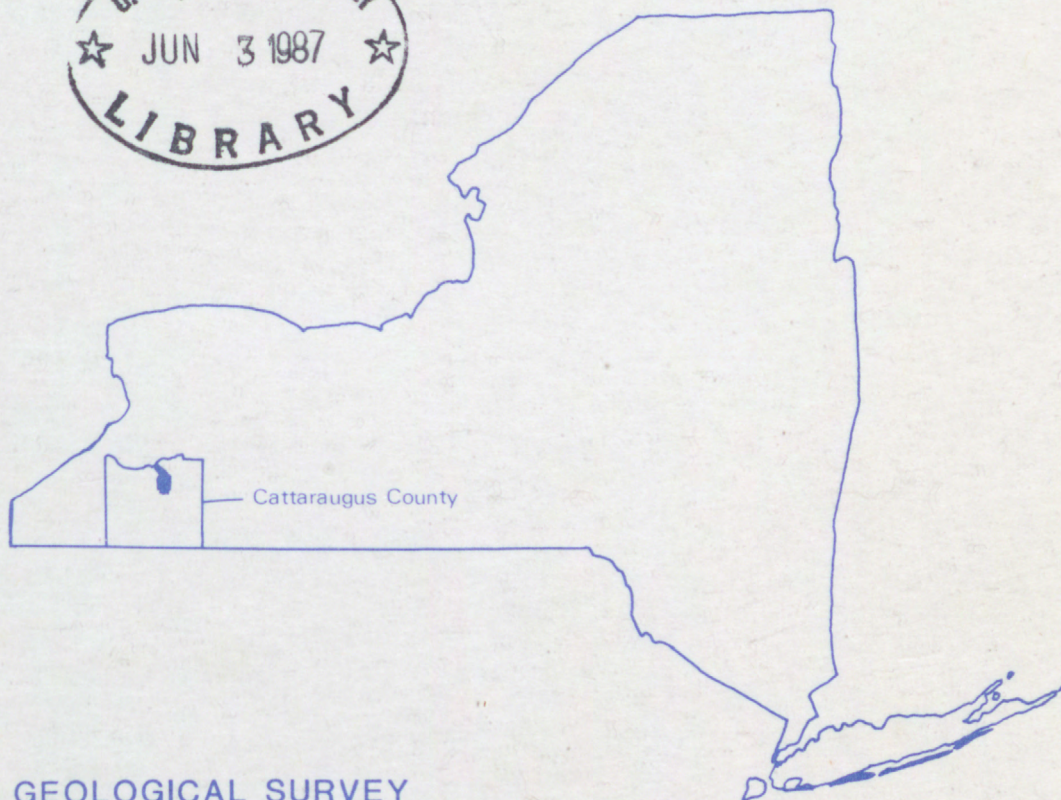
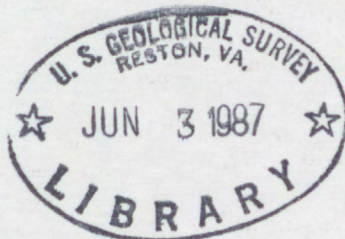


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# Surface-Water Hydrology of the Western New York Nuclear Service Center, Cattaraugus County, New York



U.S. GEOLOGICAL SURVEY  
Water-Resources Investigations  
Report 85-4309

Prepared in cooperation with the  
U.S. NUCLEAR REGULATORY COMMISSION







SURFACE-WATER HYDROLOGY OF THE WESTERN NEW YORK NUCLEAR SERVICE CENTER  
CATTARAUGUS COUNTY, NEW YORK

by William M. Kappel and William E. Harding

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Ithaca, New York

1987

UNITED STATES DEPARTMENT OF THE INTERIOR

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## CONVERSION FACTORS AND ABBREVIATIONS

Conversion factors for the terms used in this report are listed for readers who prefer to use inch-pound units rather than SI (International System) units.

<u>Multiply SI Unit</u>	<u>By</u>	<u>To Obtain Inch-Pound Units</u>
<u>Length</u>		
millimeter (mm)	0.03937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
<u>Velocity</u>		
meter per second (m/s)	3.281	foot per second (ft/s)
<u>Area</u>		
square meter (m <sup>2</sup> )	10.76	square foot (ft <sup>2</sup> )
	1.196	square yard (yd <sup>2</sup> )
	0.0002471	acre
hectare (ha)	2.471	acre
square kilometer (km <sup>2</sup> )	0.3861	square mile (mi <sup>2</sup> )
<u>Volume</u>		
cubic meter (m <sup>3</sup> )	35.31	cubic foot (ft <sup>3</sup> )
	1.308	cubic yard (yd <sup>3</sup> )
	0.0008107	acre-foot (acre-ft)
	264.2	gallon (gal)
liter (L)	1.0577	quart (qt)
<u>Discharge</u>		
cubic meter per second (m <sup>3</sup> /s)	35.31	cubic foot per second (ft <sup>3</sup> /s)
<u>Temperature</u>		
degree Celsius (°C)	°F = (9/5)°C + 32°	degree Fahrenheit (°F)

National Geodetic Vertical Datum of 1929 (NGVD of 1929): A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Mean Sea Level."





# Surface-Water Hydrology of the Western New York Nuclear Service Center, Cattaraugus County, New York

By William M. Kappel and William E. Harding

## ABSTRACT

Precipitation data were collected from October 1980 through September 1983 from three recording gages at the Western New York Nuclear Service Center, and surface-water data were collected at three continuous-record gaging stations and one partial-record gage on streams that drain a 0.7-square-kilometer part of the site. Seepage from springs was measured periodically during the study. The data were used to identify runoff characteristics at the waste-burial ground and the reprocessing-plant area, 400 meters to the north. Preliminary water budgets for April 1982 through March 1983 were calculated to aid in the development of ground-water-flow models to the two areas.

Nearly 80 percent of the measured runoff from the burial-ground area was storm runoff; the remaining 20 percent was base flow. In contrast, only 30 percent of the runoff leaving the reprocessing-plant area was storm runoff, and 70 percent was base flow. This difference is attributed to soil composition. The burial-ground soil consists of clayey silty till that limits infiltration and causes most precipitation to flow to local channels as direct runoff. In contrast, the reprocessing-plant area is overlain by alluvial sand and gravel that allows rapid infiltration of precipitation and subsequent steady discharge from the water table to nearby stream channels and seepage faces.

Measured total annual runoff and estimated evapotranspiration from the reprocessing-plant area exceeded the precipitation by 35 percent, which suggests that the ground-water basin is larger than the surface-water basin. The additional outflow probably includes underflow from bedrock upgradient from the plant, water leakage from plant facilities, and ground-water flow from adjacent basins.

## INTRODUCTION

In 1961, the New York State Office of Atomic Energy Development, now the New York State Energy Research Development Authority, acquired a 1,350-ha tract of land near the village of West Valley in northern Cattaraugus County, about 48 km south of Buffalo (fig. 1). A part of this tract was used to construct a facility to handle and reprocess radioactive waste; this facility is known as the Western New York Nuclear Service Center.

Since 1975, the U.S. Geological Survey and the New York State Geological Survey have done studies to evaluate the extent of, and potential for, radioisotope movement from the low-level radioactive waste-burial ground within this site. In 1980, the New York State Geological Survey and the U.S. Geological Survey began a series of studies to evaluate the geology, surface and subsurface hydrology, and the potential for radioisotope migration from

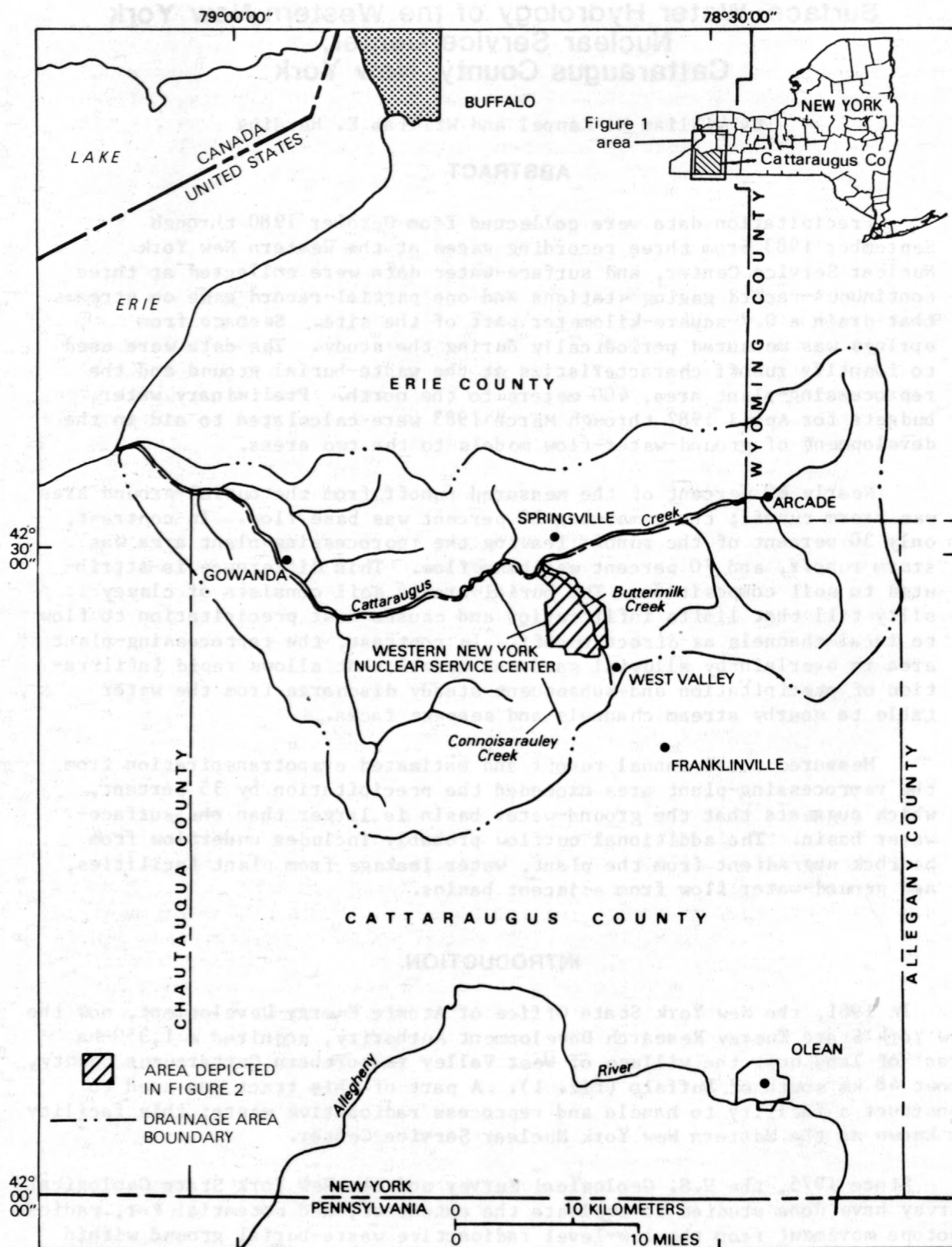


Figure 1.--Location of western New York Nuclear Service Center in Cattaraugus Creek drainage basin.



other facilities at the site and its extent. These studies were funded by the U.S. Nuclear Regulatory Commission, and many elements of those studies were jointly planned and completed by the New York State Geological Survey and the U.S. Geological Survey. Further information on the site history, references to previous investigations, and geologic and hydrologic data from the site are given in a companion report by Bergeron, Kappel, and Yager (1987).

### **Purpose and Scope**

This report describes the relationships between precipitation and surface-water runoff at the burial ground and reprocessing-plant areas and includes analyses of streamflow and precipitation data, seepage measurements from springs, and estimates of evapotranspiration. Four appendixes present (1) precipitation records, (2) stream discharge at three gaged sites, (3) seepage discharge at 19 seeps along the edge of the reprocessing-plant area, and (4) water levels measured during 1982-83 in wells around the reprocessing-plant area.

### **Acknowledgments**

Thanks are extended to Steven Potter of the New York State Geological Survey, who assisted in data collection by maintaining equipment and collecting streamflow data, and to the staff of Nuclear Fuels Service, Inc., former site operator, and the U.S. Department of Energy (the present site operator), who assisted in completion of several project elements.

## **DESCRIPTION OF STUDY AREA**

### **Site Components**

The study area is within the St. Lawrence (Lake Erie) basin and lies along the west side of the Buttermilk Creek valley (fig. 1). The reprocessing-plant area, which includes a receiving and storage facility for irradiated fuel, an underground storage-tank complex for high-level liquid wastes, a low-level radioactive-wastewater-treatment plant, and associated treatment and storage lagoons, lies on an elevated plateau known as the north plateau (figs. 2 and 3). The site also includes two separate places for shallow burial of solid radioactive wastes--a 4-ha State-licensed area for commercial low-level radioactive wastes and the facility's 2.2-ha disposal area for higher level wastes. These burial areas lie approximately 400 m south of the fuel-reprocessing-plant area.

### **Drainage**

Buttermilk Creek flows northwestward along the east side of the site to Cattaraugus Creek near Springville, about 3 km north of the site (fig. 2).

Franks Creek, a principal tributary to Buttermilk Creek, drains the West Valley site (fig. 3) and has a drainage area of 6.35 km<sup>2</sup>. The southeast side of the low-level waste-burial ground drains directly to Franks Creek; the remaining burial-ground area drains to several small intermittent streams,

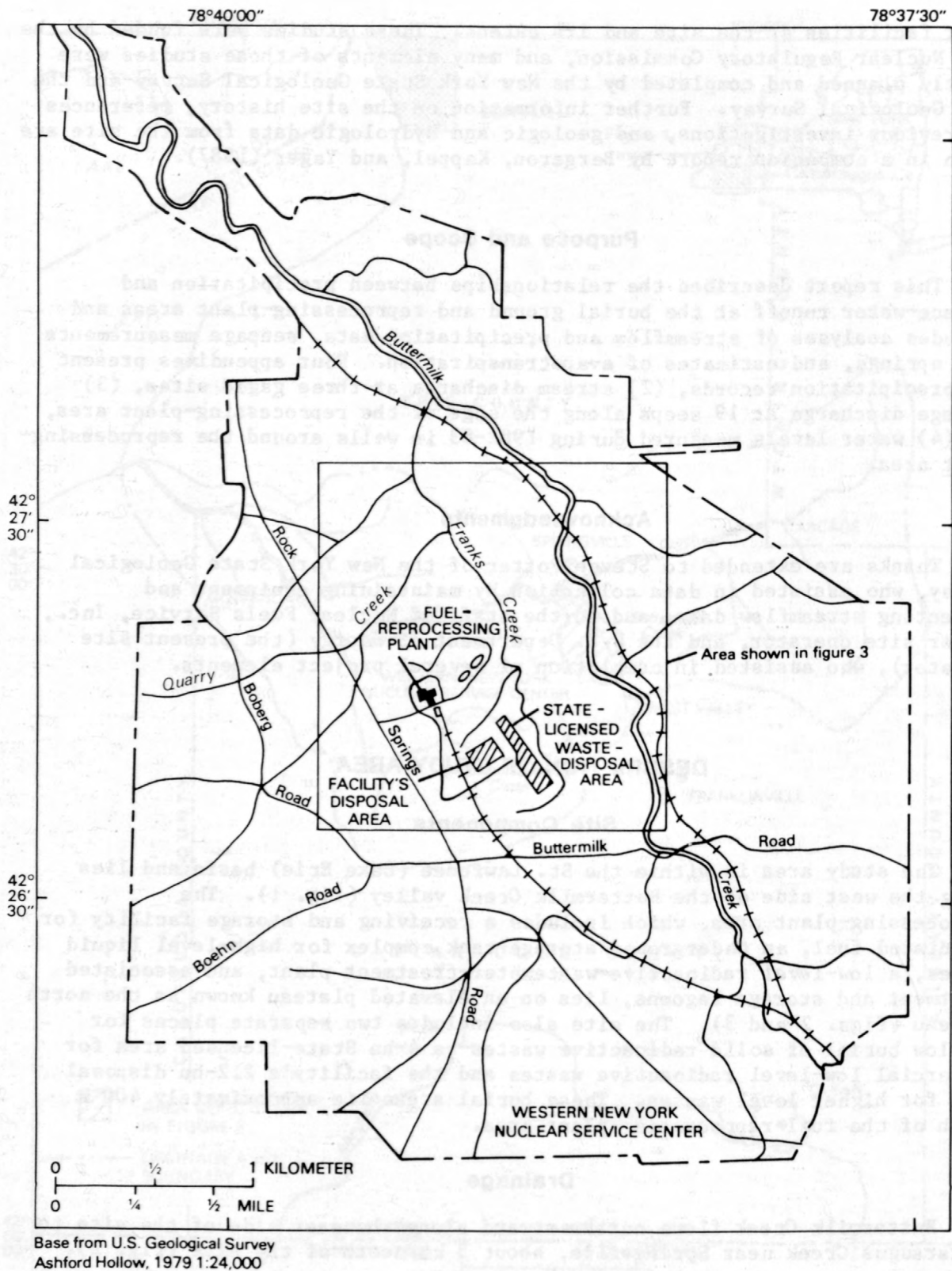
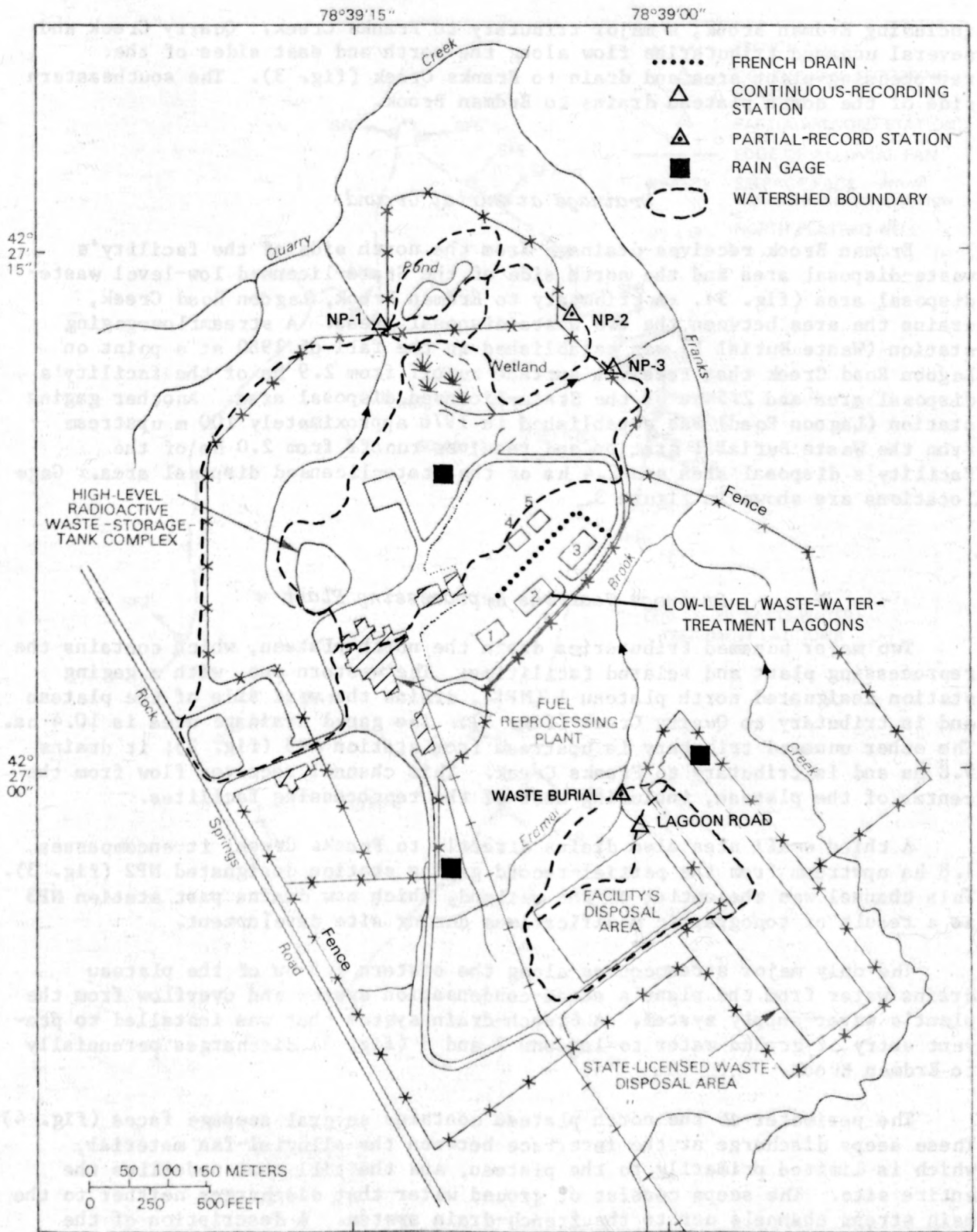


Figure 2.--Major physiographic features of the Western New York Nuclear Service Center. (Location is shown in fig. 1.)



Base from U.S. Geological Survey  
Ashford Hollow, 1979 1:24,000

Figure 3.--Major physical features within the study area.  
(Location is shown in fig. 2.)



including Erdman Brook, a major tributary to Franks Creek. Quarry Creek and several unnamed tributaries flow along the north and east sides of the reprocessing-plant area and drain to Franks Creek (fig. 3). The southeastern side of the north plateau drains to Erdman Brook.

### *Drainage at Burial Ground*

Erdman Brook receives drainage from the north side of the facility's waste-disposal area and the north side of the State-licensed low-level waste-disposal area (fig. 3). A tributary to Erdman Brook, Lagoon Road Creek, drains the area between the two waste-disposal areas. A streamflow-gaging station (Waste Burial 1) was established in the fall of 1980 at a point on Lagoon Road Creek that receives surface runoff from 2.9 ha of the facility's disposal area and 2.5 ha of the State-licensed disposal area. Another gaging station (Lagoon Road) was established in 1976 approximately 100 m upstream from the Waste Burial 1 station and receives runoff from 2.0 ha of the facility's disposal area and 2.4 ha of the State-licensed disposal area. Gage locations are shown in figure 3.

### *Drainage Near the Reprocessing Plant*

Two major unnamed tributaries drain the north plateau, which contains the reprocessing plant and related facilities. The western one, with a gaging station designated north plateau 1 (NP1), drains the west side of the plateau and is tributary to Quarry Creek (fig. 3). The gaged drainage area is 10.4 ha. The other unnamed tributary is upstream from station NP3 (fig. 3); it drains 9.8 ha and is tributary to Franks Creek. This channel receives flow from the center of the plateau, including most of the reprocessing facilities.

A third small area also drains directly to Franks Creek; it encompasses 1.8 ha upstream from the partial-record gaging station designated NP2 (fig. 3). This channel was the outlet of the wetland, which now drains past station NP3 as a result of topographic modifications during site development.

The only major streamcourse along the eastern 7.5 ha of the plateau drains water from the plant's steam-condensation system and overflow from the plant's water-supply system. A french-drain system that was installed to prevent entry of ground water to lagoons 2 and 3 (fig. 3) discharges perennially to Erdman Brook.

The perimeter of the north plateau contains several seepage faces (fig. 4). These seeps discharge at the interface between the alluvial-fan material, which is limited primarily to the plateau, and the till that underlies the entire site. The seeps consist of ground water that discharges neither to the main stream channels nor to the french-drain system. A description of the seepage faces is given in appendix III.

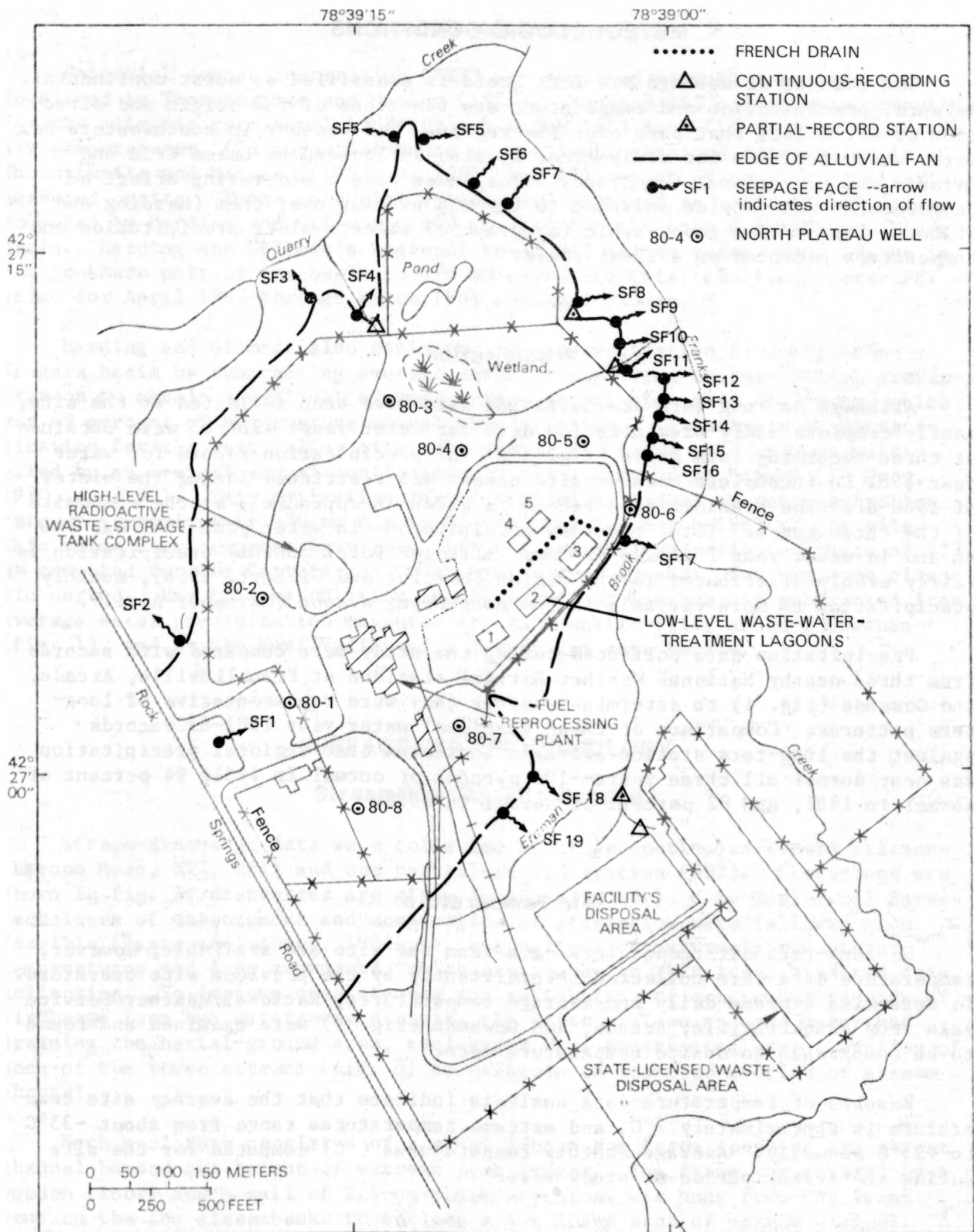


Figure 4.--Location of seepage faces and monitoring wells on north plateau.

## METEOROLOGIC CONDITIONS

The climate of western New York State is classified as moist continental. As such, precipitation and temperature are functions of the origin and direction of air masses that pass over the region. The weather in southwestern New York, which includes the study area, is also influenced by Lakes Erie and Ontario and by regional topography. The lakes have a moderating effect on temperatures and provide moisture to the air passing over them (Harding and Gilbert, 1968). The topographic (orographic) effects alter precipitation and temperature patterns on a local scale.

### Precipitation

Although no long-term precipitation data have been collected at the site, nearly complete daily precipitation data for water years 1982-83 were obtained at three recording rain gages (fig. 3). The precipitation record for water year 1981 is incomplete because site access was restricted during the winter of 1980-81. The precipitation record is given in appendix I as the composite of the three gages. Total recorded precipitation in water year 1982 was 746 mm and in water year 1983 was 914 mm. Although total monthly precipitation is fairly evenly distributed in the region (Harding and Gilbert, 1968), monthly precipitation is more variable in the nongrowing season (November-April).

Precipitation data collected during the study were compared with records from three nearby National Weather Service stations at Franklinville, Arcade, and Gowanda (fig. 1) to determine whether they were representative of long-term patterns. Comparison of these stations' water year 1981-83 records against the long-term station averages indicated that regional precipitation was near normal all three years--105 percent of normal in 1981, 94 percent of normal in 1982, and 92 percent of normal in 1983.

### Air Temperature

No long-term air-temperature data from the site are available; however, temperature data were collected intermittently by the previous site operators. To determine extreme daily and average temperatures, National Weather Service data from Franklinville, Arcade, and Gowanda (fig. 1) were examined and found to be comparable to on-site temperature data.

Results of temperature-data analysis indicate that the average site temperature is approximately 7°C, and extreme temperatures range from about -35°C to +35°C annually. Average monthly temperatures (°C) computed for the site during the 3-year period of study were:

January	-5.3	May	13.3	September	14.8
February	-5.1	June	16.4	October	9.1
March	0.4	July	19.3	November	3.9
April	5.2	August	17.6	December	-1.1



## Evapotranspiration

Potential evapotranspiration (PET) was computed through a procedure developed by Thornthwaite and Mather (1957). Monthly PET values were computed for the climatic year April 1982 through March 1983 from (1) monthly average air temperatures, (2) potential hours of sunlight, obtained from tables in Thornthwaite and Mather, (1957, p. 228), and (3) amount of total precipitation measured onsite. These potential values were compared to regional PET values computed by Harding and Gilbert (1968, p. 31) for the Lake Erie-Niagara River basin. Harding and Gilbert's regional total PET values ranged from 587 mm in the southern part of the basin to 676 mm near lake Erie; the local total PET value for April 1982 through March 1983 averaged 623 mm.

Harding and Gilbert also estimated evapotranspiration from the Erie-Niagara basin by subtracting average annual runoff from average annual precipitation to obtain a regional average evapotranspiration rate of 508 mm, which was 49 percent of the average annual precipitation. To estimate evapotranspiration for the West Valley site, the annual PET range (623 mm) was multiplied by an average annual coefficient (0.67) suggested by Penman (in Gray, 1970, p. 3.52). This estimation method yielded an annual evapotranspiration rate of approximately 420 mm for April 1982 through March 1983 at the site. This value also compares favorably with the evapotranspiration estimate of 417 mm computed for the Cattaraugus Creek drainage at Gowanda, for the same climatic period. For this calculation, total runoff at Gowanda was subtracted from average total precipitation measured at the Franklinville, Arcade, Gowanda (fig. 1), and at the West Valley site during the same period.

## SURFACE-WATER HYDROLOGY

### Streamflow-Data Collection

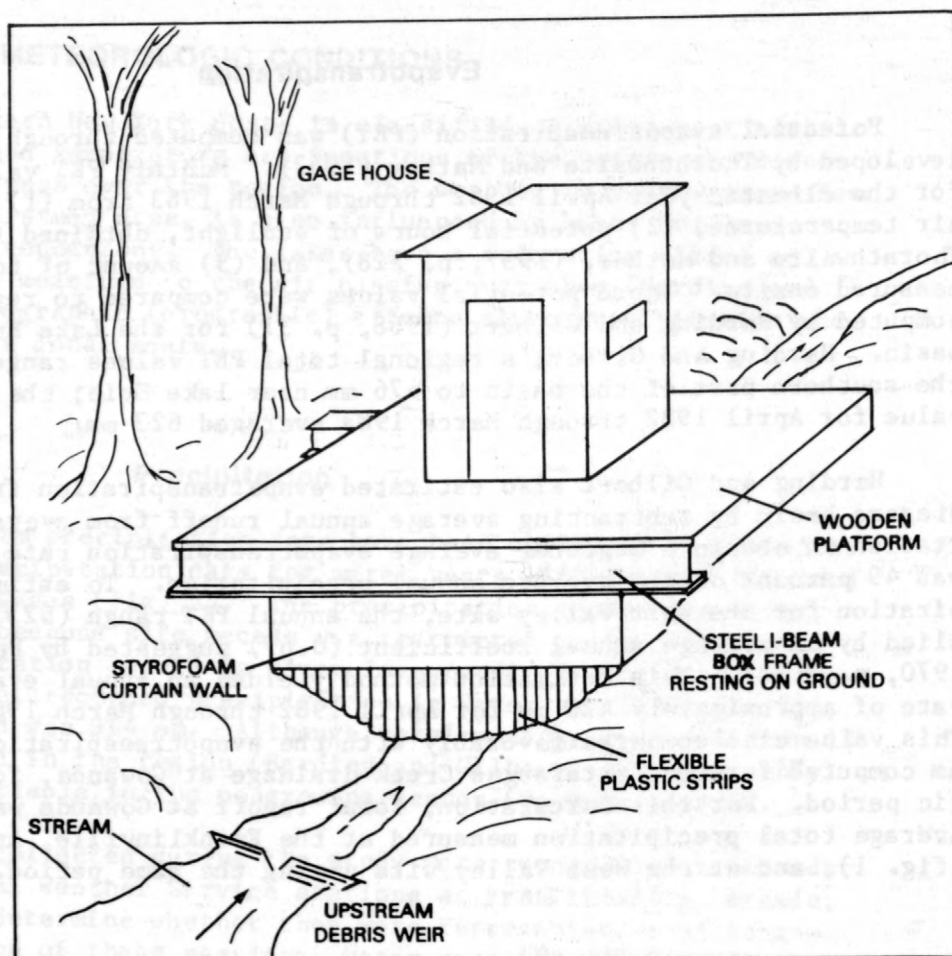
Stream-discharge data were collected at three continuous-record stations (Lagoon Road, NP3, NP1) and one partial-record station (NP2). (Locations are shown in fig. 3; discharges are given in appendix II.) U.S. Geological Survey techniques of measurement and computation of streamflow were followed when feasible (Rantz and others, 1982a,b), but periods of extremely low winter temperatures and deep snowpacks, which are common in this area, hindered data collection. To improve completeness and reliability of continuous records of discharge from two watersheds draining the north plateau and one watershed draining the burial-ground area, enclosures were constructed over a section of each of the three streams (fig. 5) to maintain an ice-free section of stream channel.

Each enclosure consisted of a steel I-beam box frame spanning the stream channel beyond the height of extreme peak stages. The frame was covered by a wooden floor, and a wall of 2.5-cm-thick styrofoam was hung from the frame down to the low streambanks to enclose a 4 x 2.5-m area of stream channel. A propane heating unit was placed over the channel near the downstream end of each enclosure to maintain temperatures above 0°C inside the enclosure. A gage house containing a float-activated water-level recorder and water-sampling equipment was installed on top of each box frame.



Figure 5.

Stream-gaging enclosure used at waste-burial station 1 and north plateau stations NP3 and NP1. (From Bergeron and others, 1987.)



The stream channel at each gaging station was cleared of all alluvial debris until the till was exposed. Initial attempts to use the natural shape of each channel as a control failed. Large amounts of alluvial debris were deposited in the control section during most storms and prevented establishment of any stable stage-versus-discharge relationship.

Two weirs were placed at each gaging station to minimize siltation and to provide a basis for developing a stable stage-versus-discharge relationship. The upstream weir, a steel-plate, 45° V-notch type, was used to trap debris. The downstream weir, placed near the downstream end of each enclosure, was a compound V-notch weir, designed and theoretically rated for flows as small as  $0.01 \times 10^{-3} \text{ m}^3/\text{s}$  but capable of rating the potential 5-year storm flow.

#### *Lagoon Road Creek and Waste Burial 1 Sites*

Two streamflow-measurement stations, Lagoon Road and Waste Burial 1, were installed on Lagoon Road Creek between the State-licensed low-level and the facility's higher level waste-disposal areas (fig. 3) at different times in the study. The upstream and earlier site, Lagoon Road, used a Parshall flume for discharge measurement. The Waste Burial 1 site, constructed as an

enclosure was 100 m downstream (fig. 3). Both stations were operated during the fall of 1980, and the quality of data collected was considered good<sup>1</sup>. After the fall of 1980, as vegetation under the enclosure at Waste Burial 1 died, the channel side slopes began to slump, and a large amount of debris was carried into the enclosure from an eroding side channel that enters Lagoon Road Creek between the stations. The almost continuous inflow of sediment and debris to the gaging pool made accurate measurement of water levels and discharge impossible during and after storms. Attempts to stabilize this stream section failed, and Waste Burial 1 station operation was discontinued in the spring of 1981.

The upstream Parshall-flume station (Lagoon Road) was used during the rest of the study to monitor flows on this stream. Streamflow records during the frost-free period (April-November) were considered good, but the winter records (December through March) were considered poor<sup>1</sup>. Daily discharge values for the Lagoon Road site are listed in table A of appendix II and summarized in table 1.

<sup>1</sup> Degree of accuracy--"Excellent" means that about 95 percent of the daily discharges are within 5 percent; "Good," within 10 percent; and "Fair," within 15 percent. "Poor" means that daily discharges have less than "Fair" accuracy.

*Table 1.--Annual mean, maximum, and minimum daily discharges at three continuous-record stations at the Western New York Nuclear Service Center.*

[Discharges are in cubic meters per second  $\times 10^{-3}$ .  
Site locations are shown in fig. 3]

Water year	Station		
	Lagoon Road	North Plateau 3	North Plateau 1
A. Annual mean daily discharge			
1981*	--	--	--
1982	0.921	3.14	1.52
1983	.530	2.19	1.09
B. Maximum recorded daily discharge (dates are in parentheses)			
1981	26.0 (10/25)	25.2 (11/8)	25.5 (10/25)
1982	28.3 (3/17, 9/2)	28.3 (3/13)	25.5 (3/14, 3/17)
1983	13.9 (11/4)	13.9 (11/4)	31.2 (11/4)
C. Minimum daily discharge (dates are in parentheses)			
1981	0.0 (many days in June-Sept.)	0.11 (6/5-6/14, 8/25-8/27)	0.0 (several days in May, June, Aug.)
1982	0.0 (many days in Jan., May-Sept.)	.28 (1/16-1/30)	0.0 (1/21-1/30)
1983	0.0 (many days in Oct., Dec., June-Sept.)	.57 (7/11-7/19)	0.0 (many days in July-Sept.)

\*Incomplete record in 1981 water year. Period of record is: Lagoon Road, 4 months; North Plateau 3, 6 months; and North Plateau 1, 7 months.

### *North Plateau Stream Sites*

Two continuous-record gaging stations (NP3 and NP1) and one partial-record site (NP2) were established on the north plateau. NP3 and NP1 used the same gaging method that was attempted at the Waste Burial 1 site, but with greater success. The channel slopes, which are primarily sand and gravel, eroded less than those at Waste Burial 1 and produced less sediment in the gage pools. These stations provided a nearly continuous record during the 3 years of gaging, and the reliability of the data was considered good. Daily discharge values for these sites are listed in tables B and C of appendix II and summarized in table 1. The partial-record site (NP2) on the third stream channel on the north plateau had a staff gage and crest-stage gage used in conjunction with a weir plate and was checked approximately once a month during the data-collection period. These data are listed in table D of appendix II. Discharge during nonstorm periods was nearly constant ( $0.04 \times 10^{-3} \text{ m}^3/\text{s}$ ). The highest observed flow was  $1.98 \times 10^{-3} \text{ m}^3/\text{s}$  on March 19, 1982; the lowest flow was nearly zero on July 9, 1982.

### *North Plateau Seeps*

Analysis of 2 years of streamflow and precipitation data (water years 1981-82) from the three north plateau streams suggested that not all water leaving the plateau was flowing in the three gaged streams at NP1, 2, and 3. The persistence of flow at NP2, albeit small, and the computation of an initial plateau water budget, suggested that more water was leaving the plateau area than could be accounted for by measured streamflow and evapotranspiration. A field reconnaissance early in the study had identified numerous seeps along the periphery of the plateau, but their hydrologic significance was not realized until the initial water budget was computed.

Location and measurement of flow from these seepage areas began in the spring of 1983. Discharge of the several seepage areas was determined by timed volumetric measurement. A half-section of PVC pipe was pushed into the till, just below the interface between the alluvial fan material and the underlying till, and the outflow was collected in a graduated cylinder or larger container for a specified time period. Each seepage area was measured three times and the results averaged. Seepage measurements taken on March 3, July 5, and October 6, 1983 are listed in appendix III. (Locations are shown in fig. 4.)

### **Stream-Discharge Characteristics**

To directly compare annual mean, maximum, and minimum discharge values among the three recording streamflow stations (Lagoon Road Creek, NP1, and NP3), the values were divided by drainage area to provide discharge per unit area (unit yield). Resulting values are given in table 2.

The annual mean unit yields show no similarity, either by gaging station or year, which indicates that the three watersheds are dissimilar in their discharge characteristics.

Comparison of annual maximum daily unit yields shows a clear difference between storm-runoff characteristics at the burial ground and those on the



north plateau. These unit yields reflect the difference in soil-infiltration rates in the two areas. During the 3 years of gage operation, the Lagoon Road station recorded higher unit yields than the two north plateau stations. The highest flows generally occurred during the late fall or early spring runoff, when evapotranspiration is diminished, soil moisture is high, and most storms are of relatively long duration but moderate intensity (5 mm/h).

Comparison of the annual minimum unit yields indicates differences between ground-water-discharge characteristics of the two areas. Lagoon Road Creek is an ephemeral stream; that is, it is dry for extended periods during the summer, which indicates little or no ground-water discharge. On the north plateau, the stream at the NP1 station is considered intermittent because streamflow was nearly continuous through the study, which indicates substantial ground-water discharge. This stream had several short periods of no flow, however, generally during the summer. The stream at the NP3 station is considered perennial; flows were diminished during each summer but never fell

*Table 2.--Annual mean, maximum, and minimum discharges expressed as unit yield for the three continuous-record stations at Western New York Nuclear Service Center.*

[Values are in cubic meters per second per hectare x 10<sup>-3</sup>. Site locations are shown in fig. 3.]

Water year	Lagoon Road	North Plateau 3	North Plateau 1
Drainage area (ha)	4.4	9.84	10.36
A. Annual mean daily unit yield			
1981*	--	--	--
1982	.209	.319	.147
1983	.120	.223	.105
B. Maximum daily unit yield (dates are in parentheses)			
1981	5.93 (10/25)	2.56 (11/8)	2.46 (10/25)
1982	6.44 (3/17)	2.88 (3/13)	2.46 (3/14, 3/17)
1983	3.15 (11/4)	1.41 (11/4)	3.01 (11/4)
C. Minimum daily unit yield (dates are in parentheses)			
1981	0.0 (many days in Oct., July-Sept.)	.011 (6/2, 6/5-6/14, 8/25-8/27)	0.0 (several days in May, June, July-Sept.)
1982	0.0 (many days in Jan., May-Sept.)	.029 (1/16-1/30)	0.0 (1/21-1/30)
1983	0.0 (many days in Oct., Dec., June-Sept.)	.058 (7/11-19)	0.0 (many days in July-Sept.)

\*Incomplete record in 1981 water-year. Period of record is: Lagoon Road, 4 months; North Plateau 3, 6 months; and North Plateau 1, 7 months.



to zero, which indicates sustained ground-water discharge. The difference between low-flow values of the two north plateau streams indicates a difference in the size and hydrologic characteristics of the ground-water systems feeding the two drainage areas.

### *Storm-Runoff Response*

On June 27-28, 1983, 37.3 mm of rain fell during a 20-h period (fig. 6). Peak yields at all stations were between  $0.36 \times 10^{-3}$  and  $1.28 \times 10^{-3}$  ( $\text{m}^3/\text{s}$ )/ha, and peak discharges were between  $3.7 \times 10^{-3}$  and  $5.6 \times 10^{-3}$   $\text{m}^3/\text{s}$ . Although the peak discharges were similar, the increases in flow at the Lagoon Road and NP1 sites were considerably greater than those at NP3.

Lagoon Road Creek.--During the initial part of this storm, no stormflow was recorded at the gaging station because surface-depression storage and the upper soil layer at the burial ground retained most of the rainfall (4.2 mm). When rainfall intensity increased several hours later, flow at the gage increased rapidly to a peak yield of  $1.28 \times 10^{-3}$  ( $\text{m}^3/\text{s}$ )/ha ( $5.6 \times 10^{-3}$   $\text{m}^3/\text{s}$ ). The yield in Lagoon Road Creek quickly returned to nearly the prestorm conditions soon after rainfall ceased (fig. 6). Streamflow ceased at the gage on June 30.

This type of discharge response resembles that of storm runoff from a large impervious area, such as a parking lot, where most of the runoff appears quickly and ends soon after precipitation ceases.

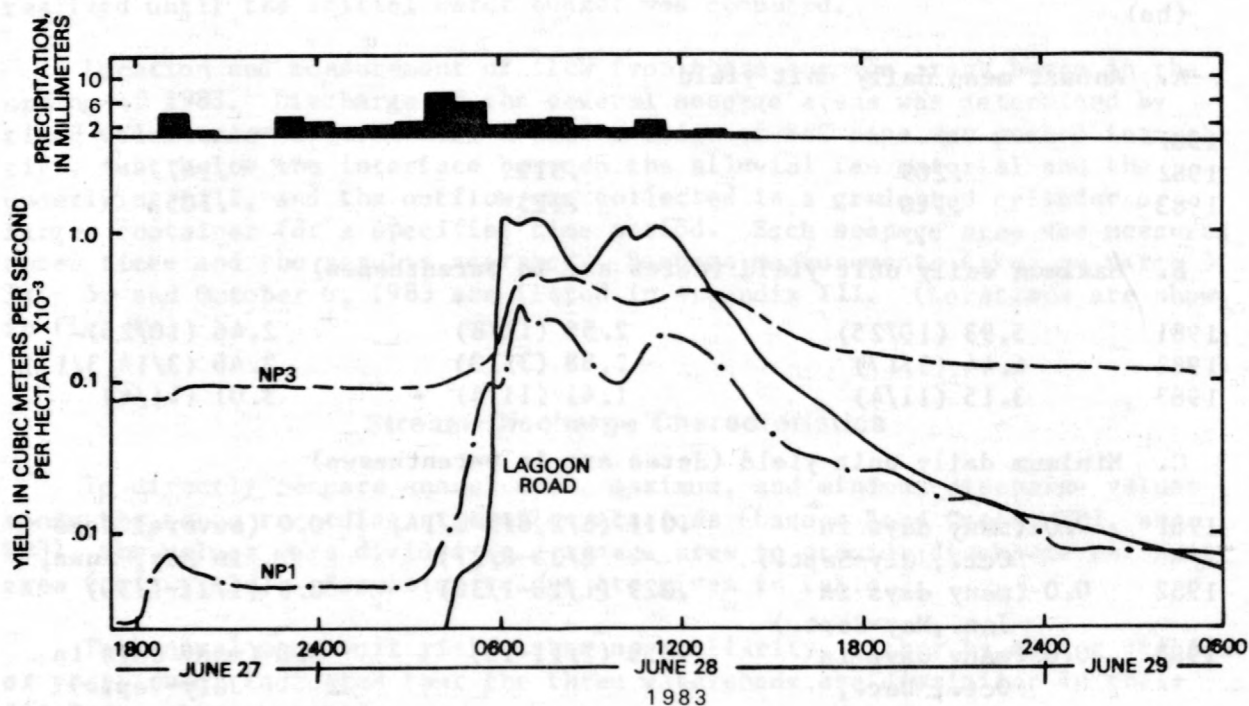


Figure 6.--Stormflow at Lagoon Road, NP3 and NP1 gaging stations during storm of June 27-28, 1983. (Locations are shown in fig. 3.)

North Plateau Streams.--The prestorm yield at site NP3,  $0.08 \times 10^{-3}$  ( $\text{m}^3/\text{s}$ )/ha, increased to  $0.098 \times 10^{-3}$  ( $\text{m}^3/\text{s}$ )/ha after the initial 4.2 mm of rainfall and remained nearly steady until the most intense rainfall occurred at 0400 on June 28 (fig. 6). For the next 3 hours, the rate of streamflow slowly climbed to a peak yield of  $0.57 \times 10^{-3}$  ( $\text{m}^3/\text{s}$ )/ha ( $5.5 \times 10^{-3}$   $\text{m}^3/\text{s}$ ) and remained nearly constant until rainfall diminished. The recession was gradual and fell to  $0.106 \times 10^{-3}$  ( $\text{m}^3/\text{s}$ )/ha within 7 hours after the end of precipitation. By July 4, yield had fallen to within 10 percent of prestorm conditions.

At site NP1, where yield was near zero [ $0.002 \times 10^{-3}$  ( $\text{m}^3/\text{s}$ )/ha], the initial 4.2 mm of rainfall increased streamflow to nearly 3 times its original rate. During the next few hours, light rainfall maintained streamflow at this slightly higher rate until the most intense rainfall, 6.8 mm/h, occurred at 0400 on June 28 (fig. 6). At this time streamflow increased at a fairly rapid rate and reached its peak yield of  $0.36 \times 10^{-3}$  ( $\text{m}^3/\text{s}$ )/ha ( $3.7 \times 10^{-3}$   $\text{m}^3/\text{s}$ ) 2.5 hours after the most intense rainfall. Initially the flow receded at a rate similar to that of Lagoon Road, but after 5 hours began to level out at a rate nearly 4 times the initial yield. By June 30, flow had receded to within 10 percent of prestorm conditions.

As seen in figure 6, the streamflow response at Lagoon Road Creek differs from that at NP3. In the Lagoon Road area, surface depression and initial soil storage take up the first rain, but runoff thereafter is rapid and short lived. At NP3, the response to rainfall is more gradual, which indicates a much higher rate of infiltration in the watershed and a correspondingly slow rate of discharge to the stream channel from increased ground-water storage.

The NP1 response to rainfall is intermediate between that of the Lagoon Road Creek site and NP3 because the soil that overlies the NP1 watershed is thinner and less extensive than at NP3 but is more permeable than the soils at the Lagoon Road site.

#### *Base Flow*

Differences in the initial base-flow rates, the response to rainfall intensity, and the rate of return to a base-flow condition at the three continuously gaged sites (fig. 6) reflect differences in permeability and moisture-retention capabilities of the soils and in the saturated thickness of the ground-water reservoir. The amount of discharge from the ground-water reservoir to the stream depends on the physical characteristics of the ground-water reservoir, the amount and timing of precipitation, and the evapotranspiration rate.

Lagoon Road Creek.--The soil at the burial-ground area along Lagoon Road Creek is a clay-silt till that allows only limited infiltration and storage of precipitation. As indicated on figure 6 and in table A of appendix II, streamflow diminishes rapidly at Lagoon Road Creek when rainfall ends.

North Plateau Streams.--On the north plateau, where alluvial gravel deposits overlie the clay till, base flow is sustained, as indicated in tables B and C of appendix II. Similarly, the base-flow yields at sites NP1 and NP3 reflect the physical differences in the ground-water reservoir supplying base flow to each stream. Examination of the alluvial stratigraphy of the north plateau by the New York State Geological Survey (Albanese and others, 1983)

indicated that the depth and saturated thickness of alluvial materials on the north plateau is greater under the NP3 drainage basin than under the NP1 basin. This is consistent with the higher and more sustained base flow at NP3 than at NP1.

Average discharges of 27 base-flow periods (a period of 5 days or more during which streamflow remained steady or diminished at a constant rate) during the 3 years of gage operation at the two north plateau gaging sites were analyzed. The ratio of NP3 to NP1 flows, normalized for differences in drainage area between the two sites, were computed on a seasonal and annual basis (table 3). The highest ratio occurred during the summer of each year, when evapotranspiration was greater than precipitation and the water table was in the annual minimum range. (Water levels in north plateau wells are given in appendix IV.) At this time, base flow consists solely of discharge from the ground-water reservoir. During the rest of the year, when precipitation equals or exceeds evapotranspiration, the water table is higher and results in increased ground-water discharge to streams. It is also supplemented by sub-surface stormflow or interflow. On an annual basis, the mean base flow at NP3 was 5.6 times the base flow at NP1.

These ratios suggest that the NP3 ground-water basin has greater storage capacity than the NP1 ground-water basin, which is further substantiated by the large number of seepage faces from which seasonal drainage is sustained on that part of the north plateau between NP3 and the french-drain system (fig. 4).

*Table 3.--Ratio of normalized base flow at North Plateau 3 site (NP3) to that at North Plateau 1 site (NP1) during 5-day base-flow periods in each season between October 1980 and September 1983.*

Season	Number of 5-day base-flow periods analyzed	Seasonal ratios of NP3 flow to NP1 flow		
		Min.	Max.	Average
Winter (Jan.-March)	6	1.3:1	4.6:1	3.0:1
Spring (April-June)	6	2.7:1	16.0:1	5.6:1
Summer (July-Sept.)	6	2.5:1	35.0:1	14.2:1
Fall (Oct.-Dec.)	9	1.3:1	11.0:1	4.1:1
Annual total	27	1.3:1	35.0:1	5.6:1

### *Seepage Flows*

The relationship between measured streamflow and measured seepage discharge during the 1983 water year was also analyzed. The three sets of seepage measurements, taken March 3, July 5, and October 6, 1983 (appendix III), represent the annual range in ground-water discharge, and this correlates with the saturated thickness of the north plateau ground-water reservoir during the study. As indicated in table 4, the ratio of measured streamflow to measured seepage flow remained relatively constant--an average of 73 percent at sites NP1 and NP3, and 27 percent from the french drain and other seepage faces.



Table 4.--Results of seepage measurements along perimeter of north plateau, March 3, July 5, and October 6, 1983.

[Locations are shown in figs. 3 and 4. Discharges are in cubic meters per second  $\times 10^{-3}$ .]

Measuring location	March 3		July 5		October 6	
	Discharge	Percent of total	Discharge	Percent of total	Discharge	Percent of total
NP 3	1.76	63	0.595	64	1.56	54
NP 1	.368	13	.028	3	.623	22
French drain	.283	10	.227	24	.312	10
Seepage faces	.396	14	.085	9	.425	15
Total	2.807	100	.935	100	2.92	100

#### Annual Flow

Preliminary annual water budgets were developed for Lagoon Road Creek and the north plateau in an attempt to estimate infiltration and runoff values for use in initial development of ground-water models for these two areas (Yager, 1987; Bergeron, U.S. Geological Survey, written commun., 1986). Computation of more refined annual water budgets was beyond the scope of the study, but enough information was available to indicate general flow conditions in the waste-burial-ground area and on the north plateau.

Lagoon Road Creek.--Runoff from the Lagoon Road basin was approximately 49 percent, and evaporation was approximately 45 percent of the precipitation that fell on the basin. The remaining 6 percent was assumed to represent either infiltration into the deeper till or part of the measurement and estimation error. The runoff and evapotranspiration values closely match those reported by Harding and Gilbert (1968) for the southern part of the Erie-Niagara basin. Storm runoff accounted for nearly 80 percent of the total runoff, and base flow accounted for 20 percent. These runoff factors indicate that the soils in the Lagoon Road Creek area are fairly impervious and that most runoff occurs as storm runoff.

North Plateau.--Total measured runoff plus estimated evapotranspiration nearly equals measured precipitation on the entire north plateau. Total runoff was approximately 55 percent of the precipitation measured on the plateau, and evapotranspiration was approximately 45 percent. Storm runoff accounted for nearly 30 percent of the total runoff from the north plateau, while base flow, including seepage discharge, accounted for nearly 70 percent. This indicates that the surficial deposits on the north plateau are highly permeable and that ground-water discharge is a major component of the flow regime.

NP3 Watershed. Total measured runoff plus estimated evapotranspiration within the NP3 watershed exceeds measured precipitation by 35 percent; evapotranspiration was estimated to be 45 percent of measured precipitation; base-flow and seepage were approximately 78 percent, and stormflow was 12 percent. The inordinately high base flow computed for this watershed is due to several factors and is probably significant beyond any measurement or estimation errors. Apparently an area larger than the surface-water basin is contributing to the



ground-water basin; presumably ground water from the NP1 basin and areas upgradient of the reprocessing plant drain into the NP3 basin. Additional ground water probably originates as leakage from the unlined infiltration pond (Lagoon 1, fig. 3) and the low-level wastewater-treatment system. These factors are explained in detail by Yager (1987).

*NP1 Watershed.* Total runoff plus estimated evapotranspiration accounted for nearly 85 percent of the total precipitation that fell on the NP1 watershed; evapotranspiration constitutes approximately 45 percent, base flow approximately 20 percent, and stormflow approximately 20 percent. The 15 percent that was unaccounted for suggests either that errors were made in the measurements and in the estimate of evapotranspiration or that the underlying ground-water basin is somewhat smaller than the surface-water basin and that part of the ground water discharges to the NP3 surface-water basin.

The numbers presented above can be considered only estimates for the Lagoon Road Creek and north plateau areas. They yield enough information, however, to indicate approximate hydrologic conditions and general runoff patterns at the two areas for which ground-water models were developed.

## SUMMARY

Results of a 3-year streamflow-monitoring program at the former West Valley Nuclear Service Center indicate that surface-water-runoff characteristics of the burial-ground area differ considerably from those of the reprocessing-plant area (the north plateau) 400 m to the north.

Comparison of discharge records of the two north plateau gaging stations with those of the burial-ground area shows that base flow on the north plateau is substantially greater owing to sustained discharge from the sand and gravel deposits that overlie the plateau. Approximately 70 percent of the total runoff from the north plateau is base flow, and the remaining 30 percent is stormflow. This contrasts sharply with the discharge measured at the Lagoon Road site, where only 20 percent of the total measured runoff is base flow, and the remaining 80 percent is stormflow. The primary difference between these two sites is the composition and distribution of the unconsolidated glacial material. The clayey, silty till at the burial-ground area near the Lagoon Road station limits infiltration and causes most precipitation to run off directly to stream channels. The alluvial sand and gravel on the north plateau, however, is highly permeable and allows most precipitation to infiltrate to the water table and subsequently discharge as ground-water outflow to stream channels and seepage faces.

Of the total streamflow discharged from the north plateau, 73 percent flows past the NP3 and NP1 gaging stations, and 27 percent discharges to the french drain and seepage faces along the edge of the plateau. Preliminary water budgets for these two sites indicate that the NP3 ground-water basin is somewhat larger, and the NP1 ground-water basin somewhat smaller, than their respective surface-water drainage basins. Streamflow in the NP3 watershed also includes underflow from the bedrock upgradient from the plant and leakage from several plant facilities. Results of this analysis were used to develop initial input terms for ground-water models of the North Plateau (Yager, 1987) and the burial-ground area (Bergeron, U.S. Geological Survey, written commun., 1985).

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APPENDIX I -- Composite mean daily rainfall at the Western New York Nuclear Service Center near West Valley, December 1980 through September 1983.

[Dashed line indicates no rain, blank spaces indicate no data, a bracketed 'a' indicates an estimated rainfall amount determined for water-budget calculations, a bracketed 'e' indicates that timing of rainfall was not available but the total amount was recorded, and 'p' indicates a partial monthly total of precipitation. All values are in millimeters.]

WATER YEAR OCTOBER 1980 THROUGH SEPTEMBER 1981

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1					6.6				--	--	--	--
2			11.9		8.1				--	4.3	--	12.4
3			4.3						10.9	--	5.1	4.1
4			.2						1.8	7.1	--	3.8
5			--						--	14.7	1.5	6.9
6			--						5.6	--	--	1.5
7			3.0						--	--	--	--
8			13.7						.5	--	2.8	9.4
9			2.3						17.5	--	1.0	--
10									3.6	--	--	--
11									--	--	41.9	--
12									--	--	--	--
13									1.5	--	--	--
14								4.0	15.5	--	--	10.9
15								.7	27.4	--	15.7	--
16								1.5	2.8	--	1.3	--
17								--	--	--	--	7.9
18								--	--	--	--	--
19								--	--	--	--	6.4
20								--	--	23.9	--	1.8
21								--	21.6	24.1	--	2.0
22								--	24.4	--	--	34.8
23								--	--	--	--	.5
24								--	--	--	3.8	--
25								--	4.1	--	--	--
26								--	--	36.6	--	--
27				1.0				8.6	--	.8	--	7.1
28				2.8				--	--	15.0	17.3	.3
29				2.3				--	--	8.6	--	--
30				--				6.6	--	--	1.5	--
31				--				.5	--	--	--	--
TOTAL			35.6p	6.1p	14.7p			22.1p	137.2	135.1	91.9	109.7

WATER YEAR OCTOBER 1981 THROUGH SEPTEMBER 1982

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	25.7	--	2.5	.8	.5	--	--	--	5.6	--	--	42.7a
2	21.8	--	--	--	--	1.3	--	--	--	--	5.3	
3	1.8	--	.8	--	1.0	--	8.1	--	.3	--	--	
4	--	--	2.0	.5	--	1.0	2.5	--	--	--	20.1	
5	--	4.6	3.6	--	.5	--	--	--	30.5	--	--	
6	7.1	18.8	.5	.3	.8	1.5	8.1	--	3.0	--	--	42.7a
7	10.2	.8	--	5.8	--	--	--	.3	--	8.6	--	
8	--	--	9.7	.8	--	--	--	12.7	--	--	9.7	
9	--	--	2.8	4.3	4.6	--	--	--	--	--	12.7	
10	--	--	1.3	1.8	--	--	--	--	4.8	--	--	
11	--	--	.3	2.0	2.8	2.5	--	--	--	7.9	--	--
12	--	--	2.0	--	--	--	--	--	4.1	.8	--	--
13	--	--	.3	--	--	2.8	2.0	--	7.4	--	--	--
14	--	--	--	2.0	--	--	--	--	--	--	--	5.8
15	--	1.5	--	.8	--	--	--	--	1.3	--	--	--



APPENDIX I -- Composite mean daily rainfall at the Western New York Nuclear Service  
Center near West Valley, December 1980 through September 1983  
(continued).

WATER YEAR OCTOBER 1981 THROUGH SEPTEMBER 1982 (continued)

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
16	3.0	10.4	.3	2.5	--	4.8	--	--	21.1	--	--	--
17	--	7.4	4.1	1.0	--	4.1	4.6	--	1.8	8.1	--	--
18	5.1	3.6	2.3	--	--	--	--	--	--	9.7	--	4.3
19	14.7	1.5	2.8	--	--	--	--	7.1	4.1	.3	--	--
20	.3	12.7	.5	2.0	1.5	--	1.8	--	1.0	9.1	--	1.5
21	--	12.7	.8	.3	2.0	2.3	--	--	1.5	--	--	--
22	1.3	6.6	1.5	3.8	--	.5	--	12.4	.5	--	--	28.7
23	13.2	.5	--	--	--	--	--	7.1	--	--	--	1.8
24	3.3	.3	--	--	1.0	4.1	--	.3	--	--	--	--
25	--	--	--	--	--	3.0	--	--	--	--	--	.3
26	4.8	1.0	--	--	--	.5	2.3	--	1.8	--	--	4.1
27	11.9	.5	--	--	--	--	--	10.4	--	6.1	--	15.7
28	1.3	.5	3.8	--	--	--	--	15.7	11.2	34.5	4.57a	.8
29	--	--	1.5	--	--	--	--	--	26.2	--	--	--
30	--	--	1.5	--	--	--	--	--	--	--	--	--
31	--	--	--	13.5	--	11.7	--	.8	--	--	--	--
TOTAL	125.5	83.3	43.2	42.2	14.7	40.1	29.5	64.3	126.0	84.6	52.4p	105.7

WATER YEAR OCTOBER 1982 THROUGH SEPTEMBER 1983

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	--	--	--	--	--	--	--	7.1	--	--	29.2	--
2	--	--	--	--	2.5	--	6.6	15.2	--	.5	--	--
3	9.7e	60.7a	--	--	4.3	.5	--	7.4	1.5	--	--	--
4	--	--	4.3	1.3	4.3	.8	3.8	.3	.8	3.6	1.0	--
5	--	.5	3.0	--	7.4	--	--	1.0	.3	.8	4.3	--
6	--	1.5	2.3	--	--	--	--	--	9.1	.5	--	3.0
7	--	--	--	4.6	6.1	.8	2.8	--	--	--	--	5.8
8	5.1	--	--	--	--	1.8	--	3.8	--	--	5.1	--
9	--	--	2.0	--	--	13.5	.3	--	--	--	.5	--
10	--	--	--	2.5	--	6.6	2.5	--	--	--	--	--
11	--	13.2	.5	5.1	--	--	7.4	--	--	--	24.4	--
12	--	13.2	.8	1.3	--	--	--	--	--	.5	4.6	--
13	.5	3.3	.5	.5	--	--	--	--	--	.3	--	2.5
14	15.5	--	--	1.3	--	--	2.0	5.8	--	--	--	--
15	10.4	2.8	3.0	2.8	--	--	7.1	6.6	17.0	--	--	--
16	--	--	9.1	3.0	--	--	--	.5	--	--	--	7.6
17	2.8	--	--	3.0	--	--	4.3	--	1.0	.5	10.7	5.3
18	--	--	--	--	--	46.0e	3.3	--	--	--	--	1.5
19	--	--	3.6	1.3	.5	--	.8	8.1	--	--	--	--
20	--	1.3	14.5	--	.3	--	1.0	1.5	--	5.1	--	--
21	--	7.1	5.8	--	.8	--	--	--	--	11.9	--	18.5
22	--	5.3	7.6	.5	.5	--	--	9.4	--	--	3.0	29.2
23	48.3e	5.1	.5	9.4	1.8	--	5.1	2.3	--	2.3	--	11.7
24	--	3.0	--	3.6	4.6	--	4.1	--	--	7.6	--	--
25	--	--	11.4	1.8	.8	--	--	8.9	--	--	--	--
26	--	5.8	--	--	.5	--	--	--	--	--	--	--
27	--	--	6.4	--	--	12.7	--	--	5.6	--	--	--
28	--	10.4	.3	--	--	2.3	--	--	31.0	--	20.8	--
29	--	1.5	4.8	--	--	--	8.4	8.4	--	15.7	.5	--
30	--	--	.5	4.8	--	--	5.3	1.5	--	11.4	13.5	--
31	0.0a	--	.3	--	--	--	--	1.5	--	1.3	17.8	--
TOTAL	92.2	134.4p	81.3	44.2	34.3	84.8	64.8	89.4	66.3	62.0	135.4	85.3

APPENDIX II -- Surface-water discharge at Lagoon Road Creek and North Plateau gaging stations, October 1980 through September 1983.

A.-- LAGOON ROAD CREEK NEAR WEST VALLEY (0421344100)

LOCATION.--Lat 42°26'55", long 78°39'03", Cattaraugus County, Hydrologic Unit 04120102, on right bank 61 m upstream from Franks Creek and 5.6 km northwest of West Valley.

DRAINAGE AREA.--0.044 km<sup>2</sup>.

PERIOD OF RECORD.--Seasonal, December 1975 through October 1979, October-November 1980; continuous July 1981 through September 1983.

GAGE.--Graphical recorder driven by a float in a 30.5-cm diameter well connected by a 3.2-cm diameter pipe to a Parshall flume. Outside reference; a vertical, enameled staff gage (base gage) attached to the flume wall.

CONTROL.--Galvanized Parshall flume (15.2-cm throat x 30.5-cm deep).

REMARKS.--Records good except for winter period, which is poor.

EXTREMES FOR PERIOD OF RECORD.--Maximum daily discharge, 0.27 m<sup>3</sup>/s June 29, 1976; no flow many days.

MEAN DISCHARGE, IN CUBIC METERS PER SECOND X 10<sup>-3</sup>, WATER YEAR OCTOBER 1980 THROUGH SEPTEMBER 1981

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.00	.03								.00	.03	.00
2	.00	.03								.00	.03	.79
3	.06	.00								.00	.03	.71
4	.06	.88								.03	.03	.31
5	.11	.77								.31	.03	.62
6	.06	.77								.06	.03	.20
7	.11	4.25								.03	.00	.06
8	.06	.74								.00	.00	1.33
9	.03	1.64								.00	.00	.09
10	.00	.06								.00	.00	.06
11	.37	.06								.00	9.06	.03
12	6.80	.06								.00	.11	.03
13	.26	.03								.00	.06	.03
14	.06	.06								.00	.06	.94
15	.06	.06								.00	1.98	.09
16	.06	.03								.00	.31	.03
17	.03	.06								.00	.06	.62
18	.23	.06								.00	.06	.06
19	.06	.20								.00	.03	.03
20	2.24	.26								.54	.03	.11
21	1.98	.40								11.61	.00	.06
22	.09	.96								1.95	.00	10.20
23	.06	.45							.03	.03	.00	.17
24	.06	3.40							.03	.00	.00	.09
25	26.05	.82							.06	.00	.00	.06
26	4.81	.20							.00	6.80	.00	.06
27	.28								.00	.11	.00	.65
28	.62								.00	2.52	.82	.06
29	.17								.00	2.75	.03	.06
30	.09								.00	.09	.03	.03
31	.06								---	.06	.03	---
TOTAL	44.93	---							---	26.89	12.85	17.58
MEAN	1.45	---							---	.87	.41	.59
MAX	26.05	---							---	11.61	9.06	10.20
MIN	.00	---							---	.00	.00	.00
M <sup>3</sup> /KM <sup>2</sup>	.035	---							---	.020	.004	.013
MM	88.2	---							---	52.8	25.2	34.5
M <sup>3</sup> /H	3.30									1.98	0.93	1.34

APPENDIX II -- Surface-water discharge at Lagoon Road Creek and North Plateau gaging stations,  
October 1980 through September 1983 (continued).

A.-- LAGOON ROAD CREEK NEAR WEST VALLEY (0421344100)

MEAN DISCHARGE, IN CUBIC METERS PER SECOND X  $10^{-3}$ , WATER YEAR OCTOBER 1981 THROUGH SEPTEMBER 1982

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	7.65	.11	.20	a3.12	a2.15	a.06	.45	.03	.11	.03	.00	.03
2	7.36	.11	.06	a.68	a.62	a.06	.20	.03	.08	.00	.00	20.96
3	1.44	.08	.03	a.25	a.40	a.03	1.36	.00	.06	.00	.00	.96
4	.20	.08	.03	7.08	a.31	a.03	.82	.00	.06	.00	3.12	.11
5	.11	.20	.03	a.85	a.25	a.11	.40	.00	7.08	.00	.03	.06
6	2.29	7.08	.03	a.90	a.20	a.31	.40	.00	1.56	.00	.03	.31
7	3.12	1.30	.14	a.31	a.17	a.25	2.83	.00	.25	.00	.00	.08
8	.31	.31	3.68	a.25	a.14	a.11	.14	.51	.11	.00	.06	.06
9	.11	.11	.74	a.20	a.11	a.06	.06	.08	.08	.00	1.93	.03
10	.06	.08	.31	a.11	a.08	a.06	1.70	.06	.08	.00	.06	.03
11	.06	.08	.25	a.06	a.08	a.62	2.27	.06	.03	.00	.03	.03
12	.06	.06	.17	a.03	a.06	a3.40	4.25	.03	.03	.00	.00	.00
13	.06	.06	.20	a0	a.06	a27.	2.75	.00	.28	.00	.00	.00
14	.06	.06	.31	a0	a.06	a28.	.42	.00	.03	.00	.00	.00
15	.06	.06	.25	a0	a.20	a7.1	.20	.00	.03	.00	.00	.00
16	.06	4.53	.25	a0	a1.70	a4.0	.20	.00	3.40	.00	.00	.00
17	.06	2.61	.17	a0	a1.13	a28.	.20	.00	.42	.00	.00	.00
18	.14	2.01	.11	a0	a.62	a1.70	.11	.00	.03	.31	.00	.00
19	3.68	.23	.06	a0	a.45	a.74	.06	.00	.03	.06	.00	.00
20	.54	5.38	.03	a0	a.40	a.45	.06	.00	.00	.71	.23	.00
21	.17	.96	.03	a0	a.31	a6.80	.06	.00	.00	.00	.03	.17
22	.08	.68	.03	a0	a.31	a.40	.06	.20	.00	.00	.00	2.63
23	3.12	.62	14.44	a0	a.25	a.25	.06	.99	.00	.00	.00	1.27
24	1.61	.82	1.30	a0	a.23	a.25	.06	.20	.00	.00	.00	.06
25	.45	.68	a.31	a0	a.20	a.20	.06	.08	.00	.00	.25	.03
26	1.13	1.53	a.14	a0	a.20	a.20	.06	.06	.00	.00	.03	.06
27	4.53	6.80	a.08	a0	a.11	a.17	.06	1.39	.00	.00	.00	4.81
28	1.53	.40	a.06	a0	a.11	a.17	.06	3.96	.85	4.25	.00	.20
29	.20	.08	a.06	a0	---	a.25	.06	.45	8.21	.08	.00	.11
30	.11	.06	a.03	a0	---	a.45	.06	.11	.06	.03	.00	.06
31	.11	---	a.03	.17	---	5.10	---	.08	---	.03	.54	---
TOTAL	40.47	37.17	23.56	13.51	10.91	115.96	19.48	8.32	22.87	5.50	6.34	32.06
MEAN	1.31	1.24	.76	.44	.39	3.74	.65	.27	.76	.18	.20	1.07
MAX	7.65	7.08	14.44	7.08	2.15	28.32	4.25	3.96	8.21	4.25	3.12	20.96
MIN	.06	.06	.03	.00	.06	.03	.06	.00	.00	.00	.00	.00
M <sup>3</sup> /KM <sup>2</sup>	.030	.028	---	---	---	---	.015	.006	.017	.004	.005	.024
MM	79.5	73.0	46.3	26.5	21.4	227.7	38.3	16.3	44.9	10.8	12.4	63.0
M <sup>3</sup> /H	2.98	2.82	1.73	1.00	.89	8.50	1.48	.61	1.73	.41	.45	2.43

WTR YR 1982 TOTAL 336.15 MEAN .92 MAX 28.32 MIN .00 M<sup>3</sup>/H 2.09 MM 660.1

a - Estimated; no gage-height record.

APPENDIX II -- Surface-water discharge at Lagoon Road Creek and North Plateau gaging stations,  
October 1980 through September 1983 (continued).

A.-- LAGOON ROAD CREEK NEAR WEST VALLEY (0421344100)

MEAN DISCHARGE, IN CUBIC METERS PER SECOND X  $10^{-3}$ , WATER YEAR OCTOBER 1982 THROUGH SEPTEMBER 1983

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.03	3.68	.17	.09	.17	.09	a.31	2.27	.03	.00	2.41	.06
2	.03	.45	.09	.06	6.80	.06	a.25	5.66	.03	.00	.09	.03
3	.03	8.21	.06	.06	1.05	.09	a1.70	3.12	.03	.00	.00	.03
4	.03	13.88	.57	.06	.45	.06	a.62	.62	.06	.00	.00	.00
5	.03	.62	.45	.03	.26	.06	a.25	.20	.03	.00	.00	.00
6	.00	.31	.54	.03	.17	.06	a.20	.11	.11	.00	.00	.00
7	.03	.26	.20	.11	.17	.06	a.54	.06	.03	.00	.00	.03
8	.03	.09	.09	.09	.11	.03	a.17	.11	.03	.00	.00	.00
9	.03	.06	.06	.06	.11	.03	a.11	.09	.00	.00	.00	.00
10	.00	.06	.06	1.70	.11	1.47	a.11	.06	.00	.00	.00	.00
11	.28	2.38	.06	2.04	.11	1.42	a1.4	.06	.00	.00	.82	.00
12	.03	5.95	.06	.20	.11	.45	a.62	.03	.00	.00	.48	.00
13	.03	2.63	.06	.11	.11	.96	a.17	.03	.00	.00	.03	.00
14	1.19	.31	.03	.11	.14	.65	.06	.06	.00	.00	.00	.00
15	4.53	.26	.09	.11	.14	.17	1.6	.34	.48	.00	.00	.00
16	.20	.31	3.40	.09	.14	.09	.11	.17	.03	.00	.00	.00
17	.20	.17	.28	.09	.14	.06	.09	.06	.00	.00	.23	.09
18	.06	.11	.06	.09	1.30	.06	.85	.06	.00	.00	.06	.03
19	.03	.06	.03	.09	1.05	5.38	.62	.03	.00	.00	.03	.03
20	.06	.06	.03	.06	.62	1.44	.54	.03	.00	.00	.00	.00
21	.06	1.19	.00	.06	.31	5.38	1.95	.03	.00	.00	.00	1.08
22	.03	1.93	.00	.06	.20	.74	.40	.34	.00	.00	.00	3.12
23	.03	1.90	.06	1.19	.20	.54	.17	.28	.00	.00	.00	3.97
24	.03	2.83	9.06	1.30	.11	.31	.31	.06	.00	.00	.00	.40
25	.03	.26	3.40	.54	.11	a.25	.96	.14	.00	.00	.00	.11
26	.03	.17	.82	.31	.11	a.20	.31	.68	.00	.00	.00	.06
27	.03	.11	1.33	.17	.11	a5.4	.11	.06	.00	.00	.00	.06
28	.03	4.53	1.10	.11	.09	a3.4	.09	.03	1.22	.00	.54	.03
29	.00	2.63	.17	.11	---	a1.2	.23	.09	.03	.00	.31	.03
30	.00	.45	.11	.11	---	a.62	2.38	.45	.00	.26	.51	.03
31	.77	---	.09	.11	---	a.48	---	.06	---	.03	2.38	---
TOTAL	7.89	55.86	22.53	9.35	14.50	31.18	17.29	15.39	2.11	.29	7.89	9.19
MEAN	.25	1.86	.73	.30	.52	1.01	.58	.50	.07	.01	.25	.31
MAX	4.53	13.88	9.06	2.04	6.80	5.38	2.38	5.66	1.22	.26	2.41	3.97
MIN	.00	.06	.00	.03	.09	.03	.06	.03	.00	.00	.00	.00
M <sup>3</sup> /KM <sup>2</sup>	.006	.042	.017	.007	.012	---	---	.011	.002	.000	.006	.007
MM	15.4	109.7	44.2	18.4	28.5	61.2	34.0	30.2	4.1	.6	15.5	18.0
M <sup>3</sup> /H	.57	4.23	1.66	.68	1.18	2.30	1.32	1.14	.16	.02	.57	.70
CAL YR 1982	TOTAL 321.23	MEAN 0.88	MAX 28.32	MIN .00	M <sup>3</sup> /H 2.00	MM 630.6						
WTR YR 1983	TOTAL 193.47	MEAN 0.53	MAX 13.88	MIN .00	M <sup>3</sup> /H 1.20	MM 379.8						
CLM YR 82-3	TOTAL 235.88	MEAN 0.65	MAX 20.96	MIN .00	M <sup>3</sup> /H 1.48	MM 463.1						

a - Estimated; no gage-height record.



APPENDIX II -- Surface-water discharge at Lagoon Road Creek and North Plateau gaging stations, October 1980 through September 1983.

B.-- NORTH PLATEAU SITE 3 (NP3) NEAR WEST VALLEY (0421344420)

LOCATION.--Lat 42°27'14", long 78°39'03", Cattaraugus County, Hydrologic Unit 04120102, on left bank at north-eastern perimeter of Western New York Nuclear Service Center, 110 m upstream from the mouth, 460 m northeast of the main plant facility and 6.1 km northwest of West Valley.

DRAINAGE AREA.--0.098 km<sup>2</sup>.

PERIOD OF RECORD.--October through November 1980, June 1981 through September 1983.

GAGE.--Graphical recorder driven by a float in a 15.3-cm steel slotted well. Outside reference: a vertical, enameled staff gage attached to the outside of the stilling well.

CONTROL.--Steel, compound V-notch weir plate driven into clay till at downstream end of gaging platform enclosure.

REMARKS.--Records good.

EXTREMES FOR PERIOD OF RECORD.--Maximum daily discharge, 28.3 x 10<sup>-3</sup> m<sup>3</sup>/s March 13, 1982; minimum daily discharge 0.11 x 10<sup>-3</sup> m<sup>3</sup>/s June 5-14, August 25-27, 1981.

MEAN DISCHARGE, IN CUBIC METERS PER SECOND X 10<sup>-3</sup>, WATER YEAR OCTOBER 1980 THROUGH SEPTEMBER 1981

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.57	.57	9.06						.14	.57	2.55	.17
2	.57	.28	11.61						.11	.57	2.27	.23
3	.57	.28	8.50						.14	.57	1.98	.23
4	.57	.57	5.38						.14	.57	1.98	.23
5	.57	3.12	4.53						.11	.28	1.98	.28
6	.57	1.42	4.53						.11	.28	1.70	.28
7	.57	5.38	10.76						.11	.28	1.70	.28
8	.57	25.20	13.31						.11	.28	1.70	.57
9	.85	9.63	13.03						.11	.28	1.42	.28
10	.85	3.96	10.76						.11	.28	1.42	.28
11	.85	2.55	9.63						.11	.28	5.10	.28
12	5.10	2.27	10.20						.11	.28	1.42	.28
13	2.27	2.27	11.89						.11	.28	1.42	.28
14	1.42	2.27	9.63						.11	.28	1.42	.57
15	1.42	1.98	8.50						6.51	.28	1.70	.28
16	1.13	1.70	8.50						1.42	.28	1.70	.28
17	.85	1.42	7.93						1.42	.28	.85	.57
18	1.13	1.13	7.65						1.13	.28	.57	.28
19	.85	1.13	7.65						.85	.28	.57	.28
20	2.55	.85	7.08						.85	.28	.28	.57
21	3.40	.85							2.55	1.70	.28	.28
22	1.70	1.98						1.42	9.06	.85	.23	8.50
23	1.42	1.42						1.42	3.12	.57	.23	5.95
24	1.13	5.66						1.42	2.27	.57	.17	4.81
25	14.73	5.38						1.13	1.98	.57	.11	4.53
26	6.51	3.96						.85	1.13	5.10	.11	4.53
27	2.83	3.96						.57	.85	2.55	.11	3.96
28	1.70	4.25						.40	.85	3.12	.28	3.96
29	.85	4.53						.23	.57	4.53	.17	3.96
30	.57	4.53						.20	.57	3.12	.17	3.40
31	.57	---						.20	---	2.83	.17	---
TOTAL	59.24	104.40	---					---	36.76	32.27	35.76	50.38
MEAN	1.91	3.48	---					---	1.23	1.04	1.15	1.68
MAX	14.73	25.20	---					---	9.06	5.10	5.10	8.50
MIN	.57	.28	---					---	.11	.28	.11	.17
M <sup>3</sup> /KM <sup>2</sup>	.019	.035	---					---	.012	.011	.012	.017
MM	52.1	91.7	---					---	32.3	28.3	31.4	44.2
M <sup>3</sup> /H	1.94	3.54							1.25	1.06	1.17	1.71

APPENDIX II -- Surface-water discharge at Lagoon Road Creek and North Plateau gaging stations,  
October 1980 through September 1983 (continued).

B.-- NORTH PLATEAU SITE 3 (NP3) NEAR WEST VALLEY (0421344420)

MEAN DISCHARGE, IN CUBIC METERS PER SECOND  $\times 10^{-3}$ , WATER YEAR OCTOBER 1981 THROUGH SEPTEMBER 1982

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	9.35	3.12	3.12	2.83	1.42	3.40	8.21	1.42	1.70	2.83	1.42	1.42
2	11.89	3.12	3.12	2.27	1.42	3.40	7.36	1.42	1.42	2.27	1.42	28.04
3	8.21	2.83	3.12	2.27	1.13	3.40	7.36	1.42	1.42	2.27	1.13	13.59
4	5.10	2.83	3.12	8.50	1.13	3.40	6.51	1.42	1.42	1.98	5.66	10.20
5	3.97	2.83	3.12	4.53	.85	2.83	6.51	1.42	2.55	1.98	1.70	5.10
6	4.53	4.81	3.12	3.97	.57	1.98	5.66	1.42	1.98	1.70	1.42	5.66
7	5.10	3.97	3.12	3.40	.57	1.70	5.10	1.42	1.42	1.70	1.13	5.10
8	4.53	3.12	4.53	3.40	.85	1.13	4.53	2.83	1.42	1.42	1.42	3.12
9	3.97	2.27	3.12	3.40	.85	1.13	3.97	1.98	1.42	1.13	3.68	2.27
10	3.40	1.70	3.12	3.12	.85	1.13	4.53	1.70	1.42	1.13	1.70	1.70
11	3.12	1.13	2.83	2.83	.85	1.98	6.51	1.70	1.42	1.13	1.42	1.70
12	2.27	1.13	2.83	2.55	.85	9.06	7.36	1.42	1.42	1.13	1.42	1.42
13	2.27	1.13	2.27	1.98	.85	28.32	8.21	1.13	1.42	1.13	1.42	1.13
14	1.98	1.13	2.27	1.42	.85	17.56	10.76	1.13	1.42	1.13	1.42	.85
15	1.98	1.13	1.98	.85	1.13	14.44	5.38	1.13	1.42	1.13	1.13	1.13
16	1.42	5.38	1.98	.57	1.98	13.31	2.27	1.13	1.98	1.13	1.13	1.13
17	1.13	2.27	1.98	.28	1.42	26.90	2.27	1.13	1.98	1.13	1.13	1.13
18	.85	4.53	1.98	.28	1.42	15.29	2.83	1.13	1.98	1.70	1.13	1.13
19	3.40	3.40	1.98	.28	1.13	13.31	2.83	1.13	1.98	1.42	1.13	1.13
20	3.97	7.08	1.70	.28	1.13	13.31	3.12	1.13	1.98	1.13	1.42	.85
21	3.97	3.97	1.42	.28	1.13	13.31	2.83	1.13	1.70	1.13	1.42	1.13
22	3.97	3.97	1.42	.28	1.70	9.06	2.27	1.13	1.70	1.13	1.42	2.55
23	5.10	3.97	13.03	.28	2.83	8.21	1.98	1.13	1.70	1.13	1.42	3.40
24	5.10	3.97	4.53	.28	4.53	8.21	1.70	1.13	1.42	1.13	1.13	1.98
25	4.53	3.97	3.97	.28	5.10	6.51	1.70	1.13	1.42	1.13	1.13	1.98
26	4.53	3.97	3.40	.28	5.10	6.51	1.70	.85	1.42	1.13	1.13	1.70
27	5.66	12.46	3.12	.28	4.25	5.10	1.70	1.42	1.42	1.13	.85	4.53
28	6.51	6.51	3.12	.28	3.40	5.10	1.42	3.68	1.70	3.97	.85	2.55
29	3.97	5.10	3.12	.28	---	5.10	1.42	2.27	10.48	2.83	1.13	2.27
30	3.40	3.97	2.27	.28	---	6.51	1.42	1.98	3.12	2.27	1.13	2.27
31	3.12	---	2.27	.57	---	13.31	---	1.70	---	1.98	1.42	---
TOTAL	132.30	110.77	96.08	52.38	49.29	263.91	129.42	46.16	59.25	49.53	46.46	112.16
MEAN	4.27	3.69	3.10	1.69	1.76	8.51	4.31	1.49	1.98	1.60	1.50	3.74
MAXIMUM	11.89	12.46	13.03	8.50	5.10	28.32	10.76	3.68	10.48	3.97	5.66	28.04
MINIMUM	.85	1.13	1.42	.28	.57	1.13	1.42	.85	1.42	1.13	.85	.85
M <sup>3</sup> /KM <sup>2</sup>	.043	.038	.031	.017	.018	.086	.044	.015	.020	.016	.015	.038
MM	116.2	97.3	84.4	46.0	43.3	231.7	113.6	40.5	52.0	43.5	40.8	98.5
M <sup>3</sup> /H	4.34	3.75	3.15	1.72	1.79	8.65	4.38	1.51	2.01	1.63	1.52	3.80

WTR YR 1982 TOTAL 1,147.71 MEAN 3.14 MAX 28.32 MIN .28 M<sup>3</sup>/H 3.19 MM 1,007

APPENDIX II -- Surface-water discharge at Lagoon Road Creek and North Plateau gaging stations,  
October 1980 through September 1983 (continued).

B.-- NORTH PLATEAU SITE 3 (NP3) NEAR WEST VALLEY (0421344420)

MEAN DISCHARGE, IN CUBIC METERS PER SECOND X  $10^{-3}$ , WATER YEAR OCTOBER 1982 THROUGH SEPTEMBER 1983

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1.98	3.12	2.83	3.12	1.27	1.70	3.12	3.96	1.42	.85	3.68	1.13
2	1.98	2.55	2.55	3.12	4.25	1.70	2.83	5.66	1.42	.85	1.13	1.13
3	1.70	5.10	2.27	2.83	4.25	1.70	3.40	5.38	1.27	.85	.85	.99
4	1.70	13.88	2.27	2.55	3.96	1.42	3.40	4.53	1.27	.85	.85	.99
5	1.70	5.38	2.27	2.27	3.68	1.42	2.83	3.40	1.27	.71	.99	.99
6	1.70	3.96	2.55	1.98	3.40	1.42	2.83	3.12	1.42	.71	.85	.99
7	1.42	3.40	2.55	1.98	3.12	1.42	2.83	2.55	1.42	.71	.85	.99
8	1.42	3.12	2.27	1.98	2.83	1.42	2.55	2.55	1.27	.71	.85	.85
9	1.42	2.83	2.27	1.98	2.83	1.27	2.27	2.55	1.13	.71	.85	.85
10	1.42	2.27	1.98	2.83	2.83	2.27	2.27	2.27	1.13	.71	.71	.85
11	1.70	4.25	1.70	4.25	2.55	3.12	3.40	2.27	.99	.57	1.70	.85
12	1.42	5.38	1.70	3.12	2.55	2.83	3.40	1.98	.99	.57	1.70	.85
13	1.42	5.38	1.70	2.55	2.27	2.83	2.55	1.98	.85	.57	.99	.85
14	1.70	3.96	1.70	2.27	2.55	2.83	2.83	1.98	.85	.57	.99	.85
15	4.81	3.68	1.70	1.98	2.27	2.55	3.68	2.27	1.27	.57	.99	.71
16	2.27	3.40	3.96	1.70	1.98	2.27	3.12	1.98	1.13	.57	.85	.71
17	2.27	3.40	2.83	1.70	1.98	1.70	2.83	1.70	.99	.57	.99	.85
18	1.98	2.83	2.27	1.70	2.55	1.70	3.12	1.70	.99	.57	.99	.71
19	1.70	2.83	2.27	1.42	2.55	7.08	3.12	1.70	.99	.57	.85	.71
20	1.42	2.55	2.27	1.42	2.27	6.51	2.83	1.70	.85	.71	.85	.71
21	1.42	2.83	1.70	1.42	2.27	8.78	3.68	1.42	.85	.85	.85	1.13
22	1.42	3.68	1.70	1.27	1.98	5.66	3.12	1.70	.85	.85	.85	3.12
23	1.42	3.96	1.98	1.70	1.98	4.25	2.55	1.70	.85	.85	.85	6.23
24	1.27	5.38	12.18	1.70	1.70	3.96	2.55	1.70	.85	.85	.85	2.83
25	1.27	3.68	9.63	1.42	1.70	3.68	2.83	1.42	.71	.71	.71	1.98
26	1.27	3.40	5.95	1.42	1.70	3.40	2.55	1.98	.71	.71	.71	1.70
27	1.27	3.12	4.81	1.42	1.70	6.80	2.27	1.70	.71	.57	.71	1.42
28	1.27	4.53	4.53	1.27	1.70	6.51	2.27	1.42	2.27	.57	1.27	1.42
29	1.27	4.81	3.40	1.27	---	4.25	1.98	1.42	.99	.85	1.13	1.27
30	1.13	3.12	3.12	1.27	---	3.68	3.68	1.70	.99	1.27	1.27	1.27
31	1.27	---	3.12	1.27	---	3.40	---	1.42	---	.71	3.96	---
TOTAL	51.41	121.78	98.03	62.18	70.67	103.53	86.64	72.81	32.70	22.29	35.67	39.93
MEAN	1.66	4.06	3.16	2.01	2.52	3.34	2.89	2.35	1.09	.72	1.15	1.33
MAX	4.81	13.88	12.18	4.25	4.25	8.78	3.68	5.66	2.27	1.27	3.96	6.23
MIN	1.13	2.27	1.70	1.27	1.27	1.27	1.98	1.42	.71	.57	.71	.71
M <sup>3</sup> /KM <sup>2</sup>	.017	.041	.032	.020	.026	.034	.029	.024	.011	.007	.012	.014
MM	45.1	106.9	86.1	54.6	62.1	90.9	76.1	63.9	28.7	19.6	31.3	35.1
M <sup>3</sup> /H	1.69	4.13	3.21	2.04	2.56	3.39	2.94	2.39	1.11	.73	1.17	1.35
CAL YR 1982	TOTAL 1,079.78	MEAN 2.96	MAX 28.32	MIN .28	M <sup>3</sup> /H 3.01	MM 948.1						
WTR YR 1983	TOTAL 797.69	MEAN 2.19	MAX 13.88	MIN .57	M <sup>3</sup> /H 2.23	MM 700.4						
CLM YR 82-3	TOTAL 950.58	MEAN 2.60	MAX 28.04	MIN .85	M <sup>3</sup> /H 2.64	MM 834.7						

APPENDIX II -- Surface-water discharge at Lagoon Road Creek and North Plateau gaging stations, October 1980 through September 1983 (continued).

C.--NORTH PLATEAU SITE 1 (NP1) NEAR WEST VALLEY (0421344600)

LOCATION.--Lat 42°27'15", long 73°39'17", Cattaraugus County, Hydrologic Unit 04120102, on left bank at northern perimeter of Western New York Nuclear Service Center, 130 m upstream from the mouth, 0.5 km upstream from Franks Creek and 6.3 km northwest of West Valley.

DRAINAGE AREA.--0.104 km<sup>2</sup>.

PERIOD OF RECORD.--October through December 1980, continuous June 1981 through September 1983.

GAGE.--Graphical recorder driven by a float in a 15.3-cm steel slotted well. Outside reference: a vertical, enameled staff gage attached to the outside of the stilling well.

CONTROL.--Steel, compound V-notch weir plate driven into clay till at downstream end of gaging platform enclosure.

REMARKS.--Records good.

EXTREMES FOR PERIOD OF RECORD.--Maximum daily discharge, 31.2 x 10<sup>-3</sup> m<sup>3</sup>/s November 4, 1982; no flow many days.

MEAN DISCHARGE, IN CUBIC METERS PER SECOND X 10<sup>-3</sup>, WATER YEAR OCTOBER 1980 THROUGH SEPTEMBER 1981

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.03	.77	7.36	.77					.00	.06	.17	.03
2	.03	.51	8.78	.77					.00	.06	.11	.06
3	.06	.40	5.10						.03	.06	.09	.06
4	.09	.91	2.80						.03	.06	.09	.06
5	.11	3.68	1.76						.03	.03	.06	.40
6	.11	1.61	1.39						.03	.03	.06	.40
7	.09	8.21	11.33						.03	.03	.06	.11
8	.06	23.79	13.88						.03	.03	.06	.94
9	.06	4.53	10.20						.40	.03	.03	.28
10	.06	1.39	5.10						.06	.03	.03	.11
11	.11	.91	2.80						.03	.03	5.38	.06
12	7.08	.77	2.80						.03	.03	1.25	.06
13	1.87	.62	5.10						.03	.03	.34	.06
14	.77	.91	1.76						.23	.03	.17	.17
15	.57	.77	1.39						5.38	.03	1.44	.11
16	.40	.62	1.10						1.42	.03	1.08	.06
17	.31	.40	.91						.65	.03	.28	.28
18	.51	.40	.77						.23	.03	.14	.14
19	.31	.40	.77						.09	.03	.09	.14
20	3.97	.60	.77						.09	.03	.06	.28
21	5.95	1.19	.68						2.49	.96	.03	.23
22	1.39	3.40	.62					.00	7.93	.11	.03	11.05
23	.77	.91	.62			.99		.00	1.81	.06	.03	3.12
24	.51	7.36	.62			.65		.00	.57	.06	.03	1.19
25	25.49	6.23	.62			.23		.00	.48	.06	.00	.57
26	18.41	1.39	.62			.14		.00	.17	4.25	.00	.40
27	7.36	.91	.57					.00	.11	1.42	.00	.94
28	6.23	2.63	.51					.00	.09	1.84	.09	.40
29	2.21	1.39	.77					.00	.06	3.12	.03	.28
30	1.10	1.47	1.10					.00	.06	.77	.03	.14
31	.91	---	.91					.00	---	.28	.03	---
TOTAL	86.93	79.08	93.51	---		---		---	22.59	13.65	11.29	22.13
MEAN	2.80	2.64	3.02	---		---		---	.75	.44	.36	.74
MAX	25.49	23.79	13.88	---		---		---	7.93	4.25	5.38	11.05
MIN	.03	.40	.51	---		---		---	.00	.03	.00	.03
M <sup>3</sup> /KM <sup>2</sup>	.027	.025	.029	---		---		---	.007	.004	.003	.007
MM	72.4	65.8	78.0	---		---		---	18.8	11.4	9.4	18.5
M <sup>3</sup> /H	2.70	2.55	2.92						.72	.42	.35	.71



APPENDIX II -- Surface-water discharge at Lagoon Road Creek and North Plateau gaging stations,  
October 1980 through September 1983 (continued).

C.--NORTH PLATEAU SITE 1 (NP1) NEAR WEST VALLEY (0421344600)

MEAN DISCHARGE, IN CUBIC METERS PER SECOND  $\times 10^{-3}$ , WATER YEAR OCTOBER 1981 THROUGH SEPTEMBER 1982

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	8.21	.57	1.53	2.75	1.93	.17	2.83	.11	.26	.40	.09	.11
2	12.46	.40	1.25	1.93	1.67	.14	1.53	.11	.23	.20	.11	13.88
3	7.93	.28	1.08	1.30	1.42	.11	1.30	.11	.20	.11	.06	2.38
4	3.12	.23	.96	12.74	1.19	.11	2.27	.09	.20	.11	1.22	1.56
5	1.93	.23	.96	3.12	.96	.20	2.38	.09	5.66	.11	.20	1.30
6	4.25	5.38	.85	1.67	.74	.28	1.81	.06	3.12	.09	.17	.96
7	5.66	3.68	.85	1.53	.57	.28	1.93	.06	1.05	.11	.11	.68
8	2.66	1.81	3.68	1.42	.34	.23	1.81	.23	.43	.11	.11	.40
9	1.19	1.08	1.53	1.19	.28	.17	1.53	.28	.28	.09	1.44	.23
10	.74	.74	1.42	.96	.23	.17	2.55	.17	.20	.09	.28	.20
11	.57	.65	1.19	.74	.23	1.64	2.83	.17	.11	.11	.17	.20
12	.40	.48	1.08	.57	.23	6.80	3.68	.14	.11	.11	.11	.17
13	.28	.28	.96	.28	.17	24.36	3.97	.14	.40	.09	.09	.11
14	.17	.23	.96	.11	.17	25.49	1.81	.11	.17	.09	.06	.11
15	.17	.23	.96	.06	.28	19.26	1.08	.11	.11	.06	.06	.11
16	.28	4.53	.96	.06	1.56	12.18	.65	.11	2.29	.06	.06	.11
17	.28	3.40	.96	.03	1.42	25.49	.48	.11	1.05	.11	.06	.11
18	.28	3.68	.96	.03	.85	10.20	.34	.11	.68	.09	.06	.11
19	3.12	1.93	.85	.03	.74	7.08	.23	.11	.40	.06	.06	.09
20	2.21	8.50	.85	.03	.65	4.81	.23	.09	.28	.17	.11	.09
21	1.19	4.53	.74	.00	.57	6.23	.23	.06	.28	.09	.06	.17
22	.74	4.25	.65	.00	.57	4.25	.23	.09	.23	.06	.03	1.59
23	3.12	3.40	14.44	.00	.48	2.83	.17	.14	.20	.06	.03	2.83
24	2.66	2.80	5.10	.00	.40	2.80	.17	.11	.17	.06	.03	.60
25	1.53	1.67	2.49	.00	.34	1.93	.17	.09	.14	.06	.06	.40
26	1.93	1.98	1.81	.00	.34	1.93	.17	.09	.11	.03	.03	.31
27	3.97	13.31	1.30	.00	.28	1.93	.17	.34	.11	.06	.03	4.81
28	4.25	5.38	1.08	.00	.23	1.53	.14	2.24	.31	1.36	.03	.94
29	1.67	3.12	.96	.00	---	2.21	.14	.88	5.66	.28	.03	.68
30	1.08	2.07	.85	.00	---	3.68	.14	.34	1.19	.11	.03	.45
31	.65	---	.74	.96	---	7.08	---	.28	---	.09	.20	---
TOTAL	78.70	80.82	54.00	31.51	18.84	175.57	36.97	7.17	25.63	4.63	5.19	35.69
MEAN	2.54	2.69	1.74	1.02	.67	5.66	1.23	.23	.85	.15	.17	1.19
MAX	12.46	13.31	14.44	12.74	1.93	25.49	3.97	2.24	5.66	1.36	1.44	13.88
MIN	.17	.23	.65	.00	.17	.11	.14	.06	.11	.03	.03	.09
M <sup>3</sup> /KM <sup>2</sup>	.024	.026	.017	.010	.006	.055	.012	.002	.008	.001	.002	.011
MM	65.6	67.4	45.0	26.3	15.7	146.4	30.8	6.0	21.4	3.9	4.3	29.8
M <sup>3</sup> /H	2.46	2.60	1.68	.98	.65	5.46	1.19	.22	.82	.14	.16	1.15

WTR YR 1982 TOTAL 554.73 MEAN 1.52 MAX 25.49 MIN .00 M<sup>3</sup>/H 1.47 MM 462.6

APPENDIX II -- Surface-water discharge at Lagoon Road Creek and North Plateau gaging stations,  
October 1980 through September 1983 (continued).

C.--NORTH PLATEAU SITE 1 (NP1) NEAR WEST VALLEY (0421344600)

MEAN DISCHARGE, IN CUBIC METERS PER SECOND  $\times 10^{-3}$ , WATER YEAR OCTOBER 1982 THROUGH SEPTEMBER 1983

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.34	3.68	1.30	1.25	.60	.40	.94	2.27	.20	.03	1.08	.11
2	.26	2.01	1.13	1.13	7.93	.34	.82	7.36	.17	.03	.09	.06
3	.23	9.63	1.02	1.02	3.97	.31	1.53	3.12	.17	.03	.03	.03
4	.20	31.15	1.16	.94	1.27	.28	1.36	1.78	.17	.03	.00	.03
5	.17	4.53	.99	.79	.79	.26	.94	1.19	.14	.03	.03	.03
6	.17	1.84	.85	.77	.71	.23	.77	1.08	.28	.03	.03	.03
7	.17	1.36	.74	1.05	.68	.20	.91	.94	.23	.03	.03	.03
8	.17	.96	.60	.91	.62	.20	.77	.79	.17	.03	.03	.03
9	.14	.82	.51	.79	.62	.20	.68	.74	.14	.03	.03	.00
10	.11	.65	.43	1.76	.60	.82	.62	.62	.14	.03	.03	.00
11	.37	3.68	.43	2.35	.60	1.47	1.53	.57	.11	.03	.23	.00
12	.23	8.50	.40	.91	.62	.85	1.36	.48	.11	.03	.37	.00
13	.20	5.10	.34	.74	.62	.85	.77	.45	.11	.03	.06	.00
14	.65	2.35	.34	.68	.65	.71	.54	.43	.09	.03	.03	.00
15	5.95	1.76	.68	.62	.65	.57	1.90	.54	.23	.00	.03	.00
16	1.02	1.44	3.97	.57	.62	.43	.85	.43	.11	.00	.00	.00
17	.91	1.30	1.44	.51	.65	.34	.62	.26	.09	.00	.03	.03
18	.57	1.19	1.08	.48	1.30	.34	1.10	.23	.09	.00	.03	.03
19	.45	1.10	1.02	.45	1.30	5.10	.94	.23	.06	.00	.03	.03
20	.37	1.02	.96	.45	1.05	3.68	.94	.23	.06	.00	.00	.03
21	.34	1.73	1.08	.43	.85	9.06	1.70	.20	.06	.03	.00	.23
22	.28	2.69	1.08	.43	.71	2.44	.94	.34	.06	.03	.00	2.15
23	.26	2.04	1.10	1.36	.68	1.76	.62	.43	.06	.03	.00	5.38
24	.23	5.10	20.67	1.53	.57	1.50	.68	.28	.06	.03	.00	1.05
25	.20	1.67	14.16	1.08	.51	1.19	1.02	.23	.03	.00	.00	.43
26	.20	1.44	6.80	.94	.48	1.10	.77	.60	.03	.00	.00	.23
27	.20	1.44	4.25	.77	.48	7.93	.57	.26	.03	.00	.00	.17
28	.20	6.23	3.40	.62	.45	7.65	.45	.23	.85	.00	.31	.14
29	.17	5.66	1.84	.54	---	2.78	.43	.23	.06	.03	.11	.11
30	.17	2.35	1.44	.57	---	1.53	2.18	.45	.03	.14	.14	.11
31	.37	---	1.36	.71	---	1.19	---	.23	---	.03	2.55	---
TOTAL	15.30	114.42	76.57	27.15	30.58	55.71	29.25	27.22	4.14	.74	5.30	10.47
MEAN	.49	3.81	2.47	.88	1.09	1.80	.98	.88	.14	.02	.17	.35
MAX	5.95	31.15	20.67	2.35	7.93	9.06	2.18	7.36	.85	.14	2.55	5.38
MIN	.11	.65	.34	.43	.45	.20	.43	.20	.03	.00	.00	.00
M <sup>3</sup> /KM <sup>2</sup>	.005	.037	.024	.008	.010	.017	.009	.008	.001	.000	.002	.003
MM	12.8	95.4	63.9	22.6	25.5	46.5	24.4	22.7	3.5	.6	4.4	8.7
M <sup>3</sup> /H	.47	3.68	2.38	.85	1.05	1.74	.95	.85	.14	.02	.16	.34
CAL YR 1982	TOTAL 547.49	MEAN 1.50	MAX 31.15	MIN .00	M <sup>3</sup> /H 1.45	MM 456.6						
WTR YR 1983	TOTAL 396.85	MEAN 1.09	MAX 31.15	MIN .00	M <sup>3</sup> /H 1.05	MM 331.0						
CLM YR 82-3	TOTAL 435.01	MEAN 1.19	MAX 31.15	MIN .03	M <sup>3</sup> /H 1.15	MM 362.8						

APPENDIX II -- Surface-water discharge at Lagoon Road Creek and North Plateau gaging stations, October 1980 through September 1983 (continued).

D.--NORTH PLATEAU SITE 2 (NP2) NEAR WEST VALLEY (0421344430)

STAFF GAGE READINGS AND DISCHARGE MEASUREMENTS,

WATER YEARS 1981-1983

(Gage height in centimeters, discharge measured in cubic meters per second x 10<sup>-3</sup>)

Water Year 1981			Water Year 1982			Water Year 1983		
Date	Gage height	Dis-charge	Date	Gage height	Dis-charge	Date	Gage height	Dis-charge
Oct. 10	1.2	0.03	Oct. 1	1.2		Oct. 15	1.8	0.34
14	1.4		Nov. 17	1.5	0.15	Nov. 10	1.8	
15	1.2	.05	19	1.8		Feb. 3	2.4	
16	1.3	.06	Dec. 1	1.5	.20	Mar. 3	1.8	
17	1.2	.05	8	1.5	.21	Apr. 23	2.1	
20	1.8		Jan. 5	1.8		May 20	2.1	
22	1.8		Mar. 19	3.4		23	2.1	
Nov. 17	1.8		July 9	1.2	.04	27	2.1	
18	1.8		Aug. 9	1.5	.14	June 6	2.1	
24	1.8					15	1.8	
30	1.5					28	2.4	
Dec. 1	1.5					July 5	1.5	
7	1.5					9	.9	
8	1.8					19	1.2	
14	1.5					24	1.8	
29	1.5					Aug. 1	2.4	
Feb. 17	1.8					16	2.1	
Mar. 3	2.1					24	1.8	
June 12	1.5					30	1.8	
July 8	1.5					Sept. 14	1.8	
Aug. 20	1.2					20	1.8	
						1984		
						Oct. 15	1.8	.34



### APPENDIX III.--Description and Discharge of Seepage Faces Along Perimeter of the North Plateau

The north plateau is the area within the West Valley study site that contains the reprocessing plant, high-level waste tanks, and associated treatment and storage facilities. Most of the water draining the north plateau flows past the NP1 and NP3 streamflow stations, but some discharges from a series of seepage faces along the perimeter of the plateau. Several seepage surveys were made during 1983 to determine the location, magnitude, and role of these springs in the discharge pattern of the north plateau.

A seepage face is typically a zone 1.5 to 10 m long, downslope from the interface between the alluvium and underlying till, where water seepage is sustained. Signs of such an area are large amounts of black decomposing organic matter and slumping ground. The soil surface is moist, and vegetative species common to wetlands can be found at some locations.

Descriptions of seepage faces around the north plateau are given below; discharge measurements and altitudes are tabulated on p. 35. The descriptions begin with the seepage area now covered by a parking lot for the site administration complex (fig. 4). The numbering system proceeds clockwise around the plateau and ends at the railroad grade. Water may flow at several distinct points within a seepage area or as general seepage from the entire area.

#### Seepage-Face Descriptions

(Locations are shown in fig. 4.)

- SF-1 Two seepage areas underlie what is now the upper parking lot for the administration building. Drainage pipes were placed to direct seepage away from the paved area. Flow from these seeps generally infiltrates back into the alluvial material downslope from the parking lot. Sampling suggests intermittent or ephemeral flow.
- SF-2 Several distinct wet zones. The northwesternmost seep at the base of a 7.5-cm-thick maple tree was measurable; the others have smaller discharge rates.
- SF-3 Several small seeps with small organic decomposition zones and little discernible discharge.
- SF-4 A 20-m face along the left bank downstream from the NP1 gaging station with several distinct wet zones; none observed on right bank. Seepage on left bank observed year-round but too diffuse to measure. Slumping is seen further downstream.
- SF-5 Two distinct seepage zones. Minimal flow, no measurement possible. Standing water observed in a small depression above the seepage faces; this area may feed these seeps.
- SF-6 Numerous seeps combined in this unit. All seeps are small and generally appear as broad mud flats on gentle slopes but disappear or become channelized on steeper slopes. No measurements made.

APPENDIX III (continued)

- SF-7 Seepage appears to begin inside old security fence northeast of the gravel pits. Seepage area broadens downslope (as in SF-6) and narrows to several distinct channels as slope steepens. Measureable flow in one channel.
- SF-8 NP2 drainage - Seepage zone begins inside security fence in swampy area. Large increase in flow between drainpipe under fence and NP2 gage pool. Measurement made at lower weir pool in NP2 channel.
- SF-9 Two seepage zones in this face. Southernmost zone measurable; the other too diffuse to measure. Alluvial material 1.5- to 2.5-m thick over the surface.
- SF-10 Very active seepage area on left bank 45 m downstream from the NP3 station. An active slump 10 m long had very diffuse flow. A new mud-flow appeared in spring of 1983 when a yellow-brown mud emanated from a 0.25 m-diameter hole on the steeper slope. A 1- to 1.25-m-wide sluiceway channels the mud to the NP3 streamcourse. No measurements possible.
- SF-11 Active seepage area along right bank of NP3 channel. Flow occurs along entire bank, from 10 m upstream of station through the gage-pool area (approximately 15 m). The major seepage point (upstream from the gage) was measured; the others were not. This area actively flows year-round.
- SF-12 7.5-m-long seepage area with flow dispersed along entire face. Flow divides into two broad channels, neither of which is measurable. Magnitude of seepage similar to SF-13.
- SF-13 Active seepage from 45-m-long face. Flow becomes channelized one-third of the way down the slope.
- SF-14 Seepage from 6-m-long face. Flow becomes channelized two-thirds of the way downslope; most seepage is probably in this channel.
- SF-15 Seepage from 6-m-long face. Flow becomes channelized halfway downslope; most seepage was measured in this channel.
- SF-16 Seepage from 10.5-m-long face. Flow is channelized halfway downslope, where most flow is probably concentrated.
- SF-17 Outlet of french-drain system, east of the large storage lagoons. Appreciable flow with black (manganese?) stain in channel.
- SF-18 Seepage from field east of plant complex that forms several small connected wetlands (opposite low-level radioactive-waste trenches). Most drainage flows along south side of road.
- SF-19 Long seepage area halfway between railroad and SF-18. Small individual seeps near crest of slope. One of four had measurable flow.
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# APPENDIX III (continued)

## Seepage-face altitudes and discharge measurements

[Locations are shown in fig. 4.]

Seepage face	Altitude (m)	Discharge, in liters per minute		
		3/3/83	7/5/83	10/6/83
SF-1 approx	435.00	FM*	FM	1.08
2	430.77	0.11	dry	dry
3 approx	418.00	FM	FM	FM
4	416.75	FM	FM	FM
5	410.66	FM	dry	FM
6	415.50	FM	FM	FM
7	415.84	1.50	FM	.95
8 (NP2)	413.67	5.57	2.10	6.04\$
9	410.96	.38	dry	.10
10	414.25	FM	.2	.32
11	414.07	2.32	1.9	2.38
12	415.44	FM	dry	dry
13	415.20	1.62	FM	FM
14	415.41	1.97	FM	FM
15	414.53	.38	1.23	1.40
16	416.14	.33	FM	FM
17	416.21	17.2	12.9	18.7
18	418.48	8.28	FM	12.0
19	419.28	.50	dry	dry
		40.17	18.3	43.0
Rainfall within 24 hours (mm)		(00.0)	(00.0)	(24.1)

\* FM - seepage face moist but no measurable flow

\$ NP2 flow at weir was 2.67 L/min, additional seepage flow from recent rains was 3.37 L/min, measured at downstream measurement section.

APPENDIX IV.--Water-level altitudes in wells on north plateau,  
March 1982 through March 1983.

[Altitudes are in meters. Well locations  
are shown in fig. 4.]

Date	Well Number							
	80-1	80-2	80-3	80-4	80-5	80-6	80-7	80-8
<u>1982</u>								
March 4	430.6	432.8	419.5	418.9	416.4	416.2	424.2	429.1
April 2	431.2	433.0	420.1	420.0	417.0	417.0	424.3	429.7
May 3	430.2	432.6	419.1	418.9	416.3	416.4	424.2	429.0
June 1	430.8	432.5	419.4	418.8	416.3	416.2	424.2	428.9
July 1	431.1	433.0	419.6	419.2	416.5	416.4	424.3	429.5
August 5	431.0	432.5	419.5	418.8	416.1	416.0	424.2	429.1
September 13	430.5	432.8	419.2	419.0	416.4	416.7	424.2	429.2
October 4	430.6	432.8	419.8	419.0	416.3	416.3	424.2	429.2
November 10	430.9	433.0	419.8	419.7	416.8	416.9	424.3	429.5
November 30	431.2	433.1	420.0	420.1	416.9	416.9	424.4	429.5
December 29	431.0	433.1	420.0	420.1	417.0	417.0	424.4	429.6
<u>1983</u>								
February 4	431.1	433.1	419.4	419.5	416.9	416.7	424.5	429.6
March 3	430.4	432.7	419.5	418.9	416.4	416.4	424.2	429.0
March 25	431.0	432.9	420.1	419.6	416.8	416.8	424.3	429.5





