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U.S. Department of Energy
Idaho Operations Office

Evaluation and Site Selection for a New Service Waste Disposal Facility for the Idaho Nuclear Technology and Engineering Center

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Date

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Assistant Secretary for Environmental Management
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ABSTRACT

This report describes the process and information used to identify areas near the Idaho Nuclear Technology and Engineering Center having no known regulatory restrictions or critical concerns for siting new service waste effluent disposal ponds. The recommendation for placement of the new facility is a 32-ha (80-acre) zone in the northwest corner of Area B. Final determination of the acceptability of this location requires the collection and analysis of site-specific field data.

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ACRONYMS

AEC	Atomic Energy Commission
bls	below land surface
BLM	U.S. Bureau of Land Management
BLR	Big Lost River
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CRMO	Cultural Resource Management Office
DEQ	Division of Environmental Quality
DOE	Department of Energy
DOE-ID	Department of Energy Idaho Operations Office
EBR-I	Experimental Breeder Reactor I
EPA	U.S. Environmental Protection Agency
ESRP	Eastern Snake River Plain
FFA/CO	Federal Facility Agreement and Consent Order
HLWF	high-level waste treatment and interim storage facility
ICDF	INEEL CERCLA disposal facility
IDAPA	Idaho Administrative Procedures Act
IDHW	Idaho Department of Health and Welfare
INEEL	Idaho National Engineering and Environmental Laboratory
INEL	Idaho National Engineering Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
ISFSI	Independent Spent Fuel Storage Installation
kPa	kilopascal

LET&D	Liquid Effluent Treatment and Disposal
LLWL	low-level waste landfill
LMITCO	Lockheed Martin Idaho Technologies Company
MCL	maximum contaminant level
MCP	management control procedure
MOA	memorandum of agreement
NHPA	National Historic Preservation Act
NPL	National Priorities List
NRF	Naval Reactors Facility
NWI	National Wetland Inventory
OU	operable unit
RCRA	Resource Conservation and Recovery Act
RI/BRA	Remedial Investigation, Baseline Risk Assessment
RWMC	Radioactive Waste Management Complex
SRPA	Snake River Plain Aquifer
SWPPP-IA	stormwater discharge associated with industrial activity
SWPPP	Storm Water Pollution Prevention Plan
SWPPP-CA	stormwater discharge associated with construction activity
SWS	Service Waste System
TAN	Test Area North
TDS	total dissolved solids
TMI	Three Mile Island
TRA	Test Reactor Area
USACOE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

UXO	unexploded ordnance
WAG	waste area group
WCFS	Woodward-Clyde Federal Services
WLAP	Wastewater Land Application Permit

Evaluation and Site Selection for a New Service Waste Disposal Facility for the Idaho Nuclear Technology and Engineering Center

1. INTRODUCTION

In November 1989, the U.S. Environmental Protection Agency (EPA) placed the Idaho National Engineering and Environmental Laboratory (INEEL), including the Idaho Nuclear Technology and Engineering Center (INTEC) on the National Priorities List (NPL). A Federal Facility Agreement and Consent Order (FFA/CO) was negotiated with the EPA and Idaho Department of Health and Welfare (IDHW) to direct the cleanup activities at the INEEL. As a part of the cleanup activities, a comprehensive study, or Remedial Investigation, Baseline Risk Assessment (RI/BRA), was conducted to evaluate the nature and extent of soil and groundwater contamination at the INTEC. The results of the RI/BRA activities indicate that soil at certain release sites and groundwater contamination pose a potential risk to human health and the environment above acceptable levels.

Beneath the INTEC, groundwater (administratively identified as Waste Area Group [WAG] 3) is recharged primarily from the percolation ponds and occasionally, during wet years, from the Big Lost River. These water sources have resulted in the formation of several perched water zones beneath the INTEC at depths ranging from 31 to 128 m (100 to 420 ft) bls. Many of the perched zones have been contaminated by downward transport of contaminants, primarily radionuclides (Sr-90, I-129, and tritium) from the overlying surface soils, and from two instances in which the INTEC injection well collapsed and service wastewater was released to the perched zones. Water flow in the perched water zones is primarily vertical and ultimately recharges the Snake River Plain Aquifer (SRPA). As a result, perched water is one contaminant transport pathway between contaminated surface soils and the SRPA. In addition, contaminants already in the perched water are a secondary source of aquifer contamination.

Reducing and controlling perched water recharge can potentially reduce the flux of contaminants to the SRPA and ultimately reduce the contaminant concentrations in the SRPA. The Service Waste System (SWS) percolation ponds account for the majority of perched water recharge. Therefore, the INTEC Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Proposed Plan for WAG 3 OU 3-13 recommends closure of the service waste percolation ponds as the preferred alternative for decreasing water content in the subsurface. Increasing contaminant travel times allows radioactive decay and natural attenuation processes to reduce contaminant concentrations and residual risk.

To implement these requirements, a new INTEC service waste disposal facility is proposed for construction in an area distant from the existing waste disposal ponds. Efforts to locate the new facility are based on the elimination of areas containing regulatory or other restrictions.

This siting study examines restrictions and recommendations applied to areas adjacent to the INTEC. Pertinent topics include:

- Local geology and soils—depth to basalt/thickness of alluvial sediments
- Location of the 100-year Big Lost River flood plain
- Storm water drainage areas

- Estimated lateral extent of perched water from new and existing percolation ponds based on WAG 3 OU 3-13 modeling
- Wellhead protection zones for INTEC, Central Facilities Area (CFA), and other adjacent potable wells
- Ecologically sensitive areas/preferred development areas
- Archaeological sites or unsurveyed areas
- Unexploded ordnance
- Railroad construction buffer
- Power line construction buffer
- Potential interference with preferred locations of the proposed high-level waste treatment and interim storage facility (HLWF), the low-level waste landfill (LLWL), and the INEEL CERCLA disposal facility (ICDF)
- Other restrictions.

The subsections that follow in Section 1 provide background information, methodology, physical characteristics, and environmental aspects that were included in the site elimination process; historical summaries and descriptions of the INTEC facility; and objectives and general assumptions for the siting evaluation. Section 2 describes the methodology that was used to identify criteria and screen locations against those criteria. Section 3 describes the physical characteristics of the INTEC. Section 4 summarizes the environmental setting of the proposed site. Section 5 presents siting recommendations and conclusions. Comprehensive summaries of INEEL history, facilities, and physical characteristics are found in Holdren et al. 1997a, DOE-ID 1997, and Hull, et al.[a]

1.1 Background

1.1.1 General Facility Information

The INTEC, formerly the Idaho Chemical Processing Plant, is a multipurpose plant located on the INEEL, approximately 4 km (2.5 mi) north of CFA (Figure 1-1). Constructed in 1951, the INTEC initially contained all the facilities necessary to receive and store spent nuclear fuels, process the fuels to recover U-235, and handle waste generated by those functions. However, due to a mission change in 1992, the facility no longer recovers U-235. The INTEC's current mission is to receive and temporarily store, prior to future disposition, spent nuclear fuel and waste fission products resulting from the spent fuel recovery processes. Research and development work is also conducted to develop and improve fuel management and waste processing technologies.

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[a] L. C. Hull, et al.., *Draft Work Plan for Operable Unit 3-14 Tank Farm Waste Area Group 3, Comprehensive Remedial Investigation/Feasibility Study*, 1999.

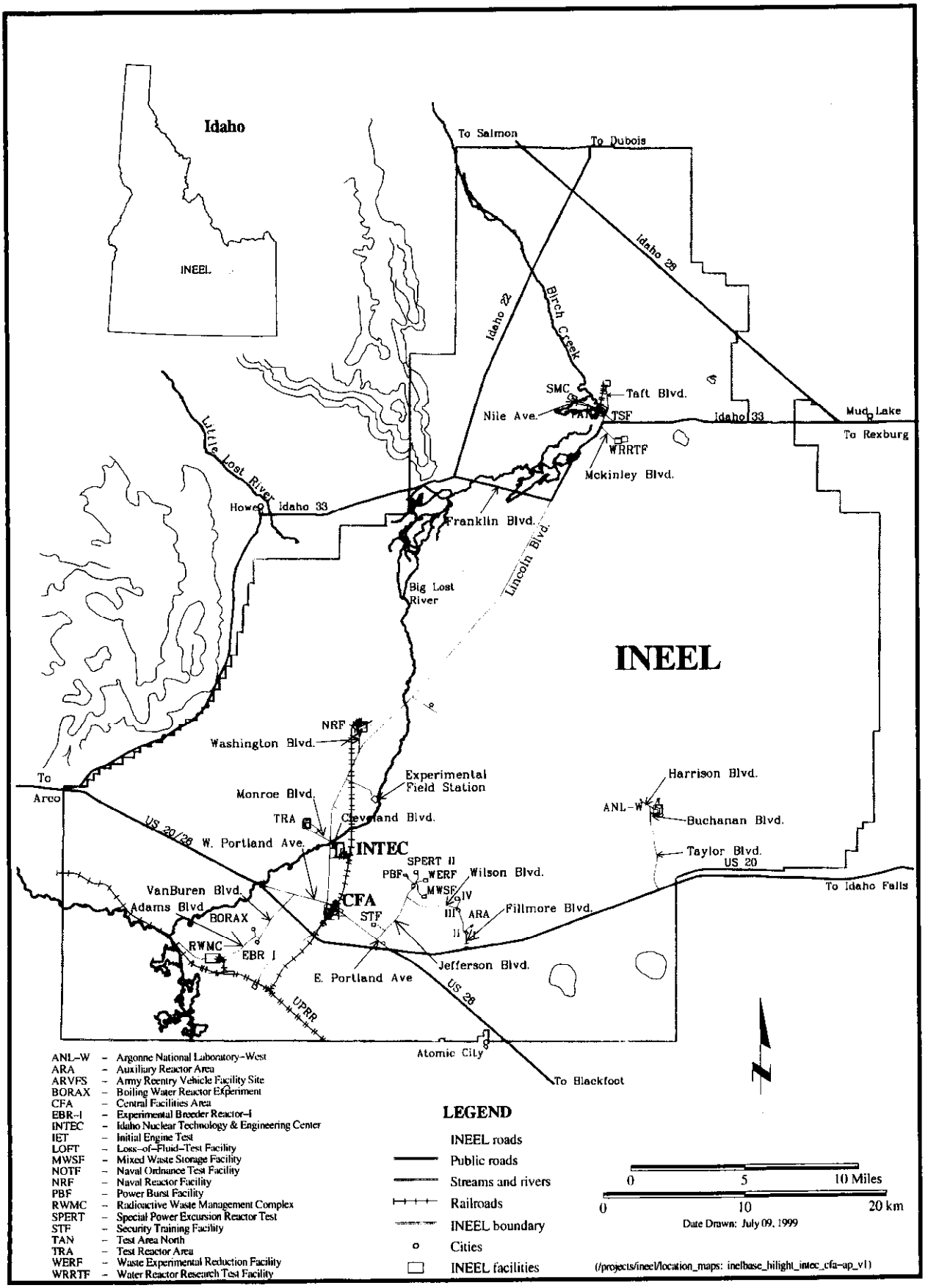

Figure 1-1. Location of INTEC and CFA on the INEEL.

1.1.2 Existing Percolation Ponds and the Service Waste System

The SWS serving all major INTEC facilities generates 5.6 to 9.4 million L/day (1.5 to 2.5 million gal/day) of process wastewater during normal operations. This process-related wastewater consists of steam condensate; noncontact cooling water; water treatment, demineralizer, and boiler blowdown wastewater; and other nonradioactive, nonhazardous liquids. Wastewater is discharged to existing percolation ponds located along the southern boundary of the facility (Figure 1-2) via the SWS.

Percolation Pond 1 is located southeast of CPP-603, is 146 × 125 m (480 × 410 ft) at the top of the berm and is 5.2 m (18 ft) deep. The gravelly alluvium in which the pond was excavated is approximately 6 to 10.1 m (20 to 35 ft) thick and overlies basalt. Prior to operation, soil was backfilled into the pond to its present depth of 5.2 m (18 ft). This pond is designed to accommodate continuous discharge of approximately 7.5 million L/day (1.5 million gal/day).

Percolation Pond 2, located immediately west of Percolation Pond 1, is 152 × 152 m (500 × 500 ft) at the top of the berm, and is 3.6 to 4.3 m (12 to 14 ft) deep. This pond was constructed by removing approximately 3.6 m (12 ft) of surficial sediments. The remaining surface material is estimated to be from 6.1 to 12.2 m (20 to 40 ft) thick. The pond is designed to accommodate continuous discharge of approximately 11 million L/day (3 million gal/day) based on the observed percolation rates.

Wastewater is normally sent to only one of the two ponds at a time. In the event the flow capacity of one pond is exceeded, the total capacity of both ponds (5 MG/day) is available. The ponds are enclosed by a 2.4-m (8-ft) high chain-link fence. Prior to discharge to the ponds, all service waste enters the final sampling and monitoring station (CPP-797) where it is measured for flow-rate, monitored for radioactivity, and sampled as prescribed by the State of Idaho Wastewater Land Application Permit (WLAP) (Permit No. LA-000130-02) for the ponds. Two sets of pumps transfer wastewater from CPP-797 to the percolation ponds.

Hazardous or radioactive wastewater from the INTEC processes and laboratories are sent to either the low-level liquid waste evaporator or the high-level waste Tank Farm for treatment or storage. These waste streams are eventually solidified in a fluidized bed calciner. Sanitary wastes from restrooms and the cafeteria are discharged to the Sewage Treatment Plant located along the northeast boundary of the facility. Some sanitary wastes are directed to on site septic tank systems.

Although all radioactive wastewater systems have been isolated from the service waste stream since January 1993, systems containing liquid radioactive wastes are still present at the facility. The service waste stream is continuously monitored for radioactivity even though the risk of a failure of the protection systems that guard against an accidental discharge of radioactive wastes to the ponds is extremely low. A series of diversion mechanisms throughout the system are automatically triggered by gamma monitoring devices set to activate the system at a specified radioactivity. Upstream gamma monitors activate the diversion mechanism at 200,000 pCi/L. The gamma monitor at CPP-797 activates at 60,000 pCi/L.

1.1.3 Service Waste Stream-Water Quality and Flow Rates

Current discharges from the SWS to the existing percolation ponds are regulated under a State of Idaho WLAP and reported annually to the Department of Health and Welfare (Lockheed Martin Idaho Technologies Company [LMITCO] 1999, LMITCO 1998a, LMITCO 1997a, LMITCO 1995). Data are collected from the waste stream at CPP-797 (the final sampling and monitoring station) prior to discharge to the ponds. Table 1-1 presents annual average effluent concentrations from 1995 to the present. Supplemental information is collected by the INTEC Environmental Support organization for radionuclide concentrations and other parameters. These data, not required under the State of Idaho permit, are reported

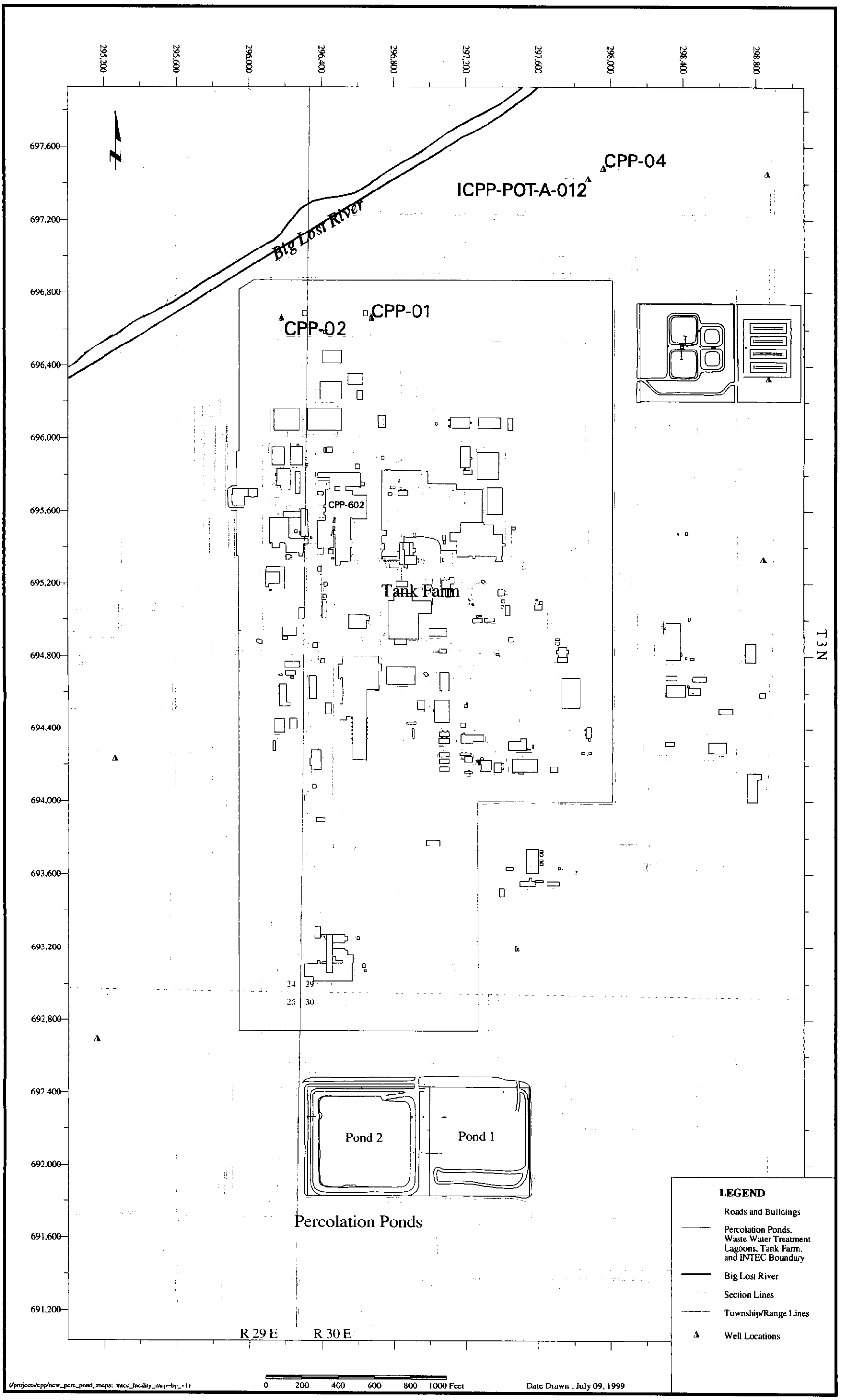

Figure 1-2. INTEC facility map showing the existing percolation ponds, Tank Farm, production wells, drinking water wells, Sewage Treatment Plant, and facility structures.

Table 1-1. Yearly average INTEC service waste effluent concentrations for 1995-1998.[a,b]

Analyte	1995[c]	1996	1997	1998
TKN (mg/L)	0.214[d]	0.194	0.119	0.09
Cl (mg/L)	242	283	263	193
TDS (mg/L)	763	631	616	548
Na (mg/L)	186	168	156	120
NO_2N(mg-N/L)	ND[e]	0.033U[f]	0.097	0.07
NO_3N (mg-N/L)	5.18	1.12	1.05	1.14
As (mg/L)	ND	0.002U	0.0015U	0.0020
Cd (mg/L)	ND	0.001U	0.0015U	0.0014U
Cr (mg/L)	0.033	0.004	0.0044	0.0037
Hg (mg/L)	ND	0.0002U	0.0001U	0.0001
Se (mg/L)	ND	0.002U	0.0022U	0.0019
Ag (mg/L)	ND	0.003U	0.0027	0.0029U
F (mg/L)	ND	0.303	0.215	0.27
Fe (mg/L)	0.034	0.022	0.026	0.0179
pH	8.53	8.51	8.38	8.09
Mn (mg/L)	0.036	0.002	0.0012	0.0014
Cu (mg/L)	ND	0.004	0.0036	0.0051
Al (mg/L)	ND	0.029	0.026U	0.0155U

a. LMITCO 1996b, 1997a, 1998a, and 1999.

b. One-half the detection limit was used in the yearly averages for those results reported as below the detection limit.

c. Data are from September and October 1995.

d. One-half the reported detection limit for the September result was used to calculate the yearly average.

e. ND = not detected.

f. U = ≤ Instrument Detection Limit.

annually to U.S. Department of Energy Idaho Operations Office (DOE-ID) and summarized in Table 1-2. Future discharge volumes are expected to remain consistent with historical ranges reported in Table 1-3.

Although the current permit does not specify concentration limits for effluent entering the percolation ponds, it does specify concentration limits in groundwater, with permit exceptions for total dissolved solids (TDS) (800 mg/L) and chloride (350 mg/L) in groundwater. Measured concentrations for chemical parameters in the effluent and groundwater are often compared to levels in the State of Idaho Groundwater Quality Standards of the *Water Quality Standards and Wastewater Treatment Requirements* (Idaho Administrative Procedures Act [IDAPA] 16, Title 1, Chapter 2). Prior to 1984, service waste containing radionuclides was discharged directly into the aquifer via an injection well. In 1984, regular use of the injection well ceased and service waste was piped to percolation ponds constructed in approximately 1984. The injection well was used for emergency purposes until 1986 and abandoned in 1989.

Table 1-2. Annual total INTEC service waste effluent radionuclide concentrations for 1993 through 1998.[a]

Radionuclide	1993 (Ci)	1994 (Ci)	1995 (Ci)	1996 (Ci)	1997 (Ci)	1998[b] (Ci)
C-14	NS[c]	ND[d]	ND	NS	NS	NS
Co-57	NS	NS	6.65E-05	NS	ND	NS
Co-60	1.00E-03	1.12E-04	1.16E-04	NS	ND	NS
Cs-134	ND	ND	ND	ND	ND	ND
Cs-137	2.18E-03	4.53E-04	7.10E-05	5.83E-04	ND	7.30E-05
Eu-152	NS	NS	6.15E-03	ND	ND	ND
H-3	ND	ND	2.06E-01	NS	NS	NS
I-129	NS	ND	ND	NS	NS	NS
Pu-238	NS	8.52E-06	3.06E-05	2.96E-06	ND	ND
Pu-239[e]	NS	ND	ND	ND	3.53E-03	ND
Pu-241	NS	ND	1.89E-04	ND	ND	ND
Pu-Total	4.82E-05	NS	NS	NS	NS	NS
Ru-106	ND	ND	ND	ND	ND	ND
Sb-125	ND	4.24E-05	ND	ND	ND	ND
Sr-90	2.74E-03	6.77E-04	1.61E-03	1.69E-04	2.05E-02	1.13E-02[f]
U-234	NS	3.17E-03	3.47E-03	3.60E-04	ND	ND
U-235	NS	6.52E-05	8.70E-05	1.06E-05	ND	ND
U-238	NS	1.36E-03	1.76E-03	1.69E-04	ND	ND
U-TOTAL	5.70E-03	NS	NS	NS	NS	NS
Gross alpha	2.42E-09	6.08E-09	4.97E-09	6.06E-09	2.89E-09	2.08E-08
Gross beta	8.28E-09	1.15E-08	1.43E-08	2.10E-08	1.04E-08	2.43E-08

a. LMITCO 1995, 1996a, 1997b, and 1998b.

b. Report not yet issued.

c. NS—not sampled.

d. ND—not detected.

e. Measured as gross alpha and reported as Pu-239.

f. Measured as gross beta and reported as Sr-90.

Table 1-3. Annual INTEC service waste effluent flow volumes in gallons per day (gpd).[a]

Year	Average (gpd)	Maximum (gpd)	Minimum (gpd)
1995[b]	1,342,500	1,441,660	1,236,000
1996	1,593,000	2,210,000	634,000
1997	1,677,454	2,284,100	196,490
1998	1,599,300	2,188,900	928,400

a. LMITCO 1996b, 1997a, 1998a, and 1999.

b. September through October

The *1998 Annual Wastewater Land Application Site Performance Reports for the Idaho National Engineering and Environmental Laboratory* (LMITCO 1999) identifies that the yearly average effluent concentrations for measured constituents met groundwater standards, except for TDS and sodium. The yearly average concentration for TDS (548 mg/L) was above the groundwater standard of 500 mg/L, but has decreased since the permit was issued in 1995. Chloride concentrations remain below the groundwater standard concentration and show a decreasing trend since 1995.

Levels of TDS, sodium, and chloride in the effluent are primarily a result of the water softening and water treatment operations in CPP-606. In January 1998, a reverse osmosis unit was installed and a demineralizer system was put into operation, both of which have reduced the amount of salt additions required for treating water. Additional equipment and operational modifications planned for 2000 are expected to significantly reduce the concentrations of these constituents. It is anticipated that this reduction of TDS, chloride, and sodium will be a permit condition for the new percolation ponds.

Effluent monitoring for radionuclides is not required for the service waste stream under the State of Idaho WLAP. However, the INTEC Environmental Support Organization routinely collects radionuclide data and reports them annually to DOE-ID (LMITCO 1998b, LMITCO 1997b, LMITCO 1996a, LMITCO 1995, WINCO 1994). (These data are not validated according to Environmental Restoration standards.) In January 1993, process equipment waste discharges containing radionuclides were isolated from the SWS and routed to the Liquid Effluent Treatment and Disposal (LET&D) facility.

Post-January 1993 data are most representative of future discharges through the SWS. At the point-of-compliance for the existing percolation ponds (downgradient wells U.S. Geological Survey [USGS]-112 and -113), there are no exceedances in the aquifer of any of the currently monitored contaminants. In effluent collected at CPP-797, contaminants exceeding maximum contaminant levels (MCLs) were TDS (558 to 897 mg/L, MCL 500 mg/L) and chloride (250 to 349 mg/L, MCL 250 mg/L). These contaminants are primarily due to the water softening and water treatment operations in CPP-606. Contaminant levels that were intermittently above MCLs were cadmium (.007 to .015 mg/L, MCL .005 mg/L), nitrate (12.1 to 17.6 mg/L, MCL 10 mg/L), iron (.578 mg/L, MCL 0.3 mg/L) and pH (8.5 to 8.78 mg/L, MCL 6.5 to 8.5). Potential sources for these contaminants were not investigated. Contaminant levels near the MCLs were lead (.003 mg/L, MCL .005 mg/L), aluminum (0.18 mg/L, MCL 0.2 mg/L) and manganese (.048 mg/L, MCL .05 mg/L). Radionuclides in CPP-797 effluent were not above the comparison levels from 1993 through 1996 and in 1998.

Additional service waste samples were collected at CPP-797 from February through August 1999 and analyzed for metals, nonmetals, I-129, Sr-90, gross alpha, gross beta, and gamma. The data are unvalidated and unreported.

1.1.4 Regulatory History of the Existing INTEC Percolation Ponds

When the percolation ponds were constructed, there were no applicable State of Idaho or federal requirements for permitting the operation of the ponds. In 1988, the State of Idaho implemented guidelines for land application of municipal and industrial wastewater. Although the INEEL and DOE-ID were exempted from compliance with the State rules for permitting, in 1994 DOE-ID began submitting formal permit applications for all percolation ponds in operation on the INEEL to conform to State of Idaho regulations. The INTEC percolation ponds received their existing permit in September 1995, which was to remain in effect for a period of 5 years. The permit will expire on September 17, 2000.

2. METHODOLOGY

The general methodology used to locate new INTEC percolation ponds incorporates an objective and scope which are constricted by general assumptions established by Federal and State regulatory guidelines.

2.1 Objective

The main objective of this siting study is to identify areas near the INTEC where new percolation ponds may be located. By eliminating restricted areas based on environmental or regulatory issues, efforts can be focused on collecting and analyzing site-specific field data.

2.2 Scope

The scope of this document includes:

- Identifying siting restrictions and concerns
- Screening areas near INTEC against siting restrictions and concerns using existing information
- Proposing clear zone(s) for siting the new service waste disposal facility
- Selecting a location for the new ponds and collecting additional data to confirm the acceptability of the proposed location.

Only the activities specific to the evaluation of locations are considered in this study. Other concerns such as radiological consequences, risk assessment, site-specific seismic studies, site-specific characterization, consequences to air quality, proximity to known Resource Conservation and Recovery Act (RCRA) or CERCLA sites, safety analysis, and other requirements for final site selection are deferred to subsequent studies. This study is qualitative and based on existing data.

2.3 General Assumptions and Site Evaluation Methodology

General assumptions applied to the site evaluation are as follows:

- The new percolation pond location will not impact existing contaminated perched water in the 34 and 116-m (110 and 380-ft) interbeds beneath INTEC.
- Only sites near INTEC will be considered.
- The IDHW will grant construction and operating permits to the INEEL for new percolation ponds.
- Concentrations of TDS, chloride, and sodium currently present in INTEC service waste will be substantially reduced prior to operating the new facility.
- For the WLAP application, it is critical that the maximal lateral extent of the zone of 100% saturation in the perching layers be estimated, detectable, and monitored. In order to satisfy the State of Idaho regulation that impact to groundwater must be measurable, aquifer

monitoring wells must be placed outside the zone of 100% saturation. Based on knowledge of the behavior of water within the vadose zone from other locations (Test Reactor Area [TRA], Radioactive Waste Management Complex [RWMC], Test Area North [TAN], and the existing INTEC percolation ponds), it is assumed that water infiltrating from new ponds will migrate downward until intercepting the least shallow, lesser permeable zone. From there, it will spread laterally some distance then migrate predominantly vertically to the aquifer. This location of initial contact of the wastewater with the aquifer water is the point from which monitoring for impacts to the aquifer must occur.

- The INEEL Comprehensive Facility and Land-use Plan recommended by DOE (DOE-ID 1996) will be observed.

- The USGS approximate boundaries (Berenbrock and Kjelstrom 1997) for the 100-year Big Lost River floodplain are conservative (i.e., the boundaries include areas at risk but may encompass areas that will not be flooded). Additional paleoflood studies are more appropriate for this site evaluation.

- Residual radioactive contamination (gross beta) in the service waste stream will be characterized and eliminated.

2.4 SITE EVALUATION METHODOLOGY

The siting study goal was to identify locations suitable for placement of new percolation ponds, focusing on an area or areas near INTEC to receive additional investigation. To do this, a simplistic methodology, based on the process of eliminating zones or areas determined to be unacceptable, evaluated criterion driven by regulatory requirements, logistical or technical considerations, or conservative professional judgement based on other characteristics not clearly defined in regulations. Section 5, "Siting Study Recommendations and Conclusions" provides more detail concerning applicable criteria. Pertinent regulations identified in Holdren et al. 1997, for the siting of waste treatment, storage, and disposal facilities were evaluated for applicability to this project. Even though the new percolation ponds are not governed by all the regulations applicable to waste facilities, conservative professional judgement was used to determine some of the area boundaries.

The driving reason for constructing new ponds (based on WAG 3 OU 3-13 modeling of the INTEC hydrogeologic system) is to eliminate the largest source of water infiltrating into the subsurface at INTEC as a best management practice. New percolation ponds will be located so that associated new perched water will not impact the subsurface beneath the INTEC facility.