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Holloman Air Force Base
Sewage Lagoons Stakeholder Closure Meeting

Albuquerque, New Mexico

3 April 1996

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Holloman Air Force Base,
New Mexico

Holloman Air Force Base
Sewage Lagoons Stakeholder Closure Meeting

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3 April 1996

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AGENDA for the
STAKEHOLDERS CLOSURE MEETING

3 APRIL 1996

8:00 - 8:15	**Arrive and Registration**
8:15 - 8:30	**Introductions and Overview of Agenda**
8:30 - 9:45	**Presentations** Environmental Setting and Site History Long-Term Groundwater Monitoring Investigation Results Risk Assessment Results Corrective Measure Study
9:45 - 10:00	**Break**
10:00 - 10:15	**Module 1: Assessing Land Uses of the Sewage Lagoons**
10:15 - 11:00	**Module 2: Identifying Human Receptors**
11:00 - 11:45	**Module 3: Identifying Ecological Receptors and Sensitive Environments**
11:45 - 1:00	**Lunch**
1:00 - 1:30	**Module 4: Identifying Closure Objectives**
1:30 - 2:00	**Module 5: Evaluation of the No Action Alternative**
2:00 - 2:30	**Module 6: Evaluation of Holloman's Proposed Closure Alternative**
2:30 - 2:45	**Break**
2:45 - 3:30	**Module 7: Evaluation of Other Proposed Closure Alternatives**
3:30 - 4:30	**Module 8: Evaluation of a Final Closure Alternative**
4:30 - 5:00	**Module 9: Evaluation of a Closure Schedule and Milestones**

STAKEHOLDERS CLOSURE MEETING PARTICIPANT LIST

Participant	Organization
Barbara Hoditschek	NMED
Ron Kern	NMED
Stephanie Kruse	NMED
David Morgan	NMED
Gene Keepper	EPA Region VI
Jeff Yurk	EPA Region VI
Mark Wilson	U.S. Fish and Wildlife Service
Gordon Ewing	Audubon Society
Tom Manning	USAF Regional Compliance Office
Fred Fisher	Holloman AFB
Warren Neff	Holloman AFB
Mark Mercier	USACE Omaha District
Sandy Frye	USACE Omaha District
Tom Zink	USACE Omaha District
Judy Strawhecker	USACE Omaha District
Steve Weber	Foster Wheeler Environmental
Fred Applehans	Foster Wheeler Environmental
Tom Holcomb	Radian International
Robert Michna	Radian International
Kathleen Alsup	Radian International
Jim Gibson	Radian International

SITE SUMMARY DOCUMENT
for the
STAKEHOLDERS CLOSURE MEETING

SEWAGE LAGOONS CLOSURE PROJECT
HOLLOMAN AIR FORCE BASE, NM

3 April 1996

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Section 1
INTRODUCTION

This section presents a brief introduction of the sewage lagoons at Holloman Air Force Base (AFB), New Mexico. The discussion includes information about the location and features of the sewage lagoons; a description of the geology, hydrology, and groundwater quality at the Base; and a brief synopsis of the issues associated with the closure of the sewage lagoons.

1.1 Location and Site Description

Holloman AFB is situated in south-central New Mexico in the northwest-central portion of Otero County. The Base is located about 75 miles northeast of El Paso, Texas, and about 7 miles west of Alamogordo, New Mexico, as shown in Figure 1-1. Alamogordo is the largest city in Otero County and the biggest population center near Holloman AFB, with a population of approximately 31,000.

As illustrated in Figure 1-1, the sewage lagoons are located in the southwestern corner of the Base. Figure 1-2 presents a land ownership map showing the recently transferred land from the Bureau of Land Management (BLM) to the United States Air Force (USAF).

The sewage lagoon system consists of seven aeration/evaporation ponds. The first three, Ponds A, B, and C, are aerated. Ponds A and B are generally operated in parallel fashion to increase residence time. Afterward, the wastewater flows in series from Pond C through Ponds D, E, and G. Pond F is a sump that recirculates wastewater from Pond E back to the headworks of the system. Discharge from the last sewage lagoon (Pond G) flows via an open ditch to Lake Holloman.

Lake Holloman was formed by constructing a non-engineered dam to collect storm water drainage and wastewater discharge. The original dam was constructed in 1964 and upgraded to the present size in 1968. The 166-acre lake was intended to be the final impoundment for evaporation; however, due to seasonal low evaporation, water from Lake Holloman occasionally overflows into Lake Stinky, a small salina. Any overflow into Lake Stinky eventually dissipates through evaporation.

Table 1-1 presents the surface area and capacity of the seven sewage lagoons, as well as the year each was constructed. The edges of Ponds A through F are steeply sloped and lined to prevent bank erosion; however; the edges of Pond G are not lined. All seven sewage lagoons are diked to prevent overflow, and none have bottom liners.

A preliminary investigation in October 1991 was performed to determine the water depth and sludge thickness in Ponds C, D, E, F, and G. Similar measurements were conducted during the 1994 investigation. No measurements were collected from Pond F during the 1994 investigation. Measurements from the 1994 investigation are presented in Table 1-2.

1.2 Soils and Geology

The soils near and beneath the sewage lagoons are either Holloman-Gypsum Land-Yesum, Complex, or Mead silty clay loam soil as shown in Figure 1-3. The Mead silty clay loam is found in low-lying areas, is less permeable, and sometimes is associated with wetlands *(Soil Survey of Otero, New Mexico, 1981)*. The soil grades into the upper sand unit, which consists of 6 to 40 ft of sand, silt, or silty sand. Clay lenses are common

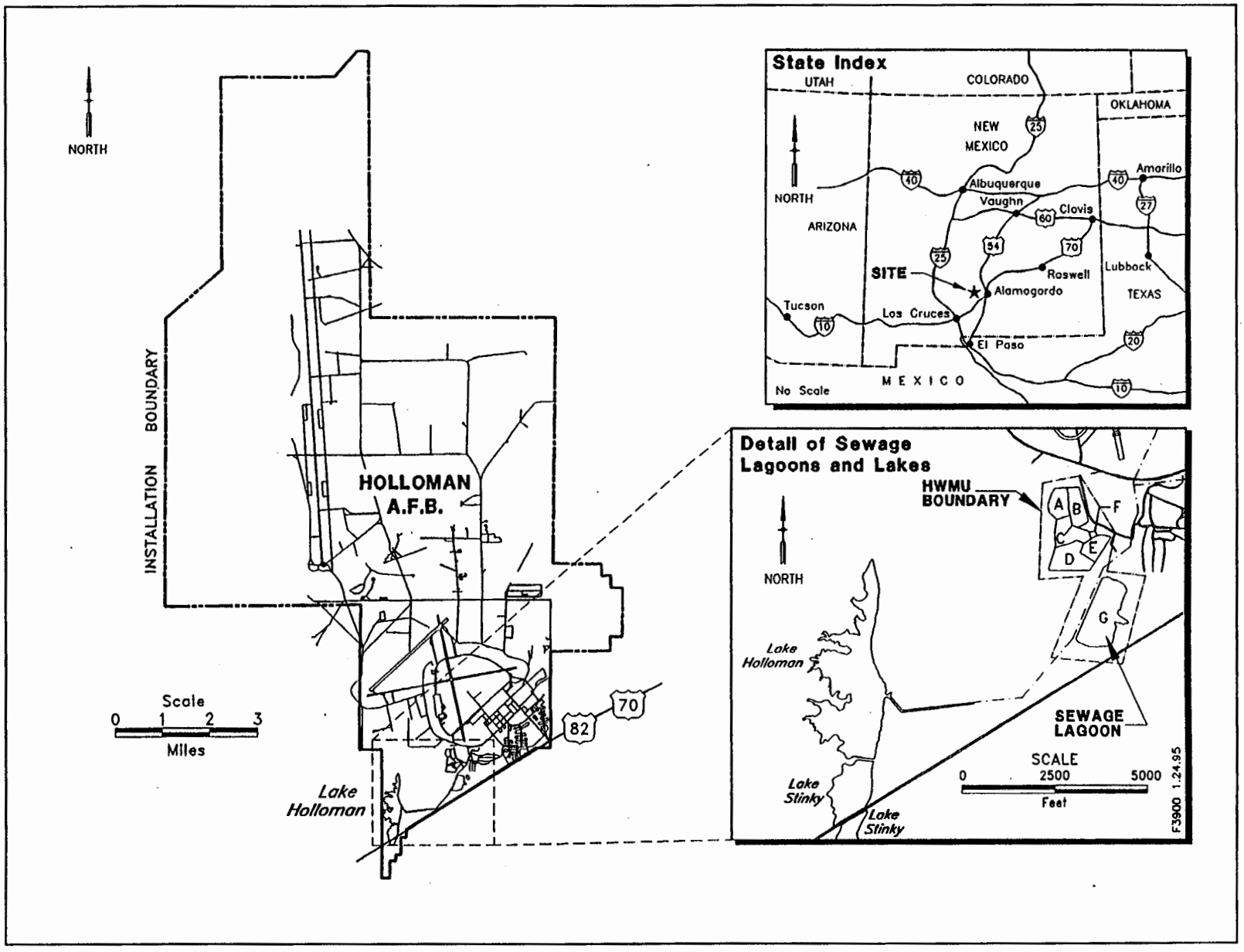

Figure 1-1. Location of the Sewage Lagoons at Holloman AFB

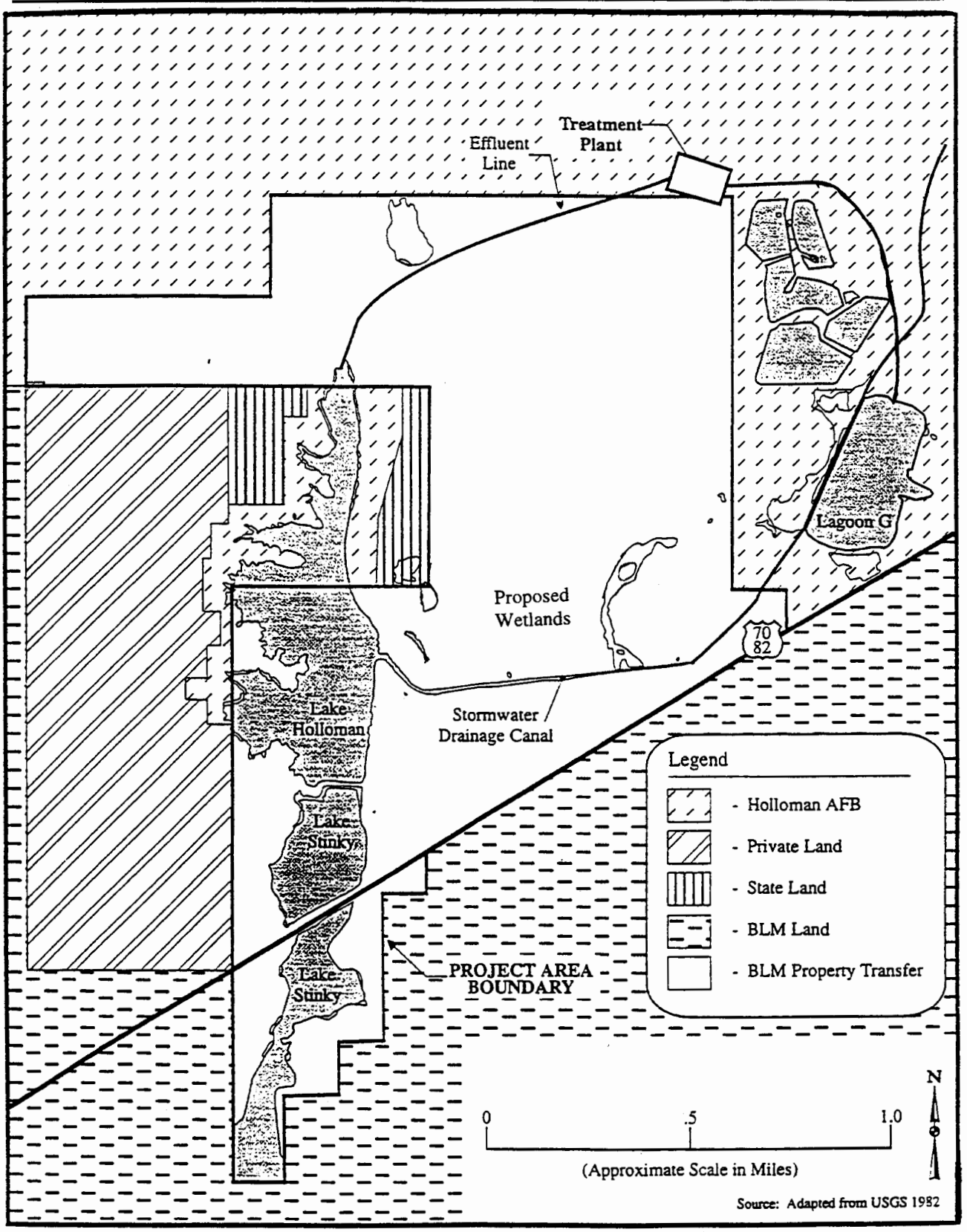

Figure 1-2. Land Ownership Patterns in the Immediate Project Area

Table 1-1
Sewage Lagoon Construction Dates and Dimensions

Pond	Year Constructed[a]	Surface Area (acres)	Capacity (million gal.)
A	1943	10.1	16.1
B	1943	11.2	16.1
C	1955-1959	12.5	21.3
D[b]	1955-1959	18.7	28.5
E	1955-1959	7.8	12.5
F	1955-1959	0.5	1.6
G	1970	39.8	64.6

[a]Ponds C, D, E, and F were constructed during the stated time interval; however, no dates were available to indicate the sequence of completion.
[b]Pond D was reconstructed in 1980.

Table 1-2
1994 Investigation Water Depth and Sludge Thickness Measurements

Pond	No. of Sample Locations	Water Depth (ft)			Sludge Thickness (in)		
		Minimum	Maximum	Average	Minimum	Maximum	Average
A	6	4.8	7.3	6	6	13	8.5
B	6	5.8	7	6.4	9	30	16.3
C	13	3.3	6.8	5.4	2	28	17.3
D	10	3.6	6.6	5.4	0.25	12	2.5
E	16	2.2	6.5	4.9	2	24	11.8
F[a]	4	5	5	5	6	10	7.5
G	19	1.1	4.6	3.4	1	16	4.6

[a]October 1991 measurements.

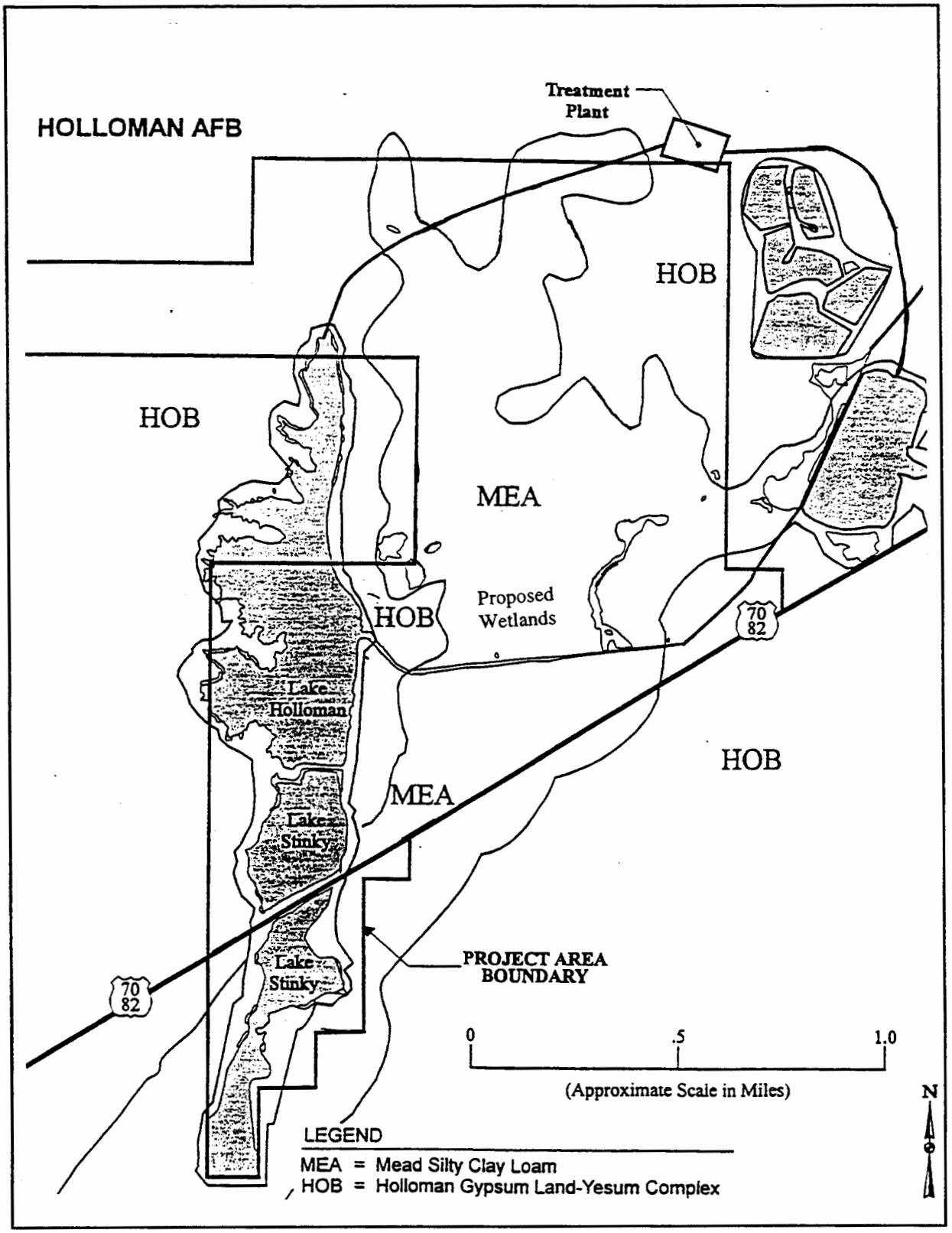

Figure 1-3. Soils Map of Holloman AFB and Project Area

in the upper sand unit. A discontinuous middle clay unit underlies the upper sand. The middle clay is reddish brown with abundant gypsum crystals and ranges from 10 to 40 ft thick where present. A lower sand unit consisting of interbedded sand, clay, and silt lies beneath the middle clay. This unit is lithologically heterogeneous and ranges from 10 to 20 ft thick.

The subsurface conditions at the sewage lagoons were defined by direct sampling and observation of the drilling operations of soil/ monitor well borings drilled between 1987 and 1993. Figures 1-4 and 1-5 illustrate and describe the general stratigraphy of the site.

The sediments consist of sand, silt, and clay, and are subdivided into six very broadly definable units that appear to be continuous across the site (Figure 1-4). This interpretation is supported by available data; however, irregularities exist on a smaller scale because of the discontinuous nature of alluvial and lacustrine deposits.

1.3 Hydrology

1.3.1 Surface Water

Holloman AFB is located in the Tularosa Basin, which is a closed basin with no surface water drainage. Precipitation is lost to evaporation, transpiration, and infiltration, or drains to Lake Lucero, the lowest point in the basin, approximately 20 miles southwest of Holloman AFB, or to other small playas in the east basin.

The Base is crossed by several southwest-trending arroyos that control surface drainage in the undeveloped parts of the Base. All of the arroyos terminate in the gypsum dune fields located in the western portion of the Base with the exception of Lost River. Lost River continues into the larger dunes of White Sands National Monument before it terminates.

Most drainage from the developed portions of the Base flows through a drainage ditch that bypasses the sewage lagoons and flows to Lake Holloman. Because of the high local groundwater table, this ditch flows most of the year. Other Base drainage flows to Dillard Draw or to on-Base undrained depressions, some of which are jurisdictional wetlands.

Lake Holloman is a playa lake which is classified as "waters of the U.S." in 40 CFR 122.2. Due to this designation, Holloman AFB submitted a National Pollutant Discharge Elimination System (NPDES) permit application in 1991 which was revised in 1995 to reflect the realignment of the Base in 1992 and the final design of Holloman AFB's new wastewater treatment plant (WWTP).

1.3.2 Wetlands

The United States Army Corps of Engineers (USACE) has identified the presence of 70 acres of jurisdictional wetlands near the sewage lagoons and location of the new WWTP. These areas were identified in accordance with Section 404 of the Clean Water Act (CWA). The location of these wetlands are shown in Figure 1-6 and are located within the boundaries of Holloman AFB.

Pond G comprises 40 of the 70 acres of jurisdictional wetlands and is currently exempt from regulation under Section 454 of the CWA 404 because it is functioning as a part of the wastewater treatment system. However, when Pond G is disconnected from the wastewater treatment system, it will lose exemption and would be subject to Section 404 in order to excavate or fill the site. The U.S. Fish and Wildlife Service (FWS) and Mesilla Valley Audubon Society have requested that Holloman AFB continue to supply water to Pond G to maintain wildlife habitat. As part of the construction of the new WWTP, restoration of existing, and construction of new wetlands will take place.

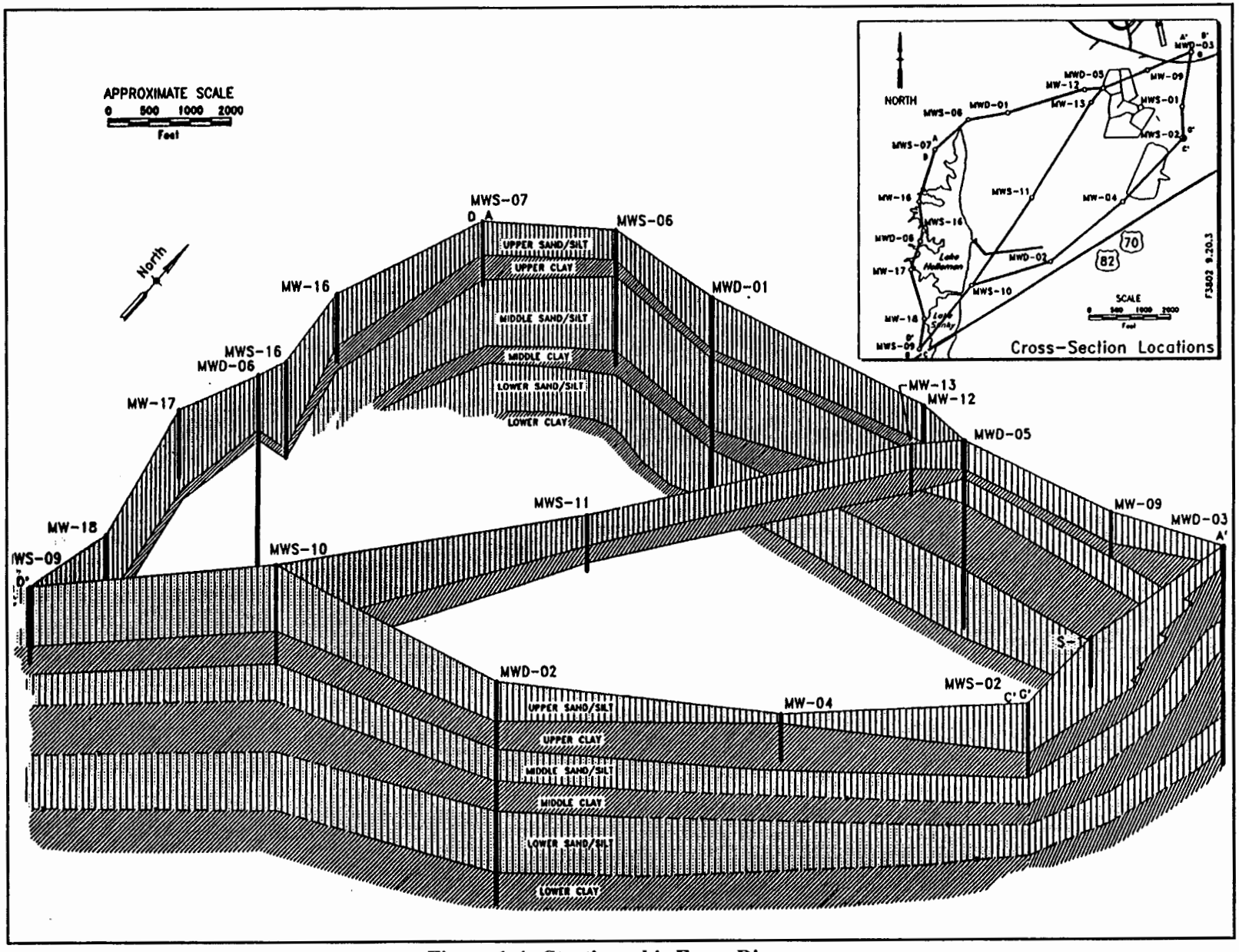

Figure 1-4. Stratigraphic Fence Diagram

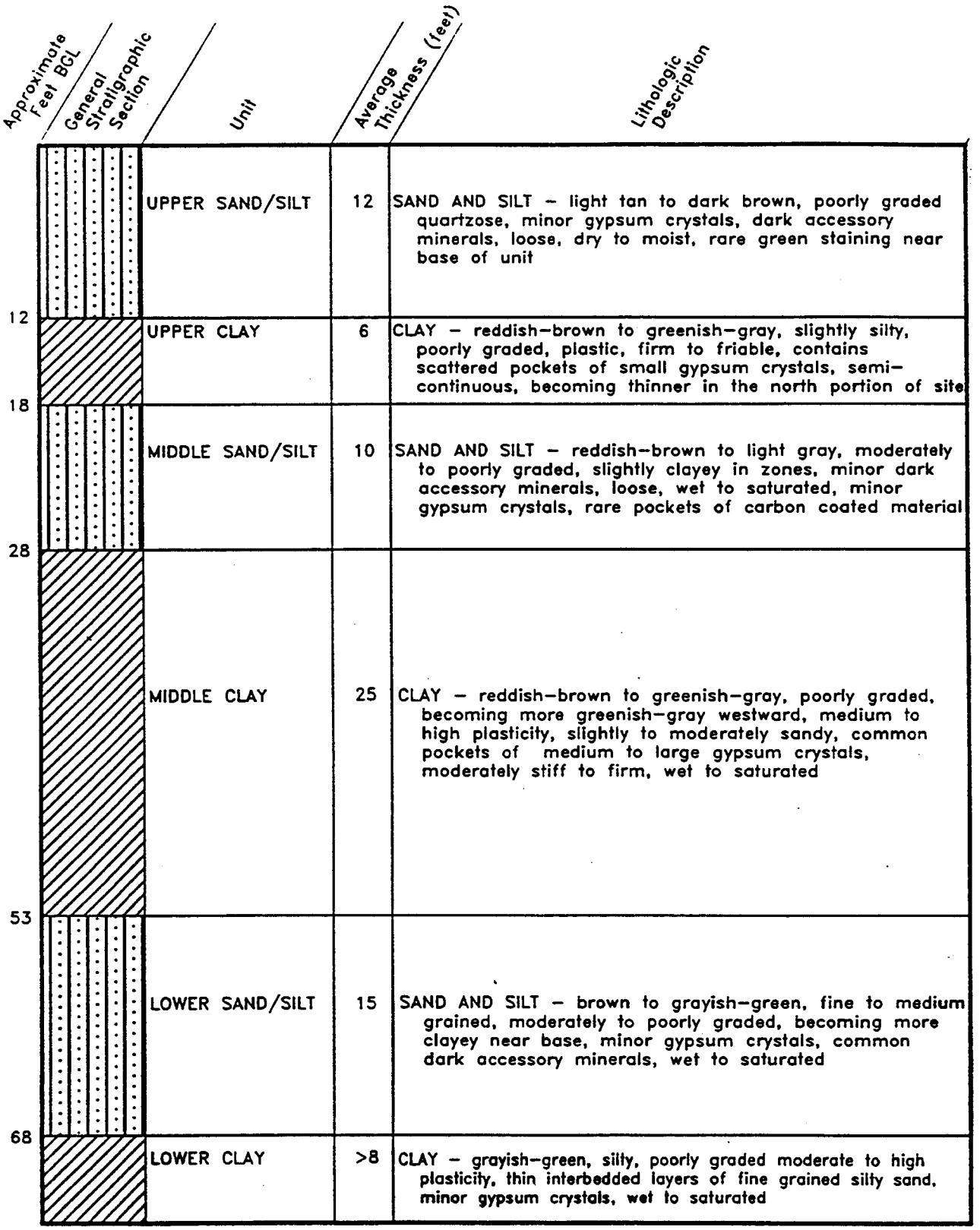

Figure 1-5. Site Stratigraphy

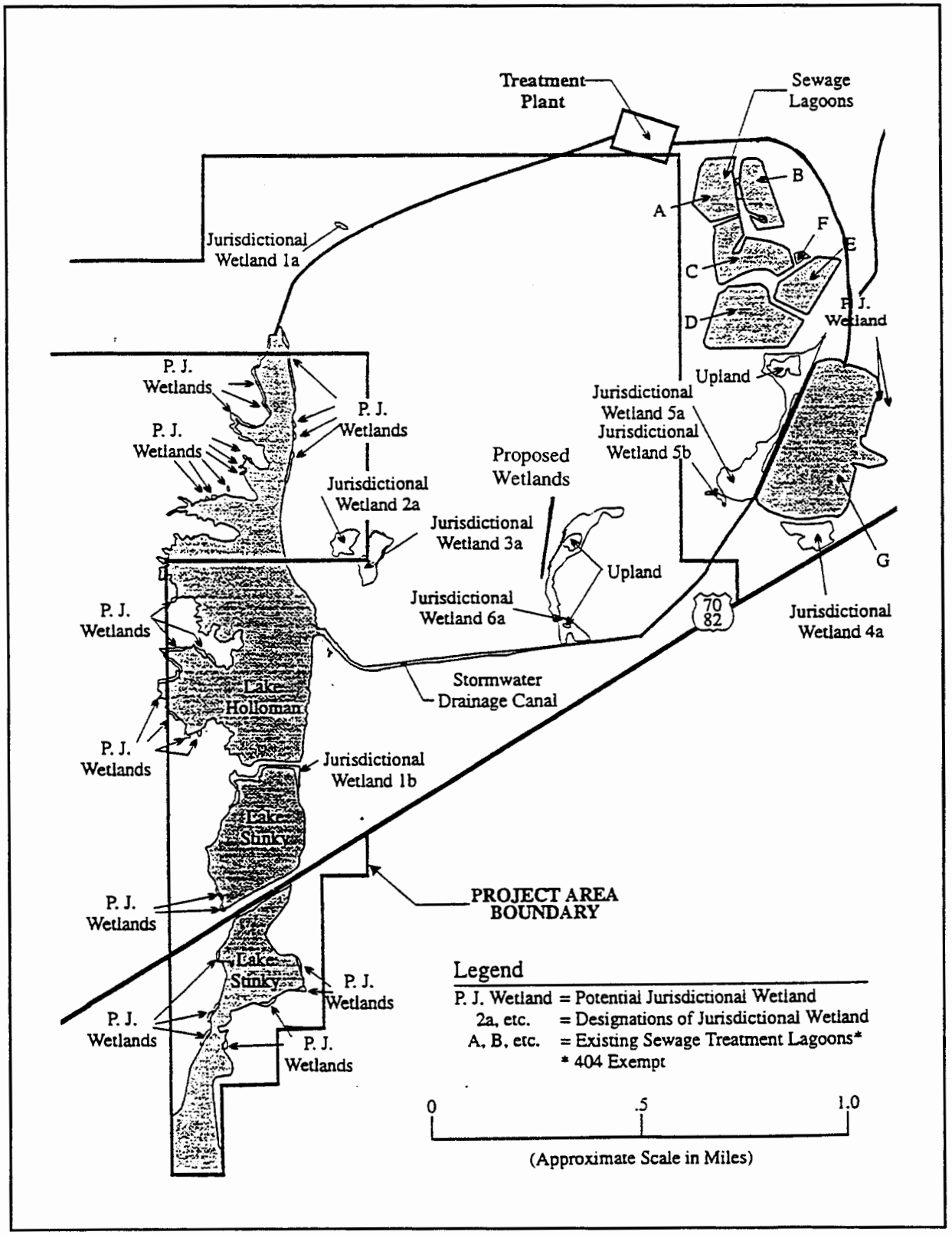

Figure 1-6. Wetlands Identified in the Current Project Area

1.3.3 Groundwater

Groundwater occurs in unconfined conditions in the unconsolidated bolson deposits beneath Holloman AFB. The primary source of recharge for groundwater in the bolson aquifer is percolation of rainfall and stream runoff through the coarse, unconsolidated alluvial fan deposits located near the base of the mountains upgradient of Holloman AFB. Groundwater discharge occurs either through evapotranspiration, springs or seeps along steep-sided arroyos, or into closed playa lakes such as Lake Lucero, the regional groundwater discharge area.

Regional groundwater flow is to Lake Lucero. Local groundwater flow is seasonally variable and is affected by the relationship between the groundwater table elevation and the elevation of the bottom of the local arroyo channels. In the southeastern portion of the Base, regional groundwater flows southwest, following the Dillard Draw surficial drainage system. In the northern portion of the Base, groundwater flows to the west, following the Ritas Draw, Malone Draw, and Lost River drainages.

The groundwater elevation at the sewage lagoons was surveyed in March, April, and August 1993 to determine seasonal variation associated with precipitation and evaporation rates at Holloman AFB. As part of that survey, surface water elevations were measured in Ponds A, D, and G and in Lakes Holloman and Stinky to provide data necessary to characterize local relationships between surface water and groundwater. The *Phase 1—Groundwater Assessment Monitoring Report* (Radian, December 1993) presents the results of this evaluation.

In the vicinity of the new WWTP, the depth to groundwater ranges from 2 ft below ground level (BGL) near the sewage lagoons to 13 ft BGL near Lakes Holloman and Stinky. Under an average hydraulic gradient of 0.3, the groundwater flows consistently from northeast to southwest. However, surface water in the unlined lakes causes groundwater mounding. Immediately to the east of Lakes Holloman and Stinky, groundwater flows toward the southeast if the elevation of Lake Holloman surface water is higher than the water table, which occurs most of the time.

1.4 Groundwater Quality

Groundwater quality in the Tularosa Basin is potable at the Boles and San Andres water well fields located at the foot of the Sacramento Mountains 14 miles southeast of Holloman AFB. Groundwater becomes progressively more mineralized as it flows downgradient toward the interior of the basin. This decrease in water quality can be attributed to slow groundwater migration from recharge to discharge areas and the presence of readily soluble minerals in the bolson sediments. Total dissolved solids exceed 100,000 mg/L in groundwater in some portions of the Tularosa Basin (USGS, 1985).

The groundwater beneath Holloman AFB is designated as unfit for human consumption based on New Mexico Water Quality Control Commission Regulations (NM WQCC 82-1, as amended through December 1, 1995 Parts 3-100 through 3-103) because it exceeds New Mexico Human Health Standards (HHSs) for total dissolved solids (TDS) and sulfate. Average values of other groundwater quality parameters measured at Holloman AFB (chloride, fluoride, and nitrate-nitrite) also exceed HHSs and, except for fluoride, also exceed federal primary and secondary drinking water maximum contaminant levels (MCLs; SMCLs). Water quality parameters reflect that the groundwater in this area is not potable under natural conditions.

Although the U.S. Environmental Protection Agency (EPA) guidelines for groundwater classification are not recognized by the State

of New Mexico, the EPA guidelines [*Guidelines for Groundwater Classification Under the EPA Groundwater Protection Strategy* (EPA, 1986)] classify the groundwater beneath Holloman AFB as a III B aquifer. Class III groundwater, characterized by having a TDS concentration greater than 10,000 mg/L, is not considered a source or a potential source of drinking water. Class III B groundwater is characterized by a low degree of interconnection to adjacent surface waters or groundwater of a higher class. The average measured TDS value of groundwater at Holloman AFB is greater than 10,000 mg/L (Radian, 1992). Because the Tularosa Basin is a closed basin, its groundwater does not discharge or connect to any adjacent aquifers. Adjacent surface waters include groundwater surfacing in Malone Draw and Lakes Holloman and Stinky. The TDS concentrations in Lake Holloman range from a winter low of 12,400 mg/L to a summer high of 17,000 mg/L (Cole, et al., 1981); therefore, groundwater at Holloman AFB is not interconnected with surface water of a higher class. In the 1993 investigation, TDS ranged from 11,000 to 12,000 mg/L in Lake Holloman and was 14,000 mg/L in Lake Stinky.

1.5 Closure Issues

The Holloman AFB sewage lagoons differ from that of a typical Resource Conservation and Recovery Act (RCRA) unit. Unlike other RCRA units that are designed to treat or dispose of hazardous wastes, the Holloman AFB sewage lagoons were never intended to treat hazardous wastes. From the time the lagoons were created, their primary function has been to treat domestic wastewater prior to discharge to Lake Holloman. Any hazardous wastes that have entered the system were a result of releases that occurred prior to 1985.

The distinction between the sewage lagoons and the lakes is a result of the water bodies' different regulatory classifications and the requirements of the Federal Facilities Compliance Agreement (FFCA). In 1994, the New Mexico Environment Department (NMED) and EPA Region VI determined that the lakes and the ditch would be regulated under the Hazardous and Solid Waste Amendments (HSWA) program as two solid waste management units (SWMUs) 139 and 140, respectively. The sewage lagoons, however, are regulated as hazardous waste management units (HWMUs). The rationale for this determination was that no information exists to suggest that hazardous wastes were ever discharged into the ditch, Lake Holloman, or Lake Stinky.

In response to a December 1984 RCRA Section 3007 request for information by EPA Region VI, Holloman AFB identified, through interviews, the wastes in Table 1-3 as having entered the sewage lagoons prior to 1985. However, the 22 November 1985 Sewage Lagoons Closure Plan presented information that indicated that the majority of these wastes had been incorrectly identified. Considering the Department of Defense's (DoD) practice of using the DRMO (Defense Reutilization Marketing Office) for redistributing pure chemicals, it is highly unlikely that any pure or off-specification "U" or "P" listed wastes were flushed to the sewer drains. However, it is possible that spent solvents or "F" listed wastes entered the sewer system. As such, the list of wastes presented in Table 1-3 and cited in the FFCA should probably be limited to only the "F" listed wastes.

The sewage lagoons are included in the Installation Restoration Program (IRP) being conducted at Holloman AFB, and are designated IRP Site 49. The IRP was established to investigate past hazardous waste disposal sites at DoD installations. Implementation of the IRP generally follows the provisions of the Superfund Amendments and Reauthorization Act (SARA). These regulations mandate that the provisions of the National Contingency Plan (NCP) apply to federal facilities.

Table 1-3
Listed Wastes Allegedly Disposed of in Sewage Lagoons

EPA Waste Code[a]	Description	Source Identified in Interviews
F001	Halogenated degreasing solvents	Corrosion Control (Bldg. 308) and DMEL
F003	Nonhalogenated degreasing solvents	NDI
U228	Trichloroethene	Flightline Area
U161	Methyl isobutyl ketone	NDI
U227	1,1,2-trichloroethane	Bldg. 308 and AGE
U188	Phenol	Bldg. 308
U154	Methanol	Hospital, Dental Clinic, NMSU PRL, Photo Labs, Solar Observatory, Dyna Corp.
U002	Acetone	Hospital, Dental Clinic, NMSU PRL
U122	Formaldehyde	Hospital, Dental Clinic, Photo Lab, Dyna Corp.
U165	Naphthalene	NMSU PRL
U220	Toluene	NMSU PRL
U239	Xylene	NMSU PRL
U003	Acetonitrile	NMSU PRL
U233	Propionic acid [b]	Photo Labs One Time Use
P095 (U211)	Phosgene (carbon tetrachloride)	Flightline Area
P012	Arsenic trioxide	West Area Photo Lab
P106	Sodium cyanide	Test Group (Bldg. 824)

Source: 1984 Response to RCRA 3007 Request and 1987 Notice of Noncompliance and Interview Notes.

Notes: NDI = Non destructive inspection. NMSU PRL = New Mexico State University Primate Research Lab.

[a] Considering DoD's practice of using the DRMO for redistributing chemicals, it is highly unlikely that "P" and "U" listed wastes (pure or off-spec chemicals) were discharged to the sewer system. It is more likely that the spent chemicals or "F" listed wastes were discharged to the sewer system.
[b] U233 [2-(2,4,5-trichlorophenoxy) propionic acid)] was eliminated from 40 CFR 261.33 by USEPA in 1984 and replaced with a reference to F027 (relating to tri-, tetra-, and pentachlorophenol formulations).

As a DoD facility, Holloman AFB receives funding for the IRP from the Defense Environmental Restoration Account (DERA). Consequently, investigation and remediation activities at the sewage lagoons must be coordinated through the IRP. To date, over $10 million have been spent performing initial removal actions of sludge contaminated with polychlorinated biphenyls (PCBs) from Ponds A and B, and on characterizing the sewage lagoons, the ditch, and Lakes Holloman and Stinky. The majority of these funds were spent on the removal activities in Ponds A and B. These funds exclude the 1981, 1983, and 1984 investigations performed internally by the USAF.

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Section 2
SUMMARY OF INVESTIGATION RESULTS

Several investigations have been performed at the sewage lagoons since 1988. These investigations have characterized surface water, sludge, soil, and biota. Table 2-1 summarizes the sewage lagoons investigated, the number of locations sampled, and the analyses performed. The following sections summarize these investigation results.

2.1 Surface Water

Surface water samples were collected from the sewage lagoons in 1990, 1993, and 1994. The results of the 1990 and 1993 investigations indicated that metals were the primary constituents of concern in the surface water and organochlorine pesticides existed in parts per trillion range. The 1990 investigation resulted in suspect concentrations for organic lead; concentrations of organic lead exceeded those for total lead, and similar concentrations were detected in the equipment rinsate samples. The 1994 investigation confirmed that the 1990 results for organic lead were not reliable. Organic lead was not detected even though a methodology with a lower detection limit was used.

The surface water concentrations in the lagoons were compared to drinking water standards established by EPA and NMED. The comparison demonstrated that bis(2-ethylhexyl)phthalate (Ponds B, D, E, and G), phenol (Pond D), and beta-BHC (Pond G) were detected below their reporting limits but above the drinking water standards. Constituents such as bis(2-ethylhexyl)phthalate, phenol, alpha-BHC, beta-BHC, delta-BHC, gamma-BHC, heptachlor epoxide, and lead were not detected in the sewage lagoon (other than those listed above) but their method detection limits were slightly above the drinking water standards. This comparison demonstrates that the sewage lagoons' surface water nearly meets the drinking water standards for the detected constituents, including metals. It should be reemphasized that the sewage lagoons do not serve as a drinking water source nor do they connect to any potable aquifers. Therefore, the drinking water standards are merely used for a means of comparison.

2.2 Sludge

Sludge samples were collected from the sewage lagoons in 1990, 1992, 1993, and 1994. Because of the apparent differences in the character of the sludge contained in Ponds A and B to that contained in Ponds C through G, the overall conclusions for these sewage lagoons are discussed separately.

2.2.1 Ponds A and B

Sludge from Ponds A and B has been investigated primarily for PCBs. Sludge found during the 1988 investigation having PCB concentrations above the Toxic Substance Control Act (TSCA) action level of 25 mg/kg in Ponds A and B was removed in 1990. Subsequent to the sludge removal, confirmation sampling was performed in 1990 to determine the effectiveness of the removal. The confirmation sampling, along with the 1994 investigation of Ponds A and B, confirmed that sludge PCB concentrations were below the TSCA action level. These investigations also indicated that metal concentrations in the sludge are below the toxicity characteristic leaching procedures (TCLP) regulatory levels and that the sludge is not characteristically hazardous due to reactivity (i.e., it contains less than 500 mg/kg reactive sulfides). In addition, metals concentrations are below pollutant concentrations for land applied sludge.

Table 2-1
Summary of Sewage Lagoon Investigations

Medium	Year	Number of Sample Locations[a] in Each Sewage Lagoon							Analyses Performed
		Pond A	Pond B	Pond C	Pond D	Pond E	Pond F	Pond G	
Surface Water	1990	--	5	5	5	5	--	5	Semivolatiles, Organochlorine Pesticides, PCBs, and Metals
	1993	1	1	--	1	1	1	1	Organochlorine Pesticides
	1994	--	--	3	3	3	--	9	Total Lead and Organic Lead
Sludge	1990	28[b]	37	6	--	--	--	--	Ponds A, B, and C - PCBs; Pond C - VOCs, Semivolatiles, Chlorinated Herbicides, Organochlorine Pesticides, and Metals
	1992	--	--	6	--	5	2	6	Appendix IX Constituents
	1994	6	6	13[c]	16	16	--	19[d]	Ponds A and B - PCBs Ponds A, B, and C - TCLP Metals, and Total and Reactive Sulfides; Ponds C, D, E, and G - Organochlorine Pesticides and Metals; Ponds C and G - Kepone
Sediment[e]	1993	1	--	--	--	1	--	--	Semivolatiles, Organochlorine Pesticides, and Metals
Soil	1990	8	6	6	--	--	--	--	Ponds A and B - Appendix IX Constituents Pond C - VOCs, Semivolatiles, Chlorinated Herbicides, Organochlorine Pesticides, PCBs, and Metals
	1992	--	--	8	9	8	1	8	Appendix IX Constituents

[a] This table presents the number of sample locations and not the number of samples collected. Multiple samples were collected as some locations. This table does not present investigation results from the 1988 investigation since sludge with PCB concentrations above the TSCA regulatory limit have been removed from the sewage lagoons.
[b] Originally 25 sludge samples were collected during the 1990 investigation. One sample had questionable data, and three additional samples were collected to verify or disprove the questionable data. Therefore, a total of 28 sludge samples were collected in 1990.
[c] Six samples were analyzed for TCLP metals and for sulfides; eight were analyzed for kepone.
[d] Twelve samples were analyzed for kepone.
[e] For purposes of characterizing the sewage lagoons, sediment samples were considered as sludge samples. Sediment samples were near-surface composite samples collected as part of the biota sampling to correlate constituents found in benthic organisms with their appropriate habitat.

PCBs = Polychlorinated biphenyls.
TCLP = Toxicity characteristic leaching procedure.
VOCs = Volatile organic compounds.

2.2.2 Ponds C, D, E, F, and G

Sludge in Ponds C, D, E, F, and G was investigated in 1990, 1992, and 1994. The sludge was analyzed for Appendix IX constituents in 1990 and 1992. These investigations indicated that organochlorine pesticides and metals were the primary constituents in the sludge. Therefore, the 1994 investigation focused on these constituents.

The only organochlorine pesticides that have been detected above their reporting limits in all of the investigations are 4,4'-DDD and 4,4'-DDE. The concentrations of 4,4'-DDD and 4,4'-DDE, as well as the other constituents that were sporadically detected, have decreased over time. To illustrate this decrease in concentration, the maximum and mean concentrations for 4,4'-DDD in Pond C are shown in Figure 2-1. The mean concentrations were calculated using only the detected concentrations. Therefore, the means represent worst-case scenarios. The figure shows that both the maximum and mean concentrations have decreased by at least one order of magnitude.

The investigations also show that 4,4'-DDT, gamma-chlordane, and delta-BHC were detected in the sludge during one or more sampling events. However, these constituents were not detected in all of the investigations, and also appear to have decreased over time. Generally, concentrations of 4,4'-DDT have decreased from concentrations of approximately 100 µg/kg in 1992 to approximately 10 µg/kg in 1994. Concentrations of gamma-chlordane have decreased to either nondetect or to below the reporting limit.

These reductions in 4,4'-DDT, 4,4'-DDD, and 4,4'-DDE can be explained as occurring by both biological and physical phenomena. Biologically, 4,4-DDT can be reduced to 4,4'-DDD and eventually to 4,4'-DDE by anaerobic bacteria (Atlas and Bartha, 1987). Bacteria use the energy associated with the contaminant's chemical bonds for growth and reproduction. Physically, dechlorination of 4,4'-DDE may result through photolysis (Wolfe, 1990).

Investigations conducted at Pond C prior to the 1994 investigation indicated that, based on the calculated maximum TCLP concentrations, the sludge could contain silver and chromium at concentrations that could potentially exceed the regulatory levels. The 1994 investigation showed that the TCLP concentrations for these constituents (as well as for all other metals) were well below the TCLP regulatory levels. Therefore the sludge is not considered toxicity characteristic (TC) hazardous. The 1994 investigation also indicated that the Pond C sludge is not characteristically hazardous due to reactivity. On the basis of the calculated maximum potential TCLP concentrations, Ponds D, E, and G do not contain metal constituents in concentrations that could potentially exceed the TC regulatory levels. Therefore, no samples from these sewage lagoons were analyzed for TCLP because the sludge is not TC hazardous.

Analytical results for inorganic constituents in the sewage lagoons' sludge were compared with allowable constituent concentrations for the land application of sewage sludge. The allowable concentrations are standards for secondary sludge and not primary sludge, as is found in the sewage lagoons. Even though inorganic concentrations typically increase in secondary sludges, the allowable concentrations are greater than four times the concentrations found in the lagoons. This qualitative comparison indicates that the inorganic constituent concentrations in the sewage lagoons' sludges would not exceed the allowable constituent concentrations for land applied sewage sludge.

Although there are some areas in each sewage lagoon with elevated concentrations, it is difficult to define any "hot spot" areas. Ponds C and E have elevated contaminant concentrations in the areas of the influent and effluent points. Ponds D, E, and G generally have one or two sample

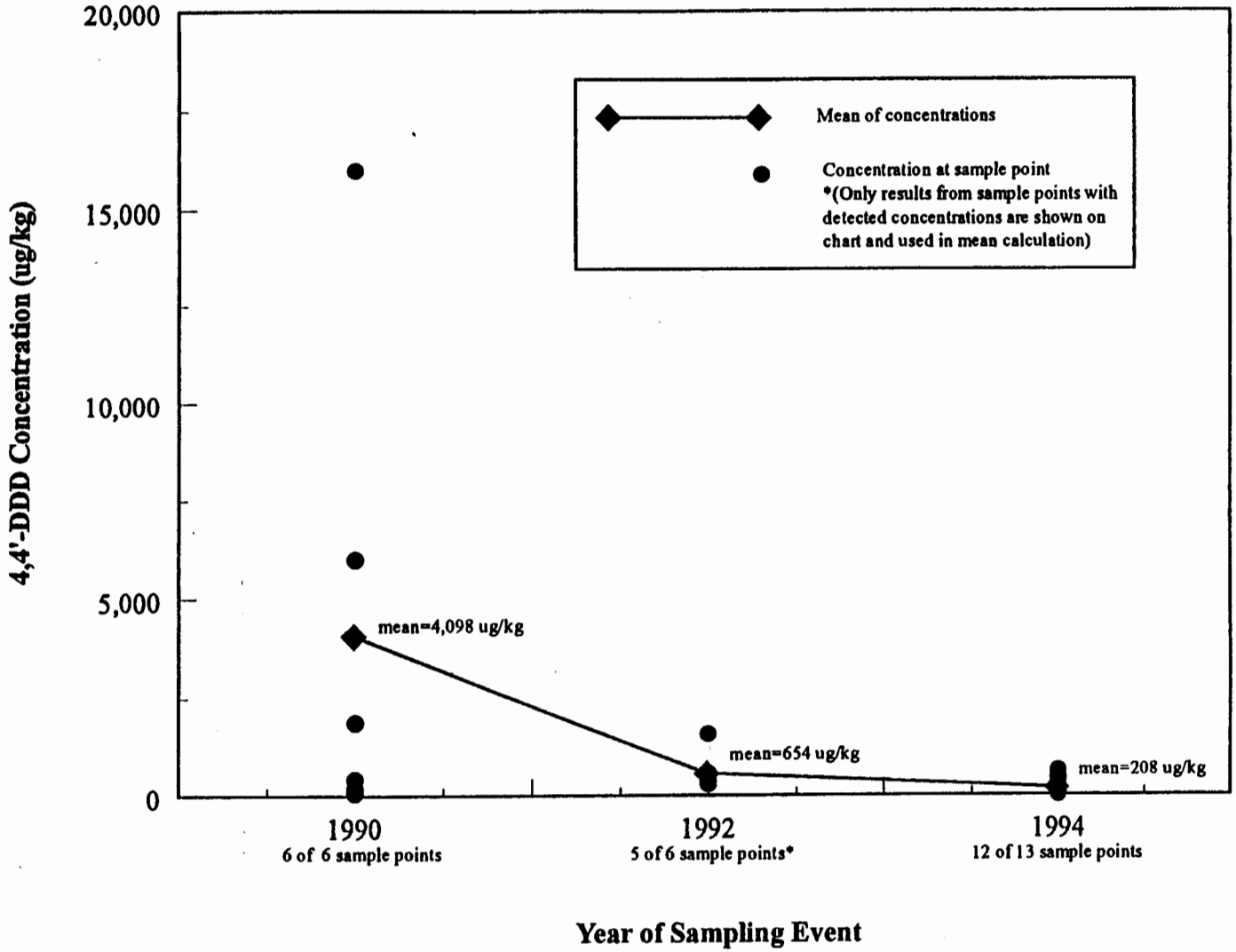

Figure 2-1. Concentration Decrease for 4,4'-DDD, Pond C

locations with elevated concentrations. However, these locations do not always have the highest concentrations for each of the constituents. For example, relatively high concentrations of 4,4'-DDD may be present in one sample location, while high concentrations of 4,4'-DDT are present in another location. This is also the case for the metals and other pesticides in the sewage lagoons.

The predominant contaminants, metals and organochlorine pesticides, do not indicate a trend of increasing or decreasing concentrations downstream in the series of sewage lagoons. Concentrations of some constituents, for example, are higher in the sludge in Pond G than the corresponding concentrations of the sludge in Ponds D or E.

Sludge samples collected in 1994 from Ponds C and G were analyzed for kepone because a previous investigation indicated that it may be present in the sewage lagoons. Eight samples from Pond C and 12 samples from Pond G were analyzed for kepone. One sample from each of the two sewage lagoons contained a detectable concentration of kepone; however, the results were below the 70 µg/kg reporting limit.

Samples for Ponds C, D, E, and G collected during the 1994 investigation were also analyzed to confirm the presence or absence of heptachlor epoxide or isodrin. These constituents were not detected in any of the samples. Therefore, the 1994 investigation indicated that the sludge in the sewage lagoons does not contain heptachlor epoxide or isodrin.

2.3 Soils

Soil samples were collected from below Ponds A, B, and C in 1990, and from below Ponds C, D, E, F, and G in 1992. Similar to the sludge, the predominant contaminants found in the soil were organochlorine pesticides and metals. However, the concentrations in soil were significantly lower than those in sludge. 4,4'-DDD and 4,4'-DDE were detected in Ponds C, D, E, F, and G but not in Ponds A and B. Other organochlorine pesticides detected in the soil include 4,4'-DDT, gamma-chlordane, beta-BHC, gamma-BHC, delta-BHC, aldrin, endosulfan sulfate, endosulfan II, and heptachlor epoxide, but many of these constituents were detected below their reporting limits during one or more investigations. The concentrations of these constituents are typically at least an order of magnitude lower in the soil below the sewage lagoons compared to the sludge.

A comparison of the results of inorganic analyses for soil samples indicate that several of the metals were detected at concentrations above the 1993 background upper tolerance limit (UTL). However, calculations of the maximum possible TCLP concentrations indicate that none of the metals exceed TC regulatory levels. Therefore, it is concluded that the soil below the sewage lagoons is not TC hazardous.

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Section 3
SUMMARY OF THE LONG-TERM MONITORING (LTM) PROGRAM

In 1988, Holloman AFB, the Region VI EPA, and NMED entered into the FFCA. The FFCA was initiated by the EPA in order to resolve compliance issues associated with the sewage lagoons. Part IX of the FFCA called for the installation of a groundwater monitoring system at the sewage lagoons. To satisfy this requirement, a RCRA groundwater monitoring program was initiated at the sewage lagoons in 1989 in accordance with 40 CFR Part 265. Figure 3-1 presents a historical overview of the groundwater monitoring program at the sewage lagoons.

The groundwater monitoring program began with detection monitoring, which indicated a potential release of waste constituents. Subsequently, assessment monitoring was performed to determine the nature and extent of contamination. The results of assessment monitoring indicated that a) pesticides and metals were the contaminants of concern, b) contamination was limited to the shallow aquifer, and c) the downgradient extent of contamination was adequately defined and did not extend beyond the immediately downgradient wells. By defining the nature and extent of the contamination in the shallow aquifer, the requirements of Part IX of the FFCA were satisfied.

3.1 Overview of LTM Program

The LTM program is designed to be conducted as part of the closure of the sewage lagoons. Closure of the sewage lagoons is described in the *Draft Final Closure Plan* (Radian, 1995) and is anticipated to occur in 1997. The LTM program is scheduled to continue to monitor groundwater quality downgradient of the sewage lagoons through their preclosure, closure, and postclosure periods.

Since the FFCA requirements for groundwater monitoring were met in the previous assessment monitoring (Radian, 1993), a more customized technical approach was developed for the long-term monitoring using historical data collected at the sewage lagoons. Since the nature of the contamination had been defined as organochlorine pesticides and metals, the LTM program focuses on those constituents. Similarly, since the extent of the contamination had been defined, downgradient monitoring will begin with wells immediately downgradient of the sewage lagoons (Figure 3-2), where any change in constituent concentrations would be immediately detected. Figure 3-3 is a flowchart that summarizes the data evaluation process developed for the entire LTM program. There are three key components to the LTM program:

Alternate Concentration Levels (ACLs)—ACLs provide site-specific standards for data assessment and release detection.

Detection Monitoring—In detection monitoring, levels of pesticides and metals in the groundwater will be compared with ACLs in order to detect any release of potential concern from the site.

Assessment Monitoring—If constituents are detected above ACLs during detection monitoring, the assessment monitoring stage will be enacted in order to determine the extent of the detected release.

3.1 ACLs

The water beneath Holloman AFB is designated as unfit for human consumption by

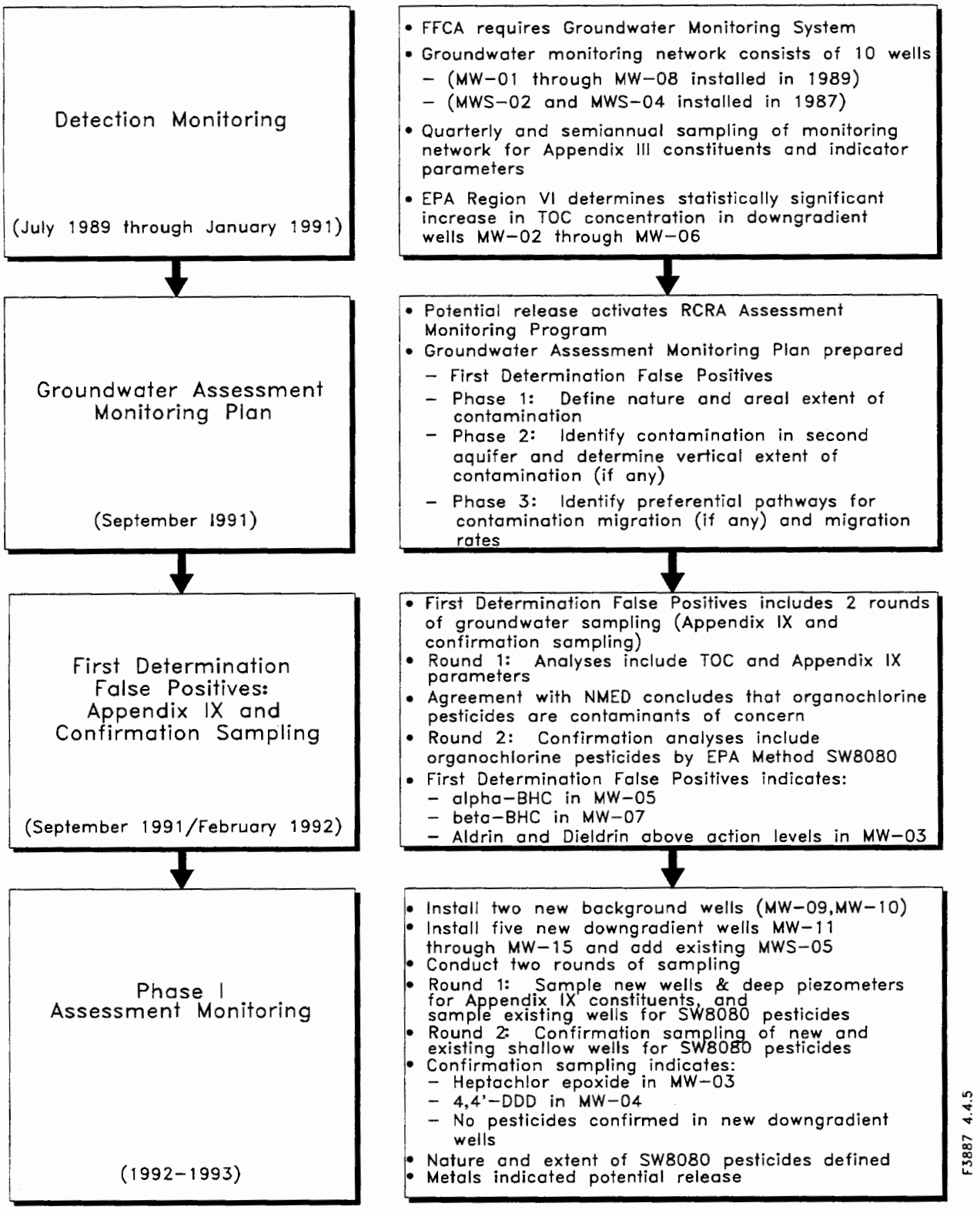

Figure 3-1. Historical Summary of Groundwater Monitoring at the Sewage Lagoons

Federal and State standards. Therefore, ACLs were developed to provide site-specific standards for data assessment that are more consistent with potential groundwater use and actual exposure scenarios than are drinking water standards.

The ACLs for organochlorine pesticides presented in Table 3-1 include risk-based values calculated for dermal exposure to an adult (the assumed exposure pathway, since the water is not potable). ACLs for metals are presented in Table 3-2 and are defined as the higher of either the risk-based calculation or the background UTL for each metal. Background values and UTLs for metals were established specifically for Holloman AFB in the *Base-wide Background Study* (Radian, 1993).

3.2 Detection Monitoring

During each sampling event, samples from each of the wells in the sewage lagoons' LTM network (Figure 3-2) are analyzed for organochlorine pesticides and metals by the methods listed in Tables 3-1 and 3-2. Following each sampling event, analytical results are compared with the ACLs listed in Table 3-1 (pesticides) and Table 3-2 (metals). If none of the screening parameters are detected at levels above the ACL, detection monitoring resumes as scheduled.

The presence of any constituents at levels above the respective ACL trigger immediate first determinations false positive (FDFP) sampling to confirm the results of those parameters detected. FDFP consists of resampling the well(s) where the exceedance occurred for the constituent(s) that were above the ACL(s). If no constituents detected above the ACL are verified in the FDFP sampling, detection monitoring resumes as scheduled. However, if detection above the ACL is verified through FDFP sampling, it is concluded that a release of constituents above the ACL has occurred from the sewage lagoons. Assessment monitoring is then initiated to identify the nature and extent of the release.

3.3 Assessment Monitoring

Confirmation of any of the screening parameters above the ACLs during FDFP sampling immediately moves the program into assessment monitoring in order to define the down-gradient extent of the detected release. The well(s) located down-gradient of the location where the release(s) occurred are sampled for those constituents detected above ACLs. If no well is present down-gradient of the location where the release occurred, one is installed and sampled. If any constituent is detected above the ACL(s) during the first round of assessment sampling, FDFP sampling is conducted to verify the results. If any of the constituents are verified through resampling, additional monitor wells are installed further down-gradient until the extent of contamination above the ACL(s) is defined.

If no constituents are detected above the ACL(s) during the second round of FDFP sampling, the down-gradient well(s) are included in the LTM network and detection monitoring resumes; all network wells are resampled for organochlorine pesticides and metals.

3.4 1995 LTM Sampling Results

Ten wells were sampled for organochlorine pesticides and metals during the fall of 1995. The analytical results of this sampling were compiled and compared with established alternate concentration levels (ACLs) list in Tables 3-1 and 3-2. No analyte was detected at levels above its respective ACL in any sample. As a result, it was recommended that LTM continue, with the next event scheduled for the fall of 1996.

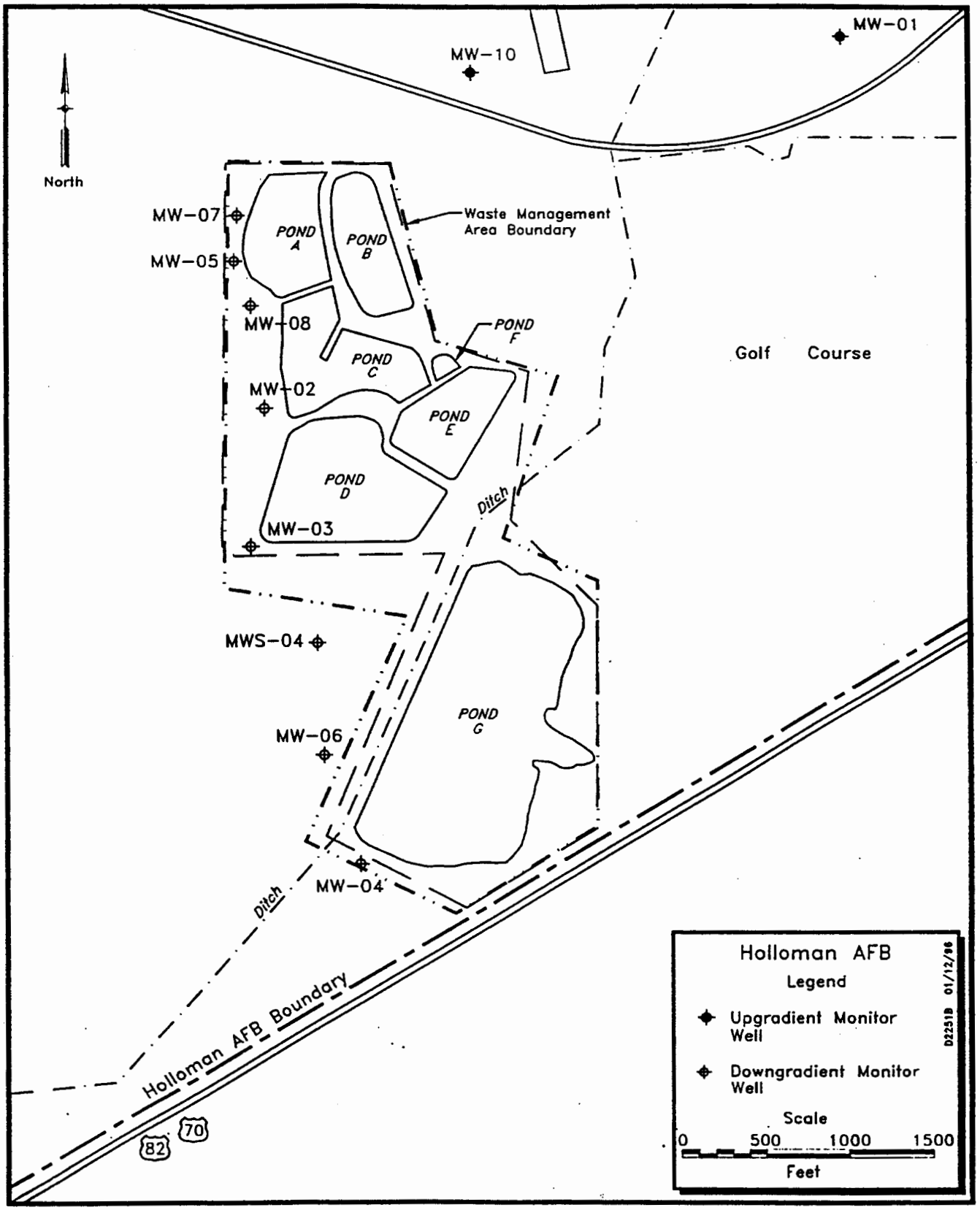

Figure 3-2. LTM Detection Monitoring Network

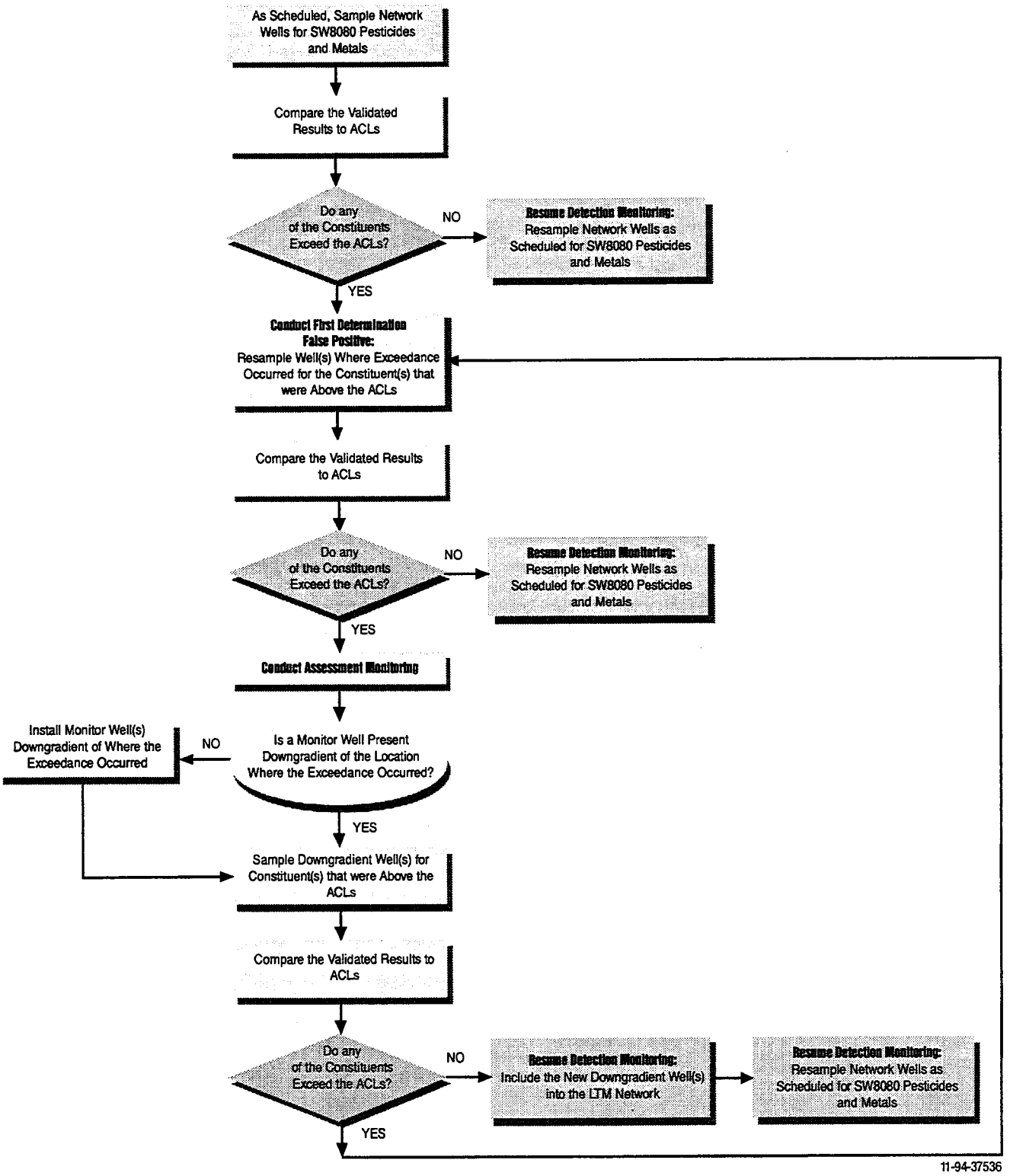

Figure 3-3. LTM Program Summary/Data Evaluation Process

Table 3-1
Summary of ACLs for Organochlorine Pesticides

Chemical Name	ACL (mg/L)
SW 8081[a]	
4,4'-DDD	0.03
4,4'-DDE	0.02
4,4'-DDT	0.01
Aldrin	0.05
Chlordane	0.04
Dieldrin	0.006
Endosulfan I	232
Endosulfan II	226
Endosulfan sulfate	16
Endrin	1
Endrin aldehyde	0.02
Heptachlor	0.04
Heptachlor epoxide	0.02
Isodrin	NA[b]
Methoxychlor	15
Toxaphene	0.12
alpha-BHC	0.02
beta-BHC	0.07
delta-BHC	1.64
gamma-BHC	0.35

[a] The analytical method specified for organochlorine pesticides in the *Long-term Monitoring (LTM) Plan* was originally SW8080. After the publication of the *LTM Plan*, SW8080 was updated, and the new method (SW8081) was selected for use prior to the 1995 LTM sampling event.

[b] No toxicity values for Isodrin are currently available.

Table 3-2
Summary of ACLs for Metals

Chemical Name	ACL (mg/L)[a]	
	UTL	Risk-based[b]
SW 6010		
Antimony	0.09	**2**
Barium	0.48	**6720**
Beryllium	0.004	**0.43**
Cadmium	0.008	**3**
Chromium	.096	**2580**
Cobalt	0.02	**310**
Copper	0.039	**191**
Nickel	0.044	**258**
Silver	0.007	**26**
Tin	0.031	**3100**
Vanadium	0.2	**36**
Zinc	0.16	**2480**
SW 7060		
Arsenic	0.072	**1**
SW 7421		
Lead	0.02	**4.13×10^6[c]**
SW 7471		
Mercury	0.00003	**2**
SW 7740		
Selenium	0.079	**26**
SW 7841		
Thallium	0.005	**8**

[a] Metals ACLs reflect the higher of either the risk-based calculation or the background UTL value for each metal. The higher value (ACL) is in bold for each analyte.

[b] EPA Region III risk-based level for industrial groundwater use; dermal contact.

[c] The risk-based calculation result for lead is 4.13×10^6 mg/L, indicating that lead poses no toxicity risk from dermal exposure due to its extremely low permeability coefficient.

Section 4
RISK ASSESSMENT SUMMARY

The risk assessment evaluated the current and future risks to human health and the environment potentially associated with the sewage lagoons and lakes at Holloman AFB.

A risk assessment for each sewage lagoon was prepared in 1993 (Radian, 1993) on the basis of existing data. Biological tissue samples were collected in 1993; however, these samples were not available at the time of the 1993 risk assessment. In the absence of this data, some of the ecological and human health risks were estimated using uptake models that were based on soil, sediment, and surface water data.

Several uncertainties existed in the analytical data that were used to estimate risks for both human and ecological receptors in the 1993 risk assessment. To address these uncertainties, an additional investigation was conducted at the sewage lagoons in 1994. In addition, a risk assessment update (addendum) was conducted.

The risk assessment update used the results of the 1994 investigation, the biota data, and the supportable data from previous investigations. Table 4-1 presents the data used for surface water, sludge, sediment, and soil. Table 4-2 presents the biological data.

4.1 Exposure Scenarios Evaluated

Four of the five exposure scenarios identified in the 1993 risk assessment were used to estimate the final health risks associated with human exposure to site-related contaminants in the risk assessment update..

At the time the 1993 risk assessment was being prepared, the disposition of the sewage lagoons and lakes was uncertain and the extent of contamination at these sites had not been fully defined. Based on that understanding of the sewage lagoons and lakes, a number of assumptions were made when selecting the potential exposure scenarios. These assumptions often erred in favor of selecting the most conservative exposure scenarios (i.e., scenarios that would be the most protective of human health). With greater understanding of the sewage lagoons and lakes, and with development of the closure plan, it is clear that the future on-site worker scenario should be eliminated, the future beef consumer scenario should be evaluated only at Lake Stinky, and the current/future recreational scenario will only consider exposure to hunters and the ingestion of waterfowl. The exposure scenarios are described below.

1) **Current On-site Worker (chronic and subchronic).** This exposure scenario was evaluated at Ponds A through G and the ditch. It addressed the exposure pathways associated with normal maintenance and operations at the sewage lagoons and the ditch.

2) **Current/Future Recreational—Hunters (chronic and subchronic).** This scenario was evaluated at Pond G, the ditch, and the lakes for both children and adults. The remaining sewage lagoons were not evaluated for this scenario since they will be closed.

For this scenario in the updated risk assessment, more appropriate ingestion rates were adopted for duck hunters in the State of New Mexico. These ingestion rates are based on the 1994 statewide average number of ducks harvested per year by active adult hunters (FWS, 1995).

3) **Current/Future Trespasser—Teenager (subchronic).** This exposure scenario was

Table 4-1
Summary of Sewage Lagoons and Lakes Investigations

Medium	Year	Number of Sample Locations[a]										Analyses Performed
		Pond A	Pond B	Pond C	Pond D	Pond E	Pond F	Pond G	The Ditch	Lake Holloman	Lake Stinky	
Surface Water	1990	--	5	5	5	5	--	5	--	6	--	Semivolatiles, Organochlorine Pesticides, PCBs, and Metals
	1993	1	1	--	1	1	1	1	1	3	2	Organochlorine Pesticides
	1994/ 1995	--	--	3	3	3	--	9	3	14	--	Total, and Organic Lead
Sludge	1990	28[b]	37	6	--	--	--	--	--	--	--	Ponds A, B, and C - PCBs; Pond C - VOCs, Semivolatiles, Chlorinated Herbicides, Organochlorine Pesticides, and Metals
	1992	--	--	6	--	5	2	6	--	7	--	Appendix IX Constituents
	1994/ 1995	6	6	13[c]	16	16	--	19[d]	--	25	--	Ponds A and B - PCBs; Ponds A, B, and C - TCLP Metals, and Total and Reactive Sulfides; Ponds C, D, E, and G - Organochlorine Pesticides and Metals; Ponds C and G - Kepone
Sediment[e]	1993	1	--	--	--	1	--	--	--	--	--	Semivolatiles, Organochlorine Pesticides, and Metals
Soil	1990	8	6	6	--	--	--	--	--	--	--	Ponds A and B - Appendix IX Constituents; Pond C - VOCs, Semivolatiles, Chlorinated Herbicides, Organochlorine Pesticides, PCBs, and Metals
	1992	--	--	8	9	8	1	8	4	9	6	Appendix IX Constituents

[a] This table presents the number of sample locations and not the number of samples collected. At some locations multiple samples were collected.
[b] Originally 25 sludge samples were collected during the 1990 investigation. One sample had questionable data, and three additional samples were collected to verify or disprove the questionable data. Therefore, a total of 28 sludge samples were collected in 1990.
[c] Six samples were analyzed for TCLP metals and for sulfides; eight were analyzed for kepone.
[d] Twelve samples were analyzed for kepone.
[e] For purposes of characterizing the sewage lagoons, the sediment samples were considered as sludge samples. The sediment samples were near surface composite samples collected as part of the biota sampling to correlate constituents found in benthic organisms with the environment in which they lived.

PCBs = Polychlorinated biphenyls.
TCLP = Toxicity characteristic leaching procedure.
VOCs = Volatile organic compounds.
-- = Not sampled.

Table 4-2
Biological Samples Collected in 1993

Site	Biological Samples					
	Algae-Benthos	Insects-Invertebrates	Fish (*Gambusia*)	Salamander	Black-Necked Stilt	Mallard
Pond A	(a)	(b)				
Pond B						
Pond C	(a)	(b)			3	
Pond D						
Pond E	(a)					
Pond F						
Pond G	(a)	(b)	(c)	4		1
Ditch	(a)	(b)	(c)			
Lake Stinky	(a)	(b)				
Lake Holloman	(a)		(c)			

(a) Numerous microscopic algae and benthic organisms were present in each sample taken. It is not possible to quantify the exact number of organisms per sample.

(b) Various insects and invertebrates were collected from these locations. Sampling records estimate the number of organisms to be greater than 100 per sample.

(c) Fish samples (gambusia) at each impoundment consisted of greater than 40 fish per sample. These fish were approximately 1 inch long on average.

Table 4-3
Summary of Human Health Risk Assessment Results

Site	Human Health Risk Estimates				
	Noncancer Hazard		Cancer Risk		Exposure Scenario Associated with Health Risks
	AVG	RM	AVG	RM	
Pond A	< 1	< 1	< 1E-6	2E-6*	Cancer risk estimates are based entirely on dermal contact with Aroclor-1254, in sludge, for the Current Onsite Worker Reasonable Maximum Scenario.
Pond B	< 1	< 1	< 1E-6	2E-6*	Cancer risk estimates are based entirely on dermal contact with sludge for the Reasonable Maximum Current On-site Worker Scenario. Aroclor-1254 contributes 76% to the overall risk estimate, with 4,4'-DDE, benzo[a]pyrene, and chlordane accounting for 19% of this estimate.
Pond C	< 1	< 1	< 1E-6	< 1E-6	NA
Pond D	< 1	< 1	< 1E-6	< 1E-6	NA
Pond E	< 1	< 1	< 1E-6	< 1E-6	NA
Pond F	< 1	< 1	< 1E-6	< 1E-6	NA
Pond G The Ditch Lake Holloman Lake Stinky	< 1	< 1	< 1E-6	6E-6*	Cancer risk estimates are based entirely on the ingestion of waterfowl hunted at these sites in the Adult Recreational Scenario. PCBs (36%), 4,4'-DDE (23%), oxychlordane (18%), dieldrin (15%), gamma-Chlordane (4%), and 4,4'-DDD (3%) account for this estimate.

* The accumulative risk for this scenario is between 10^{-4} and 10^{-6}.
AVG = Average Exposure Case
RM = Reasonable Maximum Exposure Case

evaluated only at Pond G because Ponds A through F are securely fenced and will be removed from active service in the future.

4) **Future Beef Consumer—Agricultural (chronic)**. This exposure scenario was evaluated only at Lake Stinky. The other impoundments are within the confines of Holloman AFB where grazing of livestock is not permitted due to lack of water and because of conflicts with wildlife management objectives.

The Future On-site Worker scenario, evaluated at Ponds A through F in the 1993 risk assessment, was not evaluated in the updated risk assessment. Holloman AFB will ensure that applicable health and safety requirements are implemented during closure activities, thereby precluding exposure to hazardous constituents.

4.2 Human Health Site-Specific Risk Assessments

For each carcinogenic chemical of concern (COC), the incremental probability that an individual will develop cancer over a lifetime was estimated from projected intake levels and cancer potency factors. The EPA Superfund site remediation goal set forth in the NCP established cancer risks of 1E-4 (1 in 10,000) to 1E-6 (1 in a million) as acceptable levels for known or suspected carcinogens. This range is designed to be protective of human health. For risk management decisions, a cancer risk of 1E-6 is considered a level of negligible risk and is the point of departure for determining remedial goals. As cancer risk estimates increase above 1E-6, so too does the level of concern for human health. Since these cancer risk estimates are generally upper-bound values, it is not likely that the "true risk," resulting from actual exposure, will be exceeded.

For noncarcinogenic COCs, it is assumed there is an exposure level below which it is unlikely that adverse health effects will occur (even for sensitive populations such as children). To characterize adverse noncarcinogenic health effects, comparisons were made between projected chemical intake and the toxicity of a given chemical. This relationship is referred to as the hazard quotient. For noncarcinogens then, there may be concern for potential noncancer effects when the hazard quotient (for individual chemicals) or hazard index (the sum of multiple hazard quotients) exceeds 1. In general, the greater the value above 1, the greater the level of concern.

The updated human health cancer risk and noncancer hazard estimates are listed in Table 4-3 for each site at the sewage lagoons and lakes. As shown in this table, cancer risk estimates are well within the acceptable risk range of 1E-6 to 1E-4 established by the EPA. Cancer risk estimates are greater than 1E-6, only in the reasonable maximum exposure case, at Ponds A, B, and G, the ditch, and both lakes. Cancer risk estimates are less than 1E-6 at Ponds C, D, E, and F in all exposure scenarios. The estimated noncancer hazard index at all sites, for all exposure scenarios, is less than 1.

Ponds A and B

The reasonable maximum cancer risk estimates at Ponds A and B are associated primarily with worker exposure to sludge. The estimate of 2E-6 is well within the acceptable levels for cancer effects established by EPA. Additionally, potential health risks will be mitigated once these sewage lagoons are removed from active service.

Pond G, the Ditch, Lake Holloman, and Lake Stinky

The reasonable maximum cancer risk estimate is 6E-6, well within the acceptable risk range established by EPA for remediation goals, at each of these sites and is based on the ingestion of waterfowl in the adult recreational (hunter) scenario. The data used to estimate cancer risk for this scenario came from the breast tissue of one duck that was caught while flying over Pond G.

Although this data set is limited, the risks estimated from it were also compared to the risks estimated in 1993 which were based on modeled duck tissue data. In general, the risk estimates were similar for the two data sets (actual tissue data and modeled tissue data) and indicated that PCBs were the primary COCs. Although PCBs are the primary cancer risk drivers for this scenario, the only known source of these PCBs will be eliminated once Ponds A and B are removed from active service.

Chemical concentrations in duck tissue, actual and modeled, were also compared to Federal /State tolerance levels for chemical residues in foods. This comparison indicated that the residue levels in duck tissue (actual and modeled) were 5 to 500 times lower than the tolerance levels established for commonly eaten foods such as eggs, fish, and commercial poultry. Since hunters were assumed to ingest the breast meat of 3 to 6 ducks in one year, it is likely that the allowable tolerance levels for commonly eaten foods could also apply to the ducks caught at Holloman AFB. Therefore, these tolerance levels suggest that the chemical residues in ducks taken from the sewage lagoons and lakes are not of concern to hunters who ingest them.

4.3 Ecological Risk Assessment

Ponds A through F were not evaluated in the ecological risk assessment (ERA) because they are planned to be closed and will no longer serve as a habitat for aquatic wildlife. Specific ERAs for Pond G, the ditch, Lake Holloman, and Lake Stinky were evaluated.

The potential for adverse ecological effects was evaluated using a combination of basic uptake modeling from lower trophic levels to higher trophic levels, and actual biological tissue sample data taken from the sewage lagoons and lakes. The potential for adverse effects was estimated by comparing chemical concentrations in the media at these sites with safe concentrations determined from literature studies. Adverse effects were defined as attributes that may threaten the survivorship and productivity of the aquatic food chain in the lagoons and lakes.

DDT and its derivatives, DDD and DDE, were the only constituents found to have the potential to cause adverse effects in the sewage lagoons and lakes. Table 4-4 provides a summary of the species and locations where DDT and its derivatives could potentially result in an adverse effect. These constituents are no longer used at the Base. The concentrations of DDT in the sewage lagoons decreased by an order of magnitude between 1992 and 1994, as is documented in the *Site Characterization Report* (Radian and Foster Wheeler, 1995d). It is unlikely that the survivorship and productivity of the aquatic food chains are threatened. No physical adverse affects have been observed in the mosquito fish or waterfowl that use the sewage lagoons and lakes as a habitat.

Table 4-4
Summary of Ecological Risk Assessment Results

Analyte	Pond G (Fish)	The Ditch (Fish)	Black-necked Stilt [a] (Body Burden)	Mallard [a] (Body Burden)
DDD	x	x		
DDE	x	x	x	x
DDT		x		

[a] Stilt and mallard EQs are not based on impoundment-specific samples but are intended to represent waterfowl present at the lakes and lagoons. None of the impoundment-specific EQs for waterfowl modeled from the food source data exceeded 1.0.

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Sewage Lagoons Stakeholder Closure Meeting

Holloman Air Force Base

3 April 1996

OVERVIEW

- Site History
- Long-Term Groundwater Monitoring
- Investigation Results
- Risk Assessment Results
- Corrective Measures Study

3 April 1996

Site History

3 April 1996

Site Overview

- **Seven Wastewater Treatment Lagoons (A-G)**
- **Wastewater Flow Pathway: A and B, C, D, E, and G (F recirculates)**
- **Mostly Domestic Wastewater**

Site Overview

- Ponds A and B in Use Since 1940's
- Pond G is an Impoundment Created from a Playa Lake
- Discharge from Pond G through Ditch to Lakes Holloman and Stinky
- Lake Holloman is an Impoundment of a Playa Lake

Site History

- Dates from 1980
- $ 5 Million Spent on Investigations Since 1987
- $ 6 Million Spent on Interim Cleanup in 1990
- $ 9 Million for Wastewater Treatment Plant in 1996

Site History
1980-84

Year	Inspec-tion	Sampling Water	Sampling Sludge	Events
1980				RCRA Part A permit submitted
1981	X	X	X	**EPA alleges discharge of paint strippers, etc.**
1982	X			
1983		X	X	EPA directs HAFB to continue annual sampling
1984	X	X	X	HAFB, based on interviews, develops list of hazardous wastes allegedly discharged to lagoons

Site History
1985

Month	Events
Jan	**HAFB commander formally prohibits discharge of hazardous wastes to sewer system**
Apr	First formal hazardous waste training at HAFB
Aug	EPA notification that HAFB is out of compliance for failure to install monitoring wells
Nov	USGS completes preliminary hydrogeologic study
Nov	**HAFB submits closure plan**

Site History
1986-87

Date	Events
Mar 86	**Sample results finally reported from Dec 1984 collection indicate PCB contamination**
Jul 86	Closure plan disapproved by EPA
Nov 86	Groundwater monitoring plan submitted
Jun 87	Revised groundwater monitoring plan submitted
Jul 87	**Water and sludge sampled**
Aug 87	CoE begins detailed hydrogeologic study

Site History
1988

Month	Events
Feb	NMEID inspection
May	Preliminary sampling of A & B hot spots, presence of PCBs confirmed
Aug	**More intensive sampling of A & B hot spots, PCB concentrations as high as 190 ppm**
Sep	Funding awarded for sludge removal and 2 years groundwater monitoring
Dec	**Federal Facilities Compliance Agreement (FFCA) signed by EPA, NMEID, HAFB**

Site History
1989-90

Date	Events
Jan 89	**Closure plan submitted to EPA and NMEID**
Mar 89	Revised groundwater monitoring plan submitted
Jun 89	Groundwater monitoring plan approved
Jul 89	Closure plan disapproved
Aug 89-Jan 90	Five monthly rounds of groundwater sampling
Jan 90-Oct 90	**Removal of >4000 tons sludge** **Confirmation sampling in March, July, and October**
Jul 90	**Revised closure plan submitted to EPA & NMEID**
Jul 90	Semi-annual groundwater sample collected
Oct 90	Surface water samples collected

Site History
1991

Month	Events
Jan	Semi-annual groundwater sample collected
Feb	Risk assessment finalized
May	EPA notifies HAFB of increased Total Organic Carbon in monitoring wells; Assessment monitoring required
May	**NMED notifies HAFB that delay of closure is possible pending submittal of a post-closure care permit application**
Jun	**Post-closure care permit application submitted**
Jul	FWS conducts biota sampling
Jul	Semi-annual groundwater sample collected
Sep	Groundwater assessment monitoring begins
Nov	EPA notifies HAFB of low-level pesticides in groundwater requiring confirmation sampling

Site History 1992-94

Date	Events
Feb 92	Sampled sludge and groundwater
Jun 92	HAFB notified by NMED to determine extent of pesticide contamination by developing new downgradient wells
Dec 92	Preliminary groundwater samples collected (geoprobes)
Mar 93-Apr 93	Installed new monitoring wells, collected groundwater, surface water, and biota samples
Jul 93-Aug 93	Additional soil, water and biota sample collections, including birds
Dec 93	Meeting to brief sampling results and risk assessment
Early 94	**Closure direction defined during conference calls with NMED and EPA**
Oct 94-Dec 94	Intensive sludge sampling

Site History 1995-96

Date	Submittals	Events
Mar 95	Project Assessment Report	Supplemental sludge samples
Apr 95	Long Term Groundwater Monitoring Plan	Final Environmental Assessment for Wastewater Treatment Plant (WWTP)
May 95	**Revised Closure Plan**	Construction begins on WWTP
Jun 95	Site Characterization Report	
Oct 95		Sampled groundwater
Dec 95	Revised NPDES Permit	
Mar 96	Risk Assessment Addendum Groundwater Monitoring Report	
Apr 96	Biological Resources Report	**Stakeholder Closure Meeting**
Jun 96		WWTP operation

Keeping the Lagoons "Clean"

- Chemical Concentrations are Declining
- Management Concentrates on Source Control
  - Hazardous waste training in place for over 10 years
  - Full-time inspectors working for commander
  - All hazardous wastes are captured in drums and turned in to Treatment, Storage and Disposal (TSD) Facility
  - Pollution prevention program substitutes environmentally friendly chemicals and processes
- <1% of Wastewater Influent is Industrial

Keeping the Lagoons "Clean"

- Oil/Water Separators
  - Best management program in ACC
  - Database tracks training, use, sample results, and repairs
  - Working towards zero discharge recirculating water systems for heavily used facilities
  - Plug or remove unnecessary units
- Silver recovery units
  - Regular sampling indicates past problems
  - Capture effluent in drums and turn over to TSD
  - Improve source water to improve operation

Long-Term Groundwater Monitoring

3 April 1996

Environmental Setting

- Geology
- Groundwater Flow and Depth
- Water Bearing Zones
- Groundwater Quality

Regulatory History

- Federal Facilities Compliance Agreement
- Detection Monitoring
- Assessment Monitoring
- Long-Term Monitoring (LTM) in Support of Closure

Federal Facilities Compliance Agreement

- December 1988: Signed into Effect
- Part IX Required Groundwater Monitoring System

Detection Monitoring

- July 1989 through 1991
- 10 Groundwater Monitor Wells
- Quarterly and Semiannual Sampling
- Appendix III Constituents and Indicator Parameters
- Statistically Significant Downgradient Increase of TOC Concentrations
- Potential Release Activated Assessment Monitoring

Assessment Monitoring

- Groundwater Assessment Monitoring Plan (1991)
- First Determination False Positive (1991 - 1992)
- Phase I Assessment Monitoring (1992 - 1994)

LTM to Support Closure

- Long-term Groundwater Monitoring Plan (April 1995)
- 10 Well Monitoring Network
- Sampling of Network for Metals and Organochlorine Pesticides
- LTM Will Continue 30 Years Following Closure

1995 LTM Program

- Sampling Conducted in October and November 1995
- Report Submitted to NMED in March 1996
- No Analytes Detected Above Risk-Based Trigger Criteria
- Recommendation: LTM Continue; Next Sampling Scheduled for Fall 1996

Investigation Results

3 April 1996

Scope of Investigations

- Investigations Performed at Sewage Lagoons from 1981 to 1995
- Extensive Sampling and Analysis from 1988 to 1994
- Total Number of Locations at Ponds A Through G at Which Samples Have Been Collected and Analyzed Since 1990
  - Surface Water: 49
  - Sludge: 166
  - Soil: 54

Scope of Investigations

- Initial Focus on Appendix IX Constituents
  - Volatile organics; semivolatile organics; metals; organochlorine pesticides, and PCBs
- 1988 Investigation and 1990 Sludge Removal at Ponds A and B
- Later Focus on Organochlorine Pesticides and Metals
- Volatile Organics Were Initial Constituents of Potential Concern, but Detected Only at Very Low Concentrations

Sludge Results

- Low Concentrations of Organochlorine Pesticides and Metals
- Levels of Organochlorine Pesticides (e.g., DDD and DDE) Decreasing
- Metals Concentrations Below Standards for Land Applied Sludge
- Not Hazardous (by Toxicity Characteristic) for Metals

Soil and Surface Water Results

- Soil Concentrations are an Order of Magnitude Lower than Sludge Concentrations
- Metals Concentrations in Soil are Generally Below Background Levels
- Surface Water Concentrations Nearly Meet Drinking Water Standards (for Comparison Purposes)

Risk Assessment

Methodology

- Human Health Risk Assessment
  - Traditional RAGS
  - Updated using risk ratio method
- Ecological Risk Assessment
  - Ecological hazard quotient
  - Modeled
  - Body burden

Human Health Assessment

- Average Exposure Scenarios Below Acceptable Risk Range for All Sewage Lagoons
- Reasonable Maximum Exposure Scenarios Below or at the 10^{-6} Risk Range

Human Health Assessment

	Average	Reasonable Maximum
Ponds A & B		
Cancer Risk	<1 E-6	2 E-6
Hazard Index	<1	<1
Ponds C, D, E, & F		
Cancer Risk	<1 E-6	< 1 E-6
Hazard Index	<1	<1
Pond G		
Cancer Risk	<1 E-6	6 E-6
Hazard Index	<1	<1

Ecological Samples

- Algae/Benthos/Nekton
- Gambusia (Mosquito Fish)
- Insects/Invertebrates
- Widgon Grass
- Salamanders
- Black-Necked Stilts
- Duck
- Surface Water
- Sediment Sludge

Ecological Trophic Levels and Assessment Endpoint Species

- Lower Trophic (Primary Producers)
  - Benthic
- Primary Consumer
  - Killdeer and Black-Necked Stilts
  - Mosquito Fish
  - Mallards
- Secondary Consumer
  - Merganser

Ecological Assessment Results

- Ecological Risk Evaluated in Pond G, the Ditch, Lake Holloman, and Lake Stinky
  - Ponds A-F will be closed and no longer a suitable habitat for aquatic ecosystem
- No Adverse Ecological Effects Observed for Modeled Risks at Pond G
  - Killdeer
  - Mallard
  - Merganser

Ecological Assessment Results (cont'd)

- Ecological Quotients Between One and Eight for Ecological Risks Derived from Body Burden Data at Pond G
  - 4, 4'- DDE: Black-necked Stilt, Mallard, and Mosquito Fish
  - 4, 4' - DDD: Mosquito Fish

Conclusions

- No Significant Risks to Human Health
- Unlikely that Assessment Endpoint Ecological Species are Threatened
  - DDD, DDE, and DDT concentrations decreasing in media
  - No population decreases have been observed at the site

Corrective Measures Study

3 April 1996

Overview

- Purpose and Scope
- Regulatory Drivers
- CMS Workplan
- CMS Scope of Work
- Other Considerations

Purpose and Scope

- Identify and evaluate potential remedial alternatives for the releases that have been identified at a facility
- Scope
  - CMS Workplan
  - CMS Report

Regulatory Drivers

- Risk-Based Closure by Site Specific Demonstration
- Land Disposal Restrictions
- Integration of CERCLA and RCRA

CMS Workplan

- Outlines CMS objectives, specifies plans for evaluating alternatives, and provides a schedule for conducting the CMS
- Preliminary Outline Will Follow RCRA Guidance
- Incorporate today's input

CMS Scope of Work

- Solution-Oriented Process
  - Creative
  - Cost-effective solution
  - Communication
- CMS Tasks
  - Identification of alternatives
  - Evaluation of alternatives
  - Justification and recommendation of selected alternative
  - Reporting

CMS Scope of Work (cont'd)

- Identification of Alternatives
  - Description of current situation
  - Establish corrective action objectives
  - Screening of corrective measure technologies
  - Identification of corrective measure alternatives
- Evaluation of Alternatives
  - Technical
  - Environmental
  - Human Health
  - Institutional
  - Cost

Sewage Lagoons Closure Project

CMS Scope of Work (cont'd)

- Justification and Recommendation of Selected Alternative
  - Technical
  - Environmental
  - Human Health
  - Institutional
  - Cost
  - Conceptual remedial design
- Reports
  - Progress reports
  - Draft report
  - Final report

The Streamlined Approach

- Initiatives to Expedite Remediation
  - Superfund accelerated cleanup model (SACM)
  - Presumptive remedies
  - Flexible work plans
  - Phased cleanup efforts
  - Focused cleanup efforts
- Focus CMS
- Holloman AFB proposes a focused CMS

Key Considerations

- Schedule
- Diversion of Water to Pond G and Lake Holloman
- Changing Physical Characteristics of Sludge
- Keeping Pond G Open

Closure Alternative Selection Document for the Stakeholders Closure Meeting

Sewage Lagoons Closure Project Holloman AFB, New Mexico

3 April 1996

CLOSURE ALTERNATIVE SELECTION DOCUMENT
SEWAGE LAGOONS CLOSURE PROJECT, HOLLOMAN AFB

This document contains modules that will aid in the selection of a closure alternative for the Holloman AFB Sewage Lagoons Closure Project. All of the modules have been based on the information provided in the site summary document and the site overview presentations. As you probably are aware, the process for selection of a closure alternative for the sewage lagoons is currently underway. Therefore, the purpose of these modules is to provide a format to voice your comments and questions pertaining to the closure of the sewage lagoons. **No final decisions will be made today. Instead, any opinions voiced, or consensuses reached, will be used to guide the corrective measures study. These modules are intended to accelerate the selection process by allowing Holloman AFB to fully understand the opinions and concerns of the major stakeholders prior to selecting a final closure alternative, and are not intended to be used to select an alternative today.** The Sewage Lagoons Closure Project is not a typical closure project and a large volume of information exists about the sewage lagoons. Therefore, if at any time you have questions, or are unclear about a topic, please do not hesitate to ask for clarification.

LIST OF MODULES

Module 1: Assessing Land Uses of the Sewage Lagoons 1

Module 2: Identifying Human Receptors 2

Module 3: Identifying Ecological Receptors and Sensitive Environments 6

Module 4: Identifying Closure Objectives 9

Module 5: Evaluation of the No Action Alternative 11

Module 6: Evaluation of Holloman's Proposed Closure Alternative 12

Module 7: Evaluation of Other Proposed Closure Alternatives 13

Module 8: Evaluation of a Final Closure Alternative 14

Module 9: Evaluation of a Closure Schedule and Milestones 17

MODULE 1: ASSESSING LAND USES OF THE SEWAGE LAGOONS

Objective: The objective of this module is to discuss the current and future land-use designations for the sewage lagoons and the land immediately surrounding the sewage lagoons. This objective will be achieved by presenting Holloman AFB's intended land-use scenarios and the factors that led to these designations. We will then discuss these current and future land-use designations.

Questions:

In this module, Ponds A through F have been grouped together, due to the common land uses for these sewage lagoons. Pond G is presented separately.

1. Current Land Use

   The Base Comprehensive Plan for Holloman AFB designates the current land use for Ponds A through F and the land immediately adjacent to the sewage lagoons as industrial. Pond G and its immediately adjacent land are classified as open space (see Figure 1-1).

   Do you have any comments/questions regarding these current land-use designations?

2. Future Land Use

   After closure of the sewage lagoons has occurred, Holloman AFB foresees Ponds A through F, Pond G, and all immediately adjacent land being classified as open space (see Figure 1-2).

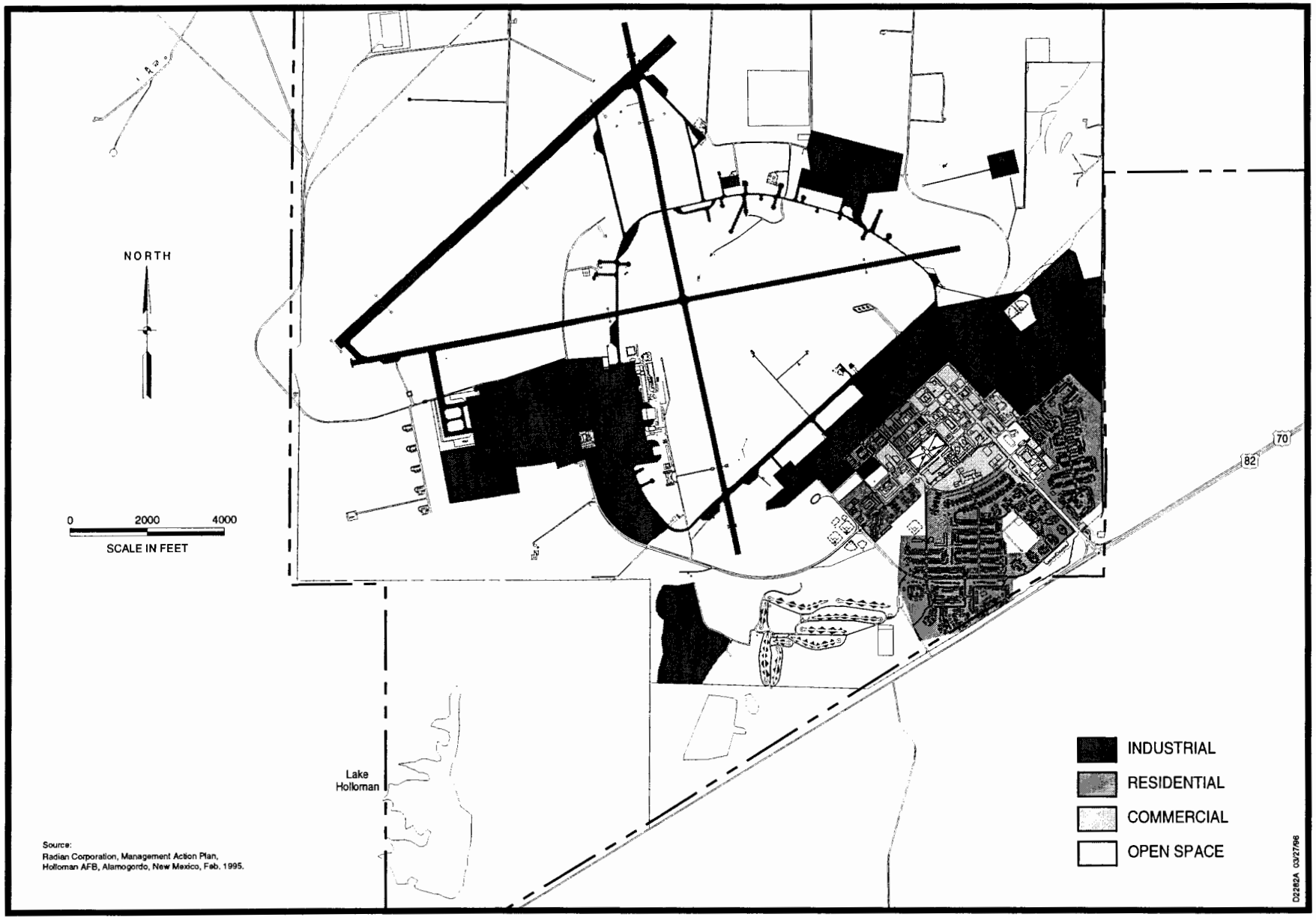
   The factors affecting this land-use designation include:

   - The sewage lagoons are within the runway clear zone;
   - Pond G is within the Lake Holloman flood plain;
   - The area is surrounded by wetlands;
   - The TDS concentrations of the underlying groundwater; and
   - The area provides poor soils for construction.

   Do you have any comments/questions regarding this future land-use designation?

STOP: Has the group answered all questions in Module 1? If not, please go back and answer them now. If this module has been completed and the group's comments and/or questions have been addressed or recorded continue to Module 2.

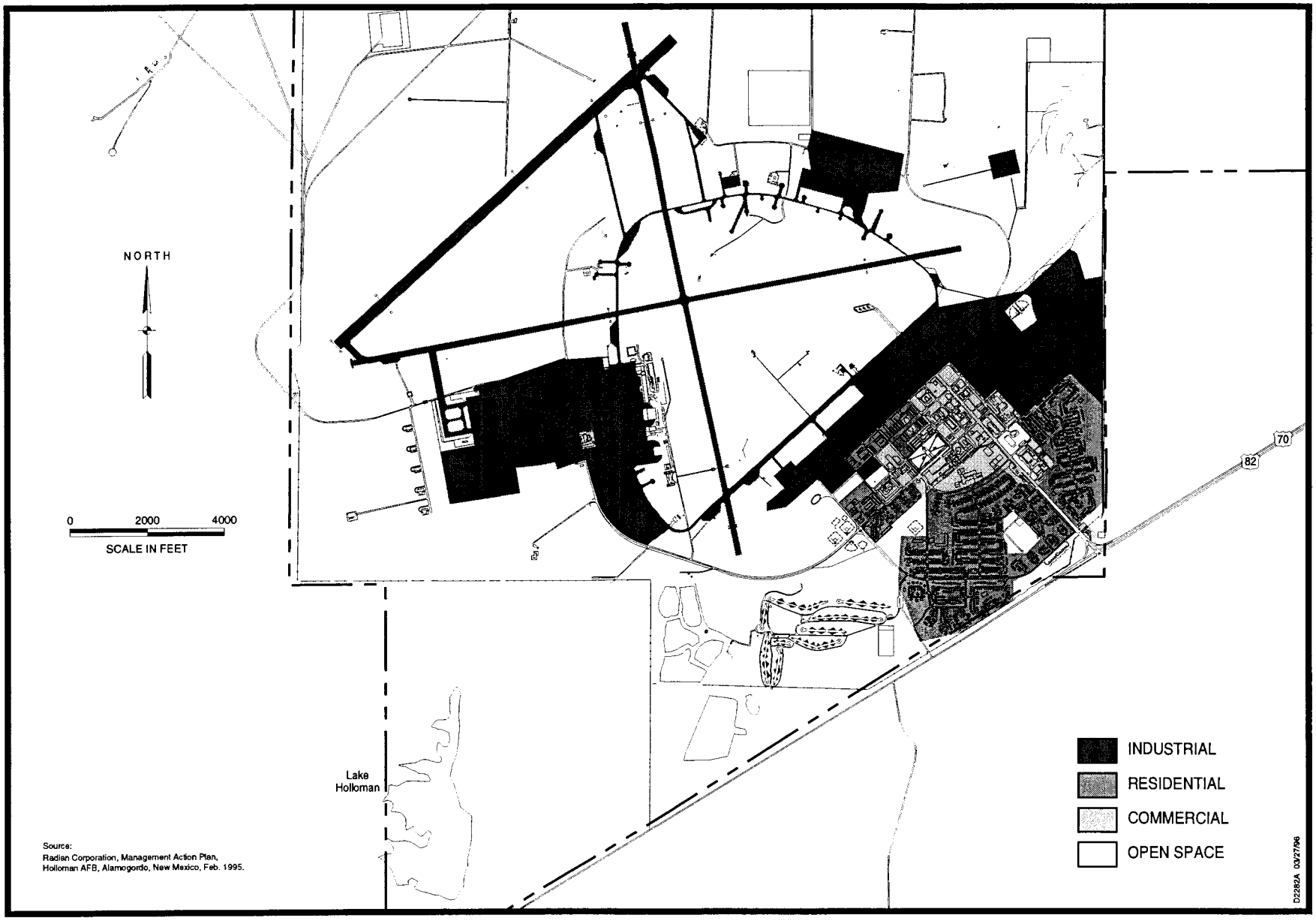
STOP



Source:
Radian Corporation, Management Action Plan,
Holloman AFB, Alamogordo, New Mexico, Feb. 1995.

Figure 1-1. Current Land Use Map, Main Base Area, Holloman AFB

Continue



Source:
Radian Corporation, Management Action Plan,
Holloman AFB, Alamogordo, New Mexico, Feb. 1995.

Figure 1-2. Future Land Use Map, Main Base Area, Holloman AFB

Continue

MODULE 2: IDENTIFYING HUMAN RECEPTORS

Objective: The objective of this module is to discuss the potential human health risks that may be posed by the Holloman AFB sewage lagoons. This objective will be accomplished by reviewing the results of the 1996 risk assessment addendum. This review will be based upon the earlier presentations and the information provided in the site summary document. During this module, you will be asked to voice your comments regarding the potential human health risks associated with the sewage lagoons. It should be mentioned that this module will not substitute for the official review of the *Draft Final Risk Assessment Addendum* (Radian and Foster Wheeler, 1996); however, this discussion will help expedite the corrective measures study (CMS) process by integrating your concerns at this time.

Questions:

1. Evaluated Human Exposure Scenarios

   Exposure scenarios evaluated for human health are presented in Figure 2-1.

   Do you have any comments/questions regarding the exposure scenarios that were evaluated during the risk assessment addendum?

   Do you agree that these exposure scenarios adequately represent a range of realistic exposure scenarios associated with the sewage lagoons?

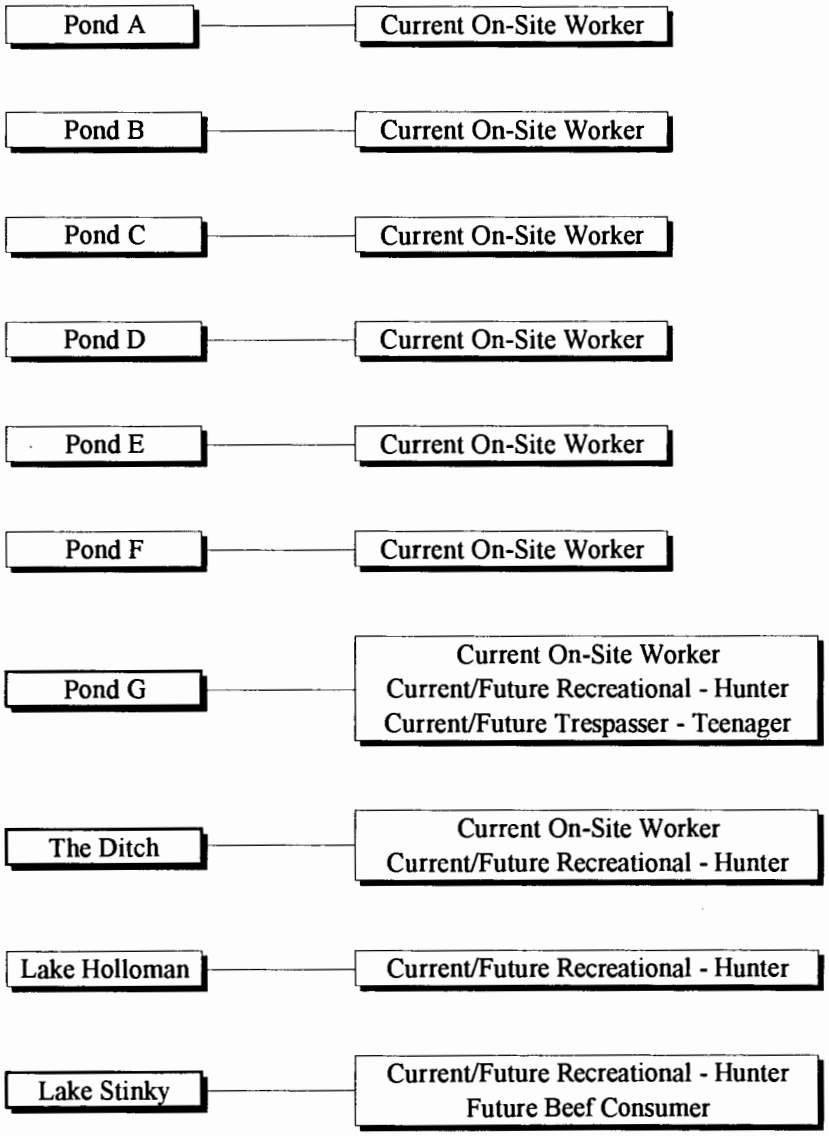
2. Risk Assessment Addendum Results and Conclusions

   Table 2-1 presents the results of the human health risk assessment addendum. Holloman AFB has concluded from these results that no unacceptable risks to human health are associated with the sewage lagoons.

   Do you have any comments/questions regarding these results and conclusions?

   Based on these results, do you agree that no unacceptable human health risks are associated with the sewage lagoons?

Continue ☞



Current On-Site Worker
(chronic & subchronic)
- Dermal Contact with Soil
- Dermal Contact with Sludge/Sediment
- Dermal Contact with Surface Water

Current/Future Recreational - Hunter
(chronic & subchronic)

Adults
- Dermal Contact with Soil
- Dermal Contact with Sludge/Sediment
- Dermal Contact with Surface Water
- Ingestion of Surface Water
- Ingestion of Waterfowl
- Inhalation of Fugitive Dust

Children
- Ingestion of Waterfowl

Current/Future Trespasser - Teenager
(subchronic)
- Ingestion of Surface Water
- Dermal Contact with Soil
- Dermal Contact with Sludge/Sediment
- Dermal Contact with Surface Water

Future Beef Consumer
(chronic)

Adults & Children
- Ingestion of Beef

Figure 2-1. Exposure Scenarios for Evaluating Human Health, Holloman AFB

Continue ☞

Site	Human Health Risk Estimates				
	Noncancer Hazard		Cancer Risk		Exposure Scenario Associated with Health Risks
	AVG	RM	AVG	RM	
Pond A	< 1	< 1	< 1E-6	2E-6*	Cancer risk estimates are based entirely on dermal contact with Aroclor-1254, in sludge, for the Current Onsite Worker Reasonable Maximum Scenario.
Pond B	< 1	< 1	< 1E-6	2E-6*	Cancer risk estimates are based entirely on dermal contact with sludge for the Reasonable Maximum Current On-site Worker Scenario. Aroclor-1254 contributes 76% to the overall risk estimate, with 4,4'-DDE, benzo[a]pyrene, and chlordane accounting for 19% of this estimate.
Pond C	< 1	< 1	< 1E-6	< 1E-6	NA
Pond D	< 1	< 1	< 1E-6	< 1E-6	NA
Pond E	< 1	< 1	< 1E-6	< 1E-6	NA
Pond F	< 1	< 1	< 1E-6	< 1E-6	NA
Pond G The Ditch Lake Holloman Lake Stinky	< 1	< 1	< 1E-6	6E-6*	Cancer risk estimates are based entirely on the ingestion of waterfowl hunted at these sites in the Adult Recreational Scenario. PCBs (36%), 4,4'-DDE (23%), oxychlordane (18%), dieldrin (15%), gamma-Chlordane (4%), and 4,4'-DDD (3%) account for this estimate.

*The accumulative risk for this scenario is between 1E-04 and 1E-06.
AVG = Average Exposure Case
RM = Reasonable Maximum Exposure Case

Table 2-1. Summary of Human Health Risk Assessment Results, Holloman AFB

Continue

3. Groundwater

Based on complete delineation of the nature and extent of groundwater contamination associated with the sewage lagoons, Holloman AFB has prepared the *Draft Final Long-Term Monitoring Plan* (Radian, 1995). The plan provides for monitoring and reporting of groundwater associated with the sewage lagoons for the 30 years following closure. Monitoring will be performed for the constituents (metals and organochlorine pesticides) that were determined to be present in the groundwater during assessment monitoring, and present in the sludge during past investigations. Holloman AFB will use risk-based trigger criteria to determine if further groundwater investigations are necessary.

Do you have any comments/questions regarding this strategy for addressing groundwater associated with the sewage lagoons?

4. Surface Water

Holloman AFB intends to shut off the influent to Ponds A through F after the new waste-water treatment plant (WWTP) is operational. Water from Ponds A through F will be allowed to drain and evaporate naturally; however, if water is disposed of it will be in accordance with applicable regulations. Treated wastewater from the new WWTP will be drained to Lake Holloman or will be pumped to Pond G via a NPDES-permitted outfall. Pond G will remain open and will be regulated under the Clean Water Act. Given that water will no longer exist in Ponds A through F, Holloman AFB does not believe any surface water will require remediation.

Do you have any comments/questions regarding this strategy to address surface water during closure?

STOP: Has the group answered all questions in Module 2? If not, please go back and answer them now. If this module has been completed and the group's comments and/or questions have been addressed or recorded continue to Module 3.

STOP

MODULE 3: IDENTIFYING ECOLOGICAL RECEPTORS AND SENSITIVE ENVIRONMENTS

Objective: The objective of this module is to discuss the potential ecological risks that result from the Holloman AFB sewage lagoons. This objective will be accomplished by reviewing the methodology and the results of the 1996 ecological risk assessment. This review will be based upon the earlier presentations and the information provided in the site summary document. During the discussion of this module, you will be asked to voice your comments regarding the ecological risk assessment. It should be mentioned that this module will not substitute for the official review of the ecological risk assessment that is presented in the *Draft Final Risk Assessment Addendum* (Radian and Foster Wheeler, 1996); however, this discussion will help expedite the CMS process by integrating your concerns at this time. **Since the closure project is limited to the sewage lagoons, this module will not address Lake Holloman, Lake Stinky, or the ditch**.

Questions:

1. Ecological Risk Assessment

Ponds A through F were not evaluated in the ecological risk assessment because they are planned to be closed and will not serve as a habitat for aquatic wildlife. An ecological risk assessment was performed for Pond G.

Do you have any comment/questions regarding this assessment strategy?

2. Ecological Risk Assessment Results

The results for the ecological risk assessment indicate that DDD and DDE, which are breakdown products of DDT, were the only constituents found to have the potential to cause adverse effects in Pond G. DDT is no longer used at the Base. Investigation results also indicate that concentrations of DDT in the sewage lagoons decreased by an order of magnitude between 1992 and 1994, as documented in the *Site Characterization Report* (Radian and Foster Wheeler, 1995). In addition, no physical adverse effects have been observed in the fish and/or waterfowl that use Pond G. Based on these results, Holloman AFB has concluded that no unacceptable ecological risks are associated with Pond G.

Do you have any comments/questions regarding these results?

Do you have any comments/questions on Holloman AFB's conclusions regarding the ecological risks associated with the sewage lagoons?

Continue ☞

3. Sensitive Environments and Special Interest Species

Holloman AFB will address sensitive environments and special interest species (threatened and endangered) in the Biological Resources Report. This report will be completed after closure alternatives have been identified, then the impacts of each alternative can be assessed. To date Holloman AFB has assessed that the loss of Ponds A through F will not constitute the loss of a critical habitat. However, Pond G provides a critical habitat to some of the bird species and also supports associated wetlands. Closure of Pond G could have adverse effects to these species.

Do you have any comments/questions regarding the sensitive environments and special interest species associated with the sewage lagoons?

4. Constructed Wetlands

Holloman AFB intends to construct 120 acres of wetlands adjacent to the sewage lagoons. The wetlands will provide holding capacity for storm water and treated effluent from the new WWTP to prevent flooding of highway 70 and lands south of highway 70 during cool, wet years. The new wetlands will consist of 15 acres of restored jurisdictional wetlands and 105 acres of new wetlands. These wetlands are expected to enhance wildlife habitats and restore existing wetlands.

Do you have any comments/questions regarding these new wetlands?

STOP: Has the group answered all questions in Module 3? If not, please go back and answer them now. If this module has been completed and the group's comments and/or questions have been addressed or recorded, continue to Module 4.

STOP

MODULE 4: IDENTIFYING CLOSURE OBJECTIVES

Objective: The objective of this module is to discuss closure objectives and closure alternative evaluation criteria for the closure of the sewage lagoons. This objective will be accomplished by presenting and discussing Holloman AFB's proposed closure objectives and the applicable alternative evaluation criteria. During this module, you will be asked to voice your comments regarding these topics or any other comments you may have regarding closure objectives and approach. We will be using the discussion from this module to help evaluate proposed closure alternatives in subsequent modules.

Questions:

1. Closure Objectives

Holloman AFB intends to use a risk-based approach to close Ponds A through F and Pond G. The objectives that Holloman AFB proposes for closure include the following:

- Ensure the protection of human health and the environment at the sewage lagoons after closure;
- Provide an adequate habitat for the wildlife associated with the sewage lagoons; and
- Ensure that closure is aesthetically suitable and eliminates odors and disease vectors (mosquito habitats) that may be associated with the sewage lagoons.

Do you have any comments/questions regarding these closure objectives?

Would you eliminate any of these objectives?

Would you add any additional objectives?

Continue ☞

2. Evaluation Criteria

Holloman AFB intends to use the four RCRA remedy selection standards for a CMS to evaluate proposed closure alternatives:

- Is the alternative protective of human health and the environment?
- Does the alternative control or eliminate the source of contamination?
- Does the alternative comply with applicable waste management standards?
- Does the alternative attain site-specific risk-based media cleanup objectives?

Do you have any comments/questions regarding these evaluation criteria?

Would you eliminate any of these criteria?

Would you add any criteria?

STOP: Has the group answered all questions in Module 4? If not, please go back and answer them now. If this module has been completed and the group's comments and /or questions have been addressed or recorded, continue to Module 5.

STOP

MODULE 5: EVALUATION OF NO ACTION ALTERNATIVE

Objective: The objective of this module is to discuss the no action alternative for the sewage lagoons. This objective will be accomplished by presenting and discussing the no action alternative with regards to the discussion in Module 4 (i.e., the alternative will be compared with regards to the closure objectives and the evaluation criteria previously discussed). The no action alternative is being discussed as a baseline against which to compare other alternatives.

Questions:

The no action alternative consists of shutting off the influent to Ponds A through F after the new WWTP is operational. Effluent from the new WWTP will be discharged to Pond G and the new wetlands via a NPDES-permitted outfall. Ponds A through F will be left to drain and evaporate naturally. No development will be allowed in the area. Groundwater will be monitored for 30 years according to the long-term monitoring (LTM) plan.

1. Closure Objectives

   Holloman AFB believes this alternative meets the first and second, but not the third, closure objectives listed below (discussed in Module 4).

   - Ensures the protection of human health and the environment at the sewage lagoons after closure;
   - Provides an adequate habitat for the wildlife associated with the sewage lagoons; and
   - Ensures that closure is aesthetically suitable and eliminates odors and disease vectors (mosquito habitats) that may be associated with the sewage lagoons.

   Do you have comments/questions regarding this statement?

Continue ☞

2. Evaluation Criteria

Holloman AFB believes this alternative meets the evaluation criteria listed below (discussed in Module 4).

- Is protective of human health and the environment;
- Controls or eliminates the source of contamination;
- Complies with applicable waste management standards; and
- Attains site-specific risk-based media cleanup objectives.

Do you have comments/questions regarding this statement?

Without losing the essence of the alternative (i.e., no action), are there modifications that you would make to this alternative?

STOP: Has the group answered all questions in Module 5? If not, please go back and answer them now. If this module has been completed and the group's comments and/or questions have been addressed or recorded, continue on to Module 6.

STOP

MODULE 6: EVALUATION OF HOLLOMAN'S PROPOSED CLOSURE ALTERNATIVE

Objective: The objective of this module is to discuss Holloman AFB's proposed alternative for the sewage lagoons. This objective will be accomplished by presenting and discussing the alternative with regards to the discussion in Module 4 (i.e., the alternative will be compared with regards to the closure objectives and the evaluation criteria previously discussed).

Questions:

Holloman AFB's proposed alternative consists of shutting off the influent to Ponds A through F after the new WWTP is operational. Effluent from the new plant will be discharged to Pond G and the new wetlands via a NPDES-permitted outfall. Ponds A through F will be drained. Sludges in the impoundments will be covered to eliminate exposure, and maintained through contouring and vegetation. Pond G will be left open to receive treated wastewater and support area wildlife. No development will be allowed in the area. Groundwater will be monitored according to the *LTM Plan.*

1. Closure Objectives

   Holloman believes this alternative:

   - Ensures the protection of human health and the environment at the sewage lagoons after closure;
   - Provides an adequate habitat for the wildlife associated with the sewage lagoons; and
   - Ensures that closure is aesthetically suitable and eliminates odors and disease vectors (mosquito habitats) that may be associated with the sewage lagoons.

   Do you have any comments/questions regarding this statement?

Continue ☞

2. Evaluation Criteria

Holloman believes this alternative:

- Is protective of human health and the environment;
- Controls or eliminates the source of contamination;
- Complies with applicable waste management standards; and
- Attains site-specific risk-based media cleanup objectives.

Do you have comments/questions regarding this statement?

3. Process Options

Holloman AFB is considering a variety of sludge management options to most cost effectively close the impoundments. The process options range from covering the sludge in place in each Pond to consolidating the sludge in a subset of Ponds. In both cases, the sludge will be covered with soil and the cover will be maintained through contouring and vegetation.

If the CMS determines it is most favorable to leave the sludge in place in each Pond and cover with soil, do you have any comments/questions regarding this process option?

If the CMS determines it is most favorable to consolidate the sludge in a subset of Ponds and cover with soil, do you have any comments/questions regarding this process option?

STOP: Has the group answered all questions in Module 6? If not, please go back and answer them now. If this module has been completed and the group's comments and/or questions have been addressed or recorded, continue to Module 7.

STOP

MODULE 7: EVALUATION OF OTHER PROPOSED CLOSURE ALTERNATIVES

Objective: The objective of this module is to discuss and evaluate other proposed alternatives. This objective will be accomplished by proposing other alternatives, and then discussing these alternatives with regards to the discussion in Module 4 (i.e., the alternatives will be compared with the closure objectives and the evaluation criteria previously discussed).

Questions:

1. Other Proposed Alternatives

Based on the information presented today and your knowledge regarding the sewage lagoons and closure activities, are there any other closure alternatives that you would like to propose?

Alternative # 3 _____
Alternative # 4 _____
Alternative # 5 _____

2. Closure Objectives

Do these alternatives meet the closure objectives listed below (discussed in Module 4)?

- Ensure the protection of human health and the environment at the sewage lagoons after closure;
- Provide an adequate habitat for the wildlife associated with the sewage lagoons; and
- Ensure that closure is aesthetically suitable and eliminates odors and disease vectors (mosquito habitats) that may be associated with the sewage lagoons.

Continue ☞

3. Evaluation Criteria

Do these alternatives meet the evaluation criteria listed below (discussed in Module 4)?

- Is the alternative protective of human health and the environment?
- Does the alternative control or eliminate the source of contamination?
- Does the alternative comply with applicable waste management standards?
- Does the alternative attain site-specific risk-based media cleanup objectives?

STOP: Has the group answered all questions in Module 7? If not, please go back and answer them now. If this module has been completed and the group's comments and/or questions have been addressed or recorded, continue to Module 8.

STOP

MODULE 8: EVALUATION OF A FINAL CLOSURE ALTERNATIVE

Objective: The objective of this alternative is to select a closure alternative from the proposed alternatives. The objective will be accomplished by comparing all of the alternatives that were consistent with the closure objectives and evaluation criteria with the five remedy selection decision factors that are proposed by Holloman AFB. These decision factors will provide the basis for comparison between the alternatives.

Questions:

1. Remedy Selection Decision Factors

The five RCRA remedy selection decision factors are:

- Long term reliability and effectiveness;
- Reduction in toxicity, mobility, or volume;
- Short-term effectiveness;
- Administrative and technical implementation; and
- Cost.

Do you have any comment/questions regarding the RCRA remedy selection decision factors?

Would you eliminate any of these factors?

Would you add any factors?

Regarding *effectiveness and reliability in the long term*, classify each alternative as excellent, good, fair, or poor, and provide a reason for your decision.

No action alternative:_____, because _____
Proposed alterative: _____, because _____
Alternative # 3: _____, because _____
Alternative # 4: _____, because _____
Alternative # 5: _____, because _____

Continue ☞

Regarding *reduction in toxicity, mobility, or volume*, classify each alternative as excellent, good, fair, or poor, and provide a reason for your decision.

No action alternative:_____, because _____
Proposed alterative: _____, because _____
Alternative # 3: _____, because _____
Alternative # 4: _____, because _____
Alternative # 5: _____, because _____

Regarding *short-term effectiveness*, classify each alternative as excellent, good, fair, or poor, and provide a reason for your decision.

No action alternative:_____, because _____
Proposed alterative: _____, because _____
Alternative # 3: _____, because _____
Alternative # 4: _____, because _____
Alternative # 5: _____, because _____

Regarding *administrative and technical implementation*, classify each alternative as excellent, good, fair, or poor, and provide a reason for your decision.

No action alternative:_____, because _____
Proposed alterative: _____, because _____
Alternative # 3: _____, because _____
Alternative # 4: _____, because _____
Alternative # 5: _____, because _____

Regarding *costs*, classify each alternative as excellent, good, fair, or poor, and provide a reason for your decision.

No action alternative:_____, because _____
Proposed alterative: _____, because _____
Alternative # 3: _____, because _____
Alternative # 4: _____, because _____
Alternative # 5: _____, because _____

2. Alternative Selection

Using the scoring values associated with each ranking category (Poor=1, Fair=2, Good=3, and Excellent=4), calculate a score for each of the alternatives

Continue ☞

	Long-Term Reliability	Reduction in T/M/V	Short-Term Effectiveness	Implementability	Cost	Total Score
No action						
Proposed						
Alternative #3						
Alternative #4						
Alternative #5						

Based on your evaluation of the closure alternatives and the selection decision factors, which is the preferred alternative?

- ☐ No action alternative
- ☐ Holloman's proposed alternative
- ☐ Alternative #3
- ☐ Alternative #4
- ☐ Alternative #5
- ☐ None of the above
- ☐ Other:_____(Specify)

What were the factors that led you to select this option or propose a modified alternative?

_____
_____
_____
_____
_____
_____
_____
_____
_____

STOP: Has the group answered all questions in Module 8? If not, please go back and answer them now. If this module has been completed and the group's comments and/or questions have been addressed or recorded, continue to Module 9.

STOP

MODULE 9: EVALUATION OF A CLOSURE SCHEDULE AND MILESTONES

Objective: The objective of this module is to discuss the schedule and milestones involved with implementing the selected alternative. This objective will be accomplished by reviewing the timeline involved with the new WWTP, the regulatory requirements, and the engineering requirements involved with implementing the selected alternative. This module will serve as the basis for developing the remaining activities in the closure process.

Questions:

1. The new WWTP

   The new WWTP will be operational in summer 1996. In conjunction with the start up of the new WWTP, Ponds A through F will no longer receive influent.

   How do you foresee the new WWTP's schedule affecting the closure of the sewage lagoons?

2. Regulatory Requirements

   What do you foresee as being the major regulatory requirements between now and final closure?

3. Engineering Requirements

   What do you foresee as being the major engineering requirements involved with implementing the selected alternative?

4. Schedule and milestones

   Is there a regulation-based date by which the sewage lagoons have to be closed?

   What is the desired date by which the sewage lagoons are to be closed?

Continue ☞

What are the milestones leading up to this date?

Are there any foreseeable barriers to reaching this desired closure date?

What are the next major action items to be accomplished?

STOP: Has the group answered all questions in Module 9? If not, please go back and answer them now. If you have completed this exercise and recorded the group's comments/questions, you have finished the modules. Thanks for your cooperation in helping Holloman AFB with the closure of the sewage lagoons.

STOP