PROGRAM MANAGER
RMA CONTAMINATION CLEANUP

U.S. ARMY
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— COMMITTED TO PROTECTION OF THE ENVIRONMENT —

Proposed Decision Document
for the Basin A Neck Groundwater Intercept
and Treatment System Interim Response Action
at the Rocky Mountain Arsenal

September 1988

Prepared for:

U.S. Army Program Manager's Office For
Rocky Mountain Arsenal Contamination Cleanup

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THIS INTERIM RESPONSE ACTION CONSISTS OF DESIGN AND CONSTRUCTION OF AN ALLUVIAL GROUND WATER INTERCEPT AND TREATMENT SYSTEM IN THE BASIN A NECK AREA.

THIS PROPOSED DECISION DOCUMENT PROVIDES SUMMARIES OF:

1. ALTERNATIVES CONSIDERED
2. SIGNIFICANT EVENTS LEADING TO THE INITIATION OF THE IRA
3. THE IRA PROJECT
4. THE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, STANDARDS, CRITERIA, OR LIMITATIONS (ARAR'S) ASSOCIATED WITH THE PROGRAM.

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PROPOSED DECISION DOCUMENT
FOR THE BASIN A NECK GROUNDWATER INTERCEPT
AND TREATMENT SYSTEM INTERIM RESPONSE
ACTION AT THE ROCKY MOUNTAIN ARSENAL

1.0 INTRODUCTION

The Interim Response Action (IRA) for the Basin A Neck Groundwater Intercept and Treatment System at Rocky Mountain Arsenal (RMA) is being conducted as part of the IRA Process for RMA in accordance with the June 5, 1987 report to the court in United States v. Shell Oil Co. (Shell) and the proposed Consent Decree.

This IRA project consists of design and construction of an alluvial groundwater intercept and treatment system in the Basin A Neck area on the RMA.

2.0 HISTORY OF RMA BASIN A NECK

Rocky Mountain Arsenal occupies over 17,000 acres, approximately 27 square miles, in Adams County, directly northeast of metropolitan Denver, Colorado (see Figure 1). The property was purchased by the government in 1942 for use in World War II to manufacture and assemble chemical warfare materials, such as mustard and lewisite, and incendiary munitions. Starting in the 1950's, RMA produced the nerve agent GB (isopropyl methylphosphonofluoridate) until late 1969. A significant amount of destruction of chemical warfare materials took place during the 1950's and 1960's. Since 1970, RMA has primarily been involved with the destruction of chemical warfare materials. In addition to these military activities, major portions of the plant facilities were leased to private industries (including Shell Chemical Co.) beginning in 1947 for the manufacture of various insecticides and herbicides.

During the 1940's and 1950's aqueous industrial wastes generated at both the North Plants Area and the South Plants Area were routinely discharged into several unlined evaporation ponds (labeled Basins A, B, C, D, and E) located in the center of the installation. (Figure 2 shows locations of these unlined evaporation ponds, the North Plants Area, and the South Plants Area). Groundwater contamination was first suspected in the mid 1950's when minor crop damage occurred on land north and northwest of the Arsenal. Alluvial groundwater beneath RMA generally flows from southeast to northwest. Concern regarding contaminants in the groundwater led to the design of an asphalt lined basin, Basin F, constructed in 1956. At that time aqueous wastes in Basin A were transferred to Basin F and aqueous wastes produced thereafter were discharged directly to Basin F. Solid wastes were routinely disposed of in trenches and pits located adjacent to Basin A and the Plants Areas.

In the mid 1970's two organic compounds, diisopropylmethylphosphonate (DIMP) and dicyclopentadiene (DCPD) were identified in groundwater off the installation.

A contamination control program at RMA was established to ensure compliance with Federal and State environmental laws. Basin A was identified through the contamination control program as a source area for groundwater contamination at RMA. Groundwater in the alluvial aquifer in the Basin A area has been determined to be contaminated with chemicals from disposal sites, sewers, test sites, storage pits, pools and other sources in the Basin A/Section 36 area. In addition, it has been determined that some of the contaminated groundwater in the South Plants Area flows into the Basin A alluvium. The primary conduit facilitating migration of contaminated groundwater out of Basin A has been identified as the Basin A Neck.

In December 1982, a Memorandum of Agreement (MOA) was entered into by the Colorado Department of Health, the U.S. Environmental Protection Agency, Shell Chemical Company, and the Army. The MOA initiated a cooperative development plan for a comprehensive remedy for the environmental situation at RMA.

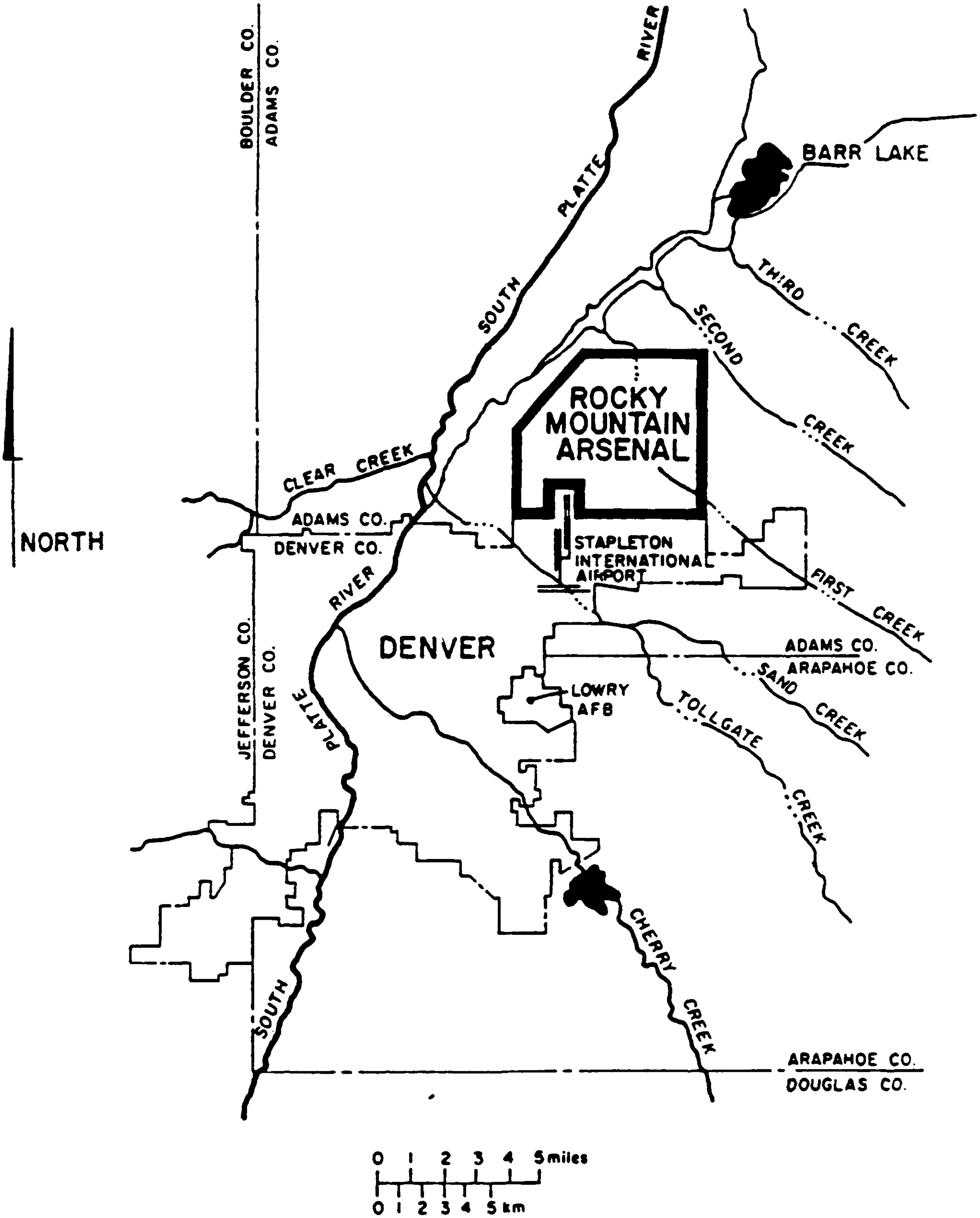
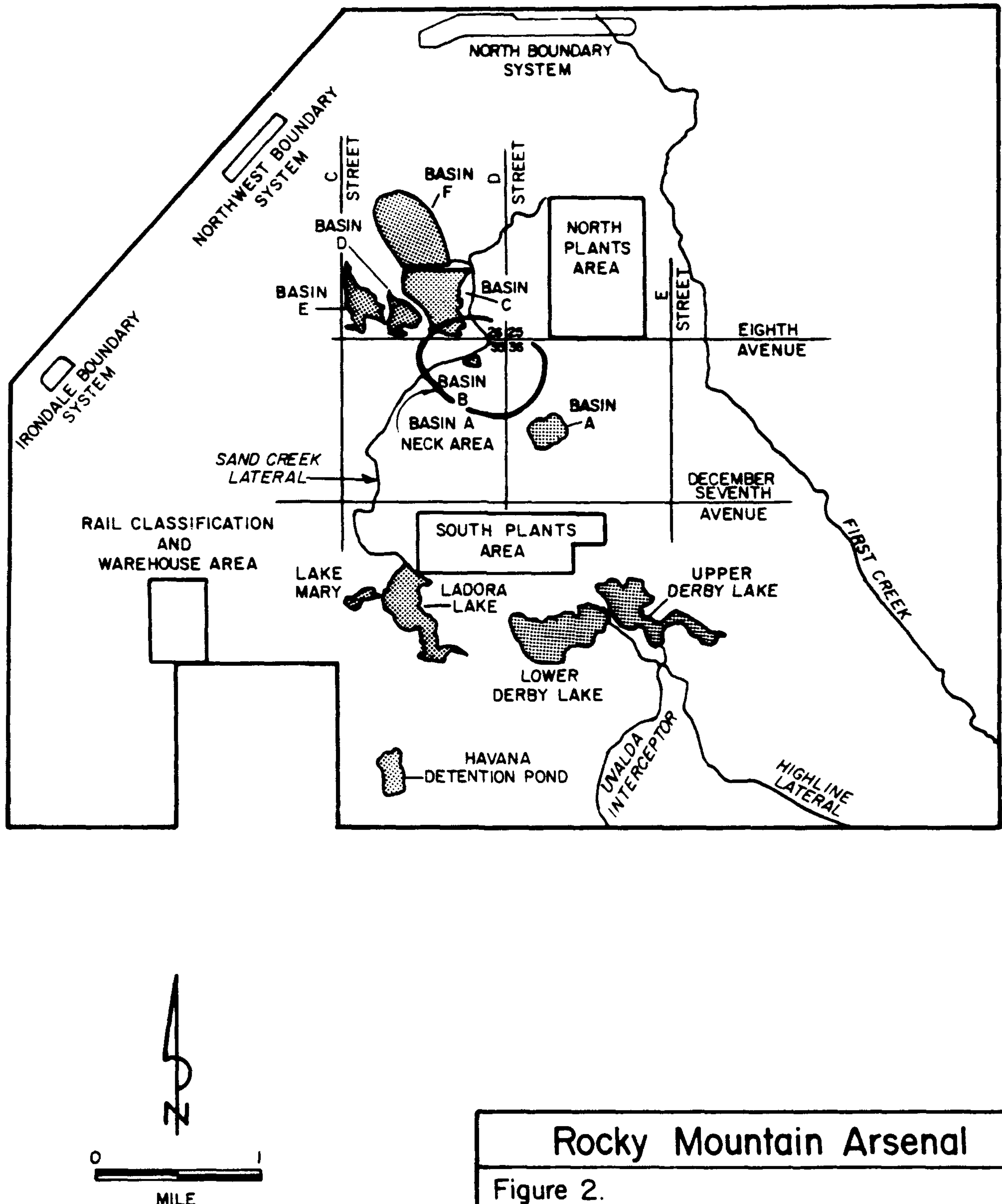


FIGURE 1

LOCATION MAP ROCKY MOUNTAIN ARSENAL

Source: MKE (1988)



Rocky Mountain Arsenal

Figure 2.

Basin A Neck
Location Map

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY
1700 Broadway, Suite 1600
Denver, Colorado 802_0

Source: MKE (1988)

In 1988, a proposed Consent Decree was lodged in the case of U.S. v. Shell Oil Company with the U.S. District Court in Denver, Colorado. The Army and Shell Oil Company agreed to share certain costs of the remediation to be developed and performed under the oversight of the U.S. Environmental Protection Agency, with opportunities for participation by the State of Colorado. The long term remediation is a complex task that will take several years to complete. The proposed Consent Decree specifies thirteen Interim Response Actions determined to be necessary and appropriate. The Basin A Neck Groundwater Intercept and Treatment System is one of the thirteen.

2.1 DESCRIPTION OF THE BASIN A NECK

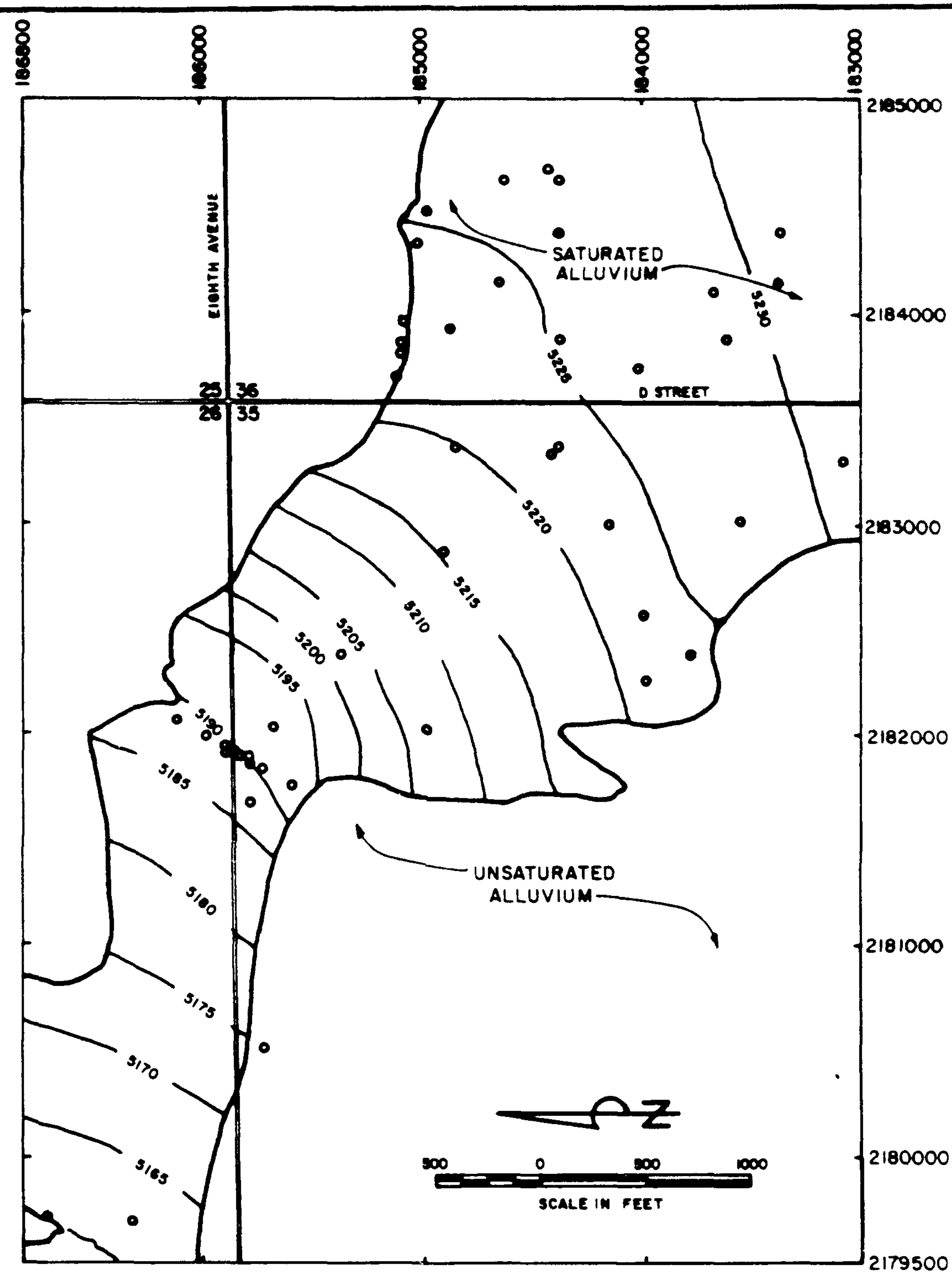
The Basin A Neck forms an alluvial outlet for Basin A groundwater. At the present time, the Basin A Neck is the only connection for which data exist to show significant migration of contaminated flow out of Basin A. As a result, the Basin A Neck was selected for implementation of an IRA to intercept this migration. Whether or not other pathways exist will be investigated in the On-Post Remedial Investigation/Feasibility Study (RI/FS) process and, if necessary, dealt with as part of the final remediation.

The regional, Basin A, and Basin A Neck hydrogeologic conditions at the Rocky Mountain Arsenal have been discussed in previous reports (May et al., 1983; and May, 1982) and consequently will not be discussed in detail in this Decision Document. The hydrogeology of the Basin A Neck Area was discussed in some detail in the Basin A Neck Groundwater Intercept and Treatment System Interim Response Action Alternatives Assessment (Ebasco Services, Inc., 1988). Some data have since been obtained that provide additional hydrogeologic information in the Neck area. These data are presented in a report by Morrison-Knudsen Engineers, Inc. (MKE, 1988). The following brief description of Basin A Neck hydrogeology reflects these recently acquired data.

The Basin A Neck is a northwest-southeast trending erosional valley carved in the surface of the Denver Formation in the northwestern portion of Section 36, the northeastern quarter of Section 35, and the extreme southern portion of Section 26. The valley has been partially filled with alluvial sediments. Denver Formation sediments are exposed on the surface at topographic highs that border the Basin A Neck to the southwest and to the northeast, but bedrock is otherwise blanketed by alluvium. The Denver Formation underlying the alluvium in the Basin A Neck Area consists of shale, mudstone, siltstone, sandstone, and lignitic to sub-bituminous coal.

Figure 3 shows the water table in the Neck as constructed from water table measurements taken during August of 1988. As shown in Figure 3, the water table gradient within the Neck varies from roughly 0.004 to about 0.022 ft/ft. The latest revision of the bedrock surface map, incorporating data obtained from drilling during the summer of 1988, is shown in Figure 4.

Hydrogeologically, the Basin A Neck consists of saturated alluvial material that links the alluvial aquifer beneath Basin A with the saturated alluvium northwest of the Neck. By subtracting the bedrock surface



Data Collected Aug. 8 - 11, 1988

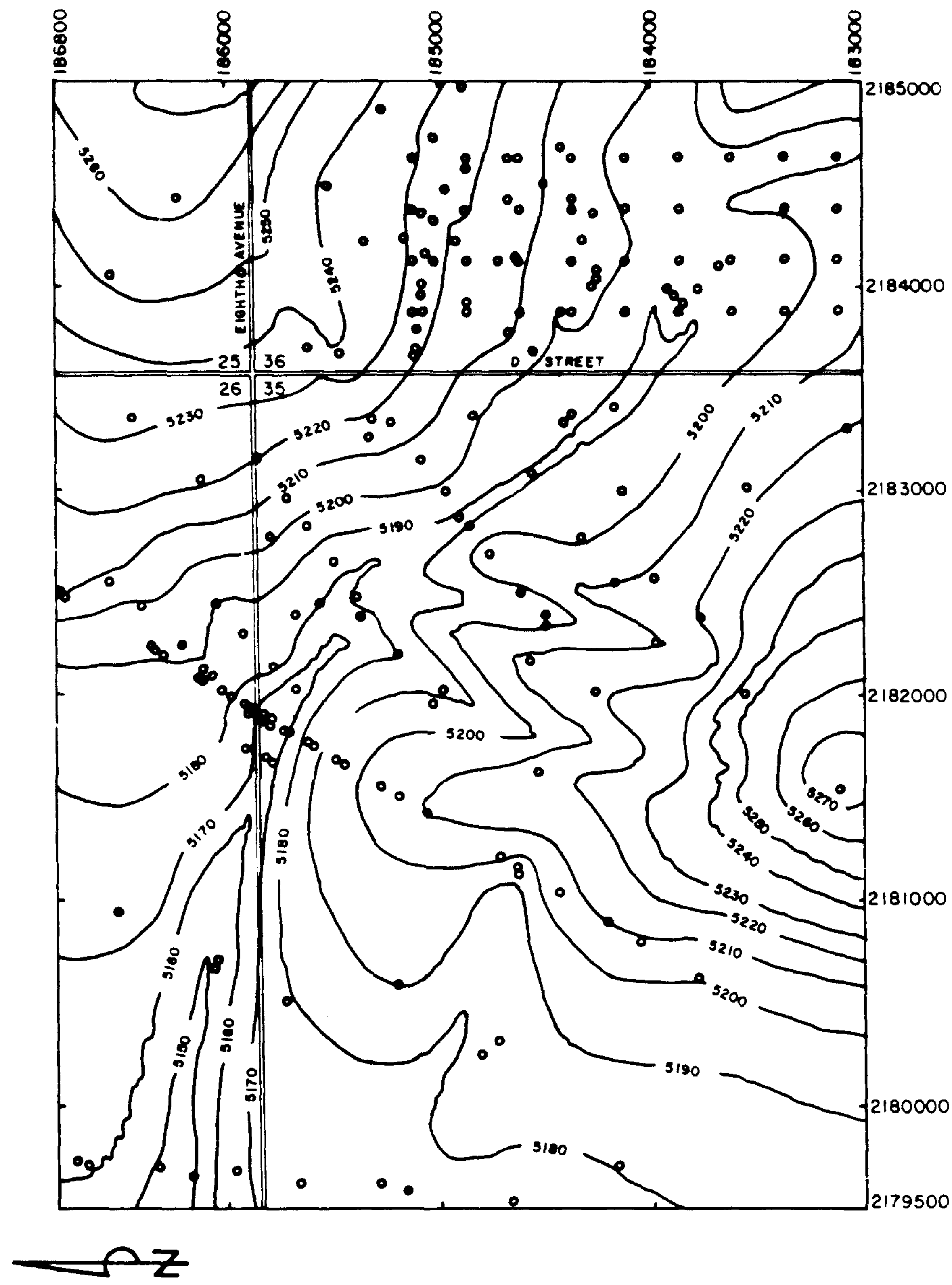
o Data Points Used to Plot Water Table Surface

Rocky Mountain Arsenal

Figure 3.
Alluvial Water Table
in the
Basin A Neck Area

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY
1700 Broadway, Suite 1600
Denver, Colorado 80290

Source: MKE (1988)



500 0 500 1000

SCALE IN FEET

o Data Points Used to Contour Bedrock Surface

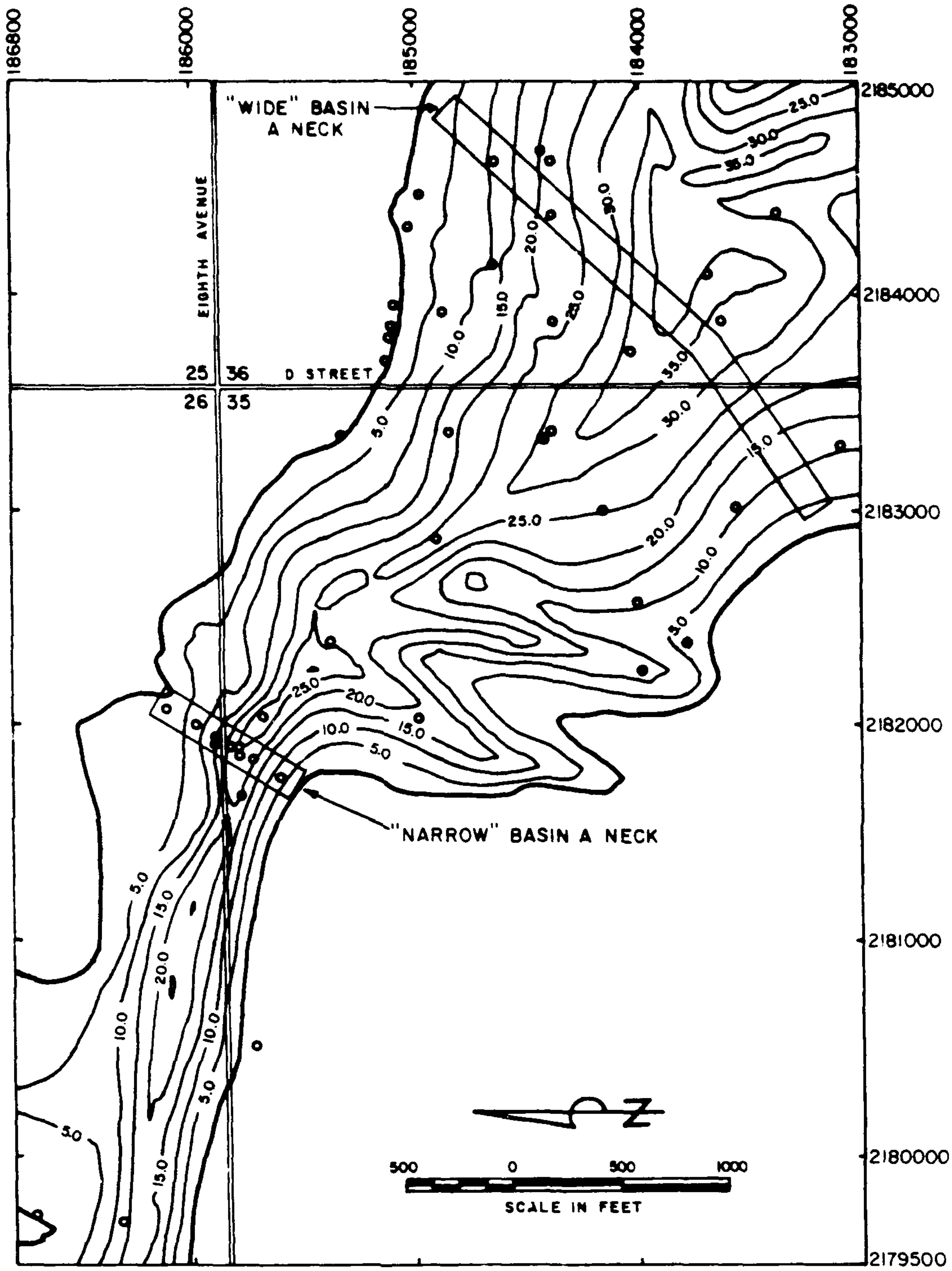
Rocky Mountain Arsenal

Figure 4.

Bedrock Surface in the Basin A Neck Area

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY
1700 Broadway, Suite 1600
Denver, Colorado 80290

Source: MKE (1988)



Based on August 8-11, 1988
Water Level Measurements

o Water Level Data Points Used in Contouring Saturated Alluvial Thickness

Rocky Mountain Arsenal

Figure 5.
Saturated Alluvial Thickness
in the
Basin A Neck Area

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY
1700 Broadway, Suite 1600
Denver, Colorado 80290

Source: MKE (1988)

elevations in Figure 4 from the water table elevations in Figure 3, Figure 5 was produced showing the estimated saturated alluvial thicknesses in the Basin A Neck Area. As shown in Figure 5, the thickness of the saturated alluvium in the Neck area varies from 0 to more than 35 feet. In the narrowest portion of the Basin A Neck channel, the saturated alluvium is approximately 800 feet wide.

There is some uncertainty in the configuration of the saturated alluvium downstream from the narrow Basin A Neck in Section 35, but recent mapping by both ESE (Ebasco Services, Inc., 1988) and MKE (1988) shows the principal alluvial channel as turning west towards the Northwest Boundary Containment System.

Two sites, shown on Figure 5, were identified in the Alternatives Assessment (Ebasco Services, Inc., 1988) as potential locations for a groundwater intercept system. The site in the narrowest portion of the Basin A Neck was termed the narrow Basin A Neck location and the site at the head of the Basin A Neck was termed the wide Basin A Neck location.

The geology of the surficial deposits in the Basin A Neck Area is comprised of a variety of soil types and eolian and alluvial sediments. The saturated alluvium in the area of the Basin A Neck is composed primarily of sand, silt, and clay materials, with gravel also being noted in the narrow Neck. Lithologic logs and experience during development of several wells in the narrow Neck have shown the presence of a relatively permeable aquifer about 300 feet wide and up to several feet thick roughly centered in the deepest portion of the narrow Neck. Based on the lithologies of several wells, it appears that the permeability in the center portion of the narrow Neck is higher than the permeability indicated by lithologic logs of wells further upstream in the wider portions of the Neck. Hydraulic conductivities of the alluvial sediments within the Basin A Neck have not been fully characterized. As reported in the Alternatives Assessment (Ebasco Services, Inc., 1988), falling head permeability tests have been conducted in or near the narrow Basin A Neck. Resulting hydraulic conductivity estimates ranged from 1.16×10^{-4} to 7.78×10^{-4} centimeters per second (cm/sec). Lithologic logs in the tested wells show that these tests were conducted in sandy and silty clays. These permeabilities may be somewhat representative of these materials, but as shown by recent drilling, these permeabilities are not representative of the materials in the primary water carrying zone through the narrow Neck. Aquifer tests have not yet been conducted in the more permeable materials, but well development experience coupled with visual inspection of well samples leads to the expectation that the more permeable zone likely has hydraulic conductivities in the 10^{-2} or 10^{-1} cm/sec range. As reported in the Alternatives Assessment, a pumping test conducted in Well 36123 in Section 36 near Basin A yielded an average hydraulic conductivity estimate of about 3.1×10^{-3} cm/sec (May, 1982).

An estimate of the groundwater flowing through the wide Basin A Neck is obtained by applying Darcy's Law. As presented in the Alternatives Assessment (Ebasco Services, Inc., 1988), an estimated hydraulic conductivity of 3.1×10^{-3} cm/sec, an estimated hydraulic gradient of 0.006 ft/ft, and a saturated cross-sectional area area of 51,500 square feet of sandy units below the water table result in an estimated flow through the wide Basin A Neck of approximately 14 gallons per minute (gpm). If the gradient measured on Figure 3 (0.0045 ft/ft in the vicinity of the pumping test in Well 36123) were used, the estimated flow rate would be 11 gpm. Pumping tests to be conducted in the narrow Neck wells will provide an additional estimate of flow through the aquifer.

Using a cross-sectional area of 2,000 square feet of saturated, relatively permeable material in the narrow Neck, and a gradient of 0.013 ft/ft (from Figure 3), an average hydraulic conductivity of 0.037 cm/sec would be required to produce the 14 gpm estimated to be flowing through the wide Neck. Based on the aquifer samples obtained from this zone in the narrow Neck, such conductivities seem reasonable. Consequently, there is no good flow evidence at this time indicating that the flow rate through the wide Basin A Neck is significantly different than that through the narrow Neck. Pumping tests are planned that will help refine the flow estimate through the narrow Neck.

As described by MKE (1988), water level data in the Denver sand units underlying the Basin A Neck Area have gradients that indicate groundwater is flowing towards the subcrop areas, resulting in small discharges into the alluvium in the narrow Basin A Neck Area.

The Alternative Assessment referred to the possibility for alluvial groundwater to flow laterally into a Denver sand unit on the north side of the wider portion of the Neck. Alluvial groundwater contours shown in Figure 3 are curved so as to indicate that most or all of the groundwater flow is converging towards the narrow neck, and not being significantly diverted in the area of the Denver sand unit. Another indication that alluvial groundwater flow into this subcropping sandstone unit is minimal is that Denver Sandstone wells downgradient (towards the north/northwest) of the subcrop area have not shown contamination consistent with the contamination evident in the Basin A Neck alluvium. These consistent indications provide no evidence that significant flows are exiting into the sandstone subcrop.

In the past, there had been some speculation of faulting in the Basin A Neck. There is now general agreement among all of the geologic contractors investigating the Basin A Neck Area that recent investigative drilling in the area has not produced any evidence of faulting in or near the Basin A Neck.

2.2 GROUNDWATER QUALITY IN THE BASIN A NECK

The groundwater quality in the Basin A Neck Area was evaluated in Section 4.3 of the Alternatives Assessment for the Basin A Neck groundwater intercept and treatment system (Ebasco Services, Inc., 1988). In summary, two sets of alluvial wells were chosen as characteristic of groundwater flowing through the narrow Neck (16 wells) and wide Neck (18 wells) areas of Basin A. Only data collected since 1978 were reviewed because of differences in analytical procedures before and after 1978. Also, values reported as being below detection limits were eliminated from statistical analyses to minimize skewing of values for range, mean, and median values.

The data as summarized are included on tables 4.3-1 and 4.3-2 of the Alternatives Assessment (Ebasco Services, Inc., 1988). The compounds, elements, water quality parameters, and respective ranges are representative of contaminants and design parameters that can be expected in groundwater from the Basin A Neck Area. However, the values indicated should not be used as the sole analytical basis for design of a treatment system. Additional analytical data are required for design purposes from wells located in the groundwater extraction area. This work is currently being undertaken by Morrison-Knudsen Engineers.

3.0 INTERIM RESPONSE ACTION OBJECTIVES

The specific objectives of the Basin A Neck Groundwater Intercept and Treatment System IRA are to:

- o Minimize the spread of contaminated groundwater migrating through the Basin A Neck as soon as practicable;
- o Improve the efficiency and efficacy of the boundary treatment system;
- o Collect operational data on the interception, treatment and recharge of contaminated groundwater from this area that may be useful in the selection and design of a Final Response Action; and
- o Have a remedial effect on groundwater within RMA.

Specific criteria considered in order to achieve these objectives include:

- o Provide rapid response;
- o Use proven technology;
- o Compliance with any designated ARARs to the maximum extent practicable;
- o Consistency with the Final Response Action; and
- o Use the most cost-effective of equivalent treatment systems available.

In addition to the specific criteria, the system should adhere to good engineering practices.

4.0 INTERIM RESPONSE ACTION ALTERNATIVES

Alternatives for the proposed Basin A Neck Groundwater Intercept and Treatment System Interim Response Action were examined in the Alternatives Assessment, (Ebasco Services, Inc., 1988). Normally, alternatives are assessed at the technology level. However, in the case of this IRA, a set of technologies (that is, groundwater interception and treatment) is specified in the Consent Decree (1988). Consequently, it is deemed appropriate to go into greater detail and assess, to the extent feasible, alternative processes or unit operations that make up the chosen technologies. However, many of the decisions relating to these processes are appropriately deferred to the design phase of the IRA. These alternatives were divided into two groups -- hydrologic and treatment. Hydrologic alternatives evaluated were further subdivided by function as either being extraction, recharge, or barrier components of the selected IRA technologies.

4.1 HYDROLOGIC ALTERNATIVES

4.1.1 EXTRACTION

Groundwater will be withdrawn from the Basin A Neck alluvium for removal of the contaminants. Two types of groundwater extraction systems, dewatering wells and subsurface drains, were considered.

Dewatering Wells

Groundwater extraction can be achieved with a series of wells. Groundwater would be pumped from the wells to the treatment system. Well spacing, pumping rates, and aquifer characteristics determine the degree of drawdown across the flowpath through the Neck, and therefore determine the effectiveness of groundwater capture. Extraction with wells is a proven methodology that has worked well with groundwater extraction at other Arsenal locations.

Indications are that extraction wells should be considered as one alternative in the final design of an extraction method within the Basin A Neck. Appropriate well spacings and pumping rates would be an important aspect of system design.

Subsurface Drains

A subsurface drain constructed across the Basin A Neck could effectively intercept migrating groundwater. Drains usually consist of a constructed permeable zone equipped with a means for lowering the water table within the zone. Typically, a trench is constructed that is filled with permeable materials, and in some cases a buried conduit. Water draining into the trench is removed by one or more pumps. Advantages of subsurface drains include their applicability to aquifers having a broad range of permeabilities and their high collection efficiency. A potential disadvantage can be their cost, depending on the required depth and construction difficulty.

Subsurface drains should be considered as an alternative in the final selection and design of an extraction system for the Basin A Neck alluvium. The costs of constructing a drain would depend on the design considerations, as well as on the measures required to handle contaminated soils and groundwater produced during construction. These factors will be an important part of design-related evaluations of the extraction system for the Basin A Neck IRA.

4.1.2 RECHARGE ALTERNATIVES

Four methods of groundwater recharge were considered in the Alternatives Assessment (Ebasco Services, Inc., 1988). These were recharge wells, subsurface drains, recharge pits, and leach fields. Recharge operations could be located adjacent to the extraction operations, or at a remote location. These four operations are briefly summarized below.

Recharge Wells

Wells could be used for recharging treated water into the Basin A Neck aquifer downstream of the extraction system. Recharging water through wells is most likely to be practical where deep permeable zones exist that cannot be feasibly recharged by other methods. When practical, other recharge methods are generally preferred over recharge wells because of the high cost, tendency for plugging, and relatively high maintenance costs of recharge wells. Particularly in the silts, clays, and fine sands common through much of the Basin A Neck Area aquifer, recharge wells can be expected to be difficult to keep operating efficiently. In the coarse sand zones discovered in the narrow Neck, wells may be more suitable.

Subsurface Drains

Subsurface drains used for recharge are essentially similar to drains used for extraction discussed above, except that they are used to recharge, rather than collect, groundwater. An advantage of subsurface drains is that they are suitable for creating a groundwater mound that is continuous over the entire length of the drain that would help ensure capture of migrating contaminated groundwater. Another advantage of subsurface drains is that they maximize the contact area of the aquifer surface, thus maximizing the service life and possible recharge rate, while minimizing the amount of required maintenance. Construction costs of subsurface drains can be quite high if the depth is great, or construction is difficult. Because of their effectiveness, subsurface drains used for recharge would be very desirable if they are determined to be economical.

Recharge Pits and Leach Fields

Recharging in shallow pits and shallow leach fields is common, often is very economical, and is generally effective if geological conditions are favorable. The performance of recharge pits and leach fields is largely related to the vertical permeability of the underlying soils. Conditions favoring water infiltration (such as sandy, highly permeable soils and the absence of low permeability layers that would impede vertical movement) increase the effectiveness and feasibility of recharge pits and leach fields. The permeabilities of the shallow alluvial materials in the Basin A Neck Area are variable, and not well defined. Further characterization of the alluvial materials would be necessary before the suitability of these operations could be fully evaluated.

Recharge pits would need to be protected from freezing, but have the advantage of being easily scraped out for fairly economical maintenance. Evaporation from recharge pits would result in a consumptive use of water that would need to be addressed from a water rights perspective. If constructed deep enough, leach fields can essentially eliminate the problem of evaporation and freezing associated with recharge pits, yet still be fairly economical.

Since the permeable portions of the Basin A Neck aquifer are often overlain by much less permeable materials, it is expected that recharging all of the aquifer flow by the use of recharge pits or leach fields may be difficult. These recharge technologies may, however, be suitable for recharging portions of the flow in some areas. Additional data and design considerations must be evaluated before such systems could be recommended.

4.1.3 BARRIERS

Groundwater flow can be stopped or obstructed by the use of barriers to help contain contaminant migration. A brief discussion of the possible use of hydraulic and physical barriers in the Basin A Neck Intercept System is given below. A more thorough discussion is contained in the Alternatives Assessment (Ebasco Services, Inc., 1988).

Hydraulic Barriers

In a groundwater intercept system, a hydraulic barrier is created by causing the water table to be shaped such that all flowpaths of the contaminated groundwater terminate at the extraction system. This is generally accomplished by recharging treated water downgradient of the extraction system, thus building a groundwater mound that blocks bypass. Hydraulic barriers are successfully used at the Northwest and Irondale boundary containment systems on the RMA.

For the conditions that exist in the Basin A Neck, a hydraulic barrier may be well suited to control the migration of contaminants. Appropriate use of the extraction and recharge systems discussed earlier can create a hydraulic barrier. One disadvantage of a hydraulic barrier is that some recycling of treated water between the recharge and extraction systems inevitably occurs. This recycled flow can even be larger than the original flow through the aquifer, depending on the design and operation of the system.

Physical Barriers

Physical barriers can be made from a variety of materials that can be installed below ground to reduce or redirect groundwater flow. A physical barrier can be used in conjunction with a hydraulic barrier by installing it between the recharge and extraction operations. In such cases the barrier would primarily serve to limit the recycling of treated water (thus lowering operation costs), so some leakage around the barrier would generally not pose significant problems, nor would the barrier be subject to significant exposure to contaminated water. In addition to restricting the amount of recycled water, the physical barrier would provide a degree of back-up to the hydraulic barrier in the event of a temporary failure (e.g. electrical power outage, etc.). A physical barrier may reduce the construction and operation costs of the extraction, treatment, and recharge portions of the Basin A Neck IRA, depending on the amount of water that would otherwise be recycled between the recharge and extraction systems.

A physical barrier can also be used in the absence of a hydraulic barrier to inhibit the passage of contaminated water. In such situations, the barrier would be exposed to contaminated water, leakage would be of more concern, and the possible degradation due to this exposure must be considered.

For this IRA, the economic benefits of reducing the recirculation of treated water may not offset the costs of constructing a physical barrier. Additionally, a physical barrier could not be modified or eliminated easily should the Final Response Action for this area be significantly different from the IRA. Additional aquifer data will be needed, and designs considered, before the final decision is made concerning the use of a physical barrier. Use of a physical barrier will be considered only if other technologies do not meet the needs of this IRA.

4.2 TREATMENT ALTERNATIVES

As stated in the Alternative Assessment (Ebasco Services, Inc., 1988), inorganic contaminants are not presently treated in the three RMA boundary groundwater intercept/treatment systems. Moreover, the extent of control of inorganic compounds in groundwater in the Final Remedial Plan is unknown at this time. Therefore, treatment of inorganic compounds are considered as not practicable within the scope of this IRA. However, inorganic contaminants can cause scaling or fouling in equipment treatment processes for removal of organic contaminants. Therefore, it may become necessary to consider treatment for inorganic contaminants in order to protect organic contaminant removal equipment against fouling or scaling.

A preliminary screening of available organic contaminant treatment technologies has been performed and only the following technologies having documented performance, applicability, and reliability are considered potentially applicable to this IRA.

1. Activated carbon adsorption
2. Air Stripping

3. Biological Treatment
4. Evaporation
5. Oxidation
6. Reverse Osmosis

The following discussion of each technology addresses system operation, required pretreatment, wastestreams generated, reliability, design flexibility, complexity, relative cost, and advantages and disadvantages.

Activated Carbon

Activated carbon adsorption is the most widely developed and used process for removal of organic contaminants from water and involves passing the contaminated water through a bed of activated carbon to allow the organic compounds to adsorb to the surfaces of the carbon particles. Activated carbon adsorption removes both volatile and non-volatile organic compounds from water. This process has been proven effective in removing the majority of organic contaminants found in the RMA groundwater, except for certain polar compounds such as methylene chloride that do not have a great affinity for a nonpolar adsorbent such as carbon.

Activated carbon adsorption is currently used at the RMA North Boundary, Northwest Boundary, and Irondale Boundary containment/treatment systems. Operating histories at these plants indicate very high removal efficiencies for many RMA organic contaminants, including dibromochloropropane (DBCP), diisopropylmethyl phosphonate (DIMP), and dicyclopentadiene (DCPD).

Activated carbon adsorption design parameters such as adsorption isotherms and empty bed contact times have been developed through pilot testing for the majority of organic compounds encountered at the Basin A Neck. One pilot study, in particular, successfully treated groundwater containing similar compounds in higher concentrations than those expected at the Basin A Neck (Stearns-Roger Engineering Corp., 1983).

The relative advantages and disadvantages of activated carbon adsorption compared to the other treatment processes are as follows:

Advantages

- Extensive experience in utilization of process
- Ability to remove mixtures of volatile and non-volatile organic compounds
- Ease of operation
- Reliability

Disadvantages

- Possible plugging of recharge system (particularly wells) with carbon fines

- Need for carbon replacement or regeneration resulting in relatively high operating costs

- Spent carbon, if not regenerated, requires disposal as a hazardous waste.

Activated carbon adsorption has been proven highly effective in the removal of most organic contaminants encountered at the RMA. As a result, it is included as one of the treatment processes of choice for use in the Basin A Neck IRA.

Air Stripping

Air stripping is an effective and proven method for removal of volatile organic compounds from water. This is accomplished through conversion of the contaminant from a liquid to a gaseous phase by contacting the liquid with air. The removal efficiencies of the compounds are proportional to their relative partial pressures. Air strippers have been used at many sites to effectively remove volatile chlorinated solvents from drinking water supplies.

A packed column type air stripper was evaluated as part of the South Plants groundwater treatment pilot plant and demonstrated removal efficiencies of 96-100% for volatile organic compounds except methylisobutyl ketone (MIBK) and carbon tetrachloride (Stearns-Roger Engineering Corp., 1983). As expected, the non-volatile organic compounds did not exhibit high removal efficiencies.

Off gas from an air stripper contains the organic compounds stripped from the contaminated groundwater. If present in low concentrations, the air can be discharged directly to the atmosphere. If air emission standards would be exceeded, the exhaust air is normally either incinerated or treated with a vapor phase carbon adsorption unit to remove the contaminants.

The relative advantages and disadvantages of air stripping compared to the other treatment processes are as follows:

Advantages

- Relatively low capital and operating costs

- Ease of operation

- Reduced loading on carbon adsorption beds when used to precede carbon adsorption process

Disadvantages

- Some organic compounds are not removed

- Low removal efficiencies for non-volatile organic compounds

- Contaminated off gas may constitute wastestream requiring treatment and/or disposal

The compounds present in the Basin A Neck Area (based on existing analytical data) that are amenable to effective removal by air stripping include chloroform, methylene chloride, tetrachloroethylene, and trichloroethylene. As indicated previously, the former two compounds are not effectively removed through activated carbon adsorption. However, air stripping and activated carbon adsorption used in combination can achieve a high level of removal of all organic contaminants contained in the Basin A Neck groundwater. Air stripping should remain in consideration as a treatment alternative that could be used in combination with activated carbon adsorption. The final process configuration will be determined during the design phase of the project.

Biological Treatment

Biological treatment removes organic contaminants through microbial assimilation and degradation. Aerobic processes such as activated sludge are most commonly used. The resultant waste activated liquor (excess biomass) from such processes is generally nontoxic.

An activated sludge system was tested by Shell Development Company for treating RMA groundwater (Rezai, 1982). The pilot test results indicated high levels of removal of chloroform, benzene, and dibromochloropropane (DBCP). Biodegradability tests using incubation, on the other hand, showed no biodegradation of aldrin, dieldin, or endrin.

The relative advantages and disadvantages of biological treatment compared to other treatment processes are as follows:

Advantages

- Adaptability of process to a variety of contaminants
- Wastestreams from system are generally non-toxic
- Relatively low capital and operating costs

Disadvantages

- Process has limited efficiency with respect to removal of certain organic compounds
- Extensive process monitoring is required
- Process is subject to upsets by compounds toxic to microorganisms
- Extensive pilot testing is required for design

- Process requires feed stream of relatively constant quantity and quality

Biological treatment systems require the total organic carbon concentration to be fairly constant, a condition that is usually met with groundwater. Also, a minimum total organic carbon (TOC) concentration in the water is needed to sustain the microorganisms. Water quality data indicate that the total organic content in groundwater from the Basin A Neck Area is too low to sustain a sufficient quantity of biomass to make biological treatment feasible (COE, 1987). In addition, not all of the compounds present are readily treatable with biological systems, particularly the pesticides. While treatment of these organics may be feasible, considerable time would be spent in developing and demonstrating an effective biological treatment system. It therefore does not appear that biological treatment would be a viable alternative for the Basin A Neck groundwater.

Evaporation

Evaporation is a process by which volatile liquids such as water and certain volatile organic compounds are removed from the wastestream, leaving behind the non-volatile components. Solar evaporation ponds as well as mechanical evaporators can be used to implement this process. Dissolved solids are precipitated through evaporation and would require disposal as a hazardous waste. Water lost through evaporation could be replaced in the aquifer by recharge of purchased water. Only solar evaporators were considered, since mechanical evaporators are cost prohibitive.

The relative advantages and disadvantages of solar evaporation compared to other treatment processes are as follows:

Advantages

- Low operating cost

Disadvantages

- Release of volatiles or odors may exceed regulatory limits
- Residue concentrate/solids would require treatment and disposal as hazardous waste
- Ponds must be designed to limit access by wildlife

A solar evaporation pond to treat the Basin A Neck wastestream would be approximately 0.75 acres in size for each gallon per minute treated (for example, an 11-acre pond would approximately handle a 15 gpm stream). A pond containing hazardous material of this size needed for the Basin A Neck could pose a risk to wildlife and the environment in general.

Evaporation, on the other hand, is a proven and highly effective process for wastestreams containing inorganic contaminants. In the event that removal of inorganic contaminants becomes a priority, evaporation might become a treatment system of choice and should be reconsidered.

Oxidation

Oxidation involves chemical or thermal destruction of organic compounds. Thermal oxidation normally involves incineration, while chemical oxidation is accomplished using a chemical oxidizing agent such as ozone, hydrogen peroxide, or potassium permanganate. Ultraviolet radiation is often used to catalyze a chemical oxidation process in order to enhance destruction and reduce chemical and contact time requirements.

Laboratory bench scale studies and pilot testing have indicated effective destruction of organic compounds using the UV/ozone process. Operating parameters must be carefully controlled for each target compound in order to achieve total destruction. These parameters include, UV dosage, ozone dosage, pH, detention time, and use of supplemental chemical oxidants.

The relative advantages and disadvantages of oxidation compared to other treatment processes are as follows:

Advantages

- Ability to achieve virtually complete destruction of contaminants
- Produces no residual wastestream requiring further treatment

Disadvantages

- Relatively high capital and operating costs
- Possible fouling of process by inorganic elements and compounds
- Difficulty in process control
- Very poor energy efficiency due to low concentration of organics

Oxidation is a promising technology, but is largely unproven for the mixture of organic compounds encountered in the Basin A Neck. Extensive pilot testing using Basin A Neck groundwater is required to demonstrate feasibility of this treatment process. Additionally, the process requires very high capital and operating expenditures. For these reasons, this process is not selected as a treatment alternative.

Reverse Osmosis

Reverse osmosis is a membrane separation process that reduces concentrations of dissolved organic and inorganic compounds. Pretreatment of reverse osmosis influent is essential to prevent fouling and plugging of the semipermeable membrane. This process is used mostly to remove inorganic dissolved solids from wastestreams such as in a desalinization process. Very little literature or pilot testing data are available to predict performance of reverse osmosis in removal of organic compounds from the Basin A Neck groundwater.

Wastestreams up to 30 percent as large as the feed stream can be expected from the process, depending on the staging configuration of the system. These wastestreams would contain higher concentrations of the organic contaminants and would require further treatment prior to disposal.

The relative advantages and disadvantages of reverse osmosis compared to other treatment processes are as follows:

Advantages

- The ability to remove simultaneously inorganic and some organic contaminants

Disadvantages

- Relatively high capital and operating costs (membranes require replacement every 2-3 years)
- Membrane susceptibility to fouling and plugging
- Production of reject stream requiring additional treatment such as evaporation and solids disposal, oxidation, adsorption, or air stripping

Reverse osmosis is a proven technology for removing organics with molecular weights down to about 150 to 200. The organic contaminants in the Basin A Neck groundwater include compounds with molecular weights both above and below this range (COE, 1987). This means that unless they were adsorbed by the membrane, dicyclopentadiene and diisopropylmethyl phosphonate and the lower molecular weight compounds would partition to the permeate, while aldrin and dieldrin would be found in the concentrate. The required removal efficiencies would consequently not be obtained by reverse osmosis for most of the compounds in Basin A Neck groundwater. In addition, extensive pretreatment would be required, pilot studies would be necessary, and capital and operating costs would be very high. Reverse osmosis is consequently eliminated from further consideration.

4.3 NO ACTION ALTERNATIVE

Section IX of the proposed Consent Decree (1988) states that the Basin A Neck Groundwater Intercept and Treatment System IRA has been determined to be both necessary and appropriate. Therefore, this alternative will not be considered.

5.0 CHRONOLOGY OF EVENTS

The significant events leading to the decision to install the groundwater intercept and treatment system described in Section 6.0 are presented below.

Date	Event
June 1987	State of Colorado, Shell Oil Company, U.S. Environmental Protection Agency, and U.S. Army agreed that 13 Interim Response Actions (including Basin A Neck Groundwater Intercept and Treatment System) would be conducted.
August 1987	Completed Basin A Neck Groundwater Recovery and Injection System (Morrison-Knudsen Engineers, Inc., 1987). Described geohydrology of area, and proposed remediation and further investigations at Basin A Neck.
September 1987	Completed Draft Final Task 26 Interim Response Action Assessment Version 1.2 (Ebasco Services, Inc., 1987). Identified and evaluated potential response actions that could be implemented prior to final remedy for RMA. Basin A Neck was the only site of nine sites studied by Task 26 that was determined to be appropriate for an Interim Response Action.
October 23, 1987	Ebasco Services, Inc., commented on Basin A Neck Groundwater Recovery and Injection System Report.
October 27, 1987	Shell Oil Company commented on Task 26 Interim Response Action Assessment Draft Report.
January 26, 1988	State of Colorado commented on Task 26 Interim Response Action Assessment Draft Report.
September 1988	Issued Final Basin A Neck Groundwater Intercept and Treatment System Interim Response Action Alternatives Assessment (Ebasco Services, Inc., 1988). Recommended extraction and recharge systems be installed, and possibly used so as to create a hydraulic barrier. Recommended a groundwater

treatment system be constructed composed of activated carbon adsorption units and post treatment filtration.

6.0 SUMMARY OF THE INTERIM RESPONSE ACTION PROJECT

The Basin A Neck Groundwater Intercept and Treatment System Interim Response Action consists of alluvial groundwater extraction, water treatment, and recharge processes in the Basin A Neck area. The location of the system within the Neck area will be selected during final design, based upon the ability of the system to meet the objectives of the IRA, cost-effectiveness, and implementability.

The goal of early implementation tends to favor the selection of technologies/processes with demonstrated effectiveness in situations similar to those at the Basin A Neck (i.e., similar contaminants, hydrology, etc.) and which can be implemented without undue delay. It is expected also that certain aspects of the Basin A Neck system design will be based on only limited data input necessary in the interest of expediting implementation. It is believed, however, that the benefit of early implementation will more than offset possible adverse effects of limited data. Typically, groundwater extraction/treatment systems consist of simple, repetitive components and thus are highly amenable to modifications/adjustments which further studies may suggest to improve system performance or to meet redefined goals (for example, from the On-Post RI/FS).

6.1 HYDROLOGY

The selection of the type of barrier (if any), extraction, and recharge processes will be made during the design phase of the IRA. Processes to be considered for extraction include wells and/or subsurface drains. Processes to be considered for recharge include recharge wells, subsurface drains, and/or recharge pits or leach fields. Physical barriers and a hydraulic barrier will be considered for use in conjunction with the extraction and recharge operations. The design choices of extraction, recharge, and barrier (if any) processes will be made based upon the ability of the resulting system to meet the IRA objectives, cost-effectiveness, and implementability.

6.2 TREATMENT

It is anticipated that a treatment process involving either activated carbon adsorption or activated carbon adsorption preceded by packed column air stripping will be utilized to treat the Basin A Neck groundwater. A process will be selected during the design phase of the project based on the following considerations:

1. Ability of selected process to efficiently remove organic contaminants from groundwater. Ongoing sampling and analysis of Basin A Neck groundwater undertaken by Shell will aid in this determination.

2. Preliminary modeling to determine need for air emission control on the packed column air stripper off-gas.

3. Evaluation of cost-effectiveness.

The following design parameters for the activated carbon and air stripping processes will be investigated during the design phase of the project.

<u>Activated Carbon Adsorption</u>

- o Empty bed contact time
- o Carbon type
- o Mode of operation: upflow or downflow
- o Backwash bed expansion
- o Frequency of carbon regeneration
- o Pretreatment and post-treatment requirements
- o Single, double, or triple staging of exchange vessels
- o Regeneration or exchange of carbon
- o Methodology for extraction of spent carbon
- o Disposition of backwash wastewater

<u>Air Stripping</u>

- o Air to water ratio
- o Column packing type
- o Pretreatment and post-treatment requirements
- o Packing depth
- o Method of air emission control (if required)

The selected treatment system will be reliable and capable of consistently achieving high levels of removal for organic compounds. In addition, the system will be flexible and expandable with respect to staging and pre/post-treatment requirements to maximize the potential for compatibility with the system selected for final remediation of the Arsenal.

Operation of the system selected for this IRA may provide valuable data that can be used in the selection and design of the Final Remedial Actions.

6.3 HEALTH AND SAFETY PLAN

A Health and Safety Plan has been developed for the prevention of occupational injuries and illnesses during field activities at RMA. This plan addresses health and safety requirements of contractors and their authorized subcontractors. Compliance with this plan will be compulsory and the contractors will be responsible for self-enforcement and compliance with this plan. The Health and Safety Plan was developed with consideration for known hazards as well as potential risks. Comprehensive environmental monitoring and site-specific personal protection are combined in an effort to best protect workers to the maximum extent practicable.

A site specific Health and Safety Plan for work to be performed on the Basin A Neck Groundwater Intercept and Treatment System will be developed and included in the Implementation Document. This site-specific plan will contain specifics of monitoring plans, worker protection and work modifications to be conducted in the event that certain levels of contaminants are detected or if necessary to ensure worker health and safety.

7.0 IRA PROCESS

With respect to this IRA for the Basin A Neck Groundwater Intercept and Treatment System, the IRA process is as follows:

1. The Army prepared a draft Basin A Neck Groundwater Intercept and Treatment System IRA Alternatives Assessment and a draft of the ARARs document that were submitted to the DOI, the State, and the other organizations for review and comment. Comments were to be submitted within 30 days after receipt of the draft assessment. After the close of the comment period, and in consideration of the comments received, the Army prepared and transmitted a final assessment to the DOI, the State, and other organizations.

2. The Army afforded the Department of Interior (DOI), the State, and other organizations an opportunity to participate, at the RMA Committee level, in the identification and selection of ARARs pertinent to this IRA. In this instance, the participation took the form of the Army's submitting an initial draft of this document to the RMA Committee members.

3. This Proposed Decision Document for the Basin A Neck Groundwater Intercept and Treatment System IRA is subject to a 30-day public comment period including a public meeting approximately two weeks into the comment period. This Proposed Decision Document is supported by an administrative record.

4. Promptly after close of the Proposed Decision Document comment period, the Army shall transmit to the DOI, the State, and other organizations a Draft Final Decision Document for the Basin A Neck Groundwater Intercept and Treatment System IRA.

5. Within 20 days after issuance of the Draft Final Decision Document for the Basin A Neck Groundwater Intercept and Treatment System IRA, an organization (including the State if it has agreed to be bound by the Dispute Resolution process, as required by the Consent Decree, or DOI under the circumstances set forth in the Consent Decree) may invoke Dispute Resolution.

6. After the close of the period for invoking Dispute Resolution (if Dispute Resolution is not invoked) or after the completion of Dispute Resolution (if invoked), the Army shall issue a final Decision Document for the Basin A Neck Groundwater Intercept and Treatment System IRA with the supporting administrative record. Thereafter, the Decision Document will be subject to judicial review in accordance with Sections 113 and 121 of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended, 42 U.S.C. Sections 9613, 9621.

7. Following issuance of the final IRA Decision Document, Shell shall be the Lead Party responsible for designing and implementing the

IRA in conformance with the Decision Document. Shell shall issue a draft IRA Implementation Document to the DOI, the State, and the other Organizations for review and comment. This draft Implementation Document shall include final drawings and specifications, final design analyses, a cost estimate, and IRA Deadlines for implementation of the IRA.

8. If any organization (including the State) or the DOI, believes that the IRA is being designed or implementated in a way that will not meet the objectives for the IRA set forth in the final IRA Decision Document or draft Implementation Document, or is otherwise not being properly implemented, it may so advise the others and shall recommend how the IRA should be properly designed or implemented. Any Organization (including the State, if it has agreed to be bound by the Dispute Resolution process, as required by the Consent Decree, or the DOI under the circumstances defined in the Consent Decree) may invoke Dispute Resolution to resolve the disagreement.

9. As Lead Party for design and implementation of this IRA, Shell will issue the final Implementation Document, as described above, and will be responsible for implementing the IRA in accordance with the IRA Implementation Document.

8.0 ARARs

8.1. ATTAINMENT OF ARARs

The interim action process reported to the court on June 5, 1987, in United States v. Shell Oil Co. provides that interim response actions (including this IRA to intercept and treat groundwater in the Basin A Neck) shall, to the maximum extent practicable, attain applicable or relevant and appropriate Federal and State standards. A similar provision appears in Paragraph 9.7 of the proposed Consent Decree.

8.2 IDENTIFICATION AND SELECTION OF ARARs

By letter dated January 19, 1988, counsel for the Army requested that EPA, Shell and the State preliminarily identify in writing the potential ARARs that they believe may be pertinent to this IRA. No responses were received from EPA, Shell, or the State.

8.3 SELECTION OF ARARs AND DETERMINATION OF ARAR IMPACT

8.3.1 AMBIENT OR CHEMICAL-SPECIFIC ARARs

Ambient or chemical-specific requirements set health or risk-based concentration limits or ranges in various environmental media for specific hazardous substances, pollutants or contaminants. Such ARARs either set protective cleanup levels for the chemicals of concern in the designated media or indicate an appropriate level of discharge.

The purpose of this IRA is to reduce the level of contamination in the groundwater in Basin A Neck in order to improve the efficiency and efficacy of treatment by the RMA boundary systems and thereby to accelerate the remediation of RMA groundwater. This IRA will be implemented prior to the final remediation to be undertaken in the context of the On-Post Operable Unit ROD.

For this IRA, the Army has selected an existing "off-the-shelf" technology for interim remediation of Basin A Neck groundwater, consistent with the IRA emphasis on speed of implementation, which the Army fully anticipates will also achieve, at the point of reinjection of the treated groundwater, the following identified standards, requirements, criteria or limitations that the Army views as relevant and appropriate here for the CERCLA hazardous substances specified below:

(1) Arsenic

- (a) CASRN: 7440382
- (b) CERCLA Hazardous Substance: Yes
- (c) Ground Water RI Analyte: Yes
- (d) Ground Water IRA Standard: 50 ug/1.
  (Source: 40 C.F.R. Section 141.11(b) (NPDW-MCL) and 40 C.F.R. Section 264.94(a)(2) (RCRA))

(2) Benzene

(a) CASRN: 71432
(b) CERCLA Hazardous Substance: Yes
(c) Ground Water RI Analyte: Yes
(d) Ground Water IRA Standard: 5 ug/l
(Source: 40 C.F.R. Section 141.61(a), 52 Fed Reg. 25716 (1987) (effective Jan. 9, 1989) (NPDW-MCL))

(3) Carbon Tetrachloride

(a) CASRN: 56235
(b) CERCLA Hazardous Substance: Yes
(c) Ground Water RI Analyte: Yes
(d) Ground Water IRA Standard: 5 ug/l.
(Source: 40 C.F.R. Section 141.61(a), 52 Fed Reg. 25716 (1987) (Effective Jan. 9, 1989) (NPDW-MCL))

(4) Chlorobenzene (Monochlorobenzene)

(a) CASRN: 108906
(b) CERCLA Hazardous Substance: Yes
(c) Ground Water RI Analyte: Yes
(d) Ground Water IRA Standard: 488 ug/l.
(Source: 45 Fed. Reg. 79327-79328 (1980) (AWQC-Human Health))

(5) Chloroform

(a) CASRN: 67663
(b) CERCLA Hazardous Substance: Yes
(c) Ground Water RI Analyte: Yes
(d) Ground Water IRA Standard: 100 ug/l.
(Source: 40 C.F.R. Section 141.12 (NPDW-MCL) (Note that this is the total combined limit for this and all other trihalomethanes.))

(6) DDT

(a) CASRN: 50293
(b) CERCLA Hazardous Substance: Yes
(c) Ground Water RI Analyte: Yes
(d) Ground Water IRA Standard: 10 ug/l.
(Source: 40 C.F.R. Section 129.101(a)(3) (TPES))

(7) 1,2-Dichloroethane

(a) CASRN: 107062
(b) CERCLA Hazardous Substance: Yes
(c) Ground Water RI Analyte: Yes
(d) Ground Water IRA Standard: 5 ug/l.
(Source: 40 C.F.R. Section 141.61(a); 52 Fed. Reg. 25716 (1987) (effective Jan. 9, 1989) (NPDW-MCL))

(8) 1,1-Dichloroethylene

(a) CASRN: 75354
(b) CERCLA Hazardous Substance: Yes
(c) Ground Water RI Analyte: Yes
(d) Ground Water IRA Standard: 7 ug/l.
(Source: 40 C.F.R. Section 141.61(a), 52 Fed. Reg. 25716 (1987) (effective Jan. 9, 1989) (NPDW-MCL))

(9) Dieldrin

(a) CASRN: 60571
(b) CERCLA Hazardous Substance: Yes
(c) Ground Water RI Analyte: Yes
(d) Ground Water IRA Standard: 0.12 ug/l.
(Source: 40 C.F.R. Section 129.100(a)(3) (TPES))

(10) Endrin

(a) CASRN: 72208
(b) CERCLA Hazardous Substance: Yes
(c) Ground Water RI Analyte: Yes
(d) Ground Water IRA Standard: 0.2 ug/l.
(Source: 40 C.F.R. Section 141.12 (NPDW-MCL))

(11) Hexachlorocyclopentadiene

(a) CASRN: 77474
(b) CERCLA Hazardous Substance: Yes
(c) Ground Water RI Analyte: Yes
(d) Ground Water IRA Standard: 206 ug/l.
(Source: 45 Fed. Reg. 79336 (1980) (AWQC-Human Health))

(12) Mercury

(a) CASRN: 7439976
(b) CERCLA Hazardous Substance: Yes
(c) Ground Water RI Analyte: Yes
(d) Ground Water IRA Standard: 2 ug/l.
(Source: 40 C.F.R. Section 141.11(b) (NPDW-MCL) and 40 C.F.R. Section 264.94(a)(2) (RCRA))

(13) 1,1,1-Trichloroethane

(a) CASRN: 71556
(b) CERCLA Hazardous Substance: Yes
(c) Ground Water RI Analyte: Yes
(d) Ground Water IRA Standard: 200 ug/l.
(Source: 40 C.F.R. Section 141.61(a); 52 Fed. Reg. 25716 (1987) (effective Jan. 9, 1989) (NPDW-MCL))

(14) Trichloroethylene (TCE)

(a) CASRN: 79016
(b) CERCLA Hazardous Substance: Yes
(c) Ground Water RI Analyte: Yes
(d) Ground Water IRA Standard: 5 ug/l.
(Source: 40 C.F.R. Section 141.61(a); 52 Fed. Reg. 25716 (1987) (effective Jan. 9, 1989) (NPDW-MCL))

While the Army believes that this manner of standard-setting is appropriate in the circumstances of this interim action, it should be emphasized that this represents quite a different approach from the process of ARAR selection that will be employed by the Army for the On-Post Operable Unit Final Response Action, consistent with the terms of CERCLA, the NCP, pertinent EPA guidance and the proposed Consent Decree. Thus, the standards identified in this context will not necessarily qualify as any or all of the ARARs to be designated in the latter context.

8.3.2 LOCATION-SPECIFIC ARARs

Location-specific requirements set restrictions on activities depending on the characteristics of the site or the immediate environment. These requirements function like action-specific requirements. Alternative remedial actions may be restricted or precluded depending on the location or characteristics of the site and the requirements that apply to it.

With respect to this interim action, the provisions of 40 CFR Section 141.5 (siting requirements for public water systems) are relevant and appropriate. The foregoing regulation does not constitute an applicable location-specific ARAR in this context. The Basin A Neck intercept and treatment system does not constitute a public water system; therefore, the regulatory jurisdiction otherwise associated with the Safe Drinking Water Act and the National Primary Drinking Water Regulations does not arise. In these circumstances, the nature of the remedial action is such that the jurisdictional prerequisites of these requirements are not met. Thus, the identified regulation is not applicable here.

Nevertheless, Section 141.5 does address location-specific problems or situations sufficiently similar to those encountered at the RMA CERCLA site so that use of this regulation is well-suited to the site and accordingly it will be treated as relevant and appropriate. A requirement that is relevant and appropriate must be complied with to the same degree as if applicable. However, there is more discretion in this determination; it is possible for only part of a requirement to be considered relevant and appropriate; the last being dismissed if judged not to be relevant and appropriate in a given case.

Accordingly, the Basin A Neck intercept and treatment system will be located to conform to the substantive siting provisions of 40 CFR Section 141.5 as follows:

(i) The system will not be located where there is a significant risk from earthquakes, floods, fires or other disasters which could cause a breakdown of these improvements; and

(ii) The system will not be located within the floodplain of a 100-year flood.

It should be noted that Paragraphs 23.2(e) and (f) of the proposed Consent Decree provide that:

(e) Wildlife habitat(s) shall be preserved and managed as necessary to protect endangered species of wildlife to the extent required by the Endangered Species Act, 16 U.S.C. Sections 1531 et seq., migratory birds to the extent required by the Migratory Bird Treaty Act, 16 U.S.C. 703 et seq., and bald eagles to the extent required by the Bald Eagle Protection Act, 16 U.S.C. Section 668 et seq.

(f) Other than as may be necessary in connection with a Response Action or as necessary to construct or operate a Response Action Structure, there shall be no change permitted in the geophysical characteristics of RMA that has a significant effect on the natural drainage at RMA for floodplain management, recharge of groundwater, operation and maintenance of Response Action Structures, and protection of wildlife habitat(s).

While these provisions are not ARARs, they obviously must be complied with for purposes of this IRA. Based on where the Basin A Neck intercept and treatment system will be located, as well as when and where IRA will take place, the Army believes that this IRA will have no adverse impact on any endangered species or migratory birds, or on the protection of wildlife habitats.

Moreover, the Army has separately determined that this IRA will not change the physical characteristics of RMA in a manner that will have significant effect on the natural drainage of RMA for floodplain management, recharge of groundwater or the operation and maintenance of Response Action Structures.

8.3.3 ACTION-SPECIFIC ARARs

8.3.3.1 DESCRIPTION

Performance, design or other action-specific requirements set controls or restrictions on particular kinds of activities related to the management of hazardous substances, pollutants, or contaminants. These action-specific requirements may specify particular performance levels, actions or technologies, as well as specific levels (or a methodology for setting specific levels) for discharged or residual chemicals.

8.3.3.2 OPERATION OF BASIN A NECK SYSTEM

There are no action-specific ARARs that apply to this IRA that will operate entirely on RMA where the existing and continuing restrictions on groundwater use apply.

8.3.3.3 CONSTRUCTION OF INTERCEPT AND TREATMENT SYSTEM

(i) Air Emissions

On the remote possibility that there may be air emissions during the course of the construction of the Basin A Neck intercept and treatment system, the Army has reviewed all potential ambient or chemical-specific air emission requirements. As a result of this review, the Army found that there are, at present, no National or State ambient air quality standards currently applicable or relevant and appropriate to any of the volatile or semi-volatile chemicals in the groundwater found in the immediate vicinity of the Basin A Neck area.

Of course, in the context of this IRA there is only a very remote chance of any release of volatiles or semi-volatiles and, even if such a release did occur, it would only be intermittent and of very brief duration (because the activity that produced the release would be stopped and modified appropriately if a significant air emission was detected by the contractor's air monitoring specialist).

The National Emissions Standards for Hazardous Air Pollutants (NESHAPS) were evaluated to determine whether they were applicable or relevant and appropriate to apply in the context of this IRA. These standards were not considered applicable because they apply to stationary sources of these pollutants, not to construction activity. They were not considered relevant and appropriate since they were developed for manufacturing processes which are significantly dissimilar to the short-term construction activity contemplated by this IRA.

(ii) Worker Protection

With respect to the workers directly participating in this IRA, the worker protection requirements of Section 126 of the Superfund Amendments and

Reauthorization Act of 1986 shall be met through compliance with the OSHA interim final rule that appears in 51 Fed. Reg. 45654 (1986).[1]

8.3.3.4 GENERAL CONSTRUCTION ACTIVITIES

The following performance, design or other action-specific State ARARs have been preliminarily identified by the Army as relevant and appropriate to this portion of the IRA and more stringent than any applicable or relevant and appropriate Federal standard, requirement, criterion or limitation:

(i) Colorado Air Pollution Control Commission Regulation No. 1, 5 CCR 100-3, Part III(D) (2) (b), "Construction Activities":

a. Applicability - Attainment and Nonattainment Areas

b. General Requirement - Any owner or operator engaged in clearing or leveling of land or owner or operator of land that has been cleared of greater than one (1) acre in nonattainment areas from which fugitive particulate emissions will be emitted shall be required to use all available and practical methods which are technologically feasible and economically reasonable in order to minimize such emissions, in accordance with the requirements of Section III.D. of this regulation.

c. Applicable Emission Limitation Guideline - Both the 20 percent opacity and the no off-property transport emission limitation guidelines shall apply to construction activities; except that with respect to sources or activities associated with construction for which there are separate requirements set forth in this regulation, the emission limitation guidelines there specified as applicable to such sources and activities shall be evaluated for compliance with the requirements of Section III.D. of this regulation. (Cross Reference: Subsections e. and f. of Section III.D.2 of this regulation.)

d. Control Measures and Operating Procedures - Control measures or operational procedures to be employed may include, but are not necessarily limited to, planting vegetation cover, providing synthetic cover, watering,

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[1]Although OSHA proposed a permanent final rule on August 10, 1987, 52 Fed. Reg. 29620, the comment period on this rule did not close until October 5, 1987. It should be noted that, pursuant to CERCLA Section 301(f), 42 U.S.C. Section 9651(f), the NCP is to be amended by December 11, 1988 to provide procedures for the protection of the health and safety of employees involved in response actions.

chemical stabilization, furrows, compacting, minimizing disturbed area in the winter, wind breaks and other methods or techniques.

(ii) Colorado Ambient Air Quality Standards, 5 CCR 1001-14, Air Quality Regulation A, "Diesel-Powered Vehicle Emission Standards for Visible Pollutants":

a. No person shall emit or cause to be emitted into the atmosphere from any diesel-powered vehicle any air contaminant, for a period greater than 10 consecutive seconds, which is of such a shade or density as to obscure an observer's vision to a degree in excess of 40 percent opacity, with the exception of Subpart b below.

b. No person shall emit or cause to be emitted into the atmosphere from any naturally aspirated diesel-powered vehicle of over 8,500 lbs gross vehicle weight rating operated above 7,000 feet (mean sea level), any air contaminant for a period greater than 10 consecutive seconds, which is of such a shade or density as to obscure an observer's vision to a degree in excess of 50 percent opacity.

c. Diesel-powered vehicles exceeding these requirements shall be exempt for a period of 10 minutes, if the emissions are a direct result of a cold engine start-up and provided the vehicle is in a stationary position.

d. This standard shall apply to motor vehicles intended, designed and manufactured primarily for use in carrying passengers or cargo on roads, streets and highways.

The following performance, design or action-specific State ARAR is applicable to this portion of the IRA and is more stringent than any applicable or relevant and appropriate Federal standard, requirement, criterion or limitation:

(iii) Colorado Noise Abatement Statute, C.R.S. Section 25-12-103:

a. Every activity to which this article is applicable shall be conducted in a manner so that any noise produced is not objectionable due to intermittence, beat frequency, or shrillness. Sound levels of noise radiating from a property line at a distance of 25 feet or more therefrom in excess of the db(A) established for the following time periods and zones shall constitute prima facie evidence that such noise is a public nuisance:

Zone	7:00 a.m. to next 7:00 p.m.	7:00 p.m. to next 7:00 a.m.
Residential	55 db(A)	50 db(A)
Commercial	60 db(A)	55 db(A)
Light Industrial	70 db(A)	65 db(A)
Industrial	80 db(A)	75 db(A)

b. In the hours between 7:00 a.m. and the next 7:00 p.m., the noise levels permitted in subsection (1) of this section may be increased by ten db(A) for a period of not to exceed fifteen minutes in any 1-hour period.

c. Periodic, impulsive, or shrill noises shall be considered a public nuisance when such noises are at a sound level of 5 db(A) less than those listed in Subpart a of this section.

d. Construction projects shall be subject to the maximum permissible noise levels specified for industrial zones for the period within which construction is to be completed pursuant to any applicable construction permit issued by proper authority or, if no time limitation is imposed, for a reasonable period of time for completion of the project.

e. For the purposes of this article, measurements with sound level meters shall be made when the wind velocity at the time and place of such measurement is not more than 5 miles per hour.

f. In all sound level measurements, consideration shall be given to the effect of the ambient noise level created by the encompassing noise of the environment from all sources at the time and place of such sound level measurements.

In substantive fulfillment of Colorado Air Pollution Control Commission Regulation No. 1, this IRA will employ the specified methods for minimizing emissions from fuel burning equipment and construction activities. In substantive fulfillment of Colorado's Diesel-Powered Vehicle Emission Standards, no diesel motor vehicles associated with the construction shall be operated in a manner that will produce emissions in excess of those specified in these standards.

The noise levels pertinent for construction activity provided in C.R.S. Section 25-12-103 will be attained in accordance with this applicable Colorado statute.

8.3.3.5 REMOVAL OF SOIL

There are no action-specific ARARs that pertain to the drilling or excavation of soil during the construction of the Basin A Neck intercept and treatment IRA.

Although not an ARAR, removal of soil from the areas where the intercept and treatment system will be located will be performed in accordance with the procedures set forth in the Task No. 32 Technical Plan -- Sampling Waste Handling (November 1987) and EPA's July 12, 1985 memorandum entitled EPA Region VIII Procedure for Handling of Materials from Drilling, Trench Excavation and Decontamination During CERCLA RI/FS Operations at the Rocky Mountain Arsenal. In general, any soils generated by drilling or excavation during the course of this IRA, either at surface or subsurface, will be returned to the location from which they originated (i.e., last out, first in). Any materials remaining after backfilling has been completed that are suspected of being contaminated based on field screening techniques,[2] will be properly stored, sampled, analyzed, and ultimately disposed of as CERCLA hazardous wastes,[3] as appropriate.

For materials determined to be hazardous waste, substantive RCRA provisions are applicable to their management. These substantive provisions include, but are not limited to: 40 CFR Part 262 (Subpart C, Pre-Transport Requirements), 40 CFR Part 263 (Transporter Standards), and 40 CFR Part 264 (Subpart I, Container Storage and Subpart L, Waste Piles). The specific substantive standards applied will be determined by the factual circumstances of the accumulation, storage or disposal techniques actually applied to any such material.

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[2]The field screening techniques to be used to determine contamination are HNU, OVA, discoloration (visual) and odor. Readings or visual and odor inspection will be taken at least every five feet.

[3]It should be noted that the "land ban" provisions of RCRA Section 3004, 42 U.S.C. Section 6924, are not pertinent to any such excavated soil that is identified as contaminated because the disposal and storage of these soils will be undertaken solely pursuant to 42 U.S.C. Section 9606 and thus will be subject to the exception in 42 U.S.C. Section 6924(d) (4) for CERCLA response actions taken through November 9, 1988, and thereafter will be subject to the exception in 42 U.S.C. Section 6924(j) for storage "solely for the purpose of accumulation of such quantities of hazardous waste as are necessary to facilitate proper recovery, treatment or disposal" since this waste will ultimately be subject to treatment pursuant to the ROD for the pertinent CERCLA operable unit.

9.0 SCHEDULE

The Draft Implementation Document will be completed September 16, 1989. This milestone has been developed based upon the Final Assessment Document and the assumption that no dispute resolution will occur. If events occur which necessitate a schedule change or extension, the change will be incorporated in accordance with the discussion in Section XVIII of the RI/FS Process Document.

10.0 CONSISTENCY WITH THE FINAL RESPONSE ACTION

The purpose of this IRA is to prevent the spread of contamination via aquifer flow through the Basin A Neck pending implementation of the Final Response Actions. Although the Final Response Actions have not been selected at this time, this IRA will be consistent with and contribute to the efficient performance of Final Response Actions through the reduction of contaminant migration and the remedial effects on groundwater at RMA.

11.0 REFERENCES

RIC 87198R01
COE, Sirrine Environmental Consultants. June 1987. Final Engineering Report, Literature Research and Review of Groundwater Quality and Treatment Systems for Basin F.

Consent Decree. 1988, June. United States of America, Plaintiff vs. Shell Oil Company, Inc., Defendant. In the United States District court for the District of Colorado. Civil Action No. 83-2379.

Ebasco Services Incorporated. September 1987. Draft Final Task 26 Interim Response Action Assessment, Version 2.1.

Ebasco Services Incorporated. September 1988. Final Basin A Neck Groundwater Intercept and Treatment System Interim Response Action Alternatives Assessment, Version 3.2.

RIC 82295R01
May, J.H. 1982. Regional Groundwater Study of Rocky Mountain Arsenal, Denver, Colorado, Report 1, Hydrogeologic Definition. Technical Report GL-82-6. Vicksburg, Mississippi: U.S. Army Engineers Waterways Experiment Station.

RIC 83299R01
May, J.H., J.D. Crabtree, R.W. Hunt and W.L. Murphy. 1983. Hydrogeology of Basin A/South Plants Area, Rocky Mountain Arsenal, Denver, Colorado, Phase I, Final Report. Technical Report GL-83-11. Vicksburg, Mississippi: U.S. Army Engineers Waterways Experiment Station.

Morrison-Knudsen Engineers, Inc. August 1987. Basin A Neck Groundwater Recovery and Injection System. Prepared for Holme Roberts and Owen, Denver, Colorado.

Morrison-Knudsen Engineers, Inc. September 1988. Hydrogeologic Investigations in the Basin A Neck. Prepared for Holme Roberts and Owen, Denver, Colorado.

Rezai, M. 1982, May 10. Denver Plant Groundwater Treatment Pilot Plant Study. Technical Report No. 82-2. Shell Development Company Technical Department, Denver Plant.

RIC 84153R01
Stearns-Roger Engineering Corporation. November 1983. South Plants Groundwater Treatment Pilot Plant Rocky Mountain Arsenal, Denver, Colorado. Prepared for Department of the Army U.S. Army Toxic and Hazardous Materials Agency.