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ORIGINAL

Disposal Evaluation

BASIN F INVESTIGATIVE STUDIES
PHASE II
DISPOSAL EVALUATION

Rocky Mountain Arsenal
Information Center
Commerce City, Colorado

BY
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HERMAN F. HILDEBRANDT

AUGUST 1978

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PROCESS TECHNOLOGY BRANCH
MUNITIONS DIVISION
CHEMICAL SYSTEMS LABORATORY

BASIN F DISPOSAL EVALUATION

OBJECTIVES

1. REVIEW TECHNICAL LITERATURE
2. CONDUCT INTEREST SURVEY TO EVALUATE CAPABILITY AND INTEREST OF PRIVATE INDUSTRY
3. ESTIMATE RECOVERY VALUE OF BASIN F CONTENTS
4. IDENTIFY WASTE TREATMENT PROCESSES
5. IDENTIFY ENVIRONMENTAL IMPACTS OF DISPOSAL
6. RECOMMEND DISPOSAL PLAN

MILESTONES AND DECISION POINTS

<u>TASK</u>	<u>DATE</u>
1. SUBMIT INDUSTRIAL SURVEY PLAN TO PMCDIR	15 FEB
2. INFORMATION DISCLOSURE CLEARED	15 MAR
3. COMPLETE LITERATURE REVIEW	14 APR
4. COMPLETE CONTRACT SCOPE OF WORK	15 MAY
5. DECIDE IF CONTRACT IS NEEDED	15 JUN
6. CONTRACT BEGINS	3 JUL
7. COMPLETE PERSONAL CONTACTS	14 JUL
8. REPORT FINDINGS TO PMCDIR	28 JUL
9. RECEIVE CONTRACTORS FINAL REPORT	15 SEP
10. MAKE FINAL REPORT TO PMCDIR	27 SEP

WASTE BASIN LIQUID ANALYSIS

COMPONENT

COMPONENT ANALYSIS RANGE

PARTS PER BILLION

ALDRIN	20 - 480
ISODRIN	<1 - 17
DIELDRIN	5 - 110
ENDRIN	5 - 42
DITHIANE .	<20 - 123

PARTS PER MILLION

DIISOPROPYLMETHYLPHOSPHONATE	6 - 55
DIMETHYLMETHYLPHOSPHONATE	320 - 3,750
P-CHLOROPHENYLMETHYLSULFOXIDE	4 - 10
P-CHLOROPHENYLMETHYLSULFONE	19 - 76
CHLORIDE	47,500 - 57,500
SULFATE	20,500 - 32,500
COPPER	709 - 760
IRON	5 - 13
NITROGEN	112 - 150
ORTHOPHOSPHATE	99 - 131
HARDNESS (AS CaCO ₃)	2,090 - 2,850
TOTAL SOLIDS	140,000 - 174,000
FLUORIDE	110 - 117
TOTAL PHOSPHORUS	2,060 - 2,170
ARSENIC	1.0 - 1.3
MAGNESIUM	35.6 - 41.2
MERCURY	0.026 - 1.53
CYANIDE	1.44 - 1.53
COD	24,400 - 26,000
TOC	20,200 - 22,800

WASTE BASIN SEDIMENT ANALYSIS

<u>COMPONENT</u>	<u>COMPONENT ANALYSIS RANGE</u> <u>PARTS PER MILLION</u>
ALDRIN	16 - 10,700
ISODRIN	2 - 870
DIELDRIN	4 - 3,600
ENDRIN	2 - 1,100
DDT	<2 - 198
DIISOPROPYLMETHYLPHOSPHONATE	1 - 10
DIMETHYLMETHYLPHOSPHONATE	<1 - 82
P-CHLOROPHENYLMETHYLSULFONE	14 - 290
COPPER	230 - 21,000
IRON	190 - 11,000
TOTAL PHOSPHATE	<1 - 34,300

PROCESS EVALUATION

I. ORGANICS:

- A. STORAGE
- B. INCINERATION
- C. WET OXIDATION
- D. EVAPORATION
- E. REVERSE OSMOSIS
- F. BIOLOGICAL TREATMENT
- G. CHEMICAL DEGRADATION
- H. OZONE
- I. ADSORPTION
- J. ELECTRO-OXIDATION
- K. RADOX PROCESS

II. INORGANIC SALTS:

- A. EVAPORATION
- B. FREEZE CONCENTRATION
- C. CRYSTALLIZATION
- D. REVERSE OSMOSIS
- E. ELECTRODIALYSIS
- F. IONIC EXTRACTION
- G. IONIC ADSORPTION
- H. CHEMICAL FIXATION

III. HEAVY METALS:

- A. CHEMICAL PRECIPITATION
- B. CARBON ADSORPTION
- C. ION EXCHANGE
- D. REVERSE OSMOSIS
- E. CEMENTATION

BASIN F INDUSTRIAL SURVEY
INDUSTRY
FURTHER CONSIDERATION

BATTELLE (COLUMBUS, OHIO)
BKK (WILMINGTON, CALIFORNIA)
CATALYTIC (PHILADELPHIA, PENNSYLVANIA)
CHEM-TROL (MODEL CITY, NEW YORK)
DYNALECTRON CORPORATION (BETHESDA, MARYLAND)
ECOLOGY PRODUCTS (SANTA BARBARA, CALIFORNIA)
IT ENVIRONMENTAL CORPORATION (MARTINEZ, CALIFORNIA)
MATRIX ENGINEERS (PITTSBURGH, PENNSYLVANIA)
MB ASSOCIATES (SAN RAMON, CALIFORNIA)
NEWCO (NIAGARA FALLS, NEW YORK)
STEARNS-ROGER (DENVER, COLORADO)
VERSAR INC. (SPRINGFIELD, VIRGINIA)
WES-CON (TWIN FALLS, IDAHO)
ZIMPRO (ROTHSCHILD, WISCONSIN)

BASIN F INDUSTRIAL SURVEY

GENERAL TYPES OF INDUSTRIAL EXPERIENCE

- I. LANDFILL DISPOSAL
 - A. BKK (WILMINGTON, CALIFORNIA)
 - B. IT ENVIRONMENTAL CORPORATION (MARTINEZ, CALIFORNIA)

- II. GENERAL DISPOSAL
 - A. CHEM-TROL (MODEL CITY, NEW YORK)
 - B. DYNALECTRON CORPORATION (BETHESDA, MARYLAND)
 - C. ECOLOGY PRODUCTS (SANTA BARBARA, CALIFORNIA)
 - D. NEWCO (NIAGARA FALLS, NEW YORK)
 - E. WES-CON (TWIN FALLS, IDAHO)

- III. ENGINEERING CONSULTANTS
 - A. BATTELLE (COLUMBUS, OHIO)
 - B. CATALYTIC (PHILADELPHIA, PENNSYLVANIA)
 - C. MATRIX ENGINEERS (PITTSBURGH, PENNSYLVANIA)
 - D. MB ASSOCIATES (SAN RAMON, CALIFORNIA)
 - E. STFARNS-ROGER (DENVER, COLORADO)
 - F. VERSAR, INC. (SPRINGFIELD, VIRGINIA)
 - G. ZIMPRO (ROTHSCHILD, WISCONSIN)

BASIN F RECOVERY VALUE

<u>COMPONENT</u>	<u>MARKET PRICE</u>	<u>VALUE</u>
ALUMINUM (BASIN LIQUID)	\$ 0.53/LB	\$ 316
CADMIUM (BASIN LIQUID)	\$ 2.25/LB	\$ 128,311
CHROMIUM OXIDE (BASIN LIQUID)	\$ 0.96/LB	\$ 162
COBALT OXIDE (BASIN LIQUID)	\$ 5.93/LB	\$ 6,243
COPPER (BASIN LIQUID)	\$ 0.60/LB	\$ 595,527
COPPER (BASIN SEDIMENT)	\$ 0.60/LB	\$1,073,400
IRON OXIDE (BASIN LIQUID)	\$ 0.36/LB	\$ 3,771
LEAD DIOXIDE (BASIN LIQUID)	\$ 0.66/LB	\$ 43
MAGNESIUM (BASIN LIQUID)	\$ 0.99/LB	\$ 51,080
MANGANESE DIOXIDE (BASIN LIQUID)	\$ 0.08/LB	\$ 128
MERCURY (BASIN LIQUID)	\$ 3.97/LB	\$ 146
NICKEL (BASIN LIQUID)	\$ 2.11/LB	\$ 16,044
SILVER (BASIN LIQUID)	\$70.25/LB	\$ 5,844
ZINC (BASIN LIQUID)	\$ 0.29/LB	\$ 512
	TOTAL	\$1,881,527

BASIN F INDUSTRIAL SURVEY

TYPES OF PROCESSES REGARDED AS HAVING POTENTIAL BY INDUSTRY

COMPANY	CONCENTRATION OR EVAPORATION	WET AIR OXIDATION	CARBON ADSORPTION	SOLVENT EXTRACTION	BIODEGRADATION	ION EXCHANGE	NEUTRALIZATION	METAL PRECIPITATION	RECOVERY TECHNOLOGIES	REJECTED RECOVERY	INCINERATION	PYROLYSIS	FIXATION	LANDFILL
BATELLE	X		X			X		X		X	X	X		
BKK						X			X		X		X	
CATALYTIC	X		X	X					X		X		X	X
DYNALECTRON CORP.											X			X
ECOLOGY PRODUCTS												X		X
IT ENVIRONMENTAL CORP.	X									X	X			X
MATRIX ENGINEERS	X									X			X	
MB ASSOCIATES	X										X			X
NEWCO	X										X		X	X
STEARNS-ROGER	X				X		X			X	X			
VERSAR, INC.											X			
WES-CON											X			X
ZIMPRO		X	X					X					X	
TOTAL OUT OF 13	7	1	3	1	1	2	1	2	2	4	10	2	6	
PERCENTAGE (%)	54	8	23	8	8	15	8	15	15	31	77	15	46	

LIQUID TREATMENT MATRIX (LITERATURE REVIEW)

<u>Component</u>	<u>Carl</u>	<u>Ion Exchange</u>	<u>Electrolytic Technology*</u>	<u>R.O.</u>	<u>Ozone*</u>	<u>WAO</u>	<u>Lime</u>	<u>Radon</u>	<u>Alumina</u>	<u>Biological</u>
Aldrin	P			P	X	X		P		X
Isodrin	P			P	P	P		P		P
Dieldrin	P			P	X	X		P		P
Endrin	X			P	X	P		P		P
Dithiane	P			P	P	P		P		P
Diisopropylmethylphosphonate	X			P	X	X		P		P
Dimethylmethylphosphonate	P			P	P	X		P		P
p-chlorophenylmethylsulfoxide	X			P	X	P		P		P
p-chlorophenylmethylsulfone	X			P	X	P		P		P
Chloride	X	X	X	X						
Sulfate										
Copper		X	X				X			
Iron			X		X	X				
Nitrogen		X								X
Orthophosphate							X			X
Fluoride		X					X		X	
Total Phosphorus										
Arsenic	X						X			
Magnesium										
Cyanide		X	X		X			X		X
COD						X				
TOC					X	X				X
Mercury	X	X	X							

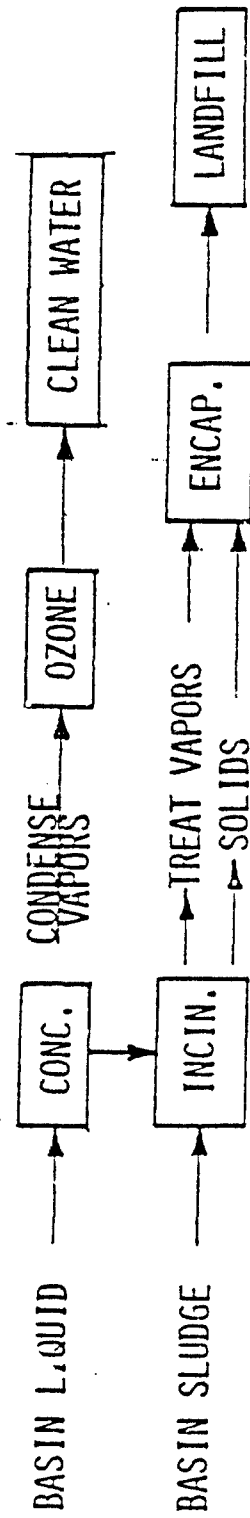
*Dilution required to treat Basin F material.

KEY: X - Literature indicates process can treat.
P - Author feels process probably can treat.

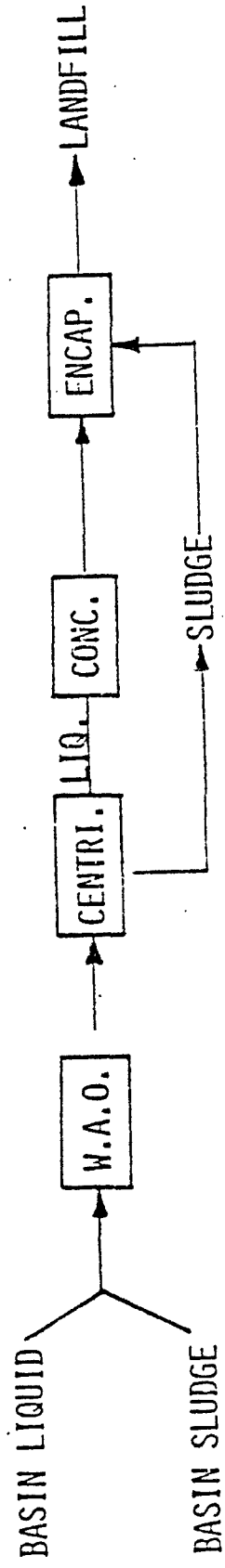
BASIN F INDUSTRIAL SURVEY
INDUSTRY
NO FURTHER CONSIDERATION

CALGON CORPORATION (PITTSBURGH, PENNSYLVANIA)
CONSERVATION CHEMICAL COMPANY (KANSAS CITY, MISSOURI)
DATACRAPHICS, INC. (PITTSBURGH, PENNSYLVANIA)
EMERY INDUSTRIES (CINCINNATI, OHIO)
ENVIRONMENTAL EQUIPMENT CORPORATION (AUSTIN, MINNESOTA)
ENVIRONMENTAL TESTING AND CONSULTING (MEMPHIS, TENNESSEE)
GARY L. CAMPBELL (OLD BRIDGE, NEW JERSEY)
HARZA (CHICAGO, ILLINOIS)
HYDROTECHNIC CORPORATION (NEW YORK, NEW YORK)
JOHN CAROLLO ENGINEERS (PHOENIX, ARIZONA)
KANSAS INDUSTRIAL ENVIRONMENTAL SERVICES, INC. (WICHITA, KANSAS)
McLAUGHLIN INDUSTRIAL WASTES ENG. (DENVER, COLORADO)
METCALF & EDDY, INC. (PALO ALTO, CALIFORNIA)
NUCLEAR ENGINEERING CO., INC. (LOUISVILLE, KENTUCKY)
NUS CORPORATION (PITTSBURGH, PENNSYLVANIA)
RECON SYSTEMS, INC. (SOMERVILLE, NEW JERSEY)
SITKIN SMELTING & REFINING, INC. (LEWISTOWN, PENNSYLVANIA)
SUBSURFACE DISPOSAL CORPORATION (BELLAIRE, TEXAS)
TECHMEDIA CORPORATION (PHILADELPHIA, PENNSYLVANIA)
WILSON & COMPANY (SALINA, KANSAS)

SCENARIO #1



SCENARIO #2



SCENARIO #3

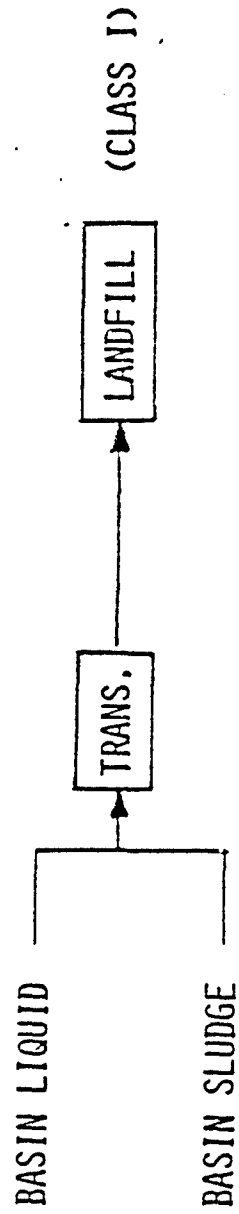


Fig.

SCENARIO #4



SCENARIO #5



BASIN F DISPOSAL EVALUATION
SUMMARY OF SCENARIO INFORMATION

A. MINIMUM LEAKAGE (SIX INCHES BELOW LINER) -

<u>SCENARIO</u>	<u>ESTIMATED TIME (YEARS)</u>	<u>ESTIMATED COST (\$ MILLIONS)</u>
#1 CONC. - INCIN.	6	37.9
#2 W.A.O.*	6	36.4
#3 TRANSPORTATION	5	70.9
#4 EVAP. - ENCAP.	9	29.2
#5 EVAP. - LANDFILL	9	19.8

B. LEAKAGE SIX FEET BELOW LINER -

<u>SCENARIO</u>	<u>ESTIMATED TIME (YEARS)</u>	<u>ESTIMATED COST (\$ MILLIONS)</u>
#1 CONC. - INCIN.	11	86.4
#2 W.A.O.*	11	76.5
#3 TRANSPORTATION	8	125.9
#4 EVAP. - ENCAP.	14	75.8
#5 EVAP. - LANDFILL	14	47.6

*WET-AIR-OXIDATION

BASIN F DISPOSAL EVALUATION

CONCLUSIONS

1. INDUSTRY IS INTERESTED IN DISPOSAL OF BASIN F.
2. NECESSARY TECHNOLOGY AND CAPABILITY EXISTS.
3. RECOVERY IS NOT ECONOMICAL.
4. AMOUNT OF CONTAMINATED SOIL UNDER BASIN LINER HAS A SIGNIFICANT IMPACT ON DISPOSAL COSTS.
5. FOR MINIMUM SOIL CONTAMINATION, BEST DISPOSAL OPTION IS SCENARIO #5
6. FOR MAJOR SOIL CONTAMINATION (GREATER THAN SIX FEET) BEST DISPOSAL OPTION IS CONTAINMENT ON BASIN SIDES AND TOP.

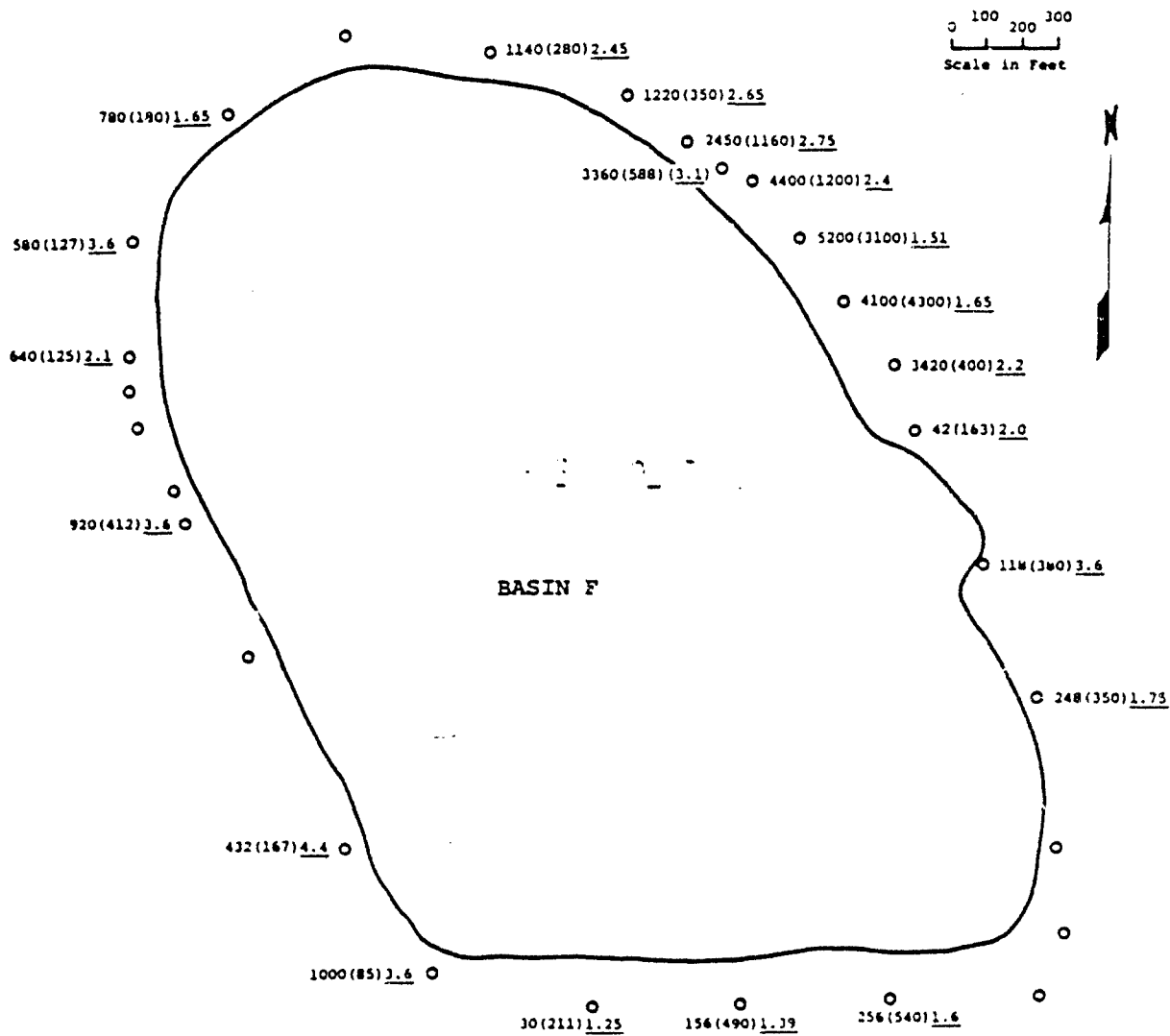
BASIN F DISPOSAL EVALUATION

RECOMMENDATIONS

1. DRILL EXPLORATORY WELLS UNDER BASIN F.
2. INVESTIGATE SEALOSAFE ENCAPSULATION PROCESS.

PLANNED WORK - CSL

1. INVESTIGATE SEALOSAFE ENCAPSULATION PROCESS.
2. EVALUATE ROCKY MOUNTAIN ARSENAL INCINERATOR SYSTEMS.
3. ASSIST MITRE CORP. IN PREPARATION OF ENVIRONMENTAL ISSUE PAPER.
4. UPDATE SCENARIO INFORMATION.
5. ATTEND ECOLOGY PRODUCTS TESTING OF BASIN F LIQUID.
6. COMPLETE FINAL REPORT.



Chloride (Sulfate) Fluoride

Figure No 7. Distribution of Chloride, Sulfate, and Fluoride (PPM)