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13. ABSTRACT *(Maximum 200 words)*

RMA AND USATHAMA HAVE BEEN TASKED WITH DEVELOPING A PRELIMINARY CONCEPTUAL DESIGN FOR THE NORTHWEST BOUNDARY CONTAMINATION CONTROL SYSTEM. SPECIFIC TASKS INCLUDED IN THIS PROGRAM FOLLOW: (1) PROVIDE A CONCEPT SELECTION WITH SUPPORTING RATIONALE FOR THE RECOMMENDED CONTROL SYSTEM. THIS DESIGN WILL INCLUDE THE NUMBER OF DEWATERING AND RECHARGE WELLS, THE TYPE OF TREATMENT SYSTEM, THE MONITORING WELL REQUIREMENTS, THE SPACING OF WELLS, THE LOCATION OF THE BARRIER AND WELLS, AND THE EXPECTED PERFORMANCE OF THE SYSTEM COMPONENTS, (2) PROVIDE A BUY VERSUS LEASE ANALYSIS FOR THE TREATMENT SYSTEM, (3) PREPARE A 1391C AND PDB-1 DOCUMENT FOR SUBMISSION FROM THE TECHNICAL OPERATIONS DIRECTORATE TO THE INSTALLATION SERVICE DIRECTORATE AT RMA.

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NORTHWEST BOUNDARY
CONTAINMENT SYSTEM

ROCKY MOUNTAIN ARSENAL
DENVER, COLORADO

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PAUL G. BERGERON, USATHAMA

AUGUST 1981

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ACKNOWLEDGEMENTS

Portions of this report have been extracted and modified from the report "Conceptual Design of the North Boundary Containment System", prepared by D'Appolonia Consulting Engineers.

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1.0 INTRODUCTION

The Rocky Mountain Arsenal (RMA) is located approximately 10 miles northeast of the central business district of Denver, Colorado, and immediately north of the Stapleton International Airport (Figure 1). RMA was established in 1942 and historically has either produced toxic chemicals and chemical filled munitions, or demilitarized these same items. In 1946, a large portion of the manufacturing facilities was leased to private industry for the production of herbicides and insecticides. Chemical wastes generated collectively by these operations have been discharged into several waste storage basins located on the Arsenal grounds.

The first reported indication of off-post contamination occurred in the summer of 1951, when some crop damage was reported on an irrigated farm northwest of RMA (Kolmer & Anderson, 1977). In 1954, several farmers north of the Arsenal complained of damage to crops irrigated with water pumped from the alluvial aquifer. Due to these complaints and subsequent damage claims, the Department of the Army initiated several studies. These studies resulted in the construction of a new disposal basin with a low permeability liner Reservoir "F". (See Figure 1). Since 1957, all chemical wastes have been pumped into this reservoir.

In May 1974, diisopropyl methylphosphonate (DIMP) and dicyclopentadiene (DCPD) were detected in waters discharging from a bog located along the north boundary of RMA. DIMP was also detected in water supply wells for the city of Brighton in December 1974. DIMP is a persistent compound produced in small quantities during the manufacture of GB, a chemical warfare agent. DCPD is a chemical used in the production of insecticides. The off-post detection of DIMP and DCPD promoted the Colorado Department of Health to issue three Cease Orders on April 7, 1975 that required an immediate stop to surface and subsurface discharge of DIMP and DCPD,

development of a plan to preclude future discharge of the contaminants, and development of a monitoring program to verify compliance with these orders.

In the summer of 1976, analysis of groundwater from the north boundary also revealed the presence of inorganic fluorides and three organic sulfur compounds (p-chlorophenyl methyl sulfide, p-chlorophenyl methyl sulfoxide, and p-chlorophenyl methyl sulfone). In 1978, dibromochloropropane (DBCP or Nemagon) was discovered in the groundwater in the vicinity of the north boundary of the Arsenal. Although these compounds were not cited in the Cease and Desist Orders, they are included in the list of compounds requiring treatment.

From 1975 to the present, several investigators were involved in hydrologic investigations and the identification and design of contaminant containment and treatment systems for several contamination problems at RMA. These studies and reviews were conducted by various government and private contractors including RMA, US Army Toxic and Hazardous Materials Agency (USATHAMA), Corps of Engineers, Waterways Experiment Station (WES), Corps of Engineers, Omaha District (COE), US Geological Survey (USGS), D'Appolonia Consulting Engineers Inc., Geraghty and Miller, Inc., and Shell Chemical Company (SCC). The studies resulted in the identification of contamination problems requiring control and the design and construction of control systems. The design and in some cases construction has been initiated on the North Boundary Containment System, Irondale DBCP Control System, and the Basin F Liquid Waste Disposal Facility which are three primary areas of concern (Figure 1). The contamination problem along the northwest boundary of RMA, excluding the Irondale area, is an area of primary concern that requires control.

Two contamination control systems have been designed for use at RMA using different groundwater control concepts. The North Boundary Containment utilizes an impermeable bentonite barrier to impede

the natural subsurface flows. Groundwater flowing toward the barrier is removed from the upgradient side of the barrier by dewatering wells and treated for the removal of organic contaminants. The treated water is then injected into the aquifer on the downgradient side of the slurry wall in a line of recharge wells. A schematic representation of the barrier containment system is provided in Figure 2. The Irondale DBCP Control System utilized a hydrologic barrier to impede flows. Groundwater flowing toward the hydrologic system is removed upgradient of the system by a series of dewatering wells and treated for the removal of organic contaminants. The treated water is injected into the aquifer downgradient of the dewatering well field in a series of recharge wells. The dewatering and recharge operations form a no flow or reverse flow condition. A schematic representation of the hydrologic containment system is provided in Figure 3.

RMA and USATHAMA prepared a report, Northwest Boundary Study, Hydrogeologic, Contamination Distribution and Control System Assessment in June 1981 (Appendix A). An additional analysis of containment systems (Appendix A) was completed in July 1981. This report used all available technical data to prepare a current assessment of the contamination problems at the northwest boundary of RMA. The study identified the requirement for a contamination control system and provided the conceptual system requirements and a recommendation. RMA and USATHAMA has been tasked with developing a preliminary conceptual design for the Northwest Boundary Contamination Control System. Specific tasks included in the program follow:

- Provide a concept selection with supporting rationale for the recommended control system. This design will include the number of dewatering and recharge wells, the spacing of wells, the location of the barrier and the wells, the type of treatment system, the monitoring well requirements, and the expected performance of the system components.

- Provide a buy versus lease analysis for the treatment system.

- Prepare a 1391c and PDB-1 document for submission from the Technical Operations Directorate to the Installation Service Directorate at RMA.

2.0 SITE HYDROGEOLOGY

The hydrogeologic system of concern along the northwest boundary of RMA consists of an unconsolidated alluvial sand and gravel aquifer that overlies a much lower permeability shale and claystone bedrock. Subsurface flow of contaminated groundwater to the northwest takes place within this alluvial aquifer and results in a discharge across the northwest boundary of the Arsenal.

2.1 BEDROCK COMPOSITION AND TOPOGRAPHY

The alluvial aquifer is underlain by predominantly shale and claystone bedrock of the Denver Formation. Previous studies of the groundwater contamination have assumed that the major portion of flow takes place within the alluvium due to the extreme permeability contrast between the bedrock and unconsolidated alluvial units. A number of deep borings show that the bedrock is composed primarily of shale and claystone with occasional silt and sand lenses. The bedrock alluvium contact varies in depth from 30 to 65 feet in the area of concern.

Weathered zones are found in the shales that extend 5 to 10 feet below the bedrock alluvium contact. The weathered material and the silt and sand lenses may be locally permeable. However, the assumption that the bedrock is impermeable relative to the alluvial aquifer is believed to be valid.

A large data base exists to evaluate the material properties (both of the bedrock and unconsolidated alluvial deposits) within and to some degree in the near vicinity of the Arsenal grounds. The location of the available boreholes and wells is provided in Figure 4. The same quality and type of information is not available for some of the sites shown in Figure 4. Consequently any one of the representations developed from this data base does not typically include information from all the boreholes or wells present in Figure 4. Relative to defining the top of

bedrock the majority of the locations identified in Figure 4 provided usable information that was used to develop an accurate top of bedrock contour map (Figure 5).

2.2 AQUIFER PROPERTIES

For the majority of the existing boring logs, the materials characteristics of the unconsolidated deposits were indicated only by a Unified Soil Classification System (USCS) group symbol. The following USCS groups were typically considered to be aquifers:

GW - well graded gravels, gravel-sand mixtures, little or no fines.

GP - poorly graded gravels, gravel-sand mixtures, little or no fines.

GM - silty gravels, poorly graded gravel-sand-silt mixtures.

GC - clayey gravels, poorly graded gravel-sand-clay mixtures.

SW - well graded sands, gravelly sands, little or no fines.

SP - poorly graded sands, gravelly sands, little or no fines

SM - silty sands, poorly graded sand-silt mixtures

SC - clayey sands, poorly graded sand-clay mixtures

Various combinations of these groups such as SPGP and SPSM were also considered.

Permeability values for the sand, and sand and gravel units were obtained from aquifer pump tests conducted in 1980 by WES. WES evaluated the test results and estimated representative permeabilities for the sand, and sand and gravel units of about 15,000 gpd/ft^2 (2,000 ft/day) to 20,250 gpd/FT^2 (2,700 ft/day). An order of magnitude reduction in

permeability exists for units that contain appreciable silt. Any unit containing clay has a negligible permeability compared with the clean sands, and sand and gravels.

The potential variance of error present in the USCS designations on the Arsenal's data is important to note when evaluating boring logs that have been accumulated over a period as long as 20 years. The exact distinction or clayey of silty soils in the USCS can frequently only be made via laboratory tests (liquid limit and plastic limit). In the field, these parameters can be difficult to accurately quantify unless the observer(s) has substantial experience. Therefore, the possibility exists that a soil classified as silty in one boring, for example, may have been described as clayey in another boring by a different inspector. In addition, relatively small amounts of clay or silt may significantly affect permeability values. For these reasons, permeability distributions from the boring logs alone are difficult to interpret in exact terms.

2.3 ALLUVIAL AQUIFER THICKNESS AND DISTRIBUTION

The alluvial aquifer is defined as all sand and gravel, gravel, and sand units that are either unconfined or confined below an impermeable layer. In both cases, the aquifer thickness is the thickness of permeable materials above and below the water table. To evaluate the saturated alluvial aquifer thickness, the difference between the potentiometric and bedrock surface is used.

The thickness of the saturated aquifer varies from zero on bedrock highs to a maximum of 25 feet in the northwest portions of section 27. As shown in Figure 6, thickness is generally greater in the southern portions of the area of interest. The contoured data illustrates the presence of a sediment trough that corresponds approximately with a bedrock valley that exists in this area (see Figure 5). In detail, many locations show a significant variation in thickness over a short horizontal distance. This variation is probably real resulting from

the lenticular nature of coarser grained channel fill deposits within the aquifer. In some cases, however, the variation may be due in part to differing interpretations of the material properties of the same deposits during logging. The use of smoothed contours highlights the major trends in the aquifer rather than minor channeling effects.

Working cross-sections were prepared at various locations across the aquifer normal to the direction of groundwater flow to assess aquifer continuity. These sections suggest that the aquifer is relatively continuous. While the thickness does vary locally there are not significant continuous impermeable barriers between the deeper permeable channel fill deposits that could have a significant effect on flow direction and distribution.

2.4 PERMEABILITY DISTRIBUTION

Variations in the permeability of the saturated sand and gravel alluvium have been found to be negligible in the area of concern. The sand and gravel aquifers is locally confined by fine-grained saturated clayey sediments. The observation suggests that the major portion of groundwater moves through the coarse-grain alluvial aquifer and that a groundwater flux across the Arsenal's boundary of 1200 gpm in the area of concern could be expected.

2.5 POTENTIOMETRIC SURFACE

The potentiometric surface for the spring of 1981 is provided in Figure 7. The potentiometric gradient is generally towards the northwest with an average gradient estimated at 0.015 ft/ft.

3.0 CONTAMINATION DISTRIBUTION

The distribution of contamination along the northwest boundary of RMA consists of those compounds previously associated with Arsenal operations. Specifically, DIMP, DBCP, chloride and fluoride are present in the area of concern with the potential for other contaminants such as chloroform, toluene, acetone, benzene and the chlorinated pesticides to also exist. At the present, DBCP and chloride are the only two contaminants that have been quantified and that also exceed the primary and secondary drinking water standards respectively. An important factor in the containment system specification is the identification of the location and concentration of contamination.

3.1 CONTAMINANTS OF CONCERN

Contamination contour maps for DBCP and Chloride were generated using the extensive data base for RMA. The maps were prepared using sets of data collected through the period 1976 to 1981 and contained in the Tier II data files at USATHAMA. These maps were used primarily for working drawings in determining the extent of contamination in the study area. Variance between the computer-generated maps and the hand worked maps is localized. Comparison of the maps suggests that the hand worked maps present a more realistic contour location. Contours located in areas of sparce data may not be representative of actual concentrations in that area. However, in most cases, the amount of data available and the interpretation is sufficient to insure reliable conclusions.

DBCP DISTRIBUTION

The contour maps (Figures 8 and 9) illustrate that DBCP is contained in a relatively narrow plume (1,500 feet wide). This plume extends for several thousand feet from the Arsenal boundary back towards the source. Presentation of the data in Figure 9, which is the hand worked map, indicates a discontinuous plume which is due to areas of sparce data. However, Figure 9 does illustrate a consistent distribution of DBCP relative to potential source locations and hydrologic conditions. The concentrations of DBCP range from below detectable limits (0.2 ppb) to 2.0 ppb within the area of concern.

CHLORIDE DISTRIBUTION

The contour maps (Figure 10 and 11) illustrate that chloride distribution is much greater than for DBCP. The cause for the major variation in the distribution of chloride vs DBCP is the difference in the operations responsible for generation of the contaminant, the waste disposal practices, and the hydrologic variations. Chloride, which has been associated with Arsenal operations from the beginning, is expected to have a wide distribution. The concentration of chloride in the area of concern range from less than 250 ppm to 900 ppm. The higher concentrations 500 ppm - 900 ppm are located in the same area as the DBCP.

4.0 CONTAMINATION CONTROL SYSTEM SELECTION

To develop a conceptual design for a contamination control system the hydrogeologic and contamination conditions for the site must be determined. the previous assessment provides the basic foundation upon which a control system selection can be developed. The contamination control system is composed of two major components, a groundwater control subsystem, and a treatment subsystem. Preliminary consideration was given to two groundwater control subsystems, a hydrologic control subsystem, and an impermeable barrier control subsystem. The hydrologic system utilizes dewatering wells in conjunction with recharge wells to create a physical hydrologic barrier. This control concept is being used by SCC on the Irondale DBCP control system. The impermeable barrier subsystem utilizes fewer dewatering and recharge wells usually separated by a bentonite barri . Both concepts apply the same hydrologic principals with the impermeable barrier, allowing for a reduced spacing between dewatering and recharge wells due to the barrier, and also minimizes recirculation of treated groundwat.r. The basic purpose of either subsystem is to control the contaminated groundwater flowing in the alluvial aquifer across the boundary of RMA. The impermeable barrier concept was selected for conceptual design based on the availability of proven technology, actual operation of a like system at the north boundary of RMA, and the relatively equal MCA costs (see Appendix A). The components of this system are as follows:

- Dewatering well subsystem
- Impermeable barrier subsystem
- Treatment subsystem
- Recharge well subsystem
- Monitoring well subsystem

4.1 DEWATERING WELL SUBSYSTEM

Assessment of the hydrologic conditions indicate that an estimated average of 1,200 gpm of groundwater crosses the north section of the

northwest boundary of RMA under present conditions. Prior operation of control systems indicates that the system dewatering and recharge will have minimal impact on potentiometric heads in the regional hydrologic system. Based on the groundwater treatment criteria (see section 4.3) the dewatering well design criteria has been established for the estimated 12 dewatering wells. Aquifer and contamination conditions allow for dewatering wells to be operated at maximum capacities, thus stressing the aquifer. This allowance reduces the requirements for the number of dewatering wells while assuring proper system operation. Figure 12 illustrates the layout of the proposed dewatering well network. Wells located on the northern end of the alignment will most likely be less productive than those on the south due to the limitations of the saturated aquifer thickness. The system has been positioned so as to intercept the contaminated groundwater flowing off the Arsenal's boundary in the area.

The conceptual design of the pumping wells is provided in a schematic form in Figure 13. To assure a long well and pump life, the wells should be constructed for minimum pumping of sand and silt. During the drilling, the damage to the formation adjacent to the boreholes should be avoided. This criteria can be met in this type of deposit by drilling the hole using a reverse rotary drilling rig, a mud rotary drilling rig using an organic polymer mud, mud scow cable tool drilling rig, or a bucket auger rig. A gravel pack and shaped wire wound screen will allow efficient development of the well after drilling and production of sand free water. A design entrance velocity to both the gravel pack and screen should be kept below about 5 feet per minute to avoid entrainment of fines. Vigorous development of the well by simultaneous jetting with polyphosphates and pumping will remove fines due to the high velocities developed and result in a maximization of production potential.

The MCA cost for each dewatering well is estimated at about $20,800 with pumps, piping and controls. The control system that is currently being used on the north boundary system appears to be satisfactory. An upper and lower level sensing probe controls each submersible pump.

The setting of the level controls and the final size selection of the pumps should be field-determined. The final components of the dewatering subsystem are the pipline and electrical networks. The pipeline network delivers the contaminated groundwater to the treatment plant. The electrical distribution system should be of the buried type where possible. The use of standard 220 volt components on wells is recommended. A summary of the estimated costs for the dewatering subsystem is provided on the 1391 (Appendix B).

4.2 BARRIER SUBSYSTEM

A bentonite-native soil material slurry wall with a performance specification based on permeability was selected as the optimum barrier. The slurry trench should be about 2 to 3 feet wide and excavated about 2 feet into the claystone bedrock and wall stability maintained while backfilling with the impermeable material. The permeability specification on the backfill material should be 1×10^{-7} cm/sec. The estimated MCA cost of the barrier is $615.00 per linear foot of barrier. The alignment of the 2600 foot barrier as indicated on Figure 12 was selected based on the hydrogeologic conditions and contamination distribution. The northern end of the barrier is located in an area of little or no alluvial groundwater. Keying the system into such a hydrogeological feature will improve containment effectiveness. Since there is no like feature on the south end of the barrier consideration must be given to dewatering and recharge well design and operation to assure complete control of the contamination plume. A summary of the estimated costs for the impermeable barrier subsystem is provided on the 1391 (Appendix B).

4.3 TREATMENT SUBSYSTEM

As a result of the extensive studies conducted by the Study Team, chloride (Cl^-) and Nemagon (DBCP) plumes have been identified and quantified within the northwest boundary study area. These investigations have led to the identification of the need for treatment along that contaminated boundary area. Previous studies have shown that Cl^- and DBCP cannot be removed via one treatment system; therefore, if it is necessary to treat and remove both

contaminants, a system will be required to remove inorganics (Cl^-) and organics (DBCP).

Due to the levels associated with the DBCP plume, it has been determined that the treatment system should include a subsystem to remove DBCP. The method of removal which has been selected is granular activated carbon (GAC). This selection can be made with a very high degree of confidence due to previous experience gained in the selection and subsequent operation of a similar system at the north boundary of the Arsenal. A schematic of the treatment system layout is provided in Figure 14. The GAC treatment system consists of the following components:

- Carbon columns
- Transfer vessels
- Water filters
- Piping, pumps, and control instrumentation.

Extensive investigations into the levels and the distribution of the chloride plume, coupled with preliminary determinations of the type and cost of inorganic removal have led to the conclusion that chloide removal is not appropriate at the boundary for the following reasons: 1. Levels at this time are not high enough to warrant concern; 2. Inorganic removal, due to the technology which must be utilized, involves both very high capital and operating expenses.

Therefore, the treatment subsystem for the northwest boundary will consist of GAC which due to the high level of expertise at RMA with this type of system will be designed by RMA. Prior to procurement by RMA of such a system, a buy vs lease study will be conducted by the Study Team to ensure the most economical system is utilized. A summary of the estimated costs for the Government Furnished Equipment (GFE) treatment facility are provided on the 1391 (Appendix B).

4.4 RECHARGE WELL SUBSYSTEM

The purpose of the recharge well subsystem is to distribute treated water back to the alluvial aqifer in a pattern similar to that which existed under natural conditions. The number of recharge wells necessary to accomplish this objective was estimated at 12 based on the hydrogeologic conditions. The recharge well network is shown in Figure 12, downgradient of the dewatering wells and impermeable barrier. The recharge capacities into the alluvial aquifer are relavtively high and uniform along the alignment. Therefore, the number of recharge wells required can be minimized. A summary of the estimated costs for the recharge well subsystem is provided on the 1391 (Appendix B).

The conceptual design for the recharge wells is provided in Figure 15. The major difference between this design and that for the pumping wells is the larger blank pipe and screen diameter. A round wire wound screen is recommended for these wells in the interest of economy. The slot size and gravel pack gradation will be similar to that for the dewatering wells. Development of the recharge wells is identical to the dewatering wells. MCA cost estimates for the recharge wells are $12,800 each, including piping and controls. The control system that is currently in use on the north boundary system would be satisfactory for this system. An upper and lower sensing probe controls a solenoid valve. Water is recharged under a gravity head. Thus, the sensing probes should be set in the field and based upon the hydrogeologic conditions at each site.

Operation and maintenance costs will be higher for the recharge well system than for the dewatering wells. A program of scheduled maintenance will be necessary to avoid failure of the wells. Many shallow injection wells of this type exhibit plugging problems after a relatively short period of operation. This plugging can be due to air entrainment, bacterial slimes, carrying of fine sediments into the gravel pack or chemical precipitation. Entrainment of corrosion flakes from the casing can also cause problems. Many of these problems

can be minimized if a yearly program of well development and chemical stimulation is maintained.

4.5 MONITORING WELL SUBSYSTEM

The purpose of the monitoring well subsystem is to provide select sites from which hydrologic and contamination data can be collected. This data is used to monitor the operation and performance of the contamination control system. The network of 30 monitoring wells for the system are indicated on Figure 12. The requirement for many of these wells can be fulfilled during the investigation period by the COE or their contractors. Coordination with RMA requirements, careful site selection and protection during system construction could eliminate the need for the new construction of all the monitoring wells identified. There are numerous advantages to operations and construction in having monitoring sites available before, during, and after construction. A detail of the monitoring well design is provided in Figure 16. A summary of the estimated cost for construction of the monitoring well subsystem is provided on the 1391 (Appendix B).

5.0 SUMMARY

This conceptual design report with the support documentation attached is the result of a comprehensive effort by RMA and USATHAMA to identify the requirements for a northwest boundary contamination control system. The reports have been based on the assessment of vast technical data bases that have been established as part of the RMA Contamination Control Program. As with any project, the potential for anomalies in the hydrogeologic conditions and contamination distribution exists.

The design, construction, and operation of a contamination control system are impacted by these anomalies. If such a condition is encountered, the technical expertise of the RMA Contamination Control Program should be notified. Assistance from this technical team can be arranged if requested. Questions concerning this report can be directed to the RMA Contamination Control Program, Commander, Rocky Mountain Arsenal.

FIGURES

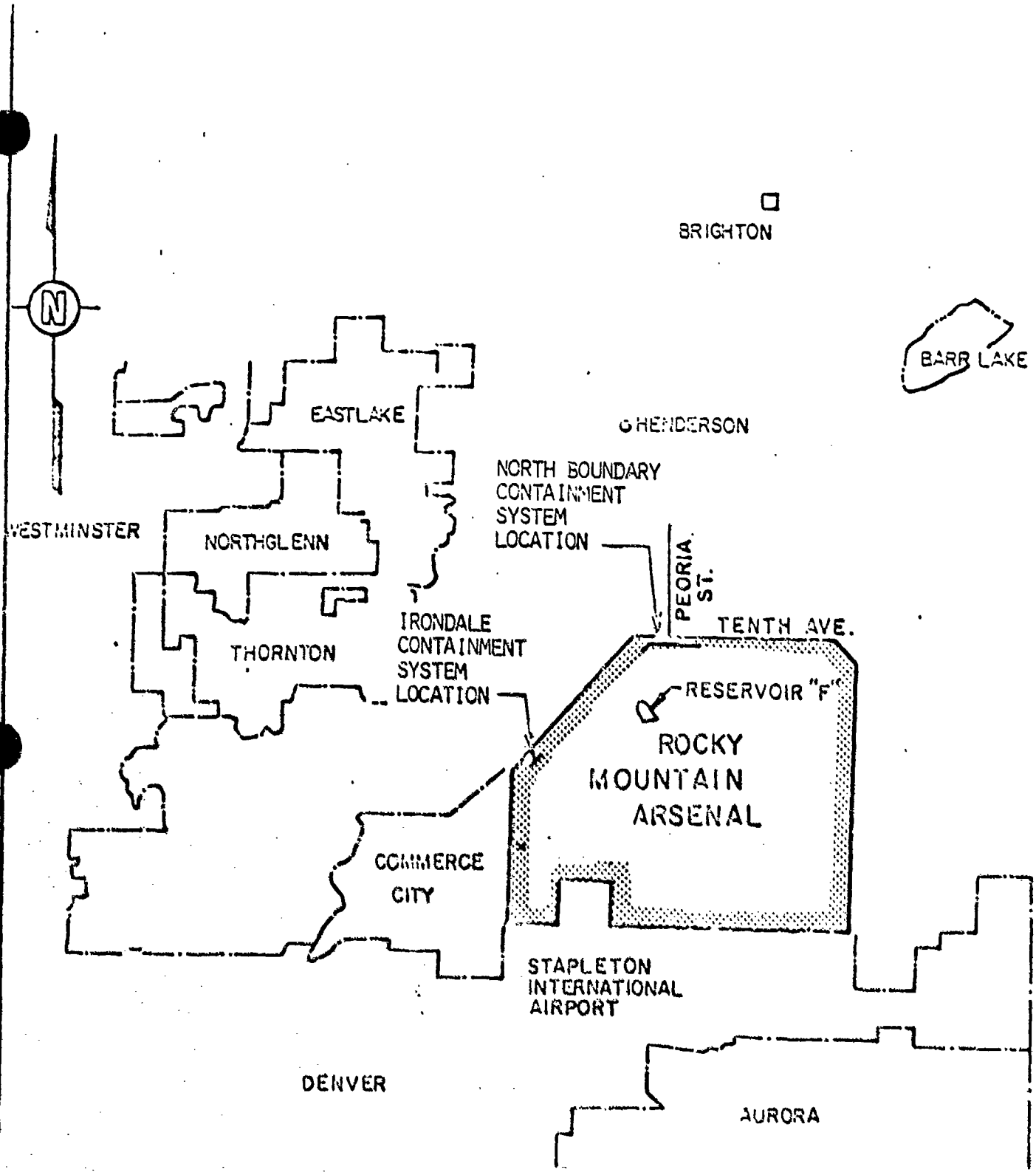

FIGURE 1
Vicinity Map
Concept Selection
Northwest Boundary Containment System
Rocky Mountain Arsenal
Denver, Colorado

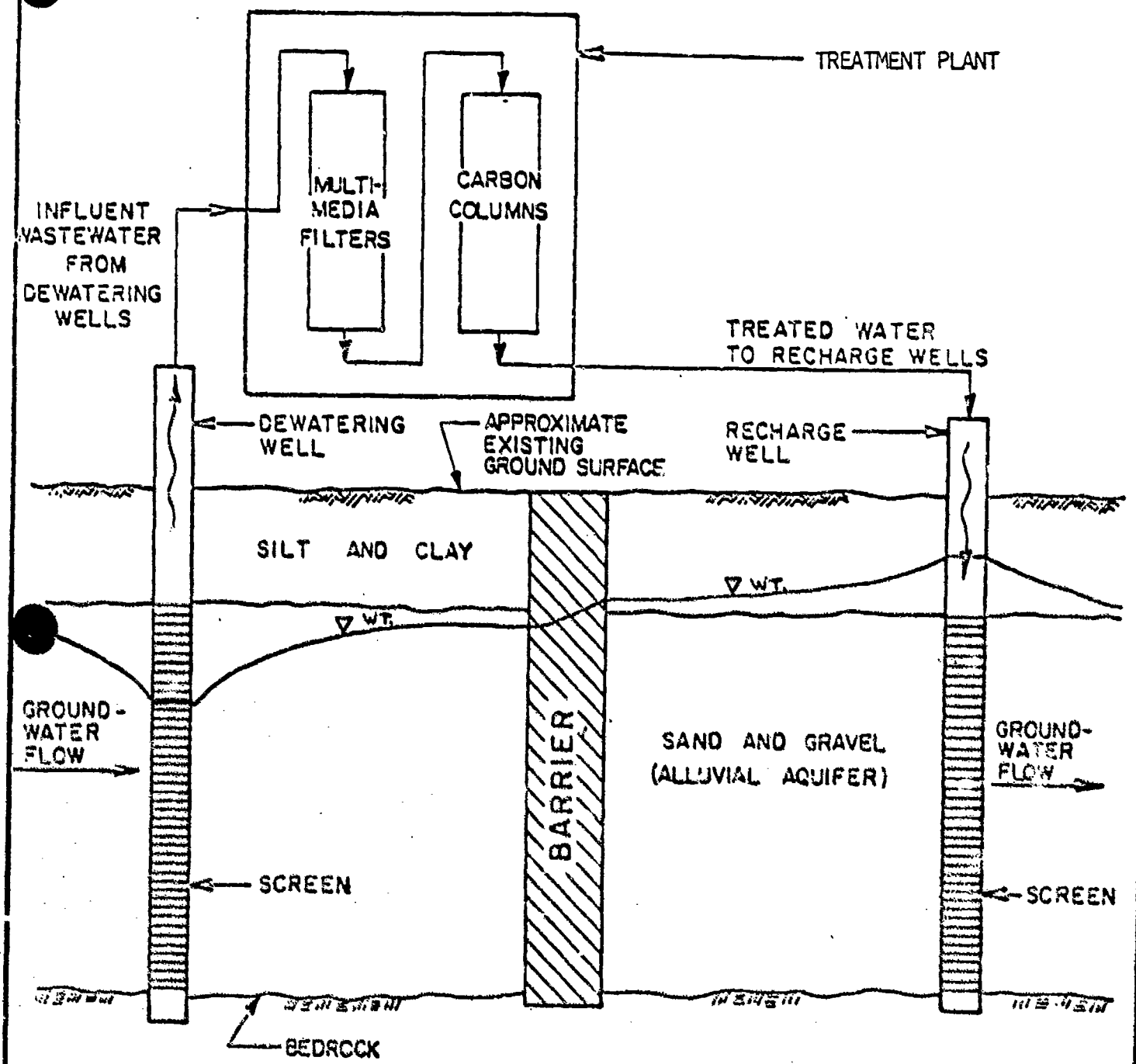

FIGURE 2
Schematic Diagram of Impermeable Barrier Containment System

Concept Selection
Northwest Boundary Containment System
Rocky Mountain Arsenal
Denver, Colorado

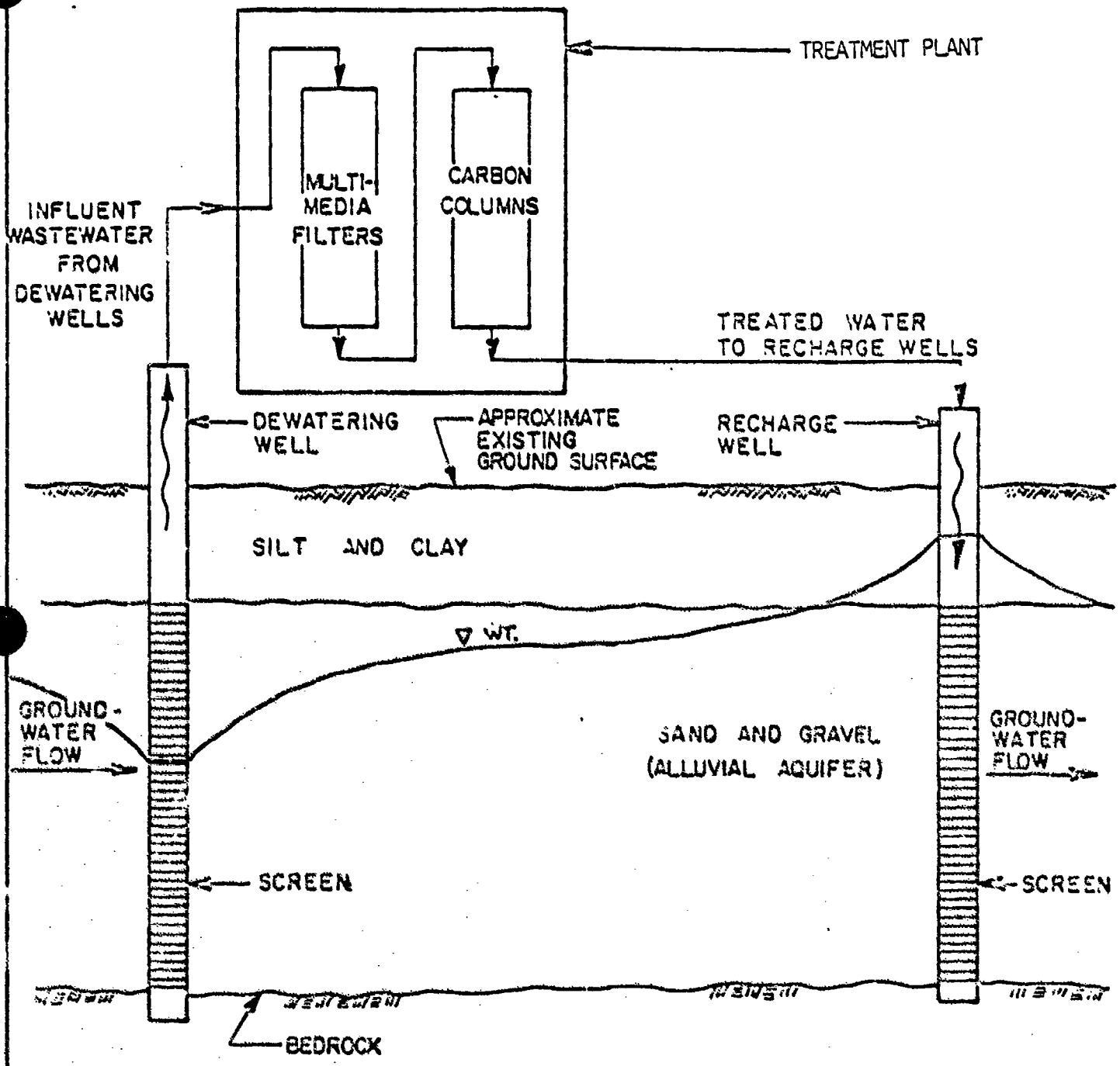

FIGURE 3
Schematic Diagram of Hydrologic Barrier Containment System

Concept Selection
Northwest Boundary Containment System
Rocky Mountain Arsenal
Denver, Colorado

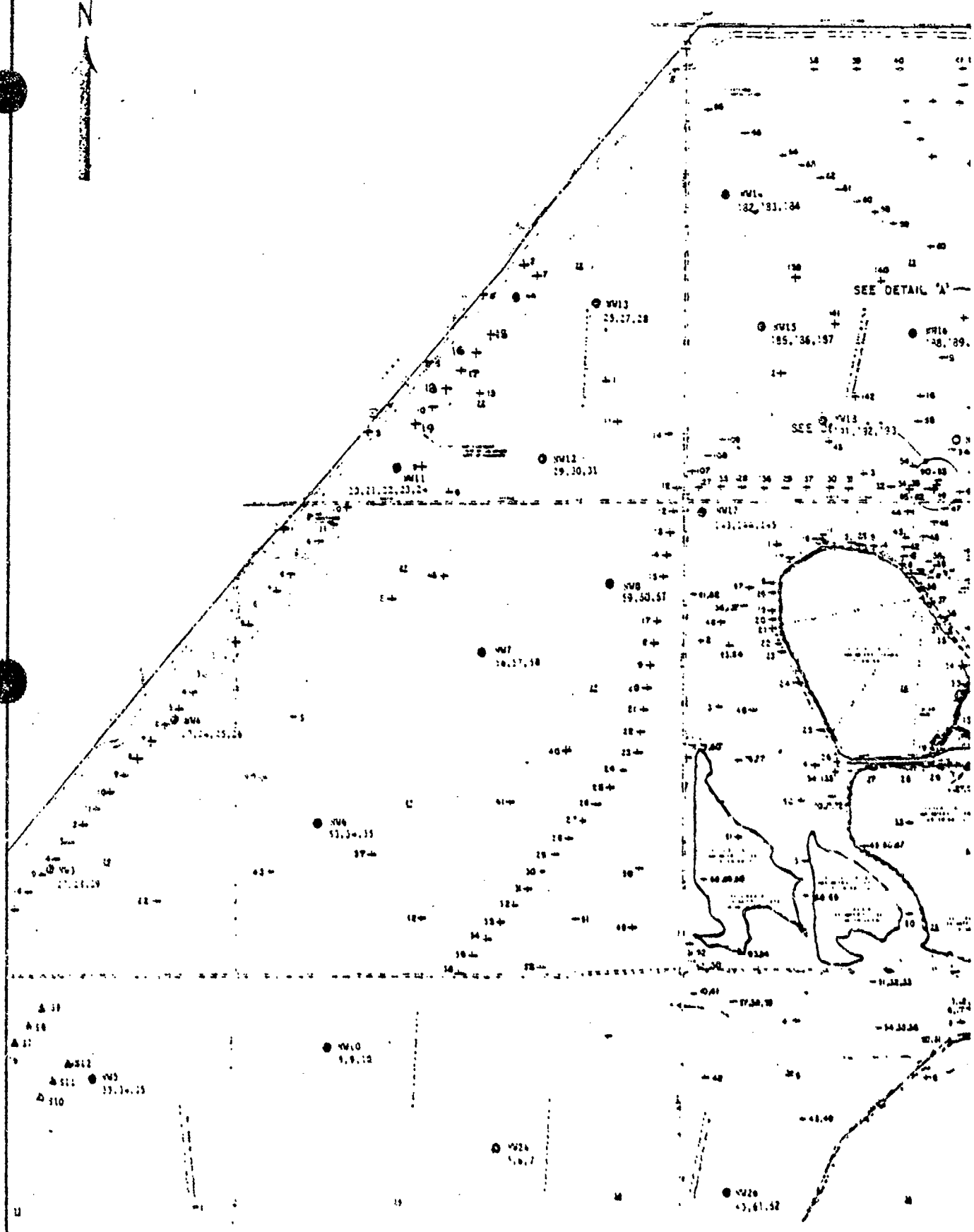

FIGURE 4
Well Location Map
Concept Selection
Northwest Boundary Containment System
Rocky Mountain Arsenal
Denver, Colorado

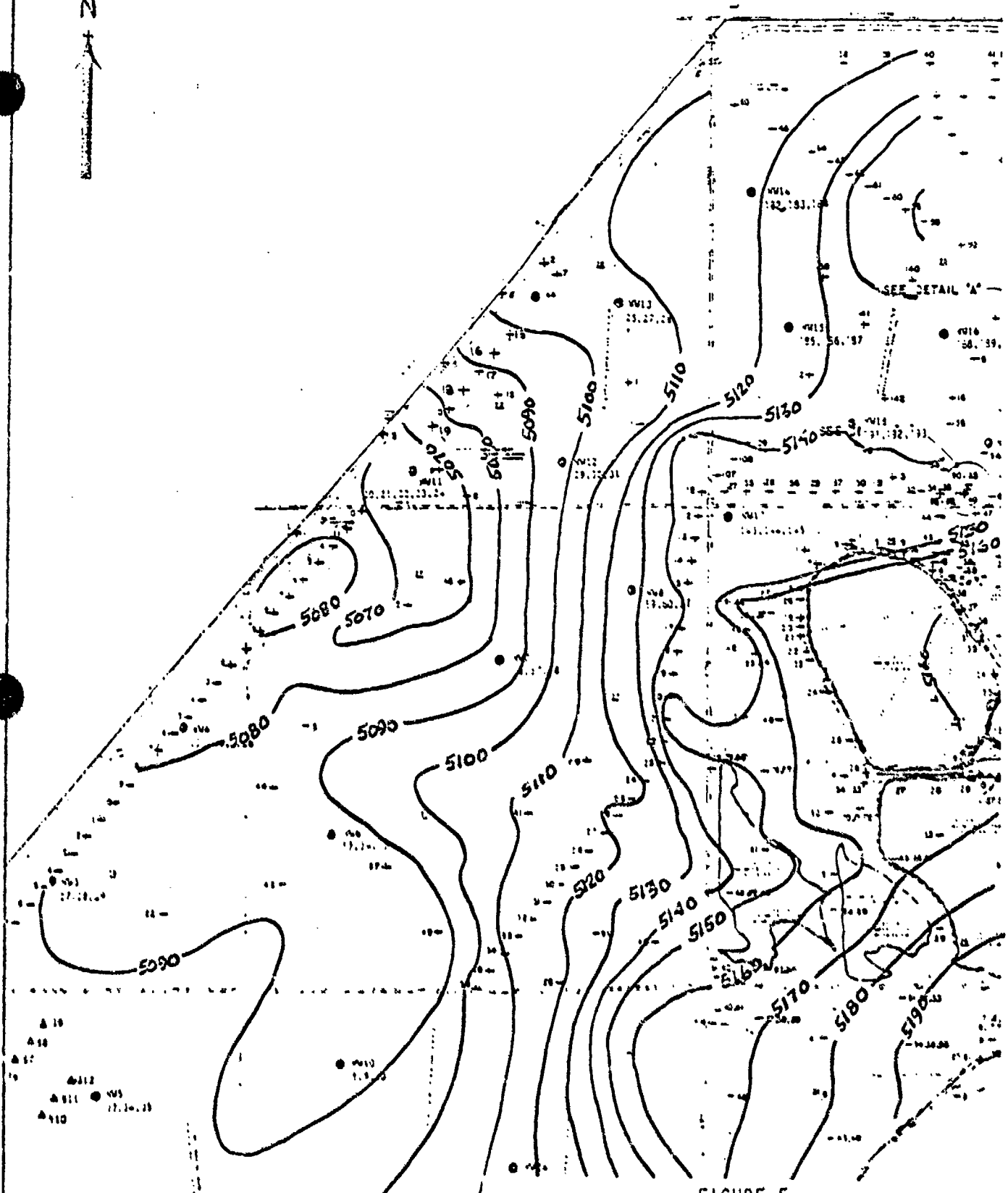

FIGURE 5

Denver Formation Contour Map
(Top of Bedrock)

Contour Interval 10.0 Feet

Concept Selection
Northwest Boundary Containment System
Rocky Mountain Arsenal
Denver, Colorado

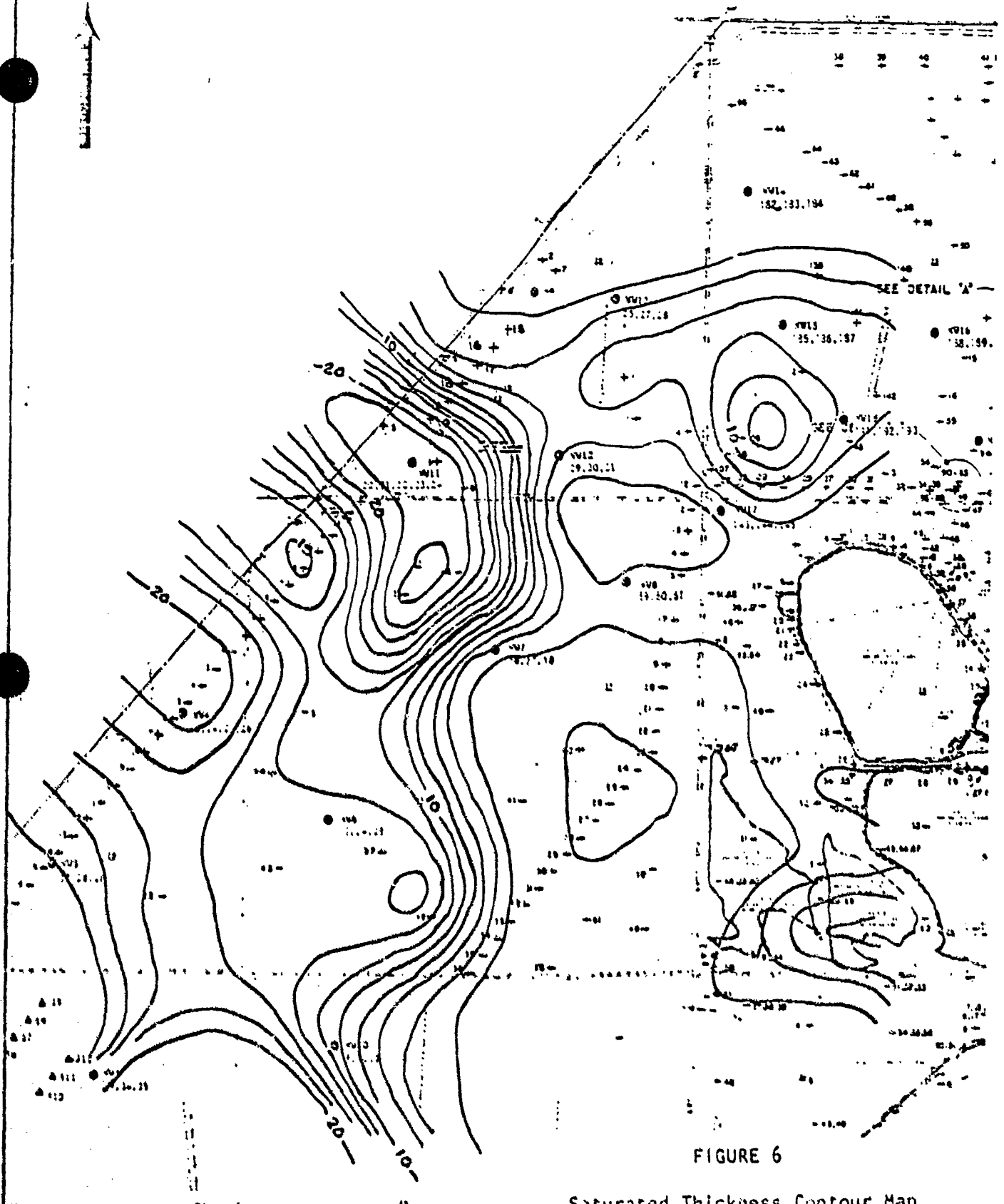

FIGURE 6

Saturated Thickness Contour Map
Alluvial Aquifer

Contour Interval 2.0 Feet

Concept Selection
Northwest Boundary Containment System
Rocky Mountain Arsenal
Denver, Colorado
June 1981

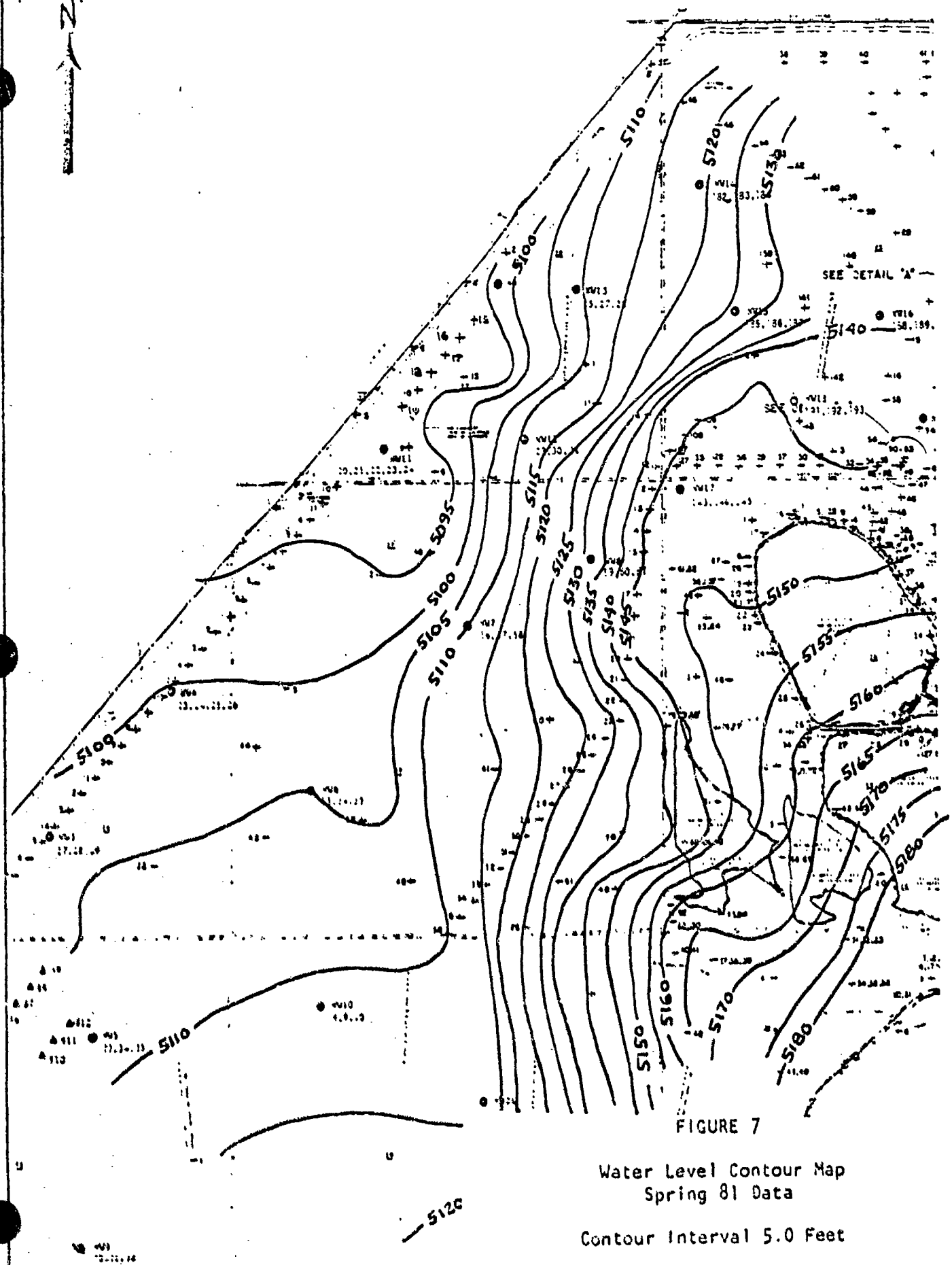

FIGURE 7

Water Level Contour Map
Spring 81 Data

Contour Interval 5.0 Feet

Concept Selection
Northwest Boundary Containment System
Rocky Mountain Arsenal
Denver, Colorado

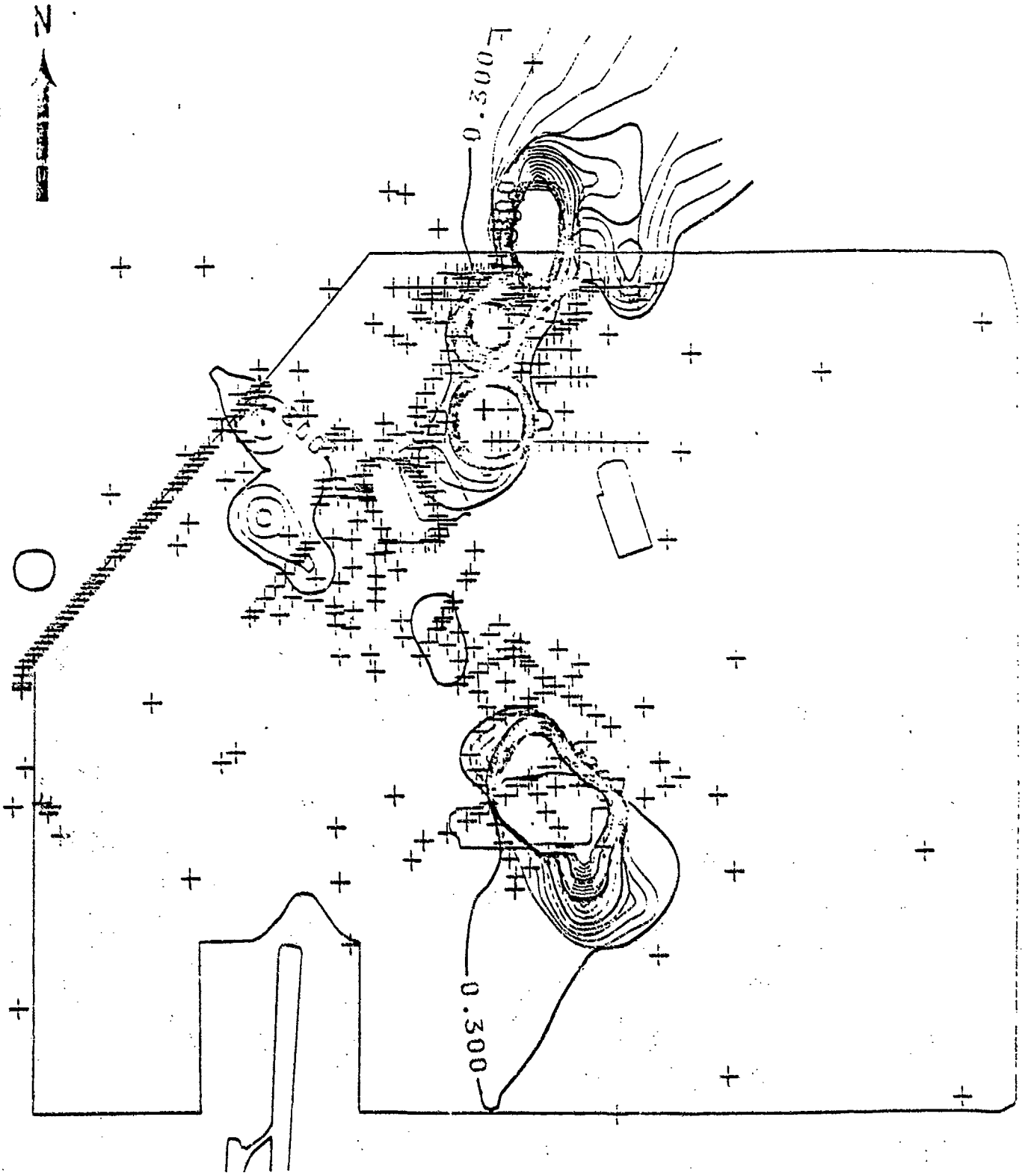

FIGURE 8

DBCP Concentration Contour Map

Contour Interval 0.300 UGL

Concept Selection
Northwest Boundary Containment System
Rocky Mountain Arsenal
Denver, Colorado

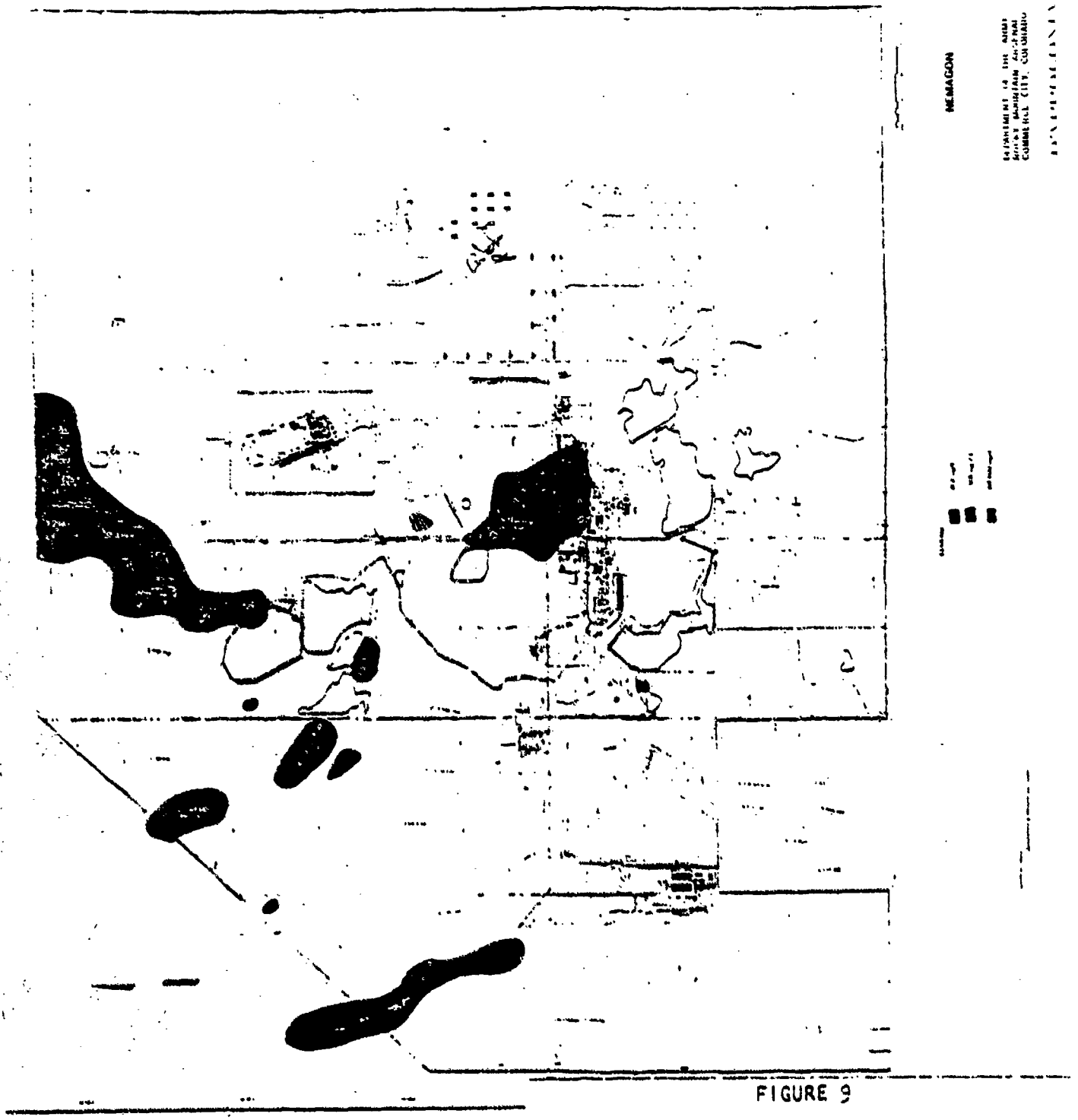

FIGURE 9

DBCP Concentration Contour Map
Contamination Control Study

Contour Interval as shown

Concept Selection
Northwest Boundary Containment System
Rocky Mountain Arsenal
Denver, Colorado

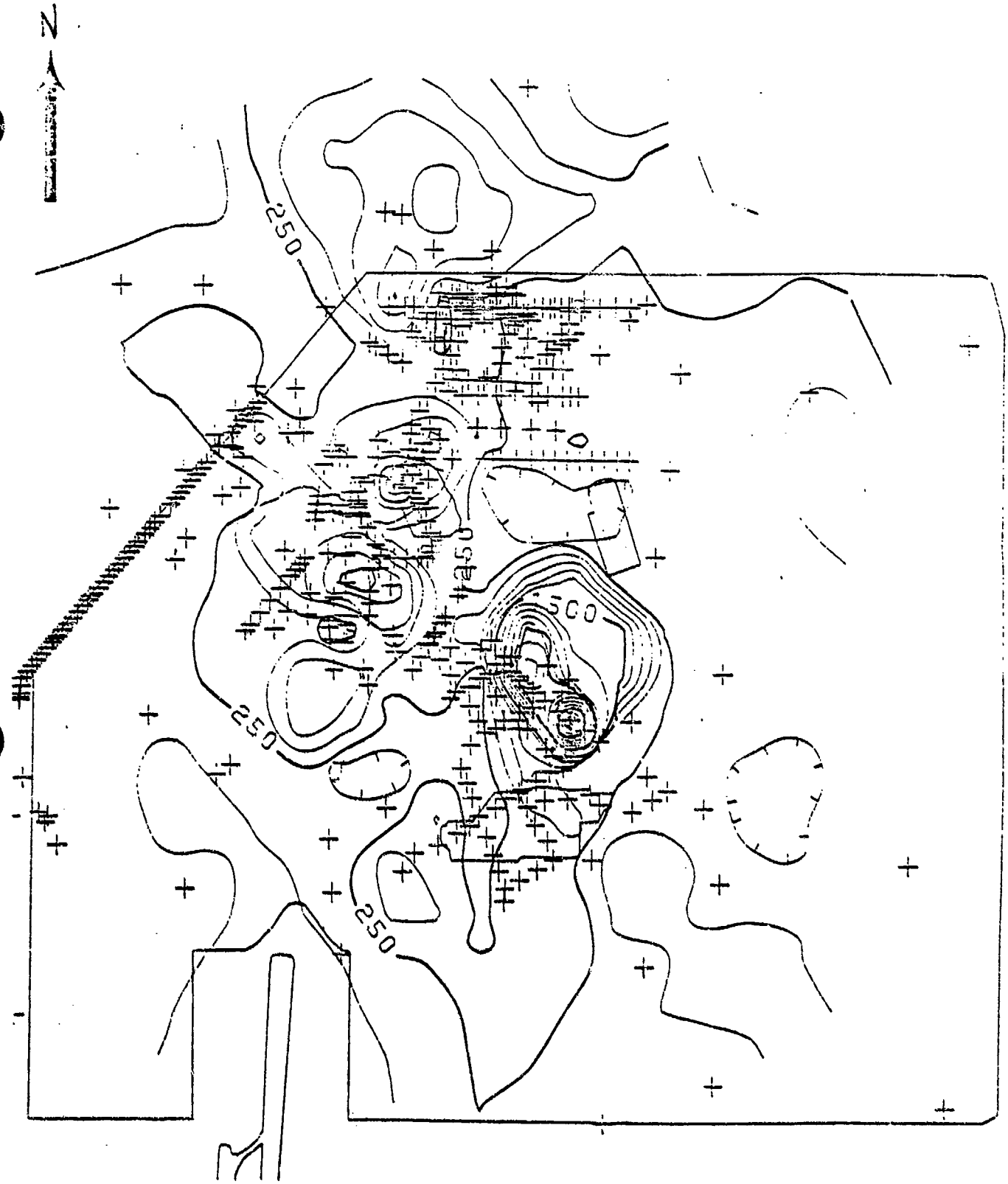

FIGURE 10

Chloride Concentration Contour Map

Contour Interval 250 MGL

Concept Selection
Northwest Boundary Containment System
Rocky Mountain Arsenal
Denver, Colorado

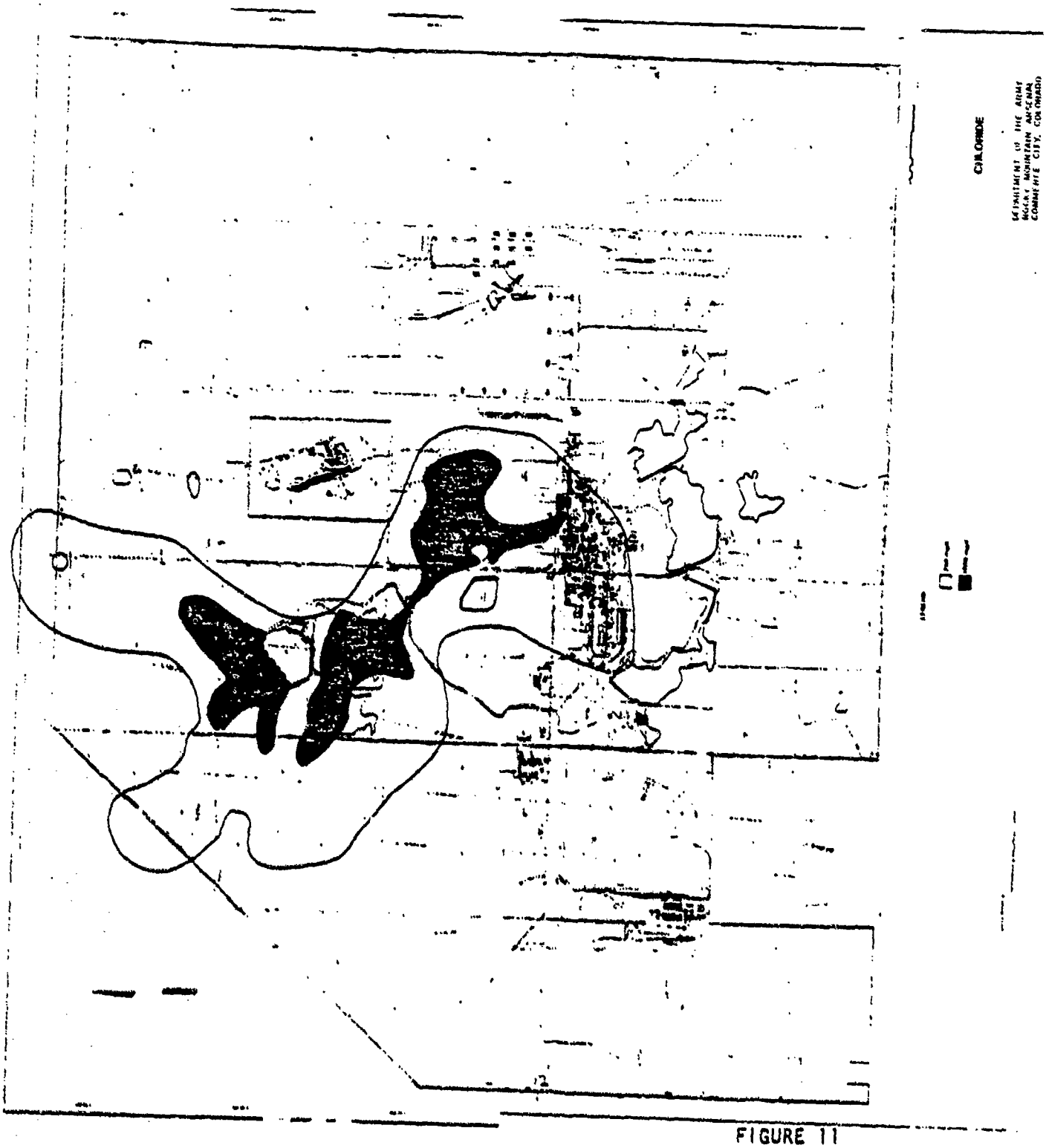

FIGURE 11

Chloride Concentration Contour Map
Contamination Control Study

Contour Interval as shown

Concept Selection
Northwest Boundary Containment System
Denver, Colorado

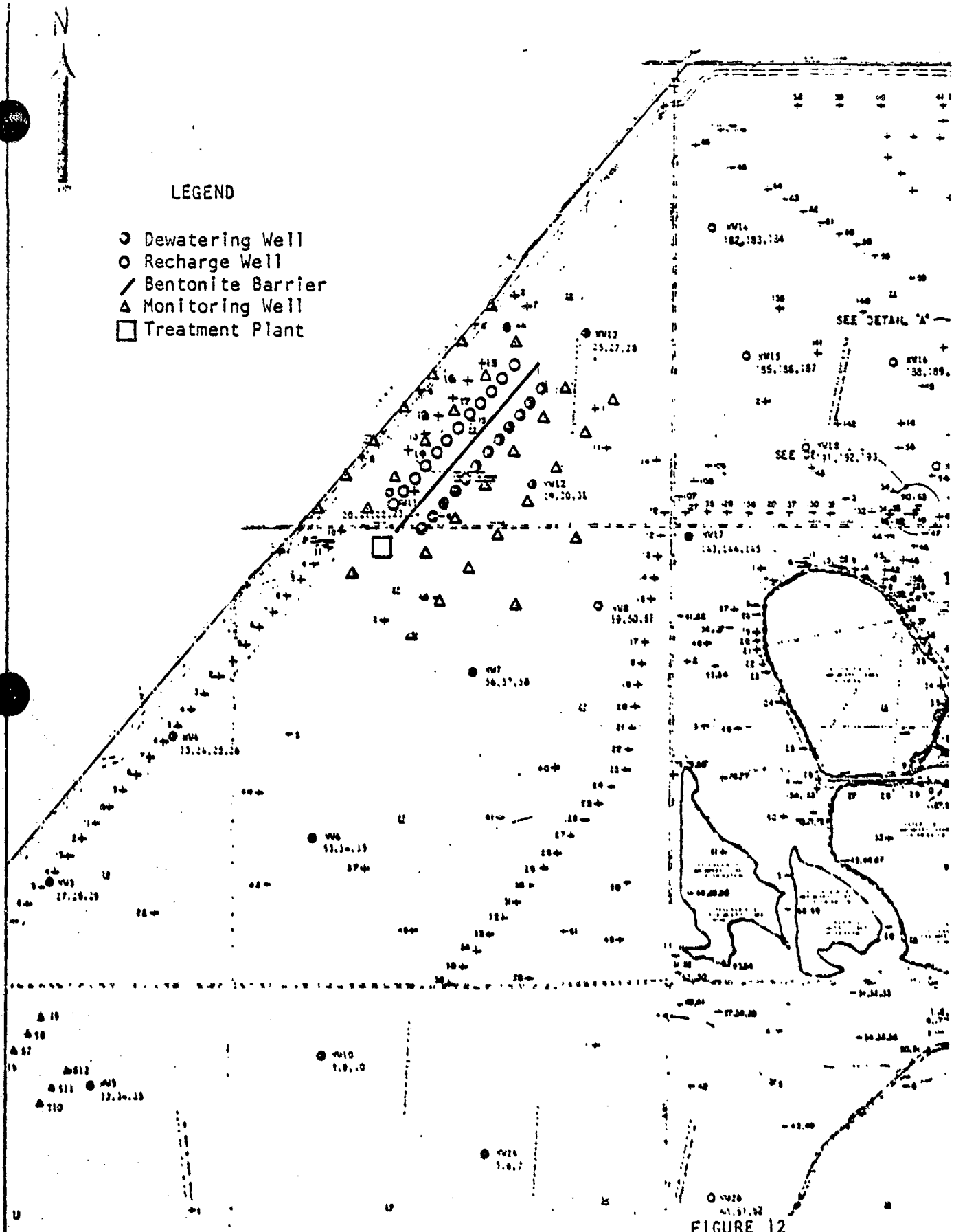

FIGURE 12

System Design Layout

Concept Selection
Northwest Boundary Containment System
Rocky Mountain Arsenal
Denver, Colorado

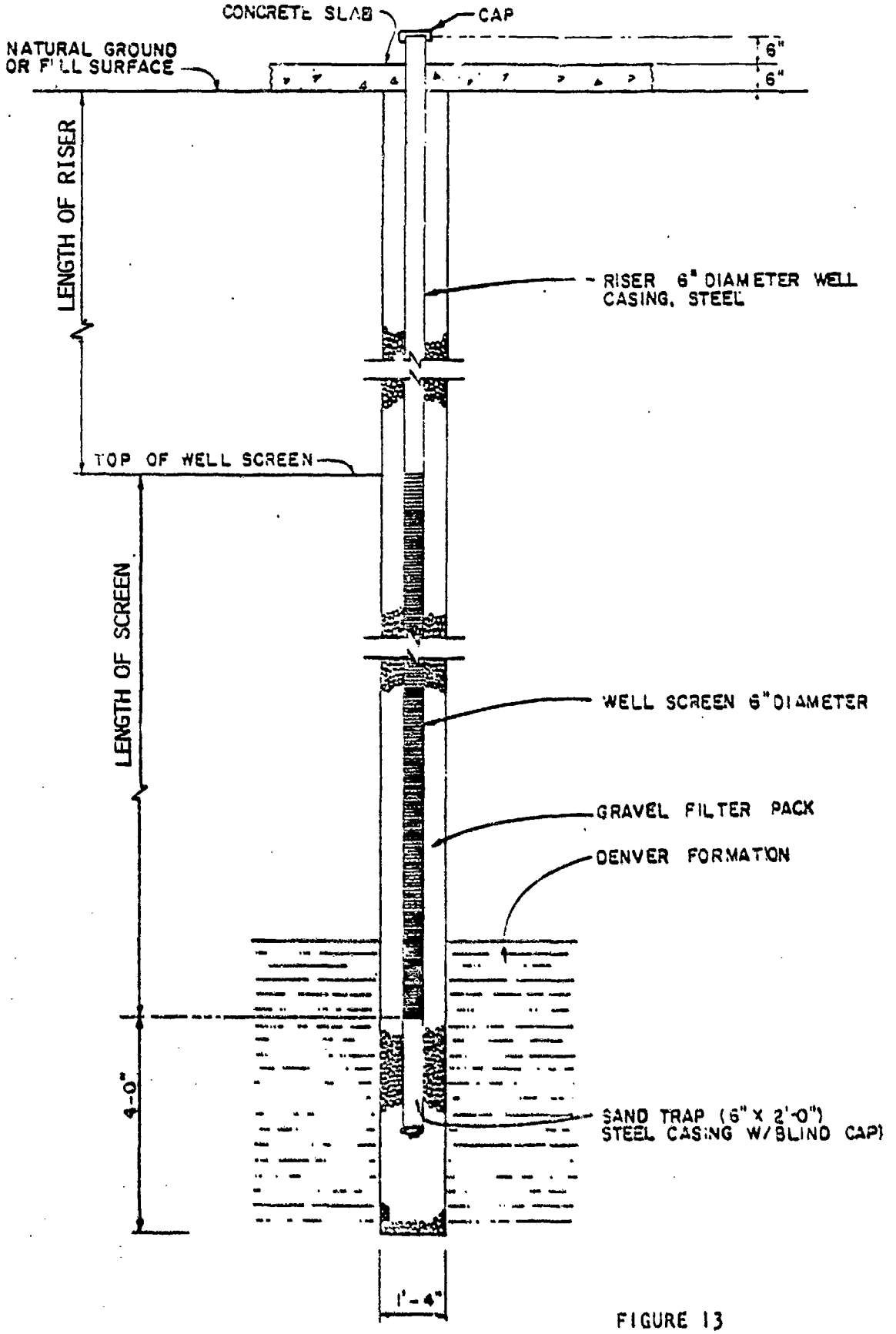

FIGURE 13

Typical Dewatering Well

not to scale

Concept Selection
Northwest Boundary Containment System
Denver, Colorado

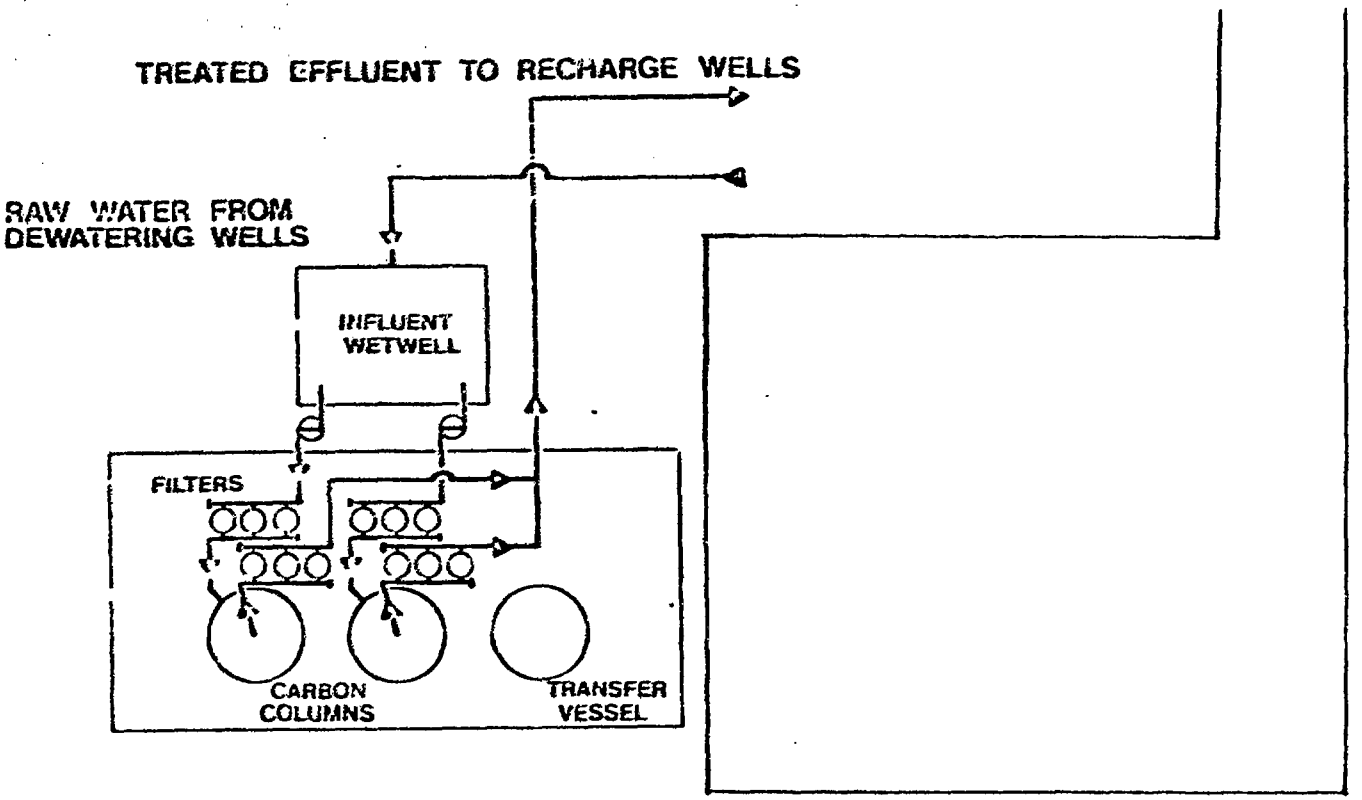

FIGURE 14

Schematic Diagram of Treatment Facility

not to scale

Concept Selection
Northwest Boundary Containment System
Rocky Mountain Arsenal
Denver, Colorado

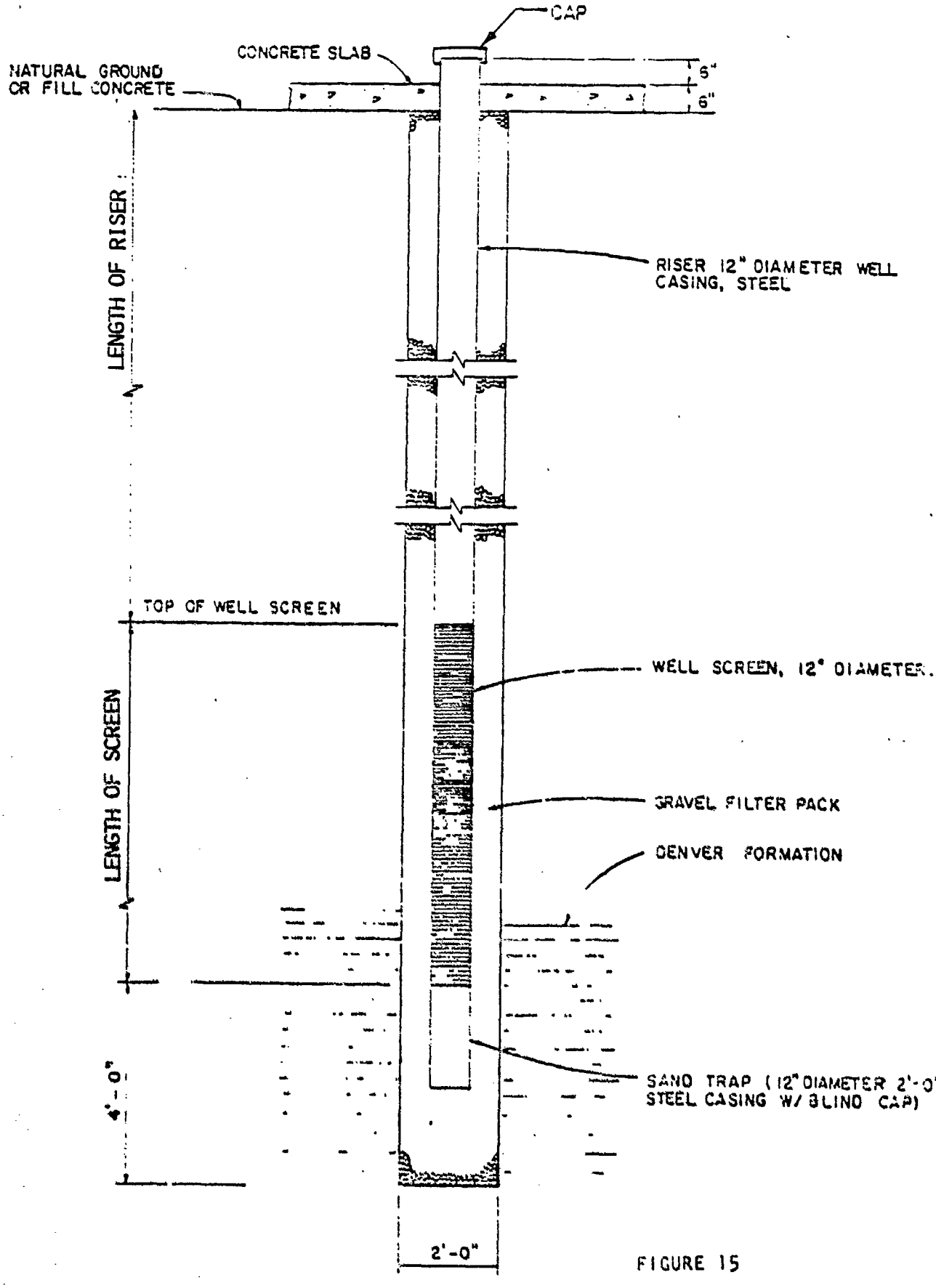

FIGURE 15

Typical Recharge Well

not to scale

Concept Selection
Northwest Boundary Containment System
Denver, Colorado

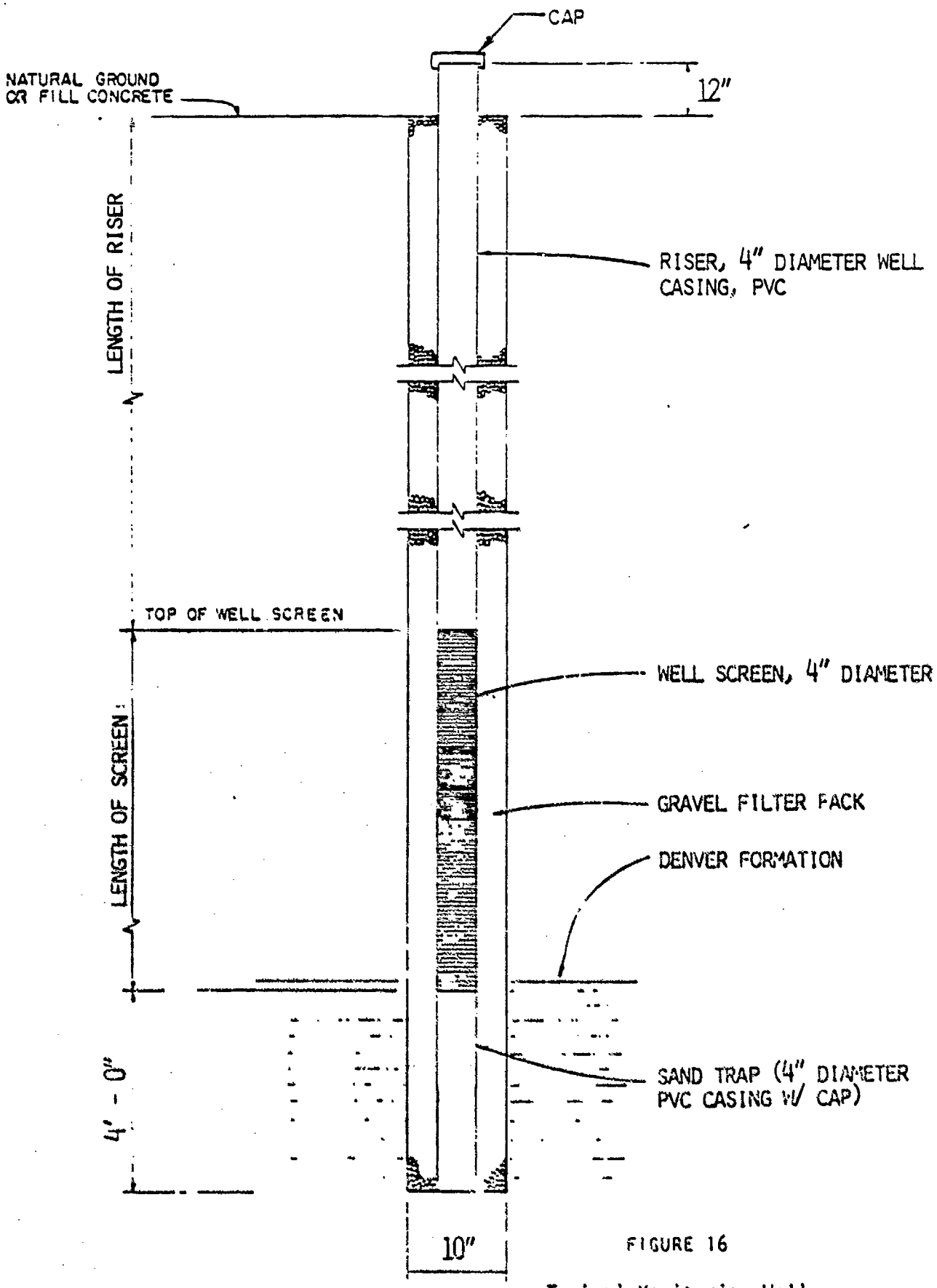

FIGURE 16

Typical Monitoring Well

not to scale

Concept Selection
Northwest Boundary Containment System
Rocky Mountain Arsenal
Denver, Colorado

APPENDIX A

NORTHWEST BOUNDARY STUDY

HYDROGEOLOGIC, CONTAMINATION DISTRIBUTION AND CONTROL SYSTEM ASSESSMENT

Rocky Mountain Arsenal
Denver, Colorado

Prepared by

BRIAN L. ANDERSON, RMA

PAUL G. BERGERON, USATHAMA

June 1981

EXECUTIVE SUMMARY

Northwest Boundary Study

The Rocky Mountain Arsenal (RMA) has been working to alleviate problems with contaminated groundwater for some time. One of the primary projects of concern presently is the movement of contaminated groundwater across the Northwest Boundary of RMA. Resolution of the Irondale DBCP contamination problem, which is the South portion of the Northwest Boundary, is being undertaken by Shell Chemical Company (SCC) with completion scheduled for September 1981. This action by SCC necessitates that a revised PDB 1391 be submitted by RMA to resolve the North portion contamination problem along the Northwest Boundary.

The requirement for a data assessment study was identified by the RMA Contamination Control Board. The scope of the study included:

- Assess hydrogeology and groundwater contamination in area of the Northwest Boundary of RMA.

- Determine whether a FY84 MCA contamination control project is required.

- If a control system is required develop the criteria for preparation of the PDB 1391.

- Develop justification for the control system selected and identify the documentation requirements for the project.

The Contamination Control Program Management Team established a project team that consist of USATHAMA and RMA representatives. The study team

- Prepared a Northwest Boundary study work statement

  a. data file update

  b. data validation

  c. contamination identification and distribution

  d. hydrogeologic assessment

  e. control system evaluation

  f. documentation requirements

- Implemented the study plan and prepared a report

The accomplishments of the Northwest Boundary study included

- Initiation of data file updates for the geotechnical, water level, map records and chemical Tier II files.

- Developed a data management approach to maximize data entry and utilization.

- Initiation of data validation of Tier II data files.

- Conducted a hydrogeologic assessment utilizing updated and partially validated data files.

  - constructed revised cross sections

  - constructed a revised bedrock contour map

  - constructed a revised water level contour map

  - computed water quantities along sections

- Conducted groundwater contamination analysis utilizing updated and partially validated data files.

  - constructed revised contamination contour maps for DBCP and Cl

  - computed mass flux values for DBCP and Cl along sections

  - identify locations of other contaminants of concern in the study area

- Compared revised hydrogeologic and contamination assessments with previous assessments.

- Prepared an evaluation of contamination control system options.

- Provided a recommendation for a contamination control system including the preparation of a draft PDB 1391.

- Provided a justification for the control system that was recommended.

- Prepared a summary of documentation requirements and suspense dates for the MCA project.

Conclusions

The data file update and validation task was not complete when the study team assessment was finalized. This task will be finalized and will provide valuable support to ongoing and future RMA studies.

The contamination problems at the Northwest Boundary are real with DBCP being the most critical and Chloride of secondary concern.

The initiation of an FY84 MCA project to address the groundwater contamination problems at the Northwest Boundary is warranted.

The proposed system configuration should include dewatering and recharge well, bentonite barrier, organic treatment facility, and be located near the North portion of the Northwest Boundary of RMA.

The treatment of inorganics should be considered for source control projects. The inorganic contamination problems at the sources are of concern and must be addressed.

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Introduction

The Rocky Mountain Arsenal (RMA) has been working to alleviate problems with contaminated groundwater for some time. One of the primary projects of concern presently is the movement of contaminated groundwater across the Northwest Boundary of RMA.

Historical

Since 1978 several investigations have addressed groundwater contamination problems and control options in the Northwest Boundary area.

- 1978 "Investigation of the Northwest Area of RMA", November 1978, RMA Report. A preliminary assessment of the hydrogeologic and contaminated groundwater status of the area.

- 1979-81 "Evaluation of Hydrogeologic System and Contamination Migration Patterns, Rocky Mountain Arsenal, Denver, Colorado", January 1981, Geraghty and Miller, Inc. A comprehensive RMA hydrogeologic and groundwater contamination data integration effort was conducted by Geraghty and Miller, Inc. (GM) beginning December 1979. The report contains an assessment of the groundwater status of RMA and makes recommendations for a Regional Investigation.

- 1980-81 (ongoing) Regional investigation being conducted by US Army Corps of Engineers, Waterways Experiment Station (WES). Work was initiated in April 1980 and includes a comprehensive hydrogeologic and groundwater contamination investigation of RMA. The investigation addresses the data gaps identified by GM Report. The report will provide a consistent evaluation of the regional hydrogeologic system and the contamination migration patterns for RMA.

- 1980-81 (ongoing) Contamination Control Study being conducted by the Rocky Mountain Arsenal Contamination Control Study Team. Work was initiated in July 1980 and includes an assessment of contamination problems, source identification and control strategies for RMA. The study addresses options, risks, costs, regulatory compliance requirements and data gaps. The interim draft report, Contamination Control Strategies for Rocky Mountain Arsenal, March 1981, provides an initial basis from which control strategies can be evaluated. Continued work by the Study Team will provide a basis from which contamination control system selections can be made.

In 1980 an FY84 MCA project was identified for the control of groundwater contamination at the Northwest Boundary. The Project Development Brochure (PDB) 1391 that was submitted identified the requirement for a control system along the entire Northwest (NW) Boundary. This system controlled both the Irondale DBCP and contamination at the North portion of the NW Boundary.

Resolution of the Irondale DBCP contamination problem is being undertaken by Shell Chemical Company (SCC) with completion scheduled for September 1981. This action by SCC necessitates that a revised PDB 1391 be submitted by RMA to resolve the North portion contamination problem along the NW Boundary.

The NW Boundary project team consisting of USATHAMA and RMA representatives was established. It is the responsibility of the project team to implement the project plans derived from the assessment of the NW Boundary contamination problems as directed by the Contamination Control Board (CCB), and Contamination Control Program Management Team (CCPMT). The following resultant summary and recommendations provide the basis upon which the NW Boundary 1391 PDB can be developed.

Project Directives

The CCPMT identified the project requirements that were to be considered in the NW Boundary assessment.

- The NW Boundary Contamination Control Project must remain as an FY84 MCA Project.

- A current assessment should be made of the hydrogeologic and contamination conditions at the NW Boundary. All existing data (new and old) should be utilized. As a minimum updates should be made on contaminant maps, mass flux computation, groundwater flow direction, gradients and quantities, and updated geologic cross sections. Data used for this effort should be validated. A defense of the data utilized should be provided.

- The assessment should recommend a contamination control system. As a minimum the assessment should include the site location, treatment type, system configuration, i.e., number of dewatering wells and recharge wells and barrier length, and projected costs. A justification of the control system recommendation should be provided.

- The documentation requirements and suspense dates should be identified. Such requirements as permits, environmental impact statements, safety documents and treatment standards must be addressed.

Project Assessment Plan

A preliminary work statement was developed by the NW Boundary project team which identified the major efforts required for the assessment of the NW Boundary area. The effort encompassed the update of computer data bases with hydrogeologic and contamination data, the screening and validation of the data, the assessment of the hydrogeologic system and contamination problems in the study area and the evaluation of a control system.

The preliminary work statement was amended upon receipt of the CCPMT project directives. A copy of the amended work statement is included in Appendix A.

Assessment/Rationale

Data File Update and Data Validation - The initial task of the study team was to update the Tier II RMA data files. Team members identified and assembled data that was not in Tier II, which included water level, geotechnical, survey and chemical data. Data was coded onto computer data forms utilizing contract support from Computer Sciences Corporation (CSC) and delivered to the RMA computer section for entry into the Tier I data files. Job streams were developed enabling the Tier I data to be transfered to the Tier II files. The development of this data management mechanism will result in the elimination of data backlogs and assure maximum utilization of the available data.

The data validation of Tier II files is being conducted by team members with CSC contractor support. Three areas of concern were identified which required validation consideration. They are as follows:

a. monitoring of the groundwater contamination representative of the groundwater contamination and hydrology.

b. resolution of discrepencies with the data files, i.e., illegal entries.

c. identification and deletion of erroneous chemical values within the data files.

A review was conducted by the study team of all wells in sections 22, 27, 28, 34 and parts of 23, 26 and 35 to identify those sites to which item "a" above applied. Fifty four (54) wells were identified and are listed in Appendix B.

CSC contractor support was utilized to resolve the descrepencies in the data files (b above). Illegal and missing entries were identified and methods of corrections made. This effort is continuing on the existing Tier II data. A low level of effort is required for new data that is entered into the data files.

The study team reviewed the chemistry data files and identified the existence of questionable chemical contaminant values for wells that were not previously eliminated.

Ideally the contaminant levels associated with the remaining wells would have been validated also and those values thought to be erroneous would be deleted from consideration. The deletion of data requires four seperate actions:

(1) development of a computerized program which will screen contaminant levels for each well and print a list of all values for a specific contaminant which exceed two standard deviations from the mean for that contaminant in that well (effort in progress, Technology Division, USATHAMA).

(2) this printout will then be examined by a CSC chemist, currently involved in RMA data update and validation, and a determination made concerning the utility of including specific data points.

(3) the list of values generated by (2) will then be reviewed by USATHAMA and RMA and forwarded to Deputy Commander, USATHAMA for approval for deletion of this data from the active data base.

(4) upon approval these values will be placed in an auxillary file which will not be used for plotting purposes.

An example of the type of misleading information for two wells in the 360° sampling program:

Analysis for DBCP

	Well 35-2	Well 27-1
3/27/79	-	<.4
6/22/79	<.4	<.4
9/20/79	22.1	<.2
12/20/79	<.2	<.2
12/20/79	<.2	-
3/21/79	.7	<.2
6/19/79	<.2	<.2
7/17/79	<.2	43.9

Since the complexity of the data validation for the entire chemical data file, is not known, a date for its completion has not been established. The utilization of a completely updated and validated data base for an assessment of the NW Boundary study area might be expected in three months. The initiation and eventual completion of this effort will be most beneficial to the ongoing and future studies at RMA.

Contamination Distribution - New contamination profile maps for Nemagon (DBCP) and Chloride (Cl) were generated using the partially validated data base, figures 1 and 2. DBCP and Cl were the only two contaminants that were identified within the NW Boundary study area that had sufficient data to generate contour maps and that also exceeded the primary or secondary drinking water standards. Figures 3 and 4 are contamination profile maps for the same two compounds that were developed for the Contamination Control Study. The relatively close agreement between maps substantiates the previous contamination assessment.

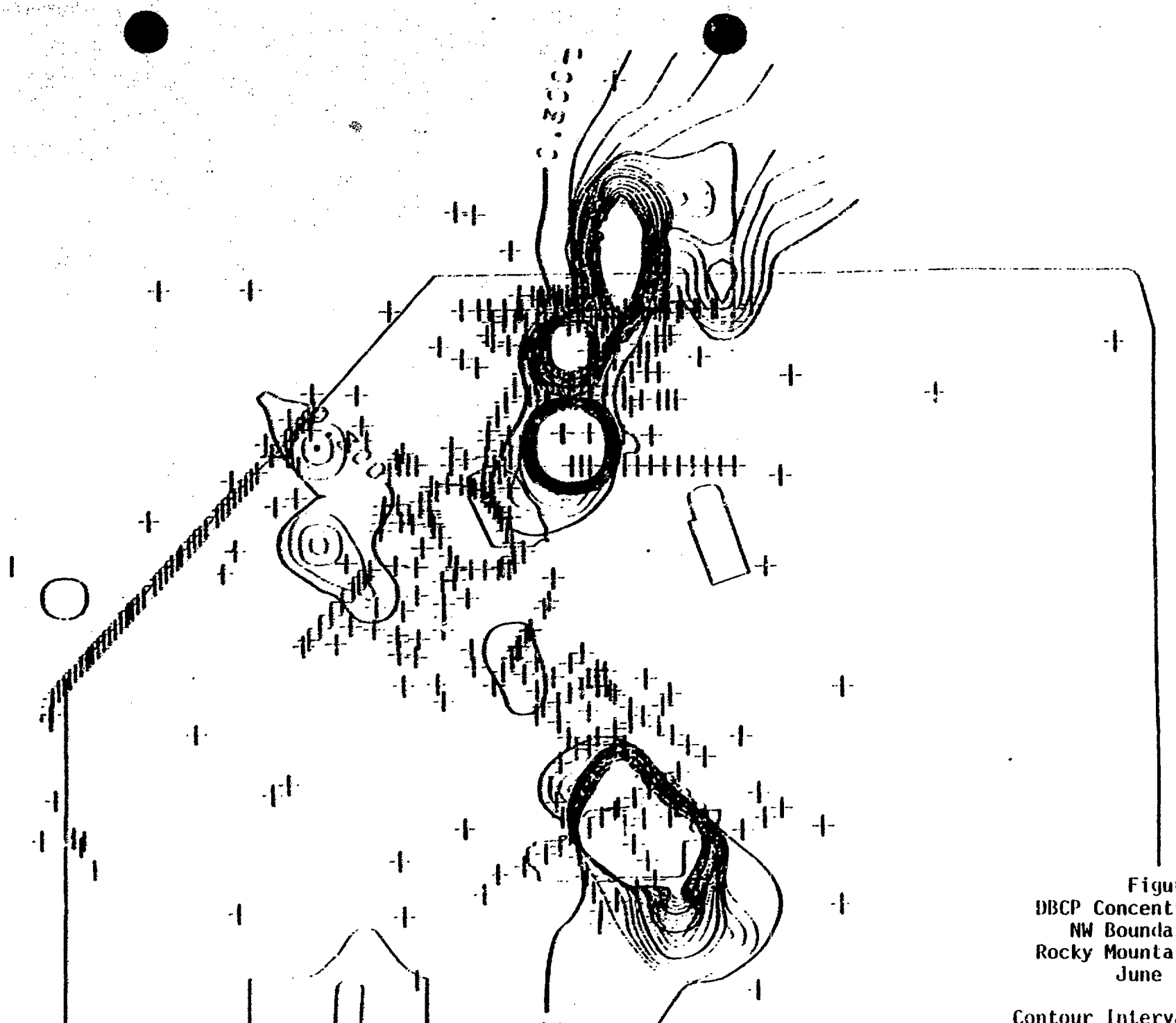

Figure 1
DBCP Concentration Map
NW Boundary Study
Rocky Mountain Arsenal
June 1981

Contour Interval 0.300 UGL

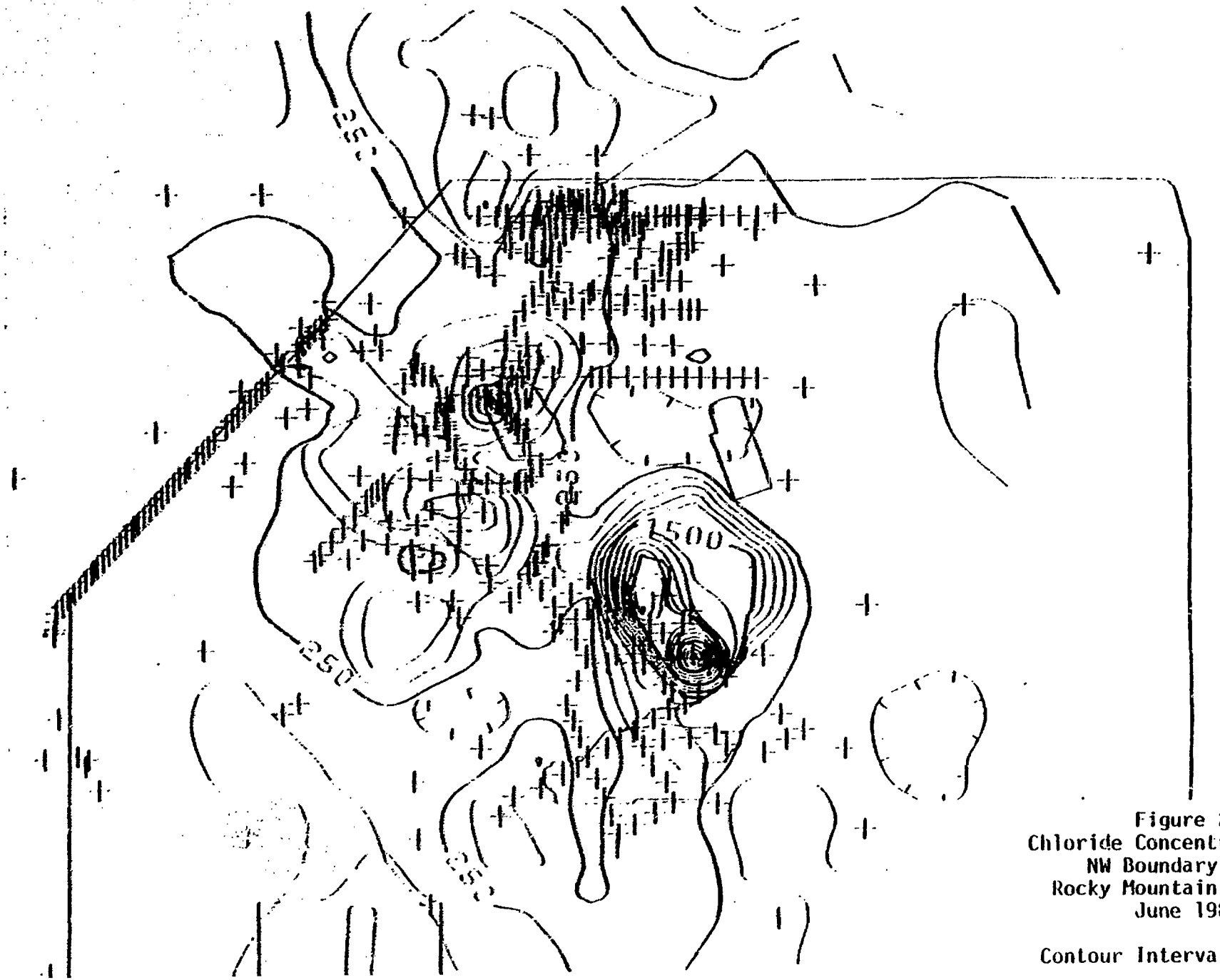

Figure 2
Chloride Concentration Map
NW Boundary Study
Rocky Mountain Arsenal
June 1981

Contour Interval 250 MGL

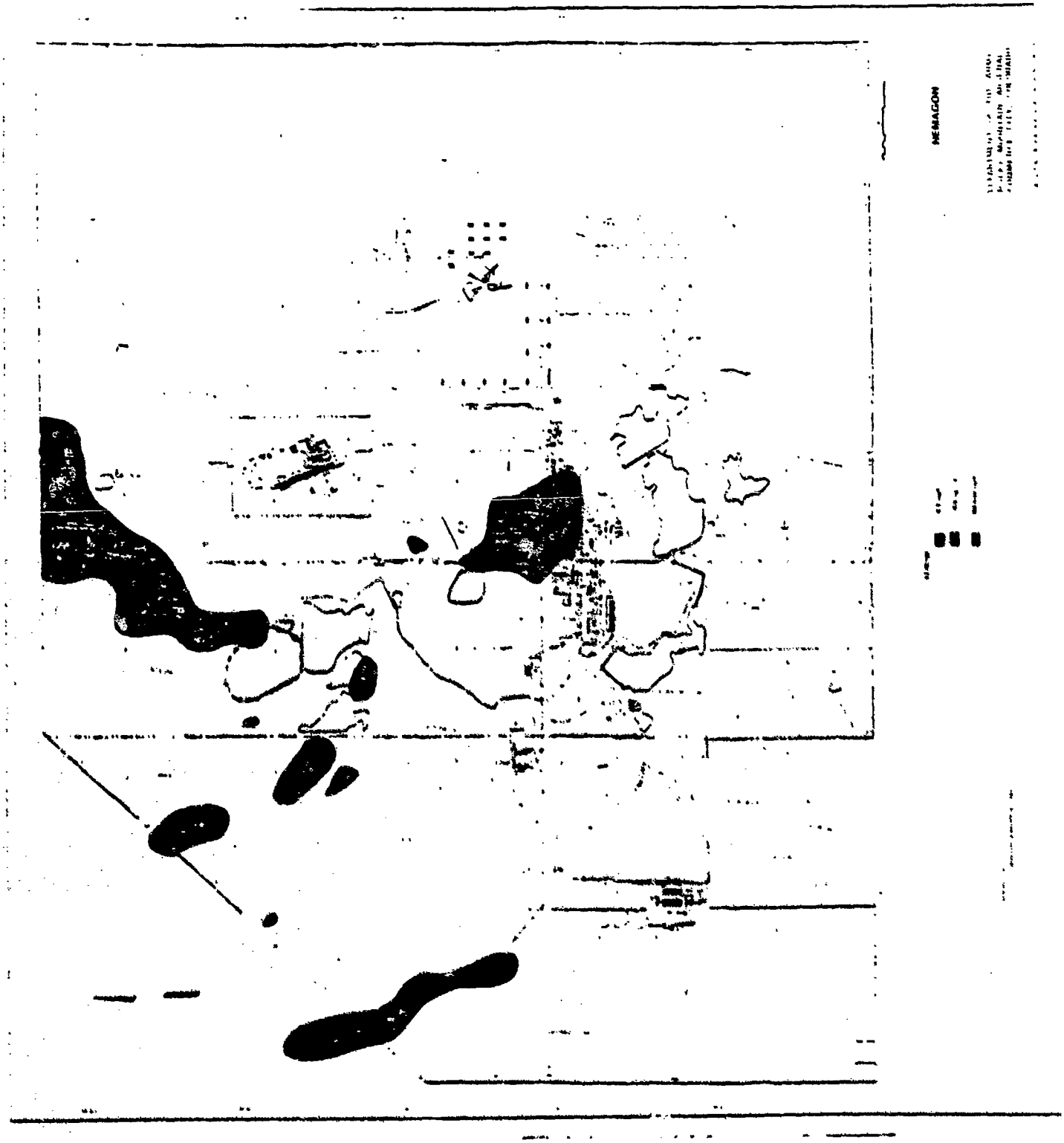

Figure 3
DBCP Concentration Map
Contamination Control Study
Rocky Mountain Arsenal
September 1980

Contour Interval as shown

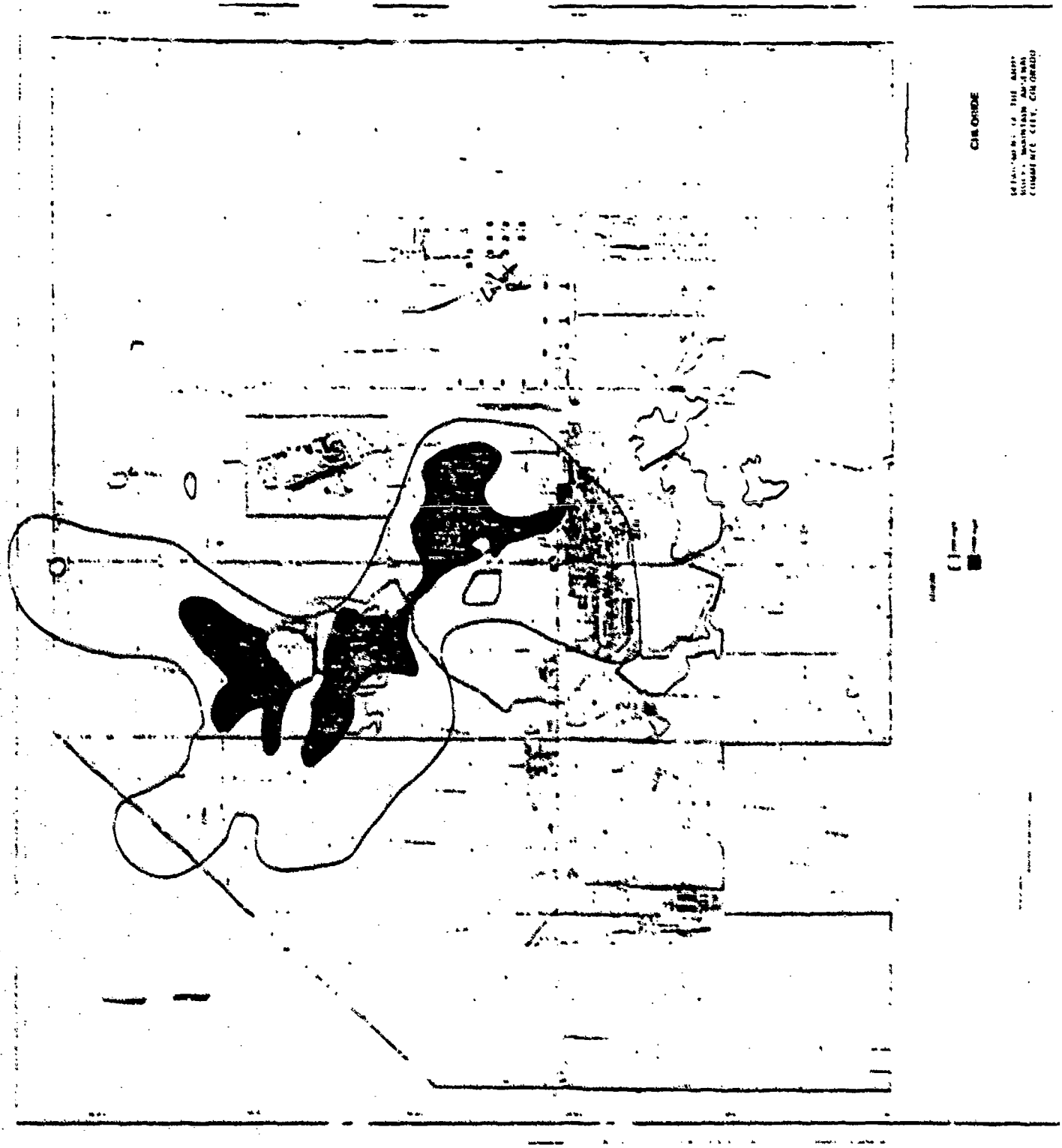

Figure 4
Chloride Concentration Map
Contamination Control Study
Rocky Mountain Arsenal
September 1980

Contour Interval as shown

Detailed inspection of the data files indicate that the number and location of valid chemical values is far greater than erroneous values identified. Based on this assessment the study team concluded that the contamination assessment for DBCP and Cl was a valid interpretation.

Qualitative data from the regional investigation has shown the potential existance of toluene, xylene and chloroform (figures 5 and 6), in the study area. Quantitative evaluation must be made for these and possibly other similar compounds to properly assess if a problem does exist. The completion of this effort lies within the scope of the regional investigation and is dependent upon:

1. RMA identifying methods with supporting precission and accuracy (P&A) data for those compounds, a date has not been established for this effort.

2. Contract lab support, using approved methods with P&A data, being investigated by USATHAMA - lab support cannot be expected before 1 Oct 81.

3. Completion of the regional investigation by WES.

Hydrogeologic Assessment - A current assessment of the hydrologic and geologic systems was made for the NW Boundary study area. This evaluation was made utilizing the data base previously discussed. This assessment incorporated new data from the regional investigation and deleted data from suspect well sites. Revised geologic cross sections were developed. Updated water level (figure 7) and Denver formation (figure 8) contour maps, were constructed for the study area. Comparison of the revised water level map with maps constructed for the Contamination Control Study (figure 9) indicate general hydrologic agreement.

Computations for groundwater flow in the study area were made using the revised data. The groundwater flux in the alluvial aquifer was estimated at 800 - 1500 gallons per minute for the contaminated areas at the boundary. Determinations of groundwater flows back onto the Arsenal were not possible due to the complexity of the hydrogeologic system and existing data gaps.

Control System Evaluation - The assessment of the hydrogeologic system and groundwater contamination distribution above, indicate that there is a need for the control of contamination crossing the NW Boundary. The options for placement of a control system in the NW Boundary area are:

(1) along the NW Boundary

(2) in the interior of RMA near Basin F

The advantages for each option are:

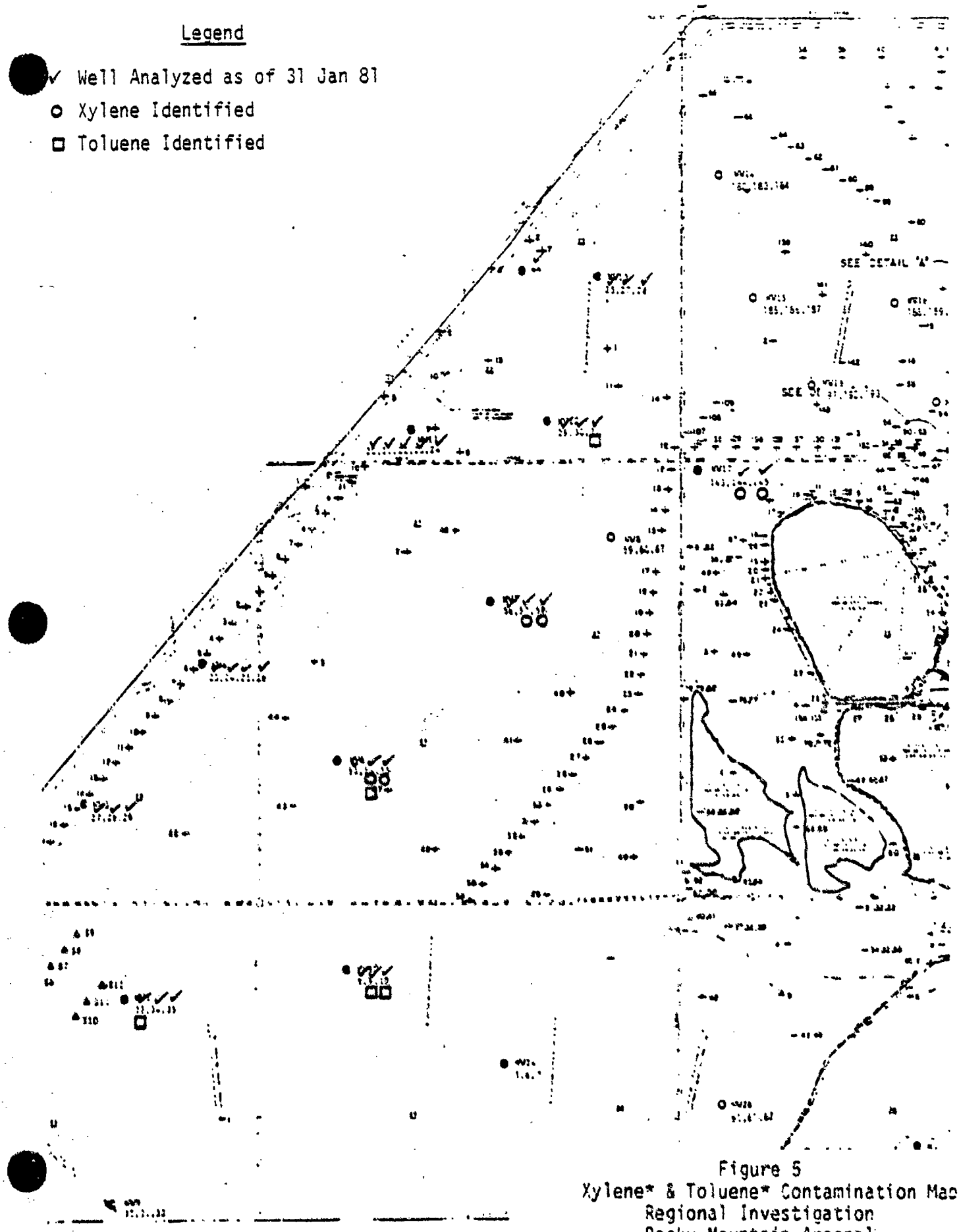

Figure 5
Xylene* & Toluene* Contamination Map
Regional Investigation
Rocky Mountain Arsenal
February 1981

*As determined using GC/MS

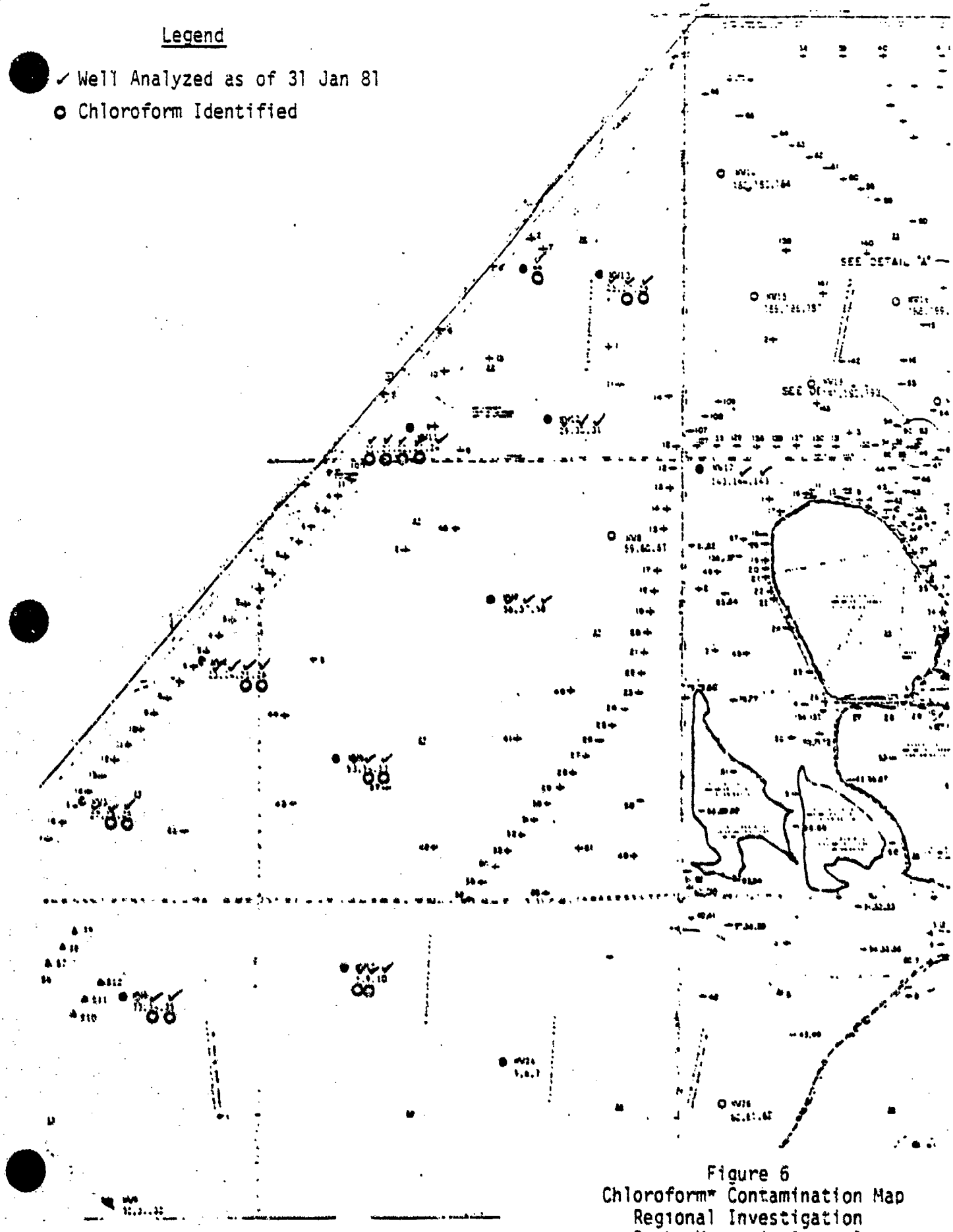

Figure 6
Chloroform* Contamination Map
Regional Investigation
Rocky Mountain Arsenal
February 1981

*As determined using GC/MS

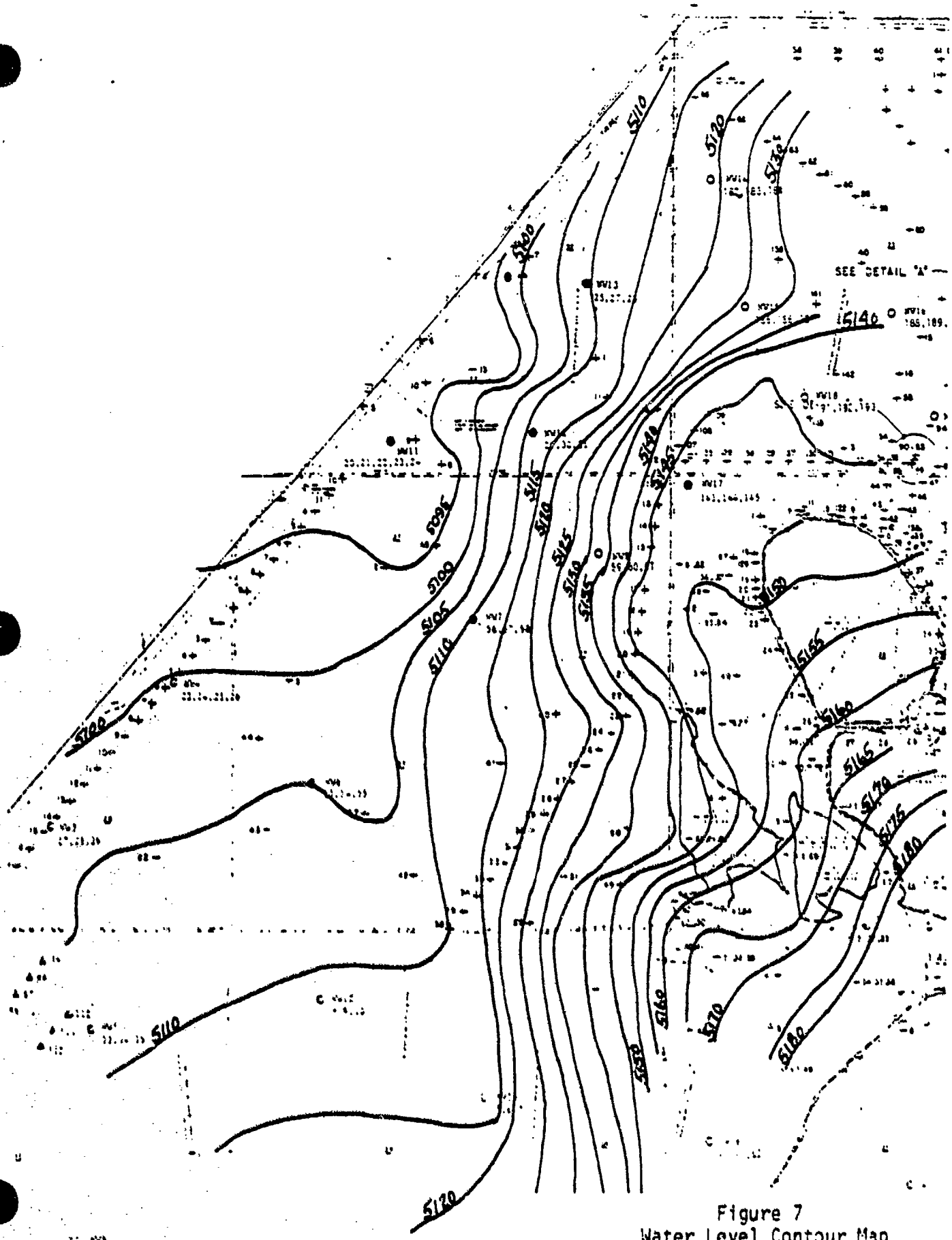

Figure 7
Water Level Contour Map
Spring 81 Data
NW Boundary Study
Rocky Mountain Arsenal
June 1981

Contour interval 5 & 2.5

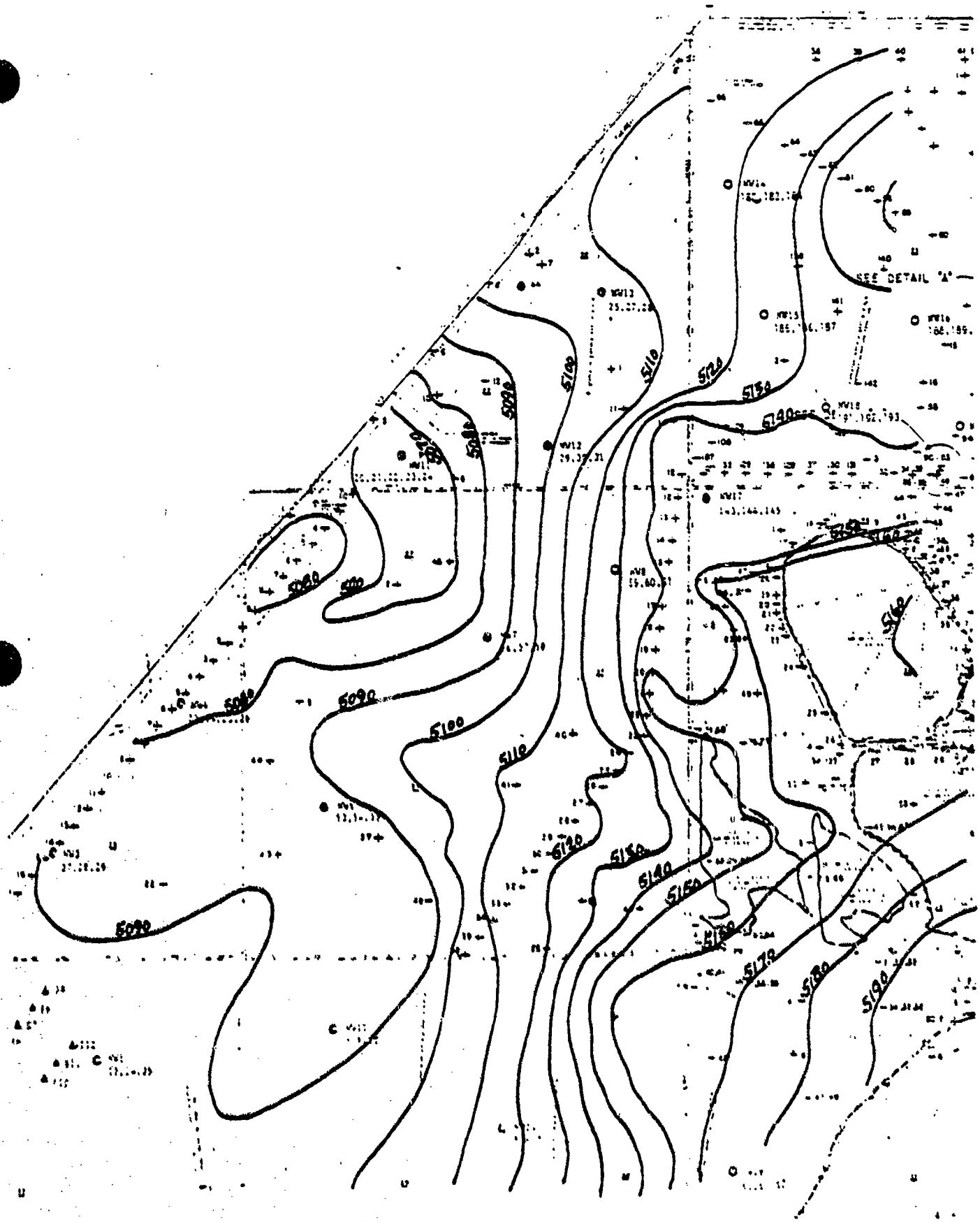

Figure 6
Denver Formation Contour Map
(Top of Bedrock)
NW Boundary Study
Rocky Mountain Arsenal
June 1981

Contour Interval 10.0 Ft.

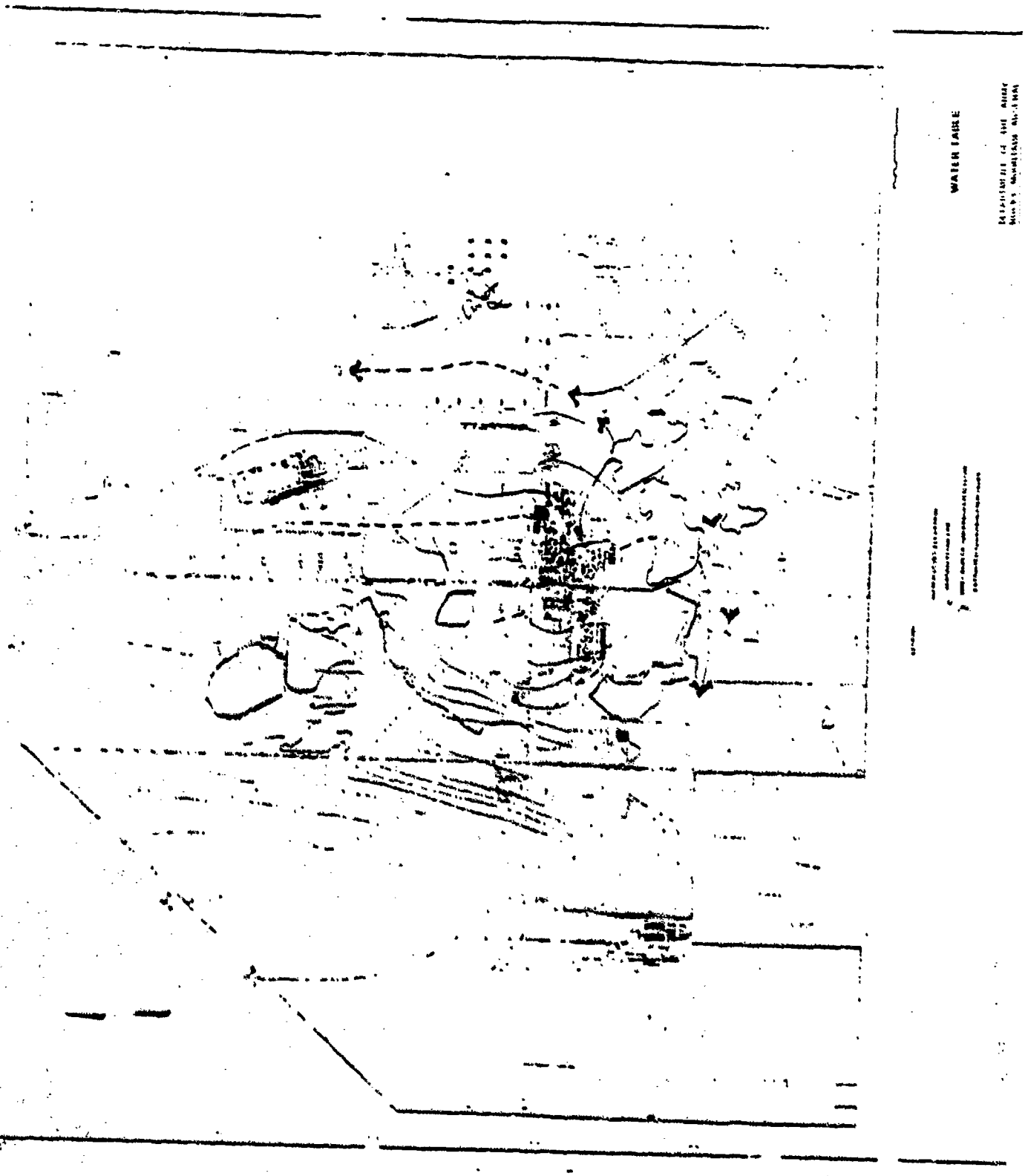

Figure 8
Water Level Contour Map
Contamination Control Study
Rocky Mountain Arsenal
September 1980

Contour Interval 10.0 Ft.

1. Boundary System

a. the hydrology and contamination plumes along the boundary are much less complex and therefore better understood than near Basin F.

b. placing a system at the boundary enables contamination near the boundary to be treated, placing a system near Basin F would miss a major portion of the DBCP plume near the boundary.

c. water quality along the boundary is similar to that which has been studied under previous carbon isotherm investigations, therefore, significantly less treatment study work will be required.

d. the distribution of contamination covers a larger width near Basin F than at the Northwest Boundary therefore requiring a larger and more complex control system.

e. maintaining an FY84 MCA program for contamination control is much more feasible at the boundary rather than near Basin F, due to data currently available.

2. Interior System

a. the amount of contaminated groundwater near Basin F is substantially less than at the boundary therefore, treatment of a concentrated stream is possible.

b. operational life of a system closer to the contamination source is determined to be shorter.

Based on the contamination assessment it is apparent that treatment of both organic and inorganic compounds may be required for either placement option since standards are exceeded in both cases. Since the removal of organics, primary DBCP, is expected for both options, the baseline treatment system will be a granular activated carbon system.

The addition of inorganic treatment will extend the required length of a containment system at the boundary and will result in the addition of a reverse osmosis unit to the treatment system and require the construction of evaporation ponds to dispose of the brine waste streams. The specifications for a reverse osmosis unit were estimated to be:

(1) flow rate: 1500 gpm

(2) influent concentration: 400 ppm Cl

(3) effluent concentration: 250 ppm Cl

The operating criteria for a single pass system are:

(1) quantity of water treated/day - 10^6 gallons

(2) waste stream - 200,000 gal/day

Costs associated with such a system are:

(1) shallow evaporation pond construction - $500K - $1,000K

(2) system capital costs - $1,000K - $1,500K

(3) O&M costs - $1,000K/year

(estimates from Mr. Doug Thompson (WES) based on sea water plant experience)

The components of the two control system options would be dewatering and recharge wells and bentonite barrier. The boundary system configuration could utilize a hydrologic barrier concept as well as a bentonite barrier system. Evaluation of the performance of both systems will eventually be possible with the operation of the North Boundary containment system expansion and the planned Irondale DBCP control system installation and operation. The interior system would most likely require a physical barrier system of some type due to the complexity of the hydrologic system. The use of bentonite in this area may not be possible due to the high dissolved salts concentration.

Control System Recommendations - It is the recommendation of the NW Boundary study team that a contamination control system be installed at the NW Boundary. The system should have the configuration as depicted in figure 10. Major components of the system and estimated specifications are:

Dewatering wells: 12
Recharge wells: 12
Bentonite barrier length: 2600 Ft.
treatment plant type: granular activated carbon (GAC)
treatment plant capacity: 800 gpm

A draft PDB 1391, figure 11, has been prepared specifying all the requirements for the NW Boundary system.

The study team justification for the indicated selection and the recommendations for future system operations in light of this selection are:

(1) selection of the boundary system best resolved the sensitive issue of continued DBCP groundwater contamination.

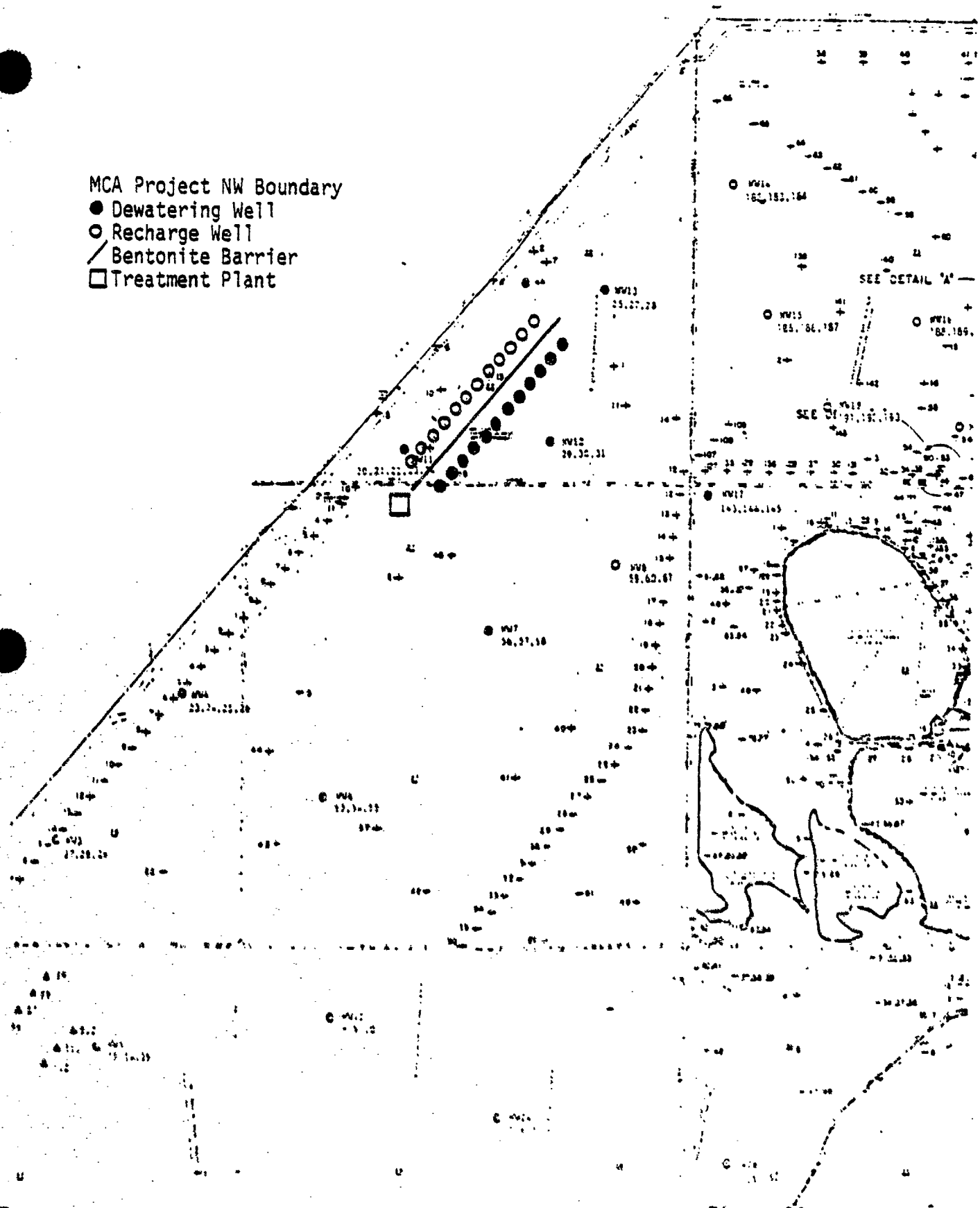

Figure 10
MCA Project Site Map
NW Boundary Study
June 1981

1. DATE	2. FISCAL YEAR	MILITARY CONSTRUCTION LINE ITEM DATA (Continued)	3. DEPARTMENT Army	4. INSTALLATION Rocky Mountain Arsenal
5. PROJECT NUMBER		6. PROJECT TITLE Liquid Waste Disposal Facility Northwest Boundary Control (North)		

Item	Unit	Quantity	Unit Cost*	Funded Project Cost*	Unfunded Project Cost
1. Containment Barrier for Northwest Boundary (North)	SF	165,000	11	1,815,000	0
2. Treatment Facility (3500 SF Building Area)	LS		1,122,500		
a. Bldg	SF	3,500	35/SF	(122,500)	
b. Treatment Equipment	LS			(1,000,000)	
				LS Total -	1,122,500
3. Evaporating Wells	EA	12	20,000	240,000	0
4. Injection Wells	EA	12	5,000	60,000	0
5. Monitoring Wells	EA	30	1,500	45,000	0
6. Electrical	LF	7,500	15.10	113,250	0
7. Paving	LF	4,000	7.50	30,000	0
8. Site Work & Access Roads					
a. Service Road	SY	12,000	2.50	(30,000)	
b. Site Work	SY	25,000	0.50	(12,500)	
				LS Total -	42,500
			Subtotal uninflated		3,468,250
			Escalation (12%)		*416,190
			Contingency (5%)		*194,222
			SIOA(5%)		*203,933
			Total HCA		4,282,595

*Estimated Cost Factors - Actual Figures to be determined using current sources from COE

DD FORM 1391, 1 OCT 701 REPLACES DD FORM 1391c, 1 Jul 62, WHICH IS OBSOLETE

Figure 11
DRAFT PDB/1391
NW Boundary Study
Rocky Mountain Arsenal
June 1981

(2) Inclusion of an inorganic treatment system, which resulted in a sizeable waste stream, with the boundary option was considered unwarrented. The study team feels that the severity of the inorganic problem is considered insignificant at the boundary in comparison to problems elsewhere on the Arsenal, especially near the contamination sources. It is highly recommended that inorganic treatment be considered for severe groundwater contamination problems associated with the contamination sources. It is felt that this position could be defended and would be agreeable to CDH.

(3) selection of a bentonite barrier system vs. a hydrologic system was based upon the known performance of a bentonite barrier system. In the event the hydrologic barrier system, to be used in the Irondale area, is judged superior a modification to the system design can be made since the bentonite barrier option is consideralby more expensive. This option provides maximum flexibility in choosing the best system without creating excessive funding requirements for the MCA project.

Documentation Requirements

Table 1 summarizes the major documents that could be required as part of an FY84 MCA project.

The actual documentation requirement is dependent upon the final site location, treatment type and operation specifications. The summary outlines the types of documents, time frame requirements, action organizations and support documents.

DOCUMENTATION REQUIREMENTS

TABLE 1

DOCUMENT TITLE	TYPE OF REQUIREMENT	AUTHORITY	TYPE OF DOCUMENT	SUSPENSE	ACTION ORGANIZATION	SUPPORT DOCUMENTS	REMARKS
1391/FYDP	Regulatory	US Army	Std Form	Aug 81	RMA/USATHAMA	NW Boundary Study Report	
Environmental Assessment	Regulatory	NEPA	Std Form	Dec 83	RMA/USATHAMA	NBC Expansion Study Report	
Biological Assessment	Regulatory	Endangered Species Act		Prior to Construction	COE	EA/EIS	May not be required for EA, only EIS
Hazardous Waste Permit	Regulatory	RCRA	Permit Application	Prior to Construction	RMA		May not be required depends on treatment
208 Permit	Regulatory	State of Colorado	Permit Application	Permit Approval Prior to Construction Start	RMA	North Boundary Containment System Permit	Amendment to NBC Permit Application
Air Pollution Control Permit	Regulatory	State of Colorado	Permit Application	Prior to Construction	COE		Exception granted in some cases for short term situations
Solid Wastes Disposal	Regulatory	State of Colorado	Permit Application	Prior to Design	RMA		Dependent upon the requirement for a landfill
Occupational Hazards Evaluation	Safety	US Army OSHA	Study/Report Safety Recommendations	Prior to Contract Award	USATHAMA/AIHA		
Right-of-Way Aquisition	General	US Army	Legal	Prior to Design	COE	Off Post Monitoring Requirement Well Locations	
Groundwater Treatment Criteria	General	Colo Dept of Health	Letter	Prior to Design	RMA/USATHAMA	Drinking Water Standards Secondary	

Conclusions

The data file update and validation task was not complete when the study team assessment was finalized. This task will be finalized and will provide valuable support to ongoing and future RMA studies.

The contamination problems at the NW Boundary are real with DBCP being the most critical and Chloride of secondary concern.

The initiation of an FY84 MCA project to address the groundwater contamination problems at the NW Boundary is warranted.

The proposed system configuration should include dewatering and recharge wells, bentonite barrier, organic treatment facility, and be located near the north portion of the NW Boundary of RMA.

The treatment of inorganics should be considered for source control projects. The inorganic contamination problems at the sources are of concern and must be addressed.

AMMENDED
WORK STATEMENTS FOR NORTHWEST BOUNDARY
FY84 MCA PROJECT

I. Data File Updates - Required to incorporate all available data as input to the hydrogeologic and contamination assessment.

Subject	Performer
Water Level	RMA/contractor
Geotechnical	WES/USATHAMA
Map File	RMA
Chemical/Dependent upon map record update	RMA/contractor

II. Data Validation - Required to assure that the assessment is the most representative of existing conditions.

Well screen placement evaluation - RMA

- develop list of questionable and bad wells

Chemical data validation - USATHAMA/contractor

Sampling method

- form preparation - USATHAMA

- program implementation - RMA

III. Contamination Identification

- dependent upon the completion of 1 and 2 above

Based on the information available, Northwest Boundary groundwater contaminants have been categorized as follows:

(1) potential regulatory concern contaminants which are above required treatable levels at or near the Northwest Boundary - DBCP

(2) potential regulatory concern contaminants which could be above required treatable levels - DIMP

(3) potential regulatory concern contaminants which are below required treatable levels and are expected to remain so - DCPD, organosulfurs, oxathiane, dithiane.

(4) contaminants which exceed secondary drinking water standard at or near the Boundary - Cl, F, TDS

(5) potential regulatory concern contaminants for which confirmation and quantification investigations are required - chloroform, toluene, acetone, benzene, chlorinated pesticides.

IV. Contamination Distribution

Contamination maps for DBCP, DIMP, DCPD and Cl have been developed as part of the Regional Investigation and the Contamination Control Study. They represent the most comprehensive mapping effort to date.

Once data file update and validation is complete, the contaminant distribution maps for the Northwest Boundary study area (sections 22, 23, 26, 27, 28, 34, 35) generated from the updated files will be compared to the other study groups maps for consistency. Additional maps and summaries will also be generated within the study area, for other than compounds identified above.

The effort to confirm and quantify contaminants of potential regulatory concern will be addressed by the regional survey. This Northwest Boundary study will examine the output of the regional survey and will determine the need for further delineation of contamination movement or mapping (i,e. further well placement).

V. Hydrogeologic Assessment

Once hydrogeoloic data (i.e. field drilling, water level, and aquifer analysis records) have been entered into the data base, a preliminary definition will be made of groundwater quantities, flow direction and the gradients in the Northwest Boundary area. Updated water level and Denver formation contour maps will be constructed and Geologic cross sections will be revised. Identification of hydrogeologic data gaps will be made.

VI. Control System Evaluation

Upon completion of the hydrogeologic and contamination problem assessment a control system selection will be made. A detailed assessment with rationale of all aspects of the control system will be made.

VII. Documentation Requirements

All regulatory and safety documentaiton requirements will be identified. The Northwest Boundary Project Team suspense dates for each document will be established. The organization responsible for development of task document will be provided.

Monitoring Well Installation
Analysis
Northwest Boundary Study

Criteria for determining wells not representative of RMA groundwater quality and hydrology.

1. Wells whose total screen is above the water table.

2. Wells which screen both alluvial and Denver aquifers with one casing.

3. Wells with long tail pieces (greater than 10 ft.)

4. Wells with less than 1 foot of saturated thickness in the screened section and a relatively long tail section (i.e. 5 ft.).

Section No.	Well No.	Remarks
22	22002	Multiple screens All-Denver
22	22007	W/L below screen
22	22012	Thin sat. thickness - near screen bot
22	22014	W/L below screen
23 (West ½ of Section)	23002	W/L below screen
23 " "	23034	W/L below screen
23 " "	23035	" "
23 " "	23036	" "
23 " "	23037	" "
23 " "	23059	" "
23 " "	23089	" "
26	26003	W/L below screen
26	26004	" "
26	26011	" "
26	26012	" "
26	26040	" "
26	26046	" "
26	26051	Long sand trap/little sat. thick
26	26052	Long sand trap
26	26053	" "
26	26062	Long sand trap/W/L below screen
26	26068	W/L below screen
26	26085	" "
26	26086	Long sand trap
26	26093	W/L below screen
26	26096	Long sand trap/W/L below screen
25	26125	Long sand trap
25	26126	" "
26	26127	" "
26	26131	" "
26	26133	" "

Section	Well No.	Remarks
27	27013	W/L below screen
27	27014	" "
27	27015	W/L below screen/dry well
27	27020	" "
27	27021	" "
27	27022	" "
27	27023	" "
27	27028	W/L below screen
27	27030	" "
27	27037	Long sand trap
27	27041	" "
27	27042	" "
27	27043	" "
28	28022	Long sand trap
35	35002	Multiple screens all-Denver
35	35004	W/L below screen
35	35006	" "
35	35009	Long sand trap
35	35012	" "
35	35020	" "
35	35031	W/L below screen
35	35034	" "

DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL | SUBJECT

SARRM-TOE-C | FY84 MCA Project, Northwest Boundary, RMA

TO: Senior Project Engineers, RMA Contamination Control Program | FROM: NW Boundary Project Team | DATE: 27 July 1981 | CMT 1: Mr. Anderson/1b/366

1. Cost estimates for the FY84 MCA project for the Northwest Boundary were prepared for both a bentonite barrier and hydrologic barrier control system. Attached at Incl 1 and 2 are the draft 1391c for each system respectively.

2. Recommend that a 1391c be prepared for the Northwest Boundary identifying a bentonite barrier control system and that this 1391 be forwarded for approval.

3. Data pertaining to the performance/operation of both the barrier systems, bentonit and hydrologic, at Rocky Mountain Arsenal should be provided to the Corps of Engineers and their design architect-engineers so that the best engineered system can be designed for the Northwest Boundary.

Brian L. Anderson

Incls
as

BRIAN L. ANDERSON
Hydraulic Engineer

DA FORM 2496

1. DATE 27 JUL 87	2. FISCAL YEAR FY89	MILITARY CONSTRUCTION LINE ITEM DATA (Continued)	3. DEPARTMENT ARMY	4. INSTALLATION ROCKY MOUNTAIN ARSENAL

5. PROJECT NUMBER

6. PROJECT TITLE

LIQUID WASTE BIOLOGICAL FACILITY, BOUNDARY CONTAINMENT/TREATMENT SYSTEM

ITEM	UNIT	QUANTITY	UNIT COST	PROJECT COST ESTIMATE
1. CONTAINMENT BARRIER FOR BOUNDARY BOUNDARY (NORTH)	LF	7,600		1,599,000
2. TREATMENT FACILITY	LS		1,500,000	1,500,000
a. Building (1500 SF Building Area)				
b. Treatment Equipment				
3. DEWATERING WELLS	EA	12	20,000	240,000
4. RECHARGE WELLS	EA	12	12,000	144,000
5. MONITORING WELLS	EA	18	8,730	161,000
6. ELECTRICAL	LF	7,500	20	150,000
7. PIPING	LF	4,000	10	40,000
8. SITE WORK	LS		450,000	450,000
a. Service Roads				
b. Grading				
c. Clay cap				
d. Roadway surface				
e. Seeding				
9. TELECOMMUNICATIONS	LS		7,000	7,000
			Sub Total	4,290,200
			Escalation (12%)	514,824
			Contingency (5%)	214,510
			S & A (5%)	214,510
			TOTAL BCA FY89	5,234,044

DD FORM 1391c (1 Oct 79) REPLACES DD FORM 1391c, 1 Jul 62, WHICH IS OBSOLETE Page No. _____

Incl 1

1. DATE	2. FISCAL YEAR	MILITARY CONSTRUCTION LINE ITEM DATA (Continued)	3. DEPARTMENT	4. INSTALLATION
7 JUN 81	FY86		ARMY	ROCKY MOUNTAIN ARSENAL

5. PROJECT NUMBER

6. PROJECT TITLE

LIQUID WASTE DISPOSAL FACILITY, NORTHEAST BOUNDARY CONTAINMENT/TREATMENT SYSTEM

ITEM	UNIT	QUANTITY	UNIT COST	PROJECT COST ESTIMATE
1. TREATMENT FACILITY	LS		1,500,000	1,500,000
a. Building (1500 SF Building Area)				
b. Treatment Equipment				
2. EXTRACTION WELLS	EA	60	20,800	1,248,000
3. RECHARGE WELLS	EA	70	12,800	259,200
4. MONITORING WELLS	EA	45	4,700	211,500
5. ELECTRICAL	LF	15,000	20	300,000
6. PIPING	LF	8,000	10	80,000
7. SITE WORK	LS		200,000	200,000
a. Service Roads				
b. Grading				
c. Seeding				
8. TELECOMMUNICATIONS	LS		7,000	7,000
			Sub Total	4,805,700
			Escalation (12%)	956,689
			Contingency (5%)	190,285
			S & A (5%)	190,285
			TOTAL BCA FY86	6,602,959

DD FORM 1391c (1 Oct 70) REPLACES DD FORM 1391c, 1 Jul 62, WHICH IS OBSOLETE Page No. _____

Sheet 2

APPENDIX B

1. DATE	2. FISCAL YEAR	MILITARY CONSTRUCTION PROJECT DATA	3. DEPARTMENT	4. INSTALLATION	ENR BLDG INDEX NO. 2859
12 Aug 81	FY84		Army	Rocky Mountain Arsenal	

5. PROJECTED AUTHORIZATION	6. PRIOR AUTHORIZATION	7. CATEGORY CODE NO.	8. PROGRAM ELEMENT NO.	9. STATE/COUNTRY
$ 4,290,200	P.A.	831 90		Colorado

10. PROJECTED APPROPRIATION	11. BUDGET ACCOUNT NUMBER	12. PROJECT NUMBER	13. PROJECT TITLE	NR	CH	RR
$ 4,290,200	6100	T-039000	Liquid Waste Disposal Facility - Northwest Boundary Containment/Treatment System		X	

SECTION A - DESCRIPTION OF PROJECT

14. TYPE OF CONSTRUCTION
- a. PERMANENT [X]
- b. SEMI-PERMANENT [ ]
- c. TEMPORARY [ ]

15. TYPE OF WORK
- a. NEW FACILITY [X]
- b. ADDITION [ ]
- c. ALTERATION [ ]
- d. CONVERSION [ ]
- e. OTHER (Specify)

16. REPLACEMENT
17. TYPE OF DESIGN
- a. STANDARD DESIGN [ ]
- b. SPECIAL DESIGN [X]
- c. MANUAL NO.

18. PHYSICAL CHARACTERISTICS OF PRIMARY FACILITY

a. NO. OF BLDGS | b. NO. OF STORIES | c. LENGTH | d. WIDTH

e. DESIGN CAPACITY | f. GROSS AREA

g. COMBINE: CAP. COST ($)

19. DESCRIPTION OF WORK TO BE DONE

This project consists of constructing (1) An impervious barrier at the northwest boundary; (2) Dewatering wells to remove contaminated groundwater; (3) Treatment facility building; (4) Recharge wells to reintroduce the treated water. (5) Monitor wells on both sides of barrier; (6) All weather road around barrier; (7) Work surface for mixing barrier material; and (8) Provide electrical power to operate the treatment facility and run the pumps. The treatment facility components will be designed by RMA and will be a GFI component to the containment system.

SECTION B - COST ESTIMATES

20. PRIMARY FACILITY	U/M	QUANTITY	UNIT COST $	COST ($000) $
a. Impervious Barrier	LF	(2600)	615,000	(1,599.0)
b. Treatment Facility	LS	(308)		(1,500.0)
1. Building 3500 SF		( )		( )
2. Treatment Equipment		( )		( )
c. Dewatering Wells	EA	12	20,800	(249.6)
d. Recharge Wells	EA	12	12,800	(153.6)
				( )
21. SUPPORTING FACILITIES				( )
a. Monitoring Wells	EA	30	4,700	(141.0)
b. Electrical	LF	7500	20	(150.0)
c. Piping	LF	4000	10	(40.0)
d. Site Work & Grading	LS	308	450,000	(450.0)
1. Roads, clay cap, working surface				( )
2. Seeding				( )
e. Telecommunications	LS	308		(6.9)
22. TOTAL PROJECT COST				$4,290.2

SECTION C - BASIS OF REQUIREMENT

23. QUANTITATIVE DATA (U/M LF)

	AUTHORIZED	FUNDED
a. TOTAL REQUIREMENT	2,600	
b. EXISTING SUSTAINMENT	(0)	
c. EXISTING AUTHORIZED	0	
d. FUNDED, NOT IN INVENTORY	0	
e. AUTHORIZED ASSETS (c + d)	0	
f. REQUIRED FOR AUTH.	0	
g. INCLUDED IN FY ___ PROG.	0	0
h. DEFICIENCY (a - e - f)	2,600	0

24. RELATED PROJECTS: FY 80 RCA, North Boundary Extension; FY 81 RCA, Containment of Basin F; FY 84 Closure of Basin F.

25. REQUIREMENT FOR PROJECT

This project is required to eliminate the migration of chemical contaminants off RMA which are leaking from contamination sources on RMA. The groundwater migration of contaminants beyond the Arsenal's northern boundary has resulted in: (1) Claims for property and personal loss by damages from land users north of the Arsenal and (2) Issuance of Cease and Desist Orders by the State of Colorado prohibiting further release of pollutants off Arsenal in subsurface waters. If this project is not approved, the same type of litigation stated above could occur involving the northwest boundary as contaminated groundwater will continue to flow past the RMA boundary. There will be no disposal action required on existing facilities. This project has been reviewed and complies with the intent of P.L. 91-190.

1. DATE 12 Aug 81	2. FISCAL YEAR FY 84	MILITARY CONSTRUCTION LINE ITEM DATA (Continued)	3. DEPARTMENT Army	4. INSTALLATION Rocky Mountain Arsenal
5. PROJECT NUMBER 1-039000		6. PROJECT TITLE Liquid Waste Disposal Facility, Northwest Boundary Containment/Treatment System		

1. General:

a. This project is located in Sections 22 and 27, Township 2 south range 67 west, 6th principal meridian, Adams County, Colorado. Chemical herbicides and pesticides were produced by Shell Chemical Company at Rocky Mountain Arsenal. Contaminated liquid waste were produced by Rocky Mountain Arsenal during chemical production and demil operations. Shell Chemical Company has ceased pumping contaminated waste to open settling and evaporation ponds (Basin F) as of 31 Mar 78.

b. At all dry and wet evaporation ponds, the existing residue has continued to leach contaminants through the ground into the groundwater aquifer. The contaminants have migrated to other areas on and off post via the aquifer(s). This project is proposed to contain and eliminate contamination of the groundwater aquifer(s) passing off Rocky Mountain Arsenal and does not address surface water and air pollution. This project will be accomplished by construction of a new barrier system at the northwest boundary, along with attendant dewatering and recharge wells and necessary treatment facilities. This project must be constructed to comply with the issuance of "Cease and Desist Orders" by the State of Colorado prohibiting farther release of pollutants off the Arsenal in subsurface water. "New Start" as defined in paragraph 1-5g of AR 235-5 is not applicable to this project.

c. A 1,500 l.f. groundwater barrier and water-treatment system was installed at the north boundary in 1978. Operational data has proven the effectiveness of this system for the limited area it serves and a project to expand its north boundary barrier is included in the FY 80 MCA program. A project to provide for the elimination of liquid in Basin F is programmed for FY 81 with encapment of this basin programmed for FY 84.

d. Project is for new construction. Facilities will not contain ammunition, explosives, chemical agents, radioactive material, radiation producing devices or other hazardous materials and are not located within established QD arcs. Site plan/safety submission not required.

2. Accommodations Now In Use: There are no facilities in existance along the northwest boundary to prevent contamination migration off the Arsenal.

3. Analysis of Deficiency: Contaminated liquid waste from Basin F leaks through the basin bed into the aquifer. Residue in Basin A (evaporization pond used prior to 1956) from contaminated waste similar to that found in Basin F is carried to the aquifer by precipitation recharge and soil contamination. The underground contaminated sewer line running through the Basin A vicinity to Basin F has been subjected to physical breakage and joint deterioration contributing to contamination of the groundwater. These contaminants are flowing off the north and northwest boundaries of the post. The pilot barrier and treatment system at the north boundary, while removing organic contaminants, was not designed to remove fluoride compounds. The FY 80 expansion of the north boundary containment/treatment system is designed to remove organic and fluoride compounds and was constructed to remove only organic contaminants. The northwest boundary system will be designed and constructed to remove organic contaminants.

1. DATE 12 Aug 81	2. FISCAL YEAR FY 84	MILITARY CONSTRUCTION LINE ITEM DATA (Continued)	3. DEPARTMENT Army	4. INSTALLATION Rocky Mountain Arsenal
5. PROJECT NUMBER T-03000		6. PROJECT TITLE Liquid Waste Disposal Facility, Northwest Boundary Containment/Treatment System		

4. Consideration of Alternate Facilities: There are no on-post facilities that can meet the requirements of this project.

5. Criteria for Proposed Construction: The construction of the northwest boundary barrier involves the installation of 2,600 L.F. of barrier to a minimum of 30 ft. and a maximum of 60 ft., addition of dewatering and recharge wells, and construction of the treatment facility building. The new treatment facility components will remove organic contaminants from the groundwater as is done now at the existing facility located at the north boundary. The treatment equipment will be housed in a new building near the boundary barrier. Treatment facility components will be designed by RMA, and will be a GFE component to the system.

6. Program for Related Furnishings and Equipment: All treatment equipment required by this project will be MCA funded. There are no related furnishings and equipment required.

7. Disposal of Present Assets: There will be no disposal of present assests.

8. Survival Measures: This project is not suitable for inclusion of protective shelter.

9. Summary of Environmental Consequences: This project has been assessed and preliminary information available from the 360° monitoring program indicated that this project is required to comply with the State of Colorado "Cease and Desist Orders". The Environmental Impact Statement for this project will consider this assessment. This project is for abatement of presently identified groundwater pollution. Its accomplishment will abate flow of contaminated groundwater through the northwest boundary to comply with existing Federal, State, and local regulations.

10. Evaluation of Flood Hazard: These facilities are not sited within areas known to be subjected to flooding.

11. Economic Savings: Not applicable. The selection of this project was not predicated on overall economic savings but on high efficiency of systems to contain and treat contaminated groundwater.

12. Utility Support: All utilities are available that are necessary to treat the contaminated aquifer water. No additional utility support projects are required.

13. Protection of Culturial Equipment: The Rocky Mountain Arsenal contains no historical places listed in the National Register of Historical Places.

14. Project Development Brochure: Preparation of the Project Development Brochure was completed on 12 Aug 81.

15. Energy Requirements:

a. This project consists of constructing the containment/treatment system at the northwest boundary.

b. Estimated energy consumption:

(1) Heating: A self-contained heating system will be required to keep the new treatment building above freezing (40°f). Estimated consumption will be 400 gal/mo fuel oil.

(2) Air Conditioning: No air conditioning is required.

(3) Water Supply: A small self-contained potable water source will be required for plant operators.

1. DATE 12 Aug 81	2. FISCAL YEAR FY84	MILITARY CONSTRUCTION LINE ITEM DATA (Continued)	3. DEPARTMENT Army	4. INSTALLATION Rocky Mountain Arsenal
5. PROJECT NUMBER T-07008J		6. PROJECT TITLE Liquid Waste Disposal Facility, Northwest Boundary Containment/Treatment System		

(4) Electrical: Electrical service is required for water treatment equipment, dewater wells, and outdoor lighting. Estimated consumption will be 64,000 Kwt/month.

(5) Sewage system: A self-contained system will be required.

c. Energy sources: Electrical service is available at the project location from adjacent off site power lines and is considered adequate.

16. Provision for the Handicapped: In accordance with PL 90-480, no provision for the handicapped will be made in the project, since in the foreseeable future the facility will be used and operated solely by able-bodied personnel.

Installation: Rocky Mountain Arsenal

Project: Liquid Waste Disposal Facility - Northwest Boundary Containment and Treatment Facility

Project number

Temporary: R-039000

Permanent:

Serial number:

Program year

Category code 33190

Point of Contact:

User

Name David L. Reim, P.E.
Title Director of Installation Services

Date
Phone (303) 289-0113
Autovon 395-2113

DFAE

Name David L. Reim, P.E.
Title Director of Installation Services

Date
Phone (303) 289-0113
Autovon 395-2113

Approved by:

Installation Facility Engineer

Name David L. Reim, P.E.
Title Director of Installation Services

Date
Phone (303) 289-0113
Autovon 395-2113

Installation Commanding Officer

Name
Title

Date
Phone
Autovon

MACOM Engineer

Name
Title

Date
Phone
Autovon

DETAILED

FUNCTIONAL REQUIREMENTS

ROCKY MOUNTAIN ARSENAL

LIQUID WASTE DISPOSAL FACILITY, NORTHWEST BOUNDARY

CONTAINMENT/TREATMENT SYSTEM

DENVER, COLORADO

PROJECT COORDINATOR FOR USING SERVICE

DAVID L. REIM, P.E.

(303) 228-1513

AUTOVON 556-2513

TABLE OF CONTENTS

	PAGE
1. Background Information	
Objective for the Facility	1
Tabulation of Occupants	1
Descriptions of Operation	1
2. Summary Data	
Space Requirements	1

OBJECTIVE

The objective for the Northwest Boundary Containment/Treatment System at the Rocky Mountain Arsenal is to contain and eliminate contamination of the groundwater aquifer passing off the Arsenal. This project must be constructed to comply with the "Cease and Desist Order" issued by the State of Colorado prohibiting further release of pollutants off the Arsenal. In addition, claims for property and personal loss from land users north of the Arsenal has also resulted. This project is required to eliminate the type of litigation stated above.

LIST OF OCCUPANTS

Unit of Operation	Number of Personnel	M	F
DFAE	Part-Time Operator	-	-

DESCRIPTION OF OPERATION

Contaminated groundwater will be pumped out and into the treatment building for decontamination. Once the decontaminated process has been completed, the treated groundwater will be reinjected.

SPACE REQUIREMENT

Treatment building will require 3500 square feet based upon preliminary equipment requirement. This list of required equipment is subject to change, pending additional criterias which may be established by the State of Colorado.

Reference	Required by AR 415-15 Paragraph:	Used For DD Forms 1391 Block	Used For DD Forms 1391 Instr. Para.	A. Special Considerations — Item	Required or Not Required To Be Determined	*	Comment Attached
AR 415-17; DOD 4270.1-M; AR 415-28; AR 37-108; AR 420-70; MIL Std 1691	7-4	9		1. Cost estimates for each primary facility	R		X
	2-4d; 3-2b	9 & 10		2. Telecommunications system coordination with USACC and authorization for exceptions	NR		
DAPAM 210-4	3-2b	10		3. Coordination with state and local governmental requirements (blind vendors, medical facilities, construction and operating permits, clearinghouse coordination, etc.)	R		X
AR 95-50	2-1c	10		4. Assignment of airspace	NR		
AR 11-28	4-1a; 3-12; 3-1	10	11	5. Economic analysis of alternatives	NR		
AR 235-2	3-4; 3-2b		1	6. Approval for new starts	NR		
AR 37-43; AR 37-109; DOD Directive 2010.5; DOD Manual 7040.4	3-11; 3-13; 3-2b		1	7. International balance of payments (IBOP) coordination with U.S. European command and NATO — overseas cost estimates and comparables (include rate of exchange used in estimates)	NR		
AR 200-4(15); MIL STD 1-481-1; PL 92-190; PL 18-665	3-2d; 3-14;		13	8. Impact on historic places — on site survey by authorized archeologist and coordination with state historic preservation officer and advisory council on historic preservation	NR		
DOD 4270.1-M; MIL STD 1-480-1; MIL STD 1-483-1	3-3a	9		9. Exceptions to established criteria	R		X
				10. Coordination with various staff agencies (Provost Marshall-physical security, etc.)	R	X A	
				11. Identification of related or support projects (so projects can be coordinated)	R		X
		9		12. Required completion date	R		X
				Other special considerations (List and number items)			

NOT REQUIRED — Not relevant or no information to communicate.
TO BE DETERMINED — Information needed but not currently available.
COMMENT ATTACHED — Significant information summarized or explained and attached.
DOCUMENT ATTACHED — Significant information is in an existing document which is attached.

*BY WHOM (Check and insert appropriate letter) ____
A — OFAS
B — Using Service
C — Construction Service
D — Designer
E — Other (Check comments attached and explain)

documentation checklist

sheet 1/6

Reference	Required by AR 415-15 Paragraph:	Used For DD Form 1391 Block	Used For DD Form 1391 Inst. Para.	B. Site Development — Item	Required or Not Required To Be Determined	Comment Attached	Document
E.O. 11988 (24 May 1977)	317; 3-11		10	1. Siting in flood plain — consultation with Corps of Engineers District Office to determine and evaluate flood plain hazards	NR		
				2. Site Plans (A) DA Approved General Site Plan	R	X	
				(B) Annotated General Site Plan	NR		
				(C) Detailed Site Plan (if different site than in (A)). (See also Technical Data Checklist, Item 9-1)	NR		
				3. Availability and location of (A) Master Plans (B) Survey Data (C) Subsoil Information	R NR R	X X	
AR 385-40	3-7	10		4. DDESB approved Safety Site Plan	NR		
				Other Site Development Considerations (List and number items)			

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COMMENT ATTACHED — Significant information summarized or explained and attached.
DOCUMENT ATTACHED — Significant information is in an existing document which is attached.

*BY WHOM (Check and insert appropriate letter) ____
A — OPAE
B — Using Service
C — Construction Service
D — Designer
E — Other (Check comments attached and explain

documentation checklist

References	Required by AR 415-15 Paragraph:	Used For DD Form 1391: Block	Used For DD Form 1391: Inst. Para.	C. Architectural & Structural — Item	Required or Not Required To Be Determined	Comment Attached	Document Attached
AR 210-13	3-13a		1	1. Reconciliation with troop housing programs and requirements	NR		
	7-5 a.d.l. 7-6d		2	2. Evaluation of existing facilities (including degree of utilization)	NR		
AR 405-90; AR 420-70	3-1d	10		3. Approval for removal and relocation of existing useable facilities	NR		
AR 31-200; AR 55-1	3-10b	10		4. Evaluation of off-post community facilities	NR		
AR 740-1; Def. Prod. Reg. 3FM-27-101; DOD DIR. 5210.41; DOD 5210.41M; AR 50-5; AR 385-60; 7 M 39 Series	3-18; 7-4a; 7-6m	10	5	5. Storage and maintenance facilities (including nuclear weapons)	NR		
AR 500-3	2-4h; 3-12; 7-4a; 7-6d	10		6. Coordination hospitals, medical and dental facilities with Surgeon General	NR		
AR 95-50	3-14; 3-2f		1	7. Coordination of aviation facilities with FAA	NR		
	2-4d		1	8. Coordination air traffic control and navigational aids with USACC	NR		
	3-2f		1	9. Tabulation of types and numbers of aircraft	NR		
	3-2g		1	10. Evaluation of laboratory, research and development, and technical maintenance facilities	NR		
	3-2a		1	11. Coordination chapels with Chief of Chaplains	NR		
DOD 4270.1-M AR 30-1	3-8; 3-2m		1	12. Review food service facilities by USATSA	NR		
AR 530-4; AR 18-1; AR 420-14; AR 420-90	3-8; 3-2e		1	13. Automated data processing system or equipment approvals — cost analysis when ADP and/or communication centers not co-located with related facilities	NR		
AR 55-1	3-10b(8); 3-2n		1	14. Coordination postal facilities with U.S. Postal Service Regional Director	NR		

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documentation checklist

sheet

Reference	Required by AR 415-15 Paragraph:	Used For DD Form 1391 Block	Used For DD Form 1391 Instr. Para.	C. Architectural & Structural (Continued) Item	Required or Not Required To Be Determined	Comment Attached	Document Attached
	3-20		1	15. Laundry and dry cleaning facilities coordination with ASD (I & L)	NR		
AR 210-41; AR 210-42; AR 210-43	2-1b; 3-2c		1	16. Tenant facilities coordination with installation where sited	NR		
385-60; TM 5-1300-206	3-7a; 3-12c; 3-2a		1	17. Facilities for or exposed to explosions, toxic chemicals, or ammunition — review by DDESB (See also Item 3-4)	NR		
	3-4		3	18. Analysis of deficiencies	R		X
	3-5		4	19. Consideration of alternatives	NR		
PL 90-480 ER 1110-1-102	3-17		15	20. Determination whether occupants will include physically handicapped or disabled persons	R		X
				21. As-built drawings for alterations or additions	NR		
AR 415-20; EP 1110-345-2				22. Availability of Standard Design	NR		
				Other Architectural and Structural (List and number items)			

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Reference	Required by AR 415-15 Paragraph:	Used For DD Form 1391: Block	Inst. Para.	D. Mechanical & Utility Systems — Item	Required or Not Required To Be Determined	Comment Attached / Document Attached
AR 420-50	3-6k; 3-2h; 3-16	13	3; 15	1. Fuel considerations and cost comparison analysis	NR	
AR 11-27; DOD 4270.1-M; AR 420-49; AR 420-54	3-16		15	2. Energy requirements appraisal (ERA)	R	X
				3. Conformance with DOD Energy Reduction requirements	NR	
	3-4h; 3-13	10	3; 12	4. Evaluation of existing and/or proposed utility systems	R	X
				Other Mechanical and Utility Systems (List and number items)		

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documentation checklist

E. Environmental Considerations

Reference	Required by AR 415-15 Paragraph:	Used For DD Form 1391 Block	Used For DD Form 1391 Ltr. Para.	Item	Required or Not Required To Be Determined	Comment Attached	Document Attached
AR 200-1, PL 91-190	3-24; 7-4c; 3-10	10	9	1. Environmental Impact assessment	R	X	X
AR 200-1; PL 91-190	3-24; 7-4c 3-10		9	2. EIA conclusions require Environmental Impact Statement	R	X	
		10	9	3. Determination of health, environmental or related hazards. Assistance to determine existence of any health, environmental, or related hazard may be requested from the Office of the Surgeon General, Attn: DASG-HCH (Army Environmental Hygiene Agency)	NR		
Clean Air Act Amend 1977	7-4c 3-8c	10	9	4. Air/water pollution permit, coordination with agencies and compliance with standards at Federal, state and local levels	R	X	
				Other Environmental Considerations (List and number items)			

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documentation checklist

COMMENT

DOCUMENTATION CHECKLIST

ITEM	COMMENT
A-1	Reference DD Form 1391, Incl 1.
A-3	Proposed project is required to comply with "Cease and Desist Orders" issued by the State of Colorado prohibiting the release of pollutants off Rocky Mountain Arsenal and contaminating surrounding areas.
A-9	Design parameters in regards to the allowable groundwater toxic level of various chemicals which have been or will be established by the State of Colorado, which will determine type of required treatment system.
A-11	FY-80, North Boundary Extension FY-81, Containment of Basin F FY-84, Capment of Basin F
A-12	Proposed project should be completed by end of FY-84.
B-2.A	General Site Plan is submitted for approval in conjunction with the PDB, Incl 2.
B-3.A	Information will be provided by the Omaha District.
B-3.C	Reference Inclosure 3.
C-18	Contaminated liquid waste from Basins A and F are being carried via the aquifer toward the north and northwest boundaries of the post. Contamination at the North Boundary has been or will be handled by the existing treatment system and the FY-80 North Boundary Extension, while this project will provide containment and treatment for the Northwest Boundary.
C-20	In accordance with PL 90-480, no provisions for the handicapped will be made in the project, since in the foreseeable future the facility will be used and operated solely by able bodied personnel.

COMMENT

DOCUMENTATION CHECKLIST

ITEM	COMMENT
D-2	Energy Requirement Appraisal
	a. This project consits of constructing the containment/treatment system at the northwest boundary.
	b. Estimated energy consumption:
	(1) Heating: A self-contained heating system will be required to keep the new treatment building above freezing (40°F). Estimated consumption will be 400 gal/mo fuel oil.
	(2) Air Conditioning: No air conditioning is required.
	(3) Water Supply: A small self-contained potable water source will be required for plant operators.
	(4) Electrical: Electrical service is required for water treatment equipment, dewater wells, and outdoor lighting. Estimated consumption will be 64,000 Kwt/month.
	(5) Sewage System: A self-contained system will be required.
	c. Energy Sources: Electrical service is available at the project location from adjacent off-site power lines and is considered adequate.
D-4	Proposed Heating, Water Supply, and Sewage System will be entirely self-contained. Adequate electrical service will be provided from the adjacent off-site power line.
E-1	Refsrence Inclosure 4.

COMMENT

DOCUMENTATION CHECKLIST

ITEM	COMMENT
E-2	Preliminary assessment indicates that this project is required to comply with the State of Colorado "Cease and Desist Orders". An Environmental Impact Statement (EIS) or an Environmental Impact Assessment (EIA) will be required for this project. Designer will provide required technical data to assist Rocky Mountain Arsenal in the preparation of the document and to obtain the required State and Federal permits.
E-4	Proposed project may require a reinjection permit from the State of Colorado and an EPA permit under the Resource Conservation and Recovery Act (RCRA).