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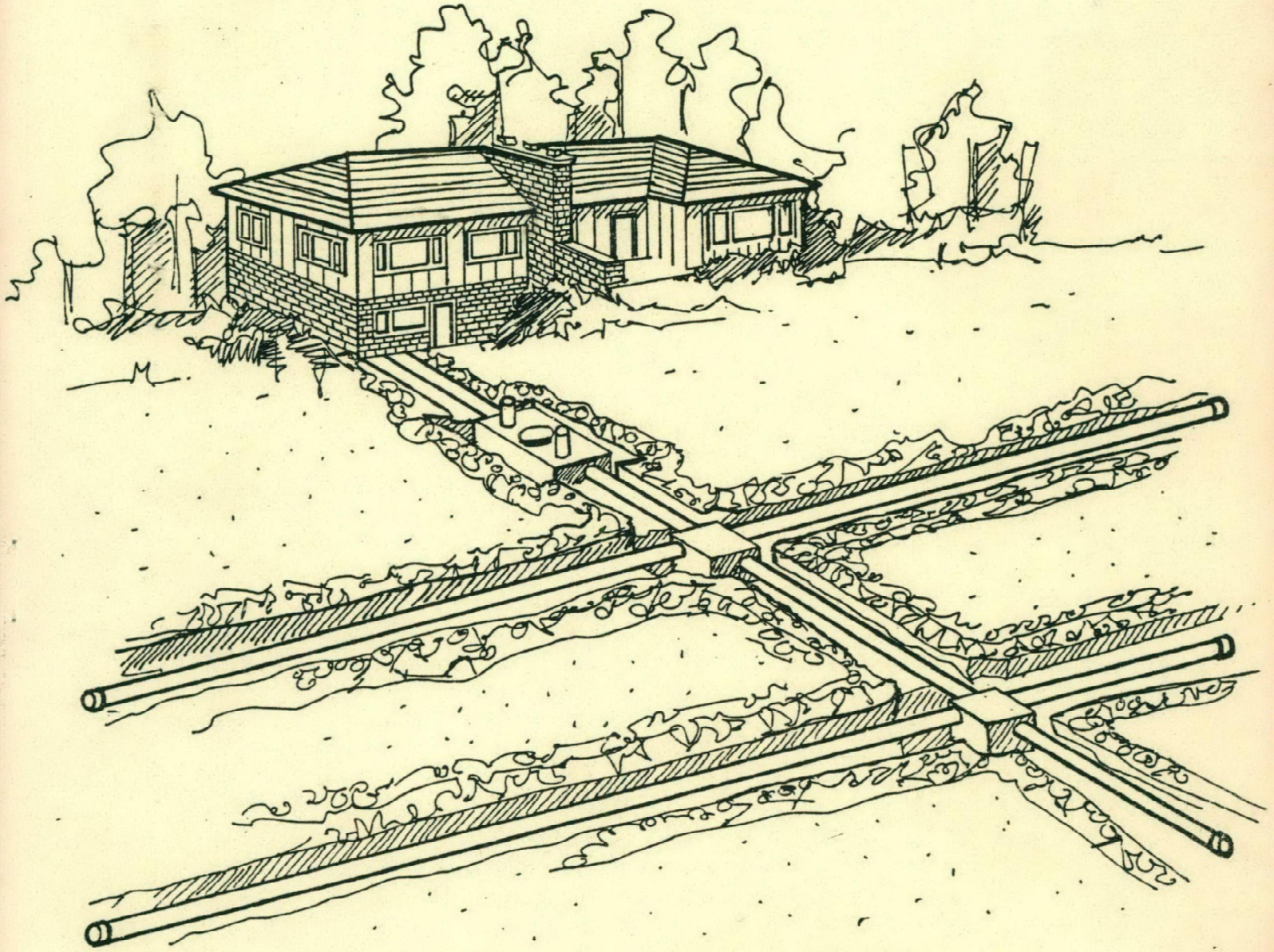
Environmental Impact Statement

Draft

Spearfish Sewerage Needs

Lawrence County near Spearfish, S.D.

APPENDIX



INTRODUCTION

This volume of the Spearfish Area Environmental Impact Statement contains supporting information and documents for the summaries, conclusions, and decisions presented in the main volume of the EIS.

Presented in Appendix A is the evaluation of the existing data base for the Study Area. Appendix B is an inventory of nonpoint source control strategies for a variety of activities, including agriculture, construction, urban development, and mining. A model floodplain ordinance is presented in Appendix C. The model ordinance was provided by Denver Urban Drainage, Denver, Colorado. It provides guidance for the development of a floodplain ordinance but is not intended to be specific to the needs of the Spearfish area. Appendix D presents the amended facilities plan report prepared by Scott Engineering.

NOTE: Oversized maps in Appendix A and D have not been included. These exhibits may be reviewed at the following locations:

- U. S. Environmental Protection Agency
  1860 Lincoln Street
  Denver, Colorado

- City Hall of Spearfish
  Spearfish, South Dakota

- Scott Engineering
  Spearfish, South Dakota

- Engineering Science
  2785 N. Speer Blvd.
  Denver, Colorado

- South Dakota Department of Environmental Protection
  Pierre, South Dakota

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Because of the magnitude of the effort required to produce this environmental impact statement, it is an impossible task to acknowledge all of the people and agencies who contributed to the final product. A heart-felt thanks is extended to the individuals who have contributed and assisted in the completion of this monumental effort. A special thanks is offered to all of the secretaries without whose patience and long hours the project could not have been competed.

DISCLAIMER

This report has been reviewed by the EPA, Region VIII, Water Division and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

DOCUMENT AVAILABILITY

This document is available in limited quantities through the U. S. Environmental Protection Agency, Environmental Evaluation Branch, 1860 Lincoln St., Denver, Colorado 80295. This document is also available to the public through the National Technical Information Service, Springfield, Virginia 22161.

EXISTING DATA BASE EVALUATION
SPEARFISH, SOUTH DAKOTA

APPENDIX A

APPENDIX A

EXISTING DATA BASE EVALUATION

SPEARFISH, SOUTH DAKOTA

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INTRODUCTION

The Environmental Protection Agency (EPA) has determined that an Environmental Impact Statement (EIS) should be prepared to analyze the effects of the interceptor portions of the wastewater treatment facility plan (201) for the City of Spearfish, South Dakota. The 201 plan developed and recommended construction of a new sewage treatment plan with a 0.8 million gallon per day (MGD) capacity to serve an estimated 1990 population of 10,325 persons. The plan also recommended construction of approximately 10 miles of interceptor sewers into presently unsewered areas.

To avoid delays in providing needed sewage treatment for Spearfish while the EIS is being prepared, EPA, the City, and the State Department of Environmental Protection have agreed to approve that portion of the proposed plan that allows construction of a new sewage treatment plant while additional facility planning work and environmental analyses are done.

The purpose of this task report is to present, with respect to the interceptor alternatives, the existing available data and identify the key issues for this EIS.

THE SETTING[1]

The City of Spearfish is situated on the northern edge of the Black Hills of South Dakota in Lawrence County. Located on Spearfish Creek, Spearfish offers a picturesque setting to its residents and visitors. Spearfish's proximity to the Black Hills offers a year round focal point for recreational enthusiasts. By virtue of its location, adjacent to the Black Hills, and growth in energy and recreation related activities, Spearfish has and will continue to experience a healthy growth and development pattern.

The Study Area for this EIS has been determined by Federal, State, and City officials and is identical to the 201 Facilities plan Study Area (Figure 1). The area is approximately 31 square miles and includes the City of Spearfish and its surrounding environs. The EIS is specifically concerned with the areas outside of the Spearfish city limit.

CLIMATE

The Study Area has a continental climate, experiencing extreme fluctuations in temperature in both summer and winter. The annual average temperature is 46.5°F with the average high and low being 57.2°F and 35.8°F, respectively. Winds in the area are generally from the north-northwest at an average velocity of 10 to 12 miles per hour. Spring and summer winds frequently blow from the south-southeast and have the highest velocities, up to 75 miles per hour.

The average annual precipitation is 20.2 inches. The highest precipitation occurs during April, May, June, and July. A great deal of the seasonal precipitation occurs as short duration, high intensity thunderstorms. The average annual temperature and precipitation data are listed in Table 1. Daily precipitation for selected years is listed in Table 2. Climatological data were obtained from the Homestake Sawmill located west of Spearfish.

GEOLOGY

Within the EIS Study Area nine geologic formations have been identified.[2] The identified formations consist of recent alluvial deposits, old terrace deposits, the Spearfish formation, Morrison shale, the Sundance formation, the Minnelusa formation, Opeche shale, Minnekahta limestone and the Brule Clay. These formations are identified on Figure 2.

The recent alluvial deposits are found in the Spearfish Creek and Higgins Gulch bottom lands. The alluvial material consists of silt, sand, gravel, and cobbles. These deposits have a high permeability, partially a consequence of their unconsolidated nature and also as a result of historic stream channels. The old stream channels meandering through the subsurface alluvium are confined to the broad bottom lands of Spearfish Creek. It is within the recent alluvial deposits that the City of Belle Fourche has located their water supply infiltration gallery.

Old terrace deposits occur as isolated outcrops along the edge of the benches of the bottom lands. These deposits are of similar material as the recent alluvial deposits but are older. Because of the location of these old terrace deposits relative to the Spearfish formation it is thought that these areas may contain perched water tables which would not be contiguous with other groundwater in the area.

The Spearfish formation underlies the alluvial deposits of the major drainages of the Study Area. This formation is found to be the dominant formation of the benches above the bottomland areas. The Spearfish formation is predominately a red siltstone, consisting of red sandy or silty shale. Massive gypsum beds and stringers occur throughout the formation and limestone outcrops are also found. There are also areas of gravel and unconsolidated sand which may be remnants of old terrace deposits. The Spearfish formation is considered to be a very impermeable material, having a low water yielding capacity.

The Morrison shale is found on the upper most areas of the Lookout Peak area east of Spearfish. This is a shale material which has little significance in this study because of its location.

The Sundance formation separates the Spearfish formation and the Morrison shale in the eastern mountains of the Study Area. This is a shale which has some sand beds within the formation.

The Minnelusa formation consists of pink and white granular sandstones with limestone lenses and layers. Red shales, white sandstone and interbedded limestone occur near the base. In some areas a thick permeable sand is found at the top of the formation. This formation surfaces in the mountains south and southwest in the Study Area. This material is permeable and where it outcrops serves as an area for groundwater recharge. Groundwater of the Minnelusa is significant to the area because of its good quality, its artesian characteristics and high yield.

The Opeche formation is composed of red silty and sandy shales and may contain streaks of gypsum. The formation is found in the western areas of the Study Area.

The Minnekahta formation is a massive gray to pink laminated limestone. Solution caverns or sinks may occur in the formation. This formation is found primarily in the southwest areas of the Study Area and underlies the Spearfish formation. This formation is more permeable than the Spearfish.

The Brule Clay is a reminant formation that is considered to be insignificant to this study. The formation occurs in the southeast corner of the Study Area.

The general dip of the geologic formations is northeast and varies from one to three degrees. A generalized geologic cross-section is illustrated on Figure 3. The general stratigraphy of these formations is indicated on this Figure.

Residential development in the Study Area has occurred over various geologic formations. In the context of water quality management and the use of absorption fields for septic tanks, geologic considerations include the depth to bedrock, and geologic formations which serve to recharge groundwater. The depth to bedrock under existing developments is described under the Soils section and groundwater recharge areas of significance are identified under the Groundwater Elevations and Movement section.

The following developments are existing in the Study Area: Weiss-West, Hardy, MacKaben No. 1, MacKaben No. 2, Deer Meadows, Deberg-Fuller, Grandview Acres, Westfield, Mountain Plains, Christensen Drive, and Old Tinton Road.

These developments have occurred over the following geologic formations:

- Weiss-West - recent alluvial deposits
- Hardy - recent alluvial deposits
- MacKaben No. 1 - recent alluvial deposits and the Spearfish formation
- MacKaben No. 2 - older terrace deposits and the Spearfish formation
- Deer Meadows - recent alluvial deposits and the Spearfish formation
- Deberg-Fuller - recent alluvial deposits and the Spearfish formation
- Grandview Acres - older terrace deposits and the Spearfish formation
- Westfield - older terrace deposits
- Mountain Plains - Minnelusa sandstone
- Christensen Drive - Spearfish formation
- Old Tinton Road - Minnekahta limestone

Of the formations on which development has occurred, the most severe limitations are found on the Minnelusa sandstone. This formation serves as a groundwater recharge area and, in the Mountain Plains area, has a shallow soil profile. Conventional septic tank absorption fields should be designed to avoid contamination of the groundwater and to insure adequate soil depth is available for filtration.

SOILS

The Soil Conservation Service (SCS) has completed the survey program necessary to map and interpret the soils of Lawrence County.[3] Within the EIS Study Area a total of 36 soils have been identified. The soils map and the soils descriptions are currently unpublished. However, the unpublished soils maps and interpretations were made available from the South Dakota State Planning Bureau (SDSPB). The detailed soils data contain several variables relative to land development and use including, water management, soil and water features (surface and groundwater), suitability for sanitary facilities, building site development, physical and chemical properties of soil, soil use as a construction material, crop and pasture production, recreational development, engineering properties, windbreaks and environmental plantings, woodland management and productivity, and wildlife habitat potentials. For the purposes of this Study those variables pertinent to urban/suburban development and associated wastewater disposal are evaluated and presented in Table 3. The distribution of soils in the Study Area is shown on Figure 4.

Land development outside the City limits of Spearfish has been predominately north and northwest, with some development west and southwest. The development have occurred on many different types of soils, some suitable to residential use and some having suitability constraints.

The following discussion identifies the soils on which residential development has occurred and the limits each soil has for such development.

Weiss-West

The Weiss-West developments consist of eleven residences, which are predominately mobile homes. These homes are located in an area which consists of four major soils:

- Barnum silt loam
- Barnum silt loam, channeled
- Swint silt loam
- St. Onge loam

The Barnum silt loam is a deep, well drained, nearly level soil of terraces and bottom lands. This soil is subject to occasional flooding for brief periods.

The surface layer is brown silt loam in the upper 3 inches and brown very fine sandy loam in the lower 3 inches. The underlying material, to a depth of 60 inches, is light reddish brown, very friable loam.

The Barnum silt loam channeled is identical in features to the Barnum silt loam except that the soil is confined to bottom lands. Entrenched streams meander through this soil (Spearfish Creek adjacent to the Weiss-West subdivision).

The Swint silt loam soil is a deep, well drained, nearly level soil on terraces and alluvial fans.

The 8 inch surface layer is dark reddish gray silt loam while the 6 inch subsurface layer is dark reddish gray, friable silt loam. The underlying material, to a depth of 44 inches, is light reddish brown, very friable silt loam in the upper part and reddish brown silt loam in the lower part. Below this the soil is light reddish brown, calcareous, very fine sandy loam.

St. Onge is a deep, well drained, nearly level soil on low terraces.

The surface layer is dark grayish brown loam about 7 inches thick. The subsurface layers, to a depth of 17 inches, are very dark grayish brown, friable silt loam in the upper part and dark grayish brown loam in the lower part. The underlying material is stratified brown and light brown loam and fine sandy loam.

The St. Onge and Swint soils contain more silt and clay, and organic matter to a greater depth than Barnum soils. All 4 soils are susceptible to occasional flooding and have been determined to have severe limitations for septic tanks, sewage lagoons, and building site development.

Hardy

The Hardy development is located on the eastern edge of Section 32 and consists of 5 residential developments. This development is situated on the following 4 soils:

- Vale silt loam, 0 to 2 percent slopes
- Vale silt loam, 2 to 6 percent slopes
- Tilford silt loam, 6 to 9 percent slopes
- Nevee silt loam, 6 to 9 percent slopes

The Vale silt loam on 0 to 2 percent slopes is deep, well drained, on terraces and uplands.

The first 6 inches are dark brown silt loam. The subsoil, about 21 inches thick, is dark brown, firm silty clay loam in the upper part; brown, firm, calcareous silty clay loam in the middle part; and light brown, friable, calcareous loam in the lower part. The underlying material is light brown, calcareous loam.

The Vale silt loam on 2 to 6 percent slopes is identical to the Vale silt loam on 0 to 2 percent slopes except that it occurs on steep slopes.

Tilford silt loam, on 6 to 9 percent slopes, is a deep, well drained soil on moderately sloping terraces, and uplands.

The surface layer is brown silt loam about 6 inches thick. The 24 inches of subsoil is friable, calcareous silt loam that is brown in the upper part and light brown in the lower part. The underlying material is pink, calcareous silt loam. In places, lime is leached deeper than 10 inches.

Nevee silt loam, 6 to 9 percent slopes, is a deep, well drained moderately sloping soil on terraces and uplands.

Typically, the surface layer is reddish brown silt loam about 6 inches thick. The underlying material to a depth of 60 inches is very friable silt loam that is reddish yellow in the upper part, yellowish red in the middle, and red in the lower part. In parts, lime has been leached deeper than 10 inches.

The Hardy development is located on the transition area from bottomlands to the bench areas. The Nevee soils have low strength and may require buildings to have foundations and footings designed to deal with potential problems to prevent structure damage. The remaining soils are well suited for building. Slow perculation of the Vale, and Nevee soils may require that septic tank absorption fields be enlarged. Absorption fields in the Nevee soil may not be feasible in places due to a shallow depth to bedrock (40 to 60 inches) which can outcrop in this transitional area between the alluvium and the bench area.

MacKaben No. 1

The MacKaben No. 1 subdivision is located on the southside of Interstate 90 in the southeast quarter of Section 32. The subdivision is in the Higgins Gulch drainage and Higgins Gulch crosses through the northern edge of the subdivision. There are four soil types in the subdivision, these include:

. Winetti cobbly loam
. Tilford silt loam, 2 to 6 percent slopes
. Tilford silt loam, 6 to 9 percent slopes
. Vale silt loam, 2 to 6 percent slopes

The Winetti cobbly loam in the MacKaben No. 1 subdivision is located on the Spearfish Creek bench region. The soil is somewhat excessively drained, gently sloping, and shallow to sand and gravel. This soil is subject to rate flooding for brief periods. Many scattered cobbles commonly occur on the surface.

Typically, the surface layer is grayish brown cobbly loam about 5 inches thick. The underlying material to a depth of 60 inches is a pale brown, very friable gravelly sandy loam.

The Tilford silt loam in the subdivision is located on 2 to 6 percent slopes. It is a deep, well drained, gently sloping soil.

The surface layer is brown silt loam about 6 inches thick. The subsoil, about 24 inches thick, is friable, calcareous silt loam that is brown in the upper part and light brown in the lower part. The underlying material is pink, calcareous silt loam. In places, lime has been leached deeper than 10 inches.

The Tilford silt loam on 6 to 9 percent slopes and the Vale silt loam on 2 to 6 percent slopes are described under the Hardy subdivision.

The Tilford soils found in the MacKabel subdivision are well suited for both building sites and septic tank leach fields. The Vale soil is suited for building but it is suggested by SCS that septic tank leach fields be enlarged due to slow percolation rates. The Winetti soil is identified to be unsuited for building sites and sanitary facilities because of the potential for flooding and seepage problems.

MacKaben No. 2

The MacKaben No. 2 subdivision located in the northeast quarter of Section 31 currently has 12 residents. The subdivision is located on the bench area of the Spearfish Creek drainage. The two principal soil types are the Tilford silt loam on 2 to 6 percent slopes and 6 to 9 percent slopes. The characteristics of both of these soils have been previously described. These soils are well suited for building sites and septic tank leach fields.

Deer Meadows

The Deer Meadows subdivision is located in the southwest quarter of Section 5 and part of the southeast quarter of Section 6. There are 15 to 20 residential units in the subdivision. There are 6 soil types found in the subdivision and include:

- .Barnum silt loam
- .Rekop-Gypnevee-Rock outcrop complex, 15 to 50 percent slopes
- .Nevee-Spearfish-Rock outcrop complex, 9 to 40 percent slopes
- .Swint silt loam
- .Vale silt loam, 2 to 6 percent slopes
- .Nevee silt loam, 2 to 6 percent slopes

The typical features of the Barnum, Swint, Vale, and Nevee soils have been described above.

The Rekop-Gypnevee-Rock outcrop complex on 15 to 50 percent slopes consist of soils that range from shallow to deep, well to somewhat excessively drained, and moderate to very steep features. The distribution of the components of this complex are about 35 percent Rekop soils, 25 percent Gypnevee soils, and 25 percent Rock outcrop. Rock outcrop is on the tops and upper sides of ridges. Rekop and Gypnevee soils and Rock outcrops are so intermingled that it is not practical to separate them.

The Rekop soil has a surface layer of reddish brown loam about 4 inches thick. The underlying material to a depth of 18 inches is loam that is light brown in the upper part and pink in the lower part. Pinkish white gypsum and alabaster bedrock occurs at a depth of 18 inches.

The Gypnevee soil has a surface layer of reddish brown loam about 7 inches thick. It has a transitional layer of yellowish-red friable silt loam about 6 inches thick. The underlying material, to a depth of about 60 inches, is friable silt loam that is reddish yellow in the upper part and light red in the lower part. In places, the bedrock is at shallower depths.

Rock outcrop consists of massive exposures of pinkish white and white gypsum and alabaster rock.

The Nevee-Spearfish-Rock outcrop complex on 9 to 40 percent slopes consists of deep and shallow, well drained to excessively drained, strongly sloping to steep soils and Rock outcrops that are on uplands. The Nevee soils are in the lower parts of the terrain, Spearfish soils are in the middle and upper parts of the landscape with the Rock outcrop on the tops and upper sides of ridges.

The Nevee soil has a surface layer of reddish brown silt loam about 6 inches thick. The underlying material to a depth of 60 inches is very friable silt loam that is reddish yellow in the upper part, yellowish red in the middle, and red in the lower part. In places, lime has been leached deeper than 10 inches.

The Spearfish soil has a reddish brown surface layer of silt loam about 2 inches thick. The transitional layer, about 5 inches thick, is reddish brown, very friable silt loam. The underlying material to a depth of 12 inches is red, very friable silt loam. Red silty shale is at a depth of 12 inches.

Rock outcrop consists of massive exposures of red, silty fractured shale.

The Barnum soil is generally not suited for building sites and sanitary facilities due to the potential for occasional flooding. The shallow depth to bedrock, low strength and presence of soluble gypsum make the Rekop-Gypnevee-Rock outcrop complex undesirable for building sites and septic tank leach fields. Building sites and sanitary facilities should be located on the lower slopes of the Nevee-Spearfish-Rock outcrop complex. If buildings are constructed on this unit proper design of foundations and footings should occur to help prevent structure damage caused by the low strength of these soils. Septic tank absorption fields should be located on the Nevee soils if possible. Enlarging the filter fields helps overcome the slow percolation rate. The potential for occasional flooding may render the Swint soil undesirable for both building sites and septic tanks, while the Vale soil is well suited for building sites but enlargement of septic tank leach fields may be required to overcome the slow percolation rate. The low strength of the Nevee soil, slow percolation rate and the depth to bedrock may limit development on the soil.

Deberg-Fuller

The Deberg-Fuller subdivision is located in the southeast quarter of Section 5. There are 20 residences in the subdivision. The four soil types found in the subdivision include:

.Nevee-Spearfish-Rock outcrop complex, 9 to 40 percent slopes
.Tilford silt loam, 2 to 6 percent slopes
.Tilford silt loam, 6 to 9 percent slopes
.Vale silt loam, 0 to 2 percent slopes

The general features and characteristics of these soils are discussed above. The Nevee-Spearfish-Rock outcrop complex is best suited for development and septic tanks on the lower slopes of the unit. Proper design of foundations and footings helps prevent structure damage caused by the low strength of these soils. Septic tank absorption fields should be located on the Nevee soils where possible. Enlarging the filter field helps overcome the slow percolation rate. The Tilford soils are well suited for both building sites and septic tank absorption fields. The Vale soil is well suited for building sites but septic tank absorption fields may require enlarging to overcome slow percolation rates.

GrandView Acres

The GrandView Acres subdivision is located in the northwest quarter of Section 5 and contains 12 residential units. An unnamed intermittent creek runs through the center of the subdivision. The principal soil types which occur within the subdivision are:

.Nevee-Spearfish-Rock outcrop complex
.Tilford silt loam, 2 to 6 percent slopes
.Tilford silt loam, 6 to 9 percent slopes
.Vale silt loam, 0 to 2 percent slopes
.Vale silt loam, 2 to 6 percent slopes
.Nevee silt loam, 2 to 6 percent slopes

The features of these soils have been described above. Residential development on the Nevee-Spearfish-Rock outcrop complex should be located on the lower slopes in this unit. Proper design of foundations and footings helps prevent structure damage caused by low strength of these soils. Septic tank absorption fields should be located on the Nevee soils and the fields should be enlarged due to slow percolation rates. The Tilford soils have no constraints for development. The Vale soils are well suited for development but for septic tanks it is recommended that enlarged absorption fields be built to offset slow percolation rates. Nevee soils are not well suited for building due to the low strength of the soils, slow percolation rates, and depth to bedrock.

Westfield

Located in the northeast quarter of Section 8, the Westfield development consists of 15 units. There are three soil types in the subdivision. These soils are:

- .Winetti cobbly loam
- .Tilford silt loam, 2 to 6 percent slopes
- .Tilford silt loam, 6 to 9 percent slopes

These soils have been described previously. Their constraints for development and septic tank systems are presented below. The Winetti soil is not suited to building sites or septic tanks because of the potential for flooding and seepage. However, the Tilford soils are suitable for both building sites and septic tanks.

Mountain Plains

The Mountain Plains subdivision is located in the southern part of Section 22. There are about 10 residences in the development. There are three major soil types in the area and include the following:

- .Paunsaugunt-Rock outcrop complex
- .Vanocker-Citadel association
- .Citadel association

The Citadel association consists of deep, well drained soils. It is typical of smooth upland divides on the sides of mountain valleys and drainageways.

The Citadel soil has been described under the Vanocker-Citadel association.

Steep slopes, stoniness, and shallow depth to bedrock make the Paunsaugunt-Rock outcrop complex unsuited for building sites and septic tanks. Steep slopes, and an associated potential for soil slippage makes the Vanocker-Citadel association unsuited for development. The Citadel association can be built on if measures are taken to overcome the potential for shrinking and swelling of this soil. Enlarging the septic tank absorption field helps overcome slow percolation. SCS suggests that if buildings and septic tanks are constructed, they should be located in the lower part of the landscape where slopes are less steep.

Christensen Drive

There are few homes in the Christensen Drive development and two campgrounds. These developments have occurred on the following soils:

- Nevee-Spearfish-Rock outcrop complex
- St. Onge, loam
- Vale, silt loam, 2 to 6 percent slopes
- Vale, silt loam, 6 to 9 percent slopes

With the exception of the Vale, silt loam on 6 to 9 percent slopes these soils have been described above. This soil is deep, well drained, moderately sloping and occurs on terraces, uplands, and alluvial fans. The top four inches is a dark brown silt loam, while subsoil, about 20 inches thick, is dark brown, firm silty clay loam in the upper part. The middle part of the subsoil is brown, calcareous silty clay loam and the lower part is a light brown, friable, calcareous loam. To a depth of 60 inches the underlying material is light brown calcareous loam.

The soil is well suited as a site for buildings with the following precautions; septic tank absorption field may need to be enlarged to help overcome the slow percolation rate.

Old Tinton Road

The Old Tinton Road, west of Spearfish, has undergone limited development. There are currently 10 to 12 residential units in this area. These units are constructed on the following soil types:

- Vale silt loam
- Paunsaugunt-Rock outcrop

Both of these soils have been described previously. The major constraints for development on these soils include slow percolation rate and potential shallow depth to bedrock for septic tank absorption fields. Enlarging the size of the absorption field helps overcome slow percolation.

LAND USE

Within the EIS Study Area existing land use has been identified by the South Dakota State Planning Bureau in cooperation with the Sixth District Council of Local Governments and local planning agencies.[4]

Of interest to this Study are the developed area outside of the City limits which are unsewered. They are broken out in the following manner:

- The Spearfish Creek Alluvial Valley
- Upper Higgins Gulch
- Mountain Plains
- Christiansen Drive

The Spearfish Creek Alluvial Valley

There are two developments in the Spearfish Creek alluvial valley, the West development and Hope Weiss development, and some scattered development. The West-Weiss developments consist of eleven residencies which are predominately mobile homes. Scattered development consists of single family dwellings.

With the exception of one dwelling, the Hope Weiss development is hooked onto the City of Spearfish's sewer system via a privately owned line which is preceded by a small package plant. The remaining developments in the area are on individual sewage disposal systems.

Upper Higgins Gulch

Residential development in this area consists of the following subdivisions:

- MacKaben No. 1
- MacKaben No. 2
- DeBerg
- Grand View Acres
- Deer Meadows
- Westfield
- Hardy
- Fuller
- Old Tinton Road

MacKaben No. 1 and MacKaben No. 2 have 25 and 12 residences, respectively. In the DeBerg and Fuller developments there are about 20 homes total. Grand View Acres currently has 12 homes, Deer Meadows has 15-20 homes, and Westfield has about 15 homes. All of these residences have on-site sewage disposal systems.

Not all of the lots in Upper Higgins Gulch have been developed, thus maximum density has not yet occurred. It is anticipated that this area will continue to develop based on the recent filing on an additional 80 acres north of Deer Meadows.

In the Deberg development plotted lots range in size from 1.92 acres to 0.51 acre. Of the 32 lots identified, four are 0.78 acre, two are 0.51 acre, and one is 0.63 acre. In the Fuller addition, 12 plotted lots are identified ranging in size from 2.57 acres to 0.61 acre. Of these lots, four are 0.61 acre, four are 0.62 acre, and there is one each 0.95, 0.74, and 0.70 acres.

Plotted lots in the existing Deer Meadows development and Grand View Acres are all larger than 1.0 acres. The Westfield development has 35 plotted lots which vary in size from 0.46 acre to 0.60 acre.

Data on the remaining subdivisions were not collected at this time.

Those areas which are not currently developed are used by livestock from ranching operations and are expected to continue under this use until development is deemed more feasible.

Mountain Plains

The Mountain Plains subdivision is adjacent to the southern border of the City of Spearfish. There are about 10 homes in the development, all on individual disposal systems. There are currently 62 lots in the development and an additional filing on an additional 600 acres has been made. This area is expected to develop into larger lots of several acres. Development is likely to be slow due to costs of development.

Christiansen Drive

The Christensen Drive development is located southeast of the City of Spearfish. The development consists of 28 residential units and two large campgrounds. Sewage disposal is accomplished by individual, on-site systems.

WATER QUALITY CRITERIA AND STREAM CLASSIFICATION

The State of South Dakota has promulgated surface water quality standards pursuant to the Clean Water Act. Numeric criteria have been established for 28 parameters/constituents which are to be applied toward achieving 12 beneficial uses. The beneficial uses and criteria for surface waters are presented in Table 4. Beneficial uses of all streams in South Dakota are designed for

irrigation and wildlife propogation and stock watering. Within the Study Area only Spearfish Creek and Higgins Gulch are designated for additional beneficial uses. Spearfish Creek from the Redwater River to the Homestake Hydro-electric Plantdischarge is designated for domestic water supply, cold water permanent fish life propogation, immersion recreation water, and limited contact recreation waters, while above the Homestake Hydro-electric Plant to the EIS Study Area boundary Spearfish Creek is designated for cold water marginal fish life propogation and limited contact recreation. Higgins Gulch from its confluence with Spearfish Creek to the EIS Study Area boundary is designated for cold water permanent fish life propogation and limited contact recreation.

WATER QUALITY

During the process of acquiring, collating, and evaluating water quality data, the following were identified as having water quality data for the Study Area:

- U. S. Geological Survey-Water Resources Division
- U. S. Environmental Protection Agency
- South Dakota Department of Environmental Protection
- South Dakota Department of Natural Resources
- Special Studies

These sources provided the bulk of the water quality information.

The U. S. Geological Survey (USGS) has been operating a surface water quality monitoring station on Spearfish Creek at Spearfish. The following four parameters have been monitored at this station: water temperature, air temperature, stream flow, and conductivity. Several samples have been collected which were tested for these parameters since 1975. These data are available from USGS and the U. S. Environmental Protection Agency.

EPA has collected one sample of wastewater at the Spearfish wastewater treatment plant on April 11, 1978. This sample was tested for the following constituents: water temperature, bio-chemical oxygen demand, pH, total dissolved solids, and ammonia.

The South Dakota Department of Environmental Protection (DEP) operates two surface water quality stations on Spearfish Creek; Station 460900 is located in Spearfish and has a period of record beginning in 1967. The second station, 460689, is below the City of Spearfish and has been monitored since late 1978.

Station 460900 samples have been tested for 47 parameters, while Station 460689 has been monitored for 14 parameters. In addition to these monitoring stations, DEP has conducted a special study of Spearfish Creek in 1978. For this study additional monitoring stations were established from the City of Spearfish to the Redwater River.

Special studies have been conducted by Drs. L. Harms, P. Rahn, and J. Gries on the water quality and geology of Spearfish Creek and Higgins Gulch, particularly in the area of the Belle Fourche water supply infiltration gallery, emphasizing groundwater quality (6,7,8,9,10,11). A total of eight surface water quality monitoring stations have been established on Spearfish Creek and six on Higgins Gulch. These surface water quality stations have been monitored at various intervals since June of 1978. Groundwater quality in the area of the infiltration gallery has been monitored at eight different sites. The main parameters monitored during the various investigations are total coliform, fecal coliform, chlorides, and sodium. The purpose of these studies has been to identify the potential sources of coliform contamination which has appeared in the Belle Fourche infiltration gallery.

As part of the 201/EIS program, Scott Engineers have monitored groundwater and surface water quality at 15 sites. Parameters monitored at these sites are total coliform, fecal coliform, nitrate, chloride, sulfate, pH, total dissolved solids, and nitrite. This special monitoring program was developed to evaluate whether or not areas outside of the gallery were being contaminated.

For purposes of the EIS special emphasis is placed on the following water quality parameters: total coliform, fecal coliform, chloride, nitrate, sodium, and total dissolved solids. Total and fecal coliforms are biological indicators of pollution. By themselves they do not represent a health hazard, however, they do serve as indicators for the presence of potentially hazardous pathogens. Fecal coliform constitute about 90 percent of the coliforms discharged in fecal matter whereas total coliforms account for organisms naturally originating in soil, grain, and decaying vegetation. The presence of fecal contamination is the best means of demonstrating a hazard for human consumption. A high total coliform population is also a suspicious symptom but not a specific indication of fecal pollution. Soils receiving septic tank effluent generally filter or entrap coliform and viral organisms.

Nitrates are a common component in wastewater. High concentrations can be hazardous to infants or pregnant women, while animals ingesting high concentrates may also suffer harmful results. A primary source of nitrates entering water is from agricultural land, both cultivated (fertilizers) and non-cultivated (animal wastes).

The principal concern for high chloride concentrations is the objectionable taste it produces in water supplies. Chloride is a common element in wastewater, especially where water softeners are used, and, as such, is an indicator of wastewater entering the ground or surface waters.

Sodium concentrations can affect people who are restricted to low sodium diets. It is also a principal salt in water softening and like chloride can indicate domestically used water entering surface and groundwaters.

High concentrations of TDS are toxic to fish, livestock, and to some plants. In humans, taste and physiological effects can occur. TDS is an indication of dissolved minerals which may be contributed to by softening of domestically used water.

While concentrations of chloride, nitrate, sodium, and TDS are not excessive enough to warrant a concern for water use, they do indicate that septic tank effluents are entering the groundwater of the Study Area. This situation is anticipated since soil absorption fields are intended to filter bacteria and virus, not minerals.

Of the assembled water quality data, only the information collected from the special studies and the City of Belle Fourche has sufficient spacial and temporal distribution to be of utility for evaluation. The available data from these sources for total coliform, fecal coliform, fecal streptococci, chloride, nitrate, and sodium are presented in Tables 5 to 38. Selected groundwater and surface water quality monitoring sites data are plotted on Figure 5 to 18 .

GROUNDWATER ELEVATIONS AND MOVEMENT

Groundwater depths have been surveyed by the special studies conducted at the Belle Fourche infiltration gallery, well drillers during well construction, and personal communications with well owners. For purposes of this study, only the depth to the shallow aquifer is identified.

Groundwater movement flows down the Higgins Gulch into the Spearfish Creek alluvial valley. In the area south of the infiltration gallery, the groundwater moves in a northeasterly direction from Higgins Gulch into the gallery area. Groundwater in the gallery area is also being recharged from surface water from Spearfish Creek. Higgins Gulch surface drainage is also recharging the groundwater as evidenced by surface flows disappearing into the permeable stream bed above the gallery area.

Studies at the gallery in the fall of 1978 indicate that the depth to the groundwater varies from one foot to over ten feet below the surface. Because these data were collected in the fall, it is not felt that they reflect the seasonally high groundwater. However, it is believed to represent a reasonable range (one to ten feet) that would consistently occur in a saturated alluvial stream bed of high permeability. Well log data for areas outside the gallery area indicate that the depth to the static water table range from 15 to 25 feet below the surface. These data are presented in Table 39.

The data from the well logs appears to have been collected at the time the well was drilled and do not necessarily indicate a seasonally high water table. However, because some of these data are outside the stream bed alluvium and in the Spearfish formation, it is felt that they represent an approximation of the groundwater level. Seasonal highs are expected to be somewhat higher but because of the low permeability of the Spearfish formation are not expected to rise appreciably.

The deeper aquifers are found in the Minnekahta, Opeche and Minnelusa formation in the Study Area. These aquifers are under artesian conditions. The features of these aquifers are described in the report, "Special Report 19. Artesian Water, Minnelusa and Pahasapa Formations, Spearfish-Belle Fourche Area."[12] (The Pahasapa formation underlies the Minnelusa sandstone. It does not outcrop in the Study Area and is not considered significant to this study.) The following description is from this report:

"In most of the Black Hills area the Minnekahta and Opeche Formations are not considered to be aquifers; however, in the area studied, the Minnekahta may yield large amounts of water under artesian conditions. The producing area is rather limited and the water probably originates in lower formations and moves upward along fissures or channels.

"Nearly all the ground water in the Minnelusa aquifer is derived from rainfall and melting snow, which enters the outcrop and moves down-dip away

from the Black Hills. It is believed that the principal area of recharge for the area studied is the Minnelusa outcrop between Spearfish Creek in Lawrence County and Sand Creek in Crook County, Wyoming. This area contains about 54 square miles of Minnelusa outcrop of which two-thirds (34 square miles) is in South Dakota. The porosity and permeability of the Minnelusa Sandstone is such that it absorbs about as much water from the base of streams crossing the outcrop as the stream gains by seepage from the valley walls above water level.

"The annual precipitation on the Minnelusa outcrop is estimated at 21 inches per year. This would result in 59,880 acre-feet of water annually falling on the 54 square miles of Minnelusa outcrop. The percentage of the annual precipitation entering the Minnelusa outcrop could not be determined. However, if as much as two inches of precipitation entered the Minnelusa aquifer it would represent a recharge of only 5,760 acre-feet per year for the area studies (or 10 percent of the total annual precipitation).

"No attempt was made to estimate the amount of ground water in transient storage in the Minnelusa aquifer.

"Withdrawal from the Minnelusa artesian aquifer in the area studied is estimated at 9,680 acre-feet per year by flowing and pumped wells, and 24,205 acre-feet per year by springs, or a total of 33,885 acre-feet.

"If the estimated Minnelusa recharge of 5,760 acre-feet is correct, then the outcrop recharge cannot equal the total withdrawal of 33,885 acre-feet. For this reason, it is believed that the Minnelusa aquifer is being partially recharged in some other manner. The most logical possibility would seem to be channeling or seepage upward from the underlying Pahasapa Formation."

SEWAGE DISPOSAL-OUTLYING AREA

It has been pointed out that, with the exception of the Hope Weiss development, all outlying areas accomplish sewage disposal by on-site systems, primarily conventional septic tanks followed by soil absorption fields. A conventional septic tank system consists of a tank which has a liquid capacity of from 500 to 1500 gallons and has two compartments. Wastewater is received in the first compartment and solids are settled out and floating matter retained. The liquid flows into the second compartment where additional settling occurs. The clarified effluent, which contains bacterial matter and dissolved solids then flows out of the tank to the absorption field via pipes. The wastewater is channeled through perforated pipe and discharged into the soil matrix. The soil matrix provides a final filter for bacterial and viral removal. The final effluent will then migrate to the groundwater, be absorbed into the soil and utilized by plants, and/or evaporate depending upon site conditions.

The State of South Dakota has established minimum site requirements [5] which must be met prior to installation of conventional septic tank systems. These requirements are as follows:

Disposal systems must comply with state regulations

All disposal systems designed for the reception and treatment of sewage from premises including, but not limited to homes, commercial establishments, businesses, and institutions, where public disposal systems are not available, constructed after February 28, 1975, shall be constructed, added to and altered in accordance with this chapter. No disposal system, regardless of when constructed, shall cause a violation of any existing water quality standard, cause a health hazard, or fail to meet the following requirements.

Private systems prohibited when public disposal systems are available

The operation, construction or installation of an individual sewage disposal system by any person is prohibited where a public disposal system is available.

A public disposal system shall be deemed to be available to any premise when: both are located within the jurisdictional boundaries of a municipality or sanitary district; the sewers of the public disposal systems exist within two hundred feet of the home, commercial establishment, business, or institution; and the municipality or sanitary district is willing and requests to provide such service to the premise.

Sewage not to be discharged into unused wells or rock formations

Sewage, treated or untreated, shall not be discharged into any abandoned or unused well, nor shall it be discharged into any crevice, sink hole or other openings, either natural or artificial, in a rock formation. (Applicable to Mountain Plains and areas where rock outcrops occur).

Sewage to receive primary treatment prior to discharge to absorption system

Sewage shall pass through a septic tank, other sedimentation rank, or aerobic system prior to discharge to an absorption system.

Sewage not allowed to surface on ground

No person shall cause sewage from any individual disposal system to be deposited upon the ground surface, nor shall any person operate any individual disposal system which causes sewage to surface upon the ground. (Applicable to Weiss development prior to installing private collection line.)

Systems not to be less than four feet above groundwater table

No subsurface filtration system shall be installed where the groundwater table is within, or likely to be within, four feet of an absorption trench bottom or any other absorption or evapotranspiration system or receptacle for sewage in the individual disposal system. (Primarily applicable to development in Spearfish Valley alluvium.)

Systems not to be within one hundred feet of lakes, streams or impoundments

No components of any individual sewage disposal system shall be located within one hundred feet, measured horizontally, of the high water line of any lake, stream or impoundment of water. (Applicable to West development.)

Distance of well, spring or cistern from seepage pit, absorption systems, pit privies, barnyard or farm silo

No seepage pit, absorption system, pit privy, barnyard, barn gutter, animal pens or farm silo shall be installed closer than seventy-five feet from wells less than one hundred feet deep or from springs, or fifty feet from cisterns or from wells which are more than one hundred feet deep. (Applicable to Upper Higgins Gulch.)

Wells, or springs or cisterns distance from disposal systems

No septic tank, aerobic system, vault privy, holding tank, sewer line of tightly jointed tile or equivalent material, shall be closer than seventy-five feet from wells less than one hundred feet deep or from springs, or fifty feet from cisterns or from wells which are more than one hundred feet deep.

Distance of plastic or cast iron pipes from systems

Sewer lines of schedule forty plastic or cast iron with leaded or gasketed joints shall not be closer than fifteen feet from any well or spring.

Distance of septic tank or aerobic unit from a building

No septic tank or aerobic unit shall be closer than ten feet from any dwelling or occupied building.

Privies and absorption systems, seepage pit distance from building

No pit privy, absorption system, or seepage pit shall be closer than twenty feet from any dwelling or occupied building.

Distance of disposal systems from property lines

Septic tanks, aerobic systems, pit privies, vault privies, absorption systems and seepage pits shall be at least ten feet from the property line of the owner.

Types of water-carriage systems allowed

An individual water-carriage sewage disposal system shall have at least one of the following alternative treatment processes within the system:

(1) A septic tank with an absorption system or a holding tank.

(2) An aerobic treatment unit with an absorption system or a holding tank; or

(3) A chemical treatment unit with a holding tank.

Calculation of the minimum square feet of absorption trench

There shall be a minimum area of absorption trench or trenches, in a water-carriage disposal system, which utilizes an absorption system. Such an area shall be expressed in terms of square feet, that is, the length times the width of the trench or trenches. The square feet of such an absorption trench or trenches shall be equal to the number derived by multiplying the gallons per day of waste flow (Q), for which the system is designed, times the square root of the rate of percolation expressed in minutes per inch (t) and dividing this product by five. This can also be expressed as A = (Q times square root of t) divided by five. In no case shall the gallons per day of waste used in this formula be less than seven hundred and fifty. The absorption trench area calculated by such formula shall be increased by an additional twenty percent when wastes from a garbage grinder are discharged into the disposal system, and the area shall further be increased by an additional forty percent when an automatic washing machine discharges into the disposal system.

Alternative methods of determining required absorption trench area

In lieu of calculating the absorption trench area required above the following criteria may be used for a residential dwelling as an alternative means of determining the area; provided, the absorption trench must be of an area sufficient for at least three bedrooms. Where the percolation rate is:

(1) At least five minutes, but slower than ten minutes per inch, the minimum absorption shall be one hundred and twenty-five square feet per bedroom;

(2) At least ten minutes, but slower than fifteen minutes per inch, the minimum absorption trench area shall be one hundred and sixty-five square feet per bedroom;

(3) At least fifteen minutes, but slower than thirty minutes per inch, the minimum absorption trench area shall be two hundred square feet per bedroom:

(4) At least thirty minutes, but slower than forty-five minutes per inch, the minimum absorption trench area shall be two hundred and fifty square feet per bedroom;

(5) At least forty-five minutes, but slower than fifty-five minutes per inch, the minimum absorption trench area shall be three hundred square feet per bedroom:

(6) At least fifty-five minutes, but slower than sixty minutes per inch, the minimum absorption trench area shall be three hundred and fifty square feet per bedroom.

Percolation test to be conducted before constructed

Any person who constructs or causes to be constructed or installed, a subsurface absorption system shall first conduct a percolation rate test, before installation of any such system.

Manner in which percolation test shall be conducted

A soil percolation test shall be made with a minimum of two test holes within five feet of where the absorption trench or shallow disposal system is desired to be located. The holes shall be in soil representative and of similar character as the rest of the area where the system will be placed.

(1) The horizontal dimension of the percolation test hole shall be from six to twelve inches and the vertical sides shall be terminated at the maximum depth of the proposed absorption trench or at a depth of at least thirty inches, whichever depth is greater;

(2) Test holes shall be located in unfrozen soil and shall be filled at least fifty percent full at least eight hours, but not more than sixteen hours before making the soil percolation test; immediately prior to making the test, each hole shall be refilled to at least fifty percent of its volume. When the water reaches the lower twenty-five percent of the test hole, the test shall be commenced. The percolation rate, in a test hole shall be expressed in the number of minutes which it took the water level to drop one inch. The percolation rate for the area where the subsurface infiltration system is desired shall be the average percolation rate of all the test holes.

Absorption or evapotranspiration system permitted -- Exceptions

Either an absorption system or evapotranspiration system may be used when the percolation rate is between five and sixty minutes per inch, providing all other requirements for a disposal system are met. No subsurface absorption system shall be installed where the percolation rate is faster than five minutes per inch. An evapotranspiration system, but not an absorption system, may be used when the percolation rate is slower than sixty minutes per inch. (Applicable to development out of the Spearfish Valley alluvium.)

Minimum capacity of septic tanks

All septic tanks shall have a minimum capacity of at least one thousand gallons of liquid before there will be an overflow into the septic tank outlet. When a housing unit or units serviced by a septic tank contain more than three bedrooms, each additional bedroom, in excess of three, shall require an additional two hundred and fifty gallon increase in the capacity of the septic tank beyond the one thousand gallons. Septic tanks serving premises other than housing units shall have a minimum capacity to permit retention of incoming sewage for thirty hours at one hundred and fifty percent of the average daily flow.

Requirements for an absorption trench

An absorption system shall have at least two absorption trenches of approximately equal length. The length of a trench shall not exceed one hundred feet; the width of a trench shall not exceed three feet; and a trench shall be at least four inches below the ground surface but the depth shall not exceed four feet. The trench shall be formed by a filler material of washed gravel, crushed stone, slag, or clean bank run gravel ranging in size from one-half inch to two and one-half inches in diameter. An absorption line shall be placed within each trench and shall run along the length of the trench. The filler material shall be at least six inches deep below the bottom of the line and two inches deep above the top of the line. The bottom of a trench be uniformly graded to a slope from a minimum of two inches to a maximum of four inches per one hundred feet. Trenches shall be at least six feet apart.

Separation required

There shall be at least four feet of soil between an absorption trench or seepage pit bottom or any other component of a subsurface absorption system and the high groundwater table elevation or rock formations or other impervious soil strata. (Applicable to Mountain Plain and areas with shallow bedrock and water table.)

Minimum lot size required

A water-carriage disposal system can only be installed and operated on a lot which is at least forty-three thousand, five hundred and sixty square feet (one acre), when the potable water is supplied by a private water supply system. A water-carriage disposal system can only be installed and operated on a lot which is twenty thousand square feet or larger when the premises are supplied by a public water supply system. The requirements of this section do not apply where sewage is emptied into a holding tank.

Water-carriage disposal not permitted in insufficient lot area unless holding tank installed

When a lot size is smaller than that specified or the rate is faster than five minutes per inch, no water-carriage disposal system shall be permitted, unless a holding tank is installed.

Individual sewage disposal system design considerations

The design of each individual sewage disposal system must take into consideration well locations, topography, groundwater table, elevations, soil characteristics, available area, and maximum occupancy of the building.

Determination of type of system

The type of disposal system shall be determined on the basis of location, soil permeability, and groundwater elevation.

Review of plans for construction not required unless deviations desired

Individual sewage disposal systems may be designed and installed in accordance with this chapter without submission of project plans and specifications to the secretary for review and approval. Where deviation from this chapter is desired by the owner, the proposed change or plans and specifications and supporting information shall be submitted to the secretary for review and approval.

Existing systems not affected by this chapter -- Exceptions

Individual sewage disposal systems existing prior to February 28, 1975 are not subject to this chapter except when the systems are changed, the groundwater becomes polluted, or sewage is surfacing. Existing abandoned sewage disposal systems are not exempt from this chapter and shall be abandoned as described.

Existing subdivisions and developments exempted from lot size requirements -- Proviso

Housing subdivisions and housing developments platted before February 28, 1975 are exempt from the lot size requirements provided compliance with other provisions of this chapter can be acheived.

Application of State Regulations to the Spearfish Area

These regulations define very specifically the requirements that must be met in order for a septic tank and absorption field to be installed. The authority of implementing these requirements is placed on the counties. Within Lawrence County the responsible agencies are the Lawrence County Planning and Zoning Commission which evaluate and approve subdivision plans and the Northern Hills Sanitarian which is responsible for approving the engineering aspects of the system and insuring that the public health is maintained.

Within the Study Area data are very limited on the types, conditions, location, and installation of existing septic tank systems. However, some information has been obtained by personal communications from Scott Engineering who contacted the Deberg-Fuller, and Deer Meadows developments. This information is presented in Table 40. From these data it appears that at least 13 septic systems are considerably deeper than the State requirement of 4 feet. The explanation for this is that these homes have basements and in order to provide sewage disposal for facilities in the basement the deeper system are required. The date of construction for these units is currently not known, thus it can not be determined whether they meet the requirement of construction before February 28, 1975 for exemption from compliance with the State regulations.

From the comments received it appears that few of the systems are failing, some have had their leach field enlarged, and most are located in fairly tight clay soil. These actions concur with the recommendations of SCS for the probable need to enlarge absorption field place in the soils of this area to overcome slow percolation rates.

The Mountain Plains area potentially will have difficulty in complying with the requirement of not discharging into a crevice of a rock formation due to the fractured nature of the Minnelusa outcrops in the area. Furthermore, some areas of Mountain Plains will not have an adequate soil profile for a conventional septic tank system.

There are several alternative on-site disposal systems which are manufactured that can be used in place of conventional septic tank systems. Some of these require some engineering design prior to installation and may require special maintenance considerations. These systems include: mounds, eletro-osmosis, vaults, composting, and mechanical aeration. As long as the discharging systems utilize the soil matrix for final disposal, obtain site approval from planning and zoning and the local sanitarian, these systems are satisfactory for installation. However, should the system be designed for a surface discharge point, the owner/operator must obtain a National Pollutant Discharge Elimination System (NPDES) permit. Such a permit will stipulate the required discharge water quality (a minimum requirement is secondary treatment), monitoring requirements, etc. In reality the issuance of such a permit to a private individual is very unlikely and the use of these systems is discouraged by EPA.

BACTERIOLOGICAL MOVEMENT BELOW SEPTIC LINES

Much of the work which has been done relative to the health effects of wastewater being filtered through soil is for land application systems. These studies have investigated the ability of soil to filter bacteria and viruses from surface-applied contaminated wastewater. However, information on the survival and migration of viral indicators in the soil below septic lines has been essentially non-existant. Recent studies have been conducted which specifically address the movement of fecal coliforms and coliphages (vireses) below septic lines. (13) The following is the abstract of this study which summarizes the investigation.

> "A 2-year lysimetric study utilizing three undisturbed soils was conducted to investigate the movement of fecal coliforms and coliphages to the groundwater. Septic tank effluent was applied to each of the three soils at appropriate design rates via subsurface septic lines. The soils included had sand contents of 80, 41 and 7.6%. Indigenous concentrations of fecal coliforms in the effluent were more than sufficient to assure detectability. During the winter the levels of indigenous coliphages decreased, and on several occasions the septic effluent was spiked with cultured coliphages. The remainder of the year, indigenous levels were sufficient to allow adequate detection.

Leachate samples were analyzed on a continuous basis, and at the end of the study the soils below the septic lines were dissected and sampled on a grid pattern. They were analyzed for both fecal coliforms and coliphages.

"On only a few occasions were fecal coliforms present in leachate collected 120 cm (4 ft) below the septic lines. Subsequent samples from the same locations did not indicate the presence of fecal coliforms so that the few samples that were collected shortly after application began may have been a result of contamination, or they may be indicative of greater mobility before organic residue built up in the soil. Soil samples taken 1 and 2 years after application began indicated limited mobility and survival of fecal coliforms in all three soils.

"Coliphages were present in the leachate only in very low concentrations immediately after spiking of the applied sewage with 10^3 times more organisms than were applied. Soil samples also confirmed the limited mobility of coliphages. Thus 120 cm of any of the soils tested appeared to be sufficient to minimize the possibility of groundwater pollution by fecal coliform or coliphages from septic effluent disposal."

AERIAL IMAGERY

An analysis was undertaken in the Spearfish Study Area to identify and locate individual home sewage disposal systems exhibiting signs of failure utilizing aerial imagery flown on November 1, 1978. The three types of film used in the aerial survey included normal color (Ektachrome 2448), color infrared (Ektachrome 2443), and thermal infrared flown at a scale of 1:8000.

Failure of septic tank systems can usually be attributed to one or more of the following causes: 1) the soil used in the absorption field has too slow a percolation rate to allow for adequate assimilation, filtration, and biodegradation of sewage effluent flowing into it, 2) the septic system is installed too close to an underlying impervious layer, 3) the septic system may have been installed in an area where the seasonal water table is too high for its designed use, 4) the soil used in the absorption field

has too high a percolation rate for effective attenuation of sewage effluent prior to its reaching underlying groundwater, 5) mechanical malfunctions, or breakage, in the septic tank, distribution box, and/or drainage pipes has occurred, 6) caustic, toxic, or otherwise harmful substances which could kill bacteria in the septic tank and/or absorption field, and cause subsequent clogging, have been flushed into the system, and 7) all or part of the system has been improperly installed. Other potential causes for on-lot disposal system malfunctions can be found in Reference.[14]

With respect to remote sensing of failing septic tank systems, only those malfunctions which are noticeable on the surface can be detected via aerial imagery. Those failures which are related to sewage backing up into the home, or too rapid transport through the soil into the groundwater, cannot be detected through remote sensing. In instances where the latter is occurring, the use of a soil lysimeter, "septic snooper",[15] or similar apparatus may be necessary to determine the existance and extent of a problem. Alternatively groundwater analyses can be made to determine if a water quality problem exists.

Based upon work undertaken to date, it has been determined that the primary surface manifestations or signatures associated with failing septic tanks and/or absorption fields are: 1) conspicuously lush vegetation, 2) dead vegetation (specifically grass), 3) standing wastewater or seepage, and 4) dark soil where excess organic matter has accumulated. All of the above are a result of the upward movement of partially treated or untreated wastewater to the soil surface, and usually appear either directly above or adjacent to one or more components of the septic system (i.e. septic tank, distribution box, and/or absorption field). More often than not, two or more of these manifestations will occur simultaneously at any given homesite. In some cases, depending upon the soils makeup of the particular area, the outline of the drainage line(s) of a properly functioning septic system can be distinguished on aerial photography. This peculiarity points up the need for tailoring "photo interpretation keys" to specific geographical areas.

Using the above signatures as aerial photo interpretation keys, approximately sixty potential septic system malfunctions were identified and located in the Spearfish area.

In order to identify residents which would be eligible for Federal assistance homes (both mobile and permanent) erected before and after October 1972 and December 1977 comparisons with historical photography was accomplished. In lieu of the limited historical aerial coverage available for the Spearfish area, aerial photography dated September 1972 and October 1977 was actually used in this analysis. This analysis revealed that there were approximately 314 homes erected between September 1972 and October 1977, and 128 homes erected between October 1977 and November 1978.

On April 9 and 10, 1979 an extensive field investigation was conducted to verify if septic tank failures by surfacing were occurring based on EPA's aerial photography analysis. Representatives of the following agencies and groups participated during the field investigation:

- EPA
- South Dakota Department of Environmental Protection
- Lawrence County Planning and Zoning
- Belle Fourche
- EIS consultant
- 201 consultant
- Citizens advisory group

Through field inspection, suspected failing septic tanks were evaluated and categorized as follows: 1) verified septic system failures - these systems were actually exhibiting effluent "break-outs" at the soil surface, 2) septic systems suspected of exhibiting seasonal effluent surfacing - various surface manifestations visible during the field check suggest that these sytems should be re-checked during periods of heavy use and/or moderate to heavy rainfall, 3) vegetative change, disturbed earth, and/or slight collapsing of the soil over the drainfield only - no immenent public health hazard is believed to be associated with these systems, and 4) false signatures - these include free-flowing wells, drainage from roof gutters, and other areas of excess soil moisture and lush growth not related to failing septic tank systems.

While very few surface failures were uncovered in the area, it is believed that all of the potentially failing septic systems were inspected, and that an accurate and thorough survey of the area was accomplished. Due to the arid nature of this region small areas of excess soil moisture and lush vegetative growth tend to be greatly enhanced with respect to their surroundings. These characteristics (i.e. "signatures") are very closely correlated with surface failures of septic systems and, consequently, any homesite exhibiting these characteristics was "suspected" of having a potentially failing system. Thus, all of the potential failures in the study area are believed to have been field-checked and evaluated. The interpretations/verifications of suspected septic system failures based on the ground truthing field survey resulted in the following conclusions:

- there are two verified septic system failures which are surfacing.
- there are thirteen septic systems which are suspected of failing seasonally.
- there are thirty-three septic systems which have visible surface manifestations, but are not associated with a public health hazard.
- there are twelve false signatures.

(See Figure 19).

The two verified failures are isolated systems. One, in Section 28 west of the Belle Fourche infiltration gallery appears to be a direct piping of effluent from the septic tank to Higgins Gulch. There is no evidence of a leach field. The other confirmed failure is west of Spearfish in Section 16. This system is located in the Vale silt loam soil which has a percolation rate of from 100-30 minutes per inch and because of this is rated by SCS to have moderate limitations for septic tank absorption fields. The underlying geology is the Minnekahta formation.

The suspected seasonal failures are distributed throughout the study area. Two are along Christensen Drive, three are west of Spearfish in Section 16, one is within the Sanitation District, four are in Deberg-Fuller, two are in Grand View acres, and one is in MacKaben No. 1. During the on-site field inspection these systems could not be classified as failing. However, it was determined that when the leach field soils of the systems become saturated, during rainfall events, there is a potential

for failure through surfacing. A review of the soils in which these systems are placed indicate very slow percolation rates (100 to 30 minutes per inch). These systems overlay a variety of geological formations, including Minnekahta, Spearfish, old terrace deposits, and alluvium.

The remaining categories, visible surface manifestations and false signatures, are concentrated in those areas north and northwest of the City of Spearfish. These areas have undergone the greatest development outside the City and have the greatest concentration of on-site wastewater disposal systems. The surface manifestations (typically lusher vegetation than the surrounding area) indicate that these systems are functioning as evapotranspiration systems. This is a consequence of the tight clay soils inhibiting wastewater percolation which creates a moister micro-environment.

During field inspection of suspected septic failures a qualitative investigation of Higgins Gulch was conducted. A field survey of Higgins Gulch from Deer Meadow to Deberg-Fuller and from the access road just north of wards to an area west of the gallery was conducted. This survey indicated that Higgins Gulch has a very narrow, very permeable alluvial flood plain. Upstream of the Deer Meadows development the Higgins Gulch stream goes into the alluvium, serving to recharge the groundwater, possible in a subterranian stream channel. Adjacent to the point where the flow becomes subsurface is an abandoned gravel quarry. The site consists of an excavated hole, twenty to thirty feet deep which contained about five feet of standing water. The pond is filled by Higgins Gulch during periods of high surface runoff as evidenced by the flood deposited material on the edge of the pond. At the time of inspection there was no indication that any recharge from groundwater was occurring.

Higgins Gulch begins to flow again in the channel east of the infiltration gallery. The stream channel appeared to be gaining water and the flow was considerably greater than that observed in the Deer Meadows development area. It is assumed that this greater flow is a consequence of Higgins Gulch being within the Spearfish Creek alluvium and groundwater being recharged by Spearfish Creek is reaching Higgins Gulch.

CONCLUSIONS

In order to evaluate the assembled data in a meaningful manner it is necessary to identify the issues which are pertinent to the study. As the EIS progressed issues were identified through the public participation process, the input of the citizens advisory group, and data manipulation. The following issues have been identified as significant at this time:

- The source of sporadic groundwater contamination at and around the Belle Fourche infiltration gallery.
- The cause of surface water contamination in Higgins Gulch and Spearfish Creek.
- Septic rank failures identified by EPA's aerial imagery photography.
- Groundwater contamination in the Higgins Gulch area, Mountain Plains area and Christensen Drive area.
- The suitability of septic tanks as a means of sewage disposal in the areas outside of Spearfish.

(NOTE: Groundwater contamination at and around the Belle Fourche infiltration gallery was also discussed in Working Paper No. 1 Water Quality Summary.)

Water quality data at the gallery are available back to 1967. However, the period of record is fragmented with no data available for the following years: 1969, 1970, 1971, 1972, and part of 1973. The record of data is further complicated by an inconsistency in the parameters monitored. In 1967 and 1968 total coliforms were the major parameter monitored, then in 1973, 1974, and the first half of 1975 samples were monitored for fecal coliform and fecal streptococci. One sample (7-16-73) was monitored for total coliform. From 8-26-75 total coliforms were monitored only until 9-9-77. In the summer of 1978 extensive monitoring was done at and around the gallery of both the surface water and groundwater.

The earliest date of contamination at the gallery is 8-7-67 when total coliforms numbered 3.6/100 ml. Contamination is also noted on 11-6-67, 11-20-67, 10-7-68, and 11-4-68 when each total coliform count was 2.2/100 ml. From 5-6-73 to 5-6-75 fecal coliform counts were mainly 2/100 ml, on 5-6-73, and on 7-31-73 counts were 3/100 ml, and on 5-7-74 a count of 4/100 ml was reported. On 7-16-73 a total coliform count of 16/100 ml is reported but fecal coliform were not tested for. From 8-26-75 to 5-10-78, 14 out of 40 monitoring events indicated contamination. Consistent contamination of the gallery was observed in the last half of 1978 but currently no contamination is reported.

Because the most comprehensive data for both surface water and groundwater quality are the result of the special studies conducted in 1978, and because of the inconsistencies in the historic data collected at the gallery, the special studies data are used to evaluate the gallery contamination problem.

Total coliform is the principal indicator of groundwater contamination. Fecal contamination occurs very sporadically at the groundwater monitoring sites. Surface waters in Spearfish Creek have fecal coliform counts that are as high as 370/100 ml, while most samples are between 30/100 ml to 90/100 ml. Total coliform data in Spearfish Creek are not adequate to evaluate. Surface water in Higgins Gulch has very high total coliform counts by comparison. All values are above 340/100 ml, with a maximum count of 15,000/100 ml reported on 7-7-78. Fecal coliform counts have a high of 276/100 ml, with most values between 30/100 ml and 90/100 ml.

It has been demonstrated that groundwater at the gallery is recharged by water from both Higgins Gulch and Spearfish Creek and that groundwater movement from the Higgins Gulch is in a northeasterly direction. This condition is a result of the groundwater from Higgins Gulch moving through the alluvial material in its stream bed entering the Spearfish Creek alluvium.

Sewage disposal by septic tanks and absorption field is practiced at the West Development and by one home in the Weiss Development which are within a few hundred feet of the infiltration gallery. These systems are located in the same alluvial deposits of the Spearfish Creek bottomland that the City of Belle Fourche has their infiltration gallery. The next closest concentration of developments using septic systems are in the Higgins Gulch area, about three miles away from the gallery. These developments are located on the Spearfish Creek bench areas. Soils, according to SCS, are of a clay-loam and because of their slow permeabilities not suited for septic tank absorption fields unless they are enlarged. (Soil permeabilities are summarized in Table 41).

On 6-16-78 groundwater contamination was identified at the gallery, Cundy drain, the well at Abernathy's and the Ward well. Surface water contamination is also indicated at three sites in Higgins Gulch. During the 24 hour period prior to the monitoring day a trace of precipitation is recorded, and five days prior 0.15 inches of rain occurred. Contamination at the gallery, Cundy's drain, Higgins Gulch also occurred on 6-23-78.

Forty-eight hours before and five days prior 0.07 inches and 0.62 inches of rain fell, respectively. The next monitoring period, 6-29-78, high coliform contamination at the gallery, Cundy's drain, Ward well, and the spring above Ward's and Higgins Gulch occurred. During a 48 hour period from 6-28-78 to 6-29-78 over 0.27 inches of rain fell in the study area. On 7-7-78 water quality samples were collected again. A lower coliform contamination than the previous sample is noted. Rain, totaling 0.85 inches fell from 7-5-78 to 7-7-78. On 7-14-78 coliform colonies have shown an increase over the previous monitored sample at the gallery, Cundy's drain, and Ward's well, but Higgins Gulch concentrations have decreased. No rain fell since the last monitoring. Coliform colonies dropped at all stations on 7-21-78 except the Cundy drain where they remained static and the spring above Ward's. Over 0.39 inches of rain fell during the 24 hour period prior to monitoring.

In conclusion, there is a correlation between rainfall events and contamination at the gallery (i.e. higher coliform concentrations follow rain and subsequent runoff).

Storm events are carrying different concentrations of coliforms off the land surface via runoff. These concentrations vary with land use within the drainage and rainfall intensity. Typically a rainfall event will initially flush the surface, delivering high concentrations to surface waters. See Higgins Gulch data and rainfall records for 7-7-78 and 6-29-78 and Spearfish Creek 9-18-78.

The contaminated material will be generated by both developed and undeveloped land and is commonly referred to as non-point source contamination.

As the runoff moves down the drainage surface water elevations rise. Groundwater elevations in the gallery area will increase due to the increased water flowing in Spearfish Creek and Higgins Gulch. As the groundwater elevation rises the potential for short-circuiting of the septic tank absorption field in the alluvium increases, thus contributing to the coliform contamination that has been carried into the groundwater from the surface water. Because of the defined movement of the groundwater the infiltration gallery becomes contaminated. This situation can be compounded

if the storm occurs in the gallery area. A high intensity rain on permeable soils will experience a downward flushing action as opposed to a runoff effect more typical of tight clays. As the rainfall percolates through alluvium it will have a flushing effect, transporting the absorption field contaminants deeper toward the groundwater.

It is therefore concluded that the sporadic contamination of the Belle Fourche infiltration gallery is a consequence of non-point source originating from runoff over livestock pasturing, and confinement areas, urban areas, and undeveloped areas. These sources are also contributing to the surface water contamination in Higgins Gulch and Spearfish Creek.

The suspected septic system failures identified by EPA's aerial imagery have been discussed in the Aerial Imagery Section. Two of the systems were confirmed as actual failures and thirteen were identified as potentially failing during wet periods. Because these systems are confirmed through surface manifestations it is concluded that tight, impervious soils are causing these problems. Therefore, these systems cannot be creating any groundwater degradation.

With the exception of the Christensen Drive area, existing data do not indicate that the groundwater in the vicinity of Higgins Gulch near the Deer Meadows, Deberg-Fuller developments or the deep aquifer which is partially recharged in the Mountain Plains area are contaminated. However, because the available data were not collected during the period of seasonal high groundwater additional studies will be conducted. This additional work will evaluate the seasonal high groundwater depth and its quality in the Spearfish and Higgins Gulch alluvium and the two perched water table areas located in the old terrace deposits. This work will be completed by July 1, 1979. There are no plans at this time to monitor the deep aquifer in the vicinity of Mountain Plains because of the very low density of development. However, surface water quality in Spearfish Creek is being monitored by the U.S. Fish and Wildlife service. This program is a consequence of the potential for non-point source contamination originating from Mountain Plains development interferring with the operation of the Spearfish Fish Hatchery.

A shallow well at the mouth of Christensen Drive has been abandoned for domestic use due to coliform contamination. The source of contamination is likely caused by development in the alluvial valley upstream of this well. Septic tanks in this area, particularly those serving the campgrounds on the north side of the valley, are suspected as failing seasonally, and those in the shallow alluvium of the valley bottom are probably the contributing factors along with non-point sources in contamination of this well. The reason this shallow aquifer is contaminated by septic discharges while the Spearfish Valley is not, is attributable to the small confined nature of the shallow alluvium underlain by impervious materials.

In summary, the findings to date indicate that septic tank systems are a feasible means of sewage disposal in areas outside the City of Spearfish and above the Spearfish alluvial valley. Because of the impermeable soils, the absorption fields must be constructed larger than the State code requires and the systems will potentially function as evapotranspiration systems as opposed to the conventional leach field system. There would be no problem in extending these fields as all lots outside the city are generally one-half acre or larger. The tighter soils and the associated evapotranspiration should afford protection of groundwater in these developed areas.

At this time no public health hazards are identified in the Mountain Plains area relative to septic tank systems. The Mountain Plains area does have a high potential risk of contaminating the Minnelusa aquifer if conventional septic systems are used to dispose of wastewater as development density increases. Therefore, the approval and installation of the systems must be monitored on an individual site basis. The ultimate success or failure of on-site disposal systems will be determined by the Lawrence County Planning and Zoning Commission, and the Northern Hills Sanitarian. Based on SCS soil interpretation, areas of septic tank limitations are illustrated in Figure 20. This data along with data collected through septic tank permitting and data presented during this project should be utilized in future septic tank review/approval.

TABLE 1

AVERAGE ANNUAL TEMPERATURE AND PRECIPITATION

SPEARFISH, SOUTH DAKOTA

	1972-1977 Ave. Temperature of			1889-1977 Ave. Precipitation in.	% of Total Precip.
	Ave. High	Ave. Low	Ave.		
January	33.6	13.9	23.7	0.62	3.1
February	40.3	20.1	30.2	0.65	3.2
March	44.8	26.0	35.4	1.26	6.2
April	54.7	36.1	45.4	2.18	10.8
May	66.8	43.5	55.1	3.14	15.6
June	63.6	53.0	58.2	3.70	18.3
July	83.7	58.1	70.9	2.94	14.6
August	82.6	55.5	69.1	1.58	7.8
September	72.0	45.2	58.6	1.49	7.4
October	60.4	35.5	48.0	1.23	6.1
November	46.3	24.3	35.3	0.77	3.8
December	37.1	18.2	27.6	0.63	3.1
	57.2	35.8	46.5	20.19	100.0

TABLE 2

DAILY PRECIPITATION-1967

Day	Jan	Feb	Mar	Apr	May	Month Jun	Jul	Aug	Sep	Oct	Nov	Dec
1					TR			0.12		0.18	0.40	
2			0.05		0.01				0.15		TR	
3	TR	TR	0.18		TR							
4		0.06		TR								
5	0.05	0.10	0.08	0.06		0.22				0.09		TR
6	0.02	0.05	0.27	TR		0.03	TR	0.66		0.06		0.01
7		TR			0.16	0.06		TR				TR
8		TR				0.01						0.05
9		0.01			TR	0.12		TR			TR	
10		TR	TR		0.13							
11					0.2	0.89			0.12			TR
12	TR		0.01	0.18	TR	0.07			0.11	TR	TR	TR
13	TR	0.03	0.02	1.80		0.31			1.20	0.02	TR	TR
14		0.41	0.05	TR		0.25	0.04	0.03	0.60			
15	0.02				0.16	0.52	0.13		1.18	0.07		
16	0.07	TR	TR	0.06					0.40			TR
17	TR	TR	TR		TR				0.25			TR
18						0.19	0.02		0.30			0.01
19		TR	0.01	0.18					TR			TR
20				TR			TR	TR			TR	0.17
21		0.01		TR		TR					TR	
22		TR				0.35						
23	0.02			0.02	TR	0.46	0.05			TR	TR	
24	0.12			0.15							0.02	0.05
25	0.02		0.01	0.06	0.51	0.26						
26			0.03	TR			0.22			TR		0.07
27							TR	TR				0.07
28				0.02	TR	TR				0.46		0.02
29	TR		TR					TR		TR		0.02
30	0.21		TR		0.03						TR	
31	0.12			0.52	TR		0.22					0.08

TABLE 2 (Continued)

DAILY PRECIPITATION-1968

Day	Jan	Feb	Mar	Apr	May	Month Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.07		TR							0.20		
2				0.16					1.06			0.19
3				0.06		0.11						
4	0.05					0.03	0.04	TR	0.18		0.20	0.02
5	0.13				0.05	0.26	TR				0.09	TR
6					TR	0.18				0.03	0.01	
7			0.05	TR	0.01	0.14			0.17	0.01	0.02	
8	TR		TR	TR	0.05	0.85		0.12			0.03	
9			0.04			TR		0.28			0.22	
10	TR		0.03		0.01	0.20	0.10					
11		0.18	TR				0.01					0.06
12				0.03							0.01	0.01
13			0.05		0.19	0.18		TR				
14					0.1	0.11		0.45			TR	
15		TR		0.02	0.25	0.39	TR	TR	0.93	0.40	TR	
16					0.11		TR	TR	0.20	TR		0.05
17					0.03	0.26	0.58	0.08	TR		0.09	0.26
18			0.22		0.01							TR
19		TR	0.04							0.06		0.05
20		0.15	0.02			0.66			0.05			0.03
21		0.05		0.5	0.33							0.02
22		0.03		0.05	0.07			0.18				TR
23	TR	0.02			0.08	0.46	0.39	0.42	TR			
24		0.05	0.02		0.03	1.32	TR					
25	0.09			0.15	0.14	0.11	0.93				0.15	0.14
26	TR			0.01	0.16		0.02			0.23		0.06
27		0.03			0.08		0.28					TR
28	0.01	TR										
29						0.03						0.02
30			TR		0.20	0.03	TR				0.05	TR
31												

TABLE 2 (Continued)

DAILY PRECIPITATION-1973

Day	Jan	Feb	Mar	Apr	May	Month Jun	Jul	Aug	Sep	Oct	Nov	Dec
1				0.11		0.09			0.06		0.06	
2	0.08			0.02	TR	0.69			0.75	0.05	0.08	
3	0.01			0.01					0.18		0.08	
4								0.01			TR	0.05
5	TR		0.1		0.08							0.01
6	0.05	0.10		0.19				0.12			TR	
7	TR	0.02		0.05				TR	0.06		TR	
8				0.06	0.08		0.23		TR			
9					0.02		0.09			1.12		
10		TR			TR					TR		
11		TR						0.12		TR		TR
12		0.12						0.43				0.29
13		0.06	2.25								TR	TR
14			0.04	0.15		0.29			0.34			
15			TR			TR			0.06	0.03		
16						0.08			0.01			0.13
17				TR		0.33						0.27
18		0.20	0.03	0.37		0.40						0.03
19	0.02	TR		1.71		0.03	0.41		0.01		0.03	
20				0.47	0.05	0.30	0.28		0.12		0.02	
21			0.19				0.02		0.15			
22			0.13				1.10	0.11				0.06
23		TR	0.30	0.06	TR		0.32	0.18	0.06	0.32		TR
24			0.32	0.20			TR	TR		0.80		TR
25				0.02	0.51				0.07	0.02		0.02
26	0.23		TR	TR	2.15			TR				
27					0.22							TR
28				0.10	0.09		0.01					0.04
29				0.20	0.02	0.03						0.01
30				0.31								TR
31												

TABLE 2 (Continued)

DAILY PRECIPITATION-1975

Day	Jan	Feb	Mar	Apr	May	Month Jun	Jul	Aug	Sep	Oct	Nov	Dec
1			TR	0.01				0.01				0.02
2												0.04
3			0.03			0.15						
4		TR	0.06					0.05				
5		0.01										TR
6		0.01			0.58		0.12					
7	0.09		0.12	0.04	0.14		0.10					
8	0.03	0.22	0.03	0.28	0.06	0.26	0.65					TR
9	0.31		TR	0.02	0.28	0.81				0.12	0.08	
10	0.05	0.08	0.04		0.09	0.20						
11			0.0	TR	0.11	0.04					TR	0.09
12		TR	0.09								TR	0.10
13	TR									TR		0.20
14	0.05	TR				0.25		0.04				
15	0.20	TR				0.09		0.23		0.04		0.01
16	0.01					0.11				0.02		0.04
17				0.23		0.42	0.02		TR			0.02
18	0.41			0.16		0.14		0.04	0.10			
19						0.47		TR			0.04	
20	0.18			0.27	0.51							
21	TR	0.17			0.0		0.20	TR				
22		0.06	0.05		0.35	0.14						
23			0.10		0.03		0.02			0.28		
24	0.01		0.05	0.03	0.16		0.01			0.34	0.07	
25				0.19	0.08					0.06	0.16	
26	0.13		TR			1.06					0.05	
27			0.09	0.45		0.02				0.04		
28			0.22	0.56					0.02	0.06	0.05	0.21
29	0.07		0.16	0.15								
30			0.02	0.01					0.14			0.12
31	0.01		0.02		0.18		0.02					0.15

TABLE 2 (Continued)

DAILY PRECIPITATION-1976

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
					Month							
1	0.08		0.09					0.02				0.04
2	TR		0.34	TR			0.04	0.10				
3				0.02		0.12	0.32					
4		0.03	0.03							0.28		
5		0.23	0.01		0.11			0.02		0.05		0.05
6	0.03	0.01			0.01	0.95		0.02		TR		0.08
7	TR			0.31		2.00			0.19	0.27		0.02
8	0.04			0.08		0.01			0.07			TR
9									0.04			
10	0.04	0.50	0.13		0.16			0.04				0.07
11			0.07	0.05				0.22			0.01	
12					0.24		0.10		TR		TR	
13		0.05			0.06		1.79	0.02				
14				0.24		1.18	0.12					
15	TR		TR	0.11		6.46	0.10		0.29			
16	0.04	0.16		0.03	0.88			0.01				
17				2.14		1.43						
18	0.01					0.98				0.05		
19		0.01		0.04			TR	0.01		0.05		
20			TR	0.14					0.05			
21			0.02		0.20		0.02					
22												
23					0.08	0.68					0.06	
24			0.02	0.10	0.11	0.12				0.04		TR
25			0.10			0.01			0.05			
26	TR		0.02		0.33	0.05			0.15		0.60	
27			TR	0.08		0.02		0.06		0.03		
28				0.16			0.12					TR
29		0.08		0.03	0.21		0.09				0.01	0.05
30					0.38		0.07				0.02	0.02
31	TR											0.02

TABLE 2 (Continued)

DAILY PRECIPITATION-1977

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
					Month							
1			0.02						0.13	0.69		
2									0.21	0.32	0.02	TR
3			0.14	TR				0.04	0.15			0.09
4	0.04		0.11	0.11				0.03		TR		0.10
5	0.03		0.02	0.13	0.13		0.64	0.01		0.05		
6					0.08							
7	0.02				0.36		0.01	TR		0.52		0.10
8										0.35	0.20	0.17
9							0.10	0.25		0.06	TR	
10								0.05		0.36		
11	TR					0.25		0.39				
12				0.44		0.30			0.02			
13				0.24	0.11	0.20						
14	TR	0.03				0.31	0.89					TR
15		TR				TR	0.19	1.34		0.05	0.02	
16	0.10	TR		0.05	0.35			0.02				0.08
17				0.02	0.18	0.32						
18	0.12			0.02	0.23	0.02						
19	TR	0.01	TR	0.37	0.33							0.16
20			0.23	TR	0.03		0.06					
21				0.02	0.02	0.13	0.03			TR	0.79	0.01
22					0.02				0.04	0.25	0.01	
23		0.65						0.03	0.04			
24						0.20	0.10		0.88			
25	0.01	0.03				0.08	0.03	0.04				0.09
26	0.03							0.02				0.03
27	0.05	0.06			0.04	0.07	0.41	0.72				
28	0.09	0.04			0.04			0.46				
29	0.06		1.06									
30			2.63	0.08		0.05			1.15	0.28		TR
31			0.7		0.27			0.11				0.27

TABLE 2 (Continued)

DAILY PRECIPITATION-1978

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
					Month							
1		0.09	0.01			0.10	1.00			TR		
2			TR					0.09				0.10
3				0.09				0.20				
4				0.02	0.69							0.02
5			0.06		0.41							0.13
6					0.48		0.20					0.01
7			0.03		0.60		0.35					0.01
8	0.10	TR			1.30	0.03	0.30					
9	0.06	0.30		0.12	0.11		0.19				0.02	
10	0.02		0.05								0.57	
11		0.14				0.15		0.83	TR	0.09	0.20	
12		0.21		0.14	0.01				0.05		0.10	
13		0.14	0.15		0.06							0.02
14		0.09	TR	0.03				0.07				
15		TR	0.01					0.46				
16	TR	0.03	0.02			TR						
17		TR			0.04		0.31	0.05				
18	0.02			0.59	0.38	0.62			0.12	0.30	0.03	
19				0.61	0.32							
20		0.18			0.09						0.10	0.11
21							0.39				0.01	
22						0.07	1.20			0.04		0.03
23	TR		0.11									
24		0.03	TR									0.07
25	0.01					0.20				0.18		0.03
26										0.02	0.12	
27	TR										0.17	
28	0.06	0.14		0.08				0.13			0.04	0.01
29	0.01			1.07	0.15	TR	0.05				TR	
30	TR			0.25	0.42	0.27	0.09	0.01	TR		0.01	
31					0.18		0.28					

TABLE 3

SOIL INTERPRETATIONS

SUITABILITIES AND LIMITATIONS

Soil Name	Map Code	Septic Tank Leach Field	FLOODING Frequency	FLOODING Duration	FLOODING Months	HIGH WATER TABLE Depth (ft.)	HIGH WATER TABLE Kind	HIGH WATER TABLE Months	Bed-Rock Depth (in.)
Barum silt loam	3A, 3F	Severe:floods	Occasional	Brief	May-Jul	>6.0	-----	------	>60
Higgins silt loam	4A	Severe:floods,wetness	Common	Very brief to brief	Mar-Oct	0-2.0	Apparent	Oct-Jul	>60
Winetti cobbly loam	6	Moderate:floods	Rare	------	-------	>6.0	-----	------	>60
Barnum silt loam channeled	7F	Severe:floods	Occasional	Brief	May-Jul	>6.0	-----	------	>60
Glenberg Variant fine sandy loam	13A	Severe:floods	Frequent	Brief	Apr-Aug	4.0-6.0	Apparent	Apr-Jul	>60
Rekop-Gypnevee	15								
Rekop		Severe:slope,bedrock	None	------	-------	>6.0	-----	-------	10-20
Gypnevee		Moderate:slope	None	------	-------	>6.0	-----	-------	>60
Paunsaugunt-Rock outcrop	17								
Paunsaugunt		Severe:slope,bedrock	None	------	-------	>6.0	-----	--------	10-20
Canyon-Bridget Complex	19								
Canyon		Severe:bedrock,slope	None	------	-------	>6.0	-----	-------	>60
Bridget		Severe:slope	None	------	-------	>6.0	-----	-------	>60
Gypnevee-Rekop loams	20								
Gypnevee		Severe:slope,bedrock	None	------	-------	>6.0	-----	-------	10-20
Rekop		Moderate:slope	None	------	-------	>6.0	-----	-------	>60
Nevee-Spearfish -Rock Outcrop	21,21R								
Nevee		Moderate:Perc.Rate,slope	None	------	-------	>6.0	-----	-------	40-60
Spearfish		Severe:slope, bedrock	None	------	-------	>6.0	-----	-------	6-20
Swint silt loam	22A,22B, 41	Moderate:floods	Rare-Occ.	Brief	Apr-Oct.	>6.0	-----	-------	>60
Tilford silt loam	23A	Slight	None	------	-------	>6.0	-----	-------	>60
Tilford silt loam	23B,137B	Slight	None	------	-------	>6.0	-----	-------	>60
Tilford silt loam	23C	Slight	None	------	-------	>6.0	-----	-------	>60
Vale silt loam	26A	Moderate:Perc.Rate	None	------	-------	>6.0	-----	-------	>60
Vale silt loam	26B	Moderate:Perc.Rate	None	------	-------	>6.0	-----	-------	>60
Vale silt loam	26C	Moderate:Perc.Rate	None	------	-------	>6.0	-----	-------	>60
Savo silt loam	27A	Severe:Perc.Rate	None	------	-------	>6.0	-----	-------	>60
Savo silt loam	27B	Severe:Perc.Rate	None	------	-------	>6.0	-----	-------	>60

TABLE 3

SOIL INTERPRETATIONS

SUITABILITIES AND LIMITATIONS (Continued)

Soil Name	Map Code	Septic Tank Leach Field	FLOODING Frequency	FLOODING Duration	FLOODING Months	HIGH WATER TABLE Depth (ft.)	HIGH WATER TABLE Kind	HIGH WATER TABLE Months	Bed-Rock Depth (in.)
Nunn clay loam	30A	Severe:Perc. Rate	None	-------	------	>6.0	----	------	>60
Nunn clay loam	30B	Severe:Perc. Rate	None	-------	------	>6.0	----	------	>60
Nunn clay loam	27C	Severe:Perc. Rate	None	-------	------	>6.0	----	------	>60
Midway-Razor silt clay loam	33								
Midway		Severe:slope,bedrock, Perc. Rate	None	-------	------	>6.0	----	------	10-20
Razor		Severe:Perc.Rate,bedrock	None	-------	------	>6.0	----	------	20-40
Nevee silt loam	37B	Moderate:Perc.Rate	None	-------	------	>6.0	----	------	40-60
Nevee silt loam	37C	Moderate:Perc.Rate	None	-------	------	>6.0	----	------	40-60
Boneek silt loam	118B,18B	Moderate:Perc.Rate	None	-------	------	>6.0	----	------	40-60
Boneek silt loam	118C,18C	Moderate:Perc.Rate	None	-------	------	>6.0	----	------	40-60
Butche-Satanta loam	124								
Butche		Severe:slope,bedrock	None	-------	------	>6.0	----	------	7-20
Satanta		Slight	None	-------	------	>6.0	----	------	> 60
Butche-Rock outcrop	124R								
Butche		Severe:slope,bedrock	None	-------	------	>6.0	----	------	7-20
Lakoha silt loam	125	Severe:slope,bedrock	None	-------	------	>6.0	----	------	40
Satanta loam	130B	Slight	None	-------	------	>6.0	----	------	> 60
Nihill gravelly loam	140	Severe:slope	None	-------	------	>6.0	----	------	>60
Weber loam	144A	Slight	None	-------	------	>6.0	----	------	>60
Rock outcrop	200								
Vanocker		Severe:slope, lrg.stones	None	-------	------	>6.0	----	------	>60
Citadel	221	Severe:slope,Perc.Rate	None	-------	------	>6.0	----	------	>60
Vanocker Citadel	223								
Vanocker		Severe:slope,larg.stones	None	-------	------	>6.0	----	------	>60
Citadel		Severe:slope,Perc.Rate	None	-------	------	>6.0	----	------	>60
Maitland	225	Severe:slope	None	-------	------	>6.0	----	------	>60
St. Onge loam	308	Severe:floods	Common	Very Brief	Sep-Jun	>6.0	-----	------	>60

TABLE 4

SURFACE WATER QUALITY STANDARDS

PARAMETER	USE DESIGNATION Water Supply	Cold Water Fishery Permanent	Cold Water Fishery Marginal
Temperature, °C		< 65	< 75
pH, units	6.0-9.0	6.6-8.6	6.5-8.8
DO, mg/l		> 6.0	> 5.0
DO spawning, mg/l		> 7.0	
Alkalinity $CaCO_3$, mg/l			
TDS, mg/l	1000		
Suspended Solids, mg/l		30	90
BOD_5, mg/l			
Conductivity μmhos/cm			
Nitrates NO_3-N, mg/l	10		
Sulfates SO_4, mg/l	500		
SAR			
Total Coliform, #/100ml	5000/20,000		
Fecal Coliform, #/100ml			
PCB		0.000001	0.000001
Chlorides, mg/l	250	100	
Chlorine Residual, mg/l		0.02	0.02
Ammonia, Unionized, mg/l		0.02	0.02
Hydrogen Sulfide, undissassociated, mg/l		0.002	0.002
Cyanide, mg/l		0.02	0.02
Free Cyanide, mg/l		0.005	0.005
Arsenic, mg/l	0.05		
Barium, mg/l	1.0		
Cadmium, mg/l	0.01		
Chromium, mg/l	0.05		
Lead, mg/l	0.05		
Mercury, mg/l	0.002		
Selenium, mg/l	0.01		

TABLE 4 (Contd.)

SURFACE WATER QUALITY STANDARDS

PARAMETER	USE DESIGNATION		
	Immersion Recreation	Limited Contact Recreation	Wildlife & Stock
Temperature, °C			
pH, units	6.5-8.3	6.0-9.0	6.0-9.5
DO, mg/l	>5.0	>5.0	
DO spawning, mg/l			
Alkalinity $CaCO_3$, mg/l			750
TDS, mg/l			2500
Suspended Solids, mg/l			
BOD_5, mg/l			
Conductivity μmhos/cm			4000
Nitrates NO_3-N, mg/l			50
SAR			
Total Coliform, #/100ml			
Fecal Coliform, #/100ml	200	1000	
PCB			
Chlorides, mg/l			
Chlorine Residual, mg/l			
Ammonia, Unionized, mg/l			
Hydrogen Sulfide, undissassociated, mg/l			
Cyanide, mg/l			
Free Cyanide, mg/l			
Arsenic, mg/l			
Barium, mg/l			
Cadmium, mg/l			
Chromium, mg/l			
Lead, mg/l			
Mercury, mg/l			
Selenium, mg/l			

TABLE 4 (Contd.)

SURFACE WATER QUALITY STANDARDS

PARAMETER	USE DESIGNATION		
	Irrigation	Commerce & Industry	Effluent Limits To Trout Fisheries
Temperature, °C			
pH, units		6.0-9.5	
DO, mg/l			
DO spawning, mg/l			
Alkalinity $CaCO_3$, mg/l			
TDS, mg/l		2000	
Suspended Solids, mg/l			10
BOD_5, mg/l			10
Conductivity Amhos/cm	2500		
Nitrates NO_3-N, mg/l			
SAR			
Total Coliform, #/100ml			
Fecal Coliform, #/100ml			
PCB			
Chlorides, mg/l			
Chlorine Residual , mg/l			
Ammonia, Unionized, mg/l			
Hydrogen Sulfide, undissassociated, mg/l			
Cyanide, mg/l			
Free Cyanide, mg/l			
Arsenic, mg/l			
Barium, mg/l			
Cadmium, mg/l			
Chromium, mg/l			
Lead, mg/l			
Mercury, mg/l			
Selenium, mg/l			

TABLE 5

GROUNDWATER QUALITY

STATION Gallery (G)

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
1-3-67	<2.2					
2-6-67	<2.2					
3-6-67	<2.2					
4-3-67	<2.2					
5-8-67	<2.2					
6-5-67	<2.2					
6-12-67	<2.2					
7-5-67	<2.2					
8-7-67	3.6	0/50 ml	0/10 ml			
9-5-67	<2.2					
10-2-67	<2.2					
11-6-67	<2.2					
11-20-67	<2.2					
1-5-68	<2.2					
2-6-68	<2.2					
3-18-68	<2.2					
4-7-68	<2.2					
5-13-68	<2.2					
6-3-68	<2.2					
7-1-68	<2.2					
8-5-68	<2.2					
9-3-68	<2.2					
10-7-68	2.2					
11-4-68	2.2					
11-18-68	<2.2					
5-6-73		<3	<4			
6-23-73		<3	<5			
7-16-73	16					
7-31-73		<3	<4			
8-7-73		2	2			
9-17-73		<2	2			
10-27-73		<2	<2			
11-27-73		<2	<2			
12-11-73		<2	<2			

TABLE 5 (Continued)

GROUNDWATER QUALITY

STATION Gallery (G)

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
1-9-74		< 2	< 2			
2-6-74		< 2	10			
3-5-74		< 2	< 2			
4-9-74		< 2	< 2			
5-7-74		4	< 2			
6-4-74		< 2	< 2			
7-10-74		< 2	< 2			
8-6-74		< 2	< 2			
9-4-74		< 2	< 2			
11-14-74		2	4			
12-10-74		< 2	< 2			
1-8-75		< 2	4			
2-10-75		< 2	< 2			
4-7-75		< 2	< 2			
4-11-75		< 2	< 2			
5-6-75		< 2	6			
8-26-75	240					
9-29-75	1					
10-28-75	1					
10-30-75	1					
11-17-75	19					
12-8-75	< 1					
1-19-76	< 1					
2-17-76	< 1					
3-22-76	< 1					
3-26-76	2					
5-24-76	< 1					
6-28-76	< 1					
7-20-76	< 1					
7-30-76	< 1					
8-23-76	< 1					
9-22-76	< 1					
9-27-76	< 1					

TABLE 5 (Continued)

GROUNDWATER QUALITY

STATION Gallery (G)

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
10-19-76	2					
11-15-76	< 1					
11-17-76	< 1					
12-6-76	2					
12-13-76	2					
1-11-77	< 1					
2-14-77	< 1					
3-9-77	< 1					
3-14-77	2					
5-16-77	< 1					
6-21-77	20					
7-19-77	<1					
8-16-77	TNTC					
8-24-77	9					
9-9-77	4	0				
9-12-77	38					
9-23-77				2.0		
11-8-77	< 1					
12-5-77	1					
1-16-78	< 1					
2-20-78	1					
3-21-78	3					
4-17-78	2					
5-10-78	< 1					
6-13-78 16	90	2		2.0		1.5
6-23-78	18	0				
6-29-78	228	0				1.0
7-7-78	55	2		2.0		1.1
7-14-78	146	<1		2.0		1.2
7-21-78	20	0		2.0		0.79
7-28-78	38	< 1		2.5		0.80

TNTC - Too Numerous To Count

TABLE 5 (Continued)

GROUNDWATER QUALITY

STATION Gallery (G)

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
8-4-78	26	0		2.5		0.97
8-11-78	24	< 1		2.0		0.95
8-18-78	36	0		2.5		1.2
9-5-78	16	0				
9-18-78	330	0				
9-11-78	12	0				
9-26-78			16			
9-28-78	160	2				
10-17-78	8	0				
10-30-78	4	0				
11-14-78	7	0				
11-27-78	< 1	0				
11-28-78	1	0				
1-23-79	< 1					
10-5-78			0			

TABLE 6

GROUNDWATER QUALITY

STATION Well at Abernathy's (A)

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Colifrom #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
6-16-78	3	0		2.5		3.0
6-29-78	0	0		2.5		2.8
7-7-78	0	0		2.5		3.0
7-14-78	0	0		2.5		3.0
7-21-78	0	0		3.0		2.8
7-28-78	0	0		2.5		2.7
8-4-78	0	0		2.5		2.6
8-11-78	3	0		2.5		2.4

TABLE 7

GROUNDWATER QUALITY

STATION Ward Well (ww)

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
6-29-78	158	0		2.0		1.7
7-7-78	0	0		2.0		1.8
7-14-78	10	0		2.5		1.8
7-21-78	1	0		2.5		1.7
7-28-78	1	0		3.0		1.8
8-4-78	0	0		3.0		2.0
8-11-78	0	0		2.0		1.9

TABLE 8

GROUNDWATER QUALITY

STATION Spring Above Ward (W,AW)

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
6-29-78	137	< 1		3.5		1.7
7-7-78	120	14		3.0		1.8
7-14-78	210	3.5		2.5		2.0
7-21-78	2560	130[E]		2.0		1.5
7-28-78	620	2.5		2.0		1.8
8-4-78	420	2		2.5		1.9
8-11-78	1060	6		2.5		1.7
8-18-78	1500	2		2.5		1.7
9-5-78		< 1				
9-11-78		6/400 ml				
9-18-78		0				
10-17-78		0				
10-30-78		0				
11-14-78		1				
11-28-78		1				

E - Estimate

TABLE 9

GROUNDWATER QUALITY

STATION Steve Peters Res.

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
2-14-79	< 1	< 1/200 ml			1.7	
2/28/79	< 1	< 1/200 ml				
3/14/79	< 1	< 1/200 ml		8.5	1.9	

TABLE 10

GROUNDWATER QUALITY

STATION B. Abernathy Res.

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
2-14-79	1	<1/200 ml			2.6	
2-28-79	<1	<1/200 ml				
3-14-79	<1	<1/200 ml		5.1	2.6	

TABLE 11

GROUNDWATER QUALITY

STATION Don Orel Res.

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
2-14-79	< 1	< 1/200 ml			2.7	
2-28-79	< 1	< 1/200 ml				
3/14/79	< 1	< 1/200 ml		5.2	2.8	

TABLE 12

GROUNDWATER QUALITY

STATION M. Blosmo

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
2-14-79	< 1	< 1/200 ml			1.6	
2/28-79	< 1	< 1/200 ml				
3-14-79	< 1	< 1/200 ml		8.9	1.7	

TABLE 13

GROUNDWATER QUALITY

STATION M. Johnson

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
2-14-79	< 1	< 1/200 ml			1.0	
2-28-79	< 1	< 1/200 ml				
3-14-79	< 1	< 1/200 ml		2.1	1.0	

TABLE 14

GROUNDWATER QUALITY

STATION M. Reed

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
2-14-79	1	1/200 ml			1.0	
2-28-79	< 1	< 1/200 ml				

TABLE 15

GROUNDWATER QUALITY

STATION H.Laprath

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
2-14-79	<1	<1/200 ml			1.4	
2-28-79	<1	<1/200 ml				
3-14-79	<1	<1/200 ml		11.7	1.5	

TABLE 16

GROUNDWATER QUALITY

STATION D. Deberg

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
2-14-79	< 1	< 1/200 ml			3.5	
2-28-79	< 1	< 1/200 ml				
3-14-79	< 1	< 1/200 ml		39.0	5.5	

TABLE 17

GROUNDWATER QUALITY

STATION J.Witt

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
2-14-79	< 1	< 1/200 ml			1.7	
2-28-79	< 1	< 1/200 ml				
3-14-79	< 1	< 1/200 ml		1.5	1.5	

TABLE 18

GROUNDWATER QUALITY

STATION L. Reuppel, Sr.

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
2-14-79	< 1	< 1/200 ml			1.2	
2-28-79	< 1	< 1/200 ml				
3-14-79	< 1	< 1/200 ml		1.1	0.9	

TABLE 19

GROUNDWATER QUALITY

STATION R. Pascoe

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
2-28-79	13	< 1/200 ml			5.9	
3-14-79	< 1	<1/200 ml		58.1	6.7	

TABLE 20

GROUNDWATER QUALITY

STATION Spring near Hwy. 14 & 85

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
2-14-79	66	< 1/200 ml			3.2	
2-28-79	2	< 1/200 ml				
3-14-79	4	1		15.1	3.2	

TABLE 21

GROUNDWATER QUALITY

STATION Spring, S. of West Subd. West Side of Rd.

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
2-14-79	56	29			0.7	
2-28-79	22	8				
3-14-79	4	2		2.3	0.8	

TABLE 22

GROUNDWATER QUALITY

STATION Spring, S. of West Subd. East Side of Rd.

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
2-14-79	66	43			0.7	
2-28-79	32	14				
3-14-79	7	7		2.3	0.8	

TABLE 23

GROUNDWATER QUALITY

STATION Spring, S. of West Subd. East Side of Rd.

	PARAMETER					
DATE MONITORED	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
2-14-79	35	< 1/200 ml			0.6	
2-28-79	< 1	< 1/200 ml				

TABLE 24

GROUNDWATER QUALITY

STATION J

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform # /100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
11-14-78	0	0				

TABLE 25

GROUNDWATER QUALITY

STATION Cundy House (CH)

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
9-28-78	< 2	< 2				
9-26-78			< 1			

TABLE 26

GROUNDWATER QUALITY

STATION Lester

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
11-14-78	26	0				

TABLE 27

SURFACE WATER QUALITY
STATION HB

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
9-11-78		137				
9-18-78		566[E]				

E - Estimate

TABLE 28

SURFACE WATER QUALITY

STATION Spearfish Creek (DP)

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
9-5-78		39				
9-11-78		90				
9-18-78		62				
10-17-78		122				
10-30-78		20				
11-14-78		6				
11-28-78		5				

TABLE 29

SURFACE WATER QUALITY

STATION Spearfish Creek (UP)

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
9-5-78		84				
9-11-78		370				
9-18-78		44				
10-17-78		136				
10-30-78		4				
11-14-78		6				
11-28-78		4				

TABLE 30

SURFACE WATER QUALITY

STATION Spearfish Creek (14)

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
9-5-78		30				
9-11-78		88				
9-18-78		102				
9-28-78		< 3				
10-17-78		10				
10-30-78		10				
11-14-78		2				
11-28-78		1				
9-7-78				3.0		
9-21-78				1.5		

TABLE 31

SURFACE WATER QUALITY

STATION Spearfish Creek (SW)

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
9-5-78		77				
9-18-78		92				
9-11-78		96				
10-17-78		76				
10-30-78		12				
11-14-78		2				
11-28-78		6				
9-7-78				2.0		
9-21-78				1.75		

TABLE 32

SURFACE WATER QUALITY

STATION Spearfish Creek (AG)

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
9-5-78		29				
9-18-78		70				
9-11-78		165				
9-28-78		34				
10-17-78		145				
10-30-78		8				
11-14-78		4				
11-28-78		3				

TABLE 33

SURFACE WATER QUALITY

STATION Higgins Gulch (H)

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/1	Nitrate mg/1	Sodium mg/1
6-16-78	7000	13		1.0		1.5
6-29-78	1400[E]	5		1.0		0.98
7-7-78	380	30		0.5		1.0
7-14-78	340	34		1.0		1.0
7-21-78	700	114		0.5		0.8
7-28-78	560	46		1.0		0.77
8-4-78	1280	68		1.0		0.80
8-11-78	440	37		0.5		0.97
8-18-78	933	22		1.0		0.97

TABLE 34

SURFACE WATER QUALITY

STATION Higgins Gulch (HC)

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
6-16-78	5600	259		1.0		1.5
6-23-78	1500[E]	29				1.0
6-29-78	4740	87		1.5		1.1
7-7-78	1000	52		1.0		1.2
7-14-78	950	276		2.5		0.79
7-21-78	633	212		1.0		0.80
7-28-78	633	8		1.0		0.97
8-4-78	2000	18		1.5		0.95
8-11-78	1000	275		1.0		1.2
8-18-78	1700	80		1.0		

E - Estimate

TABLE 35

SURFACE WATER QUALITY

STATION Higgins Gulch (HX)

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
6-29-78	2700[E]	118		5.5		2.1
7-7-78	15000	74		3.5		2.1
7-14-78	500	56		3.0		2.2
7-21-78	800	266		2.5		2.0
7-28-78	667	96		3.0		

E - Estimate

TABLE 36

SURFACE WATER QUALITY

STATION Higgins Gulch (I)

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
9-5-78		19				
9-18-78		24				
9-11-78		16				
9-28-78		13				
10-17-78		2				
10-30-78		1				
11-14-78		5				
11-28-78		0				

TABLE 37

SURFACE WATER QUALITY

STATION Irrigation Ditch (ID)

	PARAMETER					
DATE MONITORED	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
9-5-78		23				
9-11-78		40				
9-18-78		56				
9-28-78		20				

TABLE 38

GROUNDWATER QUALITY

STATION Cundy Drain (C)

DATE MONITORED	PARAMETER					
	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Strep #/100 ml	Chlorides mg/l	Nitrate mg/l	Sodium mg/l
6-16-78	70	1		3.0		4.0
6-23-78	25	0				
6-29-78	182	0		2.5		2.1
7-7-78	20	0		2.5		2.2
7-14-78	38	0		2.2		2.3
7-21-78	35	< 1/400 ml		2.5		2.1
7-28-78	18	0		2.5		2.2
8-4-78	14	0		2.5		2.2
8-11-78	9	0		2.5		2.0
8-18-78	11	0		2.5		2.0
9-5-78		0				
9-28-78	30	< 2				
9-29-78		0	3			
10-5-78		0				
10-17-78		0				
10-30-78		0				
11-14-78		0				
11-28-78		0				

TABLE 39

WELL DATA - SPEARFISH

Location 1/4	1/4	Sec.	T.	R.	Static Water Depth (Ft.)	Producing Aquifer Depth (Ft.)	Drilling Date	Owner
SE	NE	4	6N	2E	16	25	7-31-73	D. Heymeyer
SE	NE	4	6N	2E	20	40	6-08-73	T. Meyers
SE	NE	4	6N	2E	20	35	5-08-73	L. Ruppel
SE	NE	4	6N	2E	15	35	10-01-73	R. Johnson
E	SW	4	6N	2E	55	50	8-10-73	G. Ewning
SW	NW	4	6N	2E	18	30	4-24---	L. Jered
NE	NW	4	6N	2E	15	35	8-22-73	M. Blosmo
SW	SE	5	6N	2E	25	55	3-20-73	D. DeBerg
SE	SE	32	7N	2E	20	50	1-20-73	MacKaben Dev.
NE	SE	4	6N	2E	32	32	5-23-78	Johnson Enterp.
SE	N	4	6N	2E	30	30	2-15-78	J. Weiers
SE	SE	5	6N	2E	25[1]		-------	R. Pascoe
SE	SW	33	7N	2E	15[1]		-------	Abernathy
SE	SE	33	7N	2E	35[1]		-------	Campground
SE	SE	33	7N	2E	17[1]		-------	M. Johnson
SW	SW	34	7N	2E	35[1]		-------	Reed
NW	NE	4	6N	2E	15[1]		-------	Peters

1. Depth estimates made by owner.

TABLE 40

SUPPLEMENTAL DATA ON SEPTIC SYSTEMS AND WELLS

DEBERG-FULLER

Iden No.	SEPTIC SYSTEM	WELL
1.	About 4' deep, works good, very little evap., tank 500 gal., steel, clay, no gravel, about 150' pipe.	About 75' deep poor, quit using, inadequate water
2.	Deep 8'-10', tank 500 gal., steel, large crock, clay, extremely tight, added onto once, presently plugged about 200' pipe.	About 65' deep, hooked to No. 6 then went to about 100' deep
3.	About 4' deep, tank 600-700 gal., concrete, clay, slight amount of rock, added onto twice, about 250'-300' pipe.	About 325'-350' deep, good well, hooked to No. 7
4.	About 8'-10' deep, tank 500 gal., steel, about same as No. 3, added onto once, about 225' pipe.	About 90' deep, not enough water to water lawn.
5.	About 4' deep, tank 1,000 gal., concrete, mostly clay, slight loam, about 180' pipe, good system.	Central system[1].
6.	Same as No. 2	Same as No. 2
7.	About 4' deep, tank 750 gal., concrete, clay, some rock, good system, about 180' pipe.	Same as No. 3
8.	About 4' deep, tank 1,000 gal., concrete, clay, fairly tight, good system, about 180' pipe.	About 98' deep, poor quantity, household use marginal
9.	No Data	Central system [1].
10.	About 8'-10' deep, tank 500 gal., steel, clay, good system, about 180' pipe.	About 80' well, poor quantity, abandoned and went to central system[1].
11.	About 3' deep, tank 500 gal., steel, clay, loam, added onto when it looked like it was surfacing, no apparent surfacing since, about 220' pipe.	Same as No. 10

1. Central Well (Deberg) - About 350' deep, 6" casing, 600 gal. storage.
2. Central Well (Fuller) - About 350' deep, 6" casing, 600 gal. storage.

TABLE 40

SUPPLEMENTAL DATA ON SEPTIC SYSTEMS AND WELLS

DEBERG-FULLER (continued)

Iden. No.	SEPTIC SYSTEM	WELL
12.	About 3' deep, tank 1,000 gal., concrete, clay, loam, good system, no apparent surfacing, about 180' pipe.	About 95' deep, very good well
13.	About 4' deep, tank 1,000 gal., concrete, clay, good system, about 180' pipe.	About 350' well hooked to No. 14, good well
14.	About 8'-10' deep, tank 1,000 gal., concrete, clay, small amount of rock, good system, about 180' pipe.	Same as No. 13
15.	About 4' deep, tank 1,000 gal., concrete, clay, good system, about 180' pipe.	Central System[1].
16.	About 8'-10' deep, tank 1,000 gal., concrete, clay, some rock, good system, about 180' pipe.	Central System[1].
17.	About 4' deep, tank 1,000 gal., concrete, clay, good system, about 180' pipe.	Central System[1].
18.	About 8'-10' deep, tank 1,000 gal., concrete, clay, good system, about 180' pipe.	Central System[2]. Fuller
19.	About 10'-12' deep, tank 1,000 gal., concrete, clay, tight, good system, about 180' pipe.	Central System[2]. Fuller
20.	About 4' deep, tank 1,000 gal., concrete, clay, good system, about 180' pipe.	Central System[1].
21.	About 8'-10' deep, tank 1,000 gal., concrete, clay, good system, about 180' pipe.	Central System[1].
22.	About 4' deep, tank 1,000 gal., concrete, clay, good system, about 180' pipe.	Central System[1].
23.	About 3' deep, tank 1,000 gal., concrete, not surfasing soil.	Central System[2] Fuller
24.	About 8'-10' deep, tank 1,000 gal., concrete, clay, large rock, good system, about 180' pipe.	Central System[2]. Fuller

1. Central Well (Deberg) - About 350' deep, 6" casing, 600 gal. storage.
2. Central Well (Fuller) - About 350' deep, 6" casing, 600 gal. storage.

TABLE 40

SUPPLEMENTAL DATA ON SEPTIC SYSTEMS AND WELLS

DEBERG-FULLER (continued)

Iden. No.	SEPTIC SYSTEM	WELL
25.	About 4' deep, tank, 1,000 gal., concrete, clay, good system, about 180' pipe.	Central System[1.]
26.	Same as No. 25.	Central System[1.]
27.	Same as No. 25.	Central System[1.]
28.	About 4' deep, tank 1,000 gal, concrete, clay, loam, good system, about 180' pipe.	Central System[2.] Fuller
29.	No Data	Central System[2.] Fuller
30.	About 4' deep, tank, 1,000 gal., concrete, clay, loam (lighter soil), good system, about 180' pipe.	Central System[1.]
31.	Same as No. 30.	Central System[1.]
32.	Same as No. 30	Central System[1.]
33.	No data	Central System[2.] Fuller

1. Central Well (Deberg) - About 350' deep, 6" casing, 600 gal. storage.
2. Central Well (Fuller) - About 350' deep, 6" casing, 600 gal. storage.

TABLE 40

SUPPLEMENTAL DATA ON SEPTIC SYSTEMS AND WELLS

DEER MEADOWS

Iden. No.	SEPTIC SYSTEM	
4.	About 4' deep, soil unknown	About 75' deep, Hooked to No. 5.
5.	Same as No. 4	Same as No. 4
6.	About 4' deep, tank 1,000 gal., concrete, clay, slight amount of rock, never been used, about 180' pipe.	About 75' deep
7.	About 10' deep, tank 1,000 gal., clay, good system, about 180' pipe.	Hooked to No. 10
8.	About 4' deep, tank 1,000 gal., concrete, clay, never been used.	Hooked to No. 10
9.	About 7'-8' deep, tank 1,000 gal., concrete, clay, good system, about 180' pipe.	Hooked to No. 10
10.	About 4' deep, tank 1,000 gal., concrete, clay, some small rock, good system, about 180' pipe.	About 265' deep, 4" casing.
11.	About 4' deep, tank 1,000 gal., concrete, clay within gravel veines, some large rock, good syste, about 180' pipe.	Hooked to No. 13
12.	Same as No. 11 except thicker gravel veines.	Hooked to No. 13
13.	About 4' deep, tank 1,000 gal., concrete, clay, some rock, good system, about 180' pipe.	About 265' deep, 4" casing
14.	Same as No. 13	Same as No. 13
15.	About 4' deep, tank 1,000 gal., concrete, clay, some rock, good system, about 180' pipe.	About 85' deep, 6" casing.
16.	About 4' deep, tank 1,000 gal., concrete, clay, never used, about 180' pipe.	About 85' deep, 6" casing.
23.	About 4' deep, tank 1,000 gal., concrete, clay, loam, used two weeks, about 180' pipe.	Hooked to No. 39
24.	About 8'-10' deep, tank 1,000 gal., concrete, clay, loam.	Own well, depth unknown

TABLE 40

SUPPLEMENTAL DATA ON SEPTIC SYSTEMS AND WELLS

DEER MEADOWS (continued)

Iden. No.	SEPTIC SYSTEM	WELL
25.	About 4' deep, tank 1,000 gal., concrete, clay, loam, never used, 180' pipe.	Hooked to No. 39
26.	About 4' deep, tank 1,000 gal., concrete, clay, loam, being used, 180' pipe.	Hooked to No. 39
34.	About 4' deep, tank 1,000 gal., concrete, clay, loam, good system, about 180' pipe.	Hooked to No. 13
38.	About 4' deep, tank 1,000 gal., concrete, clay, good system, about 180' pipe.	About 85'-90' deep
39.	About 4' deep, tank 1,000 gal., concrete, clay, good system, about 180' pipe.	About 90'-95' deep

TABLE 41

SOIL PERCOLATION RATES

Soil Name	Depth (in.)	Permeability ln/hr	ln/min	Min/in
Barum	0-3	0.6-2.0	0.01-0.033	100-30
	3-60	0.6-2.0	0.01-0.033	100-30
Higgins	0-3	0.6-2.0	0.01-0.033	100-30
	3-35	0.6-2.0	0.01-0.033	100-30
	35-60	0.6-0.2	0.01-0.033	100-30
Winetti	0-5	2.0-6.0	0.033-0.1	30-10
	5-60	2.0-6.0	0.033-0.1	30-10
Glenberg Variant	0-7	2.0-6.0	0.033-0.1	30-10
	7-60	2.0-6.0	0.033-0.1	30-10
Rekop	0-4	0.6-2.0	0.01-0.033	100-30
	4-18	0.6-2.0	0.01-0.033	100-30
	18-60	----		
Gypnevee	0-7	0.6-2.0	0.01-0.033	100-30
	7-60	0.6-2.0	0.01-0.033	100-30
Paunsaugunt	0-5	0.6-2.0	0.01-0.033	100-30
	5-17	2.0-6.0	0.033-0.1	30-10
	17-30	----		
Canyon	0-3	0.6-2.0	0.01-0.033	100-30
	3-16	0.6-2.0	0.01-0.033	100-30
	16-35	----		
Bridget	0-10	0.6-2.0	0.01-0.033	100-30
	10-60	0.6-2.0	0.01-0.033	100-30
Nevee	0-6	0.6-2.0	0.01-0.033	100-30
	6-60	0.6-2.0	0.01-0.033	100-30
Spearfish	0-7	0.6-2.0	0.01-0.033	100-30
	7-12	0.6-2.0	0.01-0.033	100-30
	12-60	----		
Swint	0-14	0.6-2.0	0.01-0.033	100-30
	14-60	0.6-2.0	0.01-0.033	100-30
Tilford	0-6	0.6-2.0	0.01-0.033	100-30
	6-20	0.6-2.0	0.01-0.033	100-30
	20-60	0.6-2.0	0.01-0.033	100-30
Vale	0-6	0.6-2.0	0.01-0.033	100-30
	6-19	0.6-2.0	0.01-0.033	100-30
	19-60	0.6-2.0	0.01-0.033	100-30

TABLE 41

SOIL PERCOLATION RATES (Continued)

Soil Name	Depth (in.)	Permeability ln/hr	ln/min	Min/in
Savo	0-7	0.6-2.0	0.01-0.033	100-30
	7-18	0.2-2.0	0.003-0.033	333-30
	18-60	0.2-2.0	0.003-0.033	333-30
Nunn	0-5	0.2-2.0	0.003-0.033	333-30
	5-25	0.06-0.6	0.001-0.01	1000-100
	25-60	0.2-2.0	0.003-0.033	330-30
Midway	0-16	0.06-0.2	0.001-0.01	1000-100
	16-30	----		
Razor	0-3	0.06-0.2	0.01-0.033	1000-100
	3-34	0.06-0.2	0.001-0.01	1000-100
	34-60	----		
Nevee	0-6	0.6-2.0	0.01-0.033	100-30
	6-60	0.6-2.0	0.01-0.033	100-30
Boneek	0-8	0.6-2.0	0.01-0.033	100-30
	8-22	0.2-0.6	0.003-0.01	333-100
	22-47	0.6-2.0	0.01-0.033	100-30
	47-60	----		
Butche	0-3	0.6-6.0	0.01-0.1	100-10
	3-13	0.6-2.0	0.01-0.033	100-30
	13-20	----		
Satanta	0-7	0.6-2.0	0.01-0.033	100-30
	7-60	0.6-2.0	0.01-0.033	100-30
Lakoha	0-6	0.6-2.0	0.01-0.033	100-30
	6-30	0.6-2.0	0.01-0.033	100-30
	30-92	0.6-2.0	0.01-0.033	100-30
Nihill	0-8	0.6-2.0	0.01-0.033	100-30
	8-60	2.0-6.0	0.033-0.1	30-10
Weber	0-7	0.6-2.0	0.01-0.033	100-30
	7-23	0.6-2.0	0.01-0.033	100-30
	23-60	20	0.333	3.0
Vanocker	0-4	0.6-2.0	0.01-0.033	100-30
	4-60	0.6-2.0	0.01-0.033	100-30
Citadel	0-11	0.6-2.0	0.01-0.033	100-30
	11-25	0.2-0.6	0.003-0.01	333-100
	25-60	0.2-2.0	0.003-0.033	333-30
Maitland	0-11	0.6-2.0	0.01-0.033	100-30
	11-44	0.6-2.0	0.0.-0.033	100-30
	44-60	0.6-2.0	0.01-0.033	100-30
St. Onge	0-24	0.6-2.0	0.01-0.033	100-30
	24-60	0.6-2.0	0.01-0.033	100-30

FIGURE 1

EIS STUDY AREA

(over size)

FIGURE 2

GEOLOGY

(over size)

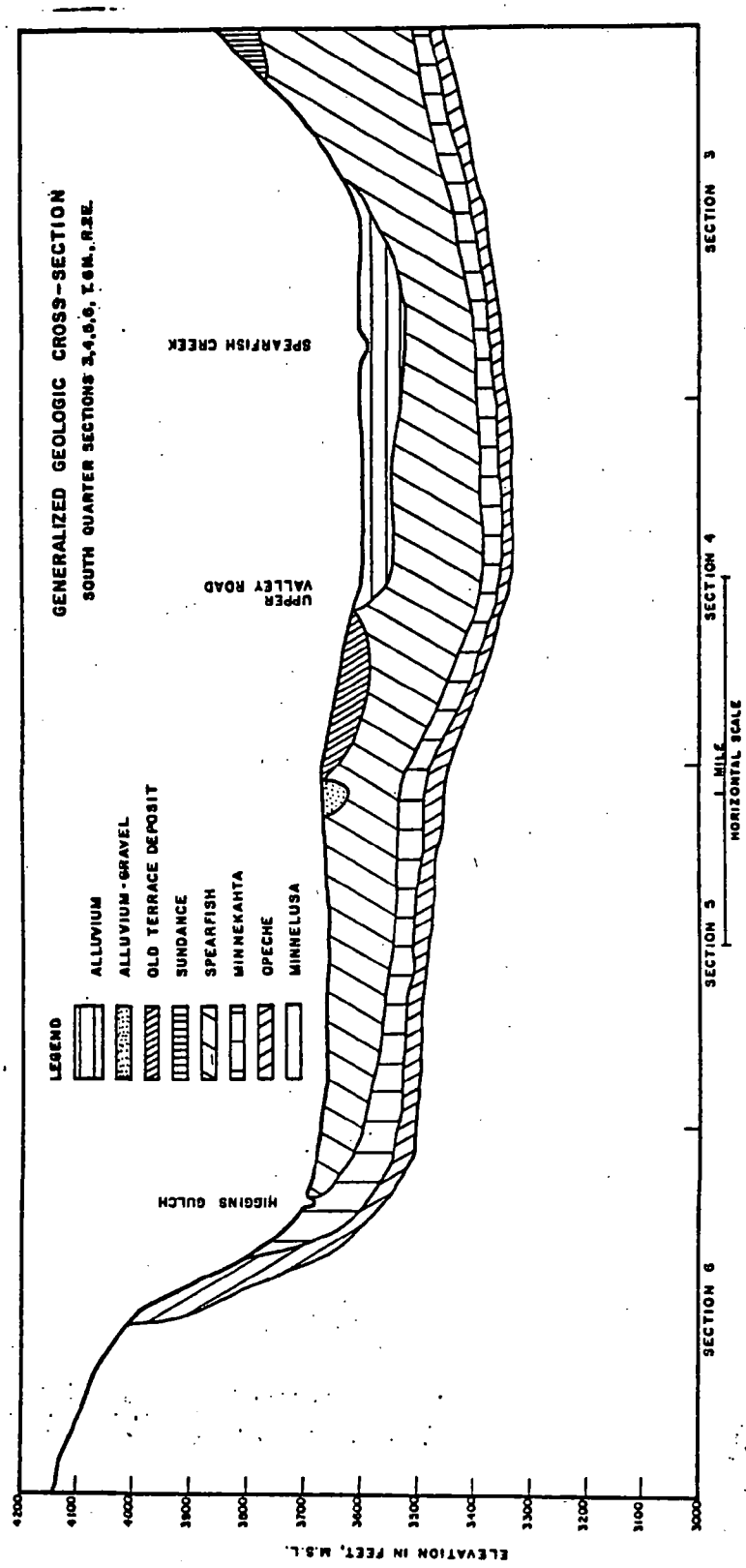
GENERALIZED GEOLOGIC CROSS-SECTION
SOUTH QUARTER SECTIONS 3,4,5,6, T.6N., R.2E.
LEGEND
ALLUVIUM
ALLUVIUM-GRAVEL
OLD TERRACE DEPOSIT
SUNDANCE
SPEARFISH
MINNEKAHTA
OPECHE
MINNELUSA
HIGGINS GULCH
UPPER VALLEY ROAD
SPEARFISH CREEK
SECTION 6
SECTION 5
SECTION 4
SECTION 3
1 MILE
HORIZONTAL SCALE
4200
4100
4000
3900
3800
3700
3600
3500
3400
3300
3200
3100
3000
ELEVATION IN FEET, M.S.L.

FIGURE 3

FIGURE 4

SOILS OF THE STUDY AREA

(over size)

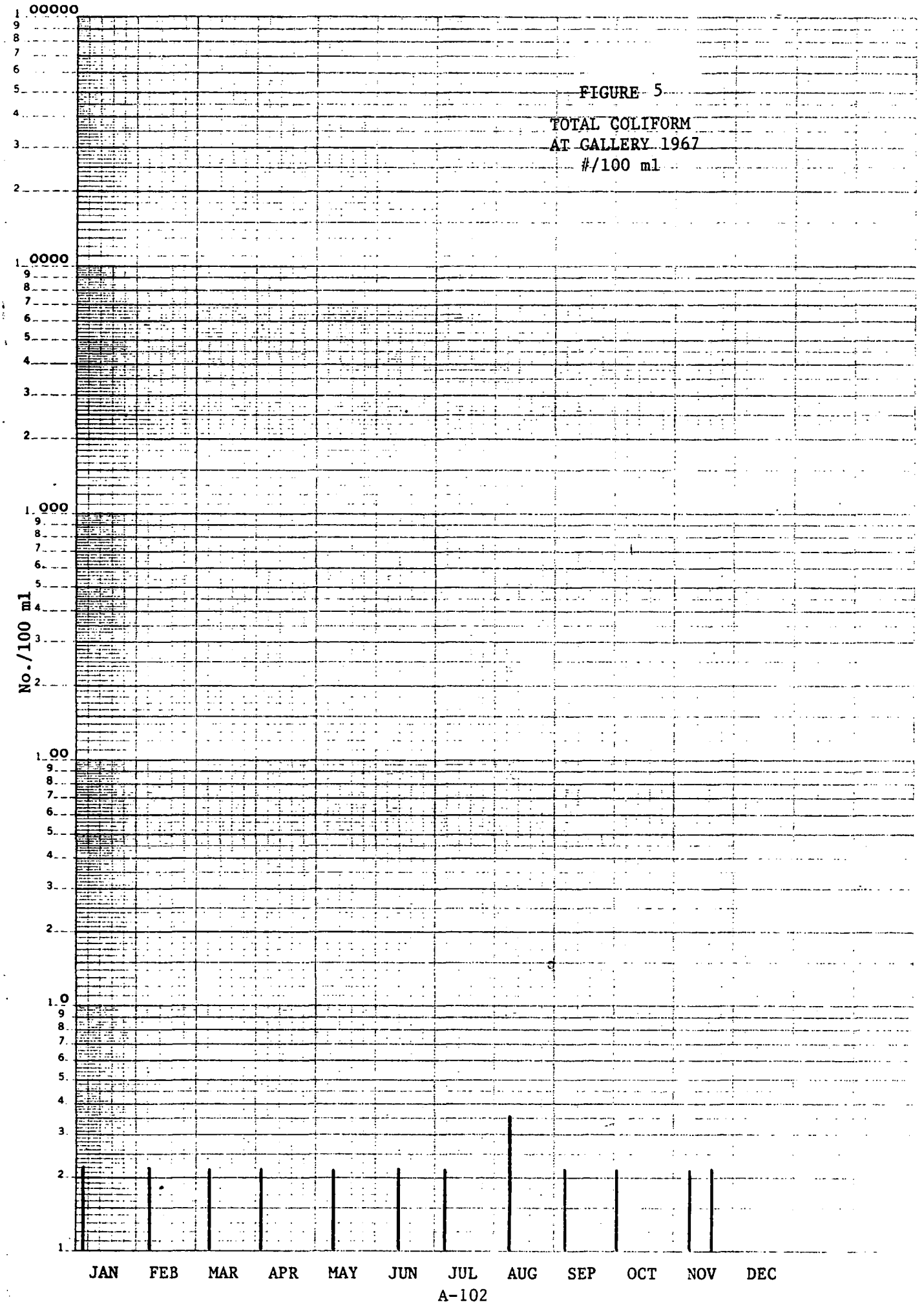
FIGURE 5
TOTAL COLIFORM
AT GALLERY 1967
#/100 ml
No./100 ml
100000
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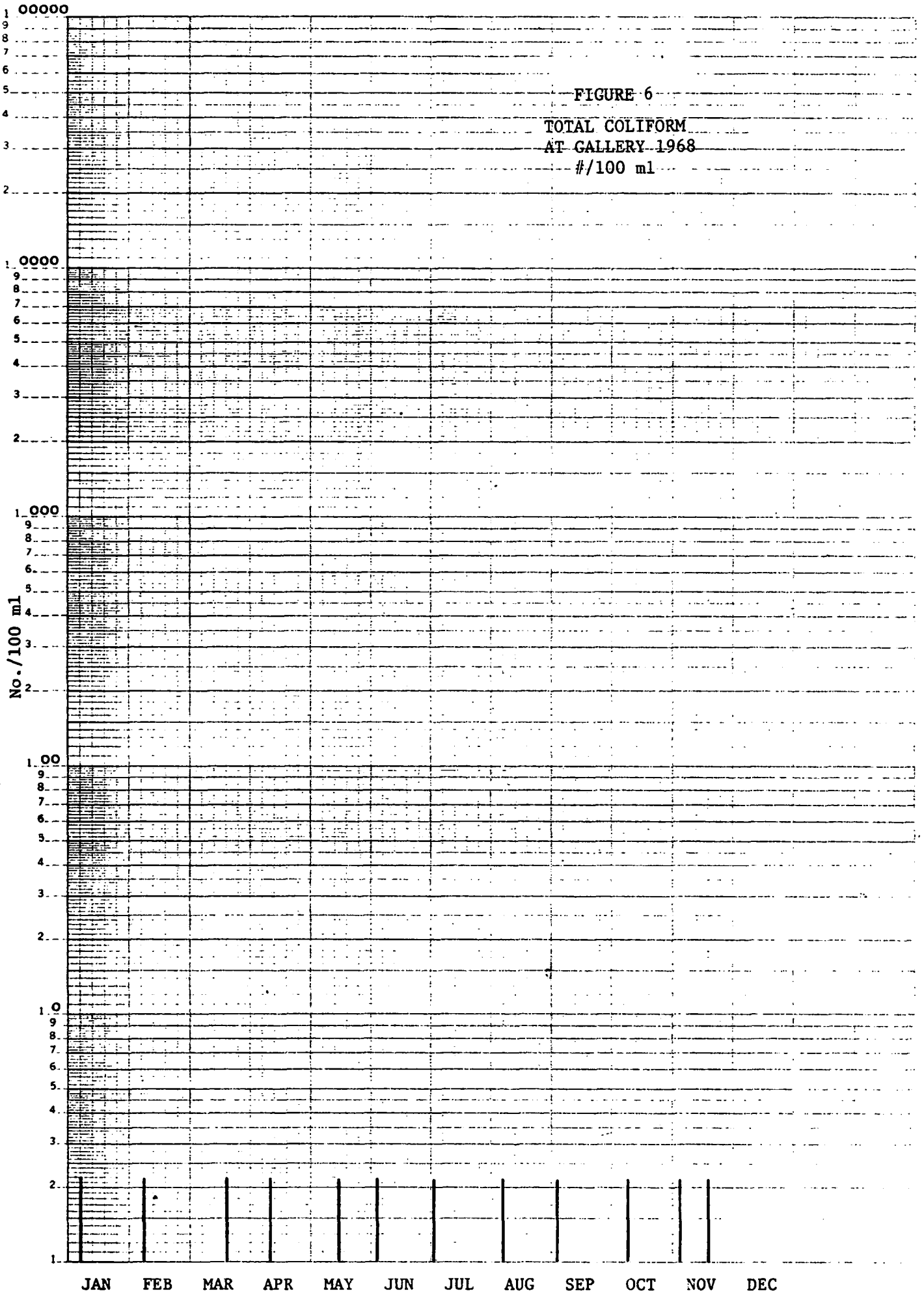
FIGURE 6
TOTAL COLIFORM
AT GALLERY 1968
#/100 ml
No./100 ml
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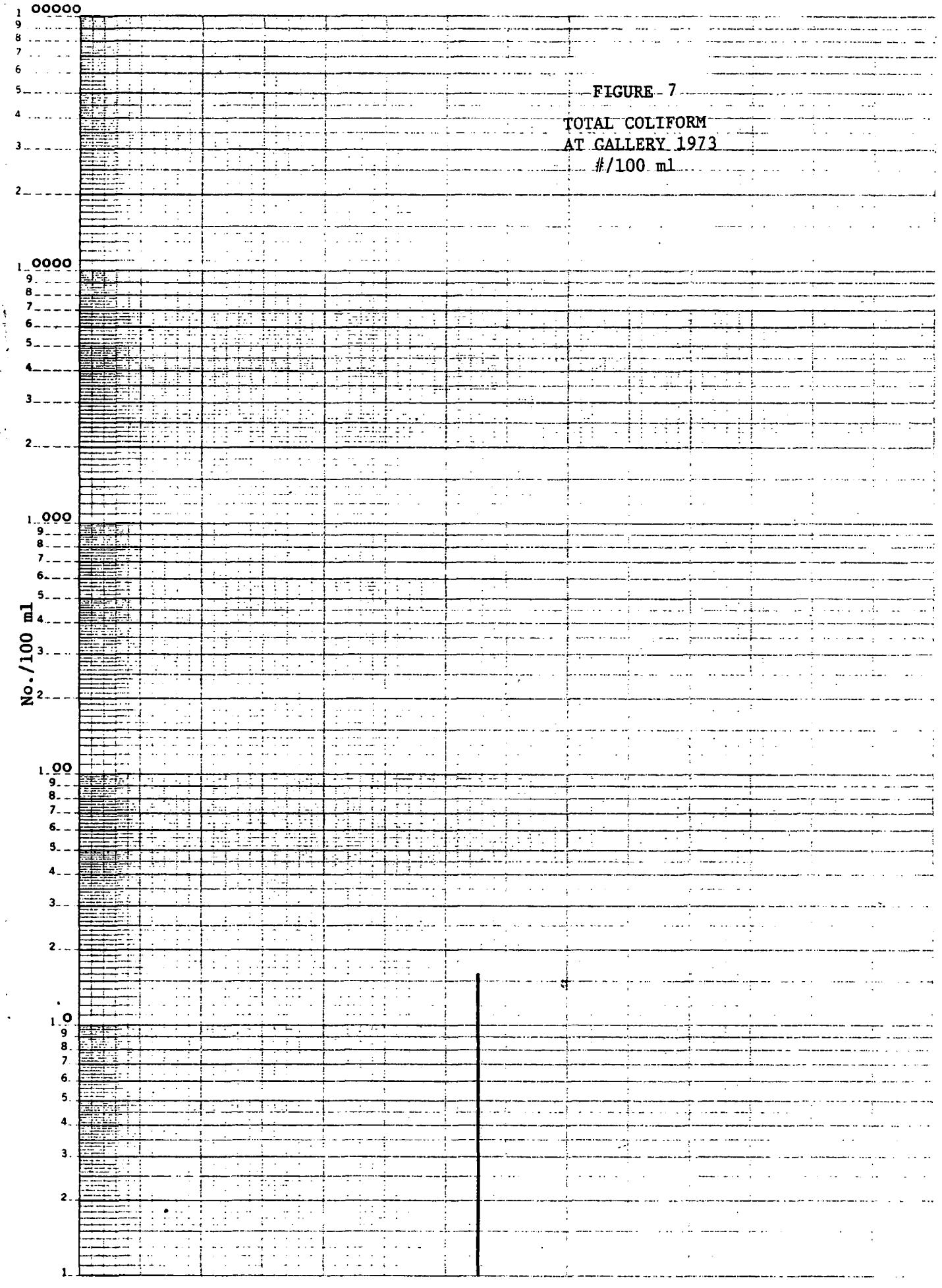
FIGURE 7
TOTAL COLIFORM
AT GALLERY 1973
#/100 ml
No./100 ml
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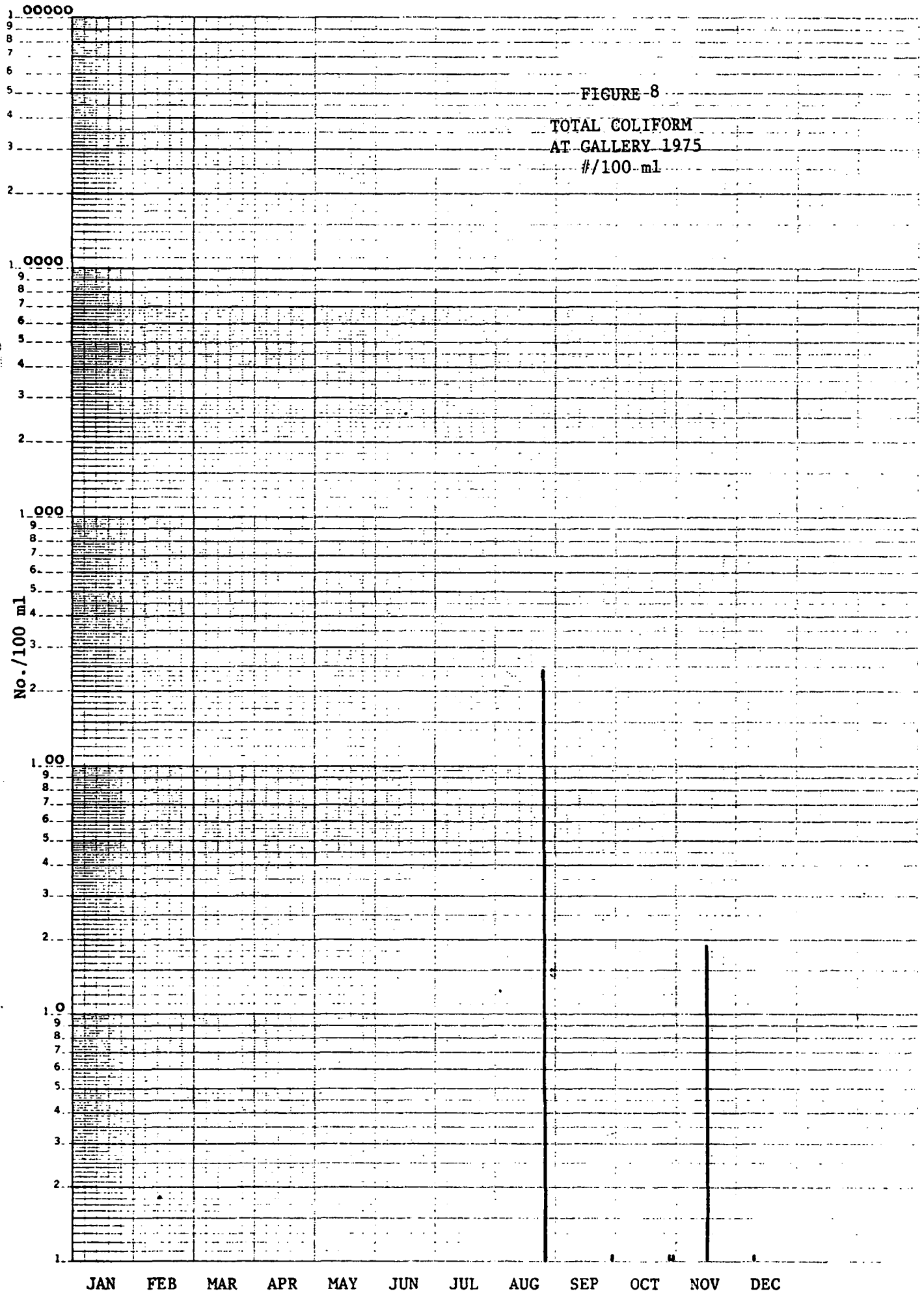
FIGURE 8
TOTAL COLIFORM
AT GALLERY 1975
#/100 ml
No./100 ml
1 00000
1 0000
1 000
1 00
1 0
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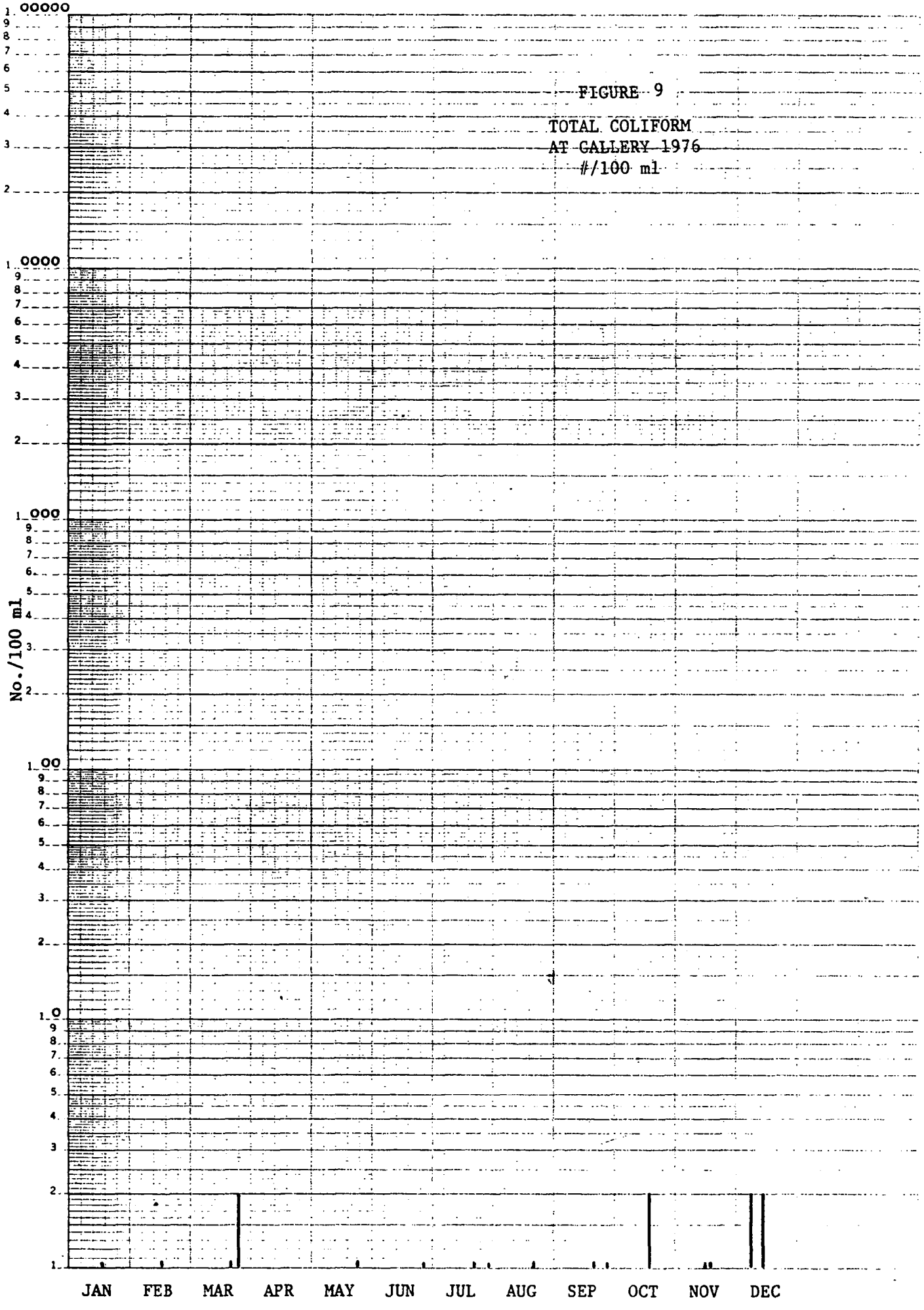
FIGURE 9
TOTAL COLIFORM
AT GALLERY 1976
#/100 ml
No./100 ml
100000
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10
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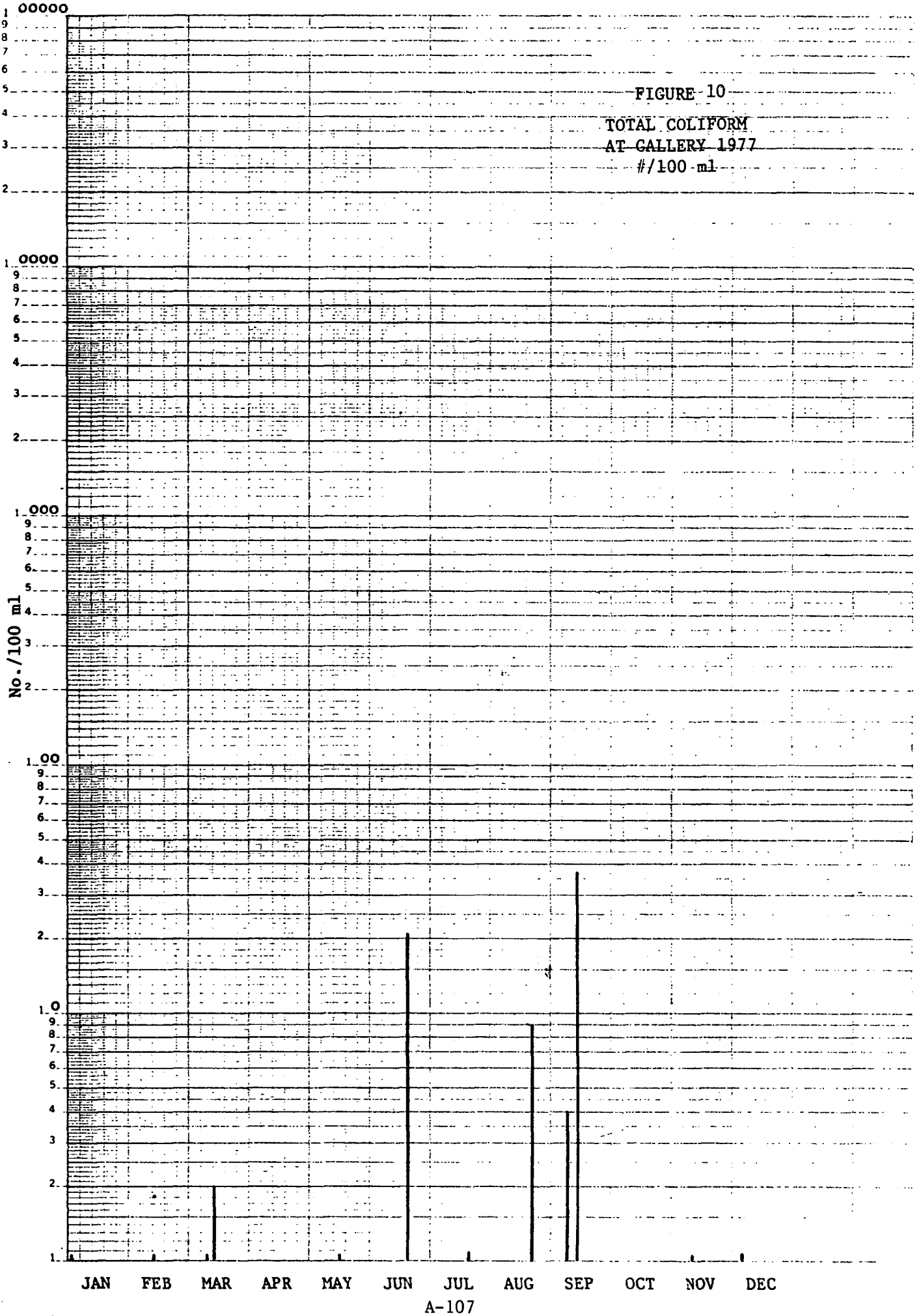
FIGURE 10
TOTAL COLIFORM
AT CALLERY 1977
#/100 ml
No./100 ml
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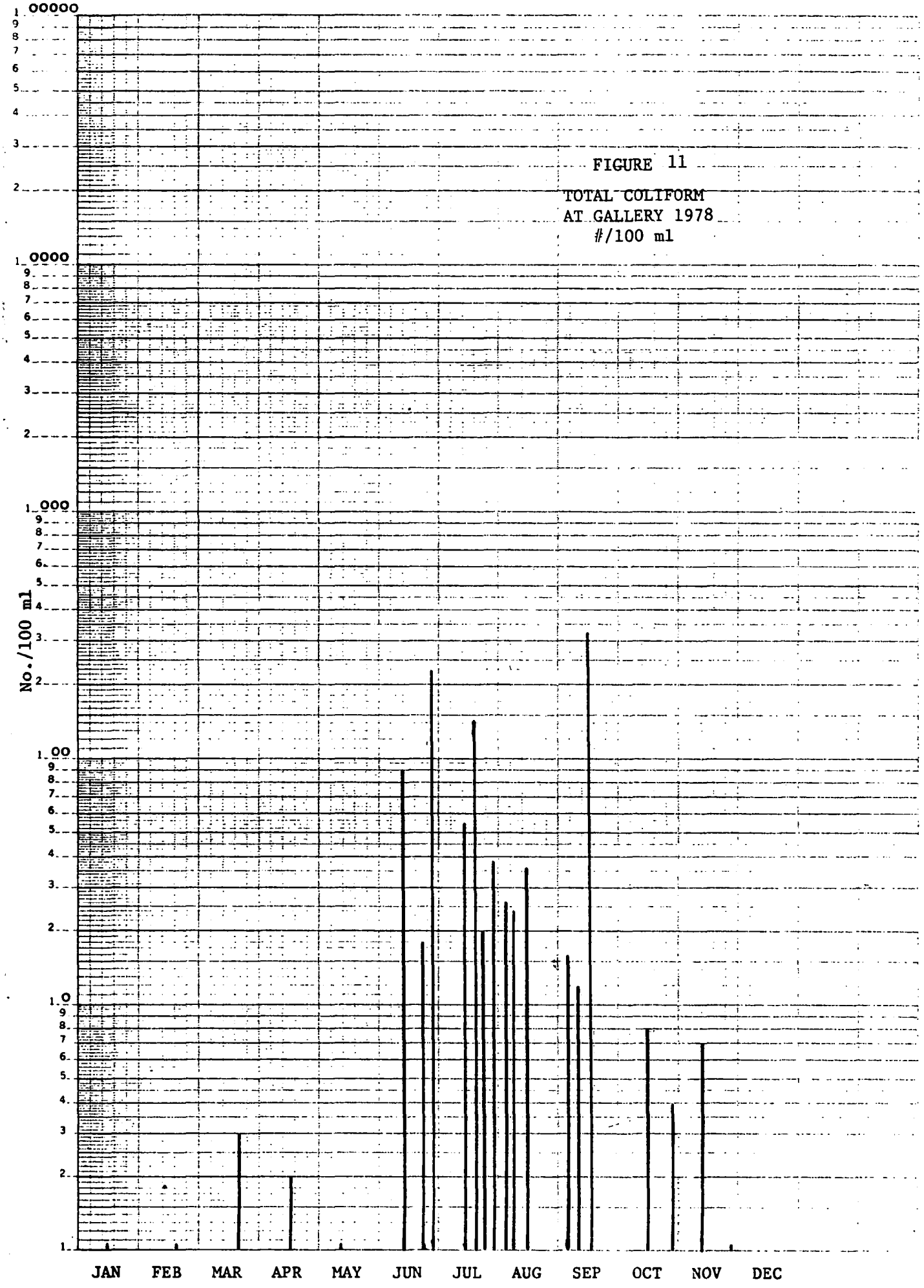
FIGURE 11
TOTAL COLIFORM
AT GALLERY 1978
#/100 ml
No./100 ml
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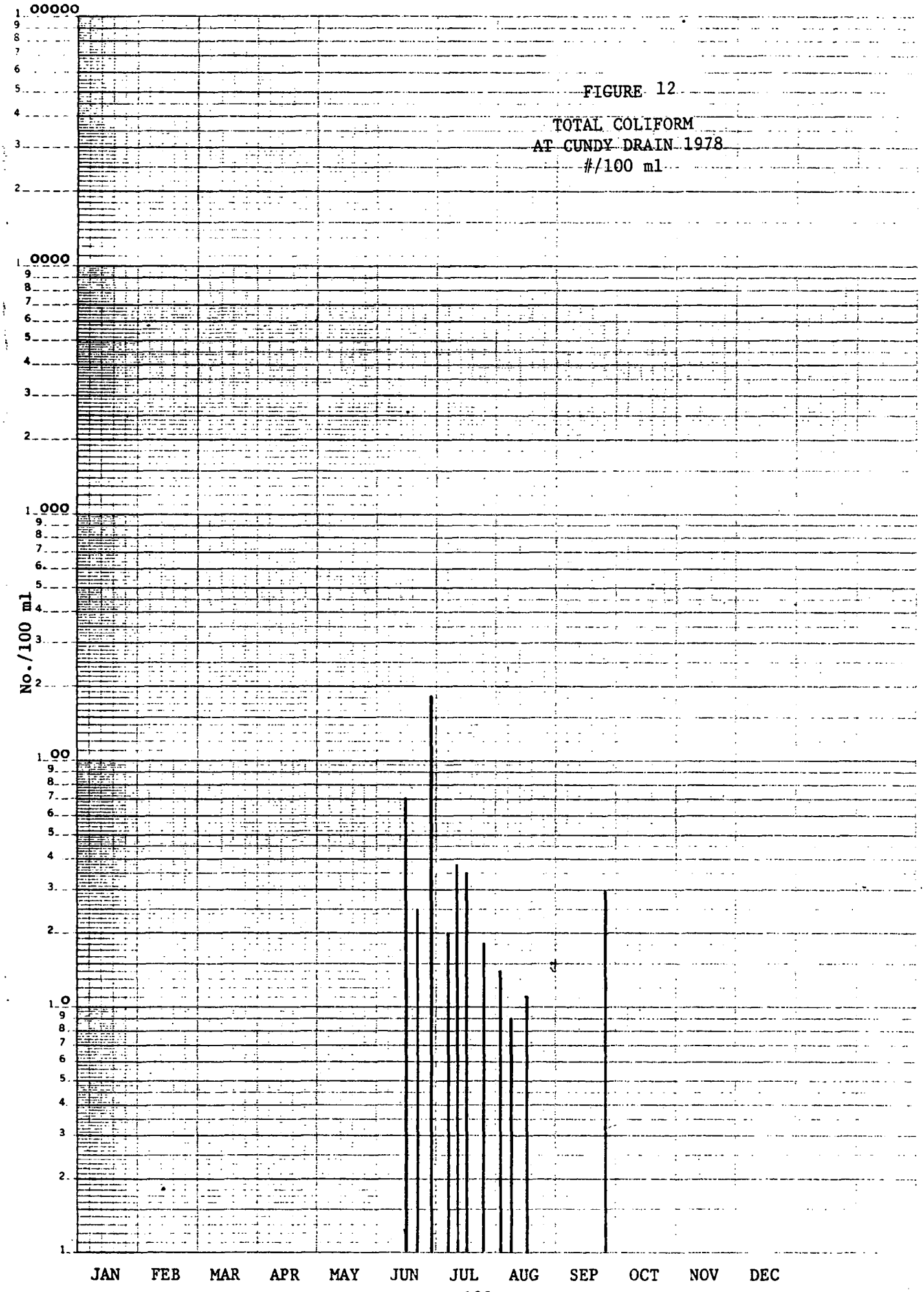
FIGURE 12
TOTAL COLIFORM
AT CUNDY DRAIN 1978
#/100 ml
No./100 ml
100000
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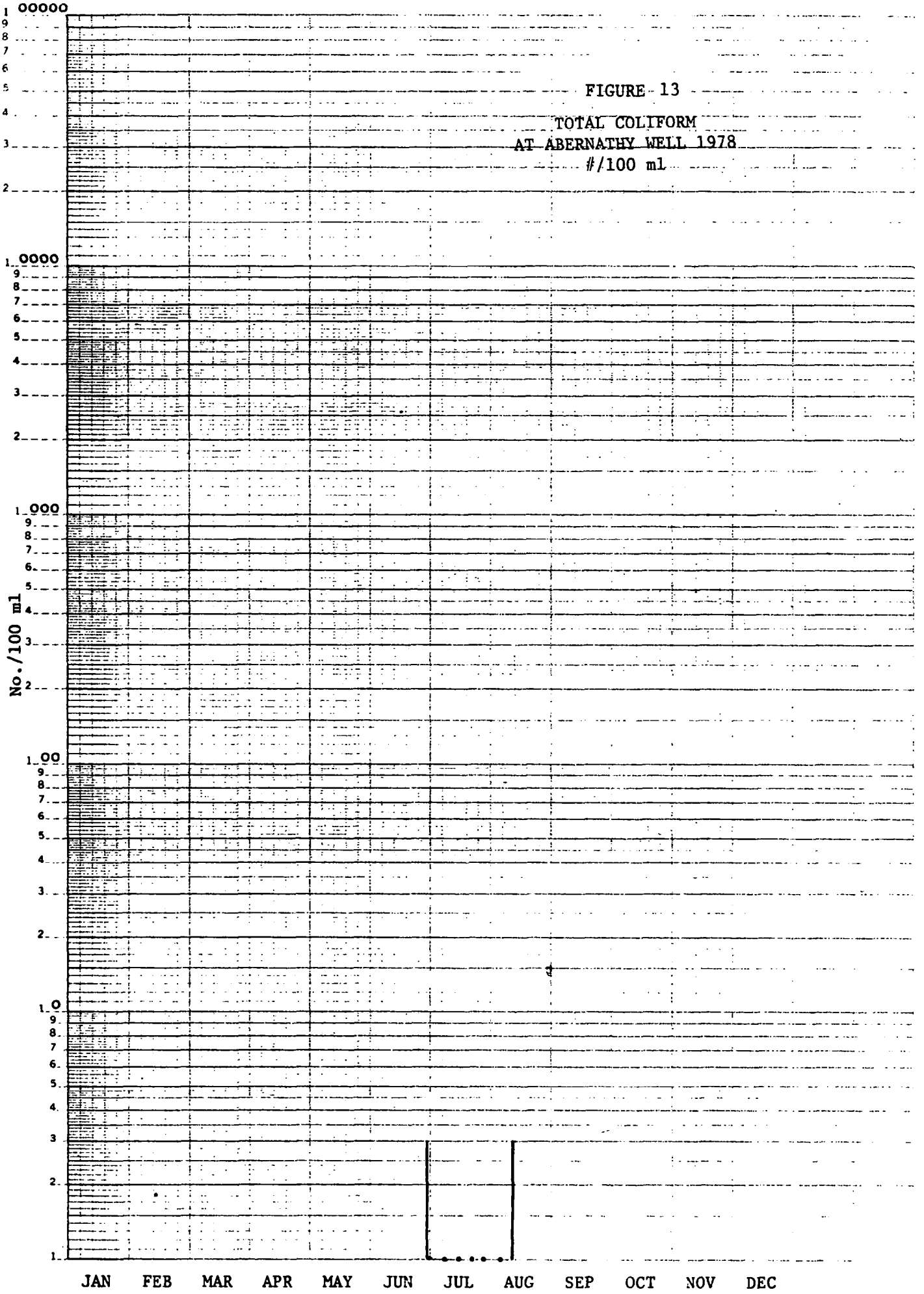
FIGURE 13
TOTAL COLIFORM
AT ABERNATHY WELL 1978
#/100 ml
No./100 ml
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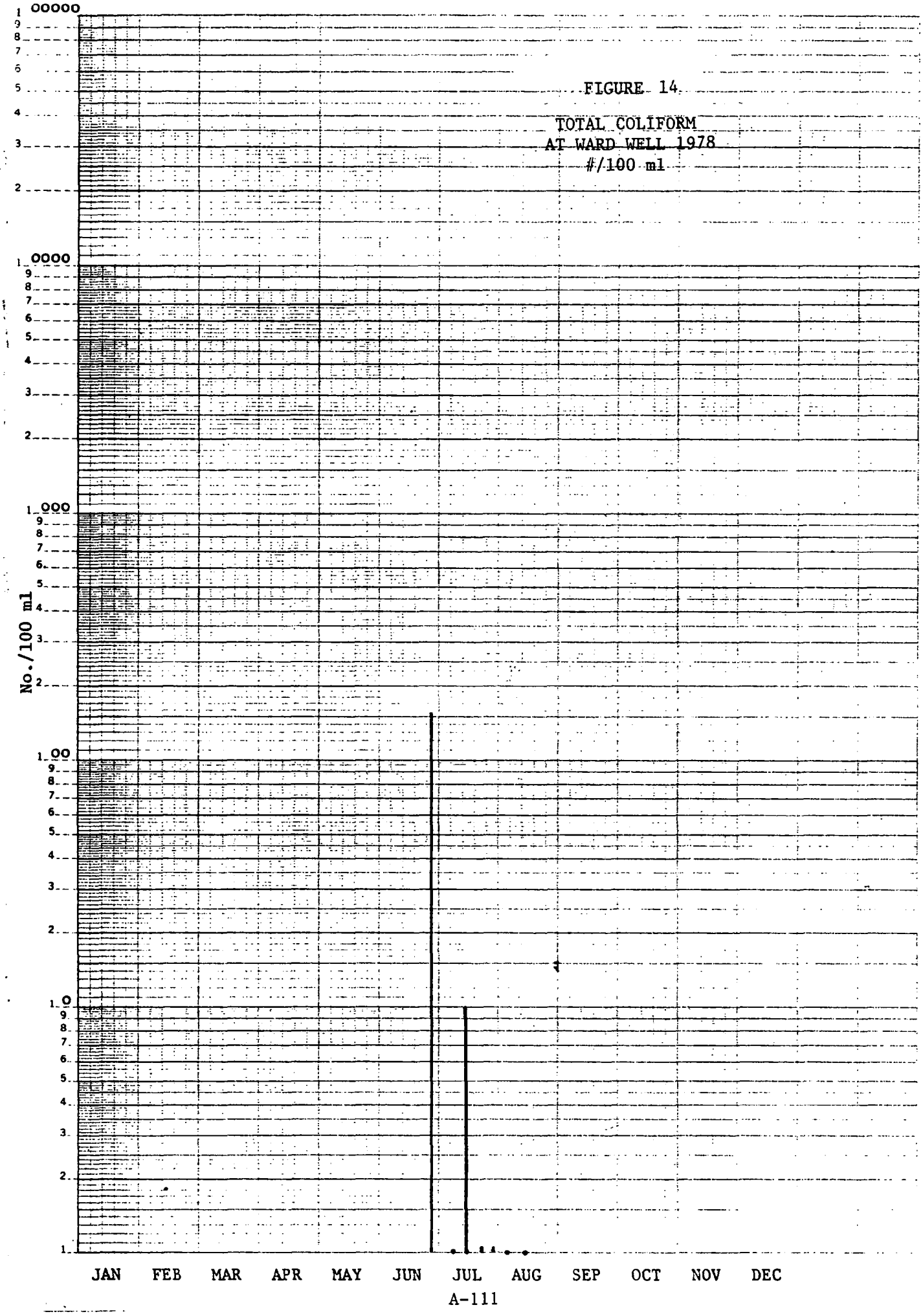
FIGURE 14
TOTAL COLIFORM
AT WARD WELL 1978
#/100 ml
No./100 ml
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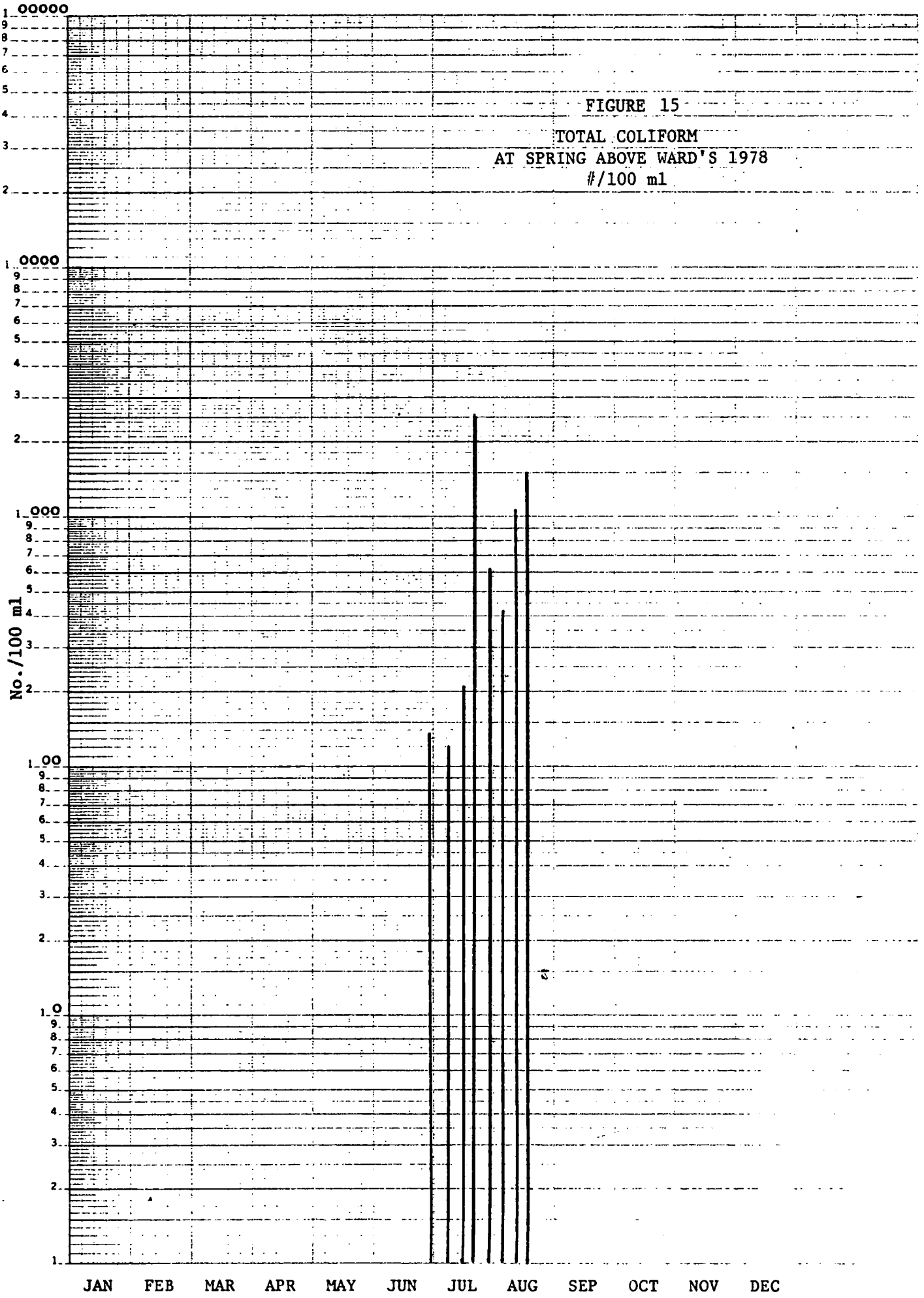
FIGURE 15
TOTAL COLIFORM
AT SPRING ABOVE WARD'S 1978
#/100 ml
No./100 ml
100000
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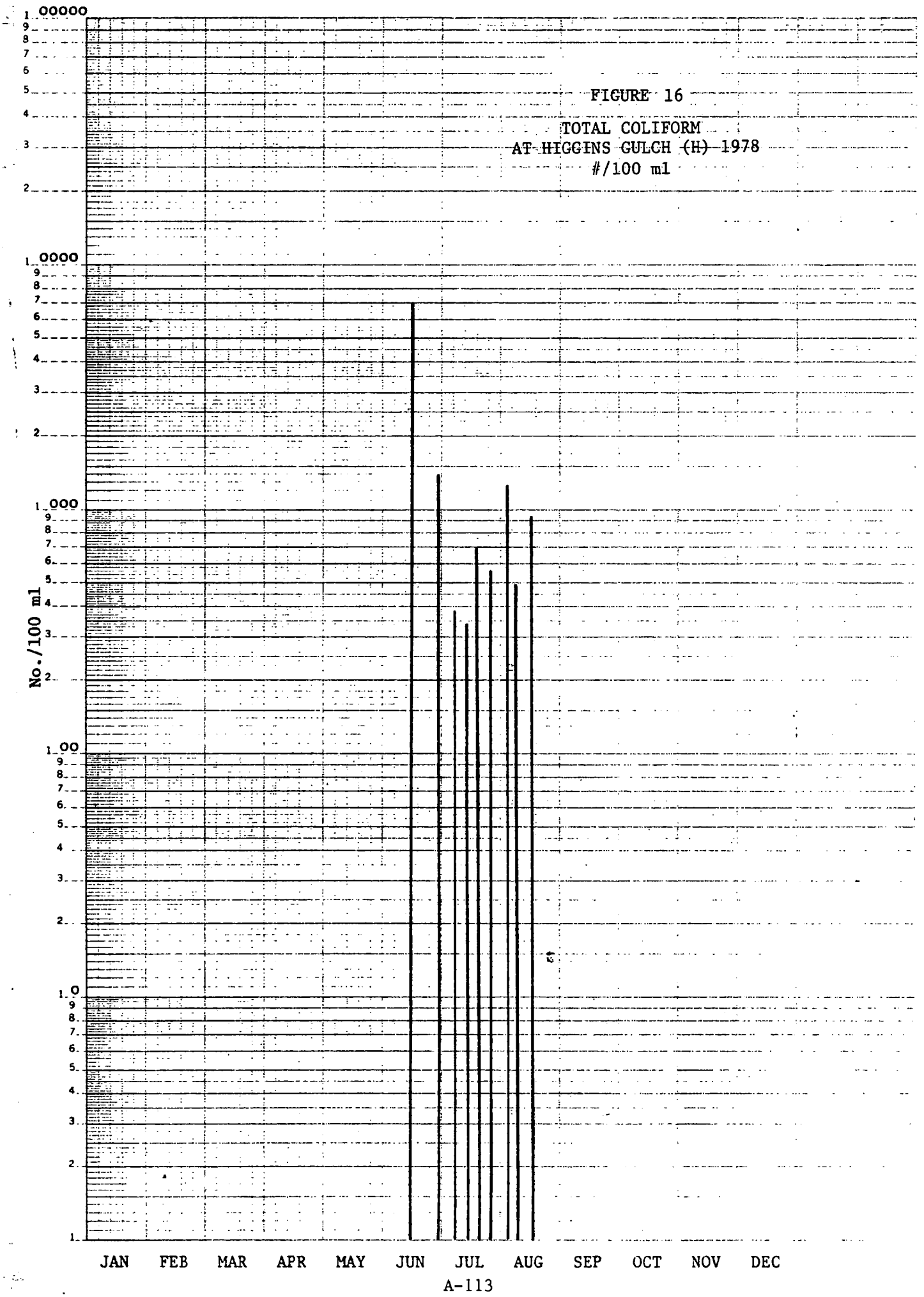
FIGURE 16
TOTAL COLIFORM
AT HIGGINS GULCH (H) 1978
#/100 ml
No./100 ml
100000
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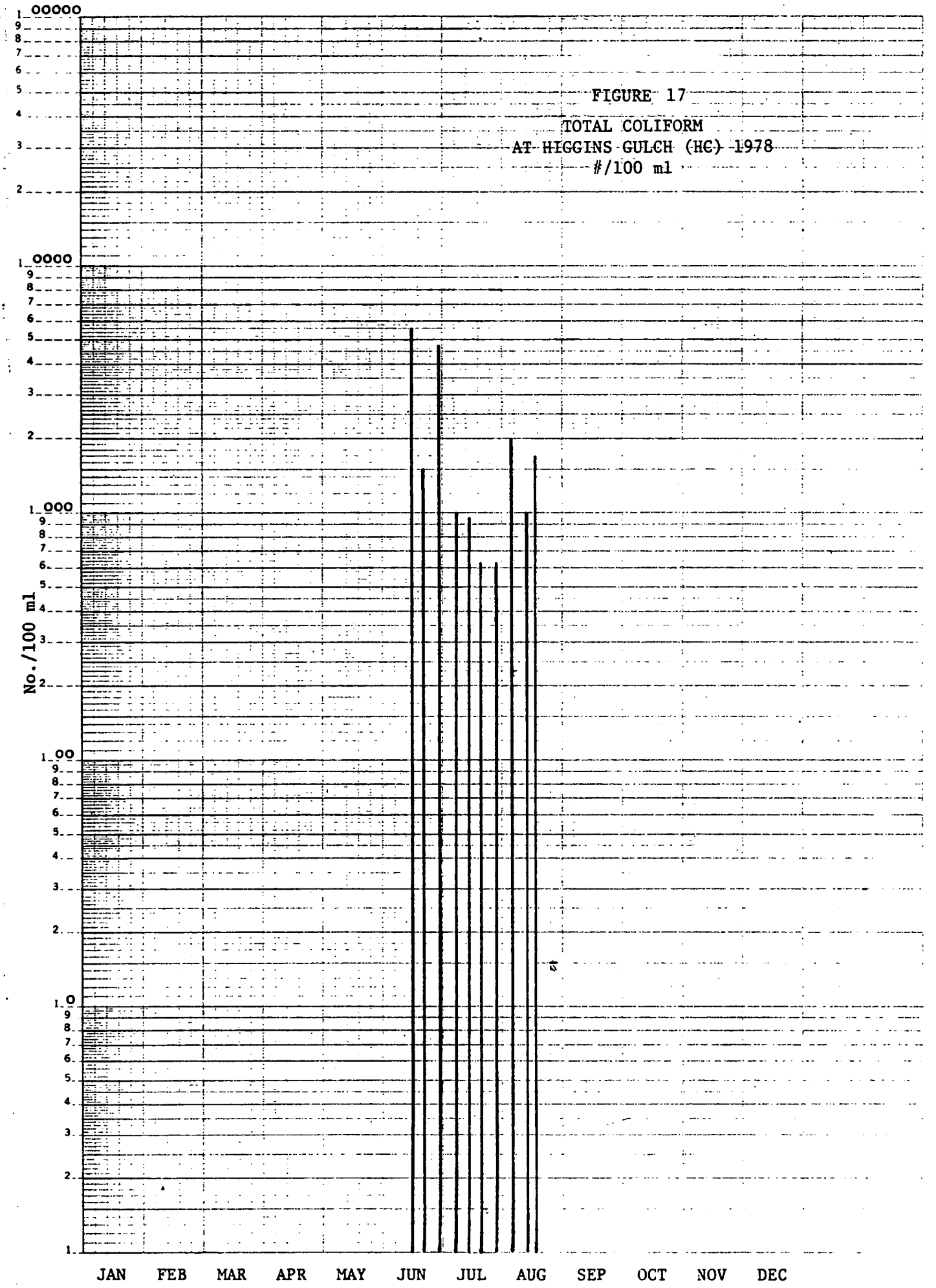
FIGURE 17
TOTAL COLIFORM
AT HIGGINS GULCH (HC) 1978
#/100 ml
No./100 ml
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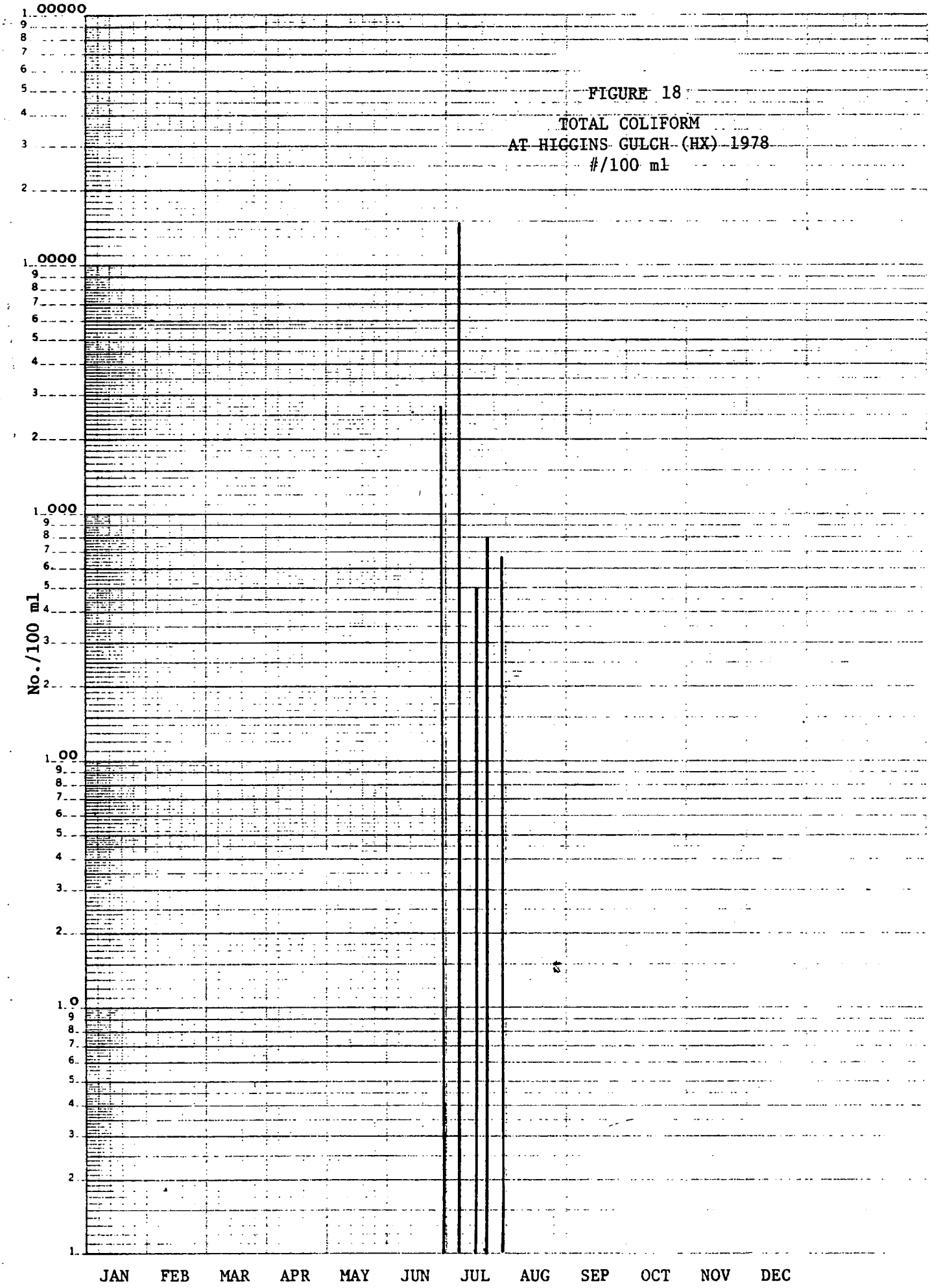
FIGURE 18
TOTAL COLIFORM
AT HIGGINS GULCH (HX) 1978
#/100 ml
No./100 ml
1.00000
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FIGURE 19

SEPTIC TANK VERIFICATIONS

(over size)

FIGURE 20

SEPTIC TANK LIMITATIONS

(over size)

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2. Darton, N.H., Page, S. Geological Atlas of the Central Black Hills Folio, South Dakota. U.S. Geological Survey. Washington, D.C. 1925.

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13. Brown, K.W., Wolf, H.W., Donnelly, K.C., and Slowly, J.F. The Movement of Fecal Coliforms and Coliphages below Septic Lines. Journal of Environmental Quality. Volume 8, Number 1, 1979.

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NONPOINT SOURCE CONTROLS

APPENDIX B

APPENDIX B

NONPOINT SOURCE CONTROLS

Access Road

Definition. A road constructed as a part of a conservation plan to provide needed access.

Scope. This standard applies to roads constructed to provide access to farms, ranches, fields, conservation systesm, structures, and recreation areas.

Purpose. To provide a route for travel, for moving equipment and supplies, and for providing access for proper operation and management of conservation enterprises.

Conditions Where Practice Applies. Where roads are needed to provide access from a township, county or state highway to the conservation enterprise, or to provide travelways within the planned area.

Agricultural Waste Management System

Definition. A planned agricultural waste management system to contain and manage liquid and solid wastes including runoff from concentrated waste areas with ultimate disposal in a manner which does not degrade air, soil, or water resources. This practice includes systems for safe disposal of livestock wastes, municipal waste treatment plant effluents and sludges, and agricultural processing wastes through use of soil and plants.

Scope. This standard establishes the minimum acceptable quality for design, installation, and operation of agricultural waste management systems. Systems shall include those components required for complete management of wastes under given site conditions. Such components may include existing practices included in the National Handbook of Conservation Practices, adaptations thereof, and other measures necessary for collection, storage, treatment, utilization, or safe disposal of wastes including treatment and management of disposal areas. They do not include municipal, industrial, commercial, or domestic waste treatment plants or in-plant modifications.

The extent of technical assistance provided shall be within guidelines established in Environmental Memorandum-4 "Guide to SCS Soil and Water Management Activities Affecting the Control of Agricultural Related Pollutants."

Purpose. Agricultural waste management systems are used to manage wastes in rural areas in a manner which prevents or minimizes degradation of air, soil, and water resources and protects public health and safety. Such systems are planned to preclude discharge of pollutants to surface or ground water and, to the fullest practicable extent, recycle wastes through soil and plants.

Where Applicable. This practice applies where there is need for a complete system to manage agricultural wastes or other wastes disposed of through use of soil and plants in agricultural areas, reduce pollution, minimize health hazards, and improve the environment.

All state and local laws, rules, and regulations governing waste management, pollution abatement, health and safety shall be strictly adhered to. The owner or operator shall be responsible for securing all required permits and for performing in accordance with such laws and regulations.

Brush Control

Definition. Killing, suppressing, or managing brush by mechanical chemical, or biological means or by controlled burning on all areas except cropland and woodland.

Purpose. To (1) eliminate or reduce competition of woody plants and thereby help to establish or reestablish a cover for soil protection and forage for livestock; (2) improve hydrologic conditions; (3) improve habitat for wildlife; and (4) maintain open land.

Where Applicable. (1) On rangeland, native pasture, pastureland, recreation land, and wildlife land where controlling invading brush or managing desirable brush is necessary to improve or establish protective cover; (2) on land which has the potential for native or adapted forage

plants to reestablish; (3) adjusting grazing management alone will not attain the conservation objective within a reasonable period; (4) controlling woody plants (phreatophytes) is desirable to conserve moisture; (5) where brush control or management will improve livestock handling and distribution; and (6) where brush management will improve wildlife, recreation, or natural beauty.

Chiseling and Subsoiling

Definition. Loosening the soil, without inversion and with a minimum of mixing of the surface soil, to shatter restrictive layers below normal plow depth that inhibit water movement or root development.

Purpose. To improve water and root penetration, and aeration.

Where applicable. On suitable soils, chiseling is applicable on land where restrictive soil layers occur at depths less than 16 inches. On suitable soils, subsoiling is applicable on land where the restrictive layers occur at depths more than 16 inches.

Clearing and Snagging

Definition. Removing snags, drifts, or other obstructions within the channel.

Scope. This standard covers the clearing of trees and brush, and the removal of sediment bars, drifts, logs, snags, boulders, piling, piers, headwalls, debris and other obstructions from the flow area of a natural or excavated channel.

Purpose. The purposes of this practice are: (1) to increase the flow capacity of the channel by improving flow characteristics, (2) to prevent bank erosion by eddies, (3) to reduce the forming of bars, and (4) to minimize the occurrent of ice jams.

Special attention will be given to maintaining or improving habitat for fish and wildlife where applicable.

Where Applicable. This practice is applicable to any channel or floodway where the removal of trees, brush and other obstructions is necessary to accomplish one or more of the purposes mentioned above. Where such removal will result in channel erosion, either the clearing and snagging shall not be done, or other practices, for the prevention of such erosion, shall be installed concurrently.

Conservation Cropping System

Definition. Growing crops in combination with needed cultural and management measures. Cropping systems include rotations that contain grasses and legumes as well as rotations in which the desired benefits are achieved without the use of such crops.

Purpose. To improve or maintain good physical condition of the soil; protect the soil during periods when erosion usually occurs; help control weeds, insects, and diseases; and meet the need and desire of farmers for an economic return.

Where Applicable. On all cropland and on certain recreation and wildlife land.

Contour Farming

Definition. Farming sloping cultivated land in such a way that plowing, preparing land, planting, and cultivating are done on the contour. (This includes following established grades of terraces, diversions, or contour strips.)

Purpose. To reduce erosion and control water.

Where Applicable. On sloping cropland and on recreation and wildlife land where other cultural and management practices in a cropping system do not control soil and water loss.

Critical Area Planting

Definition. Planting vegetation such as trees, shrubs, vines, grasses, or legumes on critical areas. (Does not include tree planting mainly for wood products.)

Purpose. To stabilize the soil; reduce damage from sediment and runoff to downstream areas; improve wildlife habitat; and enhance natural beauty.

Where applicable. On sediment-producing, highly erodible or severly eroded areas, such as dams, dikes, mine spoil, levees, cuts, fills, surface-mined areas, and denuded or gullied areas where vegetation is difficult to establish with usual seeding or planting methods.

Crop Residue Use

Definition. Using plant residues to protect cultivated fields during critical erosion periods.

Purpose. To conserve moisture; increase infiltration, reduce soil loss; and improve soil tilth.

Where Applicable. On land where adequate crop residues are produced.

Dam, Multiple-Purpose

Definition. A dam, constructed across a stream or natural water course, with designed reservoir storage capacity specifically provided for two or more purposes such as floodwater retardation and irrigation water supply, municipal water supply and recreation, etc. Does not include Farm Pond.

Scope. This standard applies to dams which have separate storage allocations for two or more of the purposes listed below. (Sediment storage is not considered a separate purpose except under practice Code 350.)

Purpose. A multiple-purpose dam must provide distinct and specific storage allocations for 2 or more of the following purposes: (1) floodwater retardation, (2) irrigation, (3) fishing, hunting, boating, swimming or other recreational use, (4) improved environment or habitat for fish or wildlife, (5) municipal, (6) industrial, and (7) other uses. (A farm pond where multiple use is made of the same pool is not considered a multiple-purpose dam.)

Where Applicable. This practice applies only to sites meeting all the following criteria:

1. The construction and operation of the dam is permitted by applicable State statutes and regulations.

2. Topographic, geologic, hydrologic and soil conditions at the proposed site are satisfactory for the development of a feasible dam and reservoir.

3. The sediment yield from the watershed is not excessive.

4. Water is available from a single or combined source of surface runoff, base flow, or from subsurface storage in sufficient quantity and adequate quality to satisfy the intended purposes.

Debris Basin

Definition. A barrier or dam constructed across a waterway or at other suitable locations to form a silt or sediment basin.

Purpose. To preserve the capacity of reservoirs, ditches, canals, diversions, waterways and streams, to prevent undesirable deposition on bottomlands, and developed areas; to trap sediment originating from construction sites; and to reduce or abate pollution by providing basins for the deposition and storage of silt, sand, gravel, stone and other detritus.

Where Applicable. This practice applies where physical conditions or land ownership preclude the treatment of the sediment source by the installation of erosion control measures to keep soil and other material in place, or a debris basin offers the most practical solution to the problem.

Deferred Grazing

Definition. Postponing grazing or resting grazing land for a prescribed period.

Purpose. To (1) promote natural revegetation by increasing the vigor of the forage stand and permitting desirable plants to produce seed; (2) provide a feed reserve for fall and winter grazing or emergency use; (3) to improve the appearance of range with inadequate cover; and (4) to improve hydrologic conditions and reduce soil loss.

Where Applicable. On all rangeland, native pasture, grazable woodland, and grazed wildlife land.

Dike

Definition. An embankment constructed of earth or other suitable materials to protect land against overflow from streams, lakes, and tidal influences; also to protect flat land areas from diffused surface waters.

Scope. This standard covers quality requirements for planning, designing, and constructing all dikes installed with Soil Conservation Service assistance to provide protection for land and property and includes dikes for floodways and wildlife improvement.

Dikes are divided into the following three classes:

Class I dikes include all dikes where one or more of the following conditions apply:

1. Where there is a possibility of loss of life should failure occur.

2. Where high value land or improvements are to be protected.

3. Where unusual or complex site conditions exist, such as organic soils outside the limits given for Classes II and III dikes.

4. Where the dike is designed to withstand more than 12 feet of water above normal ground surface, exclusive of crossings of sloughs, old channels, or low areas.

Class II dikes include embankments built to protect agricultural lands of medium to high capability with improvements generally limited to farmsteads and allied farm facilities.

Class III dikes are embankments which protect agricultural lands of relatively low capability or improvements of low value. These dikes are limited to low heads of water.

Purpose. The purposes of dikes are to permit the improvement of land for agricultural production by preventing overflow and better utilizing drainage facilities, to prevent damage to land and property, and to facilitate water storage and control in connection with wildlife and other developments.

Where Applicable. The land to be protected must be suitable for the intended use. Locations shall be such that practical and economical construction, accessibility and maintenance can be obtained. Property lines, soils, open water, watershed characteristics, runoff, and adequate outlets for either gravity or pump drainage must be favorable.

Class I dikes are used to protect improved lands where inundation, erosion and scour, or sediment and debris may cause high property damage or loss of life.

Criteria for Class II dikes are applicable for all dikes not in Classes I or III.

Class III dikes are usually built where the spoil from excavated drainage channels is available.

Disposal Lagoon

Definition. An impoundment made by constructing an excavated pit, dam, embankment, dike, levee or combination of these for biological treatment of organic waste. (This standard does not include holding ponds and tanks.)

Scope. This standard establishes the minimum acceptable quality for design construction, and maintenance of disposal lagoons located to serve predominantly rural or agricultural areas.

Purpose. Lagoons are constructed to biologically decompose organic waste by aerobic or anaerobic organisms.

Where Applicable. This practice applies where there is need for a facility to process concentrated organic waste, reduce sources of pollution, minimize health hazards and improve the local environment.

All state and local laws, rules and regulations governing use of disposal lagoons shall be strictly adhered to. The owner or operator must be responsible for securing necessary permits where required.

Diversion

Definition. A channel with a supporting ridge on the lower side constructed across the slope.

Scope. This standard covers the installation of all diversions except floodwater diversions.

Purpose. The purpose of this practice is to divert water from areas where it is in excess to sites where it can be used or disposed of safely.

Where Applicable. This practice applies to sites where:

1. Runoff from higher lying areas is damaging cropland, pasture land, farmsteads, or conservation practices such as terraces or stripcropping.

2. Surface and shallow subsurface flow is damaging sloping upland.

3. Runoff is available for diversion and use on n arby sites. These include (1) areas where diffused surface water can be spread to increase vegetation; (2) diversions to farm ponds or pits; and (3) groundwater recharge areas.

4. Required as a part of a pollution abatement system, or to control erosion and runoff on urban or developing areas and construction sites.

Diversions shall not be substituted for terraces on land requiring terracing for erosion control.

Diversions are not applicable below high sediment producing areas unless land treatment practices or structural measures, designed to prevent damaging accumulations of sediment in the channels, are installed with or before the diversions.

Drainage Field Ditch

Definition. A graded ditch for collecting excess water within a field. This does not include Drainage Main or Lateral, or Grassed Waterway or Outlet.

Purpose. Drainage field ditches are installed to:

1. Drain surface depressions.

2. Collect or intercept excess surface water such as sheet flow from natural and graded land surfaces or channel flow from furrows for removal to an outlet.

3. Collect or intercept excess subsurface water for removal to an outlet.

Where Applicable. Applicable sites are flat or nearly flat lands that:

1. Have soils of low permeability or shallowness over barriers, such as rock or clay, which hold or prevent ready percolation of water to a deep stratum.

2. Have surface depressions or barriers which trap rainfall.

3. Have insufficient land slope for ready movement of runoff across the surface.

4. Receive excess runoff or seepage from uplands.

5. Require removal of excess irrigation water.

6. Require control of the groundwater table.

7. Have adequate outlets available for disposal of drainage water by gravity flow or pumping.

8. Have soils suitable for agricultural use.

9. Can be drained within U. S. Department of Agriculture and Soil Conservation Service policy.

Drainage Land Grading

Definition. Reshaping the surface of the land to be drained by grading to planned grades. (This practice requires a detailed engineering survey and layout. This is in contrast with Land Smoothing where detailed engineering survey and layout are not performed. This does not include Irrigation Land Leveling or Recreation Land Grading and Shaping.)

Purpose. The purposes of the practice include one or more of the following: improve surface drainage, provide more effective utilization of rainfall, improve equipment operation and efficiency, and facilitate the installation of a more workable drainage system, and reduce the incidence of mosquito infestation.

Where Applicable. This practice applies on land where depressions, mounds, old terraces, turn rows and other surface irregularities prevent adequate surface drainage and where precision grading is practical. All land to be graded shall be suitable for the planned use.

Soils shall be of sufficient depth and suitable texture so that after the needed grading work is done an adequate root zone remains which will permit planned land use with the application of proper conservation measures, soil amendments and fertilizer as needed.

Drainage Main or Lateral

Definition. An open drainage ditch constructed to a designed size and grade. Does not include Drainage Field Ditch.

Scope. This standard covers ditches for disposal of surface and subsurface drainage water primarily collected by drainage field ditches and subsurface drains. It also covers the minimum drainage requirements for multiple-purpose channels which provide drainage outlets for agricultural lands, but the design criteria for such channels shall be in accord with the standard for Open Channel.

Purpose. The purpose of mains and laterals is to dispose of excess surface or subsurface water, intercept groundwater, or to control groundwater levels; to provide for leaching of saline or alkali soils; or a combination of these objectives.

Where Applicable. This practice is applicable only to lands that can be drained within U. S. Department of Agriculture and SCS policy.

All lands to be drained shall be suitable for agricultural use within their land capabilities after installation of required drainage and other conservation practices.

An outlet for the drainage system shall be available, either by gravity flow or by pumping. The outlet shall provide for the quantity and quality of water to be disposed of, with consideration of possible damages above or below the point of discharge that might involve legal actions.

Emergency Tillage

Definition. Roughening the soil surface by such methods as listing, ridging, duck-footing, or chiseling. (This practice is considered an emergency conservation measure and does not provide long-term benefits.)

Purpose. To temporarily protect cultivated land against soil loss primarily due to wind during critical erosion periods.

Where Applicable. On cropland that is in immediate danger of being eroded by wind because of insufficient residues, cloddiness, or roughness; or where other practices fail to control erosion.

Farmstead and Feedlot Windbreaks -*

Definition. A belt of trees or shrubs established next to a farmstead or feedlot.

Purpose. To protect soil resources; control snow deposition; prevent wind damage to farmsteads; provide shelter for livestock; beautify an area; or to improve an area for wildlife, and screen areas from unwanted noise levels and unsightly views.

Where Applicable. (1) Land next to farmsteads where wind damage is likely or where the natural beauty of trees and shrubs is wanted; and where rows of trees or shrubs will provide the needed protection or the desired beauty or will attract wildlife. (2) Next to feedlots or grazing areas to provide livestock shelter; to beautify an area; or to provide wildlife shelter and food.

Fencing

Definition. Enclosing or dividing an area of land with a suitable permanent structure that acts as a barrier to livestock, big game, or people. (Does not include electric or other temporary fences.)

Purpose. To (1) exclude livestock or big game from areas that should be protected from grazing; (2) confine livestock or big game on an area or prevent trespass; (3) subdivide grazing land to permit use of grazing systems; (4) protect new seedings and plantings from grazing; and (5) regulate access to areas by people.

Where Applicable. On any area where livestock or big game control or exclusion is needed, or where access to people is to be regulated.

Firebreak

Definition. A strip of bare land or fire retarding vegetation.

Purpose. To protect soil, water and plant resources by reducing or preventing damage by fire.

Where Applicable. On areas where damaging fires are likely or where fire may be prescribed as a cultural or protective measure.

Floodwater Diversion

Definition. A graded channel with a supporting embankment or dike on the lower side constructed on lowland subject to flood damage. Does not include Floodway or Diversion.)

Purpose. This practice is to divert floodwater from lowlands by the construction of a graded channel on the lowlands.

Where Applicable. This practice is applicable where:

1. Flood water which originates outside the lowland area to be protected is causing damage to agricultural land, crops, or improvements to be made in the area.

2. An adequate outlet for the design flow is available, either by gravity flow or by pumping. The outlet shall be suitable for the

quality and quantity of water and sediment to be disposed of, with consideration of possible damages above or below the point of discharge that might involve legal actions under state law. The outlet may be a Floodway, a natural channel, river, lake, bay, or tidal estuary.

3. Lands to be protected are suitable for agricultural use within their capabilities after installation of required conservation practices.

4. All state laws and property rights regarding diversion or discharge of floodwaters are complied with.

This practice does not include diversions constructed on uplands which may provide benefits to bottom lands; or dams constructed to divert floodwaters into a waterspreading system, irrigation canal, or storage facility for beneficial use. A Diversion Dam may discharge into a Floodwater Diversion.

Floodwater Retarding Structure

Definition. A single-purpose structure providing for temporary storage of floodwater and for its controlled release.

Scope. This standard applies to class (a) structures where the product of the storage (in acre-feet at the elevation of the crest of the emergency spillway) and the height of the dam (in feet as measured from the lowest point in the original cross section on the centerline to the crest of the emergency spillway) is less than 3000. A class (a) structure is defined as a structure located in rural or agricultural areas where damage due to failure is limited to farm buildings, agricultural land, or township or county roads.

Purpose. Floodwater retarding structures are installed to reduce flood damages downstream by controlling the release rate from flood flows of predetermined frequencies. They may also permit the use of more economical channel improvements or stabilizing structures in the channel downstream, and reduce environmental hazards and pollution.

Where Applicable. This practice applies only to sites meeting all of the following conditions:

1. The construction of the structure is permitted by applicable state statutes and regulations.

2. Topographic, geologic, and soils conditions at the proposed site are satisfactory for the development of a feasible dam and reservoir.

3. The sediment yield at the site is not excessive.

4. Special attention will be given to maintaining habitat for fish and wildlife where applicable.

Floodway

Definition. A channel, usually bounded by dikes, used to carry flood flows.

Purpose. Floodways are used to carry floodwater from a side drainage across a flood plain into the channel of a main stream. They are also used along the course of a main stream where, by means of dikes, a portion of the flood plain is used to carry floodwater and the balance of the flood plain is protected.

Where Applicable. Floodways are applicable to overflow areas of streams or rivers where existing channels are inadequate to carry the floodwaters without flooding and damaging property, and the design storm discharge can be confined between dikes or a combination of channel and dikes without causing excessive erosion. A floodway is applicable to sites where the storm runoff from side tributaries which will be ponded outside the floodway will not cause damages in excess of the benefits less the cost of the project.

This practice does not include Floodwater Diversions which divert water from lowlands. A floodwater diversion may empty into a floodway. This practice does not include channel improvement where the spoil is set back from the excavated areas and where no provision is made to confine the floodwater to the channel side of the spoil.

An outlet for the floodway must be available which will provide for the discharge of the quantity of water for which the floodway is to be designed without creating stage increases in the outlet which could result in damages above or below the point of discharge that might involve legal actions under state law.

Classification. Since a large percentage of floodways include dikes as a major feature of the floodway, the same classification used for dikes will be used for floodways. The classes are defined in the standard for Dike.

Class I Floodways are those which:

1. Include Class I Dikes as a feature of the floodway, or

2. Are constructed to protect areas where either of the following conditions apply:

   a. There is a possibility of loss of life.
   b. High value land or improvements are to be protected.

Class II Floodways are those which:

1. Include Class II Dikes as a feature of the floodway, or

2. Are constructed to protect agricultural lands of medium

to high capability with improvements generally limited to farmsteads and allied farm facilities.

Class III Floodways are those which:

1. Include Class III Dikes as a feature of the floodway, or

2. Are constructed to protect agricultural lands of relatively low capability or improvements of low value.

Grade Stabilization Structure

Definition. A structure to stabilize the grade or to control head cutting in natural or artificial channels. (Does not include structures used in drainage and irrigation systems primarily for water control.)

Scope. This standard applies to all types of grade stabilization structures.

Purpose. Grade stabilization structures are installed to stabilize the grade in natural or artificial channels, prevent the formation or advance of gullies, and reduce environmental and pollution hazards.

Where Applicable. These structures apply where the concentration and flow velocity of water are such that structures are required to stabilize the grade in channels or to control gully erosion. Special attention will be given to maintaining or improving habitat for fish and wildlife, where applicable.

Grassed Waterway or Outlet

Definition. A natural or constructed waterway or outlet shaped or graded and established in vegetation suitable to safely dispose of runoff from a field, diversion, terrace, or other structure.

Purpose. To prevent excessive soil loss and formation of gullies.

Where Applicable. Where concentrated runoff must be disposed of at safe velocities.

Grassed Waterway or Outlet (Natural Watercourses)

Definition. A natural or constructed waterway or outlet shaped or graded and established in suitable vegetation as needed for the safe disposal of runoff from a field, diversion, terrace or other structure.

Scope. This standard covers the grading and shaping used to rehabilitate natural watercourses through cropland. It does not cover the vegetativ measures which may be needed and required.

Purpose. To provide for the disposal of surface water in natural watercourses without damage by erosion.

Where Applicable. These practices apply to all natural watercourses where a limited amount of earthwork and vegetative protection are required to control erosion resulting from concentrated runoff. Channel slopes should not exceed 3 percent.

Grasses and Legumes in Rotation

Definition. Establishing grasses and legumes or a mixture of them and maintaining the stand for a definite number of years as a part of a conservation cropping system.

Purpose. To produce forage for hay, silage, seed, or grazing; reduce soil and water loss; maintain a favorable level of organic matter; and improve soil productivity.

Where Applicable. On cropland and certain recreation and wildlife land where they are an essential part of a conservation cropping system or otherwise needed by a land owner or operator.

Grazing Land Mechanical Treatment

Definition. Renovating, contour furrowing, pitting, or chiseling native grazing land by mechanical means.

Purpose. To improve plant cover quickly by reducing competition of undesirable plants, aerating the soil, retarding runoff and increasing available moisture, reducing erosion, and protecting lower lying land or structures from siltation.

Where Applicable. (1) On native grazing land where perennial plants should be increased; (2) where soil and slope are suitable to each method and type of equipment used; (3) where grazing will be managed to allow plants to respond to this treatment. Mechanical treatment may not be desirable on areas to be used for recreation.

Holding Pond

Definition. An impoundment made by constructing a dam or embankment, by excavation, or a combination thereof for temporary storage of livestock or other agricultural wastes, waste water, or polluted runoff. (Does not include disposal lagoon.)

Scope. This standard establishes the minimum acceptable quality for design and construction and operation of holding ponds as part of an overall waste management system in predominantly rural or agricultural areas. This standard is applicable to class (a) ponds with fill heights of 10 feet or less.

Purpose. Holding ponds are constructed to store liquid and solid manure and polluted runoff from concentrated livestock or waste areas until they can be safely utilized, evaporated or otherwise disposed of.

Where Applicable. This practice applies where there is need for facilities to temporarily store agricultural wastes or polluted runoff, reduce pollution, minimize health hazards and improve the environment.

All state and local laws, water quality standards, rules and regulations governing the disposal of manure or other agricultural wastes must be strictly adhered to. The owner or operator is responsible for securing any and all required permits or approvals.

Irrigation Canal or Lateral

Definition. A permanent irrigation canal or lateral constructed to convey water from the source of supply to one or more farms. This includes open channels and elevated canals, but does not include Irrigation Field Ditches.

Purpose. Canals and laterals convey irrigation water from a source of supply to the beginning of a farm irrigation system. The conservation objectives are to prevent erosion or loss of water quality or damage to land, to make possible proper water use, and to convey water efficiently to minimize conveyance losses.

Where Applicable. All canals and laterals and related structures shall be planned as integral parts of an irrigation water conveyance system that has been designed to facilitate the conservation use of soil and water resources on a farm or group of farms.

Canals and laterals shall be located where they will not be subject to damage from side drainage flooding, or they must be protected from such damage.

All lands served by the canals and laterals shall be suitable for irrigation.

Water quality, supply, and delivery for the area served shall be adequate to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

Unlined canals and laterals shall not be constructed on sites where the soils are excessively permeable. Where an excessively permeable soil site must be crossed, the canals and laterals shall be lined under the standards for ditch and canal linings.

Irrigation Ditch and Canal Lining (Concrete and Pneumatically Applied Mortar)

Definition. A fixed lining of impervious material installed in existing or newly constructed irrigation field ditch or irrigation canal or lateral. This includes shaping or reshaping of ditch and using material such as concrete, asphalt, or other durable lining.

Scope. This standard applies to concrete linings made of Portland cement concrete, cast in place in a preformed ditch or canal section, and pneumatically applied mortar (PAM).

This standard is restricted to installations in ditches or canals that have a bottom width not greater than 6 feet, a design capacity not greater than 100 c.f.s., and a maximum velocity of 15 feet per second.

This standard includes design and construction criteria for the ditch section as well as for the lining.

Purpose. The principal purposes of ditch and canal lining are to reduce water loss, prevent waterlogging of land, prevent erosion and to maintain water quality.

Where Applicable. Ditches and canals to be lined shall serve as integral parts of an irrigation water distribution or conveyance system that has been designed to facilitate the conservation use of soil and water resources on a farm or group of farms.

The lands served by the lined ditches or canals shall be suitable for use as irrigated land in accordance with the work unit technical guide.

Water supplies and irrigation deliveries for the area served shall be enough to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

Lined ditches and canals shall be located where they will not be subject to damage from side drainage flooding, or they shall be protected from such damage.

Non-reinforced concrete linings shall be installed only in well-drained soils or on sites where subgrade drainage facilities are installed with or before the lining. These linings shall not be installed on sites subject to severe frost heave or on sites where experience has indicated the sulphate salt concentration in the soil causes rapid concrete deterioration.

Irrigation Ditch and Canal Lining (Flexible Membrane)

Definition. A lining of impervious material installed in an existing or newly constructed irrigation field, ditch, or irrigation canal or lateral.

Scope. This standard applies to buried membrane linings made of flexible materials such as plastic, rubber, or asphalt. It includes design and construction criteria for the ditch section which affects the installation of the lining as well as for the lining itself.

Purpose. The principal purposes of ditch and canal linings with flexible membranes are to reduce water loss, and to prevent waterlogging of land and to maintain water quality.

Where Applicable. Ditches and canals to be lined shall serve as integral parts of an irrigation water distribution or conveyance system that has been designed to facilitate the conservation use of soil and water resources on a farm or group of farms.

The lands served by the lined ditches or canals shall be suitable for use as irrigated land in accordance with the work unit technical guide.

Water supplies and irrigation deliveries for the area served shall be enough to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

Lined ditches and canals shall be located where they will not be subject to damage from side drainage flooding, or they shall be protected from such damage.

Irrigation Ditch and Canal Lining (Galvanized Steel)

Definition. A fixed lining of impervious material installed in existing or newly constructed irrigation field ditch or irrigation canal or lateral.

Scope. This standard applies to linings made of galvanized steel installed in a preformed ditch or canal section.

Linings covered by this standard are restricted to ditches having characteristics as follows:

A.	Bottom Widths	Not to exceed 30 inches
B.	Velocities	Not to exceed 15 ft./sec.

This standard covers both the ditch section and the steel lining.

Purpose. The principal purposes of ditch and canal lining are to reduce water loss, prevent waterlogging of land, or to prevent erosion, and to maintain water quality.

Where Applicable. Ditches and canals to be lined shall be located to serve as integral parts of an irrigation water distribution or conveyance system that has been designed to facilitate the conservation use of soil and water resources on a farm or group of farms.

The lands served by the lined ditches or canals shall be suitable for use as irrigated land in accordance with the work unit technical guide.

Water supplies and irrigation deliveries for the area served shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

Lined ditches and canals shall be located where they will not be subject to damage from side drainage flooding, or they shall be protected from such damage.

Steel linings shall not be installed in areas high in salt or other chemical concentrations injurious to galvanized steel unless the liners are protected with coatings or anodic protection specifically designed to protect the liner from these chemicals.

Irrigation Field Ditch

Definition. A permanent irrigation ditch constructed to convey water from the source of supply to a field or fields within the farm distribution system. Includes open channels and elevated ditches. Does not include Irrigation Canal or Lateral that delivers water to the farm.

Scope. This standard covers open channels of 25 cubic feet per second or less capacity formed in and with earth materials. It does not include canals and laterals or ditches which are constructed and removed during a season and ditches shaped or constructed for lining installation.

Purpose. The main conservation objectives for field ditches are to convey the water efficiently and economically so as to minimize conveyance losses, prevent erosion, or loss of water quality and make possible proper irrigation water use.

Where Applicable. Field ditches shall be planned and located as integral parts of an irrigation water distribution system designed to facilitate the conservation use of soil and water resources on a farm.

Water quality, supply, and delivery for the area served shall be adequate to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

Field ditches shall be constructed in earth material that contains enough fines to prevent excessive seepage losses, and where shrinkage cracks will not endanger the ditch. The sealing effect of sediment carried in the irrigation water may be considered.

Irrigation Land Leveling

Definition. Reshaping the surface of land to be irrigated to planned grades. Does not include Drainage Land Grading or Land Smoothing.

Purpose. Land leveling for irrigation is done to permit uniform and efficient application of irrigation water without excessive erosion, loss of water quality, or damage to land by waterlogging and at the same time to provide for adequate surface drainage.

Where Applicable. All lands to be leveled shall be suitable for use as irrigated land and for the proposed methods of water application.

Water supplies and irrigation deliveries to the area to be leveled shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

Soils shall be deep enough so that, after the needed leveling work is done, an adequate, usable root zone remains which will permit satisfactory crop production with proper conservation measures. Limited areas with shallower soils may be leveled to provide adequate irrigation grades or a better field arrangement. The finished leveling work must not result in exposed areas of highly permeable materials that would inhibit proper distribution of water over the field.

All leveling work shall be planned as an integral part of an overall farm irrigation system to facilitate the conservation use of soil and water resources. The boundaries, elevations, and direction of irrigation of individual field leveling jobs shall be such that the requirements of all adjacent areas in the farm unit can be met.

Irrigation Pipeline

Definition. A pipe line and appurtenances installed in an irrigation system.

Scope. This standard applies only to buried aluminum pipelines, coated with plastic tape on the exterior and interior surfaces.

Purpose. The conservation objectives of this pipeline practice are to prevent erosion or loss of water quality or damage to land, to make possible proper water use, and to reduce water conveyance losses.

Where Applicable. All pipelines shall be planned and located to serve as integral parts of an irrigation water distribution system that has been designed to facilitate the conservation of water on a farm or group of farms.

All lands served by the pipelines shall be suitable for use as irrigated land.

Water supplies and irrigatin deliveries to the area shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

Irrigation Pipeline (Asbestos-Cement)

Definition. A pipeline and appurtenances installed in an irrigation system.

Scope. This standard applies to buried asbestos-cement pipelines with rubber gasket joints.

Purpose. The conservation objectives of this pipeline practice are to prevent erosion or loss of water quality or damage to land, to make possible the proper management of irrigation water, and to reduce water conveyance losses.

Where Applicable. All pipelines shall be planned and located to serve as integral parts of an irrigation water distribution or conveyance system that has been designed to facilitate the conservation use of soil and water resources on a farm or group of farms.

All lands served by the pipelines shall be suitable for use as irrigated land.

Water supplies and irrigation deliveries to the area shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

Irrigation Pipeline (Non-Reinforced Concrete)

Definition. A pipeline and appurtenances installed in an irrigation system.

Scope. This standard covers the installation of low or intermediate pressure non-reinforced concrete irrigation pipelines with rubber gasket joints, mortar joints, or cast-in-place without joints. It includes pipelines with stands and vents open to the atmosphere, and pipelines not open to the atmosphere but provided with pressure relief valves.

Purpose. The conservation objectives of this pipeline practice are to prevent erosion or loss of water quality or damage to the land, to make possible the proper management of irrigation water, and to reduce water conveyance losses.

Where Applicable. All pipelines shall be planned and located to serve as integral parts of an irrigation water distribution or conveyance system that has been designed to facilitate the conservation use of soil and water resources on a farm or group of farms.

All lands served by the pipelines shall be suitable for use as irrigated land.

Water supplies and irrigation deliveries for the area served shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application methods to be employed.

Concrete pipelines shall not be installed on sites where the sulphate salt concentration in the soil or soil water exceeds 1.0 percent. On sites where the sulphate concentration is more than 0.1 percent but not more than 1.0 percent, concrete pipe may be used only if the pipe is made with Type V cement or Type II cement whose tricalcium aluminate content does not exceed 5.5 percent.

Cast-in-place pipe shall be used only in stable soils which are capable of being used as the outside form for approximately the bottom half of the conduit.

Irrigation Pipeline (High Pressure Underground Plastic)

Definition. A pipeline and appurtenances installed in an irrigation system.

Scope. This standard applies to underground thermoplastic pipelines from 1/2 inch to 12 inches in diameter that are closed to the atmosphere, and that are subject to internal pressures up to 315 pounds per square inch.

The standard includes the design criteria for irrigation pipelines, the minimum installation requirements for plastic pipelines, and the specifications for the thermoplastic pipe to be used.

Purpose. The conservation objectives of this pipeline practice are to prevent erosion or loss of water quality or damage to the land, to make possible the proper management of irrigation water, and to reduce water conveyance losses.

Where Applicable. All pipelines shall be planned and located to serve as integral parts of an irrigation water distribution or conveyance system that has been designed to facilitate the conservation use and management of the soil and water resources on a farm or group of farms.

Water supplies and rates of irrigation delivery for the area served by the pipeline shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application method to be used.

Plastic pipelines installed under this standard shall be placed only in suitable soils where the bedding and backfill requirements can be fully met.

Irrigation Pipeline (Low Head Underground Plastic)

Definition. A pipeline and appurtenances installed in an irrigation system.

Scope. This standard applies to underground thermoplastic pipelines from 4 to 15 inches in diameter that are subject to internal working pressures up to 50 feet head of water.

The standard includes the design criteria for these irrigation pipelines, the minimum installation requirements, and the specifications for the thermoplastic pipe to be used. It includes pipelines with stands and vents open to the atmosphere, and pipelines not open to the atmosphere but provided with pressure relief valves.

Purpose. The conservation objectives of this pipeline practice are to prevent erosion or loss of water quality or damage to the land, to make possible the proper management of irrigation water, and to reduce water conveyance losses.

Where Applicable. All pipelines shall be planned and located to serve as integral parts of an irrigation water distribution or conveyance

system that has been designed to facilitate the conservation use and management of the soil and water resources on a farm or group of farms.

Water supplies and rates of irrigation delivery for the area served by the pipeline shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

Plastic pipelines installed under this standard shall be placed only in suitable soils where the bedding and backfill requirements can be fully met.

Irrigation Pit

Definition. Small storage reservoirs constructed to regulate or store the supply of water available to the irrigator.

Scope. This standard includes open pits excavated below the ground surface to intercept and store either surface water or unconfined groundwater for irrigation. It includes pits where a portion of the water is impounded above natural ground provided that the depth of water above the ground surface, as measured at the spillway crest elevation, does not exceed three feet. It does not apply to excavated pits designed primarily for the control or regulation of flow.

This standard establishes the minimum acceptable quality level for the planning and functional design of irrigation pits. It does not include detailed design criteria or construction specifications for individual pits or components of the storage facility.

Purpose. Irrigation pits are constructed to collect and store water until it can be used beneficially to satisfy crop irrigation requirements.

Where Applicable. This practice applies only to sites meeting all of the following criteria and conditions:

1. The existing water supply available to the irrigated area is insufficient to meet conservation irrigation requirements during part or all of the irrigation season.

2. The construction of an irrigation pit is the most practical means of developing the needed additional supply of water.

3. An adequate supply of good quality water is available for storage from surface runoff, streamflow, or from a subsurface source.

4. Topographic, geologic, water table, and soils conditions at the site are satisfactory for the feasible development of the irrigation pit.

5. Where surface runoff enters the pit, the contributing drainage area is or can be protected against erosion to the extent that normal sedimentation will not materially shorten the planned life of the pit.

6. The contemplated excavation of the pit and storage of water are permitted by applicable state statutes and regulations.

Regulating Reservoir

Definition. Small storage reservoir constructed to regulate or store the supply of water available to the irrigator. Sometimes referred to as overnight storage reservoir.

Scope. This standard establishes the minimum acceptable quality for the design and construction of class (a) ponds located in predominantly rural or agricultural areas.

This standard includes reservoirs created by impounding structures and pits excavated below ground surface for the short-period storage of either diverted surface waters or waters from pumped or flowing wells.

The depth of water in regulating reservoirs created by impounding structures shall not exceed 20 feet, measured as the vertical distance between the lowest point along the centerline of the embankment and the crest elevation of the emergency spillway.

The surface area of the reservoir shall not exceed 20 acres.

This standard establishes the minimum acceptable quality level for the planning and functional design of irrigation regulating reservoirs. It does not include detailed design criteria or construction specifications for individual reservoirs or components of the regulating facility.

Purpose. Regulating reservoirs are constructed to store water for relatively short periods of time (usually less than 4 days) for such purposes as:

1. To provide for the regulation of fluctuating flows in streams or canals.

2. To provide suitable (usually larger) irrigation streams.

3. To provide for improved management of irrigation water.

4. To permit more efficient use of available labor.

5. To avoid nighttime operation.

Where Applicable. This practice applies only to sites meeting all of the following criteria and conditions:

1. The existing available irrigation stream is of such size that regulation is necessary to accomplish the intended purposes.

2. An adequate and dependable volume of good quality water is or can be made available.

3. Topographic, geologic, and soils conditions are suitable for the practical construction of a regulating reservoir with an adequate storage capacity. Pervious soils encountered in the reservoir area can be sealed to such degree that seepage losses will not be excessive.

4. Where surface runoff enters the reservoir, the contributing drainage area is or can be protected against erosion to the extent that normal sedimentation will not materially shorten the planned life of the reservoir.

5. The owner will have, or be able to obtain, a valid right to use the water.

Irrigation Storage Reservoir

Definition. An irrigation storage reservoir made by constructing a dam.

Scope. This standard applies to irrigation water storage structures designed to be filled during the season of low irrigation demand in order to provide water needed for irrigation during some other portion of the year, or in some future year. It does not apply to structures designed primarily for flow control or those designed to store water for only a few hours or a few days.

This standard covers the planning and functional design of irrigation storage reservoirs. It does not include detailed design criteria or construction specifications for individual structures or components of the storage facility.

Purpose. Irrigation storage reservoirs are constructed to conserve water by holding it in storage until it can be beneficially used to meet crop irrigation requirements.

Where Applicable. This practice applies only to sites meeting all of the following criteria:

1. The water supply available to the irrigated area is insufficient to meet conservation irrigation requirements during part or all of the conservation season.

2. Water is available for storage from surface runoff, streamflow, or from a subsurface source during periods of low or non-irrigation use.

3. Topographic, geologic, and soils conditions are satisfactory at some suitable site for the development of an economically feasible storage reservoir.

4. The construction of a dam and the storage of water are permitted by applicable state statutes and regulations.

Irrigation System, Drip

Definition. A planned irrigation system where all necessary facilities have been installed for the efficient application of water directly to the root zone of plants by means of applicators (orifices, emitters, porous

tubing, perforated pipe, etc.) operated under low pressure. The applicators may be placed on or below the surface of the ground.

Scope. This standard covers the planning and design of the drip irrigation system through which water is distributed within the irrigated area by means of small diameter pipes and applied at or near the soil surface. It includes all components of the on-farm system except for special structures such as surface water inlets, pumping plants, and components covered by other standards. Permanently installed mains and laterals will be designed and installed under the standard for Irrigation Pipelines.

Purpose. Drip irrigation systems are installed to apply irrigation water efficiently directly to plant root zone in order to maintain soil moisture within the range for good plant growth without excessive water loss, erosion, reduction in water quality or salt accumulation.

Where Applicable. Drip irrigation plans shall be based on an evaluation of the site and the expected operating conditions. The soils and topography shall be suitable for irrigation of the proposed crops.

Water supply must be sufficient in quantity and quality for the crops to be grown.

The drip method of irrigation is adapted to most orchard crops and row crops; to steep slopes where other methods would cause excessive erosion; to areas where application devices cause less interference with cultural operations and to most climatic conditions where irrigated agriculture is feasible. This method is also adapted for irrigation of gardens, flowers, and shrubs in urban settings. Small flow rates of water can be utilized efficiently.

Irrigation System, Sprinkler

Definition. A planned irrigation system where all necessary facilities have been installed for the efficient application of water for irrigation by means of perforated pipes or nozzles operated under pressure.

Purpose. Sprinkler irrigation systems are installed to apply irrigation water efficiently and uniformly in order to maintain soil moisture within the range for optimum plant growth, without excessive water loss, erosion or reduction in water quality.

Where Applicable. Sprinkler irrigation plans shall be based on an evaluation of the site and the expected operating conditions. The soils and topography shall be suitable for irrigation for the proposed crops.

Enough good quality water shall be available for the practical irrigation of the crops to be grown.

The sprinkler method of water application is adaptable to most crops except rice, to most irrigable lands, and to most climatic conditions where irrigated agriculture is feasible. It is not adapted to areas where extremely high temperatures and high wind velocities prevail.

Irrigation System, Tailwater Recovery

Definition. A facility to collect, store, and transport irrigation tailwater for reuse in the farm irrigation distribution system.

Scope. This standard covers the planning and functional design of irrigation tailwater recovery systems including pickup ditches, sumps, pits, and pipelines. It does not include detailed design criteria or construction specifications for individual structures or components of the recovery system.

Purpose. Tailwater recovery systems are installed to conserve farm irrigation water supplies and water quality by collecting the water that runs off the surface of sloping fields and making this water available for reuse on the farm.

Where Applicable. Tailwater recovery systems are adapted for use on sloping lands that are served by a surface irrigation system properly designed and installed to facilitate the conservation use of soil and water resources, and where recoverable irrigation runoff occurs or can be anticipated under the management practices used or expected to be used.

The soils at the storage site shall be impervious enough to prevent excessive seepage losses, or reservoir lining or sealing must be practical.

Irrigation Water Management

Definition. Determining and controlling the rate, amount and timing of irrigation water application to soils to supply crop water needs in a planned and efficient manner.

Purpose. To effectively utilize the available irrigation water supply in managing and controlling the moisture environment of crops to promote the desired crop response; to minimize soil erosion and loss of plant nutrients; to control undesirable water loss; and to protect water quality.

Where Applicable. This practice is adapted to all lands that are suitable for irrigation and that have a water supply of suitable quality and quantity.

An adapted conservation irrigation system must be available, either as a portable system or a system that has been established on the land to be irrigated.

The irrigator shall have the knowledge and capability to manage and apply irrigation water in such a manner that the objectives mentioned above under "Purpose" can be reasonably attained. The knowledge should include such things as:

1. How to determine when irrigation water needs to be applied based on crop water-use rates and stages of plant growth.

2. How to measure or estimate the amount of water required for each irrigation including the leaching needs.

3. How to compute the amount of water delivered to an area.

4. The normal time needed for the soil to absorb the required amount of water and how to detect changes in intake rate.

5. How to adjust stream size, application rate or irrigation time as necessary to compensate for changes in such factors as intake rate or amount of water to be applied.

6. How to recognize erosion caused by irrigation.

7. How to estimate the amount of irrigation runoff from an area.

8. How to evaluate the uniformity of water application.

Land Smoothing

Definition. Removing irregularities on the land surface by use of special equipment. Ordinarily, this does not require a complete grid survey. This includes operations ordinarily classed as rough grading. This does not include the "floating" done as a regular maintenance practice on irrigated land or the "planing" done as the final step in Irrigation Land Leveling or Drainage Land Grading.

Purpose.

1. Improve surface drainage.

2. Provide for more effective use of precipitation.

3. Obtain uniform planting depths.

4. Provide for more uniform cultivation.

5. Improve equipment operation and efficiency.

6. Improve terrace alignment.

7. Facilitate contour cultivation.

Where Applicable. This practice applies on lands where depressions, mounds, old terraces, turn rows, and other surface irregularities interfere with the application of needed soil and water conservation and management practices.

It is limited to areas having adequate soil depths.

Livestock Exclusion

Definition. Excluding livestock from an area where grazing is not wanted.

Purpose. To protect, maintain or improve the quantity or quality of the plant and animal resources, to maintain enough cover to protect the soil, to maintain moisture resources and to increase natural beauty.

Where Applicable. Where desired forest reproduction, soil hydrologic values, existing vegetation (including trees) or other things, such as aesthetic values or recreation are prevented or damaged by livestock. This practice is applicable only if an owner or operator physically constructs or maintains the barrier (fence, etc.) necessary to exclude livestock. It is not applicable on areas where livestock are not present or are usually confined to fenced areas such as pastures or feedlots.

Minimum Tillage

Definition. Limiting the number of cultural operations to those that are properly timed and essential to produce a crop and prevent soil damage.

Purpose. To retard deterioration of soil structure; reduce soil compaction and formation of tillage pans; improve soil aeration, permeability and tilth; and pollution abatement.

Where Applicable. On all cropland, and certain recreation and wildlife land.

Mulching

Definition. Applying plant residues or other suitable materials not produced on the site to the soil surface.

Purpose. To conserve moisture; prevent surface compaction or crusting; reduce runoff and erosion; control weeds; and help establish plant cover.

Where Applicable. On soils subject to erosion on which low-residue-producing crops, such as grapes and small fruits are grown; on critical areas; and on soils that have a low infiltration rate.

Straw Mulching

Definition. Applying straw mulch not produced on the site to the soil surface.

Purpose. To conserve moisture; prevent surface compaction or crusting; reduce runoff and erosion; and help establish vegetative cover.

Where Applicable. On all soils subject to erosion, but particularly critical areas on the following land uses:

Commercial/Industrial
Community Services
Recreation
Residential
Transportation Services

Open Channel

Definition. Constructing or improving a channel, either natural or articificial, in which water flows with a free surface.

Scope. This standard covers the construction of open channels or improvement of existing streams or ditches having a drainage area in excess of one square mile. It does not apply to Diversion, Drainage Field Ditch, Grassed Waterway or Outlet, Irrigation Canal or Lateral, or Irrigation Field Ditch.

Purpose. Open channels are constructed or improved and maintained to provide discharge capacity required for flood prevention, drainage, other authorized water management purposes, or any combination of these purposes.

Where Applicable. Provisions of this standard are applicable to all earth channel construction or improvement which includes flood prevention or drainage as a project purpose, alone or in combination with other purposes, except as noted under "Scope" above.

Functional requirements for specific purposes such as flood prevention, drainage, etc., are in the standards covering those purposes. Stability requirements for all channels to which this standard is applicable, as defined in "Scope" above, shall be as specified herein.

An adequate outlet for the improved channel reach must be available for discharge by gravity flow or pumping.

Construction or other improvements of the channel must not cause significant erosion upstream or flooding and/or sediment deposition downstream.

Pasture and Hayland Management

Definition. Proper treatment and use of pastureland.

Purpose. To prolong life of desirable forage species; to maintain or improve the quality and quantity of forage; and to protect the soil, and reduce water loss.

Where Applicable. On all pasture and hayland.

Pasture and Hayland Planting

Definition. Establishing and re-establishing long-term stands of adapted species of perennial, biennial, or reseeding forage plants. (Includes Pasture and Hayland Renovation. Does not include Grassed Waterway or Outlet on cropland.)

Purpose. To reduce erosion, to produce high quality forage, and to adjust land use.

Where Applicable. On existing pasture and hayland or on land that is converted from other uses.

Pipeline

Definition. Pipeline installed for the conveyance of water for livestock or recreational use.

Scope. This standard covers pipelines of less than 4 inches inside diameter installed for livestock watering or for use of recreational areas.

Purpose. To convey water from source of supply to points of use.

Where Applicable. Where conveyance of water in a closed conduit is desirable or necessary to conduct water from one point to another, conserve the supply, or for reasons of sanitation.

Planned Grazing Systems

Definition. A system in which two or more grazing units are alternately rested from grazing in a planned sequence over a period of years, and the rest period may be throughout the year or during the growing season of the key plants.

Purpose. (1) To maintain or speed up improvement in plant cover while properly using the forage on all grazing units; (2) to improve efficiency of grazing by uniformly using all parts of each grazing unit; and (3) to insure a supply of forage throughout the grazing season; (4) for watershed protection; and (5) to enhance wildlife habitat.

Where Applicable. On all rangeland, native pasture, grazable woodland, and grazed wildlife land.

Planning Considerations. (1) The specific grazing system to choose depends on size, number of grazing units, climate, range sites or other soil grouping and conditions, kinds of grazing animals, and the operator's objectives; (2) each system must be tailored to help meet the operator's objectives; (3) each system must be able to be applied practically and flexible enough to meet the needs of key plants in relation to climatic fluctuations while providing forage throughout the grazing season; (4) fences and watering facilities must be carefully considered in terms of adequacy and costs in relation to the benefits expected from the total system; and (5) special provisions for prolonged drought or other unusual circumstances should be included.

Pond

Definition. A water impoundment made by constructing a dam or embankment, or by excavating a pit or "dugout."

Ponds constructed by the first of these methods are referred to hereinafter as "Embankment Ponds" and those constructed by the latter method as "Excavated Ponds." Ponds resulting from both excavation and embankment are classified as "Embankment Ponds" where the depth of water impounded against the embankment at spillway elevation is 3 feet or more.

Scope. This standard establishes the minimum acceptable quality for the design and construction of class (a) ponds located in predominantly rural or agricultural areas when:

1. Failure of the structure would not result in loss of life; in damage to homes, commercial or industrial buildings, main highways, or railroads; or in interruption of the use or service of public utilities.

2. The product of the storage times the effective height of the dam does not exceed 3,000 where the storage is defined as the original volume (acre-feet) in the reservoir at the elevation of the crest of the emergency spillway and the effective height of the dam is defined as the difference in elevation (feet) between the emergency spillway crest and the lowest point in the cross section taken along the centerline of the dam.

3. The vertical distance between the lowest point along the centerline of the dam and the crest of the emergency spillway does not exceed 20 feet.

Purpose. Ponds are constructed to provide water for livestock, fish and wildlife, recreation, fire control, crop and orchard spraying and related uses.

Where Applicable. This practice applies only where it is determined that additional water supply on the farm is justified. Reasonably dependable livestock water ponds in a pasture bounded by fences or a natural livestock barrier generally should not be located closer together than:

1. One-half mile in rough mountain land;

2. Three-fourths mile in foothills or rolling land; or

3. One mile in undulating prairie land.

Site conditions shall be such that the peak rate of runoff that can be expected to occur once in 25 years can be safely passed through (1) a natural or constructed emergency spillway, or (2) a combination of a principal structural spillway and an emergency spillway. Livestock Water Tanks shall meet the requirements of the State Engineer of Colorado. Livestock Water Tanks, as defined by the State of Colorado, are permitted only on watercourses, the channels of which are normally dry as determined by the State Engineer of Colorado.

Drainage area above the pond must be protected against erosion to the extent that expected normal sedimentation will not shorten the planned effective life of the structure. The pond must have an expected useful life of at least 25 years.

▯ Pond Sealing or Lining (Flexible Membranes)

Definition. Installing fixed lining of impervious material or treating the soil in a pond mechanically or chemically to impede or prevent excessive water loss.

Scope. This standard applies to the use of flexible membrane linings made of plastic, rubber, and similar material.

Where Applicable. This practice applies where water loss from a pond through leakage is or will be of such proportion as to prevent the pond from fulfilling its planned purposes, or where leakage will damage land or crops or will cause waste of water.

▯ Pond Sealing or Lining (Soil Dispersants)

Definition. Installing fixed lining of impervious material or treating the soil in a pond mechanically or chemically to impede or prevent excessive water loss.

Where Applicable. Where water loss from a pond through leakage is or will be of such proportion as to prevent the pond from fulfilling its planned purpose, or where leakage will damage land or crops or will cause waste of water.

▯ Pond Sealing or Lining (Bentonite and Clay Blankets)

Definition. Installing fixed lining of impervious material or treating the soil in a pond mechanically or chemically to impede or prevent excessive water loss.

Scope. This standard covers the sealing of ponds with bentonite or similar high swell clay materials.

Where Applicable. Where water loss from a pond through leakage is or will be of such proportion as to prevent the pond from fulfilling its planned purpose, or where leakage will damage land or crops or will cause waste of water.

- Pond Sealing or Lining (Cationic Emulsion - Water-Borne Sealant)

  Definition. Installing a fixed lining of impervious material or treating the soil in a pond mechanically or chemically to impede or prevent excessive water loss.

  Where Applicable. Where water loss from a pond through leakage is, or will be, of such proportion as to prevent the pond from fulfilling its planned purpose or where leakage will damage land or crops or will cause waste of water, and where seepage reduction of 70 to 95 percent will adequately solve the leakage problem.

- Proper Grazing Use

  Definition. Grazing at an intensity which will maintain enough cover to protect the soil and maintain or improve the quantity and quality of desirable vegetation.

  Purpose. To: (1) increase the vigor and reproduction of key plants; (2) accumulate litter and mulch necessary to conserve soil and water; (3) improve or maintain condition of the vegetation; (4) increase forage production; (5) maintain natural beauty; and (6) reduce the fire hazard on forest land.

  Where Applicable. On all rangeland, native pasture, grazable woodland, and grazed wildlife land.

- Pumping Plant for Water Control

  Definition. A pumping facility installed to transfer water for a conservation need, including removing excess surface or ground water; filling ponds, ditches or wetlands; or for pumping from wells, ponds, streams and other sources.

  Purpose. To provide a dependable water source or disposal facility for water management on wet lands or to provide a water supply for such purposes as irrigation, recreation, livestock, or wildlife.

  Where Applicable. Wherever water must be pumped to accomplish the conservation objective. It is especially applicable for maintaining critical water levels in existing swamps, marshes, or open water and for providing water sources for newly constructed wetlands and ponds.

- Range Seeding

  Definition. Establishing adapted plants by seeding on rangeland. (Does not include pasture and hayland planting.)

  Purpose. To (1) prevent excessive soil and water loss; (2) produce more forage on rangeland or land converted to range from other uses; and (3) improve the natural beauty of grazing land.

Where Applicable. On rangeland, native pasture, grazable woodland, and grazed wildlife land.

Planning Considerations. (1) Land to be seeded must have soil and climate that can support a satisfactory cover of adapted range forage plants; and the land must not have enough of the desired species to recover within a reasonable period through grazing management alone. (2) Management following seeding should be able to maintain the stand.

Recreation Area Improvement

Definition. Establishing grasses, legumes, vines, shrubs, trees, or other plants or selectively reducing stand density and trimming woody plants to improve an area for recreation.

Purpose. To increase the attractiveness and usefulness of recreation areas and to protect the soil and plant resources.

Where Applicable. On any area planned for recreation use.

Recreation Area Stabilization

Definition. Stabilizing recreation areas subject to heavy use by surfacing with suitable materials or by installing needed structures.

Purpose. To stabilize a recreation or essential facility area for sustained heavy use by people, animals or vehicles.

Where Applicable. On recreation areas where physical conditions at the site, prolonged or concentrated use, or other factors make vegetative protection impracticable.

Recreation Land Grading and Shaping

Definition. Altering the surface of land to meet the requirement of recreation facilities.

Scope. This standard applies where modification of the land surface is required to permit installation of recreation facilities.

Where Applicable. On sites where surface irregularities, slopes, kinds of soil, obstructions or wetness interfere with planned recreational use; or where such use requires designed land surfaces.

Seecial attention will be given to maintaining or improving habitat for fish and wildlife where applicable.

Recreation Trail and Walkway

Definition. A pathway prepared especially for pedestrian, equestrian and cycle travel.

Scope. This standard applies to walkways and trails constructed within recreation and scenic areas.

Purpose. To provide recreation area users with travel routes for activities such as walking, sightseeing, horseback riding, and bicycling.

Where Applicable. This practice applies to lands where prepared paths, trails, and walkways are needed for effective and safe use of the recreation resources.

Regulating Water in Drainage Systems

Definition. Controlling the removal or impoundment of surface runoff, primarily through the operation of water control structures.

Scope. This standard is applicable to the regulation of surface and subsurface water inflow and outflow through drainage systems. This frequently involves other allied reportable practices, such as are listed under Design Criteria for this standard.

Purpose. The purpose of the practice is to conserve surface or subsurface water by controlling the outflow from drainage systems to maintain optimum water levels, flow rates and soil moisture conditions. Such conservation of water will make it possible to:

1. Establish and encourage the growth of desired field or forest plants.

2. Maintain field laterals, channel banks, side slopes, and bottoms

3. Reduce subsidence and wind erosion of organic soils.

4. Provide habitat for fish and other aquatic life.

5. Hold water in channels in forest areas to act as ground-fire breaks and provide drinking water for wildlife and a resting and feeding place for waterfowl.

6. Improve environment for recreation use.

7. Improve water quality in streams and ponds by limiting erosion, reducing sediment movement and controlling flow rates.

Where Applicable. This practice applies to areas needing drainage and where it is advantageous to control the outflow or pumping rate at other times. It is applicable especially in organic soils and in highly

permeable soils of low available water holding capacity. This practice can be used to improve habitat for fish and wildlife. It also applies to recreational areas.

Regulation of outflow should be undertaken only when soil water salinity or alkalinity is not likely to be a problem.

A water supply sufficient for leaching shall be available.

Spring Development

Definition. Improving springs and seeps by excavating, cleaning, capping, or providing collection and storage facilities. Does not include Trough, Tank, or Pipeline.

Purpose. Spring developments usually are made to improve the distribution or to increase the quantity of livestock water supplies, but may be made for irrigation if water in suitable quantity and quality is available.

Where Applicable. Development shall be confined to springs or seepage areas that appear able to furnish a dependable supply of suitable water during the planned period or periods of use.

The need for, and feasibility of, protection from flooding, sedimentation, and contamination shall be considered in determining the suitability of a site for development.

Stock Trails and Walkways

Definition. A livestock trail or walkway constructed to improve grazing distribution and access to forage and water.

Purpose. To (1) provide or improve aceess to forage and water; (2) reduce livestock concentrations; (3) control livestock to permit proper grazing use and planned grazing systems; and (4) improve grazing efficiency.

Where Applicable. On grazing areas where free livestock movement is hampered, such as on steep mountain slopes, across rock outcrops, through dense timber, over rough lava beds, and on marsh range or grazing areas subject to overflow.

Stream Channel Stabilization

Definition. Stabilizing the channel of a stream with suitable structures.

Scope. This standard covers the structural work done to control aggradation or degradation in a stream channel. It does not include work done to prevent bank cutting or meander.

Where Applicable. This practice applies to stream channels undergoing damaging aggradation or degradation that cannot be feasibly controlled by clearing or snagging, by the establishment of vegetative protection, or by installation of upstream water control facilities, and which require the application of structural measures.

Streambank Protection

Definition. Stabilizing and protecting banks of streams, lakes, estuaries, excavated channels against scour and erosion by vegetative and structural means.

Scope. This standard covers the structural means used to stabilize and protect the banks of natural streams, lakes, estuaries, and excavated channels. It is not applicable to erosion problems on main ocean fronts and similar areas of complexity not normally within the scope of SCS authority or expertise.

Purpose. Streambank protection is established to stabilize or protect streambanks for one or more of the following purposes:

1. To prevent the loss of land or damage to utilities, roads, buildings or other facilities adjacent to the channel.

2. To maintain the capacity of the channel.

3. To control channel meander which would adversely affect downstream facilities.

4. To reduce sediment loads causing downstream damages or to improve the stream for recreational use or as a habitat for fish and wildlife.

Where Applicable. This practice applies to natural or excavated channels where the streambanks are subject to erosion from the action of water, ice or debris or to damage from livestock or vehicular traffic.

Stripcropping, Contour

Definition. Growing crops in a systematic arrangement of strips or bands on the contour to reduce water erosion. The crops are arranged so that a strip of grass or close-growing crop is alternated with a strip of clean-tilled crop or fallow or a strip of grass is alternated with a close-growing crop.

Purpose. To reduce erosion and control water.

Where Applicable. On sloping cropland and certain recreation and wildlife land where the topography is uniform enough that tilling and harvesting can be done practically; and where it is an essential part of a cropping system, to effectively reduce soil and water losses.

Stripcropping, Field

Definition. Growing crops in a systematic arrangement of strips or bands across the general slope (not on the contour) to reduce water erosion. The crops are arranged so that a strip of grass or close-growing crop is alternated with a clean-tilled crop or fallow.

Purpose. To help control erosion and runoff on sloping cropland where contour stripcropping is not practical.

Where Applicable. On sloping cropland and certain recreation and wildlife land.

Stripcropping, Wind -*

Definition. Growing wind-resisting crops in strips alternating with row crops or fallow and arranged at angles to offset adverse wind effects.

Purpose. To reduce wind velocity at the soil surface, thereby reducing soil blowing and damage to crops.

Where Applicable. On cropland subject to soil blowing and where needed as part of a cropping system.

Structure for Water Control

Definition. A structure in an irrigation, drainage, or other water management system that conveys water, controls the direction or rate of flow, or maintains a desired water surface elevation. These structures are also for the protection of fish and wildlife and other environmental values, as well as for protection and management of soils and plants. (Does not include structures for which the primary purpose is to control head cutting and control erosion.)

Scope. This standard applies to the structures normally installed in a well planned irrigation or drainage system, wildlife facility or other water management system for the conveyance, flow control, or level regulation of water. It covers the planning and functional design of such water control structures but not the detailed design criteria or construction specifications for specific structures. It does not include structural components of irrigation pipelines or subsurface drains.

Purpose. Water control structures are installed to control the stage, discharge, distribution, delivery or direction of flow of water in open channels, or water use areas. They may also be used for water quality control such as sediment reduction or temperature regulation.

Where Applicable. This practice applies wherever a permanent structure is needed as an integral part of an irrigation, drainage, or other water

control system to serve one or more of the following functions:

1. To conduct water from one elevation to a lower elevation within, to, or from a ditch, channel, or canal. Typical structures: drops, chutes, turnouts, surface water inlets, head gates, pump boxes, stilling basins.

2. To control the elevation of water in drainage or irrigation ditches, Typical structure: checks.

3. To control the division or measurement of irrigation water. Typical structures: division boxes, water measurement devices.

4. To protect pipelines from the entry of trash, debris, or weed seeds. Typical structure: debris screens.

5. To control direction of channel flow resulting from tides and high water or backflow from flooding. Typical structure: tide and drainage gates.

6. To control water table or removal of surface or subsurface water of adjoining land; to flood land for frost protection or to manage water levels for wildlife or recreational purposes. Typical structures: water level control structures, pipe drop inlets, box inlets.

7. To provide water level control for recreation or similar purposes.

8. To provide conveyance for water over, under, or along a ditch, canal, road, railroad or other barrier. Typical structures: bridges, culverts, flumes, inverted siphons.

9. To modify water flow to provide habitat for fish, wildlife, and other aquatic animals. Typical structures: deflectors, chutes, cold water release, or structures to make pools and riffles.

Stubble Mulching

Definition. Managing plant residues on a year-round basis in which harvesting, tilling, planting, and cultivating operations are performed in such a way to keep protective amounts of vegetation on the soil surface.

Purpose. To reduce soil loss from wind and water; improve water infiltration; and improve the physical condition of the soil.

Where Applicable. On nonirrigated cropland in semiarid and subhumid areas when wind or water erosion occurs.

Subsurface Drain

Definition. A conduit, such as tile, pipe, or tubing, installed beneath the ground surface and which collects and/or conveys drainage water.

Purpose. A subsurface drain may serve one or more of the following purposes:

1. Improve the soil environment for vegetative growth by regulating the water table and ground water flow.
2. Intercept and prevent water movement into a wet area.
3. Relieve artesian pressures.
4. Remove surface runoff.
5. Facilitate leaching of saline and alkali soils.
6. Serve as an outlet for other subsurface drains.
7. Provide ground water regulation and control for subirrigated areas or waste disposal areas.
8. Collect groundwater for beneficial uses.
9. Remove water from around buildings, roads, airports, play fields, and other physical improvements.
10. Provide water regulation to control health hazards caused by liver fluke, flies, mosquitoes, etc.

Where Applicable. This practice is applicable only to lands that can be drained within U. S. Department of Agriculture and Soil Conservation Service policy.

Drains are used in areas having a high water table where benefits of lowering or controlling ground water or surface runoff justify the installation of such a system.

All lands to be drained shall be suitable for the intended use after installation of required drainage and other conservation practices. The soil shall have enough depth and permeability to permit installation of an effective and economically feasible system. The drainability and treatment of saline and alkali soils shall be considered where this is a problem.

An outlet for the drainage system shall be available, either by gravity flow or by pumping. The outlet shall be adequate for the quantity and quality of effluent to be disposed of with consideration of possible damages above or below the point of discharge that might involve legal actions under state laws.

▯ Terrace, Basin

Definition. A form of level terrace with closed ends constructed on noncropland with permeable soils and designed to impound a given amount of runoff from the drainage area above it.

Scope. This standard covers the planning and design of basin terraces. It does not apply to Gradient, Level, or Parallel Terraces, or Diversions.

Purpose. Basin terraces are constructed to retain runoff from noncropland areas, check erosion on the lower slopes, prevent gully development, reduce flooding, and increase infiltration opportunity, and reduce pollution from sediment and runoff.

Where Applicable. This practice is applicable on sites where:

1. Runoff from higher lying areas will damage crop or pastureland; conservation practices such as terraces, farm ponds, and similar structural installations; roads, buildings, or other cultural features.

2. The soil is deep and capable of absorbing and storing extra water.

▯ Toxic Salt Reduction

Definition. Reducing or redistributing the harmful concentrations of salt in the soil. (Sometimes referred to as "leaching.)

Purpose. To create a soil condition which permits desirable plants to grow.

Where Applicable. On land where the accumulation of salt at or near the surface limits the growth of desirable plants.

▯ Tree Planting

Definition. Planting tree seedlings or cuttings.

Purpose. To establish or reinforce a stand of trees to conserve soil and moisture, beautify an area, protect a watershed or produce wood crops.

Where Applicable. In open fields, in understocked woodland, beneath less desirable tree species or in other areas suitable for producing wood crops where erosion control or watershed protection is needed, where greater natural beauty is wanted or where a combination of these is desired.

Trough or Tank

Definition. A trough or tank with needed devices for water control and waste water disposal installed to provide drinking water for livestock.

Scope. This standard covers all trough or tank installations to provide livestock watering facilities supplied from a spring, reservoir, well or other source.

Purpose. To provide watering facilities at selected locations which will bring about the desired protection of vegetative cover through proper distribution of grazing or better grassland management.

Where Applicable. This practice applies where there is a need for new or improved watering places to permit the desired level of grassland management and reduce health hazards to livestock.

Range Planning Requirements. The practice must facilitate proper grazing use by improving distribution of grazing over all parts of the range; meeting the water requirements of livestock with adequately distributed water supplies where less expensive water developments are not feasible. Reasonably dependable stockwater facilities generally should not be located closer together than one-half mile in rough mountain country, three-quarters mile in foothills or rolling land, or one mile in level or undulating prairie.

Well

Definition. A well constructed or improved to provide water for irrigation, livestock, or recreation.

Scope. This standard covers wells for irrigation, livestock water, wildlife, and recreation.

Where Applicable. Wells are applicable on ranges, pastures, and wildlife and recreation areas where present facilities are inadequate, but with an underground water supply which is adequate in quantity and quality for the purpose to be served.

All irrigation wells shall be planned and located to serve as a source of water for an irrigation water distribution or conveyance system that has been designed to facilitate the conservation use of the soil and water resources on a farm or group of farms.

All lands served by the irrigation well shall be suitable for use as irrigated land.

The water produced by irrigation wells must be of adequate quality and sufficient quantity to make irrigation practical for the crops to be grown and the water application methods to be used.

▯ Woodland Direct Seeding

Definition. Spreading tree seed by hand or by mehcanical means in open areas or understocked woodlands to establish an adequate stand.

Purpose. To establish a stand of trees that will conserve soil and moisture, produce wood crops, and produce related values.

Where Applicable. In open areas or understocked woodlands where soils are suited to growing wood crops, where suitable site preparation can be attained, and where adequate measures for the protection of seed and seedlings can be provided.

▯ Woodland Improvement

Definition. Improving woodland by removing unmerchantable or unwanted trees, shrubs, or vines.

Purpose. To fully use the potential of a site, to maintain plant cover for soil protection, to improve stand composition by leaving the best trees spaced for best growth, to improve forage production on grazable woodland, or to improve the natural beauty, wildlife or recreation values of an area.

Where Applicable. In a woodland where a stand of trees is overstocked or where desirable trees are overtopped by less desirable trees, shrubs or vines, where removing part of a stand will improve stand quality, forage production or the recreation, wildlife, aesthetic or hydrologic values of an area.

▯ Woodland Pruning

Definition. Removing all or parts of selected branches from trees.

Purpose. To improve the quality of the wood product or the appearance of trees.

Where Applicable.

1. On land growing trees where the quality of the final product and the potential of the site justify the cost.

2. Where removing all or parts of branches enhances the beauty of an area.

3. On Christmas tree sites where removing all or parts of branches increases the value of the trees.

[] Woodland Site Preparation

Definition. Treating open areas or understocked woodland areas to encourage natural seeding of desirable trees or to permit reforestation by planting or direct seeding.

Purpose. To prepare land for the establishment of a stand of forest trees for conservation of soil and water, watershed improvement and the production of wood crops.

Where Applicable. On understocked areas suitable for growing wood crops.

MODEL FLOODPLAIN ORDINANCE

APPENDIX C

APPENDIX C

MODEL FLOODPLAIN ORDINANCE

THE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

RESOLUTION NO. 2, SERIES OF 1979
(Amending the District's Flood Plain Regulation)

WHEREAS, authority for the Board of Directors to adopt, amend, repeal, enforce and otherwise administer under the police power reasonable flood plain zoning resolutions, rules, regulations and orders pertaining to properties within the District of any public body or other person affecting the disposition of water drainage is contained in Section 32-11-218 (1) (f) (I) , C.R.S. 1973, as amended; and

WHEREAS, the uncontrolled use of the flood plains and watercourses within the District boundaries adversely affects the public health, safety and welfare of the citizens of the District; and

WHEREAS, the Board of Directors by Resolution No. 11, Series of 1970, adopted a Flood Plain Regulation; and

WHEREAS, the Board of Directors by Resolution No. 26, Series of 1974, amended the Flood Plain Regulation; and

WHEREAS, the Flood Plain Regulation has been the subject of study, use, and commentary since 1970; and

WHEREAS, such study, use, and commentary have indicated the desirability of certain revisions of the Flood Plain Regulation; and

WHEREAS, a public hearing on the amendments proposed by the District has been held by the Board of Directors at which any public body owning drainage and flood control facilities in the District or exercising powers affecting drainage and flood control therein had an opportunity to be heard along with other persons having an interest in the proposed regulations as required by Section 32-11-218 (1) (f) (II) , C.R.S. 1973, as amended; and

WHEREAS, the Board of Directors has, with due consideration, determined the said Flood Plain Regulation to be necessary to execute the legal duties inposed upon the District by its enabling legislation;

NOW, THEREFORE, BE IT RESOLVED that the Board of Directors of the District does hereby adopt the following amendments to its Flood Plain Regulation:

SECTION 1.0 PURPOSES. To promote the public health, safety, and general welfare, to minimize flood losses in areas subject to flood hazards, and to promote wise use of the flood plain, this flood plain Regulation has been established with the following purposes intended:

1.1 To reduce the hazards of floods to life and property by:

1.11 Prohibiting certain uses which are dangerous to life or property in time of flood.

1.12 Restricting uses which would be hazardous to the public health in time of flood.

1.13 Restricting uses which are particularly susceptible to flood damage, so as to alleviate hardship and eliminate demands for public expenditures for relief and protection.

1.14 Requiring permitted flood plain uses, including public facilities which serve such uses, to be protected against floods by providing flood proofing and general flood protection at the time of initial construction.

1.2 To alert flood plain occupants or potential occupants to flood damages, which may result from their own, or other, land use and which is or may be undertaken without full realization of the danger by:

1.21 Regulating the manner in which structures designed for human occupancy may be constructed so as to prevent danger to human life within such structures.

1.22 Regulating the method of construction of water supply, sanitation systems and other utilities, so as to prevent disease, contamination and unsanitary conditions.

1.23 Delineating and describing areas that could be inundated by floods so as to protect individuals from purchasing flood plain lands for purposes which are not in fact suitable.

1.3 To protect the public from the burden of avoidable financial expenditures for flood control and relief by:

1.31 Regulating all uses within the flood plain areas so as to produce a method of construction and a pattern of development which will minimize the probability of damage to property and loss of life or injury to the inhabitants of the flood hazard areas.

1.4 To protect the storage capacity of flood plains and to assure retention of sufficient floodway area to convey flood flows which can reasonably be expected to occur by:

1.41 Regulating filling, dumping, dredging, and alteration of channels by deepening, widening, or relocating.

1.42 Prohibiting unnecessary and damage-creating encroachments.

1.43 Encouraging open space uses such as agriculture and recreation.

1.5 To protect the hydraulic characteristics of the small watercourses, including the gulches, sloughs and artificial water channels used for conveying flood waters, which make up a portion of the urban drainage system by:

1.51 Regulating filling, dumping and channelization so as to maintain natural storage capacity and slow flow characteristics.

1.52 Prohibiting encroachment into the small watercourses to maintain their water carrying capacity.

1.53 Encouraging uses such as greenbelt, open space, recreation and riding trails.

SECTION 2.0 GENERAL PROVISIONS.

2.1 Jurisdiction: The jurisdiction of this section includes all lands adjacent to any watercourse within the Urban Drainage and Flood Control District that would be inundated by the 100-year flood for that watercourse as defined in the Definitions section of this Resolution.

2.2 District Types: The Flood Regulatory District covers the 100-year flood plain. Where deemed to be in the public interest by the Urban Drainage and Flood Control District, and to promote wise use of the flood plain, the Flood Regulatory District may be subdivided into the Floodway District and the Flood Storage District.

The Flood Regulatory District is defined by computing the 100-year flood plain limits under existing channel and flood plain conditions.

Subdivision of the Flood Regulatory District into the Floodway District and the Flood Storage District must not cause a 100-year flood water surface profile rise of more than one-half foot above that for the Flood Regulatory District based on the assumption that there will be an equal degree of encroachment extending for a significant "reach" on both sides of the stream.

The subdivision of the Flood Regulatory District and accompanying hydraulic studies must be based upon all of the Flood Storage District reach being filled. Creation of the Floodway District and Flood Storage District must be made only with the full understanding that such subdivision may tend to increase flood peaks downstream. ~~The Floodway District and Flood Storage District shall be added to the flood plain zoning map for the Flood Regulatory District which is subdivided.~~

2.3 Boundaries: The boundaries of the Flood Regulatory District, the ~~Floodway District and the Flood Storage District~~ shall be as they appear on the flood plain zoning maps kept on file with the Executive Director, Urban Drainage and Flood Control District. The boundary lines on the map shall be determined by the use of the scale appearing on the map. Where there is a conflict between the boundary lines illustrated on the map and actual field conditions, the dispute shall be settled according to Section 7.3, "Mapping Disputes" of this Regulation.

2.4 Interpretation: In the Flood Plain ~~Board of Zoning Adjustment's~~ ADMINISTRATOR'S interpretation and application, the provisions of this Regulation shall be held to be minimum requirements and shall be liberally construed in favor of the governing body and shall not be deemed a limitation or repeal of any other powers granted by Colorado Statutes.

2.5 Warning and Disclaimer of Liability: The degree of flood protection intended to be provided by this section is considered reasonable for regulatory purposes and is based on engineering and scientific methods of study. Larger floods may occur on occasions or the flood height may be increased by man-made or natural causes, such as ice jams and bridge openings restricted by debris. This Regulation does not imply the areas outside flood plain area boundaries or land uses permitted within such areas will always be totally free from flooding or flood damages. Nor shall this section create a liability on the part of or a cause of action against the Urban Drainage and Flood Control District or any officer or employee thereof for any flood damages that may result from reliance on this Regulation.

2.6 Adoption of Official FLOOD PLAIN Maps: The location and boundaries of the ~~Flood Areas established by this Regulation are shown upon the "Flood Plain Zoning Maps of the Urban Drainage and Flood Control District," which are hereby incorporated into this Regulation. The said zoning maps, together with everything shown thereon and all amendments thereto, shall be as much a part of this Regulation as if fully set forth and described herein.~~ FLOOD REGULATORY DISTRICTS ESTABLISHED BY THIS REGULATION SHALL BE AS THEY APPEAR ON THE MAPS AND PROFILES CONTAINED IN ENGINEERING REPORTS ADOPTED AFTER A PUBLIC HEARING BY THE BOARD OF DIRECTORS. THE BOARD OF DIRECTORS MAY DESIGNATE FLOODWAY AND FLOOD STORAGE DISTRICTS BY ADOPTING FLOODWAY TABLES CONTAINED IN THE ABOVE MENTIONED ENGINEERING REPORTS AFTER A PUBLIC HEARING. Each change in the official maps shall be subject to the Amendment procedure as required in Section 7.3, Mapping Disputes. For the purpose of final determination of the flood plain limits, the flood profile shall control. The description ~~of the~~ ADOPTED MAPS AND flood profiles shall be on file with the County Clerk and Recorder of the county in which the flood plain is located.

SECTION 3.0 NONCONFORMING USES

3.1 The existing lawful use of a structure or premises which is not in conformity with the provisions of this Regulation may be continued subject to the following conditions:

3.11 No such use shall be expanded or enlarged except in conformity with the provisions of this Regulation.

3.12 Substantial improvement, as herein defined, to any nonconforming structure or use must result in the permanent change of the structure or use to a conforming use.

3.13 If such use is discontinued for twelve (12) consecutive months, any future use of the building and premises shall conform to this Regulation.

3.14 Uses or adjuncts thereof which are public nuisances shall not be permitted to continue as nonconforming uses.

3.15 Any alteration, addition, or repair to any existing nonconforming structure shall be protected, where applicable, by flood proofing measures pursuant to Section 7.45 (1), Flood Proofing, of this Regulation.

SECTION 4.0 FLOOD REGULATORY DISTRICT

4.1 Application: The provisions for this district apply to all flood plains of watercourses in the Urban Drainage and Flood Control District of Colorado, for which 100-year flood data and corresponding elevations or profiles are available.

4.2 Description of District: The Flood Regulatory District shall include the areaS delineated on the maps and profiles for the 100-year flood plain limits for the watercourses ~~in-the-Urban-Drainage-and Flood-Control-District-of-Colorado,-signed-by-the-engineer,-Executive-Director-and-Chairman-of-the-Board-of-the-Urban-Drainage-and-Flood-Control-District,-and-on-file-and-available-in-the-Clerk-and Recorder's-Office-of-each-county-within-the-District.~~ ADOPTED BY THE BOARD OF DIRECTORS IN ACCORDANCE WITH SECTION 2.6, ADOPTION OF FLOOD PLAIN MAPS, OF THIS REGULATION.

4.3 Special Provisions: The following regulations shall apply to all uses within the Flood Regulatory District, notwithstanding that such uses may be permitted under the terms of this Regulation.

~~4.31---The-flood-protection-elevation-or-height-shall-correspond-to a-point-one-foot-above-the-elevation-or-"flood-profile"-shown on-or-attached-to-the-flood-map-for-a-particular-area.~~

4.321 ~~No "structure-(temporary-or-permanent)",~~ NEW CONSTRUCTION; SUBSTANTIAL IMPROVEMENT; fill, including fill for roads and levees; deposit; obstruction; as herein defined; storage of materials, or other flood plain uses which acting alone or in combination with existing or future flood plain uses, shall be permitted that decreases the efficiency or the capacity of the floodway.

4.332 No flood plain uses shall adversely affect the efficiency of or unduly restrict the capacity of the channels or floodways of any tributaries to the main stream, drainage ditches, or any other drainage facilities or systems.

4.33 ALL NEW CONSTRUCTION AND SUBSTANTIAL IMPROVEMENTS SHALL BE ANCHORED TO PREVENT FLOTATION, COLLAPSE OR LATERAL MOVEMENT OF THE STRUCTURE.

4.34 ALL NEW CONSTRUCTION AND SUBSTANTIAL IMPROVEMENTS SHALL BE CONSTRUCTED WITH MATERIALS AND UTILITY EQUIPMENT RESISTANT TO FLOOD DAMAGE.

4.35 ALL NEW CONSTRUCTION OR SUBSTANTIAL IMPROVEMENTS SHALL BE CONSTRUCTED BY METHODS AND PRACTICES THAT MINIMIZE FLOOD DAMAGE.

4.36 ALL NEW AND REPLACEMENT WATER SUPPLY SYSTEMS SHALL BE DESIGNED TO MINIMIZE OR ELIMINATE INFILTRATION OF FLOOD WATERS INTO THE SYSTEM; AND ALL NEW AND REPLACEMENT SANITARY SEWAGE SYSTEMS SHALL BE DESIGNED TO MINIMIZE OR ELIMINATE INFILTRATION OF FLOOD WATERS INTO THE SYSTEMS AND DISCHARGES FROM THE SYSTEMS INTO FLOOD WATERS.

4.37 ONSITE WASTE DISPOSAL SYSTEMS SHALL BE LOCATED TO AVOID IMPAIRMENT TO THEM OR CONTAMINATION FROM THEM DURING FLOODING.

4.38 ALL MOBILE HOMES TO BE PLACED WITHIN THE FLOOD REGULATORY DISTRICT SHALL BE ANCHORED TO RESIST FLOTATION, COLLAPSE, OR LATERAL MOVEMENT BY PROVIDING OVER THE TOP AND FRAME TIES TO GROUND ANCHORS. SPECIFIC REQUIREMENTS SHALL BE THAT:

(1) OVER-THE-TOP TIES BE PROVIDED AT EACH OF THE FOUR CORNERS OF THE MOBILE HOME, WITH TWO ADDITIONAL TIES PER SIDE AT INTERMEDIATE LOCATIONS AND MOBILE HOMES LESS THAN FIFTY FEET LONG REQUIRING ONE ADDITIONAL TIE PER SIDE;

(2) FRAME TIES BE PROVIDED AT EACH CORNER OF THE HOME WITH FIVE ADDITIONAL TIES PER SIDE AT INTERMEDIATE POINTS AND MOBILE HOMES LESS THAN FIFTY FEET LONG REQUIRING FOUR ADDITIONAL TIES PER SIDE;

(3) ALL COMPONENTS OF THE ANCHORING SYSTEM BE CAPABLE OF CARRYING A FORCE OF 4800 POUNDS; AND

(4) ANY ADDITIONS TO THE MOBILE HOME BE SIMILARLY ANCHORED.

4.4 Description of Uses

Permitted Uses: The following open uses shall be permitted within the Flood Regulatory District to the extent that they are not prohibited in a particular area by any underlying county or city zoning ordinance or regulation.

4.41 Agricultural uses such as: general farming, pasture, truck farming, forestry, sod farming, and wild crop harvesting;

4.42 Industrial-commercial uses such as: loading areas, parking areas, airport landing strips, and storage yards for equipment or machinery easily moved or not subject to flood damage;

4.43 Public and private recreational uses not requiring "permanent or temporary structures" designed for human habitation such as: parks, swimming areas, golf courses, driving ranges, picnic grounds, wildlife and nature preserves, game farms, fish hatcheries, shooting preserves, target ranges, trap and skeet ranges, and hunting, fishing and hiking areas;

4.44 Utility facilities such as: flowage areas, transmission lines, pipelines, water monitoring devices, roadways, and bridges.

4.5 Special Exceptions: Any use enumerated in subsections 4.51 through 4.55 may be permitted only upon ~~application-to-the-Flood-Plain-Zoning Administrator-and~~ the issuance of a special exception permit by the Flood Plain ~~Board-of-Zoning-Adjustment~~ ADMINISTRATOR as provided in Section 7.4, Special Exception Permits of this Regulation.

~~4.51 "Structures"-Accessory-to-Open-Uses-permitted-in-Section-4.4-Description-of-Uses,-of-this-Regulation,-whether-temporary-or permanent-may-be-permitted-only-upon-a-determination-by-the-Flood-Plain-Board-of-Zoning-Adjustment-pursuant-to-a-finding under-the-procedure-required-by-Section-7.4,-Special-Exception Permits-of-this-Regulation-that:~~

~~(1)--Structures-will-not-be-designed-for-human-habitation;~~

~~(2)--Structures-will-have-a-low-flood-damage-potential;~~

~~(3)--The-structure-or-structures,-if-permitted,-will-be-constructed-and-placed-on-the-building-site-so-as-to-offer the-minimum-obstruction-to-the-flow-of-flood-waters:~~

~~(a)--Whenever-possible,-structures-will-be-constructed with-the-longitudinal-axis-parallel-to-the-direction of-flow-of-flood-waters;-and~~

~~(b)--So-far-as-practicable,-structures-will-be-placed so-their-longitudinal-axes-are-approximately-on the-same-line-as-those-of-adjoining-structures.~~

~~(4)--Structures will be firmly anchored to prevent the structure or building from floating away and thus threatening to further restrict bridge openings and other restricted sections of the stream or river; --and~~

~~(5)--Service facilities such as electrical equipment will be at or above the flood protection elevation for the particular area.~~

RESIDENTIAL CONSTRUCTION. NEW CONSTRUCTION OR SUBSTANTIAL IMPROVEMENT OF ANY RESIDENTIAL STRUCTURE MAY BE PERMITTED ONLY UPON A FINDING BY THE FLOOD PLAIN ADMINISTRATOR THAT THE LOWEST FLOOR, INCLUDING BASEMENT, IS TO BE ELEVATED TO OR ABOVE THE FLOOD PROTECTION ELEVATION.

4.52 ~~Other Structures (Temporary or Permanent for People) may be permitted only upon a finding by the Flood Plain Board of Zoning Adjustment that:~~

~~(1)--Such structures shall comply with Section 4.51 (3), (4), and (5) of this Regulation.~~

~~(2)--The first floor, or basement floor of any structure to be erected, constructed, reconstructed, or moved on the flood plain shall be constructed on fill at or above a point two (2) feet above the 100-year flood elevation for the particular area and the fill shall extend at such elevation at least fifteen (15) feet beyond the limits of any structure or building erected thereon.~~

NON-RESIDENTIAL CONSTRUCTION. NEW CONSTRUCTION OR SUBSTANTIAL IMPROVEMENT OF ANY COMMERCIAL, INDUSTRIAL OR OTHER NON-RESIDENTIAL STRUCTURE MAY BE PERMITTED ONLY UPON A FINDING BY THE FLOOD PLAIN ADMINISTRATOR THAT THE LOWEST FLOOR, INCLUDING BASEMENT, IS TO BE ELEVATED TO OR ABOVE THE FLOOD PROTECTION ELEVATION OR, TOGETHER WITH ATTENDANT UTILITY AND SANITARY FACILITIES, IS TO BE FLOOD PROOFED SO THAT BELOW THE FLOOD PROTECTION ELEVATION THE STRUCTURE IS WATER TIGHT WITH WALLS SUBSTANTIALLY IMPERMEABLE TO THE PASSAGE OF WATER AND WITH STRUCTURAL COMPONENTS HAVING THE CAPABILITY OF RESISTING HYDROSTATIC AND HYDRODYNAMIC LOADS AND EFFECTS OF BUOYANCY. A REGISTERED PROFESSIONAL ENGINEER OR ARCHITECT SHALL CERTIFY TO THE FLOOD PLAIN ADMINISTRATOR THAT THE STANDARDS OF THIS SUBSECTION ARE SATISFIED.

4.53 MOBILE HOMES

(1) NEW MOBILE HOME PARKS AND MOBILE HOME SUBDIVISIONS, EXPANSIONS OF EXISTING MOBILE HOME PARKS AND MOBILE HOME SUBDIVISIONS, AND EXISTING MOBILE HOME PARKS AND MOBILE HOME SUBDIVISIONS WHERE THE REPAIR, RECONSTRUCTION, OR IMPROVEMENT OF THE STREET UTILITIES AND PADS EQUALS OR EXCEEDS 50 PERCENT OF THE VALUE OF THE STREETS, UTILITIES AND PADS BEFORE THE REPAIR, RECONSTRUCTION OR IMPROVEMENT HAS COMMENCED AND FOR MOBILE HOMES NOT PLACED IN A MOBILE HOME PARK OR MOBILE HOME SUBDIVISION, MAY BE PERMITTED ONLY UPON A FINDING BY THE FLOOD PLAIN ADMINISTRATOR THAT:

a) STANDS OR LOTS WILL BE ELEVATED ON COMPACTED FILL OR ON PILINGS SO THAT THE LOWEST FLOOR OF THE MOBILE HOME WILL BE ELEVATED TO OR ABOVE THE FLOOD PROTECTION ELEVATION: AND

b) ADEQUATE SURFACE DRAINAGE AND ACCESS FOR A HAULER WILL BE PROVIDED.

4.534 Fills or Deposits of Materials may be permitted only upon a finding by the Flood Plain Board of Zoning Adjustment ADMINISTRATOR that:

(1) Any fill or deposit of materials will comply with the Section 4.3 Special Provisions, of this Regulation, and

(2) The fill or deposit of materials will have some beneficial purpose and the amount thereof will not be greater than is necessary to achieve that purpose, as demonstrated by a plan submitted by the owner showing the final dimensions of the proposed fill or other material and the use to which the filled land will be put;

(3) The fill or deposit of materials does not imprudently reduce the flood storage capacity of the waterway unless ~~a permit has been granted by the Flood Plain Board of Zoning Adjustment~~ and the other requirements of this section are met; and the fill or deposit of materials does not encroach on that portion of the flood plain which would have significant flow during the flood, and which for that reason would help convey the flood waters. Any filling that reduces the hydraulic capacity requires appropriate hydraulic studies and a review of the urban impact of such reduction.

(4) The fill or other materials will be protected against erosion by rip-rap, strong vegetative cover or bulk-heading.

4.545 The storage or processing of materials that are buoyant, flammable, toxic, explosive, or in times of flooding, could be injurious to human, animal, or plant life, shall be at or above the flood protection elevation for the particular area ~~or "flood proofed" in compliance with Section 7.44, --Conditions Attached to Special Exception Permits of this Regulation.~~ Solid waste disposal facilities, such as junkyards or areas for the dumping of refuse shall also require a permit from the Board of Directors.

4.566 Uses very similar in nature to permitted uses may be allowed provided that they are consistent with the provisions of this Regulation.

SECTION 5.0 FLOODWAY DISTRICT

5.1 Application: Section 4.1, Application, Flood Regulatory District, of this Regulation shall apply thereto.

5.2 Description: The Floodway District shall include the areas shown as ~~such on the maps described in Section 4.2 Description of District, Flood Regulatory District,~~ DESIGNATED BY THE BOARD OF DIRECTORS IN ACCORDANCE WITH SECTION 2.6, ADOPTION OF FLOOD PLAIN MAPS.

5.3 Special Provisions: ~~Sections 4.22, 4.23, Special Provisions, Flood Regulatory District, of this Regulation shall apply hereto.~~ THE FOLLOWING ADDITIONAL PROVISIONS SHALL APPLY TO ALL USES WITHIN THE FLOODWAY DISTRICT.

5.31 NO ENCROACHMENTS, INCLUDING FILL, NEW CONSTRUCTION, SUBSTANTIAL IMPROVEMENTS, OR OTHER DEVELOPMENT SHALL BE PERMITTED WITHIN THE FLOODWAY DISTRICT THAT WOULD RESULT IN ANY INCREASE IN FLOOD LEVELS DURING THE OCCURRENCE OF THE 100-YEAR FLOOD.

5.32 NO MOBILE HOMES SHALL BE PLACED IN THE FLOODWAY DISTRICT.

5.4 Description of Uses: The open uses that are permitted in Section 4.4, Description of Uses, Flood Regulatory District of this Regulation are permitted, provided that such use does not include any filling or deposit of materials, and the capacity of the floodway is left completely unimpaired.

~~5.5--Special Exceptions:--Section 4.51, Structures Accessory to Open Space Uses of this Regulation shall apply hereto.~~

SECTION 6.0 FLOOD STORAGE DISTRICT

6.1 Application: Section 4.1, Application, Flood Regulatory District of this Regulation shall apply thereto.

6.2 Description of District: The Flood Storage District shall include the areas ~~shown as such on the maps described in Section 4.2 Description of District,~~ DESIGNATED BY THE BOARD OF DIRECTORS IN ACCORDANCE WITH SECTION 2.6, ADOPTION OF FLOOD PLAIN MAPS of this Regulation.

6.3 Special Provisions

~~6.31---No fill, structure, deposit or other flood plain uses shall be permitted that adversely affects the efficiency of any channels or floodways of any tributaries to the main stream or river, drainage ditches, or any other drainage facilities or systems.~~

~~6.32---The first floor or basement opening of any building or structure to be erected, constructed, reconstructed, altered, or moved in the Flood Storage District shall be constructed on fill at or above a point two (2) feet above the 100 year flood elevation for the particular area and the fill shall extend at such elevation at least fifteen (15) feet beyond the limits of any structure or building erected thereon.~~

~~6.33---The storage or processing of materials that are buoyant, toxic, flammable, explosive, or in times of flooding, could be injurious to human, animal, or plant life, shall be at or above a point two (2) feet above the 100 year flood elevation for the particular area.~~

6.31 THE PROVISIONS OF SECTIONS 4.3 AND 4.5 SHALL APPLY TO ALL USES IN THE FLOOD STORAGE DISTRICT.

6.32 WITHIN AREAS OF SHALLOW FLOODING ALL NEW CONSTRUCTION AND SUBSTANTIAL IMPROVEMENT OF RESIDENTIAL STRUCTURES MAY BE PERMITTED ONLY UPON A FINDING OF THE FLOOD PLAIN ADMINISTRATOR THAT THE LOWEST FLOOR, INCLUDING BASEMENT, IS TO BE ELEVATED ONE FOOT ABOVE THE CROWN OF THE NEAREST STREET.

6.33 WITHIN AREAS OF SHALLOW FLOODING, ALL NEW CONSTRUCTION AND SUBSTANTIAL IMPROVEMENTS OF NONRESIDENTIAL STRUCTURES MAY BE PERMITTED ONLY UPON A FINDING OF THE FLOOD PLAIN ADMINISTRATOR THAT THE LOWEST FLOOR, INCLUDING BASEMENT, WILL BE ELEVATED ONE FOOT ABOVE THE CROWN OF THE NEAREST STREET, OR TOGETHER WITH ATTENDANT UTILITY AND SANITARY FACILITIES, WILL BE COMPLETELY FLOODPROOFED TO OR ABOVE THAT LEVEL SO THAT ANY SPACE BELOW THAT LEVEL IS WATERTIGHT WITH WALLS SUBSTANTIALLY IMPERMEABLE TO THE PASSAGE OF WATER AND WITH STRUCTURAL COMPONENTS HAVING THE CAPABILITY OF RESISTING HYDROSTATIC AND HYDRODYNAMIC LOADS AND EFFECTS OF BUOYANCY.

SECTION 7.0 ADMINISTRATION

7.1 Flood Plain Zoning Administrator: The Flood Plain Zoning Administrator shall administer the provisions of this Regulation.

7.2 Special Exception Permit: A special exception permit must be obtained from the Flood Plain ~~Board of Zoning Adjustment~~ ADMINISTRATOR before any new land use not expressly allowed by this Regulation may be initiated.

7.3 Mapping Disputes: The following procedure shall be used by the Flood Plain ~~Board of Zoning Adjustment~~ ADMINISTRATOR in deciding contested cases in which the location of a district boundary is disputed:

7.31 In all cases the person contesting the location of the district boundary shall be given ~~a hearing before the Board at which he may~~ THE OPPORTUNITY TO submit his own technical evidence if he so desires. ~~The Board shall schedule a hearing within 30 days of receipt of a written request therefor.~~ The Board ADMINISTRATOR shall not allow deviations from the boundary line as mapped unless the evidence clearly and conclusively establishes that the mapped location of the line is incorrect.

7.32 The Board ADMINISTRATOR shall render a written opinion within 30 days following ~~the last day of such a hearing~~ RECEIPT OF THE APPLICANT'S TECHNICAL EVIDENCE setting forth its THE findings of fact and the reasons for its THE decision.

7.33 Contestants shall have the right to appeal such decisions to ~~any court of competent jurisdiction.~~ THE FLOOD PLAIN BOARD OF ADJUSTMENT. SUCH APPEAL MUST BE MADE WITHIN 30 DAYS.

7.4 Special Exception Permits

7.41 Application for: Any use listed in this Regulation as requiring a special exception permit may be allowed only upon ~~application to the Flood Plain Zoning Administrator and~~ THE issuance of a special exception permit by the Flood Plain ~~Board of Zoning Adjustment,~~ ADMINISTRATOR.

7.42 Procedure to be Followed in Passing on Special Exception Permits: ~~The Board shall schedule a hearing within 30 days of receipt of a special exception permit application if an applicant desires a hearing.--At such a hearing, an applicant may be represented by counsel and may submit his own technical evidence.~~ Pursuant to ~~such an~~ A SPECIAL EXCEPTION PERMIT application, ~~the Board, or~~ the Administrator, may:

(1) Require the applicant to submit, at the time of application, two copies of an aerial photograph, or a plan certified by a registered engineer, competent in open channel hydraulics, which accurately locates the flood plain proposal with respect to the district limits, channel of stream, existing flood plain developments, together with all pertinent information such as the nature of the proposal; legal description of the property; fill limits and elevations; building floor elevations; and flood proofing measures.

(2) Require the applicant to furnish such of the following additional information as is deemed necessary by the Board ADMINISTRATOR for the evaluation of the effects of the proposal upon flood flows and flood plain storage and to render a decision on the proposed flood plain use.

(a) A typical valley cross-section showing the channel of the stream, the flood plain adjoining each side of channel, cross-sectional area to be occupied by the proposed development, and high water information.

(b) Plan (surface view) showing elevations or contours of the ground; pertinent structure, fill or storage elevations; size, location and spatial arrangement of all proposed and existing structures on the site; location and elevations of streets, water supply, sanitary facilities, and soil types and other pertinent information.

(c) Profile showing the slope of the bottom of the channel or thalweg of the stream, AND EXISTING AND PROPOSED 100-YEAR WATER SURFACE PROFILES.

(d) Specifications for building construction and materials, "flood proofing," filling, dredging, grading, channel improvement, storage of materials, water supply, and sanitary facilities.

(E) HYDRAULIC CALCULATIONS FOR ALL PROPOSED CHANNELIZATION.

The Board ADMINISTRATOR shall render, within 30 days of receipt of all necessary application documents and material, ~~or within 30 days from the final day of a hearing~~, a written decision granting or denying a permit application. If a denial is made, the decision shall set forth the Board's ADMINISTRATOR'S findings of fact and reasons for the denial. Applicants shall have the right to appeal any adverse finding or decision to ~~any court of competent jurisdiction~~, THE FLOOD PLAIN BOARD OF ADJUSTMENT. SUCH APPEAL MUST BE MADE WITHIN 30 DAYS.

7.43 Factors upon which the decision of the Flood Plain ~~Board of Zoning Adjustment~~ ADMINISTRATOR shall be based: The determination of the Board ADMINISTRATOR on each special exception permit application shall be based on the effects of the proposed land use with respect to the objectives and purposes of this Regulation.

7.44 Conditions Attached to Special Exception Permits: Upon consideration of the factors listed above and the purposes of this Regulation, the Flood Plain ~~Board of Zoning Adjustment~~ ADMINISTRATOR may attach such conditions, ~~in addition to those required by special permits~~, as ~~it~~ HE deems necessary in furthering the purposes of this Regulation. Such conditions may include specifications for, without limitation because of specific enumeration, modification of other waste disposal methods and facilities, landscaping, periods of operation, operational controls, sureties, deed restriction, and adequate flood proofing.

(1) Floodproofing. Special exceptions requiring flood proofing measures such as the following shall be designed consistent with the flood protection elevation for the particular area ~~as described in the Special Provisions, Section 4.31~~, and flood velocities, forces and other factors associated with the flood-protection elevation.

The ~~Board~~ ADMINISTRATOR shall require that the applicant submit a plan or document certified by a registered professional engineer that the flood proofing measures are consistent with the flood protection elevation for the particular area.

(a) Anchorage to resist flotation and lateral movement.

(b) Installation of watertight doors, bulkheads and shutters.

(c) Reinforcement of walls to resist water pressures.

(d) Use of paints, membranes or mortars to reduce seepage of water through walls.

(e) Addition of mass or weight to structures to resist flotation.

(f) Installation of pumps to lower water levels in structures.

(g) Construction of water supply and waste treatment systems to prevent the entrance of flood waters.

(h) Pumping facilities for subsurface drainage systems for buildings to relieve external foundation wall and basement floor pressures.

(i) Construction to resist rupture or collapse, caused by water pressure or floating debris.

(j) Cutoff valves on sewer lines or the elimination of gravity flow basement drains.

SECTION 8.0 CERTIFICATE OF COMPLIANCE

8.1 No vacant land shall be occupied or used and no buildings shall hereafter be erected, altered, or moved on any flood plain of any watercourse nor shall such building be occupied until a certificate of compliance shall have been issued by the Flood Plain Zoning Administrator, indicating that the use or proposed use complies with the provisions herein. A certificate shall be applied for upon completion of any project, construction, or use for which a special exception permit was granted, and the excepted land use shall not commence until a certificate is issued.

8.2 The Flood Plain Zoning Administrator shall request the applicant, when applicable, to submit a certification by a registered professional engineer that the finished fill and building floor elevations, flood proofing measures, or other flood protection factors were accomplished in compliance with the provisions of this Regulation. The Flood Plain Zoning Administrator shall within ten days after receipt of such certification from the applicant issue a certificate of compliance only if the building or premises and the proposed use thereof conform with all the requirements of this Regulation.

8.3 The Administrator shall issue a certificate upon receipt of proof that a use or structure is expressly permitted by this Regulation, such as those uses listed in Section 4.4.

SECTION 9.0 ENFORCEMENT AND PENALTIES

9.1 Every structure, building, fill or development placed or maintained within any flood plain in violation of this Regulation is a public nuisance and the creation thereof may be enjoined and maintenance thereof may be abated by action at suit of the City, Town, or County in which it is located or by the Urban Drainage and Flood Control District or any citizen thereof. Any person who places or maintains any structure, building, fill or development within any flood plain in violation of this Regulation may be fined not more than $50 for each offense. Each day during which such violation exists is a separate offense.

SECTION 10.0 AMENDMENTS

10.1 The Board of Directors of the Urban Drainage and Flood Control District of Colorado may from time to time alter, supplement or change the district boundaries and the provisions contained in this Regulation in the manner provided by law.

10.11 Amendments to this Regulation may be made on petition of any interested party in accordance with the provisions of the Colorado Revised Statutes.

10.12 The subdivisions of the Flood Regulatory District into the Floodway District and Flood Storage District will only be made by action of the Board of Directors of the Urban Drainage and Flood Control District.

SECTION 11.0 DEFINITIONS

Unless specifically defined below, words or phrases used in this Regulation shall be interpreted so as to give them the same meaning as they have at common law and to give this Regulation its most reasonable application.

11.1 Channel - that area of a watercourse where water normally flows and not that area beyond where vegetation exists.

11.2 Encroachment Lines - are limits of obstruction to flood flows. These lines are generally parallel to the stream. The lines are established by assuming that the area landward (outside) of the encroachment lines may be ultimately developed in such a way that it will not be available to convey flood flows. The stream channel and adjoining flood plains between these lines will be maintained as open space and will be adequate to convey the 100-year flood without adversely increasing flood heights, such increase under any condition not exceeding one-half foot.

11.3 Equal Degree of Encroachment - is established by considering the effect of encroachments on the hydraulic efficiency of the flood plain along a significant reach of the stream, on both sides.

11.4 Flood - a general and temporary condition of partial or complete inundation of normally dry land areas from (a) the overflow of streams, rivers, or other inland water, or (b) the unusual and rapid accumulation or runoff of surface waters from any source.

11.5 Flood Plain - an area adjacent to a watercourse, which area is subject to flooding as the result of the occurrence of the 100-year flood and which area thus is so adverse to past, current, or foreseeable construction or land use as to constitute a significant hazard to public health and safety or to property.

The term includes but is not limited to:

(a) Mainstream floodplains;

(b) Debris-fan floodplains; and

(c) Dry wash channels and dry wash floodplains.

11.6 Flood Regulatory District - that portion of the flood plain subject to inundation by the 100-year flood. The Regulatory District is MAY BE subdivided into the Flooway District and the Flood Storage District.

11.7 Flood Storage District - the fringe portion of the Flood Regulatory District in which flows are characteristically of shallow depths and low velocities.

11.8 Floodway District - that portion of the Flood Regulatory District required for the reasonable passage or conveyance of the 100-year flood which is characterized by hazardous and significant depths and velocities.

11.9 Flood Profile - a graph or a longitudinal profile showing the relationship of the water surface elevation of a flood event to location along a stream or river.

11.10 Flood Proofing - a combination of structural provisions, changes, or adjustments to properties and structures subject to flooding primarily for the reduction or elimination of flood damages to properties, water and sanitary facilities, structures, and contents of buildings in a flood hazard area.

11.11 Flood Protection Elevation - an elevation one foot above the elevation or "flood profile" of the 100-year flood under existing channel and flood plain conditions. It is one foot above the elevation of the flood for the Flood Regulatory District as shown on the zoning-FLOOD PLAIN maps in the office of the Urban Drainage and Flood Control District.

~~11.12--Flood-Stage---for-purposes-of-this-Regulation-the-term-is-used-to mean-the-height-or-elevation-of-a-flood-as-referred-to-some-datum. For-other-purposes-it-is-commonly-used-to-refer-to-the-elevation at-which-a-stream-will-overtop-its-normal-stage-banks.~~

11.12 Hundred-year Flood - is one that has a frequency of occurrence of one hundred (100) years determined from an analysis of floods on a particular watercourse and other watercourses in the same general region. It has about a one percent chance of occurring in any given year.

11.13 Obstruction - sandbars formed by the natural flow of a watercourse, temporary structures, planks, snags and debris in and along an existing channel which cause a flood hazard.

~~11.15--Ordinary-High-Water-Mark---the-highest-point-on-the-bank-of-a-normal-stage-channel-at-which-the-water-level-has-been-for-a-sufficient-period-of-time-to-leave-a-definite-mark.~~

11.14 Reach - a hydraulic engineering term to describe longitudinal segments of a stream or river. A reach will generally include the segment of the flood plain where flood heights are primarily controlled by manmade or natural flood plain obstructions or restrictions. In an urban area, the segment of a stream or river between two consecutive bridge crossings would most likely be a reach.

11.15 SHALLOW FLOODING AREA - AN AREA OF SHALLOW INDETERMINATE FLOODING NOT RELATED TO THE FLOOD PROFILE.

11.176 Storage Capacity of a Flood Plain - the volume of space above an area of flood plain land that can be occupied by flood water of a given stage at a given time, regardless of whether the water is moving. Storage capacity tends to reduce downstream flood peaks.

11.187 Structure - anything constructed or erected, the use of which requires a more or less permanent location on or in the ground. Includes but is not limited to objects such as buildings, factories, sheds, and cabins.

11.198 Structure, Permanent - a structure which is built of such materials and in such a way that it would commonly be expected to last and remain useful for a substantial period of time.

11.2019 Structure, Temporary - a structure which is built of such materials and in such a way that it would commonly be expected to have a relatively short useful life, or is built for a purpose that would commonly be expected to be relatively short-term.

11.210 Substantial Improvement - any repair, reconstruction, or improvement of a structure, the cost of which equals or exceeds 50 percent of the actual cash value of the structure either (a) before the improvement has started, or (b) if the structure has been damaged and is being restored, before the damage occurred. Substantial improvement is started when the first alteration of any structural part of the building commences.

11.221 Watercourse - a channel, natural depression, slough, artificial channel, gulch, arroyo, stream, creek, pond, reservoir, or lake in which storm runoff and flood water flows either regularly or infrequently. This includes major drainageways for carrying urban storm runoff.

11.232 Flood Plain Zoning Administrator - that individual appointed by the Board of Directors to administer the provisions of these Regulations.

~~11.243 Flood Plain Zoning Adjustment --- the procedure undertaken by the Flood Plain Board of Adjustment in the consideration, granting or denial of variances or special exception permits to the Regulations.~~

11.253 Flood Plain Board of Zoning Adjustment - the seven (7) - member board appointed by the Board of Directors who determine the ~~issuance of special exception permits,~~ granting of variances, ~~mapping disputes~~ and to review decisions of THE Flood Plain Zoning Administrator.

11.264 Flood Plain Zoning Maps - those maps that accurately indicate the boundaries of the Flood Regulatory District, ~~the Floodway District and the Flood Storage District.~~

DATED this 1st day of February, 1979.

THE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

(SEAL)
ATTEST:

Secretary

Chairman

AMENDED FACILITY PLAN

APPENDIX D

AMENDED FACILITY PLAN

for

SPEARFISH, SOUTH DAKOTA

January, 1980

Prepared By:

SCOTT ENGINEERING COMPANY
SPEARFISH, SOUTH DAKOTA

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1. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This facility plan deals only with the residential development areas surrounding the Spearfish city limits and the Spearfish Valley Sanitary District (SVSD). This facility plan only addresses the problem of centrally sewering these development areas or leaving them with on-site disposal as is presently being practiced. This facility plan will not get involved with the type of wastewater treatment facility that is being proposed for the City of Spearfish and the SVSD.

These subdivisions, as shown on Figure I, the planning area map, are presently serviced by private individual septic tanks and leach fields. They are under the jurisdiction of the Lawrence County Government.

In July of 1978, a wastewater facility plan was submitted to EPA for the City of Spearfish by Brady Consultants. In that report it was recommended that these subdivisions be serviced by a sewer collection system tied into the City of Spearfish, the basic reason being the possibility of ground water contamination. EPA felt that further study was necessary before a recommendation could be made. They also decided that an environmental impact statement was necessary. EPA hired Engineering Sciences to write the environmental impact statement. The conclusions of this study are basically as follows:

1. With the exception of West Subdivision and that surrounding area and the Christensen Drive area, septic tanks and leach fields are a viable means of sewage disposal.

2. It was found through aerial photography and surface inspection that one leach field was failing and that twelve others were suspected as possible seasonal failures.

3. The West Subdivision area is not suitable for leach fields because of the seasonal high ground water, the close proximity to the Belle Fourche water infiltration gallary, and the area suspected of being located in a flood plain.

4. There is presently a shallow well located at the beginning of Christensen Drive that is polluted. It is suspected that the septic tanks and leach fields from the 27 homes and two campgrounds in that area are the cause of this pollution.

After evaluating the economic, social and environmental aspects of the alternative plans for the different areas, it is recommended that:

1. With the exception of the West Subdivision area and the Christensen Drive area, on-site disposal can continue to be used if properly designed and constructed.

2. The one leach field found to be failing should be reconstructed. The twelve others should continue to be monitored to see if failure does occur in high ground water conditions. If any of these are found to be failing, action should be taken to correct the problem.

3. The West Subdivision area should be serviced by a gravity collection system and a pressure interceptor line.

4. The Christensen Drive area should be serviced by a gravity collection and interceptor system.

5. A Step II Grant should be applied for to design those lines that are grant eligible.

In accordance with the Environmental Protection Agency's Program Guidance Number 55, Subject: Format for Reporting Costs of Planned Treatment Works in Step I Facility Plans, Dated July 25, 1975, Table I presents a summary of costs of planned treatment works scheduled by project and category for Spearfish, South Dakota.

TABLE I

TO BE COMPLETED IN FINAL DRAFT

SUMMARY OF COSTS OF PLANNED TREATMENT WORKS SCHEDULED BY PROJECT AND CATEGORY *(Read instructions on reverse before completing form)*		MUNICIPALITY *(Applicant)*:				
1.		* SECOND ** PROJECT	* THIRD PROJECT	* FOURTH PROJECT	* FIFTH PROJECT	TOTAL ALL PROJECTS
2.	PROJECT STEP	STEP	STEP	STEP	STEP	
3.	ESTIMATED CALENDAR QTR/YEAR APPLICATION WILL BE SUBMITTED TO EPA FOR FUNDING					
		$	$	$	$	$
4.	a. CATEGORY I Secondary Treatment and BPWTT					
	b. CATEGORY II More Stringent Treatment					
	c. CATEGORY IIIA Infiltration/Inflow Correction					
	d. CATEGORY IIIB Major Sewer System Rehabilitation					
	e. CATEGORY IVA New Collectors, etc.					
	f. CATEGORY IVB New Interceptors, etc.					
	g. CATEGORY V Correction of Combined Sewer Overflows					
	h. CATEGORY VI Treatment and/or Control of Stormwaters					
5.	TOTAL ESTIMATED COST OF RECOMMENDED PROJECTS	$	$	$	$	$
6.	STEP 1 PROJECT COST Project No. C_____-01					$
7.	GRAND TOTAL ESTIMATED COST OF ALL PROJECTS TO BE INCLUDED IN THE ENTIRE GRANT					$

8 COST ESTIMATES OF RECOMMENDED PROJECTS WERE COMPUTED AS OF Dec. 1979 *(month and year)* AND REFLECT THE LATEST CONSTRUCTION COST INDEX OF 3129.6 AS REPORTED BY THE ENGINEERING NEWS RECORD

NOTE: Suggested format for data to be included in the facilities plan.

* Include project description in Facilities Plan narrative.
** The First Project is the initial *(Step 1)* project under this grant for the treatment works.

2. INTRODUCTION

2.1 Study Purpose and Scope

The purpose of this study was to: (1) Determine if the existing septic tanks and leach fields in the development areas outside the Spearfish service area are functioning properly; (2) determine if these areas are suitable for the continued use of on-site disposal; (3) determine if any of the developments are causing any ground water pollution, in particular the Belle Fourche Water Infiltration Gallery; (4) determine ground water elevations; (5) determine what alternatives of sewage collection and treatment are best suited for the areas; and (6) present preliminary designs and costs for the alternatives determined to be most suitable for the individual areas.

Normally a 201 Facility Plan would get involved with the discussion of all of the above mentioned problems plus get involved with present land use, geography of the area, population predictions, water uses and quality, environmental conditions, etc. This document will only cover costs of the alternatives for the different development areas and the eligibility of these areas for the different alternatives. The rest of this information is covered in the Environmental Impact Statement. This document should be studied congruently with the Environmental Impact Statement.

2.2 Planning Area

The planning area is the same 31 square mile area designated in the previous 201 Facility Plan dated July, 1978. This area is shown on Figure I.

FIGURE 1

Planning Area Map

(oversized)

3. EVALUATION OF ALTERNATIVES

This only covers the economic evaluation of selected alternatives for different areas. The reasons for selecting these alternatives are discussed completely in the EIS.

Each area includes the individual holding tank and the individual evapo-transpiration system alternatives. These two alternatives were examined in the original facility plan by Brady Consultants. In that facility plan, dated July, 1978, all the costs were calculated at an interest rate of 6 and 5/8 percent.

In this report the capital costs and annual O & M costs calculated by Brady Consultants were used, but the annual equivalent costs were recalculated at the present discount rate of 7 and 1/8 percent. This report also shows the costs split between those houses that were erected before December, 1977 and those houses built after December 1977. Those built before December, 1977 could be eligible for 85% federal funds and those after that date are not eligible for any funds. See Tables XV-XVIII.

3.1 West Subdivision

West Subdivision is shown on Figure II and is located in Section 28, T7N R2E. Just to the Northeast is located the City of Belle Fourche Water Infiltration Gallery. Just across the road to the East is located Brookview Acres (Weiss), this is a development for mobile homes.

Brookview Acres presently is serviced with a collection system and its own package treatment plant. From the treatment plant the effluent is pumped through a 2" line into the City of Spearfish's interceptor line approximately one half mile away. Brookview Acres' package plant is sized to handle the eighteen mobile homes that the development is

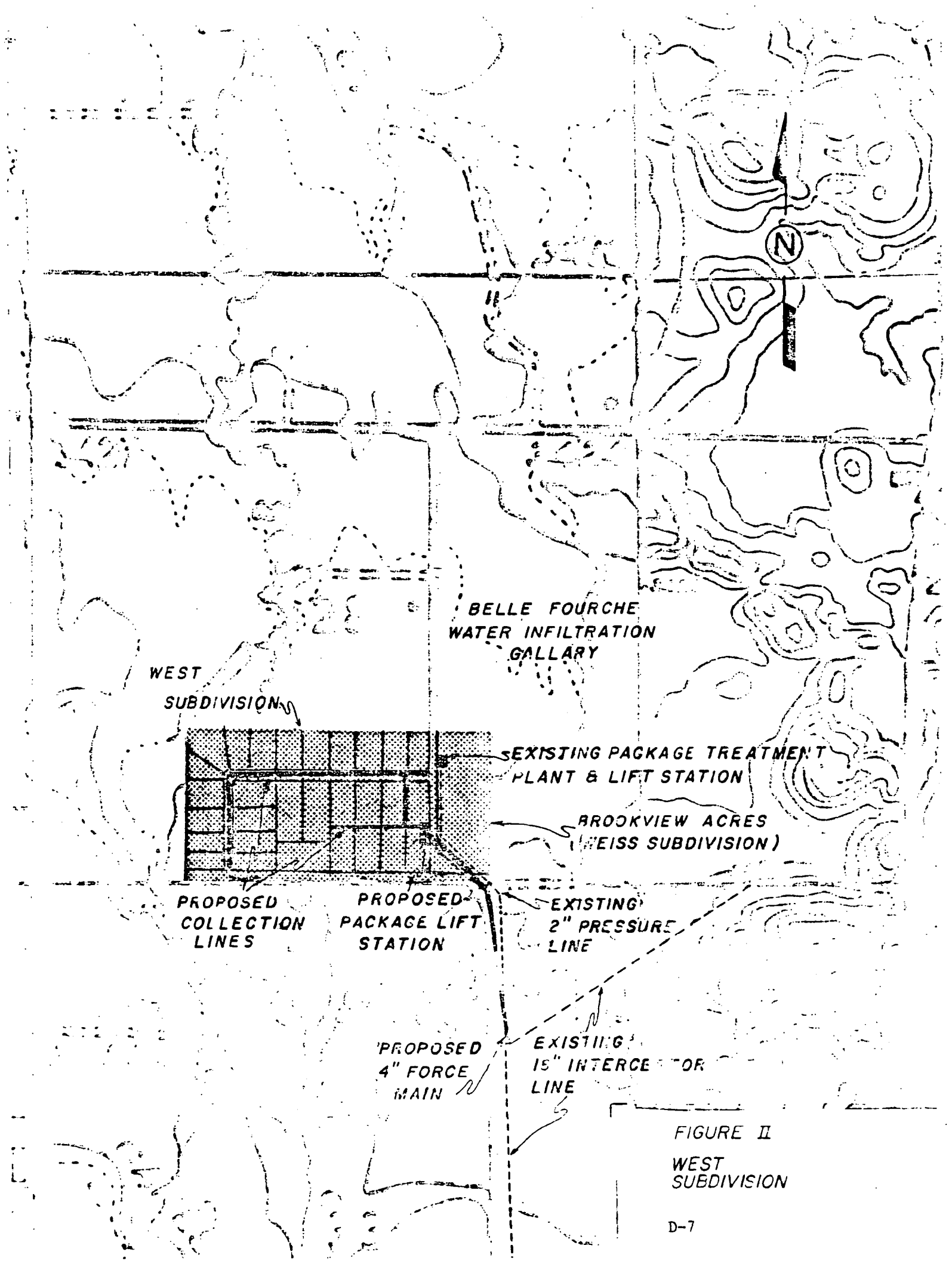

FIGURE II

WEST
SUBDIVISION

platted for. The lift station is part of the package plant. There are presently twelve trailers in the development. Brookview Acres was platted in 1974 and only four mobile homes were there before December, 1977.

West Subdivision was platted in August, 1973 and contains thirty-two lots, varing in size from one to two and one half acres. There are presently nine lots occupied with one lot containing three mobile homes. Of the eleven houses and mobile homes located there, six were there before December, 1977. Nothing was there before October, 1972.

Prices for five alternatives were calculated for West Subdivision. The five alternatives were: (1) a gravity collection line and a pressure interceptor line to the City's existing interceptor line; (2) a small diameter pressure effluent system connected to the package plant and lift station in Brookview Acres; (3) a gravity collection system tied to the package plant and lift station in Brookview Acres. Some type of pressure interceptor line is required from that area to the City's interceptor line; (4) individual holding tanks; and (5) individual evapo-transpiration systems.

(1) Gravity Collection Line and Pressure Interceptor.

With this alternative, there would be a new lift station and new four inch pressure interceptor line. The lift station would be sized to handle all of West Subdivision and Brookview Acres. In doing this, Brookview Acres could continue to operate as they are, or operate the package plant and discharge into the new lift station, or completely discontinue operating the package plant and hook directly into the new system. With the rising cost of energy, the last alternative could be the most energy efficient.

TABLE II

CONSTRUCTION COST ESTIMATE
Gravity Collection, Pressure Interceptor

West Subdivision

ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT
		Collection Line		
8" PVC	L.F.	4,000	8.50	34,000.00
Manholes	Each	12	850.00	10,200.00
4" Wyes	Each	32	30.00	960.00
Miscellaneous	L.S.	1		1,000.00
			Total Const. Cost	46,160.00
			Contingency	4,600.00
			Engineering	6,900.00
			Legal, Admin. & Fiscal	500.00
			Total Eligible Cost	58,160.00
			Annual O & M	1,000.00
		Interceptor Line		
4" Pressure Line	L.F.	2,050	7.25	14,862.50
Package Lift Station	L.S.	1	25,000.00	25,000.00
2" Pressure Line	L.F.	75	6.00	450.00
Road Gravel	Ton	200	3.50	700.00
			Total Const. Cost	41,012.50
			Contingency	4,100.00
			Engineering	6,100.00
			Legal, Admin. & Fiscal	500.00
			Total Eligible Cost	51,712.50
			Annual O & M	4,000.00

(2) Small Diameter Pressure Effluent System.

As stated previously, this system would be connected to the package plant and lift station in Brookview Acres. This system would only transport the effluent with each home retaining its own septic tank. Part of the operation and maintenance cost

would be the periodic pumping of the individual septic tanks. It was estimated in these costs that the tanks would be pumped on an average of every three years. There would also be a pumping chamber behind each septic tank and these would be maintained by the governing body. The pumps and the holding tank in the package plant would have to be modified to accommodate these flows. The package plant would be purchased from the private owners.

The pressure effluent system is considered an alternative treatment and therefore part of this system is eligible for 85% funding. The system is also eligible for the 15% preference in the cost-effective analysis.

TABLE III

CONSTRUCTION COST ESTIMATE
Small Diameter Pressure Effluent System

West Subdivision

ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT
1½" Pressure Line	L.F.	1,600	2.00	3,200.00
3½" Pressure Line	L.F.	4,100	3.00	12,300.00
Pumping Chamber	Each	11	1,800.00	19,800.00
Cleanouts	Each	4	70.00	280.00
Modify Lift Station	L.S.		5,000.00	5,000.00
Miscellaneous	L.S.		3,000.00	3,000.00
			Total Const. Cost	43,580.00
			Contingency	4,300.00
			Engineering	6,500.00
			Legal, Admin. & Fiscal	1,000.00
			Total Eligible Cost	55,380.00
			Purchase Package Plant	16,000.00
			Total Capital Cost	71,380.00
			Annual O & M	9,000.00

(3) Gravity Collection System Connected to Package Plant.

This alternative would have the same collection system as alternate (1) but then send it to the package plant for treatment and then to the City interceptor line. To do this, modifications will have to be made to the package plant and lift station to handle the increase in flows. The package plant would be purchased from the private owners.

TABLE IV

CONSTRUCTION COST ESTIMATE
Gravity Collection to Package Plant

West Subdivision

ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT
Collection System Same as Before				46,160.00
Add. 8" PVC	L.F.	400	8.50	3,400.00
Add. Manhole	Each	1	850.00	850.00
Modify Treatment System	L.S.		8,000.00	8,000.00
			Total Const. Cost	58,410.00
			Contingency	5,800.00
			Engineering	8,800.00
			Legal, Admin. & Fiscal	1,000.00
			Total Eligible Cost	74,010.00
			Purchase Package Plant	16,000.00
			Total Capital Cost	90,010.00
			Annual O & M	8,000.00

3.2 Christensen Drive

Christensen Drive is shown on Figure III and is located primarily in Section 24, T6N R2E. Of all the development areas examined, this is the oldest development area. There are 27 residents and two campgrounds in this area. All but eight of these residents have been here prior to October of 1972.

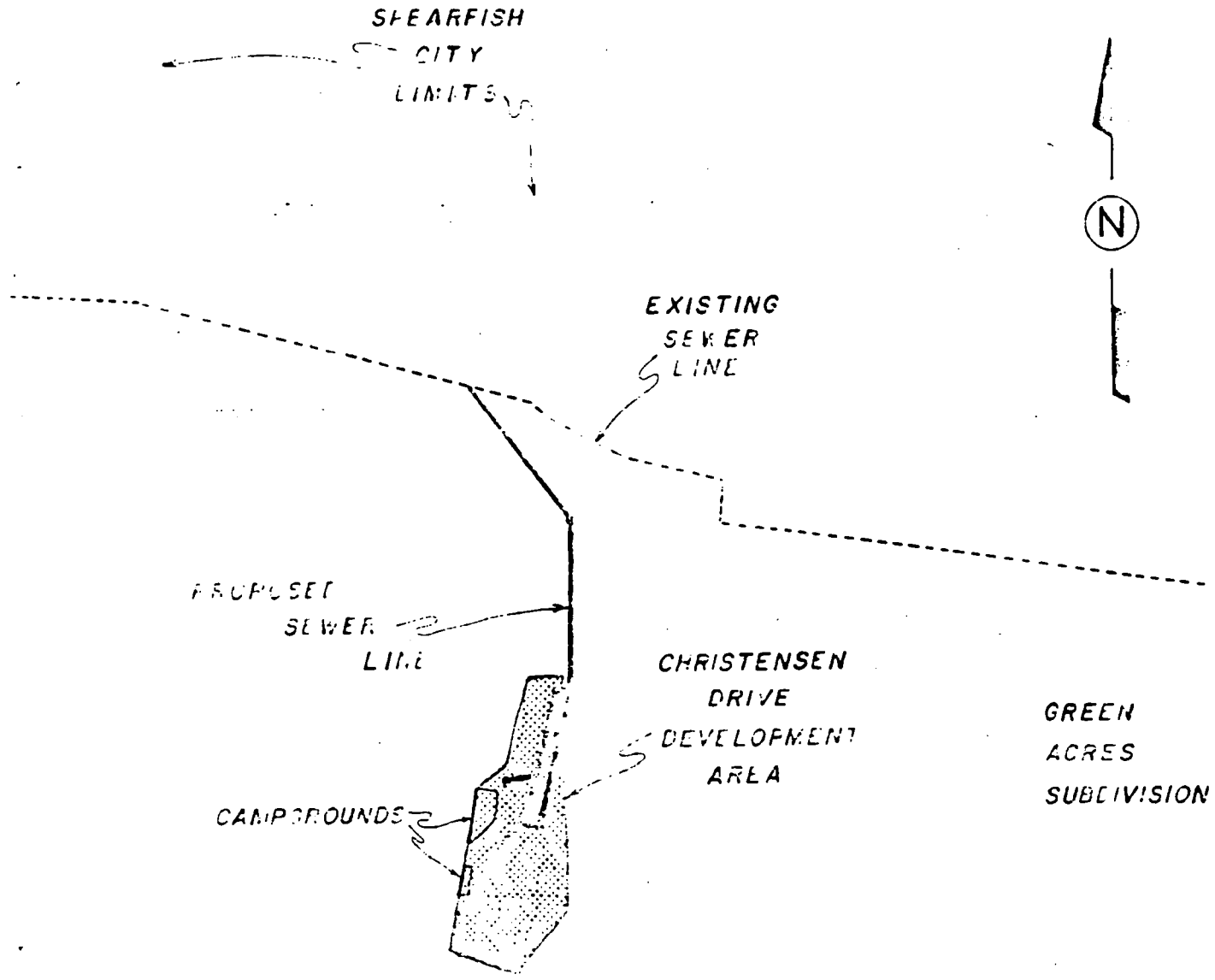

FIGURE [illegible]
CHRISTENSEN DRIVE
DEVELOPMENT AREA

The two campgrounds are Chris' Campground and Mountain View Campground. Chris' Campground has 140 total camping spots with 20 of those having sewer and water services. They also have two central restroom and shower facilities, laundry facilities and a swimming pool. Mountain View Campground has 75 total camping spots with 25 of those having sewer and water hookups. They have one central restroom and shower facility, laundry facility and swimming pool.

Three alternatives were priced for this area, a gravity interceptor and collection line, individual holding tanks and evapo-transpiration systems. There is a collection line about a quarter mile to the North that the collection line alternative would be connected to.

TABLE V

CONSTRUCTION COST ESTIMATE
Gravity Interceptor and Collection Line

Christensen Drive

ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT
8" PVC	L.F.	5,300	8.50	45,050.00
Manholes	Each	16	850.00	13,600.00
4" Wyes	Each	28	30.00	840.00
Boring	L.F.	100	75.00	7,500.00
Asphalt	S.Y.	400	4.00	1,600.00
Miscellaneous	L.S.			1,000.00
			Total Const. Cost	69,590.00
			Contingency	6,900.00
			Engineering	10,400.00
			Legal, Admin. & Fiscal	500.00
			Total Eligible Cost	87,390.00
			Easements	2,000.00
			Total Capital Cost	89,390.00
			Annual O & M	1,000.00

There is an additional 80 acres to the South that potentially could become a housing development. This area was taken into consideration when sizing a line. An eight inch line at 2% slope will be capable of handling all the flows.

3.3 Higgins Gulch Development Area.

This area includes DeBerg Subdivision, Deer Meadows Subdivision, Fuller Subdivision, Westfield, and MacKaben No. 1. All these areas are shown on Figure IV and are located west of Spearfish and the SVSD. This does not include Deer Meadows No. 2 which is subdivided into 3 to 5 acre lots and through its covenants it cannot be further subdivided. None of these subdivisions were developed before October, 1972.

This area can be serviced by gravity interceptor and collection lines and that is one of three alternatives priced. The other two are individual holding tanks and evapo-transpiration systems.

The twenty year peak design flows of 165,000 GPD, estimated in the original 201 Facility Plan done in July, 1978, still appear valid. Therefore, the 8 inch line at 1.3% grade that was proposed is still functional. The existing line now extends to the south edge of Spearfish Valley Mobile Estates.

FIGURE IV

HIGGINS GULCH DEVELOPMENT AREA

(over sized)

TABLE VI

CONSTRUCTION COST ESTIMATE
Gravity Interceptor Line

Higgins Gulch Development Area

ITEM	UNIT	QUANTITY	UNIT COST	AMOUNT
8" PVC	L.F.	12,200	8.50	103,700.00
Manhole	Each	35	850.00	29,750.00
8" DIP Creek Crossing	L.F.	200	20.00	4,000.00
Miscellaneous	L.S.			4,000.00
			Total Const. Cost	141,450.00
			Contingency	14,000.00
			Engineering	21,200.00
			Legal, Admin. & Fiscal	2,000.00
			Total Eligible Cost	178,650.00
			Easements	20,000.00
			Total Capital Cost	198,650.00
			Annual O & M	2,000.00

TABLE VII

CONSTRUCTION COST ESTIMATE
Gravity Collection Lines

Higgins Gulch Development Area

ITEM	UNIT	QUANTITY	UNIT COST	AMOUNT
8" PVC	L.F.	12,700	8.50	107,950.00
Manhole	Each	38	850.00	32,300.00
4" Wyes	Each	150	30.00	4,500.00
Miscellaneous	L.S.			7,000.00
			Total Const. Cost	151,750.00
			Contingency	15,100.00
			Engineering	22,700.00
			Legal, Admin. & Fiscal	1,500.00
			Total Eligible Cost	191,050.00
			Annual O & M	4,000.00

3.4 Mountain Plains.

This consists of two subdivisions, the first, Mountain Plains No. 1, has 54 lots all in excess of one acre. The second subdivision has 119 lots and these also are in excess of one acre each. They are located in Section 22, T6N R2E, and are shown on Figure V. The first area was platted in September, 1975 and there are presently 13 homes in this subdivision. Two of these were built before December of 1977. There are no houses presently in the second subdivision.

The quantities and costs shown in the following tables are only to service Mountain Plains No. 1. Mountain Plains No. 2 was not figured because zero development has occured at this time. An 8 inch line is capable of handling all the estimated flows from both developments.

TABLE VIII

CONSTRUCTION COST ESTIMATE
Gravity Interceptor
Mountain Plains Subdivision

ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT
8" PVC	L.F.	1,200	8.50	10,200.00
Manhole	Each	4	850.00	3,400.00
Miscellaneous	L.S.			5,000.00
			Total Const. Cost	18,600.00
			Contingency	1,800.00
			Engineering	2,500.00
			Legal, Admin. & Fiscal	200.00
			Total Eligible Cost	23,100.00
			Annual O & M	500.00

FIGURE V

Mountain Plains Subdivision

(over sized)

TABLE IX

CONSTRUCTION COST ESTIMATE
Gravity Collection

Mountain Plains Subdivision No. 1

ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT
8" PVC	L.F.	2,300	8.50	19,550.00
8" Rock Excav.	L.F.	10,450	17.00	177,650.00
Manholes	Each	40	850.00	34,000.00
4" Wyes	Each	45	30.00	1,350.00
Miscellaneous	L.S.			3,000.00
			Total Const. Cost	235,550.00
			Contingency	23,500.00
			Engineering	35,300.00
			Legal, Admin. & Fiscal	2,300.00
			Total Eligible Cost	296,650.00
			Annual O & M	2,000.00

3.5 Failing or Possible Seasonal Failure of Individual Leach Fields Scattered Throughout the Study Area.

As mentioned previously, EPA had aerial photos taken of the study area for the purpose of locating any leach fields in the area that may be surface failing. After the photos were examined, a ground inspection was done on those leach fields suspected of failing. From the photographs there were found to be 60 individual septic systems that were suspected of failing. When the field inspection was completed it was determined that there were two confirmed failures and twelve suspected seasonal failures. The rest were false signatures. These are shown on Figure VI.

FIGURE VI

Verified and Suspected Seasonal
Failures of Individual Septic Systems

(over sized)

The suspected seasonal failures were those that were not presently failing but appeared that they could fail during high ground water conditions. One of the reasons these were singled out was that the grass was very lush above the leach field and that the leach field appeared under sized. These systems were then further studied and were physically measured to attempt to determine their size. In some cases it was not possible to determine the exact size. These were approximated as close as possible.

No perculation tests were done on the individual sites to determine if these leach fields were undersized. The Soil Conservation Service soils map was used as a guide line for the types of soil and their perculation rates. In some cases there had been perculation tests done nearby and these results were taken into consideration.

These leach fields should be continued to be monitored. If it is found that any are failing, a perculation test should be done on the individual site at that time. It can then be determined if the system is undersized and exactly by how much. If the system is undersized, an extension of the leach field may be all that is necessary to correct the problem. If it is determined that the system is not undersized, then a totally different solution may be necessary.

The following is a list of those verified failures and the suspected seasonal failures. This list contains the field measurement of the leach field, the theoretical perculation rate data, the estimated increase of each individual leach field and the estimated cost of each extension. This data is meant to be used only as a guide line and not as design criteria for any of these potential extensions.

TABLE X

FAILING OR SUSPECTED SEASONAL FAILURES OF LEACH FIELDS THROUGHOUT THE STUDY AREA

Present Size, Theoretical Proposed Size, Estimated Cost

(VERIFIED SEPTIC FAILURES)

1	Palmer Pearson	No Leach Field	Now has one built
2	Robert Oien	Size of Leach Field Maximum Possible - 280 ft^2 Probably less, 200 to 250 ft^2	No Perc. data is available for this immediate area. Soils in area indicated to be 30-100 min/in. Will use 30 min/in. Area required about 250 ft^2/bedroom

2 bdrms x 250 ft^2 = 500 ft^2

Leach field probably needs additional 250 ft^2 maximum or about 80 L.F.

80 L.F. x $6.00/L.F. = $480.00

Price Mound System

500 ft^2 ÷ 3 = 167 L.F.

No Pump Should Be Needed

Const. Cost = $2,000.00

(SUSPECTED SEASONAL FAILURES)

1.	Robert Klumb	Size of Leach Field About 100 L.F. of line 300 ft^2 leach field	Same perc. data information as Robert Oien

3 bdrms x 250 ft^2 = 750 ft^2

Leach field probably needs additional 450 ft^2 maximum or about 150 L.F.

150 L.F. x $6.00/L.F. = $900.00

(Table X Continued)

(SUSPECTED SEASONAL FAILURES)

2.	Jack Delaney	Size of Leach Field About 120' long, 20' wide Looks to have 3 lines About 720 ft^2 Leach Field	Same perc. data information as Robert Oien

3 bdrms x 250 ft^2 = 750 ft^2
Leach Field is adequate, may need 10 L.F. addition
10 L.F. x $6.00/L.F. = $60.00

3.	Bob Koski	Not able to determine the exact leach field, believed to be about 250 ft^2	Same perc. data information as Robert Oien

2 bdrms x 250 ft^2 = 500 ft^2
Leach field probably needs additional 250 ft^2 or about 80 L.F.
80 L.F. x $6.00/L.F. = $480.00

4.	Bob Hanson	About 118 L.F. of line 354 ft^2 Leach Field	Many leach fields in area have 540 ft^2. Perc. test in lot nearby showed 5 min/in. which would be 125 ft^2/bdrm. Soil charts show area should be 30-100 min/in. Will use 15 min/in. or 190 ft^2/bdrm

3 bdrms x 190 ft^2 = 570 ft^2
Leach field probably needs additional 210 ft^2 or about 70 L.F.
70 L.F. x $6.00/L.F. = $420.00

5.	Melvin Seymour	About 150 L.F. of line 450 ft^2 leach field	Same Perc. data information as Bob Hanson

4 bdrms x 190 ft^2 = 760 ft^2
Leach field probably needs additional 310 ft^2 or about 103 L.F.
103 L.F. x $6.00/L.F. = $618.00

(Table X Continued)

(SUSPECTED SEASONAL FAILURES)

6.	Rick Price	Size of Leach Field About 103 L.F. of line 309 ft^2 leach field	Same perc. data information as Bob Hanson

3 bdrms x 190 ft^2 = 570 ft^2
Leach field probably needs additional 260 ft^2 or about 87 L.F.
87 L.F. x $6.00/L.F. = $522.00

7.	Curtis McKee	About 110 L.F. of line 330 ft^2 leach field	Same perc. data information as Bob Hanson

3 bdrms x 190 ft^2 = 570 ft^2
Leach field probably needs additional 240 ft^2 or about 80 L.F.
80 L.F. x $6.00/L.F. = $480.00

8.	Fred Fox	110 L.F. (Could be one or two lines) 330 ft^2 to 660 ft^2 leach field	Leach fields in area have 600 ft^2 Data available for this general area show perc rates to be 15 to 30 min/in. Soil charts show 30-100 min/in., will use 30 min/in. or 250 ft^2/bdrm.

3 bdrms x 250 ft^2 = 750 ft^2
Under worst conditions leach field might need 420 ft^2 extension or 140 L.F.
140 L.F. x $6.00 = $840.00

9.	Stan Allen	600 ft^2 leach field	Same perc. data information as Fred Fox

3 bdrms x 250 ft^2 = 750 ft^2
Leach field probably needs 150 ft^2 additional or 50 L.F.
50 L.F. x $6.00 = $300.00

(Table X Continued)

(SUSPECTED SEASONAL FAILURES)

10	Tom Freece	Originally undersized Leach field has been extended, 600 ft^2	Same perc. data information as FredOx

3 bdrms x 250 ft^2 = 750 ft^2
Leach field might need 150 ft^2 additional or 50 L.F.
50 L.F. x $6.00 = $300.00

12	John Jeffery	106 L.F. of line 318 ft^2 leach field	No perc. data is available for this immediate area. Soils charts show perc. rates to be 30-100 min/in. Owner indicated there was some gravel in soil and perc. rate was definitely not that slow. Will use 30 min/in or 250 ft^2/bdrm.

2 bdrms x 250 ft^2 = 500 ft^2
Leach field may need 180 ft^2 addition or about 60 L.F.
60 L.F. x $6.00 = $360.00

11 Chris' Campground

140 total sites
20 complete hookups
1 bath house - 4 showers - 7 stools
1 bath house - 4 showers - 7 stools
1 laundry

#1 Leach Field

60 sites, 1 bath house
60 sites x 2 persons/site x 35 gal/person = 4,200 gal/day

Length of field approx. 660 L.F. or about 1,980 ft^2
Will use 30 min/in. perc. rate, same as Jeffery
with perc. rate 30 min/in. = 0.9 gal/ft^2/day
4,200 gals ÷ 0.9 gal/ft^2 = 4,667 ft^2 required

This drain field probably needs about 2,687 ft^2 more or about 895 L.F.
895 L.F. x $4.00/L.F. = $3,580.00

(Table X Continued)

(SUSPECTED SEASONAL FAILURES)

11. Chris' Campground (Continued)

#2 Leach Field

60 sites, 1 bath house = 4,200 gal/day

Length of field approx. 1,058 L.F. or about 3,174 ft^2 + 1 dry well (63 ft^2) (ave. 4' dia., 5' deep)

Same perc. rate data.

Need about 2,625 ft^2
This leach field probably needs about 1,430 ft^2 or about 477 L.F.
477 L.F. x $4.00 = $1,908.00

#3 Leach Field

20 sites, complete hookups
20 sites x 2 persons/site x 50 gal/person = 2,000 gal/day

Length of field approx. 130 L.F. or about 390 ft^2 + 1 dry well (63 ft^2)

Same perc. rate data.

2,000 gal/day ÷ 0.9 gal/ft^2 = 2,222 ft^2

Need about 1,769 ft^2 additional drain field or about 590 L.F.
590 L.F. x $4.00 = $2,360.00

#4 Leach Field

House & Two trailers - 7 bedrooms

Same perc. rate data as John Jeffery 250 ft^2/bdrm

Length of field approx. 260 L.F. or about 780 ft^2 + 3 dry wells (63 ft^2) ave. 4' dia., 5' deep)

7 bdrms x 250 ft^2 = 1,750 ft^2
Increase leach field about 781 ft^2 or about 260 L.F.
260 L.F. x $4.00 = $1,040.00

(Table X Continued)

(SUSPECTED SEASONAL FAILURES)

11. Chris' Campground (Continued)

#5 Leach Field 6 trailers - 12 bdrms

Same perc. rate data as John Jeffery

Length of field approx. 250 L.F. or about 750 ft^2 + 1 dry well (63 ft^2)

12 bdrms x 250 ft^2 = 3,000 ft^2
Increase leach field about 2,187 ft^2 or about 729 L.F.
729 L.F. x $4.00 = $2,916.00

The Robert Oien system was discovered to be failing by talking with the owner. This system is not surface failing, but is backing up. It was very difficult to determine the exact size of the leach field. What was determined to be the leach field was undersized. This, however, may not be the only problem because it appears that the leach field may be fairly close to bedrock. Therefore, when estimating costs for the individual systems the cost of a mound system was also calculated for this property.

3.6 Amortization of Alternatives.

Table XI shows the annual equivalent cost of the previously mentioned alternatives. It does this by amortizing the costs over a 20-year period. This table does not show the annual equivalent costs for the individual leach fields because these costs would be minor and they most likely would not be funded over 20 years. It does show Chris' Campground because there could be a substantial cost to get that facility into compliance. In Table XIV, under local costs, the comparison for Chris' Campground's monthly fee is shown.

TABLE XI

ECONOMIC EVALUATION OF ALTERNATIVES[1]

ALTERNATIVES	CAPITAL COST	LIFE (YRS.)	SALVAGE[2] VALUE (0.2529)	ANNUAL[2] EQUIV. COST (0.09532)	ANNUAL O & M COST	TOTAL ANNUAL EQUIV. COST
WEST SUBDIVISION						
Gravity Collection & Pressure Interceptor	109,870	40 Pumps (20 yrs)	13,893	9,149	5,000	14,149
Pressure Effluent System Connected to Brookview Acre's System	71,380	20	0	6,804	9,000	15,804
Gravity Collection----------	50,410	40				
Connected to Brookview---------	39,600	20				
Acre's System	90,010		6,374	7,972	8,000	15,972
CHRISTENSEN DRIVE						
Gravity Collection & Interceptor	89,390	40	11,303	7,443	1,000	8,443
HIGGINS GULCH DEVELOPMENT AREA						
Interceptor Line	198,650	40	25,119	16,541	2,000	18,541
Collection Line	191,050	40	24,159	15,908	4,000	19,908

(Table XI Continued)

ALTERNATIVES	CAPITAL COST	LIFE (YRS.)	SALVAGE[2] VALUE (0.2529)	ANNUAL[2] EQUIV. COST (0.09532)	ANNUAL O & M COST	TOTAL ANNUAL EQUIV. COST
MOUNTAIN PLAINS						
Interceptor	23,100	40	2,921	1,923	500	2,423
Collection	296,650	40	37,511	24,701	2,000	26,701
CHRIS' CAMPGROUND						
Extensions on Existing Leach Fields	11,805	20	0	1,125	500	1,725

1. Reference: Engineering Economy By E.L. Grant and W.G. Ireson, Ronald Press, New York, 1970.

2. Interest (Discount) Rate = 7 and 1/8 percent, 20 yrs.

4. ELIGIBILITY FOR FEDERAL FUNDING AND LOCAL COSTS

4.1 West Subdivision

West Subdivision was platted in August, 1973 and, therefore, would not qualify for any assistance on a standard collection system. This requires two thirds of the houses to be in existance by October of 1972.

Any type of interceptor line extending from West Subdivision or Brookview Acres to the City of Spearfish's interceptor line would be eligible for 75% funding.

The gravity collection and pressure interceptor alternative would, therefore, be eligible for funding as described above.

As mentioned previously, part of the pressure effluent system alternative is eligible for 85% funding under the alternative treatment concept. The portion that is 85% fundable is that which extends from the house to the street. The lines in the street to the package plant in Brookview Acres are considered collection lines so in this case, are not eligible for any funding. The cost to modify the package plant and lift station to handle the additional flows is considered part of the interceptor system and, therefore, eligible for 75% funding. Also, the additional line to get from West Subdivision to the package plant is considered interceptor line. If the package plant and lift station are to be used in this concept, it is necessary to purchase the plant from the private owners. The cost of purchasing this plant is not eligible for funding.

Any concept that is considered alternative treatment is also eligible for 15% preference in the cost-effective analysis. Table XII shows the present worth of the three alternatives. The 15% is then applied.

TABLE XII
WEST SUBDIVISION

COST-EFFECTIVE ANALYSIS FOR 15% PREFERENCE

	GRAVITY COLLECTION & PRESSURE INTERCEPTOR	PRESSURE EFFLUENT SYSTEM	GRAVITY COLLECTION TO PACKAGE PLANT
Capital Cost	109,870	71,380	90,010
Salvage	-13,893	0	-6,374
Annual O & M (7 1/8% - 10.497)	($5,000 x 10.497 = $52,485)	($9,000 x 10.497 = $94,473)	($8,000 x 10.497 = $83,976)
Total Present Worth	$148,462	$165,853	$167,612

The pressure effluent system gets 15% preference over the gravity collection and pressure interceptor system, ($148,462 x 115% = $170,731). With the 15% preference the pressure effluent system becomes cost effective.

One other factor needs to be considered in determining cost-effectiveness, energy consumption. The flow from this area could be about 17,000 gpd. Of this 17,000 gpd, about 11,000 gals. would be effluent from West Subdivision and about 6,000 gals of raw sewage from Brookview Acres. This is very minor compared to the over 2 mgd flows that the City of Spearfish's treatment plant is being designed for. The difference in energy consumption at the main treatment plant would be minimal in handling 17,000 gpd of pre-treated effluent or 17,000 gpd of raw sewage. The energy consumption would be greater to operate the small package plant and lift station in Brookview Acres at maximum capacity, 32 small individual effluent pumps, and operate a truck to pump the 32 septic tanks.

In calculating the monthly user charge there are only eleven houses that will receive the pumping chamber and line going to the street, any new houses will be required to install their own. The 15% local share for that portion of the system was, therefore, divided between those eleven connections. The collection line portion will be extended throughout the subdivision, therefore, that cost was divided between all 32 lots. The cost of modifying the package plant and lift station and the cost of purchasing the plant was also divided between all 32 lots since each lot will potentially benefit.

Hope Weiss, who developed Brookview Acres and installed the package plant system, valued the plant and lines at approximately $25,000. This was the value used in estimating capital costs. Because both developments would utilize the package plant and lift station, both developments should share in the purchasing of the plant. The formula used to determine how much of the purchase price should be paid by West Subdivision is as follows:

Brookview Acres - 18 lots
West Subdivision - 32 lots

Total - 50 lots

$25,000 ÷ 50 lots x 32 lots = cost to West Subdivision = $16,000.

There will have to be a monthly user fee calculated for Brookview Acres but that will not be done in this report.

The eligibility for funding the alternative using the gravity collection line connected to the package plant has the same perameters as the previously mentioned alternative. The gravity collection lines would not be eligible for any funds. The modifications on the package plant would be considered part of the interceptor system and would be eligible for 75% funding and the purchase of the plant would be noneligible.

4.2 Christensen Drive

Of the 27 residents and two campgrounds in this area, all but eight residents have been in existance prior to October, 1972. This would make this area eligible for 75% funding on both the interceptor line and collection line.

Because the two campgrounds are in this area, a users fee must be calculated other than simply dividing the cost by the number of residents. The following is an estimation of the flows from the campgrounds and the residents and a possible method for determining user fees:

TABLE XIII
CHRISTENSEN DRIVE FLOW ESTIMATIONS

	MT. VIEW CAMPGROUND	CHRIS' CAMPGROUND
Total Camp Sites	75	140
Camp Sites w/Complete Hookups	25	20
Washing Machines	2	2
Swimming Pools	1	1

Average Daily Flows

Complete Hookups (50 gpd x 3 persons = 150 gpd/site)	150 gpd x 25	= 3,750 gpd	150 gpd x 20	= 3,000 gpd
Regular Camp Sites (35 gpd x 3 persons = 105 gpd/site)	105 gpd x 50	= 5,250 gpd	105 gpd x 120	= 12,600 gpd
Washing Machines (300 gpd/machine)	300 gpd x 2	= 600 gpd	300 gpd x 2	= 600 gpd
Swimming Pools (Dumped Once a Year)	26,928 gpy ÷ 365 dpy	= 74 gpd	23,963 gpy ÷ 365 dpy	= 66 gpd
TOTAL		9,674 gpd		16,266 gpd

Daily Flow From Average House
(Will use 3 people because majority of houses are mobile homes)

100 gpdpc x 3.0 persons = 300 gpd

Average Yearly Flow

Resident	300 gpd x 365 days	= 109,500 gal/yr
Mt. View Campground	9,674 gpd x 90 days x 60% Ave. Capacity	= 522,396 gal/yr
Chris' Campground	12,266 gpd x 90 days x 60% Ave. Capacity	= 878,364 gal/yr

Mt. View Campground User Charge = 4.75 times average resident charge.
Chris' Campground User Charge = 8 times average resident charge.

4.3 Higgins Gulch Development Area

None of the subdivisions included in this area were established before October of 1972. Therefore, none of these subdivisions would be eligible for funding on any collection lines. The interceptor lines connecting these subdivisions would be eligible for 75% funding.

4.4 Mountain Plains.

Mountain Plains was platted in 1975 and, therefore, is not eligible for funds on a collection line. An interceptor line leading to the subdivision could be eligible for 75% funding.

4.5 Failing or Possible Seasonal Failure of Individual Leach Fields Scattered Throughout the Study Area.

All of the homes found to be failing or suspected of seasonal failures were constructed before December of 1977. These homes would, therefore, be eligible for 85% funding on any individual on-site treatment.

4.6 Monthly User Fee.

Table XIV amoritizes the local share of each alternative over 20 years and gives what the monthly user fee will be for each alternative. See Table XIV.

5. SELECTED PLAN

The Environmental Impact Statement must be consulted for which alternative was selected for each area. That document gives all the reasons for the selections.

TABLE XIV
LOCAL SHARE AND MONTHLY USER FEE[1]

ALTERNATIVES	% FED. FUNDED	CAPITAL COST (LOCAL SHARE)	ANNUAL[2] EQUIV. COST (0.09532)	ANNUAL O & M	TOTAL ANNUAL EQUIV. COST	NO. OF USERS	MONTHLY COST
WEST SUBDIVISION							
Gravity Collection	0%	58,160	6,776	5,000	11,776	32 users	$30.67
Pressure Interceptor	75%	12,928					
Pressure Effluent System Connected to Brookview System							
(From House To Street)	85%	4,575	436	2,000	2,436	11 users	18.45
(Lines In Street)	0%	17,250					
(Mod. Brookview Syst.)	75%	1,908	3,351	7,000	10,351	32 users	26.96
(Purchase Brookview Syst.)	0%	16,000					45.41[3]
Gravity Collection Connected to Brookview System							
(Collection Lines)	0%	58,490	7,470	8,000	15,470	32 users	40.29
(Interceptor Lines)	75%	1,345					
(Mod. Brookview Syst.)	75%	2,535					
(Purchase Package Plant)	0%	16,000					
CHRISTENSEN DRIVE							
Gravity Collection & Interceptor	75%	23,847	2,273	1,000	3,273	27 res.	6.85
						Chris'	54.98
						Mount. View	32.70
Chris' Campground Leach Field Extensions	85%	1,771	169	500	669		55.75

(Table XIV Continued)

ALTERNATIVES	% FED. FUNDED	CAPITAL COST (LOCAL SHARE)	ANNUAL[2] EQUIV. COST (0.09532)	ANNUAL O & M	TOTAL ANNUAL EQUIV. COST	NO. OF USERS	MONTHLY COST
HIGGINS GULCH DEVELOPMENT AREA							
Interceptor Line	75%	64,662	6,164	2,000	8,164	150 users	$ 4.54
Collection Line	0%	191,050	18,211	4,000	22,211	150 users	12.34
							$16.88[4]
MOUNTAIN PLAINS							
Interceptor Line	75%	5,775	550	500	1,050	54 users	1.62
Collection Line	0%	296,650	28,277	2,000	30,277	54 users	46.72
							48.34[5]

1. Reference: Engineering Economy by E.L. Grant and W.G. Ireson, Ronald Press, New York, 1970.

2. Interest (Discount) Rate = 7 and 1/8 percent, 20 yrs.

3. Those eleven existing houses would have a total monthly charge of $45.41. Those lots that do not have houses on them would have to pay $26.96. When the house was built on the lot and the septic tank and pumping chamber were installed at the owner's expense, then there would be an additional O & M fee for pump maintenance, pumping septic tank, etc.

4. The monthly fee for all the houses in the Higgins Gulch Development Area would be the interceptor line and collection line combined which is $16.88.

5. The monthly fee for all the houses in Mountain Plains would be the interceptor line and collection line combined which is $48.34

TABLE XV
ECONOMIC EVALUATION
West Subdivision

ALTERNATIVE	CAPITAL COST	LIFE YRS.	SALVAGE VALUE	[1]ANNUAL EQUIV. COST	ANNUAL O & M	TOTAL ANNUAL EQUIV. COST	MONTHLY COST PER TAP
Holding Tank							
[2]Before 77; (6)	18,000	20	0	1,716	11,580	13,296	
[3]After 77; (29)	87,000	20	0	8,293	55,970	64,263	
Evapo-transpiration System							
[2]Before 77; (6)	36,000	20	0	3,432	4,020	7,452	
[3]After 77; (29)	174,000	20	0	16,586	19,430	36,016	
			Local Share				
Holding Tank							
[2]Before 77; (6)	2,700	20	0	257	11,580	11,837	164.41
[3]After 77; (29)	87,000	20	0	8,293	55,970	64,263	184.66
Evapo-transpiration System							
[2]Before 77; (6)	5,400	20	0	515	4,020	4,535	62.98
[3]After 77; (29)	174,000	20	0	16,586	19,430	36,016	103.49

1. Interest Rate; 7 and 1/8 percent, 20 yrs.
2. Houses built before Dec. 1977 - 85% Federal Funded.
3. Houses built after Dec. 1977 & Future Development - 0% Federal Funded.

TABLE XVI
ECONOMIC EVALUATION
Christensen Drive

ALTERNATIVE	CAPITAL COST	LIFE YRS.	SALVAGE VALUE	[1]ANNUAL EQUIV. COST	ANNUAL O & M	TOTAL ANNUAL EQUIV. COST	MONTHLY COST PER TAP
Holding Tank							
[2]Before 77; (27)	81,000	20	0	7,721	52,110	59,831	
[3]After 77: (0)	0	0	0	0	0	0	
Evapo-transpiration System							
[2]Before 77; (27)	162,000	20	0	15,442	18,090	33,532	
[3]After 77: (0)	0	0	0	0	0	0	
LOCAL SHARE							
Holding Tank							
[2]Before 77; (27)	12,150	20	0	1,158	52,110	53,268	164.41
[3]After 77; (0)	0	0	0	0	0	0	0
Evapo-transpiration System							
[2]Before 77; (27)	24,300	20	0	2,316	18,090	20,406	62.98
[3]After 77; (0)	0	0	0	0	0	0	0

1. Interest rate, 7 and 1/8 percent, 20 yrs.
2. Houses built before Dec. 1977 - 85% Federal Funded
3. Houses built after Dec. 1977 & Future development - 0% Federal Funded

TABLE XVII
ECONOMIC EVALUATION
Higgins Gulch Development Area

ALTERNATIVE	CAPITAL COST	LIFE YRS.	SALVAGE VALUE	[1]ANNUAL EQUIV. COST	ANNUAL O & M	TOTAL ANNUAL EQUIV. COST	MONTHLY COST PER TAP
Holding Tank							
[2]Before 77; (54)	162,000	20	0	15,442	104,220	119,662	
[3]After 77; (96)	288,000	20	0	27,452	185,280	212,732	
Evapo-transpiration System							
[2]Before 77; (54)	324,000	20	0	30,884	36,180	67,064	
[3]After 77; (96)	576,000	20	0	54,904	64,320	119,224	
			LOCAL SHARE				
Holding Tank							
[2]Before 77; (54)	24,300	20	0	2,316	104,220	106,536	164.41
[3]After 77; (96)	288,000	20	0	27,452	185,280	212,732	184.66
Evapo-transpiration System							
[2]Before 77; (54)	48,600	20	0	4,633	36,180	40,813	62.98
[3]After 77; (96)	576,000	20	0	54,904	64,320	119,224	103.49

1. Interest Rate, 7 and 1/8 percent, 20 yrs.
2. Houses built before Dec. 1977 - 85% Federal Funded
3. Houses built after Dec. 1977 & future development - 0% Federal Funded

TABLE XVIII
ECONOMIC EVALUATION
Mountain Plains No. 1 Subdivision

ALTERNATIVE	CAPITAL COST	LIFE YRS.	SALVAGE VALUE	[1]ANNUAL EQUIV. COST	ANNUAL O & M	TOTAL ANNUAL EQUIV. COST	MONTHLY COST PER TAP
Holding Tank							
[2]Before 77; (2)	6,000	20	0	572	3,860	4,432	
[3]After 77; (52)	156,000	20	0	14,870	100,360	115,230	
Evapo-transpiration							
[2]Before 77; (2)	12,000	20	0	1,144	1,340	2,484	
[3]After 77; (52)	312,000	20	0	29,740	34,840	64,580	
			LOCAL SHARE				
Holding Tank							
[2]Before 77; (2)	900	20	0	86	3,860	3,946	164.41
[3]After 77; (52)	156,000	20	0	14,870	100,360	115,230	184.66
Evapo-transpiration							
[2]Before 77; (2)	1,800	20	0	172	1,340	1,512	63.00
[3]After 77; (52)	312,000	20	0	29,740	34,840	64,580	103.49

1. Interest Rate, 7 and 1/8 percent, 20 yrs.
2. Houses built before Dec. 1977 - 85% Federal Funded
3. Houses built after Dec. 1977 & future development - 0% Federal Funded