Enclosure 1

TENNESSEE VALLEY AUTHORITY

EDGEMONT URANIUM MILL DECOMMISSIONING PLAN

ENVIRONMENTAL REPORT REVISION 5

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3.0 DECOMMISSIONING PLAN

3.1 INTRODUCTION

The following plan outlines the conceptual steps proposed for decommissioning the present Edgemont uranium mill site. Proposed disposal site preparation, transportation methods, drainage systems, and handling sequence described are based on available information. More detailed engineering studies may suggest alternative methods to be utilized in the final design.

3.2 SUMMARY

Approximately 2.1 x 10^6t (2.3 x 10^6 tons) of tailings were produced at the Edgemont mill from 1956-1972. It is estimated that about 7.1 x 10^6t (7.8 x 10^6 tons) of tailings, stabilization cover, contaminated soil, building debris and equipment will be removed from the Edgemont mill site to the disposal area approximately 3.2 km (2 miles) to the southeast.

At the disposal site, a diversion system will be constructed to divert uncontaminated offsite runoff around the disposal area, an impoundment dike will be constructed across the lower end of the site, and the disposal area will be excavated into shale to provide sufficient volume to contain the contaminated material.

Contaminated material will be removed from the mill site by trucks and slurry pipeline. It is proposed that a slurry pipeline will be used to transport up to 80 percent of the sand tailings present at the site. Structures and equipment for burial and the remaining contaminated material will be removed by trucks over the specially constructed haul roads.

Reclamation of the disposal site will involve covering the contaminated material with a clay cap, overburden and topsoil; the site will then be revegetated. Analysis of the soil materials at the disposal site for these covering needs indicates that sufficient quantities of each are available. At the mill site, it is expected that borrow material will be required for reclamation. This material is expected to be obtained from the disposal site or other offsite borrow areas. The mill site will be recontoured, topsoil added and the site revegetated. It is expected that decommissioning activities will be conducted such that the site can be released for unrestricted use. Rev. 5

REVISION 5

EDGEMONT URANIUM MILL DECOMMISSIONING PLAN

ENVIRONMENTAL REPORT

This amendment consists of revised parts from the environmental report. In making these revisions the entire text of Chapters 3 and 5 is being replaced, as is the text of Sections 4.2, 4.4, 4.5, 4.6 and 4.8. As a result much of the material in these chapters and sections is merely reprinted rather than changed. All revised areas in these chapters and sections are marked by revision bars in the right hand margin of each page containing a change. Parts of the environmental report which have been revised should be removed and replaced with the attached pages as follows.

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Appendix D Title Page	Appendix D Title Page and Nonradiological Air Monitoring Plan

3.3 DISPOSAL SITE PREPARATION

3.3.1 Disposal Site Description

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The proposed disposal site is located approximately 3.2 km (2 mi) southeast of the City of Edgemont. The site is at the head of an ephemeral drainage, which is a tributary of the Cheyenne River. The site is located primarily in Sections 8 and 17, T9S, R3E with minor portions located in Sections 7 and 18, T9S, R3E (see Figure 2.1-3). The site lies to the east of County Road 6N and south of County Road 6E. Of the total acreage 104 ha (258 acre) to be disturbed at the disposal site, approximately 96 ha (236 acre) of the site are privately owned. Of the remainder, 5.7 ha (14 acre) are owned by the State of South Dakota and 3.2 ha (8 acre) are held by the U.S. Government and are administered by the Bureau of Land Management.

Figure 3.3-1 shows residences within a 5 km (3.18 mi) radius of the site. The nearest residence is 2.4 km (1.5 mi) from the site. Present land use of the site is for livestock grazing.

The topography of the site is gently rolling with about 18 m (60 ft) of relief within the proposed impoundment area. Vegetation is primarily native rangeland grasses including western wheat grass, buffalograss, blue grama and sagebrush. The clay and silt-textured soils found predominantly at the site have developed from the weathering of the lower unit of the Greenhorn Formation or the Belle Fourche Shale. The soil profile extends from a few centimeters to about 3.66 m (12 ft). The shale of the Greenhorn, Belle Fourche Mowry, and Skull Creek units extends in excess of five hundred feet below the site (see Figure 3.3-2). Rev. 5

Access to the disposal site for initial work will be via the county road system. Initial preparation of the impoundment area will involve the construction of a diversion system to prevent offsite runoff from entering the disposal area (see Figure 3.3-3). A surface runoff isolation course will be prepared at the northwestern portion of the disposal area to divert runoff to an intermittent drainage to the northwest. An isolation course will also be constructed along the western edge of the impoundment area to control offsite runoff from the west. The isolation courses will be constructed into the shale and should drain any subsurface water at the shale subsoil interface. This runoff will be diverted to the southeast and will reenter the drainage channel below the impoundment dike. The isolation courses will remain after completion of disposal operations. A natural drainage divide will prevent offsite runoff from entering the disposal site from the east. A small stockpond located immediately downstream of the impoundment dike will be removed during construction operation. A sediment pond will be constructed first below the impoundment dike to control any sediments resulting from construction.

Upon completion of the diversion system, large earthmoving equipment will be used to excavate the impoundment area into shale, requiring removal of approximately 5 x 10^6 tons of materials (topsoil, subsoil, and overburden). The overburden will be used in the construction of the impoundment dike. It is anticipated that some of the overburden can be used for fill at the mill site upon completion of activities and also for the cover of the impoundment area. The topsoil and subsoil removed will be segregated and stockpiled for future reclamation and will be contoured and seeded to prevent erosion. Locations of stockpile areas are indicated on Figure 3.3-4. Approximately 36 ha (90 acre) will be used for stockpile areas.

Shale will form the base of the impoundment area. Preliminary geotechnical work[1] indicates the shale at the base of the disposal site has a permeability of about 1 x 10^{-8} cm/sec and therefore precludes the need for a clay liner. This shale structure provides a highly impermeable surface at relatively shallow depths and is fairly uniform and does not exhibit any apparent faulting, folding or other tectonic disturbances[1] (Figure 3.3-5). A test hole drilled near the site indicates that a very substantial thickness of this shale material exists (Figure 3.3-2). This extensive depth of aquitard should preclude contamination of the underlying groundwater. These facts will be verified upon final engineering and site excavation. Potential areas of higher permeability will be investigated at that time and mitigated if necessary. In the unlikely event that areas having a permeability greater than 1 x 10^{-7} cm/sec were found, engineering practices appropriate to each particular situation would be employed to ensure the integrity of the entire impoundment area. An example of this potential mitigation would be to excavate the suspect area, backfill with appropriate material, and compact to a permeability of 1 x 10^{-7} cm/sec or less. Rev. 5

Construction of the impoundment dike will be concurrent with the excavations of the impoundment site. Initial preparation of the dike will include removal of material into unweathered shale. A gravel drain system will be installed along the base of the dike area as shown in Figure 3.3-6. The gravel drain will be composed of graded sizes of gravel to filter out soil material, yet allow for the relief of hydrostatic pressure within the dike. The gravel drain will be constructed within the dike, as shown, to remove any water which may enter the dike. To prevent the infiltration of water from the impoundment area, an impermeable liner will be keyed into the shale bedrock and placed on the upstream face of the dike; the liner will be extended along the upstream face of the dike as construction continues. The clay liner will be constructed to have a permeability of about 1 x 10^{-7} cm/sec.

Material used in the construction of the impoundment dike will be unclassified fill obtained from within the impoundment area. The material will be placed, spread, and compacted in small lifts to ensure proper construction of the dike. The final height of the dike will be approximately 17 m (55 ft) with a length of about 549 m (1800 ft). The final slope of the upstream face is planned at 4:1. The downstream face, planned at a 5:1 slope, will be revegetated to protect it from erosion. The slope could be decreased should it be deemed necessary for the stat ity of the dike. Final configuration of the dike may be alterec following detailed engineering design studies.

3.3.2 Disposal System Stability

Emphasis of the proposed disposal system is to ensure impoundment integrity by designing and locating the tailings isolation area so that disruption and dispersion by natural forces are eliminated or reduced to the maximum extent reasonably achievable. Both existing natural conditions and engineered properties are to be utilized in achieving this integrity. The proposed disposal site has been identified through a site selection program(2) based on NRC criteria(3) and factors identified by TVA and others.(4) To enhance tailings isolation for very long periods of time, development of the proposed dispoosal system has taken into account a number of potential failure mechanisms.(5) To demonstrate the overall acceptability of the disposal site control measures the following discussion address: 1) Erosion and Seepage Control and 2) Embankment Stability.

1) Erosion and Seepage Control - This control utilizes both natural characteristics and engineered properties. The proposed disposal site is considered to be of natural low water erosion potential as a result of: Rev.5
   - i) low topographical relief of the site and minimal active erosion (ER Section 4.2).
   - ii) existing drainage area and pattern produces low average runoff, and low velocity runoff (ER Section 4.2).
   - iii) regional climate is semi arid (ER Section 4.1).
   - iv) potential for significant drainage pattern change is considered unlikely.

Proper engineering of the disposal system should further reduce erosion potential and stabilize the disposal area. This engineering is planned to include:
   - i) a surface runoff isolation course to divert any offsite runoff away from the site (ER Section 3.3).
   - ii) a reclamation plan involving utilization of quality topsoil and overburden available at the site, and seeding and revegetating of the site (ER Section 4.6.3).
   - iii) a embankment design utilizing minimum stepness and potential ripraping (ER Section 3.3).

In addition periodic monitoring of the disposal site is planned to assess the adequacy of these control measures and to determine corrective action if required (ER Section 5.1.2).

The potential for severe erosion and/or failure of the disposal system by flooding is considered minimal because of the topographic features of the disposal site. The site is located at the head of an ephemeral drainage system, and has a very small upstream catchment area (ER Section 4.2). These features combine to minimize the size of the maximum possible flood at the disposal site and to preclude the site from being in a flood pathway (Tables 4.2-1, 4.2-2).

Wind erosion of the disposal site will be controlled by site reclamation and revegetation, and minimization of embankment slope (ER Sections 3.3, 4.6). As areas of the deposited tailings reach final grade and are recontoured an intermediate crop cover will be placed immediately to limit erosion (ER Section 4.6.3). When the area is available for final reclamation seeding with the reclamation mixture will occur (ER Section 4.6.3)

Seepage both into and out of the impoundment, will be controlled to prevent contamination of adjacent land, streams, and groundwater. To prevent infiltration of water into the disposal area the impoundment base will be excavated into impermeable shale (ER Section 3.3), a clay cap will cover the top of the tailings and a clay liner will be placed on the upstream face of the impoundment dike and keyed into the shale bedrock base (ER Section 3.3). It has been determined that clay soils available at the disposal site should perform well when properly utilized, designed and engineered as materials for construction of the impervous liner for the embankment and capping of the site. The impermeable shale forming the impoundment base will preclude seepage out of the impoundment. In addition, the nature of disposed materials being relatively dry will reduce the potential for seepage. Rev.5

2) Embankment Stability

To ensure the long term integrity of the impoundment, embankment construction must follow good engineering practices. Planned excavation of the impoundment site is to result in the need for construction of one embankment dike (ER Section 3.3, Fig. 3.3-3) with the remaining disposal site perimeter being at grade. The final slope of the dike will be as necessary to ensure the stability of the dike (Fig. 3.3-6). A slope protection scheme, which as a minimum will incorporate revegetation, will be employed to retard wind and water erosion of the dike. Soils available at the disposal site have been determined, both in quantity and quality, suitable as construction materials for the impoundment dike. In addition, a gravel drain (Fig. 3-3-6) will be constructed within the dike for the relief of hydrostatic pressure within the dike. Also, the relatively dry tailings and materials disposed of in the impoundment should not result in any hydrostatic pressure development on or within the dike to effect its stability.

Seismology (ER Section 4.4.3) concerns in the disposal site region should not significantly effect anticipated dike stability. The site is not located near a potentially active fault that could generate a credible earthquake larger than that which the dipsosal system could be expected to withstand. The foundation of the embankment dike will be the shale material that underlies the entire disposal site. This material has been shown to be of high density, fairly uniform in structure and of extensive thickness and therefore should be adequate to support the dike without failure or excessive total or differential settlement.

Land use controls at the disposal site can be effectively administrated to further enhance isolation of the tailings. Initially, the reclaimed disposal site will be fenced to preclude grazing inorder to allow the vegetative cover to become established. Additional land use control, by deed agreement (as required by Uranium Mill Tailings Radiation Control Act of 1978, Section 202) will be aimed at precluding 1) the site from being occupied and/or structures being sited on it, and 2) excavation on the site into or through the tailings.

Detailed engineering design studies will further address and verify the adequacy of erosion and seepage control measures, embankment configuration and stability, impoundment base impermeability and foundation conditions. Rev. 5

While the proposed disposal system is not strictly below-grade, it does fit another NRC option of being at the head of a small drainage. The system, as proposed, is designed to minimize the erosion potential of the disposal site. If completely below-grade disposal were to be utilized, the final profile of the disposal site would likely have to be brought back to the original design countour as shown in Figure 3.3-3 in order to maintain minimal water erosion potential. To simply return to present contour after below-grade disposal would enhance erosion because of the existing drainage basin.

The disposal system, as proposed, already contains some disposal below the existing grade (Figure 3.3-3). It has been estimated that approximately 30% of the contaminated material (at least 55% of the tailings) would be contained below the original surface at the impoundment area using the proposed disposal design. To switch to a completely below-grade disposal would require the excavation and stockpiling of an estimated additional 8 million cubic yards of material. Movement of this much material will result in the need for additional surface disturbance and temporary land use change for stockpiles alone.

The proposed impoundment will not be subjected to the same hydraulic stresses as a conventional tailings pond or even the same stresses as a below-grade disposal site for an active uranium mill. The containment dam will be engineered and constructed to withstand the hydraulic stresses normally associated with tailings management. However, those normal stresses will not be present because the tailings will be dewatered. Excess water associated with the hydraulic transport system will be collected in a decant pond and recycled for use by means of a floating barge pump. The decant pond will move upstream as the tailings are deposited in the impoundment area. Any precipitation which falls directly onto the impoundment area would, in addition, be collected in the decant pond and be used in the recycle circuit. The dewatered tailings will be compacted and covered with dry materials which will further reduce the nominal moisture content of the tailings. Therefore, even though the dam is constructed to retain wet tailings, the stresses of wet tailings will not be present.

As a method to remove any contained liquid resulting from the hydraulic transport of tailings which may migrate to the bottom of the impoundment area during the placement of the tailings and subsequent placement of the contaminated material, a collector drain field system could be utilized, if determined necessary. The details of design and placement would be determined during the detailed engineering portion of the project.

Conceptually, the system would consist of a sectional large diameter, acid resistant pipe extending vertically from a sump located near the upstream base of the impoundment dike. A series of interceptor drains placed along the base of the impoundment area would collect any liquid and direct it to the sump. The collected liquid would be removed by a submersible pump and would return to the decant pond during the material placement process. Rev. 5

After all the contaminated material has been removed from the mill site, final reclamation of the disposal site will near completion. The vertical pipe would be plugged with an acid resistant material and would be placed over the pipe and joined into the clay cap. Overburden would bring the area up to the grade at that time and final reclamation procedures would be completed.

Below-grade disposal at the proposed site and the resultant excavation of additional material would result in an extension of the life of the project and the onset of tailings movement by at least one year and possibly two. The extension and additional materials handling would also result in the cost of disposal site preparation being two to three times that now proposed.

In summary, it is believed that below-grade disposal at the proposed site would provide limited additional benefit to the project results with a potential increase in environmental impacts. The proposed system of utilizing a properly engineered and constructed containment dam will afford a long-term stability and protection equivalent to that offered by below-grade disposal at the proposed site. Should the proposed site not be acceptable, the more environmentally preferable option of moving certain portions of sand tailings by slurry pipeline transportation would be in serious jeopardy. Rev. 5

3.3 REFERENCE

1) Francis,Meador,Gellhans, Inc., Subsurface Soil Exploration for Proposed Edgemont Uranium Waste Desposal Site, June 1980

2) TVA's Site Selection Program Used in Identifying the Preferred Disposal Site, June 13, 1980.

3) NRC Branch Position on Uranium Mill Tailings Management, May 13, 1977.

4) Ford, Bacon, & Davis, Utah, Inc., Engineering Assessment of Inactive Uranium Mill Tailings, Edgemont Site, May 1978. Rev. 5

5) NRC Generic Environmental Impact Statement on Uranium Milling, NUREG-0511, April 1979

3.4 HAUL ROAD AND SLURRY PIPELINE CONSTRUCTION

As the disposal site is being prepared, construction of the haul roads will begin. At the mill site, a 17 m (55 ft), two-way traffic haul road will be constructed to the east of Pond 10. The road bed will consist of a subbase of clean sand, a base of coarse crushed rock, and a final surface of fine crushed rock. The road will be slightly crowned, with a slope of about 1/4" per ft from the centerline. See Figure 3.4-1(Part A) for a cross section of the haul road. As the haul road leaves the mill site, separate haul roads will be constructed for one-way traffic to the disposal site and return to the mill site (see Figure 3.3-4). Each road will be 10 m (33 ft) wide and constructed similar to the mill site haul road see Figure 3.4-1(Part B) .

Approximately 12 ha (30 acre) will be disturbed by the haul road. Topsoil and other material removed will be stockpiled along the route for future reclamation. During its construction, dust control measures will be implemented. The route will be designed so that curves and grades will be as gentle as practical. Some cut and fill may be required as shown by a typical section in Figure 3.4-2). Speeds of vehicles will be maintained at safe levels depending upon road conditions and loads. Average speed will be approximately 32 kph (20 mph). In loading and unloading areas, a speed of 16 kph (10 mph) will be more practical. The route will cross a seldom-used county road. It is anticipated that some type of underpass system will be used to route public traffic under the haul roads.

No major drainages will be crossed by the haul roads. Runoff from the mill site haulroad will be contained onsite. To prevent contamination due to runoff from the haulroad, a trench drain system will be constructed along the outside of the roads. The construction of the divided portion of the haulroad is such that the majority of the runoff is in the median drain section of the haulroad. Near pond 10, a drop box and underdrain is to be installed to divert runoff from the east trench drain to the median drain. At the south end of Pond 10, where the divided haulroads join, a second larger underdrain will be constructed to divert trapped runoff in the median to Pond 10. At the point that the west trench drain intersects the underdrain, a second drop box is to be installed to divert runoff into the underdrain and into Pond 10.

At the disposal site, the haul roads will enter the site inside of the diversion system. Any contamination associated with the haul roads will be contained within the impoundment area.

The proposed slurry pipeline and recycle water pipeline will be constructed between the haulroads (see Figure 3.4-3). The repulping plant for the pipeline will be located south of the East tailings pile. The 25 cm (10 in) diameter polyethylene slurry pipeline will be placed along the east side of Ponds 7 and 10 and then proceed southeast of the mill site to the disposal area. The pipeline will be designed to allow for mobility at the disposal site, providing for planned placement of the contaminated materials. The 20 cm (8 in) diameter polyethylene pipeline will recylce water from the decant pond to the mill site. The pipelines will be designed so that any spills or ruptures of the pipelines will be contained within the median drain system and any flow will return to Pond 10 with the runoff from the haulroads. If it becomes necessary to remove a blockage in the slurry pipelines, any material removed will be routed to Pond 10.

The haul road design and pipeline locations will ensure the containment of any contaminated materials within the median area. Near the completion of the decommissioning activity, any contaminated material along the haulroads or pipelines will be removed to the impoundment area. The route will be contoured to blend with the surrounding landforms and ripped to reduce compaction prior to replacement of topsoil. After topsoiling, the route can be seeded with the same mixture used at the disposal site.

3.5 MILL SITE CLEANUP

Before cleanup operations begin at the mill site, a diversion ditch will be constructed along the eastern perimeter of the mill site to prevent uncontaminated runoff from offsite reaching the contaminated areas see Figure 2.1-2 and 3.5-1 (part C) . Windblown tailings to the east of the mill site will require cleanup before the completion of the diversion ditch. A more detailed field examination will be required to determine the extent of the windblown tailings.

The diversion ditch will be constructed as shown on Figure 3.5-1 (part A) in which approximately 5.3 ha (13 acre) will be disturbed as a result of its construction. The ditch will be gently sloped and vegetated to minimize erosion potential. The diversion will be designed to contain flow of up to a 100-year flood event from the major drainages entering it from the east. Where practicable, the ditch will be constructed into shale to intercept subsurface drainage. Figure 3.5-1 (part B) shows the flow volume expected from each drainage A-E on Figure 3.5-1 (part C) and the cumulative capacity of the diversion drain as it approaches the Cheyenne River floodplain. Water from the diversion will be dispersed onto the floodplain. Routine inspections will be performed to ensure that the diversion ditch is properly maintained. At the completion of decommissioning activities, the diversion channel will be reclaimed along with the mill site.

3.5.1 Structure and Equipment Disposition

The structures and buildings on the mill site (see Section 2.2) have been evaluated with respect to their general condition and radioactive contamination. Plans for their disposition are as follows:

Decontaminate	Demolish
Office Building	FeV Building
Mobile Equipment Shop	Electric Shop
Storage Shed with above	Crusher and Sampler Building
Reagent Warehouse	Shaker Car Building
Scale House	Fly Ash Pump House
Carpenter Shop	Lime Plant Building

The disposition of the mill building is being evaluated separately to determine if portions of it should be preserved for further use.

3.5.1.1 Demolition Methods

Demolition methods may vary from building to building. Considerations will include structure type, contamination level, and location relative to the site perimeter and other buildings.

Specific procedures will be determined on a building-by-building basis.

In general, the demolition will proceed from the interior to the exterior and from top to bottom. Salvagable items, utilities, insulation, and interior non-supporting walls will be removed before non-supporting exterior walls; then the roof, supporting walls, and finally structural support will be removed. All foundations will be excavated in conjunction with the removal of contaminated soil.

Concurrent with demolition, radiation surveys will be conducted to identify any areas with unexpected higher levels of contamination. Some buildings or portions of buildings may require wetting down or application of fixing agents to prevent dispersal of contaminanats.

<u>3.5.1.2 Decontamination Methods</u>

Depending on the level of contamination and the type of structure, decontamination methods may vary. Specific procedures will be determined on a building-by-building basis.

In general, the decontamination will proceed in the same order as demolition activities: from interior to exterior and from top to bottom. Methods may include sandblasting, hydrolasing, and treatment with commercial decontamination agents. Items that cannot be readily decontaminated, such as partitions, insulation, or the roof, will be removed and buried in the impoundment area. During decontamination, radiation surveys will be conducted to identify any areas with unexpected higher levels of contamination.

<u>3.5.1.3 Equipment</u>

The bulk of equipment at the site is contained within the mill building. Motors and pumps comprise a large portion of the loose equipment. All sealed pumps and motors will require internal surveys before unconditional release. Previous surveys have disclosed that little or no contamination exists on the surveyed office equipment, and most items would be releaseable. Some recently acquired equipment, i.e., end loaders, forklifts, and large trucks were surveyed on site and indicated various levels of contamination. Each piece of equipment will be surveyed and a determination made on whether to decontaminate, remove, or dispose of it. The use of conventional and electro-chemical decontamination methods will be evaluated. Equipment which can be decontaminated for release may be sold. Useable equipment which cannot feasibly be decontaminated will be considered for use in other licensed facilities. The transport of any existing equipment will be conducted in accordance with applicable regulations on transportation and radiation protection. The remaining equipment for which decontamination is not feasible will be buried in the impoundment area.

Structures and equipment which are not decontaminted will be dismantled for removal to the impoundment area. The structures will be moved by truck and placed near the base of the impoundment dike as shown in Figure 3.5-2 (part B). When disposal of the structures and equipment is completed, operation of the slurry pipeline will begin.

3.5.2 Disposal of Tailings and Contaminated Materials

Varying characteristics of contaminated material at the mill site will require the use of small rubber-tired front-end loaders, bulldozers, backhoes, self-loading scrapers, and draglines (refer to Table 3.6-1). In general, cleanup will progress from the northwestern portion of the mill site to the southeast to minimize the recontamination of any previously cleaned areas. Operations will continue as weather conditions permit. Removal operations will cease during extreme weather conditions, such as heavy rainfall or high winds. Determination of when operations will be discontinued will be made by an onsite supervisor. Freezing temperatures in combination with other extreme weather conditions will restrict the disposal operations to approximately 6 months per year. Removal operations will be planned during the working season so that areas of contaminated material will not be exposed over the winter.

3.5.2.1 Cleanup of Cottonwood Creek

As cleanup operations proceed from the western portion of the mill site, the removal of contaminated material in and around the Cottonwood Creek channel will be necessary. This phase of the cleanup will require the temporary diversion of the creek. A diversion channel will be constructed of uncontaminated material to divert Cottonwood Creek through the mill site. A detailed soil testing program will be required to determine the best location for the diversion channel. Figure 3.5-3 shows the general location of the diversion channel from points A to B. The diversion channel will be constructed to handle runoff from a 100-year flood event. The base of the diversion will be excavated to uncontaminated material. The banks will be excavated outward either into existing uncontaminated native materials or overexcavated into contaminated material if necessary and uncontaminated fill material brought in to construct the banks. Uncontaminated fill material will be used as needed to obtain the proper configuration for the diversion channel. During excavation operations, sumps will be used to remove any excess water as discussed in Section 3.5.2.2, Handling Sequence of Tailings and Contaminated Material.

The diversion channel will be designed to eliminate erosion of this uncontaminated channel, including the use of riprap as required. The channel will be completed from point A to point B (refer to Figure 3.5-3) with a temporary dike at each end to prevent floodwaters from entering the excavation. At the time of low flow in Cottonwood Creek, as determined from flow records maintained over the past several years, a coffer dam will be constructed at point C (refer to Figure 3.5-3) to divert the flow of the creek through a pipeline from point D to E (refer to Figure 3.5-3) to the Cheyenne River. Based upon available flow records, the pipeline will have a capacity such that it can accomodate 100 percent over low flow.

While the flow is being diverted, contaminated material from the creek channel from point F to G (refer to Figure 3.5-3) will be removed and the channel stabilized as described above. Once this section of the channel has been decontaminated and prepared for flow, Cottonwood Creek will be allowed to flow over the present channel. Flow entering the mill site will be uncomtaminated and will flow over the newly decontaminated section and continue through the mill site over the existing channel.

During the next season at low flow, the coffer dam will again be used to divert the creek through the pipeline. The creek channel between points H and I (refer to Figure 3.5-3) will then be cleaned and prepared for flow. Once this is completed, the diversion channel from point A to B (refer to Figure 3.5-3) will be connected to the upstream (F-G) and the downstream (H-I) portion of the existing channel. Access to the remaining creek channel will be blocked. Flow from Cottonwood Creek will then be directed through the diversion channel. Removal of contaminated material to the east of the diversion can then proceed. Once the eastern portion of the mill site has been cleaned, the permanent route for Cottonwood Creek will be prepared. It is expected to follow the original creek channel as close as practical to form a gentle meandering course through the former mill site. When the creek has been reestablished in its permanent channel, any remaining contaminated material will be removed.

The diversion channel will be reclaimed along with other areas of the mill site which will be discussed in new ER Section 4.6.3, Reclamation. Revegetation of the stream banks will occur as soon as each portion of the rechannelization is completed.

3.5.2.2 Handling Sequence of Tailings and Contaminated Material

Approximately 80 percent of the sand tailings at the mill site could be removed by the proposed slurry pipeline. The tailings in Pond 2, the AEC pile, Area B, and the East pile are considered to be of the proper consistancy for transport in slurry form. As cleanup operations continue, other material may be determined to be acceptable for transport by the slurry method.

Topsoil and stabilization cover material will be removed from Pond 2, the AEC pile, Area B, and the East pile as tailings are tranported to the repulping plant near the East pile. Material to be slurried will be stockpiled near the repulping plant for transport at night in order that the slurry operation can continue

24 hours a day. Approximately 6813 lpm (1800 gpm) of slurry will be transported during the slurry operation (see Figure 3.5-4). The water will be supplied from TVA's existing well at the mill site, from Pond 10 and from dewatering sumps around the mill site. Excess water, about 4,000 lpm (1045 gpm) from the slurried tailings will be collected in the decant pond at the impoundment area see Figure 3.5-2 (part C and D) and returned via the recycle pipeline to the repulping plant at the mill site. About 985 lpm (260 gpm) of makeup water will be supplied from the above three sources. TVA has an appropriation permit from the State of South Dakota for the onsite well.

Because the majority of the contamination will be concentrated in the tailings, removal of the sand tailings by slurry pipeline will significantly decrease the potential for the release of airborne contaminants along the haul route. In addition, the slurry deposition of sand tailings in the impoundment area will fill void spaces in and around the mill structures and equipment placed in the bottom of the area. This will ensure that differential settlement associated with the structures which might threaten the integrity of the final clay cap and overburden cover of the impoundment area will be kept to a minimum.

As water drains from the sand tailings deposited by the slurry pipeline, a tailings beach is formed. Once this beach has been established the deposition of tailings and contaminated material removed by trucks will commence concurrently with the operation of the slurry pipeline and will proceed from the impoundment dike in an upstream direction to cover the tailings deposited by slurry pipeline see Figure 3.5-2 (part C) . Material deposited by trucks will be spread and compacted to an accepted density as determined by soils engineering studies. Throughout the slurry disposal operation, the decant pond will proceed in an upstream direction along the leading edge of the deposited tailings. Upon completion of the slurry operation, the decant pond will be pumped to Pond 10 for evaporation.

Removal of slimes from Pond 3 and Pond 7 will require special handling. Excess surface water will be pumped to Pond 10 for evaporation. To increase the evaporation rate, perforated sections of PVC pipe could be used to spray the water over Pond 10 during appropriate climatic conditions. This operation will be directed by an onsite supervisor. Topsoil, stabilization cover material, and dike material removed from other tailings areas can be used to mix with the slimes in Pond 3 and 7 to make them manageable for truck transportation and compaction. The material will be spread and compacted during the disposal operation. This multiple handling of the slime material will break up any localized concentrations of slime and eliminate any possible differential settlement of the slimes.

Removal of contaminated material by the truck from the mill site to the impoundment area will be over specially constructed haul roads as previously described. Haul roads will be watered using water from the onsite well, as necessary, to minimize the release of fugitive dust. Contaminated material in the trucks may be watered or sprayed with a suitable material to prevent fugitive dust emissions during transport. Adverse weather conditions, such as high winds, excessive precipitation, or freezing temperatures, may temporarily halt the transportation process. Removal operations are expected to continue approximately 6 months per year for 2.5 years.

As removal operations progress toward the Edgemont city sewage lagoon, it will be necessary to protect the integrity of the lagoon. To prevent its collapse, sheetpile or other type of containment device will be driven along the exposed side of the lagoon prior to the commencement of nearby removal operations.

During cleanup operations at the mill site, sumps will be constructed to collect excess water encountered on site from precipitation and ground water seepage. A portion of the water can be used as makeup water for the slurry operation. Excess water will be routed to Pond 10 for evaporation. Once the slurry operation is complete, the pipeline could be used to remove water from the mill site to decant pond at the disposal site for evaporation if additional area is required.

The dismantling of the pipelines and the removal of Pond 10 will complete cleanup operations at the mill site. The pipeline will be considered for use in other licensed facilities. Any contaminated material and excess water remaining in Pond 10 will be mixed with embankment material surrounding the pond to make it manageable for transportation to the disposal site and for compaction.

3.6 OTHER CONSIDERATIONS

3.6.1 Equipment and Manpower Requirements

The major portion of the contaminated material will be removed, transported, and deposited utilizing front-end loaders and 45 t (50 ton) trucks. Self-loading scrapers, bulldozers, small front-end loaders, trucks, and a dragline will be used to remove contaminated material from some limited-access areas. (See Table 3.6-1). Removal of a portion of the sand tailings by slurry pipeline is proposed.

Fuel and lubricant storage for the equipment will be at the present mill site (see Figure 2.2-1). The storage area will be diked and will be of sufficient capacity to retain 110 percent of the total volume contained.

The total number of employees will vary depending upon the phases of decommissioning and the time of year of operations. Figure 3.6-1 shows a peak of 91 employees during the second full working year. As indicated by the table, the peak number of employees throughout operations will occur during the summer season when the greatest amount of activity will be occurring. A much smaller working force will be maintained year round.

3.6.2 Cost

Preliminary estimates for the decommissioning project range from 20 million to 30 million in 1979 dollars.

3.6.3 Security and Maintenance

The mill site, disposal site, and haul road areas will be enclosed with a 1.8 m (6 ft) fence to prevent unauthorized access to the sites. Inspections will ensure the integrity of the fencing.

Successful reclamation of the mill site and haul road area will preclude any need for further maintenance; these areas will be released for unrestricted use. To control site access the disposal site will remain fenced following decommissioning and upon completion of reclamation. Unlike the decontaminated mill site, the disposal site would be available only for restricted use.

Possible future land uses of both the mill site and disposal site following reclamation are discussed in Section 4.3.

3.6.4 Operational Monitoring

Monitoring programs will be implemented during the decommissioning activity (refer to Chapter 5.0, Monitoring and Security Requirements. These programs will continue until the reclaimed area has reached stability, at which time no further routine monitoring or maintenance will be ne sary.

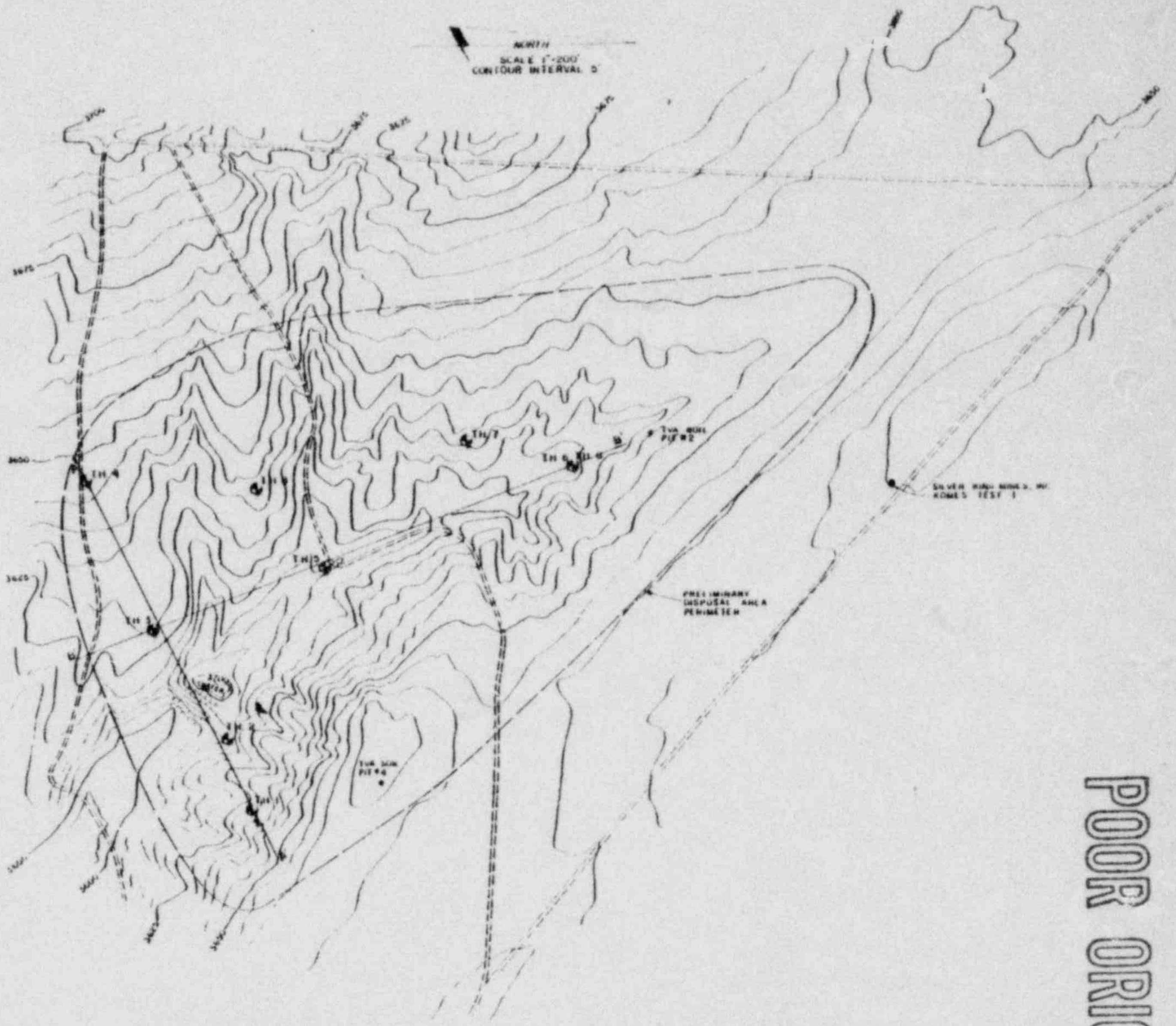
3.6.5 Schedule

The duration and scheduling for the various activities associated with the decommissioning project are shown in Figure 3.6-2. Adverse weather conditions, such as excessive precipitation, high winds, or extremely low temperatures are expected to limit the working year to approximately 26 weeks. Disposal site preparation, haul road, and slurry pipeline construction are planned to be completed during one working season. It is expected that actual contaminated material removal will be completed within three working seasons. Reclamation, partially concurrent with disposal operations, will progress for about four years. The total duration of the project is planned for approximately 7 years.

AGE	FORMATION	DESCRIPTION
Upper Cretaceous	Lower Greenhorn	Noncalcareous shale (Aquitard)
	Belle Fourche	Dark-gray marine shale (Aquitard)
	Mowry	Hard light-gray shale (Aquitard)
	Newcastle *	Lenticular fine grained sandstone to siltstone (Relatively permeable but not an aquifer because of its limited thickness and areal extent)
	Skull Creek	Black marine shales (Aquitard)
	Fall River	Interbedded mudstone, siltstone and channel sandstone (Aquifer)
	Lakota	Fusion Member-mudstone interbedded with sandstone (Aquitard) Chilson Member-channel sandstone above mudstone (Aquifer)
Jurrassic	Morrison	Green shale (Aquitard)

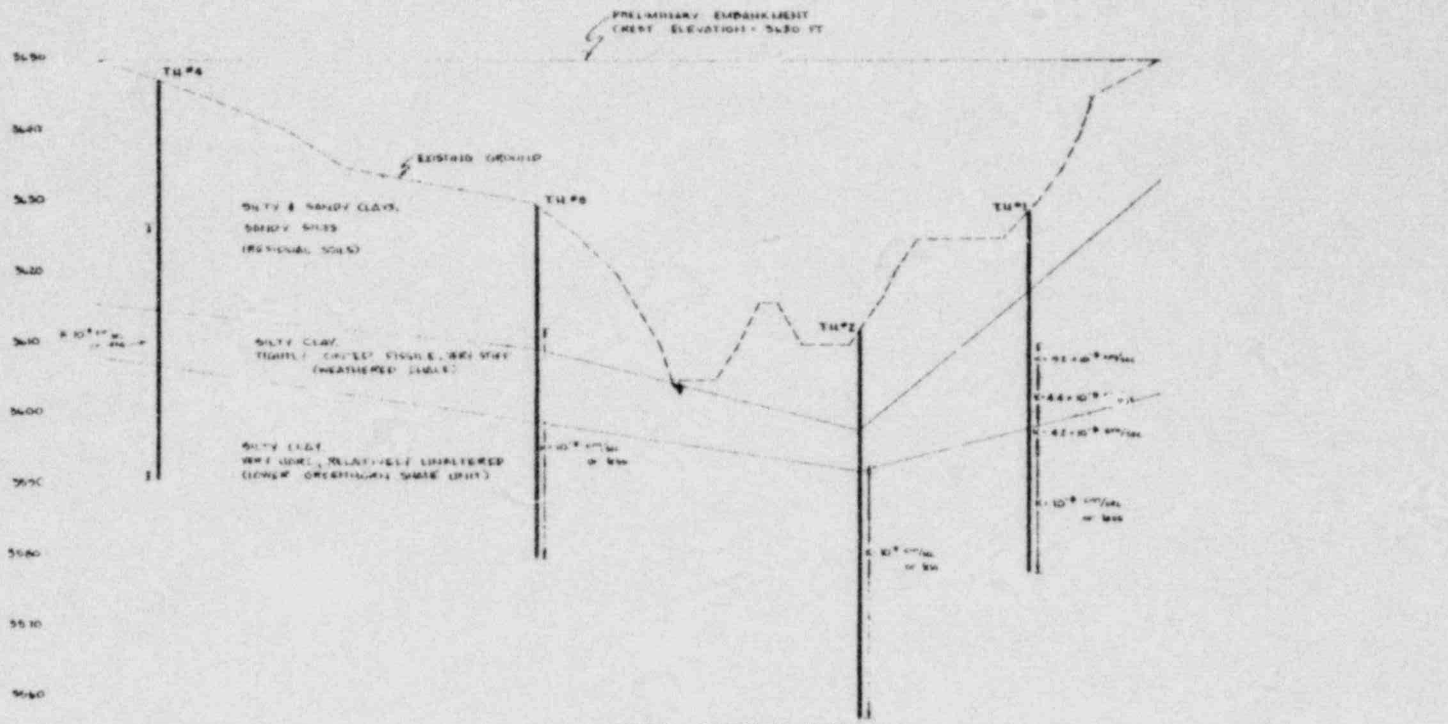
VERTICAL SCALE .9=100'   * Assumed

FIGURE 3.3-2 TYPICAL STRATIGRAPHIC COLUMN AT DISPOSAL SITE

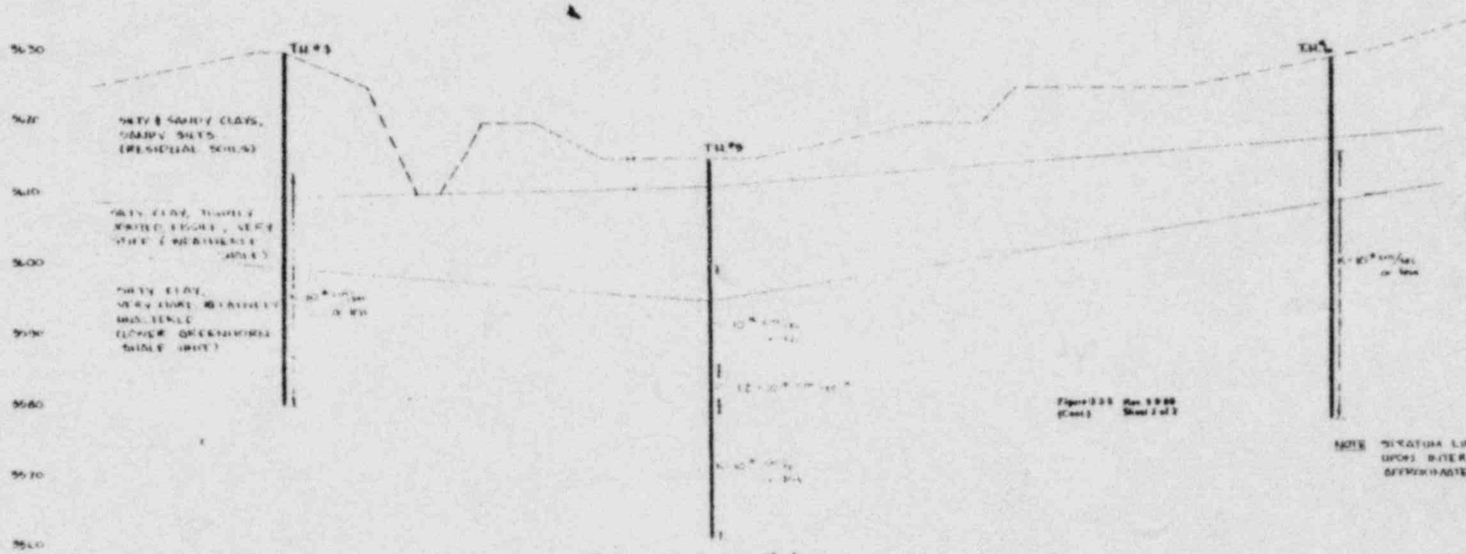


BORING LOCATION PLAN AND TOPOGRAPHY

Figure 3.2.5
DETAILS OF DISPOSAL SITE
EXPLORATORY BORING
Sheet 1 of 2



CROSS SECTION A-A'



CROSS SECTION B-B'

NOTE: STRATUM LINES ARE BASED UPON INTERPOLATIONS FROM APPROXIMATE BOUNDARIES

*Reading of Zone of relatively high permeability considered due to a problem in the testing apparatus.

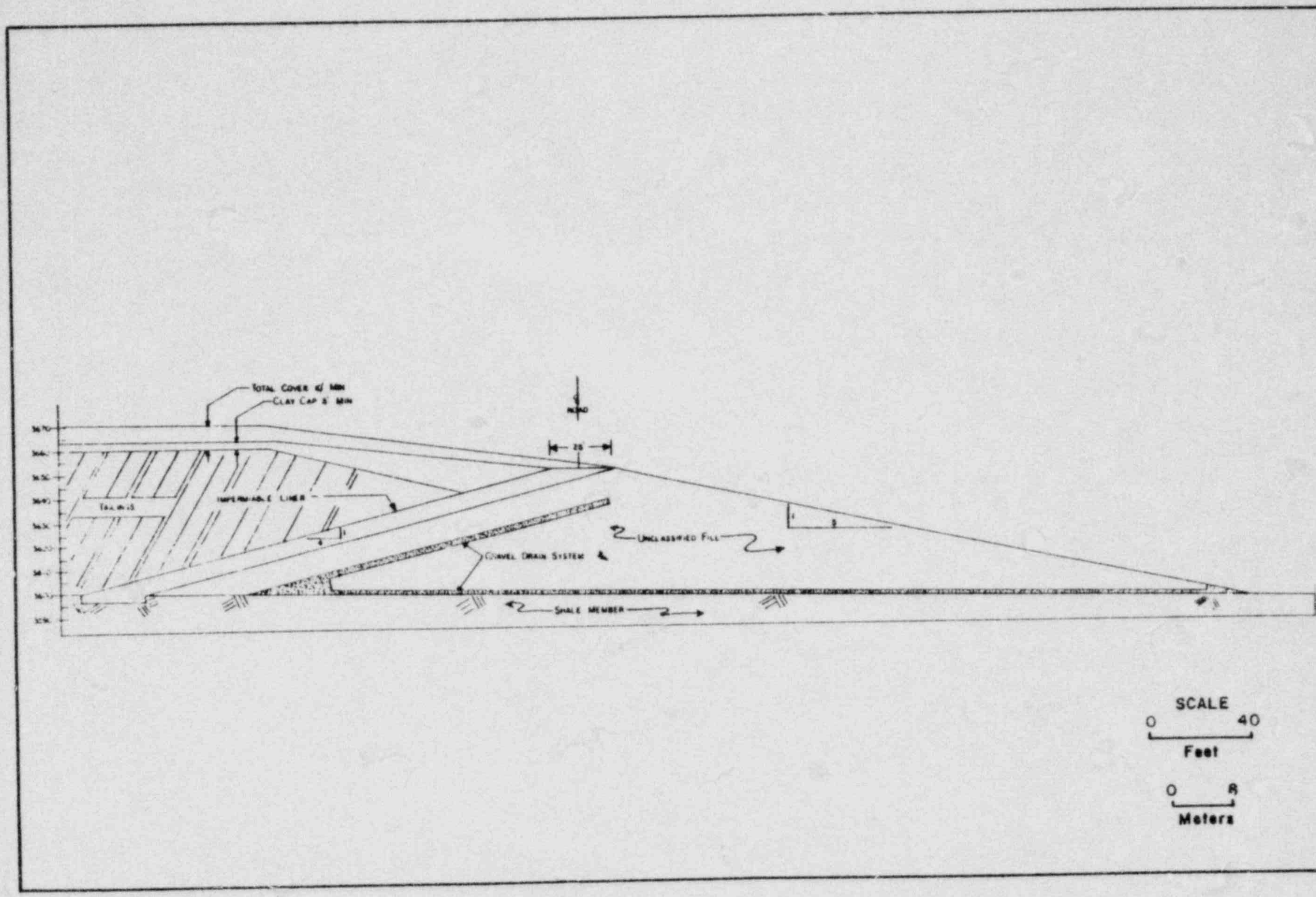


FIGURE 3.3-6 DETAILS OF IMPOUNDMENT DIKE

4.2 WATER

4.2.1 Hydrologic Characteristics

4.2.1.1 Surface Water

4.2.1.1.1 Description

The area in which decommissioning will occur is within the watershed of the Cheyenne River. The Cheyenne River begins on Pine Ridge about 185 km (115 mi) west of Edgemont. The course of the river approximates the boundary between the Black Hills Section and Missouri Plateau Section of the Great Plains Physiographic Province and has a drainage area of 18,500 km^2 (7,143 mi^2) at Edgemont. The river channel is braided, reflecting the low gradient of about 0.0014 in the vicinity of Edgemont. The Cheyenne River is impounded for irrigation and flood control by Angostura Reservoir about 54 km (34 mi) downstream from Edgemont. Angostura Dam is about 10.4 km (6.5 mi) southeast of Hot Springs. Contents of the reservoir since initial filling in October 1949 have ranged from a minimum of 55.96 hm^3 (cubic hectometers) (45,350 acre-ft) in September 1960 to a maximum of 179 hm^3 (145,200 acre-ft) in June 1962. The Cheyenne River flows northeasterly from Angostura Dam for another 240 km (150 mi) and empties into Oahe Reservoir which is impounded by Oahe Dam on the Missouri River near Pierre, South Dakota.

The Edgemont Uranium Mill site is located at Edgemont on the Cheyenne River at the mouth of Cottonwood Creek. The Cheyenne River flows from west to east along the northern boundary of the site. Cottonwood Creek flows northerly through the site and empties into the Cheyenne River. (See Figures 4.2-1 and 4.2-2). | Rev. 5

Flow characteristics of these two streams are included in Tables 4.2-1 and 4.2-2. The USGS (United States Geological Survey) operates a stream gaging station on the Cheyenne River at Edgemont. Records from this station through September 1977(1) indicate that the Cheyenne River at this location drains an area of 18,500 km^2 (7,143 mi^2). Average flow of the river during the 35-year period of record was 2.76 m^3/s (97.4 ft^3/s), equivalent to 0.48 cm (0.19 in) of annual runoff from the watershed. Average annual flow varies widely and has ranged from 0.37 m^3/s (12.9 ft^3/s) in 1961 to 12.3 m^3/s (434 ft^3/s) in 1962.(2) The river experiences periods of no flow during most years. Sustained flow was recorded during only eight of the 31 water years from 1947 through 1977.(2) May, June, and July are the months of highest runoff, generally as the result of snowmelt and higher precipitation amounts experienced during these months. Runoff is generally lowest during the fall and winter months when precipitation is low and occurs mostly as snow.

Flows of the Cheyenne River are influenced by many small reservoirs (9,320 in 1965) in the watershed which are used for stock water and irrigation. The increasing number of these small reservoirs has the potential for decreasing the future flow rate of the river and, subsequently, its ability to dilute contaminants which may enter the river.

Maximum peak flow during the period of record was 793 m^3/s (28,000 ft^3/s) on May 20, 1978.(3) This flood reached a stage of 4.16 m (13.65 ft) (3,428 ft elevation) at the gage.(3)

A flood on May 1, 1922, reached a stage of 4.26 m (14.0 ft) (3,428 ft elevation).(1)

Estimates of peak flood discharges for floods of selected recurrence intervals are included in Table 4.2-2.(4) In addition an estimate of the 500-year flood on the Cheyenne River provided by the USGS (3) indicates this flood, with a discharge of 1,775 m^3/s (62,700 ft^3/s), would reach a stage of 5 to 5.5 m, 17 to 18 ft (elevation 3,431.6 to 3,432.6 ft).

Cottonwood Creek, which flows through the site, drains an area of about 388 km^2 (150 mi^2). No historical flow records are available on the stream. Flow characteristics of the stream were determined using techniques developed by the USGS.(5,6) These are shown in Tables 4.2-1 and 4.2-2. Average flow was estimated to be 0.066 m^3/s (2.3 ft^3/s), equivalent to an annual runoff of 0.53 cm (0.21 in.). In August 1975, TVA established a staff gage on the stream at the culvert about 274 m (900 ft) above the mouth. A stage-discharge relationship was developed by USGS from discharge measurements and culvert flow formulas. Observations of the staff gage at about weekly intervals from August 1975 through August 1978 indicate the flow has varied from zero during freezing weather to 1.56 m^3/s (55 ft^3/s) at the time of observations. Much of the flow at the culvert during dry weather is overflow from the Edgemont municipal lake which is fed by an artesian well. Much higher flows occurred during this period. Floods in July or early August 1976, March 1977, March 1978 and May 1978 are estimated to have been in the range of 7 to 8.5 m^3/s (250 to 300 ft^3/sec). Estimates of flood peak discharges for floods of selected recurrence intervals are included in Table 4.2-2.(6)

Additional sources of surface flow to the site are from: the sewage outfall line (intermittent, depending on system breakdown), city well, and mill fire safety tank which form a combined discharge at the pumphouse just north of sand tailings area B (see Figure 4.2-2); potential seepage from ponded waters in tailings ponds on the site; and from both direct and ponded precipitation runoff. Figure 4.2-2 shows the surface drainage and ponded areas on and off the site.(7)

Runoff from an area of about 310 acres east of the mill tailings ponds 7 through 10 contributes to standing surface water in the ponds (see Figure 4.2-2).

The following description of the potential for surface water contamination from the mill area (with minor revisions) was prepared by Ford, Bacon, and Davis Utah, Inc., as part of the engineering assessment of the Edgemont Site.(7)

> Potential means whereby surface waters near the site could be contaminated by mill tailings are:
>
> (a) Physical transport by runoff or dike failure
>
> (b) Seepage of ponded waters through the dikes or pond basins into surface water courses
>
> (c) Erosion of tailings dikes or sand tailings piles adjacent to the Cheyenne River or Cottonwood Creek
>
> Physical transport of tailings off-site is already evident at some and is a potential at almost every pile or pond. The northern bank of pond 1 is designed to limit erosion to the Cheyenne River; however, there is evidence of erosion along the eastern side of the dike which can enter the Cheyenne River via the roadway or adjacent gully. Erosion is also evident along the northern and eastern border of pond 2 and could reach the nearby Cheyenne River and Cottonwood Creek. Also, wind erosion has drifted tailings into ponded surface waters along pond 3 and along the northern border of pond 4 where there also is evidence of water erosion. The eastern side of pond 8 has withstood erosion and pond 9 has been stabilized. However, some of the cover material along the eastern side and along the southern border of pond 9 has eroded. On pond 10, off-site erosion can take place at the southwestern corner and along steeper sections of the western dike. A vegetated berm protects most runoff from pond 7 from running off site except at the northwestern corner where ponded water exists. At the East sand tailings, eroded materials could easily reach Cottonwood Creek from severely eroded sections of the southwestern, western, northwestern sides. Also, the dirt road bordering the East sandpile might have been a protective measure to prevent runoff; however, it has been breached in several places providing direct runoff paths to the creek. Another source of eroded material to Cottonwood Creek includes sections of the eastern and southern sides of the sand tailings area A and from sand tailings area B near the mill site.
>
> Off-site and on-site runoff collection in the tailings ponds or behind dikes has occurred along the southern margin of pond 9, the eastern side of pond 7, at the intersection with ponds 9 and 7, and further south at

pond 10. At some of these interceptions, water is seeping through the dikes into the tailings ponds or beneath the dikes via buried drainage channels. As an example, a series of catchment areas exist toward the southeastern border of pond 7. Immediately north of and within the dike a pond has formed which is being recharged by the infiltrating runoff waters.

Ponded waters within inactive tailings ponds consist of the residual process waters further recharged by precipitation that is trapped in the broad surface areas of the ponds and collected in the smaller lower areas. Although annual evaporation exceeds annual precipitation, the precipitation is not entirely evaporated in a year's time. Therefore, the hydraulic head in these ponds varies considerably and likewise the associated piezometric groundwater surface. It is speculated that collected waters from pond 7 percolate through the tailings dike and appear as seeps along the western margin of the pond at times of high pond levels. Available data indicate that when the head in the tailings pond is high, the associated phreatic line (water table) is encountered quite high at drill holes in the western dike. Likewise, when the head is low, the water table configuration in the dikes is below the base or nonexistent. The potential seep in the western dike of pond 7 is masked by surface runoff collection at the same location. Runoff has migrated off site to the west of pond 10 also.

Physical transport of tailings due to flooding of the Cheyenne River or Cottonwood Creek is possible. The meandering Cheyenne River channel is braided and its flood plain is broad, but the flood stages can reach the base of the tailings in ponds 1 and 2.

The flood of May 20, 1978, at the U.S. Geological Survey stream gaging station at the Highway 18 bridge over the Cheyenne River reached an elevation of 3,428.2 feet at the gage with a peak flow of 793 m^3/sec (28,000 ft^3/sec). The highest recorded flood in May 1922 was 0.35 foot higher and near the 100-year flood (900 m^3/sec, 31,800 ft^3/sec) level. (3,1)

The riverbed in the reach containing the tailings is at elevations between 3,412 and 3,416 ft, whereas the base of the tailings is near 3,425 ft; therefore, the potential of flood transport of tailings from an intermediate flood (25 yr) or a more severe flood (100 yr) is moderate. A flow of 13,800 cfs (elevation 3,425.1 ft) (25-yr flood equivalent) was recorded at Edgemont in 1971. High flows could erode and undercut sections of the alluvial bank on which the northeastern corner of pond 2 is situated and could also undercut the bank underlying the northwestern corner of pond 1. A continuing high flow would be required to erode through the dikes and reach the tailings.

The projected elevation of the 500-year flood, flow of 1,775 m^3/sec (62,700 cfs) is about 3,432 feet.(3) The maximum probable flood, 5,950 m^3sec (210,000 ft^3/sec) is difficult to project but a conservative estimate is 3,435 feet.

Cottonwood Creek within the reach adjacent to the mine tailings has cut through the Cheyenne River alluvium and upper bedrock to reach levels of 3,414 to 3,430 feet.

An estimated 25-yr and 100-yr flood level was calculated for Cottonwood Creek utilizing a theoretical USGS technique.(6) A value of approximately 3,600 cfs was estimated as a 25-yr flow whereas a value of about 7,850 cfs was estimated for a 100-yr flow (TVA estimate 7,680 cfs for 100-year flood). Respective water levels predicted at the site should not exceed 3,440 ft. Flooding of the creek would not reach the community living level. During mill operations, the channel was straightened and covered in the vicinity of sand tailings area A and the East sandpile. Both the Cheyenne River and Cottonwood Creek are gaining streams during most of the year, meaning that they are, in part, recharged by unconfined ground waters along their paths, such as those at the Edgemont site. Wells located within the flood plain are likewise recharged by entering ground water and/or by flood plain surface water flows. Should these waters be affected by seepage from the tailings ponds/sandpiles, an impact on the wells, creek and river waters could occur.

Disposal Site

The selected disposal site, shown on Figure 4.2-1 is drained by an ephemeral, unnamed tributary of the Cheyenne River which ends at a pond near the western edge of the river's flood plain at point 2. Another small pond of about 0.1 ha (0.25 acre) in size is located about halfway between the disposal site and the Cheyenne River. A small stock pond about 0.8 ha (2 acre) in size is located at the southwestern limit of the disposal site (point 1). It is impounded by an earth dam about 64 m (210 ft) long, 4.6 m (15 ft) high, and 7.6 m (25 ft) wide at the crest.(8) Most of the runoff from the disposal site is probably contained by this structure. Any overflow from this reservoir and not contained by the ponds downstream could eventually reach the Cheyenne River. Elevations of the watershed in which the disposal site is located range from about 1,128 m (3,700 ft) at the highest point on the western watershed divide to about 1,091 m (3,580 ft) near the proposed location of the earth fill at the lower boundary of the disposal site. Runoff characteristics at point 1 and 2, based on techniques developed by the Water Resources Division of the USGS(4,5,6), are presented in Tables 4.2-1 and 4.2-2. Average annual runoff from the watersheds above these locations is very low, in the order of 0.53 cm (0.21 in). Annual runoff may vary considerably from year to year depending upon rainfall occurrence. More than half the runoff can be expected to occur during the months of May, June, and July as the result of snowmelt and heavy rainfall. The peak discharges of floods at selected recurrence intervals shown in Table 4.2-2 indicate the range of flood discharges which could be expected at each site. Flood events are generally the result of heavy local thunderstorms. The disposal site is well above any possible floods on the Cheyenne River.

4.2.1.1.2 Impacts

The major impact of the decommissioning plan upon the surface water features would be the complete and permanent alteration of the present drainage system in the 68 ha (168-acre) disposal site. As described in Section 3.3, Disposal Site Preparation a surface runoff diversion system will be constructed to prevent offsite runoff from entering the disposal area. Isolation courses constructed at the northern and northwestern edges of the disposal area (see Figure 3.3-3) will divert surface runoff from small areas north and west of the site into existing intermittent drainage courses to the northwest. This diversion would increase the drainage area of the drainage courses to the northwest by about 2.8 ha (7 acre) and decrease the drainage area of the intermittent drainage channel now draining the disposal area by this amount. Surface runoff from outside the western perimeter of the disposal area would be diverted to the southeast and returned to the existing drainage channel immediately downstream from the containment dike. The diversion of surface runoff would have no significant impact on the annual runoff volumes or peak flood flows on the drainage courses involved because only small changes will occur in their drainage areas.

During the four-year period required for excavation of the disposal site, construction of the containment dike and placement of contaminated material in the disposal area, no runoff will occur from an area of approximately 44.5 ha (110 acre) included in the disposal site. Water from precipitation accumulating in the excavated area will either evaporate or, during disposal operations, be returned to Pond 10 at the mill site through the recycle pipeline as described in Section 3.4, Haul Road and Slurry Pipeline Construction. This elimination of runoff from 44.5 ha (110 acre) will temporarily reduce the volume of annual runoff now available for supplying two stock ponds downstream from the disposal site and could cause a small reduction in peak flood flows in the drainage course downstream. However, because of the relatively small size of the area to be eliminated, the impacts are not considered to be significant or adverse.

During construction activities at the disposal site, a small stock pond located immediately downstream from the containment dike will be removed. Construction of the isolation courses and containment dike and storage of material from the excavated area could cause some temporary increases in erosion and sedimentation in the existing drainage systems until areas are revegetated. No significant long-term impacts on the drainage system below the disposal area or on the Cheyenne River are anticipated since any eroded material will be controlled by a sediment pond to be constructed downstream from the containment dike and reclamation measures (see Section 4.6.3, Reclamation Plan will largely reduce erosion of the disposal site.

Construction of the haul road will disturb the existing drainage system along its route and may also cause some temporary increase in erosion and subsequent sedimentation in the small intermittent drainage courses it crosses between the mill site and the disposal area (see Figure 3.3-4). However, since runoff from the completed road will be contained on site as described in Section 3.4, Haul Road and Slurry Pipeline Construction no significant adverse impacts from erosion or sedimentation are anticipated. The effect of reducing the areas contributing to runoff in the small drainage courses due to construction of the haul road is considered insignificant because of the relatively small area, 12 ha (30 acre), involved. The reclamation of the haul road following the four-year period of disposal activity will restore this area to unrestricted use (see Section 3.4) and essentially restore the previous drainage pattern. Therefore, no significant, long-term impacts from construction, use, and restoration of the haul road are anticipated.

The major impacts of the decommissioning upon the existing surface water features at the existing mill site will include the elimination of standing water in the tailings ponds; removal of a source of contamination to Cottonwood Creek and the Cheyenne River; changes in the existing local drainage by construction of a diversion ditch along the eastern edge of the mill area to intercept uncontaminated surface runoff from the area east of the mill site and divert it onto the Cheyenne River floodplain (see Section 3.5, Mill Site Cleanup. Construction of the diversion ditch will disturb about 5.3 ha (13 acre) and may cause a short-term increase in sediment transported to the Cheyenne River in the immediate vicinity of the mill site until the ditch can be vegetated. No significant changes in flow characteristics of the Cheyenne River are anticipated because of the small area involved.

Cottonwood Creek through the mill site will be diverted as described in Section 3.5.2.1, Cleanup of Cottonwood Creek to facilitate removal of contaminated material. This diversion and the subsequent restoration of Cottonwood Creek to near its original channel will have no significant long-term effects on the hydrologic characteristics of the stream. Construction activities could cause temporary, short-term increases in sediment loads and concentrations in Cottonwood Creek and the

Cheyenne River in the immediate vicinity of the mill site from loose material being carried from the banks of Cottonwood Creek before the banks are stabilized by rip-rap or vegetation. Tailings will be removed and land reclaimed on an area of the mill site which is within the floodplain of Cottonwood Creek. There is no alternative to this activity which would result in the safe stabilization and/or disposal of these tailings which would not involve floodplain activity to the same degree. Because of the need to stabilize and dispose of these tailings, no practical alternative to the proposed action exists. Additional sources of surface flow from the city well and mill fire safety tank can be handled with the Cottonwood Creek diversion.

Reclamation measures as described in Section 4.6.3, Reclamation Plan, will restore the mill site to unrestricted use and the long-term impacts of the decommissioning plan upon surface water features will be favorable.

4.2.1.1.3 Mitigation

Mitigation measures to be used to protect surface water features at the disposal site include: the diversion of offsite surface and subsurface runoff away from the containment area by a system of isolation courses as described in Section 3.3, Disposal Site Preparation; the placement of a clay liner on the upstream face of the containment dike as described in Section 3.3 to prevent infiltration of water from the impoundment area; the placement of an impermeable clay cap and cover material over the containment area to exclude infiltration of surface water into the contaminated material as described in Section 4.6.3, Reclamation Plan the installation of a sediment pond downstream from the containment dike to trap sediment transported from the site during construction and reclamation activities; the contouring and revegetation of the disposal site and borrow areas to prevent erosion and possible sedimentation in adjacent drainage courses.

Mitigation measures to be used to protect surface water features along the haul road route include: diversion of offsite runoff away from the route to avoid possible transport of contaminated material to adjacent drainage courses; construction of the road and slurry pipeline to contain runoff from the road onsite and return it to the mill site or disposal area; cleanup of all contaminated material along the haul route at completion of the decommissioning activity; reclamation and revegetation of the haul route upon completion of activities to prevent erosion and sedimentation of adjacent drainage courses.

Mitigation measures to be used at the mill site to protect surface water features include: construction and maintenance of a diversion ditch along the eastern perimeter of the site to prevent offsite runoff from reaching contamianted areas, as described in Section 3.5, Mill Site Cleanup; the diversion of Cottonwood Creek during removal of contaminated material to prevent possible transport of the material into the Cheyenne River; the restoration of Cottonwood Creek to near its original channel and rip-rap and revegetating of stream banks to prevent erosion and tranport of sediment to the Cheyenne River (see Section 3.5.2.1, Cleanup of Cottonwood Creek; the removal of contaminated material from the banks of the Cheyenne River during periods of low flow to prevent possible transport downstream by flood flows; the use of sediment ponds and sumps to contain sediment-laden or contaminated water onsite; the protection of the integrity of the Edgemont city sewage lagoon by sheetpiling or other means; the recontouring and revegetating of the mill site and borrow areas to prevent erosion and sedimentation of adjacent areas.

4.2.1.1.4 Benefits

The benefit of this decommissioning plan is the elimination of the possibility for contamination of the surface water features adjacent to the Edgemont site. The floodplain activity described on the mill site is aimed at restoring and reclaiming floodplain areas previously impacted by milling activities.

4.2.1.2 Ground Water

4.2.1.2.1 Description

1. Regional Setting

Western Fall River County is underlain by five principal aquifers: Quaternary Alluvium; the Fall River Formation, 3 to 60 m (10 to 200 ft) thick, and the Lakota Formation, 7.6 to 148 m (25 to 485 ft) thick, both of Cretaceous age; the Sundance Formation, 21 to 137 m (70 to 450 ft) thick, of Jurassic age; and the Pahasapa Formation, 91 to 192 m (300 to 630 ft) thick, of Mississippian age. These formations crop out peripherally to the Black Hills, where they receive recharge from precipitation. Ground water movement is in the direction of dip, radially from the central Black Hills. In most cases, the water is under artesian conditions away from the outcrop areas, and many wells in the region flow at the surface. The common practice for many years has been to allow wells to flow, which has resulted in declining regional potentiometric head.(9)

Alluvium is used locally as a water source for domestic and stock water supplies. Recharge is derived from infiltration of precipitation and from streams during periods of high flow.

The Fall River and Lakota Formations are the principal sources of water in the area. The Sundance Formation in Fall River County is used as an aquifer near its outcrop area in the central and northwestern parts of the county. The Pahasapa Formation, accessible in Fall River County only by very deep wells, is a source of water for Edgemont.(9)

The Fall River and Lakota Formations together form the Inyan Kara Group. Water in the Fall River is separated from that in overlying formations by one or more of the following geologic units: (1) the Greenhorn formation which regionally averages 69 m (225 ft) in thickness; (2) the Belle Fourche Shale regionally averaging 55 m (180 ft) in thickness; (3) the Mowry Shale regionally averaging 49 m (160 ft) in thickness; and (4) the Skull Creek Shale which ranges from 60 to 70 m (200 to 230 ft) in thickness in the region. Shale beds in the Fuson Member of the Lakota, 12 to 43 m (40 to 140 ft) thick, generally separate water in the Fall River from that in the 15 to 45 m (50 to 150 ft) thick Chilson Member of the Lakota, which is the water-bearing unit of this formation. The Minnewaste Member of the Lakota, consisting of up to 8 m (25 ft) of limestone, lies below the Fuson Member and does not appear to be water bearing. The Lakota Formation is underlain by the Jurassic Morrison Formation, which consists mostly of shale and clay and is not considered to be an aquifer.(9)

Faults and fractures associated with the Dewey and Long Mountain structural zones, which trend southwesterly through northwestern Fall River County, are believed to affect ground water movement. According to Bowles (11,12), and Gott, Wolcott, and Bowles (13), large volumes of water may migrate upward from the Minnelusa Formation, along solution collapses and breccia pipes associated with fractures, to recharge the Inyan Kara Group near the margin of the Black Hills. This theory, which is supported by water quality data, is used to account for the source and deposition of ubanium in the Inyan Kara Group.

2. Edgemont Uranium Mill Site

The present mill site is located on the east side of the city of Edgemont (see Figure 4.2-3). The site is underlain by Quaternary-age alluvial deposits ranging up to 9 m (30 ft) in thickness, and consisting of interbedded lenses and layers of primarily fine-grained sands, silts, clays and minor amounts of gravel. Horizontal hydraulic conductivity of the alluvium was measured in situ at 14 piezometers at the mill site. Values range from 1.8×10^{-5} to 6.1×10^{-2} centimeters per second (cm/s), and average approximately 1.3×10^{-2} cm/s.(7) Vertical conductivity was measured in situ at four site piezometers and by laboratory testing of recompacted formation samples. Vertical conductivities range from 4.0×10^{-6} to 6.5×10^{-3} cm/s, and average 2.7×10^{-3} cm/s.(7) In general, conductivity of the alluvial deposits is variable, with magnitudes in the low to moderate range.

The water table, or phreatic surface, lies in the alluvial deposits at the mill site. A contour map of the water-table elevation is presented on Figure 4.2-4. As indicated on the figure, ground water movement is generally directed toward Cottonwood Creek and the Cheyenne River.

The alluvium is underlain by more than 60 m (200 ft) of Skull Creek Shale. The Skull Creek forms the upper confining layer for the underlying Fall River aquifer, and acts as a hydrologic barrier between the alluvial and Fall River aquifers. Because of confined conditions in the Fall River aquifer, any leakage between the two aquifers is upward.

The majority of private wells in the vicinity of the mill site are developed in the alluvium due primarily to its accessibility and shallow depth of occurrence.(7) Well depths average approximately 7 m (23 ft); yields average less than 11 l/min (36 gal/min).(7) A few wells tap the deeper confined aquifers of the Fall River, Lakota, Sundance and Pahasapa formations. Five wells developed in the Pahasapa at depths of more than 700 m (2,300 ft) provide water for the city of Edgemont, Burlington-Northern Railroad, and the mill facility.

Recent growth in the Edgemont area is occurring to the west of the city, away from the existing mill site. Future growth is expected to follow the same trend.(7) Thus, it is unlikely that there will be any significant population growth in the immediate vicinity of the mill site which might alter present ground water conditions.

3. Disposal Site

The proposed site for disposal of the Edgemont mill tailings is located approximately 3.2 km (2 mi) southeast of the mill site in T.9S, R.3E, Sec. 8 and 17 (see Figure 4.2-3). The overburden materials at the site consist of alluvial and aeolian sediments and weathered shale residuum. The alluvial and aeolian soils are composed of fine-grained sand and silts with varying amounts of clay ranging from 15 to 30 percent by weight.(22) These materials have a gradational contact with the underlying silty clay residuum of the Lower Greenhorn Shale. The combined thickness of the soil and weathered shale ranges from approximately 20 to 40 feet and averages about 27 feet.(22) In situ packer tests conducted in test boreholes indicate that the permeability of these materials is generally very low. Hydraulic conductivity values of less than 10^{-8} cm/sec were measured in all borings except one located in the southeastern corner of the disposal site.(22) Conductivities in the 10^{-5} cm/sec range were reported at this location.(22) The water table at the site generally lies within the unconsolidated surficial soils, a few feet above the soil-bedrock contact.(8) The configuration of the water table as shown on Figure 4.2-5 is generally a subdued reflection of the site topography. Ground water levels in the vicinity of the stock-watering pond located on the southern side of the site are affected by seepage from the pond. In the absence of the stock pond, the water table in this area would be expected to be lower, probably within a few feet of the bedrock surface. Rev. 5

The unconsolidated surficial materials are underlain by a thick sequence of shale units including (in descending order) the Lower Rev. 5

Greenhorn Formation, the Belle Fourche Formation, the Mowry Shale, the Newcastle Sandstone (less than 10 feet thick), and the Skull Creek Shale (see Figure 3.3-2, Typical Stratigraphic Column at Disposal Site). The combined thickness of these shale units is approximately 177 m (580 feet) at the disposal site based on results of a deep exploratory borehole (Komes Test 1) located some 300 feet northeast of the site. Packer tests indicate the hydraulic conductivity of the upper portion of the Lower Greenhorn shale is less than 10^{-8} cm/sec.(22) The permeability of the underlying shale units is also expected to be extremely low. Thus, the shallow unconfined ground-water system in the overburden is separated from the major underlying confined aquifers of the Fall River and Lakota Formations by approximately 177 m (580 feet) of highly impermeable material. Potentiometric levels and gradients in the confined aquifers of the Fall River, Lakota, Sundance and Pahasapa Formations are expected to follow regional trends as discussed previously. The nearest residences are located approximately 2.4 km (1.5 mi) from the disposal site. No significant population growth is expected in the site vicinity which might affect ground water conditions. Rev. 5

4.2.1.2.2 Impacts

Ground water impacts at the proposed disposal site are expected to be minimal. Currently, there are no water wells within 2.4 km (1.5 mi) of the site. It is isolated from population concentrations and is in an area where no significant future growth is expected. The manner in which the tailings will be disposed should minimize effects on ground water quality and levels in the site vicinity. Isolation courses will be excavated to bedrock across the northwestern and western portions of the disposal area to intercept shallow ground water and surface runoff which might otherwise infiltrate the tailings pile. Intercepted water will be channeled onto the existing drainage below the containment dike. The disposal area will be capped with compacted clay preventing infiltation of precipitation into the tailings pile.

Near surface disposal will not affect the underlying confined aquifers. The buried tailings will be separated from the shallowest confined aquifer (Fall River Formation) by some 177 m (580 ft) of relatively impervious shale. Furthermore, the regional relationship between the potentiometric head in the shallow ground water system and the Fall River aquifer indicates that any leakage between the two systems is upward. Rev. 5

Under this disposal scheme the present mill site, although reclaimed, would remain impacted to the extent that it would not be suitable for future development of shallow ground water supplies.

4.2.1.2.3 Mitigation

No mitigation related to ground water will be needed to implement the proposed mill decommissioning and tailings stabilization plan.

4.2.1.2.4 Benefits

Tailings would be located away from existing wells, population centers, and surface water sources. The proposed design for tailings stabilization will provide a reliable means of containment of tailings contaminants.

4.2.2 Water Quality

This section describes the nonradiological surface and ground water quality characteristics in the Edgemont, South Dakota, area.

4.2.2.1 Surface Water Quality

4.2.2.1.1 Description

1. Regional Setting

The Edgemont, South Dakota, region is drained by the Cheyenne River and several tributary streams. These streams, including the Cheyenne River, experience extended periods of no flow. The State of South Dakota has classified the Cheyenne River in this vicinity as being suitable for the following uses: (1) warm water semipermanent fish life propagation, (2) limited contact recreation (3) wildlife propagation and stock watering, and (4) irrigation. Beaver Creek (South Dakota) has been classified as being suitable for the same uses as the Cheyenne River except that this stream has been classified as being suitable for cold marginal fish life propagation rather than warm water semipermanent fish life propagation.

Surface water quality investigations were performed in the region by TVA during the period of December 1974 through September 1977. The data resulting from these investigations are listed in Table 4.2-3 and analytical methods are listed in Table 4.2-4. Samples were collected semiannually during the high runoff season (May-July) and the low flow season (fall and winter). Sampling station locations are shown in Figure 4.2-6.

Additional water quality data from the USGS and the State of South Dakota were utilized in this assessment. A summary of the TVA, USGS, and South Dakota data is presented in Tables 4.2-5 and 4.2-6. Specific aspects of these data are discussed below.

The warmest water temperature 36.0^0 C (96.8^0 F) within the Cheyenne River was observed at station S-5 (upstream of Red Canyon Creek). The warmest temperature 31.0^0 C (87.8^0) within Beaver Creek was observed at station S-3 (near the mouth of the creek). The South Dakota temperature standard for the Cheyenne River 32.2^0 C (90^0 F) was exceeded in August 1973 and June 1974 at Station

S-5, and the South Dakota temperature standard for Beaver Creek 23.9° C (75° F) was exceeded in July 1976 at Station S-3.

In the Cheyenne River and Beaver Creek, observed dissolved oxygen concentrations were normally well above State standards. The pH values were observed to be in the normal range of 6.5 to 9.0 Standard Units. Total alkalinity and hardness of the Cheyenne River averaged 156 mg/1 (milligram/liter) and 1,390 mg/1, respectively, and Beaver Creek averaged 148 mg/1 and 1,425 mg/1, respectively. Both waters are considered to be very hard. Dissolved solids averaged 3,513 mg/1 and 2,960 mg/1 in Cheyenne River and Beaver Creek, respectively. The mean dissolved solids concentrations of the Cheyenne River exceed established criteria for livestock watering, and mean dissolved solids concentrations for both streams exceed the State of South Dakota water quality standard.

Coliform bacteria data at Edgemont (S-4) showed that high concentrations of fecal, fecal streptococci, and total coliforms were present during various times of the year. The fecal to fecal streptococci ratios suggest that the source of pollution to be animal feces.

The chemical water quality of the Cheyenne River and Beaver Creek was poor. Mean concentrations of barium and some arsenic measurements were above those concentrations identified by the EPA "National Interim Primary Drinking Water Standards"(16) for finished drinking water. Mean concentrations of cadmium above these standards were observed in Beaver Creek. Mean concentrations of chlorides, iron, manganese, and sulfates in both the Cheyenne River and Beaver Creek were above those concentrations identified by the EPA "Proposed Secondary Drinking Water Standards."(17) These conditions are probably the reason why these streams are not classified for domestic water supply use. Concentrations of iron and conductivity levels in the Cheyenne River and Beaver Creek exceeded the State of South Dakota water quality standards. Based upon the "1972, NAS - NAE Water Quality Criteria,"(18) water from both the Cheyenne River and Beaver Creek is unsuitable for irrigation use (continuously on all soils) due to high concentrations of iron, manganese, and dissolved solids. High concentrations of chemical oxygen demand were observed in both the Cheyenne River and Beaver Creek in the project vicinity.

Water quality data resulting from the surveys performed during the later summer and early fall months correlate closely with regional historical ground water quality data (9) from the upper Quaternary and Pierre Formations. This indicates that during this time of the year flows in Beaver Creek and the Cheyenne River are predominately composed of ground water base flows which enter the stream beds through seeps, springs, and flowing wells. Conversely, water quality data resulting from the surveys performed during the spring and early summer months show increased concentrations of those constituents characteristic of stormwater runoff and snow melt (suspended solids, color, nutrients, iron, manganese, etc.).

2. Edgemont Uranium Mill Site

The Edgemont uranium mill site is dissected by Cottonwood Creek which enters the Cheyenne River at the northern boundary of the mill site. A discussion of the water quality of the Cheyenne River is presented in the Regional Setting section.

Water quality investigations of Cottonwood Creek were performed from December 1974 through September 1977. Sampling station locations are shown in Figure 4.2-2. The data are presented for each semiannual survey in Table 4.2-3, and a summary is included in Tables 4.2-5 and 4.2-6. Cottonwood Creek, like the majority of the surface streams in the area, has reasonably poor water quality.

All streams in South Dakota are classified for the beneficial uses of wildlife propagation and stock watering and irrigation. Cottonwood Creek is not assigned any other beneficial use.

The pH values observed in Cottonwood Creek were within NAS-NAE criteria for irrigation water, South Dakota water quality standards, and EPA drinking water standards. Observed dissolved oxygen concentrations were well above the minimum State standards. Maximum recorded water temperature in Cottonwood Creek was 29.5^{0} C (85.1^{0} F). At times, the dissolved solids content has exceeded established criteria for livestock watering.

Chemical water quality for Cottonwood Creek during the monitoring period was generally poor. Barium, iron, chloride, manganese, and sulfate concentrations exceeded drinking water standards. Mean values for ammonia nitrogen, iron, and conductivity in Cottonwood Creek were above South Dakota water quality standards for all four stations. Chemical water quality criteria for livestock watering were met in all cases. Boron, manganese, and fluoride concentrations exceeded NAS-NAE criteria for irrigation water.

Certain water quality characteristics of Cottonwood Creek changed as the stream passed through the mill site. Turbidity in Cottonwood Creek increased from a mean value of 6.6 JTU upstream from the mill site to 67 JTU at the confluence with the Cheyenne River. The mean suspended solids concentrations in Cottonwood Creek were 27 and 127 mg/1, respectively, for the farthest stations upstream and downstream from the mill site. Nitrogen species in the water increased dramatically as the stream passed through the mill site. For example, the ammonia nitrogen concentration in Cottonwood Creek at the confluence with the Cheyenne River was 4.4 mg/1, as compared with 0.02 mg/1 upstream from the mill site. This indicates that sewage from the Edgemont municipal sewerage system, which contains two outfall lines and a pumping station within the mill property, probably migrated to Cottonwood Creek and degraded its quality.

3. Disposal Site

Drainage ways in the vicinity of the site are ephemeral, and no water quality data are available tc date. Any runoff leaving this site could enter the Cheyenne River. This stream has been discussed in the Regional Setting section.

4.2.2.1.2 Impacts and Mitigation

Potential surface water quality impacts associated with the decommissioning of the mill would be a result of area runoff, point source discharges, dredging, seepage, and accidental and unavoidable discharges. These vehicles of contamination are discussed individually below.

1. Area Runoff

Area runoff is considered to be the primary route by which surface waters can be adversely impacted by the decommissioning operations. The contaminants of significance are in both the suspended and dissolved state and the discussion of impacts and mitigation is structured accordingly. The suspended constituents of the runoff will be collectively referred to as sediment.

a. Sediment

Sediment as a water quality pollutant creates turbidity that detracts from recreational use of water and reduces photosynthetic activity, degrades water for consumptive uses and increases water treatment costs, and acts as a carrier of other pollutants. The major sources of sediment for the project includes the areas requiring decontamination (which for practical purposes covers the total mill site), the haul road, the disposal site, and any borrow area. Sediment control is based on the use of best engineering practices (BEP's). The principles which constitute BEP's are identified by EPA (19) as follows:

- Plan the operation to fit the topography, soils, waterways, and natural vegetation at the site.
- Expose the smallest practical area of land for the shortest possible time.
- Apply soil erosion control practices as a first line of defense against offsite damage.
- Apply sediment control practices as a second line of defense against offsite damage.
- Implement a thorough maintenance program for the duration of the project.

In applying these principles to the Edgemont decommissioning project, the first principle relates primarily to the proposed disposal site. The topography and waterways were primary considerations in the selection of the site because of the need for long-term stability. Site features critical to the selection process that are particularly relevant to water erosion included minimization of the upstream drainage area and exposed slopes (which was achieved by locating the site within a drainage head with enough relief so that tailings can be effectively buried to blend in with the existing topography). The haul road is also sited to fit the area between the mill and the disposal site, following the natural ground contour and avoiding unstable slopes and stream crossings.

The second principle relates primarily to the mill site. The phased approach outlined in Section 3.5, Mill Site Cleanup for removal of contaminated materials should assure that the total amount of nonstabilized land at any particular time will be as small as practical.

The third principle is applicable to all disturbed areas and assures that erosion is controlled at its source to prevent excessive sediment from being produced. There are two types of such practices that are effective soil stabilization techniques and runoff control techniques. Both will be used for the decommissioning project. Soil stabilization practices include a variety of vegetative, chemical, and structural measures used to shield the soil from the impact of raindrops or to bind the soil in place. Revegetation will be the primary technique used for this project although use of riprap and other materials will be used as necessary in problem spots. Runoff control practices, on the other hand, include a number of measures designed to reduce the amount of runoff that is generated on site, prevent offsite runoff from entering the project site, or slow the runoff moving through and exiting from the project site. Diversion ditches and dikes, site grading, sediment ponds, and revegetation constitute the primary measures to be used for runoff control for the decommissioning project. Details of these erosion control practices are contained in Chapter 3.0, Decommissioning Plan, and Section 4.6.3, Reclamation Plan.

The fourth principle, sediment control, is also applicable to all disturbed areas. Even with the best erosion control plan, some sediment will always be generated and will require control. Control is achieved by reducing the ability of runoff to transport sediment (by reducing the velocity of the flow) and by containing the sediment onsite (by use of various types of sediment filters, traps, or basins). The techniques to be used for the Edgemont project are similar to some of those identified above for runoff control. They include (1) the preservation of vegetated buffer zones downslope of disturbed areas, (2) the construction of small depressions or dikes to catch sediment as close to its point of origin as possible, and (3) the construction of a larger basin at the proposed disposal site to catch additional sediment from the runoff.

The final important control principle is the implementation of a thorough maintenance and followup operation. When inspections reveal problems, modifications, repairs, cleaning, or other maintenance operations will be performed expeditiously. When sediment containment structures fill to capacity, they will be cleaned promptly, and the sediment disposed of in a manner that will not allow it to be reintroduced into the drainage system.

The quantity of sediment reaching the Cheyenne River as a result of site disturbance depends upon the actual efficiency of each of the control practices described above; however, their effectiveness should be sufficient to assure that the quantity will be within an order of magnitude of that currently reaching the river from the same area for any particular storm event. Consequently, implementation of the control practices will not necessarily preclude impacts upon the Cheyenne River due to site erosion, but the practices should assure that any impacts are minimized and insignificant.

b. Dissolved Contaminants

Site runoff from disturbed areas will normally have a higher amount of dissolved solids than that otherwise occurring due to the exposure of minerals to oxidation or leaching. The specific contaminants and their concentration in the runoff depends upon the actual mineral content of the disturbed strata and the intensity and duration of the precipitation event. The most serious impact normally associated with land disturbances in the west is degradation of the quality of water for agricultural uses. The quality of the Cheyenne River does not presently meet recommended standards for agricultural use (see Section 4.2.2.1, <u>Surface Water Quality,</u>) and runoff reaching the river from disturbed areas may aggravate this condition during the period that the site soils are not fully stabilized. However, even during this period, the increase of contaminants in the Cheyenne River would be small and probably nondetectable after dilution.

Site runoff from the Edgemont mill site is of special concern. In addition to the constituents that would normally be associated with runoff from disturbed soils, the runoff from the decontamination operations at the mill may contain radioactive and trace metals and other contaminants contained in the tailings. However, the operations are being planned to minimize the potential for contaminated runoff accessing the Cheyenne River. The perimeter diversion ditch will divert offsite runoff from the east (for the peak discharge of a 100-year flood event) around the site, leaving only the onsite runoff to Cottonwood Creek to control. Onsite runoff control will be keyed to grading so that runoff will be contained in sumps within the areas being decontaminated. A portion of the water may be used as makeup for the slurry operation. Excess water will be routed to Pond 10 for evaporation. Consequently, potential impacts resulting from site runoff at the mill should be precluded.

2. Point-Source Discharges

No point-source dischrges are planned for the decommissioning project. Area runoff from the disturbed areas at the proposed disposal site will be contained on site by a pond constructed to retain the runoff from a 100-year flood. The pond will be dewatered by pumping to the tailings impoundment after each significant precipitation event. As additional details of the plan are finalized, point-source discharges may be identified and necessary permits will be obtained.

Any point source discharge would probably be the result of site runoff, and ponds would be used to remove all particle sizes greater than 0.005 mm in diameter during a 10-year, 24-hour precipitation event. Consequently, only the clay-size particles contained in site runoff would be discharged to the Cheyenne River. A portion of these particles would settle in Angostura Reservoir but this should not result in significant adverse impacts. Assessment of the impact of dissolved contaminants is included in the preceding discussion.

3. Dredging

The removal of contaminated material in and around Cottonwood Creek and the Cheyenne River potentially could adversely impact the water quality of the Cheyenne River if contaminants are flushed downstream during the cleanup operations. Adverse impacts are unlikely, however, due to strategy to be employed during this phase of the operations. The cleanup of Cottonwood Creek is described in Section 3.5.2.1 and will be a phased operation in which a diversion channel and a pipiline system will be constructed to bypass flow from the stream segment being decontaminated at any particular time. Dikes will be used to prevent flood waters from entering the excavation, and pumps will be used to divert to Pond 10 excess water resulting from precipitation and ground water seepage. This strategy should effectively preclude loss of contaminants during the cleanup of the creek.

Less control is available, however, for the cleanup of the Cheyenne River if contaminated sediments are discovered. If cleanup is found to be necessary, the operation would be scheduled during the low-flow seasons of fall and winter (weather permitting) when most of the sediments would be exposed. Specific mitigative techniques for minimizing further migration of the contaminants in the Cheyenne River would be dependent upon size and location of the contaminted sediments in relation to stream flow.

4. Seepage

Assessment of the impacts of seepage upon surface water quality is included with the ground water assessment (see Section 4.2.2.2.2, Impacts and Mitigation.

5. Accidental and Unavoidable Discharges

Accidental discharges of contaminants (tailings, contaminated soils, oil, and other hazardous materials) will be minimized to the extent practicable by carefully planning, supervising, and inspecting the decommissioning operations. Release of contaminants resulting from accidents should be totally contained onsite by the runoff control practices. Severe natural forces, however, could result in release of contaminants to the Cheyenne River. A severe flood is probably the most serious failure mechanism in terms of catastrophic, irrevocable dispersion of the contaminants. However in such an event, the resulting dilution should alleviate the acute toxicity potential of the contaminants and appropriate corrective action to minimize chronic effects could be taken after the catastrophy.

a. Sewage

The mill site is serviced by the Edgemont municipal sewerage system. The proposed disposal site will be serviced by approved portable facilities. Consequently, no impact upon water quality is anticipated as a result of sewage disposal for the project.

The Edgemont municipal sewerage system does represent a potential source of surface water contamination during the decommissioning, however. Two pipelines traverse the mill site and the sewage lagoon is located immediately to the east of Pond 3. These pipelines will be rerouted during the decommissioning operation by TVA's operator and the lagoon will be protected as discussed in Section 3.5.2.2, Handling Sequence of Tailings and Contaminated Material Leaks or breakage of the pipelines or the lagoon would necessitate expedient action to preclude adverse impacts to the Cheyenne River. Sumps and pumps would be used to route leakage to the lagoon during the time the system was under repair.

b. Hazardous Material Supplies

Fuels and oils are the only supplies expected to be stored and used onsite that would be hazardous or toxic if released to surface waters. These materials will be stored within diked areas of sufficient capacity to retain 110 percent of the total volume contained. If applicable, a Spill

Prevention Countermeasure Control plan (SPCC) will be prepared for the storage of these materials. In the event of an accidental spill within a diked area, the spilled material will be contained and disposed of with the radiologically contaminated material or disposed of in the nearest state-approved hazardous waste disposal facility that will accept the waste (refer Table 1.2-1).

Waste oil will be collected and sold for reprocessing, disposed of with the radiologically contaminated material, or disposed of in the nearest State-approved hazardous waste disposal facility that will accept the waste.

4.2.2.1.3 Benefits

The disposal of the mill tailings and contaminated soils at the containment area will ensure that the contaminants are hydrologically isolated, thereby, protecting the water quality and future use of Cottonwood Creek and the Cheyenne River.

4.2.2.2 Ground Water Quality

4.2.2.2.1 Description

1. Regional Setting

The Edgemont, South Dakota, area is underlain by five principal aquifers: Quaternary Alluvium; the Fall River Formation; the Lakota Formation; the Sundance Formation; and the Pahasapa Formation. Ground water data used in assessing the background quality of the Quaternary Alluvium and the Fall River Formation are provided in Table 4.2-" (the only aquifers that could be impacted).

Alluvium is used locally as a water source for domestic and stock water supplies. Many wells are located in the alluvial deposits along the larger streams. The alluvium deposits represent an existing and future water supply zone primarily due to accessibility, adequate amount, and lowest cost outlay due to the shallower drilling depths.

Evaluation of the water quality data from the alluvium shows its physical-chemical quality to be very poor. Concentrations of dissolved solids ranged from 3,480 mg/l to 6,969 mg/l and the ground water is considered to be very hard. The principal cations were sodium and magnesium, and the principal anions were sulfate and bicarbonate. The pH ranged from acidic to slightly alkaline. Concentrations of dissolved solids, irons, sulfate, and chloride were greater than those concentrations specified by the proposed EPA secondary (aesthetically undesirable) standards for finished drinking water(17). Using the USDA (20) diagram for evaluating ground water for irrigation purposes, the ground water is unsuitable for irrigation purposes because of its high salinity hazard. In the Edgemont, South Dakota, region the Fall

River and Lakota Formations, which together form the Inyan Kara Group, are the principal sources of water for domestic, irrigation, and livestock uses. An evaluation of the water quality data from the Fall Riveb Formation shows its physical-chemical quality to be fair to very poor. Concentrations of dissolved solids rangea from 1,010 mg/1 to 3,189 mg/1 and the ground water is considered to range from soft to very hard. The principal cations were sodium and calcium, and the principal anions were sulfate and bicarbonate. The pH was alkaline, ranging from 7.7 to 8.9. Concentrations of dissolved solids, iron, sulfate, and chloride were grater than the proposed EPA secondary standards. The ground water is unsuitable for irrigation purposes because of its high salinity and sodium hazards.

2. Edgemont Uranium Mill Site

The Edgemont mill site is underlain by Quarternary-age alluvial deposits (unconfined conditions) ranging up to 9 m (30 ft) in thickness. Ground water movement in the alluvium is generally directed toward Cottonwood Creek and the Cheyenne River. The alluvium is underlain by the Skull Creek Shale, which acts as a hydrologic barrier between the alluvial and Fall River aquifers. Because of confined conditons in the Fall River aquifer, any leakage between the two aquifers is upward.

Approximately 2.1 x 10^6 t (2.3 x 10^6 ton) of solid uranium mill tailings, approximately 80% of which were sand tailings and the balance were slime tailings, were deposited in 11 ponds or piles approximate surface area - 50 ha (123.4 acre) . Except for Pond 10, the storage areas were probably not designed to prohibit or minimize the migration of leachates beneath the areas. At present, ponds 3, 4, 7, 8, and 10 contain V_2O_5-bearing liquors of varying assay. Listed in Table 4.2-8 are the results of chemical analysis of water and/or sediment samples collected from ponds 1, 3, 4, 7, 8, and 10.

Evaluation of the chemical data from the ponds show the standing water to be acidic and contain extremely high concentrations of dissolved solids, sulfate, cadmium, chromium, iron, nickel, titanium, and vanadium. Sediment samples from the ponds were heavily concentrated with aluminum, barium, chromium, iron, nickel, titanium, and vanadium. Lower concentrations of other metals were measured in both the water and sediment samples. Leachates migrating from the ponds and tailings piles are a potential source of contamination of the alluvial aquifer, Cottonwood Creek, and the Cheyenne River near the mill site.

The quality of the water found in the alluvial aquifer beneath the mill site has been determined by the sampling of 14 observation wells (piezometers). Observation wells M-9 and M-11 were equipped with a submersible pump for routine sampling. The locations of the observation wells are shown in Figure 4.2-4 and the results of the well sampling program are listed in

Table 4.2-9.

An evaluation of the water quality data for the alluvial aquifer below the mill site show that the ground water has been contaminated with leachates from the areas used for the storage of mill tailings and slimes. Ground water that enters the site from the southeast contained concentrations of dissolved solids on the order of 6,500 mg/1. As the water passed under the site, it mixed with contaminated leachates resulting in concentrations of dissolved solids ranging from 1[illegible],545 mg/1 to 32,000 mg/1. This pattern also was observed west of Cottonwood Creek, but the maximum observed concentration was much lower (15,575 mg/l). This pattern was also found to generally exist for nitrate, sulfate, and most metals analyzed. Extremely high concentrations of dissolved solids, nitrate, sulfate, lead, manganese, and nickel were measured in those wells east of Cottonwood Creek adjacent to the Cheyenne River. Figure 4.2-4 indicates that leachate from a large precentage of the tailings/slime storage areas would migrate in the direction of these observation wells. Data from the onsite observation wells east of and adjacent to Cottonwood Creek also indicate contamination by leachates from the storage areas. Samples from those observation wells west of Cottonwood Creek indicate some contamination, but not as significant as contamination found to the east.

3. Disposal Site

Ground water at the disposal site occurs under unconfined and confined conditons. Test borings showed the unconfined water table to be shallow. No data is currently available to assess the existing ground water quality at the disposal site.

4.2.2.2.2 Impacts and Mitigation

The tailings ponds at the Edgemont mill contain high quantities of heavy metals and other constituents that could adversely impact the water quality of the alluvial aquifer and Cottonwood Creek and the Cheyenne River. The primary concern is the potential toxicity of the constituents to aquatic life and terrestrial consumers, such as wildlife, livestock, and humans. Increased salinity and other effects may constitute additional concerns. There is virtually no risk of contamination of the Fall River or other deeper aquifer due to the impermeable, intervening shale deposits and the large piezometric heads of the confined aquifers.

As identified in the preceding section, the ground water data show that the alluvial aquifer in the vicinity of the tailings ponds is heavily contaminated by seepage. The fate of the contaminanats not absorbed or precipitated on the alluvial materials would eventually be to Cottonwood Creek and the Cheyenne River. Surface water data indicate that the contaminated ground water has not adversely impacted the water quality of these two streams. This is due to the normally large dilution capacity of the streams in relation to the seepage inflow and the capacity of the alluvial materials to neutralize, absorb, and retain a large portion of the seepage contaminants, particularly the relatively toxic cations

The highest potential for impacting surface water quality is during periods of extreme low-flow when the alluvial ground water is the primary or only source of streamflow. The Cheyenne River in the immediate vicinity of the mill site may be adversely impacted by the seepage during such times.

The removal of the tailings and contaminated soils and subsoils will preclude additional degradation of ground water quality in the future. However, residual contaminated ground water will remain until flushed out with time. Consequently, use of the alluvial ground water on site should be restricted until monitoring shows the water is of acceptable quality.

Seepage from the proposed disposal impoundment should be precluded over at least the short-term due to the design of the facility. The sides and bottom of the impoundment will be excavated into impermeable shale that extends several hundred feet below the site. Ponded water will be decanted and the tailings covered with at least a 1 m (3 ft) clay cap. The embankment of the impoundment will contain about 1.8 m (6 ft) of clay with a premeability of about 10 cm/sec keyed into the underlying shale, followed by a gravel drain. This drain would route any seepage that might get through the clay liner to the surface where it could be detected and controlled as necessary (see Figure 3.3-3).

This design provides reasonable assurance that seepage will also be precluded over the long-term; however, long-term stability will always be somewhat uncertain. If seepage were to occur, it should not lead to catastrophic effects, and there should be ample time to take corrective action(21).

4.2.2.2.3 Benefits

The removal of tailings and contaminated soils at the mill would eliminate future contamination of the alluvial aquifer and surface waters.

The tailings and contaminated soils would be hydrologically isolated from the environment at the proposed disposal site, thus protecting the future use of the region's ground water resource.

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4.4 GEOLOGY

4.4.1 Structure

The proposed disposal site is located regionally within the Cheyenne River Basin on the Missouri River Plateau, along the southwest flank of the Black Hills Uplift. The uplift, an elongate northwest trending dome of Laramide age, is about 200 km (125 mi) long and is 97 km (60 mi) wide. To the west and southwest of the project area is the Powder River Basin. Superimposed on the Black Hills Uplift are numerous folds plunging radially outward. Local structures of this type are the Chilson Anticline and Sheep Canyon Monocline east of the community of Edgemont, and the Cottonwood Creek Anticline trending southwest from the community of Edgemont (Figure 4.4-1). The regional dip of the sedimentary rocks in the project area is 2 to 4 degrees southwesterly.

Two major structural zones, Dewey and Long Mountain, are conspicuous within the project area. These structural zones consist principally of a number of en echelon faults. Two subordinate fracture systems are prevalent within the project area. One set of fractures strikes about N 30-60 degrees W and the second set strikes about N 30-60 degrees E. Movement along the fractures appears to have been less than 2 m (6 ft) based on observations in existing pits in the area and on information based on electric logs derived from drill holes.

Preliminary geotechnical exploration (8) of the disposal site shows the subsurface geologic conditions to be suitable for construction of the proposed disposal system. The geologic structure is fairly uniform and does not exhibit any apparent faulting, folding, or other tectonic disturbances. The shallowest water-bearing formation encountered in a deep test hole drilled near the site was the Fall River Formation at a depth in excess of five hundred feet. Rev. 5

4.4.2 Geologic Description

The proposed disposal site is located at the head of an intermittent drainage, which is a tributary to the Cheyenne River. Local relief is less than 18 m (60 ft) and the site has low erosion potential. Sedimentary rocks of Early to Late Cretaceous age are of major importance at the disposal site (Figure 4.4-2). The lower unit of the Greenhorn Formation is the uppermost unit at the site. The Belle Fourche Shale underlies the site and is exposed near the northwestern boundary and may be exposed in the bottom of this drainage. The Mowry Shale underlies the Belle Fourche Shale at the disposal site area. (Refer to Figure 3.3-2, Typical Stratigraphic Column at Disposal Site .

At the proposed disposal site, the lower unit of the Greenhorn Formation is exposed. It is of Late Cretaceous age and is composed of a noncalcareous shale, which is brownish-gray on fresh surfaces and weathers dark-gray. This formation is primarily composed of carbonaceous clay and quartz silt, is plastic when wet, and averages a thickness of 69 m (225 ft). Approximately 8.5 m (28 ft) are present at the disposal site. The basal unit of the lower portion appears to be a single unit of thin limestone that averages 23 cm (9 in) in thickness. This limestone bed is gray to brown in color, competent, and fossiliferous. A large portion of the broken shell fragments are the phylum Mollusca, class Pelecypoda, genus Inoceramus with associations of the class Cephalopoda genus Prionicyclus (1). Bentonite beds are interbedded with the noncalcareous shale sequence and average approximately 10 cm (4 in) in thickness.

Exposed in a portion of the disposal area and underlying the lower Greenhorn Formation is the Belle Fourche Shale. It is of Late Cretaceous age and averages a thickness of 55 m (180 ft) thick. Approximately 43 m (140 ft) are present at the disposal site. This shale unit is dark gray and thought to be deposited in a marine environment. The Belle Fourche Shale contains a few bentonite beds; a zone of magnosiderite concretions varies in thickness from 9.1 m (30 ft) to approximately 31 m (100 ft) and forms a convenient marker bed between the Mowry Belle Fourche contact. The concretions are reddish-brown, round to subround and bun-shaped, and range in diameter from several inches to three or four feet. The concretions are composed of euhedral and subhedral crystals of magnosiderite. Calcite filled joints form polygons on the exterior of the concretions. These concretions occur in outcrop to the northwest of the disposal site. | Rev. 5

The Belle Fourche Shale is dark-gray weathering to brownish-black, and is slightly plastic when wet. It is composed of carbonaceous clay and quartz silt with unidentified organic material disseminated throughout. Thinning and thickening of alternating light and dark shales present in the Belle Fourche may have been the result of climatic fluctuations (2).

Underlying the Belle Fouche Shale is the Mowry Shale of Early Cretaceous age. It is a competent light-gray shale with minor amounts of siltstone, sandstone, and thinly laminated beds of bentonite. The average thickness of this shale is 49 m (160 ft); at the site, thickness is approximately 46 m (150 ft). The Mowry Shale crops out in broad shallow valleys and forms low, rounded hills. On a fresh fracture, the shale is dark gray to grayish-black, while weathered surfaces are light gray and often contrast greatly with the adjacent formations. Being derived from organic material, with minor associated amounts of disseminated crypotocrystalline quartz and clay films, this very brittle shale could be the result of silicification as derived by the alteration of volcanic ash in place to form bentonite (3).

The basal 4.6 m (15 ft) of the Mowry Shale consists of laminations of thin discontinuous sandstone and siltstone beds. This association, when the Newcastle Sandstone is absent, forms a well pronounced marker bed between the Mowry Shale and the underlying Skull Creek Shale. These beds are fine-grained, light brown sandstones which grade laterally into gray to red siltstones. This facies change often forms persistent ledges.

4.4.3 Seismicity

The seismic events associated with the proposed disposal site in the Black Hills region have been few in number and low to moderate in magnitude. According to the files of the National Geophysical and Solar-Terrestrial Data Center (4), only seven earthquakes of any significance have occurred within a 200-km (124-mi) radius of the proposed disposal site during the period from the first documented earthquake in 1895 through 1976.

The strongest observed earthquake, which had an intensity of VII based on the modified Mercalli intensity scale (5), occurred in 1964 and was centered approximately 178 km (110 mi) east-southeast of the proposed disposal site. Some damage was reported in Alliance and Rushville, Nebraska (Figure 4.4-3). Using attenuation curves (6), the maximum estimated acceleration that could be expected at the proposed disposal site from such an earthquake would be less than 0.04 g (gravity).

The nearest tremor to the site occurred in 1895. The epicenter was located approximately 80 km (50 mi) northeast of the site and the tremor was reported to have had an intensity of V. There was no reported damage associated with that tremor. The maximum acceleration at the site for a seismic event of this intensity is so small that it cannot be estimated from an attenuation curve. According to the recent probabilistic acceleration map of the United States (7), the proposed project site is within an area of low seismic risk and the probability that accelerations exceeding 0.04 g (gravity) may be experienced at the proposed disposal site is estimated to be ten percent in fifty years.

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4.5 SOILS

4.5.1 Description

4.5.1.1 Regional Description

There are nine soil mapping units within the disposal site boundaries (Figure 4.5-1).(1) Clay- and silt-textured soils, derived from the weathering of the lower unit of the Greenhorn Formation, predominate. These soils vary from a loose, friable silt clay loam to a sticky or plastic clay. The remaining soils are formed from aeolian deposits. Rev. 5 Rev. 5

A large portion of the soils are in the mapping unit of the Minnequa-Midway silty clay loam. The Minnequa soil is found on lower, less steeply sloping areas and composes 40 to 60 percent of the unit. Typically, the Minnequa soil has a surface layer of grayish brown silty clay loam about 15.2 cm (6 in) thick containing numerous segregations and threads of lime. The underlying material is pale brown silty clay loam about 33.0 cm (13 in) thick. Below this layer, to a depth of 152.4 cm (60 in), is light gray chalky shale with ledges of brittle limestone that are 2.5 to 7.6 cm (1 to 3 in) thick and discontinuous in places. In some of the lower areas, shale predominates below 101.6 cm (40 in).

The Minnequa soil has a low fertility and organic matter content. It also has a low available water capacity and slow permeability, and has a moderate shrink-swell potential. Runoff from the Minnequa soil is medium to rapid.

The Minnequa soil is poorly suited as cropland, but has good potential as rangeland, on less steep slopes and fair to poor potential on steep slopes. It has a fair suitability for recreational uses and fair potential for most engineering uses. The Minnequa soil also has fair to poor suitability for openland and rangeland wildlife.

The Midway soil composes 30 to 50 percent of the Minnequa-Midway unit and is located on steep slopes and ridgetops. It typically has a surface layer of pale olive heavy silty clay loam about 10.2 cm (4 in) thick. The transition layer is light yellowish-brown heavy silty clay loam about 10.2 cm (4 in) thick. The underlying material is olive silty clay loam about 22.9 cm (9 in) thick composed of numerous small shale chips intermixed with the soil material. Below the underlying material, to a depth of 152.4 cm (60 in) is pale yellow calcereous shale. Some areas have less clay content and the shale is deeper than 101.6 cm (40 in). The Midway soil, like the Minnequa soil has a low fertility and organic matter content. It also has a low available water capacity and moderate permeability, and has a high shrink-swell potential. Runoff from the Midway soil is medium to rapid.

The Midway soil is poorly suited as cropland but has good potential as rangeland on less steep slopes and fair to poor potential on steep slopes. The Midway soil has a poor suitability for recreation use and severe limitations for engineering uses due to its high shrink-swell potential.

Norka silt loam is found on the ridge forming the site's northeast boundary. This deep, well-drained, very gently sloping soil is formed from aeolian deposits on uplands. Norka soil is medium in fertility and moderate in organic matter. It has good tilth and a deep root zone. The available water capacity is high, and permeability is moderate to moderately slow. The shrink-swell potential is moderate and runoff is slow to medium. Most areas of this soil are in cropland. Norka soil has good potential for cropland, range, windbreaks, and most recreation uses. It has fair to good potential for most engineering uses.

Pierre-Grummit clays are moderately deep and shallow, well drained, undulating to hilly soils formed in clayey material derived from shale on uplands. The Pierre soil is generally on lower, less steep slopes. The Grummit unit, a very acid soil, is on higher, steeper slopes. Many areas have small rocks, broken siltstone fragments, and exposed shale on the surface. These soils are low in fertility. The Pierre soil has moderately low organic matter content and the Grummit has low organic matter content. The Pierre soil has a moderately deep root zone and low available water capacity. The Grummit soil has a shallow root zone and very low available water capacity. Both soils have a high shrink-swell potential. The Pierre soil has very slow permeability and medium runoff. The Grummit soil has moderate permeability and medium runoff.

The Nunn clay loam is deep, well-drained, very gently sloping soil found on terraces, alluvial fans and uplands. The Nunn soil is medium in fertility and moderate in organic matter content. It has good tilth and unrestricted root zone depth, and is well suited for cropland use. It has moderate to high available water capacity. Permeability is moderately slow. The subsoil is very hard when dry and firm when moist. Runoff is slow to medium, and it has a high shrink-swell potential which severely limits its engineering uses.

The Pierre clay is moderately deep, well-drained, very gently sloping soil formed in clayey material derived from shale on uplands. Pierre clay is low in fertility and has a moderately deep root zone. Available water capacity is low and permeability is very slow. It has a high shrink-swell potential. Runoff is medium. When dry, Pierre soil develops deep long cracks up to 5.1 cm (2 in) wide. Most areas of this soil are in rangeland and used for range and native hay. The soil has good potential for this use. Pierre soil has fair potential for use as cropland and as habitat for openland and rangeland wildlife. It has poor potential for use as recreation sites. This soil has poor potential for most engineering uses.

The Manvel silty clay loam composes 25 to 35 percent of the Minnequa-Manvel unit and is located on valley sideslopes and uplands. This deep, well drained, gently undulating, calcareous soil is low in fertility and organic matter content, but has a deep rooting zone. The available water capacity is moderate to high, and permeability is moderately slow. The shrink-swell potential is moderate; runoff is medium to rapid. The Manvel soil has fair potential for cropland and good potential for rangeland. The soil has fair to poor suitability for windbreaks and fair potential for most recreation uses and as habitat for rangeland wildlife. It has moderate to severe limitations for most engineering uses.

4.5.1.2 Site Description

Table 4.5-1 lists the soil mapping units found at the disposal site as ranked for suitability as plant growth media.(1) This ranking indicates the Norka silt loam and Nunn clay loam to be the preferred soil units for use as plant growth media in reclamation. In June 1980 the Nunn Clay loam and Norka silt loam associations were sampled to determine the onsite volume and suitability of material for use as plant growth media.

Norka silt loam and Nunn clay loam soils at the preferred disposal site were found to be predominantly sandy loams ranging in depth from 165 cm (70 in) to 300 cm (120 in) (Table 4.5-2). Texture, pH, salinity (EC) and percent saturation indicate that a good potential for plant growth exists in all the soils investigated. Calcium and magnesium levels are typical of arid western soils. The low salinity values, percent saturation values, and calcium and magnesium levels show there should be little problem with sodic or alkaline conditions. Soil samples taken from areas 24 km (15 mi) north of Edgemont have indicated the potential for toxic levels of molybdenum or copper deficiencies due to copper-molybdenum imbalance. However, both the level of molybdenum and the pH levels of soils at the disposal site indicate there will be no toxicity or copper deficiency problems. The absence of primary and secondary selenium indicator plants within the plant communities growing on Norka silt loam and Nunn clay loam soils is evidence of a low selenium content. Rev. 5

Experience has shown that the major nutrients, nitrogen and phosphorus, are generally lacking in regional soils. Therefore, application of commercial fertilizer will be necessary to improve the suitability of the existing soil material.

Volume estimates of plant growth media were calculated from the Nunn clay loam and Norka silt loam associations lying within the proposed disposal pit and along the immediate boundaries (Table 4.5-3). Considering a topsoil depth of 0.3 m (12 in) for the haul road, diversion ditch and disposal area about 255,000 m^3

($9,005,000 \ ft^3$) of material will be needed for reclamation purposes. With approximately $751,500 \ m^3$ ($26,535,000 \ ft^3$) of plant growth media existing onsite. There is a potential reserve of $496,500 \ m^3$ ($17,530,000 \ ft^3$) after the disposal site requirements have been met. Rev. 5

4.5.2 Impacts

Inhibition of soil forming processes and soil structure destruction are unavoidable consequences of soil removal during disposal site preparation. Lack of structure and destruction of soil microorganisms will result in low fertility and compaction within material selected as topsoil. Potential mixing of soil types during stripping can further reduce topsoil quality, while wind and water erosion reduce the quantity of stockpiled topsoil, overburden and capping material, and increase sediment loads in local ephemeral streams.

4.5.3 Mitigation

Due to the light texture of surface and subsurface materials available for use as topsoil, immediate temporary stabilization of the stockpiles will be necessary until cover vegetation is established. Vegetation will not only reduce the potential of wind erosion but also maintain some level of soil nutrient and microbe content. Disturbance to nonimpact areas for "borrow" material at the mill site could be limited by using excess material from the disposal site. Rev. 5

Application of recommended fertilizer rates will improve topsoil quality by replacing nutrients lost during soil removal and storage.

Stubble mulching and use of drought tolerant grass species will provide both vegetative cover and plant survival levels sufficient to prevent erosion of the completed disposal site.

4.5 REFERENCES

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TABLE 4.5-1

SUITABILITY OF SOIL ASSOCIATIONS AT THE PREFERRED TAILINGS DISPOSAL SITE FOR PLANT GROWTH MEDIA

Mapping Unit	Soil Association	Suitability As Topsoil
18B	Nunn Clay Loam	Fair
67C	Colby-Norka Silt Loam	Fair
69B & C	Norka Silt Loam	Good
76D	Minnequa-Midway Silty Clay Loams	Poor
90	Grummit-Snomo Clays	Poor
91	Grummit-Rock Outcrop	Poor
95A & B	Kyle Clay	Poor
96B	Pierre Clay	Poor
197D	Pierre-Grummit Clay	Poor

TABLE 4.5-2

CHEMICAL AND PHYSICAL PROPERTIES
OF SELECTED TOPSOIL MATERIAL

Association	Characteristic	Range of Ratings*
Nunn Clay Loam	pH	Good
	Electrical Conductivity (EC)	Fair-Good
	Saturation Percentage	Good
	Texture Class	Fair-Good
	Soluble	
	Calcium	Fair-Good
	Magnesium	Fair-Good
	Copper	Good
	Molybdenum	Good
Norka Silt Loam	pH	Good
	Electrical Conductivity	Good
	Saturation Percentage	Good
	Texture Class	Fair-Good
	Soluble	
	Calcium	Fair-Good
	Magnesium	Fair-Good
	Copper	Good
	Molybdenum	Good

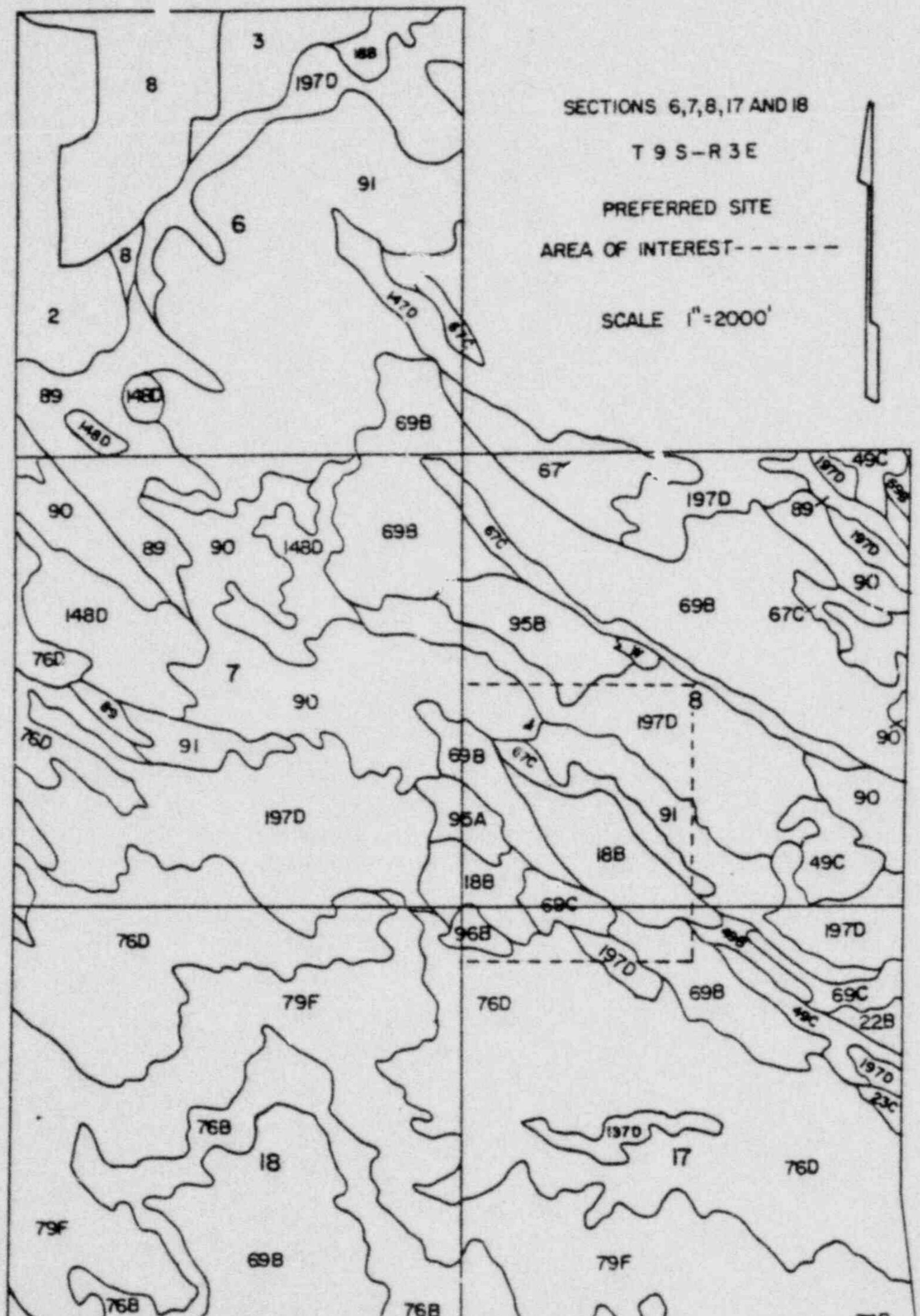
*Based on Land Quality Division's Guideline No. 3, "Suitability Ratings for Soils as Sources of Topsoiling Material," Wyoming Department of Environmental Quality, Cheyenne, Wyoming.

TABLE 4.5-3

ESTIMATED ONSITE VOLUME OF MATERIAL SUITABLE
FOR PLANT GROWTH AT THE PREFERRED TAILINGS DISPOSAL SITE

Nunn Clay Loam		
Surface area	227,300 m^2	(2,446,000 ft^2)
Average depth	2.0 m	(6.5 ft)
Estimated volume	454,600 m^3	(16,052,000 ft^3)
Norka Silt Loam		
Surface area	148,450 m^2	(1,597,000 ft^2)
Average depth	2.0 m	(6.5 ft)
Estimated volume	296,900 m^3	(10,483,000 ft^3)

FIGURE 4.5-1 DISPOSAL SITE SOILS MAP



4.6 BIOLOGICAL

4.6.1 Terrestial

4.6.1.1 Flora

4.6.1.1.1 Description

Natural vegetation communities found in the vicinity of Edgemont are expected to be shortgrass prairie, Black Hills ponderosa pine, and sagebrush steppe (1). Shortgrass communities are dominated by buffalograss Buchloe dactyloides (Nutt.) Engelm.), blue grama Bouteloua gracilis (HBK) lag.), western wheatgrass Agropyron smithii Rydb.), sandberg bluegrass Poa secunda Presl.) and threadleaf sedge Carex filifolia Nutt.). The ponderosa pine Pinus ponderosa Lawson) region extends out of the Black Hills to include a large portion of Fall River and Custer counties in South Dakota. Major species within this zone are ponderosa pine, Rocky Mountain Juniper, (Juniperus scopulorum Sarg.) and sedge Carex spp.). Big Sagebrush Artemisia tridentata Nutt.) and black greasewood Sarcobatus vermiculatus Hood. Emory) communities, part of the sagebrush steppe association cover a major portion of Fall River and Custer counties.(2)

The three major vegetation regions in the Edgemont area were subdivided into 14 vegetation types.(2) Of these 14 types, four were identified on the proposed disposal site: (1) big sagebrush-medium stand, (2) big sagebrush-heavy stand, (3) grassland, and (4) rough breaks. Representative dominant species and percent cover for each of the four vegetation types are found in Table 4.6-1. However, variations in species composition do occur within these vegetation types as a result of microclimatic influences of slope, aspect, topographic position, historical land use, soil type, and moisture availability.

Range condition on the project area has not extensively deteriorated from livestock use, but intensive overgrazing does occur in some areas (particularly near water).

Although sheep grazing is important in areas of Custer and Fall River counties, rangeland use is predominantly by cattle. Generally 2.7 to 3.9 ha (6.6 to 9.5 acre) are required to support one animal use month (area required to support a 1,000-pound cow and calf, or the equivalent for one month) in the grassland and 4.1 to 5.1 ha (10 to 12.5 acre) for pine forests.(3) Crop production is generally limited to native hay, alfalfa hay or grain. Hay crops usually yield less than 3.4 t/ha (1.5 ton/acre). Wheat yields vary, but are generally below 3 m^3/ha (35 bu/ac). Other crops occasionally grown in Fall River and Custer counties include dry land barley and oats, and irrigated corn.

There are no plant species classified as threatened or endangered within the state. Also, no wetland habitat (Executive Order 11990) will be impacted during this project.

4.6.1.1.2 Impacts

A summary of the vegetative types that will be destroyed or greatly altered is given in Table 4.6-2.

4.6.1.1.3 Mitigation

A reclamation plan will be followed that includes revegetating the disturbed areas (reference Section 4.6.3, Reclamation Plan . While the reclamation plan will attempt to stabilize erosion at a rate consistent with the surrounding area and return the land to its previous productive condition for livestock grazing, wildlife habitat, and various forms of recreation, the plant composition will be less diverse for many years than the naturally occurring species assemblage. The change in microhabitat, mixing of soils, and the difficulty in artifically reestablishing native forbs, shrubs, and trees all place limitations on immediate reclamation success.

4.6.1.2 Fauna

4.6.1.2.1 Description

The plant community complex described in Section 4.6.1.1 combined with a wide range of topographic features create several habitat types. Of particular importance are habitat types of water courses (refer to Section 4.6.2), riparian vegetation, sagebrush steppe, rimrocks and canyons, and ponderosa pine. These five habitat types provide a diverse species composition of mammals, birds, reptiles, and amphibians.(4,5,6,7) A number of these species are important hunting resources while others have high esthetic and ecological values.

Riparian habitat is found along permanent and ephemeral water courses. Due to the diverse structure, species composition, and increased density of trees, shrubs, sedges, grasses and forbs, they provide food, shelter and breeding areas for numerous animals. Riparian habitat in Fall River and Custer counties provide important habitat components for turkey *Meleagris gallopavo* and white-tailed deer *Odocoileus virginianus* .

Sagebrush steppe associations, particularly certain species of sagebrush, are critical both directly to several wildlife species as food and cover and indirectly by modifying the environment. Shrubs increase soil moisture by acting as miniature snow fences to drift the snow and then providing shade to slow the melting process. This environmental modification provides microhabitats favorable for mixed grasses and forbs. Shrublands are an especially important feeding ground for antelope (*Antilocapra* americana), mule deer (Odocoileus hemionus), and sage grouse Centrocercus urophasianus . Sagebrush shrublands are also used as strutting grounds by sage grouse. Local sagebrush/grass and grass associations provide habitat for at least five species of small mammals (Table 4.6-3) and 11 species of nongame birds (Table 4.6-4). Rev. 5

Ponderso pine affords yet another habitat type and is utilized by a number of species for feeding, nesting, and escape cover. Wild turkey, raptors (hawks and owls) and mule deer utilize pine stands extensively. Rev. 5

A significant niche of rimrock and canyon habitat in the Edgemont area is that occupied by birds of prey which rely heavily on this habitat for feeding and nesting. Eleven species of hawks, owls, and vultures are considered common in the area and 22 species have been recorded.(7) Not all of these species intensively use rimrock and canyon areas but may nest and feed there. Rimrocks and canyons also provide important habitat components for small birds, small mammals, deer, turkey, and reptiles which provide in turn a rich food source for many predator species.

Hunting on and near the project area is primarily for antelope, deer, and turkey.(8) Since white-tailed deer are generally restricted to river bottom habitat along the Cheyenne River, hunting for mule deer is more common. Due to existing land use conditions, there is limited habitat for sharptail grouse (Pediocetes phasianellus) and ring-necked phesant (Phasianus colchicus) . Sage grouse and mourning dove (Zenaida macroura) inhabit the area but there is no season for these species. Waterfowl hunting on area streams and reservoirs is popular and significant numbers of migrating ducks and geese pass through the area. Cottontail rabbits (Sylvilagus spp.) also provide important small game hunting opportunities. Predator (red fox, Vulpes fulva bobcat, Lynx rufus coyote, Canis latrans) and varmint (blacktail prairie dog, Cynomys ludovicianus) hunting is also popular in the area. Mountain lion (Felis concolor) and bear (Ursus americanus) are not considered game species by South Dakota and therefore, are not protected by seasonal harvest regulations. Trapping for beaver (Castor canadensis,) muskrat (Ondatra zibethica,) and predators such as coyotes, red fox and bobcat occurs in the area.(8)

Threatened and endangered terrestrial fauna species listed for South Dakota by State and Federal agencies, as of January 16, 1979, are:

Mammals: Black-footed ferret (Mustela nigripes)
Black bear (Ursus americanus)
Northern swift fox (Vulpes velox hebes)
Mountain lion (Felis concolor)

Birds: American peregrine falcon (Falco peregrinus anatum)
Arctic peregrine falcon (Falco peregrinus tundrius)

Bald eagle (*Haliaeetus leucocephalus*)
Whooping crane (*Grus americana*)

Field surveys in 1978 and 1979 did not reveal the presence of any of these species on or near the disposal site.

The peregrine falcon is known to inhabit the Black Hills and conceivably could occur on or near the project area. The southern bald eagle could be found in the area during winter as a transient. The ferret is not known to inhabit the area but potentially exists because of the presence of suitable habitat conditions (prairie dog towns provide a primary food source). Unsuitable or marginal habitat probably precludes the occurrence of bear, mountain lion, swift fox, and whooping crane in the proposed project area. In summary, it is not anticipated that activities of this project will adversely affect populations of any endangered species.

4.6.1.2.2 Impacts

Grassland and shrubland habitat will be lost for several years during the clean-up and reclamation period (refer to Table 4.6-2). As described above, species occupying these habitat types will be affected. However, both the number of species and the individuals affected will be minimal. A big game utilization transect established on the disposal site in December 1979 has shown no use by either mule deer or pronghorn during winter, spring or summer quarters. Onsite nongame bird and small mammal surveys indicate population levels are lower than other nearby areas sampled by TVA's consultant in 1975 and 1976.(12) This in addition to the ubiquity of the onsite vegetation associations indicates that impacts to local wildlife populations should not be widespread nor long term. Rev. 5

4.6.1.2.3 Mitigation

Attempts to minimize impacts to wildlife will be made through reclamation of the disturbed habitat types (reference Section 4.6.3, Reclamation Plan). While the primary objective of the plant species used in reclamation will be selected for their value of stabilizing topsoil and returning the land to livestock grazing, benefit will also be realized by creating corridors of riparian habitat at the mill site.

4.6.1.2.4 Benefits

Assuming the reclamation plan is successful for the area of the existing tailings ponds, a long-term benefit would be the establishment of habitat for wildlife species adapted to shrubland (and grassland) and riparian habitat types. These habitat types will be established along the rechannelization of Cottonwood Creek and the revegetation of the existing tailings ponds.

4.6.2 Aquatic

4.6.2.1 Nonfish

4.6.2.1.1 Description

Surface waters flowing in the Edgemont area were sampled in September 1975 and June 1976 to document the composition and diversity of indigenous aquatic communities during dry and wet seasons, respectively. Sampling sites were selected based, in part, on the need to delineate the biota indigenous to each of the representative habitat types (riffles, pools, vegetative areas) and each of the major substrates (silt, clay, detritus, cobble, submerged and emergent aquatic plants). Biological sampling stations and their proximity to Edgemont and the tailings disposal site are illustrated in Figure 4.6-1.

Surface waters in the area of Edgemont provide habitats suitable for a variety of aquatic biota. The extent of these habitats vary, depending upon flow. The majority of the streams have intermittent and/or interrupted flows, being subject to alternate periods of drying and flooding. The effects of variable discharge upon habitat are significant as such discharges may deposit quantities of silt at one time and then scour the substrate at another.(9) Variable discharge also affects the habitat when periods of extremely low flow exist, since much of the benthic substrate can be exposed and subjected to rapid drying.

There are four aquatic systems which occur near the Edgemont area. These are: Beaver Creek and its major tributary, Stockade Beaver Creek (State of Wyoming Class I waters), Pass Creek (State of South Dakota--intermittent stream), Cheyenne River (State of South Dakota--warm water semipermanent fish life propagating waters, limited contact recreation, wildlife and stock watering, and irrigation), and Cottonwood Creek (perennial stream). Representative riffle and pool habitats characterize the creeks and the Cheyenne River.

The flora and fauna of the aquatic habitats in the site vicinity are representative of aquatic environments in semiarid climates. Wide fluctuations in species diversity and numbers occurred and are expected due to frequent changes in habitat availability. No rare, threatened or unique nonfish species were identified from any of the site visits. Similarly, no unique habitats were identified. Detailed descriptions of the fauna and flora are available in a TVA report.(10)

Cottonwood Creek exhibits rich biological (nonfish) communities, due primarily to restricted flows and the abundance of submerged and emergent aquatic vegetation.

4.6.2.1.2 Impacts

As previously discussed, Section 3.5.2.1, Cleanup of Cottonwood Creek, decommissioning may require the rerouting of a reach of Cottonwood Creek. The relocation of this would destroy existing substrate in the rerouted section and the biological communities that inhabit this substrate. It is believed that recolonization of the new streambed by upstream populations would occur without a significant overall loss to the biological health and diversity of the creek.

While impacts from sedimentation and accidental spillage of hazardous or toxic chemicals or wastes into the adjacent surface streams may occur because of decommissioning activities at the mill site, TVA will take the necessary steps described below to limit such impacts.

Specific aquatic biota impacts, etc., are not anticipated at the disposal site because of its significant distance from surface water bodies. However, stormwater runoff controls and monitoring may be required in a manner similar to that discussed in the water quality section.

4.6.2.1.3 Mitigation

Best management practices for the control of erosion and the prevention of sediment discharge as a result of runoff will be necessary as discussed in Section 4.2.2, Water Quality. Special precautions will be necessary to ensure that during the decommissioning and disposal operations, accidental spillage of hazardous or toxic wastes do not enter adjacent surface streams.

4.6.2.2 Fish

4.6.2.2.1 Description

Surface waters were sampled for fish in July 1976 and May 1979 at nine stations indicated in Figure 4.6-2. The Cheyenne River in the western portion of Fall River County is a typical high plains riverine habitat. Flowing through a broad valley, the present river channel is generally very wide in relation to base flow regimes ($<$100 cfs). Gradient from the Wyoming line to the Edgemont area is low and creates an aquatic habitat characterized by long reaches of moderate depth generally less than 15 cm (6 in) interspersed by occasional "deep" pools $>$75 cm (30 in) and shallow riffles $<$5 cm (2 in) . Periods of spring runoff result in the Cheyenne River channel being completely filled and water depths of 2 to 3 m (6.5 to 10 ft). Irregularities in substrate elevations combined with low flows produce small sloughs and backwater areas with little flow. The extreme fluctuations in flow and the little or no flow in dry summers, limits both habitat and productivity.

Water velocities, although frequently low, appear sufficient to keep the substrate in all but the deeper pools relatively free of silt. These areas are composed primarily of shifting fine-to coarse-grained sand. Deep pools, as indicated, are heavily silted and in some areas examined deposition was as great as 40 cm (15.7 in). Substrate in riffle areas is characterized by cobbles stones 5 to 15 cm (2 to 6 in) in diameter interspersed by coarse sand.

The lack of large substrate and manmade or natural obstructions in the river channel provides little cover for fish. This is compounded by little effective security from overhanging riparian vegetation. Submergent and emergent vegetation was reported in 1976 in tributaries and areas of the Cheyenne River, however, it was not present in 1979. The physical nature of the river and lack of vegetative cover combine to produce yearly temperature regimes in the river having extreme variations. These factors, plus an apparent scarcity of invertebrate food items, are the primary variables controlling the diversity and production of the fish population in the river.

Within the study vicinity there are only two perennial tributaries to the Cheyenne River. Other stream channels have water only during spring runoff or following heavy precipitation. In some cases small pools are present in an otherwise dry watercourse. These are created by such factors as poor soil drainage or intersection with the water table.

The two major tributaries (Beaver Creek and Cottonwood Creek) are similar in topographic character to the Cheyenne River. Beaver Creek arises in eastern Wyoming and flows southeasterly to its confluence with the Cheyenne River in South Dakota near Burdock. Its flow at this point is approximately one-fourth that of the Cheyenne. Ambient temperature at its mouth is generally lower than the Cheyenne reflecting the trout habitat which occurs in the Wyoming portion. Cottonwood Creek, while it is perennial, has little influence on the biotic or abiotic character of the Cheyenne.

Thirty-four species (20 native, 14 introduced) representing nine families have been reported (11) for the entire Cheyenne River drainage. Of these, twelve species were recorded in Fall River County above Augostura Dam (Table 4.6-5). Sampling in 1976 and 1979 collected fifteen species of which the plains topminnow (collected in 1976 Table 4.6-6) is a new record for the South Dakota portion of the Cheyenne River. (The plains topminnow is relatively common in headwater streams of the Cheyenne River in Wyoming). | Rev. 5 | Rev. 5

Only two species (bluegill, black bullhead) are of interest as sportangling species. No significant fishing exists for either of the two sport species in the vicinity of Edgemont. Most intensive fishing pressure occurs on Angostura Reservoir.

The plains topminnow, a South Dakota threatened species, was collected in 1976. Perhaps due to prior low flow conditions, aquatic vegetation (the preferred habitat of the plains topminnow) was present in tributaries and in restricted areas of the Cheyenne River. The 1979 survey did not confirm the presence of either the aquatic vegetation or the plains topminnow. This would indicate that this species is transient in the Edgemont vicinity with its presence dependent on the occurrence of its preferred habitat.

4.6.2.2.2 Impacts

The principal impacts on the fish fauna and its habitat from the proposed action are: (1) possible release of contaminated materials to the aquatic system during removal and disposal activities and (2) additional siltation/sedimentation as the result of earth-moving activities and erosion of the resulting exposed surfaces.

Any material, whether contaminated or not, which is released to the Cheyenne River is susceptible to downstream transport, perhaps as far as Angostura Reservoir.

4.6.2.2.3 Mitigation

Both impacts can be minimized or avoided by instituting control measures appropriate to earth-moving and channelization activities (refer to Section 4.2.2). With implementation of technically feasible and acceptable controls, impacts to the fish fauna and habitat will be temporary and minimal.

4.6.3 Reclamation Plan

4.6.3.1 Objectives

The reclamation plan is designed to (1) stablilize the tailings containment site; (2) provide livestock forage on both the containment site and the former mill site; and (3) rehabilitate the riparian community of the rechannelized portion of Cottonwood Creek. This program should provide for improved pastures for livestock production and restore riparian habitat for indigenous wildlife species. The scenic quality of Cottonwood Creek through the mill property will also be improved.

4.6.3.2 Site Preparation

4.6.3.2.1 Mill Site

Approximately 86 ha (213 acre) at the mill site disturbed during decommissioning will have to be recontoured prior to revegetation. Depending upon the volume of contaminated soil removed, the amount of excess overburden at the disposal site, and the flexibility of the engineering schedule, additional acreage may have to be disturbed for "borrow" material. Any areas used for borrow will Rev. 5

be contoured to blend with surrounding landforms and revegetated. Sufficient material suitable for use as topsoil exists at the disposal site for reclaiming both the disposal and mill site disturbed areas, but the engineering schedule may not allow the use of this material at the mill site, or more cost effective topsoil acquisition areas may be located. Rev. 5

As the recontouring nears completion, water spreading bars will probably be constructed below drainages originating on the hill east of the site. These bars will reduce gully formation on the newly reclaimed site and improve vegetative cover in their immediate vicinity.

The reconstructed channel of Cottonwood Creek will approximate the predevelopment configuration with banks graded to a 10-degree slope.

Before application of topsoil, the area will be ripped to a depth of 26 cm to 31 cm (10 in to 12 in) to reduce compaction and increase soil water holding capacity. Material suitable for plant growth will then be applied to a minimum depth of 15 cm to 10 cm (6 in to 8 in).

4.6.3.2.2 Tailings Disposal Site

Disposal site reclamation will begin after sufficient area of tailings reaches the final grade. An impermeable clay cap will be placed over the tailings and compacted to a depth of about 1 m (3 ft) thick. Overburden and topsoil will come from material removed during construction of the containment site which is projected to have a final surface area of 44.5 ha (110 acre). Additional acreage will be distrubed by stockpiling of overburden and topsoil and to acquire sufficient topsoil to revegetate the containment site. Any "borrow" areas will be revegetated at the same time as the containment area.

Following placement of the clay cap, a minimum of 2.1 m (7 ft) of overburnden will be applied to near the final tailings grade. After final placement of the contaminated material and overburden, the overburden will be ripped to a depth of 26 cm to 31 cm (10 in to 12 in) and material suitable for plant growth will be applied to a 15 cm to 20 cm (6 in to 8 in) depth as the final step.

The overburden and topsoil stockpile area should be ripped but should not require topsoiling.

Excess overburden or topsoil can be used in reclaiming the mill site, if scheduling permits, to lessen disturbance to additional areas for "borrow" material.

The grade of the final reclaimed surface area will be a minimum of 1.0 percent slope to the sides and a 0.5 percent slope in both the upstream and downstream directions (see Figure 3.3-3).

4.6.3.2.3 Haul Roads

The roads and drainage channels will be ripped and graded to blend with existing land forms. Material suitable for plant growth will then be applied to a 15 cm to 20 cm (6 in to 8 in) depth.

4.6.3.3 Revegetation

4.6.3.3.1. Seedbed Preparation

Recontoured sites, haul roads, and borrow areas will be disced to roughen the surface and reduce compaction caused by topsoil application.

4.6.3.3.2 Seeding

If seeding the sites, haul roads, and/or borrow areas is done during late summer or early fall, mixtures such as those shown in Table 4.6-7 will be applied with a drill type seeder. After the area has been seeded, native hay mulch may be applied at a rate of 2.2 metric tons per hectare (approximately 2,200 pounds per acre). The mulch would then be anchored with a heavy-duty disc or sheeps-foot roller; anchoring of the mulch would also cover the seed. Rev. 5

Along both sides of the reconstructed Cottonwood Creek channel, a 10 m (32-ft) wide strip may be seeded with the understory mixture shown in Table 4.6-8. Rev. 5

In the event that the recontouring is completed before late May, 54 kg/ha (48 lbs/acre) of barley, rye, or oats will be seeded into the prepared seedbed. This annual crop will provide both organic matter and cover for the reclaimed sites until early fall when the desired grass/forb mixture will be seeded directly into the existing stubble. This crop will be cut at the onset of seed head formation to prevent production of crop seed that would compete with the reclamation mixture.

On those areas not immediately available for seeding with the reclamation mixture due to decommissioning scheduling, a temporary oat, rye, or barley cover crop will be established to limit wind and water erosion. This cover crop will be clipped to prevent germinable seed formation.

4.6.3.3.3 Shrub Plantings

Containerized stock (overwintered in a lath house) will be planted along the reconstructed Cottonwood Creek channel during the spring of the second growing season. Two 2.4 m (8 ft) wide bands 5 m (16 ft) apart will be plowed and disced along both sides of the Cottonwood Creek channel in preparation for planting.

Pygmy peashrub (Caragana pygmea) and willow (Salix ssp.) will be planted at 1.5 m (4.8 ft) intervals in the streamside band. Every 20 m (65 ft) a plains cottonwood (Populus sargenti) sapling will be planted rather than willow or peashrub. In the outermost band, russian olive (Elaeagnus angustifolia,) chokecherry (Prunus) virginiana) and buffaloberry (Shepherdia argentea) will be planted with plant spaced at 1.5 m (4.8 ft) intervals.

4.6.3.3.4 Fertilizer

Due to low nutrient content, rec) imed areas should be fertilized after seeding with 45 to 54 kg/ha .100-120 lbs/ac) of nitrogen and 91 kg/ha (200 lbs/ac) of phosphorus. Use of acrylic or asphalt tacking agents rather than hay mulch for erosion control will require only 50 percent of the above mentioned rates. Rev. 5

4.6 REFERENCES

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TABLE 4.6-1

VEGETATION TYPES ON THE PROPOSED TAILINGS DISPOSAL SITE

Community	Average Total Percent Ground Cover (Perennial)	Representative Dominant Species (Based on percentage composition)
Big sagebrush, medium stand	40.0	Buffalograss, blue grama, big sagebrush, western wheatgrass, prairie sandreed
Big sagebrush, heavy stand	58.0	Buffalograss, big sagebrush, western wheatgrass, blue grama, threadleaf sedge
Rough breaks	14.0	Big sagebrush, wild buckwheat, blue grama, buffalograss, side-oats grama
Grassland	29.0	Buffalograss, blue grama, prairie sandreed, little bluestem, western wheatgrass

TABLE 4.6-2

VEGETATION TYPES EXPECTED TO BE IMPACTED AS A RESULT OF DECOMMISSIONING (INCLUDES DIVERSION DITCH, HAUL ROAD, STOCKPILE, AND DISPOSAL AREA)

Vegetation Type	Hectares	(Acres)
Sagebrush, heavy stand	63	(155)
Sagebrush, medium stand	25	(62.5)
Rough breaks	18	(44.5)
Grassland	16	(39)
Ponderosa pine*	17	(41)

* Removal of tailings which migrated off site.

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TABLE 4.6-3

SMALL MAMMALS OBSERVED OR COLLECTED
ON THE PROPOSED TAILINGS DISPOSAL SITE

Species	Observed[1]	Estimated[2] Population	Density No./HA	Density No./AC
Black-tailed prairie dog (*Cynomys ludovicianus*)	3			
Cottontail (*Sylvilagus* ssp.)	1			
Deer mouse (*Peromyscus maniculatus*)		10	2	0.81
Hispid pocket-mouse (*Perognathus hispidus*)		1	0.2	0.08
White-tailed jackrabbit (*Lepus townsendii*)	2			

[1] Animals observed along avian transect lines.

[2] Estimates developed from mark-recapture trapping of a 225 m by 225 m grid within the proposed tailings containment area.

TABLE 4.6-4

NONGAME BIRD DENSITY
ON THE PROPOSED TAILS DISPOSAL SITE

Species	Spring			Summer		
	Mean* Observed	Density No./HA	Density No./AC	Mean* Observed	Density No./HA	Density No./AC
Chipping sparrow (<u>Spizella passerina</u>)	0.5	.019	.008	-	-	-
Grasshopper Sparrow (<u>Ammodramus savannarum</u>)	-	-	-	3	.115	.05
Killdeer (<u>Charadrius vociferus</u>)	2	.077	.031	2	.077	.031
Lark bunting (<u>Calamospiza melanocorys</u>)	0.5	.019	.008	5.5	.211	.085
Mourning dove (<u>Zenaidura macroura</u>)	0.5	.019	.008	1.5	.058	.023
Prairie horned lark (<u>Eremophila alpestris</u>)	1	.038	.015	4	.154	.062
Redtail hawk (<u>Buteo jamaicensis</u>)	0.5	.019	.008	-	-	-
Savannah sparrow (<u>Passerculus sandwichensis</u>)	2.5	.096	.039	1	.038	.015
Turkey vulture (<u>Cathartes aura</u>)	1.5	.058	.023	-	-	-
Vesper sparrow (<u>Pooecetes gramineus</u>)	1	.038	.015	1	.038	.015
Western meadowlark (<u>Sturnella neglecta</u>)	14.5	.558	.226	10	.385	.156
		0.941	0.381		1.08	.437

*Value is average of sightings for that species for two consecutive days along two transect lines on the preferred disposal site.

TABLE 4.6-5

TABLE COMPARISON OF FISH SPECIES COLLECTED IN THE CHEYENNE RIVER

	Bailey and Allum		TVA	South Dakota Dept. Game, Fish & Parks
	1962 Entire Cheyene drainage	Fall River Co. above Angostura Dam	1979	1975
Salmo trutta	(X)			
Salmo gairdneri	(X)			
Salvelinus fontinalis	(X)			
Esox . lucuis				(X)
Hiodon alosoides	X			
Cyprinus carpio	(X)		(X)	
Carassius auratus	(X)			
Notemigonus crysoleucas	(X)	(X)		(X)
Semotilus atromaculatus	X			
Hybopsis plumbea	X			
Hybopsis gracilis	X	X	X	
Hybopsis gelida T	X			
Rhinichthys cataractae	X	X	X	
Notropis stramineus missuriensis	X	X	X	
Hybognathus placitus	X	X	X	
Hybognathus nuchalis	X			
Pimephales promelas	X	X	X	
Carpiodes carpio	X		X	
Moxostoma macrolepidotum	X			Moxostoma sp.
Catostomus commersoni	X	X	X	X
Catostomus catostomus T	X			
Pantosteus platyrhynchus	X			
Ictalurus melas	X	X	X	X
Ictalurus punctatus	X		X	X
Noturus flavus	X			
Fundulus kansae	(X)		(X)	
Lota lota	X			
Micropterus salmoides	(X)	(X)		
Micropterus dolomieui				(X)
Lepomis cyanellus	(X)	(X)	(X)	
Lepomis macrochirus	(X)			(X)
Lepomis humilis	(X)			
Ambloplites rupestris	(X)			
Pomoxis sp.				(X)
Stizostedion vitreum	(X)	(X)		(X)
Perca flavescens	(X)	(X)		(X)
Totals	34	12	12	13
Native	20	9	9	7
Introduced	14	3	3	6

X Species present
(X) Species present has been introduced
T Listed as Threatened by the State of South Dakota

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TABLE 4.6-5

TABLE COMPARISON OF FISH SPECIES COLLECTED IN THE CHEYENNE RIVER

	Bailey and Allum		TVA	South Dakota Dept. Game, Fish & Parks
	1962 Entire Cheyene drainage	Fall River Co. above Angostura Dam	1979	1975
Salmo trutta	(X)			
Salmo gairdneri	(X)			
Salvelinus fontinalis	(X)			
Esox lucuis				(X)
Hiodon alosoides	X			
Cyprinus carpio	(X)		(X)	
Carassius auratus	(X)			
Notemigonus crysoleucas	(X)	(X)		(X)
Semotilus atromaculatus	X			
Hybopsis plumbea	X			
Hybopsis gracilis	X	X	X	
Hybopsis gelida T	X			
Rhinichthys cataractae	X	X	X	
Notropis stramineus missuriensis	X	X	X	
Hybognathus placitus	X	X	X	
Hybognathus nuchalis	X			
Pimephales promelas	X	X	X	
Carpiodes carpio	X		X	
Moxostoma macrolepidotum	X			Moxostoma sp.
Catostomus commersoni	X	X	X	X
Catostomus catostomus T	X			
Pantosteus platyrhynchus	X			
Ictalurus melas	X	X	X	X
Ictalurus punctatus	X		X	X
Noturus flavus	X			
Fundulus kansae	(X)		(X)	
Lota lota	X			
Micropterus salmoides	(X)	(X)		
Micropterus dolomieui				(X)
Lepomis cyanellus	(X)	(X)	(X)	
Lepomis macrochirus	(X)			(X)
Lepomis humilis	(X)			
Ambloplites rupestris	(X)			
Pomoxis sp.				(X)
Stizostedion vitreum	(X)	(X)		(X)
Perca flavescens	(X)	(X)		(X)
Totals	34	12	12	13
Native	20	9	9	7
Introduced	14	3	3	6

X Species present
(X) Species present has been introduced
T Listed as Threatened by the State of South Dakota

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TABLE 4.6-6 | Rev. 3

FISH SPECIES COMPOSITION, EDGEMONT SOUTH DAKOTA, SAMPLING SITES*

Sampling Site	Species
Site 1	Plains killifish (Fundulus kansae) Garman
Cheyenne River	Plains top minnow (Fundulus sciadicus) Cape
	Plains minnow (Hybognathus placitus) Girard
Site 2	Plains killifish (Fundulus kansae) Garman
Cheyenne River	Plains top minnow (Fundulus sciadicus) Cape
	Plains minnow (Hybognathus placitus) Girard
Site 3	Plains killifish (Fundulus kansae) Garman
Cottonwood Creek	Plains top minnow (Fundulus sciadicus) Cape
	Plains minnow (Hybognathus placitus) Girard
	Flathead chub (Hybopsis gracilis) Richardson
Site 4	Plains killifish (Fundulus kansae) Garman
Cottonwood Creek	Plains top minnow (Fundulus sciadicus) Cape
	Plains minnow (Hybognathus placitus) Girard
	Flathead chub (Hybopsis gracilis) Richardson
	Bluegill (Lepomis macrochirus) Rafinesque
	Green sunfish (Lepomis cyanellus) Rafinesque
	Black bullhead (Ictalurus melas) Rafinesque
Site 5	Plains top minnow (Fundulus sciadicus) Cape
Hat Creek	Plains killifish (Fundulus kansae) Garman
	Green sunfish (Lepomis cyanellus) Rafinesque
	Black bullhead (Ictalurs melas) Rafinesque
Site 8	Plains top minnow (Fundulus sciadicus) Cape
Beaver Creek	Plains killifish (Fundulus kansae) Garman
	Plains minnow (Hybognathus placitus) Girard
Site 9	Plains top minnow (Fundulus sciadicus) Cape
Stockade Beaver Creek	Plains killifish (Fundulus kansae) Garman
	Plains minnow (Hybognathus placitus) Girard

*Results of a survey performed by Mine Reclamation Consultants, July 1976.

TABLE 4.6-7

SEED MIXTURES PROPOSED FOR REVEGETATION OF MILL, DISPOSAL AND BORROW SITES

MILL SITE

	Kg(PLS*)/ha	(lbs(PLS*)/acre)
Western wheatgrass (*Agropyron smithii*) var. Rosana	7.5	(7)
Thickspike wheatgrass (*Agropyron dasystachyum*) var. Critana	4	(3.5)
Russian wildrye (*Elymus junceus*) var. Vinall	7.5	(7)
Slender wheatgrass (*Agropyron trachycaulum*) var. Primar	4	(3.5)
Louisiana sagewort (*Artemisia ludoviciana*)	1	(1)
Sainfoin (*Onobrychis viciaefolia*) or Yellow sweetclover (*Melilotus officinalis*)	4	(4)
	28.0	26

DISPOSAL SITE AND BORROW AREAS

	Kg(PLS*)/ha	(lbs(PLS*)/acre)
Western wheatgrass	7.5	(7)
Streambank wheatgrass (*Agropyron riparium*) var. Sodar	7.5	(7)
Thickspike wheatgrass	4	(3.5)
Sand dropseed (*Sporobolus cryptandrus*)	1	(1)
Blue grama (*Bouteloua gracilis*) var. Lovington	1	(1)
Russian wildrye	1	(1)
Louisiana sagewort	1	(1)
Sainfoin or yellow sweetclover	4	(4)
*PLS = Pure Live Seed	27	25.5

TABLE 4.6-8

SEED MIXTURE PROPOSED FOR REVEGETATION OF COTTONWOOD CREEK BANKS

	kg(PLS)/HA*	(lbs(PLS)/AC)*
Streambank wheatgrass (*Agropyron riparium*) var Sodar	11	(10)
Western wheatgrass (*Agropyron smithii*) var Rosana	11	(10)
Yellow sweetclover (*Melilotus officinalis*)	2	(2)
	24	(22)

*PLS = Pure Live Seed

TABLE 4.7-13

RADIONUCLIDE CONCENTRATIONS IN SURFACE AND GROUND WATER

ROUTINE SAMPLING BY MILL PERSONNEL

Sample No.	Sampling Location	Uranium n	Uranium (10^{-7} µCi/ml)	Dissolved Radium-226 n	Dissolved Radium-226 (10^{-9} µCi/ml)
R-1	Cottonwood Creek, 1/2 mi S	16	<5.7	16	0.37±0.25[a]
R-2	Cottonwood Creek, 1/4 mi N	17	<5.7	17	0.88±0.70
R-3	Cheyenne River, 1/2 mi W	17	<5.7	17	0.29±0.28
R-4	Cheyenne River, 1 mi E	17	<5.7	17	0.48±0.78
W-1	Silver King Mines, Inc., feed water	17	<5.7	17	3.27±0.51
W-3	City of Edgemont water works	17	<5.7	17	3.18±0.77

a. Uncertainty reported is one standard deviation.
Note: 1 µCi = 3.7×10^{4} Bq.
Note: Samples are collected quarterly. Results reported are only those for about the 1976 to 1979 time period.

4.8 SOCIOECONOMIC CONSIDERATIONS

4.8.1 Socioeconomic Environment

Mill decommissioning will create a small, temporary increase in income and population in the area. In most situations, the potential impacts would be so small as to not warrant much discussion. However, energy-related developments in the Edgemont area have resulted in rapid population growth which has stressed certain aspects of community infrastructure. This section presents information regarding the capabilities of the governmental entities likely to absorb portions of the population increase.

4.8.1.1 Definition of the Impact Area

Examination of the regional map (see Figure 2.1-1) for the area makes the definition of the impact area relatively straightforward. Only two communities, Edgemont and Hot Springs, are close enough to the project area to serve as potential locations for new residents. Also, they are both located in Fall River County in which the project is located.

4.8.1.2 Impact Area Characteristics

Community profiles for Edgemont and Hot Springs are discussed in Sections 4.8.1.2.1 and 4.8.1.2.2, respectively. These profiles contain a brief description of the status of community development, the facilities and services presently available, and the outlook for community growth and expansion. This information forms the basis for evaluating the potential for impacts created by the population influx presented in Section 4.8.2, Socioeconomic Impacts .

4.8.1.2.1 Edgemont

1. Population and Employment

Since 1960, population and employment have undergone significant shifts in Edgemont. In 1960, the population was about 1,800 but by 1970, this had decreased to about 1,200 as a result of the closing of the Black Hills Army Depot in 1967. Although some small industries have located near Edgemont, the community reverted to essentially a small trade and service center for the surrounding agriculture-based population. However, the advent of major energy-related development in the west has begun to alter the situation. The biggest change has been the expansion of Burlington Northern Railroad's operation in Edgemont. As a result of coal activities in Wyoming, Burlington Northern's employees have increased from 20 in 1968 to about 200. This increase has included both construction employees for upgrading the tracks and train crews. As a result, Edgemont had reached an estimated population of 2100 in 1979. However, the current population is estimated to be about 1,800 primarily because of layoffs by Burlington Northern.

Despite the recent population decrease, employment in Edgemont is expected to increase in the near future. Burlington Northern has begun construction on a new depot and will require an increase in its local work force. Unitram will soon increase its work force from between 35 to 100 workers. Also, several other nonmining industrial prospects are considering the city for plant locations. Each would employ between 30 to 100 persons.

2. Education

Edgemont Independent School District No. 23-1 serves all but the eastern part of Fall River County. Edgemont has consolidated all schools into one large structure, but has divided it up for administrative purposes. Enrollment, which totaled 455 students in the spring of 1980, can fluctuate from week to week. Also, enrollment is usually higher in the fall and spring and lower during the winter, according to the local employment situation. The enrollments and capacities are:

	Enrollment	Maximum Capacity
High School(9-12)	130	474
Junior High(4-8)	161	158
Elementary School(k-3)	164	205

The school district was recently reorganized into the present three divisions with the junior high school classification being eliminated. High school and elementary school capacities are currently in excess of enrollment while the middle school is experiencing overcrowding. The large apparent excess in capacity indicated for the high school is somewhat misleading. The use of special classrooms (band, laboratories, industrial arts, library, etc.) tends to increase the disparity between enrollment and capacity figures because actual utilization varies greatly throughout the day. Also, while some physical capacity exists, part of the facility dates back to 1931. The only recent improvement was an insulation program funded by a $132,000 Department of Energy grant.

School district personnel consists of 25 teachers, 14 support staff, and 3 administrative staff. The school superintendent contends that enrollment increases will necessitate hiring of additional teachers before expansion of physical facilities are necessary.

3. Transportation

U.S. Highway 18 is the major highway through Edgemont. It runs through Hot Springs 43 km (27 mi) to the east and into Wyoming to the west. This highway has recently been upgraded in the Edgemont Area. Already mentioned is the Burlington Northern Railroad which offers freight service. Bus service is provided by Continental Trailways with connections to Rapid City in the north and Denver, Colorado, to the south. The Edgemont area is also served by a sod runway which accommodates small private aircraft.

4. Utilities - Communications

Privately provided utilities include Black Hills Power and Light (electricity) and Peoples Telephone and Telegraph Company (telephone). The city provides water, sewer, and solid waste collection.

Water supply is obtained from wells with a flow estimated to be adequate for a population of 10,000. Although the quantity of the supply is adequate, the water is very hot (53^0 C, 128^0 F) and high in minerals which is damaging to water mains and valves. Until recently storage capacity was 2.6×10^6 1 (700,000 gal) which corresponds to the peak daily use. However, a new reservoir with a capacity of about 23.8×10^6 1 (6.3×10^6 gal) is serving as a cooling pond for most of the wells. The city has also been involved in a program of installing new water lines in certain parts of town.

Wastewater treatment is provided by a single stabilization lagoon. The facility does not meet the requirements of the National Pollutant Discharge Elimination System (NPDES) permit. The city intends to expand wastewater treatment service to a capacity of 4,000 persons. The existing facility is currently operating at capacity.

Solid waste disposal is contracted by the city with a private operator. The operator provides once-a-week pickup and also operates the city-owned and state approved landfill.

5. Housing

The recent surge in population growth has placed tremendous pressure on existing housing. From 1962 to 1976 only three houses were built. However, since 1977, 45 new homes and 50 new apartment units have been built. Also, a building permit program began in 1977. In the past several years housing availability has been very limited although the recent decrease in population has contributed to a slight increase in availability. Few developments are planned or underway at the present time with the exception of an 8-ha (20-acre) project by a local developer.

The potential for an additional provision of 150 to 200 housing units exists under the 601-Energy Impact Assistance Program administered by the Farmers Home Administration. This program provides grants to assist in developing and acquiring sites for homes and public services and facilities. Funds are being held in reserve for Edgemont until definite determination of housing needs are made and final project approval is granted by Farmers Home Administration.

6. Health, Police and Fire Protection

Most medical services must be obtained in Hot Springs, 43 km (27 mi) away. Ambulance service is provided by the volunteer fire department. About 10 members have completed an 81-hour emergency medical technician course.

Twenty-four-hour police protection is provided by four full-time officers. The department has two patrol cars and three persons serving as dispatchers. The local department is supported by a local deputy sheriff based in Edgemont.

Fire protection is provided by a 40-member volunteer fire department. Its equipment consists of two pumpers, one a 1958 3,785 l (1,000 gal) pumper, two 4-wheel drive rural service trucks with 530 l (100 gal) capacity each, a salvage truck with smoke extractor, and a 16,000 l (6,000 gal) tanker used for water supply for rural fires. The insurance classification of Edgemont is eight on a scale of 1 (best) to 10 (worst) .

7. Recreation

Volunteers presently operate the recreation program although local officials have indicated plans for hiring a recreation director to organize activities. There are two tennis-basketball courts, and the high school has a football-baseball complex. Activities in the summer include softball and hardball leagues for all ages and the city leases the motel swimming pool for public use during certain hours. In the winter, there are a few men's basketball teams.

There are several improvements planned for Edgemont's city park in the near future. Generally, the park will be upgraded and made more usable. Burlington Northern is providing funds for dragging the lake of debris and has donated an old caboose for use as a shelter. A Federal grant was recently obtained for construction of tennis courts.

4.8.1.2.2 Hot Springs

1. Population and Employment

Hot Springs underwent a small population decline from 1960 to 1970 dropping from 4,943 to 4,434. Since 1970, the population has increased to approximately 5,100, a 13 percent increase.

Employment in the government sector is one of the major reasons for the relative stability of the population. The Veterans Administration Center which employs about 500 people contains 232 general hospital beds and 511 domiciliary care beds. At the State Veterans Home, about 100 people are employed caring for about 69 patients. Since Hot Springs serves a very large trade area, trades and services employment constitutes the other major employment sector.

2. Education

Hot Springs Independent School District No. 23-2 covers the northeastern part of Fall River County. Enrollment in the spring of 1980 totaled 1,068 distributed among four elementary schools, one middle school and one senior high school. However, three of the elementary schools are rural schools and would not serve children of persons moving to Hot Springs. Thus, the relevant enrollments and capacities are:

	Enrollment	Maximum Capacity
High School(9-12)	346	420
Middle School(6-8)	256	270
Elementary School(k-5)	419	500

There is currently adequate capacity in the physical facilities of the Hot Springs school district. However, as indicated for Edgemont, enrollment can fluctuate significantly during the school year. School district personnel consists of 66 teachers and 44 adminstrative and support staff. There have been no recent major improvements in school facilities during the past several years.

3. Transportation

Bus service is provided by Continental Trailways and the Omaha-Rapid City bus line. Continental Trailways provides a direct connection with Rapid City to the north and Denver (through Edgemont) to the south. The Omaha-Rapid City bus line also connects with Rapid City but goes to Chadron, Nebraska, and other stops across Nebraska.

Rapid City offers the nearest commercial airline connection. However, there is a municipal airport in Hot Springs which serves light aircraft. This airport has a 1,372 m (4,500 ft) asphalt runway and 1,158 m (3,800 ft) sod runway and two hangars with fuel availability. Lights are operable by radio control.

4. Utilities - Communication

Private utilities include Black Hills Power and Light (electricity) and Peoples Telephone and Telegraph Company (telephones). The city provides water, sewer, and solid waste disposal service.

Water supply is from ground water sources which are adequate for the existing population. Additional sources exist which can be tapped to serve population growth. Recent improvements in storage capacity have increased capacity to 9.8 x 10 (2.6 x 10^6 gal). The city has a pumping capacity of 8.3 x 10^6 (2.2 x 10^6 gal), adequate for a population of 6,500. The major problem in the Hot Springs water system concerns distribution. Much of the system is deteriorated and undersized. A limited program of pipe replacement and enlargement is in progress.

Hot Springs is served by an old secondary treatment facility which currently provides inadequate treatment. Some sections of the city are not served by this facility but instead use private systems or septic tanks. A design has been completed for a new treatment plant with a capacity to serve a population of 6,500. However, uncertainties in the actual amount of expected population have delayed action on the plant.

5. Housing

Conventional housing is in short supply, but market response to increased demand should be assisted by the large availability of building lots in the city. Construction on these lots could make use of existing utility lines thus eliminating both the time and expense associated with developing, new unserved areas. Mobile homes supplement conventional housing with about 15 mobile home parks containing about 300 spaces. The individual vacant building lots are not available for placement of mobile homes because community regulations restrict mobile homes to approved mobile home parks.

The number of housing units in Hot Springs has increased in the past few years by 20 to 30 houses per year and by one or two apartment buildings (four to eight units a piece) per year. There have been no new mobile home parks developed. Housing development in Hot Springs in the previous decade before this recent increase was similar to Edgemont's in that there was almost no growth.

6. Health, Police and Fire Protection

The Southern Hills General Hospital is the only civilian hospital in the area. It contains 50 beds and is operating at about 30 percent occupancy. Further, the auxiliary facilities already in the hospital are sized to serve 150 beds. Thus, it has a great deal of capacity to serve additional needs. Four doctors, one surgeon, and three general practitioners are in the community and utilize the hospital. There are also two dentists and two optometrists in Hot Springs. In addition to the general hospital, there is a 50-bed nursing home which is operating at capacity and a 232-bed Veterans Administration hospital.

The police department which provides 24-hour protection has six patrolmen, four desk sergeants, and a dispatcher shared with the county. There is a new city-county jail and the department has two patrol cars.

Fire protection is provided by a volunteer department consisting of 57 men. Facilities include two 1,892 l (500 gal) pumpers, a ladder truck, smoke extractor, two rural service pumper trucks and an emergency ambulance.

7. Recreation

A full range of community recreation facilities is available. Swimming is available at the Evans Plunge and Larive Lake. Tennis courts are located at the high school and at Butler Park. The high school also has a football field and baseball facilities are available at the VA center. There is a nine-hole golf course at the country club and other recreation activities are sponsored by various civic organizations such as the American Legion, Jaycees, VFW and Elks.

Recent improvements in Hot Springs' recreation facilities include a new nine-hole municipal golf course and three new municipal tennis courts. There have also been small improvements in city parks.

4.8.2 Socioeconomic Impacts

4.8.2.1 Introduction

This section discusses potential socioeconomic impacts of this project in the context of all known energy-related developments in the area. This analysis is based on a set of assumptions and methodology which were developed in concert with planning officials at the State, regional, and local levels.

4.8.2.2 Magnitude and Distribution of Impacts

4.8.2.2.1 Employment Rev. 5

A number of energy-related projects are occuring or expected in the Edgemont area. These include expansion of railroad and related activity, the proposed decommissioning, TVA's proposed mining project and the consideration for a potential mill, and another small uranium mining operation. From 1975 to 1979, energy-related employment increased about 175 (from 200 to 375). Growth is projected to be more rapid in the future (1979-1989), and it is for this period that the projections and evaluations have been prepared. Also, because community infrastructure data are from the late 1979 and early 1980 time period, impacts will be evaluated for the increases over the 1979 employment level.

Between 1979 and 1986, total energy-related basic employment is expected to increase to a peak of about 599 and then decrease by 1989 to a long-term level of about 461 (refer to Table 4.8-1). Of the peak, TVA-related employment totals about 388 and of the long-term, about 250. Most of the employment causing the peak is temporary and is associated with construction of the above mentioned mill. The remainder is primarily composed of TVA operating personnel of which a majority is for the proposed mining project. In 1989, most of the basic employment will be operational and over half will be TVA related. Rev. 5

Mill decommissioning employment comprises a small portion of total TVA employment through the decade. Decommissioning employment should reach a peak of 91 in 1983, three years before the cumulative peak of all projects (see Table 4.8-2). In the cumulative peak year of 1986, decommissioning employment should comprise all of the TVA basic seasonal employment (19) and an insignificant portion of the operating employment. (Compare Tables 4.8-1 and 4.8-2). The decommissioning project should be completed by 1987 leaving all TVA employment related to the proposed mill and mining project. Rev. 5

Employment was projected in three categories: seasonal, temporary, and operational because each category was believed to exhibit significantly different characteristics (refer to Table 4.8-3). The two common characteristics used were 3.5 for the average family size and 1.0 for the average school-age children per family.

Increases in basic employment such as mining and transportation will eventually result in increase in secondary employment such as clerks and barbers. Based upon a study of South Dakota's secondary employment multiplier for the past 20 years, TVA determined that the State's first year multiplier is 1.8 and the long-term multiplier is 2.5. The time lag to reach the long-term multiplier was 2 years. Because State-wide employment data are not available for the categories used in this analysis, the multiplier was applied equally to all of them and then the total adjusted to reduce the unrealistic peaks.

From 1979 to 1986, total secondary employment is expected to increase by about 623 (refer to Table 4.8-1). About 40 percent of this increase (261) should be TVA related, most of which should be a result of operational personnel (187). By 1989, total secondary employment should have increased by about 747 over the 1979 base figure. About half of this increase (375) should be TVA related, all of which should be a result of operational personnel. In 1989, most secondary employment is expected to be operational related (733). Thus, total secondary employment is expected to increase rapidly between 1979 and 1986 and at a much slower pace between 1986 and 1989. TVA's share of this employment should maintain a rate of about 50 percent. Rev. 5 Rev. 5

In summary, total employment (basic and secondary) should increase by 1,222 from 1979 to 1986 (refer to Table 4.8-1). Over half of this increase (649) should be TVA related with a small portion related to decommissioning. In 1989, total employment should have decreased slightly from the 1986 peak with TVA's share being about half. There should be no employment related to decommissioning at this time. Rev. 5 Rev. 5

4.8.2.2.2 <u>Population</u> Rev. 5

The assumptions used to convert the basic employment projections into population projections were discussed above and shown in Table

4.8-3. This analysis assumes secondary employees exhibit the same characteristics as the basic employees which generated the opportunity. That is secondary employees generated by seasonal jobs are assigned the same family status and size, and distribution as basic seasonal employees. The exception is that a mover rate of 65 percent was used for all secondary employees because dependents of basic employees moving into the area will provide a portion of the secondary employment demand. Tables 4.8-4, 4.8-5, and 4.8-6 show the results of applying the various factors to the employment projections. Rev. 5

Population is expected to significantly increase between 1979 and 1986 as a result of the various energy-related projects. The 1986 level of total population should also represent the long-term peak beginning in 1989 as projects are completed. In 1983, the peak year fro mill decommissioning, the expected population increase related to temporary employment is small compared to operational and seasonal population (Table 4.8-4). By 1986, seasonal population should decrease as decommissioning nears completion and temporary population should reach its peak. Most of the temporary population should be related to TVA projects other than decommissioning (Table 4.8-5). Total population in 1989 is expected to remain at about the same level as in 1986 as seasonal and temporary related population decreases and operating population increases (Table 4.8-6).

The population of Edgemont should increase by about 721 by 1983 and by about 828 between 1983 and 1986 (compare Tables 4.8-4 and 4.8-5). While the overall rate of growth should stay about the same during that time period, the population mix should significantly change with reductions in seasonal population and increases in temporary and operational population. By 1989, Edgemont's population is expected to decrease by about 100 as temporary population decreases sharply and operating population increases slightly (compare Tables 4.8-5 and 4.8-6). Rev. 5

Hot Springs should experience a population increase of about 472 by 1983, an additional 617 by 1986, and increasing slightly by 1989 (compare Tables 4.8-4, 4.8-5, and 4.8-6). As with Edgemont, Hot Springs should receive a large increase in temporary and operational population by 1986 with a large decrease in temporary and a slight increase in operating population by 1989 (compare Tables 4.8-5 and 4.8-6). Hot Springs is not expected to receive seasonal population increases. Other areas should not experience such shifts and should continue to grow slightly during the 1979-89 time period. However, the magnitude of the expected population growth is so small as to have no significant impact.

TVA projects should account for virtually all of the seasonal population in 1983 and 1986, but none in 1989. TVA projects should account for none of the temporary population in 1983 and 1989 but most of the large increase in the peak year of 1986. TVA projects are expected to account for a small portion of the operational population in 1983, about 40 percent in 1986, and about half in

1989. Population growth related to decommissioning employment should be a small proportion of the total population growth in 1983 and 1986 and nonexistent in 1989 (refer to Tables 4.8-4, 4.8-5, and 4.8-6). Rev. 5

4.8.2.3 Impacts on Community Facilities and Services

This assessment of impacts on community facilities is based on the presence of inmovers related to all known energy development in the area. The cumulative impacts from all the proposed energy developments are expected to be significant, particularly for Edgemont. However, impacts related specifically to decommissioning are expected to be insignificant because the work force required for the projects is small, both in absolute terms and relative to the other proposed projects. Rev. 5

4.8.2.3.1 Edgemont

Significant impacts can be expected for Edgemont if all the projects are conducted on schedule and if the population projections are realized. It is assumed that without this energy development Edgemont's future population growth would follow past trends of small temporary increases and decreases and would therefore fall into a range of between 1,800 and 2,200. By 1986 the population of Edgemont could increase by about 1,549 as a result of energy development. Rev. 5 Approximately two-thirds of this population increase should be operational and, therefore, permanent. Approximately 60 percent of the total increase should be TVA related. By 1989, population should decline slightly as construction workers leave. At that time the energy-related population present should be about 1,435. Rev. 5 Almost all of this population increase should be operational and about half should be TVA related.

Significant numbers of additional school-age children are expected for Edgemont school district which also includes Igloo in both 1986 and 1989 (see Tables 4.8-5 and 4.8-6). By 1986 a total of about 416 school-age children are expected, 70 percent of which (290) should be with operational (permanent) families. Rev. 5 Approximately 60 percent (230) of the total school-age children expected should be TVA related. By 1989 the estimated number of school-age children of project-related families should decrease to about 397 with nearly all being part of operational families and Rev. 5 over half being TVA related. Thus, using the present day enrollment of 455 as a baseline figure, the enrollment should nearly double by 1986 and be somewhat less by 1989 as a result of Rev. 5 energy development projects. Estimates of specific facility needs have not been made. However, when comparing the present capacity in physical facilities to the projected enrollment increases, it is obvious substantial improvements and expansions will be necessary. In addition to overcrowding of facilities, increases in teachers and staff will be needed.

The estimated population increase should result in additional strains on the Edgemont housing market. The total number of dwelling units needed was projected by assuming one dwelling unit per each employee with a family and one dwelling unit per two employees without a family. The housing choice for each employment category is shown in Table 4.8-7. Using those factors and the population projections found in Tables 4.8-4, 4.8-5, and 4.8-6 Table 4.8-8 showing the number, type, and distribution of housing demand for 1983, 1986, and 1989 was prepared. Rev. 5

Demand for single family dwellings is expected to be about 183 in 1986 and reach about 208 in 1989. All other types of dwelling units reach a peak in 1986 and decline slightly by 1989. Most of the declines are very small and would not cause a significant surplus in the housing market. The only major change is in the "other" category which includes recreational vehicles, sleeping rooms, motels, and campers. The private housing market in Edgemont is expected to maintain pace with demand although the vacancy rate should be very low. A large surplus of housing is not expected after the construction workers leave. Many of the temporary and seasonal workers are not expected to utilize traditional housing (single family units). Thus, the increase in single family units should be filled by operational workers. One possible change in the local housing market could be a change from contract house building to construction of large developments on a speculative basis. Final approval of the 601-Farmers Home Administration program should aid the local market in meeting demand. Rev. 5

Impacts on Edgemont's wastewaster treatment facilities are not likely if the current expansion plans are implemented. Recent improvements in the water supply system should prevent any negative impact from population increases.

The expected increase in population should create significant impacts on the police and fire protection services. The current level of service would need upgrading. Similar impacts would also be evident in the health and recreation services.

4.8.2.3.2 Hot Springs

In comparison to Edgemont, less significant impacts are expected for Hot Springs. By 1986 the population of Hot Springs could increase by about 1,089. Nearly 80 percent of this increase should be operational and, therefore, permanent. Approximately 50 percent of the total increase should be TVA related. By 1989, population should increase very slightly as the increases in operational workers balance out the decrease in construction workers. In 1989, nearly all of the project-related population increase should be operational and about half should be TVA related. It is important to note that this estimated population increase is due to the various energy projects included in this assessment. Nonenergy related population growth, which has been significant since 1970, is not included in the estimate of population increase. However, if the past decade's trend continues, Hot Springs should grow by a larger amount than Rev. 5

discussed in this assessment.

A large number of additional school-age children are expected for Hot Springs in both 1986 and 1989 (see Tables 4.8-5 and 4.8-6). By 1986 a total of about 293 students are expected, nearly 80 percent of which (227) should be with operational (permanent) families. Approximately 55 percent of the total school-age children expected should be TVA related. By 1989 the estimated number of school-age children of project-related families should increase very slightly with nearly all being part of operational families and over half being TVA related. Estimates of specific facility needs have not been made. However, when comparing the present capacity in physical facilities to the projected enrollment increase, it appears that some improvements and expansions should be necessary. In addition to overcrowding of facilities, increases in teachers and staff should be needed. In comparison to Edgemont, the impacts on the Hot Springs school district should be significantly less serious. However, it should be noted that nonenergy-related population growth in Hot Springs may also result in additional students. Rev. 5

The estimated population increase related to energy development should place strains on the Hot Springs housing market. The methodology for estimating housing needs is included in the Edgemont discussion (refer to Section 4.8.2.3.1). Demand for single family dwellings is expected to be about 139 in 1986 and reach about 166 in 1989 (refer to Table 4.8-8). All other types of dwelling units reach a peak in 1984 and remain about the same for 1989. Most of the declines are very small and would not cause a significant surplus in the housing market. The major change in the "other" category is similar to Edgemont. The expected effects on the Hot Springs housing market are similar to those discussed for Edgemont. A low vacancy rate is expected with no large surplus in housing after construction is completed. Rev. 5

Major impacts on Hot Springs' wastewater treatment facilities are not likely if the current expansion plans are implemented. Recent improvements in the Hot Springs' water supply system should prevent any negative impact from population increases although some additional impact could be felt on the city's inadequate distribution system. The additional population expected for Hot Springs could create impacts on the police and fire protection services. The current level of service may need minor upgrading. Similar impacts would also be evident in the health and recreation services.

4.8.2.3.3 Igloo

A small percentage of workers and dependents may locate in the Igloo area. Any population influx would be expected to utilize facilities and services available in nearby Edgemont. The Igloo share of inmovers has been included in the assessment of impacts of Edgemont's schools.

4.8.3 Socioeconomic Mitigation

Currently, TVA is funding the major portion of a two-year planning program in Edgemont to facilitate the community's ability to accommodate projected growth. Also, TVA has acted as a guarantor on a loan related to the 601-Farmers Home program funds. A TVA program coordinator has been assigned to Casper, Wyoming. The coordinator has the responsibility for TVA mitigation efforts related to projects in several western states. TVA is committed to assisting in the mitigation of TVA-related impacts and is currently working with local and State officials concerning development of mitigation strategies.

TABLE 4.8-1

INCREASES IN BASIC AND SECONDARY EMPLOYMENT

	1979		1983*		1986*		1989*	
	TVA	All	TVA	All	TVA	All	TVA	All
Total Basic Employment	0	374	122	303	388	599	250	461
Seasonal	0	90	93	93	19	19	0	0
Temporary	0	0	0	15	225	240	0	15
Operational	0	284	29	195	144	340	250	446
Total Secondary Employment	0	500	61	318	261	623	375	747
Seasonal-related	0	142	28	28	18	18	0	-9
Temporary-related	0	0	0	23	56	60	0	23
Operational-related	0	358	33	267	187	545	375	733
Grand Total	0	874	183	621	649	1,222	625	1,208

*Increase over 1979.

TABLE 4.8-2

TOTAL TVA EMPLOYMENT
FOR EDGEMONT MILL DECOMMISSIONING*

	1980	1981	1982	1983	1984	1985	1986	1987
Mill Decommissioning								
Seasonal	0	78	52	70	59	37	19	0
Temporary	0	0	0	0	0	0	0	0
Operating	0	5	20	21	14	11	2	0
TOTAL	0	83	72	91	73	48	21	0

*Basic employment only

TABLE 4.8-4
1983 POPULATION PROJECTIONS AND DISTRIBUTION
FOR MILL DECOMMISSIONING,
OTHER TVA PROJECTS,
AND ALL OTHER ENERGY-RELATED
PROJECTS IN FALL RIVER COUNTY[a]
(Increase Over Base Year 1979)

	Edgemont			Igloo			Hot Springs			Other			Total		
	Mill[b]	TVA[c]	All	Mill	TVA	All	Mill	TVA	All	Mill	TVA	All	Mill	TVA	All
Total Population	141	191	721	0	0	11	44	62	472	11	13	100	196	266	1304
Seasonal	86	114	115	0	0	0	0	0	0	0	0	0	86	114	115
Temporary	0	0	50	0	0	0	0	0	28	0	0	0	0	0	78
Operational	55	77	556	0	0	11	44	62	444	11	13	100	110	152	1111
Total School-Age Children	22	30	173	0	0	3	12	17	128	3	4	27	37	51	331
Seasonal	7	9	9	0	0	0	0	0	0	0	0	0	7	9	9
Temporary	0	0	13	0	0	0	0	0	7	0	0	0	0	0	20
Operational	15	21	151	0	0	3	12	17	121	3	4	27	30	42	302
Total Employees With Families	22	30	173	0	0	3	12	17	128	3	4	27	37	51	331
Seasonal	7	9	9	0	0	0	0	0	0	0	0	0	7	9	9
Temporary	0	0	13	0	0	0	0	0	7	0	0	0	0	0	20
Operational	15	21	151	0	0	3	12	17	121	3	4	27	30	42	302
Total Employees Without Families	65	86	91	0	0	0	2	3	23	0	0	5	67	89	142
Seasonal	62	82	82	0	0	0	0	0	0	0	0	0	62	82	82
Temporary	0	0	5	0	0	0	0	0	2	0	0	0	0	0	7
Operational	3	4	4	0	0	0	2	3	21	0	0	5	5	7	53

a. Some totals may not add due to rounding.
b. Includes mill decommissioning.

TABLE 4.8-5

1986 POPULATION PROJECTIONS AND DISTRIBUTION
FOR MILL DECOMMISSIONING,
OTHER TVA PROJECTS,
AND ALL OTHER ENERGY-RELATED
PROJECTS IN FALL RIVER COUNTY[a]
(Increase Over Base Year 1979)

	Edgemont			Igloo			Hot Springs			Other			Total		
	Mill[b]	TVA[c]	All	Mill	TVA	All	Mill	TVA	All	Mill	TVA	All	Mill	TVA	All
Total Population	39	877	1549	0	8	21	0	558	1089	0	72	188	39	1515	2847
Seasonal	33	33	33	0	0	0	0	0	0	0	0	0	33	33	33
Temporary	0	443	473	0	0	0	0	239	255	0	0	0	0	682	728
Operational	6	401	1043	0	8	21	0	320	834	0	72	188	6	801	2086
Total School-Age Children	5	228	410	0	2	6	0	149	293	0	20	51	5	399	759
Seasonal	3	3	3	0	0	0	0	0	0	0	0	0	3	3	3
Temporary	0	116	123	0	0	0	0	62	66	0	0	0	0	178	189
Operational	2	109	284	0	2	6	0	87	227	0	20	51	2	218	567
Total Employees With Families	5	228	410	0	2	6	0	149	293	0	20	51	5	399	759
Seasonal	3	3	3	0	0	0	0	0	0	0	0	0	3	3	3
Temporary	0	116	123	0	0	0	0	62	66	0	0	0	0	178	189
Operational	2	109	284	0	2	6	0	87	227	0	20	51	2	218	567
Total Employees Without Families	23	80	114	0	0	1	0	36	62	0	3	9	23	120	186
Seasonal	23	23	23	0	0	0	0	0	0	0	0	0	23	23	23
Temporary	0	38	41	0	0	0	0	21	22	0	0	0	0	59	63
Operational	0	19	50	0	0	1	0	15	40	0	3	9	0	38	100

a. Some totals may not add due to rounding.
b. Although mill decommissioning employment should actually reach peak in 1983, comparison is made with 1986 estimates to show relation to cumulative peak temporary-related population growth.
c. Includes mill decommissioning.

TABLE 4.8-6

1989 POPULATION PROJECTIONS AND DISTRIBUTION FOR TVA AND ALL OTHER ENERGY-RELATED PROJECTS IN FALL RIVER COUNTY [a,b]

	Edgemont		Igloo		Hot Springs		Other		Total	
	TVA	All	TVA	All	TVA	All	TVA	All	TVA	All
Total Population	743	1435	15	28	595	1135	134	249	1487	2847
Seasonal	0	0	0	0	0	0	0	0	0	0
Temporary	0	51	0	0	0	27	0	0	0	78
Operational	743	1384	15	28	595	1108	134	249	1487	2769
Total School-Age Children	202	389	4	8	162	308	36	68	404	773
Seasonal	0	0	0	0	0	0	0	0	0	0
Temporary	0	13	0	0	0	7	0	0	0	20
Operational	202	376	4	8	162	301	36	68	404	753
Total Employees with Families	202	389	4	8	162	308	36	68	404	773
Seasonal	0	0	0	0	0	0	0	0	0	C
Temporary	0	13	0	0	0	7	0	0	0	20
Operational	202	376	4	8	162	301	36	68	404	753
Total Employees Without Families	36	71	1	2	28	55	6	12	71	140
Seasonal	0	0	0	0	0	0	0	0	0	0
Temporary	0	5	0	0	0	2	0	0	0	7
Operational	36	67	1	2	28	53	6	12	71	133

a. Some totals may not add due to rounding.
b. Mill decommissioning should be completed before 1989.

TABLE 4.8-7

HOUSING CHOICE BY EMPLOYMENT CATEGORY

Employment Category	Housing Choice (Percent)			
	Single Family	Multi-Family	Mobile Homes	Other*
Seasonal	0	10	50	40
Temporary	20	15	40	25
Operational	50	15	35	0

* Recreational vehicles, sleeping rooms, motels, and campers.

TABLE 4.8-8

HOUSING PROJECTIONS AND DISTRIBUTIONS
FOR 1983, 1986, AND 1989: TVA AND ALL PROJECTS

1983

	Edgemont			Igloo			Hot Springs			Other			Total		
	Mill	TVA[a]	All	Mill	TVA	All	Mill	TVA	All	Mill	TVA	All	Mill	TVA	All
Total Dwelling Units[b]	55	73	219	0	0	3	13	19	140	3	4	30	71	96	402
Seasonal	38	50	50	0	0	0	0	0	0	0	0	0	38	50	50
Temporary	0	0	16	0	0	0	0	0	8	0	0	0	0	0	24
Operational	17	23	153	0	0	3	13	19	132	3	4	30	33	46	329
Single Family	9	12	80	0	0	2	7	9	68	2	2	15	17	23	169
Multi-Family	6	8	30	0	0	0	1	3	21	0	1	4	9	12	58
Mobile Homes	25	33	85	0	0	1	5	7	49	1	1	11	30	41	149
Other[c]	15	20	24	0	0	0	0	0	2	0	0	0	15	20	26

a. Includes mill decommissioning.
b. Employees without families were assumed to average two employees per dwelling.
c. Recreational vehicles, sleeping rooms, motels, and campers.
d. Mill decommissioning should be completed before 1989.

TABLE 4.8-8 (CONT.)

1986

	Edgemont			Igloo			Hot Springs			Other			Total		
	Mill	TVA[a]	All	Mill	TVA	All	Mill	TVA	All	Mill	TVA	All	Mill	TVA	All
Total Dwelling Units[b]	17	268	468	0	2	7	0	167	324	0	22	56	17	459	852
Seasonal	15	15	15	0	0	0	0	0	0	0	0	0	15	15	15
Temporary	0	135	144	0	0	0	0	73	77	0	0	0	0	208	221
Operational	2	118	309	0	2	7	0	94	247	0	22	56	2	236	617
Single Family	1	86	183	0	1	4	0	62	139	0	11	28	1	160	354
Multi-Family	2	40	70	0	0	1	0	25	49	0	3	8	2	68	128
Mobile Homes	9	103	174	0	1	2	0	62	117	0	8	20	9	174	313
Other[c]	5	39	41	0	0	0	0	18	19	0	0	0	5	57	60

1989[d]

	Edgemont		Igloo		Hot Springs		Other		Total	
	TVA	All	TVA	All	TVA	All	TVA	All	TVA	All
Total Dwelling Units[b]	220	425	5	9	176	336	39	74	440	844
Seasonal	0	0	0	0	0	0	0	0	0	0
Temporary	0	15	0	0	0	8	0	0	0	23
Operational	220	410	5	9	176	328	39	74	440	821
Single Family	110	208	3	4	88	166	20	37	221	415
Multi Family	33	64	1	2	26	50	6	11	66	126
Mobile Homes	77	150	2	3	62	118	14	26	155	296
Other[c]	0	4	0	0	0	2	0	0	0	6

a. Includes mill decommissioning.
b. Employees without families were assumed to average two employees per dwelling.
c. Recreational vehicles, sleeping rooms, motels, and campers.
d. Mill decommissioning should be completed before 1989.

5.0 MONITORING AND SECURITY REQUIREMENTS

5.1 MONITORING REQUIREMENTS

The monitoring programs discussed in the following subsections are intended to reflect conceptual plans only. It is recognized that specific monitoring programs will be developed and submitted as revisions to the environmental report.

5.1.1 Nonradiological Air Quality Monitoring

A monitoring network of four or five standard high volume total suspended particulate samplers is planned for the project. Tentative monitor locations are (1) southeast of the mill area, approximately 500 m (1640 ft) east of the haul road, (2) in Cottonwood Community, approximately 150 m (490 ft) from the site boundary, (3) west of the mill area in the city of Edgemont, approximately 250 m (820 ft) from the site boundary, (4) north northeast of the mill area, approximately 3000 m (9500 ft) from the site boundary, and (5) east southeast of the disposal area, approximately 500 m (1640 ft) from the site boundary. Sampling will take place every six days and will coincide with the sampling schedule of the State of South Dakota. A letter from the State of South Dakota, indicating their suggested monitoring program for the decommissioning, and the proposed monitoring plan are provided in Appendix D. Rev. 5 Rev. 5

5.1.2 Water

5.1.2.1 Hydrologic

5.1.2.1.1 Surface Water

Monitoring of surface water features or effects other than water quality monitoring will include: periodic visual inspections during and following reclamation to insure that surface water diversion ditches are maintained and functioning as designed; that riprap material is being maintained in place and providing adequate protection of the disposal site; and to assess erosion of the reclaimed and/or stabilized areas and to determine corrective action if required.

5.1.2.1.2 Ground Water

Ground water levels are not expected to change significantly as a result of tailings disposal thus, precluding the need for monitoring of ground water levels.

5.1.2.2 Water Quality

5.1.2.2.1 Surface Water

A comprehensive surface water monitoring program will be implemented for the project. The components of the program are outlined below. Details will be finalized in coordination with the appropriate regulatory agencies.

The first component of the program will be the establishment of an adequate water quality data base for predicting impacts of the decommissioning activities and for determining the actual impacts resulting from the activities. The key variables that will be considered are flow, time, and point source and nonpoint source discharges resulting from cultural activities. The data base for the period December 1974 through September 1977 provides basic information on water quality during the high runoff season (May-July) and the low-flow season (fall and winter months), but lacks sufficient depth to characterize water quality for a typical portion of the hydrograph before, during, and after a precipitation event of sufficient size to cause a substantial rapid change in stream stage or flow--a period in which water quality may change dramatically. Such data in conjunction with land use and other information is needed seasonally to quantitatively predict and document the impacts of the decommissioning activities upon water quality. TVA intends to begin collecting this type of baseline in 1981. Rev. 5

The second component of the monitoring program will be aimed at determining and documenting the actual effectiveness of the mitigative measures used during the decommissioning activities. This will be achieved by a flexible site monitoring program tailored specifically to the nature of the decommissioning activities underway at any particular time. A good example of this type of monitoring would be that for determining the effectiveness of erosion control measures. Water quality (suspended solids) would be monitored downstream of disturbed areas several times during a precipitation event large enough to cause substantial runoff from the site, and compared to upstream control water quality to determine if additional mitigative measures are warranted. This would be done as practicable for each significant precipitation event until the effectiveness of the erosion control measures is demonstrated.

The last component of the program will determine and document the actual impact of the decommissioning activities upon the water quality of the Cheyenne River. This will be achieved by implementing a monitoring program similar to the baseline program in conjunction with the monitoring for determining the effectiveness of the mitigative measures.

5.1.2.2.2 Ground Water

TVA is not proposing any ground water quality monitoring. The effects of any residual contaminated ground water at the mill site will be determined by the surface water monitoring. These results should determine the need for any ground water monitoring at the reclaimed mill site.

The design and location of the proposed disposal system eliminates the need for ground water monitoring at this site. Seepage should be precluded, but if any was to occur, it would occur as surface water at the outside of the gravel drain. The gravel drainage system will be periodically inspected and, if sufficient drainage is present, samples will be periodically collected for analyses.

5.1.3 Land Use

No monitoring is planned specifically for land use considerations.

5.1.4 Biological

5.1.4.1 Terrestrial

5.1.4.1.1 Flora

Permanent sampling stations will be used to monitor plant cover development. There should be at least ten such points randomly located in each reseeded area. At each point, two 25 m (82 ft) lines will be laid out with plant cover and species density determined by the line intercept method. Both ends of each line will be staked to allow monitoring of the same area each year. Control stations will be established in nearby communities which will not be disturbed during decommissioning.

Reclamation shall be determined complete when the cover and density of perennial species in the reclaimed areas equals the cover of perennial species at the control stations. This condition must be met for two consecutive growing seasons.

This program will be consistent with the South Dakota policy for establishment of vegetation capable of maintaining and regenerating itself without irrigation or artifcial aids.

Livestock grazing on the grass/forb areas will be deferred for at least two years, but the streambank plantings should be protected for at least five years. If wildlife damage to shrub and tree plantings becomes a problem, control measures will be implemented.

A weed problem may occur on all or part of the reclaimed areas and in the event that it does, a control program will be implemented.

If the property is to be leased or sold, a provision may be added to the terms of lease or sale that will protect the reconstructed and revegetated Cottonwood Creek on the property.

5.1.4.1.2 Fauna

No monitoring program is planned specifically for wildlife.

5.1.4.2 Aquatic

Five sites will be evaluated on the Cheyenne River to allow an upstream control as well as downstream stations to detect possible short-term or long-term changes within the biological community. Sampling results will be correlated with climatic and flow data. Due to the great variability in flows, only biological collections made within comparable flow regimes will be utilized to detect changes from baseline conditions.

Approximate sample sites will be those used in baseline surveys. Sites will be established during an initial sampling trip in the spring of 1980 and will approximate those sites used in baseline studies. Monitoring will be seasonal (four times a year) during tailings removal. A survey of Cottonwood Creek (baseline data already collected) will be made after decommissioning, at such a time as deemed appropriate to document recolonization of the reach to be rerouted. The monitoring program will concentrate on documenting the standing crops and diversities of fish, macrobenthic, and planktonic organisms.

5.1.5 Radiological

5.1.5.1 Occupational

Comprehensive radiological safety practices will be utilized for workers during decommissioning activities. These practices will reflect the radiological hazards of airborne dust and external radiation hazards. The operations will be conducted to minimize airborne particulate hazards. Personnel monitoring will include an evaluation of airborne radionuclides and external radiation. Respiratory protection will be used as appropriate. Bioassay techniques are expected to be used in evaluating any internal uptake of radionuclides. There should be very low exposures from the stabilized tailings.

5.1.5.2 Environmental

An environmental radiological monitoring program will be conducted to determine the radiological impacts of decommissioning operations on the environment. The monitoring program being conducted by TVA at the existing mill site will be continued, as possible, throughout decommissioning activities, and additional monitoring will be conducted at the disposal area. The program includes the collection of air, surface water, ground water, sediment, soil, and vegetation samples. In addition, a site survey will be conducted at the disposal site prior to decommissioning and at both sites to document completion of the decommissioning.

5.1.5.2.1 Air

Low volume air samplers will be placed in at least a total of 5 locations around the existing mill site and the disposal site. When possible, the locations of these sites will be coordinated with those for the nonradiological air monitors. Samples will be collected continuously at a flow rate of about 3 ft /min. Filters will be changed weekly and composited for monthly analysis for uranium, thorium-230, radium-226, and lead-210. Determination of radon-222 or radon-222 progeny concentrations will be made for at least 5 locations at which air particulates are sampled. These determinations will be made from samples collected normally one week each month; however, samples will be collected over a period of at least 48 hours per month.

5.1.5.2.2 Ground Water

Ground water samples are being taken quarterly from 3-5 observation wells around the existing mill site and of the Edgemont public water supply. This monitoring will continue through the decommissioning activities, as possible. Samples will be analyzed for total uranium and radium-226.

5.1.5.2.3 Surface Water

Surface water samples are being taken quarterly from 3 locations on Cottonwood Creek and from 3 locations on the Cheyenne River in the vicinity of the existing mill. Collection of these samples will continue through decommissioning, as possible. In addition, surface runoff samples will be taken from the area of the disposal site. The collection of these samples from the disposal area will be coordinated with the nonradiological water monitoring when possible. Samples will be analyzed for total uranium, thorium-230, and radium-226.

5.1.5.2.4 Sediment

Sediment sampling will continue, as possible, at 3 locations on Cottonwood Creek and 3 locations on the Cheyenne River near the existing mill site. These samples will be collected quarterly and analyzed for uranium, thorium-230 and radium-226. Selected samples will also be analyzed for lead-210 and/or polonium-210.

5.1.5.2.5 Soil and Vegetation

Soil and vegetation samples are being collected quarterly from 7 locations near the existing mill site. Collection of these samples will continue, as possible, throughout the decommissioning activities. In addition, samples will be taken from at least 3 locations around the disposal site. The soil samples will be collected quarterly, with vegetation samples being collected semiannually. Uranium, thorium-230, and radium-226 analyses will be performed on all samples, while lead-210 or polonium-210 analyses will be performed on selected samples.

5.1.5.2.6 Other

If, in the course of the decommissioning operation, it becomes evident that concentrations of radionuclides in the above noted media are significantly in excess of expected background levels, an evaluation will be conducted to determine the necessity of implementing a wildlife and/or fish sampling program. If it is determined that the source of the increased radiation levels can not be readily and effectively mitigated, such a program will be instituted. Samples would be analyzed for uranium, thorium-230, radium-226, and lead-210 content.

5.1.5.2.7 Site Surveys

A survey of the disposal site and its immediate environs will be conducted prior to decommissioning activities. This survey will include gamma dose rate measurements, surface and subsurface soil sampling, and radon-222 flux measurements. Similar surveys will be conducted at the existing and disposal sites after reclamation activities are completed, to assure that reclamation objectives have been met. Gamma dose rate measurements and soil sampling also will be performed in offsite areas where windblown tailings have been removed as part of the decommissioning activities.

1. Gama Dose Rate Measurements

Measurements will be made at approximately 100-m (328 ft) intervals in perpendicular traverses across the disposal area and at the same locations used for collection of air particulate samples. The approximate center of the disposal area will be the location at which the traverses cross. Each measurement "arm" will be no less than 1,500 m (4920 ft) in length.

2. Soil

Surface soil samples will be taken at approximately 300 m (984 ft) intervals in perpendicular traverses across the disposal area and at the same locations used for the collection of air particulate samples. Subsurface soil samples will be taken on the same grid, but at 750 m (2460 ft) intervals. Each measurement arm will be no less than 1,500 m (4920 ft) in length. The subsurface samples will be taken to a depth of about 1 m (3.2 ft) and divided into approximately 30-cm (12 in) sections for analysis. All samples will be analyzed for uranium, thorium-230, radium-226, and lead-210.

3. Radon Flux Measurements

Radon-222 flux measurements will be made near each soil sampling location. Additional measurements will be made as required at the disposal site to assure reclamation objectives have been met. These measurements will be made at least once per month over a three-month period.

5.1.5.3 Analytical

Samples will be collected using accepted techniques such as those developed by Environmental Measurements Laboratory (EML) and the U.S. Environmental Protection Agency (EPA). At the time of collection, all pertinent information (e.g., sampling location, date and time, volume) will be noted for each sample. This information is used to compute final results in the logical units for a given sample type (e.g., pCi/m for air samples, pCi/l for water samples). Written procedures will be maintained describing sampling techniques, equipment calibration, and use.

Written procedures will be maintained for all analyses of the sample types. These procedures will be modifications of standard procedures developed by EPA, EML, and the American Public Health Association, as such procedures are available. Sources for each procedure will be referenced in the procedure itself. The procedures will be complete and include such items as methods for calibration of results, cautions and notes for the analysts, and defined responsibilities for analysts and supervisory staff. All procedures will be tested with standard materials obtained from the National Bureau of Standards, EPA, EML, or other recognized sources. An analytical error will be provided, as possible, with each analytical result and a compilation of detection limits, as determined using the so-called HASL-300 method, will be available.

The laboratory procedures manual will detail the complete laboratory quality assurance program and methods of data review. Written quality control procedures, instrument operation procedures, and standardization and calibration procedures will be given in the laboratory procedures manual. Procedures for calibration of lower levels of detection and preparation of control charts will also be included.

5.1.6 Socioeconomic

No formal socioeconomic monitoring program related to the mill decommissioning or other TVA uranium development is planned. However, one of the responsibilities of the TVA program coordinator is to keep abreast of changing socioeconomic characteristics of the area (see Section 4.8.3, Socioeconomic Mitigation . If the need is later determined, the coordinator may initiate more detailed analysis relating to specific impacts such as examination of school enrollment records or personnel records of TVA contractors.

5.1.7 Other

5.1.7.1 Noise

When decommissioning activities begin, a survey will be made to determine boundary noise levels for the mill site operations and, if deemed necessary, the proposed disposal site and transportation route.

5.1.7.2 Solid Waste Management Monitoring

The storage, collection, treatment, transportation, and disposal of all non-radiological solid waste will be periodically inspected to determine compliance with the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, EPA Solid Waste Management Guidelines, and applicable laws and regulations.

5.1.7.3 Industrial Hygiene and Safety

Decommissioning activities will utilize the necessary industrial hygiene and safety practices to protect workers from potentially harmful physical and chemical hazards in the work environment. Personnel monitoring and appropriate work site inspections shall be conducted to assure that adequate protective measures are taken.

5.2 SECURITY REQUIREMENTS

Access to both the existing site and the disposal site will be controlled, and inspections will be conducted during the decommissioning. Fencing around both sites will be maintained during the decommissioning activities. The fences will be removed after reclamation efforts are successful.

APPENDIX D

Letters From Regulatory Authorities Stating Nonradiological Air Quality Monitoring Requirements And The Proposed Nonradiological Air Monitoring Plan.

Nonradiological Air Monitoring Plan for the
Edgemont Uranium Mill Decommissioning Project

INTRODUCTION

The following nonradiological air monitoring plan has been prepared by the Air Resources Program, Office of Natural Resources, Tennessee Valley Authority (TVA), for the Edgemont Uranium Mill Decommissioning Project at Edgemont, South Dakota. The monitoring plan is based on previous communication with the South Dakota Department of Health, Division of Air Quality and Solid Waste,[1] pursuant to the request that an approved monitoring scheme be designed and implemented for the decommissioning.[2]

The nature and location of the decommissioning project indicates the necessity to monitor the nonradiological air quality impacts of the total suspended particulates (TSP), even though the proposed decommissioning activities do not involve an air quality emission source which is regulated by the State of South Dakota. The objective of the monitoring is to provide data for evaluating the project's impacts on local air quality. The data, to be taken from a network of monitors, will provide information on the background TSP concentrations in the Edgemont vicinity and on the TSP levels during the decommissioning and reclamation.

NETWORK DESCRIPTION

A TVA meteorological station has been in operation at Edgemont since March 24, 1977. It is located in the northwest portion of the inactive mill site on dry Pond 2 (identified by "M" on the attached figure). The instruments at the station measure wind speed and wind direction at the top of a 10-meter tower and temperature, relative humidity, precipitation, and atmospheric pressure (since February 23, 1978) at about the 1-meter level. Limited background TSP data are available from a high-volume (hi-vol) sampler that has operated near Burdock, South Dakota (approximately 22 km northwest of the Edgemont mill site), since April 1979.

The proposed monitoring plan includes continued operation of a meteorological station and the Burdock hi-vol, in addition to the installation and operation of five hi-vol samplers in the vicinity of the project. The general locations of the five new hi-vols are indicated on the attached figure. The location and function of each hi-vol is as follows:

NUMBER	LOCATION	FUNCTION
EG-01	Approximately 3000 m north-northeast of the site boundary.	Remote (reference) monitor.
EG-02	Approximately 250 m west of the site boundary. In east-central Edgemont.	TSP impacts at residences near the site boundary
EG-03	Approximately 150 m from the site boundary. In Cottonwood Community.	TSP impacts at residences near the site boundary.
EG-04	Approximately 500 m east of the haul road.	TSP impacts in the area of predicted maximum short term and maximum annual average concentrations from combined sources of the project.
EG-05	Approximately 500 m east-southeast of the disposal area site boundary.	TSP impacts downwind of the most frequent wind direction.

The selection of specific sites for the hi-vols will be decided, using the guidelines in reference 3, which provide for consideration of distances from trees, buildings, and sources of particulates (e.g., stacks or roads), and types of ground cover. Standard hi-vol samplers equipped with flow controllers, flow measuring orifices, and elapsed time indicators will be used for the TSP monitoring. TVA will purchase the hi-vols, prepare them for use, and prepare installation and operation instructions. The samplers and installation instructions will be shipped to Edgemont where site preparation, installation, operation, and maintenance will be handled by Silver King Mine, Inc., personnel.

The sampling frequency will remain flexible throughout the decommissioning to facilitate representative monitoring of the decommissioning activities. Sampling every 6th day from midnight to midnight (in accordance with the South Dakota Ambient Air Sampling Schedules supplied as an enclosure to reference 1) is anticipated for the background data gathering period and for inactive periods of the decommissioning. The sampling frequency may be increased during the active periods of decommissioning, depending upon the type and extent of anticipated activities and the results of the monitoring program. Any change in the sample collection frequency will be coordinated with the State prior to its implementation. The samples will be shipped to TVA laboratories for weight analysis by the reference method for TSP, as described in 40 Code of Federal Regulations (CFR) 50.

The meteorological station will be moved since decommissioning activities at Pond 2 will disrupt its operation. A new location will be chosen, which is near enough to the project to provide representative data but is far enough away to avoid having its operation adversely affected by the project. TVA will continue having Silver King Mine personnel maintain the meteorological system and National Weather Service personnel calibrate the instruments.

SCHEDULE

TVA proposes to meet with the appropriate State of South Dakota staff at the Edgemont site after review of the monitoring plan has been completed. The purpose of the meeting will be to select more specific locations for the hi-vol and meteorological monitors and to work out final details of interaction between the staffs of the two organizations. It is anticipated that this meeting can take place in August or September of 1980.

TVA will then have the equipment installed. Installation is expected to be completed in the fall of 1980. The network will be operated for the duration of the decommissioning activities. Modifications to the monitoring plan may be necessary as final decommissioning design is completed and as the actual decommissioning progresses. Any significant adjustment to the monitoring network during, or prior to, the project will be presented to the State prior to its implementation.

After completion of the decommissioning activities, TSP monitoring will be discontinued, except for the TSP monitor east-southeast of the disposal area (EG-05), and either the Edgemont (EG-02) or the Cottonwood Community (EG-03) monitor. These two monitors will be operated until TVA determines that the project reclamation program is successful.

RESULTS

Monthly hi-vol sample results will be provided to the State of South Dakota, within 35 days after the end of each sampling month. A form similar to the "South Dakota Ambient Air Monitoring Program" form, included as an enclosure to reference 1, will be used to transmit the results. The date, location, monitor number, and concentration will be included. A form will also be provided which notes dates that dust control measures were utilized. A printout of the meteorological data will be provided on a quarterly basis.

References

1. Brich, Randy, Personal Communication, South Dakota Department of Health, Division of Air Quality and Solid Waste, Pierre, South Dakota, to TVA, Air Quality Branch, February 28, 1980.

2. Brich, Randy, Personal Communication, South Dakota Department of Health, Division of Air Quality and Solid Waste, Pierre, South Dakota, to Oak Ridge National Laboratory, December 14, 1980.

3. U.S. Environmental Protection Agency, Ambient Monitoring Guideline for Prevention of Significant Deterioration (PSD), EPA-450/2-78-019, May 1978.

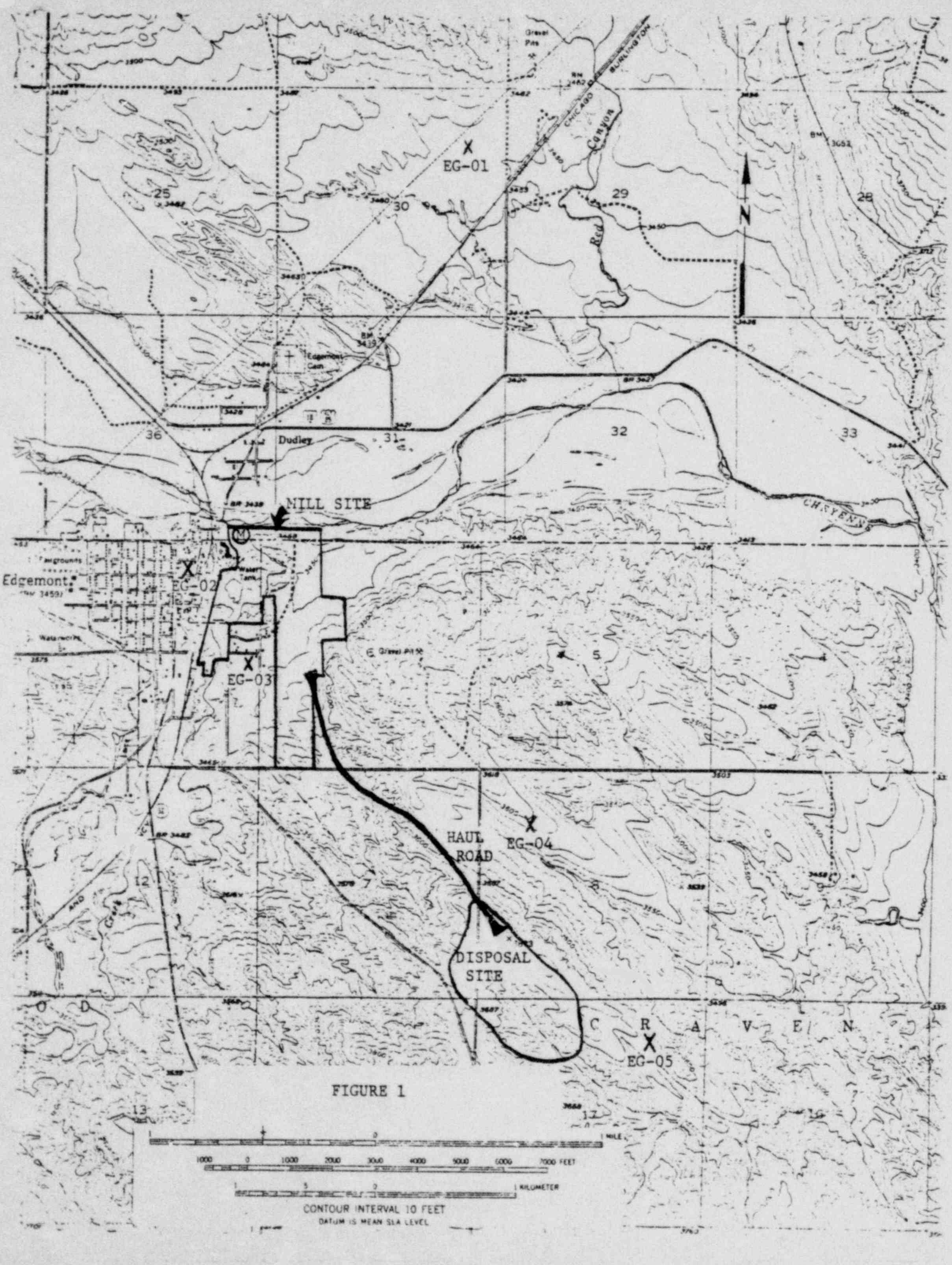

EG-01
EG-02
EG-03
EG-04
EG-05
MILL SITE
HAUL ROAD
DISPOSAL SITE
Edgemont
Dudley
N
CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

FIGURE 1

VEGETATION DISTRIBUTION - SITE 10

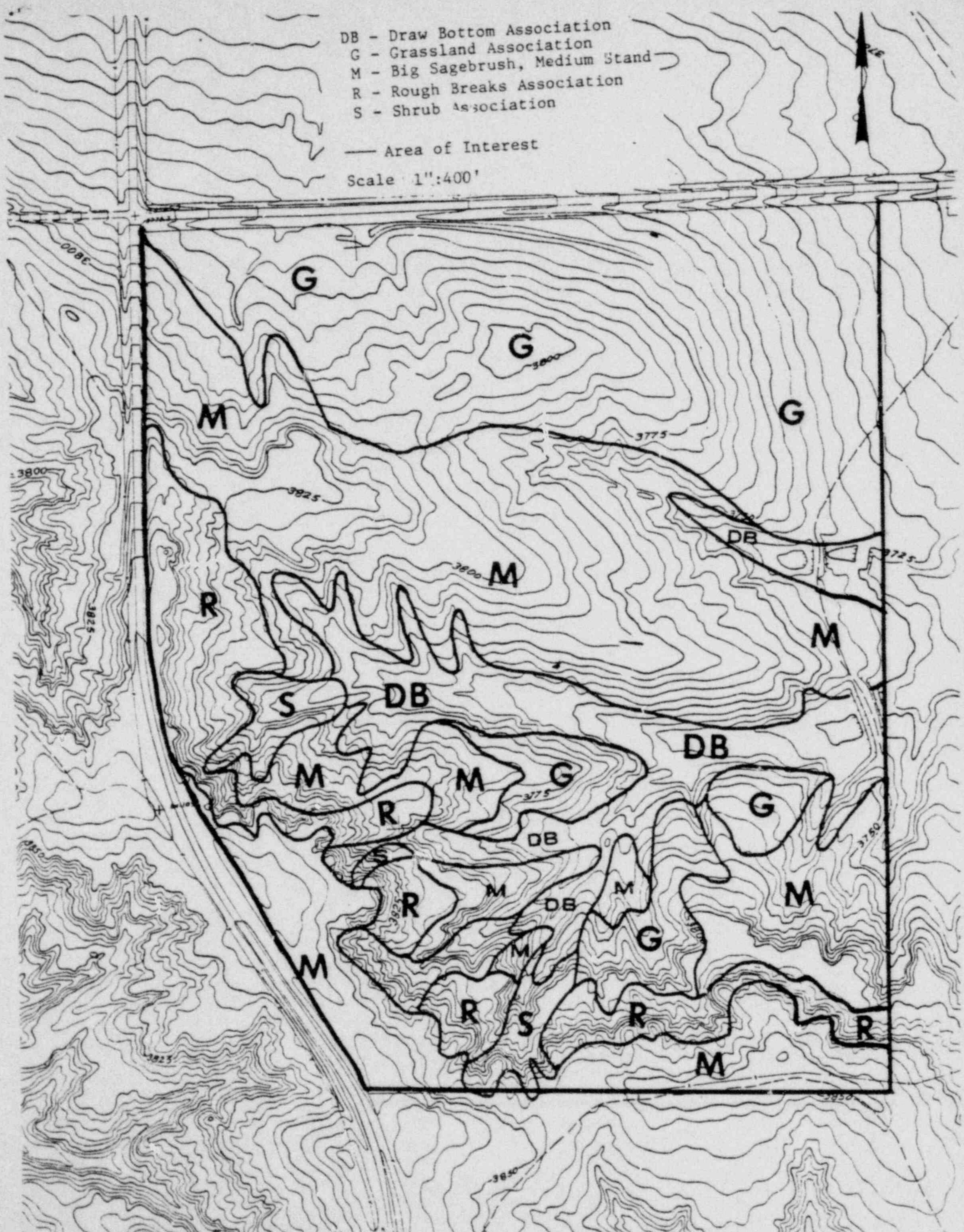
In October 1979 two employees from TVA's Office of Natural Resources performed a visual reconnaissance of the vegetation existing in Sect. 30, T9S, R3E. The two observers listed each species encountered and the landform (ridge top, slope or draw bottom) where the species occurred. In June 1980 the same two observers returned to the site and using a topography map (1"=400') drew in the relative boundaries of the major vegetation associations (attached figure). Percentage cover for vegetative associations on the preferred disposal site was used to gain an estimate for corresponding associations on Site 10. Species lists for both sites did not differ greatly.

VEGETATIVE COMMUNITIES OF ALTERNATIVE TAILINGS DISPOSAL SITE 10

Association	Average Percent Cover	Representative Dominant Species (Based on Percentage Composition)
Draw bottom	61.0*	Buffalograss, western wheatgrass, inland saltgrass, common dandelion, prairie sandreed
Grassland	29.0*	Buffalograss, blue grama, prairie sandreed, little bluestem, western wheatgrass
Big sagebrush, medium stand	40.0*	Buffalograss, blue grama, big sagebrush, western wheatgrass, prairie sandreed
Rough breaks	14.0**	Buffalograss, blue grama, sideoats grama, little bluestem, Louisiana sagewort, wildbuckwheat
Shrub	Not Available	Western snowberry, skunkbrush, sumac, wax currant, woods rose, silver buffaloberry

* Based on vegetative survey in June 1980 at the preferred disposal site

** Based on information in Schreibeis, R., et. al., "Vegetation Report," TVA, unpublished manuscript, Norris, TN, 1977.


DB - Draw Bottom Association
G - Grassland Association
M - Big Sagebrush, Medium Stand
R - Rough Breaks Association
S - Shrub Association
— Area of Interest
Scale 1":400'
3800
3775
3825
3725
3750
3850
3823
G
M
R
S
DB

Enclosure 3

Question: Section 4.2, 4.2-14

Mitigation. The applicant should submit a specific plan of erosion control measures to be taken at the mill site during decommissioning. The applicant should outline a monitoring program for implementation to ensure that water quality is not degraded by sediment or chemical contamination during decommissioning. If sedimentation is occurring even with control measures, what additional steps will be taken to alleviate the problem?

Response

A discussion of the erosion control plan is presented in revised Chapter 3 of the ER.

A surface water monitoring program is being planned for the mill site. Details will be finalized in coordination with the appropriate regulatory agencies.

Measures which TVA will take to address surface water quality issues are:

1. Establish an adequate water quality data base for predicting impacts of the decommissioning activities and for determining the actual impacts resulting from the activities.

   The key variables that need to be considered are flow, time, and point source and nonpoint source discharges resulting from human activities. The data base for the period December 1974 through September 1977 provides basic information on water quality during the high runoff season (May-July) and the low flow season (fall and winter months), but lacks sufficient depth to characterize water quality for a typical portion of the hydrograph prior to, during, and after a precipitation event of sufficient size to cause a substantial rapid change in stream stage or flow--a period in which water quality may change dramatically. Such data in conjunction with land use and other information is needed seasonally to quantitatively predict and document the impacts of the decommissioning activities upon water quality. TVA intends to begin collecting this type of baseline in 1981.

2. Quantify water quality impacts of the proposed decommissioning activities to determine the conditions that may require use of additional mitigative measures.

   The only practical way to quantify the effects of the many variables that determine the probable hydrologic consequences of the decommissioning activities is through mathematical models. TVA is initiating actions for the adaptation of and/or development and use of such models for our uranium mining and milling activities. TVA plans to have model results available before tailings removal begins in order to identify additional mitigative measures as appropriate.

3. Determine and document the actual effectiveness of the mitigative measures used during the decommissioning activities.

   This will be achieved by a flexible site monitoring program tailored specifically to the nature of the decommissioning activities underway at any particular time. A good example of this type of monitoring would be that for determining the effectiveness of erosion control measures. Water quality (suspended solids) would be monitored downstream of disturbed areas several times during a precipitation event large enough to cause substantial runoff from the site, and compared to upstream control water quality to determine if additional mitigative measures are warranted. This would be done as practicable for each significant precipitation event until the effectiveness of the erosion control measures is demonstrated.

4. Determine and document the actual impact of the decommissioning activities upon the water quality of the Cheyenne River.

This will be achieved by implementing a monitoring program similar to the baseline program in conjunction with the monitoring for determining the effectiveness of the mitigative measures.

Definition of additional steps if sedimentation occurs with control measures would be dependent upon the reason or cause for the problem. The proposed monitoring program will identify whether sedimentation is likely to be a problem and the source of the sedimentation.