KERR-McGEE CORPORATION

GROUNDWATER MITIGATION PROGRAM
KERR-MCGEE CHEMICAL CORPORATION
HENDERSON, NEVADA FACILITY

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Engineering Services

GROUNDWATER MITIGATION PROGRAM

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HENDERSON FACILITY

Prepared by:

Bert J. Smith
Staff Hydrologist
Hydrology Department
Kerr-McGee Corporation
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Approved by:

W. J. Ganus

W. J. Ganus, Vice-President
Hydrology

R. B. Chase, Plant Manager
Henderson Facility

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SUMMARY

The Kerr-McGee Henderson Facility proposes a groundwater corrective action program which will intercept and treat the chromium contaminated groundwater. The mitigation program consists of an interceptor well field to be installed downgradient from the source areas near the 5 mg/l chromium concentration limit. The interceptor field will span a buried stream channel that principally controls the migration of the plume in this area and will assure that the major portion of the contaminated groundwater will be intercepted and treated. The recovery system will be approximately 1400 feet long, consist of 10 interceptor wells (each producing about 7.5 gallons/minute), and will remove and treat 75 (±25) gpm of chromium contaminated groundwater. The interceptor wells will be placed so overlapping cones of depression prevent migration of the plume past the interceptor well field. The groundwater pumped from the aquifer will be sent to a treatment facility where the chromium will be removed. The treated groundwater will then be reinjected back into the aquifer through recharge trenches installed downgradient of the interceptor field. A monitoring well network will be installed to monitor the effectiveness of the intercept system and rate of aquifer cleanup.

CONCLUSIONS

1) An interceptor well field can be installed across the channel north of AP ponds that will effectively capture chromium contaminated groundwater that flows from upgradient areas. A well field of approximately 10 wells spaced roughly 150 feet apart and spanning the ancient stream channel 600' north of the AP ponds will intercept the contaminant plume. Each well will discharge at a rate of 7.5 gallons/minute (75 (±25) gpm total from all wells).

2) All captured groundwater can effectively be treated to remove chromium. All treated groundwater will be recharged back into the Near-Surface aquifer through recharge trenches installed downgradient from the interceptor wells.

INTRODUCTION

Kerr-McGee describes in this report a corrective action program to intercept and treat the chromium contaminated groundwater at a location downgradient from the Facility sources. Recovered groundwater will be processed through a treatment system which will reduce the chromium. The treated groundwater will be reinjected back to the Near-Surface aquifer through recharge trenches.

Geohydrological information supporting this program was previously submitted to the Nevada Division of Environmental Protection on July 31, 1985.

GROUNDWATER MITIGATION PROGRAM

Past Mitigation Programs

Beginning in August, 1983, Kerr-McGee initiated a trial program to recover impacted groundwater and recycle it back through the process. Well M-3 was pumped until July, 1984 when excessive rainfall collected in Facility ponds prevented recycling of recovered groundwater and the well was shut down. This well was successful in capturing impacted groundwater immediately adjacent to this well and creating a decline in the chromium levels.

In early 1983 ponds S-1 and P-1 were drained and taken out of service and are currently undergoing closure. This effectively eliminated a potential source area of impact to the groundwater system.

The repair of Units 4 and 5 is progressing by sealing all cracks in the concrete basement floor, effectively eliminating leakage from these areas.

To further reduce the source of chromium contamination, the basements under Units 4 and 5 have been regulated to insure that liquids are restricted to the drainage system and do not flow onto or remain on the basement floor.

Proposed Groundwater Interception System

The data gathered to date indicates that the installation of a groundwater recovery well system approximately 600 feet north of the AP impoundments (shown in Plate 1) will provide control and recovery of chromium contamination. The basis for installing the recovery system in this area is to intercept the groundwater with the highest chromium concentrations in an area which exhibits favorable hydrogeological properties. Groundwater having chromium concentrations greater than 5.0 mg/l will be intercepted while lower concentrations downgradient from the recovery area will be allowed to attenuate toward background levels.

A geological cross-section approximately 300 feet south of the recovery area is shown in Figure 1 (section A-A'). The cross-section is along the same east-west line as the proposed recovery program. As shown by section A-A', the recovery well system will span a buried stream channel system developed on the Muddy Creek surface. Referring to Plate 1, the recovery well field will trend in an east-west direction and will be approximately 1400 feet long. The length of the recovery system will cross the entire width of the chromium plume and capture or recover contaminated groundwater that occurs upgradient or south of this recovery well area. The outline of the chromium plume is shown in Plate 1. Details of chromium concentrations for June/July, 1985 are presented in Plate 2.

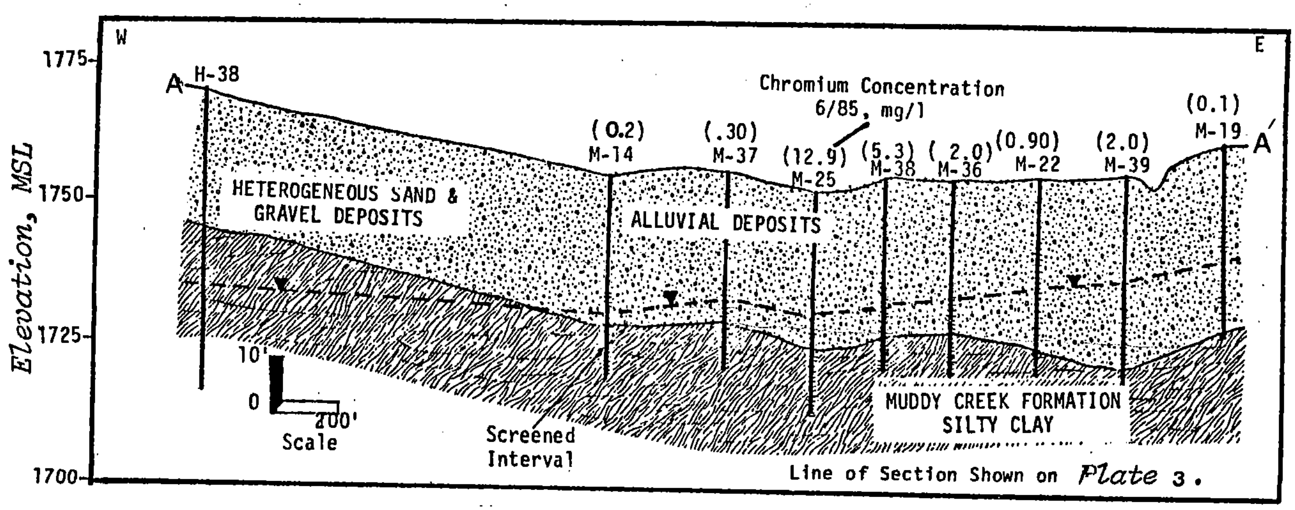

FIGURE 1. GEOLOGICAL CROSS SECTION (EAST-WEST) THROUGH THE INTERCEPTOR WELL AREA, HENDERSON FACILITY.

The aquifer properties of this buried channel system were used to simulate a recovery well field. Aquifer coefficients typical to this channel system are: transmissivity (range 2000-5000 gpd/ft; average 3000 gpd/ft) and storage coefficient (.053). Maximum drawdown in the recovery wells was set at four feet. A recovery well field across the channel system was simulated (using Theis equation) and an effective well spacing of 150 feet was determined. In other words, after pumping for 10 days a minimum drawdown of 1 foot in the aquifer at a distance of 150 feet from this well will be produced by cone of influence or capture. Therefore, all recovery wells will have overlapping cones of at least 1 foot as a design safety factor. To effectively capture the plume over this channel width will require approximately 10 recovery wells (Plate 1) each pumping at a rate of about 7.5 gallons/minute. This pumping rate creates a maximum drawdown of approximately 4 feet in the recovery wells. The total discharge from the recovery system should be 75 (±25) gallons/minute. All recovered groundwater will be sent through a treatment system which removes chromium.

The numbers described above are best estimates upon available site specific data. Field pumping tests will be conducted on each of the recovery wells to further refine the exact well spacings, number of wells and pumping rates.

All interceptor or recovery wells will be installed at least 15 feet into the Muddy Creek formation and screened throughout the saturated alluvial sediments and the upper 10 feet of Muddy Creek formation. The recovery wells will be screened within the upper portions of the Muddy Creek formation to insure capture of any chromium moving through fine sand and silt lenses in the upper part of the formation. A typical recovery well design is shown in Figure 2.

Chromium Removal System

The contaminated groundwater removed from the recovery or interceptor system will require treatment prior to discharge into a reinjection or recharge field. A report on the groundwater treatability studies will be submitted at a later date. The report indicates that the chromium contaminated groundwaters could successfully be treated to remove the chromium.

Proposed Treated Groundwater Reinjection/Recharge System

Once the groundwater has been removed from the aquifer, the resulting treated water will be returned to the groundwater system at a point downgradient (Plate 1) from the recovery field. The treated groundwater will be recharged back to the alluvial or "Near Surface" aquifer through recharge trenches.

The recharge system will be placed downgradient of the recovery line to create a hydraulic barrier to groundwater flow along the edge of the cone of depression for the recovery field. Placing the recharge system at this location will insure little recycling of the groundwater back through the interceptor wells. Placing the recharge system upgradient from the well field or within the plume would actually inhibit the migration of the plume.

Based upon infiltration tests conducted by Stauffer Chemical Corporation, the recharge rate which the formation will accept was determined to be 7.2 cubic feet of water per day per square foot of surface area (Hall,

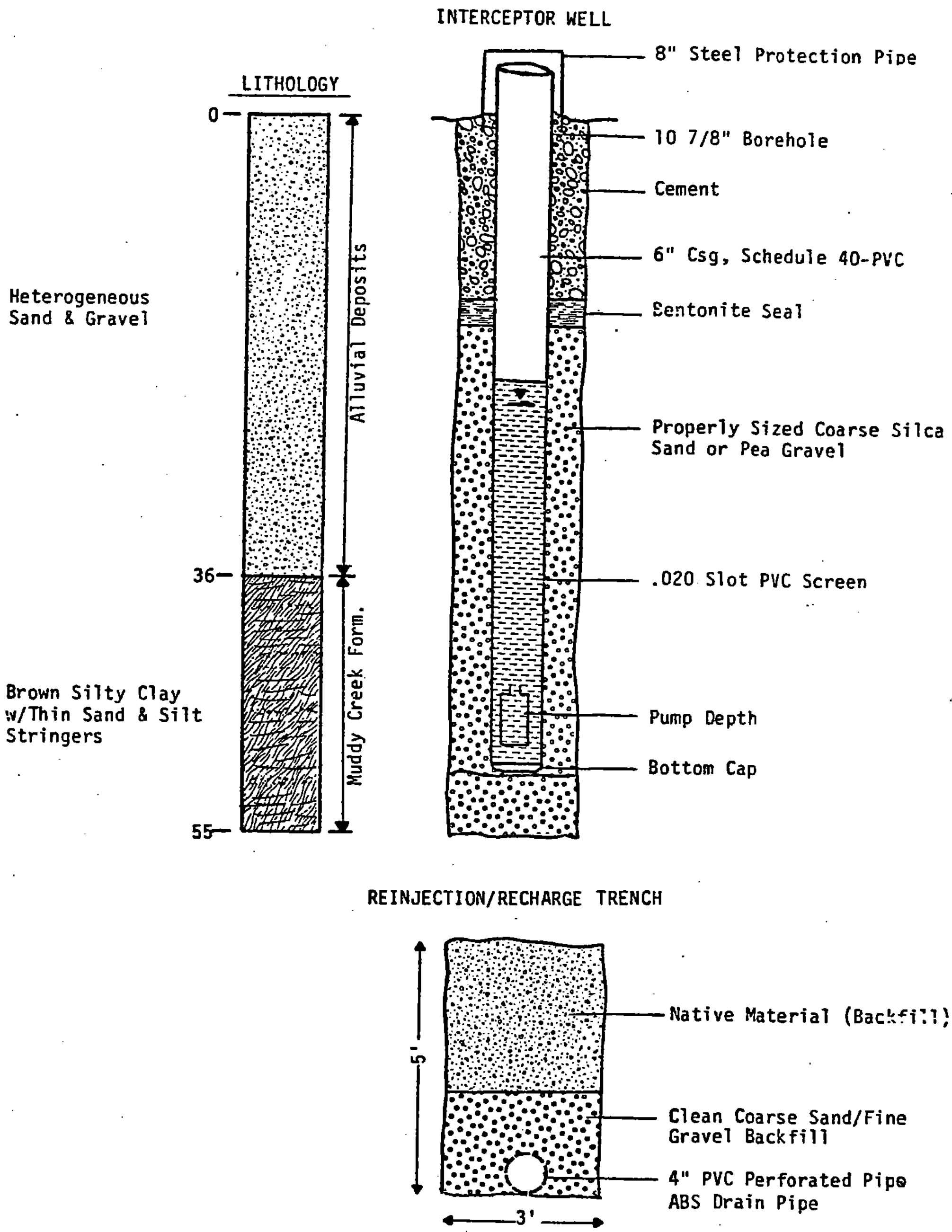

FIGURE 2 . DIAGRAMS SHOWING DETAILS OF INTERCEPTOR WELL DESIGN AND RECHARGE TRENCH DESIGN, HENDERSON FACILITY.

1985). Calculated losses from the Alpha Ditch indicates a recharge rate of 1.5 cubic feet of water per day per square foot. Assuming an infiltration rate of 5 cubic feet/day/ft^2 and a ditch with a wetted perimeter of 7 feet, approximately 3850 square feet of recharge area would be needed to handle 100 gallons/minute (19,233 ft^3/day). Based upon these numbers, two recharge trenches each 600 feet long and having a wetted perimeter of 7 feet (assuming a 2-foot water level in the trench) would be installed approximately 150 feet downgradient (Plate 1). The two trenches would be 50 feet apart, 600' long, 3 feet wide and 5 feet deep as shown in Figure 2. The bottom 2 feet of the trench would contain a 4" perforated drain pipe surrounded by a clean gravel filter blanket. The remainder of the trench will be backfilled with excavated soils. The coarse-grained nature of the backfilled soils should eliminate any significant capillary rise. All treated groundwater may be filtered to remove excessive suspended particles.

GROUNDWATER INTERCEPT AND RECHARGE SYSTEM MONITORING PROGRAMS

An important part of any groundwater mitigation program is the ability to accurately monitor the effectiveness of the program.

The groundwater monitoring programs that will be implemented as part of this program involve both the chemical characterization and physical measurement of the groundwater system. The details of these two monitoring programs are discussed below along with a description of the proposed monitoring well network.

Monitor Well Network

The groundwater monitoring program for the intercept and recharge system will accurately monitor: 1) the rate and magnitude of chemical change in the groundwater in both the upgradient and downgradient directions and 2) the physical configuration of the groundwater system to insure proper function of the intercept and recharge systems.

The upgradient groundwater monitoring well network for the recharge and intercept systems will involve the monitoring of previously drilled wells M-37, M-25, M-36, and M-39 as shown on Plate 1. The downgradient monitoring network for the recharge and interceptor fields will involve the installation of five monitoring wells and use of existing well M-18 as shown on Plate 1. In addition to these wells, five wells will be installed for the purpose of water-level measurements. All five wells will monitor the effectiveness of the interceptor field. The details of this network are shown on Plate 1. Plate 3 shows the location of all monitoring wells at the Henderson Facility.

Chemical Monitoring Program

All wells involved in the interception of the groundwater (interceptor wells) and all upgradient and downgradient monitoring wells associated with the interceptor and recharge system will be monitored on a quarterly basis. Groundwater samples from these wells will be analyzed for specific conductance, pH, and chromium. In addition to the program associated with the intercept and recharge system, groundwater samples will be collected annually from all Kerr-McGee M-series wells and selected Stauffer wells (on Kerr-McGee property) and analyzed for the constituents noted above.

All chemical analytical results will be monitored to track the progress of the cleanup and note any changes in the plume configuration. KMCC reserves the right to change the frequency and number of wells monitored if data indicates the system can be adequately monitored after the reduction.

Water Level Monitoring Program - It is important to monitor the configuration of the groundwater surface to insure that an effective cone of depression or influence is maintained to insure full capture of the chromium plume. In efforts to closely monitor water levels, two continuous water level recorder installations will be evaluated. One recorder is proposed to be installed within the middle of the intercept system and a second recorder installed slightly downgradient of the recharge or reinjection area. In addition, [1]water levels will be measured on all M-series wells, the intercept wells, and monitoring wells associated with the recovery and recharge program on a quarterly frequency. Data developed from this program will be reviewed to insure proper well field management to produce the desired drawdown within the intercept system.

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[1]5 wells will be installed within interceptor well area to verify the cone of depression.

SCHEDULE OF IMPLEMENTATION

The following presents a schedule of implementation for the proposed groundwater mitigation program at the Henderson Facility with time for completion after approval by the Nevada DEP.

	Action Taken	Months After Plan Approval
1)	Complete further treatability studies on removal of chromium from the groundwater	6 mo.
2)	Install three 6" interceptor wells along the intercept line and conduct pumping tests to define exact well cpacings	8 mo.
3)	Drill additional geological borings along the intercept line to define the subsurface features of the Muddy Creek Formation	8 mo.
4)	Install other interceptor wells along the intercept line. (The number of additional wells determined by 2 above).	9 mo.
5)	Install upgradient and downgradient monitoring wells and collect initial or background samples	9 mo.
6)	Construct a test recharge trench and conduct a short term reinjection/infiltration test	10 mo.
7)	Complete construction of treatment facility	13 mo.
8)	Complete construction of recharge trenches	14 mo.
9)	Install permanent pump in interceptor wells and install all necessary piping	14 mo.
10)	Start recovery program	15 mo.
11)	Interim Report on recovery program to Nevada Department of Environemental Protection	21 mo.

REFERENCES

Hall, L. E., March, 1983; 1982 Hydrogeologic Investigation in Support of the Groundwater Intercept System at Stauffer Chemical Company, Henderson, Nevada; Inhouse Report.