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TES IV WORK ASSIGNMENT #419
RCRA FACILITY ASSESSMENT
PRELIMINARY REVIEW REPORT

KERR-MCGEE CHEMICAL CORPORATION

JE JACOBS ENGINEERING GROUP INC.
ENVIRONMENTAL SYSTEMS DIVISION

IN ASSOCIATION WITH:
TETRA TECH
METCALF & EDDY
ICAIR LIFE SYSTEMS
KELLOGG CORPORATION
GEO/RESOURCE CONSULTANTS
BATTELLE PACIFIC NORTHWEST LABORATORIES
DEVELOPMENT PLANNING AND RESEARCH ASSOCIATES

ENVIRONMENTAL PROTECTION AGENCY
TECHNICAL ENFORCEMENT SUPPORT
AT HAZARDOUS WASTE SITES

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NVD 008290330

JACOBS ENGINEERING GROUP INC.
PROJECT NUMBER 05-B419-00

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EXECUTIVE SUMMARY

This Preliminary Investigation report focuses on the Kerr-McGee Chemical Corporation (KMCC) facility located in Henderson, Nevada. KMCC is one of many industrial companies which are housed in the Business Management Inc. (BMI) complex. Industrial operations began at the BMI site in the early 1940's. Two other companies had earlier occupied the KMCC property, and eventually merged into business with them. These other companies manufactured the same inorganic products that KMCC currently produces. These products consist of perchlorates, manganese dioxide, sodium chlorate and boron chemicals. The boron chemicals have been produced only since KMCC took over in 1967.

Throughout the forty years of chemical production, several methods of disposal have been employed. Unlined ponds operated by BMI were used for waste disposal, as were unlined ponds on KMCC property. KMCC stopped using the BMI ponds in the mid-70's when nine lined ponds, on their property, were constructed to accommodate the wastes. A landfill was also used for solid waste. Currently seven ponds exist; two of the ponds have been closed under the direction of the Nevada Department of Environmental Protection (NDEP). The hazardous waste landfill, containing chromium-laden wastes, has been closed and is currently under a post-closure program.

Basements of the sodium chlorate process buildings were used as sumps for many years, until it was discovered that they were the source of the chromium contamination in the groundwater. KMCC is currently undergoing corrective measures to clean up the contaminated groundwater.

Recommendations for the visual site inspection (VSI) are provided to ensure a complete environmental impact assessment of the past and present operations at KMCC. The VSI should include an additional document review to maintain a more complete disposal history and a facility inspection to determine the structural integrity of the solid waste management units.

SECTION 1.0
INTRODUCTION

1.1 PURPOSE OF THE PRELIMINARY REVIEW

The preliminary review (PR) is part of the RCRA Facility Assessment (RFA), the first step in implementing the corrective action requirements specified by the 1984 Resource Conservation and Recovery Act (RCRA) Hazardous and Solid Waste Amendments (HSWA). In these amendments, Sections 3004(u), 3004(v) and 3008(h) require corrective actions for releases of hazardous waste or constituents from any solid waste management unit (SWMU) at RCRA-regulated facilities. The assessments are the means by which releases from hazardous and solid waste management units are identified and documented. RFA results are then used in developing corrective actions at the facilities, if necessary.

The RFA consists of a PR and a Visual Site Inspection (VSI). During the PR, available information about the subject facility is reviewed, data gaps and potential problems are identified for special focus in the following VSI. Depending on the findings during the PR and VSI, further corrective action may be recommended such as sampling, site investigation, remedial investigation and remedial actions.

1.2 SCOPE OF THE PR

The PR focuses on the Kerr-McGee Chemical Corporation (KMCC) facility near Henderson, Nevada. Past records confirming plant operations, the history of solid waste management units, waste disposal history and practices and regulatory compliance were reviewed and evaluated for presentation in this report. Primary sources of information used in this PR were obtained from the Environmental Protection Agency (EPA) Region IX, and the State of Nevada Department of Conservation and Natural Resources, Division of Environmental Protection (NDEP). The reviewed documents included the facility's RCRA Part A and Part B applications, the KMCC SWMU response letter (September 29, 1986), various geologic and hydrogeologic reports, and miscellaneous correspondence between KMCC, EPA and NDEP.

1.3 ORGANIZATION OF THE PR

A general description of the operations and disposal practices of the Kerr-McGee Chemical facility is presented in Section 2.0. The environmental setting is described in Section 3.0. Sections 4.0 through 7.0 presents the various SWMU's over the history of KMCC. Each discussion of the SWMU's addresses their general use, documented releases of hazardous constituents, monitoring programs, and the potential of future releases to the soil water and atmosphere. Section 4.0 describes the various surface impoundments used for storage and disposal at the facility, Section 5.0 addressess the dump sites and drainage channels observed from a history of aerial photographs and spills. Section 6.0 discusses the hazardous waste landfill and waste piles. Section 7.0 presents information about the sumps. Section 8.0 provides recommendations and conclusions for the VSI. Section 9.0 list the references used in preparing this report.

SECTION 2.0
FACILITY DESCRIPTION

2.1 GENERAL INFORMATION

KMCC operates an inorganic chemical production plant at the BMI industrial complex in Henderson, Nevada. The BMI complex was originally owned by the United States government which produced manganese metal at the facility. A portion of the BMI complex, currently owned by KMCC, was taken over by Western Electrochemical Co. in 1945. Western Electrochemical merged into American Potash and Chemical Corp. (APCC), which took over the facility in 1955. APCC merged into KMCC, which gained control of plant operations in 1967. Since the beginning of operations at this site, essentially the same inorganic products have been produced. The only documented change in chemical production came in the early 1970's, when KMCC initiated the production of boron compounds.

Over the years, wastes generated at KMCC were disposed at various locations throughout the complex. Solid wastes were disposed of at the BMI dump, located northwest of the facility, until the dump closed in early 1980. Solid wastes were also disposed on KMCC property. Prior to 1976, liquid waste streams and slurried solid wastes from the facility were discharged to the unlined BMI ponds located across Boulder Highway and northeast of the production area. In the mid-1970's lined ponds were constructed on the KMCC property to accommodate liquid waste for both evaporation and recycle streams.

KMCC submitted a Part A application to Region IX EPA for various storage, treatment and disposal units in November 1980. The Part A has since been revised and several of the disposal units have been closed under the direction of NDEP. Currently, KMCC is attempting to close a hazardous waste landfill and cleanup chromium contaminated groundwater.

2.2 PROCESS DESCRIPTION

Activities at the KMCC facility encompasses four major production processes: 1) sodium chlorate, 2) perchlorates, 3) manganese dioxide, and 4) boron chemicals.

In the first process, sodium chlorate ($NaClO_3$) is produced in an electrolytic process from raw materials of sodium chloride and water. Sodium chlorate is used as a bleach in the production of paper pulp and as an intermediate in the production of perchlorates. Waste from sodium chlorate production consists of a filter cake containing impurities from the raw materials and filter aid.

The second process at KMCC involves the production of ammonium perchlorate (NH_4ClO_4) and potassium perchlorate ($KClO_4$), which are used in the manufacture of rocket fuels. Perchlorates are derived from electrolytically converting a solution of sodium chlorate to sodium perchlorate ($NaClO_4$). The $NaClO_4$ is then combined with salts of either ammonia or potassium to form the respective perchlorates. Wastes from the NH_4ClO_4 process include a filter cake with calcium carbonate, calcium sulfate and chromic hydroxide, which is derived from the use of chromium as a filter aid. Wastes from the $KClO_4$ process include sodium chloride, potassium chloride and $KClO_4$.

The third process at KMCC is the production of manganese dioxide (MnO_2), which is sold for use in high performance dry cells. This product is derived by roasting crushed low grade manganese ore and then combining it with sulfuric acid. The resulting manganese sulfate ($MnSO_4$) is then converted to manganese dioxide by electrolysis. Wastes from this process include a solid waste containing silica, alumina, iron and heavy metals which is filtered from the roasted ore after it has been combined with sulfuric acid. A minor waste stream of sodium phosphate solution, used for cleaning electrolytic cell electrodes, is also generated.

The fourth process at KMCC is the production of elemental boron, boron trichloride, and boron tribromide. Boron trichloride is used in the manufacture of boron filament for aircraft structures. Boron tribromide is used in semiconductor doping and elemental boron is used in pyrotechnics. Waste streams from the production of boron chemicals include a liquid stream containing manganese sulfate and a wet scrubber stream.

2.3 WASTE MANAGEMENT

Prior to the construction of the lined ponds on the KMCC property, both liquid and solid wastes were disposed in the BMI unlined ponds, and in the BMI dump. Solid waste was disposed in unlined ponds on the property. The only wastes apparently dumped on site were manganese dioxide and associated production wastes. These wastes are not considered hazardous.

In the 1970's, KMCC constructed nine ponds for either storage or disposal of process waste streams. The two RCRA regulated ponds have been closed under the direction of the NDEP. A non-hazardous waste pile contains tailings from the production of manganese dioxide. Tailings include filter aid, diatomaceous earth and various iron salts. A hazardous waste landfill, which has been closed, is currently under post-closure management. The landfill is considered hazardous due to the presence of hexavalent chromium waste. Table 2-1 provides a description of wastes generated from each of the production areas and the method of disposal over the years. Figure 2-1 identifies the location of the Solid Waste Management Units.

2.4 REGULATORY COMPLIANCE HISTORY

KMCC is regulated by EPA Region IX and the NDEP for the storage, treatment and disposal of non-hazardous and hazardous wastes, and the discharge of process effluent water into the waters of the state. A brief description of KMCC's permits, changes in their regulatory history and pertinent issues are presented in this section.

KMCC submitted a Part A application in November 1980 to EPA Region IX. The application specified the following storage treatment and disposal (TSD) units and their design capacities.

TSD Unit	Maximum Capacity
Storage Container (S01)	250 gals/day
Surface Impoundment (S04)	2,270,000 gals/day
Treatment tank (T01)	6,000 gals/day
Filtration Treatment (T04)	7,500 gals/day
Surface Impoundment (D83)	960,000 gals/day
Landfill (D80)	44 acre-feet

TABLE 2-1 WASTES GENERATED BY KERR-McGEE

Process	Wastes Generated	Method of Disposal	Date	Quantity
Sodium Chlorate ($NaClO_3$)	Filter cake containing impurities for the $CaCO_3$, $CaSO_3$, graphite and diatomaceous earth.	Unlined to BMI ponds.	1945-1974	391,000 ft^3
		Disposed at BMI dump.	1975-1980	90,000 ft^3
		Dumped on the ground surface in the north-west corner of the plant property.	post 1981	Unknown
	Cooling tower effluent, leaks, spills.	Discharge prior to 1976 is unknown. Discharged to lined ponds as storage for recycle back to process.	post 1976	Unknown
	Non-contact cooling water.	Discharged to Las Vegas Wash via BMI storm ditch.	1945-present	Unknown
PERCHLORATES				
Ammonium Perchlorate (uses chromium hydroxide for filter aid)	Filter cake with chromium, $CaCO_3$ and $CaSO_3$.	Unlined to BMI ponds.	1951-1974	No records
		KMCC lined ponds.	1973	
	Caustic scrubber solution (NaOH).	Discharge prior to 1974 is unknown. Lined pond on property.	1974	No records
	Overflow from cooling tower.	Discharge prior to 1974 is unknown. Lined pond on property.		
Potassium Perchlorate	NaCL, KCl, $KClO_4$, $KClO_4$ sludge and wastewater.	BMI unlined ponds.	1945-1976	293,756 tons
		KMCC lined ponds.	1976-1983	

TABLE 2-1 WASTES GENERATED BY KERR-McGEE (cont.)

Process	Wastes Generated	Method of Disposal	Date	Quantity
Manganese Dioxide	Manganese solid waste (Mn ore, heavy metal, sulfides, diatomaceous earth).	KMCC unlined ponds.	1951-1973	896,000 ft^3
	Manganese tailings.	Waste pile on KMCC property.	1974-1980	583,000 ft^3
	Manganese dioxide (slurried in water).	Leach beds on KMCC property.	Unknown	330,000,000 gal.
	Sodium phosphate ($NaPO_3$) used for cleaning electrolytic cell.	Lined pond on property	after 1976	Unknown
	All other production water is recycled			
Elemental Boron Boron Trichloride and Boron Tribromide	Wet scrubber and leachate stream (contains manganese sodium, sulfite, borate tons).	Disposal prior to 1972 is not known. Disposed in BMI unlined ponds.	1972-1976	1,000,000 gal.
		KMCC unlined ponds.	1976-present	1,250,000 gal.
Plant Effluent from Boilers Cooling Towers	Contains sodium hexa-metaphosphate and sulfuric acid.	Disposal prior to 1974 is not known. Lined pond on KMCC.	1974-present	1,730,000 gal.

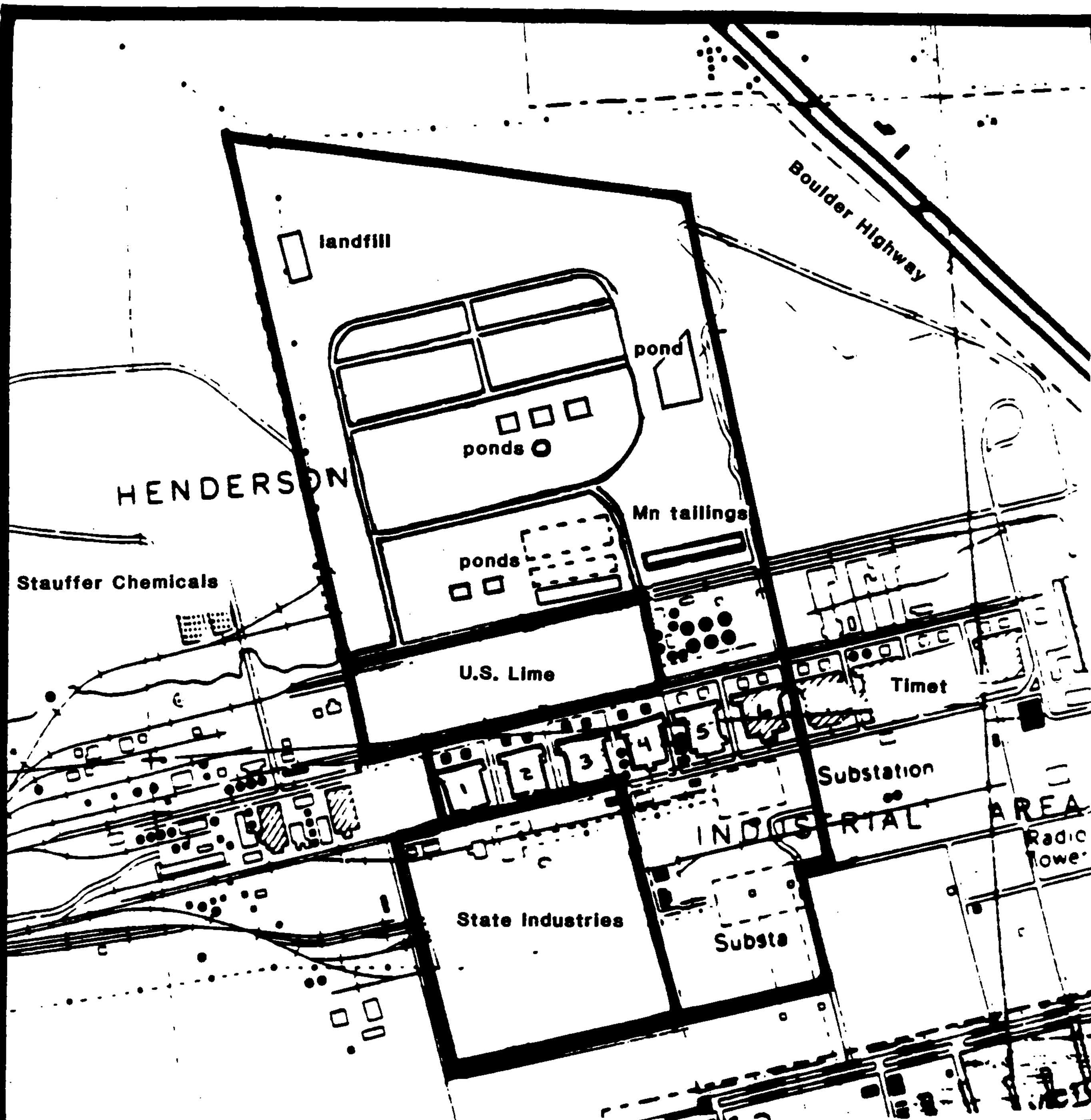


Figure 2-1 : KMCC Facility - Solid Waste Management Units.

The following waste types, amount of waste generated and waste management method are listed below.

Waste Type	Amount Generated	TSD unit
Halogenated Solvent (F001)	25 lbs/yr	Container (S01)
Non-halogenated Solvent (F003)	25 lbs/yr	Container (S01)
Non-halogenated Solvent (F005)	25 lbs/yr	Container (S01)
EP Toxic: Chromium (D007)	6,000 tons/yr	Surface Impoundment (S04)
EP Toxic: Chromium (D007)	100,000 lbs/yr	Surface Impoundment (S04)
EP Toxic: Chromium (D007)	900 tons/yr	Filtration Unit (T04/ Landfill (D80)
EP Toxic: Chromium (D007)	3,000 tons/yr	Tank (T01)/ Surface Impoundment (D83)
Corrosive (D002)	2,000,000 lbs/yr	Tank (T01)/Surface Impoundment (D83)

A revised Part A application was submitted in July 1982. The revision changed the process design capacities of the surface impoundments (D83) from 960,000 gallons to 2,660,000 gallons. Also deleted from the original Part A were the treatment units and the surface impoundments used for storage. The surface impoundments were deleted because the waste was tested by Desert Research Institute (DRI) and determined to be below EP toxic test limits.

A Part B application was requested by EPA on January 28, 1983, but was never submitted due to anticipated process changes and anticipated closure of the two RCRA impoundments and landfill. KMCC submitted a closure and post-closure plan for the chromium waste surface impoundments because the potassium perchlorate production had ceased. Subsequently EPA notified KMCC that a Part B application was not necessary for the facility due to closure of the RCRA units.

NDEP discovered that KMCC was using the basements of building units 4 and 5 as sumps to collect wastewater effluent from the sodium chlorate process. Sodium dichromate was used in low quantities in part of this process. It was the only source of chromium in the effluent. An Administrative Order (AO) to cease basement storage of the process wastewater was issued to KMCC on March 21, 1984. The AO stipulated a compliance by June 21, 1984. KMCC proceeded to discontinue the use of the basements and sampled the soil in the area. It was determined that no chromium migration from the area had occurred. NDEP conceded that the AO requests had been satisfied as of July 23, 1984.

Procedures for closing two surface impoundments and a landfill began in June 1983 when KMCC submitted closure plans. In April 1985 KMCC received final approval for closure plans from NDEP. The closure of the impoundments was approved in December 1985 and the landfill was finally approved one month later. Post-closure management is required for these units.

KMCC had authorization, under an NPDES permit No. NV0000078, to discharge non-contact cooling water, from the sodium chlorate process, and stormwater runoff to the lower BMI ponds, via an unlined storm ditch. An inspection report dated June 19, 1980 indicated that KMCC was not maintaining the required self-monitoring program. NDEP requested a revision of the NPDES permit in December 1984, when the current water quality standards of the Las Vegas Wash were exceeded by KMCC discharge. Information regarding subsequent action on this measure was not available in the documents.

NDEP issued a Consent Order, on May 30, 1986, to KMCC for the cleanup of chromium contaminated groundwater. Details on the method of cleanup were approved by the NDEP. Actual cleanup procedures were scheduled to begin September 9, 1987.

SECTION 3.0
ENVIRONMENTAL SETTING

3.1 LOCATION AND PHYSIOGRAPHIC SETTING

The following discussion regarding the location and physiographic setting of the BMI Complex is taken from the Ecology and Environment, Inc. (E&E) report (1/1984).

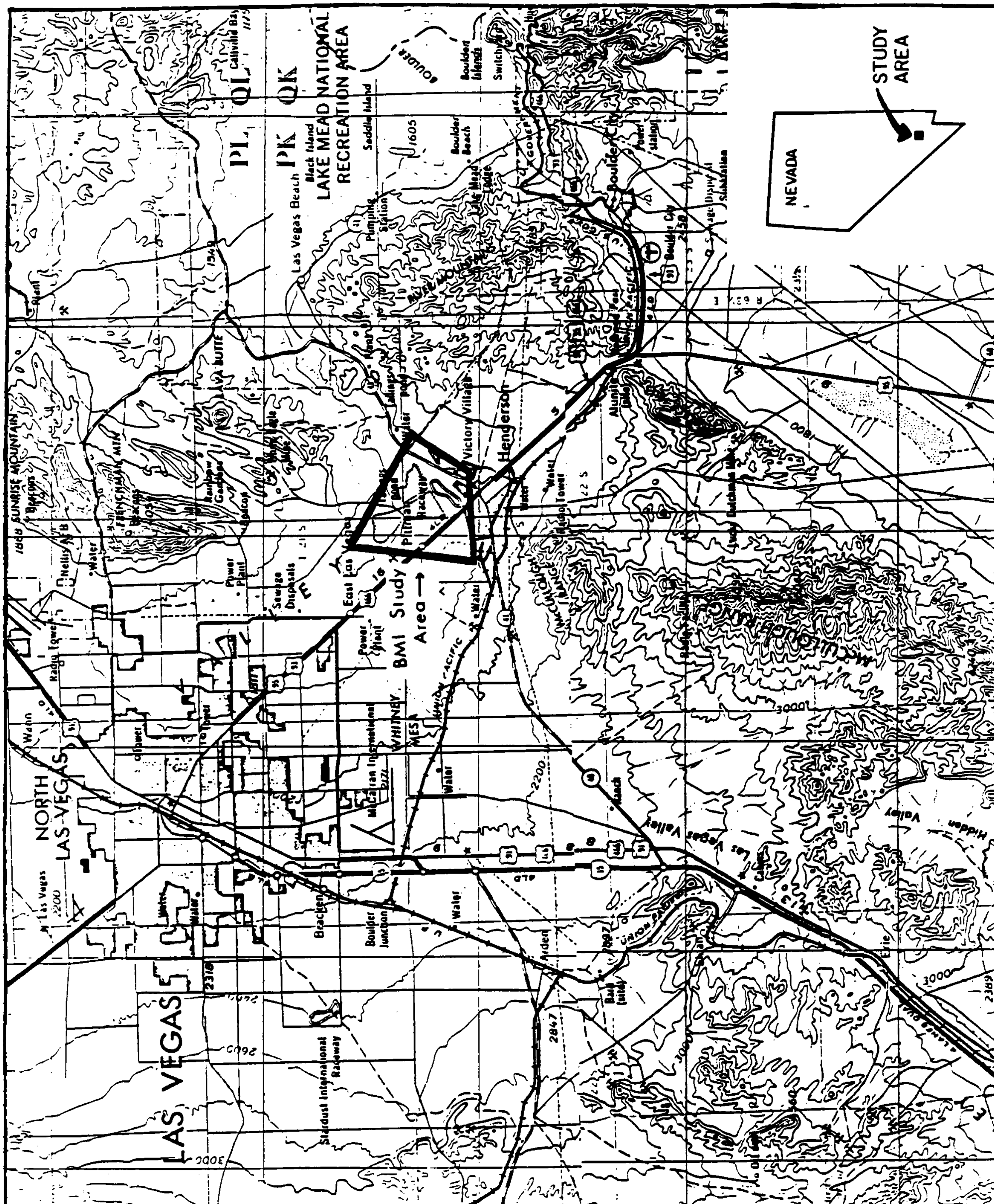
The BMI Complex, west-northwest of Henderson, Nevada, is in the south-central portion of the Las Vegas Valley. It occupies portions of Sections 11, 12, 13, 14, of T22S, R62E and portions of Sections 5, 6, 7 of T22S, R63E in Clark County.

Las Vegas Valley lies within the Basin and Range physiographic province and consists of desert basins with interior drainages flanked by sparsely vegetated mountains. It is approximately 50 miles in length and trends from the northwest to the southeast. The southern portion of the valley is a rectangular shaped basin averaging 20 miles in width. On the western edge of the valley are the Spring Mountains, to the north are the Pintwater, Desert, Sheep, and Las Vegas Mountains, to the east are the Frenchman Mountains, and to the south are the River Mountains and the McCullough Range (refer to Figure 3-1).

The BMI Complex lies on top of alluvial deposits originating from the McCullough Range. The alluvial slope is gentle and trends to the north. Site elevation ranges from 1880 feet above mean sea level in the south to 1600 feet above mean sea level in the north. The site is characterized by spare vegetation and intertwining ephemeral drainage.

3.2 SITE SURFACE DRAINAGE

The BMI complex is located on an alluvial fan with a surface drainage pattern composed of a network of shallow washes (E&E, 8/1984). The development of the surface drainage is the result of locally intense precipitation events. The drainages trend to the north-northeast and eventually discharge into the Las Vegas Wash (E&E, 1/1984).



Source: EPA 1980

Figure 3-1 BMI Study Area

Historically, the activities at the BMI complex have influenced these natural drainage courses. In an attempt to divert runoff around the complex and to channel cooling waters, plant runoff, and industrial wastewaters, drainage or diversion structures have been constructed (E&E 8/1984).

3.3 GEOLOGIC SETTING

3.3.1 Regional Stratigraphy

The complex is located at the southern edge of the Las Vegas Valley. The mountain ranges bounding the east, north, and west sides of the Valley consist primarily of Paleozoic and Mesozoic sedimentary rocks such as limestones, sandstones, siltstones, and fanglomerates (Kerr-McGee Chemical Corp., (KMCC, 1985). The mountains on the south and southeast consist primarily of Tertiary volcanic rocks such as basalts, rhyolites, and andesites that lie directly on Precambrian metamorphic and granitic rocks. A generalized geological map of the Las Vegas Valley Area is provided in Figure 3-2.

The Las Vegas Valley occupies a deep structural basin that has been filled with a thick sequence of sediments. Figure 3-3 presents the regional stratigraphic column for the area. According to Bert Smith, staff hydrologist at KMCC, a thick sequence of alluvial and lacustrine sediments began accumulating in the Basin during the Miocene Epoch. The earliest of these deposits are the Thumb and Horse Springs formations. These formations outcrop in the Frenchman Mountain area and consist primarily of limestone, sandstone, siltstone, and conglomerate. These formations occur at depths of at least from 3000 to 3700 feet in the Las Vegas area (KMCC, 1985).

Overlying the Thumb and Horse Springs formations is the Muddy Creek formation. Lithologically, the Muddy Creek formation is characterized by thin layers of sand with some gravel interbedded with thick layers of silt and clay (KMCC, 1984). Sediments of the Muddy Creek formation are typically light-colored, ranging from reddish tan to light green or white. This formation reaches thicknesses of 3000 feet and occurs at depths from 0 to 3000 feet in the Las Vegas area (KMCC, 1985). It is typically flat lying, gently tilted and has been cut by many small faults. The surface configuration of the Muddy Creek formation is often characterized by erosional features which give considerable relief to its surface in some areas.

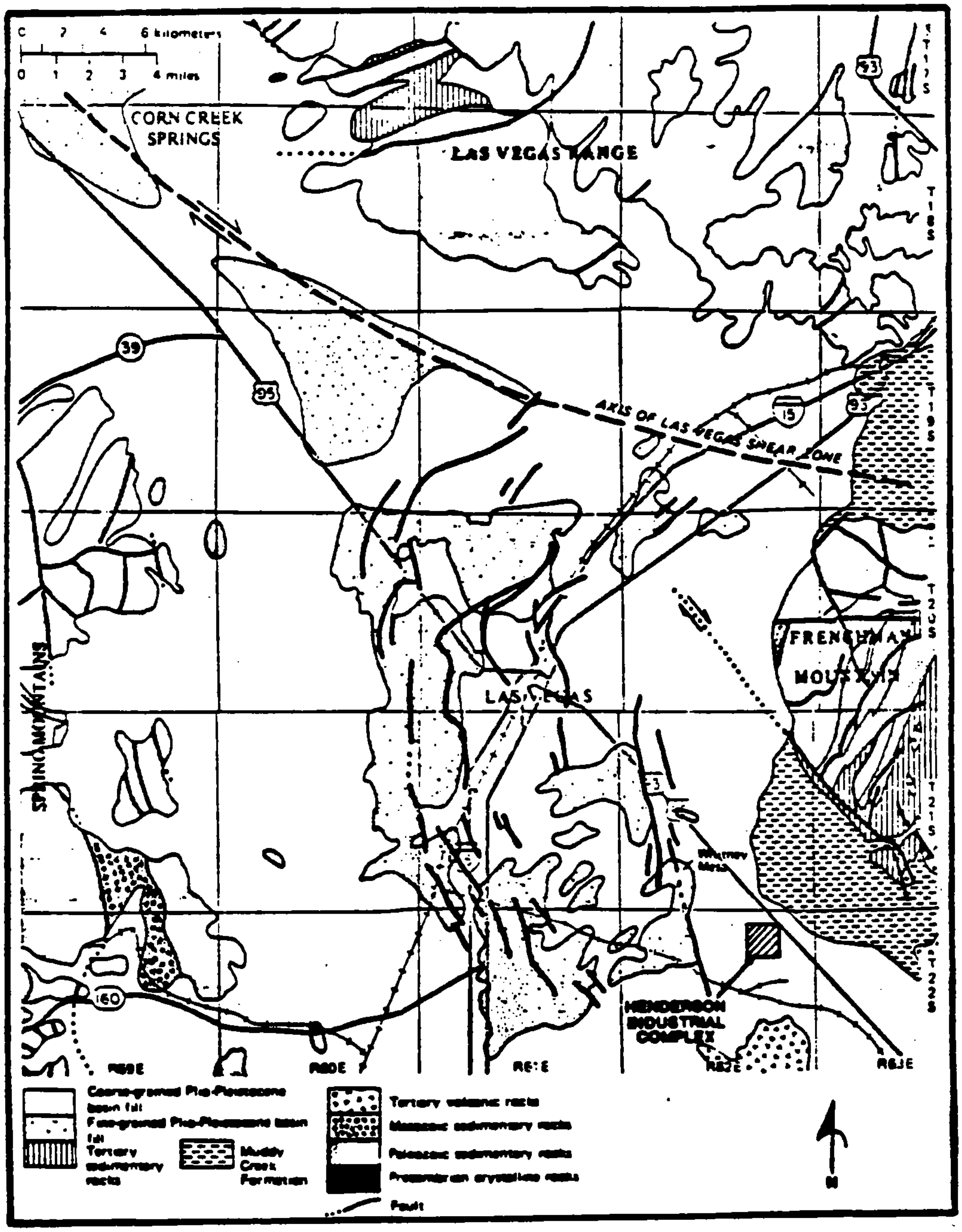


Figure 3-2 Generalized Geological Map of the Las Vegas Valley Area

Source: Kerr-McGee Chemical Corp. 1985

Geologic unit in Las Vegas area	Epoch	Period	Era	Age before present (millions of years)
Recent alluvium	Holocene	Quaternary	Cenozoic	0.01
Plio-Pleistocene Basin Fill	Pleistocene	Quaternary	Cenozoic	1.8
Muddy Creek Fm	Pliocene	Tertiary	Cenozoic	5.2
Horse Spring Fm Thumb Fm	Miocene	Tertiary	Cenozoic	22.5
Intrusive (igeneous), extrusive (volcanic), and sedimentary (continental limestone, sandstone, shale) rocks	pre-Miocene	Tertiary	Cenozoic	65
Sedimentary rocks (marine); dominantly sandstones and limestones			Mesozoic	225
Sedimentary rocks (marine); dominantly carbonate rocks with sandstones			Paleozoic	570
Igneous and metamorphic "basement" rocks			Precambrian	

Figure 3-3 Regional Stratigraphic Column For the Las Vegas Valley Area
Source: Kerr-McGee Chemical Corp. 1985

According to Bert Smith (1985), the Muddy Creek formation is unconformably overlain by Plio-Pleistocene basin fill sediments. These sediments represent semi-continuous sedimentary filling of the Basin that was probably periodically interrupted, either by nondeposition or erosion. Distinct subsurface beds are generally thin, discontinuous, and laterally variable, making Basin-wide correlation difficult.

These alluvial sediments consist primarily of sand and gravel (with lesser amounts of silt and clay) derived from the erosion of the McCullough Range Mountains (KMCC, 1984). Alluvial fans along the mountain front have overlapped to form coalescent alluvial fans with collectively similar deposits. The infrequent flood runoff periods formed two basic types of deposits within the alluvial fans. According to local geologists, the most widespread deposits consist of poorly-sorted mixtures of boulders, cobbles, gravel, sand, silt, and clay. Distinct layers may be present in the form of gravel beds cemented with caliche (calcium carbonate). Cutting through and encased by these poorly sorted deposits are stream or wash deposits consisting of moderately well-sorted deposits of sand and gravel resembling "gravel trains." These deposits are probably similar to sand and gravel in the wash channels present on the surface at the site. The "gravel trains" were buried by subsequent deposits of poorly sorted sediments and are characteristically narrow and linear in configuration. Thickness of these alluvial deposits range from 20 to 50 feet in the BMI complex area, with an overall average thickness of about 40 feet (KMCC, 10/1984).

A distinct formation change between the alluvial sediments and the Muddy Creek formation generally does not exist. Normally, a 5- to 10-foot transitional zone occurs above the Muddy Creek where clay lenses are interbedded with sand and gravel (KMCC, 10/1984).

3.3.2 Site Stratigraphy

Similar geological conditions exist over the entire BMI complex. The principle hydrogeologic units underlying the site are described in this section. The units include the upper 200 feet of the Muddy Creek formation and overlying alluvial fan sediments. Figure 3-4 provides a (north-south) geological cross section through the Henderson facility. In addition, a detailed site stratigraphic column is presented in Figure 3-5. The following site stratigraphy information was obtained from a 1985 hydrogeological investigation study headed by Bert Smith at Kerr-McGee Chemical Corporation.

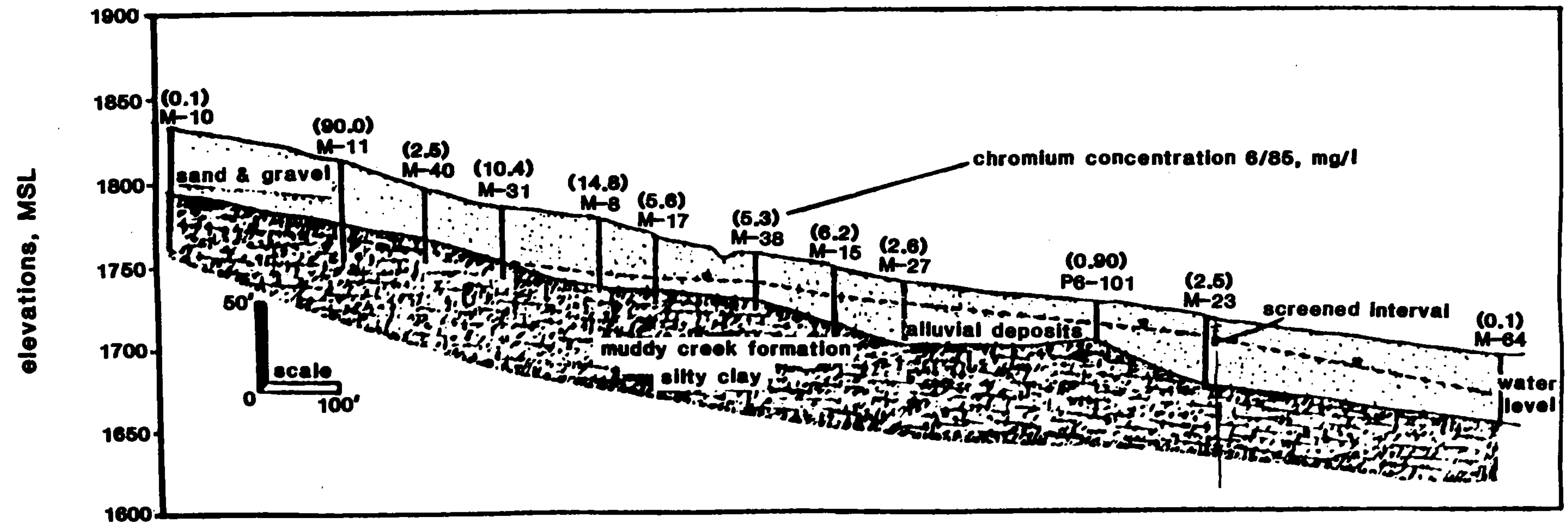


Figure 3-4 : Geologic Cross Section (north-south) Through the BMI Complex.

adapted from Kerr-McGee Chemical Corp. 1985.

GEOLOGIC AGE	GEOLOGIC FORMATION	APPROXIMATE THICKNESS, FT	LITHOLOGIC DESCRIPTION
PLEISTOCENE	ALLUVIAL FAN DEPOSITS	19.5 - 61.5	Heterogeneous, poorly sorted, unconsolidated deposits of silty sandy gravels and silty gravelly sands consisting primarily of reworked volcanics and meta-volcanics. Sands and gravels typically multi-colored with reddish-brown the dominant color. Gravels may be locally cemented or slightly cemented by calcium carbonate. Small lenses of a white clayey silt common near the base of this deposit. Boulder and large cobbles are common throughout.
PLIOCENE	MUDDY CREEK FORMATION	500? - 3000	NOTE: This description for upper 200 feet of Muddy Creek. The Muddy Creek is typically a moderately consolidated sandy-silty clay to a clayey silt. The upper 2 feet of the formation is typically a brown clayey silt grading into a brown silty clay. Small discontinuous silt and fine sand lenses may be present locally.

Figure 3-5 Site Specific Stratigraphic Column For the BMI Complex
Adopted from: Kerr-McGee Chemical Corp. 1985

Pleistocene Muddy Creek Formation

The Muddy Creek formation of Pleistocene age underlies the subsurface at the Henderson facility. It consists of brown to reddish-brown silty clay and clayey silt. In addition, thin discontinuous lenses of fine sand and silt may be present locally.

The upper surface of the Muddy Creek formation has been modified through erosion. According to the hydrogeological investigation, an erosional surface is evident on the top of the Muddy Creek formation. The surface slopes at gradients that range from 0.80% (42 feet/mile) to 5.4% (285 feet/mile) with an average of 2.5% (132 feet/mile).

Plio-Pleistocene Alluvial Fan Deposits

The BMI Complex is situated over alluvial sediments derived from erosion of the McCullough Range that form northwest-sloping coalescing alluvial fans. These alluvial fans were deposited during the infrequent flood runoff periods and were deposited on the older erosional surface of the Muddy Creek formation. The thickness of these deposits varies locally depending upon the erosional configuration of the Muddy Creek surface. Generally, these alluvial deposits thicken from south to north beneath the facility. These sediments are thickest over the erosional channels and thinnest over intervening interfluve areas. Thickness of these sediments range from 19.5 to 61.5 feet beneath the facility.

The lithology of these deposits consists primarily of a reddish-brown, heterogeneous, poorly-sorted mixture of sand and gravel (volcanics) with lesser amounts of silt and clay. Boulders and cobbles are common. Due to their mode of deposition, no distinct beds or units are continuous over the area. Distinct layers are only present in the form of gravel beds cemented with caliche (calcium carbonate) and are only present in the northwest corner of the site.

A major feature of these alluvial deposits is the stream deposited sands and gravels that were deposited within the old channels developed on the Muddy Creek formation. These deposits conform to the old channel boundaries which were characteristically linear and narrow in configuration. These "channel fill" deposits are typically uniform sands and gravels and show higher permeability than the adjacent poorly-sorted alluvial deposits. Once the old erosional channels were filled with the "channel fill" deposits, they were encased by the poorly-sorted alluvial fan deposits. The importance of these "channel fill" deposits is that they greatly affect and control the occurence and movement of the groundwater.

A distinct formation change between the Muddy Creek formation and alluvial sediments does not exist. Normally, a 5-foot transitional zone occurs above the Muddy Creek formation where small white clayey silt lenses are interbedded with sand and gravel.

3.3.3 Structural Geology

The structural features of the Muddy Creek formation is generally flat lying to gently tilted in surface exposures. Locally it has been cut by many small faults and has been severely disrupted (KMCC, 1985). This formation is sheared and tilted in the Las Vegas Wash area and is in sharp contact with the fault at the Frenchman Mountain Block.

The structure within the Plio-Pleistocene basin fill is characterized by a series of generally north-south trending faults. According to Smith (1985) these faults are thought to be the result of the natural consolidation of basin-fill sediments. These faults are typically marked by escarpments exhibiting heights up to 100 feet or more. These escarpments have also been considerably modified by erosion in many areas (KMCC, 1985).

3.3.4 Geological History

The geologic history of the Henderson region is characterized by repeated periods of deposition, uplift, igneous activity, and erosion. Thick sequences of marine sedimentary deposits accumulated throughout Paleozoic and Mesozoic time with periodic episodes of orogenic (crustal deformation) activity (KMCC, 1985). Continental-type sedimentary deposition and widespread volcanic and fault activity continued through Cenozoic time. Consequently, thick deposits of volcanics were extruded over broad areas and accompanied by strike-slip faulting during mid- to late-Tertiary time. The volcanic and tectonic activity peaked during the Miocene epoch. Following the volcanic and tectonic activity in Miocene time, and continuing through Pliocene time, a thick sequence of alluvial and lacustrine sediments was deposited in a deep structural basin (KMCC, 1985). These sedimentary deposits included the Horse Springs and Muddy Creek formations. Following the deposition of the Muddy Creek formation, a period of erosion occurred, followed by periodic deposition of Pleistocene coarse-grained alluvial deposits consisting of coalescing sequences of alluvial fans which flanked the mountain ranges (KMCC, 1985).

3.3.5 Subsurface Geology

Exploratory drilling done for the purpose of determining the subsurface lithology at the BMI Complex, showed the soil to be composed of loose to medium dense, poorly graded sediments such as silty sandy gravel in the top 12 to 15 feet of the near surface, unsaturated soil zone (E&E, 1985). Tables 3-1 through 3-4 depict the lithology log for the Henderson facility. Partially cemented sand and gravel, cobbles, and silty gravel with abundant gypsum were found in the 15 to 32 feet interval in several borings at the Kerr-McGee Chemical Corporation facility located within the BMI Complex. As stated in Section 3.3.2, the geological conditions for the entire Complex is similar, therefore a similar subsurface soil lithology is expected. Data both from Geraghty and Miller (G&M) (1980) and E&E (1/1984) encountered layers of caliche (alluminum cemented with sodium salts) and caliche-cemented sand and gravel below the 32 feet interval. G&M encountered silty, clayey sand with reworked caliche in the 44 to 51 feet interval (1980). According to E&E (8/1984), the caliche is fairly consolidated and fracturing is readily apparent within the ten feet thick and greater sequences. In addition, there is some indication of high residual porosity and permeability in the caliche although it is well cemented. However, in some cases caliche deposits act as confining layers restricting the degree of saturation (E&E, 8/1984).

The top of the Muddy Creek formation was discovered to be in the range of 29 to 32 feet (E&E, 8/1984). The nature of the soil's depositional history, alluvial fan deposits and playa deposits, produces varying soil profiles and varying degrees of cementation across the BMI area. Consequently, the level of saturation changes across the site.

3.4 SURFACE WATER SETTING

The Las Vegas Valley is a tributary to the Colorado River through the Las Vegas Wash. Surface water in the Wash flows to the east and eventually reaches Lake Mead at Las

TABLE 3-1

LITHOLOGY LOG FOR HENDERSON WELL NO. M-5

Depth in Feet	Lithology Description
0-12.0	Silty sandy gravel
12.0-15.0	Partially cemented sand and gravel
15.0-20.0	Cobbles
20.0-23.0	Silty sand and gravel
23.0-24.5	Gravel and sand with cobbles
24.5-25.5	White clay and gravel with gypsum and cobbles
25.5-28.0	Brown clayey silt with about 50% gypsum
28.0-31.0	Brown clayey silt with sand and gravel and white streaks
31.0-43.0	Brown clay with occasional thin caliche lenses

Top of Muddy Creek at 31 feet

Source: Kerr-McGee Chemical Corp. 1984

TABLE 3-2

LITHOLOGY LOG FOR HENDERSON WELL NO. M-6

Depth in Feet	Lithology Description
0-29.0	Silty gravel and sand; slightly cemented from 12' - 13'
29.0-32.0	Silty sand and gravel with gypsum
32.0-32.5	Brown silty clay
32.5-34.0	Silty sand and gravel
34.0-38.0	Brown silty clay
38.0-43.0	Brown clay with sand and gravel

Top of Muddy Creek at 32 feet

Source: Kerr-McGee Chemical Corp. 1984

TABLE 3-3

LITHOLOGY LOG FOR HENDERSON WELL NO. M-7

Depth in Feet	Lithology Description
0-15.0	Silty gravel and sand
15.0-18.0	Silty gravel and sand with gypsum
18.0-22.5	Silty gravel and sand with abundant gypsum; approximately 40% gypsum
22.5-28.0	Light brown silty clay with thin beds of caliche. Cemented from 27' - 27.5'
28.0-29.5	Clayey gravel (not cemented)
29.5-37.0	Brown silty clay

Top of Muddy Creek at 29.5 feet

Source: Kerr-McGee Chemical Corp. 1984

TABLE 3-4

LITHOLOGY LOG FOR HENDERSON WELL NO. H-28

Description	Depth Below Land Surface (feet)
Sand, silty to clayey, grayish-brown very fine to very coarse (poorly sorted), and gravel, pebbles, cobbles and boulders, rounded to subangular; also with layers of caliche and caliche-cemented sand and gravel	0 - 44½
Clay, silty, to silt, clayey, light brown with traces of sand and gravel in matrix; also, with occasional thin layers of sand, reworked caliche, and caliche (Muddy Creek Formation)	44½ - 51

Source: Kerr-McGee Chemical Corp. 1984

Vegas Beach, according to E&E (10/1984). Lake Mead waters then flow south into the Colorado River. The quantities are controlled by the Hoover Dam.

Las Vegas Wash, the only nearby perennial stream is located three miles north of the Complex. The Wash empties into Lake Mead about nine miles northeast of Henderson. It is naturally a dry stream bed with only intermittent flows for most of its length. However the last portion of the Wash, from Las Vegas to Lake Mead, is a continuously flowing channel of approximately 60 million gallons per day (E&E, 1/1984). In addition, this report mentioned that prior to human settlement in the area, the Wash did not have an outlet stream. A defined stream channel was created to receive the wastewater discharge to the Wash.

3.5 HYDROGEOLOGIC SETTING

3.5.1 Regional Hydrogeology

Groundwater in the Las Vegas Valley occurs mainly in the unconsolidated sediments of the valley fill (E&E, 1/1984). The upper alluvial fan deposits and the lower Muddy Creek formation store and yield different quantities of water. The upper unit, although poorly sorted, is able to store and transmit relatively large quantities of groundwater (E&E, 1/1984). The hydraulic properties of this unit vary due to its lithologic heterogeneities. The Muddy Creek formation stores and yields lesser quantities of water because it contains massive clay beds of low permeability. However, a few water-bearing sand and gravel layers are found interbedded with the clays.

Groundwater in the Las Vegas Valley occurs under artesian and semi-artesian conditions. Regionally, there are three principle artesian aquifer zones within the Muddy Creek formation. The so-called shallow, middle, and deep artesian zones are tapped by wells at about 200 to 450, 500, and 700 feet, respectively, in the Las Vegas Valley (G&M, 1980). However, a fourth water-bearing zone, which does not exist regionally, is termed the near-surface aquifer and is found at the top of the Muddy Creek formation usually in the alluvial sand and gravel. However, the near-surface aquifer also occurs in the semi-confining beds above the shallow artesian aquifer in places. Although separated by low permeability layers of fine-grained sediments, all aquifers in the valley fill are interconnected by upward leakage along fault zones and through semi-confining layers. According to a hydrogeological study (G&M, 1980), this upward leakage is responsible for the presence and recharge of the near-surface aquifer which is further augmented by artificial recharge from irrigation and other forms of water applications to the land surface. The upward leakage or positive head in the artesian zones does not allow the downward movement of groundwater in the aquifer system (G&M, 1980).

The primary source of recharge is runoff from precipitation occurring in the surrounding mountains which infiltrates the alluvium along the Valley margins. Rainfall (less than 5 inches annually) occurring in the Valley itself is consumed by evaporation and transpiration by vegetation (KMCC, 1984). Therefore, the near-surface aquifer receives little or no direct recharge from infiltrating rainfall in the Valley and is recharged by upward leakage from deeper aquifers and recharge from the infiltration of water applied to the land surface in the forms of irrigation and wastewater discharges to unlined ditches.

According to KMCC (1984), groundwater from the shallow, middle, and deep aquifers is discharged from the system through springs and pumping wells in Las Vegas Valley. In the Henderson area, groundwater from the near-surface water-bearing alluvial deposits is discharged by seepage into Las Vegas Wash, as well as by evapotranspiration, but not by any known pumping wells.

Based on test drilling results at the Henderson plant site, G&M (1980) reported that groundwater occurs in the near-surface aquifer at depths ranging from about 20 feet (at the northern boundary) to 90 feet below land surface (at the southern property boundary). However, water levels in the near surface alluvial aquifer have remained fairly constant (E&E, 1/1984). In all test wells groundwater flowed into the borehole at about the same depth (or slightly below) at the top of the Muddy Creek Formation. Water levels generally rose to a static level in the borehole within 24 hours time. This rise in water level according to G&M (1980) is probably due to varying degrees of local aquifer confinement by clay or caliche layers in the transition zone, or by caliche layers in the Muddy Creek formation where the near-surface aquifer occurs in the fine-grained materials of that formation.

Estimating the thickness of the near-surface water-bearing zone is made difficult by the variable layering within the transition zone. Furthermore, in one well (H-12), the Muddy Creek formation was found at a depth of 22 feet but groundwater was not tapped until drilling through a layer of caliche at 43 feet and then the water level rose to 26 feet below land surface (G&M, 1980). It is concluded by hydrogeologists that the near-surface aquifer occurs at the top of the Muddy Creek formation, perched in and/or confined by clay layers in the transitional zone above the Muddy Creek formation; and within the uppermost part of the Muddy Creek formation where it may be confined by a layer of caliche. After lowering the water level in some of the test wells by pumping, water could be observed by G&M (1980) entering the open borehole and a direct measurement was made. Based on these observations, the aquifer thickness is estimated to be about one-foot over most of the studied area.

3.5.2 Site Hydrogeology

Two types of aquifers are present in the BMI areas: the upper unconfined or water table aquifer and lower or deep confined aquifer. Attachment 1 provides a hydrogeologic cross section of the BMI Complex. The upper unconfined aquifer has been penetrated by many of the monitoring wells drilled in the area and is comprised of groundwater contained in upper alluvial fan unit and the upper portions of the Muddy Creek Formation (E&E, 1/1984).

Groundwater recharge for this aquifer can be attributed to three different sources: rain and storm runoffs that infiltrate in small quantities; industrial and sanitary wastewater discharges which contribute large quantities of water to this shallow water table system; and local upward recharge from underlying artesian aquifers. The upward recharge occurs only in few locations at the BMI site and is limited in the rest of the area. Discharge from the surficial aquifer occurs as direct evaporation, transpiration from phreatophytes, and discharge to surface water courses like Las Vegas Wash (E&E, 1/1984). A 1980 groundwater elevation contour map is presented in Attachment 2.

The lithology of this aquifer varies widely from a poorly sorted sequence of boulders, gravels and sand in the higher elevation areas to gravels, sands, silts and clays in the valley floor near the Las Vegas Wash. Caliche beds occur at various depths within the aquifer. Gravel filled channels form high transmissivity zones within this aquifer and tend to funnel an increased groundwater flow, according to E&E (1/1984).

Though the thickness of these materials ranges from 30 to 60 feet, only the lower 10 to 20 feet are saturated (Stauffer Chemical Company, 1984). Under the fan materials is the uneven surface of the Muddy Creek formation which forms an impermeable base on which water flows.

An important hydrogeologic consideration in the BMI studies, according to E&E (1984), has been the question of hydraulic communication between the surface alluvial aquifer and the underlying upper Muddy Creek Formation. Various studies have had differing conclusions as to the role of artesian flow from the upper Muddy Creek formation into the shallow aquifer.

The characteristics of the deep confined aquifer in the BMI area were not available during this preliminary review.

After studies of drilling results and water level monitoring data, hydrogeologists at E&E (1/1984) reported that it is most likely that vertical flow between the two aquifer systems is not a major flow component and that the gradient directions may vary locally. They concluded that groundwater contained in the surficial aquifer and the upper portions of the Muddy Creek formation within the BMI area are in limited hydraulic communication.

3.5.3 Groundwater Movement

Groundwater gradients at the KMCC facility vary from as little as 0.2% to 5.7% according to Stauffer Chemical Company (1984). Groundwater movement is generally north. In addition, the fluctuations of groundwater levels throughout the property ranged from zero to an increase of as much as 8 feet (1984 RCRA Report, EPA file).

The main elements controlling the groundwater occurrence and movement, and water table configuration in the upper aquifer are the presence of the high transmissivity gravel channels, the slope, topography of the Muddy Creek formation, and the lithology of the upper portions of Muddy Creek formation (E&E, 1/1984).

3.5.4 Hydraulic Characteristics of the Near-Surface Aquifer

Aquifer transmissivities vary considerably in the near-surface water-bearing zone due to the presence of high permeability zones probably in the form of buried stream channels which resemble "gravel trains" (G&M, 1980). The overall transmissivity of the alluvial fan deposits that comprise most of the near-surface aquifer is low because of the poorly-sorted nature of the deposits and limited thickness of the saturated zone. However, well-sorted deposits in "gravel trains" have higher permeabilities as well as a probable thicker saturated zone. Consequently, they transmit the bulk of groundwater flow in the near-surface zone. Because of its poor water-bearing characteristics and generally poor water quality (historically high dissolved salts content), the near-surface aquifer is not tapped by any known domestic or other type of supply well downgradient, between the BMI site and Las Vegas Wash (G&M, 1980).

An 8-hour pumping test was performed by G&M on Wells H-18, H-19, and H-21 (located on Stauffer Chemical Company property) to determine the hydraulic characteristics of the near-surface aquifer. The results of these tests are plotted on Figures 3-6, 3-7, and 3-8, as well as the transmissivities calculations using the Modified Jacobs Formula.

Well H-19 is probably typical of the near-surface aquifer having transmissivity values of about 1,300 gallons per day per foot (gpd/ft). Well H-19 was pumped at rates of 5 and 10 gallons per minute (gpm). Specific capacities for Well H-19 was 1.4 gallons per minute per foot (gpm/ft). An increase in pumpage rate caused the water level to drop below the relatively thin water-bearing zone, resulting in an increased drawdown rate. Pumpage rates chosen for the test were considered the maximum rates that Well H-19 could sustain (G&M, 1980).

All H-test wells were pumped for short periods and drawdown measurements were made by G&M whenever possible. Based on the short tests the average well yield is probably 5 to 10 gpm for the near-surface aquifer (G&M, 1980). As shown on Figure 3-8, Well H-21 has a calculated transmissivity of about 14,500 gpd/ft, or about 10 times greater than that of Well H-19. The near-surface aquifer in the vicinity of Well H-21 obviously has a greater permeability and may have a greater thickness (G&M, 1980). Observations made during the drilling of Well H-21 and analysis of the gamma log, however, revealed no indications of a greater aquifer thickness of Well H-21.

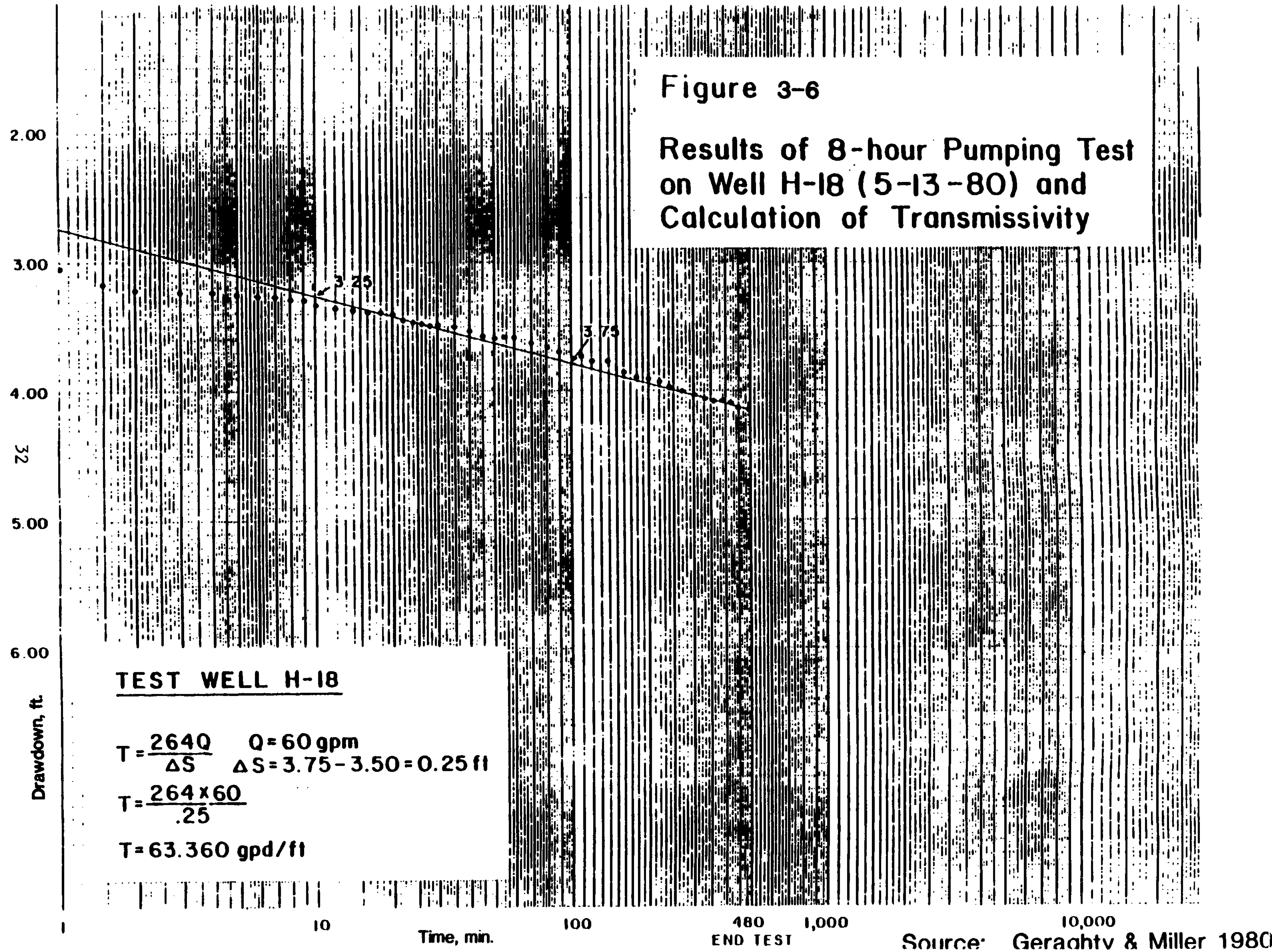


Figure 3-6

Results of 8-hour Pumping Test on Well H-18 (5-13-80) and Calculation of Transmissivity

Source: Geraghty & Miller 1980

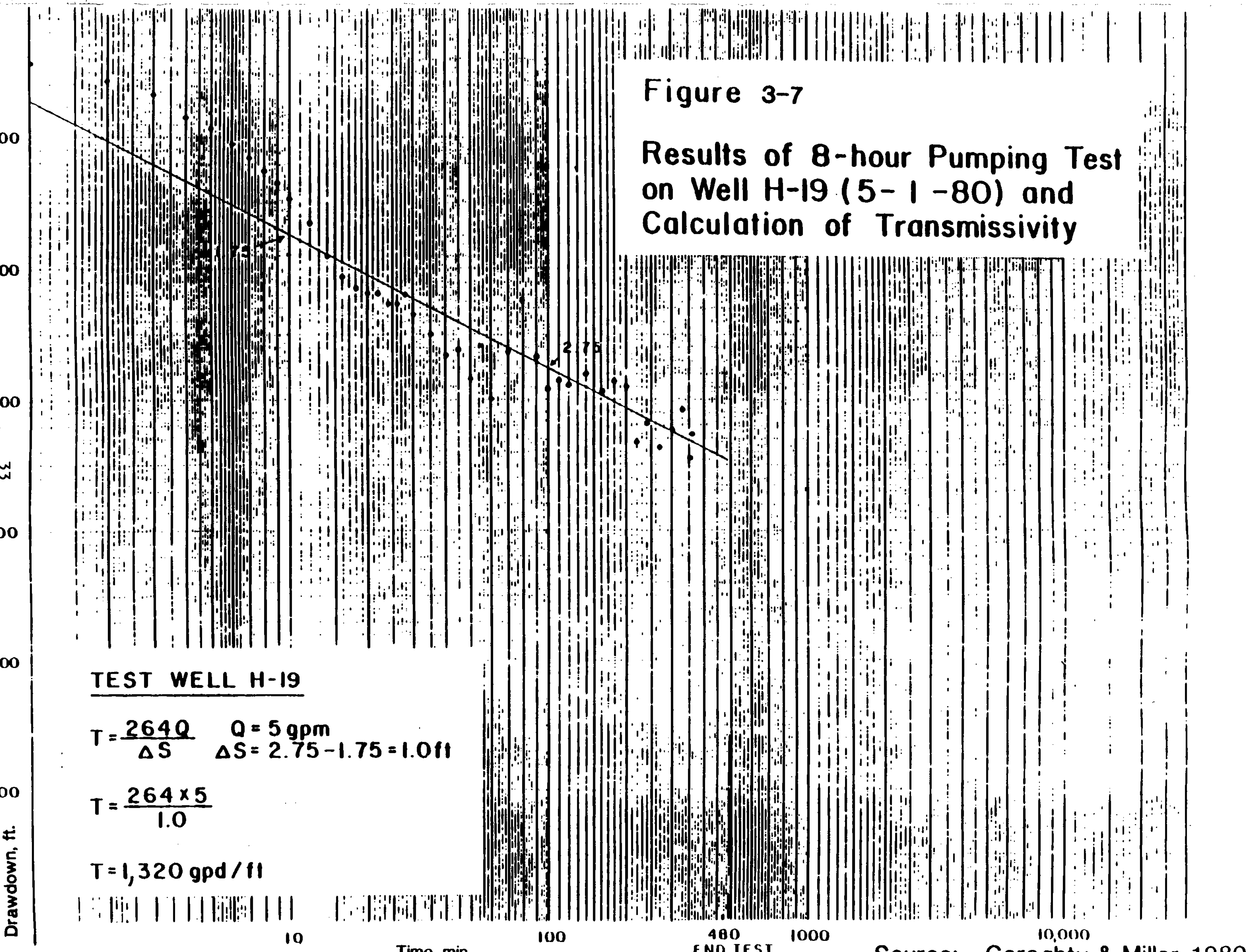


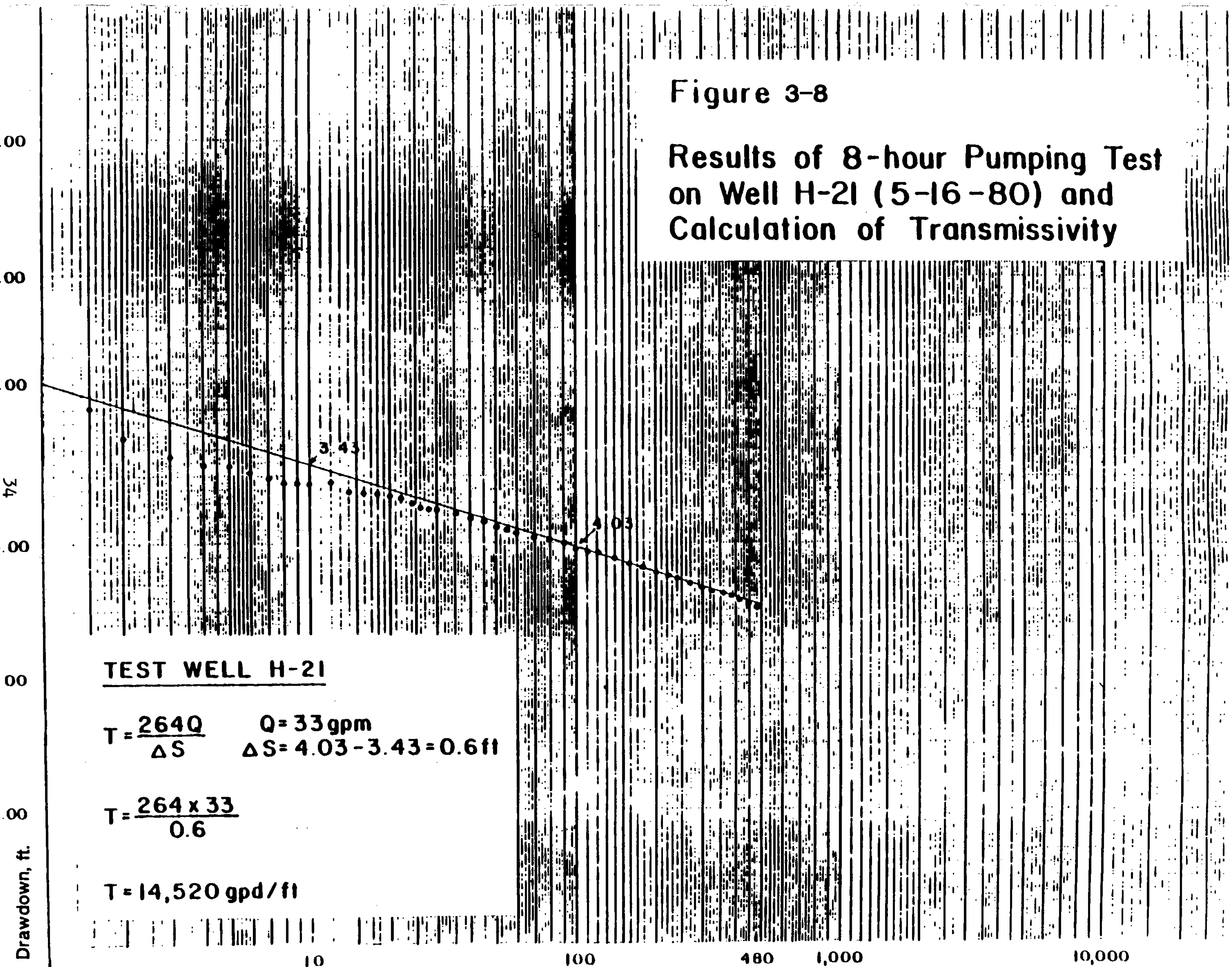
Figure 3-7

Results of 8-hour Pumping Test on Well H-19 (5-1-80) and Calculation of Transmissivity

Source: Geraghty & Miller 1980

Figure 3-8

Results of 8-hour Pumping Test on Well H-21 (5-16-80) and Calculation of Transmissivity



Source: Geraghty & Miller 1980

Consequently, G&M hydrogeologists concluded that it is not possible to make an accurate estimation of aquifer thickness at Well H-21. The specific capacity of Well H-21 is about 7.3 gpm/ft, or about seven times higher than that of Well H-19 (G&M, 1980). Pumpage at a higher rate would result in the same conditions of increased drawdown rate described above for Wells H-19 and H-21.

The highest well yield was obtained from Well H-18 which produced 60 gpm with about 4 feet of drawdown, as shown on Figure 3-6 (G&M, 1980). The calculated value for transmissivity is about 63,000 gpd/ft or about 48 times greater than Well H-19 (G&M, 1980). Well H-18 is located in what appears to be a larger, more pronounced trough on the Muddy Creek formation.

As in the case of Well H-21, no indications of aquifer thickness could be ascertained during drilling or by an examination of gamma logs. It is likely, however, that the water-bearing zone is thicker in the vicinity of Well H-18 than average for the near-surface aquifer because of the extremely high well yield. The specific capacity of Well H-18 is about 15 gpm/ft, or 15 times greater than Well H-19 (G&M, 1980).

According to G&M (1980), a comparison of the calculated values for transmissivity with published data is inconclusive because of the extreme variations in the character of the near-surface aquifer.

3.5.5 Hydraulic Characteristics of the Upper Muddy Creek Formation

The upper part of the Muddy Creek formation was explored by six test wells in 1980 by G&M, and by two test wells drilled by Stauffer's Geology Department in 1971. As noted in the section "Geologic Setting," sand layers in the upper part of the Muddy Creek formation are not extensive in the study area. There are no known water supply wells developed in these confined sand layers in the area between the plant and Las Vegas Wash primarily because of the poor water bearing characteristics of the formation, and the availability of water supplies from the Lake Mead Reservoir (G&M, 1980).

Undisturbed core samples from various depths in the upper Muddy Creek formation were obtained during G&M's drilling of Wells H-34, H-35, and H-36 (located on Stauffer Chemical Company property). The cores were preserved and sent to a testing laboratory for permeability tests. The cores consisted of silty clay typical of the predominant lithology of the upper formation, according to G&M (1980). The well locations represent a downgradient cross section between the northern boundary of the BMI dump and the northern BMI property line. The results shown on Table 3-5 verify the extremely low permeability of the clays of the Muddy Creek formation underlying the near-surface aquifer (G&M, 1980).

A comparison of water levels by G&M in the confined water-bearing zone and in the near-surface aquifer shows that the water level in the confined zone is about 15 feet higher than the level in the near-surface aquifer. Moreover, the head differential for the lower aquifer is almost 34 feet higher. According to G&M (1980) this upward head in the lower water-bearing zone has been referred to as being the source of recharge to the near-surface zone. More importantly, it prevents the downward leakage of dissolved chemicals in the near-surface aquifer.

3.6 CLIMATIC FACTORS

The climate of the Henderson, Nevada area is semi-arid, consisting of mild winters and dry hot summers according to data from the Environmental Data Service of the National Oceanic and Atmosphere Administration. Low humidity, low precipitation, strong winds, and wide extremes in daily temperatures create high evaporation rates (E&E, 1/1984). The average annual temperature is 60°F with a range of 46°F while the mean annual precipitation is 3.76 inches. The Las Vegas Valley has the average monthly precipitation rates in inches as follows:

Month	Precipitation (inc.)	Month	Precipitation (inc.)
January	0.45	July	0.44
February	0.30	August	0.49
March	0.33	September	0.27
April	0.27	October	0.22
May	0.10	November	0.43
June	0.09	December	0.37

Precipitation in this arid southwest area is divided into two defined rainy seasons (KMCC, 1985). During the winter, frontal storms produce low intensity rainfall over

TABLE 3-5

RESULTS OF LABORATORY VERTICAL PERMEABILITY TESTS ON UNDISTURBED SAMPLES FROM TESTS WELLS H-34, H-35, AND H-36

Boring Number and Sample Depth	Coefficient of Permeability (cm/sec)
H 34 at 44' to 44½'	1.2×10^{-7}
H 34 at 60' to 60½'	1.0×10^{-7}
H 35 at 36' to 36½'	2.0×10^{-6}
H 36 at 41' to 41½'	1.2×10^{-7}
H 36 at 101' to 101½'	5.8×10^{-8}

Source: Geraghty & Miller 1980

large areas. During the summer, rainfall results from thundershowers occurring during period of influx of warm, moist tropical air. The KMCC hydrogeological investigation in 1985 reported that the short term, high intensity rainfall during these thunderstorms can be severe and result in flash floods.

E&E (1/1984) stated that the average annual evapotranspiration rate has been estimated at 82 inches or roughly 20 times the annual precipitation since natural solar and wind evaporation will rapidly remove water from surface areas. Vertical penetration of rainfall is minimal (KMCC, 1984).

SECTION 4.0
SURFACE IMPOUNDMENTS

4.1 INTRODUCTION

Nine surface impoundments or ponds were constructed in the mid-1970's to accept discharged waste effluent from process buildings. Some of the ponds were used for evaporation of the waste while others were used as holding ponds for recycle. Two ponds were considered RCRA hazardous waste units under Interim Status. These ponds were closed in 1985 under the direction of the NDEP. The remaining seven ponds in operation at KMCC were not under RCRA regulation. Figure 4-1 is a map of the KMCC facility with the location of the nine ponds.

4.2 DESCRIPTION OF PONDS

Currently Operating

Pond C-1

Surface Area: 69,000 ft^2

Volume: 3,125,000 gallons

Use: Pond C-1 receives non-hazardous wastewater from the main boiler and cooling tower blowdown, which generate 4,000 and 15,000 gallons/day, respectively. Discharge is reported to contain 22,450 ppm TDS. A non-hazardous cleaning solution, containing sodium phosphate from the MnO_2 production contributes 5,000 gallons once or twice a week. Neutralization waste from boron production is discharged at a rate of 0.9 gpm. Pond C-1 is used for evaporation. It has a single liner which is PVC on the bottom and reinforced butyl on the walls.

Pond Mn-1

Surface Area: 53,000 ft^2

Volume: 3,500,000 gallons

Use: Pond Mn-1 receives non-hazardous water solutions including MnO_2 cell feed filter waste and potassium phosphate cathode wash solution. This pond is used for evaporation. It is

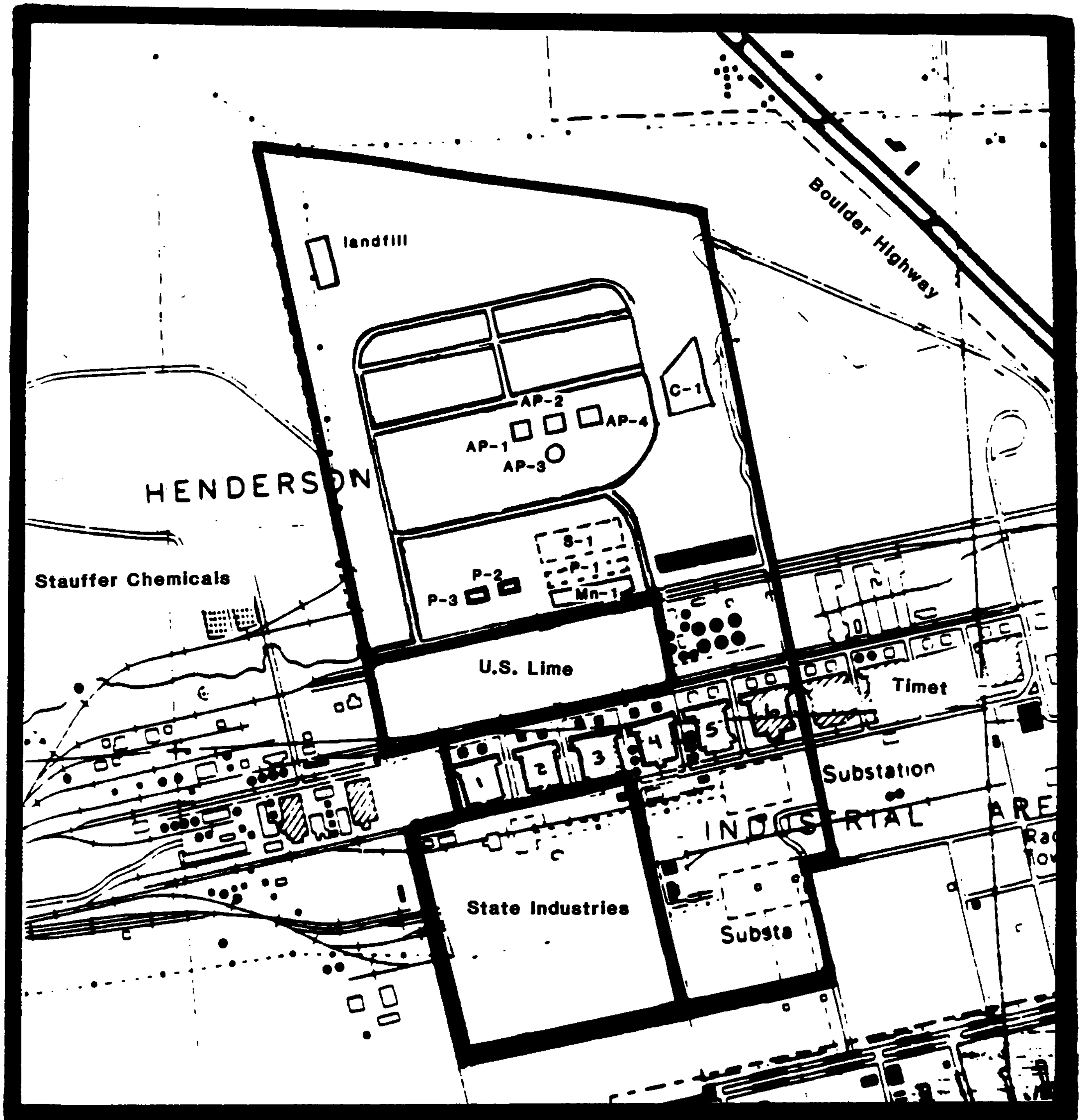


Figure 4-1 : Location of Ponds.

double-lined with a bottom of 4"-6" compacted bentonite clay, a side underliner of geotextile polypropylene and a top liner of HDPE.

Pond AP-1

Surface Area: 14,000 ft^2

Volume: 370,000 gallons

Use: Pond AP-1 is used for recycle of the $NaClO_4$ process purification filter wash liquor. The pond has a single liner. The material of the liner is PVC and the walls are CPE.

Pond AP-2

Surface Area: 16,000 ft^2

Volume: 425,000 gallons

Use: Pond AP-2 is also used for the recycle of $NaClO_4$ process purification filter wash liquor. The pond has a single liner which is PVC on the bottom with CPE walls.

Pond AP-3

Surface Area: 2000 ft^2

Volume: 65,000 gallons

Use: Pond AP-3 is used as a pump basin for AP-1 and AP-2. The pond has a double liner made from PVC.

Pond AP-4

Surface Area: 20,000 ft^2

Volume: 650,000 gallons

Use: Pond AP-4 is used for the evaporation of the NH_4ClO_4 cooling tower waste. Salt crystallizer washout was reported to be discharged at a rate of 500 gallons/day. The pond has a PVC bottom liner and CEP sides.

Liquid and sludge from Ponds AP-1, AP-2, and AP-4 were sampled and analyzed by the Desert Research Institute in March 1983. Results indicated that all eight metals designated in the EP toxicity test were well below the test limits. Perchlorates are strong reducing agents and are usually considered hazardous wastes due to their reactivity. It is assumed that the perchlorates in the waste stream are extremely dilute and offer no hazard to the environment at the measured concentration. However, sampling data is needed to confirm this assumption.

Pond P-2

Surface Area: 13,000 ft^2

Volume: 350,000 gallons

Use: Pond P-2 is used for the recycle of spills from the $NaClO_4$ production. The pond is lined with reinforced butyl rubber.

Pond P-3

Surface Area: 12,000 ft^2

Volume: 350,000 gallons

Use: Pond P-3 is used for the recycle of spills from the $NaClO_3$ production. This pond has been reported to receive caustic scrubber solution from the NH_4ClO_4 plant at a rate of 500 gallons/day. No pH of this stream was available for review. It is not clear if this solution recycles back to the $NcClO_3$ process. This pond is lined with reinforced butyl rubber.

Closed Ponds

Pond S-1

Surface Area: 47,500 ft^2

Volume: 1,700,000 gallons, allowing 2 foot freeboard

Use: Pond S-1 was used for evaporation of $KClO_4$ process liquor (approximately 5,000 gallons/day), boron leach liquor which contained manganese sulfate (approximately 500 gallons/day) and the wet scrubber effluent from the boron process (approximately 7000 gallons/day). The liquid phase of $KClO_4$ waste contained total chromium in excess of 5 ppm. The pond was lined with PVC on the bottom and CPE on the walls.

Pond S-1 was constructed in the same location as a dump site which existed prior to 1960 (please see Section 5.0 for further information). No information was available on the construction of the pond. Therefore, it is impossible to determine whether any cleanup activities took place prior to the pond's installation. No information was available on the characteristics of the dump site.

Closure: After the termination of potassium perchlorate production in 1982, Pond S-1 was removed from service. Some liquid was allowed to evaporate, but the remaining free liquid was pumped to Pond P-1. The dewatered solids and the bottom and side liners were removed and disposed of in the hazardous waste landfill. Two feet of soil under the liner were also removed. Six soil borings were taken around the pond to determine if any chromium migration had occurred. The soil samples were analyzed by Desert Research Institute and results indicated the presence of chromium. The highest concentration was 0.11 ppm which is below the hazardous limit. The results were not compared to background values, since the NDEP did not require this action, however the presence of chromium could be attributed to past operations. The sampling results did not indicate the depths at which the soil samples were taken. No indication of filling and grading the surface impoundment with clean soil was seen in the reviewed documents. The NDEP approved closure of this facility under RCRA Interim Status on October 22, 1985.

Pond P-1

Surface Area: 26,000 ft^2

Volume: 700,000 gallons

Use: Pond P-1 was used for the evaporation of potassium perchlorate waste material. The liquid waste had a total chromium concentration above 5 ppm which made it a RCRA hazardous waste. This pond received some hazardous waste from the closure activities of Pond S-1 and the decommissioning of the potassium perchlorate process. However, the pond did not receive any hazardous waste after January 23, 1973. This pond was constructed in April 1972 and reports indicated that it was relined in 1980 with a high strength polymer, Hypalon.

Closure: All liquid in the pond had been either evaporated or recycled back to the process to take advantage of chromium's corrosion inhibition characteristics. The remaining solids in the pond were analyzed for chromium by an EP toxicity test and found to be non-hazardous. Soil samples in the area of the pond were analyzed non-hazardous, since the maximum chromium concentration was .41 ppm. All samples were taken at depths of less than 5 feet. The sampling results were not compared to background values since the NDEP did not require this action, however, the presence of chromium could be attributed to past operations. No indication of filling and grading the surface impoundment with clean soil was seen in the reviewed documents. Reports indicated disposal of the liner and soil in a non-hazardous waste landfill on the KMCC property in July 1985. The location of the landfill is not known. The NDEP approved final closure of the facility under RCRA Interim Status on October 22, 1985.

4.3 DOCUMENTED RELEASES

Chromium contamination has been found in the groundwater. This also means that chromium has migrated through the vadose zone to the saturated zone. However, due to past activities, contamination could have arisen from various areas, thus it is difficult to indicate specific source(s) of the contamination. The groundwater contamination is presented in Section 7.0.

4.4 GROUNDWATER MONITORING PROGRAM

In 1982, KMCC installed four monitoring wells, in accordance with RCRA regulations 40 CFR 265, around the surface impoundments. Figure 4-2 shows the location of the wells adjacent to the ponds. Three of the wells (M-2, M-8 and M-9) are downgradient of impoundments S-1 and P-1, the other well, M-1 is upgradient. Quarterly samples (between August 1982 and October 1983) of groundwater were taken from these wells and analyzed for baseline constitutents. Analysis showed that concentrations of chromium, cadmium, nitrate and silver were significantly above the National Interim Primary Drinking Water Standards (NIPDWS) levels in some of the samples. Table 4-1

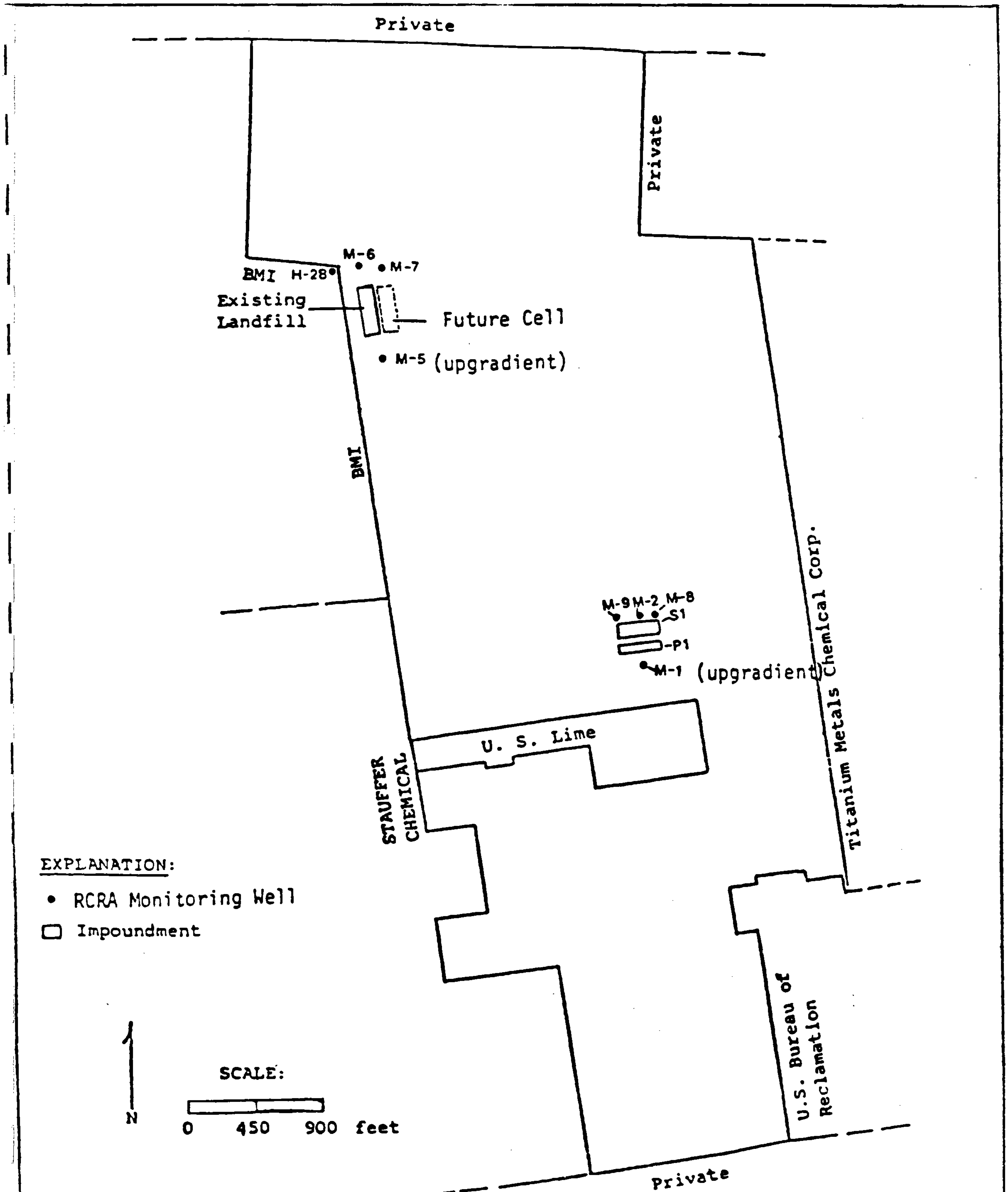


Figure 4-2 : Location of RCRA Groundwater Monitoring Wells

TABLE 4-1

CHROMIUM CONCENTRATIONS IN GROUNDWATER

Date	Constituent	Found in Samples from Wells	Concentration ranges (mg/l)
8-82	Cd	M-1,M-2,M-3,M-9	0.02-0.05
	Cr	M-1, M-2	12.9
	NU_3	M-1	11.2
	Ag	M-2	0.1
10-82	Cd	M-1,M-2,M-8,M-9	0.01-0.06
	Cr	M-1,M-2,M-3	10-44
	NO_3	M-1,M-3,M-4	8.8-44
	Ag	M-2,M-3	0.09-0.10
2-83	Cd		
	Cr	M-1,M-2,M-8,M-9	0.02-0.07
	NO_3	M-1,M-2,M-8,M-9	5.1-16.3
	Ag	M-1,M-2,M-8,M-9	14.7-18.7
		M-9	0.02-0.06
5-83	Cr	M-1,M-2,M-8,M-9	6-18.5
	NO_3	M-9	2.5
	Ag	M-8,M-9	16.7-19.4
	Fl	M-9	0.07
8-83 (M-8 and M-9 only)	Cd	M-8,M-9	0.1
	Cr	M-8,M-9	3.-26
	NO_3	M-9	22.4

Source: Groundwater Monitoring Reports submitted by KMCC to NDEP on the noted dates.

presents the analyses of the wells sampling. It is clear from these results that the upgradient well M1 has concentrations of chromium that are considered hazardous and therefore, cannot feasibly be used for background measurements. This data indicates that all the groundwater is contaminated. No other background groundwater data was available for further comparison.

ERTEC, Inc., a contractor of EPA Region IX, conducted a review of KMCC's groundwater monitoring program in April 1983. This report indicated that concentrations of sodium, chloride and specific conductance were higher in the downgradient wells than in the upgradient well. The concentration of total organic carbon in two downgradient well samples is twice the concentration in the upgradient well samples. Concentrations of total organic halogens were found in all well samples both upgradient and downgradient.

The semi-annual RCRA groundwater monitoring report from KMCC, October 4, 1984 showed some of the statistically significant increases in specific conductivity and TOC in the surface impoundment monitoring wells. The background value of specific conductance for upgradient well M-1 is 11,803 umhos and the mean sample value is 16,400 umhos. The downgradient well, M-9 has a mean specific conductance of 24,500 umhos. The TOC concentration for the background M-1 is 11.7 mg/l and the mean value reported at this date is 8.9 mg/l. The TOC concentration in downgradient Well M-9 is 23.1 mg/l.

The results of the sampling reported in October 1985, show a continued increase in specific conductance for wells M-1 and M-9. The TOC concentrations were decreased by more than fifty percent. KMCC stated in both reports that the specific conductance in the M-9 area varied significantly between 15,000-40,000 umhos. They asserted that because the samples from M-9 fell within this background range, the groundwater quality had not been affected.

4.5 POTENTIAL RELEASES

Air

At the present time, none of the substances held in the active ponds have the potential to release any emissions to the atmosphere which could prove to be harmful.

Contaminated airborne soil particles could be released to the air from the closed surface impoundments S1 and P1. These areas have not been filled and graded with clean soil.

Soil

Past activities at KMCC included the use of unlined ponds. Disposal of liquid waste in an unlined pond results in evaporation and percolation through the soil. Depending on the type of waste disposed, contaminants could have been adsorbed on soil particle, adversely impacting the unsaturated zone.

Currently all ponds are lined with at least one liner. There is a possibility that liners will deteriorate, to some degree, over time and eventually leak into the soil. The released contaminants could adsorb on soil particles.

Surface Water

The ammonium perchlorate numbered ponds hold perchlorate wastes from the sodium and ammonium perchlorate processes. Perchlorates are strong oxidizers and are thus considered hazardous wastes because of their explosive nature and fire risk. The perchlorate area is bermed and the storm drains are plugged so that any overflow would be contained in the area. In this respect, there is no potential threat to the local surface water.

Indirect surface water contamination could arise from the contamination found in groundwater. The contaminated groundwater flows towards Las Vegas Wash with discharges into Lake Mead. Therefore, contaminated groundwater could eventually reach a surface water. Future implementation of a groundwater cleanup system will reduce the potential impact on Las Vegas Wash from this source.

Groundwater

The surface and subsurface geology of the area is comprised of primarily silty and clayey sand, gravel and pebbles. This type of material has a high porosity which allows for the migration of liquids to the groundwater of the pond's liners had cracks.

If the liners of the active ponds have cracks, a potential for the migration of $NaClO_4$, NH_3ClO_4, $KClO_4$ to the groundwater. Waste and process waters containing sodium and potassium phosphate may also migrate. Chromium contamination may also result from liner failure in the active ponds.

Although Ponds S-1 and P-1 are under the process of closure, these ponds once handled waste considered hazardous due to its chromium concentration. Perchlorate-containing material was placed in these ponds, presenting an additional potential contaminant release.

SECTION 5.0
DUMP SITES, DRAINAGE CHANNELS, SPILLS

5.1 DUMP SITES

5.1.1 Description

Aerial photographs over the past forty years indicated several dump sites and drainage channels on the KMCC property. Figure 5-1 thorugh 5-4 indicate the changes that occurred on the plant property between 1943 and 1979.

Several dump sites were observed in the aerial photographs over the history of operation at KMCC. The only solid wastes reported to have been dumped on the property were magnesium tailings, consisting of magnesium ore, paraffin wax and diatomaceous earth. The tailings, which are considered non-hazardous, were reported to have been dumped in unlined ditches in the northwest portion of KMCC property. Aerial phtographs document the first dump site in this area of KMCC property, in 1943 (please see Figure 5-1). The site was approximately 5.0 acres, with the eastern portion of the dump site on KMCC property. At that time, the site was owned and operated by the federal government. KMCC's operations started in 1947. In 1950 (Figure 5-2), the entire site grew to approximately 45 acres, and a much larger fraction was located on the KMCC property.

In 1960 (Figure 5-3), the portions of the northwest dump site on KMCC property, appeared to be inactive. Four new dump sites appeared north of U.S. Lime property (Figure 5-3). A dump site to the far west of the property was about 6.0 acres in size. Two dump sites north of U.S. Lime and east of the perchlorate area were about 3.0 acres each. The fourth dump site was north of the magnesium dioxide area and had an area of 5.0 acres. This dump site appeared to be split into 5 cells. The 1969 photograph does not indicate any changes in the size or soil patterns of the four dump sites.

The 1979 photograph (Figure 5-4) indicated a variety of dump sites around the property. Two dump sites appeared again in the northwest corner of the property which corresponds to the area of the hazardous waste landfill. No other information regarding the nature of wastes at the other dumps sites other than the hazardous

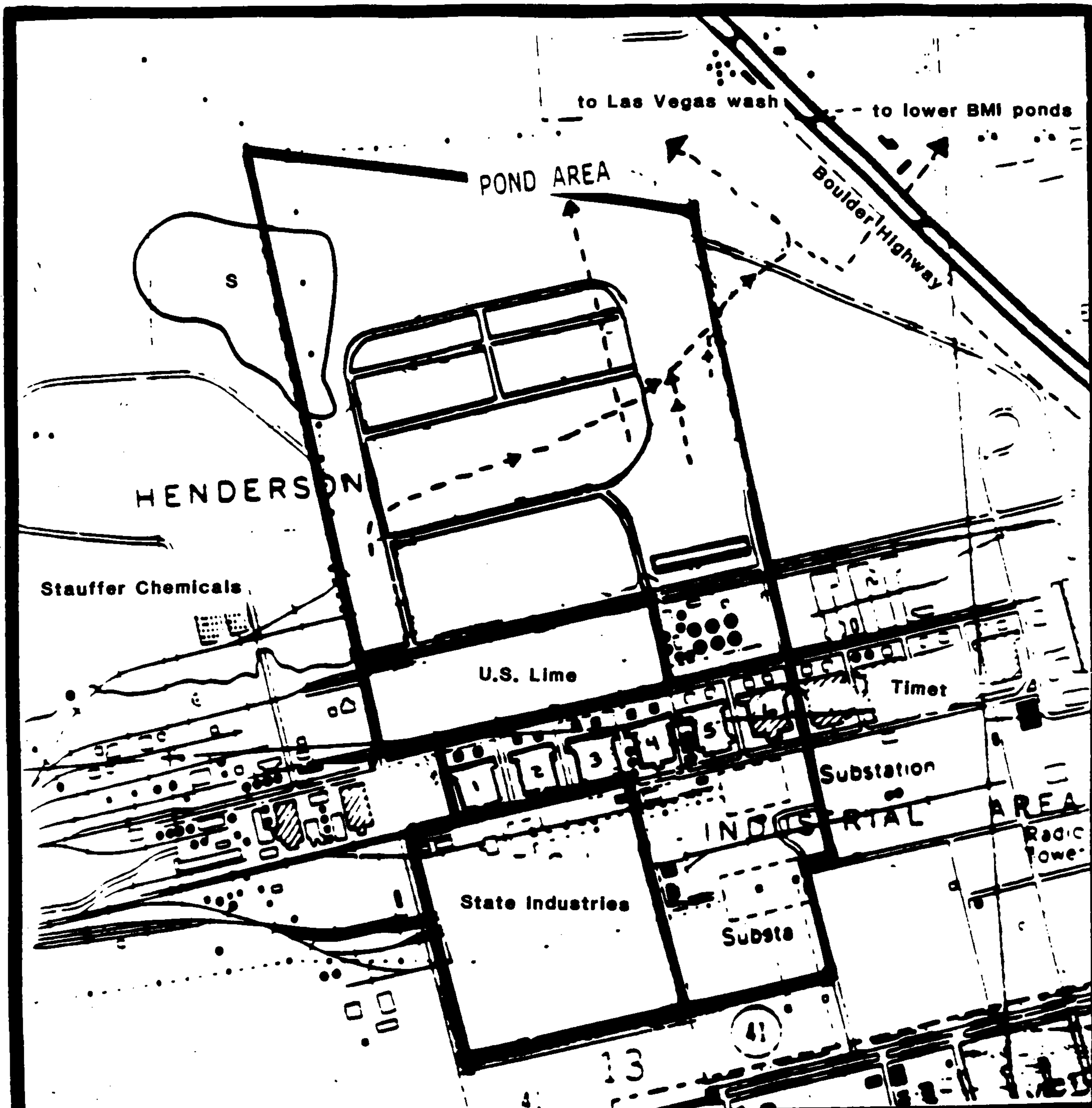


Figure 5-1 : Aerial Photograph 1943.

legend

---- drainage channels

S dump site

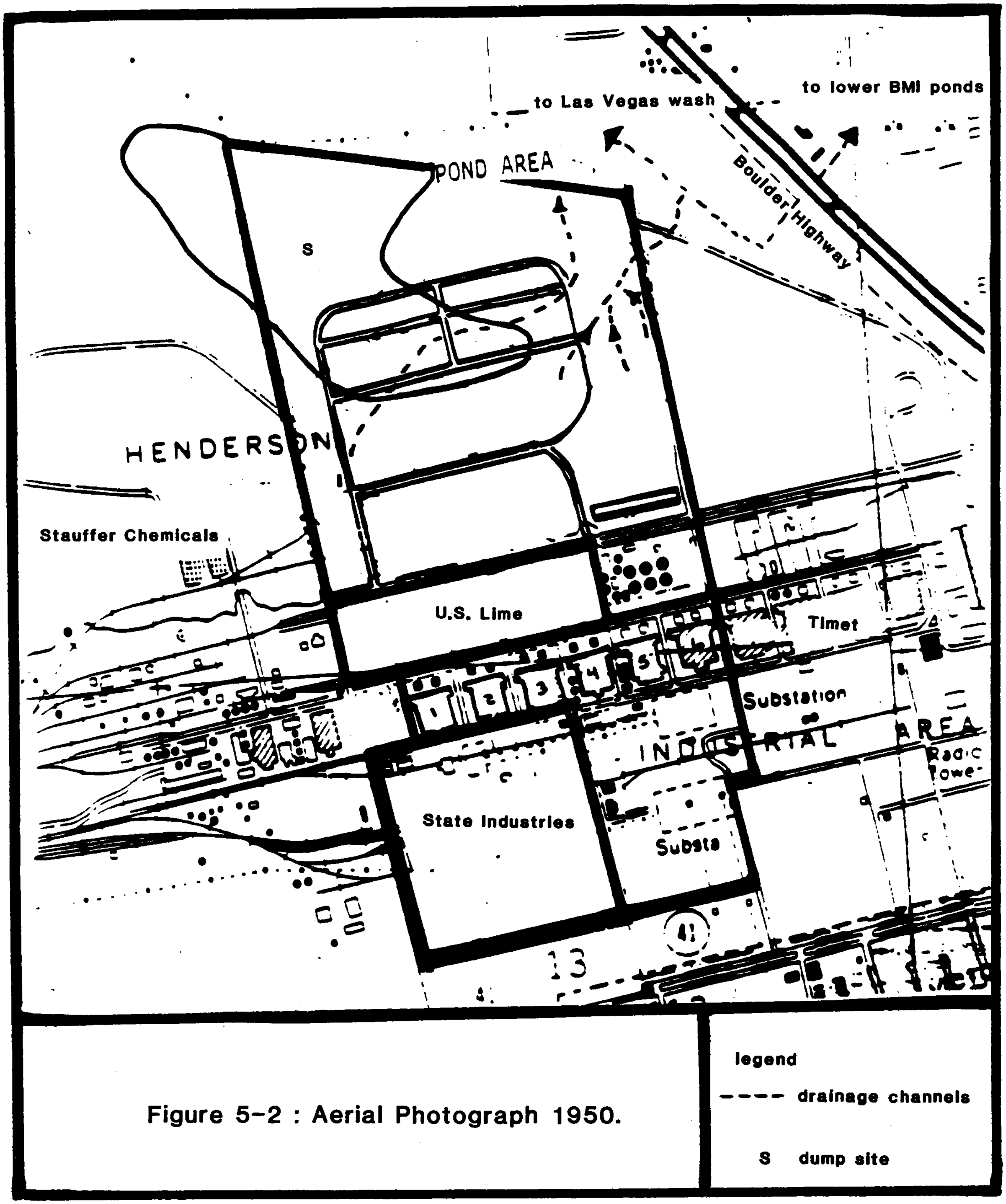


Figure 5-2 : Aerial Photograph 1950.

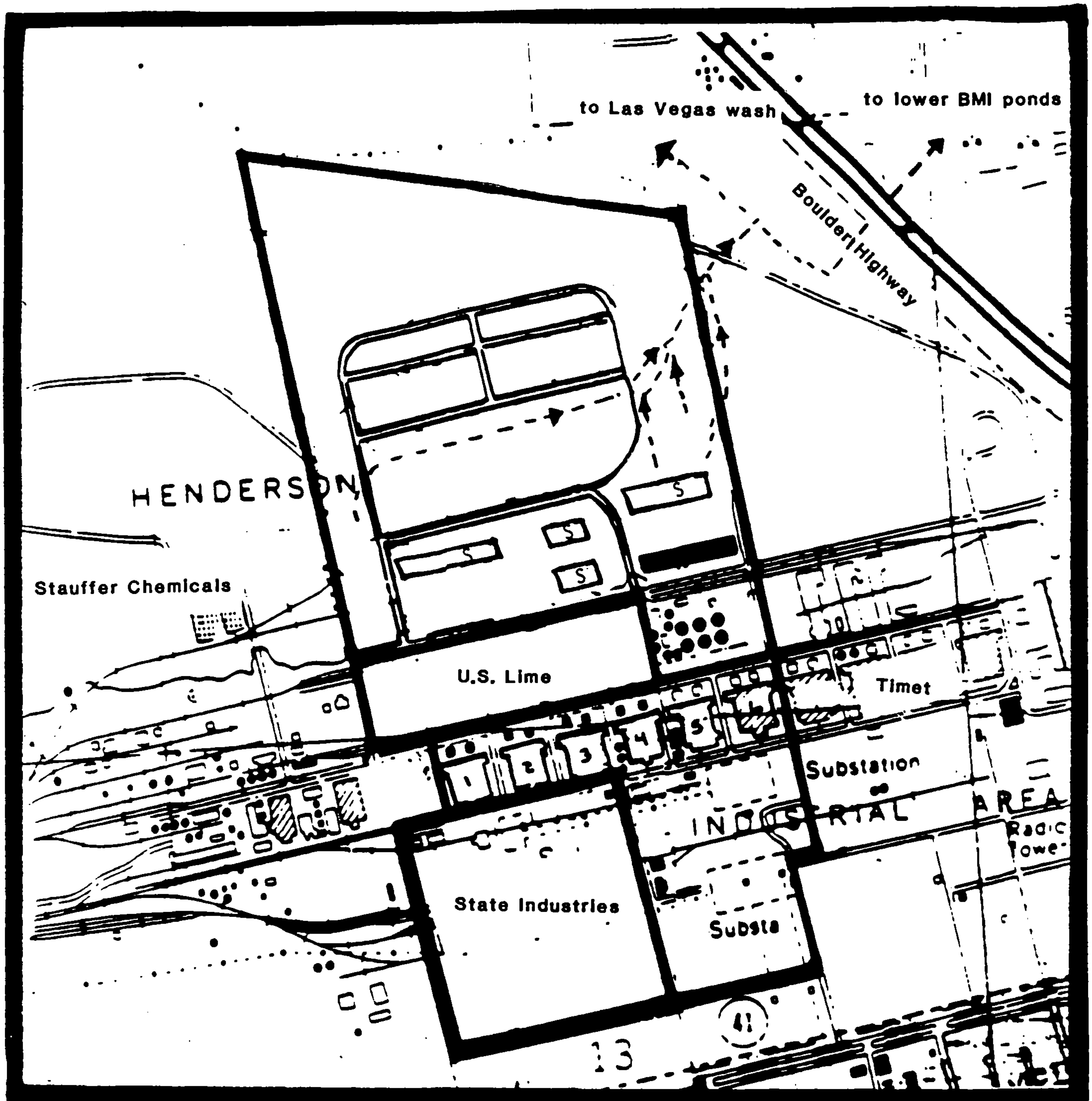


Figure 5-3 : Aerial Photograph 1960.

legend

---- drainage channels

S dump site

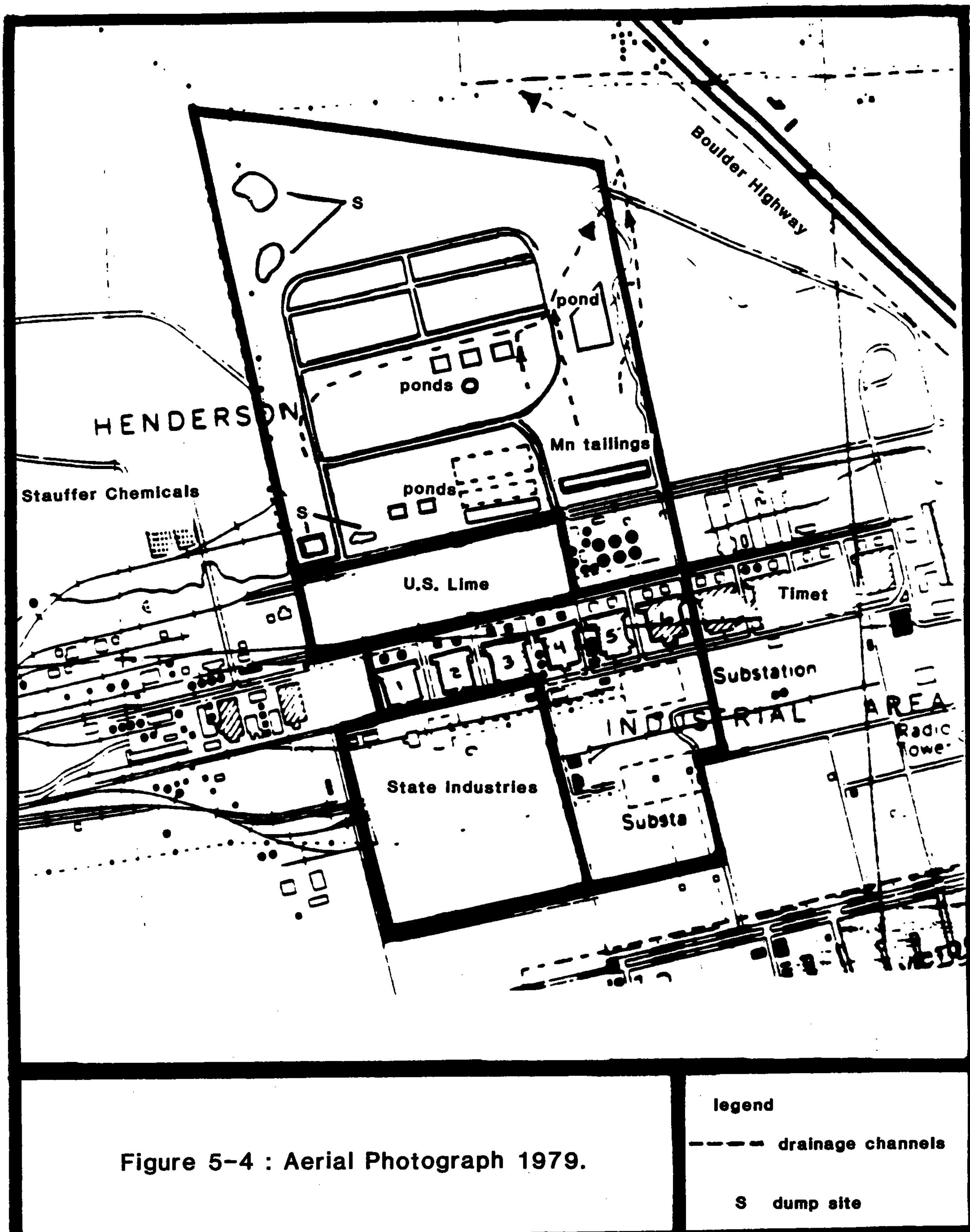


Figure 5-4 : Aerial Photograph 1979.

waste landfill was available. The four previously mentioned sites were still in existence, with the exception of one site which had become Pond S-1.

5.1.2 Contaminant Releases

Air releases could arise from contaminated airborne particulates if adequate cover is not provided for the dump sites. The potential for surface, water contamination would also depend upon the type of lever provided for the piles/dumps. NPDES permit regulates such discharges from KMCC's property (refer to Section 5-3). it is not known from the reviewed information if adequate cover (if any) was provided for these sites. In addition, contamination could have migrated through the soil and the groundwater if liquid waste was disposed or the amount of rainfall at any one time was sufficient to induce any movement.

5.2 DRAINAGE CHANNELS

5.2.1 Description

Prior to the construction of the lined ponds on its property, KMCC was reportedly discharging all other liquid wastes into the lower BMI unlined ponds, northeast of the complex. It is assumed that the drainage channels, which appeared in the photographs, carried the effluent wastes to the BMI unlined ponds for nearly thirty years until the on-site ponds were installed. The drainage channels also carried stormwater runoff and non-contact cooling water from the process areas.

The types of wastes which were apparently disposed in the BMI ponds via these drainage channels are as follows:

- Filter cake containing impurities, $CaCO_3$, $CaSO_3$, chromium, graphite and diatomaceous earth from the sodium chlorate and perchlorate processes;
- Caustic scrubber solution (unknown pH) from ammonium perchlorate process; and
- Potassium chlorite and perchlorate sludge from the potassium perchlorate process.

The boron production did not begin until after 1967. The exact date is unknown. Available information did not indicate disposal of boron waste in any BMI ponds. Based on the available information, hazardous contaminants discharged through the drainage channels were heavy metals, such as chromium.

Over the years the drainage system remained essentially unchanged. In 1943 four drainage segments appeared on KMCC property. All segments joined at the upper east side of KMCC and flowed north across Boulder Highway joining with drainage from the western outskirts of the industrial ponding system and eventually draining into the Las Vegas Wash. One of the channels flowed directly into a pond at the north end of the complex. (It is not clear if the pond is on Kerr-McGee property).

The 1950 photograph (Figure 5-2) indicated drainage from the large dump site on the northwest side which discharged into the pond. Three other drainage channels joined together and drained into two other channels, one which flowed north towards the Las Vegas Wash and the other discharged into the lower BMI ponds. The 1960 photograph (Figure 5-3) documented that the pond at the north end of the complex was dry and that the dump on the west side was gone. Therefore, there was no drainage from these areas. The four drainage channels remained essentially the same, except for the channel at the far east side. This channel now combined with drainage from the TIMET property and then joined the other drainage channels from Kerr-McGee at the northeast end. Drainage still appeared to discharge to both the lower BMI ponds and Las Vegas Wash. In 1969, the drainage channels remained unchanged. The 1979 photograph (Figure 5-4) was taken after the construction of the lined ponds on KMCC. Drainage patterns remain unchanged, however. The only discharge, at that time, was non-contact cooling water and stormwater runoff from the process areas.

5.2.2 Contaminant Releases

From past practices, it is possible that chromium contamination percolated through the soil and reached the groundwater. These channels are unlined and used to carry generated wastewater to the BMI ponds. Currently, these drainage channels are conduit for NPDES regulated water discharge. Thus, further downward movement of existing contaminants might still occur. Due to the past disposal practices, it is not possible to correlate the groundwater contamination to any single unit. Some of the drainage channeled toward the Las Vegas Wash, therefore, contamination of that surface water could have occurred as a result of past disposal practices. Currently, surface discharges from the KMCC property are regulated under an NPDES permit (refer to Section 5.3)

In addition, air release could occur from airborne contaminated particulates, if the discharge channels get dry.

5.3 PERMITTED NPDES DISCHARGE

The current NPDES permit (May 1986) designates two discharge points at the Kerr-McGee facility. There are actually four outfall areas, three for stormwater runoff, and one for non-contact cooling water. Two of the stormwater runoff outfalls and the non-contact cooling water outfall combine on KMCC property and were designated as one discharge point. The outfalls are monitored for flow, pH, temperature and total dissolved solids. None of the discharge is treated. Figure 5-5 shows the outfall areas.

Outfall 1 is the point for once-through noncontact cooling water from the manganese leach plant. It is also the outfall point for the west storm sewer collection, identified by outfall 2, in addition to the Genstar Lime property and any areas to the west and north of it which are served by storm sewers. In the past, once-through cooling water from the heat exchangers serving the sodium chlorate process was discharged at this point. This was stopped in July 1984, when a cutback in production level allowed for complete recirculation of cooling water. Outfall 2 is a monitoring point for the storm sewer collection system serving the area surrounding buildings #1, #2, #3 and the western half of #4. The sodium chlorate recovery operation in the eastern half of building 4 does not impact on this outfall location, since the storm drains in that area have been sealed and barriers have been placed to prevent runoff from the area. The stormwater runoff is collected and discharged into the unlined ditch which flows into the Las Vegas Wash.

Outfall 3 is a manhole monitoring point for stormwater collection servicing the area surrounding the eastern half of buildings #4, #5 and #6. The process areas of these buildings are reported to be isolated from the stormwater collection system. Stormwater from this location flows into an interceptor that also serves the westside of Titanium Metal Corp. (TIMET). The outfall flows north through an unnamed ditch to

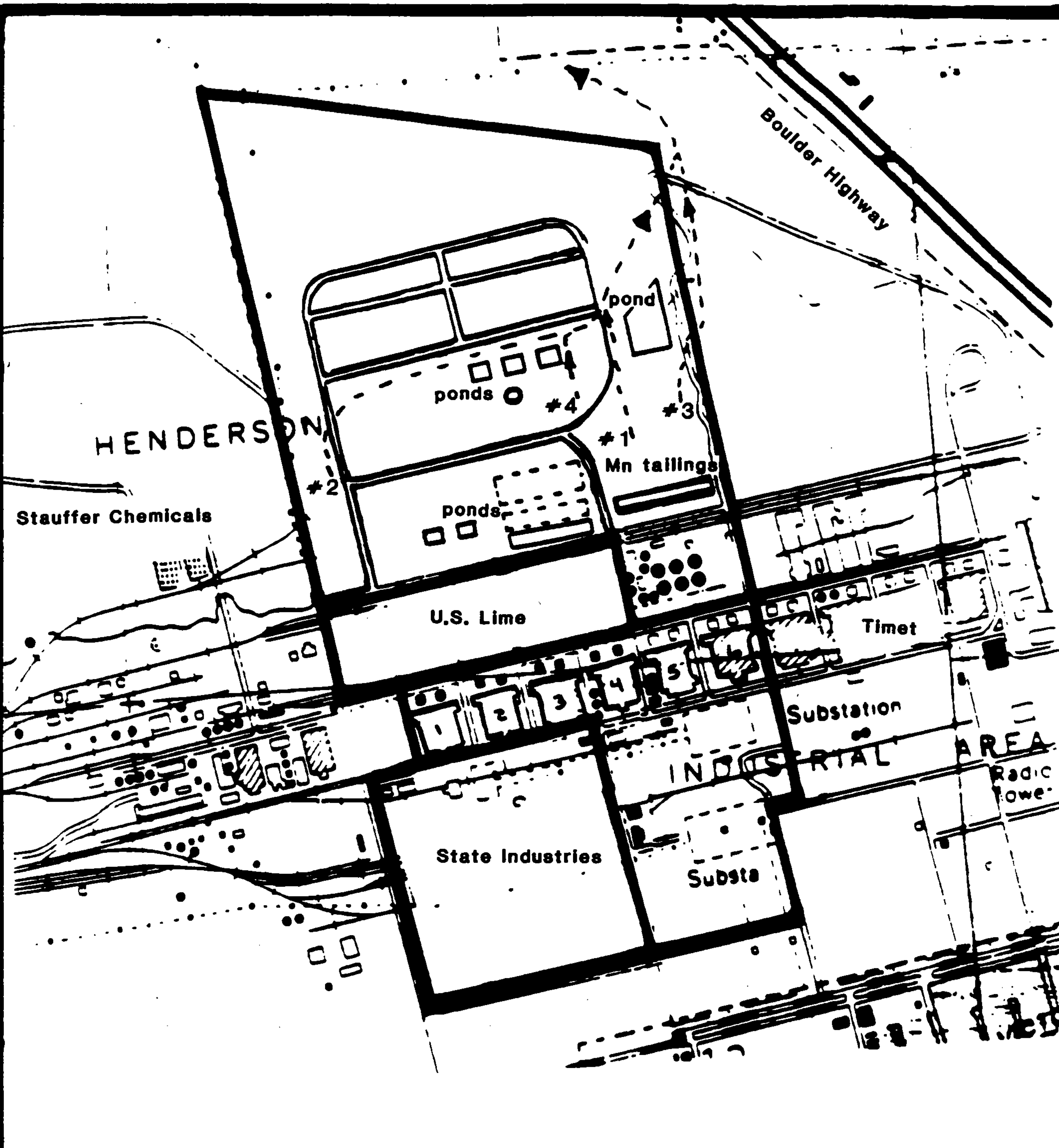


Figure 5-5 : NPDES Outfalls.	legend - - - - drainage channels

the BMI siphon portal located on the north side of the Boulder Highway and is transported to the Las Vegas Wash via the Alpha Ditch.

Outfall 4 is the collection point for any stormwater in the northern part of the property surrounding the ammonium perchlorate area. Stormwater from within ammonium perchlorate production and product storage area is fully contained and diverted to ponds. This outfall intercepts the discharges from the outfall 1 and 2 locations.

5.4 SPILLS

The reviewed documents pertaining to KMCC revealed only three spill incidents reported to the NDEP. All three spills were from the magnesium dioxide process and involved the same process liquid (anolyte). The first occurrence was a leak from a storage tank in January 1983. Approximately 100,000 gallons of solution containing 40 gpl of sulfuric acid and 50 gpl manganese sulfate leaked out of the tank. The area around the tank was diked and the liquid was neutralized with soil. The second occurrence involved a leak from the same tank in July 1983. A solution containing approximately 100 gallons of sulfuric acid leaked out of the refurbished glass-lined tank. The liquid was mixed with soil and magnesium tailings until it was no longer corrosive, and then disposed of in a non-hazardous waste landfill. The third spill occurred in February 1986 when a process line carrying the same solution broke. Approximately 5500 gallons of solution which contained 139 gallons sulfuric acid spilled onto the ground. The spill was neutralized with lime and soda ash until it was no longer corrosive and subsequently disposed in a non-hazardous waste landfill.

The aerial photograph from 1979 indicated a stream of yellow liquid effluents draining east through the titanium metals plant and emptying into the Palsco Road drainage ditch and eventually into the Las Legas Wash. This drainage channel is designated on KMCC's NPDES permit; however, the color of the effluent indicated some type of contamination.

The 1979 photograph also indicated a larger (0.5 acre) spill stain in the southwest corner, directly north of the buildings. The type of chemical spill was not discernible from the photograph because it was not a well-defined color.

Such releases, if not adequately contained and cleaned, might have contributed to the contamination found on site. Soil, surface water and groundwater contamination could have occurred during spillage of large amounts of waste.

SECTION 6.0
LANDFILL AND WASTE PILE

6.1 LANDFILL DESCRIPTION

A hazardous waste landfill was operated at KMCC prior to January 23, 1983. The landfill was considered hazardous due to the presence of hexavalent chromium. Aerial photographs indicated that filling in this area began after 1950. A document indicating when the chromium wastes were first deposited was not available. The landfill unit is now closed and is currently receiving post-closure activity, as required in the NDEP approved Closure/Post Closure Plan, April 16, 1985.

The maximum volume of the landfill's single cell was approximately 13,000 cubic yards. This estimate is based on the cell dimensions of 410 x 45 x 20 feet, including 2 feet of free board. The cell contained an estimated 300 cubic yards of mud from the sodium chlorate process which was solidified with an equal volume of native soil. The mud contained calcium sulfate, calcium carbonate, chromium graphite and diatomaceous earth. In addition, 2,900 cubic yards of chromium contaminated soil from closure of Pond S-1, solidified with background soil and the liner were placed in the cell.

The cell was capped with a multi-layer cover system which consist of a bottom low permeability (less than 10^{-7} cm/s) layer of 1.5 feet of clay. The clay layer extends five feet in all directions beyond the perimeter of the cell to ensure that seepage does not occur. A high density polyethylene membrane (HDPE), 40 mil thick, was placed over the clay layer. An overlying six inch layer of the same clay used in the bottom layer, was spread over the top. A one foot thick drainage layer was placed over the clay at a final slope of 3%.

6.2 GROUNDWATER MONITORING PROGRAM

In 1982, KMCC installed four groundwater monitoring wells pursuant to 40 CFR 265. Three wells (M-6, M-7, M-8) were installed downgradient to the landfill and one (M-5) upgradient. Please see Figure 4-1 for location of monitoring wells. Baseline groundwater data was obtained from quarterly sampling between 1982 and 1983. Some of the wells indicated levels of cadmium and coliform bacteria which were in exceedence of the NIPDWS levels. No chromium contamination was found, indicating that the landfill contents had not migrated. Table 6-1 presents the sampling results for the baseline groundwater study of the wells.

The semi-annual groundwater monitoring reports issued by KMCC did not indicate that the landfill had affected groundwater quality. The only reports available were October 4, 1984 and October 21, 1985; no interim report found in the files. Both reports specified that no chromium was detected in any of the wells. Chromium is the parameter most representative of the waste contained in the landfill.

A report prepared by ERTEC, Inc for Region IX, indicated that concentrations of gross alpha and gross beta particles in all monitoring wells appeared to be high. This information was based on a review of water quality data provided by KMCC. Since the use of or disposal of radioactive chemicals has not been documented at KMCC, this may indicate contamination from previous site activities.

6.3 POTENTIAL RELEASES

Air

The landfill was covered and capped by October 1985 to prevent the wastes in the landfill from escaping to the atmosphere.

Soil

The landfill was not capped until 1985, two years after it had stopped accepting hazardous waste. During this time, the rare but heavy rains could have induced percolation of some of the constituents through the soil

Surface Water

The landfill is protected from flooding by its elevation and nearby surface contours. A diversion drainage berm was constructed around the cover to control surface water run-on. Run-off from the cover will not cause excessive errosion of the surface because the slope will allow steady drainage. The clay layer should prevent any percolation of water into the landfill. However, in the remote chance that surface

TABLE 6-1

BASELINE GROUNDWATER RESULTS FOR LANDFILL

Date	Constituent	Found in Well H-28	Concentration ranges (mg/l)
10-82	Cd	M-5,M-6,M-7,H-28	0.02-0.06
	Fl	M-5,M-6,M-7	2.5-3.6
	Coliform	M-5,M-6,M-7	4-240 (ml)
2-83	Cd	M-5,M-6,M-7,H-28	0.01-0.06
	Coliform	M-7	16
5-83	Cd	M-5,M-6,M-7,H-28	0.02
	Fl	M-6	2.5

First quarter sampling results are not included. The information was not available.

Sources: Quarterly Groundwater Monitoring Reports submitted to NDEP.

water penetrates the cap and clay cover, the synthetic membrane will intercept and drain it away from the cell contents. Based on the construction of the landfill, contaminants will not be released through the cover.

Groundwater

The groundwater appears to be contaminated in this area with cadmium, fluoride and coliform bacteria in concentrations greater than the NIPDWS levels. These constituents could have been part of the earlier landfill activities at the site which percolated through the soil over the years. It is possible that contamination of the groundwater will continue if these constituents still remain in the soils of the area.

6.4 WASTE PILE

The SWMU response provided by KMCC mentioned that they presently operate a non-hazardous waste pile under the approval of NDEP dated May 15, 1985. The pile is located to the east of the manganese dioxide production area. (Figure 6-1). The pile is approximately 350 feet by 300 feet by 20 feet high. The waste pile contains the tailings from purification of manganese ore. The tails contain filter ore and diatomaceous earth, as the primary constituents and other iron salts. In March 1983, these tailings were analyzed as non-hazardous by the Desert Research Institute, in accordance with the EP toxicity test.

Some documents contain information which indicates that tailings piles may have been in existence prior to KMCC activities. Since the magnesium wastes are non-hazardous, there is essentially no threat to the environment; therefore potential releases need not be considered. An inspection report conducted by EPA Region IX for an NPDES permit in June 1980 indicated two large areas of manganese tailings. One is directly south of the P-1 Pond and the other is north of the manganese dioxide area, just east of the S-1 Pond.

SECTION 7.0
SUMPS

7.1 SUMP DESCRIPTION

Units 4 and 5 at the KMCC facility have been used for the production of sodium chlorate. These buildings were constructed in the early 1940's. Each of the buildings had basements which were used as sumps to collect sodium chlorate liquor, spillage, wash water and storm water runoff. The actual size and design parameters of the sumps were not available. These liquids were continuously pumped back into the process. The sodium chlorate process used sodium dichromate in concentrations up to 4-5 grams per liter of process liquor as a pH buffer and a corrosion inhibitor. The only other reported raw materials used in this process were sodium chloride and water. KMCC did not have these basements permitted as storage units on their Part A application.

7.2 DOCUMENTED RELEASES

Elevated concentrations of chromium were found in upgradient and downgradient monitoring wells located around ponds S-1 and P-1. A total of 15 additional groundwater monitoring wells were installed in an effort to determine the source of contamination (location of the wells is unknown). The source of contamination was traced to the basements of Units 4 and 5. Apparently, through the years, deterioration and cracking of the basements occurred which allowed leaking of the chromium wastewater.

Since the time the chromium contamination was discovered, several efforts have been made by KMCC to reduce the amount of chromium in the groundwater. The cracks and structural deterioration in the basements of Units 4 and 5 were repaired. Various groundwater monitoring wells were pumped back to the process. The basements continued to be used as sumps until March 1984. At that time, an Administrative Order was issued to KMCC by NDEP (March 21, 1984) to immediately cease and desist the use of the "basement" area for the storage of chlorate process waste.

Table 7-1 presents the groundwater sampling results over the period of testing between 1982 and 1984. The data is from the first and last analysis at each well.

TABLE 7-1

CHROMIUM CONCENTRATIONS IN MONITORING WELLS

Well	Date	Chromium Concentration (ppm)	Comments
M-1	1-14-82 12-14-83	12.2 9.5	25% reduction in Cr.
M-2	1-14-82 12-15-83	9.0 5.6	45% reduction in CR may be attributed to pumping of Well M-3.
M-3	1-14-82 12/83 average	31.1 20.0	40% reduction in Cr may be attributed to pumping of Well M-3.
M-4	1-14-82 8-24-82	0.18 < 0.02	Indicates western extent of plume.
M-8	10-5-82 12-14-83	5.1 6.7	
M-9	10-5-82 12-14-83	16.3 29.7	A "sink" between M-9 and M-3 possibily equalized the Cr in this area.
M-10	6-20-83 8-24-83	< 0.02 < 0.02	Upgradient of Units 4 and 5.
M-11	6-14-83 10-83	72 44	The decrease in Cr is attributed to pumping M-11 and fixing the basement in Unit 5.
M-12	6-14-83	44	Additional samples to be collected.
M-13	6-20-83 8-24-83	0.14 1.1	
M-14	6-20-83 8-24-83	0.34 0.41	Indicates western extent of plume.
M-15	6-20-83 8-24-83	6.5 6.3	
M-16	6-20-83 8-24-83	9.0 7.0	Additional samples to be collected.
M-17	6-20-83 8-24-83	7.0 6.7	Additional samples to be collected.
M-18	8-24-83	0.73	Indicates eastern extent of plume.

TABLE 7-1

CHROMIUM CONCENTRATIONS IN MONITORING WELLS

(Continued)

Well	Date	Chromium Concentration (ppm)	Comments
M-19	8-24-83	0.03	
M-20	8-24-83	0.02	
M-22	8-24-83	1.5	
M-23	8-24-83	3.5	Additional samples will be collected.
Well M-22 was silted in.			

Source: Correspondence, KMCC to NDEP, February 1, 1984.

NDEP issued a Consent Order, on May 30, 1986 for the cleanup of chromium-contaminated groundwater. KMCC has initiated a program to cleanup the chromium contaminated groundwater. The plan, approved by NDEP is to pump the water out of the ground. The groundwater will be treated by the ANDCO Electrochemical Heavy Metal Removal System, which was scheduled to be installed in July, 1987. The chromic hydroxide sludge generated from the process will be disposed of at an approved site. The groundwater recovery treatment program is scheduled to begin on September 9, 1987.

7.3 POTENTIAL RELEASES

Although the basements are no longer being used as sumps there is a possibility of future releases from the contaminated units to the soil underneath and around the strctures. The contaminants in the soil could eventually reach the groundwater and the Las Vegas Wash. Contamination of surface water from direct runoff is unlikely, since the contamination source exists below the ground surface, under buildings.

SECTION 8.0
CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS OF THE PR

The KMCC facility is located in an arid region. However during intense rainfall, heavy erosion does occur. In this respect, consideration must be given to the effect of precipitation on the existing waste management units. The only waste management units which were regulated under RCRA have been closed under the direction of the NDEP. These units consist of surface impoundments and a landfill which have been regulated because of high chromium concentrations. The landfill is currently under post-closure management. The surface impoundments were not required to have post-closure monitoring because all hazardous waste was removed. Adequate soil sampling has not been conducted around the areas where chromium waste was contained. It is possible that chromium contamination still exists in the soil around the two impoundments. Soil samples were taken only at depths of less than 5 feet. The basements, previously used as sumps, might still present a source of chromium contamination. The soil underneath these buildings was not analyzed for chromium and therefore could contain hazardous concentrations and continue to contaminate the groundwater.

The groundwater monitoring program is in effect, under the direction of NDEP, for chromium detection. However, other hazardous constituents in exceedance of the NIPDWS levels were found in the baseline groundwater monitoring results. Also, sufficient background data does not appear to have been acquired because the sampled downgradient wells yielded concentrations of constituents which were also in exceedance of EP toxic levels.

In general, an adequate assessment of contamination in the groundwater and soil has not been completed. The sources of the other constituents, besides chromium, which are in exceedance of EP toxic levels need to be identified, so corrective action measures can be initiated.

8.2 RECOMMENDATIONS FOR THE VSI

The VSI should have two major activities: additional document review and a facility inspection. The documents reviewed at the EPA and NDEP offices did not provide complete information. In particular, additional documentation on the disposal of the liquid wastes prior to the implementation of the ponds is necessary. The VSI at the facility should also include inspection of all the areas where disposal activities appeared on the aerial photographs to see if any waste characteristics can be deduced. An inspection of the sodium chlorate process building basements should be conducted to check for any potential contamination.

8.3 RECOMMENDATIONS FOR FUTURE CORRECTION ACTIONS

The following corrective actions are recommended for the facility as a result of the PR. Results of the VSI will confirm the validity of the recommendations. Final recommendations will be presented after the VSI in the final report.

- Expand the groundwater monitoring to include analysis for other constituents identified in the baseline monitoring results.

- Identify the sources of this contamination.

- Sample the soil underneath and around the basements of Units 4 and 5 for chromium. Excavate soil if results show exceedance of EP toxic standards.

Since contamination of the groundwater is apparent, sources contibuting to the contamination must be identified and corrected. Any additional information found regarding past waste disposal practices could assist in the identification of the sources of contamination.

SECTION 9.0

REFERENCES AND OTHER SOURCES OF INFORMATION

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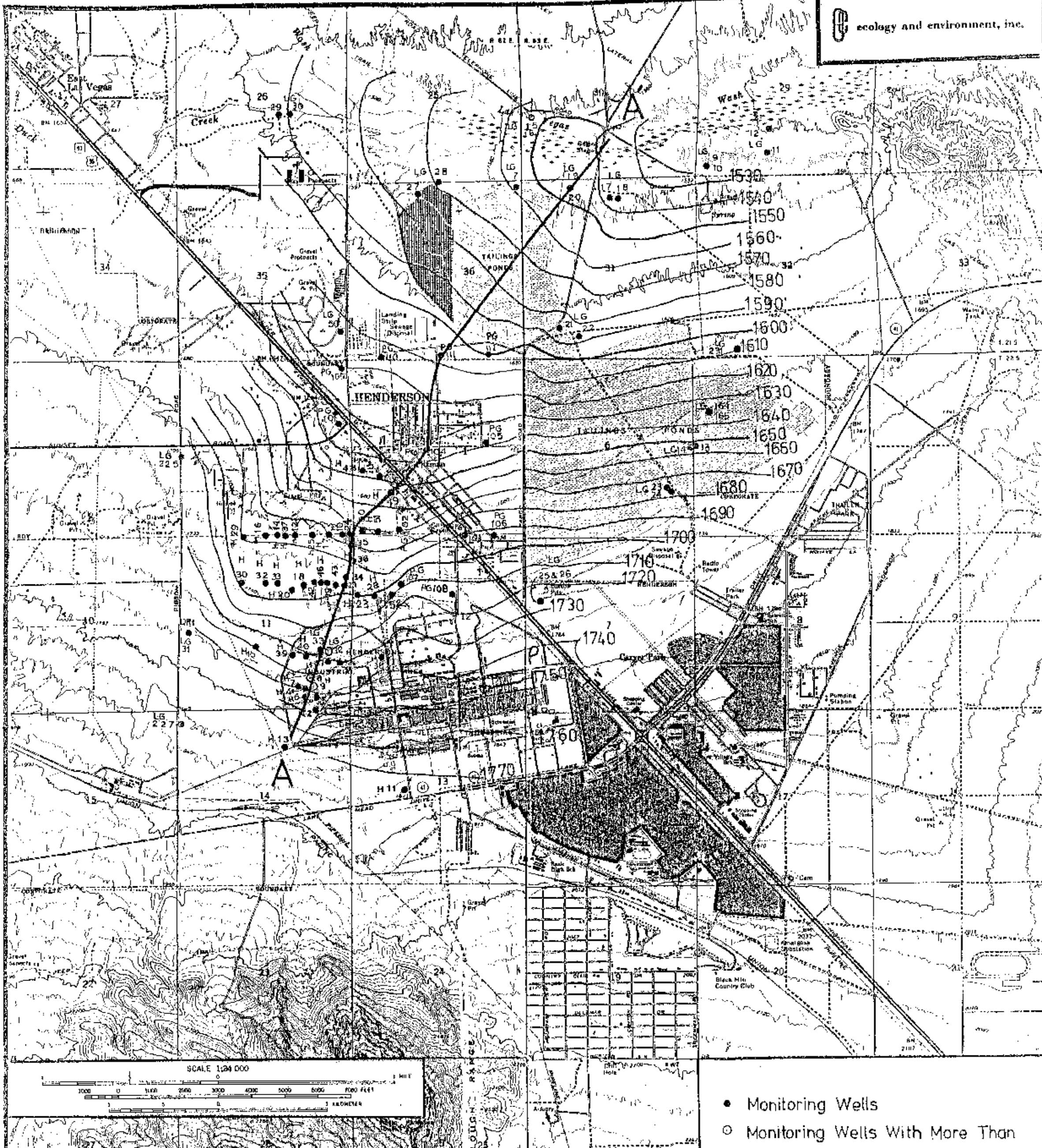
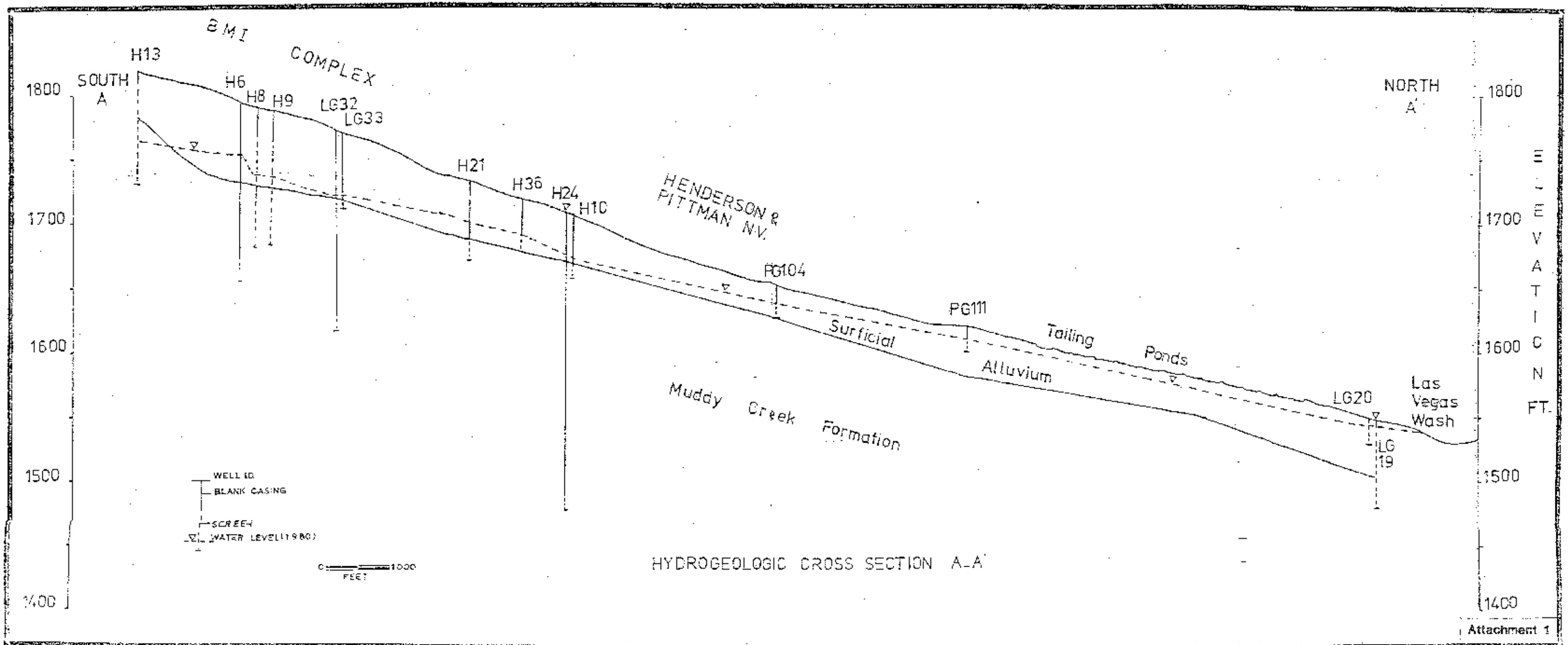


1980 GROUNDWATER ELEVATION
CONTOUR MAP

Attachment 2



Attachment 1