MARYLAND PORT ADMINISTRATION

US Army Corps of Engineers
Philadelphia District

Pearce Creek Upland Dredged Material Placement Site Phase I Groundwater Study

Executive Summary Report

July 1995

Prepared for
Maryland Port Administration
and
U.S. Army Corps of Engineers, Philadelphia District

Prepared by
Maryland Environmental Service

MARYLAND ENVIRONMENTAL SERVICE

MARYLAND PORT ADMINISTRATION

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Pearce Creek Upland Dredged Material Placement Site Phase I Groundwater Study

Appendices C & D

July 1995

Prepared for
Maryland Port Administration

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Maryland Environmental Service

MARYLAND ENVIRONMENTAL SERVICE

MARYLAND
ENVIRONMENTAL
SERVICE

Parris N. Glendening
Governor

James W. Peck
Director

September 2, 1997

MR. Ken Cowley
195 Edgewater Dr.
Earleville, MD 21919
(410) 275-2168

RE: Request for Pearce Creek Report

Dear Mr. Cowley,

Please find enclosed one copy of the report entitled *"Pearce Creek Upland Dredged Material Placement Site Phase I Groundwater Study".*

This report was prepared for the Maryland Port Administration and the U.S. Army Corps of Engineers, Philadelphia District by the Maryland Environmental Service. Should you have any questions regarding this report, please call me at (410) 974-7261.

Sincerely,

Tammy Banta
Environmental Dredging

TRB/jl
Enclosure

cc: Mr. Frank Hamons (MPA)
Mr. Tony Serio (MPA)

2011 Commerce Park Drive • Annapolis, Maryland 21401 • 410/974/7281 • Fax 410/974/7267

MARYLAND
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Parris N. Glendening
Governor

James W. Peck
Director

WATER STUDY

September 29, 1995

Mr. William Hemphill
27 Bluff Road
Earleville, MD 21919

Dear Mr. Hemphill:

With reference to my letter of May 19, 1995, we forwarded the results of the analysis that was performed on water samples obtained from your well during October 1994. As you may recall, these samples were collected to support a preliminary assessment of the groundwater conditions underlying the West View Shores Subdivision. The assessment was recently completed. A copy of the Executive Summary of the results is enclosed for your information as is a copy of a fact sheet which provides an update on follow-up actions.

Once again, thank you for your cooperation and assistance with the phase I assessment.

Sincerely,

Wayne Young
Director
Environmental Dredging Program

Enclosure

2011 Commerce Park Drive • Annapolis, Maryland 21401 • 410/974/7281 • Fax 410/974/7267

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MARYLAND ENVIRONMENTAL SERVICE

EXECUTIVE SUMMARY

This Phase I Groundwater Study was conducted by the Maryland Environmental Service for the Maryland Port Administration, the Philadelphia District of the U.S. Army Corps of Engineers and the Maryland Department of the Environment. This report provides a preliminary assessment of the relationship, if any, between the Pearce Creek Upland Dredged Material Placement Facility and the groundwater underlying the West View Shores Subdivision (WVSS) in Cecil County, Maryland. This report also includes evaluations of other potential contributors such as saltwater intrusion and existing geologic conditions. Information and water samples from existing wells and surface water locations were obtained and used as the data base for this study.

Aquifer water quality in Cecil County generally exhibits elevated concentrations of iron and sodium, and low pH. Additionally, the water quality of the Magothy aquifer typically exhibits elevated concentrations of manganese. Approximately sixty percent of the sampled WVSS wells screened within the Potomac aquifer exhibited elevated concentrations above existing baseline groundwater quality for certain constituents, including manganese, chloride, potassium, sodium, calcium, iron, sulfate and dissolved solids. These elevated concentrations exceed levels that can be attributable to geologic conditions alone. Other potential sources of elevated concentrations of these parameters in the groundwater system include intrusion of saltwater, leaching from a reported abandoned dumping area within the subdivision, leaching from the Pearce Creek Upland Dredged Material Placement Facility, or a combination of these sources. The available data were insufficient to conclusively identify a source or sources as contributors to the existing state of groundwater quality.

Collection and analysis of additional field data on groundwater movement and hydrogeologic conditions would be required in order to conclusively determine the source or sources of degraded groundwater quality at the West View Shores Subdivision. The direction of groundwater flow could not be determined from the data available for analysis because (1) the potential for damage to residential wells and pumping systems precluded the

use of standard environmental sampling technologies for determination of water levels, and (2) available data were insufficient to enable effective placement of piezometers or monitoring wells.

Based on evaluation of the available data, the following observations are made:

- groundwater quality within the West View Shores Subdivision exhibits elevated concentrations of certain parameters typical and atypical of existing geologic conditions for Cecil County;

- samples taken from several wells indicate that the groundwater underlying the West View Shores Subdivision contains higher concentrations of certain constituents when compared to aquifer water quality within Cecil County, particularly for groundwater from the upper Potomac aquifer;

- several well water samples analyzed for this study show elevated concentrations of manganese, chloride, potassium, sodium, calcium, iron, and sulfate. General research performed by the U.S. Army Engineer Waterways Experiment Station suggests that the presence of these constituents may indicate groundwater degradation associated with the upland placement of marine sediments;

- most of the sampled wells yielding degraded groundwater quality are screened within the upper Potomac aquifer between the elevations -50 and -100 feet (NGVD 1929) and the degree of degradation increases with the depth of the screen elevation;

- saltwater intrusion may be occurring within the West View Shores Subdivision, but the extent of this influence on the groundwater system cannot be determined with the available data;

- evidence indicates that there is influence to the local groundwater system due to the

oxidation of sulfide rich minerals, although it is not certain whether this reaction is occurring due to pyritic soils from naturally existing geologic conditions or sulfide-bearing dredged material. High levels of sulfates can be indicative of pyritic soils and sediments commonly found in Maryland;

- the degraded groundwater from the upper Potomac aquifer underlying the West View Shores Subdivision is not likely due to residential septic systems;

- the Pearce Creek Upland Dredged Material Placement Facility cannot be either ruled out or positively identified as a contributor to the existing state of groundwater quality based on available data;

- additional groundwater study is required to estimate the water movement in the area of the West View Shores Subdivision and surrounding area; and

- some homeowners have not installed water treatment systems, although water quality at some wells does not satisfy applicable federal drinking water standards.

The scope of this study was limited to information gathered through readily available or existing sources. Additional study is required in order to conclusively identify a potential source or sources as contributors to the existing quality of groundwater underlying the West View Shores Subdivision. In particular, the groundwater movement and hydrogeologic conditions underlying the West View Shores Subdivision, Pearce Creek Facility and Pearce Creek should be examined in further detail. In addition, subsurface exploration of the abandoned dumping site in the community and investigation of existing geologic conditions including naturally occurring pyritic soils should be performed.

Groundwater Assessment

September 26,1995

Fact Sheet for West View Shores Residents and Property Owners

Groundwater Situation

The residential wells in the West View Shores Subdivision obtain groundwater from the Magothy and Potomac aquifers. Water from these aquifers typically contains naturally occurring concentrations of iron, manganese, and sodium, and low pH. However, some residential wells were reported to contain higher than normal background levels of certain constituents. Community residents brought these conditions to the attention of the Cecil County Health Department and the Maryland Department of the Environment. Concerns were expressed by some residents that the Army Corps of Engineers' Pearce Creek Dredged Material Disposal Facility, which is adjacent to West View Shores, could be contributing to the degraded groundwater quality in some wells.

Interagency Response

In mid 1994, the Maryland Department of the Environment, Cecil County Health Department, U.S. Army Corps of Engineers Philadelphia District and Maryland Port Administration initiated a phased groundwater assessment in an attempt to determine the cause of the degraded groundwater.

The Maryland Environmental Service began a preliminary assessment in August 1994 to investigate the quality of water from residential wells in the West View Shores area and gather available historic data about the groundwater in the area. Geotechnical support was provided by the Maryland Geological Survey.

Letters were sent in September 1994 to 100 residents of the West View Shores Subdivision requesting their participation in the collection of well water samples. Seventy residents responded to the survey and gave permission to sample their well water. Samples were taken during October 1994 at points prior to any influence from household water treatment systems where installed.

The results of the water quality testing showed that water samples for some wells exceeded EPA recommended levels for iron, pH, manganese, sulfate, chloride, dissolved solids, sodium, lead, aluminum, and nickel. Residents who participated in the study were provided with the sampling results from their wells. The Cecil County Health Department established a point of contact for responding to resident inquiries about these data. An analysis of these data and a preliminary assessment of the data's implications were incorporated into a detailed Phase I report during the first half of 1995. A final report of the findings was completed in July 1995. A copy of the report is available for review at the Cecil County Health Department.

The available data were not sufficient to conclusively pinpoint the source of constituents found in the degraded groundwater. The Phase I report concluded that a more rigorous examination was needed because of the complicated nature of groundwater flow and the similarities between the various potential sources of constituents.

Phase II Assessment

The U.S. Army Corps of Engineers, Philadelphia District has initiated a Phase II study to develop additional information that will help to better understand the groundwater flow patterns and sources of constituents found in the local groundwater. Monitoring wells will be installed around the community and the Pearce Creek Dredged Material Disposal Site. Efforts will be made to install the wells on public property, however, placement on private property with the permission of property owners may be necessary to obtain a suitable distribution of sampling points. The Phase II study will assist in the identification of the cause or causes of the degraded groundwater. The results of the Phase II study will be available for use by the participating agencies in determining remediation needs.

DID ACE EVER DRILL WELLS

? Questions and Inquiries ?

Contact Charles Smyser at Cecil County Health Department at (410) 996-5160

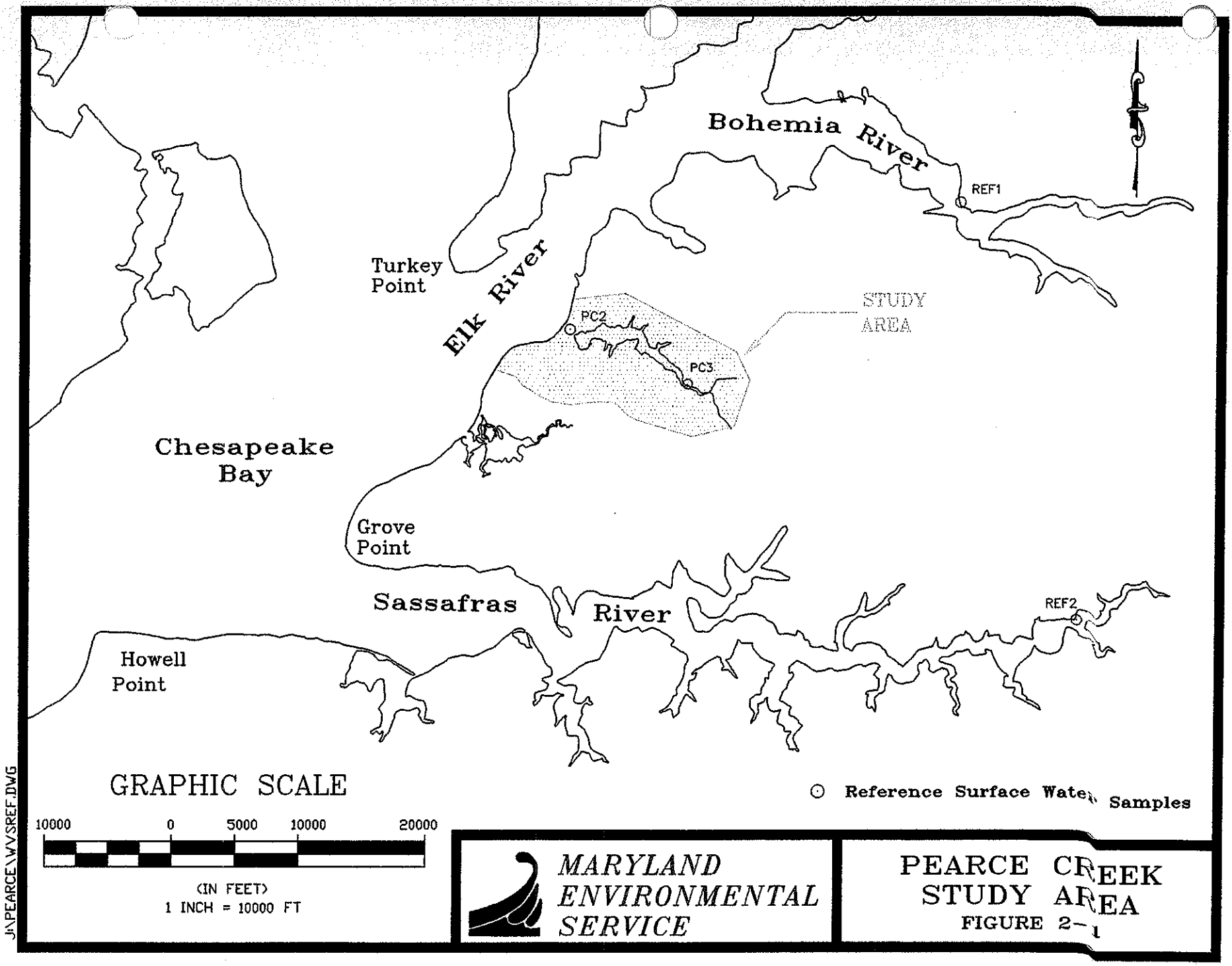
1.0 INTRODUCTION

Residents of the West View Shores Subdivision, a Cecil County community have reported to the Maryland Department of the Environment (MDE) that the quality of their groundwater is degraded. The subdivision is located adjacent to the Pearce Creek Upland Dredged Material Placement Facility. A review of existing groundwater data by MDE in 1991 suggests that the Pearce Creek Facility may be a potential contributor to the degraded groundwater (Dougherty, 1991). The 1991 review is not conclusive due to limited availability of data. It has been determined that additional investigation and data analysis are necessary to substantiate the level of potential impact of the Pearce Creek Facility and to identify other possible contributors to the degraded groundwater condition.

Phase I is a groundwater study of the area consisting of the Pearce Creek Placement Facility and the West View Shores Subdivision. The Phase I study was designed to gather information to provide a preliminary assessment of the relationship of the Pearce Creek Facility and the groundwater supplying the West View Shores Subdivision and to evaluate other potential contributors. The study was performed utilizing readily attainable data from existing sampling structures and documented information sources. It has been recognized by participants of the study that conclusive identification or disassociation of the Pearce Creek Placement Facility as a contributor may require additional study that is outside of the scope of work for the Phase I Study.

2.0 FACILITY AND COMMUNITY BACKGROUND

The Pearce Creek Dredged Material Placement Facility is operated by the U.S. Army Corps of Engineers, Philadelphia District. The facility was constructed at the confluence of Pearce Creek and the Elk River in Cecil County, Maryland (See Figure 2-1). The site was constructed to receive material dredged from the approach channels to the C&D Canal. It was first used in 1937-1938 for the placement of approximately 4 million cubic yards of dredged material (Dougherty, 1991).


Bohemia River
REF1
Turkey Point
Elk River
STUDY AREA
PC2
PC3
Chesapeake Bay
Grove Point
Sassafras River
REF2
Howell Point
GRAPHIC SCALE
10000 0 5000 10000 20000
(IN FEET)
1 INCH = 10000 FT
⊙ Reference Surface Water Samples
MARYLAND ENVIRONMENTAL SERVICE
PEARCE CREEK STUDY AREA
FIGURE 2-1
J:\PEARCE\WVSREF.DWG

The original elevation of the site was 18 to 23 feet above the National Geodetic Vertical Datum of 1929 (NGVD). Since then, the site has been used intermittently between 1938 and 1993 for dredged material placement. The current elevation is 41 feet above the NGVD. The facility was last utilized for placement of 200,000 cubic yards of material in 1992 and 1993 (DePrefontaine, 1994).

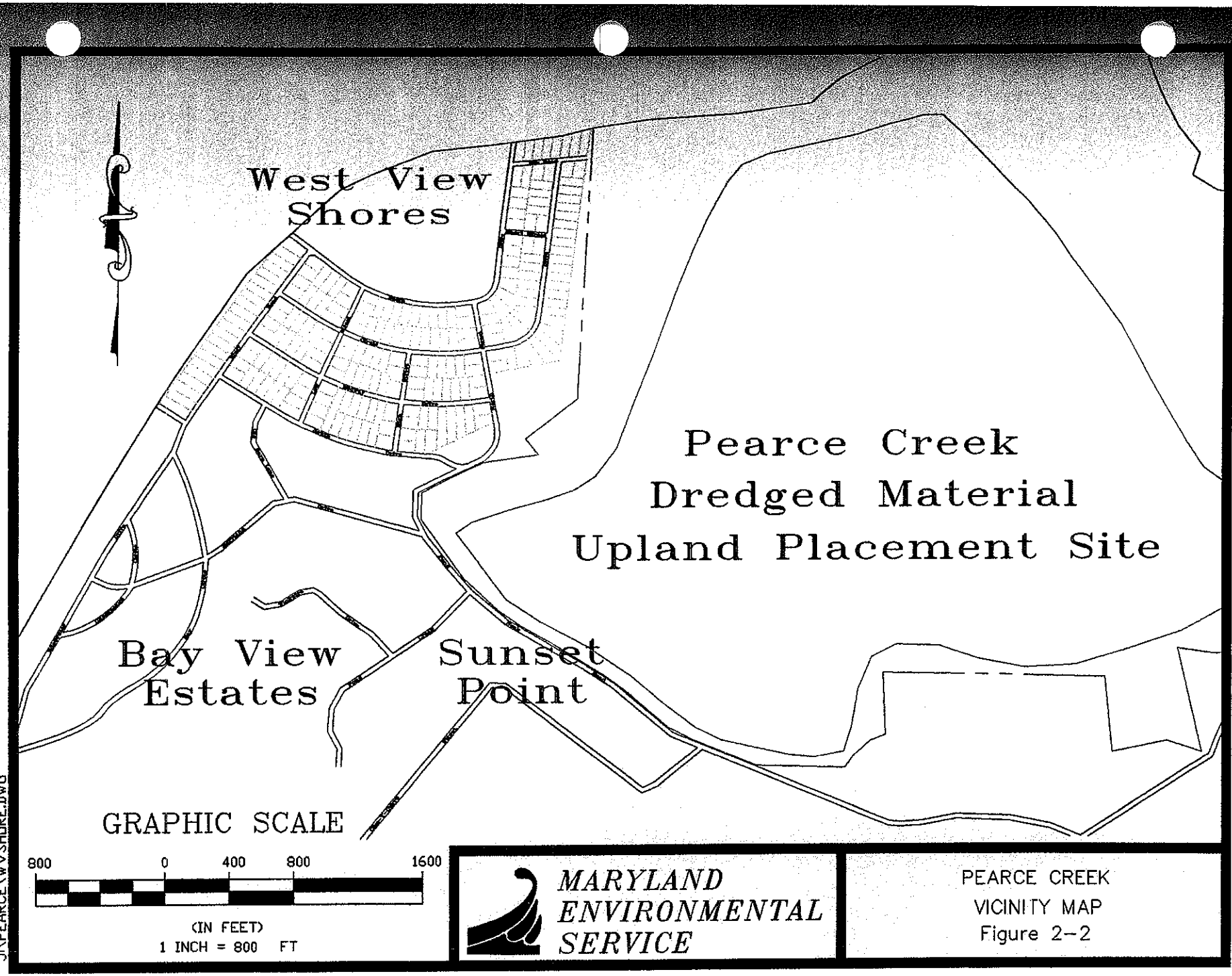
Active dewatering operations were not apparent at the time of this study. The majority of the discharge from the facility is due to precipitation, which is collected and released from a weir structure located near the northeastern portion of the facility.

The Pearce Creek Dredged Material Placement Facility borders the east side of the West View Shores Subdivision. The subdivision is bordered on the north by the Elk River and the Chesapeake Bay. The community is made up of approximately 140 households, of which roughly half claim West View Shores as their permanent residence. Adjacent communities include the Bay View Estates and the Sunset Point Subdivision to the south and Crystal Beach to the northeast. Figure 2-2 shows the location of the communities and the Pearce Creek Facility. The adjacent communities have not registered concerns with the Cecil County Health Department regarding the quality of their groundwater, according to available records.

3.0 PHASE I METHODOLOGY

The Phase I study gathered information through readily obtainable or existing sources to enable a timely preliminary assessment of the relationship of potential contributors to groundwater quality.

The methodology for this phase involved collecting existing data from the Maryland Department of the Environment, the Cecil County Health Department, the Maryland Geological Survey, the U.S. Geological Survey, and the U.S. Army Corps of Engineers, Philadelphia District and developing supplemental data from local residents and environmental field sampling. Residential wells were selected for sampling based on the information derived from


West View Shores
Pearce Creek Dredged Material Upland Placement Site
Bay View Estates
Sunset Point
GRAPHIC SCALE
800 0 400 800 1600
(IN FEET)
1 INCH = 800 FT
J:\PEARCE\WVSHORE.DWG
MARYLAND ENVIRONMENTAL SERVICE
PEARCE CREEK
VICINITY MAP
Figure 2-2

questionnaires which were distributed to the residents. Wells and surface water locations in the area were then sampled.

3.1 EXISTING DATA ASSEMBLY

Existing information regarding site and local area conditions was assembled for review and comparison with field data. Previous data were acquired from several wells in the West View Shores Subdivision and adjacent communities by the Maryland Department of the Environment in conjunction with the Cecil County Health Department. Well completion reports, reports on local groundwater quality, geologic and hydrogeologic data were gathered from various agencies of the State of Maryland. Boring logs and plans of the Pearce Creek Dredged Material Placement Facility were obtained from the U.S. Army Corps of Engineers, Philadelphia District. Other relevant information regarding the Pearce Creek Dredged Material Placement Facility was not found through the U.S. Army Corps of Engineers, Philadelphia District. Information pertaining to the facility effluent discharge, groundwater, or soil conditions underlying the facility was not available. All pertinent information collected as part of this study is referenced in the text.

3.2 FIELD SURVEY

3.2.1 QUESTIONNAIRE

Prior to performing field data collection, several Board Members of the West View Shores Community Association were contacted to inform them of this study. A letter was then sent to West View Shores residents soliciting volunteers to participate in the study. A questionnaire was included with the letter to request relevant information regarding the residential well taps. Appendix A includes the residential survey information obtained.

3.2.2 WELL AND SURFACE WATER SAMPLING

Approximately 70 existing wells and surface water locations were sampled and analyzed. Figures 3-1a and b show the well sample locations. Reference water sample locations are provided in Figure 2-1. Sampling activities were conducted, where possible, using wells that had documented installation records. Efforts were made to sample wells at locations uninfluenced by existing water treatment systems. No additional wells or piezometers were installed during this study since available information prior to this study was not sufficient to enable effective placement. The information obtained as result of this study will assist in future installation of sampling structures.

The written protocol and field sampling records used for well sampling is attached as Appendix E. All sampling procedures used in this study complied with methods from the Environmental Protection Agency Code of Federal Regulations, Title 40, Part 136 for collection, handling, and preservation. The protocol specified the following sampling procedures:

- Visual inspection of wells;
- Recording the location of the wells with reference to nearby structures or roads;
- Recording identification numbers from the well;
- Measuring the depth of the well and the depth of standing water in the well;
- Removing three volumes of standing water from the well; and
- Obtaining samples.

For most wells, measuring and obtaining samples directly from the well casing was difficult since the majority of the wells were in use and contained well pumps. Instead, samples were collected from taps, in or outside of the homes, at locations uninfluenced by water treatment systems. Prior to collection of samples, water was allowed to run until temperature change indicated that all standing water within the well casing and residential plumbing system

had been removed.

Surface water was collected as grab samples in locations that were free-flowing and well mixed, where possible. This procedure was difficult to implement on the Pearce Creek Facility surface run-off due to minimal discharge of effluent during the sample collection period. Although several attempts were made, only one sample was collected to represent Facility effluent discharge. During this sampling event, an extremely low flow discharged from the center outfall pipe. A grab sample was collected from this discharge and composited with effluent which had trickled down into a pool of ponded water. The ponded water did not appear to be stagnant as there was a flow entering it. It is recommended that additional samples be taken from the outfall pipes over a year's period of time to truly characterize the quality of the Facility discharge.

3.2.3 WATER SAMPLE ANALYSIS

Water samples were analyzed by a certified laboratory for parameters that are indicative of potential contributing sources (i.e., salt water intrusion, dredged material). Table 3-1 lists the constituents that were analyzed and the EPA approved methods that were used.

Many of the parameters that were analyzed include Maximum Contaminant Levels (MCL's) established by the EPA. MCL's are set by the EPA for public water-supply systems, but can be used for private water supplies as an indicator of drinking water suitability. Most of these parameters are indicators of taste or potability, others, such as nitrate, can cause health problems if present in levels over the MCL's.

3.2.4 TOPOGRAPHIC SURVEY

An initial objective of the study was to estimate the underlying groundwater movement by measuring water levels in existing wells to determine current water elevations. A topographic survey of the community and wells was performed as part of this effort to convert

TABLE 3-1

GROUNDWATER AND EFFLUENT PARAMETER LIST

Parameter	Method #	Parameter	Method #
Alkalinity ($CaC0_3$)	EPA 310.1	Aluminum (Al)	EPA 200.7
Arsenic (As)	EPA 206.2	Ammonia (NH_3)	EPA 350.2
Bicarbonates (HCO_3)	SM4500-CO2-D	Biochemical Oxygen Demand (BOD 5 day)	EPA 405.1
Bromide (Br)	ASTM D1246-88	Cadmium (Ca)	EPA 200.7
Calcium (Ca)	EPA 200.7	Chloride (Cl)	EPA 325.3
Chromium (Cr)	EPA 200.7	Chemical Oxygen Demand (COD)	EPA 410.4
Specific Conductance	EPA 120.1	Copper (Cu)	EPA 200.7
Dissolved Oxygen (DO)	EPA 360.1	Fluoride (Fl)	EPA 340.2
Iron (Fe)	EPA 200.7	Lead (Pb)	EPA 200.7
Magnesium (Mg)	EPA 242.1	Manganese (Mn)	EPA 200.7
Nickel (Ni)	EPA 200.7	Nitrate (NO_3)	EPA 353.2
pH	EPA 150.1	Potassium (K)	EPA 200.7
Sodium (Na)	EPA 200.7	Sulfate (SO_4)	EPA 375.4
Sulfide (S^{2-})	EPA 376.2	Total Dissolved Solids (TDS)	EPA 160.1
Zinc (Zn)	EPA 200.7		

measured depths to elevations relative to the National Geodetic Vertical Datum (NGVD) of 1929 as taken from USGS Well CE-DD-81. A topographic map of the West View Shores survey is included in Appendix B. Additional survey information of the Pearce Creek Facility was obtained through the U.S. Army Corps of Engineers, Philadelphia District.

Successful measurement of water elevations in the wells was prevented due to the presence of well pumps which obstructed the interior of the well casing. To preclude the risks of damaging residential pump equipment, the pumps were not removed. As a consequence, measurements of water depths were not performed and the underlying groundwater movement in the area could not be identified during this study. The survey information which was gathered will still be useful for estimating potential groundwater movement in any future assessments of the groundwater flow in the area.

3.3 DATA ANALYSIS

The information obtained from field sampling events was correlated with existing data from the Pearce Creek Facility and the West View Shores community to identify potential levels of contribution from residential septic systems, saltwater intrusion, the dredged material placement site and other sources. Well locations and water quality data were then graphed on a topographical map of the study area in an effort to estimate any contaminant patterns. Well sampling data were also compared with regional geologic and hydrogeologic data, effluent and surface water data, and surrounding area water quality.

4.0 GEOLOGICAL DESCRIPTION

The Pearce Creek Dredged Material Placement Facility and the West View Shores Subdivision are located in the southern portion of the Coastal Plain of Cecil County which is composed of unconsolidated, stratified sand, gravel, silt and clay materials (MGS, 1988). From the boring logs and well completion reports, it appears that the West View Shores residential wells are screened predominately in the upper Potomac and Magothy aquifers. Below is a

description of the sediments comprising the geologic formations found in the two principal aquifer groups within the study area.

Potomac Group Sediments

The sediments composing the Potomac Group are predominantly fine-grained sand, silt and clay with variable scattered sections of coarse-grained materials including medium to coarse sand and gravel (MGS, 1988). Sand colors range from white to orange-brown and fine materials are white and yellow, red, purple and dark grey.

Magothy Formation Sediments

The sediments composing the Magothy Formation are light colored to white fine-grained materials including some darker sands and dark-colored clays and silts predominately black and dark grey in color (MGS, 1988).

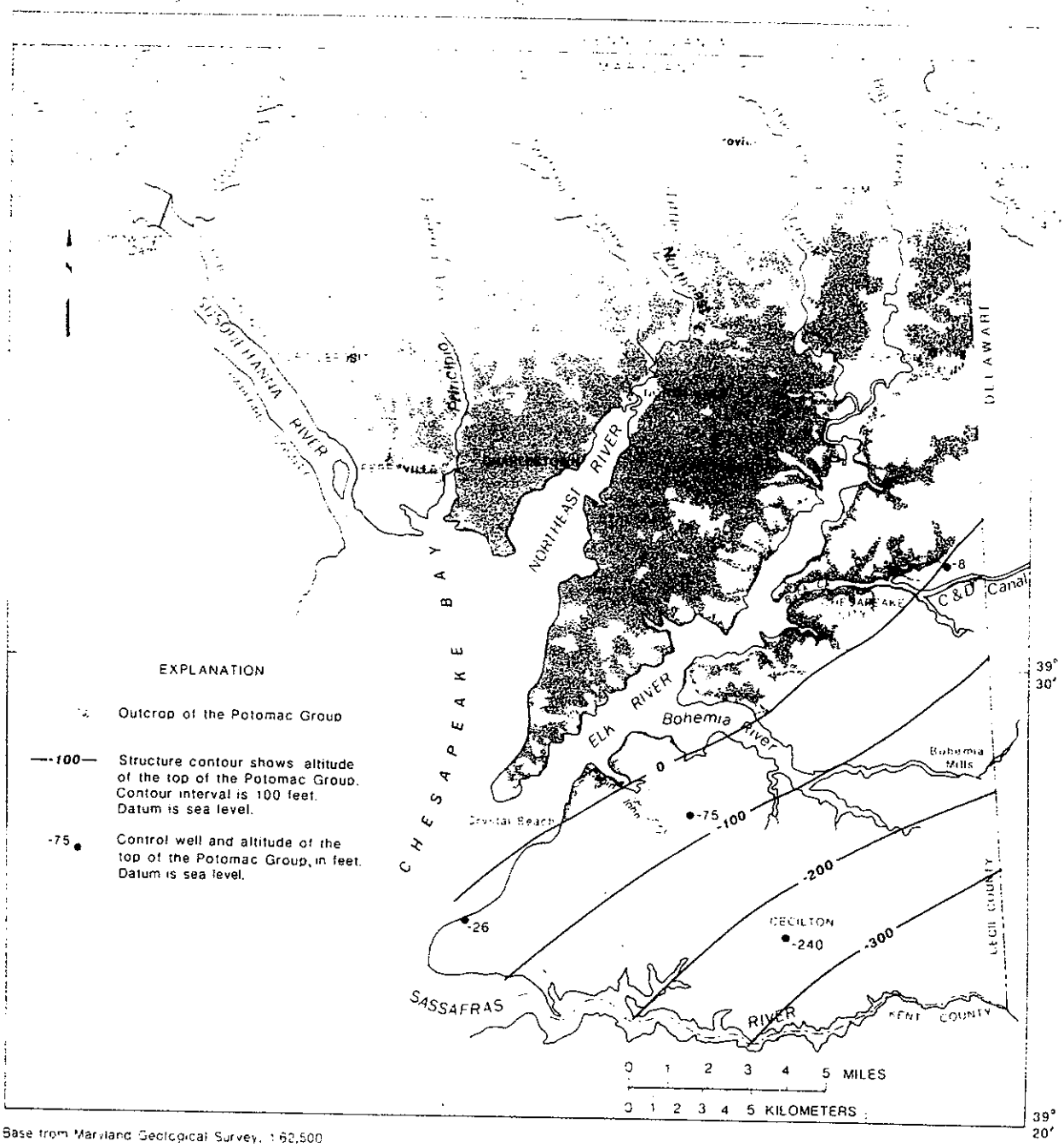
The aquifer designation for each well, as provided in this report, was interpolated based on the screening medium and depth as indicated on well completion reports and interpretation of the geological documentation of the local aquifer formations. Appendix C contains the residential well completion reports and boring log information from the Pearce Creek Facility, dated 1988. The geological descriptions from the well completion reports and the boring logs are consistent with the typical geology of the Coastal Plain.

When constructed, the base of the Pearce Creek Facility was at an elevation of +18 to +23 feet NGVD (DePasquale, 1995). The only available facility boring log information indicates that immediately below this elevation, the geology consists mostly of unconsolidated sand, gravel and silt medium with a few areas containing clay lenses. This information is limited to areas located along the facility dike. Identification of the soil conditions underlying the facility are not certain. If the geology underlying the site is consistent with the geology indicated by the available boring logs, such soil conditions could potentially allow for a vertical

hydraulic gradient below the facility, particularly during dredged material inflow operations. Precipitation and hydraulic inflow of dredged material to the Pearce Creek Facility could provide a source of groundwater recharge to the local and unconfined aquifers underlying the West View Shores Community. Soil and groundwater investigations of the dredged material facility and the underlying geologic conditions may be performed to determine whether this site provides a source of recharge to the groundwater underlying the West View Shores Subdivision.

Precipitation in upland areas is the major source of recharge to the Potomac Group aquifers and direct recharge can occur along outcropping areas of aquifers (MGS, 1984). Figure 4-1, taken from MGS Bulletin 34 (MGS, 1988), shows the outcrop area and altitude of the top of the Potomac Group sediments. Some outcrop areas of the Potomac Group sediments are located along the shoreline of the Elk River at Crystal Beach. From this figure, it is possible to interpret that the Elk River is in direct contact with outcrop areas of the Potomac Group sediments and could be locally influencing the upper Potomac aquifer underlying the West View Shores Subdivision through recharge. According to Figure 4-1, the top of the Potomac Group sediments in the area of the facility is at an elevation between 0 to 100 feet below sea level. Depending on the existing local geology, this may or may not allow the facility to influence the Potomac aquifer.

The local geologic formation could explain the variability of the well data, however, due to the complex nature of the existing geology, it cannot be described without additional study. On a regional scale, the upper Potomac formation dips toward the southeast (MGS Bulletin 34). This could indicate that the groundwater flow is in this same general direction. If this were true on a local level, then the Pearce Creek Facility could not be contributing to the degraded groundwater supply of the West View Shores Subdivision. Additional study is recommended to determine the localized groundwater flow which could be controlled by pumping, by the Elk River, or by Pearce Creek.



Base from Maryland Geological Survey, 1:62,500

Figure 4-1. Outcrop area and altitude of the top of the Potomac Group aquifer. (MGS Bulletin 34, 1988)

5.0 DATA EVALUATION AND INTERPRETATION

For the purpose of this study, wells located in the West View Shores Subdivision were sampled from tap locations. Permission for sampling was granted by the property owners on a voluntary basis. Wells are identified by the subdivision lot numbers to protect the privacy of the residents. Residential names or addresses are not provided in this report. A legend to sample identifications and the raw data laboratory analysis reports are included in Appendix D.

Seventy-three water and surface water samples were collected during this study. The majority of the water samples were obtained from the West View Shores Subdivision. Some samples were also obtained from residential wells along Pond Neck Road, south of the facility.

Of the approximate 140 households from the West View Shores Subdivision, 110 residences were surveyed and 58 responded. 62% of the respondents are from full-time, permanent residences, 74% drink the well water and 82% have some type of water treatment system. Of the forty-two households who drink the well water, 19% indicated they do not have a water treatment system.

5.1 DATA QUALITY CONTROL AND QUALITY ASSURANCE

Quality Control are the measures within a sample analysis methodology that assure that the process is in control (Clesceri, 1992). Quality control can be internal to a laboratory and/or external to a laboratory and can be performed on all steps of the process from sample collection techniques through laboratory analysis and reporting.

5.1.1 ANALYTICAL QUALITY CONTROL AND QUALITY ASSURANCE

The laboratory which analyzed the Pearce Creek Phase I samples performed quality control/quality assurance procedures which meet or exceed all of the requirements of the Safe Drinking Water Act, 40 CFR Part 136, and SW-846. These quality control procedures

were met by the laboratory prior to generation of the data report. This section describes the quality control used during the sample collection techniques.

5.1.2 SAMPLE COLLECTION QUALITY CONTROL AND QUALITY ASSURANCE

Sample collection quality control was accomplished using trip blanks, field blanks and duplicate samples. Trip blanks were prepared by the contract laboratory and delivered to the Maryland Environmental Service (MES). One trip blank was used each sample day. Field blanks were prepared by MES on-site for selected sample events. Duplicate samples were collected by MES every ten samples.

5.1.3 TRIP BLANK AND FIELD BLANK ANALYSIS

The trip blank measures potential contamination that could occur from bottles, preservatives and sample handling procedures. Field blanks are used to establish quality control for sample collection techniques.

Results for the field and trip blanks from the Pearce Creek Phase I samples are summarized in Table 5-1. The majority of the results were generally acceptable with concentrations at or below detection limit.

There were a few parameters in the blanks with concentrations that were well above the detection limit (an example is the sodium concentration in the 10/20/94 trip blank). The laboratory explained that results such as this could be explained by "carry-over." This occurs when a sample with high concentrations is measured prior to another sample. The prior sample contaminates the following sample and yields falsely high concentrations. Concentrations of parameters just above the detection limit may also indicate low level contamination in the laboratory, the bottles, the preservatives or the water used to prepare the blanks. The results from the analysis of the field blanks and trip blanks are judged to indicate acceptable quality

Table 5–1
Pearce Creek Phase I – Quality Control Review of Trip & Field Blank Data

Sample #	Sample Date	Time	pH units	Field Data Temp deg C	Field Data DO mg/l	Cond. umhos/ cm	Bicarb. Alkalinity mg/l	BOD mg/l	Br mg/l	Na mg/l	Cl mg/l	F mg/l	Diss. Solids mg/l	SO4 mg/l	Fe mg/l	Mn mg/l	Total Alkalinity mg/l
10/15 Trip Blank	10/13/94	1540					1 L	2	0.40 L	0.200 L	1.0 L	0.02 L	21	0.14 L	0.011	0.005 L	1 L
10/18 Trip Blank	10/18/94	0800					1 L	2 L	0.40 L	0.310	1.0 L	0.02 L	10 L	0.14 L	0.009 L	0.005 L	1 L
10/19 Trip Blank	10/13/94	1540					1 L	3	0.40 L	0.300	1.0 L	0.13	10 L	0.14 L	0.009 L	0.005 L	1 L
10/20 Trip Blank	10/13/94	1540					1 L	2	0.40 L	1.180	1.9	0.02 L	10 L	0.14 L	0.042	0.007	1 L
10/25 Trip Blank	10/13/94	1540					1 L	2 L	0.40 L	0.539	1.0 L	0.02 L	10 L	0.14 L	0.009 L	0.005 L	1 L
Field Blank	10/13/94	1150	5.88	16.3	12.47	0	1 L	2 L	0.40 L	0.238	1.0 L	0.02 L	10 L	0.14 L	0.119	0.013	1 L
10/13 Trip Blank	10/11/94	1435					1 L	2 L	0.40 L	0.300	1.0 L	0.02 L	10 L	0.14 L	0.033	0.005 L	1 L

Sample #	Sample Date	Time	NH4 mg/l	COD mg/l	NO3 mg/l	Al mg/l	As mg/l	Cd mg/l	Ca mg/l	Cr mg/l	Cu mg/l	Pb mg/l	Mg mg/l	Ni mg/l	K mg/l	Zn mg/l	Sulfide mg/l
10/15 Trip Blank	10/13/94	1540	1.0 L	10 L	0.50 L	0.052 L	0.001 L	0.004 L	0.080 L	0.008 L	0.003 L	0.024 L	0.009	0.011 L	0.39 L	0.017	0.03 L
10/18 Trip Blank	10/18/94	0800	1.0 L	10 L	0.50 L	0.052 L	0.001 L	0.004 L	0.080 L	0.008 L	0.006	0.024 L	0.004 L	0.011 L	0.39 L	0.003 L	0.03 L
10/19 Trip Blank	10/13/94	1540	1.0 L	10 L	0.50 L	0.052 L	0.001 L	0.004 L	0.080 L	0.008 L	0.003 L	0.024 L	0.004 L	0.011 L	0.39 L	0.003 L	0.03 L
10/20 Trip Blank	10/13/94	1540	1.0 L	10 L	0.50 L	0.052 L	0.001 L	0.004 L	0.080 L	0.008 L	0.007	0.024 L	0.010	0.011 L	0.39 L	0.003 L	0.03 L
10/25 Trip Blank	10/13/94	1540	1.0 L	10 L	0.50 L	0.052 L	0.001 L	0.004 L	0.081	0.008 L	0.007	0.024 L	0.015	0.011 L	0.39 L	0.011	0.05
Field Blank	10/13/94	1150	1.0 L	10 L	0.50 L	0.052 L	0.001 L	0.004 L	0.152	0.008 L	0.003 L	0.024 L	0.101	0.011 L	0.39 L	0.003 L	0.03 L
10/13 Trip Blank	10/11/94	1435	1.0 L	10 L	0.56	0.052 L	0.001 L	0.004 L	0.080 L	0.008 L	0.015	0.024 L	0.033	0.017	0.39 L	0.003 L	0.03 L

An "L" indicates that the value recorded is below the detection limit

control in the analytical data.

5.1.4 DUPLICATE ANALYSIS

Duplicate samples establish quality control for sample collection techniques as well as laboratory analyses. Results on the duplicates were evaluated using relative percent difference (RPD) of the sample results. The RPD is calculated as the difference of duplicate results over the average of the two results.

The relative percent differences on duplicates for the Pearce Creek Phase I samples are summarized in Table 5-2. The majority of the duplicates are within an acceptable range of 0 to 20 %. Results outside of this range may be attributed to non-homogeneous samples; results whose concentrations are so close to the detection limit that variability exists due to the amount of signal generated by the analyte during the sample analysis and; the presence of suspended solids in the samples which yields RPD's outside the acceptable range. The results from the analysis of duplicates are judged to indicate acceptable quality control in the analytical data.

5.2 COMPARISON OF WELL DATA WITH EPA DRINKING WATER STANDARDS

As part of this study, water quality sample data from the wells in West View Shores were compared with drinking water standards as established by the U.S. Environmental Protection Agency (EPA, 1993). This comparison found that most of the well water, particularly the well water drawn from the upper Potomac aquifer, is not suitable for human consumption without appropriate treatment. Table 5-3 highlights the well water samples for which EPA drinking water standards are not satisfied.

A significant number of the samples taken from the wells exceed the EPA drinking water Maximum Contaminant Levels (MCL) for iron, pH, sulfate, manganese, chloride, dissolved solids, sodium, lead, aluminum and nickel. One well (49b) also exceeds the EPA MCL for

Table 5–2

Pearce Creek Phase I – Relative Percent Difference on Duplicate Analyses

January 13, 1995

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Well #	pH units	Field Data		Cond. umhos/ cm	Bicarb. Alkalinity mg/l	BOD mg/l	Br mg/l	Na mg/l	Cl mg/l	F mg/l	Dissolved Solids mg/l	SO4 mg/l	Fe mg/l	Mn mg/l	Total Alkalinity mg/l
		Temp deg C	DO mg/l												
232	0%	1%	0%	0%	1%	0%	0%	5%	26%	0%	14%	0%	1%	37%	1%
HH2	0%	0%	0%	0%	18%	0%	0%	8%	3%	0%	26%	7%	4%	86%	18%
18	0%	0%	0%	0%	7%	0%	5%	5%	0%	0%	10%	4%	22%	11%	7%
REF1	5%	0%	3%	0%	0%	13%	4%	2%	0%	0%	4%	5%	16%	9%	0%
71	10%	2%	10%	0%	14%	0%	21%	5%	4%	0%	0%	4%	22%	5%	14%
54	0%	0%	0%	0%	0%	*	0%	3%	7%	0%	6%	0%	3%	2%	0%
147	0%	0%	1%	0%	0%	0%	16%	1%	2%	0%	0%	2%	3%	2%	0%
172	*	*	*	*	*	8%	*	*	*	*	*	*	*	*	*

Well #	NH4 mg/l	COD mg/l	NO3 mg/l	Al mg/l	As mg/l	Cd mg/l	Ca mg/l	Cr mg/l	Cu mg/l	Pb mg/l	Mg mg/l	Ni mg/l	K mg/l	Zn mg/l	Sulfide mg/l
232	12%	0%	0%	0%	0%	0%	2%	0%	29%	0%	5%	0%	9%	0%	0%
HH2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	0%	17%	0%	0%
18	26%	0%	24%	9%	0%	0%	5%	0%	28%	32%	5%	11%	0%	36%	22%
REF1	0%	7%	0%	23%	0%	0%	3%	0%	0%	0%	3%	0%	21%	26%	25%
71	11%	33%	0%	26%	0%	0%	4%	0%	0%	0%	5%	2%	4%	7%	0%
54	4%	52%	0%	1%	0%	22%	2%	0%	0%	0%	2%	6%	4%	5%	0%
147	0%	40%	0%	18%	0%	0%	3%	0%	0%	0%	3%	4%	5%	3%	0%
172	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

* Indicates duplicate analysis not performed.

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Table 5-6
West View Shores Subdivision Well Data (1991 – 1994)

PARAMETERS (mg/l)	WELL NO. / PERMIT NO. / SCRN MEDIUM / DATE	EPA Standards	217a CE 73-2227 Blue Clay 9/2/92	217a CE 73-2227 Blue Clay 10/19/94	138a CE 81-1463 Coarse Wht Sand / Grvl 8/20/92	138a CE 81-1463 Coarse Wht Sand / Grvl 10/18/94	76 CE 88-1774 Gray Tan Sand 7/15/92	76 CE 88-1774 Gray Tan Sand 10/13/94	40 CE 73-1473 Coarse White Sand 12/16/91	40 CE 73-1473 Coarse White Sand 10/15/94	69 CE 93-0349 Coarse Tan Sand 6/23/94	69 CE 93-0349 Coarse Tan Sand 10/13/94
	Alkalinity		11	1 L	3	3.5	21	1 L	65	43	20	8
	Nitrate	10		0.50 L		2.40		4.10		0.5 L		0.50 L
	Nitrate-Nitrite		7.7		3.9		--		0.2 L		0.2 L	
	Chloride	250	810	160	15	19	132	120	11	5	144	140
	Fluoride	2	0.1 L	0.02 L	0.1 L	0.02 L	0.1 L	0.02 L	0.11	0.12	0.10 L	0.02 L
	Sulfate	250	39.7	590	28.6	19	107	240	3.8	2.4	670.0	580
	Dissolved Solids	500	1426	1400	94	81	396	420	58	97	1146	1300
	COD		10 L	10 L	10 L	10 L	--	10 L	10 L	10 L	10 L	12
	Cadmium	0.005	0.005 L	0.004 L	0.005 L	0.004 L	0.005 L	.004 L	0.005 L	0.004 L	0.005 L	0.004 L
	Lead	0.015	0.01 L	0.024 L	0.01 L	0.041	0.01 L	.024 L	0.01 L	0.024	0.014	0.024 L
	Calcium		57.4	143.0	6.2	7.92	22.6	24.19	9.4	9.64	109.0	33.72
	Copper	1	0.05 L	0.003 L	0.05 L	0.068	0.33	0.009	0.05 L	0.003 L	0.07	0.090
	Iron	0.3	0.06	34.31	0.05 L	0.072	19.31	0.628	36.6	31.45	6.88	1.69
	Magnesium		30.4	89.85	5.9	5.88	26.2	25.35	2.3	2.22	94.6	31.33
	Manganese	0.05	0.27	27.35	0.12	0.067	1.08	1.65	0.75	1.03	21.5	5.66
	Nickel	0.1	0.05 L	0.089	0.05 L	0.011 L	0.02	0.024	0.05 L	0.011 L	0.12	0.046
	Potassium		15.4	4.11	2.4	2.06	6.3	5.38	1.1	0.97	8.60	2.86
	Sodium	20	461.3	91.31	9.8	11.18	73.4	62.26	7.1	5.74	120.1	42.00
	Zinc	5	0.05 L	0.035	0.05 L	0.003 L	0.19	0.089	0.25	0.138	0.49	0.142
	Cond. (umhos/cm)		2650	1600	153	130	657	600	98	150	1484	900

PARAMETERS (mg/l)	WELL NO. / PERMIT NO. / SCRN MEDIUM / DATE	EPA Standards	79 CE 88-1441 Med. Fine White Sand 12/18/91	79 CE 88-1441 Med. Fine White Sand 10/12/94	147 CE 88-1923 Yellow / White Sand 4/13/93	147 CE 88-1923 Yellow / White Sand 10/25/94	2 CE 73-2006 Coarse White Sand 8/10/92	2 CE 73-2006 Coarse White Sand 10/25/94	31 CE 93-0286 Coarse Tan Sand 4/20/94	31 CE 93-0286 Coarse Tan Sand 10/27/94
	Alkalinity		53	37	5	5.5	58	54	5	30
	Nitrate	10		0.50 L		0.50 L		0.50 L		0.50 L
	Nitrate-Nitrite		0.2 L		0.2		--		0.2 L	
	Chloride	250	12	9.5	240	490	8	5	107	10
	Fluoride	2	0.1 L	0.02 L	0.1 L	0.10	0.1 L	0.02 L	0.1 L	0.10
	Sulfate	250	19.1	62	760	1270	4.1	28	1505	0.14 L
	Dissolved Solids	500	118	170	1702	2300	96	89	2108	96
	COD		10 L	14	10 L	15	--	10 L	22	10
	Cadmium	0.005	0.005 L	0.004 L	0.005 L	0.004	0.005 L	0.004 L	0.005 L	0.004 L
	Lead	0.015	0.01 L	0.024 L	0.01 L	0.024 L	0.01 L	0.024 L	0.13	0.024 L
	Calcium		11	20.50	143.8	185	12.9	12.04	146.6	8.40
	Copper	1	0.05 L	0.011	0.05 L	0.045	0.05 L	0.011	0.21	0.010
	Iron	0.3	20.68	19.92	2.09	3.51	6.80	7.34	165.6	19.17
	Magnesium		2.7	6.19	137.4	178	2.1	1.92	136.7	1.74
	Manganese	0.05	0.18	0.183	35.76	64.74	2.14	1.53	50.4	0.362
	Nickel	0.1	0.05 L	0.011 L	0.40	0.586	0.05 L	0.011 L	0.12	0.011 L
	Potassium		1.1	0.95	6.4	4.87	1.6	0.70	7.85	0.39 L
	Sodium	20	6.8	10.39	145.7	190.00	7.3	7.01	82.7	5.72
	Zinc	5	0.05 L	0.006	0.42	0.790	0.24	0.141	0.24	0.005
	Cond. (umhos/cm)		137	230	2280	2500	125	125	2390	130

An "L" indicates that values reported are less than the detection limit

The exceptions are Well 147 where concentrations of chloride, sulfate, dissolved solids, calcium, iron, magnesium, manganese, sodium and zinc have increased from 1993 to 1994 and Well 217a where concentrations of sulfate, calcium, iron, magnesium and manganese have increased from 1992 to 1994.

5.6 EVALUATION OF POTENTIAL CONTRIBUTION FROM SEPTIC SYSTEMS

The parameters that were reviewed during this study to determine if there is a potential impact from septic systems were BOD, nitrates, and ammonia. Although there are elevated levels of each of these compounds in various wells, without additional testing, in particular for coliforms, it is not possible to draw the conclusion that the elevated levels of these compounds are solely due to septic contamination. As previously stated in Section 4.0, it is possible to interpret that the Elk River is in direct contact with outcrop areas of the Potomac Group sediments and could be locally influencing the upper Potomac aquifer underlying the West View Shores Subdivision through recharge.

The nitrate concentration for one of the wells (217b) is above acceptable drinking water levels. Since the effluent from the containment site is very low in nitrates, the elevated level of nitrate in the well sample most likely occurs from some source other than the dredged material placement site. The source of the contamination could be fertilizers or septic contamination and cannot at this time be conclusively determined without additional information.

5.7 EVALUATION OF POTENTIAL CONTRIBUTION FROM SALT WATER INTRUSION

Salt water intrusion is a relatively common phenomenon in Maryland and saline water is the most common pollutant in fresh water. Salt water intrusion can result from several sources. One source is the upward advance of saline waters of geologic origin. Another source is in shallow aquifers from surface water discharges with saline characteristics. A third source is in coastal aquifers from the invasion of seawater (Todd, 1980).

Evaluation of saline intrusion into freshwater can be performed by evaluating the chemical characteristics of the water in question. There are certain concentrations of parameters which are characteristic of freshwater aquifers and other concentrations of parameters which are characteristic of saline waters.

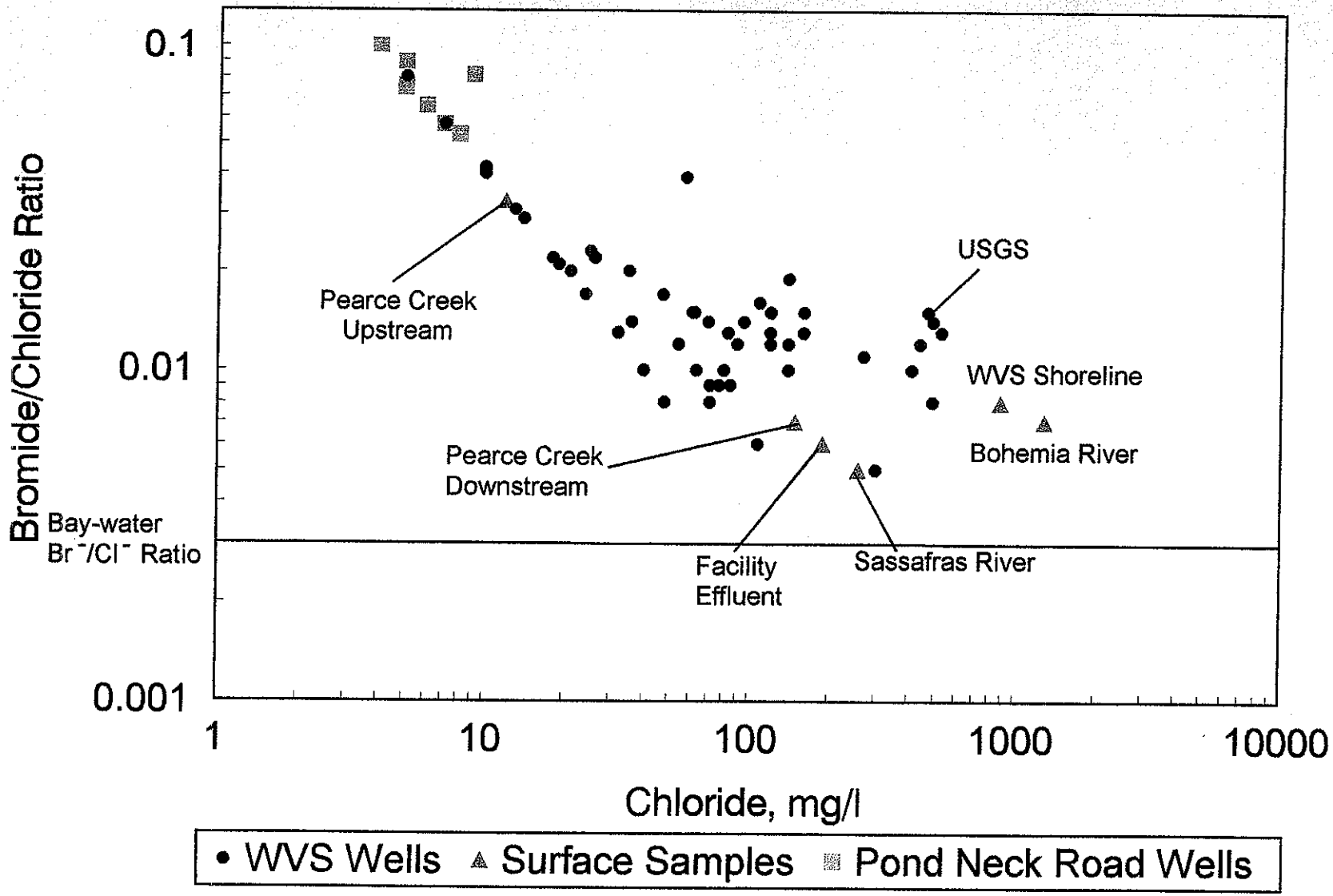
Evaluation of saline contamination can be performed using standard ratios of constituents in fresh water versus saline waters or through evaluation of individual constituents present in characteristic concentrations in either saltwater or fresh water. These evaluations must be qualified, however, as analysis of water samples collected in zones of seawater intrusion can show a chemical composition differing from a simple proportional mixing of seawater and water. In addition, more than one source can be responsible for the presence of saline waters.

As an example, bicarbonate is an individual constituent used for evaluation as it is usually the most abundant anion in freshwater and occurs in only minor amounts in seawater (Todd, 1980). Thus, if higher bicarbonate concentrations are present in saline waters, the aquifer may contain saline waters of geologic origin versus seawater origin.

Chloride concentration is also useful for comparison as it is the dominant anion in ocean water, and is unaffected by many chemical reactions such as base exchanges, sulfate reductions, substitution of carbonic or other weak acid radicals, solution and precipitation processes. It also normally occurs in only small amounts in freshwater (Todd, 1980). Other major constituents such as sulfate, magnesium, potassium, calcium, sodium and bromide also dominate sea salt and their ratios are very constant (Stumm & Morgan, 1981). Due to this consistency, these ratios can be used to indicate whether salt water may be intruding into a freshwater system. The bromide/chloride ratio has been recommended by local resource agencies in evaluating the potential for saltwater intrusion in the West View Shores Subdivision (WVSS) wells. This evaluation is presented below.

Figure 5-1 presents bromide/chloride (Br^-/Cl^-) ratios for water samples from the WVSS wells, the Pond Neck Road well samples, Bay and river samples and the predicted

Figure 5-1: Bromide/Chloride Ratio vs. Chloride
West View Shores Subdivision Wells



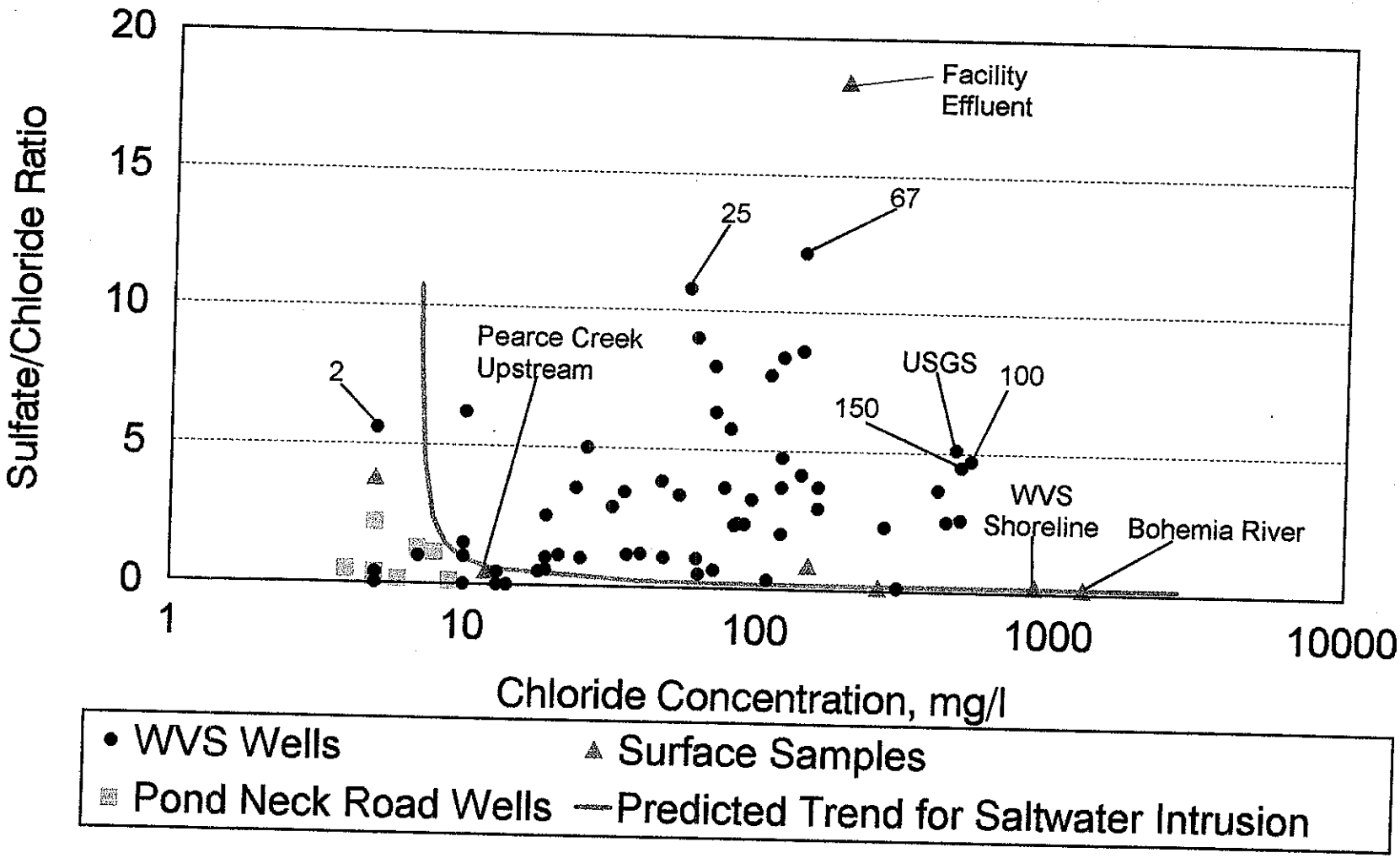
bromide/chloride ratio for the conservative mixing of regional Bay and aquifer waters. The Pond Neck Road wells are located outside WVSS and further from the shoreline. The predicted ratios for the conservative mixing of Bay and aquifer waters are calculated using known concentrations of constituents in each body of water. The conservative mixing model was provided by the Maryland Geological Survey and can be found in Appendix G. The bromide/chloride ratios for both the Pond Neck samples and the conservative mixing model can be used as a frame of reference in reviewing the WVSS data. However, it should be noted that the apparent elevated bromide/chloride ratios for the Pond Neck Road well samples may be lower than presented, since the reported concentrations for bromide on these wells are less than the 0.4 mg/l detection limit. Nonetheless, this information is useful in evaluating the relationship of the chloride concentrations in these wells.

Upon examination of the data, it appears that the WVSS wells have higher concentrations of chloride than the Pond Neck Road wells indicating a source of chloride in the WVSS wells. Although elevated chloride concentrations could be indicative of saltwater intrusion, the bromide/chloride ratios in the WVSS well water are generally greater than the surface water samples suggesting a different chloride source. Contaminants such as road salt and sewage effluent can probably be ruled out because the Br^-/Cl^- signature for these are typically low (Andreason, 1995).

The sulfate/chloride ratios for the WVSS wells are presented in Figure 5-2. This Figure allows for further investigation of the potential for saltwater intrusion in these wells. The sulfate/chloride ratios are also presented for the Pond Neck wells, the Bay and river samples and for the conservative mixing of regional Bay and aquifer waters. This data serves as a frame of reference for evaluating the WVSS data.

Upon examination of the data, it appears that WVSS wells have elevated concentrations of sulfate and chloride in comparison with the Pond Neck Road wells indicating a source of sulfate in addition to chloride in the WVSS wells. Although elevated sulfate concentrations could be indicative of saltwater intrusion, the sulfate/chloride ratios for the WVSS wells are

Figure 5-2: Sulfate/Chloride Ratio vs. Chloride West View Shores Subdivision Wells



generally higher than Bay and river ratios and predicted ratios for the conservative mixing of Bay and regional aquifer waters. As previously mentioned, sulfate/chloride ratios should remain relatively constant if saltwater is intruding into a freshwater system. However, this is not demonstrated by the WVSS sulfate/chloride ratios, again suggesting a non-conservative source of sulfate in the WVSS wells.

Although there is some evidence for mixing of Bay and aquifer waters in the West View Shores Subdivision wells, there appears to be a different source for the elevated constituents in the wells. As depicted in Figures 5-1 and 5-2, bromide/chloride and sulfate/chloride ratios for the West View Shores Subdivision wells were higher than Bay and river ratios and predicted ratios for the conservative mixing of Bay and regional waters for these constituents. The source for the elevated constituents in the wells may be identified after determination of local groundwater directional flow.

5.8 EVALUATION OF POTENTIAL CONTRIBUTION FROM PEARCE CREEK FACILITY

From studies of other upland dredged material placement sites conducted by the U.S. Army Engineer Waterways Experiment Station, degradation of local groundwater may potentially be identified by elevated levels of manganese, chloride, potassium, sodium, calcium, alkalinity and iron (EL, 1980). Several well water samples analyzed for this study show elevated concentrations of manganese, chloride, potassium, sodium, calcium, iron, sulfate and dissolved solids. The wells exhibiting concentrations notably higher than documented regional groundwater quality have been identified in Section 5.3 as 22a, 22b, 25, 49b, 52a, 52b, 54, 61, 62, 67, 71, 100, 132, 135, 138b, 147, 150, 161, 217a and USGS. In addition, samples from some of these wells contained elevated concentrations of alkalinity.

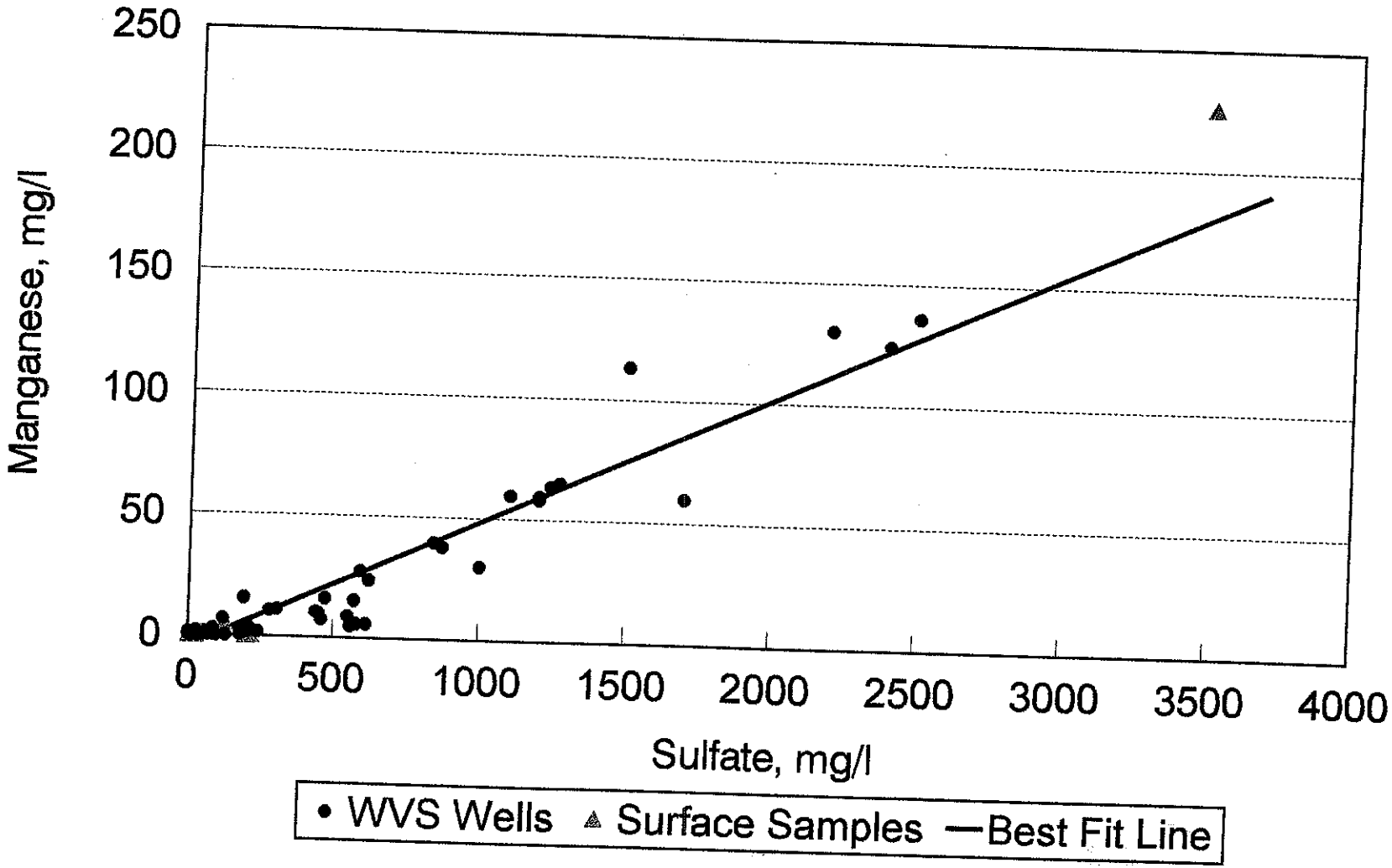
A preliminary evaluation of the existing data by the Maryland Geological Survey indicates evidence of influence to the local waters due to the oxidation of sulfide rich minerals (Appendix G). This oxidation process occurs when the sulfide minerals react with oxygen, such

as dissolved oxygen in the groundwater or through exposure to air or weathering, and releases sulfuric acid (EL, 1985). This reaction may occur due to pyritic soils from naturally existing geologic conditions or sulfide bearing marine sediments, including dredged material. The oxidation results in the release of acid forming salts and free sulfuric acid which causes the pH in the soils to drop and dissolved metals to form. Upon review of the groundwater sample data from this study, the oxidation process is evidenced by the presence of significantly low pH and exceedingly high sulfate and manganese concentrations which appear to be linearly related (Appendix G). Although the pH of groundwater in Cecil County is generally low, groundwater samples from some of the wells indicate pH levels lower than documented aquifer water quality. For instance, groundwater samples taken from wells 49b and USGS indicate pH levels of 3.01 and 2.7, respectively. The linear relationship between the manganese and sulfate concentrations in the groundwater sampled from the residential wells in this study can be observed in Figure 5-3. Manganese and sulfate concentrations in the groundwater samples range as high as 136 mg/l and 2500 mg/l, respectively. These concentrations are significantly higher than the documented regional groundwater quality as shown in Table 5-4. High manganese concentrations found in the groundwater samples may be related to the acidity which releases metals into solution (Appendix G).

As discussed in Section 5.7, the graphed relationship of sulfate and chloride concentrations from the groundwater samples (Figure 5-2) indicates that sulfate concentrations are increased due to a source other than exclusively conservative mixing of bay water intrusion into aquifer waters. This increased sulfate concentration could potentially be explained by sulfide oxidation of marine sediments or pyritic soils (Appendix G).

The sulfide oxidation process is common in drying dredged material. Therefore, the presence of sulfates and other constituents in the WVSS groundwater suggests a possible chemical link between the degraded groundwater quality underlying the West View Shores Subdivision and the Pearce Creek Facility. However, additional physical evidence is required to substantiate a link between the two. The high levels of sulfates could also be indicative of naturally occurring pyritic soils and sediments found in Maryland. Such soils and sediments are

Figure 5-3: Manganese vs. Sulfate
West View Shores Subdivision Wells



known to produce high sulfates in waters of geologic origin in areas of the Eastern coast of the United States (EL, 1985).

Figures 5-4 through 5-11 present plan views of the community with chemical concentrations of alkalinity, calcium, chloride, iron, manganese, potassium, sodium and sulfate. The expected ranges of the various chemical constituents may be found in Table 5-4 and Appendix F for comparison. These figures are developed to identify potential patterns in the groundwater underlying the West View Shores Subdivision. In each of these figures, there are no apparent patterns regarding the distribution of the wells having less desirable water quality within the community. Wells with poor water quality appear interspersed with wells yielding better water quality. What is observed from Figures 5-4 through 5-11 is that the wells yielding lesser quality have consistently high concentrations of the selected parameters with the exception of alkalinity, and where documentation is available, these wells are screened at lower elevations. The exception, lower alkalinity can be attributable to low pH values of the surrounding medium (EL, 1980).

To demonstrate the vertical distribution of wells yielding groundwater with elevated concentrations of sodium, chloride, manganese and sulfate, cross sections were taken of the subdivision as shown on Figure 5-12. The locations of the cross sections were selected to intersect as many wells as possible with available well boring information. In addition, borings from the dike of the dredged material facility were also included in some of the cross sections. The interpolated cross sections subsequently appear on Figures 5-13a and b through 5-16a and b. Although the soil conditions provided in these cross sections rely upon drillers' boring logs and assumptions of soil conditions between each documented boring, the information is helpful in portraying the vertical distribution of constituents in the sampled well water. Where documentation is available, it appears most of the wells with degraded groundwater quality are screened within the upper Potomac aquifer between elevations -50 and -100 feet (NGVD 1929) and that the concentrations increase with the depth of the screen elevation. In addition, the screening medium of most of these wells is documented as coarse yellow white sand.

Additional data are needed to conclusively describe the groundwater conditions within this area and the potential impact from the dredged material facility.

As described in Section 4.0, outcroppings of the Potomac Group sediments are located within the vicinity of the Pearce Creek Facility along the shoreline of Crystal Beach. The location of the Pearce Creek Facility may be locally influencing the upper Potomac aquifer underlying the West View Shores Subdivision, provided the geologic conditions underlying the Facility sustain. This condition could potentially allow for a significant vertical hydraulic gradient below the facility, particularly during dredged material inflow operations. Yet, without additional data to verify the water movement and to further identify the water quality in all areas of the subdivision, this cannot be conclusively determined since other factors may be influencing the water quality underlying the West View Shores community, such as salt water intrusion and naturally occurring pyritic soils.

5.9 EVALUATION OF POTENTIAL CONTRIBUTION FROM OTHER SOURCES

Since this document reports only the findings of a Phase I Study, data gathering is limited to the scope of a preliminary investigation. Some areas of the site still require additional examination, including the following factors.

Potential Solid Waste Dump Site

During the field sampling portion of this study, several residents reported that a dumping area had existed within the community near the intersection of North Street and Midway Drive. The disposal material and dates are unknown. Review of the existing data, does not confirm or refute these reports.

Other Potential Sources

There is no information available as to the conditions underlying the Pearce Creek

Facility. Therefore, it is not known if there are other potential sources beneath the facility which pre-date the facility and may be contributing to the degraded groundwater condition underlying the West View Shores Subdivision.

Subsurface Exploration, Hydrogeologic Investigation

The scope of this study is limited to existing available information. Therefore, no subsurface exploration was performed. Due to the lack of information regarding subsurface exploration and groundwater flow patterns from this Phase I Report, potential influences from other sources including pyritic soils cannot be determined without further study.

6.0 CONCLUSIONS

The purpose of this study was to perform a groundwater study of the area consisting of the Pearce Creek Placement Facility and the West View Shores Subdivision utilizing only readily obtainable data from existing sampling structures and documented data. This study provides information to further characterize the relationship of the degraded groundwater underlying the West View Shores Subdivision and designates potential sources of contribution, including salt water intrusion, naturally occurring sediments including pyritic soils, an abandoned dump site within the subdivision, and the Pearce Creek Dredged Material Placement Facility.

Based on evaluation of the available data, the following observations are made:

- groundwater quality within the West View Shores Subdivision exhibits elevated concentrations of certain parameters typical and atypical of existing geologic conditions for Cecil County;

- samples taken from several wells indicate that the groundwater underlying the West View Shores Subdivision contains higher concentrations of certain constituents when compared

to aquifer water quality within Cecil County, particularly for groundwater from the upper Potomac aquifer;

- several well water samples analyzed for this study show elevated concentrations of manganese, chloride, potassium, sodium, calcium, iron, and sulfate. General research performed by the U.S. Army Engineer Waterways Experiment Station suggests that the presence of these constituents may indicate groundwater degradation associated with the upland placement of marine sediments;

- most of the sampled wells yielding degraded groundwater quality are screened within the upper Potomac aquifer between the elevations -50 and -100 feet (NGVD 1929) and that the concentrations increase with the depth of the screen elevation;

- saltwater intrusion may be occurring within the West View Shores Subdivision, but the extent of this influence on the groundwater system cannot be determined with available data;

- evidence indicates that there is influence to the local groundwater due to the oxidation of sulfide rich minerals, although it is not certain whether this reaction is occurring due to pyritic soils from naturally existing geologic conditions or sulfide-bearing dredged material. High levels of sulfates can be indicative of pyritic soils and sediments commonly found in Maryland;

- the degraded groundwater from the upper Potomac aquifer underlying the West View Shores Subdivision is not likely due to residential septic systems;

- the Pearce Creek Upland Dredged Material Placement Facility cannot be either ruled out or positively identified as a contributor to the existing state of groundwater quality based on available data;

- additional groundwater study is required to estimate the water movement in the area of the Pearce Creek Dredged Material Placement Facility; and

- some homeowners have not installed water treatment systems, although water quality at some wells does not satisfy applicable federal drinking water standards.

7.0 RECOMMENDATIONS

Additional study is recommended in order to conclusively identify a potential source or sources as contributors to the existing quality of groundwater underlying the West View Shores Subdivision. In particular, the groundwater movement and hydrogeologic conditions underlying the West View Shores Subdivision, Pearce Creek Facility and Pearce Creek should be examined in further detail. In addition, subsurface exploration of the abandoned dumping site in community and investigation of existing geologic conditions including naturally occurring pyritic soils should be performed.

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