NOTICE

All drawings located at the end of the document.

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FINAL

FIELD TREATABILITY STUDY

FIELD SAMPLING PLAN PHASE II

SOUTH WALNUT CREEK BASIN SURFACE WATER INTERIM MEASURES/ INTERIM REMEDIAL ACTION

OPERABLE UNIT NO. 2

U.S. DEPARTMENT OF ENERGY

Rocky Flats Plant
Golden, Colorado

ENVIRONMENTAL RESTORATION PROGRAM

22 January 1993

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TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

LIST OF FIGURES

LIST OF TABLES

TABLE OF CONTENTS
(Continued)

GLOSSARY OF ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
CLP	Contract Laboratory Program
CRDL	Contract Required Detection Limit
CS	Collection System (Surface Water)
DOE	U.S. Department of Energy
EG&G	EG&G-Rocky Flats, Inc.
EMAD	Environmental Monitoring and Assessment Division
EPA	U.S. Environmental Protection Agency
FI	Flow Indicator
FSP	Field Sampling Plan
FTU	Field Treatability Unit
GAC	Granular-Activated Carbon
gpm	gallons per minute
GRRASP	General Radiochemistry and Routine Analytical Services Protocol
IM/IRA	Interim Measures/Interim Remedial Action
MDA	minimum detectable activity
mg	milligram
OU2	Operable Unit No. 2
PA	Protected Area
pCi	picocuries
PQL	Practical Quantitation Limit
ppm	Parts per million
QAA	Quality Assurance Addendum
QAPjP	EG&G Rocky Flats Site-Wide Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RFP	Rocky Flats Plant
RI	Remedial Investigation
RQL	Required Quantitation Limit
SOP	Standard Operating Procedure
SW	Surface Water
TAL	Target Analyte List
TBC	To Be Considered
TCL	Target Compound List
TCLP	Toxicity Characteristic Leachate Procedure
TOC	Total Organic Carbon
VOC	Volatile Organic Compound
ℓ	liter
μg	microgram

SECTION 1
INTRODUCTION

This Field Sampling Plan (FSP) presents detailed guidance for sampling the South Walnut Creek Basin Field Treatability Unit (FTU). This FSP has been prepared as part of the Field Treatability Study Workplan (EG&G, 1991a) for the South Walnut Creek Basin Surface Water Interim Measures/Interim Remedial Action (IM/IRA) at Operable Unit No. 2 (OU2).

The field treatability study at South Walnut Creek Basin is part of a comprehensive remedial investigation (RI), feasibility study, and remedial action program at the Rocky Flats Plant (RFP). RIs at OU2 have identified the presence of volatile organic compounds (VOCs), radionuclides, and metals in South Walnut Creek Basin surface waters. EG&G–Rocky Flats, Inc. (EG&G) and the U.S. Department of Energy (DOE) have conducted a detailed analysis of interim remedial alternatives for collection and treatment of contaminated South Walnut Creek Basin surface water (EG&G, 1991b). This analysis resulted in selection of the following preferred IM/IRA alternative:

- Collect contaminated surface water by diversion at three surface water (SW) monitoring stations located within the South Walnut Creek Basin: SW-59, SW-61, and SW-132 (Figure 1-1).
- Remove suspended solids, radionuclides, and metals from the collected surface water by chemical treatment (i.e., coagulation and flocculation) and microfiltration.
- Remove VOCs from the surface water by granular-activated carbon (GAC) treatment.

The selected IM/IRA treatment process is illustrated in Figure 1-2. Initial operation of the IM/IRA treatment system is considered a field treatability study to confirm the selection of the preferred treatment system or to provide the basis for selection of an alternative system should the preferred IM/IRA process be judged to not perform adequately. The treatability study is being executed in two phases.

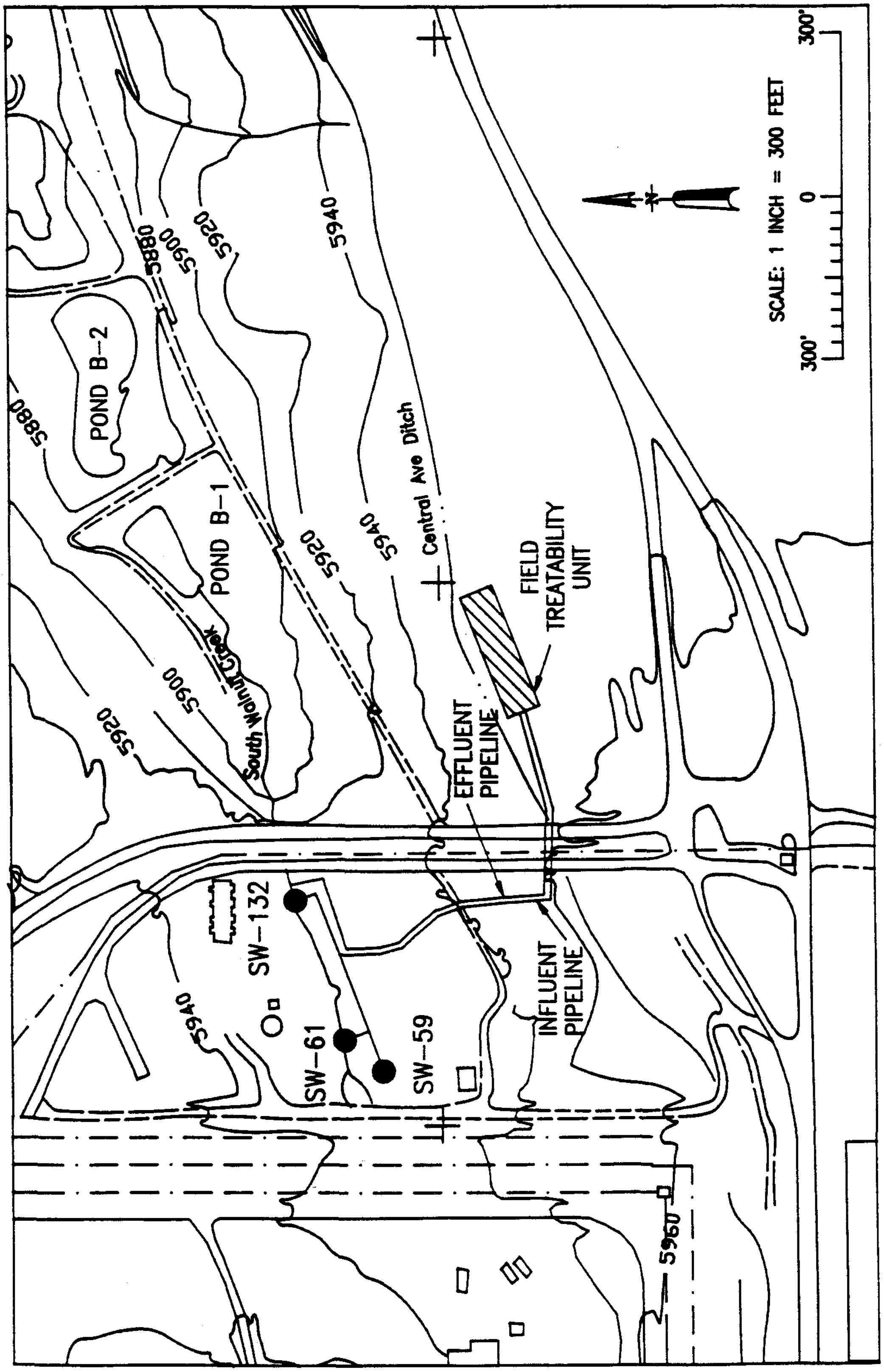


FIGURE 1-1

FIELD TREATABILITY UNIT PLOT PLAN
SOUTH WALNUT CREEK BASIN IM/IRA

Phase I involved the installation of surface water collection systems (CSs) and the VOC removal units (i.e., GAC units). The Phase I system was operational on 13 May 1991. Field treatability testing of the Phase I unit also began in May 1991 (EG&G, 1992).

Phase II of the field treatability study involved the addition of chemical treatment, microfiltration, and solids removal systems to the Phase I FTU for eliminating suspended solids and inorganic contaminants (refer to Figure 1-2). Startup and treatability testing of the Phase II FTU began in the Spring of 1992.

1.1 PROJECT BACKGROUND

The RFP began operations in 1951. Past hazardous waste management practices at the RFP have resulted in environmental contamination at several plant site areas. One such area, designated as OU2, includes the 903 Pad, Mound, and East Trenches Areas. Past waste management practices at these areas include solid and liquid waste disposal, reactive metals destruction, and waste burning. Contamination arising from OU2 has impacted South Walnut Creek.

A Phase I RI for OU2 was completed in 1987, and the RI Report was submitted to the regulatory agencies in December 1987. The investigation included soil, ground-water and surface water sampling, and various types of subsurface soil surveys. The RI identified the presence of VOCs, radionuclides, and metals in OU2 soils, ground waters, and surface waters. While investigations to fully characterize OU2 contamination continue and a final remedy is being determined, the DOE is pursuing OU2 surface water cleanup under an IM/IRA.

On 8 May 1991, the DOE released an IM/IRA Plan (EG&G, 1991b) to collect and treat contaminated surface water in a portion of the South Walnut Creek drainage at OU2. Although no immediate threat to public health or the environment is posed by this surface water contamination, there is a potential threat. Implementation of this IM/IRA will enhance DOE's efforts toward containing and managing contaminated OU2 surface water and will mitigate downgradient contaminant migration. The South Walnut Creek Basin Surface Water IM/IRA

Plan dated 8 May 1991 was approved for implementation by the U.S. Environmental Protection Agency (EPA) and the Colorado Department of Health in May 1991.

1.2 SURFACE WATER IM/IRA DESCRIPTION

The IM/IRA addresses surface water collection from the portion of the South Walnut Creek Basin located between the east perimeter of the Protected Area (PA) and the RFP security fence (Figure 1-1). Surface water will be collected at three locations within the drainage: SW-59, SW-61, and SW-132. SW-59 represents a surface water seep flow on the south bank of the South Walnut Creek drainage. SW-61 is located within the drainage and represents the combined flows of SW-59, surface water runoff south of the PA (discharge from a corrugated metal culvert), and surface water runoff from within the PA (discharge from a concrete culvert). SW-132 represents the discharge from a second corrugated metal culvert approximately 225 feet downstream of SW-61; this discharge is the flow from the upper reach of South Walnut Creek. During construction of the RFP, the headwater area of South Walnut Creek had been filled, and, as a result, flow originates from a buried culvert located west of Building 991. This flow is directed to the south of Building 991 under the PA by a buried, corrugated metal culvert and discharged at SW-132.

As presented in the South Walnut Creek Basin Surface Water IM/IRA Plan (EG&G, 1991b), surface water will be collected from each of the monitoring stations. The design flows, listed in Table 1-1, were developed to ensure collection of above-average precipitation wet season flows not corresponding to major storm events at the monitoring stations. The total design flow of 60 gallons per minute (gpm) is the IM/IRA treatment system capacity.

1.2.1 Contaminants of Concern

The Phase I RI at OU2 indicated the presence of VOCs, radionuclides, and metals in South Walnut Creek Basin surface waters. Analysis of the data with regard to the IM/IRA surface water collection locations (i.e., SW-59, SW-61, and SW-132) identified the potential for many of the contaminants to be present above regulatory concentration limits (EG&G, 1991b). These contaminants of concern, along with their expected maximum concentrations in the influent to

Table 1-1

Design Flows for IM/IRA
Surface Water Diversion and Collection System

Station	Design Flow (gpm)
SW-59	4.5
SW-61	37.5
SW-132	18.0
Total Design Flow Rate	60.0 gpm

Source: "Surface Water Interim Measure/Interim Remedial Action Plan/ Environmental Assessment and Decision Document, South Walnut Creek Basin, Operable Unit No. 2," EG&G-Rocky Flats, Inc., 8 March 1991.

Table 1-2

Basis for Design of Surface Water IM/IRA Treatment System

Constituent	Unit	Influent Concentration[a]	Effluent Requirements[b]
Organics:			
Vinyl Chloride	µg/ℓ[c]	14	2
1,1-Dichloroethene	µg/ℓ	142	7
1,1-Dichloroethane	µg/ℓ	6	5 U[d]
1,2-Dichloroethene (total)	µg/ℓ	10	5 U[d]
Chloroform	µg/ℓ	82	1 U
Carbon Tetrachloride	µg/ℓ	219	5
Trichloroethylene	µg/ℓ	153	5
Tetrachloroethylene	µg/ℓ	279	1 U
Methylene Chloride	µg/ℓ	40	5 U[d]
Acetone	µg/ℓ	117	10 U[d]
Dissolved Metals:			
Beryllium	mg/ℓ[e]	0.0053	0.1
Manganese	mg/ℓ	0.5790	0.05
Strontium	mg/ℓ	0.8396	0.396
Tin	mg/ℓ	0.9036	0.1
Total Metals:			
Arsenic	mg/ℓ	0.01 U	0.025 U
Aluminum	mg/ℓ	25.1214	0.2 U
Antimony	mg/ℓ	0.0655	0.064[d]
Barium	mg/ℓ	1.853	1
Beryllium	mg/ℓ	0.0519	0.1
Cadmium	mg/ℓ	0.0132	<0.005
Chromium	mg/ℓ	0.1918	0.01
Cobalt	mg/ℓ	0.1232	0.05[d]
Copper	mg/ℓ	0.2664	0.025 U
Iron	mg/ℓ	183.9643	1
Lead	mg/ℓ	0.1954	0.005 U
Lithium	mg/ℓ	0.41	2.5[d]
Manganese	mg/ℓ	3.3068	1
Mercury	mg/ℓ	0.0022	0.0002 U
Nickel	mg/ℓ	0.2239	0.04 U
Selenium	mg/ℓ	0.007	0.01

Table 1-2 (Continued)

Basis for Design of Surface Water IM/IRA Treatment System

Constituent	Unit	Influent Concentration[a]	Effluent Requirements[b]
Total Metals (Con't):			
Strontium	mg/ℓ	0.8600	0.382[f]
Vanadium	mg/ℓ	0.5019	0.1[d]
Zinc	mg/ℓ	1.3475	0.05
Dissolved Radionuclides:			
Gross Alpha	pCi/ℓ[g]	20.11	11.00
Gross Beta	pCi/ℓ	39.90	19.00
Total Uranium	pCi/ℓ	9.96	10.00
Total Radionuclides:			
Gross Alpha	pCi/ℓ	730.0	11.00
Gross Beta	pCi/ℓ	545.0	19.00
Plutonium 239,240	pCi/ℓ	3.28	0.05
Americium 241	pCi/ℓ	0.53	0.05
Total Uranium	pCi/ℓ	11.69	10.00

[a] The influent concentrations are based on flow-weighted maximum concentrations of station SW-59 and the following group of stations: SW-56, SW-60, SW-61, and SW-101. The maximum observed concentrations for each station or group of stations is multiplied by the corresponding collection station design flow. The multiplication products for each collection station are summed and divided by the sum of the CS-59 and CS-61 design flows (42 gpm). Concentration data used in the flow-weighted maximum concentration computation is obtained from the 1987, 1988, and 1990 field investigations.

[b] Based on Applicable or Relevant and Appropriate Requirements (ARARs). The "U" designation following many of the effluent concentrations indicate that the concentration is the detection limit for that constituent.

[c] Micrograms per liter.

[d] No ARAR standard exists for this constituent; effluent requirements is To Be Considered (TBC) concentration, considered as an IM/IRA treatment goal.

[e] Milligrams per liter.

[f] No ARAR or TBC standard exists for this constituent; effluent requirement is background concentration, considered as an IM/IRA treatment goal.

[g] Picocuries per liter.

Source: "Surface Water Interim Measures/Interim Remedial Action Plan/Environmental Assessment and Decision Document, South Walnut Creek Basin, Operable Unit No. 2," EG&G-Rocky Flats, Inc., 8 March 1991.

the IM/IRA treatment system, are listed in Table 1-2. The maximum expected contaminant influent concentrations listed in Table 1-2 are based on the flow-weighted maximum concentrations of station SW-59 and the following group of stations:
SW-56, SW-60, SW-61, and SW-101 (EG&G, 1991b). The effluent requirements listed in Table 1-2 are based on an analysis of all applicable or relevant and appropriate requirements (ARARs). Expected flow and influent concentration together with the effluent requirements provided the basis of design for the IM/IRA treatment system.

1.3 FIELD TREATABILITY UNIT DESCRIPTION (PHASE II)

Installation of the Phase II FTU (i.e., chemical precipitation, microfiltration, and GAC) was completed in the Spring of 1992. The Phase II FTU is illustrated in Figure 1-3 and consists of the following subsystems:

- Surface water collection and equalization.
- Chemical treatment.
- Concentration and microfiltration.
- Neutralization.
- Solids dewatering.
- GAC adsorption.

Each of these FTU process subsystems are discussed in detail below.

Collection and Equalization System

Surface water collection systems CS-59, CS-61, and CS-132 serve to divert and transfer design flows from SW-59, SW-61 and SW-132, respectively. Surface water flows at each station in excess of the CS design flows may be permitted to overflow the collection system and continue downstream along its pre-IM/IRA flow path. Each collection system includes a precast reinforced concrete catch basin with a stainless steel submersible pump. The pump is

The pump is located inside each catch basin and its operation is controlled by a float switch. The raw water is pumped from the catch basins to a flow equalization tank through double-wall polyethylene piping. The piping is wrapped with heat tape and insulation to protect against freezing during the winter months.

The equalization tank has a capacity of 10,000 gallons and is fabricated of cross-linked polyethylene. Surface water influent levels in the tank are continuously monitored and displayed. Level indication includes low, high, and overflow visual and audible alarms at 5, 90, and 95 percent of tank capacity, respectively. At peak flow the tank can provide nearly 3 hours of equalization time.

Chemical Treatment System

The first step of chemical treatment is to lower influent pH to approximately 4.5 to avoid carbonate complexation of uranium and to neutralize total alkalinity. Ferric sulfate is then added as a coagulant and co-precipitating agent. Lime is added in Reaction Tank No. 2 to raise the pH to 9.5 which causes the precipitation of iron and dissolved heavy metals as metal hydroxides. Radionuclides and metals adsorb to particulates and are entrained in the floc. Auxiliary chemicals such as biological inhibitors and coagulant aids may be added to enhance the overall effectiveness of the process. The chemical treatment system consists of two reaction tanks (800 gallons each); one ferric sulfate addition tank (50 gallons); one lime addition tank (250 gallons); and one auxiliary chemical addition tank (250 gallons). All the tanks are equipped with level control instrumentation and agitators.

Ferric sulfate solution is added at a rate to maintain its concentration in Reaction Tank No. 1 at approximately 7.5 to 20 parts per million (ppm). The ferric sulfate and any auxiliary chemical solutions are prepared in feed tanks by mixing powdered reagent and water and are fed to Reaction Tank No. 1 by metering pumps. The pH in Reaction Tank No. 1 is maintained within the optimal range by acid addition, which is controlled by on-line pH instrumentation. From Reaction Tank No. 1, the surface water overflows to Reaction Tank No. 2 where lime slurry (approximately 5 percent) and any required auxiliary chemicals are added. The lime slurry is prepared in the lime addition tank which is provided with a filter, dust control hood, and a slurry recirculation pump. The supply of lime to Reaction Tank No. 2 is controlled by an automated pH monitoring and control system. Residence time in each tank is approximately 20 minutes.

Concentration and Microfiltration System

The concentration and microfiltration system physically separates the floc formed in Reaction Tank No. 2. Surface waters from Reaction Tank No. 2 overflow to the concentration tank (3,000 gallons), which is constructed of fiberglass reinforced plastic and equipped with baffles, level controls and a corrosion resistant recirculation pump (50 horsepower, 700 gpm). The process stream is pumped from the concentration tank to a microfiltration system. The membrane filter is in a shell and tube configuration with the membrane on the inside of the tubes. The permeate passes through the tubes perpendicular to the main flow at a relatively low operating pressure. Manifolds are provided to collect the filtrate and direct it by gravity to the neutralization tank.

Filtered solids (2 to 5 percent slurry) are returned to the concentration tank. Solids in the concentration tank are periodically pumped to the slurry holding tank. Overflow from the slurry holding tank is recycled to the concentration tank. The solids removal rate from the concentration tank is adjusted manually to maintain the desired solids concentration in the filtration modules. All piping and valves in contact with the process streams are fabricated of heavy-duty, corrosion resistant plastic. A clean-in-place system, comprised of a flush tank and a chemical holding tank, is included in the design of the microfiltration unit operation. Both tanks are made of high-density polyethylene and have a 400-gallon capacity.

Neutralization System

A skid-mounted neutralization system is provided to adjust the filtrate pH to 7 by addition of sulfuric acid. The pH adjustment makes the filtrate amenable for GAC treatment and discharge or recycle. The equipment and components of the neutralization system are as follows:

- 1,500-gallon, heavy-duty plastic tank.
- Heavy-duty rim mounted mixer.
- 55-gallon acid drum with metering pump.
- Control panel containing:
  - pH monitor/controller/alarm.
  - pH recorder.

Solids Dewatering System

The *solids dewatering system* is used to process the solids in the slurry holding tank. This system includes an air operated slurry pump to transfer concentrated solids from the solids holding tank to the filter press. The filter press removes water from the solids and creates a filter cake that is 35 to 50 percent solids by weight. The filtrate produced by the filter press is recycled to the concentration tank. The filter cake is transferred into drums placed beneath the elevated filter press.

Granular-Activated Carbon Treatment System for VOC Removal

After neutralization, the process water is pumped through two GAC columns configured in series, and operated in a downflow, fixed-bed mode. Two additional GAC adsorption units are configured in parallel to the on-line units and are maintained in an online, standby mode. Each carbon column is 60 inches in diameter and 87 inches high. Based on a flow rate of 60 gpm, the hydraulic loading to each column is approximately 3 gpm per square foot. Empty bed contact time for each column is approximately 18 minutes. The GAC units are skid-mounted and are connected to the process piping via stainless steel, quick connect couplings. The vessels are fabricated of stainless steel and all process piping, fittings, and valving are manufactured from Schedule 80 polyvinyl chloride.

When the lead GAC unit becomes spent, it is taken out of service. The GAC unit in the polishing position becomes the new lead unit and one of the on-line, standby units is placed in the polishing position. "Rotation" of the GAC units into the lead, polishing, and standby positions is accomplished by changing the open/closed configuration of the process valves. Physical movement of unspent GAC units is not necessary. The spent GAC unit is replaced with a new unit containing virgin GAC. The newly installed unit is immediately placed in the on-line, standby mode. Each of the four vessels contains 2,000 pounds of GAC.

Locally mounted, stainless steel pressure gauges on the inlets and outlets of the GAC units are provided. Pressure drop readings will indicate the presence of particulate or possible biofouling of the GAC units. Fouling is not expected because of upstream chemical treatment and 0.1 micrometer (μm) microfiltration.

Following treatment, the water will be continuously discharged to South Walnut Creek just downgradient of the surface water collection systems.

FTU Process Instrumentation

The FTU will include a central control panel for enclosure of all controls, electrical switches, disconnects, and motor starters. Primary FTU instrumentation and electrical equipment will include the following;

- pH monitors, controllers, and alarms.
- Pump motor starters and circuit breakers.
- Tank level controls and alarms.
- FTU effluent flow indicator and totalizer.
- Indicator lights, switches, and alarms.

All wiring and controls will meet applicable national electrical codes.

1.4 FIELD SAMPLING PLAN ORGANIZATION

Sections 2 through 5 of this FSP have been prepared to specifically address Phase II of the field treatability study program. Section 2 of this FSP discusses the objectives of the field treatability study. Section 3 presents the sampling and analysis program necessary to fulfill the objectives of the treatability study. The locations, frequencies, and analyses of the treatability test samples are provided. Section 4 presents quality assurance/quality control (QA/QC) guidance, and Section 5 lists the literature sources referenced in this FSP.

SECTION 2

FIELD TREATABILITY STUDY OBJECTIVES

The primary objectives for Phase II of the field treatability study include evaluation of the performance of the Phase II FTU with regard to:

- Collection of the required South Walnut Creek Basin flows (i.e., CS design flows).
- Chemical characterization of the FTU surface water influent.
- Removal of VOCs, radionuclides, and metals from the collected surface water.
- Characterization of FTU waste streams.

The first objective will be satisfied by daily monitoring of the flow rates of surface water pumped from each collection system (i.e., CS-59, CS-61, and CS-132) and periodic visual inspections of the systems to verify proper working conditions. Design flow rates are presented in Table 1-1.

The second objective will be achieved by sampling and analyzing the surface water influent to the equalization tank. The influent samples will be analyzed for all contaminants of concern listed in Table 1-2. Analytical methodology will establish the contaminant detection limits required by ARARs.

Removal of radionuclides and metals will be assessed by sampling and analysis of (1) the influent to the equalization tank, (2) the effluent from the equalization tank, and (3) the effluent from the neutralization tank. VOC removal across various stages in the process will be determined by sampling and analysis of (1) the influent to the equalization tank; (2) the effluent from the equalization tank; (3) the effluent from the neutralization tank (i.e., influent to GAC adsorption units); and (4) the effluent from the lead and polishing GAC units. The details of the FTU sampling and analysis program are presented in Section 3.

The final objective for Phase II of the field treatability study is to characterize secondary waste streams. Filter cake (generated by the filter press), spent GAC, spent cleaning solutions, and other residuals will be analyzed to assess disposal options and satisfy the waste characterization requirements of disposal facilities. If during the course of surface water treatment GAC is contaminated with radionuclides, it may not be suitable for regeneration and may require disposal as a mixed waste. Sampling and analysis procedures to characterize filter cake and GAC are presented in Section 3.

SECTION 3

FIELD TREATABILITY UNIT SAMPLING AND ANALYSIS PROGRAM

This section presents the sampling and analysis program necessary to satisfy the process performance and chemical characterization objectives of Phase II of the field treatability study (Section 2). Specifically, the objectives addressed by this program include:

- Characterization of collected surface water with respect to VOCs, radionuclides, and metals.
- Performance evaluation of the FTU in removing VOCs, radionuclides, and metals from collected South Walnut Creek Basin surface water.
- Chemical characterization of spent GAC, filter cake, and other residuals.

The procedures presented in this sampling and analysis program may be modified during conduct of Phase II testing based on newly acquired process operating and performance knowledge.

3.1 FTU PROCESS SAMPLING LOCATIONS

The FTU sampling locations are shown in Figure 1-3. The sampling locations are designated RS1 through RS12, and are defined as follows:

- RS1 – Equalization tank influent.
- RS2 – Equalization tank effluent.
- RS3 – Reaction Tank No. 1 effluent.
- RS4 – Reaction Tank No. 2 effluent.
- RS5 – Neutralization tank effluent.
- RS6 – Lead GAC unit effluent.
- RS7 – Polishing GAC unit effluent.
- RS8 – Filter press solids cake.
- RS9 – Spent GAC (lead unit).
- RS10 – Spent cleaning tank solution.

- RS11 – Spent flush tank solution.
- RS12 – Equalization tank vapor-phase GAC.

Aqueous process samples will be collected from sample lines installed in the process piping at each sampling location. The sample lines will be purged prior to delivery of process liquid to appropriate sample containers.

3.2 FTU PROCESS SAMPLING AND ANALYSIS

FTU process samples will be collected for analysis of VOCs, radionuclides, metals, total organic carbon (TOC), turbidity, and other water quality parameters as described below. The FTU sampling locations and frequencies that will be used for the Phase II field treatability study are discussed below. The methods that will be used for chemical analysis are presented in the RFP General Radiochemistry and Routine Analytical Services Protocol (GRRASP) (EG&G, 1990).

3.2.1 Volatile Organic Compounds

In order to characterize VOC levels in the surface water influent and to establish VOC removals, grab samples will be collected at FTU sample locations RS1, RS2, RS5, RS6, and RS7 (refer to Figure 1-3). A grab sample at RS1 will be collected once per month and will be collected on the same days as monthly surface water samples are collected at SW-59, SW-61 and SW-132. This sampling scenario will allow comparison of the VOC analysis results of the RS1 samples with the monthly RI surface water data. Grab samples at RS2, RS5, RS6, and RS7 will be collected once per week. The samples collected at RS1, RS2, RS5, RS6, and RS7 will be analyzed for the full suite of EPA Target Compound List (TCL) VOCs (EPA, 1988) according to EPA Methods 502.2 or 524.22.

3.2.2 Radionuclides and Metals

FTU process samples will be collected at locations RS1, RS2, and RS5 (Figure 1-3) and analyzed for total and dissolved radionuclides and metals. As discussed in Section 3.2.1, monthly grab samples will be collected at RS1 concurrent with collection of RI surface water samples at SW-59, SW-61, and SW-132. Hourly samples will be collected at RS2 and RS5. Hourly samples will be collected and composited on a monthly basis. The monthly composites will be submitted for radionuclide and metal analysis.

The samples collected at RS1, RS2, and RS5 will be analyzed for the metals and radionuclides listed in Tables 3-1 and 3-2, respectively. The metals listed in Table 3-1 include the full suite of EPA Target Analyte List (TAL) constituents (EPA, 1987) as well as five non-TAL constituents: cesium, lithium, molybdenum, strontium, and tin. The aqueous-phase detection limits for the metal analytes and the minimum detectable activities (MDAs) for radionuclides (EG&G, 1990) are presented in Tables 3-1 and 3-2, respectively. Many of the analytes in the TAL are not considered hazardous (e.g., sodium, calcium, etc.); however, they are included in the TAL to establish baseline data.

3.2.3 Total Organic Carbon

Process samples will be collected weekly at RS5, RS6, and RS7 and analyzed for TOC. The GAC utilization rate may be influenced by influent TOC concentrations. TOC loading may be a factor in the rate of GAC consumption.

3.2.4 Turbidity

Turbidity measurements will be performed for process samples collected at RS1, RS2, RS5, RS6, and RS7. One grab sample will be collected from each of these FTU sampling locations per day. Turbidity of surface water influent and FTU process streams will be used as an indication of suspended solids concentrations.

3.2.5 pH

Process samples will be collected at RS1, RS2, RS3, RS4, RS5, and RS7 for field pH measurement. Coagulation and flocculation chemistry and carbon adsorption kinetics are strongly influenced by pH. Measuring the pH of samples collected at locations RS3, RS4,

Table 3-1

Metal Analytes and Aqueous-Phase Detection Limits

Analyte	Aqueous-Phase Detection Limit ($\mu g/\ell^a$)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5,000
Celsium	1,000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	5
Lithium	100
Magnesium	5,000
Manganese	15
Mercury	0.2
Molybdenum	100
Nickel	40
Potassium	5,000
Selenium	5
Silver	10
Sodium	5,000
Strontium	200
Thallium	10
Tin	200
Vanadium	50
Zinc	20

[a] Micrograms per liter.

Source: General Radiochemistry and Routine Analytical Services Protocol (GRRASP), Revision 1.1, EG&G–Rocky Flats, Inc., September 1990.

Table 3-2

Radionuclides and Minimum Detectable Activities

Analyte	MDA	
	Water (pCi/ℓ[a])	Soil (pCi/g[b])
Gross Alpha	2	4
Gross Beta	4	10
Strontium 89,90	1	1
Plutonium 239,240	0.01	0.03
Americium 241	0.01	0.02
Tritium	400	400
Total Uranium 233/234, 235, 238	0.6	0.3

[a] Picocuries per liter.
[b] Picocuries per gram.

Source: General Radiochemistry and Routine Analytical Services Protocol (GRRASP), Revision 1.1, EG&G-Rocky Flats, Inc., September 1990.

26

and RS5 will also provide a verification of the process instrumentation readings at these locations. pH measurements will be made once per day with an Orion Portable pH meter.

3.3 FTU PROCESS WASTE SAMPLING AND ANALYSIS

Filter cake solids and spent GAC will be sampled and characterized to assess disposal and regeneration (in the case of spent GAC) options, and to also satisfy waste characterization requirements of disposal facilities. Filter cake and spent liquid-phase GAC samples will be analyzed for the presence of radionuclide contamination and will also be characterized using the EPA Toxicity Characteristic Leachate Procedure (TCLP) (Table 3-3). Spent vapor-phase GAC from the Equalization Tank vent will also be characterized by TCLP. The filter cake sampling location is denoted as RS8 (Figure 1-3). The spent liquid-phase and vapor-phase GAC sampling locations are denoted RS9 (lead unit) and RS12, respectively.

3.3.1 Filter Cake

The average rate of FTU dewatered solids production is a function of several variables including surface water influent flow rate and suspended solids concentration, and chemical addition rates. When the filter press is emptied, approximately one drum of wet solids will be produced. Each batch will be sampled using RFP Standard Operating Procedure (SOP) 113.1.3 to facilitate characterization of solids by TCLP for metals and VOCs, and by acid digestion for radionuclide analysis.

3.3.2 Granular-Activated Carbon

Spent GAC samples will be obtained from small sidestream GAC canisters plumbed alongside each GAC unit, containing approximately 5 pounds of GAC. Two GAC canisters are supplied with each GAC unit. The canisters are plumbed in parallel with their "parent" GAC unit so that proportionally sized process sidestreams are directed through the canisters throughout the operating life of the GAC vessel. When the GAC in a lead unit becomes spent, the two canisters are removed and forwarded to an approved laboratory for radionuclide analysis and TCLP testing. Radiological examination of the GAC will involve

Table 3-3

Maximum Concentrations of Contaminants for Toxicity Characteristic

Analyte	Contaminant Concentration in TCLP Extract (ppm)
Arsenic	5.0
Barium	100.00
Benzene	0.5
Cadmium	1.0
Carbon tetrachloride	0.5
Chlordane	0.03
Chlorobenzene	100.0
Chloroform	6.0
Chromium	5.0
o-Cresol	200.0
m-Cresol	200.0
p-Cresol	200.0
Cresol	200.0
2,4-D	10.0
1,4-Dichlorobenzene	7.5
1,2-Dichloroethane	0.5
1,1-Dichloroethylene	0.7
2,4-Dinitrotoluene	0.13
Endrin	0.02
Heptachlor (and its epoxide)	.008
Hexachlorobenzene	0.13
Hexachlorobutadiene	0.5
Hexachloroethane	3.0
Lead	5.0
Lindane	0.4
Mercury	0.2
Methoxychlor	10.0
Methyl ethyl ketone	200.0
Nitrobenzene	2.0
Pentachlorophenol	100.0
Pyridine	5.0
Selenium	1.0
Silver	5.0
Tetrachloroethylene	0.7
Toxaphene	0.5
Trichloroethylene	0.5
2,4,5-Trichlorophenol	400.0
2,4,6-Trichlorophenol	2.0
2,4,5-TP Silvex	1.0
Vinyl chloride	0.2

analysis for the radionuclide parameters listed in Table 3-2. The MDAs listed in Table 3-2 to soil analysis apply for GAC analysis. Over a period of 6 months it is expected that three or four samples will be generated. Until representativeness of the canisters can be established, GAC samples will also be taken from the parent unit and analyzed for comparison with the results obtained from analyzing the GAC from the sidestream canisters.

As with all materials, virgin GAC may exhibit some levels of radioactivity. To accurately assess baseline contamination of this media, samples of virgin GAC will be collected and analyzed for the radionuclides listed in Table 3-2.

3.3.3 Spent Cleaning Solutions

Spent cleaning and flushing solutions resulting from cleaning the microfiltration unit will be sampled and analyzed for total metals and total radionuclides. The sampling frequency for these streams will be determined during conduct of the treatability study. Cleaning and Flush Tank solutions are denoted RS10 and RS11 (Figure 1-3).

3.3.4 Vapor-Phase GAC

Spent vapor-phase GAC from the Equalization Tank vent (RS12) will be sampled and characterized by TCLP. The results of TCLP analysis will be used to assess disposition options for spent vapor-phase GAC.

3.4 SAMPLING AND ANALYSIS SUMMARY

A sampling and analysis summary for Phase II of the field treatability study is provided in Table 3-4. Table 3-4 provides the project engineer and FTU operator with a convenient sampling and analysis summary. Table 3-5 is provided to summarize the sample preservatives, containers, and holding times necessary for VOC, radionuclide, and metal analysis.

Table 3-4

Field Treatability Study (Phase II) Sampling and Analysis Summary

Sample Type	Process Sample Locations[a]	Sampling Frequency[b]
I. AQUEOUS PROCESS SAMPLES		
VOCs	RS1	One grab sample per month (concurrent with sampling of surface water at SW-59, SW-61, and SW-132).
	RS2, RS5, RS6, and RS7	One grab sample per week.
Dissolved Metals	RS1	One grab sample per month (concurrent with sampling of surface water at SW-59, SW-61, and SW-132).
	RS2 and RS5	One composite sample per month.[c]
Total Metals	RS1	One grab sample per month (concurrent with sampling of surface water at SW-59, SW-61, and SW-132).
	RS2 and RS5	One composite sample per month.[c]
Dissolved Radionuclides	RS1	One grab sample per month (concurrent with sampling of surface water at SW-59, SW-61, and SW-132).
	RS2 and RS5	One composite sample per month.[c]
Total Radionuclides	RS1	One grab sample per month (concurrent with sampling of surface water at SW-59, SW-61, and SW-132).
	RS2, RS5	One composite sample per month.[c]
TOC	RS5, RS6, and RS7	One grab sample per week.
Turbidity	RS1, RS2, RS5, RS6, and RS7	One grab sample per day.
pH	RS1, RS2, RS3, RS4, RS5, and RS7	One grab sample per day.

Sample Media	Sample Type	Process Sample Locations[a]	Sampling Frequency
II. SOLIDS SAMPLES			
Filter Cake[d]	TCLP/ Radionuclides	RS8	One grab sample per batch. Samples will be split for TCLP and for radionuclide analysis by digestion. Samples for metals analysis by digestion may be required periodically.
Virgin GAC	Radionuclides	NA	Three composite samples. Each composite sample will be obtained from a new sidestream GAC canister (see Section 3.3.2).
Spent GAC	TCLP/ Radionuclides	RS9	Every time a lead GAC unit is determined to be spent and is taken out of service.[c]

Table 3-4 (Continued)

Field Treatability Study (Phase II) Sampling and Analysis Summary

Sample Media	Sample Type	Process Sample Locations	Sampling Frequency
III. AQUEOUS WASTE SAMPLES Spent Cleaning Tank and Flush Tank Solutions	Total Radionuclides and Total Metals	RS10 and RS11	To be determined.
Equalization Tank Vapor-Phase GAC	TCLP	RS12	To be determined.

[a] Process sample locations are defined as follows:

RS1 - Equalization Tank influent
RS2 - Equalization Tank effluent
RS3 - Reaction Tank No. 1 effluent
RS4 - Reaction Tank No. 2 effluent
RS5 - Neutralization Tank effluent
RS6 - Lead GAC unit effluent
RS7 - Polishing GAC unit effluent
RS8 - Filter Press solids cake
RS9 - Spent GAC (lead unit)
RS10 - Spent Cleaning Tank solution
RS11 - Spent Flush Tank solution
RS12 - Equalization Tank Vapor-Phase GAC

[b] The sampling frequencies listed are those that will initially be used for the Phase II field treatability study. The sampling frequencies may be modified based on the results obtained during the initial sampling and analysis program.

[c] Samples will be collected hourly to obtain a monthly composite sample for analysis.

[d] If the interval between generation of each fresh batch of filter cake is more than one week, individual samples will be collected whenever a fresh batch is generated. A composite sample will be comprised of four individual samples.

[e] Spent GAC samples will initially be taken from both the sidestream GAC canister and the parent GAC unit (see Section 3.3.2).

NA = Not applicable

Table 3-5

Sample Preservatives, Containers, and Holding Times for Aqueous Process Samples

Analytes	Preservative	Container	Maximum Holding Time
VOCs	Acidify to pH <2 with HNO_3 [a]	2x40 mℓ amber vials with Teflon-lined septa	7 days for extraction 14 days for analysis
Metals	Acidify to pH <2 with HNO_3 [a]	1 liter plastic	Mercury: 28 days. All other metals 180 days
Gross Alpha	Acidify to pH <2 with HNO_3 [a]	1 liter plastic	180 days
Tritium	None	Plastic 250 ml	180 days
Select Isotopes	HNO_3 to pH <2	Three, 1-gallon polyethylene bottles.	180 days
TOC	Acidify to pH <2 with H_2SO_4	125-mℓ glass	28 days for analysis
Turbidity [b]	N/A	N/A	N/A
pH[b]	N/A	N/A	N/A

[a] After collection and preservation, samples will be maintained at 4°C during shipment and for storage.
[b] Field measurement with portable meter.

NA = Not applicable

Source: General Radiochemistry and Routine Analytical Services Protocol (GRRASP), Revision 1.1, EG&G - Rocky Flats, Inc., September 1990.

SECTION 4
QUALITY ASSURANCE/QUALITY CONTROL

FTU sampling and analysis activities will be conducted in accordance with QA/QC guidance presented in the RFP Site-Wide Quality Assurance Project Plan (QAPjP) (EG&G, 1991c), QAPjP Quality Assurance Addendum (QAA) 2.3 (EG&G, 1991d), and QAPjP QAA 2.3(A) (EG&G, 1991e). QAA 2.3 and QAA 2.3(A) have been prepared to specifically address QA/QC requirements for construction/installation and operation of the South Walnut Creek Basin FTU, respectively. The QA/QC guidance presented in these documents provides the framework for ensuring that the sampling and analytical data collected during conduct of the field treatability study are of acceptable quality.

In addition to QA/QC guidance presented in the QAPjP, QAA 2.3, and QAA 2.3(A), several SOPs prepared by the EG&G Environmental Monitoring and Assessment Division (EMAD) will be followed in conduct of specific FTU field operation, sampling, and data management activities. EMAD-prepared SOPs (EG&G, 1991f) relevant to the field treatability study are summarized in Table 1 of QAA 2.3(A). Two SOP Addenda will also be prepared to include FTU-specific sampling guidance not addressed by the current SOPs. The SOPs to be amended and the nature of the amendments are summarized below.

SOP	Title	Nature of Amendment
1.13 sampling	Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples	Filter cake composite procedure.
4.7	Collection of Tap Water Samples	FTU process stream purging and sampling.

SECTION 5

REFERENCES

EG&G, 1990. General Radiochemistry and Routine Analytical Services Protocol (GRRASP), Revision 1.1, September 1990.

EG&G, 1991a. Treatability Study Workplan, Surface Water Interim Measures/Interim Remedial Action, South Walnut Creek Basin, Operable Unit No. 2, Version 1.1, June 1991.

EG&G, 1991b. Surface Water Interim Measures/Interim Remedial Action Plan/Environmental Assessment and Decision Document, South Walnut Creek Basin, Operable Unit No. 2. 8 March 1991.

EG&G, 1991c. Rocky Flats Plant Site-Wide Quality Assurance Project Plan, Draft, 13 February 1991.

EG&G, 1991d. Rocky Flats Plant Site-wide Quality Assurance Project Plan, Quality Assurance Addendum 2.3, South Walnut Creek Surface Water Treatment Facility, Operable Unit No. 2, March 1991.

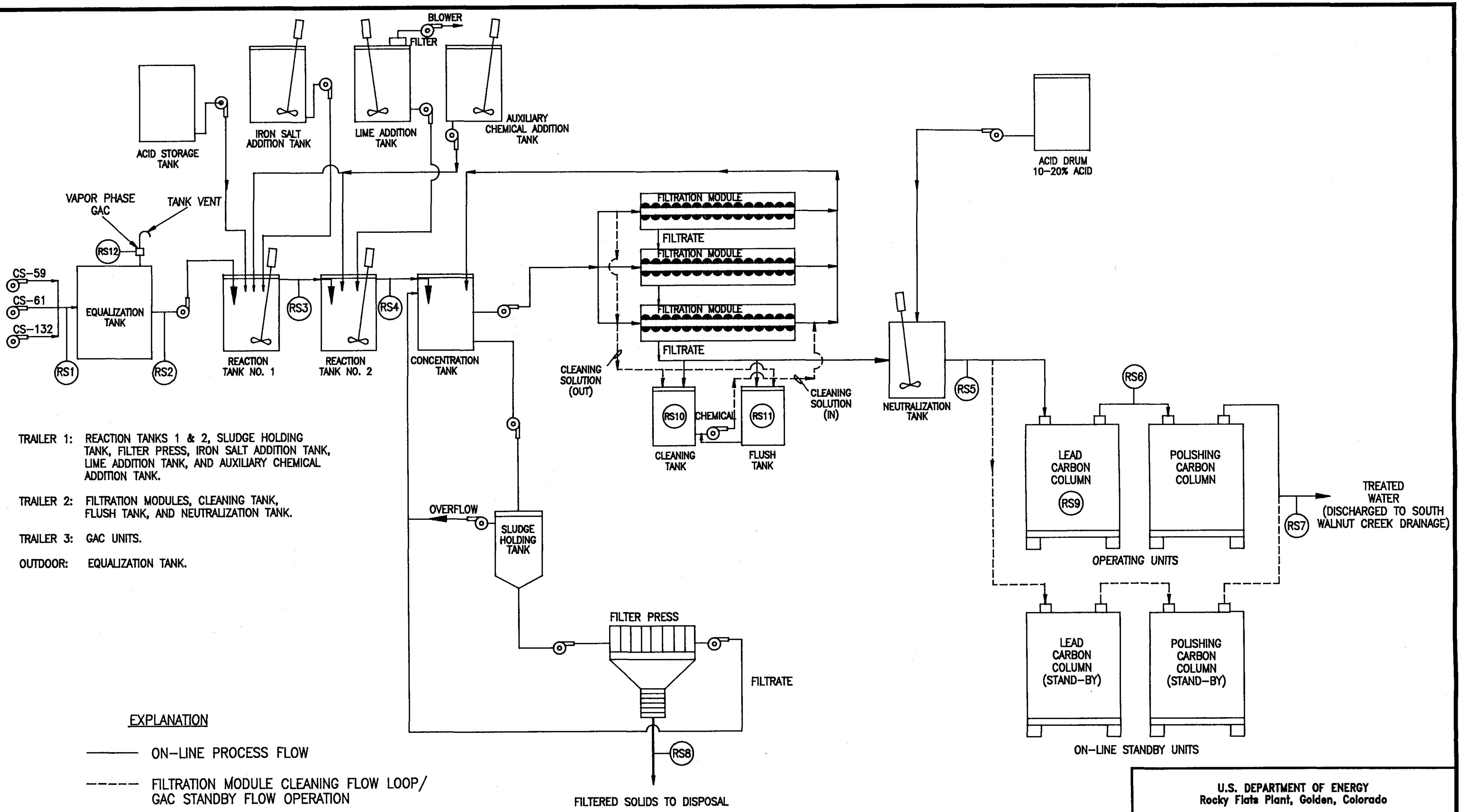
EG&G, 1991e. Rocky Flats Plant Site-wide Quality Assurance Project Plan, Quality Assurance Addendum 2.3(A), South Walnut Creek Surface Water Treatment Facility, Operable Unit No. 2, May 1991.

EG&G, 1991f. Rocky Flats Plant Environmental Monitoring and Assessment Standard Operating Procedures, Volume IV—Surface Water. February 1991.

EG&G, 1992. Summary of Analysis of Results, Field Treatability Study for Granular Activated Carbon Treatment System, South Walnut Creek Surface Water Interim Measures/Interim Remedial Action, Operable Unit No. 2. March 1992.

EPA, 1987. Statement of Work for Inorganic Analysis, Multi Media, Multi Concentration.

EPA, 1988. Statement of Work for Organic Analysis, Multi Media, Multi Concentration.



TRAILER 1: REACTION TANKS 1 & 2, SLUDGE HOLDING TANK, FILTER PRESS, IRON SALT ADDITION TANK, LIME ADDITION TANK, AND AUXILIARY CHEMICAL ADDITION TANK.

TRAILER 2: FILTRATION MODULES, CLEANING TANK, FLUSH TANK, AND NEUTRALIZATION TANK.

TRAILER 3: GAC UNITS.

OUTDOOR: EQUALIZATION TANK.

EXPLANATION

——— ON–LINE PROCESS FLOW

– – – – – FILTRATION MODULE CLEANING FLOW LOOP/ GAC STANDBY FLOW OPERATION

(RS5) ANALYTICAL SAMPLING LOCATION (SOLIDS AND LIQUIDS)

CS–59 SURFACE WATER COLLECTION SYSTEM

PUMP

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

OPERABLE UNIT NO. 2
SURFACE WATER IM/IRA

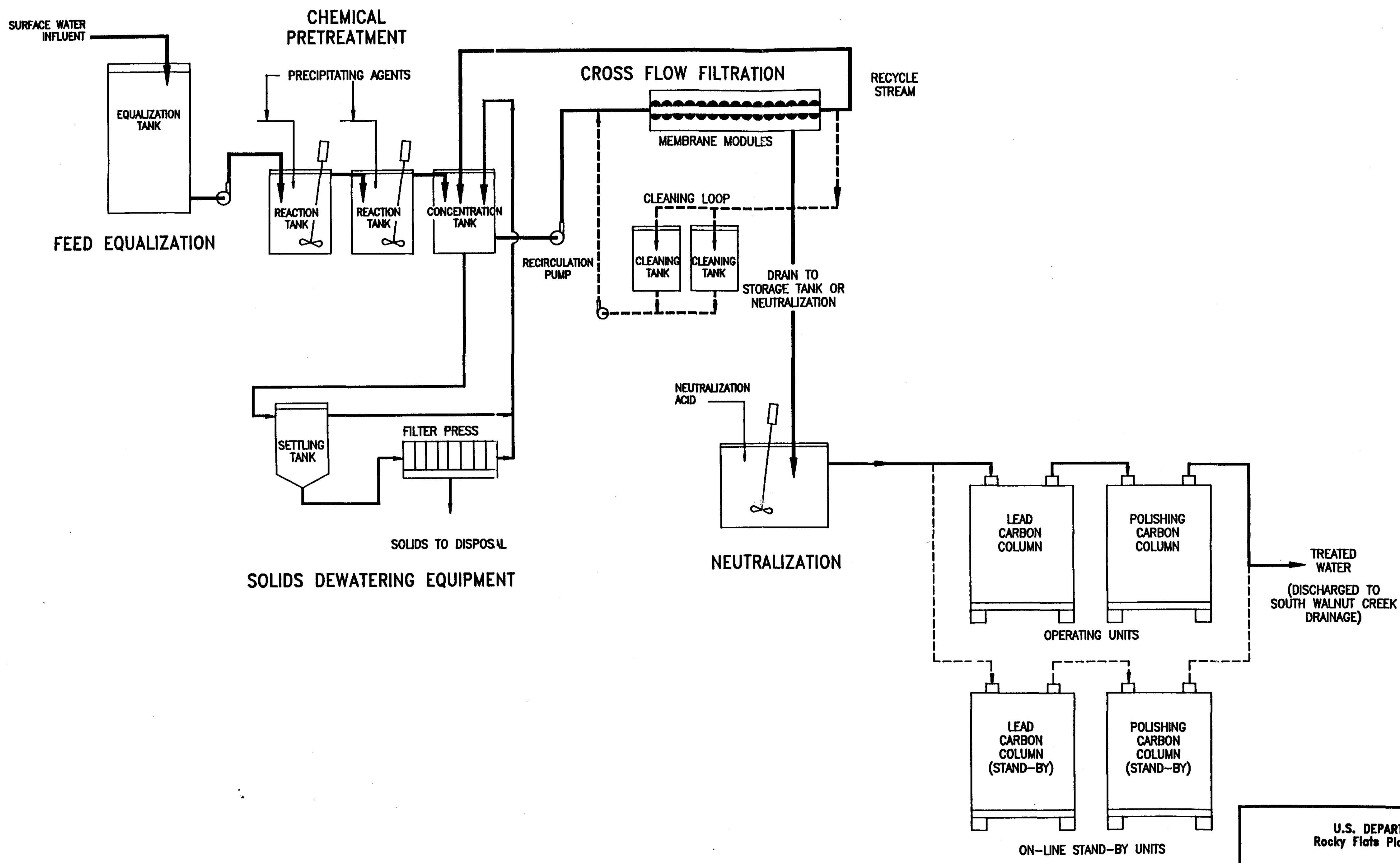
FIELD TREATABILITY UNIT
(PHASE II)
PROCESS FLOW DIAGRAM

Rev.: January, 1993
Rev: August, 1992

FIGURE 1-3

March, 1992

R37067.CWCW–012093



U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

OPERABLE UNIT NO. 2
SURFACE WATER IM/IRA

SOUTH WALNUT CREEK BASIN
IM/IRA TREATMENT SYSTEM
PROPOSED PROCESS FLOW DIAGRAM

FIGURE 1-2

March, 1992

R37070.PJMB032792

7