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# IMPACT AREA GROUNDWATER STUDY PROGRAM

AT THE MASSACHUSETTS MILITARY RESERVATION

Overview and Update

Fact Sheet No. 2001-02

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## Introduction

This fact sheet provides an overview of the environmental investigations and cleanup activities being performed by the Impact Area Groundwater Study Program (IAGWSP) at the Massachusetts Military Reservation on Cape Cod. It was developed in collaboration with the Impact Area Review Team (IART), a citizen advisory committee, as well as the Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (MADEP).

This fact sheet also updates information contained in an original fact sheet for the IAGWSP dated June 16, 1999.

## Impact Area Groundwater Study Program

The goal of the Impact Area Groundwater Study Program is to assess and clean up the impacts of certain types of historic training activities conducted at the Camp Edwards' Impact Area and training ranges. These areas lie directly over the Sagamore Lens, the most productive part of the Cape Cod Aquifer. The National Guard Bureau is required by EPA to conduct the project and is overseen by both the EPA and MADEP.

For nearly 90 years, military, law enforcement and contractor activities have been conducted in the training ranges and Impact Area. Activities included:

- Small arms firing at several ranges involving the use of small caliber munitions
- Artillery firing and mortar firing into the Impact Area from gun and mortar positions
- Burning of excess propellant bags at firing ranges and gun and mortar locations
- Demolition training with explosives at demolition ranges
- Detonation and/or abandonment of unexploded ordnance
- Training activities with various other munitions including pyrotechnic devices, rockets, grenades and mines
- Packing, testing, development and disposal of weapons by Department of Defense contractors

## Administrative Orders

During the 1980's, much attention was given to environmental issues both nationwide and on Cape Cod. Groundwater contamination was first discovered flowing off the southern portion of MMR. The groundwater plumes emanated from areas of previous activity, mainly associated with those conducted at the former Otis Air Force Base (now Otis Air National Guard Base). The discovery of significant off-base contamination led to increased community interest in the existing environmental cleanup program at MMR, now the Air Force Center for Environmental Excellence's Installation Restoration Program (IRP). As interest and activity grew in the IRP, the citizens and local community organizations began to look at other activities taking place at MMR and voiced concern about the effect of historic and current training in the northern 15,000 acres of MMR. This growing awareness of possible groundwater contamination led the EPA to issue the first of four Administrative Orders in 1997.

In February of 1997, the Environmental Protection Agency issued the first Administrative Order concerning Camp Edwards. The Impact Area Groundwater Study Program was established to respond to this order. Administrative Order 1 (AO1) was issued to the National Guard Bureau (NGB) and it required the NGB to investigate the nature and extent of contamination at and emanating from the training ranges and Impact Area on Camp Edwards. AO1 also required that Groundwater Study Program activities be conducted with adequate public involvement, including coordinating work with the citizen advisory committee established by the EPA, the IART.

The second Administrative Order (AO2) was issued in April of 1997 to the National Guard Bureau and the Massachusetts National Guard. It required that certain training activities (artillery and mortar firing) cease pending the completion of environmental investigations at the training ranges and Impact Area.

In January of 2000, EPA issued Administrative Order No. 3 (AO3), which required the National Guard Bureau and the Massachusetts National Guard to conduct rapid response actions, feasibility studies and remedial actions to address contamination in certain areas at the training ranges and Impact Area. It required the NGB to undertake a feasibility study to address unexploded ordnance (UXO) and munitions, which have been disposed of or fired at the training ranges and Impact Area.

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It also required the NGB, upon approval from EPA, to implement remedial measures relating to UXO and munitions.

Administrative Order No. 4 (AO4) was issued on January 4, 2001 under the Resource Conservation and Recovery Act (RCRA) to the National Guard Bureau. This order requires that munitions found subsurface or in burial pits be properly stored and disposed of in a Contained Detonation Chamber (CDC), or by other means which prevent the release of explosives, metals and other contaminants into the environment. As of June 2001, 1703 items have been destroyed using the CDC with additional items awaiting disposal.

## Status of Investigations

To date, more than 170 monitoring wells have been installed throughout the 15,000-acre training ranges and Impact Area as part of the program. As a result of the investigation, several sites/areas of Camp Edwards are being more closely examined to assess the nature and extent of contamination from past military activities. The following major sites are under investigation:

- Demolition Area 1
- Southeast Corner of the Ranges
- Central Impact Area
- Gun and Mortar Firing Positions
- Chemical Spill-19

See the map for the location of these sites.

It has been determined that for each major site, a feasibility study must be prepared to evaluate potential alternatives for conducting groundwater and soil cleanup. A feasibility study evaluates technologies and alternatives to be used for the containment, treatment and or removal of contamination from a site.

In addition, the IAGWSP is conducting an investigation and a feasibility study to address potential environmental impacts from unexploded ordnance throughout Camp Edwards.

What follows is a summary and update on the investigations at these sites, as well as an update on other surveys and investigations being conducted on Camp Edwards.

### Demolition Area 1

Demolition (Demo) Area 1, a former training area used primarily for demolition training and open burning/open detonation of explosives since the mid 1970's, is located south of the Impact Area and north of Pocasset-Forestdale Road. The area is a topographic depression, or kettle hole, that covers approximately one acre at its base and is 45 feet below the surrounding grade. Types of explosives and munitions either used for training purposes and/or disposed of at this location included C4, TNT, dynamite, shape charges, cratering charges, bangalore torpedoes, claymore mines and detonating cord.

Soil and groundwater investigations have been conducted at Demolition Area 1 to identify the nature and extent of contamination at the site. Investigations began in June of 1997 and continue to date. For groundwater, the Contaminants of Concern (COCs) are the explosive compounds – RDX, TNT, HMX, 2A-DNT, 4A-DNT, 2,4-DNT, and perchlorate.

RDX and perchlorate have migrated the farthest in the groundwater. Plumes of these compounds as currently defined extend about 5,500 feet west of Demo Area 1 and are about 400 feet wide and 100 feet deep in the aquifer. The maximum measured groundwater contamination found to date is 370 parts per billion (ppb) for RDX and 300 ppb for perchlorate. The lifetime health advisory for RDX in drinking water is 2 ppb. There is currently no federal or state drinking water standard for perchlorate, but the EPA has calculated that a safe exposure level in drinking water for perchlorate is in the range of 4 – 18 ppb. A detailed evaluation of six remedial technologies for these constituents is currently under discussion with the regulatory agencies.

The 12 contaminants of concern for soil are under review by the regulatory agencies. They are primarily explosives and propellants, but also include several other compounds such as metals, semi-volatile organic compounds (SVOCs), and dioxin. Once approved by the agencies, the selected COCs will form the basis for evaluating the cleanup alternatives for the soil contamination.

### Southeast Corner of the Ranges

Explosives have been detected in groundwater and soil southeast of the Impact Area and north of Snake Pond. This area lies at the top of the groundwater mound of the Sagamore Lens of Cape Cod's sole source aquifer, and groundwater flows out radially from this area. This area contains three former defense contractor test ranges (the "J" Ranges) and one Massachusetts Army National Guard range (the "L" Range). The U.S. Army - from the 1930s to the 1950s - extensively used this entire area for training. Existing documentation on defense contractor activities at the J Ranges suggests that bulk explosives were disposed of to the ground surface as well as below ground into holding tanks. Open burn/open detonation disposal of munitions also occurred in numerous locations throughout the J Ranges. In addition, buried caches totaling approximately 1700 mortar rounds have been exhumed from locations since 1998. Also various test firings and research and development activities by numerous contractors occurred in this area. The L Range was utilized for training with high explosives during the 1940s and from the 1970s to the 1980s.

What appears to be five distinct areas of groundwater contamination have been detected between Snake Pond and the Southeast Corner of the Ranges.

Additional areas of groundwater contamination have been detected further north in the J range area. The explosives detected in these areas will most likely migrate northwest towards the Central Impact Area. Perchlorate has also been detected at 6 locations in the southeast corner of the range. The National Guard Bureau is continuing to investigate the extent of soil and groundwater contamination in this area.

### **Central Impact Area**

Detections of explosives at various depths and locations in the aquifer track back to, or originate from, the Central Impact Area where mortar and artillery rounds were fired for many years. To date, an area of groundwater containing primarily RDX and HMX, has been delineated as extending as far as 11,000 feet northwest from its probable source. The groundwater contamination underlies an area of approximately 621 acres with approximately 880 million to 1.3 billion gallons of water having been affected above the 2 ppb health advisory for RDX. The main source for the explosives in groundwater appears to be an area along Turpentine Road and Tank Alley, which coincides with the location of the targets for the Central Impact Area. The source likely covers about 440 acres of land within the Central Impact Area.

### **Gun and Mortar Firing Positions**

Camp Edwards contains approximately 36 current and former locations from which artillery and mortar rounds were fired. EPA requested that NGB conduct detailed evaluations of these positions based on detections in soil of elevated levels of the propellant and explosive compound 2,4-DNT, in addition to several metals, SVOCs and pesticides. The IAGWSP is evaluating contamination at these positions and will begin developing remedial alternatives for cleanup in the near future.

### **Chemical Spill-19 (CS-19)**

The CS-19 site is a small area in the west-central region of the Impact Area. The area was used for the burial and burning of ordnance. The highest concentration of RDX detected in groundwater at this location was 20 ppb in the central area of CS-19. Elevated levels of explosives, metals and SVOCs have also been found in soils at this location. Groundwater contamination in this area, which is currently known to extend 2,500 feet west and is underlain by contamination originating further upgradient in the Central Impact Area, is currently being addressed by the Air Force under the Installation Restoration Program (IRP) through a Remedial Investigation/Feasibility Study.

## **EXPLOSIVE CONTAMINANTS**

Explosives used by the Department of Defense (DOD) that have been detected in the soil and groundwater under the Training Ranges and Impact Area at Camp Edwards include:

**RDX** - Royal Dutch or Research Department Explosive is used as a part of a composite explosive in military munitions and in explosive demolition charges

**HMX** - High Melting Explosive is white crystalline solid used as a part of a composite explosive used in military munitions

**TNT** - 2,4,6-Trinitrotoluene is produced both at military arsenals and commercial facilities and is used alone or as part of a composite explosive in military munitions.

**2,4-DNT** - 2,4-Dinitrotoluene is used to produce ammunition and explosives, and is a compound of most propellants.

**Perchlorate** - a component in solid propellant for rockets, fireworks and missiles.

The explosive compound most frequently detected is RDX, which is currently classified by EPA as a Class C carcinogen (a possible human carcinogen). To date, RDX has been detected in groundwater both below and above EPA's Health Advisory of 2 parts per billion (ppb). According to validated groundwater data, RDX has been reported in 75 monitoring wells; 42 of the wells had RDX above the Health Advisory.

See figure on page 6 for a map of explosive compound detections.

## **MASSACHUSETTS CONTINGENCY PLAN**

In addition to complying with the Administrative Orders issued by the EPA, the IAGWSP must conduct investigations and remediation to meet the substantive requirements of the Massachusetts Contingency Plan, or MCP, regulated by the Massachusetts Department of Environmental Protection. The MCP is the state regulation that provides for the protection of health, safety, public welfare, and the environment by establishing regulations and procedures for the assessment of environmental contaminants, the evaluation of alternatives of and the implementation of remedial actions to abate, prevent and remedy contamination. More information on the MCP can be found at:

<http://www.state.ma.us/dep/bwsc>.

## RAPID RESPONSE ACTIONS

Under Administrative Order No. 3, a series of rapid response actions (RRAs) were required to be implemented in order to protect the groundwater at Camp Edwards.

The administrative order identified several rapid response action areas to be addressed. The first round of rapid response actions has been completed. The areas included contaminated soils at the:

- KD range firing points and target areas
- Gun position 7
- Armored Personnel Carrier
- J-3 Wetland
- Study Area 2 of the Impact Area

These areas are located within the training ranges and Impact Area and have been investigated as part of the ongoing IAGWSP. The results of these investigations have identified explosives, metals, propellants, and pesticides in soil and sediment. Several of the areas had concentrations of contaminants detected above Massachusetts Contingency Plan (MCP) Reportable Concentration Soil-1 (RCS-1) levels. The RCS-1 levels are concentrations that, when exceeded, require notification of MADEP and may require further investigation and remediation of contamination.

A soil sampling program was conducted to determine the extent of soil within five rapid response areas that exceeded the proposed soil cleanup goals. Results of the sampling program identified approximately 810 cubic yards of contaminated soil, which exceeded the RRA soil cleanup goals.

The RRA addressed the following requirements:

- Elimination of current and potential sources of contaminants to the aquifer from soils and sediment in the areas
- Development and implementation of a monitoring plan to assess compliance with the cleanup goals for source control measures
- Excavation, treatment and or disposal of contaminated sediments, soils, debris and other materials generated during the RRA
- Restoration of areas disturbed by the removal actions, particularly vegetation and habitat

A second round of Rapid Response Actions to address contamination at Mortar Target 9 and the former H Range is currently underway.

## MUNITIONS SURVEY PROJECT

An extensive Munitions Survey Project (MSP) has been underway since July of 1998 in addition to the investigation and remediation of soil and groundwater contamination at Camp Edwards. The MSP was designed to locate buried munitions at locations on Camp Edwards. Phase I of the project was intended to investigate selected sites by conducting geophysical surveys to detect subsurface metallic objects (anomalies or targets). Phase II of the MSP will involve investigations of other sites at Camp Edwards. To verify the geophysical surveys, a limited number of subsurface validations have been performed during Phase I of the MSP. Before field investigations for the MSP began, several sites, locations, and functional areas were selected for investigations. Those areas included selected gun and mortar positions, Demolition Area 1, Central Impact Area, the High Use Target Area, a slit trench, selected water bodies, and portions of the J Ranges.

The MSP was designed to acquire data that could be used to support the groundwater study. In particular, it was intended to fill significant gaps in data relevant to the issue of ordnance, buried munitions, and burial pits at Camp Edwards. The intention of the MSP was to provide to stakeholders information about the current condition of the ranges and locations at Camp Edwards. The original set of tasks drafted in mid-1999 has been refined and modified as new information about buried ordnance at Camp Edwards has been discovered and analyzed. The survey focuses on locating large burial pits or disposal sites because such sites were assumed to be potential sources of explosive chemicals detected in groundwater. Preliminary findings suggest that smaller burial sites or even individual unexploded ordnance can be located using geophysical techniques. All of the information gathered as part of the MSP will be utilized to support the UXO Feasibility Study required by the EPA Administrative Order No. 3.

## REMEDIATION – HOW DOES THE IAGWSP IDENTIFY AND CLEAN UP CONTAMINATION?

The following actions will be taken to address contamination at each site that poses a risk to human health and the environment.

- **Feasibility Study** – a separate feasibility study will be prepared for each area of concern. A feasibility study is used to evaluate cleanup technologies and alternatives to be used for the containment, treatment, or removal of contamination from a site.
- **Remedial Design** – the engineering design necessary to complete the remediation or cleanup of the contamination
- **Remedial Action** – the construction of the remediation or cleanup alternative and its operation

The remedy selection process for each area of concern is as follows: A draft feasibility study will be developed outlining alternatives and technologies being considered for the cleanup process. After all input is received, a proposed plan which lays out the recommended approach for the cleanup will be written. This plan will be developed by the IAGWSP then reviewed by the EPA, MADEP and the IART prior to being released for a public comment period. The IART serves as an advisory group on decision making. Upon the receipt and evaluation of any comments received during the public comment period, NGB will prepare a decision document for approval by EPA that describes the cleanup remedy that will be performed. Upon selection of the remedy, the cleanup phase of the project begins. A Remedial Design document that describes the design of the system to be used for the cleanup will be prepared by IAGWSP and reviewed by the EPA, MADEP and presented to the IART. The design will then be reviewed by the regulatory agencies when it is 60% designed and again at 100% design. This plan will detail the actual construction phase of the project.

## FOR MORE INFORMATION

A Community Involvement program has been organized to inform and involve the community in the activities of the Impact Area Groundwater Study Program. In addition, technical updates are provided at monthly Impact Area Review Team meetings. The Impact Area Review Team, or IART, is a citizen team that serves as an advisory resource on the project.

There are several ways to get more information on the IAGWSP. Visit the program's web site at <http://www.tiac.net/users/mmreis/>. Information repositories have been established in five local libraries to make information on the program available to the public. The repositories are updated to ensure that all necessary documents including copies of work plans, sampling results, site reports, fact sheets, meeting minutes and other materials are available. The repositories are located at:

Falmouth Public Library  
123 Katharine Lee Bates Road  
Falmouth, MA 02540

Jonathan Bourne Library  
19 Sandwich Road  
Bourne, MA 02532

Mashpee Public Library  
Steeple Street, Mashpee Commons  
Mashpee, MA 02649

Sandwich Public Library  
142 Main Street  
Sandwich, MA 02563

U.S. Coast Guard Library  
Building 5205, Ent Street  
Otis ANGB, MA 02542

Interested citizens can also visit the IAGWSP office located on West Outer Road on the Massachusetts Military Reservation.

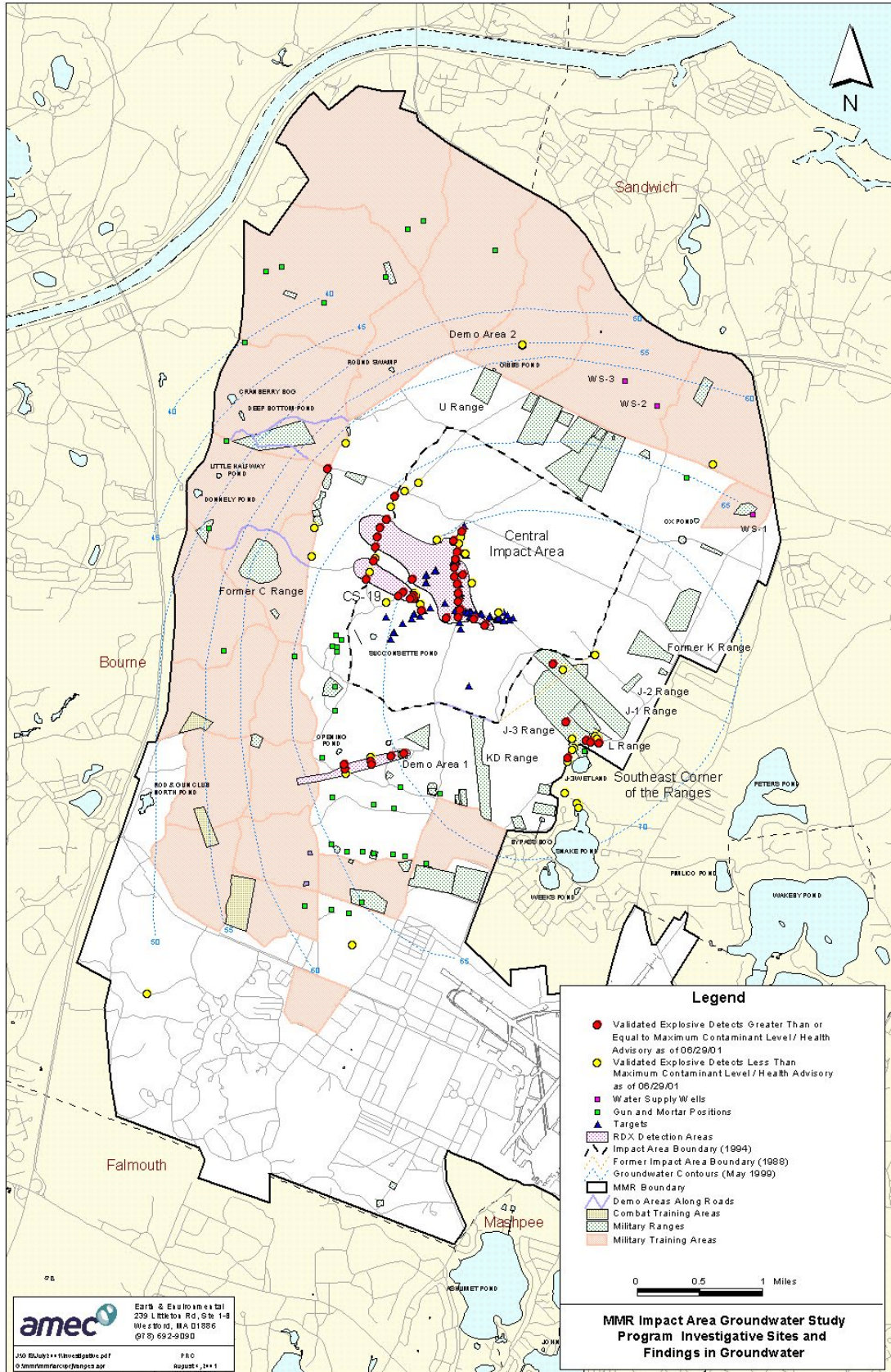
Members of the public are encouraged to attend the IART meetings, typically held on the fourth Tuesday of each month.

Contact the following individuals for more information:

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