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Site Analysis
Tutu Wellfield
St. Thomas, Virgin Islands

Volume 1

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ABSTRACT

The following report contains an analysis of historical aerial photography of a study area surrounding the Tutu Wellfield, located in Tutu, St. Thomas, Virgin Islands. Drinking water contamination has caused the closing of public supply wells in the area. This analysis has been conducted to support the U.S. Environmental Protection Agency's (EPA) Superfund activities in locating possible contamination sources within a study area comprising approximately 320 hectares (800 acres).

Aerial photography of the study area was obtained to represent the period from 1954 to 1983. Six main areas containing potential contamination sources: four industrial areas, one possible liquid waste disposal area, and a junkyard, were noted within the study area. Other minor features of potential significance include staining, debris, a pit, a probable fill area, and a possible discharge point.

The EPA's Environmental Photographic Interpretation Center in Warrenton, Virginia, a branch of the Advanced Monitoring Systems Division of the Environmental Monitoring Systems Laboratory in Las Vegas, Nevada, performed this study at the request of the Superfund Support Section of EPA Region 2 in New York, New York and the Office of Emergency and Remedial Response in Washington, D.C. This report was completed in March 1988.

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INTRODUCTION

This report presents an analysis of historical aerial photography of a study area surrounding the Tutu Wellfield, located in Tutu, St. Thomas, Virgin Islands. The Tutu Wellfield has been contaminated with volatile organic compounds and gasoline, which has resulted in the closing of public supply wells in the area.¹ The purpose of this report is to assist the U.S. Environmental Protection Agency's (EPA) Superfund activities in locating possible contamination sources within the study area, which comprises approximately 320 hectares (800 acres).

Figure 1 depicts the study area boundary, keyed to a photocopy of a U.S. Geological Survey (USGS) 1:24,000-scale topographic map. Site and area boundaries used in this analysis were determined from observations made from aerial photography and from collateral data provided by EPA Region 2 and do not necessarily represent legal property lines or ownership. Each photo enlargement included in this report (Figures 2-6) has been reproduced to correspond to the approximate study area boundary.

Aerial photography of the study area was obtained to represent the period from 1954 to 1983.² Black and white photography for the years 1954, 1964, 1965, 1971, 1974, 1978 and color infrared photography from 1970 and 1983 were used in this report. Photography from 1954, 1964 and 1970 was not reproduced due to insignificant activity or change noted within the study area.

¹Collateral data provided by EPA Region 2.

²A complete listing of maps and photography used in this report can be found in the References section.

Six areas of potential contamination: four industrial areas, one possible liquid waste disposal area and a junkyard, were noted within the study area. These areas are designated as "sites," and their location within the study area is shown on Figure 1. Other features of significance not large enough to designate as sites are also annotated and discussed with each year of analysis.

The EPA's Environmental Photographic Interpretation Center in Warrenton, Virginia, a branch of the Advanced Monitoring Systems Division of the Environmental Monitoring Systems Laboratory in Las Vegas, Nevada, performed this study at the request of the Superfund Support Section of EPA Region 2 in New York, New York, and the Office of Emergency and Remedial Response in Washington, D.C. This report was completed in March 1988.

METHODOLOGY

A search of government and commercial sources was undertaken to obtain the best available aerial photography of the study area spanning the desired time frame. The photography and other sources of information used in this report are listed in the References section.

The analysis was performed by viewing backlit transparencies of aerial photography through stereoscopes. Stereoscopic viewing creates a perceived three-dimensional effect which, when combined with viewing at various magnifications, enables the analyst to identify signatures associated with different features and environmental conditions. The term "signature" refers to a combination of visible characteristics (such as color, tone, shadow, texture, size, shape, pattern and association) which permit a specific object or condition to be recognized on aerial photography.

Photographic prints were made from those years of aerial photographic coverage that reveal significant information about the study area. The analyst's findings are annotated on overlays to prints and/or base maps and described in the accompanying text. Site boundaries or areas used in this analysis were determined from the aerial photography and from collateral data provided by EPA Region 2 and do not necessarily denote legal property lines or ownership.

Due to factors inherent in the photographic printing process, prints do not exhibit the level of detail that is visible in the original aerial photography. Therefore, some features identified from the aerial photography may not be clearly discernible, or even visible, on the photographic prints presented in this report.

The terms "possible" and "probable" are used to indicate the degree of certainty of signature identification. "Possible" is used when only a few characteristics are discernible or these characteristics are not unique to a signature. "Probable" is used when incrementally more characteristics or stronger characteristics of a signature are discernible. No qualifying terms are used when the characteristics of a signature allow for a definite feature identification.

AERIAL PHOTO SITE ANALYSIS

MARCH 9, 1965 (FIGURE 2)

Site 1: Industrial Area

Treated (TL) and untreated lumber (UL) are stored at the site, suggesting onsite lumber treatment. An excavated area (EX) containing light-toned, coarse-textured debris (DB) is present. Coarse-textured, dark-toned debris is located in a vacant area in the northeast corner of the site.

Site 2: Industrial Area

A stained (ST) disturbed area (DA) fans out downslope from a large building at a light industrial facility. This stained area or area of moist or wet ground may be the result of liquid discharged from the building (also noted in 1964). Dump trucks are visible in the lot nearby. A stained area with debris and possible drums (not annotated) is located just southwest of the building. The purpose of this facility could not be ascertained from the available photography.

Other Features

Coarse-textured, dark-toned debris is piled at the end of a stained access road west of Site 1 near a sewage treatment plant (STP). The access road may have been sprayed with oil to keep down dust. A vertical tank (VT) is visible south of the access road. The purpose of the tank cannot be ascertained from the aerial photography.

A possible discharge point is visible at a light industrial facility immediately west of Site 1. The stream channel leading away from this point flows southeast and is dark-toned, possibly from staining. This may only be a storm drain; however, the possibility of waste discharge should not be overlooked.

South of Site 1 are a large bermed area and a long trench (TR) (also visible in 1964). These features are likely related to the routing of drainage. West of the trench is a small, square pit, possibly containing liquid.

Drainage

Intermittent stream channels wind southeastward through the karst (limestone) terrain toward Turpentine Run. Drainage will only be discussed further when major changes are noted.

FEBRUARY 7, 1971 (FIGURE 3)

Site 1: Industrial Area

A group of probable drums, open storage (OS) of material and debris crowd the facility's lot. Additional buildings (annotated as new buildings--NB) have been constructed since 1965. No lumber storage is visible within Site 1; however, a large lumber storage area with a connecting access road is located just southwest of the site. Probable staining is visible around treated lumber here. Possible drums and scattered debris, similar to the material at Site 1, are also located in this area. Due to the additional number of buildings onsite, it is likely the storage of lumber and other material had to be moved to this location.

Site 2: Industrial Area

The stained areas, debris, possible drums and dump trucks noted in 1965 are no longer present and the area appears inactive. This site will no longer be discussed.

Site 3: Impoundment/Industrial Facility

A rectangular impoundment (possibly unlined), containing dark liquid and a possible aerator (not annotated), is present.

Site 4: Light Industrial Facility

The majority of the site appears to be occupied by debris and/or construction-related material. Dump trucks, probable staining and possible drums with associated staining are present here also.

Other Features

Those features noted near the sewage treatment plant in 1965 are no longer present. The possible discharge point west of Site 1 remains; however, the drainage channel now flows south rather than southeast as it did in 1965. Possible staining is visible in the lot west of Site 1. Probable debris is located in a disturbed area east of Site 1.

The bermed area and trench noted south of Site 1 in 1965 are no longer present, and a continuous drainage channel has been constructed here. Mounded material (MM), mostly probable earthen material with some possible debris (not annotated), has been deposited east of the channel.

FEBRUARY 13, 1974 (FIGURE 4)

NOTE: Due to the small scale of the original photography, detailed features could not be identified.

Site 1: Industrial Area

Possible debris is visible onsite. The possible drums seen in 1971 are no longer visible. An access road leads from Site 1 to the lot that contained lumber storage and other material in 1971. This lot appears much less crowded with material, although scattered debris is visible throughout the area.

Site 3: Industrial Facility

The impoundment visible in 1971 is no longer present. Site 3 will no longer be annotated or discussed because no further significant activity occurs throughout the remainder of the study period.

Site 4: Former Light Industrial Facility

None of the features noted onsite in 1971 are present this year. The area appears inactive, although an access road still enters the site and leads to a ground scarred (GS) area. Neither the access road nor the ground scar was present in 1971.

Site 5: Possible Waste Disposal Area

Dark-toned (DK) standing liquid (SL) appears in two depressions onsite. This may be the result of natural precipitation, although the possibility of liquid waste disposal should not be overlooked. Much of the area around a small building (B) appears scarred.

Site 6: Junkyard

Site 6 consists of junked automobiles.

Other Features

The possible discharge point and staining located west of Site 1 in 1971 are no longer visible. A probable fill area is located east of Site 1 where debris was noted in 1971. The fill material here appears even in tone and

texture and is probably earthen material. Possible debris and staining are noted near a light industrial building northeast of the fill area.

Two additional sewage treatment plants have been constructed within the study area. No environmentally significant activity is visible around these facilities, and they will not be discussed further.

The area southwest of Site 1, which contained mounded material in 1971, has revegetated (REV).

MARCH 1, 1978 (FIGURE 5)

NOTE: Due to the small scale of the original photography, detailed features could not be identified.

Site 1: Industrial Area

Several buildings have been removed, and the site appears to be in a state of transition or inactivity. Several large buildings are under construction (UC) southwest of Site 1.

Site 4: Former Light Industrial Facility

No access roads lead into the site, which appears inactive and revegetating. This feature will not be discussed further.

Site 5: Possible Waste Disposal Area

An access road leads to a ground scarred area. Both features were visible in 1974; however, no evidence of solid or liquid waste disposal is noted onsite.

Site 6: Junkyard

The area encompassed by the junkyard has expanded slightly to the east since 1974.

Other Features

Heavy staining and a new building are located on a former fill area that was noted in 1974 east of Site 1.

Three vertical tanks (probable water tanks) are located north of Site 5. Several access roads lead to the tanks.

Possible debris is visible within an extraction area southeast of the junkyard. It is difficult to positively identify the material here due to the small scale photography.

The staining visible in a lot northeast of Site 4 appears to emanate from a nearby building.

FEBRUARY 5, 1983 (FIGURE 6)

NOTE: Detailed feature identification was not possible due to the small scale of the original photography.

Site 1: Industrial Area

Possible debris is located onsite. Several new buildings (not annotated) have been added since 1978, and the site once again appears active.

Site 5: Possible Waste Disposal Area

The site has revegetated and no evidence of waste disposal is seen.

Site 6: Junkyard

No significant change has occurred onsite since 1978.

Other Features

Heavy staining remains on a former fill area, now an industrial area, east of Site 1. The area north of Site 1 appears scarred and disturbed.

The three vertical tanks remain; however, only one access road leading to the tanks remains in use.

A large disturbed area is located near a group of buildings in the southwest portion of the study area.

REFERENCES

AERIAL PHOTOGRAPHY

<u>Date</u>	<u>Agency</u>	<u>Mission Code</u>	<u>Agency Frame #</u>	<u>Orig. Scale</u>	<u>EPIC Frame #</u>
January 29, 1954	USGS ¹	YM	1:158-160; 1:173-175	1:28,000	18718,18722-18726
February 21, 1964	NOS ²	64W	3413-3417	1:24,000	19012-19016
March 9, 1965	NOS	65L	1500-1504	1:15,000	19021-19025
July 31, 1970	NASAJS ³	1380	42:4844-4848	1:24,000	18837-18841
February 7, 1971	ASCS ⁴	PCFD	3:101-103	1:20,000	18895-18897
February 13, 1974	NOS	74E	41-30:3325-3328	1:30,000	19026-19029
March 1, 1978	NOS	78BP	46-1:1692-1695	1:30,000	18997-19000
February 5, 1983	EPA ⁵	83/104	553,554	1:40,000	83/104:553,554

MAP

<u>Source</u>	<u>Name</u>	<u>Scale</u>	<u>Date</u>
USGS	Eastern St. Thomas, V.I.	1:24,000	1982

¹U.S. Geological Survey, U.S. Department of the Interior

²National Ocean Survey, U.S. Department of Commerce

³National Aeronautics and Space Administration, Houston, Texas

⁴Agricultural Stabilization and Conservation Service, U.S. Department of Agriculture

⁵U.S. Environmental Protection Agency

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ADDENDUM

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Fracture Trace Analysis A1

References A3

FIGURES

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7. Fracture Traces A1

8. Generalized Ground Water Flow Direction A1

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Fracture Trace Analysis
Tutu Wellfield
St. Thomas, Virgin Islands

Volume 1 - Addendum

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FRACTURE TRACE ANALYSIS

Ground water contamination in the vicinity of the Tutu Wellfield prompted the request for this fracture trace analysis. Fracture trace analysis involves using aerial photography to identify linear features on the earth's surface. These features may have several origins: geological (fractures, bedding planes, dikes); vegetational (row crops, orchards); man-made (roads, railroads, fence rows); etc. Fracture traces are defined as linear features, visible on aerial photographs, that are naturally occurring surface manifestations of subsurface vertical or near vertical zones of fractured bedrock. These features are of particular environmental concern because they represent potential pathways for ground water flow.

Tutu Wellfield is located in the upper valley of Turpentine Run in eastern St. Thomas. The valley has gentle topography consisting of rolling hills in a basin surrounded by steep slopes and sharp ridges. The rocks in this area are mainly volcanics of Cretaceous age. Lava flows and flow breccias (spilites and keratophyres) of the Water Island formation and breccia, tuffs and flows (augite andesites) of the Louisenhoj formation are the principal rocks. Ground water supplies are contained in a surficial mantle of fractured and weathered rock. The general direction of ground water flow is southeastward along Turpentine Run. It has been postulated that when water levels are high, ground water flow is divided, with part moving along Turpentine Run and part moving through the fractured and altered zone at Mt. Zion and emerging as springs located farther downstream in the lower basin of Turpentine Run (see approximate spring locations on Figure 7). During periods of low ground water levels, nearly all ground water is discharged through the fractured zone at Mt.

Zion and a temporary ground water divide is established (see Figure 8).¹ It is likely that contaminant movement/plume within the ground water would mimic these pathways during periods of high and low water levels.

Fracture traces found over the volcanic rocks within the Tutu Wellfield study area were identified using three years of historical aerial photographs: 1954, 1964 and 1965. These features were located as accurately as possible; however, caution should be exercised if the fracture traces are to be used for locating monitoring wells. Because the difference of a few feet can determine whether or not a well is located on a fracture trace structure, it is important that a trained photogeologist be onsite to locate the fracture traces accurately.

A total of 34 fracture traces have been identified (see Figure 8), classified according to the strength of their photographic signatures (weak, moderate, and strong), and keyed to a March 9, 1965 photo of the site. Any monitoring wells located along, and more importantly at the intersection of, two fracture traces should produce higher yields and give a more accurate indication of ground water conditions around a site than randomly placed monitoring wells.

¹D.G. Jordan and O.J. Cosner, A Survey of the Water Resources of St. Thomas, Virgin Islands, U.S. Geological Survey open-file Report, 1973.

REFERENCES

PUBLICATIONS

Jordan, D.G. and Cosner, O.J., A Survey of Water Resources of St. Thomas, Virgin Islands, USGS Caribbean District open-file Report, 1973.

Donnelly, Thomas W., Geology of St. Thomas and St. John, U.S. Virgin Islands, The Geological Society of America, Memoir 98, Caribbean Geological Investigations, 1966.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DATE:

28 OCT 1985

REGION 1

SUBJECT:

Field Reports

FROM:

Robert N. Ogg, Chief
Site Investigation & Compliance Branch

TO:

Site Investigation & Compliance Branch Staff

So that we can maintain a complete set of files on each of our respective sites (NPL and non-NPL), be able to record and follow up on all significant events concerning them, and assure consistency of field reports, effective immediately, all staff members must prepare and complete field reports within two weeks of the site visit.

Please use the attached Site Inspection Report for this purpose. The report should be addressed to the site "File" and copies sent to the Section Chief. If more than one staff person (remedial and enforcement) participates in the site visit, then whoever has the lead for the project prepares the report.

If you have any questions, please let me know.

Attachment

cc: W. Librizzi
S. Luftig
F. Rubel
G. Pavlou
J. Frisco
R. Basso
J. Mateo
V. Pitruzzello

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