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296

REMOVAL SITE EVALUATION
WASTE PIT AREA ~~CONTAINMENT IMPROVEMENT~~
Storm Water Runoff Control

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REMOVAL SITE EVALUATION

WASTE PIT AREA STORM WATER RUNOFF CONTROL

FEED MATERIALS PRODUCTION CENTER
U.S. DEPARTMENT OF ENERGY
FERNALD, OHIO

Introduction

The Feed Materials Production Center (FMPC) is a uranium processing complex operated by the Westinghouse Materials Company of Ohio (WMCO) for the U.S. Department of Energy (DOE). The location of the 1050 acre site is shown in Figure 1. The Production Area comprises 136 acres and is adjacent to a Waste Storage Area of approximately 65 acres to the NNW as shown in Figure 2.

The Waste Pit Area occupies approximately 65 acres with features shown in Figure 3. These features include six low level radioactive waste storage pits, 4 concrete storage silos, and a Clearwell pond. The legend also identifies the various contractors related to the surface water sampling locations.

Since the early 1950s, various chemical and metallurgical processes have been used to manufacture uranium products. A substantial quantity and variety of wastes have been generated. These wastes have been characterized as hazardous, toxic, radioactive, and combustible. Since 1985, wastes have been processed and stored in drums for either future disposal or reprocessing. Prior to 1985, solid wastes were transferred (by various means) for disposal in the pits and silos in the Waste Storage Area.

None of the waste pits currently receive material and four of the six have been back-filled and covered. The Clear Well receives most of the storm water runoff from the waste pit area. Supernatant from that pond is lifted and piped through the Biodenitrification Surge Lagoon (BSL) to the outfall from the sewage treatment plant. The diagram, Figure 4, shows the liquid waste stream flow and other effluent which joins decanted discharge from the Clear Well. The diagram also shows the National Pollutant Discharge Elimination System (NPDES) Permit sampling location at Manhole-175 (MH-175). The outfall from MH-175 is piped to the Great Miami River. Outfall from the Stormwater Retention Basin, which receives overflow from Production Area storm sewers, is south on the site and ultimately joins Paddy's Run. This is an infrequent source and occurs only during periods of heavy precipitation. An upstream portion of Paddy's Run, an intermittent tributary to the Great Miami River, also experiences some storm water runoff from the Waste Pit Area. There is no known direct use of surface water runoff (e.g. irrigation). However, it is known that water in Paddy's Run can migrate to the ground water at several points along that stream bed.

Since 1985, different contractors have been collecting and analyzing surface water samples in the Waste Pit Area. Some of this work was done in conjunction with development of the FMPC Best Management Practices (BMP) Plan. Since 1987, WMCO has collected and analyzed most of the samples as part of its routine Environmental Monitoring Program. Through a Federal Facilities Compliance Agreement (July 18, 1986), and pursuant to the

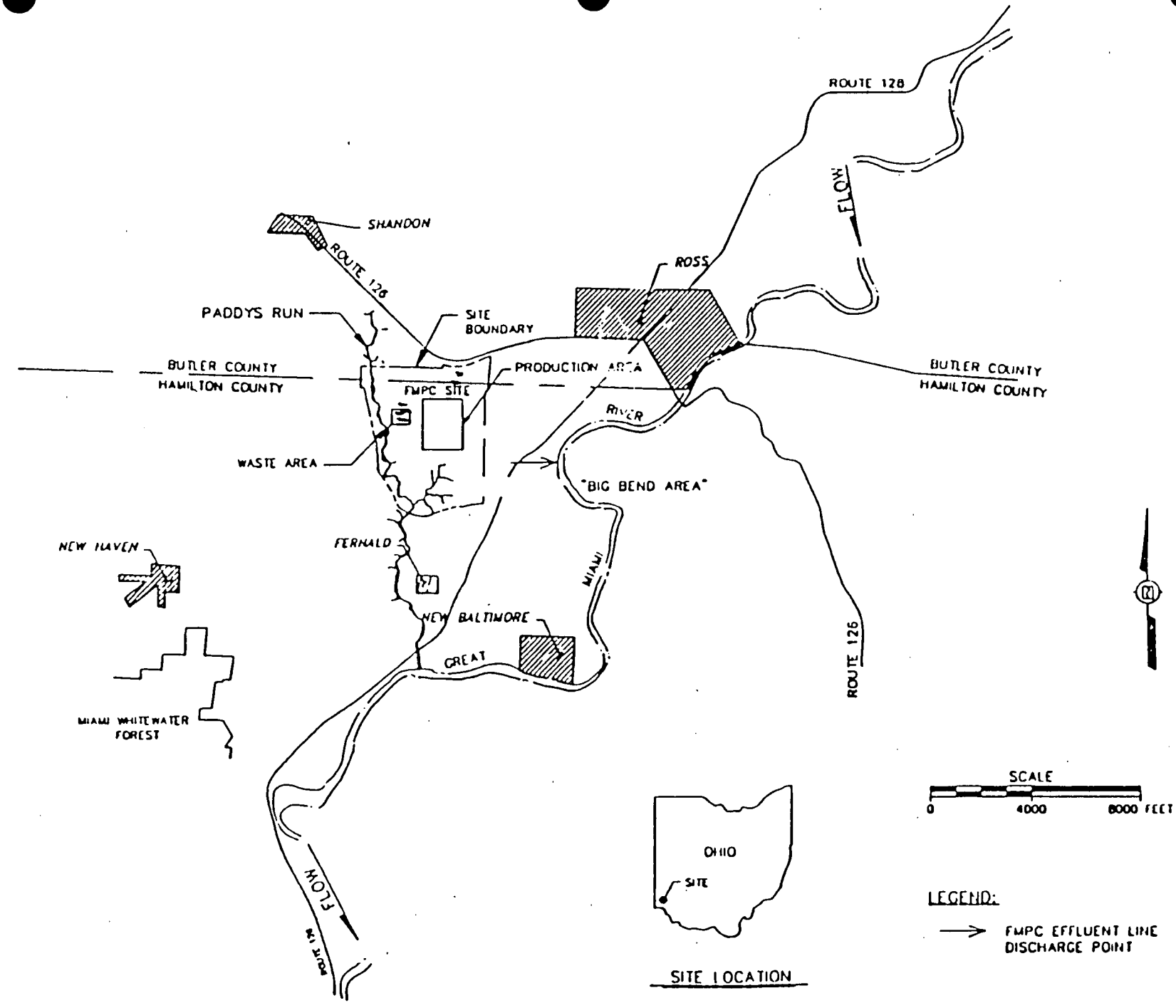


FIGURE 1 FMPC SITE AND VICINITY

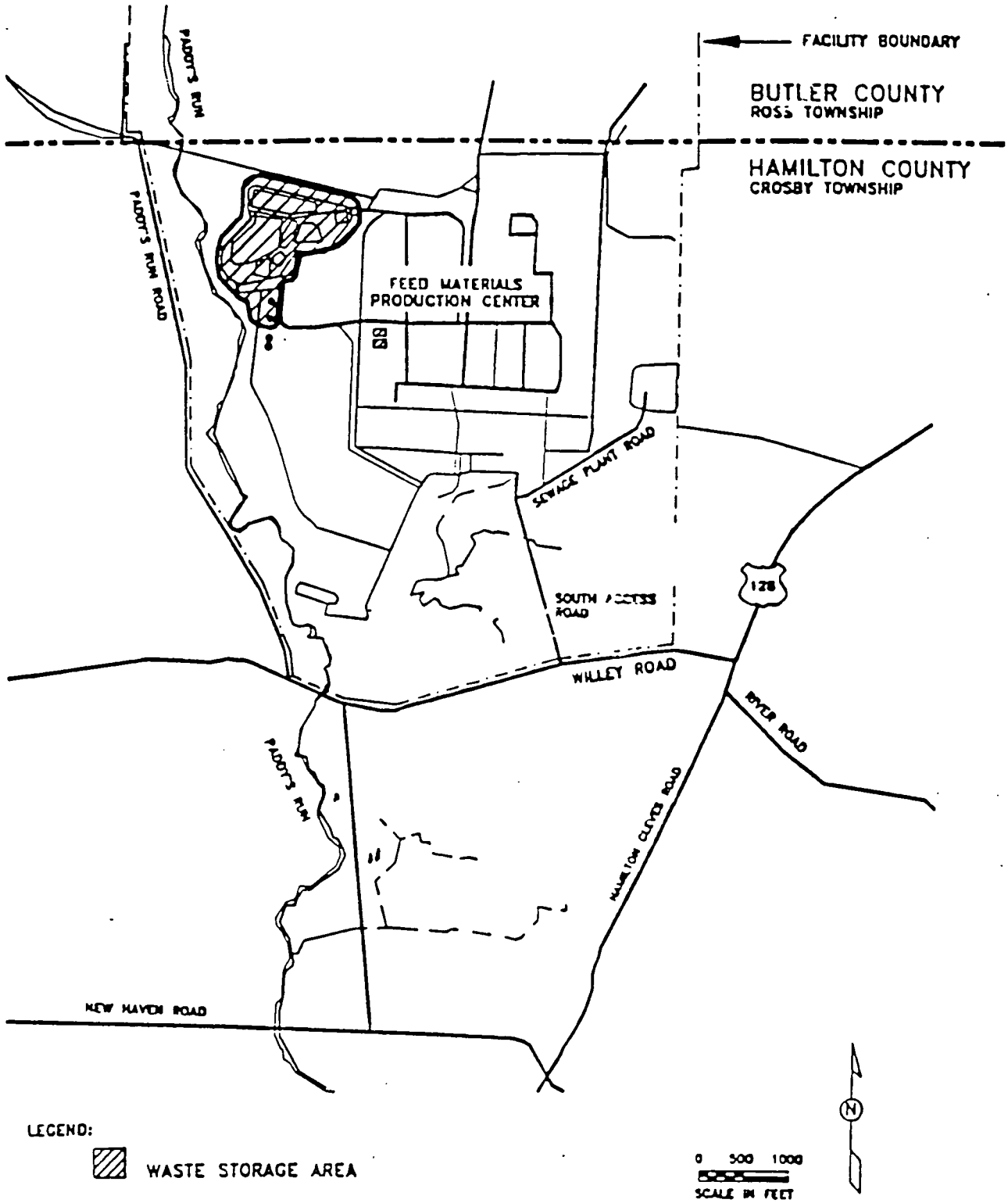
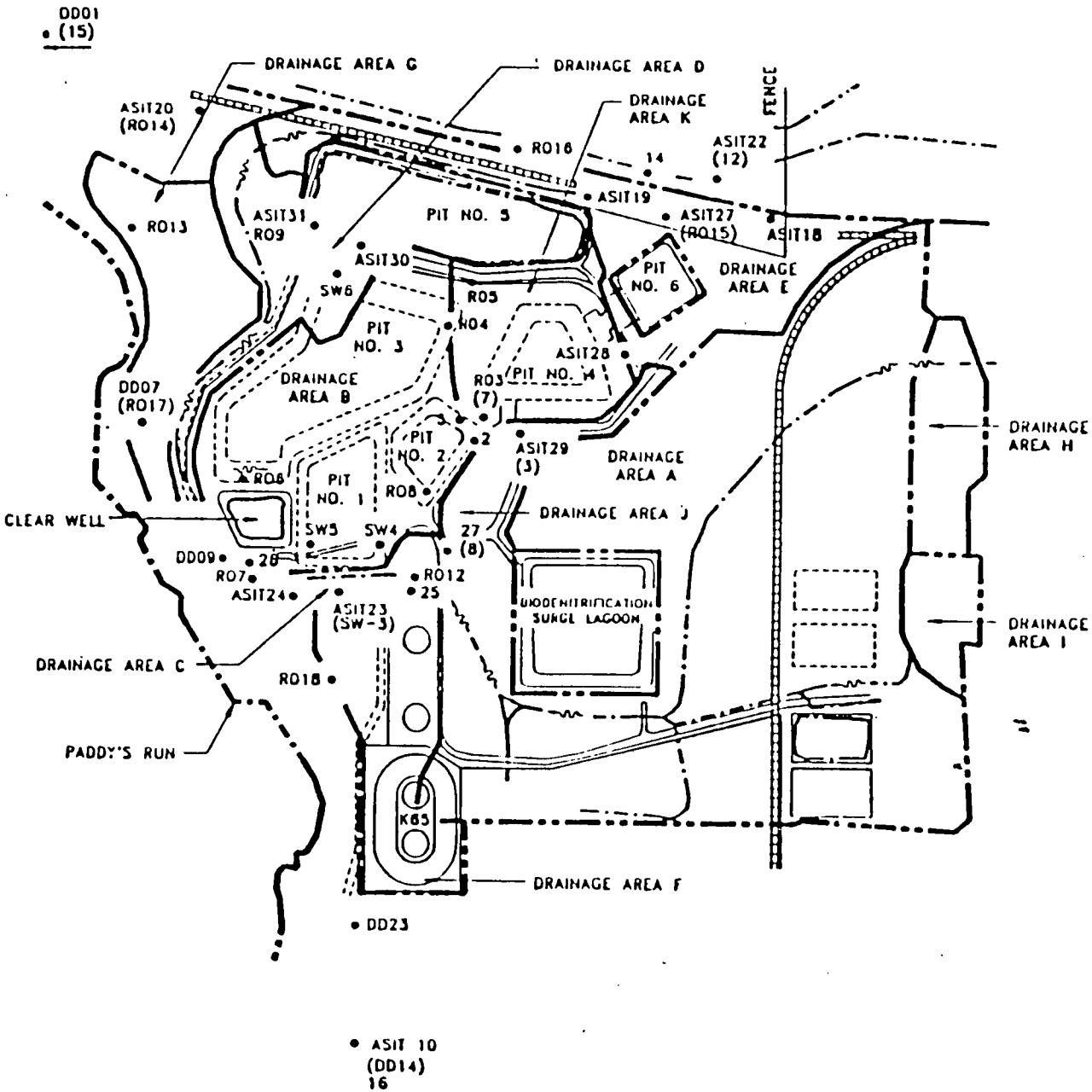


FIGURE 2 FMPC GENERAL LAYOUT



LEGEND:
SWX & ROXX=DAMES & MOORE
DDXX=WESTON
XX=WMCO
ASITXX=ASI/IT RI/FS
DRAINAGE AREA BOUNDARY
DRAINAGE

NOTES:

1. LOCATION NUMBERS IN ( ) INDICATE SAME SAMPLE LOCATION BY DIFFERENT CONTRACTORS AT VARIOUS TIMES.
2. REFER TO FIGURE 4-4 FOR DEFINITION OF DRAINAGE AREAS. DRAINAGE AREA ISOLATION LINES ON THIS ON THIS DRAWING HAVE BEEN BROKEN FOR CLARITY TO SHOW SAMPLE LOCATION POINTS.
3. THIS FIGURE WAS PREPARED USING WESTINGHOUSE/A. M. KINNEY, INC. DWG. NO. 87-D-159; D087502 WBS 1.1.2.4.01, SHEET C4, REV. 0, DATED 6/89 "WESTINGHOUSE TREATMENT IMPROVEMENTS LOCATION PLAN WASTE PIT AREA" AS A BASE MAP AND SOURCE.

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SCALE IN 100 FEET

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FIGURE 3

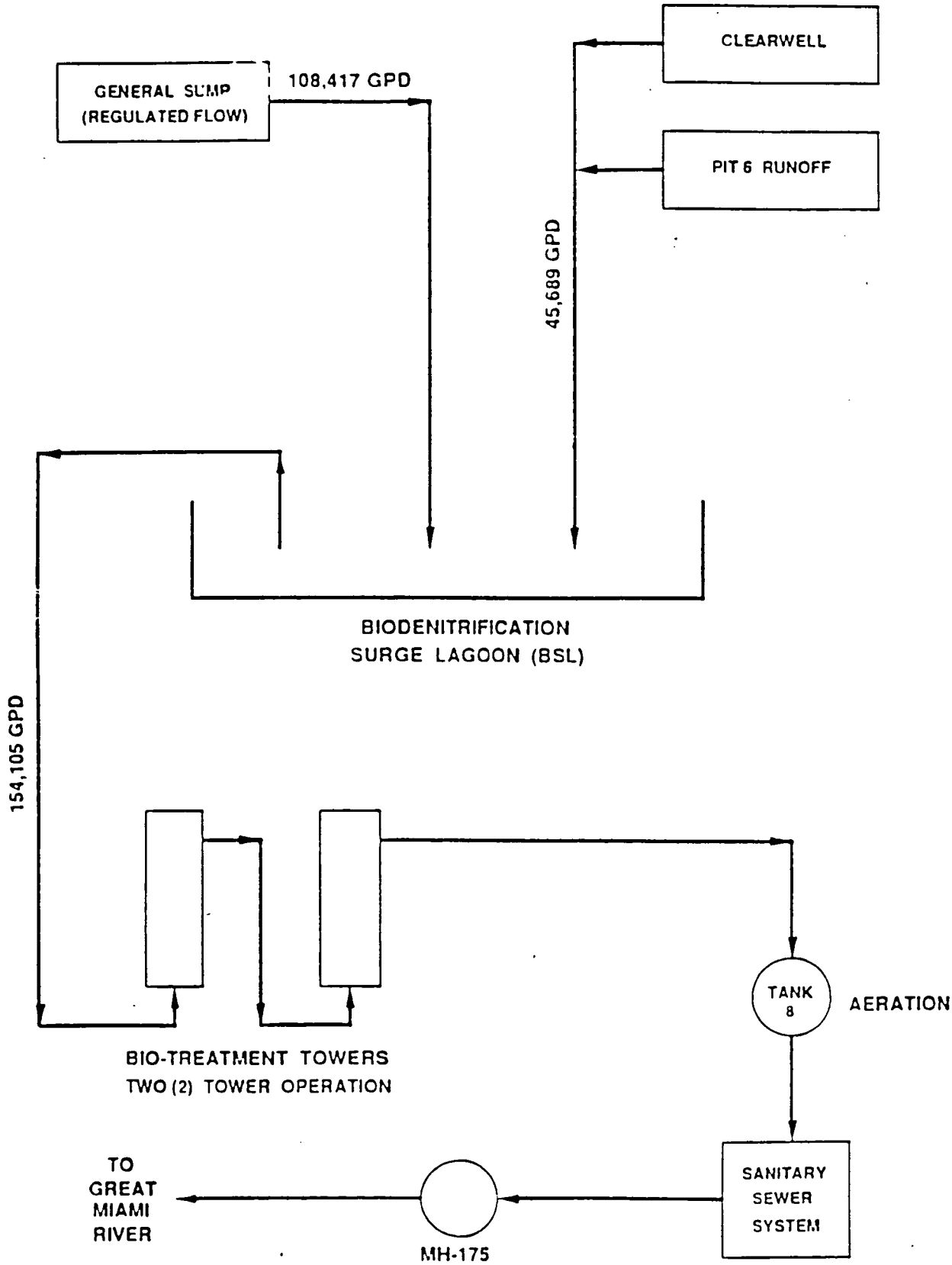

FIGURE 4 BLOCK FLOW DIAGRAM - EXISTING FLOW CONFIGURATION THROUGH BIODENITRIFICATION FACILITY

6

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Advanced Sciences, Inc. (ASI) and its subcontractor, International Technology (IT), are conducting a Remedial Investigation Feasibility Study (RI/FS) for five Operable Units of the FMPC. As part of the RI/FS program, ASI/IT collected and analyzed thirteen Waste Pit Area surface water samples during March and May of 1989.

Results of those analyses are tabulated in Appendix A. A summary of the data in Appendix A is presented in Table 1 by Contractor and chronology, as well as by the number of samples which exceeded DOE's average annual limit, Derived Concentration Guide (DCG), for the discharge of uranium to the environment. In accordance with 40 CFR 300.400 (g)(3), DOE Orders providing guidance or criteria such as DCGs can be implemented as "to be considered (TBC)" for public health protection standards. For purposes of the comparison in Table 1, the DCG corresponded to the combined DCG for U-234 and U-238 (explained later). The third column of Table 1, which shows the fraction greater than the DCG, is a comparison of sample results exceeding the DCG to the total number of samples collected at that time. It was necessary to estimate the concentration of U-234 and U-238 in samples analyzed by WMCO and Dames and Moore since values were presented for total uranium (mg/l).

Use of the data in Appendix A, and even comparison among sample results must be circumspect. A close analysis is not possible since there are no specific dates for heavy precipitation events which could dilute the observed concentrations. Similarly, samples collected near an eroding higher level source (around pits 4 and 6) could be expected to have elevated concentrations. Comparison to DOE's limit for discharge to the environment (DCG) is a conservative assumption that the ultimate risk to the public is most likely to be through the potential ingestion of ground water and food products which might eventually receive the effluents.

As more data became available, it was apparent that several of the higher combined concentrations (U-234 and U-238) were from 10 to 20 times the DCG. Certain non-radiological contaminants were also present at or above the maximum consentration limit (MCL) as shown in Table 2.

Consistent with regulatory guidance, this Preliminary Assessment is an evaluation related to the eight factors provided in Section 300.415 of the National Contingency Plan and is conducted under authority delegated through Executive Order 12580 for Section 104 of CERCLA.

Source Term

The most significant contaminants of concern among the materials disposed in the waste pits were designated for analysis in samples of runoff surface water collected in the FMPC waste storage area. The non-radiological contaminants were compared to contaminant specific Applicable or Relevant and Appropriate Requirements (ARARs) such as state of Ohio primary and secondary drinking water MCL parameters. As stated above radiological contaminants were compared to TBCs.

Table 1

A Summary of Surface Water Sample Results from the Waste Pit Area

Contractor	No. of Locations Sampled	Fraction > DCG	Sampling Period
Dames & Moore	14	6/14	3/85
	4	3/4	8/11/86
WMCO	3	0/9	4/23/87 - 1/20/88
	6	6/24	2/01/88 - 3/25/88
	4	0/4	3/21/89
	10	10/20	9/14/89 & 11/8/89
Weston	5	1/5	7/88
ASI/IT	11	3/11	3/89
	2	2/2	5/89

Table 2

Summary of Higher Concentrations of Non-Radiological Parameters for Drinking Water

Parameter	MCL	Analytical Result	Sample Identification
Chromium	50 ug/l*	52.5 ug/l	ASIT 30
Sulfate	250 mg/l**	317 mg/l	DD-01
TDS	500 mg/l**	119 mg/l 692 mg/l	DD-07 DD-01
Nitrate	10 mg/l*	10.9 mg/l	ASIT 31

* Ohio Primary MCL, OAC-3745-81-11(B)
** Ohio Secondary MCL, OAC-3745-82-02

Certain standards, such as the Ohio secondary standard for total dissolved solids (TDS), were not expected to be achieved since the samples were collected from drainage areas. One or two samples were found to exceed the criteria for chromium, sulfate and nitrate. Table 2 summarizes and compares the concentrations of non-radiological contaminants in surface water to the maximum contaminant levels (MCL) of the state of Ohio primary and secondary drinking water standards as footnoted in Table 2.

The principal contaminant of concern in runoff storm water is uranium. All of the initial analyses performed by WMCO and Dames and Moore were for total elemental uranium. No isotopic uranium analyses were performed. Natural uranium is expected to have equal activity concentrations of U-238 and U-234, but the concentration of U-235 would be about 5 percent of that for U-238. Due to its much longer half-life and relatively low specific activity, most of the uranium mass derived through total U analysis is due to U-238. The uranium that has been processed at FMPC has included natural, enriched (in U-234 and U-235), and depleted uranium. The isotopic composition of uranium in effluent, through routine (proportionate continuous sampling) monitoring at Manhole 175, has shown approximately equal activity concentrations of U-234 and U-238 with negligible U-235. However, a representative number of samples from the waste pit surface water runoff samples showed a preponderance of uranium-238. While the ratio is variable, the average 238/234 ratio was 3.7 ($\pm$ 33% with 68 percent confidence). This ratio was calculated for one purpose, to estimate the concentration of U-234 and U-238 in samples analyzed (by WMCO and Dames and Moore) for total uranium. A number of other radiochemical analyses were performed: Th-228, Th-230, Th-232, Ra-226 and Ra-228. Sample No. ASIT 28, 29, and DD-14 indicated that combined concentrations of Ra-226 and Ra-228 exceeded the ARAR (40 CFR 141.15(a) drinking water MCL of 5 pCi/l). Sample DD-09 showed a low concentration of all three thorium isotopes. Tables of analytical results are given in Appendix A.

Risk Evaluation

From the analytical data herein and from the attendant guidelines for ingestion, the risk can be evaluated on the basis of observed U-234 and U-238 concentrations.

The Derived Concentration Guides for ingestion (from DOE Order 5400.XX) are based upon a committed effective dose equivalent limit of 100 mrem/yr. These limits correspond to:

U-238	600 pCi/l	(1.8 mg/l)
U-234	500 pCi/l	(9.7×10^{-5} mg/l)

This forms the basis for the comparison in Table 3 when combined with the analytical data.

Even though U-234 is somewhat more dose limiting, the total uranium mass analysis represents U-238. The mass of U-234 and U-235 will contribute little, if any, to the Total U measurement. An estimate of the relative U-238 to U-234 concentrations by activity is made on the basis of other isotope specific analyses performed by Weston and ASI/IT. That basis was described earlier, and the activity ratio used is 3.7:1 for 238 to 234. Table 3 lists the analytical results in descending order with either estimated or actual concentrations of these two uranium isotopes along with the multiple of the respective DCG. A total of 93 samples were analyzed. The 31 samples listed in Table 3 are those which exceeded the DCG. The sparse and lower level concentrations of other radionuclides were not utilized because their relative contribution to estimated dose is minuscule.

It should be pointed out that the DCGs used in this discussion and in Table 3 represent, if ingested at the normal annual water consumption rate, intakes of uranium which would result in a committed effective dose equivalent of 100 mrem. The DOE dose standard for drinking water is 4 mrem/yr which corres-ponds to a DCG for U-238 and U-234 of 24 pCi/l and 20 pCi/l respectively. These are compared with TBC public health standards Therefore the risk associated with consumption of water represented by sample No. RO-8 in table 3 would be about 600 times greater than water containing U-238 and U-234 at respective concentrations of 24 pCi/l and 20 pCi/l (the DOE drinking water limit).

Magnitude of Potential Risk

It is recognized that the waste pit area will ultimately be restored or stabilized based on the Record of Decision (ROD) for Operable Unit No. 1 of the RI/FS. However, this Preliminary Assessment (PA) addresses the potential need for a removal action. The conservative assumption for pathways to off-site receptors include but are not limited to surface water runoff (wildlife) and infiltration of the underlying aquifer with migration to the south plume (ingestion and irrigation). Potential exposure paths also include resuspension of radionuclides in sediments, which will be addressed in the RI/FS. Current routine environmental monitoring does not indicate significant airborne concentrations originating from this process. Ground water monitoring has shown a uranium contaminated plume south of the site. This is the subject of another removal action and any contribution from storm water runoff will be addressed in other documents.

There are too many unknown parameters to present radiation dose commitments through the many potential environmental paths. It is significant, however, that 31 of 93 samples showed concentrations in excess of the DCG which represents 100 mrem/yr due to ingestion (Table 3). It is further significant that uranium in these samples represent potential doses which range from 28 to 613 times the U.S. EPA drinking water regulation.

Table 3

Uranium Concentrations in Samples Exceeding the DCG

Sample Identifi.	U-238 (pCi/l)	Multiple of U-238 DCG*	U-234 (pCi/l)	Multiple of U-234 DCG**	Total Multiple DCG
RO-8 1	1.1×10^4	18.3	3.1×10^3	6.2	24.5
RO-4	9.3×10^3	15.5	2.5×10^3	5.0	20.5
SW-5	8.9×10^3	14.8	2.4×10^3	4.8	19.6
RO-5	8.0×10^3	13.3	2.2×10^3	4.4	17.7
SW-4	5.5×10^3	9.2	1.5×10^3	3.0	12.2
3C	5.1×10^3	8.5	1.4×10^3	2.8	11.3
5	5.0×10^3	8.3	1.3×10^3	2.6	10.9
27[A]	3.8×10^3	6.3	1.0×10^3	2.0	8.3
RO-17[F]	3.6×10^3	6.0	9.9×10^2	2.0	8.0
ASIT-27	3.1×10^3	5.2	8.4×10^2	1.7	6.9
2	2.8×10^3	4.7	7.5×10^2	1.5	6.2
ASIT-30	2.8×10^3	4.7	6.5×10^2	1.3	6.0
ASIT-31[G]	2.5×10^3	4.2	5.9×10^2	1.2	5.4
8[A]	2.2×10^3	3.7	5.9×10^2	1.2	4.9
27[A]	2.1×10^3	3.5	5.8×10^2	1.2	4.7
ASIT-28	1.9×10^3	3.2	5.2×10^2	1.0	4.2
3[C]	1.6×10^3	2.7	4.2×10^2	0.8	3.5
RO-6	1.5×10^3	2.5	4.1×10^2	0.8	3.3
SW-3	1.3×10^3	2.2	3.4×10^2	0.7	2.9
7[B]	1.1×10^3	1.8	3.1×10^2	0.6	2.4
RO-9[G]	1.0×10^3	1.5	2.7×10^2	0.5	2.2
27[A]	9.0×10^2	1.5	2.4×10^2	0.5	2.0
8[A]	8.4×10^2	1.4	2.3×10^2	0.5	1.9
25[D]	7.9×10^2	1.3	2.1×10^2	0.4	1.7
26[E]	7.5×10^2	1.3	2.0×10^2	0.4	1.7
DD-07[F]	7.4×10^2	1.2	1.6×10^2	0.3	1.5
2	6.7×10^2	1.1	1.8×10^2	0.4	1.5
5	5.8×10^2	1.0	1.6×10^2	0.3	1.3
25[D]	5.5×10^2	0.9	1.5×10^2	0.3	1.2
7[B]	5.2×10^2	0.9	1.4×10^2	0.3	1.2
26[E]	5.1×10^2	0.9	1.4×10^2	0.3	1.2

A Same Location
B Two Samples
C Two Samples
D Two Samples
E Two Samples
F Same Location
G Same Location

* 600 pCi/l (1.8 mg/l)
** 500 pCi/l (9.7×10^{-5} mg/l)

Assessment for Need for Removal

There is no apparent or measurable evidence of actual transport to the nearby population, animals, and their food chains, however due to the observed condition of the stream bed of Paddy's Run, migration to the shallow aquifer and to the South Plume is probable during stream flow. Uranium in the South Plume is measurable, and with components attributable to the FMPC. This could result in the contamination of water for agricultural and wildlife use. Without additional controls the potential for this transport will continue.

Precipitation averages 40.0 in/yr (at Greater Cincinnati Airport) with typical monthly rainfall ranging from one to seven inches. This amount of precipitation can result in the migration of surface contamination to off-site areas. There is a high probability that this has already occurred with off-site contamination of ground water south and down gradient of FMPC.

Appropriateness of Response

It is probable that a response can control waste pit storage area runoff and deter the release of contaminants of concern (uranium) that exceed a specific ARAR (National Primary Drinking Water regulation for radiation dose (4 mrem/yr) as stated in 40 CFR 141.16(b)).

If a planning period of less than six months exists prior to initiation of a response, DOE will prepare an Action Memorandum. The Action Memorandum will describe the selected response and supporting documentation for the decision. This will serve as a decision document for the Administrative Record.

If it is determined that there is a planning period greater than six months before a response is initiated, DOE will prepare an Engineering Evaluation/Cost Analysis (EE/CA) Approval Memorandum. This memorandum is to be used to document the threat to public health and environment. It would then serve as the decision document for the Administrative Record File.

APPENDIX A

SUMMARY OF SURFACE WATER SAMPLES

WASTE PIT AREA STORM WATER RUNOFF

TABLE A-1

DAMES AND MOORE DATA
FOR SURFACE WATER RUNOFF

Sample Point Location	Date Collected	Total Uranium, mg/L
SW-3	8/11/86	3.76
SW-4	8/11/86	16.42
SW-5	8/11/86	26.55
SW-6	8/11/86	1.21
RO-3	3/85	0.007
RO-4	3/85	28.0
RO-5	3/85	24.0
RO-6	3/85	4.6
RO-7	3/85	0.31
RO-8	3/85	34.0
RO-9	3/85	3.0
RO-12	3/85	0.34
RO-13	3/85	0.54
RO-14	3/85	0.48
RO-15	3/85	0.71
RO-16	3/85	0.62
RO-17	3/85	11.0
RO-18	3/85	0.53

SOURCE: WMCO, Aug. 25, 1986, Letter EH (EC): 86-0365.

TABLE A-2
WMCO DATA FOR SURFACE WATER RUNOFF

Sample Point Location	TOTAL URANIUM (mg/L) BY SAMPLING DATE (Unfiltered)									
	4/23/87	7/28/87	1/20/88	2/1/88	3/2/88	3/3/88	3/25/88	3/21/89	9/14/89	11/8/89
2	-	-	-	-	-	-	-	-	2.00	8.3
3	-	-	-	-	-	-	-	-	4.70	15.2
5	-	-	-	-	-	-	-	0.800	1.74	14.9
7	-	-	-	-	-	-	-	-	1.56	3.4
8	-	-	-	-	-	-	-	0.770	2.52	6.6
14	DRY	0.163	0.320	0.128	0.043	0.096	0.042	-	0.027	-
15	0.052	0.028	0.200	0.047	0.046	0.078	0.050	-	0.051	15N-0.265 15S-0.224
16	0.007	0.256	0.160	0.071	0.801	0.32	0.28	-	0.16	0.226
25	-	-	-	0.793	2.38	1.64	0.70	0.440	0.28	0.249
26	-	-	-	1.013	2.24	1.54	0.72	0.340	0.32	0.449
27	-	-	-	0.454	11.30	2.70	6.44	-	-	-

SOURCE: Site Environmental Monitoring Data

TABLE A-3

WESTON DATA FOR SURFACE WATER RUNOFF

ANALYTE	DRAINAGE DITCH SAMPLES COLLECTED JULY, 1988				
	DD-07	DD-09	DD-14	DD-23	DD-01
Aluminum, µg/L	456	964	14,400	11,700	869
Barium, µg/L	320	209	387	226	217
TOC, mg/L	118	7.6	16.6	9.4	14.4
TOX, µg/L	260	37	39	43	41
TDS, mg/L	1190	414	358	155	692
TSS, mg/L	20.0	148	2150	385	266
Chloride, mg/L	28.1	39.3	227	2.5*	11.3
Fluoride, mg/L	1.2	1.3	0.68	0.32	0.24
Nitrate, mg/L	0.20*	2.6	1.8	0.20*	1.0*
Gross Alpha pCi/L	850±50	420±30	450±60	100±20	8±5
Gross Beta pCi/L	560±20	380±10	370±30	110±10	13±3
Thorium-228 pCi/L	NR	0.1±0.3	NR	NR	NR
Thorium-230 pCi/L	NR	1.4±0.5	NR	NR	NR
Thorium-232 pCi/L	NR	0.1±0.2	NR	NR	NR
Uranium-234 pCi/L	160±30	57±30	120±10	14±4	0.6±0.5

TABLE A-3
WESTON DATA FOR SURFACE WATER RUNOFF

ANALYTE	DRAINAGE DITCH SAMPLES COLLECTED JULY, 1988				
	DD-07	DD-09	DD-14	DD-23	DD-01
Uranium-235 pCi/L	5±10	1.0±8.6	21±5	2.0±1.3	0.3±0.2
Uranium-238 pCi/L	740±60	310±40	220±20	64±6	2.4±0.5
Radium-226 pCi/L	NR	NR	7.0±0.6	NR	NR
Radium-228 pCi/L	NR	NR	4.5±1.8	NR	NR
Chromium, µg/L	10.0*	10.0*	12.8	18.5	10.0*
Sulfate, mg/L	38.3	89.9	48.4	14.3	317

* - The value reported is the laboratory detection limit. The sample was analyzed, but the specified contaminant was not detected.

NR - An analysis for the parameter was not requested.

SOURCE: Addendum to Best Management Practices Plan: Stormwater Sampling Program Results prepared by Roy F. Weston, Inc., October 18, 1988