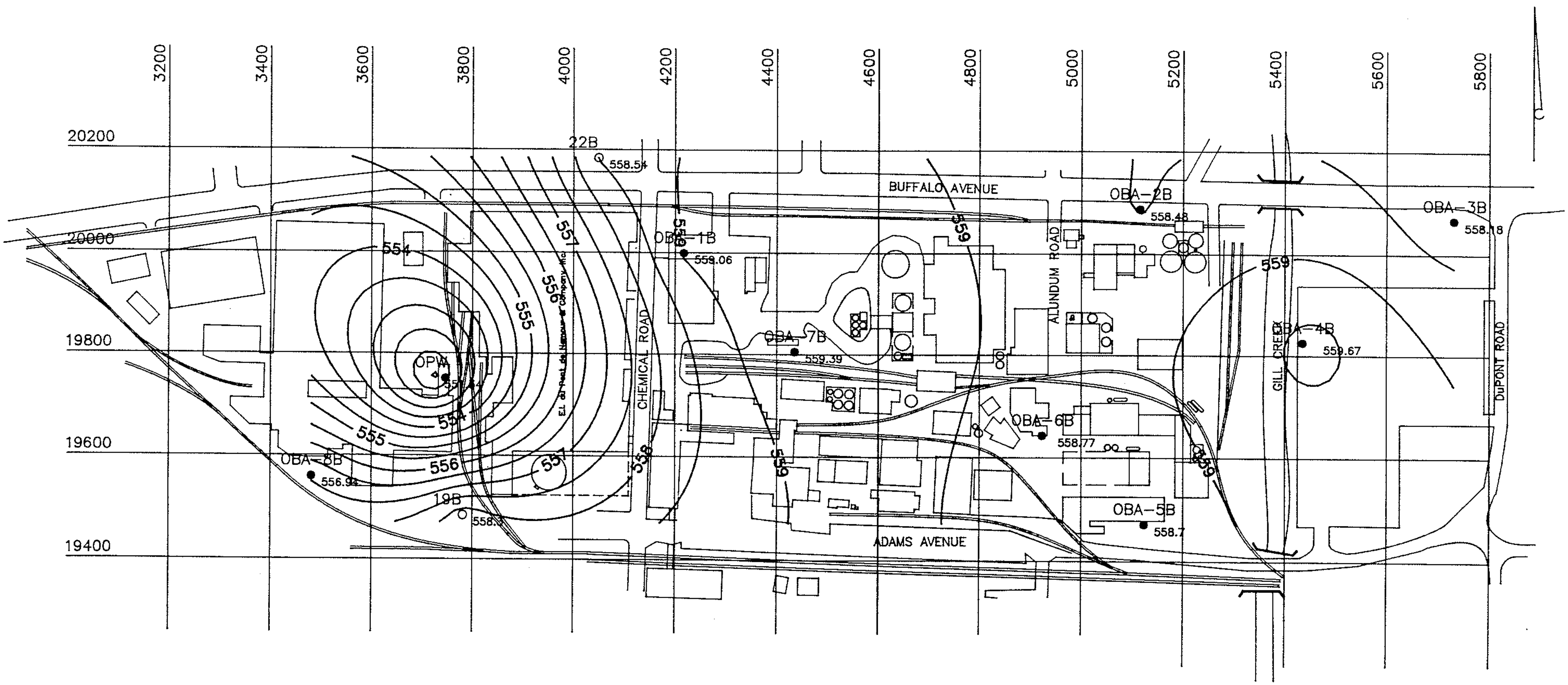
STATIC WATER LEVEL AT GILL CREEK: 561.99

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
A-ZONE
1000 GPM PUMPING STEP: STEP 3

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5-13
Scale: 0 200 Feet		



DATE/TIME OF MEASUREMENT: 2/19/91, 1000 hours

ELAPSED TIME FROM START OF PUMP TEST: 285 hours

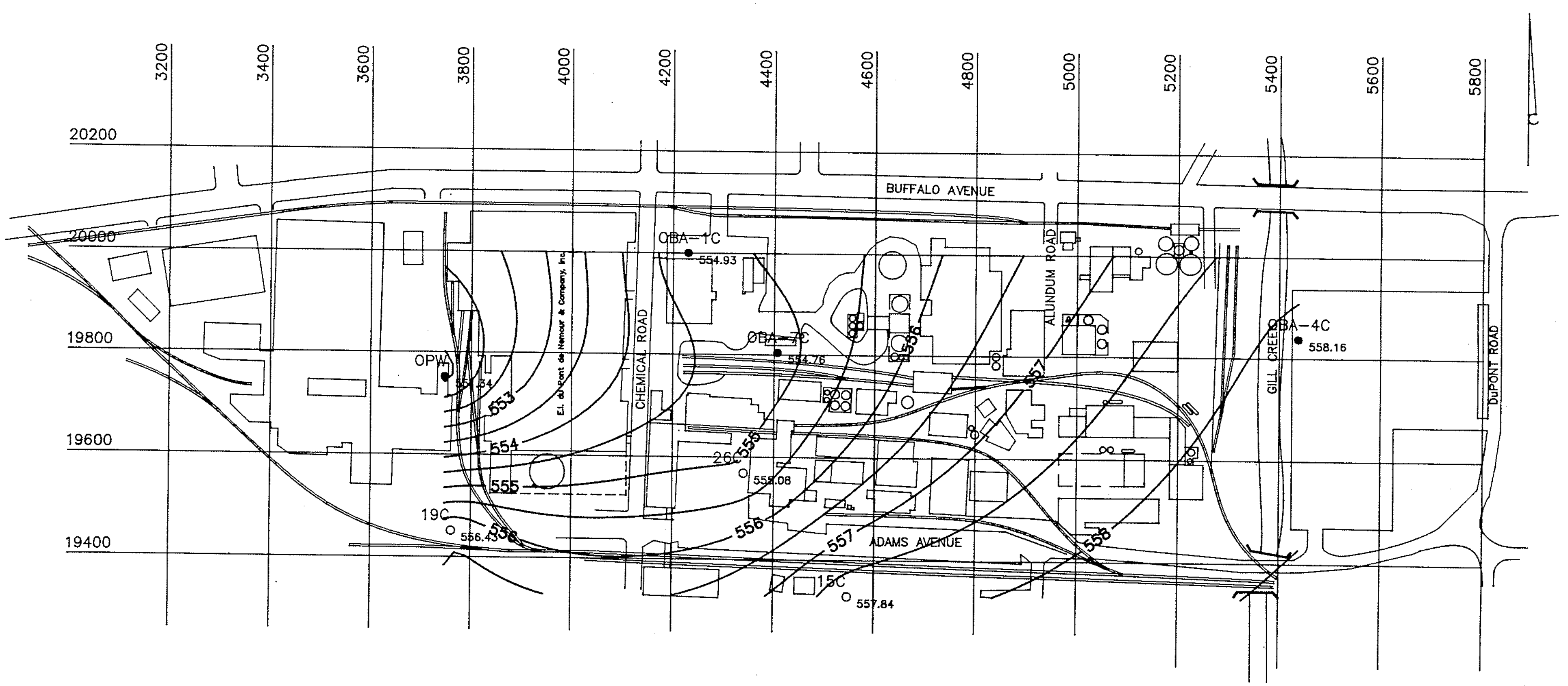
STATIC WATER LEVEL AT GILL CREEK: 561.99

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
B-ZONE
1000 GPM PUMPING STEP: STEP 3

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5-14
Scale: 0 200 Feet		



DATE/TIME OF MEASUREMENT: 2/19/91, 1000 hours

ELAPSED TIME FROM START OF PUMP TEST: 285 hours

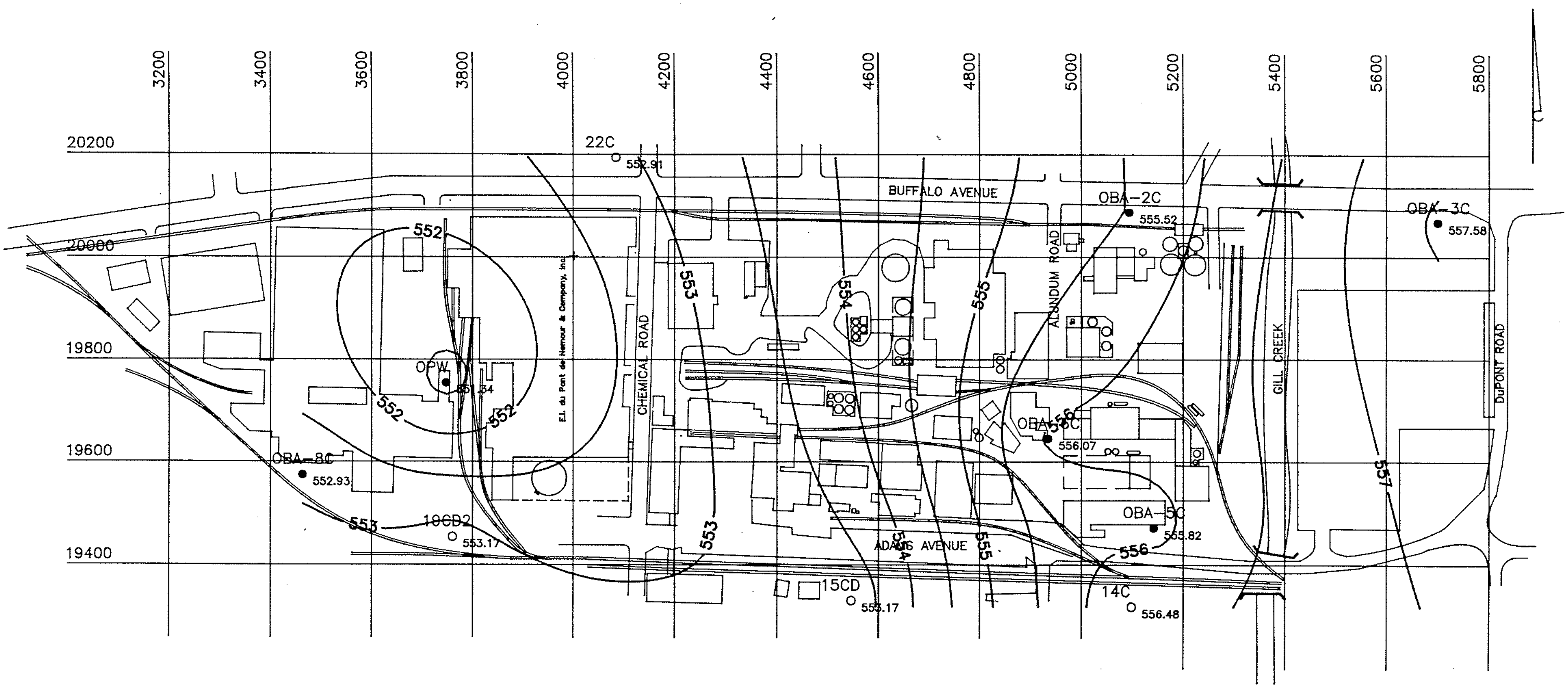
STATIC WATER LEVEL AT GILL CREEK: 561.99

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
C-ZONE
1000 GPM PUMPING STEP: STEP 3

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5-15
Scale: 0 200 Feet		

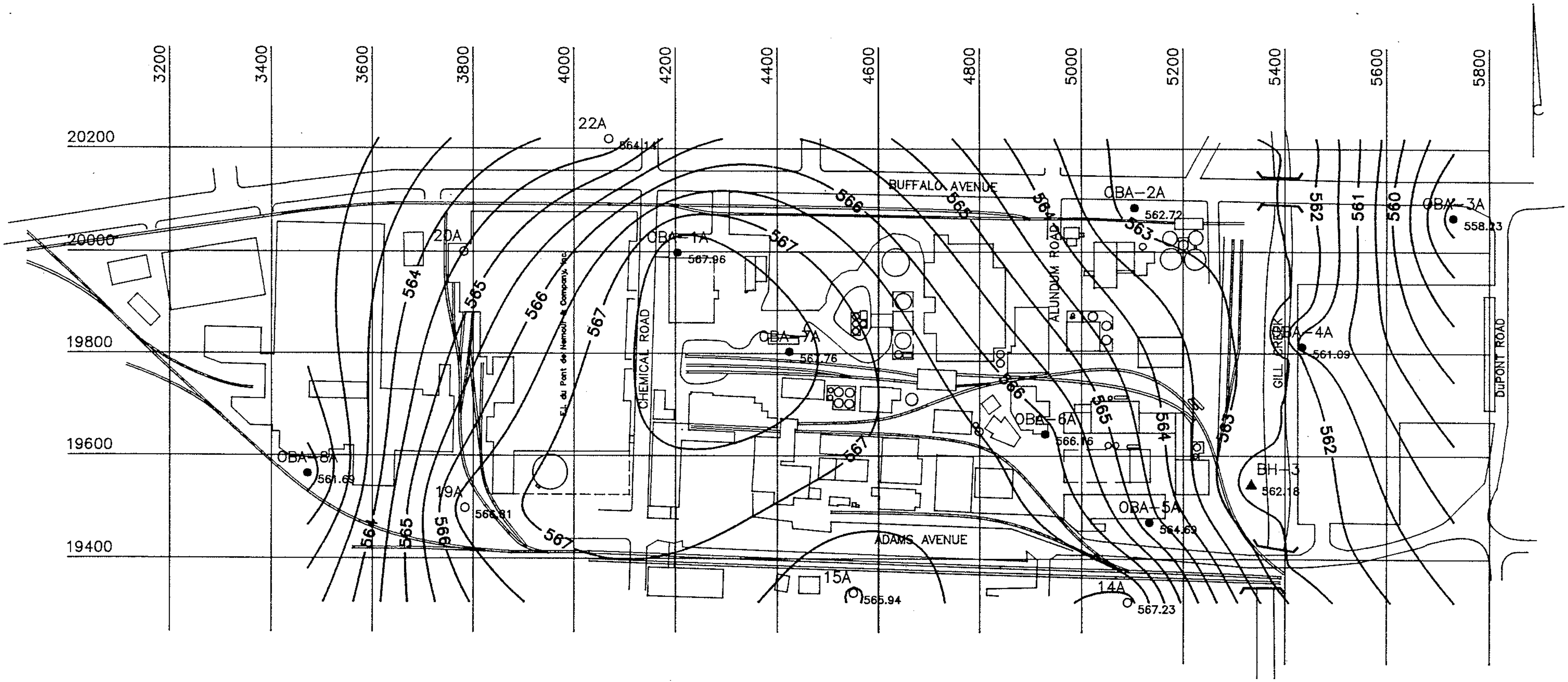


DATE/TIME OF MEASUREMENT: 2/19/91, 1000 hours

ELAPSED TIME FROM START OF PUMP TEST: 285 hours

STATIC WATER LEVEL AT GILL CREEK: 561.99

OLIN CHEMICALS NIAGARA PLANT RCRA FACILITY INVESTIGATION		
WOODWARD-CLYDE CONSULTANTS Consulting Engineers, Geologists and Environmental Scientists		
POTENTIOMETRIC SURFACE CONTOUR MAP CD-ZONE 1000 GPM PUMPING STEP: STEP 3		
Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5-16
Scale: 0 200 Feet		



DATE/TIME OF MEASUREMENT: 2/21/91, 1030 hours

ELAPSED TIME FROM START OF PUMP TEST: 333.5 hours

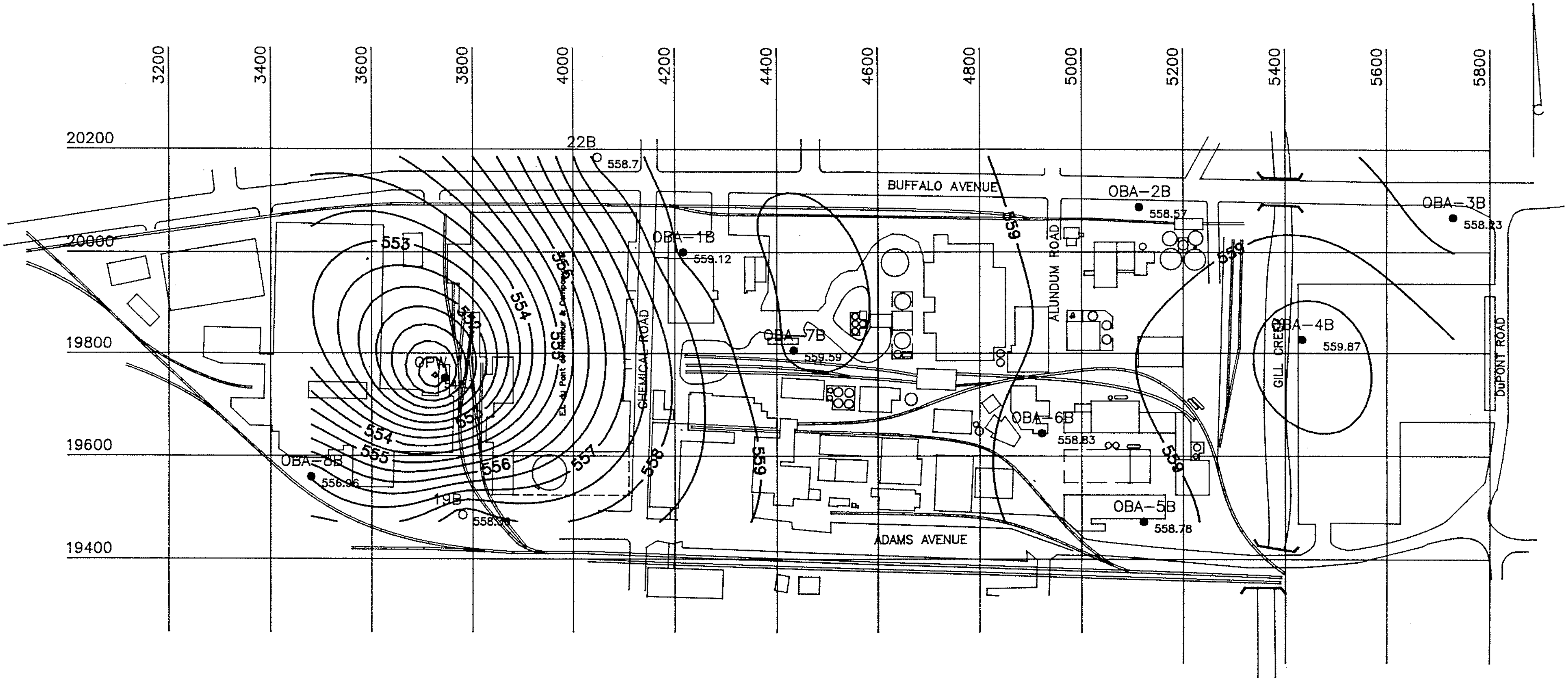
STATIC WATER LEVEL AT GILL CREEK: 562.45

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
A-ZONE
1500 GPM PUMPING STEP: STEP 4

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5-17
Scale: 0 — 200 Feet		



DATE/TIME OF MEASUREMENT: 2/21/91, 1030 hours

ELAPSED TIME FROM START OF PUMP TEST: 333.5 hours

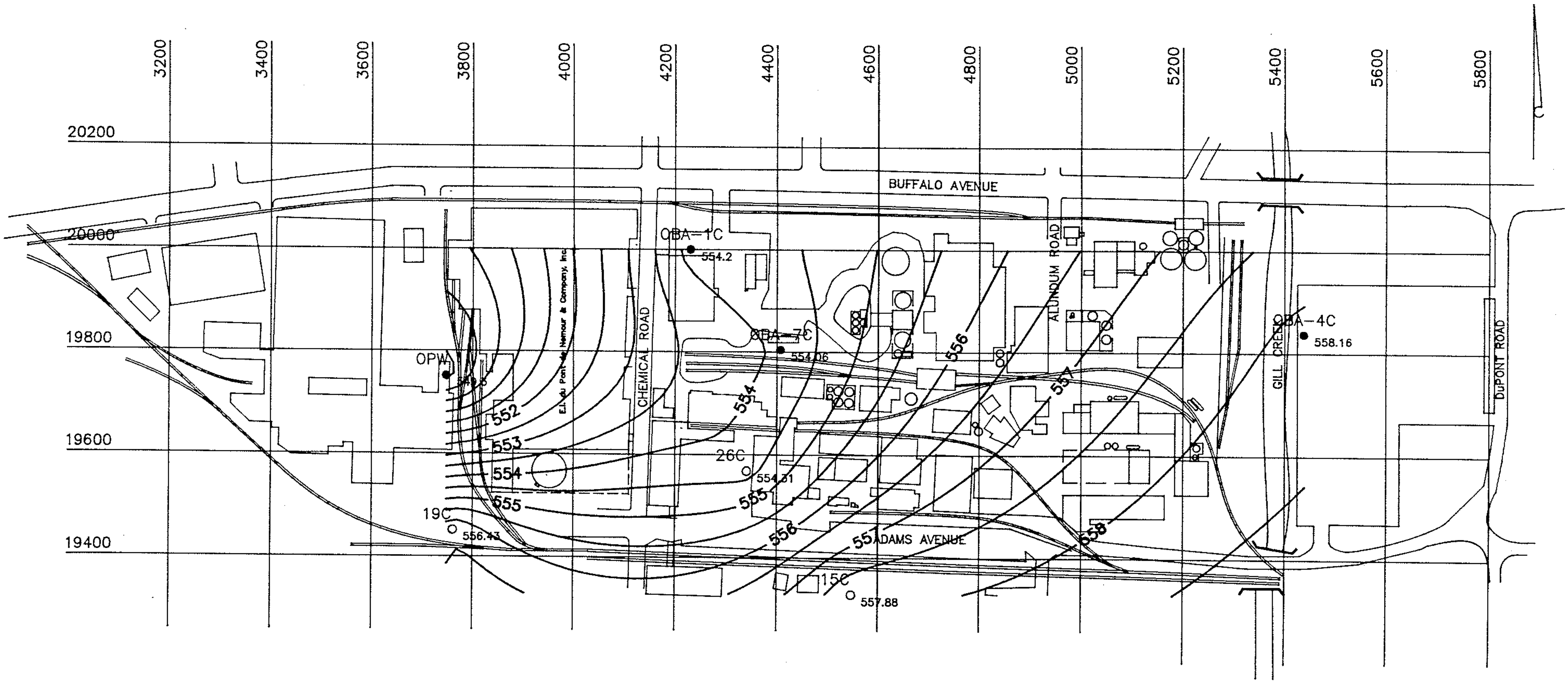
STATIC WATER LEVEL AT GILL CREEK: 562.45

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
B-ZONE
1500 GPM PUMPING STEP: STEP 4

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5-18
Scale: 0 200 Feet		



DATE/TIME OF MEASUREMENT: 2/21/91, 1030 hours

ELAPSED TIME FROM START OF PUMP TEST: 333.5 hours

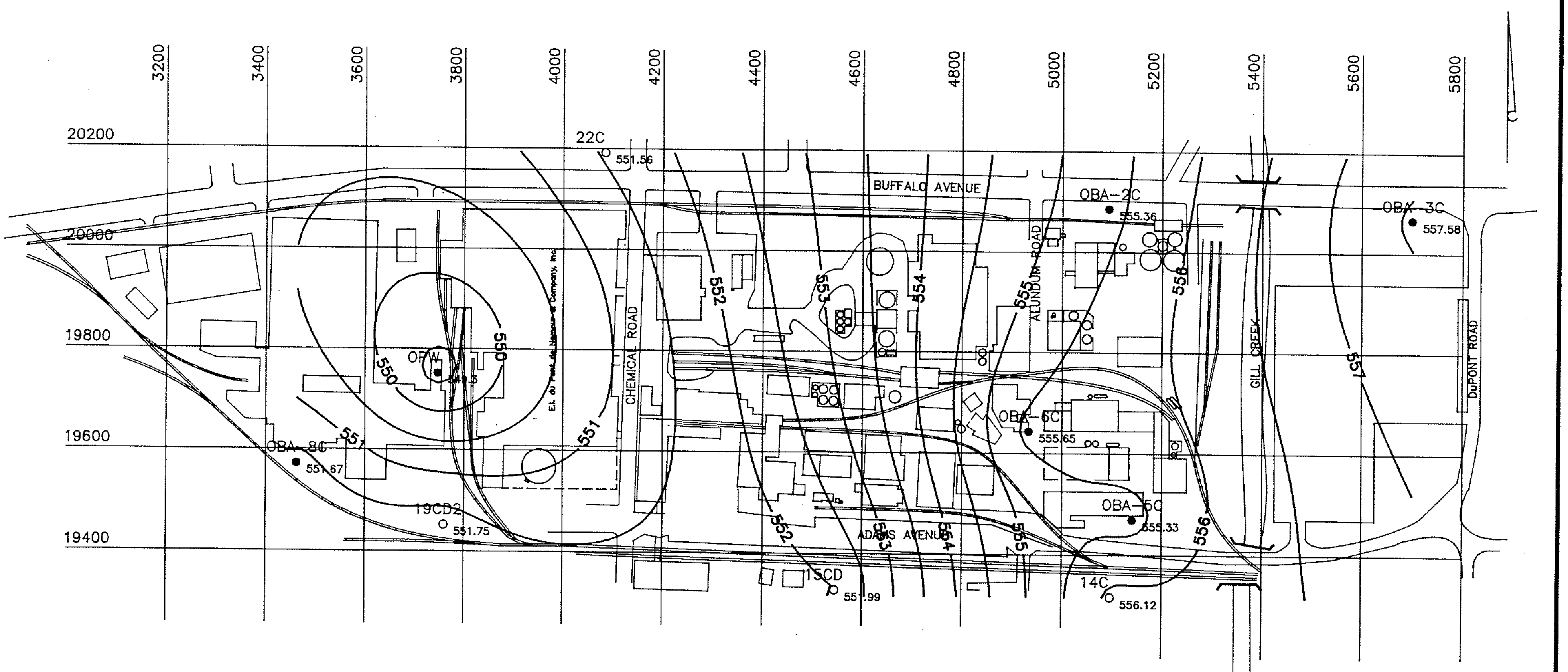
STATIC WATER LEVEL AT GILL CREEK: 562.45

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
C-ZONE
1500 GPM PUMPING STEP: STEP 4

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	
Scale: 0 200 Feet		Figure 5-19



DATE/TIME OF MEASUREMENT: 2/21/91, 1030 hours

ELAPSED TIME FROM START OF PUMP TEST: 333.5 hours

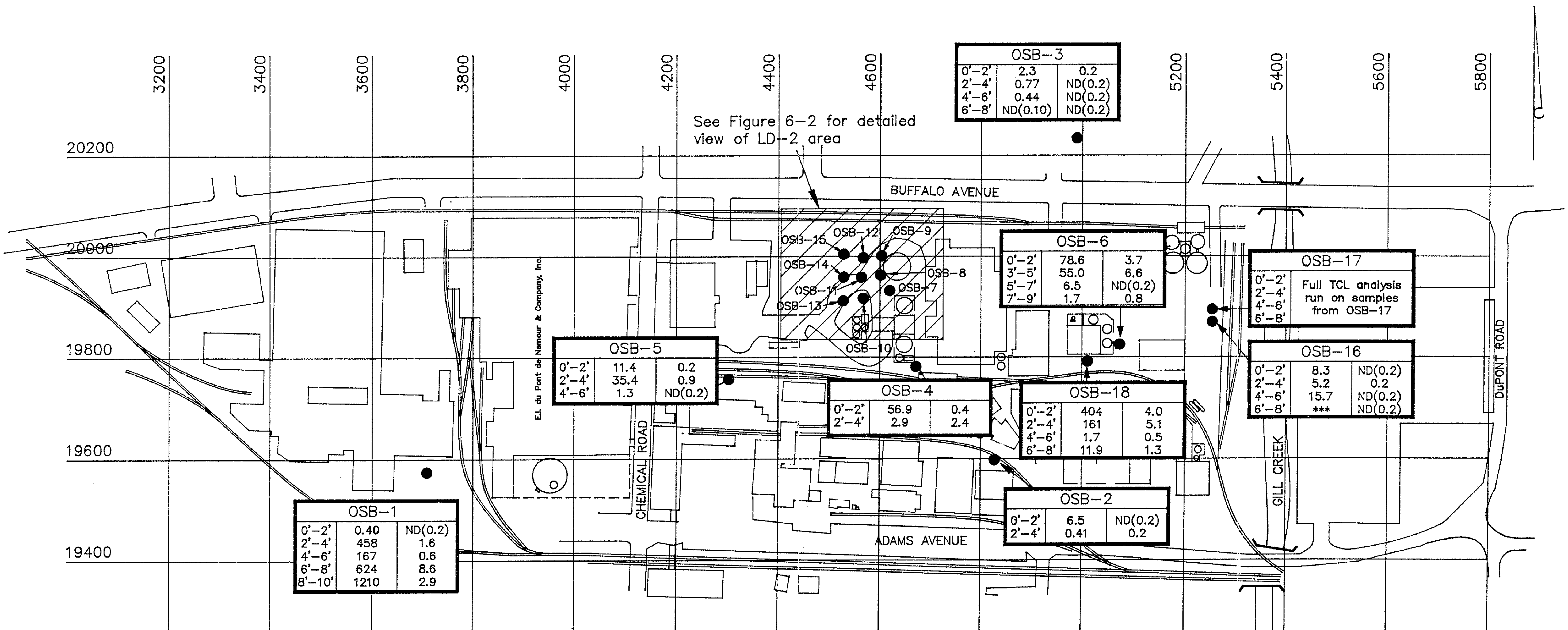
STATIC WATER LEVEL AT GILL CREEK: 562.45

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

POTENTIOMETRIC SURFACE CONTOUR MAP
CD-ZONE
1500 GPM PUMPING STEP: STEP 4

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 5-20
Scale: 0 200 Feet		



LEGEND:

Soil Boring ID		
Sample Depth	Total Hg Concentration (mg/kg)	TCLP Hg Concentration (ug/L)

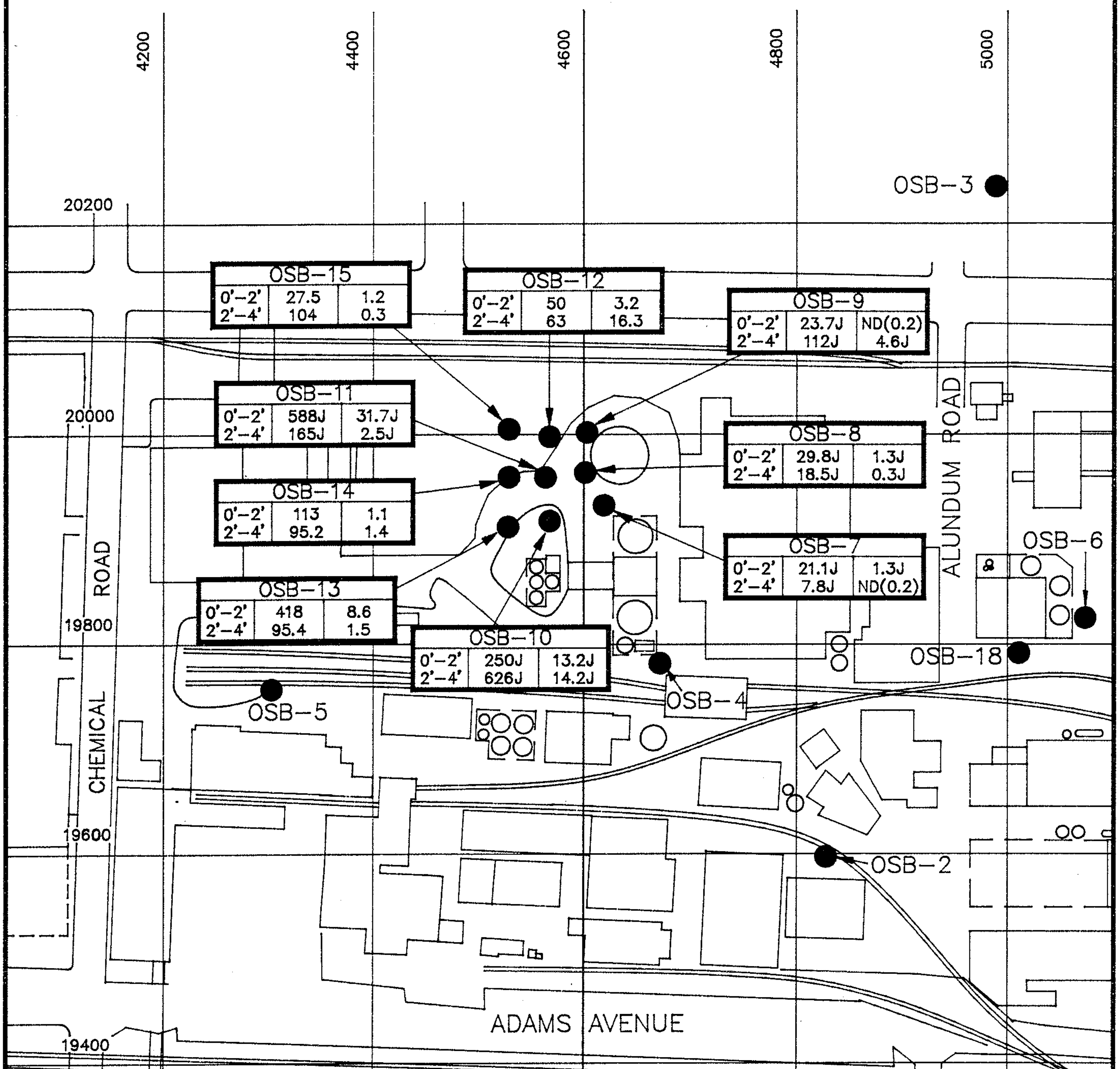
*** – soil sample OSB-16 6'-8' not analyzed for total mercury due to a laboratory error

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

TOTAL AND TCLP MERCURY CONCENTRATIONS IN SOIL

Job No.: 88C2346-12	Drawing No.	Date:
Checked by:	Rev. No.:	Figure 6-1
Scale: 0 — 200 Feet		



LEGEND:

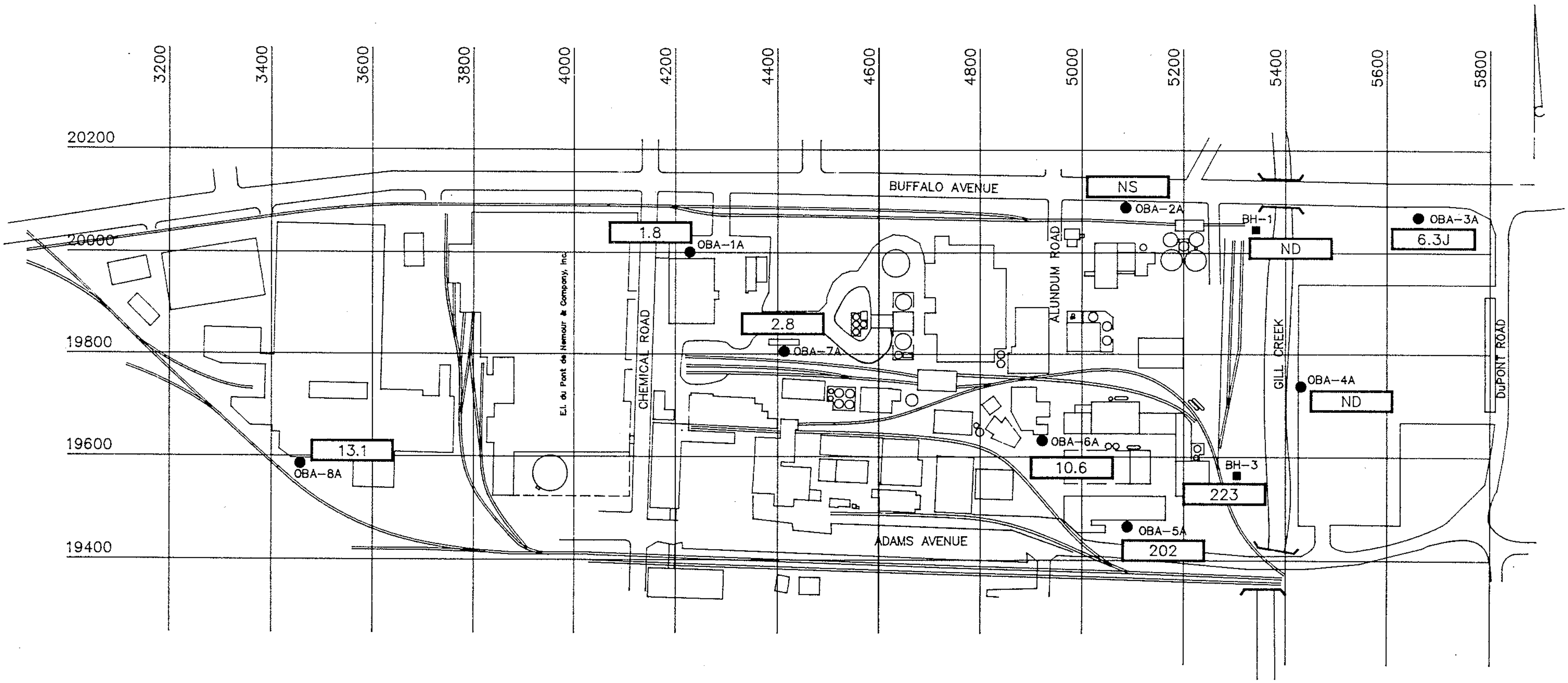
Soil Boring ID		
Sample Depth	Total Hg Conc. (mg/kg)	TCLP Hg Conc. (ug/L)

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

TOTAL AND TCLP MERCURY
CONCENTRATIONS IN SOIL
EXPANDED VIEW OF LD-2 AREA

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 6-2
Scale: NOT TO SCALE		



LEGEND:

13.1 ← MERCURY CONCENTRATION (ug/L)

OBA-8A

WELL ID

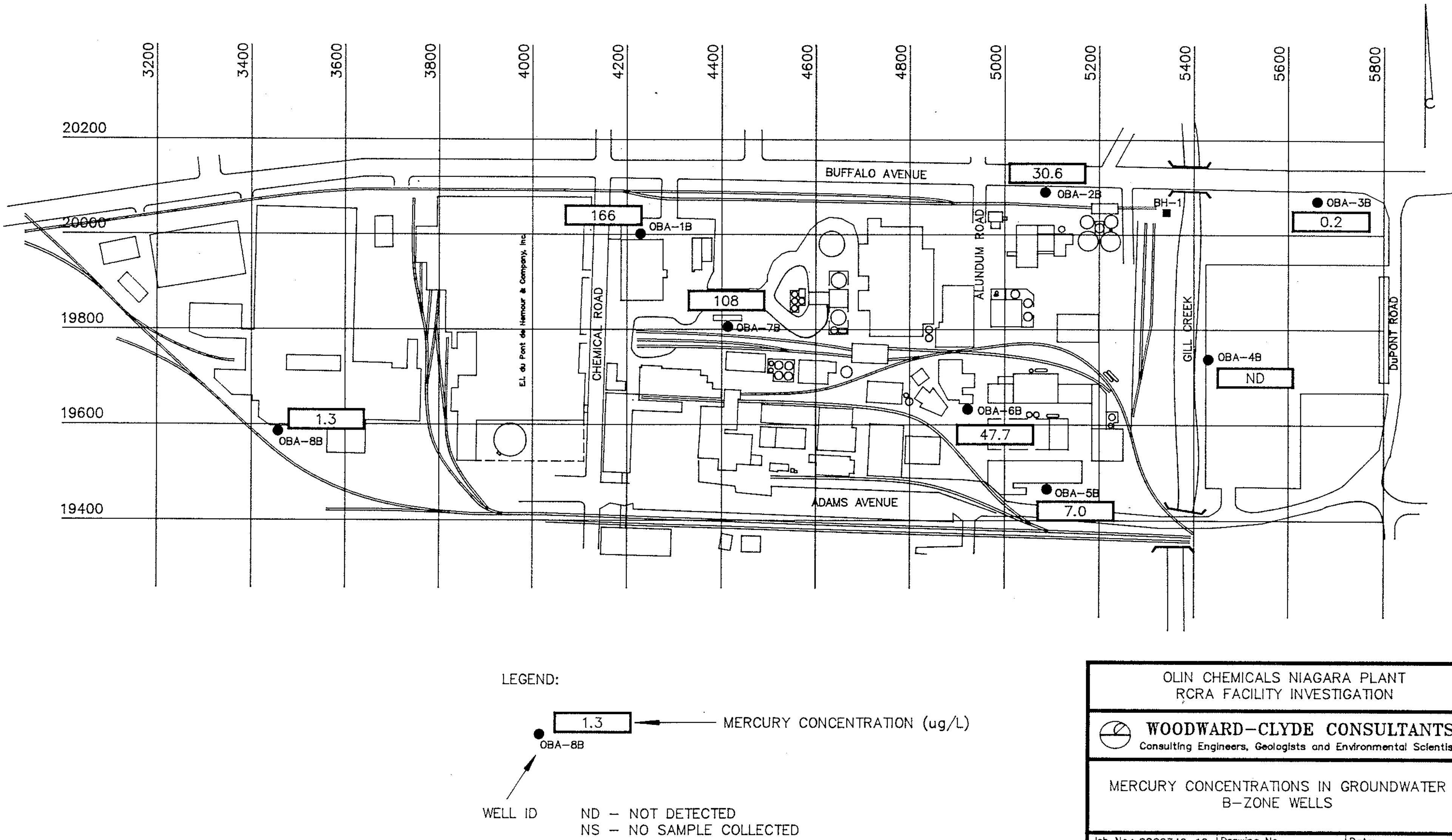
ND – NOT DETECTED
NS – NO SAMPLE COLLECTED (DRY WELL)

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD–CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

MERCURY CONCENTRATIONS IN GROUNDWATER
A–ZONE WELLS

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 7–1
Scale: 0 200 Feet		

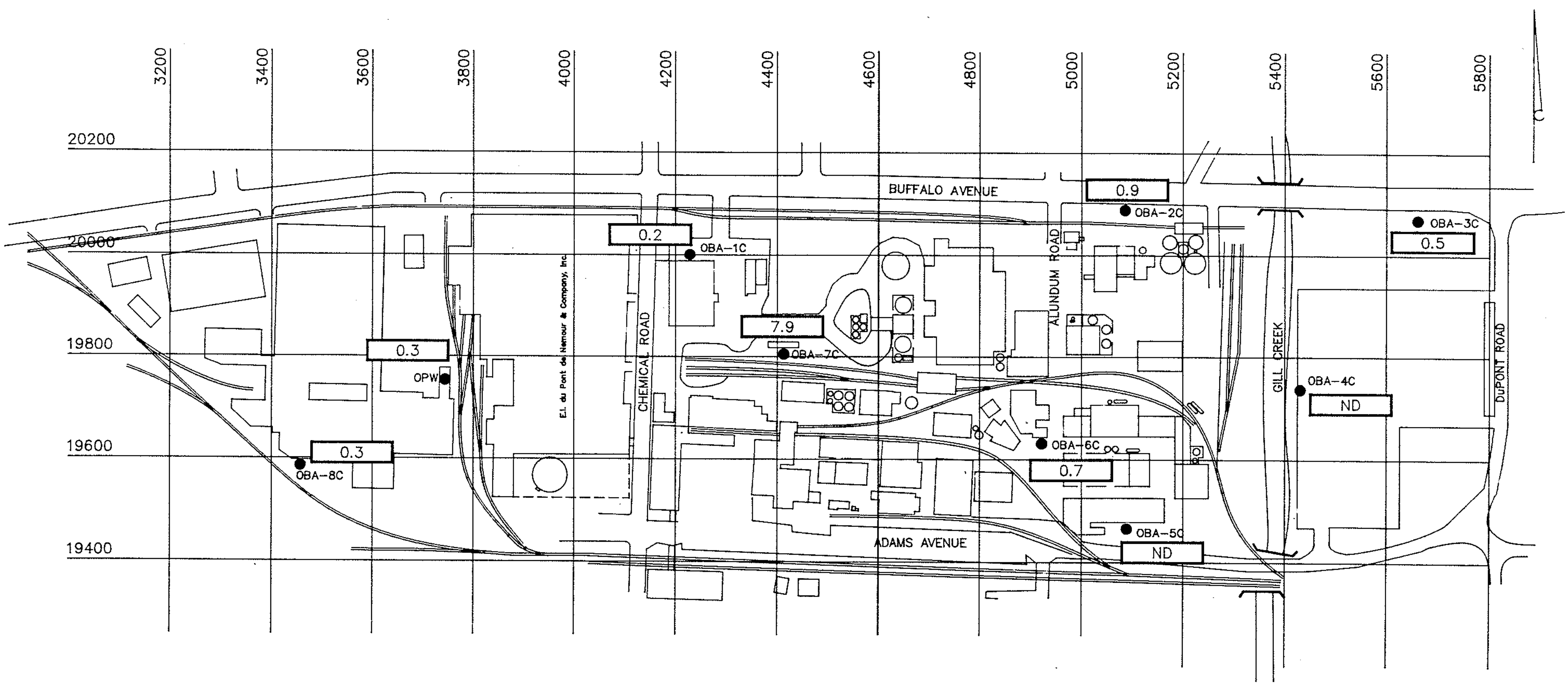


OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

MERCURY CONCENTRATIONS IN GROUNDWATER
B-ZONE WELLS

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 7-2
Scale: 0 200 Feet		



LEGEND:

0.3 — MERCURY CONCENTRATION (ug/L)

OBA-8C

WELL ID

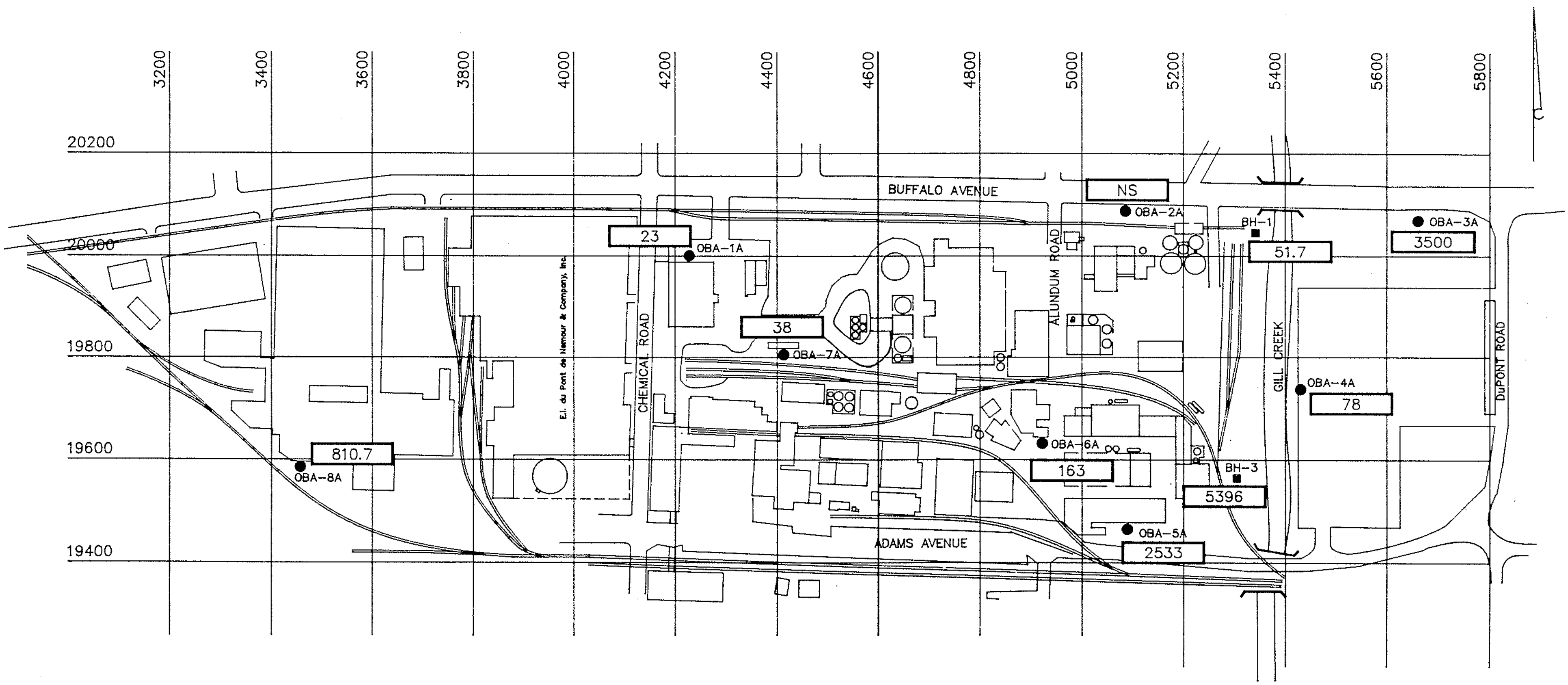
ND – NOT DETECTED
NS – NO SAMPLE COLLECTED
OPW – OLIN PUMPING WELL

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

MERCURY CONCENTRATIONS IN GROUNDWATER
C-ZONE WELLS

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	
Scale: 0 200 Feet		Figure 7-3



LEGEND:

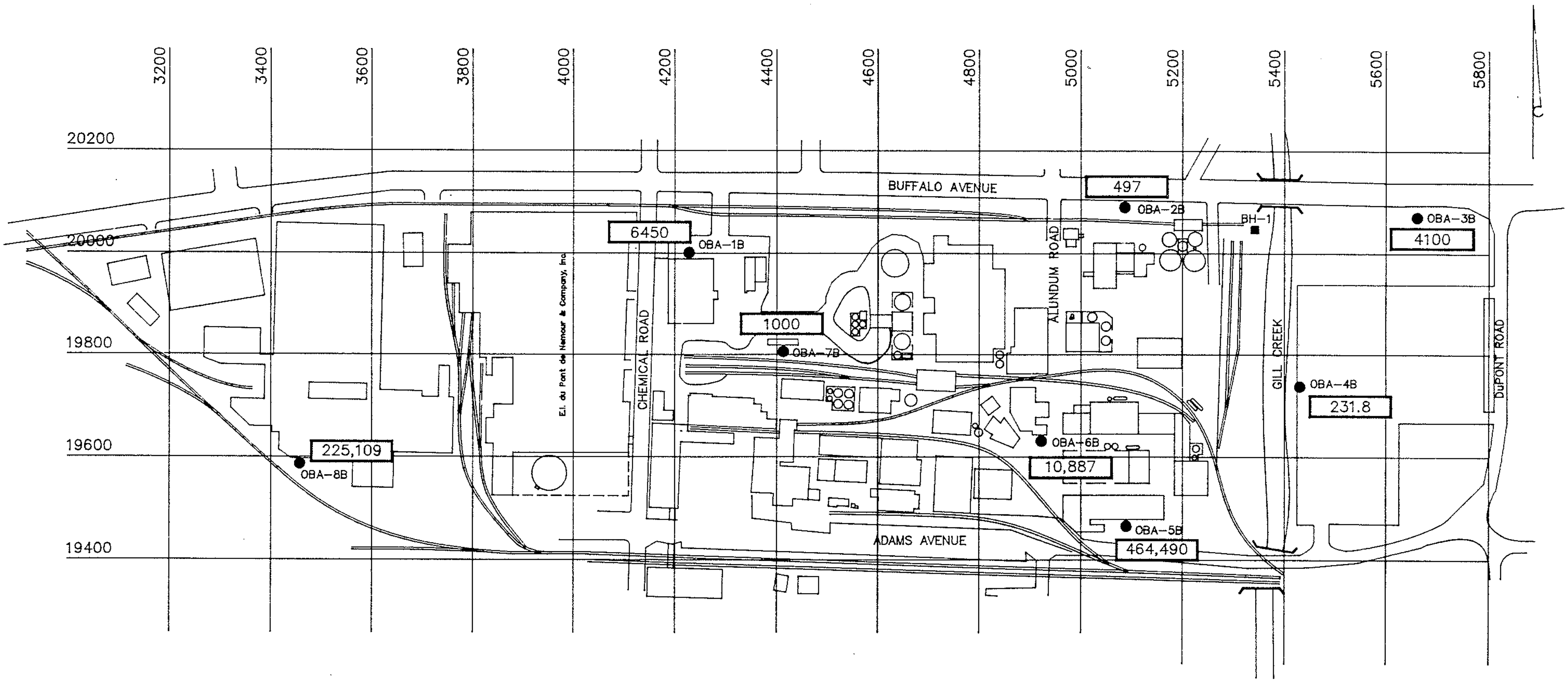
810.7 ← TOTAL CHLORINATED ALIPHATIC VOLATILE ORGANIC COMPOUND CONCENTRATION (ug/L)

OBA-8A

WELL ID

ND – NOT DETECTED
NS – NO SAMPLE COLLECTED (DRY WELL)

OLIN CHEMICALS NIAGARA PLANT RCRA FACILITY INVESTIGATION		
WOODWARD–CLYDE CONSULTANTS Consulting Engineers, Geologists and Environmental Scientists		
TOTAL CHLORINATED ALIPHATIC VOLATILE ORGANIC COMPOUND CONCENTRATIONS IN GROUNDWATER A–ZONE WELLS		
Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 7–4
Scale: 0 200 Feet		



LEGEND:

225,109 ← TOTAL CHLORINATED ALIPHATIC VOLATILE ORGANIC COMPOUND CONCENTRATION (ug/L)

OBA-8B

WELL ID

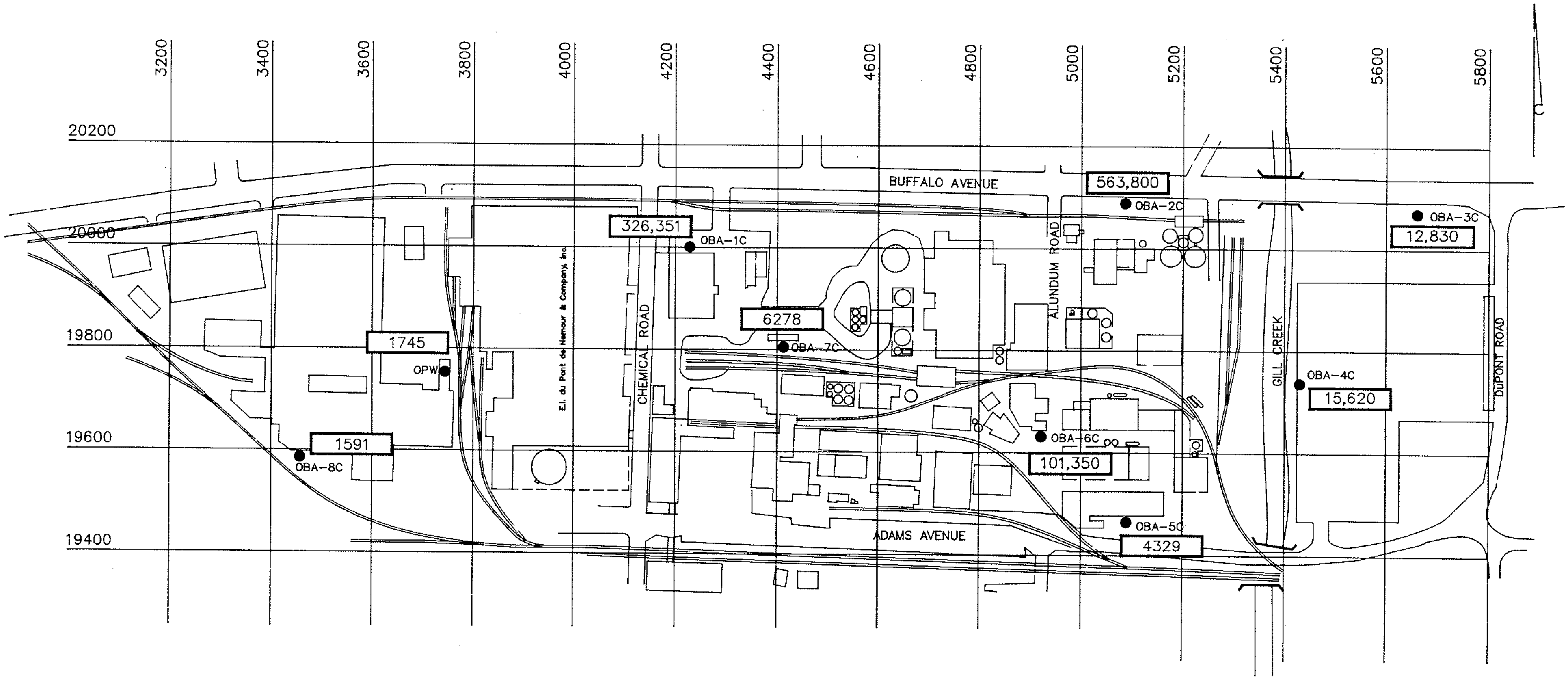
ND – NOT DETECTED
NS – NO SAMPLE COLLECTED

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

TOTAL CHLORINATED ALIPHATIC VOLATILE
ORGANIC COMPOUND CONCENTRATIONS
IN GROUNDWATER
B-ZONE WELLS

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	
Scale: 0 200 Feet		Figure 7-5



LEGEND:

1591 ← TOTAL CHLORINATED ALIPHATIC VOLATILE ORGANIC COMPOUND CONCENTRATION (ug/L)

OBA-8C

WELL ID

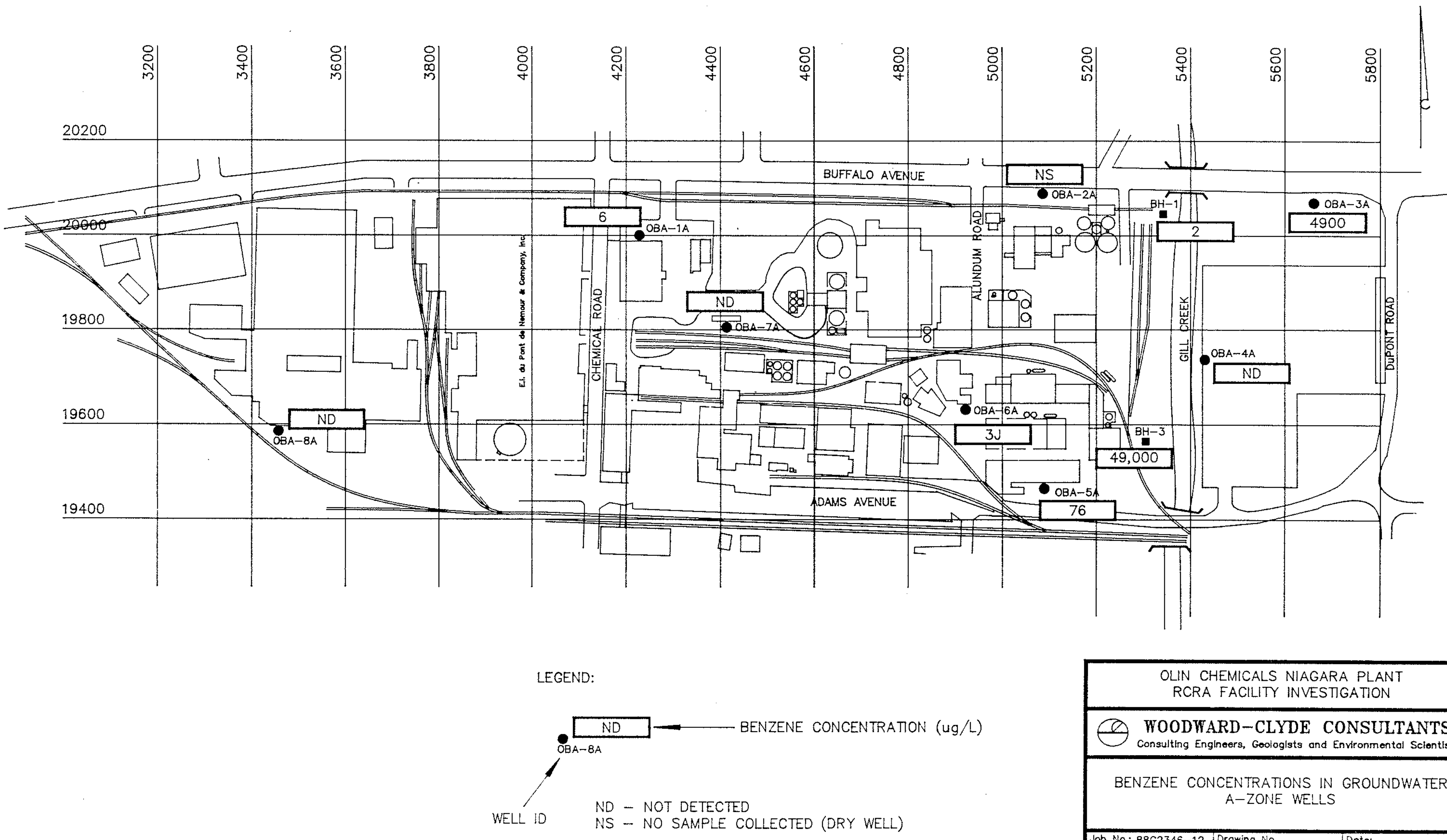
ND – NOT DETECTED
NS – NO SAMPLE COLLECTED
OPW – OLIN PUMPING WELL

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

TOTAL CHLORINATED ALIPHATIC VOLATILE ORGANIC COMPOUND CONCENTRATIONS IN GROUNDWATER C-ZONE WELLS

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	
Scale: 0 200 Feet		Figure 7-6

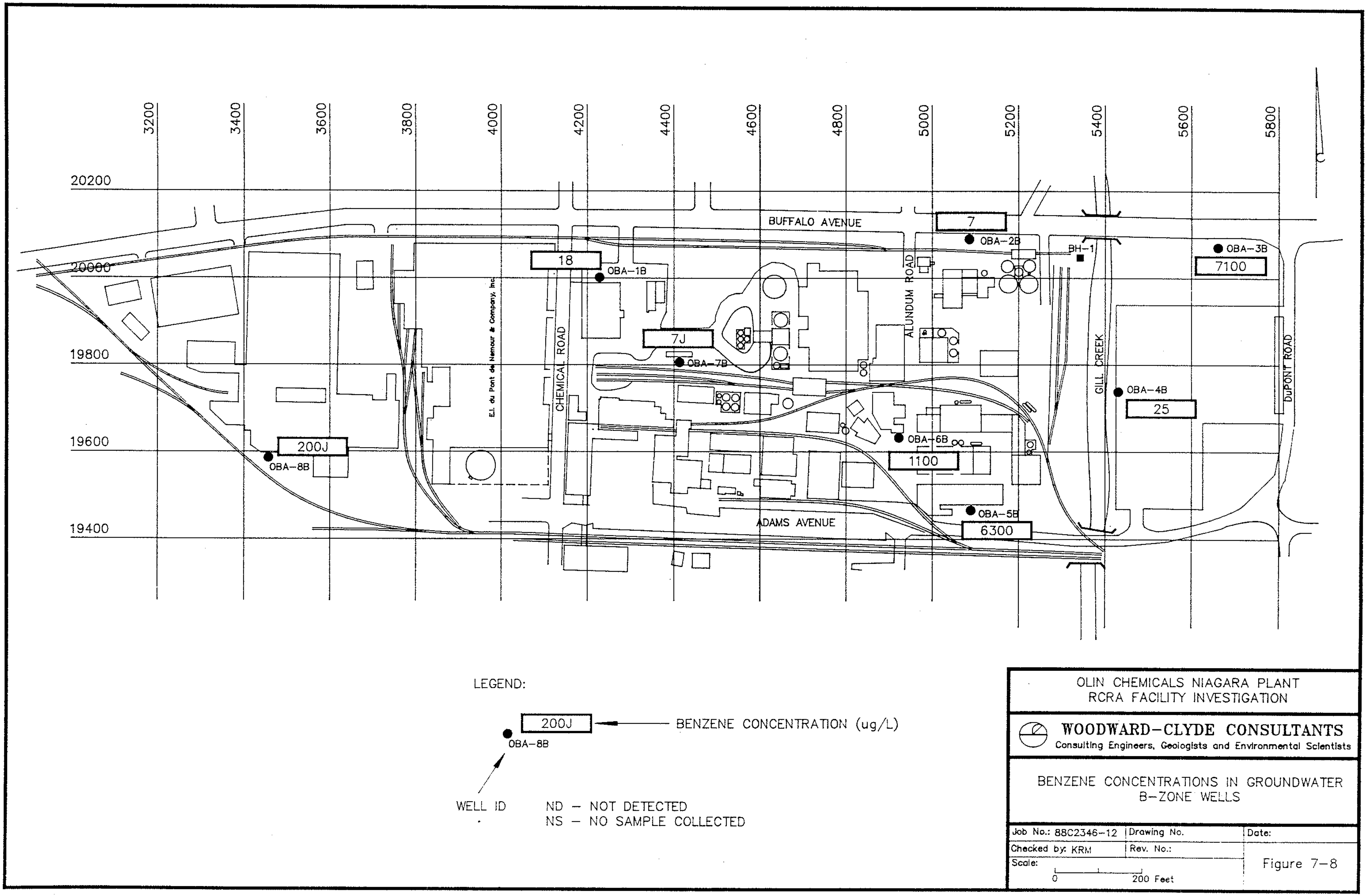


OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

BENZENE CONCENTRATIONS IN GROUNDWATER
A-ZONE WELLS

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 7-7
Scale: 0 200 Feet		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3800
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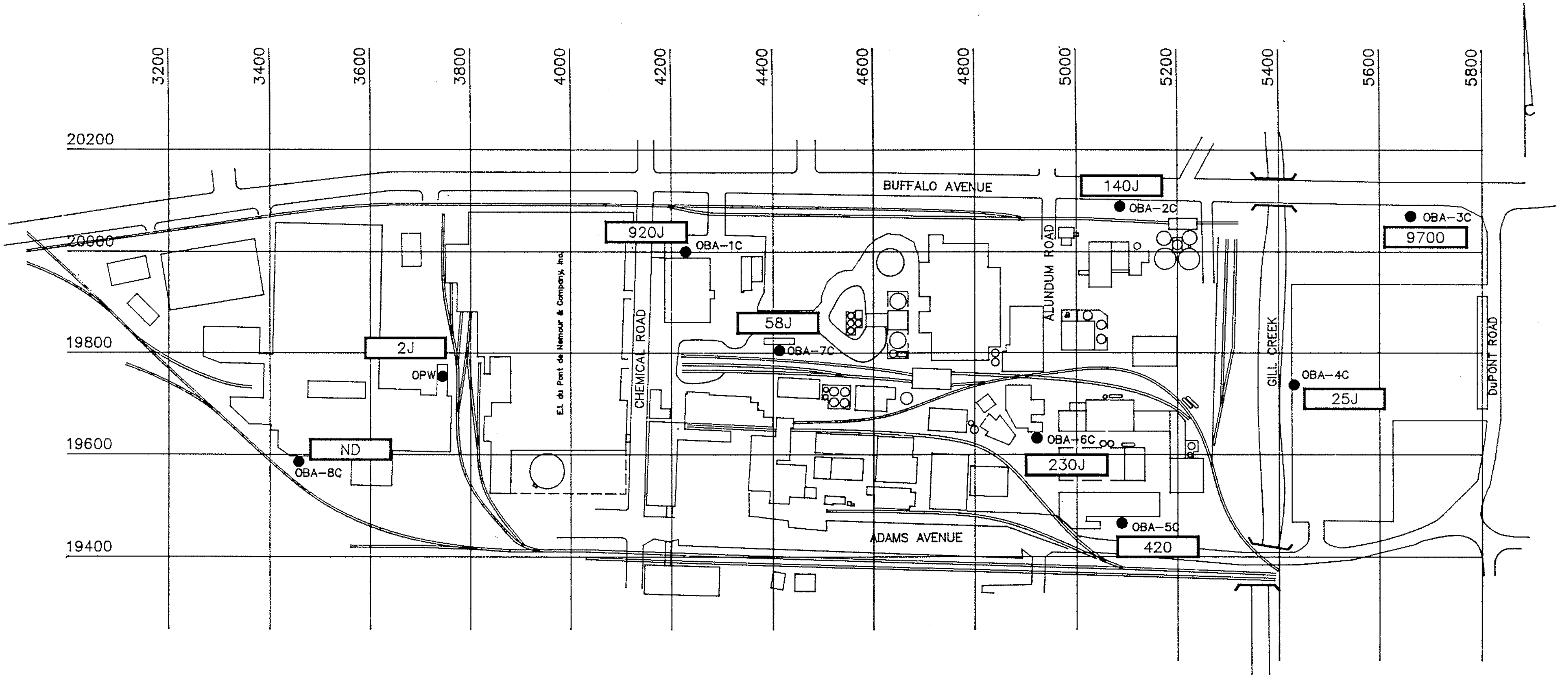
5000
5200
5400
5600
5800
20200
20000
19800
19600
19400
BUFFALO AVENUE
ADAMS AVENUE
CHEMICAL ROAD
ALUNDUM ROAD
GILL CREEK
DuPONT ROAD
E.I. du Pont de Nemour & Company, Inc.
7
OBA-2B
BH-1
OBA-3B
7100
18
OBA-1B
7J
OBA-7B
OBA-4B
25
200J
OBA-8B
OBA-6B
1100
OBA-5B
6300
LEGEND:
200J
BENZENE CONCENTRATION (ug/L)
OBA-8B
WELL ID
ND - NOT DETECTED
NS - NO SAMPLE COLLECTED
OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION
WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists
BENZENE CONCENTRATIONS IN GROUNDWATER
B-ZONE WELLS
Job No.: 88C2346-12
Drawing No.
Date:
Checked by: KRM
Rev. No.:
Scale:
0
200 Feet
Figure 7-8



LEGEND:

ND ← BENZENE CONCENTRATION (ug/L)

OBA-8C ← WELL ID

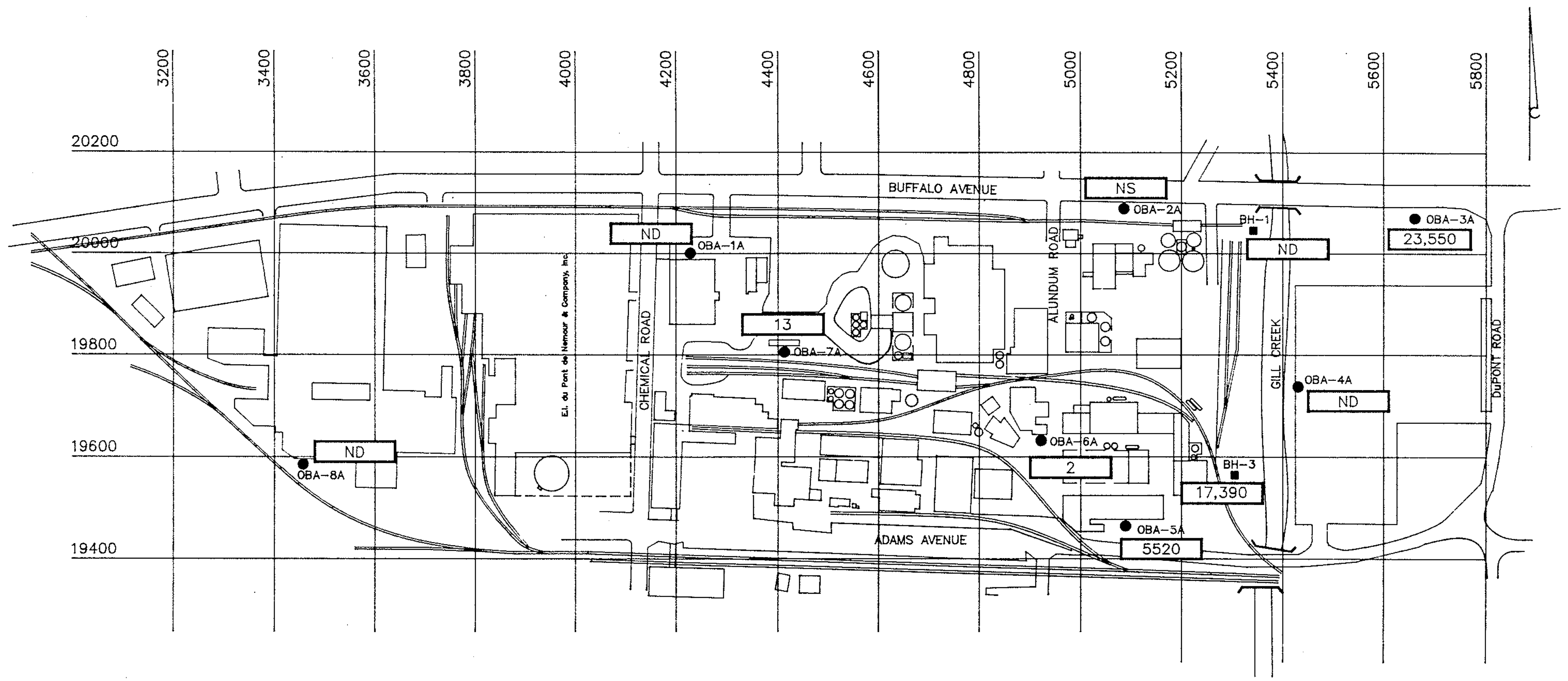
ND – NOT DETECTED
NS – NO SAMPLE COLLECTED
OPW – OLIN PUMPING WELL

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

BENZENE CONCENTRATIONS IN GROUNDWATER
C-ZONE WELLS

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 7-9
Scale: 0 — 200 Feet		



LEGEND:

ND — TOTAL CHLORINATED BENZENE CONCENTRATION (ug/L)

OBA-8A — WELL ID

ND – NOT DETECTED

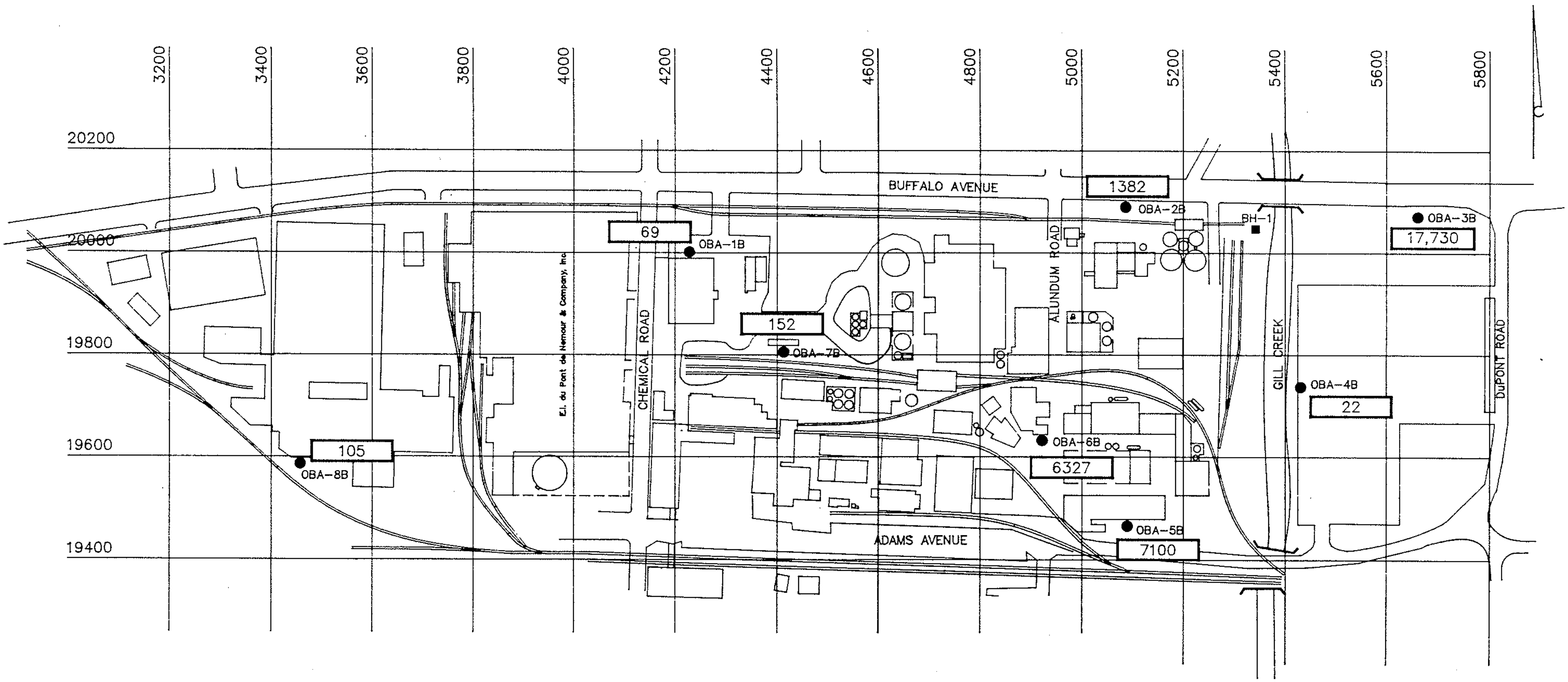
NS – NO SAMPLE COLLECTED (DRY WELL)

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

TOTAL CHLORINATED BENZENE
CONCENTRATIONS IN GROUNDWATER
A-ZONE WELLS

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 7-10
Scale: 0 — 200 Feet		



LEGEND:

105 ← TOTAL CHLORINATED BENZENE CONCENTRATION (ug/L)

OBA-8B

WELL ID

ND – NOT DETECTED

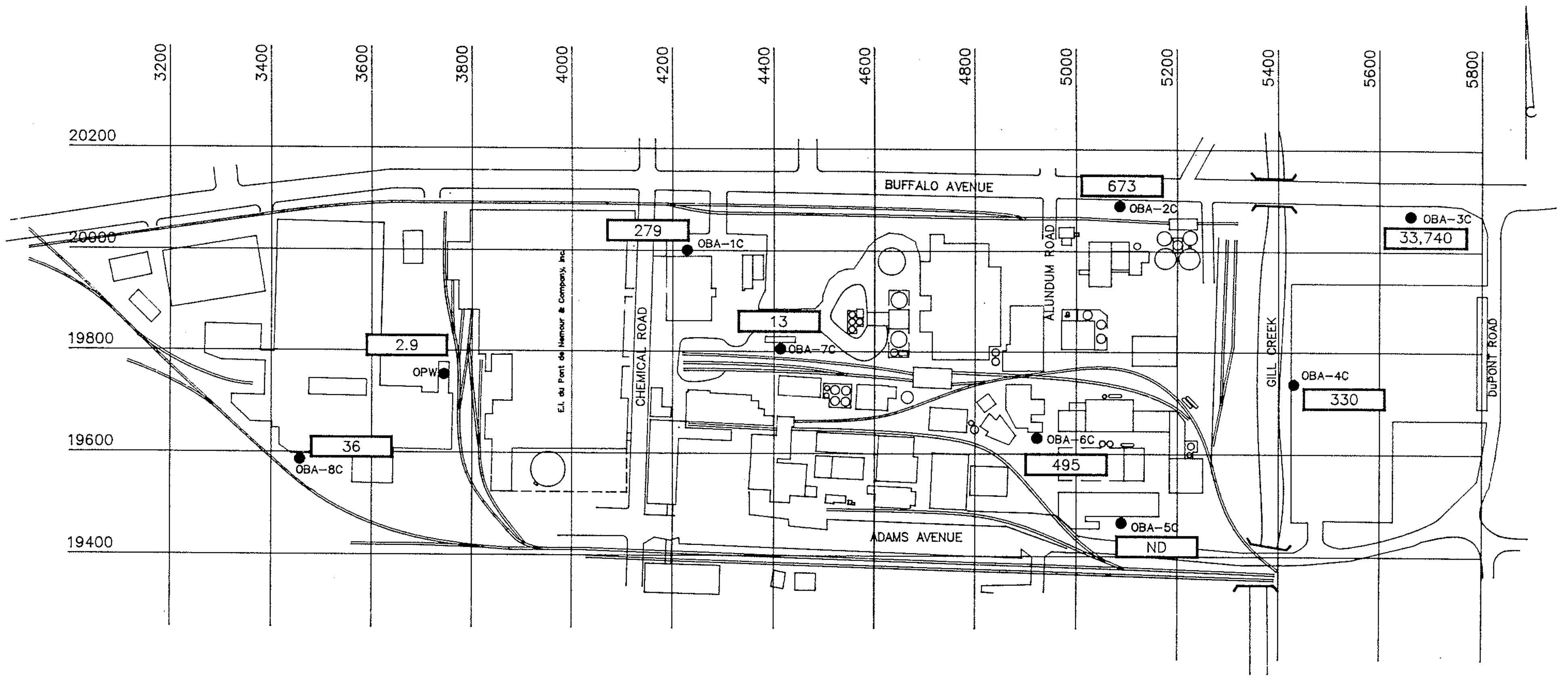
NS – NO SAMPLE COLLECTED

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

TOTAL CHLORINATED BENZENE
CONCENTRATIONS IN GROUNDWATER
B-ZONE WELLS

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 7-11
Scale: 0 200 Feet		



LEGEND:

36 (OBA-8C)	TOTAL CHLORINATED BENZENE CONCENTRATION (ug/L)
WELL ID	

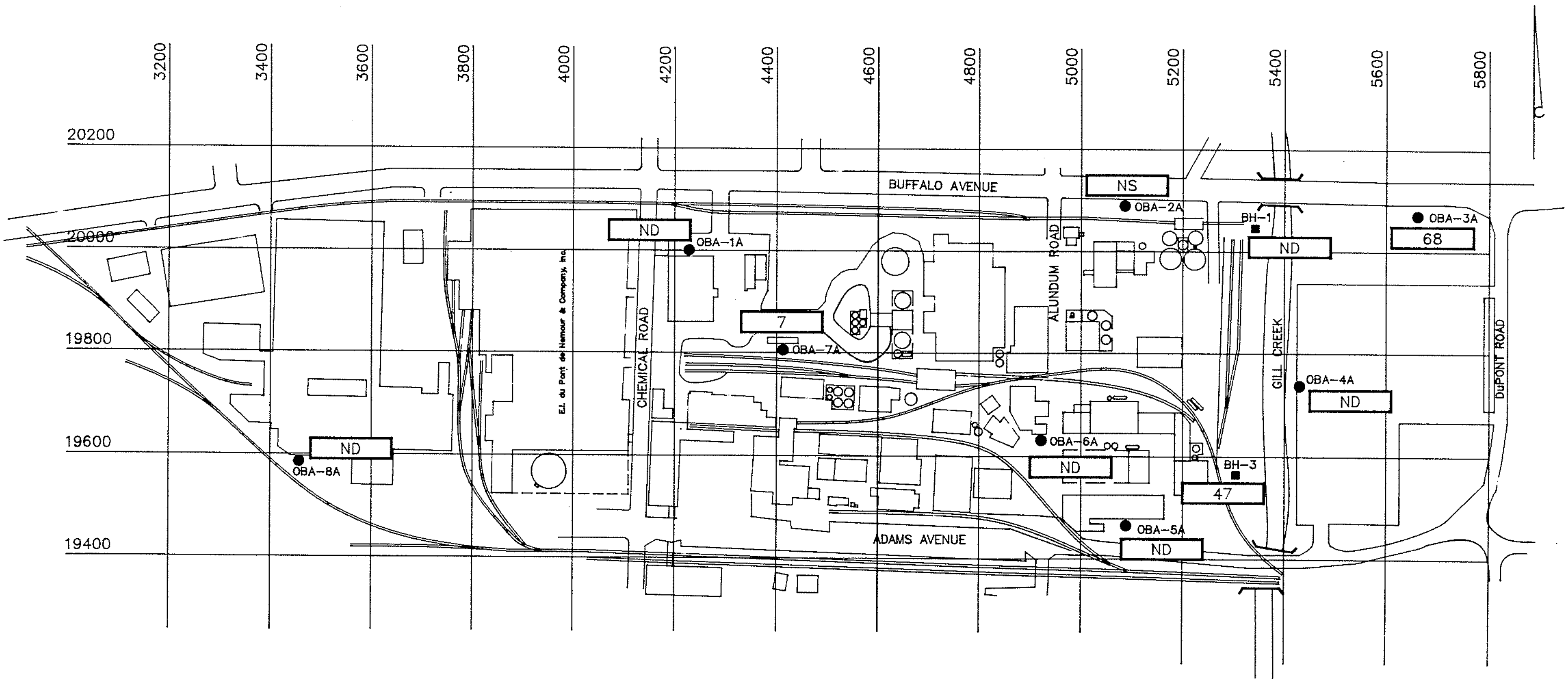
ND – NOT DETECTED
NS – NO SAMPLE COLLECTED
OPW – OLIN PUMPING WELL

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

TOTAL CHLORINATED BENZENE
CONCENTRATIONS IN GROUNDWATER
C-ZONE WELLS

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 7-12
Scale: 0 — 200 Feet		



LEGEND:

TOTAL CHLORINATED PHENOL CONCENTRATION (ug/L)

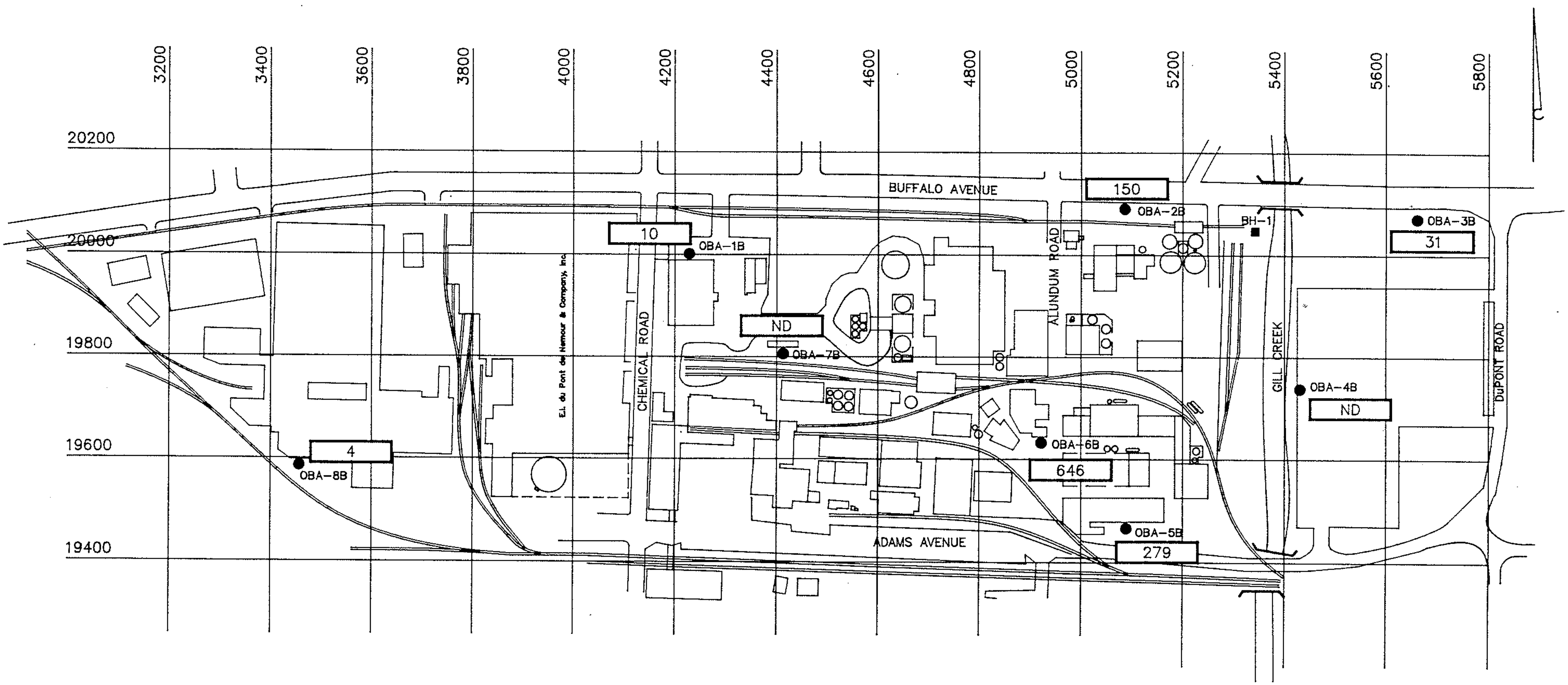
ND – NOT DETECTED
NS – NO SAMPLE COLLECTED (DRY WELL)

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

TOTAL CHLORINATED PHENOL
CONCENTRATIONS IN GROUNDWATER
A-ZONE WELLS

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 7-13
Scale: 0 — 200 Feet		



LEGEND:

4 ← TOTAL CHLORINATED PHENOL CONCENTRATION (ug/L)

OBA-8B

WELL ID

ND – NOT DETECTED

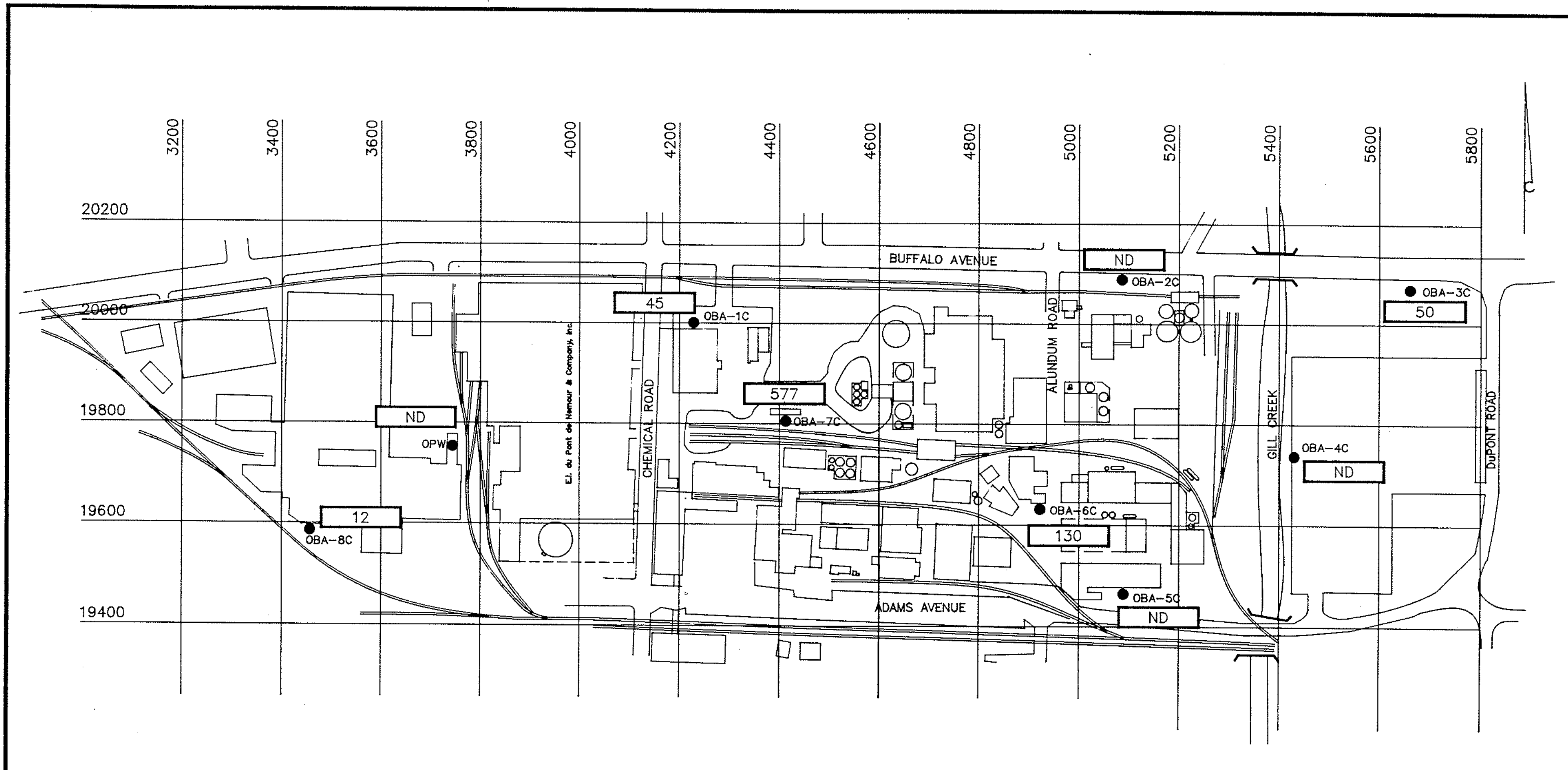
NS – NO SAMPLE COLLECTED

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

TOTAL CHLORINATED PHENOL
CONCENTRATIONS IN GROUNDWATER
B-ZONE WELLS

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 7-14
Scale: 0 — 200 Feet		

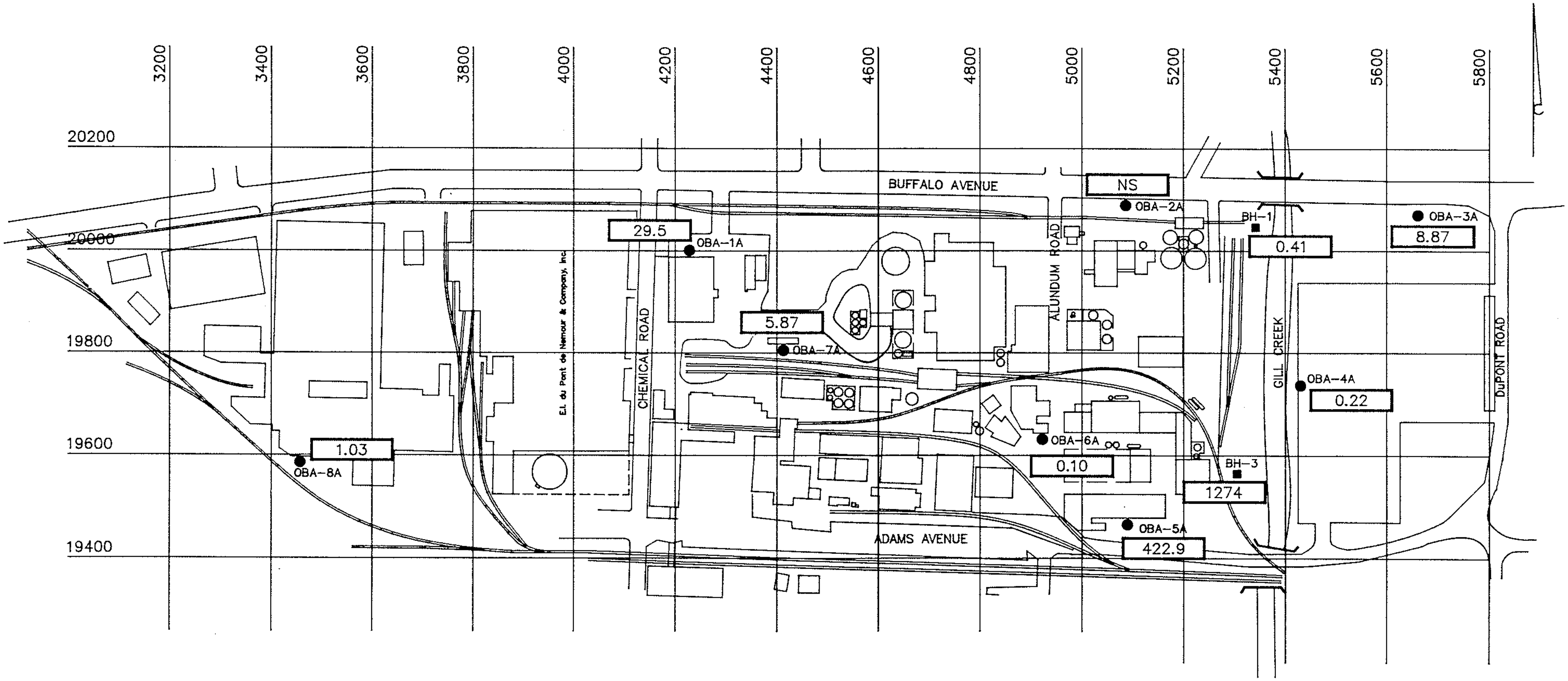


OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

TOTAL CHLORINATED PHENOL
CONCENTRATIONS IN GROUNDWATER
C-ZONE WELLS

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 7-15
Scale: 0 200 Feet		



LEGEND:

1.03 ← TOTAL BHC CONCENTRATION (ug/L)

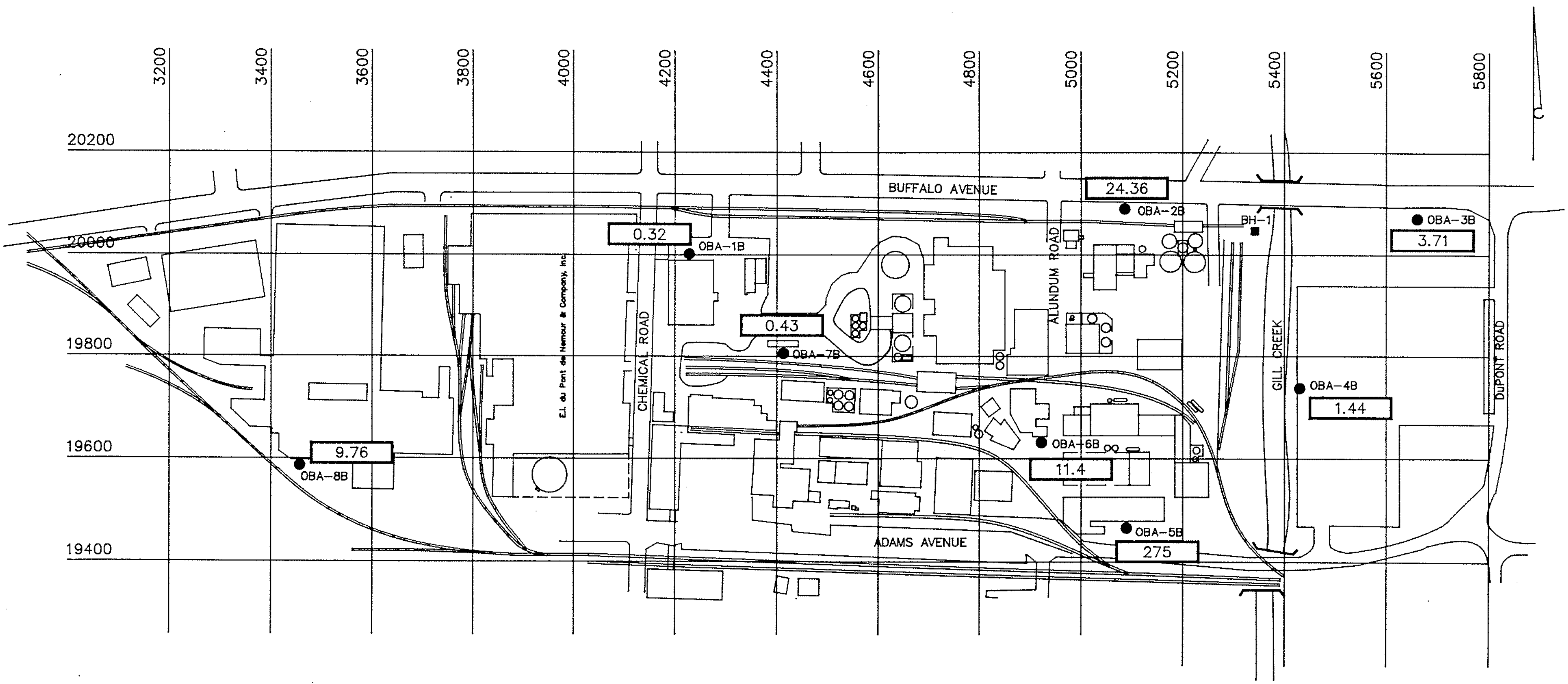
OBA-8A

WELL ID

ND – NOT DETECTED

NS – NO SAMPLE COLLECTED (DRY WELL)

OLIN CHEMICALS NIAGARA PLANT RCRA FACILITY INVESTIGATION		
WOODWARD-CLYDE CONSULTANTS Consulting Engineers, Geologists and Environmental Scientists		
TOTAL BHC CONCENTRATIONS IN GROUNDWATER A-ZONE WELLS		
Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 7-16
Scale: 0 200 Feet		



LEGEND:

9.76 ← TOTAL BHC CONCENTRATION (ug/L)

OBA-8B

WELL ID

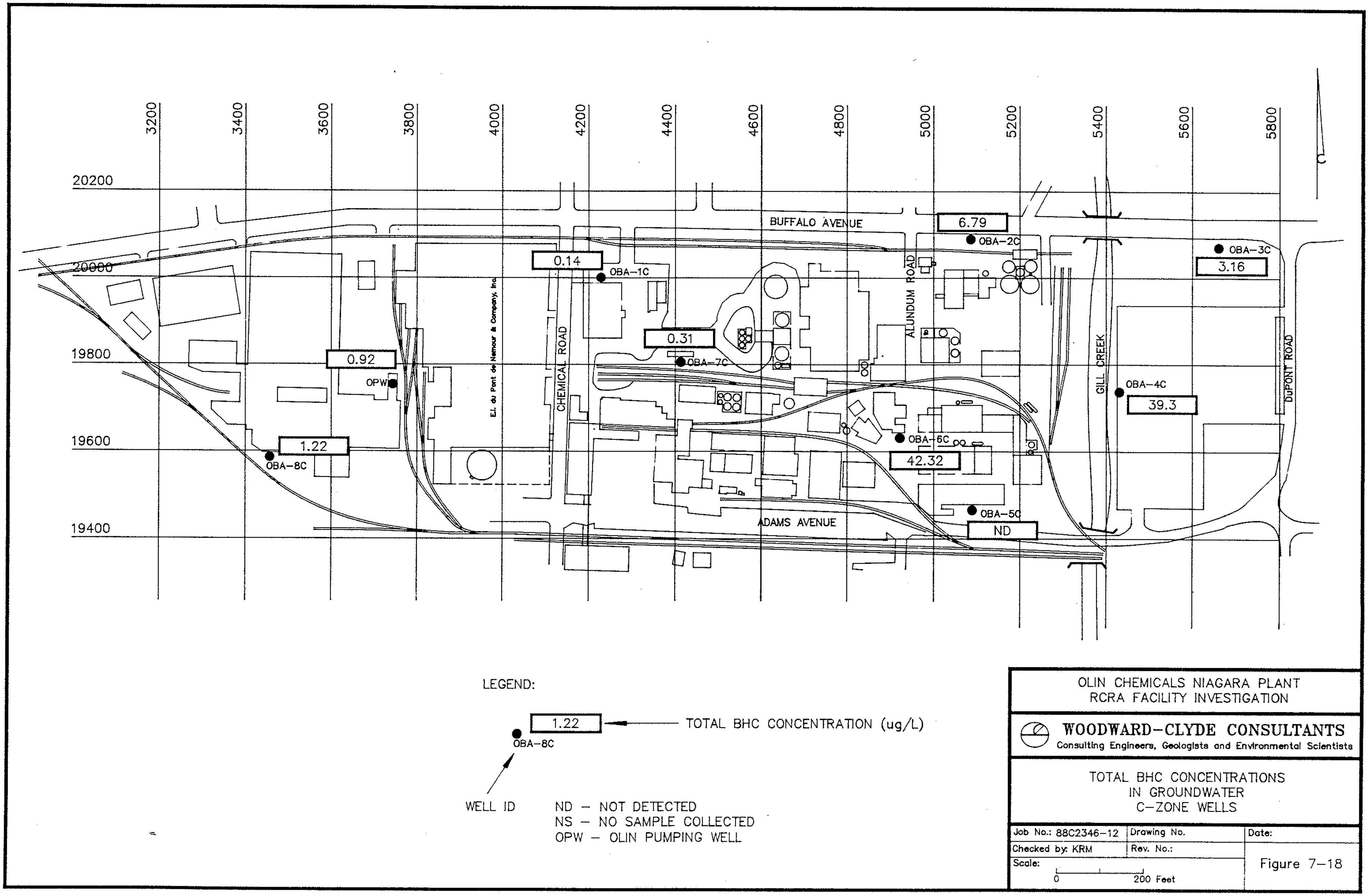
ND – NOT DETECTED
NS – NO SAMPLE COLLECTED

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

TOTAL BHC CONCENTRATIONS
IN GROUNDWATER
B-ZONE WELLS

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 7-17
Scale: 0 — 200 Feet		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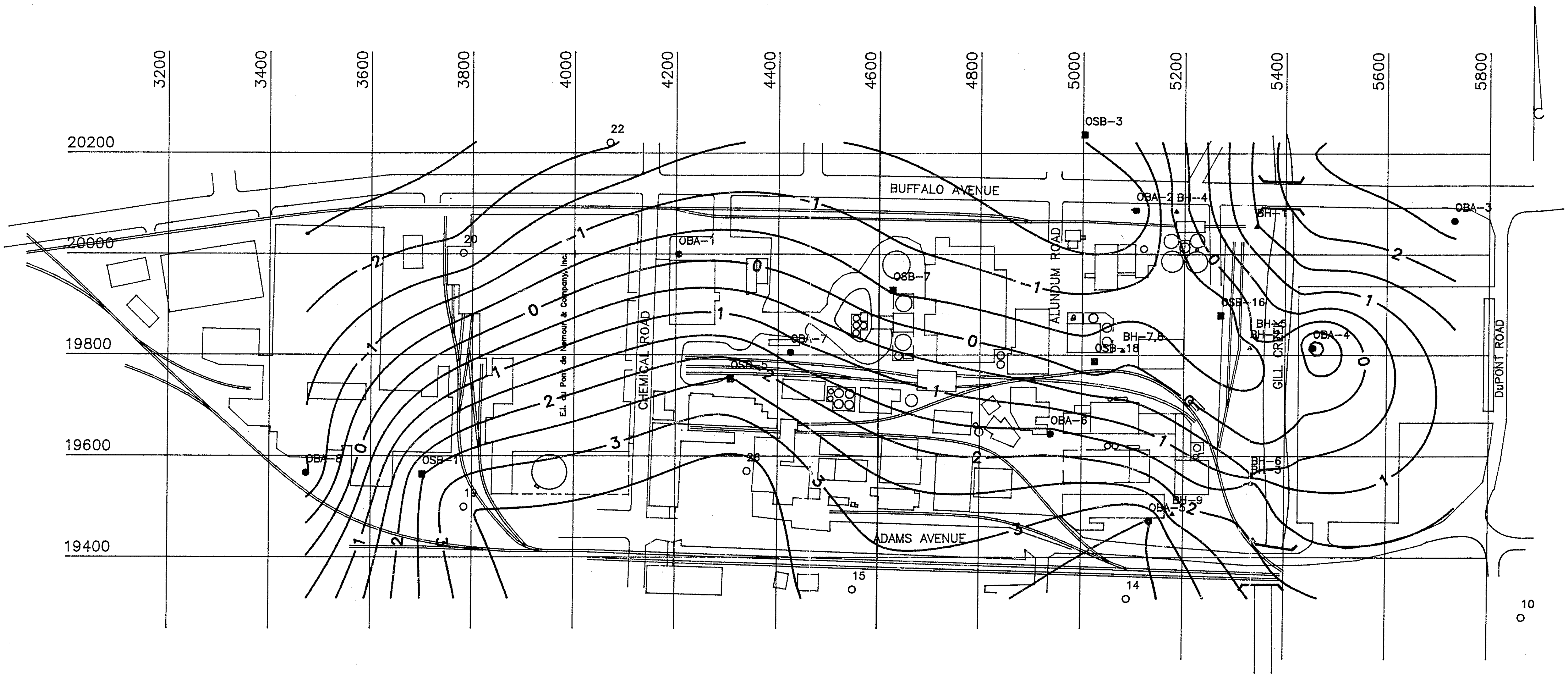
19400
BUFFALO AVENUE
ADAMS AVENUE
CHEMICAL ROAD
ALUNDUM ROAD
GILL CREEK
DuPONT ROAD
E.I. du Pont de Nemour & Company, Inc.
6.79
OBA-2C
OBA-3C
3.16
0.14
OBA-1C
0.31
OBA-7C
0.92
OPW
OBA-4C
39.3
1.22
OBA-8C
OBA-6C
42.32
OBA-5C
ND
LEGEND:
1.22
TOTAL BHC CONCENTRATION (ug/L)
OBA-8C
WELL ID
ND – NOT DETECTED
NS – NO SAMPLE COLLECTED
OPW – OLIN PUMPING WELL
OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION
WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists
TOTAL BHC CONCENTRATIONS
IN GROUNDWATER
C-ZONE WELLS
Job No.: 88C2346-12
Drawing No.
Date:
Checked by: KRM
Rev. No.:
Scale:
0
200 Feet
Figure 7-18



OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

A-ZONE SATURATED THICKNESS
ABOVE TOP-OF-BEDROCK

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 8-1
Scale: 0 200 Feet		

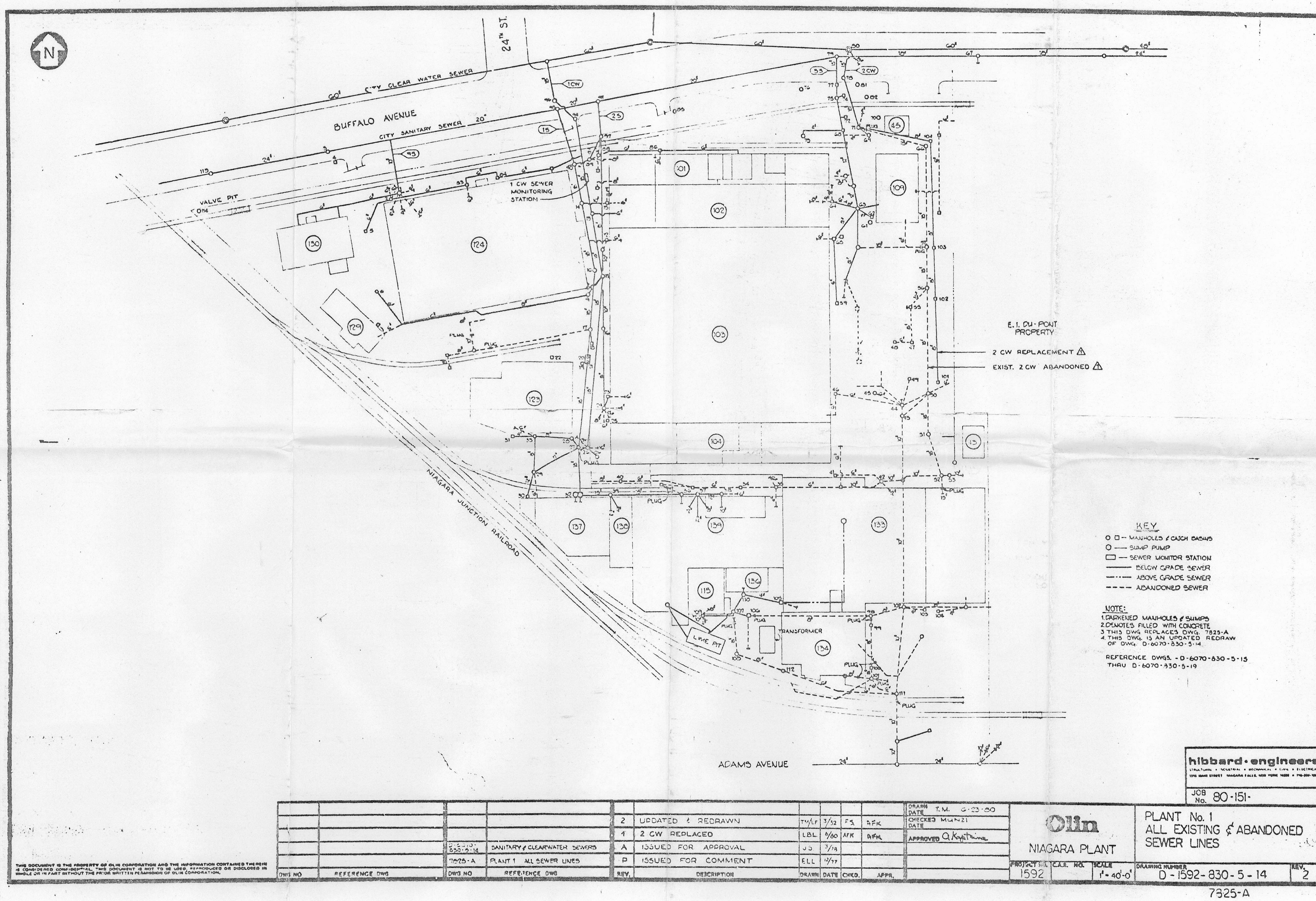
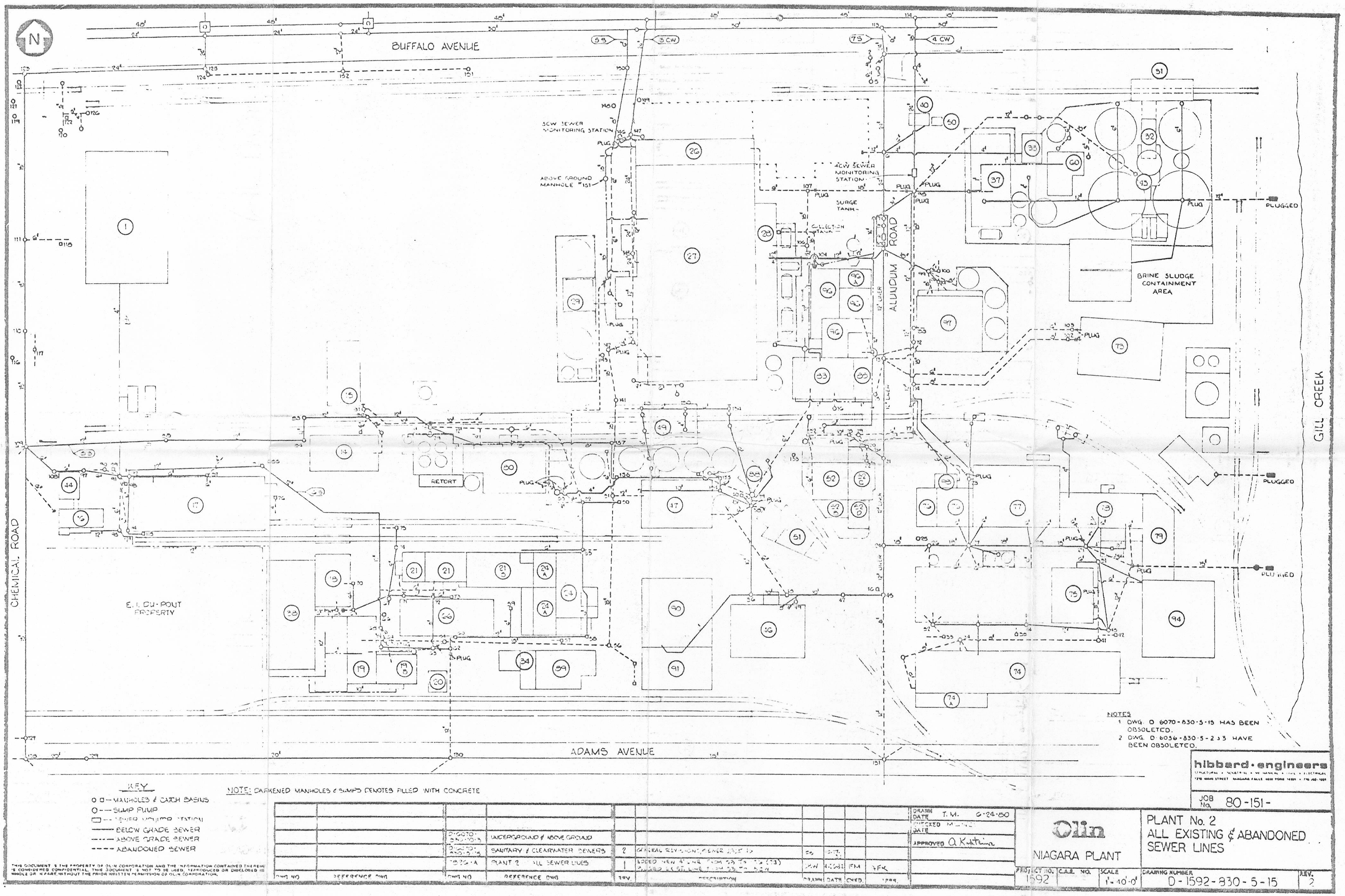
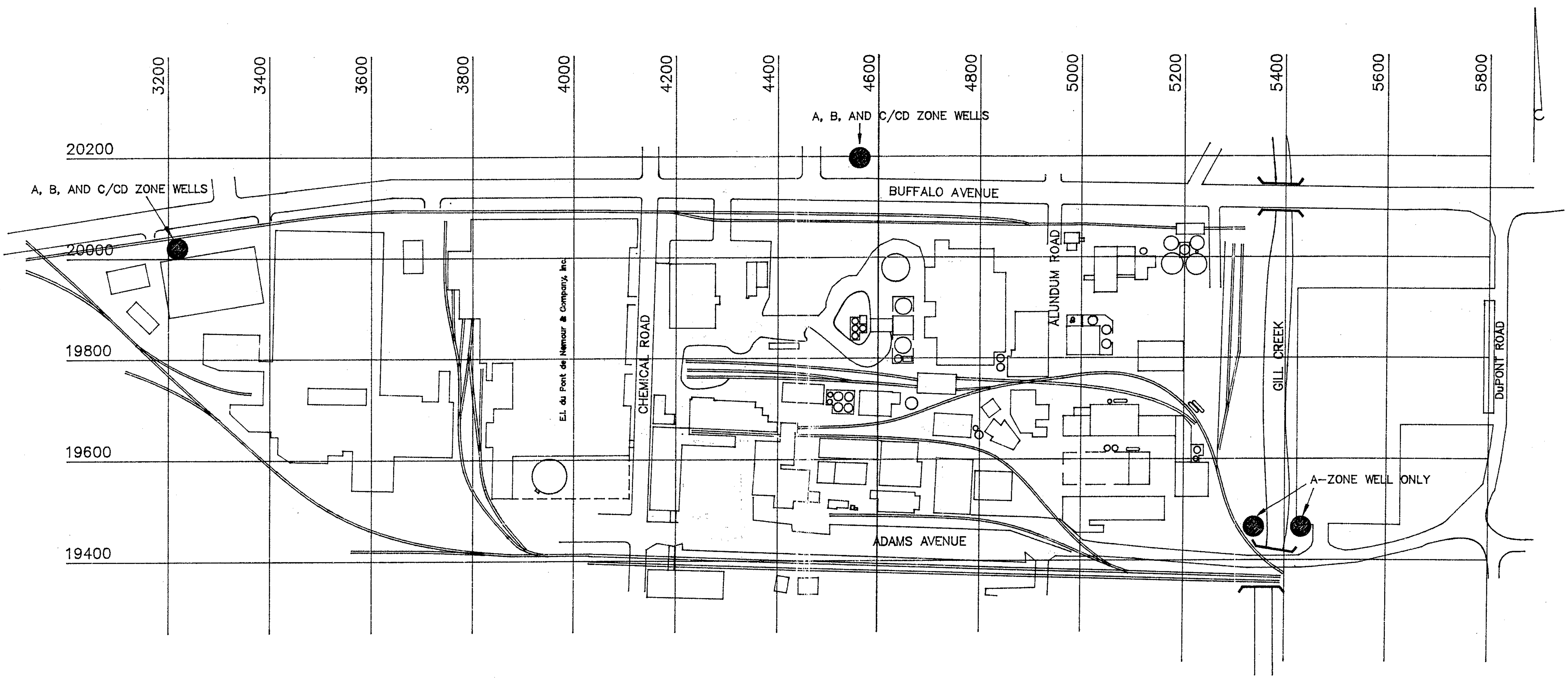

N
24TH ST.
60" CITY CLEAR WATER SEWER
BUFFALO AVENUE
CITY SANITARY SEWER 20"
VALVE PIT
1 CW SEWER MONITORING STATION
E. I. DU-PONT PROPERTY
2 CW REPLACEMENT
EXIST. 2 CW ABANDONED
NIAGARA JUNCTION RAILROAD
LIME PIT
TRANSFORMER
ADAMS AVENUE
KEY
MANHOLES & CATCH BASINS
SUMP PUMP
SEWER MONITOR STATION
BELOW GRADE SEWER
ABOVE GRADE SEWER
ABANDONED SEWER
NOTE:
1. DARKENED MANHOLES & SUMPS
2. DENOTES FILLED WITH CONCRETE
3. THIS DWG REPLACES DWG. 7825-A
4. THIS DWG. IS AN UPDATED REDRAW OF DWG. D-6070-830-5-14
REFERENCE DWGS. - D-6070-830-5-15 THRU D-6070-830-5-19
hibbard · engineers
JOB No. 80-151-
2 UPDATED & REDRAWN
1 2 CW REPLACED
A ISSUED FOR APPROVAL
P ISSUED FOR COMMENT
SANITARY & CLEARWATER SEWERS
PLANT 1 ALL SEWER LINES
DRAWN T.M. 6-23-80
CHECKED MUNZI
Olin
NIAGARA PLANT
PLANT No. 1
ALL EXISTING & ABANDONED SEWER LINES
SCALE 1" = 40'-0"
DRAWING NUMBER D-1592-830-5-14
REV. 2
7825-A

Figure 8–2



BUFFALO AVENUE
ADAMS AVENUE
CHEMICAL ROAD
ALUNDUM ROAD
GILL CREEK
E.I. DU-PONT PROPERTY
BRINE SLUDGE CONTAINMENT AREA
3CW SEWER MONITORING STATION
4CW SEWER MONITORING STATION
ABOVE GROUND MANHOLE #151
SURGE TANK
RETORT
PLUGGED
NOTES
1. DWG. D 6070-830-5-15 HAS BEEN OBSOLETED.
2. DWG. D 6036-830-5-2 & 3 HAVE BEEN OBSOLETED.
KEY
MANHOLES & CATCH BASINS
SUMP PUMP
SEWER VOLUME STATION
BELOW GRADE SEWER
ABOVE GRADE SEWER
ABANDONED SEWER
NOTE: DARKENED MANHOLES & SUMPS DENOTES FILLED WITH CONCRETE
hibbard·engineers
JOB No. 80-151-
Olin
NIAGARA PLANT
PLANT No. 2
ALL EXISTING & ABANDONED SEWER LINES
DRAWN T.M. 6-24-80
APPROVED
UNDERGROUND & ABOVE GROUND
SANITARY & CLEARWATER SEWERS
PLANT 2 ALL SEWER LINES
PROJECT NO. 1592
SCALE 1"=40'-0"
DRAWING NUMBER D-1592-830-5-15
REV. 2

Figure 8–3



A, B, AND C/CD ZONE WELLS

APPROXIMATE LOCATIONS FOR PROPOSED
ADDITIONAL MONITORING WELLS

OLIN CHEMICALS NIAGARA PLANT
RCRA FACILITY INVESTIGATION

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

PROPOSED ADDITIONAL MONITORING
WELL LOCATIONS

Job No.: 88C2346-12	Drawing No.	Date:
Checked by: KRM	Rev. No.:	Figure 9-1
Scale: 0 — 200 Feet		