

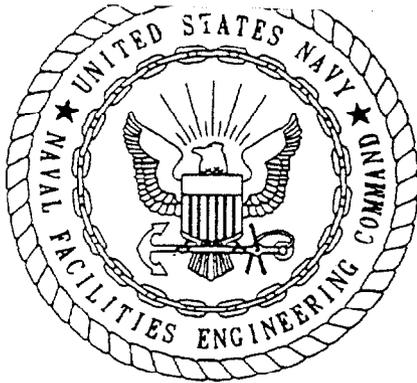
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FINAL DRAFT CONTAMINATION ASSESSMENT REPORT FOR ELECTRIC POWER PLANT  
BUILDING 103 TRUMAN ANNEX NAS KEY WEST FL  
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ABB ENVIRONMENTAL SERVICES INC

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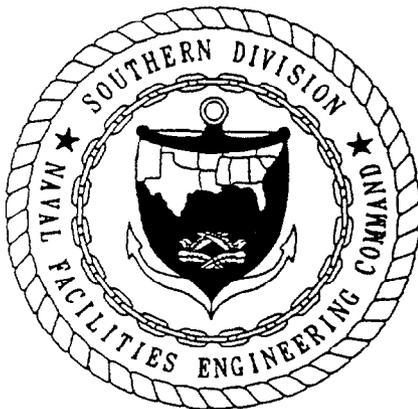


**FINAL DRAFT**

**CONTAMINATION ASSESSMENT  
REPORT**

**ELECTRIC POWER PLANT  
BUILDING 103  
TRUMAN ANNEX  
NAVAL AIR STATION  
KEY WEST, FLORIDA**

**SEPTEMBER 1992**



**SOUTHERN DIVISION  
NAVAL FACILITIES ENGINEERING COMMAND  
CHARLESTON, SOUTH CAROLINA  
29411-0068**

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**CONTAMINATION ASSESSMENT REPORT**

**ELECTRIC POWER PLANT**

**BUILDING 103**

**TRUMAN ANNEX  
NAVAL AIR STATION  
KEY WEST, FLORIDA**

**UIC NO.: N00213**

**Contract No. 62467-89-D-0317**

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**September 1992**

## EXECUTIVE SUMMARY

The Electric Power Plant site, Building 103, is located in Truman Annex, Naval Air Station (NAS), Key West. In January 1991, after a heavy rain, petroleum product was observed on the land surface above the location of an underground lubricating oil storage tank. The tank was excavated and removed from the site, thus abating the source of product. During tank removal activities, free product was observed in the excavation pit.

A contamination assessment (CA) was performed by ABB Environmental Services Inc. (ABB-ES) in August 1991 and March 1992. The objectives of the CA were to identify petroleum contaminants at the site, to assess the degree and extent of petroleum contamination in soils and in the surficial aquifer, and to recommend a feasible course of action, if necessary, to attain compliance with State regulatory constraints.

Twenty-four soil borings and 14 groundwater monitoring wells were installed at the site. Soil samples were collected from each monitoring well borehole. Groundwater samples were collected from each of the newly installed monitoring wells and an existing well. All samples were analyzed for petroleum constituents of the kerosene analytical group as defined in Florida Department of Environmental Regulation Chapter 17-770, Florida Administrative Code. Figure ES-1 shows the locations of the soil borings and monitoring wells, the results of the laboratory analysis, and the delineation of the contamination at the site. A contamination assessment report (CAR) was prepared and presents the CA results. The findings, conclusions, and recommendations of the CA are summarized below.

### FINDINGS

- Petroleum contaminated soils with >50 parts per million concentration were identified by organic vapor analyzer (OVA) headspace analysis.
- No official potable wells are present in the Key West area. Groundwater from the surficial aquifer has been designated as an unlikely source of potable water, and is designated as a Class G-III non-potable groundwater source.
- Groundwater is tidally influenced at the site.
- No free product was found at the site.
- The groundwater contaminants benzene, ethyl benzene, toluene, xylenes, methyl tert-butyl ether, acenaphthene, anthracene, 1-methylnaphthalene, 2-methylnaphthalene, phenanthrene, fluorene, fluoranthene, and total recoverable petroleum hydrocarbons were detected at various concentrations onsite.
- Benzene concentrations were detected at or in excess of the State regulatory standard of 1 microgram per liter ( $\mu\text{g}/\ell$ ) in the groundwater samples from monitoring wells KYW-103-3 at  $2 \mu\text{g}/\ell$  and KYW-103-14 at  $17 \mu\text{g}/\ell$ .

- Polynuclear aromatic hydrocarbons (PAH) concentrations, excluding naphthalenes, were detected in excess of the State target level of 10  $\mu\text{g}/\ell$  in the groundwater samples from monitoring wells KYW-103-3 at 11  $\mu\text{g}/\ell$  and KYW-103-12 at 500  $\mu\text{g}/\ell$ .
- Total naphthalenes concentrations, including naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene, were detected in excess of the State target level of 100  $\mu\text{g}/\ell$  in the groundwater samples from monitoring wells KYW-103-3 at 368  $\mu\text{g}/\ell$ , KYW-103-12 at 2,490  $\mu\text{g}/\ell$ , and KYW-103-14 at 660  $\mu\text{g}/\ell$ .
- Total recoverable petroleum hydrocarbons (TRPH) concentrations were detected in excess of the State target level of 5 milligrams per liter ( $\text{mg}/\ell$ ) in groundwater samples from monitoring wells KYW-103-3 at 24  $\text{mg}/\ell$ , KYW-103-5 at 8  $\text{mg}/\ell$ , KYW-103-7 at 7  $\text{mg}/\ell$ , KYW-103-8 at 90  $\text{mg}/\ell$ , KYW-103-9 at 46  $\text{mg}/\ell$ , KYW-103-10 at 38  $\text{mg}/\ell$ , KYW-103-12 at 16  $\text{mg}/\ell$ , KYW-103-14 at 110  $\text{mg}/\ell$ , and KYW-103-15 at 49  $\text{mg}/\ell$ .

### CONCLUSIONS

- The predominant groundwater flow direction in the surficial aquifer is westerly toward the Turning Basin. The most likely chance for contaminant contact with potential receptors is through seaward migration of groundwater contaminants. The presence of two seawalls at the site and, to some degree, the impervious nature of the limestone, the buoyant effect caused by the saltwater, and the piezometric surface configuration is expected to hinder seaward contaminant migration.
- A tidal influence study revealed that water level elevations and flow directions within the confines of the Berthing Wharf are affected by tidal fluctuations.
- Five limited and isolated soil and/or groundwater petroleum contaminated areas were identified at the site during the field investigation. These areas are delineated on Figure ES-1.
- The contaminated areas between Buildings 102 and 103 and southeast of Building 103 are attributed to associated petroleum storage tanks that, in the past, existed at the site.
- The petroleum contamination in the two areas along the Berthing Wharf and the area north of Building 102 appear to be isolated and limited in their extent and contamination levels. The petroleum contamination along the Berthing Wharf may be attributed to fuel pipelines that existed at the site. The source of the contamination in the area north of Building 102 is unknown.

RECOMMENDATIONS

- Because the surficial aquifer is a Class G-III non-potable groundwater source, groundwater contamination levels are relatively low and limited in their extent, and because the site conditions are not conducive to contaminant migration, a Monitoring Only Plan (MOP) is recommended for this site.

## ACKNOWLEDGMENTS

In preparing this report, the Underground Storage Tank (UST) Section of the Comprehensive Long-Term Environmental Action, Navy (CLEAN) Group at ABB Environmental Services Inc. (ABB-ES) commends the support, assistance, and cooperation provided by the personnel at Naval Air Station (NAS) Key West, Florida, and Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM). In particular, ABB-ES acknowledges the effort, dedication, and professionalism provided by the following people during the investigation and preparation of this report.

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## GLOSSARY

The following list contains many of the acronyms, initialisms, abbreviations, and units of measure that may be used in this report.

ABB-ES	ABB Environmental Services Inc.
AST	above ground storage tank
BDL	below detection limits
BETX	benzene, ethyl benzene, toluene, and xylenes
bls	below land surface
bm	benchmark
CA	Contamination Assessment
CAP	Contamination Assessment Plan
CAR	Contamination Assessment Report
CFR	Code of Federal Regulations
CompQAP	Comprehensive Quality Assurance Plan
CNO	Chief of Naval Operations
CTO	Contract Task Order
EDB	ethylene dibromide
FAC	Florida Administrative Code
FDER	Florida Department of Environmental Regulation
FID	flame ionization detector
ft/day	feet per day
ft <sup>2</sup> /day	feet squared per day
ft/ft	foot/feet
ft/mile	feet per mile
GC	gas chromatograph
gpd/ft	gallons per day per foot
HSWA	Hazardous and Solid Waste Amendments of 1984
$\mu\text{g}/\ell$	micrograms per liter
$\mu\text{mhos}/\text{cm}$	micromhos per centimeter
$\text{mg}/\ell$	milligram per liter
msl	mean sea level
MOP	Monitoring Only Plan
MTBE	methyl tert-butyl ether
NAS	Naval Air Station
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NOFAP	No Further Action Plan
OVA	organic vapor analyzer

GLOSSARY (Continued)

PAH	polynuclear aromatic hydrocarbons
Pb	lead
POA	Plan of Action
ppb	parts per billion
ppm	parts per million
pvc	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
SOUTHNAVFACENGCOM	Southern Division Naval Facilities Engineering Command
SPT	standard penetration test
SWDA	Solid Waste Disposal Act of 1965
TDS	total dissolved solids
TRPH	total recoverable petroleum hydrocarbons
UIC	unit identification code
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	underground storage tank
VOA	volatile organic aromatics
1,2-DCE	1,2-dichloroethene

## 1.0 INTRODUCTION

ABB Environmental Services Inc. (ABB-ES) was contracted by Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) to conduct a contamination assessment (CA) and develop a contamination assessment report (CAR) for the Electric Power Plant, Building 103, Truman Annex, Naval Air Station (NAS), Key West, Monroe County, Florida.

In January 1991, after a heavy rain, petroleum product was observed on the land surface above the location of an underground lubricating oil storage tank. The tank was excavated and removed from the site. During tank removal activities, free product was observed in the excavation pit. Additional site investigation was required to identify petroleum contaminants present at the site and to assess the extent of contamination.

The scope of services provided by ABB-ES to SOUTHNAVFACENGCOM during the CA was defined by and performed under contract task order (CTO) No. 007, the plan of action (POA), and the contamination assessment plan (CAP), and included the following:

- installing soil borings and monitoring wells,
- analyzing groundwater and soil samples to assess the extent of soil and groundwater petroleum contamination (no deep monitoring well was installed because of the low levels of contamination and the Class G-III groundwater classification),
- collecting water level data,
- conducting an inventory of potable wells within a ¼-mile radius of the site,
- performing slug tests on selected wells to estimate aquifer characteristics, and
- reducing and analyzing data gathered during the CA to prepare a CAR.

The assessment under this contract was conducted during August 1991 and completed in April 1992. The following sections of the report present the background information, investigative methodologies, data compilation, results, conclusions, and recommendations of the CA.

## 2.0 SITE BACKGROUND

2.1 SITE DESCRIPTION. Naval Air Station Key West (NAS Key West) is located approximately 150 miles southwest of Miami in Monroe County, Florida (Figure 2-1). NAS Key West, a complex of activities located in numerous areas of the Lower Florida Keys, encompasses approximately 5,000 acres. The majority of these activities are concentrated on Boca Chica Key and Key West. The mission of NAS Key West is to maintain and operate facilities and provide services and materials to support operations of aviation activities and units designated by the Chief of Naval Operations (CNO). The site is located on Key West at the Electric Power Plant, Building 103, in Truman Annex (Figure 2-2).

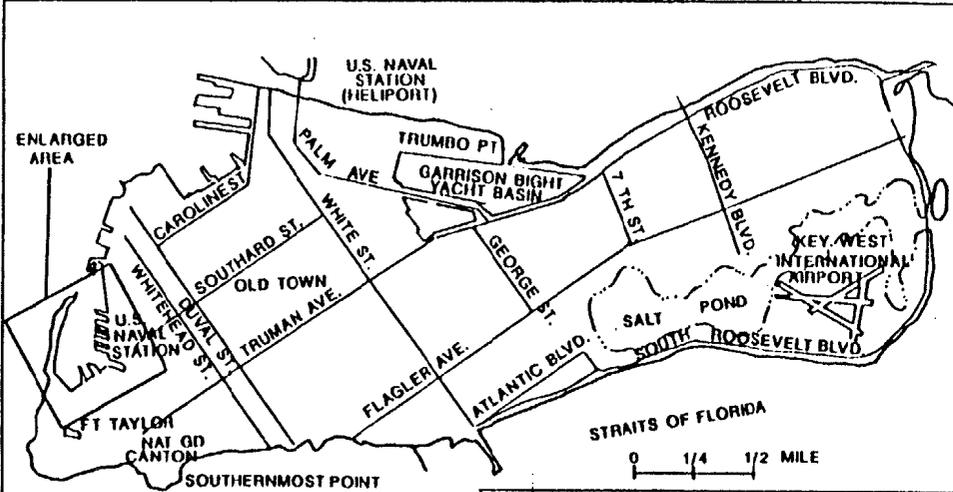
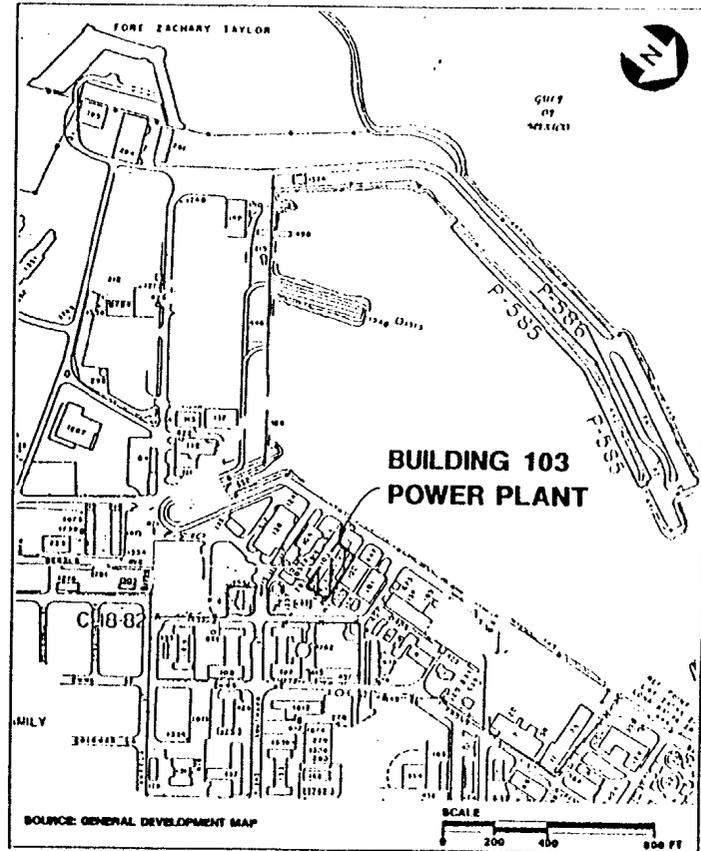
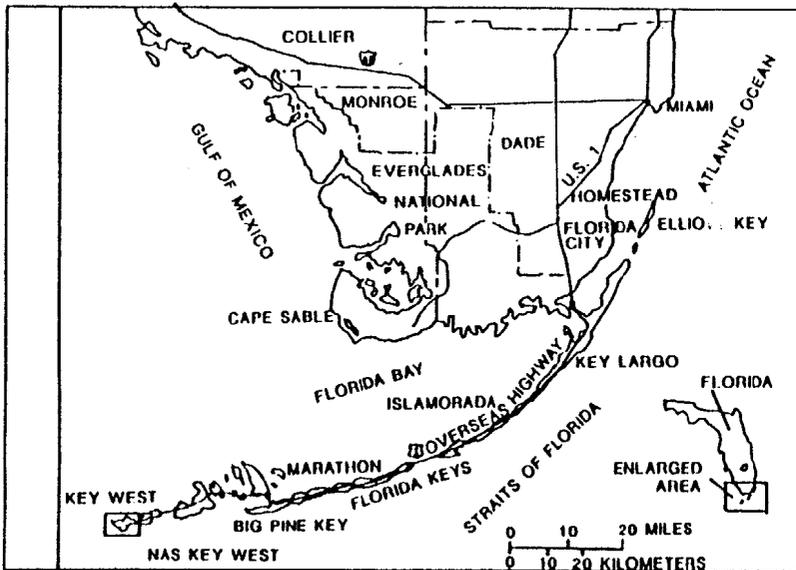
2.2 SITE HISTORY. The former lubricating oil underground storage tank (UST) was located on the north side of Building 103 at the Electric Power Plant in Truman Annex. The former tank location is designated as the "excavated UST area" in Figure 2-2.

It was reported that petroleum product was observed on the land surface above the location of an underground lubricating oil storage tank subsequent to a heavy rainfall event. The tank was excavated and removed from the site, thus abating the source of petroleum product. During tank removal activities, free product was observed in the excavation pit. Additional site investigation was required and conducted to identify petroleum contaminants present at the site and to assess the extent of contamination.

The UST contained "clean" lubricating oil for the generators in Building 103. The UST was connected to a system of piping where generator lubricating oil was recycled by centrifuging the oil to remove condensation (water) and may fuels it came in contact with.

*any*

The remaining area around Building 103, in the past, contained pipelines (Wharf area) and storage tanks (east) that contained petroleum. Petroleum products that have been used in the past at Truman Annex have been predominantly fuel oils (Bunker C and Diesel Fuel Marine) and, to a lesser extent, lubricating oil.



**FIGURE 2-1  
FACILITY LOCATION MAP  
BUILDING 103  
POWER PLANT**



**CONTAMINATION  
ASSESSMENT REPORT  
TRUMAN ANNEX  
NAVAL AIR STATION  
KEY WEST, FLORIDA**

Turning Basin

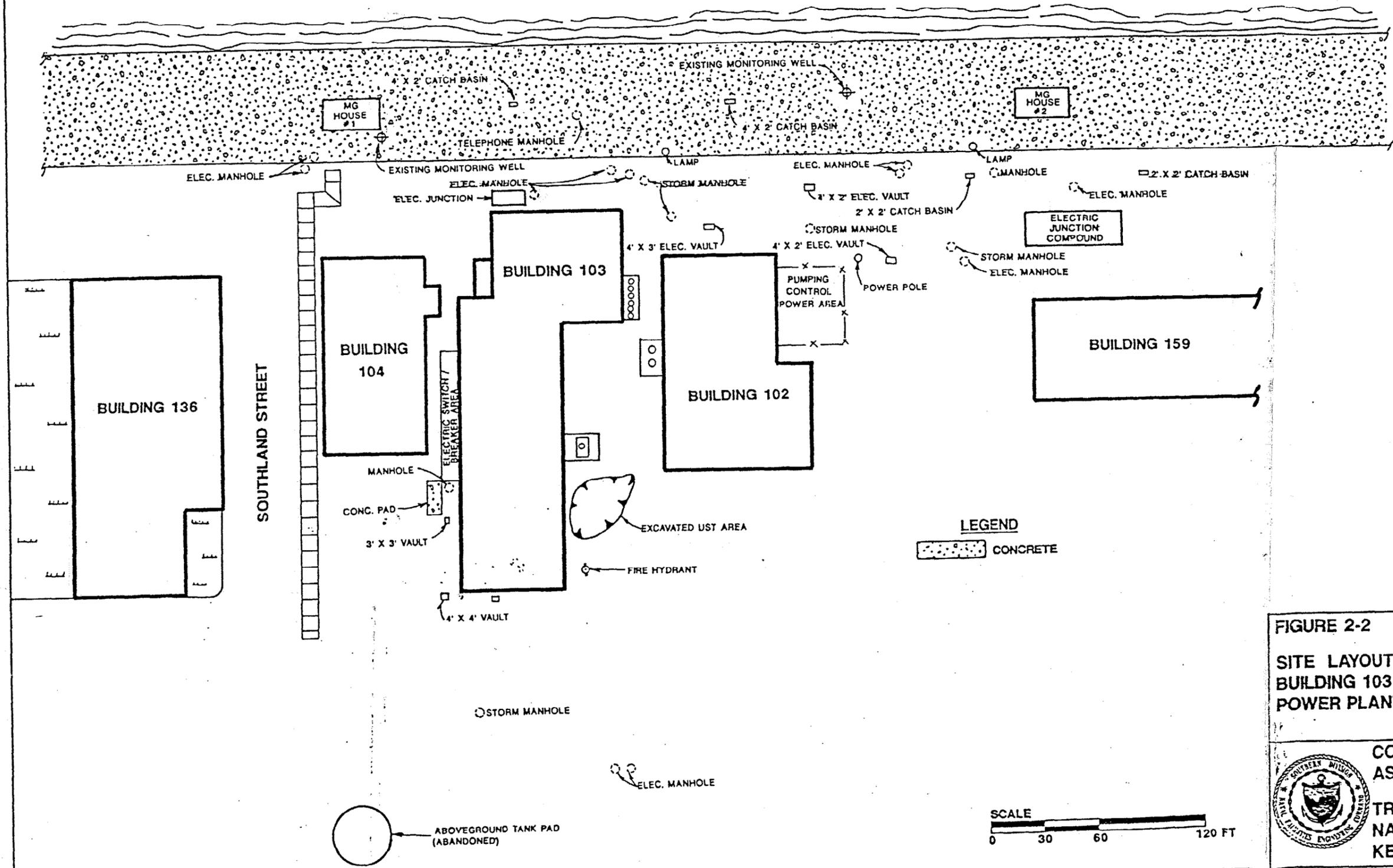


FIGURE 2-2  
SITE LAYOUT  
BUILDING 103  
POWER PLANT

CONTAMINATION  
ASSESSMENT REPORT

TRUMAN ANNEX  
NAVAL AIR STATION  
KEY WEST, FLORIDA

### 3.0 SITE CONDITIONS

3.1 PHYSIOGRAPHY. Regional physiography is discussed in Appendix A, Site Conditions. The site lies within the southern or distal geomorphic zone of Florida (White, 1970). Ground elevations at the Truman Annex site are approximately 10 feet above mean sea level.

#### 3.2 HYDROGEOLOGY.

3.2.1 Regional Regional hydrogeology is discussed in Appendix A.

3.2.2 Site Specific Site-specific hydrogeologic characteristics were predominantly obtained from information gleaned during soil borings and monitoring well installations. The unconfined surficial aquifer is the only aquifer of concern in the Key West area. During this investigation, depth to water ranged from 5 to 7 feet below land surface (bls). Groundwater flow direction in the surficial aquifer is predominantly to the west, toward the seawall and turning basin of the Berthing Wharf. Evidence indicates that the groundwater flow direction of the surficial aquifer is tidally influenced.

The site is underlain by light gray, silty, fossiliferous, weathered limestone. The limestone is present to a total depth of at least the 14 feet penetrated by borings and monitoring wells at the site. Fill material, composed of coarse-grained, light gray sand, which contains some shell fragments, overlies the limestone to an approximate depth of 5 feet bls in each well. A geologic description and complete lithologic logs for all site monitoring wells are presented in Appendix B, Lithologic Logs.

## 4.0 METHODOLOGIES AND EQUIPMENT

All methodologies and equipment that were used during the course of this CA are in accordance with the ABB-ES, FDER-approved, Comprehensive Quality Assurance Plan (CompQAP).

Appendix C, Investigative Methodologies and Procedures, describes all the investigative methodologies and equipment that were used during the CA.

4.1 SOIL BORING PROGRAM. Soil borings were placed at areas of suspected contamination (Figure 4-1). Soil borings are designated with the prefix "SB." Twenty-four soil borings (SB-1 through SB-24) were advanced into the water table to assess the degree and extent of soil contamination, identify the type of subsurface material, and aid in the placement of subsequent groundwater monitoring wells. Soil samples collected from each borehole were analyzed with an organic vapor analyzer (OVA) equipped with a flame ionization detector. Soil samples were also screened with a field gas chromatograph (GC). The results of the soil boring program are discussed in Section 5.2.

4.2 MONITORING WELL INSTALLATION PROGRAM. Fourteen monitoring wells were installed using a hollow-stem auger drill rig. Each well was installed to a total depth of approximately 13 feet bls. Monitoring wells were installed to assess the degree and approximate the horizontal and vertical extent of petroleum contamination in the groundwater beneath the site. Monitoring well locations are shown in Figure 4-1 and are designated with the prefix "KYW-103". An existing groundwater monitoring well on the Berthing Wharf was sampled and used in this investigation. This existing monitoring well was designated KYW-103-15.

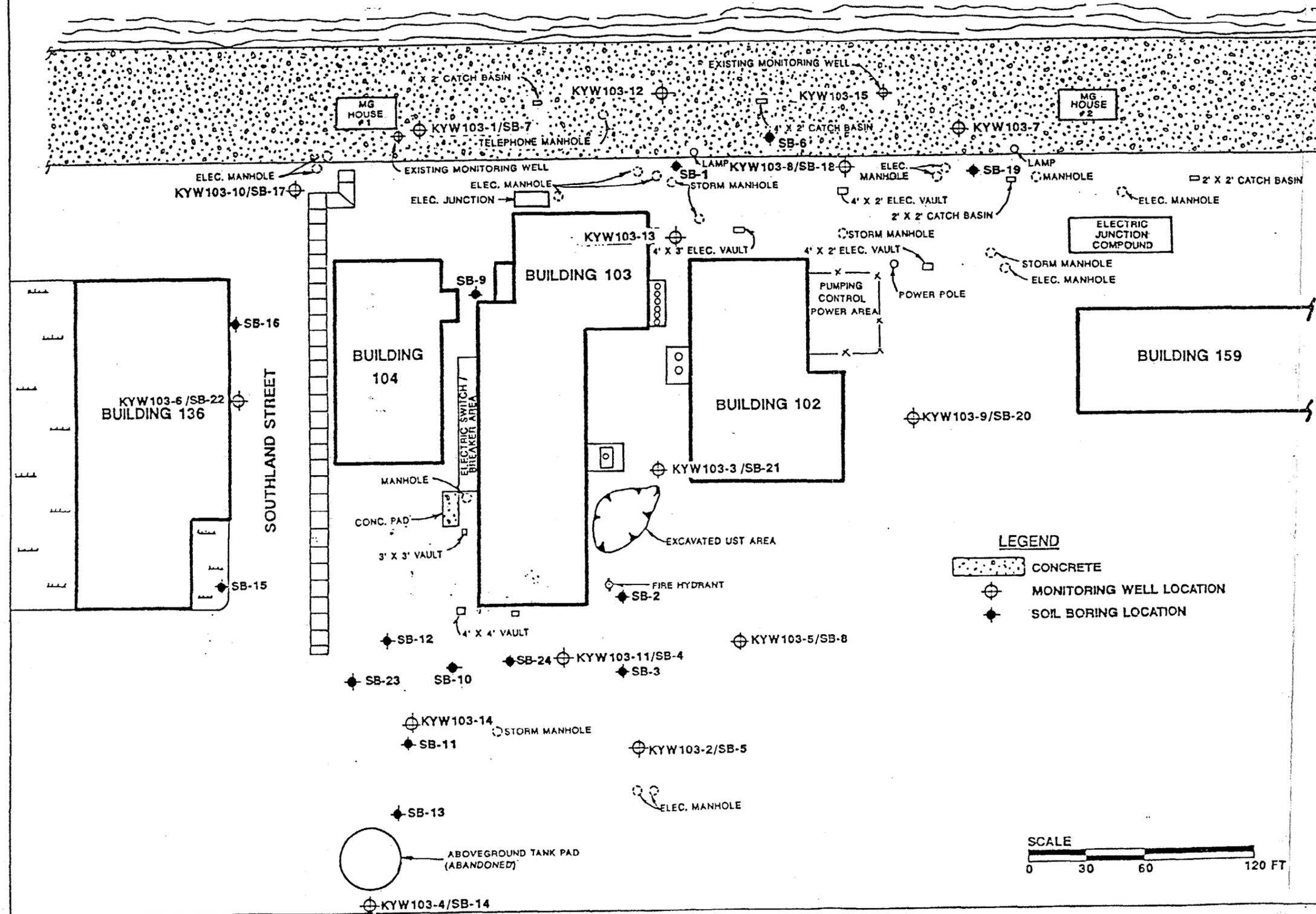
4.3 GROUNDWATER ELEVATION SURVEY. The elevation and slope of the water table were measured against the field surveyed top of the well casing for each monitoring well to a common reference datum using a surveyor's level and stadia rod. No benchmark referencing an elevation to the National Geodetic Vertical Datum (NGVD) of 1929 was located in the area; therefore, an arbitrary benchmark (bm) elevation of 10.00 feet was established at the north side of the top of well casing of monitoring well BMWW-1. Monitoring well BMWW-1 is located north of this site at the Berthing Wharf site. The elevations and water level data for all monitoring wells were measured from the north side of the polyvinyl chloride (PVC) well casing.

To assess the effects of tidal fluctuations, groundwater levels were measured over an 8-hour period on August 13, 1991, three days after a new moon (August 10, 1992). Groundwater levels were collected during a tidal cycle in which at least one low tide and one high tide occurred.

4.4 GROUNDWATER SAMPLING PROGRAM. Groundwater samples were collected from monitoring wells on August 14 and 15, 1991, and on April 9, 1992. The appropriate number of field blanks, equipment blanks, and duplicates were collected. The groundwater samples were collected in accordance with the ABB-ES, FDER-approved CompQAP. Samples were sent, under chain of custody, to Wadsworth/ALERT Laboratories, Inc., in Tampa, Florida, for analysis. The samples

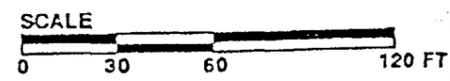


# Turning Basin



BENCH MARK LOCATED AT MG HOUSE #3 →

- LEGEND**
- CONCRETE
  - MONITORING WELL LOCATION
  - SOIL BORING LOCATION



**FIGURE 4-1**  
**SOIL BORINGS AND MONITORING WELL LOCATIONS**  
**BUILDING 103**  
**POWER PLANT**



**CONTAMINATION ASSESSMENT REPORT**  
**TRUMAN ANNEX**  
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**KEY WEST, FLORIDA**

were analyzed for the FDER Chapter 17-770, Florida Administrative Code (FAC), kerosene analytical group that includes US Environmental Protection Agency (USEPA) Methods 418.1 (total recoverable petroleum hydrocarbons [TRPH]), 504 (ethylene dibromide [EDB]), 601 (chlorinated hydrocarbons), 602 (volatile organic aromatics [VOA]), 610 (polynuclear aromatic hydrocarbons [PAH]), and dissolved lead (Pb).

4.5 AQUIFER SLUG TESTS. Aquifer slug tests were performed on monitoring wells KYW-103-4 and KYW-103-7 to assess the hydraulic conductivity of the response zone of the surficial aquifer.

## 5.0 CONTAMINATION ASSESSMENT RESULTS

5.1 AQUIFER CHARACTERISTICS AND HYDROGEOLOGIC PARAMETERS. The slug test analyses indicate an average horizontal hydraulic conductivity of 8.0 feet per day (ft/day) and 12.0 ft/day for wells KYW-103-4 and KYW 103-7, respectively. The average hydraulic conductivity for the two monitoring wells is 10.0 ft/day. This value correlates with the hydraulic conductivity of a silty to clean sand (Freeze and Cherry, 1979).

Hydraulic gradients were assessed for both low tide and high tide periods. The calculated hydraulic gradients vary from  $4.0 \times 10^{-3}$  feet per foot (ft/ft) at low tide to  $1.1 \times 10^{-2}$  ft/ft at high tide. The average hydraulic gradient for the high and low tide measurements is  $7.5 \times 10^{-3}$  ft/ft or approximately 40 feet per mile (ft/mile).

Calculated average pore water velocity in the surficial aquifer varies from  $2.7 \times 10^{-1}$  ft/day to  $4.1 \times 10^{-1}$  ft/day. Transmissivity varies from 56.0 feet squared per day (ft<sup>2</sup>/day) to 84.0 ft<sup>2</sup>/day.

The slug test results and aquifer calculations are presented in Appendix D, Aquifer Slug Test Results and Calculations.

## 5.2 CONTAMINATION ASSESSMENT AND CHARACTERIZATION.

5.2.1 Soil Assessment Soil samples, collected with a split-spoon sampler from soil and monitoring well borings, were analyzed on an OVA. Samples were collected immediately above the surficial aquifer at the soil and groundwater interface. For kerosene analytical group constituents, excessively contaminated soils are defined in Chapter 17-770, FAC, as those having OVA-detected concentrations in excess of 50 parts per million (ppm) (FDER, 1991). Excessively contaminated soils (>50 ppm) were identified by OVA headspace analysis in the area southeast of Building 103 and west of Building 102. Table 5-1 summarizes the results of the OVA headspace analysis. Figure 5-1 depicts the approximate extent of soil contamination at the two areas on the site.

5.2.2 Groundwater Assessment Water quality field parameters were measured for each monitoring well installed during the field investigation. In summary, the pH ranged from 6.8 to 7.5 standard units and the specific conductance ranged from 86 to 10,400 micromhos per centimeter ( $\mu$ mhos/cm). Temperature measurements were not taken due to equipment problems.

Table 5-2 summarizes groundwater analytical results. Figure 5-2 shows the distribution of the various petroleum contaminants detected at the site. The volatile organic aromatics (VOAs) 1,2-dichloroethene, benzene, toluene, ethyl benzene, and total xylenes were detected in the groundwater, generally at concentrations below the State target level of 50 micrograms per liter ( $\mu$ g/l) for total VOAs. The target level was exceeded in only one sample, from monitoring well KYW-103-14, with a total VOA concentration of 56  $\mu$ g/l.

**Table 5-1  
Summary of Soil Sample  
Organic Vapor Analyzer (OVA) Readings**

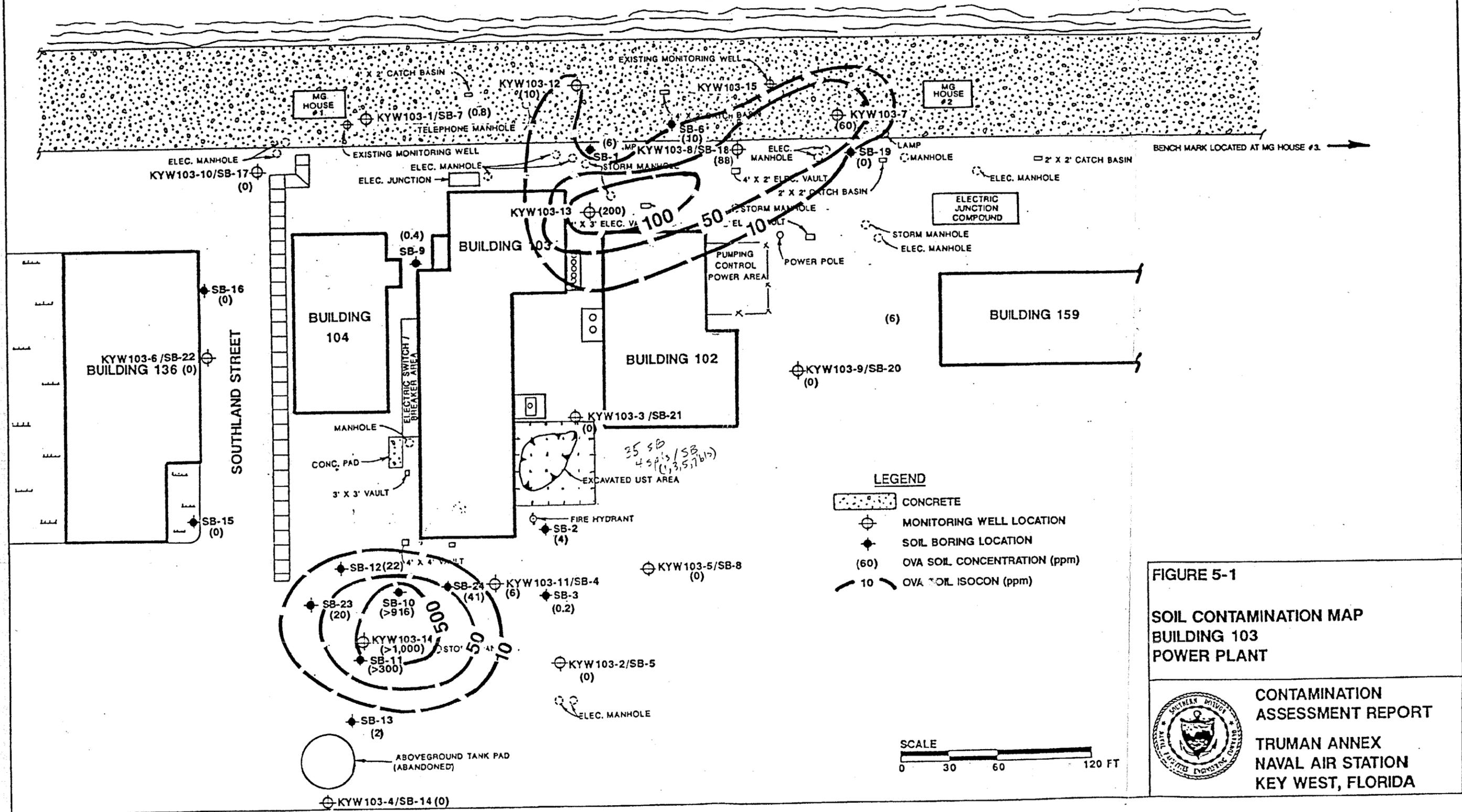
Contamination Assessment Report  
Electrical Power Plant, Building 103  
Truman Annex  
NAS Key West, Florida

Location	Depth (feet)	OVA Reading (ppm)
SB-1	5.0	6
SB-2	5.0	4
SB-3	5.0	0.2
SB-4/KYW-103-11	5.0	6
SB-5/KYW-103-2	5.0	0
SB-6	5.0	10
SB-7/KYW-103-1	5.0	0.8
SB-8/KYW-103-5	5.0	0
SB-9	4.5	0.4
SB-10	6.5	>916
SB-11	5.0	>300
SB-12	5.0	22
SB-13	4.0	2
SB-14/KYW-103-4	5.5	0
SB-15	5.0	0
SB-16	5.0	0
SB-17/KYW-103-10	5.0	0
SB-18/KYW-103-8	5.0	88
SB-19	5.0	0
SB-20/KYW-103-9	5.0	0
SB-21/KYW-103-3	6.0	0
SB-22/KYW-103-6	5.0	0
SB-23	5.0	20
SB-24	5.0	41
KYW-103-7	5.0	60
KYW-103-12	5.0	10
KYW-103-13	5.0	200
KYW-103-14	5.0	>1,000

Values corrected for methane.

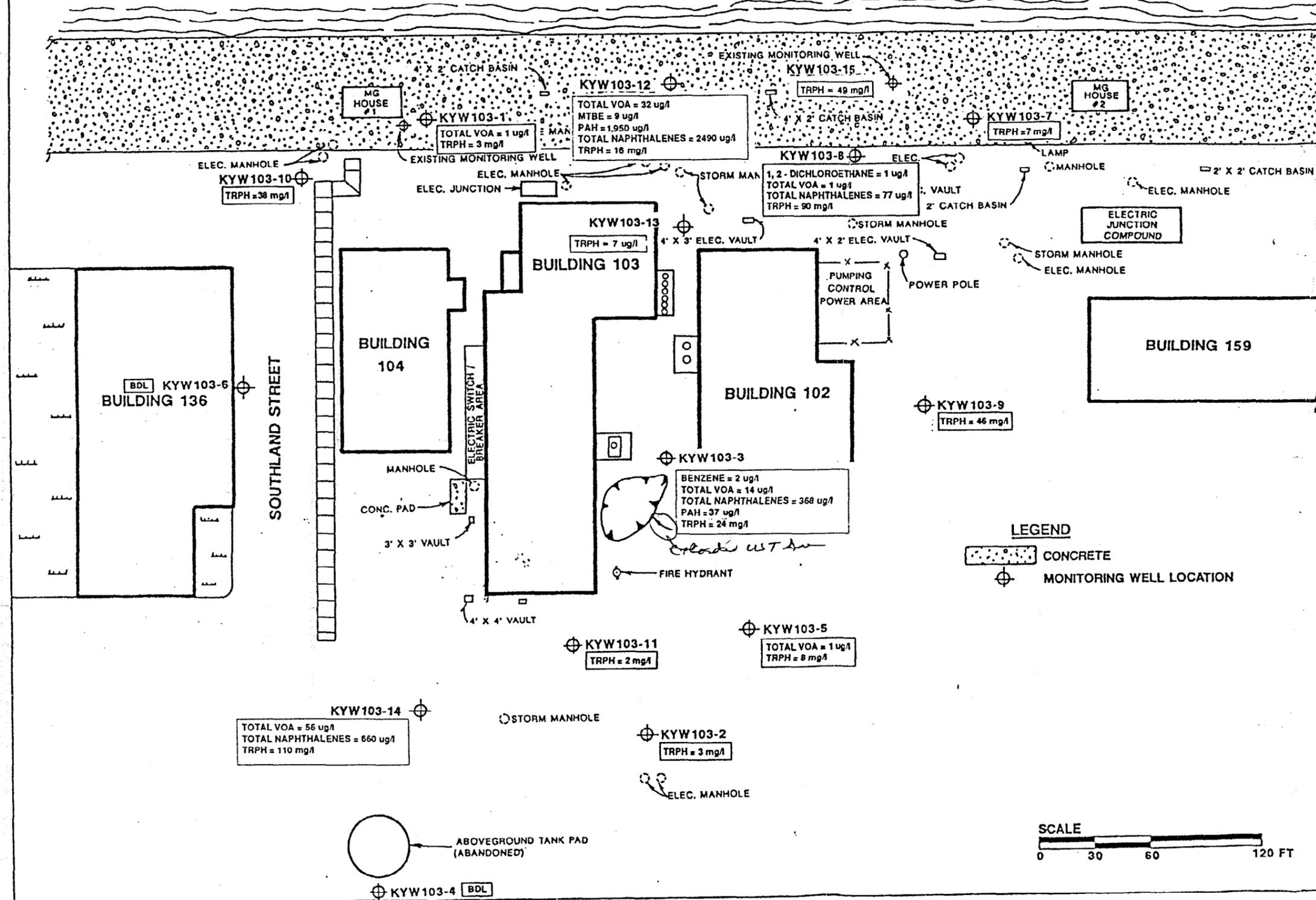
Note: ppm = parts per million.

# Turning Basin



0024AB37

# Turning Basin



**LEGEND**  
 CONCRETE  
 MONITORING WELL LOCATION



**FIGURE 5-2**  
**GROUNDWATER CONTAMINATION**  
**DISTRIBUTION (APRIL 9, 1992)**  
**BUILDING 103**  
**POWER PLANT**

**CONTAMINATION**  
**ASSESSMENT REPORT**  
**TRUMAN ANNEX**  
**NAVAL AIR STATION**  
**KEY WEST, FLORIDA**

Benzene concentrations were excess of the State regulatory standard of 1  $\mu\text{g}/\text{l}$  in samples from two monitoring wells. Benzene concentrations were detected in KYW-103-3 at 2  $\mu\text{g}/\text{l}$  and in KYW-103-14 at 17  $\mu\text{g}/\text{l}$ .

USEPA Method 610 analyses revealed the contaminants acenaphthene, anthracene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene, phenanthrene, fluorene, and fluoranthene at the concentrations shown on Table 5-2. Total naphthalenes concentrations (naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene) were in excess of the State target level of 100  $\mu\text{g}/\text{l}$  in samples from three monitoring wells. These were KYW-103-3 at 368  $\mu\text{g}/\text{l}$ , KYW-103-12 at 2,490  $\mu\text{g}/\text{l}$ , and KYW-103-14 at 660  $\mu\text{g}/\text{l}$ . A map showing the distribution of the concentrations of total naphthalenes in the groundwater is presented on Figure 5-3. The figure shows three areas at the site where total naphthalenes exceeded the State target levels (for Class G-II groundwater). These areas include the area immediately downgradient from the excavated UST between Buildings 102 and 103; the area immediately downgradient from a removed above ground storage tank (AST), southeast of Building 103; and an area on the berthing wharf west of Buildings 102 and 103. The sources of the contamination for two of the areas is attributed to associated petroleum storage tanks. The contamination on the Berthing Wharf appears to be isolated and cannot be attributed to any recorded activity at the site, therefore, the source is unknown and may be attributed to fuel pipelines that existed at the site.

PAH concentrations (excluding total naphthalenes) were in excess of the State target level of 10  $\mu\text{g}/\text{l}$  in samples from four monitoring wells. These are KYW-103-3 at 37  $\mu\text{g}/\text{l}$ , KYW-103-8 at 15  $\mu\text{g}/\text{l}$ , KYW-103-12 at 1,670  $\mu\text{g}/\text{l}$ , KYW-103-15 at 20  $\mu\text{g}/\text{l}$ .

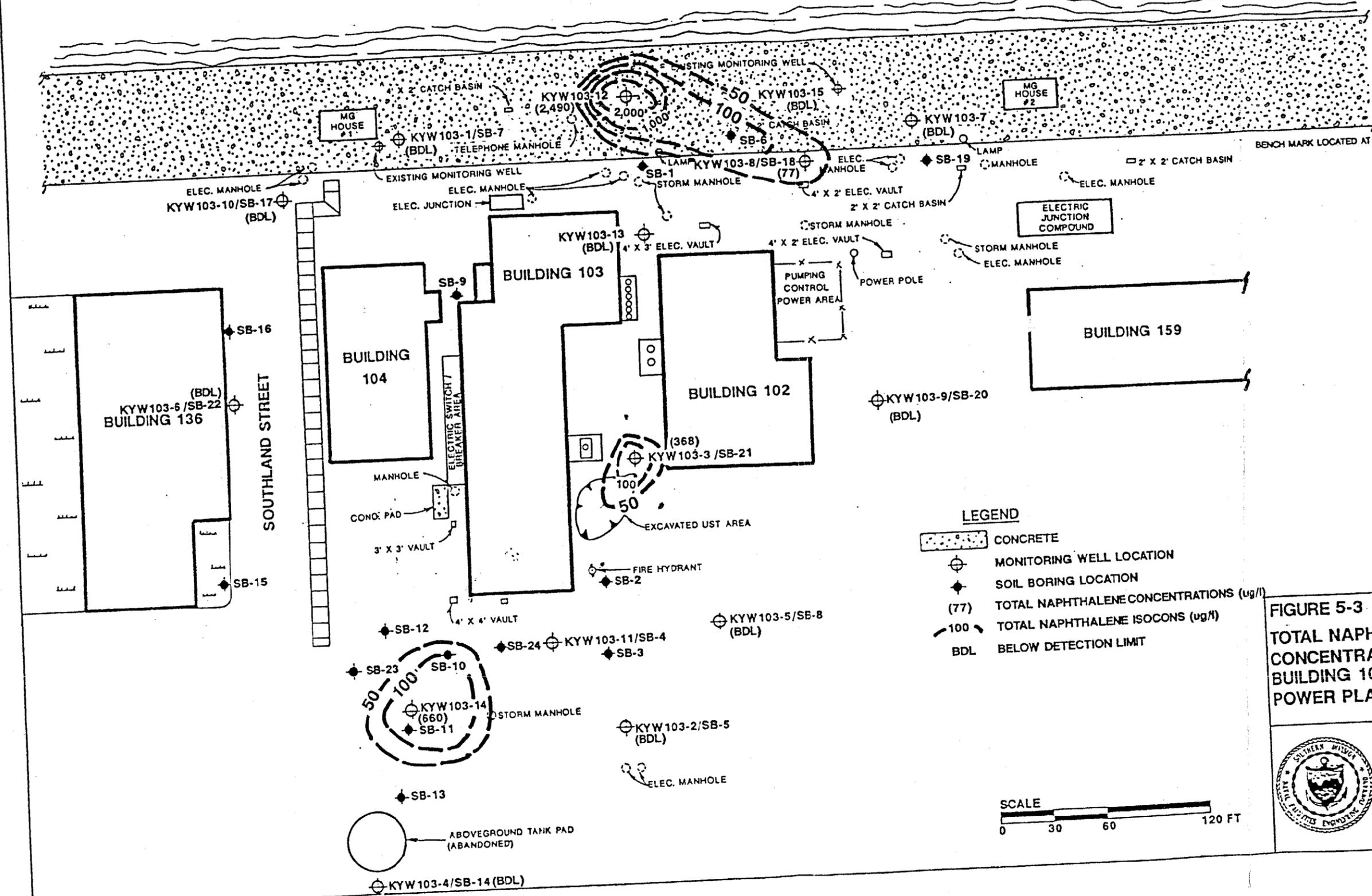
TRPH concentrations were detected at various areas across the site with the highest value reported in monitoring well KYW-103-14 at 110 milligrams per liter (mg/l). TRPH concentrations in excess of the State target level of 5 mg/l (for Class G-II groundwater) were detected in groundwater samples from eight other wells. These were KYW-103-3 at 24 mg/l, KYW-103-5 at 8 mg/l, KYW-103-7 at 7 mg/l, KYW-103-8 at 90 mg/l, KYW-103-9 at 46 mg/l, KYW-103-10 at 38 mg/l, KYW-103-12 at 16 mg/l and KYW-103-15 at 49 mg/l. A map showing the distribution of recoverable petroleum hydrocarbon concentrations is presented on Figure 5- map shows TRPH concentrations above the State target level in five isolated areas. The TRPH plumes associated with the areas between Building 102 and 103 and southeast of Building 103 are attributed to associated petroleum storage tanks that, in the past, existed at the site. The TRPH contamination in the two areas along the Berthing Wharf and the area north of Building 103 is to be isolated and may be attributed to fuel pipelines that existed at the site and an undocumented activities, respectively. However, the sources of contamination for these areas have not been positively identified.

Groundwater laboratory analytical results are attached in Appendix E, Groundwater Analytical Results.

The contaminated in the area north of Building 102 is also isolated, however, the source is not known.



# Turning Basin

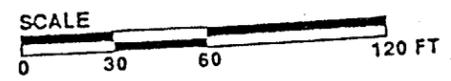


- LEGEND**
- CONCRETE
  - MONITORING WELL LOCATION
  - SOIL BORING LOCATION
  - TOTAL NAPHTHALENE CONCENTRATIONS (ug/l)
  - TOTAL NAPHTHALENE ISOCONS (ug/l)
  - BELOW DETECTION LIMIT

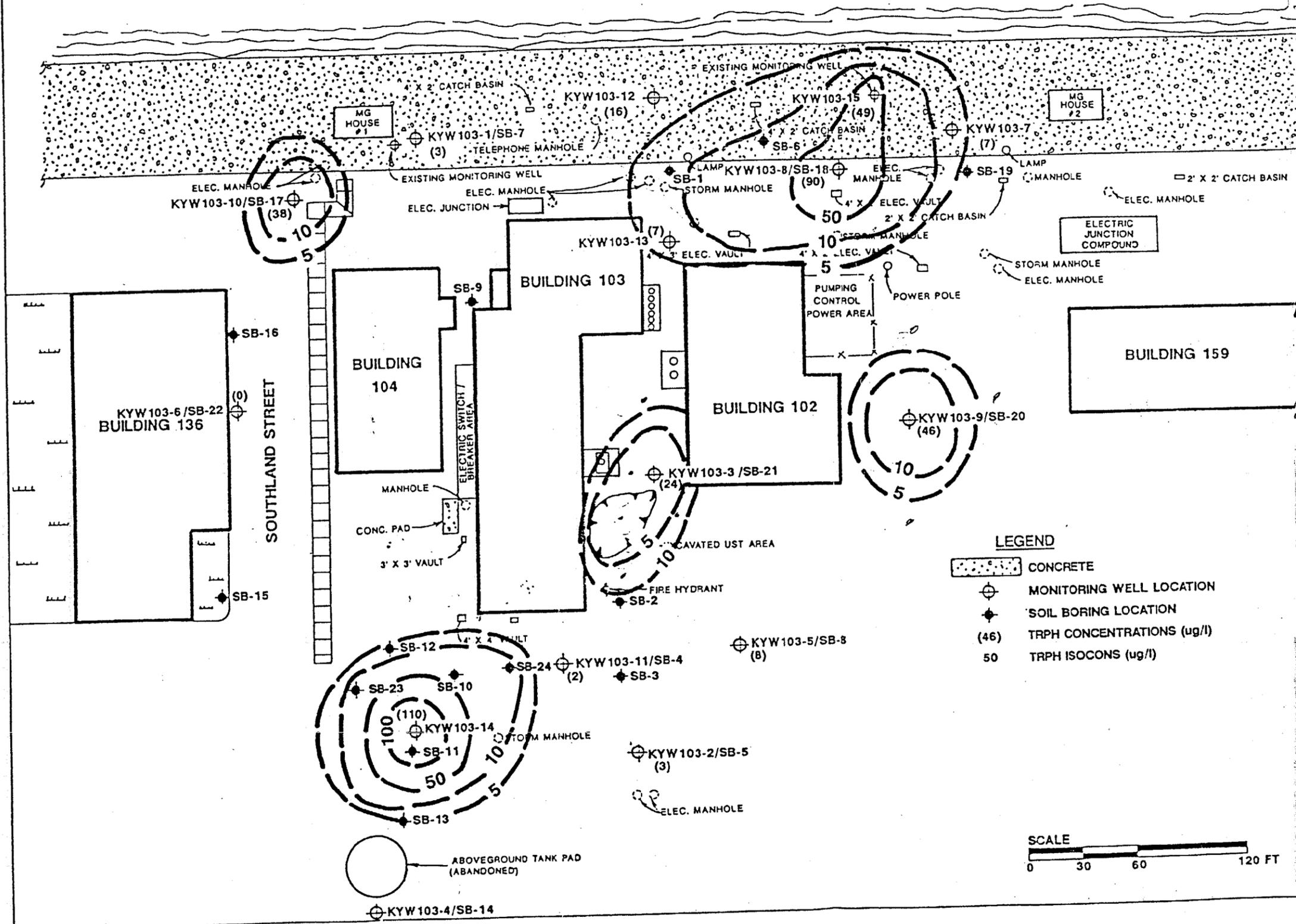
**FIGURE 5-3**  
**TOTAL NAPHTHALENES**  
**CONCENTRATION MAP (APRIL 9, 1992)**  
**BUILDING 103**  
**POWER PLANT**



**CONTAMINATION**  
**ASSESSMENT REPORT**  
**TRUMAN ANNEX**  
**NAVAL AIR STATION**  
**KEY WEST, FLORIDA**



# Turning Basin



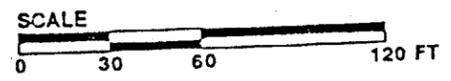
### LEGEND

- CONCRETE
- MONITORING WELL LOCATION
- SOIL BORING LOCATION
- (46) TRPH CONCENTRATIONS (ug/l)
- 50 TRPH ISOCONS (ug/l)

**FIGURE 5-4**  
**TOTAL RECOVERABLE PETROLEUM**  
**HYDROCARBONS CONCENTRATION MAP**  
**(AUGUST 14 & 15, 1991 & APRIL 19, 1992)**  
**BUILDING 103**  
**POWER PLANT**



**CONTAMINATION**  
**ASSESSMENT REPORT**  
**TRUMAN ANNEX**  
**NAVAL AIR STATION**  
**KEY WEST, FLORIDA**



5.2.3 Tidal Influence Study On August 13, 1991, an 8-hour tidal influence study was conducted at the site. The purpose of the study was to observe water level fluctuations over a higher high water and a lower low water tidal event, to determine the impact of the fluctuations on groundwater flow directions, and to determine if a groundwater flow reversal occurs. The study took place from 0800 to 1630 hours during which a 1.7 foot flood (rising) tide sea level change occurred, followed by a 1.5 foot ebb (falling) tide event. The measurements were taken three days after the occurrence of a new moon lunar event (August 10, 1991). The difference between the higher high water and lower low water on August 13, 1991, was 1.7 feet versus a 1.8-foot difference during the full moon lunar event (August 25, 1991). Therefore, the results of the study are sufficient in determining the tidal effects on the groundwater flow gradient and direction at the site.

Over the course of the study, water level measurements were obtained from monitoring wells KYW-103-1 through KYW-103-10. Table 5-3 summarizes groundwater elevation data collected from onsite monitoring wells during the study.

One high tide and one low tide was realized during the course of an 8-hour monitoring period. At the lowest recorded elevations (Figure 5-5), the piezometric surface displays a trough, the long axis of which trends southeast to northwest. The center line of the trough runs diagonally through and is beneath Building 103. The groundwater flow directions are toward the trough, then westward toward the Turning Basin.

As the groundwater elevations rise, the area along the Berthing Wharf has a groundwater gradient reversal with flow toward the east, while the groundwater in the area of the site further inland still flows toward the west (Figures 5-6 and 5-7). As the groundwater elevations decline with the tide, the groundwater gradient in the area of the Berthing Wharf again undergoes a reversal gradient with groundwater flowing in a southwesterly direction (Figure 5-8).

Graphs of water level elevations versus time for each well monitored during the study are in Appendix F, Groundwater Elevation Graphs from Tidal Influence Study. The predicted high and low tides based on information from tide tables published by the U.S. Department of Commerce (1990) are shown on each graph.

**Table 5-3  
Top of Casing Elevations, Depth to Groundwater, and Groundwater Elevations  
From Tidal Influence Study of August 13, 1991, 8-Hour Period**

Contamination Assessment Report  
Electrical Power Plant, Building 103  
Truman Annex  
NAS Key West, Florida

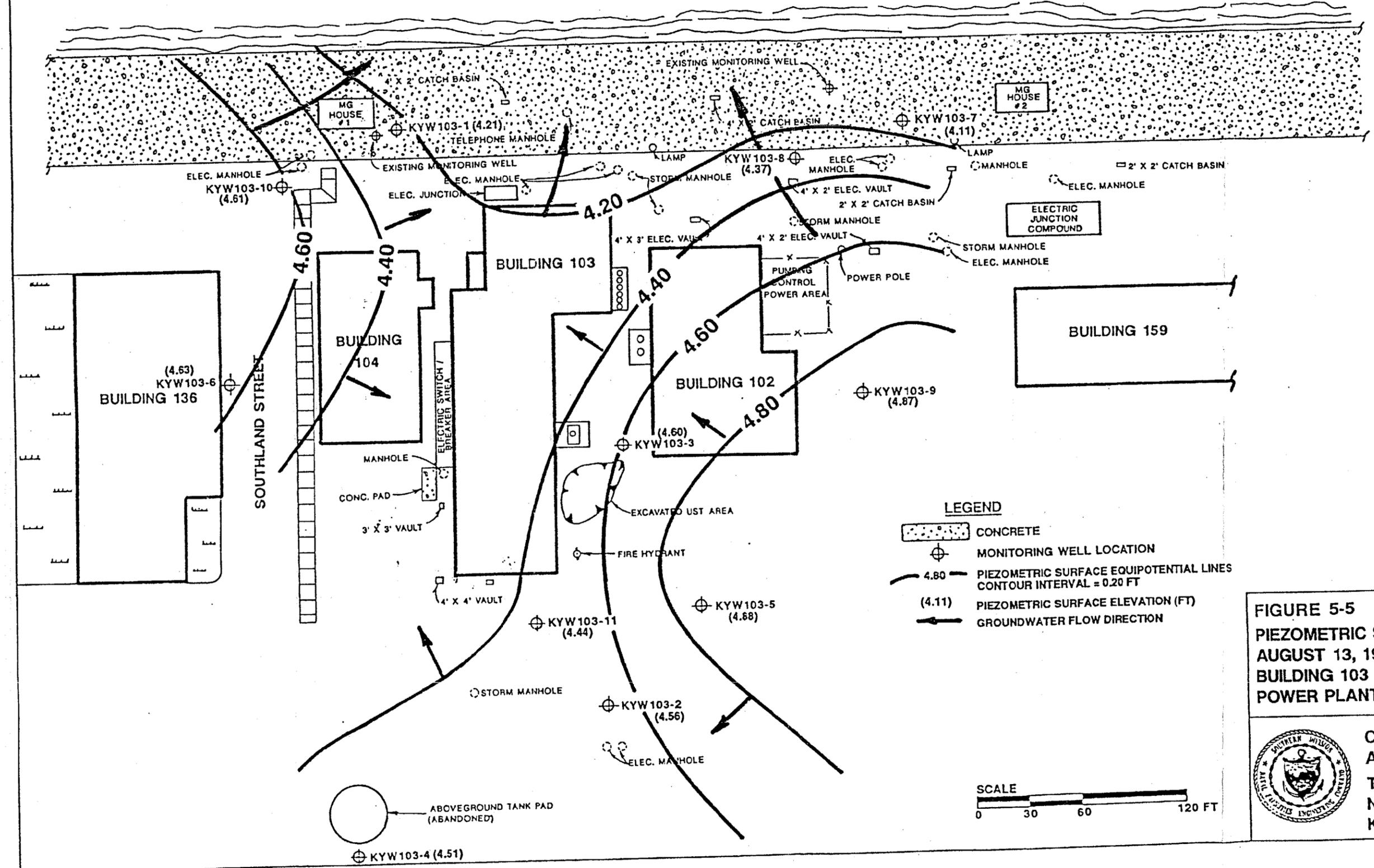
Monitoring Well Number	TOC Elevation <sup>1</sup>	24-Hour Time													
		815		915		1000		1115		1350		1545		1645	
		Depth to Water (feet)	Water Elevation <sup>1</sup>	Depth to Water (feet)	Water Elevation <sup>1</sup>	Depth to Water (feet)	Water Elevation <sup>1</sup>	Depth to Water (feet)	Water Elevation <sup>1</sup>	Depth to Water (feet)	Water Elevation <sup>1</sup>	Depth to Water (feet)	Water Elevation <sup>1</sup>	Depth to Water (feet)	Water Elevation <sup>1</sup>
KYW-103-1	10.63	6.42	4.21	6.16	4.47	5.94	4.69	5.63	5.00	5.30	5.33	5.66	4.97	5.97	4.66
KYW-103-2	12.33	7.77	4.56	7.48	4.85	7.28	5.05	7.00	5.33	6.72	5.61	6.90	5.43	7.25	5.08
KYW-103-3	12.37	7.77	4.60	7.60	4.77	7.45	4.92	7.25	5.12	7.03	5.34	7.23	5.14	7.44	4.93
KYW-103-4	12.05	7.54	4.51	7.27	4.78	7.10	4.95	6.81	5.24	6.48	5.57	6.81	5.24	7.09	4.96
KYW-103-5	12.13	7.25	4.88	7.03	5.10	7.04	5.09	6.90	5.23	6.68	5.45	6.82	5.31	6.98	5.15
KYW-103-6	11.38	6.75	4.63	6.61	4.77	6.49	4.89	6.33	5.05	6.16	5.22	6.33	5.05	6.49	4.89
KYW-103-7	10.51	6.40	4.11	6.17	4.34	6.00	4.51	5.72	4.79	5.29	5.22	5.52	4.99	5.80	4.71
KYW-103-8	10.68	6.31	4.37	6.24	4.44	6.10	4.58	5.85	4.83	5.47	5.21	4.60	6.08	5.90	4.78
KYW-103-9	11.41	6.54	4.87	6.52	4.89	6.49	4.92	6.41	5.00	6.23	5.18	6.20	5.21	5.28	6.13
KYW-103-10	10.94	6.33	4.61	6.35	4.59	6.29	4.65	6.15	4.79	5.86	5.08	5.82	5.12	5.93	5.01
KYW-103-11	12.21	7.77	4.44	7.46	4.75	7.25	4.96	6.92	5.29	6.58	5.63	6.90	5.31	7.26	4.95
KYW-103-12	10.71	NM	NM												
KYW-103-13	11.54	NM	NM												
KYW-103-14	12.14	NM	NM												

<sup>1</sup>Elevation = top of casing elevation based on a reference elevation of 10.00 feet established at BMMW-1.

Notes: High tides were at 0320 and 1700 o'clock.  
Low tides were at 1049 and 2123 o'clock.  
All measurements in feet.  
NM = not measured.



# Turning Basin

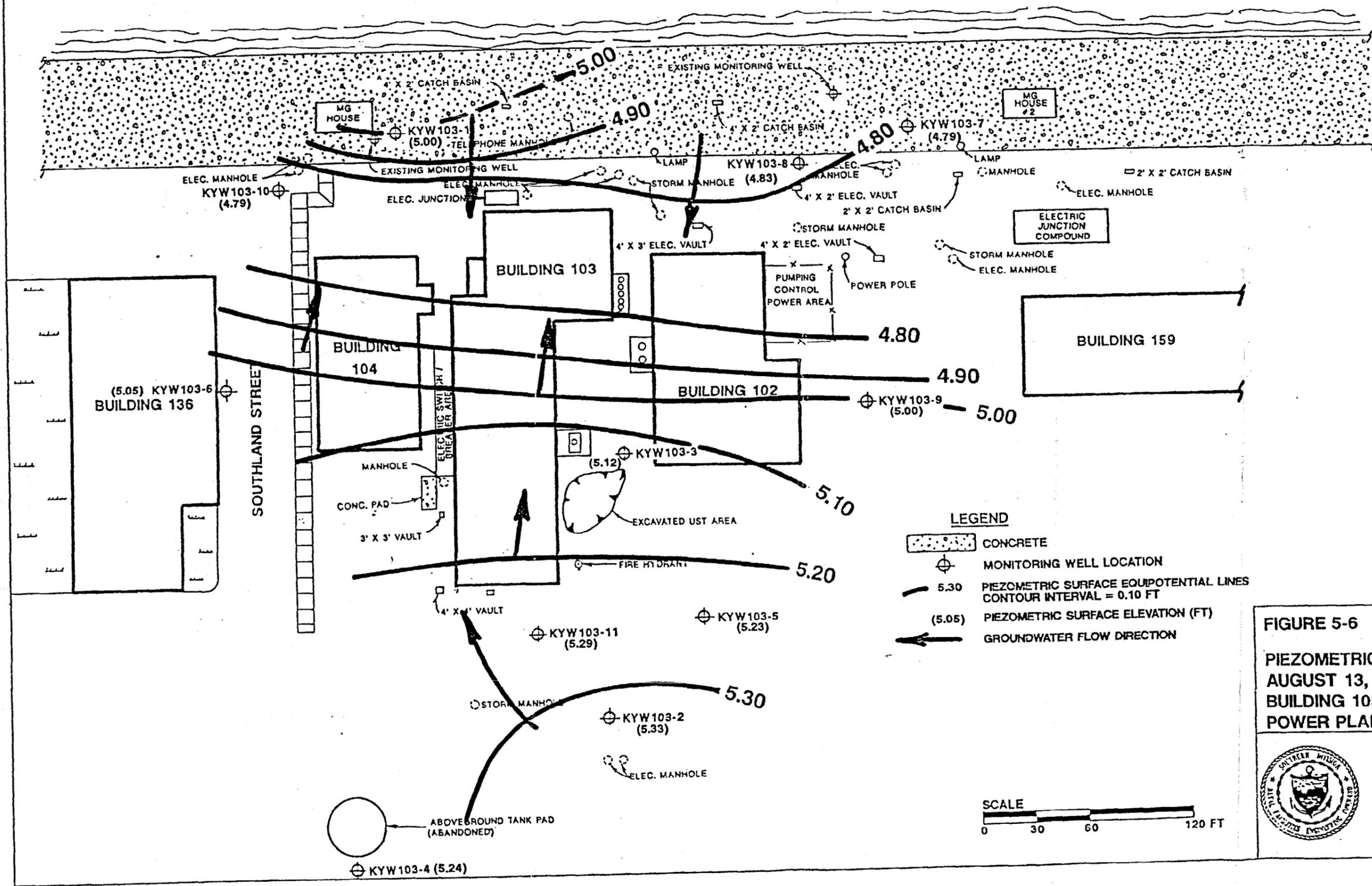


**FIGURE 5-5**  
**PIEZOMETRIC SURFACE ELEVATIONS**  
**AUGUST 13, 1991 0815 HOURS**  
**BUILDING 103**  
**POWER PLANT**



**CONTAMINATION**  
**ASSESSMENT REPORT**  
**TRUMAN ANNEX**  
**NAVAL AIR STATION**  
**KEY WEST, FLORIDA**

# Turning Basin



**LEGEND**

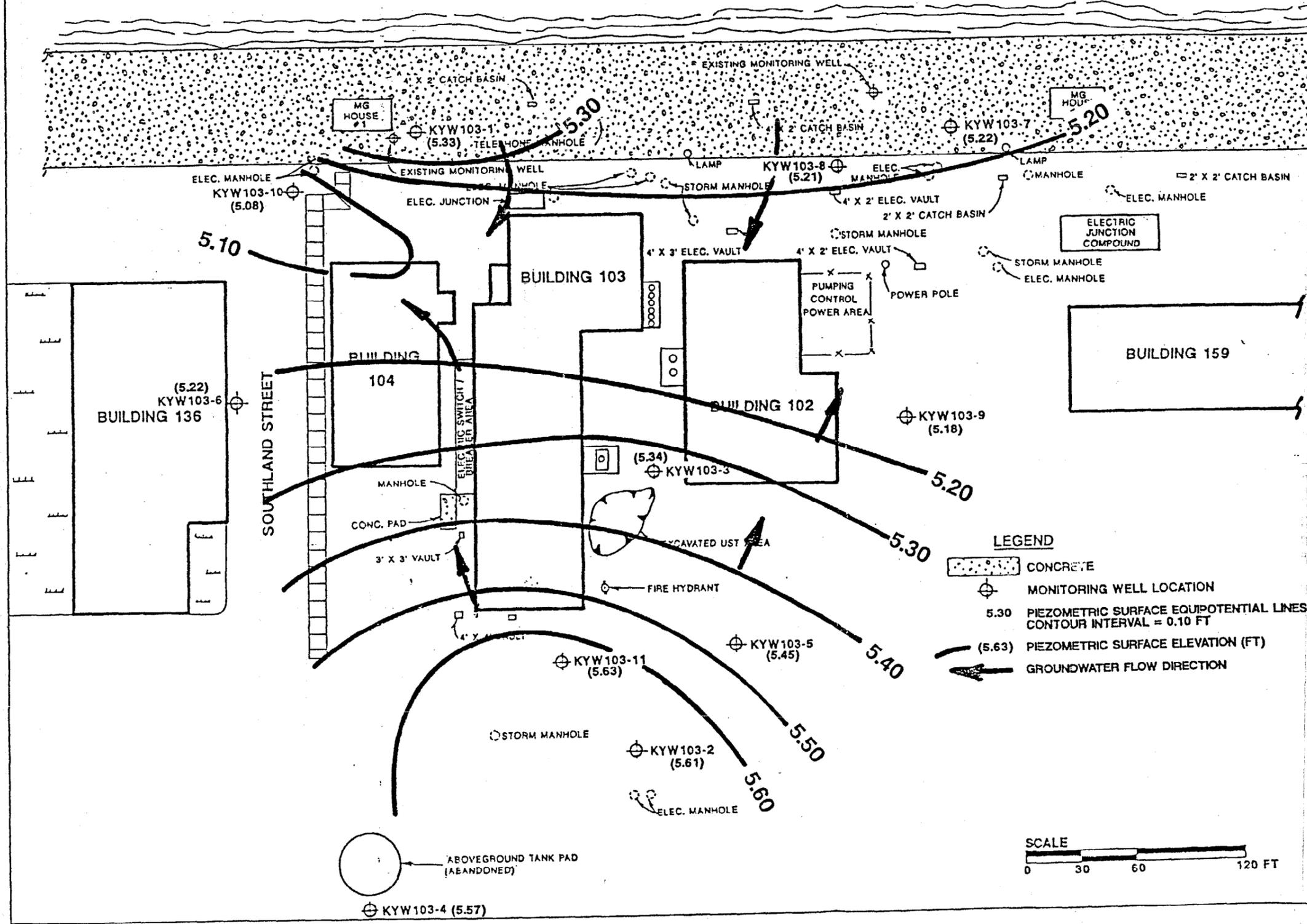
- CONCRETE
- MONITORING WELL LOCATION
- 5.30 PIEZOMETRIC SURFACE EQUIPOTENTIAL LINES  
CONTOUR INTERVAL = 0.10 FT
- (5.05) PIEZOMETRIC SURFACE ELEVATION (FT)
- GROUNDWATER FLOW DIRECTION



**FIGURE 5-6**  
**PIEZOMETRIC SURFACE ELEVATIONS**  
**AUGUST 13, 1991 1115 HOURS**  
**BUILDING 103**  
**POWER PLANT**

**CONTAMINATION ASSESSMENT REPORT**  
**TRUMAN ANNEX**  
**NAVAL AIR STATION**  
**KEY WEST, FLORIDA**

# Turning Basin

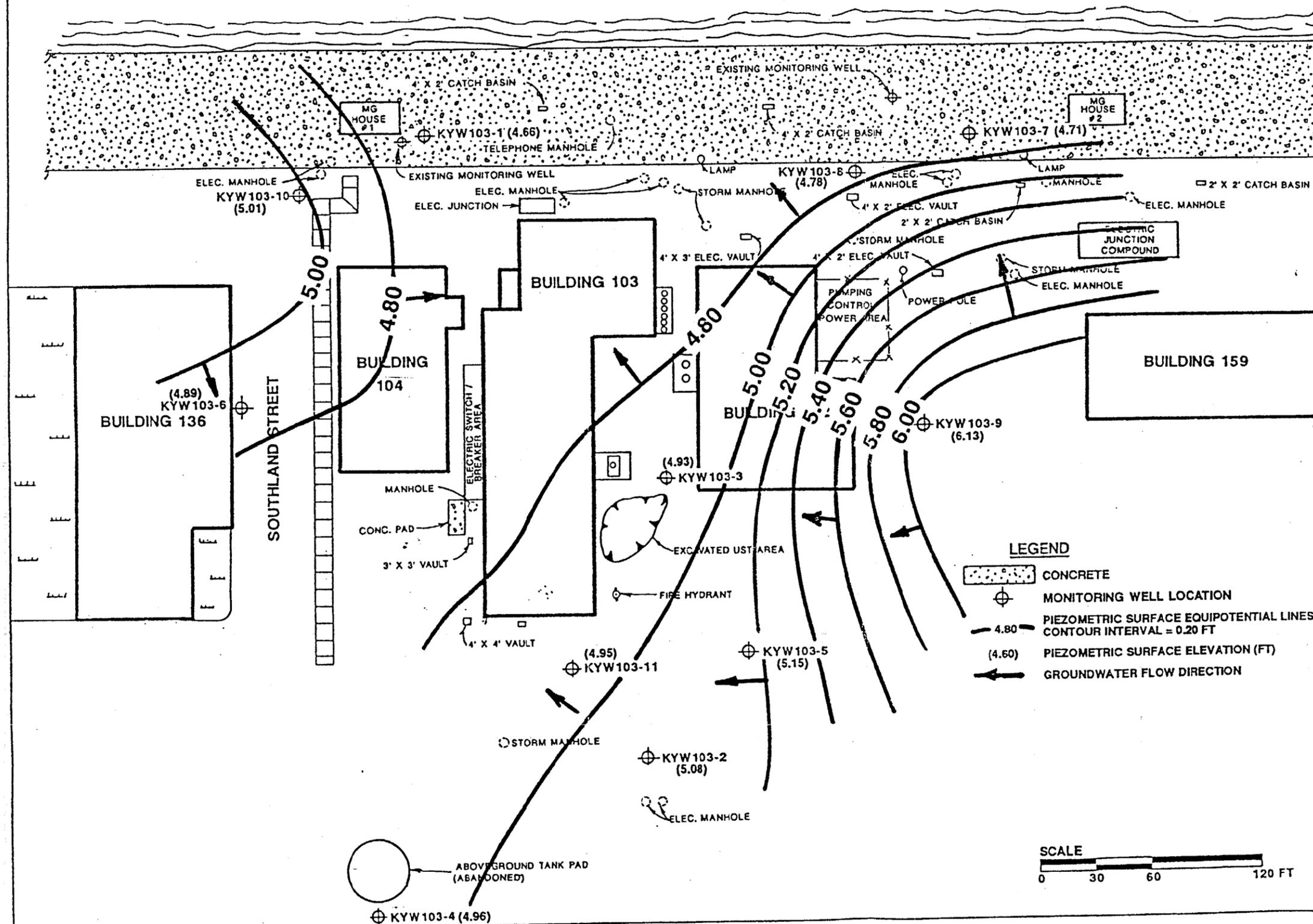


**FIGURE 5-7**  
**PIEZOMETRIC SURFACE ELEVATIONS**  
**AUGUST 13, 1991 1350 HOURS**  
**BUILDING 103**  
**POWER PLANT**

**CONTAMINATION ASSESSMENT REPORT**  
**TRUMAN ANNEX**  
**NAVAL AIR STATION**  
**KEY WEST, FLORIDA**



# Turning Basin



**FIGURE 5-8**  
**PIEZOMETRIC SURFACE ELEVATIONS**  
**AUGUST 13, 1991 1645 HOURS**  
**BUILDING 103**  
**POWER PLANT**



**CONTAMINATION**  
**ASSESSMENT REPORT**  
**TRUMAN ANNEX**  
**NAVAL AIR STATION**  
**KEY WEST, FLORIDA**

5.2.4 Potential for Contaminant Migration The sources of the contamination at the site between Buildings 102 and 103 and southeast of Building 103 were the result of petroleum storage tank systems and have been removed from the site; thus, the sources for these areas have been abated. Soil and groundwater contaminants detected in these two areas are the residuum of the sources.

The isolated and limited soil and/or groundwater contamination in the areas of monitoring wells KYW-103-10, KYW-103-12 and KYW-103-8 may be attributed to fuel pipelines that existed at the site. The isolated and limited groundwater contamination in the area of KYW-103-9 is of an unknown source.

ABB-ES field personnel observed that the groundwater elevations were at least one to two feet higher in elevation than the water in the Turning Basin, indicating that groundwater is not directly connected to the water in the basin. A direct connection is impeded by both the rock units beneath the site and the presence of two seawalls adjacent to the site. The limestone beneath the site is silty, weathered, and fine-grained. Effective porosity within the limestone will be reduced, causing the limestone to act as a semi-impermeable unit. The seawalls are constructed of steel, making it an impermeable to semi-impermeable unit. The old seawall is located approximately 10 feet seaward of the eastern edge of the Berthing Wharf area. The new seawall is at the waters edge. The saltwater beneath and adjacent to the site has a greater specific gravity than either the freshwater or the contaminants in question. Groundwater flow directions are toward a piezometric surface trough that remains in the vicinity of Building 103. Thus, the contaminants are confined by the seawalls and to some degree the limestone, the buoyant effect caused the saltwater, and the piezometric surface configuration. Because of these conditions at the site, it is unlikely that the contaminants will migrate off site and into the Turning Basin.

5.3 POTABLE WELL SURVEY AND GROUNDWATER CLASSIFICATION. There are no official potable wells in the Key West area. Potable water in the area is imported from mainland Florida through the Florida Keys Aqueduct. The volume of fresh groundwater in the Key West area is limited. Small lenses of fresh groundwater exist in the Key West area, but these lenses are subject to saltwater intrusion (Black, Crow, and Eidness, 1977).

Groundwater in the Key West area is classified as G-III groundwater for the following reasons.

- There are no official potable wells in the Key West area.
- Water quality data indicate that the surficial aquifer is an unlikely potable water source (McKenzie, 1990).
- Total dissolved solid concentrations (TDS) in the water table aquifer are often in excess of 10,000 ppm (McKenzie, 1990).

## 6.0 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

6.1 SUMMARY. Based on the results of the field investigations and the laboratory analytical results collected during the CA, the following is a summary of conditions at the site.

- The surficial aquifer in the Key West area is classified as a Class G-III groundwater source. There are no official potable wells in the Key West area. Groundwater from the surficial aquifer has been designated as an unlikely source of potable water (McKenzie, 1990).
- Surficial sediments are composed of fill material to an approximate depth of 5 feet underlain by a silty, weathered limestone.
- Groundwater was found at depths of 5 to 7 feet bls.
- Groundwater flow at the site area is generally toward the west; however, the surficial aquifer is tidally influenced in the area of the Berthing Wharf. At low tide, groundwater flow is to the west. At high tide, the direction of groundwater flow in the area of the Berthing Wharf is reversed and is toward the east, while the remainder of the site has groundwater flow generally toward the west.
- The calculated hydraulic conductivity in the surficial aquifer varies from 8.0 ft/day to 12.0 ft/day.
- No free product was found at the site.
- Excessively contaminated soils (>50 ppm) were identified in the OVA headspace survey.
- The volatile organic compounds 1,2-dichloroethene, benzene, toluene, ethyl benzene, and total xylenes were detected in the groundwater at low levels. The State target level for total volatile organic aromatics (total VOA) is 200  $\mu\text{g}/\ell$  for Class G-III groundwater. The total VOA concentrations from samples taken at the site did not exceed this standard.
- Benzene was detected in the sample from KYW-103-14 at a concentration of 17  $\mu\text{g}/\ell$ . This is in excess of the State regulatory standard of 1  $\mu\text{g}/\ell$ .
- USEPA Method 610 analyses revealed the contaminants acenaphthene, anthracene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene, phenanthrene, fluorene, and fluoranthene in the groundwater at various concentrations. The highest concentration of total naphthalenes (naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene) was detected in the sample from KYW-103-12 at 2,490  $\mu\text{g}/\ell$ . The State target level for total naphthalene is 100  $\mu\text{g}/\ell$ . The highest concentration of polynuclear aromatic hydrocarbons (excluding naphthalenes) was detected in the sample from KYW-103-12 at 1,620

$\mu\text{g}/\ell$ . The State target level for polynuclear aromatic hydrocarbons is  $10 \mu\text{g}/\ell$ .

- TRPH concentrations varied across the site with the highest value reported in the sample from monitoring well KYW-103-14 at 110 milligrams per liter ( $\text{mg}/\ell$ ).

## 6.2 CONCLUSIONS.

- Five limited and isolated soil and/or groundwater petroleum contaminated areas were identified at the site during the field investigation.
- The contaminated areas between Buildings 102 and 103 and southeast of Building 103 are attributed to associated petroleum storage tanks that, in the past, existed at the site.
- The petroleum contamination in the two areas along the Berthing Wharf appears to be isolated and limited in its extent and contamination levels, and may be attributed to pipelines that existed at the site. The contamination in the area north of Building 102 appears to be isolated and limited in extent and contamination levels; however, the source of the contamination has not been positively identified.
- The presence of two seawalls and to some degree the impervious nature of the limestone, the buoyant effect of the saltwater, and the piezometric surface configuration is expected to hinder seaward contaminant migration.
- A tidal influence study revealed that water level elevations and flow directions within the confines of the Berthing Wharf are affected by tidal fluctuations.

6.3 RECOMMENDATIONS. Based on the site conditions, the limited extent of the contamination, and the concentration levels of the contaminants, a *Monitoring Only Plan (MOP)* is recommended for this site.

7.0 PROFESSIONAL REVIEW CERTIFICATION

The CA contained in this report was prepared using sound hydrogeologic principles and judgment. This assessment is based on the geologic investigation and associated information detailed in the text and appended to this report. If conditions are revealed that differ from those described, the undersigned geologist should be notified to evaluate the effects of any additional information on the assessment described in this report. This CAR was developed for the NAS Key West site at Building 103, the Electric Power Plant, Truman Annex, and should not be construed to apply to any other site.

---

Kenneth L. Busen  
Professional Geologist  
P.G. No. 0000191

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Date

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**APPENDIX A**  
**SITE CONDITIONS**

## Physiography

The State of Florida is divided into three geomorphic zones: the northern or proximal zone, the central or mid-peninsular zone, and the southern or distal zone (White, 1970). The Key West area is part of the Lower Keys and is located entirely within the southern or distal zone. This area is characterized by a sparse veneer of residual soil and surface vegetation overlying eroded limestone. The topography of the Lower Keys is generally smooth and flat in the center of the key and slopes gently downward toward the shoreline (White, 1970). Ground elevations at the site are approximately 10 feet above mean sea level.

## Regional Hydrogeology

The Lower Keys are overlain by an oolitic member of the Pleistocene Miami Limestone. The Key Largo coral reef limestone underlies the Miami Limestone. Hoffmeister (1974) reported that the Miami Limestone is 27 feet thick and the Key Largo Limestone is greater than 270 feet thick in the western part of Key West. The Key Largo Limestone is generally more porous than the Miami Limestone. Surficial and shallow subsurface features in the area have often been altered by imported fill material.

The surficial aquifer in the Key West area is unconfined. The water table is found at shallow depths in the area, generally occurring from less than 1 foot to 10 feet below land surface. Water table elevations can be influenced by local rainfall and tidal fluctuations (McKenzie, 1990). The surficial aquifer is contained within the Miami Limestone, the underlying Key Largo Limestone, and surficial fill materials. The limestones generally contain brackish or saline water. Recharge to the aquifer is directly from precipitation, and infiltration rates are rapid. Groundwater flow discharge is to surrounding surface waters.

The surficial aquifer contains a small freshwater lens that floats on the saline groundwater. The lens, which is very thin (from less than 1 foot near the edge to an average of 5 feet near the center), is located below the center of the western half (Old Town) of the island. The lens contains about 20 million gallons of freshwater during the dry season and about 30 million gallons during the wet season.

The water table fluctuates and the configuration of the lens constantly changes, largely as a result of tidal action. On the average the lens is approximately 8,000 feet in length by 4,000 feet in width. Water quality data indicate that the lens is an unlikely source of potable water (McKenzie, 1990).

**APPENDIX C**  
**INVESTIGATIVE METHODOLOGIES AND PROCEDURES**

### Soil Borings

Soil borings were used to assess the degree of soil contamination at the site and to aid in the placement of subsequent monitoring wells. Soil borings were advanced into the water table using rotary drilling and hollow-stem augers. For each boring, a soil sample was collected immediately above the soil-groundwater interface. Samples were collected with a standard penetration test (SPT) split-spoon sampler. Samples were placed in 16-ounce glass jars, and headspace analysis was performed with an organic vapor analyzer (OVA) equipped with a flame ionization detector (FID).

### Monitoring Well Construction

All monitoring wells were constructed of 2-inch diameter, schedule 40, polyvinyl chloride (PVC) casing. The bottom 10 feet of each well was screened with 2-inch diameter, 0.010-inch slotted, PVC well screen. The shallow water table conditions necessitated limiting the thickness of the sand filter pack, bentonite seal, and grout above the screened interval. A 6/20 grade silica sand filter pack was placed in the annular space around each well to approximately 7 inches above the top of the screen. A 4-inch thick bentonite seal was then placed on top of the filter pack. The remaining annular space was grouted to the surface with neat cement. A protective traffic-bearing vault was installed to complete each well. Each monitoring well was equipped with a locking well cap. Typical monitoring well construction details are presented in Figure C-1.

### Groundwater Elevation Measurements and Tidal Influence Study

The elevation of the water table was estimated by surveying the top of the well casing of each monitoring well to a common reference datum. No benchmark was located in the area; therefore, an arbitrary reference elevation of 10.00 feet was established at the top of casing at monitoring well KYW-189-01. KYW-189-01 is located north of the site, at the Berthing Wharf, near MG House No. 3. Groundwater levels were measured using an electronic water level indicator. Water level elevations were calculated by subtracting the measured depth to groundwater from the elevation at the top of the well casing. To assess the effect of tidal fluctuations on water level elevations, water elevations were measured over an 8 hour period.

### Groundwater Sampling

Groundwater samples were collected from site monitoring wells on August 14, 1991. The groundwater samples were collected in accordance with ABB Environmental Services' Florida Department of Environmental Regulation approved Comprehensive Quality Assurance Plan (CompQAP). Before sampling, monitoring wells were properly developed and purged with Teflon™ bailers. Purging continued until a minimum of three well volumes had been removed. Groundwater samples were then collected, and the samples were placed into appropriate containers. The containers were labeled, placed on ice, and shipped under chain of custody to Wadsworth/Alert Laboratories in Tampa, Florida, for analyses. Pursuant to FDER Chapter 17-770, Florida Administrative Code, groundwater samples collected from monitoring wells underwent analyses for U.S. Environmental Protection Agency Methods 418.1, 601, 602, 610, ethylene dibromide (EDB), and lead. Field blanks, trip blanks, and equipment blanks were also analyzed.

## Slug Tests

Aquifer slug tests were performed on monitoring wells KYW-103-4 and KYW-103-7 to assess the hydraulic conductivity of the surficial aquifer. The slug was constructed of 1-inch outside diameter PVC pipe, 5 feet in length. The slug was filled with sand and capped watertight at both ends. Water level changes in the monitoring wells were recorded with a data logger and pressure transducer.

The pressure transducer was suspended less than 6 inches above the bottom of the well and the initial water level was recorded prior to beginning the test. The slug was then lowered into the well until it was totally submerged beneath the water table. Following recovery, the slug was quickly removed, and water level measurements were recorded until the water level recovered. Three rising head tests were conducted for each well in order to obtain an average recovery response. Slug test results are attached in Appendix D.

Hydraulic conductivities were calculated from slug test data based on the analytical method of Bouwer and Rice (1976) for partially penetrating wells screened in an unconfined aquifer. The computer program AQTESOLV™ (Geraghty and Miller, 1989) was used to calculate a hydraulic conductivity (K) value based on linear regression of the data gathered during the slug test.