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IDENTIFICATION OF SITES FOR THE LOW-LEVEL WASTE DISPOSAL DEVELOPMENT AND DEMONSTRATION PROGRAM

R. H. Ketelle
D. W. Lee

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ORNL/TM-10221

Energy Division

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R. H. Ketelle
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ABSTRACT

This report presents the results of site selection studies for potential low-level radioactive waste disposal sites on the Oak Ridge Reservation (ORR). Summaries of the site selection procedures used and results of previous site selection studies on the ORR are included.

This report includes recommendations of sites for demonstration of shallow land burial using engineered trench designs and demonstration of above-grade disposal using design concepts similar to those used in tumulus disposal.

The site selection study, like its predecessor (ORNL/TM-9717, *Use of DOE Site Selection Criteria for Screening Low-Level Waste Disposal Sites on the Oak Ridge Reservation*), involved application of exclusionary site screening criteria to the region of interest to eliminate unacceptable areas from consideration. Also like the previous study, the region of interest for this study was limited to the Oak Ridge Department of Energy Reservation. Reconnaissance-level environmental data were used in the study, and field inspections of candidate sites were made to verify the available reconnaissance data.

Five candidate sites, all underlain by Knox dolomite residuum and bedrock, were identified for possible development of shallow land burial facilities. Of the five candidate sites, the West Chestnut site was judged to be best suited for deployment of the shallow land burial technology.

Three candidate sites, all underlain by the Conasauga Group in Bear Creek Valley, were identified for possible development of above-grade disposal technologies. Of the three sites identified, the Central Bear Creek Valley site lying between State Route 95 and Gum Hollow Road was ranked most favorable for deployment of the above-grade disposal technology.

1. INTRODUCTION

The U.S. Department of Energy (DOE) operates nuclear-related facilities at Oak Ridge, Tennessee, including the Oak Ridge National Laboratory (ORNL), the Y-12 Plant, and the Oak Ridge Gaseous Diffusion Plant. Currently operating low-level radioactive waste disposal facilities are nearly filled to capacity, and efforts are under way to develop more advanced waste disposal facilities than those at the Oak Ridge Reservation (ORR).

The Low-Level Waste Disposal Development and Demonstration Program (LLWDDD) has as its goals the design and demonstration of low-level waste (LLW) disposal technologies which will allow environmentally acceptable disposal of LLW at the ORR. Among the alternatives under consideration are demonstration of improved shallow land burial (SLB) using engineered trenches constructed in unsaturated soils, and demonstration of above-ground, earth-covered disposal cells, or tumuli.

This report summarizes the selection of sites for construction of demonstration experiments and for possible development as LLW disposal facilities which may evolve from the demonstration experiments. The site selection process used in this site screening study is similar to that presented in a previous site selection report.[1] The previous study considered only selection of sites for SLB, while this study considers selection of SLB sites as well as selection of sites for construction of above-ground tumuli. The results of the previous screening study and the revised site selection criteria are used as the basis for site screening for SLB sites.

2. SUMMARY OF METHODOLOGY

The site selection methodology is described in detail in ref. 1. The process of site selection (Fig. 1) encompasses the screening of viable sites within a region for a preferred site and the characterization of the preferred site for evaluation of site acceptability. The criteria used for site selection and the application of the criteria are discussed in subsequent sections.

2.1 SITE SCREENING

The objective of site screening is to identify a preferred site for detailed site characterization. Site screening is performed using reconnaissance-level information such as available literature or observations from site inspection. Each step in the site screening process uses progressively more restrictive criteria based on the site selection criteria which include the needs of the developer.

2.1.1 Region Definition

The definition of the region of interest is the first step in site screening. The region is defined on the basis of the need for additional LLW disposal facilities to service waste generators and is described as a geographical unit. It must be large enough in size to include several candidate areas.

2.1.2 Candidate Area Identification

The first step in the identification of candidate areas is to determine area screening requirements. These exclusionary requirements eliminate areas having features that preclude them from further consideration. They are based on the essential needs for the facility and the applicable regulatory criteria relating to site suitability. These requirements are used to identify areas having the fewest obvious deficiencies that would inhibit site development. The goal is to have several candidate areas for identifying a sufficient number of candidate sites to conduct a valid site comparison incorporating regional variability.

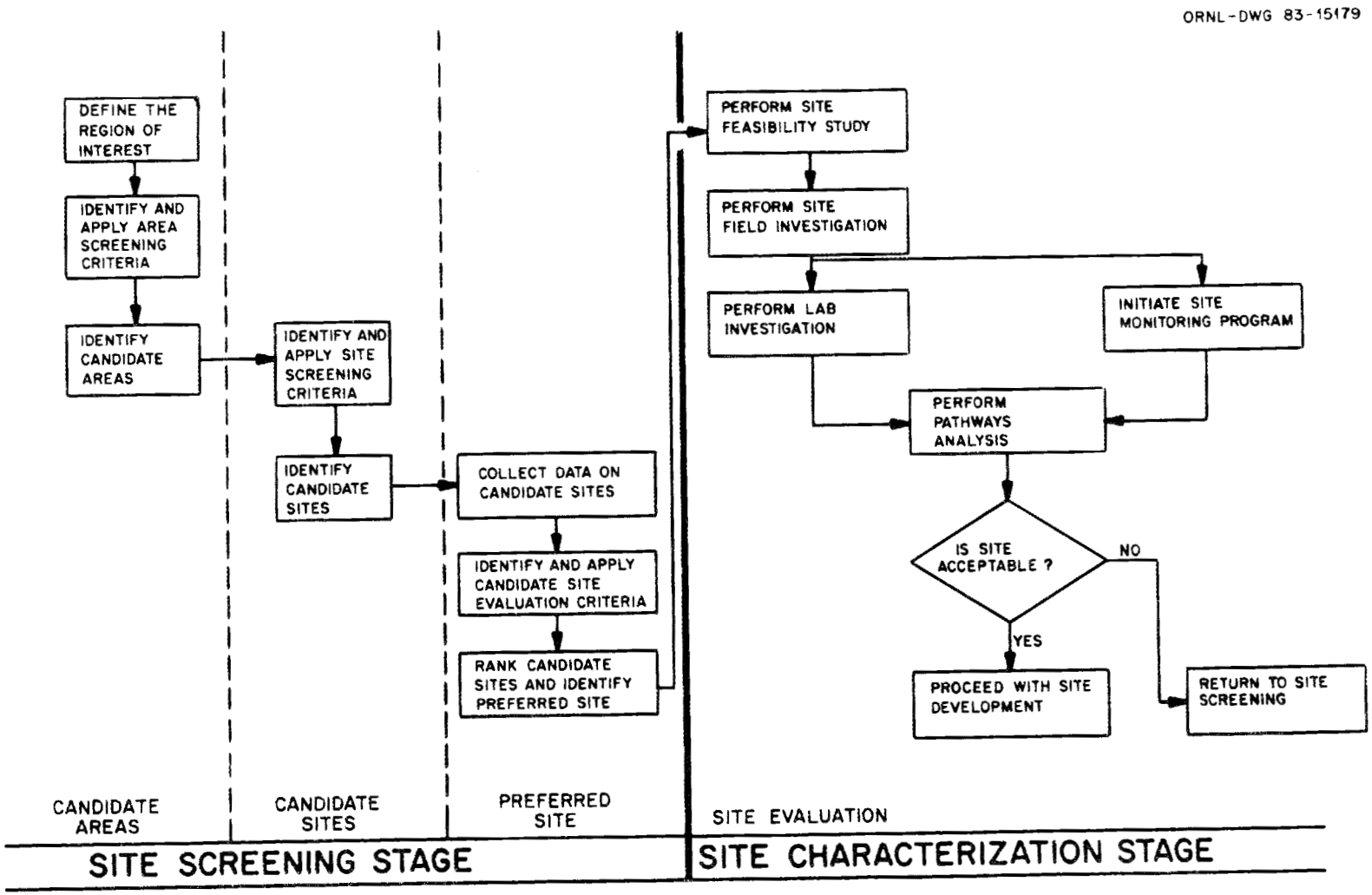

Fig. 1. Summary of site selection process.

2.1.3 Candidate Site Identification

The first step in identifying candidate sites is determining site screening requirements, which include exclusionary requirements and features that are desirable for a site. The exclusionary requirements should be based on site-specific factors developed from the site selection criteria which would preclude utilization of the site for LLW disposal. Desirable features to be included in the site screening requirements could include facility needs or other site conditions derived from the site selection criteria. These requirements are used to identify the sites within the candidate areas that have the greatest potential as waste disposal sites and are representative of the regional variability within the candidate areas. The site screening requirements are tightened or relaxed until a reasonable number of candidate sites are identified.

2.1.4 Preferred Site Identification

All available reconnaissance-level data on each of the candidate sites are gathered and reviewed. Site reconnaissance does not include detailed field studies but does provide for field inspection of the existing environmental conditions. Site evaluation parameters are then developed from the site selection criteria and regional factors. The site evaluation parameters should be identified with consideration of the significance of the most important regional factors (e.g., geology, hydrology, soils, land use, socioeconomics, and ecology and meteorology). The significance of each site evaluation parameter is determined by reviewing the available data and by making a subjective evaluation. The candidate sites are then ranked for the identification of the preferred site using a comparative matrix for each site evaluation parameter. The composite of the site rankings and the significance of each parameter are examined to identify the preferred site.

This last step may not necessarily lead to a definitive result. In such cases, the preferred site may be determined by the interests of the developer rather than the slight superiority established by the ranking exercise. The objective of the identification of the preferred site is not necessarily to identify the best site because the available information limits the capability to make such a determination. Instead, the preferred site should be the site which is best suited to the needs of the developer and which can satisfy the site selection criteria.

2.2 SITE CHARACTERIZATION

Site characterization evaluates in depth the suitability of the preferred site for LLW disposal based on conformance with the site selection criteria. If the field investigations reveal that the preferred site cannot meet the site selection criteria, then a return to site screening is necessary to identify an alternative site. Site characterization includes the investigation of the feasibility of site development and conceptual design development, a comprehensive field study, a laboratory analysis of field samples, a site monitoring program, and a pathway analysis. The methods employed at this stage are considerably more costly and time consuming than site screening. Prudence, therefore, dictates that the activities most likely to discover critical deficiencies be performed first. Characterization provides the site-specific data needed for verifying the compliance of the site with the site selection criteria and for establishing the requirements for site design and utilization.

3. REVIEW OF PREVIOUS SCREENING RESULTS

Previous site screening investigations[1] were directed towards the selection of a site for the application of SLB technology for the disposal of low-level radioactive waste. However, much of the data developed during these investigations are applicable to LLW disposal with other disposal technologies.

Before the development of site selection criteria for low-level radioactive waste disposal by DOE and the Nuclear Regulatory Commission (NRC), a site selection study was performed.[2] This study was performed without the use of deductive methodology for site selection, such as the methodology described in Sect. 2. The results of the study suggested the use of Bear Creek Valley and Melton Valley for LLW disposal using SLB technology. Because site selection criteria were not available and the methodology for site selection did not provide a comparative evaluation of the available alternative sites, the results are difficult to interpret in light of the site selection criteria developed by DOE and NRC.

A subsequent site selection study was performed using methodology described in Sect. 2 (ref. 1). The results of the study did not identify a clearly environmentally superior site for the application of SLB technology. Sites in the Knox Group and the Conasauga Group were identified, but deficiencies that detracted from their suitability for LLW disposal were noted. The use of sites in the Knox or Conasauga Group for SLB was dependent on the results of ongoing technical studies and disposal requirements. Bear Creek Valley was identified as the best site within the Conasauga Group. The central section of the Central Chestnut Ridge site was identified as the best Knox Group site but was considered to be roughly equivalent to the East Chestnut Ridge, West Chestnut Ridge, and the west section of the Central Chestnut Ridge sites (see Fig. 4 for a map of alternative sites).

The results of follow-up studies of the sites identified in ref. 1 led to the identification of the West Chestnut Ridge site as the preferred site for the use of SLB technology for LLW disposal. The Central Chestnut Ridge site was characterized to a limited extent using seismic refraction techniques[4] and a limited drilling program.[5] The results of these studies indicated that the available land area and constraints on site development severely limited the use of the site for LLW disposal operations with SLB technology. Geohydrologic data collected at the Bear Creek site demonstrated that the groundwater levels during the wet season were too close to the ground surface to permit the application of SLB technology for LLW disposal. East Chestnut Ridge was

dismissed as a suitable site for LLW disposal because of the limited land area suitable for development. West Chestnut Ridge was then subjected to extensive site characterization investigations and was proposed for LLW disposal as the Central Waste Disposal Facility. A Draft Environmental Impact Statement[3] was prepared to document the site selection process and its results.

The review of the Draft Environmental Impact Statement questioned the consideration of alternatives and suggested the need to consider sites for LLW disposal that utilized other disposal technologies. The site selection process has been reviewed in response to these comments, and subsequent investigations into the identification of sites using alternative disposal technologies have been performed. The results of these investigations are discussed in the following sections.

4. SELECTION OF LOW-LEVEL WASTE SHALLOW LAND BURIAL SITES ON THE OAK RIDGE RESERVATION

Previous site selection studies reviewed in Sect. 3 have inventoried the ORR for SLB sites.[1-3] Screening criteria used in a previous study are presented in ref. 1. In the present review of the ORR for SLB sites, revised site selection criteria and area and site screening criteria were developed and approved by the DOE Oak Ridge Operations Office.[6] The site selection criteria used for selecting candidate sites for SLB are listed below. These site selection criteria were developed with consideration of the DOE requirements for management of LLW (ref. 7), and they emphasize the hydrologic performance of the site because the ORR is located in a humid region.

Site Selection Criteria for Shallow Land Burial

New sites will be

1. large enough to include a waste disposal area, administrative area, and adequate buffer zone to allow unrestricted human use beyond the site boundary;
2. located so that waste can be buried in the unsaturated zone;
3. located where flooding at the 500-year frequency, wind and water erosion, and geologic hazards such as earthquakes, landslides, and mud flows do not jeopardize performance;
4. located where hydrogeologic processes such as infiltration, runoff, freeze-thaw, and water table fluctuations do not jeopardize performance;
5. be designed with buffer zones in consideration of hydrogeologic characteristics so that radioactivity releases comply with permissible limits;
6. selected with consideration given to current and projected population distributions, land use, and resource development; accessibility of all-weather highways, rail routes, and utilities; and the location of waste generators;
7. selected in compliance with applicable federal, state, and local laws and regulations;
8. located where nearby facilities or activities will not adversely impact the performance of the waste disposal facility or significantly mask the environmental monitoring program; and
9. selected with consideration given to minimizing the potential for inadvertent intrusion into the waste disposal units.

4.1 IDENTIFICATION OF CANDIDATE AREAS FOR SHALLOW LAND BURIAL

Candidate areas within which suitable sites may be located are identified by establishing and applying area screening requirements over the region of interest. The area screening requirements used to identify candidate areas for SLB are listed below. A brief explanation of the basis for each requirement follows the list.

Area Screening Requirements for Shallow Land Burial

Candidate areas will

1. exclude the 500-year floodplain and wetlands;
2. have estimated soil thicknesses exceeding 10 m (30 ft);
3. have an estimated unsaturated zone thickness exceeding 10 m (30 ft);
4. be large enough to include at least 12 ha (30 acres) of land suitable for SLB; and
5. be defined exclusive of land previously used for radioactive waste disposal.

Exclusion of areas within the 500-year floodplain is consistent with DOE compliance with Executive Order 11988 (Floodplain and Wetland Avoidance) by avoiding placement of critical facilities within the 500-year floodplain. The estimated soil thickness requirement is derived from the facility conceptual design wherein large trenches would be constructed to contain the LLW. Siting where the water table lies below the maximum depth of trench construction is required to enable construction of trenches which are not flooded by groundwater fluctuations. The land area requirement is derived from estimated waste volumes generated for disposal by the three Oak Ridge facilities and land use requirements estimated for the Central Waste Disposal Facility Project (approximate 1 acre/year). Formerly used sites are excluded because trench excavations would breach existing disposal trenches.

Area screening of the ORR consists of review of the floodplain locations, general soil development characteristics of the major geologic units present, typical depth to water table for each geologic unit, and location of existing SLB facilities. The criteria for soil thickness and depth to water table eliminate all areas on the ORR except those in the Knox Group outcrop belts and isolated small tracts (<5 acres) on hilltops in Conasauga Group outcrop belts. Geology of the ORR and locations of key facilities and areas discussed in this report are shown in Fig. 2. The largest areas of contiguous land

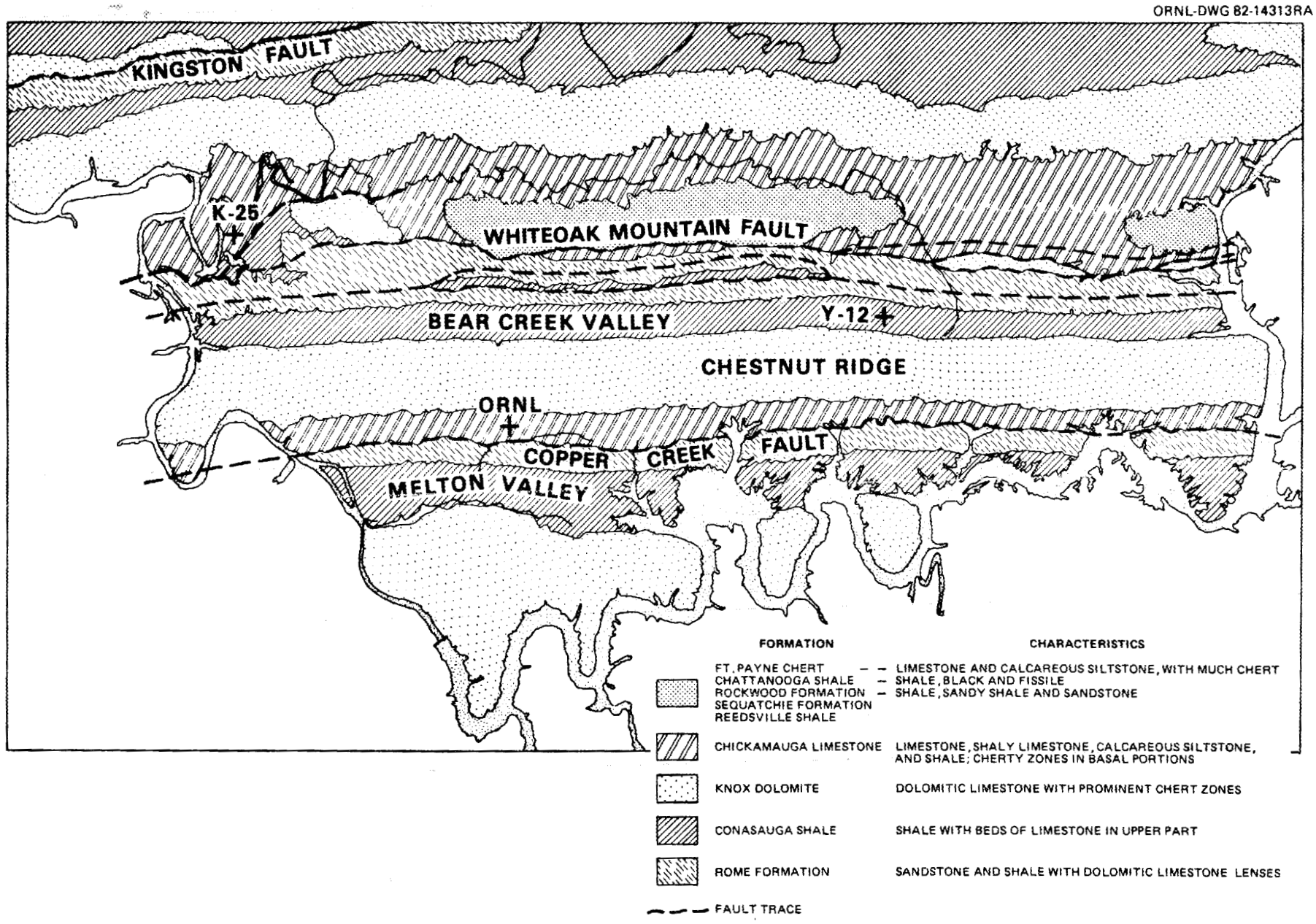

Fig. 2. Geology and major features of the Oak Ridge Reservation.

which pass the candidate area screening are the three Knox ridges (Black Oak Ridge, Chestnut Ridge, and Copper Ridge) previously identified (Fig. 3 and ref. 1).

4.2 IDENTIFICATION OF CANDIDATE SITES FOR SHALLOW LAND BURIAL

Candidate sites are identified by application of the site screening criteria listed below to the candidate areas identified in Sect. 4.1. The site screening requirements include exclusionary requirements as well as desirable features.

Site Screening Requirements for Shallow Land Burial

Exclusionary Requirements

1. Exclude from the active site area land having evidence of karst topography.
2. Exclude from the active site area land with slopes >25%.
3. Exclude from the active site area land within a security boundary defined as (a) 250 m from existing plants, (b) 250 m from public roads, and (c) 250 m from reservation boundary.
4. Exclude from the active site area land that is adjacent to residential development.

Desirable Features

1. The desirable active site area would be larger than 12 ha (30 acres).
2. The desirable active site area would have slopes <10%.
3. The desirable site would have easy access by road.
4. The desirable site would be in close proximity to the waste generators.
5. The desirable site would have utilities available for site development.
6. The desirable active site area would not have ephemeral and/or perennial surface runoff channels.
7. The desirable site would have minimum land areas upslope of the active area to minimize surface and subsurface water run-on.

The SLB site screening exclusionary requirements are briefly discussed as follows. Areas having evidence of karst topography are excluded from active disposal in an attempt both to limit the potential of karst subsidence in the disposal area and to avoid the potential of placing waste directly above the rapid infiltration conduits provided by karst features. Land with slopes >25% is excluded from use for disposal because of the

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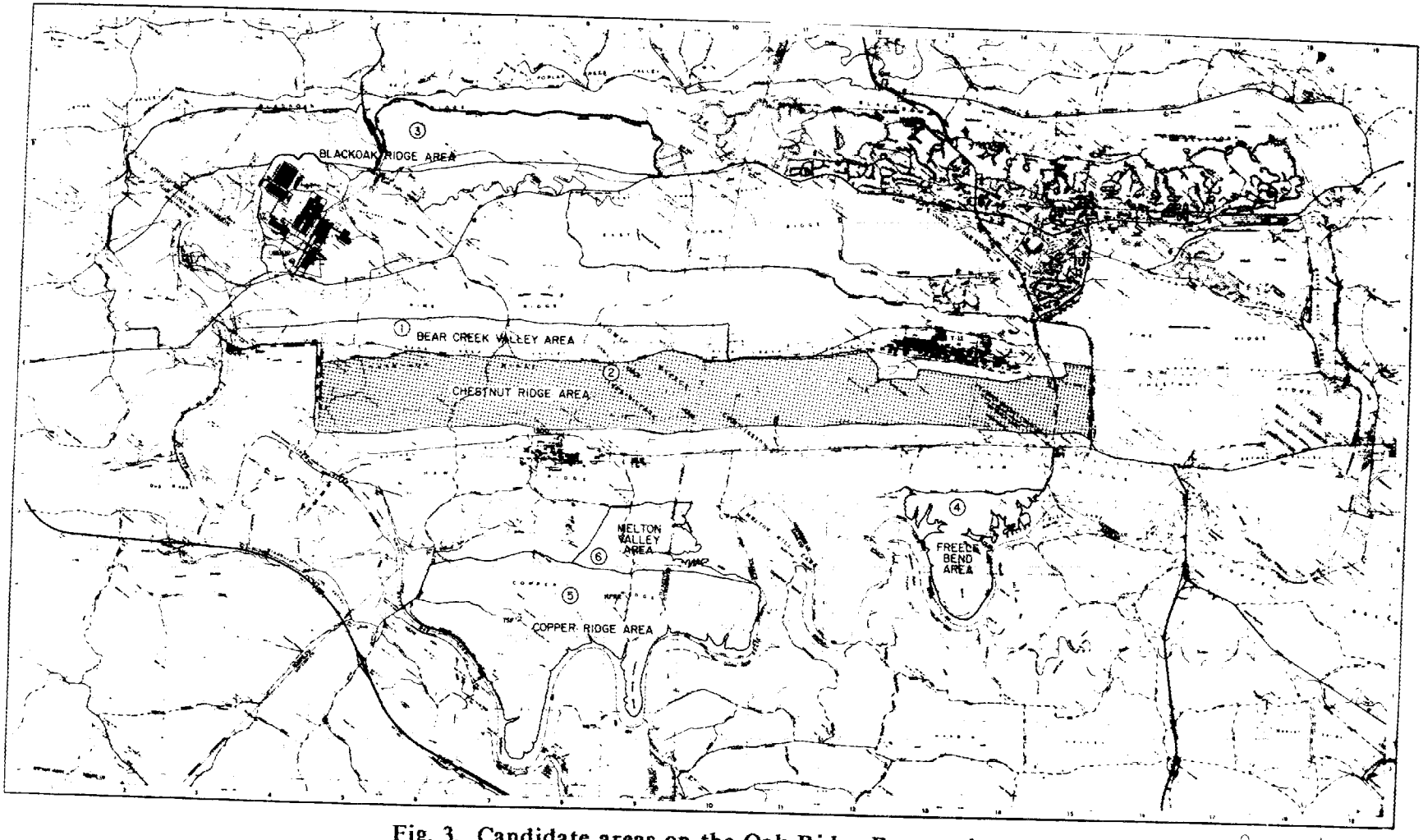

Fig. 3. Candidate areas on the Oak Ridge Reservation.

impracticability of facility construction on such slopes and because of elevated potential erosion rates on steeply sloping land. A security buffer of 250 m from existing plants, public roads, and the reservation boundary is required to reduce the potential for inadvertent intrusion during the operating period and to provide a buffer between the site and public use areas. Land adjacent to residential areas at the perimeter of the ORR is excluded from consideration because of the increased potential for intrusion onto the site during the operating life of the facility.

The desirable site would be at least 12 ha (30 acres) of gently sloping land located close to waste generators and near roads and utility corridors. The desirable site would also have minimal upslope land area to contribute surface flow onto the site and would have no perennial or ephemeral runoff channels crossing the site.

Review of the physical environment of the ORR does not yield sites which are viewed as ideal for SLB of LLW. The only geologic unit identified that can satisfy the tract size, slope, and depth to groundwater criteria is the Knox Group, which has thick residual soils developed over cavitose dolomite bedrock (Fig. 2). These thick soils are attractive as the host for an SLB facility because they are incompletely saturated and have strong attenuation characteristics for infiltrating contaminants. The presence of karst geohydrology in this geologic setting increases the complexity of characterization and introduces uncertainty into analysis of site performance. Site screening results in identification of five potential sites located on Chestnut Ridge (Fig. 4), which are the same sites identified in the previous site selection study.[1]

4.3 RANKING OF CANDIDATE SITES

In a previous study, four of the five sites on Chestnut Ridge were judged to be roughly equivalent regarding their potential for use as SLB sites[1] (Fig. 3). The East Chestnut Ridge site was ranked lower than other Knox sites because of land use considerations in that area. Although portions of the East Chestnut Ridge area are topographically attractive for use as SLB sites and portions of the area are in use for waste management, land use pressures in that area may pose difficulties to additional site development. One portion of the area has been developed as an industrial park, and several areas are environmental research sites.

Being underlain by carbonate bedrock, all the Knox sites have the potential for development of karst groundwater flow systems and karst topography. Karst features were observed on all the Knox sites during field reconnaissance investigations. The

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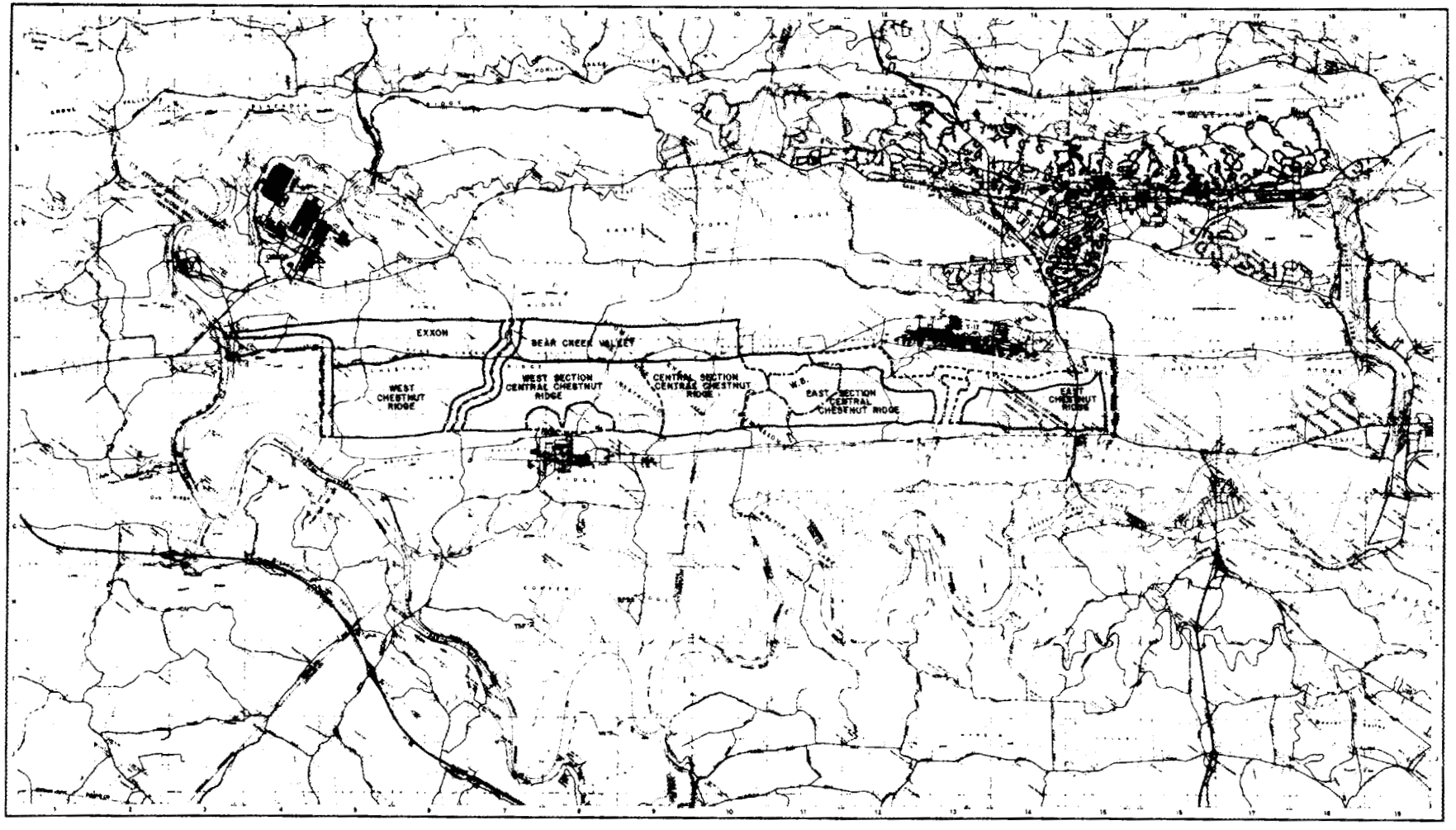

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Fig. 4. Candidate sites on the Oak Ridge Reservation.

karst features observable at the ground surface tend to be located along stratigraphically controlled zones, and distribution of the karst features along these zones is fairly uniform in the Chestnut Ridge area.

Initial site characterization studies at the Central Chestnut Ridge site indicated a lower desirability for development in that area than at the West Chestnut Ridge on the basis of topographic considerations. Geology, hydrology, soils, land use, socioeconomics, and ecology are essentially equivalent at the Central and West Chestnut Ridge sites. The West Chestnut Ridge site is judged to be superior to the Central Chestnut Ridge sites on the basis of topography and access.

5. SELECTION OF AN ABOVE-GRADE ENGINEERED DISPOSAL FACILITY SITE FOR LOW-LEVEL WASTE ON THE OAK RIDGE RESERVATION

Development of LLW disposal technologies other than SLB provides the possibility of successfully siting and constructing facilities on sites which are not amenable to development of SLB facilities but which have desirable characteristics for above-grade waste disposal. The concept of above-grade disposal has been utilized for LLW disposal by the French at their national LLW disposal site. The site selection criteria developed and approved by the DOE Oak Ridge Operations Office[6] for an above-grade disposal facility are listed below. These site selection criteria emphasize site performance and monitorability.

Site Selection Criteria for Above-Grade Disposal Facility

New sites will be

1. large enough to include a waste disposal area, administrative area, and adequate buffer zone to allow unrestricted human use beyond the site boundary;
2. located where flooding, wind and water erosion, and geologic hazards such as earthquakes, landslides, and mudflows do not jeopardize performance;
3. selected with consideration given to current and projected population distributions, land use, and resource development; accessibility of all-weather highways, rail routes, and utilities; and the location of waste generators;
4. selected in compliance with applicable federal, state, and local laws and regulations;
5. be designed with buffer zones in consideration of hydrogeologic characteristics so that radioactivity releases comply with permissible limits;
6. located where nearby facilities or activities will not adversely impact the performance of the waste disposal facility or significantly mask the environmental monitoring program;
7. located where hydrogeologic processes such as infiltration, runoff, freeze and thaw, and water-table fluctuations do not jeopardize performance; and
8. selected with consideration given to minimizing the potential for inadvertent intrusion into the waste disposal units.

5.1 IDENTIFICATION OF CANDIDATE AREAS FOR AN ENGINEERED DISPOSAL FACILITY

The area screening requirements used to identify candidate areas for an above-grade facility are listed below. The avoidance of the 500-year floodplain for the facility is consistent with floodplain avoidance mandated by Executive Order 11988. Stable and predictable foundation conditions are sought to enable construction of a facility which will maintain structural integrity. The candidate site area requirement would provide a site of sufficient size to operate for a period of 10 years or more. Sites previously utilized for SLB are excluded from consideration for two reasons. First, without extensive stabilization measures the previously utilized sites would not provide sufficient structural integrity for facility construction. Second, water quality degradation from previous disposal activities could interfere with performance monitoring of a new disposal facility.

Area Screening Requirements for Above-Grade Disposal Facility

Candidate areas will

1. exclude the 500-year floodplain and wetlands area;
2. have stable and predictable geotechnical conditions;
3. be large enough to include at least 12 ha (30 acres) of land suitable for engineered disposal facility construction; and
4. exclude previously utilized radioactive waste disposal sites which could inhibit effective monitoring of the engineered disposal facility performance.

Geologic settings on the ORR which meet the area screening requirements include the areas underlain by Conasauga Group shales and Chickamauga Group silty limestones. The Chickamauga Group consists of limestone and calcareous shales. Karst features and solution cavity groundwater flow occur in many areas underlain by the Chickamauga Group. The Conasauga Group includes shales, siltstones, limestones, and silty limestones. The bedrock weathers to form a saprolitic residual soil ranging from a few to approximately 15 m thick. Weathering results in opening of fractures which conduct groundwater flow. Karst features have not been observed in the shales and calcareous siltstone formations of the Conasauga Group; however, the Maynardville Limestone (the uppermost formation in the Conasauga Group) has extensive cavity development.

The Conasauga Group areas are preferred due to soil and foundation conditions and groundwater flow characteristics. Two Conasauga Group outcrop belts occur on the ORR, one in Melton Valley and one in Bear Creek Valley. Portions of both these outcrop belts have been used for previous SLB operations, and problems with groundwater intrusion into excavated trenches have occurred.

Melton Valley is the site of most of the ORNL radioactive SLB waste disposal sites, and much of the topographically attractive land has previously been used for waste disposal. One sizeable tract has been studied to evaluate its potential for additional waste disposal activities. Bear Creek Valley is the site of the Y-12 Plant and its associated waste disposal areas. Sizeable tracts remain in Bear Creek Valley to the southwest of the Y-12 disposal areas which are considered feasible for future engineered disposal facilities. The available land areas and the terrain conditions in Bear Creek Valley are preferable to those of Melton Valley, although the water table is typically shallower in Bear Creek Valley than in Melton Valley.

5.2 IDENTIFICATION OF CANDIDATE SITES FOR AN ABOVE-GRADE DISPOSAL FACILITY

Site screening requirements for an Above-Grade Disposal Facility are listed below.

Site Screening Requirements for Above-Grade Disposal Facility

Exclusionary Requirements

1. Exclude from the active site area land having perennial surface runoff channels.
2. Exclude from the active site area land with slopes >25%.
3. Exclude from the active site area land within a security boundary defined as (a) 250 m from existing plants, (b) 250 m from public roads, and (c) 250 m from reservation boundary.

Desirable Features

1. The desirable active site area would be larger than 16 ha (40 acres).
2. The desirable active site area would have slopes <10%.
3. The desirable site would have easy access by road.
4. The desirable site would be in close proximity to the waste generators.
5. The desirable site would have utilities available for site development.

Desirable Features (Continued)

6. The desirable active site area would have naturally stable and well-drained soils.
7. The desirable site would have minimum land areas upslope of the active area to minimize surface and subsurface water run-on.

Areas having perennial surface water runoff channels are excluded from active site development to minimize the potential for surface water intrusion into the facility. Areas have slopes steeper than 25% are excluded from consideration because of the potential for rapid erosion in such areas and the impracticality of facility construction on steeply sloping terrain. An exclusionary buffer zone for the above-grade disposal facility reduces the potential for inadvertent intrusion during operation and provides a buffer between the site and public use areas. Desirable site features listed above describe the desired physical setting for the engineered disposal facility.

Figures 5, 6, and 7 show the physical setting of Bear Creek Valley southwest of the Y-12 waste management area. The figures show the valley in sections: the western section, previously identified as the Exxon Site (Fig. 5), lying to the southwest of Tennessee Highway 95; the central section (Fig. 6), lying between Tennessee Highway 95 and Gum Hollow Road; and the east section (Fig. 7), lying between Gum Hollow Road and the Roane-Anderson County line. The Y-12 waste management area is in Anderson County east of the east section shown in Fig. 7. Features shown on these maps include topography and slope steepness, location of natural surface water drainage courses, the estimated 500-year flood elevation for Bear Creek, roads, and utility corridors.

Gently sloping areas above the estimated 500-year floodplain are distributed through the central portion of the valley, and much of this gentle topography is underlain by the Maryville limestone and Nolichucky shale. A power-line corridor runs the length of the valley through the middle of this topographically attractive terrain. Boundaries for potential sites may be drawn in several configurations in the three Bear Creek Valley sections identified in Figs. 5 through 7. For this reason, the overall suitability of each Bear Creek Valley section is discussed for the purpose of ranking. The boundary of a potential tract on the central Bear Creek Valley site is shown in Fig. 6.

5.3 RANKING OF CANDIDATE SITES

In Table 1 the three Bear Creek Valley areas are comparatively ranked for site evaluation parameters, including hydrology, geology, soils, land use, socioeconomics, and

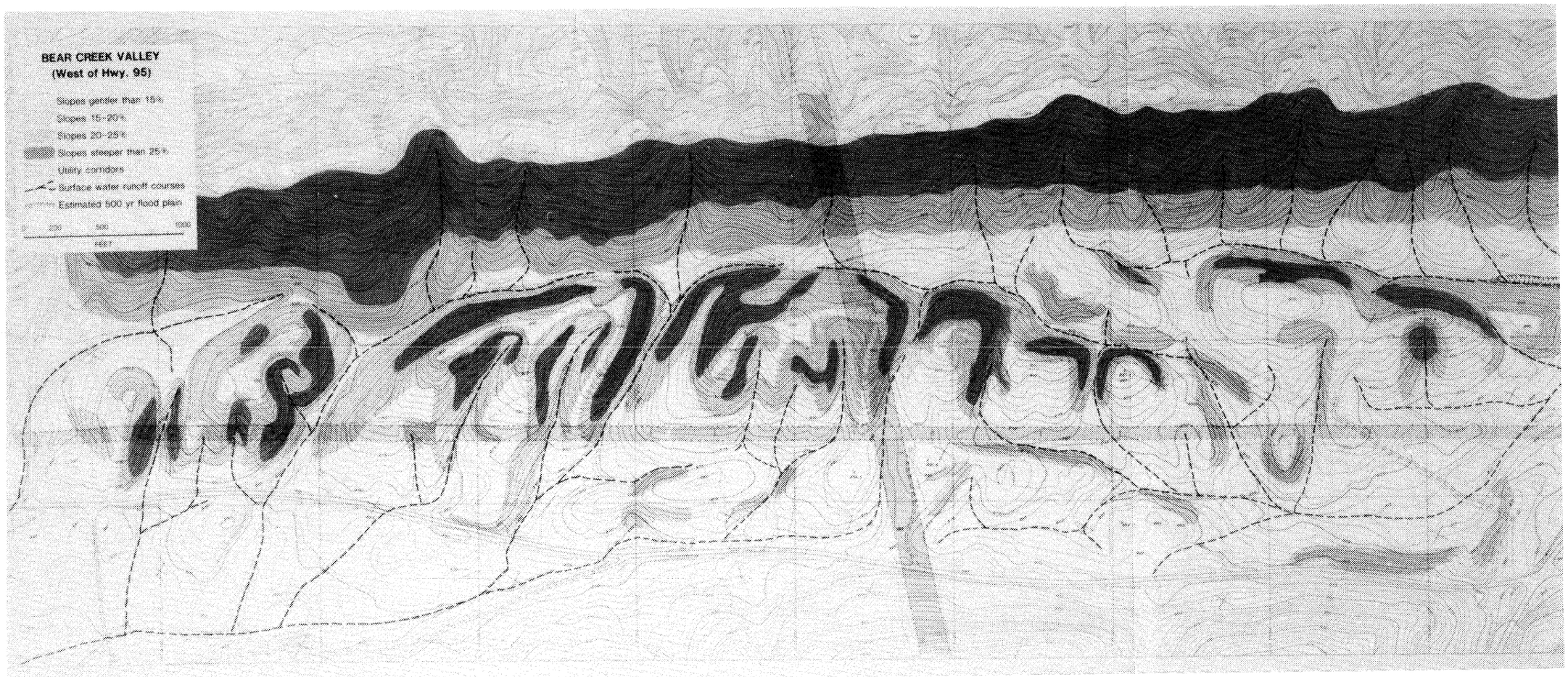

Fig. 5. Map of Bear Creek Valley west of Tennessee Highway 95.

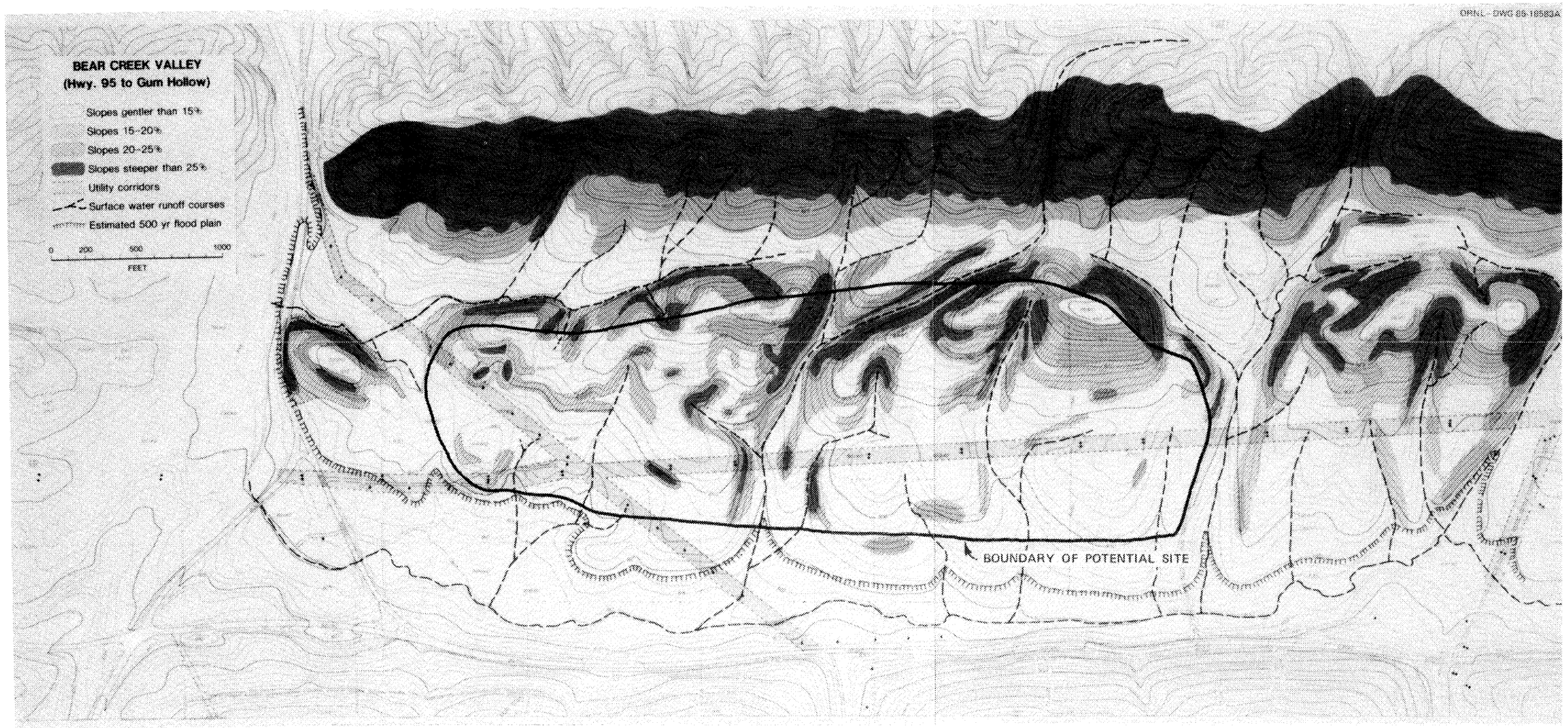

Fig. 6. Map of Bear Creek Valley between Highway 95 and Gum Hollow.

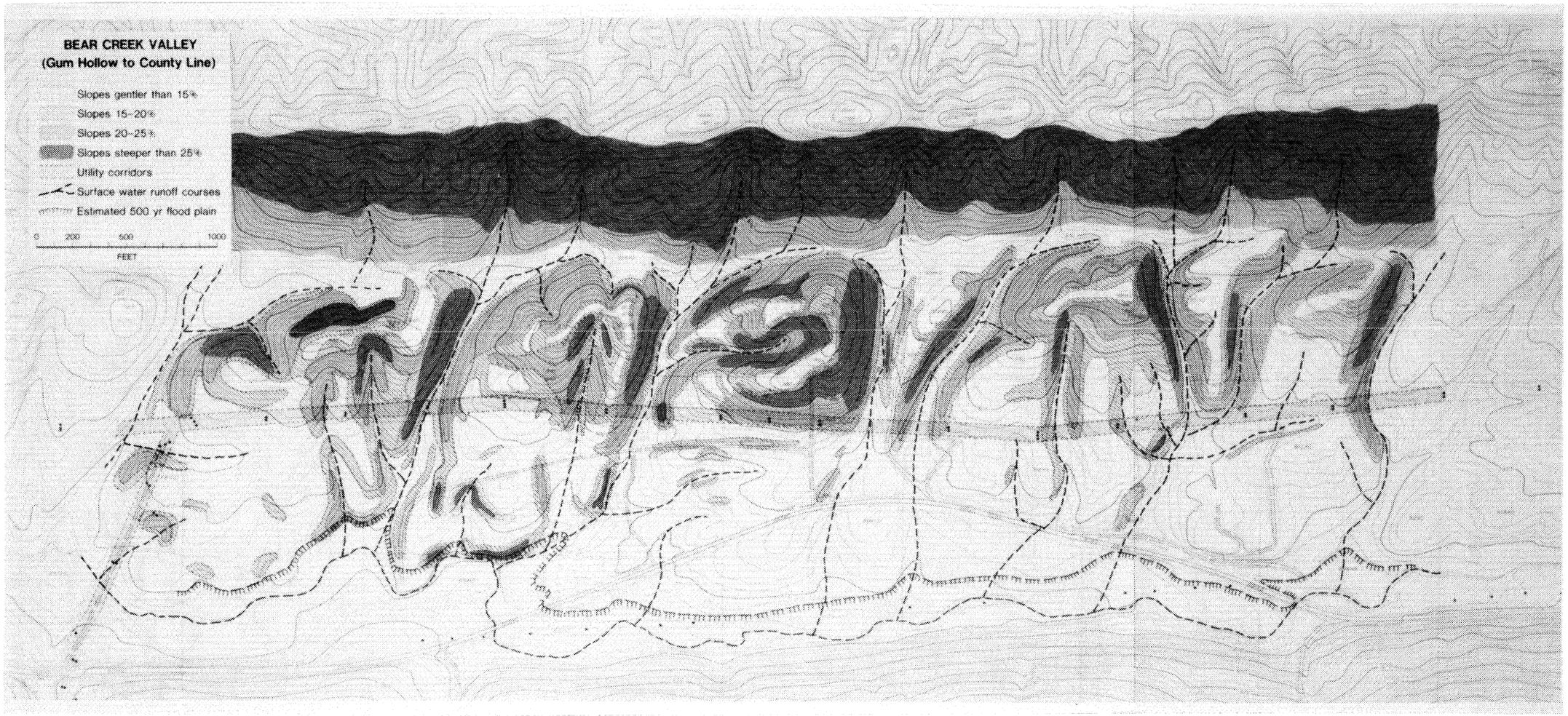

Fig. 7. Map of Bear Creek Valley between Gum Hollow Road and the Anderson/Roane County line.

ecology and meteorology. Hydrology and geology are assigned a high significance, soil and land use characteristics are assigned medium significance, and socioeconomics and ecology and meteorology are assigned low significance for site selection. The context of significance of site evaluation parameters is the importance of each parameter for technically successful design and construction of an above-grade facility on the site.

Table 1. Comparative ranking of Bear Creek Valley sites

	Bear Creek Valley Area[a]		
Evaluation parameter	West	Central	East
Hydrology	-	0	0
Geology	0	+	0
Soils	0	0	0
Land use	-	0	0
Socioeconomics	-	0	+
Ecology and meteorology	0	0	0
Relative site desirability rank	Least	Most	Intermediate

[a]A + indicates higher site desirability for the evaluation parameter, a 0 indicates no significant difference between sites for the evaluation parameters, and a - indicates lower site desirability for the evaluation parameter.

The central and eastern sections of Bear Creek Valley were judged to be hydrologically preferable to the western section because of the more complex surface drainage system present on the western section. Short, mostly seasonal streams drain the central and eastern sections. Drainage of the western section is more complex with the presence of a small stream diagonally crossing the Bear Creek watershed portion of the section. This Bear Creek tributary originates on Pine Ridge and carries runoff from an area upstream of the potential site area.

The geologic evaluation parameter includes consideration of bedrock geologic and structural conditions as well as site topography, geologic hazards, and mineral resources. The same bedrock formations and structural characteristics are present on the three

Bear Creek Valley areas. Slope conditions vary among the sections, with the west and central sections containing more gently sloping land than the eastern section. Topography on the western section is more favorable in the Bear Creek watershed (east of the Bear Creek-Grassy Creek watershed divide) than in the Grassy Creek watershed. The central section is topographically very attractive, with large tracts of gently sloping land. The eastern section contains a rather narrow strip of topographically attractive land on the southeast slope of rather steep knobs. The location of Bear Creek Road near the center of the valley in the eastern section substantially reduces the available favorable terrain in that section. Relocation of the road to an alignment further south in the valley could result in the eastern Bear Creek Valley section ranking equivalent to the central sections for the geologic parameter.

Based on available information, soil conditions on the three sections are judged to be equivalent. The western section is ranked lower than the central and eastern section for the land use and socioeconomic parameters because of the nearby Bear Creek Valley Industrial Park. The eastern section is ranked higher than west and central sections for socioeconomics because of its location closer to the Y-12 area and further from Highway 95. The three sections are ranked equivalent for ecology and meteorology parameters. Ranking of the three Bear Creek Valley sections according to the evaluation parameters indicates that the central section is most attractive, followed by the east section, and the west section appears least desirable for development. The central section is favored for its topography. The east section is ranked very close to the central section but has less desirable topography. The west section was ranked lower than the central and east sections for hydrology.

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