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ENVIRONMENTAL AND ECOLOGY BRANCH PROGRESS REPORT 1974 THROUGH 1976

TRIENNIAL REPORT

Volume II

June 1978

ENVIRONMENTAL AND LIFE SCIENCES DIVISION
U.S. ARMY DUGWAY PROVING GROUND
Dugway, Utah 84022

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In accordance with the National Environmental Policy Act (NEPA), all projects at Dugway Proving Ground (DPG) are evaluated for their potential for causing adverse environmental impact.

Environmental studies for other U.S. Army installations include baseline ecological surveys, demography of jackrabbits and selected rodents. These programs have provided population and

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Block 20. Abstract

toxicological baseline data on wildlife. Investigations have been made of hazards associated with bacterial aerosols generated by cooling towers using biocontaminated wastewater. The organic nitrogen wastes generated by manufacture of Army explosives have been studied with regard to aeration rates, residence times, nutrient requirements and other physical and biological factors.

A handbook for evaluating ecological effects of pollution on DARCOM installations has been prepared for the Pollution Abatement and Environmental Control Technical Lead Laboratory. Consultation services concerning environmental and epidemiological problems and mosquito control were provided to the Facilities Engineering Directorate of U.S. Army, Yuma Proving Ground, Arizona.

FOREWORD

The primary mission and function of the Environmental and Ecology Branch (E&E) of U.S. Army Dugway Proving Ground (DPG) are presented in Volume I of this two-volume series. Volume II presents mission-related work as outlined in the requirements of the Organization, Mission and Function (DPGR 10-3, July 1975) under Environmental and Life Sciences Division, pages 20-8 and 20-9, parts a and b. These requirements are summarized below.

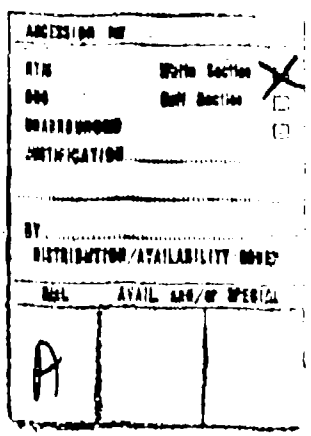
1. Environmental impact assessments and statements for DPG activities will be prepared.

2. Other DARCOM installations will be assisted in the preparation of environmental impact assessments and statements.

3. Environmental baseline studies at other DARCOM installations will be planned and conducted.

4. Ecologically related studies for other government agencies will be planned and conducted.

Volume II describes this work for calendar years 1974, 1975 and 1976.



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INTRODUCTION

This volume reports on ecological, environmental, epidemiological and toxicological studies conducted by the DPG Environmental and Ecology Branch of the Environmental and Life Sciences Division. Reported studies are separated by funding sources and funding citations.

OBJECTIVES

1. To prepare and staff evaluations of the potential environmental impact of DPG project activities.

2. To assist other DARCOM installations in the preparation of environmental impact assessments and statements.

3. To plan and conduct environmental baseline studies at other DARCOM installations.

4. To plan and conduct ecologically related studies for other government agencies.

BASELINE ECOLOGICAL SURVEYS OF ROCKY MOUNTAIN ARSENAL AND TOOELE ARMY DEPOT, SOUTH AREA

Sponsor: Department of Army Office of the Project Manager for Chemical Demilitarization and Installation Restoration, Aberdeen Proving Ground, MD 21010.

TECOM TRMS Project No.: 0-CO-523-ECP-005

DPG Document Nos.: DPG-FR-X950A and DPG-FR-X955A

1. Background

By request,[1] U.S. Army Dugway Proving Ground (DPG) initiated an ecological baseline survey of selected wildlife species on two Army installations in December 1972, in support of the chemical demilitarization program. Data on density and age structure of mammal populations were required to measure population changes. Once normal cyclical and seasonal population trends are established for selected wildlife species, future trends can be evaluated against the norm. When future trends are significantly different from the norm, consideration must be given to the possibility that an adverse effect of man's activity is responsible.

Symptoms produced by most organosphosphorus chemicals of military and agricultural use result from inhibition of the cholinesterase enzymes of the nervous system, muscles and secretory glands. These agents also inhibit the activity of erythrocyte acetylcholinesterase (blood AChE). Although the physiological function of blood AChE is not well understood, it does serve as an indicator of exposure to cholinesterase blocking agents.

As a rule, large animals such as sheep and cattle are excluded from the immediate vicinity of sites for chemical demilitarization and storage of toxic chemicals. This is not true with small mammals, which are usually permanent residents of these sites, subsequently should agent be released accidentally, the small mammals could be exposed.

The living habits of animals to be studied determine the degree of exposure. Nocturnal mice, for example, have decreased risk of exposure during the daylight hours when they are underground. In contrast, jackrabbits live entirely above ground and would be subject to risk continuously.

[1]Letter from U.S. Army, Edgewood Arsenal, Maryland, 21010 SMUEA-BL-RE, to Rocky Mountain Arsenal, Colorado, 80240 Funded Ecological Studies November 1972.

Past investigations have provided data on the AChE response of sheep and cattle dosed orally with the cholinesterase blocking agents GB and VX.[1,2] The response for small mammals exposed to those toxicants is not well-defined.

2. Objective

The objective of this program was to provide population and toxicological baseline data on wildlife that could be used in the assessment of an environmental impact, if any, caused by known or suspected incidents of organophosphorus exposure from the demilitarization, handling and storage of toxic military agents on RMA and TEAD-S.

3. Accomplishments

From December 1972 to August 1975, DPG personnel surveyed selected small mammals widely distributed on RMA and TEAD-S.

Surveillance sites for the field studies were established near chemical demilitarization and storage areas, within the potentially contaminated zones, as determined by meteorological data. The black-tailed jackrabbit (Lepus californicus) and the deer mouse (Peromyscus maniculatus) were chosen as the species for primary study.

Populations of jackrabbits and deer mice were examined in the spring and fall over 3 years and analyzed for seasonal and cyclical trends in population densities and age structures. Also, the distribution and relative abundance of other small rodents collected during these studies were analyzed. In addition, acetylcholinesterase

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[1] U.S. Army, Dugway Proving Ground, UT, 84022. Erythrocyte Acetylcholinesterase Recovery in Sheep Following Various Acute Organophosphate Treatment, by Nelson, C.A. and Sutton, W.W. Preliminary Report, 1972.

[2] U.S. Army, Dugway Proving Ground, UT, 84022. Program SAFEST, Toxicology Research, by Materiel Test Directorate, 4 Qtr FY73 Status Report, 1973.

enzyme levels in the red blood cells of jackrabbits and deer mice were determined seasonally for 3 years, and baselines were established for these species.

The results from these studies are reported in two DPG technical reports (see references 1.l and 1.m, Appendix A).

ORGANOCHLORINE RESIDUES IN RMA INDUSTRIAL LAKES

Sponsor: Aberdeen Proving Ground, MD 21010

TECOM TRMS Project No.: O-CO-523-ECP-005

DPG Document No.: None (letter).

1. Background

Upon request of the Post Surgeon, RMA, support was provided for monitoring the residual levels of pesticides in fish from the industrial lakes (Ladora, Upper Derby and Lower Derby), which supply the process water for Shell Chemical Company. Although these lakes are generally healthy and support a variety of waterfowl, fish and other aquatic life, the possibility of an accidental spillage of pesticides into the lakes from Shell's operations poses a hazard to these life forms and to man.

2. Objective

The objective of this study was to provide limited monitoring of residual levels of the pesticides, aldrin and dieldrin, in fish from the industrial lakes.

3. Accomplishments

These compounds were present in the edible portions of largemouth bass and bluegills in sufficient quantities to pose a potential health hazard to man. All fishing on the industrial lakes has been restricted to catch-and-release fishing until the pesticide hazard has been eliminated.

The results of these studies are reported in two interim reports (see references 1.f. and 1.g., Appendix A).

WATERFOWL MORTALITIES IN AND AROUND A WASTE BASIN ON RMA

Sponsor: Aberdeen Proving Ground, MD 21010

TECOM TRMS Project No.: 0CO-523-ECP-005

DPG Document No.: None (letter)

1. Background

Basin F, located at RMA and more commonly referred to as Lake F or Reservoir F, is a man-made reservoir with a capacity of 908,496 m^3 (240 million gallons) and a surface area of approximately 36.4 hectares (89.9 acres). The sides and bottom of the reservoir have been sealed with asphalt to render it leakproof. Except for demilitarization operations, which have their own pollution control system, total containment and evaporation of the industrial wastes in Reservoir F is the arsenal's only method of industrial waste disposal. Reports of wildlife mortalities, crop failure and bovine deaths on and off the arsenal have been studied.[1],[2],[3]

Concern for a significant increase in duck mortalities on Reservoir F in the Spring of 1973 prompted an in-depth field and laboratory investigation by DPG and Edgewood ecology personnel, which continued into 1975. Initial studies concentrated on a toxicological evaluation of the water.

2. Objective

The objective of this study was to find the cause of recurring waterfowl die-offs on a 908,500 m^3 (90-acre) industrial waste basin in the central flyway of migratory birds.

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[1] U.S. Army Edgewood Arsenal, MD, 21010. Composition of Lake F by Crane, G.B., DEIS Report No. 7, November 1965.

[2] U.S. Army Environmental Hygiene Agency. Reports of Results of Laboratory Analyses of Lake F Industrial Wastes at U.S. Army Rocky Mountain Arsenal, Project No. 3471E10-59/60, June 1965.

[3] U.S. Army Edgewood Arsenal, MD, 21010. Toxicological Evaluation of the Contents of Rocky Mountain Arsenal Wastes, Lakes F and F1 DRAL Technical Memorandum 2-25, November 1965.

3. Accomplishments

Waterfowl mortalities in and around Reservoir F were attributable to detergents, which destroyed the insulating mechanism of the feathers, causing the ducks to become wet and lose body heat. Survival time was heavily dependent on water temperature. As a result of these findings, a successful waterfowl rehabilitation program has been implemented on Reservoir F.

Preventive measures have recently been taken at RMA to minimize environmental impact of industrial waste on wildlife and man. Shell Chemical Company is constructing a completely self-contained pollution control facility which will eventually eliminate the need for Reservoir F.

The results of these studies are reported in several summary reports and an open literature account recently submitted to the Journal of Wildlife Management (see references 1 a, 1 c, 1 f, 1 g, 1 h, 1 l, 1 m and 3. Appendix A).

FUNDED ENVIRONMENTAL STUDIES RELATED TO PRIMARY MISSION

1. Background

The National Environmental Policy Act (NEPA) of 1969[1] requires that all federal activities be assessed for their environmental impact.

2. Objective

All military actions which require more than a cursory examination are investigated for environmental impacts. Projects of a type not previously assessed and documented to fulfill NEPA requirements are considered for preparation of an Environmental Impact Assessment (EIA).[2]

3. Accomplishments

Numerous EIAs have been produced that can serve as basic references for future actions and thereby reduce many future investigations for potential environmental impact to the level of a conscientious mental evaluation (CME).[3] Consequently, whenever possible, projects requiring evaluation for environmental impact were prepared as CMEs with reference to the installation EIA and other pertinent environmental impact evaluation documents. However, the nature of some of the operations at DPG require the preparation of EIAs or EISs.[4]

[1] United States Congress. The National Environmental Policy Act of 1969. Public Law 91-190, 1 January 1970. (Requires environmental impact considerations to be included in project planning).

[2] EIA - Environmental Impact Assessment (a key step in meeting requirements of NEPA; anticipates change in the environment due to possible impacts from projects).

[3] CME - Conscientious Mental Evaluation (a decision making process in which data are reviewed to determine whether or not an EIA is necessary).

[4] EIS - Environmental Impact Statement (essentially the EIS is an EIA at a "higher level" in which there is a summary of the environmental inventory and findings of the EIA.

a. Demilitarization

Sponsor: Department of the Army Office of the Project Manager for Chemical Demilitarization and Installation Restoration, Aberdeen Proving Ground, MD 21010

TECOM TRMS Project Nos.: 2-MU-014-055-003
2-CO-503-000-010

DPG Document No.: None (published by sponsor)

U.S. Army Dugway Proving Ground has the responsibility for the demilitarization (demil) of DPG test residue of various lethal chemical agents and munitions. The demil program was divided into one through five (I - V) phases. Priority was given the different phases of the demil program according to their potential for a diverse effect on the environment.

From August 1975 through December 1976, the following documents were prepared:

DPG DEMIL PROJECT	ENVIRONMENTAL IMPACT ASSESSMENT (EIA) OR STATEMENT (EIS)
Phase II (Assessment and containment of M139 Bomblets Test Residue)	A draft EIA Supplement to Phase V Assessment
Phase II (Demil) of M139 Bomblets Test Residue	A draft EIS Supplement to Phase I
Phase III (Demil) Agent in Containers and Munitions without explosives	A rough draft EIA was prepared prior to a determination that the munitions of Phase III were to be shipped to TEAD-S for demil
Phase V (Assessment of Test Residue and Range Duds)	EIA

Phase II Munition assessment EIA was an supplemental EIA to Phase V Munition assessment. The initial draft was prepared by the Environmental and Life Sciences Division. This project was concerned with approximately 1,400 M139 bomblets, which were inspected and prepared for adequate storage at Tower Grid holding area, DPG. The final assessment was published by the DPG Demilitraization Office.

The initial draft EIA for Phase III demil was prepared and given to the DPG Demil office in April 1976, after which the Demil office assumed responsibility for further preparation and coordination. This EIA was concerned with agent and an assortment of munitions which have since been included in the shipment of DPG ammunitions to TEAD-S as described later in this report.

Phase V document concerned 124 potentially toxic-filled chemical munitions that had been identified at DPG as test residue and as part of the Phase V demil inventory. Ninety-five of these munitions were at Tower Grid holding area and 29 at the West Granite holding area.

These munitions in their initial storage arrangement were stacked and covered with inverted conex containers and were not segregated by munition type or by presence or absence of fuzes. Twelve rounds were identified at Tower Grid as leakers. In the defined storage configuration, it was not possible to inspect the condition of the munition or the fuzes. To determine the best possible method of disposing of these munitions, a thorough inspection and assessment were required to be followed by a segregation by munition type. The draft assessment was prepared in the Fall of 1975, coordinated in December 1975, and approved for local use.

b. Transportation of DPG Munitions to TEAD-S (EIS)

Sponsor: Department of Army Office of the Project Manager for Chemical Demilitarization and Installation Restoration, Aberdeen Proving Ground, MD 21010

TECOM TRMS Project No.: 2-CO-503-000-014

DPG Document No.: None (published in Federal Register, 9 Dec 1976)

A draft Environmental Impact Statement (EIS) was initially prepared at DPG in May 1976 and sent to the Project Office, Maryland[1] for final typing, review and approval

This draft EIS addressed the proposed movement of approximately 115 tons of chemical munitions and storage containers filled with toxic chemicals with military designations of GB, VX, GA, HD, L, and CG. The operational concept specifies movement in 11 cargo vehicles accompanied by 12 additional escort and support vehicles. This motor convoy traveled the 55 miles from the Carr Facility, DPG, to TEAD-S over an existing, improved gravel road. Selected segments of the convoy route were cordoned off to preclude interruption to the movement of the convoy. Sufficient security and technical escort personnel accompanied the convoy to immediately react to any emergency situation which might have developed. The EIS was published in the Federal Register in December 1976.

This movement was accomplished in August 1977.

[1]The Program Manager's Office assumed primary responsibility for the draft EIS through final approval and publication.

c. D049 Environmental Impact Assessment (EIA), A Life-cycle EIA

Sponsor: U. S. Army Test and Evaluation Command, Aberdeen Proving Ground, MD 21005

TECOM TRMS Project No.: 2-CO-210-049

RDT&E No.: 1-U-7-657-10-D-049

DPG Document No.: None (copies on file at DPG)

Research, Development, Test and Evaluation (RDT&E) Project No. 1U765710D049, Joint Chemical and Biological (CB) Contact Point and Test D049, was established 1 July 1974 to continue the Commanders-in-Chief (CINCS) and Joint Service tests, operations research studies and Joint Contact Point tasks, which were previously funded under RDT&E Project No. 1X665704DL14 (Project DESERET). Project DESERET was terminated 30 June 1974.

The objectives of this project are to plan, conduct, execute, evaluate, and report on joint CB tests or operations research studies in response to requirements from the CINCS and Services, and to serve as the Department of Defense Joint Contact Point for all CB Defense Tests and Technical Data. A D049 EIA document was published in June 1976.

d. Smoke/Obscurants EIA

Sponsor: U.S. Army Test and Evaluation Command (TECOM), Aberdeen Proving Ground, MD 21005

TECOM TRMS Project No.: 7-CO-RD6-DP1-005

DPG Document No.: None (letter)

A 41-page document on DPG project: Methodology Investigation for Testing Effectiveness of Smoke/Aerosol Munitions was published in October 1976.

e. XM 256 Kit EIA

Sponsor: U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, MD 21005

TECOM TRMS Project No.: 2-ES-680-256

DPG Document No.: None (letter)

A 34-page draft document on DPG project: Development Testing of the XM 256 Chemical Agent Detector Kit was prepared in September 1976.

f. Binary Warhead EIA

Sponsor: Chemical Systems Laboratory, Aberdeen Proving Ground, MD 21010

TECOM TRMS Project No.: 2-MI-180-GSR-001

DPG Document No.: None (letter)

A draft 18-page document with an attached safety statement: Exploratory Development Testing of Binary Warhead for Army Rocket Systems TECOM Project No. 2-MI-180-GSR-001 was prepared in September 1976.

9. Multiple Mission Drone Project CME

Sponsor: U.S. Air Force: System Program Office Wright Patterson AFB, OF 45433

TECOM TRMS Project No.: 2-CO-213-RPV-022

DPG Document No.: None (letter)

A CME was prepared for the BGM-34C Multiple Mission Drone Remotely Piloted Vehicle (RPV) Project at DPG. The three-page document, prepared to detect and define any potential environmental impact from the project, was prepared in November 1976.

h. C990 EIA

Sponsor: Director, U.S. Army Ballistic Research Laboratory, Aberdeen, MD 21005

TECOM TRMS Project No.: 2-CO-153-000-034

A classified test program known as C990 was assessed in April 1975.

i. National Guard EIA

Sponsor: National Guard

TECOM TRMS Project No: None

XO No.: 3737810401

DPG Document No.: None (letter)

Annually, the National Guards of Utah and other states train at DPG, mainly from March through July. Training consists of maneuvers involving artillery batteries and aerial gunnery helicopters. The initial assessment was prepared by the National Guard in July 1975 with the help of DPG personnel. An update is being prepared by DPG personnel.

j. Hercules Rocket Motor Test Site EIA

Sponsor: Hercules Incorporated, Box 98, Magna, UT 84044

TECOM TRMS No.: 5CO-213-000-015

DPG Document No.: None (letter)

Hercules Inc. was considering construction of a rocket motor testing site at DPG. An EIA was prepared in March 1975. An alternate site located off the proving ground was selected.

DARCOM RDT&E EIAs

Sponsor: Chemical Systems Laboratory, Aberdeen Proving Ground, MD 21010

TECOM TRMS Project No.: 0-CO-523-ECP-000

DPG Document No.: None (incomplete)

1. Background

The National Environmental Policy Act (NEPA) of 1969 requires that all Federal activities be assessed for their environmental impact. When an adverse impact has been identified by the assessment procedures, alternative procedures with lesser impact or mitigating actions are desirable. Shortly after the enactment of NEPA, DARCOM (then AMC) requested the ecology groups at Chemical Systems Laboratory and DPG to review all RDT&E projects for potential environmental impact.

2. Objectives

The formal objective is to assist DARCOM RDT&E project officers in the preparation of environmental documentation for their projects. The long-range objective is to develop a program that will ultimately streamline the NEPA procedure through use of life-cycle EIA's while at the same time ensuring all environmental factors are protected in the best possible manner.

3. Accomplishments

Each year, DPG reviews and comments on about sixty RDT&E EIA's from throughout DARCOM. The long-range program includes upgrading the technical data necessary to predict the likely environmental effects in these life-cycle EIA's. A new step called the Environmental Impact Evaluation (EIE) is being developed in which each project is quickly but thoroughly examined to determine whether the predicted impacts are acceptable. If the EIE examination shows acceptable impacts, then a written Conscientious Mental Evaluation will satisfy the requirements of NEPA. If the EIE shows the impacts are unacceptable an EIA or EIS must be prepared.

HANDBOOK FOR EVALUATING ECOLOGICAL EFFECTS OF POLLUTION ON DARCOM INSTALLATIONS

Sponsor: Chemical Systems Laboratory, Aberdeen Proving Ground, MD 21010

TECOM TRMS Project No.: None

DPG Document No.: None (incomplete)

1. Background

During the past several years, there has been a growing concern for the environmental consequences of Department of Defense (DOD) actions. Specifically, NEPA charges all federal agencies to plan their actions to minimize insults to the environment rather than resort to costly means of reclamation after adverse impacts.

The U.S. Army Environmental Protection and Enhancement Program[1] delineates the fundamental environmental policies, goals, objectives and assigned responsibilities within the Army Staff and subordinate commands for actions that will enable fulfillment of environmental obligations. The regulations specifically address the management of the program and the full spectrum of categorical activities, such as abatement of air and noise pollution, management of water resources and solid wastes, environmental research and management of energy resources and natural and cultural resources.

As the extent of the environmental obligations becomes more apparent, it is increasingly evident that the Department of Army lacks adequately trained personnel to meet these objectives. On the other hand, most installations have a few individuals, who by virtue of environmental interest and experience in the out-of-doors, easily could be trained to accomplish the routine tests which compose the majority of most surveys into the ecological effects of pollution. Thus the professional environmental scientists can spend more time designing and directing the surveys where their talent, training and expertise are most needed. In this manner, a nucleus of scientists could work with a large corps of "paraecologists" (as medical doctors work with paramedics) to meet the Army's environmental obligations.

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[1] United States Army. Environmental Quality, Environmental Protection and Enhancement, AR 200-1, 7 Dec 75; C1, 25 Oct 1974; C2, 1975.

In late 1975, the DARCOM Laboratory for Pollution Abatement and Environmental Control Technology indicated interest and support for a plan to develop a pollution ecology handbook. This handbook would provide the mechanism whereby a manager at the command level can respond quickly to a potential or actual pollution incident with a decisive program to evaluate the ecological effects of the pollution. The program would be guided by one or more environmental scientists, who establish program requirements and direct paraecologists in the assimilation of data. With the handbook, the paraecologist would learn to locate relevant information, conduct field surveys and collate the resulting data for computerized analysis.

2. Objective

The object of this study is to develop a handbook for conducting ecological surveys on DARCOM Installations.

3. Accomplishments

The approved conceptual plan for the handbook consists of two volumes with a total of six chapters:

a. Checklist of Basic Questions

b. Preliminary Environmental Survey

c. Specific Effects of Pollutants in Specific Environments

d. Terrestrial Sampling Techniques

e. Aquatic Sampling Techniques

f. Analysis Methods

Chapters 1 and 2 have been completed in draft form. A draft of Chapter 3 is being prepared. Preparation of the handbook will continue through 1978. After completion, annual updates will insure that the handbook remains current.

ENDANGERED AND OR THREATENED FLORA AND FAUNA AT 12 SITES IN THE UNITED STATES

Sponsor: Chemical Systems Laboratory, Aberdeen Proving Ground, MD 21010 (From Energy Reserch and Development Administration)

TECOM TRMS Project No.: 2-CO-210-000-003

DPG Document No.: None (letter)

1. Background

In June 1976, the ecology group at Chemical Systems Laboratory requested the assistance of DPG personnel, in conducting an assigned study for ERDA. This was one part of a project to select several prospective sites for the construction of pilot coal-gasification plants.

2. Objective

The objective of the DPG participation in the study was to identify and locate protected flora and fauna within a 40-mile radius of each of 12 candidate sites identified by ERDA.

3. Accomplishments

The information was gathered through an intensive literature search, supplemented by telephone and written communication with federal and state officials. The end product was a series of maps for each of the 12 sites, showing the location of the protected flora and fauna within a 40-mile radius of each site. In those cases where a map could not show all of the essential information, a narrative was prepared to supplement the map. The study was expeditiously completed by August 1976, and the information was forwarded to Chemical Systems Laboratory for inclusion in the final report to ERDA.

BIOLOGICAL TREATMENT OF EXPLOSIVE WASTES

Sponsor: Picatinny Arsenal, Dover, NJ 07801

TECOM TRMS Project No.: 5-CO-523-ECP-011
5-CO-523-ECP-015
5-CO-523-ECP-025
0-CO-523-ECP-011

DPG Document No.: DPG-FR-X911P
DPG-FR-X935A
DPG-FR-911P
DPG-FR-X910P

1. Background

The manufacture of military explosives results in the use of many chemicals and explosive compounds, some of which eventually find their way into the liquid waste of the munitions plant. Before these wastes can be allowed to flow into streams, rivers and lakes, they must meet certain pollution standards. Waste may be treated by physical, chemical or biological processes to meet these standards. Many of the wastes are heavily polluted with organic nitrobodies and ammonium and nitrate ions. These compounds are particularly suited for biological waste treatment. Several of the organic nitrobodies can be degraded by activated-sludge treatment. The ammonium ion can be oxidized in a biological nitrifier to the nitrate ion, which in turn can be denitrified by facultative anaerobes to produce atmospheric nitrogen gas. Several organic compounds and some of the explosives in the waste stream were suspected of being toxic to the biological processes, and DPG was tasked to find the limits and nature of this toxicity on biological processes for treating wastes.

2. Objective

a. To determine the effect of trinitrotoluene and nitroglycerine on denitrification.

b. To determine the effect of trinitrotoluene, HMX and RDX on nitrification and denitrification.

c. To determine the effect of hexamethylene tetramine, formaldehyde, monomethylamine, dimethylamine and trimethylamine on nitrification and denitrification.

d. To determine the biodegradability of hexamethylene tetramine, monomethylamine, dimethylamine and trimethylamine by the activated sludge process.

3. Accomplishment

Studies were conducted on bench-model units processing 12 to 100 liters of simulated waste water per 24 hours. Studies have been in progress for over 4 years on simulated waste waters from several plant processes. Both suspended-sludge and columnar fixed-film denitrification units have been used in the studies. Aeration rates, residence times, optimum nutrient requirements, trace mineral requirements, pH requirements and fill size have been determined. The processes have been monitored for explosive compounds, ammonia, nitrate, nitrite, pH and for specific organic chemical compounds. The findings from these studies have been used to aid in the design of pilot plants and full-scale facilities. Five final reports have been written describing the results of the research (see references 1.e, 1.i, 1.j and 1.k, Appendix A).

BACTERIAL AEROSOLS GENERATED BY COOLING TOWERS

Sponsor: Energy Research and Development Agency, Administered through Argonne National Laboratory, 9700 S. Caso Avenue, Argonne, IL 60439

TECOM TRMS Project No.: 0-CO-520-EQC-001

DPG Document No.: None (incomplete)

1. Background

The demand for electrical energy in the United States is constantly increasing. Over the next 10 years, the requirement for electrical energy is expected to double. All steam electric generating plants require cooling water. Recycling cooling systems on new plants, under EPA requirements, may employ natural draft towers, mechanical draft towers or spray ponds. The recycling system uses the off-stream cooling device to reduce the temperature of the condenser discharge water before recycling it back through the plant. Approximately 5 percent of the water is lost by drift, evaporation and blowdown; thus makeup water is continually required. In the west and southwest, where water is in short supply, this water in some cases comes from sewage-treatment plants. The midwest and east usually obtain makeup water from lakes and rivers, many of which are heavily polluted with sewage.

Cooling towers operate by spraying or splashing the water over a series of wooden or plastic baffles while air is drawn through the system by a large fan, which promotes evaporative cooling. Several hundred gallons of water are aerosolized per minute in this process, and if the microbial load in the makeup water, is heavy a potential aerosol hazard may exist. Many disease-producing bacteria and viruses occur in sewage. Aerosolization of such biologicals may be of public health concern.

2. Objective

To determine the aerosol potential from cooling towers and spray ponds using makeup water from sewage-treatment plants and heavily contaminated surface waters.

3. Accomplishments

The study consisted of four phases: (a) cooling towers using effluent water from sewage-treatment plants, (b) cooling towers using heavily polluted surface water as makeup water, (c) spray canals and cooling ponds using heavily polluted water, and (d) cooling towers to which a biological tracer [Bacillus subtilis var. niger (BG)] and fluorescent tracer were added. Downwind studies were conducted Major emphasis was placed on identification and enumeration of major groups of bacteria.

The program was funded by ERDA for $94,204 and is a joint project between DPG and Argonne National Laboratory. The field and laboratory work was performed by DPG, with Argonne personnel assisting in preparing final reports and consulting on the problem status. The field and laboratory work are completed, and the final report is being written.

TESTS PERFORMED IN ACCORDANCE WITH DEPARTMENT OF TRANSPORTATION ARTICLE 173.343 (DOT SCREEN)

Sponsor: Chemical Systems Laboratory, Aberdeen Proving Ground, MD 21010

TECOM TRMS Project No.: 2-CO-503-000-010

Dugway Document No.: None (letter)

1. Background

During the past year, a cooperative effort in demilitarization techniques development has been underway. Briefly, GA and VX samples were subjected to several chemical treatments designed to destroy their toxicity. The residues were tested by gas chromatography and enzyme agent activity, the residues were subjected to Department of Transportation (DOT) live-animal tests.

2. Objectives

To provide technical advice and assistance with the development of new decontamination techniques. To set up DOT testing procedures and provide a critical toxicity assay of demil residues. To provide an effective back up for the chemical demilitarization and testing procedures

3. Accomplishment:

Tests were performed as specified in Title 49, Subtitle 13, Chapter 1, Department of Transportation Article 173.343. Additionally, specific tests were made for antiacetylcholinesterase (AChE) activity and vesicant effects. These additional tests greatly increased the effectiveness of the DOT screening procedures. The tests are summarized as follows:

a. Oral Toxicity

Each of a group of 10 laboratory rats (sex unspecified), weighing between 200 and 300 grams, was exposed to a dose of 50 mg/kg body weight of the suspected chemical. The observation period was 48 hours after the treatment.

b. Inhalation

A group of 10 rats was exposed to each of the chemicals as described in the oral tests above. Exposure was for 1 hour at a minimum concentration of 2 mg/liter of vapor, mist or dust, whichever was appropriate for the chemical tested. The observation period totaled 48 hours after exposure.

c. Dermal Toxicity

Groups of 10 rabbits (size and sex unspecified) were exposed to chemicals at the rate of 200 mg/kg for 24 hours. The observation period was 48 hours.

d. Additional AChE Tests

Exposed rats and rabbits were bled after the 48 hour observation period and the AChE levels measured in packed red blood cells derived from the blood samples.

e. Additional Visual Observations

The effects on rabbit skin were noted, and gross necropsy examinations were perfomed on rats after they were bled.

f. Warburg Enzyme Analysis

Sheep red blood cells were treated directly with diluted residue samples, then assayed by Warburg manometry. This procedure proved to be 10 or more times as sensitive to agent activity than was either gas chromatography or enzyme analysis.

4. Summary:

Since the tests began, late in 1975, approximately 25 residue preparations have been examined. A draft final report of this work is in preparation. This work has produced significant findings. Early in the testing schedule, it was found that contrary to previous reports, disulfide products in VX residues have no agent or vesicant effect. The agent activity, however, was not completely

destroyed by the caustic procedures previously in use, and due to the sulfur content of the VX moleucle, the residues had given false negative results with the standard enzyme tests. The DOT screening procedure quickly confirmed the false results. The inadequacy of the standard enzyme tests for VX activity was recognized, and the Warburg procedure was modified to provide the needed results. The Warburg enzyme analysis was introduced to prevent a recurrence of the prior experiences when VX residues were tested. After the above finding, all samples were prescreened, using the Warburg method. No false negatives have occurred since that time.

SOIL INCORPORATION/BIODEGRADATION OF HERBICIDE ORANGE:
MICROBIAL AND BASELINE ECOLOGICAL STUDY

Sponsor: U.S. Air Force Academy, Colorado 80840

TECOM TRMS Project No.: 5-CO-213-000-015

DPG Document No.: DPG-FR-C-615F

1. Background

A 2,000-acre site on the Air Force Logistics Command (AFLC) Test Range was being considered as a potential disposal area for organic herbicides by incorporating them into the soil.

2. Objectives

The study provided for an examination of the natural microbial population of the soil in an area where the herbicides were to be mixed into various concentrations[1]. The composition, density and seasonal changes in the flora and fauna in nearby designated areas were determined, also.

3. Accomplishments

Herbicide Orange incorporated into the soil at rates up to 4,000 pounds per acre did not inhibit the four predominant species of soil bacteria studied. Moisture in the soil enhanced bacterial growth in the presence of the herbicide. Actinomycetes and fungi of the area were identified. Their relative abundance was assessed. It was concluded that Herbicide Orange is little, if at all, harmful to the mycoflora of soils.

The climax community of shadscale and gray molly was stable, but it existed at the extreme limit of the drought and salt concentration tolerated by these plants. Density and canopy cover in 12 vegetative transects were measured in the late summer and early spring.

Vertebrate fauna were identified that would best serve as indicator organisms for changes brought about if disposal of the herbicide were to be undertaken in the area. The white-footed deer mouse is common in the area. Density of this rodent was estimated at between 6.5 and 9.9 mice per acre in the spring of 1974. Other common permanent residents measured for density included the jackrabbit and horned lark.

[1]U.S. Army Dugway Proving Ground, Dugway, UT 84022. Soil Incorporation/ Biodegradation of Herbicide Orange. Volume I. Microbial and Baseline Ecological Study of the U.S. Air Force Logistics Command Test Range, Hill Air Force Base, Utah by H.E. Stark, J.K. McBride and G.F. Orr. TECOM Project No. 5-CO-213-000-015, DPG Document No FR-C 615F. 1975.

CONSULTATION SERVICES TO FACILITIES ENGINEER DIRECTORATE,
U.S. ARMY YUMA PROVING GROUND, ARIZONA,
CONCERNING ENVIRONMENTAL AND EPIDEMIOLOGICAL PROBLEMS
AND MOSQUITO CONTROL

Sponsor: U.S. Army Yuma Proving Ground, Yuma, AZ 85364

TECOM TRMS Project No.: 0-CO-520-EQC-005

DPG Document No.: None (letter)

1. Background

Personnel occupying the administrative area at U.S. Army Yuma Proving Ground (YPG) are subjected to large numbers of disease-carrying and annoying mosquitoes during April through October. The suspected breeding ground of the mosquitoes affecting YPG consists of a large marsh between Laguna and Imperial Dams with open water, dry ground, isolated pools and heavy emergent littoral vegetation. This area is a known habitat of the Yuma clapper rail (now listed as endangered) and the California black rail (proposed for listing as an endangered species). Under the provisions of Public Law (PL) 93-205, The Endangered Species Act of 1973, activity in the habitat of an endangered species must be closely regulated to avoid adverse effect on the endangered species. Spraying of a larvicide which could affect non-target species in the food chain of the rails had to be considered in the light of the public law, above.

2. Objectives

To evaluate the mosquito problem at YPG and current control measures in operation. To devise effective control measures for mosquitoes which will have minimal effect on the rails as well as other protected game and fish and be amenable to interests of other federal, state and local agencies.

3. Accomplishments

Two DPG scientists investigated the situation in April, 1976. Preliminary findings and recommendations were presented to COL Jerry M. Bunyard, Commander, YPG. Agencies contacted included Bureau of Land Management, Bureau of Reclamation, Arizona State Department of Health, Yuma County Public Health Unit, U.S. Fish and Wildlife Service, National Audubon Society and local chapters, Arizona State University, Center for Disease Control, U.S. Public Health Service, DARCOM Headquarters and YPG. A report of findings and recommendations was provided to YPG.

From the survey, it was concluded that the current control program and surveys afford adequate protection on a short-term basis. For long-term protection, consideration was given to a cooperative effort involving several federal, state, local and private agencies. Included, in part were recommendations for; planned environmental modification of dredging and filling by the Bureau of Reclamation (the marsh will go through a succession of filling-in, unfavorable to the endangered rails), use of predatory fish for controlling mosquito larvae, and surveys for arboviruses and other pathogens in nature communicable to man. To assure adequate concern for the health and safety of local residents.

APPENDIX A

PUBLICATIONS AND REPORTS

1. U.S. Army Reports - completed, submitted and printed

a. U.S. Army, Dugway Proving Ground, Utah 84022. Incident Report on the Wildlife Mortalities at Rocky Mountain Arsenal During the Period 4 April 1973 Through 14 June 1973, by Environmental and Life Sciences Division, July 1973.

b. U.S. Army Dugway Proving Ground, Utah 84022. Biological Denitrification of Nitrate Waste Effluents from Munition Plants. Part I: Effect of Trinitrotoluene and Nitroglycerine. Part II: Operational Parameters of Columnar Denitrification, by A.P. Adams, D.S. Thorne and J.H. Whiting. DPG-FR-X910P, Aug, 1974.

c. U.S. Army Dugway Proving Ground, Utah 84022. Interim Summary Report of Dugway's Findings on the Cause(s) of Waterfowl Mortalities In and Around Reservoir F at Rocky Mountain Arsenal, by Environmental and Life Sciences Division, February 1975.

d. U.S. Army Dugway Proving Ground, Utah 84022. Soil Incorporation/Biodegradation of Herbicide Orange. Volume I: Microbial and Baseline Ecological Study of the U.S. Air Force Logistics Command Test Range, Hill Air Force Base, Utah. Final Report. by H.E. Stark, J.K. McBride, and G.F. Orr, DPG-FR-C-615F, February 1975.

e. U.S. Army Dugway Proving Ground, Utah 84022. Ammonia Removal from Wastewaters: A Review of the State of the Art, by J.H. Whiting and A.P. Adams. DPGFR-911P, February 1975.

f. U.S. Army Dugway Proving Ground, Utah 84022. Interim Report on Pesticide Levels in Fish from Two Industrial Lakes at Rocky Mountain Arsenal, by Environmental and Life Sciences Laboratory Division, March 1975.

g. U.S. Army Dugway Proving Ground, Utah 84022. Interim Report on Pesticide Levels in Fish Collected 20 March 1975 from Lake Ladora at Rocky Mountain Arsenal, by Environmental and Life Sciences Laboratory Division, May 1975.

h. U.S. Army Dugway Proving Ground, Utah 84022. Second Interim Summary Report of Dugway's Findings on the Cause(s) of Waterfowl Mortalities In and Around Reservoir F at Rocky Mountain Arsenal, by Environmental and Life Sciences Division, May 1975.

i. U.S. Army Dugway Proving Ground, Utah 84022. The Effect of Hexamethylenetetramine and Copper Ion on the Nitrification-Denitrification of Effluents from the Manufacture of RDX and HMX, by A.P. Adams and J.H. Whiting. DPG-FR-X911P, May 1976.

j. U.S. Army Dugway Proving Ground, Utah 84022. The Effect of Trinitrotoluene and RDX on the Nitrification-Denitrification of Ammonium Nitrate in Effluent Waters, by D.S. Thorne, A.P. Adams and J.H. Whiting, DPG-FR-X-935A, June 1976.

k. U.S. Army Dugway Proving Ground, Utah 84022. Biological Degradation of the Chemical Components of the Holston Army Ammunition Plant (HAAP) A-1 Waste Stream, by A.P. Adams and G.L. Choules. TECOM No. 5-CO-523-ECP-001, Nov 1976.

l. U.S. Army Dugway Proving Ground, Utah 84022. Baseline Ecology Survey of Selected Small Mammals on Tooele Army Depot, South Area, Tooele, Utah, by D.A. Gauthier, C.F.A. Pinkham and J.K. McBride. DPG-PR-X950l, May 1977.

m. U.S. Army Dugway Proving Ground, Utah 84022. Baseline Ecological Survey of Selected Small Mammals on Rocky Mountain Arsenal, Denver, Colorado, by D.A. Gauthier, C.F.A. Pinkham and 1 LT Frederick Faulkner. DPG-FR-X955A, June 1977.

2. In Preparation

a. A.P. Adams, M. Garbett, H.B. Rees, Jr., and B.G. Lewis. "Bacterial Aerosols Produced by Cooling Towers Using Sewage Effluent as Makeup Water. I: Electrical Utility Using Chlorine Dioxide to Control Microbial Growth."

b. A.P. Adams, M. Garbett, H.B. Rees, Jr., and B.G. Lewis. "Bacterial Aerosols Produced by Cooling Towers Using Sewage Effluent as Makeup Water. II: Electrical Utility Using Lime Precipitation to Reduce Condenser Deposits."

c. G.L. Choules, W.C. Russell and D.A. Gauthier. "Duck Mortality from Detergent-Polluted Water", J. Wildlife Mgmt.

3. Open Literature Publications

a. A.T. Hereim and B. Ritchie. "Resuspended Bacteria from Desert Soil" ERDA Symposium Series 38, Atmosphere Surface Exchange of Particulate and Gaseous Pollutants 1974, Batelle Pacific Northwest Laboratories. p. 835-845.

b. C.F.A. Pinkham and J.G. Pearson. 1976. "Applications of a New Coefficient of Similarity to Pollution Surveys" J. Water Poll. Contr. Fed 48:717-723.

APPENDIX B

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