FINAL CORRECTIVE MEASURES STUDY

BUFFALO AVENUE PLANT
NIAGARA FALLS, NEW YORK

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EXECUTIVE SUMMARY

A Corrective Action Program (CAP) is being performed at Occidental Chemical Corporation's (OxyChem) Buffalo Avenue Plant (Plant) pursuant to the Plant's RCRA/Part 373 Permit dated August 23, 1993. The final RCRA Facility Investigation (RFI) was completed in February 1995. The RCRA/Part 373 Permit stated that the CAP for the Plant would be implemented in four separate phases as Interim Corrective Measures (ICMs):

i) bedrock groundwater flow regime;

ii) overburden groundwater flow regime;

iii) overburden soils; and

iv) off-Site areas.

Pursuant to the RCRA Permit, OxyChem submitted a scoping plan outlining the Corrective Measures Program for the Plant and potential remedial technologies in the document entitled "Scoping Plan - Phase I, Corrective Measures Study", dated December 1991.

OxyChem has submitted to the State corrective measures studies for the bedrock groundwater flow regime, overburden groundwater flow regime, and overburden soils and has implemented interim corrective measures (ICMs) for each. The purpose of this report is to combine the previous corrective measure studies into one comprehensive corrective measures study and evaluate the performance of the ICMs implemented to date. A corrective measures study for the off-Site areas also is included.

The implemented ICMs evaluated for each of the four phases were:

Bedrock Groundwater

- extraction wells along the downgradient west and northwest Plant property boundaries in the D, C, and B-zones.
- on-Site groundwater treatment system;
- hydraulic monitoring program to monitor the effectiveness of the hydraulic containment system;
- chemical monitoring program to verify long-term changes;
- NAPL collection from on-Site bedrock wells; and,

- treatment of NAPL.

Overburden Groundwater

- Flow Zone 1 - Stages 1, 3, and 4 groundwater collection systems;
- Flow Zone 3 - Energy Boulevard Drive Tile System (EBDTS);
- hydraulic monitoring program to monitor the effectiveness of the hydraulic containment system;
- chemical monitoring program to verify long-term changes;
- collection of groundwater via sanitary sewers and treatment at the City Wastewater Treatment Plant (WWTP); and
- address groundwater infiltration into the outfall sewers as indicated by State Pollution Discharge Elimination System (SPDES) monitoring.

Overburden Soil

- maintenance of overburden groundwater ICM components;
- deed restrictions;
- institutional controls;
- maintenance of Plant perimeter fence;
- perimeter overburden NAPL monitoring;
- NAPL recovery (when sufficient quantity is encountered) and treatment of recovered NAPL;
- capping of dioxin and elemental phosphorus areas and surface drainage control; and
- maintenance of capped and existing hard surfaced areas.

Off-Site Areas

- the existing bedrock groundwater extraction system which will continue to draw chemicals back toward the Plant and prevent further off-Site chemical migration;
- the Falls Street Tunnel (FST) which will continue to collect D-Zone groundwater. All dry weather flow in the FST is treated by the Niagara Falls WWTP; and
- Monitored natural attenuation. Monitoring of off-Site bedrock groundwater quality is already performed on a semi-annual basis as part of on-Site bedrock groundwater corrective measures.

Each ICM was evaluated for suitability as the principal alternative for the corresponding corrective measures component based on the following:

- effectiveness;
- implementability;
- protection of human health and the environment;
- consistency with cleanup goals;
- cost effectiveness;
- permanence of remedy;
- reduction of toxicity, mobility and volume; and
- compliance with State and Federal standards and guidelines.

The following conclusions have been made based on the results of the CMS:

- The ICMs implemented for the bedrock groundwater flow regime achieve the goals of the corrective action program and are protective of human health and the environment;
- The ICMs implemented for the overburden groundwater flow regime achieve the goals of the corrective action program and are protective of human health and the environment;
- The ICMs implemented for overburden soils achieve the goals of the corrective action program and are protective of human health and the environment;
- The ICMs implemented for off-Site areas achieve the goals of the corrective action program and are protective of human health and the environment; and
- The ICMs implemented for the above four components achieve all ten remedial goals for the CAP as a whole.

Based on the above conclusions, it is recommended that the ICMs implemented become the final corrective measures for the Plant and that the performance monitoring programs developed for the ICMs be combined into one long-term performance monitoring program to ensure that the ICMs continue to achieve remedial goals.

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GLOSSARY

BGCMS	Bedrock Groundwater Corrective Measures Study
City	City of Niagara Falls
CMI	Corrective Measures Study
CMS	Corrective Measures Study
CAP	Corrective Action Program
DWTP	Drinking Water Treatment Plant
EBDTS	Energy Boulevard Drain Tile System
FST	Falls Street Tunnel
HDPE	High-Density Polyethylene
ICM	Interim Corrective Measure
INAPL	Immobile Non-Aqueous Phase Liquid
NAPL	Dense Non-Aqueous Phase Liquid
LTDU	Liquid Thermal Destruction Unit
NYPA	New York Power Authority
NYSDOT	New York State Department of Transportation
OGCMS	Overburden Groundwater Corrective Measures Study
OSCMS	Overburden Soils Corrective Measures Study
OSI	Off-Site Investigation
OxyChem	Occidental Chemical Corporation
Plant	Buffalo Avenue Plant
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RMP	Robert Moses Parkway
SDCP	Supplemental Data Collection Program
SIP	Source Investigation Program
SPDES	State Pollution Discharge Elimination System
SSI	Site Specific Indicator
SWMU	Solid Waste Management Unit
WWTP	Wastewater Treatment Plant

1.0 INTRODUCTION

A Corrective Action Program (CAP) is being performed at Occidental Chemical Corporation's (OxyChem) Buffalo Avenue Plant (Plant) pursuant to the Plant's RCRA/Part 373 Permit dated August 23, 1993. The final RCRA Facility Investigation (RFF) was completed in February 1995. The RCRA/Part 373 Permit stated that the CAP for the Plant would be implemented in four separate phases as Interim Corrective Measures (ICMs):

v) bedrock groundwater flow regime;

vi) overburden groundwater flow regime;

vii) overburden soils; and

viii) off-Site areas.

Pursuant to the RCRA Permit, OxyChem submitted a scoping plan outlining the Corrective Measures Program for the Plant and potential remedial technologies in the document entitled "Scoping Plan - Phase I, Corrective Measures Study", dated December 1991.

OxyChem has submitted to the State corrective measures studies for the bedrock groundwater flow regime, overburden groundwater flow regime, and overburden soils as summarized in Table 1.1.

The purpose of this report is to combine the previous corrective measure studies into one comprehensive corrective measures study and evaluate the performance of the selected ICMs implemented to date. A corrective measures study for the off-Site areas also is included.

This report is presented in nine sections as follows:

- Section 2.0 provides a brief description of the Plant;
- Section 3.0 summarizes existing geologic, hydrogeologic, chemical presence, and chemical migration conditions at the Plant;
- Section 4.0 describes the remedial goals for the corrective measures program;
- Section 5.0 describes the areas that were considered for corrective measures including Solid Waste Management Units (SWMUs);

- Section 6.0 details the interim corrective measures that have been implemented at the Plant and planned future corrective measures;
- Section 7.0 presents an evaluation of the interim corrective measures that have been implemented at the Plant;
- Section 8.0 presents conclusions regarding present conditions at the Plant and the interim corrective measures that have been implemented;
- Section 9.0 presents recommendations for the final corrective measures at the Plant; and
- Section 10.0 outlines the long-term monitoring and reporting plan for the Plant.

2.0 GENERAL SITE DESCRIPTION

2.1 SITE LOCATION

OxyChem's Buffalo Avenue Plant is located in the City of Niagara Falls, New York. The Plant is a chemical manufacturing facility that commenced operations in 1911 and currently covers an area of approximately 123 acres. The location of the Plant is presented on Figure 2.1.

Various industrial properties are located to the north and west of the Plant boundary while the former City of Niagara Falls Drinking Water Treatment Plant (DWTP) is located to the east of the Plant and south of Buffalo Avenue. The DWTP was decommissioned and demolished in 1997. The area east of the Plant and north of Buffalo Avenue is predominantly residential. A utility right-of-way, the Robert Moses Parkway (RMP), an industrial wharf, and the Niagara River are located south of the Plant boundary. The utility right-of-way contains Niagara Mohawk Power Corporation electrical transmission lines and the industrial intake pipe trench (IIPT).

The present Plant facilities have been divided into alphabetical areas for ease of identification. These Plant area designations are presented on Figure 2.2.

2.2 HISTORY

The Development and Funding Company purchased the original Plant site, which covered approximately 7 acres, in 1905 from the Niagara Power Company. This parcel of land was located on the north side of Buffalo Avenue and was bounded to the east by the Niagara Junction Railroad, to the west by 47th Street, and to the north by the Niagara Falls Power Company. The Development and Funding Company changed its name to Hooker Electrochemical Company in 1909.

Hooker Electrochemical continued to expand along the north side of Buffalo Avenue and by 1927 the Plant site was approximately 29 acres in size, and was bounded to the west by Iroquois Street, to the east by approximately 52nd Street, and to the north by railroad property. The adjacent property on the south side of Buffalo Avenue was occupied mainly by Niagara Alkali Company and Oldbury Electrochemical Company. These companies were acquired by Hooker Electrochemical on November 30, 1955, and November 30, 1956, respectively.

Hooker Electrochemical or its successors obtained additional parcels of land over the years. At the present time, the Plant encompasses approximately 143 acres of which 123 acres is owned by OxyChem. Other landowners include the City of Niagara Falls (8 acres), Niagara Mohawk Power Corporation (6 acres), and Consolidated Rail Corporation (6 acres). The Plant area does not include the former Energy from Waste Facility (13 acres).

Over the years the ownership of the Buffalo Avenue Plant has been changed to reflect corporate title changes. These changes have included:

• Development and Funding Company	May 5, 1905
• Hooker Electrochemical Company	November 6, 1909
• Hooker Chemical Corporation	May 29, 1958
• Hooker Chemicals & Plastics Corp.	January 17, 1974
• Occidental Chemical Corporation	April 1, 1982

2.3 SITE TOPOGRAPHY

The Plant site slopes from north to south toward the Niagara River. The property is relatively flat with the exception of a raised landfill (S-Area) and a raised railroad embankment. A survey of Plant ground surface characteristics was completed in April 1996 and the results are presented on Plan 1. Ground surfaces included impoundment areas (concrete areas enclosed with dikes), grass-covered areas, hard surface areas (including areas covered with concrete or asphalt), gravel-covered areas, and roof areas. A summary of the surface areas expressed in acres, square feet, and as a percentage of the entire Plant surface area is presented on Plan 1.

3.0 PRE INTERIM CORRECTIVE MEASURE CONDITIONS

3.1 SITE GEOLOGY

The local geology of the Plant consists of overburden materials overlying a series of bedrock formations. The overburden geologic stratigraphy beneath the Plant consists of the following from top to bottom:

Unit	*Thickness*	*Description*
Fill Material	0.0 to 15.0 feet (5.5 feet average)	mixture of gravel, sand, silt, and clay, as well as demolition debris, building foundations, flyash, cinders, and other foreign material
Alluvial River Deposits	0.0 to 14.9 feet (6.4 feet average)	permeable, brown/gray, fine to medium sandy soil
Glacial Lake Deposits	0.0 to 14.7 feet (8.4 feet average)	texturally homogeneous red-brown silty clay and a more homogeneous gray brown sandy to clayey silt
Glacial Till	0.0 to 14.8 feet (6.8 feet average)	red-brown sandy silt with variable amounts of clay and gravel

The overburden thickness beneath the Plant averages 27 feet.

The bedrock geologic stratigraphy beneath the Plant consists of the following:

Unit	*Thickness*	*Description*
Oak Orchard	72 to 94 feet	bituminous, light to dark gray, very thin to medium bedded, fine to medium grained saccharoidal dolostone
Eramosa	15 to 30 feet	bituminous, light to medium gray, thin to medium bedded, fine to medium grained argillaceous dolostone
Goat Island	10 to 23 feet	bituminous, medium to dark gray, thin to medium bedded, fine to medium grained dolostone
Gasport	22 to 37 feet	bituminous, medium to dark gray, very thin to medium bedded, fine to medium grained dolomitic limestone
Decew	7 to 11 feet	bituminous, medium to dark gray, thin to massively bedded, fine grained argillaceous dolostone
Rochester	(study did not penetrate unit)	uniform, dark gray, platy to fissile bedded, fine grained shale

The overburden and bedrock geologic stratigraphies are presented on Figures 3.1 and 3.2, respectively.

3.2 SITE HYDROGEOLOGY

3.2.1 OVERBURDEN

The overburden in the Plant area consists of two hydrogeologic units. The upper unit, consisting of the fill and alluvium stratigraphic units, is water bearing. The lower unit, consisting of the clay and till stratigraphic units, acts as an aquitard (confining layer). This clay/till unit maintains a physical separation between the fill/alluvium and the bedrock water-bearing units and prevents the downward migration of groundwater and non-aqueous phase liquids (NAPL). The clay/till unit has been penetrated by man-made structures such as sewers, building foundations, and piles in some localized areas.

Testing performed during the SDCP showed that the hydraulic conductivity of the fill/alluvium unit ranges from 6.1×10^{-6} to 3.8×10^{-1} cm/sec with a geometric mean of 8.2×10^{-3} cm/sec. The reason for the broad range of hydraulic conductivities in the fill/alluvium unit is the considerable variation in the composition of these strata. The fill/alluvium materials ranged from fine sand and silt to brick and construction debris.

The clay/till aquitard unit has a typical hydraulic conductivity of 1×10^{-8} cm/sec.

Extensive overburden hydraulic monitoring has been performed at the Plant. Groundwater contours show the overburden groundwater flow is toward existing sewers and collection systems and, in perimeter areas, toward the Plant boundary.

Figure 3.3 shows the overburden groundwater contours as determined from groundwater levels measured in June 1992. Groundwater in the fill/alluvium unit is perched on top of the clay/till aquitard and consequently, the flow in this unit is dictated in part by the contours of this aquitard. Hydraulic monitoring data also show that a downward vertical gradient exists between the fill/alluvium unit and the upper bedrock zone (D-Zone).

The contours on Figure 3.3 show that overburden groundwater flow at the Plant is highly influenced by man-made structures, particularly the sanitary and outfall sewers and existing groundwater collection systems. The sanitary and storm sewers within the boundaries of the Plant are in general, deep installations typically close to or below the top of the clay/till unit. The sanitary sewers and the majority of the storm sewers are gravity sewers that do not flow at capacity most of the time and thus the hydraulic head within the sewers is almost always lower than the hydraulic head in the surrounding overburden groundwater flow regime. Consequently, the sewers are subject to groundwater infiltration. The majority of the groundwater flow in the overburden beneath the Plant is toward the existing sewers and collection systems with subsequent migration through the sewer bedding and/or by infiltration into the sewers themselves. The following sewers and utilities have the most influence on the overburden groundwater flow at and near the Plant:

- Industrial Intake Pipe Trench (IIPT);
- Buffalo Avenue Sanitary Sewer;
- Iroquois Street Sanitary Sewer;
- 47th Street Sanitary Sewer;
- 53rd Street Sanitary Sewer;
- 001 Outfall;
- 003 Outfall;
- 004 Outfall; and
- 005 Outfall.

The locations of these systems are shown on Figure 3.4.

There are also other man made features near the Plant that influence overburden groundwater flow. These are:

- NYPA Power Conduits;
- Energy Boulevard Drain Tile System (EBDTS);
- NYPA Intake Wall;
- Plant Barrier Wall;
- S-Area Barrier Wall; and
- Flow Zone 1 Groundwater Collection Systems.

The locations of these features are also shown on Figure 3.4. The NYPA Power Conduits have drain systems that collect overburden and bedrock groundwater to reduce the external pressure on the conduits. The EBDTS is a collection system designed to intercept overburden groundwater at the eastern section of the northern Plant boundary. The NYPA Intake Wall, the Plant Barrier Wall, and the S-Area Barrier Wall prevent overburden groundwater from entering the Niagara River adjacent to the Plant.

3.2.1.2 PERIMETER OVERBURDEN GROUNDWATER MOVEMENT

The contours along the southern perimeter of the Plant as presented on Figure 3.3, show that overburden groundwater in the vicinity of the S-Area flows from the Plant to the River. Along the rest of the southern Plant boundary, the contours drop steeply into the deep fill layer underlying the Robert Moses Parkway. Comparing the contours with the Niagara River water levels shows that the groundwater flow is from the River north toward the Plant in this area. Thus, the River flow combines with the off-Site groundwater flow from the southwest corner of the Plant and moves westerly eventually discharging to the NYPA conduits. Perimeter groundwater flow along the southern boundary of the Plant has been addressed by the construction of two barrier walls that extend from the NYPA Power Conduit Intake Wall to the former City of Niagara Falls Drinking Water Treatment Plant (DWTP). The construction of these walls prevents river water from recharging the overburden groundwater flow regime. The barrier walls, in conjunction with the Flow Zone 1 groundwater collection systems, also ensure that the groundwater flow from the Plant cannot enter the Niagara River. The barrier walls deflect groundwater migrating across the southern Plant boundary toward the west where it will eventually enter the NYPA Power Conduits.

The primary direction of groundwater flow along the western Plant boundary is westerly toward the NYPA conduits. There is a component of the flow from the north portion of the western Plant boundary that is directed toward the vicinity of the Iroquois Street Sanitary Sewer.

There is a small component of northerly off-Site flow along the north Plant boundary from the vicinity of the northwest corner of the Plant to the approximate vicinity of well OW305. Between wells OW305 and OW308, the overburden groundwater flow is easterly from the A/G-Areas and westerly from the B/H-Areas toward the 47th Street sewers. East of OW308, the contours show the effect of the EBDTS. The EBDTS acts as a line sink that effectively prevents off-Site groundwater flow from migrating further north beyond the EBDTS. The EBDTS actually draws water from areas further north of the EBDTS creating a southerly flow component of the overburden groundwater regime.

There is a very small component of off-Site groundwater flow at the northeast corner of the Plant and along the east Plant boundary.

3.2.1.3 INTERIOR OVERBURDEN GROUNDWATER MOVEMENT

The overburden groundwater level within the interior of the Plant, as shown on Figure 3.3, is generally high and relatively flat. These characteristics are typically representative of low flow rates. Off-Site migration of groundwater through the overburden from the interior of the Plant does not occur. Existing sewer systems are the primary influences on groundwater movement within this area. The contours on Figure 3.3 show that the sewers on 47th Street, 53rd Street, and Buffalo Avenue act as localized groundwater sinks and consequently are the primary controllers of groundwater movement within the interior of the Plant. Outfalls 001, 003, 004 and 005 and their tributaries also influence groundwater movement within the interior of the Plant but to a lesser extent. The groundwater regime within the interior of the Plant is replenished by precipitation infiltration and watermain leakage. Watermain leakage was estimated to be approximately 272,000 gpd in the RFI.

3.2.2 BEDROCK GROUNDWATER MOVEMENT

Bedrock groundwater in the vicinity of the Plant occurs in highly connected microscopic pores, solution cavities, bedding joints and vertical joints. The bedding joints have been identified as the primary conduits for groundwater flow through the Lockport Group (Johnston, 1964).

Regional groundwater flow in the Lockport Group is generally toward the Niagara Gorge but in the Plant area, the groundwater flow has been altered by man-made structures. The two man-made structures that have the most effect on groundwater flow are the NYPA power conduits and the FST.

The bedrock beneath the Plant consists of the following hydrogeologic units:

D-Zone	0 to 45± feet below top of rock (BTOR)	top of bedrock to middle of Oak Orchard Formation;
C-Zone	55± feet to 85± feet BTOR	middle of Oak Orchard Formation to top of Eramosa Formation;
B-Zone	85± feet to 150± feet BTOR	top of Eramosa Formation to top of Gasport Formation; and
A-Zone	150± feet to 190± feet BTOR	middle of Gasport Formation to top of Rochester Formation.

The D-Zone and the C-Zone are the two major water-bearing units in the bedrock. A less permeable layer (aquitard) separates these two units. The B-Zone also is a water-bearing unit although to a lesser extent compared to the D and C-Zones.

Bedrock hydraulic conductivities were determined by injection testing during the RFI studies. D-Zone wells, which generally monitor intervals between the top of bedrock and the middle of the Oak Orchard Formation, exhibited hydraulic conductivities ranging from 7.8×10^{-6} to 3.6×10^{-1} cm/sec. C-Zone wells, which generally monitor intervals from the middle of the Oak Orchard Formation to the top of the Eramosa Formation, exhibited hydraulic conductivities ranging from 3.9×10^{-4} to 3.3×10^{-1} cm/sec. The B-Zone wells, which generally monitor intervals from the top of the Eramosa Formation to the top of the Gasport Formation, exhibited hydraulic conductivities ranging from 1.1×10^{-5} to 1.1×10^{-1} cm/sec. The A-Zone wells which generally monitor intervals from mid-Gasport to top of the Rochester, exhibited hydraulic conductivities ranging from 3.5×10^{-5} to less than 1×10^{-7} cm/sec. The majority of A-Zone wells exhibited hydraulic conductivities less than 1×10^{-7} cm/sec.

The A-Zone bedrock in the vicinity of the Plant acts as an aquitard (poor waterbearing characteristics). The mean hydraulic conductivity was 4.7×10^{-7} cm/s; 100 times less than the minimum hydraulic conductivity required for meeting the conditions of a water-bearing unit established for the RFI (5.0×10^{-5} cm/s). Another indication of the non-water-bearing characteristic of the A-Zone was the gas releases observed during penetration and testing. The presence of gas is indicative of a formation with isolated, non-connected joints, fractures, and openings. Otherwise, the gas would have dissipated through the available fracture network. Therefore, the A-Zone bedrock acts as an aquitard and prevents the downward migration of groundwater and NAPL. Thus, the formations below the A-Zone do not require evaluation in this CMS.

Groundwater contours, flow directions, and major influences on groundwater flow for the D, C, and B-Zone bedrock prior to implementation of the bedrock groundwater ICM are presented on Figures 3.5, 3.6, and 3.7, respectively.

Groundwater in the D-Zone flows north-northwest toward the intersection of the FST and NYPA power conduits. Groundwater flow in the D-Zone from the Plant is limited in the northerly direction by the FST. The westernmost limit is the NYPA power conduits. Ultimately, shallow D-Zone bedrock groundwater from beneath the Plant is expected to be captured by either the NYPA conduits, FST, South Side Interceptor and/or the Resource Recovery Facility (RRF), formerly called Energy from Waste dewatering system. Groundwater flow in the C-Zone is similar to that of the D-Zone. The vertical gradient between the C and D-Zones is slight and fluctuates between upward and downward at various well locations. Groundwater flow in the B-Zone is generally toward the north-northeast. The vertical gradient between the B and C-Zones is downward with a potentiometric difference of less than one foot to more than two feet. Groundwater flow patterns in the A-Zone could not be established due to the non-waterbearing nature of this zone.

3.3 CHEMICAL PRESENCE

3.3.1 OVERBURDEN GROUNDWATER

Chemical presence in the overburden groundwater beneath the Plant was extensively investigated during the RFI and earlier investigations. Chemical presence in the overburden groundwater is described in detail in the RFI Report.

There are four chemical categories present in the overburden groundwater beneath the Plant as follows:

i) elevated pH;

ii) organic chemicals;

iii) acid compounds (benzoic, chlorobenzoic, and chlorendic acids); and

iv) soluble phosphorus.

Elevated pH

Elevated pH levels (pH>10) were identified in the overburden groundwater beneath the Plant in the areas shown on Figure 3.8. Elevated pH levels occur beneath the G-Area and the southern portion of the U-Area where caustic is and historically was used, stored, and handled. RCRA characterizes liquids with pH greater than 12.5 as hazardous and pH levels greater than 12.5 were detected at OW314 in the U-Area (pH of 14). The pH of the G-Area plume ranges between 10.5 and 12.0.

The pH levels in overburden groundwater beneath the remainder of the Plant interior range between 6 and 9 except for one isolated occurrence at BH5B-89 (pH of 11.0) in the northeast corner of the V-Area.

Organic Chemicals

Four overburden groundwater organic chemical plumes were identified beneath the Plant as shown on Figure 3.9. The plumes represent areas where concentrations of total organic SSI chemicals in the overburden groundwater are expected to be greater than 1,000 μg/L. The SSI parameters are listed in Table 3.1. These plumes are generally located within perimeter areas of the Plant in the C and D-Areas, F-Area, N-Area, and U-Area. Each of these plumes, except the N-Area plume, also extends to a degree into interior areas of the Plant. These four plumes coincide with the observed presence of NAPL in the overburden as discussed in Section 3.3.3 – Overburden Soil Chemical Presence.

The C and D-Area organic chemical plume is centered in the vicinity of wells OW308, OW320, and OW321. The principal compounds detected in the C-Area portion of the plume were benzenes and chlorobenzenes and the principal compounds detected in the D-Area portion of the plume were toluenes, chlorotoluenes, and chloroethylenes. The presence of these compounds is consistent with historic Plant operations in these areas.

The F-Area organic chemical plume is centered in the vicinity of wells OW304 and OW317. The principal compounds detected in these wells were benzene and chlorobenzenes, which accounted for approximately 96 to 99 percent of the total organic parameters detected at these wells. The presence of these compounds is consistent with historic Plant operations in this area.

The N-Area organic chemical plume is centered in the vicinity of wells BH6-88 and OW314. These wells are located close to the southern Plant boundary. The principal compounds detected were chlorotoluenes, which accounted for approximately 97 and 94 percent of the total organic parameters at BH6-88 and OW314, respectively. The presence of these compounds is consistent with the overburden groundwater flow direction and historic Plant operations in this area.

The U-Area organic chemical plume was centered in the vicinity of wells OW300 and OW316. The principal compounds detected were chloroethylenes, chlorobenzenes, and chlorotoluenes at OW300 and chloroethylenes at OW316. Most of the chloroethylene was in the form of trichloroethylene. These compounds accounted for approximately 93 to 99 percent of the total organic parameters detected at these wells. The presence of these compounds is consistent with historic Plant operations in this area.

Organic Acids

Four acid compound (benzoic acid, chlorobenzoic acids, and chlorendic acid) plumes in the overburden groundwater were identified as shown on Figure 3.10. The plumes represent areas where concentrations of organic acids in the overburden groundwater are greater than 1,000 μg/L. These four plumes are all located within perimeter areas of the Plant in the C and D-Areas, F-Area, N-Area, and U-Area. The presence of these compounds is consistent with current and historic Plant operations in these areas.

Soluble Phosphorus

Six soluble phosphorus plumes in the overburden groundwater were identified as shown on Figure 3.11. The plumes represent areas where concentrations of soluble phosphorus compounds or elemental phosphorus in the overburden groundwater are greater than 1,000 μg/L. Four of these plumes are located in perimeter areas of the Plant in the C-Area, F-Area, and U-Area (soluble phosphorus compounds) and N-Area (elemental phosphorus). The other two plumes are located in interior areas of the Plant in the V-Area (elemental phosphorus) and W-Area (hypophosphite). The presence of soluble phosphorus is consistent with historic Plant manufacturing, storage, disposal, and handling activities in these areas. The V-Area phosphorus plume corresponds with the location of the elemental phosphorus presence in overburden soil discussed in Section 3.3.3 – Overburden Soil Chemical Presence.

3.3.2 BEDROCK GROUNDWATER

Chemical presence in the bedrock groundwater beneath the Plant was investigated extensively during the RFI and earlier investigations. Chemical presence in the bedrock groundwater is described in detail in the RFI Report.

The most prevalent chemical category detected in the bedrock was organic chemicals present as dissolved constituents in the bedrock groundwater and as NAPL. High pH levels, acid compounds, and soluble phosphorus, identified as significant chemical categories in the overburden groundwater, were detected sporadically and at significantly lower concentrations in the bedrock groundwater.

Chemical presence observed based on Site-Specific Indicator (SSI) data in each of the bedrock groundwater zones is summarized below. The presence of organic compounds at the Plant is consistent with historic manufacturing, storage, disposal, and handling activities and the presence of NAPL.

D-Zone

The highest total organic SSI concentrations in the D-Zone groundwater were located in the area of the Plant west of 47th Street as shown on Figure 3.12. The highest concentrations for total organic SSI occurred in the U-Area (OW416D) and the F-Area (OW405D and OW417D). The principal compounds in the U-Area were chloroethylenes (98 percent), while those in the F-Area were benzenes and chlorobenzenes (99 percent). This is the expected pattern considering observed overburden groundwater presence and the overburden and bedrock groundwater flow directions. The high total organic SSI concentrations detected in the F-Area are due to the NAPL presence observed in these wells.

A third area of elevated total organic SSI concentrations was observed in the N-Area (OW413D) adjacent to the S-Area. The principal compounds were chlorotoluenes and chlorobenzenes (95 percent).

C-Zone

The highest total organic SSI concentrations in the bedrock C-Zone groundwater were located in the area of the Plant west of 47th Street as shown on Figure 3.13. The highest total organic SSI concentration was detected in the U-Area (OW416C). The principal compounds in the U-Area were chloroethylenes, chlorobenzenes, and chlorotoluenes

(99 percent), the same as in the D-Zone. NAPL was observed in the C-Zone of the U-Area. Significantly lower total organic SSI concentrations were detected in the F-Area (OW417C), the principal compounds of which were benzene and chlorobenzenes (89 percent) similar to the D-Zone.

B-Zone

The highest total organic SSI concentrations in the bedrock B-Zone groundwater were located west of 47th Street in two distinct areas, the F-Area (OW417B) and the U-Area (OW401B and OW416B), as shown on Figure 3.14. The principal compounds in the U-Area were chloroethylenes and chlorotoluenes (99 percent for both wells). Significantly lower total organic SSI concentrations were detected in the F-Area the principal compounds of which were benzenes and chlorobenzenes (97 percent), similar to the D and C-Zones.

A-Zone

The highest total organic SSI concentrations in the A-Zone groundwater were located west of 47th Street in the F-Area (OW417A) and the U-Area (OW402A) as shown on Figure 3.15. This was expected due to the observed NAPL presence in the A-Zone in these areas. The principal compounds in the U-Area were chloroethylenes and chlorotoluenes (99.7 percent) similar to the D, C, and B-Zones. The principal compounds at the F-Area were benzene and chlorobenzenes (98 percent) similar to the D, C, and B-Zones.

A third area of elevated total organic SSI concentrations was observed in the N-Area (OW413A) adjacent to the S-Area. The principal compounds were chlorotoluenes and chlorobenzotrifluorides (96 percent). NAPL was observed in this area.

NAPL

NAPL was observed in the bedrock in the locations shown on Figure 3.16.

NAPL was observed at three locations in the D-Zone bedrock unit, OW417D, OW405D and OW409D on the northern study area boundary; and at three locations, OW216, OW225 and OW233, on the southeast study area boundary (all associated with the S-Area landfill). The presence of NAPL within the shallow bedrock was not unexpected considering the observed overburden NAPL presence in similar Plant areas. The three Plant wells located in the northern half of the Plant are positioned in the D and F-Areas where the thickness of the clay/till aquitard separating the overburden and bedrock waterbearing units is on the order of 10 to 16 feet. Since the NAPL does not penetrate the aquitard significantly, it is believed the NAPL penetrated to the bedrock unit via manmade pathways. The most likely routes are building foundations, piles and excavations for utility installations.

NAPL was observed at one location in the C-Zone bedrock unit, OW416C, which is located in the central portion of the U-Area. Historical operations in the U-Area included the production, use and storage of chloroethylenes.

NAPL was observed at two locations in the B-Zone bedrock unit, OW401B (southwest corner of the Plant) and the equivalent B-Well level of OW207 (southeast corner of the N-Area). OW207 was not installed as a well cluster but as a deep bedrock well, and hence does not have separate wells to monitor each bedrock interval. The presence of NAPL at the OW401B location was probably due to horizontal migration from OW416C towards OW401 until a vertical fracture was encountered which allowed downward migration. The potential for vertical fracturing increases in this area (i.e., OW401) as the NYPA conduits are approached. It is postulated that the blasting activities performed to remove the bedrock for conduit construction induced additional vertical fracturing and that drilling for the grout curtain wall provided a pathway for vertical migration. The presence of NAPL in OW207 is attributable to the historic Plant operations in the N-Area. The principal compounds in the N-Area bedrock NAPL (OW207) were chlorotoluenes and chlorobenzotrifluorides. This was consistent with historic Plant operations in this area.

NAPL was observed at five locations in the A-Zone bedrock unit, OW402A (west T-Area), OW417A (central F-Area), OW407A (southeast of EFW), OW413A (southeast N-Area) and the equivalent A-Well level of OW207 (southeast N-Area).

The presence of NAPL in the A-Wells was not expected due to the typically low geometric mean hydraulic conductivity (5×10^{-7} cm/sec) of this unit in the horizontal plane as measured by the injection tests performed at the time of well installation. Thus, the pathway by which NAPL may have penetrated to depth is uncertain. Possible routes may include:

- vertical bedrock fractures,
- during well construction,

- bedrock fracturing due to bedrock blasting for the construction of the NYPA conduits, and
- unsealed grout hole drilled to seal the bedrock around the intake structure for the NYPA conduits.

3.3.3 OVERBURDEN SOIL

Chemical presence in the overburden soil beneath the Plant was investigated extensively during the RFI and earlier investigations. Chemical presence in the soil is described in detail in the RFI Report.

There are four significant chemical categories present in the overburden soil beneath the Plant as follows:

i) immobile NAPL (NAPL);

ii) dioxins;

iii) elemental phosphorus; and

iv) mercury.

NAPL

NAPL in the soil beneath the Plant is present as a dense fluid mixture of chemicals which is essentially immiscible in water. The majority of the NAPL presence at the Plant is immobile NAPL (NAPL that is locked into the soil's pore spaces). NAPL in the overburden soil exists in thin discontinuous layers of porous soil and fill materials. NAPL does not penetrate into the clayey soil layers that exist at depths of 8 to 30 feet below the ground surface. NAPL in the overburden soil beneath the Plant can be found between the ground surface and the clay/till-confining unit.

NAPL has been detected in the soil beneath the B, C, D, F, N, and U-Areas of the Plant as shown on Figure 3.17. The shaded areas on Figure 3.17, which identify the areal extent of NAPL presence, do not represent areas of continuous NAPL presence but indicate areas in which NAPL is often found to be present.

Dioxins

Soils with dioxin concentrations above 1 ppb are expected to be present beneath the Plant in the areas shown on Figure 3.18. Dioxin is immobile and does not readily dissolve in water; it binds tightly to soil and sediment. Therefore, soils with dioxin concentrations above 1 ppb are located close to historic release points. Dioxin is a by-product of trichlorophenol production and is present in overburden soil in areas where historic trichlorophenol production/handling occurred. Dioxin is present in the soil beneath portions of the D, M, and X-Areas of the Plant and beneath much smaller portions of the F and U-Areas. Dioxin has not been found in the groundwater beneath the Plant.

Elemental Phosphorus

Elemental phosphorus is a waxy brown or white substance that will spontaneously combust when exposed to oxygen and produces a dense white smoke and intense heat.

Elemental phosphorus was detected in the overburden soils beneath a small portion of the V-Area as shown on Figure 3.19. Elemental phosphorus was used in various Plant chemical-manufacturing processes and is present in fill soils beneath areas where these historic manufacturing processes occurred.

Mercury

Mercury is a silvery-white, heavy, odorless liquid, insoluble in its elemental form. Mercury was detected in the overburden soil beneath former Building U-75 in the northern U-Area as shown on Figure 3.20. Mercury was used as an electrode in chlor-alkali production from 1960 to 1984 at this location.

3.3.4 OFF-SITE AREAS

Chemical presence in the bedrock and overburden north and west of the Plant was extensively investigated during the Off-Site Investigation (OSI).

The OSI was conducted in the areas north and west of the Plant because they are downgradient with respect to both bedrock and overburden groundwater flow. Chemical presence observed based on OSI data in the groundwater is summarized below.

Overburden Groundwater

Elevated concentrations of total organic SSI were detected in the overburden groundwater in three areas as shown on Figures 3.9 and 3.10. The northeast area (OW554) is located adjacent to an on-Site area of elevated overburden groundwater chemical presence situated on the Plant boundary (D-Area). There is a significant decrease in chemical content (several orders of magnitude) between OW554 and on-Site wells (OW308, OW320, OW321, WS107, and WS109), which shows that off-Site migration of chemicals in the overburden groundwater at this location is being significantly retarded. This is further shown by the total organic SSI concentrations in wells immediately north of OW554 (MW-1, MW-2 and MW-3), which were less than 7 µg/L. Even though traces of NAPL have been observed at OW554, the chemical concentrations are considerably reduced compared to on-Site. Currently, the EBDTS prevents any additional NAPL from migrating into the area near OW554 and collects APL from the areas both north and south of the EBDTS including the area of OW554.

The second area of elevated chemical presence is located in the northwest area (OW559), adjacent to an on-Site area of elevated chemical presence in the overburden groundwater. There is a significant decrease in chemical concentration between OW559 and adjacent on-Site wells (OW304 and OW317) which shows that off-Site migration of chemicals in the overburden groundwater is limited at this location.

The third area of elevated chemical presence is south of the Plant. The pattern of chemical presence in this area presented on Figure 3.9 shows total organic SSI compounds greater than 10 mg/L in areas north of the RMP extending from the southwest corner of the Plant perimeter (OW300) to the southeast corner of the N-Area (OW269). By comparison, in the areas south of the RMP, trace chemical concentrations less than 200 µg/L are present.

The organic SSI analysis conducted for wells in the immediate vicinity of the Intake Wall and Power Conduit drain system (SP6A, SP5A, OW324, OW560 and OW561) showed that the Class GA groundwater standards were met for the majority of parameters in all the wells. Table 3.2 presents a summary of the results of both rounds of analysis and the Class GA groundwater standards.

D-Zone Bedrock

Chemical presence in the D-Zone bedrock groundwater to the north and west of the Plant was evaluated during the OSI. As shown on Figure 3.12, the first line of bedrock wells located approximately 1,000 feet beyond the northern Plant boundary (OW651, OW652, OW653, OW657, OW658, and OW659) showed chemical concentrations significantly (several order of magnitude) lower than concentrations detected in wells along the Plant boundary.

Further to the north, samples collected from two wells along the south side of Royal Avenue (OW654 and OW655) and from two wells on the north side of Royal Avenue (MW-84-11, MW-88-6B) showed elevated chemical presence. These wells are located 500 to 600 feet further north of the first line of wells. Given that groundwater flow direction in the D-Zone is toward the northwest and the decreasing concentration pattern observed between the Plant boundary and the first line of wells, OxyChem believes that the chemical presence observed in the Royal Avenue wells did not migrate from the Plant.

Elevated chemical presence in the D-Zone west of the Plant was not observed as shown on Figure 3.12.

C-Zone Bedrock

Chemical presence in the C-Zone bedrock groundwater to the north and west of the Plant exhibited the same pattern as observed in the D-Zone. Total organic SSI concentrations at the first line of wells approximately 1,000 feet north of the Plant boundary were significantly lower than concentrations observed at the Plant boundary as shown on Figure 3.13. Further to the north, samples collected from along Royal Avenue (OW654C) showed slightly higher total organic SSI concentrations. Given that groundwater flow direction in the C-Zone is toward the northwest and the decreasing concentration pattern observed, OxyChem believes that the chemical presence observed in the Royal Avenue well did not migrate from the Plant.

Elevated chemical presence in the C-Zone west of the Plant was not observed as shown on Figure 3.13.

B-Zone Bedrock

Chemical presence in the B-Zone bedrock groundwater to the north and west of the Plant exhibited continuously decreasing concentrations in the area from the Plant boundary wells to the Royal Avenue wells as shown on Figure 3.14.

Elevated chemical presence was not observed in the B-zone west of the Plant as shown on Figure 3.14.

Overburden NAPL Presence

NAPL was observed in the overburden at three off-Site locations: OW554; OW300 and BH7-89; and OW241 and OW524. A trace amount of NAPL was observed during the installation of OW554. OW554 is located north of Energy Boulevard. A small quantity of NAPL was observed in the form of very small droplets during the installation of both OW300 and BH7-89. These wells are located near the southwest corner of the Plant. NAPL was observed at well OW241 and in trace amounts at OW524 during well installation. These wells are located near the southwest corner of the N-Area as shown on Figure 3.22.

Bedrock NAPL Presence

NAPL within the bedrock was observed in off-Site areas (i.e., near Royal Avenue) but OxyChem believes that an off-Site source of NAPL exists north of Royal Avenue. The geologic, hydrogeologic, and chemical distribution findings of the OSI support the conclusion that the chemistry noted in the vicinity of Royal Avenue did not originate from the Plant.

3.4 CHEMICAL MIGRATION

3.4.1 OVERBURDEN GROUNDWATER

Chemical migration potential in the overburden is different for perimeter and interior areas of the Plant. Chemical migration in each of these two areas is described below.

3.4.1.1 PERIMETER AREAS

Estimates of the off-Site overburden groundwater chemical flux crossing the Plant boundary were presented in the RFI Report. The estimated chemical fluxes, by overburden flow zone, are presented in Table 3.3.

Five major overburden flow zones for off-Site chemical migration exist beneath the Plant as shown on Figure 3.23, each representing the following perimeter areas:

Flow Zone	*Perimeter Area*	*Off-Site Flow (gpd)*	*Most Likely Mass Flux Expressed as TOC/TOX (lbs/day)*
1	South Boundary	9,700	22.1
2	East Boundary	540	0.02
3	North Boundary – East	2,500	2.03
4	North Boundary – West	2,200	0.30
5	West Boundary	4	0.001
		Total	**24.4**

The estimated total TOC/TOX chemical mass flux crossing the Plant boundary ranged from 13.3 to 37.6 lbs/day with a most likely value of 24.4 lbs/day. The chemical mass flux estimates shown are considered the most likely estimate of chemical migration based on the mean TOC/TOX concentrations at the Plant boundary and assuming a precipitation infiltration rate of 14.3 inches per year. Chemical migration through each of these flow zones is discussed below.

Flow Zone 1

The chemical mass flux is uniform through all the flow zones except for Flow Zone 1. This is attributable to the high groundwater flow rates and high TOX and TOC concentrations found in wells in this flow zone. The chemical mass flux from Flow Zone 1 represents 90 percent (22 lbs/day) of the chemical mass flux leaving the Plant through the overburden groundwater.

The direction of groundwater flow through Flow Zone 1 across the Plant boundary is toward the south. Flow through Flow Zone 1 is prevented from entering the upper Niagara River by the NYPA intake wall and by the Plant Barrier Wall as discussed in

Section 3.2.1.2. The flow is collected by the NYPA conduit drain system and eventually enters the lower Niagara River.

Flow Zone 2

The chemical flux from Flow Zone 2 is very small comprising 0.1 percent (<0.1 lb/day) of the total overburden groundwater mass flux leaving the Plant. South of Buffalo Avenue the groundwater flows south and east toward the S-Area. The S-Area Barrier Wall (completed in 1994) prevents the off-Site chemical migration from this portion of Flow Zone 2.

Groundwater in the portion of Flow Zone 2 north of Buffalo Avenue flows east and west toward 56th Street and south toward Buffalo Avenue. Off-Site chemical migration from these areas is captured by the sanitary sewers and treated at the WWTP. The easterly component of groundwater flow exhibits extremely low levels of chemical presence as indicated by SSI sampling. Wells OW311 and OW323 have concentrations below 22 μg/L.

Flow Zone 3

The loading for Flow Zone 3 at the eastern portion of the north Plant boundary is a small portion of the total flux of 24.5 lb/day (i.e., approximately 8 percent).

The analytical results for the OSI samples show that three of the four off-Site overburden groundwater wells north of Flow Zone 3 have minimal chemical presence. There is one isolated location where chemicals are present in the off-Site groundwater north of this flow zone (OW554) but the three other wells further north of OW554 have total organic SSI concentrations over the two sample rounds that do not exceed 7 μg/L and are non-detect for two of the three wells. Therefore, these results show that there is no significant off-Site migration of Plant chemicals to the north through the overburden groundwater

Flow Zone 4

The chemical mass flux from Flow Zone 4 represents approximately 1 percent (0.3 lbs/day) of the chemical mass flux passing the Plant boundary in the overburden groundwater.

Two groundwater flow directions exist in this zone; one component flows toward the 47th Street sanitary sewer within the central area of this zone, and a second component flows northwest and likely discharges to the Iroquois Street sanitary sewer. Groundwater migration to the north does not occur as demonstrated by the groundwater contours shown on Figure 3.21 and the low concentrations of chemicals in the off-Site overburden groundwater wells north and west of Flow Zone 4.

Flow Zone 5

The chemical flux from Flow Zone 5 represents <0.01 percent (<0.1 lbs/day) of the chemical mass flux leaving the Plant through the overburden groundwater.

Groundwater from Flow Zone 5 flows north toward Buffalo Avenue and west toward Iroquois Street due to the presence of sanitary sewers beneath these streets. Therefore, the minimal off-Site chemical migration that occurs from Flow Zone 5 will be captured by the sanitary sewer system and treated at the WWTP. Analytical results for the four off-Site wells west of the Plant have minimal chemical presence (i.e., total organic SSI concentrations for these four wells over the two sample rounds do not exceed 45 µg/L). These results support the flux calculations and show that there is no significant off-Site migration of Plant chemicals to the west through the overburden groundwater.

3.4.1.2 INTERIOR AREAS

Due to groundwater flow patterns within the interior areas of the Plant, chemicals present within the overburden groundwater in the interior areas cannot migrate off Site via the overburden groundwater flow regime. Chemical migration within the interior areas is toward existing sanitary and outfall sewer systems, which act as line sinks along their length. The chemicals present in the groundwater that infiltrate into these sewers are discharged off Site and are regulated by the City of Niagara Falls WWTP discharge permit and the Plant SPDES Permit. The sanitary and outfall sewer systems including permit monitoring points are shown on Figures 3.24 and 3.25, respectively. The City of Niagara Falls WWTP discharge permit and the SPDES permit are presented in Appendix A and B, respectively.

The chemical mass loading leaving the Plant via the sanitary and outfall sewers was estimated in the RFI Report. The estimated chemical mass loading leaving the Plant via the sanitary and outfall sewers was estimated to be 45.2 and 58.1 lbs/day, respectively.

All sanitary sewer flow is treated by the City of Niagara Falls WWTP and all outfall flow is in compliance with SPDES discharge requirements.

3.4.2 BEDROCK GROUNDWATER

The predominant flow direction in the bedrock zones beneath the Plant is toward the north and northwest. No component of bedrock groundwater beneath the Plant flows toward the south. Therefore, chemical migration is toward the north and northwest.

Estimates of off-Site bedrock groundwater chemical flux crossing the Plant boundary were presented in the RFI report. A summary for each bedrock zone is presented below.

Bedrock D-Zone

The D-Zone was divided into six flow zones. Chemical mass flux estimates for the nine scenarios in the D-Zone are shown in Table 3.4. The D-Zone Round 2 total organic SSI plumes and groundwater flow zones for March 1990 are shown on Figure 3.26.

The estimated total chemical mass flux crossing the Plant boundary ranged from 0.1 to 6.8 lbs/day with a most likely value of 1.3 lbs/day at the most likely flow rate. The highest flux occurred in Flow Zone 1 located along the western boundary of the Plant. Flow Zone 1 represented 67 percent of the total D-Zone chemical mass flux. The direction of groundwater flow through all D-Zone flow zones was toward the north/northwest.

Bedrock C-Zone

Chemical mass flux estimates for the nine scenarios in the C-Zone are shown in Table 3.5. The C-Zone Round 2 total organic SSI plumes and groundwater flow zones for March 1990 are shown on Figure 3.27.

It was estimated that the total chemical mass flux crossing the Plant boundary ranged from 0.2 to 45.4 lbs/day. The average most likely chemical flux was 4.4 lbs/day.

The highest flux occurred along the western boundary and the west part of the northern boundary. The chemical mass flux from the western boundary and west part of the northern boundary represented 55 percent and 33 percent of the total C-Zone chemical mass flux, respectively. The elevated chemical mass flux for these flow zones was attributable to the high groundwater flow rates and elevated chemical concentrations through these flow zones. The direction of groundwater flow through the bedrock C-Zone interval, in general, was toward the north.

Bedrock B-Zone

The B-Zone was divided into seven flow zones. Chemical mass flux estimates for the nine scenarios in the B-Zone are shown in Table 3.6. The B-Zone Round 2 total organic SSI plumes and groundwater flow zones for March 1990 are shown on Figure 3.28.

The estimated total chemical mass flux crossing the Plant boundary ranged from 0.009 to 1.7 lbs/day with an average most likely value of 0.25 lbs/day.

The highest chemical mass flux occurred in Flow Zones 4, 5, 6, and 7 located along the northern boundary of the Plant. The chemical mass flux from Zones 4, 5, 6, and 7 represented 21 percent, 20 percent, 22 percent, and 36 percent of the total B-Zone chemical mass flux, respectively.

Bedrock A-Zone

Chemical mass flux estimates for the nine scenarios in the A-Zone are shown in Table 3.7. The A-Zone Round 2 total organic SSI plumes and B-Zone groundwater flow zones for March 1990 are shown on Figure 3.29. B-Zone hydraulic data was used for A-Zone estimates because the A-Zone wells had not recovered sufficiently to determine groundwater flow paths in this zone. This provides a conservative estimate.

The estimated total chemical mass flux crossing the Plant boundary ranged from 0.0013 to 0.0057 lbs/day with an average most likely value of 0.003 lbs/day.

The highest chemical mass flux occurred in Flow Zone 1 located along the western boundary of the Plant. The chemical mass flux from Flow Zone 1 represented 85 percent of the A-well chemical mass flux. The elevated chemical mass flux for this zone was attributable to the high TOX concentrations observed in well OW402A. The TOX concentrations observed in OW402A were 470,000 and 220,000 µg/L for SSI Rounds 1 and 2 respectively. The next highest TOX concentration observed in the A-Zone wells was 4,000 µg/L.

NAPL

For the purpose of this report all bedrock NAPL discussions refer to dense NAPLs, which are those NAPLs that are more dense than water. NAPL movement is primarily controlled by gravity. Therefore, the primary migration pathway for NAPL is downward. The higher density of NAPL combined with sloped or vertical pathways (e.g., rock fractures) controls the extent and depth of movement of NAPL through the bedrock. Natural bedrock groundwater movement beneath the Plant appears to have little influence on NAPL migration but groundwater movement induced by the S-Area remedial program has confined N-Area NAPL presence in the bedrock. NAPL migration is controlled by the presence or absence of vertical and horizontal rock fractures and can occur in the opposite direction of groundwater flow. Considering that the majority of the bedding planes (pathways) in the bedrock beneath the Plant dip in a southerly direction, the most prominent direction of NAPL migration in the bedrock beneath the Plant is expected to be to the south.

3.4.3 OVERBURDEN SOIL

Chemicals in the overburden soil at the Plant can migrate by three mechanisms:

- NAPL flow;
- dissolution into groundwater; and
- erosion of soils by wind and surface water.

NAPL Flow

The ability for mobile NAPL to flow depends on the NAPL head and the porosity of the surrounding soil. Low porosity soil, such as the clay/till aquitard beneath the Plant, blocks the movement of NAPL. The volume of mobile NAPL present also determines the distance that NAPL will flow. The direction of NAPL flow is controlled by gravity.

Whenever NAPL flows through a soil it leaves a volume of immobile residual in the pore spaces it travels through. The NAPL continues to flow until all of it becomes residual, the NAPL head is not great enough for movement through the soil's pore spaces, or flow is blocked by a lower porosity soil. Most of the NAPL beneath the Plant occurs in the soil's pore spaces as an immobile residual (NAPL). The remainder is in small pools of free product that are either blocked from further movement or lack the head required to flow through the surrounding soil.

The flow of mobile NAPL is primarily downward until a barrier to vertical migration is encountered. Vertical flow will stop at this contact and horizontal flow may result with migration following the slope of the top of the barrier. The direction of NAPL flow is not influenced by groundwater flow and NAPL often flows in the opposite direction of the local groundwater. If the horizontally migrating NAPL encounters a discontinuity in the barrier (a vertical migration pathway), the preferred direction of flow again will be vertically downward along the steepest available path.

Dissolution

Chemicals in the overburden soil can dissolve or diffuse into the overburden groundwater where the chemicals and groundwater are in contact. The chemicals will then migrate with the groundwater. There are some exceptions to this such as dioxin, which binds tightly to soil and sediment. Therefore, dioxin is not present in the groundwater beneath the Plant. NAPL and elemental phosphorus are known to have dissolved into the overburden groundwater beneath the Plant as evidenced by the groundwater chemical plumes in the vicinity of high concentrations of these chemicals in the soil.

Erosion

Exposed surface soil containing NAPL, dioxin, or elemental phosphorus could be eroded and transported to other areas of the Plant or off-Site areas by wind, surface water flow, and disturbances caused by human activities. This process is believed to have been the most likely migration/transport mechanism for dioxin because the highest concentrations of dioxin at the Plant were detected in surface soil where erosion is most likely to have historically occurred. Elemental phosphorus, dioxin, and NAPL in subsurface soil also could have been exposed by erosion of clean overlying soil layers.

4.0 REMEDIAL GOALS

The corrective action design goals for the remediation of the Plant are as follows:

1. Restrict off-Site migration of OxyChem hazardous waste constituents in the bedrock groundwater.
2. Restrict off-Site migration of OxyChem hazardous waste constituents in the overburden groundwater.
3. Restrict discharge of OxyChem hazardous waste constituents to the outfalls.
4. Restrict discharge of OxyChem hazardous waste constituents to the sanitary sewers.
5. Restrict migration of OxyChem hazardous waste constituents from the overburden to bedrock.
6. Minimize human contact with OxyChem hazardous waste constituents in on-Site soils.
7. Minimize need for future/ongoing remediation and operation and maintenance activities by implementing solutions or technologies that will be reliable and effective over the long term.
8. Maintain compatibility with remedial efforts for specific areas of the Plant (e.g., S-Area and any off-Site remediations) and with Plant operations.
9. Reduce the concentration of hazardous waste constituents within the soil and groundwater at the Plant with time to acceptable State and Federal levels consistent with the use of the property and adjacent property.
10. Protect City of Niagara Falls drinking water supply system components at the Plant from releases of hazardous waste constituents.

These goals will be achieved through implementation of the corrective measures developed during the CMS, including the bedrock groundwater CMS (BGCMS), overburden groundwater CMS (OGCMS), and overburden soils CMS (OSCMS), and the corrective measures for the off-Site areas detailed in Section 6.0. The definition of "restrict", as used in the above goals, is to eliminate significant off-Site discharge or migration of OxyChem hazardous waste constituents that pose a potential threat to human health or the environment to the extent possible or technically feasible.

Based on discussions with EPA/State, it was agreed that the primary objective of the corrective measures program is to restrict chemical migration from crossing the Plant boundary to off-Site areas with containment technologies.

5.0 DEVELOPMENT OF AREAS FOR CORRECTIVE MEASURES

5.1 BEDROCK GROUNDWATER

The predominant flow direction in the bedrock zones beneath the Plant is toward the north and northwest. No component of bedrock groundwater beneath the Plant flows toward the south or east. Therefore, chemical migration is to the north and northwest. Through discussions with the EPA/State it was agreed that the primary objective of the BGCMS was to reduce chemical loadings crossing the Plant boundary. The most likely chemical flux crossing the Plant boundary as discussed in Section 3.4.2 is as follows:

		Most Likely Chemical Flux (lbs/day)
D-Zone		1.3
C-Zone		4.4
B-Zone		0.25
A-Zone		0.003
	Total	6.0

The following reviews off-Site chemical migration patterns and identifies where corrective measures are required in each bedrock zone.

D-Zone

The most likely chemical mass flux crossing the Plant boundary in the D-Zone was estimated to be 1.3 lbs/day. Approximately 67 percent of the total chemical mass flux crosses the west Plant boundary and approximately 29 percent crosses the north Plant boundary west of OW408D. This represents 96 percent of the chemical mass flux crossing the Plant boundary and corresponds to the location of major chemical plumes in the D-Zone as shown on Figure 3.22. Corrective measures have been implemented to address chemical migration across the west Plant boundary and the north Plant boundary west of OW408D.

The most likely chemical mass flux crossing the Plant boundary east of OW408D was estimated to be 0.04 lbs/day or 4 percent of the total mass flux crossing the Plant boundary. Groundwater flow through this area exhibits low levels of chemical presence as shown by SSI sampling. Total organic SSI concentrations in monitoring wells OW409D and OW410D were 220 μg/L and 4 μg/L, respectively. Therefore, chemical migration from the area east of OW408D is not a significant off-Site discharge that requires remediation.

C-Zone

The most likely chemical mass flux crossing the Plant boundary in the C-Zone was estimated to be 4.4 lbs/day. Approximately 55 percent of the total chemical mass flux crosses the west Plant boundary and approximately 33 percent crosses the north Plant boundary west of OW408C. This represents 88 percent of the chemical mass flux crossing the Plant boundary and corresponds to the location of major chemical plumes in the C-Zone as shown on Figure 3.23. Corrective measures have been implemented to address chemical migration in these areas.

The most likely chemical mass flux crossing the Plant boundary east of OW408C was estimated to be 0.5 lbs/day or 12 percent of the total mass flux crossing the Plant boundary in the C-Zone. Groundwater flow through this area exhibits extremely low levels of chemical presence as shown by SSI sampling. The total organic SSI concentration in monitoring wells OW409C and OW410C east of OW408C was 3 µg/L and 1 µg/L, respectively, which are below New York State Class GA groundwater standards. Therefore, chemical migration from the area east of OW408C is not a significant off-Site discharge that requires remediation.

B-Zone

The most likely chemical mass flux crossing the Plant boundary in the B-Zone was estimated to be 0.25 lbs/day. Approximately 70 percent of the total chemical mass flux crosses the east half of the north Plant boundary. This does not correspond to the location of the major chemical plumes in the B-Zone as shown on Figure 3.24. Total SSI concentrations along the west Plant boundary ranged between 260 µg/L and 82,000 µg/L and the total SSI concentrations along the north Plant boundary west of OW408B ranged 210 µg/L and 67,000 µg/L. The total SSI concentrations in these areas were substantially higher than those observed east of OW408B. The total SSI concentrations east of OW408 at OW409B and OW410B were 19 µg/L and 65 µg/L, respectively. The higher chemical mass flux east OW408B is a result of greater groundwater flow and not elevated chemical concentrations. The mass flux through this area (0.18 lbs/day) represents only 3 percent of the total mass flux migrating off Site via the entire bedrock unit. Therefore, chemical migration from the area east of OW408B is not a significant off-Site discharge that requires corrective measures.

Although the chemical mass flux that crosses the west Plant boundary and the north Plant boundary west of OW408B is very small, corrective measures have been implemented to address the elevated chemical presence in these areas.

A-Zone

The most likely chemical mass flux crossing the Plant boundary in the A-Zone was estimated to be 0.003 lbs/day. This represents 0.05 percent of the total chemical mass flux migrating off Site via the entire bedrock unit. The chemical presence in the A-Zone is localized to small areas and has extremely limited potential for off-Site migration due to the low hydraulic conductivity of the unit ($<1 \times 10^{-7}$ cm/sec). Therefore, corrective measures are not required to address the groundwater chemical presence in the A-Zone.

NAPL was observed in only a few locations in the bedrock as shown on Figure 3.16 and discussed in Section 3.3.2. Due to the NAPL's high specific gravity, it has migrated through the available fracture network to deeper units and has been observed to be present in the A-Well unit. The pathway by which NAPL may have penetrated to the depth monitored by the A-Wells is uncertain. Once the NAPL reaches the A-Zone, however, its ability to migrate further is very limited due to the low hydraulic conductivity of the A-Zone bedrock unit and the underlying Rochester Shale. The low hydraulic conductivity of these units indicates the tight nature of these formations. The presence of a regional upward gradient at this depth may also have a slight retarding effect on the downward migration of NAPL.

The majority of NAPL observed in the bedrock was found in trace amounts and is not collectable. Collectable quantities of NAPL were found in only three wells: OW402A, OW413A, and OW417A. Corrective measures are required to address the presence of NAPL in these three wells.

5.2 OVERBURDEN GROUNDWATER

The OGCMS evaluated the chemical migration potential within perimeter and interior areas of the Plant. Through the discussions held with the EPA/State, it was agreed that the primary objective of the OGCMS was to reduce the chemical loading crossing the Plant boundary. The following section reviews the off-Site chemical migration patterns, and identifies where corrective measures are required.

5.2.1 PERIMETER AREAS

The overburden groundwater flow leaving the Plant was subdivided into five flow zones as described in Section 3.4.1.1. Figure 3.21 shows the location of the five perimeter flow zones. The respective off-Site chemical flux estimates for each flow zone are as follows:

Flow Zone	*Perimeter Area*	*Off-Site Flow (gpd)*	*Most Likely Mass Flux expressed as TOC/ TOX (lbs/day)*
1	South Boundary	9,700	22.1
2	East Boundary	540	0.02
3	North Boundary - East	2,500	2.03
4	North Boundary - West	2,200	0.3
5	West Boundary	4	0.001
		Total	**24.4**

Flow Zone 1 - South Boundary

The chemical mass flux from Flow Zone 1 represents 90 percent (22.1 lbs/day) of the total chemical mass flux leaving the Plant through the overburden groundwater (24.4 lbs/day). The groundwater flow direction along the southern Plant boundary is initially to the south and then to the west following the alignment of the IIPT. The flow is intercepted by the NYPA conduit drain system that eventually discharges to the lower Niagara River.

No overburden groundwater discharge from the Plant enters the upper Niagara River as the construction of the Plant Barrier Wall and the existence/enhancement of the inward gradient through the wall have eliminated this possibility. Nonetheless, Flow Zone 1 will be further addressed to reduce the chemical mass flux leaving the Plant boundary.

Flow Zone 2 - East Boundary

The Flow Zone 2 chemical mass flux is very small comprising 0.1 percent (<0.1 lbs/day) of the total mass flux leaving the Plant through the overburden groundwater (24.4 lbs/day). Figure 3.21 shows the groundwater flow paths for Flow Zone 2. South of Buffalo Avenue the groundwater flows south and east toward the S-Area. The S-Area Barrier Wall prevents off-Site chemical migration from this portion of Flow Zone 2.

Groundwater within the portion of Flow Zone 2 north of Buffalo Avenue flows east toward 56th Street, south toward Buffalo Avenue, and west toward 53rd Street. The westerly and southerly component of groundwater flow is created by the influences of sanitary sewers beneath 53rd Street and Buffalo Avenue. Off-Site chemical migration from these areas is captured by the sanitary sewers and treated at the WWTP. The easterly component of groundwater flow exhibits extremely low levels of chemical presence as shown by SSI sampling. Wells OW311 and OW323 have concentrations below 22 µg/L.

Therefore, chemical migration from Flow Zone 2 is not a significant off-Site discharge that requires remediation.

Flow Zone 3 - North Boundary – East

The Flow Zone 3 chemical mass flux represents approximately 8 percent (2 lbs/day) of the total mass flux leaving the Plant through the overburden groundwater (24.4 lbs/day).

The off-Site flow estimates show that approximately 2,500 gallons of groundwater per day cross the Plant boundary from this zone. The westerly portion of this flow zone is captured by the Energy Boulevard Drain Tile System (EBDTS) which collects groundwater and NAPL. The groundwater is discharged to the Iroquois Street sanitary sewer for treatment. The NAPL is contained within a wet well and is periodically collected from the wet well and treated. Flow measurements taken during dry weather conditions show groundwater collection rates ranging from 2.4 gpm (April 1982) to 10.0 gpm (April 1991). The average groundwater collection rate is 6.0 gpm or 8,600 gallons per day. The EBDTS creates a radial capture zone around the system and captures groundwater from areas north, south, east, and west of the system. Assuming that half of this flow originates from off-Site areas, the remaining flow captured by the EBDTS is from the Plant perimeter (i.e., 4,300 gallons per day). Off-Site groundwater flow from Flow Zone 3 was estimated to be 2,500 gallons per day. Comparison to the EBDTS dry weather flow measurement average of 4,300 gallons per day shows that the EBDTS is effective in this flow zone and captures the majority of off-Site groundwater flow and chemical loading from this boundary of the Plant.

The EBDTS was installed to prevent groundwater from infiltrating into the storm sewer that was constructed to drain Energy Boulevard. The EBDTS is effective in reducing chemical loading in the storm sewer along Energy Boulevard to levels below discharge limits. The storm sewer on Energy Boulevard extends substantially to the east and west of the EBDTS. The chemical loading in the storm sewer remains below discharge limits supporting the postulation that the EBDTS captures the majority of off-Site chemical migration from Flow Zone 3.

The effectiveness of the EBDTS is substantiated further by the Off-Site Investigation (OSI) and SSI sampling performed and the hydraulic monitoring data collected. The analytical data presented in the OGCMS showed that the wells north of Energy Boulevard have minimal chemical presence. Hydraulic monitoring data also show groundwater flow gradients to the EBDTS demonstrating effective capture of the off-Site overburden groundwater flow. Consequently, the remediation for Flow Zone 3 is already in place and has been operating effectively since 1981.

Flow Zone 4 - North Boundary – West

The chemical mass flux from Flow Zone 4 represents approximately 1 percent (0.3 lbs/day) of the total chemical mass flux leaving the Plant boundary via the overburden groundwater (24.5 lbs/day).

Figure 3.21 shows the groundwater flow pattern of Flow Zone 4. Two groundwater flow directions exist in this zone; one flow component direction is toward the 47^{th} Street sanitary sewer within the central area of this zone and one is a northwesterly component of groundwater flow that discharges to the Iroquois Street sanitary sewer. Both systems discharge to the WWTP for treatment (i.e., Iroquois/47^{th} Street sewers). Subsequently, groundwater movement, although minor in mass and volume, ultimately drains into the respective sewers, which are treated.

Groundwater movement to the north does not occur as demonstrated by the groundwater contours shown on Figure 3.21 and the low level of chemicals in the off-Site overburden groundwater wells north and west of this flow zone.

The Iroquois Street sanitary sewer and its bedding is considered a preferential migration pathway for overburden groundwater. Groundwater discharge may occur to the sewer itself or to the bedrock regime as this sewer bedding is located on top of or within the bedrock. Groundwater discharge to the sanitary sewer is treated at the WWTP. If discharge occurs to the bedrock, capture and treatment will occur through the bedrock corrective measures. Consequently, remedial efforts in this area are not required as a significant off-Site discharge does not occur.

Flow Zone 5 - West Boundary

The chemical mass flux from Flow Zone 5 represents <0.01 percent (<0.1 lbs/day) of the chemical mass flux leaving the Plant through the overburden groundwater (24.5 lbs/day). The off-Site flow estimate for this flow zone is approximately 4 gallons per day.

As shown on Figure 3.21, groundwater from this flow zone flows north toward Buffalo Avenue and west toward Iroquois Street due to the presence of sanitary sewers beneath these streets (Iroquois Street Sanitary Sewer). Therefore, the minimal off-Site chemical migration that may occur from this flow zone will be captured by the sanitary sewer system and treated at the WWTP.

The trace chemical mass flux from this flow zone is not a significant discharge that requires remediation.

5.2.2 INTERIOR AREAS

Due to groundwater flow patterns within the interior areas of the Plant, chemicals present within the overburden groundwater in the interior areas cannot migrate off Site via the overburden groundwater flow regime. Consequently, remedial efforts in the overburden groundwater flow regime are not required in the interior areas.

Groundwater flow within interior areas of the Plant migrates toward the sanitary and outfall sewer system. Therefore chemicals in the groundwater have the potential to infiltrate into the sewers and migrate off Site. The estimated total TOC/TOX chemical mass flux across the Plant boundary from the outfall and sanitary sewer systems is 58.1 lbs/day and 45.2 lbs/day, respectively. Therefore, corrective measures are required to reduce the chemical mass flux crossing the Plant boundary via outfall and sanitary sewers.

5.3 OVERBURDEN SOIL

Overburden soil conditions at the Plant are affected by localized conditions such as geology, hydrogeology, chemical source areas, surface conditions, varying chemical composition, and hydraulic influences. Therefore, different areas of the Plant may require specific remedial technologies to address the localized conditions encountered. Areas of NAPL presence and elevated chemical concentrations for dioxin, elemental phosphorus, and mercury are shown on Figures 3.17 through 3.20, respectively.

The primary compounds of concern with respect to remediation of the above four chemical groupings are NAPL and dioxins. Although elemental phosphorus is not a regulated compound, it was included as a chemical grouping due to its flammable nature when exposed to air.

The four chemical groupings encountered at the Plant can be divided into seven areas that may need to be addressed. These areas are summarized as follows:

Area	*Chemical Group*	*Current Status of Area*
• C/D-Area	NAPL and dioxin	Asphalt cap, NAPL collection trench
• F-Area	NAPL and dioxin	Asphalt cap, gravel surface
• T-Area	NAPL	Asphalt cap
• U-Area	NAPL	Asphalt cap, gravel surface
	dioxin	asphalt cap
	mercury	asphalt cap, sheet pile wall containment
• N-Area	NAPL	Asphalt cap, NAPL collection trench/sump/wells
• X-Area	dioxin	Soil/grass cap
• V-Area	elemental phosphorus	Asphalt cap, gravel surface

The only overlapping of areas with elevated chemical presence in the overburden soils occurs in the C/D-Area where the NAPL and dioxin areas overlap. NAPL and dioxin have distinctly different chemical and physical characteristics and may need to be addressed differently even in areas where they are both present.

5.3.1 SOLID WASTE MANAGEMENT UNITS

Within the Plant area there are areas where materials that contain hazardous waste constituents are managed or have been spilled historically. The SWMUs at the Plant include storage areas, treatment systems, disposal areas, spill areas, containment cells, and the Plant sewer systems.

The SWMUs capable of being potential sources of chemical release have been categorized according to the area of the Plant in which they are located. These SWMUs are located in nine areas, the C-Area, D-Area, F-Area, M-Area, N-Area, T-Area, Mercury Cell Area, U-Area, and X-Area, as shown on Plan 2. SWMUs that were not included in these areas have not released chemicals to the environment or exhibit a low potential for chemical release. The S-Area and V-Area SWMUs are being addressed separately under the S-Area Settlement Agreement.

All of the SWMUs listed in the 1988 RCRA Permit will be addressed as a part of a source area instead of on a unit-by-unit basis. Any historic releases from these SWMUs will be addressed based on the chemical groups present in the overburden soil (i.e., NAPL, dioxin, elemental phosphorus, and mercury). Any releases to the overburden groundwater from these SWMUs will be addressed by existing and proposed groundwater corrective measures. The only SWMU listed in the 1988 RCRA Permit that requires remediation outside of the six source areas is the historic V-56 phosphorus storage area.

5.3.2 SPILL AREAS

Chemicals have been inadvertently spilled at the Plant during the course of production, storage, and handling. Spills can be postulated to have occurred at or in the areas suspected to contain NAPL or waste based on field observations or in former production/storage areas of the Plant.

All of the elevated concentration areas at the Plant are located within the immediate vicinity of current or historic storage or production areas. It is likely that spills that occurred during the course of normal production/operation activities within these areas were the major sources of elevated chemical concentrations in the soil.

5.4 OFF-SITE AREAS

5.4.1 OVERBURDEN GROUNDWATER

Elevated chemical presence was not observed in 10 of the 12 OSI overburden wells located along the north and west boundaries of the Plant as described in Section 3.3.4. This shows that off-Site chemical migration through the overburden groundwater generally is limited to areas in close proximity to the Plant. Therefore, corrective measures to address these areas are not required.

Elevated chemical presence was observed in the northeast area at OW554. Off-Site chemical migration in this area is being significantly retarded as evidenced by:

- significant decrease in chemical concentrations (several orders of magnitude) between OW554 and on-Site wells;
- chemical concentrations at three wells north of OW554 were less than 7 μg/L; and
- the EBDTS prevents further off-Site chemical migration.

Therefore, corrective measures to address this area are not required.

Elevated chemical presence was also observed in the northwest area at OW559. Off-Site chemical migration in this area is limited as evidenced by a significant decrease in chemical concentrations between OW559 and on-Site areas. Therefore, corrective measures to address this area are not required.

Elevated chemical presence (greater than 10 μg/L total organic SSI) was observed in areas south of the Plant and north of the RMP extending from the southwest corner of the Plant to the southeast corner of the N-Area but total organic SSI concentrations were less than 200 μg/L south of the RMP. Hazardous waste constituents that have crossed the Plant boundary and entered the shotrock to the southwest of the Plant (Figure 3.9) have naturally attenuated to Class GA standards prior to entering the conduit drain system as shown by the results of SDCP and OSI sampling. Based on these results and the large volumes of groundwater that would require extraction, OxyChem believes that it is unnecessary to attempt to capture hazardous waste constituents which have entered the shotrock southwest of the Plant.

5.4.2 OVERBURDEN NAPL PRESENCE

The NAPL plume south of the U-Area shown on Figure 3.22 was defined by wells OW300 and BH7-89. A small quantity of NAPL was observed in the form of very small droplets during the installation of OW300. NAPL was not observed during subsequent well development or sampling for the Site-specific Indicator (SSI) program. A small quantity of NAPL was observed in the form of very small droplets during the installation of BH7-89. NAPL was not observed in the split spoons but was observed on the augers during removal. A small quantity of NAPL was observed during SSI sampling but the quantity was insufficient to collect a sample for analysis. Therefore, the overburden exhibits trace amounts of immobile NAPL which is isolated to the immediate vicinity of OW300 and BH7-89. Thus, it is not practicable to remove the NAPL from these areas.

The NAPL plume south of the N-Area shown on Figure 3.22 was defined by wells OW313, OW241 and OW524. Wells OW241 (bedrock well) and OW524 were installed under the S-Area remedial program. A trace quantity of NAPL was observed during the installation of OW524. Well OW241 and OW524 are separated by wells OW523 and OW537. Neither of these wells exhibited NAPL presence. Therefore, the NAPL presence south of the N-Area is isolated to the area of OW241 which is approximately 25 feet south of the Plant perimeter. NAPL presence along the Plant perimeter is being addressed by the NAPL collection programs in-place for OW313 and the Outfall 003 NAPL collection trench, the Stage 3 groundwater collection system, and by the S-Area barrier wall. Therefore, additional NAPL collection is not necessary.

5.4.3 BEDROCK GROUNDWATER

Chemical presence in the off-Site D-, C-, and B-Zone bedrock groundwater to the north of the Plant was detected in a line of wells approximately 1,000 feet north of the Plant but at concentrations significantly lower (several orders of magnitude) than concentrations detected in wells along the Plant boundary as shown on Figures 3.12, 3.13, and 3.14. Although the chemical presence north of the Plant boundary is not significant, corrective measures may be required to address the chemical presence. This is further discussed in Section 6.4.2.

Elevated chemical presence in the off-Site D, C, and B-Zone bedrock groundwater to the west of the Plant was not observed as shown on Figures 3.12, 3.13, and 3.14, respectively. Therefore, corrective measures to address this area are not required. Elevated chemical presence observed in the immediate vicinity of the west Plant boundary will be addressed by on-Site bedrock groundwater corrective measures.

5.4.4 BEDROCK NAPL PRESENCE

NAPL within the bedrock was observed in off-Site areas (i.e., near Royal Avenue) but OxyChem believes that an off-Site source of NAPL exists north of Royal Avenue. The geologic, hydrogeologic, and chemical distribution findings of the OSI support the conclusion that the chemistry noted in the vicinity of Royal Avenue did not originate from the Plant. Therefore, remediation of the observed NAPL is not required under OxyChem's Corrective Action Program.

6.0 IMPLEMENTATION OF INTERIM CORRECTIVE MEASURES

ICMs have been implemented at the Plant to address the remedial goals for three of the four Plant media that require corrective measures discussed in Section 5.0 (bedrock groundwater, overburden groundwater, and soil). ICMs have not been implemented for off-Site areas at this time. ICMs that have been implemented at the Plant are discussed in the following sections in the order in which they were implemented.

6.1 BEDROCK GROUNDWATER

A CMS for bedrock groundwater was completed in August 1992. The remedial system chosen involved hydraulic containment, treatment, and monitoring of the chemical plume in the bedrock groundwater beneath the Plant and consisted of the following components:

- A groundwater extraction system capable of creating a hydraulic barrier in the D, C, and B-Zones of the bedrock along the northern and western Plant property boundaries.
- An on-Site groundwater treatment system capable of treating 800 gpm.
- A hydraulic monitoring program to monitor the effectiveness of the hydraulic containment system.
- A chemical monitoring program to verify long-term changes.

The bedrock groundwater remedial system components collect and treat bedrock groundwater flow at the north and west (downgradient) boundaries of the Plant except the east portion of the north Plant boundary (east of OW408). Concentrations of Site-related chemicals in the bedrock groundwater in the eastern downgradient area are low and have been decreasing over time. Therefore, as discussed in Section 5.1, corrective measures are not needed in this area.

In addition, an ICM was implemented to address the presence of NAPL within the bedrock. The ICM consisted of the following components:

- NAPL collection from on-Site bedrock wells where substantial quantities of NAPL could be recovered.
- treatment of collected NAPL.

Each of these ICMs is discussed below.

6.1.1 EXTRACTION AND TREATMENT SYSTEM

The primary goals of the bedrock groundwater remedial system are to restrict off-Site migration of hazardous waste constituents in the bedrock groundwater (Goal 1) and to reduce the concentration of hazardous waste constituents within the bedrock groundwater with time (Goal 9). A hydraulic barrier in the D, C, and B-Zones was created along the north and west Plant boundaries by operating a groundwater extraction and treatment system as shown on Figure 6.1.

The extraction and treatment system consists of 19 extraction wells (six D-Zone wells, six C-Zone wells, and seven B-Zone wells), a connecting forcemain, and an on-Site treatment system. The location of each extraction well nest is shown on Figure 6.1. The extraction wells were installed with 6-inch diameter open bedrock coreholes to accommodate high rate pumps. A carbon treatment facility was constructed in the F-Area to treat the extracted groundwater before discharging the water to Outfall 007. The treatment facility and forcemain system is shown on Figure 6.2.

OxyChem began operating the bedrock groundwater extraction and treatment system on April 1, 1996. Operation of the bedrock groundwater extraction and treatment system is being implemented in three phases as described in the document entitled "Corrective Measures Implementation, Bedrock Groundwater Remediation, Design Report (30 Percent Completion)", dated June 1993. The three phases are:

Phase I - Startup;
Phase II - Optimization; and
Phase III - Full-scale operation.

OxyChem completed Phase I and the original Phase II period (one year) as discussed in the "One Year Performance Evaluation", dated July 1997. The Phase II optimization period has been extended because the system could not be operated at the desired flow rate due to higher than anticipated vinyl chloride concentrations and the need for an increase in treatment capacity. An air-stripping/thermal oxidation system is currently under construction at the treatment facility to address the presence of vinyl chloride in the D-Zone bedrock groundwater regime. The treatment system upgrade will be operational by late-1998. Phase III will commence when the treatment system has been completed and the optimum flow rate for containment has been achieved.

The treatment system currently consists of an equalization tank and two sets of three carbon beds in series. The current pumping rate is approximately 740 gpm from the three zones (100 gpm from the D-Zone, 600 gpm from the C-Zone, and 40 gpm from the B-Zone). After planned modifications are made, the treatment system will consist of an equalization tank, an air stripping/thermal oxidation system, and three sets of two carbon beds in series. The modifications will allow the treatment system to accommodate a maximum flow rate of 1,200 gpm. The air stripping/thermal oxidation system has been installed and the carbon beds are currently being realigned. The anticipated flow rate to achieve complete hydraulic containment is approximately 1,000 gpm. A flow diagram for the planned modifications is shown on Figure 6.3.

Consistent bedrock hydraulic containment has not yet been attained along the north and west Plant boundaries; however, OxyChem anticipates that when the pumping rates are increased to the target levels (1,000 gpm), complete on-Site hydraulic containment of bedrock groundwater will be achieved.

The fourth semi-annual performance evaluation for the bedrock groundwater extraction and treatment system concluded the following:

- hydraulic containment was maintained in the D-Zone from December 1997 to April 1998 as shown on Figure 6.4. The capture zone extended up to 500 feet off-Site. Local inward gradients were present in two to four of the seven flow zones during the monitoring events;
- hydraulic containment was maintained in the C-Zone from December 1997 to April 1998 as shown on Figure 6.5. The capture zone extended up to 600 feet off-Site. Local inward gradients were present in two to five of the seven flow zones during the monitoring events;
- hydraulic containment was maintained in the B-Zone groundwater flow regime by pumping the existing B-Zone extraction wells at a total rate of approximately 40 gpm as shown on Figure 6.6. The capture zone extended up to 1,000 feet off-Site. Local inward gradients were present in two to three of the eight flow zones;
- total organic SSI concentrations in the majority of the wells included in the Year Two sampling program have decreased compared to the previous sampling event as shown in Table 6.1; and
- the groundwater extraction system has been effective in removing chemicals present in the bedrock groundwater flow system. The chemical loading to the treatment system for the March 1998 monitoring event was 30 lbs/day.

6.1.2 NAPL REMOVAL

A NAPL recovery program has been implemented to provide containment of NAPL in the bedrock beneath the Plant. The program involves the collection of NAPL from any bedrock well exhibiting substantial collectable quantities of NAPL. There are only three bedrock wells that exhibit collectable quantities of NAPL, OW402A, OW413A, and OW417A.

The current program to address the presence of NAPL in the bedrock involves NAPL collection and/or monitoring in 17 A-Zone wells as shown on Figure 6.7. The schedule for NAPL recovery and collection activities for the bedrock regime is summarized below.

- All bedrock A-Zone wells are checked for NAPL presence on an annual basis. If NAPL is detected in an A-Zone well, the corresponding B-Zone well also is checked for NAPL.
- NAPL is collected on a semi-annual basis from wells OW402A and OW413A. If the volume of NAPL collected from either well is greater than 100 gallons during any one event, the collection frequency increases to quarterly until the volume collected in one event is less than 50 gallons, after which semi-annual pumping resumes.
- NAPL is collected from well OW417A on an annual basis. If the volume of NAPL collected during any one event is greater than 100 gallons, the pumping frequency increases to quarterly until the volume of NAPL collected in one event is less than 50 gallons, after which annual pumping resumes.

Collected NAPL currently is incinerated at OxyChem's LTDU.

The following amounts of NAPL have been collected from these wells as of the end of 1997:

	Amount of NAPL (gallons)
OW402A	5,700
OW413A	320
OW417A	25

The collection and incineration of NAPL from the bedrock beneath the Plant is consistent with Goal 9 – reduction of the concentration of hazardous waste constituents within the bedrock groundwater with time.

6.2 OVERBURDEN GROUNDWATER

The second phase of the CAP addressed chemical presence in the overburden groundwater beneath the Plant. The area identified for corrective measures as discussed in Section 5.2 were:

Perimeter Areas	-	Flow Zone 1
		Flow Zone 3
Interior Areas	-	Sanitary Sewer System
		Outfall Sewer System

The ICMs implemented for the above are described below.

6.2.1 PERIMETER AREAS

The remedial concept for the identified perimeter areas is to establish hydraulic containment along the Plant boundary to restrict off-Site chemical migration. The hydraulic containment concept is illustrated on Figure 6.8.

6.2.1.1 FLOW ZONE 1

The corrective measures for Flow Zone 1 were implemented in four stages as described below:

Stage 1

The Stage 1 groundwater collection system was created along the southern boundary of the Plant by converting abandoned Outfall 002 into a groundwater collection system. The system is located immediately downgradient of Flow Zone 1 as shown on Figure 6.9 and consists of five manholes connected by approximately 1,300 feet of 36-inch diameter pipe. The invert of the sewer is approximately 12 to 15 feet below ground surface.

The Stage 1 system collects overburden groundwater leaving the Plant from Flow Zone 1.

The conversion of Outfall 002 into a groundwater collection system was completed by:

- installing a pumping system in MH A;
- constructing a forcemain to connect MH A to the existing U-Area carbon treatment system; and
- adding a pH adjustment unit adjacent to the U-Area carbon treatment system to reduce the pH of the groundwater prior to carbon treatment.

Seven overburden monitoring wells were installed to create four well pairs (with existing well OW314) straddling the collection system. The well pairs are used to determine if pumping will create a hydraulic gradient toward the system.

The underground portion of the Stage 1 system was completed in May 1996 and the above ground portion (pH adjustment unit) was completed in May 1997. The system commenced operation in June 1997.

Stage 2

Stage 2 of the Flow Zone 1 corrective measure was to monitor the performance of the Stage 1 system for a period of 3 months to determine if enhancements were necessary to achieve hydraulic containment. The monitoring showed that a hydraulic connection between MH A and MH E could not be established. This is contrary to the results of a pumping test performed on Outfall 002 in August 1995 that showed all manholes were hydraulically connected. Based on the lack of a hydraulic connection, OxyChem implemented Stage 3 and Stage 4 concurrently, which are described below.

Stage 3

Stage 3 of the Flow Zone 1 corrective measure consisted of enhancements to the Stage 1 system to create a hydraulic connection between the manholes and improve groundwater collection performance. OxyChem initially planned to clean out the Stage 1 system but, after subsequent review, OxyChem revised the plan. The revised plan involves the installation of a new collection pipe in granular backfill directly on top of the existing 36-inch diameter 002 Outfall pipe. Replacing the existing 36-inch diameter pipe with a new collection pipe will provide a system capable of producing the collection rates necessary to achieve hydraulic containment without additional enhancements. The new system will be able to collect more groundwater than the 36-inch diameter existing pipe. The new system will collect water through perforated pipe and granular backfill whereas the existing 36-inch diameter pipe could only collect groundwater through joints and cracks and native material backfill which is substantially less permeable.

The new collection system will consist of a 6-inch diameter perforated HDPE collection pipe on top of the existing 002 Outfall pipe. The new collection pipe also will be extended further east past MH-E approximately 230 feet as shown on Figure 6.9. The depth of the new collection pipe will be approximately 9 to 12 feet below ground surface. The collection trench will be backfilled with NYSDOT 1A gravel to approximately 3 feet below ground surface and the remaining 3 feet will be backfilled with low hydraulic conductivity clay. The collection pipes will be pulled through coreholes drilled through the existing manholes and grouted in place.

Construction of the Stage 3 system was be completed in September 1998.

<u>Stage 4</u>

The Stage 4 groundwater collection system was constructed southwest of the Plant to supplement the Stage 1 system by collecting overburden groundwater flow across the southwest corner of the Plant. The Stage 4 system consists of a 740-foot long groundwater collector extending west along the Plant boundary from Outfall 002 at MH-A to the southwest corner of the Plant as shown on Figure 6.9 (WW1 to CMH1). A second section of groundwater collector was installed along the Plant boundary extending northwest to Adams Avenue as shown on Figure 6.9 (WW2 to CMH2). The groundwater collection system was installed along the top of the clay/till confining unit to the extent possible. Six overburden wells were installed to create three monitoring well pairs straddling the collection system.

The Stage 4 system intercepts and collects groundwater from the area of greatest off-Site chemical loading (estimated to be 19.5 lbs/day of the total 22 lbs/day) from Flow Zone 1. The other portion of Flow Zone 1 is addressed by the Stage 1 and Stage 3 systems.

The Stage 4 system commenced operation in August 1998.

6.2.1.2 FLOW ZONE 3

In 1979, a storm water collection system was installed beneath Energy Boulevard as part of road and access improvements. The Energy Boulevard storm sewer system discharges to an off-Site section of Outfall 004 immediately north of the northern Plant boundary at 47th Street. Historic SPDES sampling showed elevated organic chemical presence in this storm system as a result of groundwater infiltration. The EBDTS was installed in 1980 parallel to and at an elevation below the invert of the storm sewer system to prevent infiltration of overburden groundwater and NAPL into the sewer. The location of the EBDTS is shown on Figure 6.8.

The EBDTS consists of approximately 500 feet of perforated collection tile that drains to a dual stage wet well chamber. NAPL is pumped from the first stage wet well for treatment before the NAPL level reaches 36 inches above the wet well bottom (approximately 250 gallons). NAPL has been removed from the first stage wet well 20 times in the past 17 years (1981 to 1998). Approximately 4,800 gallons of NAPL has been collected by the system. Groundwater in the first stage wet well overflows to the second stage wet well where it is pumped through overhead piping to the Iroquois Street sanitary sewer. Both the Energy Boulevard storm sewer discharge and the EBDTS groundwater discharge are monitored on a regular basis pursuant to their respective discharge permits.

The westerly portion of overburden Flow Zone 3 is captured by the EBDTS. Flow measurements taken during dry weather conditions show groundwater collection rates ranging from 2.4 gpm (April 1982) to 10 gpm (April 1991). The average groundwater collection rate is 6 gpm or 8,600 gpd. The EBDTS creates a radial capture zone around the system. Assuming that half of this flow originates from off-Site areas, the remaining flow captured by the EBDTS is from the Plant perimeter (i.e., 4,300 gpd). Off-Site groundwater flow from Flow Zone 3 was estimated to be 2,500 gpd. Therefore, the EBDTS is effective and likely captures most of the off-Site groundwater flow and chemical loading from Flow Zone 3.

The EBDTS was installed to prevent groundwater from infiltrating into the storm sewer which had been constructed to drain Energy Boulevard. The EBDTS has been effective in reducing chemical loading in the storm sewer along Energy Boulevard to levels below discharge limits. It should be noted that the storm sewer on Energy Boulevard extends substantially to the east and west of the EBDTS. The fact that chemical loading in the storm sewer remains below discharge limits supports the postulation that the EBDTS captures the majority of off-Site chemical migration from Flow Zone 3.

The effectiveness of the EBDTS is further substantiated by OSI and SSI sampling performed and the hydraulic monitoring data collected. The analytical data presented in the OGCMS show that the wells north of Energy Boulevard have minimal chemical presence. Hydraulic monitoring data also show groundwater flow gradients to the EBDTS demonstrating effective capture of the off-Site overburden groundwater flow. Consequently, the remediation for Flow Zone 3 is already in place and has been operating effectively since 1981.

6.2.2 INTERIOR AREAS

6.2.2.1 GROUNDWATER INFILTRATION TO SANITARY SEWER SYSTEM

Historic sewer installations at the Plant did not use watertight construction materials and methods. Consequently, groundwater infiltration into the sanitary sewer system occurred. Throughout the late 1970s and to the present, OxyChem has been upgrading the sewers to improve the quality of the water leaving the Plant. A chronological list of sanitary sewer modifications made at the Plant is presented in Table 6.2.

The results of the sanitary sewer modifications are consistent with Goal 4 – restrict discharge of OxyChem hazardous waste constituents to the sanitary sewers and have resulted in significant loading reductions or improved (i.e., decreased) discharges from the Plant sanitary sewer network. Total organic loadings, consisting of toluene, benzene, and selected chlorinated compounds decreased by approximately 37 percent from 30.5 lbs/day in 1984 to 19.3 lbs/day in 1990. The current total organic loading in the sanitary sewer system is less than 5 lbs/day.

At this time, OxyChem will not propose corrective measures on the sanitary sewer system at the Plant. The sanitary systems currently operate within the discharge limit established by the City of Niagara Falls (and the WWTP SPDES Permits); and secondly, these systems provide an essential component of groundwater collection within the Plant area and at the Plant boundary. SDCP estimates show that the loading to the sanitary sewers accounts for approximately 34 percent (45 lbs/day) of total chemical mass flux leaving the Plant via the overburden groundwater flow regime. Elimination of this flow to the sanitary system by remedial efforts on the sewers would divert this flow and loading to outfall sewers or off-Site areas. This would lead to the need for additional remedial collection systems and components in areas not required at this time. As conditions currently exist, the overburden flow which discharges to the sanitary sewer is treated prior to discharge to the Niagara River. The sanitary sewer system is an effective collection system and as such will remain part of the overall Plant remedial plan.

The WWTP was originally built with the intent of providing treatment for industrial discharges. OxyChem played a major role through the Industrial Liaison Group that pushed to have the WWTP built and was the largest contributor. OxyChem therefore believes that to continue using the WWTP is an appropriate action.

In the event the City cannot meet its discharge requirements imposed by the SPDES permit on the WWTP discharge, OxyChem will cooperate with the City to evaluate OxyChem's sanitary discharge and implement corrective measures on the on-site sanitary sewer system.

OxyChem has reviewed the most recent permit renewal application and the resulting City of Niagara Falls wastewater discharge permit for the Plant as requested by EPA/State. The purpose of the review was to determine if the City is aware that groundwater infiltration into the sanitary sewer system is discharged to the City wastewater treatment plant under the requirements of the CAP. The existing discharge permit is presented in Appendix A.

The permit renewal application of June 1995 specifies all sources of water that will be discharged to the City’s sanitary sewer system from the Plant. The application states that groundwater is a component of the discharge to the City sanitary sewer system from both of the on-Site sanitary sewer systems. (One discharges on Iroquois Street and the other discharges on 47th Street.) The October 1995 discharge permit was issued by the City based on the information contained in the permit renewal application. The permit itself does not specify sources of water to be discharged to the sanitary sewer systems. Therefore, based on the information contained in the permit renewal application, the City is aware that groundwater is a source of water and will be for the duration of the permit.

The permit has a duration of five years. Each subsequent permit renewal application will list groundwater as a source of discharge to the sanitary sewer system. The Plant’s discharge permit should be renewed every five years as long as the City’s SPDES discharge limits are being achieved. Therefore, as long as the Plant is operating and discharging water to the sanitary sewer system, groundwater will be permitted for discharge to the sanitary sewer system.

6.2.2.2 GROUNDWATER INFILTRATION TO OUTFALL SEWER SYSTEM

OxyChem has made numerous modifications to the outfall sewer network beneath the Plant to reduce chemical loadings to the Niagara River. Modifications have included abandoning sewer sections in demolished areas of the Plant, replacing sewers with watertight piping, lining existing sewer pipes, repairing and parging manholes, cleaning and conducting video inspections of sewers, and sampling sewer flows.

Outfall sewer modifications have reduced the total loading of chlorinated compounds and benzene and toluene to the Niagara River from the outfall sewers from approximately 119 lbs/day in 1984 to 8 lbs/day in 1990 for the sum of the outfalls. The current loading to the river from the outfall sewers is less than 5 lbs/day. The results of the outfall sewer modifications are consistent with Goal 3 – restrict discharge of OxyChem hazardous waste constituents to the outfalls.

The following paragraphs describe modifications that have been made to the outfall sewer network since 1981 to reduce chemical loading. A chronological list of outfall sewer modifications made at the Plant is presented in Table 6.2.

Outfall 001

Modifications to Outfall 001 included lining the southern section of the outfall and abandonment of several sections of sewer beneath the U-Area. Other modifications have included the following:

- installation of a pH adjustment unit at MH585;
- construction of a new sewer connection from Building U-87;
- manhole restoration, including cleaning, parging, pressure grouting manhole exteriors, and lining manhole interiors;
- sewer cleaning; and
- inspection and sampling activities.

MH/CB2 was grouted to eliminate an infiltration source identified during the Phase II sewer investigation.

Outfall 002

In 1982, OxyChem diverted the flows entering Outfall 002 and abandoned the entire Outfall 002 system, eliminating the associated chemical loading to the Niagara River.

Outfall 003

Numerous sections of Outfall 003 have been abandoned as described in Table 6.2. Portions of Outfall 003 have been reconstructed and replaced with watertight fused HDPE pipe as part of S-Area remedial construction activities.

Sediment in CB9, west of MH770, was removed and the catchbasin was cleaned to eliminate a chemical loading source identified during the Phase II sewer investigation. A video inspection of the outfall sewer between CB9 and MH770 was conducted to determine potential water sources. A process related flow entering the sewer through a blind connection was identified adjacent to Building N-21 and the flow was diverted to the sanitary sewer network where it could be treated.

Outfall 004

Numerous sections of Outfall 004 have been abandoned as described in Table 6.2. In 1981, a groundwater collection system was installed to reduce groundwater infiltration into the Energy Boulevard drain tile system. Operation of this system has lowered the overburden groundwater table, thereby preventing groundwater infiltration into the outfall.

Outfall 005

Numerous sections of Outfall 005 have been abandoned as described in Table 6.2. In 1986, OxyChem installed an Insituform liner in the gravity section of the 42-inch diameter outfall pipe extending from MH159A (at the end of the forcemain exiting the H-20 Lift Station) to MH159N (near the K-28 Lift Station). During 1991 and 1992, sections of Outfall 005 were cleaned and additional lining installed, manholes were cleaned and grouted, the K-28 Lift Station chambers were cleaned, sewers were reconstructed, and gravel surface areas were paved, reducing infiltration to Outfall 005. Additional cleaning and repair to the K-28 Lift Station chambers and to Outfall 005 manholes were performed in September 1996 and June 1998.

An outfall sewer investigation was performed in July 1995 pursuant to the OGCMS to further restrict discharge of chemicals to the Outfalls. The investigation identified sewer sections where groundwater infiltration was contributing chemical loading to the system. The results of the investigation were described in the report entitled "Outfall Sewer Investigation – Phase I Report and Phase II Recommendations", dated September 1995. A subsequent investigation was performed in November 1995 to further define chemical loading sources in the outfall sewers. The results of the second investigation were described in the report entitled "Outfall Sewer Investigation – Phase II Report and Corrective Measures Implementation Plan", dated June 1996.

The investigation identified four areas of groundwater infiltration that needed to be addressed. Corrective measures for three of the four areas were completed as follows:

Area	*Date Completed*
• repair of infiltration point in MH/CB2 on Outfall 001	September 1996
• remove sediment from CB9 west of MH770 on Outfall 003	September 1996
• address chemical presence in Outfall 003 between MH770 and CB9	
- video inspection	September 1996
- divert section to sanitary sewer	June 1998

The fourth outfall sewer corrective measure was to repair MH2 of Outfall 003. This activity must be performed under dry conditions and therefore is scheduled to be performed during the next shutdown of Outfall 003. OxyChem will continue to implement corrective measures to the outfall sewer system as dictated by SPDES monitoring results.

6.2.3 OVERBURDEN BARRIER WALL

Three barrier walls have been constructed south of the Plant; the NYPA intake wall, the Plant barrier wall, and the S-Area barrier wall. These walls form a continuous physical barrier to prevent Plant overburden groundwater from migrating to the upper Niagara River. The NYPA intake wall, which extends from the NYPA water conduits at the west end to the Plant barrier wall at the east end, was constructed between 1959 and 1960 as part of the intake structures and water conduits. The concrete NYPA intake wall was constructed from the ground surface and extends 60 to 80 feet below the top of the bedrock. The Plant barrier wall, which extends from the NYPA intake wall at the west end to the S-Area barrier wall at the east end, was constructed between 1993 and 1994. The Plant barrier wall, which is a soil-bentonite slurry wall sandwiched between sheet pile walls, was constructed from near the ground surface to the clay/till confining layer or the top of bedrock. The southern segment of the S-Area barrier wall, which encircles the S-Area and the southern portion of the V-Area, was constructed in 1994. The S-Area barrier wall, which also is a soil-bentonite slurry wall sandwiched between sheet pile walls, was constructed from near the ground surface to the clay/till confining layer or the top of bedrock.

These barrier walls have severed the direct hydraulic link between the overburden groundwater flow regime and the Niagara River.

6.3 OVERBURDEN SOILS

The third phase of the CAP addressed chemical presence in the overburden soil beneath the Plant. Overburden soil conditions beneath the Plant are affected by localized conditions such as geology, hydrogeology, chemical source areas, surface conditions, chemical composition, and hydraulic influences. Therefore, different areas of the Plant require specific remedial technologies to address the localized conditions encountered. The four chemical groupings encountered at the Plant (NAPL, dioxin, elemental phosphorus, and mercury) can be divided into seven areas that need to be addressed as follows:

- C/D-Area NAPL and dioxin;
- F-Area NAPL and dioxin;
- T-Area NAPL;
- U-Area NAPL, dioxin, and mercury;
- N-Area NAPL;
- X-Area dioxin; and
- V-Area elemental phosphorus.

The only overlapping of areas with elevated chemical presence in overburden soil occurs in the C/D-Area where the NAPL and dioxin areas overlap. NAPL and dioxin have distinctly different chemical and physical characteristics and may need to be addressed differently even in the areas where they are both present.

Plant SWMUs will be addressed as part of six potential source areas. ICMs have been conducted to address several individual SWMUs and some of the chemical presence areas described above.

6.3.1 SOLID WASTE MANAGEMENT UNITS

During the development of the Source Investigation Program (SIP) all SWMUs listed in the 1988 Plant RCRA Permit were evaluated for their potential to release chemicals to the environment and their ability to act as continuing chemical source areas. This included an evaluation of historic landfills, dewatering, and spill areas. Based on this evaluation, specific areas were defined within the C-Area, D-Area, F-Area, M-Area, N-Area, and U-Area that contain all of the SWMUs capable of being potential sources of chemical releases. These areas are shown on Plan 2. Any historic releases from these SWMUs will be addressed based on the chemical categories present in the overburden soil beneath the Plant (i.e., NAPL, dioxin, elemental phosphorus, and mercury). The existing and proposed groundwater remedies will address any releases to the overburden groundwater.

SWMUs that were not included in the above six areas have not released chemicals to the environment and have a low potential for future chemical release. The only SWMU listed in the 1988 RCRA Permit that requires additional remediation outside of the six source areas is the historic V-56 phosphorus storage area.

Since 1988 when the six source areas were identified, three additional SWMUs have been identified at the Plant. These additional SWMUs are presented on Plan 2 and include:

- T-Area;
- Mercury Cell Area; and
- X-Area.

The assessment of the T-Area SWMU concluded that the petroleum presence within the T-Area is an extremely localized occurrence. Therefore, this unit is not a significant source of chemical release that requires remediation.

Interim corrective measures for the Mercury Cell Area (former Building U-75) were completed in January 1992. A description of the interim corrective measures implemented is presented in the document entitled "Implementation Report, Building U-75 Interim Corrective Measure", August 1992. During the interim corrective measures, more than 33 tons of mercury were recovered from the area. The remaining trace amounts of mercury were contained within a sheet pile wall that encircled all of Building U-75 and was keyed into the native till confining unit. Although the Mercury Cell Area was considered as a potential contributor of mercury to the overburden groundwater, mercury presence has only been detected at very low concentrations in the groundwater beneath this area. Therefore, the mercury presence in the soil beneath the Mercury Cell Area has been addressed and is no longer a potential source for elevated mercury concentrations in the surrounding soil or groundwater.

Interim corrective measures for the X-Area, which included a soil cap, were completed in June 1992. A description of the implemented interim corrective measures is presented in the document entitled "X-Area Corrective Measures Implementation Report", August 1992. Structures in the X-Area were demolished in 1988, vegetation was cleared and the entire area was capped in 1991. A groundwater monitoring program for this area has been implemented.

Interim corrective measures have been performed to address the W-107 Hypo-Mud Dewatering Area. These actions were performed between 1960 and 1962 and included the excavation of dewatered hypo-mud and capping the area with asphalt and buildings. The hypo-mud was determined to be non-hazardous by the EP toxicity test and is currently disposed of at a sanitary landfill. Therefore, the hypo-mud dewatered at W-107 would similarly be considered non-hazardous. Chemical presence due to hypo-mud dewatering (phosphite) is limited to the immediate vicinity of the dewatering area.

Interim corrective measures have been performed to address the V-56 elemental phosphorus storage and spill area. These actions were performed in 1982 and included removal of the storage tanks and covering the area with gravel or asphalt. The assessment of the area concluded that phosphorus presence is limited to the immediate area of the historical storage tanks.

Included in the six source areas are historic landfills which were located within the D, F, and N-Areas of the Plant. The landfills primarily contained chlorotoluenes, chlorobenzenes and inorganic wastes, and chlorobenzenes and chlorotoluenes, respectively.

The materials deposited at the historical landfills have been largely removed and landfilled at other sites. For example, wastes were removed from the F-Area landfill after 1946 as part of Plant expansion in this area. Thus, it was expected that these landfills either no longer exist or the waste materials remaining at the historic landfill locations are small in volume. Work performed pursuant to the SDCP and SIP did not identify any large areas filled with waste, which confirmed this.

The S-Area and V-Area landfill SWMUs are being addressed separately under the S-Area Settlement Agreement and are not discussed in this report.

Chemicals may have been spilled inadvertently at the Plant during the course of production, storage, and shipping. Spills can be postulated to have occurred at or in the areas suspected to contain NAPL or waste based on field observations or in former production/storage areas of the Plant.

There are four general elevated chemical concentration groupings within the Plant soils as indicated in Section 3.3.3; NAPL, dioxins, elemental phosphorus and mercury. All of these elevated concentration areas are located within the immediate vicinity of current or historic storage or production areas. It is likely that spills during the course of normal production/operation activities within these areas were the major source of these elevated chemical concentrations in the overburden soil.

6.3.2 INSTITUTIONAL CONTROLS

Restrictions will be placed on the deed for the Plant to ensure that future owners of the property are aware of the NAPL, dioxin, and elemental phosphorus presence in the overburden soil. The deed restrictions will include a description of the potential areal and vertical presence of the chemicals, typical properties of the chemicals, a list of the potential human exposure routes, and a reference to the Plant Health and Safety Plan for Construction Activities (HASP).

OxyChem has developed and implemented a standard operating procedure (SOP) for conducting subsurface excavations at the Plant. The SOP was submitted to the State in June 1997 and approved in a letter dated July 29, 1997. The SOP includes procedures for soil and water handling and presents plans showing the potential areal and vertical extent of NAPL, dioxin, and elemental phosphorus, and procedures to reduce the potential for worker exposure. The SOP also contains procedures to ensure that the confining clay/till unit is not penetrated during construction activities. The SOP is referred to by Plant personnel and contractors before any subsurface work at the Plant is performed to restrict the potential for disturbance of the soils, prevent chemical migration, and to protect workers who may perform excavation activities.

An OxyChem SOP also has been developed for repair of watermains. The SOP contains procedures to flush out any groundwater that may have centered the watermain from an excavation during repair activities.

The Plant perimeter fence and security system will be maintained to ensure that unauthorized people cannot access the Plant soil. This will ensure that people who are unaware of the chemical presence in the soil will not be exposed inadvertently.

6.3.3 MAINTENANCE OF COVER MATERIALS

The areas of dioxin and elemental phosphorus presence shown on Figures 3.18 and 3.19, respectively, have been covered with a cap consisting of either 6 inches of granular material, 6 inches of granular material and 3 inches of asphalt, or 6 inches of clean topsoil vegetated with perennial grasses as required.

All areas with elevated dioxin concentrations have been capped with granular, hard, or grassed surfaces and additional capping is not required.

The area of potential elemental phosphorus presence in the V-Area is already completely covered with asphalt. Therefore, no capping is required for elemental phosphorus.

Capped areas and existing asphalt, concrete, impoundment and grassed surfaces will be inspected and maintained regularly to ensure their integrity. Special permission is required by Plant Environmental to store equipment or for parking vehicles on asphalt capped areas.

6.3.4 NAPL EXTRACTION AND TREATMENT

Mobile NAPL that is detected during construction activities will be extracted using either extraction wells or an extraction trench. The most suitable extraction method will be chosen depending on local conditions such as underground utility congestion, soil porosity and quantity of mobile NAPL available for extraction. Extracted NAPL will be treated either on Site at the Plant's LTDU or off Site at an approved facility. NAPL encountered in sewers during maintenance or construction activities will be extracted and treated.

An ongoing NAPL collection program has been implemented at the Plant. NAPL is monitored and collected if necessary from the Outfall 003 NAPL collection trench, OW313, abandoned sewer manholes, and two NAPL collection sumps in the N-Area. The location of these collection points is shown on Figure 6.10. The results of NAPL collection activities are submitted to the State annually.

The SOP for conducting subsurface excavations contains procedures to implement the NAPL collection program discussed above.

6.3.5 F-AREA LONG-TERM SOIL STOCKPILES

6.3.5.1 DESCRIPTION OF LONG-TERM SOIL STOCKPILES

Excess soils generated during construction of the Corrective Measures Implementation (CMI) activities, Plant maintenance activities, and Plant revitalization activities have been handled in accordance with the procedures described in the following reports:

- "Soil Management Plan for Corrective Measures Implementation Activities", dated January 1995; and
- "Soil Management Plan for Corrective Measures Implementation – Overburden Activities", dated November 1995, and an associated addendum submitted to NYSDEC under letter on July 17, 1997.

The Soil Management Plan procedures allowed handling of the soils without actively managing the soils and thereby did not trigger any "land ban" restrictions.

Three soil classifications were used to categorize the soils:

i) Category A - ≤10 ppm organic vapor concentration and no observable NAPL present;

ii) Category B - >10 ppm organic vapor concentration and no observable NAPL present; and

iii) Category C - observable NAPL present.

Category C soils are hauled off-Site for disposal; no Category C soils were placed in the long-term stockpiles.

As of October 1998, the volume of soils placed in each area of the soil stockpile were as follows:

Location	*Soil Category*	*Volume (cubic yards)*
West Pile	Category A	8,950
	Category B	2,120
Stores Enclosure Pad	Category A	2,040
East Pile	Category A	6,060
	Category B	1,310
		20,480

The existing and proposed extent of the long-term soil stockpiles is presented on Figure 6.11. The total capacity of the long-term soil stockpiles is approximately 24,000 cubic yards. Future activities that may generate excess soils include:

- plant maintenance; and
- on-going Revitalization Projects.

Sediment transport and surface water runoff from the long-term Category A stockpile is controlled by the construction of low-profile soil berms constructed using Category A soils. Precipitation falling within the bermed area will infiltrate into the ground.

Sediment transport for the long-term Category B stockpiles is controlled by:

- lining the bottom of the stockpiles with polyethylene sheeting;
- constructing low-profile soil berms around the stockpiles using Category A soils; and
- covering the stockpiles with polyethylene sheeting to direct runoff onto the ground surface outside of the bermed area.

The long-term Category A and B soil stockpiles were graded to promote positive drainage. The west stockpile was closed in September 1998. The stockpile was covered with 6 inches of soil capable of sustaining vegetative growth and then seeded in August and September 1998. The stores enclosure pad was covered with granular material to provide a structural base for equipment storage. Future stockpiled Category A and B soil will be covered with 6 inches of soil capable of sustaining growth and will be seeded.

6.3.6 BIOREMEDIATION PILOT PROJECT

In July 1994, OxyChem initiated a pilot-scale field study to treat chlorinated chemicals in soil using anaerobic biotechnology at the Plant. The pilot-scale treatability study began in August 1994 and continued for approximately 30 months. The pilot-scale study concluded in January 1997. The pilot-scale study closure was reported in the document entitled "Final Report, Pilot and Bench-Scale Treatment Study, Anaerobic/Aerobic Biodegradation of Chlorinated Chemicals in Soils", dated February 1998 (Closure Report). The results of the pilot-scale study showed that the concentration of chlorinated compounds in soil could be effectively reduced by anaerobic and aerobic degradation.

Based on the conclusions of the pilot-scale study, OxyChem intends to implement a full-scale treatment demonstration study. The full-scale study will be conducted in the existing F-Area soil stockpile. The objective of the full-scale study will be to demonstrate the feasibility of using anaerobic followed by aerobic biotreatment techniques to degrade chlorinated benzenes and toluenes on a larger scale. A work plan for the study will be submitted under separate cover.

6.3.7 LONG-TERM NAPL MONITORING PROGRAM

A comprehensive overburden NAPL survey will be conducted at the Plant. The survey will include all existing Plant overburden wells as shown on Plan 3. After the initial survey, the Plant overburden wells will be categorized as either NAPL-bearing wells or non-NAPL-bearing wells.

NAPL-bearing wells will be pumped to determine the quantity of NAPL present in each well. The wells will then be further categorized as either NAPL-bearing wells with greater than one gallon of mobile NAPL or NAPL-bearing wells with less than one gallon of mobile NAPL. All extracted NAPL will be treated either on Site at the Plant's LTDU or off Site at an approved facility.

Wells with greater than one gallon of mobile NAPL will be pumped quarterly. If the quantity of mobile NAPL in one of these wells is less than one gallon on each of two consecutive quarterly pumping events, the well will be categorized as a NAPL-bearing well with less than one gallon of mobile NAPL. Wells with less than one gallon of mobile NAPL will be pumped semi-annually. If a well contains no NAPL after two consecutive semi-annual pumping events, it will be categorized as a non-NAPL-bearing well and pumping and monitoring will cease. A decision chart for the NAPL pumping program is presented on Figure 6.12.

A second NAPL survey will be conducted two years after the initial survey. Only wells that contained no NAPL in the first survey will be included in the second survey. If NAPL is detected in a well during the second survey, the well will be categorized as a NAPL-bearing well and pumping will be conducted according to the above schedule. If NAPL is not detected in a well during the second survey, no further NAPL monitoring will be conducted at that well.

The perimeter wells shown on Figure 6.13 will be monitored for NAPL on a semi-annual basis to ensure the NAPL is not migrating to off-Site areas. These wells will be monitored for two years following the initial NAPL survey. The program will be re-evaluated after the two-year period and, based on previous monitoring results, the program may be modified or discontinued.

Monitoring reports will be prepared and submitted to the EPA/State annually. The reports will contain a description of all monitoring conducted in the previous year and the monitoring results.

6.4 OFF-SITE AREAS

6.4.1 OVERBURDEN GROUNDWATER

Significant migration of Plant-related chemicals to off-Site overburden groundwater has not occurred. Off-Site overburden groundwater north of Flow Zone 3 flows toward and is collected by the EBDTS. Off-Site overburden groundwater south of Flow Zone 1 flows toward and is collected by the Stage 1, 3, and 4 groundwater collection systems. Therefore, additional corrective measures are not required.

6.4.2 BEDROCK GROUNDWATER

Significant Plant-related chemical presence was not detected in the off-Site bedrock wells west of the Plant or in a line of wells 1,000 feet north of the Plant. Off-Site bedrock groundwater adjacent to the north Plant boundary flows toward and is collected by the bedrock groundwater extraction system. Bedrock groundwater beyond the capture zone of the groundwater extraction system north of the Plant is intercepted by the NYPA conduits and the FST which act as regional groundwater line sinks. All dry weather flow in the FST is treated in the Niagara Falls WWTP. Bedrock groundwater west of the Plant is in the capture zone of the NYPA conduit drains. The NYPA conduit drains act as a groundwater divide and prevent groundwater from flowing further to the west.

Corrective measures to address the low level chemical presence in off-Site bedrock groundwater have not been implemented at this time since the bedrock groundwater extraction system will have a positive and significant effect on the low level off-Site bedrock groundwater chemical presence. It is recognized that the extent of the influence has not yet been fully defined. Nonetheless, monitoring data for the past two years has shown that chemical concentrations in the off-Site bedrock groundwater have decreased. This is described in detail below.

The total organic SSI concentrations observed in the D-, C-, and B-Zone monitoring wells during the fourth semi-annual event were compared to the most recent historic total organic SSI concentrations [Supplemental Data Collection Program (SDCP) or Off-Site Investigation (OSI)] and the first three semi-annual events. The comparison is presented in Table 6.1.

D-Zone

The comparison of individual wells in Table 6.1 showed that the total organic SSI concentration in five of the eight D-Zone monitoring wells included in the March 1998 sampling event (OW403D, OW407D, OW409D and OW651, OW652) decreased compared to the September/October 1997 chemical monitoring events. The total organic SSI concentration in OW410D, OW649D, and OW653D remained consistent compared to the previous chemical monitoring event.

C-Zone

The comparison of individual wells in Table 6.1 showed that the total organic SSI concentration in six of the eight C-Zone monitoring wells included in the March 1998 sampling event (OW403C, OW407C, OW409C, OW410C, OW651C and OW653C) continued to decrease compared to the September/October 1997 chemical monitoring events and were less than historic levels. The total organic SSI concentration in OW649C remained constant compared to the previous monitoring event. The total organic SSI concentration in OW652C increased by a factor of two.

B-Zone

The comparison of individual wells in Table 6.1 showed that the total organic SSI concentrations in most of the B-Zone monitoring wells included in the second year sampling program (OW403B, OW407B, OW409B, OW410B, and OW652B) have either decreased or remained constant compared to the previous two sampling events and historic levels. The total organic SSI concentration in OW653B increased slightly compared to the previous three sampling events and historic levels but was within the order-of-magnitude established by previous events.

Based on the above discussion, it is evident that the bedrock groundwater extraction system is restricting off-Site chemical migration as chemical concentrations are decreasing with time. Furthermore, groundwater contours for the D-, C-, and B-Zone presented on Figures 6.3, 6.4, and 6.5, respectively, show that the capture zone produced by the extraction system extends several hundred feet off Site. Therefore, off-Site chemical presence is being drawn back toward the Plant where it is captured by the extraction system. Capture will improve when the treatment plant upgrade is complete and higher pumping rates can be achieved which will decrease off-Site chemical presence even further.

Groundwater that is beyond the capture zone will be captured by the NYPA conduit drains or the FST. All dry weather flow in the FST is treated by the Niagara Falls WWTP and has been since October 1993. Wet weather flows (overflow from WWTP) is discharged to the Niagara River under a SPDES Permit. The City is required to monitor wet weather flows twice per month and collect samples when water is present in the overflow. Samples have been collected on only five locations since October 1993. The loadings to the River of OxyChem SSI chemicals based on these sampling events are compared to the FST SPDES limits in Table 6.3. The loadings for the five events were in general, substantially below the SPDES limits except for the February 1997 event where trichlorobenzene (4.3 lbs/day) slightly exceeded the SPDES limit (3.2 lbs/day). The concentration of trichlorobenzene for this event was 18 μg/L.

Therefore, based on the capture of off-Site groundwater by the on-Site extraction system and the FST, additional corrective measures to address the low level off-Site chemical presence are not required.

The corrective measures for off-Site bedrock groundwater chemical presence will be composed of the following components:

- the existing bedrock groundwater extraction system which will continue to draw chemistry back toward the Plant and prevent further off-Site chemical migration;
- the FST which will continue to collect D-Zone groundwater. All dry weather flow in the FST is treated by the Niagara Falls WWTP; and
- Monitored natural attenuation. Monitoring of off-Site bedrock groundwater is performed as part of the on-Site bedrock groundwater corrective measures.

7.0 EVALUATION OF IMPLEMENTED INTERIM CORRECTIVE MEASURES

The following subsections present an evaluation of the ICMs implemented or proposed to be implemented as presented in Section 6.0. Each ICM was evaluated for suitability as the principal alternative for the corresponding corrective measures component. The basis of this evaluation was:

- effectiveness;
- implementability;
- protection of human health and the environment;
- consistency with cleanup goals;
- cost effectiveness;
- permanence of remedy;
- reduction of toxicity, mobility and volume; and
- compliance with State and Federal standards and guidelines.

7.1 BEDROCK GROUNDWATER

The system to remediate the chemical plume in the bedrock includes the following components:

- extraction wells along the downgradient west and northwest Plant property boundaries in the D, C, and B-zones.
- on-Site groundwater treatment system;
- hydraulic monitoring program to monitor the effectiveness of the hydraulic containment system;
- chemical monitoring program to verify long-term changes;
- NAPL collection from on-Site bedrock wells; and,
- treatment of NAPL.

7.1.1 EFFECTIVENESS

Pumping from the bedrock along the west and northwest Plant property boundaries is an effective way to reduce the chemistry in the bedrock groundwater and to achieve an inward hydraulic gradient toward the Plant boundary.

The operation of the extraction system produces the following results:

- any bedrock groundwater beneath the Plant is captured by the extraction wells before migrating off-Site;
- off-Site bedrock groundwater adjacent to the Site is drawn back to the extraction wells;
- chemicals in the on-Site groundwater and adjacent off-Site groundwater are removed and treated.

The hydraulic and chemical monitoring results for the fourth semi-annual optimization period (November 1997 to April 1998) showed that the extraction system is operating effectively. The hydraulic monitoring data showed that hydraulic containment along the Plant boundary has been achieved in the bedrock D, C and B zones, and in some cases extends well beyond the Plant boundary. The chemical monitoring data obtained from the off-Site monitoring wells since pumping commenced in April 1996 have shown that there has been an overall decrease in the total organic SSI concentrations; a decrease attributable to the groundwater containment and extraction.

The collection of NAPL from on-Site bedrock wells has removed significant quantities of NAPL from the bedrock and as a result is helping to remove the source of the chemical presence in the groundwater.

Therefore, the groundwater extraction and treatment system and the NAPL removal program are considered highly effective.

7.1.2 IMPLEMENTABILITY

The extraction and treatment system was constructed between the fall of 1994 and spring of 1996 using standard construction methods. Operation of the system is controlled by a programmable logic controller (PLC) and monitored by Plant personnel.

A regular inspection and maintenance program for the extraction and treatment system is in place.

The NAPL collection program was readily achieved as it utilizes existing bedrock wells and no additional systems were required to make it operational.

Therefore, this ICM for bedrock groundwater was readily implementable.

7.1.3 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The risk posed by the implementation and operation of the extraction and treatment system to human health (i.e. general public and workers) and the environment is minimal. The reasons for this are as follows:

i) bedrock groundwater is not used as a source of drinking water at or in the vicinity of the Plant;
ii) bedrock groundwater is not used for industrial purposes at or in the vicinity of the Plant;
iii) the extraction system prevents further off-Site migration of OxyChem hazardous waste constituents; and
iv) worker contact with the groundwater is prevented during monitoring and maintenance activities by the implementation of health and safety procedures including the use of personnel protection equipment (PPE).

Therefore, the ICM selected for bedrock groundwater is protective of human health and the environment.

7.1.4 CONSISTENCY WITH REMEDIAL GOALS

The remedial goals achieved by the bedrock groundwater ICMs are summarized in Table 7.1 and described below.

Operation of the extraction and treatment system is consistent with the primary cleanup goal of restricting off-Site migration of OxyChem hazardous waste constituents in the bedrock groundwater (Goal No. 1). The extraction system prevents off-site migration of bedrock groundwater and draws a portion of off-site bedrock groundwater back toward the Plant. The extraction and treatment systems are composed of technologies that have been proven to be reliable and effective and are industry standards for extracting groundwater from the bedrock and for removing and treating chlorinated organic compounds (Goal No. 7). The extraction system is compatible with other bedrock groundwater remedial programs at the Plant (i.e., S-Area) in that the capture zone created by the system does not affect the operation of the S-Area collection systems (Goal No. 8). Natural groundwater flow in the bedrock is from the south/southeast to the northwest. Therefore, any groundwater that may escape the S-Area remedial program would most likely be captured by the Plant's extraction system.

The extraction and treatment system and the NAPL collection program will reduce the concentration of hazardous waste constituents in the groundwater which is consistent with Goal No. 9.

7.1.5 COST EFFECTIVENESS

The system comprised of extraction wells and a groundwater treatment system is considered the most cost-effective method for achieving hydraulic containment in the bedrock. Several technologies for the treatment system were reviewed during the design phase and the most efficient and cost effective technology (carbon) was chosen. OxyChem is also in the process of upgrading the carbon treatment facility to include an air stripper and thermal oxidation unit which will further increase efficiency and reduce operating costs.

Therefore, the ICM implemented was cost effective.

7.1.6 PERMANENCE OF REMEDY

The extraction well and treatment system alternative does not offer a permanent remedy except for the volume of chemicals removed and treated by the system. Groundwater concentrations will decline to low levels but residual chemical presence in the bedrock may always have the potential for release to the bedrock groundwater regime.

The life expectancy of an extraction system is on the order of 20 to 30 years. Therefore, components of the system may require replacement on an infrequent basis.

7.1.7 REDUCTION OF TOXICITY, MOBILITY, AND VOLUME

The extraction and treatment system provides the following:

- an effective reduction of toxicity and chemical mass (volume) over time as observed by the extraction system removing chemicals at 30 lbs/day for March 1998 when the estimated pre-remedial mass flux across the Plant boundary was approximately 6 lbs/day;
- reduced mobility of the chemical plume by eliminating groundwater/chemical migration beyond the extraction system's area of capture;
- decreased overall volume of source chemicals indicated by the extraction system removing more chemicals than historically migrated across the Plant boundary.

The NAPL removal program has resulted in the collection and treatment of over 6,000 gallons of NAPL from the A-Zone. Therefore, the volume and mobility of chemicals has been reduced by collection and toxicity reduced by treatment.

7.1.8 COMPLIANCE WITH STATE/FEDERAL STANDARDS AND GUIDELINES

Implementation of the bedrock groundwater ICMs is compliant with State and Federal Standards and Guidelines presented in Table 7.2.

7.2 OVERBURDEN GROUNDWATER

The system to remediate the chemical presence in the overburden groundwater beneath the Plant includes the following components:

- Flow Zone 1 - Stages 1, 3, and 4 groundwater collection systems;
- Flow Zone 3 - Energy Boulevard Drive Tile System (EBDTS);
- hydraulic monitoring program to monitor the effectiveness of the hydraulic containment system;
- chemical monitoring program to verify long-term changes;
- collection of groundwater via sanitary sewers and treatment at the City WWTP; and

- address groundwater infiltration into the outfall sewers as indicated by SPDES monitoring.

7.2.1 EFFECTIVENESS

Collection of overburden groundwater utilizing the three collection components of the Flow Zone 1 collection systems, the Energy Boulevard Drain Tile System (EBDTS), and the on-Site sanitary sewer network is a very effective way to reduce the chemical presence in the overburden groundwater and to achieve hydraulic containment along the Plant boundary.

The Flow Zone 1 collection systems and the EBDTS are perimeter systems that collect overburden groundwater and divert it to either an on-Site treatment system or to the City of Niagara Falls WWTP. These systems also provide hydraulic containment along the Plant boundary in areas where off-Site flow of groundwater historically occurred.

The sanitary sewer network beneath the Plant is not a watertight system and as a result there is the potential for groundwater infiltration into the system. The system has not been remediated to prevent such infiltration as the sanitary sewer system provides a means for collection and treatment of the groundwater. The infiltrated groundwater and associated chemical loading then flows to the City of Niagara Falls WWTP and is treated prior to discharge to the Niagara River. Collection of groundwater in the sewers in the middle of the Plant results is considerably less groundwater migrating across the Plant perimeter.

Therefore, the collection of groundwater utilizing dedicated groundwater collectors and the sanitary sewer network is highly effective.

The outfall sewer system is currently monitored under the Plant's SPDES permit. OxyChem will continue to implement corrective measures to the outfall system as dictated by SPDES monitoring. Previous corrective measures to the outfall system have been very effective in reducing groundwater infiltration. Similarly, the discharge of the sanitary sewer is continuously monitored to confirm that the effluent is within discharge limits set by the City WWTP. Consequently, it is on occasion, necessary for OxyChem to implement corrective measures on the sanitary sewers to address specific groundwater infiltration situations.

7.2.2 IMPLEMENTABILITY

The groundwater collection systems for Flow Zone 1 and Flow Zone 3 are in place and operational. The extensive sanitary sewer system also is in place. Therefore, the ICMs for overburden groundwater were readily implementable.

7.2.3 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The risk proposed by the implementation and operation of the groundwater collection systems to human health (i.e. general public and workers) and the environment is minimal. The reasons for this are as follows:

i) overburden groundwater is not used as a source of drinking water at or in the vicinity of the Plant;

ii) overburden groundwater is not used for industrial purposes at or in the vicinity of the Plant;

iii) the collection systems prevent the off-Site migration of OxyChem hazardous waste constituents;

iv) worker contact with groundwater is prevented during monitoring and maintenance activities by the implementation of health and safety protocols, including the use of PPE;

v) worker contact with groundwater will be prevented during future construction activities by implementation of the SOP developed for excavation and soil handling discussed in Section 6.3.2; and

vi) all of the collected groundwater is treated prior to its release to the Niagara River.

Therefore, the ICMs selected for overburden groundwater are protective of human health and the environment.

7.2.4 CONSISTENCY WITH REMEDIAL GOALS

The remedial goals achieved by the overburden groundwater ICMs are summarized in Table 7.1 and described below.

Operation of the groundwater collection systems is consistent with the primary cleanup goal of restricting off-Site migration of OxyChem hazardous waste constituents in the overburden groundwater (Goal No. 2). The collection and treatment systems in place utilize technologies that have been proven to be reliable and effective and are industry standards for collecting overburden groundwater and for removing and treating chlorinated organic compounds (Goal No. 7).

The collection and treatment system and the sanitary sewer system reduce the concentration of OxyChem hazardous waste constituents in the overburden groundwater consistent with Goal No. 9.

The collection and treatment systems and the sanitary sewer system are compatible with other remedial systems (i.e., S-Area) and with Plant operations (Goal No. 8).

Outfall sewer modifications have reduced the total loading of chlorinated compounds and benzene and toluene to the Niagara River from the outfall sewers from approximately 119 lbs/day in 1984 to 8 lbs/day in 1990 for the sum of the outfalls. The results of the outfall sewer modifications are consistent with Goal 3 – restrict discharge of OxyChem hazardous waste constituents to the outfalls. OxyChem's commitment to implement corrective measures to the outfall sewer system in the future, as dictated by SPDES monitoring results, is consistent with Goal No. 3 to restrict discharge of OxyChem hazardous waste constituents to the outfalls.

One of the remedial goals is to restrict the discharge of OxyChem hazardous waste constituents to the sanitary sewers (Goal No. 4). This goal was based on observations that groundwater infiltrates into the sanitary sewer system. Historic modifications to the sanitary sewer system have resulted in significant loading reductions from the Plant sanitary sewer network, thereby achieving this goal. Total organic loadings, consisting of toluene, benzene, and selected chlorinated compounds decreased by approximately 37 percent from 30.5 lbs/day in 1984 to 19.3 lbs/day in 1990. During development of the ICM for overburden groundwater, it was determined by OxyChem and EPA/State that this goal may not benefit the overall CAP for the Plant. The reasons for this determination are as follows:

i) the sanitary sewer network is extensive and is present throughout the entire Plant thereby allowing groundwater to be collected from the majority of the Plant;

ii) the sanitary sewer network extends into existing production areas where it would be difficult and costly to construct new groundwater collectors;

iii) elimination of infiltration to the sanitary sewers by remedial efforts would divert some of this flow to the outfall sewers which is inconsistent with Goal No. 3;

iv) elimination of infiltration to the sanitary sewers by remedial efforts would divert some of this flow to the off site groundwater regime which is inconsistent with Goal No. 2;

v) discharge from the sanitary sewer network is monitored under permit with the City of Niagara Falls WWTP;

vi) discharge from the sanitary sewer network is treated by the City of Niagara Falls WWTP;

vii) sufficient capacity is available in the sanitary sewers and WWTP to accommodate overburden groundwater infiltration;

viii) the WWTP was specifically designed to treat discharges from industrial users in the area; and

ix) the WWTP was funded by the industrial users in the area and the use of the WWTP by industrial users generates revenue for the City of Niagara Falls.

Therefore, Goal No. 4 does not need to be achieved at this point in time. If at some point in the future the WWTP is unable to accept overburden groundwater from the Plant, OxyChem will evaluate options to achieve Goal No. 4 if appropriate.

7.2.5 COST EFFECTIVENESS

The ICM composed of groundwater collection trenches and a groundwater treatment system is the most cost-effective alternative to achieve hydraulic containment at the Plant boundary. Permitting and collection of groundwater that infiltrates into the sanitary sewer network is a very cost-effective means for capturing on-Site groundwater as the system is already in place and no additional work is required.

Therefore, the ICM implemented was cost effective.

7.2.6 PERMANENCE OF REMEDY

The groundwater collection trenches do not offer a permanent remedy except for the volume of chemicals removed and treated by the system. Groundwater concentrations will decline to low levels but residual chemical presence in the soils may always have the potential for release to the overburden groundwater regime.

The life expectancy of a groundwater collection and treatment system is on the order of 20 to 30 years. Therefore, components of the system may require replacement on an infrequent basis.

The use of the sanitary sewer network as a groundwater collector is considered a permanent remedy provided that the existing sewers that permit infiltration are not replaced with a water-tight system and that the discharge remains permitted by the City of Niagara Falls.

7.2.7 REDUCTION OF TOXICITY, MOBILITY, AND VOLUME

The infiltration of groundwater to the sanitary sewer network and the groundwater collection trenches provides for the following:

- reduction of toxicity and chemical mass (volume) over time;
- reduction of mobility by eliminating groundwater/chemical migration off site; and
- reduction of the overall volume of groundwater with elevated chemical presence.

7.2.8 COMPLIANCE WITH STATE/FEDERAL STANDARDS AND GUIDELINES

Implementation of the overburden groundwater ICMs is compliant with State and Federal Standards and Guidelines presented in Table 7.2.

7.3 OVERBURDEN SOIL

The remedy selected to address chemical presence in the overburden soil beneath the Plant included the following components:

- maintenance of overburden groundwater ICM components;
- deed restrictions;
- institutional controls;

- maintenance of Plant perimeter fence;
- perimeter overburden NAPL monitoring;
- NAPL recovery (when sufficient quantity is encountered) and treatment of recovered NAPL;
- capping of dioxin and elemental phosphorus areas and surface drainage control;
- maintenance of capped and existing hard surfaced areas; and
- on-Site management of excavated soils.

7.3.1 EFFECTIVENESS

The selected remedy is effective for restricting the migration of NAPL constituents and elemental phosphorus dissolved in overburden groundwater to off-Site areas by capping affected areas and by recovering NAPL whenever sufficient quantities are encountered. The selected remedy is also effective for restricting the migration of dioxin and phosphorus to off-Site areas by wind and surface water run-off vectors by capping affected areas and maintaining cover materials.

The F-Area long-term soil stockpiles are effective for restricting the migration of chemicals in the soils by limiting infiltration via grading and cover materials. The polyethylene cover and liner for the Category B soils further restricts releases of chemicals to the overburden from the stockpiles.

7.3.2 IMPLEMENTABILITY

A monitoring program has been implemented at the Plant. Deed restrictions and institutional controls also have been implemented. The institutional controls (SOPs) present procedures to control excavations at the Plant to prevent chemical migration and exposure and ensure groundwater does not remain in potable watermains following repair. Source removal as future NAPL is encountered can be readily implemented as personnel and equipment are available. Capping of exposed soil areas that contain dioxin, or elemented phosphorus, with gravel, asphalt, or clean topsoil has been implemented. Capping of dioxin soils is more implementable than excavation and off-Site disposal of dioxin soils. Soils with dioxin concentrations greater than 1 ppb cannot be disposed off-Site due to the Land Disposal Restrictions. There also are no incineration facilities available to accept F020 waste at present. Treatment of extracted NAPL would be conducted either at the existing Plant LTDU or off Site. The F-Area long-term soil stockpiles will not interfere with any other implemented of future ICMs. All aspects of this alternative would require coordination with Plant operations.

The selected remedy is easily implemented.

7.3.3 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The use of existing overburden groundwater corrective measures will protect off-Site waters from dissolved Plant NAPL and from contact with hazardous waste constituents in the soil and dissolved elemental phosphorus. Source removal will reduce the mobility of the NAPL by reducing the volume and monitoring at the Plant perimeter will ensure detection of any off-Site migration. Capping will reduce the potential for human contact with dioxin and elemental phosphorus and will restrict the migration of dioxin by wind and surface water run-off vectors. Capping also will reduce the percolation of precipitation through the elemental phosphorus and thereby reduce the generation of dissolved elemental phosphorus in the groundwater. An exposure/environmental risk may exist if the groundwater remedial system should fail, although the technology is reliable and readily controlled. Should the groundwater remedial system fail, the performance monitoring activities will indicate system failure, resulting in the implementation of corrective actions. Deed restrictions, implementation of institutional controls such as SOPs for excavation and watermain repair, maintenance of the Plant perimeter fence, and NAPL volume reduction will ensure long term protection of workers and public.

The soil stockpile cover materials minimize human contact with hazardous waste constituents in the contained soils. The long-term soil stockpiles have been constructed within an area of overburden soil NAPL presence (see Figure 3.17) and/or within the F-Area Source Area (see Plan 2). Soils containing NAPL have not been placed in the long-term soil stockpiles. Thus, the chemical concentrations in the stockpiled soils are less than in the soils underlying them. Any release of chemicals to the overburden groundwater from the stockpiles will be less than any release from the underlying soils containing NAPL. Therefore, any release from the soil stockpiles will have a minimal adverse impact on the overburden groundwater quality compared to a release from the underlying soils containing NAPL.

The selected remedy is protective of human health and the environment.

7.3.4 CONSISTENCY WITH REMEDIAL GOALS

The remedial goals achieved by the overburden soils ICMs are summarized in Table 7.1 and described below.

The selected remedy is consistent with Goal No. 6 of minimizing human contact with hazardous waste constituents in the overburden soil and with other goals such as maintaining compatibility with other Plant remedial efforts and Plant operations (Goal No. 8), restricting migration of NAPL from the overburden to the bedrock via implementation of the SOP for excavations (Goal No. 5), minimizing the need for future/ongoing remediation and operation and maintenance activities (Goal No. 7) and protecting City water supply components at the Plant from releases of hazardous waste constituents via the implementation of the SOP for watermain repair (Goal No. 10).

7.3.5 COST EFFECTIVENESS

The selected remedy is cost effective. Costs for this alternative are associated with monitoring personnel, sample analysis and data interpretation, cap maintenance, maintenance of the F-Area long-term soil stockpiles, implementation of deed restrictions and institutional controls, maintenance of the Plant perimeter fence and periodic NAPL extraction and treatment either on Site at the Plant LTDU or off Site.

Capping in-place is the only cost effective option currently available for addressing soils with dioxin presence. Off-Site disposal/treatment is currently unavailable as there are no available facilities to incinerate F020 wastes. Facilities could become available but the cost of incineration is prohibitively expensive.

7.3.6 PERMANENCE OF REMEDY

The selected ICMs are not a permanent remedy. Groundwater concentrations would approach very low levels as free NAPL and dissolved constituents are extracted, but residual NAPL presence in the soils could continue to have the potential for release of chemical constituents to the overburden groundwater regime. Soils with elevated dioxin and elemental phosphorus concentrations would remain in place.

7.3.7 REDUCTION OF TOXICITY, MOBILITY, AND VOLUME

The selected remedy reduces mobility of NAPL, dioxin and elemental phosphorus and the volume of NAPL in the overburden soils beneath the Plant. The toxicity of NAPL, dioxin and elemental phosphorus and the volume of dioxin and elemental phosphorus would not be reduced. The proposed bioremediation project, if successful, will demonstrate that chemicals can be degraded on a large scale. If successful, bioremediation will be used on a larger scale to address the F-Area long-term soil stockpile. If implemented, the project would reduce the toxicity, mobility and volume of residual chemicals in the soils within F-Area long-term soil stockpile.

7.3.8 COMPLIANCE WITH STATE/FEDERAL STANDARDS AND GUIDELINES

The overburden soil ICMs are compliant with State and Federal Standards and Guidelines presented in Table 7.2.

7.4 OFF-SITE AREAS

No corrective measures are required for off-Site overburden groundwater, overburden NAPL presence, and bedrock NAPL presence as discussed in Section 5.4. The corrective measures for off-Site bedrock groundwater chemical presence will be composed of the following components:

- the existing bedrock groundwater extraction system which will continue to draw chemicals back toward the Plant and prevent further off-Site chemical migration;
- the FST which will continue to collect D-Zone groundwater. All dry weather flow in the FST is treated by the Niagara Falls WWTP; and
- Monitored natural attenuation. Monitoring of off-Site bedrock groundwater quality is already performed on a semi-annual basis as part of on-Site bedrock groundwater corrective measures.

7.4.1 EFFECTIVENESS

Utilizing the existing on-Site groundwater extraction system and the FST are effective means for capturing the bedrock groundwater.

The on-Site bedrock groundwater system has a zone of capture that extends well beyond the Plant boundary and as a result draws chemicals from off-Site areas back toward the Plant and treats the water prior to discharge to the Niagara River.

The D-Zone bedrock groundwater that is beyond the northern zone of capture for the on-Site extraction system is captured by the FST. The FST is a combined sewer and all flow in the FST during dry weather periods is treated at the Niagara Falls WWTP, thereby treating any D-Zone bedrock groundwater prior to discharge to the Niagara River.

Bedrock groundwater that is beyond the zone of capture for the on-Site extraction system and is not captured by the FST, eventually will enter the NYPA conduit drain system. The hydraulic containment provided by the on-Site extraction system has removed the source of off-Site chemical releases and as a result, no additional chemical discharges from the Plant will occur. For the chemicals in the groundwater beyond the zone of capture, natural attenuation processes will continue to reduce chemical presence but most of the residual chemicals would be expected to enter the NYPA conduit drain system. The dilution of the chemicals in the groundwater upon entering the NYPA power conduit forebay will minimize the effect of these residual off-site chemicals.

7.4.2 IMPLEMENTABILITY

Implementation of the selected remedy requires no further action beyond the systems and monitoring programs that are in place to control on-Site bedrock groundwater.

7.4.3 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The risk proposed by the implementation of the off-Site corrective measures to human health (i.e. general public and workers) and the environment is minimal.

Operation of the on-Site bedrock groundwater extraction system will be effective in eliminating off-Site migration of groundwater flow as well as the source of the off-Site chemical presence. Performance monitoring activities will indicate system failure resulting in implementation of corrective action.

The capture of D-Zone groundwater by the FST will occur on a continuous basis and treatment of the water at the WWTP will protect human health and the environment.

Utilizing natural attenuation as a corrective measure for off-Site bedrock groundwater that is not captured by the on-Site system or the FST will pose minimal risk to the public health or the environment as long as chemical concentrations continue to decline. None of the bedrock groundwater downgradient of the Site is used as a water source or either potable or industrial usage and as a result there is minimal risk of exposures.

There is a potential local exposure pathway for off-Site bedrock groundwater located at the American Refuel facility north of the Plant. Foundation drains surround the perimeter of the facility and collect bedrock groundwater. The groundwater collected by the foundation drains flows to an interior sump where the water is discharged to the sanitary sewer under permit with the City. The groundwater in this sump was sampled during the OSI conducted in 1991 and 1992. The total organic SSI concentrations detected in the sump were 4,900 µg/L and 5,500 µg/L, respectively. The only potential exposure to the groundwater in the sumps is worker contact during maintenance activities. Worker exposure is prevented by the implementation of health and safety protocols including the use of PPE which are in place at the facility. The monitoring conducted as part of the on-site bedrock groundwater ICM has shown that chemical concentrations in off-Site areas are decreasing. Therefore, it is expected that the chemical concentrations in the water collected in the sump will decrease over time as well since chemicals are no longer migrating from the Site (i.e., the source has been contained).

7.4.4 CONSISTENCY WITH REMEDIAL GOALS

Implementation of the off-Site corrective measures is consistent with the primary cleanup goal of restricting off-Site migration of OxyChem hazardous waste constituents in the bedrock groundwater (Goal No. 1). Implementation of the off-Site corrective measures also will reduce the concentration of OxyChem hazardous waste constituents in the bedrock groundwater (Goal No. 9).

7.4.5 COST EFFECTIVENESS

The ICMs outlined above utilize existing on-Site systems for bedrock groundwater collection/extraction as well as the existing FST. Therefore, the ICMs are cost-effective as no additional systems are required.

7.4.6 PERMANENCE OF REMEDY

The on-Site bedrock groundwater ICM has eliminated off-Site migration of chemicals by containing the source at the Plant boundary. There also is no off-Site source of chemicals (i.e., NAPL). Therefore, the ICMs for the off-Site area will be a permanent remedy and chemical concentrations will be reduced to acceptable levels with time provided that the on-Site extraction system maintains the hydraulic barrier.

The life expectancy of the on-Site extraction system is on the order of 20 to 30 years; system rehabilitation may be required.

D-zone groundwater will continue to be captured by the FST as long as it exists.

Monitored natural attenuation is a permanent remedy. The attenuation processes will continue to act on chemical presence in the groundwater until such point that there is no longer a chemical presence to attenuate or equilibrium is reached.

7.4.7 REDUCTION OF TOXICITY, MOBILITY, AND VOLUME

The systems including the on-Site extraction and treatment system, the FST capture of D-Zone groundwater, and monitored natural attenuation provide for the reduction of toxicity, mobility and volume in the off-Site areas.

The on-Site extraction system has eliminated the source of the chemical presence by creating a hydraulic barrier at the Plant boundary. The on-site system also reduces the toxicity, volume, and mobility of the off-Site chemical presence by removing chemical presence from off-Site groundwater within the capture zone (i.e., drawing off-Site groundwater back toward the Plant boundary for extraction and treatment).

The capture of groundwater by the FST and natural attenuation processes serve to reduce the volume and toxicity of chemicals present in the groundwater by treatment at the WWTP or by means of natural attenuation.

7.4.8 COMPLIANCE WITH STATE/FEDERAL STANDARDS AND GUIDELINES

The off-Site corrective measures are compliant with State and Federal Standards and Guidelines presented in Table 7.2.

8.0 CONCLUSIONS

The following conclusions have been made based on the results of the CMS:

- The ICMs implemented for the bedrock groundwater flow regime achieve the goals of the corrective action program and are protective of human health and the environment;
- The ICMs implemented for the overburden groundwater flow regime achieve the goals of the corrective action program and are protective of human health and the environment;
- The ICMs implemented for overburden soils achieve the goals of the corrective action program and are protective of human health and the environment;
- The ICMs implemented for off-Site areas achieve the goals of the corrective action program and are protective of human health and the environment; and
- The ICMs implemented for the above four components achieve all 10 remedial goals presented in Table 7.1 as a whole.

9.0 RECOMMENDATIONS FOR FINAL CORRECTIVE MEASURES

Based on the conclusions presented in Section 8.0, the ICMs implemented or to be implemented for the four components of the CAP (bedrock groundwater, overburden groundwater, overburden soils and off-Site areas) achieve all 10 remedial goals as a whole. The ICM components that will be implemented in the future include deed restrictions, outfall sewer repairs, and bioremediation study. Therefore, it is recommended that the ICMs implemented become the final corrective measures for the Plant and that the performance monitoring programs developed for the ICMs be combined into one long-term performance monitoring program to ensure that the ICMs continue to achieve the remedial goals. The performance monitoring program that has been implemented is presented in Section 10.0.

10.0 LONG-TERM MONITORING AND REPORTING

A summary of the compliance monitoring program for the CAP is presented in Table 10.1. Specific details are presented in the following subsections.

10.1 BEDROCK GROUNDWATER

A performance monitoring program has been implemented to evaluate the effectiveness of the bedrock groundwater extraction and treatment system. The performance monitoring program includes hydraulic monitoring to establish the extent and continuity of plume capture, chemical monitoring to evaluate the changes in groundwater chemistry both on- and off-Site, and effluent monitoring to ensure discharge limits are achieved.

10.1.1 HYDRAULIC MONITORING

Since the objective of the bedrock extraction system is to create a hydraulic barrier along the western Plant boundary and portions of the northern Plant boundary, the primary emphasis of the performance monitoring program is hydraulic monitoring.

Hydraulic monitoring is conducted monthly using interior monitoring well nests, OW415, OW416 and OW417; perimeter monitoring well nests OW400, OW401, OW402, OW404, OW405, OW406, OW667, OW408, OW409 and OW410 located along the Plant boundary midway between the extraction well nests; monitoring well nests OW660 to OW666 and OW668 installed approximately 100 feet outside the Plant boundary; off-Site monitoring well nests OW649, OW403, OW651, OW657, OW652, OW658, OW659, OW407, and OW653; and extraction wells BEW700 to BEW706. The locations of these wells are shown on Figure 10.1.

Hydraulic monitoring of the wells is performed to allow simultaneous measurement of water levels at wells along vectors perpendicular to the Plant boundary (i.e. wells OW667, OW666, OW407, and OW653). Each hydraulic monitoring event is typically completed within a 2-hour period. The Niagara River level and the water level in NYPA well OW139 is measured at the beginning of each event (before well water levels are measured) and at the end of each event (after well water levels are measured) to determine the change in River level and water level in the NYPA conduit drains during the monitoring event.

Instantaneous water level monitoring data will be collected on the extraction and monitoring wells shown on Figure 10.1 on a monthly basis during the optimization period and for one year after hydraulic containment has been achieved. Thereafter, the frequency of monitoring will be set in accordance with the recommendations of the performance report submitted at the end of the first year.

Results of the hydraulic monitoring program will be presented in performance reports as described in 10.1.4 used to evaluate system operation.

10.1.2 CHEMICAL MONITORING

The purpose of the chemical monitoring program is to monitor bedrock groundwater chemistry in areas beyond the extent of the capture zone created by the extraction system. In addition, limited chemical monitoring within the capture zone will be used to monitor changes in the APL plumes.

Chemical monitoring is performed on the seven extraction well nests and existing well nests OW403, OW407, OW409, OW410, OW649, OW651, OW652 and OW653. The location of these wells is shown on Figure 10.2. Each of these wells is sampled semi-annually using SDCP protocols and analyzed for the list of parameters presented in Table 10.2.

After the first two years of chemical monitoring, the analytical parameter list may be reduced further based on trends observed in the chemical data.

Recommendations for changes to the frequency of sampling and the list of parameters will be set in accordance with the recommendations of the performance reports described in Section 10.1.4.

10.1.3 FLOW MONITORING

The volume of groundwater pumped by each extraction well will be monitored to provide data to assist in optimizing the performance of the extraction system. The volume of groundwater pumped from each extraction well will be recorded on a totalizing flow meter installed within the extraction well chamber. Flow measurements will be recorded on a weekly basis and submitted with the performance reports.

10.1.4 REPORTING

10.1.4.1 OPTIMIZATION

Operation of the bedrock groundwater extraction and treatment system is still in the optimization period. This period will extend for one year following startup of the treatment system upgrade. During this period, the operation of the system will be adjusted by OxyChem to obtain the maximum operating efficiency of the system. Quarterly progress reports will be submitted to the EPA/State. After the year of system optimization, a report will be submitted to the EPA/State. The report will evaluate the effectiveness of the extraction system in creating the required hydraulic barrier over the past year. If hydraulic containment has not been achieved, the report will evaluate the possibility of adding more extraction wells, increasing the capacity of the treatment system or implementing groundwater enhancement programs (i.e., groundwater injection and groundwater containment by grout curtain wall construction).

Following system adjustments or enhancement, the modified bedrock extraction system (if required) will be operated for a period of one year and will be re-evaluated. The process will be repeated until hydraulic containment has been achieved.

10.1.4.2 LONG-TERM OPERATION

Once hydraulic containment has been achieved, the performance of the system will be evaluated on a quarterly basis for the first year of operation. After the first year of operation, the frequency of the performance evaluation will be re-evaluated and modified as appropriate. A recommendation to abandon all bedrock monitoring wells not required for the monitoring program will be made after the first year of operation. The performance evaluations will be submitted to the EPA/State and will contain the hydraulic and chemical monitoring results obtained during the monitoring periods, the observed pumping impacts and recommendations.

10.2 BEDROCK NAPL

The current ICM program to address the presence of NAPL in the bedrock involves NAPL collection and/or monitoring in 17 SDCP A-wells. The current schedule for ICM

NAPL recovery and collection activities for the bedrock regime at the Plant is summarized below.

- All bedrock A-wells are checked for NAPL presence on an annual basis. If NAPL is detected in an A-well, the corresponding B-well is also checked for NAPL;
- NAPL is collected on a semi-annual basis from wells OW402A and OW413A. If the volume of NAPL collected from a well is greater than 100 gallons during any one event, the pumping frequency increases to quarterly until the volume collected is less than 50 gallons, after which quarterly pumping resumes; and
- NAPL is collected from well OW417A on a annual basis. If the volume of NAPL collected during any one event is greater than 100 gallons, the pumping frequency increases to quarterly until the volume of NAPL collected is less than 50 gallons, after which annual pumping resumes.

Monitoring reports are submitted to EPA/State on an annual basis. The reports contain a description of monitoring and collection activities conducted in the previous year, the results, and recommendations for changes to the monitoring and collection frequency, if appropriate. The monitoring report for bedrock NAPL has been combined with the monitoring report for overburden soils (NAPL) presented in Section 10.4.2.

10.3 OVERBURDEN GROUNDWATER

A performance monitoring program has been implemented to evaluate the effectiveness of the overburden groundwater collection and treatment systems. The performance monitoring program includes hydraulic monitoring to verify that hydraulic containment has been achieved, limited chemical monitoring to evaluate the changes in groundwater chemistry and effluent monitoring to ensure discharge limits are achieved.

10.3.1 HYDRAULIC MONITORING

The primary emphasis of the performance monitoring program is hydraulic monitoring since the objective of the collection system is to create a hydraulic barrier along the south and west perimeter of Flow Zone 1.

The effectiveness of Flow Zone 1 groundwater collection is evaluated by monitoring the groundwater levels within overburden wells and the collection systems. The resulting elevation data is contoured to show groundwater flow patterns during system operation. Hydraulic containment is demonstrated by a lower water level in the collection system compared to water levels in monitoring wells downgradient of the collection system based on pre-pumping conditions. Figure 10.3 shows the monitoring well and collection system locations from which hydraulic elevation data are collected. Eleven new overburden wells were installed to monitor the effects of groundwater removal.

Hydraulic monitoring conducted during SDCP activities showed that overburden wells exhibit a slow response to changes in groundwater levels. Therefore, the hydraulic monitoring program will involve manual water level monitoring. Manual water level data will be collected at the wet well, manhole, and monitoring well locations shown on Figure 10.3 on a monthly basis during the first two years of system operation. Thereafter, the monitoring frequency will be set in accordance with the recommendations of the performance report submitted at the end of the second year.

10.3.2 CHEMICAL MONITORING

Limited chemical monitoring within the capture zone is performed to monitor changes in the groundwater chemical plume. It is anticipated that decreases in overburden groundwater chemical concentrations will occur slowly due to the large volume of groundwater within the overburden. Consequently, no changes in groundwater quality are expected in the short term. Therefore, the chemical monitoring will not be used to judge performance of the system.

Chemical monitoring is performed on the two Stage 4 system wet wells. The wet wells are sampled semi-annually using SDCP protocols and analyzed for the parameter list presented in Table 10.3. The parameters presented in Table 10.3 are representative of the chemicals present in the overburden groundwater in the vicinity of the groundwater collection systems based on SSI Round 1 and 2 data.

After the first two years of chemical monitoring, the analytical parameter list and frequency may be revised based on trends observed in the chemical data. Recommendations for changes to the sampling frequency and the list of parameters will be set in accordance with the recommendations of the performance reports described in Section 10.3.4.

10.3.3 FLOW MONITORING

The volume of groundwater pumped from the wet wells is monitored to provide data to assist in optimizing the performance of the collection system. The volume of groundwater pumped from the wet wells is recorded on a totalizing flow meter installed within the wet well chambers. Flow measurements are monitored on a monthly basis and submitted with the performance reports described in Section 10.3.4.

Monitoring of the effluent from the U-Area treatment system will be conducted in accordance with the Plant's discharge permit with the City or with the modified SPDES permit if discharge is routed to an outfall.

10.3.4 REPORTING

The performance of the system will be evaluated on a semi-annual basis for the first two years of operation and then annually for three years. After the first five years of operation, the frequency of performance evaluation will be re-evaluated. A recommendation to abandon all overburden monitoring wells not required for the monitoring program will be made after the first year of operation. The performance evaluations will be submitted to EPA/State and will contain the hydraulic and chemical monitoring results obtained during the monitoring period, the observed drawdown impacts and recommendations.

10.4 OVERBURDEN SOILS

10.4.1 NAPL MONITORING

The current ICM program to address the presence of NAPL in the overburden involves NAPL collection and/or monitoring in the 003 NAPL Collection Trench, two SDCP overburden wells (OW313 and OW270), six abandoned sewer manholes, and two sumps in the N-Area. The current schedule for ICM NAPL recovery and collection activities for the overburden regime at the Plant is summarized below.

- The two sumps at the north and south ends of the 003 NAPL Collection Trench are currently monitored for the presence of NAPL on a monthly basis. NAPL collection occurs from the sumps if the depth of NAPL in any one sump is equal to or greater than 9 inches (approximately 10 gallons);

- Monitoring well OW313 is checked for NAPL presence on a monthly basis. NAPL collection from OW313 occurs when the depth of NAPL is greater than 8 inches (approximately 0.25 gallons). Monitoring well OW270 is checked for the presence of NAPL on an annual basis; and
- Six abandoned sewer manholes and the two sumps in the N-Area are checked for NAPL presence on an annual basis. NAPL is removed when collectable quantities are present.

A comprehensive overburden NAPL survey will be conducted at the Plant to supplement the current ICM program. The survey will include all existing Plant overburden wells as shown on Plan 3. After the initial survey, the Plant overburden wells will be categorized as either NAPL wells or non-NAPL wells.

NAPL wells will be pumped to determine the quantity of NAPL present in each well. The wells will then be further categorized as either NAPL wells with greater than one gallon of mobile NAPL or NAPL wells with less than one gallon of mobile NAPL. All extracted NAPL will be treated either on Site at the Plant's LTDU or off Site.

Wells with greater than one gallon of mobile NAPL will be pumped quarterly. If the quantity of mobile NAPL in one of these wells is less than one gallon on each of two consecutive quarterly pumping events, the well will be categorized as a NAPL well with less than one gallon of mobile NAPL. Wells with less than one gallon of mobile NAPL will be pumped semi-annually. If a well contains no NAPL after two consecutive semi-annual pumping events, it will be categorized as a non-NAPL well and pumping and monitoring will cease. A decision chart for the NAPL pumping program is presented on Figure 6.12.

A second NAPL survey will be conducted two years after the initial survey. Only wells that contained no NAPL in the first survey will be included in the second survey. If NAPL is detected in a well during the second survey, the well will be categorized as a NAPL well and pumping will be conducted according to the above schedule. If NAPL is not detected in a well during the second survey, no further NAPL monitoring will be conducted at the well.

The wells identified by the two NAPL surveys will be added to the current ICM program.

The perimeter wells shown on Figure 6.13 will be monitored for NAPL on a semi-annual basis to ensure that NAPL is not migrating off Site. These wells will be monitored for two years following the initial NAPL survey. The program will be re-evaluated after the two-year period. A recommendation to abandon all overburden monitoring wells not required for the monitoring program will be made after the two-year period.

10.4.2 REPORTING

Monitoring reports will be submitted to the EPA/State annually. The reports will contain a description of all monitoring conducted in the previous year, the results of the monitoring, and recommendations for changes to the monitoring and collection frequency, if appropriate.

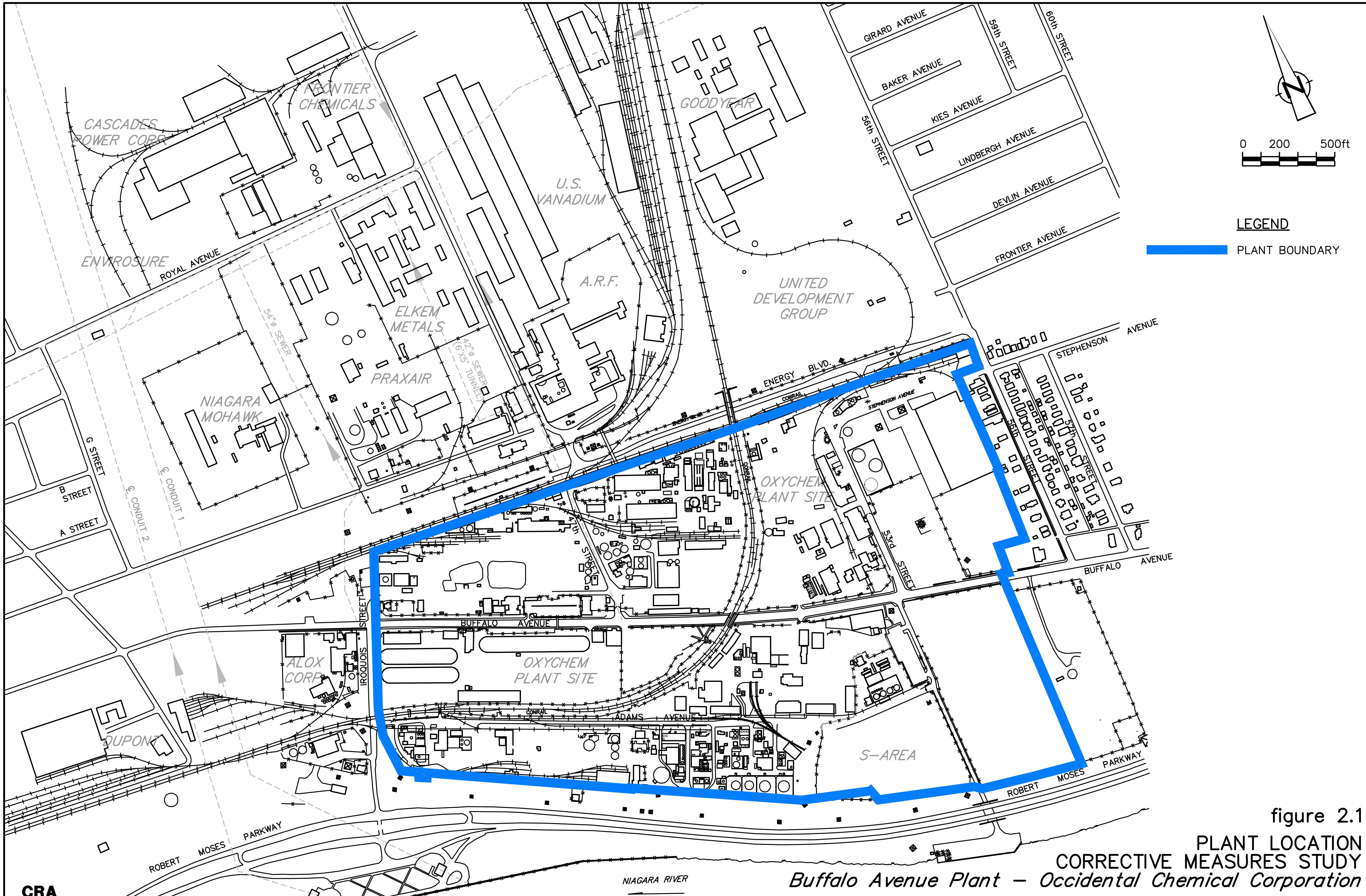


figure 2.1

PLANT LOCATION
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA001 NOV 13/98

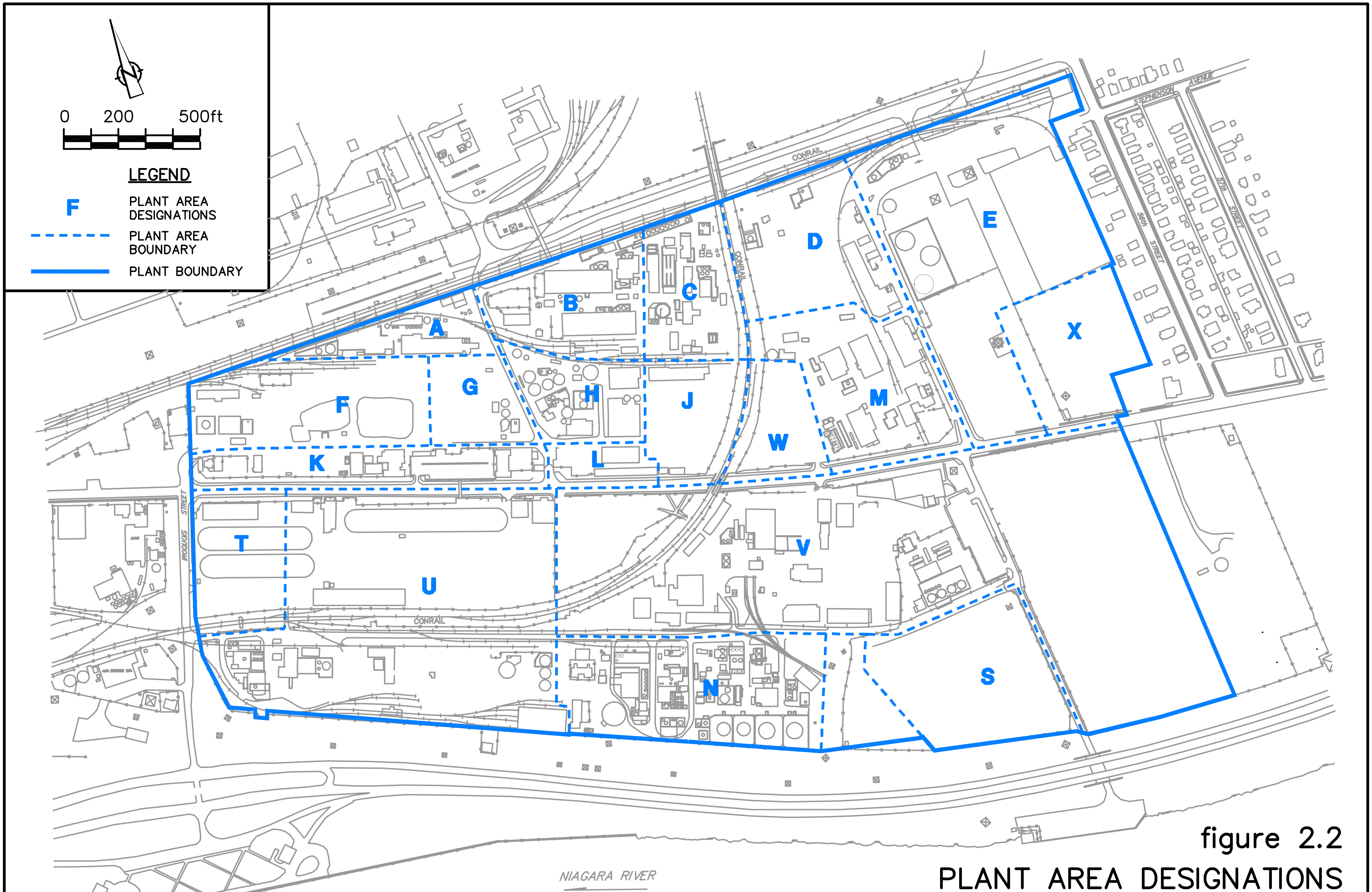


figure 2.2

PLANT AREA DESIGNATIONS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583–00(191)GN–WA002 NOV 13/98

FORMATION	COLUMNAR SECTION	THICKNESS IN FEET	CHARACTER
FILL		0–15	GRAVEL, SAND, SILT AND CLAY, DEMOLITION DEBRIS, FLYASH, CINDERS, CHEMICAL WASTE
ALLUVIUM		0–15	LIGHT BROWN SILT AND VEGETATION, GRADING INTO THIN BLACK AND DARK BROWN SILTY SAND, GRADING INTO BLACK IN THE LOWER PART
GLACIOLACUSTRINE CLAY		0–15	RED BROWN SILTY CLAY AND GRAY BROWN SANDY TO CLAYEY SILT
TILL		0–15	RED BROWN SANDY SILT, TRACE TO SOME CLAY AND GRAVEL
BEDROCK			LOCKPORT DOLOMITE

figure 3.1

OVERBURDEN STRATIGRAPHY
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583–00(191)GN–WA003 NOV 13/98

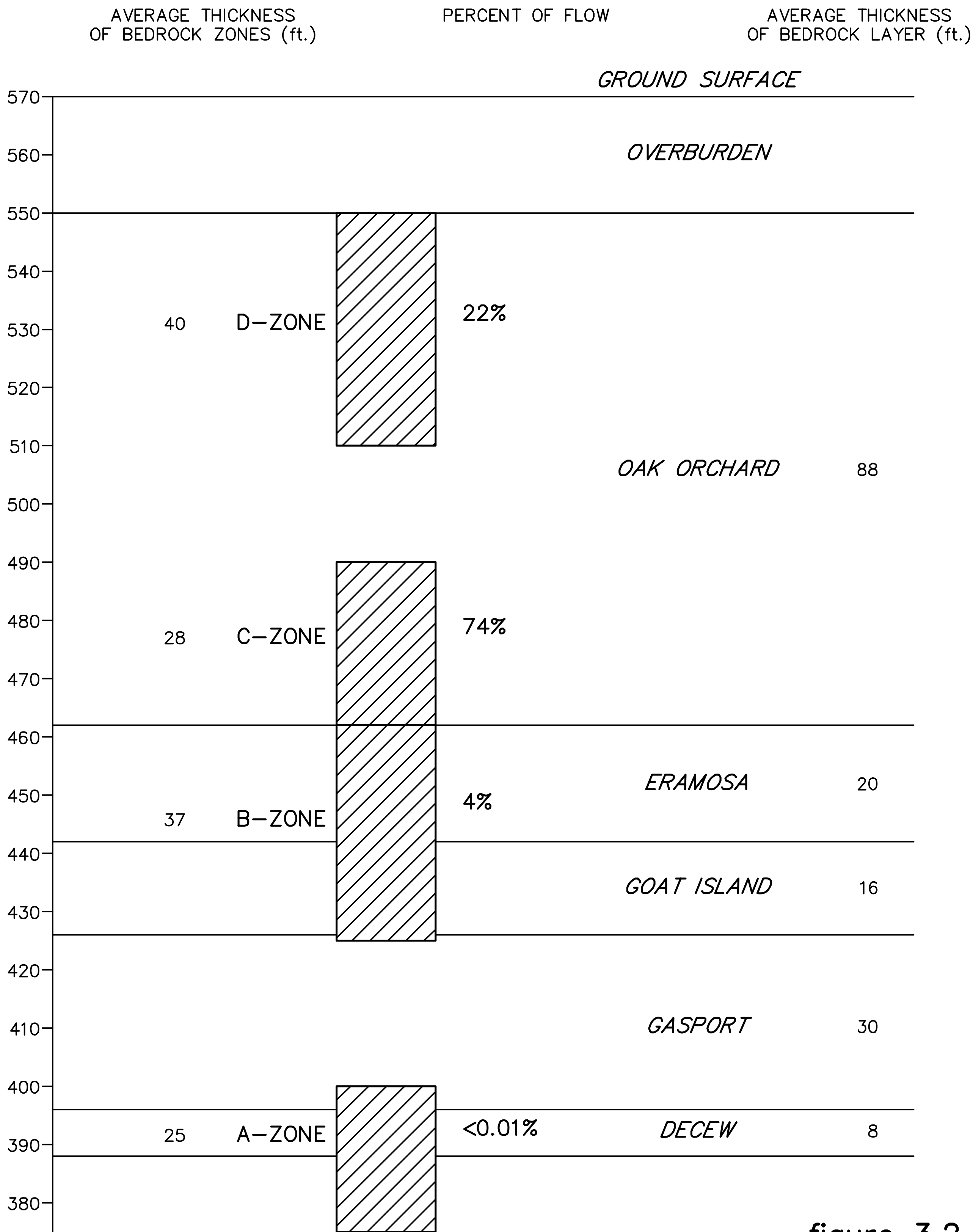


figure 3.2

BEDROCK STRATIGRAPHY
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583–00(191)GN–WA004 NOV 13/98

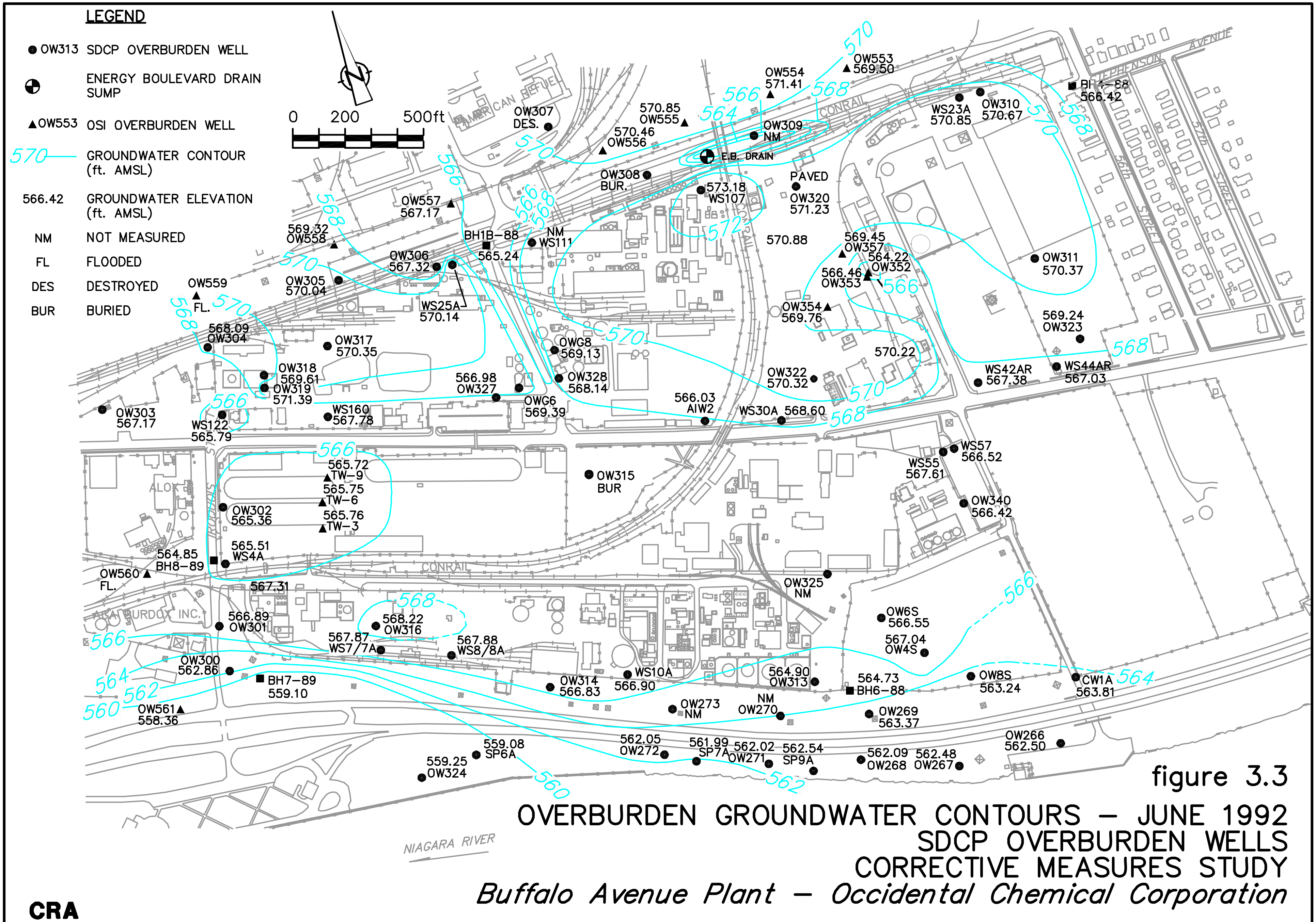


figure 3.3

OVERBURDEN GROUNDWATER CONTOURS – JUNE 1992
SDCP OVERBURDEN WELLS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA041 NOV 13/98

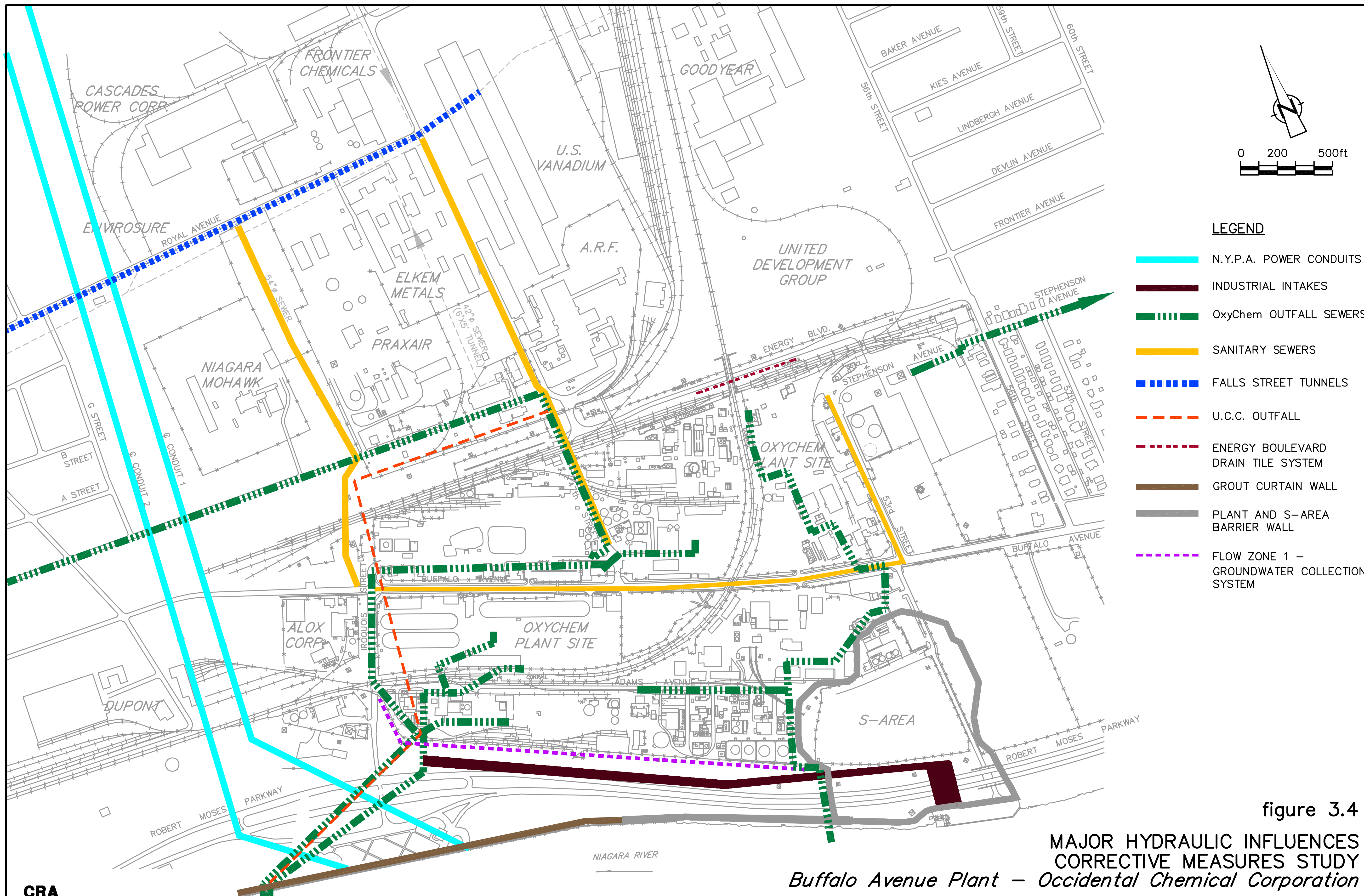


figure 3.4

MAJOR HYDRAULIC INFLUENCES
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

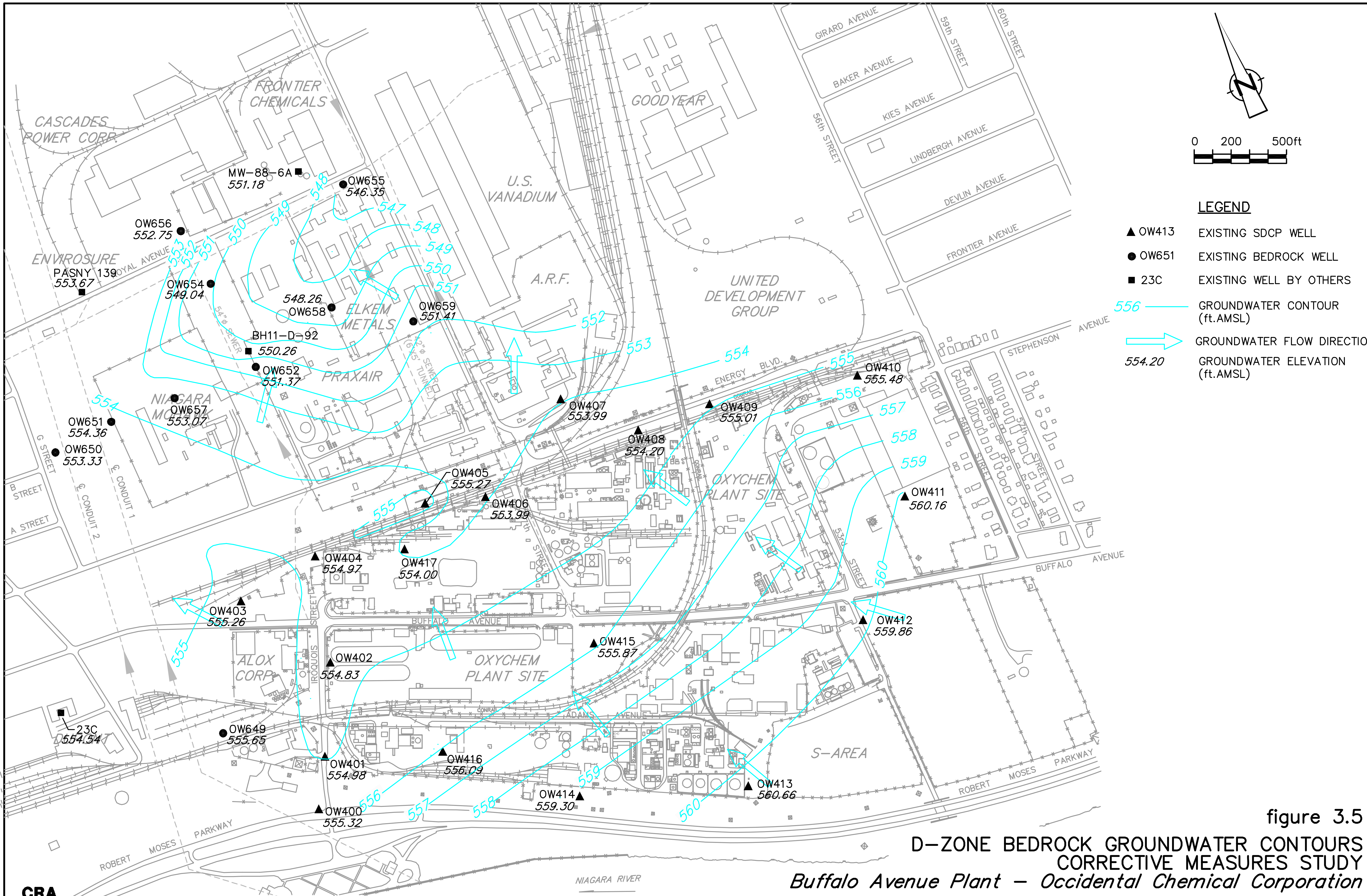


figure 3.5

D-ZONE BEDROCK GROUNDWATER CONTOURS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA006 NOV 13/98

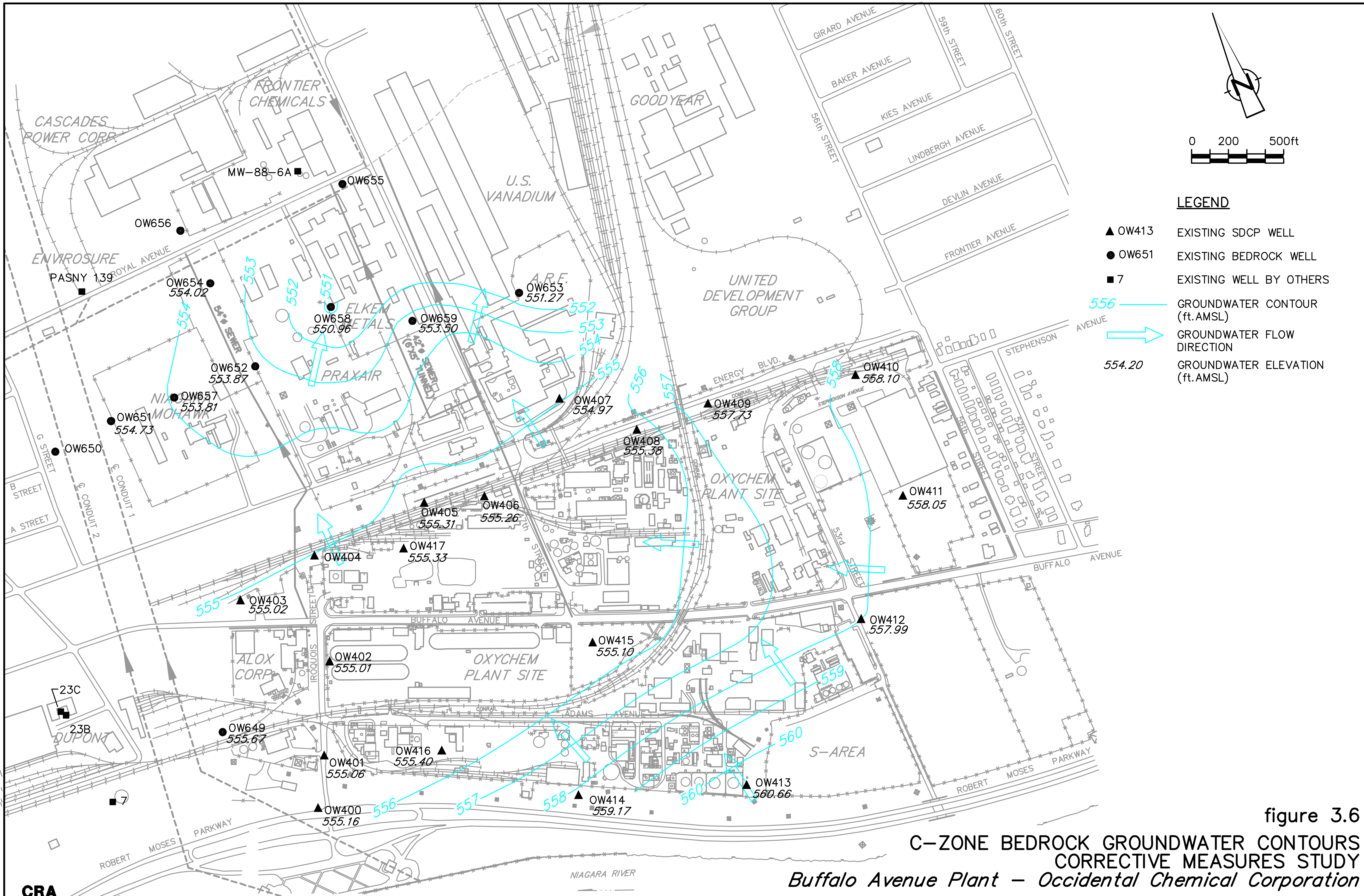


figure 3.6

C–ZONE BEDROCK GROUNDWATER CONTOURS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583–00(191)GN–WA007 NOV 13/98

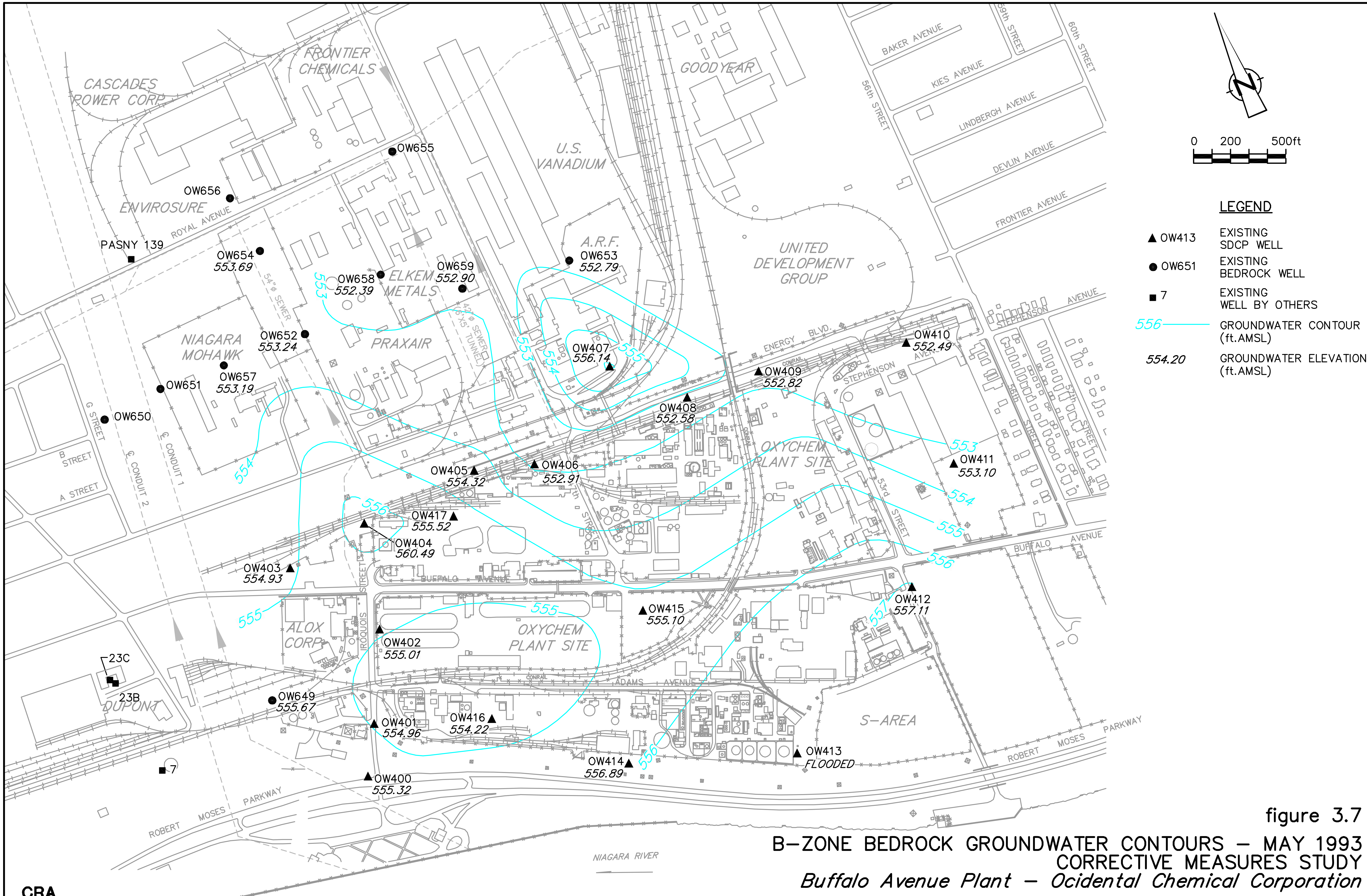


figure 3.7

B-ZONE BEDROCK GROUNDWATER CONTOURS – MAY 1993
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Ocidental Chemical Corporation

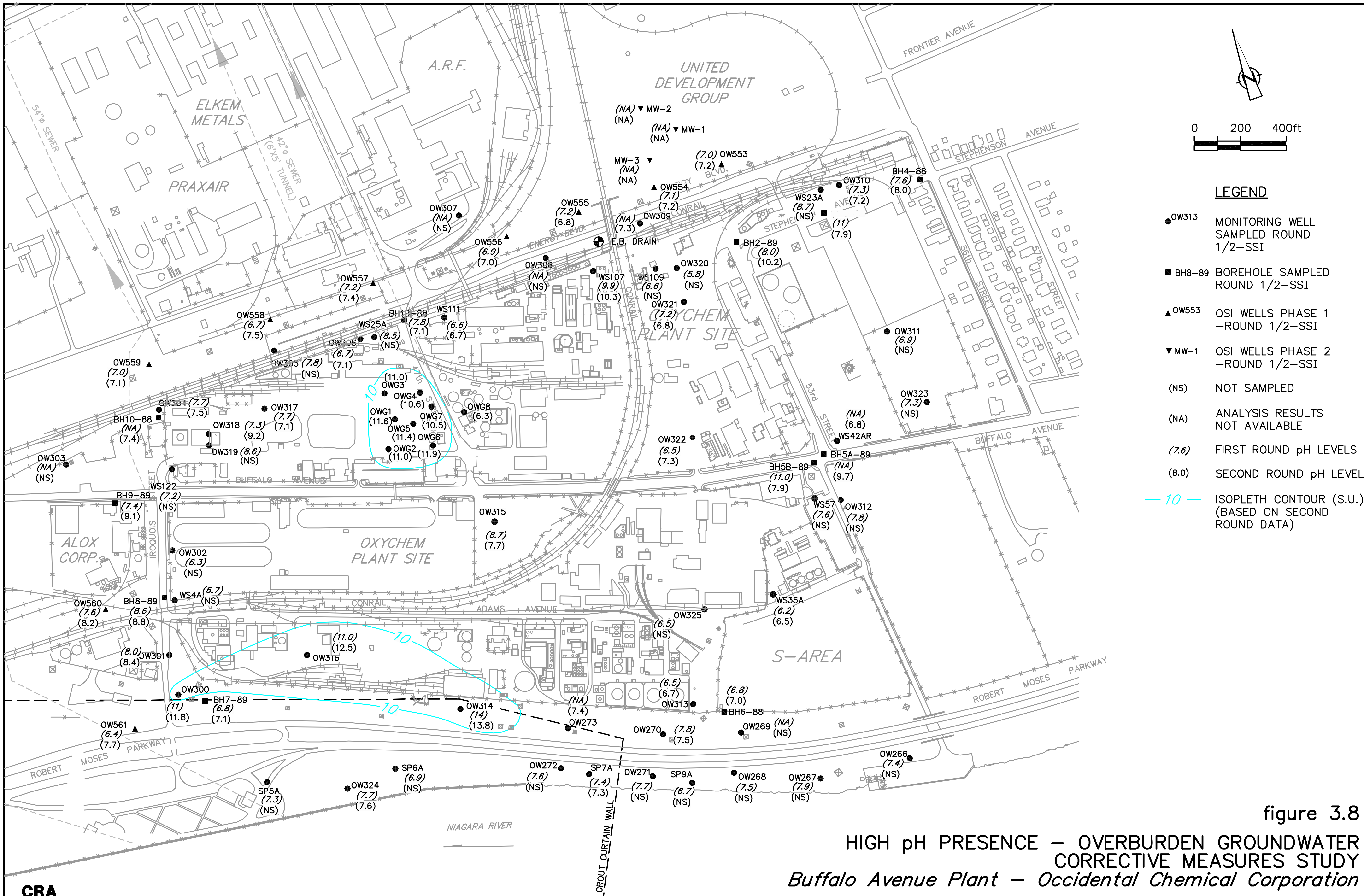


figure 3.8

HIGH pH PRESENCE – OVERBURDEN GROUNDWATER
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583–00(191)GN–WA013 NOV 13/98

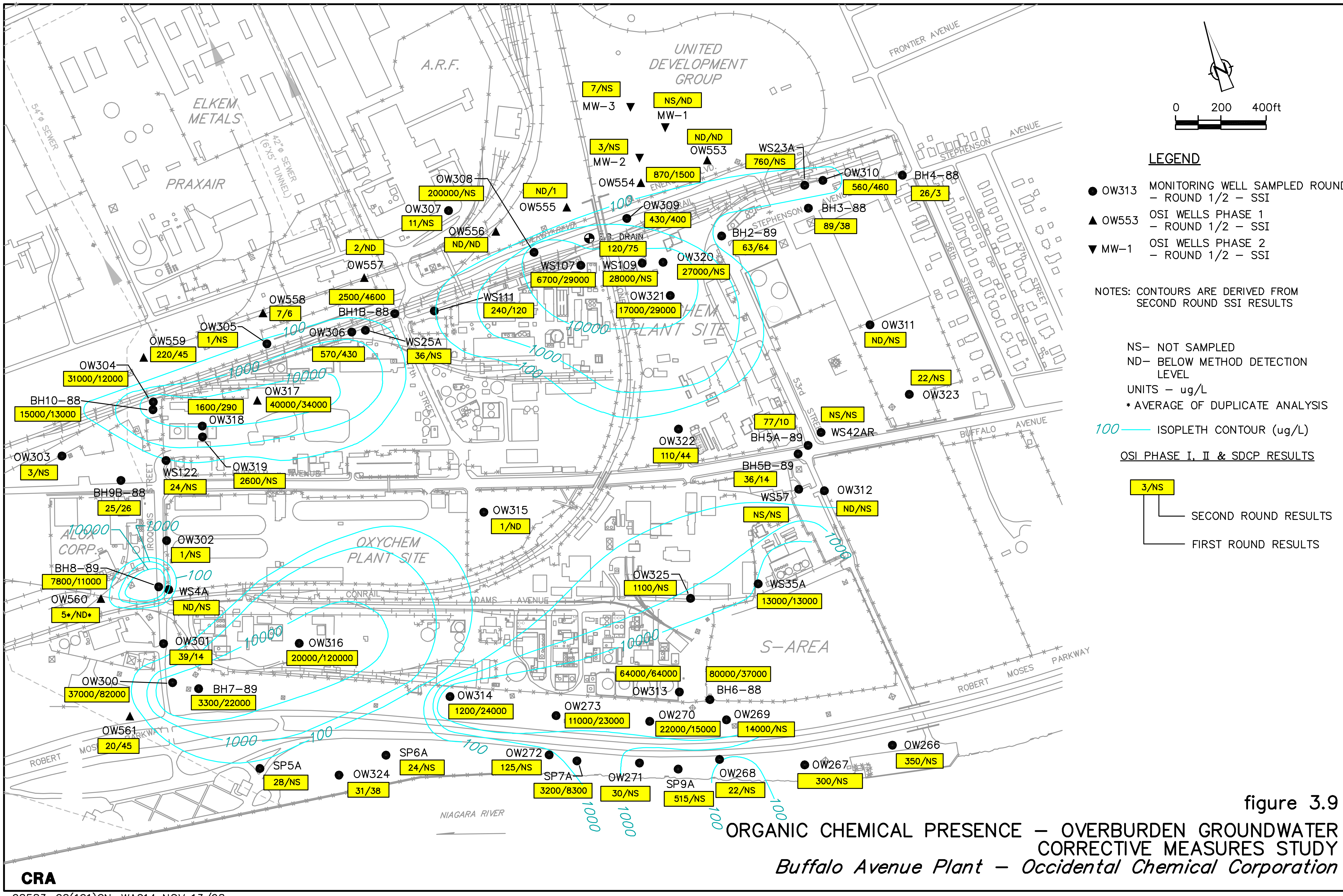


figure 3.9

ORGANIC CHEMICAL PRESENCE – OVERBURDEN GROUNDWATER
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

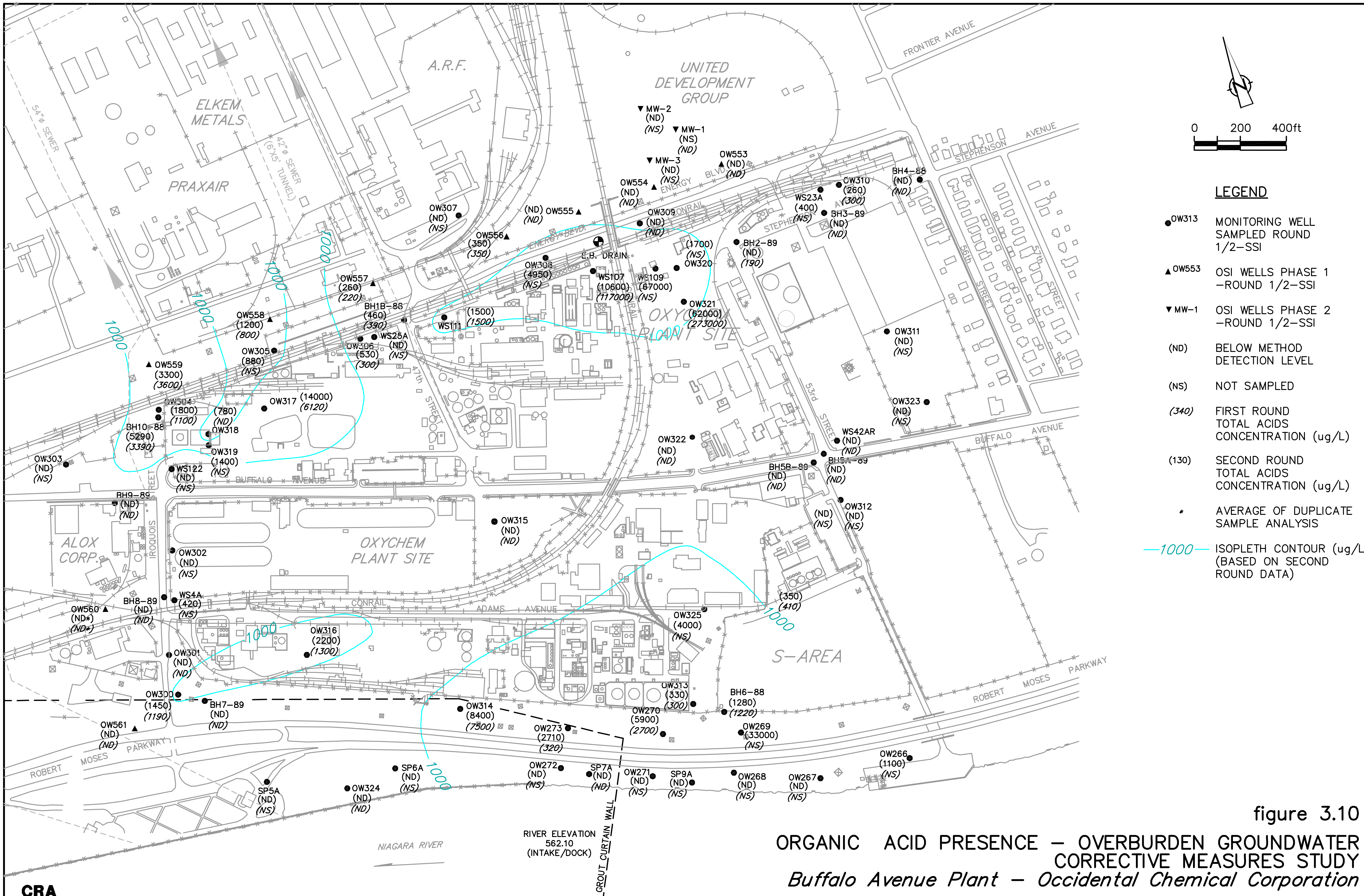


figure 3.10

ORGANIC ACID PRESENCE – OVERBURDEN GROUNDWATER
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA015 NOV 13/98

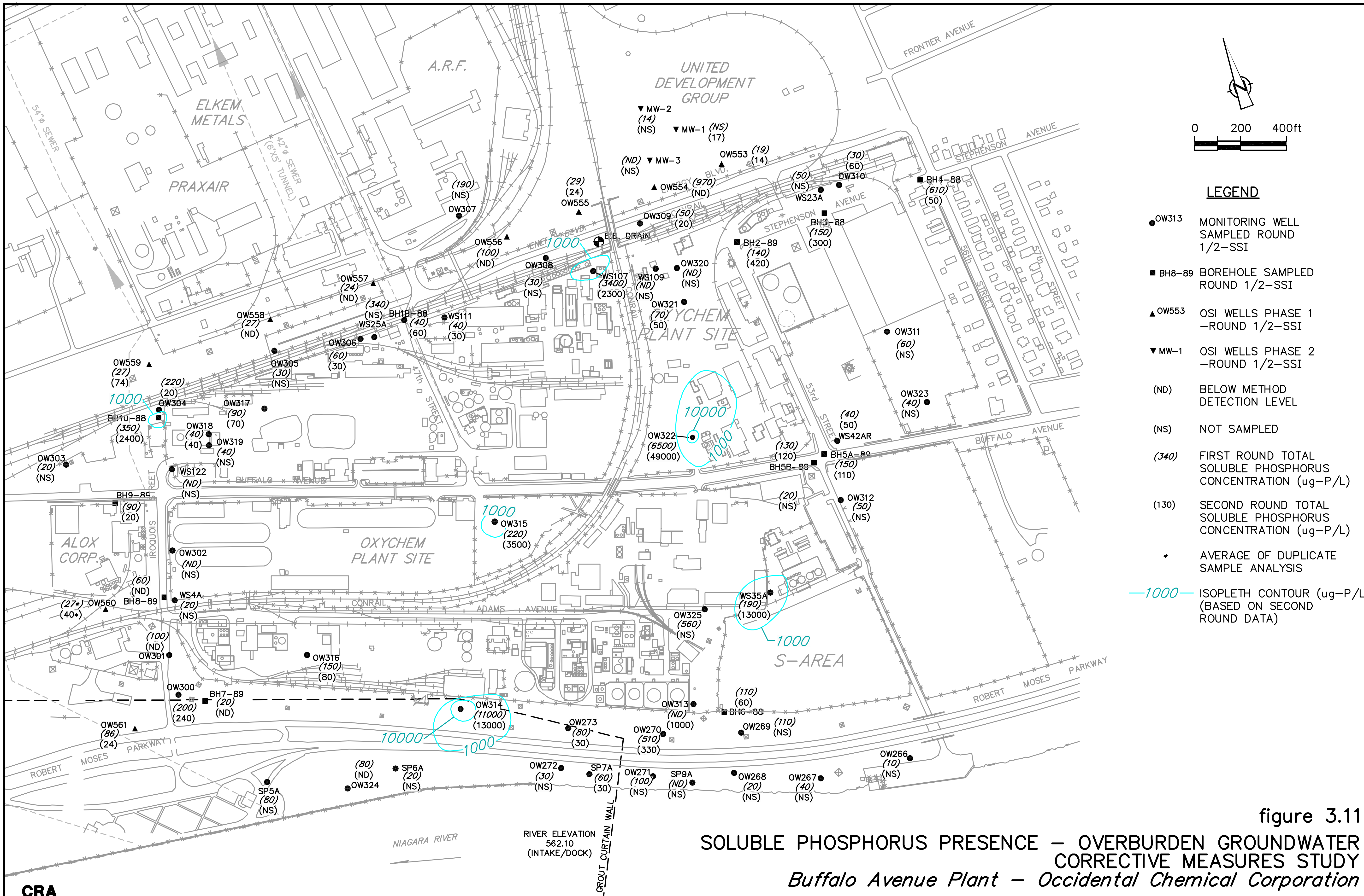


figure 3.11

SOLUBLE PHOSPHORUS PRESENCE – OVERBURDEN GROUNDWATER
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA016 NOV 13/98

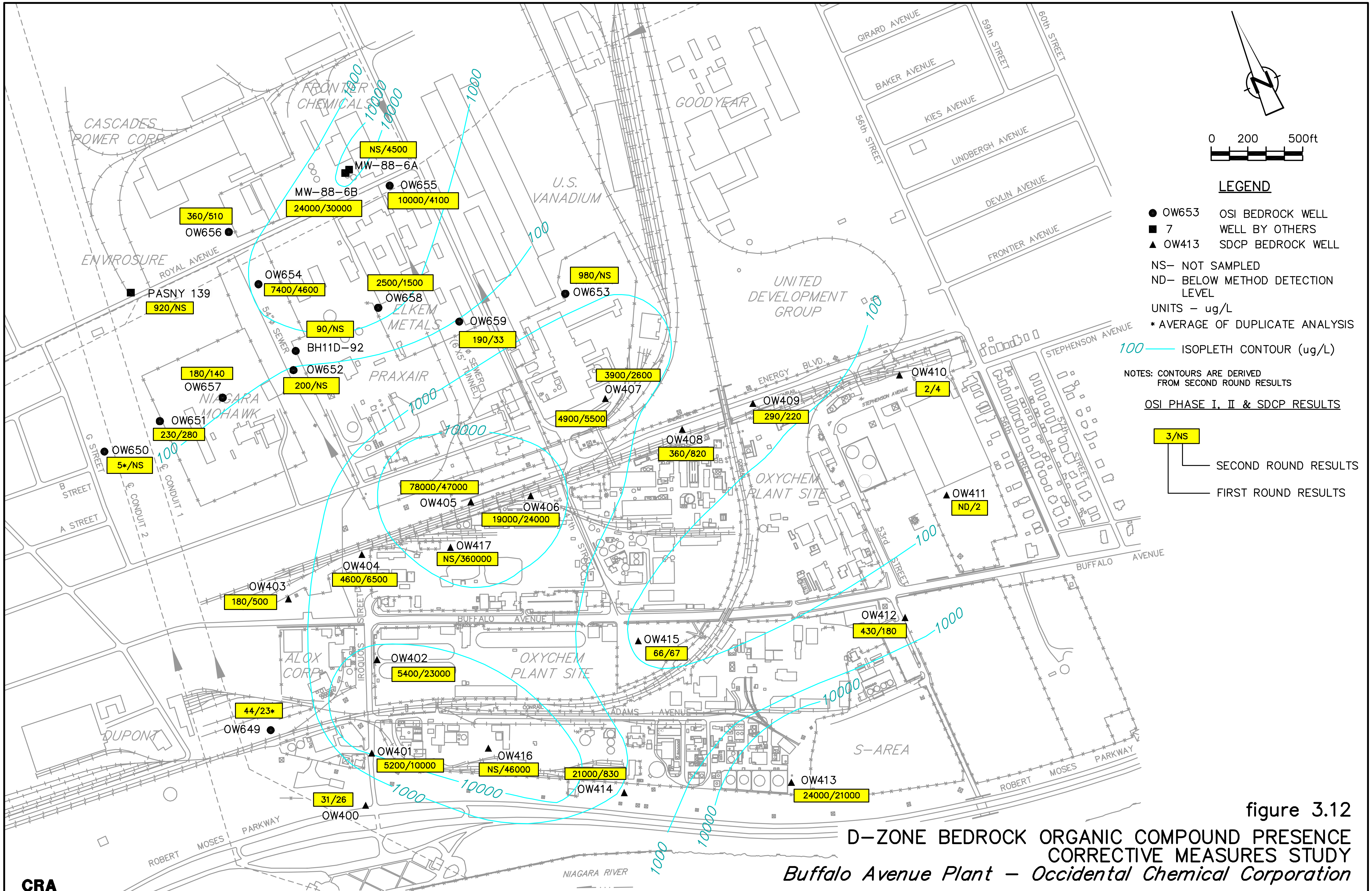


figure 3.12
D-ZONE BEDROCK ORGANIC COMPOUND PRESENCE
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA008 NOV 13/98

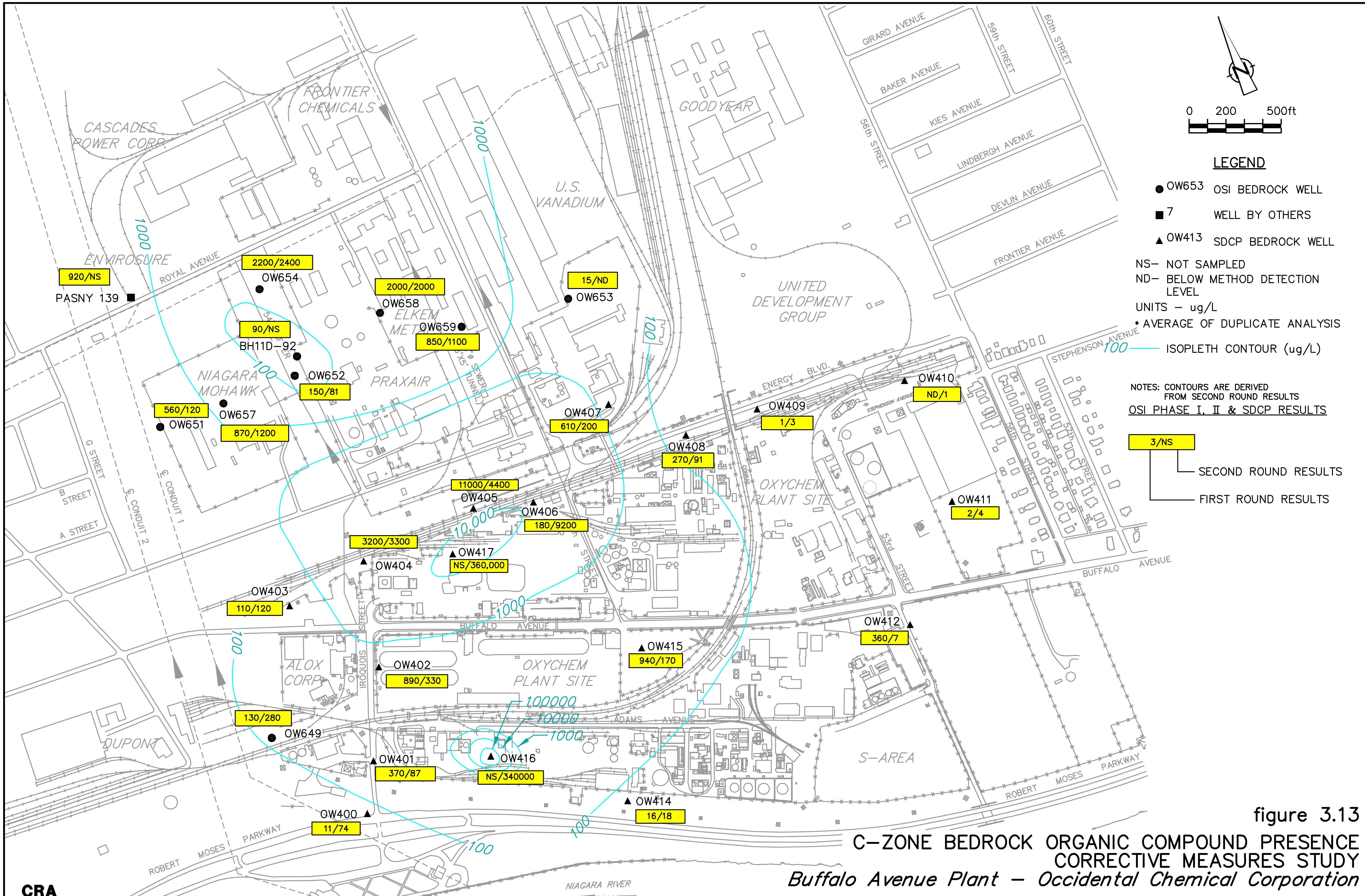


figure 3.13

C–ZONE BEDROCK ORGANIC COMPOUND PRESENCE
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

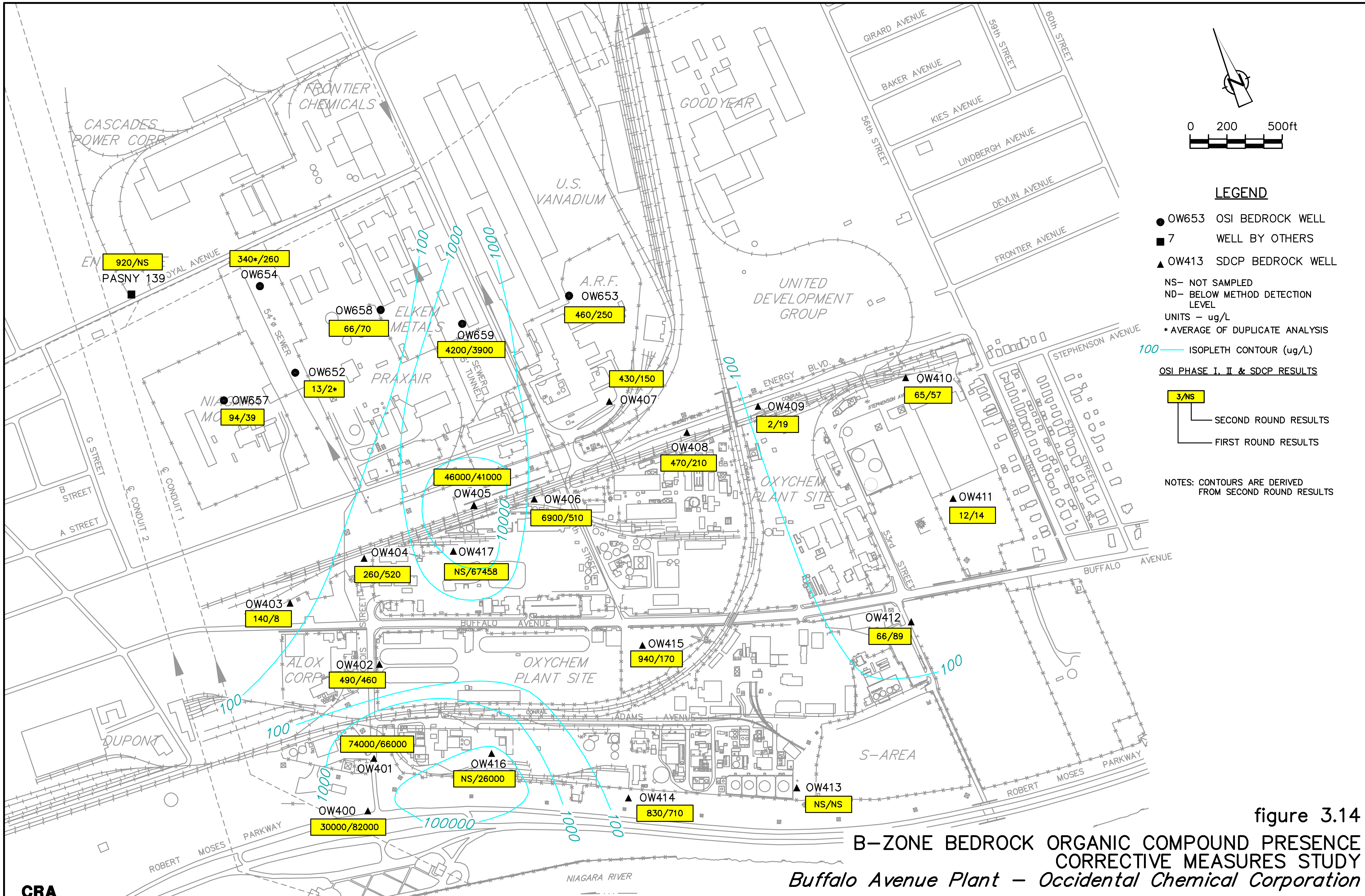


figure 3.14

B–ZONE BEDROCK ORGANIC COMPOUND PRESENCE
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583–00(191)GN–WA010 NOV 13/98

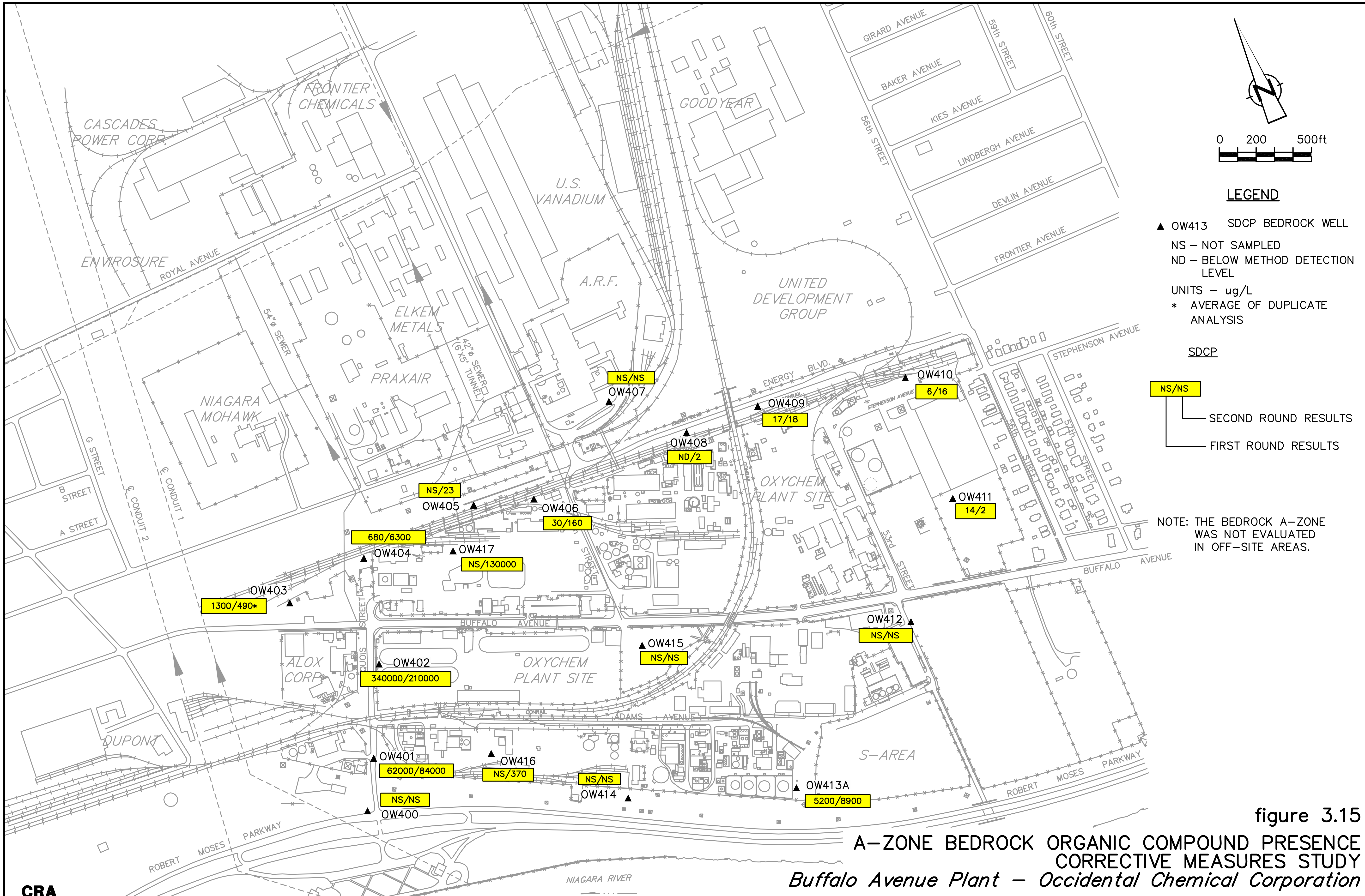


figure 3.15

A–ZONE BEDROCK ORGANIC COMPOUND PRESENCE
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583–00(191)GN–WA011 NOV 13/98

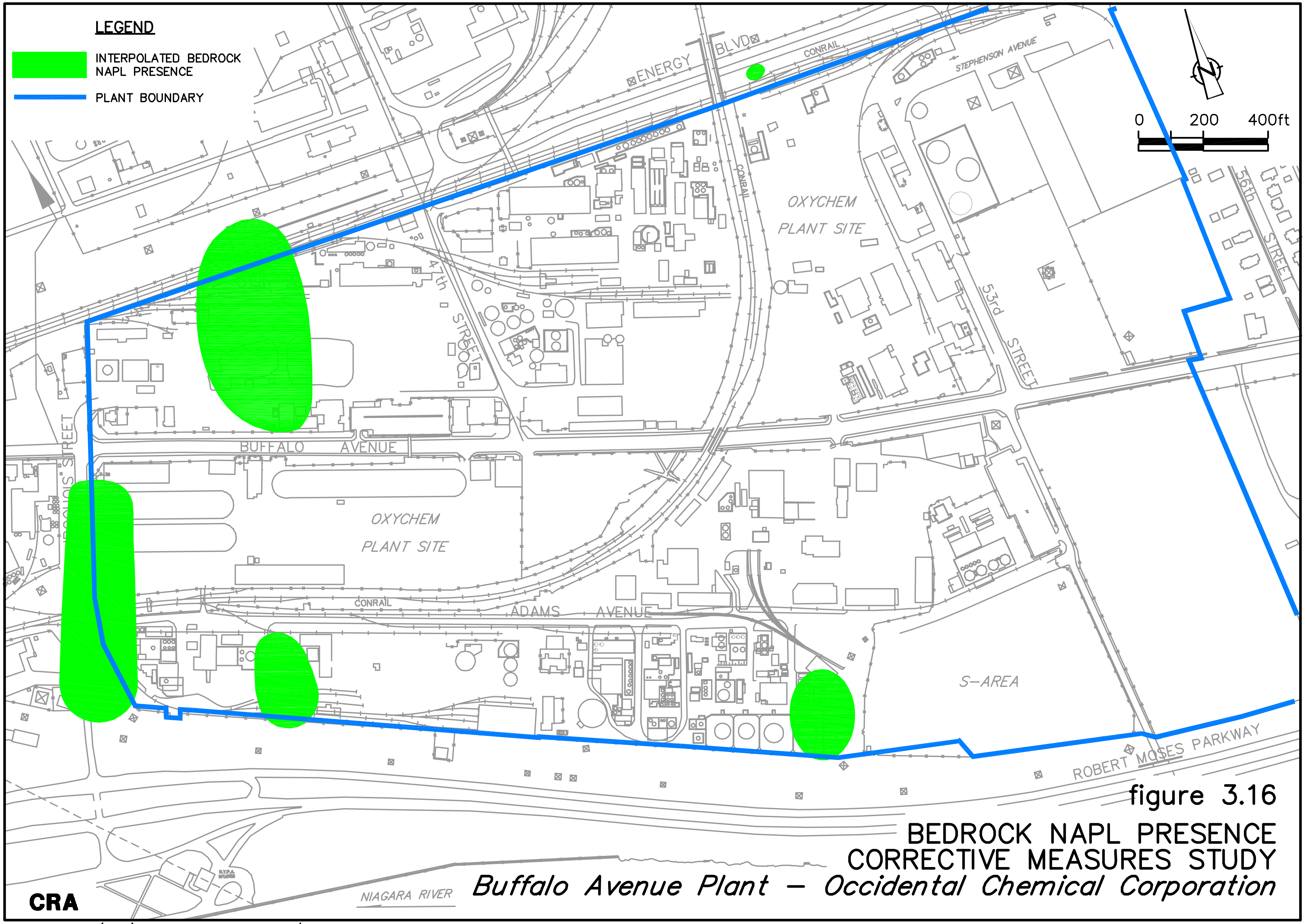


figure 3.16

BEDROCK NAPL PRESENCE
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA012 NOV 13/98

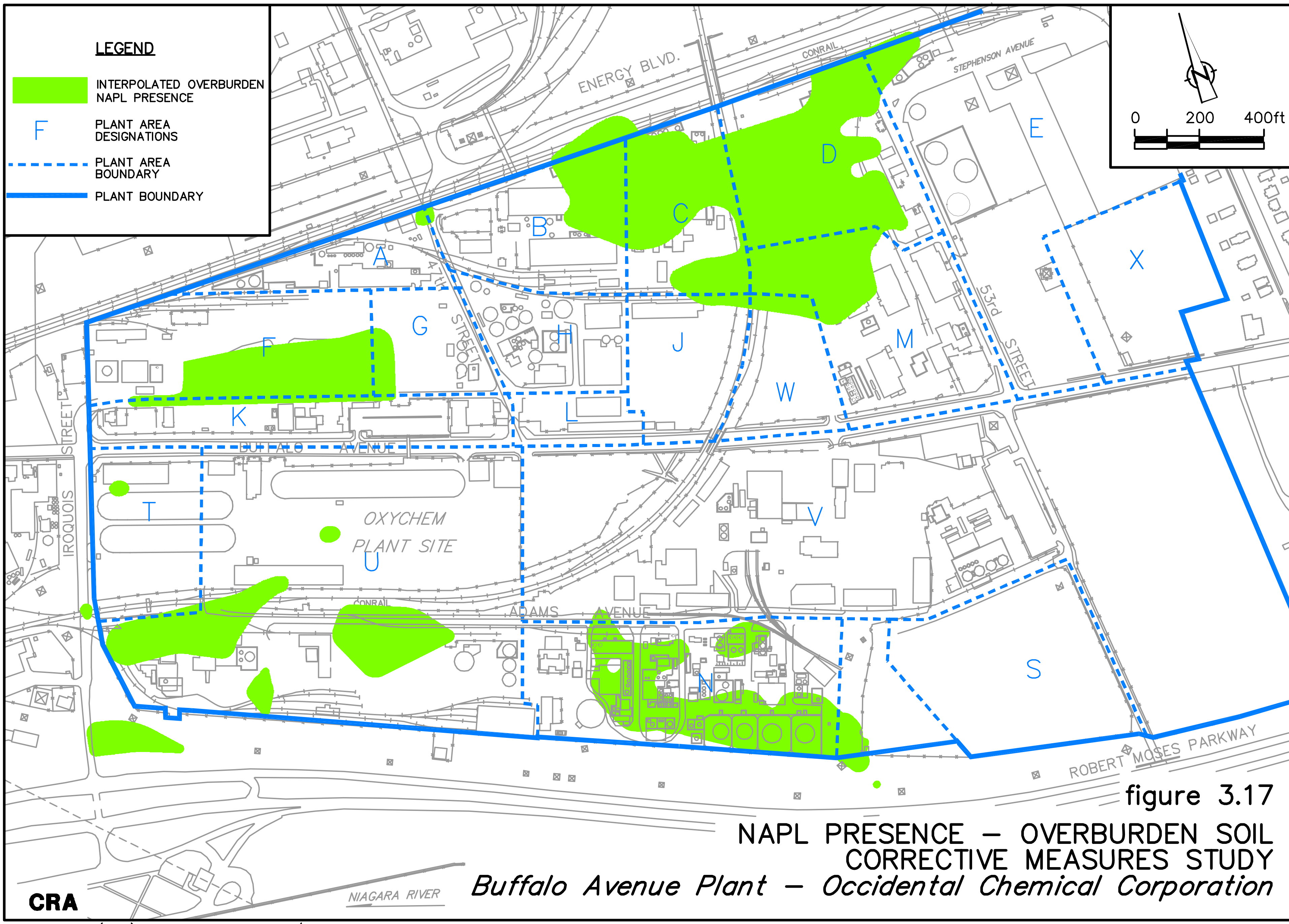


figure 3.17

NAPL PRESENCE – OVERBURDEN SOIL
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583–00(191)GN–WA020 NOV 13/98

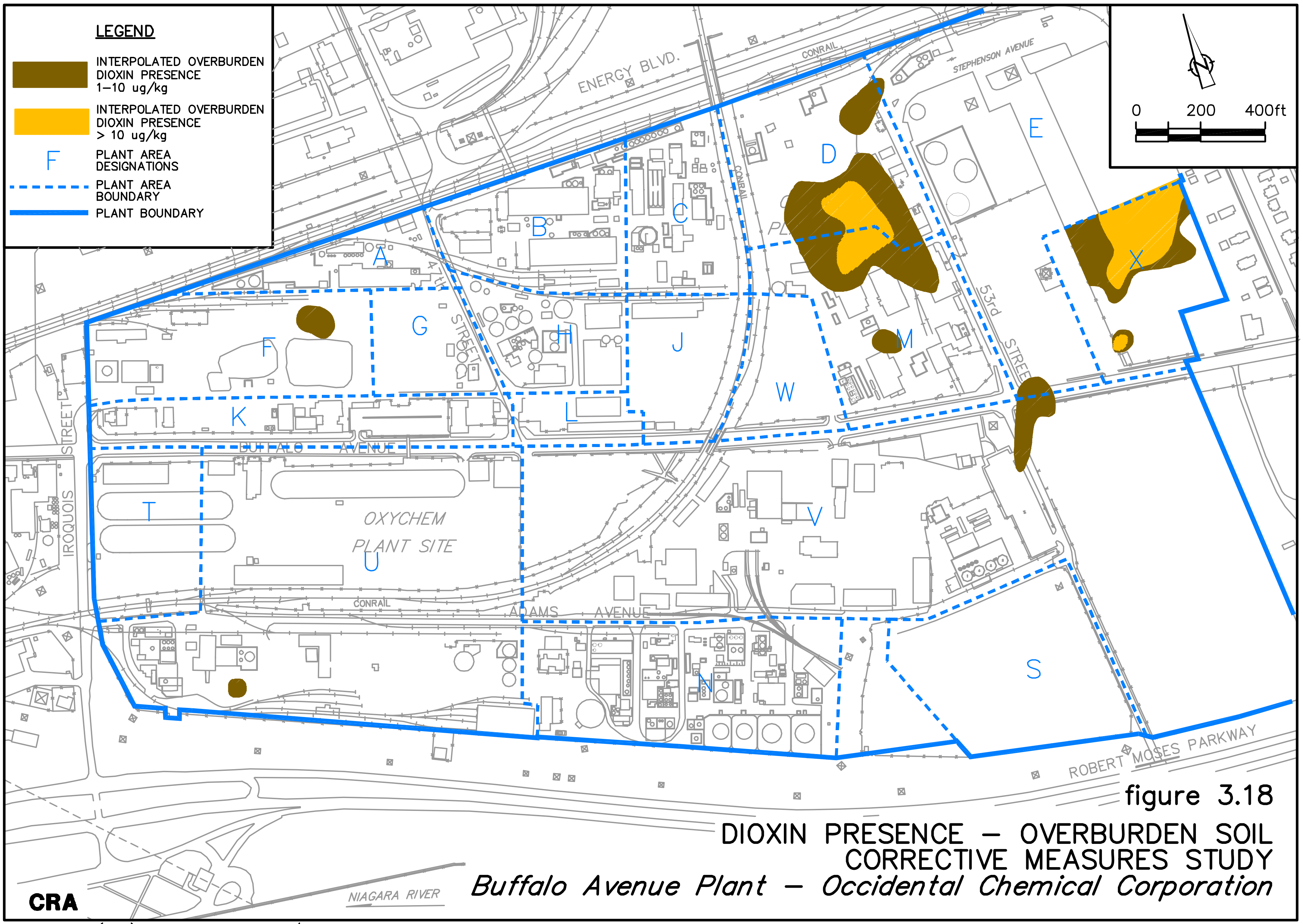


figure 3.18

DIOXIN PRESENCE – OVERBURDEN SOIL
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583–00(191)GN–WA021 NOV 13/98

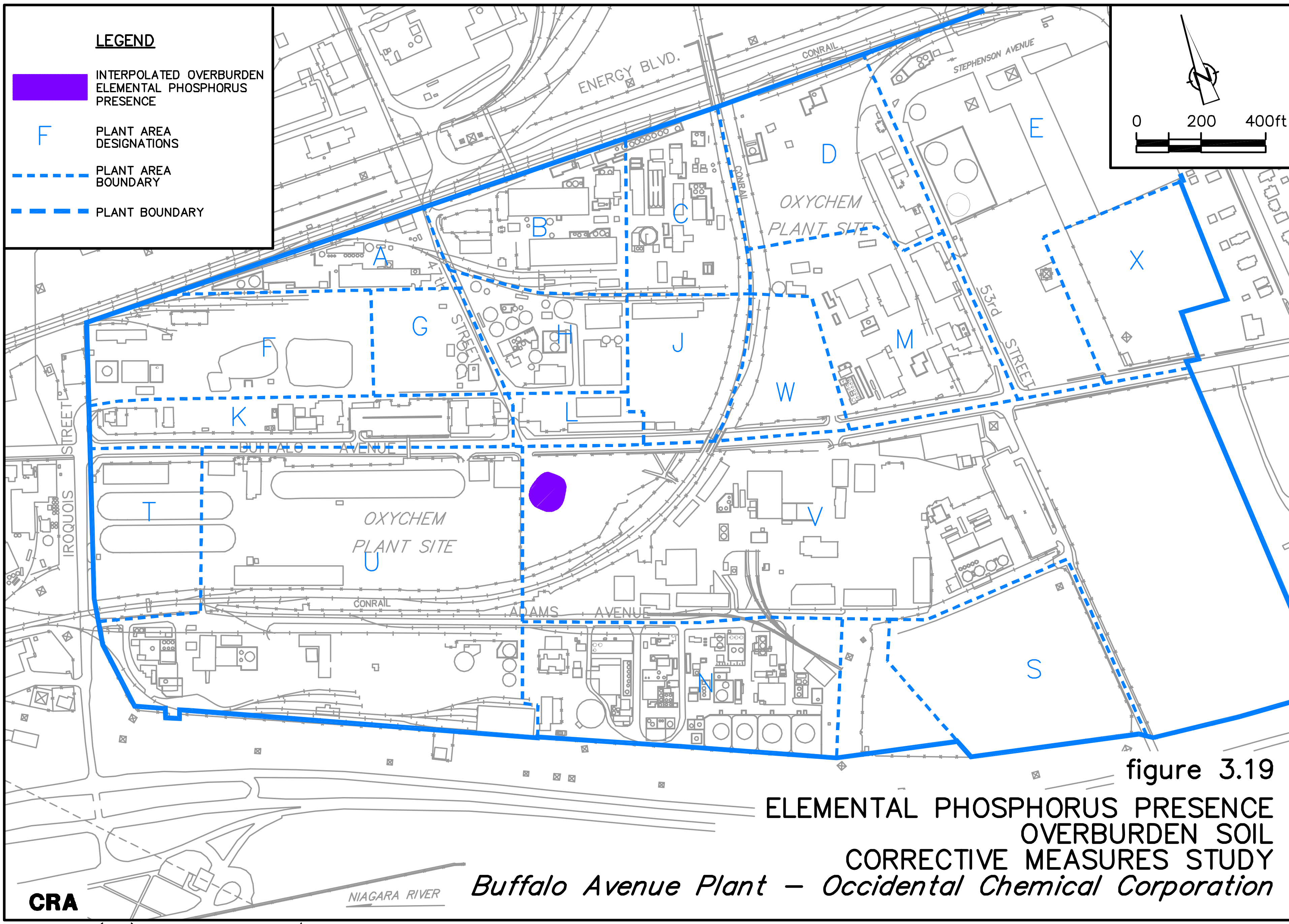


figure 3.19

ELEMENTAL PHOSPHORUS PRESENCE
OVERBURDEN SOIL
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA022 NOV 13/98

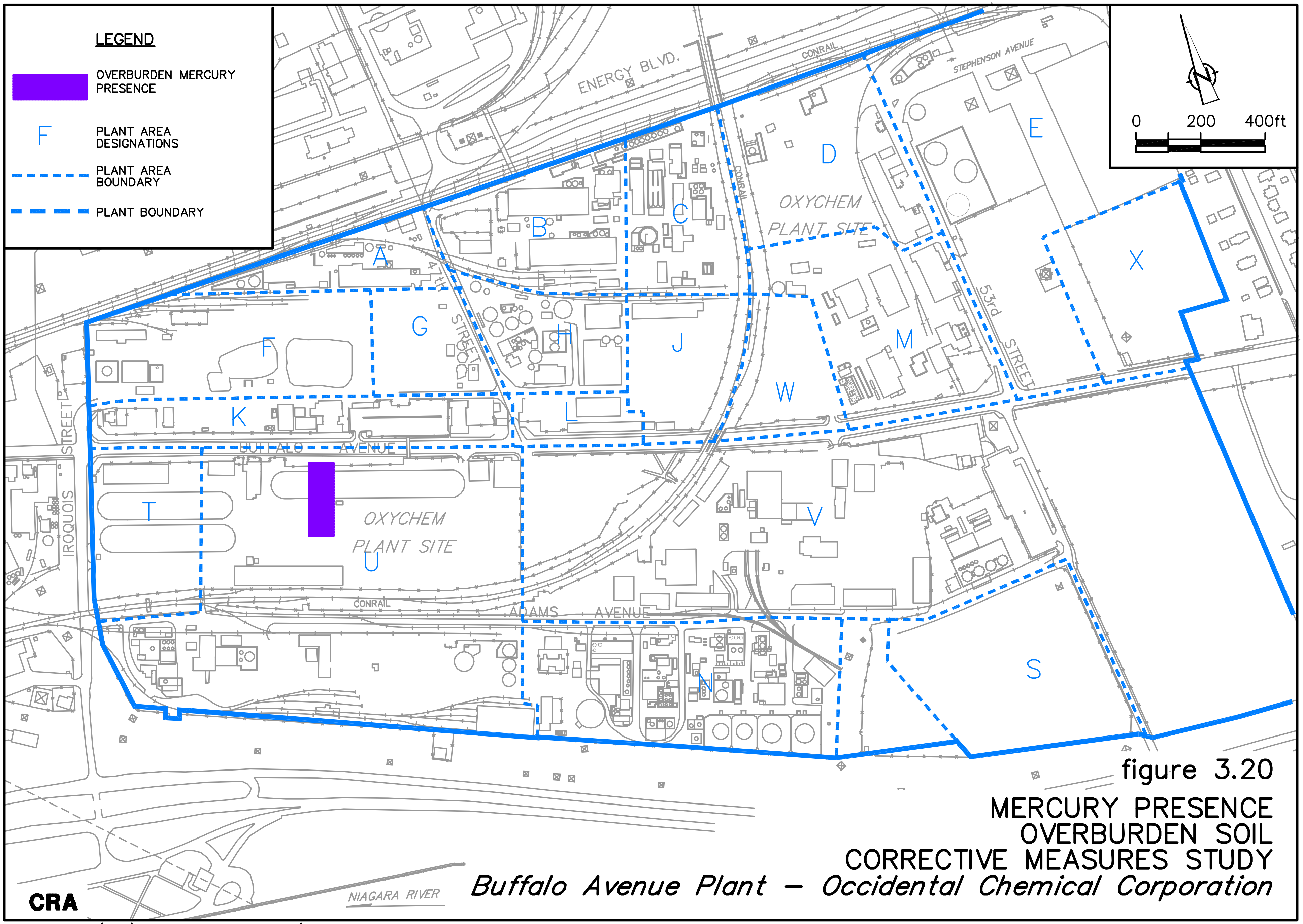


figure 3.20

MERCURY PRESENCE
OVERBURDEN SOIL
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583–00(191)GN–WA034 NOV 13/98

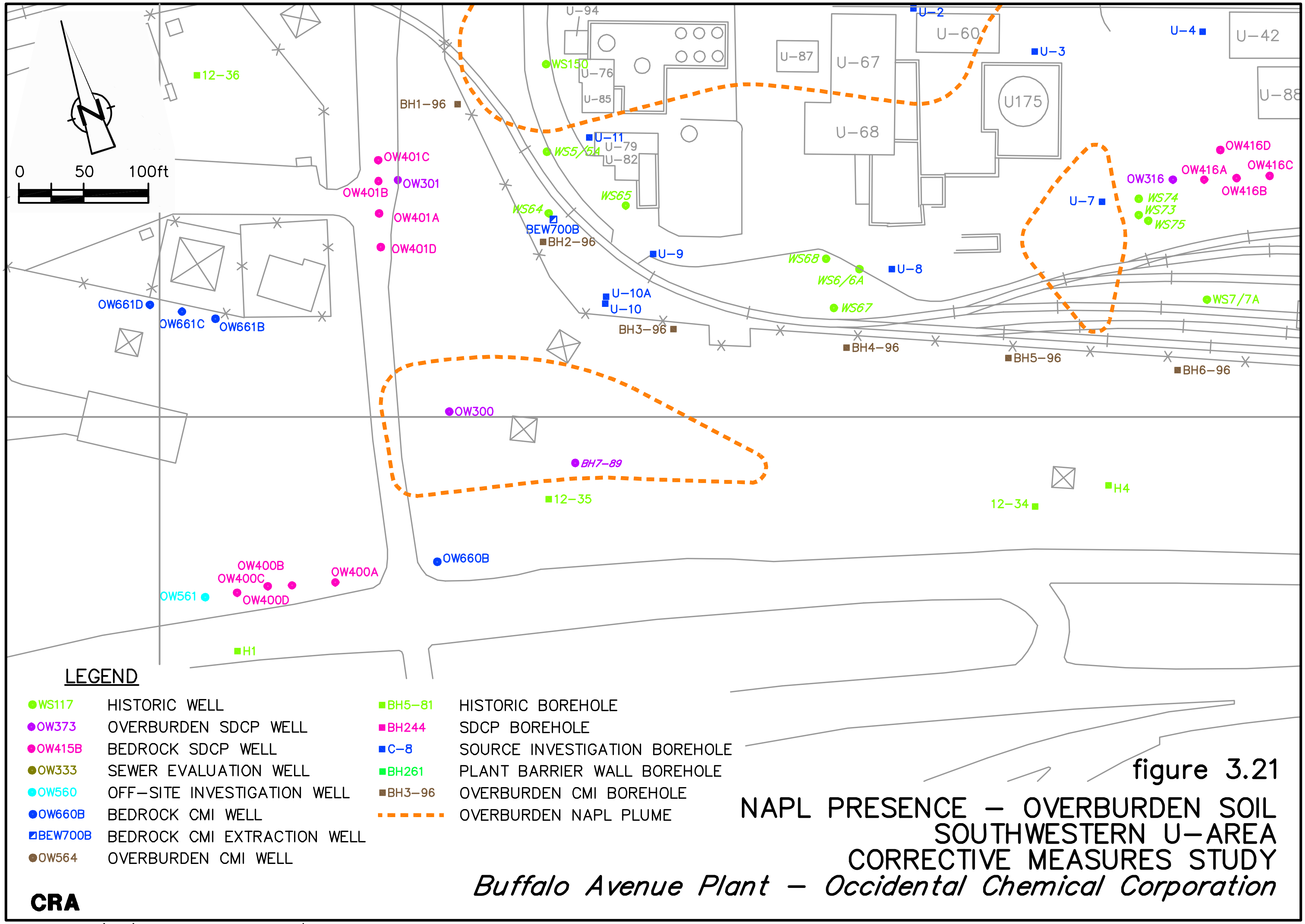


figure 3.21

NAPL PRESENCE – OVERBURDEN SOIL
SOUTHWESTERN U–AREA
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583–00(191)GN–WA054 NOV 13/98

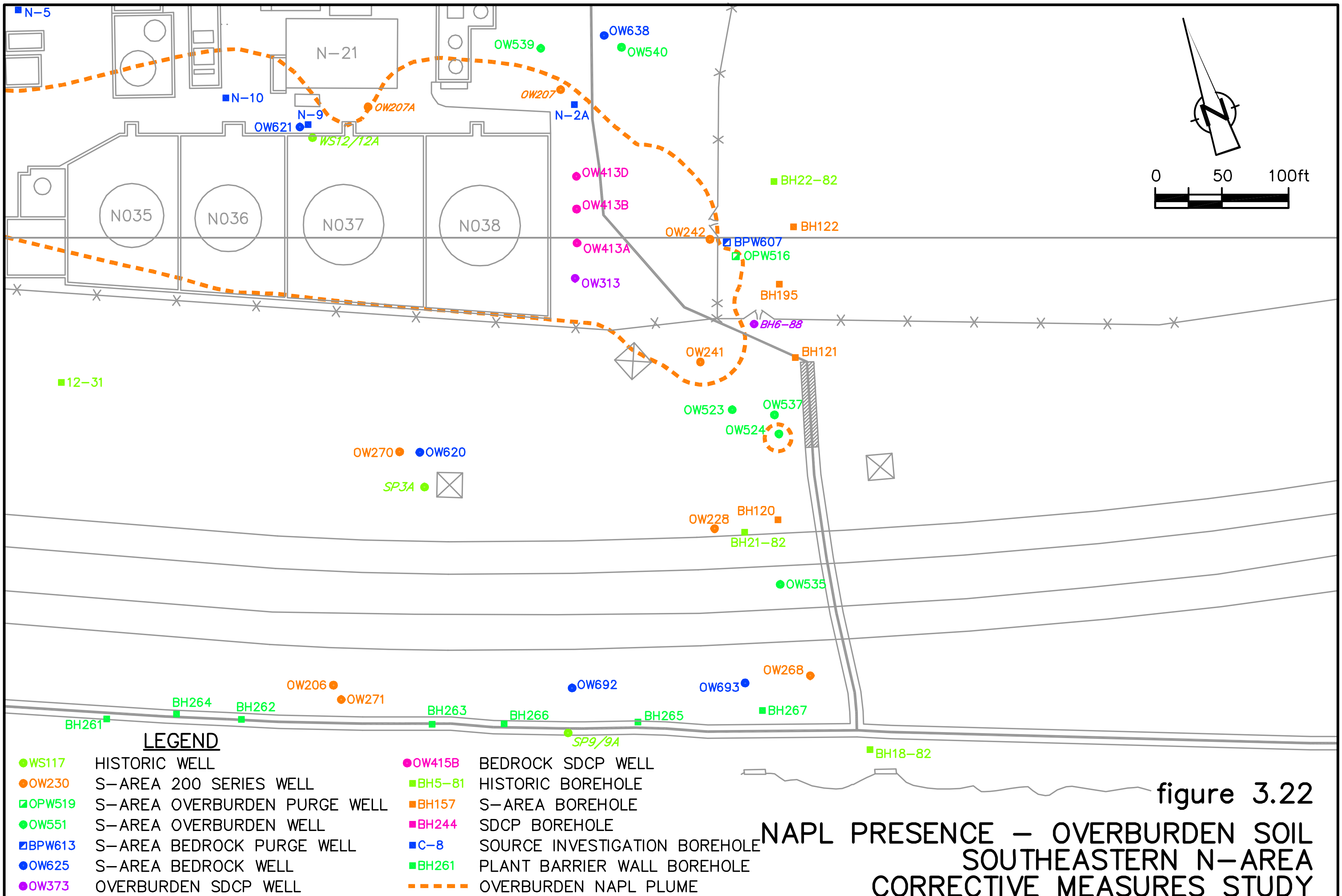


figure 3.22

NAPL PRESENCE – OVERBURDEN SOIL
SOUTHEASTERN N-AREA
CORRECTIVE MEASURES STUDY

Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA053 NOV 13/98

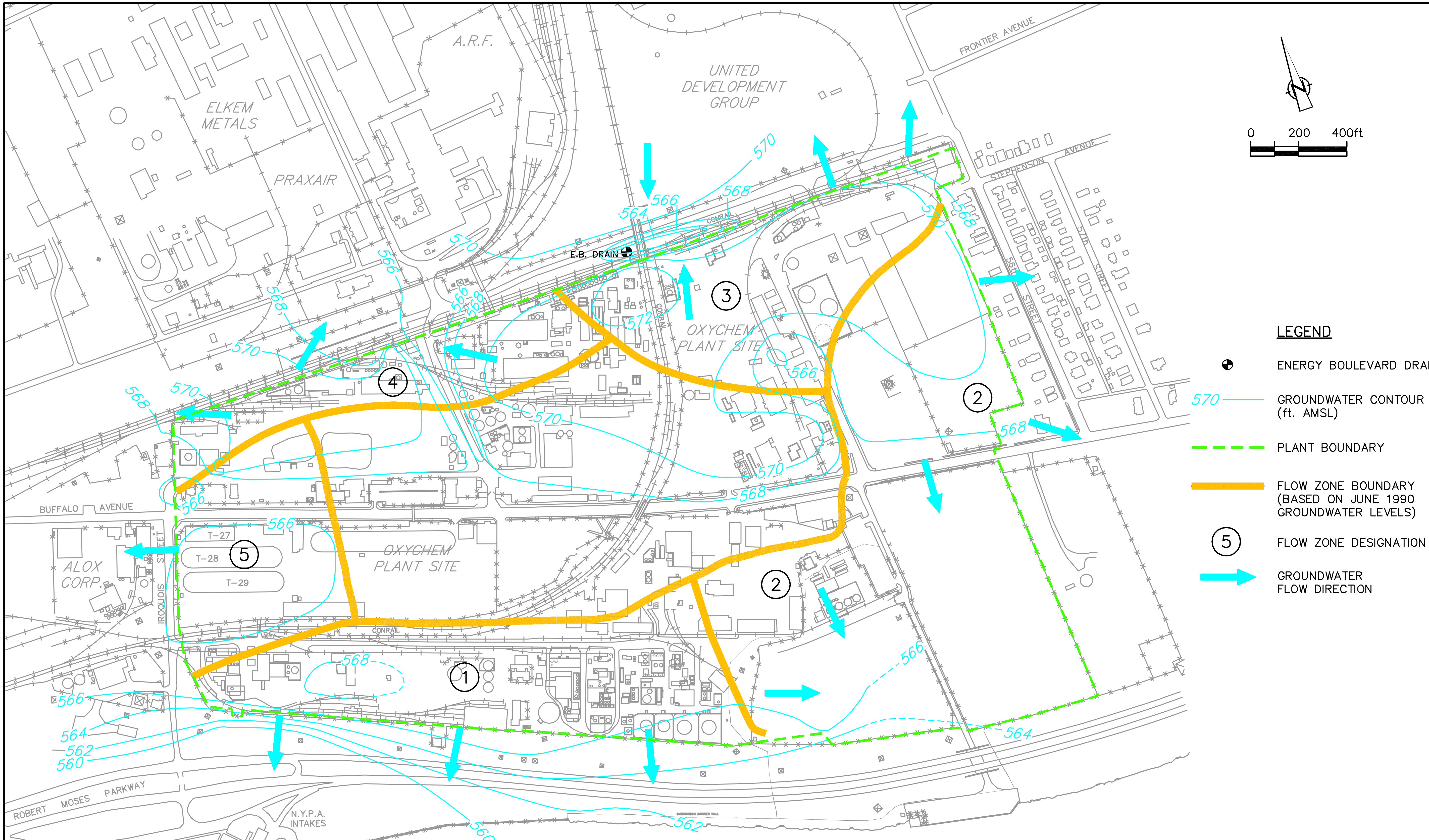


figure 3.23

OVERBURDEN GROUNDWATER FLOW ZONES
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA005 NOV 13/98

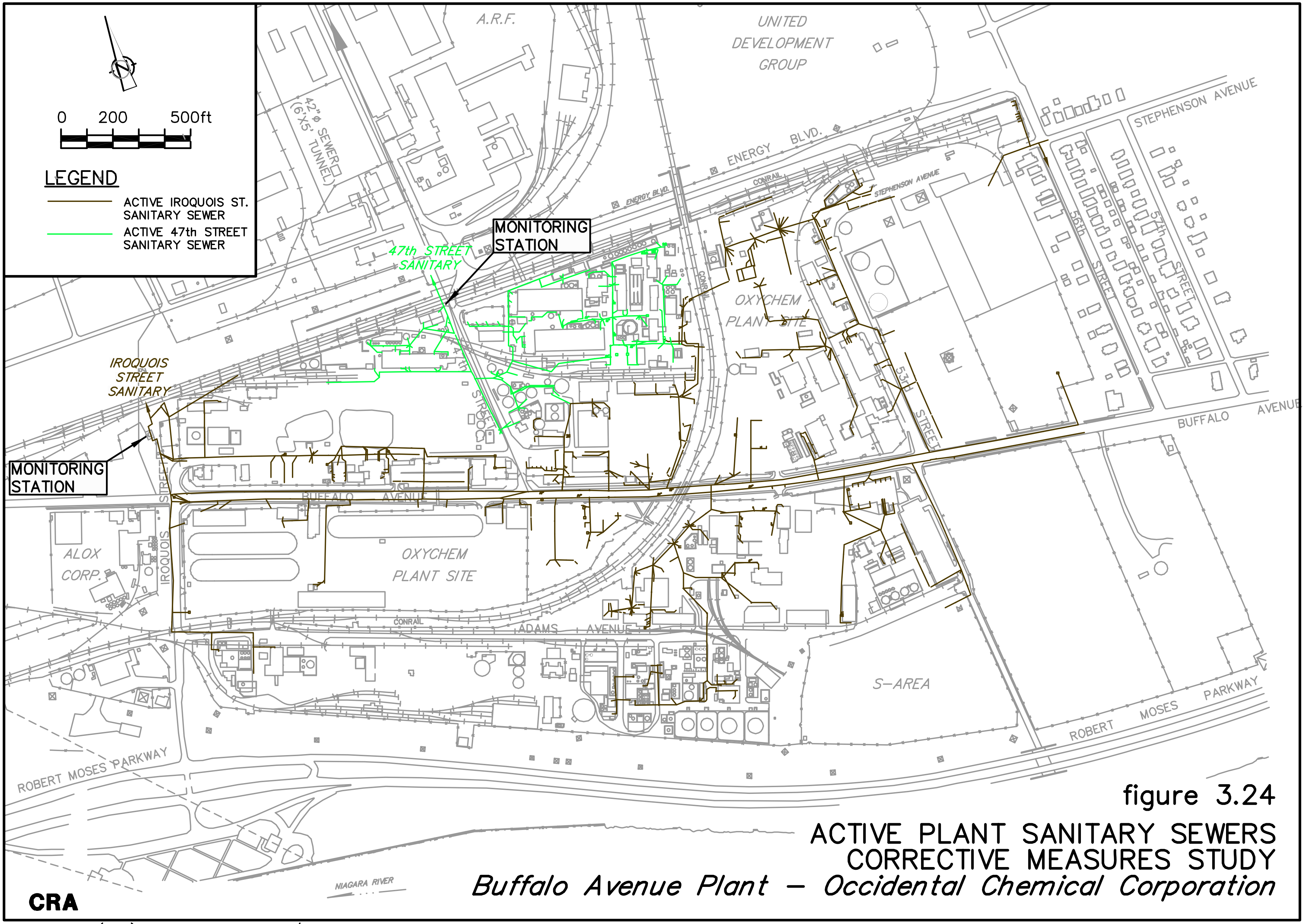


figure 3.24

ACTIVE PLANT SANITARY SEWERS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA017 NOV 13/98

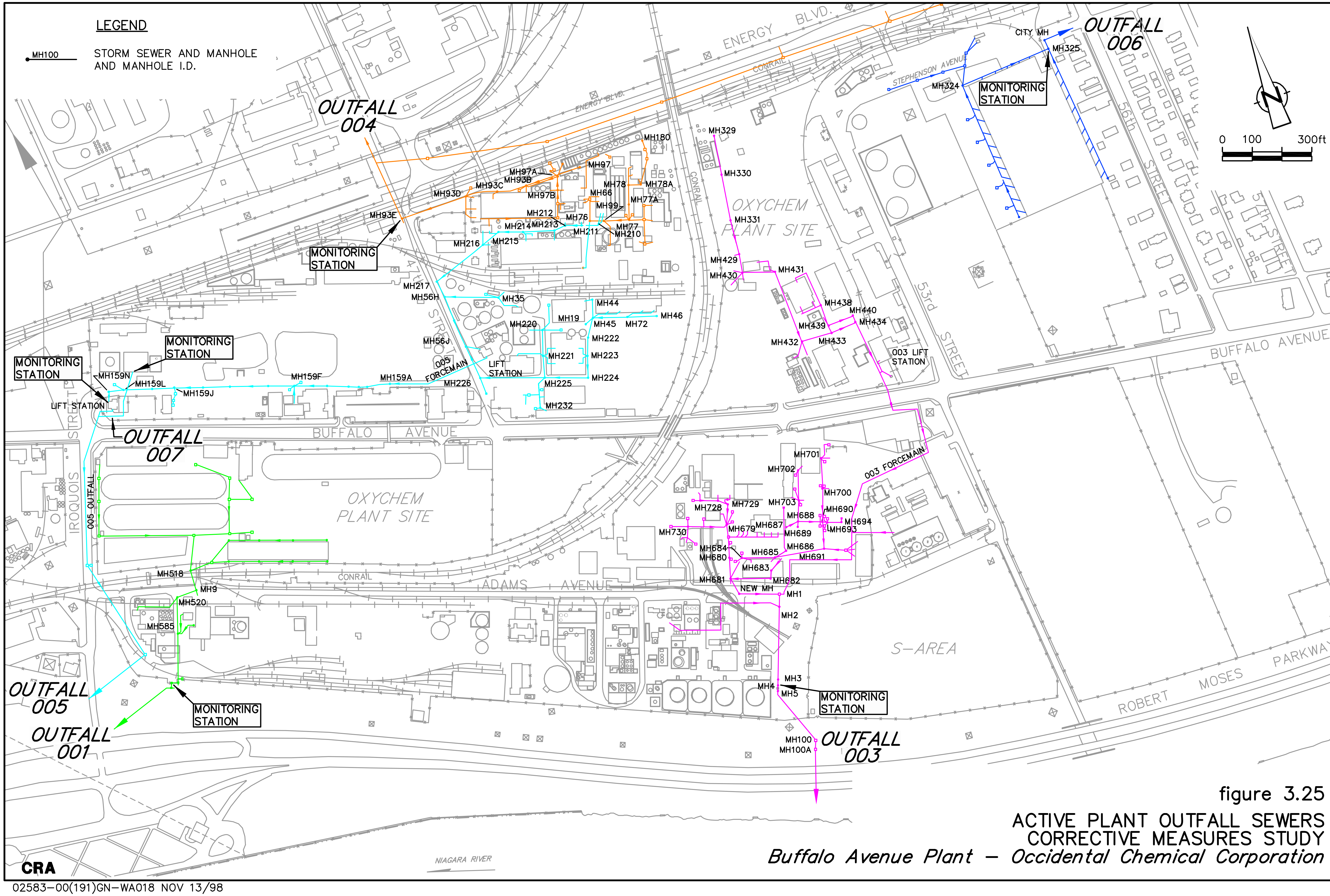


figure 3.25

ACTIVE PLANT OUTFALL SEWERS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

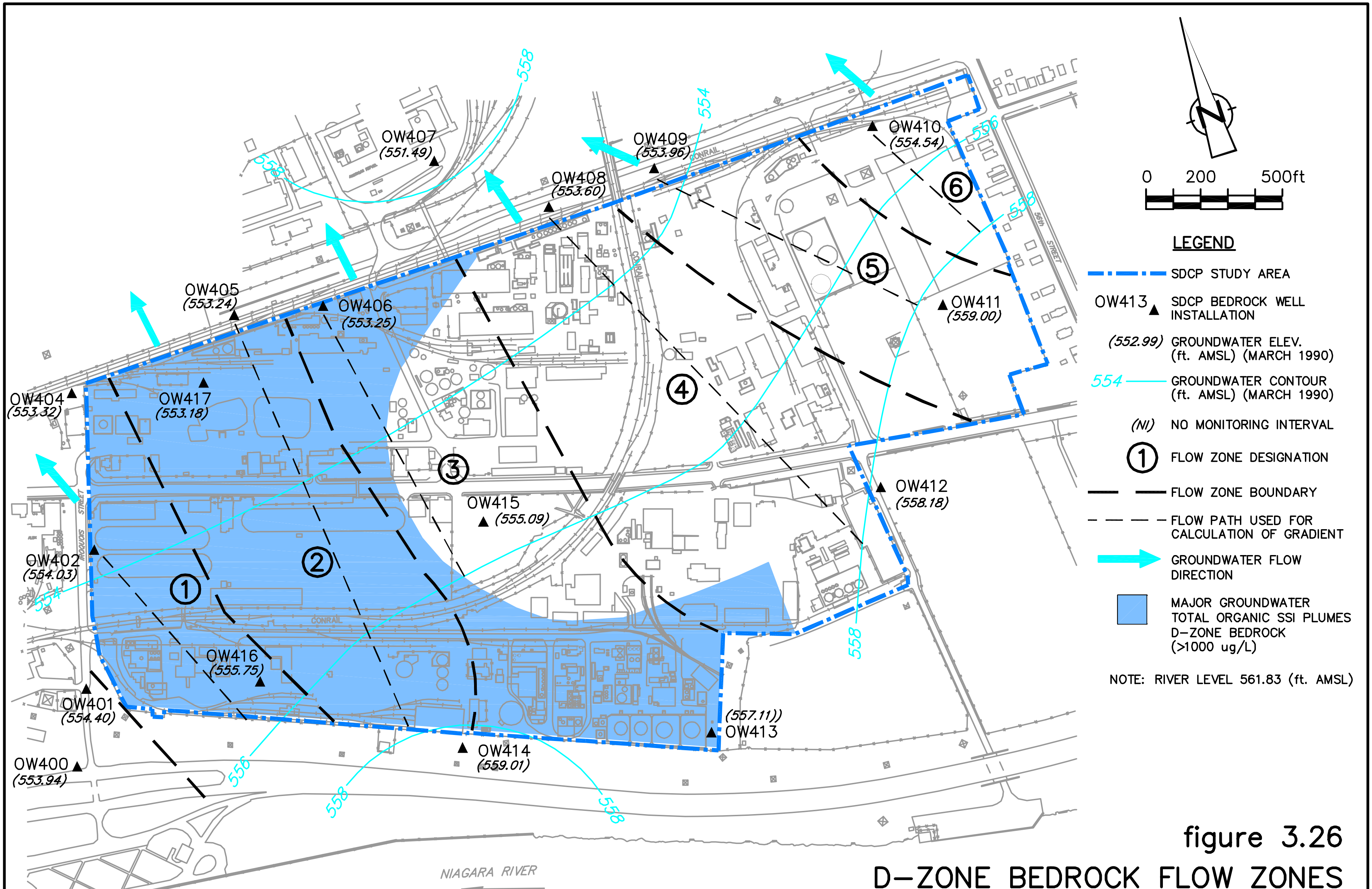


figure 3.26

D-ZONE BEDROCK FLOW ZONES
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA035 NOV 13/98

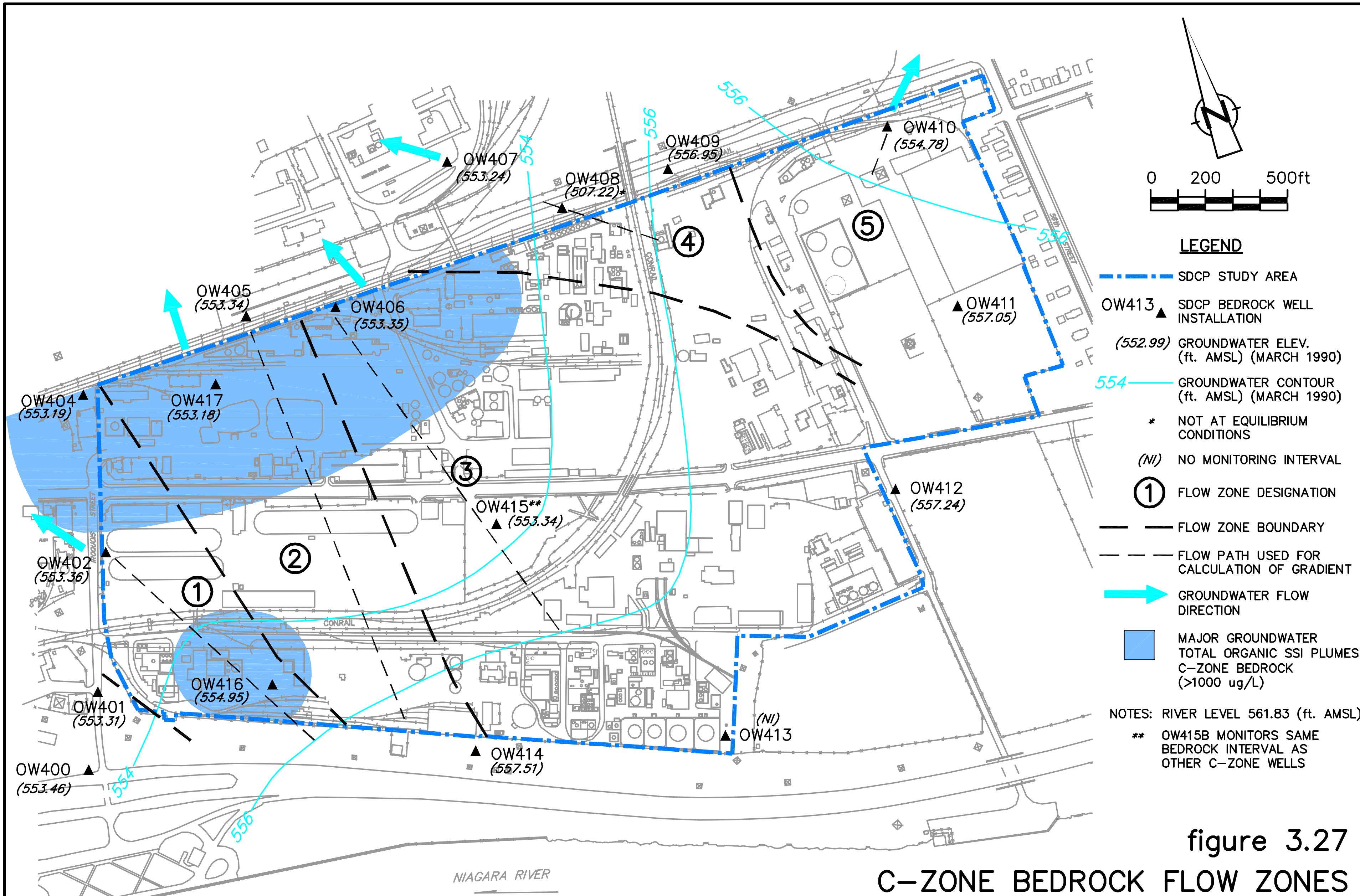


figure 3.27

C–ZONE BEDROCK FLOW ZONES
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583–00(191)GN–WA036 NOV 13/98

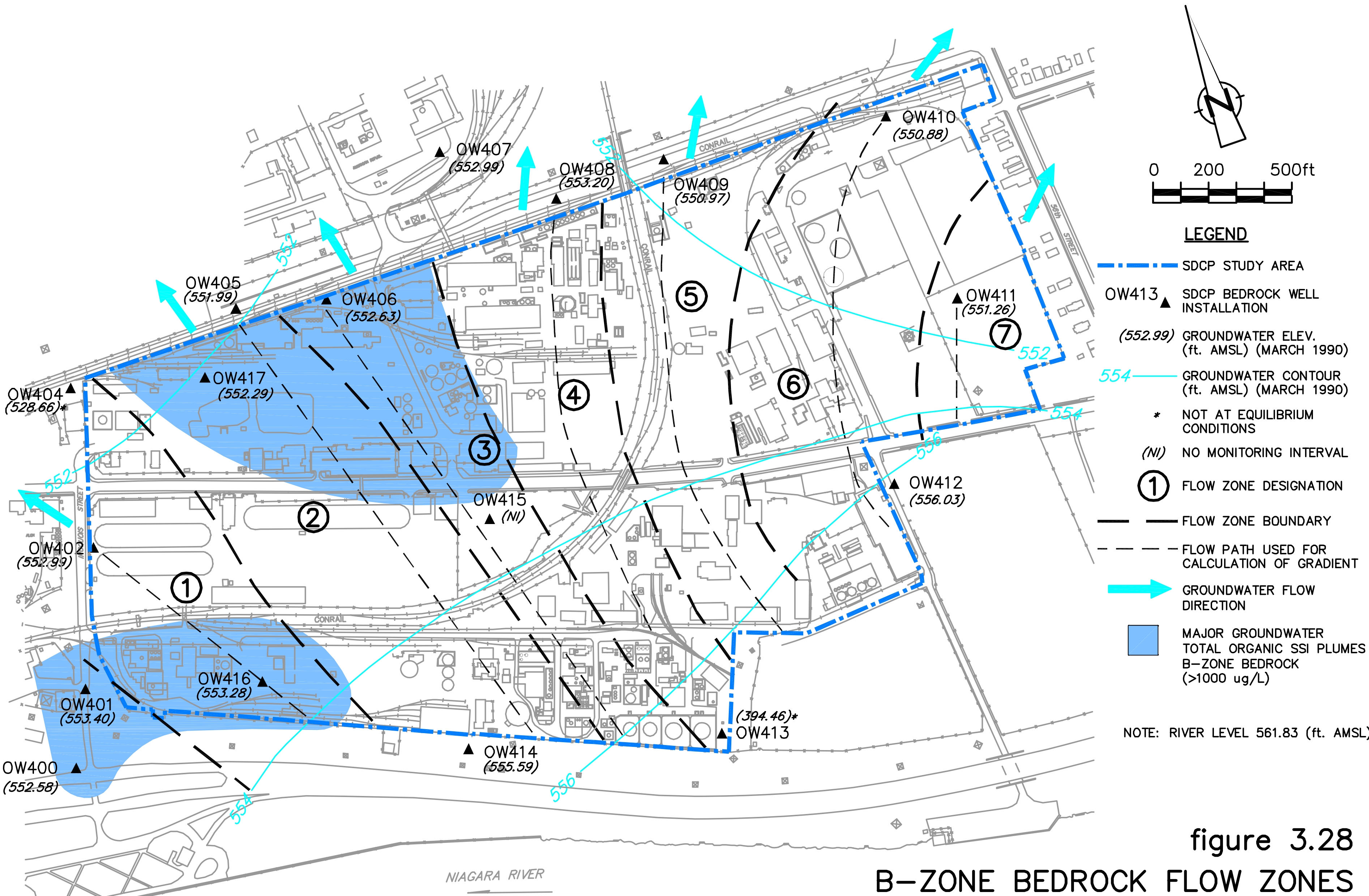


figure 3.28

B–ZONE BEDROCK FLOW ZONES
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583–00(191)GN–WA037 NOV 13/98

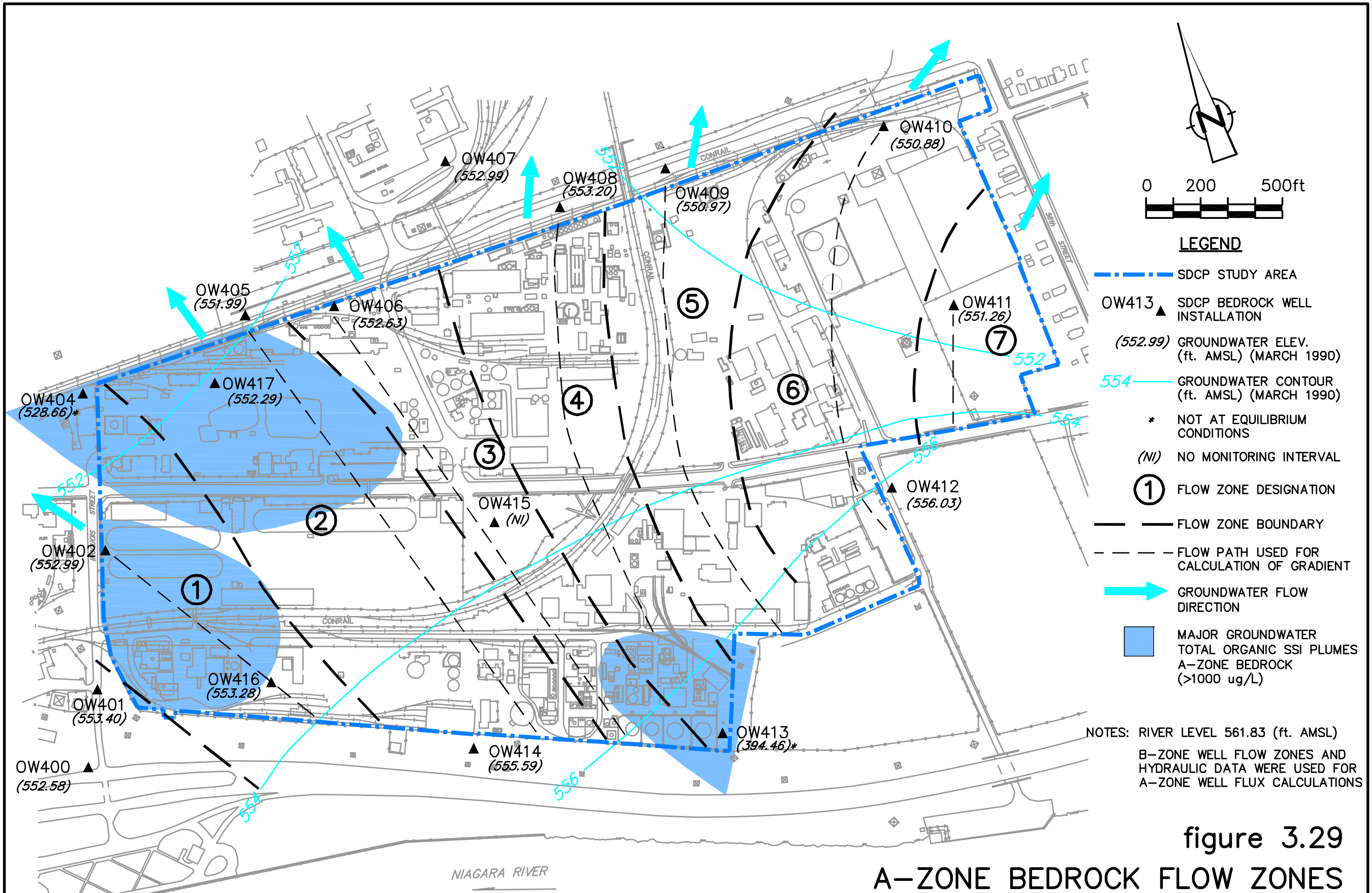


figure 3.29

A-ZONE BEDROCK FLOW ZONES
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA038 NOV 13/98

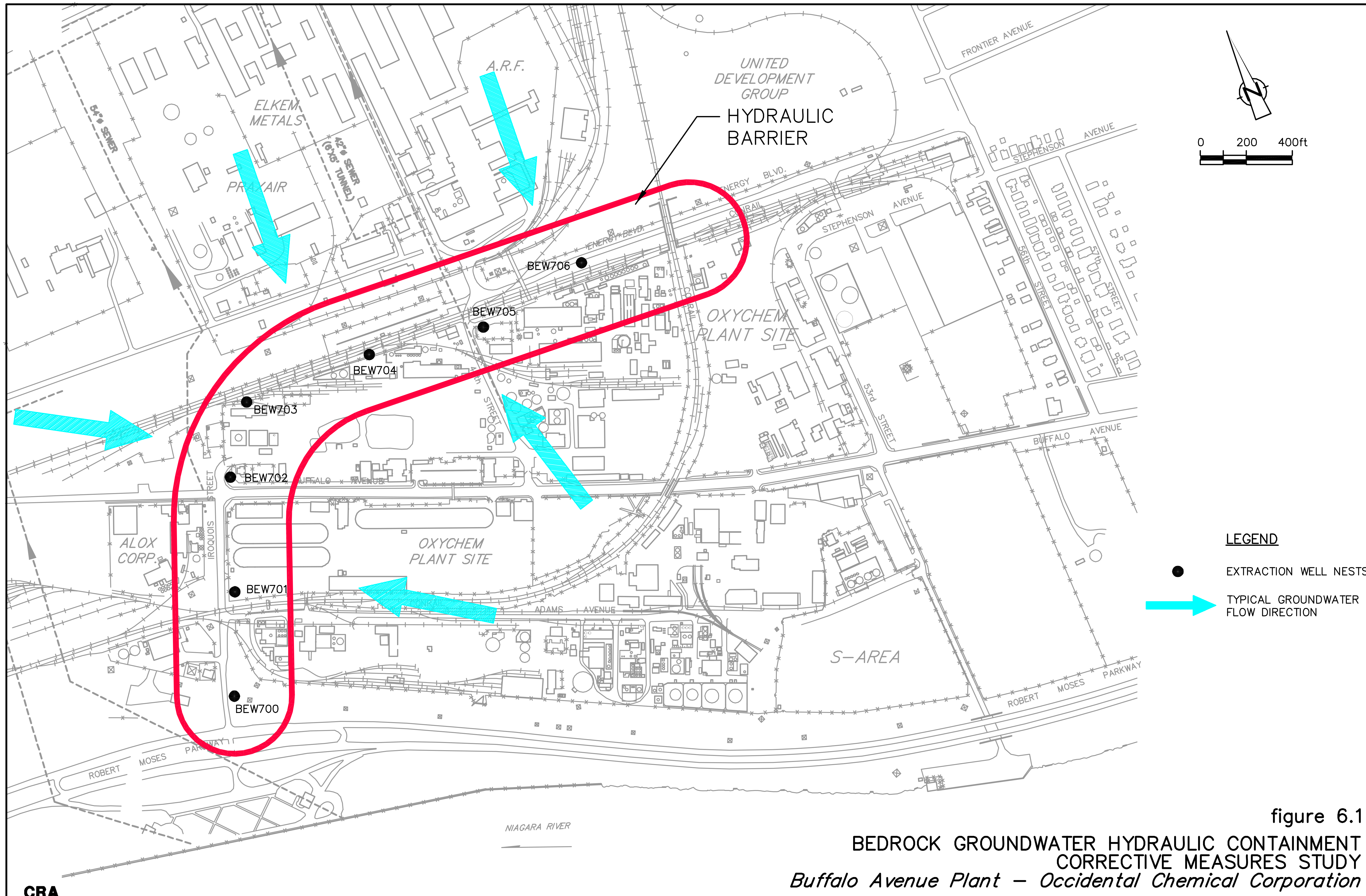


figure 6.1

BEDROCK GROUNDWATER HYDRAULIC CONTAINMENT
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

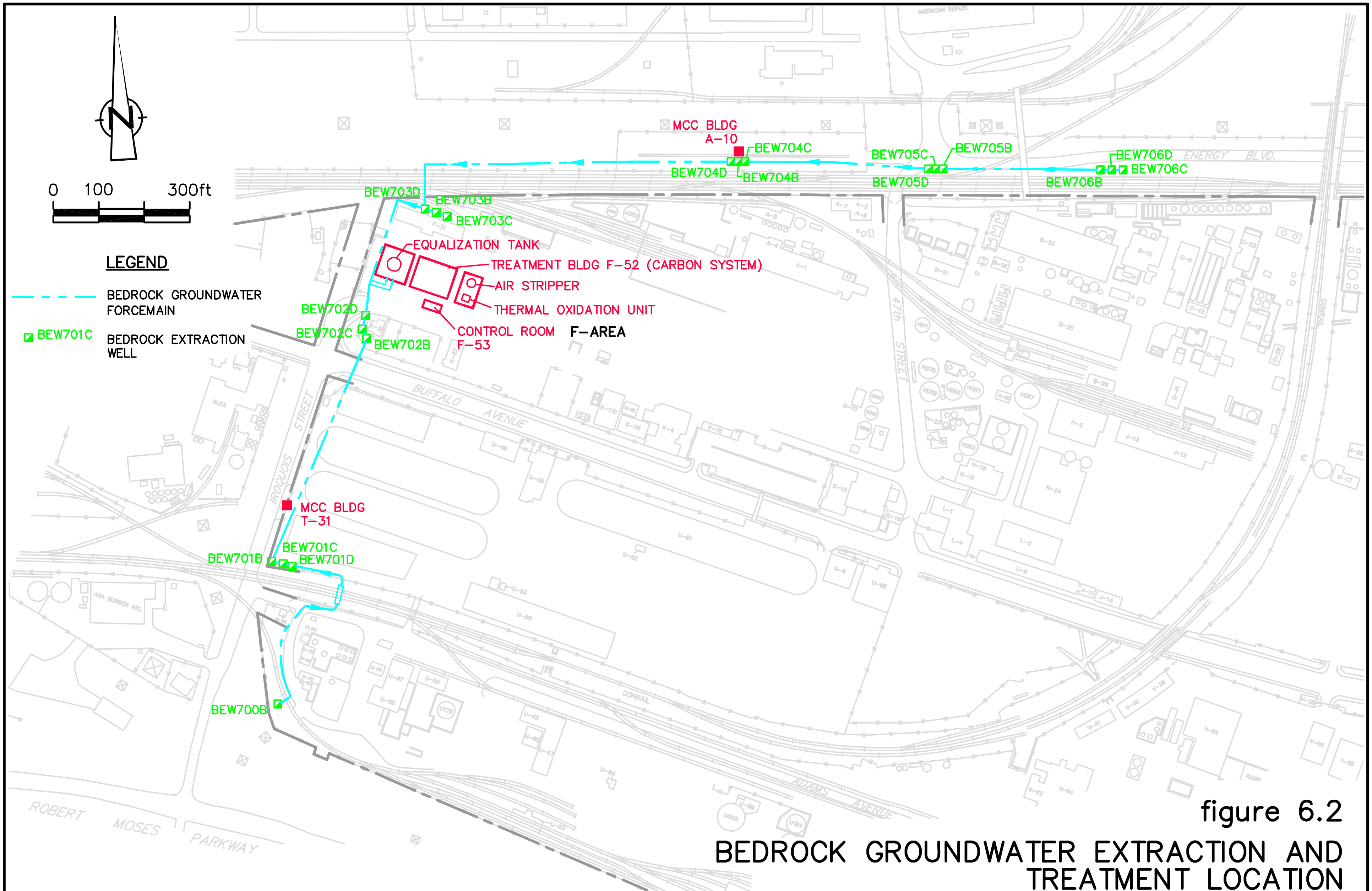


figure 6.2

BEDROCK GROUNDWATER EXTRACTION AND TREATMENT LOCATION
CORRECTIVES MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA045 NOV 13/98

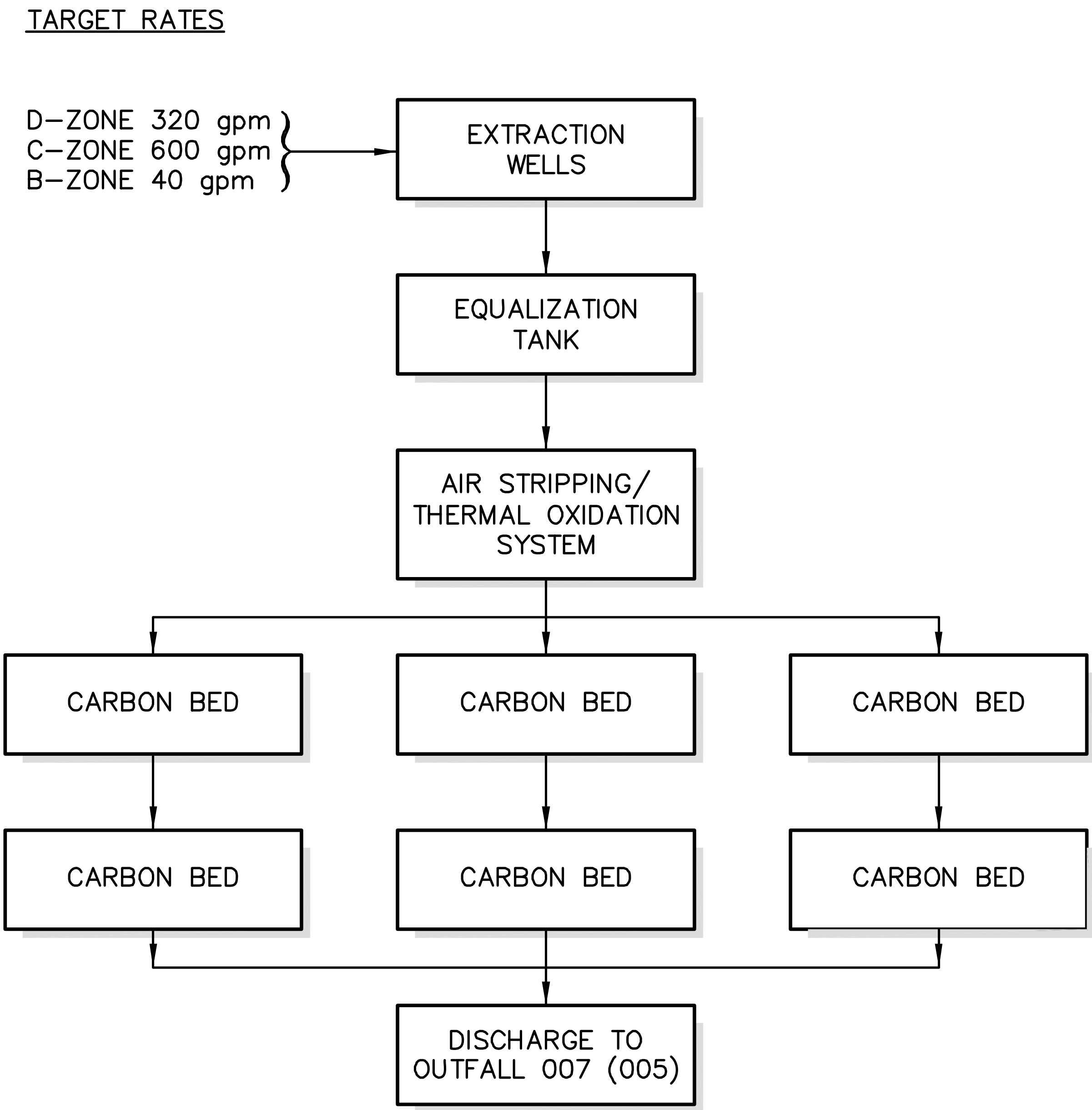


figure 6.3

FLOW DIAGRAM
BEDROCK GROUNDWATER TREATMENT SYSTEM
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583–00(191)GN–WA025 NOV 13/98

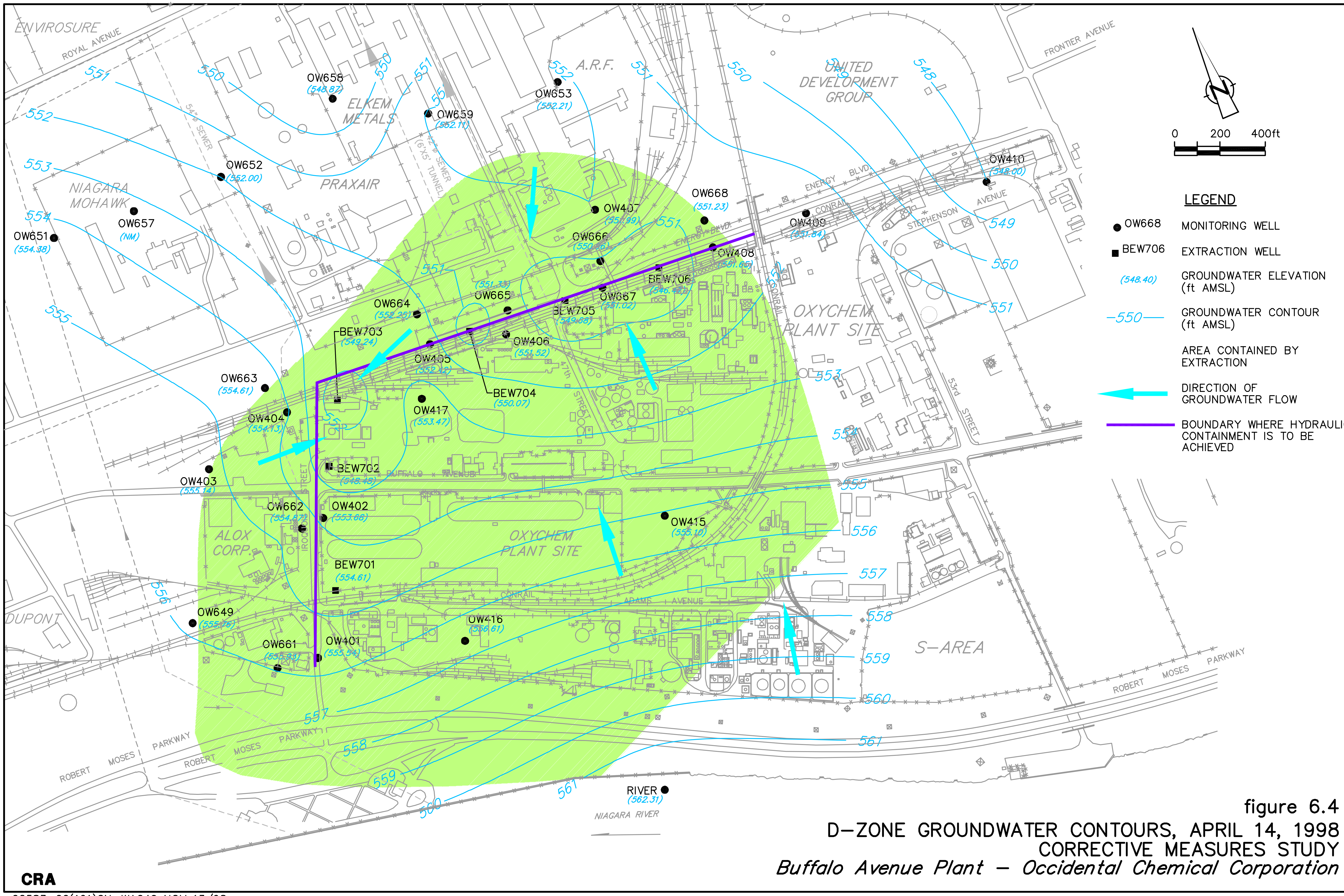


figure 6.4

D-ZONE GROUNDWATER CONTOURS, APRIL 14, 1998
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

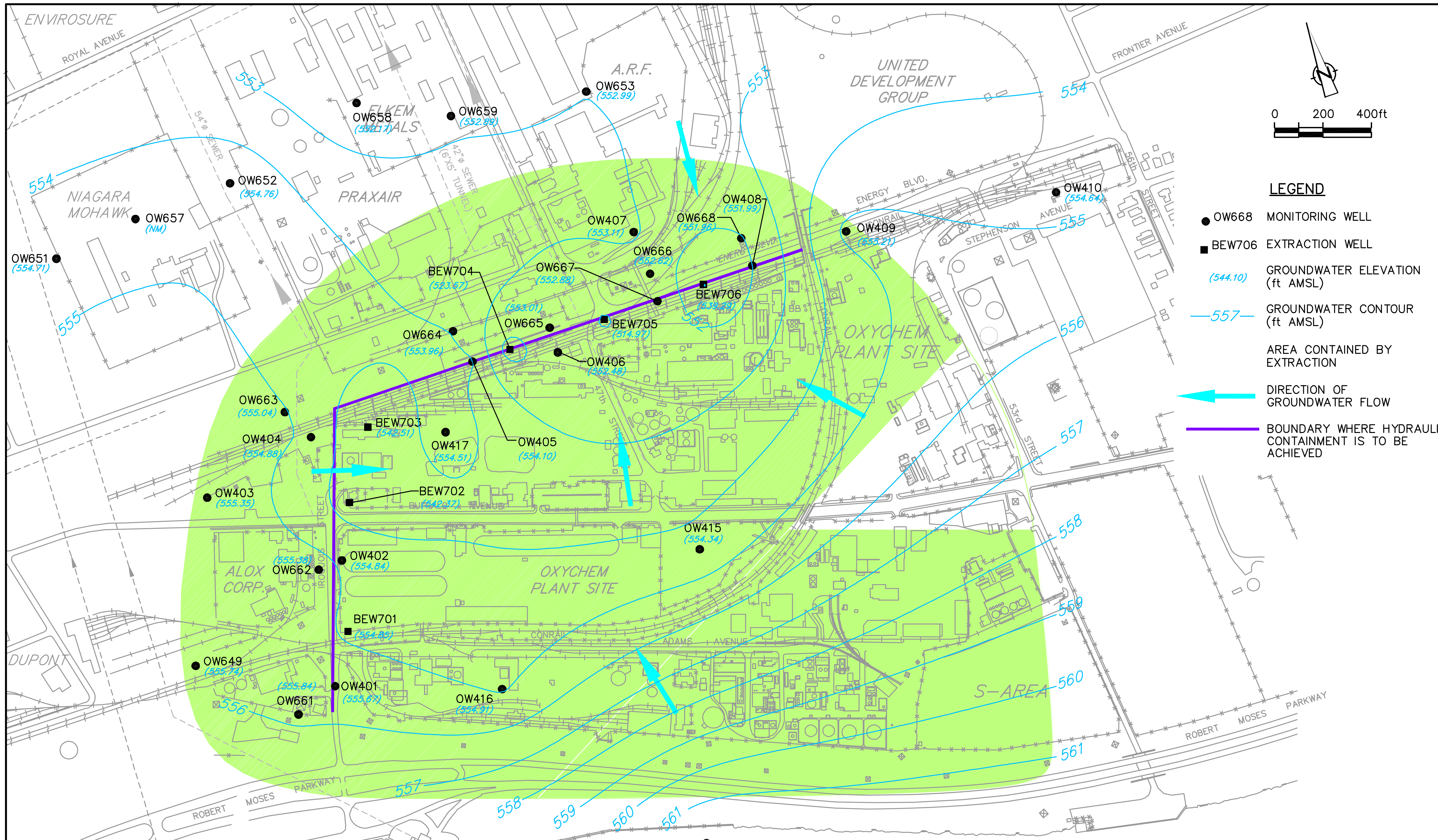


figure 6.5

C–ZONE GROUNDWATER CONTOURS, APRIL 14, 1998

CORRECTIVE MEASURES STUDY

Buffalo Avenue Plant – Occidental Chemical Corporation

02583–00(191)GN–WA048 NOV 13/98

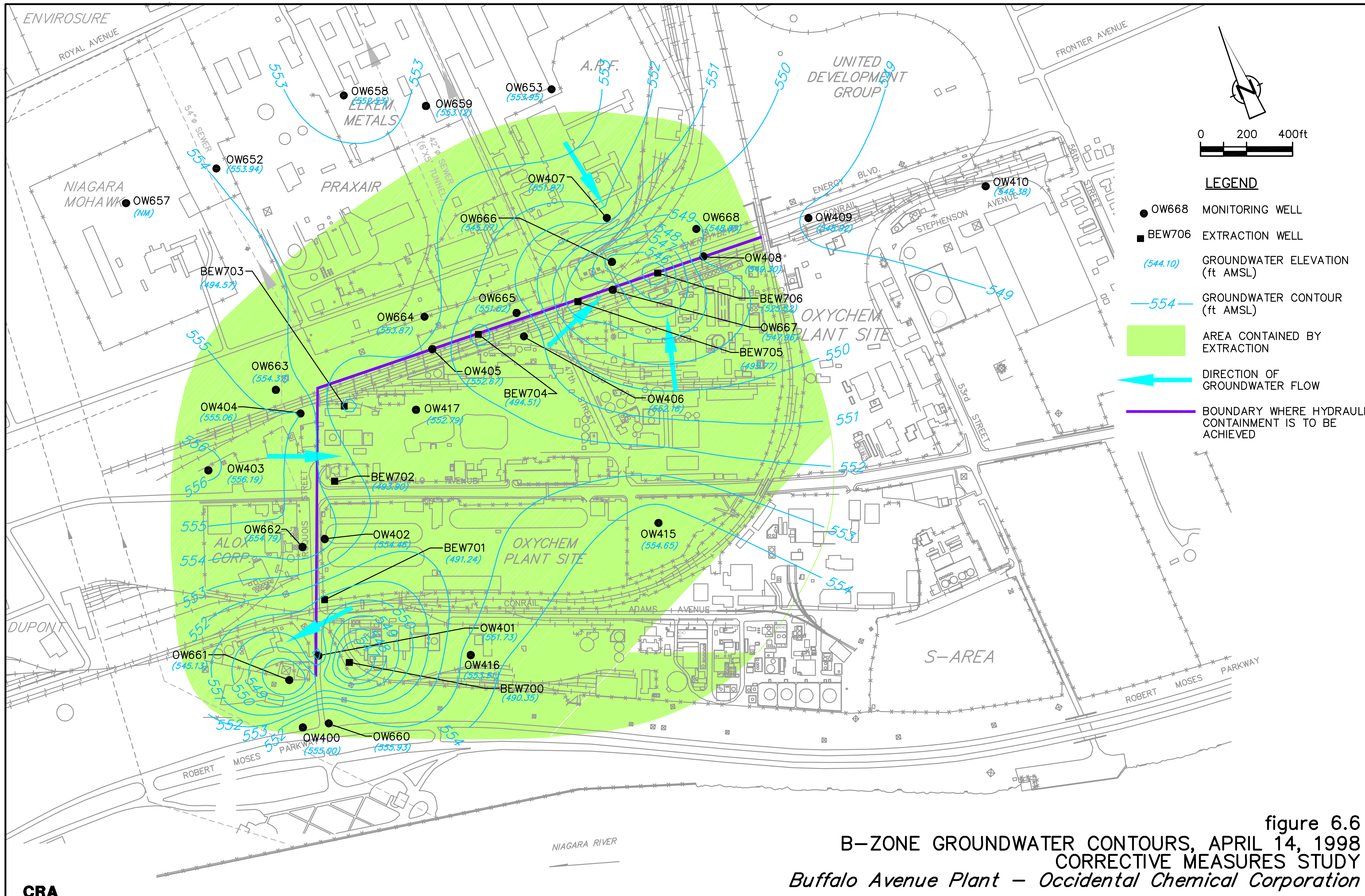


figure 6.6
B-ZONE GROUNDWATER CONTOURS, APRIL 14, 1998
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA047 NOV 13/98

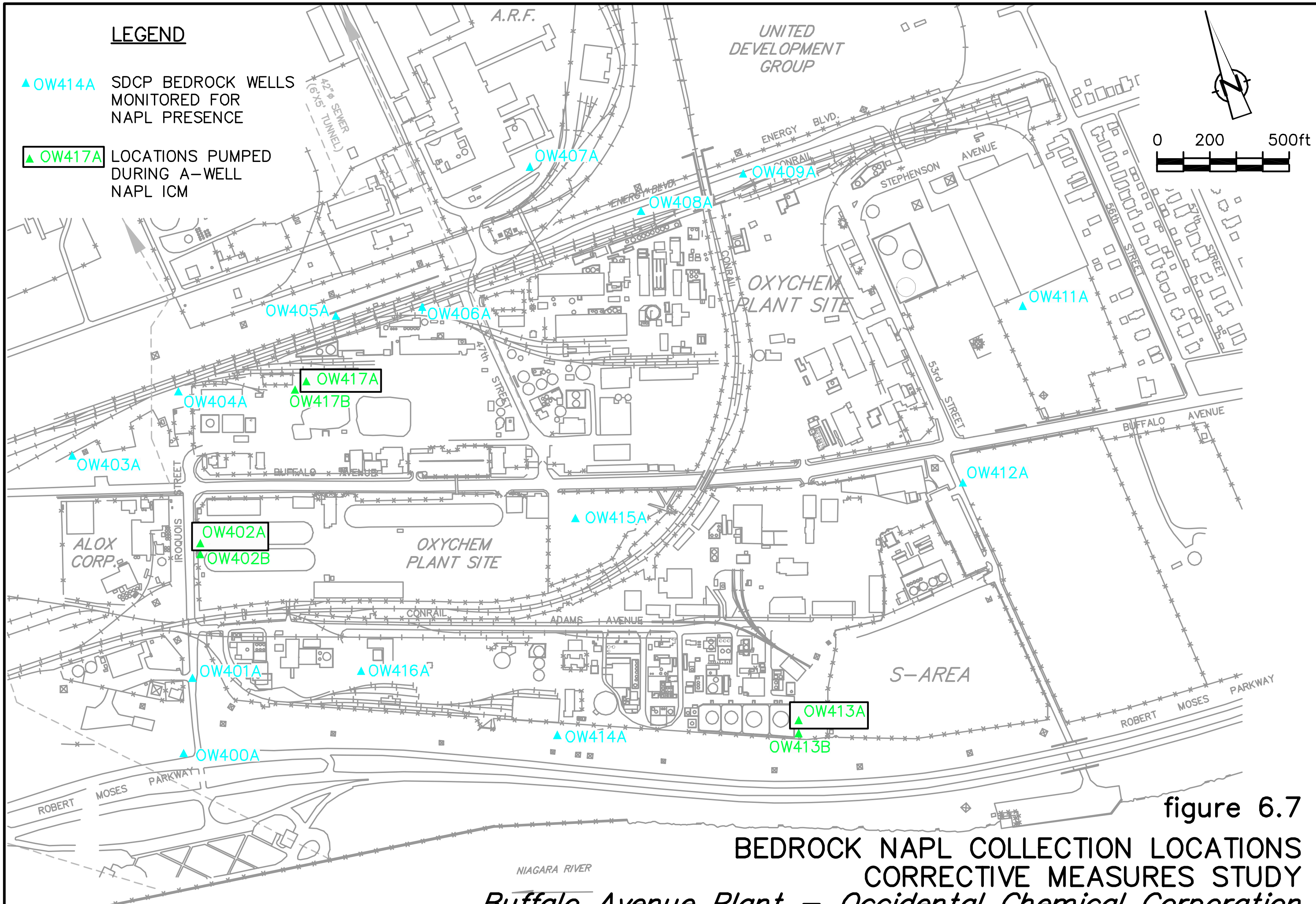


figure 6.7

BEDROCK NAPL COLLECTION LOCATIONS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA039 NOV 13/98

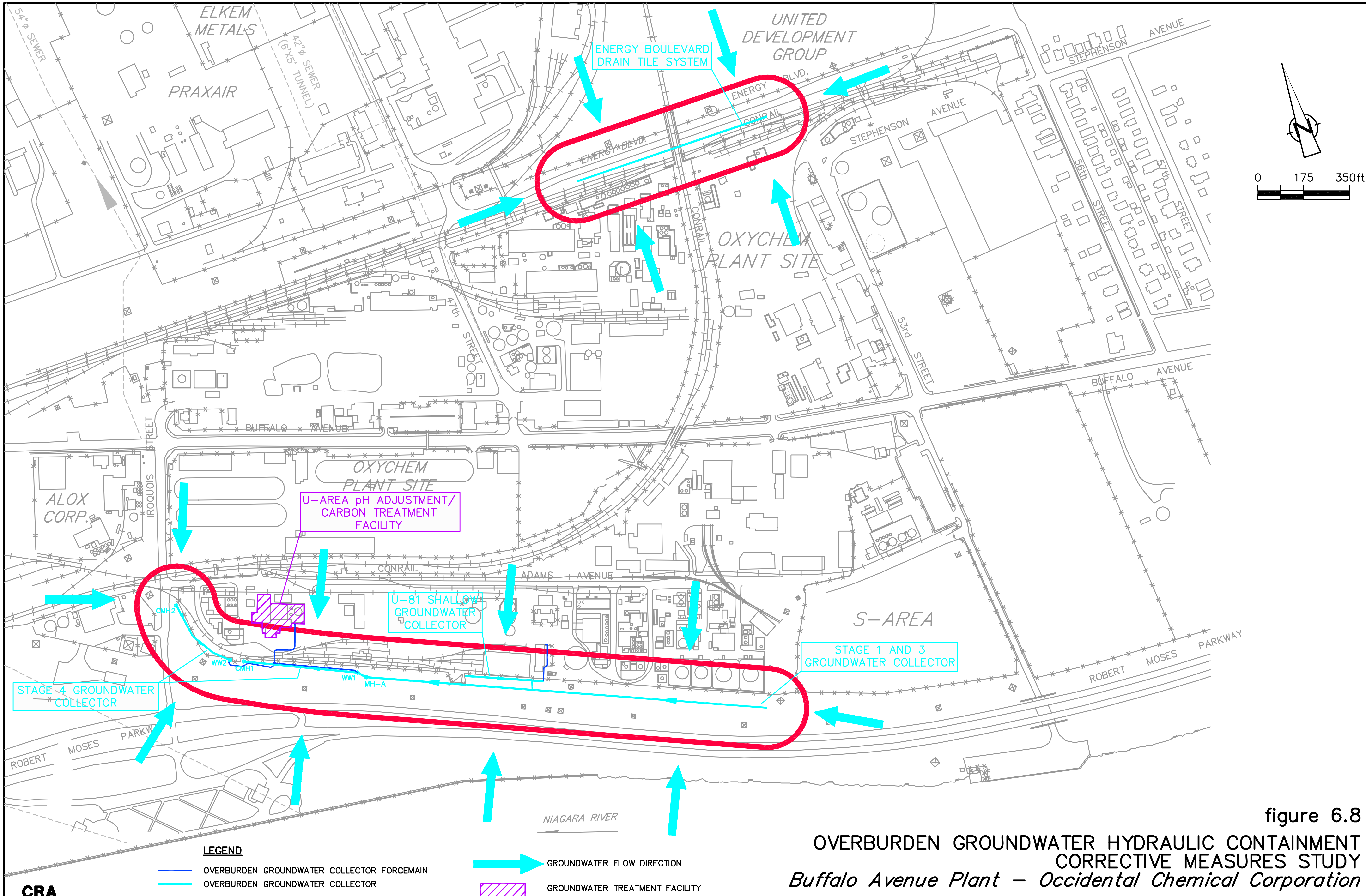
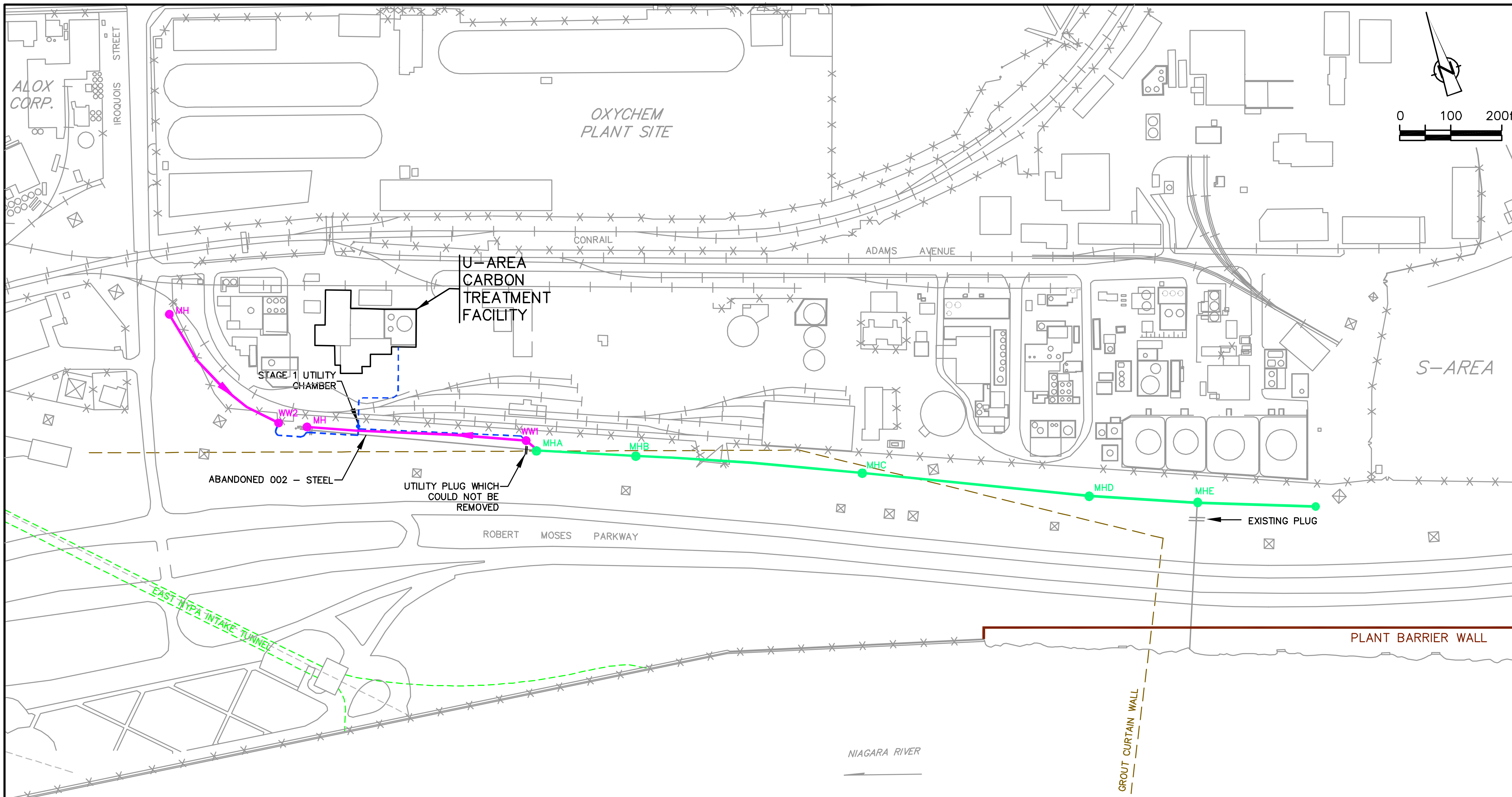


figure 6.8

OVERBURDEN GROUNDWATER HYDRAULIC CONTAINMENT
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA027 NOV 13/98



LEGEND

- STAGE 1 AND STAGE 3 COLLECTOR
- STAGE 4 COLLECTOR
- FORCEMAIN
- BARRIER WALL ALIGNMENT

figure 6.9

STAGE 1 AND STAGE 4 OVERBURDEN GROUNDWATER COLLECTION SYSTEMS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA028 NOV 13/98

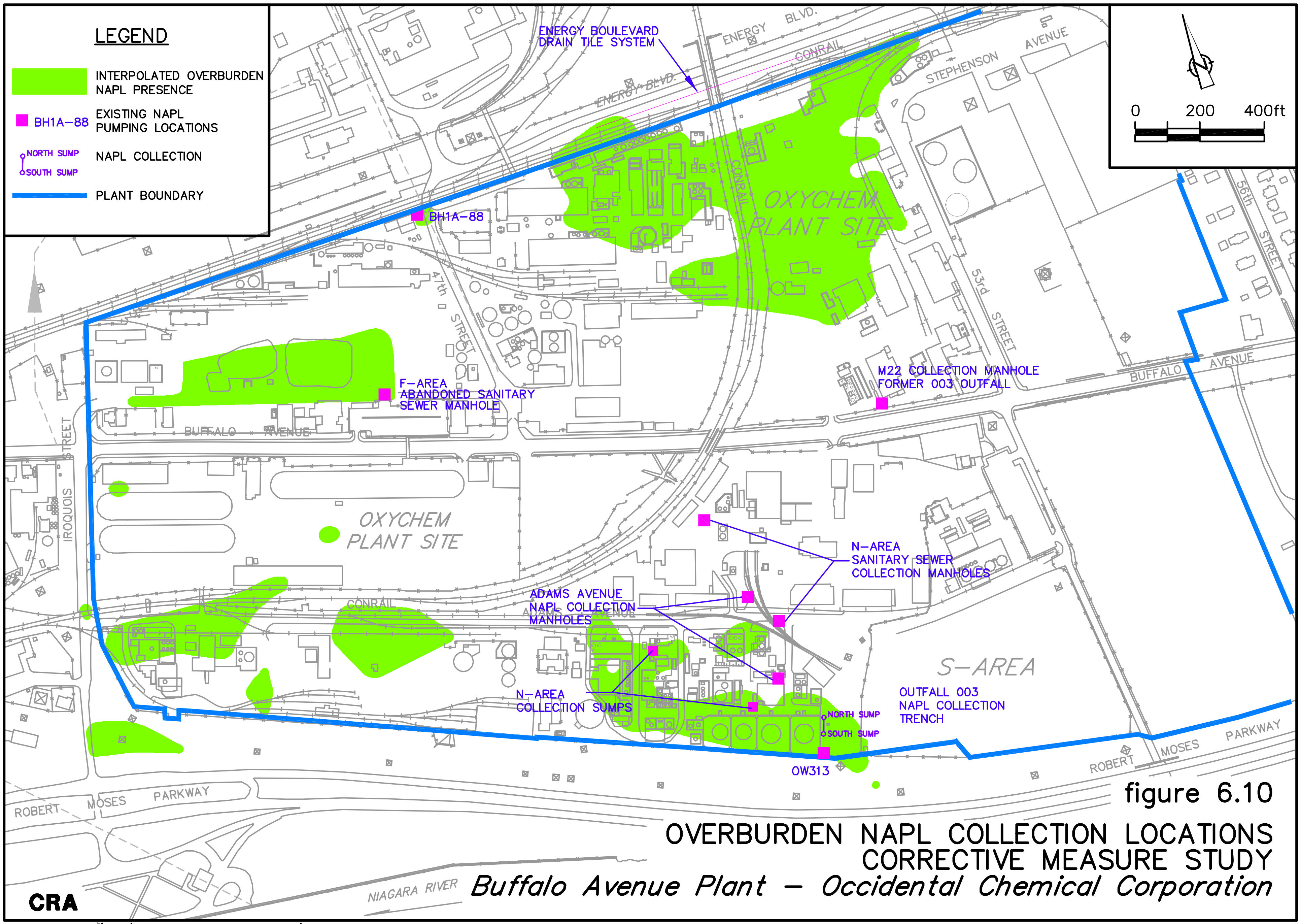


figure 6.10

OVERBURDEN NAPL COLLECTION LOCATIONS
CORRECTIVE MEASURE STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA044 NOV 13/98

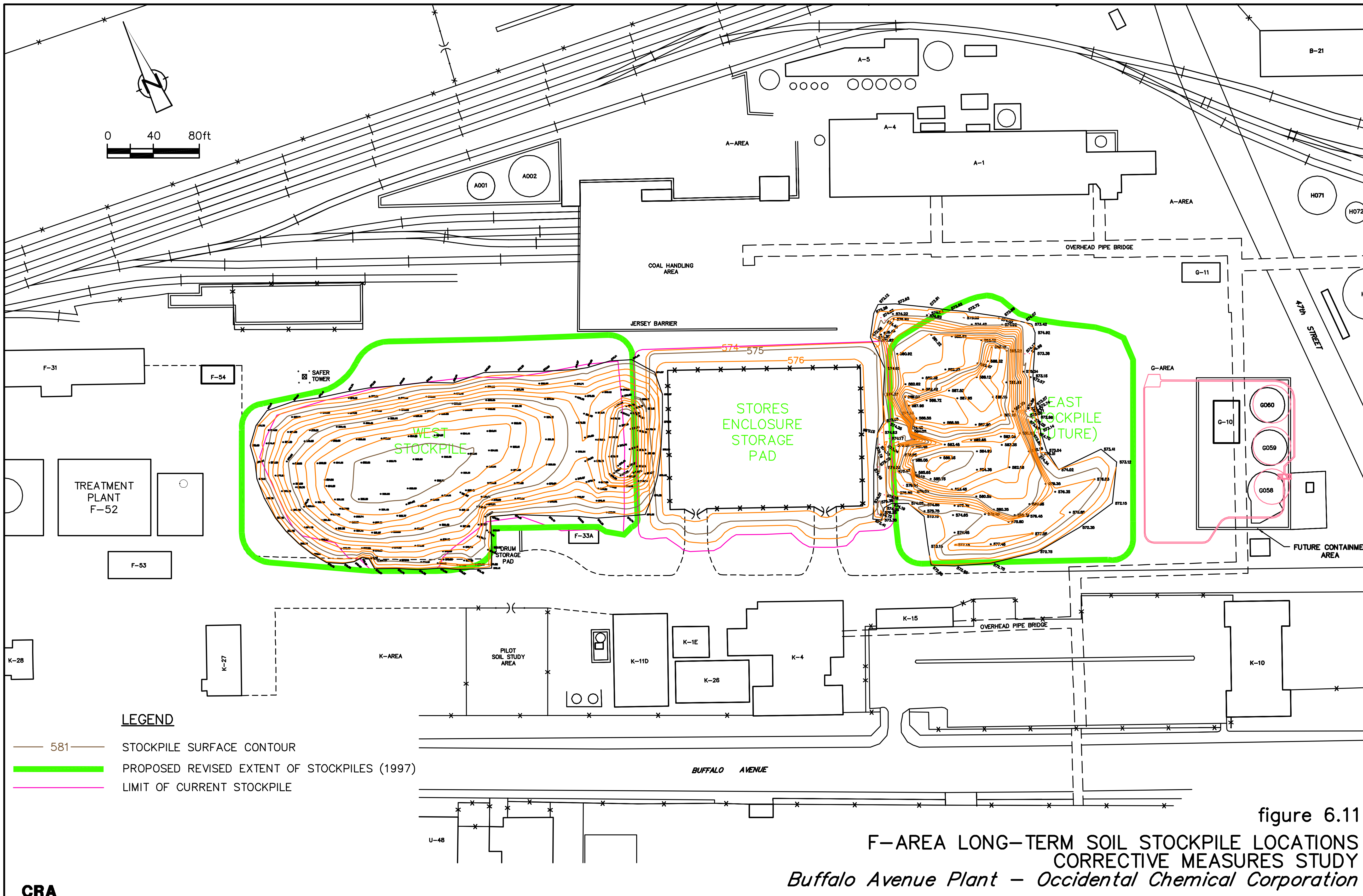


figure 6.11

F-AREA LONG-TERM SOIL STOCKPILE LOCATIONS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA055 NOV 13/98

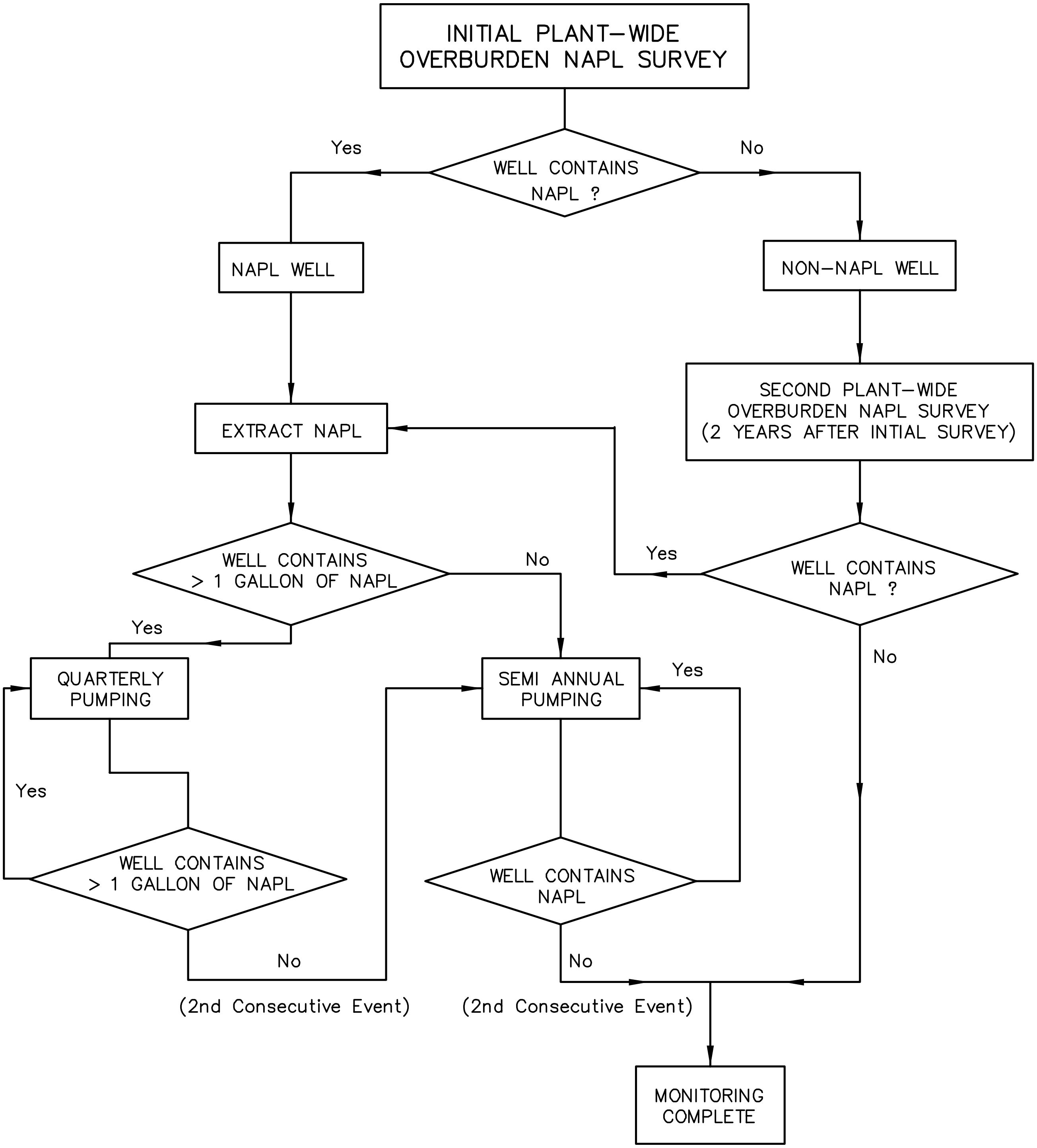


figure 6.12

NAPL MONITORING DECISION CHART
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corpration

CRA

02583-00(191)GN-WA042 NOV 13/98

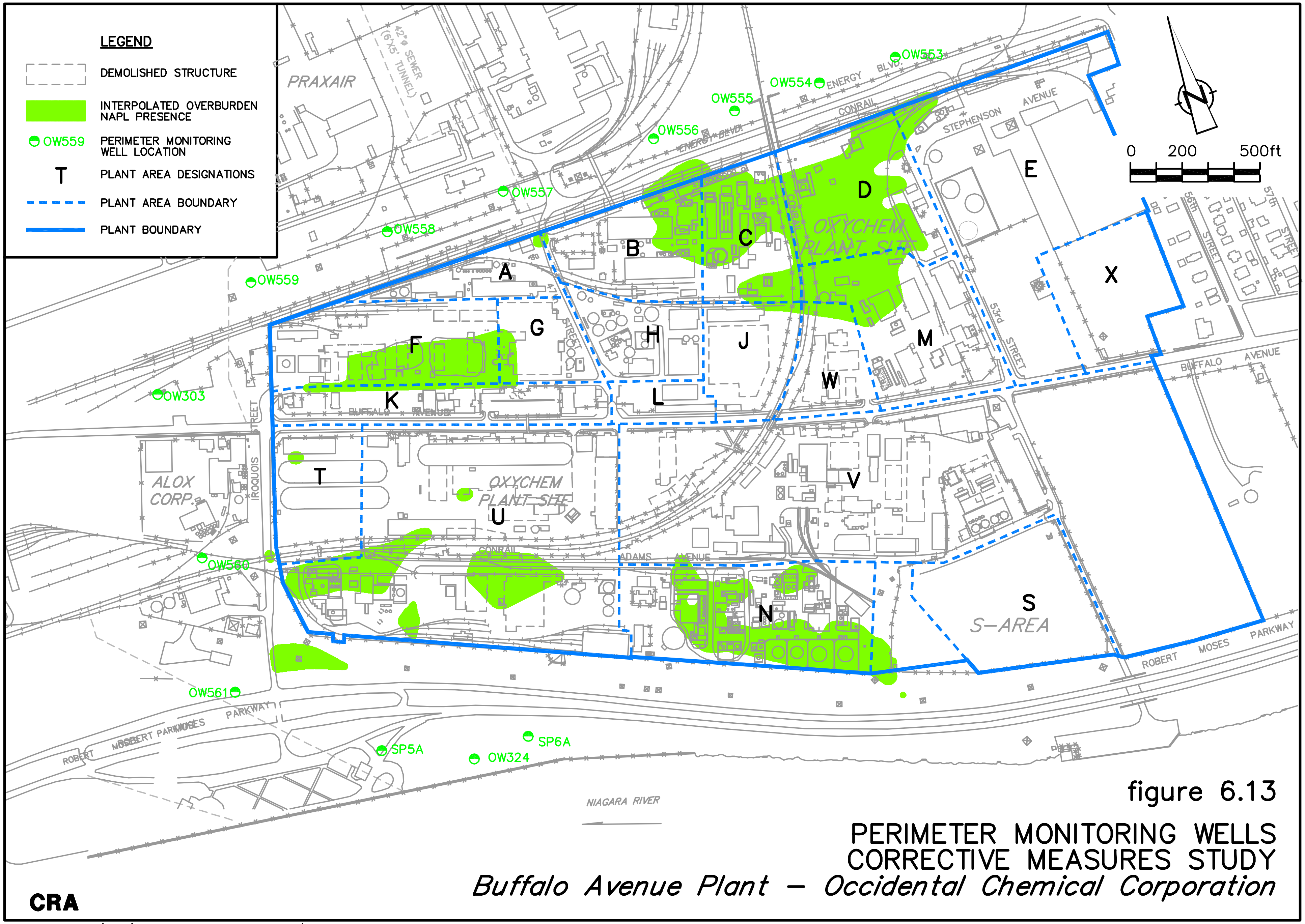


figure 6.13

PERIMETER MONITORING WELLS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA043 NOV 13/98

TABLE 1.1

CORRECTIVE MEASURES STUDY, DESIGN, AND STARTUP REPORTS

Bedrock Groundwater Corrective Measures

- Corrective Measures Study
  Bedrock Groundwater Remediation
  August 1992

- Corrective Measures Implementation
  Bedrock Groundwater Remediation
  Design Report (30 Percent Completion)
  June 1993

- Part 1, Mechanical Construction
  Scope of Work and Specifications
  March 3, 1994

- Design Calculations
  June 20, 1994

- Part II, Civil Construction
  Scope of Work and Specifications
  March 3, 1994

- Part III, Electrical Construction
  Scope of Work and Specifications (Revised)
  June 10, 1994

- Part IV, Treatment Facility Civil Construction
  Scope of Work and Specifications
  July 15, 1994

- Part V, Treatment Facility Mechanical Construction
  Scope of Work and Specifications
  July 29, 1994

- Part VI, Treatment Facility Electrical Construction
  Scope of Work and Specifications
  September 12, 1994

- Soil Management Plan
  Corrective Measures
  January 1995

TABLE 1.1

**CORRECTIVE MEASURES STUDY, DESIGN,
AND STARTUP REPORTS**

- Corrective Measures Implementation
  Bedrock Groundwater Remediation
  Phase I - Individual Extraction Well Pumping Test Report
  November 1995

- Corrective Measures Implementation
  Bedrock Groundwater Remediation
  Phase I - Combined Extraction Well Pumping Test Report
  May 1996

- Corrective Measures Implementation
  Bedrock Groundwater Remediation
  Vinyl Chloride Treatment Assessment
  November 1996

- Corrective Measures Implementation
  Bedrock Groundwater Remediation
  Six Month Performance Evaluation
  November 1996

- Corrective Measures Implementation
  Bedrock Groundwater Remediation
  One Year Performance Evaluation
  July 1997

- Corrective Measures Implementation
  Bedrock Groundwater Remediation
  Treatment System Upgrade Design
  Report (30 Percent Completion)
  October 1997

- Corrective Measures Implementation
  Bedrock Groundwater Remediation
  Semi-Annual Performance Evaluation
  April to October 1997
  January 1998

- Corrective Measures Implementation
  Bedrock Groundwater Remediation
  Semi-Annual Performance Evaluation
  November 1997 to April 1998
  October 1998

TABLE 1.1

**CORRECTIVE MEASURES STUDY, DESIGN,
AND STARTUP REPORTS**

Overburden Groundwater Corrective Measures

- Corrective Measures Study
  Overburden Groundwater Remediation
  January 1994

- Corrective Measures Study
  Overburden Groundwater Remediation
  Supplemental Plan
  September 1995

- Corrective Measures Implementation
  Overburden Groundwater Remediation
  Flow Zone 1 Design Report (30 Percent Completion)
  June 1995

- Corrective Measures Implementation
  Overburden Groundwater Remediation
  Outfall Sewer Investigation Work Plan
  June 1995

- Corrective Measures Implementation
  Overburden Groundwater Remediation
  Abandoned Sewer Pumping Test Programs
  June 1995

- Corrective Measures Implementation
  Overburden Groundwater Remediation
  Abandoned Sewer Pumping Test Report
  August 1995

- Corrective Measures Implementation
  Overburden Groundwater Remediation
  Outfall Sewer Investigation
  Phase I Report
  Phase II Recommendations
  September 1995

- Corrective Measures Implementation
  Overburden Groundwater Remediation
  Scope, Specifications, and Drawings for Stage 1-002 Outfall Conversion
  November 1995

TABLE 1.1

CORRECTIVE MEASURES STUDY, DESIGN, AND STARTUP REPORTS

- Corrective Measures Implementation
  Overburden Groundwater Remediation
  Scope and Specifications for pH Adjustment System
  at U-67
  November 1995

- Corrective Measures Implementation
  Overburden Groundwater Remediation
  Soil Management Plan for Corrective Measures Implementation
  Overburden Activities
  November 1995

- Corrective Measures Implementation
  Overburden Groundwater Remediation
  Outfall Sewer Investigation
  Phase II Report
  Corrective Measures Implementation Plan
  June 1996

- Corrective Measures Implementation
  Overburden Groundwater Remediation
  Flow Zone 1 Stage 4
  July 1996

- Corrective Measures Implementation
  Overburden Groundwater Remediation
  Scope, Specifications, and Drawings for Stage 4 Groundwater
  Collection System
  Part 1 - Introduction/Drawings
  Part 2 - Civil
  Part 3 - Mechanical
  October 1997

- Flow Zone 1 - Stage 4
  Electrical Construction
  Scope and Specifications
  December 1997

TABLE 1.1

CORRECTIVE MEASURES STUDY, DESIGN, AND STARTUP REPORTS

- Letter
  Overburden Groundwater CMI Activities
  Stage 3 - Enhancement of Stage 1 System
  March 24, 1998

- Letter
  Overburden Groundwater CMI Activities
  Stage 3 - Enhancement of Stage 1 System
  May 15, 1998

Overburden Soils Corrective Measures

- Corrective Measures Study
  Overburden Soils
  August 1996

TABLE 3.1

SITE SPECIFIC INDICATORS
BUFFALO AVENUE PLANT

Analytes	*Units*	*Method Detection Level*
pH	Standard Units	
Specific Conductance	µmhos	1
Phosphorus, Total Soluble (As P)	µg-P/L	10
Arsenic	µg/L	53
Mercury	µg/L	0.4
Lead	µg/L	42
Toluene	µg/L	1
2-Chlorotoluene	µg/L	1
4-Chlorotoluene	µg/L	1
2,4/2,5-Dichlorotoluene	µg/L	1
2,6-Dichlorotoluene	µg/L	1
2,3/3,4-Dichlorotoluene	µg/L	1
2,3,6-Trichlorotoluene	µg/L	1
2,4,5-Trichlorotoluene	µg/L	1
Benzene	µg/L	1
Chlorobenzene	µg/L	1
1,2-Dichlorobenzene	µg/L	1
1,3-Dichlorobenzene	µg/L	1
1,4-Dichlorobenzene	µg/L	1
1,2,3-Trichlorobenzene	µg/L	1
1,2,4-Trichlorobenzene	µg/L	1
1,2,3,4-Tetrachlorobenzene	µg/L	1
1,2,4,5-Tetrachlorobenzene	µg/L	1
Hexachlorobenzene	µg/L	1
Trichloroethylene	µg/L	1
Tetrachloroethylene	µg/L	1
2-Chlorobenzotrifluoride	µg/L	1
4-Chlorobenzotrifluoride	µg/L	1
2,4-Dichlorobenzotrifluoride	µg/L	1
3,4-Dichlorobenzotriflouride	µg/L	1
Hexachlorobutadiene	µg/L	1
Hexachlorocyclopentadiene	µg/L	1
Octachlorocyclopentene	µg/L	1
Perchloropentacyclodecane (Mirex)	µg/L	1
2,4,5-Trichlorophenol	µg/L	10
a-Hexachlorocyclohexane	µg/L	1
b-Hexachlorocyclohexane	µg/L	1
g-Hexachlorocyclohexane	µg/L	1
d-Hexachlorocyclohexane	µg/L	1
Benzoic Acid	µg/L	100
2-Chlorobenzoic Acid	µg/L	100
3-Chlorobenzoic Acid	µg/L	100
4-Chlorobenzoic Acid	µg/L	100
Chlorobenzoic Acid, Total	µg/L	100
Chlorendic Acid	µg/L	200
Total Organic Carbon (TOC)	µg/L	1
Total Organic Halides (TOX)	µg/L	50

TABLE 3.2

ORGANIC SSI COMPOUND CONCENTRATIONS FOR WELLS SOUTH AND WEST OF THE PLANT (OW560, OW561, SP5A, OW324, SP6A)

Parameter	*Class GA Standard (µg/L)*	*OW560 Round I (µg/L)*	*OW560 Round II (µg/L)*	*OW561 Round I (µg/L)*	*OW561 Round II (µg/L)*	*SP5A Round I (µg/L)*	*OW324 Round I (µg/L)*	*OW324 Round II (µg/L)*	*SP6A Round I (µg/L)*
Trichloroethylene	5	ND	ND	**11**	**27**	1	ND	3/3	ND
Tetrachloroethylene	5	ND	ND	3	**8**	ND	ND	1/1	ND
4-Chlorobenzotrifluoride	5	ND	ND	4	**10**	**25**	**25**	**33/32**	**20**
3,4-Dichlorobenzotrifluoride	5	ND	ND	ND	ND	1	ND	1/1	ND
Benzene	0.7	ND	ND	ND	ND	ND	**1**	ND/ND	ND
Chlorobenzene	5	4	ND	ND	ND	ND	3	ND/ND	ND
1,2-Dichlorobenzene	4.7	ND	ND	ND	ND	ND	1	ND/ND	ND
1,3-Dichlorobenzene	5	ND	ND	ND	ND	ND	ND	ND/ND	3
1,4-Dichlorobenzene	4.7	ND	ND	ND	ND	1	1	ND/ND	ND
2,3/3,4-Dichlorotoluene	5	ND	ND	ND	ND	ND	ND	ND/ND	1

TABLE 3.3

OVERBURDEN CHEMICAL MASS EFFLUX
SDCP

Flow Zone	*SDCP Flow Zone*	*Flow (gpd)*	*(TOX + TOC)/CF(1) (µg/L)*			*Mass Efflux (lbs/day) Qinfilt = 14.3 in/yr*			*Mass Efflux (lbs/day) Qinfilt = 10.0 in/yr*			*Mass Efflux (lbs/day) Qinfilt = 18.0 in/yr*		
			Min	*Mean*	*Max*	*Min*	*Most Likely*	*Max*	*Min*	*Most Likely*	*Max*	*Min*	*Most Likely*	*Max*
1	1	6,493	291,443	360,400	429,356	16	20	23	11.0	13.7	16.3	20	25	29
	2	2,237	54,133	120,267	186,400	1.0	2.2	3.5	0.71	1.6	2.4	1.3	2.8	4.4
	3	929	24,889	38,889	52,889	0.19	0.30	0.41	0.13	0.21	0.29	0.24	0.38	0.52
2	4	26	14,823	17,455	20,087	0.0032	0.0038	0.0044	0.0022	0.0026	0.0030	0.0040	0.0048	0.0055
	5	32	11,620	12,502	13,383	0.0031	0.0033	0.0036	0.0022	0.0023	0.0025	0.0039	0.0042	0.0045
	6	172	4,000	4,000	4,000	0.0057	0.0057	0.0057	0.0040	0.0040	0.0040	0.0072	0.0072	0.0072
	7	308	2,767	4,139	5,511	0.0071	0.011	0.014	0.0050	0.0074	0.01	0.0089	0.013	0.018
3	8	1,681	5,933	21,127	36,320	0.083	0.30	0.51	0.058	0.21	0.4	0.10	0.37	0.64
	9 (2)	839	239,840	248,387	256,933	1.7	1.7	1.8	1.2	1.2	1.3	2.1	2.2	2.3
4	10	929	7,933	11,167	14,400	0.061	0.087	0.11	0.043	0.061	0.078	0.077	0.11	0.14
	11	282	1,947	8,040	14,133	0.0046	0.019	0.033	0.0032	0.013	0.023	0.0058	0.024	0.042
	12	1,033	25,333	26,789	28,244	0.22	0.23	0.24	0.15	0.16	0.17	0.27	0.29	0.31
5	13	4	8,356	16,800	25,244	0.0003	0.0006	0.0008	0.0002	0.0004	0.0006	0.0004	0.0007	0.0011
		14,965												
					Total Flux =	19	24	30	13	17	21	24	31	38

Notes:

(1) CF - Correction Factor = 0.75

(2) Groundwater flow from Flow Zone 9 is collected and treated via the Energy Boulevard Tile Collection System.

TABLE 3.4

CHEMICAL MASS EFFLUX FOR BEDROCK D-WELLS
SDCP

		Flow (gpd)			*(TOX+TOC)/CF(1) (µg/L)*			*Mass Efflux Minimum Flow (lbs/day)*			*Mass Efflux Most Likely Flow (lbs/day)*			*Mass Efflux Maximum Flow (lbs/day)*		
Flow Zone	*Well*	*Min*	*Most Likely*	*Max*	*Min*	*Most Likely*	*Max*	*Min*	*Most Likely*	*Max*	*Min*	*Most Likely*	*Max*	*Min*	*Most Likely*	*Max*
1	OW402/OW404	580	2293	7533	22000	45333	68667	0.11	0.22	0.33	0.42	0.87	1.3	1.4	2.8	4.3
2	OW405	59	794	2584	17200	19933	22667	0.0085	0.010	0.011	0.11	0.13	0.15	0.37	0.43	0.49
3	OW406	64	1650	8390	10133	17467	24800	0.0054	0.0093	0.013	0.14	0.24	0.34	0.71	1.2	1.7
4	OW408	23	788	3779	1093	1280	1467	0.00021	0.00025	0.00028	0.0072	0.0084	0.010	0.034	0.040	0.046
5	OW409	501	2221	7009	1067	2093	3120	0.0045	0.0088	0.013	0.020	0.039	0.058	0.062	0.12	0.18
6	OW410	28	342	3419	700	1739	2779	0.00017	0.00041	0.00066	0.0020	0.0050	0.0079	0.020	0.050	0.079
	Total Flow =	1256	8087	32715			Total Flux =	0.13	0.25	0.37	0.70	1.3	1.9	2.6	4.7	6.8

Notes:

(1) CF = Correction Factor = 0.75

TABLE 3.5

CHEMICAL MASS EFFLUX FOR BEDROCK C-WELLS
SDCP

		Flow (gpd)			*(TOC+TOX)/CF(1) (µg/L)*			*Mass Efflux Minimum Flow (lbs/day)*			*Mass Efflux Most Likely Flow (lbs/day)*			*Mass Efflux Maximum Flow (lbs/day)*		
Flow Zone	*Well*	*Min*	*Most Likely*	*Max*	*Min*	*Most Likely*	*Max*	*Min*	*Most Likely*	*Max*	*Min*	*Most Likely*	*Max*	*Min*	*Most Likely*	*Max*
July 1989																
1	OW402/OW404	10742	34607	143885	4167	10467	16767	0.37	0.94	1.5	1.2	3.0	4.8	5.0	13	20
2	OW405/OW406	8014	31782	230675	4267	6733	9200	0.29	0.45	0.61	1.1	1.8	2.4	8.2	13	18
3	OW406/OW408	663	3181	24787	3673	5498	7323	0.020	0.030	0.040	0.097	0.15	0.19	0.76	1.1	1.5
	Total Flow =	19419	69570	399346			Total Flux =	0.68	1.4	2.2	2.4	5.0	7.5	14	27	39
November 1989																
1	OW401/ OW402/OW404	13373	43083	179125	3058	7642	12227	0.34	0.85	1.4	1.1	2.7	4.4	4.6	11	18
2	OW405	8638	34256	248633	2667	4600	6533	0.19	0.33	0.47	0.76	1.3	1.9	5.5	9.5	14
3	OW406/OW408	888	4260	33192	3673	5498	7323	0.027	0.041	0.054	0.13	0.20	0.26	1.0	1.5	2.0
	Total Flow =	22898	81599	460950			Total Flux =	0.56	1.2	1.9	2.0	4.3	6.5	11	22	34

Notes:

(1) CF = Correction Factor = 0.75

TABLE 3.5

CHEMICAL MASS EFFLUX FOR BEDROCK C-WELLS
SDCP

Flow Zone	Well	Flow (gpd) Min	Flow (gpd) Most Likely	Flow (gpd) Max	(TOC+TOX)/CF(1) (µg/L) Min	(TOC+TOX)/CF(1) (µg/L) Most Likely	(TOC+TOX)/CF(1) (µg/L) Max	Mass Efflux Minimum Flow (lbs/day) Min	Mass Efflux Minimum Flow (lbs/day) Most Likely	Mass Efflux Minimum Flow (lbs/day) Max	Mass Efflux Most Likely Flow (lbs/day) Min	Mass Efflux Most Likely Flow (lbs/day) Most Likely	Mass Efflux Most Likely Flow (lbs/day) Max	Mass Efflux Maximum Flow (lbs/day) Min	Mass Efflux Maximum Flow (lbs/day) Most Likely	Mass Efflux Maximum Flow (lbs/day) Max
March 1990																
1	OW402/OW404	13999	45102	187520	4167	10467	16767	0.49	1.2	2.0	1.6	3.9	6.3	6.5	16	26
2	OW405	11313	45025	252199	2667	4600	6533	0.25	0.43	0.62	1.0	1.7	2.5	5.6	9.7	14
3	OW406	352	1690	13165	5867	8867	11867	0.017	0.026	0.035	0.083	0.12	0.17	0.64	0.97	1.3
4	OW408/OW409	4694	23638	76740	2213	2735	3256	0.087	0.11	0.13	0.44	0.54	0.64	1.4	1.8	2.1
5	OW410	1863	12199	60775	2667	3333	4000	0.041	0.052	0.062	0.27	0.34	0.41	1.4	1.7	2.0
	Total Flow =	32222	127654	590399			Total Flux =	0.88	1.8	2.8	3.4	6.7	10	16	30	45
June 1990																
1	OW402/OW404	2130	6861	28525	4167	10467	16767	0.074	0.19	0.30	0.24	0.60	0.96	0.99	2.5	4.0
2	OW405	4181	16642	93214	2667	4600	6533	0.093	0.16	0.23	0.37	0.64	0.91	2.1	3.6	5.1
3	OW406	492	2549	24946	5867	8867	11867	0.024	0.036	0.049	0.12	0.19	0.25	1.2	1.8	2.5
4	OW408	710	3990	23504	779	2129	3480	0.0046	0.013	0.021	0.026	0.071	0.12	0.15	0.42	0.68
5	OW409	927	4522	12277	947	3340	5733	0.0073	0.026	0.044	0.036	0.13	0.22	0.097	0.34	0.59
6	OW410	54	326	1314	2667	3333	4000	0.0012	0.0015	0.0018	0.0072	0.0090	0.011	0.029	0.037	0.044
	Total Flow =	8495	34888	183780			Total Flux =	0.20	0.42	0.64	0.80	1.6	2.5	4.6	8.7	13

Notes:

(1) CF = Correction Factor = 0.75

TABLE 3.6

CHEMICAL MASS EFFLUX FOR BEDROCK B-WELLS
SDCP

		Flow (gpd)			*(TOX+TOC)/CF(1) (μg/L)*			*Mass Efflux Minimum Flow (lbs/day)*			*Mass Efflux Most Likely Flow (lbs/day)*			*Mass Efflux Maximum Flow (lbs/day)*		
Flow Zone	*Well*	*MIn*	*Most Likely*	*Max*	*Min*	*Most Likely*	*Max*	*Min*	*Most Likely*	*Max*	*Min*	*Most Likely*	*Max*	*Min*	*Most Likely*	*Max*
November 1989																
1	OW402/OW404	7	19	40	4300	6660	9020	0.00025	0.00039	0.0005	0.0007	0.0011	0.0014	0.0014	0.0022	0.0030
2	OW405	7	17	38	18000	19667	21333	0.0011	0.0011	0.0012	0.0026	0.0028	0.0030	0.0057	0.0062	0.0068
3	OW406	24	55	136	307	2953	5600	0.00006	0.00059	0.0011	0.00014	0.0014	0.0026	0.00035	0.0033	0.0064
4	OW408	208	1765	9905	947	4733	8520	0.0016	0.0082	0.015	0.014	0.070	0.13	0.078	0.39	0.70
5	OW409	248	1798	8171	700	3067	5435	0.0014	0.0063	0.011	0.010	0.046	0.081	0.048	0.21	0.37
6	OW410	90	679	2507	987	6093	11200	0.0007	0.0046	0.0084	0.0056	0.034	0.063	0.021	0.13	0.23
7	OW411	954	2818	5855	827	4080	7333	0.0066	0.032	0.058	0.019	0.096	0.17	0.040	0.20	0.36
	Total Flow =	1537	7150	26651			Total Flux=	0.012	0.054	0.096	0.053	0.25	0.45	0.19	0.94	1.7
March 1990																
1	OW402/OW404	4	11	24	4300	6660	9020	0.00014	0.00022	0.00030	0.00039	0.00061	0.00083	0.0009	0.0013	0.0018
2	OW405	8	18	41	18000	19667	21333	0.0012	0.0013	0.0014	0.0027	0.0030	0.0032	0.0062	0.0067	0.0073
3	OW406	27	62	153	307	2953	5600	0.00007	0.00067	0.0013	0.00016	0.0015	0.0029	0.00039	0.0038	0.0071
4	OW408	82	698	3917	947	4733	8520	0.00065	0.0032	0.0058	0.0055	0.028	0.050	0.031	0.15	0.28
5	OW409	230	1667	7576	700	3067	5435	0.0013	0.0059	0.010	0.010	0.043	0.076	0.044	0.19	0.34
6	OW410	149	1130	4174	987	6093	11200	0.0012	0.0076	0.014	0.0093	0.057	0.11	0.034	0.21	0.39
7	OW411	662	1955	4061	827	4080	7333	0.0046	0.023	0.040	0.013	0.067	0.12	0.028	0.14	0.25
	Total Flow =	1162	5541	19946			Total Flux=	0.0092	0.041	0.074	0.041	0.20	0.36	0.14	0.71	1.3

Notes:

(1) CF = Correction Factor = 0.75

TABLE 3.7

CHEMICAL MASS EFFLUX FOR BEDROCK A-WELLS
SDCP

		Flow (gpd)			*(TOX+TOC)/CF(1) (µg/L)*			*Mass Efflux Minimum Flow (lbs/day)*			*Mass Efflux Most Likely Flow (lbs/day)*			*Mass Efflux Maximum Flow (lbs/day)*		
Flow Zone	*Well*	*Min*	*Likely*	*Max*	*Min*	*Likely*	*Max*	*Min*	*Likely*	*Max*	*Min*	*Likely*	*Max*	*Min*	*Likely*	*Max*
November 1990																
1	OW402/OW404	1.44	1.52	1.71	152253	241943	331633	0.0018	0.0029	0.0040	0.0019	0.0031	0.0042	0.0022	0.0035	0.0047
2	OW405	0.70	0.74	0.83	24000	24000	24000	0.00014	0.00014	0.00014	0.00015	0.00015	0.00015	0.00017	0.00017	0.00017
3	OW406	0.05	0.05	0.05	933	1547	2160	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
4	OW408	0.11	0.11	0.11	16125	32796	49467	0.00001	0.00003	0.00005	0.00001	0.00003	0.00005	0.00001	0.00003	0.00005
5	OW409	0.27	0.42	0.58	2880	4920	6960	0.00001	0.00001	0.00002	0.00001	0.00002	0.00002	0.00001	0.00002	0.00003
6	OW410	0.29	0.52	0.77	700	4395	8089	0.00000	0.00001	0.00002	0.00000	0.00002	0.00004	0.00000	0.00003	0.00005
7	OW411	2.17	5.31	9.68	4547	6407	8267	0.00008	0.00012	0.00015	0.00020	0.00028	0.00037	0.00037	0.00052	0.00067
	Total Flow =	5.02	8.67	13.74			Total Flux=	0.0021	0.0032	0.0044	0.0023	0.0036	0.0048	0.0027	0.0042	0.0057
March 1990																
1	OW402/OW404	0.87	0.93	1.04	152253	241943	331633	0.0011	0.0018	0.0024	0.0012	0.0019	0.0026	0.0013	0.0021	0.0029
2	OW405	0.75	0.80	0.90	24000	24000	24000	0.00015	0.00015	0.00015	0.00016	0.00016	0.00016	0.00018	0.00018	0.00018
3	OW406	0.05	0.05	0.05	933	1547	2160	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
4	OW408	0.04	0.04	0.04	16125	32796	49467	0.00001	0.00001	0.00002	0.00001	0.00001	0.00002	0.00001	0.00001	0.00002
5	OW409	0.25	0.39	0.54	2880	4920	6960	0.00001	0.00001	0.00001	0.00001	0.00002	0.00002	0.00001	0.00002	0.00003
6	OW410	0.47	0.86	1.29	700	4395	8089	0.00000	0.00002	0.00003	0.00001	0.00003	0.00006	0.00001	0.00005	0.00009
7	OW411	1.50	3.68	6.72	4547	6407	8267	0.00006	0.00008	0.00010	0.00014	0.00020	0.00025	0.00025	0.00036	0.00046
	Total Flow =	3.95	6.76	10.58			Total Flux=	0.0013	0.0020	0.0027	0.0015	0.0023	0.0031	0.0018	0.0027	0.0037

Notes:

(1) CF = Correction Factor = 0.75

TABLE 6.1

COMPARISON OF PRE- AND POST-START-UP
CHEMICAL CONCENTRATIONS IN BEDROCK MONITORING WELLS
BEDROCK GROUNDWATER EXTRACTION SYSTEM
BUFFALO AVENUE PLANT

Well No.	*Pre-Startup*	*Total Organic SSI Concentration Post-Startup*			
	Historic	*Aug/Sept 1996*	*Mar/Apr 1997*	*Sept/Oct 1997*	*March 1998*
D-Zone					
OW404	6,500	20,000	5,200	--	--
OW405	47,000	93,000	110,000	--	--
OW406	24,000	26,000	88,000	--	--
OW408	820	5,200	620	--	--
OW409	220	24	56	1,100	310
OW410	4	1.3	ND	1	1
OW649	23	20	33	37	37
OW403	500	100	56	86	71
OW407	2,600	3,700	510	1,600	560
OW650	11	4	31	--	--
OW651	140	37	16	45	22
OW652	950	380	350	490	470
OW653	1,500	400	560	2,800	2,800
C-Zone					
OW404	3,300	580	310	--	--
OW405	4,400	4,000	340	--	--
OW406	9,200	12,000	500	--	--
OW408	91	280	440	--	--
OW409	3	ND	ND	6	ND
OW410	1	ND	19	3	ND
OW649	280	410	42	36	38
OW403	120	120	12	110	42
OW407	200	1,600	500	3,200	550
OW651	1,200	93	52	88	47
OW652	81	270	800	880	1,500
OW653	0	4	8	8	6
B-Zone					
OW404	520	61	69	--	--
OW405	41,000	9,200	1,200	--	--
OW406	510	2,500	35,000	--	--
OW408	210	310	180	--	--
OW409	19	13	6	13	18
OW410	57	20	17	26	4
OW403	8	420	65	120	23
OW407	150	490	490	760	780
OW652	2	39	190	210	160
OW653	250	160	260	160	830

-- Well not included in Year Two sampling.
ND - Compound was not detected.

TABLE 6.2

MAJOR SEWER SYSTEM MODIFICATIONS

	Location	*Sewer Modification*	*Date*
Outfall 001	Outlet Structure	Sediment removal	November 1981
	MH518/MH521	Temporary inflatable plug placement	1984/1985±
	Metering chamber/ Interceptor chamber	Replacement of chamber manholes and piping	June 1985
	MH520-MH584	Lining of 36-inch sewer section	June 1985
	MH584	Severance and abandonment of easterly U-Area system	June 1985
	MH520	Severance and abandonment of easterly stub	August 1989
		Replacement of sewer section to northeast to service T-Area	August 1989
	MH518	Severance and abandonment of northeasterly stub	August 1989
	T-Area	Installation and connection of new storm system servicing T-Area bag storage facility contributing into MH518 north	August 1989
	U-Area	Mercury abatement discharges diverted to sanitary sewer	November 1989
	MHCB7-MH585	Clean and line manholes and sewer through	October 1990 May 1991
	MH520	Repair manhole to eliminate infiltration	September 1997

TABLE 6.2

MAJOR SEWER SYSTEM MODIFICATIONS WITHIN BUFFALO AVENUE PLANT

	Location	*Sewer Modification*	*Date*
Outfall 002	--	Closure of entire outfall system	December 1982
Outfall 003	MH716	Severance and abandonment of westerly 24-inch stub	Early 1985
	V-Area (MH703, MH769 and others)	Miscellaneous stub closure by plugging	Unknown
	Lift Station	Severance and abandonment of easterly 24-inch stub from MH424 to lift station	June 1985
	Metering chamber/ Interceptor chamber	Replacement of chamber manholes and piping	December 1986
	D-Area	Severance and abandonment of numerous stubs	1988/1989±
	N-Area	Severance of sewer in vicinity of Bldg. N-21 and reconnection for sanitary sewer	July 1998
Outfall 004	Energy Boulevard	Energy Boulevard Drain Tile System	November 1981
	MH93E	Severance and abandonment of southern 36-inch stub	1987/1988±
	B/C-Area (MH97B, MH78 and MH77A)	Miscellaneous stub closures by plugging	Unknown
Outfall 005	Outlet Structure	Sediment removal from outlet structure	November 1981
	H-Area	Modify H-20 Pump Station discharge to outlet at MH159A. Original outlet was at City MH155	March 1984
	K-28 Lift Station	Outlet forcemain section	November 1986

Modifications	elevated above ground from K-28 to property line

TABLE 6.2

MAJOR SEWER SYSTEM
MODIFICATIONS WITHIN BUFFALO AVENUE PLANT

	Location	*Sewer Modification*	*Date*
Outfall 005 (cont'd)			
	159A-MH159N	Lining of main line sewer. Majority of F-Area stubs contributing to the 005 Outfall were abandoned	December 1986
	MH159N	Liner repair to address NAPL NAPL entry at 42-inch easterly stub	June/July 1989
	H-Area (MH221, MH214, MH56H)	Miscellaneous stub closures by plugging	Unknown
	K-28 Lift Station MH159A-MH159	Cleaned and repaired K-28 and manholes	September 1997
	K-28 Lift Station MH159A-MH159	Cleaned and repaired K-28 and manholes	June 1998
Iroquois Street Sanitary Sewer	U-Area West (residue burner, MH595, U-42 west)	Abandon various sanitary connections and materials	Unknown
	U-Area East (MH597, MH598)	Abandon various sanitary connections	Unknown
	N-Area (MH572, MH573, MH574)	Abandon various sanitary connections and laterals	Unknown
	N-Area (MH767)	Install organic separator	September 1979
	N-Area	Closure of lagoon (MH764)	January 1988±
	T-Area (MH503, MH502)	Abandon various sanitary connections and laterals	Unknown
	U-Area North (MH529B, lift station, MH546)	Numerous sanitary connections catchbasins, laterals and sewer sections abandoned	Unknown

TABLE 6.2

MAJOR SEWER SYSTEM
MODIFICATIONS WITHIN BUFFALO AVENUE PLANT

	Location	*Sewer Modification*	*Date*
Iroquois Street Sanitary Sewer (cont'd)	U-Area North East (MH545)	Abandon southerly sewer sections and manholes	Unknown
	V-Area West (MH651, MH653)	Numerous sanitary connections, catchbasins, laterals and sewer sections abandoned	Unknown
	V-Area East (MH697, MH695; MH664, MH670, MH677, MH699, City MH769D)	Abandon various sumps, catchbasins, laterals and connections	Unknown
	F-Area West/East (MH144, MH143, MH141, MH139, MH128, MH136, MH147, MH127, MH126, MH86, MH109, MH156)	Abandon various sanitary laterals, catchbasins, sumps and sewer sections	May 1985
	V-Area	Abandon various sanitary catchbasins, sumps and laterals	Unknown
	S-Area	Install servicing to S-Area trailer/office facility	Mid 1986
47th Street Sanitary Sewer	B-Area (MH48A, MH64, MH49, MH85A, MH68B, MH68D and B-24 & B-25 Building areas)	Abandonment of sanitary sewer laterals, sumps, manholes and catchbasins	April 1981±
	D/E-Area (MH303, MH317, MH319)	Abandonment of sanitary sewer laterals, catchbasins and sumps	September 1982

TABLE 6.2

MAJOR SEWER SYSTEM
MODIFICATIONS WITHIN BUFFALO AVENUE PLANT

	Location	*Sewer Modification*	*Date*
47th Street Sanitary Sewer cont'd.	D-Area (MH302, MH311, MH307, MH301, MH305, MH308, MH306, 53rd Street (15" Ø)	Abandonment of sanitary sewer laterals, sumps, manholes, catchbasins, floor drains and roof drains	September 1982
	M-Area (MH441, MH435, MH404, MH322)	Abandonment of sanitary sewer laterals and catchbasins	June 1983
	K/G-Area (MH114A, MH178)	Abandonment of entire sewer sewer section and laterals	October 1985±
	H-Area (MH56E, MH56G, MH26)	Abandonment of entire sewer section, sumps, catchbasins and manholes	Unknown
	M/E-Area (City MH)	Abandonment of 53rd Street sanitary (15" Ø) sewer	Unknown
	A-Area (MH153A, MH94, MH151, MH174)	Abandonment of sanitary sumps, laterals and manholes	Unknown
	C-Area (MH67A, MH92A, MH96, MH97 MH91B, MH55, MH83)	Abandonment of sanitary sewer laterals, sumps, manholes, catchbasins and roof drains	Unknown
	C-Area	Abandonment of sanitary sewer between MH97 and MH180 and reconnection of MH180 to MH79	February 1997

TABLE 6.3

WET WEATHER LOADING IN THE FALLS STREET TUNNEL

	Loading (lbs/day)					SPDES Effluent Limit (lbs/day)	
Date	*5/26/94*	*12/9/1996*	*2/27/97*	*8/1/1998*	*1/4/1998*	*Monthly*	*Daily*
Flow Rate (mgd)	*3.75*	*1.11*	*30*	*20*	*10*	*Average*	*Maximum*
Mercury	0.006	0.009	0.4	0.2	0.1	0.44	
Lead	0	0	0	0	4.7		80
Toluene	0	0	1	0.31	0.044	10	
Chlorotoluene	0.023	0.026	5.2	2.5	0.13	10	
Dichlorotoluene	0	0	1.3	0.52	0	7.2	
Trichlorotoluene	0	0	0.29	0	0	6.6	
Benzene	0.064	0.014	0.63	0.26	0.1	10	
Chlorobenzene	0.27	0.069	2.1	1.2	0.42		25
Dichlorobenzene	0.3	0.13	4	2.1	0.41		8
Trichlorobenzene	0.073	0.046	4.3	1.6	0.078		3.2
Tetrachlorobenzene	0	0.0087	1.1	0.12	0	4	
Hexachlorobenzene	0	0	0	0	0	0.44	
Trichloroethylene	2.4	0.41	5.2	3.3	2.5	18	
Tetrachloroethylene	0.97	0.15	2.7	1.6	1.1	10	
Chlorobenzotrifluoride	0.035	0.025	0.86	0.26	0.078	12	
Dichlorobenzotrifluoride	0	0	0.31	0	0	3.2	
Hexachlorobutadiene	0	0.018	0.24	0	0	1.6	
Hexachlorocyclopentadiene	0	0	0	0	0		4
Perchloropentacyclodecane (Mirex)	0	0.00015	0.006	0	0	0.016	
Trichlorophenol	0	0	0.11	0	0	4	
Hexachlorocyclohexane	0.0032	0.0031	0.21	0.12	0.026		0.5

TABLE 7.1

SUMMARY OF REMEDIAL GOALS ACHIEVED BY IMPLEMENTED INTERIM CORRECTIVE MEASURES

Remedial Goal	*Bedrock Groundwater Corrective Measures*	*Overburden Groundwater Corrective Measures*	*Overburden Soil Corrective Measures*	*Off-Site Corrective Measures*
1. Restrict off-Site migration of OxyChem hazardous waste constituents in the bedrock groundwater.	•			•
2. Restrict off-Site migration of OxyChem hazardous waste constituents in the overburden groundwater.		•		
3. Restrict discharge of OxyChem hazardous waste constituents to the outfalls.		•		
4. Restrict discharge of OxyChem hazardous waste constituents to the sanitary sewers.		•		
5. Restrict migration of OxyChem hazardous waste constituents from the overburden to the bedrock.			•	
6. Minimize human contact with OxyChem hazardous waste constituents in on-Site soils.			•	
7. Minimize need for future/ongoing remediation and operation and maintenance activities.	•	•	•	
8. Maintain compatibility with remedial efforts for specific areas of the Plant and Plant operations.	•	•	•	
9. Reduce concentration of OxyChem hazardous waste constituents within the soil and groundwater.	•	•	•	•
10. Protect City of Niagara Falls drinking water supply system from releases of hazardous waste constituents.			•	

TABLE 7.2

APPLICABLE STATE AND FEDERAL STANDARDS AND GUIDELINES

Activity	*FEDERAL SCGs* Title	Subtitle	Citation	*NEW YORK STATE SCGs* Title	Subtitle	Citation
Container Storage	Standards for owners and operators of hazardous waste treatment, storage and disposal facilities	Condition of containers	40 CFR 264.171	Hazardous waste treatment, storage and disposal facility permitting requirements	--	6 NYCRR Subpart 373-1
		Compatibility of waste with containers	40 CFR 264.172			
		Management of containers	40 CFR 264.173			
		Inspections	40 CFR 264.174			
		Containment	40 CFR 264.175			
Discharge of Treatment System Effluent	Administered permit programs: The national pollutant discharge elimination system	Establishing limitations, standards and other permit conditions	40 CFR 122.44 and State regulations approved under 40 CFR 131	Implementation of NPDES program in New York State	--	6 NYCRR Part 750-757
				Technical and Operations Guidance Series	--	--
				Blending policy for use of sources of drinking water	--	NYSDOH PWS 68
	Criteria and standards for the national pollutant discharge elimination program	Best management practices	40 CFR 125.100	Drinking water supplies	--	Part 5 of State Sanitary Code
		Discharge to waters of the U.S.	40 CFR 125.104	Use and protection of waters	--	6 NYCRR Part 608
	Guidelines establishing test procedures for the analysis of pollutants	Identification of test procedures and alternate test procedures	40 CFR 136.1-4			
	Effluent guidelines and standards	Organic chemicals plastics and synthetic fibres	40 CFR Part 414			
Excavation	Land disposal restrictions (also see Closure)	Treatment standards	40 CFR 268 (Subpart D)	Hazardous waste treatment, storage and disposal facility permitting requirements	--	6 NYCRR Subpart 373-1
Incineration Off Site	Standards for owners and operators of hazardous waste treatment, storage and disposal facilities	Waste analysis	40 CFR 264.341			
Placement of Waste in Land Disposal Unit	Land disposal restrictions	Treatment standards	40 CFR 268 (Subpart D)	Hazardous waste treatment, storage and disposal facility permitting requirements	--	6 NYCRR Subpart 373-1
Surface Water Control	Standards for owners and operators of hazardous waste treatment, storage and disposal facilities	Design and operating requirements for waste piles	40 CFR 264.251(c),(d)	Hazardous waste treatment, storage and disposal facility permitting requirements	--	6 NYCRR Subpart 373-1 6 NYCRR Part 701 and Part 703
		Design and operating requirements for land treatment	40 CFR 264.273(c),(d)			
		Design and operating requirements for landfills	40 CFR 264.301(c),(d)			
Treatment (in a unit)	Standards for owners and operators of hazardous waste treatment, storage and disposal facilities	Design and operating requirements for waste piles	40 CFR 264.251	Hazardous waste treatment, storage and disposal facility permitting requirements	--	6 NYCRR Subpart 373-1
		Design and operating requirements for thermal treatment units	40 CFR 265.373	Interim status standards for owners and operators of hazardous waste facilities	--	6 NYCRR Subpart 373-3
		Design and operating requirements for miscellaneous treatment units	40 CFR 264.601	New York air pollution control regulations	General provisions	6 NYCRR Part 200
					Permits and certificates	6 NYCRR Part 201
					General prohibitions	6 NYCRR Part 211
					General process emission sources	6 NYCRR Part 212

TABLE 7.2

APPLICABLE STATE AND FEDERAL STANDARDS AND GUIDELINES

Activity	*FEDERAL SCGs*			*NEW YORK STATE SCGs*		
	Title	*Subtitle*	*Citation*	*Title*	*Subtitle*	*Citation*
Treatment (when waste will be land disposed)	Land disposal restrictions	Identification of waste Treatment Standards Waste Specific prohibitions - Solvent wastes	40 CFR 268.10-12 40 CFR 268 (Subpart D) 40 CFR 268.30 RCRA Sections 3004 (d) (3), (e) (3) 42 USC 6924 (d) (3), (e) (3)	Hazardous waste treatment, storage and disposal facility permitting requirements Interim status standards for owners and operators of hazardous waste facilities	-- --	6 NYCRR Subpart 373-1 6 NYCRR Subpart 373-3
Waste Pile	Standards for owners and operators of hazardous waste treatment, storage and disposal facilities	Design and operating requirements	40 CFR 264.251	New York air pollution control regulations	General provisions Permits and certificates General prohibitions General process emission sources	6 NYCRR Part 200 6 NYCRR Part 201 6 NYCRR Part 211 6 NYCRR Part 212
				Hazardous waste treatment, storage and disposal facility permitting requirements Interim status standards for owners and operators of hazardous waste facilities	-- --	6 NYCRR Subpart 373-1 6 NYCRR Subpart 373-3
Closure with Waste in Place	Standards for owners and operators of hazardous waste treatment, storage and disposal facilities	Closure and post-closure care Post-closure care and groundwater monitoring	40 CFR 264.258 40 CFR 264.310			
Transporting Hazardous Waste Off Site	Standards applicable to transporters of hazardous waste	--	40 CFR 263	Waste transport permits Hazardous waste manifest system and related standards for generators, transporters and facilities	-- --	5 NYCRR Part 364 6 NYCRR Part 372
Air Releases through Remedial Processes	Clean Air Act	National Primary and Secondary Ambient Air Quality Standards National Emissions Standards for Hazardous Air Pollutants	40 CFR 53 to 60			

TABLE 10.1

COMPLIANCE SCHEDULE FOR MONITORING AND REPORTING ACTIVITIES
CORRECTIVE ACTION PROGRAM
NIAGARA PLANT

Monitoring Event	***Required Frequency (1)***
Bedrock Groundwater Corrective Measures	
- Flow Monitoring	Weekly
- Hydraulic Monitoring	Monthly
- Chemical Monitoring	Semi-annual
Overburden Groundwater Corrective Measures	
- Flow Monitoring	Weekly
- Hydraulic Monitoring	Monthly
- Chemical Monitoring	Semi-annual
NAPL Monitoring and Collection	
- Outfall 003 Collection Trench and OW313	Monthly
- OW402A and OW413A	Semi-annual
- OW417A	Annual
- A-Well and OW270 NAPL checks	Annual
- Plant NAPL sumps	Annual
- Energy Boulevard Drain Tile System	Monthly
- Flow Zone 1 - MHA, MHB, MHC, MHD, MHE, OW572 (2)	Monthly
Reporting Event	
Bedrock Groundwater Corrective Measures	
- Performance Report	Quarterly
- Performance Evaluation	Semi-annual
Overburden Groundwater Corrective Measures	
- Performance Report	Quarterly
- Performance Evaluation	Semi-annual
NAPL Monitoring and Collection	
- Monitoring and Collection Report	Annual

Notes:
(1) Current required monitoring frequency. Monitoring frequency is subject to change based on periodic performance reviews.
(2) Activity will commence in November 1998.

TABLE 10.2

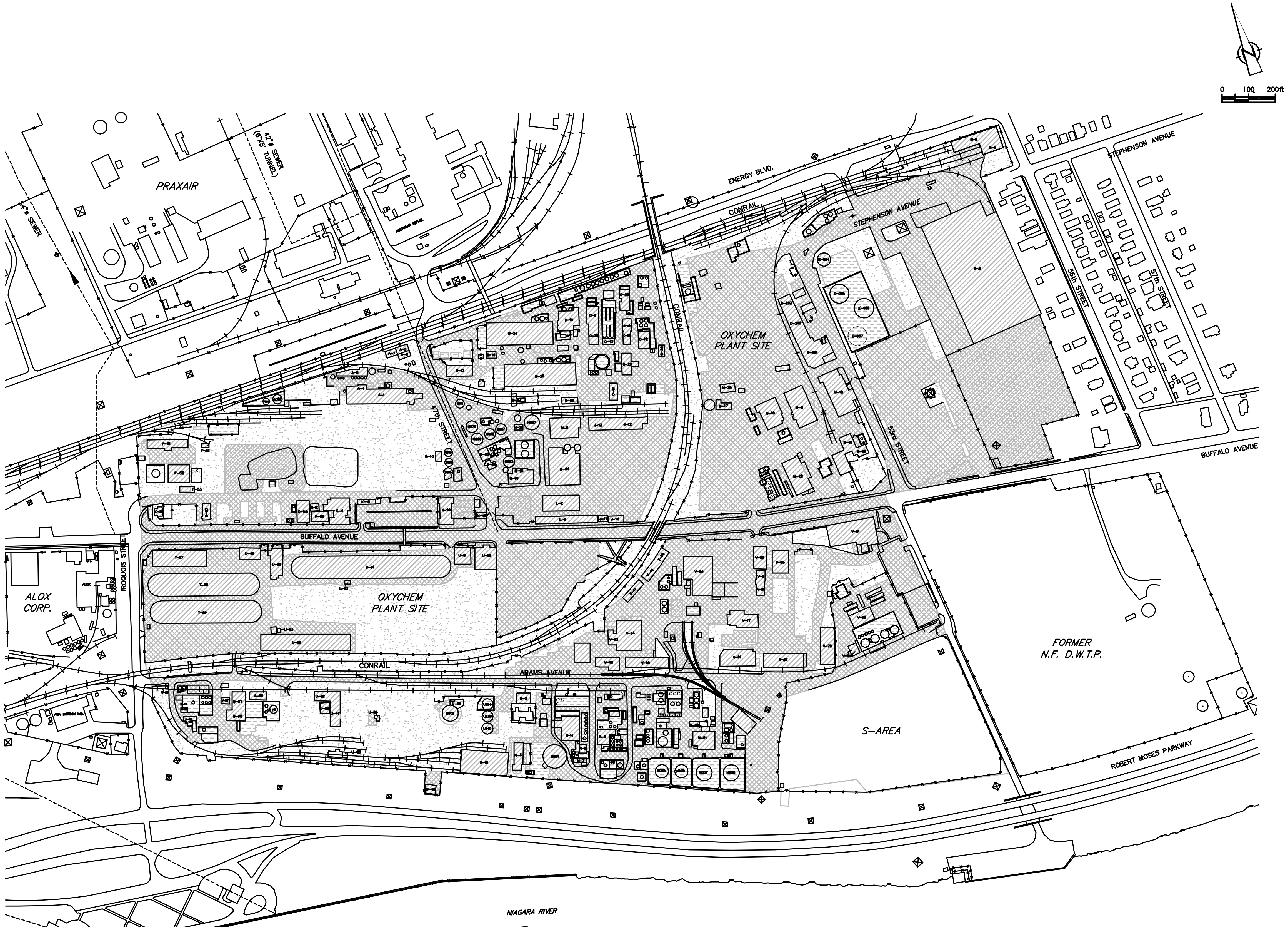
BEDROCK GROUNDWATER CHEMICAL MONITORING PARAMETERS

Analytes	*Units*	*Method Detection Level*
Toluene	µg/L	1
2-Chlorotoluene	µg/L	1
4-Chlorotoluene	µg/L	1
2,4/2,5-Dichlorotoluene	µg/L	1
2,6-Dichlorotoluene	µg/L	1
2,3/3,4-Dichlorotoluene	µg/L	1
2,3,6-Trichlorotoluene	µg/L	1
2,4,5-Trichlorotoluene	µg/L	1
Chlorobenzene	µg/L	1
1,2-Dichlorobenzene	µg/L	1
1,3-Dichlorobenzene	µg/L	1
1,4-Dichlorobenzene	µg/L	1
1,2,3-Trichlorobenzene	µg/L	1
1,2,4-Trichlorobenzene	µg/L	1
1,2,3,4-Tetrachlorobenzene	µg/L	1
1,2,4,5-Tetrachlorobenzene	µg/L	1
Hexachlorobenzene	µg/L	1
Trichloroethylene	µg/L	1
Tetrachloroethylene	µg/L	1
2-Chlorobenzotrifluoride	µg/L	1
4-Chlorobenzotrifluoride	µg/L	1
2,4-Dichlorobenzotrifluoride	µg/L	1
3,4-Dichlorobenzotriflouride	µg/L	1
Hexachlorobutadiene	µg/L	1
Hexachlorocyclopentadiene	µg/L	1
Octachlorocyclopentene	µg/L	1
Perchloropentacyclodecane (Mirex)	µg/L	1
2,4,5-Trichlorophenol	µg/L	10
a-Hexachlorocyclohexane	µg/L	1
b-Hexachlorocyclohexane	µg/L	1
g-Hexachlorocyclohexane	µg/L	1
d-Hexachlorocyclohexane	µg/L	1

TABLE 10.3

OVERBURDEN GROUNDWATER
CHEMICAL MONITORING PARAMETERS

Analytes	*Units*	*Method Detection Level*
Toluene	µg/L	1
2-Chlorotoluene	µg/L	1
4-Chlorotoluene	µg/L	1
2,4/2,5-Dichlorotoluene	µg/L	1
Benzene	µg/L	1
Chlorobenzene	µg/L	1
1,2-Dichlorobenzene	µg/L	1
1,3-Dichlorobenzene	µg/L	1
1,4-Dichlorobenzene	µg/L	1
1,2,4-Trichlorobenzene	µg/L	1
1,2,3,4-Tetrachlorobenzene	µg/L	1
1,2,4,5-Tetrachlorobenzene	µg/L	1
Trichloroethylene	µg/L	1
Tetrachloroethylene	µg/L	1
2-Chlorobenzotrifluoride	µg/L	1
4-Chlorobenzotrifluoride	µg/L	1
3,4-Dichlorobenzotrifluoride	µg/L	1
2,4,5-Trichlorophenol	µg/L	10
a-Hexachlorocyclohexane	µg/L	1



SYMBOL	SURFACE TYPE	AREA (Acres)	AREA (Sq. Ft.)	% OF TOTAL
	IMPOUNDMENT	7.9	345,300	6.2%
	GRASS	8.2	360,000	6.6%
	HARD SURFACE (Concrete/Asphalt)	54.1	2,357,705	42.7%
	GRAVEL	38.5	1,675,054	30.4%
	ROOF	17.8	775,082	14.1%
	TOTAL	126.6	5,513,141	100%

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

OCCIDENTAL CHEMICAL CORPORATION BUFFALO AVENUE PLANT

CORRECTIVE MEASURES STUDY

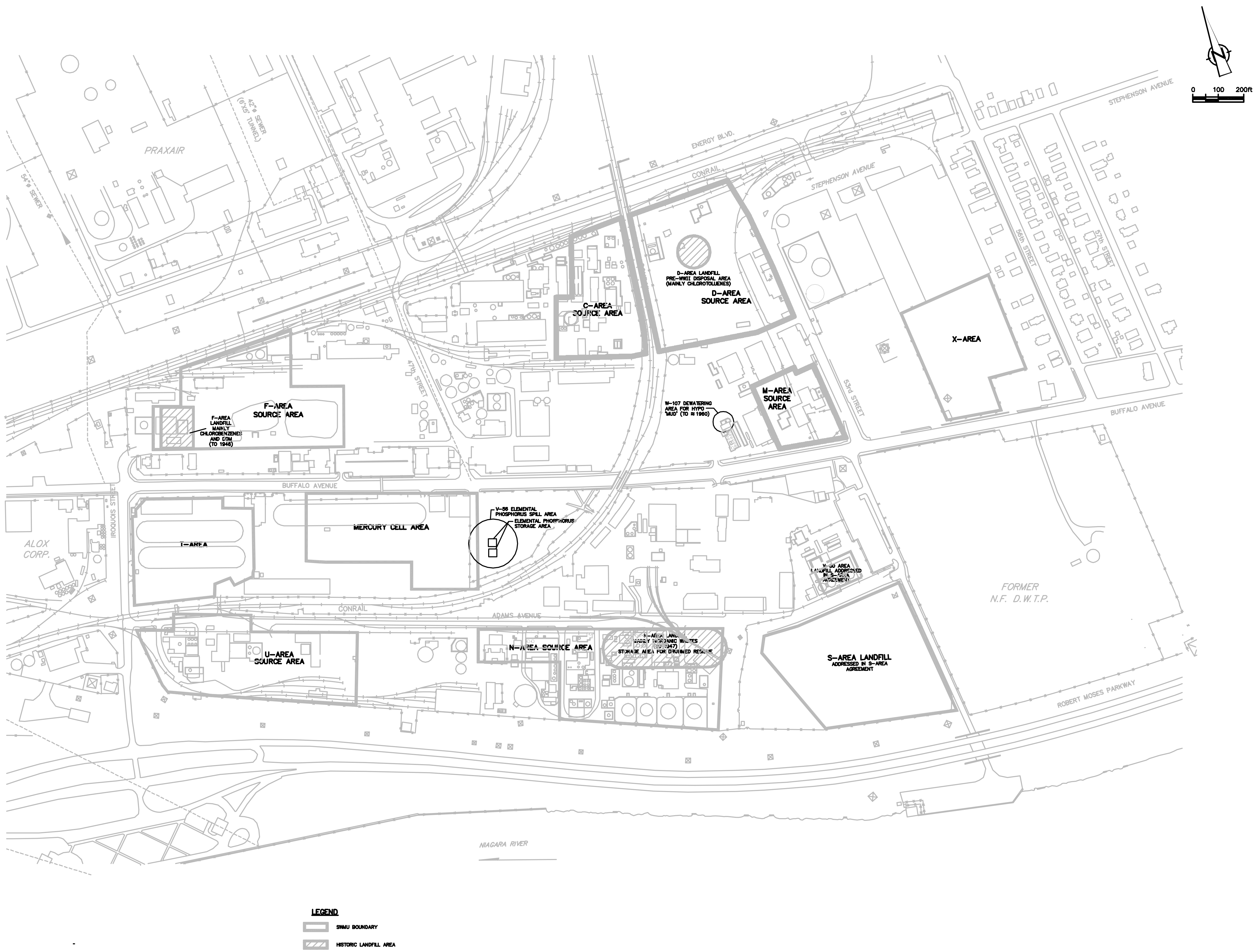
PLANT SURFACE CHARACTERISTICS

CRA CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
JWP	JWP	MAY 21, 1998	
Scale: 1" = 200'	Project Nº: 02583-00	Report Nº: 191	Drawing Nº: 1

02583-00(191)GN-WA032 JUN 08/2000



Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

OCCIDENTAL CHEMICAL CORPORATION BUFFALO AVENUE PLANT

CORRECTIVE MEASURES STUDY

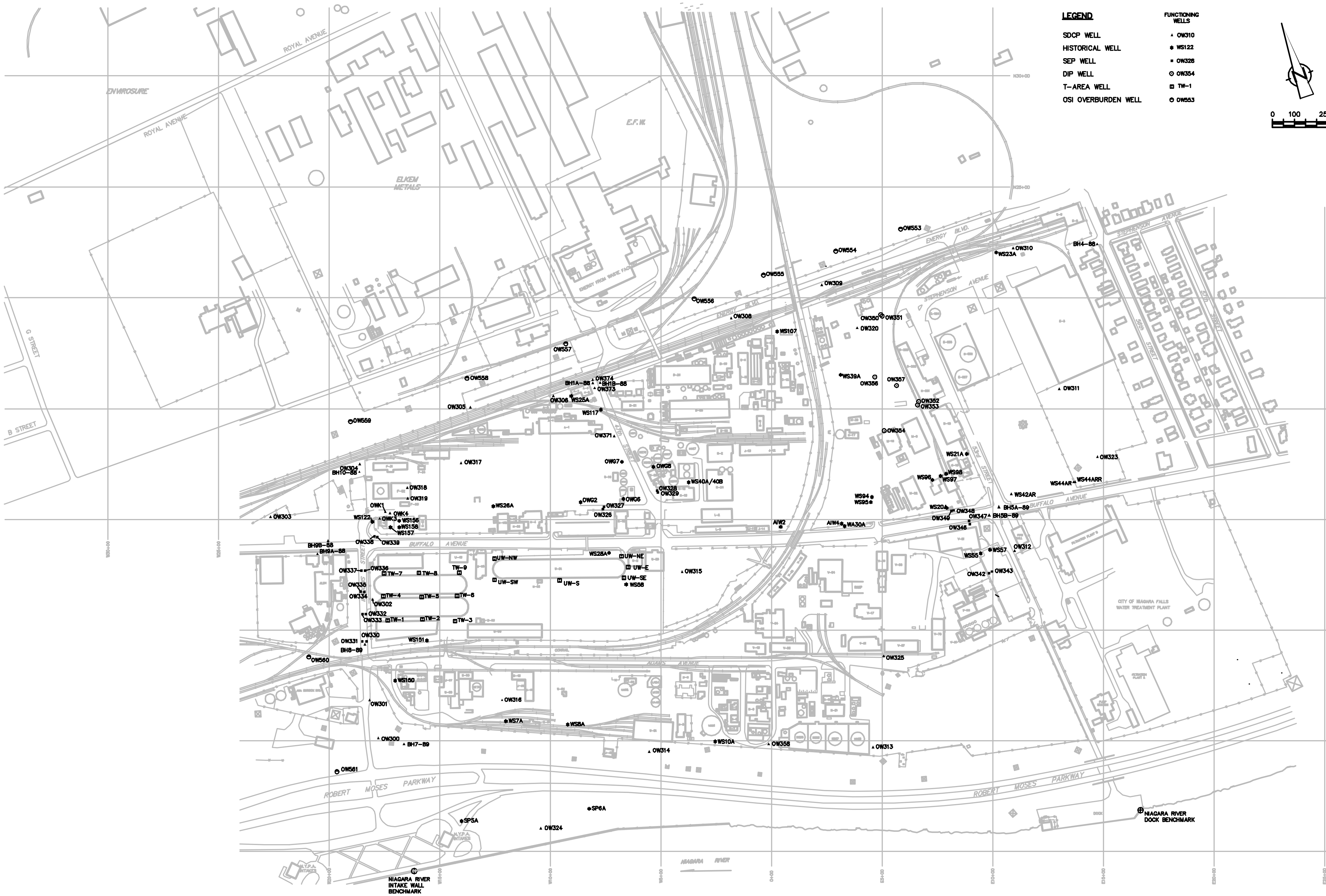
SOLID WASTE MANAGEMENT UNITS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager: JWP	Reviewed By: JWP	Date: MAY 21, 1998	
Scale: 1" = 200'	Project Nº: 02583-00	Report Nº: 191	Drawing Nº: 2

02583-00(191)GN-WA033 MAY 11/1999



Nº	Revision	Date	Initial

SCALE VERIFICATION

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Approved

DRAWING STATUS

Status	Date	Initial

OCCIDENTAL CHEMICAL CORPORATION BUFFALO AVENUE PLANT

CORRECTIVE MEASURES STUDY

ACTIVE OVERBURDEN WELL LOCATIONS

CRA CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
JWP	JWP	MAY 21, 1998	
Scale:	Project Nº:	Report Nº:	Drawing Nº:
1=250	02583-00	191	3

02583-00(191)GN-WA031 MAY 11/99

APPENDIX A

CITY OF NIAGARA FALLS SANITARY SEWER DISCHARGE PERMIT

CITY OF NIAGARA FALLS

DEPARTMENT OF WASTEWATER FACILITIES

SIGNIFICANT INDUSTRIAL USER

WASTEWATER DISCHARGE PERMIT

PERMIT NO. 22 Occidental Chemical Corporation

In accordance with all terms and conditions of Chapter 250 of the City of Niagara Falls Municipal Code; Sewer Use Ordinance, as adopted by City Council on July 25, 1983; et seq. and also with all applicable provisions of Federal and State Law or regulation:

Permission is Hereby Granted To: Occidental Chemical Corporation

Located at: Buffalo Avenue & 47th Street, P.O. Box 344, Niagara Falls, NY 14301-0344

Classified by SIC No(s): 2812, 2819, 2842, 2865, 2869

For the contribution of wastewater into the City of Niagara Falls Publicity-Owned Treatment Works (POTW).

Effective this 3rd day of October, 1995

To Expire this 3rd day of October, 2000

This permit modified 9/9/97, 8/5/98, 8/26/98

Albert C Zaeppel for

William G. Bolents, Jr.
Acting Director of Wastewater Facilities

Signed this 25th day of August 1998

DISCHARGE IDENTIFICATION

OUTFALL	DESCRIPTION	LOCATION	RECEIVING
MS # 1	Monitoring Station No. 1	47th Street near Energy Blvd.	Plant process and sanitary from Areas A, B and C (See map)
MS # 2	Monitoring Station No. 2	Iroquois Street near Buffalo	Plant process and sanitary from Areas D through V. (See map). Also includes LaSalle area domestic Wastewater
MS # 4 *	Monitoring Site No. 4 C - 32 Neutralization Sump	Manhole No. 83 discharging to MS # 1	Water syphons and caustic scrubber
MS # 5 *	Monitoring Site No. 5 C - 41 Drum Station scrubber	Manhole No. 91 A discharging to MS # 1	Air duct water scrubber
MS # 6 *	Monitoring Site No. 6 V - 70 alkyl acid Phosphate Building	Manhole No. 696 discharging to MS # 2	Process area wash downs
MS # 7 *	Monitoring Site No. 7 M - 22 limestone box	Manhole No. 428 discharging to MS # 2	Steam syphon condensate
MS # 8 *	Monitoring Site No. 8 N - 13 South Building	Manhole No. 767 discharging to MS # 2	Acid and wastewater Neutralization

NOTE: * OCPSF Wastestream, MS #1 and MS #2 contain these wastewaters.

Effective 9/9/97, MS # 3 deleted. This monitoring site will be reissued under a separate permit.

WASTEWATER DISCHARGE PERMIT REQUIREMENTS FOR:		ACTION REQUIRED	REQUIRED DATE OF SUBMISSION
A.	Discharges to the City Sewer		
1.	Identification of all discharges to the City Sewer System on a current plant sewer map certified by a New York State licensed professional engineer.	None	Submission Received June 29, 1995
2.	Identification of each contributing waste stream to each discharge to the City Sewer System clearly marked on, or referenced to, a current plant sewer map certified by a New York State licensed professional engineer.	None	Submission Received June 29, 1995
3.	Elimination of all uncontaminated discharges to the City Sewer System. All uncontaminated flows should be clearly identified on a current sewer map certified by a New York State licensed professional engineer.	None	
4.	Establishment of a control manhole that is continuously and immediately accessible for each discharge to the City Sewer System.	None	Previously Received
B.	Wastewater Discharge Management Practices		
1.	Identification of a responsible person(s) (day to day and in emergencies).	None	
C.	Slug Control Plan**		
1.	Pursuant to Section 40 CFR 403.12 (v) of the Federal Pretreatment Standards the City will evaluate the permittee, a minimum	None	Performed By City

WASTEWATER DISCHARGE PERMIT REQUIREMENTS FOR:	ACTION REQUIRED	REQUIRED DATE OF SUBMISSION
of once every two years for the need for a "Slug Control Plan." If a plan is required by the City then the plan will contain, at a minimum, the following elements: a) Description of discharge practices, including non-routine batch discharges; b) Description of stored chemicals; c) Procedures for immediately notifying the POTW of slug discharges, including any discharge that would violate a prohibition under 40 CFR 403.5 (b), with procedures for follow-up written notification within five days; d) If necessary, procedures to prevent adverse impact from accidental spills, including inspection and maintenance of storage areas, handling and transfer of materials, loading and unloading operations, control of plant site runoff, worker training, building of containment structures or equipment, measures for containing toxic organic pollutants (including solvents), and/or measures and equipment necessary for emergency response.		
2. A written commitment from a responsible party of manpower, equipment and materials required to expeditiously control and remove any harmful quantity discharged.	None	

** This section applies to all compounds limited by the City's SPDES Permit and all prohibited wastewater discharges (See Section 250.5.1-A of the Sewer Use Ordinance)

D. General Wastewater Discharge Permit Conditions

1. Flow monitoring should be performed concurrently with any Wastewater Discharge Permit sampling and should be reported at the same time as analytical results. If it is not feasible to perform flow monitoring, an estimate of flow (method of estimated flow preapproved by the City) should be submitted with the analytical results.

2. All sampling for billing and pretreatment compliance purposes will be coordinated through the City's Industrial Monitoring Coordinator.

3. All analysis must be performed by a State certified laboratory using analytical methods consistent with 40 CFR 136 and quality control provisions as required by the City's Environmental Chemist. The permittee will report the results as directed in Section G of this permit. Results should be reported using the Method Detection Limit (MDL). Reporting results less than MDL will be indicated in the report by a less than sign (<) followed by the numeric MDL concentration reported by the laboratory. In these cases the pollutant load will be calculated and reported as zero (0). The MDL will be defined as the level at which the analytical procedure referenced is capable of determining with a 99% probability that the substance is present. The value is determined in reagent water. The precision at this level is +/- 100%.

4. An estimate of relative production levels for wastewater contributing processes at the time of any pretreatment compliance sampling will be submitted upon request of the Director of Wastewater Facilities.

5. All samples will be handled in accordance with EPA approved methods. Chain of Custody records will be submitted with all sampling results.

6. All conditions, standards and numeric limitations of Section 250 of the Sewer Use Ordinance are hereby incorporated into this permit by reference. These conditions, standards and numeric limitations must be complied with. Failure to comply with any part of said ordinances constitutes a violation and is subject to enforcement actions(s) described in Section 250.9 of said ordinances, and in the City of Niagara Falls's Pretreatment Administrative Procedure Number Five (5) - "Enforcement Response Guide." Violators are subject to all applicable Civil and Criminal penalties. In the event of a violation, including slug discharges or spills, the City of Niagara Falls must be notified immediately by phone and confirmed by letter within five (5) working days.

   Any person adjudicated of violating any provision in the Sewer Use Ordinance shall be assessed a fine in the amount of up to $5,000. This amount is available for each violation, and each day of a violation is a separate incident for which penalties may be sought.

6. The person violating any of the provisions of the Sewer Use Ordinance will be liable to the City for any expense, loss, or damage occasioned by the City by reason of such violation. The expense, loss or damage will be taken to be to the extent determined by the Director.

   In addition, any person who knowingly makes any false statements; representation or certification in any application, record, report, plan or other document filed or required to be maintained pursuant to the Sewer Use Ordinance, or Wastewater Discharge Permit, or who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required under the Sewer Use Ordinance will, upon conviction be punished by a fine up to $5,000. Furthermore, the City of Niagara Falls may recover reasonable attorney's fees, court costs, court reporting fees, and other expenses of litigation by appropriate suit at law against the person found to have violated applicable laws, orders, rules and permits required by the Sewer Use Ordinance.

7. In accordance with Federal Regulation CFR 40, Part 403.12(g), any exceedance of a numeric limitation noted by the SIU must be re-sampled, analyzed and resubmitted to the City's Wastewater Facilities (WWF) within 30 days.

   NEW

   Specifically, if any limit that is *listed* in Section F of this permit is exceeded, then the permittee will undertake a short term monitoring program for that pollutant. Samples will be collected identical to those required for routine monitoring purposes and will be collected on each of at least *two (2)* operating days and analyzed. Results will be reported in both concentration and mass, and will be submitted within 30 days of becoming aware of the exceedance.

8. Sampling frequency for any permitted compounds may be increased beyond the requirements set forth in Section F and G of this permit. If the permittee monitors (sample and analysis) more frequent than required under this permit, **all** results of this monitoring must be reported.

9. As noted in Section 250.6.2 of the Sewer Use Ordinance, "Personnel as designated by the Director will be permitted at any time for reasonable cause to enter upon all properties served by the City WWF for the purpose of, and to carry out, inspection of the premises, observation, measurement, sampling and testing, in accordance with provisions of the Ordinance."

10. As noted in Section 250.5.3 of the Sewer Use Ordinance, significant changes in discharge characteristics or volume must be reported immediately to the WWF.

11. As noted in Section 250.5.4 of the Sewer Use Ordinance, samples required to be collected via a 24-hour composite sampler must be retained refrigerated for an additional 24 hour plus unrefrigerated an additional 48 hours (total 72 hours).

12. As noted in Section 250.5.4 of the Sewer Use Ordinance, all "SIU's will keep on file for a minimum of five years, all records, flow charts, laboratory calculations or any other pertinent data on their discharge to the WWF."

13. As noted in Section 250.6.8 of the Sewer Use Ordinance, "Permits are issued to a specific user for a specific monitoring station. A permit will not be reassigned or transferred without the approval of the Director which approval will not be unreasonably withheld. Any succeeding owner or user to which a permit has been transferred and approved will also comply with all the terms and conditions of the existing permit."

14. The Annual Average Limitation is equivalent to the specific SIU allocation, and will be defined as the permissible long term average discharge of a particular pollutant. These limitations are listed in Section F of this permit. The computation of the Annual Average will be as follows; for each compound listed in Section G of this permit, the Annual Average will be the average of the present monitoring quarter and three previous quarters' data.

15. The Daily Maximum Limitation will be defined as the maximum allowable discharge on anyone day. The Daily Maximum Limitation will allow for periodic short term discharge fluctuations. These specific limitations are listed in Section F of this permit.

16. Enforcement of the Annual Average Limitation will be based on the reported average of the last four quarters data vs. the Annual Average Limited listed in Section F of this permit. Enforcement of the Daily Maximum Limitation will be based on individual analysis results vs. the Daily Maximum Limit listed in Section F of this permit. These results may be obtained from self monitoring (Section G), City Verification, incident investigation or billing samples.

17. The City's Administrative Procedure Number 6 "Procedure for Determination and Use of Local Limits" lists all pollutants noted in the City WWF SPDES Permit. The limits defined in the procedure are values which are based on the quantity of substances discharged which can be easily related to the Treatment Plant's removal capacity.

The pollutants listed in this procedure which are not specifically listed in Section F and G of this permit may be present in the permittee's wastewater discharge, but at levels which do not require specific permit limitations. Consequently, if any of the limits listed in this procedure, for pollutants not identified in Section F and G of this permit, are exceeded then the permittee will undertake a short-term, high intensity monitoring program for that pollutant. Samples identical to those required for routine monitoring purposes will be collected on each of at least three operating days and analyzed. Results will be expressed in terms of both concentration and mass, and will be submitted no later than the end of the third month following the month when the limit was first exceeded.

If levels higher than the limit are confirmed, the permit may be reopened by the City for consideration of revised permit limits.

E. Specific Wastewater Discharge Permit Conditions

1. Billing Agreement:

a) Determination of quantities of flow, TSS and SOC shall be made at the City's expense and shall be based on five representative 24 hour flow proportion composite samples collected from each monitoring station.

b) Occidental shall receive credit for domestic wastewater from the City's LaSalle residential district and the City's Water Facilities discharge which flows through MS # 2.

2. General Sampling:

Occidental will continue to collect a 72 hour composite sample from each monitoring station on weekends. The period covered will be Friday A.M. through Monday A.M.

3. U 67 Centralized Carbon Treatment Facility (CCTF)

The City agrees to accept wastewater processed through OCC's Carbon Treatment Facility. These waters in addition to plant process wastewater shall include leachate and other wastewaters from remedial sites at the Niagara Plant (Buffalo Avenue) and the 102nd Street remedial site. This approval is subject to the following conditions:

a) The CCTF shall be properly operated and maintained at all times.

E. Specific Wastewater Discharge Permit Conditions Continued

3. U 67 Centralized Carbon Treatment Facility (CCTF)

b) To ensure proper operation OCC shall ensure sufficient feed, interstage (breakthrough), and effluent analysis to ensure timely carbon changes. Treatment levels of 10 ug/L shall be achieved and verified with weekly composite sample analysis for the following compounds: trichloroethylene, tetrachloroethylene, monochlorotoluene, monochlorobenzenes, monochlorobenzotrifluorides and monthly composite sample analysis for: trichlorobenzenes, tetrachlorobenzenes, hexachlorobutadiene, octochlorocyclopentene, hexachlorocyclohexanes, hexachlorobenzene and hexachlorocyclopentadiene.

c) The issuance of this approval is based on Occidental's previous assertions that there is no reason to anticipate the presence of tetrachlorodibenzo-p-dioxins in the discharge from the treatment facility. The City hereby reserves the right to collect samples from the treatment facility effluent and analyze such wastewaters for their chemical constituents, including tetrachlorodibenzo-p-dioxins. If such analysis indicates the presence of tetrachlorodibenzo-p-dioxins, this approval may be withdrawn. If at anytime, the City determines on any basis that the discharge of these wastewaters to the POTW is interfering with the operation of that facility, the City will direct Occidental to discontinue the discharge.

d) These pretreated wastewaters shall be discharged to the POTW via MS # 2.

4. Federal Categorical Standards - Inorganic Chemicals

a) Occidental shall comply with Federal Categorical Pretreatment Standards, specifically Inorganic Chemical Standards 40 CFR, Part 415, Subpart F, Chloralkali - Diaphragm Cells.

b) Occidental is subject to Paragraph 415.64 of the standard which specifies Pretreatment Standards to Existing Sources (PSES) and delineates effluent limitations, either concentration or mass based.

c) To obtain the best assessment of the impact of Occidental's discharge on the POTW mass limitations shall be imposed. Paragraph 415.64 of the standard proposes the calculation of alternative mass limitations.

E. Specific Wastewater Discharge Permit Conditions Continued

4. Federal Categorical Standards - Inorganic Chemicals

d) Paragraph 425.61 of the standard requires these mass limits be based on product production. Furthermore, the standard defines "product" as chlorine.
Based on OCC's chlorine production (confidential) mass limits for copper, lead and nickel have been applied in Section F of this permit.

5. Federal Categorical Standards - Organic Chemicals

Organic Chemicals and Plastics and Synthetic Fibers Effluent Limitations (OCPSF)

a) Occidental shall comply with Federal Categorical Pretreatment Standards, specifically OCPSF Standards 40 CFR Part 414, Subpart H - Specialty Organics.

b) Occidental is subject to Paragraph 414.85 of the standard which specifies the Pretreatment Standards for Existing Sources (PSES) and delineates specific effluent standards.

c) For enforcement purposes, the limitations noted in Paragraph 414.85 of the standards shall be converted to mass limitations lbs/day using current representative process flow data. The mass limitations for those pollutants known to be present are listed in Section F of this permit.

d) The standard requires the development of PSES limits for those pollutants listed in Paragraph 414.85. However, since the majority of pollutants are not known to be or expected to be present in the regulated wastestreams, the PSES limits for those pollutants are not written into this permit. However, if any of these pollutants are shown to be present in significant quantities in subsequent monitoring then a mass based PSES limit shall be developed using current average process flow data.

F. Discharge Limitations & Monitoring Requirements

During the Period beginning the effective date of this Permit and lasting until the expiration date, discharge from the permitted facility outfall(s) will be limited and monitored by the permittee as specified below.

OUTFALL NUMBER/ EFFLUENT PARAMETER	DISCHARGE LIMITATIONS ANNUAL AVERAGE	DAILY MAX	UNITS	MINIMUM MONITORING REQUIREMENTS MEASUREMENT FREQUENCY	SAMPLE TYPE
MS # 1 + MS # 2 Flow	5.0	12.5	MGD	Continuous	N / A
MS # 1 + MS # 2 Total Suspended Solids	5,000	10,000	lbs/day	5/Quarter	7
MS # 1 + MS # 2 Soluble Organic Carbon	700	1,050	lbs/day	5/Quarter	7
MS # 1 + MS # 2 Carbon Tetrachloride	1.96	4.90	lbs/day	1/Quarter	2
MS # 1 + MS # 2 Chlorodibromethane	0.75	1.88	lbs/day	1/Quarter	2
MS # 1 + MS # 2 Dichlorobromomethane	0.66	1.65	lbs/day	1/Quarter	2
MS # 1 + MS # 2 Chloroform	1.68	4.20	lbs/day	1/Quarter	2
MS # 1 + MS # 2 Bromoform	1.74	4.35	lbs/day	1/Quarter	2
MS # 1 + MS # 2 Toluene	3.63	18.20	lbs/day	1/Quarter	2
MS # 1 + MS # 2 Tetrachloroethylene	3.76	6.0	lbs/day	1/Quarter	2
MS # 1 + MS # 2 Monochlorotoluenes	27.0	45.0	lbs/day	1/Quarter	2

F. <u>Discharge Limitations & Monitoring Requirements</u>

During the Period beginning the effective date of this Permit and lasting until the expiration date, discharge from the permitted facility outfall(s) will be limited and monitored by the permittee as specified below.

OUTFALL NUMBER/ EFFLUENT PARAMETER	DISCHARGE LIMITATIONS		UNITS	MINIMUM MONITORING REQUIREMENTS	
	ANNUAL AVG.	DAILY MAX.		MEASUREMENT FREQUENCY	SAMPLE TYPE
MS # 1 + MS # 2 Dichlorobenzenes	1.00	1.80	lbs/day	1/Quarter	3
MS # 1 + MS # 2 Dichlorotoluenes	5.0	7.0	lbs/day	1/Quarter	3
MS # 1 + MS # 2 Trichlorobenzenes	3.55	17.75	lbs/day	1/Quarter	3
MS # 1 + MS # 2 Trichlorotoluenes	1.97	5.0	lbs/day	1/Quarter	3
MS # 1 + MS # 2 Total Phenols	2.65	3.5	lbs/day	1/Quarter	3
MS # 1 + MS # 2 Tetrachlorobenzenes	1.55	3.96	lbs/day	1/Quarter	3
MS # 1 + MS # 2 Hexachlorobenzenes	0.042	1.0	lbs/day	1/Quarter	3
MS # 1 + MS # 2 Hexachlorocyclohexanes	0.19	1.0	lbs/day	1/Quarter	3
MS # 1 + MS # 2 Endosulfan I + Endosulfan II + Endosulfan Sulfate	0.42	1.0	lbs/day	1/Quarter	3
MS # 1 + MS # 2 Trichlorophenols	1.60	2.25	lbs/day	1/Quarter	3

F. <u>Discharge Limitations & Monitoring Requirements</u>

During the Period beginning the effective date of this Permit and lasting until the expiration date, discharge from the permitted facility outfall(s) will be limited and monitored by the permittee as specified below.

OUTFALL NUMBER/ EFFLUENT PARAMETER	DISCHARGE LIMITATIONS ANNUAL AVG.	DAILY MAX.	UNITS	MINIMUM MONITORING REQUIREMENTS MEASUREMENT FREQUENCY	SAMPLE TYPE
MS # 1 + MS #2 Total Residual Chlorine	600	1500	lbs/day	2/day *	Grab
MS # 1 + MS # 2 Total Cadmium	0.37	0.93	lbs/day	1/Quarter	3
MS # 1 + MS # 2 Total Zinc	30.00 new	55.0	lbs/day	1/Quarter	3
MS # 1 + MS # 2 Total Nickel	10.3	25.8	lbs/day	1/Quarter	3
MS # 1 + MS # 2 Total Chromium	2.48	6.20	lbs/day	1/Quarter	3
MS # 1 + MS # 2 Total Mercury	0.11	0.28	lbs/day	1/Quarter	3
MS # 1 Ethylbenzene	0.90	2.25	lbs/day	1/Quarter	2
MS # 1 Total Copper	19.67	49.18	lbs/day	1/Quarter	2
MS # 2 Benzene	0.95	2.38	lbs/day	1/Quarter	2
MS # 2 Chlorobenzene	1.07	3.30	lbs/day	1/Quarter	2

* Two (2) grab samples per day shall be collected at least four (4) hours apart, three (3) days per week and shall be analyzed and reported.

F. <u>Discharge Limitations & Monitoring Requirements</u>

During the Period beginning the effective date of this Permit and lasting until the expiration date, discharge from the permitted facility outfall(s) will be limited and monitored by the permittee as specified below.

OUTFALL NUMBER/ EFFLUENT PARAMETER	DISCHARGE LIMITATIONS ANNUAL AVG.	DISCHARGE LIMITATIONS DAILY MAX.	UNITS	MINIMUM MONITORING REQUIREMENTS MEASUREMENT FREQUENCY	MINIMUM MONITORING REQUIREMENTS SAMPLE TYPE
MS # 2 Trichloroethylene	0.53	2.08	lbs/day	1/Quarter	2
MS # 2 Monochlorobenzotrifluoride	7.81	19.52	lbs/day	1/Quarter	2
MS # 2 Hexachlorocyclopentadiene	0.42	1.0 New	lbs/day	1/Quarter	3
MS # 2 Dichlorobenzotrifluoride	0.56	5.0	lbs/day	1/Quarter	3
MS # 2 Dechlorane Plus	0.51	0.80	lbs/day	1/Quarter	3
MS # 2 PCB's	0.42	1.0 New	lbs/day	1/Quarter	3
MS # 2 Hexachlorobutadiene	0.34	1.0 New	lbs/day	1/Quarter	3
MS # 2 Mirex	0.42	1.0 New	lbs/day	1/Quarter	3
MS # 2 Vinyl Chloride	1.16	1.50	lbs/day	1/Quarter	2
MS # 2 1,1 – Dichloroethylene	1.00	3.37	lbs/day	1/Quarter	2
MS #2 Fluoranthene	0.42	1.0 New	lbs/day	1/Quarter	3

F. Discharge Limitations & Monitoring Requirements

During the Period beginning the effective date of this Permit and lasting until the expiration date, discharge from the permitted facility outfall(s) will be limited and monitored by the permittee as specified below.

OUTFALL NUMBER/ EFFLUENT PARAMETER	DISCHARGE ANNUAL AVG.	LIMITS DAILY MAX.	UNITS	MINIMUM MONITORING REQUIREMENTS MEASUREMT FREQUENCY	SAMPLE TYPE
MS # 2 Total Phosphorous	388	983	lbs/day	6/Quarter	3
MS # 2 Total Copper	12.88	33.12	lbs/day	1/Quarter	3
MS # 2 Total Lead	18.4	47.8	lbs/day	1/Quarter	3
MS # 2 Arsenic	MONITOR	MONITOR	lbs/day	1/Quarter	3
MS # 2 Beryllium	MONITOR	MONITOR	lbs/day	1/Quarter	3
MS # 4 Benzene	0.031	0.073	lbs/day	1/Quarter	2
MS # 4 Carbon Tetrachloride	0.077	0.206	lbs/day	1/Quarter	2
MS # 4 Chlorobenzene	0.077	0.206	lbs/day	1/Quarter	2
MS # 4 Methylene Chloride	0.02	0.092	lbs/day	1/Quarter	2
MS # 4 Chloroform	0.06	0.176	lbs/day	1/Quarter	2

F. Discharge Limitations & Monitoring Requirements

During the Period beginning the effective date of this Permit and lasting until the expiration date, discharge from the permitted facility outfall(s) will be limited and monitored by the permittee as specified below.

OUTFALL NUMBER/ EFFLUENT PARAMETER	DISCHARGE LIMITATIONS ANNUAL AVERAGE	DAILY MAXIMUM	UNITS	MINIMUM MONITORING REQUIREMENTS MEASUREMENT FREQUENCY	SAMPLE TYPE
MS # 4 Tetrachloroethylene	0.028	0.089	lbs/day	1/Quarter	2
MS # 4 Toluene	0.015	0.040	lbs/day	1/Quarter	2
MS # 4 Zinc	0.57	1.415	lbs/day	1/Quarter	2
MS # 4 All Other Parameters 40 CFR 414.85	MONITOR	MONITOR	lbs/day	2/Year	2
MS # 5 Methylene Chloride	0.002	0.009	lbs/day	1/Quarter	2
MS # 5 Zinc	0.053	0.131	lbs/day	1/Quarter	2
MS # 5 All Other Parameters 40 CFR 414.85	MONITOR	MONITOR	lbs/day	2/Year	2
MS # 6 Benzene	0.0001	0.0002	lbs/day	1/Quarter	2
MS # 6 Methylene Chloride	0.0002	0.0005	lbs/day	1/Quarter	2
MS # 6 Nitrobenzene	0.0037	0.0107	lbs/day	1/Quarter	2

F. Discharge Limitations & Monitoring Requirements

During the Period beginning the effective date of this Permit and lasting until the expiration date, discharge from the permitted facility outfall(s) will be limited and monitored by the permittee as specified below.

OUTFALL NUMBER/ EFFLUENT PARAMETER	DISCHARGE LIMITATIONS ANNUAL AVERAGE	DAILY MAXIMUM	UNITS	MINIMUM MONITORING REQUIREMENTS MEASUREMENT FREQUENCY	SAMPLE TYPE
MS # 6 Lead	0.0005	0.0012	lbs/day	1/Quarter	2
MS # 6 Zinc	0.0018	0.0044	lbs/day	1/Quarter	2
MS # 6 All Other Parameters 40 CFR 414.85	MONITOR	MONITOR	lbs/day	2/Year	2
MS # 7 Benzene	0.001	0.003	lbs/day	1/Quarter	2
MS # 7 Carbon Tetrachloride	0.004	0.010	lbs/day	1/Quarter	2
MS # 7 Chlorobenzene	0.004	0.010	lbs/day	1/Quarter	2
MS # 7 Chloroform	0.003	0.008	lbs/day	1/Quarter	2
MS # 7 Methylene Chloride	0.001	0.004	lbs/day	1/Quarter	2
MS # 7 Tetrachloroethylene	0.001	0.004	lbs/day	1/Quarter	2
MS # 7 1,2,4 Trichlorobenzene	0.005	0.020	lbs/day	1/Quarter	2

F. Discharge Limitations & Monitoring Requirements

During the Period beginning the effective date of this Permit and lasting until the expiration date, discharge from the permitted facility outfall(s) will be limited and monitored by the permittee as specified below.

OUTFALL NUMBER/ EFFLUENT PARAMETER	DISCHARGE LIMITATIONS ANNUAL AVERAGE	DAILY MAXIMUM	UNITS	MINIMUM MONITORING REQUIREMENTS MEASUREMENT FREQUENCY	SAMPLE TYPE
MS # 7 Zinc	0.026	0.065	lbs/day	1/Quarter	2
MS # 7 All Other Parameters 40 CFR 414.85	MONITOR	MONITOR	lbs/day	2/Year	2
MS # 8 Lead	0.053	0.115	lbs/day	1/Quarter	2
MS # 8 Zinc	0.18	0.44	lbs/day	1/Quarter	2
MS #8 All Other Parameters 40 CFR 414.85	MONITOR	MONITOR	lbs/day	2/Year	2

F. Discharge Limitations & Monitoring Requirements con't

SAMPLE TYPE FOOTNOTES

(1) The sample will consist of a laboratory composite of four grabs collected equally throughout the batch discharge period. A total of four samples (batches) will be analyzed and reported each quarter for each outfall.

(2) The sample will consist of a 24-hour laboratory composite of four grab samples, one taken each six hours, collected for each outfall.

(3) The sample will consist of a 24-hour flow proportion composite sample collected from each monitoring station.

(4) Flow will be monitored continuously via water meters.

(5) The sample will consist of a 24-hour time proportion composite sample from each approved discharge monitoring point.

(6) Determination of quantities will be derived from five (5) 24 hour time proportion composite samples collected from each approved monitoring point.

(7) Same as (3), however, five (5) samples will be collected per quarter from the monitoring station and analyzed by and at the City's expense.

G. Discharge Monitoring Reporting Requirements

During the period beginning the effective date of this permit and lasting until its expiration date, discharge monitoring results will be summarized and reported by the permittee; Monthly - 14 days after monitoring period, Quarterly - by the last day of the monitoring period – February 28, May 31, August 31, November 30. Semiannual reports will be submitted on the last day of the monitoring period – February 28, August 31. The annual average for each parameter listed in Section F, will be computed and reported quarterly. The individual sample analysis for present quarter will also be reported quarterly unless directed otherwise in this permit.

OUTFALL NO	PARAMETER	REPORTING FREQUENCY
MS # 1	Ethylbenzene	Quarterly
MS # 1	Total Copper	Quarterly
MS # 2	Vinyl Chloride	Quarterly
MS # 2	Fluoranthene	Quarterly
MS # 2	1,1 - Dichloroethylene	Quarterly
MS # 2	1,2 - Dichloroethylene	Quarterly
MS # 2	Benzene	Quarterly
MS # 2	Monochlorobenzene	Quarterly
MS # 2	Trichloroethylene	Quarterly
MS # 2	Monochlorobenzotrifluoride	Quarterly
MS # 2	Hexachlorocyclopentadiene	Quarterly
MS # 2	Dichlorobenzotrifluoride	Quarterly
MS # 2	Declorane Plus	Quarterly

G. Discharge Monitoring Reporting Requirements

During the period beginning the effective date of this permit and lasting until its expiration date, discharge monitoring results will be summarized and reported by the permittee; Monthly - 14 days after monitoring period, Quarterly - by the last day of the monitoring period - February 28, May 31, August 31, November 30. Semiannual reports will be submitted on the last day of the monitoring period - February 28, August 31. The annual average for each parameter listed in Section F, will be computed and reported quarterly. The individual sample analysis for present quarter will also be reported quarterly unless directed otherwise in this permit.

OUTFALL NO	PARAMETER	REPORTING FREQUENCY
MS #2	Hexachlorobutadiene	Quarterly
MS #2	Mirex	Quarterly
MS #2	Total Phosphorous	Monthly
MS # 2	Total Copper	Quarterly
MS # 2	Total Lead	Quarterly
MS # 2	PCB's	Quarterly
MS # 2	Arsenic	Quarterly
MS # 2	Beryllium	Quarterly
MS # 1 + MS # 2	Flow	Monthly (See Section E-7)
MS #1 + MS #2	Carbon Tetrachloride	Quarterly
MS #1 + MS #2	Chlorodibromomethane	Quarterly
MS #1 + MS #2	Dichlorobromomethane	Quarterly
MS #1 + MS #2	Chloroform	Quarterly

G. Discharge Monitoring Reporting Requirements

During the period beginning the effective date of this permit and lasting until its expiration date, discharge monitoring results will be summarized and reported by the permittee; Monthly - 14 days after monitoring period, Quarterly - by the last day of the monitoring period – February 28, May 31, August 31, November 30. Semiannual reports will be submitted on the last day of the monitoring period – February 28, August 31. The annual average for each parameter listed in Section F, will be computed and reported quarterly. The individual sample analysis for present quarter will also be reported quarterly unless directed otherwise in this permit.

OUTFALL NO	PARAMETER	REPORTING FREQUENCY
MS # 1 + MS # 2	Bromoform	Quarterly
MS # 1 + MS # 2	Tetrachloroethylene	Quarterly
MS # 1 + MS # 2	Toluene	Quarterly
MS # 1 + MS # 2	Monochlorotoluenes	Quarterly
MS # 1 + MS # 2	Dichlorobenzenes	Quarterly
MS # 1 + MS # 2	Dichlorotoluenes	Quarterly
MS # 1 + MS # 2	Trichlorobenzenes	Quarterly
MS # 1 + MS # 2	Trichlorotoluenes	Quarterly
MS # 1 + MS # 2	Tetrachlorobenzenes	Quarterly
MS # 1 + MS # 2	Hexachlorobenzenes	Quarterly
MS # 1 + MS # 2	Hexachlorocyclohexanes	Quarterly
MS # 1 + MS # 2	Endosufan I + Endosulfan II + Endosulfan Sulfate	Quarterly
MS # 1 + MS # 2	Chromium	Quarterly
MS # 1 + MS # 2	Mercury	Quarterly

G. Discharge Monitoring Reporting Requirements

During the period beginning the effective date of this permit and lasting until its expiration date, discharge monitoring results will be summarized and reported by the permittee; Monthly - 14 days after monitoring period, Quarterly - by the last day of the monitoring period – February 28, May 31, August 31, November 30. Semiannual reports will be submitted on the last day of the monitoring period – February 28, August 31. The annual average for each parameter listed in Section F, will be computed and reported quarterly. The individual sample analysis for present quarter will also be reported quarterly unless directed otherwise in this permit.

OUTFALL NO	PARAMETER	REPORTING FREQUENCY
MS # 1 + MS # 2	Trichlorophenols	Quarterly
MS # 1 + MS # 2	Total Phenols	Quarterly
MS # 1 + MS # 2	Total Residual Chlorine	Quarterly
MS # 1 + MS # 2	Total Cadmium	Quarterly
MS # 1 + MS # 2	Total Zinc	Quarterly
MS # 1 + MS # 2	Total Nickel	Quarterly
MS # 4	Benzene	Quarterly
MS # 4	Carbon Tetrachloride	Quarterly
MS # 4	Chlorobenzene	Quarterly
MS # 4	Chloroform	Quarterly
MS # 4	Methylene Chloride	Quarterly
MS # 4	Tetrachloroethylene	Quarterly
MS # 4	Toluene	Quarterly
MS # 4	Zinc	Quarterly
MS # 4	All Other Effluent Characteristics Listed in 40 CFR Part 414 Subpart H Paragraph 414.85	Semiannual

G. <u>Discharge Monitoring Reporting Requirements</u>

During the period beginning the effective date of this permit and lasting until its expiration date, discharge monitoring results will be summarized and reported by the permittee; Monthly - 14 days after monitoring period, Quarterly - by the last day of the monitoring period – February 28, May 31, August 31, November 30. Semiannual reports will be submitted on the last day of the monitoring period – February 28, August 31. The annual average for each parameter listed in Section F, will be computed and reported quarterly. The individual sample analysis for present quarter will also be reported quarterly unless directed otherwise in this permit.

OUTFALL NO	PARAMETER	REPORTING FREQUENCY
MS # 5	Methylene Chloride	Quarterly
MS # 5	Zinc	Quarterly
MS # 5	All Other Effluent Characteristics Listed in 40 CFR Part 414 Subpart H Paragraph 414.85	Semiannual
MS # 6	Benzene	Quarterly
MS # 6	Methylene Chloride	Quarterly
MS # 6	Nitrobenzene	Quarterly
MS # 6	Lead	Quarterly
MS # 6	Zinc	Quarterly
MS # 6	All Other Effluent Characteristics Listed in 40 CFR Part 414 Subpart H Paragraph 414.85	Semiannual
MS # 7	Benzene	Quarterly
MS # 7	Carbon Tetrachloride	Quarterly

G. Discharge Monitoring Reporting Requirements

During the period beginning the effective date of this permit and lasting until its expiration date, discharge monitoring results will be summarized and reported by the permittee; Monthly - 14 days after monitoring period, Quarterly - by the last day of the monitoring period – February 28, May 31, August 31, November 30. Semiannual reports will be submitted on the last day of the monitoring period – February 28, August 31. The annual average for each parameter listed in Section F, will be computed and reported quarterly. The individual sample analysis for present quarter will also be reported quarterly unless directed otherwise in this permit.

OUTFALL NO	PARAMETER	REPORTING FREQUENCY
MS # 7	Chlorobenzene	Quarterly
MS # 7	Chloroform	Quarterly
MS # 7	Methylene Chloride	Quarterly
MS # 7	Tetrachloroethylene	Quarterly
MS # 7	1,2,4 - Trichlorobenzene	Quarterly
MS # 7	Zinc	Quarterly
MS # 7	All Other Effluent Characteristics Listed in 40 CFR Part 414 Subpart H Paragraph 414.85	Semiannual
MS # 8	Lead	Quarterly
MS # 8	Zinc	Quarterly
MS # 8	All Other Effluent Characteristics Listed in 40 CFR Part 414 Subpart H Paragraph 414.85	Semiannual

H. Comments/Revisions

1. Effective September 9, 1997, Monitoring Station No. 3 eliminated. This monitoring location issued under new permit to Occidental/Glen Springs Holding Inc.

2. Effective August 5, 1998, Section D-6 modified in response to a recent EPA audit requiring this change to all SIU permits regarding civil and criminal penalties.

3. Effective August 5, 1998, the limits for Zinc at MS #1/MS #2 modified.

4. Effective August 26, 1998 all limits at MS #4 modified as a result of an increase in the average discharge volume.

APPENDIX B

SPDES PERMIT

91-20-2 (1/89)

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

State Pollutant Discharge Elimination System (SPDES)

DISCHARGE PERMIT

Special Conditions (Part I)

CONTROLLED DOCUMENT

OXY

NIAGARA PLANT

Industrial Code: 2869
Discharge Class (CL): 03
Toxic Class (TX): T
Major Drainage Basin: 01
Sub Drainage Basin: 01
Water Index Number: O-158
Compact Area: IJC

SPDES Number: NY-0003336
DEC Number: 9-2911-00112/00009-0
Effective Date (EDP): 01/01/96
Expiration Date (ExDP): 01/01/01
Modification Date(s): 11/15/95
Attachment(s): General Conditions (Part II) Date: 11/90

This SPDES permit is issued in compliance with Title 8 of Article 17 of the Environmental Conservation Law of New York State and in compliance with the Clean Water Act as amended, (33 U.S.C. Section 1251 et. seq.)(hereafter referred to as "the Act").

PERMITTEE NAME AND ADDRESS Attention: Marvin Spring

Name: Occidental Chemical Corporation
Street: P.O. Box 344
City: Niagara Falls State: NY Zip Code: 14302

is authorized to discharge from the facility described below:

FACILITY NAME AND ADDRESS

Name: Occidental Chemical Corporation
Location (C,T,V): Niagara Falls (C) County: Niagara
Facility Address: 47th Street at Buffalo Avenue
City: Niagara Falls State: NY Zip Code: 14302
NYTM - E: 171.1 NYTM - N: 4777.9
From Outfall No.: 001 at Latitude: 43° 04' 40" & Longitude: 79° 00' 50"
into receiving waters known as: Niagara River Class: A-S

and; (list other Outfalls, Receiving Waters & Water Classifications)

003 - to Niagara River
004 - to Niagara River, via Diversion Sewer
005 - to Niagara River
006 - to Niagara River, via Stephenson Avenue Storm Sewer
007 - to Niagara River

in accordance with the effluent limitations, monitoring requirements and other conditions set forth in Special Conditions (Part I) and General Conditions (Part II) of this permit.

DISCHARGE MONITORING REPORT (DMR) MAILING ADDRESS

Mailing Name: Occidental Chemical Corporation
Street: P.O. Box 344
City: Niagara Falls State: NY Zip Code: 14302
Responsible Official or Agent: Marvin Spring Phone: (716)278-7587

This permit and the authorization to discharge shall expire on midnight of the expiration date shown and the permittee shall not discharge after the expiration date unless this permit has been renewed, or extended pursuant to law. To be authorized to discharge beyond the expiration date, the permittee shall apply for a permit renewal no less than 180 days prior to the expiration date shown above.

Permit Administrator: Paul D. Eismann (Deputy)	
Address: 270 Michigan Ave., Buffalo, NY 14023-2999	
Signature: [signature]	Date: 11/15/95

DISTRIBUTION:
DRS File No. 9-2911-00112/00009-0
Mr. R. Swiniuch/Mr. D. Leemhuis
Mr. R. Hannaford - BWFD-TSS, Albany
EPA Region II; IJC
Mr. J. Devald - NCHD
Mr. T. Tseng - Environment Canada
Mr. R. Koblik - Ontario Ministry of the Environment

CONTROLLED DOCUMENT

91-20-2a (1/89)

SPDES No.: NY 000 3336

NIAGARA PLANT

Modification Date(s): 11/15/95

FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning January 1, 1996

and lasting until January 1, 2001

the discharges from the permitted facility shall be limited and monitored by the permittee as specified below:

Outfall Number & Effluent Parameter	(see Note 3) Discharge Limitations Daily Avg.	Daily Max.	Units	Minimum Monitoring Requirements Measurement Frequency	Sample Type
Outfall 001 - Non-Contact Cooling Water, Surface Runoff, and the Liquid Waste Incinerator Wet Scrubber Cooling Tower Blowdown					
Flow	Monitor	Monitor	MGD	Continuous	Meter
Temperature	Monitor	95	Deg.F	2 per Week	Instantaneous
pH (Range)	(6.0 to 9.0)		SU	2 per Week	Grab
TOC	Monitor	Monitor	mg/l	2 per Week	24-hr. Comp.
Chlorine Residual (Total)	0.500	Monitor	mg/l	Weekly	Grab
Outfall 002 - (Abandoned Outfall - No Discharge Permitted)					
Outfall 003 - Non-Contact Cooling Water, Steam Condensate, Surface Runoff, S-Area RRT APL Treatment System and N-Area Neutralization System Effluent (Outfall)					
Flow	Monitor	Monitor	MGD	Continuous	Meter
Temperature	Monitor	95	Deg.F	2 per Week	Instantaneous
pH (Range)	(6.0 to 9.5)		SU	Weekly	Grab
Mirex	Monitor	ND (2)	mg/l	Semiannual	24-hr. Comp.
TOC	Monitor	Monitor	mg/l	2 per Week	24-hr. Comp.
Antimony, Total	Monitor	5.0	lb/d	Monthly	24-hr. Comp.
Chlorine Residual (Total)	0.500	Monitor	mg/l	Weekly	Grab

91-20-2a (1/89)

OXY

NIAGARA PLANT

SPDES No.: NY 000 3336

Modification Date(s): 11/15/95

FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning January 1, 1996

and lasting until January 1, 2001

the discharges from the permitted facility shall be limited and monitored by the permittee as specified below:

Outfall Number & Effluent Parameter	Discharge Limitations Daily Avg.	Discharge Limitations Daily Max.	Units	Minimum Monitoring Requirements: Measurement Frequency	Minimum Monitoring Requirements: Sample Type
03R - S-Area RRT APL Treatment System Discharge					
Flow	Monitor	Monitor	MGD	Continuous	Meter
Benzene	Monitor	0.042	lb/d	2/month	24-hr. Comp.
Carbon Tetrachloride	Monitor	0.042	lb/d	2/month	24-hr. Comp.
Chlorobenzene	Monitor	0.042	lb/d	2/month	24-hr. Comp.
Chloroform	Monitor	0.042	lb/d	2/month	24-hr. Comp.
Tetrachloroethylene	Monitor	0.042	lb/d	2/month	24-hr. Comp.
Toluene	Monitor	0.042	lb/d	2/month	24-hr. Comp.
1,2-(trans)-Dichloroethylene	Monitor	0.042	lb/d	2/month	24-hr. Comp.
Trichloroethylene	Monitor	0.042	lb/d	2/month	24-hr. Comp.
Phenolics, Total	Monitor	0.168	lb/d	2/month	24-hr. Comp.
Pentachlorophenol	Monitor	0.084	lb/d	Monthly	24-hr. Comp.
Sum of Dichlorobenzenes	Monitor	0.13	lb/d	Monthly	24-hr. Comp.
Hexachlorobenzene	Monitor	0.042	lb/d	Monthly	24-hr. Comp.
Hexachlorobutadiene	Monitor	0.042	lb/d	Monthly	24-hr. Comp.
Sum of Trichlorobenzenes	Monitor	0.042	lb/d	2/month	24-hr. Comp.
Sum of Hexachlorocyclohexanes	Monitor	0.042	lb/d	Monthly	24-hr. Comp.
Sum of Tetrachlorobenzenes	Monitor	0.042	lb/d	2/month	24-hr. Comp.
Octachlorocyclopentene	Monitor	0.042	lb/d	Monthly	24-hr. Comp.
Monochlorotoluenes	Monitor	0.042	lb/d	Monthly	24-hr. Comp.
Monochlorobenzotrifluorides	Monitor	0.042	lb/d	Monthly	24-hr. Comp.
Sum of Chlorinated dibenzo-p-dioxins and Chlorinated dibenzo-p-furans	Monitor	3.37×10^{-5}	lb/d	Quarterly	24-hr. Comp.
Solids, Total Suspended	80	200	lb/d	2/month	24-hr. Comp.
Sum of Chlorobenzoic Acids	Monitor	Monitor	lb/d	Monthly	24-hr. Comp.

Note: Sacrificial Carbon Bed changeout shall occur when the discharge from the sacrificial bed exceeds 20 μg/l of Hexachlorobenzene on a monthly basis.

Note: The operations and maintenance manual for the S-Area RRT APL Treatment System shall be incorporated into the facility's Best Management Practices Plan.

91-20-2a (1/89)

NIAGARA PLANT

SPDES No.: NY 000 3336

Modification Date(s): 11/15/95

FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning January 1, 1996

and lasting until January 1, 2001

the discharges from the permitted facility shall be limited and monitored by the permittee as specified below:

Outfall Number & Effluent Parameter	(see Note 3) Discharge Limitations Daily Avg.	Daily Max.	Units	Minimum Monitoring Requirements Measurement Frequency	Sample Type
03S - N-Area Neutralization System Effluent (Phase II, Average Flow 0.174 MGD)					
Flow	Monitor	Monitor	MGD	Continuous	Meter
pH (Range)	(6.0 to 9.0)		SU	Continuous	Meter
Halogenated Toluenes (4)	Monitor	4.5	lb/d*	2 per month	24-hr. Comp.
Fluoride, Total	125	250	lb/d*	Weekly	24-hr. Comp.
Carbon Tetrachloride	0.2	0.6	lb/d*	2 per month	24-hr. Comp.
Chloroform	0.16	0.5	lb/d*	2 per month	24-hr. Comp.
Methylene Chloride	0.05	0.25	lb/d*	2 per month	24-hr. Comp.
Copper, Total	2.1	5.0	lb/d*	2 per month	24-hr. Comp.
Chromium, Total	1.6	4.0	lb/d*	2 per month	24-hr. Comp.
Lead, Total	0.5	1.0	lb/d*	2 per month	24-hr. Comp.
Nickel, Total	2.5	6.0	lb/d*	2 per month	24-hr. Comp.
Zinc, Total	1.5	4.0	lb/d*	2 per month	24-hr. Comp.
BOD, 5-day	65	174	lb/d*	2 per month	24-hr. Comp.
Solids, Total Suspended	83	266	lb/d*	2 per month	24-hr. Comp.

* The concentrations, in ppb, shall also be reported on monthly DMR's.

The discharge of treated process wastewater from the "Halogenated Toluene" Operations at outfall 03S, is governed by EPA Effluent guidelines for the Organic Chemicals, Plastics, and Synthetic Fibers Category, promulgated at 52 FR 42522 through 42584, as 40 CFR section 414.80, Subpart H - Specialty Organic Chemicals. The pollutant parameters which are reported present in outfall 03S and regulated by these OCPSF guidelines, are limited above using a process flow of 0.174 MGD. Item 1(b) of Part II - General Conditions prohibits the discharge of those pollutants not authorized above, and, therefore, are more stringent than the BAT effluent limits promulgated by EPA. If any of these pollutants were present in Outfall 03S, a BAT limit would be developed using a process flow of 0.174 MGD.

Allowable pH excursions under continuous monitoring:

Where the pH is continuously recorded, the permittee shall be allowed excursions from the designated allowable pH Range, subject to the following conditions:

(1) The total time which pH values of each discharge are outside the required range shall not exceed 7 hours and 26 minutes in any calendar month, and

(2) no individual excursion shall exceed 60 minutes in duration.

CONTROLLED DOCUMENT

91-20-2a (1/89)

OXY

NIAGARA PLANT

SPDES No.: NY 000 3336

Modification Date(s): 11/15/95

FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning January 1, 1996

and lasting until January 1, 2001

the discharges from the permitted facility shall be limited and monitored by the permittee as specified below:

Outfall Number & Effluent Parameter	(see Note 3) Discharge Limitations Daily Avg.	Daily Max.	Units	Minimum Monitoring Requirements Measurement Frequency	Sample Type
Outfall - 004 - Non-Contact Cooling Water, Steam Condensate					
Flow	Monitor	Monitor	MGD	Continuous	Meter
Temperature	Monitor	95	Deg.F	2 per Week	Instantaneous
pH (Range)	(6.0 to 9.0)		SU	2 per Week	Grab
TOC	Monitor	Monitor	mg/l	2 per Week	24-hr. Comp.
Chlorine Residual (Total)	0.500	Monitor	mg/l	Weekly	Grab
Outfall 005 - Non-Contact Cooling Water and Storm Water					
Flow	Monitor	Monitor	MGD	Continuous	Meter
Temperature	Monitor	95	Deg.F	Weekly	Instantaneous
pH (Range)	(6.0 to 9.0)		SU	Weekly	Grab
Chlorendic Acid	Monitor	7.5	lb/d	Monthly	24-hr. Comp.
TOC	Monitor	Monitor	mg/l	2 per Week	24-hr. Comp.
Chlorine Residual (Total)	0.500	Monitor	mg/l	Weekly	Grab
Outfall 006 - Storm Water					
Flow	Monitor	Monitor	gpd	Monthly	Calculated
Oil & Grease	Monitor	15	mg/l	Monthly	Grab

Energy Boulevard Storm Drain Monitoring

The permittee shall take monthly, an eight-hour composite sample at the point of discharge of the Energy Boulevard Storm Drain into the City Diversion Sewer which shall be analyzed for all those pollutant parameters listed in footnote 1 of the "Effluent Limitations and Monitoring Requirements" of this permit (these are the same thirteen parameters included in the "Sum of Parameters (1)"). The permittee shall also collect, on an annual basis, an eight-hour composite sample at the point of discharge of the Energy Boulevard Storm Drain into the City Diversion Sewer, which shall be analyzed for all Volatile Priority Pollutants using EPA Method 624, for all Base/Neutral Priority Pollutants using EPA Method 625 and 608 for Organochlorine Pesticides and PCBs, and Priority Pollutant Metals using Method 200.7.

The results of these analyses shall be tabulated and submitted along with the monthly Discharge Monitoring Reports.

Note: Sampling for Outfall 006 shall be conducted for a storm event that is greater than 0.1 inches and at least 72 hours from the previously measurable (greater than 0.1 inch equivalent rainfall) storm event. Flow measurements for these events shall be calculated from the size of the drainage area, runoff coefficient, and intensity of the storm event. The size of the drainage area, runoff coefficient, and intensity of the storm event shall be reported with the monthly DMRs.

CONTROLLED DOCUMENT

91-20-2a (1/89)

OXY

NIAGARA PLANT

SPDES No.: NY 000 3336

Modification(s): 11/15/95

FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning January 1, 1996

and lasting until January 1, 2001

the discharges from the permitted facility shall be limited and monitored by the permittee as specified below:

Outfall Number & Effluent Parameter	Discharge Limitations Daily Avg.	Discharge Limitations Daily Max.	Units	Minimum Monitoring Requirements Measurement Frequency	Minimum Monitoring Requirements Sample Type
Outfall 007 - Treated Groundwater					
Flow	Monitor	Monitor	MGD	Continuous	Meter
Monochlorotoluenes	Monitor	0.15	lb/d	2/month	24-hr. Comp.
Monochlorobenzotrifluorides	Monitor	0.15	lb/d	2/month	24-hr. Comp.
Dichlorobenzotrifluorides	Monitor	0.15	lb/d	2/month	24-hr. Comp.
Hexachlorocyclopentadiene	Monitor	0.15	lb/d	2/month	24-hr. Comp.
Monochlorobenzenes	Monitor	0.15	lb/d	2/month	24-hr. Comp.
Dichlorobenzenes	Monitor	0.46	lb/d	2/month	24-hr. Comp.
Trichlorobenzenes	Monitor	0.15	lb/d	2/Month	24-hr. Comp.
Trichloroethylene	Monitor	0.15	lb/d	2/Month	24-hr. Comp.
Tetrachloroethylene	Monitor	0.15	lb/d	2/Month	24-hr. Comp.
Toluene	Monitor	0.15	lb/d	2/Month	24-hr. Comp.
Sum of Hexachlorocyclohexanes	Monitor	0.15	lb/d	2/month	24-hr. Comp.
Phenolics, Total	Monitor	0.6	lb/d	2/month	24-hr. Comp.
Bromodichloromethane	Monitor	0.15	lb/d	2/Month	24-hr. Comp.
Chloroform	Monitor	0.15	lb/d	2/Month	24-hr. Comp.
1,1 Dichloroethylene	Monitor	0.15	lb/d	2/Month	24-hr. Comp.
1,2-(trans)-Dichloroethylene	Monitor	0.15	lb/d	2/Month	24-hr. Comp.
Vinyl Chloride	Monitor	0.15	lb/d	2/Month	24-hr. Comp.
Pentachlorophenol	Monitor	0.3	lb/d	2/Month	24-hr. Comp.
Benzene	Monitor	0.15	lb/d	2/Month	24-hr. Comp.
Carbon Tetrachloride	Monitor	0.15	lb/d	2/month	24-hr. Comp.
1,2-Dichloroethane	Monitor	0.15	lb/d	2/month	24-hr. Comp.
Solids, Total Suspended	280	720	lb/d	2/Month	24-hr. Comp.
1,1-Dichloroethane	Monitor	0.15	lb/d	2/Month	24-hr. Comp.
Ethylbenzene	Monitor	0.15	lb/d	2/Month	24-hr. Comp.
2,3,7,8-Tetrachloro dibenzo-p-dioxin	Monitor	0.008	μg/l	2/month	24-hr. Comp.
Sum of Chlorinated dibenzo-p-dioxins and Chlorinated dibenzo-p-furans	Monitor	0.00012	lb/d	Quarterly	24-hr. Comp.

Note: The influent and effluent of the 007 treatment system will be tested for 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) at a frequency of 2/month. After six months of operating data shows that 2,3,7,8-TCDD is less than 0.008 μg/l in the effluent, the permittee may drop this analysis but still maintain the quarterly analyses for the sum of chlorinated dioxins and furans. The individual chlorinated dioxins and furans detected in the quarterly analyses will be reported as an addendum to the monthly DMR.

91-20-2a (1/89)

OXY

NIAGARA PLANT

SPDES No.: NY 000 3336

Part 1, Page 7 of 16

Modification Date(s): 11/15/95

FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning January 1, 1996

and lasting until January 1, 2001

the discharges from the permitted facility shall be limited and monitored by the permittee as specified below:

Outfall Number & Effluent Parameter	(see Note 3) Discharge Limitations Daily Avg.	Daily Max.	Units	Minimum Monitoring Requirements Measurement Frequency	Sample Type
001, 003, 004, 005, and 007 - (Sum of Outfalls)					
Flow	Monitor	Monitor	MGD	2/month	Calculated*
Monochlorotoluenes	Monitor	30	lb/d	2/month	24-hr. Comp.
Dichlorotoluenes	Monitor	8	lb/d	2/month	24-hr. Comp.
Monochlorobenzotrifluorides	Monitor	10	lb/d	2/month	24-hr. Comp.
Dichlorobenzotrifluorides	Monitor	3	lb/d	2/month	24-hr. Comp.
Hexachlorocyclopentadiene	Monitor	1	lb/d	2/month	24-hr. Comp.
Monochlorobenzenes	Monitor	4	lb/d	2/month	24-hr. Comp.
Dichlorobenzenes	Monitor	4	lb/d	2/month	24-hr. Comp.
Trichlorobenzenes	Monitor	9	lb/d	2/Month	24-hr. Comp.
Tetrachlorobenzenes	Monitor	8	lb/d	2/Month	24-hr. Comp.
Trichloroethylene	Monitor	15	lb/d	2/Month	24-hr. Comp.
Tetrachloroethylene	Monitor	5.0	lb/d	2/Month	24-hr. Comp.
Toluene	Monitor	9	lb/d	2/Month	24-hr. Comp.
Sum of Hexachlorocyclohexanes	Monitor	0.26	lb/d	2/month	24-hr. Comp.
Sum of Parameters (1)	Monitor	74	lb/d	2/month	24-hr. Comp.
Phenolics, Total	19.5	Monitor	lb/d	Monthly	24-hr. Comp.
Zinc, Total**	9	Monitor	lb/d	Monthly	24-hr. Comp.
Arsenic, Total	4	Monitor	lb/d	Semi-annual	24-hr. Comp.
Copper, Total**	4	Monitor	lb/d	Semi-annual	24-hr. Comp.
Lead, Total	3	Monitor	lb/d	Semi-annual	24-hr. Comp.
Selenium, Total	7	Monitor	lb/d	Semi-annual	24-hr. Comp.

Note: The permit application must list all the corrosion/scale inhibitors used by the permittee. If use of new boiler/cooling water additives is intended, application must be made prior to use. Enerlink boilr/cooling water additives BW-9090, BW-9377, BW-9300, CW-7275, CW-7330, CW-7430, IPC-8950, and CL_2OUT1000 are approved for use in the manner outlined in J.T. Distefano, Enerlink Vice President - Operations, May 31, 1989 letter to Marvin A. Spring, Staff Environmental Engineer, Occidental Chemical Corporation; Marvin Spring's January 23, 1992 chemical useage request; and Occidental Chemical Corporation's SPDES Permit modification request dated October 21, 1992. Other water treatment chemicals approved for use are listed in the permittee's permit renewal application.

* The flow shall be measured at each outfall (001, 003, 004, 005, and 007) over the same 24-hour periods that the samples are collected for the parameters limited here by "Sum of Outfalls" limits; the flow reported shall be the arithmetic sum of the individual flows measured at these outfalls. It is intended here that this flow summation will be reported only for those sampling days during which the organics samplings are conducted.

** Outfall 006 grab samples for Total Zinc and for Total Copper shall be collected on a semiannual basis and included in the "sum of Outfalls" discharge.

FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

Modification Date(s): 11/15/95

Footnotes:

(1) The "Sum of Parameters (1)" shall be reported as the arithmetic sum of each of the following pollutants, at outfalls 001, 003, 004, 005, and 007:

(a) Monochlorotoluene
(b) Dichlorotoluenes
(c) Monochlorobenzotrifluoride
(d) Dichlorobenzotrifluoride
(e) Hexachlorocyclopentadiene
(f) Monochlorobenzenes
(g) Dichlorobenzenes
(h) Trichlorobenzenes
(i) Tetrachlorobenzenes
(j) Trichloroethylene
(k) Tetrachloroethylene
(l) Hexachlorocyclohexanes (BHCs)
(m) Toluene

Constituents shall also be reported individually for each parameter at each outfall, in both micrograms/liter and lbs/d. This report shall list the results of each sampling individually if more than one sampling is done during the monthly reporting period.

(2) The concentrations of this pollutant shall be undetectable, using a Method Detection Limit (MDL) Goal of 0.1 ppb.

(3) Limitations for pH (Range) and Temperature are effluent values; limitations for the N-Area Neutralization System Effluent, and for Mirex, and PCBs (Arochlor 1248), are Gross values; all other effluent limits are net loadings or concentrations, as indicated.

Where this permit requires the determination of Net pollutant loadings, 24-hour composite samples shall be taken at each outfall, as well as the river water intake. The observed concentration of a given pollutant in the intake water shall then be subtracted from the concentration observed at the given outfall, to determine the 24-hour average NET concentration at each outfall. The NET loadings at each outfall shall be calculated using these net concentrations and the appropriate flow for each outfall.

(4) This parameter shall be reported as the arithmetic sum of the pollutants listed below:

(a) Monochlorobenzotrifluoride
(b) Dichlorobenzotrifluoride
(c) Monochlorotoluenes
(d) Dichlorotoluenes
(e) Monochlorobenzotrichlorides

(5) Whenever 24-hour composite samples are required in this permit for Purgeable Halocarbons or Purgeable Aromatics, the permittee shall collect a series of at least four discrete grab samples of the discharge, approximately eight hours apart, over the course of the operating day, which samples shall be combined in the laboratory at analysis. Field compositing for Volatiles shall not be practiced.

(6) An annual report describing the effectiveness of the zebra mussel control program shall be submitted to NYSDEC Region 9 Regional Water Engineer within 60 days of the final treatment.

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ACTION LEVEL REQUIREMENTS (TYPE I)

The parameters listed below have been reported present in the discharge but at levels that currently do not require water quality or technology based limits. Action levels have been established which, if exceeded, will result in reconsideration or water quality or technology based limits.

Routine action level monitoring results, if not provided for on the Discharge Monitoring Report (DMR) form, shall be appended to the DMR for the period during which the sampling was conducted. If submission of DMR's is not required by this permit, the results shall be maintained in accordance with instructions on the RECORDING, REPORTING AND MONITORING page of this permit.

If any of the action levels is exceeded, the permittee shall undertake a short-term, high-intensity monitoring program for this parameter. Samples identical to those required for routine monitoring purposes shall be taken on each of at least three operating days and analyzed. Results shall be expressed in terms of both concentration and mass, and shall be submitted no later than the end of the third month following the month when the action level was first exceeded. Results may be appended to the DMR or transmitted under separate cover to the addresses listed on the RECORDING, REPORTING AND MONITORING page of this permit. If levels higher than the actions levels are confirmed the permit may be reopened by the Department for consideration of revised action levels or effluent limits.

The permittee is not authorized to discharge any of listed parameters at levels which may cause or contribute to a violation of water quality standards.

Outfall Number & Effluent Parameter	NET Action Level	Units	Minimum Monitoring Requirements Measurement Frequency	Sample Type
Outfall 001:				
Antimony, Total	0.2	lb/d	Semi-annual	24-hr. comp.
Chromium, Total	0.2	lb/d	Semi-annual	24-hr. comp.
Nickel, Total	0.1	lb/d	Semi-annual	24-hr. comp.
Silver, Total	0.2	lb/d	Semi-annual	24-hr. comp.
Chlorendic Acid	0.5	lb/d	Semi-annual	24-hr. comp.
Benzene	0.1	lb/d	Semi-annual	24-hr. comp.
Bromodichloromethane	0.1	lb/d	Semi-annual	24-hr. comp.
Chloroform	0.1	lb/d	Semi-annual	24-hr. comp.
1,1,2,2-Tetrachloroethane	0.1	lb/d	Semi-annual	24-hr. comp.
1,1,1-Trichloroethane	0.1	lb/d	Semi-annual	24-hr. comp.
1,1-Dichloroethylene	0.05	lb/d	Semi-annual	24-hr. comp.
1,2-(trans)-Dichloroethylene	1.0	lb/d	Semi-annual	24-hr. comp.
Methylene Chloride	0.1	lb/d	Semi-annual	24-hr. comp.
Vinyl Chloride	0.1	lb/d	Semi-annual	24-hr. comp.
Bis(2-ethylhexyl)Phthalate	0.5	lb/d	Semi-annual	24-hr. comp.
Di(N-Butyl)Phthalate	0.1	lb/d	Semi-annual	24-hr. comp.
Cadmium, Total	0.06	lb/d	Semi-annual	24-hr. comp.
Pentachlorophenol	0.06	lb/d	Semi-annual	24-hr. comp.
Mercury, Total	0.07	lb/d	Quarterly	24-hr. comp.

SEMI-ANNUAL OUTFALL MONITORING:

The permittee shall take 24-hour composite samples from outfalls 001, 003, 003S, 004, and 005, on a semiannual basis, which shall be analyzed for all Priority Pollutants, Dechlorane Plus, Pentac, Chlorendic Acid and Trichlorotoluene. Analyses should be made using Atomic Adsorption for Metals; EPA Method 624 for Purgeable Halocarbons and Purgeable Aromatics; EPA Method 625 for Base/Neutral and Acid Extractable Priority Pollutants; and EPA Method 608 for Organochlorine Pesticides and PCB's (other analyses by methods approved by the Department). The results of those analyses shall be tabulated, including both concentrations and mass loadings for each parameter at each outfall, and submitted to the Department as an addendum to the appropriate Discharge Monitoring Report (DMR) form.

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ACTION LEVEL REQUIREMENTS (TYPE I)

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Outfall Number & Effluent Parameter	NET Action Level	Units	Minimum Monitoring Requirements Measurement Frequency	Sample Type
Outfall 003:				
Chromium, Total	0.5	lb/d	Semi-annual	24-hr. comp.
Cadmium, Total	0.5	lb/d	Semi-annual	24-hr. comp.
Nickel, Total	0.6	lb/d	Semi-annual	24-hr. comp.
Mercury, Total	0.001	mg/l	Semi-annual	24-hr. comp.
Silver, Total	0.5	lb/d	Semi-annual	24-hr. comp.
Thallium, Total	0.5	lb/d	Semi-annual	24-hr. comp.
Benzene	0.1	lb/d	Semi-annual	24-hr. comp.
Bromodichloromethane	0.1	lb/d	Semi-annual	24-hr. comp.
Bromoform	0.4	lb/d	Semi-annual	24-hr. comp.
Chloroform	0.1	lb/d	Semi-annual	24-hr. comp.
1,2-trans-dichloroethylene	1.0	lb/d	Semi-annual	24-hr. comp.
Carbon Tetrachloride	0.5	lb/d	Semi-annual	24-hr. comp.
1,1,2,2-Tetrachloroethane	0.5	lb/d	Semi-annual	24-hr. comp.
Methylene Chloride	1.0	lb/d	Semi-annual	24-hr. comp.
1,1,1-Trichloroethane	0.1	lb/d	Semi-annual	24-hr. comp.
Vinyl Chloride	0.5	lb/d	Semi-annual	24-hr. comp.
Chlorendic Acid	0.5	lb/d	Semi-annual	24-hr. comp.
Dechlorane Plus	0.4	lb/d	Semi-annual	24-hr. comp.
Pentac	0.4	lb/d	Semi-annual	24-hr. comp.
Bis(2-ethylhexyl)Phthalate	0.5	lb/d	Semi-annual	24-hr. comp.
Di(N-Butyl)Phthalate	0.5	lb/d	Semi-annual	24-hr. comp.
Outfall 004:				
Cadmium, Total	0.5	lb/d	Semiannual	24-hr. Comp.
Chromium, Total	1.0	lb/d	Semiannual	24-hr. Comp.
Mercury, Total	0.001	mg/l	Semiannual	24-hr. Comp.

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ACTION LEVEL REQUIREMENTS (TYPE I) NIAGARA PLANT

The parameters listed below have been reported present in the discharge but at levels that currently do not require water quality or technology based limits. Action levels have been established which, if exceeded, will result in reconsideration or water quality or technology based limits.

Routine action level monitoring results, if not provided for on the Discharge Monitoring Report (DMR) form, shall be appended to the DMR for the period during which the sampling was conducted. If submission of DMR's is not required by this permit, the results shall be maintained in accordance with instructions on the RECORDING, REPORTING AND MONITORING page of this permit.

If any of the action levels is exceeded, the permittee shall undertake a short-term, high-intensity monitoring program for this parameter. Samples identical to those required for routine monitoring purposes shall be taken on each of at least three operating days and analyzed. Results shall be expressed in terms of both concentration and mass, and shall be submitted no later than the end of the third month following the month when the action level was first exceeded. Results may be appended to the DMR or transmitted under separate cover to the addresses listed on the RECORDING, REPORTING AND MONITORING page of this permit. If levels higher than the actions levels are confirmed the permit may be reopened by the Department for consideration of revised action levels or effluent limits.

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The permittee is not authorized to discharge any of listed parameters at levels which may cause or contribute to a violation of water quality standards.

Outfall Number & Effluent Parameter	NET Action Level	Units	Minimum Monitoring Requirements Measurement Frequency	Sample Type
Outfall 004 (cont'd):				
Nickel, Total	1.0	lb/d	Semi-annual	24-hr. comp.
Silver, Total	1.0	lb/d	Semi-annual	24-hr. comp.
Chlorendic Acid	0.001	mg/l	Semi-annual	24-hr. comp.
Bis(2-ethylhexyl)Phthalate	0.5	lb/d	Semi-annual	24-hr. comp.
Benzene	0.2	lb/d	Semi-annual	24-hr. comp.
Chloroform	0.5	lb/d	Semi-annual	24-hr. comp.
Bromoform	0.1	lb/d	Semi-annual	24-hr. comp.
Dichlorobromomethane	0.1	lb/d	Semi-annual	24-hr. comp.
Dibromochloromethane	0.1	lb/d	Semi-annual	24-hr. comp.
Methylene Chloride	0.2	lb/d	Semi-annual	24-hr. comp.
Carbon Tetrachloride	0.2	lb/d	Semi-annual	24-hr. comp.
1,2-Dichloroethane	0.1	lb/d	Semi-annual	24-hr. comp.
1,2-Dichloropropane	0.1	lb/d	Semi-annual	24-hr. comp.
Outfall 005:				
Cadmium, Total	0.2	lb/d	Semi-annual	24-hr. comp.
Chromium, Total	0.5	lb/d	Semi-annual	24-hr. comp.
Mercury, Total	0.001	mg/l	Semi-annual	24-hr. comp.
Nickel, Total	0.5	lb/d	Semi-annual	24-hr. comp.
Benzene	1.0	lb/d	Semi-annual	24-hr. comp.
Dichlorobromomethane	0.2	lb/d	Semi-annual	24-hr. comp.
Chloroform	1.5	lb/d	Semi-annual	24-hr. comp.
Methylene Chloride	0.5	lb/d	Semi-annual	24-hr. comp.
Bis(2-ethylhexyl)Phthalate	1.0	lb/d	Semi-annual	24-hr. comp.
Di(N-Butyl)Phthalate	1.0	lb/d	Semi-annual	24-hr. comp.
Heptachlor Epoxide	0.1	lb/d	Semi-annual	24-hr. comp.

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ACTION LEVEL REQUIREMENTS (TYPE I)

The parameters listed below have been reported present in the discharge but at levels that currently do not require water quality or technology based limits. Action levels have been established which, if exceeded, will result in reconsideration or water quality or technology based limits.

Routine action level monitoring results, if not provided for on the Discharge Monitoring Report (DMR) form, shall be appended to the DMR for the period during which the sampling was conducted. If submission of DMR's is not required by this permit, the results shall be maintained in accordance with instructions on the RECORDING, REPORTING AND MONITORING page of this permit.

If any of the action levels is exceeded, the permittee shall undertake a short-term, high-intensity monitoring program for this parameter. Samples identical to those required for routine monitoring purposes shall be taken on each of at least three operating days and analyzed. Results shall be expressed in terms of both concentration and mass, and shall be submitted no later than the end of the third month following the month when the action level was first exceeded. Results may be appended to the DMR or transmitted under separate cover to the addresses listed on the RECORDING, REPORTING AND MONITORING page of this permit. If levels higher than the actions levels are confirmed the permit may be reopened by the Department for consideration of revised action levels or effluent limits.

The permittee is not authorized to discharge any of listed parameters at levels which may cause or contribute to a violation of water quality standards.

Outfall Number & Effluent Parameter	Action Level	Units	Minimum Monitoring Requirements: Measurement Frequency	Minimum Monitoring Requirements: Sample Type
Outfall 006				
1,1,2,2-Tetrachloroethane	0.002	lb/d	Semi-annual	Grab
Mercury, Total	0.0005	lb/d	Semi-annual	Grab
Outfall 007				
Antimony, Total	0.43	lb/d	Semi-annual	24-hr. comp.
Chromium, Total	0.15	lb/d	Semi-annual	24-hr. comp.
Silver, Total	0.15	lb/d	Semi-annual	24-hr. comp.
Bis(2-ethylhexyl)Phthalate	0.43	lb/d	Semi-annual	24-hr. comp.
Di-(N-Butyl)Phthalate	0.15	lb/d	Semi-annual	24-hr. comp.
Pyrene	0.07	lb/d	Semi-annual	24-hr. comp.
2,4-Dinitrotoluene	0.15	lb/d	Semi-annual	24-hr. comp.
2,6-Dinitrotoluene	0.07	lb/d	Semi-annual	24-hr. comp.
Fluoranthene	0.07	lb/d	Semi-annual	24-hr. comp.
Hexachloroethane	0.07	lb/d	Semi-annual	24-hr. comp.
Indeno(1,2,3-cd)Pyrene	0.07	lb/d	Semi-annual	24-hr. comp.
Naphthalene	0.15	lb/d	Semi-annual	24-hr. comp.
Phenanthrene	0.07	lb/d	Semi-annual	24-hr. comp.
2,4-Dichlorophenol	0.15	lb/d	Semi-annual	24-hr. comp.
Benzo(a)pyrene	0.07	lb/d	Semi-annual	24-hr. comp.
3,4-Benzofluoranthene	0.07	lb/d	Semi-annual	24-hr. comp.
Benzo(ghi)Perylene	0.07	lb/d	Semi-annual	24-hr. comp.
Benzo(k)Fluorenthene	0.07	lb/d	Semi-annual	24-hr. comp.
Bis(2-chloroethoxy)Methanes	0.07	lb/d	Semi-annual	24-hr. comp.
Chrysene	0.07	lb/d	Semi-annual	24-hr. comp.
Dibenzo(a,h)Anthracene	0.07	lb/d	Semi-annual	24-hr. comp.
Hexachlorobenzenes	0.15	lb/d	Semi-annual	24-hr. comp.
Hexachlorobutadiene	0.15	lb/d	Semi-annual	24-hr. comp.

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SPECIAL CONDITIONS - BEST MANAGEMENT PRACTICES

1. The permittee shall continue to implement a Best Management Practices (BMP) plan, to prevent, or minimize the potential for, release of significant amounts of toxic or hazardous pollutants to the waters of the State through plant site runoff; spillage and leaks; sludge or waste disposal; or drainage from raw material storage.

2. The permittee shall review all facility components or systems (including material storage areas; in-plant transfer, process and material handling areas; loading and unloading operations; and sludge and waste disposal areas) where toxic or hazardous pollutants are used, manufactured, stored or handled to evaluate the potential for the release of significant amounts of such pollutants to the waters of the State. In performing such an evaluation, the permittee shall consider such factors as the probability of equipment failure or improper operation, settlement of facility air emissions, the effects of natural phenomena such as freezing temperatures and precipitation, fires, and the facility's history of spills and leaks. For hazardous pollutants, the list of reportable quantities as defined in 40 CFR, Part 117 may be used as a guide in determining significant amounts of releases. For toxic pollutants, the relative toxicity of the pollutant shall be considered in determining the significance of potential releases.

   The review shall address all substances present at the facility that are listed as toxic pollutants under Section 307(a)(1) of the Clean Water Act or as hazardous pollutants under Section 311 of the Act or that are identified as Chemicals of Concern by the Industrial Chemical Survey.

3. Whenever the potential for a significant release of toxic or hazardous pollutants to State waters is determined to be present, the permittee shall identify Best Management Practices that have been established to minimize such potential releases. Where BMPs are inadequate or absent, appropriate BMPs shall be established. In selecting appropriate BMPs, the permittee shall consider typical industry practices such as spill reporting procedures, risk identification and assessment, employee training, inspections and records, preventive maintenance, good housekeeping, materials compatibility and security. In addition, the permittee may consider structural measures (such as secondary containment devices) where appropriate.

4. Development of the BMP plan shall include sampling of waste stream segments for the purpose of toxic "hot spot"* identification. The economic achievability of technology-based end-of-pipe treatment will not be considered until plant site "hot spot" sources have been identified, contained, removed or minimized through the imposition of site specific BMPs or application of internal facility treatment technology.

5. The BMP plan shall be documented in narrative form and shall include any necessary plot plans, drawings or maps. Other documents already prepared for the facility such as a Safety Manual or a Spill Prevention, Control and Countermeasure (SPCC) plan may be used as part of the plan and may be incorporated by reference. A copy of the BMP plan shall be maintained at the facility and shall be available to authorized Department representatives upon request. As a minimum, the plan shall include the following BMP's:

   a. BMP Committee
   b. Reporting of BMP Incidents
   c. Risk Identification and Assessment
   d. Employee Training
   e. Inspections and Records
   f. Preventive Maintenance
   g. Good Housekeeping
   h. Materials Compatibility
   i. Security

6. The BMP plan shall be modified whenever changes at the facility materially increase the potential for significant releases of toxic or hazardous pollutants or where actual releases indicate the plan is inadequate.

* A "hot spot" is a segment of an industrial facility; including but not limited to soil, equipment, material storage areas, sewer lines etc.; which contributes elevated levels of problem pollutants to the wastewater and/or storm water collection system of that facility. For the purposes of this definition, problem pollutants are substances for which end of pipe treatment to meet a water quality or technology requirement may, considering the results of wastestream segment sampling, be deemed unreasonable. For the purposes of this definition, an elevated level is a concentration or mass loading of the pollutant in question which is adequately higher than the end of pipe concentration of that same pollutant so as to allow for an economically justify removal and/or isolation of the segment and/or B.A.T. treatment of wastewaters emanating from the segment.

DEFINITIONS OF DAILY AVERAGE AND DAILY MAXIMUM

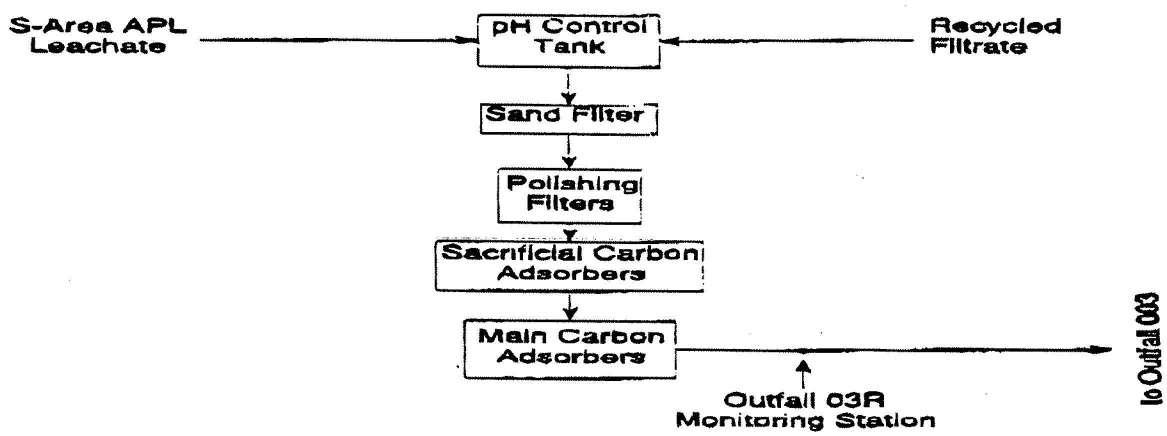
The daily average discharge is the total discharge by weight or in other appropriate units as specified herein, during a calendar month divided by the number of days in the month that the production or commercial facility was operating. Where less than daily sampling is required by this permit, the daily average discharge shall be determined by the summation of all the measured daily discharges in appropriate units as specified herein divided by the number of days during the calendar month when measurements were made.

The daily maximum discharge means the total discharge by weight or in other appropriate units as specified herein, during any calendar day.

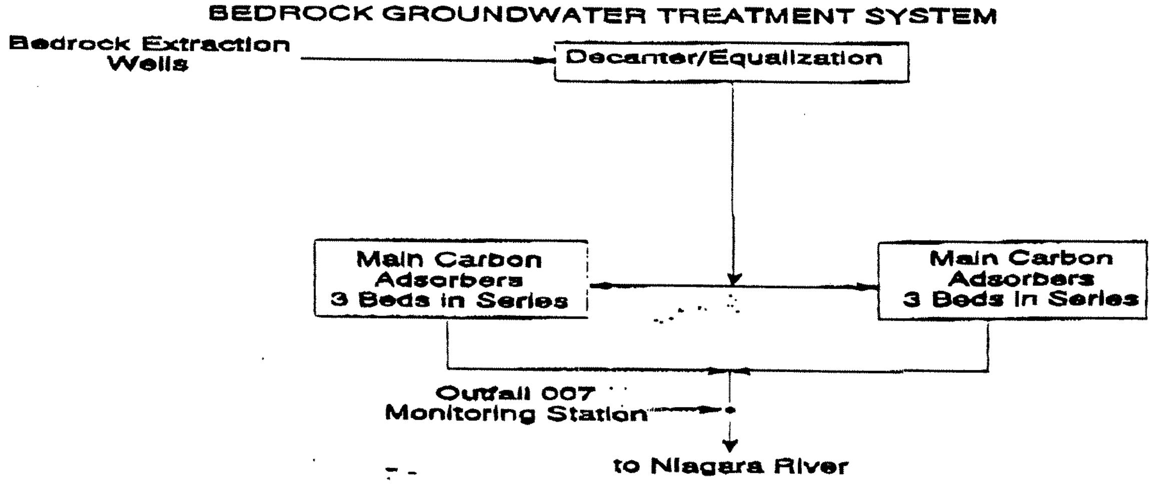
MONITORING LOCATIONS

The permittee shall take samples and measurements, to comply with the monitoring requirements specified in this permit, at the location(s) indicated below:

S-AREA APL LEACHATE TREATMENT SYSTEM



BEDROCK GROUNDWATER TREATMENT SYSTEM



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SPDES No.: NY 000 3336

Modification Date(s): 11/15/95

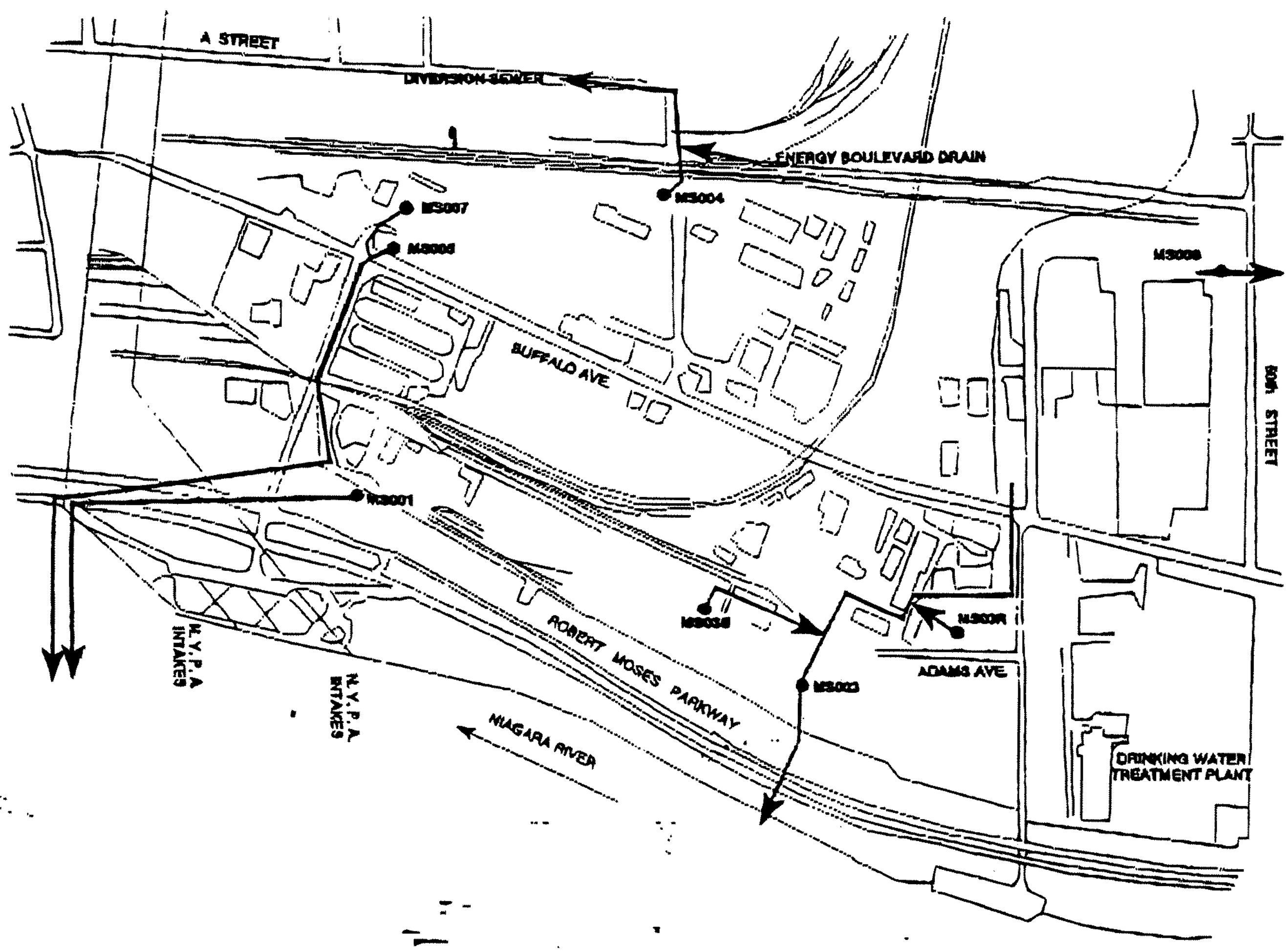
DEFINITIONS OF DAILY AVERAGE AND DAILY MAXIMUM

The daily average discharge is the total discharge by weight or in other appropriate units as specified herein, during a calendar month divided by the number of days in the month that the production or commercial facility was operating. Where less than daily sampling is required by this permit, the daily average discharge shall be determined by the summation of all the measured daily discharges in appropriate units as specified herein divided by the number of days during the calendar month when measurements were made.

The daily maximum discharge means the total discharge by weight or in other appropriate units as specified herein, during any calendar day.

MONITORING LOCATIONS

The permittee shall take samples and measurements, to comply with the monitoring requirements specified in this permit, at the location(s) indicated below:



RECORDING, REPORTING AND ADDITIONAL MONITORING REQUIREMENTS

a) The permittee shall also refer to the General Conditions (Part II) of this permit for additional information concerning monitoring and reporting requirements and conditions.

b) The monitoring information required by this permit shall be summarized, signed and retained for a period of three years from the date of the sampling for subsequent inspection by the Department or its designated agent. **Also;**

[X] (if box is checked) monitoring information required by this permit shall be summarized and reported by submitting completed and signed Discharge Monitoring Report (DMR) forms for each 1 month reporting period to the locations specified below. Blank forms are available at the Department's Albany office listed below. The first reporting period begins on the effective date of this permit and the reports will be due no later than the 28th day of the month following the end of each reporting period.

Send the **original** (top sheet) of each DMR page to:

Department of Environmental Conservation
Division of Water
Bureau of Water Compliance Programs
50 Wolf Road
Albany, New York 12233-3506

Phone: (518) 457-3790

Send the second copy (third sheet) of each DMR page to:

Niagara County Health Department
5467 Upper Mountain Road
Lockport, New York 14094

Send the **first copy** (second sheet) of each DMR page to:

Department of Environmental Conservation
Regional Water Engineer
Region 9
270 Michigan Avenue
Buffalo, New York 14203-2999

Phone: (716) 851-7070

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OXY
NIAGARA PLANT

c) A monthly "Wastewater Facility Operation Report..." (form 92-15-7) shall be submitted (if box is checked) to the [ ] Regional Water Engineer and/or [ ] County Health Department or Environmental Control Agency listed above.

d) **Noncompliance** with the provisions of this permit shall be reported to the Department as prescribed in the attached General Conditions (Part II).

e) Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit.

f) If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR Part 136 or as specified in this permit, the results of this monitoring shall be included in the calculations and recording on the Discharge Monitoring Reports.

g) Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified in this permit.

h) Unless otherwise specified, all information recorded on the Discharge Monitoring Report shall be based upon measurements and sampling carried out during the most recently completed reporting period.

i) Any laboratory test or sample analysis required by this permit for which the State Commissioner of Health issues certificates of approval pursuant to section five hundred two of the Public Health Law shall be conducted by a laboratory which has been issued a certificate of approval. Inquiries regarding laboratory certification should be sent to the Environmental Laboratory Accreditation Program, New York State Health Department Center for Laboratories and Research, Division of Environmental Sciences, The Nelson A. Rockefeller State Plaza, Albany, New York 12201.

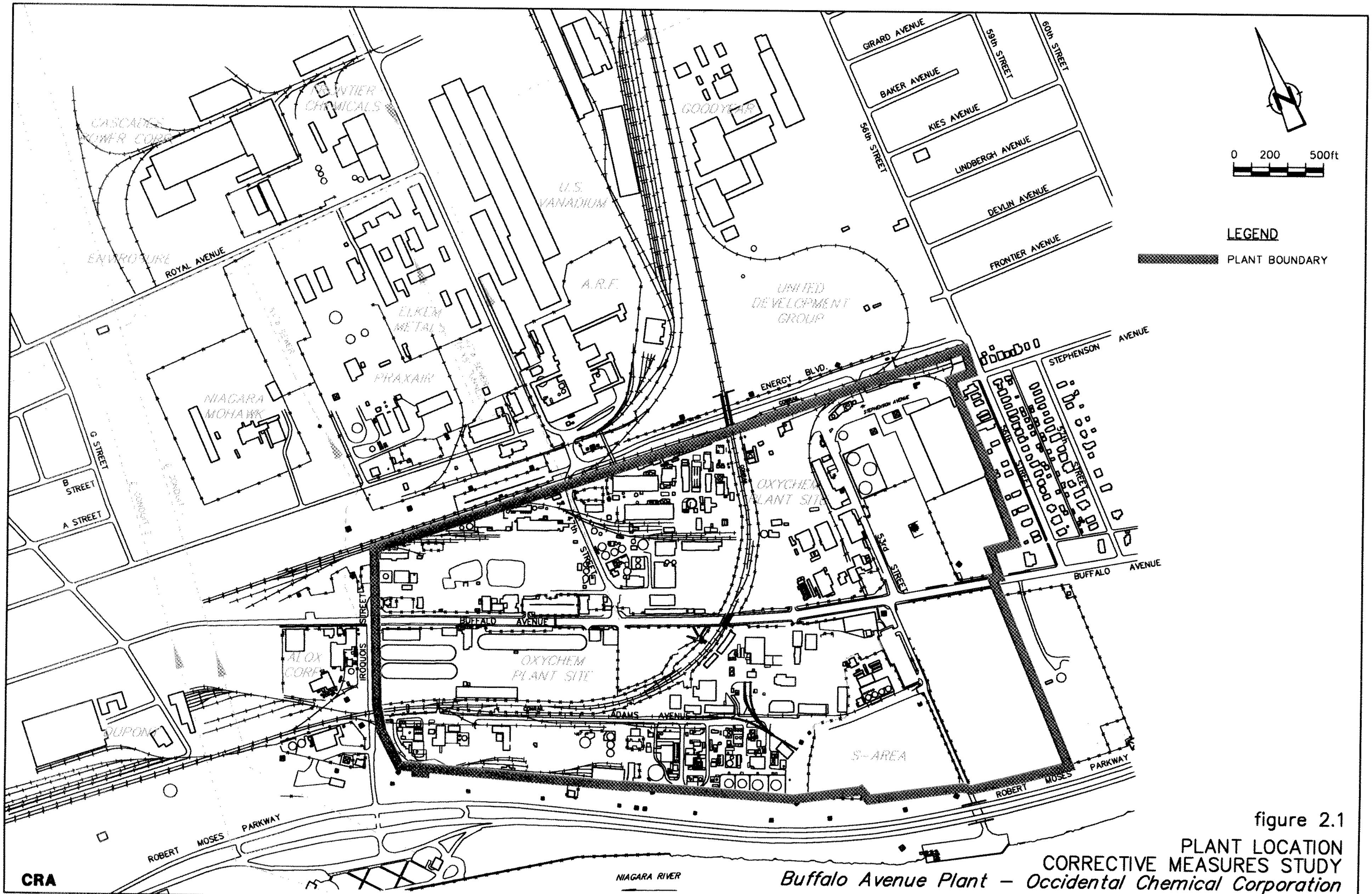


figure 2.1
PLANT LOCATION
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA
02583-00(191)GN-WA001 NOV 10/98

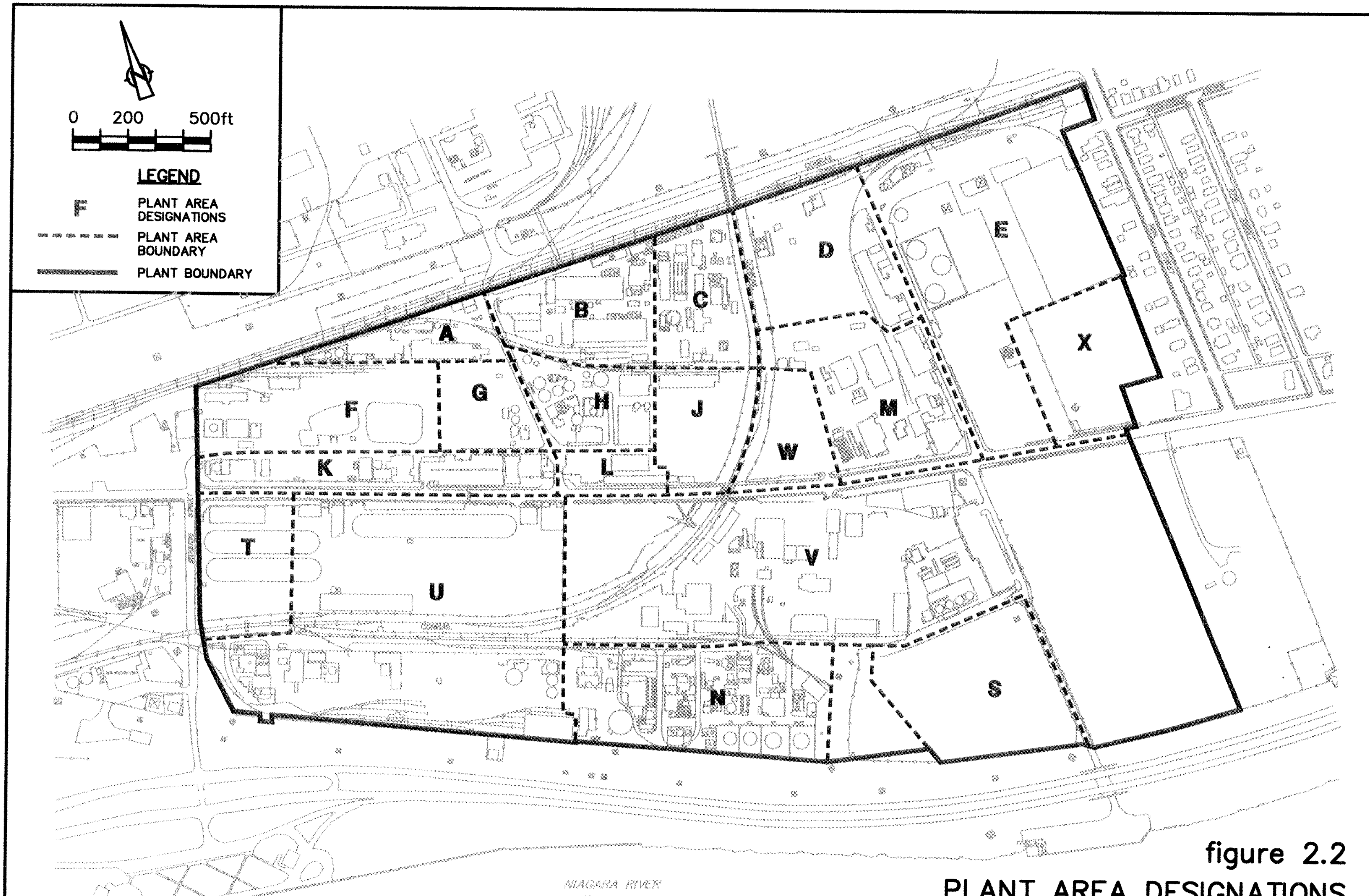


figure 2.2

PLANT AREA DESIGNATIONS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583–00(191)GN–WA002 NOV 10/98

FORMATION	COLUMNAR SECTION	THICKNESS IN FEET	CHARACTER
FILL		0–15	GRAVEL, SAND, SILT AND CLAY, DEMOLITION DEBRIS, FLYASH, CINDERS, CHEMICAL WASTE
ALLUVIUM		0–15	LIGHT BROWN SILT AND VEGETATION, GRADING INTO THIN BLACK AND DARK BROWN SILTY SAND, GRADING INTO BLACK IN THE LOWER PART
GLACIOLACUSTRINE CLAY		0–15	RED BROWN SILTY CLAY AND GRAY BROWN SANDY TO CLAYEY SILT
TILL		0–15	RED BROWN SANDY SILT, TRACE TO SOME CLAY AND GRAVEL
BEDROCK			LOCKPORT DOLOMITE

figure 3.1

OVERBURDEN STRATIGRAPHY
CORRECTIVE MEASURES STUDY

CRA *Buffalo Avenue Plant – Occidental Chemical Corporation*

02583-00(191)GN-WA003 NOV 13/98

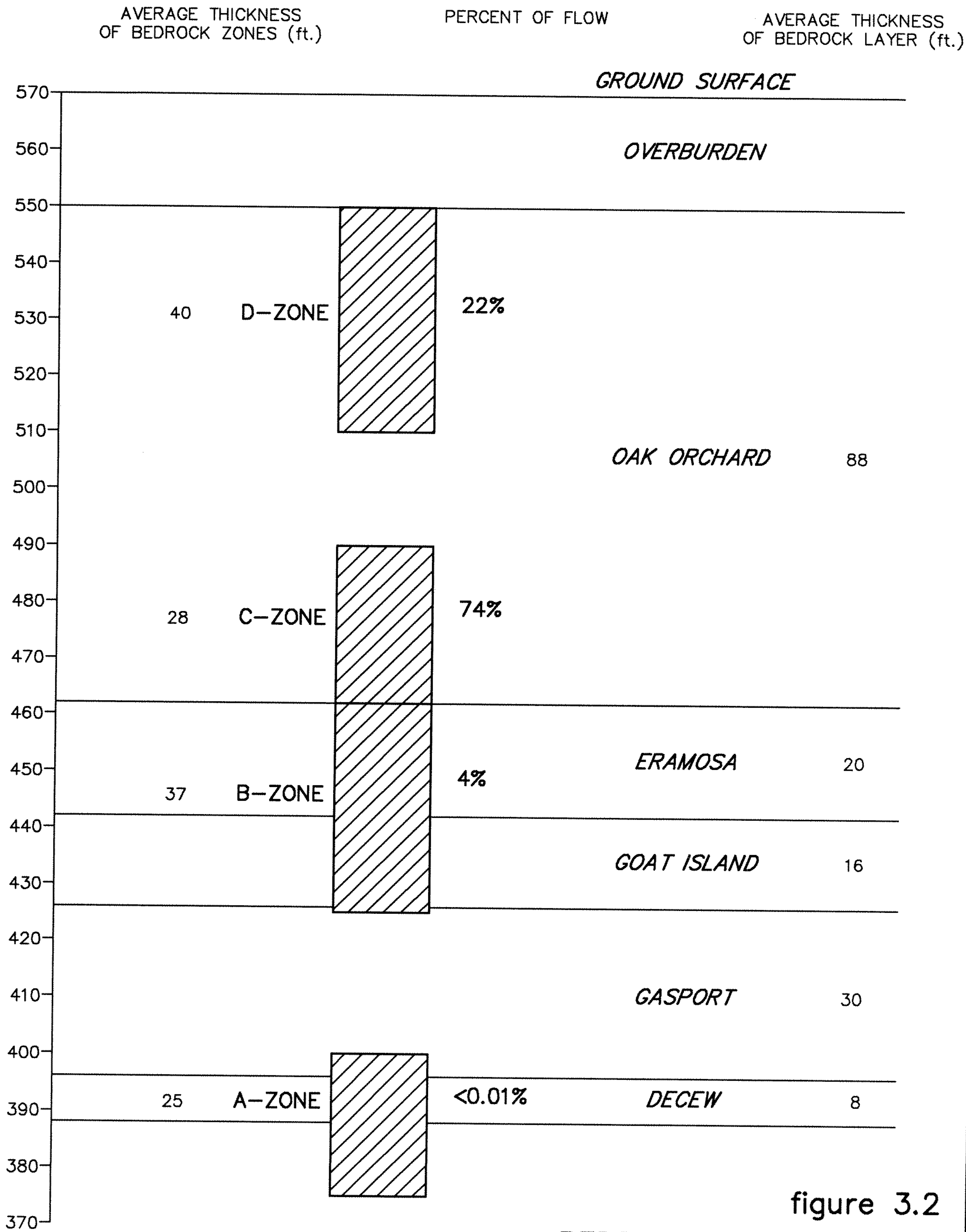


figure 3.2

BEDROCK STRATIGRAPHY
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583–00(191)GN–WA004 SEP 10/98

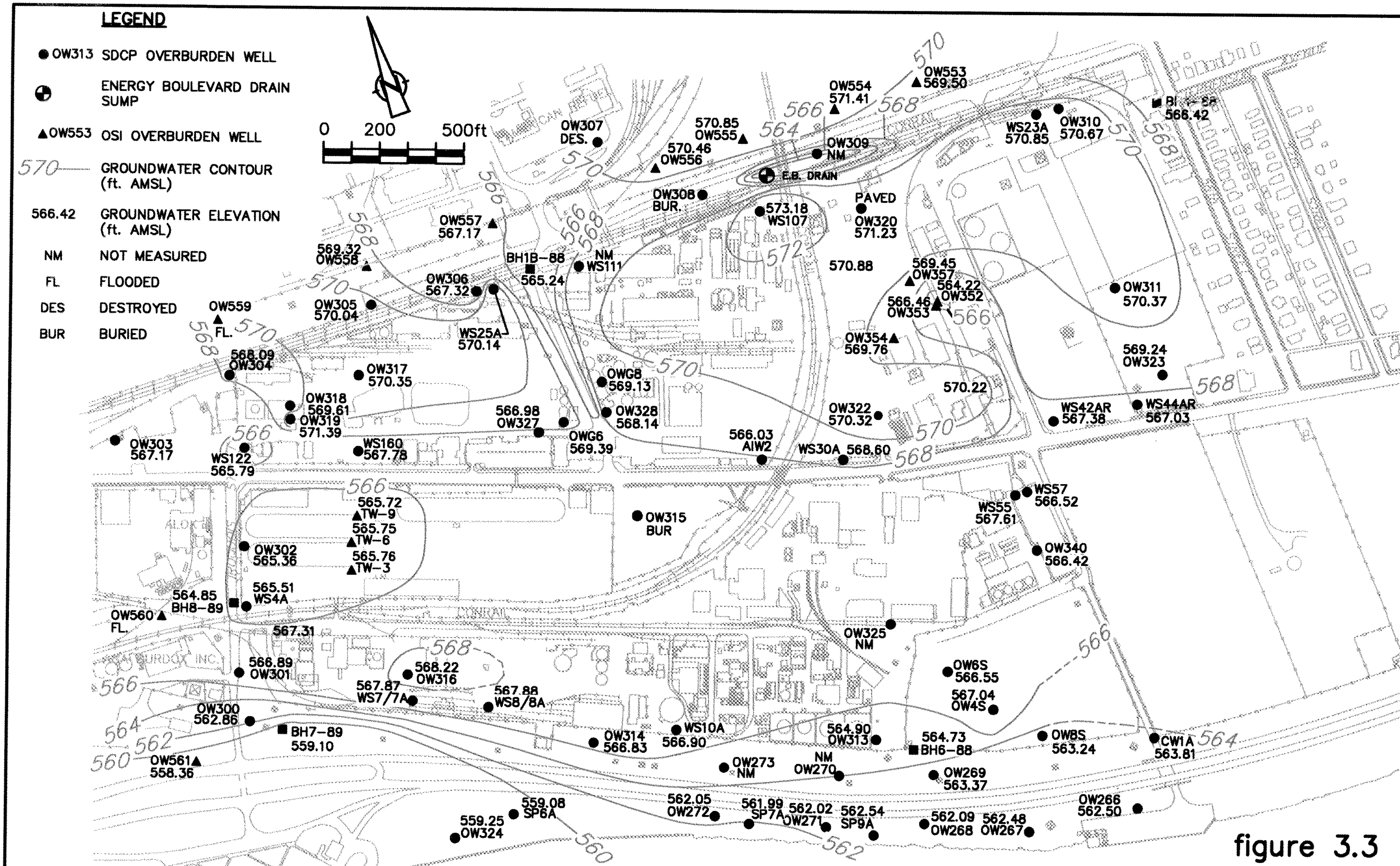


figure 3.3

OVERBURDEN GROUNDWATER CONTOURS – JUNE 1992
SDCP OVERBURDEN WELLS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA041 NOV 10/98

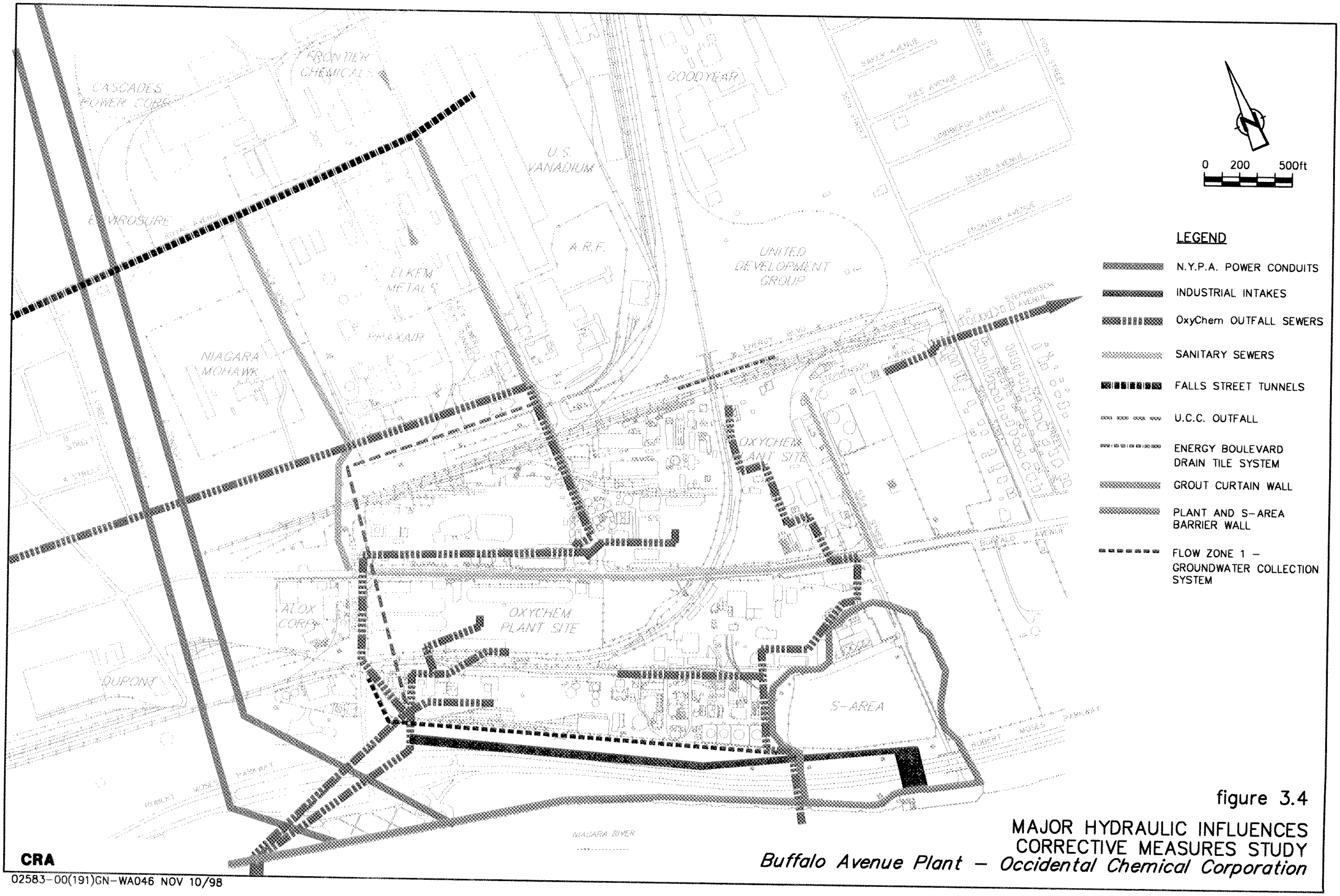


figure 3.4

MAJOR HYDRAULIC INFLUENCES
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA046 NOV 10/98

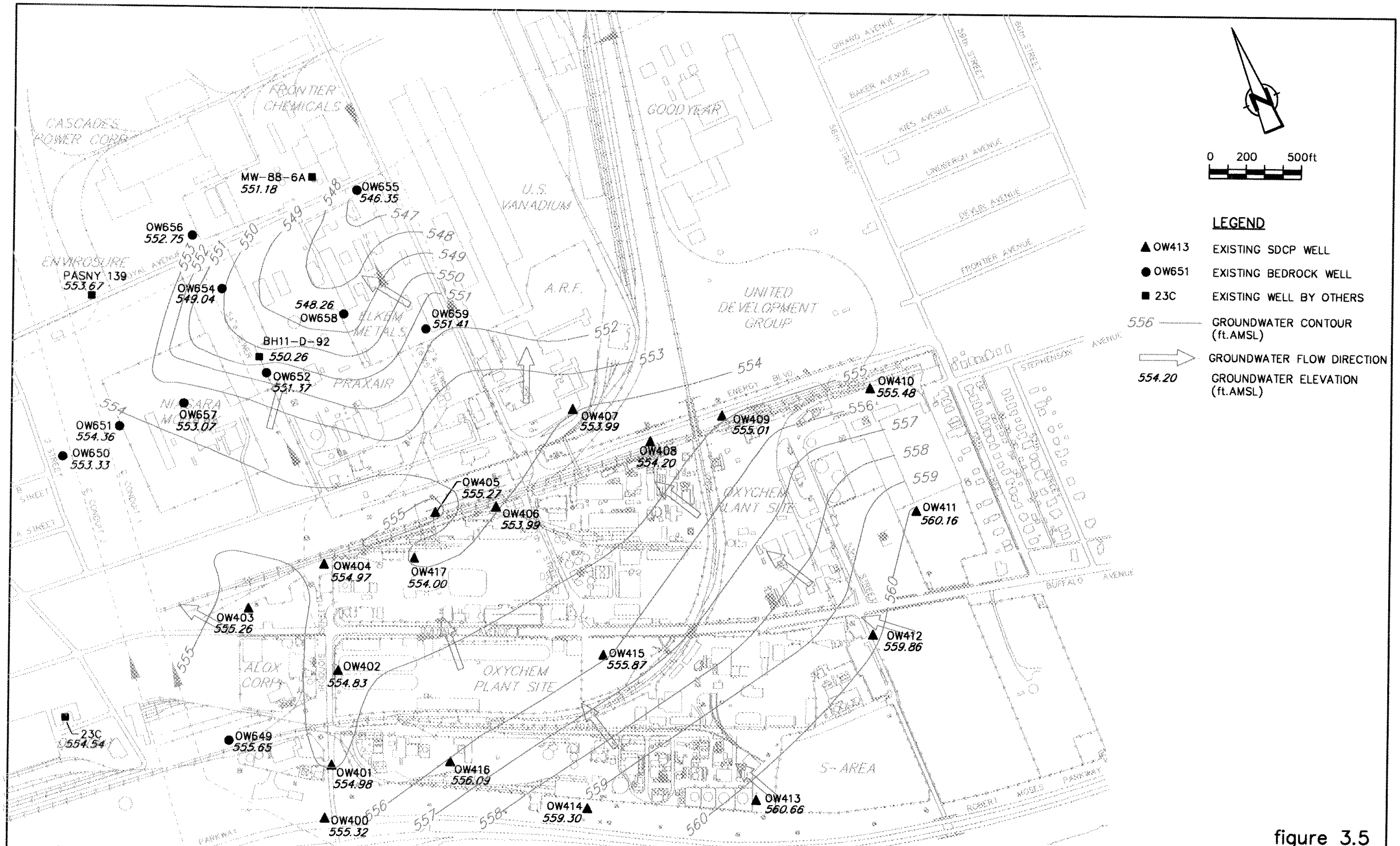


figure 3.5

D-ZONE BEDROCK GROUNDWATER CONTOURS
CORRECTIVE MEASURES STUDY

Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA006 NOV 10/98

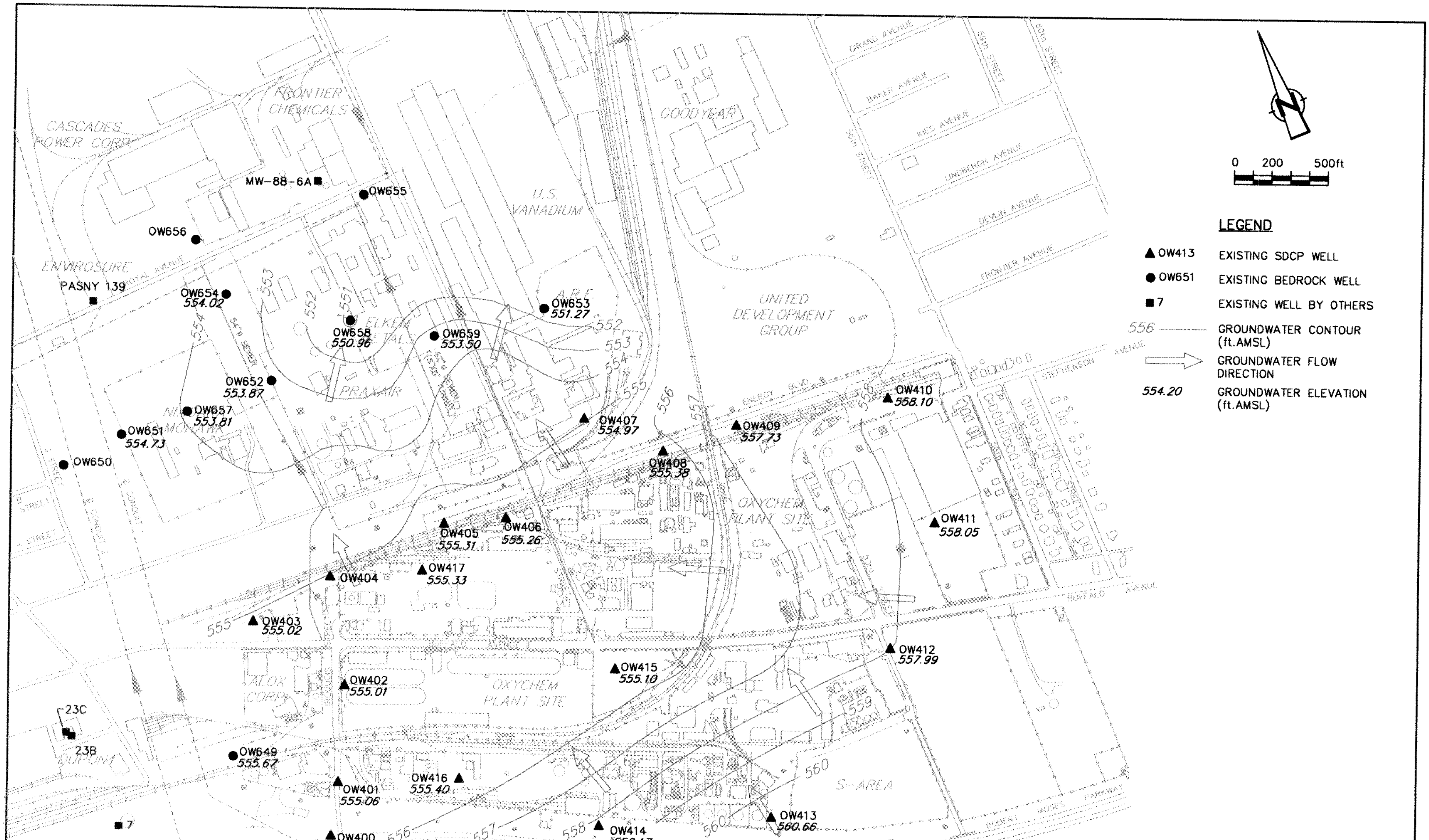


figure 3.6

C–ZONE BEDROCK GROUNDWATER CONTOURS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA007 NOV 10/98

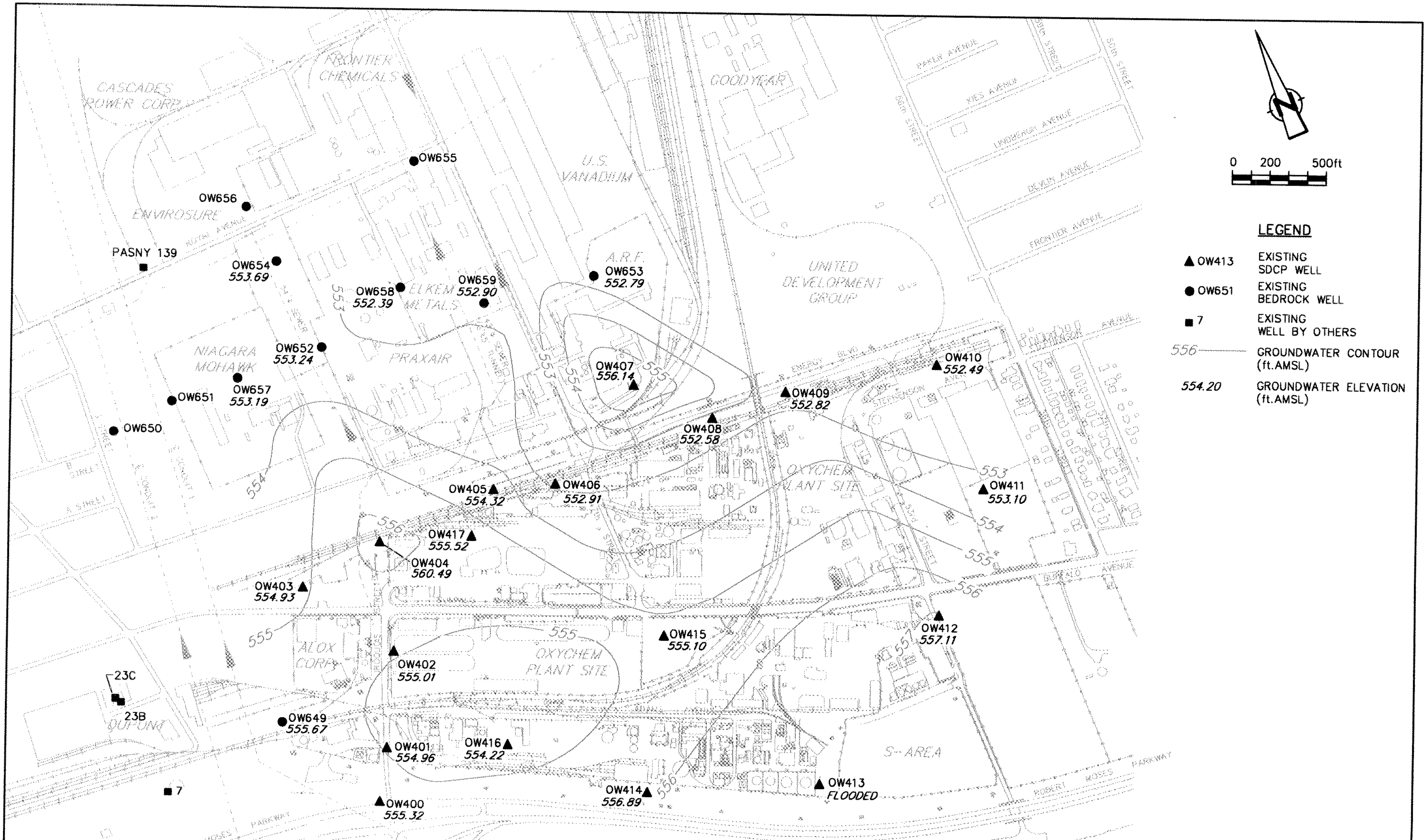


figure 3.7

B-ZONE BEDROCK GROUNDWATER CONTOURS - MAY 1993
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant - Ocidental Chemical Corporation

CRA

02583-00(191)GN-WA040 NOV 10/98

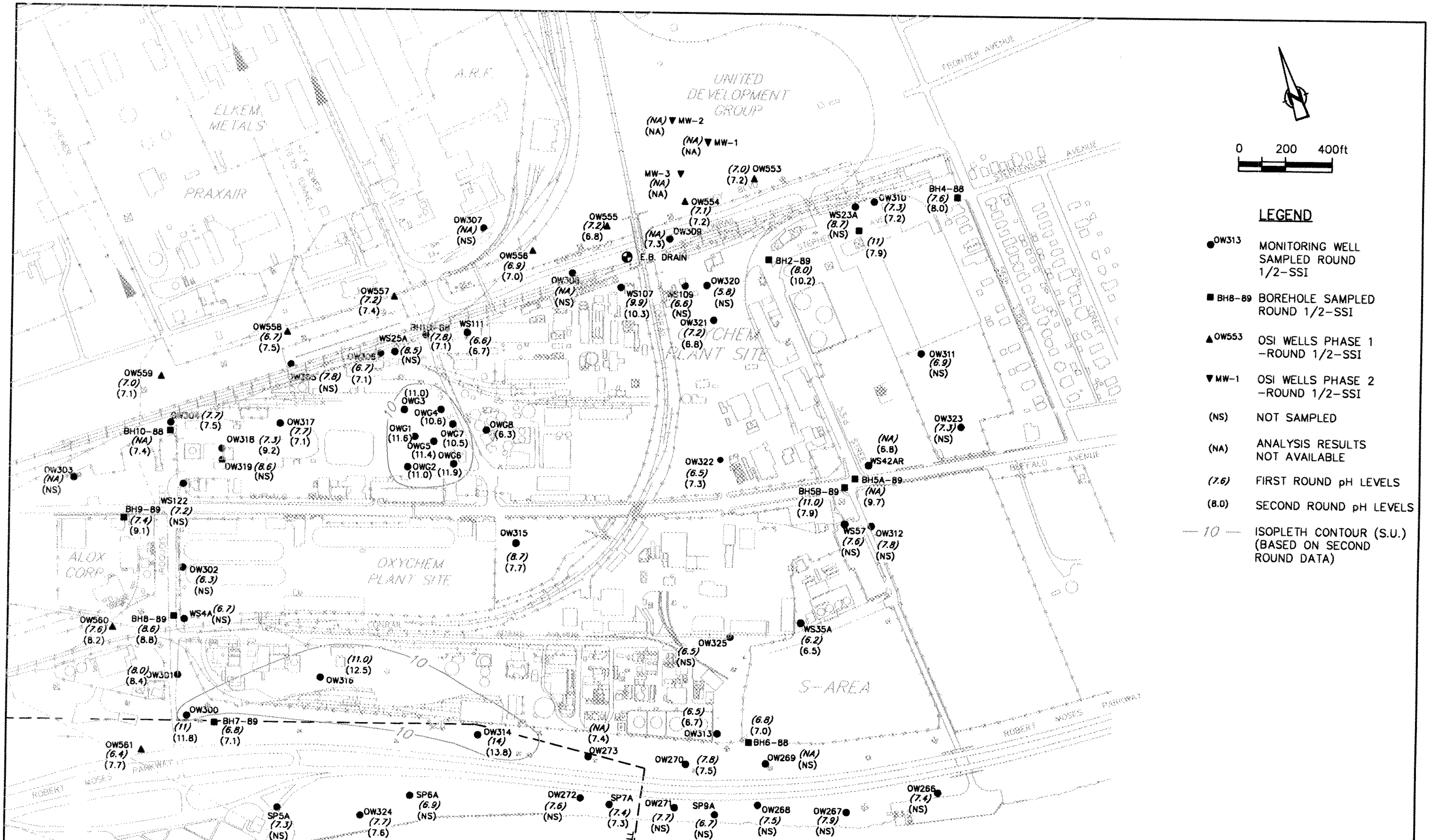


figure 3.8

HIGH pH PRESENCE – OVERBURDEN GROUNDWATER CORRECTIVE MEASURES STUDY

Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA013 NOV 10/98

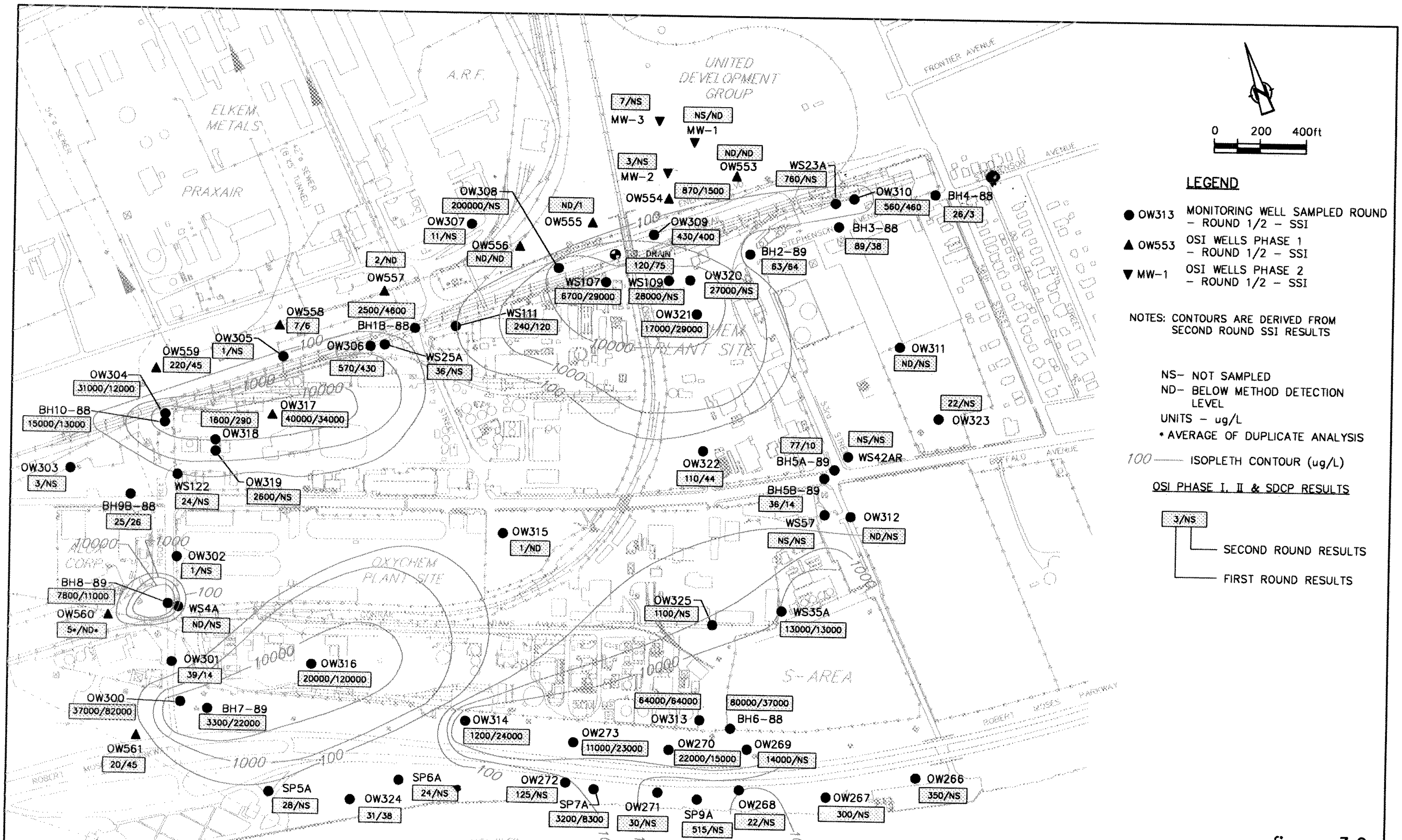


figure 3.9
ORGANIC CHEMICAL PRESENCE – OVERBURDEN GROUNDWATER
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA
02583-00(191)GN-WA014 NOV 10/98

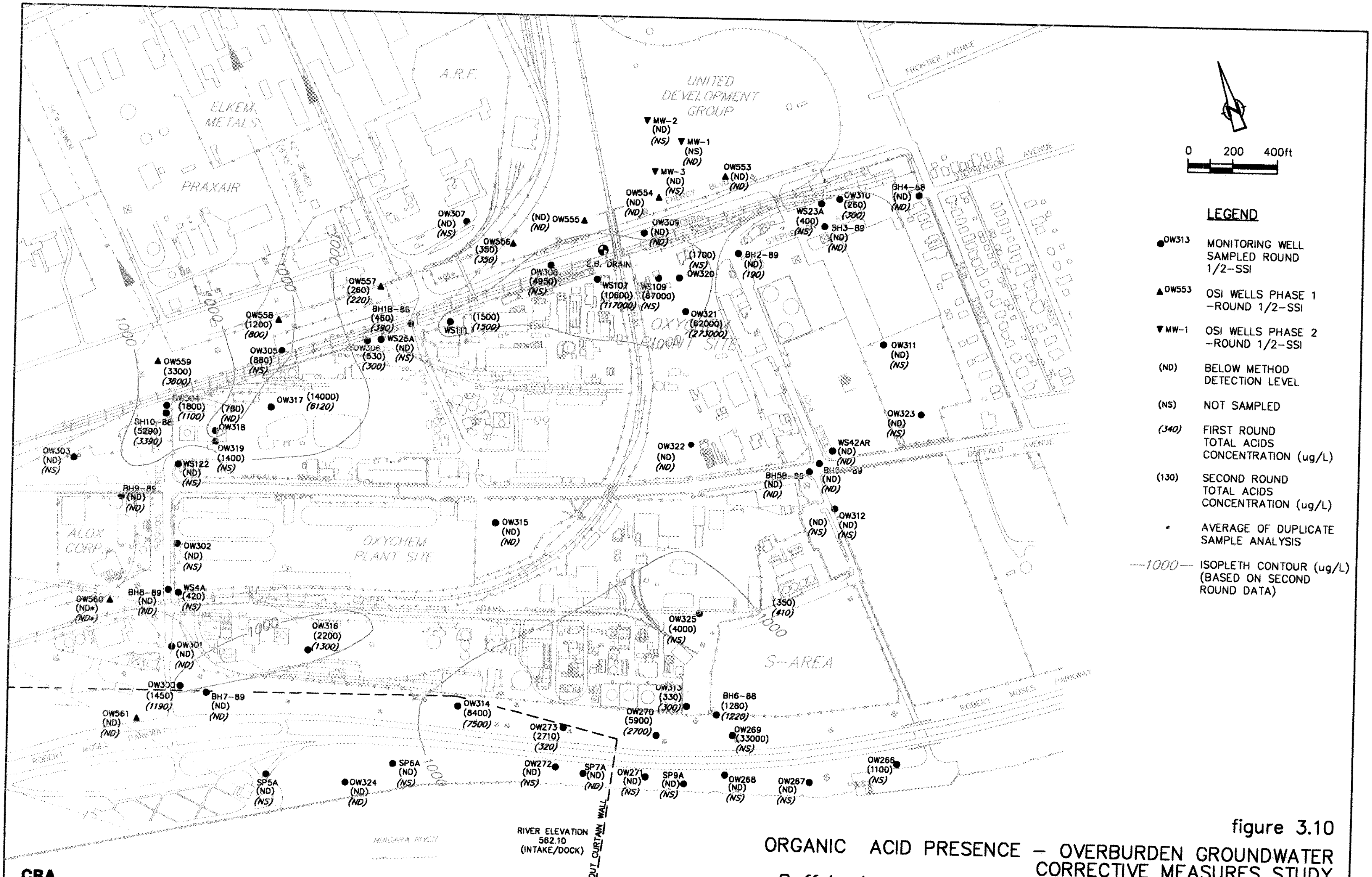


figure 3.10

ORGANIC ACID PRESENCE – OVERBURDEN GROUNDWATER CORRECTIVE MEASURES STUDY

Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA015 NOV 10/98

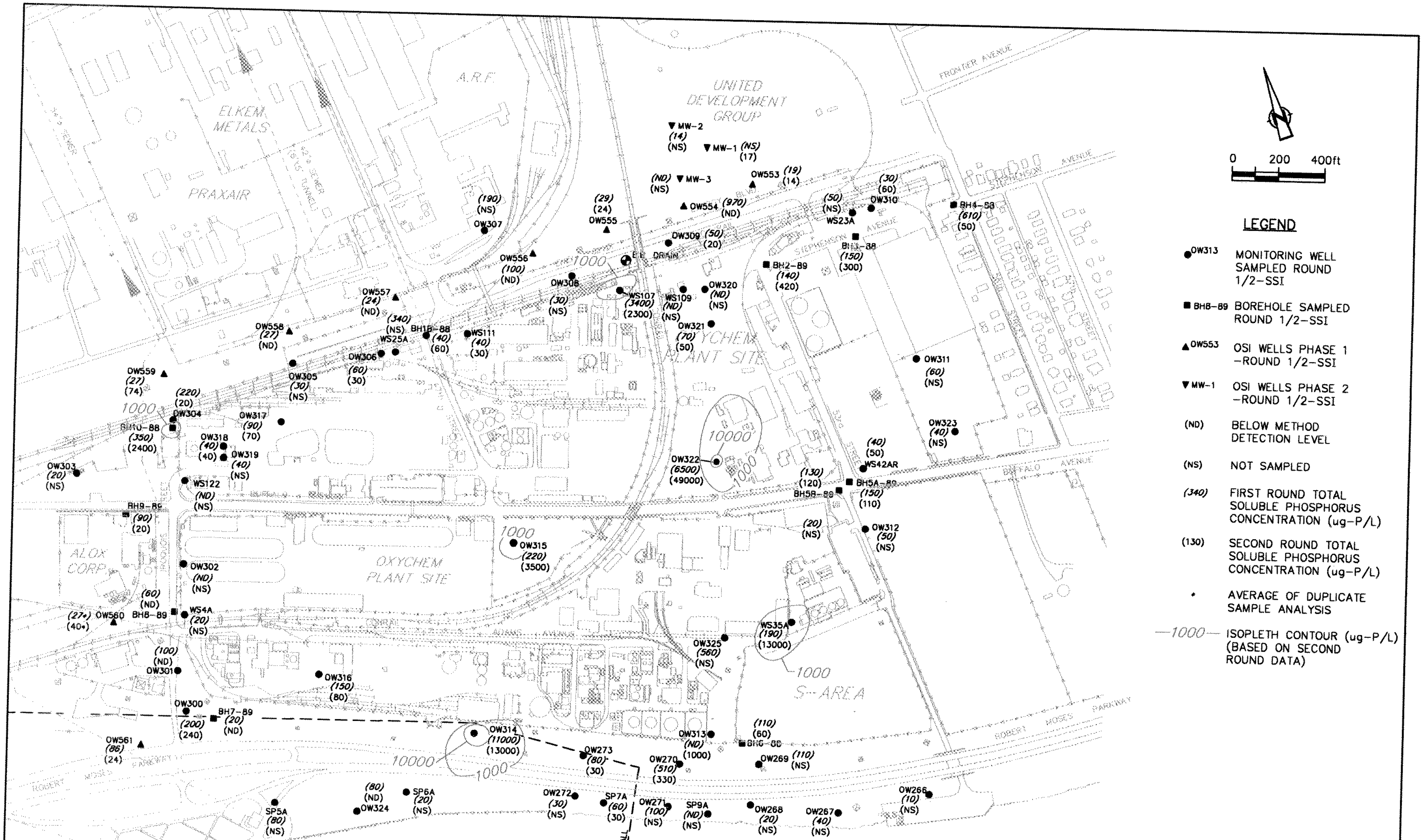


figure 3.11

SOLUBLE PHOSPHORUS PRESENCE – OVERBURDEN GROUNDWATER CORRECTIVE MEASURES STUDY

Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA016 NOV 10/98

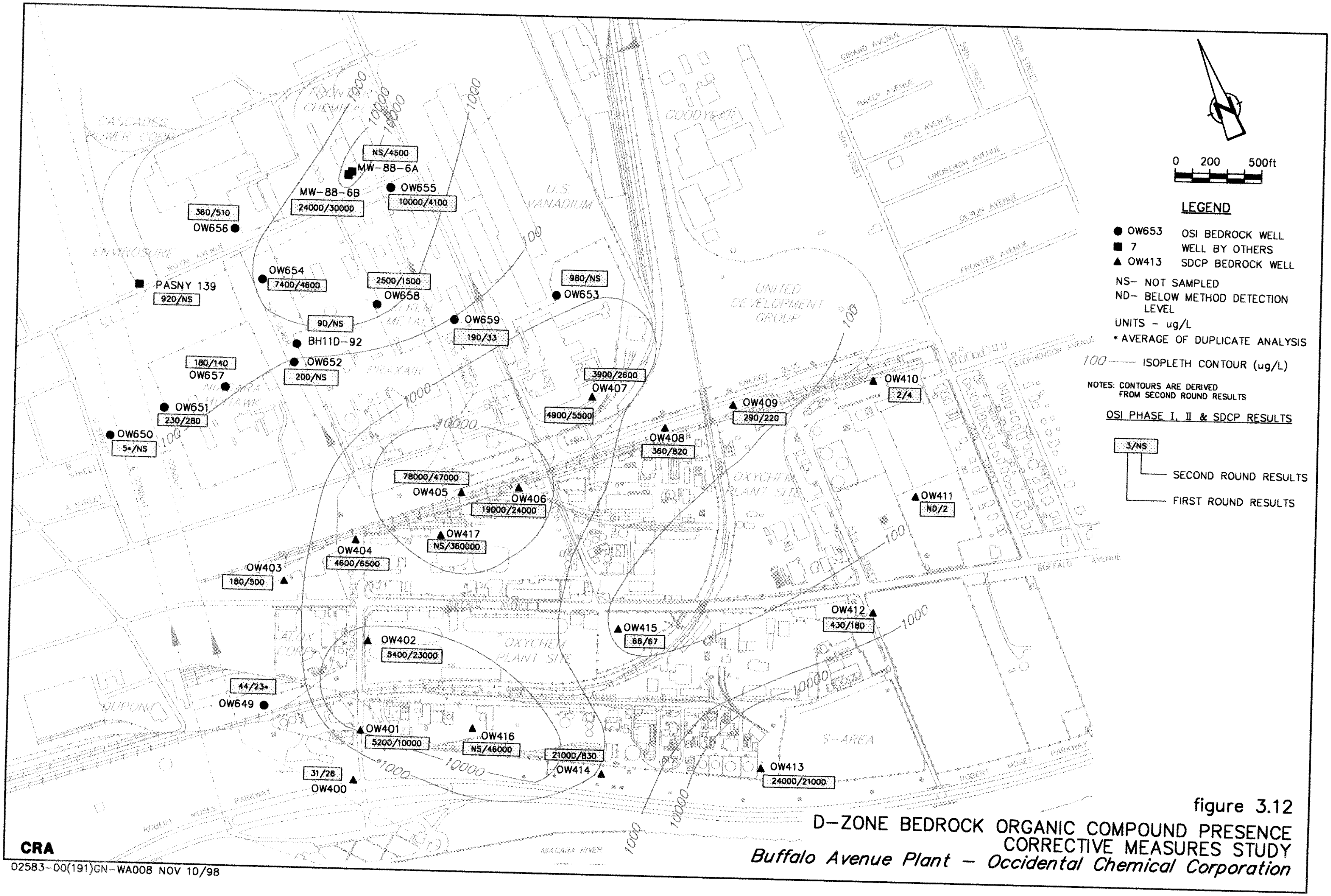


figure 3.12
D-ZONE BEDROCK ORGANIC COMPOUND PRESENCE
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

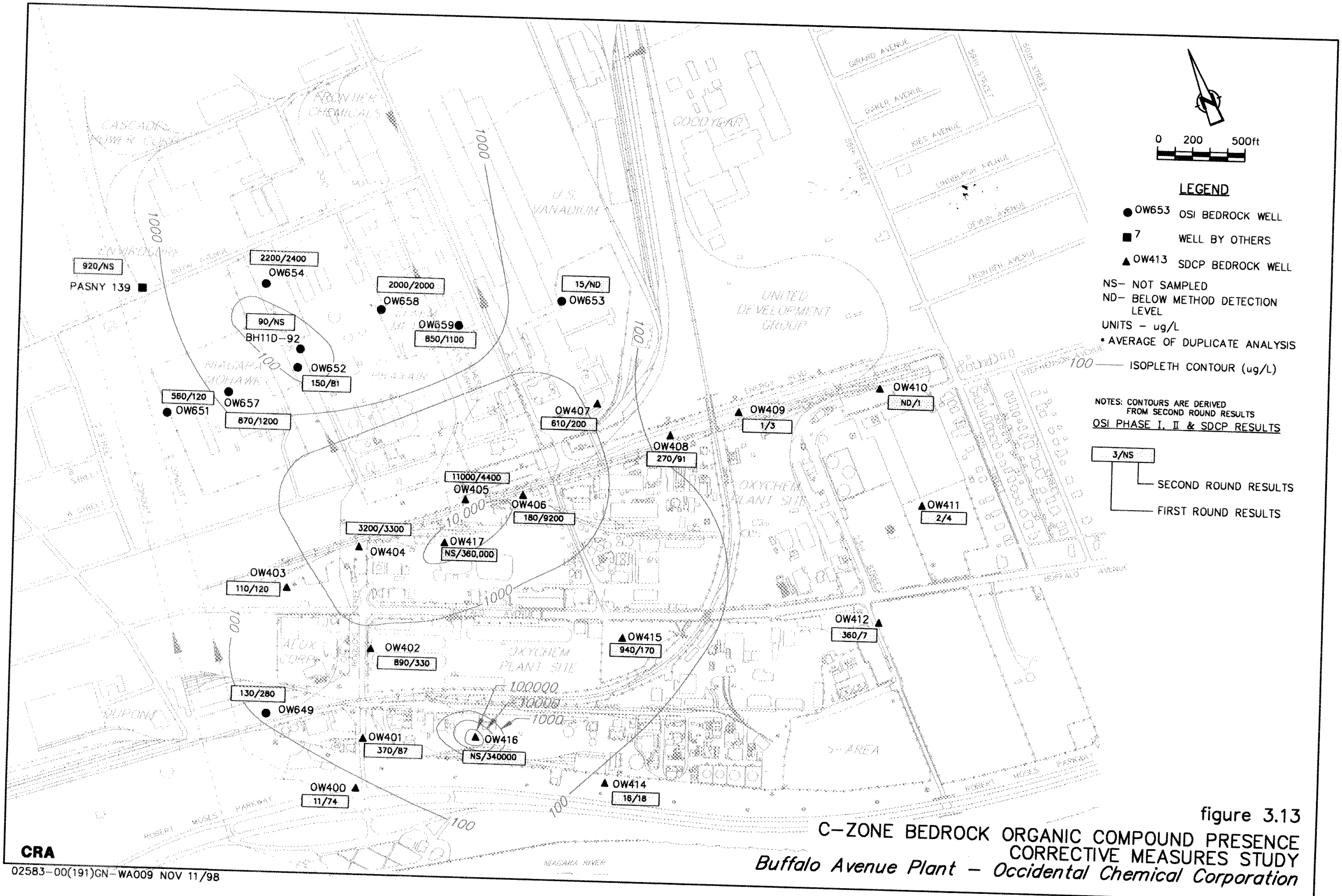


figure 3.13

C–ZONE BEDROCK ORGANIC COMPOUND PRESENCE
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583–00(191)GN–WA009 NOV 11/98

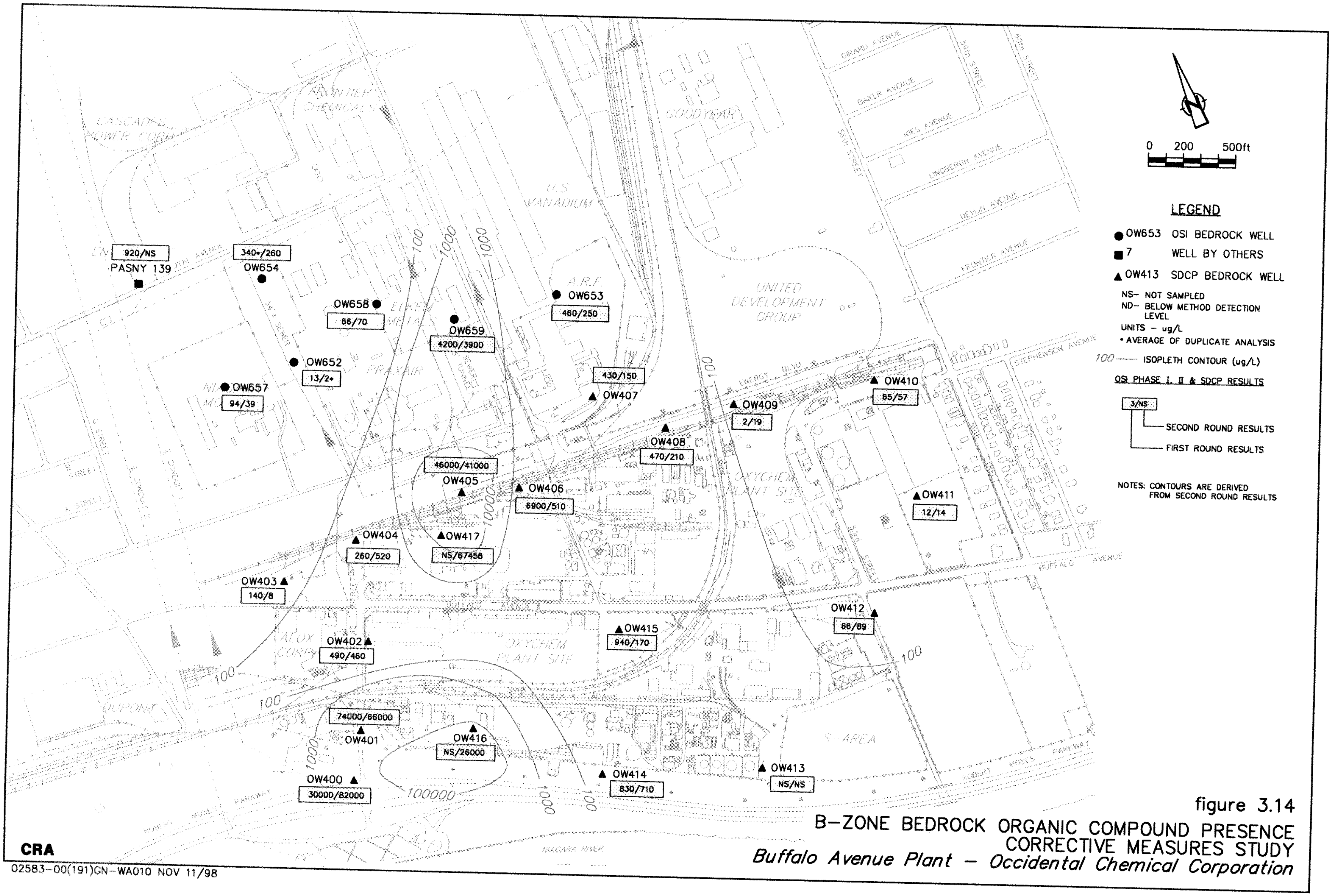


figure 3.14

B–ZONE BEDROCK ORGANIC COMPOUND PRESENCE
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA010 NOV 11/98

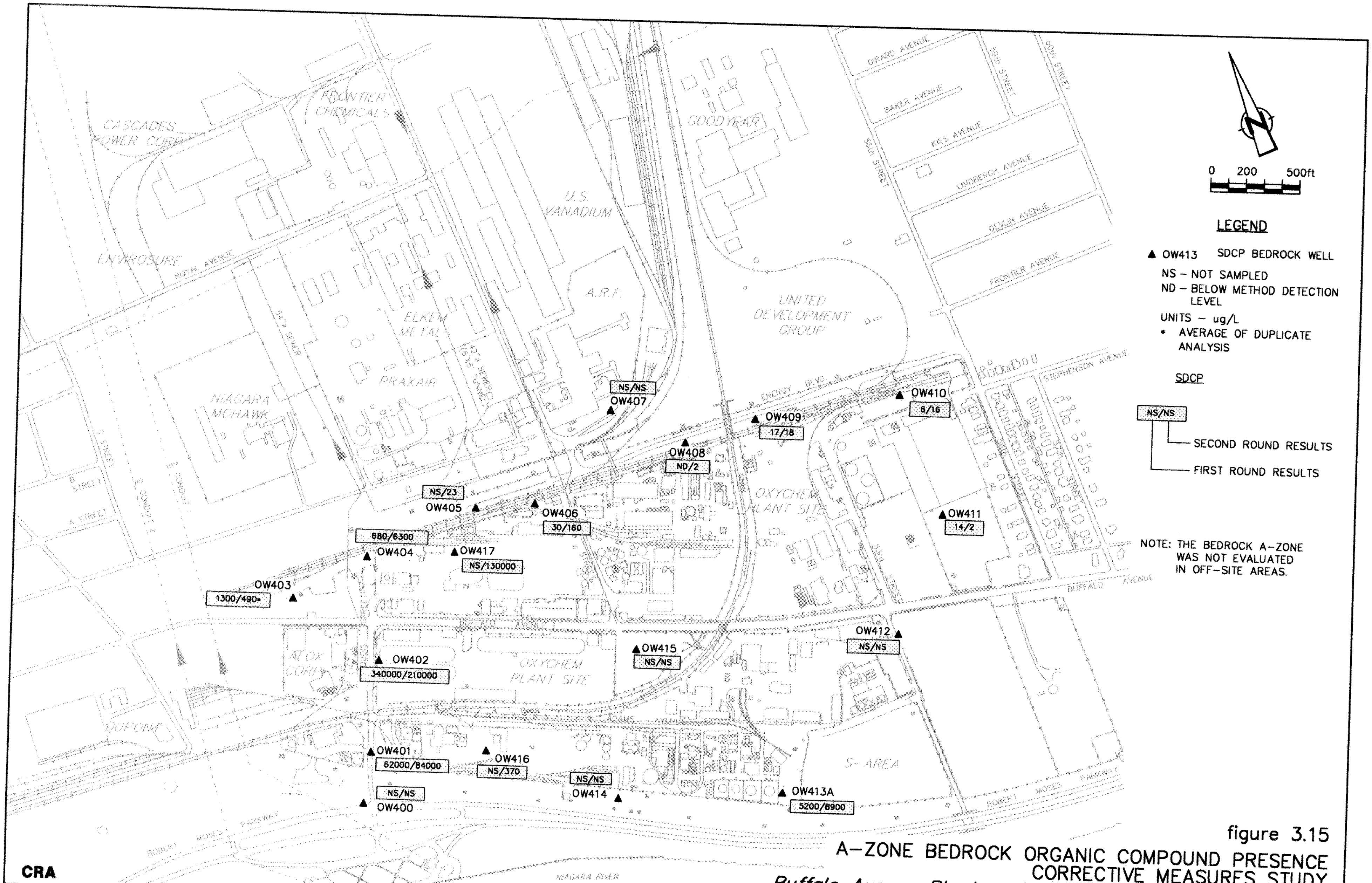


figure 3.15
A-ZONE BEDROCK ORGANIC COMPOUND PRESENCE
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant - Occidental Chemical Corporation

CRA

02583-00(191)GN-WA011 NOV 11/98

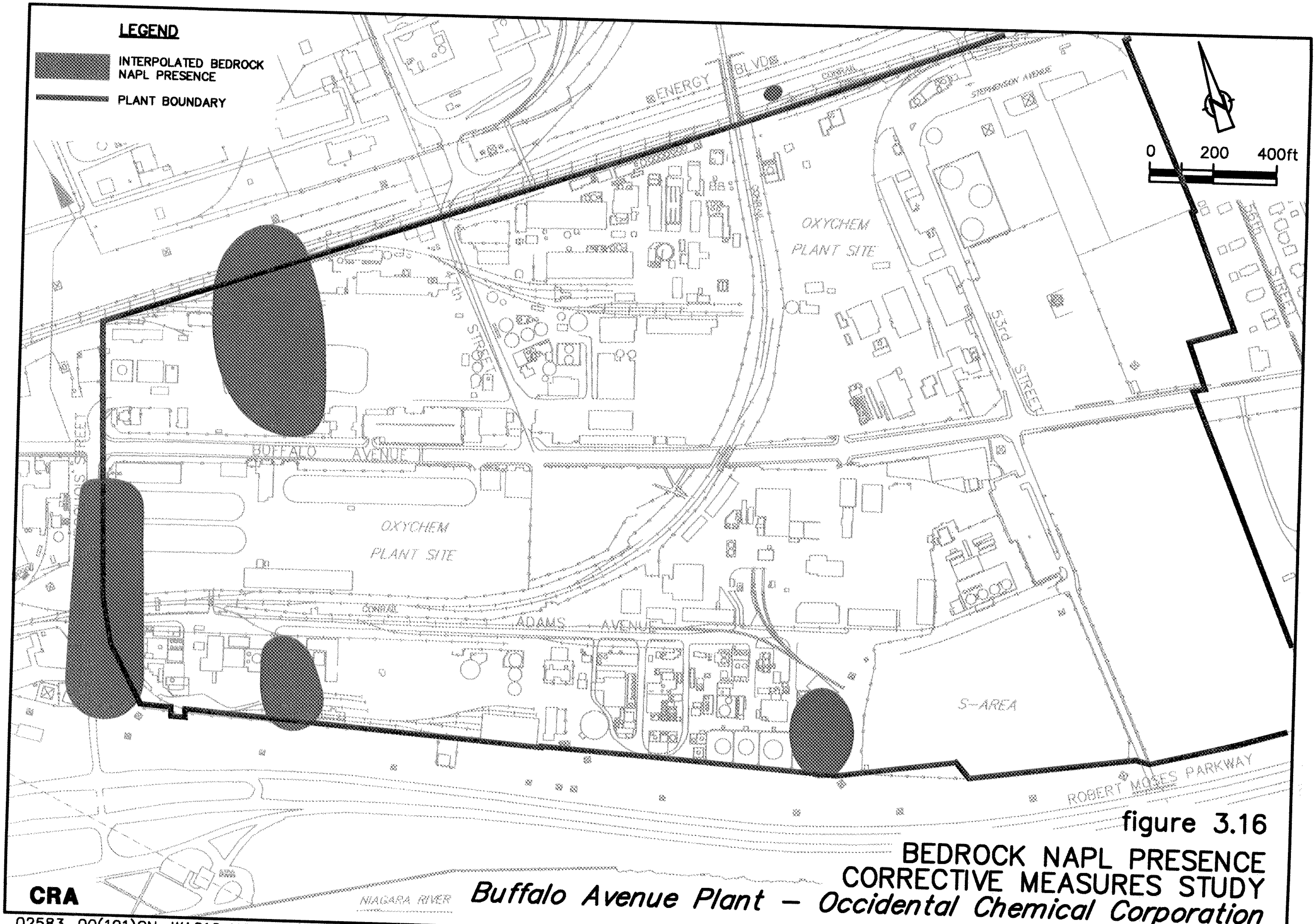


figure 3.16

BEDROCK NAPL PRESENCE
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA012 NOV 13/98

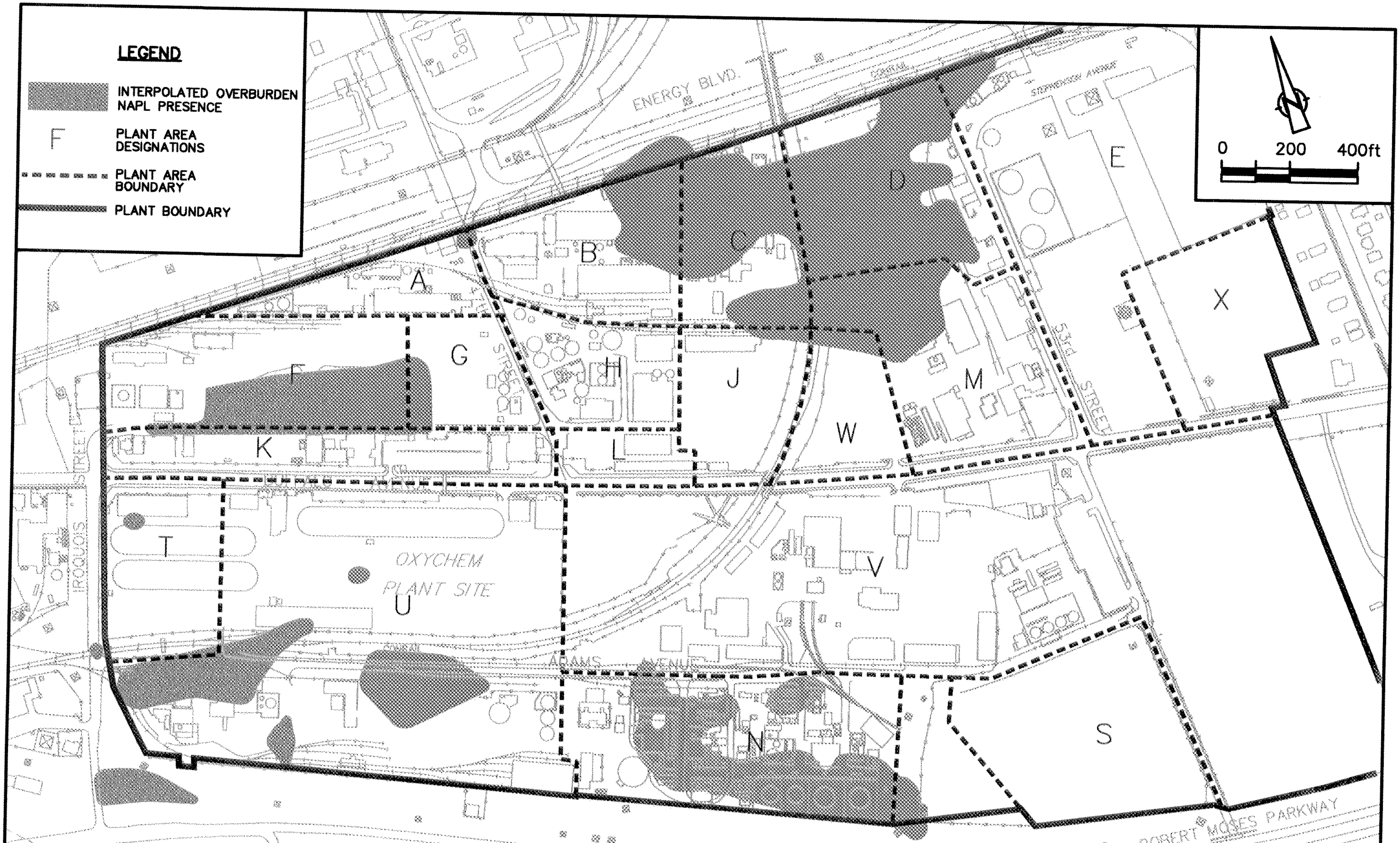


figure 3.17

NAPL PRESENCE – OVERBURDEN SOIL CORRECTIVE MEASURES STUDY

Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA020 NOV 11/98

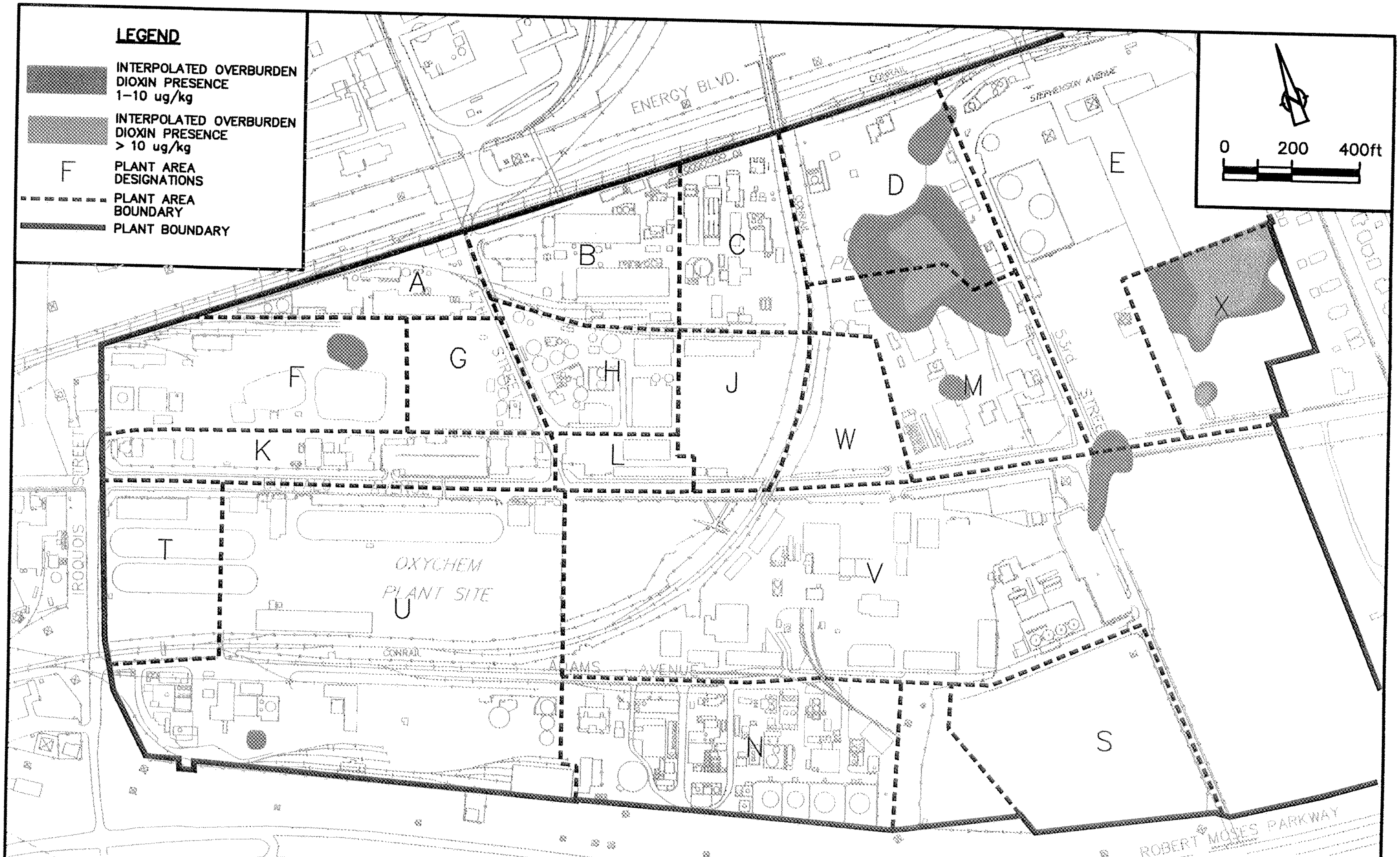


figure 3.18

DIOXIN PRESENCE – OVERBURDEN SOIL CORRECTIVE MEASURES STUDY

Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA021 NOV 13/98

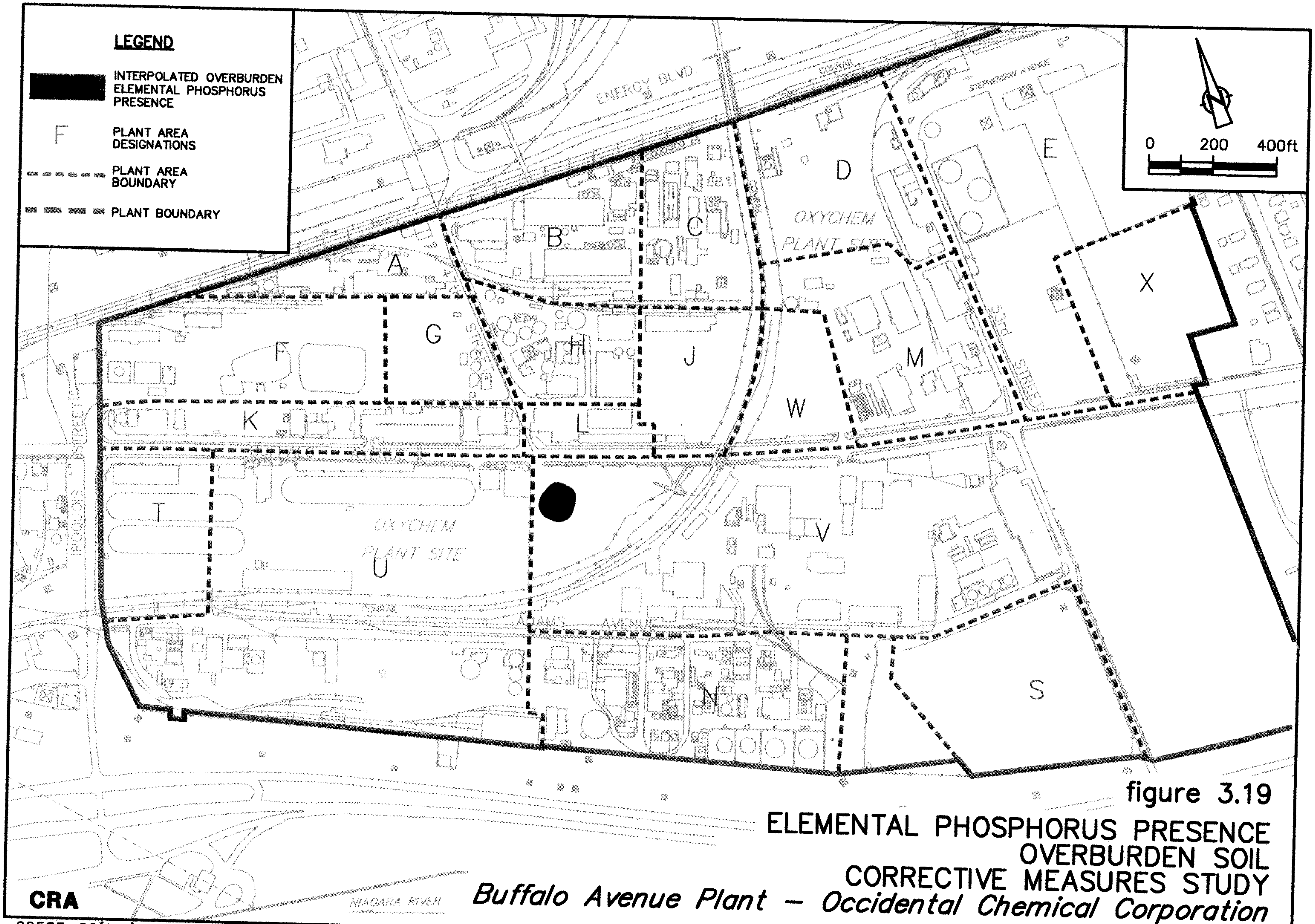


figure 3.19
ELEMENTAL PHOSPHORUS PRESENCE
OVERBURDEN SOIL
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA022 NOV 11/98

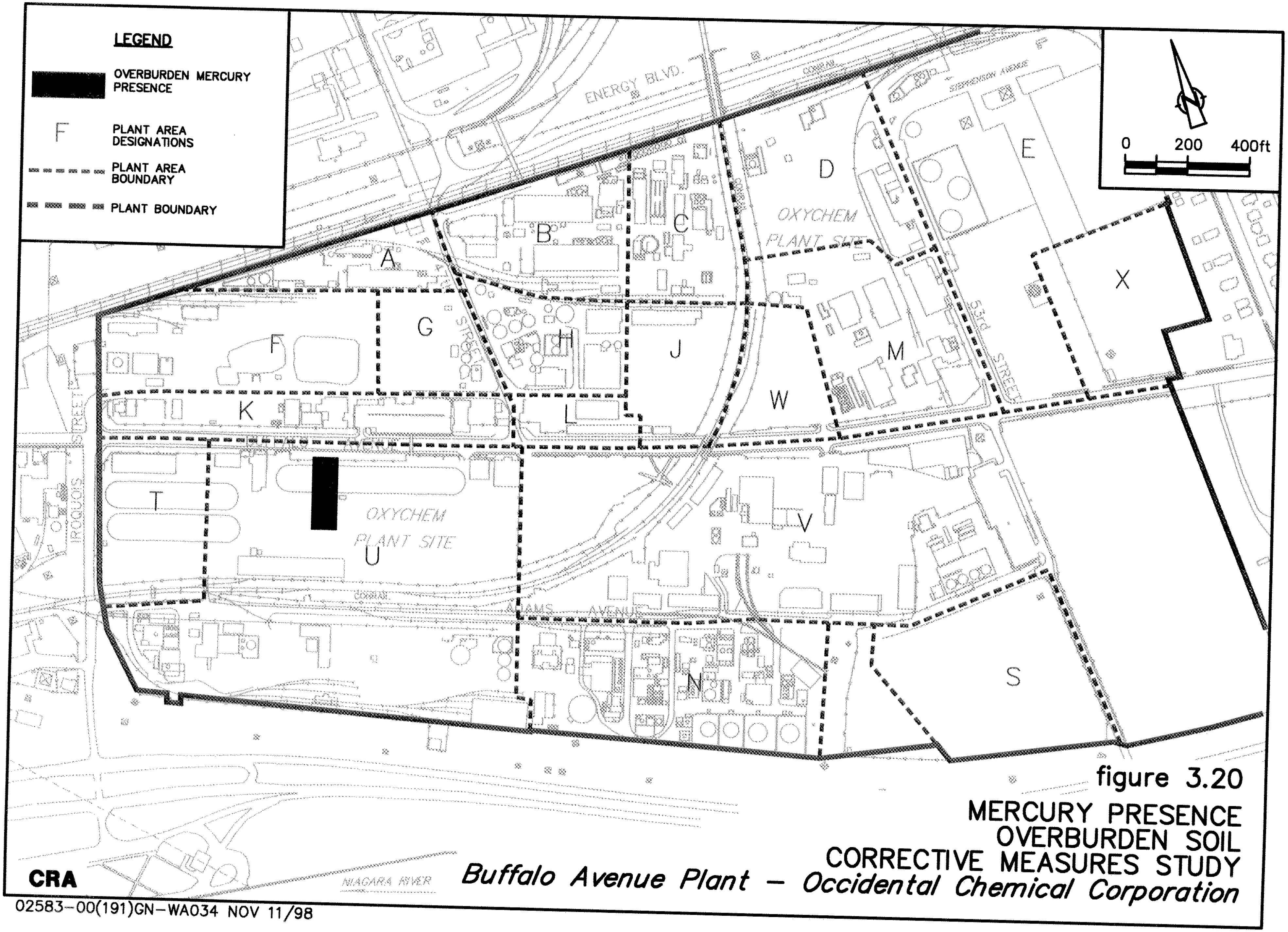


figure 3.20

MERCURY PRESENCE
OVERBURDEN SOIL
CORRECTIVE MEASURES STUDY

Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA034 NOV 11/98

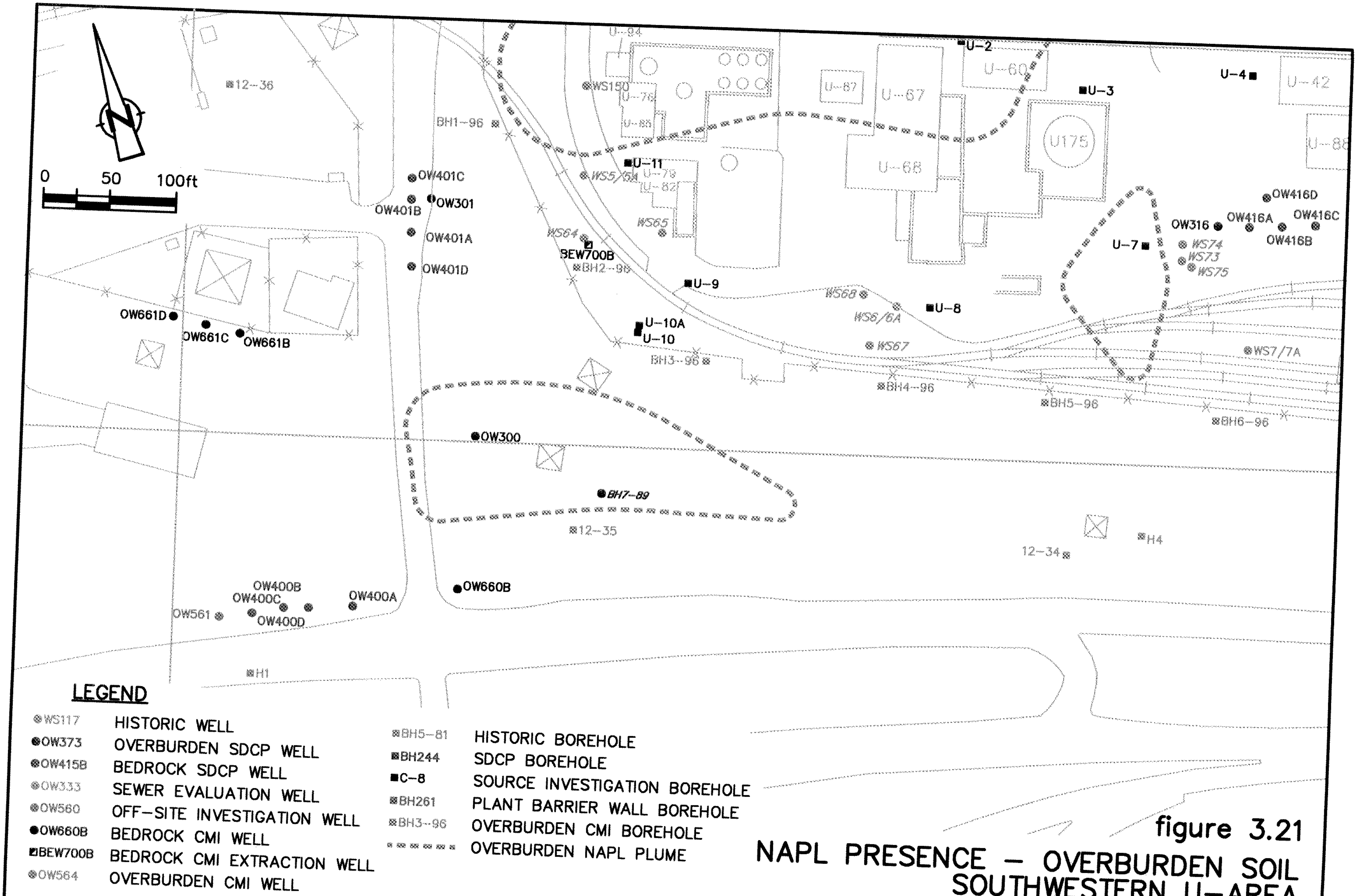


figure 3.21

NAPL PRESENCE – OVERBURDEN SOIL
SOUTHWESTERN U-AREA
CORRECTIVE MEASURES STUDY

Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA054 OCT 22/98

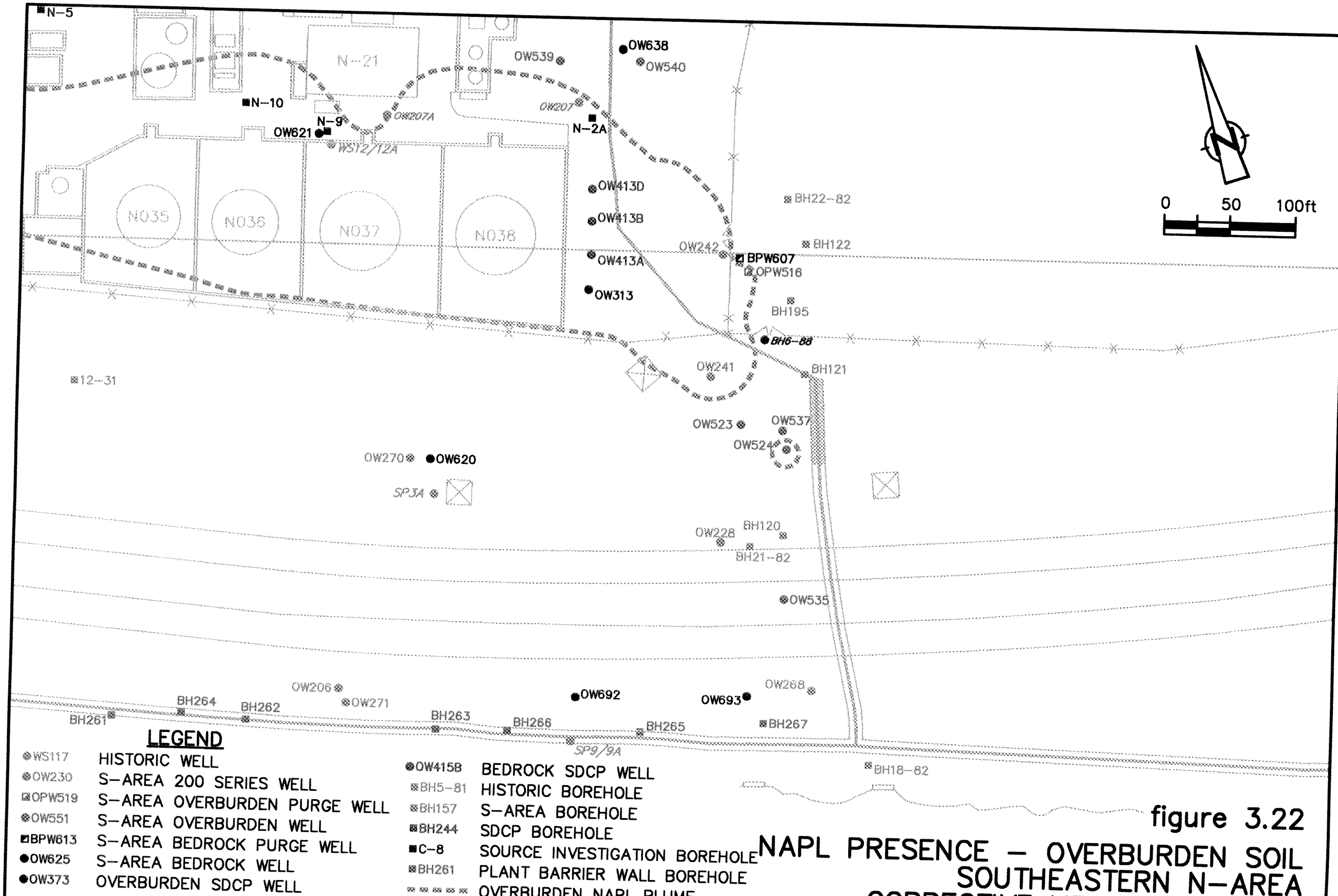


figure 3.22

NAPL PRESENCE – OVERBURDEN SOIL
SOUTHEASTERN N-AREA
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA053 OCT 22/98

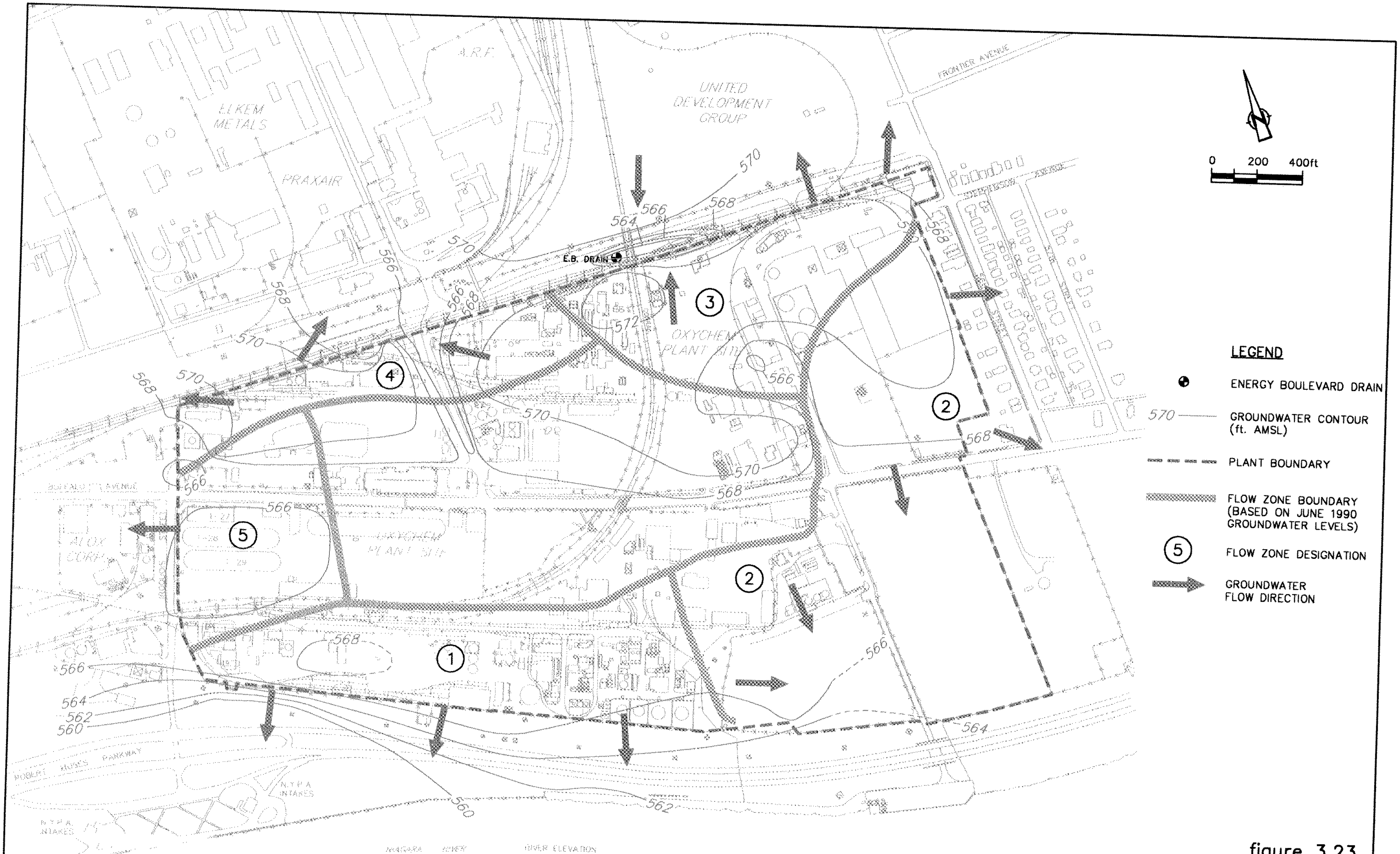


figure 3.23
OVERBURDEN GROUNDWATER FLOW ZONES
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA
02583-00(191)GN-WA005 NOV 04/98

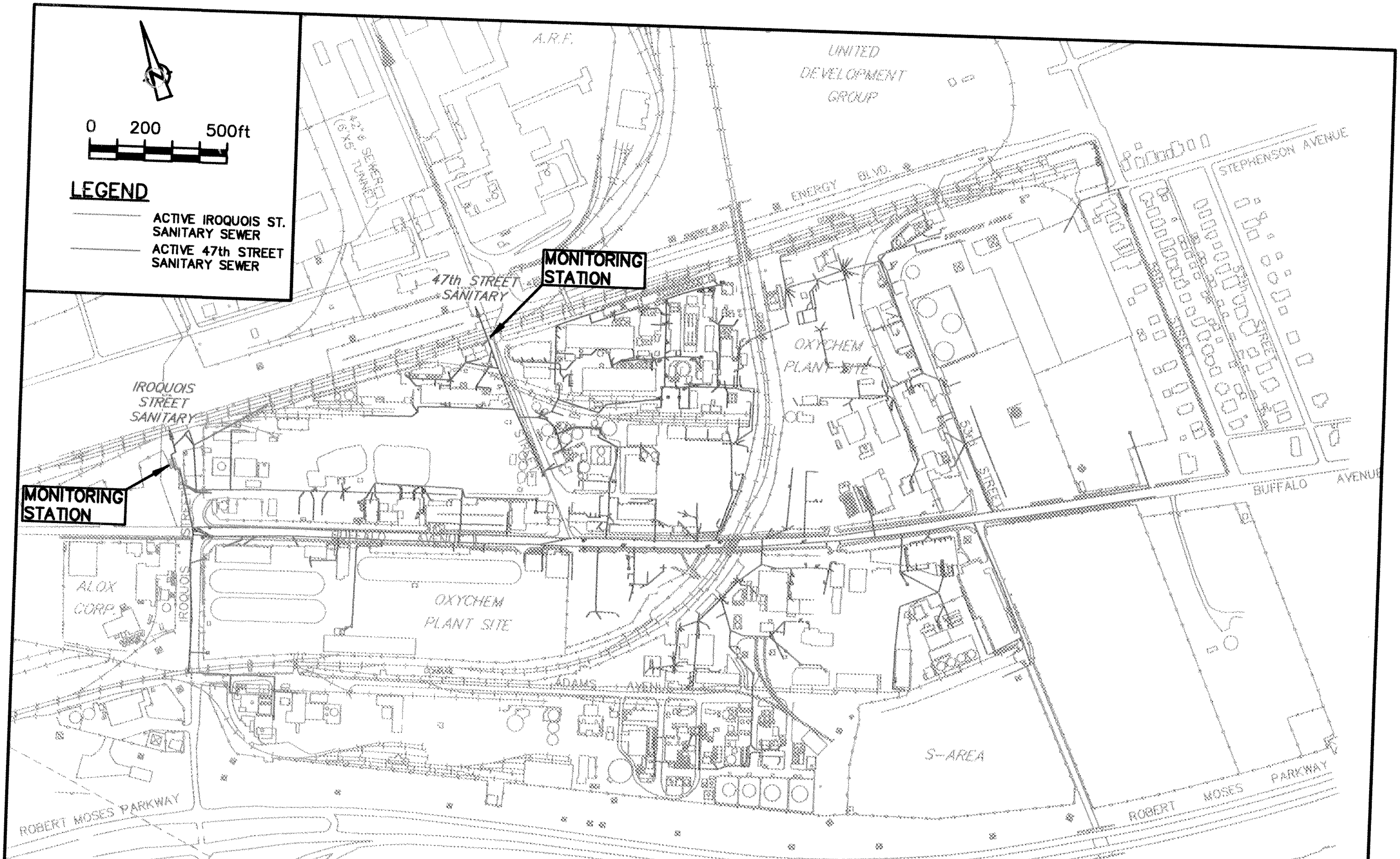


figure 3.24

ACTIVE PLANT SANITARY SEWERS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA017 NOV 11/98

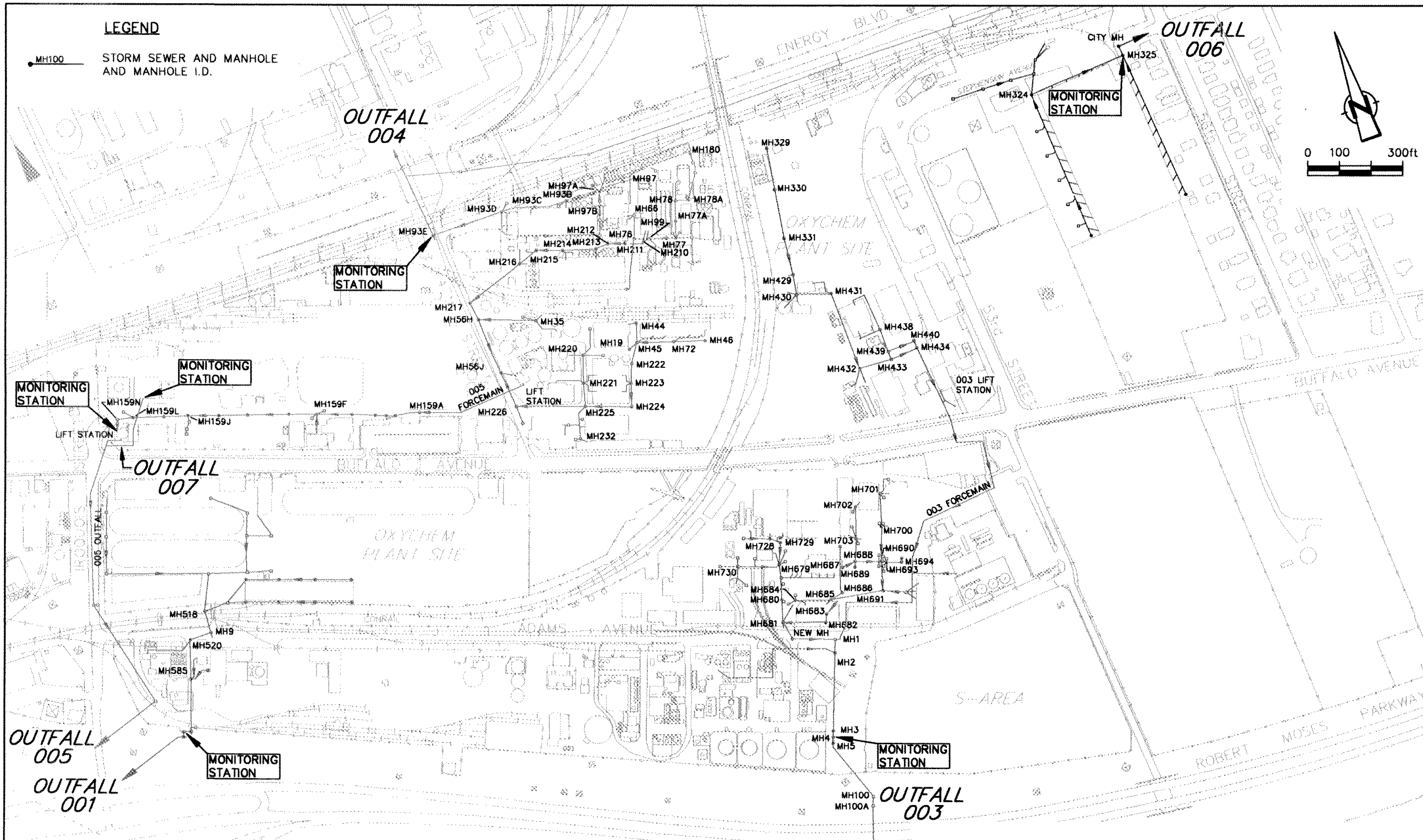


figure 3.25

ACTIVE PLANT OUTFALL SEWERS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA018 NOV 11/98

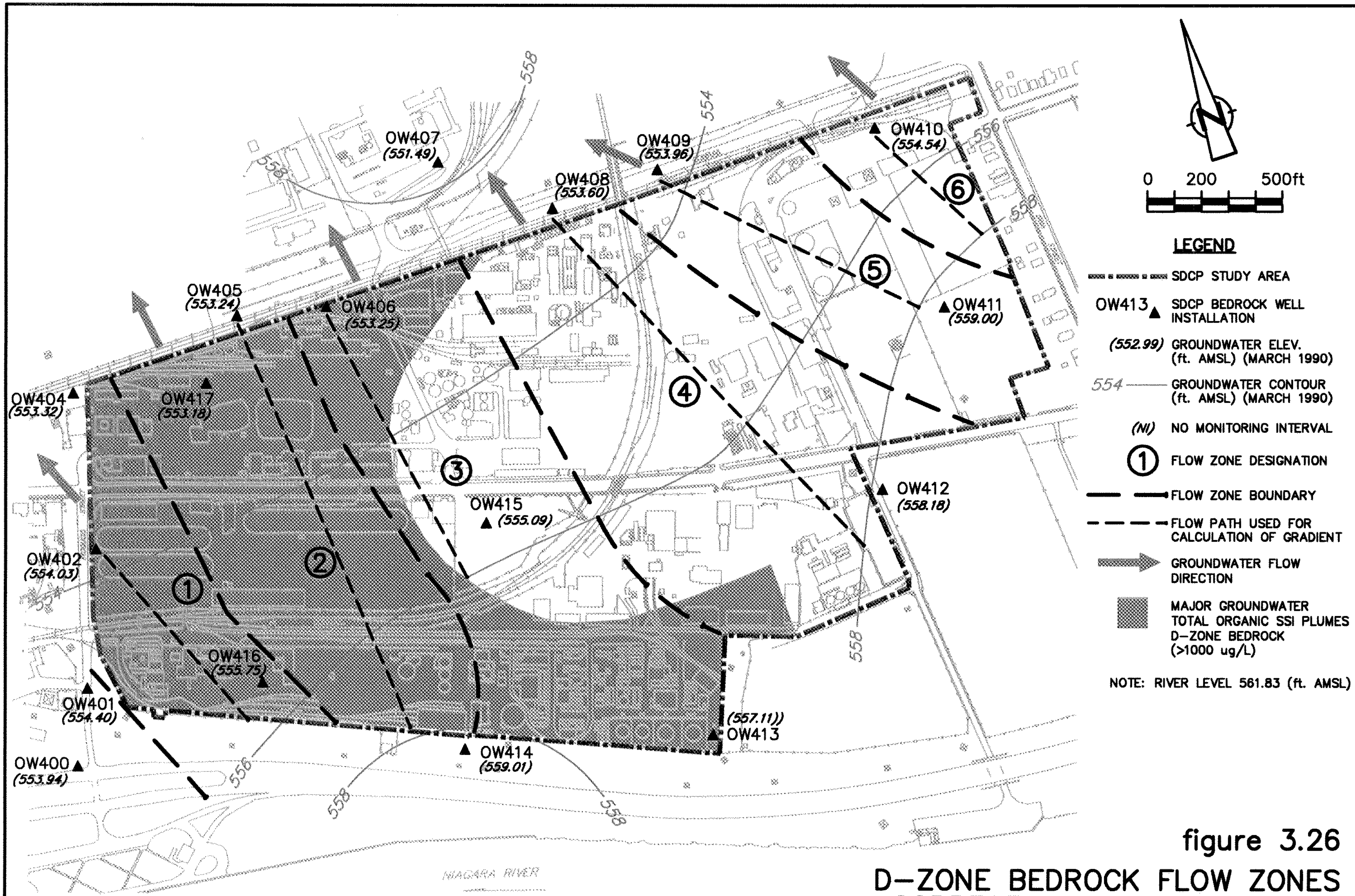


figure 3.26

D-ZONE BEDROCK FLOW ZONES
CORRECTIVE MEASURES STUDY

Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA035 NOV 11/98

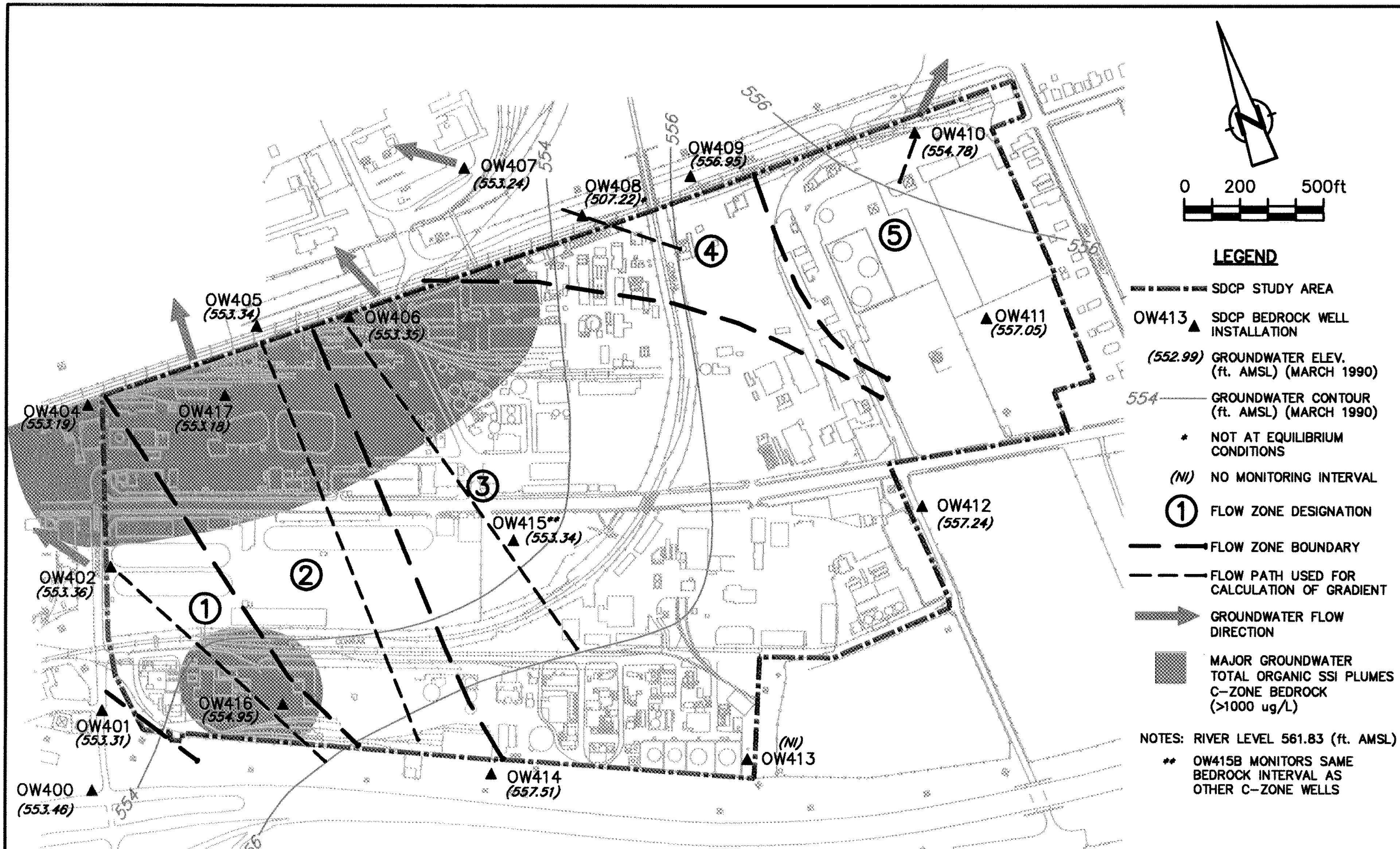


figure 3.27

C-ZONE BEDROCK FLOW ZONES
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA036 NOV 11/98

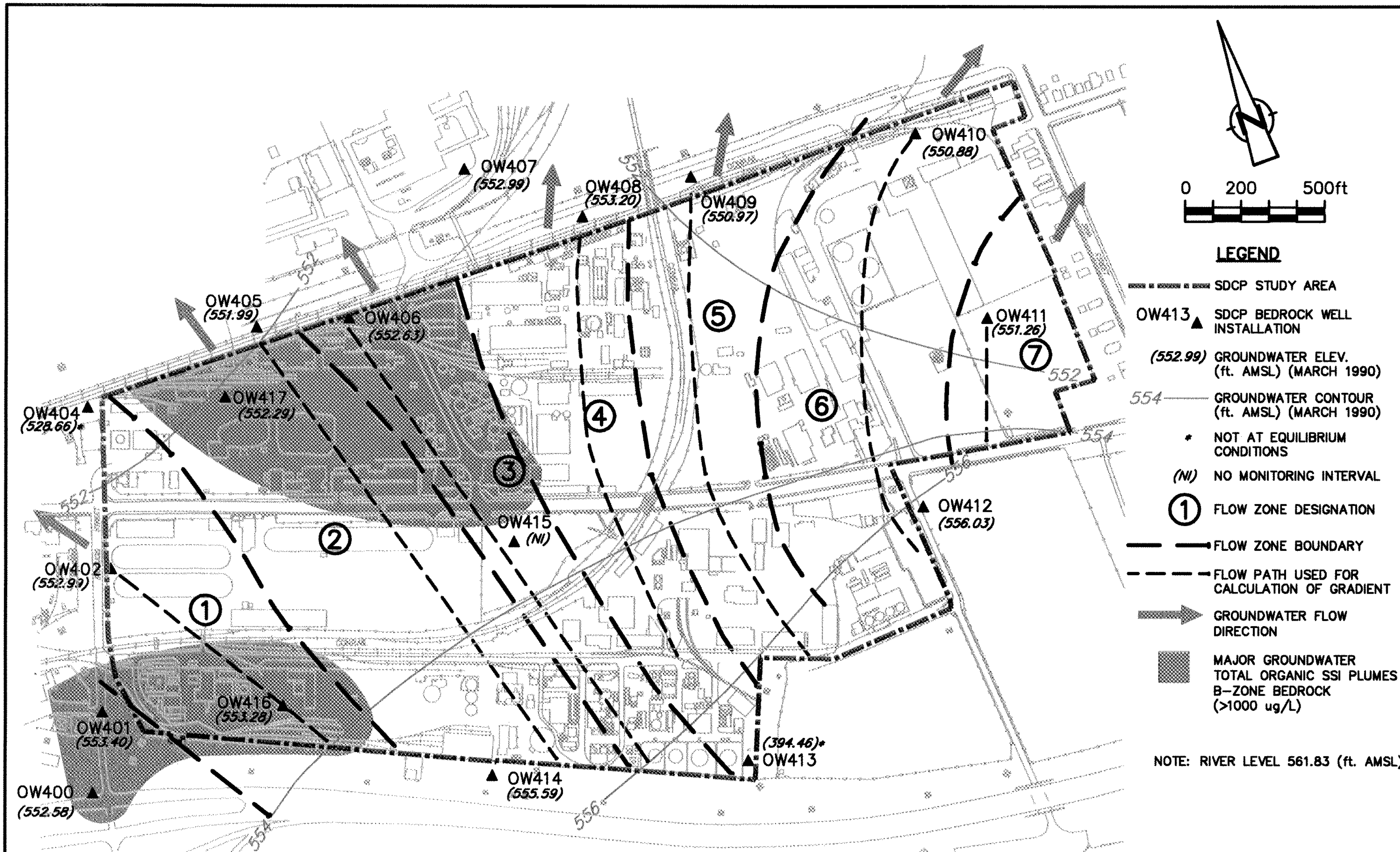


figure 3.28

B–ZONE BEDROCK FLOW ZONES
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583–00(191)GN–WA037 NOV 11/98

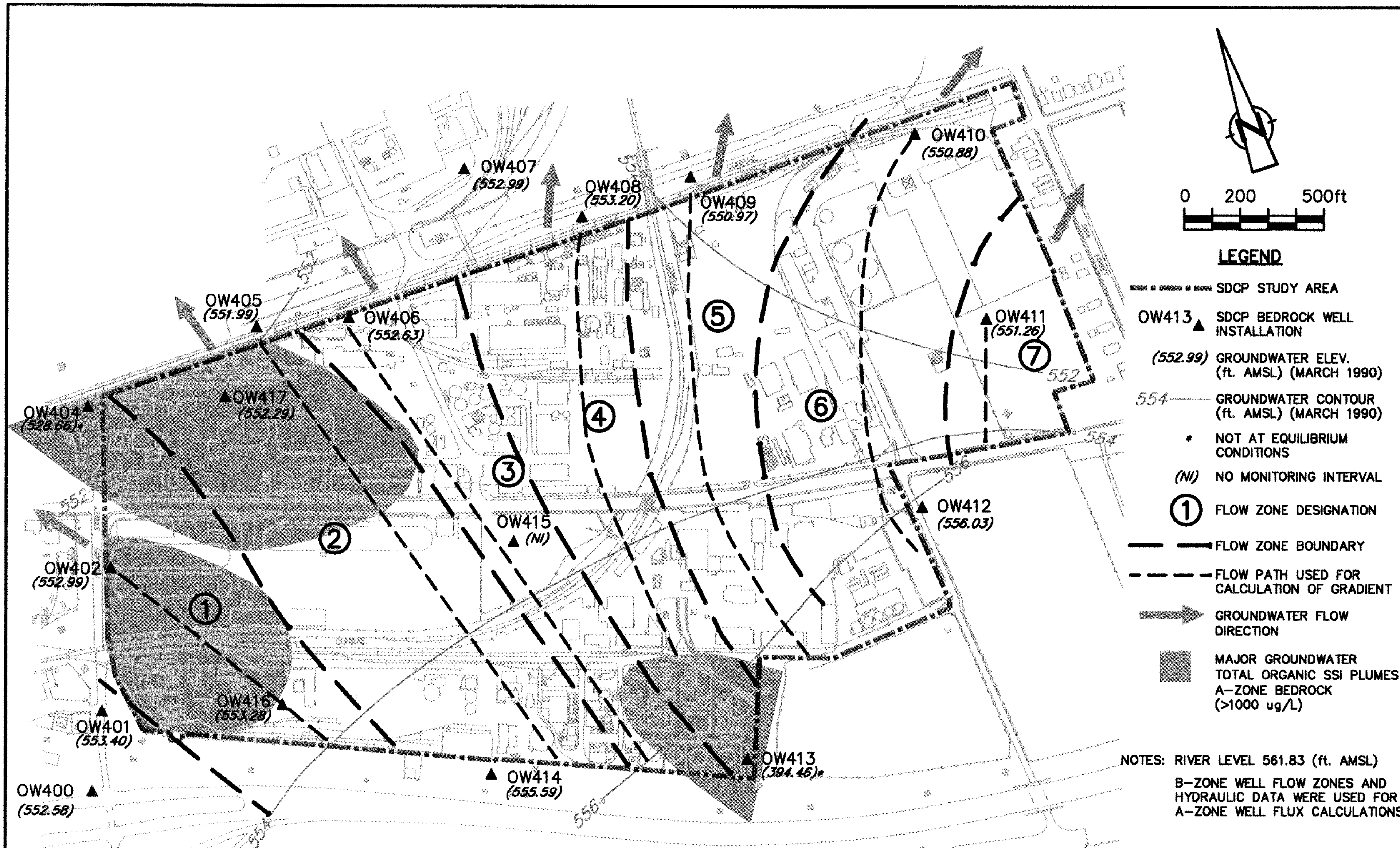


figure 3.29

A–ZONE BEDROCK FLOW ZONES
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583–00(191)GN–WA038 NOV 11/98

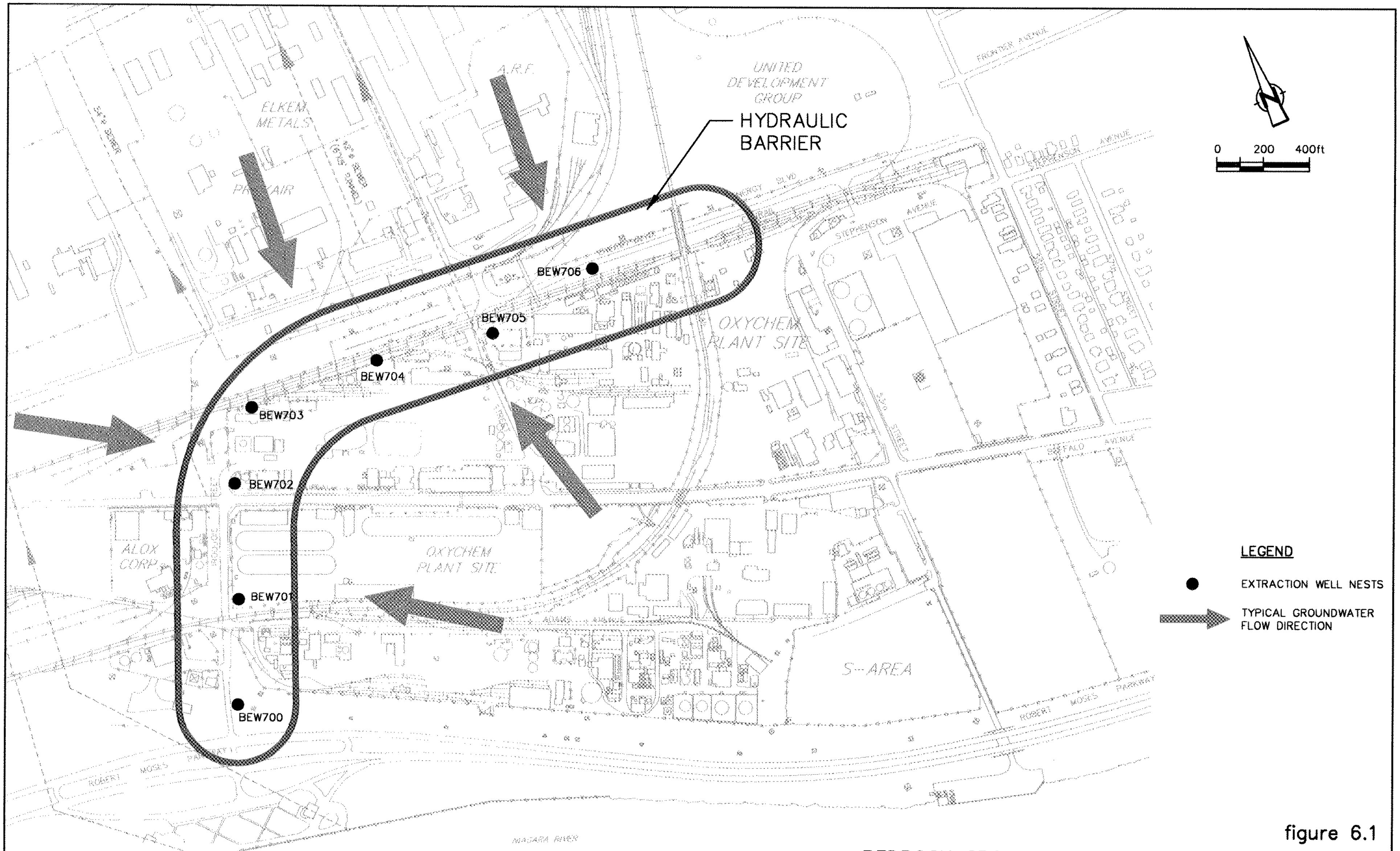


figure 6.1
BEDROCK GROUNDWATER HYDRAULIC CONTAINMENT
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA026 NOV 11/98

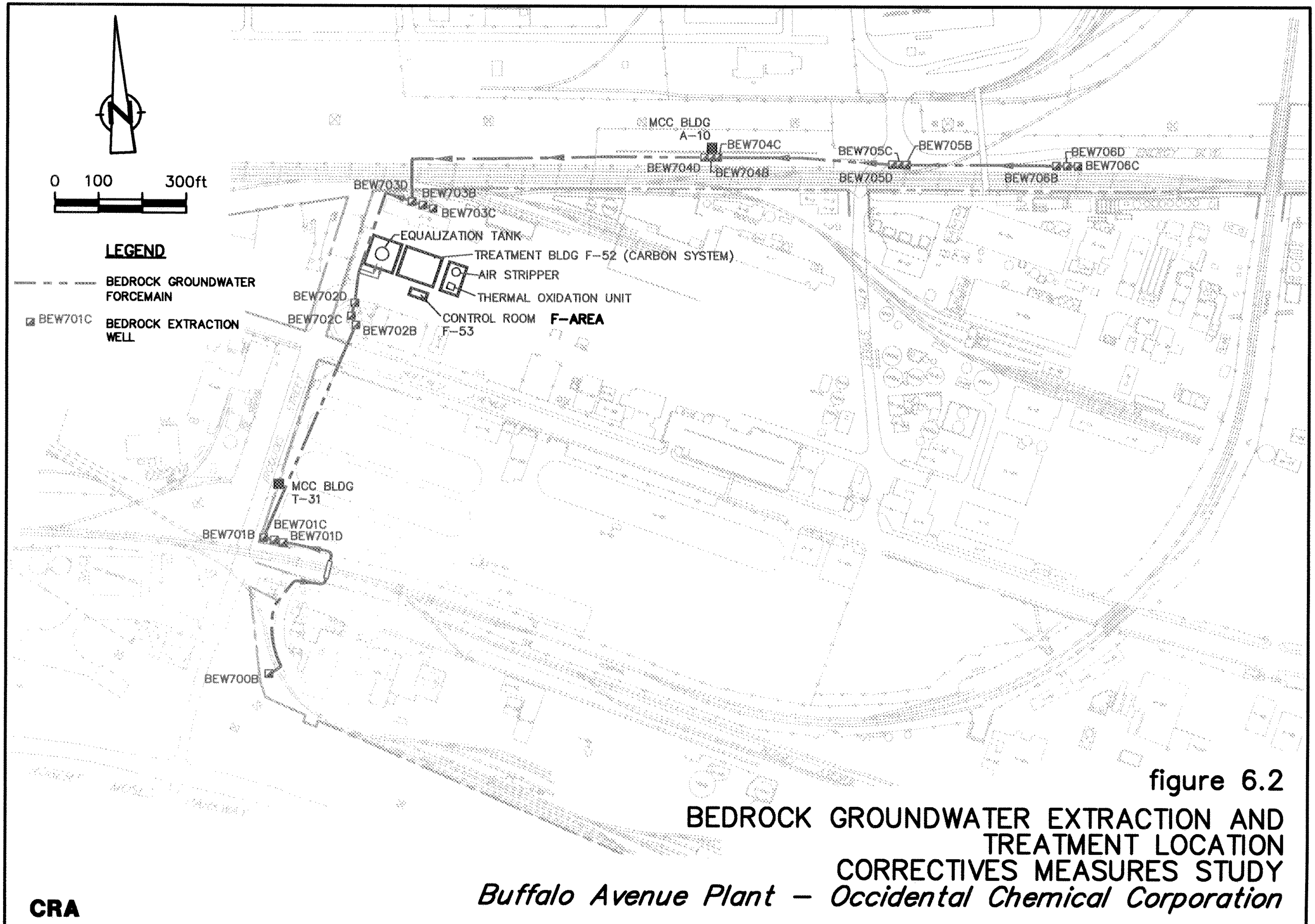


figure 6.2

BEDROCK GROUNDWATER EXTRACTION AND TREATMENT LOCATION
CORRECTIVES MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA045 NOV 11/98

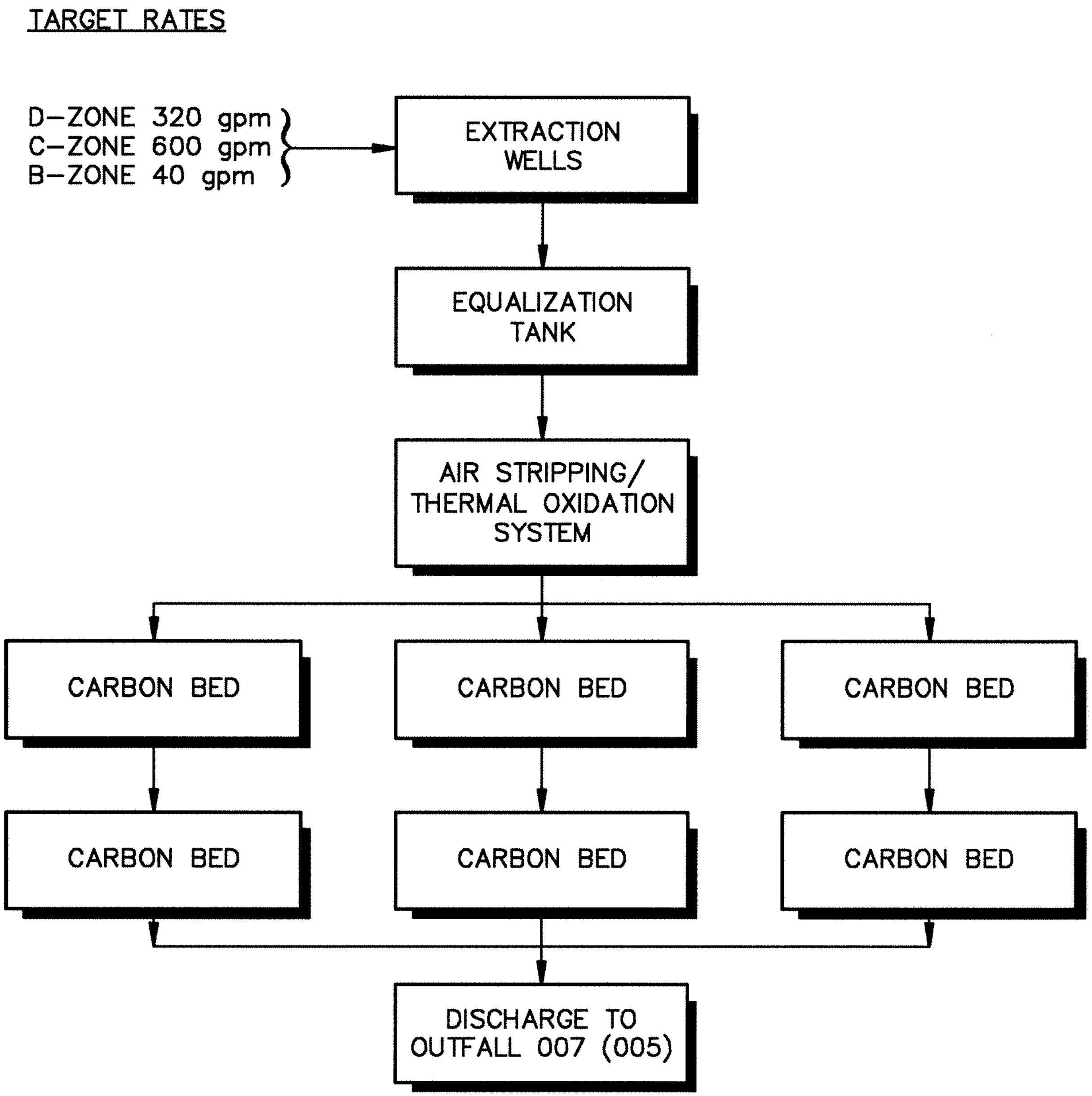


figure 6.3

FLOW DIAGRAM
BEDROCK GROUNDWATER TREATMENT SYSTEM
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583–00(191)GN–WA025 SEP 11/98

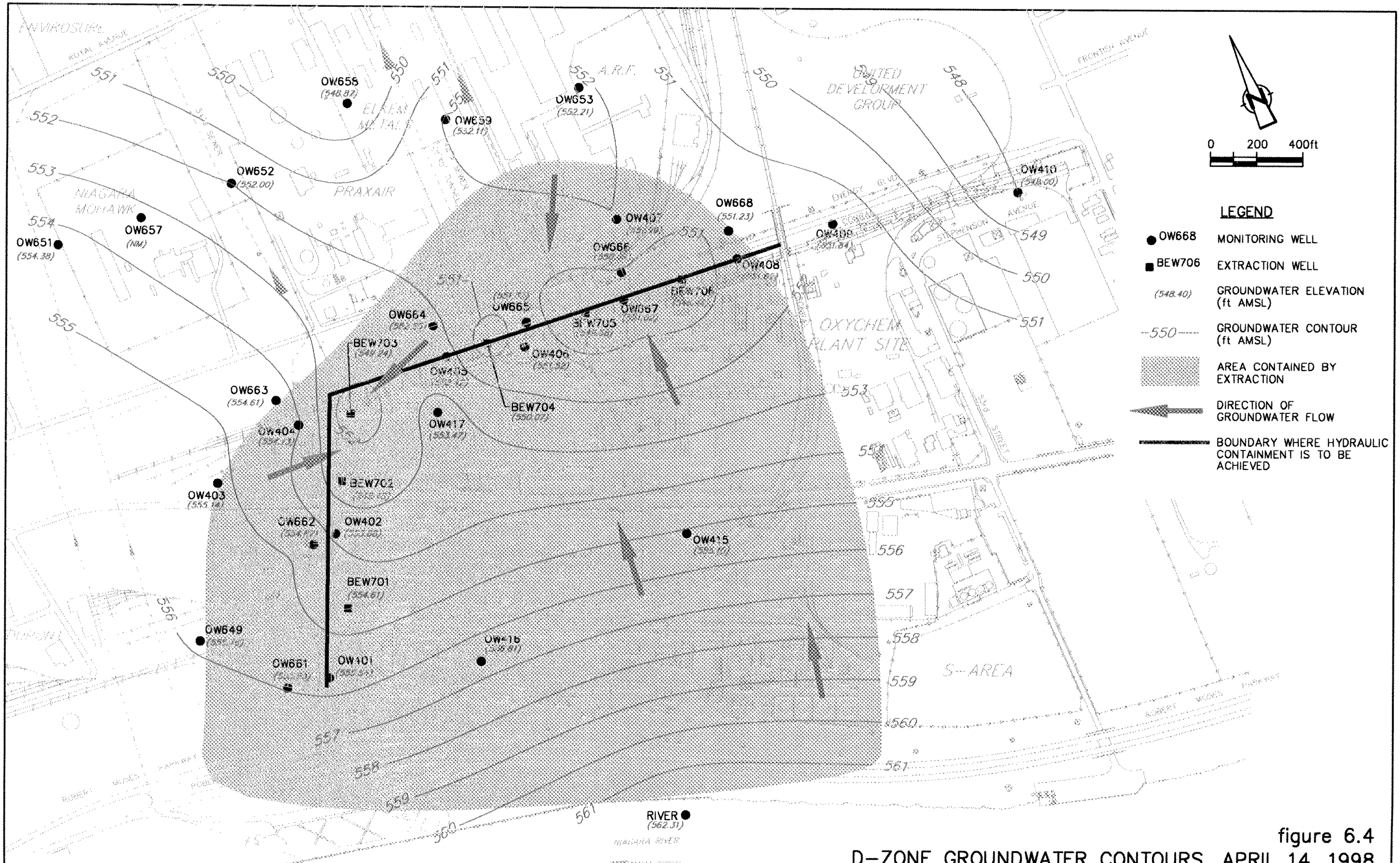


figure 6.4

D-ZONE GROUNDWATER CONTOURS, APRIL 14, 1998

CORRECTIVE MEASURES STUDY

Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA049 NOV 11/98

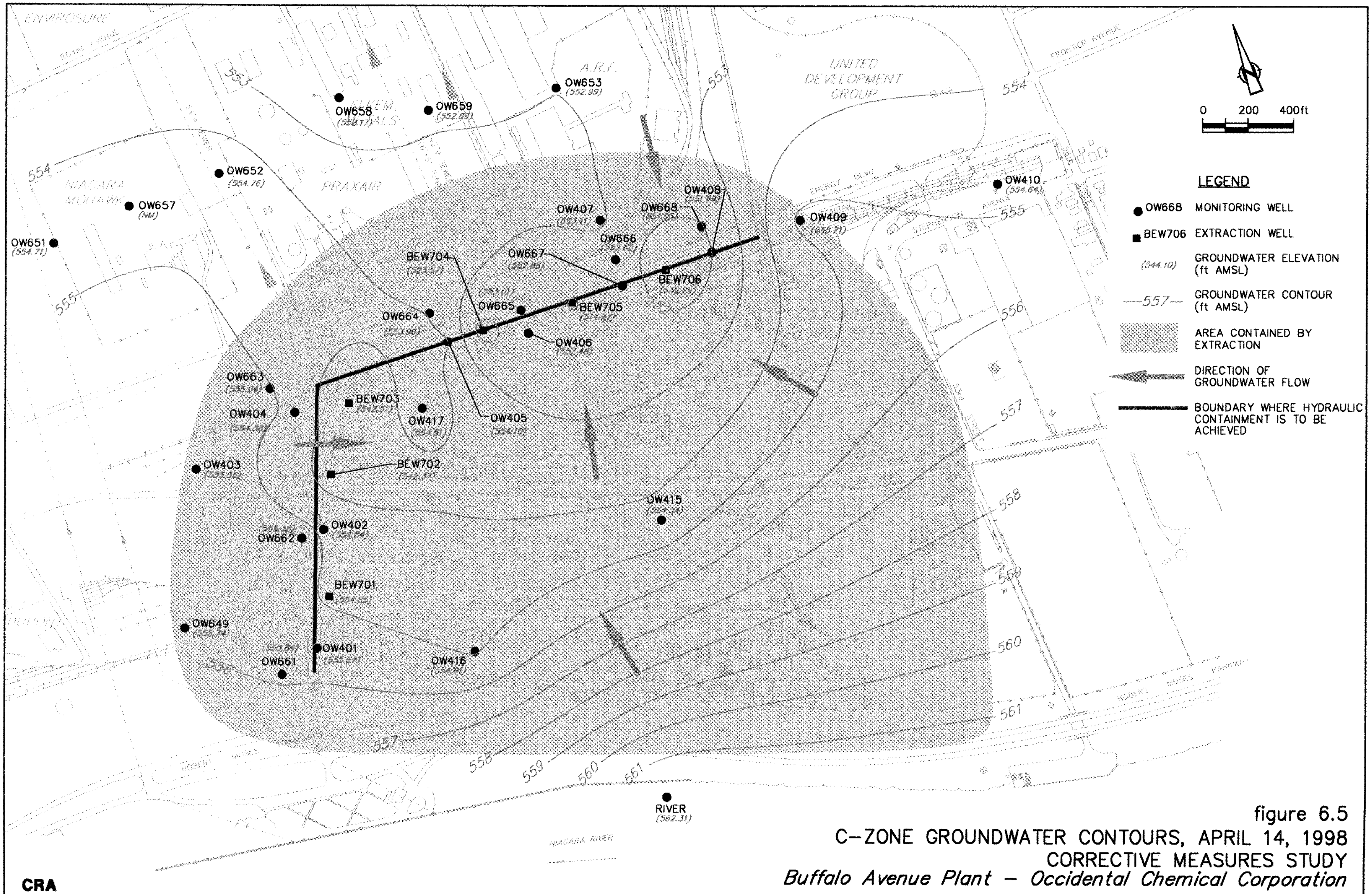


figure 6.5

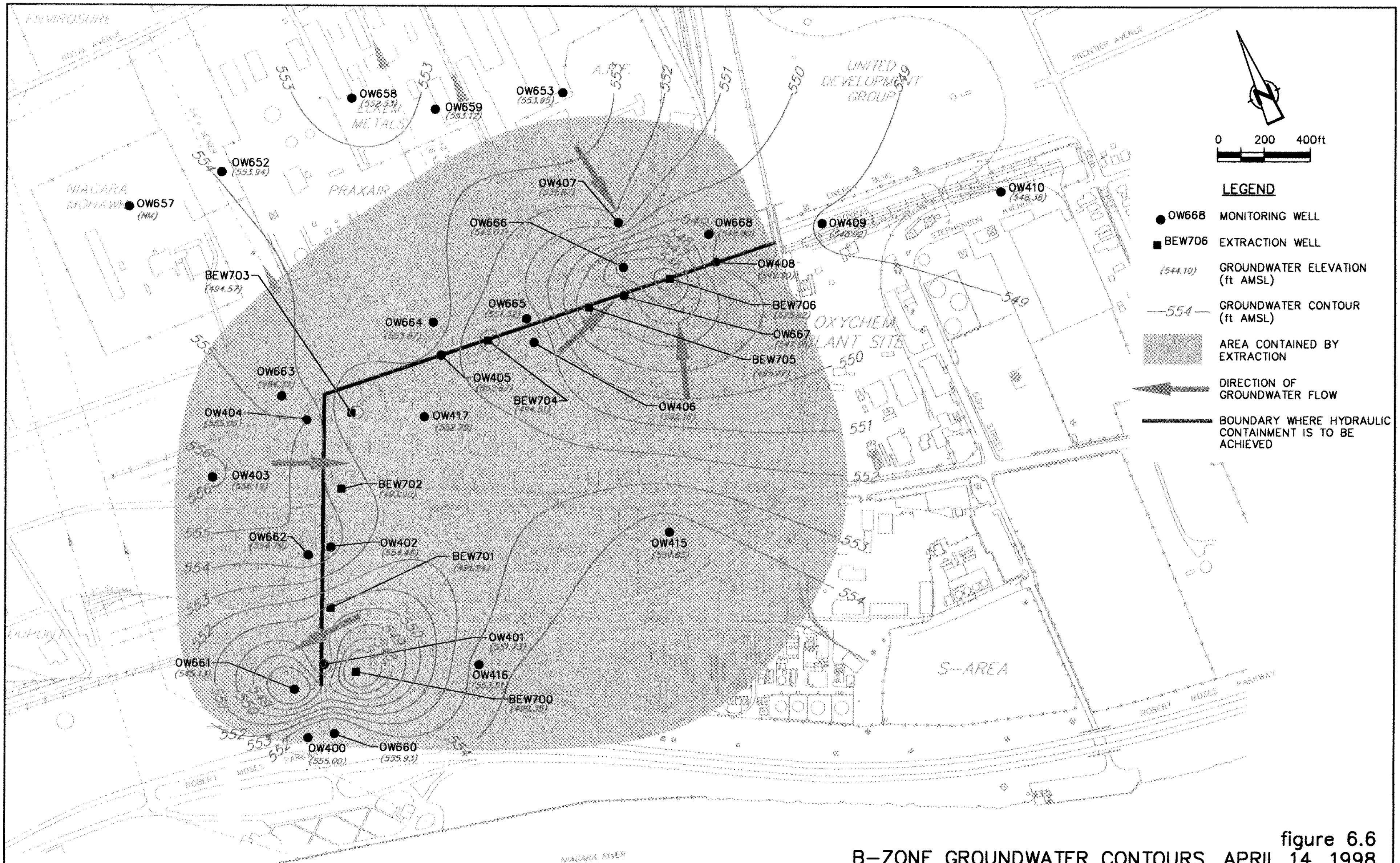
C–ZONE GROUNDWATER CONTOURS, APRIL 14, 1998

CORRECTIVE MEASURES STUDY

Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA048 NOV 11/98



CRA

figure 6.6
B-ZONE GROUNDWATER CONTOURS, APRIL 14, 1998
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA047 NOV 11/98

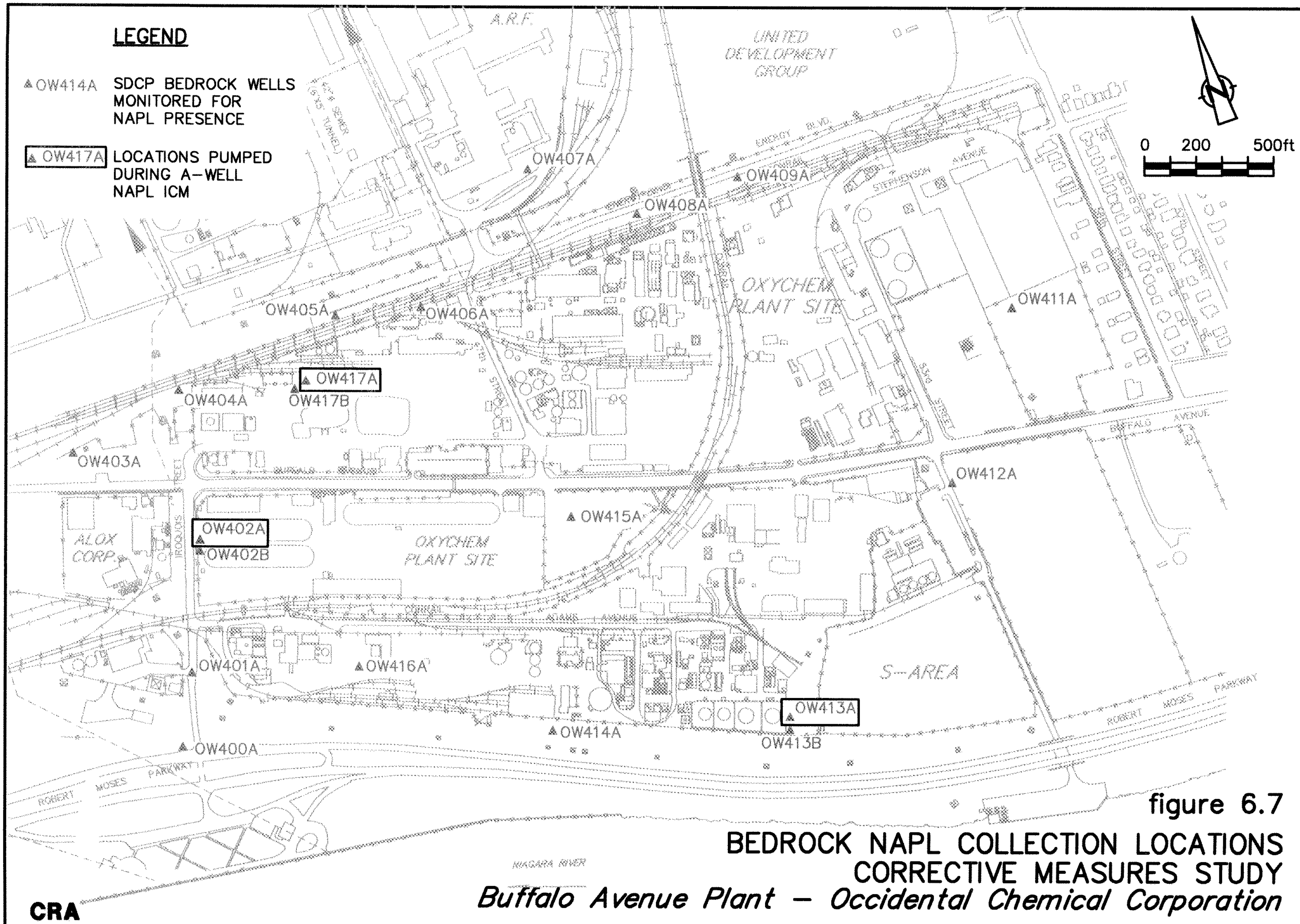


figure 6.7

BEDROCK NAPL COLLECTION LOCATIONS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA039 NOV 11/98

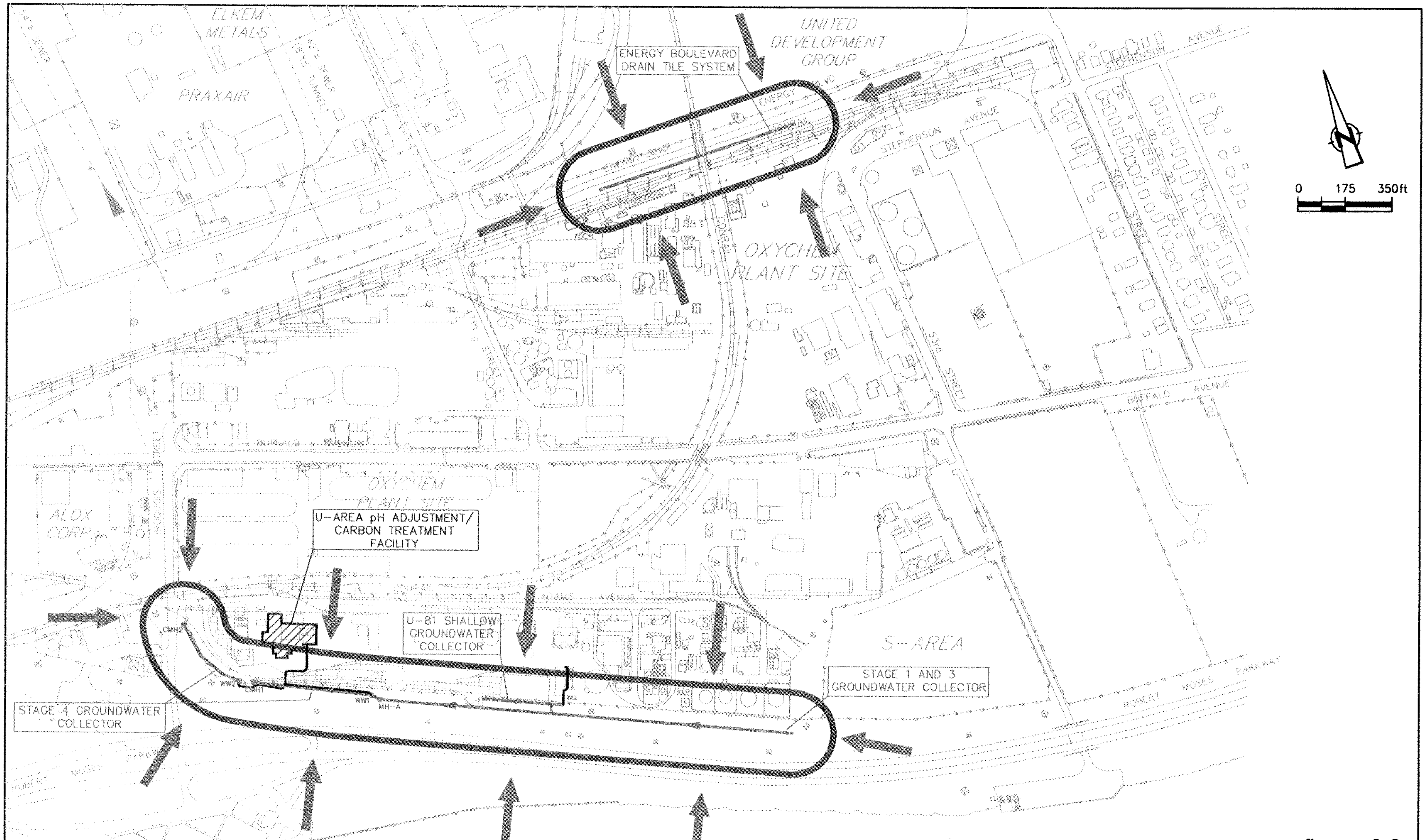


figure 6.8

OVERBURDEN GROUNDWATER HYDRAULIC CONTAINMENT
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA027 NOV 11/98

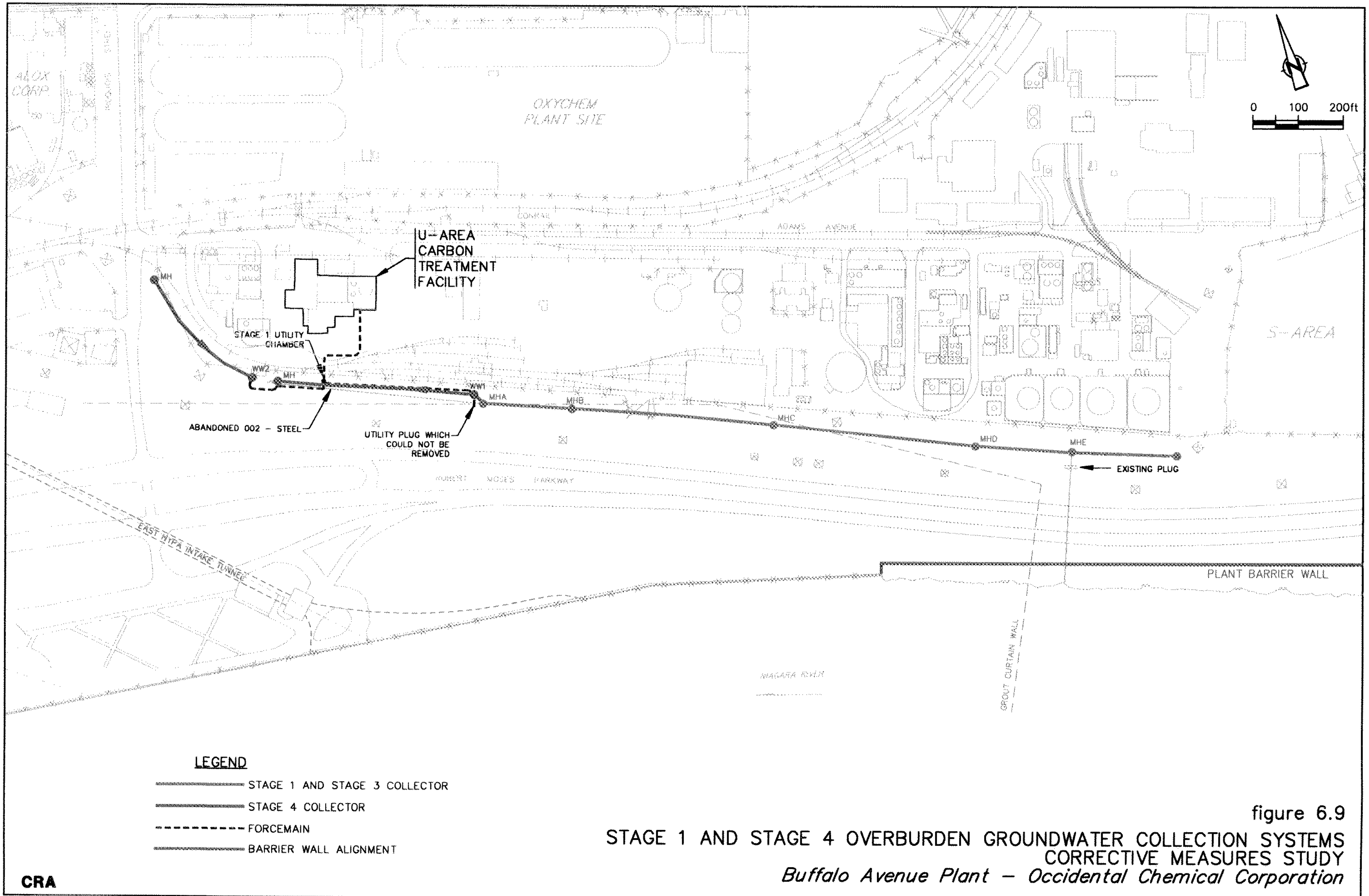


figure 6.9
STAGE 1 AND STAGE 4 OVERBURDEN GROUNDWATER COLLECTION SYSTEMS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA028 NOV 11/98

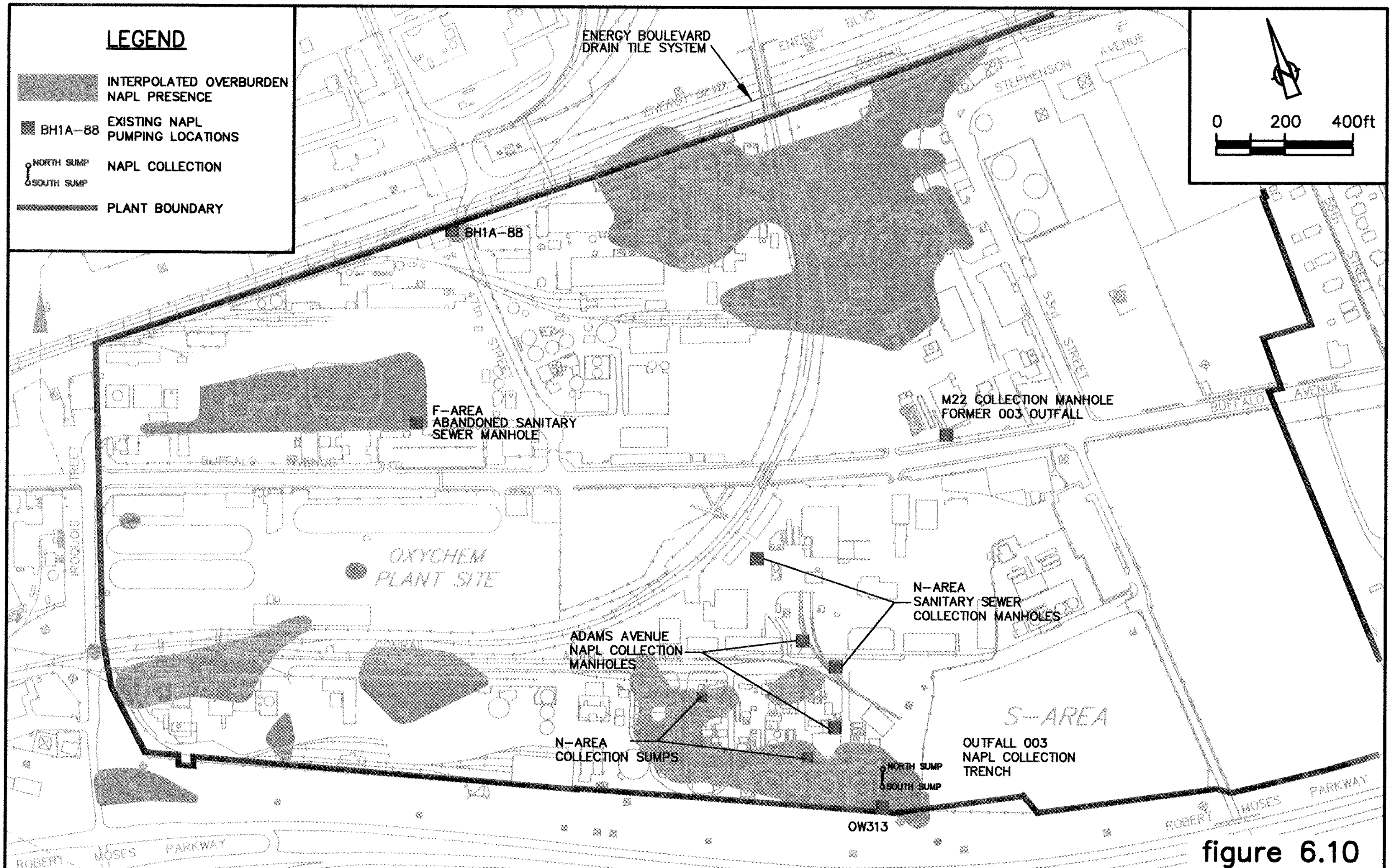


figure 6.10

OVERBURDEN NAPL COLLECTION LOCATIONS
CORRECTIVE MEASURE STUDY

Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA044 NOV 11/98

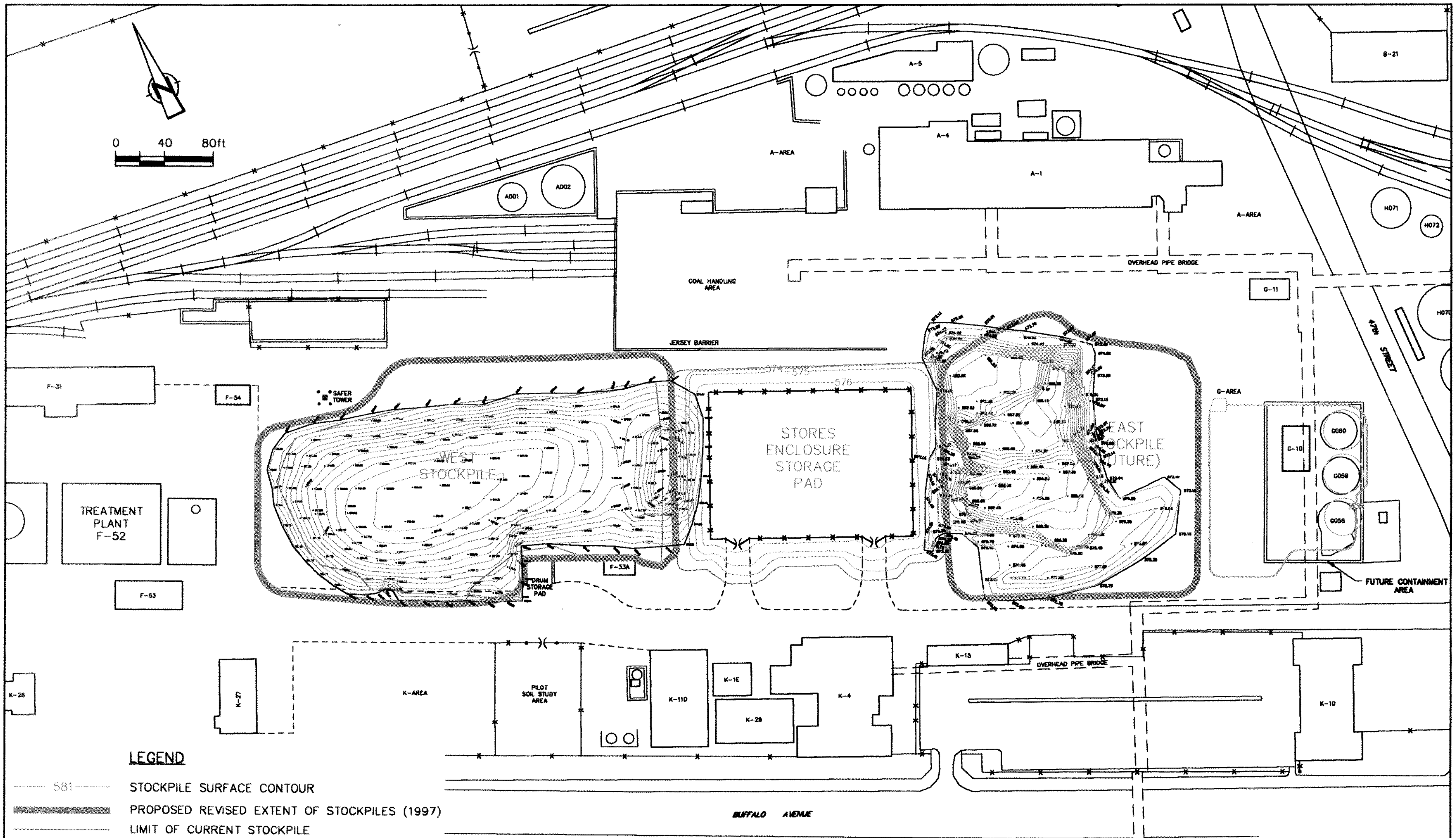


figure 6.11

F–AREA LONG–TERM SOIL STOCKPILE LOCATIONS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA055 NOV 13/98

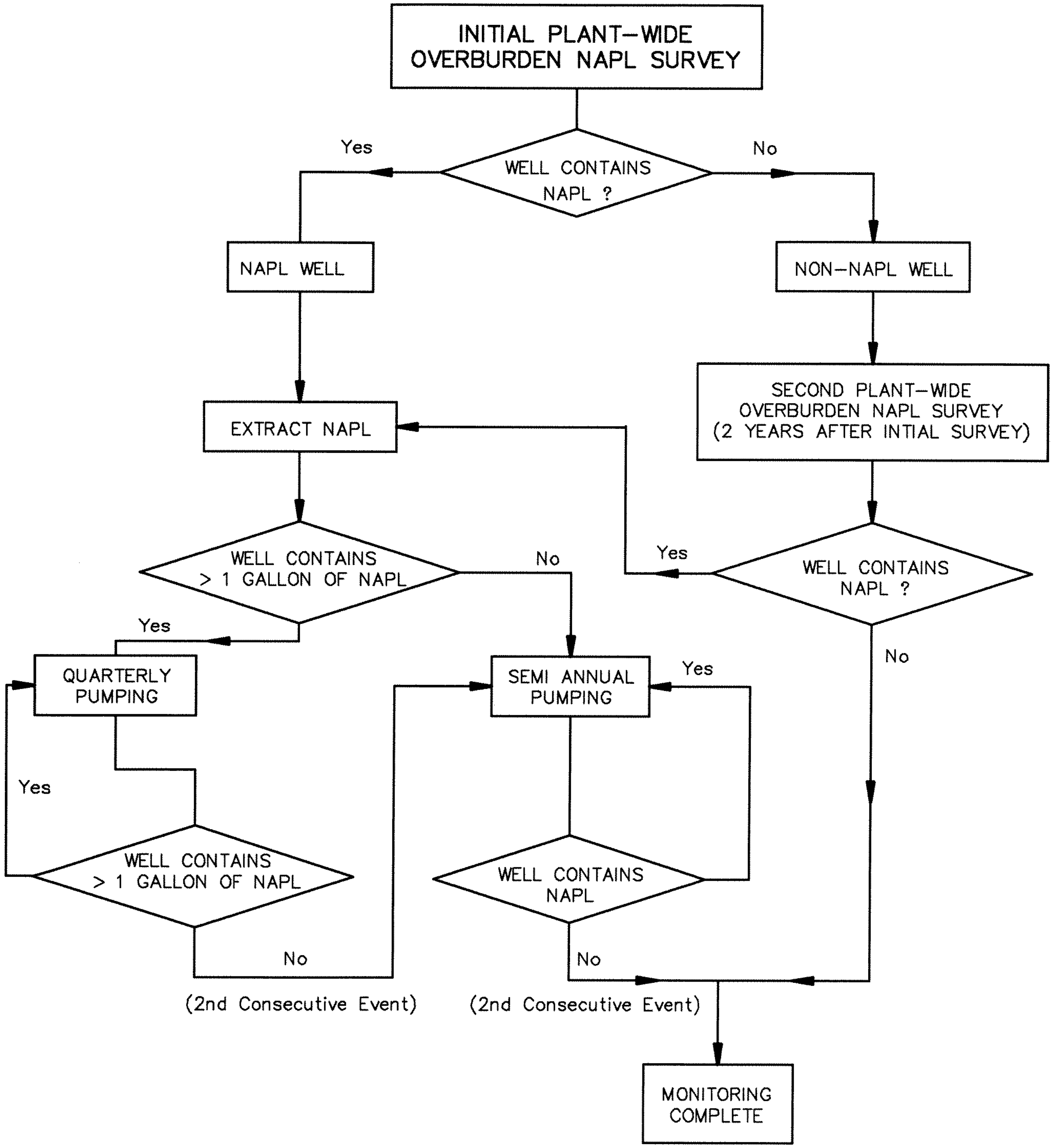


figure 6.12

NAPL MONITORING DECISION CHART
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corpration

CRA

02583–00(191)GN–WA042 SEP 11/98

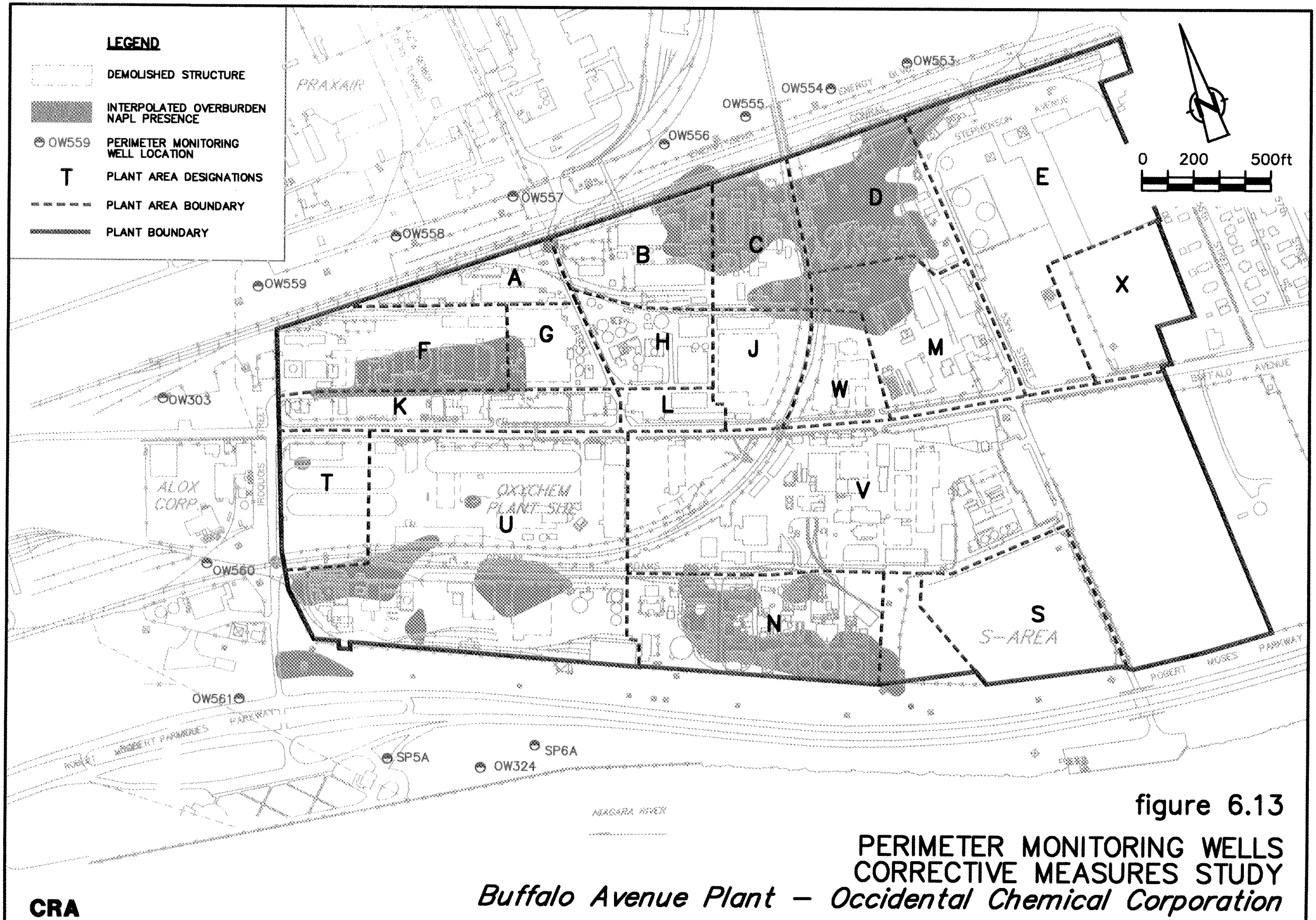


figure 6.13

PERIMETER MONITORING WELLS
CORRECTIVE MEASURES STUDY
Buffalo Avenue Plant – Occidental Chemical Corporation

02583-00(191)GN-WA043 NOV 11/98

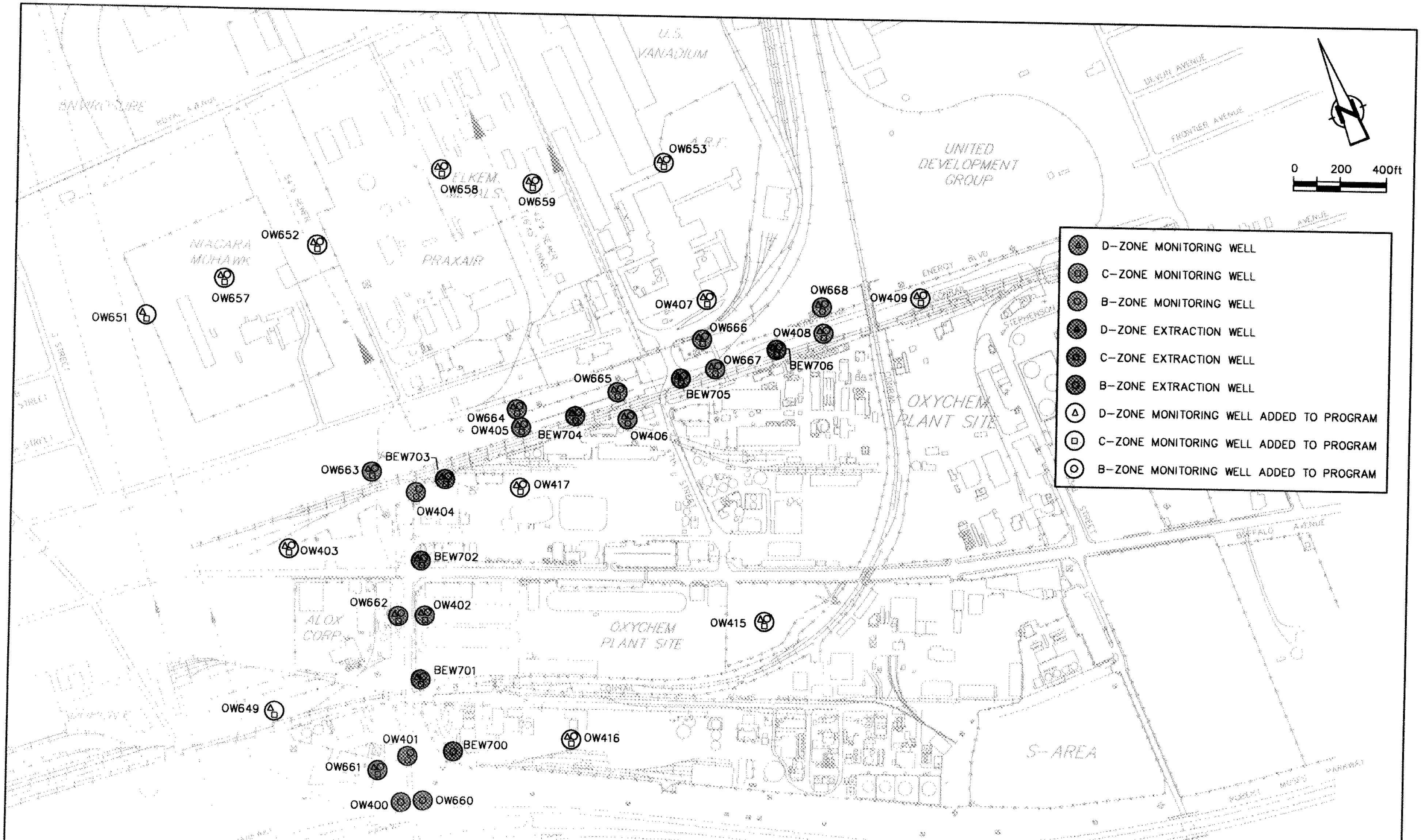


figure 10.1
HYDRAULIC MONITORING WELL LOCATIONS
CORRECTIVE MEASURES STUDY
Occidental Chemical Corporation–Buffalo Avenue Plant

CRA
02583-00(191)GN-WA051 NOV 11/98

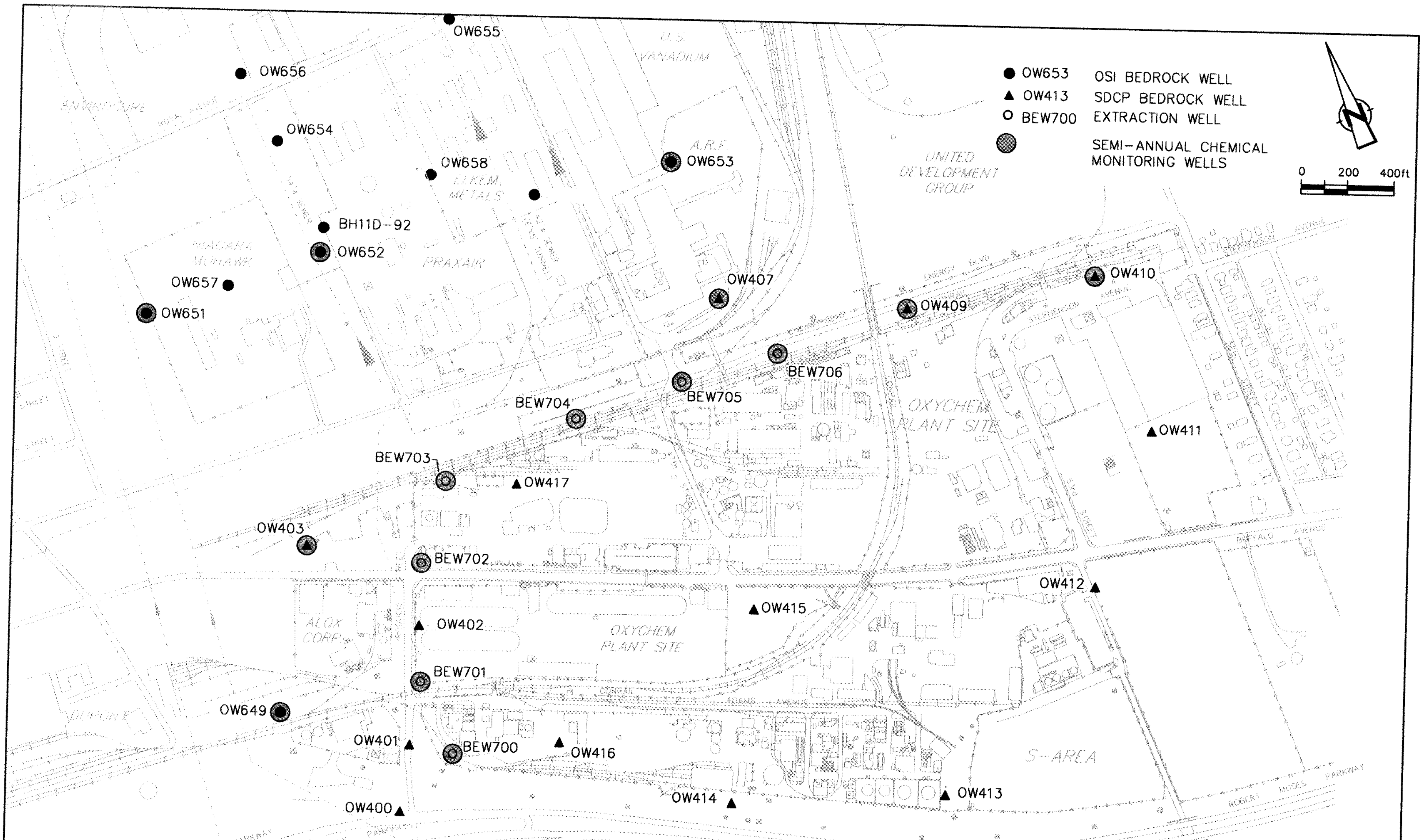


figure 10.2

CHEMICAL MONITORING WELL LOCATIONS
CORRECTIVE MEASURES STUDY
Occidental Chemical Corporation–Buffalo Avenue Plant

CRA

02583-00(191)GN-WA050 NOV 11/98

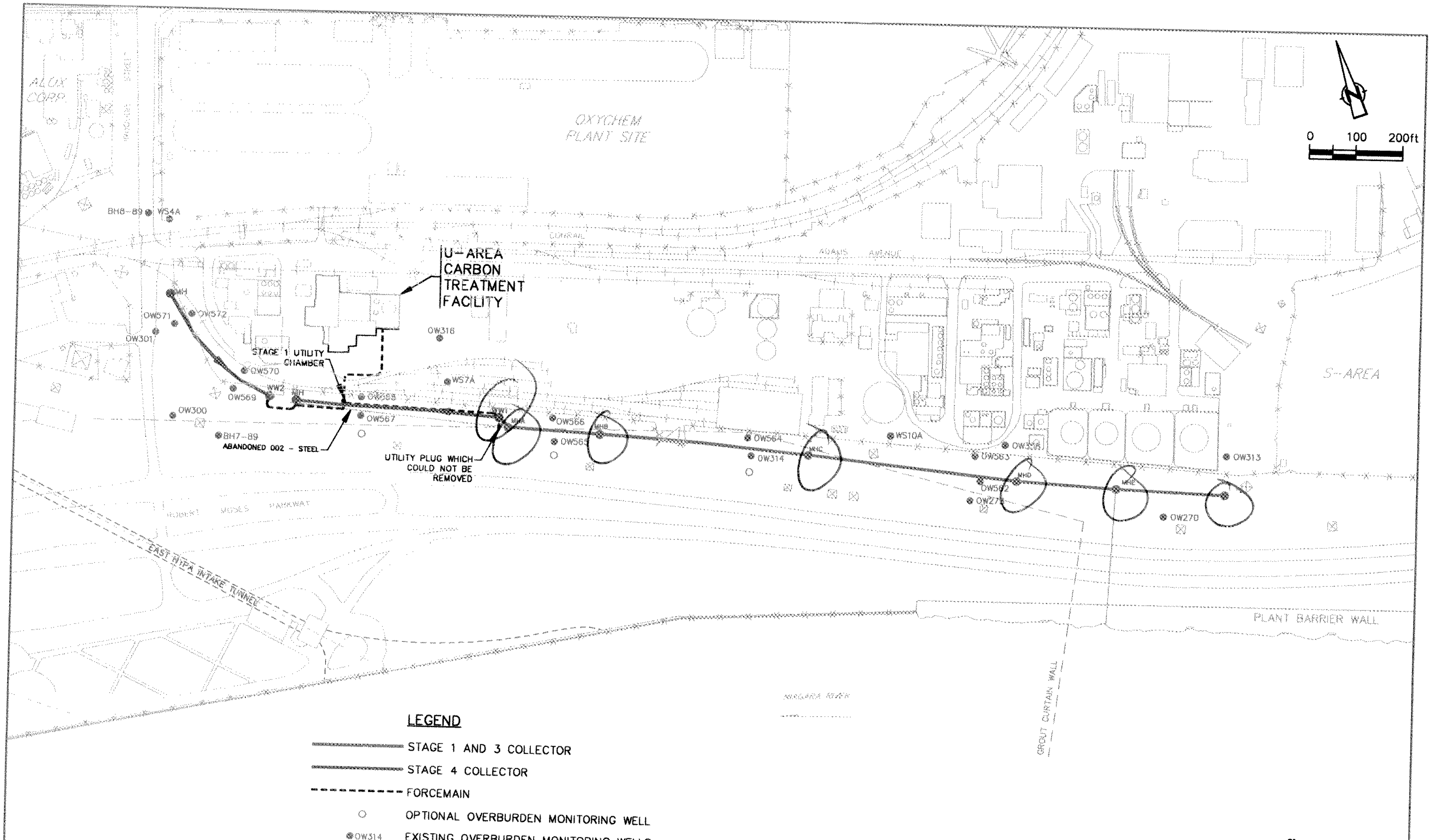


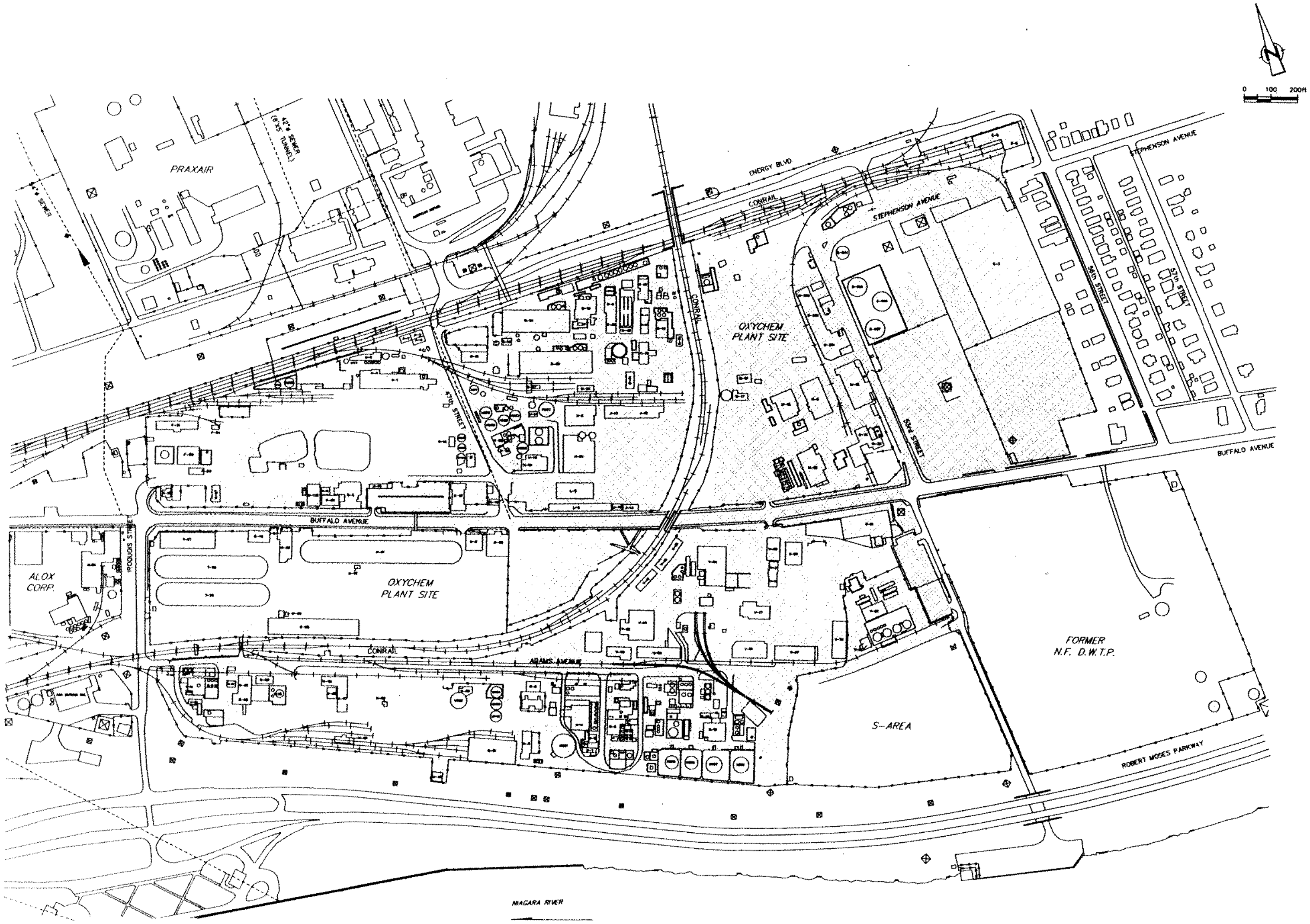
figure 10.3

FLOW ZONE 1 – GROUNDWATER COLLECTION SYSTEM
HYDRAULIC MONITORING NETWORK
CORRECTIVE MEASURES STUDY

Buffalo Avenue Plant – Occidental Chemical Corporation

CRA

02583-00(191)GN-WA052 NOV 11/98



SYMBOL	SURFACE TYPE	AREA (Acres)	AREA (Sq. Ft.)	% OF TOTAL
	IMPOUNDMENT	7.9	345,300	6.2%
	GRASS	8.2	360,000	6.6%
	HARD SURFACE (Concrete/Asphalt)	54.1	2,357,705	42.7%
	GRAVEL	38.5	1,675,054	30.4%
	ROOF	17.8	775,082	14.1%
	TOTAL	126.6	5,513,141	100%

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

OCCIDENTAL CHEMICAL CORPORATION BUFFALO AVENUE PLANT

CORRECTIVE MEASURES STUDY

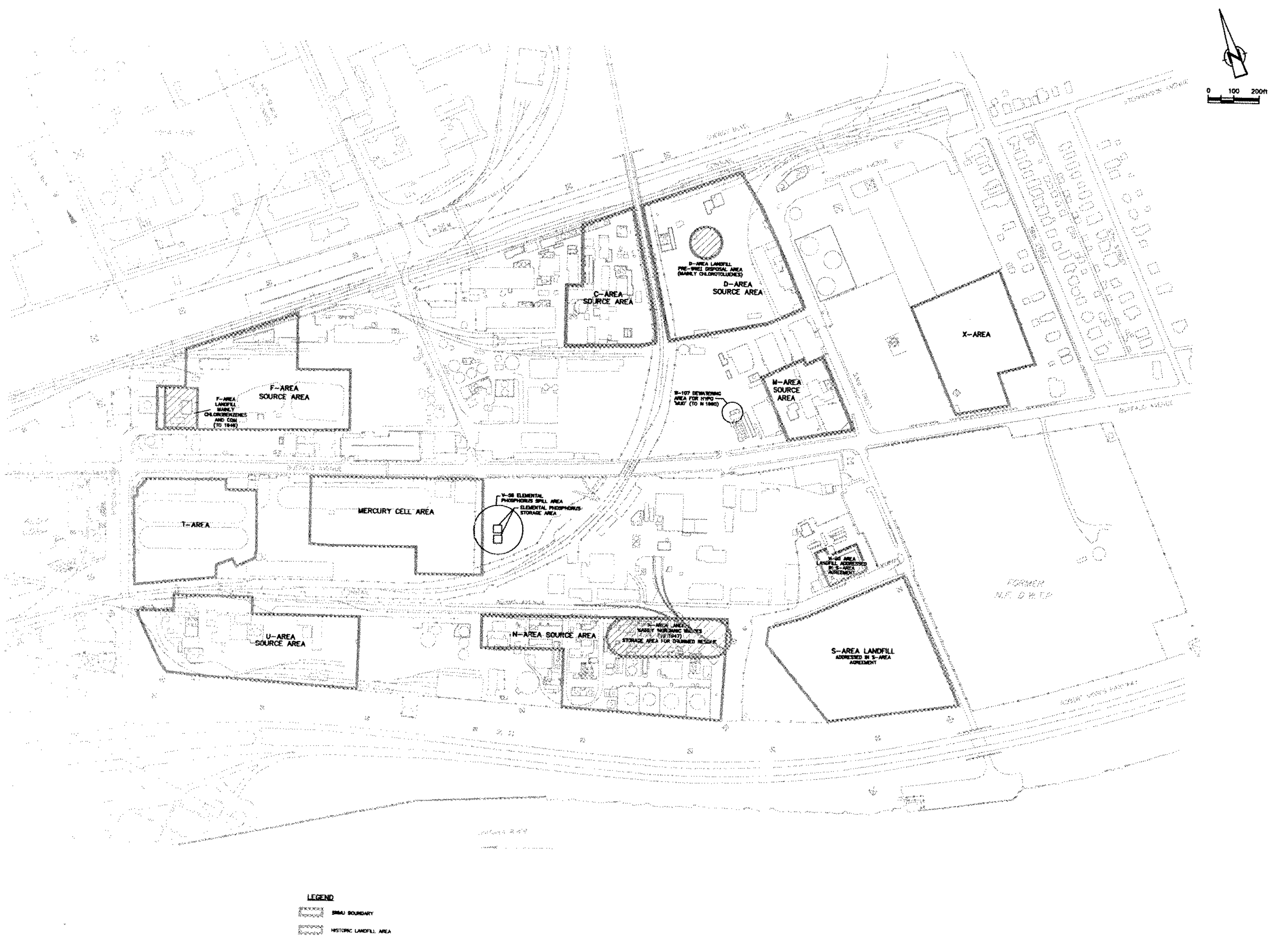
PLANT SURFACE CHARACTERISTICS

CRA CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager: JWP	Reviewed By: JWP	Date: MAY 21, 1998	
Scale: 1" = 200'	Project Nº: 02583-00	Report Nº: 191	Drawing Nº: 1

02583-00(191)GN-WA032 OCT 29/98



No	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

OCCIDENTAL CHEMICAL CORPORATION
BUFFALO AVENUE PLANT

CORRECTIVE MEASURES STUDY

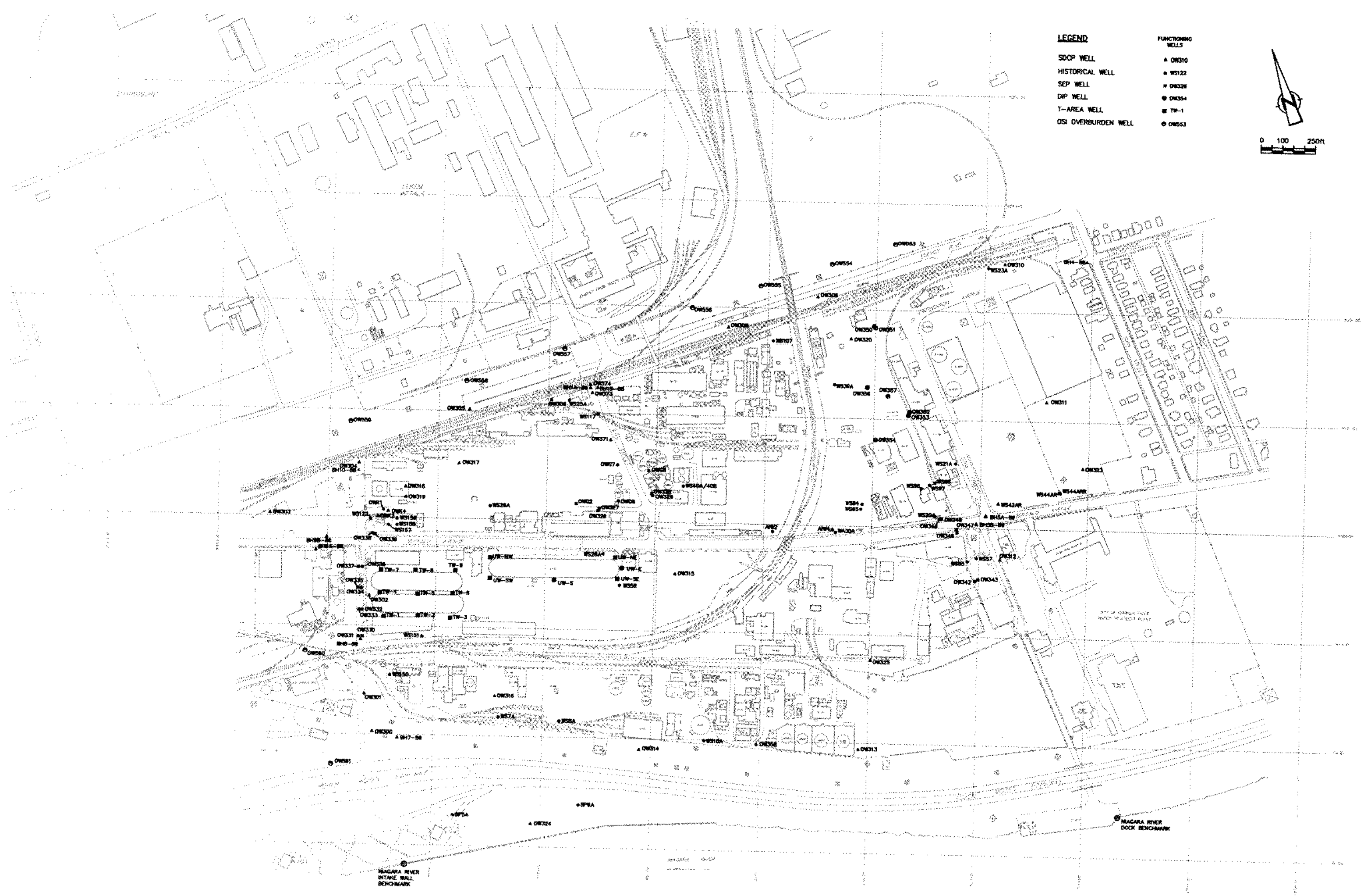
SOLID WASTE MANAGEMENT UNITS

CRA CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager: JWP	Reviewed By: JWP	Date: MAY 21, 1998	
Scale: 1" = 200'	Project Nº: 02583-00	Report Nº: 191	Drawing Nº: 2

02583-00(191)GN-WA033 MAY 11/1999



Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

OCCIDENTAL CHEMICAL CORPORATION
BUFFALO AVENUE PLANT

CORRECTIVE MEASURES STUDY

ACTIVE OVERBURDEN WELL LOCATIONS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager: JWP	Reviewed By: JWP	Date: MAY 21, 1998	
Scale: 1=250	Project Nº: 02583–00	Report Nº: 191	Drawing Nº: 3

02583–00(191)GN–WA031 MAY 11/99