Multiyear Work Element Plan

AL 3.5.1 AR Environmental Methods

National Low-Level Waste Program

University of California

Los Alamos Scientific Laboratory

Life Sciences Division

Environmental Science Group, LS-6

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Lead Field Office for Low-Level Waste Management

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1. Summary

The goals of this task are to achieve an understanding of the processes controlling radionuclide migration from wastes disposed of in shallow-land burial facilities in a semi-arid environment, and to develop a monitoring system to detect this migration. The approach taken is to assess the migration of radionuclides from wastes buried during the last 35 years at LASL in order to determine waste/soil interactions and radionuclide movement in a semi-arid environment. Potentially significant pathways are being identified and modeled. A method of monitoring radionuclide movement along these pathways will be developed along with identifying the constraints that must be imposed upon disposal site operating practices and waste forms.

2. Introduction

Since the beginning of large-scale nuclear activities in the United States in 1943, solid low-level waste has been disposed of by shallow-land burial in controlled areas. Initially the waste volume was quite small, but it has now grown to an annual volume of about 3×10^6 ft^3. Some estimates indicate that this volume could grow to 40×10^6 ft^3/year by 2000.

Public concern and environmental regulations dictate that this large volume of potentially hazardous material must be kept out of man's biosphere as long as the wastes remain hazardous. Examination and evaluation of what has happened to long-buried wastes at DOE facilities will provide an insight into the processes, which take place after disposal, and also provide a basis for the development of predictive models to estimate the fate of buried radionuclides in various types of environments.

Waste has been buried at LASL for the past 35 years in a near surface geologic media (tuff). A careful evaluation of what has taken place during this time period

in the prevailing chemical environment within the tuff should increase the understanding of radionuclide migration in a semi-arid environment. This understanding will serve as the basis for the development of a surveillance system to assure that any radionuclide movement is observed.

3. Goals and Objectives

The objectives of this task are to; 1) define the source term (waste quantity and disposal location), 2) describe potential release mechanisms and migration pathways (geophysical, geochemical and hydrological properties), and 3) design a method to detect radionuclide movement (monitoring system).

4. Sub-Tasks

a. Work Breakdown Structure (see Table I)

b. Description of Tasks.

1. Source Term Definition

Before waste/soil interactions can be defined, it is necessary to identify the initial quantities, kinds and locations of the buried waste. To accomplish this, the following activities are being conducted.

1.1 Records Review

As a result of its long operating history, the records of past disposal activities at LASL exist in different forms and in different locations. However, due to early security requirements and jargon, some of the entries in the records are vague or in a local code. Existing records are being assembled, reviewed and interpreted with the help of as many people involved in the early operations as can be located. This information will be added to the more recent records to provide as accurate a definition of the source term as possible.

1.2 Field Sampling

Samples are being taken from closed burial grounds and analyzed to determine the presence and distribution of radionuclide movement. These samples consist of vegetation, animal excavation, surface soil, and subsurface cores. It may also be necessary to do some excavating in and along side of an existing waste burial pit.

2. Migration Potential

Estimation of migration potential will require an understanding of the geological and hydrological properties of the disposal site as well as an understanding of transport mechanisms. To accomplish this, the following activities are being carried out.

2.1 Site Destription

Site geological, hydrological, and climatological characteristics are being investigated and defined because this information is essential input into pathway models. These properties at LASL are fairly representative of large areas in southwestern United States and the results should have wide applications.

2.2 Tranport Mechanisms

Potential transport mechanisms include plant uptake, burrowing animals, wind erosion, soil runoff, and transport by groundwater. The primary dispersal mechanisms are water and wind. At LASL, there is a low enough rainfall coupled with a long distance to the water table through a very dry porous media that saturated flow is considered to be extremly unlikely. Therefore, the transport mechanisms, which are receiving the most of the attention are surface vectors (erosion and intrusion) and unsaturated flow in the subsurface environment.

2.3 Impact Assessment

At the present time, a joint effort is underway with PNL funded by the TRU program to couple the LASL BIOTRAN (biological transport model) with the PNL ARM/SERATRA (surface runoff and stream sediment transport model). If successful, this model will be adopted to non-TRU radionuclides. The results will be generic enough to represent typical arid site conditions as well as being adequate for LASL site specific needs.

3. Action Plans

The completion of subtask 2.3 above will provide a basis for developing several action plans. These are:

3.1 Monitoring System

Monitoring migration in an arid environment is quite difficult. Based upon the results of 2.3 above, the most likely pathways and movement rates will be identified. With this information, a monitoring system will be designed, which not only will be compatible with the local situation, but also one that will be dynamic in that sampling requirements will be reduced as confidence in the pathway models increase.

3.2 Site Modification

If the impact assessment done in 2.3 or the DOE Disposal Criteria indicate that the existing natural barriers in the burial grounds are not adequate, engineered changes or barriers will be designed and recommended for improvements to the burial ground (based upon the work in AL 3.5.4 AR).

3.3 Input Waste Restrictions

Based upon the results of this task and other waste management projects at LASL, the impact of incoming waste forms will be

evaluated and recommendations will be made where necessary to prohibit or modify incoming wastes to maintain the integrity of the burial grounds.

12. ZBB Impact Statement

Minimum Level

At the minimum level, the impact assessment of buried radionuclides will be deferred one year. This will result in radionuclide impact not being available when required by LASL Waste EIS.

Table I

Work Breakdown Structure

1. Source Term Definition
    - 1.1 Record Review
    - 1.2 Field Sampling

2. Migration Potential
    - 2.1 Site Characterization
    - 2.2 Transport Mechanisms
    - 2.3 Impact Assessment

3. Action Plans
    - 3.1 Monitoring System
    - 3.2 Site Modification
    - 3.3 Input Waste Restrictions

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TASK REQUIREMENTS FOR OPERATING/EQUIPMENT COSTS AND OBLIGATIONS

CONTRACTOR NAME
LASL

WORK PACKAGE NUMBER	TASK NO.	REV. NO.	DATE PREPARED	CONTRACTOR NUMBER
		0	2-13-80	A415

21. STAFFING (in staff years)	FY 80	FY 81 PRESIDENT'S	FY 81 REVISED	FY 1982 Min.	FY 1982 Curr.	FY 1982 Enhanced
a. SCIENTIFIC	2.4	2.4		2.4	3.4	3.4
b. OTHER DIRECT	1.0	1.0		1.0	1.0	1.0
c. TOTAL DIRECT	3.4	3.4		3.4	4.4	4.4
22. OBLIGATIONS AND COSTS (in Thousands)						
a. TOTAL COSTS	300	350		350	450	450
b. TOTAL OBLIGATIONS	300	365		350	485	485
23. EQUIPMENT (in Thousands)						
a. EQUIPMENT COSTS						
b. EQUIPMENT OBLIGATIONS	40	50		0	0	0
24. OTHER COSTS (specify)						
a. Subcontracts	60	85		50	50	50
b.						
c.						
d.						

25. OPTIONAL FIVE-YEAR PLAN (in Thousands) Constant BY dollars	FY 83	FY 84	FY 85	FY 86
a. TOTAL OPERATING COSTS	250	200	0	0
b. TOTAL OPERATING OBLIGATIONS	185	200		
c. TOTAL EQUIPMENT COSTS				
d. TOTAL EQUIPMENT OBLIGATIONS				

26. MILESTONE SCHEDULE	PROPOSED SCHEDULE	AUTHORIZED SCHEDULE

Table III

Explanation of Milestones

Milestone Numbers	Milestone	Date
1.1	Summary Report on Source Term	9/30/81
1.2	Field Sampling Completed	9/30/81
2.1A	Summary report on Hydrologic Properties	6/15/80
2.1B	Summary Report on Geologic Properties	9/30/80
2.2A	Feasibility of Coupling PNL/LASL Surface Models Determined	9/30/79
2.2B	PNL/LASL Surface Models for TRU Adapted to LLW	9/15/81
2.3	Report on Methodology to Assess Impact of Burial LLW Issued	9/30/82
3.1	Monitoring System Plan Issues	9/30/84
3.2	Disposal Site Improvement Plan Issued	9/30/84
3.3	Waste Input Restrictions Issued	9/30/84

Table V. Program Costs According to Work Breakdown Structure

Research	Fiscal Year ($,000)					
	1980	1981	1982	1983	1984	1985
1. Source Term Definition	90	38				
2. Migration Potential	210	312	450			
3. Action Plans				250	200	
TOTAL	300	350	450	250	200	0

Table IV. Program Manpower Requirements

Research Activity	Fiscal Year (Manyears)											
	1980		1981		1982		1983		1984		1985	
	S	0	S	0	S	0	S	0	S	0	S	0
Source Term Definition	1	0.5	0.4									
Migration Potential	1.4	0.5	2.0	1.0	3.4	1						
Action Plans							1	1	1	1		
	2.4	1.0	2.4	1.0	3.4	1	1	1	1	1		
	3.4		3.4		4.4		2		2			

Table VI

Capital Equipment Requirements

Work Breakdown Structure Number	Equipment Item	Cost ($,000)
	FY-1980	
1.2	Drill Rig	$80
	FY-1981	
1.2	Field Survey Instrumentation	$10
2.1	Borehole Logger	$25
2.3	Sample Processing Equipment	$15
	FY-1982	

Nuclear Waste Management Program: Low-Level Waste

ALO Contractor/Lab: Los Alamos Scientific Laboratory

FY 1982 Budget Submission Summary
(Dollars in Thousands)

DoE Lead Field Organization: IDO/EGG

WPAS Task Title #1	R&D Category #2	Prime Procurement Allocation #3	FY 1980		FY 1981		FY 1982					
							Minimum		Current		Enhanced	
			BA	BO	BA	BO	BA	BO	BA	BO	BA	BO
Defense AL 3.5.1	II	LASL	300	300	365	350	350	350	485	450	485	450

Table VII

Subcontracts

Work Breakdown Structure Number	Purpose	Cost ($,000)
	FY-1980	
2.1	Geologic Map Printing	40
2.2	Consultant	20
	FY-1981	
2.3	PNL Potential Pathways Models	75
2.3	Consultant	20
	FY-1982	
2.3	Analytical Services	50
	FY-1983	
3.1	Monitoring System Design	20
3.2	Site Improvements Design	40
	FY-1984	
3.0	Printing of Action Plans	5

13. Technical Accomplishments

Migration of soil mositure, with the possibility of transport of radionuclides, is strongly dependent on the moisture content of the tuff. Soil moisture distribution readings are taken monthly from depth (six monitoring holes at Area G and four holes at Area C) with a neutron moisture probe at intervals of 0.5 m. Monitoring of the soil moisture at LASL disposal sites indicates that the water content by volume does not exceed 6% at depths exceeding 5 m. The rate at which water and dissolved or suspended radionuclides can move in unsaturated conditions decreases rapidly as a function of moisture content indicating downward movement of radionuclides is not a significant pathway at LASL.

Vertical shafts augered in Bandelier tuff are used at LASL for disposal of tritiated wastes. Tritiated water vapor from these shafts has been observed to migrate into the surrounding tuff, from both unlined shafts and asphalt coated shafts. In 1976, special tritium waste packaging requirements were implemented. These requirements specified various degrees of encapsulation in asphalt, using 210ℓ steel drums as the final container. These wastes were placed in a new disposal shaft (Shaft 150), located in an area where no previous tritium disposals had occurred, thus permitting an evaluation of the effectiveness of the new procedures.

The first disposals to Shaft 150 occurred on May 12, 1976, and the shaft was filled (capped with concrete) in the fall of 1979. In the winter of 1977, after more than 30 000 curies of tritium had been disposed to the shaft, nine sampling holes were augered around the shaft. The tuff samples were processed to remove the contained water and the water was analyzed for tritium.

Measurements made during former investigations showed a release of 0.3 to 0.6% of the tritium in the shaft to the surrounding tuff. The present study showed values of 0.5 to 0.7%. It is apparent that no substantial improvement in tritium containment was obtained by the new packaging requirements. It is difficult to establish whether the packaging procedures themselves were inadequate, or whether the

problem derived from inadequate quality control. The results of this study have led to the use of asphalt-coated steel liners inside an augered shaft. The shafts will be equipped with monitoring pipes external to the liner.

A comparison of the Th/U ratios between the core and outcrop samples suggests there may be a redistribution of these elements within the tuff. The Th/U ratios in the cores seem to be a function of both horizontal distance from the mesa rim and depth below the original surface of the mesa. It seems probable that there has been some redistribution of natural U relative to Th by water movement through the tuff on a geologic time scale. More data are needed for verification and will be collected in the coming year.

All waste disposal pits and shafts at Los Alamos are excavated in the Bandelier Tuff, a series of volcanic ashflows and ashfalls with a total maximum thickness on the Pajarito Plateau of 305 m. Geologic descriptions of the structure and stratigraphy of the tuff are essential to a through understanding of possible migration pathways from buried waste. Subunits of the Tshirege Member of the Bandelier Tuff can now be correleated across the Pajarito and Los Alamos Faults. Estimates of displacement on these faults have been based on topographic relief. More precise values are now possible. Additional information on erosion rates for the tuff may also be gained from this study.

New map subunits for the Tshirege Member of the Bandelier Tuff were established for the Pajarito Plateau in the LASL environs. These subunits cover all of the Tshirege cropping out in the LASL environs and enable correlation of the tuff exposed at the distal end of the plateau with tuff exposed at the proximal end. All of the new subunits have recognizable lithologies and/or depositional boundaries, which are traceable across the area of the plateau in which any subunit crops out. To aid in correlation of the units a test of one sample each from several units were analyzed by high-magnification reflected-light microscopy and by scanning electron microscopy (SEM). The reflected-light microscope revealed textural differences among the 3 units

Table X. Milestone Schedule (ZBB)

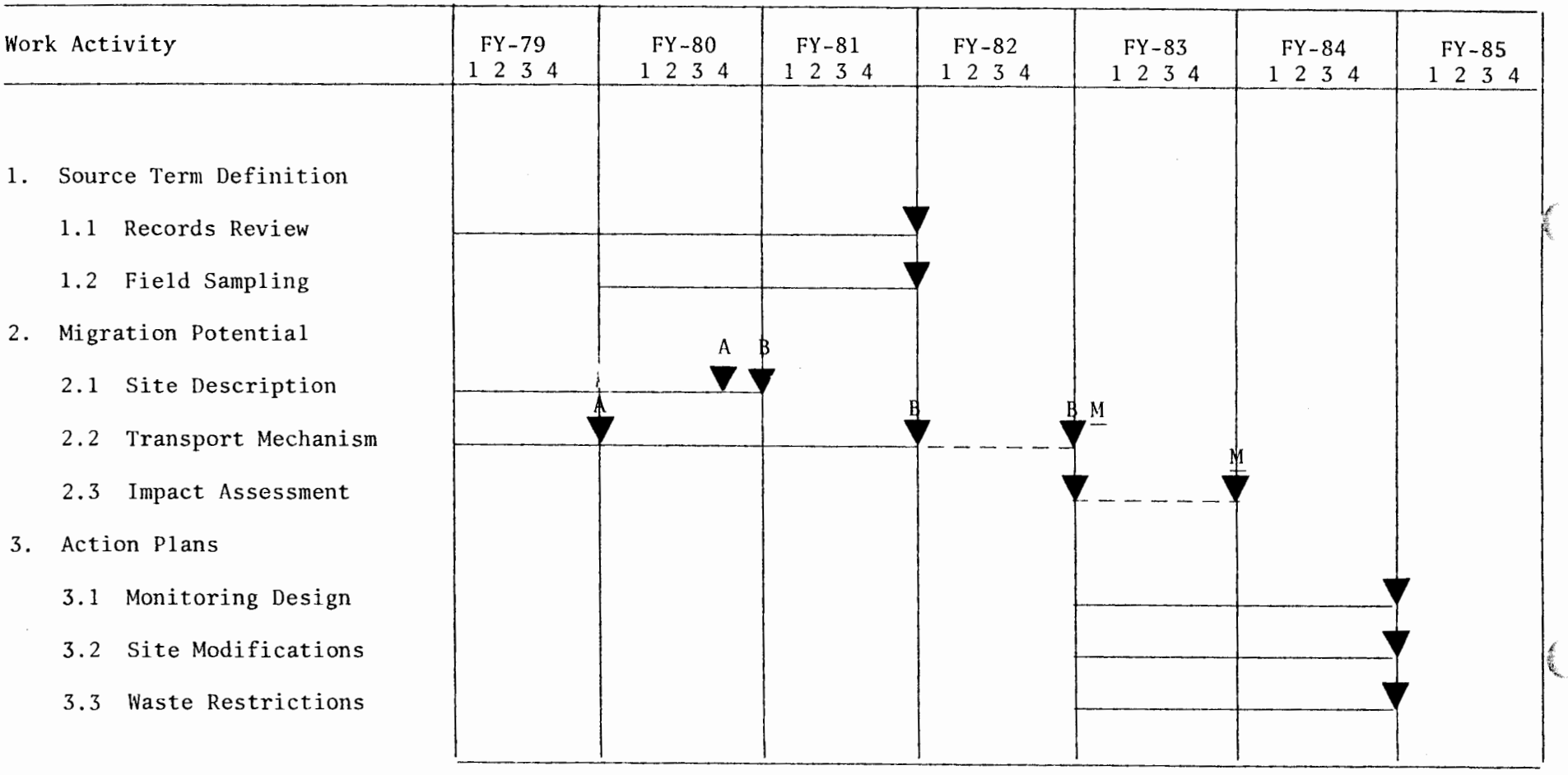
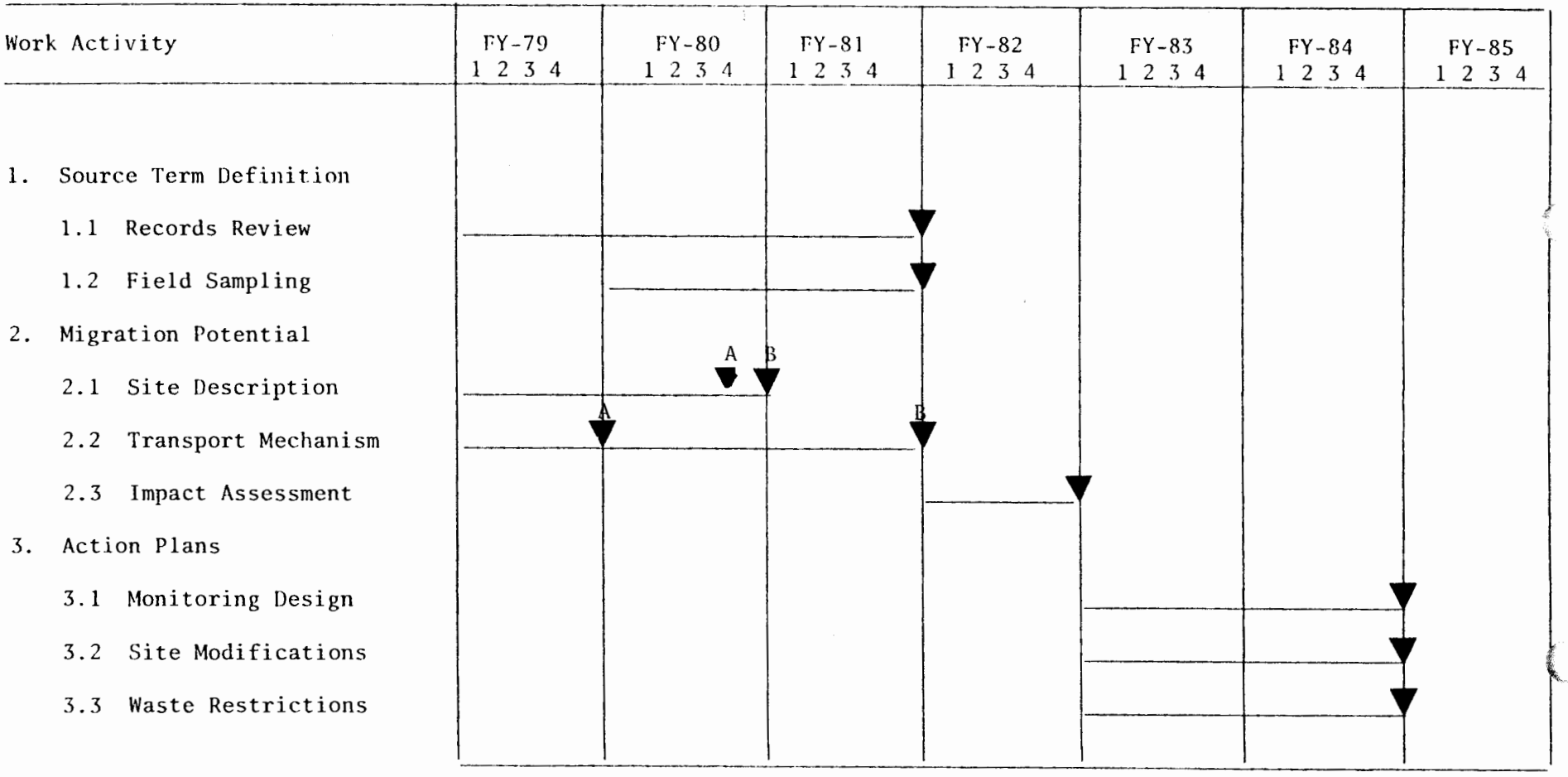


Table II. Milestone Schedule



TMO FY-82 Supplementary Data Budget Sheet

Attachment #3

Form B Code or New Program Title A415

Participating Cost Centers 5606

	FY 1980	PB FY 1981	RR FY 1981	FY 1982
COST ESTIMATES (in thousands)				
Direct Salaries				
SM	(2.4) 91	(2.4) 101	(2.4) 101	(3.4) 156
GR	(1.0) 18	(1.0) 20	(1.0) 20	(1.0) 22
Indirect	85	100	100	160
Normal M&S	46	44	44	62
Major Procurement	60	85	85	50
Total Operating Cost	300	350	350	450
Capital Equipment Obligations (in thousands)				
Major CE	40	50	50	0
Other ADP				
Other CE				

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	FY 1983	FY 1984	FY 1985	FY 1986
Person Years (to nearest 0.5)				
SM	1.0	1.0		
GR	1.0	1.0		
COST ESTIMATES (in thousands)				
Direct Salaries				
SM	50	54		
GR	24	26		
Indirect	71	79		
Normal M&S	55	41		
Major Procurement	50	0		
Total Operating Cost	250	200		
Capital Equipment Obligations (in thousands)				
Major CE	0	0	0	0
Other ADP				
Other CE				

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