SITE CHARACTERIZATION PLAN

Chapter 8 - SITE CHARACTERIZATION PROGRAM

Section 8.7
Decontamination and Decommissioning Plans for the Candidate Site

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8.7.0 INTRODUCTION

If, during site characterization, the candidate site at Hanford, Washington is not selected, a specific plan for decontaminating and decommissioning the site will be developed together with specific plans for the mitigation of any significant adverse environmental impacts associated with site characterization activities (NWPA, 1983, Section 113(b)(1)(A)(iii)). Only after a determination of unsuitability would specific plans be developed to address decontamination and decommissioning issues. Because no high-level radioactive materials are currently planned to be used during site characterization, it is expected that no decontamination plans will be required. Specific decommissioning plans would be developed in consultation with the involved states and the affected Indian tribes.

Analogous, but much larger-scale, reclamation activities associated with deep shaft and surface strip mines are well documented. There is a large body of experience in these activities over a long period of time. Because it is not known at what point (if at all) a candidate site might be declared unsuitable, it is not known to what extent a site will have been characterized. Therefore, it would not serve any purpose to prepare decommissioning or decontamination plans in any great detail. Rather, typical activities that might be employed will be presented.

Decontamination (Section 8.7.1) provides steps taken to retrieve any radioactive material used at the repository site during site characterization.

Closure and decommissioning (Section 8.7.2) provides steps for the closure of the following:

- o Test boreholes.
- o Two main exploratory shafts.
- o Any drifts.
- o Other underground features of the site characterization activities.

All surface facilities (e.g., drill pads, utility sheds, mud pits, parking lots, etc.) will also be closed and removed. Borehole sealing and shaft sealing concepts for the repository are found in Section 6.2.6.

The section on plans for mitigation (Section 8.7.3) covers steps that would be taken to eliminate any significant environmental impacts should site characterization activities cease.

8.7.1 DECONTAMINATION

The plans (NWPA, 1983, Section 113(c)(2)) for site characterization activities do not include the use of high-level radioactive materials. Radioactive sources used in geophysical logging at the Exploratory Shaft Facility are designed to be fully contained and retrievable (DOE, 1985). If necessary, these sources can be totally removed from the environment by the over-coring methods used to perform the various tests described in Section 8.3.1.3. Radioactive materials used as tracer material in these hydrologic tests have short half-lives ranging from several hours to tens of days (DOE, 1985) and, therefore, pose no environmental impact. In many instances, biodegradeable organic tracers or inorganic tracers would be used in lieu of radioactive tracers. Therefore, no decontamination is expected to be required after site characterization (DOE, 1985).

8.7.2 CLOSURE AND DECOMMISSIONING

What will eventually happen to the candidate repository site at Hanford depends on site characterization results and many decisions that could lead to the four identifiable alternatives discussed below.

If the Hanford Site is determined to be suitable and is subsequently picked as the first repository, then the Exploratory Shaft Facility will be incorporated into the repository as per Section 6.2. The Exploratory Shaft Facility would be modified for the initial phase of repository construction.

If the Hanford Site is determined to be suitable but is not chosen as the first site for the repository, it would not be decommissioned until a final decision was made on the second repository. This would require maintenance of the facility in a ready, or caretaker, status (e.g., ventilation and pumping systems would remain in operation; some testing would be continued).

If the Hanford Site is determined to be unsuitable for the repository and an alternative use is proposed for the Exploratory Shaft Facility, resulting plans would depend on whether this use was either near term or long term. These uses are as follows:

- o A near-term alternate use for the Exploratory Shaft Facility would require limited standby decommissioning until the alternate program could be started. The ventilation and pumping system would remain in operation. Periodic maintenance would preserve the structural integrity of the facility. Adequate surface physical security would be retained to prevent unauthorized access.

- A long-term alternate use for the Exploratory Shaft Facility would require a cost benefit analysis to determine if it is more economical to turn off the ventilation and pumping systems until the underground facility was needed. At the time of use, the water filling the facility would be pumped out. Prior to turning off these systems, utilities and all underground salvageable material and equipment would be removed. The shafts would then be sealed at the surface. Surface facilities needed for the new use would remain in place in a "mothballed" condition. Adequate security would be required to protect the mothballed surface facilities.

There are no known near-term or long-term alternative uses identified or implied by these alternatives.

If the Hanford Site is determined to be unsuitable and no alternative uses are identified, closure and decommissioning would begin. The exploratory shafts and exploratory boreholes would be sealed to maintain aquifer isolation, and the surface facilities would be decommissioned. The underground openings in the Cohassett flow will be backfilled only if there are unusual circumstances where caving of the back (top) of the drift would change the hydrologic regime of the involved area.

Closure and decommissioning will be discussed in detail in the following sections on boreholes (surface and subsurface), shafts, subsurface openings, surface facilities, earthworks, emplacements, and utilities.

Borehole and shaft sealing will be done in accordance with applicable U.S. Environmental Protection Agency groundwater protection standards to protect aquifer systems.

8.7.2.1 Surface borehole closure and decommissioning

The location and characteristics of all drill holes at and near the Hanford Site were identified in Section 1.6. The boreholes used for hydrologic characterization were further described in Section 3.9. The locations of those key BWIP boreholes presently drilled in the controlled area study zone are shown in Figure 8.7-1. Any additional boreholes planned for site characterization activities were described in Section 8.3.1. Even though these are program-related boreholes, only those not identified for future use by other projects or programs on the Hanford Site would be sealed or closed and decommissioned. In some instances, only the lower portion of the drill hole will be sealed as either future monitoring or other uses may continue in the near-surface portion of the borehole.

The finished boreholes vary in diameter from 76 to 273 mm (3.0 to 10.75 in.), and in depth from 46 m (150 ft) to nearly 1,400 m (4,600 ft). The holes are cased with steel, flush-jointed casing from the surface to appropriate testing levels.

A 4.6-m (15-ft) cement plug shall be placed in accordance with current Washington State regulations approximately 15.5 m (50 ft) below all freshwater strata along with a cement plug at the surface. The fill between plugs will be an approved heavy drilling mud. These regulations require an uncased hole to be plugged between saline and freshwater zones. None of the aquifers evaluated in the controlled area study zone meet the definition of saline water (10,000 p/m solids). If the casing covers the freshwater sands, mud may be used below the casing, but a 4.6-m (15-ft) cement plug must be placed in the bottom of the casing string. A steel plate shall then be welded to the top of the casing at the surface consistent with applicable regulatory requirements. Any cement plugs located above the drilling mud are placed on top of a hole packer.

The surface area disturbed by this drilling activity will be returned as nearly as practicable to its original condition (DOE, 1985, Vol. I, Part II, Section 7.6).

After a complete review of borehole logs and histories, a plan for sealing each borehole will be prepared and will include the following steps (not necessarily in this sequence for every borehole):

1. Piezometer tubes, cables, and instruments will be removed from the boreholes before any sealing activities begin. If these items were previously grouted in place, they will be removed by grinding, using a junk milling tool.

2. The downhole water chemistry will be analyzed for salt, chloride, fluoride, and other ion content to (a) determine where the water is no longer fresh or potable and (b) adjust the cement chemistry in the plugs to handle the various ion contents found at various levels in the boreholes.

3. The condition of the borehole may be confirmed by a downhole television camera survey or other well-logging techniques.

4. Whipstocks will be removed and all holes whipstocked from a parent will be sealed.

5. Borehole casings that have not been grouted in place will be pulled from the hole before any sealing activities begin.

6. Seals or plugs will then be placed in locations where the rock conditions are most favorable. The sequence of grouting or sealing of the borehole starts at the bottom of the hole and extends by stages to the surface. Plugs, muds, and backfills will be placed at predetermined elevations by standard techniques.

7. The portions of the boreholes in the Hanford and Ringold Formations may be filled with sand; it is not necessary to prevent vertical communication of water in these formations since they are unconfined aquifers and are largely sands and gravels.

8. A concrete cap at the top of the hole (below the steel plate) will be installed to prevent surface water from flowing down into the hole.

Plans for determining alternative concepts and additional details of the borehole sealing program are found in Section 8.3.3.4. Borehole sealing concepts for the repository are found in Section 6.2.8.

Surface facilities required to support borehole drilling including equipment, structures, and concrete pads will be removed. The bermed drill cuttings pit will be backfilled and compacted with the berm material. The 4,047 m^2 (1-acre) site (approximately) will be graded as nearly as possible to the natural grade, and the disturbed surface will be planted with native vegetation. Permanent markers may be installed at each decommissioned borehole.

8.7.2.2 Subsurface borehole closure and decommissioning

In addition to the boreholes drilled from the surface, a large number (50 to 150) of boreholes in diameters ranging from 45.7 to 76.2 mm (1.8 to 3.0 in.) will be drilled from underground openings with penetrations ranging from approximately 3 to 300 m (10 to 1,000 ft). From the shafts, boreholes will be drilled through portholes in and above the shaft station area before excavation and then through other portholes at various depths to support testing and to verify shaft-liner grouting. Additional boreholes will be drilled from the drifts and test chambers to support testing, excavation advance, and other needs.

Boreholes drilled outward from the exploratory shafts at various elevations above the shaft station area will be plugged or sealed as needed with compatible cement grout prior to, during, or at the conclusion of their useful service. This will be accomplished by standard high-pressure grouting techniques from the shafts. Those drill holes in the drifts, test chambers, and shaft station excavations not previously sealed as part of the testing program will not be sealed unless they have penetrated a water-bearing zone above or below the Cohassett flow, which contains the underground openings.

8.7.2.3 Shaft closure and decommissioning

The two shafts constructed to support the Exploratory Shaft Facility underground construction and test activities were described in Section 8.4.2.2. A vertical cross section of a shaft constructed by drilling techniques is shown in Figure 8.7-2. The innermost steel liner will extend the entire length of the shaft. The annular regions between liner and excavation wall and between successive liners in the upper portions of the shaft will be filled with grout except where sealing rings in the annular regions will be installed to prevent or reduce vertical interconnection between aquifers. There are shaft fixtures inside the shaft liner and utility pipes (compressed air and water lines) in the annular grouted region outside the liner. (See Fig. 8.4-8 for a view of the shaft fixtures.)

The first consideration in shaft seal design is the location of the aquifer seals. In an unlined shaft, the seals would be placed above and below any water-bearing zones. To provide assurance that interconnection of aquifers would not take place (even if a hole were to develop in the shaft lining at the aquifer location), the seals in the lined shaft are placed in the same location as they would have been in an unlined shaft. The geologic formations and potential seal locations are shown in Figure 8.7-3.

As previously stated, the final closure of the shafts will be accomplished in accordance with applicable requirements. At this time, many concepts of shaft sealing have been proposed. The concepts presented here are preliminary and appear to fulfill the basic requirement to provide low permeability barriers to vertical groundwater flow. Shaft sealing concepts to slow radionuclide travel for the filled repository are found in Section 6.2.8.

Prior to shaft sealing, the water and compressed air lines that are embedded in the cemented annulus outside the shaft casing will be filled with grout. The interior of the shaft casings will be cleared of vertical pipelines or other utility lines and other shaft fixtures. This will be done either initially or as backfilling progresses up the shaft.

The fundamental shaft sealing concept is to create vertical compartments within the lined shaft. These are composed of seal materials or backfills. If the seals or backfills need to be restrained, bulkheads will be constructed.

Seals will typically be composed of two different seal materials to provide diversity and redundancy. These seals may be compacted bentonite, crushed basalt and bentonite, impermeable concretes, or seals of the same composition as the annulus seal rings. Backfills between seals may be composed of sand, crushed basalt, graded crushed basalt mixed with sodium bentonite, or sand or crushed basalt with a small amount of cement.

Bulkheads, if required to prevent backfill or seal movement, would be tied into anchors on the inside of the shaft liner. They would be composed of concrete of either standard composition or a prepack of aggregate with cement slurry filling the voids.

Since the shaft stations must be backfilled as part of the shaft filling and sealing, a concrete bulkhead will be placed in the shaft stations or in the drift at the end of the station to create a holding dam.

After the backfilling is placed into the shaft (now sealed) and the last major aquifer (Rattlesnake Ridge interbed) is confined, the remainder of the shaft may be filled with sand, crushed basalt, or graded material with bentonite. Sand and crushed basalt could be emplaced as a slurry, while the graded material could be dumped directly down the shaft. Slurry emplacement would require a pumping system to decant the excess water from the top of the fill material. Sand is less costly than crushed basalt and is more compatible with the constituents of these formations above the last aquifer.

The top of the shafts will be sealed by a cap created by cutting off the shaft liner 6 m (20 ft) down the shafts and removing this liner and the grout between it and the next outer liner. The resulting hole will then be filled with concrete to about 0.6 m (2 ft) below the planned final ground level. This concrete plug will be sitting on top of the shaft liner not inside the liner. See Figure 8.7-4 for a view of this conceptual shaft cap.

After the shafts have been sealed and the surface of the site has been restored, a marker explaining the history of the shafts may be emplaced.

8.7.2.4 <u>Closure and decommissioning of subsurface openings</u>

The horizontal subsurface openings excavated out from the exploratory shafts for the exploratory shaft test program are described in Section 8.4.2.2. Ground support for these openings could vary from none at all to various combinations of rock bolts, wire mesh, shotcrete, and steel sets (with lagging) depending on the in situ rock conditions encountered.

Major structures and equipment, including test equipment, dewatering pumps, and materials handling equipment, will be removed from shaft stations, all underground drifts, and test chambers during closure operations.

Test chambers, drifts, and shaft stations 3 m (10 ft) high or with overexcavation up to 4 m (13 ft) in height are located within the dense interior of the Cohassett flow. If the rock in the back of the overexcavated 4-m (13-ft) drift were to fall into the drift and this caving action continued upward until the accumulation or bulking of the broken rock stopped it, the height reached would be approximately 12 m (39 ft) above the back of the drift. The overlying aquifer would not be reached by a significant safety margin. If some very unusual condition in the Exploratory Shaft Facility is found that indicates this caving potential must be minimized, this can be accomplished by filling the underground openings with hydraulic sand fill from the surface or by other backfilling techniques. Hydraulic sand fill is essentially crushed rock of sand-size particles and smaller carried in water delivered by pipeline as a relatively high-density slurry of 55% to 63% solids. A pipeline in one of the shafts would deliver the slurry to the area to be filled. Excess water from the slurry would be pumped back to the surface.

Hydraulic sand fill is an effective backfill used in mining to minimize rock movement around large underground openings. The sand fill does not shrink or expand when emplaced. However, any subsequent rock movement around the filled area will compress the sand fill. Greater compressive strength can be obtained from the sand fill by the addition of cement to the slurry.

Hydraulic filling of underground openings is illustrated in Figure 8.7-5. The sand pile in the figure would probably be created by crushing the basalt taken from the underground excavation. Backfilling concepts for the repository were discussed in Section 6.2.7.

8.7.2.5 Surface facility decommissioning

Site structures include buildings, concrete foundations, the shaft headframes, and the cooling tower. The prefabricated metal buildings protecting the switchgear and the main and standby hoists are on concrete foundations. Other concrete foundations on the site include those beneath the shaft headframes and the cooling tower.

For each of the exploratory shaft surface facilities, the major pieces of equipment are the main hoist, standby hoist, shaft conveyance, standby generator, compressors, shaft ventilation equipment, and electrical distribution equipment.

The conceptual decommissioning plan for those onsite surface facilities not identified for future use includes the following:

- Buildings will be emptied of their contents, disassembled, trucked off the site, and salvaged.
- Equipment (e.g., items required for hoisting, mine ventilation, pumps, electrical generators, and storage tanks) will be removed from the site and salvaged.
- The hoist and headframe footings and other foundations standing above the ground surface will be cut or broken into manageable pieces, loaded onto trucks, and moved to acceptable disposal sites. These foundation areas will be backfilled and graded smooth. Subsurface concrete foundations will be left in place and, where appropriate, covered with fill material.
- All fences will be removed.

All salvaging activities will be done in accordance with the Nuclear Waste Fund requirements of the Nuclear Waste Policy Act of 1982 (NWPA, 1983).

8.7.2.6 Earthworks and surface emplacements and utilities

Principal earthworks on the Exploratory Shaft Facility site are roads, mud pits, mine water discharge pond, basalt storage pile, a safety berm for the explosives storage magazine, and a retention pond for storage of Exploratory Shaft Facility underground inflow water. Emplacements include diesel fuel storage and septic tanks and intrasite utilities distribution equipment. The buried diesel fuel storage tank has a capacity of 18,900 L (5,000 gal), and septic tanks are in the capacity range of several thousand gallons. Intrasite utilities include water, sanitary sewage, and communications and electric power lines.

The present concepts for decommissioning these earthworks, surface emplacements, and utilities are explained in the following list of specific actions:

- Any asphaltic road surfaces will be broken up and stockpiled for future use as subbase in major road building projects. Road subbases and unsurfaced roads will be scarified and graded to near-natural ground contours, density, and permeability. Since major road cuts and fills are not expected, there would be minimal effort to smooth the contours.

- Drilling mud will be disposed of in accordance with applicable regulations.

- The mud pit baffles will be removed and the pit will be filled and compacted with rock and soil materials using material from the basalt storage pile and the explosive magazine berm.

- Any liner in the mine water discharge pond will be removed, and the pond will be filled with berm and other material.

- The remaining portion of the basalt storage pile will have its contours smoothed by grading. The basalt may be used as aggregate for future Hanford Site construction.

- Power and water distribution to the Exploratory Shaft Facility site will be disconnected near the site boundary. The water and power lines extending from the site boundary to the sources will be left in place for possible future use.

- The power lines and poles will be removed from the site back to the east side of Army Loop Road (see Fig. 8.4-1).

- The water line will be drained, cut at the Exploratory Shaft Facility site boundary, and capped underground.

- Water and sewer pipes and electrical conduits extending above ground surface will be cut off at below-grade main connections.

- o Septic tanks and similar facilities will be filled with dirt and abandoned in place.

- o Fuel storage tanks will be dug out and removed from the site, and the disturbed area will be backfilled.

Other decommissioning concepts will be evaluated during Advanced Conceptual Design.

8.7.3 PLANS FOR MITIGATION OF ANY POTENTIAL SIGNIFICANT ADVERSE ENVIRONMENTAL IMPACTS CAUSED BY SITE CHARACTERIZATION ACTIVITIES

The Nuclear Waste Policy Act of 1982 (NWPA, 1983, Section 113(b)) requires that the site characterization plan include plans (e.g., the Environmental Monitoring and Mitigation Plan) for mitigating significant adverse environmental impacts caused by site characterization activities at a candidate site determined unsuitable as a repository. As previously mentioned, specific plans for mitigation of any significant adverse environmental impact will be developed in consultation with the states and Indian tribes if such a determination of unsuitability is made.

8.7.4 REFERENCES

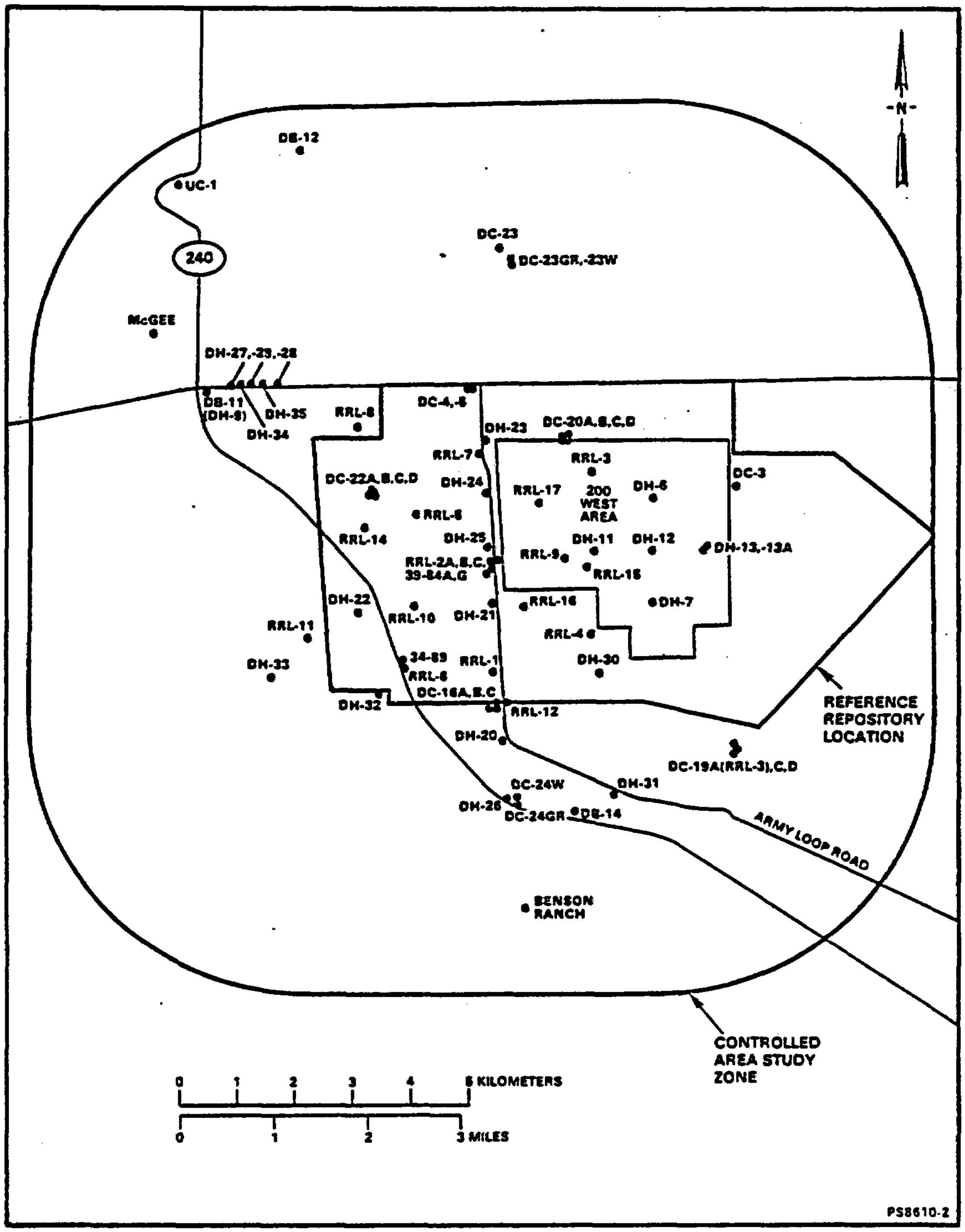
DOE, 1985. Mission Plan for the Civilian Radioactive Waste Managment Program, DOE/RW-0005, U.S. Department of Energy, Washington, D.C. [MF 1173; __; C-__; __]

NWPA, 1983. Nuclear Waste Policy Act of 1982, Public Law 97-425, 96 Stat. 2201, 42 USC 10101. [MF 1017; __; C-__; __]

RKE/PB, 1984. Exploratory Shaft Phase I Title II Design Report System Design Description, SD-BWI-DR-001, Vols. 1 and 2, Raymond Kaiser Engineers, Inc./Parsons Brinckerhoff Quade and Douglas for Rockwell Hanford Operations, Richland, Washington. [MF 0891; __; C-__; __]

Figure 8.7-1. Location map for key Basalt Waste Isolation Project boreholes presently drilled in the controlled area study zone. Information for this location map was taken from borehole status charts and location maps.

PS8610-2



N
DB-12
UC-1
240
DC-23
DC-23GR,-23W
McGEE
DH-27,-29,-28
DB-11
(DH-8)
DH-35
DH-34
RRL-8
DC-4,-6
DH-23
DC-20A,B,C,D
RRL-7
RRL-3
DC-22A,B,C,D
DH-24
RRL-17
200
WEST
AREA
DH-6
DC-3
RRL-5
RRL-14
DH-25
DH-11
DH-12
DH-13,-13A
RRL-9
RRL-2A,B,C,
39-84A,G
RRL-15
DH-22
RRL-10
DH-21
RRL-16
DH-7
RRL-11
RRL-4
DH-33
34-89
RRL-6
RRL-1
DH-30
DC-16A,B,C
DH-32
RRL-12
REFERENCE
REPOSITORY
LOCATION
DH-20
DC-19A(RRL-3),C,D
DC-24W
DH-31
DH-26
DC-24GR
DB-14
ARMY LOOP ROAD
BENSON
RANCH
CONTROLLED
AREA STUDY
ZONE
0 1 2 3 4 5 KILOMETERS
0 1 2 3 MILES
PS8610-2

Figure 8.7-2. Drilled shaft concept. (Taken from RKE/PB, 1984.)

PS8404-35F

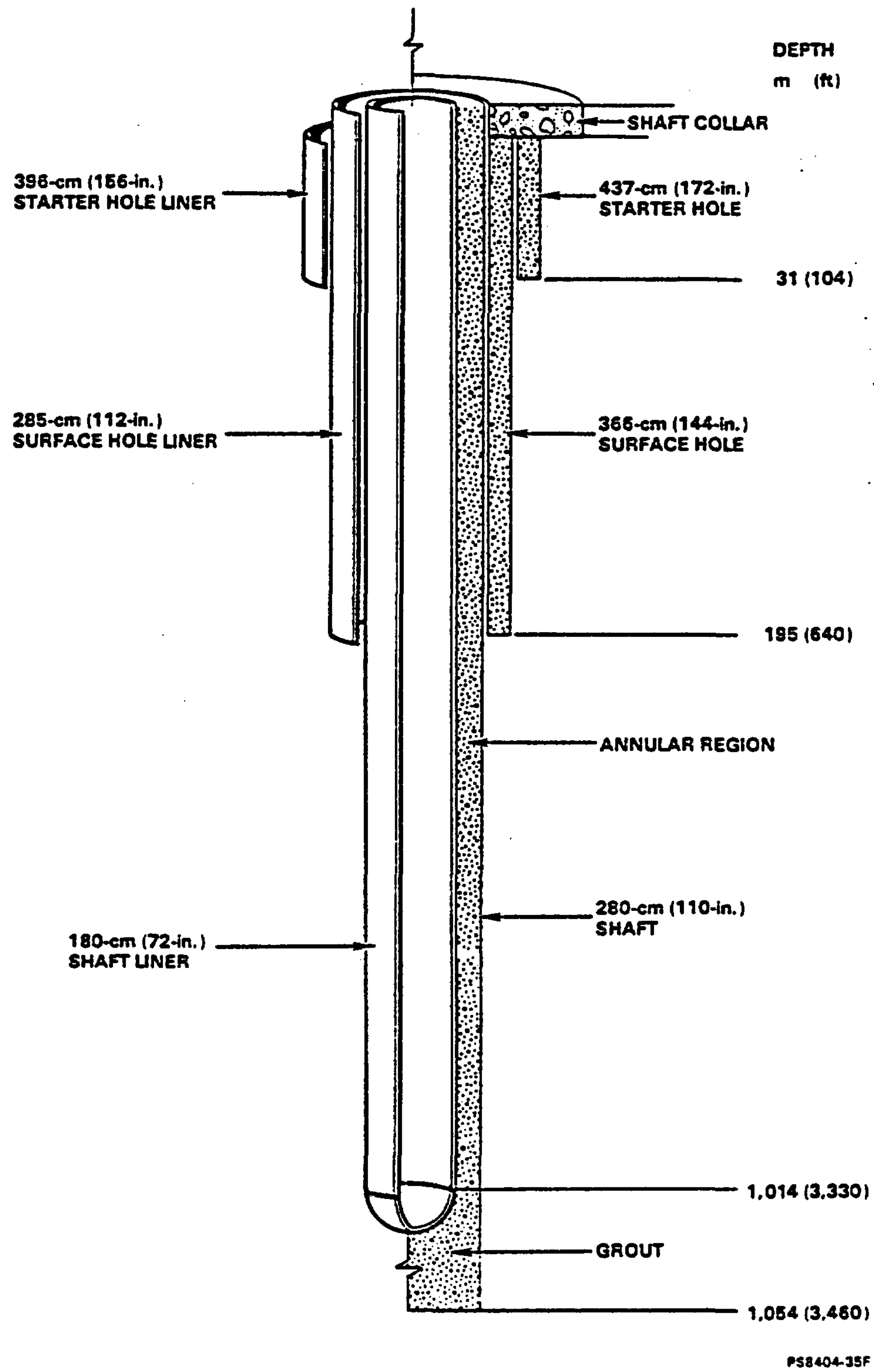

DEPTH
m (ft)
SHAFT COLLAR
396-cm (156-in.)
STARTER HOLE LINER
437-cm (172-in.)
STARTER HOLE
31 (104)
285-cm (112-in.)
SURFACE HOLE LINER
366-cm (144-in.)
SURFACE HOLE
195 (640)
ANNULAR REGION
280-cm (110-in.)
SHAFT
180-cm (72-in.)
SHAFT LINER
1,014 (3,330)
GROUT
1,054 (3,460)
PS8404-35F

Figure 8.7-3. Conceptual location of aquifer seals.

RCPS112-109N

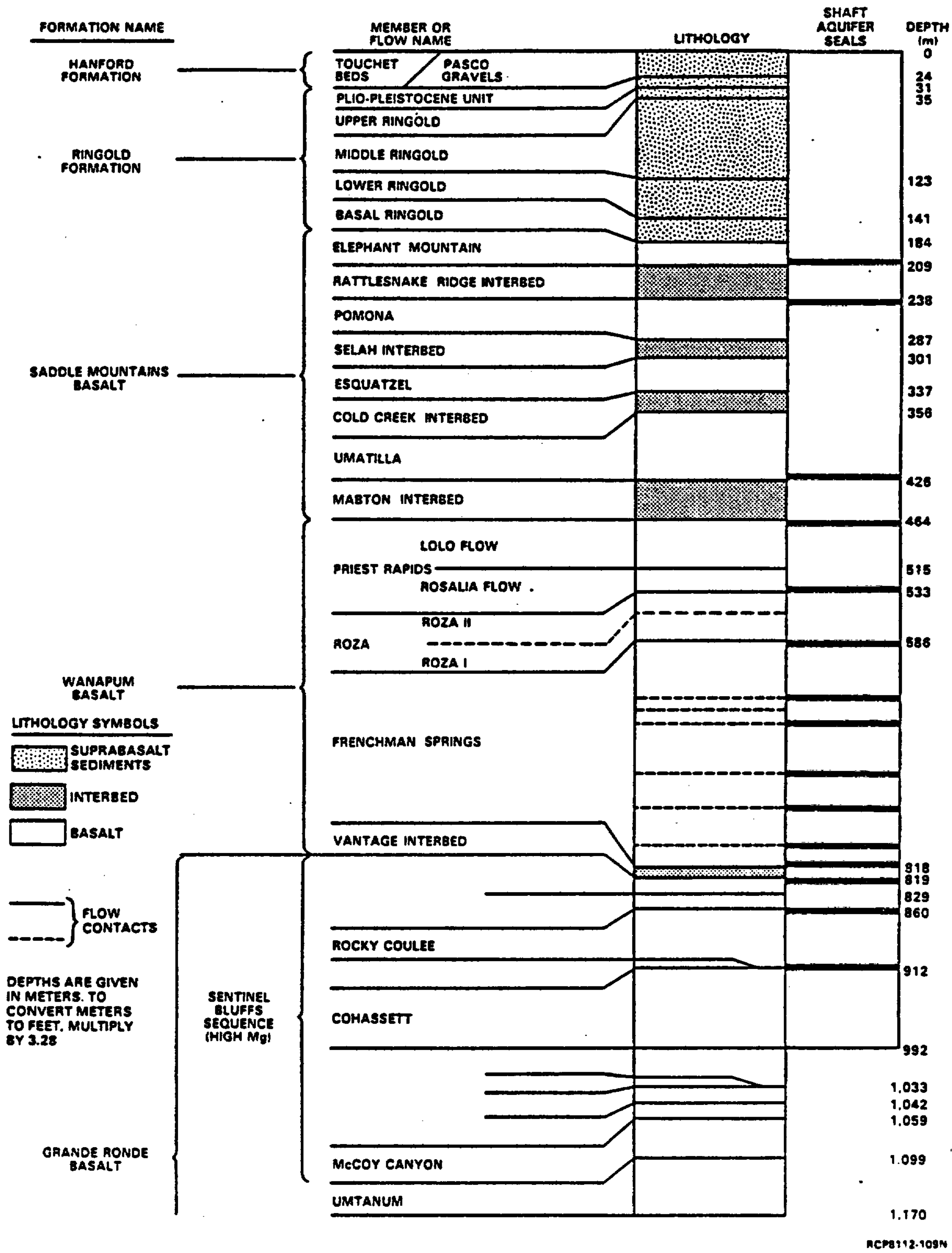
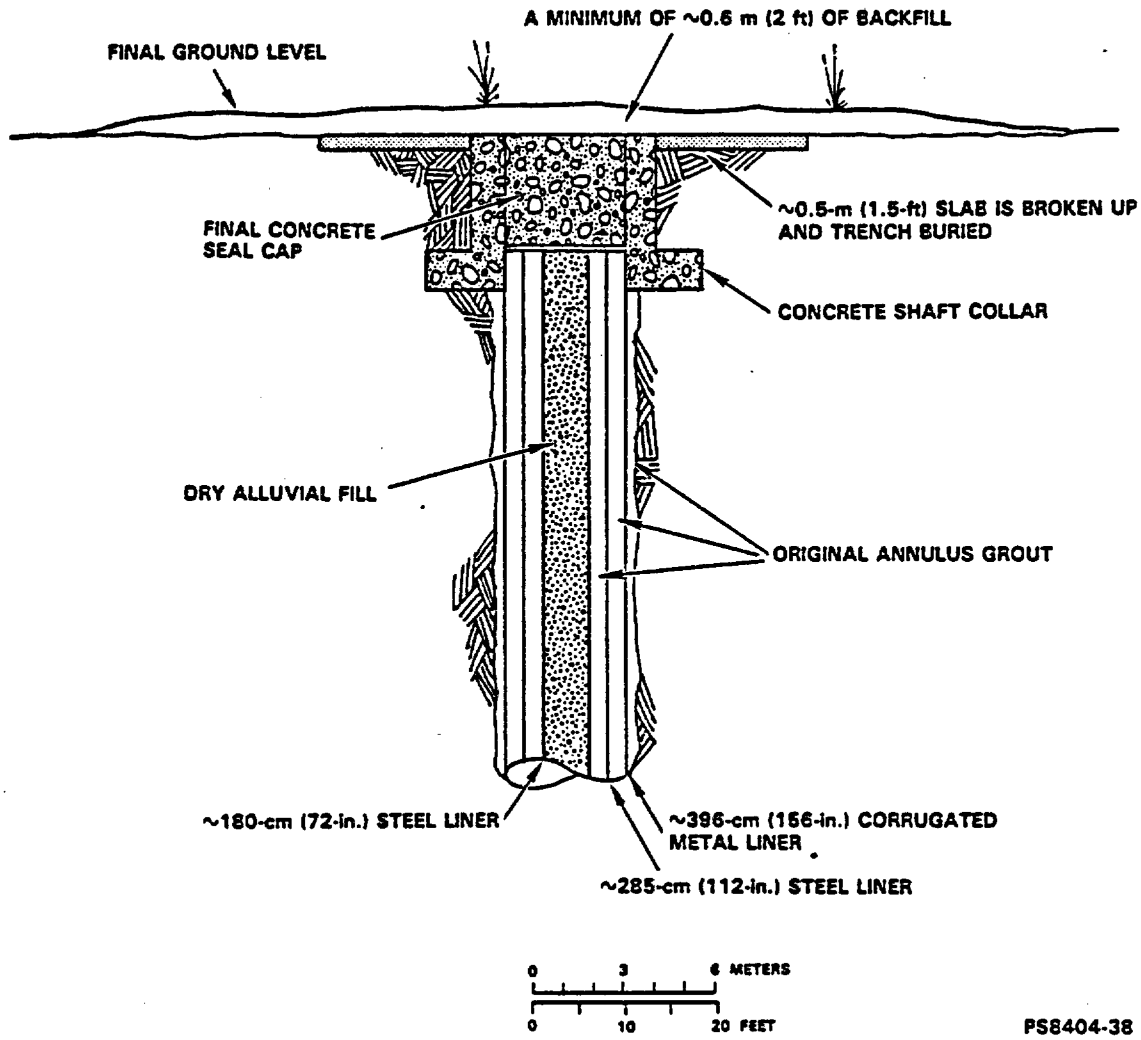

FORMATION NAME
MEMBER OR FLOW NAME
LITHOLOGY
SHAFT AQUIFER SEALS
DEPTH (m)
HANFORD FORMATION
TOUCHET BEDS
PASCO GRAVELS
PLIO-PLEISTOCENE UNIT
UPPER RINGOLD
RINGOLD FORMATION
MIDDLE RINGOLD
LOWER RINGOLD
BASAL RINGOLD
ELEPHANT MOUNTAIN
RATTLESNAKE RIDGE INTERBED
POMONA
SELAH INTERBED
SADDLE MOUNTAINS BASALT
ESQUATZEL
COLD CREEK INTERBED
UMATILLA
MABTON INTERBED
LOLO FLOW
PRIEST RAPIDS
ROSALIA FLOW
ROZA II
ROZA
ROZA I
WANAPUM BASALT
FRENCHMAN SPRINGS
VANTAGE INTERBED
ROCKY COULEE
COHASSETT
SENTINEL BLUFFS SEQUENCE (HIGH Mg)
GRANDE RONDE BASALT
McCOY CANYON
UMTANUM
0
24
31
35
123
141
184
209
238
287
301
337
356
426
464
515
533
586
818
819
829
860
912
992
1,033
1,042
1,059
1,099
1,170
LITHOLOGY SYMBOLS
SUPRABASALT SEDIMENTS
INTERBED
BASALT
FLOW CONTACTS
DEPTHS ARE GIVEN IN METERS. TO CONVERT METERS TO FEET, MULTIPLY BY 3.28
RCP8112-109N

Figure 8.7-4. Conceptual shaft cap.

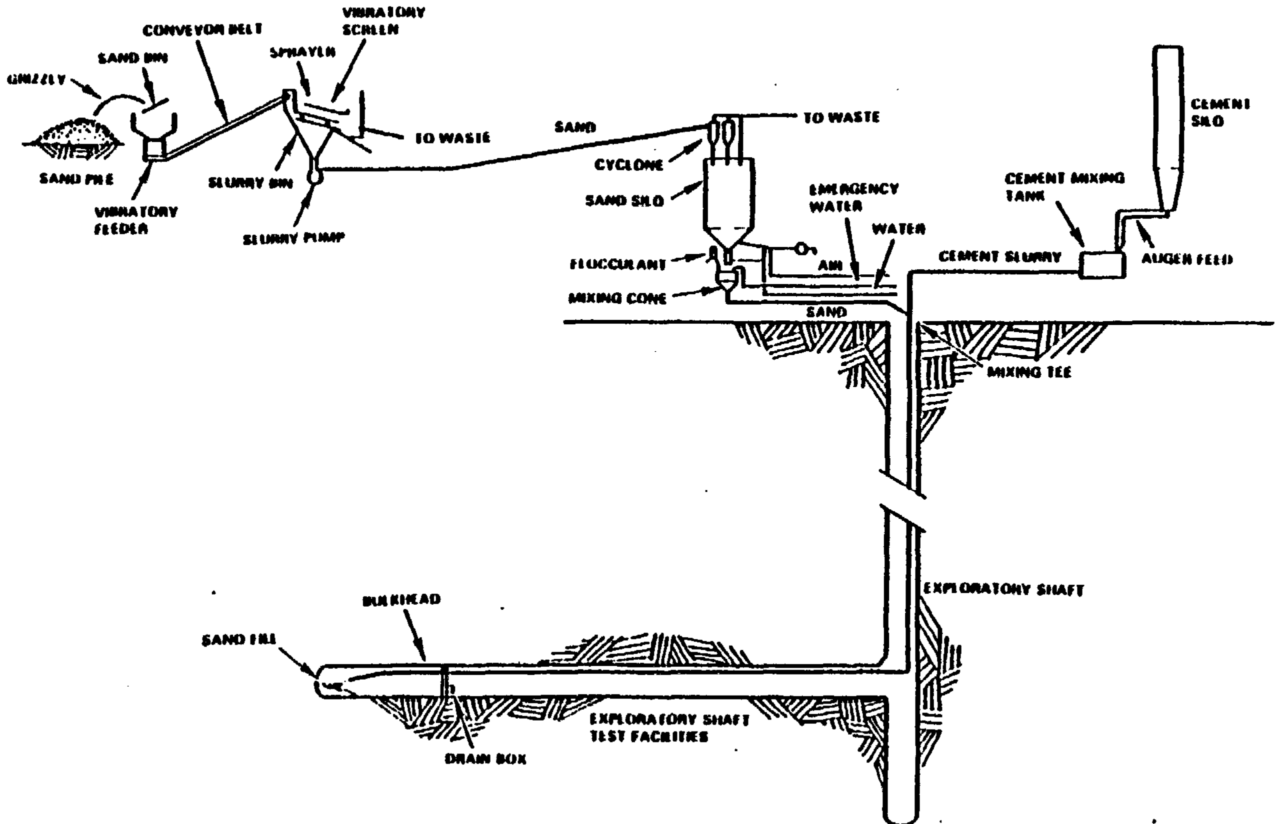
PS8404-38


A MINIMUM OF ~0.6 m (2 ft) OF BACKFILL
FINAL GROUND LEVEL
~0.5-m (1.5-ft) SLAB IS BROKEN UP AND TRENCH BURIED
FINAL CONCRETE SEAL CAP
CONCRETE SHAFT COLLAR
DRY ALLUVIAL FILL
ORIGINAL ANNULUS GROUT
~180-cm (72-in.) STEEL LINER
~396-cm (156-in.) CORRUGATED METAL LINER
~285-cm (112-in.) STEEL LINER
0 3 6 METERS
0 10 20 FEET

PS8404-38

Figure 8.7-5. Hydraulic sand-fill flow chart.

PS8405-178A



GRIZZLY
SAND BIN
CONVEYOR BELT
SPRAYER
VIBRATORY SCREEN
TO WASTE
SAND PILE
VIBRATORY FEEDER
SLURRY BIN
SLURRY PUMP
SAND
TO WASTE
CYCLONE
SAND SILO
EMERGENCY WATER
WATER
AIR
FLOCCULANT
MIXING CONE
SAND
CEMENT SILO
CEMENT MIXING TANK
CEMENT SLURRY
AUGER FEED
MIXING TEE
EXPLORATORY SHAFT
BULKHEAD
SAND FILL
DRAIN BOX
EXPLORATORY SHAFT TEST FACILITIES

PS8406 178A