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V&M/Albaladejo Farms

Vega Baja, Puerto Rico
CERCLIS #PRD987366101

■ Site Exposure Potential

The V&M/Albaladejo Farms site is in the Almirante Norte Ward of the municipality of Vega Baja, Puerto Rico, 1.6 km west of Route 160. The site consists of four zones (Zones 1 through 4), four burned areas (Burned Areas I through IV), and two suspected burned areas (Figures 1 and 2). The Río Indio flows north approximately 650 m northwest of the site (CDM 1996). About 5 km north of the site, the Río Indio joins the Río Cibuco, which discharges to the Atlantic Ocean about 14 river km north of the site (USGS 1982a & b). The area covered by the site includes two farms located in the limestone uplands characterized by landforms typical

of karst terrain, including heavily vegetated, steep hills surrounded by small valleys, sinkholes, subsurface channels, and caves (CDM 1996).

Zone 1 (280 m²) cuts directly into the hillside at the end of a vehicular path and is littered with scrap, wire, and ash. Portions of the site have soil stained green, and surface contamination is estimated to vary in depth from 0.3 to 1 m below the surface (CDM 1996).

Zone 2 covers an area of 186 m² and is north of Zone 1. A hand-dug pit is coated with metal shavings and is surrounded by scrap metal. A steep, vehicular path from the site provides a

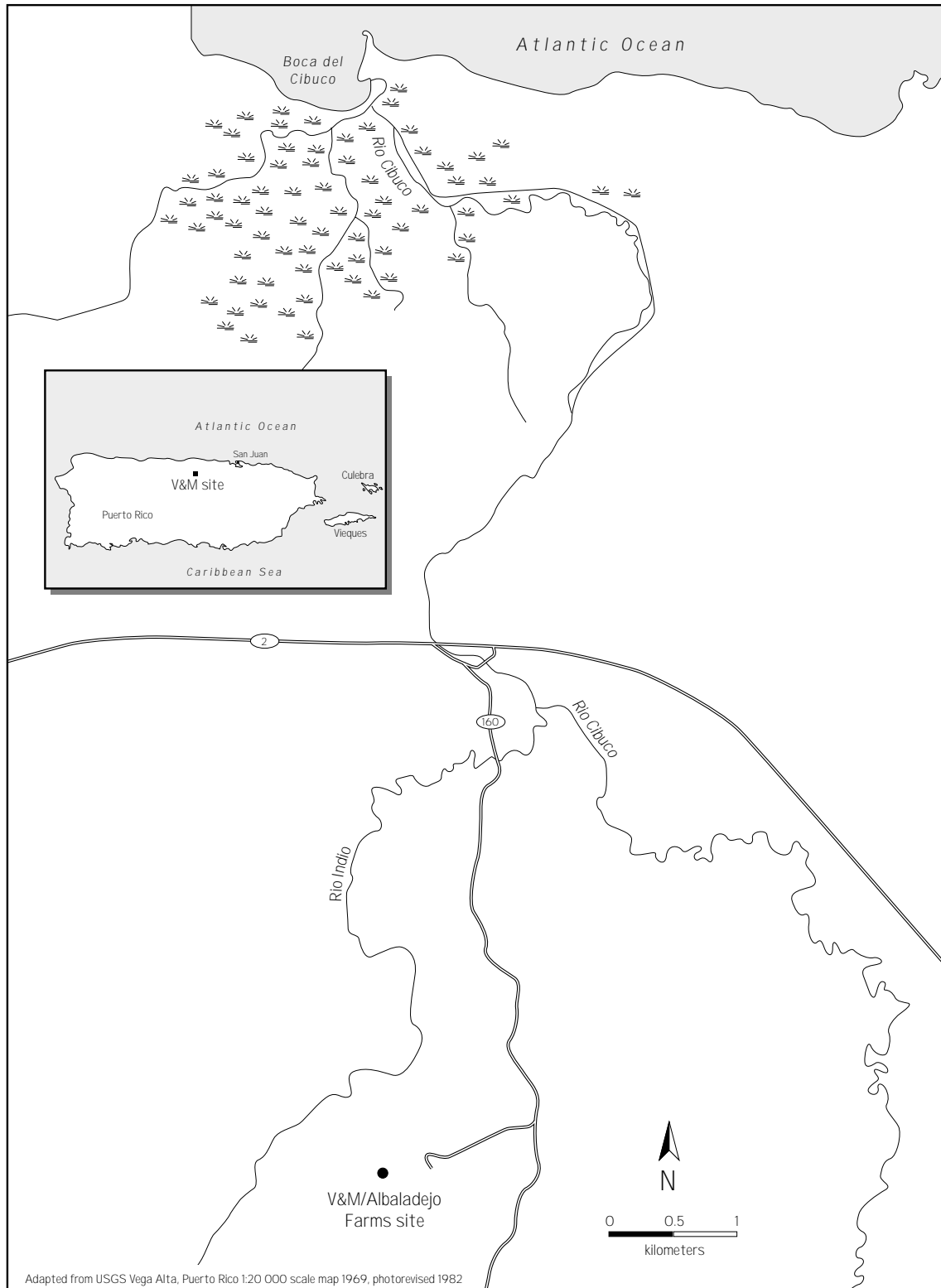


Figure 1. Location of V&M/Albaladejo Farms site in Puerto Rico.

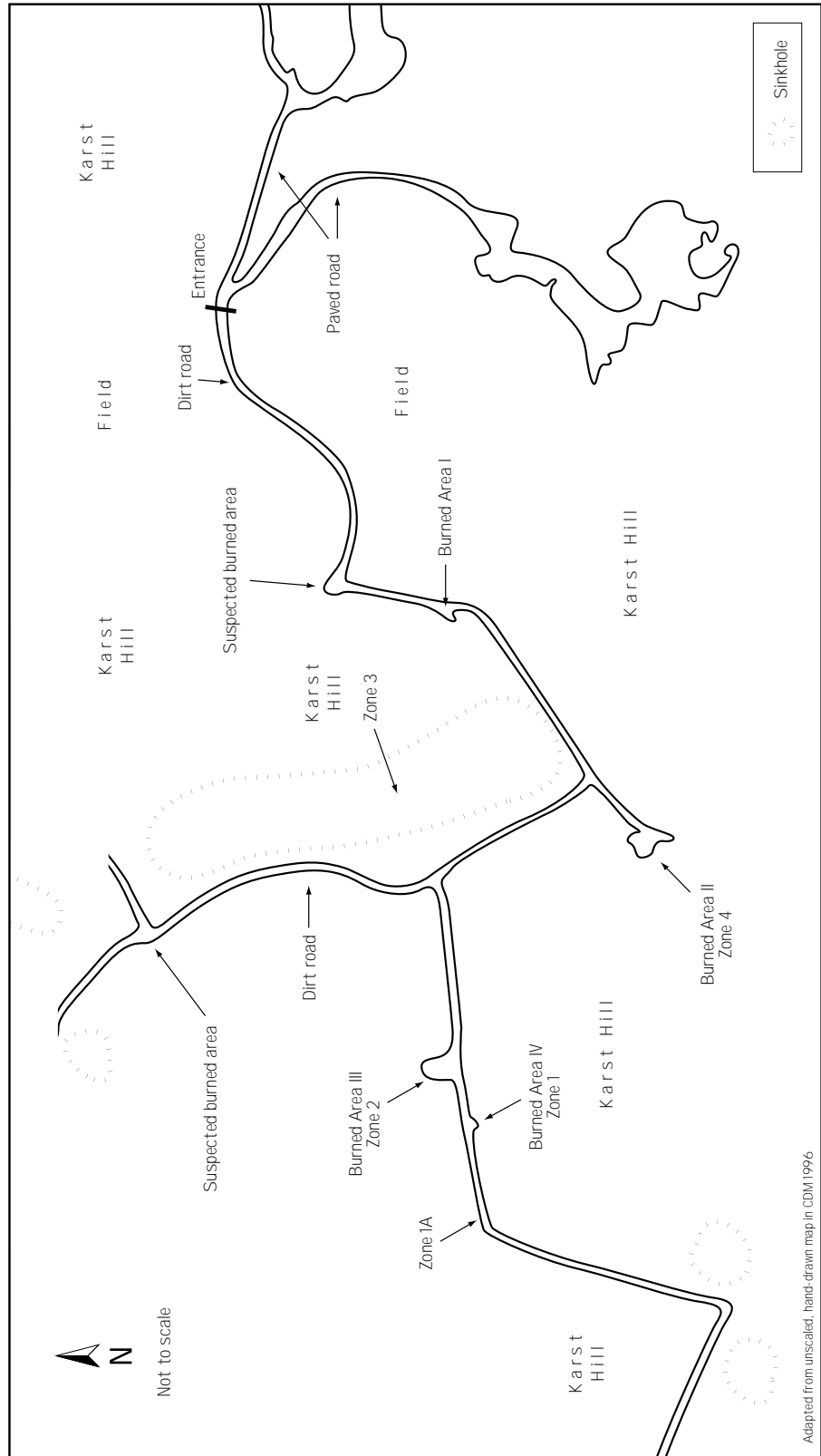


Figure 2. Detail of the V&M/Albaladejo Farms site.

direct route for surface water runoff to flow towards sinkholes located approximately 180 m east of the site (CDM 1996).

Zone 3 is heavily vegetated and is located within a large sinkhole that occupies the center of the site, and reportedly consists of two burn areas. Two smaller sinkholes are located within the large sinkhole. The areal extent of soil contamination at Zone 3 is unknown (CDM 1996).

Zone 4 is located east of Zone 1 across a heavily vegetated ridge. Scrap and wire remnants cover this cleared area of approximately 370 m². The hillside east of Zone 4 is believed to have been tilled in the past, possibly introducing contamination deeper into the soil (CDM 1996).

The V&M site was used for dumping plastic-coated electric cables, electrical equipment, and car batteries. The wastes were burned to recover copper, aluminum, and lead. It is believed that open burning without containment was used during the burning and recovery process. It is not known when the burning activity began on either the V&M or the Albaladejo farm properties. Beginning in 1985, trucks that were allegedly working for the Puerto Rico Telephone Company and the Puerto Rico Electric and Power Authority were observed carrying wastes onto the site. Burning reportedly ceased in 1986 when the V&M farm was purchased by its current owner, but continued into 1988 on the Albaladejo farm. The total quantity of waste disposal at the site is unknown (CDM 1996).

Groundwater movement is believed to be the primary mechanism of contaminant transport from the site. The Aymamon and Aguada Formations together form one of the primary sources of groundwater within the region, comprising the upper, unconfined aquifer system. On a regional scale, groundwater in the Aymamon-Aguada Formation flows northward towards the Atlantic Ocean. Local groundwater flow direction near the site may be to the north-northwest, possibly discharging to the Río Indio (CDM 1996).

Direct infiltration of precipitation on outcrop areas and surface runoff into sinkholes is the primary source of recharge to the water table aquifer. The bedrock/soil interface is probably part of a highly irregular, well-developed karst. This implies that recharge, be it percolation through soil or into sinkholes, follows a complex path of least resistance influenced by joints, bedding planes, and open or sediment-filled solution channels. Hydraulic conductivity estimates of the upper aquifer range from about 150 m/day to more than 450 m/day.

■ NOAA Trust Habitats and Species

Habitats of concern to NOAA are surface water and bottom substrates of the Río Indio, the Río Cibuco, and their tributaries. Riparian zones, estuaries, and wetlands associated with these

ivers, including mangrove swamps located at the mouth of the Río Cibuco, also are NOAA trust habitats potentially threatened by the transport of contaminants from the site.

Most of the native fish and shrimp species in Puerto Rico are compulsory migrators, either catadromous or amphidromous, and thus NOAA trust species (Oland 1997; Yoshioka 1997; Table 1). The term *amphidromous* refers to predominantly freshwater species in which the life cycle includes a larval phase in marine or estuarine water. These fish and shrimp mature and reproduce in freshwater, releasing either eggs or larvae which are carried downstream. These species are iteroparous (they do not die after spawning) and can spawn several times during their life cycle. For shrimp, the first-stage larvae are non-feeding and must reach waters containing salinities of approximately 15 ppt in order to molt to a feeding-stage larvae (Oland 1997).

The gobies and most of the shrimp species are capable of passing large obstacles (high waterfalls, and dams with surface water overflow) in their migrations upstream; they are found in the headwaters, up to the point where flow becomes intermittent (Oland 1997).

The mountain mullet is a popular native game fish that can sustain swimming speeds similar to trout, is very active, and is sensitive to disturbance. High dams and reservoirs have eliminated the mullet from many upland streams. The fat sleeper and spiny-cheeked sleeper are usually restricted to the lower portions of the river near

the estuary. Larval sirajo gobies, known as setí, are collected during their upstream migration and eaten as a local delicacy. The catadromous American eel is occasionally taken by fishermen and likely used as bait (Oland 1997).

Bigmouth sleepers and the river goby are found in most rivers as well as some reservoirs. Both are believed to pass part of their life cycle in salt-water, but may be capable of completing their life cycles in freshwater. Although both species are taken as a food fish, little is known about the life history of the river goby (Oland 1997).

Shrimp are diverse and abundant, and are often the predominant predators, herbivores, and detritivores found in these streams. Shrimp of the genus *Macrobrachium* provide a popular fishery for both food and bait. *Macrobrachium* can grow quite large; for example, the big claw river shrimp is over 50 cm long with claws. Shrimp of the genus *Atya* are also large, and are commonly fished throughout the Caribbean (Oland 1997).

No information was found regarding dams or barriers on either Río Indio or Río Cibuco that might prevent migration of NOAA trust resources along the river near the site.

An extensive wetland system exists at the mouth of Río Cibuco. This wetland system includes extensive estuarine mangrove forests and herbaceous wetlands. It is listed by the Puerto Rico Department of Natural and Environmental Resources as a Critical Coastal Wildlife Area (Oland 1997).

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Table 1. Target species of commercial and recreational interest likely to be found in Río Indio, Río Cibuco, and the estuary. (This table is not a complete listing of NOAA trust resources found in lower Río Cibuco and the estuary.)

Common Name	Scientific Name	Habitat Use			Fisheries	
		Spawning	Nursery/ Juvenile Rearing	Adult Forage	Comm.	Recr.
AMPHIDROMOUS/CATADROMOUS FISHES						
American eel	<i>Anguilla rostrata</i>		♦	♦		♦
Big-mouth sleeper ¹	<i>Gobiomorus dormitor</i>	♦	♦	♦	♦	♦
Fat sleeper	<i>Dormitator maculatus</i>	♦	♦	♦		
Mountain mullet	<i>Agonostomus monticola</i>	♦	♦	♦		♦
River goby ¹	<i>Awaous tajasica</i>	♦	♦	♦	♦	♦
Sirajo goby	<i>Sicydium plumieri</i>	♦	♦	♦	♦	
Spiny-cheek sleeper	<i>Eleotris pisonis</i>	♦	♦	♦		
CRUSTACEANS						
Big Claw River shrimp	<i>Macrobrachium carcinus</i>	♦	♦	♦	♦	♦
Cascade River prawn	<i>Macrobrachium heterochirus</i>	♦	♦	♦	♦	♦
Cinnamon River shrimp	<i>Macrobrachium acanthurus</i>	♦	♦	♦	♦	♦
Shrimp ²	<i>Atya innocous</i>	♦	♦	♦	♦	♦
Shrimp ²	<i>Atya lanipes</i>	♦	♦	♦	♦	♦
Shrimp ²	<i>Atya scabra</i>	♦	♦	♦	♦	♦
Shrimp ²	<i>Jonga serrei</i>	♦	♦	♦		
Shrimp ²	<i>Macrobrachium crenulatum</i>	♦	♦	♦	♦	♦
Shrimp ²	<i>Macrobrachium faustinum</i>	♦	♦	♦	♦	♦
Shrimp ²	<i>Micratya poeyi</i>	♦	♦	♦		
Shrimp ²	<i>Potimirrim americana</i>	♦	♦	♦		
Shrimp ²	<i>Potimirrim glabra</i>	♦	♦	♦		
Shrimp ²	<i>Potimirrim mexicana</i>	♦	♦	♦		
Shrimp ²	<i>Xiphocaris elongata</i>	♦	♦	♦		
<p>1: There are some reports of populations located in reservoirs; may not be an obligate migrator.</p> <p>2: No common name provided by USFWS or found in <i>Common and Scientific Names of Aquatic Invertebrates of the United States and Canada</i> published by the American Fisheries Society.</p>						

Site-Related Contamination

Aluminum, antimony, arsenic, cadmium, chromium, copper, lead, manganese, mercury, selenium, and silver were reported in soils from the site at concentrations exceeding their mean concentrations in soils of the earth's crust (U.S. EPA 1983). Groundwater, surface water, and sediment samples have not yet been collected at the site or from off-site areas near the site. These data will be collected following completion of a planned removal of the most contaminated soils (Kwan 1997).

Surface soil samples collected during the 1989 site investigation were reported to have elevated concentrations of copper (403,000 mg/kg), antimony (633 mg/kg), and dioxins (110 ng/kg

TCDD TEQ). Mercury, silver, toluene, fluoranthene, pyrene, and 4,4'-DDD were also reported in soil samples. Soil samples collected from burn areas during November 1994 had the following average trace element concentrations: aluminum (24,356 mg/kg), antimony (1,363 mg/kg), cadmium (329 mg/kg), copper (57,697 mg/kg), lead (16,410 mg/kg), and silver (20 mg/kg; CDM 1996). Table 2 presents results of a soil study conducted in 1994.

In a study conducted by the U.S. Environmental Protection Agency in March 1996, more than 230 soil samples were collected along grids set out in Zones 1, 2, and 4 and analyzed for copper and lead. The maximum reported copper concentration was 214,000 mg/kg, while that for lead was 116,000 mg/kg (CDM 1996).

Table 2. Maximum concentrations of trace elements detected in soils at the V&M/Albaladejo Farms Site in 1994 (CDM 1996) compared to their mean concentrations in U.S. soils (Lindsay 1979; Shacklette and Boerngen 1984).

Trace Element	Maximum Concentration, mg/kg	Frequency of Detection	Location	Mean Conc. in U.S. Soils ^a , mg/kg
Antimony	2,600	16/16	Zone 2	0.5
Arsenic	250	16/16	Zone 4	5.2
Cadmium	40	16/16	Zone 2	0.06 ^b
Chromium	170	16/16	Zone 2	37
Copper	240,000	16/16	Zone 1	17
Lead	68,000	16/16	Zone 4	16
Manganese	2,100	16/16	Zone 2	330
Mercury	0.36	14/16	Zone 4	0.06
Selenium	8.2	14/16	Zone 4	0.3
Silver	20	15/16	Zone 2	0.05 ^b
a:	Shacklette and Boerngen (1984)			
b:	Lindsay (1979; cadmium and silver represent average concentrations in the earth's crust)			

Summary

Studies at the V&M site indicate that site soils are contaminated with trace elements, particularly antimony, arsenic, cadmium, silver, copper, and lead. No investigations examined contamination in on-site groundwater or in surface water and sediments of Río Indio, 650 m northwest of the site (and the nearest identified habitat that could support NOAA trust resources). Groundwater migration is the primary mechanism for potential transport of contaminants off-site to NOAA trust resources, although no studies have yet been conducted to verify this.

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