

## **2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES**

### **2.1 Operational History**

Congress established RMA in 1942. The United States acquired land included within the boundaries of the Arsenal for chemical weapons manufacturing, constructed a base, and commenced Army weapons production and ancillary activities in 1943. From 1945 to 1950, RMA distilled available stocks of mustard, demilitarized several million rounds of mustard-filled shells and incendiary munitions, and test-fired mortar rounds filled with smoke and high explosives. Also, many different types of obsolete World War II ordnance were destroyed by detonation or burning.

After the conclusion of World War II, selected surplus facilities were leased to nongovernment entities as warehouses and for the manufacture of agricultural chemicals. Colorado Fuel and Iron (CF&I) leased facilities at RMA in 1946. Julius Hyman & Company (Hyman) first leased facilities in 1947 and succeeded to the CF&I leasehold interest, with some modifications and additions in 1949. Shell Oil Company (Shell) acquired a majority interest in Hyman in 1952 and operated the plant as the Julius Hyman Company until 1954, when the operation became the Shell Chemical Company - Denver Plant.

RMA was selected as the site for construction of a facility to produce Sarin, a nerve agent. The facility was completed in 1953, with the manufacturing operation continuing until 1957 and the munitions-filling operations continuing until late 1969. From 1970 until 1984, the primary operation at RMA was the disposal of chemical warfare material. Disposal practices included incinerating VX anticrop agent and mustard agent explosive components and destroying Sarin and related munitions casings by caustic neutralization.

Chemicals were introduced to the RMA environment primarily by the burial or surface disposal of solid wastes, discharge of wastewater to basins, and leakage of wastewater and industrial fluid from chemical and sanitary sewer systems. Munitions were destroyed and disposed in trenches.

Wastewater generated by the U.S. Department of the Army (Army) and private industry in the South Plants and North Plants areas was discharged to a series of unlined evaporation and holding basins (Basins A, B, C, D, and E) and to asphalt-lined Basin F at various times throughout the history of RMA operations. The locations of these source areas are shown in Figure 2.1.

The primary areas that have contributed to groundwater contamination at RMA include (1) former manufacturing facilities, (2) former waste storage basins, (3) solid waste disposal areas, (4) the chemical sewer system, (5) locations within the rail classification yard, and (6) the motor pool area.

### **2.2 Previous Investigations**

From 1975 to the present, numerous groundwater monitoring programs have been conducted at RMA, both onpost and offpost, by the Army. The U.S. Environmental Protection Agency (EPA) has also conducted several offpost investigations. The Army designed and implemented monitoring programs to monitor regional groundwater and surface-water quality. The Army also designed and implemented the boundary system monitoring program to support the operation of the boundary groundwater containment systems.

#### **2.2.1 U.S. Environmental Protection Agency Study Area**

Several organic chemicals were detected in South Adams County Water and Sanitation District (SACWSD) wells in 1981, as part of a random national survey of drinking water systems conducted by EPA. Additional sampling in 1982 and 1985 confirmed these initial findings. As a result, EPA began a remedial investigation/feasibility study (RI/FS) of an area west of RMA and south of the Offpost Study Area (Figure 1.1).

RMA was suspected as one of the possible sources of contaminants in the EPA study area because of RMA's historical waste disposal practices. To mitigate the groundwater contamination problem, the Army and EPA built a water-supply system for SACWSD. Further investigation by EPA's Field Investigation Team indicated that source areas in addition to RMA contributed to groundwater

contamination detected within the EPA study area. Groundwater monitoring wells installed on the Chemical Sales Company (CSC) property have since identified CSC as a significant source of groundwater contamination in the EPA study area. Recent investigations by EPA and the Army have detected the presence of a trichloroethene plume entering RMA at Section 9, Township 3S, Range 67W along the southern boundary of RMA, as described in the Western Tier Report, the Stapleton Airport Environmental Assessment (Camp Dresser & McKee, Inc., 1993), and the CSC ROD (EPA, 1991a, 1991b, 1992). (Ebasco Services, Inc., 1988),

### **2.2.2 U.S. Department of the Army Investigation**

Because chemicals were detected in the Offpost Study Area, the Army initiated a regional hydro-geologic surveillance program requiring the quarterly collection and analysis of samples from more than 100 onpost and offpost wells and surface-water stations. The program was carried out under the direction of the RMA Contamination Control Program, established in 1974 to ensure compliance with federal and state environmental laws. The objectives of the program were to (1) evaluate the nature and extent of contamination and (2) develop response actions to control contaminant migration. Potential and actual contaminant sources were assessed, and contaminant migration pathways were evaluated.

From 1975 to the present, numerous groundwater monitoring programs have been conducted at RMA. The Army designed and implemented the 360 Degree Monitoring Program to monitor regional groundwater and surface water. The Army designed and implemented a boundary system monitoring program to support the operation of the boundary groundwater containment systems. Studies conducted at RMA to assess groundwater and surface-water conditions are discussed below.

The RMA Offpost Contamination Assessment Report (CAR) (Environmental Science and Engineering, Inc. [ESE], 1987a) incorporated data from several studies to define the concentrations and distribution of offpost contamination north and northwest of RMA. The scope of the CAR investigation

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was intended to address critical data gaps required to evaluate a comprehensive set of multimedia exposure pathways.

The potential for contamination of private wells was investigated in the mid-1980s during the Consumptive Use (CU) Studies, Phases I, II, and III. The CU Phases I and II studies addressed the Offpost Study Area. In the CU Phase III study, the Army conducted an inventory of privately-owned drinking water wells in an area bound by East 80th Avenue on the south, East 96th Avenue on the north, the South Platte River on the west, and RMA on the east. The objectives of the CU Phase III study were as follows:

- Locate all shallow domestic wells (less than 100 feet) in the Offpost Study Area.
- Sample a representative number of the located wells.
- Assess the groundwater quality of the shallow alluvial aquifer.

The Army developed the Comprehensive Monitoring Program (CMP), a long-term multimedia monitoring program designed to provide data to facilitate evaluation of response actions, in the mid-1980s. Sample collection under the CMP commenced in 1987 and is continuing as the Groundwater Monitoring Program (GMP).

An RI was initiated in 1985 by the Army in the Offpost Study Area. The primary objectives of the Offpost RI were as follows:

- Collect additional data to refine the current understanding of groundwater flow and surface-water patterns and the nature and extent of contaminants offpost of RMA.
- Evaluate the potential for chemical migration to the Offpost Study Area in various environmental media, such as groundwater, surface water, sediment, air, and biota.

Following completion of the RI, it was apparent that additional data were needed before evaluation and selection of a remedial alternative could occur. Therefore, a second RI was initiated in 1988 to collect additional data for groundwater, surface water, soil, sediment, and biota (plants and animals).

The results of the second RI are reported in the Offpost Operable Unit Remedial Investigation, Final Addendum (HLA, 1992b).

## **2.3 Boundary Containment Systems**

Concurrent with and as a result of the EPA and Army investigations, the Army constructed three boundary containment systems (the North Boundary Containment System [NBCS], the Northwest Boundary Containment System [NWBCS], and the Irondale Containment System [ICS] at the north, northwestern, and western boundaries of RMA, respectively) to minimize offpost discharge of RMA chemicals via groundwater. The locations of these containment systems are shown in Figure 1.1. All three systems currently intercept and treat contaminated groundwater and recharge treated water to the UFS.

### **2.3.1 North Boundary Containment System**

The NBCS is just south of the RMA north boundary in Sections 23 and 24. The NBCS consists of (1) a system of extraction wells that remove contaminated groundwater from the UFS, (2) a soil-bentonite barrier that impedes migration of contaminated groundwater to the Offpost Study Area, (3) a carbon-adsorption treatment system that removes organic contaminants from extracted groundwater, and (4) a system of recharge wells and trenches that return treated groundwater to the UFS.

The NBCS pilot system became operational in 1978. The pilot system was expanded approximately 1400 feet to the west and 3840 feet to the east in 1981 during the second phase of construction. Several improvements have been made to the NBCS since 1981: ten recharge trenches were added to the west end of the system and became operational in December 1988, and five additional recharge trenches were added to the east end of the system in 1990. Currently, the soil-bentonite barrier is 6740 feet long, approximately 3 feet wide, and varies in depth from 20 feet at the western end to more than 40 feet along the eastern extension. The barrier is anchored in the Denver Formation.

Review of groundwater contaminant distribution patterns indicates that the NBCS is having a significant effect on the distribution of organic compounds in the Offpost Study Area. Monitoring program data indicate that contaminant concentrations downgradient of the NBCS are decreasing.

Activated carbon is being used to effectively remove the organic contaminants from the extracted groundwater to meet containment system remediation goals. Organic contaminant concentrations are generally below certified reporting limits (CRLs) in system effluent.

### **2.3.2 Northwest Boundary Containment System**

The NWBCS is along the northwest boundary of RMA in the southeast quarter of Section 22.

Construction of the NWBCS began in 1983, and the system became operational in 1984. The NWBCS originally consisted of (1) 15 extraction wells, (2) a soil-bentonite-barrier approximately 1600 feet in length, (3) a carbon adsorption treatment system, and (4) a system of 21 downgradient recharge wells. The carbon adsorption system was designed to intercept and remove dibromochloropropane and other organic compounds from a plume of contaminated groundwater originating onpost.

Contaminant bypass was observed at the southwest and northeast ends of the NWBCS in 1988. An interim response action (IRA) to improve the NWBCS was initiated in 1989. In April 1990, the NWBCS Improvements IRA was divided into two phases: NWBCS Short-term Improvements IRA and NWBCS Long-term Improvements IRA. Under the NWBCS Short-term Improvements IRA, which was completed in 1991, the existing slurry wall was extended 665 feet to the northeast to prevent contaminant bypass, and two additional extraction wells were added at the northeast end of the extraction well alignment. Three additional extraction wells and four additional recharge wells were installed in Section 27, southwest of the NWBCS in August 1991. The NWBCS Long-term Improvements IRA is being used to assess the NWBCS and its short-term improvements by reviewing groundwater monitoring data.

### **2.3.3 Irondale Containment System**

The ICS, which became operational in 1981, is at the southern end of the RMA northwest boundary within Section 33 and consists of (1) a hydraulic control system of extraction and recharge wells, and (2) a carbon adsorption treatment system. The ICS was originally developed to intercept the migration of dibromochloropropane (DBCP) at the RMA boundary. There have been no downgradient

detections of DBCP after the first two years of operation. The majority of the area downgradient of the ICS is contained within the EPA study area, although portions of the downgradient area are within the confines of the Offpost Study Area. Therefore, the design and operation of the ICS was not included in the evaluation of alternatives; however, the continued operation of the ICS, as required, for onpost contaminants consistent with the Irondale IRA remains an integral part of the Army's offpost contaminant reduction program to meet onpost cleanup goals defined in the Irondale IRA. Cessation of operation of the ICS will be in accordance with paragraphs 35.2 and 35.4 of the FFA and paragraph 20 of the Conceptual Remedy Agreement.

## **2.4 Interim Response Actions**

As part of the Army's compliance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and as described in the FFA, the Army has instituted several IRAs that have been performed concurrently with the ongoing onpost and offpost RI programs. IRAs, which are designed to be compatible with the final remedy, are actions taken before the signing of the Record of Decision (ROD) and are expedited remedial measures to contain, remove, or treat wastes before the final remedy is selected. Numerous IRAs have been implemented to mitigate contamination both onpost and offpost. As indicated in the previous sections, some portions of the boundary containment systems have been constructed as IRAs. The Offpost IRA is discussed in the following section.

### **2.4.1 Offpost Interim Response Action**

The Offpost IRA addresses groundwater contaminant migration north of RMA and downgradient of the NBCS along two primary contaminant pathways, defined by the First Creek and northern paleochannels.

Evaluation and selection of the collection and treatment system components that comprise IRA A, referred to as the Offpost Groundwater Intercept and Treatment System, began in 1988. The Offpost Groundwater Intercept and Treatment System Decision Document (HLA, 1989) presents the basis for

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system placement to address remediation of contamination in alluvial groundwater in the First Creek and northern paleochannels. The system was designed to intercept and extract contaminated groundwater from the UFS, treat the groundwater for organics, and recharge treated water to the UFS. Construction of the Offpost Groundwater Intercept and Treatment System began in November 1991 and was completed in June 1993. Groundwater extraction is accomplished through a network of extraction wells. The organic contaminants in extracted groundwater are treated using activated carbon adsorption, and the treated water is then recharged to the UFS using a combination of recharge wells and trenches.

The Offpost Groundwater Intercept and Treatment System was designed to be flexible and to be compatible with the final remedy, consistent with EPA guidance and the FFA.

### **2.5 History of CERCLA Enforcement Activities**

Most of RMA was added to the National Priorities List (NPL) in 1987; Basin F was added in 1989. As such, RMA is subject to compliance with CERCLA (also known as Superfund). A facility is subject to compliance with CERCLA when a release or a threat of a release of hazardous substances from the facility has occurred and when response costs have been incurred. In some cases, the potentially responsible parties (PRPs) either cannot respond or cannot be found, so funding for the response comes from the government fund called Superfund. At RMA, the Army and Shell were identified as PRPs and are funding the cleanup.

On February 1, 1988, a proposed Consent Decree was filed in the case of *U.S. v. Shell Oil Company* with the U.S. District Court in Denver, Colorado. A modified version of the Consent Decree was filed on June 7, 1988. The Consent Decree was entered by the U.S. District Court on February 12, 1993.

On February 17, 1989, an FFA was executed by the Army, Shell, EPA, the U.S. Department of the Interior (DOI), the U.S. Department of Justice (DOJ), and the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). The FFA sets forth the procedures to be followed by the Organizations (i.e., signatories to the FFA) to cooperate in the assessment, selection, and implementation of

response actions resulting from the release or threat of release of contaminants from RMA. The FFA designates the Army as the lead agency.