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WEST VALLEY DEMONSTRATION PROJECT

SAFETY ANALYSIS REPORT

SUPPLEMENTS

Controlled Copy No. 30

25396

LIST OF SUPPLEMENTS

SUPPLEMENT A.3.1-A

POPULATION PROJECTIONS USING DEMOG2

SUPPLEMENT A.3.1-A

POPULATION PROJECTIONS USING DEMOG2

The U.S. Bureau of the Census projection series for the nation is based upon two fertility assumptions. One is that the complete cohort fertility is 2.7 children per woman, and the other is 2.1 children per woman. These levels are such that the value 2.1 represents a completed cohort fertility which eventually would result in population replacement only, and the value of 2.7 results in a growing population. This report uses a fertility ratio of 2.1 based on the current national trend.

The U.S. Bureau of the Census projections for the nation assume a closed population. That is, on the national level, the migration of persons into or out of the United States is considered negligible. However, such a situation does not generally exist for individual states, including the states in the study area. For example, between 1960 and 1970, the United States population increased by 13 percent; however, Pennsylvania's population increased by only 4 percent and New York's population increased by 8.7 percent. These figures indicate that Pennsylvania and New York experienced outmigration. Thus, one set of state projections used in this report will include a migration component equivalent to that for the period 1970-1975. It is not possible to assign a confidence level to population projections. Instead, it is customary to provide a range of values believed to bracket the likely population. For this reason, a second set of projections will assume that net migration is zero, and is presented for comparison.

DEMOG2 uses two distinct steps in generating population projections on a spatial basis. The first step is to generate projections for an appropriate geographic unit. The second step is to allocate these geographic unit projections to the 160 population wheel compass sectors, formed by ten concentric circles at 1.6, 3.2, 4.8, 6.4, 8, 16, 32, 48, 64 and 80 km distance from the site, and 16 radii at 22.5 degree intervals.

The geographic unit used for this study is the Minor Civil Division (MCD). This is the smallest unit for which there are population data from 1940 to the present, which is required input to DEMOG2. Further, projections from state agencies are available for MCDs. The federal, state and local population data used to compute the population projections are as follows:

Federal Projections

[1] U.S. by Cohort Survival Method. This projection is updated every year.

Symbol = F

[2] U.S. and State by Cohort Survival Method and different assumptions. (Note: These projections are not updated regularly; therefore, they may be different for U.S. than projections reported in [1] above.)

Symbol = FS for U.S.; SFS for States

State Projections

[1] State - Various methods are used.

Symbol = S

[2] County - Various methods are used.

Symbol = CS

County Projections

[1] County - Various methods are used.

Symbol = C

[2] MCD - Various methods are used.

Symbol = MCDC

Therefore:

$$MCD = \frac{MCDC}{C} \; \frac{CS}{S} \; \frac{SFS}{FS} \; (F)$$

Note: Few if any of the projections described above will be the same. That is, state projections for counties will differ from county projections for counties (i.e., C may not equal CS).

The key assumptions to this technique are that: a) the national projections are accurate; and b) all other projections are accurate only in terms of their ratio (e.g., CS/S). Though local agencies may overestimate or underestimate population growth, they have a good concept of where local growth will occur.

This method has been developed to overcome the differences inherent in the population projections produced by various sources using different assumptions and methods. These differences are expected to occur and are not unique to this project area.

After producing the projections for the Minor Civil Divisions, DEMOG2 allocates this population to the 160 sectors of the population wheel. There are three steps to the allocation process:

[1] Area 0 to 8 km from wheel center. The population estimates for this area are obtained by:

(a) Using aerial photographs/site visits/maps to count the houses occurring in each population wheel sector.

(b) Multiplying the houses by the appropriate persons per housing unit for Cattaraugus and Erie counties.

(c) Converting the population estimated in (a) and (b) into a proportion of the MCD.

[2] Area 8 to 16 km from wheel center. The population for this area is obtained by:

(a) Placing small towns with reported populations (U.S. Census of Population, 1980) into sectors.

(b) Subtracting small towns' population from the MCD's total population to obtain the MCD rural population.

(c) Assume the MCD rural population is evenly spread over the rural area which is habitable - water and extremely mountainous terrain are excluded (using US GS 7-1/2 minute topographic maps).

(d) Estimate the area proportion of each MCD (rural) in a wheel sector.

[3] Area 16 to 80 km from wheel center. The population for this area is obtained by:

(a) Assuming that the MCD population is uniformly distributed over the MCD area.

(b) Estimating the area proportion of a MCD in a wheel sector.

After the allocation proportions are estimated, populations for 1980 and the projected years are obtained by multiplying the population for a MCD by the proportion of the MCD which occurs in a wheel sector, and then summing for all the MCD's that occur in a sector. As indicated, this technique assumes that the area proportions remain constant over the life of the plant (i.e., that MCD boundaries remain constant).

Population data for Canadian municipalities were prepared by the Regional Municipality of Niagara, Canada (Richard D. Miller, written communication, November 1982).

REFERENCES FOR SECTION SUPPLEMENT A.3.1-A

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SUPPLEMENT A.3.1-8

TRANSIENT POPULATION

SUPPLEMENT A.3.1-B

TRANSIENT POPULATION

The transient population around the site is primarily one of three types:

[1] Transportation

[2] Daily, or

[3] Seasonal.

Many of the people associated with one of the transient types will also be residents of the area and therefore any statistics for transient population will contain some double counting. Because a transient population occurs for only a portion of the time, it is necessary to weight it accordingly in order to produce an accurate representation of the risk, if any, for that population. The weighted transient population takes into account the length of time that transients remain in the area. For example, a group of people within the area of concern for only 8 hours per day (40 hours per 168-hour week) would constitute a daily transient population. The number of such persons would be multiplied by a factor (in this case 40/168 or 0.238) to produce the equivalent full-time population represented by the transients. The result is termed the weighted population.

A transportation population is associated with some mode of transportation or transportation terminal, for example, an airport or train station, where the total number of people may be quite large but the time "in residence" is normally very brief.

Tourists and users of outdoor recreation areas (seasonal transients) are attracted to an area, generally for a particular purpose, for only a portion of a year. They are not considered residents of the area, and are not

generally counted in the populations of inhabited places. A daily transient population is present for only a portion of a day on a year-round basis, such as workers at an industrial site.

Transportation Population

The major transportation routes in the site vicinity are 2-lane state highways. The nearest interstate highway is I-90, more than 32 km northwest of the site. There are no major transportation terminals within 48 km of the site, therefore, the transportation population in the site vicinity consists primarily of approximately 3,000 vehicles per day using Route 219 west of the site (Cattaraugus County Planning Board, 1979). This population is present in the site vicinity for only a matter of minutes. It is not included in the population tables and figures.

Daily Population

The City of Buffalo is the central work location for a substantial part of the Buffalo Standard Metropolitan Statistical Area (SMSA). The City center is approximately 51.5 km from the site. Cattaraugus County is outside the Buffalo SMSA, and published statistics on worker commutation are not available. It is unlikely that many workers commute into Southern Erie County or Cattaraugus County from Buffalo. Residents of many Erie County communities, ranging from 5 percent to more than 30 percent of the employed work forces in these communities, commute to work in Buffalo. Thus, the daytime transient population reduces the weighted population within the 48 km area. However, for the purposes of the present analysis, the resident population is not reduced to lower levels. Declining job opportunities in Buffalo, local planning for industrial sites in the Southtowns of Erie County, and increasing transportation costs would seem to indicate a greater dependence on local employment with less emphasis on commuting in the future.

Seasonal Population

Cattaraugus and Southern Erie County do not contain many large seasonal vacation resorts, but there are many small recreation sites in the area, especially in Southern Cattaraugus County. The Cattaraugus County Planning Board (1979) estimates there are 160 recreation facilities in the County, including ski areas, campgrounds, a state park and marina. The transient populations associated with significant facilities are described in the following sections.

Ski Areas

Cattaraugus County contains 7 ski areas; many of them are small - less than 200 acres. The largest ski area is Holiday Valley (280 hectares) near Ellicottville, approximately 24 km south of the site. A second large ski area is Kissing Bridge (280 hectares) 16 km north of the site in Erie County. Although skiing is a locally prominent recreation activity, it remains primarily a weekend activity. Most users are believed to be from the Buffalo area (Cattaraugus County Planning, 1979); however, one local survey placed 66 percent of skiers from out-of-state (CATB, 1981). It has been estimated that up to 800,000 ski trips to Cattaraugus County were made in 1977-1978; however, use varies widely according to weather conditions and the number of visits were considerably lower during 1976-1977 (482,000 visits) and 1980-1981 (500,000 visits). Assuming a 4-month ski season yields an estimated 4,170 average daily ski season visitors at an annual level of 500,000 visits. Holiday Valley's share of the ski population was 135,000 visits in 1977-1978.

Census data indicate that the towns near the Holiday Valley ski area (Ellicottville, Mansfield and Great Valley) increased in population by 346 (8.4 percent) between 1970 and 1980, while housing units increased by 826 units (50.1 percent). The year-round occupancy rate is 61 percent. It is

evident that a large number of housing units, many of them relatively new, are not occupied year-round and many are, therefore, available for seasonal use. At an occupancy rate of 3.2 persons per unit, 1,398 units would be required to accommodate the resident population, leaving 1,051 units unaccounted for.

Analyzed another way, the 346 new residents since 1970 could be accommodated in 108 housing units at an average unit occupancy rate of 3.2, leaving 718 of the 826 new units unaccounted for.

It is apparent that the Holiday Valley area of Cattaraugus County has a substantial localized seasonal population. For the purposes of this analysis the population is located at 16 to 32 km from the site, evenly divided between the south and the south-southwest compass sectors. The transient population is assumed to consist of the (weighted) equivalent of 188 residents (718 units occupied on weekends, for 16 weeks, by 3 persons) and the (weighted) equivalent of 122 residents (135,000 ski visits for 8 hours each), for a total of 310. This may be an overestimate to the extent that local residents constitute a portion of the ski visitors and are double-counted. However, it may also tend to underestimate the population due to the fact that some visitors stay overnight in the few motels in the area.

The Kissing Bridge ski area in Erie County is not served by a significant transient housing industry, but the area is close to urban areas (primarily Buffalo), making day skiing trips the predominant form of recreation. Visitors to Kissing Bridge have held relatively constant at approximately 250,000 per year (Hatfield, 1983) during recent years, and average about 8 hours per visit. This number results in a weighted transient population of 228 located at 8-16 km north of the site.

Camping Areas

Like skiing, camping and boating are highly weather dependent. The Cattaraugus County Tourist Bureau reports (1976, 1977 and 1981) indicate a peak attendance of 71,000 in 1977, declining to 16,500 campers in 1981. A partial survey (1981) indicates the following distribution by length of stay:

Weekend	36 percent
One Week	48 percent
Two Weeks	13 percent
Longer Than Two Weeks	3 percent

Most campers are from the Buffalo area or from out-of-state.

Applying the above length-of-visit distribution to a maximum annual visitation of 71,000 produces a weighted population equivalent of 1,263. This is equal to 1.5 percent of the resident 1980 population. Distributed among a dozen sites throughout the County, none closer than eight kilometres, this population is not believed to represent a significant change. However, two large campgrounds are proximal to each other and have a combined capacity of 950 campsites. These are Timber Lake and Jellystone, approximately 10.5 km south of the site (N.Y. State Dept. of Commerce, 1982). These sites are generally fully occupied on weekends during the summer season. Assuming 3 persons per camp site for 16 weekends results in the (weighted) equivalent of 250 residents at this location. This number is included in the population figures and tables. Other campgrounds at greater distances from the site, such as Lone Pine (200 sites) and Mockingbird (170) sites located 24 km west and 24 km north-northeast respectively, do not contain a significant weighted transient population.

Allegany State Park

Allegany State Park is the largest park in Western New York, consisting of 27,513 ha of mostly undeveloped woodland with swimming, fishing, camping and skiing.

In 1981, approximately 1.5 million people visited Allegany State Park, about the same as in 1976 (CATB, 1981). During 1977-1979 the number of visitors was closer to one million annually. A survey conducted in 1976 indicated that of 34,289 campers that year, 50 percent were from Buffalo-Erie County, 16 percent were from out-of-state, and 15 percent were from the local region. Applying the length of stay distribution shown above and assuming 85 percent of campers are nonlocal yields a weighted population equivalent of 520.

In order to calculate the noncamping transient population at the State Park it is necessary to determine the frequency of local residents' use of the park, and subtract this from the total visitor population in order to prevent double-counting. It has been estimated that 75 percent of the park visitors are from Buffalo and Erie County (Cattaraugus County Planning Board, 1979). If it is assumed that 75 percent of the park visitors (noncamping) are from outside the Cattaraugus County area, at an annual visitation rate of 1.45 million this results in a noncamping transient population of 1,087,500. Assuming an average length of stay of 8 hours results in a weighted transient population of 993.

The total camping and noncamping transient population is estimated to be 1,513. This is added to the population tables and figures, divided equally between the south and south-southwest sectors 32-64 km from the site.

Fishing/Boating Areas

Onoville Marina Park is located on the Allegheny Reservoir, 54.5 km southwest of the site. The reservoir itself is 43.5 km long and extends to within 42 km of the site. The marina is operated by Cattaraugus County, and maintains docks for 335 boats, mooring space, launch ramps, picnic sites, and a few campsites. Visitation in 1979 has been estimated at 212,728, higher than previous years. Given the availability of water bodies in region, many visitors to Onoville Marina would not likely travel long distances to use this facility, and most of the visitor population is believed to be included in the resident population statistics for the region. Therefore, visitors to the marina are not included as transient population in the population tables and figures.

Other Areas

A major new park is proposed for the Zoar Valley along Cattaraugus Creek, approximately 11.5 to 16 km west of the site. The proposed 3,643 ha Zoar Valley Recreation Area is expected to accommodate 5,000 to 6,000 people per day, with a peak design capacity of 10,000 (Cattaraugus County Planning Board, 1979). Most of the visitors are expected to come from the Buffalo area. At a visitation rate of 5,000 people per day during the summer season weekends (16 weekends), and assuming an average length of stay of 4 hours and 50 percent nonlocal visitors, this would result in additional weighted transient population of 37 people. This number is added to the population tables and figures beginning at year 1990.

A substantial seasonal population may be associated with Lime Lake in Machias, 14.5 km east-southeast of the site. Approximately 300 seasonal dwellings are located around the lake, presumably to take advantage of water-based recreation opportunities. Visitor statistics are not available, and the origins of the visitors are not known. This population is not included in the tables and figures.

REFERENCES FOR SECTION SUPPLEMENT A.3.1-B

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SUPPLEMENT A.3.1-C

USES OF NEARBY LAND AND WATERS

SUPPLEMENT A.3.1-C

USES OF NEARBY LAND AND WATERS

Cattaraugus and Erie Counties

Cattaraugus County Land Use

The site is located in northern Cattaraugus County (3,460 sq km). Land use has been described by land use type in the County Land Use Plan (1977). Existing and projected land use is quantified in Table A.3.1-C-1. The following is a brief discussion of each land use category in terms of patterns and trends. The numbers presented in this section are based primarily on the tax rolls of each town and city prepared by the respective assessors, supplemented by previous county planning publications. With the exception of the City of Salamanca, the figures do not include land belonging to the Seneca Nation of Indians (139 sq km).

Agriculture

Approximately 31 percent of Cattaraugus County (101,555 ha) is classified as agricultural by the County Planning Board (1977). This classification includes cropland, land for livestock and products, nurseries and greenhouses, specialty farms and other farmland. It differs slightly from the U.S. Census Bureau's (1982) estimate of 102,205 ha. Most of the County's agricultural land occurs within the crescent shaped area extending from the southwest through the western and northern portions of the County, including the site vicinity. In the southern portion of the county farming is limited to the relatively narrow flat stream valleys. The amount of land in agriculture and the number of farms in the county has declined during the past half-century, as it has nation-wide. However, average farm size and overall agricultural production has been increasing. Marginal farms are reverting back to forest, and it is likely that some cropland may convert to pasture and the production

of hay required by expanding livestock production. Census Bureau (1982) estimates indicate that since 1974 the trend toward fewer and larger farms abated in New York and in Cattaraugus County:

	Cattaraugus County		
	1974	1978	1982
Number of Farms	1,220	1,262	1,211
Average Farm Size (hectares)	87	86	86
Cropland (hectares)	56,467	58,729	54,821
Harvested Cropland (hectares)	37,718	39,892	38,098
Pasture, All Types (hectares)	NA	35,388	NA
Percent of County in Farms	31.1	31.8	29.9

The Census data also indicate that harvested cropland in 1982 exceeded the 1974 amount, and agriculture remains a significant component of the local economy. The unadjusted value of agriculture products sold in Cattaraugus County increased from $40.8 million to 48.4 million between 1978 and 1982. Livestock and poultry-related products lead the way, generating sales of $44.6 million in 1982. The average sales per farm increased from $32,352 to 39,982 during this period, and 137 farms reported sales in excess of $100,000 in 1982, up 88 percent from the number reported in 1978. Nearly 87 percent of farms in Cattaraugus County are privately owned by individuals or families, and most operators (62 percent) consider farming to be their principal occupation. Most of the corporate-owned farms are actually family corporations. A growing source of income for farm operators is the direct sale of farm products to consumers, which created income of $495,000 in 1982, more than double the income generated by this source in 1978.

The U.S. Soil Conservation Service estimates the county contains significantly greater pastureland than is estimated by the township or the Census Bureau, and estimates that total farmland is around 127,530 ha. For the purposes of this report the higher figure will be used.

Milk production in Cattaraugus County increased from 138.7 million kilograms in 1974 to 146 million kilograms in 1980. In 1981, only 9.8 million kilograms was sold for consumption as milk. The primary markets were metropolitan New York-New Jersey (8.8 million kilograms) and the Buffalo area (Niagara Frontier) market (1 million kilograms). The remainder was either consumed on the farm, otherwise consumed locally, or sold to manufacturers of cheese, butter, ice cream, etc. (Ryder, 1982).

Cattaraugus County's milk production in 1980 was 2.94 percent of the state's production (N.Y. State Crop Reporting Service, June 1981). Assuming this same proportion for cheese production indicates the County supplied milk for 9.3 million kg of cheese. The ratio of milk to cheese is 10 to 1; that is, it requires 10 kg of milk to produce 1 kilogram of (cheddar) cheese. Therefore, it is estimated that approximately 42.7 million kg of milk went to cheese production.

The procedures by which milk is collected, transported and processed provide significant mixing and dilution of milk obtained from each farm. Milk is accumulated in bulk transporters from several farms and mixed with other bulk shipments at the processing plants. This standard mixing procedure prevents the output from a farm or herd from being individually recognized in the final milk product.

The Cattaraugus County Land Use Plan recognizes that it is extremely important to make every effort to protect prime agricultural land. This has been done to a certain degree by creating five agricultural districts in the County (totaling 20,124 ha) which enhance the economic viability of agriculture through special (tax) incentives. These districts do not, however, include all the prime land in the County, nor do they encompass only agricultural land. Competition for prime agricultural land, which is also highly desirable for other types of land uses, will undoubtedly intensify.

Recreation

The major recreation area is Allegany State Park (27,513 ha) located 35 km south of the site; other recreation land is scattered throughout the County on medium to large tracts. Camping, skiing, golfing and water-oriented activities are the most popular outdoor recreational activities. Outdoor recreation is one of the fastest growing industries in the County, suggesting that Cattaraugus County, with its diverse physiography, will continue to experience increases in both public and private land devoted to this use.

Residential, Commercial and Industrial Land

Residential land use is scattered, radiating out from the cities, villages and hamlets along town and county roads. Lot sizes are largest in the towns and smallest in the cities. There are no major rural subdivisions.

Residential land development is projected to occur primarily in rural villages, but some cities, particularly Olean, are also projected to experience a large increase in residential units. These urban units will not significantly increase the amount of residential land use, but the density of residential areas will increase.

Business land use is more closely related to the cities, villages and hamlets. Most of this land use is clustered in the central business districts of the urbanized areas, with random business uses distributed along the more heavily traveled and developed roads, particularly at intersections.

New business developments will tend to concentrate in shopping plazas or malls, while existing central business districts are expected to undergo structural improvements in order to maintain a competitive nature.

Industrial land occurs primarily on smaller tracts of land in the cities. There are no rural industrial parks.

Other Lands

Forest lands in Cattaraugus County are irregularly distributed throughout the County, primarily on the steeply sloped lands. Although only 77,720 ha of land are categorized as forest, county planning indicates that an additional 19,684 ha now classified as rural residence could classify as forest. The amount of forest land is expected to increase in the future as unproductive farmlands are abandoned and revert to forest land.

With the exception of the incorporated City of Salamanca, the lands of the Seneca Nation of Indians are not considered in the preceding information. A summary of total land in Cattaraugus County on the Reservations is given below:

Allegany Reservation (includes Allegany Reservoir and City of Salamanca)	12,336 ha
Cattaraugus Reservation	1,490 ha
Oil Springs Reservation	104 ha
	13,930 ha

The overall Cattaraugus County Land Use Plan (1977) envisions major growth around existing urban centers and adjacent to new industrial and recreational resources for the year 2000. These centers will be connected by a pattern of highway and rail facilities based predominantly upon the present location of these routes including the proposed upgrading of Route 219 and the remaining rail lines serving the Regional Rail Reorganization Act of 1973.

Agricultural use is projected to remain much the same as today, with slight increases in the hectares of farms and the hectares of cropland harvested. These increases will be attained primarily by the reclamation of marginal farmland which has become idle.

Recreation sites will relate largely to the major water resources, public parks and seasonal types of recreation utilizing the topography of the area. Recreational activities usually do not require a large, highly skilled labor force and thus could be adapted to many areas of the County. One body of water that contains much recreation potential and will be utilized and exploited to greater degrees by the year 2000 is the Allegheny River, approximately 34 km south of the site. The western terminus in Cattaraugus County, the Allegheny Reservoir, has a master plan implemented by the U.S. Army Corps of Engineers. The eastern section in the County also has a master plan; however, it lacks an implementation sponsor or sponsors. In the next 20 years, the demand on the river is projected to increase such that a plan will be implemented.

Residential land use will emanate outward from communities such as Olean, Allegany, Portville, Salamanca and Franklinville to lands logically serviced by sewer and water lines. Residential uses in the villages, City of Salamanca and especially the City of Olean are projected to increase in density.

Commercial sites are projected to change little. Most commercial sites will occur in the presently occupied commercial centers of the villages, cities and large hamlets. Additional businesses will occur in revitalized areas such as Olean Center Mall in the City of Olean and the Main Street renovation program in the City of Salamanca.

Population increase and land development in the northern part of the County, especially Yorkshire Township, is projected to result from substantial industrial expansion in the Arcade (Wyoming County) area, which is 20 km from the site. Some industry has spilled over into Cattaraugus County. The prime industrial site potential is in the Village of Franklinville, 21 km southeast of the site, a stable village with a variety of small retail stores and manufacturing plants, which provide employment for much of the surrounding nonfarm population. Two potential industrial sites are both on State Route 16, one containing 38.5 ha located in the southern part of the village; the other just north of the village in the southwestern part of the Town of Farmersville on a site containing approximately 36.4 ha.

The County Land Use Plan (1977) recognizes that one important factor that will directly affect this portion of the County is the future of the Western New York Nuclear Service Center (containing the site) in the Town of Ashford. The County believes that this site may be important for County development if nuclear energy once again becomes a prime consideration in the search for additional energy, or it may even support some different type of industry if the direction of the nuclear program changes. However, the County is not planning for a particular scenario at this site.

The essentially rural towns are not expected to change radically by the year 2000. Any new homes in the site vicinity would probably be at low densities. Additional seasonal homes may be built on marginal farmlands. Agriculture should remain strong.

Erie County Land Use

Erie County exhibits a very diverse land development pattern. The Buffalo metropolitan area dominates the northern portion of the County, while the Southtowns near the site are relatively rural with agricultural land uses predominant within 50 km of the site.

Agriculture

Within the Southtowns the Village of Springville is the largest nonagricultural area. Agricultural land uses are distributed throughout the Southtowns, and in the towns east of the Buffalo metropolitan area. The U.S. Census Bureau (1982) estimates that 28 percent of Erie County's land, totaling 77,062 ha, is in farms:

	Erie County		
	1974	1978	1982
Number of Farms	1,487	1,398	1,361
Average Farm Size (ha)	60	59	57
Cropland (ha)	60,318	60,660	55,303
Harvested Cropland (ha)	45,981	47,587	45,150
Pasture, all types (ha)	NA	13,610	NA
Percent of Farms in County	31.3	30	28

The trend toward fewer farms remains evident, although the change is small. Owing to the large amount of land in urban uses, Erie County's recent annual milk production of 113.8 million kg (Ryan, 1982) is less than for neighboring counties. Average production per cow remains about the same as in Cattaraugus County, 5,035 kg.

The value of agricultural products sold in Erie County increased from $58.9 million to $74.3 million between 1978 and 1982. Sales per farm averaged $54,586, up from $42,163 in 1974. Most farm operators consider farming as their principal occupation, although the proportion (54 percent) is not as great as noted for Cattaraugus County. Another difference between the counties is in the growth of the high-income farms. In Erie County, 185 farms reported sales in excess of $100,000 in 1982, up 32 percent from 1978, but less than the increase noted above for Cattaraugus County.

The Erie County legislature and New York State recognize the importance of retaining Erie County farmland and assisting farm owners to complete with nonagricultural land uses, as evidenced by the relatively large agricultural districts which have been designated in the Southtowns and in eastern Erie County. One of the largest districts encompasses more than 10,000 ha located 8-24 km northeast of the site.

Recreation

Recreation land consists primarily of county parks and reforestation projects and is scattered throughout Erie County. These tracts are generally less than 500 ha, and do not greatly influence land development trends in the County.

Residential, Commercial and Industrial Land

The bulk of urban land uses in Erie County are concentrated within the approximately 700 sq km of the Buffalo metropolitan area, along the shore of Lake Erie, and in Springville, East Aurora, Alden and Akron.

Existing industrial sites are located along the Niagara River and Lake Erie, the railroads in the towns of Cheektowaga, Lancaster, West Seneca, Elma, Tonawanda and the City of Buffalo. New industrial sites have been proposed for the Southtowns adjacent to major transportation corridors, but these remain essentially undeveloped. The long-range industrial development plan for the County (Erie County Division of Planning, 1974) indicates an airport to be located northwest of Springville as demand for service is warranted.

The Erie County Planning Department (1981) does not anticipate any significant change in the County's demographic trend in the next decade. The population of the Buffalo area will continue to decline as residents migrate to other towns in the County and elsewhere. Any growth in the Southtowns will occur as a result of this continuing trend. It is not possible to predict which towns

will absorb this population; however, if the Southtowns do not develop an overall economic development/marketing strategy and comprehensive plan, then the more aggressive northern suburban communities stand a good chance of further developing, while the economically weaker communities will change relatively little.

REFERENCES FOR SECTION SUPPLEMENT A.3.1-C

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TABLE A.3.1-C-1

CATTARAUGUS COUNTY LAND USE*

Land Use Category	Existing 1977 Hectares	Existing 1977 Percent of County	Projected 2000 Hectares	Projected 2000 Percent of County
Agriculture	101,557	30.57	108,411	32.64
Recreation	4,234	1.27	5,866	1.92
Residential	68,726	20.69	74,380	22.40
Revised**	32,811	(9.87)	41,321	(12.44)
Commercial	2,066	.62	2,169	.65
Industrial	7,064	2.13	7,113	2.14
Community	8,180	2.46	8,343	2.51
Forest Land	77,731	23.40	78,107	23.52
Water and R/W	8,400	2.53	8,788	2.65
Vacant Land	54,267	16.33	38,916	11.57
	322,222	100.00	373,414	100.00

*This area does not include land owned by the Seneca Nation, except for the City of Salamanca.

**Excludes rural residences "with acreage" (88,707.7 acres), which is not used for residential purposes.

Source: Cattaraugus County Planning Board, 1977.

-COM005238:160H

SUPPLEMENT A.3.3-A

JOINT WIND SPEED - WIND DIRECTION FREQUENCY DISTRIBUTION OF WIND DIRECTION PERSISTENCE

TABLE A.3.3-A-1

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: JANUARY 1, 1973 0100 CST - DECEMBER 31, 1977 2400 CST

DATA SOURCE: BUFFALO SURFACE DATA
TABLE GENERATED: 2-MAY-84 12:28:12

BUFFALO, NEW YORK

WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-23

FREQUENCY IN PERCENT

WIND DIR	INTERVALS OF WIND SPEED IN MPS 0.0- 1.5	1.5- 3.0	3.0- 5.0	5.0- 7.5	7.5-10.0	10.0-12.5	12.5-15.0	15.0-17.5	>17.5	TOTAL	MEAN WIND SPEED
NNE	0.23	0.67	1.18	0.59	0.08	0.00	0.00	0.00	0.00	2.75	3.8
NE	0.29	0.92	1.38	0.88	0.23	0.03	0.00	0.00	0.00	3.73	4.1
ENE	0.25	0.63	1.41	1.32	0.50	0.09	0.01	0.00	0.00	4.21	4.9
E	0.20	0.82	1.72	1.19	0.39	0.04	0.00	0.00	0.00	4.35	4.5
ESE	0.14	0.63	1.40	0.35	0.03	0.01	0.00	0.00	0.00	2.55	3.6
SE	0.10	0.41	1.51	0.44	0.05	0.00	0.00	0.00	0.00	2.52	3.9
SSE	0.10	0.91	2.66	0.69	0.11	0.03	0.01	0.00	0.00	4.52	3.9
S	0.35	2.11	5.23	2.38	0.90	0.18	0.01	0.00	0.00	11.16	4.4
SSW	0.20	0.77	2.98	2.75	1.23	0.25	0.04	0.01	0.00	8.23	5.3
SW	0.17	0.74	3.52	5.09	2.99	0.98	0.40	0.10	0.03	14.02	6.5
WSW	0.16	0.80	2.74	4.44	3.29	1.43	0.37	0.10	0.02	13.36	6.8
W	0.18	0.71	2.65	3.86	2.20	0.59	0.12	0.02	0.00	10.32	6.1
WNW	0.09	0.35	1.42	1.57	0.77	0.15	0.02	0.00	0.00	4.36	5.6
NW	0.10	0.46	1.24	1.50	0.59	0.12	0.01	0.00	0.00	4.02	5.3
NNW	0.12	0.52	1.29	1.31	0.49	0.05	0.00	0.00	0.00	3.78	5.0
N	0.30	1.04	2.00	1.10	0.19	0.01	0.00	0.00	0.00	4.64	4.0
CALM	1.47									1.47	
TOTAL	4.45	12.48	34.34	29.46	14.04	3.97	0.99	0.24	0.05	100.00	5.2

NUMBER OF VALID OBSERVATIONS 43824 100.00 PCT.
NUMBER OF INVALID OBSERVATIONS 0 0.00 PCT.
TOTAL NUMBER OF OBSERVATIONS 43824 100.00 PCT.

TABLE A.3.3-A-2

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: JANUARY 1, 1973 0100 CST - DECEMBER 31, 1977 2400 CST

DATA SOURCE: BUFFALO SURFACE DATA
TABLE GENERATED: 2-MAY-84 14:18:53

BUFFALO, NEW YORK
(WINTER DATA : DECEMBER-FEBRUARY)
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-23

FREQUENCY IN PERCENT

WIND DIR	INTERVALS OF WIND SPEED IN MPS										MEAN WIND
	0.0- 1.5	1.5- 3.0	3.0- 5.0	5.0- 7.5	7.5-10.0	10.0-12.5	12.5-15.0	15.0-17.5	>17.5	TOTAL	SPEED
NNE	0.11	0.36	0.89	0.55	0.11	0.02	0.00	0.00	0.00	2.03	4.3
NE	0.23	0.81	1.48	1.02	0.34	0.07	0.00	0.00	0.00	3.95	4.4
ENE	0.27	0.60	1.52	1.90	0.72	0.15	0.04	0.00	0.00	5.20	5.3
E	0.13	0.79	1.60	1.42	0.53	0.03	0.00	0.00	0.00	4.49	4.8
ESE	0.10	0.45	1.62	0.40	0.06	0.01	0.00	0.00	0.00	2.63	3.8
SE	0.07	0.40	1.56	0.35	0.07	0.00	0.01	0.00	0.00	2.47	4.0
SSE	0.06	0.61	2.04	0.60	0.14	0.09	0.05	0.00	0.00	3.59	4.3
S	0.29	1.02	3.39	2.71	1.60	0.33	0.02	0.01	0.00	9.36	5.3
SSW	0.18	0.44	1.56	2.48	2.05	0.41	0.10	0.02	0.00	7.23	6.4
SW	0.15	0.39	1.66	3.21	3.26	1.70	0.95	0.34	0.09	11.75	8.1
WSW	0.15	0.42	2.32	4.10	3.92	2.32	0.91	0.26	0.05	14.44	7.8
W	0.13	0.56	3.12	5.77	4.47	1.31	0.35	0.06	0.00	15.78	6.9
WNW	0.11	0.29	1.41	1.99	1.11	0.17	0.02	0.00	0.00	5.09	5.9
NW	0.13	0.31	1.13	1.49	0.55	0.14	0.00	0.01	0.00	3.75	5.5
NNW	0.09	0.30	0.91	1.15	0.46	0.06	0.01	0.00	0.00	2.97	5.3
N	0.26	0.51	1.74	1.15	0.25	0.02	0.00	0.00	0.00	3.92	4.5
CALM	1.34									1.34	
TOTAL	3.80	8.25	27.95	30.27	19.63	6.82	2.46	0.69	0.14	100.00	6.1

NUMBER OF VALID OBSERVATIONS 10824 100.00 PCT.
NUMBER OF INVALID OBSERVATIONS 0 0.00 PCT.
TOTAL NUMBER OF OBSERVATIONS 10824 100.00 PCT.

TABLE A.3.3-A-3

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: MARCH 1, 1973 0100 CST - MAY 31, 1977 2400 CST

DATA SOURCE: BUFFALO SURFACE DATA
TABLE GENERATED: 2-MAY-84 15:57:59

BUFFALO, NEW YORK
(SPRING DATA : MARCH-MAY)
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-23

FREQUENCY IN PERCENT

WIND DIR	INTERVALS OF WIND SPEED IN MPS 0.0- 1.5	1.5- 3.0	3.0- 5.0	5.0- 7.5	7.5-10.0	10.0-12.5	12.5-15.0	15.0-17.5	>17.5	TOTAL	MEAN WIND SPEED
NNE	0.23	0.57	1.20	0.58	0.14	0.00	0.00	0.00	0.00	2.72	4.0
NE	0.34	0.84	1.33	1.08	0.41	0.06	0.00	0.00	0.00	4.07	4.5
ENE	0.23	0.55	1.43	1.60	1.03	0.22	0.00	0.00	0.00	5.06	5.5
E	0.21	0.65	1.89	1.56	0.69	0.12	0.00	0.00	0.00	5.12	5.0
ESE	0.10	0.53	1.37	0.55	0.04	0.02	0.00	0.00	0.00	2.62	4.0
SE	0.09	0.34	1.47	0.72	0.07	0.02	0.00	0.00	0.00	2.72	4.3
SSE	0.08	0.45	1.88	1.00	0.16	0.02	0.00	0.00	0.00	3.60	4.3
S	0.34	1.39	4.00	1.87	0.83	0.17	0.02	0.00	0.00	8.61	4.5
SSW	0.22	0.75	3.50	2.45	0.98	0.31	0.02	0.01	0.00	8.23	5.1
SW	0.11	0.79	3.71	5.79	3.09	1.09	0.34	0.05	0.00	14.97	6.4
WSW	0.16	0.62	2.48	4.60	3.85	1.70	0.32	0.10	0.00	13.83	7.1
W	0.17	0.48	1.83	3.36	1.79	0.57	0.05	0.02	0.00	8.29	6.3
WNW	0.10	0.32	0.95	1.71	1.23	0.32	0.04	0.00	0.00	4.66	6.4
NW	0.07	0.36	1.20	2.19	1.20	0.27	0.04	0.00	0.00	5.34	6.1
NNW	0.09	0.50	1.26	1.58	0.77	0.10	0.00	0.00	0.00	4.29	5.5
N	0.20	0.91	1.80	1.29	0.32	0.02	0.00	0.00	0.00	4.54	4.3
CALM	1.33									1.33	
TOTAL	4.07	10.06	31.31	31.94	16.60	5.00	0.83	0.18	0.00	100.00	5.5

NUMBER OF VALID OBSERVATIONS 11040 100.00 PCT.
NUMBER OF INVALID OBSERVATIONS 0 0.00 PCT.
TOTAL NUMBER OF OBSERVATIONS 11040 100.00 PCT.

TABLE A.3.3-A-4

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: JUNE 1, 1973 0100 CST - AUGUST 31, 1977 2400 CST

DATA SOURCE: BUFFALO SURFACE DATA
TABLE GENERATED: 2-MAY-84 16:14:10

BUFFALO, NEW YORK
(SUMMER DATA : JUNE-AUGUST)
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-23

FREQUENCY IN PERCENT

WIND DIR	INTERVALS OF WIND SPEED IN MPS 0.0- 1.5	1.5- 3.0	3.0- 5.0	5.0- 7.5	7.5-10.0	10.0-12.5	12.5-15.0	15.0-17.5	>17.5	TOTAL	MEAN WIND SPEED
NNE	0.32	0.82	1.33	0.72	0.03	0.00	0.00	0.00	0.00	3.22	3.7
NE	0.28	1.03	1.36	0.80	0.05	0.00	0.00	0.00	0.00	3.51	3.7
ENE	0.20	0.69	1.29	0.64	0.05	0.00	0.00	0.00	0.00	2.86	3.8
E	0.25	0.98	1.34	0.44	0.05	0.01	0.00	0.00	0.00	3.07	3.5
ESE	0.20	0.76	1.21	0.17	0.00	0.00	0.00	0.00	0.00	2.35	3.2
SE	0.15	0.50	1.48	0.28	0.02	0.00	0.00	0.00	0.00	2.43	3.5
SSE	0.16	1.69	3.14	0.47	0.07	0.00	0.00	0.00	0.00	5.54	3.4
S	0.43	3.66	7.64	2.00	0.26	0.01	0.00	0.00	0.00	14.01	3.7
SSW	0.21	1.29	4.37	3.02	0.50	0.08	0.00	0.00	0.00	9.46	4.6
SW	0.23	1.10	6.11	7.80	3.23	0.50	0.09	0.01	0.00	19.07	5.7
WSW	0.14	1.11	3.54	5.43	2.84	0.77	0.14	0.04	0.01	14.03	6.1
W	0.27	0.82	1.99	1.66	0.43	0.07	0.01	0.01	0.00	5.25	4.6
WNW	0.05	0.40	1.17	0.64	0.07	0.01	0.00	0.00	0.00	2.34	4.2
NW	0.07	0.53	1.10	0.67	0.14	0.00	0.00	0.00	0.00	2.51	4.2
NNW	0.15	0.65	1.32	0.85	0.31	0.02	0.00	0.00	0.00	3.31	4.4
N	0.36	1.42	2.20	1.05	0.12	0.00	0.00	0.00	0.00	5.15	3.7
CALM	1.89									1.89	
TOTAL	5.37	17.45	40.60	26.65	8.16	1.47	0.24	0.05	0.01	100.00	4.5

NUMBER OF VALID OBSERVATIONS 11040 100.00 PCT.
NUMBER OF INVALID OBSERVATIONS 0 0.00 PCT.
TOTAL NUMBER OF OBSERVATIONS 11040 100.00 PCT.

TABLE A.3.3-A-5

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: SEPTEMBER 1, 1973 0100 CST - NOVEMBER 30, 1977 2400 CST

DATA SOURCE: BUFFALO SURFACE DATA
TABLE GENERATED: 2-MAY-84 16:36:56

BUFFALO, NEW YORK
(FALL DATA . SEPTEMBER-NOVEMBER)
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-23

FREQUENCY IN PERCENT

WIND DIR	INTERVALS OF WIND SPEED IN MPS										
	0.0- 1.5	1.5- 3.0	3.0- 5.0	5.0- 7.5	7.5-10.0	10.0-12.5	12.5-15.0	15.0-17.5	>17.5	TOTAL	MEAN WIND SPEED
NNE	0.25	0.92	1.32	0.52	0.03	0.00	0.00	0.00	0.00	3.03	3.6
NE	0.30	0.99	1.34	0.62	0.14	0.00	0.00	0.00	0.00	3.39	3.8
ENE	0.31	0.66	1.41	1.15	0.18	0.01	0.00	0.00	0.00	3.73	4.3
E	0.22	0.86	2.04	1.34	0.28	0.00	0.00	0.00	0.00	4.74	4.3
ESE	0.15	0.77	1.39	0.26	0.05	0.00	0.00	0.00	0.00	2.61	3.5
SE	0.10	0.39	1.53	0.39	0.04	0.00	0.00	0.00	0.00	2.45	3.9
SSE	0.11	0.89	3.57	0.71	0.06	0.01	0.00	0.00	0.00	5.35	3.8
S	0.36	2.34	5.87	2.97	0.91	0.19	0.01	0.00	0.00	12.65	4.4
SSW	0.20	0.60	2.47	3.07	1.40	0.19	0.04	0.00	0.00	7.98	5.6
SW	0.19	0.70	2.55	3.52	2.37	0.66	0.22	0.00	0.01	10.22	6.2
WSW	0.18	1.04	2.61	3.59	2.56	0.94	0.13	0.03	0.03	11.12	6.3
W	0.14	0.96	3.66	4.71	2.15	0.41	0.06	0.00	0.00	12.10	5.7
WNW	0.12	0.38	2.15	1.94	0.68	0.10	0.01	0.00	0.00	5.38	5.2
NW	0.11	0.65	1.55	1.64	0.47	0.05	0.00	0.00	0.00	4.47	4.9
NNW	0.13	0.63	1.68	1.65	0.43	0.04	0.00	0.00	0.00	4.56	4.9
N	0.38	1.30	2.24	0.92	0.08	0.01	0.00	0.00	0.00	4.93	3.7
CALM	1.30									1.30	
TOTAL	4.54	14.09	37.40	28.98	11.83	2.62	0.47	0.03	0.04	100.00	4.9

NUMBER OF VALID OBSERVATIONS 10920 100.00 PCT.
NUMBER OF INVALID OBSERVATIONS 0 0.00 PCT.
TOTAL NUMBER OF OBSERVATIONS 10920 100.00 PCT.

TABLE A.2.3-A-6 (1 of 2)

FREQUENCY DISTRIBUTION OF PERSISTENCE
PERIOD: 73010101 TO 77123124
SITE: BUFFALO SURFACE DATA
SENSOR HEIGHT: 10 M
SECTOR WIDTH: 22.5

WEST VALEY NUCLEAR SERVICES
JOB NO: 10805-137-23
GENERATED: 2-MAY 84
PAGE 1

DIRECTION (DEGREES)	1- 2 HRS NUM*	1- 2 HRS PCT*	3- 5 HRS NUM	3- 5 HRS PCT	6- 7 HRS NUM	6- 7 HRS PCT	8-10 HRS NUM	8-10 HRS PCT	11-15 HRS NUM	11-15 HRS PCT	16-20 HRS NUM	16-20 HRS PCT	>20 HRS NUM	>20 HRS PCT	MAXIMUN DURATION (HRS)	MEAN SPEED FOR MAXIMUM (MPS)	MEAN SPEED TOTAL (MPS)
5.0	70	0.2	80	0.2	15	0.0	8	0.0	3	0.0	0	0.0	0	0.0	13	4.2	3.7
10.0	234	0.5	125	0.3	26	0.1	25	0.1	4	0.0	0	0.0	0	0.0	11	3.7	3.7
15.0	46	0.1	51	0.1	4	0.0	3	0.0	0	0.0	0	0.0	0	0.0	10	3.8	3.8
20.0	243	0.6	111	0.3	32	0.1	14	0.0	7	0.0	5	0.0	0	0.0	20	4.3	4.2
25.0	70	0.2	50	0.1	5	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	6.7	4.2
30.0	270	0.6	141	0.3	42	0.1	29	0.1	26	0.1	4	0.0	0	0.0	18	5.7	4.5
35.0	65	0.1	66	0.2	4	0.0	5	0.0	2	0.0	0	0.0	0	0.0	12	4.1	4.2
40.0	272	0.6	176	0.4	49	0.1	41	0.1	23	0.1	8	0.0	0	0.0	20	6.0	4.6
45.0	67	0.2	94	0.2	15	0.0	4	0.0	3	0.0	0	0.0	0	0.0	13	6.8	4.7
50.0	299	0.7	215	0.5	74	0.2	66	0.2	53	0.1	20	0.0	17	0.0	33	7.3	5.3
55.0	72	0.2	60	0.1	10	0.0	7	0.0	5	0.0	5	0.0	3	0.0	23	5.5	4.4
60.0	345	0.8	192	0.4	70	0.2	70	0.2	68	0.2	30	0.1	18	0.0	28	9.9	6.5
65.0	70	0.2	89	0.2	15	0.0	8	0.0	1	0.0	0	0.0	0	0.0	11	8.6	5.4
70.0	264	0.6	161	0.4	64	0.1	62	0.2	61	0.1	17	0.0	4	0.0	24	7.7	5.9
75.0	57	0.1	76	[illegible]	11	0.0	4	0.0	0	0.0	0	0.0	0	0.0	10	7.2	5.1
80.0	262	0.6	202	0.5	83	0.2	59	0.1	50	0.1	20	0.0	11	0.0	29	6.8	5.8
85.0	73	0.2	57	0.1	7	0.0	2	0.0	0	0.0	0	0.0	0	0.0	8	5.3	4.4
90.0	321	0.7	146	0.3	34	0.1	25	0.1	16	0.0	3	0.0	0	0.0	18	7.5	5.3
95.0	57	0.1	47	0.1	9	0.0	6	0.0	0	0.0	0	0.0	0	0.0	10	8.2	5.4
100.0	224	0.5	109	0.2	15	0.0	6	0.0	0	0.0	0	0.0	0	0.0	10	6.3	4.1
105.0	43	0.1	44	0.1	6	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	4.6	4.1
110.0	273	0.6	99	0.2	14	0.0	5	0.0	0	0.0	0	0.0	0	0.0	10	3.3	3.8
115.0	53	0.1	51	0.1	7	0.0	4	0.0	1	0.0	0	0.0	0	0.0	11	4.4	3.6
120.0	306	0.7	129	0.3	24	0.1	8	0.0	0	0.0	0	0.0	0	0.0	10	3.9	3.7
125.0	55	0.1	59	0.1	13	0.0	6	0.0	1	0.0	0	0.0	0	0.0	11	3.6	4.0
130.0	226	0.5	112	0.3	38	0.1	20	0.0	6	0.0	1	0.0	0	0.0	16	4.7	4.2
135.0	52	0.1	42	0.1	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	6.5	4.5
140.0	241	0.5	160	0.4	43	0.1	20	0.0	7	0.0	0	0.0	0	0.0	14	4.2	4.1
145.0	68	0.2	75	0.2	10	0.0	4	0.0	0	0.0	0	0.0	0	0.0	9	3.9	3.9
150.0	281	0.6	214	0.5	54	0.1	31	0.1	12	0.0	0	0.0	0	0.0	12	7.9	4.3
155.0	88	0.2	94	0.2	16	0.0	3	0.0	0	0.0	0	0.0	0	0.0	9	3.8	3.8
160.0	382	0.9	303	0.7	87	0.2	65	0.1	23	0.1	2	0.0	0	0.0	17	8.0	4.3
165.0	92	0.2	113	0.3	25	0.1	11	0.0	3	0.0	0	0.0	0	0.0	13	3.6	3.8
170.0	444	1.0	371	0.8	150	0.3	114	0.3	43	0.1	6	0.0	0	0.0	19	8.0	4.2
175.0	143	0.3	188	0.4	31	0.1	15	0.0	3	0.0	0	0.0	0	0.0	12	8.8	4.4
180.0	583	1.3	366	0.8	117	0.3	89	0.2	44	0.1	6	0.0	39	0.1	59	5.7	4.8
185.0	151	0.3	196	0.4	52	0.1	33	0.1	11	0.0	5	0.0	9	0.0	29	6.5	5.3
190.0	516	1.2	455	1.0	165	0.4	129	0.3	58	0.1	14	0.0	7	0.0	27	8.8	5.3
195.0	131	0.3	171	0.4	33	0.1	15	0.0	7	0.0	0	0.0	0	0.0	13	5.6	5.7
200.0	570	1.3	420	1.0	141	0.3	121	0.3	83	0.2	26	0.1	14	0.0	26	8.0	6.4

*NUM - NUMBER OF OCCURRENCES, PCT - PERCENT OF VALID OBSERVATIONS

TABLE A.3.3-A[illegible] (2 of 2)

FREQUENCY DISTRIBUTION OF PERSISTENCE
PERIOD: 73010101 TO 77123124
SITE: BUFFALO SURFACE DATA
SENSOR HEIGHT: 10 M
SECTOR WIDTH: 22.5

WEST VALEY NUCLEAR SERVICES
JOB NO. 10805-139-23
GENERATED. 2-MAY-84
PAGE 2

DIRECTION	1- 2 HRS		3- 5 HRS		6- 7 HRS		8-10 HRS		11-15 HRS		16-20 HRS		>20 HRS		MAXIMUN DURATION	MEAN SPEED FOR MAXIMUM	MEAN SPEED TOTAL
(DEGREES)	NUM*	PCT*	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	(HRS)	(MPS)	(MPS)
205.0	160	0.4	174	0.4	25	0.1	21	0.0	7	0.0	0	0.0	0	0.0	13	6.5	6.0
210.0	613	1.4	461	1.1	148	0.3	111	0.3	73	0.2	18	0.0	19	0.0	38	7.3	6.0
215.0	156	0.4	190	0.4	25	0.1	7	0.0	3	0.0	0	0.0	0	0.0	13	5.2	5.6
220.0	595	1.4	662	1.5	273	0.6	288	0.7	180	0.4	63	0.1	71	0.2	36	8.0	6.8
225.0	179	0.4	295	0.7	84	0.2	59	0.1	23	0.1	7	0.0	0	0.0	20	12.4	6.7
230.0	725	1.7	740	1.7	419	1.0	389	0.9	303	0.7	154	0.4	106	0.2	44	13.0	7.2
235.0	191	0.4	393	0.9	124	0.3	90	0.2	41	0.1	4	0.0	0	0.0	19	7.8	6.9
240.0	701	1.6	721	1.6	363	0.8	378	0.9	289	0.7	127	0.3	121	0.3	43	6.2	7.5
245.0	190	0.4	351	0.8	81	0.2	42	0.1	24	0.1	2	0.0	0	0.0	16	11.4	6.6
250.0	568	1.3	515	1.2	244	0.6	242	0.6	157	0.4	55	0.1	46	0.1	38	9.3	7.9
255.0	141	0.3	177	0.4	31	0.1	14	0.0	2	0.0	0	0.0	0	0.0	12	8.4	6.6
260.0	548	1.3	476	1.1	206	0.5	193	0.4	152	0.3	66	0.2	27	0.1	27	11.8	7.1
265.0	135	0.3	206	0.5	54	0.1	31	0.1	14	0.0	0	0.0	0	0.0	14	5.5	6.2
270.0	483	1.1	326	0.7	133	0.3	128	0.3	103	0.2	30	0.1	21	0.0	31	8.2	6.7
275.0	87	0.2	109	0.2	16	0.0	7	0.0	0	0.0	0	0.0	0	0.0	10	7.8	6.2
280.0	390	0.9	302	0.7	113	0.3	78	0.2	56	0.1	15	0.0	7	0.0	24	7.5	6.6
285.0	93	0.2	93	0.2	14	0.0	8	0.0	0	0.0	0	0.0	0	0.0	10	8.6	5.8
290.0	369	0.8	222	0.5	65	0.1	47	0.1	14	0.0	0	0.0	0	0.0	14	8.3	6.4
295.0	89	0.2	94	0.2	16	0.0	6	0.0	1	0.0	0	0.0	0	0.0	11	8.5	6.1
300.0	359	0.8	215	0.5	68	0.2	42	0.1	34	0.1	5	0.0	0	0.0	18	7.0	6.1
305.0	85	0.2	91	0.2	12	0.0	7	0.0	0	0.0	0	0.0	0	0.0	10	5.2	5.6
310.0	357	0.8	206	0.5	68	0.2	42	0.1	22	0.1	9	0.0	0	0.0	20	11.4	6.4
315.0	82	0.2	80	0.2	16	0.0	3	0.0	0	0.0	0	0.0	0	0.0	9	7.3	5.3
320.0	335	0.8	198	0.5	79	0.2	53	0.1	31	0.1	5	0.0	14	0.0	34	6.6	5.9
325.0	65	0.1	75	0.2	10	0.0	5	0.0	1	0.0	0	0.0	0	0.0	11	5.3	4.6
330.0	272	0.6	198	0.5	82	0.2	61	0.1	19	0.0	3	0.0	0	0.0	17	7.2	5.5
335.0	77	0.2	80	0.2	13	0.0	4	0.0	0	0.0	0	0.0	0	0.0	9	5.6	5.1
340.0	251	0.6	180	0.4	66	0.2	55	0.1	16	0.0	5	0.0	3	0.0	23	6.4	5.3
345.0	58	0.1	67	0.2	16	0.0	5	0.0	1	0.0	0	0.0	0	0.0	11	7.0	4.9
350.0	256	0.6	210	0.5	86	0.2	80	0.2	38	0.1	6	0.0	23	0.1	43	5.4	4.8
355.0	77	0.2	104	0.2	15	0.0	5	0.0	0	0.0	0	0.0	0	0.0	10	3.3	3.8
360.0	292	0.7	114	0.3	41	0.1	31	0.1	18	0.0	8	0.0	0	0.0	20	4.2	4.3
CALM	535	1.2	88	0.2	14	0.0	6	0.0	0	0.0	0	0.0	0	0.0	10	0.0	0.1
TOTAL	17593	40.1	14323	32.7	4631	10.6	3697	8.4	2246	5.1	754	1.7	580	1.3			
MEAN SPEED	4.2		5.3		6.0		6.6		7.3		7.8		7.9				6.1

TOTAL VALID HOURS: 43824
TOTAL INVALID HOURS: 0

*NUM - NUMBER OF OCCURRENCES. PCT - PERCENT OF VALID. OBSERVATIONS

TABLE A.3.3-A-7 (1 of 2)

FREQUENCY DISTRIBUTION OF PERSISTENCE
PERIOD: 73010101 TO 77123124
SITE: BUFFALO SURFACE DATA (WINTER DATA : DECEMBER - FEBRUARY)
SENSOR HEIGHT: 10 M
SECTOR WIDTH: 22.5

WEST VALEY NUCLEAR SERVICES
JOB NO: 10805-139-23
GENERATED: 2-MAY-84
PAGE 1

DIRECTION	1- 2 HRS		3- 5 HRS		6- 7 HRS		8-10 HRS		11-15 HRS		16-20 HRS		>20 HRS		MAXIMUN DURATION	MEAN SPEED FOR MAXIMUM	MEAN SPEED TOTAL
(DEGREES)	NUM*	PCT*	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	(HRS)	(MPS)	(MPS)
5.0	11	0.1	18	0.2	4	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	3.7	3.9
10.0	37	0.3	19	0.2	6	0.1	4	0.0	1	0.0	0	0.0	0	0.0	11	5.4	4.5
15.0	13	0.1	21	0.2	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	3.0	4.0
20.0	37	0.3	24	0.2	7	0.1	5	0.0	0	0.0	0	0.0	0	0.0	9	6.2	4.3
25.0	7	0.1	14	0.1	3	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	6.7	5.4
30.0	36	0.3	31	0.3	7	0.1	5	0.0	5	0.0	1	0.0	0	0.0	16	6.6	5.4
35.0	20	0.2	20	0.2	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	8.3	4.2
40.0	57	0.5	37	0.3	18	0.2	17	0.2	13	0.1	3	0.0	0	0.0	18	5.5	4.7
45.0	16	0.1	29	0.3	5	0.0	3	0.0	3	0.0	0	0.0	0	0.0	13	6.8	5.9
50.0	52	0.5	71	0.7	26	0.2	26	0.2	25	0.2	7	0.1	0	0.0	19	6.1	5.1
55.0	20	0.2	14	0.1	2	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	4.2	4.0
60.0	75	0.7	59	0.5	22	0.2	25	0.2	23	0.2	14	0.1	9	0.1	28	9.9	7.2
65.0	18	0.2	31	0.3	8	0.1	1	0.0	0	0.0	0	0.0	0	0.0	8	7.2	5.1
70.0	56	0.5	57	0.5	24	0.2	36	0.3	27	0.2	7	0.1	4	0.0	24	7.7	6.0
75.0	18	0.2	23	0.2	7	0.1	4	0.0	0	0.0	0	0.0	0	0.0	10	7.2	5.9
80.0	55	0.5	52	0.5	27	0.2	15	0.1	21	0.2	6	0.1	0	0.0	19	7.1	6.1
85.0	17	0.2	25	0.2	2	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	5.3	4.4
90.0	59	0.5	41	0.4	12	0.1	9	0.1	4	0.0	0	0.0	0	0.0	12	6.9	5.4
95.0	10	0.1	10	0.1	2	0.0	3	0.0	0	0.0	0	0.0	0	0.0	10	8.2	7.0
100.0	46	0.4	31	0.3	5	0.0	2	0.0	0	0.0	0	0.0	0	0.0	8	7.3	4.1
105.0	10	0.1	17	0.2	3	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	5.8	4.4
110.0	57	0.5	28	0.3	3	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	3.3	4.1
115.0	15	0.1	17	0.2	4	0.0	4	0.0	1	0.0	0	0.0	0	0.0	11	4.4	4.2
120.0	65	0.6	45	0.4	6	0.1	1	0.0	0	0.0	0	0.0	0	0.0	8	3.6	3.8
125.0	11	0.1	15	0.1	2	0.0	3	0.0	1	0.0	0	0.0	0	0.0	11	3.6	3.5
130.0	52	0.5	34	0.3	11	0.1	4	0.0	5	0.0	1	0.0	0	0.0	16	4.7	4.3
135.0	13	0.1	11	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	5.2	4.5
140.0	45	0.4	34	0.3	11	0.1	6	0.1	1	0.0	0	0.0	0	0.0	11	3.3	4.1
145.0	19	0.2	13	0.1	2	0.0	2	0.0	0	0.0	0	0.0	0	0.0	9	3.9	4.1
150.0	58	0.5	55	0.5	16	0.1	7	0.1	4	0.0	0	0.0	0	0.0	12	7.9	4.7
155.0	17	0.2	18	0.2	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	3.4	3.8
160.0	78	0.7	55	0.5	15	0.1	12	0.1	11	0.1	2	0.0	0	0.0	17	8.0	3.9
165.0	17	0.2	25	0.2	4	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	3.1	4.3
170.0	72	0.7	54	0.5	27	0.2	18	0.2	9	0.1	0	0.0	0	0.0	14	6.6	4.8
175.0	23	0.2	28	0.3	5	0.0	3	0.0	1	0.0	0	0.0	0	0.0	11	3.0	5.4
180.0	93	0.9	76	0.7	23	0.2	19	0.2	16	0.1	6	0.1	39	0.4	59	5.7	5.4
185.0	25	0.2	37	0.3	21	0.2	11	0.1	10	0.1	5	0.0	9	0.1	29	6.5	6.6
190.0	73	0.7	86	0.8	28	0.3	26	0.2	28	0.3	7	0.1	7	0.1	27	8.8	6.7
195.0	20	0.2	26	0.2	2	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	4.0	5.8
200.0	102	0.9	100	0.9	51	0.5	41	0.4	38	0.4	11	0.1	6	0.1	26	8.0	7.3

*NUM - NUMBER OF OCCURRENCES. PCT - PERCENT OF VALID OBSERVATIONS

TABLE A.3.3-A-[illegible] (2 of 2)

FREQUENCY DISTRIBUTION OF PERSISTENCE
PERIOD: 73010101 TO 77123124
SITE: BUFFALO SURFACE DATA (WINTER DATA : DECEMBER - FEBRUARY)
SENSOR HEIGHT: 10 M
SECTOR WIDTH: 22.5

WEST VALEY NUCLEAR SERVICES
JOB NO: 10805-139-23
GENERATED: 2-MAY-84
PAGE 2

DIRECTION (DEGREES)	1- 2 HRS NUM*	1- 2 HRS PCT*	3- 5 HRS NUM	3- 5 HRS PCT	6- 7 HRS NUM	6- 7 HRS PCT	8-10 HRS NUM	8-10 HRS PCT	11-15 HRS NUM	11-15 HRS PCT	16-20 HRS NUM	16-20 HRS PCT	>20 HRS NUM	>20 HRS PCT	MAXIMUN DURATION (HRS)	MEAN SPEED FOR MAXIMUM (MPS)	MEAN SPEED TOTAL (MPS)
205.0	34	0.3	48	0.4	7	0.1	7	0.1	2	0.0	0	0.0	0	0.0	12	7.6	7.4
210.0	107	1.0	79	0.7	35	0.3	26	0.2	18	0.2	3	0.0	13	0.1	38	7.3	7.4
215.0	25	0.2	34	0.3	7	0.1	3	0.0	0	0.0	0	0.0	0	0.0	9	3.8	6.3
220.0	94	0.9	134	1.2	59	0.5	68	0.6	59	0.5	21	0.2	34	0.3	35	8.0	8.7
225.0	35	0.3	71	0.7	27	0.2	23	0.2	13	0.1	5	0.0	0	0.0	20	12.4	8.7
230.0	107	1.0	122	1.1	76	0.7	73	0.7	74	0.7	46	0.4	29	0.3	44	13.0	9.0
235.0	32	0.3	73	0.7	14	0.1	3	0.0	0	0.0	0	0.0	0	0.0	9	6.9	7.8
240.0	137	1.3	162	1.5	90	0.8	119	1.1	111	1.0	51	0.5	32	0.3	30	9.2	9.0
245.0	42	0.4	83	0.8	16	0.1	10	0.1	10	0.1	2	0.0	0	0.0	16	11.4	7.5
250.0	121	1.1	156	1.4	75	0.7	86	0.8	61	0.6	21	0.2	14	0.1	27	11.7	8.6
255.0	37	0.3	54	0.5	10	0.1	4	0.0	0	0.0	0	0.0	0	0.0	9	8.7	6.9
260.0	136	1.3	182	1.7	103	1.0	114	1.1	101	0.9	43	0.4	18	0.2	27	11.8	7.6
265.0	53	0.5	104	1.0	32	0.3	17	0.2	8	0.1	0	0.0	0	0.0	13	8.0	6.7
270.0	124	1.1	134	1.2	66	0.6	71	0.7	62	0.6	21	0.2	16	0.1	31	8.2	7.2
275.0	23	0.2	36	0.3	3	0.0	3	0.0	0	0.0	0	0.0	0	0.0	10	7.8	7.1
280.0	119	1.1	90	0.8	43	0.4	32	0.3	24	0.2	6	0.1	4	0.0	24	7.5	7.4
285.0	35	0.3	32	0.3	5	0.0	3	0.0	0	0.0	0	0.0	0	0.0	9	5.4	5.6
290.0	107	1.0	66	0.6	23	0.2	15	0.1	1	0.0	0	0.0	0	0.0	11	9.3	6.4
295.0	22	0.2	28	0.3	4	0.0	3	0.0	0	0.0	0	0.0	0	0.0	10	8.7	7.1
300.0	91	0.8	54	0.5	22	0.2	9	0.1	10	0.1	3	0.0	0	0.0	18	7.0	6.0
305.0	24	0.2	28	0.3	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	3.7	6.3
310.0	83	0.8	43	0.4	17	0.2	11	0.1	6	0.1	2	0.0	0	0.0	17	8.5	6.5
315.0	19	0.2	22	0.2	5	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	8.7	5.1
320.0	82	0.8	32	0.3	14	0.1	10	0.1	11	0.1	5	0.0	14	0.1	34	6.6	5.9
325.0	9	0.1	12	0.1	2	0.0	3	0.0	1	0.0	0	0.0	0	0.0	11	5.3	5.3
330.0	47	0.4	46	0.4	17	0.2	15	0.1	6	0.1	2	0.0	0	0.0	17	7.2	6.1
335.0	21	0.2	11	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	5.3	4.7
340.0	46	0.4	43	0.4	11	0.1	9	0.1	0	0.0	0	0.0	0	0.0	10	6.0	5.6
345.0	14	0.1	21	0.2	8	0.1	2	0.0	0	0.0	0	0.0	0	0.0	9	4.9	4.5
350.0	42	0.4	46	0.4	23	0.2	24	0.2	10	0.1	0	0.0	0	0.0	14	5.4	5.1
355.0	11	0.1	26	0.2	5	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	4.5	4.7
360.0	37	0.3	20	0.2	10	0.1	11	0.1	10	0.1	3	0.0	0	0.0	18	7.6	5.8
CALM	110	1.0	25	0.2	6	0.1	4	0.0	0	0.0	0	0.0	0	0.0	10	0.0	0.1
TOTAL	3551	32.8	3518	32.5	1260	11.6	1096	10.1	845	7.8	306	2.8	248	2.3			
MEAN SPEED	4.7		5.8		6.6		7.3		7.9		8.7		8.8				7.1

TOTAL VALID HOURS: 10824
TOTAL INVALID HOURS: 0

*NUM - NUMBER OF OCCURRENCES, PCT - PERCENT OF VALID, OBSERVATIONS

TABLE A.3.3-A-8 (1 of 2)

FREQUENCY DISTRIBUTION OF PERSISTENCE
PERIOD: 73030101 TO 77053124
SITE: BUFFALO SURFACE DATA (SPRING DATA : MARCH - MAY)
SENSOR HEIGHT: 10 M
SECTOR WIDTH: 22.5

WEST VALEY NUCLEAR SERVICES
JOB NO: 10805-139-23
GENERATED: 2-MAY-84
PAGE 1

DIRECTION	1- 2 HRS		3- 5 HRS		6- 7 HRS		8-10 HRS		11-15 HRS		16-20 HRS		>20 HRS		MAXIMUN DURATION	MEAN SPEED FOR MAXIMUM	MEAN SPEED TOTAL
(DEGREES)	NUM*	PCT*	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	(HRS)	(MPS)	(MPS)
5.0	18	0.2	17	0.2	3	0.0	3	0.0	0	0.0	0	0.0	0	0.0	10	6.8	4.6
10.0	63	0.6	26	0.2	3	0.0	2	0.0	1	0.0	0	0.0	0	0.0	11	3.8	3.5
15.0	9	0.1	11	0.1	2	0.0	3	0.0	0	0.0	0	0.0	0	0.0	10	3.8	3.7
20.0	61	0.6	27	0.2	8	0.1	2	0.0	2	0.0	0	0.0	0	0.0	12	4.8	4.6
25.0	18	0.2	10	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	4.4	4.1
30.0	81	0.7	41	0.4	13	0.1	7	0.1	7	0.1	3	0.0	0	0.0	18	5.7	4.5
35.0	15	0.1	16	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	6.5	4.9
40.0	74	0.7	42	0.4	16	0.1	14	0.1	4	0.0	0	0.0	0	0.0	12	8.4	5.3
45.0	14	0.1	24	0.2	4	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	6.5	4.7
50.0	83	0.8	59	0.5	21	0.2	25	0.2	19	0.2	8	0.1	4	0.0	25	5.6	5.8
55.0	20	0.2	21	0.2	4	0.0	5	0.0	5	0.0	5	0.0	3	0.0	23	5.5	4.8
60.0	83	0.8	33	0.3	24	0.2	24	0.2	25	0.2	10	0.1	6	0.1	26	7.6	7.2
65.0	22	0.2	35	0.3	5	0.0	6	0.1	1	0.0	0	0.0	0	0.0	11	8.6	6.3
70.0	85	0.8	50	0.5	25	0.2	26	0.2	14	0.1	0	0.0	0	0.0	15	5.4	6.6
75.0	15	0.1	19	0.2	2	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	4.5	5.0
80.0	77	0.7	64	0.6	30	0.3	28	0.3	19	0.2	4	0.0	0	0.0	18	8.6	6.3
85.0	20	0.2	17	0.2	3	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	7.1	4.8
90.0	97	0.9	48	0.4	8	0.1	8	0.1	10	0.1	3	0.0	0	0.0	18	7.5	5.9
95.0	16	0.1	12	0.1	2	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	4.6	5.3
100.0	55	0.5	25	0.2	5	0.0	3	0.0	0	0.0	0	0.0	0	0.0	10	4.9	4.8
105.0	10	0.1	4	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	1.7	3.9
110.0	67	0.6	22	0.2	3	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	5.8	3.9
115.0	12	0.1	10	0.1	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	4.2	3.3
120.0	87	0.8	34	0.3	7	0.1	2	0.0	0	0.0	0	0.0	0	0.0	8	3.9	4.1
125.0	13	0.1	20	0.2	6	0.1	1	0.0	0	0.0	0	0.0	0	0.0	8	3.7	4.6
130.0	63	0.6	34	0.3	14	0.1	9	0.1	0	0.0	0	0.0	0	0.0	10	4.0	4.5
135.0	15	0.1	19	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	6.2	4.8
140.0	60	0.5	52	0.5	14	0.1	7	0.1	4	0.0	0	0.0	0	0.0	14	4.2	4.2
145.0	13	0.1	11	0.1	2	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	4.0	4.2
150.0	62	0.6	44	0.4	6	0.1	5	0.0	2	0.0	0	0.0	0	0.0	12	5.8	5.2
155.0	23	0.2	13	0.1	2	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	3.2	3.9
160.0	91	0.8	57	0.5	13	0.1	6	0.1	1	0.0	0	0.0	0	0.0	11	6.4	4.7
165.0	21	0.2	19	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	3.6	4.4
170.0	96	0.9	72	0.7	24	0.2	13	0.1	3	0.0	4	0.0	0	0.0	19	8.0	5.3
175.0	29	0.3	46	0.4	8	0.1	3	0.0	2	0.0	0	0.0	0	0.0	12	8.8	5.5
180.0	132	1.2	79	0.7	18	0.2	13	0.1	4	0.0	0	0.0	0	0.0	12	6.6	5.4
185.0	38	0.3	37	0.3	7	0.1	2	0.0	0	0.0	0	0.0	0	0.0	9	9.1	5.3
190.0	131	1.2	105	1.0	31	0.3	10	0.1	2	0.0	0	0.0	0	0.0	12	9.4	4.9
195.0	23	0.2	37	0.3	5	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	8.1	5.6
200.0	129	1.2	102	0.9	23	0.2	25	0.2	21	0.2	7	0.1	5	0.0	25	7.7	6.3

*NUM - NUMBER OF OCCURRENCES. PCT - PERCENT OF VALID OBSERVATIONS

TABLE A.3.3-A-[illegible] (2 of 2)

FREQUENCY DISTRIBUTION OF PERSISTENCE
PERIOD: 73030101 TO 77053124
SITE: BUFFALO SURFACE DATA (SPRING DATA : MARCH - MAY)
SENSOR HEIGHT: 10 M
SECTOR WIDTH: 22.5

WEST VALEY NUCLEAR SERVICES
JOB NO: 10805-139-23
GENERATED: 2-MAY-84
PAGE 2

DIRECTION	1- 2 HRS		3- 5 HRS		6- 7 HRS		8-10 HRS		11-15 HRS		16-20 HRS		>20 HRS		MAXIMUN DURATION	MEAN SPEED FOR MAXIMUM	MEAN SPEED TOTAL
(DEGREES)	NUM*	PCT*	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	(HRS)	(MPS)	(MPS)
205.0	43	0.4	45	0.4	11	0.1	8	0.1	2	0.0	0	0.0	0	0.0	12	3.7	5.5
210.0	146	1.3	124	1.1	50	0.5	39	0.4	19	0.2	5	0.0	2	0.0	22	6.9	5.3
215.0	40	0.4	61	0.6	13	0.1	4	0.0	3	0.0	0	0.0	0	0.0	13	5.2	5.5
220.0	151	1.4	178	1.6	80	0.7	80	0.7	51	0.5	13	0.1	6	0.1	24	6.9	6.5
225.0	46	0.4	87	0.8	20	0.2	11	0.1	0	0.0	0	0.0	0	0.0	10	5.6	5.9
230.0	206	1.9	165	1.5	106	1.0	98	0.9	84	0.8	39	0.4	35	0.3	39	11.3	7.5
235.0	57	0.5	118	1.1	44	0.4	35	0.3	14	0.1	0	0.0	0	0.0	14	8.7	7.1
240.0	180	1.6	184	1.7	90	0.8	83	0.8	71	0.6	29	0.3	42	0.4	36	7.5	7.3
245.0	51	0.5	104	0.9	29	0.3	13	0.1	8	0.1	0	0.0	0	0.0	15	7.4	6.8
250.0	145	1.3	134	1.2	75	0.7	79	0.7	39	0.4	18	0.2	6	0.1	24	12.7	8.0
255.0	29	0.3	39	0.4	9	0.1	5	0.0	0	0.0	0	0.0	0	0.0	9	9.7	7.2
260.0	124	1.1	100	0.9	36	0.3	24	0.2	25	0.2	13	0.1	8	0.1	24	6.2	6.9
265.0	27	0.2	33	0.3	8	0.1	4	0.0	1	0.0	0	0.0	0	0.0	11	5.5	6.4
270.0	102	0.9	54	0.5	21	0.2	27	0.2	22	0.2	3	0.0	0	0.0	17	6.3	6.3
275.0	17	0.2	26	0.2	3	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	7.3	5.7
280.0	78	0.7	67	0.6	20	0.2	10	0.1	7	0.1	1	0.0	0	0.0	16	10.5	7.2
285.0	20	0.2	21	0.2	6	0.1	2	0.0	0	0.0	0	0.0	0	0.0	9	6.5	6.4
290.0	81	0.7	72	0.7	21	0.2	22	0.2	7	0.1	0	0.0	0	0.0	13	9.5	7.2
295.0	28	0.3	22	0.2	5	0.0	3	0.0	1	0.0	0	0.0	0	0.0	11	8.5	6.6
300.0	86	0.8	77	0.7	26	0.2	21	0.2	20	0.2	2	0.0	0	0.0	17	8.6	7.1
305.0	15	0.1	22	0.2	5	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	5.7	5.9
310.0	93	0.8	75	0.7	27	0.2	23	0.2	11	0.1	6	0.1	0	0.0	20	11.4	7.5
315.0	24	0.2	29	0.3	10	0.1	2	0.0	0	0.0	0	0.0	0	0.0	9	7.3	6.1
320.0	89	0.8	62	0.6	36	0.3	27	0.2	19	0.2	0	0.0	0	0.0	15	7.3	6.4
325.0	18	0.2	25	0.2	7	0.1	2	0.0	0	0.0	0	0.0	0	0.0	9	2.8	4.6
330.0	81	0.7	60	0.5	29	0.3	23	0.2	8	0.1	1	0.0	0	0.0	16	7.3	5.5
335.0	16	0.1	21	0.2	3	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	7.5	6.2
340.0	69	0.6	53	0.5	23	0.2	18	0.2	5	0.0	0	0.0	0	0.0	12	8.2	5.6
345.0	17	0.2	10	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	3.4	4.8
350.0	74	0.7	56	0.5	14	0.1	13	0.1	6	0.1	0	0.0	0	0.0	15	8.4	5.5
355.0	24	0.2	25	0.2	5	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	5.9	4.2
360.0	72	0.7	24	0.2	10	0.1	12	0.1	4	0.0	0	0.0	0	0.0	13	3.8	4.3
CALM	127	1.2	19	0.2	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	0.8	0.1
TOTAL	4417	40.0	3602	32.6	1205	10.9	952	8.6	573	5.2	174	1.6	117	1.1			
MEAN SPEED	4.4		5.6		6.5		6.9		7.5		7.9		7.9				6.4

TOTAL VALID HOURS: 11040
TOTAL INVALID HOURS: 0

*NUM - NUMBER OF OCCURRENCES, PCT - PERCENT OF VALID, OBSERVATIONS

TABLE A.3.3-A-[illegible] (1 of 2)

FREQUENCY DISTRIBUTION OF PERSISTENCE
PERIOD: 73060101 TO 77083124
SITE: BUFFALO SURFACE DATA (SUMMER DATA : JUNE - AUGUST)
SENSOR HEIGHT: 10 M
SECTOR WIDTH: 22.5

WEST VALEY NUCLEAR SERVICES
JOB NO: 10805-139-23
GENERATED: 3-MAY-84
PAGE 1

DIRECTION (DEGREES)	1- 2 HRS NUM*	1- 2 HRS PCT*	3- 5 HRS NUM	3- 5 HRS PCT	6- 7 HRS NUM	6- 7 HRS PCT	8-10 HRS NUM	8-10 HRS PCT	11-15 HRS NUM	11-15 HRS PCT	16-20 HRS NUM	16-20 HRS PCT	>20 HRS NUM	>20 HRS PCT	MAXIMUN DURATION (HRS)	MEAN SPEED FOR MAXIMUM (MPS)	MEAN SPEED TOTAL (MPS)
5.0	23	0.2	22	0.2	4	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	3.6	3.2
10.0	81	0.7	42	0.4	8	0.1	9	0.1	1	0.0	0	0.0	0	0.0	11	5.5	3.9
15.0	12	0.1	12	0.1	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	4.1	3.7
20.0	79	0.7	30	0.3	7	0.1	0	0.0	0	0.0	0	0.0	0	0.0	7	3.5	3.8
25.0	25	0.2	12	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	5.0	3.5
30.0	94	0.9	38	0.3	10	0.1	4	0.0	1	0.0	0	0.0	0	0.0	13	3.9	3.6
35.0	17	0.2	15	0.1	3	0.0	5	0.0	2	0.0	0	0.0	0	0.0	12	4.1	4.4
40.0	82	0.7	51	0.5	8	0.1	7	0.1	3	0.0	0	0.0	0	0.0	12	3.8	4.2
45.0	17	0.2	17	0.2	2	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	4.6	4.1
50.0	83	0.8	55	0.5	12	0.1	5	0.0	3	0.0	0	0.0	0	0.0	13	4.4	4.0
55.0	16	0.1	13	0.1	4	0.0	2	0.0	0	0.0	0	0.0	0	0.0	9	4.7	3.9
60.0	99	0.9	41	0.4	9	0.1	5	0.0	2	0.0	0	0.0	0	0.0	12	5.3	4.3
65.0	17	0.2	10	0.1	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	3.1	4.0
70.0	73	0.7	31	0.3	5	0.0	4	0.0	5	0.0	5	0.0	0	0.0	20	3.9	4.0
75.0	8	0.1	6	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	3.6	3.6
80.0	62	0.6	22	0.2	6	0.1	0	0.0	0	0.0	0	0.0	0	0.0	7	3.1	3.7
85.0	18	0.2	6	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	4.6	3.9
90.0	83	0.8	23	0.2	2	0.0	2	0.0	0	0.0	0	0.0	0	0.0	10	6.6	3.8
95.0	12	0.1	6	0.1	2	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	6.4	4.9
100.0	55	0.5	19	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	4.3	3.3
105.0	9	0.1	7	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	5.8	4.0
110.0	78	0.7	20	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	3.4	3.2
115.0	14	0.1	13	0.1	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	2.7	3.0
120.0	74	0.7	24	0.2	6	0.1	2	0.0	0	0.0	0	0.0	0	0.0	9	3.3	3.2
125.0	12	0.1	8	0.1	2	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	4.6	3.8
130.0	59	0.5	24	0.2	7	0.1	2	0.0	0	0.0	0	0.0	0	0.0	9	4.8	3.5
135.0	13	0.1	9	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	3.8	3.9
140.0	73	0.7	31	0.3	8	0.1	5	0.0	0	0.0	0	0.0	0	0.0	9	4.8	3.9
145.0	20	0.2	30	0.3	6	0.1	2	0.0	0	0.0	0	0.0	0	0.0	9	3.9	3.7
150.0	93	0.8	52	0.5	10	0.1	5	0.0	1	0.0	0	0.0	0	0.0	11	5.0	3.5
155.0	26	0.2	34	0.3	7	0.1	1	0.0	0	0.0	0	0.0	0	0.0	8	6.0	3.7
160.0	119	1.1	101	0.9	33	0.3	20	0.2	3	0.0	0	0.0	0	0.0	12	3.1	3.3
165.0	30	0.3	41	0.4	11	0.1	5	0.0	0	0.0	0	0.0	0	0.0	10	3.2	3.5
170.0	158	1.4	119	1.1	47	0.4	27	0.2	7	0.1	0	0.0	0	0.0	13	6.3	3.6
175.0	59	0.5	65	0.6	6	0.1	1	0.0	0	0.0	0	0.0	0	0.0	8	3.7	3.6
180.0	207	1.9	114	1.0	43	0.4	23	0.2	7	0.1	0	0.0	0	0.0	14	3.6	3.7
185.0	49	0.4	69	0.6	17	0.2	13	0.1	1	0.0	0	0.0	0	0.0	11	2.5	4.1
190.0	182	1.6	148	1.3	48	0.4	35	0.3	11	0.1	2	0.0	0	0.0	17	5.1	4.1
195.0	55	0.5	44	0.4	9	0.1	6	0.1	2	0.0	0	0.0	0	0.0	12	9.0	5.4
200.0	199	1.8	117	1.1	26	0.2	13	0.1	3	0.0	0	0.0	0	0.0	12	5.9	4.6

*NUM - NUMBER OF OCCURRENCES. PCT - PERCENT OF VALID OBSERVATIONS

TABLE A.3.3-A-[illegible] (2 of 2)

FREQUENCY DISTRIBUTION OF PERSISTENCE
PERIOD: 73060101 TO 77083124
SITE: BUFFALO SURFACE DATA (SUMMER DATA : JUNE - AUGUST)
SENSOR HEIGHT: 10 M
SECTOR WIDTH: 22.5

WEST VALEY NUCLEAR SERVICES
JOB NO: 10805-139-23
GENERATED: 3-MAY-84
PAGE 2

DIRECTION	1- 2 HRS		3- 5 HRS		6- 7 HRS		8-10 HRS		11-15 HRS		16-20 HRS		>20 HRS		MAXIMUN DURATION	MEAN SPEED FOR MAXIMUM	MEAN SPEED TOTAL
(DEGREES)	NUM*	PCT*	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	(HRS)	(MPS)	(MPS)
205.0	53	0.5	45	0.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	4.7	4.8
210.0	233	2.1	133	1.2	31	0.3	18	0.2	13	0.1	5	0.0	2	0.0	22	6.0	5.0
215.0	59	0.5	57	0.5	3	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	7.0	5.1
220.0	229	2.1	231	2.1	95	0.9	99	0.9	41	0.4	18	0.2	23	0.2	35	6.1	5.6
225.0	62	0.6	90	0.8	27	0.2	20	0.2	10	0.1	2	0.0	0	0.0	17	5.9	5.4
230.0	234	2.1	312	2.8	175	1.6	171	1.5	122	1.1	59	0.5	33	0.3	38	5.3	6.3
235.0	60	0.5	123	1.1	32	0.3	20	0.2	19	0.2	4	0.0	0	0.0	19	7.8	6.3
240.0	229	2.1	216	2.0	119	1.1	107	1.0	54	0.5	30	0.3	42	0.4	43	6.2	6.3
245.0	49	0.4	78	0.7	15	0.1	10	0.1	1	0.0	0	0.0	0	0.0	11	6.6	5.6
250.0	153	1.4	110	1.0	40	0.4	38	0.3	31	0.3	2	0.0	0	0.0	16	9.3	7.1
255.0	34	0.3	26	0.2	4	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	7.1	5.8
260.0	141	1.3	64	0.6	18	0.2	12	0.1	1	0.0	0	0.0	0	0.0	11	5.2	5.1
265.0	22	0.2	19	0.2	2	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	3.3	4.3
270.0	102	0.9	30	0.3	4	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	5.8	4.5
275.0	9	0.1	11	0.1	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	3.7	4.3
280.0	71	0.6	16	0.1	5	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	3.7	3.9
285.0	11	0.1	8	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	3.0	3.8
290.0	57	0.5	19	0.2	2	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	5.0	4.1
295.0	19	0.2	16	0.1	4	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	5.4	4.9
300.0	81	0.7	31	0.3	4	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	5.5	4.4
305.0	13	0.1	7	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	3.6	3.9
310.0	79	0.7	22	0.2	4	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	3.5	4.0
315.0	14	0.1	16	0.1	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	5.8	4.7
320.0	81	0.7	31	0.3	7	0.1	4	0.0	0	0.0	0	0.0	0	0.0	9	5.9	4.8
325.0	16	0.1	17	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	4.4	3.6
330.0	76	0.7	26	0.2	8	0.1	6	0.1	3	0.0	0	0.0	0	0.0	13	7.4	5.4
335.0	15	0.1	13	0.1	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	3.9	4.7
340.0	65	0.6	30	0.3	8	0.1	5	0.0	1	0.0	0	0.0	0	0.0	11	5.3	4.2
345.0	11	0.1	19	0.2	5	0.0	3	0.0	1	0.0	0	0.0	0	0.0	11	7.0	5.4
350.0	78	0.7	40	0.4	22	0.2	23	0.2	13	0.1	5	0.0	23	0.2	43	5.4	4.8
355.0	24	0.2	25	0.2	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	3.7	3.3
360.0	97	0.9	50	0.5	14	0.1	8	0.1	2	0.0	0	0.0	0	0.0	12	2.5	3.4
CALM	179	1.6	25	0.2	5	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	0.7	0.1
TOTAL	5141	46.6	3497	31.7	1028	9.3	755	6.8	364	3.3	132	1.2	123	1.1			
MEAN SPEED	3.7		4.6		5.2		5.7		6.5		6.8		6.1				5.1

TOTAL VALID HOURS: 11040
TOTAL INVALID HOURS: 0

*NUM - NUMBER OF OCCURRENCES, PCT - PERCENT OF VALID, OBSERVATIONS

TABLE A.3.3-A (1 of 2)

FREQUENCY DISTRIBUTION OF PERSISTENCE
PERIOD: 73090101 TO 77113024
SITE: BUFFALO SURFACE DATA (FALL DATA : SEPTEMBER - NOVEMBER)
SENSOR HEIGHT: 10 M
SECTOR WIDTH: 22.5

WEST VALEY NUCLEAR SERVICES
JOB NO: 10805-139-23
GENERATED: 3-MAY-84
PAGE 1

DIRECTION	1- 2 HRS		3- 5 HRS		6- 7 HRS		8-10 HRS		11-15 HRS		16-20 HRS		>20 HRS		MAXIMUN DURATION	MEAN SPEED FOR MAXIMUM	MEAN SPEED TOTAL
(DEGREES)	NUM*	PCT*	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	(HRS)	(MPS)	(MPS)
5.0	18	0.2	23	0.2	4	0.0	3	0.0	3	0.0	0	0.0	0	0.0	13	4.2	3.4
10.0	53	0.5	38	0.3	9	0.1	10	0.1	1	0.0	0	0.0	0	0.0	11	3.7	3.2
15.0	12	0.1	7	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	5.1	3.5
20.0	66	0.6	30	0.3	10	0.1	7	0.1	5	0.0	5	0.0	0	0.0	20	4.3	4.1
25.0	20	0.2	14	0.1	2	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	4.6	3.8
30.0	59	0.5	31	0.3	12	0.1	13	0.1	13	0.1	0	0.0	0	0.0	15	3.9	4.6
35.0	13	0.1	15	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	1.5	3.3
40.0	59	0.5	46	0.4	7	0.1	3	0.0	3	0.0	5	0.0	0	0.0	20	6.0	4.2
45.0	20	0.2	24	0.2	4	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	4.1	3.4
50.0	81	0.7	30	0.3	15	0.1	10	0.1	6	0.1	5	0.0	13	0.1	33	7.3	5.9
55.0	16	0.1	12	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	3.8	3.3
60.0	88	0.8	59	0.5	15	0.1	16	0.1	18	0.2	6	0.1	3	0.0	23	6.5	5.4
65.0	13	0.1	11	0.1	1	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	3.0	4.6
70.0	52	0.5	24	0.2	10	0.1	16	0.1	13	0.1	5	0.0	0	0.0	20	6.2	5.8
75.0	16	0.1	29	0.3	2	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	5.5	4.5
80.0	68	0.6	64	0.6	20	0.2	16	0.1	10	0.1	10	0.1	11	0.1	29	6.8	5.5
85.0	18	0.2	9	0.1	2	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	8.1	4.0
90.0	82	0.8	34	0.3	12	0.1	6	0.1	2	0.0	0	0.0	0	0.0	12	5.1	4.9
95.0	19	0.2	19	0.2	3	0.0	2	0.0	0	0.0	0	0.0	0	0.0	9	6.3	4.6
100.0	68	0.6	34	0.3	5	0.0	1	0.0	0	0.0	0	0.0	0	0.0	10	6.3	4.0
105.0	14	0.1	16	0.1	3	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	4.6	3.9
110.0	71	0.7	29	0.3	8	0.1	4	0.0	0	0.0	0	0.0	0	0.0	10	3.3	3.9
115.0	12	0.1	11	0.1	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	2.7	3.4
120.0	80	0.7	27	0.2	4	0.0	3	0.0	0	0.0	0	0.0	0	0.0	10	3.9	3.7
125.0	20	0.2	16	0.1	3	0.0	2	0.0	0	0.0	0	0.0	0	0.0	9	3.9	3.9
130.0	53	0.5	20	0.2	4	0.0	5	0.0	1	0.0	0	0.0	0	0.0	11	5.3	4.5
135.0	11	0.1	3	0.0	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	6.5	4.4
140.0	63	0.6	43	0.4	10	0.1	2	0.0	2	0.0	0	0.0	0	0.0	13	3.6	4.2
145.0	16	0.1	21	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	4.3	4.1
150.0	70	0.6	63	0.6	22	0.2	14	0.1	5	0.0	0	0.0	0	0.0	12	4.3	4.0
155.0	22	0.2	29	0.3	6	0.1	2	0.0	0	0.0	0	0.0	0	0.0	9	3.8	3.7
160.0	94	0.9	90	0.8	25	0.2	26	0.2	8	0.1	0	0.0	0	0.0	15	3.7	3.9
165.0	24	0.2	25	0.2	10	0.1	6	0.1	3	0.0	0	0.0	0	0.0	13	3.6	3.7
170.0	120	1.1	127	1.2	51	0.5	56	0.5	24	0.2	2	0.0	0	0.0	17	3.9	4.0
175.0	32	0.3	50	0.5	12	0.1	8	0.1	0	0.0	0	0.0	0	0.0	10	4.9	3.8
180.0	151	1.4	97	0.9	33	0.3	34	0.3	17	0.2	0	0.0	0	0.0	15	3.5	4.5
185.0	39	0.4	53	0.5	7	0.1	7	0.1	0	0.0	0	0.0	0	0.0	10	6.6	4.5
190.0	131	1.2	118	1.1	58	0.5	56	0.5	14	0.1	3	0.0	0	0.0	18	4.2	5.5
195.0	35	0.3	63	0.6	16	0.1	8	0.1	5	0.0	0	0.0	0	0.0	13	5.6	6.0
200.0	141	1.3	101	0.9	41	0.4	42	0.4	21	0.2	8	0.1	3	0.0	23	5.8	6.4

*NUM - NUMBER OF OCCURRENCES. PCT - PERCENT OF VALID OBSERVATIONS

TABLE A.3.3-A-[illegible]2 of 2)

FREQUENCY DISTRIBUTION OF PERSISTENCE
PERIOD: 73090101 TO 77113024
SITE: BUFFALO SURFACE DATA (FALL DATA : SEPTEMBER - NOVEMBER)
SENSOR HEIGHT: 10 M
SECTOR WIDTH: 22.5

WEST VALEY NUCLEAR SERVICES
JOB NO. 10805-139-23
GENERATED: 3-MAY-84
PAGE 2

DIRECTION	1- 2 HRS		3- 5 HRS		6- 7 HRS		8-10 HRS		11-15 HRS		16-20 HRS		>20 HRS		MAXIMUM DURATION	MEAN SPEED FOR MAXIMUM	MEAN SPEED TOTAL
(DEGREES)	NUM*	PCT*	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	NUM	PCT	(HRS)	(MPS)	(MPS)
205.0	30	0.3	36	0.3	7	0.1	6	0.1	3	0.0	0	0.0	0	0.0	13	6.5	6.0
210.0	129	1.2	125	1.1	32	0.3	28	0.3	23	0.2	5	0.0	2	0.0	22	6.6	6.4
215.0	32	0.3	38	0.3	2	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	5.6	5.7
220.0	120	1.1	119	1.1	39	0.4	41	0.4	29	0.3	11	0.1	7	0.1	25	6.2	6.3
225.0	37	0.3	48	0.4	10	0.1	3	0.0	0	0.0	0	0.0	[illegible]	0.0	8	10.5	6.2
230.0	180	1.6	140	1.3	62	0.6	47	0.4	23	0.2	10	0.1	[illegible]	0.1	29	5.9	6.4
235.0	43	0.4	82	0.8	36	0.3	32	0.3	8	0.1	0	0.0	0	0.0	14	11.3	6.9
240.0	157	1.4	160	1.5	63	0.6	61	0.6	50	0.5	17	0.2	5	0.0	23	7.4	7.2
245.0	48	0.4	86	0.8	21	0.2	9	0.1	5	0.0	0	0.0	0	0.0	15	7.7	6.0
250.0	149	1.4	113	1.0	53	0.5	39	0.4	26	0.2	14	0.1	26	0.2	38	9.3	7.6
255.0	41	0.4	58	0.5	8	0.1	5	0.0	2	0.0	0	0.0	0	0.0	12	8.4	6.2
260.0	147	1.3	130	1.2	49	0.4	43	0.4	25	0.2	10	0.1	1	0.0	21	8.3	6.7
265.0	33	0.3	50	0.5	12	0.1	9	0.1	5	0.0	0	0.0	0	0.0	14	5.5	[illegible]
270.0	155	1.4	108	1.0	42	0.4	29	0.3	19	0.2	6	0.1	5	0.0	25	9.3	6.2
275.0	38	0.3	36	0.3	9	0.1	3	0.0	0	0.0	0	0.0	0	0.0	10	9.1	6.0
280.0	122	1.1	133	1.2	45	0.4	35	0.3	25	0.2	8	0.1	3	0.0	23	8.3	6.0
285.0	27	0.2	32	0.3	3	0.0	3	0.0	0	0.0	0	0.0	0	0.0	10	8.6	6.0
290.0	124	1.1	65	0.6	19	0.2	9	0.1	6	0.1	0	0.0	0	0.0	14	8.3	5.9
295.0	20	0.2	28	0.3	3	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	4.8	5.0
300.0	101	0.9	53	0.5	16	0.1	11	0.1	4	0.0	0	0.0	0	0.0	13	5.6	5.3
305.0	33	0.3	34	0.3	6	0.1	6	0.1	0	0.0	0	0.0	0	0.0	10	5.2	5.3
310.0	102	0.9	66	0.6	20	0.2	8	0.1	5	0.0	1	0.0	0	0.0	16	6.5	5.3
315.0	25	0.2	13	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	6.8	4.5
320.0	83	0.8	73	0.7	22	0.2	12	0.1	1	0.0	0	0.0	0	0.0	11	7.0	5.5
325.0	22	0.2	21	0.2	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	3.7	4.7
330.0	68	0.6	66	0.6	28	0.3	17	0.2	2	0.0	0	0.0	0	0.0	12	4.9	4.9
335.0	25	0.2	35	0.3	9	0.1	3	0.0	0	0.0	0	0.0	0	0.0	9	5.6	4.8
340.0	70	0.6	53	0.5	24	0.2	23	0.2	10	0.1	5	0.0	3	0.0	23	6.4	5.4
345.0	16	0.1	17	0.2	3	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	6.3	4.9
350.0	63	0.6	69	0.6	27	0.2	20	0.2	9	0.1	1	0.0	0	0.0	16	3.7	4.1
355.0	18	0.2	28	0.3	4	0.0	3	0.0	0	0.0	0	0.0	0	0.0	10	3.3	3.2
360.0	86	0.8	20	0.2	7	0.1	0	0.0	2	0.0	5	0.0	0	0.0	20	4.2	3.5
CALM	119	1.1	19	0.2	2	0.0	2	0.0	0	0.0	0	0.0	0	0.0	9	0.0	0.1
TOTAL	4503	41.2	3709	34.0	1132	10.4	887	8.1	456	4.2	142	1.3	91	0.8			
MEAN SPEED	4.1		5.1		5.6		6.0		6.6		6.9		7.7				5.6

TOTAL VALID HOURS: 10920
TOTAL INVALID HOURS: 0

*NUM - NUMBER OF OCCURRENCES, PCT - PERCENT OF VALID OBSERVATIONS

SUPPLEMENT A.3.3-B

SITE SPECIFIC METEOROLOGY DATA

SUPPLEMENT A.3.3-B

This report provides a summary of the data collected for the West Valley Demonstration Project during the period of October 1983 to September 1984.

Data were collected at seven different locations as shown in the List of Tables. At the Primary site, wind speed and direction are monitored at 10 metre and at 60 metre heights, while temperature and temperature difference is measured between the two heights. At each of the other sites, wind speed and wind direction were measured at a height of 10 metres.

Data are recorded digitally and collected by telephone on a daily basis from the Primary and Remote sites; a back-up chart recorder is also used. The five "remote" sites recorded on charts only.

SUPPLEMENT A.3.3-B

LIST OF TABLES

LIST OF TABLES (CONTINUED)

TABLE A.3.3-B-1a

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: OCTOBER 1, 1963 0100 - SEPTEMBER 30, 1984 2400

DATA SOURCE: PRIMARY SITE 10-METERS
TABLE GENERATED: 21-DEC-84 07:13:16

PRIMARY SITE

WEST VALLEY NUCLFAR SERVICES
DAMES AND MOORE JOB NO: 10835-139-23

FREQUENCY IN PERCENT

WIND DIR	INTERVALS OF WIND SPEED IN MPS										MEAN WIND SPEED
	0.0- 1.5	1.5- 3.0	3.0- 5.0	5.0- 7.5	7.5-10.0	10.0-12.5	12.5-15.0	15.0-17.5	>17.5	TOTAL	
NNE	0.42	0.75	0.35	0.00	0.00	0.00	0.00	0.00	0.00	1.53	2.3
NE	0.51	1.20	0.40	0.00	0.00	0.00	0.00	0.00	0.00	2.11	2.2
ENE	0.31	0.46	0.38	0.00	0.00	0.00	0.00	0.00	0.00	1.14	2.5
E	0.46	0.44	0.52	0.07	0.00	0.00	0.00	0.00	0.00	1.49	2.6
ESE	0.67	0.64	0.65	0.17	0.00	0.00	0.00	0.00	0.00	2.13	2.6
SE	1.65	1.51	1.40	0.57	0.03	0.00	0.00	0.00	0.00	5.17	2.8
SSE	5.76	3.23	2.78	2.19	0.73	0.17	0.00	0.00	0.00	14.85	3.1
S	6.12	3.94	3.17	0.76	0.22	0.02	0.00	0.00	0.00	14.23	2.4
SSW	2.61	4.05	1.62	0.09	0.00	0.00	0.00	0.00	0.00	8.37	2.2
SW	1.62	3.22	2.53	0.08	0.00	0.00	0.00	0.00	0.00	7.65	2.5
WSW	1.37	2.24	0.98	0.05	0.00	0.00	0.00	0.00	0.00	4.64	2.3
W	1.51	2.05	0.69	0.00	0.00	0.00	0.00	0.00	0.00	4.26	2.0
WNW	1.70	3.90	1.50	0.18	0.00	0.00	0.00	0.00	0.00	7.28	2.4
NW	1.57	5.91	5.49	0.83	0.00	0.00	0.00	0.00	0.00	13.80	3.0
NNW	0.97	3.77	3.43	0.49	0.00	0.00	0.00	0.00	0.00	8.64	3.0
N	0.52	1.40	0.73	0.05	0.00	0.00	0.00	0.00	0.00	2.70	2.5
CALM	0.00									0.00	
TOTAL	27.97	33.72	26.62	5.51	0.98	0.19	0.00	0.00	0.00	100.00	2.6

NUMBER OF VALID OBSERVATIONS 8780 99.95 PCT.
NUMBER OF INVALID OBSERVATIONS 4 0.05 PCT.
TOTAL NUMBER OF OBSERVATIONS 8784 100.00 PCT.

TABLE A.3.3-B-1b

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: OCTOBER 1, 1983 0100 - SEPTEMBER 30, 1984 2400

DATA SOURCE: PRIMARY SITE 60-METERS
TABLE GENERATED: 21-DEC-84 07:14:13

PRIMARY SITE

WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10905-139-23

FREQUENCY IN PERCENT

INTERVALS OF WIND SPEED IN MPS

WIND DIR	0.0- 1.5	1.5- 3.0	3.0- 5.0	5.0- 7.5	7.5-10.0	10.0-12.5	12.5-15.0	15.0-17.5	>17.5	TOTAL	MEAN WIND SPEED
NNE	0.33	0.79	0.78	0.17	0.00	0.00	0.00	0.00	0.00	2.07	3.1
NE	0.45	1.10	0.83	0.07	0.00	0.00	0.00	0.00	0.00	2.44	2.7
ENE	0.42	0.60	0.70	0.10	0.00	0.00	0.00	0.00	0.00	1.82	2.8
E	0.32	0.52	0.54	0.40	0.02	0.00	0.00	0.00	0.00	1.80	3.4
ESE	0.44	0.57	0.62	0.39	0.09	0.00	0.00	0.00	0.00	2.10	3.5
SE	0.85	1.04	1.19	0.77	0.16	0.00	0.00	0.00	0.00	4.02	3.5
SSE	2.33	4.74	3.25	2.25	1.17	0.54	0.19	0.00	0.00	14.45	4.1
S	1.20	1.96	1.86	2.33	0.87	0.37	0.05	0.00	0.00	8.64	4.6
SSW	0.52	1.19	2.74	1.93	0.19	0.00	0.00	0.00	0.00	6.57	4.2
SW	0.31	1.24	3.74	2.62	0.29	0.01	0.00	0.00	0.00	8.20	4.5
WSW	0.39	1.29	3.38	3.41	0.74	0.02	0.00	0.00	0.00	9.25	4.8
W	0.21	1.62	3.90	1.75	0.40	0.00	0.00	0.00	0.00	7.87	4.3
WNW	0.25	1.49	4.18	3.54	1.07	0.23	0.02	0.00	0.00	10.78	5.1
NW	0.31	1.91	3.93	4.04	0.99	0.13	0.02	0.00	0.00	11.37	4.9
NNW	0.31	1.34	2.44	1.32	0.34	0.00	0.00	0.00	0.00	5.75	4.3
N	0.35	1.15	0.85	0.46	0.01	0.00	0.00	0.00	0.00	2.82	3.3
CALM	0.05									0.05	
TOTAL	9.69	22.55	34.91	25.54	6.31	1.29	0.30	0.00	0.00	100.00	4.3

NUMBER OF VALID OBSERVATIONS	8727	99.35 PCT
NUMBER OF INVALID OBSERVATIONS	57	0.65 PCT
TOTAL NUMBER OF OBSERVATIONS	8784	100.00 PCT

TABLE A.3.3-B-1c

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: OCTOBER 1, 1983 0100 - SEPTEMBER 30, 1984 2400

DATA SOURCE: REGIONAL SITE 10-METERS
TABLE GENERATED: 21-DEC-84 07:15:01

REGIONAL SITE

WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-23

FREQUENCY IN PERCENT

INTERVALS OF WIND SPEED IN MPS

WIND DIR	0.0- 1.5	1.5- 3.0	3.0- 5.0	5.0- 7.5	7.5-10.0	10.0-12.5	12.5-15.0	15.0-17.5	>17.5	TOTAL	MEAN WIND SPEED
NNE	0.18	1.06	0.86	0.20	0.00	0.00	0.00	0.00	0.00	2.30	3.1
NE	0.12	0.80	1.25	0.26	0.08	0.00	0.00	0.00	0.00	2.51	3.6
ENE	0.20	0.69	1.23	0.48	0.18	0.01	0.00	0.00	0.00	2.78	4.1
E	0.13	1.12	1.25	0.73	0.26	0.00	0.00	0.00	0.00	3.49	4.1
ESE	0.15	0.61	1.32	1.43	0.25	0.00	0.00	0.00	0.00	3.96	4.6
SE	0.10	0.52	1.42	1.05	0.18	0.00	0.00	0.00	0.00	3.26	4.6
SSE	0.15	0.67	1.12	1.20	0.49	0.14	0.00	0.00	0.00	3.76	5.2
S	0.12	1.23	1.83	2.14	1.49	0.32	0.01	0.00	0.00	7.14	5.7
SSW	0.29	1.65	2.50	2.21	0.95	0.07	0.00	0.00	0.00	7.67	4.8
SW	0.37	2.78	4.46	2.65	0.52	0.06	0.00	0.00	0.00	10.86	4.2
WSW	0.42	2.51	4.23	5.15	1.19	0.12	0.00	0.00	0.00	13.62	4.9
W	0.37	2.72	3.90	4.03	1.42	0.29	0.02	0.00	0.00	12.75	5.0
WNW	0.32	1.89	3.53	2.87	0.80	0.21	0.02	0.00	0.00	9.63	4.8
NW	0.35	2.12	4.14	2.35	0.45	0.02	0.00	0.00	0.00	9.43	4.3
NNW	0.51	1.42	1.69	0.45	0.12	0.00	0.00	0.00	0.00	4.21	3.4
N	0.42	1.23	0.71	0.17	0.00	0.00	0.00	0.00	0.00	2.52	2.7
CALM	0.12									0.12	
TOTAL	4.33	23.19	35.43	27.33	8.36	1.25	0.05	0.00	0.00	100.00	4.5

NUMBER OF VALID OBSERVATIONS 8408 95.72 PCT.
NUMBER OF INVALID OBSERVATIONS 376 4.28 PCT.
TOTAL NUMBER OF OBSERVATIONS 8784 100.00 PCT.

TABLE A.3.3-B-1d

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: OCTOBER 1, 1983 0100 - SEPTEMBER 30, 1984 2400

DATA SOURCE: REMOTE SITE 10-METERS
TABLE GENERATED: 21-DEC-84 07:09:17

WEST VALLEY REMOTE SITE

WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-23

FREQUENCY IN PERCENT

INTERVALS OF WIND SPEED IN MPS

WIND DIR	0.0- 1.5	1.5- 3.0	3.0- 5.0	5.0- 7.5	7.5-10.0	10.0-12.5	12.5-15.0	15.0-17.5	>17.5	TOTAL	MEAN WIND SPEED
NNE	0.33	0.89	0.80	0.21	0.00	0.00	0.00	0.00	0.00	2.19	3.0
NE	0.17	0.48	0.43	0.17	0.00	0.00	0.00	0.00	0.00	1.26	3.2
ENE	0.14	0.33	0.33	0.04	0.00	0.00	0.00	0.00	0.00	0.84	2.9
E	0.14	0.30	0.41	0.07	0.00	0.00	0.00	0.00	0.00	0.91	3.1
ESE	0.10	0.30	0.39	0.15	0.00	0.00	0.00	0.00	0.00	0.94	3.4
SE	0.31	0.47	0.68	0.26	0.00	0.00	0.00	0.00	0.00	1.71	3.3
SSE	0.82	1.59	1.36	0.49	0.14	0.04	0.00	0.00	0.00	4.44	3.2
S	2.81	10.03	7.82	3.23	0.92	0.15	0.00	0.00	0.00	24.96	3.4
SSW	1.79	6.70	8.66	2.80	0.32	0.02	0.00	0.00	0.00	20.29	3.5
SW	0.69	1.60	2.53	0.85	0.14	0.01	0.00	0.00	0.00	5.82	3.6
WSW	0.49	0.75	0.39	0.01	0.00	0.00	0.00	0.00	0.00	1.65	2.3
W	0.44	0.96	0.53	0.02	0.01	0.00	0.00	0.00	0.00	1.97	2.5
WNW	0.64	1.31	1.47	0.33	0.14	0.04	0.01	0.00	0.00	3.97	3.3
NW	0.65	2.85	4.16	1.56	0.14	0.06	0.00	0.00	0.00	9.43	3.7
NNW	0.62	3.06	5.98	2.92	0.43	0.00	0.00	0.00	0.00	13.00	4.1
N	0.74	2.25	2.25	0.78	0.06	0.00	0.00	0.00	0.00	6.09	3.3
CALM	0.54									0.54	
TOTAL	11.43	33.64	38.20	13.90	2.29	0.32	0.01	0.00	0.00	100.00	3.5

NUMBER OF VALID OBSERVATIONS 8116 92.40 PCT.
NUMBER OF INVALID OBSERVATIONS 668 7.60 PCT.
TOTAL NUMBER OF OBSERVATIONS 8784 100.00 PCT.

TABLE A.3.3-B-1e

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: OCTOBER 1, 1983 0100 - SEPTEMBER 30, 1984 2400

DATA SOURCE: REMOTE SITE 10 METERS
TABLE GENERATED: 21-DEC-84 07:10:00

RICEVILLE REMOTE SITE

WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-23

FREQUENCY IN PERCENT

WIND DIR	INTERVALS OF WIND SPEED IN MPS 0.0- 1.5	1.5- 3.0	3.0- 5.0	5.0- 7.5	7.5-10.0	10.0-12.5	12.5-15.0	15.0-17.5	>17.5	TOTAL	MEAN WIND SPEED
NNE	1.03	1.35	0.73	0.07	0.00	0.00	0.00	0.00	0.00	3.16	2.2
NE	2.01	1.65	0.82	0.11	0.00	0.00	0.00	0.00	0.00	4.62	2.0
ENE	2.90	3.99	1.08	0.55	0.01	0.00	0.00	0.00	0.00	8.54	2.2
E	1.78	5.82	1.61	0.48	0.07	0.00	0.00	0.00	0.00	9.76	2.5
ESE	0.72	2.33	1.24	0.45	0.01	0.00	0.00	0.00	0.00	4.72	2.9
SE	0.55	2.33	1.34	0.65	0.08	0.02	0.00	0.00	0.00	4.96	3.2
SSE	0.22	1.65	2.32	1.31	0.37	0.07	0.00	0.00	0.00	5.95	4.2
S	0.18	1.50	2.53	2.32	0.72	0.09	0.00	0.00	0.00	7.34	4.8
SSW	0.03	1.05	1.41	0.54	0.07	0.00	0.00	0.00	0.00	3.16	3.8
SW	0.14	1.0[illegible]	1.85	0.62	0.05	0.00	0.00	0.00	0.00	3.69	4.0
WSW	0.19	1.13	2.33	2.16	0.47	0.07	0.00	0.00	0.00	6.35	4.7
W	0.21	1.48	3.67	2.93	0.88	0.11	0.01	0.00	0.00	9.30	4.9
WNW	0.46	1.55	3.64	4.04	1.04	0.25	0.00	0.00	0.00	10.98	5.0
NW	0.52	2.61	4.75	2.05	0.33	0.04	0.00	0.00	0.00	10.29	4.0
NNW	0.5[illegible]	1.5[illegible]	1.55	0.16	0.06	0.01	0.00	0.00	0.00	3.85	3.0
N	0.71	1.21	0.73	0.13	0.01	0.00	0.00	0.00	0.00	2.79	2.5
CALM	0.34									0.34	
TOTAL	12.55	32.19	31.62	18.80	4.17	0.66	0.01	0.00	0.00	100.00	3.7

NUMBER OF VALID OBSERVATIONS	8491	96.66 PCT.
NUMBER OF INVALID OBSERVATIONS	293	3.34 PCT.
TOTAL NUMBER OF OBSERVATIONS	8784	100.00 PCT.

TABLE A.3.3-B-1f

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD OCTOBER 1, 1983 0100 - SEPTEMBER 30, 1984 2400

DATA SOURCE: REMOTE SITE 10 METERS
TABLE GENERATED: 21-DEC-84 07:10:46

CATTARAUGUS REMOTE SITE

WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-23

FREQUENCY IN PERCENT

INTERVALS OF WIND SPEED IN MPS

WIND DIR	0.0- 1.5	1.5- 3.0	3.0- 5.0	5.0- 7.5	7.5-10.0	10.0-12.5	12.5-15.0	15.0-17.5	>17.5	TOTAL	MEAN WIND SPEED
NNE	0.97	1.46	0.26	0.00	0.00	0.00	0.00	0.00	0.00	2.69	1.8
NE	1.49	1.80	0.55	0.02	0.00	0.00	0.00	0.00	0.00	3.87	2.0
ENE	1.65	1.73	1.08	0.16	0.00	0.00	0.00	0.00	0.00	4.61	2.3
E	1.32	1.60	0.84	0.26	0.01	0.00	0.00	0.00	0.00	4.04	2.4
ESE	0.83	0.88	0.39	0.13	0.01	0.00	0.00	0.00	0.00	2.30	2.2
SE	0.81	0.54	0.40	0.27	0.07	0.00	0.00	0.00	0.00	2.09	2.8
SSE	1.02	0.81	0.70	0.40	0.12	0.10	0.00	0.00	0.00	3.14	3.2
S	1.63	2.42	2.70	2.14	1.03	0.34	0.07	0.00	0.00	10.34	4.4
SSW	1.29	3.29	2.48	1.57	0.75	0.20	0.01	0.00	0.00	9.97	3.8
SW	1.17	2.03	2.30	1.75	0.75	0.07	0.02	0.00	0.00	8.10	4.1
WSW	1.01	1.77	3.40	3.99	1.54	0.15	0.02	0.00	0.00	11.92	5.0
W	0.95	2.50	2.69	1.93	0.66	0.11	0.00	0.00	0.00	8.85	4.1
WNW	0.76	2.57	4.04	2.75	0.78	0.12	0.01	0.00	0.00	11.04	4.3
NW	0.65	2.04	3.18	1.77	0.28	0.06	0.03	0.00	0.00	8.00	4.0
NNW	0.64	1.70	1.92	0.67	0.09	0.00	0.00	0.00	0.00	5.02	3.4
N	0.76	1.42	0.54	0.11	0.04	0.00	0.00	0.00	0.00	2.86	2.4
CALM	1.17									1.17	
TOTAL	18.60	28.56	27.48	17.94	6.13	1.15	0.15	0.00	0.00	100.00	3.7

NUMBER OF VALID OBSERVATIONS	8173	93.04 PCT.
NUMBER OF INVALID OBSERVATIONS	611	6.96 PCT.
TOTAL NUMBER OF OBSERVATIONS	8784	100.00 PCT.

TABLE A.3.3-B-1g

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: OCTOBER 1, 1983 0100 - SEPTEMBER 30, 1984 2400

DATA SOURCE: REMOTE SITE 10-METERS
TABLE GENERATED: 21-DEC-84 07:11:44

CONNOISARAULEY REMOTE SITE

WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10835-139-23

FREQUENCY IN PERCENT

WIND DIR	INTERVALS OF WIND SPEED IN MPS 0.0- 1.5	1.5- 3.0	3.0- 5.0	5.0- 7.5	7.5-10.0	10.0-12.5	12.5-15.0	15.0-17.5	>17.5	TOTAL	MEAN WIND SPEED
NNE	1.13	1.13	0.55	0.05	0.01	0.00	0.00	0.00	0.00	2.87	2.1
NE	0.73	0.71	0.68	0.12	0.00	0.00	0.00	0.00	0.00	2.23	2.5
ENE	0.60	0.35	0.18	0.09	0.00	0.00	0.00	0.00	0.00	1.22	2.0
E	0.51	0.65	0.06	0.00	0.00	0.00	0.00	0.00	0.00	1.22	1.8
ESE	0.65	0.56	0.19	0.01	0.00	0.00	0.00	0.00	0.00	1.41	1.9
SE	1.42	1.95	0.80	0.18	0.01	0.00	0.00	0.00	0.00	4.36	2.3
SSE	2.94	5.42	3.04	1.49	0.58	0.11	0.00	0.00	0.00	13.58	3.1
S	1.67	3.60	3.81	3.69	1.30	0.25	0.00	0.00	0.00	14.32	4.3
SSW	0.59	1.50	2.77	2.45	0.40	0.02	0.00	0.00	0.00	7.74	4.3
SW	0.55	1.25	3.07	2.93	0.63	0.01	0.00	0.00	0.00	8.44	4.7
WSW	0.42	1.43	2.35	1.81	0.28	0.02	0.00	0.00	0.00	6.32	4.2
W	0.65	1.58	2.46	1.11	0.34	0.07	0.00	0.00	0.00	6.20	4.0
WNW	0.25	1.95	3.14	2.00	0.41	0.05	0.00	0.00	0.00	8.41	4.1
NW	1.39	2.53	3.42	1.74	0.26	0.01	0.00	0.00	0.00	9.35	3.6
NNW	1.70	2.40	1.83	0.65	0.05	0.00	0.00	0.00	0.00	6.64	2.8
N	1.27	1.55	1.05	0.40	0.06	0.00	0.00	0.00	0.00	4.33	2.7
CALM	1.36									1.36	
TOTAL	18.43	28.57	29.40	18.70	4.35	0.54	0.00	0.00	0.00	100.00	3.6

NUMBER OF VALID OBSERVATIONS	8506	96.84 PCT.
NUMBER OF INVALID OBSERVATIONS	278	3.16 PCT.
TOTAL NUMBER OF OBSERVATIONS	8784	100.00 PCT.

TABLE A.3.3-B-1h

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD OCTOBER 1, 1983 0100 - SEPTEMBER 30, 1984 2400

DATA SOURCE: REMOTE SITE 10-METERS
TABLE GENERATED: 21-DEC-84 07:12:26

SPRINGVILLE REMOTE SITE

WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10305-139-23

FREQUENCY IN PERCENT

INTERVALS OF WIND SPEED IN MPS

WIND DIR	0.0- 1.5	1.5- 3.0	3.0- 5.0	5.0- 7.5	7.5-10.0	10.0-12.5	12.5-15.0	15.0-17.5	>17.5	TOTAL	MEAN WIND SPEED
NNE	1.49	1.15	1.27	0.26	0.02	0.00	0.00	0.00	0.00	4.19	2.6
NE	0.80	0.98	0.93	0.40	0.01	0.00	0.00	0.00	0.00	3.12	2.9
ENE	0.51	0.81	0.70	0.33	0.02	0.00	0.00	0.00	0.00	2.40	3.1
E	0.31	0.85	0.80	0.20	0.00	0.00	0.00	0.00	0.00	2.17	3.1
ESE	0.40	0.59	0.69	0.33	0.01	0.00	0.00	0.00	0.00	2.02	3.2
SE	0.65	0.54	0.76	0.24	0.02	0.00	0.00	0.00	0.00	2.21	2.9
SSE	1.15	0.74	0.77	0.51	0.12	0.00	0.00	0.00	0.00	3.30	3.0
S	2.36	1.65	2.00	1.04	0.32	0.04	0.00	0.00	0.00	7.40	3.2
SSW	2.93	2.39	2.06	0.83	0.11	0.00	0.00	0.00	0.00	8.31	2.7
SW	3.57	3.02	2.63	1.13	0.04	0.02	0.00	0.00	0.00	10.41	2.7
WSW	2.70	3.20	4.53	2.44	0.54	0.07	0.00	0.00	0.00	13.49	3.6
W	2.03	2.94	4.20	2.32	0.40	0.05	0.00	0.00	0.00	11.95	3.6
WNW	1.64	2.71	3.61	1.27	0.01	0.02	0.00	0.00	0.00	9.27	3.2
NW	1.45	1.96	2.38	0.81	0.05	0.00	0.00	0.00	0.00	6.65	3.1
NNW	1.43	1.68	1.70	0.52	0.02	0.00	0.00	0.00	0.00	5.35	2.8
N	1.98	1.33	1.06	0.25	0.00	0.00	0.00	0.00	0.00	4.62	2.2
CALM	3.14									3.14	
TOTAL	28.55	26.54	30.10	12.90	1.70	0.20	0.00	0.00	0.00	100.00	3.0

NUMBER OF VALID OBSERVATIONS	8403	95.66 PCT.
NUMBER OF INVALID OBSERVATIONS	381	4.34 PCT.
TOTAL NUMBER OF OBSERVATIONS	8784	100.00 PCT.

TABLE A.3.3-B-2a

STABILITY CLASS COMPARISON BY WIND SECTOR

WEST VALLFY NUCLEAR SERVICES

DELTA TEMPERATURE 10-60 METERS - PRIMARY WIND 10-METERS

OCTOBER 1, 1983 - SEPTEMBER 30, 1984

WIND SECTOR	PASQUILL STABILITY CLASS A	B	C	D	E	F	G	ALL CLASSES
NNE	3.38 0.47	3.13 0.13	1.53 0.07	1.79 0.77	0.34 0.07	0.00 0.00	0.13 0.01	1.51
NE	3.54 0.49	4.27 0.17	1.79 0.08	2.94 1.26	0.22 0.05	0.39 0.02	0.26 0.02	2.09
ENE	2.06 0.29	1.42 0.06	1.79 0.08	1.42 0.61	0.45 0.09	0.20 0.01	0.13 0.01	1.14
E	1.40 0.19	1.99 0.08	3.07 0.14	2.08 0.89	0.67 0.14	0.79 0.05	0.13 0.01	1.50
ESE	2.47 0.34	1.42 0.06	3.07 0.14	2.38 1.02	2.02 0.41	2.17 0.13	0.52 0.05	2.14
SE	3.87 0.54	5.98 0.24	5.12 0.23	4.81 2.06	7.00 1.43	6.89 0.40	3.41 0.30	5.18
SSE	3.87 0.54	5.70 0.23	7.16 0.32	11.08 4.74	18.32 3.73	25.98 1.51	44.04 3.84	14.90
S	4.28 0.59	3.70 0.15	5.88 0.26	7.50 3.21	22.58 4.60	30.31 1.76	42.33 3.69	14.26
SSW	4.94 0.69	6.55 0.26	4.60 0.21	6.46 2.76	16.53 3.37	11.02 0.64	5.37 0.47	8.39
SW	7.33 1.02	9.40 0.38	12.28 0.55	8.76 3.75	6.67 1.36	8.27 0.48	1.70 0.15	7.67
WSW	5.85 0.81	5.70 0.23	4.60 0.21	5.31 2.27	3.75 0.77	4.72 0.27	1.05 0.09	4.65
W	4.70 0.65	5.70 0.23	3.07 0.14	4.83 2.07	4.59 0.94	3.54 0.21	0.39 0.03	4.26
WNW	6.43 0.89	6.55 0.26	8.18 0.37	9.99 4.27	6.39 1.30	2.56 0.15	0.26 0.02	7.26
NW	22.08 3.06	22.79 0.91	17.65 0.79	17.49 7.48	6.95 1.42	1.77 0.10	0.13 0.01	13.77
NNW	17.22 2.39	11.40 0.46	14.07 0.63	10.65 4.56	2.52 0.51	0.59 0.03	0.13 0.01	8.59
N	6.59 0.91	4.27 0.17	6.14 0.27	2.51 1.07	1.01 0.21	0.79 0.05	0.00 0.00	2.68
CALM	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00
TOTAL	100.00 13.86	100.00 4.01	100.00 4.46	100.00 42.77	100.00 20.38	100.00 5.80	100.00 8.71	100.00

XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE A.3.3-B-2b

STABILITY CLASS COMPARISON BY WIND SECTOR

WEST VALLEY NUCLEAR SERVICES

DELTA TEMPERATURE 10-60 METERS - PRIMARY WIND 60-METERS

OCTOBER 1, 1983 - SEPTEMBER 30, 1984

	PASQUILL STABILITY CLASS							
WIND SECTOR	A	B	C	D	E	F	G	ALL CLASSES
NNE	4.19 0.57	4.30 0.17	2.56 0.11	2.16 0.93	0.90 0.18	1.00 0.06	0.39 0.03	2.07
NE	3.02 0.41	4.87 0.20	1.28 0.06	3.23 1.39	1.30 0.26	0.60 0.03	0.53 0.05	2.40
ENE	2.10 0.29	1.72 0.07	2.56 0.11	2.30 0.99	1.07 0.22	1.60 0.09	0.66 0.06	1.83
E	1.59 0.22	1.72 0.07	2.31 0.10	2.14 0.92	1.92 0.39	0.40 0.02	0.92 0.08	1.80
ESE	2.77 0.38	0.57 0.02	3.59 0.16	2.49 1.07	1.47 0.30	1.40 0.08	1.05 0.09	2.10
SE	2.93 0.40	6.30 0.25	3.33 0.15	3.61 1.55	5.14 1.05	6.21 0.36	3.16 0.28	4.03
SSE	4.19 0.57	5.73 0.23	6.67 0.30	9.75 4.19	17.50 3.56	32.26 1.85	43.29 3.78	14.49
S	2.93 0.40	2.87 0.11	5.13 0.23	6.60 2.84	14.68 2.99	13.83 0.79	14.87 1.30	8.66
SSW	4.36 0.60	3.15 0.13	4.36 0.20	4.28 1.84	11.24 2.29	10.62 0.61	10.66 0.93	6.58
SW	5.70 0.78	8.02 0.32	7.44 0.33	5.99 2.57	13.55 2.76	8.42 0.48	11.05 0.97	8.21
WSW	9.14 1.25	10.03 0.40	11.28 0.51	11.06 4.76	8.07 1.64	5.21 0.30	4.74 0.41	9.27
W	6.96 0.95	8.88 0.36	6.41 0.29	10.05 4.32	5.99 1.22	6.01 0.34	4.74 0.41	7.89
WNW	12.07 1.65	11.75 0.47	13.33 0.60	14.86 6.39	7.00 1.42	2.20 0.13	1.71 0.15	10.81
NW	22.46 3.08	19.77 0.79	14.62 0.65	12.69 5.46	5.03 1.02	4.61 0.26	0.66 0.06	11.33
NNW	10.65 1.46	6.88 0.28	7.44 0.33	6.20 2.67	3.22 0.65	3.61 0.21	0.66 0.06	5.65
N	4.95 0.68	3.44 0.14	7.69 0.34	2.57 1.10	1.81 0.37	1.80 0.10	0.92 0.08	2.81
CALM	0.00 0.00	0.00 0.00	0.00 0.00	0.03 0.01	0.11 0.02	0.20 0.01	0.00 0.00	0.05
TOTAL	100.00 13.71	100.00 4.01	100.00 4.48	100.00 42.99	100.00 20.35	100.00 5.73	100.00 8.73	100.00

XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE A.3.3-B-3

PERCENT RECOVERIES
OCTOBER 1983 - SEPTEMBER 1984

PARAMETER	PERCENT RECOVERY
Primary temperature	99.7
Primary delta temperature (10-60 meters)	99.7
Primary wind speed (10-meters)	100.0
Primary wind direction (10-meters)	100.0
Primary horizontal sigma (10-meters)	99.5
Primary wind speed (60-meters)	100.0
Primary wind direction (60-meters)	100.0
Primary horizontal sigma (60-meters)	99.5
Regional wind speed	99.2
Regional wind direction	96.4
Regional horizontal sigma	96.0
West Valley wind speed	94.4
West Valley wind direction	96.0
West Valley horizontal sigma	82.0
Riceville wind speed	96.8
Riceville wind direction	98.9
Riceville horizontal sigma	94.7
Cattaraugus wind speed	95.5
Cattaraugus wind direction	96.3
Cattaraugus horizontal sigma	96.3
Connoisarauley wind speed	97.1
Connoisarauley wind direction	98.1
Connoisarauley horizontal sigma	95.7
Springville wind speed	96.2
Springville wind direction	98.1
Springville horizontal sigma	96.9

TABLE A.3.3-B-4a

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: OCTOBER 1, 1983 TO SEPTEMBER 30, 1984

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 21-DEC-84 07:19:59

WEST VALLEY
DELTA TEMPERATURE HEIGHT: 60-10M
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	2	22	17	0	0	0	41	2.87
	0.16	1.81	1.40	0.00	0.00	0.00	3.38	
	0.02	0.25	0.19	0.00	0.00	0.00	0.47	
NE	5	25	13	0	0	0	43	2.62
	0.41	2.06	1.07	0.00	0.00	0.00	3.54	
	0.05	0.29	0.15	0.00	0.00	0.00	0.49	
ENE	2	6	17	0	0	0	25	3.24
	0.16	0.49	1.40	0.00	0.00	0.00	2.06	
	0.02	0.07	0.19	0.00	0.00	0.00	0.29	
E	2	5	10	0	0	0	17	3.24
	0.16	0.41	0.82	0.00	0.00	0.00	1.40	
	0.02	0.06	0.11	0.00	0.00	0.00	0.19	
ESE	1	16	10	3	0	0	30	3.09
	0.08	1.32	0.82	0.25	0.00	0.00	2.47	
	0.01	0.18	0.11	0.03	0.00	0.00	0.34	
SE	6	18	12	10	1	0	47	3.61
	0.49	1.48	0.99	0.82	0.08	0.00	3.87	
	0.07	0.21	0.14	0.11	0.01	0.00	0.54	
SSE	2	16	12	12	3	2	47	4.44
	0.16	1.32	0.99	0.99	0.25	0.16	3.87	
	0.02	0.18	0.14	0.14	0.03	0.02	0.54	
S	2	20	24	6	0	0	52	3.46
	0.16	1.65	1.98	0.49	0.00	0.00	4.28	
	0.02	0.23	0.27	0.07	0.00	0.00	0.59	
SSW	1	24	34	1	0	0	60	3.24
	0.08	1.98	2.80	0.08	0.00	0.00	4.94	
	0.01	0.27	0.39	0.01	0.00	0.00	0.69	
SW	2	45	42	0	0	0	89	2.99
	0.16	3.71	3.46	0.00	0.00	0.00	7.33	
	0.02	0.51	0.48	0.00	0.00	0.00	1.02	
WSW	1	43	27	0	0	0	71	2.94
	0.08	3.54	2.22	0.00	0.00	0.00	5.85	
	0.01	0.49	0.31	0.00	0.00	0.00	0.81	
W	4	43	10	0	0	0	57	2.56
	0.33	3.54	0.82	0.00	0.00	0.00	4.70	
	0.05	0.49	0.11	0.00	0.00	0.00	0.65	
WNW	1	52	25	0	0	0	78	2.79
	0.08	4.28	2.06	0.00	0.00	0.00	6.43	
	0.01	0.59	0.29	0.00	0.00	0.00	0.89	
NW	3	82	168	15	0	0	269	3.49
	0.25	6.75	13.84	1.24	0.00	0.00	22.09	
	0.03	0.94	1.92	0.17	0.00	0.00	3.06	
NNW	2	95	99	13	0	0	209	3.26
	0.16	7.83	8.15	1.07	0.00	0.00	17.22	
	0.02	1.08	1.13	0.15	0.00	0.00	2.39	
N	1	45	30	4	0	0	80	3.10
	0.08	3.71	2.47	0.33	0.00	0.00	6.59	
	0.01	0.51	0.34	0.05	0.00	0.00	0.91	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	37	557	550	64	4	2	1214	3.22
	3.05	45.88	45.30	5.27	0.33	0.16	100.00	
	0.42	6.36	6.28	0.73	0.05	0.02	13.86	

KEY: XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE A.3.3-B-4b

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: OCTOBER 1, 1983 TO SEPTEMBER 30, 1984

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 21-DEC-84 07:19:59

WEST VALLEY
DELTA TEMPERATURE HEIGHT: 60-10M
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	4	6	1	0	0	0	11	2.05
	1.14	1.71	0.28	0.00	0.00	0.00	3.13	
	0.05	0.07	0.01	0.00	0.00	0.00	0.13	
NE	3	5	7	0	0	0	15	2.61
	0.85	1.42	1.99	0.00	0.00	0.00	4.27	
	0.03	0.06	0.08	0.00	0.00	0.00	0.17	
ENE	1	2	2	0	0	0	5	2.40
	0.28	0.57	0.57	0.00	0.00	0.00	1.42	
	0.01	0.02	0.02	0.00	0.00	0.00	0.06	
E	1	1	5	0	0	0	7	3.20
	0.28	0.28	1.42	0.00	0.00	0.00	1.99	
	0.01	0.01	0.06	0.00	0.00	0.00	0.08	
ESE	1	1	0	3	0	0	5	4.18
	0.28	0.28	0.00	0.85	0.00	0.00	1.42	
	0.01	0.01	0.00	0.03	0.00	0.00	0.06	
SE	1	4	9	7	0	0	21	4.26
	0.28	1.14	2.56	1.99	0.00	0.00	5.98	
	0.01	0.05	0.10	0.08	0.00	0.00	0.24	
SSE	0	2	5	9	4	0	20	5.87
	0.00	0.57	1.42	2.56	1.14	0.00	5.70	
	0.00	0.02	0.06	0.10	0.05	0.00	0.23	
S	1	5	5	2	0	0	13	3.75
	0.28	1.42	1.42	0.57	0.00	0.00	3.70	
	0.01	0.06	0.06	0.02	0.00	0.00	0.15	
SSW	0	19	3	1	0	0	23	2.65
	0.00	5.41	0.85	0.28	0.00	0.00	6.55	
	0.00	0.22	0.03	0.01	0.00	0.00	0.26	
SW	1	22	9	1	0	0	33	2.82
	[illegible]	6.27	2.56	0.28	0.00	0.00	9.40	
	[illegible]	[illegible]	0.10	0.01	0.00	0.00	0.38	
WSW	[illegible]	[illegible]	6	0	0	0	20	2.88
	[illegible]	[illegible]	1.71	0.00	0.00	0.00	5.70	
	[illegible]	0.16	0.07	0.00	0.00	0.00	0.23	
W	1	13	6	0	0	0	20	2.70
	0.28	3.70	1.71	0.00	0.00	0.00	5.70	
	0.01	0.15	0.07	0.00	0.00	0.00	0.23	
WNW	2	13	7	1	0	0	23	2.82
	0.57	3.70	1.99	0.28	0.00	0.00	6.55	
	0.02	0.15	0.08	0.01	0.00	0.00	0.26	
NW	0	31	45	4	0	0	80	3.34
	0.00	8.83	12.82	1.14	0.00	0.00	22.79	
	0.00	0.35	0.51	0.05	0.00	0.00	0.91	
NNW	2	21	16	1	0	0	40	2.93
	0.57	5.98	4.56	0.28	0.00	0.00	11.40	
	0.02	0.24	0.18	0.01	0.00	0.00	0.46	
N	0	8	7	0	0	0	15	3.01
	0.00	2.28	1.99	0.00	0.00	0.00	4.27	
	0.00	0.09	0.08	0.00	0.00	0.00	0.17	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	18	167	133	29	4	0	351	3.23
	5.13	47.58	37.89	8.26	1.14	0.00	100.00	
	0.21	1.91	1.52	0.33	0.05	0.00	4.01	

KEY: XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE A.3.3-B-4c

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: OCTOBER 1, 1983 TO SEPTEMBER 30, 1984

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 21-DEC-84 07:19:59

WEST VALLEY
DELTA TEMPERATURE HEIGHT: 60-10M
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	1	5	0	0	0	0	6	2.05
	0.26	1.28	0.00	0.00	0.00	0.00	1.53	
	0.01	0.06	0.00	0.00	0.00	0.00	0.07	
NE	1	5	1	0	0	0	7	2.33
	0.26	1.28	0.26	0.00	0.00	0.00	1.79	
	0.01	0.06	0.01	0.00	0.00	0.00	0.08	
ENE	1	3	3	0	0	0	7	2.93
	0.26	0.77	0.77	0.00	0.00	0.00	1.79	
	0.01	0.03	0.03	0.00	0.00	0.00	0.08	
E	2	4	4	2	0	0	12	3.25
	0.51	1.02	1.02	0.51	0.00	0.00	3.07	
	0.02	0.05	0.05	0.02	0.00	0.00	0.14	
ESE	0	2	6	4	0	0	12	4.30
	0.00	0.51	1.53	1.02	0.00	0.00	3.07	
	0.00	0.02	0.07	0.05	0.00	0.00	0.14	
SE	3	5	5	7	0	0	20	3.86
	0.77	1.28	1.28	1.79	0.00	0.00	5.12	
	0.03	0.06	0.06	0.08	0.00	0.00	0.23	
SSE	1	4	12	9	2	0	28	4.53
	0.26	1.02	3.07	2.30	0.51	0.00	7.16	
	0.01	0.05	0.14	0.10	0.02	0.00	0.32	
S	0	9	9	3	2	0	23	3.96
	0.00	2.30	2.30	0.77	0.51	0.00	5.88	
	0.00	0.10	0.10	0.03	0.02	0.00	0.26	
SSW	1	11	6	0	0	0	18	2.72
	0.26	2.81	1.53	0.00	0.00	0.00	4.60	
	0.01	0.13	0.07	0.00	0.00	0.00	0.21	
SW	3	21	23	1	0	0	48	2.94
	0.77	5.37	5.88	0.26	0.00	0.00	12.28	
	0.03	0.24	0.26	0.01	0.00	0.00	0.55	
WSW	0	11	5	2	0	0	18	3.16
	0.00	2.81	1.28	0.51	0.00	0.00	4.60	
	0.00	0.13	0.06	0.02	0.00	0.00	0.21	
W	1	10	1	0	0	0	12	2.57
	0.26	2.56	0.26	0.00	0.00	0.00	3.07	
	0.01	0.11	0.01	0.00	0.00	0.00	0.14	
WNW	4	14	9	5	0	0	32	3.10
	1.02	3.58	2.30	1.28	0.00	0.00	8.18	
	0.05	0.16	0.10	0.06	0.00	0.00	0.37	
NW	1	38	30	0	0	0	69	2.89
	0.26	9.72	7.67	0.00	0.00	0.00	17.65	
	0.01	0.43	0.34	0.00	0.00	0.00	0.79	
NNW	6	24	21	4	0	0	55	3.04
	1.53	6.14	5.37	1.02	0.00	0.00	14.07	
	0.07	0.27	0.24	0.05	0.00	0.00	0.63	
N	0	19	5	0	0	0	24	2.42
	0.00	4.86	1.28	0.00	0.00	0.00	6.14	
	0.00	0.22	0.06	0.00	0.00	0.00	0.27	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	25	185	140	37	4	0	391	3.16
	6.39	47.31	35.81	9.46	1.02	0.00	100.00	
	0.29	2.11	1.60	0.42	0.05	0.00	4.46	

KEY: XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE A.3.3-B-4d

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: OCTOBER 1, 1983 TO SEPTEMBER 30, 1984

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 21-DEC-84 07:19:59

WEST VALLEY
DELTA TEMPERATURE HEIGHT: 60-10M
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-07

WIND SECTOR	WIND SPEED CATEGORIES(METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	21	33	13	0	0	0	67	2.14
	0.56	0.88	0.35	0.00	0.00	0.00	1.79	
	0.24	0.38	0.15	0.00	0.00	0.00	0.77	
NE	28	68	14	0	0	0	110	2.11
	0.75	1.82	0.37	0.00	0.00	0.00	2.94	
	0.32	0.78	0.16	0.00	0.00	0.00	1.26	
ENE	15	27	11	0	0	0	53	2.35
	0.40	0.72	0.29	0.00	0.00	0.00	1.42	
	0.17	0.31	0.13	0.00	0.00	0.00	0.61	
E	22	25	27	4	0	0	78	2.65
	0.59	0.67	0.72	0.11	0.00	0.00	2.08	
	0.25	0.29	0.31	0.05	0.00	0.00	0.89	
ESE	20	26	38	5	0	0	89	2.88
	0.53	0.69	1.01	0.13	0.00	0.00	2.38	
	0.23	0.30	0.43	0.06	0.00	0.00	1.02	
SE	28	62	65	23	2	0	180	3.24
	0.75	1.66	1.74	0.61	0.05	0.00	4.81	
	0.32	0.71	0.74	0.26	0.02	0.00	2.06	
SSE	39	70	129	116	48	13	415	4.80
	1.04	1.87	3.44	3.10	1.28	0.35	11.08	
	0.45	0.80	1.47	1.32	0.55	0.15	4.74	
S	40	80	113	36	11	1	281	3.53
	1.07	2.14	3.02	0.96	0.29	0.03	7.50	
	0.46	0.91	1.29	0.41	0.13	0.01	3.21	
SSW	46	128	62	6	0	0	242	2.54
	1.23	3.42	1.66	0.16	0.00	0.00	6.46	
	0.53	1.46	0.71	0.07	0.00	0.00	2.76	
SW	37	156	130	5	0	0	328	2.84
	0.99	4.17	3.47	0.13	0.00	0.00	8.76	
	0.42	1.78	1.48	0.06	0.00	0.00	3.75	
WSW	31	119	47	2	0	0	199	2.50
	0.83	3.18	1.26	0.05	0.00	0.00	5.31	
	0.35	1.36	0.54	0.02	0.00	0.00	2.27	
W	47	90	44	0	0	0	181	2.27
	1.26	2.40	1.17	0.00	0.00	0.00	4.83	
	0.54	1.03	0.50	0.00	0.00	0.00	2.07	
WNW	71	214	79	10	0	0	374	2.51
	1.90	5.71	2.11	0.27	0.00	0.00	9.99	
	0.81	2.44	0.90	0.11	0.00	0.00	4.27	
NW	77	315	221	42	0	0	655	2.91
	2.06	8.41	5.90	1.12	0.00	0.00	17.49	
	0.89	3.60	2.52	0.48	0.00	0.00	7.48	
NNW	55	179	145	20	0	0	399	2.86
	1.47	4.78	3.87	0.53	0.00	0.00	10.65	
	0.63	2.04	1.66	0.23	0.00	0.00	4.56	
N	26	46	22	0	0	0	94	2.21
	0.69	1.23	0.59	0.00	0.00	0.00	2.51	
	0.30	0.53	0.25	0.00	0.00	0.00	1.07	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	603	1638	1160	269	61	14	3745	2.98
	16.10	43.74	30.97	7.18	1.63	0.37	100.00	
	6.89	18.71	13.25	3.07	0.70	0.16	42.77	

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE A.3.3-B-4e

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD OCTOBER 1, 1983 TO SEPTEMBER 30, 1984

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 21-DEC-84 07:19:59

WEST VALLEY
DELTA TEMPERATURE HEIGHT: 60-10M
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	6	0	0	0	0	0	6	1.10
	0.34	0.00	0.00	0.00	0.00	0.00	0.34	
	0.07	0.00	0.00	0.00	0.00	0.00	0.07	
NE	4	0	0	0	0	0	4	0.85
	0.22	0.00	0.00	0.00	0.00	0.00	0.22	
	0.05	0.00	0.00	0.00	0.00	0.00	0.05	
ENE	7	1	0	0	0	0	8	1.05
	0.39	0.06	0.00	0.00	0.00	0.00	0.45	
	0.08	0.01	0.00	0.00	0.00	0.00	0.09	
E	8	4	0	0	0	0	12	1.37
	0.45	0.22	0.00	0.00	0.00	0.00	0.67	
	0.09	0.05	0.00	0.00	0.00	0.00	0.14	
ESE	22	11	3	0	0	0	36	1.59
	1.23	0.62	0.17	0.00	0.00	0.00	2.02	
	0.25	0.13	0.03	0.00	0.00	0.00	0.41	
SE	52	40	30	3	0	0	125	2.20
	2.91	2.24	1.68	0.17	0.00	0.00	7.00	
	0.59	0.46	0.34	0.03	0.00	0.00	1.43	
SSE	76	118	80	46	7	0	327	3.04
	4.26	6.61	4.48	2.58	0.39	0.00	18.32	
	0.87	1.35	0.91	0.53	0.08	0.00	3.73	
S	98	158	120	20	6	1	403	2.78
	5.49	8.85	6.72	1.12	0.34	0.06	22.58	
	1.12	1.80	1.37	0.23	0.07	0.01	4.60	
SSW	96	162	37	0	0	0	295	2.06
	5.33	9.08	2.07	0.00	0.00	0.00	16.53	
	1.10	1.85	0.42	0.00	0.00	0.00	3.37	
SW	62	39	18	0	0	0	119	1.85
	3.47	2.18	1.01	0.00	0.00	0.00	6.67	
	0.71	0.45	0.21	0.00	0.00	0.00	1.36	
WSW	57	9	1	0	0	0	67	1.16
	3.19	0.50	0.06	0.00	0.00	0.00	3.75	
	0.65	0.10	0.01	0.00	0.00	0.00	0.77	
W	58	24	0	0	0	0	82	1.25
	3.25	1.34	0.00	0.00	0.00	0.00	4.59	
	0.65	0.27	0.00	0.00	0.00	0.00	0.94	
WNW	54	48	12	0	0	0	114	1.80
	3.03	2.69	0.67	0.00	0.00	0.00	6.39	
	0.62	0.55	0.14	0.00	0.00	0.00	1.30	
NW	48	46	18	12	0	0	124	2.41
	2.69	2.58	1.01	0.67	0.00	0.00	6.95	
	0.55	0.53	0.21	0.14	0.00	0.00	1.42	
NNW	16	10	15	4	0	0	45	2.79
	0.90	0.56	0.84	0.22	0.00	0.00	2.52	
	0.18	0.11	0.17	0.05	0.00	0.00	0.51	
N	15	3	0	0	0	0	18	1.20
	0.84	0.17	0.00	0.00	0.00	0.00	1.01	
	0.17	0.03	0.00	0.00	0.00	0.00	0.21	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	679	673	334	85	13	1	1785	2.32
	38.04	37.70	18.71	4.76	0.73	0.06	100.00	
	7.75	7.69	3.81	0.97	0.15	0.01	20.38	

KEY
XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE A.3.3-B-4f

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: OCTOBER 1, 1983 TO SEPTEMBER 30, 1984

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 21-DEC-84 07:19:59

WEST VALLEY
DELTA TEMPERATURE HEIGHT: 60-10M
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	2 0.39 0.02	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 0.39 0.02	0.85
ENE	0 0.00 0.00	1 0.20 0.01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 0.20 0.01	1.80
E	4 0.79 0.05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 0.79 0.05	0.75
ESE	11 2.17 0.13	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 2.17 0.13	0.88
SE	30 5.91 0.31	3 0.59 0.03	2 0.39 0.02	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	35 6.89 0.40	1.14
SSE	95 18.70 1.03	33 6.50 0.38	4 0.79 0.05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	132 25.98 1.51	1.32
S	104 20.47 1.19	45 8.86 0.51	5 0.98 0.06	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	154 30.31 1.76	1.34
SSW	45 8.65 0.51	11 2.17 0.13	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	56 11.02 0.64	1.08
SW	42 8.27 0.48	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	42 8.27 0.48	0.82
WSW	23 4.53 0.26	1 0.20 0.01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	24 4.72 0.27	0.93
W	18 3.54 0.21	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	18 3.54 0.21	0.95
WNW	12 2.36 0.14	1 0.20 0.01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	13 2.56 0.15	1.04
NW	4 0.79 0.05	5 0.98 0.06	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 1.77 0.10	1.43
NNW	3 0.59 0.03	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 0.59 0.03	1.07
N	4 0.79 0.05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 0.79 0.05	0.77
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	397 78.15 4.53	100 19.69 1.14	11 2.17 0.13	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	508 100.00 5.80	1.19

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE A.3.3-B-4g

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: OCTOBER 1, 1983 TO SEPTEMBER 30, 1984

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 21-DEC-84 07:19:59

WEST VALLEY
DELTA TEMPERATURE HEIGHT: 60-10M
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-07

WIND SECTOR	WIND SPEED CATEGORIES(METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	1	0	0	0	0	0	1	0.70
	0.13	0.00	0.00	0.00	0.00	0.00	0.13	
	0.01	0.00	0.00	0.00	0.00	0.00	0.01	
NE	2	0	0	0	0	0	2	0.85
	0.26	0.00	0.00	0.00	0.00	0.00	0.26	
	0.02	0.00	0.00	0.00	0.00	0.00	0.02	
ENE	1	0	0	0	0	0	1	0.50
	0.13	0.00	0.00	0.00	0.00	0.00	0.13	
	0.01	0.00	0.00	0.00	0.00	0.00	0.01	
E	1	0	0	0	0	0	1	0.80
	0.13	0.00	0.00	0.00	0.00	0.00	0.13	
	0.01	0.00	0.00	0.00	0.00	0.00	0.01	
ESE	4	0	0	0	0	0	4	0.75
	0.52	0.00	0.00	0.00	0.00	0.00	0.52	
	0.05	0.00	0.00	0.00	0.00	0.00	0.05	
SE	25	1	0	0	0	0	26	0.90
	3.28	0.13	0.00	0.00	0.00	0.00	3.41	
	0.29	0.01	0.00	0.00	0.00	0.00	0.30	
SSE	293	41	2	0	0	0	336	1.15
	38.40	5.37	0.26	0.00	0.00	0.00	44.04	
	3.35	0.47	0.02	0.00	0.00	0.00	3.84	
S	292	29	2	0	0	0	323	1.05
	38.27	3.80	0.26	0.00	0.00	0.00	42.33	
	3.33	0.33	0.02	0.00	0.00	0.00	3.69	
SSW	40	1	0	0	0	0	41	0.84
	5.24	0.13	0.00	0.00	0.00	0.00	5.37	
	0.46	0.01	0.00	0.00	0.00	0.00	0.47	
SW	13	0	0	0	0	0	13	0.68
	1.70	0.00	0.00	0.00	0.00	0.00	1.70	
	0.15	0.00	0.00	0.00	0.00	0.00	0.15	
WSW	8	0	0	0	0	0	8	0.74
	1.05	0.00	0.00	0.00	0.00	0.00	1.05	
	0.09	0.00	0.00	0.00	0.00	0.00	0.09	
W	3	0	0	0	0	0	3	0.77
	0.39	0.00	0.00	0.00	0.00	0.00	0.39	
	0.03	0.00	0.00	0.00	0.00	0.00	0.03	
WNW	2	0	0	0	0	0	2	0.75
	0.26	0.00	0.00	0.00	0.00	0.00	0.26	
	0.02	0.00	0.00	0.00	0.00	0.00	0.02	
NW	1	0	0	0	0	0	1	0.80
	0.13	0.00	0.00	0.00	0.00	0.00	0.13	
	0.01	0.00	0.00	0.00	0.00	0.00	0.01	
NNW	1	0	0	0	0	0	1	1.00
	0.13	0.00	0.00	0.00	0.00	0.00	0.13	
	0.01	0.00	0.00	0.00	0.00	0.00	0.01	
N	0	0	0	0	0	0	0	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	687	72	4	0	0	0	763	1.06
	90.04	9.44	0.52	0.00	0.00	0.00	100.00	
	7.85	0.82	0.05	0.00	0.00	0.00	8.71	

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE A.3.3-B-4h

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: OCTOBER 1, 1983 TO SEPTEMBER 30, 1984

ALL CLASSES
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 21-DEC-84 07:19:59

WEST VALLEY
DELTA TEMPERATURE HEIGHT: 60-10M
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-07

WIND SECTOR	WIND SPEED CATEGORIES(METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	35	66	31	0	0	0	132	2.30
	0.40	0.75	0.35	0.00	0.00	0.00	1.51	
NE	45	103	35	0	0	0	183	2.23
	0.51	1.18	0.40	0.00	0.00	0.00	2.09	
ENE	27	40	33	0	0	0	100	2.48
	0.31	0.46	0.38	0.00	0.00	0.00	1.14	
E	40	39	46	6	0	0	131	2.62
	0.46	0.45	0.53	0.07	0.00	0.00	1.50	
ESE	59	56	57	15	0	0	187	2.63
	0.67	0.64	0.65	0.17	0.00	0.00	2.14	
SE	145	133	123	50	3	0	454	2.77
	1.65	1.52	1.40	0.57	0.03	0.00	5.18	
SSE	506	284	244	192	64	15	1305	3.06
	5.78	3.24	2.79	2.19	0.73	0.17	14.90	
S	537	346	278	67	19	2	1249	2.38
	6.13	3.95	3.17	0.77	0.22	0.02	14.26	
SSW	229	356	142	8	0	0	735	2.21
	2.62	4.07	1.62	0.09	0.00	0.00	8.39	
SW	160	283	222	7	0	0	672	2.52
	1.83	3.23	2.54	0.08	0.00	0.00	7.67	
WSW	120	197	86	4	0	0	407	2.28
	1.37	2.25	0.98	0.05	0.00	0.00	4.65	
W	132	180	61	0	0	0	373	2.05
	1.51	2.06	0.70	0.00	0.00	0.00	4.26	
WNW	146	342	132	16	0	0	636	2.42
	1.67	3.91	1.51	0.18	0.00	0.00	7.26	
NW	134	517	482	73	0	0	1206	3.00
	1.53	5.90	5.50	0.83	0.00	0.00	13.77	
NNW	85	329	296	42	0	0	752	2.97
	0.97	3.76	3.38	0.48	0.00	0.00	8.59	
N	46	121	64	4	0	0	235	2.49
	0.53	1.38	0.73	0.05	0.00	0.00	2.68	
CALM	0						0	CALM
	0.00						0.00	
TOTAL	2446	3392	2332	484	86	17	8757	2.63
	27.93	38.73	26.63	5.53	0.98	0.19	100.00	

NUMBER OF VALID OBSERVATIONS 8757 99.69 PCT
NUMBER OF INVALID OBSERVATIONS 27 0.31 PCT
TOTAL NUMBER OF OBSERVATIONS 8784 100.00 PCT

KEY: XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE A.3.3-B-4i

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: OCTOBER 1, 1983 TO SEPTEMBER 30, 1984

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 21-DEC-84 07:19:59

WEST VALLEY
DELTA TEMPERATURE HEIGHT: 60-10M
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-07

WIND SECTOR	WIND SPEED CATEGORIES(METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	37	66	31	0	0	0	134	2.28
	0.42	0.75	0.35	0.00	0.00	0.00	1.53	
NE	45	105	35	0	0	0	185	2.22
	0.51	1.20	0.40	0.00	0.00	0.00	2.11	
ENE	27	40	33	0	0	0	100	2.48
	0.31	0.46	0.38	0.00	0.00	0.00	1.14	
E	40	39	46	6	0	0	131	2.62
	0.46	0.44	0.52	0.07	0.00	0.00	1.49	
ESE	59	56	57	15	0	0	187	2.63
	0.67	0.64	0.65	0.17	0.00	0.00	2.13	
SE	145	133	123	50	3	0	454	2.77
	1.65	1.51	1.40	0.57	0.03	0.00	5.17	
SSE	506	284	244	192	64	15	1305	3.06
	5.76	3.23	2.78	2.19	0.73	0.17	14.86	
S	537	346	278	67	19	2	1249	2.38
	6.12	3.94	3.17	0.76	0.22	0.02	14.23	
SSW	229	356	142	8	0	0	735	2.21
	2.61	4.05	1.62	0.09	0.00	0.00	8.37	
SW	160	283	222	7	0	0	672	2.52
	1.82	3.22	2.53	0.08	0.00	0.00	7.65	
WSW	120	197	86	4	0	0	407	2.28
	1.37	2.24	0.98	0.05	0.00	0.00	4.64	
W	133	180	61	0	0	0	374	2.04
	1.51	2.05	0.69	0.00	0.00	0.00	4.26	
WNW	149	342	132	16	0	0	639	2.41
	1.70	3.90	1.50	0.18	0.00	0.00	7.28	
NW	139	519	482	73	0	0	1212	2.99
	1.57	5.91	5.49	0.83	0.00	0.00	13.80	
NNW	85	331	301	42	0	0	759	2.97
	0.97	3.77	3.43	0.48	0.00	0.00	8.64	
N	46	123	64	4	0	0	237	2.49
	0.52	1.40	0.73	0.05	0.00	0.00	2.70	
CALM	0						0	CALM
	0.00						0.00	
TOTAL	2455	3400	2337	484	86	17	8780	2.63
	27.97	38.72	26.62	5.51	0.98	0.19	100.00	

NUMBER OF VALID OBSERVATIONS	8780	99.95 PCT.
NUMBER OF INVALID OBSERVATIONS	4	0.05 PCT.
TOTAL NUMBER OF OBSERVATIONS	8784	100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE A.3.3-B-5a

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: OCTOBER 1, 1983 TO SEPTEMBER 30, 1984

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 21-DEC-84 07:19:59

WEST VALLEY
DELTA TEMPERATURE HEIGHT: 60-10M
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10305-139-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	2 0.17 0.02	14 1.17 0.16	30 2.51 0.34	4 0.34 0.05	0 0.00 0.00	0 0.00 0.00	50 4.19 0.57	3.64
NE	0 0.00 0.00	13 1.09 0.15	23 1.93 0.26	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	36 3.02 0.41	3.26
ENE	0 0.00 0.00	6 0.50 0.07	17 1.42 0.20	2 0.17 0.02	0 0.00 0.00	0 0.00 0.00	25 2.10 0.29	3.80
E	1 0.08 0.01	5 0.42 0.06	9 0.75 0.10	4 0.34 0.05	0 0.00 0.00	0 0.00 0.00	19 1.59 0.22	3.85
ESE	3 0.25 0.03	13 1.09 0.15	14 1.17 0.16	2 0.17 0.02	1 0.08 0.01	0 0.00 0.00	33 2.77 0.38	3.48
SE	3 0.25 0.03	13 1.09 0.15	7 0.59 0.08	8 0.67 0.09	4 0.34 0.05	0 0.00 0.00	35 2.93 0.40	4.30
SSE	1 0.08 0.01	13 1.09 0.15	15 1.26 0.17	13 1.09 0.15	3 0.25 0.03	5 0.42 0.06	50 4.19 0.57	5.21
S	0 0.00 0.00	11 0.92 0.13	8 0.67 0.09	13 1.09 0.15	2 0.17 0.02	1 0.08 0.01	35 2.93 0.40	4.60
SSW	1 0.08 0.01	11 0.92 0.13	20 1.68 0.23	19 1.59 0.22	1 0.08 0.01	0 0.00 0.00	52 4.36 0.60	4.55
SW	0 0.00 0.00	13 1.09 0.15	32 2.68 0.37	21 1.76 0.24	2 0.17 0.02	0 0.00 0.00	68 5.70 0.78	4.47
WSW	0 0.00 0.00	11 0.92 0.13	46 3.85 0.53	48 4.02 0.55	4 0.34 0.05	0 0.00 0.00	109 9.14 1.25	4.96
W	0 0.00 0.00	15 1.26 0.17	53 4.44 0.61	13 1.09 0.15	2 0.17 0.02	0 0.00 0.00	83 6.96 0.95	4.23
WNW	0 0.00 0.00	17 1.42 0.20	52 4.36 0.60	58 4.86 0.67	17 1.42 0.20	0 0.00 0.00	144 12.07 1.65	5.23
NW	1 0.08 0.01	41 3.44 0.47	103 8.63 1.18	106 8.89 1.22	15 1.26 0.17	2 0.17 0.02	268 22.46 3.08	4.92
NNW	1 0.08 0.01	30 2.51 0.34	60 5.03 0.69	27 2.26 0.31	9 0.75 0.10	0 0.00 0.00	127 10.65 1.45	4.32
N	1 0.08 0.01	16 1.34 0.18	28 2.35 0.32	13 1.09 0.15	1 0.08 0.01	0 0.00 0.00	59 4.95 0.68	3.97
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	14 1.17 0.16	242 20.28 2.78	517 43.34 5.94	351 29.42 4.03	61 5.11 0.70	8 0.67 0.09	1193 100.00 13.71	4.56

WIND SPEED CATEGORIES (METERS PER SECOND)

KEY
XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE A.3.3-B-5b

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: OCTOBER 1, 1983 TO SEPTEMBER 30, 1984

STABILITY CLASS: PASQUILL B	WEST VALLEY
DATA SOURCE: ON SITE	DELTA TEMPERATURE HEIGHT: 60-10M
WIND SENSOR HEIGHT: 60.00 METERS	WEST VALLEY NUCLEAR SERVICES
TABLE GENERATED: 21-DEC-84 07:19:59	DAMES AND MOORE JOB NO: 10805-139-07

WIND SECTOR	WIND SPEED CATEGORIES(METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	1 0.29 0.01	6 1.72 0.07	4 1.15 0.05	4 1.15 0.05	0 0.00 0.00	0 0.00 0.00	15 4.30 0.17	3.45
NE	3 0.86 0.03	4 1.15 0.05	10 2.87 0.11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	17 4.87 0.20	3.10
ENE	0 0.00 0.00	3 0.86 0.03	3 0.86 0.03	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 1.72 0.07	3.13
E	1 0.29 0.01	0 0.00 0.00	3 0.86 0.03	2 0.57 0.02	0 0.00 0.00	0 0.00 0.00	6 1.72 0.07	4.12
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 0.29 0.01	1 0.29 0.01	0 0.00 0.00	2 0.57 0.02	7.35
SE	2 0.57 0.02	2 0.57 0.02	9 2.58 0.10	9 2.58 0.10	0 0.00 0.00	0 0.00 0.00	22 6.30 0.25	4.73
SSE	0 0.00 0.00	3 0.86 0.03	2 0.57 0.02	7 2.01 0.08	4 1.15 0.05	4 1.15 0.05	20 5.73 0.23	6.94
S	0 0.00 0.00	1 0.29 0.01	3 0.86 0.03	4 1.15 0.05	2 0.57 0.02	0 0.00 0.00	10 2.87 0.11	5.65
SSW	0 0.00 0.00	3 0.86 0.03	5 1.43 0.06	3 0.86 0.03	0 0.00 0.00	0 0.00 0.00	11 3.15 0.13	3.87
SW	0 0.00 0.00	5 1.43 0.06	18 5.16 0.21	3 0.86 0.03	1 0.29 0.01	1 0.29 0.01	28 8.02 0.32	4.23
WSW	1 0.29 0.01	1 0.29 0.01	21 6.02 0.24	11 3.15 0.13	1 0.29 0.01	0 0.00 0.00	35 10.03 0.40	4.74
W	0 0.00 0.00	3 0.86 0.03	19 5.44 0.22	8 2.29 0.09	1 0.29 0.01	0 0.00 0.00	31 8.88 0.36	4.36
WNW	0 0.00 0.00	4 1.15 0.05	14 4.01 0.16	19 5.44 0.22	3 0.86 0.03	1 0.29 0.01	41 11.75 0.47	5.39
NW	0 0.00 0.00	8 2.29 0.09	30 8.60 0.34	25 7.16 0.29	4 1.15 0.05	2 0.57 0.02	69 19.77 0.79	5.09
NNW	0 0.00 0.00	5 1.43 0.06	13 3.72 0.15	6 1.72 0.07	0 0.00 0.00	0 0.00 0.00	24 6.88 0.28	4.17
N	2 0.57 0.02	5 1.43 0.06	4 1.15 0.05	1 0.29 0.01	0 0.00 0.00	0 0.00 0.00	12 3.44 0.14	3.03
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	10 2.87 0.11	53 15.19 0.61	158 45.27 1.82	103 29.51 1.18	17 4.87 0.20	8 2.29 0.09	349 100.00 4.01	4.68

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE A.3.3-B-5c

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: OCTOBER 1, 1983 TO SEPTEMBER 30, 1984

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 21-DEC-84 07:19:59

WEST VALLEY
DELTA TEMPERATURE HEIGHT: 60-10M
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-07

WIND SECTOR	WIND SPEED CATEGORIES(METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0	7	2	1	0	0	10	3.03
	0.00	1.79	0.51	0.26	0.00	0.00	2.56	
	0.00	0.08	0.02	0.01	0.00	0.00	0.11	
NE	1	2	2	0	0	0	5	2.72
	0.26	0.51	0.51	0.00	0.00	0.00	1.28	
	0.01	0.02	0.02	0.00	0.00	0.00	0.06	
ENE	2	1	7	0	0	0	10	3.17
	0.51	0.26	1.79	0.00	0.00	0.00	2.56	
	0.02	0.01	0.08	0.00	0.00	0.00	0.11	
E	1	3	1	3	1	0	9	4.44
	0.26	0.77	0.26	0.77	0.26	0.00	2.31	
	0.01	0.03	0.01	0.03	0.01	0.00	0.10	
ESE	1	2	3	7	1	0	14	5.18
	0.26	0.51	0.77	1.79	0.26	0.00	3.59	
	0.01	0.02	0.03	0.08	0.01	0.00	0.16	
SE	1	2	3	6	1	0	13	4.93
	0.26	0.51	0.77	1.54	0.26	0.00	3.33	
	0.01	0.02	0.03	0.07	0.01	0.00	0.15	
SSE	0	5	8	11	2	0	26	4.91
	0.00	1.28	2.05	2.82	0.51	0.00	6.67	
	0.00	0.06	0.09	0.13	0.02	0.00	0.30	
S	0	3	6	4	3	4	20	6.24
	0.00	0.77	1.54	1.03	0.77	1.03	5.13	
	0.00	0.03	0.07	0.05	0.03	0.05	0.23	
SSW	0	4	8	5	0	0	17	4.32
	0.00	1.03	2.05	1.28	0.00	0.00	4.36	
	0.00	0.05	0.09	0.06	0.00	0.00	0.20	
SW	0	7	15	6	1	0	29	4.11
	0.00	1.79	3.85	1.54	0.26	0.00	7.44	
	0.00	0.08	0.17	0.07	0.01	0.00	0.33	
WSW	1	2	16	18	5	2	44	5.46
	0.26	0.51	4.10	4.62	1.28	0.51	11.28	
	0.01	0.02	0.18	0.21	0.06	0.02	0.51	
W	0	4	14	6	1	0	25	4.47
	0.00	1.03	3.59	1.54	0.26	0.00	6.41	
	0.00	0.05	0.16	0.07	0.01	0.00	0.29	
WNW	0	9	14	24	0	5	52	5.46
	0.00	2.31	3.59	6.15	0.00	1.28	13.33	
	0.00	0.10	0.16	0.28	0.00	0.06	0.60	
NW	0	17	17	22	0	1	57	4.48
	0.00	4.36	4.36	5.64	0.00	0.26	14.62	
	0.00	0.20	0.20	0.25	0.00	0.01	0.65	
NNW	0	8	12	8	1	0	29	4.38
	0.00	2.05	3.08	2.05	0.26	0.00	7.44	
	0.00	0.09	0.14	0.09	0.01	0.00	0.33	
N	1	19	4	6	0	0	30	3.29
	0.26	4.87	1.03	1.54	0.00	0.00	7.69	
	0.01	0.22	0.05	0.07	0.00	0.00	0.34	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	8	95	132	127	16	12	390	4.65
	2.05	24.36	33.85	32.56	4.10	3.08	100.00	
	0.09	1.09	1.52	1.45	0.18	0.14	4.48	

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE A.3.3-B-5d

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: OCTOBER 1, 1983 TO SEPTEMBER 30, 1984

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 21-DEC-84 07:19:59

WEST VALLEY
DELTA TEMPERATURE HEIGHT: 60-10M
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	13	32	30	6	0	0	81	3.00
	0.35	0.86	0.80	0.16	0.00	0.00	2.16	
	0.15	0.37	0.34	0.07	0.00	0.00	0.93	
NE	23	57	35	6	0	0	121	2.66
	0.61	1.52	0.94	0.16	0.00	0.00	3.23	
	0.26	0.65	0.40	0.07	0.00	0.00	1.39	
ENE	12	33	34	7	0	0	86	3.00
	0.32	0.88	0.91	0.19	0.00	0.00	2.30	
	0.14	0.38	0.39	0.08	0.00	0.00	0.99	
E	7	22	27	23	1	0	80	3.82
	0.19	0.59	0.72	0.61	0.03	0.00	2.14	
	0.08	0.25	0.31	0.26	0.01	0.00	0.92	
ESE	19	18	28	23	5	0	93	3.65
	0.51	0.48	0.75	0.61	0.13	0.00	2.49	
	0.22	0.21	0.32	0.26	0.06	0.00	1.07	
SE	16	27	43	40	9	0	135	4.21
	0.43	0.72	1.15	1.07	0.24	0.00	3.61	
	0.18	0.31	0.49	0.46	0.10	0.00	1.55	
SSE	15	61	73	97	70	49	365	6.16
	0.40	1.63	1.95	2.59	1.87	1.31	9.75	
	0.17	0.70	0.84	1.11	0.80	0.56	4.19	
S	8	30	57	97	34	21	247	5.83
	0.21	0.80	1.52	2.59	0.91	0.56	6.60	
	0.09	0.34	0.65	1.11	0.39	0.24	2.84	
SSW	7	31	64	51	7	0	160	4.55
	0.19	0.83	1.71	1.36	0.19	0.00	4.28	
	0.03	0.36	0.74	0.59	0.08	0.00	1.84	
SW	3	28	108	70	15	0	224	4.82
	0.08	0.75	2.89	1.87	0.40	0.00	5.99	
	0.03	0.32	1.24	0.80	0.17	0.00	2.57	
WSW	10	45	137	173	49	0	414	5.22
	0.27	1.20	3.66	4.62	1.31	0.00	11.06	
	0.11	0.52	1.57	1.99	0.56	0.00	4.76	
W	5	59	173	109	30	0	376	4.68
	0.13	1.58	4.62	2.91	0.80	0.00	10.05	
	0.06	0.68	1.99	1.25	0.34	0.00	4.32	
WNW	7	69	229	177	63	11	556	5.15
	0.19	1.84	6.12	4.73	1.68	0.29	14.86	
	0.08	0.79	2.63	2.03	0.72	0.13	6.39	
NW	12	69	153	177	58	6	475	5.09
	0.32	1.84	4.09	4.73	1.55	0.16	12.69	
	0.14	0.79	1.76	2.03	0.67	0.07	5.46	
NNW	7	47	99	64	15	0	232	4.52
	0.19	1.26	2.65	1.71	0.40	0.00	6.20	
	0.03	0.54	1.14	0.74	0.17	0.00	2.67	
N	6	39	31	20	0	0	96	3.51
	0.16	1.04	0.83	0.53	0.00	0.00	2.57	
	0.07	0.45	0.36	0.23	0.00	0.00	1.10	
CALM	1						1	CALM
	0.03						0.03	
	0.01						0.01	
TOTAL	171	667	1321	1140	356	87	3742	4.84
	4.57	17.82	35.30	30.46	9.51	2.32	100.00	
	1.96	7.66	15.18	13.10	4.09	1.00	42.99	

KEY:
XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE A.3.3-B-5e

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: OCTOBER 1, 1983 TO SEPTEMBER 30, 1984

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 21-DEC-84 07:19:59

WEST VALLEY
DELTA TEMPERATURE HEIGHT: 60-10M
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	5	9	2	0	0	0	16	2.14
	0.28	0.51	0.11	0.00	0.00	0.00	0.90	
	0.05	0.10	0.02	0.00	0.00	0.00	0.18	
NE	7	14	2	0	0	0	23	1.86
	0.40	0.79	0.11	0.00	0.00	0.00	1.30	
	0.08	0.16	0.02	0.00	0.00	0.00	0.26	
ENE	11	8	0	0	0	0	19	1.43
	0.62	0.45	0.00	0.00	0.00	0.00	1.07	
	0.13	0.09	0.00	0.00	0.00	0.00	0.22	
E	10	14	7	3	0	0	34	2.55
	0.56	0.79	0.40	0.17	0.00	0.00	1.92	
	0.11	0.16	0.08	0.03	0.00	0.00	0.39	
ESE	6	11	9	0	0	0	26	2.64
	0.34	0.62	0.51	0.00	0.00	0.00	1.47	
	0.07	0.13	0.10	0.00	0.00	0.00	0.30	
SE	23	31	33	4	0	0	91	2.75
	1.30	1.75	1.86	0.23	0.00	0.00	5.14	
	0.26	0.36	0.38	0.05	0.00	0.00	1.05	
SSE	28	85	107	61	23	6	310	4.14
	1.58	4.80	6.04	3.44	1.30	0.34	17.50	
	0.32	0.98	1.23	0.70	0.26	0.07	3.56	
S	28	38	63	85	35	11	260	5.15
	1.58	2.15	3.56	4.80	1.98	0.62	14.68	
	0.32	0.44	0.72	0.98	0.40	0.13	2.99	
SSW	17	21	81	71	9	0	199	4.49
	0.96	1.19	4.57	4.01	0.51	0.00	11.24	
	0.20	0.24	0.93	0.82	0.10	0.00	2.29	
SW	10	22	95	110	3	0	240	4.74
	0.56	1.24	5.36	6.21	0.17	0.00	13.55	
	0.11	0.25	1.09	1.26	0.03	0.00	2.76	
WSW	7	30	54	46	6	0	143	4.41
	0.40	1.69	3.05	2.60	0.34	0.00	8.07	
	0.08	0.34	0.62	0.53	0.07	0.00	1.64	
W	4	25	59	17	1	0	106	3.83
	0.23	1.41	3.33	0.96	0.06	0.00	5.99	
	0.05	0.29	0.68	0.20	0.01	0.00	1.22	
WNW	8	23	48	30	10	5	124	4.68
	0.45	1.30	2.71	1.69	0.56	0.28	7.00	
	0.09	0.26	0.55	0.34	0.11	0.06	1.42	
NW	4	20	32	22	9	2	89	4.77
	0.23	1.13	1.81	1.24	0.51	0.11	5.03	
	0.05	0.23	0.37	0.25	0.10	0.02	1.02	
NNW	9	15	20	8	5	0	57	3.92
	0.51	0.85	1.13	0.45	0.28	0.00	3.22	
	0.10	0.17	0.23	0.09	0.06	0.00	0.65	
N	9	18	5	0	0	0	32	2.26
	0.51	1.02	0.28	0.00	0.00	0.00	1.81	
	0.10	0.21	0.06	0.00	0.00	0.00	0.37	
CALM	2						2	CALM
	0.11						0.11	
	0.02						0.02	
TOTAL	183	234	617	457	101	24	1771	4.24
	10.62	21.68	34.84	25.80	5.70	1.36	100.00	
	2.16	4.41	7.09	5.25	1.16	0.28	20.35	

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE A.3.3-B-5f

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: OCTOBER 1, 1983 TO SEPTEMBER 30, 1984

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 21-DEC-84 07:19:59

WEST VALLEY
DELTA TEMPERATURE HEIGHT: 60-10M
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	4	1	0	0	0	0	5	1.32
	0.80	0.20	0.00	0.00	0.00	0.00	1.00	
	0.05	0.01	0.00	0.00	0.00	0.00	0.06	
NE	2	1	0	0	0	0	3	1.60
	0.40	0.20	0.00	0.00	0.00	0.00	0.60	
	0.02	0.01	0.00	0.00	0.00	0.00	0.03	
ENE	8	0	0	0	0	0	8	0.89
	1.60	0.00	0.00	0.00	0.00	0.00	1.60	
	0.09	0.00	0.00	0.00	0.00	0.00	0.09	
E	1	1	0	0	0	0	2	1.85
	0.20	0.20	0.00	0.00	0.00	0.00	0.40	
	0.01	0.01	0.00	0.00	0.00	0.00	0.02	
ESE	3	4	0	0	0	0	7	1.70
	0.60	0.80	0.00	0.00	0.00	0.00	1.40	
	0.03	0.05	0.00	0.00	0.00	0.00	0.08	
SE	15	9	7	0	0	0	31	2.07
	3.01	1.80	1.40	0.00	0.00	0.00	6.21	
	0.17	0.10	0.08	0.00	0.00	0.00	0.35	
SSE	62	56	38	5	0	0	161	2.32
	12.42	11.22	7.62	1.00	0.00	0.00	32.26	
	0.71	0.64	0.44	0.06	0.00	0.00	1.85	
S	26	32	11	0	0	0	69	1.93
	5.21	6.41	2.20	0.00	0.00	0.00	13.83	
	0.30	0.37	0.13	0.00	0.00	0.00	0.79	
SSW	6	12	24	11	0	0	53	3.70
	1.20	2.40	4.81	2.20	0.00	0.00	10.62	
	0.07	0.14	0.28	0.13	0.00	0.00	0.61	
SW	7	6	16	13	0	0	42	3.88
	1.40	1.20	3.21	2.61	0.00	0.00	8.42	
	0.08	0.07	0.18	0.15	0.00	0.00	0.48	
WSW	6	9	9	2	0	0	26	2.68
	1.20	1.80	1.80	0.40	0.00	0.00	5.21	
	0.07	0.10	0.10	0.02	0.00	0.00	0.30	
W	5	14	11	0	0	0	30	2.72
	1.00	2.81	2.20	0.00	0.00	0.00	6.01	
	0.06	0.16	0.13	0.00	0.00	0.00	0.34	
WNW	3	3	4	1	0	0	11	2.85
	0.60	0.60	0.80	0.20	0.00	0.00	2.20	
	0.03	0.03	0.05	0.01	0.00	0.00	0.13	
NW	7	9	6	1	0	0	23	2.55
	1.40	1.80	1.20	0.20	0.00	0.00	4.61	
	0.08	0.10	0.07	0.01	0.00	0.00	0.26	
NNW	7	7	4	0	0	0	18	2.22
	1.40	1.40	0.80	0.00	0.00	0.00	3.61	
	0.08	0.08	0.05	0.00	0.00	0.00	0.21	
N	5	2	2	0	0	0	9	1.82
	1.00	0.40	0.40	0.00	0.00	0.00	1.80	
	0.05	0.02	0.02	0.00	0.00	0.00	0.10	
CALM	1						1	CALM
	0.20						0.20	
	0.01						0.01	
TOTAL	169	166	132	33	0	0	499	2.53
	33.67	33.27	26.45	6.61	0.00	0.00	100.00	
	1.93	1.91	1.52	0.38	0.00	0.00	5.73	

KEY: XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE A.3.3-B-5g

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: OCTOBER 1, 1983 TO SEPTEMBER 30, 1984

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 21-DEC-84 07:19:59

WEST VALLEY
DELTA TEMPERATURE HEIGHT: 60-10M
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	3	0	0	0	0	0	3	1.13
	0.39	0.00	0.00	0.00	0.00	0.00	0.39	
	0.03	0.00	0.00	0.00	0.00	0.00	0.03	
NE	3	1	0	0	0	0	4	1.23
	0.39	0.13	0.00	0.00	0.00	0.00	0.53	
	0.03	0.01	0.00	0.00	0.00	0.00	0.05	
ENE	4	1	0	0	0	0	5	1.30
	0.53	0.13	0.00	0.00	0.00	0.00	0.66	
	0.05	0.01	0.00	0.00	0.00	0.00	0.06	
E	7	0	0	0	0	0	7	0.96
	0.92	0.00	0.00	0.00	0.00	0.00	0.92	
	0.08	0.00	0.00	0.00	0.00	0.00	0.08	
ESE	6	2	0	0	0	0	8	1.34
	0.79	0.26	0.00	0.00	0.00	0.00	1.05	
	0.07	0.02	0.00	0.00	0.00	0.00	0.09	
SE	15	7	2	0	0	0	24	1.58
	1.97	0.92	0.26	0.00	0.00	0.00	3.16	
	0.17	0.08	0.02	0.00	0.00	0.00	0.28	
SSE	95	191	41	2	0	0	329	2.08
	12.50	25.13	5.39	0.26	0.00	0.00	43.29	
	1.09	2.19	0.47	0.02	0.00	0.00	3.78	
S	43	56	14	0	0	0	113	1.98
	5.65	7.37	1.84	0.00	0.00	0.00	14.87	
	0.49	0.64	0.16	0.00	0.00	0.00	1.30	
SSW	14	22	37	8	0	0	81	3.21
	1.84	2.89	4.87	1.05	0.00	0.00	10.65	
	0.16	0.25	0.43	0.09	0.00	0.00	0.93	
SW	10	26	42	6	0	0	84	3.36
	1.32	3.42	5.53	0.79	0.00	0.00	11.05	
	0.11	0.30	0.48	0.07	0.00	0.00	0.97	
WSW	9	15	12	0	0	0	36	2.53
	1.18	1.97	1.58	0.00	0.00	0.00	4.74	
	0.10	0.17	0.14	0.00	0.00	0.00	0.41	
W	4	21	11	0	0	0	36	2.57
	0.53	2.76	1.45	0.00	0.00	0.00	4.74	
	0.05	0.24	0.13	0.00	0.00	0.00	0.41	
WNW	4	5	4	0	0	0	13	2.10
	0.53	0.66	0.53	0.00	0.00	0.00	1.71	
	0.05	0.06	0.05	0.00	0.00	0.00	0.15	
NW	5	0	0	0	0	0	5	0.98
	0.65	0.00	0.00	0.00	0.00	0.00	0.66	
	0.05	0.00	0.00	0.00	0.00	0.00	0.06	
NNW	2	3	0	0	0	0	5	1.84
	0.26	0.39	0.00	0.00	0.00	0.00	0.66	
	0.02	0.03	0.00	0.00	0.00	0.00	0.06	
N	7	0	0	0	0	0	7	1.13
	0.92	0.00	0.00	0.00	0.00	0.00	0.92	
	0.03	0.00	0.00	0.00	0.00	0.00	0.08	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	231	350	163	16	0	0	760	2.31
	30.39	46.05	21.45	2.11	0.00	0.00	100.00	
	2.65	4.02	1.87	0.18	0.00	0.00	8.73	

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE A.3.3-B-5h

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: OCTOBER 1, 1983 TO SEPTEMBER 30, 1984

ALL CLASSES
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 21-DEC-84 07:19:59

WEST VALLEY
DELTA TEMPERATURE HEIGHT: 60-10M
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	28	69	68	15	0	0	180	3.06
	0.32	0.79	0.78	0.17	0.00	0.00	2.07	
NE	39	92	72	6	0	0	209	2.67
	0.45	1.06	0.83	0.07	0.00	0.00	2.40	
ENE	37	52	61	9	0	0	159	2.79
	0.43	0.60	0.70	0.10	0.00	0.00	1.83	
E	28	45	47	35	2	0	157	3.44
	0.32	0.52	0.54	0.40	0.02	0.00	1.80	
ESE	33	50	54	33	8	0	163	3.46
	0.41	0.57	0.62	0.38	0.09	0.00	2.10	
SE	75	91	104	67	14	0	351	3.53
	0.86	1.05	1.19	0.77	0.16	0.00	4.03	
SSE	201	414	284	196	102	64	1261	4.06
	2.31	4.76	3.26	2.25	1.17	0.74	14.49	
S	105	171	162	203	76	37	754	4.61
	1.21	1.96	1.86	2.33	0.87	0.43	8.66	
SSW	45	104	239	168	17	0	573	4.24
	0.52	1.19	2.75	1.93	0.20	0.00	6.58	
SW	30	107	326	229	22	1	715	4.48
	0.34	1.23	3.75	2.63	0.25	0.01	8.21	
WSW	31	113	295	298	65	2	807	4.83
	0.39	1.30	3.39	3.42	0.75	0.02	9.27	
W	18	141	340	153	35	0	687	4.28
	0.21	1.62	3.91	1.76	0.40	0.00	7.89	
WNW	22	130	365	309	93	22	941	5.06
	0.25	1.49	4.19	3.55	1.07	0.25	10.81	
NW	29	164	341	353	86	13	986	4.90
	0.33	1.88	3.92	4.06	0.99	0.15	11.33	
NNW	26	115	208	113	30	0	492	4.26
	0.30	1.32	2.39	1.30	0.34	0.00	5.65	
N	31	99	74	40	1	0	245	3.28
	0.36	1.14	0.85	0.46	0.01	0.00	2.81	
CALM	4						4	CALM
	0.05						0.05	
TOTAL	790	1957	3040	2227	551	139	8704	4.31
	9.03	22.48	34.93	25.59	6.33	1.60	100.00	

NUMBER OF VALID OBSERVATIONS 8704 99.09 PCT
NUMBER OF INVALID OBSERVATIONS 80 0.91 PCT
TOTAL NUMBER OF OBSERVATIONS 8784 100.00 PCT

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE A.3.3-B-5i

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: OCTOBER 1, 1983 TO SEPTEMBER 30, 1984

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 21-DEC-84 07:19:59

WEST VALLEY
DELTA TEMPERATURE HEIGHT: 60-10M
WEST VALLEY NUCLEAR SERVICES
DAMES AND MOORE JOB NO: 10805-139-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	29 0.33	69 0.79	68 0.78	15 0.17	0 0.00	0 0.00	181 2.07	3.05
NE	39 0.45	96 4.10	72 0.83	6 0.07	0 0.00	0 0.00	213 2.44	2.67
ENE	37 0.42	52 0.60	61 0.70	9 0.10	0 0.00	0 0.00	159 1.82	2.79
E	28 0.32	45 0.52	47 0.54	35 0.40	2 0.02	0 0.00	157 1.80	3.44
ESE	33 0.44	50 0.57	54 0.62	33 0.38	8 0.09	0 0.00	183 2.10	3.46
SE	75 0.86	91 1.04	104 1.19	67 0.77	14 0.16	0 0.00	351 4.02	3.53
SSE	201 2.30	414 4.74	284 3.25	196 2.25	102 1.17	64 0.73	1261 14.45	4.06
S	105 1.20	171 1.96	162 1.86	203 2.33	76 0.87	37 0.42	754 8.64	4.61
SSW	45 0.52	104 1.19	239 2.74	168 1.93	17 0.19	0 0.00	573 6.57	4.24
SW	30 0.34	108 1.24	326 3.74	229 2.62	22 0.25	1 0.01	716 8.20	4.48
WSW	34 0.39	113 1.29	295 3.38	298 3.41	65 0.74	2 0.02	807 9.25	4.83
W	18 0.21	141 1.62	340 3.90	153 1.75	35 0.40	0 0.00	687 7.87	4.28
WNW	22 0.25	130 1.49	365 4.18	309 3.54	93 1.07	22 0.25	941 10.78	5.06
NW	30 0.34	167 1.91	343 3.93	353 4.04	86 0.99	13 0.15	992 11.37	4.89
NNW	27 0.31	117 1.34	213 2.44	115 1.32	30 0.34	0 0.00	502 5.75	4.25
N	31 0.35	100 1.15	74 0.85	40 0.46	1 0.01	0 0.00	246 2.82	3.27
CALM	4 0.05						4 0.05	CALM
TOTAL	793 9.09	1968 22.55	3047 34.91	2229 25.54	551 6.31	139 1.59	8727 100.00	4.31

NUMBER OF VALID OBSERVATIONS	8727	99.35 PCT.
NUMBER OF INVALID OBSERVATIONS	57	0.65 PCT.
TOTAL NUMBER OF OBSERVATIONS	8784	100.00 PCT.

KEY: XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

SUPPLEMENT A.3.3-C

ATMOSPHERIC DISPERSION MODELS

SUPPLEMENT A.3.3-C

ATMOSPHERIC DISPESION MODELS

Meteorological Data Base

Table A.3.3-C-1 identifies the sources of hourly wind direction, wind speed, atmospheric stability, and ambient temperature data used in the analysis.

The model calculations require that the data base not contain any invalid or missing data. Furthermore, the data base must be sequential and not have time gaps. To meet these requirements, all missing or invalid data were approximated. The replacement of missing or invalidated data was accomplished by the following:

[1] Linear temporal interpolation between the nearest valid values at the same sensor for all short (6 consecutive hours or less) periods of missing or invalid data.

Methods 2 and 3 below were employed for runs of more than 6 consecutive hours of invalid sensor readings.

[2] For the 60 m primary tower, estimation of missing parameter values from data taken at another tower level - direct substitution for wind direction, use of power-law extrapolation for wind speed.

[3] For remote and Regional sensors, replacement of missing values by valid values from the sensor which best correlated with the sensor over the period from 12 hours before to 12 hours after the run of missing or invalid data, modified by the observed deviation between the two sensors' readings over this period.

Hourly mixing depth measurements for the WVDP area for the October 1, 1983 through September 30, 1984 data period were not available at the time of the modeling analysis. Representative site-specific hourly mixing depth values for atmospheric modeling purposes were derived by temporal interpolation in a table of seasonal mean morning and afternoon mixing depth values for the study area derived by Holzworth (1972) from a large base of NWS rawinsonde upper air data (see Table A.3.3-C-2).

For input to the EPM3 atmospheric dispersion model, hourly meteorological data values were provided at each grid point in a nonuniform rectangular grid covering the region out to a distance of 100 km from the WVDP in all directions for each of the 8,784 hours modeled. For each hour, the ambient temperature, atmospheric stability class, and mixing depth were assumed to be uniform across the study area. The distribution of wind directions and speeds across the study area for each hour was nonuniform due to the variations in measured winds at each of the 10 wind monitoring stations, caused by the complex terrain in the site area as well as by Lake Erie coastal effects and mesoscale wind flow patterns.

Wind Field Model

The WNDSRF3 program was used to generate gridded fields of wind data for input to the EPM3 atmospheric dispersion model. WNDSRF3 constructs a mass-consistent 2-dimensional wind field on a nonuniform rectangular grid

using scattered wind data from the region of interest. The surface wind data from scattered locations are first interpolated to grid points using inverse-distance-squared weighting. The maximum radius of influence for data interpolation may be specified individually for each monitoring station. Barriers to interpolation may also be specified to restrict the influence of measurements at particular stations to sub-regions of the grid.

Following construction of a gridded wind field from sparse wind measurements, a certain amount of anomalous divergence will be present in the field. The approach used in WNDSRF3 interactively reduces the divergence in the surface layer to a specified value by satisfying the continuity equation exactly at each grid point, thus rendering the wind field mass-consistent.

The wind field grid for the WVDP long-term dispersion estimation analysis consisted of 17 east-west rows and 18 north-south columns covering a 200 km by 200 km area centered on the WVDP. Grid row and column spacing were varied between a minimum of 1 km and a maximum of 40 km, depending upon terrain complexity and the spatial density of meteorological monitoring stations. Meteorological station radii of influence and data interpolation barriers were determined to assure that the derived hourly wind fields satisfy the following conditions:

[1] Wind flow patterns in the immediate vicinity of the WVDP (i.e., within 10 km of the plant) explicitly reflect all significant local terrain influences monitored by the 7 on-site and remote meteorological stations. Terrain influences present in the monitored data include channelling along the axes of valleys, wind speed reductions due to sheltering in the lee of obstacles to flow, and downslope nocturnal drainage flow.

[2] Large-scale wind flow patterns beyond the immediate plant vicinity are based upon wind observations at the Regional remote site, and at the 3 distant NWS monitoring stations. The site for the Regional monitor was selected specifically to provide the best local estimate of overall regional wind conditions, free of local terrain influences, while the NWS wind sensors are at well-exposed airport sites.

Separate sets of hourly wind fields were developed for the ground release and elevated release dispersion estimates. Wind fields for the ground release analysis were based on 10 m level winds at all 10 meteorological monitoring stations. For the elevated release analysis, the 60 m level winds at the WVDP on-site tower were used, along with the 10 m winds at the other 9 sites. To standardize all observed wind speeds to the same reference height, 60 m wind speeds were extrapolated downward to 10 m via the standard set of stability-dependent vertical wind profile power law exponents listed in Table A.3.3-C-3. The same vertical wind profiles were used in the EPM3 dispersion model to adjust transport winds to the height above ground of each effluent puff.

The large numbers of hourly mass-consistent wind field data sets needed for the ground and elevated release dispersion analyses were generated by means of a highly efficient computational scheme described by Ludwig, et al. (1980) and Endlich, et al. (1982), which takes advantage of the nondivergent properties of the WNDSRF3-generated wind fields. This approach was implemented in the following steps:

[1] A factor analysis was performed on the east and north components of the observed hourly wind vectors at each of the 10 meteorological monitoring stations, for the full 8-month data base. Results of this step included 8-month mean wind vectors and 20 normalized eigenvectors (one per wind component per station) derived from the covariance matrix of observed winds.

[2] The WNDSRF3 program was run 21 times using the set of mean wind vectors and the 20 sets of eigenvectors as input. The resulting 21 sets of wind solutions at each wind field grid point were saved in a mass storage file for subsequent use in Step 3, below.

[3] For each hour modeled, the observed winds at the 10 meteorological monitoring stations were input to a matrix manipulation program, along with the mean vector and eigenvector wind field solutions derived in Step 2. This program computed wind vectors at each grid point as linear combinations of the input wind components, the mean vector and eigenvectors from Step 1, and the mean vector and eigenvector wind field solutions from Step 2. The resulting wind fields for each hour are the same as the wind fields which would have been obtained using the WNDSRF3 program directly. The eigenvector approach required roughly 4 percent of the computer resources that would have been needed to generate wind fields for each hour using WNDSRF3.

Steps 1-3 above were performed separately for the ground level and elevated release analyses.

Atmospheric Dispersion Model

Long-term average relative concentration and deposition due to ground and elevated releases at the WVDP were computed by Dames and Moore's EPM3 variable-trajectory Gaussian puff atmospheric dispersion model. The EPM3 model uses a number of discrete puffs which are serially released from each source to simulate a continuous plume. Each puff is assumed to have a Gaussian concentration distribution in three dimensions. Puffs expand in size as they move downwind from the source, in response to spatially and temporally varying wind and stability conditions. They are tracked until they leave the grid region.

Puff Transport - Each puff is transported independently by the nonuniform wind field. Winds experienced by puff are those at the center of the puff, interpolated from values at the surrounding windfield points.

Each simulation segment (e.g., 1 hour for routine releases) is divided into advection steps of approximately 1-minute to 5-minute duration. In each advection step, a new puff position is derived by time integration of the wind field over the advection step from the puff's position at the beginning of the step, using a two-step predictor-corrector technique.

Puff Sampling - Each advection step is broken down into 1 or more sampling steps. The number of sampling steps is determined independently for each puff, depending on its size (σ_y) at the beginning of the advection step, and the distance covered in the advection step, such that the puff is sampled at distance intervals no greater than twice the σ_y value at the beginning of the advection step. This sampling interval is sufficient to ensure an accurate representation of the passage of the puff, at any receptor location. Concentration and deposition are computed at each receptor location in the

receptor grid. Average concentration and deposition values at each receptor for a given time interval are the sums of contributions for all sampling steps, for all puffs, for all advection steps in the interval.

<u>Puff Dispersion</u> - Pasquill-Gifford dispersion parameters (Turner, 1970), with RG 1.111 and 1.145 modifications for building wake effect, as appropriate, are used to characterize puff dispersion.

Puff growth in each sampling step is computed by EPM3 using the virtual distance method, as described by Ludwig, et al. (1977) and Zanetti (1981), in which increases in σ_y and σ_z occur as a function of current local stability class, distance traveled in the sampling step, and σ_y and σ_z at the beginning of the sampling step.

In calm wind situations, a certain amount of puff growth will occur, even if the puff does not change position. As suggested by Zanetti (1981), the virtual distance method is utilized by EPM3 in this situation. Puff σ_y and σ_z in calm conditions increase over the sampling step time interval Δt as though the puff had traveled a distance $u_{min}\Delta t$ in the time interval, where u_{min} may be chosen by the user; an appropriate value would be the threshold speed of the wind speed sensors. A value of 0.1 m/s was chosen for u_{min} in the WVDP analyses.

Effects of the limitations to vertical puff growth at the top of the surface-based mixing layer are addressed by the method of multiple plume images, in which the puff's Gaussian vertical mass distribution function is assumed to be reflected at the ground and at the top of the mixing layer. This approach, proposed by Bierly and Hewson (1962), is currently utilized in most US EPA dispersion models. When the "reflected" terms in the EPM3 concentration equation become comparable to the "direct" term, the puff is taken to be

well-mixed within the mixing layer, and a uniform vertical mass distribution is substituted for the more complex reflected Gaussian distribution.

Terrain Effects - Effects of terrain on 2-dimensional wind flow patterns are handled by the WNDSRF3 wind field model. In addition, EPM3 adjusts puff center heights above terrain using the Egan (1975) "half-height" method during unstable and neutral atmospheric conditions, and the Burt (1977) method during stable atmospheric conditions, as recommended in RG 1.111, Revision 1.

Deposition and Depletion - Particulate deposition at receptor locations, and plume depletion due to deposition, are computed by EPM3 using the concept of a deposition flux and deposition velocity. Mass is removed from each puff in this manner at each time step.

Plume Rise - EPM3 computes plume rise due both to thermal buoyancy and upward momentum using the generalized, downwind distance-dependent formulae of Briggs (1975). Plume rise in calm wind situations is addressed explicitly by these formulae.

Aerodynamic Building Wake Effects - EPM3 addresses building wake effects for nonelevated sources in a manner consistent with both Regulatory Guide 1.111, Revision 1, and Regulatory Guide 1.145, Revision 1. The building wake adjustment to the vertical plume dispersion parameter, σ_z, presented in Subsection C.2.c of Regulatory Guide 1.111 is applied when appropriate. For consistency with the wake-affected concentration expressions found in

Subsection C.1.3.1 of Regulatory Guide 1.145, a building wake adjustment with the same functional form is also applied to the horizontal plume dispersion parameter, σ_y. Thus, for a nonelevated release,

$$\sigma_z = \sqrt{\sigma_{z_o}^2 + \frac{A}{2\pi}} \quad \text{or} \quad \sqrt{3}\sigma_{z_o}\text{, whichever is smaller,}$$

and

$$\sigma_y = \sqrt{\sigma_{y_o}^2 + \frac{A}{2\pi}} \quad \text{or} \quad \sqrt{3}\sigma_{y_o}\text{, whichever is smaller,}$$

where:

σ_z = wake-affected vertical dispersion parameter,

σ_{z_o} = vertical dispersion parameter without wake effects,

A = cross-sectional area of building,

σ_y = wake-affected horizontal dispersion parameter,

σ_{y_o} = horizontal dispersion parameter without wake effects.

Since the complexes of structures at nuclear facilities generally present a substantially different silhouette from different viewing angles, the cross-sectional area of the turbulent building wake, and thus the resulting ground-level effluent concentrations, vary with wind direction. To account for this phenomenon, EPM3 accounts for building wake effects using direction-dependent building cross-sectional areas stored in data tables. Information for these EPM3 input data tables for the WVDP analyses was developed by the Dames and Moore PREWAKE building wake effect preprocessor program. Input to PREWAKE consists of the location of all sources, along with the location, dimensions, and orientation of all solid structures in the vicinity of the sources.

The program essentially builds a mathematical model of each building to determine its effective horizontal and vertical crosswind dimensions and its potential influence on each source for 36 different wind directions (integral multiples of 10 degrees). Complex building shapes are simulated by combining a number of rectangular and cylindrical "building blocks" of arbitrary dimensions and orientation. PREWAKE is capable of viewing a complex building shape from any azimuthal angle and determining the following:

[1] Effective building height, h_b, for 36 viewing angles. This is the average height of the building shape as seen in silhouette from a given viewing angle. For a complex building, h_b usually varies with viewing angle.

[2] Effective building width, w_b, for 36 viewing angles. This is the total width of building shape as seen in silhouette from a given viewing angle. Unless the building is cylindrical, w_b will vary with viewing angle.

Cross-sectional area values used in the EPM3 concentration computations are the product of h_b and w_b for the release point and wind direction of interest.

Table A.3.3-C-4 gives WVDP source emission parameters used in the ground and elevated release dispersion estimates. Table A.3.3-C-5 lists the wind direction-dependent building dimension data used to asses aerodynamic building wake effects for the ground release point.

Advection step times of 3 minutes for the ground and 3 minutes for the elevated release analyses were used. A constant deposition velocity of 0.01 m/s was assumed for both analyses. Radioactive decay was not considered.

Undepleted and depleted relative concentration and undepleted and depleted deposition were computed at each of 192 model receptor locations. A total of 160 receptors were placed at 22.5-degree azimuthal intervals in 10 concentric rings centered upon the WVDP. Receptor ring radii were 805, 2414, 4023, 5633, 7242, 12070, 24140, 40234, 56327, and 72420 metres. An additional 16 receptors were placed at 22.5-degree intervals along the WVDP site area boundary, and another 16 receptors were deployed at the distance from the site to the nearest actual residence in each 22.5 degree sector. The concentration values thus calculated for ground and elevated releases are presented in in SAR text in Tables A.3.3-8 and A.3.3-9. Because these calculations are based upon a unit curie release, these values also represent the relative dispersion factors χ/Q.

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TABLE A.3.3-C-1
SOURCES OF HOURLY METEOROLOGICAL DATA
FOR LONG-TERM DISPERSION ANALYSES

MONITORING STATION	MONITORING STATION LOCATION WITH RESPECT TO WVDP: DISTANCE (km)	BEARING (degrees)	PARAMETERS USED IN DISPERSION ANALYSES
WVDP On-site 60 m Tower	--	--	Wind Direction and Speed (10 m)[a] Wind Direction and Speed (60 m)[b] Atmospheric Stability Class Index[c] Temperature (10 m)
WVDP Regional Site	4.9	190	Wind Direction and Speed (10 m)
WVDP Springville Remote Site	8.3	353	Wind Direction and Speed (10 m)
WVDP Cattaraugus Remote Site	4.0	359	Wind Direction and Speed (10 m)
WVDP Riceville Remote Site	4.1	87	Wind Direction and Speed (10 m)
WVDP West Valley Remote Site	4.6	140	Wind Direction and Speed (10 m)
WVDP Connoisarauley Remote Site	3.9	245	Wind Direction and Speed (10 m)
Buffalo, NY NWS Station	55.4	353	Wind Direction and Speed (10 m)
Bradford, PA NWS Station	71.9	177	Wind Direction and Speed (10 m)
Erie, PA NWS Station	132.3	251	Wind Direction and Speed (10 m)

[a]Used in ground release analysis only.

[b]Used in elevated release analysis only.

[c]Derived from 60 m - 10 m temperature difference (ΔT) as specified in US NRC Regulatory Guide 1.23.

TABLE A.3.3-C-2

SEASONAL MEAN MORNING AND AFTERNOON MIXING DEPTHS FOR THE WVDP SITE VICINITY

SEASON	MIXING DEPTH (meters) MORNING	AFTERNOON
Spring	620	1500
Summer	440	1700
Fall	600	1250
Winter	830	900

Reference: Holzworth (1972).

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TABLE A.3.3-C-3

VERTICAL WIND PROFILE POWER LAW EXPONENTS

PASQUILL STABILITY CLASS	POWER LAW EXPONENT, P*
A (extremely unstable)	0.10
B (moderately unstable)	0.15
C (slightly unstable)	0.20
D (neutral)	0.25
E (slightly stable)	0.30
F (moderately stable)	0.30
G (extremely stable)	0.30

*Wind speed U_1 at height Z_1 is related to wind speed U_2 at height Z_2 as follows:

$$\frac{U_1}{U_2} = \frac{Z_1}{Z_2}^{P}$$

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TABLE A.3.3-C-4

WVDP EMISSION SOURCE PARAMETERS

	GROUND RELEASE	ELEVATED RELEASE
UTM East Coordinate (m)*	692,900	692,900
UTM North Coordinate (m)*	4,702,200	4,702,200
Release Height (m)	0.00	61.57
Effective Diameter of Vent (m)	0.00	1.70
Exit Temperature (°K)	294.26	322.00
Exit Velocity (m/s)	0.00	14.25

*Universal Transverse Mercator coordinate system, Zone 17.

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TABLE A.3.3-C-5

EFFECTIVE CROSSWIND BUILDING DIMENSIONS
FOR WVDP GROUND RELEASE POINT

WIND DIRECTION (degrees)	BUILDING HEIGHT (m)	BUILDING WIDTH (m)	WIND DIRECTION (degrees)	BUILDING HEIGHT (m)	BUILDING WIDTH (m)
10	17.5	91.8	190	17.5	91.8
20	17.7	89.3	200	17.7	89.3
30	18.9	88.7	210	18.9	88.7
40	19.1	89.7	220	19.1	89.7
50	19.1	88.9	230	19.1	88.9
60	18.7	88.9	240	18.7	88.9
70	17.4	94.0	250	17.4	94.0
80	16.4	97.0	260	16.4	97.0
90	15.2	101.2	270	15.2	101.2
100	14.2	102.5	280	14.2	102.5
110	13.4	100.6	290	13.4	100.6
120	14.0	102.3	300	14.0	102.3
130	15.3	101.0	310	15.3	101.0
140	16.9	98.6	320	16.9	96.6
150	17.3	95.7	330	17.3	95.7
160	17.6	95.3	340	17.6	95.3
170	17.8	92.0	350	17.8	92.0
180	17.6	92.1	360	17.6	92.1

SUPPLEMENT A.3.4-A

<u>PROBABLE MAXIMUM FLOOD INFORMATION</u>

SUPPLEMENT A.3.4-A

PROBABLE MAXIMUM FLOOD INFORMATION

The probable maximum flood (PMF) for a given area is the runoff based on storm precipitation resulting from the most critical hydrometeorological conditions that are considered probable. Such flood is the largest that realistically can be expected to occur. The PMP was used as a basis in setting an upper bound to the extent of flood related impacts on Buttermilk Creek, the Dam sites and the WVDP Facilities.

The procedure for determining the PMF involves the following steps:

[1] The preparation of probable maximum depth-area-duration rainfall curves representative of the region in which the basin under study is a part.

[2] The selection of a critical pattern storm from these curves for use in the basin. These storm patterns are adjusted to include the effect of infiltration into the soil.

[3] The development of a unit hydrograph for the basin.

[4] The development of the total PMF hydrograph.

The above steps were implemented to determine the PMF for the various drainage basins of interest and the results are summarized in Table A.3.4.-A-1.

Flood Design Considerations in Buttermilk Creek

There are two potential sources for flooding in the vicinity of the nuclear site facility, one from Buttermilk Creek and the other from the local drainage stream channels. Each has been evaluated.

In order to ensure that flood levels in the Buttermilk Creek and tributaries due to probable maximum precipitation (PMP) do not encroach upon the nuclear facilities, a hydrologic and hydraulic investigation of the results of such precipitation was undertaken.

The drainage area of the Buttermilk Creek is 7903 ha at its confluence with Cattaraugus Creek. Stationing along the Buttermilk was started at 0+00 at the confluence and increased upstream. The corresponding stations near the WNYNSC and a Dam 2 are approximately 180 + 00 and 220 + 00, respectively. The channel bottom profile and cross sections along the reach are shown in Figures A.3.4-A-1 through A.3.4-A-3.

The first step in the procedure for determining the probable maximum flood (PMF) on Buttermilk Creek was the development of the probable maximum precipitation (PMP) from Hydromet No. 33 using a drainage area of 7903 ha. A PMP rainfall intensity-duration curve was generated and is shown on Figure A.3.4-A-4. From the intensity-duration curve, rainfalls of three-hour intervals were computed and the pattern rearranged to obtain a maximum runoff storm pattern as shown in the hyetograph on Figure A.3.4-A-5. The abstractions from the rainfall were taken as 2.54 cm initial loss plus 0.254 cm per hour as subsequent infiltration.

The second step was the development of the unit hydrograph (Figure A.3.4-A-5) of Buttermilk Creek drainage basin as the confluence with Cattaraugus Creek about 4.8 km downstream from the plant site. The unit hydrograph was developed in accordance with the procedures outlined in Design of Small Dams. The time of concentration was determined to be three hours. The rainfall pattern as shown on the hyetograph was applied to the unit hydrograph. The total flood hydrograph thus developed is shown on Figure A.3.4-A-6. Using these data, a maximum discharge of 2400 m^3/s is computed. The computational procedure was repeated using unit rainfall periods of one-half hour and the maximum discharge was found to be 2100 m^3/s. The more conservative value of 2400 m^3/s has been used in subsequent analyses.

The resulting water levels in the Creek were estimated using the slope-area method with average channel slopes of 0.0079 and 0.00371 above and below station 107 + 00 respectively. The Manning's "n" friction coefficients assumed were 0.03 in the main channel and 0.1 on the overbanks. The estimated water surface profiles at normal depths for the PMP of 2400 m^3/s and for the PMP increased by fifty percent (i.e., 3625 m^3/s) are illustrated on Figure A.3.4-A-1. To grossly overestimate the PMF, the computed value was increased by fifty percent.

The maximum PMF water surface level attained in Buttermilk Creek opposite the facilities is at elevation 379.5 mMSL for the 2407 m^3/s discharge and 381.6 mMSL for the 3625 m^3/s discharge. All elevations are in metres above mean sea level datum. Since the nuclear site facility is at approximately elevation 431.3 mMSL, no flooding of the plant site will result from the probable maximum flood in Buttermilk Creek. The maximum water surface levels opposite Dam 2 are at elevation 388.9 mMSL and 390.4 mMSL for 2407 m^3/s and 3625 m^3/s discharges respectively.

Localized PMF At Facility

The localized probable maximum precipitation (PMP) was developed for the drainage basin of the major tributary in which the Nuclear facility is sited, Figure A.3.4-A-7. The drainage area of the tributary at its confluence with Buttermilk Creek, approximately station 125 + 00, is 6.06 ha.

The same procedure as outlined in Section 5 was used in the development of water surface elevation, PMP intensity-duration curve Figure A.3.4-A-8, unit hydrograph and hyetograph (Figure A.3.4-A-9), and the total runoff hydrograph (Figure A.3.4-A-10). The maximum probable flood discharge was found to be 540 m^3/s.

Using this discharge, water levels along the principal drainage tributary or channel in the vicinity of the nuclear facility were computed by the slope-area method. An average slope of channel of 0.033 and Manning's "n" friction value of 0.05 were used to determine the normal depths of flow for the PMF of 538 m^3/s and for 1.5 x PMF = 820 m^3/s. The maximum water surface level downstream near the confluence with Buttermilk Creek reaches elevation 376.9 m for the discharge of 540 m^3/s and elevation 378 m for the discharge of 820 m^3/s.

Opposite the Project facilities, maximum water surface levels just downstream of Rock Springs Road were determined to be at elevation 417 mMSL and 419 mMSL for discharges of 540 m^3/s and 820 m^3/s respectively. These water levels are well below the nuclear site elevation of 431.3 mMSL.

It can therefore be concluded that no flooding of the plant site will result from PMF discharges from either Buttermilk Creek or its tributary.

Reservoir Floods And Flood Routing

For the dam reservoir sites a detailed hydrologic and hydraulic study of spillway operation and water level fluctuations due to PMF inflows was made. The drainage area (Figure A.3.4-A-11), of the reservoir basis is 1257 ha. From Hydromet Report No. 33, a PMP intensity-duration curve was developed (Figure A.3.4-A-12). A unit hydrograph and PMP hyetograph for one-hour rainfall periods were developed (Figure A.3.4-A-13).

The hyetograph was constructed over one hour rainfall periods and arranged to maximize the runoff hydrograph.

The runoff model for the lake reservoir system was based on procedures outlined previously. The total inflow hydrograph into the reservoir was constructed (Figure A.3.4-A-14). The peak inflow into the reservoir lake system was routed through the reservoirs to develop the peak outflow hydrograph.

The maximum projected (once in 100 years) runoff is only 114 m^3/s and is derived from the analysis of rainfall-frequency-duration curves developed by the U.S. Weather Bureau, Technical Report 40, May, 1961.

The inflow hydrograph was routed through the reservoirs. There is an emergency overflow spillway near Dam 1 and a modified Francis Weir Discharge Formula was used to determine the head required to carry the discharge over the spillway. The spillway was treated as a broad crested weir in which the value of the coefficient was at 3.03 and where:

$$Q = 3.03\ lh^{3/2}$$

Q = discharge, m^3/s

l = width of weir, m

h = head on weir, m

Using the 53.3 m width of the weir and assuming that initial water level in the reservoir is at the crest of the weir, elevation 412.7 mMSL, a flood routing procedure for the PMF inflow hydrograph was undertaken to establish resulting water levels in the reservoirs. The peak PMF outflow discharge was found to be 829.7 (See Figure A.3.4-A-14 for outflow hydrograph) and it would raise water levels in Dam 1 to elevation 417 mMSL if the dam top were above that elevation. However, since the dam top is an elevation 414.5 mMSL, the dam will in all probability fail for the PMF occurrence. The top Dam 2 is also at elevation 414.5 mMSL and therefore it will also probably fail.

Reservoir Safe Flood

In order to establish the largest flood that the reservoir can sustain without failure, dams elevation vs. spillway discharge curves were developed as shown in Figure A.3.4-A-15. The difference in water elevations between Dams 1 and 2 was due to losses through the connecting canal. It was assumed that inflow to

Dam 2 was one-third of the reservoir total inflow. Dam 2 water level is higher than at Dam 1 for the same weir outflow and therefore dam failure is controlled by water surface elevations at Dam 2. Allowing for a minimum freeboard of 0.9 m against wind generated waves as recommended in Design of Small Dams, the safe outflow through the spillway is only 68 m^3/s. With no freeboard (i.e., water level in Dam 2 close to over topping at elevation 414.5 mMSL), the discharge over the weir is 193 m^3/s.

A 100-year flood inflow hydrograph was generated by the analysis of rainfall-frequency-duration curves developed by U.S. Weather Bureau, Technical Report 40. A hyetograph for 1-hour duration storm with 0.2-hour rainfall interval was developed (Figure A.3.4-A-16). An infiltration of 0.254 cm per hour was assumed. The rainfall excess was applied to the unit hydrograph (Figure A.3.4-A-13) to obtain the total inflow hydrograph (Figure A.3.4-A-16). The 100-year flood was routed through the reservoir from elevation 412.7 mMSL, the top of weir. The reservoir was assumed full at the beginning of the storm. The peak inflow discharge was 114 m^3/s and the peak outflow discharge 102.5 m^3/s (Figure A.3.4-A-16). This outflow discharge over the weir corresponds to a water level elevation in Lake 1 at 413.85 mMSL and in Lake 2 at elevation 413.9 mMSL. At this level the is a freeboard of 0.61 m at the dams. It may be said that the reservoir will accept a 100-year flood without failure. Maximum water level elevations reached in the lake occurred during the flood of September 28, 1967 and was at elevation 414.1 mMSL.

Due to the depth of the stream beds below the nuclear site facility elevation, a probable maximum flood in Buttermilk Creek cannot flood the plant site. A probable maximum flood, however, would probably have great effect on the plant water supply system (Figure A.3.4-A-17).

Since the maximum elevation of the impounded water would be no more than about 414.5 mMSL even a catastrophic failure of the dams would not result in flooding of the WVDP facility site which is at about elevation 413.3 mMSL, however the supply of water from this source would be eliminated until such time as repair could be made.

REFERENCES FOR SECTION SUPPLEMENT A.3.4-A

Design of Small Dams, Second Edition, 1973, U.S. Department of Interior, Bureau of Reclamation, Washington, D.C.

Rainfall Frequency Atlas of the United States, for durations fro 30 minutes to 24 hours and return periods for 1 to 100 years, U.S. Weather Bureau, Technical Report 40, May 1961.

TABLE A.3.4-A-1

PMF FOR THE VARIOUS DRAINAGE BASINS

Drainage Area, Hectares	Maximum PMF Discharge/m^3sec	
Buttermilk Creek	7903	2407
Dam Reservoir Site	1257	949
Western NY Nuclear Service Center Facilities Basin	606	538

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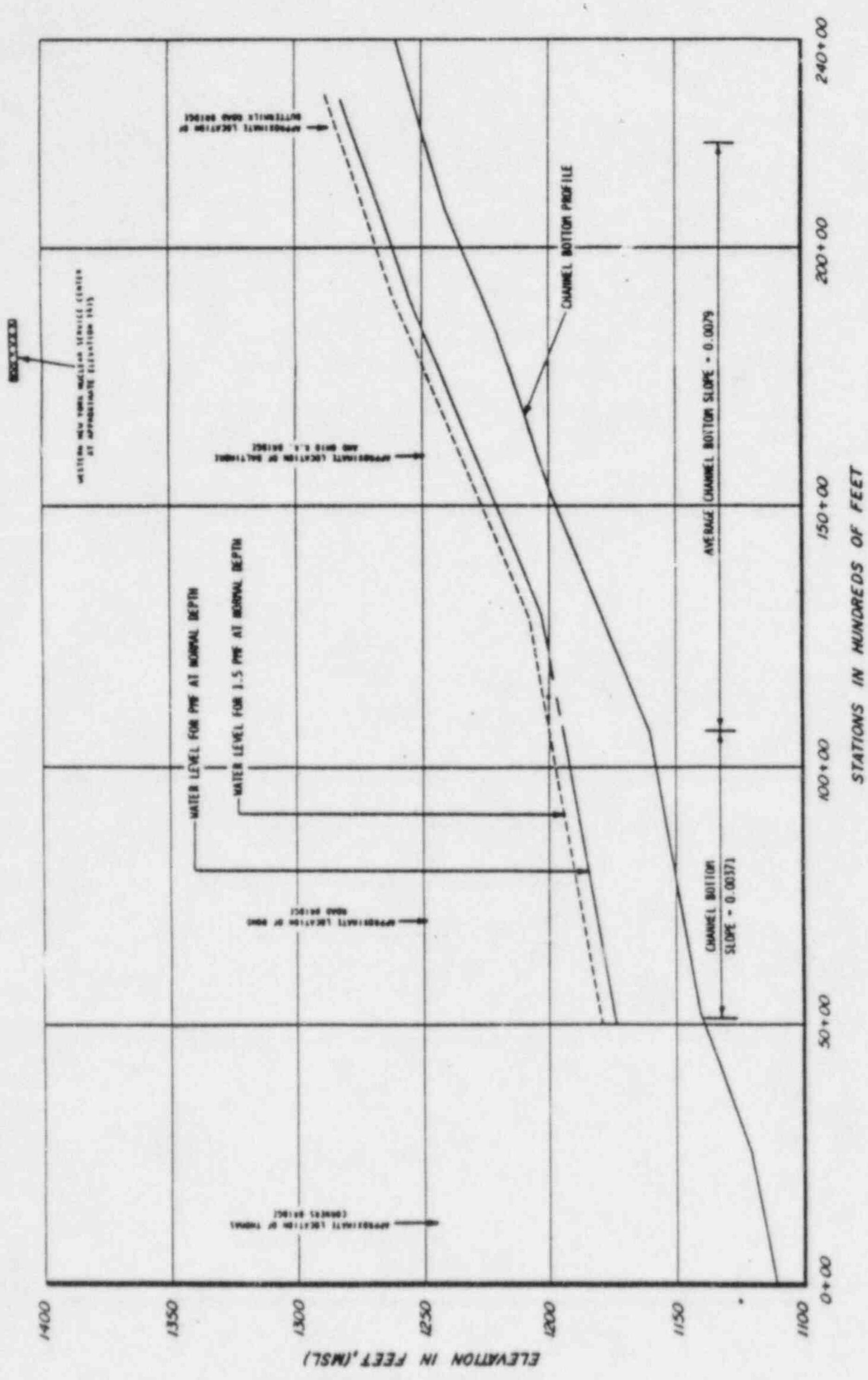


FIGURE A.3.4-A-1

BUTTERMILK CREEK CHANNEL AND WATER LEVEL PROFILES

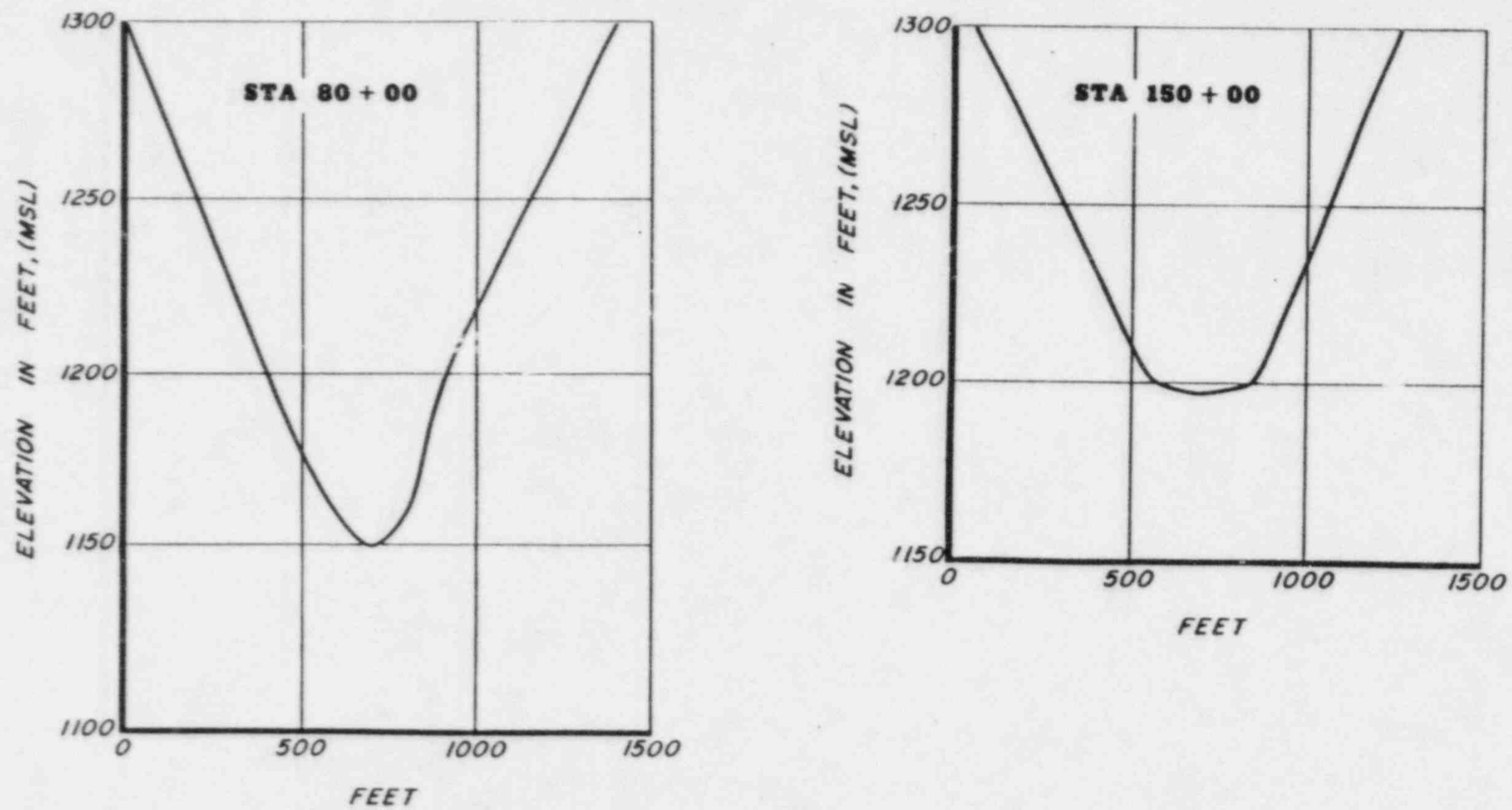
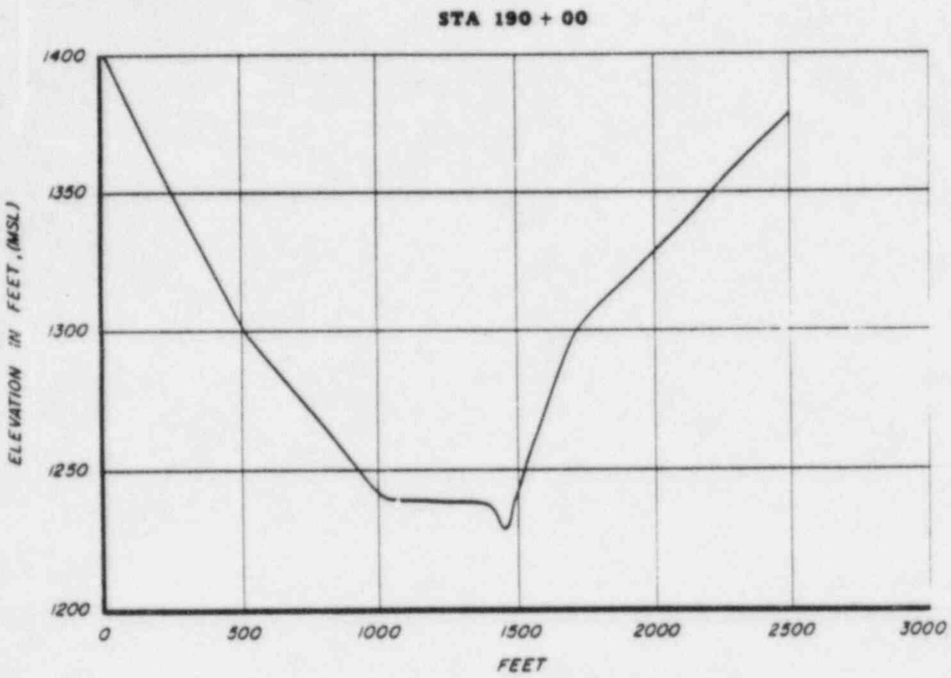


FIGURE A.3.4-A-2

BUTTERMILK CREEK CHANNEL CROSS-SECTIONS



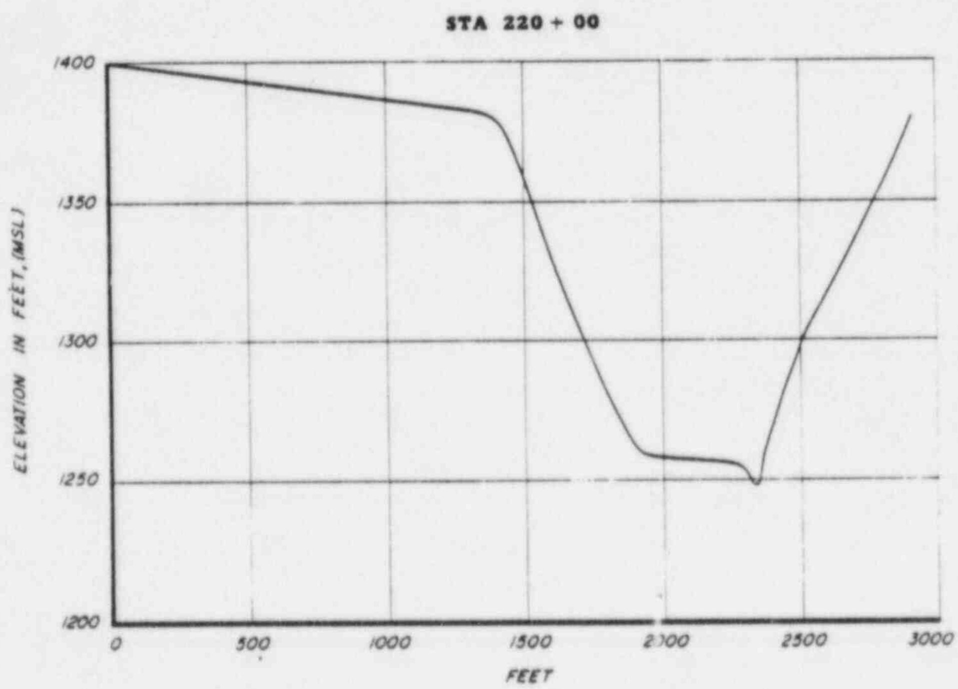


FIGURE A.3.4-A-3

BUTTERMILK CREEK CHANNEL CROSS-SECTIONS

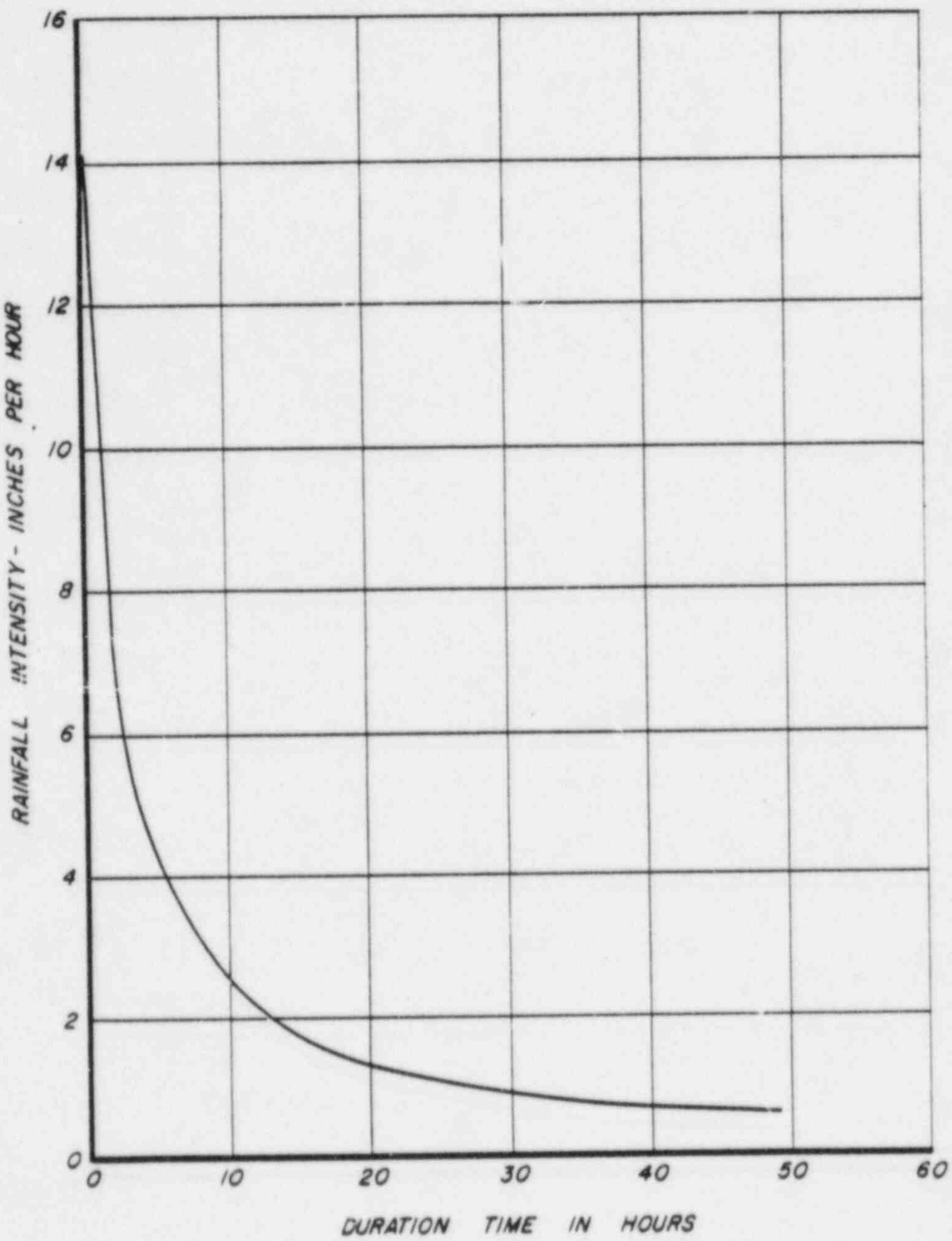
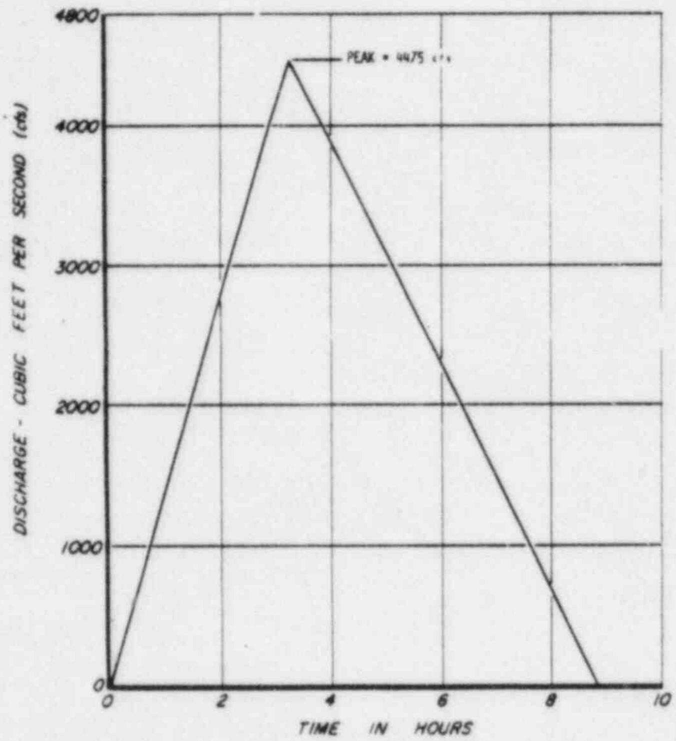
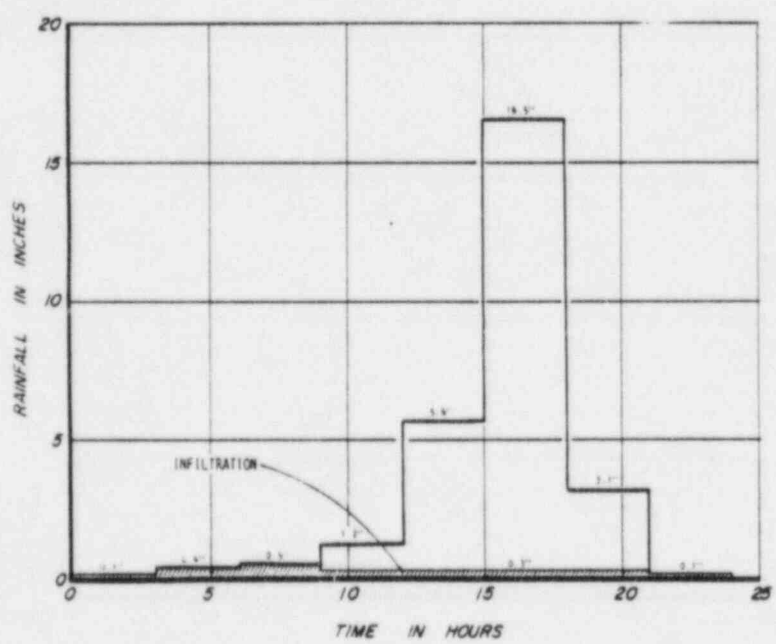


FIGURE A.3.4-A-4

PMP INTENSITY-DURATION CURVE FOR BUTTERMILK CREEK DRAINAGE BASIN



UNIT HYDROGRAPH



PMP HYETOGRAPH

FIGURE A.3.4-A-5

PMP HYETOGRAPH AND UNIT HYDROGRAPH FOR BUTTERMILK CREEK DRAINAGE BASIN

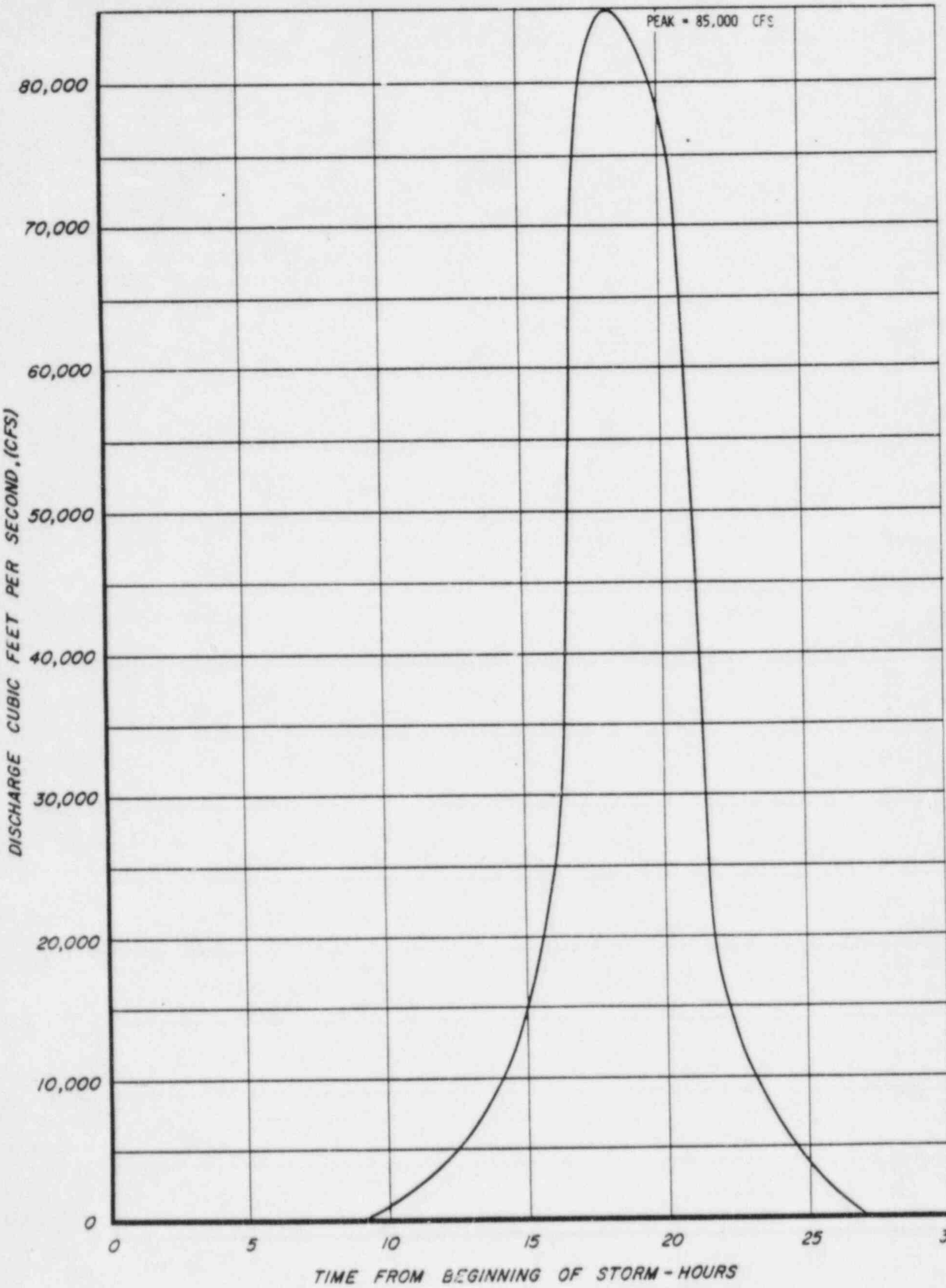


FIGURE A.3.4-A-6

PMF TOTAL HYDROGRAPH FOR BUTTERMILK CREEK DRAINAGE BASIN

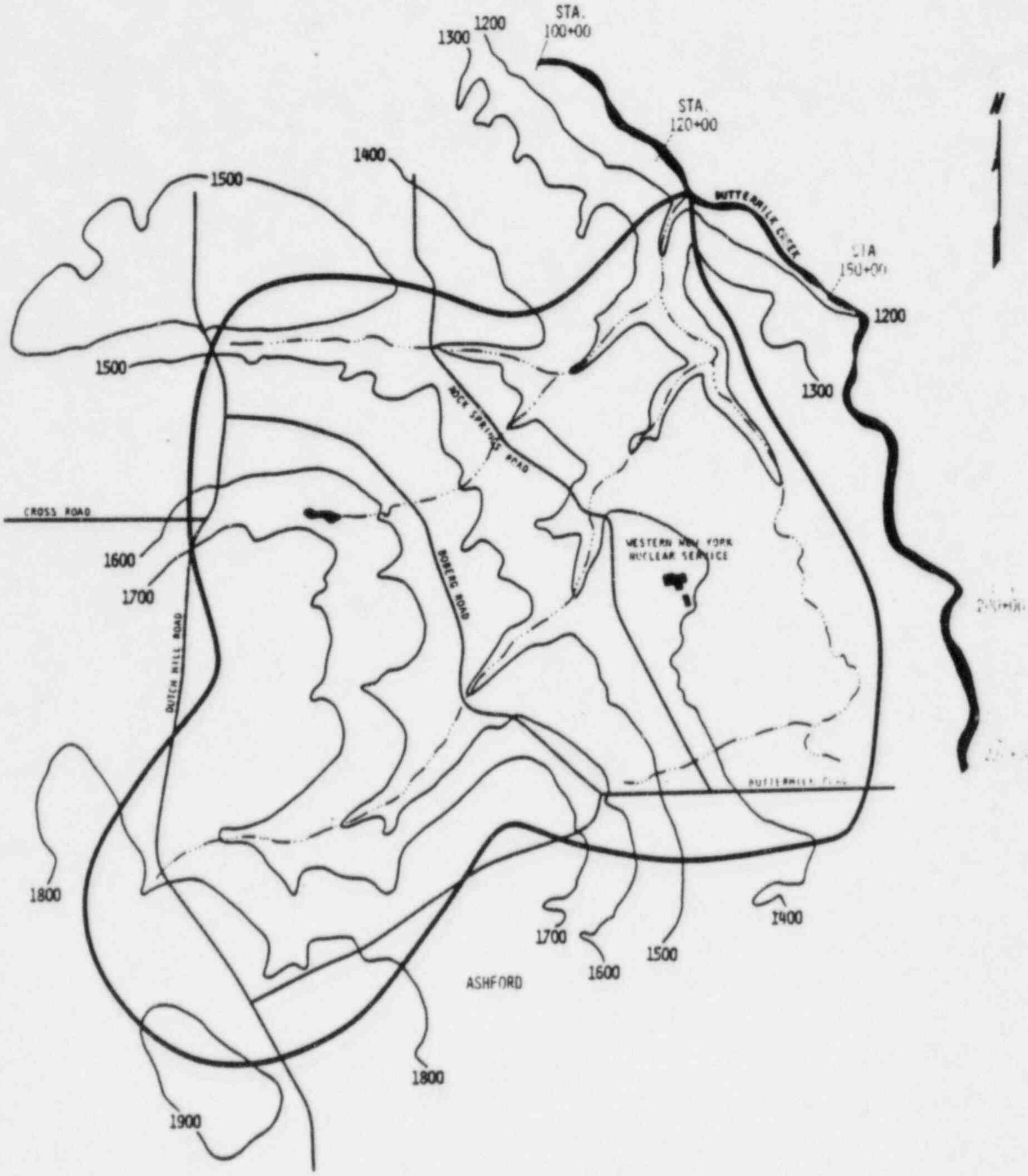


FIGURE A.3.4-A-7

WESTERN NEW YORK NUCLEAR SERVICE
CENTER DRAINAGE BASIN

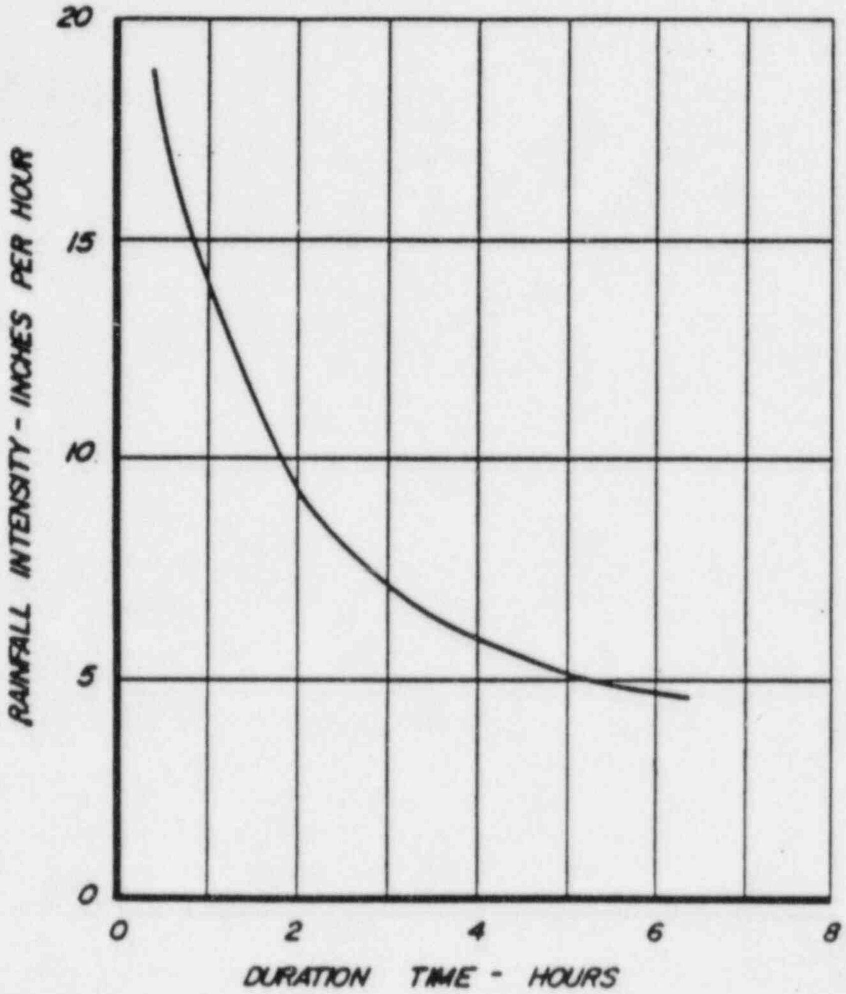
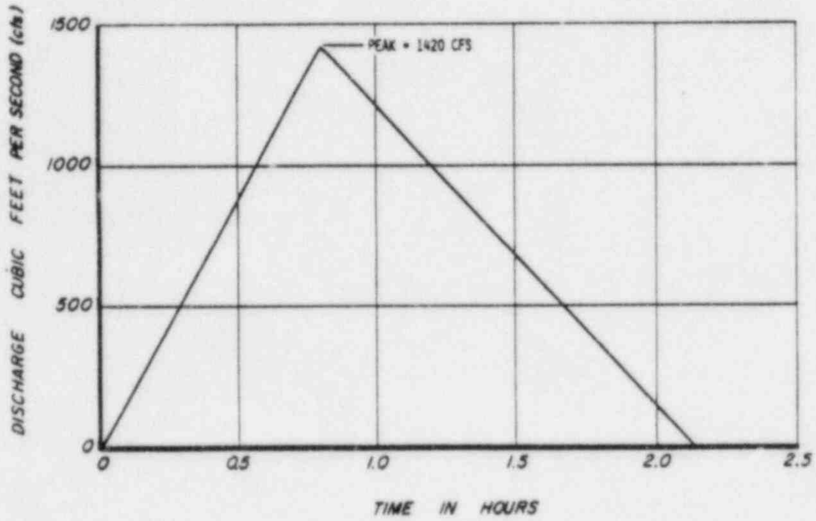
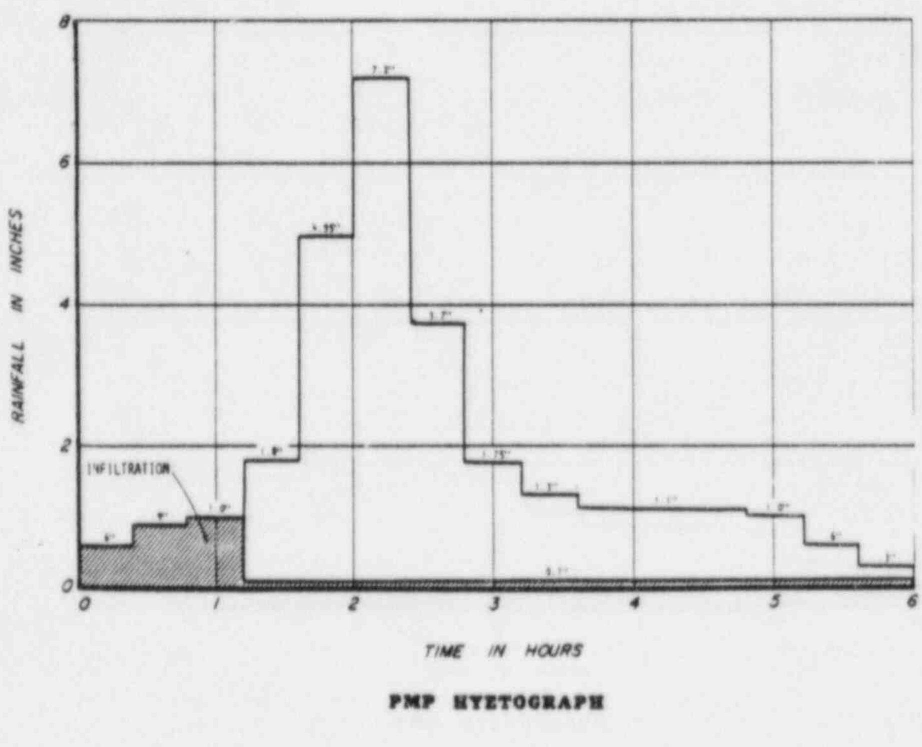


FIGURE A.3.4-A-8

LOCAL PMP INTENSITY-DURATION CURVE FOR WESTERN NEW YORK NUCLEAR SERVICE CENTER BASIN



UNIT HYDROGRAPH



PMP HYETOGRAPH

FIGURE A.3.4-A-9

PMP HYETOGRAPH AND UNIT HYDROGRAPH FOR WESTERN NEW YORK NUCLEAR SERVICE CENTER BASIN

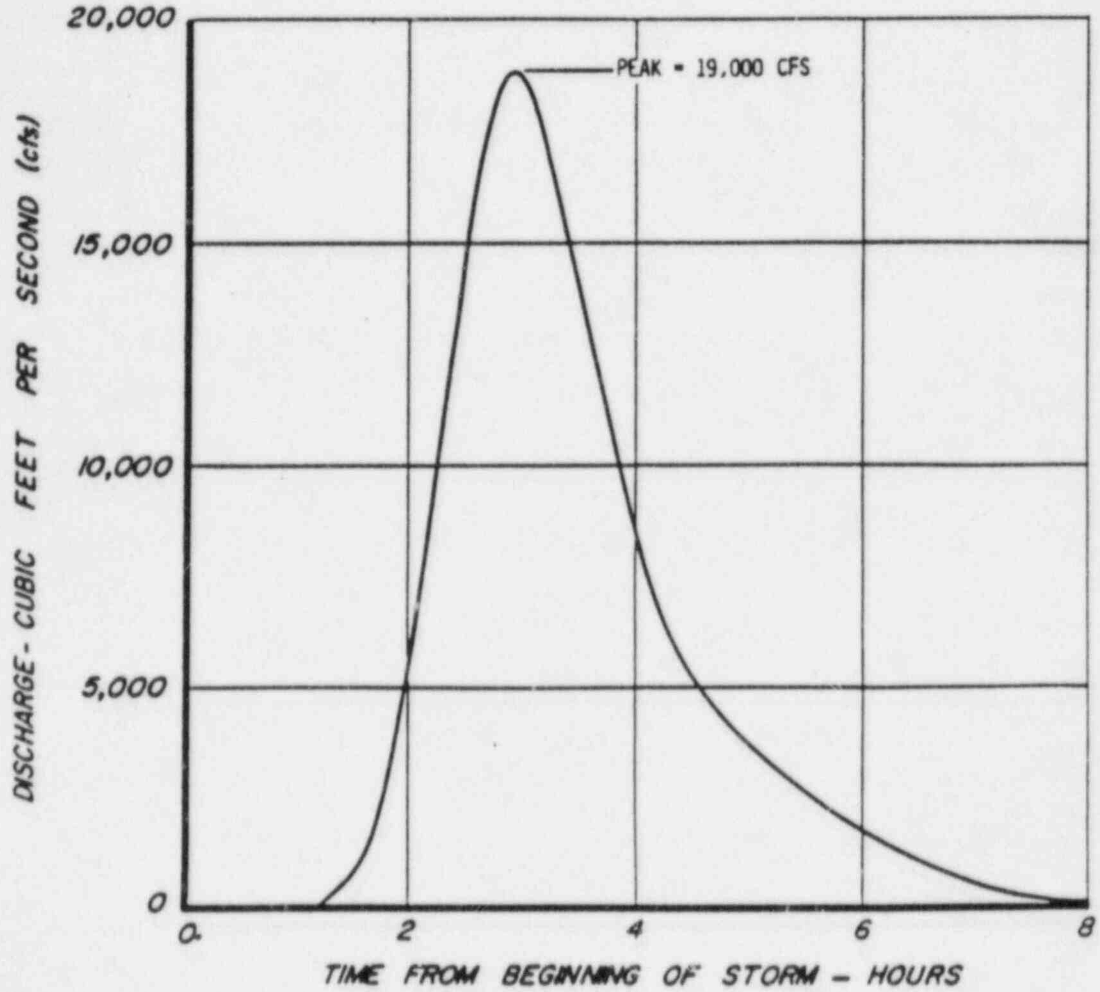


FIGURE A.3.4-A-10

PMF TOTAL HYDROGRAPH FOR WESTERN NEW YORK NUCLEAR SERVICE CENTER BASIN

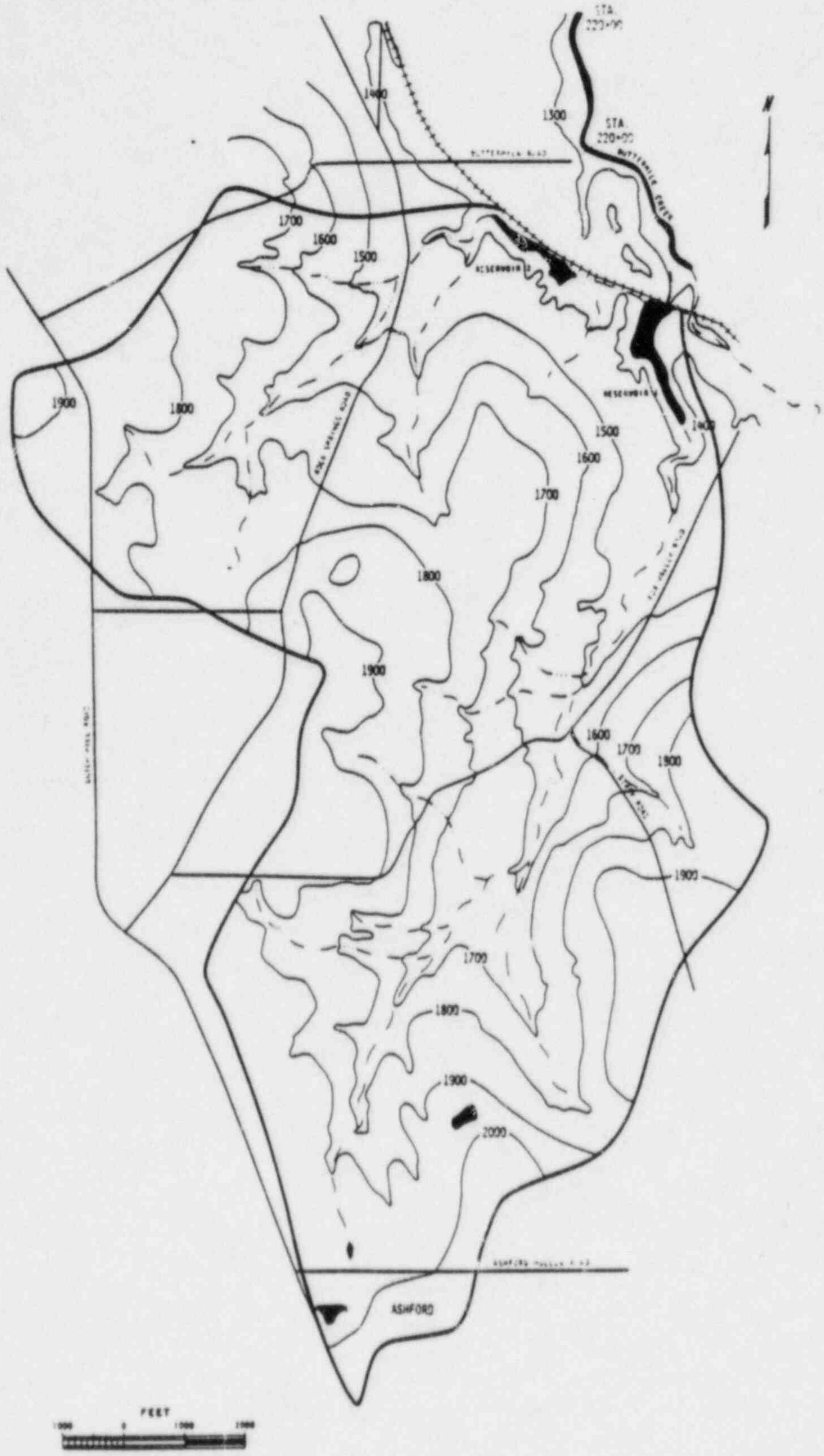


FIGURE A.3.4-A-11

DRAINAGE AREA OF DAM RESERVOIR BASIN

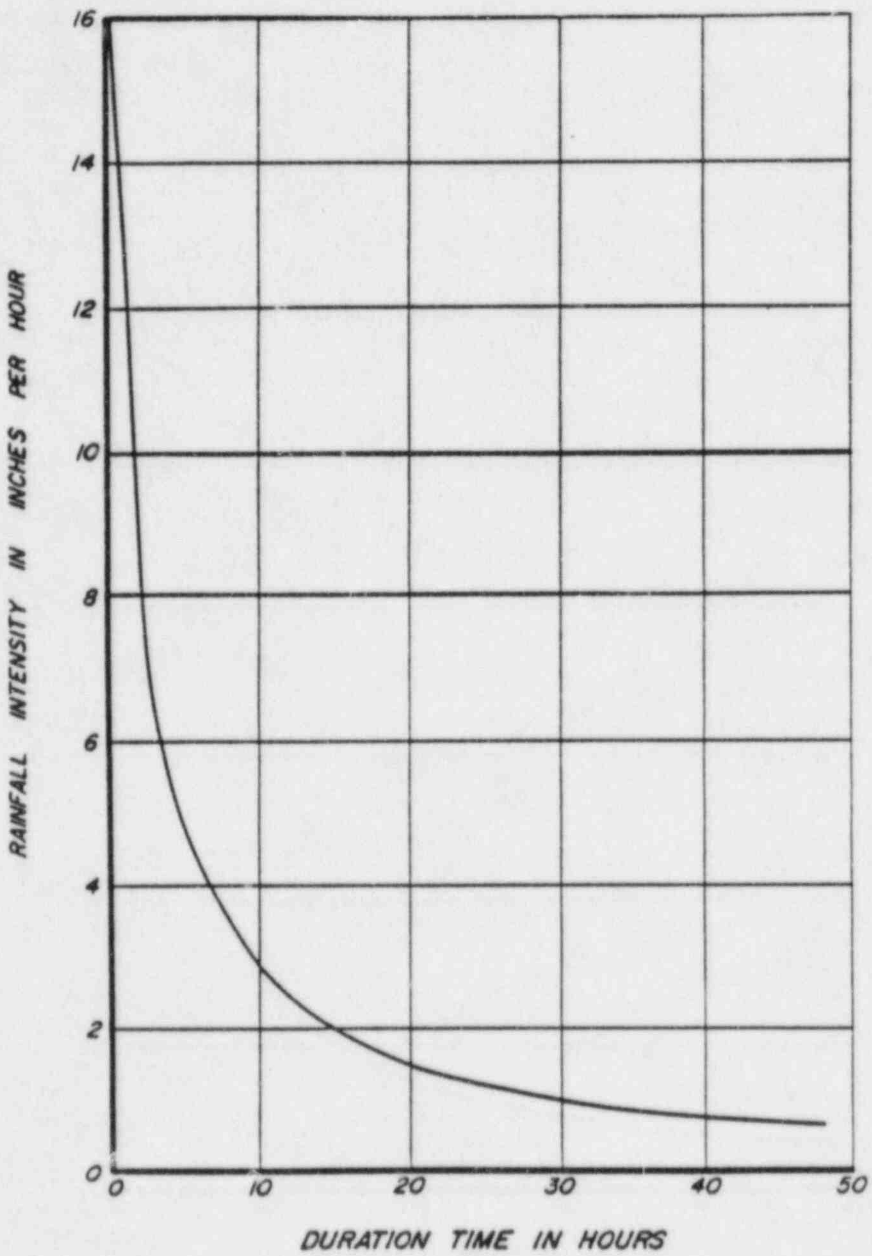
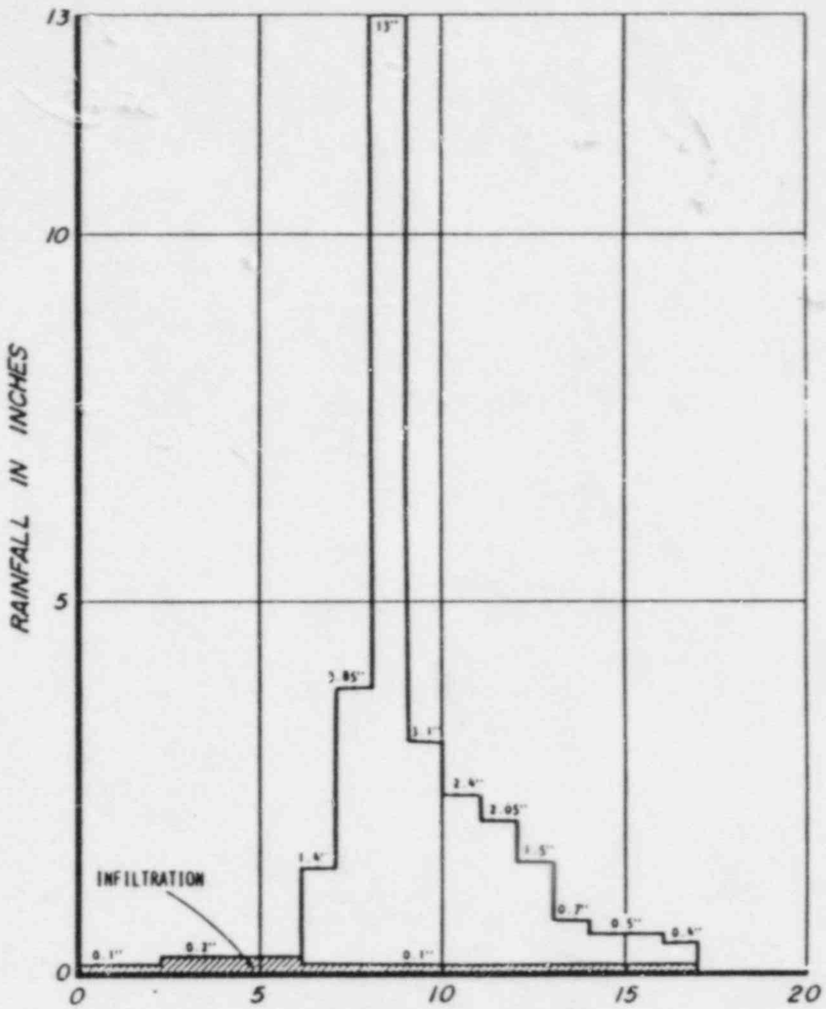
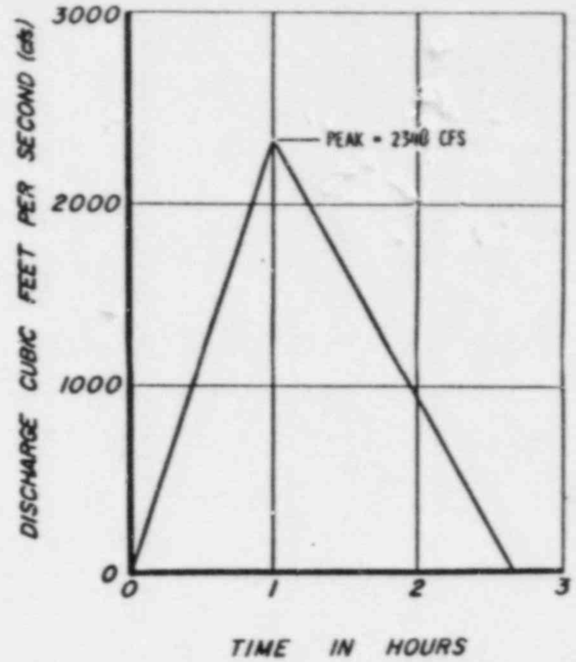


FIGURE A.3.4-A-12

PMP INTENSITY-DURATION CURVE FOR DAM RESERVOIR BASIN



PMP HYETOGRAPH



UNIT HYDROGRAPH

FIGURE A.3.4-A-13

DAM RESERVOIR SITE UNIT HYDROGRAPH AND PMP HYETOGRAPH

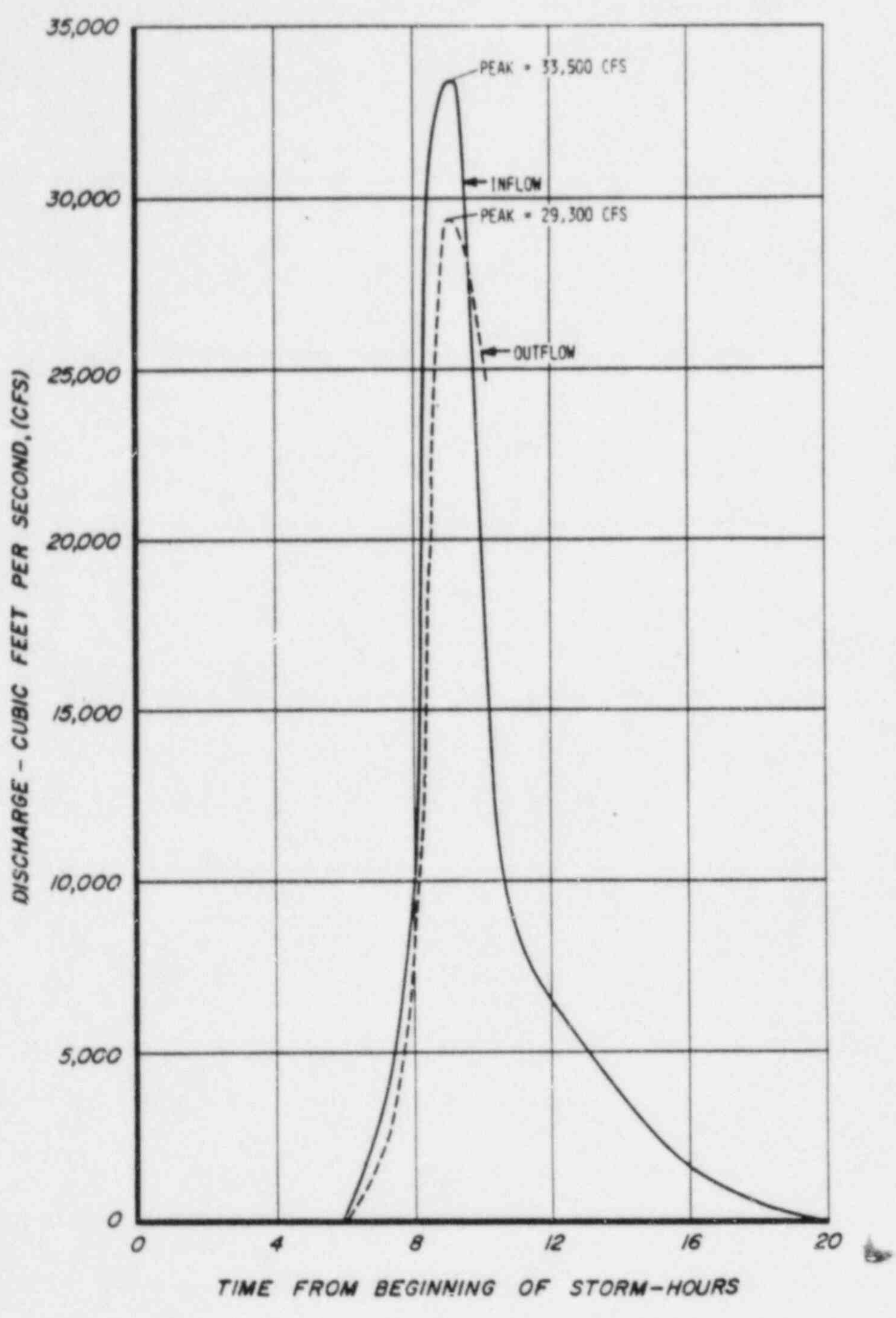


FIGURE A.3.4-A-14

INFLOW AND OUTFLOW PMF TOTAL HYDROGRAPH FOR THE RESERVOIRS

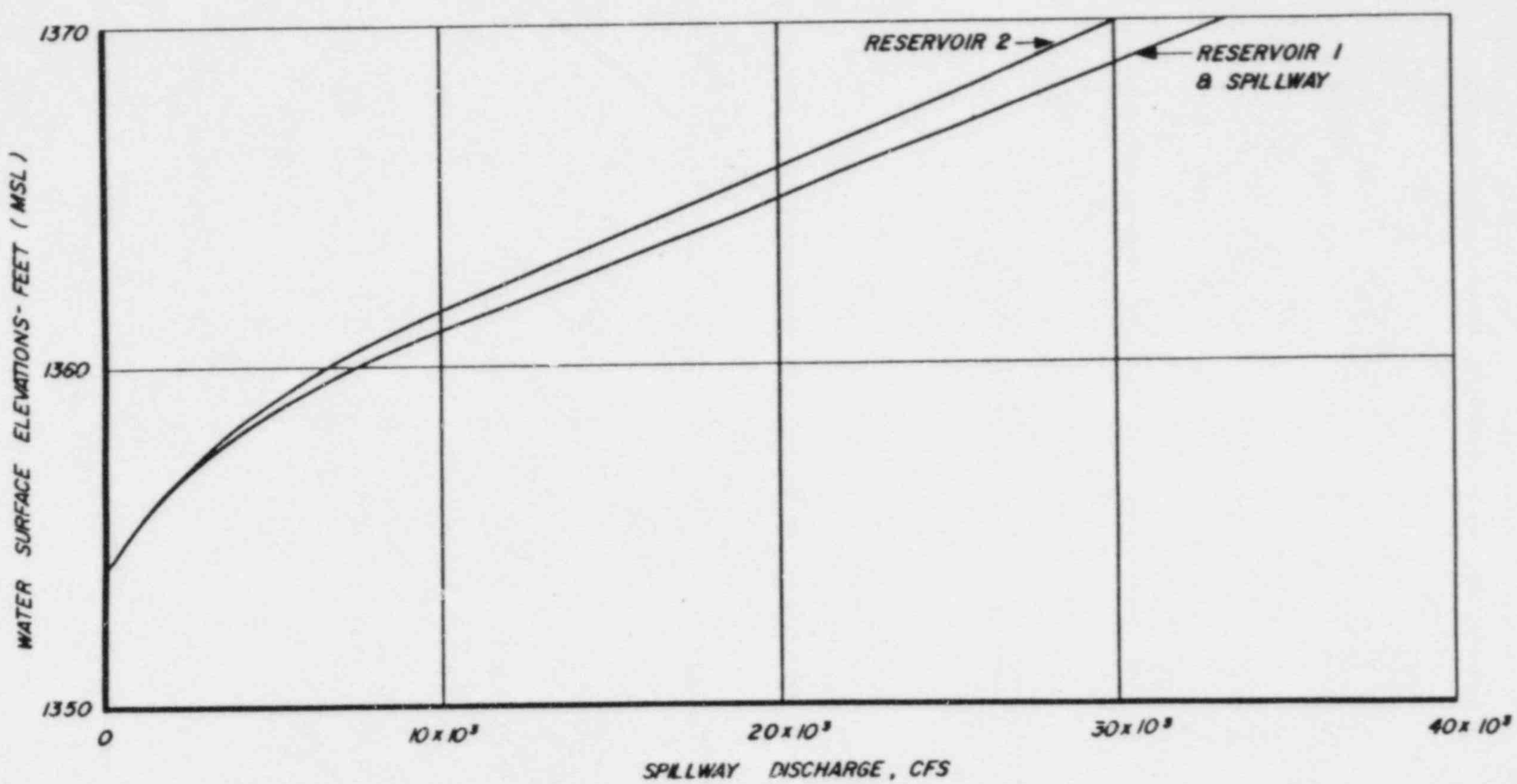
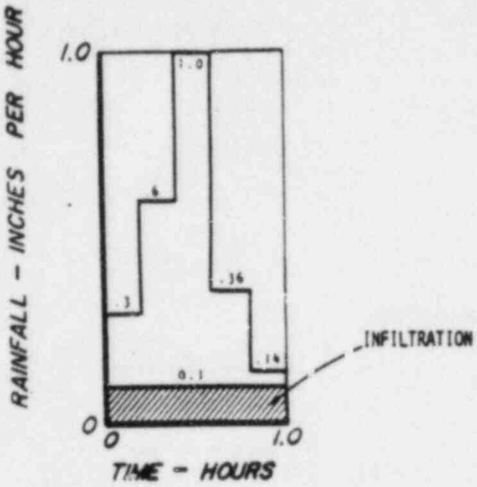


FIGURE A.3.4-A-15

SPILLWAY DISCHARGE VS. WATER SURFACE ELEVATIONS



HYETOGRAPH

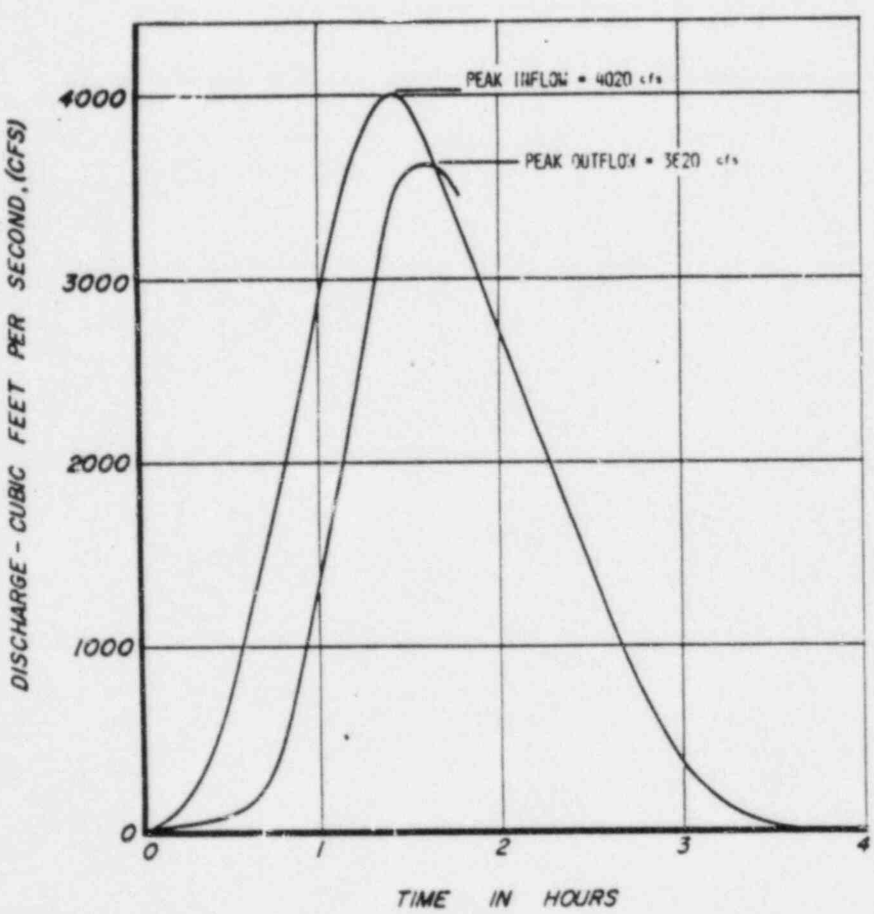


FIGURE A.3.4-A-16

100-YEAR FLOOD HYETOGRAPH INFLOW AND OUTFLOW TOTAL HYDROGRAPHS FOR RESERVOIRS

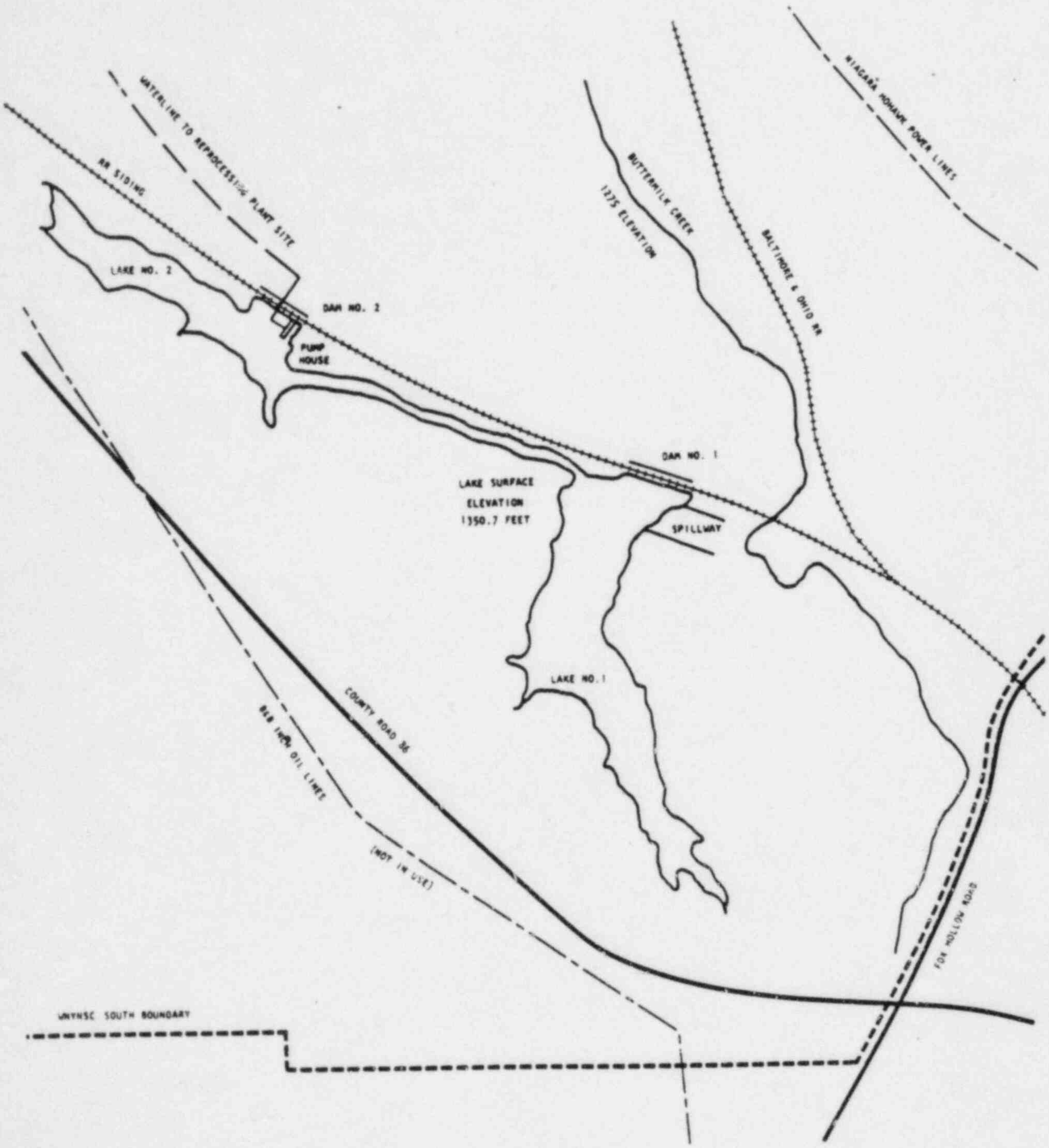


FIGURE A.3.4-A-17

WESTERN NEW YORK NUCLEAR SERVICE CENTER
WVDP SITE WATER SUPPLY

SUPPLEMENT A.3.6-A

REGIONAL AND SITE GEOLOGY

SUPPLEMENT A.3.6-A

REGIONAL AND SITE GEOLOGY

Regional Physiography

Located within the Glaciated Allegheny Plateau section of the Appalachian Plateau Province (Fenneman, 1938), the WVDP is bounded on the north by the Erie Ontario Lowlands, on the east by the Tughill Upland, on the south by the unglaciated portions of the Appalachian Plateau, and on the west by the Interior Lowlands. Figure A.3.6-A-1 illustrates the location of the site relative to these regional physiographic divisions.

The Appalachian Plateau is underlain by a sequence of Paleozoic sedimentary rock units from Cambrian to Permian age and extends as an elongate broad synclinal structure, from Northwestern New York State to Northwestern Alabama. The plateau borders are characterized by escarpments on the west and north which mark the descent to lower elevations of the adjacent provinces.

The Glaciated Allegheny Plateau section is a maturely dissected plateau with surficial bedrock units of Devonian shales and sandstones (Figure A.3.6-A-2). The underlying Paleozoic sedimentary rocks range in age from Cambrian to Devonian and dip gently (4 to 75 metres per kilometre) and uniformly to the south (Figure A.3.6-A-3) exposing younger sedimentary rock units in roughly east-west outcrop bands proceeding toward the south. The depth to crystalline basement rocks of Precambrian age ranges from 610 metres below sea level on the north to about 3,600 metres below sea level on the south near the Pennsylvania border. The depth to Precambrian basement rocks at the WVDP is about 2,135 metres.

The plateau has been subjected to the erosional and depositional actions of repeated glaciations, resulting in accumulation of various glacial deposits (till, outwash and lacustrine deposits) over the area. Glacial scour deepened many valleys which were later filled with sequences of glacial deposits up to 153 metres thick. Glacial deposits are much thinner on hillsides and thin to about 1.5 metres or less in thickness on summits (LaFleur, 1979).

The elevation of the plateau ranges from 610 metres to 763 metres and slopes to the south. The northern portion of the Allegheny Plateau is drained by the headwaters of the Allegheny River which flows to the south. Small streams drain the north-facing plateau escarpment toward the lowlands to elevations of about 76 metres along the Lake Erie shoreline.

Site Physiography

The WVDP site is situated on a relatively flat plateau on the west flank of the Buttermilk Creek Valley. Elevations at the site range from 420 metres to 433 metres above mean sea level. The site is bounded on the east, west, and south by hills which attain elevations of approximately 650 metres. Topographic maps of the site area showing the location of principal plant facilities are presented on the plot plans showing boring locations in Figures A.3.6-A-4 through A.3.6-A-6.

Bedrock in the area consists of shale belonging to the Caneadea-Machias formation of the Canadaway group. Relief of the present land surface is due to preglacial erosion of the bedrock and subsequent topographic modification by glaciation. Thickness of the glacial cover in the area ranges from 1.5 metres on the margin of the valley to about 169 metres or more toward the center of the valley. Bedrock outcrops in the site area occur in the deep rock units of the lower portion of Buttermilk Creek not far from its confluence with Cattaraugus Creek.

Ongoing fluvial and mass wasting processes are constantly altering the present-day landscape. The sites of active erosion at the WNYNSC are confined to the valley walls and channel bottoms of the major watercourses draining the site. This erosion is caused by scour in Buttermilk Creek and its tributaries (Frank's Creek, Quarry Creek, Erdman Brook, and Lagoon Road).

Figure A.3.6-A-7 shows the area of known active landsliding within the Buttermilk Creek channel. This area is approximately 275 metres northeast of the closest buried waste and poses no immediate short-term threat to site operations. Another more immediate erosion hazard exists in the Erdman Brook/Frank's Creek Tributaries.

Boothroyd et al (1982) believe that the convex profile of these channels indicates instability and that they will continue to downcut and widen even if base-level at the confluence of Buttermilk Creek does not change. Through a combination of tributary widening, alluvial funhead incision and drainage capture, the channels will encroach on the waste burial sites and breach the trenches. This can be seen at the site where small erosion gullies (offshoots of the Erdman Brook/Frank's Creek Channel System) have established well defined channels up to the security fence at the state's low-level waste disposal area.

In addition, Albanese et al (1983) have determined that specific locations for probable further landslide activity include the areas directly south, east, and north of New York State Licensed Disposal Areas and the NDA.

Boothroyd and others (1982) calculated a simple denudation rate for Buttermilk Creek Valley. Applying this same rate to Frank's Creek and its tributaries indicates that breaching of the NDA trenches could take place within the next 34 years if current erosion processes remain unchecked. This highly conservative estimate indicates a need for long-term erosion protection to ensure the long-term integrity of the disposal medium.

Buttermilk Creek flows through the site in a generally northwesterly direction before joining Cattaraugus Creek at the north end of the site 8.5 kilometres below its point of entry onto the site at Riceville Station. Its elevation is slightly over 336 metres at its confluence with Cattaraugus Creek (NFS, 1973). Cattaraugus Creek flows in a westerly direction from the site to Lake Erie some 62 kilometres downstream.

The NDA is drained by Erdman Brook, a tributary of Frank's Creek, which discharges into the Buttermilk Creek.

Erdman Brook originates as two very narrow (less than 0.5 metres wide) branches with intermittent precipitation-induced flow. The west branch enters the WVDP area at Rock Spring Road and flows generally northeast until it joins the east branch to the north of the NDA. The east branch is joined by two ditches; one ditch flows between the NDA and the New York State Licensed Disposal Area and is referred to as Lagoon Road. The other ditch is subperpendicular to Lagoon Road and is named Erdman Brook. This brook gradually widens to approximately 3 metres as it courses by the New York State Licensed Disposal Area into Frank's Creek. The stream bed contains mostly small, angular rocks, gravel, and sand. In some places the stream bed consists solely of a dense, slippery, gray till. There are a few areas of soft sediment (silts and clays) which are frequently inundated by spates. Water depths range from several centimetres in riffles and up to approximately 30 centimetres in pools found in this channel.

Frank's Creek is a second-order stream which receives flow from both Erdman Brook and other tributaries. This channel is wider than its tributaries, ranging from approximately two to five metres in width. Depth ranges from several centimetres in riffles to pools greater than 0.5 metre. The stream bed contains rocks ranging in size from gravel to small boulders and areas of bare, exposed till. Like its tributaries, Frank's Creek has very few areas of soft sediment, and these are usually located on the inside of meander curves. Also like its tributaries, this creek is subject to spates which can inundate areas of sediment deposition.

Regional Geologic History

The Appalachian Plateau is the westernmost geologic component of the Appalachian mountain province. These mountains resulted from the late Paleozoic deformation and uplift of a thick sequence of sedimentary material which accumulated in subsiding geosyncline trough during the Paleozoic Era. Structural deformation increases to the east in the Appalachian range and is evidenced by folding and thrust faulting in the Valley and Ridge province to the east of the plateau.

Within the Appalachian Plateau area, the Paleozoic sediments accumulated in a geosyncline characterized by shallower and more stable areas to the west than those to the east where deeper water deposits accumulated. In general, the sedimentary units in the study area represent deposits which accumulated in a shallow sea and are characterized by carbonate rocks and clastic deposits. For the most part, the periods of clastic deposition (sandstones and shales) represent the increase in sediment source areas to the east. These sediment influxes correspond to periods of deformation and uplift of eastern areas in response to periods of continental collisions related to continental drift and related mountain building episodes (called orogenies).

The initial deposits of the Cambrian period include clean shallow water sandstones followed by the deposition of marine carbonates of stable shelf environments. This pattern of carbonate shelf deposition continued up into the Ordovician period.

Mountain building to the east from the Taconic Orogeny characterized the middle and later portion of the Ordovician period. The sedimentary basin to the west of the site records this event as deltaic clastic units of the Middle and Upper Ordovician age such as the Queenston formation. Following widespread uplift and erosion, the shallow shelf seas returned in the Silurian to deposit basal marine clastics followed by marine carbonates.

The seas withdrew in the Late Silurian and transitional marine deposits were laid down in a coastal plain setting. Evaporite deposits accumulated in isolated arms of the sea forming the Salina-Syracuse Salt units of Western New York.

The restricted circulation which resulted in the isolated seas and evaporite deposits ended in the later stages of the Silurian when more normal marine carbonate deposition returned.

Similar shallow marine conditions were present for the Early Devonian limestones and clean sandstones. Following this initial period, the Devonian period records the accumulation of a great clastic wedge of sediments from mountain areas to the east. The Devonian deposits range from coarse clastic continental deposit of the east to deeper, water marine fine-grained shales and sandstones on the west (Figure A.3.6-A-8).

These Devonian deposits occupy the broad area of New York State from the Hudson Valley on the east where the conglomerates and sandstone form the Catskill Mountains to the western edge of the Allegheny Plateau where the finer-grained shales and siltstones form the surficial bedrock.

The later stages of the Paleozoic Era (Mississippian, Pennsylvanian and Permian) are not recorded in the sedimentary rocks of the region. The final episode in the mountain building process was the Appalachian Orogeny. It resulted in the folding and faulting of rocks in Eastern New York State and elsewhere in the Eastern Appalachian Plateau province where only regional uplift took place.

The final stage in the geologic history of the region is recorded in Pleistocene glacial advances and deposits which veneer the plateau. A complete discussion of these glacial deposits and their geological history follows.

Site Geologic History

The geologic history of the Paleozoic rock sequences at the site is very similar to the regional geologic history as described above. Repeated Pleistocene glaciations by Wisconsinan and older ice sheets, however, have covered the area with a complex of tills, lacustrine sediments, moraines, and outwash deposits.

Five or more glacial ice sheets advanced over the West Valley region, and deposited a thick sequence of tills and lacustrine sediments. Part of these are now buried below the level of Buttermilk Creek. The lowest exposed till section has been assigned to Olean glaciation. Lying in channels cut in Olean till are gravels deposited during the Plum Point interstadial. Overlying the Olean till is a thick sequence of Kent till and associated proglacial lacustrine sediments. These till and lacustrine units are capped by Kent recessional kame deltas and associated intervening clastic sediments that form a sand blanket of varying thickness across Buttermilk Valley. The sand blanket is covered in part by channel gravels and gravel blankets that may have been deposited in other fluvial environments. The Kent sequence was subsequently overridden by Lavery-age ice which deposited a thick sequence of tills and included overridden proglacial sands and gravels. Partly capping the Lavery till are late Wisconsinan proglacial outwash and fluvial gravels and holocene alluvial fan deposits (Dana, et al 1979a).

Regional Stratigraphy

Throughout Western New York State, bedrock consists of middle Paleozoic sedimentary formations with an average dip to the south of from 4 to 7.5 metres per kilometre. The Paleozoics increase in thickness from 610 metres at the south shore of Lake Ontario to 3,600 metres at the New York-Pennsylvanian line. Based on oil and gas well logs, the predominant lithologies of the underlying crystalline basement complex are: granite, gneiss, schist, calcitic marble, and dolomitic marble.

Cambrian sandstone and shale uncomformably overlie the Precambrian basement. Unconformably overlying the Cambrian strata are Ordovician rocks which are similar to the Cambrian and distinguishable from them primarily on the basis of fossil content. The Ordovician rocks in turn are overlain by rocks of Silurian age, comprised mostly of sandstone, limestone, and dolomites grading upward into shale. The overlying rocks are of Devonian age and consist mostly of shale with few persistent limestone or sandstone beds. Devonian rocks immediately underlie the area surveyed. (A complete discussion of Paleozoic lithologies in the site area is presented in the discussion of Site Stratigraphy and Lithology.)

Unconsolidated materials deposited by glacial action action during Pleistocene time blanket the area. These deposits consist of till, bedded lake deposits, and sand and gravel deposits laid down by glacial streams. Relief of the present land surface is due to preglacial erosion of the bedrock, with subsequent deepening and modification by glaciation some 10,000 to 15,000 years ago.

The preglacial valleys cut into the shale bedrock and deepened by glacial erosion are now partially filled with glacial sediments. Some of the streams presently flowing on the valley fill are as much as 180 metres above the bedrock floor of the valley. At the site, the approximate thickness of valley fill ranges from 15 to 170 metres.

Site Stratigraphy and Lithology

The Paleozoic sequence of consolidated rocks that underlie the unconsolidated Holocene and Pleistocene deposits at the site are approximately 2,300 metres thick and range in age from Cambrian to Devonian. The sequence includes shales, siltstones, sandstones, and carbonates (limestone and dolomite); the Salina group of the upper Silurian includes some evaporite beds in the depth

range of approximately 800 to 1,000 metres. The bedrock underlying the area is nearly flat and quite undeformed; the average dip is 6-8 m/km (about 30-40 ft/mi) to the south. The Paleozoic sequence is underlain by Precambrian crystalline rock.

In the immediate vicinity of the site, the bedrock underlying the Pleistocene glacial deposits in the upper Devonian shale belong to the Caneadea-Machias formation of the Canadaway group. This unit is a thin-bedded, black and grey, moderately hard shale and siltstone that may attain a thickness of 120 metres or more beneath the site. A generalized stratigraphic column for the site vicinity is presented in Figure A.3.6-A-9. The discussion that follows presents a description of each of the Paleozoic strata.

Bedrock Cambrian System

The Cambrian system is composed of the rocks belonging to the Saratoga Springs group which includes the following units: Little Falls formation, Theresa formation, and Potsdam formation.

The Little Falls formation consists predominantly of buff to light gray to brown, fine to medium crystalline dolomite, with some thinly bedded siltstone. The formation contains much fine to medium-coarse quartz and is commonly pyritic, cherty, and oolitic. The basal portion of the unit is characterized by a silty-sandy facies. The formation is approximately 60 metres thick.

The Theresa formation may be subdivided into an upper sandstone facies and a sandy dolomite unit. The sandstone unit is a clean, white sandstone with subrounded quartz grains. The dolomite is pale yellow-brown to dark yellow-brown, fine to medium crystalline and in places contains oolites and chert, as well as disseminated grains of pyrite, quartz, and biotite. Some glauconitic muds are present in the section. The formation is 215 metres thick.

The Potsdam formation consists of fine to medium coarse grained grey to reddish-brown sandstone. The sandstone is both quartzose and dolomitic. Some beds of dolomite and dark gray shale are present. The sand grains are frosted. Other minerals present are muscovite and feldspar. This formation is estimated to be 30 metres thick.

Ordovician System

The Ordovician rocks consist of the following groups or formations: Queenston formation, Oswego formation, Lorraine Utica sequence, and Trenton-Black River groups.

The Queenston formation is predominantly composed of grayish-red, slightly silty, and calcareous shale. The grayish-red shale is interbedded with greenish-gray shales, grayish-red siltstones, and grayish-red argillaceous fine-grained sandstone. This formation is approximately 300 metres thick.

Approximately 35 metres thick, the Oswego formation is composed of pinkish to greenish-gray, very fine to fine-grained sandstone, interbedded with some greenish-gray, purplish-gray siltstones and shales.

The Lorraine-Utica sequence is composed of shale with some interbedded siltstones. The Lorraine shales are medium dark gray, slightly calcareous with some medium light gray and light greenish-gray siltstones. The Utica shales are dark gray to brownish-black, slightly calcareous and interbedded with light to dark gray siltstones. The Lorraine-Utica sequence is about 250 metres thick.

The Trenton-Black River formation consists primarily of limestones with some interbedded shales. The Trenton limestones are dark, olive-gray, and yellowish-brown in color, microcrystalline and cryptocrystalline in texture

and fossiliferous. The shales are dusky brown. The Black River limestone is sublithographic to lithographic in texture and light to dark brown in color. Some yellow-brown microcrystalline sucrosic dolomites are present in the section.

The basal section of the group is a heterogeneous mixture of lithologies with oolitic limestones and sucrosic dolomites predominating at the top and varicolored shales and gray siltstones predominating near the base. The total thickness of the Trenton-Black River group is about 255 metres.

Major Unconformity

Most of the Chasey group and Beekmantown group rocks are not present below the Trenton-Black River group and are separated from the underlying rock units by the Knox unconformity. This unconformity is one of the most notable stratigraphic breaks in Paleozoic rock in the Eastern United States and represents one of the most significant erosional periods of that time.

The subsurface correlation of lithostratigraphic units found below this unconformity in the area covered in this report varies in New York, Pennsylvania, and Ontario. In this report, the Tribes Hill-Beekmantown rock units, where present, are considered to be a part of the Cambrian Section. The Tribes Hill section at the plant site is about 30 metres thick.

Silurian System

The Silur[illegible] ks consist of the following formations or groups in descending order: Ak[illegible] Bertie group, Salina group, Clinton group, and Medina group.

The Akron-Bertie group is composed of grayish-yellow, olive-gray, yellow-brown, microcrystalline sucrosic dolomites. In the lower portions of the group, the dolomites are interbedded with medium gray and dusky brown shale beds. The group is approximately 15 metres thick.

The Salina group consists of the Camillus, Syracuse Salt, and Vernon Formations. The Camillus formation is composed of brown dolomites with gray shales and pale, yellow-brown anhydrites. The Syracuse formation consists of rock salt, with interbedded shales, dolomites, and anhydrites. In this area it is only about 5 metres thick. The Vernon formation is composed of grayish-green to reddish-brown, slightly dolomitic shale. The Salina group is approximately 215 metres thick.

The Lockport group of middle Silurian age consists of dolomites and limestones with some interbedded shale. The dolomites are brownish-gray, very fine (sugary) to crystalline with some scattered dolomite crystals. The limestones are dolomitic and the shales are dusky brown. The Lockport group is approximately 70 metres thick.

In the area of investigation, the Clinton group can be subdivided into the following units in descending order: Rochester shale, Irondequoit limestone, Reynales dolomite, Meahga shale, and Thorold sandstone. The Rochester shale is predominantly dark olive-gray and interbedded with brownish-gray and olive-gray, silty dolomites and olive-gray dolomitic siltstones. The underlying limestone is pinkish-gray, fine to coarsely crystalline, and slightly fossiliferous. It is interbedded with dark gray calcareous shale near the base. Unconformably underlying the Irondequoit is a grayish-yellow to light gray crystalline and slightly cherty Reynales dolomite. Beneath the dolomite is a grayish-green shale and light greenish-gray siltstone. The base of the group is represented by a light greenish-gray, very fine to fine grained, friable micaceous, slightly dolomitic Thorold sandstone. The Clinton group is approximately 45 metres thick.

The Medina group of early Silurian age is composed of red, green, and gray shales and red sandstones.

The sandstones lie on light greenish-gray shales and siltstones of the Cabothead formation. The basal Medina consists of white to light gray, fine to medium grained, slightly calcareous and friable, quartzose sandstone (Whirlpool formation). The Medina group is about 30 metres thick.

Devonian System

Upper Devonian

The lithologies of the upper Devonian in Western New York are difficult to correlate and to trace because of lithologic changes and varying nomenclature.

The following groups have been recognized in this area, from bottom to top: the Genesee group, the Sonyea group, the Java and West Falls group, and the uppermost Canadaway group which forms the surficial bedrock near the site. The siltstones and shales of these groups are light-gray to medium-gray and calcareous. Dark gray to black shales are also present as well as thin, fine-grained sandstone units. The upper Devonian sequence is approximately 580 metres thick.

Middle Devonian

In the area of investigation, the middle Devonian consists of the Tully formation, the Hamilton group, and the Onondaga formation.

The Tully formation is a very fine, grayish-brown limestone approximately 5 metres thick.

The Hamilton group is composed of predominantly gray to dark gray to grayish-black shales that are slightly calcareous. A few thin-bedded, brownish-gray to dark gray limestone beds are present in this sequence. The Hamilton group is approximately 110 metres thick.

The Onondaga formation consists of gray to brownish-gray, fine-grained limestone with light to medium gray chert. This unit is separated from a light brownish-gray, very fine-grained limestone with dark grayish-brown chert and fossils by a brownish-gray micaceous bentonite. The rest of the formation consists of medium gray, thin-bedded limestone with abundant dark gray chert and light gray coarsely crystalline, massive limestone with some light gray chert. The formation is approximately 50 metres thick.

Glacial Units

The distribution of glacial deposits in the site vicinity is shown in Figure A.3.6-A-10. A generalized east-west geologic cross section through the plant and extending east of Buttermilk Creek is shown in Figure A.3.6-A-11. The section illustrates the presence of a preglacial valley that had been eroded in the bedrock and was subsequently filled with glacial deposits. This buried valley trends approximately north 25° west, slopes northward, and has an average depth of approximately 168 metres (NFS, 1973). The current valley of Buttermilk Creek was eroded in the unconsolidated glacial materials during the 10,000 to 15,000 years since the disappearance of the last glacier.

Figure A.3.6-A-12 is a schematic north to south cross section through the site area which summarizes the key features of the glacial stratigraphy. This figure is based on the work published by La Fleur (1979) modified by more recent data and interpretations by the WVDP geologists. Three glacial till complexes are suggested, from bottom to top: (1) Olean and older tills and associated glacial lake deposits; (2) Kent till and related deposits; (3) the Lavery Till complex which forms the host material of the NDA. Northwest of the NDA, the Lavery Till complex is overlain by a fluvial gravel related to the Defiance glacial advance and Holocene alluvial fan gravels.

As the ice withdrew after each glacial stage, the surface of the till complex was exposed to erosion and weathering. Fluvial channel gravels formed locally on three erosional surfaces. In addition, ice retreat and melting often resulted in the deposition of stratified sand and gravel deposits as kame delta complexes along the valley margins. Also, due to blocked drainage, glacial lakes formed within the valley at various stages and rhythmically deposited clay formed lacustrine deposits.

The kame delta deposits consist of three components: (1) an upper component comprised of coarse-grained sands and gravels, (2) a middle unit comprised of beds of sands and silt deposited as a delta front, and (3) a lower unit comprised of deeper water fine-grained suspension deposits (silt and clay) which were laid down at the toe of the kame delta deposit as it prograded into the lake.

Glacial lake and kame delta deposits developed in the melt waters as the ice withdrew following deposition of the Kent Till. Material eroded from these deposits formed local fluvial gravels during the Lake Erie interstadial stage. Ice advanced over these deposits during the subsequent Lavery glacial stage. Some deformation of the underlying sediments occurred and masses of lacustrine material were incorporated into the Lavery Till at some locations. La Fleur (1979) mapped three kame delta sequences north of Riceville Station at intervals of 0.8 km or less in the bluffs of Buttermilk Creek. These lacustrine units are found locally above the Lake Erie interstadial erosion surface which overlies the kame deposits. This indicates that as the Lavery ice advanced, proglacial lakes formed in the valley before till deposition. Lenses of deformed sand and gravel are found in the upper portion of the Lavery Till and appear to represent ice frontal deposits which were overridden by late surges of the Lavery ice (La Fleur, 1979).

Lavery Till Complex

The Lavery Till is of particular significance because it is the host material in the burial areas. Comprehensive descriptions of the Lavery Till have been given in Whitney, 1977; La Fleur, 1979, 1980a, 1980b; Fickies et al, 1979; Fakundiny et al, 1980; and Hollman et al, 1980.

Geologic cross sections through the Lavery Till at the site are presented in Figures A.3.6-A-13 and A.3.6-A-14. The location of these geologic sections are shown in Figure A.3.6-A-15.

An isopach map of the Lavery Till is presented in Figure A.3.6-A-16. Over 31 metres thick toward the northeast, the till thins to 5 metres at Riceville Station to the southeast. Beneath the NDA, the Lavery Till averages about 24 metres thick.

La Fleur (1979) recognized three subfacies units within the Lavery Till complex: [1] Pebble and Cobble Till, [2] Till, and [3] Stratified Sand and Gravel.

The most abundant subfacies forms about 70 percent of the formation thickness; it is a pebble and cobble till, moderately bright, with a clayey silt matrix. Stones constitute 10 to 20 percent of the unit in field exposures. (Cobbles larger than 6 centimetres could not be recovered in the core barrel during drilling.) Textural and mineralogical analyses by Whitney (1977) on three till matrix samples from the waste burial site show nearly uniform percentages of clay (40 percent), silt (48 percent), and sand (12 percent), with the silt and clay fractions dominated by quartz, mica (illite), and chlorite. Textural analyses of two core samples by the U.S. Geological Survey (unpublished) showed 55 percent clay, 25 percent silt, and 20 percent sand and gravel.

The second subfacies is texturally similar to the first, except that stone content is less than 5 percent, and the matrix contains thin, torn wisps of light-gray (N8)[1] quartz silt. The till rarely includes, or grades into, layered silt and clay; otherwise, there is no indication of varved or other rhythmic bedding in either of these subfacies. Both subfacies interfinger, and although they have a general stratiform relationship, each is internally deformed. Any particular lens of each subfacies is of small areal extent. Unoxidized matrix color is a consistent medium olive gray (N5-5Y5/1).[1] Oxidation extends to a depth of about 2.5 metres. Altered matrix colors above this depth are olive gray (5Y6/1) or pale yellowish-brown (10YR6/1). The matrix is highly calcareous and leached to a depth of less than 1/3 metre. X-ray analyses showed that quartz and illite constitute well over half the material in each of the seven samples of the till (Table A.3.6-A-1).

The third subfacies, exposed only in excavations on the burial site at depths of 2 to 3.8 metres, consists of stratified sand and gravel with included torn masses of till (subfacies 1) and rhythmic clay. Lenticular and discontinuous, this subfacies represents ice frontal deposits overridden by late surges of Lavery ice or perhaps by the slightly later Defiance glacier. One torn mass of 32 varves embedded in disjointed laminated fine sand 0.3 to 1 metre thick was exposed in 1975 at the bottom of a new lagoon. The strong deformation, variable podlike thickness, and small areal extent of this subfacies preclude its serving as a water transmitting body for more than a few yards in any direction. Figure A.3.6-A-12 shows idealized stratigraphic relationships among the various deposits exposed and drilled in the vicinity of the waste burial-site.

Holocene Deposits

Development of the Holocene landscape has been controlled by fluvial and mass wasting processes (Boothroyd et al, 1979, 1981).

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[1]Colors designated according to Munsell Soil Color Charts, 1954, Baltimore, MD

After deglaciation, drainage from upland areas deposited sand and gravel alluvial fans on the older glacial deposits. One of these fan deposits forms the surface of the North Plateau area of the WNYNSC facility (Figure A.3.6-A-17). A series of small fans are also developed along the low terraces of Buttermilk Creek.

The drainage pattern of Buttermilk Creek and its tributaries was developed during the late-glacial meltwater drainage: its initial incision occurred prior to 9920240 BP (Boothroyd et al, 1979). Fluvial sedimentation is accomplished by bed load and suspended load transport with the highest rates related to flood events. A series of fluvial terraces have been created as the Buttermilk downcut and widened its valley by lateral migration of the channel. Mass wasting in the Lavery deposits exposed along valley walls is widespread (La Fleur, 1979; Boothroyd et al, 1979, 1981). Soil creep, earth flow, and slump block sliding enhance widening of the stream valleys.

Regional Structure

The Paleozoic rock strata are essentially undeformed within the glaciated Allegheny section of the Appalachian Plateau Province. The province is bounded on all sides by out-facing escarpments which reflect regional synclinal structure. The area is apparently on the relatively undeformed north limb of a syncline.

As indicated on Figure A.3.6-A-1, a series of northeast-southwest trending structural features characterizes the unglaciated portion of the Appalachian Plateau Province lying to the south. This relatively closely spaced elongated folding is typical of much of the geologic structure encountered in a large portion of Pennsylvania.

No fold or fault of any consequence is recognized within the site area. The closest major structural feature is the St. Lawrence Rift Valley System located about 480 km to the northeast. During this study the north-south trending Clarendon-Linden feature, located some 50 km northeast of the site, was the only significant structural feature encountered in the region.

The Clarendon-Linden feature was originally described by Chadwick (1920) as a normal fault believed to extend from the Niagara escarpment near Clarendon, New York on the north, to Linden, New York on the south, a distance of some 42 km. Chadwick found displacement of the Onondaga and Niagara Escarpments with the western side displaced farther north relative to the eastern side. In the vicinity of Linden, he discovered that formations to the west were at a much lower elevation than the same formations on the east. Thus Chadwick was led to believe that the structure was a fault with the downthrown side on the west. After further study, Chadwick (1932) termed the feature a monocline at the Linden end and a fault at the Clarendon end. He called the whole feature the Clarendon-Linden Displacement.

More recently, the subsurface location of the fault was traced by seismic means and by studying gas well logs as far south as the village of Hermitage, New York (AIDS, 1969). In these seismic data, the reflections from the basement were too poor to place the fault any deeper than the top of the Trenton Formation (bottom of Ordovician).

Since the Clarendon-Linden feature appears to pass from a fault at its northern end to a monoclinal flexure as it trends southward, the entire feature will be referred to as the Clarendon-Linden Structure.

Except for the offset beds on the Niagara escarpment as previously described by Chadwick, the only other surface features possibly related to the Clarendon-Linden structure were found in the shale bedrock exposures just north and south of Batavia (Adams, personal communication, 1970) and in a railroad cut at East Bethany, 9 km southwest of Batavia.

At this location, the observed dips were about 3° and anomalous to the west. This apparent fault at East Bethany is a small reverse fault with the east side displaced upward on the order of two metres; a north-northeast trend of major fractures was noted in the Batavia-Attica area by Belcher and Associates (1970). In the site area, the trend acquires a northeast-southwest direction similar to the trend of the previously mentioned Pennsylvania structure.

It would normally be expected that stresses induced in the Paleozoic "fabric" by regional deformation would be reflected as joint and fracture systems over a broad area. These major fractures are shown on Figure A.3.6-A-18. To explore a possible relationship between the joint and fracture system to the Clarendon-Linden Structure, subsurface structural contour maps of the region were prepared. Both published (Kreidler, 1963) and unpublished oil and gas well data were used to compile the map. Since the only consistent and recognizable marker beds in the region are the Onondaga Limestone formation of Middle Devonian age and the Grimsby formation (red Medina) of lower Silurian age, the structural contours were drawn on the tops of those formations, and are presented on Figures A.3.6-A-19 and A.3.6-A-20, respectively.

A study of the structural contours indicated that the Clarendon-Linden Structure is the outstanding feature shown. It is manifested by the offsets in the Onondaga and Grimsby structural contours. The Onondaga contours suggest an offset in structure of from 45 to 60 metres. Grimsby offsets are similar north of Attica but less to the south (perhaps due to sparse well control). All flexures shown on maps are inferred from offsets in the regional trend of structure contours. As the Onondaga map shows, the flexure may extend south-southeast, possibly to Belmont in Central Allegany County. There is no suggestion that the main portion of the flexure trends to the southwest as proposed by Fisher (1966) based on his isopachous map of the Medina.

Two branches or auxiliary flexures, herein designated "Attica Flexure" and Warsaw Flexure," may be associated with the Clarendon-Linden Structure. If the well data are reliable, then these features, with structural offsets of about 30 metres, suggest possible subsidiary faulting or folding at depth.

The Attica Flexure may be particularly important since it branches from the main flexure to Attica, site of a rather severe shock in August 1929 and several subsequent smaller shocks. Again, additional well control or seismic data are needed to verify these features. The Grimsby map does not show the Warsaw Flexure, probably because of the sparse well control at the Grimsby level.

The Belfast Monocline may exist and may indicate the south edge of an uplifted block to the east of the Clarendon-Linden Structure. What is shown on Figure A.3.6-A-19 is hypothetical and controlled by only a few wells.

All of the above described flexures may pass into faults at depth. Bradley and Pepper (1938) report that Oriskany strata, lying just below the Onondaga, were faulted east of the area of mapping with zones of folded Devonian units above the faults. The Oriskany strata were reported displaced 60 metres in the southwest part of the Wellsville Quadrangle; the Tully formation, located above the Onondaga, was reported displaced 58 metres (based on seismic data) 42 kilometres east of the Belfast Monocline. Some faults detected at the Oriskany horizon are not found in the Tully formation above.

The contours shown on Figure A.3.6-A-19 indicate a flexure west of the Attica branch. This "West Flexure" and associated anomalies may be a region of minor folding and faulting, making structural contouring difficult with the control available. Cumulative errors in well data are another possible cause for the anomaly. The "West Flexure" trends southwestward to an area where definite folds can be outlined with the control data available. These northeast-southwest trending folds are probably related to general Appalachian folding in this region and thus are associated with "Pennsylvania" type structure. Over most of this area, however, control is not adequate to pick up subtle folding associated with an Appalachian ("Pennsylvania") fold belt. Another possibility is that the folding is taken up in the upper units (the Devonian shales and sandstones).

The Attica Flexure apparently does not pass through the site but appears to terminate some 29 to 33 kilometres northeast of it.

Data from a comprehensive gravity survey and partial magnetic survey report encompassing the area under consideration were reviewed. Frank A. Revetta (1970) submitted the report to the University of Rochester in partial fulfillment of the requirements for a doctorate. The gravity and magnetic anomaly contours are presented on Figures A.3.6-A-21 and A.3.6-A-22 respectively. Revetta comments that the origin of the major gravity anomalies in Central and Western New York lies within the Precambrian crystalline basement rocks.

Little is known of the structure of the Precambrian basement in this area, but the complex structure is anticipated to be similar to that exposed in the Precambrian faulting. Adjustments along this anomalous zone subsequent to Paleozoic time probably resulted in the development of the Clarendon-Linden Structure. While the gravity anomaly contours are not as definitive as the magnetic anomaly contours for the Clarendon-Linden Structure, they both suggest that a Precambrian fault controls the structure.

The potential for surface or subsurface subsidence, collapse or uplift resulting from natural features (i.e., karst terrains, potential landslides), human activities (i.e., withdrawal or addition of subsurface fluids or mineral extraction), or regional warping is discussed in Section A.3.6.4.1.

Site Structure

The regional geology discussion described the site as located in an elongated, broad, relatively undeformed synclinal structure whose sediments dip gently (4 to 7.5 metres per kilometre) and uniformly to the north. No fold or fault of any consequence is recognized within 38 kilometres of the site (NFS, 1973). The closest major structural system is the St. Lawrence Rift Valley System, located about 480 km northeast of the NDA (Dames and Moore, 1974).

Approximately 38 kilometres east of the NDA is the projected trace of the Clarendon-Linden Structure. South of the Attica-Dale area (and at its closest approach to the WVDP site), this feature has been determined to be a monoclinal flexure with no surface (topographic) expression (Dames and Moore, 1974).

An analysis of aerial photographs (NFS, 1973) revealed a northeast/southwest trend of bedrock fractures in the site area. These features were subsequently determined to be joint and fracture systems developed from stress relief in the Paleozoic strata (NFS, 1973) caused by regional deformation or related to rebound following deglaciation. Locally, these joints and fractures may be seen as pop-ups in nearby shale outcrops. (Pop-ups are recent, localized, displaced fractures in the bedrock ranging from less than one to approximately 20 centimetres in vertical or horizontal extent. They have been attributed to release of confining pressures such as deglaciation or broad scale compressive stress.)

These features serve to increase the permeability of the shale. If closely spaced and interconnected, they can act as a water transmitting mechanism, and most of the groundwater movement in the bedrock aquifer takes place in the upper fractured and weathered zones of the shale. Fracture density and extent are expected to decrease with depth (US DOE, 1982), and the top of this zone lies approximately 170 metres below the design bottom of the disposal trenches.

The Lavery Till (the disposal medium in the NDA) exhibits the following structural features:

[1] Fractures - Random fractures with oxidized surfaces extending to a depth of 4.5 metres in trenches and outcrops of the till. They have been estimated to extend to a maximum depth of 15 metres by Hoffman and others (1980).

[2] Distortion - Thin (less than 5 centimetres) torn layers of silt and sand can be seen in the valley walls of Buttermilk Creek (La Fleur, 1979) and have been reported from several of the burial trenches (Albanese and others, 1983). These have been related to differential settling or reworking as a result of glacial advance and retreat (La Fleur, 1979).

These features have the potential to increase the vertical and horizontal hydraulic conductivity of the Lavery Till. Iron staining along the surface of many of the fractures indicates that oxygen-bearing waters have circulated among them (US EPA, 1977). Extensive analysis by the New York State Geological Survey (Dana et al, 1979b) has shown that these fractures are often saturated and transmit water at a slow rate. Given the systematic orientation and distribution of these fractures, the state survey recommends (ibid) that for groundwater modeling purposes the upper 0.4 to 5 metres of undisturbed, weathered Lavery Till be considered a homogeneous, permeable material capable of transmitting water in all directions.

A recent field study by Dames and Moore (WVNS, 1984) concluded that the migration of kerosene and tributyl phosphate from one area of the NDA is taking place through these fractures.

Geophysical Survey Data

The original survey of the WNYNSC in 1962 obtained surface and bedrock profiles along two seismic lines. Figure A.3.6-A-23 shows the location of the seismic lines; Figure A.3.6-A-24 shows the resulting profiles. The results of this survey showed that the only outcropping bedrock in the site area occurs in the deep rock cuts of the lower portion of Buttermilk Creek not far from its confluence with Cattaraugus Creek.

Results of a comprehensive gravity survey and partial magnetic survey conducted in partial fulfillment of a doctoral dissertation at the University of Rochester (Revetta, 1970) were also reviewed. The dissertation concluded that the origin of the major gravity anomalies in Central and Western New York lie within the Precambrian crystalline basement rocks. (Additional conclusions based on this data are included in the Regional Structure discussion and the gravity and magnetic anomaly maps are presented in Figures A.3.6-A-21 and A.3.6-A-22, respectively.)

More recently, a geophysical investigation employing electromagnetics, resistivity and magnetometry was conducted in and around the US NRC licensed disposal area to investigate the migration of a kerosene-tributyl phosphate (TBP) mixture from the disposal areas. A plan showing the survey area is presented in Figure A.3.6-A-25. The electroconductivity map location of the resistivity soundings with respect to the EM conductivity data, and the geoelectric vertical sections derived from the computer modeling of resistivity sounding data are presented in Figures A.3.6-A-26 through A.3.6-A-28.

The following conclusions are based on the results of this survey and subsequent analysis of the data obtained:

[1] Because of its relatively small dimensions and nonconductive nature, the contaminant plume intercepted at USGS well 82-5A and subsequent borings in the immediate vicinity could not be detected with the electrical geophysical approach used in this survey.

[2] Notwithstanding the inability of these techniques to detect the kerosene-TBP plume, the EM and resistivity surveys revealed three anomalous conductivity features: at the southern corner, near the northwestern corner and along the northwestern side of the NDA. Although further investigation should probably be pursued in these areas, it appears that these features are likely to be areas of greater permeability than their surroundings.

[3] No unrecorded burials which might be contributing to the subject contamination were discovered during the survey.

[4] Within a few metres, trenches SH-10 and SH-11 appear to be located as recorded in the site burial records.

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Table A.3.6-A-1

Mineral Composition of Selected Core Samples from Western New York Nuclear Service Center

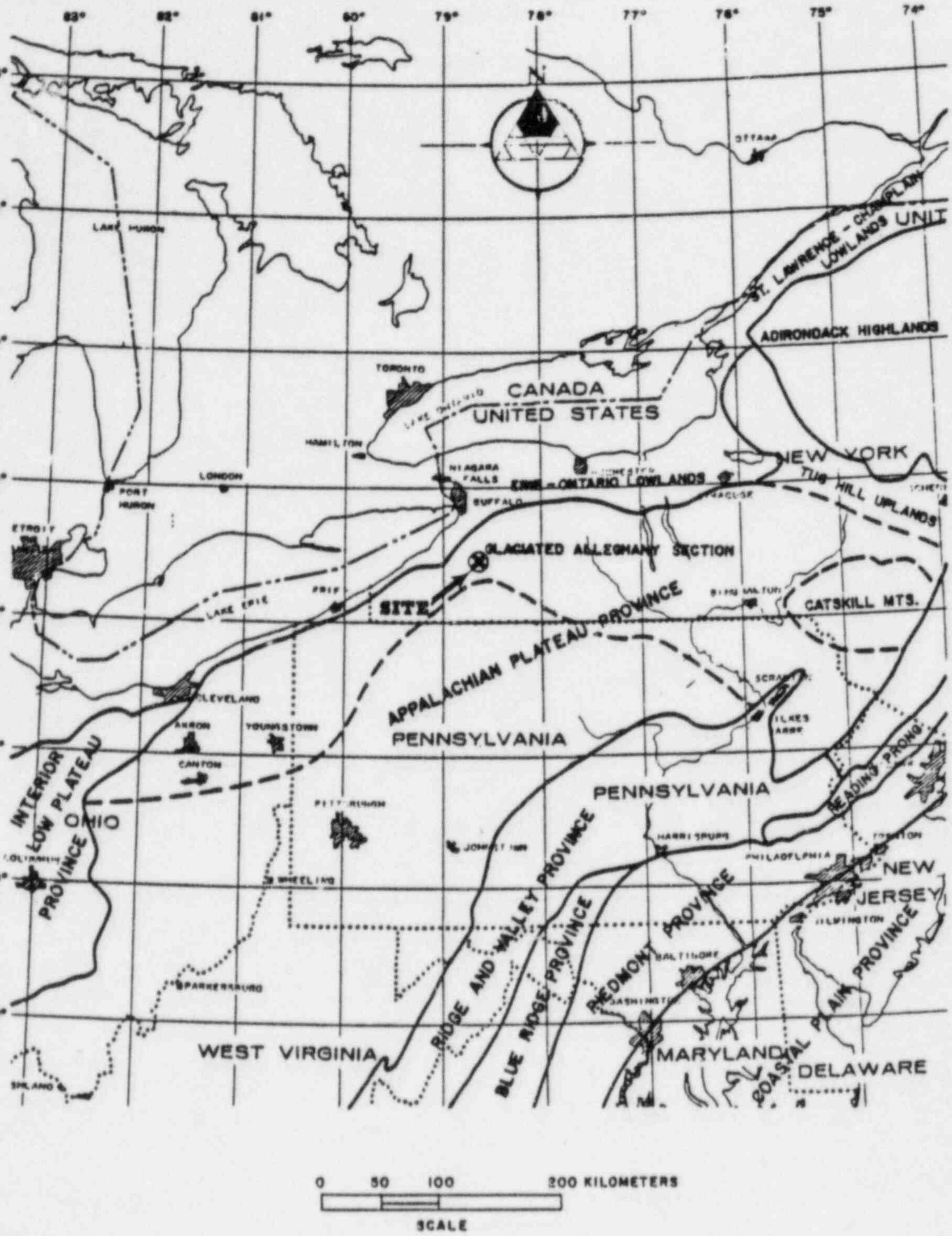
[All values are in weight percent; locations of test holes are shown in Prudic and Randall, 1977, Figure 1]

Minerals	F 22.4-22.9 Till	I3 7.5 7.9 Oxidized Till	J 52.7-53.2 Till	N 24.5-24.9 Till	C2 9.5-10.0 Oxidized Till	C2 42.5-43.0 Till	D 14.0-14.5 Till	D 29.8-30.3 Lake Beds	G 36.2-36.7 Lake Beds	L 15.3-15.8 Lake Beds
	Test-hole Identification Symbol; depth interval;[2] and material									
quartz	24	24	24	22	26	22	27	32	23	33
potassium feldspar	1	<1	<1	1	2	1	1	3	0	3
plagioclase feldspar	7	7	5	4	7	5	5	9	6	10
calcite	11	7	7	8	9	7	9	11	7	9
dolomite	5	3	5	5	7	5	5	9	5	11
chlorite	3	0	4	4	1	12	5	4	6	4
kaolinite	9	9	10	9	7	0	9	6	8	5
illite	24	27	27	21	28	26	30	16	19	15
montmorillonite	0	<1	0	0	0	0	0	0	0	0
mixed-layer clay minerals	4	9	4	6	4	1	<1	4	7	5
Totals	88	86	86	80	91	79	91	94	81	95

[1] Mineral composition determined by B. J. Anderson, US Geological Survey, by X-ray diffraction according to method of Schultz (1964). Totals between 90 and 105 percent are considered normal for this semiquantitative method. Low totals in some samples probably indicate a higher iron content; the florescent radiation produced by iron causes loss of peak intensity and therefore generally lower percentages (B. J. Anderson, written communication, 1978).

[2] Depths are in feet below land surface.

LeFleur, 1979



REFERENCE:

THIS MAP WAS PREPARED FROM A PORTION OF THE U.S.G.S. "IFR WALL PLANNING CHART, EAST AND WEST, 1968."

PHYSIOGRAPHIC DIVISIONS TAKEN FROM PHYSIOGRAPHY OF EASTERN UNITED STATES BY N. M. FENNEMAN, 1938.

REGIONAL PHYSIOGRAPHIC MAP

FIGURE A.3.6-A-1

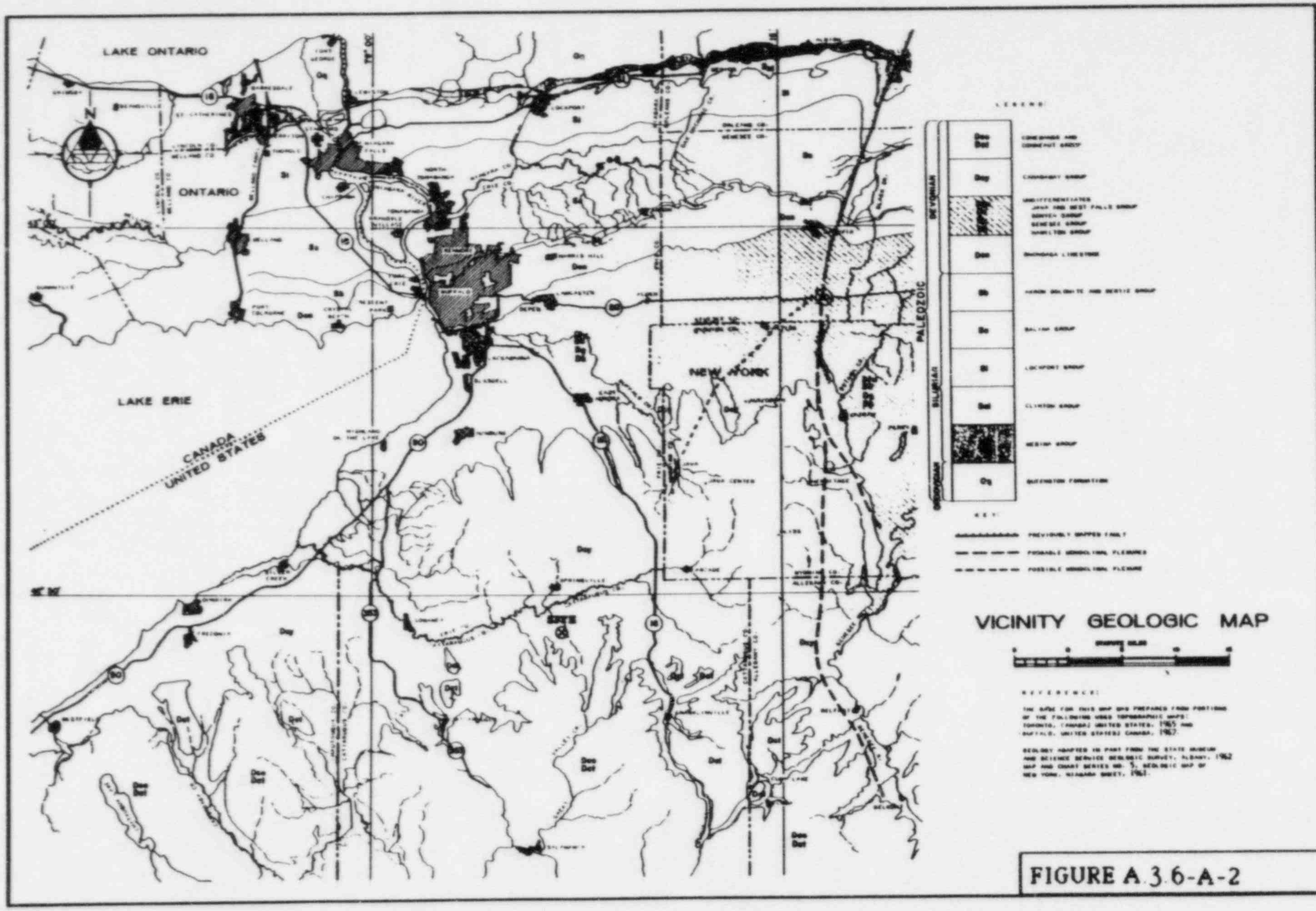
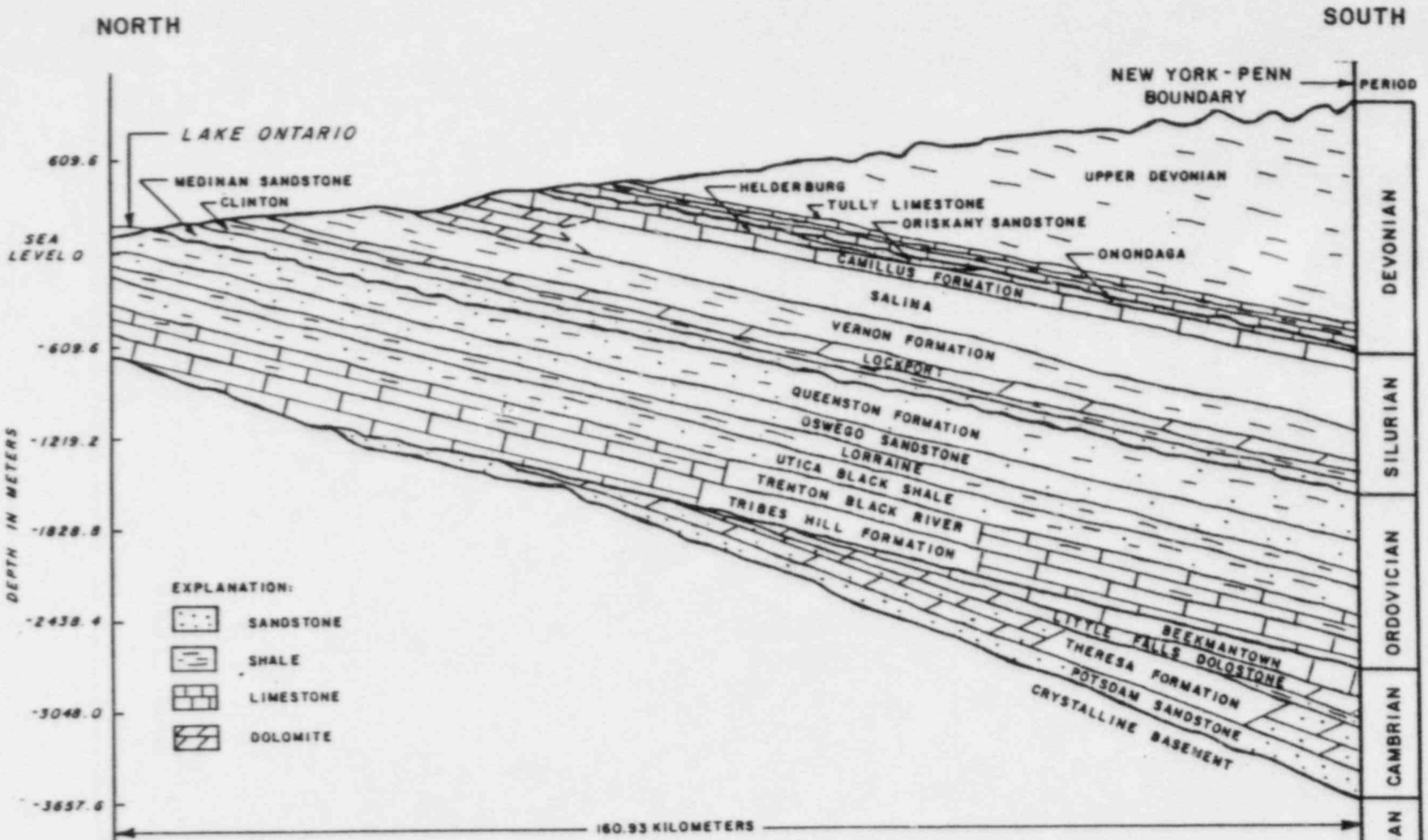
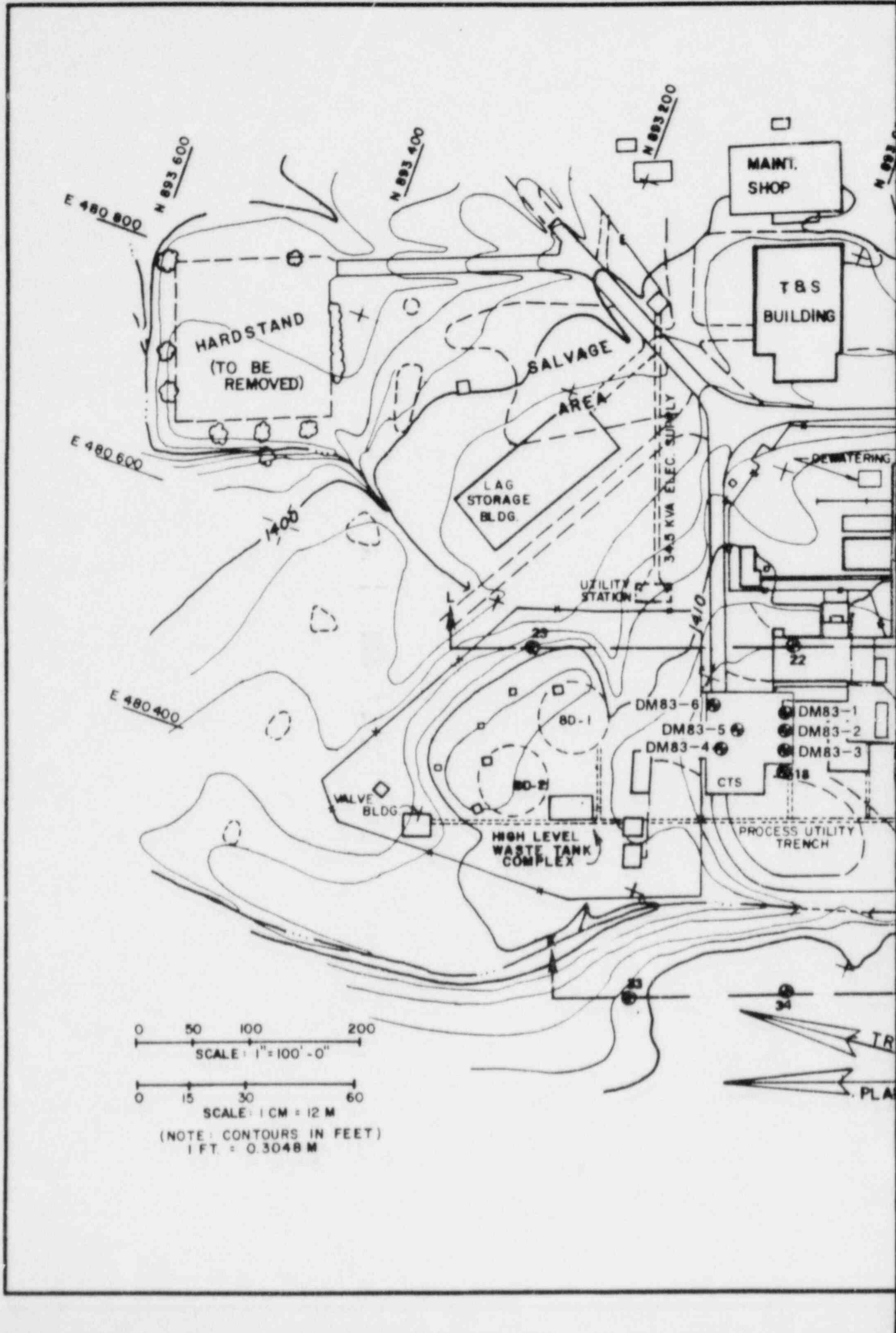


FIGURE A.3.6-A-2

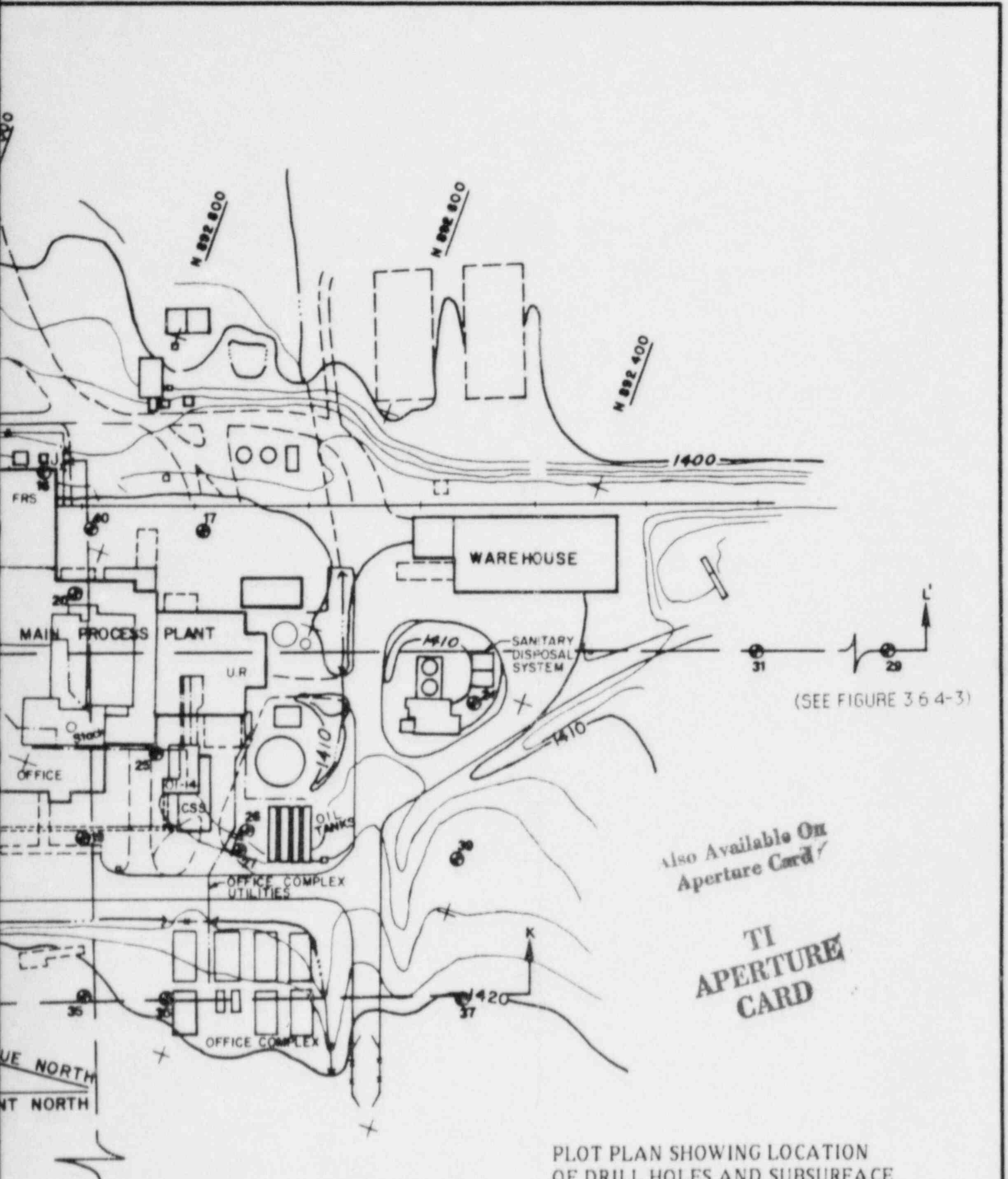


DIAGRAMATIC CROSS SECTION ALONG 77° MERIDIAN
WESTERN NEW YORK

FIGURE A.3.6-A-3

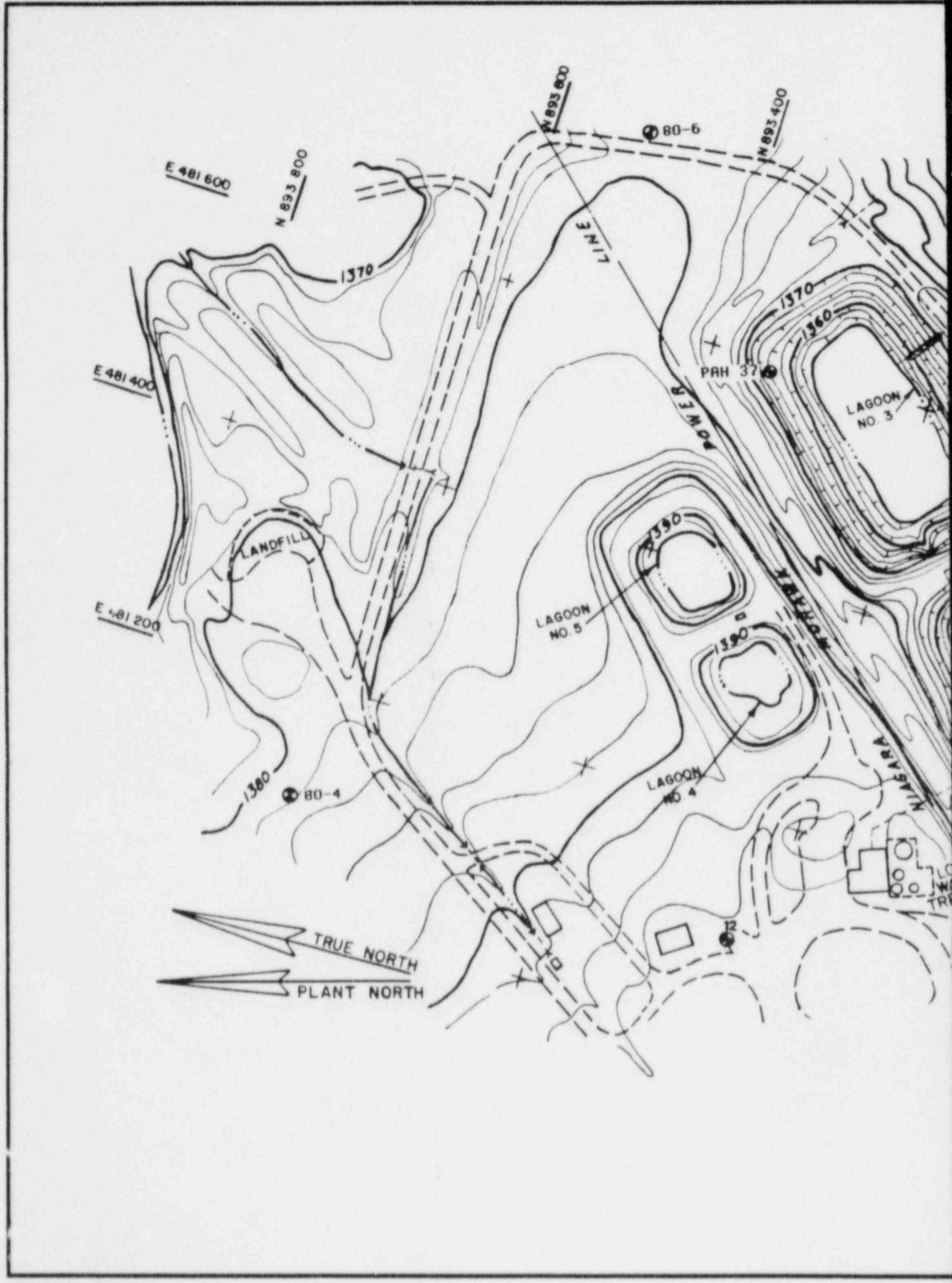


E 480 800
N 893 600
N 893 400
N 893 200
MAINT. SHOP
T&S BUILDING
HARDSTAND (TO BE REMOVED)
SALVAGE AREA
LAG STORAGE BLDG.
34.5 KVA ELEC. SUPPLY
DEWATERING
E 480 600
1400
1410
UTILITY STATION
23
22
E 480 400
8D-1
8D-2
DM83-6
DM83-5
DM83-4
DM83-1
DM83-2
DM83-3
18
CTS
VALVE BLDG
HIGH LEVEL WASTE TANK COMPLEX
PROCESS UTILITY TRENCH
33
34
0 50 100 200
SCALE: 1" = 100'-0"
0 15 30 60
SCALE: 1 CM = 12 M
(NOTE: CONTOURS IN FEET)
1 FT. = 0.3048 M

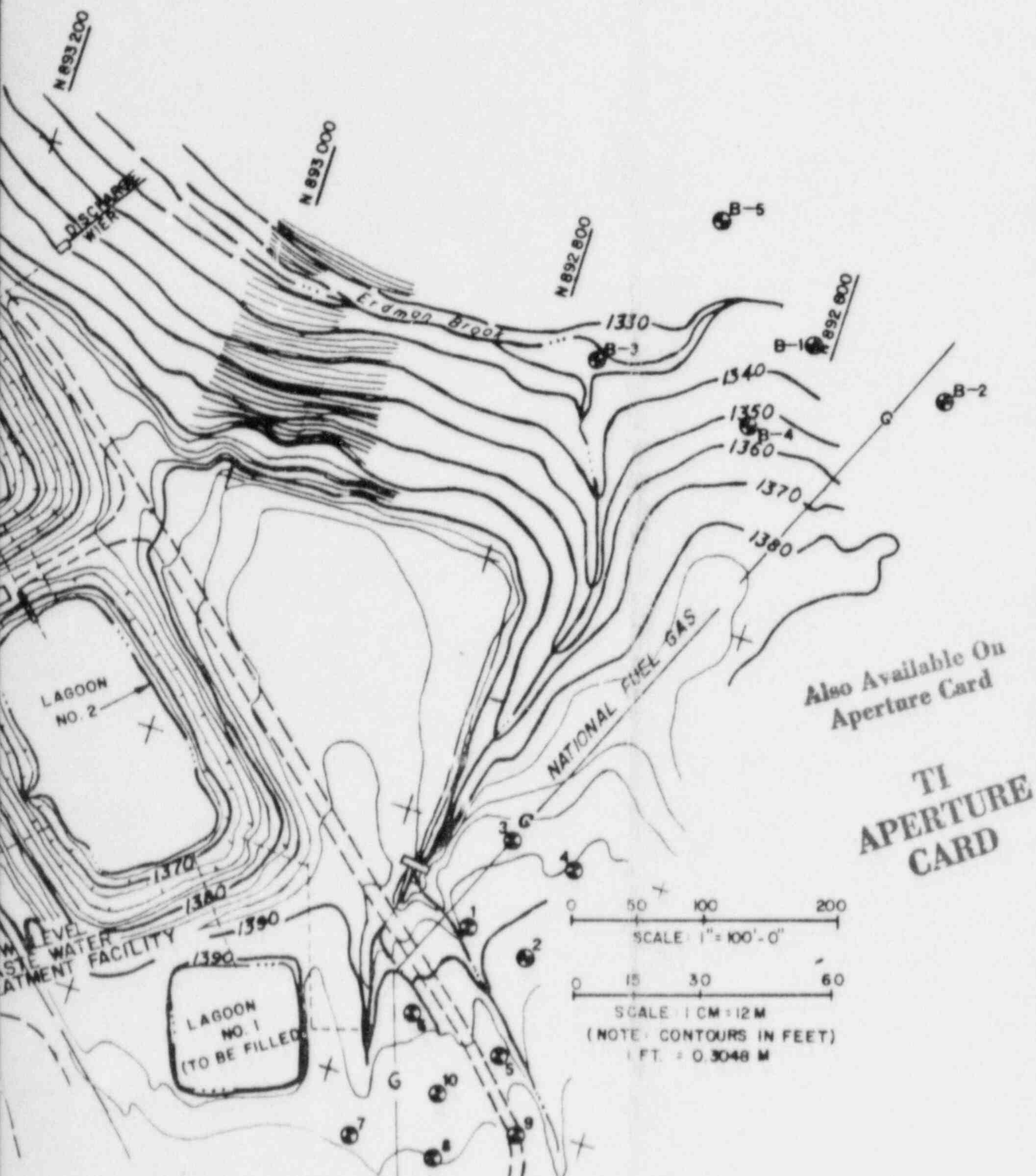


PLOT PLAN SHOWING LOCATION OF DRILL HOLES AND SUBSURFACE SECTIONS (REPROCESSING PLANT AREA)

FIGURE A 3.6-A-4

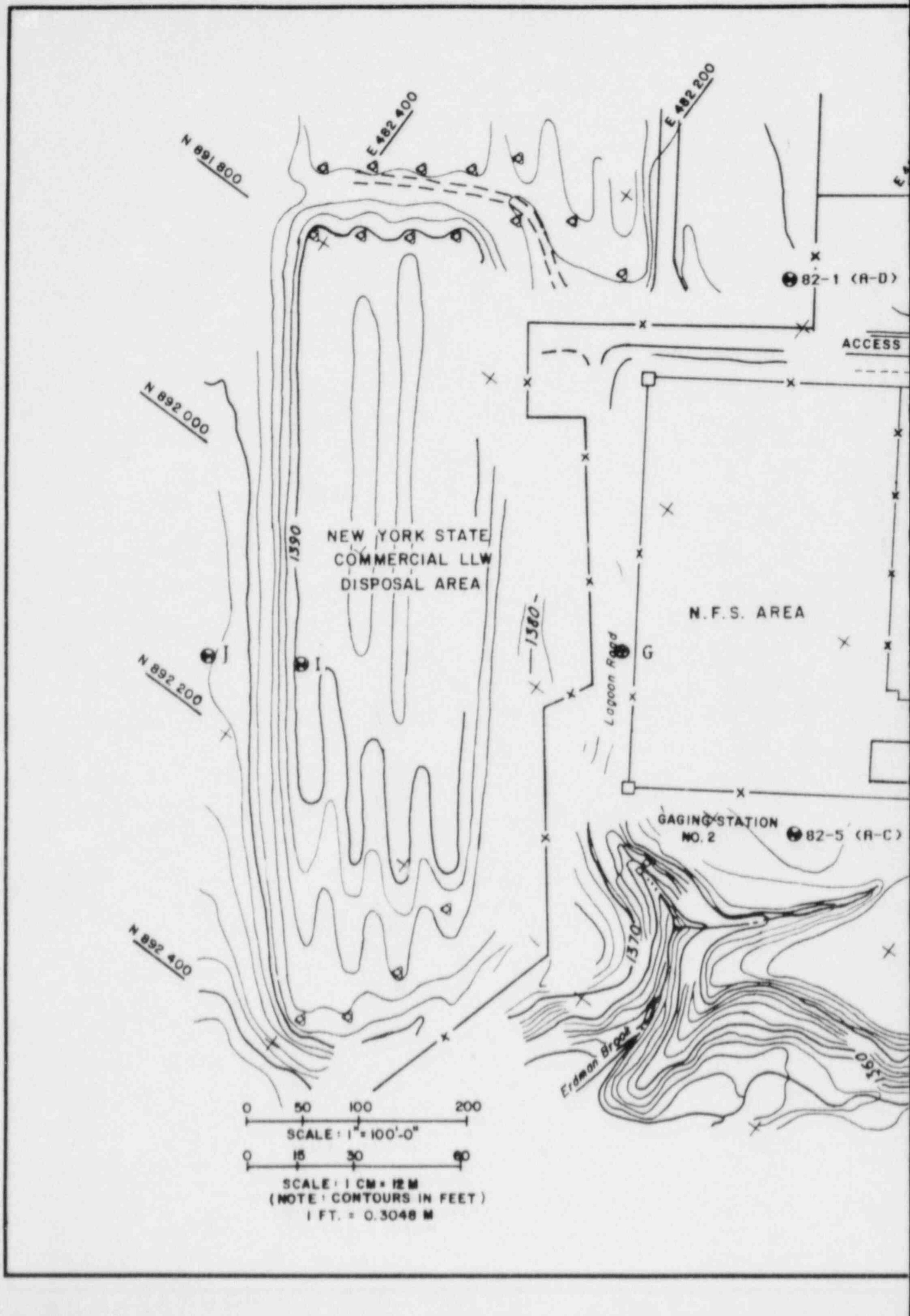


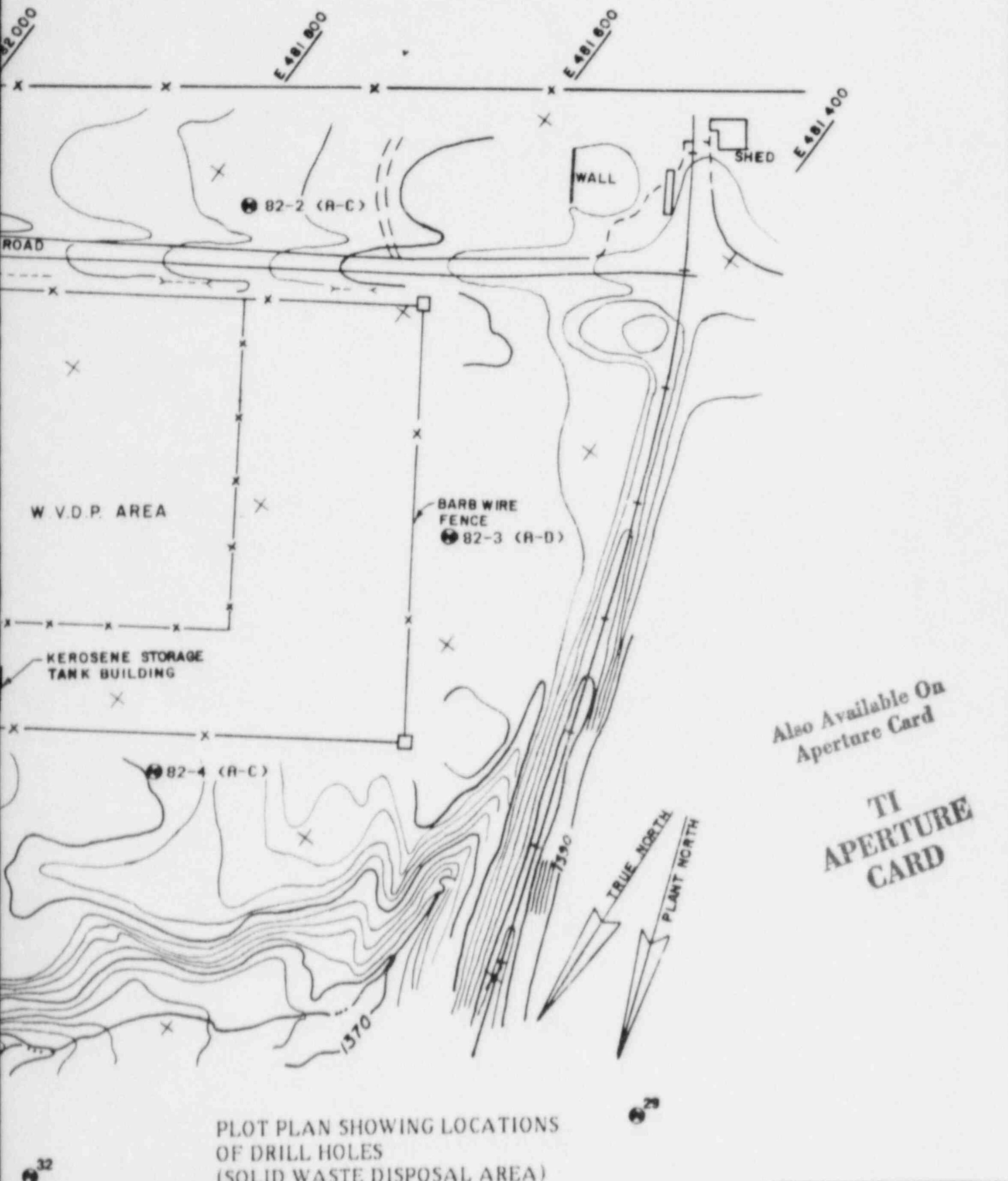
E 481 600
N 893 800
N 893 600
80-6
N 893 400
1370
LINE
E 481 400
1360
PAH 37
POWER
LAGOON NO. 3
1390
LANDFILL
E 481 200
LAGOON NO. 5
1390
NIAGARA
1380
80-4
LAGOON NO. 4
TRUE NORTH
PLANT NORTH
12



PLOT PLAN SHOWING LOCATIONS
OF DRILL HOLES (LOW-LEVEL WASTE
TREATMENT FACILITY AREA)

FIGURE A.3.6-A-5


N 891 800
E 482 400
E 482 200
N 892 000
N 892 200
N 892 400
82-1 (A-D)
ACCESS
NEW YORK STATE
COMMERCIAL LLW
DISPOSAL AREA
1390
1380
1370
1360
N.F.S. AREA
J
I
G
Lagoon Road
GAGING STATION
NO. 2
82-5 (A-C)
Erdman Brook
0 50 100 200
SCALE: 1" = 100'-0"
0 15 30 60
SCALE: 1 CM = 12 M
(NOTE: CONTOURS IN FEET)
1 FT. = 0.3048 M



Also Available On Aperture Card

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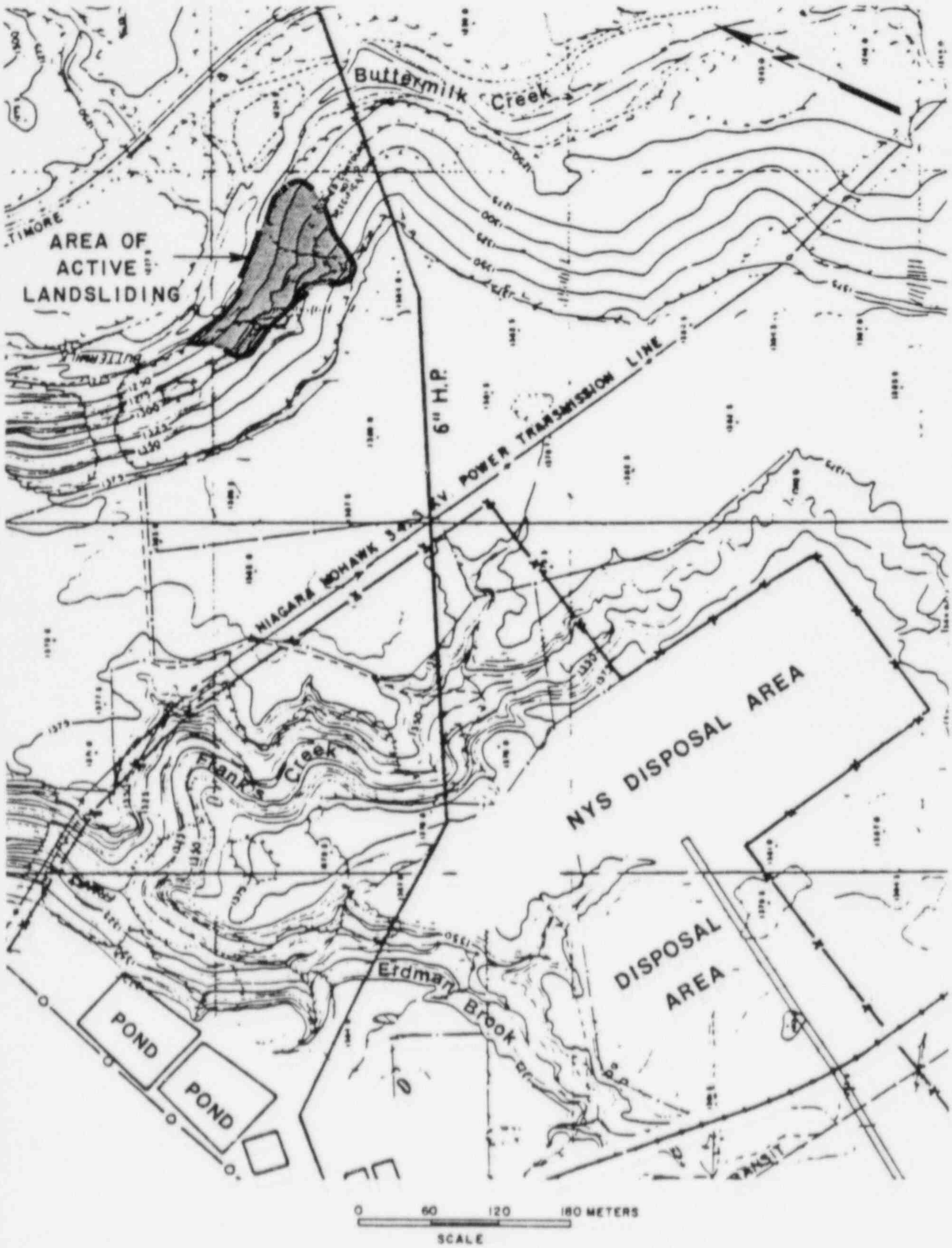
PLOT PLAN SHOWING LOCATIONS OF DRILL HOLES (SOLID WASTE DISPOSAL AREA)

FIGURE A 36-A-6

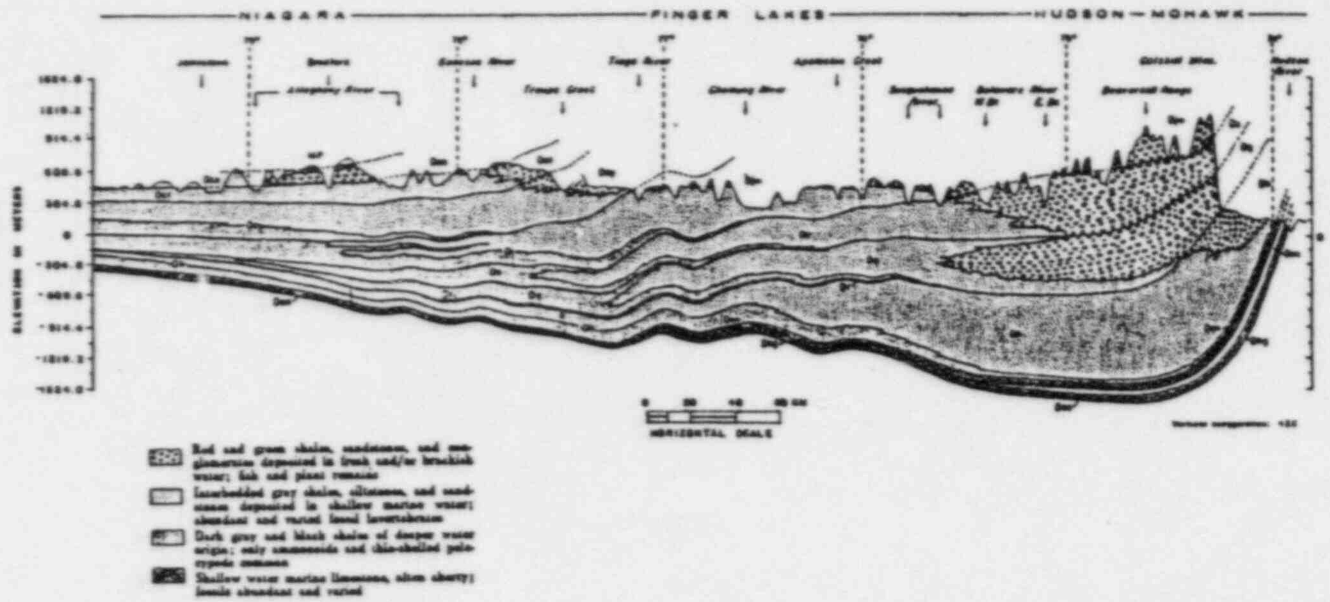
8507030448 -03



AREA OF CLOSEST BUTTERMILK CREEK LANDSLIDING

ADAPTED FROM BOOTHROYD AND OTHERS, 1982.

FIGURE A.3.6-A-7



CROSS SECTION OF DEVONIAN ALONG NEW YORK - PENNSYLVANIA BORDER

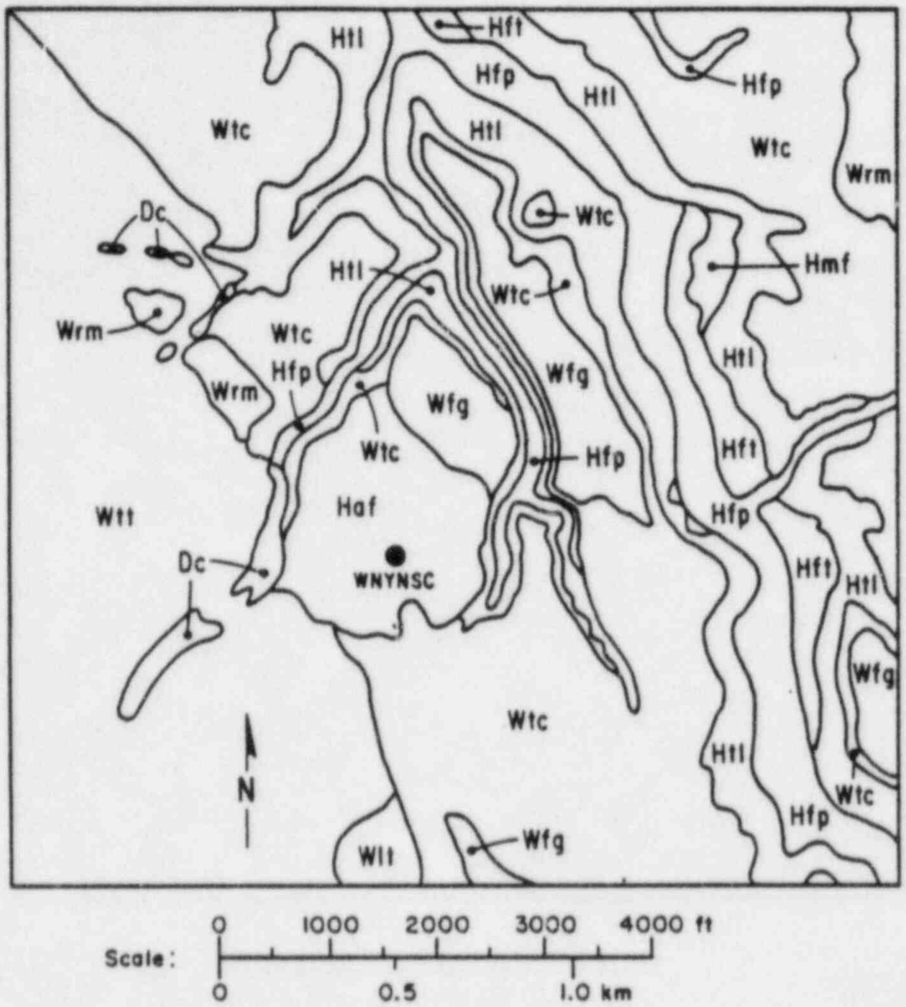
FIGURE A.3.6-A-8

System	Series	Unit	Thickness (m)	Approx. Depth (m)
Quaternary	Holocene	Alluvial fans; floodplain alluvium	0-6	3
	Pleistocene	Glacial till; fluvial sands & gravels	0-160	30
Devonian	Upper	Canadaway Group Java & West Falls Group (shales) Sonyea Group Genesee Group	580	610
	Middle	Tully Formation	5	615
		Hamilton Group (shale & limestone)	110	725
		Onondaga Limestone	50	775
Silurian	Upper	Akron-Bertie Salina Group	230	1005
	Middle	Lockport Group	70	1075
		Clinton Group	45	1120
	Lower	Medina (sandstone)	30	1150
Ordovician	Upper	Queenston Formation (red shales)	300	1450
		Oswego Formation (sandstone)	35	1485
	Middle	Lorraine Group Utica Formation	250	1735
		Trenton-Black River Group	255	1990
Cambrian	Upper	Tribes Hill-Beekmantown	30	2020
		Little Falls Dolomite	60	2080
		Theresa Formation	215	2295
		Potsdam Formation	30	2325
Precambrian				

GENERALIZED STRATIGRAPHIC COLUMN
FOR THE VICINITY OF WEST VALLEY
DEMONSTRATION PROJECT

FIGURE A.3.6-A-9

SURFICIAL GEOLOGIC MAP IN THE VICINITY OF THE WESTERN NEW YORK NUCLEAR SERVICE CENTER*

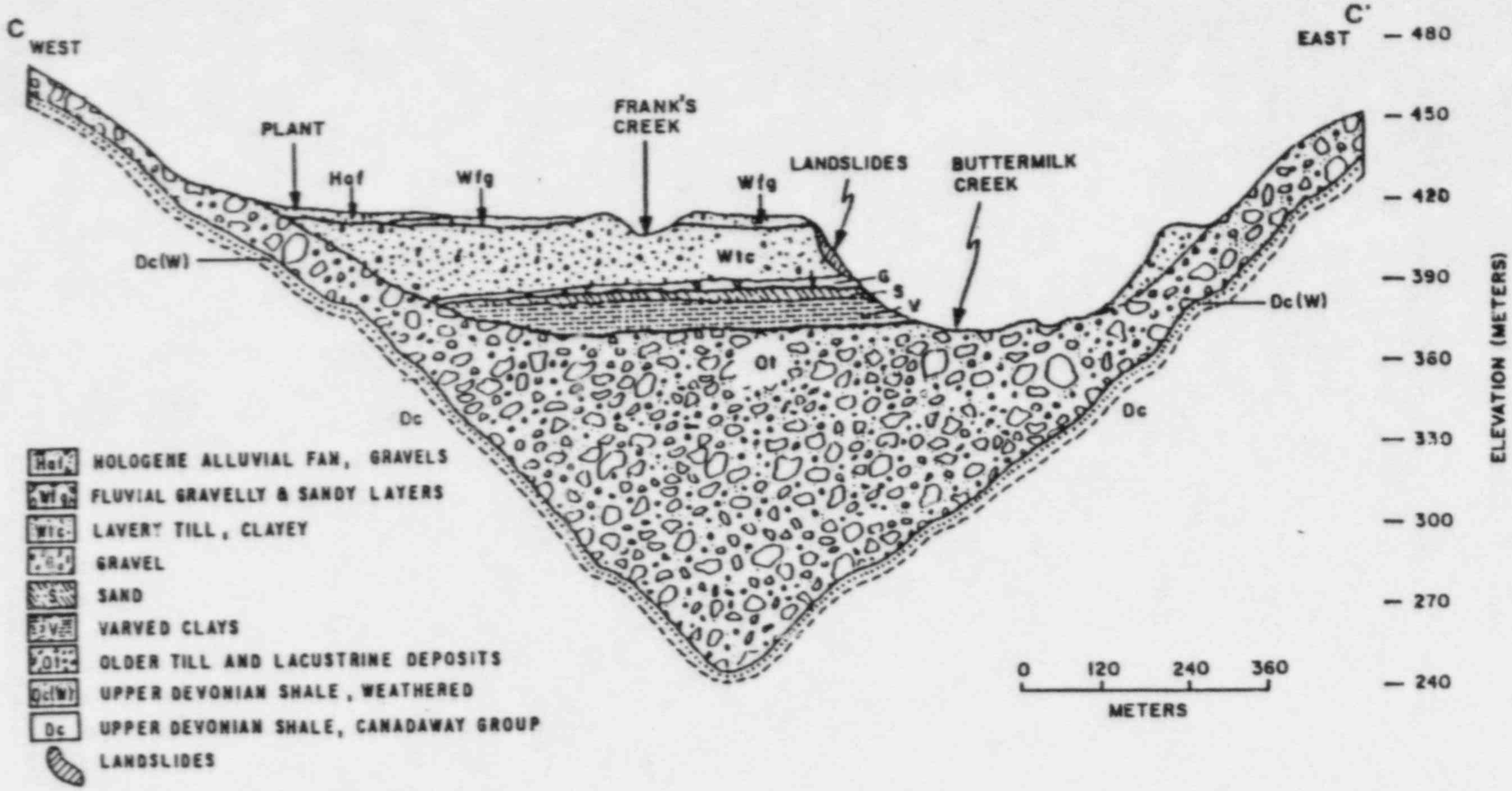


LEGEND:

Hfp - Floodplain; gravel, silt alluvium
Hmf - Mudflows; Pebbly silt, marginal to floodplains, derived from clayish till (Wtc)
Htl - Landslides, slumps; developed on exposures of clayish till (Wtc)
Hft - Low terraces of Cattaraugus Creek and tributaries; ferruginous gravel and silt, wood-bearing
Haf - Alluvial fans; channery gravel, sand
Wfg - Fluvial gravel, sand, derived from upland drainage hummmocky where land over thin ice; overlays clayish till (Wtc)
Wtc - Till, clayish with pebbles and cobbles; deformed silt stingers, minor overridden pebble gravel, sand; mainly reworked lacustrines. May include Hiram equivalent till in upper few feet.
Wrm - Ground moraine; mixed stony till, stratified drift; ice marginal
Wlt - Lodgment till, > 5-ft thick; stony, silty, variously bright and drab
Wtt - Lodgment till, < 5-ft thick; occasional rock outcrop
Dc - Bedrock outcrop; shales of the Canadaway Group

* **Adapted from LaFleur (1979).**

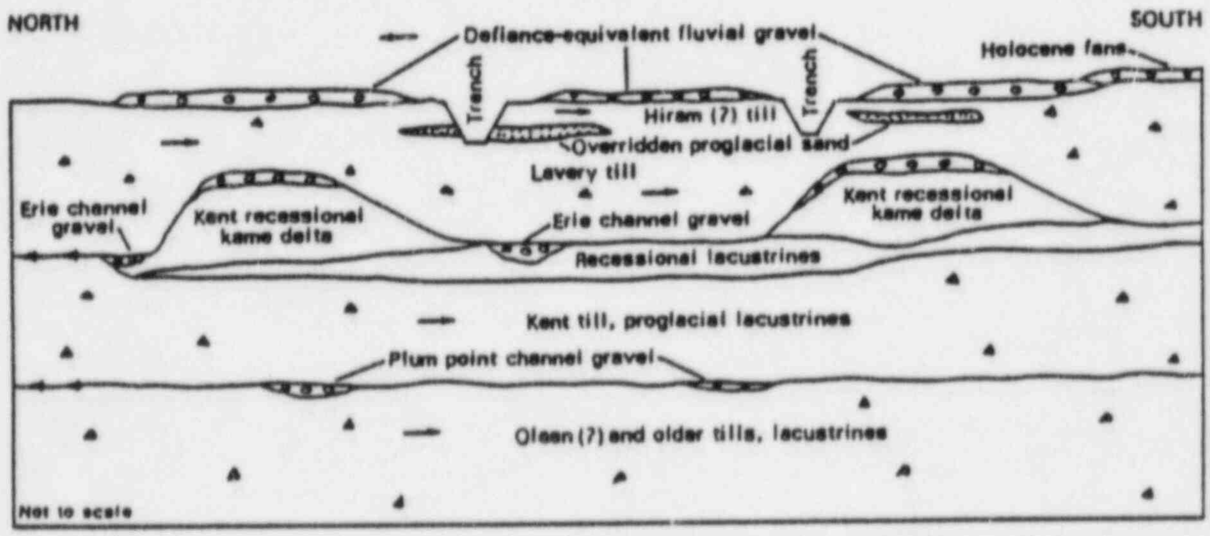
FIGURE A.3.6-A-10



GENERALIZED EAST-WEST GEOLOGIC CROSS SECTION
AT THE WEST VALLEY DEMONSTRATION PROJECT

NOTE:
Vertical scale = 1/4 horizontal scale.
Adapted from Dana et al. (1979a).

FIGURE A.3.6-A-11

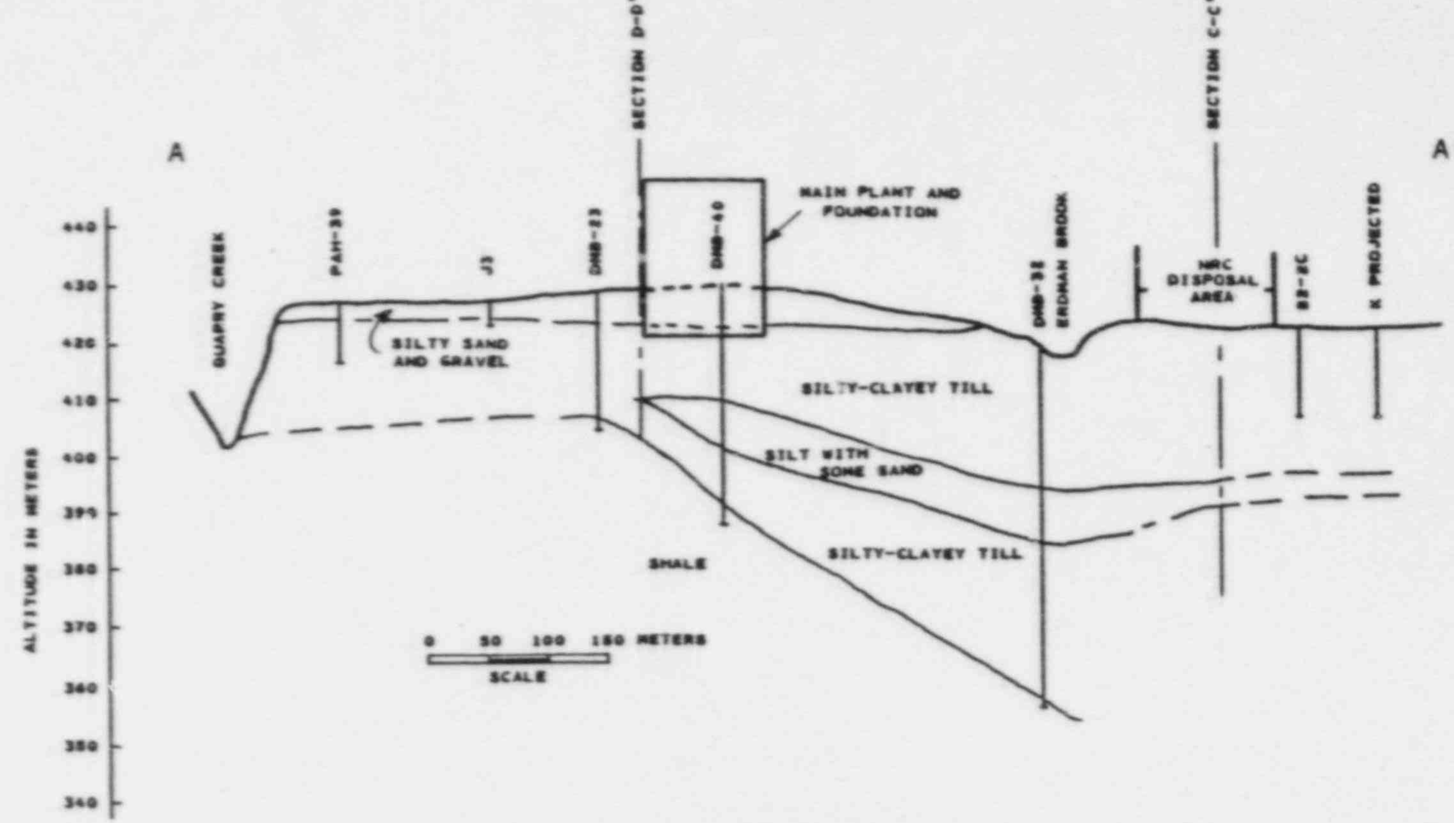


IDEALIZED STRATIGRAPHIC RELATIONSHIPS OF LAVERY TILL AND ADJACENT DEPOSITS NEAR WASTE-BURIAL SITE

NOTE:

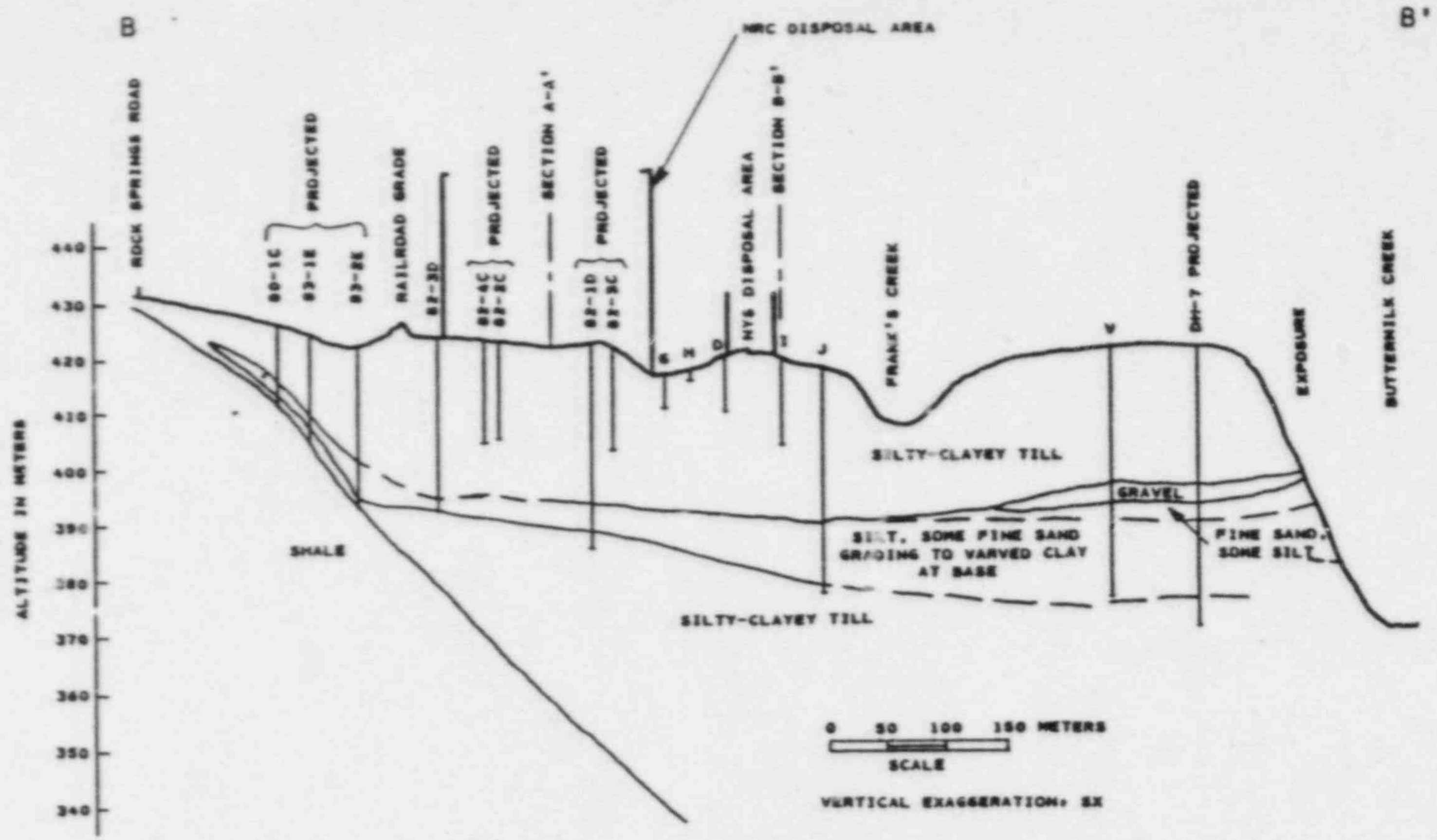
Arrows indicate direction of ice flow or streamflow during deposition or erosion.

FIGURE A.3.6-A-12



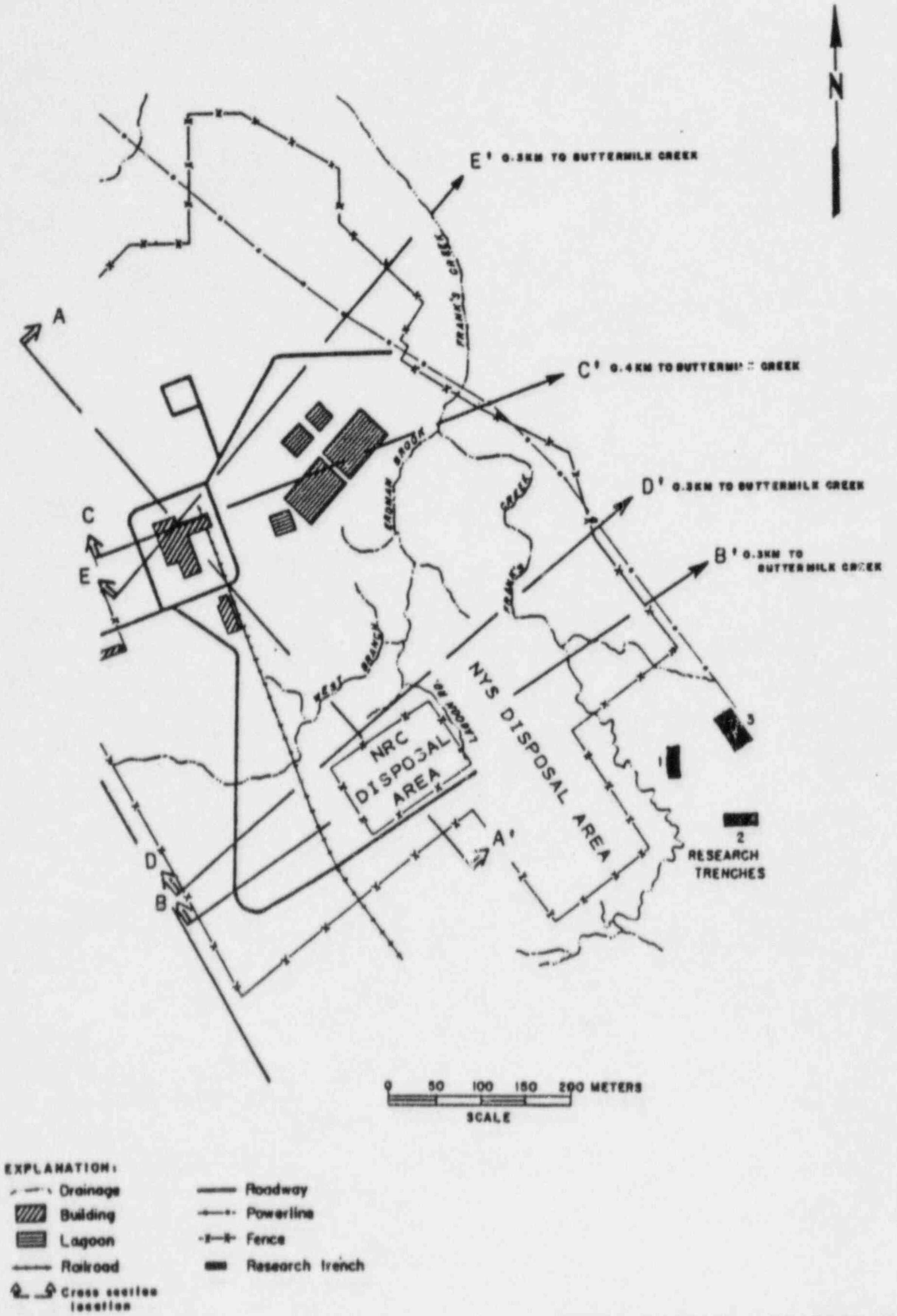
GENERALIZED GEOLOGIC SECTION SHOWING MAJOR LITHOLOGIC UNITS FOR SECTION A-A'
(NORTH-SOUTH THROUGH PLANT AND NRC-BURIAL)

FIGURE A.3.6-A-13



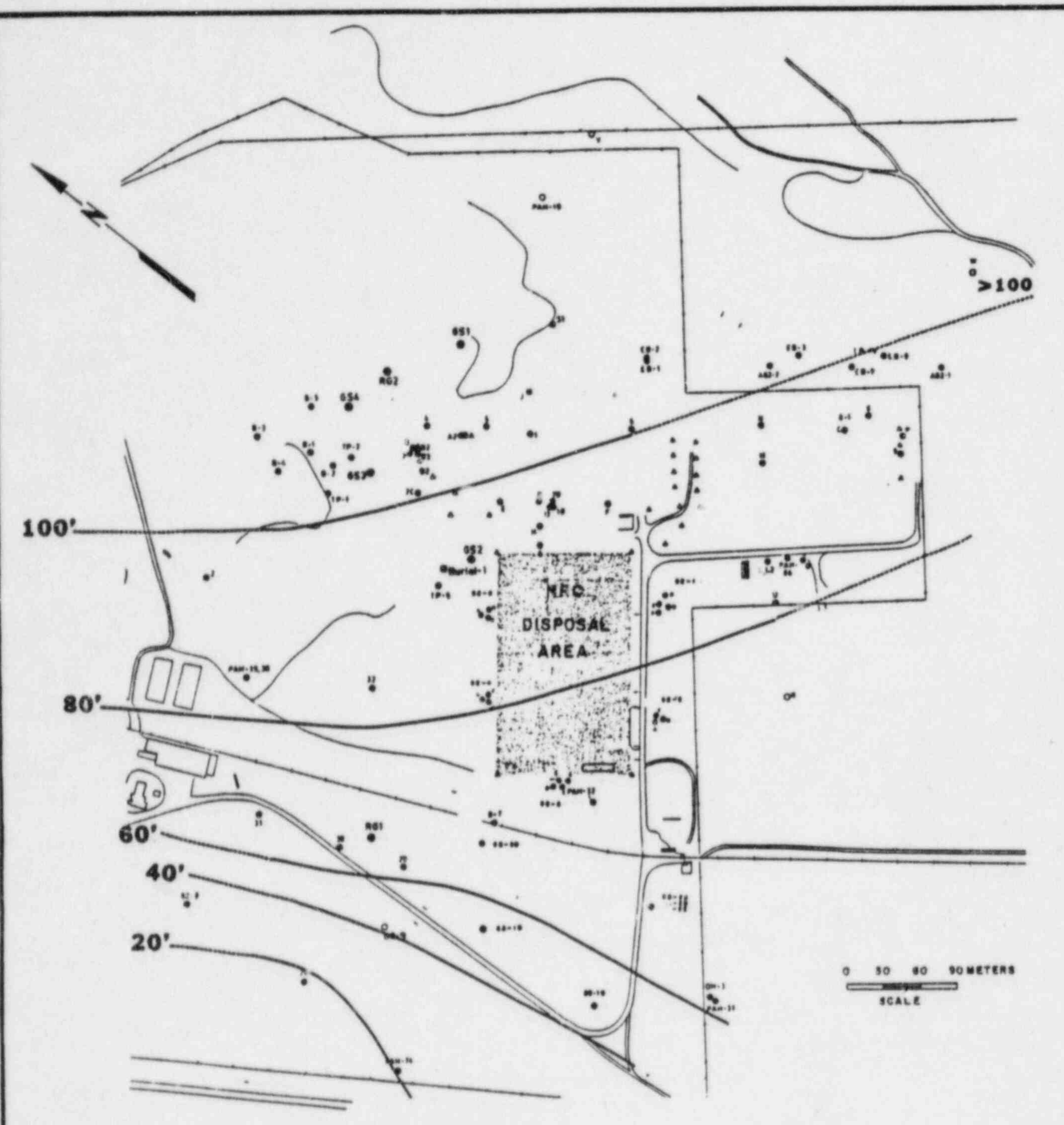
GENERALIZED GEOLOGIC SECTION SHOWING MAJOR LITHOLOGIC UNITS FOR SECTION B-B'
(WEST-EAST THROUGH NORTH PLATEAU)

FIGURE A.3.6-A-14



CROSS SECTION LOCATION MAP

FIGURE A.3.6-A-15



EXPLANATION:

- ROADS, TRAILS, CONCRETE PADS, GRADED AREAS
- FENCES
- RAILROAD TRACKS
- POWER LINES, WITH POLES
- BUILDINGS, OTHER UPRIGHT STRUCTURES
- LAGOONS, LINE AT WATER LEVEL
- CULVERTS
- CONCRETE MONUMENTS
- STREAM GAGING STATIONS
  - GS1-ERDMANN'S BROOK
  - GS2-LAGOON ROAD
  - GS3-BUCKET
  - GS4-SWAMP
- AUTOMATED STREAM STATIONS
- RAIN GAGES

HOLES, TEST PITS, EXCAVATIONS:

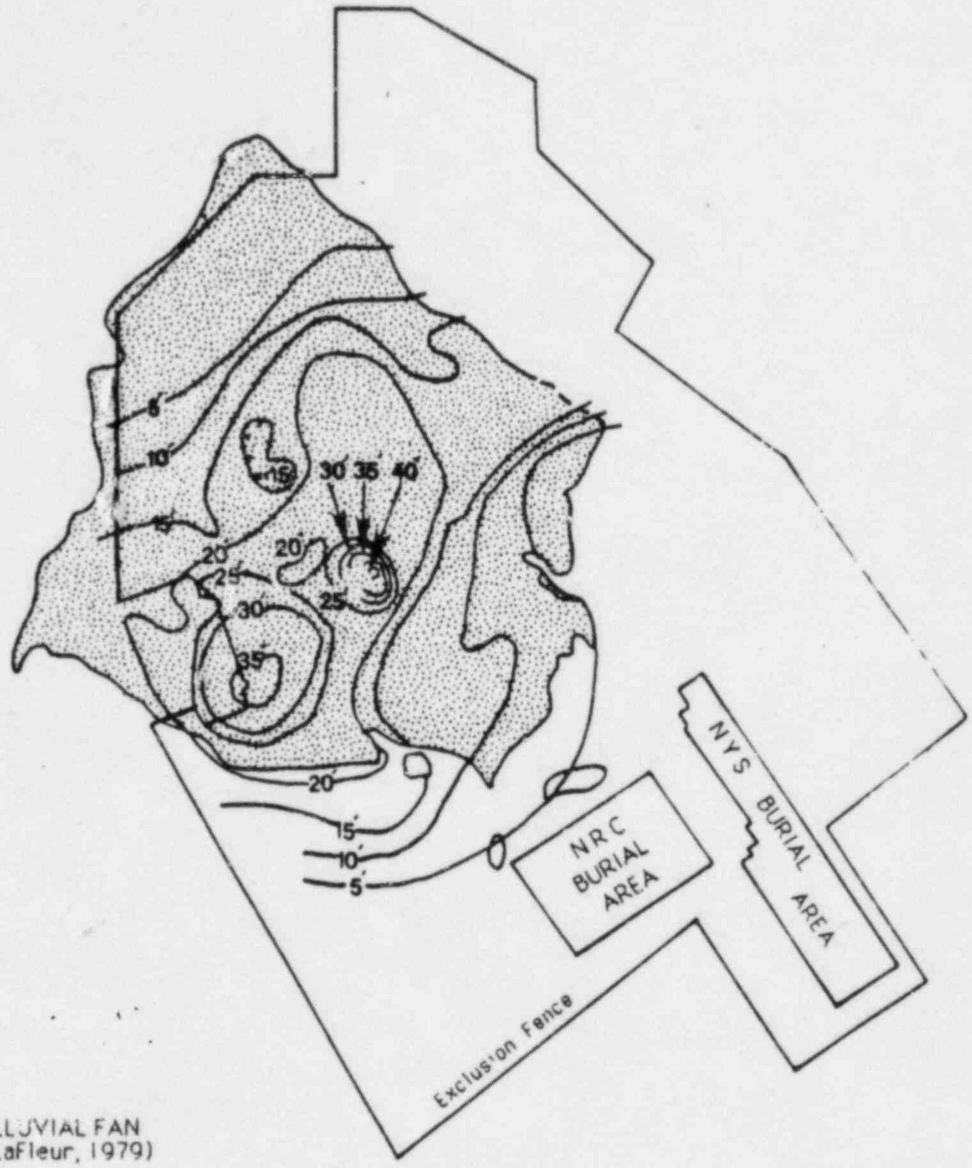
- WITH LITHOLOGIC INFORMATION AND CONFIRMED LOCATION
- LOCATION CONFIRMED, NO LITHOLOGIC INFORMATION IS AVAILABLE
- LACKING LITHOLOGIC INFORMATION OR CONFIRMED LOCATION, OR BOTH, BUT BOTH MAY BE AVAILABLE

REFERENCE: BASE MAP ADAPTED FROM E. L. ANDERSON, MAY 1982.

APPROXIMATE THICKNESS OF LAVERY TILL (FT.)
WEST VALLEY NUCLEAR SERVICE CENTER
WEST VALLEY, NEW YORK

FIGURE A.3.6-A-16

ISOPACH MAP OF THE HOLOCENE ALLUVIAL FAN
DEPOSIT ON THE NORTH PLATEAU
SHOWING AREAL EXTENT AND THICKNESS



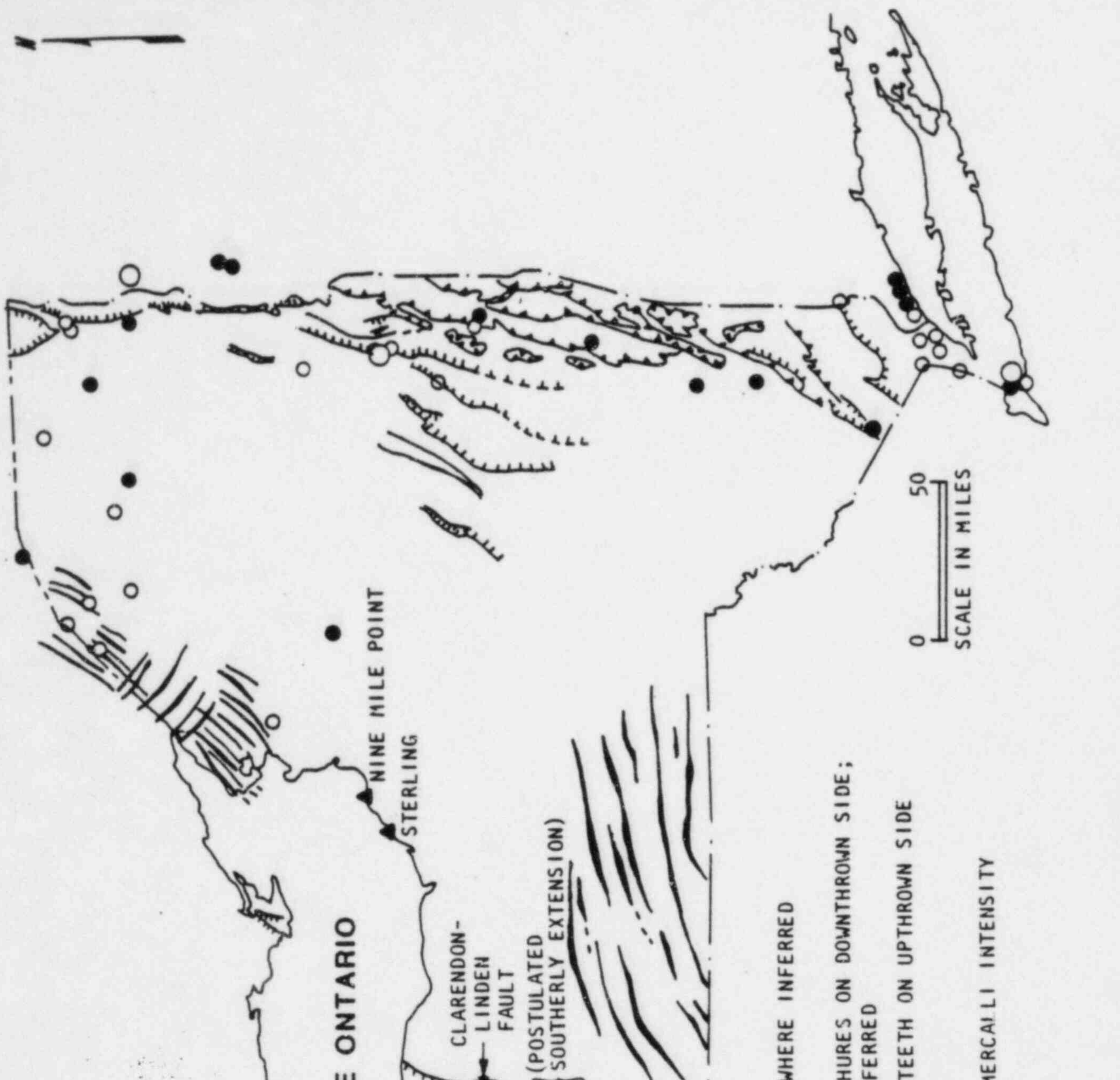
HOLOCENE ALLUVIAL FAN
(from LaFleur, 1979)

ISOPACHS INDICATING DEPTH TO BOTTOM
OF HOLOCENE ALLUVIAL FAN (in feet)

0' 500' 1000'
0 100 200 300 m

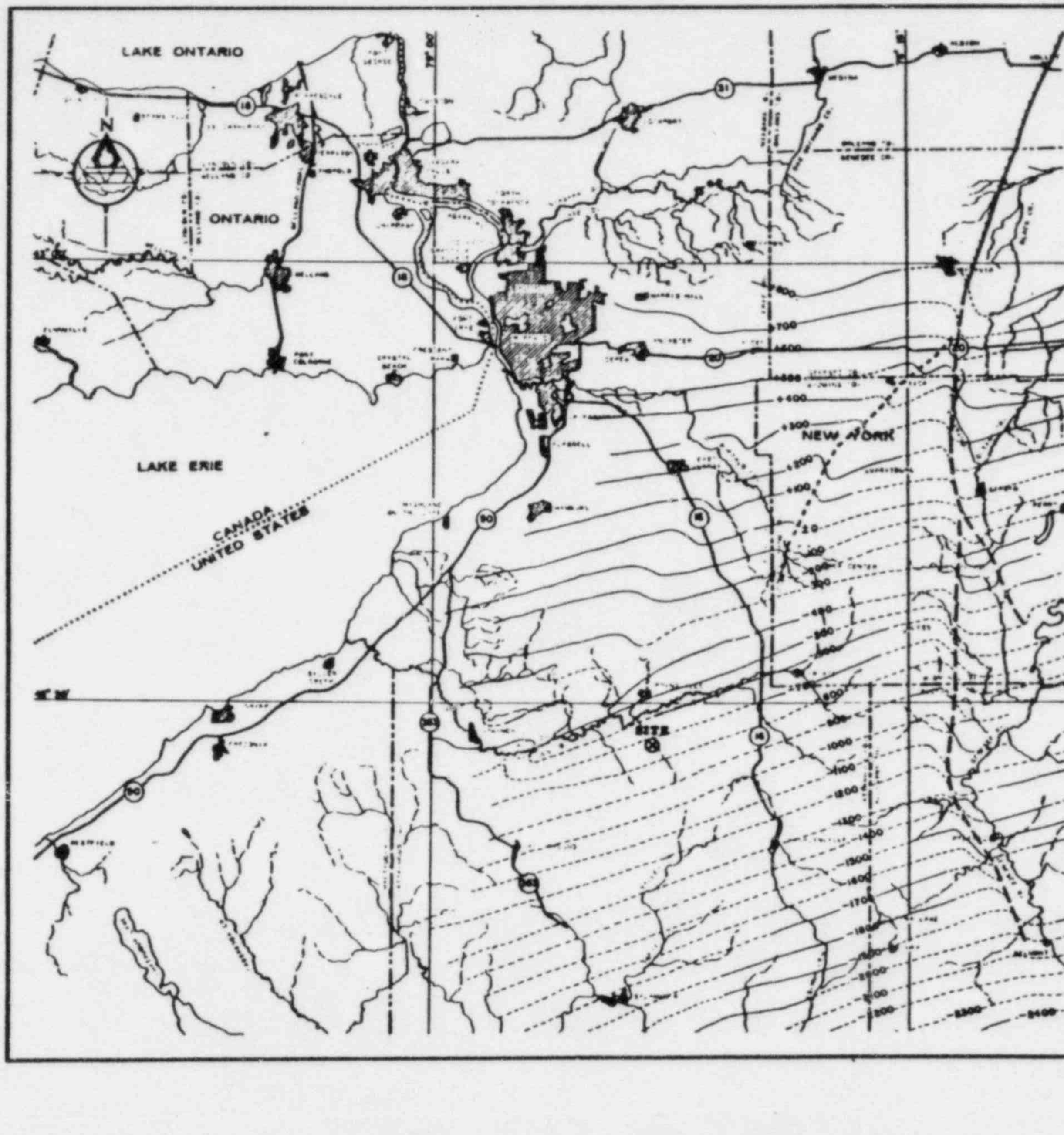
Reference Albanese and others, 1981

FIGURE A.3.6-A-17



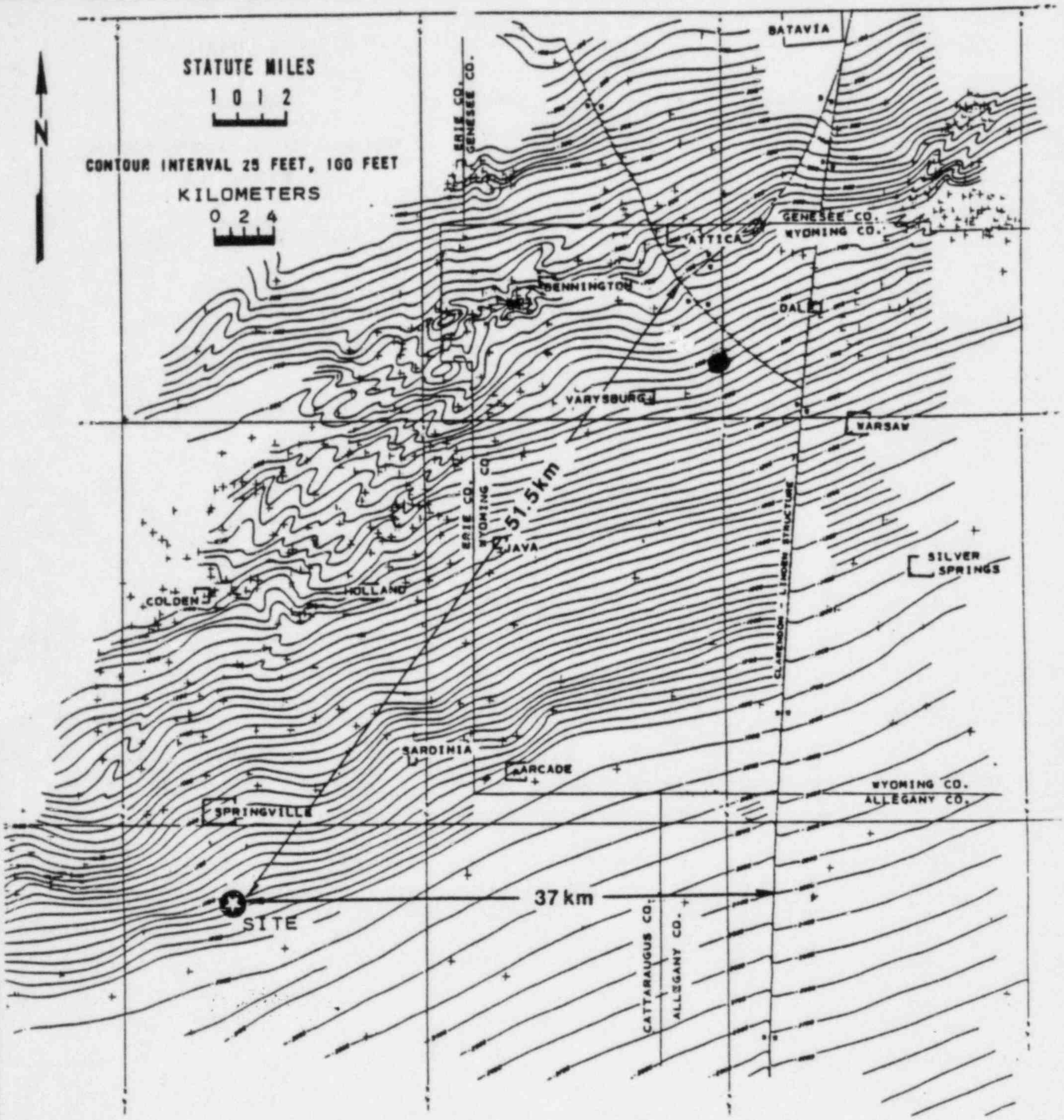
GENERALIZED SEISMO-TECTONIC MAP OF NEW YORK SHOWING HISTORICAL SEISMICITY

FIGURE A.3.6-A-18



VICINITY MAP
SHOWING BEDROCK STRUCTURAL CONTOURS
TOP OF ONONDAGA FORMATION

FIGURE A.3.6-A-19



SUBSURFACE MAP
SHOWING STRUCTURE CONTOURS ON THE MEDINA FORMATION

MAP PREPARED BY ARTHUR M. VAN TYNE,
GEOLOGIST, N.Y.S. GEOLOGICAL SURVEY
WELLSVILLE, N.Y., JULY & AUGUST, 1971.
BASED ON FIELD-CHECKED, CORRECTED EXPLOR-
ATORY WELL LOG DATA, PUBLISHED AN UNPUBLISHED.

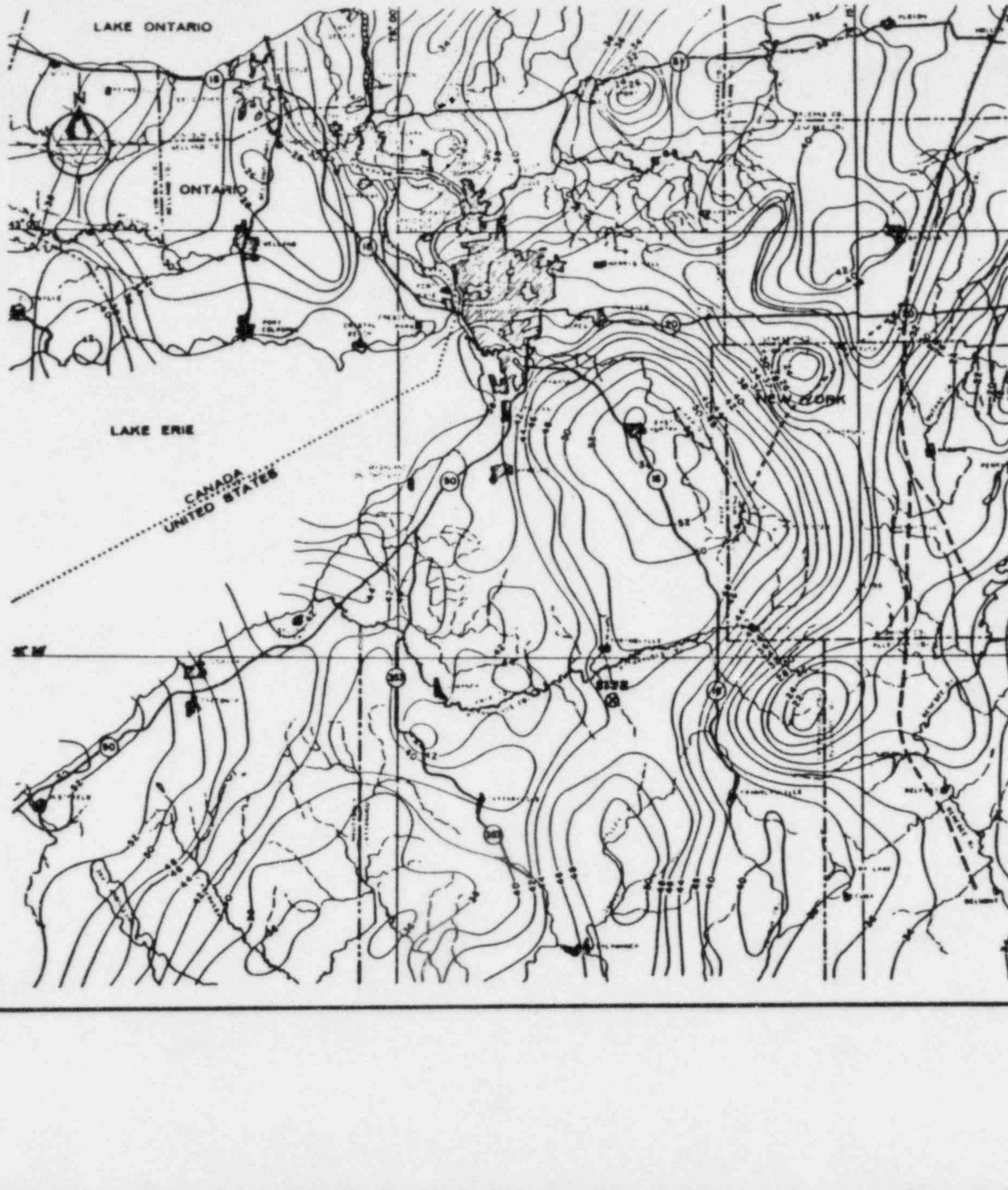
THE BASE FOR THIS MAP WAS PREPARED FROM
PORTIONS OF THE FOLLOWING U.S.G.S. 15
MINUTE QUADRANGLE MAPS: ATTICA 1949,
ARCADE 1923, BATAVIA 1950, PORTAGE 1903
DEPEW 1948, SPRINGVILLE 1923, ELLICOTTVILLE
1939, & FRANKLINVILLE 1938.

SOURCE: NFS, 1973

LEGEND:

——1500——	CONTOUR LINE SHOWING DEPTH BELOW SEA LEVEL TO TOP OF MEDINA
+	WELL LOCATION
-------------	FAULT

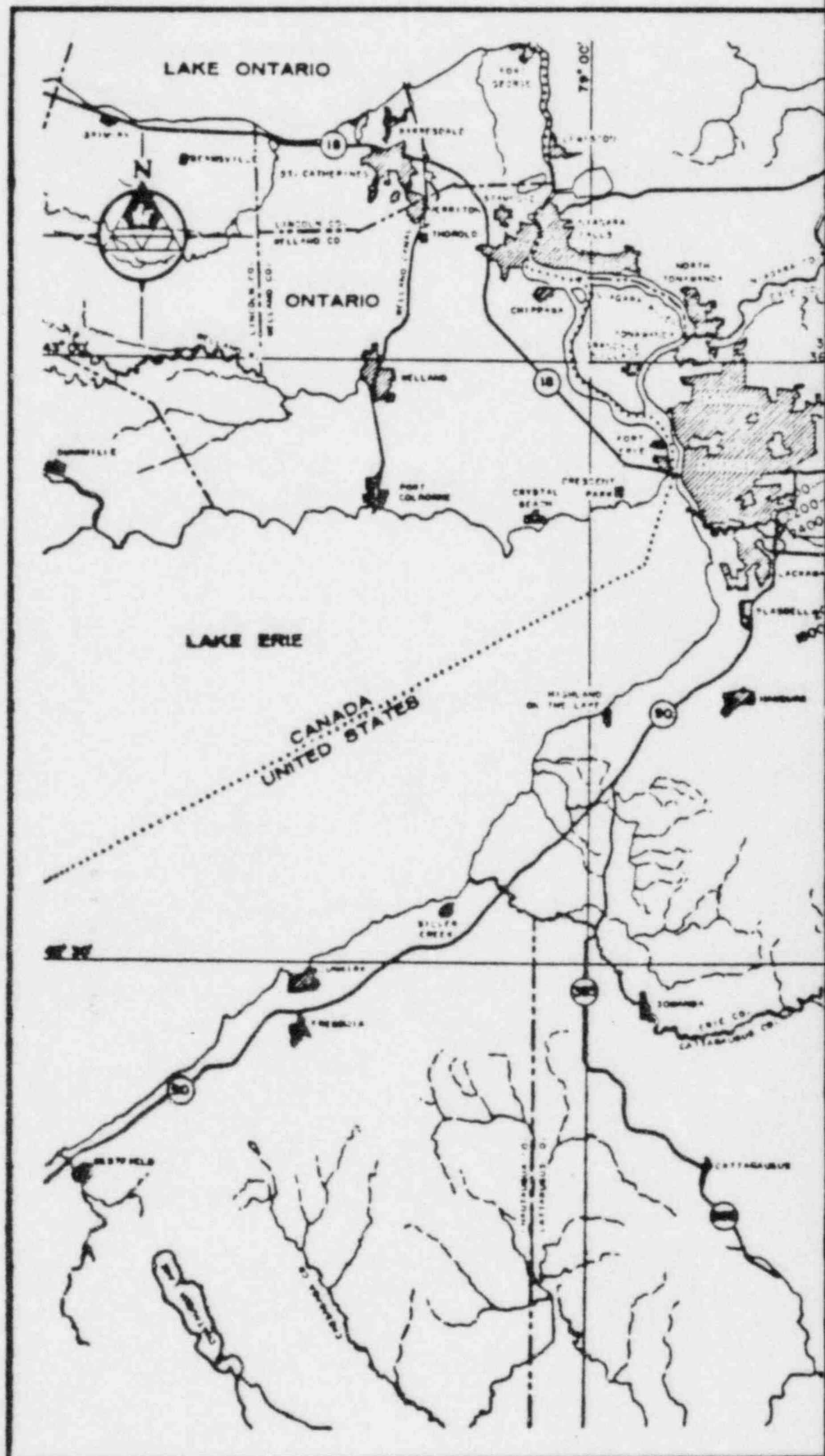
FIGURE A.3.6-A-20

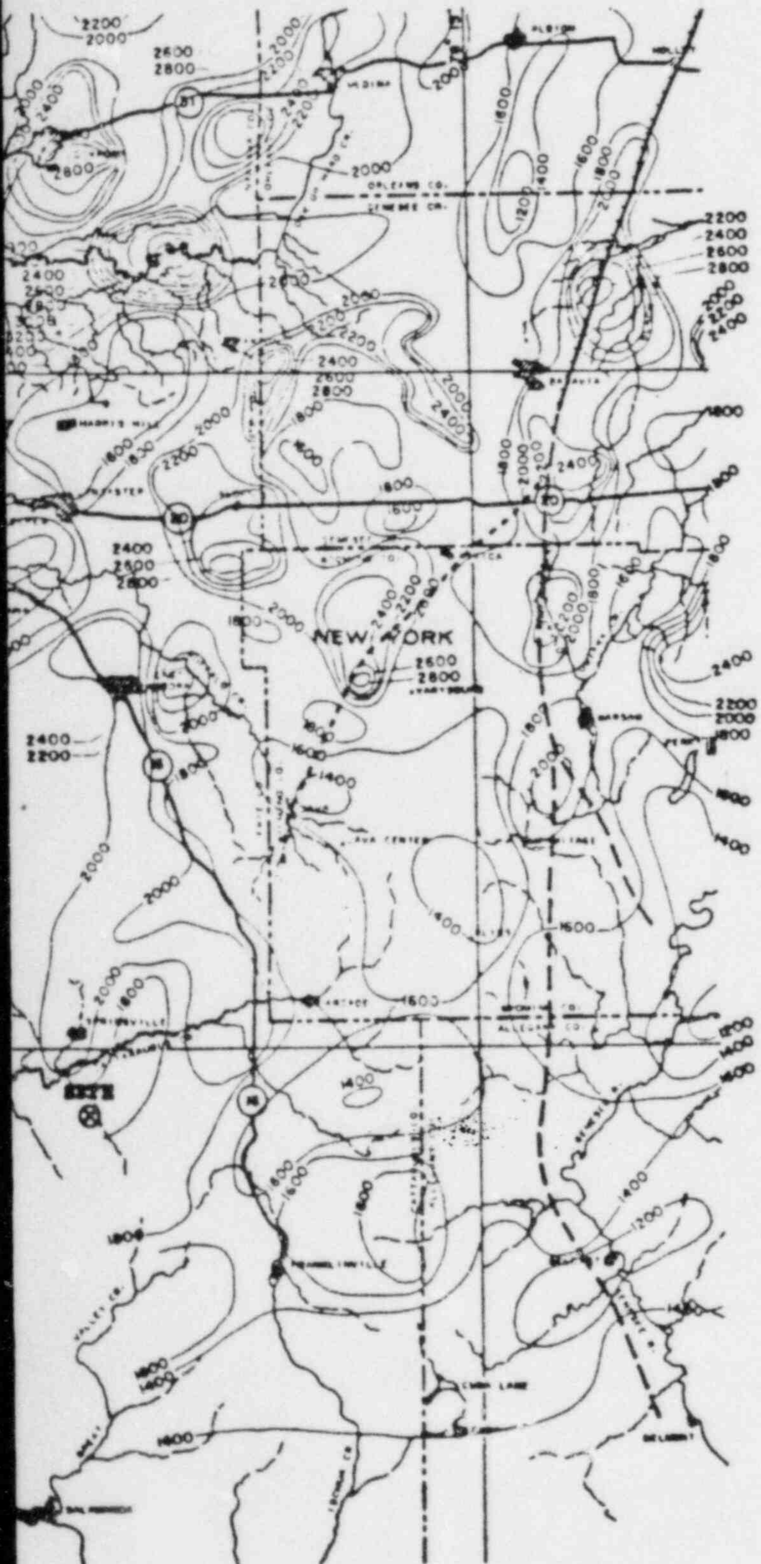


VICINITY MAP

SHOWING GRAVITY SURVEY DATA

FIGURE A.3.6-A-21

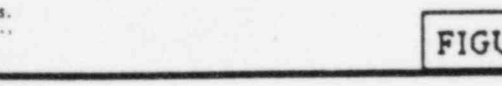

LAKE ONTARIO
ONTARIO
LAKE ERIE
CANADA
UNITED STATES
N
79° 00'
THOROLD
WELLAND
CHIPPAWA
PORT COLBORNE
CRYSTAL BEACH
CRESCENT PARK
FORT ERIE



VICINITY MAP
SHOWING MAGNETIC SURVEY DATA

FIGURE A.3.6-A-22

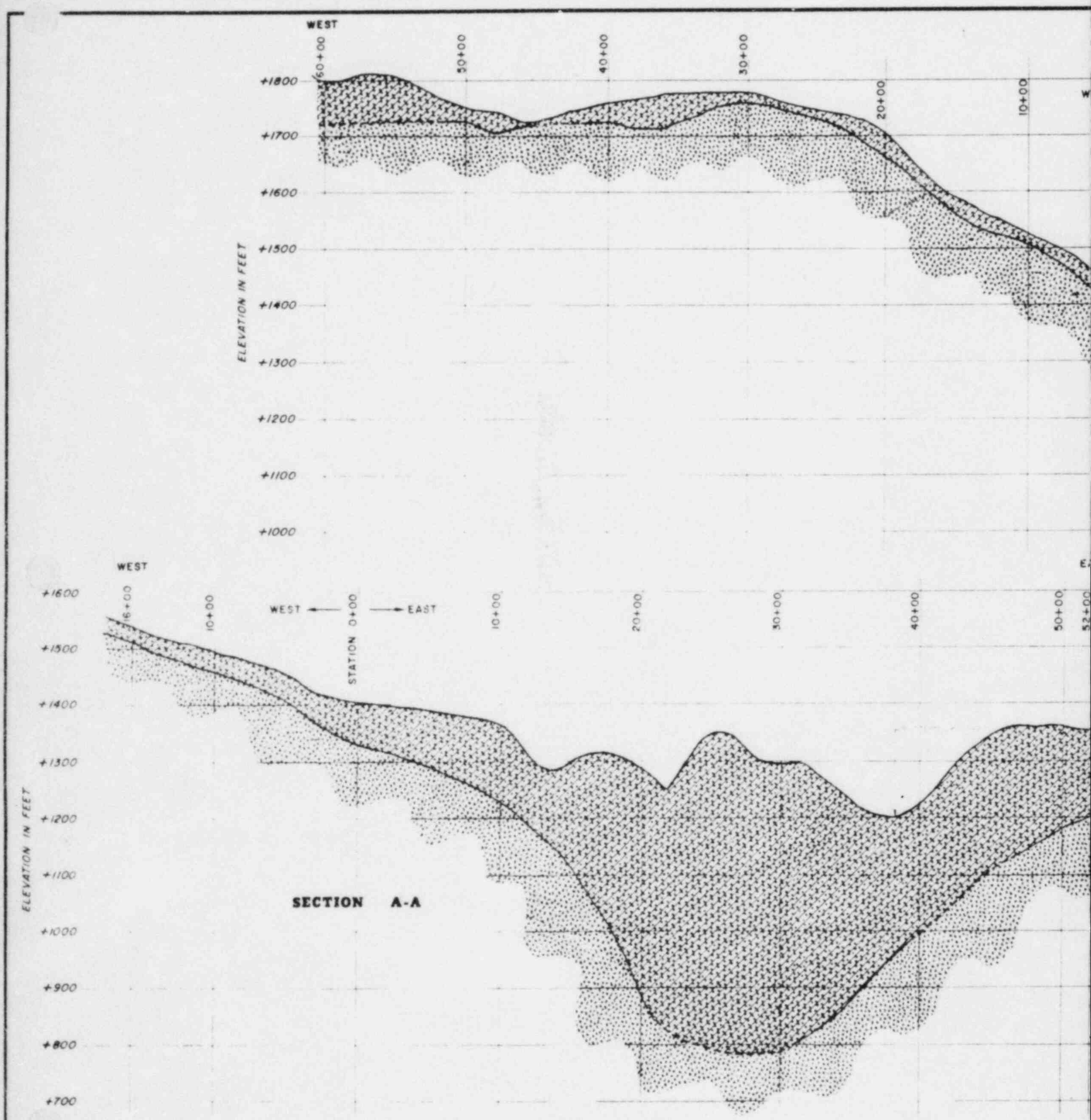
"SEISMIC LINE LOCATION MAP"

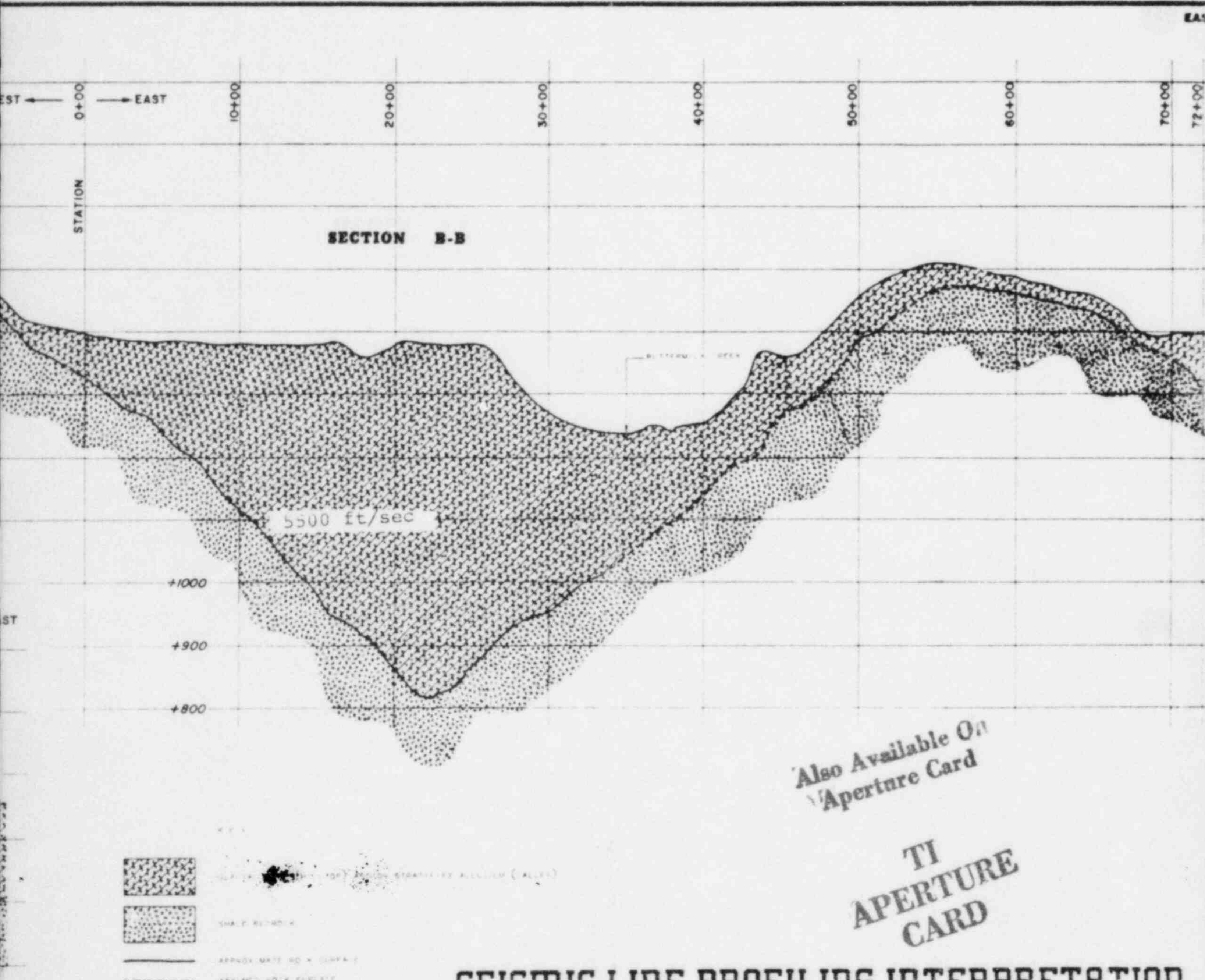


REFERENCE:

THIS MAP WAS PREPARED FROM A PORTION OF U.S.G.S. MAP, ASHFORD HOLLOW, 1964 AND WEST VALLEY, N.Y., 1964 QUADRANGLES.

FIGURE A.3.6-A-23


WEST
60+00
50+00
40+00
30+00
20+00
10+00
+1800
+1700
+1600
+1500
+1400
+1300
+1200
+1100
+1000
ELEVATION IN FEET
WEST
36+00
10+00
WEST
STATION 0+00
EAST
10+00
20+00
30+00
40+00
50+00
52+00
+1600
+1500
+1400
+1300
+1200
+1100
+1000
+900
+800
+700
ELEVATION IN FEET
SECTION A-A



Also Available On Aperture Card

TI APERTURE CARD

SEISMIC LINE PROFILING INTERPRETATION

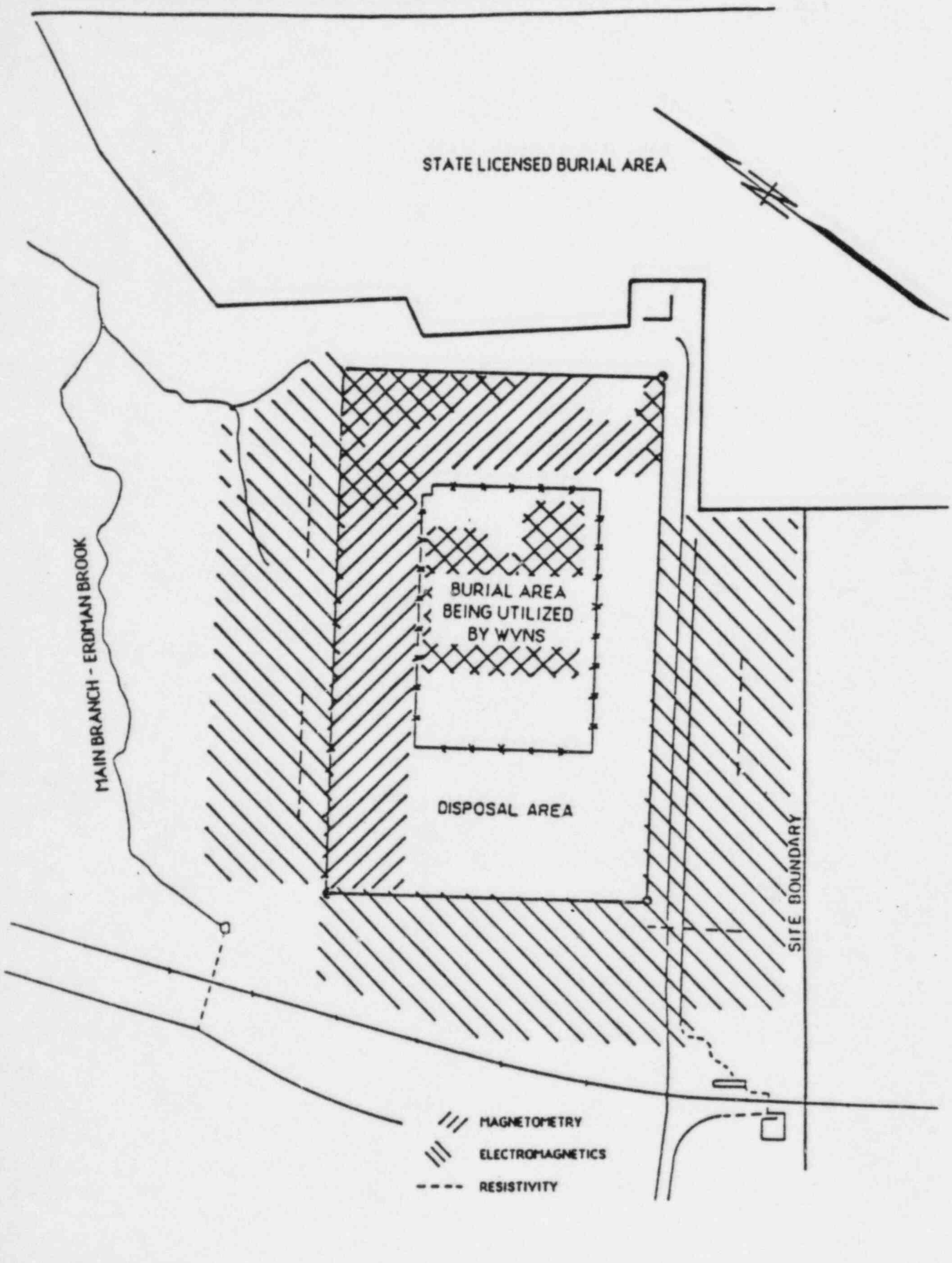
HORIZONTAL SCALE IN FEET
500 0 500 1000

NOTE:

1. BASED ON DATA FROM "BEDROCK PROFILES FROM SEISMIC DATA, WESTERN NEW YORK NUCLEAR SERVICE CENTER, TOWN OF ASHFORD" BY STATE OF NEW YORK, DEPARTMENT OF PUBLIC WORKS, DIVISION OF CONSTRUCTION BUREAU OF SOIL MECHANICS, DATED 3-20-62
2. REFER TO PLATE 1 FOR LOCATION OF PROFILES A-A AND B-B IN PLAN.

FIGURE A.3.6-A-24

8507030448 -5



GEOPHYSICAL SURVEY COVERAGE - NDA

FIGURE A.3.6-A-25

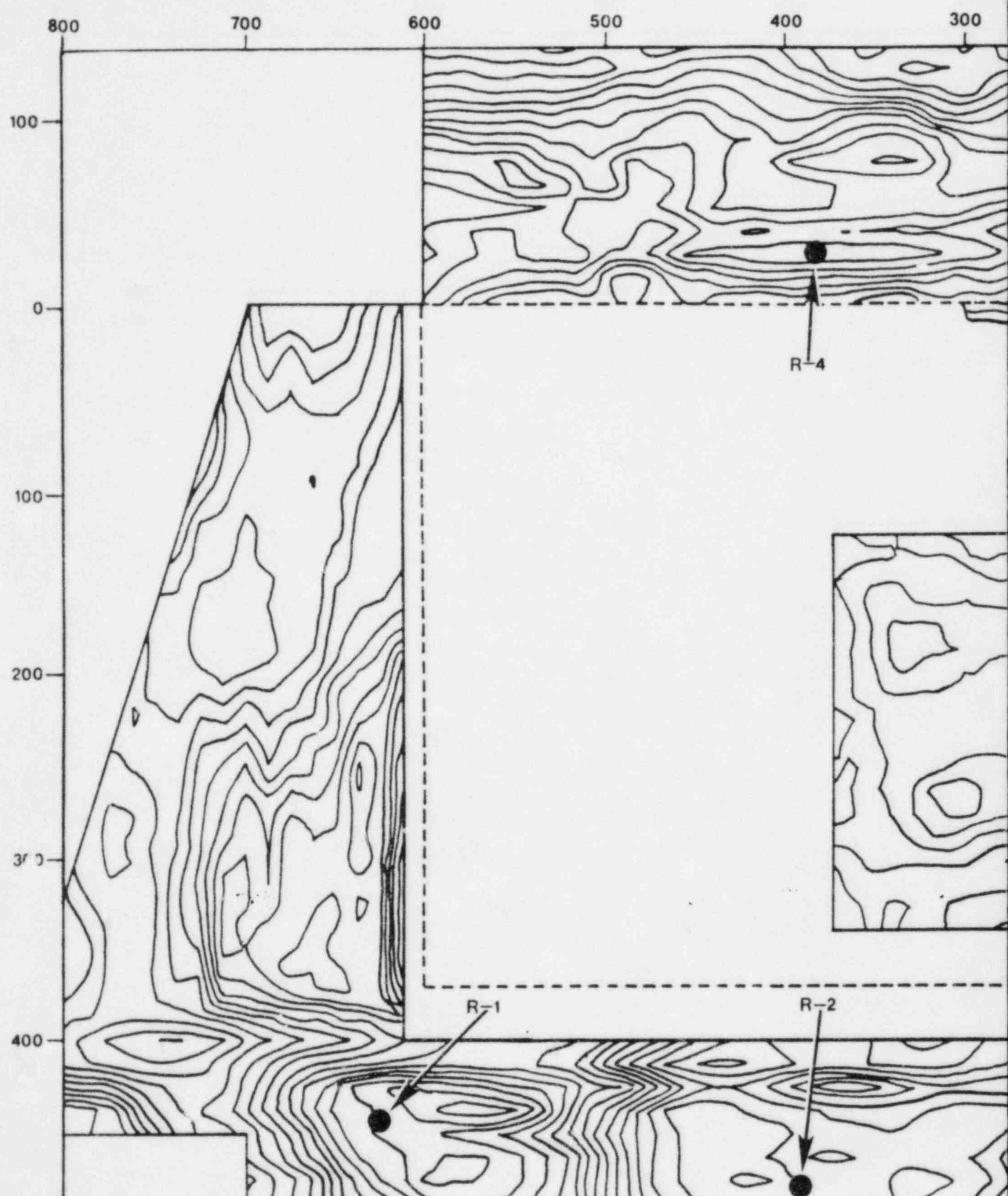
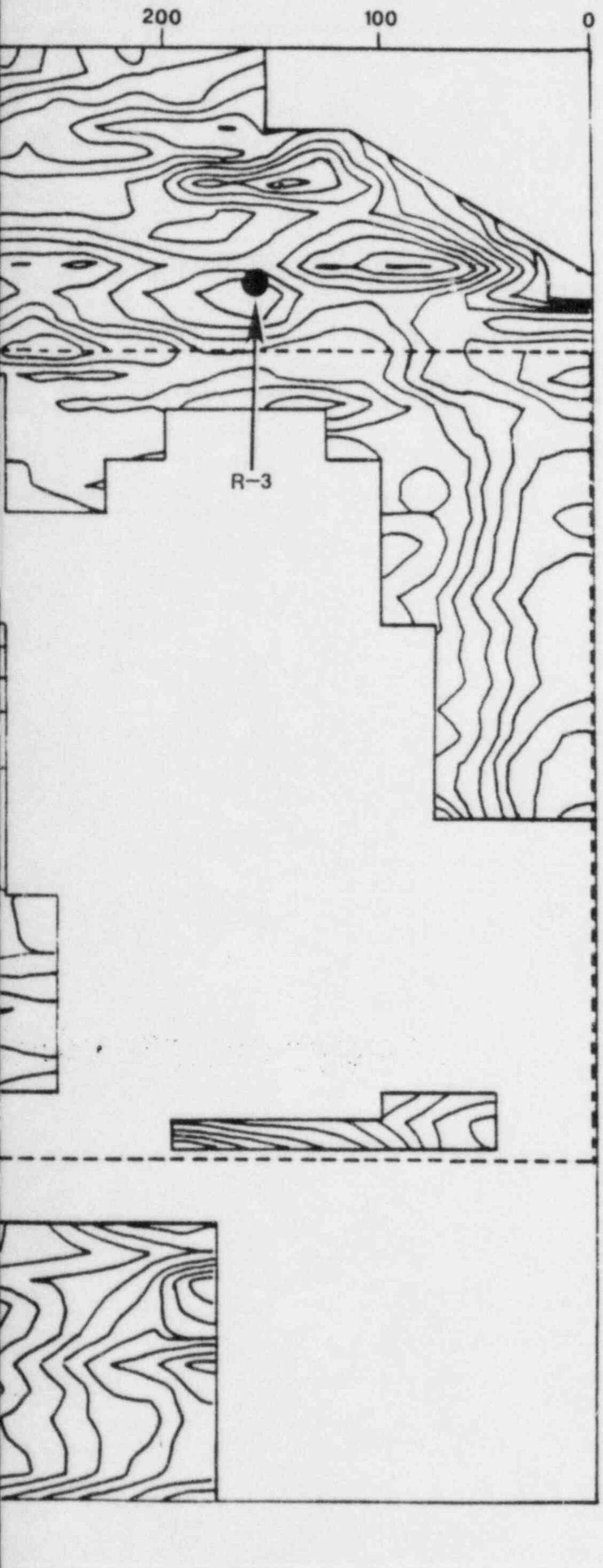


FIGURE A.3.6-A-26 LOCATION OF RESISTIVITY SOUNDINGS WITH RESPECT TO EM CONDUCTIVITY DATA.



ELECTROMAGNETIC CONDUCTIVITY MAP IN AND AROUND THE NRC-LICENSED BURIAL AREA. GRID MARKS ARE IN FEET.

CONTOUR INTERVAL 1 mm/m

NRC BURIAL AREA

N

0 50 100

SCALE IN FEET

8507030448-6

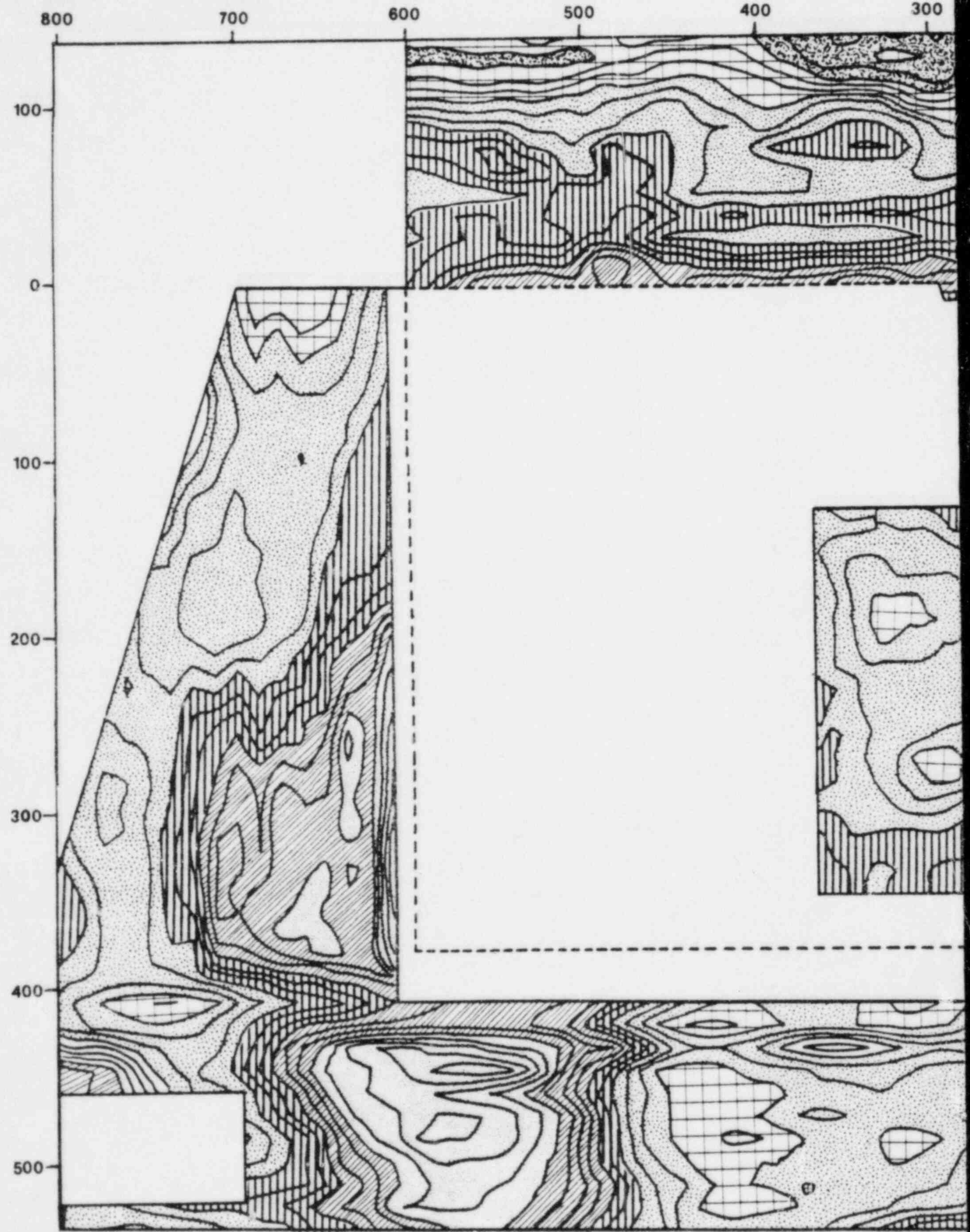
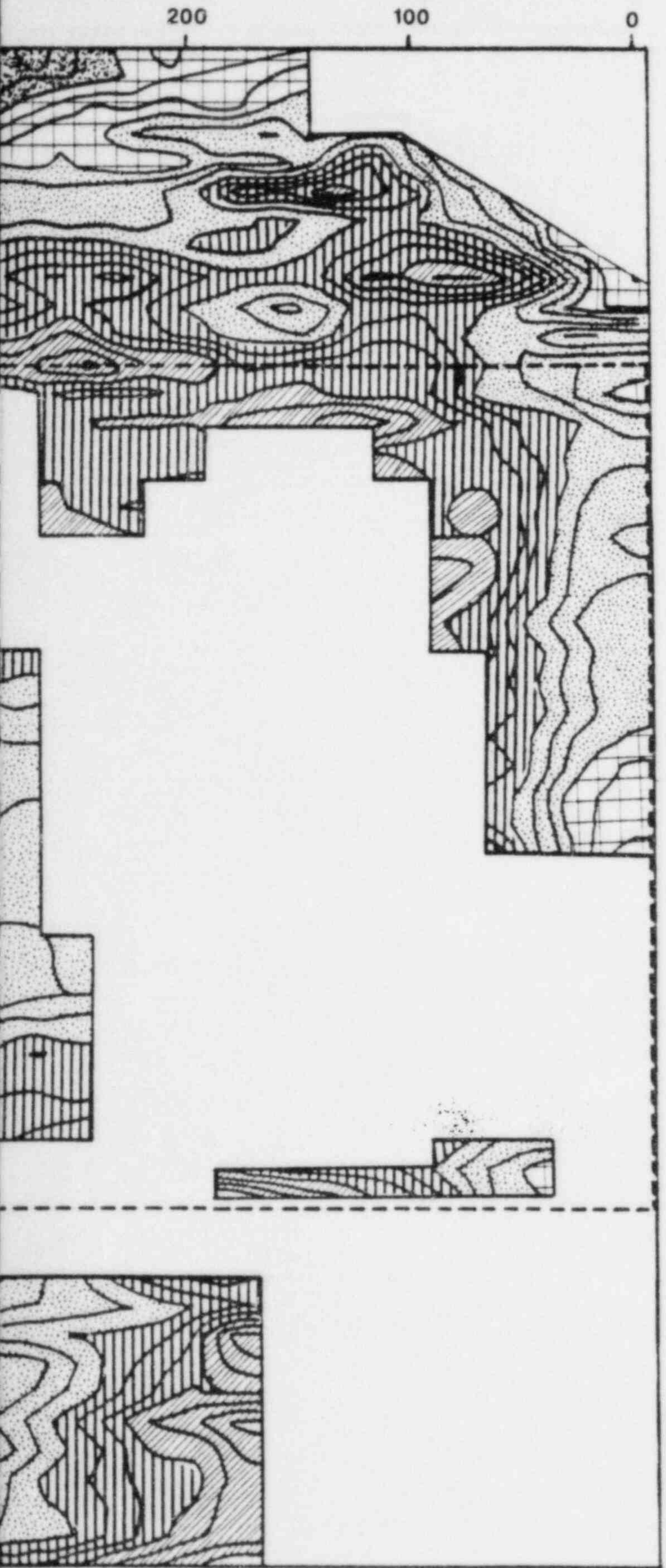
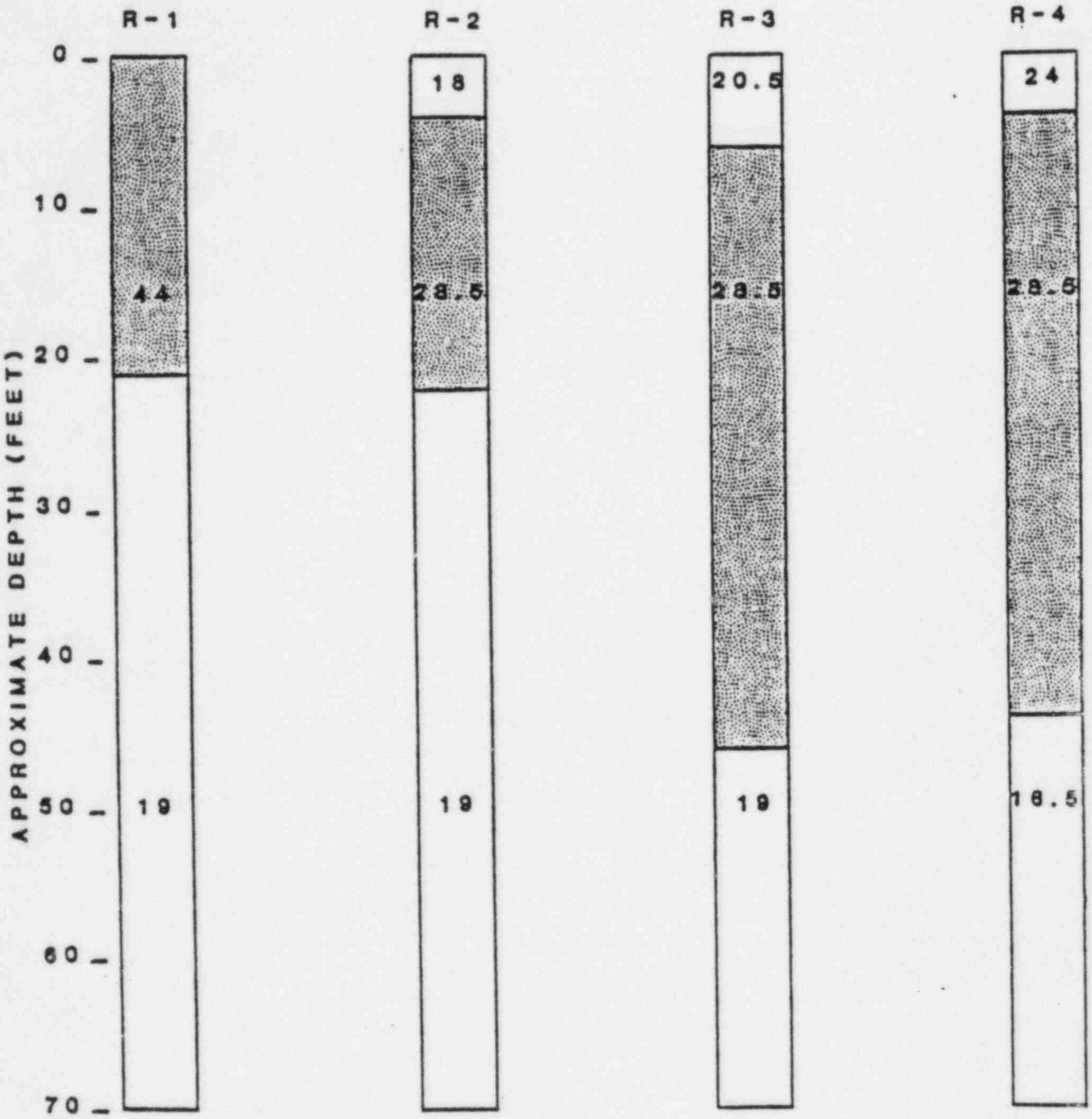


FIGURE A.3.6-A-27 LOCATION OF RESISTIVITY SOUNDINGS WITH RESPECT TO EM CONDUCTIVITY DATA.



ELECTROMAGNETIC CONDUCTIVITY MAP IN AND AROUND THE NRC-LICENSED BURIAL AREA. GRID MARKS ARE IN FEET.



Notes:

Geoelectric vertical sections derived from computer modelling of resistivity sounding data. Layer conductivities are given in millimhos/meter.

FIGURE A.3.6-A-28

SUPPLEMENT A.3.6-B

LOGS OF BORINGS

LOGS OF BORINGS

The logs of the following borings are incorporated by reference to: Albanese, et al., 1983. (NUREG/CA-3207)

G	I	J	PAH-37	80-4	80-6

The logs of the following borings are incorporated by reference to: Albanese, et al., 1984. (NUREG/CR-3782)

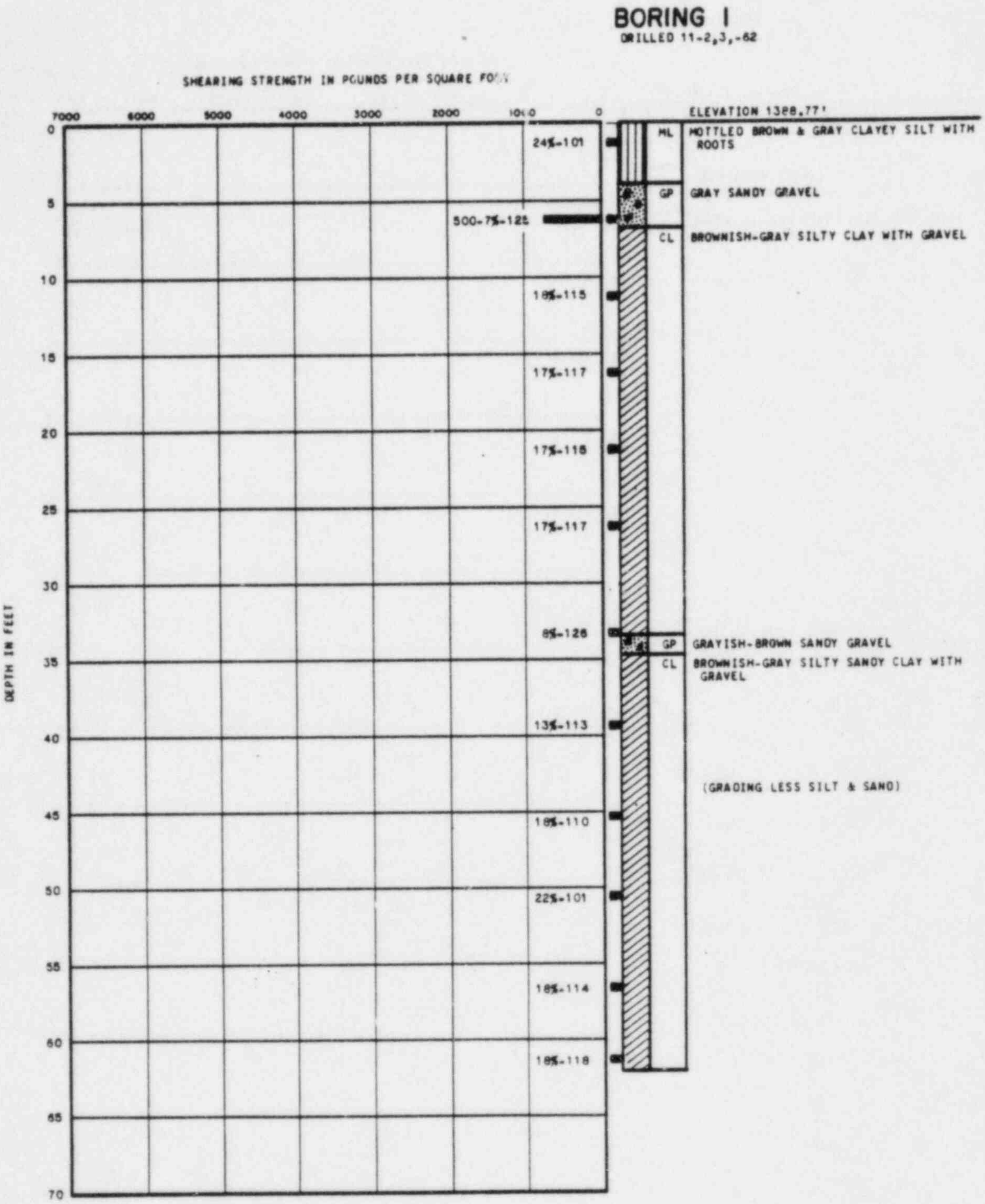
82-1-A	83-1-B	82-1-C	82-1-D	82-2-A	82-2-B	82-2-C
82-3-A	83-3-B	82-3-C	83-3-D	82-4-A	82-4-B	82-4-C
82-5-A	82-5-B	83-5-C	83-1-D	83-1-E	83-2-D	83-2-E
83-3-E						

REFERENCES FOR SUPPLEMENT A.3.6-B

Albanese, J. R., Anderson, S. L., Fakundiny, R. H., Potter, S. M., Rogers, W. B., Whitbeck, L. F., June 1984. Final Report: August 1982 - December 1983: Geologic and Hydrologic Research at the Western New York Nuclear Service Center, West Valley, New York. U.S. Nuclear Regulatory Commission Report NUREG/CR-3782 RE, RW.

Albanese, J. R., Anderson, S. L., Dunne, L. A., and Weir, B. A., 1983. Geologic and Hydrologic Research at the Western New York Nuclear Service Center, West Valley, New York. Annual Report, August 1981 - July 1982, U.S. Nuclear Regulatory Commission Report, NUREG/CR-3207.

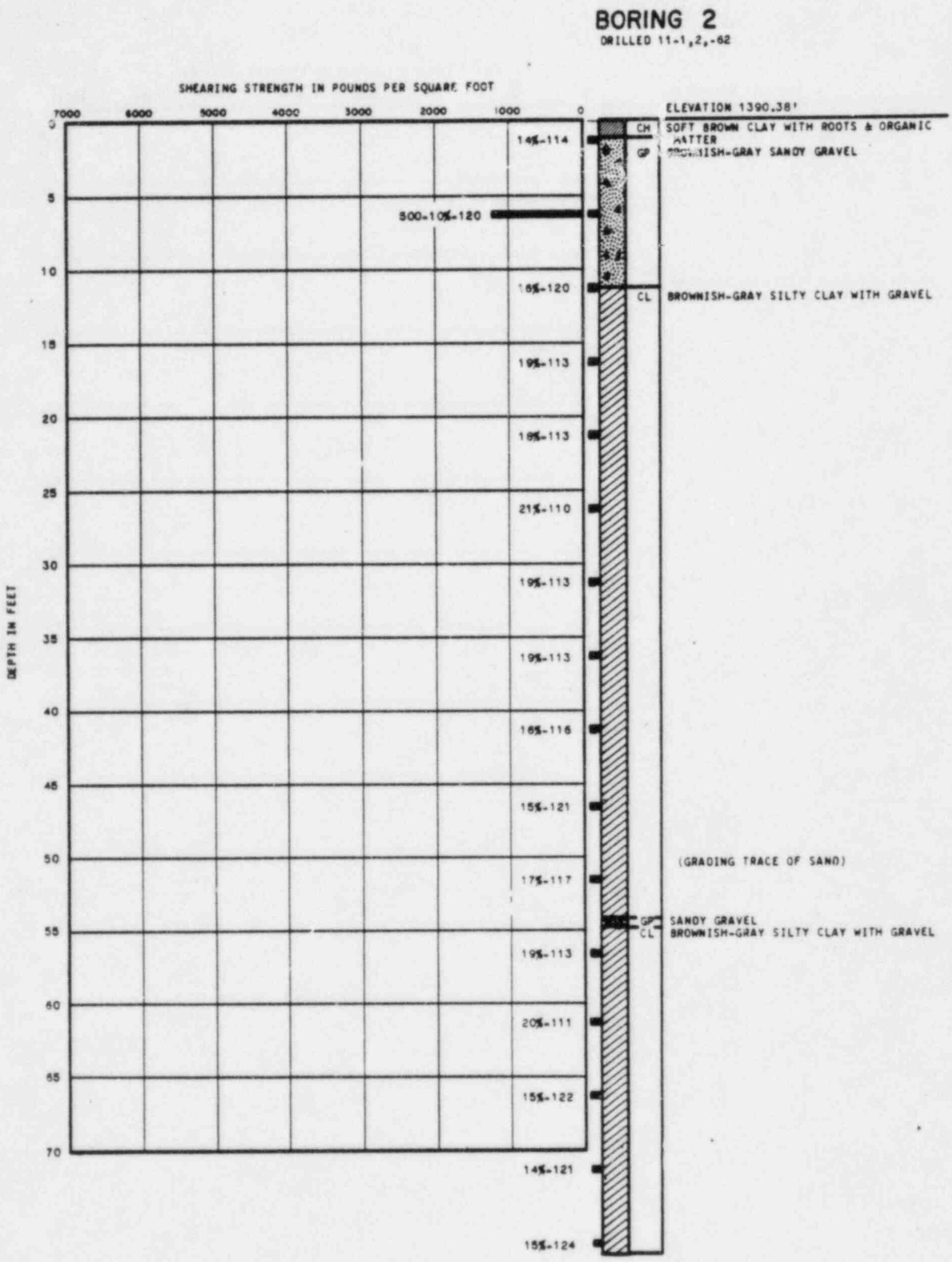
Albanese, J. R., Dunne, L. A., Rogers, W. B., and Potter, S. N., 1982. Geologic and Hydrologic Research at the Western New York Nuclear Services Center, West Valley, New York. Program Report: August 1979 - July 1971. U.S. Nuclear Regulatory Commission Report NUREG/CR-2381.



NOTE: BORINGS DRILLED WITH 6" DIAMETER
ROTARY-WASH EQUIPMENT.
ELEVATIONS REFER TO U.S.G.S. DATUM
(M.S.L. = 0')

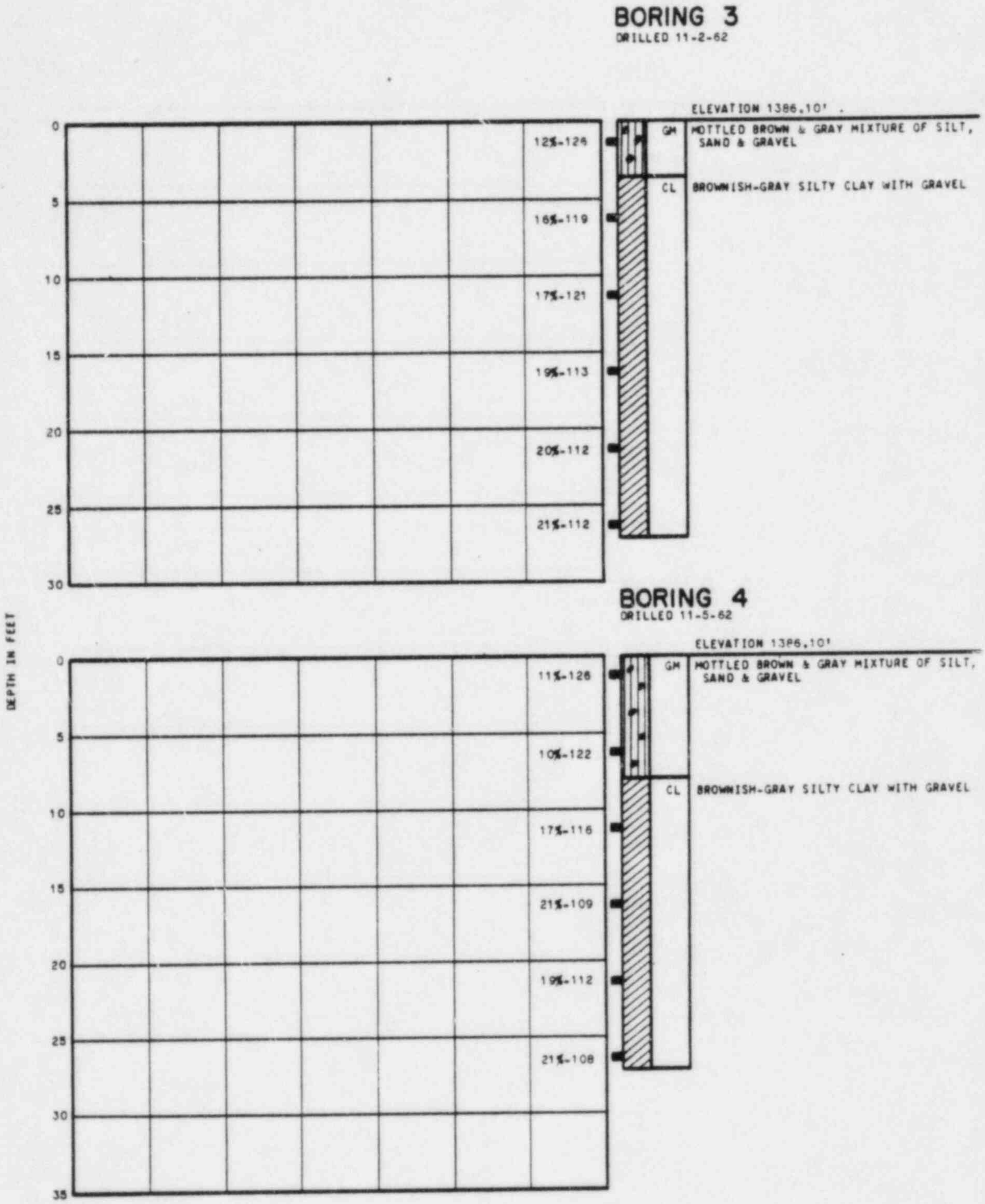
LOG OF BORINGS

FIGURE A.3.6-B-1 LOG OF BORING 1



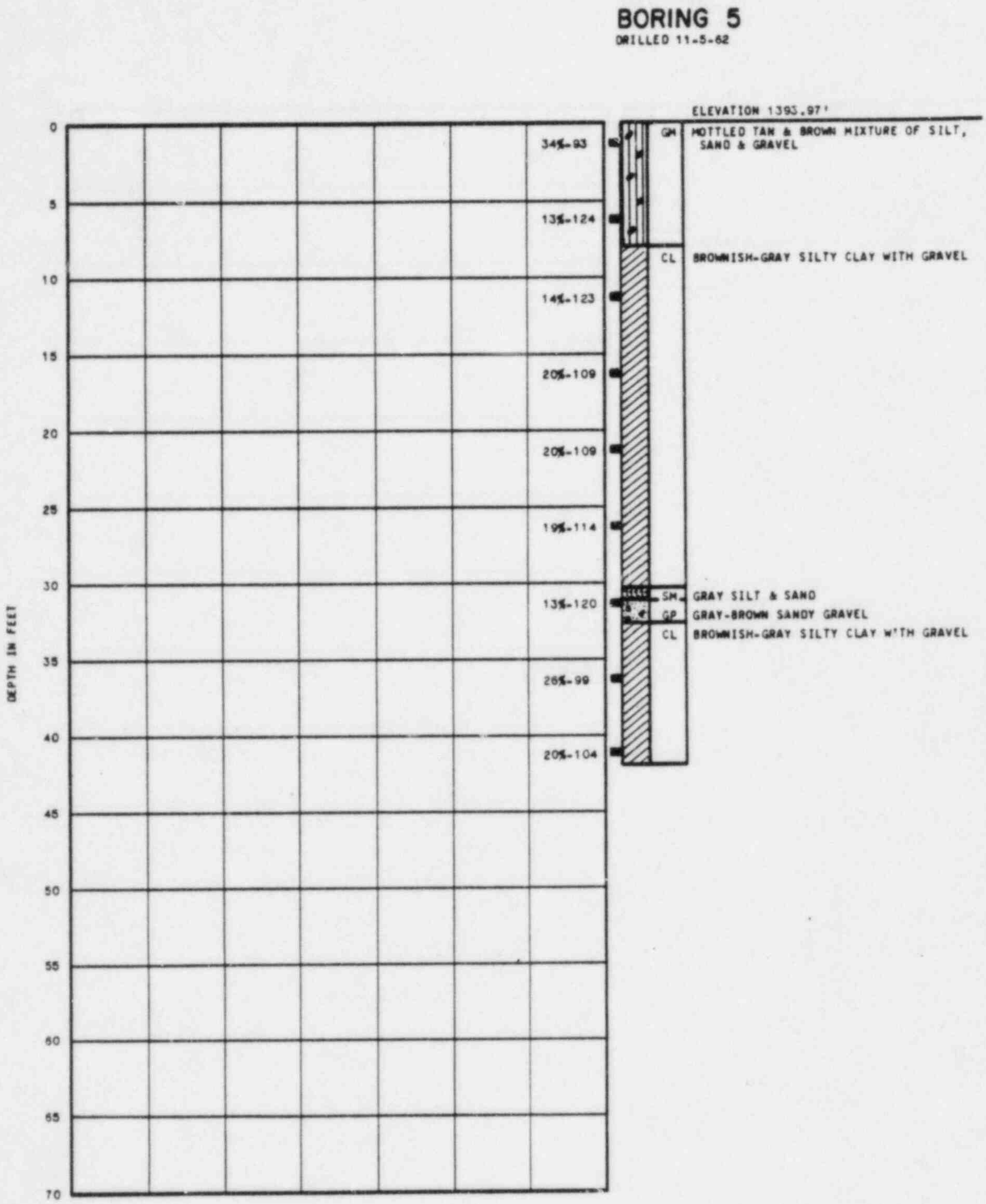
LOG OF BORINGS

FIGURE A.3.6-B-2 LOG OF BORING 2



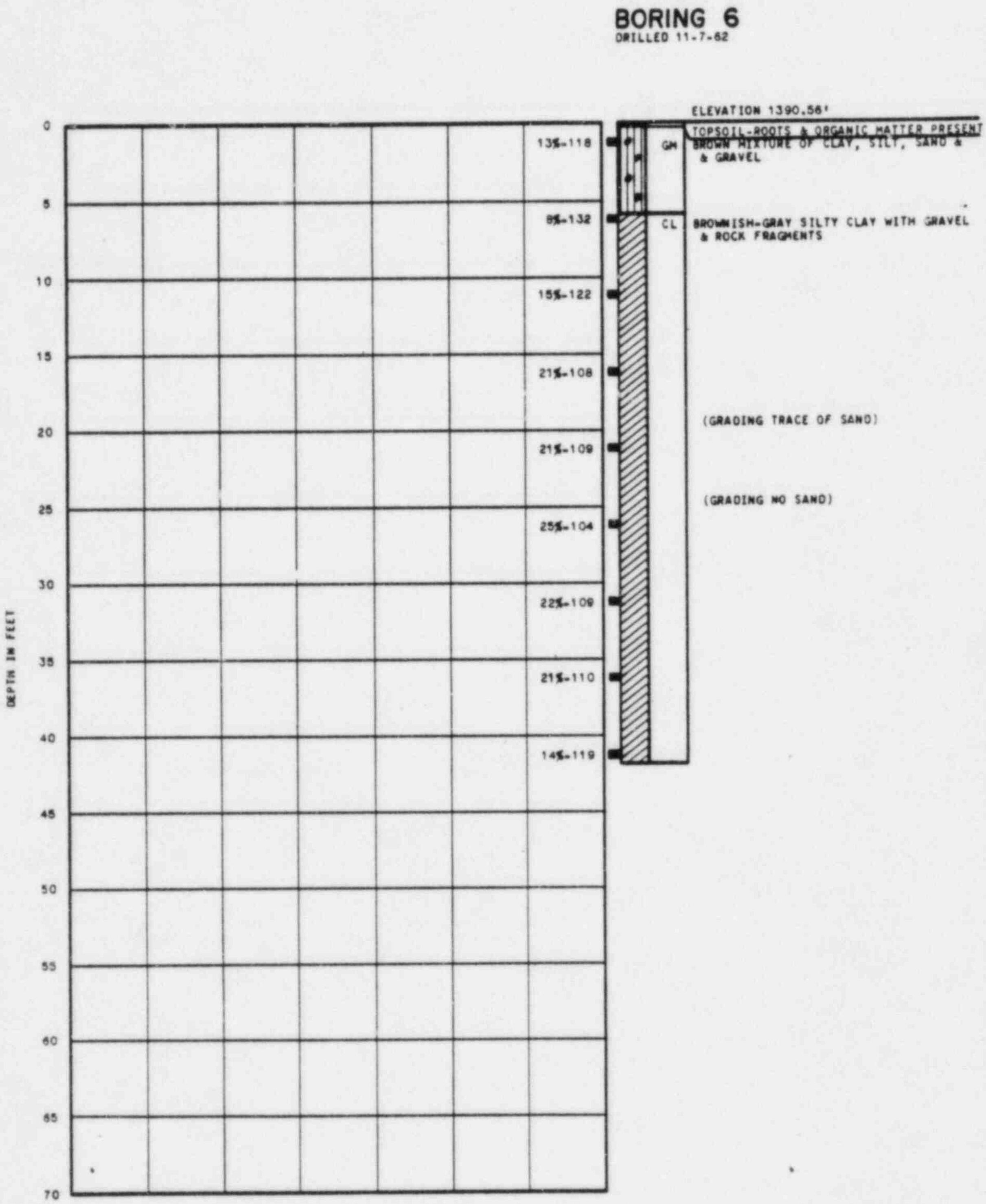
LOG OF BORINGS

FIGURE A.3.6-B-3 LOG OF BORING 3 & 4



LOG OF BORINGS

FIGURE A.3.6-B-4 LOG OF BORING 5



LOG OF BORINGS

FIGURE A.3.6-B-5 LOG OF BORING 6

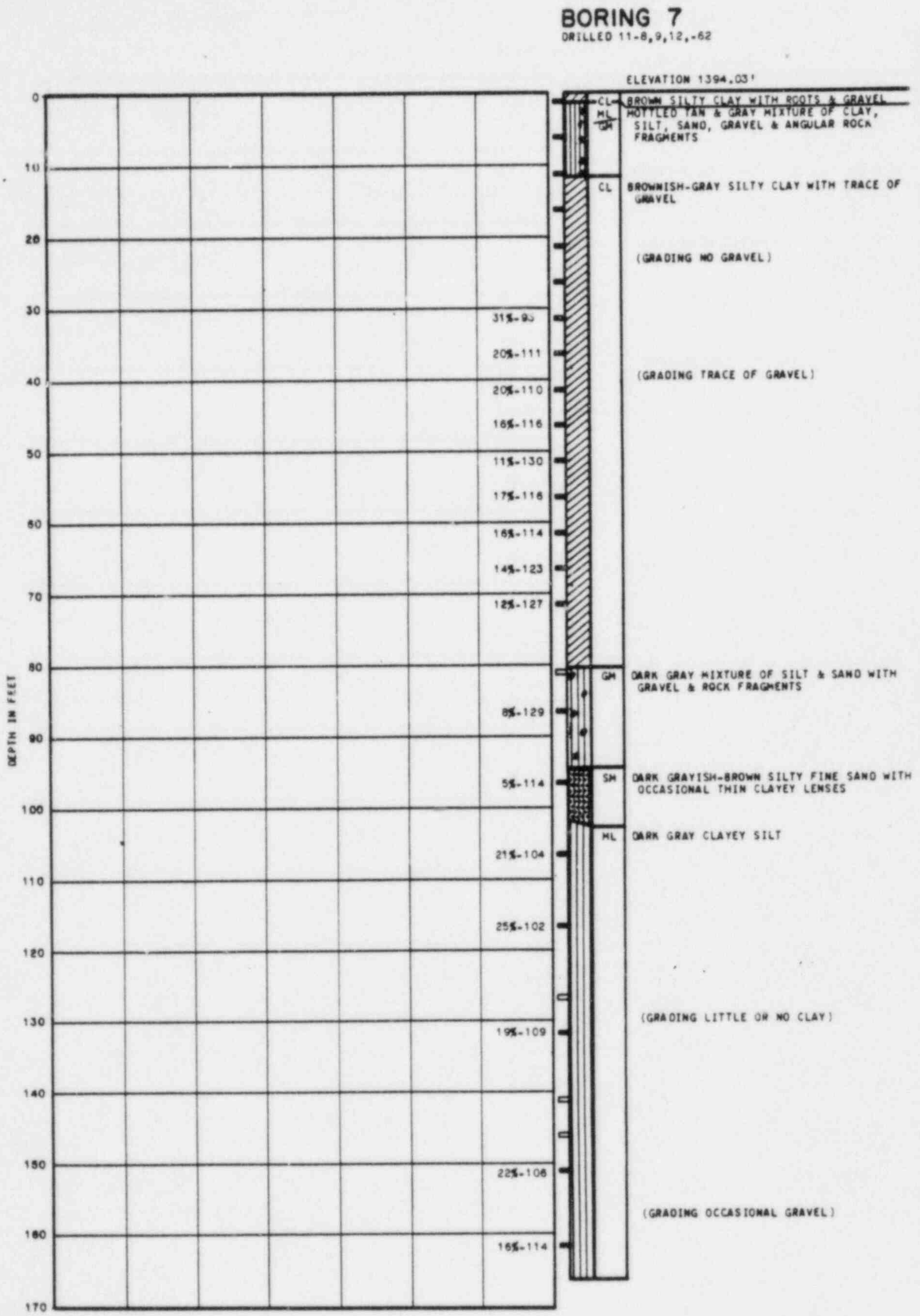
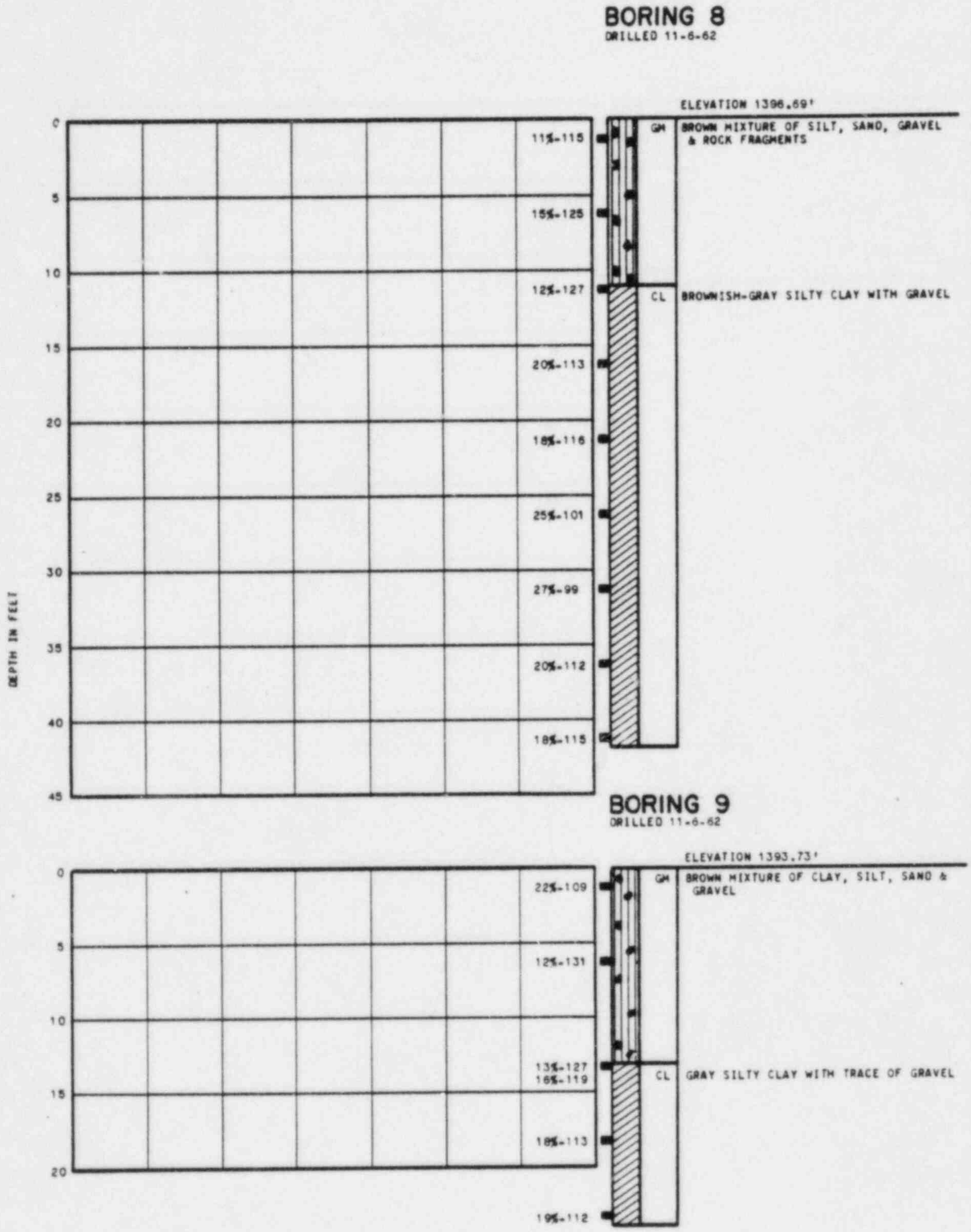
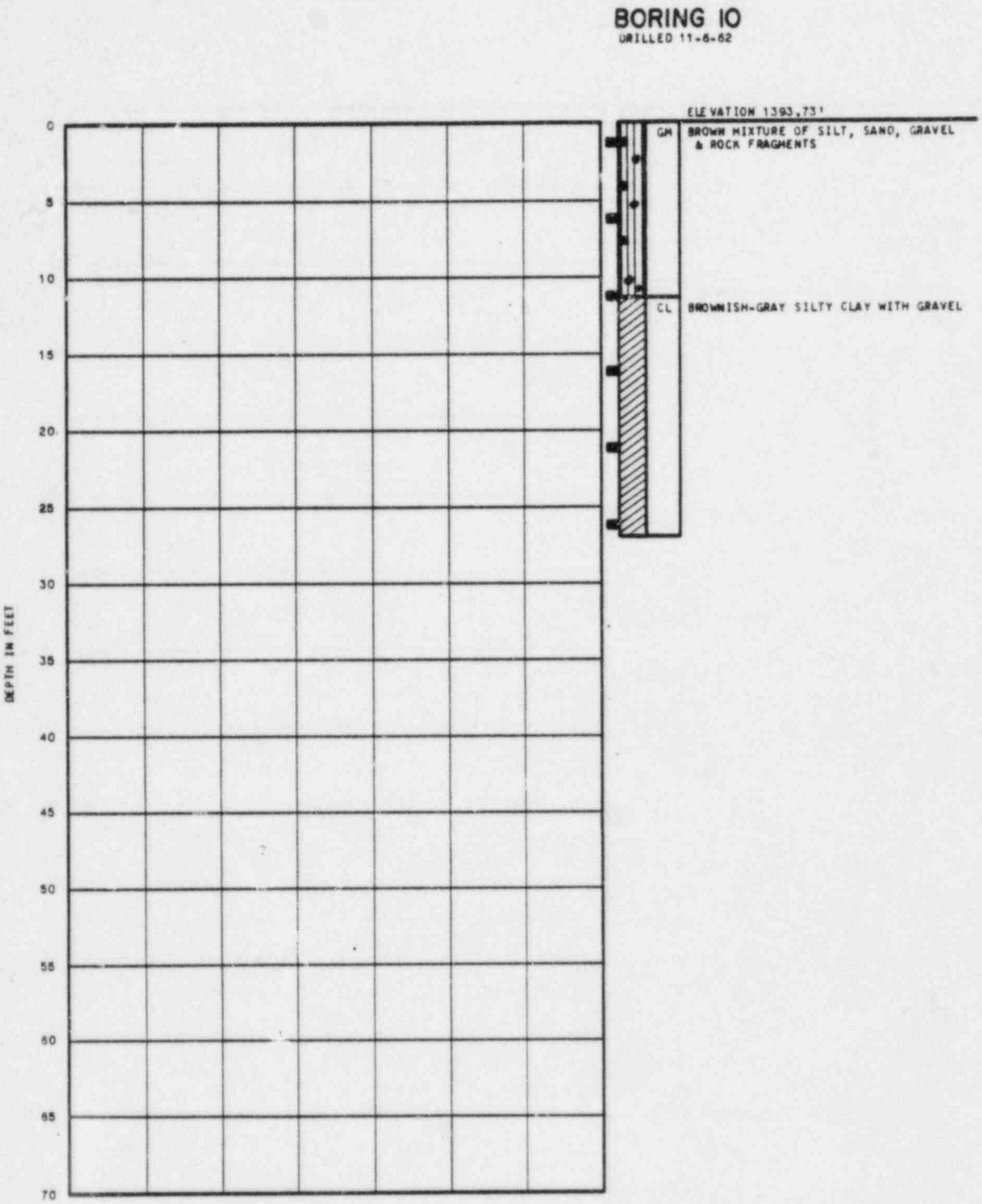


FIGURE A.3.6-B-6 LOG OF BORING 7



LOG OF BORINGS

FIGURE A.3.6-B-7 LOG OF BORING 8 & 9



LOG OF BORINGS

FIGURE A.3.6-B-8 LOG OF BORING 10

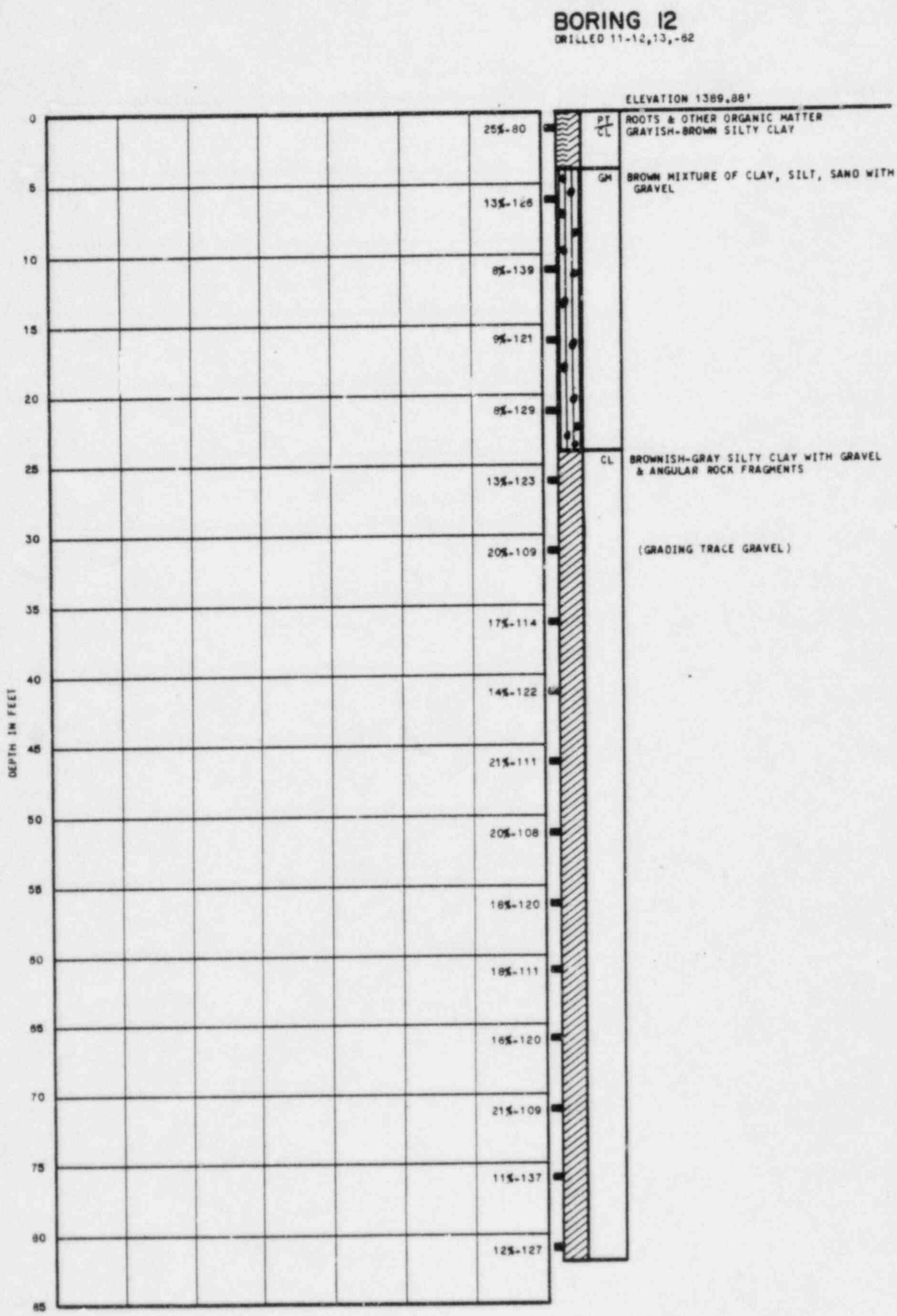
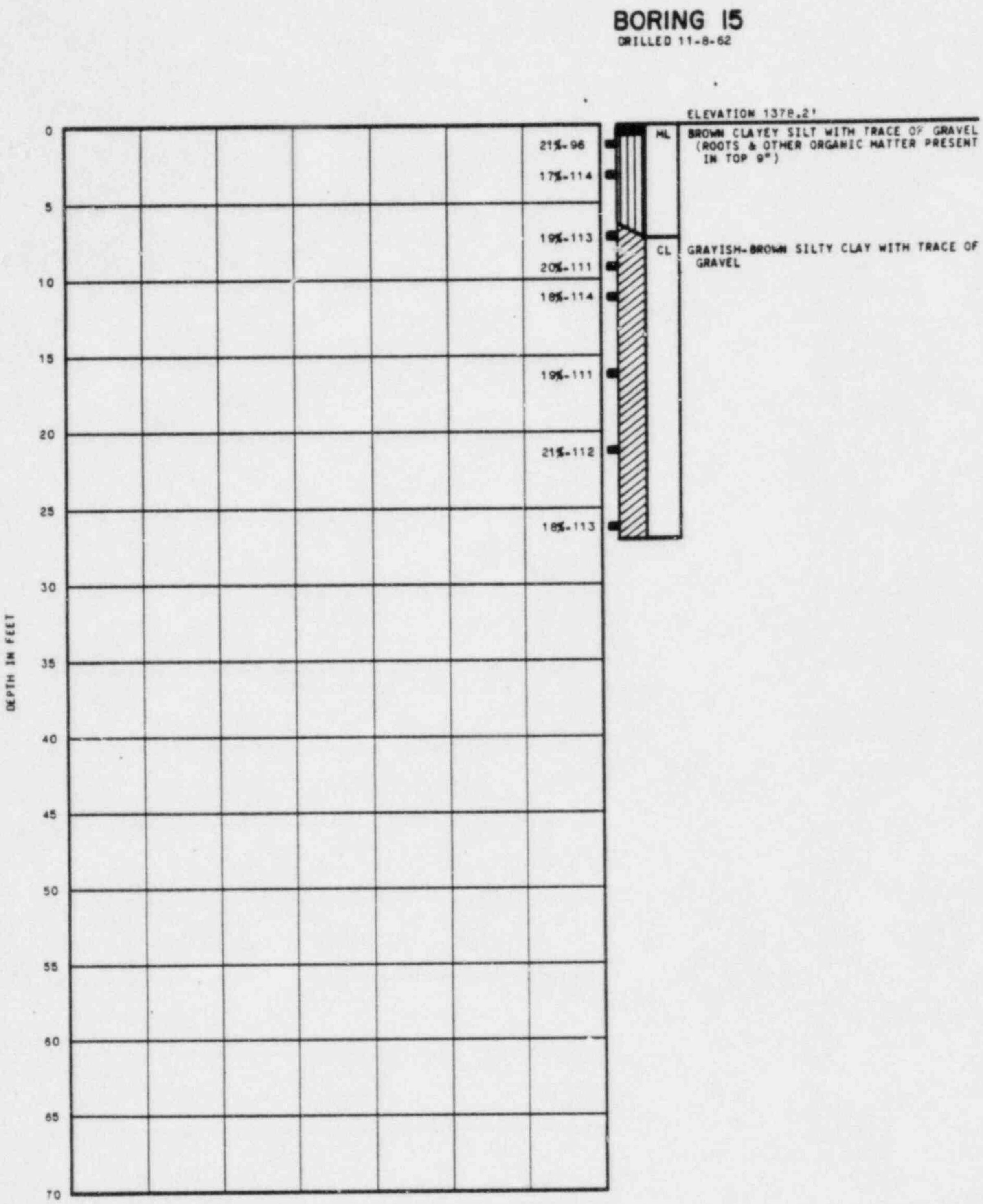
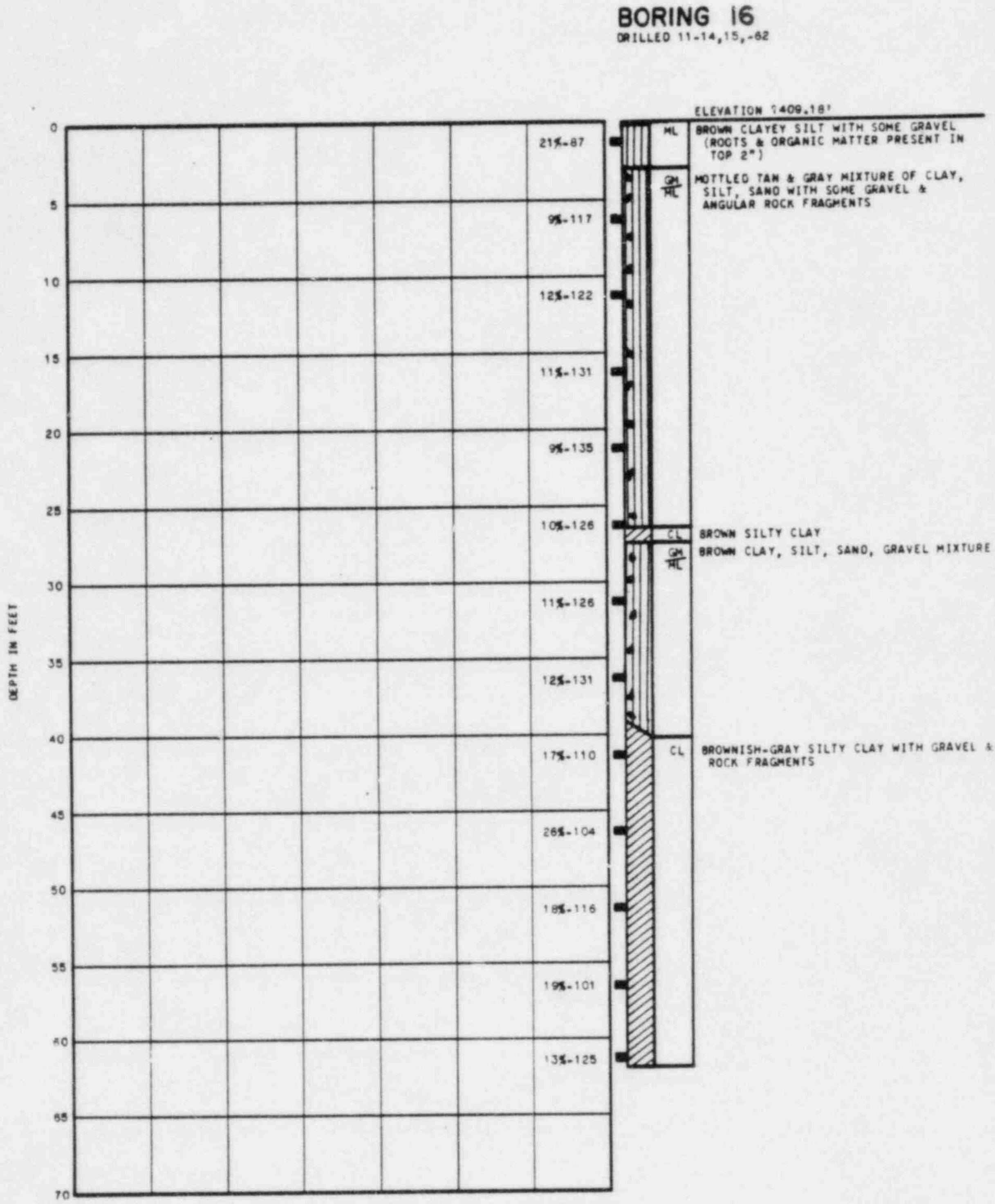


FIGURE A.3.6-B-9 LOG OF BORING 12



LOG OF BORINGS

FIGURE A.3.6-B-10 LOG OF BORING 15

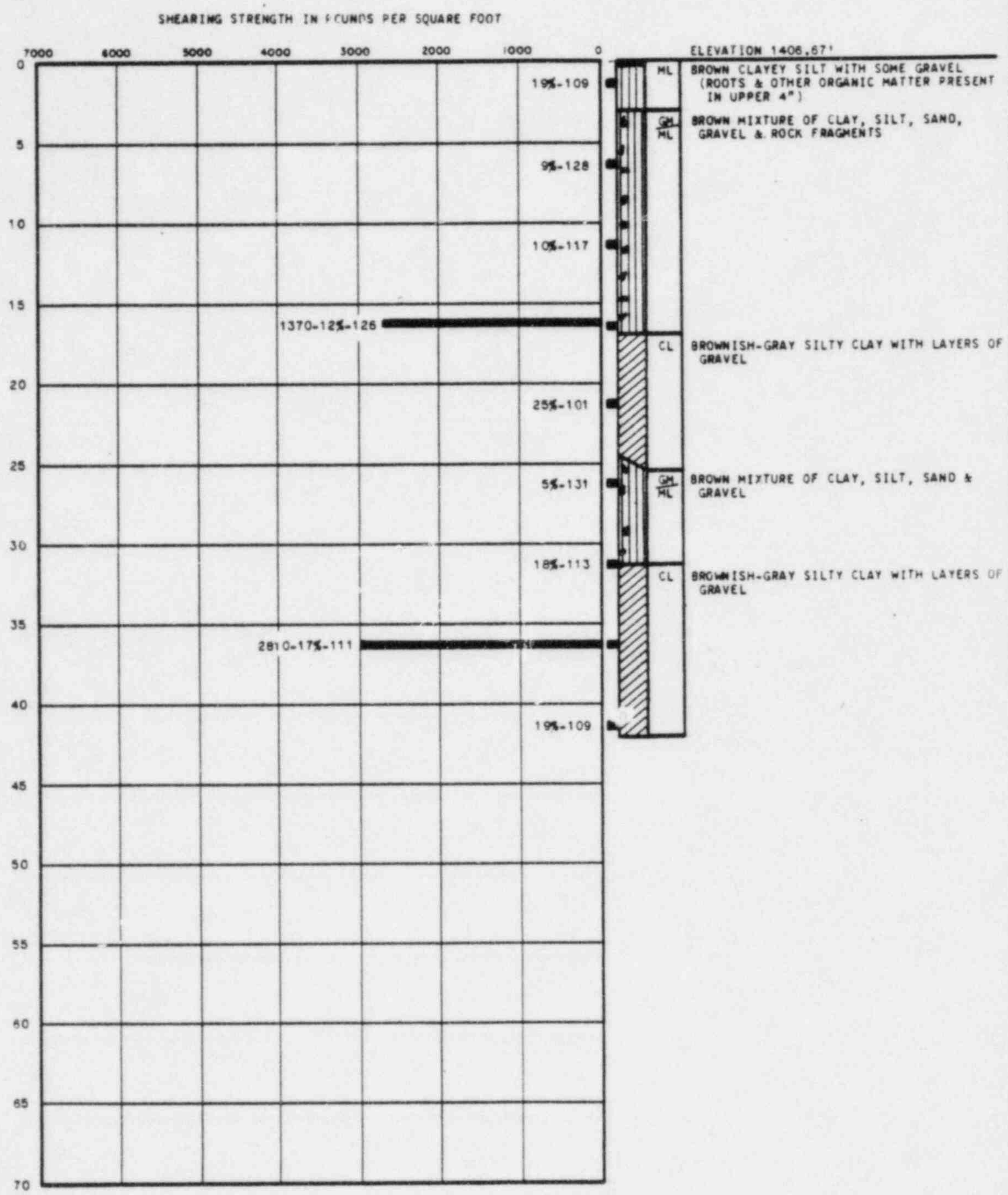


LOG OF BORINGS

FIGURE A.3.6-B-11 LOG OF BORING 16

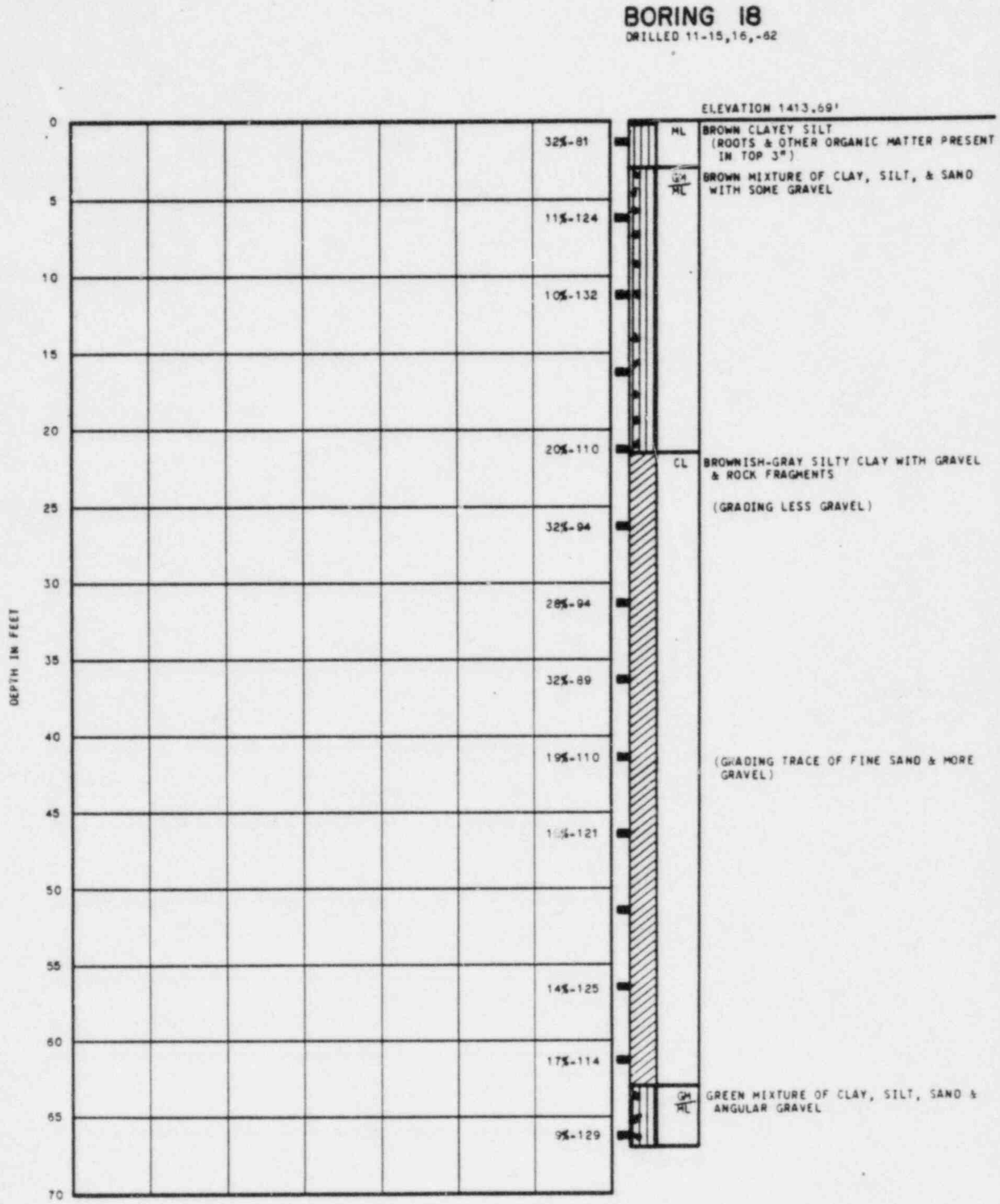
BORING 17

DRILLED 11-17-62



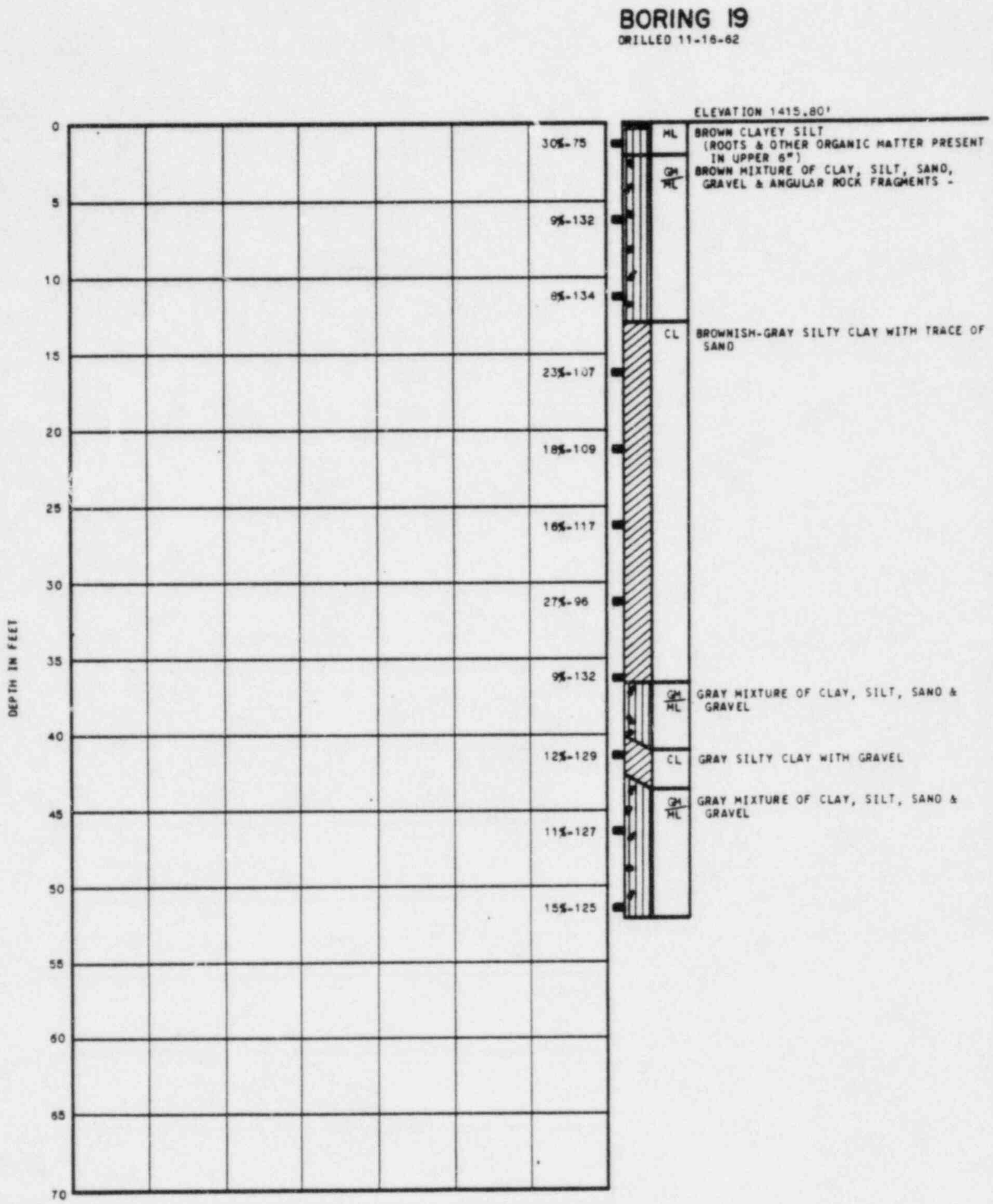
LOG OF BORINGS

FIGURE A.3.6-B-12 LOG OF BORING 17



LOG OF BORINGS

FIGURE A.3.6-B-13 LOG OF BORING 18



LOG OF BORINGS

FIGURE A.3.6-B-14 LOG OF BORING 19

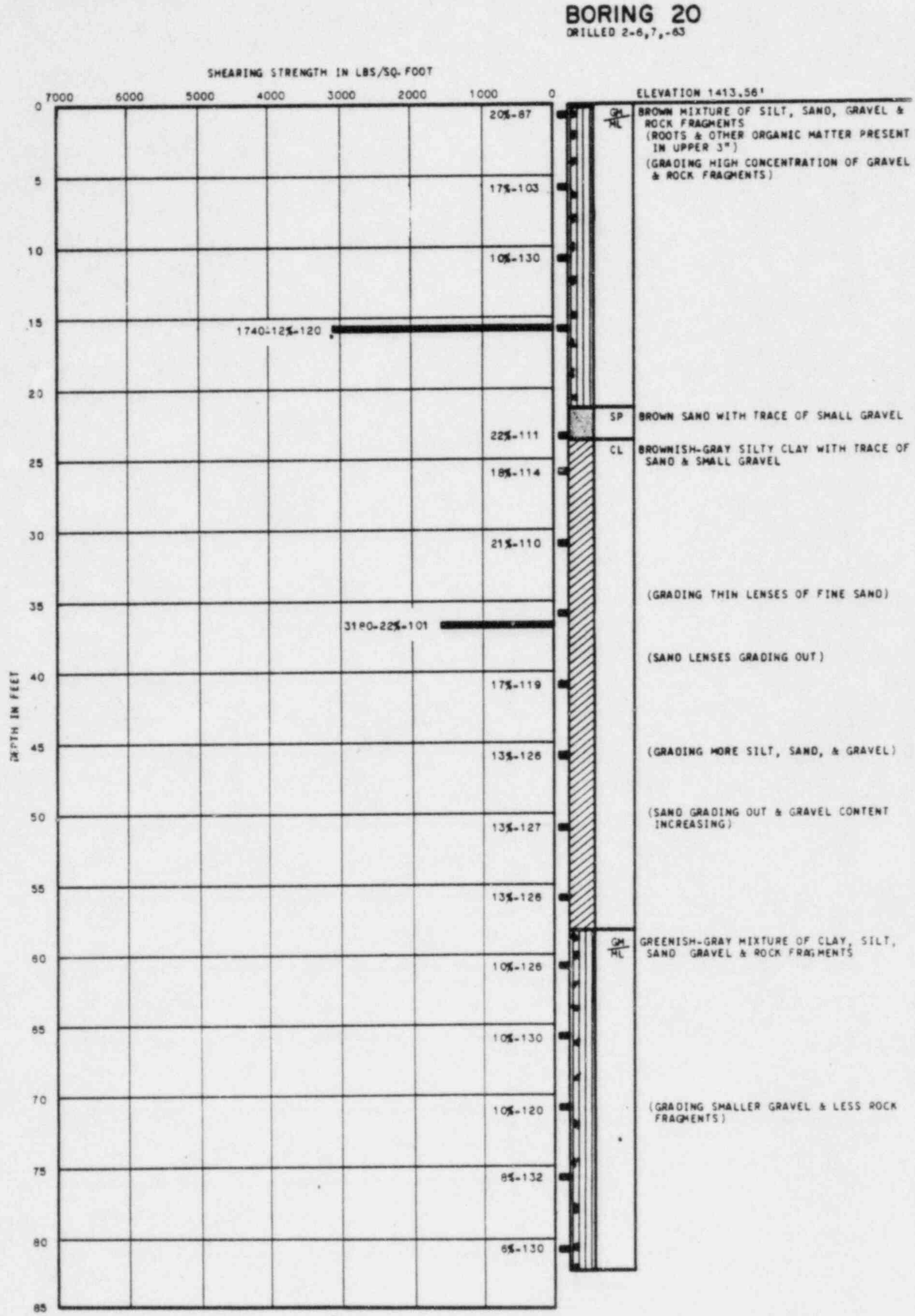
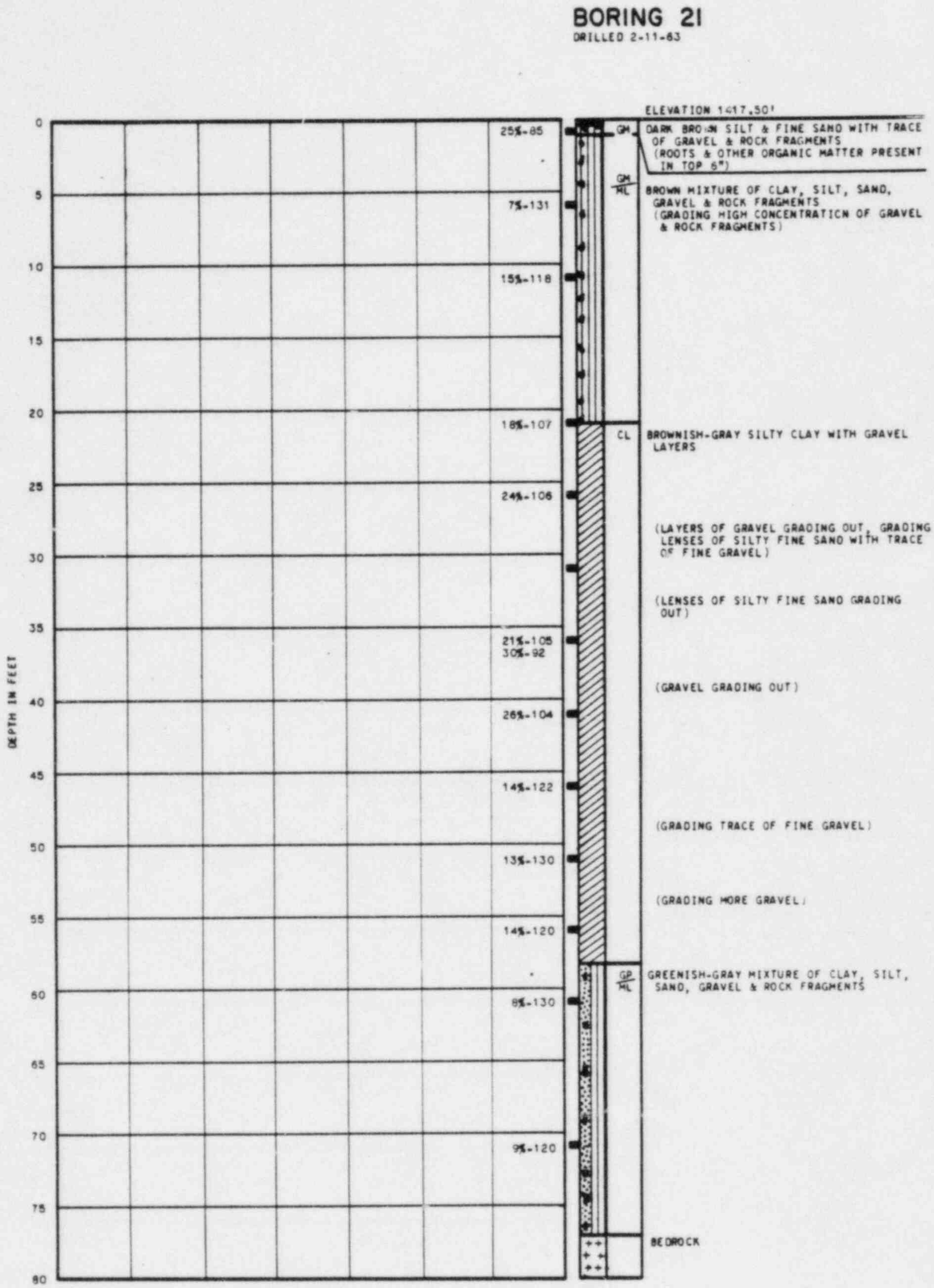
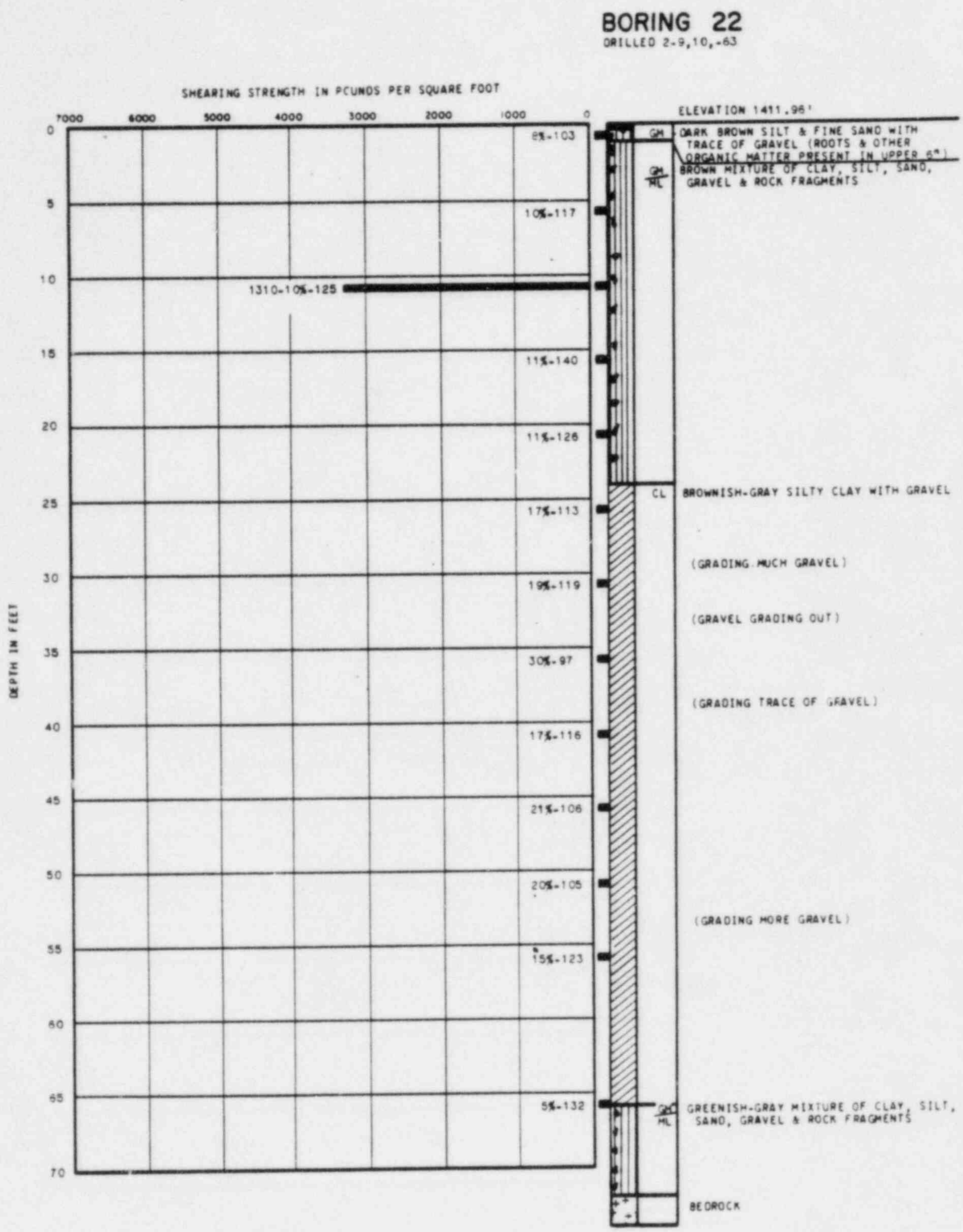


FIGURE A.3.6-B-15 LOG OF BORING 20



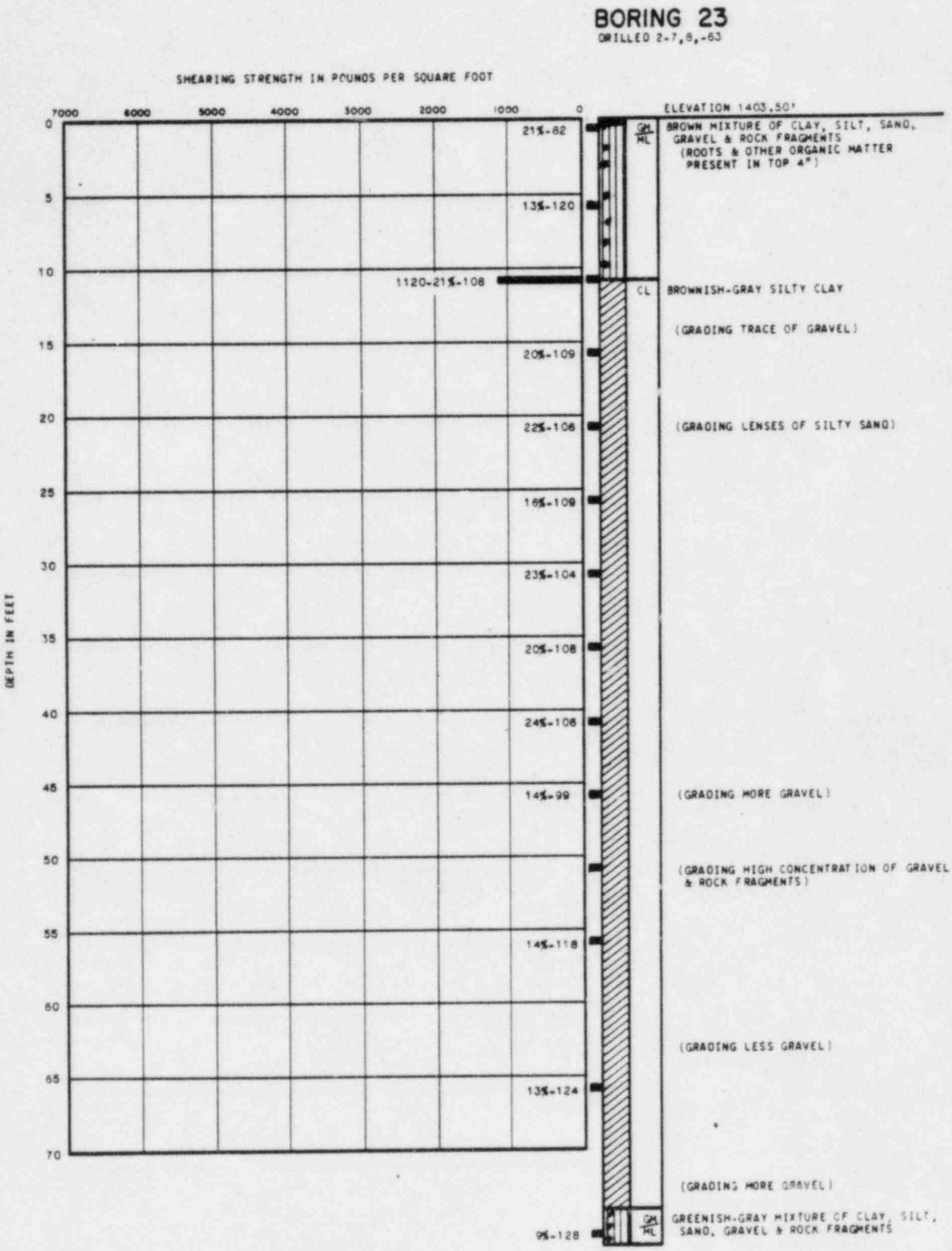
LOG OF BORINGS

FIGURE A.3.6-B-16 LOG OF BORING 21



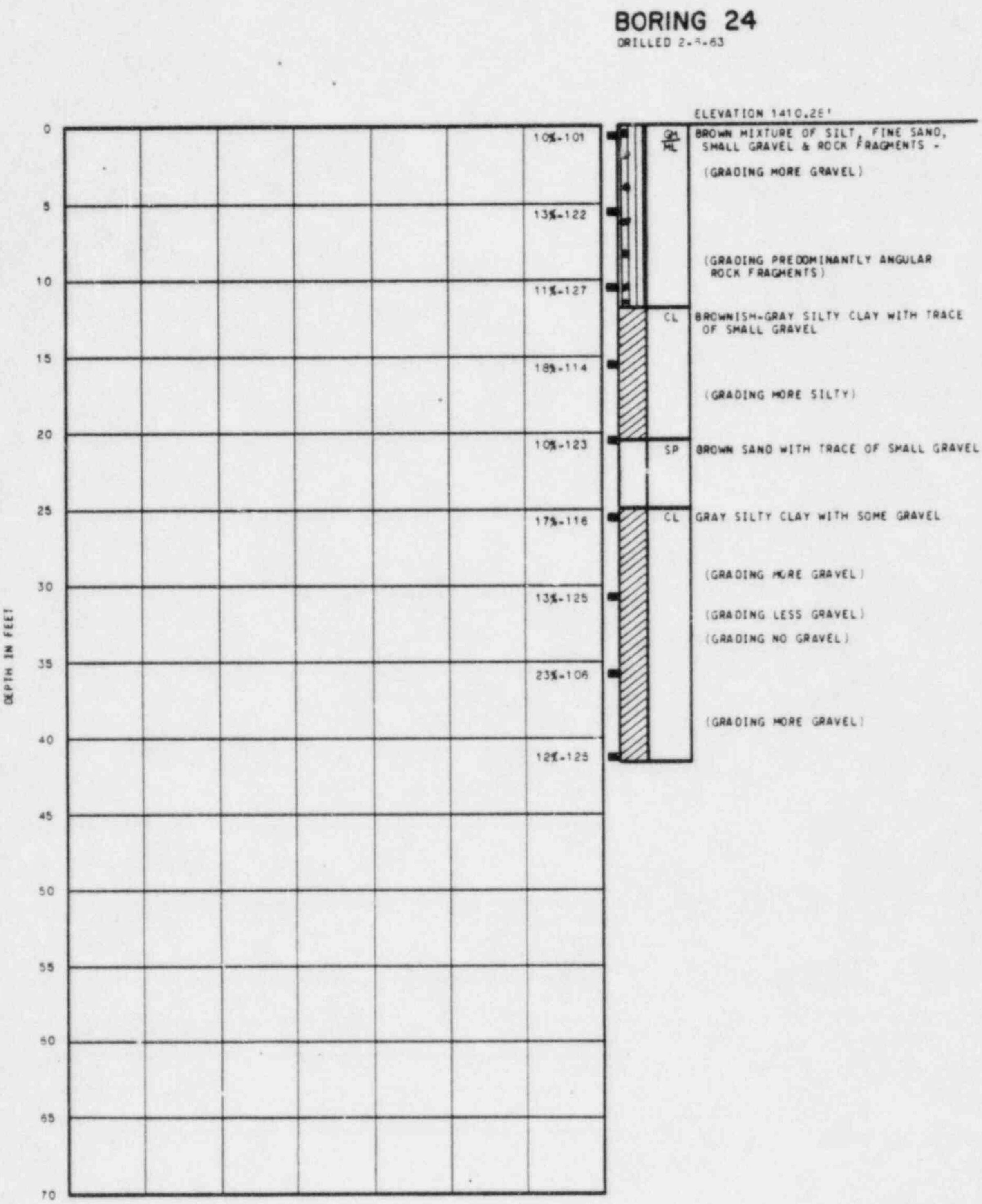
LOG OF BORINGS

FIGURE A.3.6-B-17 LOG OF BORING 22



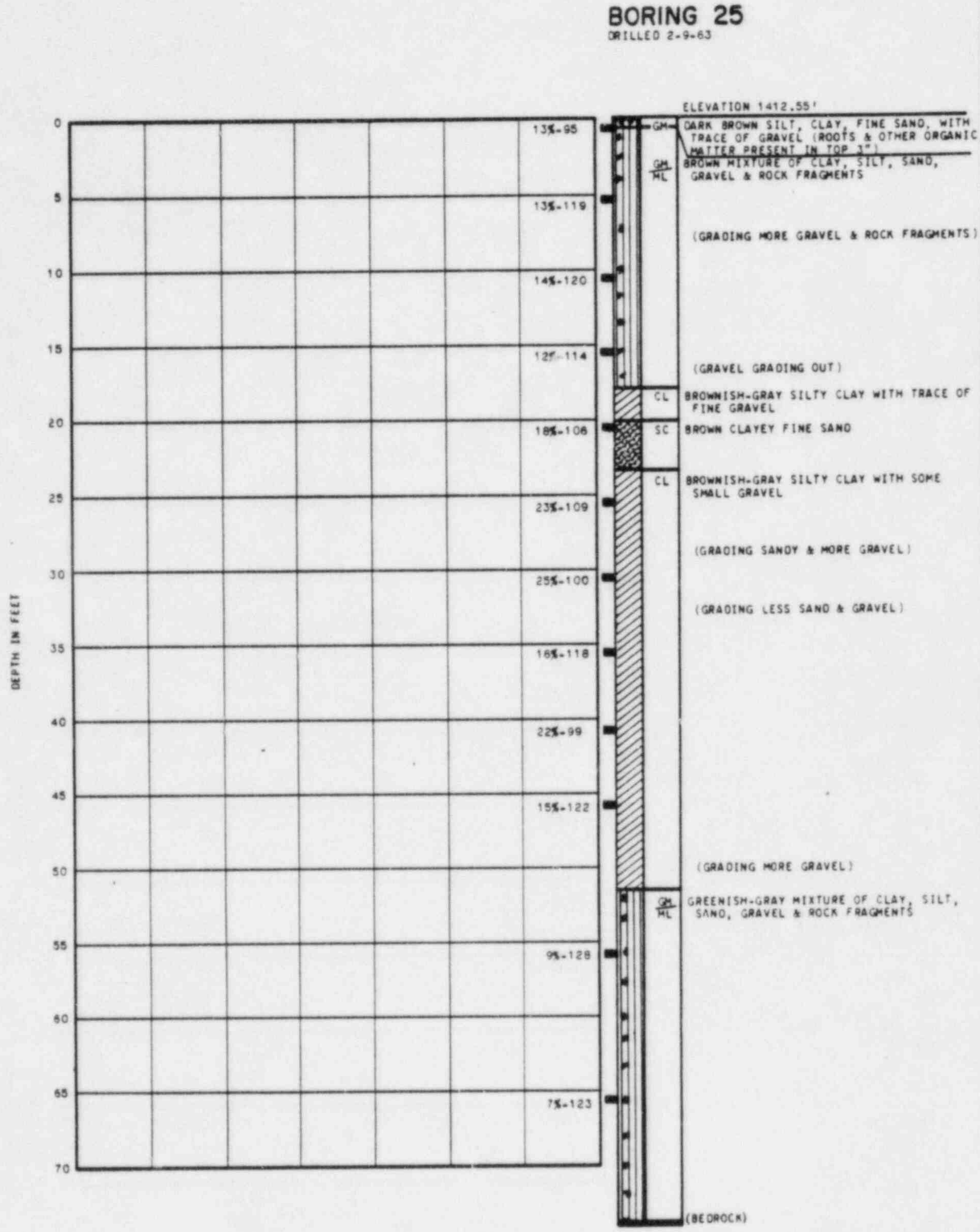
LOG OF BORINGS

FIGURE A.3.6-B-18 LOG OF BORING 23



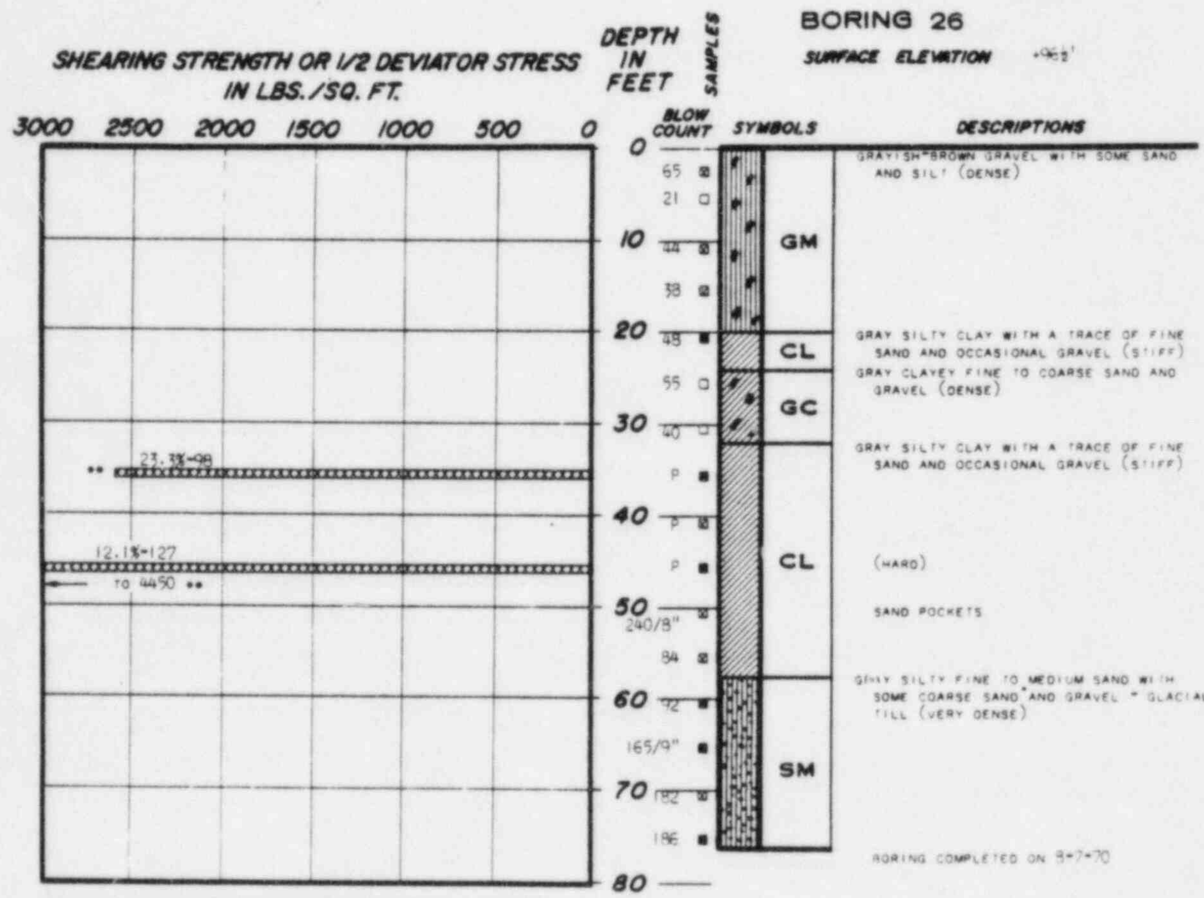
LOG OF BORINGS

FIGURE A.3.6-B-19 LOG OF BORING 24



LOG OF BORINGS

FIGURE A.3.6-B-20 LOG OF BORING 25



NOTES:

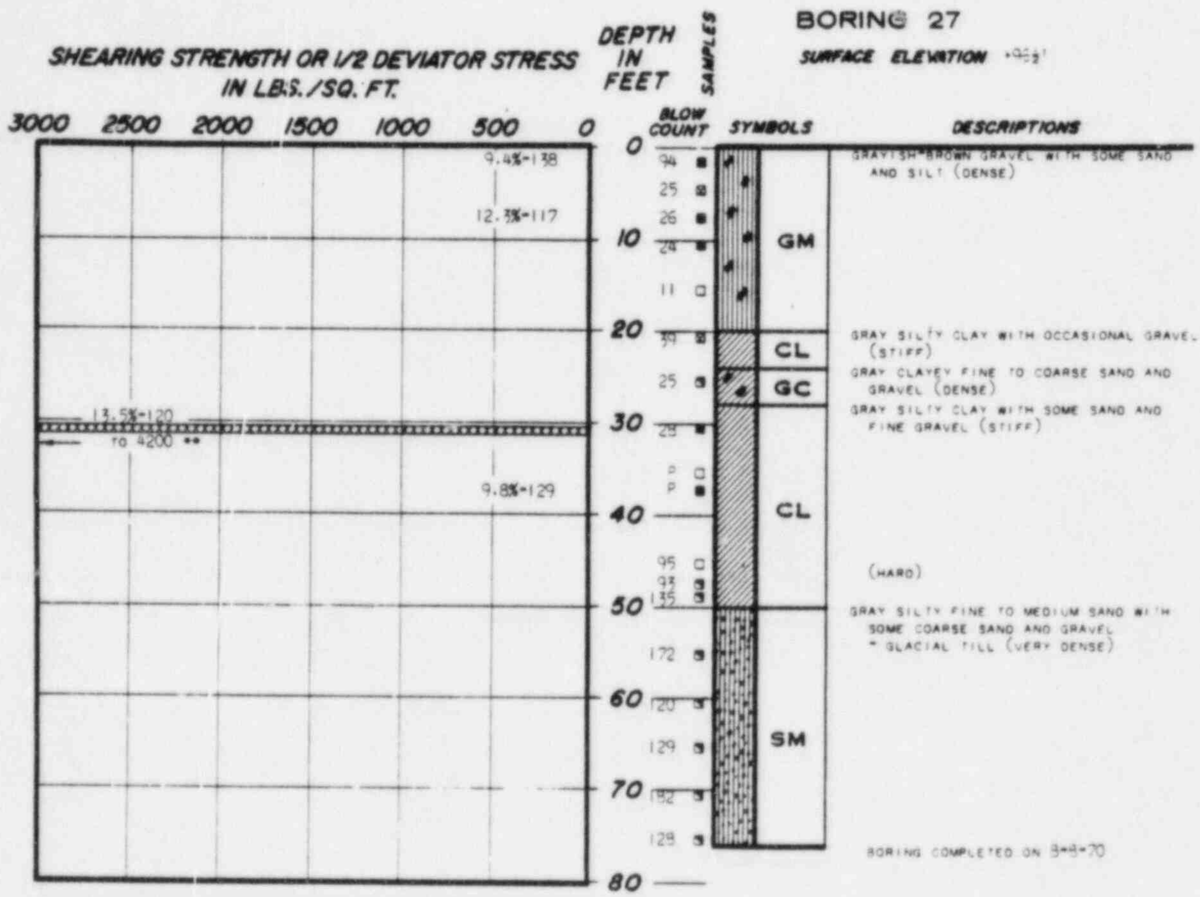
THE FIGURES IN THE COLUMN LABELED "BLOW COUNT" REFER TO THE NUMBER OF BLOWS REQUIRED TO DRIVE THE DAMES & MOORE SOIL SAMPLER, OR A STANDARD SPLIT-SPOON SAMPLER, A DISTANCE OF ONE FOOT USING A 300-POUND HAMMER FALLING 24 INCHES. THE DAMES & MOORE SAMPLER IS 3¼" O.D. AND APPROXIMATELY 2½" I.D. THE STANDARD SPLIT-SPOON SAMPLER IS 2" O.D. AND 1-⅜" I.D.

THE LETTER "P" IN THE "BLOW COUNT" COLUMN INDICATES THAT THE SAMPLER WAS ADVANCED BY MEANS OF HYDRAULIC PRESSURE, WITHOUT DRILLING.

ELEVATIONS REFER TO PLANT DATUM.

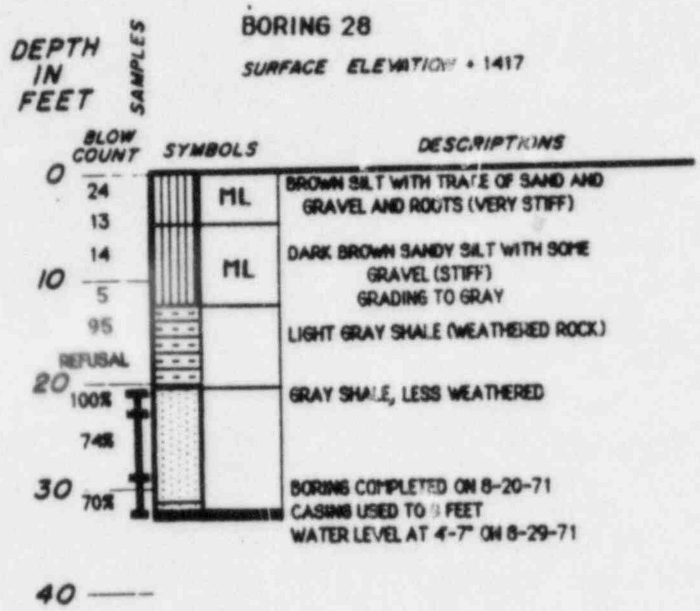
THE DISCUSSION IN THE TEXT OF THE REPORT IS NECESSARY FOR A PROPER UNDERSTANDING OF THE NATURE OF THE SUBSURFACE MATERIALS.

FIGURE A.3.6-B-21 LOG OF BORING 26



LOG OF BORING

FIGURE A.3.6-B-22 LOG OF BORING 27



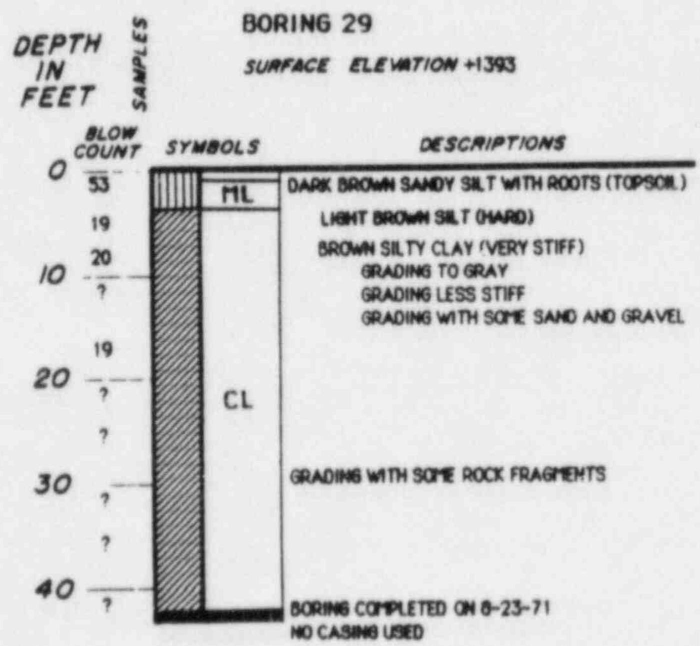


FIGURE A.3.6-B-23

LOG OF BORING 28 & 29

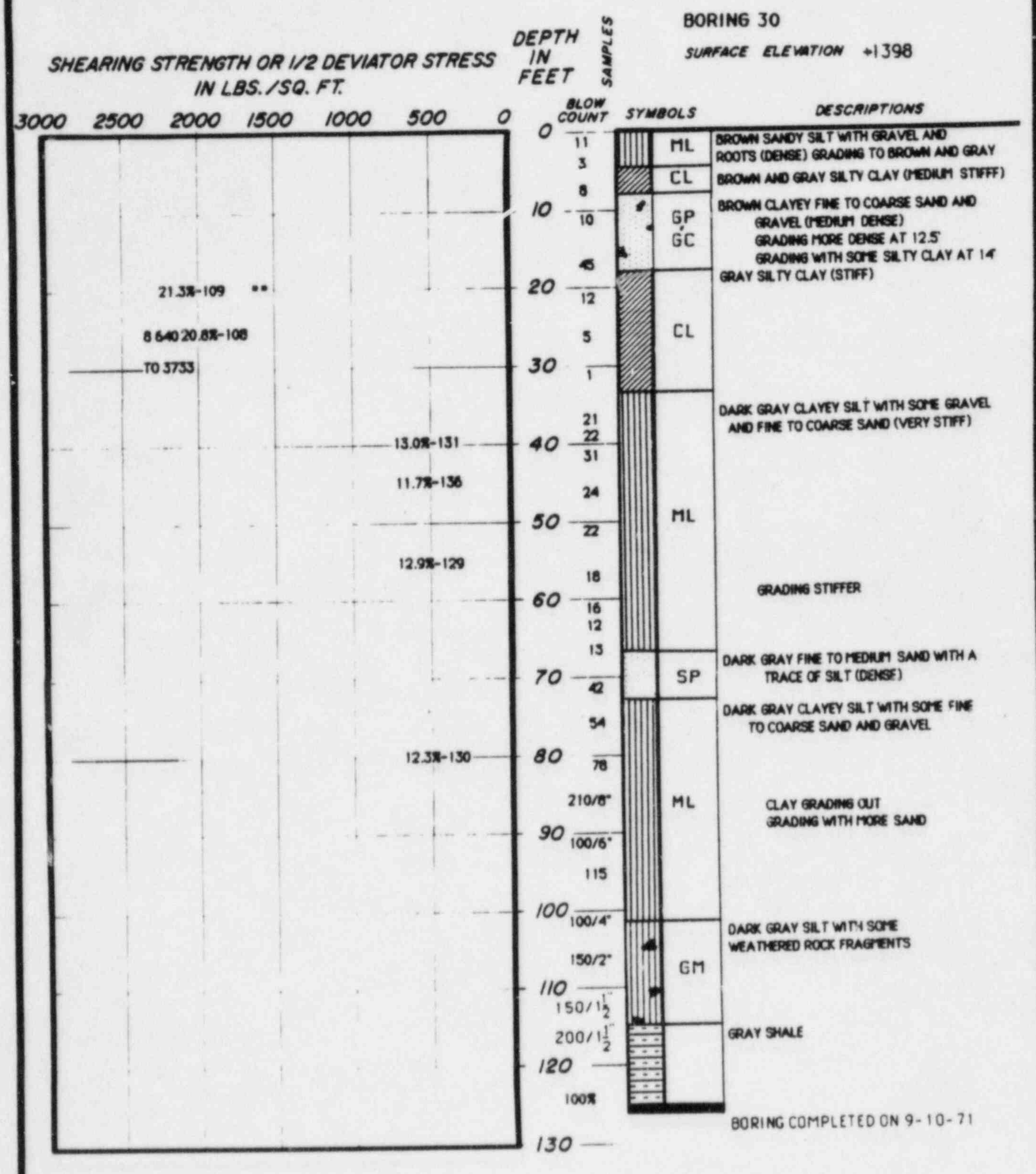


FIGURE A.3.6-B-24

LOG OF BORING 30

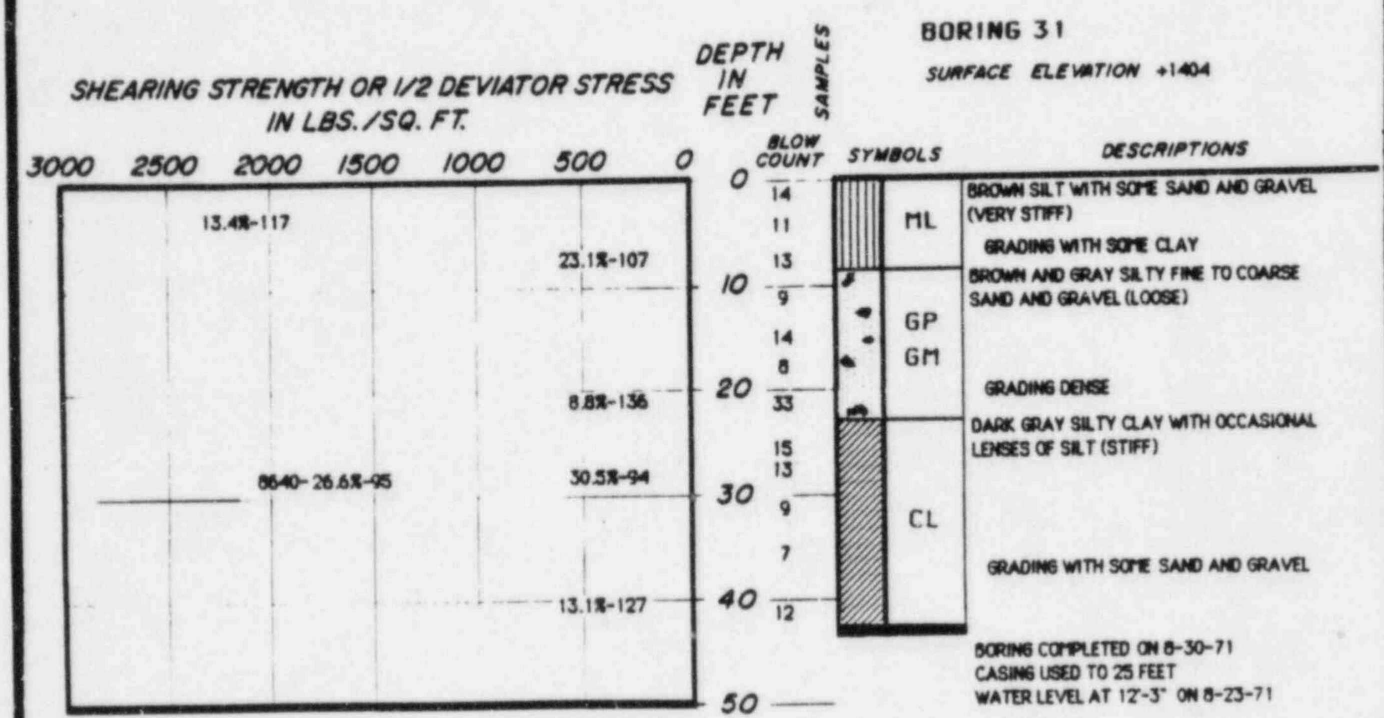


FIGURE A.3.6-B-25

LOG OF BORING 31

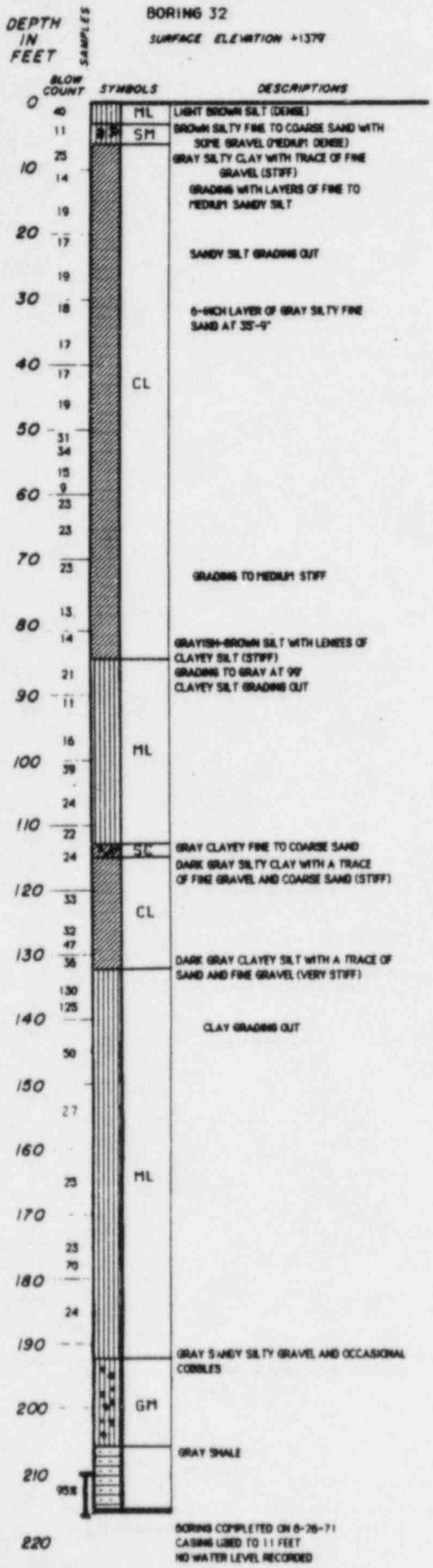


FIGURE A.3.6-B-26

LOG OF BORING 32

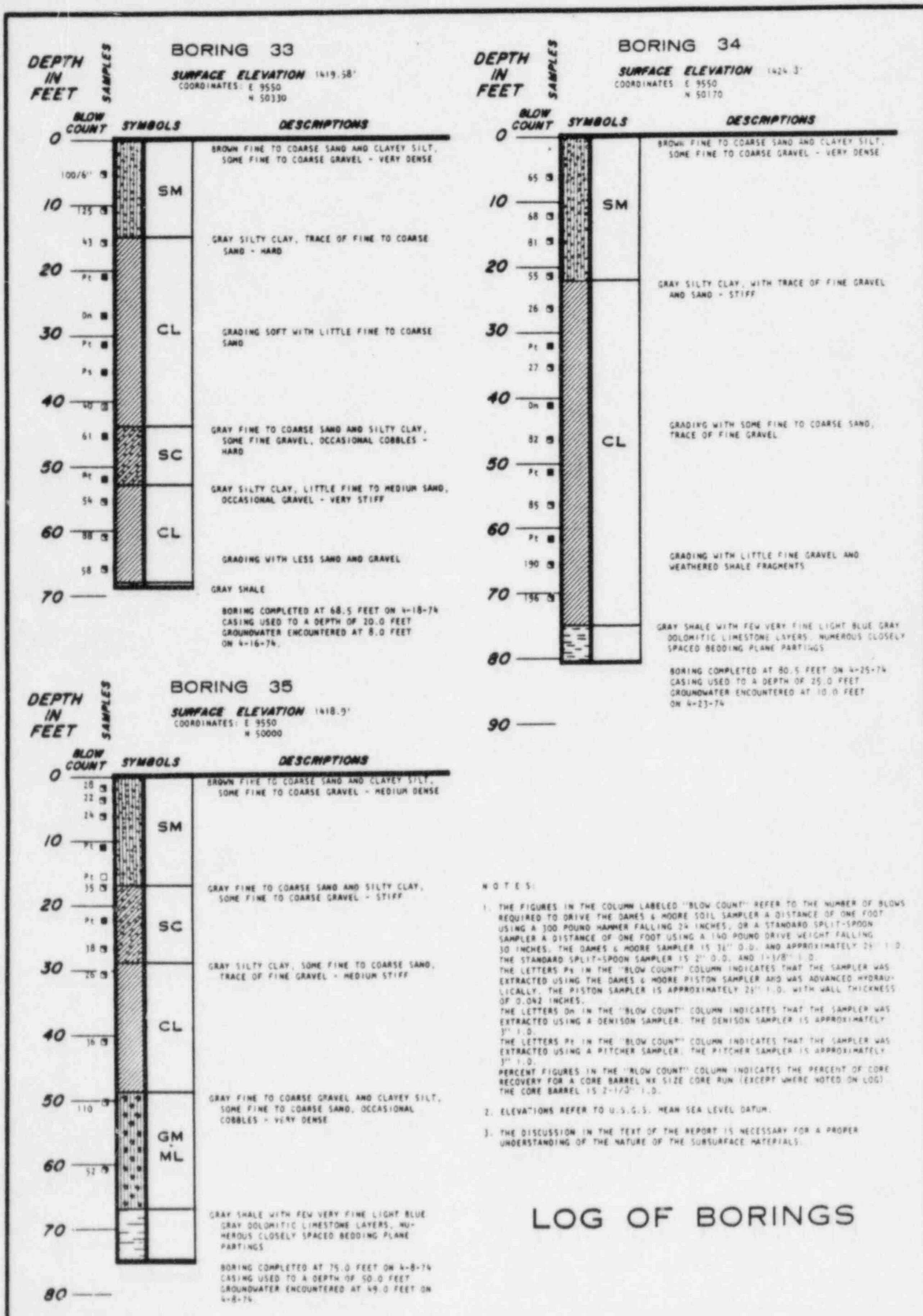


FIGURE A.3.6-B-27 LOG OF BORING 33, 34, & 35

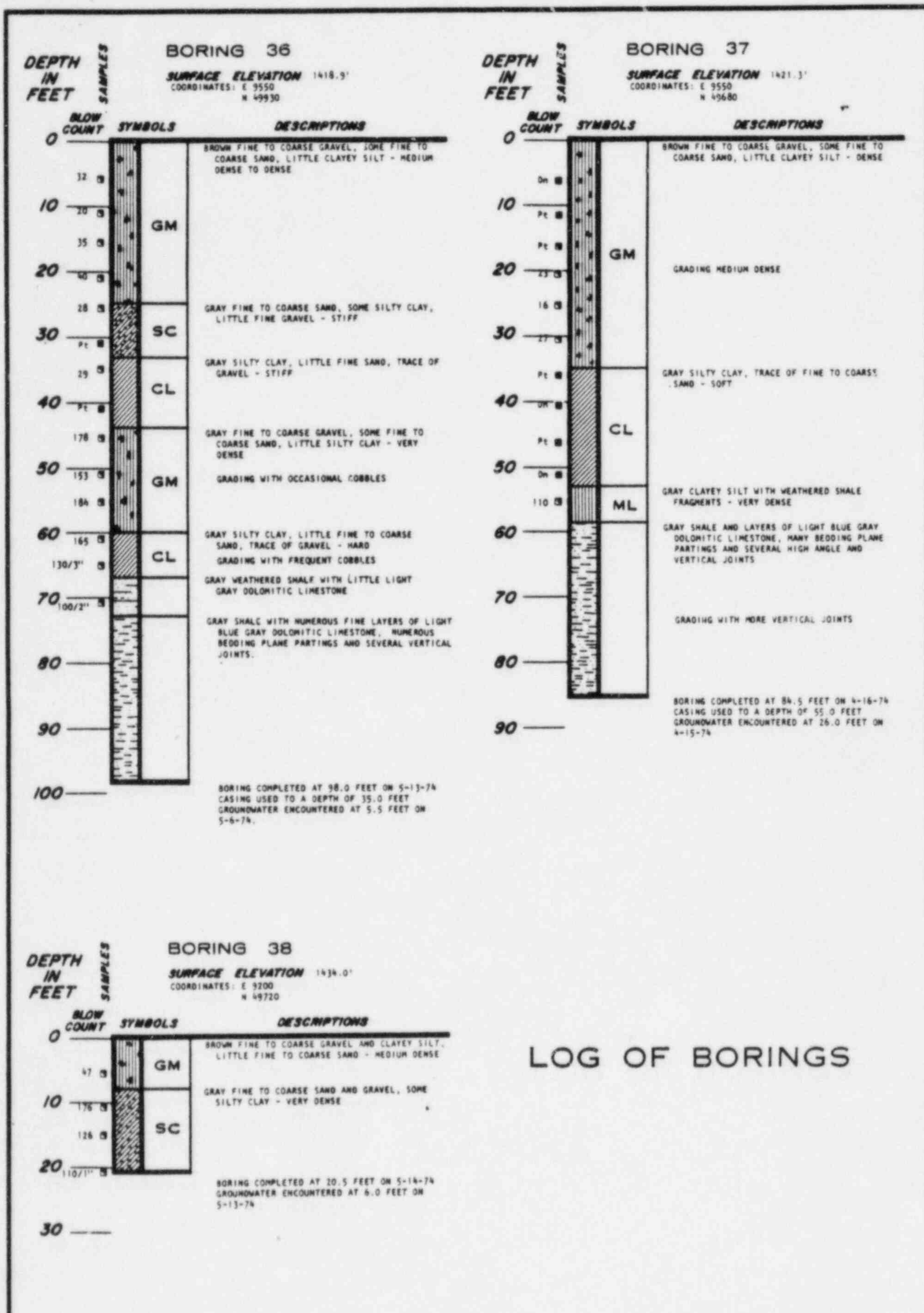
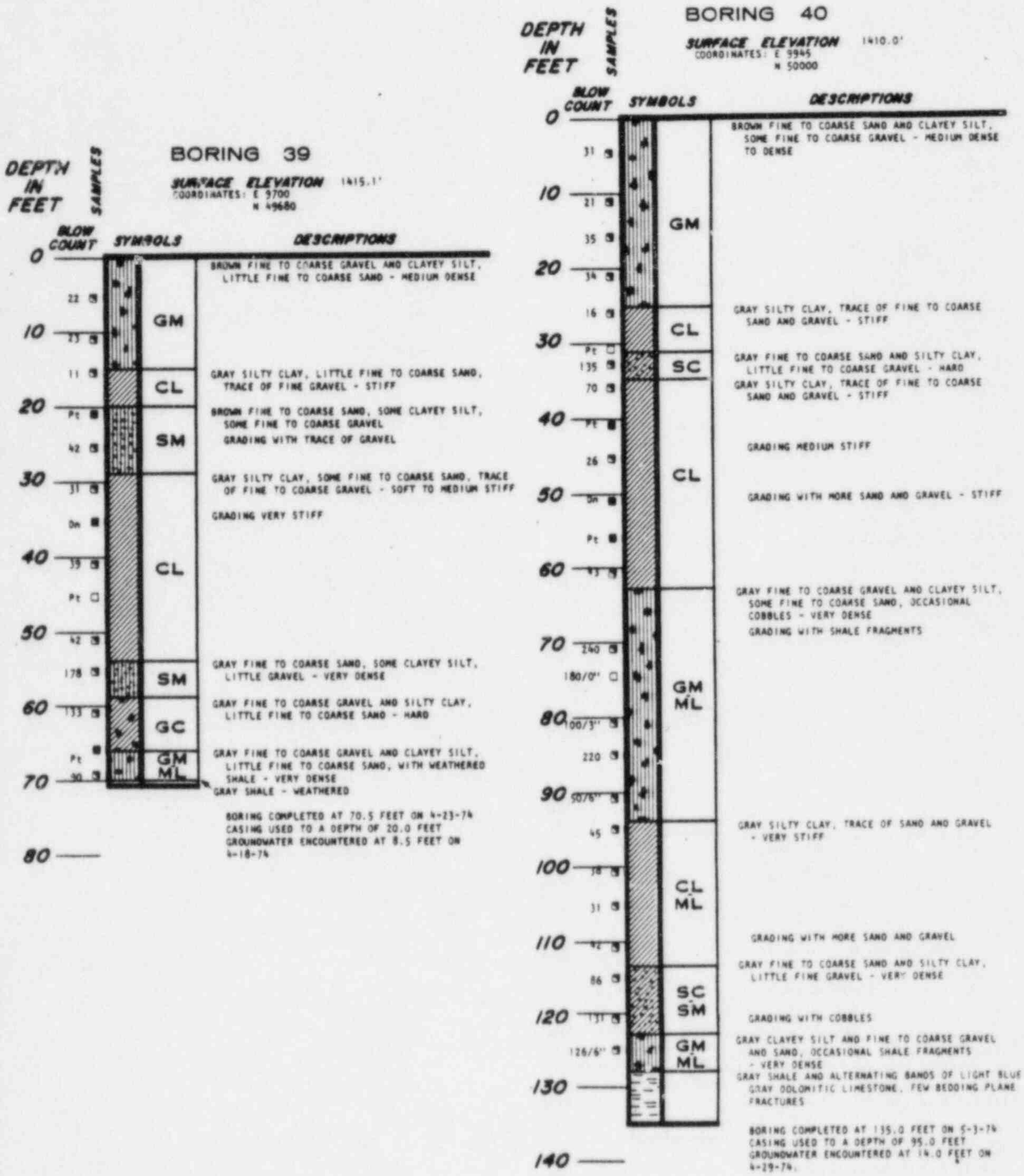
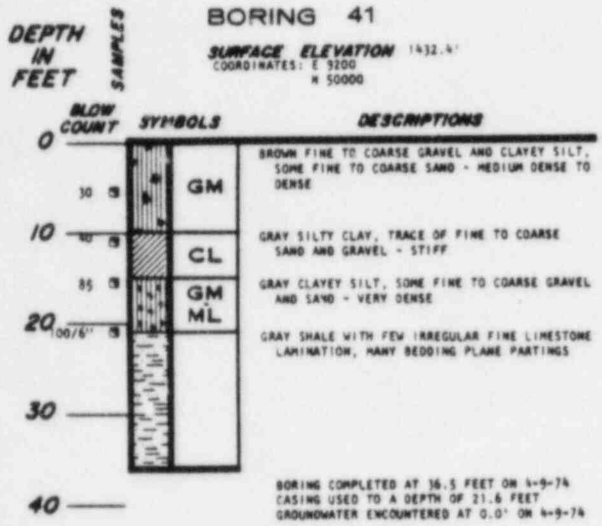


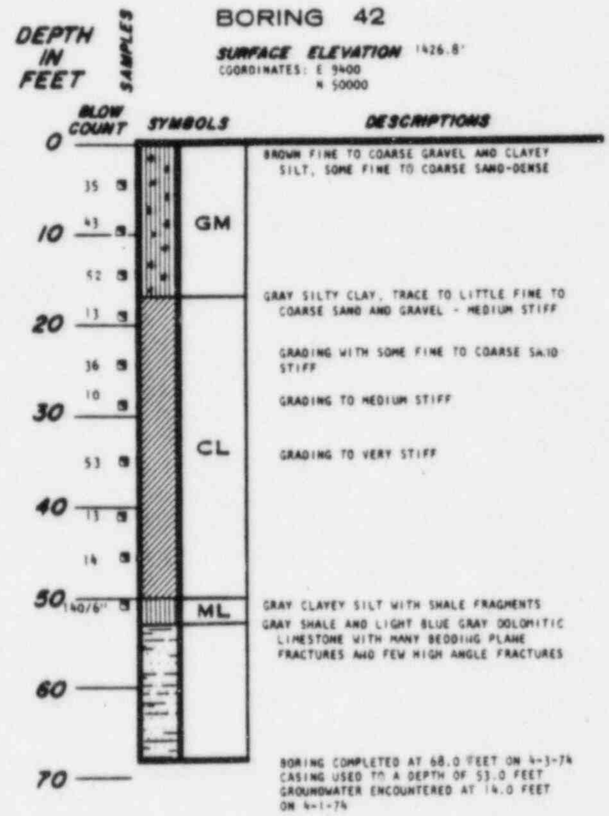
FIGURE A.3.6-B-28 LOG OF BORING 36, 37, & 38

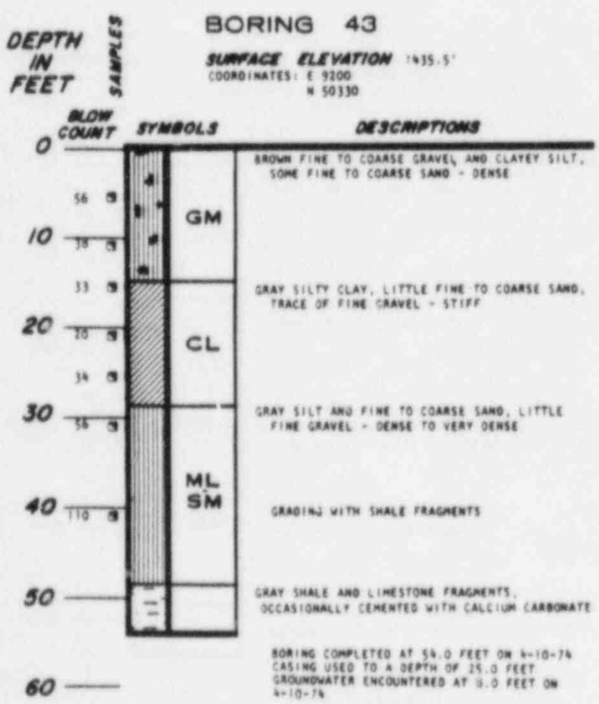


LOG OF BORINGS

FIGURE A.3.6-B-29 LOG OF BORING 39 & 40







LOG OF BORINGS

FIGURE A.3.6-B-30 LOG OF BORING 41, 42, & 43

NUCLEAR FUEL SERVICES, INC.

BORING NO. B-1

Coordinates: E 481,798.19
N 892,181.75

Location: West Valley, N.Y.

Completion: 10-27-74

Surface Elevation: 1341.40'

Drilling Method: Rotary Rig, Mud-Supported Holes

Sampling Method: Split Spoon Sampler
Driven with 140 lb. hammer falling 30"

Water Level		3.0'	2.5'	2.0'
Time		8:30	9:00	13:05
Date	1974	10/27	10/28	11/1
Casing Depth				

SAMPLE				UNIFIED SOIL CLASSIFICATION		Lab Test
Depth Feet	No.	SYM	Blows Feet	SYM	Description	
0						
	1		24	GC	Brownish gray, fine to coarse gravel, some silty clay, occasional cobbles (dense)	
5	2		17	CL	Gray silty clay, occasional fine to coarse gravel (stiff to very stiff)	
10	3					
15						
20	4					
25	5					
30	6		45			
35						
40						

FIGURE A.3.6-B-31 1 OF 4 LOG OF BORING B-1

Location
Completion Date

Surface Elevation
Drilling Method
Sampling Method

BORING NO. B-1
(Continued)

SAMPLE				UNIFIED SOIL CLASSIFICATION		Lab Test
Depth Feet	No	SYM	Blows Feet	SYM	Description	
40	7	■				
50	8	■				
60	9	■				
65				ML	Gray clayey silt, trace fine sand (stiff to very stiff)	
70	10	■				
75						
80						

FIGURE A.3.6-B-31 2 OF 4 LOG OF BORING B-1

Location
Completion Date

Surface Elevation
Drilling Method
Sampling Method

BORING NO. B-1
(Continued)

SAMPLE				UNIFIED SOIL CLASSIFICATION		Lab Test
Depth Feet	No.	SY	Blows Feet	SYM	Description	
80	11		98			
85					Drilling indicates gravel from 86 ft to 88 ft.	
90	12					
	13		86	CL	Dark gray silty clay (very stiff)	
95						
100	14			ML	Gray clayey silt (stiff)	
	15			CL	Gray silty clay, fine gravel (very stiff)	
105						
110	16		113	GC	Gray fine to coarse gravel, some fine to coarse sand, little clay (very dense)	
				CL	Gray silty clay (very stiff)	
115						
120						

FIGURE A.3.6-B-31 3 OF 4 LOG OF BORING B-1

Location
Completion Date

Surface Elevation
Drilling Method
Sampling Method

BORING NO. B-1
(Continued)

SAMPLE				UNIFIED SOIL CLASSIFICATION		Lab Test
Depth Feet	No.	SYM	Blows Feet	SYM	Description	
120	17		122			
130	18		74			
135				ML	Dark gray clayey silt (very stiff)	
140	19		100			
150	20		91	CL	Dark gray silty clay (very stiff)	
					Boring terminated at 151'6" on 10/27/74	

Depth scale: 120, 125, 130, 135, 140, 145, 150, 155, 160

FIGURE A.3.6-B-31 4 OF 4 LOG OF BORING B-1

NUCLEAR FUEL SERVICES, INC.

BORING NO. B-2

Coordinates: E 481,756.12
N 892,107.36

Location: West Valley, N.Y.

Completion Date: 10-28-74

Surface Elevation: 1336.14'

Drilling Method: Rotary Rig, Mud-Supported Holes

Sampling Method: Split Spoon Sampler
Driven with 140 lb. hammer falling 30"

Water Level	0.5	0.75	
Time	9:00	12:45	
Date 1974	10/28	11/1	
Casing Depth			

SAMPLE Depth Feet	No.	S/YM	Blows Feet	UNIFIED SOIL CLASSIFICATION SYM	Description	Lab Test
	1			CL	Brownish gray silty clay, frequent roots (medium stiff)	
			17	CL	Gray silty clay, trace fine gravel, occasional lenses of fine sand (medium stiff)	
5	2			SM	Dark gray fine to medium sand, occasional fine gravel (medium dense)	
10	3			CL	Gray silty clay, trace fine to coarse gravel, occasional cobbles (stiff to very stiff)	
15	4		23			
20	5					
25	6		29			
30	7					
35	8		48			
40						

FIGURE A.3.6-B-32 1 OF 3 LOG OF BORING B-2

Location
Completion Date

Surface Elevation
Drilling Method
Sampling Method

BORING NO. B-2
(Continued)

Depth Feet	No.	SYM	Blows Feet	SYM	Description	Lab Test
40	9					
45						
50	10		40			
55						
				SM	Brownish gray fine sand, little silt (dense)	
60	11					
65						
70	12 13			SP	Brownish gray fine to medium sand, trace silt, (very dense)	
				GW	Brownish gray fine gravel, some fine to medium sand (dense)	
75				ML	Gray clayey silt (stiff)	
80						

FIGURE A.3.6-B-32 2 OF 3 LOG OF BORING B-2

Location
Completion Date

Surface Elevation
Drilling Method
Sampling Method

BORING NO. B-2
(Continued)

SAMPLE				UNIFIED SOIL CLASSIFICATION		Lab Test
Depth Feet	No.	SYM	Blows Feet	SYM	Description	
80	14					
90	15		110	GC	Gray fine to coarse gravel, little clay, trace silt, occasional fine to coarse sand (very dense)	
95				CL	Gray silty clay, occasional fine to coarse gravel (very stiff)	
100	16		99			
					Boring terminated at 101'6" on 10/28/74	
105						
110						
115						
120						

FIGURE A.3.6-B-32 3 OF 3 LOG OF BORING B-2

NUCLEAR FUEL SERVICES, INC.

BORING NO. B- 3

Coordinates: E 481,831.64
N 892,329.30

Surface Elevation: 1328.08'

Drilling Method: Rotary Rig, Mud-Supported Holes

Sampling Method: Split Spoon Sampler
Driven with 140 lb. hammer falling 30"

Location: West Valley, N.Y.

Completion Date: 10-29-74

Water Level	1.0'		
Time	13:10		
Date 1974	11/1		
Casing Depth			

SAMPLE				UNIFIED SOIL CLASSIFICATION		Lab Test
Depth Feet	No.	SYM	Blows Feet	SYM	Description	
3	1	■		CL	Gray silty clay, trace fine gravel, occasional fibrous material	
6				GP	Drilling indicates gravel layer, 3" cobbles in wash	
10	2	◣	25	CL	Gray silty clay, trace embedded fine to medium gravel (medium stiff to stiff)	
18	3	⊠				
23	4	■				
28	5	◣	47			
33	6	■				
38	7	◣	43			

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40

FIGURE A.3.6-B-33 1 OF 3 LOG OF BORING B-3

Location
Completion Date

Surface Elevation
Drilling Method
Sampling Method

BORING NO. B- 3
(Continued)

Depth Feet	SAMPLE No.	SAMPLE SYM	SAMPLE Blows Feet	UNIFIED SOIL CLASSIFICATION SYM.	UNIFIED SOIL CLASSIFICATION Description	Lab Test
45						
	8					
50						
55						
	9		92			
60						
65					grading less stiff	
	10					
70						
75				SM/ML	Brownish gray fine sand, some silt (very dense)	
	11		86			
80						

FIGURE A.3.6-B-33 2 OF 3 LOG OF BORING B-3

Location
Completion Date

Surface Elevation
Drilling Method
Sampling Method

BORING NO. B- 3
(Continued)

SAMPLE Depth Feet	No	SYM	Blows Feet	UNIFIED SOIL CLASSIFICATION SYM	Description	Lab Test
85						
	12	■				
90						
95				GM	Gray fine to coarse angular gravel, little silt, trace clay, trace fine to coarse sand (very dense)	
	13	■	20 for 2"			
100					Boring terminated at 100'6" on 10/29/74	
105						

FIGURE A.3.6-B-33 3 OF 3 LOG OF BORING B-3

NUCLEAR FUEL SERVICES, INC.

BORING NO. B-4

Location: West Valley, N.Y.
Completion Date: 10-30-74

Coordinates: E 481,730.84
N 892,247.56

Surface Elevation: 1362.2'
Drilling Method: Rotary Rig, Mud-Supported Holes
Sampling Method: Split Spoon Sampler
Driven with 140 lb. hammer falling 30"

Water Level	30.0'		
Time	12.30		
Date 1974	11/1		
Casing Depth			

SAMPLE				UNIFIED SOIL CLASSIFICATION		Lab Test
Depth Feet	No.	SYM	Blows Feet	SYM	Description	
				GC	Brownish gray fine to coarse gravel, some clay, occasional fine to coarse sand (very dense)	
	1		18	CL	Gray silty clay, trace fine to medium gravel (stiff to very stiff)	
5	2					
10	3		22			
15	4					
20						
25	5					
30	6		44			
35	7		48	GC	Gray fine to coarse gravel, some silty clay, and fine occasional with pockets of fine to medium sand (very dense)	
				CL	Gray silty clay, trace fine to medium gravel (very stiff)	
40						

FIGURE A.3.6-B-34 1 OF 3 LOG OF BORING B-4

Surface Elevation
Drilling Method
Sampling Method

BORING NO. B- 4
(Continued)

Location
Completion Date

Depth Feet	No.	SYM	Blows Feet	SYM	Description	Lab Test
	8					
				SM	Gray fine sand, little silt (medium dense)	
				CL	Gray silty clay, trace fine to medium gravel (very dense)	
45						
50	9		52			
55						
60						
65						
				SC	Gray fine to medium sand, some clay, occasional fine gravel (dense)	
70	10		64			
				CL ML	Gray silty clay, trace fine gravel, occasional lenses of fine sand (very stiff)	
75						
80						

FIGURE A.3.6-B-34 2 OF 3 LOG OF BORING B-4

Location
Completion Date

Surface Elevation
Drilling Method
Sampling Method

BORING NO. B- 4
(Continued)

SAMPLE				UNIFIED SOIL CLASSIFICATION		Lab Test
Depth Feet	No.	SYM	Blows Feet	SYM	Description	
	11					
85						
90	12		56			
95						
100	13		61		Brownish gray fine sand, some silt (very dense)	
					Boring terminated at 101'6" on 10/30/74	
105						
110						
115						
120						

FIGURE A.3.6-B-34 3 OF 3 LOG OF BORING B-4

NUCLEAR FUEL SERVICES, INC. **BORING NO. B-5**

Location: West Valley, N.Y.
Completion Date: 10-31-74

Coordinates: E 481,911.28
N 892,309.54

Surface Elevation: 1359.9'
Drilling Method: Rotary Rig, Mud-Supported Holes
Sampling Method: Split Spoon Sampler
Driven with 140 lb. hammer falling 30"

Water Level	26'		
Time	12:30		
Date 1974	11/1		
Casing Depth			

SAMPLE				UNIFIED SOIL CLASSIFICATION		Lab Test
Depth Feet	No.	SYM	Blows Feet	SYM	Description	
	1		26	CL	Gray silty clay, trace fine to coarse gravel, occasional cobbles (stiff to very stiff)	
5	2					
10	3		34			
15	4					
20	5		29			
25	6					
30	7		31			
35	8					
40						

FIGURE A.3.6-B-35 1 OF 3 LOG OF BORING B-5

Location
Completion Date

Surface Elevation
Drilling Method
Sampling Method

BORING NO. B- 5
(Continued)

SAMPLE				UNIFIED SOIL CLASSIFICATION		Lab Test
Depth Feet	No.	SYM	Blows Feet	SYM	Description	
	9	■	52			
45						
50	10	■				
55						
60	11	■	52			
65						
70	12	■				
75						
80						

FIGURE A.3.6-B-35 2 OF 3 LOG OF BORING B-5

Location
Completion Date

Surface Elevation
Drilling Method
Sampling Method

BORING NO. B- 5
(Continued)

SAMPLE				UNIFIED SOIL CLASSIFICATION		Lab Test
Depth Feet	No.	SYM	Blows Feet	SYM	Description	
	13		52			
85					grading less stiff	
90						
95						
				SM	Brownish gray fine sand, some silt (very dense) trace gravel	
100	14		76			
					Boring terminated at 102'0" on 10/31/74	
105						
110						
115						
120						

FIGURE A.3.6-B-35 3 OF 3 LOG OF BORING B-5

NUCLEAR FUEL SERVICES, INC

BORING NO. B-6

Location: West Valley, N.Y.
Completion Date: 11-5-74

Coordinates: E 485,101.20
N 889,898.66

Surface Elevation: 1286.8'
Drilling Method: Rotary Rig, Mud-Supported Holes
Sampling Method: Split Spoon Sampler, Driven with 140 lb. hammer falling 30"

Water Level			
Time			
Date			
Casing Depth			

Depth Feet	No.	SYM	Blows Feet	SYM.	Description	Lab Test
	1			CL ML	Brownish gray silty clay, trace fine sand, occasional gravel	
	2					
	3		Push	CL	Gray silty clay, trace fine gravel	
5	4				Sand lenses	
					grading stiff to very stiff	
10	5					
15	6		35			
20	7					
25	8		63			
30	9					
35	10		48			
40						

FIGURE A.3.6-B-36 1 OF 3 LOG OF BORING B-6

Surface Elevation
Drilling Method
Sampling Method

BORING NO. B- 6
(Continued)

Location
Completion Date

SAMPLE				UNIFIED SOIL CLASSIFICATION		Lab Test
Depth Feet	No	SYM	Blows Feet	SYM	Description	
	11					
45	12					
50	13		56		grading with occasional lenses of fine sand	
55						
				ML	Gray clayey silt, trace fine sand	
60	14					
65						
70	15		49			
75						
					Drilling indicates gravel pocket at 79 feet	
80						

FIGURE A.3.6-B-36 2 OF 3 LOG OF BORING B-6

Location
Completion Date

Surface Elevation
Drilling Method
Sampling Method

BORING NO. B- 6
(Continued)

SAMPLE				UNIFIED SOIL CLASSIFICATION		Lab Test
Depth Feet	No.	SYM	Blows Feet	SYM	Description	
	16	▬				
85				CL	Gray silty clay, trace fine gravel (very stiff)	
90	17	◣	51			
95						
100	18	◣	104			
					Boring terminated at 101'6" on 11/5/74	
105						
110						
115						
120						

FIGURE A.3.6-B-36 3 OF 3 LOG OF BORING B-6

NUCLEAR FUEL SERVICES, INC.

BORING NO. B-7

Location: West Valley, N.Y.
Completion Date: 11-1-74

Coordinates: E 481,067.55
N 891,573.49

Surface Elevation: 1382.78'
Drilling Method: Rotary Rig, Mud-Supported Holes
Sampling Method: Split Spoon Sampler Driven with 140 lb. hammer falling 30"

Water Level	17.0'		
Time	14:06		
Date 1974	11-1		
Casing Depth			

Depth Feet	No.	SYM	Blows Feet	SYM.	Description (Unified Soil Classification)	Lab Test
	1			GM	Brownish brown fine to coarse gravel, little silt frequent fine to medium sand (very dense)	
	2		89	CL/ML	Brown clayey silt, little fine to coarse gravel trace sand (very stiff)	
	3		56	CL	Gray silty clay, trace fine to medium gravel (very stiff)	
1	4					
1	5		33			
2	6					
					grading with frequent gravel	
2	7					
3	8		34			
3	9		47			
4						

FIGURE A.3.6-B-37 1 OF 2 LOG OF BORING B-7

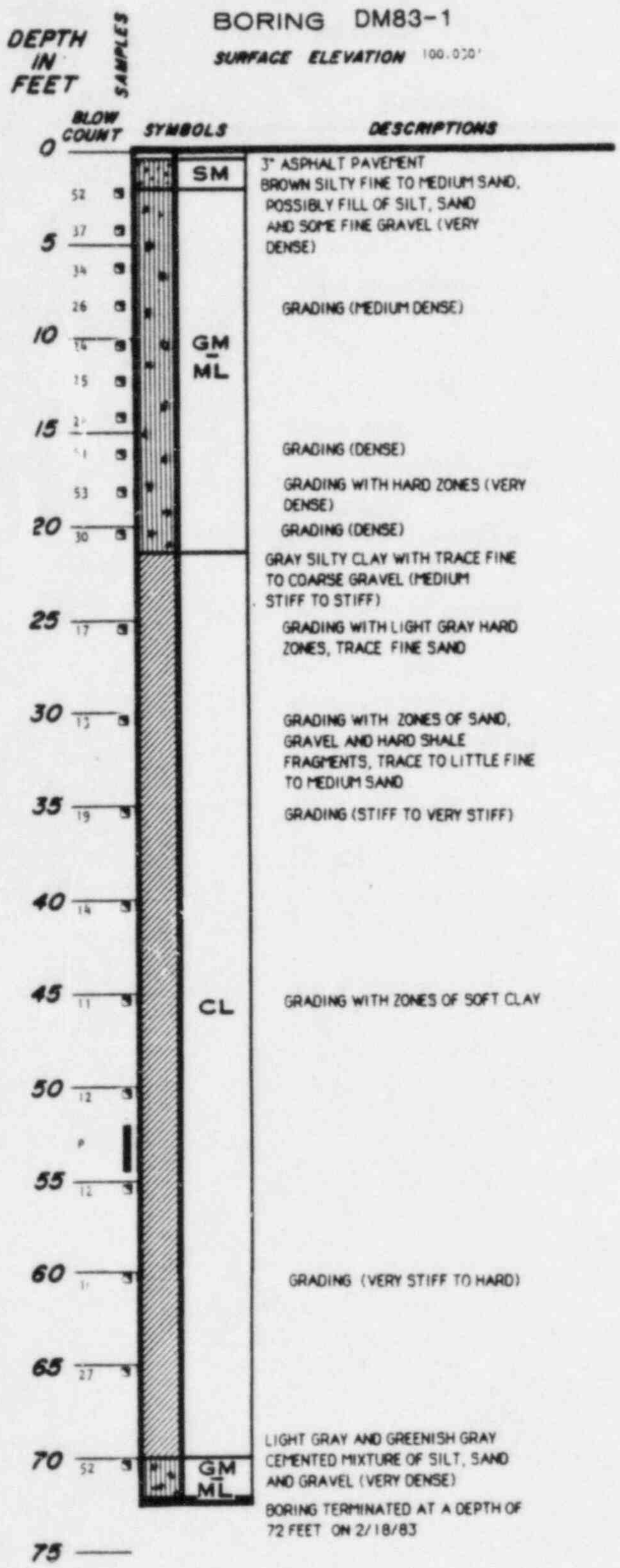
Surface Elevation
Drilling Method
Sampling Method

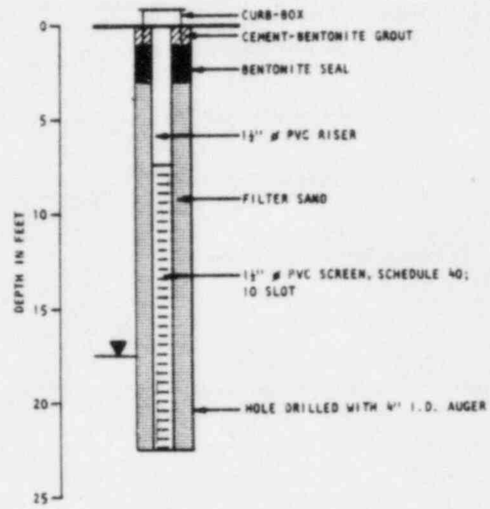
BORING NO. B- 7
(Continued)

L[illegible]ation
[illegible]mpletion Date

SAMPLE Depth Feet	No.	SYM	Blows Feet	UNIFIED SOIL CLASSIFICATION SYM	Description	Lab Test
	10	■				
4	11	■				
5	12	■			grading with occasional cobbles	
5						
					grading with less gravel	
6						
6						
					Drilling indicates gravel pocket at 67 feet	
7				ML	Gray clayey silt, trace fine sand	
					Boring terminated at 72' on 11/1/74	
7						
8						

FIGURE A.3.6-B-37 2 OF 2 LOG OF BORING B-7





NOTES:

1. THE FIGURES IN THE COLUMN LABELED "BLOW COUNT" REFER TO THE NUMBER OF BLOWS REQUIRED TO DRIVE A STANDARD SPLIT-SPOON SAMPLER A DISTANCE OF ONE FOOT USING A 140 POUND DRIVE WEIGHT FALLING 30 INCHES. THE STANDARD SPLIT-SPOON SAMPLER IS 2" O.D. AND 1-3/8" I.D.

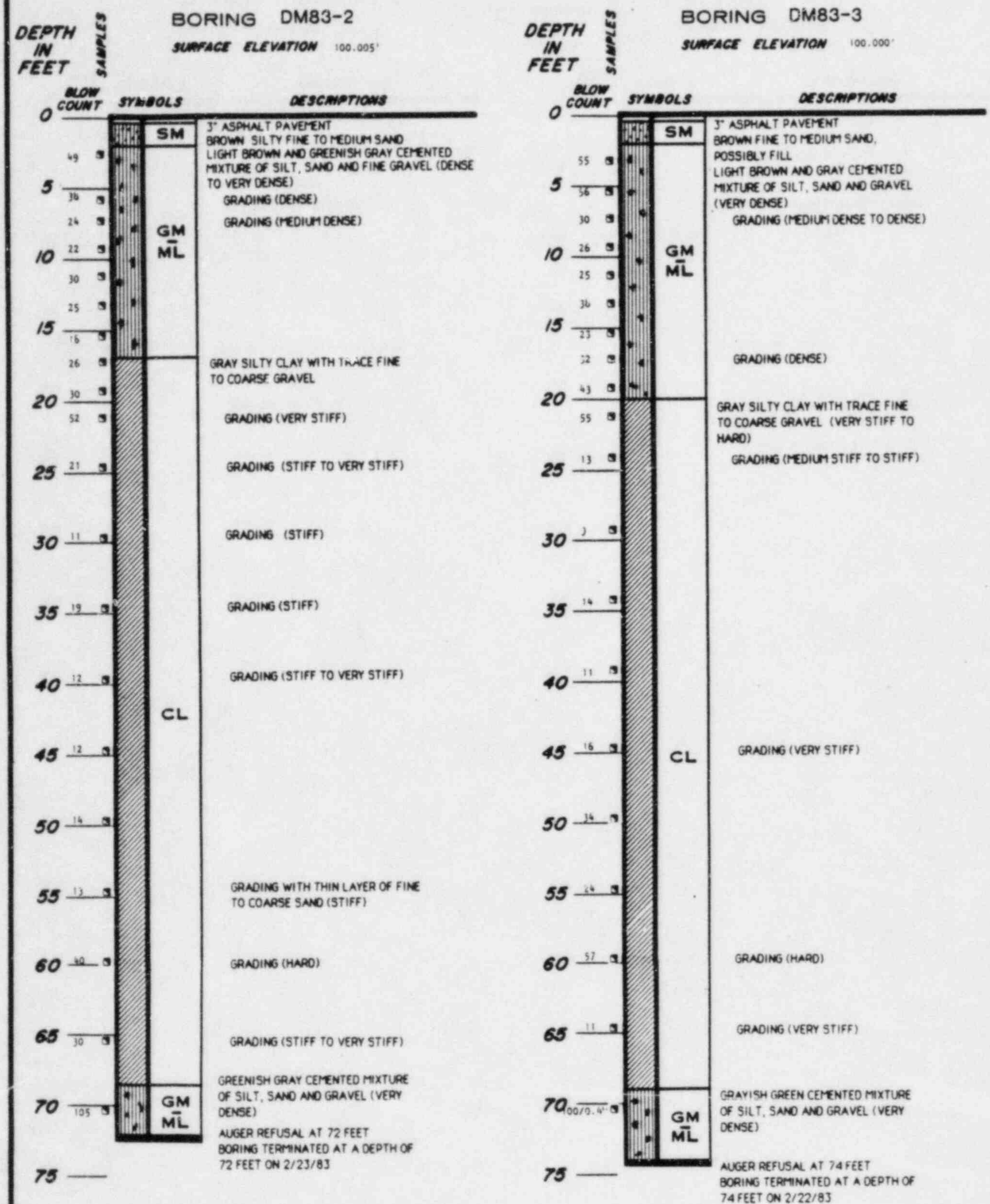
   THE LETTER "P" IN THE "BLOW COUNT" COLUMN INDICATES THAT THE SAMPLER WAS ADVANCED BY THE WEIGHT OF THE DRILL ROD AND DRIVE WEIGHT WITHOUT DRIVING.

2. ELEVATIONS REFER TO SITE DATUM.

3. THE DISCUSSION IN THE TEXT OF THE REPORT IS NECESSARY FOR A PROPER UNDERSTANDING OF THE NATURE OF THE SUBSURFACE MATERIALS.

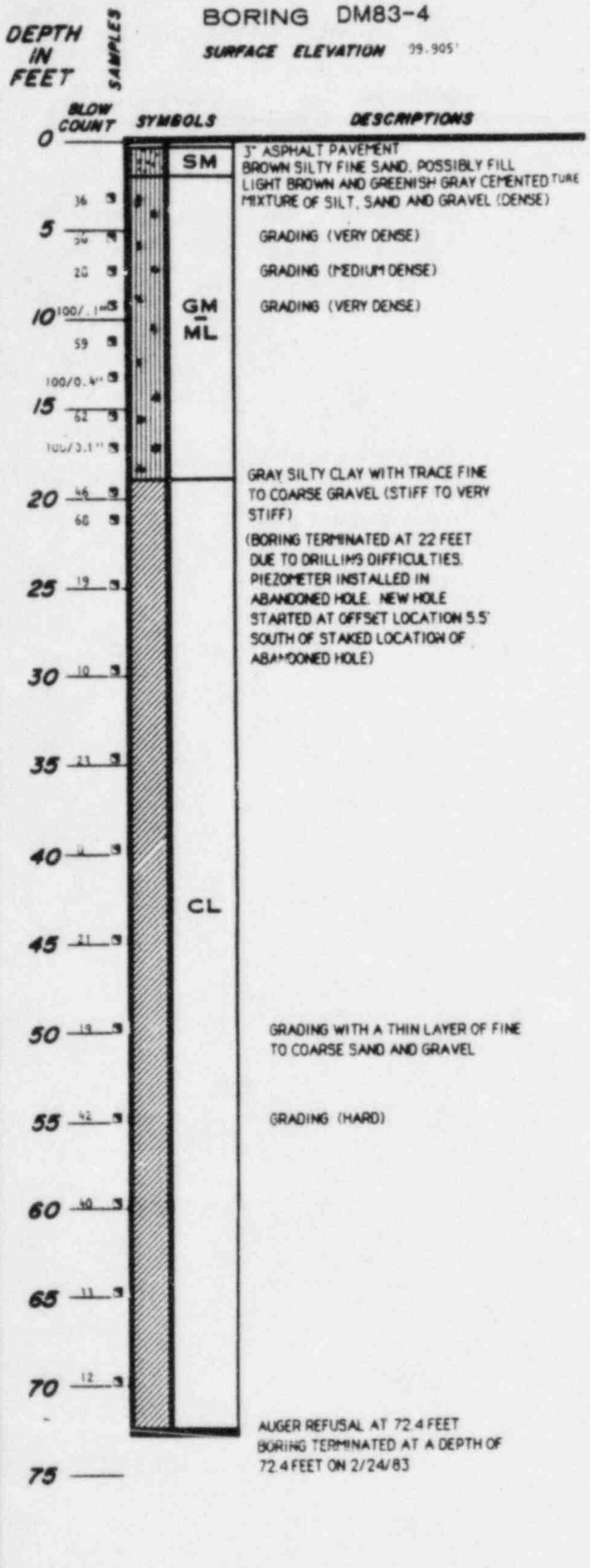
LOG OF BORING AND MONITORING WELL DETAILS

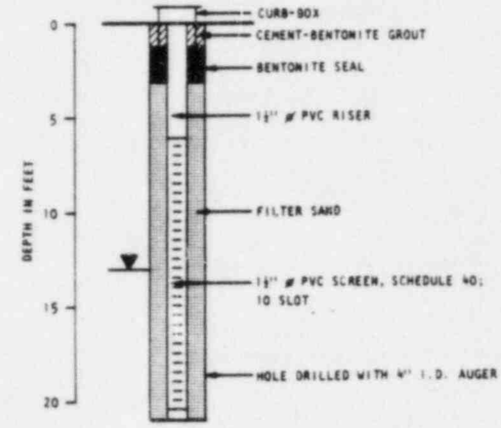
FIGURE A.3.6-B-38 LOG OF BORING DM83-1



LOG OF BORINGS

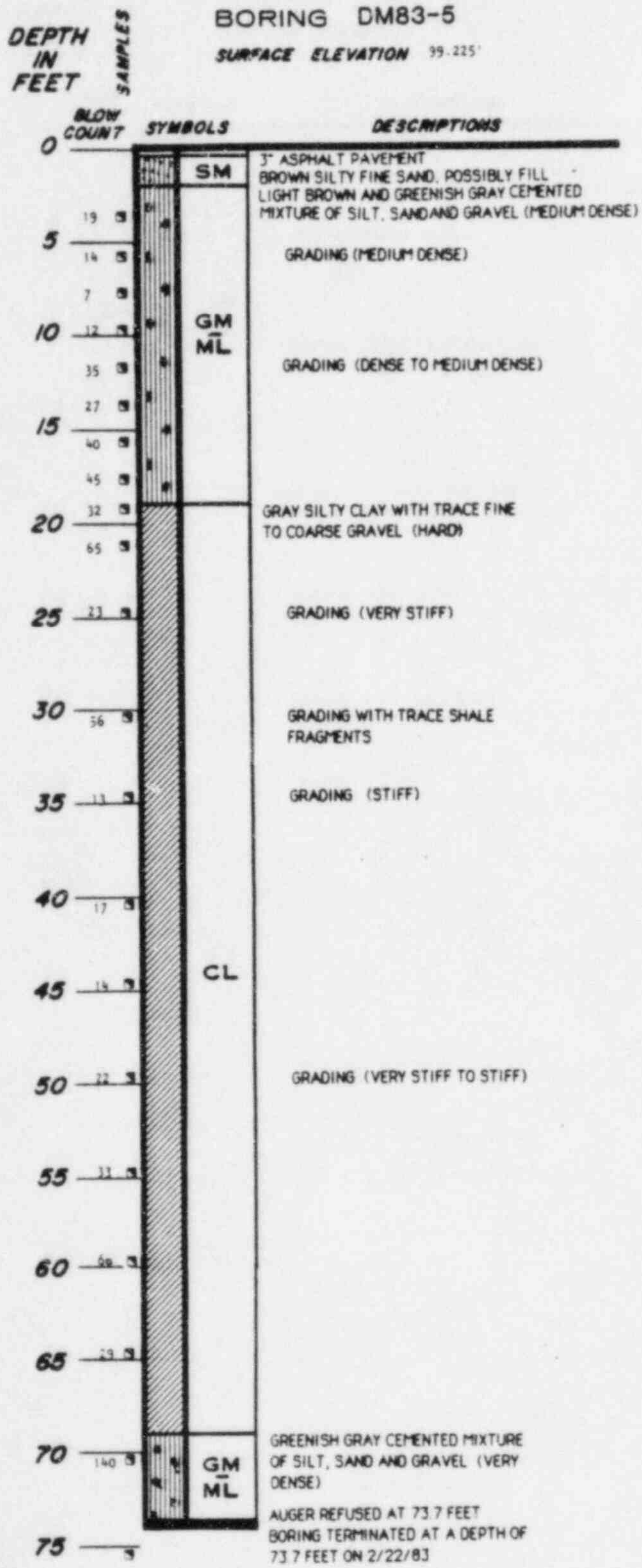
FIGURE A.3.6-B-39 LOG OF BORING DM83-2 & DM83-3

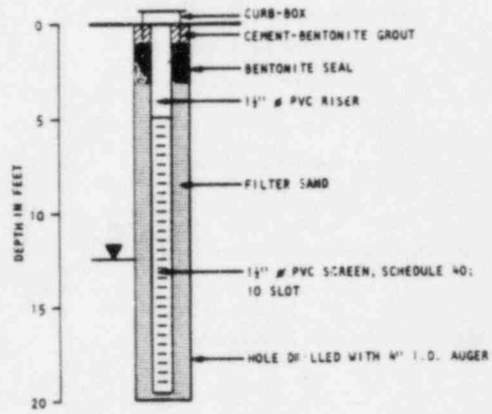




LOG OF BORING AND MONITORING WELL DETAILS

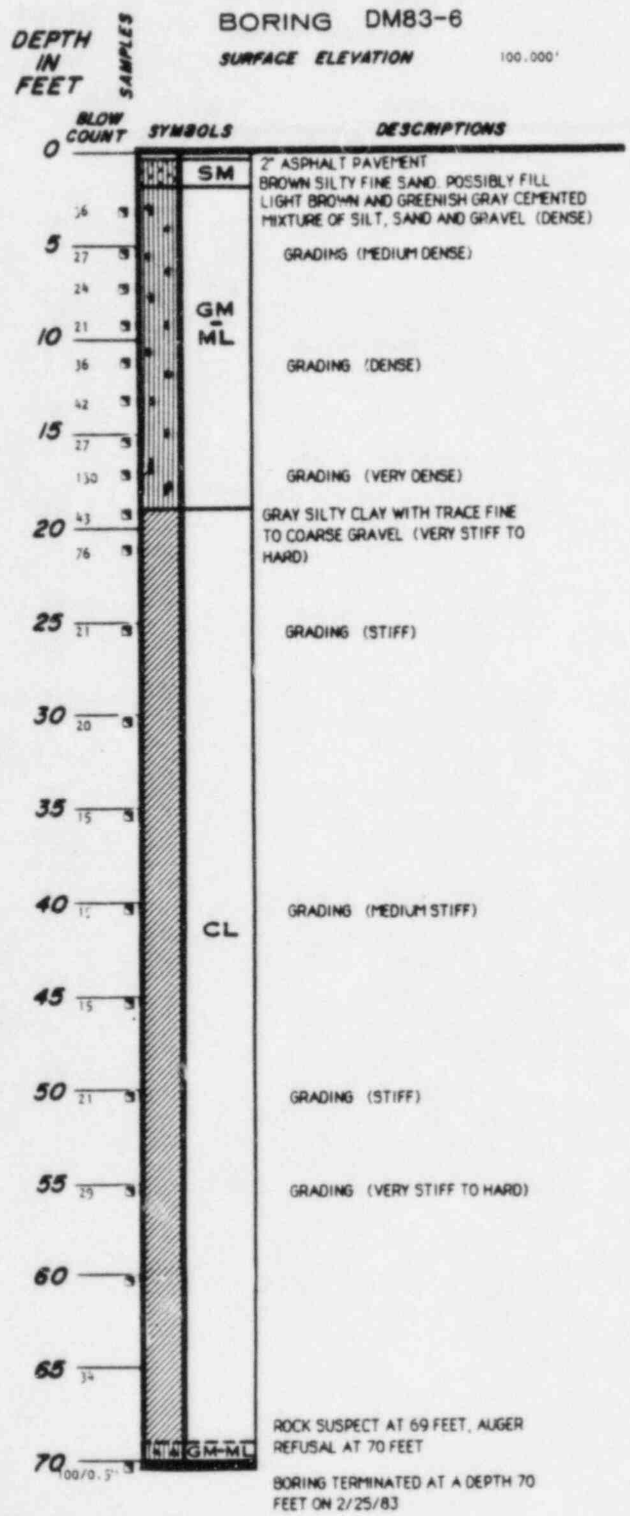
FIGURE A.3.6-B-40 LOG OF BORING DM83-4

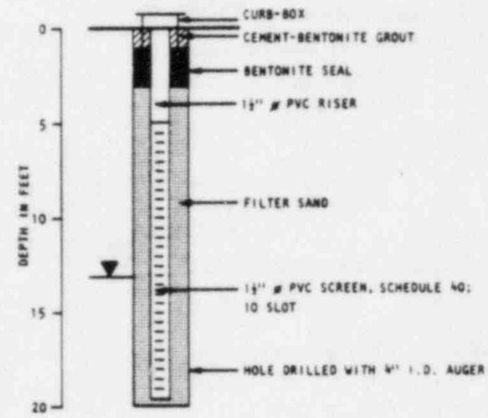




LOG OF BORING AND MONITORING WELL DETAILS

FIGURE A.3.6-B-41 LOG OF BORING DM83-5





LOG OF BORING
AND MONITORING WELL DETAILS

FIGURE A.3.6-B-42 LOG OF BORING DM83-6

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

UNIFIED SOIL CLASSIFICATION SYSTEM

FIGURE A.3.6-B-43 SOIL CLASSIFICATION CHART

SUPPLEMENT A.3.6-C

TECTONIC PROVINCES OF THE SITE REGION

Tectonic Lithofacies Provinces

Figure A.3.6-C-1 is a generalization and simplification of the thoroughly detailed work compiled by Williams (1978) for the entire Appalachian Orogen, from Alabama to Newfoundland, and the tectonic map of Canada (1968). Williams' (1978) map is based upon surface geologic relations within the orogen. Use of tectonic lithofacies provinces assumes that such relations are extended to depths appropriate to the occurrence of shallow intraplate seismicity. One geological factor which could affect this assumption is the presence and extent of a major decollement (subhorizontal crustal detachment).

Recent evidence of such a feature in the Southern Appalachians was reported several years ago (Cook and others, 1979; Iverson and Smithson, 1982) and Harris and Bayer (1979) advanced the hypothesis of its importance in the orogenic history of the Appalachians. There is no general consensus regarding whether or not the decollement is present beneath the central and Northern Appalachians (Williams, 1980; Reed and Bryant, 1980; Moench, 1980; Cook and others, 1980a and 1980b; Harris and Bayer, 1980) even though recent deep seismic reflection data in the region are available (Oliver and others, 1982). Consequently, Williams' tectonic lithofacies model (1978) is probably a valid model to consider for the Northeastern United States.

The digitized model of these provinces (Figure A.3.6-C-2) assumes that the location of contemporary seismicity in the northeastern region is in some way fundamentally controlled by the lithofacies destruction characterizing the tectonic evolution of the continental crust of the eastern US. The same basic

concept is employed in the development of "tectonic provinces" for the determination of the Safe Shutdown Earthquake for a nuclear power plant (10 CFR, Part 100, Appendix A, 1973). Two such interpretations recently developed for nuclear plant sites in New York State are discussed below. (See NYSEG (1979) Regional Tectonic Provinces and NMPC (1983) Tectonic Province Model.)

The provinces shown in Figure A.3.6-C-1 reflect a long geologic history of mountain-building episodes (orogenies). According to the theory of plate tectonics (Wilson, 1966), the ancestral North American continent collided with another continental land mass as far back as Precambrian time (more than 575 million years ago) and the crust was intensely deformed and altered compositionally (Grenville Orogeny). This type of deformation also occurred throughout the Paleozoic Era (575 to 230 million years ago) during several later orogenies (Tectonic, Acadian, and Alleghenian). In the plate tectonic theory, continent-continent collision results in the subduction (overriding) of the edge of one continent by the edge of the opposing one. The principles of tectonophysics call for the margin of the overriding "plate" to be uplifted, block faulted, and ringed by a chain of volcanos (called a volcanic arc) which is fed by magma derived from deep within the collision zone. In the advanced stage of continental convergence, the crust in the collision zone undergoes intense deformation and metamorphism accompanied with the formation of accretionary basins in which additional sediments are deposited. Some accretionary basins may subsequently be destroyed, whereas others may not (successor basins). Figure A.3.6-C-1 delineates the various terrains in the West Valley region which relate to the evolution of the modern Atlantic continental margin of eastern North America and the present position of the ancient continental margin, volcanic arc, accretionary terrains, and successor basins.

Because of the distance from the site, those zones along the continental margin were considered as one zone for the purposes of seismic hazard analysis. The dominant zone in this model (with respect to seismic hazard at West Valley) is the Appalachian Basin, with a maximum historic magnitude of 5.8 (Cornwall-Massena, 1944 MM VIII earthquake).

Hadley and Devine Provinces

This seismic source zone model was developed by Hadley and Devine (1974) in conjunction with the US AEC (now US NRC) as a means to evaluate the distribution of seismic activity in relation to geologic structures and tectonic provinces in the Eastern United States. As shown on Figure A.3.6-C-3 and A.3.6-C-4, Hadley and Devine (1974) have prepared a seismotectonic map (Map C in their report) that combines both seismicity and an inferred level of geologic structural control.

The seismicity, representing events greater than MMI 111 between 1800 and 1972, was contoured at intervals of 4, 8, 16, 32, and 64 epicenters, using a 10^4 and km squared (km^2) area circle on the original 12,500,00 map compilation scale. Historical earthquake intensities were not used, as Hadley and Devine were interested in the areal distribution of seismic events, not total seismic energy release.

Map A in the Hadley and Devine paper outlined the gross structural features and major tectonic provinces of the Eastern United States. This included the Tectonic Map of the United States (Cohgee, 1962), a tectonic map of the Appalachians (Rodgers, 1970) and many other published and unpublished sources. For information regarding possible deeper structure in the Appalachian tectonic belts, they reviewed and combined potential field data in their interpretation of earthquakes within a particular region.

Figure A.3.6-C-3 shows the tectonic province boundaries Hadley and Devine (1974) chose as having some bearing on the relationship of seismicity to geologic structure and tectonic provinces. For simplicity, the subareas within tectonic provinces that Hadley and Devine singled out as representative of structural control (except for the faulted part of the Appalachian Fold Belt which they consider a separate tectonic province) have not been reproduced. This is considered appropriate for the level of seismic hazard analysis needed by this report.

The specific zones shown on Figure A.3.6-C-3 that were used in the Dames and Moore (1983) hazard study are:

[1] Edge of Precambrian: The boundary of this province reflects the edge of Precambrian rocks of the Adirondack massif and the Laurentian Shield. High angle faulting (interpreted to be of post-early Cretaceous age based on dating techniques) occurs along the east flank of the Adirondacks and the Ottawa Basin.

The distribution of seismicity in the region affected by the relatively "late" disruption of the Precambrian rocks shows good correlation of seismicity and tectonic features, although there is little direct evidence that distinctively Precambrian structures are involved.

[2] Central Stable Region: This region embodies the bulk of the Appalachian Basin (partly folded) and related successor basins, the Michigan and Illinois Basins. While much of the seismicity within this

province is really diffuse, several seismic areas have obvious structural control. These are the Mississippi Embayment (New Madrid Region); Anna, Ohio; The Clarendon-Linden Fault Zone in Western New York; and the Ottawa Basin-Lower St. Lawrence Zone.

The WVDP site lies within the Central Stable Region in this model.

[3] Piedmont - Blue Ridge Green Mountain Belt - New England Maritimes: Briefly referred to as the Appalachian system by Hadley and Devine (1974), this province includes the Blue Ridge and Piedmont and their New England equivalents as a single tectonic province. Seismicity within this province cannot generally be related to specific geologic structures, although certain areas (i.e., Central Virginia Seismic Zone, the Ramapo Fault Zone and the Connecticut River Basin) have a higher frequency of seismic activity and epicentral trends; this suggests some geologic structural influence.

[4] Faulted Fold Belt: Earthquakes occur more frequently in the faulted part of the Appalachian fold belt than in the remainder of the Appalachian fold belt. Generally considered to be the southernmost portion of the Appalachians, where faulting has predominated over folding as the dominant tectonic mode, epicentral alignments in several areas suggest geologic structural control in the release of seismic energy. Bollinger (1973) has described the Giles County Seismic Zone, where the 1897 Giles County MM V111 earthquake originated.

[5] Atlantic Coastal Plain: Hadley and Devine note that in general seismic frequency is much lower in the Atlantic Coastal Plain than in other areas of the Eastern United States. One anomalous exception to this record of earthquake occurrence in the coastal plain is the Charleston,

South Carolina area, site of the 1886 earthquake (MMI = X, estimated m_b = 6.8). At the time of Hadley and Devine's paper (1974), the lithologic character and structure of the rocks in the epicentral area were poorly known and not well understood. Subsequent detailed investigation by the US Geological Survey and others in recent years has yet to pinpoint the causal mechanism of the 1886 Charleston Earthquake, although many and varied hypotheses have been espoused.

The dominant zone in this model (Figure A.3.6-C-4) was the Central Stable Region, with an estimated maximum historic event of m_b = 5.8 (Cornwall-Massena, 1944, and Montreal, 1732).

Seismic Source Zone Map - A Neotectonic Approach

For the purposes of this report, an attempt was made to develop an empirical seismic source zone map (Figure A.3.6-C-5) based upon considerations of many factors believed to be important in the genesis of intraplate seismicity. These factors may be grouped into three broad categories: geophysical, kinematic, and structural. (Relevant data were compiled from numerous sources and are presented as maps in Appendix A of the Dames and Moore 1983 report.)

Geophysical Factors

Five main geophysical factors were considered [1] in situ stress; [2] gravity; [3] geomagnetic field; [4] seismic travel time residuals; and [5] heat flow.

[1] In Situ Stress: Zoback and Zoback (1980) have interpreted the state of stress in the conterminous United States. By evaluating several indicators of stress in the upper crust (geologic, focal mechanisms for earthquakes and in situ measurement) and the relationship to heat flow in the crust and upper mantle (see below), they suggest that the Northern United States consists of two stress provinces, the Atlantic Coast and the Mid-Continent provinces (Figure A.1-1, Dames and Moore, 1983). Each is characterized by a certain, but different, orientation of horizontal stresses. The boundary between the two approximately coincides with the ancient continental margin and island arc lithofacies belts (Figure A.3.6-C-1) largely represented by province B on Figure A.3.6-C-5.

[2] Gravity: Gravity anomaly and terrain maps have been interpreted by several workers in terms of possible neotectonic implications with respect to the origin of contemporary seismicity. Diment and others (1972; Figure A.1-1) subdivided the Eastern United States into eastern, central, and western gravity provinces; Dames and Moore (1983), Simpson and others (1981), and Diment and others (1980) correlated patterns of anomalies with north-northeast and northwest-striking discontinuities. Notably, the gravity province boundaries of Diment and others (1972) correspond approximately to boundaries between provinces B, C, and D of Figure A.3.6-C-5.

[3] Geomagnetic Field Variations: Geomagnetic Variation (GMV) is the combined result of external field variations due to perturbations of the ionospheric and magnetospheric currents, and the inductive response of the earth to these source field variations. Greenhouse and Bailey (1981) reviewed GMV data for all available stations in eastern North America and prepared induction arrow maps from them. Their maps are semiquantitative tools for outlining zones of relatively high or low conductivity with

rough estimates of their depth and lateral extent (conductivity structure). Although many geophysicists consider conductivity to be a reflection of minority constituents of rocks (in contrast with density or seismic velocity), the conclusions of Greenhouse and Bailey (1981) are considered relevant and consistent with other geophysical parameters, thereby lending credence to the relationship of thi parameter to kinematic and structural factors that may influence where intraplate seismicity recurs.

The GMV province map of Greenhouse and Bailey (1981, Figure A-1; Dames and Moore 1983) corresponds to the gravity provinces of Diment and others (1972) in the Northeast United States and Canada in general respects, and with the stress provinces of Zoback and Zoback (1980). However, they interpret a well-defined conductivity boundary across Northern New York State. This boundary also corresponds well with the southern limit of the residual stages of glacioisostatic rebound as modeled by Vanicek and Nagy (1979) from releveling data (see below). The northern boundary of Province C (Figure A.3.6-C-5) was drawn based on these interpretations.

[4] Seismic Travel - Time Residuals: Several authors have effectively used seismic travel-time residuals (the difference between an observed and a computed travel-time) to study each structure. The data of Herrin (1969) and Fletcher and others (1978) for the Eastern United States appear to support the idea that there is a shift of residuals which is linear and transverse to the structural grain of the Appalachian orogen in the New York-Pennsylvania Region.

Herrin's (1969) and Chaffin's (1981) studies support the existence of the boundary subdividing Province C (Figure A.3.6-C-5). The interpretation of Fletcher and others (1978) is consistent with the boundary across Northern New York State separating Provinces C and D (Plate 3; Figure A.1-1, Dames and Moore, 1983). The explanations most favored are: (1) ultramafic rocks extending to the upper mantle as evidenced by alkalic intrusives such as the kimberlitic dikes of Pennsylvania and New York, and the Plutons of the Monteregian Hills, Quebec; (2) velocity inhomogeneities related to the ancient suture zone such as the Grenvillean-age belt of rocks along the western lowlands of the Adirondacks; and (3) a region of thickened crust (Chaffin, 1981), as suggested by analysis of global heat flow (Chapman and Pollack, 1977).

[5] Heat Flow: Several studies of heat flow variations in the Eastern United States have been made (Birch and others, 1968; Diment and others, 1972; Lachenbruch and Sass, 1977; Chapman and Pollack, 1977). Variations in this region are small and are attributed to variations in radioactive heat generation which in turn indicate petrologic differences in the crust associated with paleotectonic deformation. Nevertheless, the boundaries shown on Figure A.3.6-C-5 conform to the pattern of heat flow variation of Diment and others (1972) and of Lachenbruch and Sass (1977) (Figure A.2-1, Dames and Moore, 1983).

Kinematic Factors

The two kinematic factors considered were:

[1] General: Because many investigators have acknowledged their importance in neotectonics, a review of studies of past and contemporary differential vertical crustal movements in the Northeastern United States and adjacent Canada (Brown and Oliver, 1976; Brown, 1978; Vanicek and Nagy, 1979; Officer and Drake, 1981) was performed. Bollinger (1973) initially suggested a relationship of such movements to seismicity in the Atlanta, Georgia region. Statistical studies of movements on young faults that focused upon the rates of fault movements (Trask, 1982) and the relationship of fault length to movement history (Shaw and others, 1981) were also reviewed. Not enough data are yet available on fault movement for the Eastern United States to apply these factors in the selection of seismotectonic province boundaries.

[2] Differential Vertical Crustal Movements from Releveling and Related Data: Measurements of elevation change over time based on survey benchmarks, tide gauge stations and lake level stations (The Great Lakes, Hudson Bay) are used to calculate the velocity of differential vertical crustal movement. Contours of the movement velocities are called isobases. Isobase maps for the majority of the Northeastern United States and adjacent Canada are available (Meade, 1971; Holdahl and Morrison, 1974; Brown and Oliver, 1976; Brown 1978; Vanicek and Nagy, 1979 and 1980). The origin of these movements is related to dynamic equilibrium conditions in the upper mantle which are manifest in rates of seafloor

spreading (Sbar and Sykes, 1973) and epeirogenic plate movements (Officer and Drake, 1981). These phenomena affect the intraplate crystalline basement where seismicity is generated in the upper few tens of kilometres in the crust. Sykes (1978) has pointed out that for most such regions, the locations of those faults which generate earthquakes are unknown. Nevertheless, concentrations of distortional strain energy are developed where either gentle warping or differential displacements in the basement produce stress concentrations in the cover materials. Shear strain is most pronounced at the hingeline of basement flexure or above a step-like discontinuity (Sanford, 1959). It follows that the zero-isobase for contemporary (the past 100 years) vertical crustal movements delineates portions of the crust with a relatively high shear strain. This zone is likely to have higher rates of seismicity. The boundary between Provinces A and B (except for the segment between New York City and the Gulf of Maine) on Figure A.3.6-C-5 nearly coincides with the approximate position of the zero-isobase (Figure A.2-2, Dames and Moore, 1983) compiled from the aforementioned sources.

Structural Factors

Four structural factors were considered: [1] paleotectonic deformation deduced from evaluation of the erosion resistance of rocks; [2] the occurrence of Cretaceous and Cenozoic deformation features; [3] the distribution of fundamental tectonic lithofacies boundaries, i.e., the evolution of the continental margin; and [4] cross-strike structure.

[1] Erosion Resistance of Rocks: Hack (1979) used topographic analysis to search for indications of tectonic deformation in late geologic time. He concludes that the origin of most landforms in the Eastern United States is due to erosion of rocks of different resistances rather than to tectonic processes. He recognizes several areas that may have undergone local uplift at a higher rate than adjacent areas; these are considered tectonically slow rates such as oroad epeirogenic warping or tilting. In the Northeastern United States, Hack (1979) identifies the Piedmont Region northwest of the Chesapeake Bay and the Adirondack dome as tectonically "late" areas of uplift. The former area (in the Piedmont) occurs almost entirely within Province B (Figure A.3.6-C-5) reflecting the unusually narrow belt comprised primarily of Precambrian basement rocks and late Precambrian metasediments west of the Fall Line. Reed (1981) suggests that the disequilibrium stream profiles indicate that the differential uplift of the Piedmont with respect to the Coastal Plain is occurring along a zone coincident with the Fall Line. His data are in strong accord with those of Heck (1979) in the Maryland Piedmont. Uplift of the Adirondack dome area is consistent with conclusions by Isachsen (1975) from releveling data, and the sharp right angle bend in the boundary at the the northern terminus of province C (Figure A.3.6-C-5) reflects this trend.

[2] Cretaceous and Cenozoic Deformation Features: A map of reported Cretaceous and Cenozoic deformation features for the Northeastern United States was compiled before preparation of Figure A.3.6-C-5 (Figure A.2-4, Dames and Moore, 1983). A similar map was compiled of discontinuities or fault zones which are either known or else suspected to exhibit or be associated with contemporary seismicity (Figure A.2-5, Dames and Moore, 1983). The majority of high-angle faults with Cretaceous and Cenozoic

displacements and probable or suspected contemporary seismicity occur in three of the four major provinces: A (Coastal Plain and modern continental margin), B (ancient continental margin), and D (eastern interior craton). Province C, (the central Appalachian Basin, containing the site) is mostly comprised of late deformation features known as valley bottom stress relief faults related to glacioisostatic processes. These features formed at relatively slow rates of strain and are not potentially seismogenic. The obvious anomaly in Province C is the Clarendon-Linden fault zone. The seismically active portion of the zone occurs near the boundary with Province C, whereas the southern portion of the structure does not appear to be active. It is possible that the boundary transects the fault zone. However, for conservatism, the province boundary on Figure A.3.6-C-5 was chosen based on the correspondence of the position of the zero-isobase with the change in geomagnetic variation across Northern New York State (Figure A.1-1, Dames and Moore, 1983).

[3] Tectonic Lithofacies: A generalized map of fundamental tectonic lithofacies of the Northeastern Appalachian Orogen after Williams (1978) was prepared for consideration as a possible seismic source zone map (Figure A.3.6-C-1). Certain gross similarities between the lithofacies map and the distribution and zonation of various factors discussed above are apparent and further underscore the reasoning employed to prepare Figure A.3.6-C-5. Province D corresponds to the greatest extent of the Paleozoic successor basins (Williams, 1978) of the orogen. Similarly, Province B corresponds to the ancient Appalachian continential margin and volcanic arc belts, within the region of the major Appalachian salients (Renkin, 1976) corresponding to the Salisbury and Raritan Embayments. In

New England and Central and Southern Virginia, Province B widens to include additional accretionary terrains of the Paleozoic orogenic period. In general, tectonic lithofacies and paleostructure correlate poorly except for the western boundary of Province B (the Appalachian gravity gradient delineating the ancient continental margin).

[4] Cross-Strike Structure: Cross-strike subdivisions of Provinces A and C (Figure A.3.6-C-5) have been delineated. Province A has been subdivided by northwest trending boundaries occurring along (1) the Hudson Canyon-Raritan Bay trend and (2) the Salisbury Embayment trend.

Officer and Drake (1981) state that the continental shelf (Province A) has subsided 140 m downward toward the northeast over a distance of 3,000 km since Wisconsinan time (18,000 years before present). The general tectonic framework of the Coastal Plain region is characterized by a series of troughs and arches which trend perpendicular to the older paleotectonic structures in the Appalachian Orogen. These cross-strike features segmented the crust during diastrophic events of the past and continue to function in the same way (Owens, 1970). The northward tilt is tectonically induced by the relative northerly motions of the Carribbean and Cocos tectonic plates as depicted by Malfeit and Dinkelman (1972). Based upon the aspect ratio of the eastern margin of the North American plate (the continental shelf), tilting would therefore be accomplished by differential displacements at the boundaries of a series of blocks such as those postulated by Sheridan (1974).

In the Northeastern United States one selected boundary is the prominent structural lineament suggested by the Raritan Embayment - Hudson Canyon alignment (between A1 and A2, Figure A.3.6-C-5). This feature coincides with a prominent change in regional strike of Coastal Plain deposits in New Jersey (Minard and Owens, 1960), and a projection of it coincides with the southern terminus of the Mesozoic Watchung basalt flows and a Bouguer gravity cross-strike lineament of Diment and others (1980). The other boundary (between A2 and A3, Figure A.3.6-C-5) coincides with the trend of the Salisbury Embayment, a continental margin fault of Sheridan (1974), and the pattern of aeromagnetic anomalies. On strike with this boundary in Province C (Figure A.3.6-C-5), a boundary has been selected which corresponds to the lineament proposed by several authors (e.g. Diment and others, 1980; Chaffin, 1981) and appears to correspond to a line of seismic delay time shift (Herrin, 1969). This cross-strike boundary does not appear to transect the ancient continental margin (Diment and others, 1980).

The neotectonic model is shown on Figure A.3.6-C-6. Zones A, B, and C have been treated as one zone for the purposes of this seismic hazard evaluation. The hazard from these zones for the West Valley site is negligible because of the distance from the zone to the site. The dominant zone in this model for West Valley was Zone C, which contains the seismicity and maximum historic earthquake (m_b 5.3) at Attica.

New York State Electric and Gas (1979) Regional Tectonic Provinces

NYSEG prepared a Preliminary Safety Analysis Report (NYSEG, 1979) for a proposed nuclear power plant site at New Haven, New York about 24 km east of Oswego, New York. They defined "regional tectonic provinces" for determining

the seismic design basis earthquakes (Safe Shutdown Earthquake and Operating Basis Earthquake) for the plant. The provinces are presented on Figure A.3.6-C-7 from the NYSEG PSAR. The basis of determining each province boundary location is threefold: (1) structural geology; (2) Bouguer gravity gradient; and (3) distribution of earthquake epicenters since 1930.

Dames and Moore (Figure A.3.6-C-8) modeled this alternative because we believe it to be a valid model of potential seismic source zones in the West Valley region. The use of contemporary seismicity to define seismic source zone boundaries implies the assumption that the general location of recent seismic activity will not change in the near future as it affects the WVDP. The dominant zone in this model for West Valley was the Clarendon-Linden Fault zone, with a maximum historic earthquake of m_b 5.3 (MMI VII-VIII at Attica).

Niagara Mohawk Power Corporation (1983) Tectonic Province Model

NMPC has recently docketed their Final Safety Analysis Report (FSAR) for the Nine Mile Point Nuclear Station, Unit 2 near Oswego, New York. Chapter 2.5.2 of the FSAR defines the seismic design basis earthquakes, namely the Safe Shutdown Earthquake (SSE) and the Operating Basis Earthquake (OBE). The seismic source zone model used to determine the SSE is a modified version of the tectonic map from Hadley and Devine's (1974; Plate A) seismotectonic map of the Eastern United States.

Hadley and Devine's (1974) model is discussed in detail above. The NMPC (1983) tectonic province model (Figure A.3.6-C-9) is a modification of the Hadley and Devine model (Figure A.3.6-C-10) in that subprovinces are defined on the basis of structural geology.

The Central Stable Region (Hadley and Devine, 1974) is subdivided into three subprovinces: the eastern and western stable plateaus and the Ottawa Basin. The boundary separating the stable plateau subprovinces is the Findley Arch and its northern extension, the Algonquin Axis. The Ottawa Basin is delineated on the south side from the eastern stable plateau by a prominent zone of Mesozoic block faults and related igneous intrusives (NMPC, 1983).

The dominant zone contributing to the seismic hazard at the site was the Clarendon-Linden Fault zone, with a maximum historic magnitude of m_b =5.3. This model (Figure A.3.6-C-10) is a special case of the tectonic lithofacies model (see Tectonic Lithofacies Provinces above.)

Cross-Strike Lineaments

Odom and Hatcher (1980) classify two types of structural lineaments: basement-controlled and supra-crustal. There are two types of basement-controlled structural lineaments: active (reflecting motion of the basement) and passive (reflecting basement surface irregularities). Supra-crustal cross-strike structural discontinuties are broad, diffuse, transverse zones of structural disruption in the "overthrust belts" such as those characteristic of the Appalachian Basin (Wheeler, 1980). Typically, folds of various scales, longitudinal faults, simple Bouguer gravity anomalies, and geomorphologic features either terminate or change style across or between these features. Where structural lineaments have been studied, they have been found to have very long ecological histories extending back to late Precambrian-Cambrian time (Odom and Hatcher, 1980). Some contain regions of contemporary seismicity and in general warrant careful consideration with respect to the seismic design of critical facilities.

Six prominent cross-strike features are postulated in West Virginia, Virginia, Maryland, Pennsylvania, New York, and Southern Ontario (Diment and others, 1980; Chaffin, 1981) based principally on the regional configuration of simple Bouguer gravity anomalies and the regional aeromagnetic signature (Figure A.3.6-C-11). There is little compelling geologic evidence to support the speculation that these lineaments are direct manifestations of fundamental discontinuties emanating from the Precambrian basement. However, what evidence there is may be significant. The possible relationship of the New York-Pennsylvania lineaments to historic seismicity is speculative. However, Diment and others (1980) suggest that regions of intense seismic activity may coincide with one or more of these lineaments, implying that the crust is segmented by both northwest and northeast discontinuities and that the interior portions of these blocks are relatively aseismic. This viewpoint is supported by Fakundiny's (1981) review of available geologic and geophysical data. These blocks are approximately 150 km square. Moreover, Fakundiny (1981) recognized possibly less distinct east-west discontinuities extending across Central New York through the Finger Lakes. These east-west lineaments are not shown on Figure A.3.6-C-11. Lineaments 1 through 4 are after Diment and others (1980), 4 and 5 are from Chaffin (1981) and 6 is from Wheeler (1980). The northwestern extent of these lineaments is uncertain. The southeastern extent is interpreted by all sources to be limited to the prominent Appalachian gravity gradient (Diment and others, 1972, 1980).

A seismic risk assessment was not performed for this model (Figure A.3.6-C-12) because there is no apparent correlation between the cross-strike lineaments and earthquake occurrences. Because the location and nature of lineaments are subject to interpretation, future refinement of these data is likely and correlation with seismic activity may be accurate in the future.

Crustal Block Seismic Source Zones

The set of zones shown in Figure A.3.6-C-13 combines the arguments posed by Diment and others (1980) with those of Wentworth and others (1981). Earthquakes are assumed to occur within northwesterly trending crystal blocks (Zones 1-7, 10 and 11, Figure A.3.6-C-13) and along the boundaries of northeast trending Mesozoic rift basins (Zones 8 and 9, Figure A.3.6-C-13).

The dominant zone for this model is Zone 5 (Figure A.3.6-C-13), north and east of the site. The largest historical event in this zone was the 1929 MMI VII-VIII Attica shock (m_b =5.3).

Geological Survey Seismic Source Zones

The seismic source zones delineated by Algermissen and others (1982) are shown in Figure A.3.6-C-14. They are used in this analysis to represent the cause of seismicity. These zones were derived using a combination of geologic data, historical earthquake occurrences and expert judgment, and as such, they represent one interpretation of tectonics for the Eastern United States.

The West Valley site lies within Zone 093 (Figure A.3.6-C-14), close to the boundaries of Zones 116 and 115 which represent the Clarendon-Linden Fault Zone. The largest historical earthquake in Zone 115, the dominant zone in this model in the analysis, was the 1929 Attica MM Intensity VII-VIII (estimated magnitude of m_b =5.3).

REFERENCES FOR SECTION SUPPLEMENT A.3.6-C

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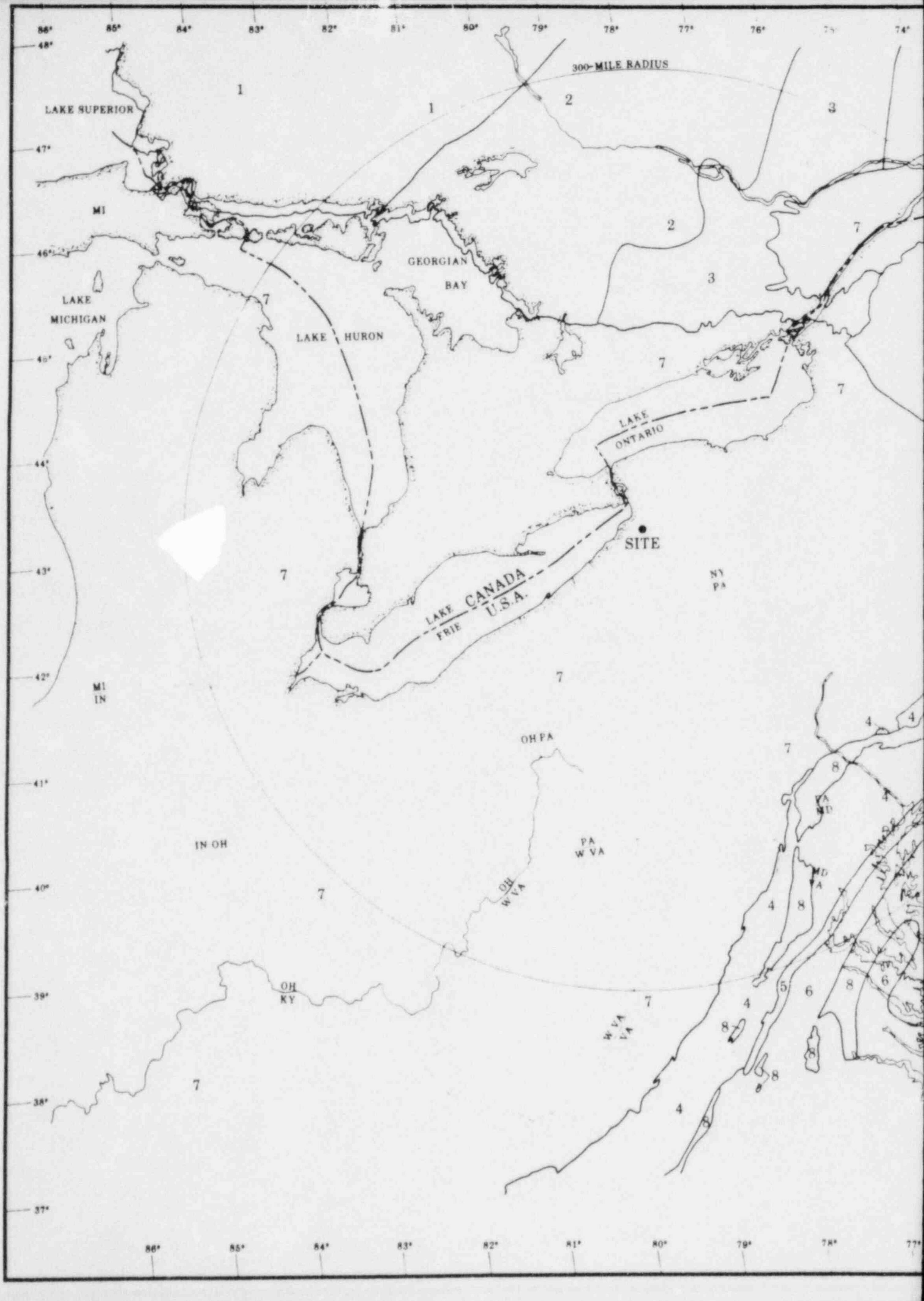
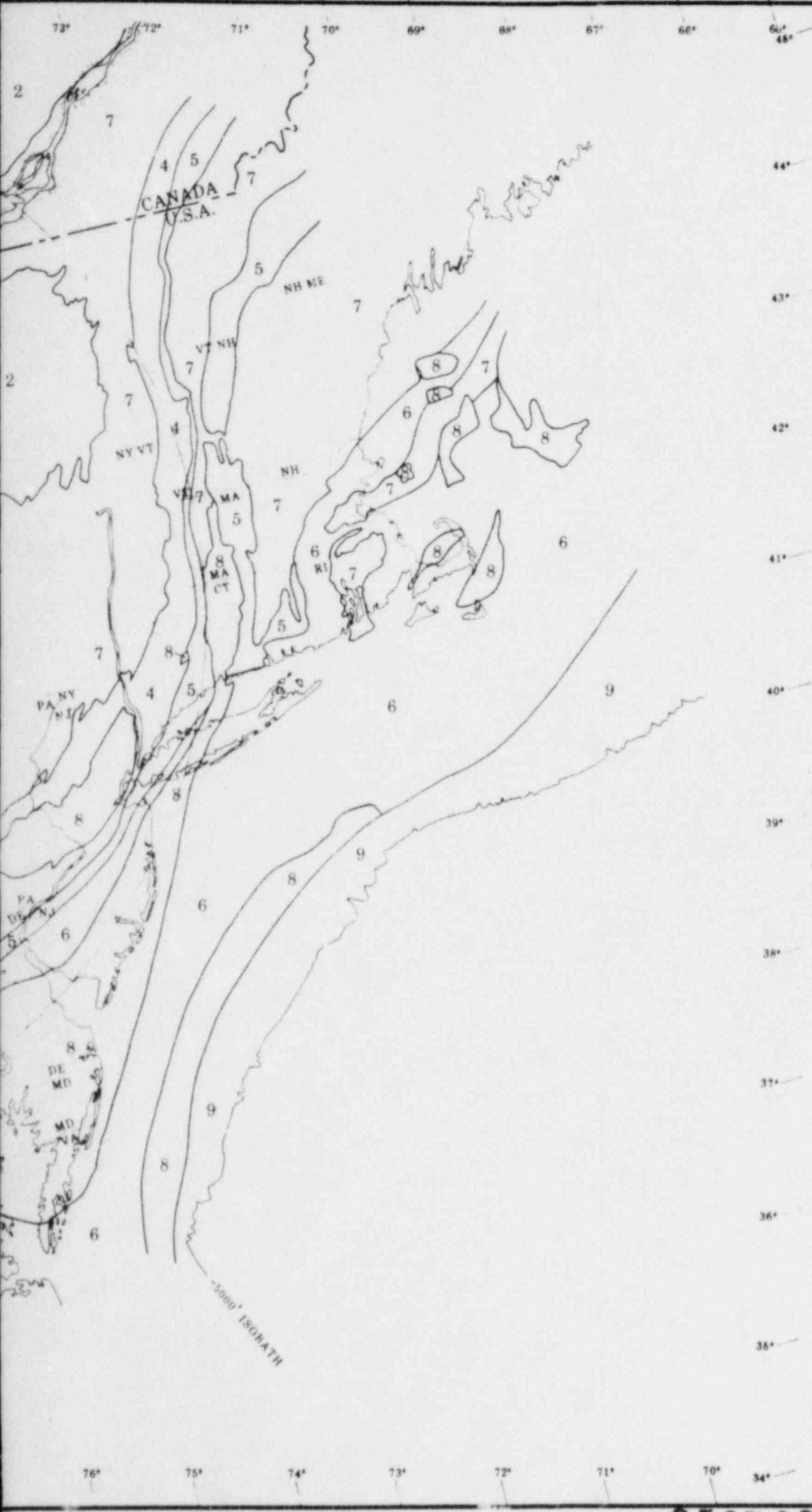


300-MILE RADIUS
LAKE SUPERIOR
MI
LAKE MICHIGAN
GEORGIAN BAY
LAKE HURON
LAKE ONTARIO
SITE
CANADA
U.S.A.
LAKE ERIE
NY PA
MI IN
OH PA
IN OH
PA W VA
OH W VA
OH KY
W VA VA
PA MD
MD VA



SEISMIC SOURCE ZONE MAP

TECTONIC LITHOFACIES

Also Available On Aperture Card

TI APERTURE CARD

EXPLANATION

9 MODERN ATLANTIC CONTINENTAL MARGIN
8 MESOZOIC SUCCESSOR BASINS TO APPALACHIAN OROGEN
7 PALEOZOIC SUCCESSOR BASINS TO APPALACHIAN OROGEN
6 APPALACHIAN ACCRETIONARY TERRANE
5 APPALACHIAN VOLCANIC ARC
4 APPALACHIAN CONTINENTAL MARGIN
3 GRENVILLEAN ACCRETIONARY TERRANE
2 GRENVILLEAN CONTINENTAL MARGIN
1 ARCHEOZOIC CONTINENTAL MARGIN

SOURCES:

WILLIAMS, H.,1978, TECTONIC LITHOFACIES MAP OF THE APPALACHIAN OROGEN. MEMORIAL UNIVERSITY OF NEWFOUNDLAND, MAP NO.1,1:1,000,000

BALLARD, R.D. AND UCHUPI, E.,1975, AAPG BULLETIN 59 , p 1041-1071

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FIGURE A.3.6-C-1

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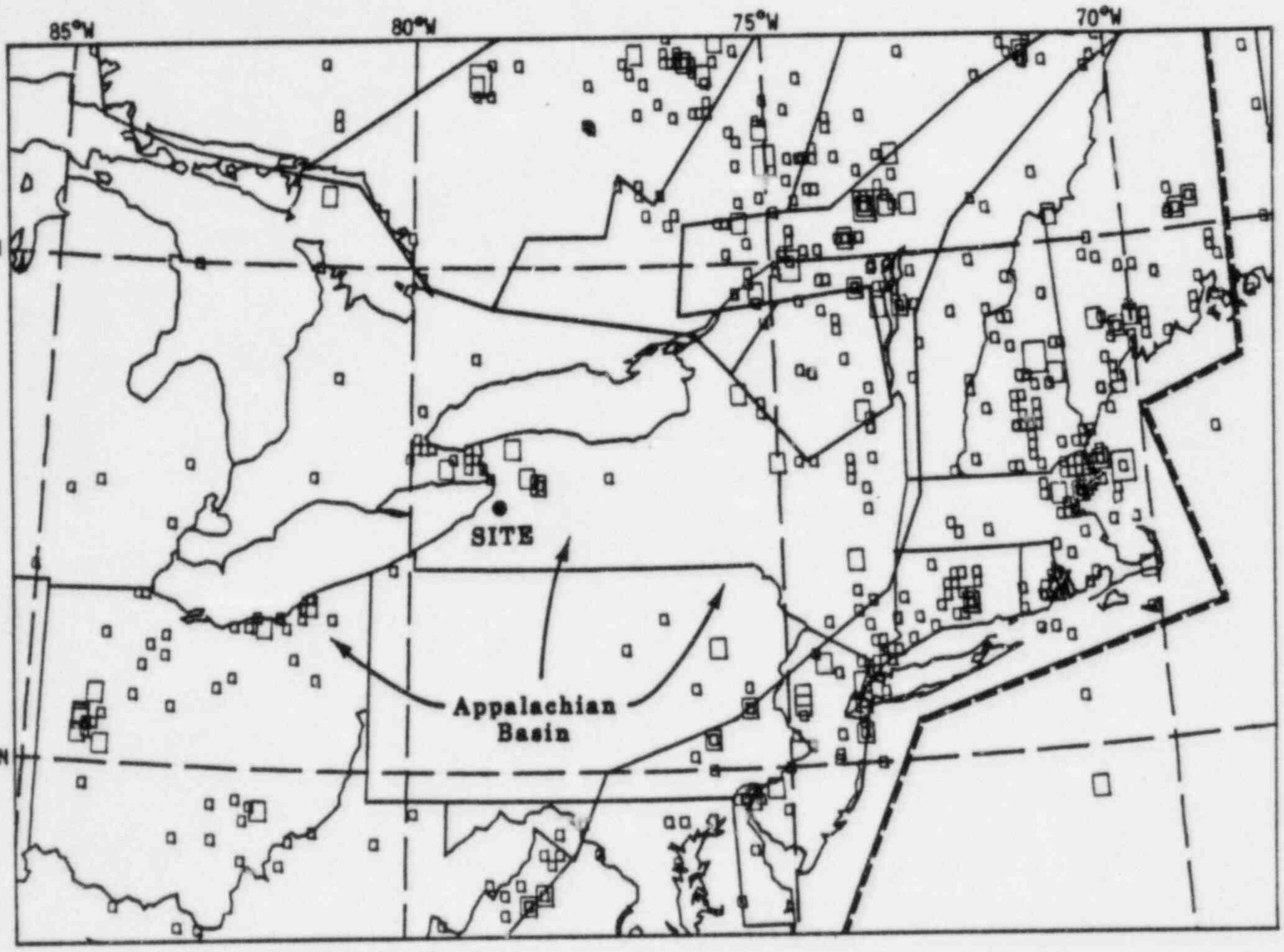


LEGEND:

MAGNITUDE

□ $3.5 \le m_b < 4.5$

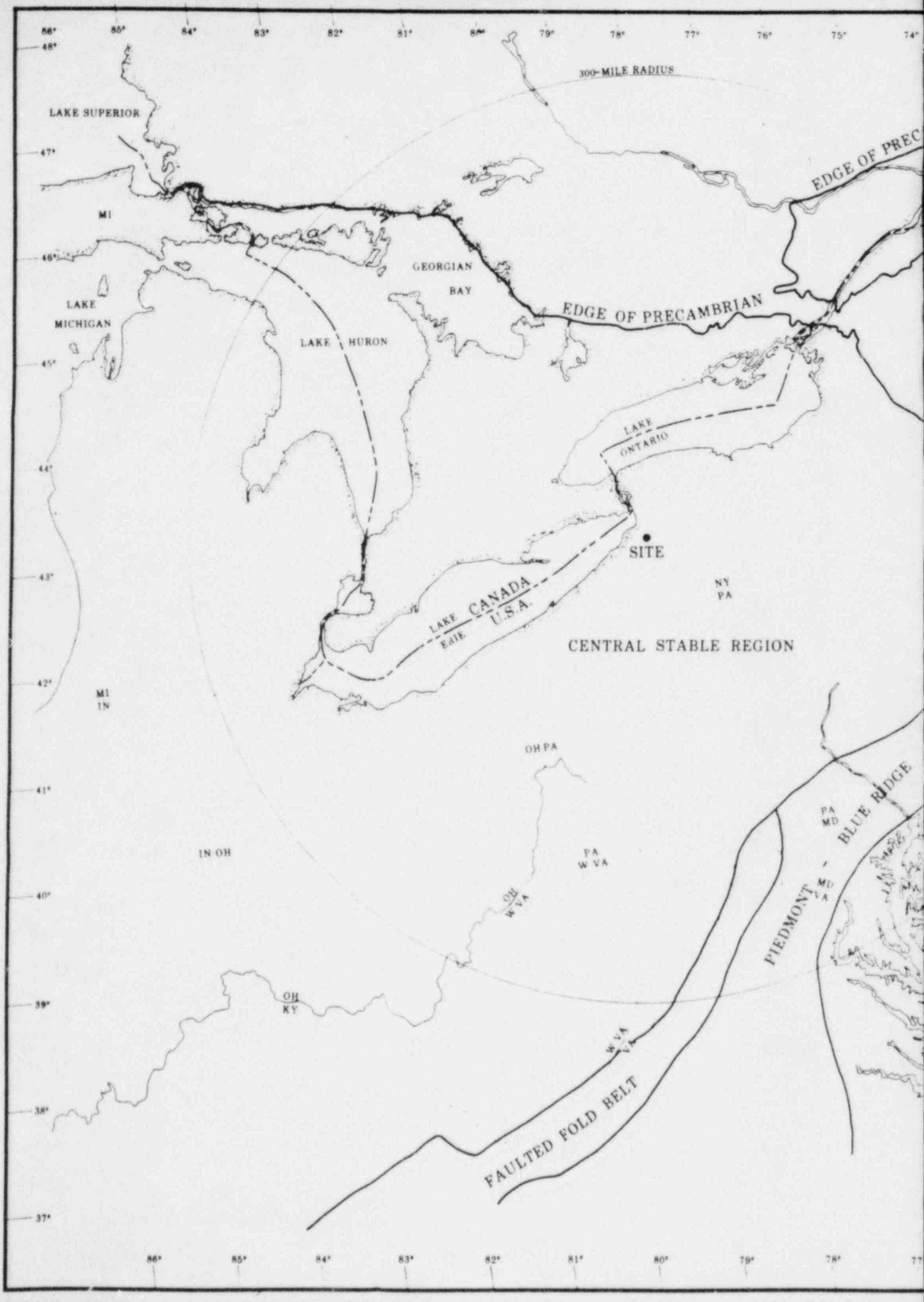
□ $4.5 \le m_b < 5.5$

□ $5.5 \le m_b$

— — — ARBITRARY BOUNDARY

DIGITIZED
SEISMIC SOURCE ZONE MAP
TECTONIC LITHOFACIES

FIGURE A.3.6-C-2



300-MILE RADIUS
LAKE SUPERIOR
MI
LAKE MICHIGAN
LAKE HURON
GEORGIAN BAY
EDGE OF PRECAMBRIAN
EDGE OF PREC
LAKE ONTARIO
SITE
NY PA
LAKE ERIE
CANADA
U.S.A.
CENTRAL STABLE REGION
MI IN
OH PA
IN OH
PA W VA
OH W VA
OH KY
W VA VA
PA MD
MD VA
PIEDMONT - BLUE RIDGE
FAULTED FOLD BELT

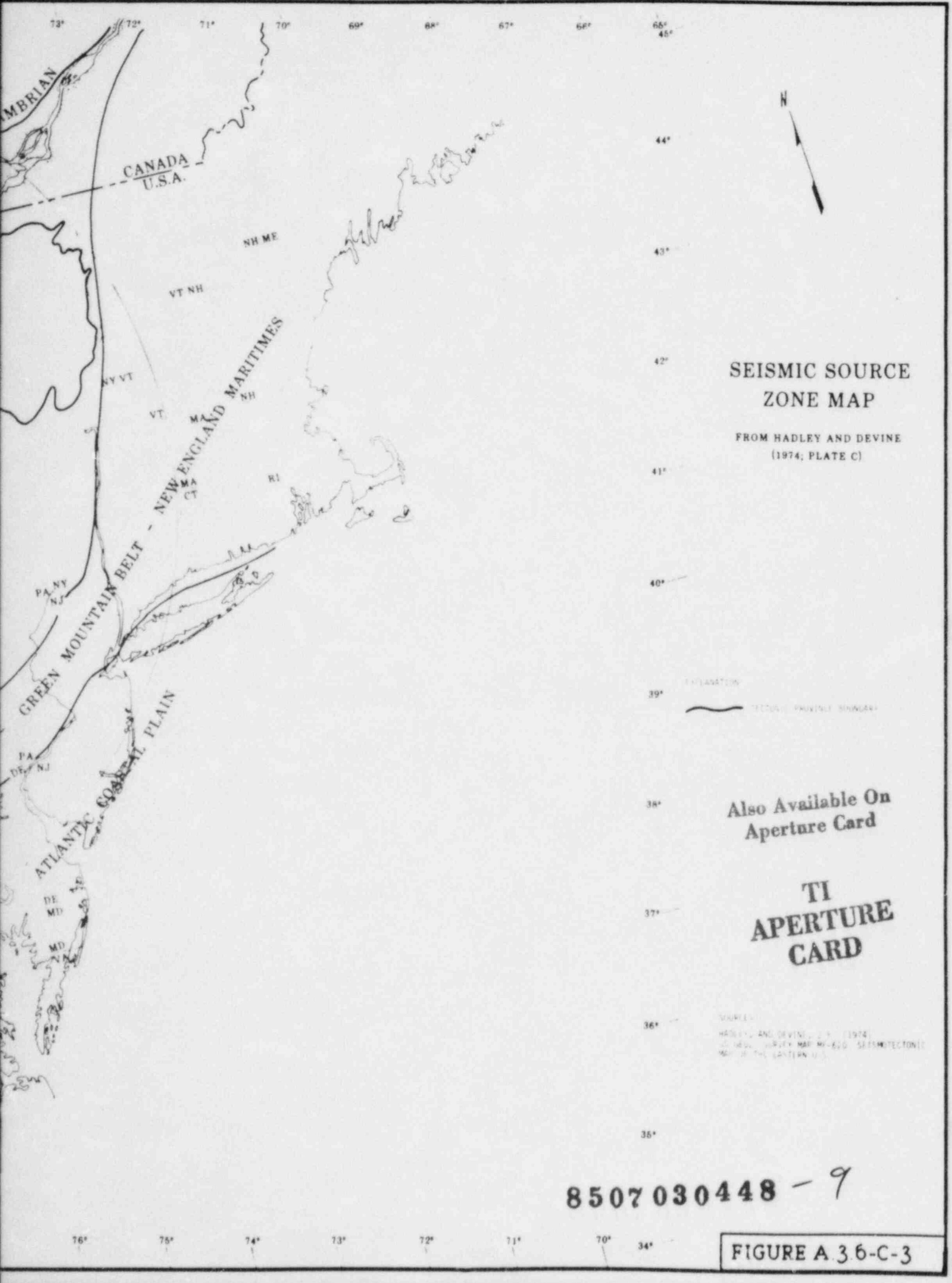
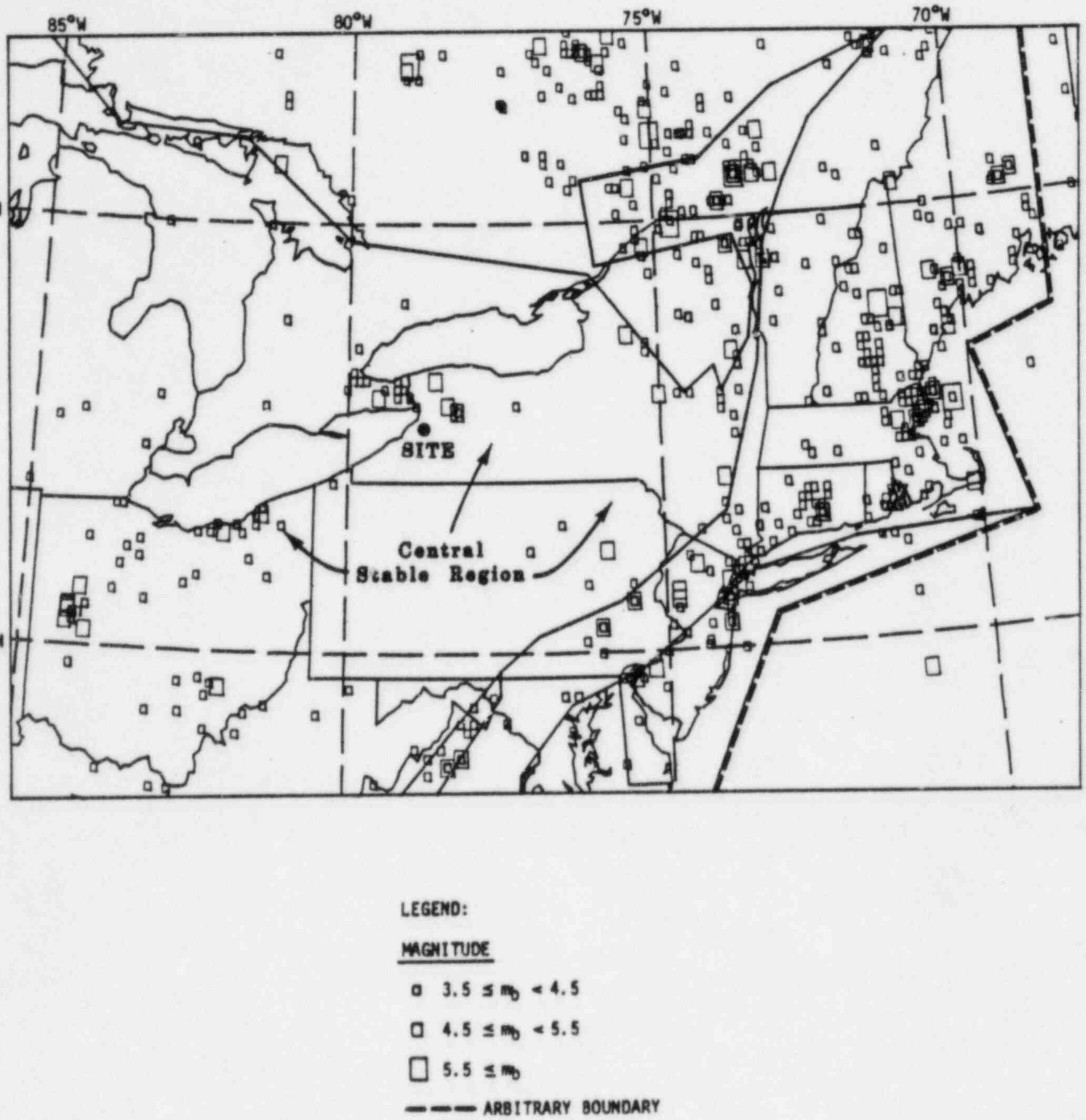
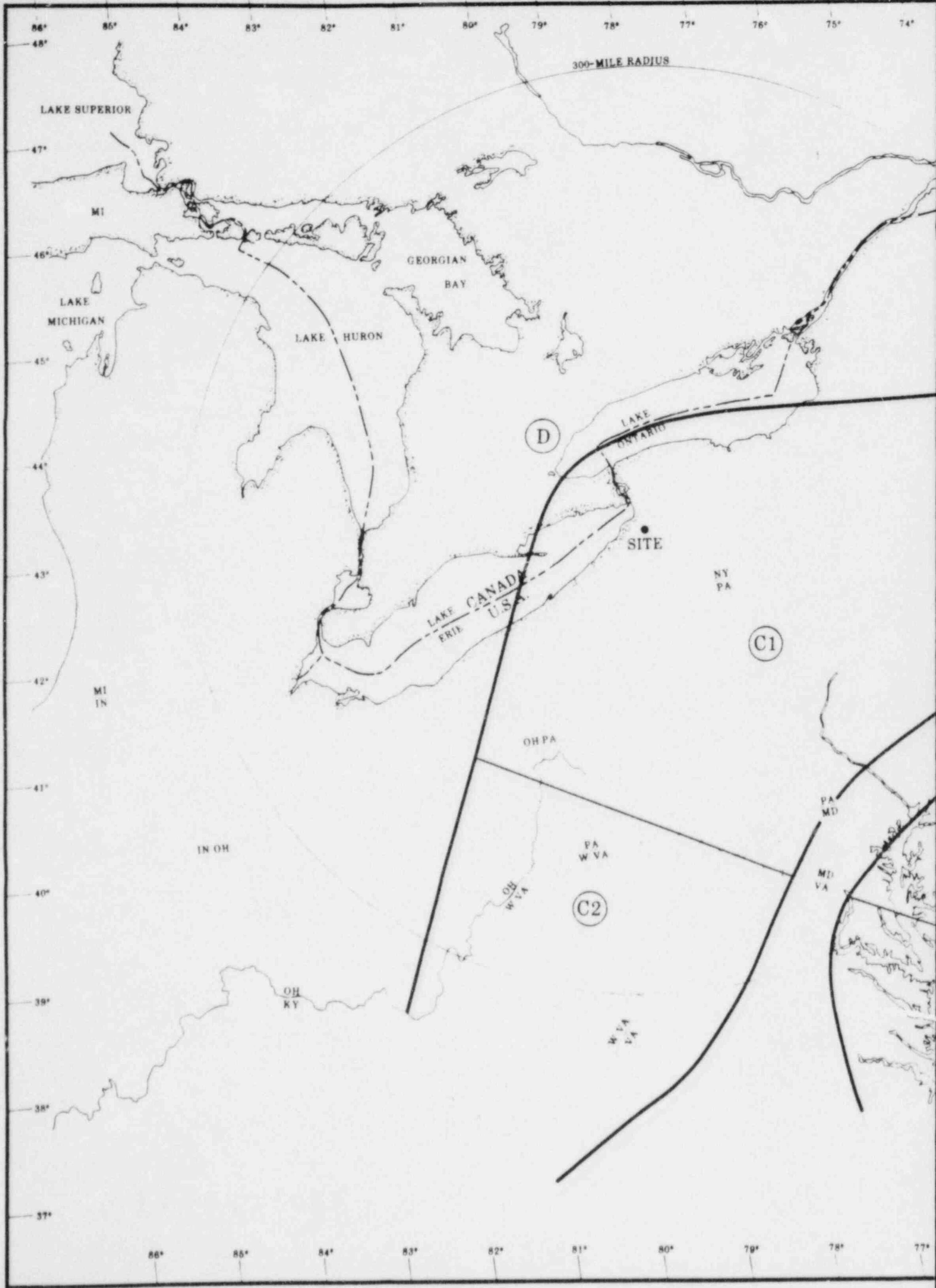


FIGURE A.3.6-C-3



DIGITIZED
SEISMIC SOURCE ZONE MAP
FROM HADLEY & DEVINE (1974, PLATE C)

FIGURE A.3.6-C-4



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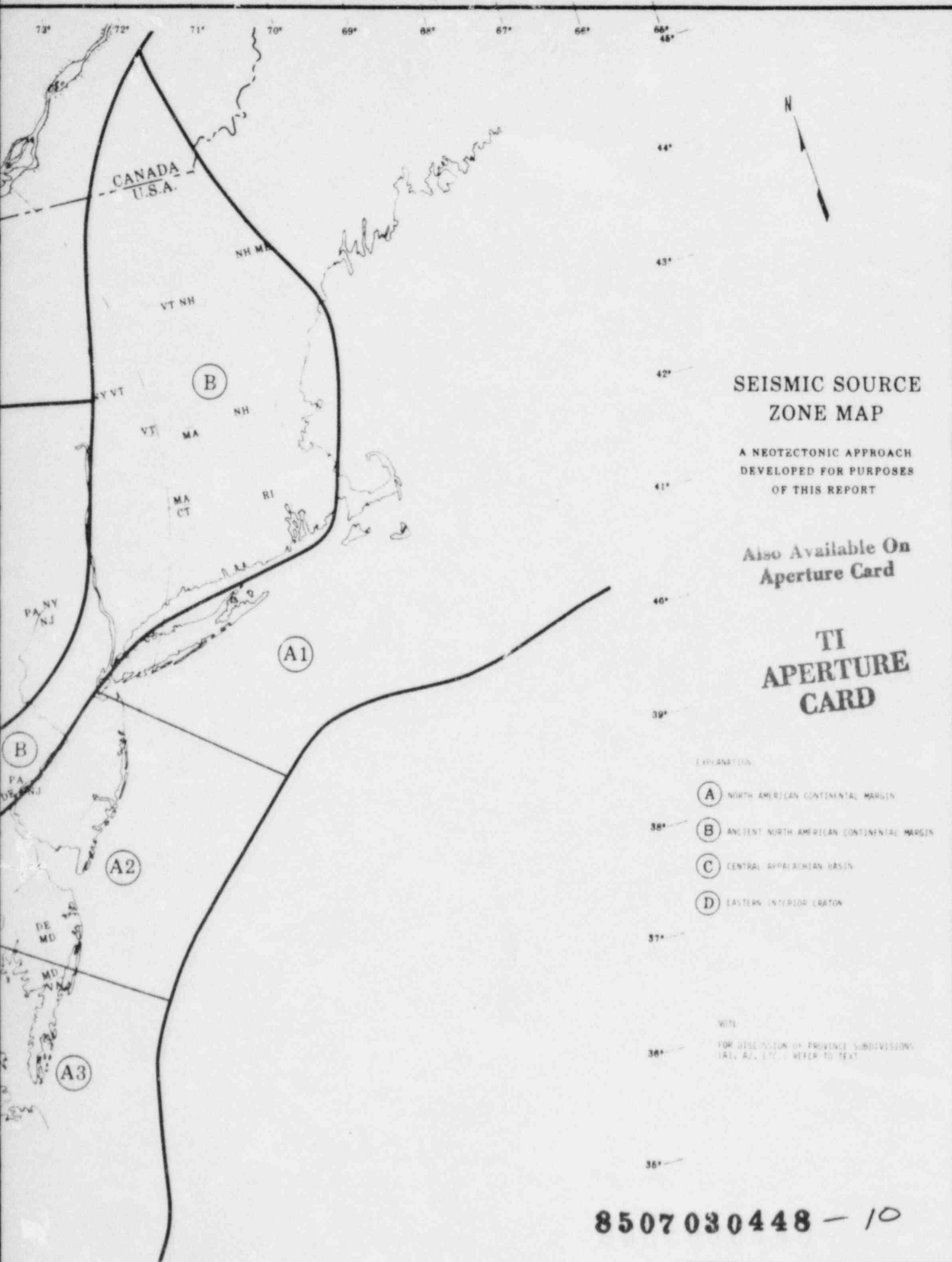
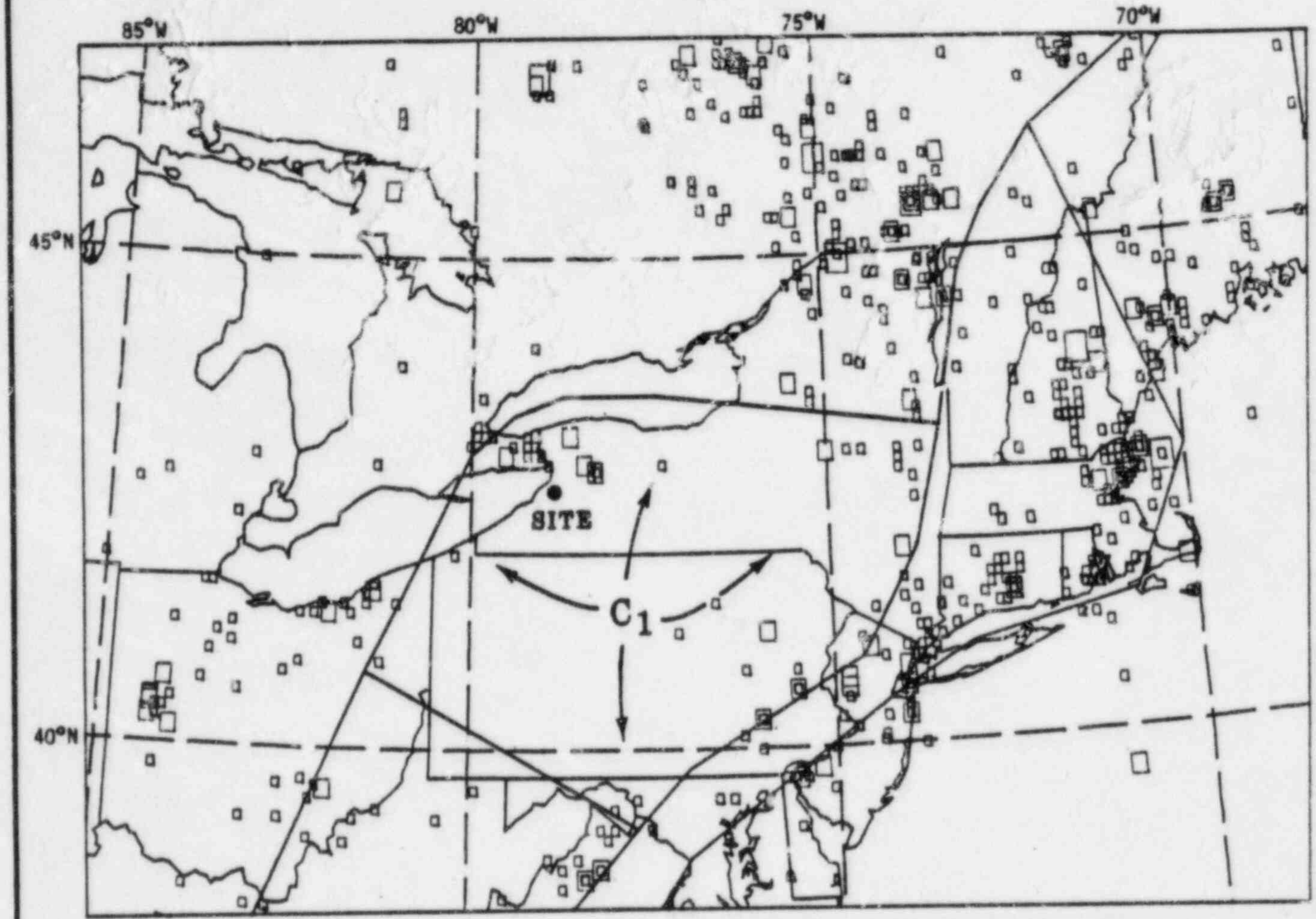


FIGURE A.3.6-C-5



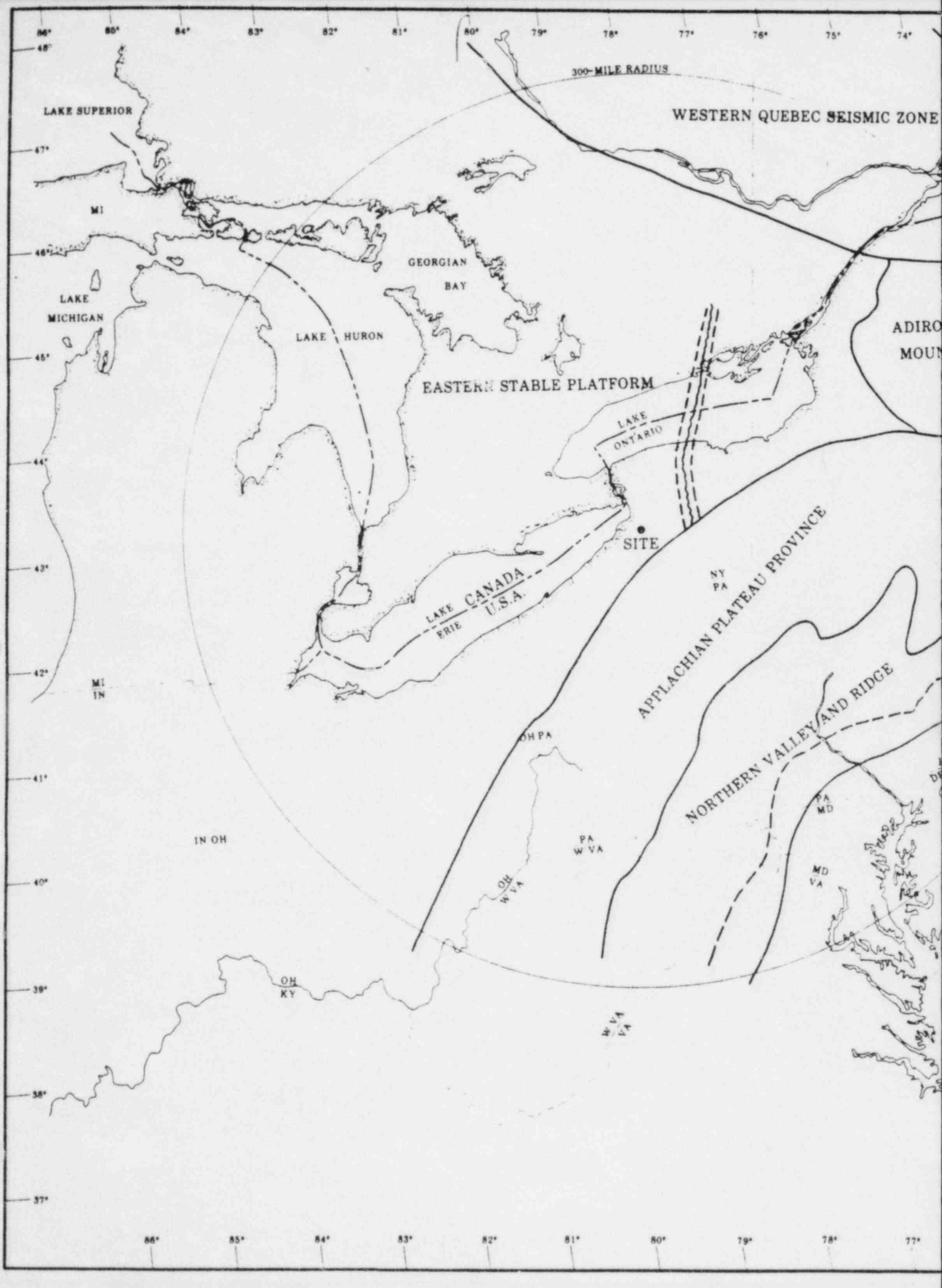
LEGEND:

MAGNITUDE

- $3.5 \leq m_b < 4.5$
- $4.5 \leq m_b < 5.5$
- $5.5 \leq m_b$

DIGITIZED
SEISMIC SOURCE ZONE MAP
NEOTECTONIC APPROACH DEVELOPED
FOR THE PURPOSES OF THIS REPORT

FIGURE A.3.6-C-6



300-MILE RADIUS
WESTERN QUEBEC SEISMIC ZONE
LAKE SUPERIOR
MI
LAKE MICHIGAN
GEORGIAN BAY
LAKE HURON
ADIRO
MOUN
EASTERN STABLE PLATFORM
LAKE ONTARIO
SITE
CANADA
U.S.A.
LAKE ERIE
NY
PA
APPLACHIAN PLATEAU PROVINCE
MI
IN
NORTHERN VALLEY AND RIDGE
OH PA
PA
MD
IN OH
PA
W VA
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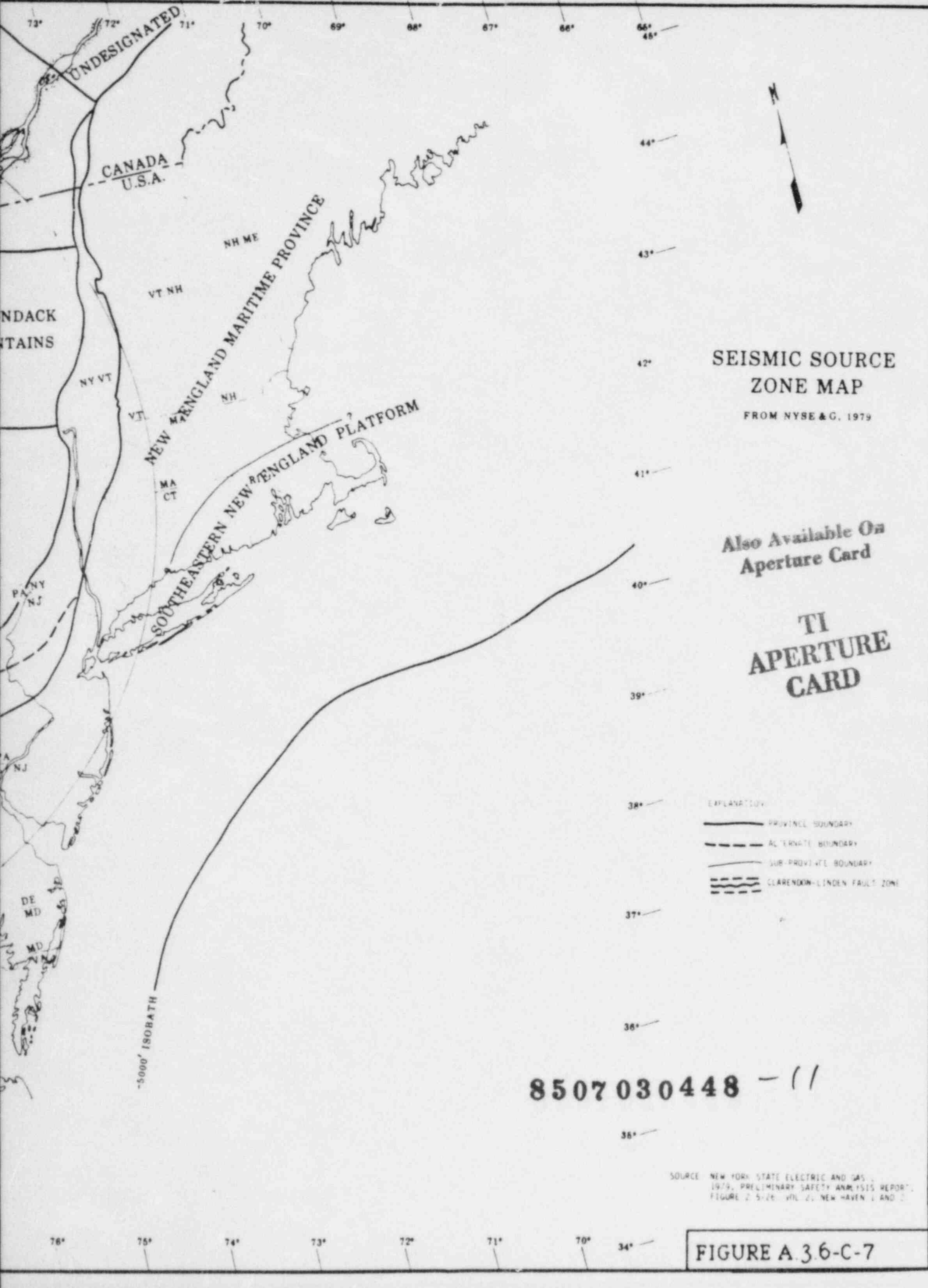

SEISMIC SOURCE ZONE MAP

FROM NYSE&G, 1979

Also Available On Aperture Card

TI APERTURE CARD

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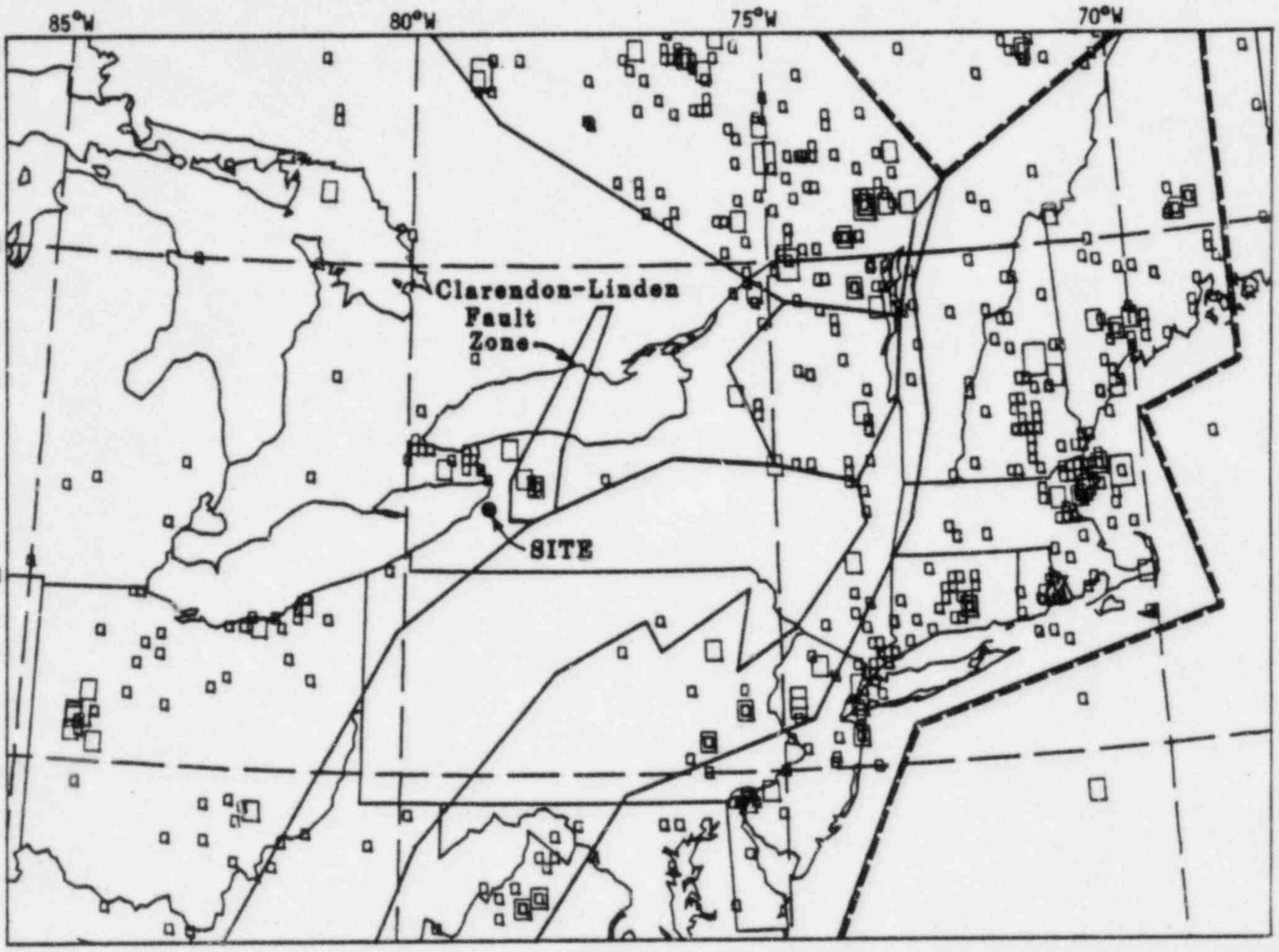
SOURCE: NEW YORK STATE ELECTRIC AND GAS, 1979, PRELIMINARY SAFETY ANALYSIS REPORT, FIGURE 2.5-26, VOL 2, NEW HAVEN 1 AND 2

FIGURE A.3.6-C-7



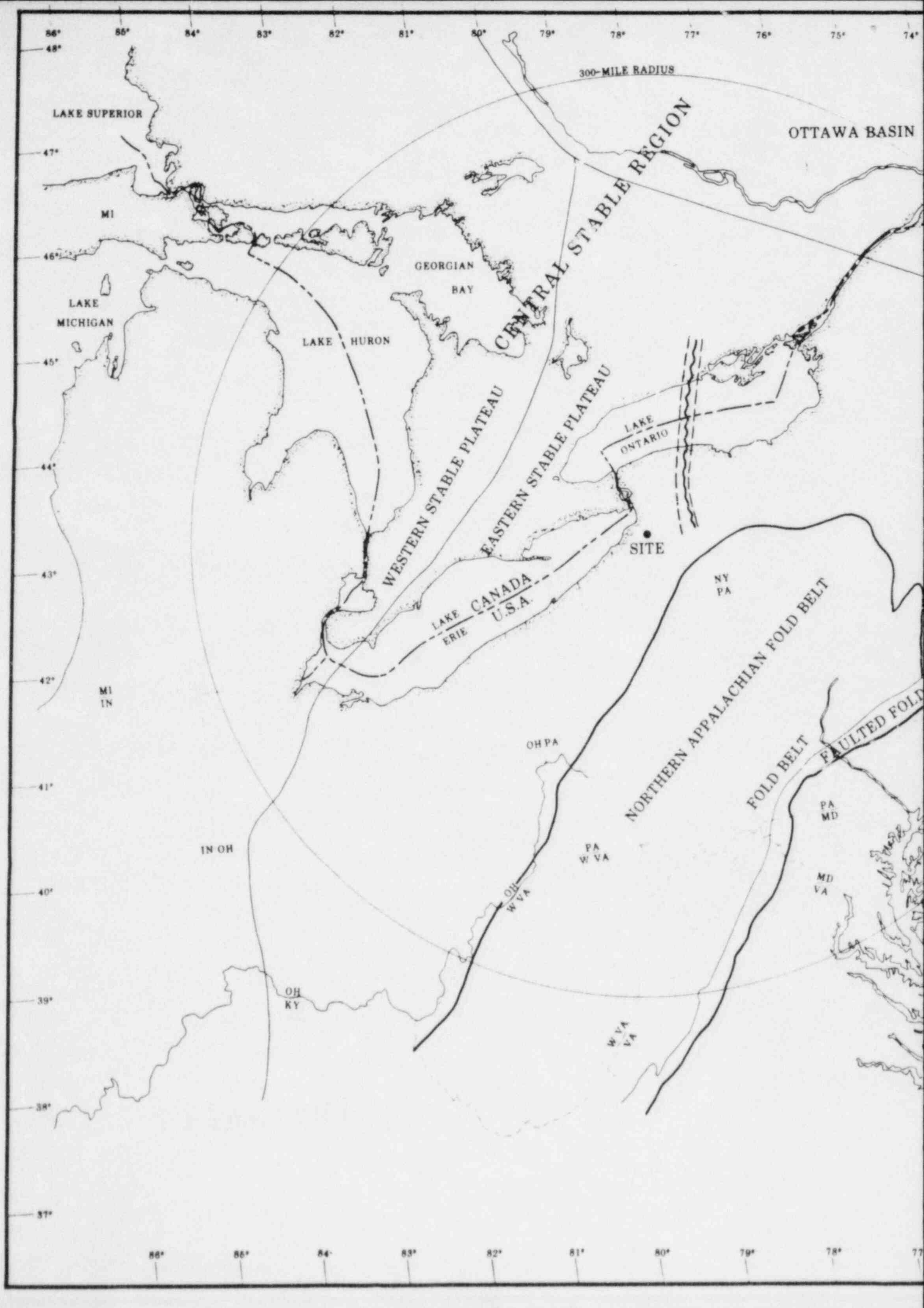
LEGEND:

MAGNITUDE

- ▫ $3.5 \le m_b < 4.5$
- □ $4.5 \le m_b < 5.5$
- ☐ $5.5 \le m_b$
- — — — ARBITRARY BOUNDARY

DIGITIZED
SEISMIC SOURCE ZONE MAP
FROM NYSE & G, 1979

FIGURE A.3.6-C-8



300-MILE RADIUS
LAKE SUPERIOR
OTTAWA BASIN
CENTRAL STABLE REGION
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GEORGIAN
BAY
LAKE
MICHIGAN
LAKE HURON
WESTERN STABLE PLATEAU
EASTERN STABLE PLATEAU
LAKE
ONTARIO
SITE
NY
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CANADA
U.S.A.
LAKE
ERIE
NORTHERN APPALACHIAN FOLD BELT
FOLD BELT
FAULTED FOLD
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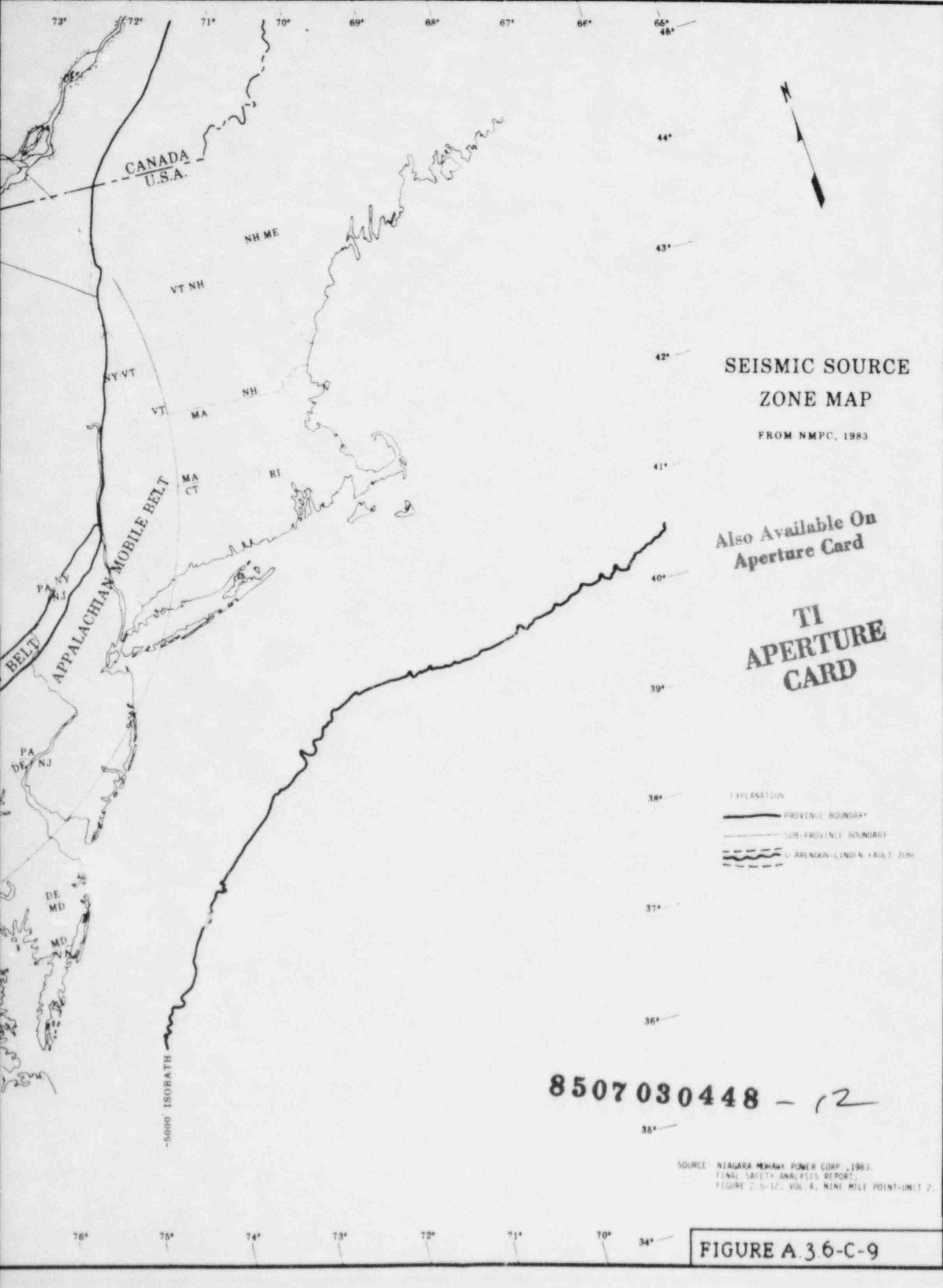


SEISMIC SOURCE ZONE MAP

FROM NMPC, 1983

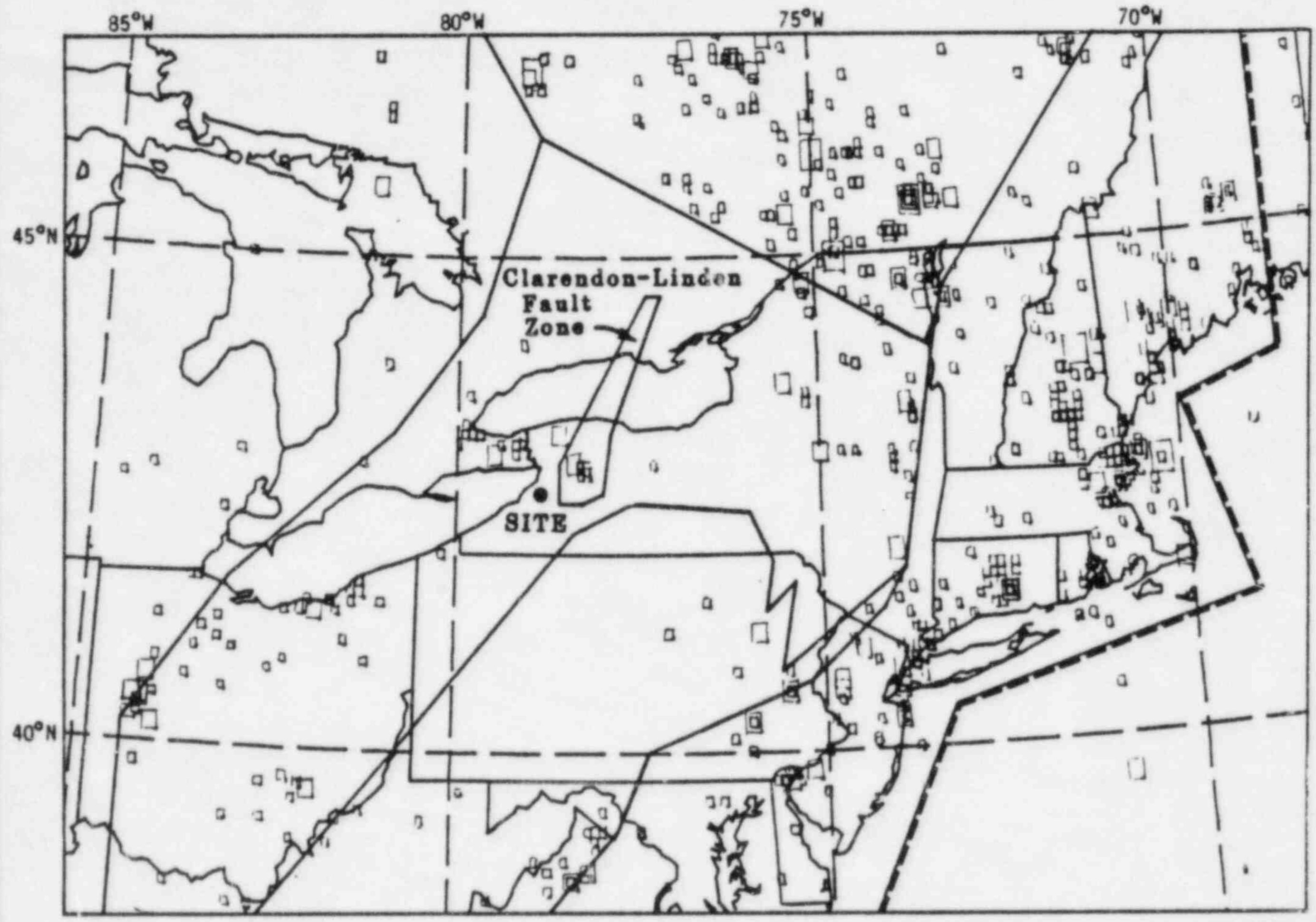
Also Available On Aperture Card

TI APERTURE CARD

8507030448 - 12

SOURCE: NIAGARA MOHAWK POWER CORP., 1983.
FINAL SAFETY ANALYSIS REPORT,
FIGURE 2.5-12, VOL. 4, NINE MILE POINT-UNIT 2.

FIGURE A.3.6-C-9



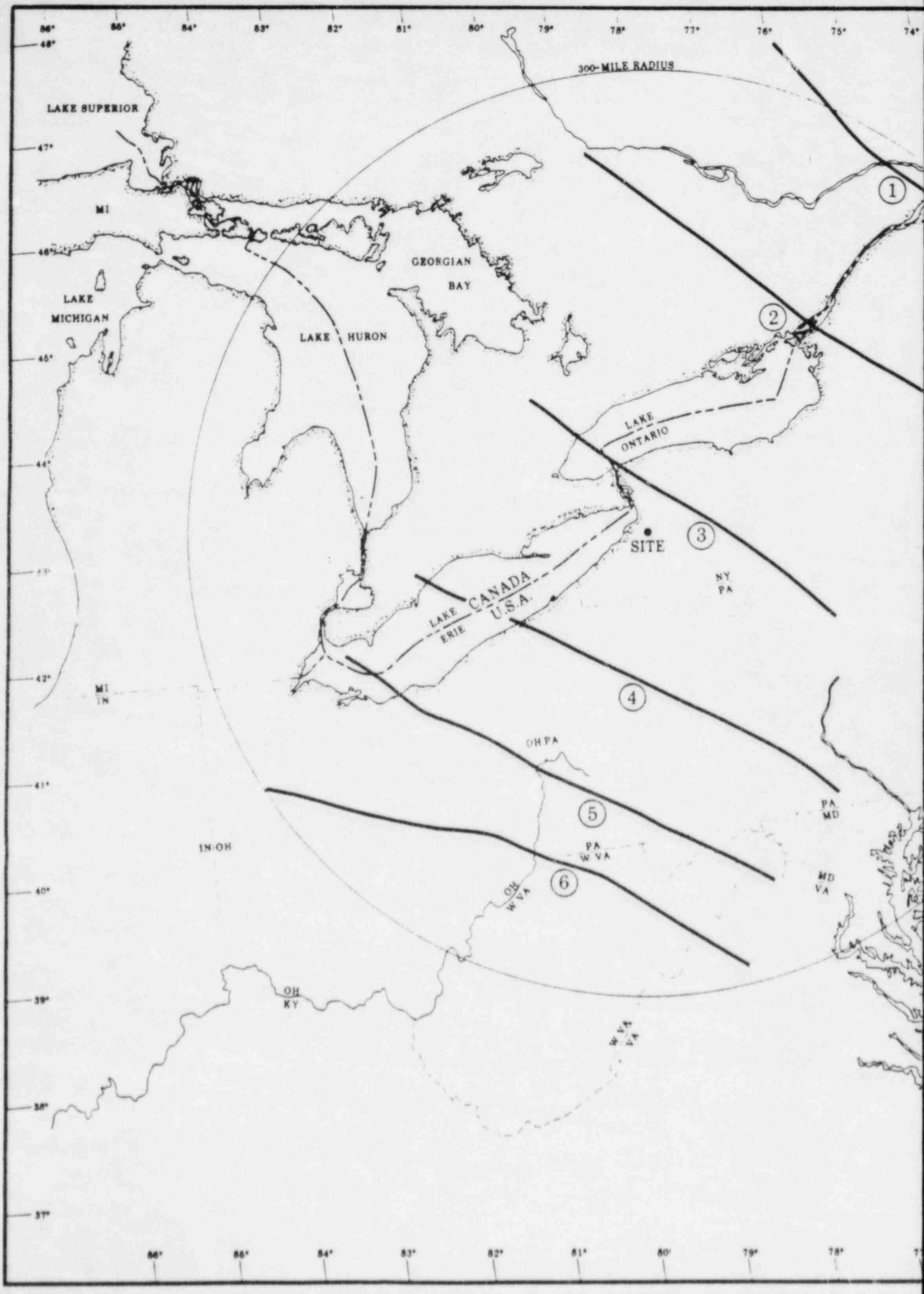
LEGEND:

MAGNITUDE

- $3.5 \le m_b < 4.5$
- $4.5 \le m_b < 5.5$
- $5.5 \le m_b$
- ARBITRARY BOUNDARY

DIGITIZED
SEISMIC SOURCE ZONE MAP
FROM NIAGARA MOHAWK POWER CORPORATION, 1983

FIGURE A.3.6-C-10



300-MILE RADIUS
LAKE SUPERIOR
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LAKE MICHIGAN
GEORGIAN BAY
LAKE HURON
LAKE ONTARIO
SITE
NY PA
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U.S.A.
LAKE ERIE
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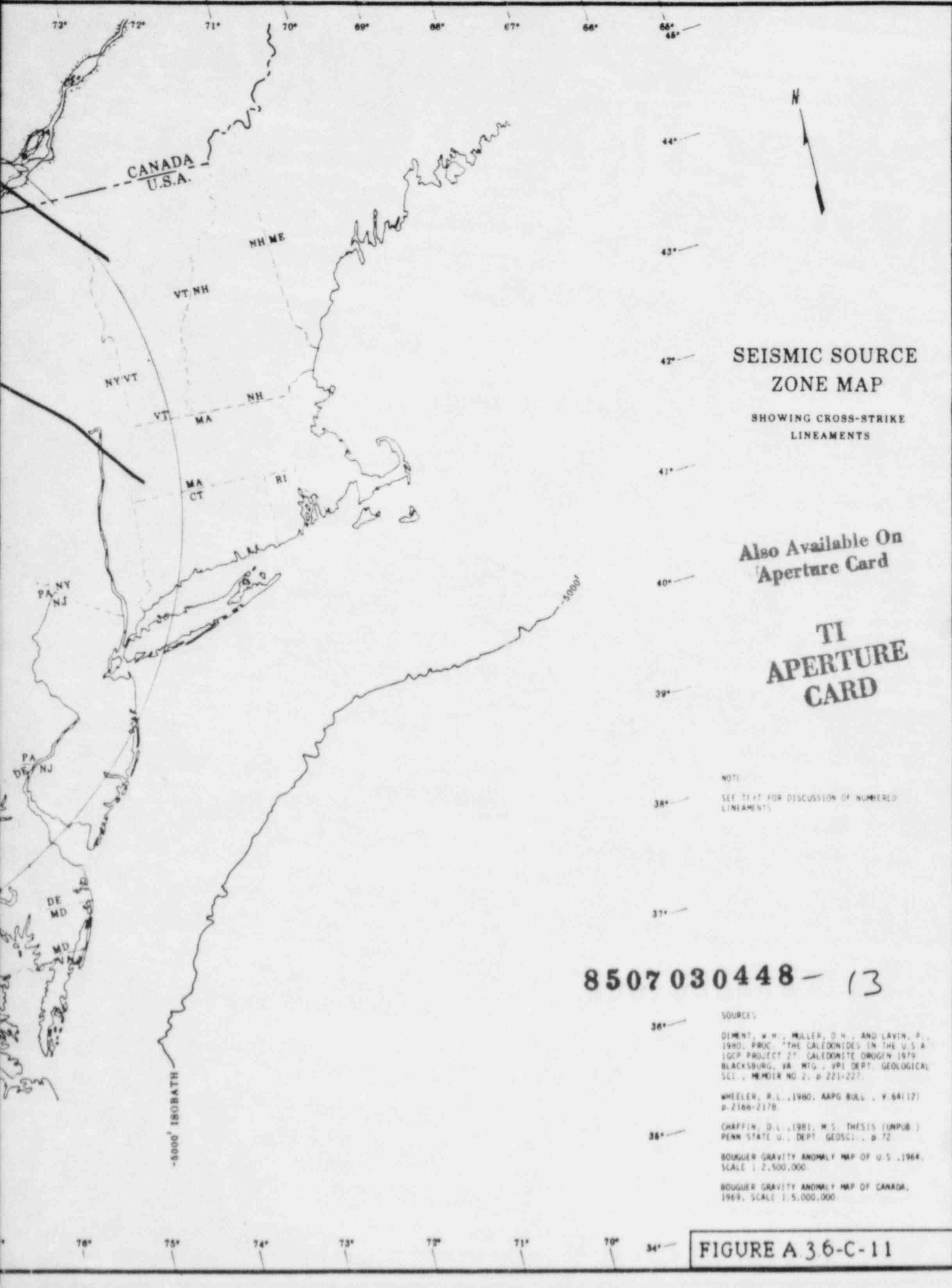

SEISMIC SOURCE ZONE MAP

SHOWING CROSS-STRIKE LINEAMENTS

Also Available On Aperture Card

TI APERTURE CARD

NOTE:

SEE TEXT FOR DISCUSSION OF NUMBERED LINEAMENTS

8507030448 - 13

SOURCES:

DIMENT, W.H., MULLER, O.H., AND LAVIN, P., 1980, PROC. "THE CALEDONIDES IN THE U.S.A IGCP PROJECT 27: CALEDONITE OROGEN 1979 BLACKSBURG, VA. MTG., VPI DEPT. GEOLOGICAL SCI., MEMOIR NO. 2, p. 221-227.

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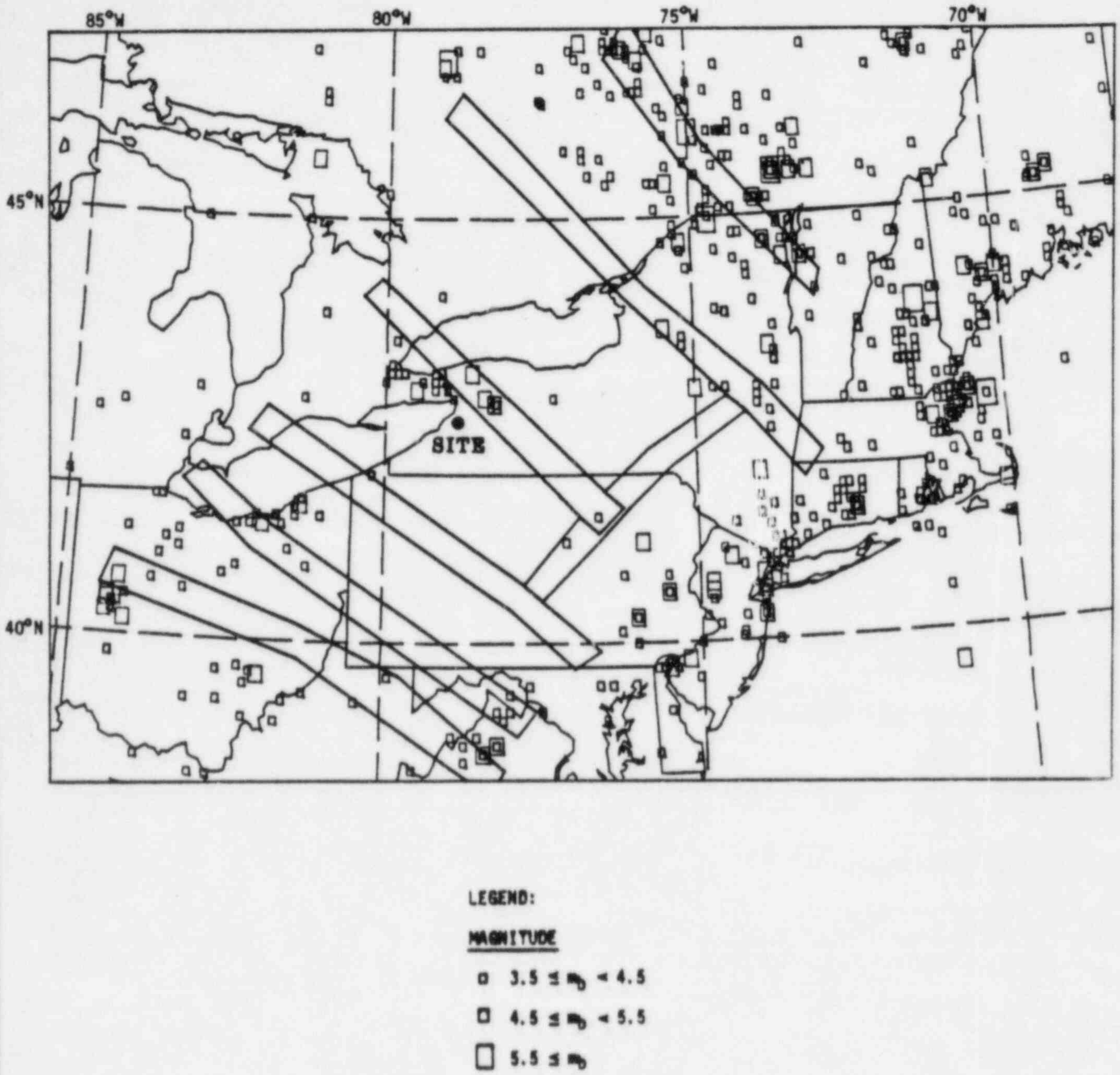
CHAFFIN, D.L., 1981, M.S. THESIS (UNPUB.) PENN STATE U., DEPT. GEOSCI., p. 72.

BOUGUER GRAVITY ANOMALY MAP OF U.S., 1964, SCALE 1:2,500,000.

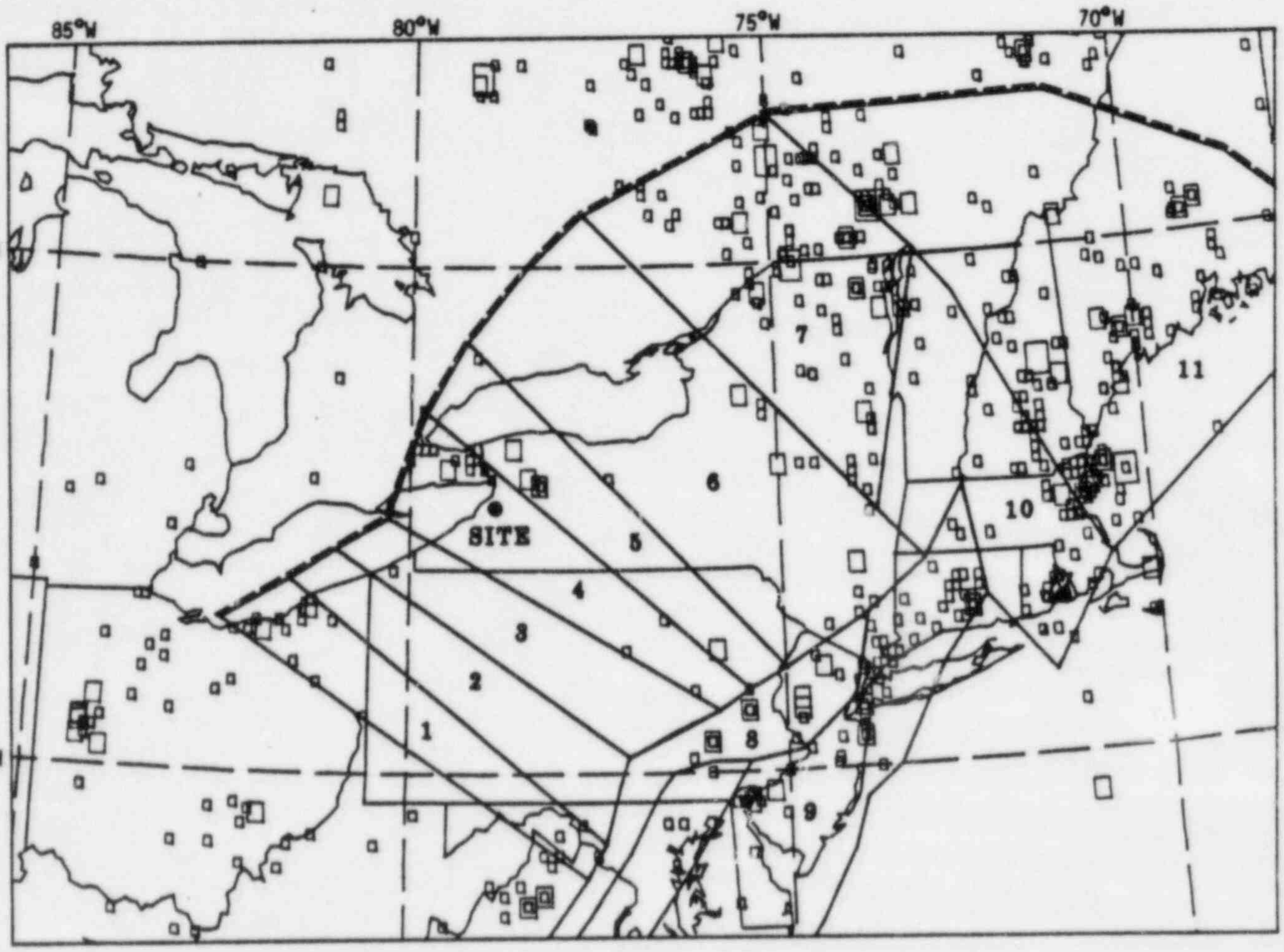
BOUGUER GRAVITY ANOMALY MAP OF CANADA, 1969, SCALE 1:5,000,000.

FIGURE A 3.6-C-11



DIGITIZED
SEISMIC SOURCE ZONE MAP
SHOWING CROSS-STRIKE LINEAMENTS

FIGURE A.3.6-C-12



LEGEND:

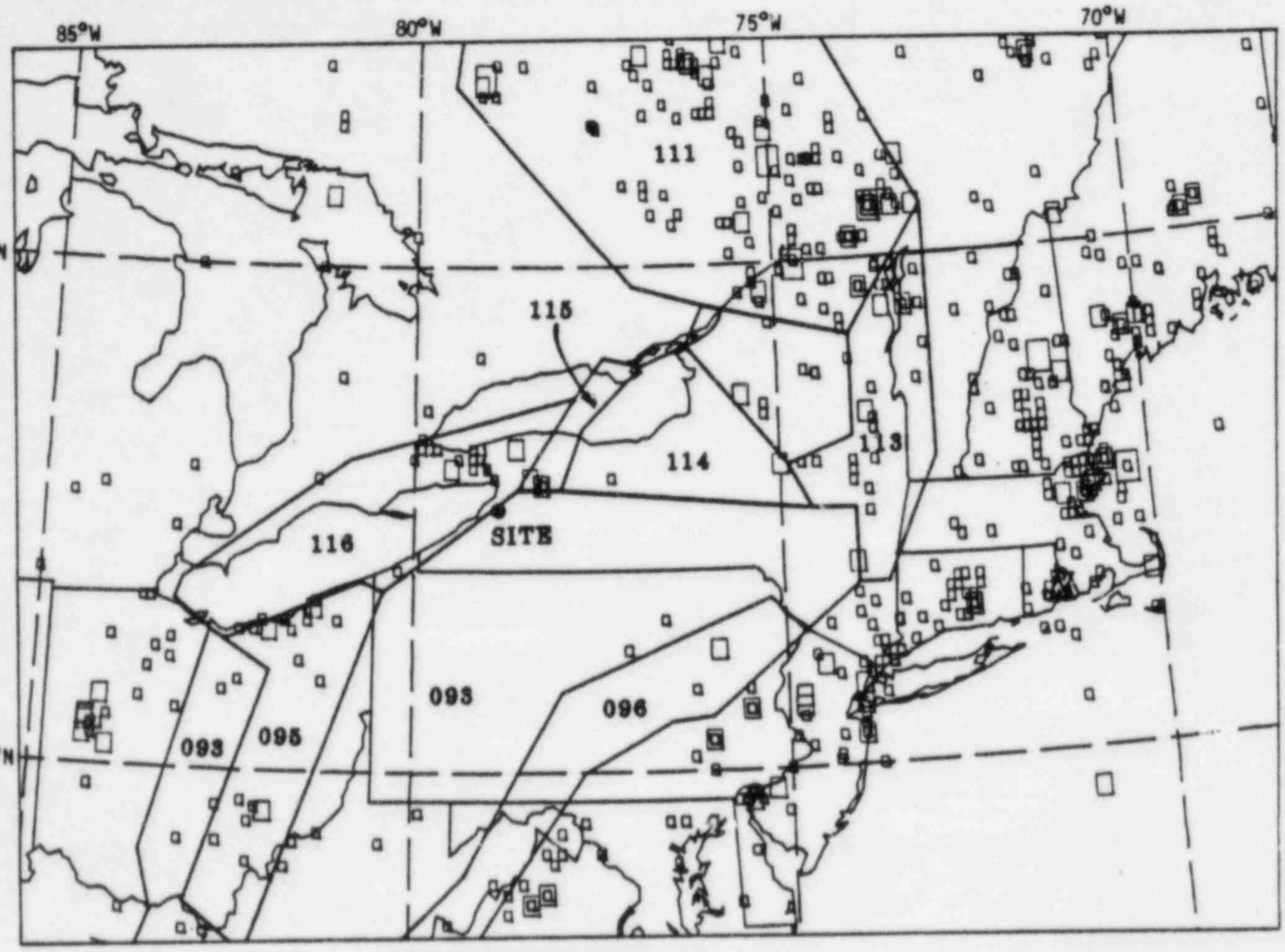
MAGNITUDE

- $3.5 \le m_b < 4.5$
- $4.5 \le m_b < 5.5$
- $5.5 \le m_b$
- ARBITRARY BOUNDARY

SEISMIC SOURCE ZONE MAP

CRUSTAL BLOCK SOURCES

FIGURE A.3.6-C-13



SEISMIC SOURCE ZONE MAP

USGS SOURCES

FIGURE A.3.6-C-14

SUPPLEMENT A.3.6-D

TECTONIC PROVINCE MAXIMUM EARTHQUAKE

A probabilistic assessment of the seismic ground motion hazard was performed for the WVDP at West Valley, New York. As much available information as possible regarding possible seismic source zone models was utilized, including the published works of others and suggestions of US DOE, US NRC and the NYS GS.

The seismic hazard model adopted for this study can be summarized as follows:

Step 1 - Delineate zones of potential future seismic activity using seismicity, geology, and tectonic evidence;

Step 2 - Gather data on historical seismicity and establish the recurrence rate of earthquakes in each zone of each source zone model;

Step 3 - Adopt or derive an attenuation function to represent the decrease in amplitude of seismic waves with distance from the source to the site; and

Step 4 - Mathematically integrate overall earthquake magnitudes and locations and calculate the distribution of peak accelerations at the site for each location.

Having adopted a seismic hazard model, several basic assumptions regarding the validity of treating the input to the model were required. These were:

[1] that seismogenic zones can be drawn to represent the occurrence of future earthquakes and that those occurrences can be represented probabilistically using statistics of historical earthquakes in those zones (see Figures A.3.6-C-1 through A.3.6-C-14 for seismogenic zones used);

[2] that a truncated exponential distribution can be used to represent earthquake sizes;

[3] that the rate of seismic activity can be represented by the historical rate of occurrence; and

[4] that the peak acceleration at the site can be represented as a function of magnitude and distance from the source to the site.

Taking into account the subjective weighting assigned to the various seismic source zone models discussed below, a standard computer program was used to compute the seismic hazard at the West Valley site. The results were characterized as a set of curves plotting annual exceedance probability against peak acceleration.

Subjective weights were assigned to the sets of seismogenic zones described in Supplement A.3.6-C in order to derive the relative likelihood associated with hazard curves. These weights reflect the subjective judgment that each set of zones is the correct one for describing seismic hazard.

The subjective weights were derived in the following manner. Two categories of zones were judged to be equally likely and each category was assigned a subjective weight of 0.30. They are:

[1] NYSE&G, 1979 (PSAR Tectonic Provinces) and Niagara Mohawk, 1983 (FSAR Tectonic Provinces) representing zonation based on Appendix A to 10 CFR 100 deterministic practices; and

[2] Crustal Block Sources and Neotectonic Provinces which represent some of the latest thinking regarding causes of contemporary seismicity.

A third category includes the Hadley and Devine (1974) source zones. This model was subjectively weighted the highest (0.25) of any single set of zones because it constitutes the most general interpretation and was drawn taking historical seismicity into account.

A fourth category includes two models considered less likely than the correct models (USGS sources and tectonic lithofacies sources) to explain current seismic activity, but which represent an interpretation of Eastern United States tectonics. The subjective weights assigned to each set of seismic source zones are:

Model	Weight
Hadley and Devine Sources	0.25
Crustal Block Sources	0.15
Neotectonic Provinces	0.15
NYSE&G, 1979 (PSAR)	0.15
Niagara Mohawk, 1983 (FSAR)	0.15
Tectonic Lithofacies	0.10
USGS Sources	0.05
Total	1.00

A sensitivity analysis of all zones considered (Dames and Moore, 1983) demonstrates that no single model contributes overwhelmingly to the seismic hazard at the West Valley site, even though one model (Hadley and Devine) was given more credibility than the rest. The seven sets of zones in Figures A.3.6-C-1 through A.3.6-C-14 represent a range of possible seismogenic zone interpretations in the Northeastern United States and represent a reasonable range of hypotheses with which to investigate seismic hazard at the West Valley site.

The probabilistic calculation of seismic hazard requires several parameters describing seismicity for each seismogenic zone. These parameters and the methods used to estimate mean values and to quantify uncertainty are discussed below. The Chiburis (1981) catalog of historical earthquakes was used as the data base for this study. All earthquakes in the catalog within 300 km of the site and with MM intensity greater than or equal to are listed in Supplement A.3.6-F. For statistical data analysis, earthquakes with an

epicentral MM intensity I_e but without a magnitude estimate (preinstrumental seismicity) were converted to a body-wave magnitude m_b using the relation (Nuttli and Herrmann, 1978):

$$m_b = 1.75 + 0.5\ I_e \tag{1}$$

Equation (1) was derived for the Central United States, but is considered reliable for the Eastern United States as well (Bollinger, personal communication, 1983).

Richter b-value

The Richter b-value describes the slope of the log-number versus magnitude relation:

$$\log_{10} N\ (m_b) = \Theta - bm_b \tag{2}$$

where $n(m_b)$ is the annual number of earthquakes of body-wave magnitude m_b, and Θ and b are parameters statistically fit to seismicity data. Parameter Θ is related to seismic activity rate as discussed in later in this supplement.

The method of estimating b-values used in this study is as follows. Magnitudes were estimated from MM Intensities using equation (1), and the number of events per decade were counted into magnitude intervals centered on magnitudes estimated from whole MM Intensity values. Periods of historical completeness were determined as follows:

Magnitude (m_b)	MM Intensity	Period
3.25	III	1970-1980
3.75	IV	1940-1980
4.25	V	1920-1980
4.75	VI	1880-1980
5.25	VIII	1780-1980
6.25	IX	1720-1980
6.75	X	1610-1980

Where alternative periods appeared more appropriate or gave higher rates for particular zones (especially in more recent years), these alternative periods were used.

For each zone, the number of events in each magnitude range was used as data and a b-value and its uncertainty were determined using the maximum likelihood methods (Weichert, 1980). In almost all cases a b-value close to (within one standard error of) 0.9 was obtained and is typical of numbers offered by experts polled in the TERA Corp. (1980) study. These experts generally felt a single b-value for all zones in the Central and Eastern United States was appropriate. Statistical uncertainty in the b-value by this method of calculation was examined by changing the calculated b-values by 15 percent in conjunction with the changes in maximum magnitude described below. Fifteen percent is a typical one standard deviation uncertainty in b-value calculations for the Eastern United States. Probabilities associated with these changes are discussed below in the section on uncertainty in maximum magnitude.

Seismic Activity Rate

The rate of earthquake occurrence was determined for each seismogenic zone by using historical earthquakes of that zone. Activity rates were calculated for occurrences of earthquakes with M ±4.5 (where m_b is body-wave magnitude); this corresponds to MM Intensity VI. This decision was based on the observation that earthquakes of smaller magnitude rarely cause structural damage, even with high peak accelerations due to the short duration impulsive-type ground motions associated with these small events. No uncertainty in activity rates was considered herein, because historical rates of seismic activity are relatively well-determined, even in the Eastern United States (McGuire, 1977). Important in this assumption is the consideration that calculated frequencies to exceedance are directly proportional to activity rates, and ground motion amplitudes at levels of interest change relatively slowly with respect to frequency of exceedance.

Activity rates were calculated by converting equation (2) to the cumulative number of earthquakes (number of events per year greater than a specified magnitude) and determining this cumulative number for m = 4.5. This cumulative number then became the seismic activity rate, "b".

Uncertainty in Maximum Magnitude

The best estimate of maximum possible magnitude, $m_{b.max}$, in each zone was generally taken to be 0.5 magnitude units above the magnitude of the largest historical earthquake. This corresponds to one MM Intensity unit higher than the maximum historical MM Intensity and is consistent with a consensus of experts polled in the TERA Corp. (1980) study. The only exception was for the Clarendon-Linden fault zone, which is discussed at greater length in Sections A.3.6.2.6, A.3.6.2.7, and A.3.6.2.8. Using the zone in each model which

dominated the risk at the site, alternative values of ±0.5 magnitude units from the best estimate in those zones were examined to determine the effect of uncertainty in maximum magnitude on the hazard calculations. The three values of maximum magnitude were weighted equally (i.e., one-third each). In the hazard calculations, it was assumed that uncertainty in maximum magnitude was perfectly correlated with statistical uncertainty in the Richter b-value (described above). The reason for this assumption is that there is some suspected negative correlation between these two variable (small b-values tend to correlate with high maximum magnitudes, and vice verse). An accurate modeling of this negative correlation is beyond the level of sophistication required for this assessment. An assumption of perfect negative correlation gives accurate results in the mean and if anything overemphasizes the effect sought.

In all cases, all zones shown in Figures A.3.6-C-1 through A.3.6-C-'4 were used in the hazard calculations to confirm that only the most active zone closest to the site contributed to seismic hazard. Table A.3.6-D-1 presents the seismicity parameters for the dominant seismic source zone in all the models considered. Also included in Table A.3.6-D-1 are the subjective weights given to each model. These probabilities are an indication of how valid the model is thought to be for explaining seismic hazards in the northeast.

REFERENCES FOR SECTION SUPPLEMENT A.3.6-D

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TABLE A.3.6-D-1

Seismic Source Zones and Associated Seismicity Parameters

Seismic Source Zone	Dominant Zone	Area ($10^4 km^2$)	Activity Rate (m_b 4.5)	Richter b-value	$m_{b,max}$	Subjective Weight
Tectonic Lithofacies	Appalachian Basin	95.38	0.2662	0.86/1.01/1.17	6.8/6.3/5.8	0.10
NYSE and G (1978)	Clarendon-Linden Fault Zone	0.79	0.0352	0.77/0.90/1.04	6.5/6.0/5.5	0.15
Niagara Mohawk Power Corp. (1983)	Clarendon-Linden Fault Zone	0.79	0.0352	0.77/0.90/1.04	6.5/6.0/5.5	0.15
A Neotectonic Approach	C_1	20.82	0.0810	0.71/0.84/0.97	6.3/5.8/5.3	0.15
Hadley and Devine (1974, Plate C)	Central Stable Region	87.05	0.2319	0.82/0.97/1.11	6.8/6.3/5.8	0.25
Cross-Strike	-	-	-	-	-	-
Crustal Block Sources	5	3.47	0.0806	0.77/0.90/1.04	5.8/5.3/5.3	0.15
USGS Sources	115	0.55	0.0352	0.77/0.90/1.04	6.5/6.0/5.5	0.05

SUPPLEMENT A.3.6-E

ESTIMATION OF GROUND MOTION

Dames and Moore (1983) estimated peak single-component horizontal ground acceleration, a_p, for the WVDP using two methods. These are described in the following paragraphs.

The first attenuation equation used is that of Nuttli and Herrmann (1981):

$$\ln a_p = 1.265 + 1.15\ m_b - 0.0044\ \% - 0.833 \ln \Delta \quad (3)$$

where Δ is epicentral distance and a_p is in cm/sec^2. This function is plotted in Figure A.3.6-E-1. For any given magnitude, accelerations in the near-field are assumed to be constant (see the horizontal portion of the curves shown in Figure A.3.6-E-1) and limited as a function of magnitude by the following relationship (Nuttli and Herrmann, 1981):

$$\ln a_p\ (\max) = 0.933\ m_b \quad (4)$$

A second attenuation was derived from MM Intensity attenuation observed during earthquakes in New England (G. Klimkiewicz, personal communication, 1982). This intensity attenuation is:

$$I_s = -1.43 + 1.79\ m_b - 0.80 \ln \Delta\ 0184\ \Delta;\ \Delta \geq 10 \text{ km} \quad (5)$$

where I_s is MM Intensity at a site located at an epicentral distance Δ from the earthquake. The method used to convert I_s to a_p (McGuire, 1977) is as follows:

$$\ln a_p = 1.45 - 0.359 \ln \Delta + 0.68\ \ I_s \quad (6)$$

This method recognizes that the transformation between site intensity and peak acceleration may be a function of epicentral distance. Equation 6 was derived for stiff soil sites and is assumed here to apply to rock sites as well. Substituting Equation 5 into 6 gives:

$$\ln a_p = 0.478 + 1.22\, m_b - 0.90 \ln \Delta - 0.00125\, \Delta;\ \Delta\ 10\ \text{km} \qquad (7)$$

Equation 7 is designated as the "AID" ("Acceleration from Intensity with Distance-dependance") attenuation. This function is plotted in Figure A.3.6-E-2. In this assessment, both attenuation equations were used. For the purposes of deriving best-estimate and fractile hazard curves, a subjective weight of one-half was used with each attenuation function (Equations 3 and 7).

For calculation of seismic hazard, a log normal distribution of acceleration about the mean value was assumed, with a standard deviation of $\ln\sigma$ equal to 0.6 corresponding to a factor of 1.8 uncertainty in the estimate. The distribution is widely used to represent uncertainty in ground motion estimates; the uncertainty modeled is typical of the scatter exhibited by strong motion data set, as shown in Table A.3.6-E-1, when the data are restricted to a specific area such as the Western United States. Data from a specific earthquake may show a standard deviation less than 0.6 (for example, the Donovan study of the San Fernando earthquake) but this is only

representative of that one event. When data from worldwide locations are used in the analysis, larger values of uncertainty are obtained because of different mean attenuations. For this study it was more appropriate to use an uncertainty typical of a specific geographic area.

Results of Analysis

Figures A.3.6-E-3 through A.3.6-E-6 present seismic hazard results in terms of annual frequency of exceedance versus peak acceleration. These figures also show sensitivities of seismic hazard to the ranges of variables and assumptions used. Figure A.3.6-E-6 shows fractiles of seismic hazard results.

The sensitivity to the choice of seismogenic zones is shown in Figure A.3.6-E-3. For the Nuttli and Herrmann (1981) attenuation, the total range in hazard (frequency of exceedance for a given acceleration) for the range of seismic source zones is about a factor of three.

Seismic hazard curves as a function of maximum magnitude, $m_{b.max}$, are shown in Figure A.3.6-E-2. The curves shown are for the Nuttli and Herrmann (1981) attenuation using the Hadley and Devine (1974) seismic source zones. The sensitivity using the AID attenuation is similar. The uncertainty in the $m_{b.max}$ in the dominant zone (and simultaneous statistical uncertainty in the b-value, as described in Supplement A.3.6-D) translates into uncertainty of a factor of ±2 in annual frequency, from the best-estimate value of $m_{b.max}$ for that zone.

Figure A.3.6-E-5 shows the calculated annual frequency of exceedance for Hadley and Devine (1974) seismic source zones for the two attenuation equations. The Nuttli and Herrmann (1981) attenuation equation indicates higher hazard than the AID attenuation equation by a factor of about three.

However, use of the Nuttli's (1979) sustained maximum horizontal acceleration attenuation curves yields results in good agreement with the AID relationship. In all, 42 seismic hazard curves were generated in this study (seven sets of seismogenic zones, times two attenuation functions, times three maximum magnitudes in the dominant zone). To synthesize and present these results, the curves were aggregated into three representative curves which describe the uncertainty resulting from the different parameters used. Based on the subjective weight (probability) of each model, the median, 16 percent and 84 percent (± approximately one standard deviation) fractile curves were developed. Figure A.3.6-E-7 shows these fractile hazard curves. This figure gives an indication of the uncertainty in the hazard as a result of the combined uncertainty in seismogenic zones, attenuation functions, and maximum magnitudes. From the sensitivities shown in Figures A.3.6-E-3 through A.3.6-E-5, no single uncertainty in input dominates the uncertainty in seismic hazard. Figure A.3.6-E-6 shows that uncertainty in models and assumptions results at the one standard deviation level in an uncertainty of about a factor of two in frequency of exceedance from the median results.

Recommended SSE

The analysis discussed in Section A.3.6.2.10.2 provides a detailed examination of the seismic hazard at the West Valley site, including the uncertainty in the hazard as a result of uncertainty in the input parameters to the hazard model. To identify an appropriate seismic design level for West Valley, results from similar studies at nuclear power plants can be used if the differences in design lifetimes of the two types of facilities are accounted for.

A typical nuclear power plant has a potential operational lifetime of 40 years, whereas WVDP will have an operational lifetime of about one and one-half years, or an inverse ratio of 26.6. All other factors being equal, it is thus reasonable that an acceptable annual risk at West Valley might be about 26.6 times the acceptable annual risk at a conventional nuclear power plant. Current seismic hazard analysis for conventional nuclear power plants indicates an annual probability of exceedance for the design seismic event (SSE) acceleration of between 10^{-3} and 10^{-4}, or 3×10^{-4}. Applying the operation lifetime inverse ratio of 26.6 to this exceedance probability as representative of the scaled "time exposure" between WVDP and a conventional nuclear power plant to seismic hazard yields an annual exceedance probability in the range of 3×10^{-2} to 3×10^{-3} as a scaled comparison of design acceleration for the West Valley facility. Examining Figure A.3.6-E-6 at this level of exceedance shows that the corresponding peak acceleration would be less than 0.07 g even at the 84 percent fractile (+1) level on the aggregate seismic hazard curves.

Additionally, it has been previously presented (Position Paper on a Maximum Earthquake Seismic Criterion, July 9, 1982) that the radioactivity at risk for facilities at the West Valley site is substantially less (about 0.1 percent) than that associated with a typical 1000 Mw power plant. Qualitatively, it is reasonable to assume that the attendant risk to the population at large would be less as well. This would imply that an even higher annual risk than 8×10^{-3} would be acceptable at West Valley as compared to typical nuclear power plant.

As a result of the previously described analysis, a range of annual exceedance probabilities of 3×10^{-2} to 3×10^{-3} for the WVDP is adopted as conservatively representative of the seismic hazard at the site and comparable to current analyses for a typical Eastern United States nuclear power plant. This would translate into ground motion levels of less than 0.07 g, even at the 84 percent fractile (+1), a level of ground motion less than the 0.12 g design level acceleration adopted herein for the existing West Valley facilities. The adopted acceleration is equivalent to that from an intensity VIII on the Clarendon-Linden Structure, 23 miles from the site.

REFERENCES FOR SECTION SUPPLEMENT A.3.6-E

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TABLE A.3.6-E-1

UNCERTAINTIES REPORTED FOR ATTENUATION EQUATIONS

Reference	Data Base	∂ ln a
Campbell (1981)	Western U.S.	0.37
Cornell et al, (1979)	Western U.S.	0.57
Donovan (1973)	World-Wide	0.84
Donovan (1974)	San Fernando	0.481
Donovan (1974)	World-Wide	0.707
Esteva and Villaverde (1974)	Western U.S.	0.64
Joyner and Boore (1981)	Western U.S.	0.60
McGuire (1974)	Western U.S.	0.51.
McGuire (1978a)	Western U.S.	0.62
Patwardhan et al (1978)	California, Japan Nicaragua, India (Shallow focus)	0.58
Shannon and Wilson, Inc. and Agbabian Assoc. (1979)	Western U.S.	0.573
Trifunac (1976)	Western U.S.	0.60*

*Calculated using procedure discussed in McGuire (1978b).

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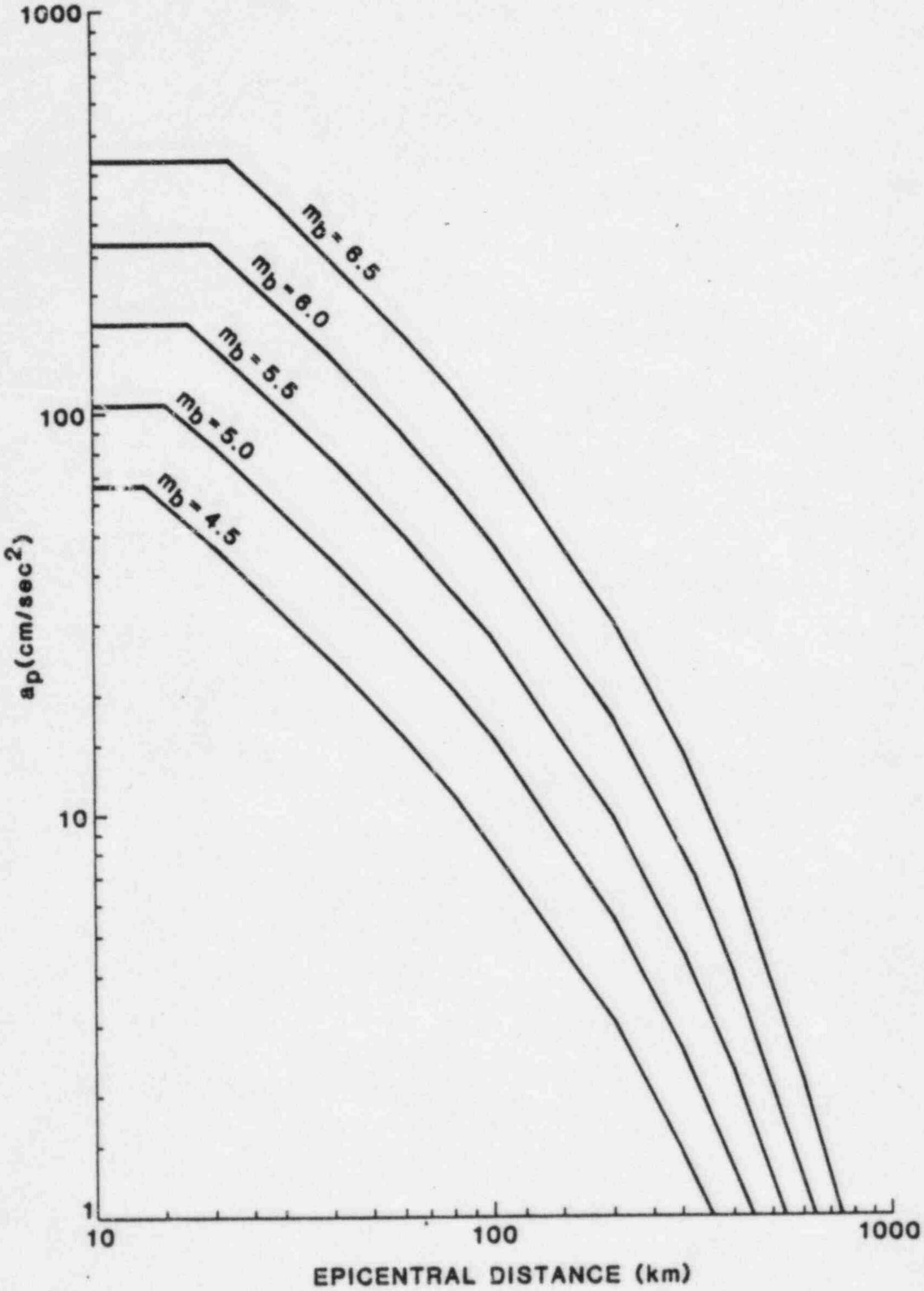
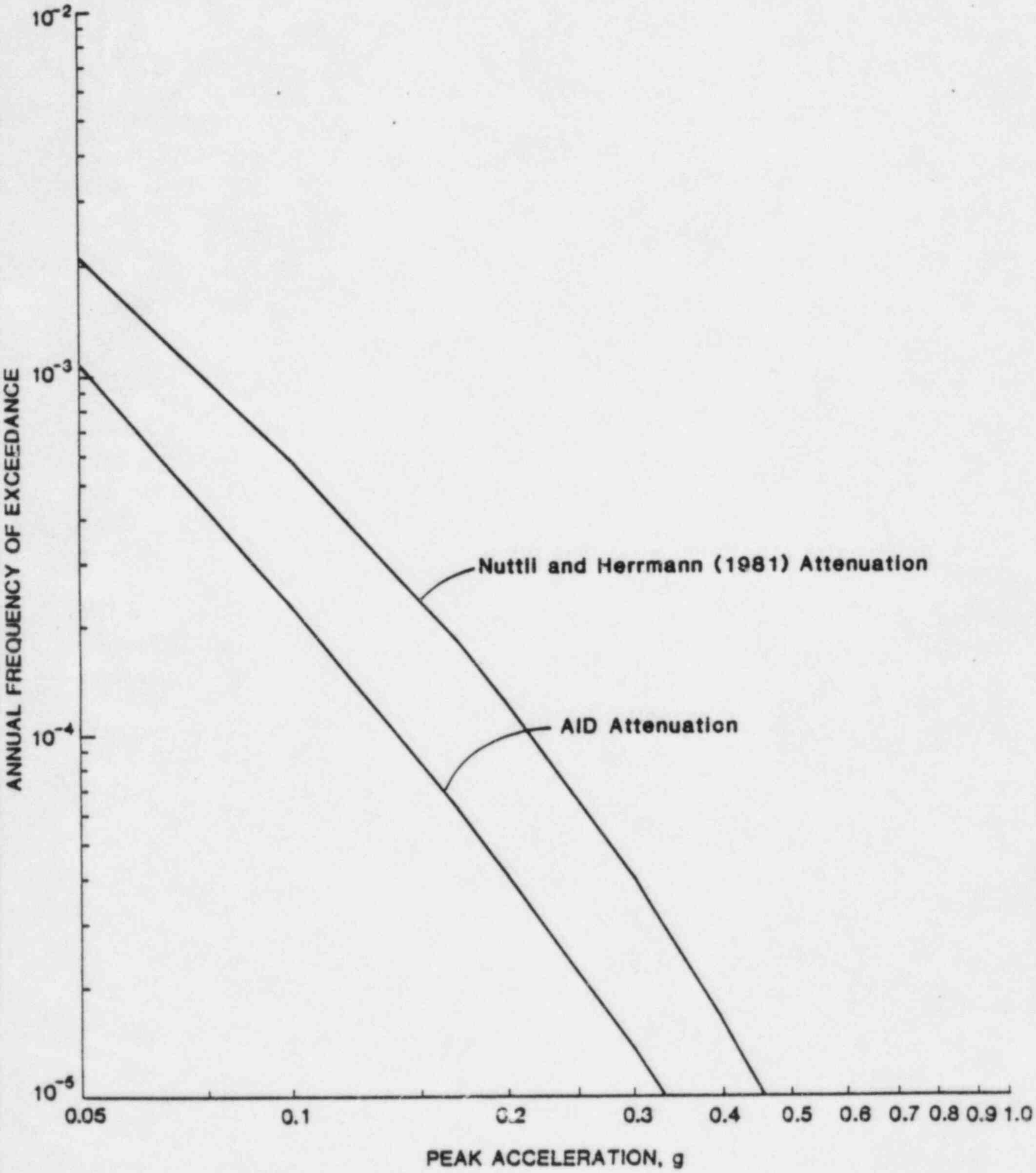


Nuttli and Herrmann (1981) Attenuation Function (Equation 3)

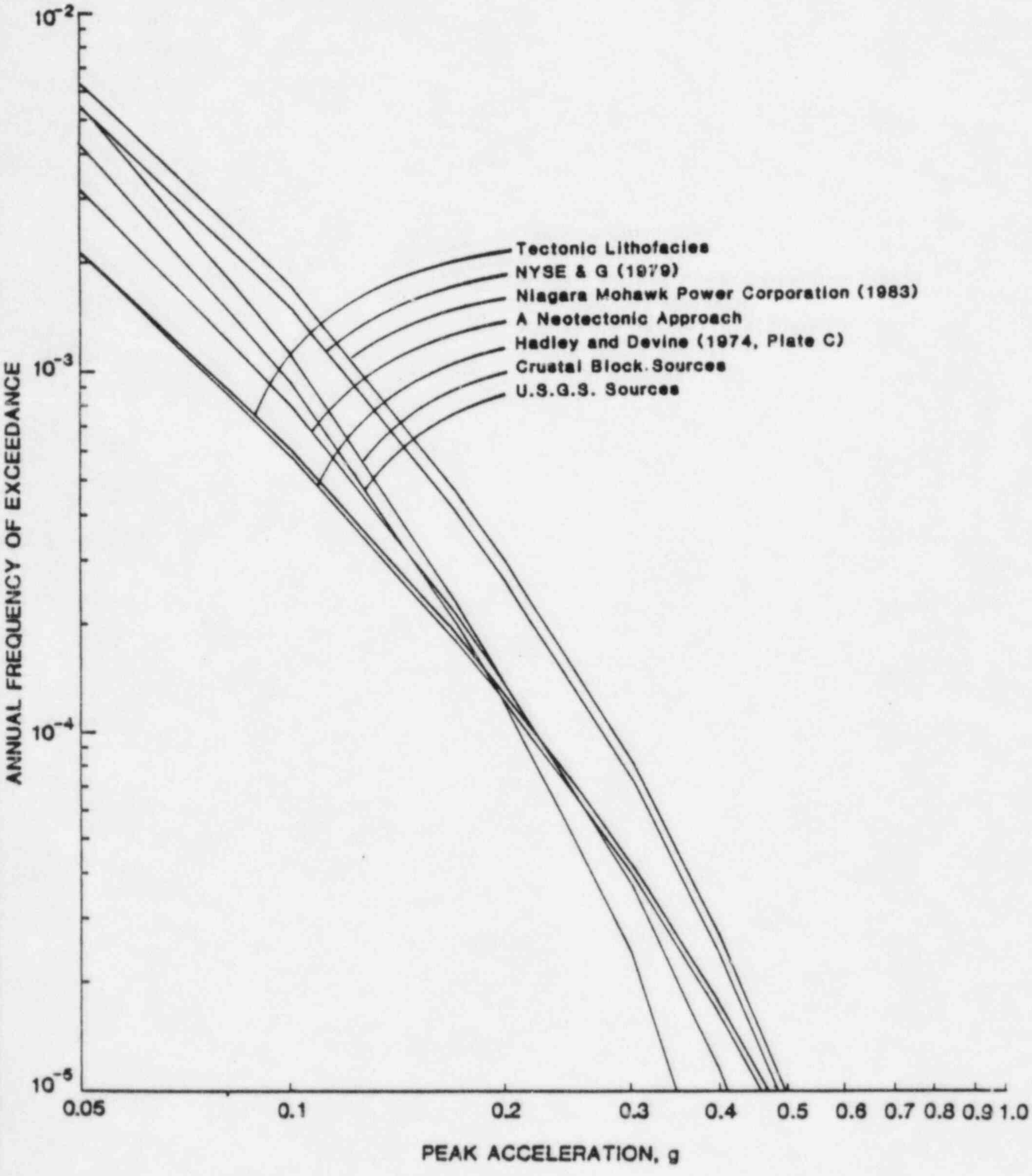
FIGURE A.3.6-E-1



Seismic Hazard: Attenuation Sensitivity

Hadley and Devine (1974, Plate C) Seismic Source Zones
Maximum Historical Magnitude +0.5

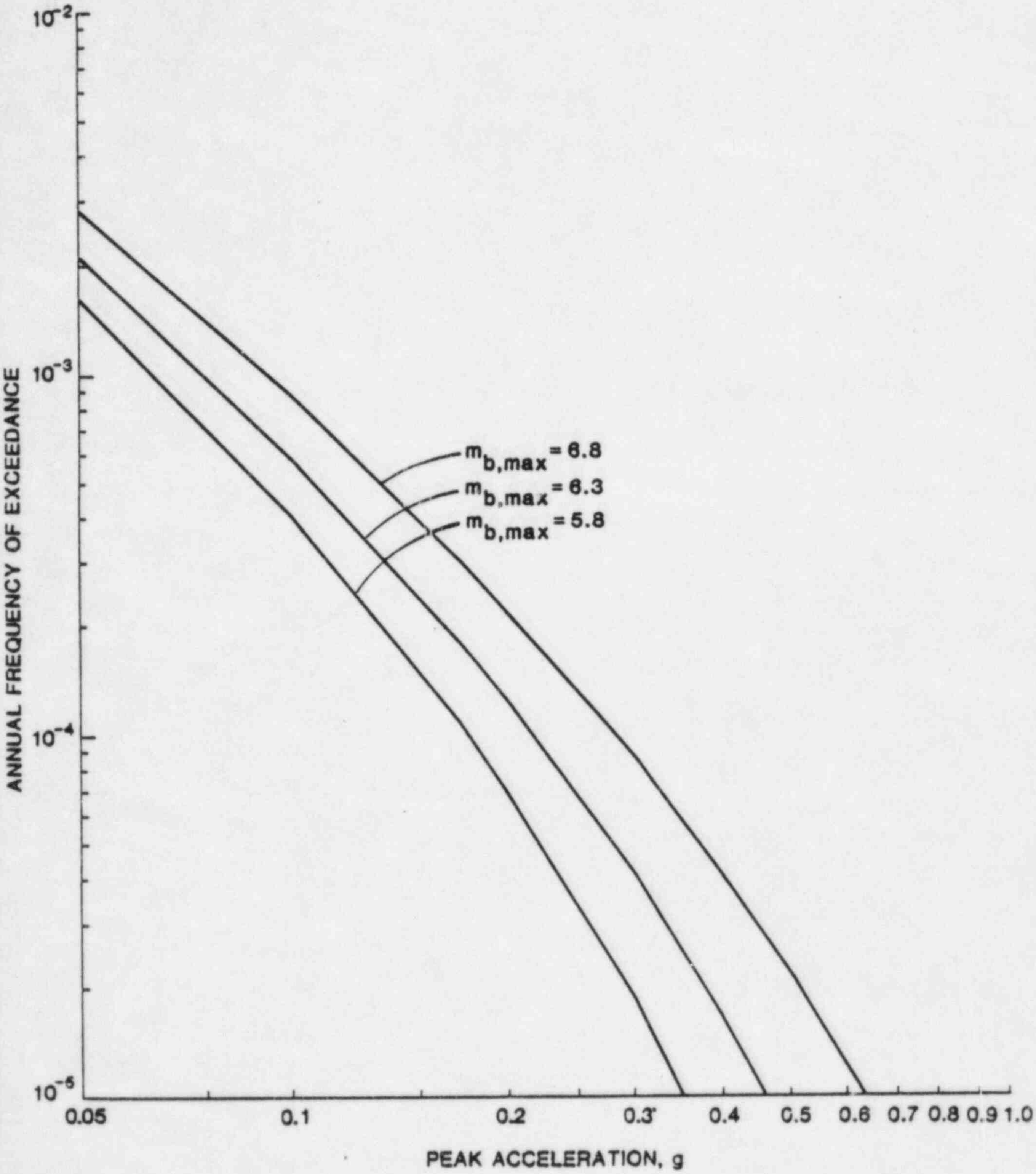
FIGURE A.3.6-E-2



Seismic Hazard: Zone Sensitivity

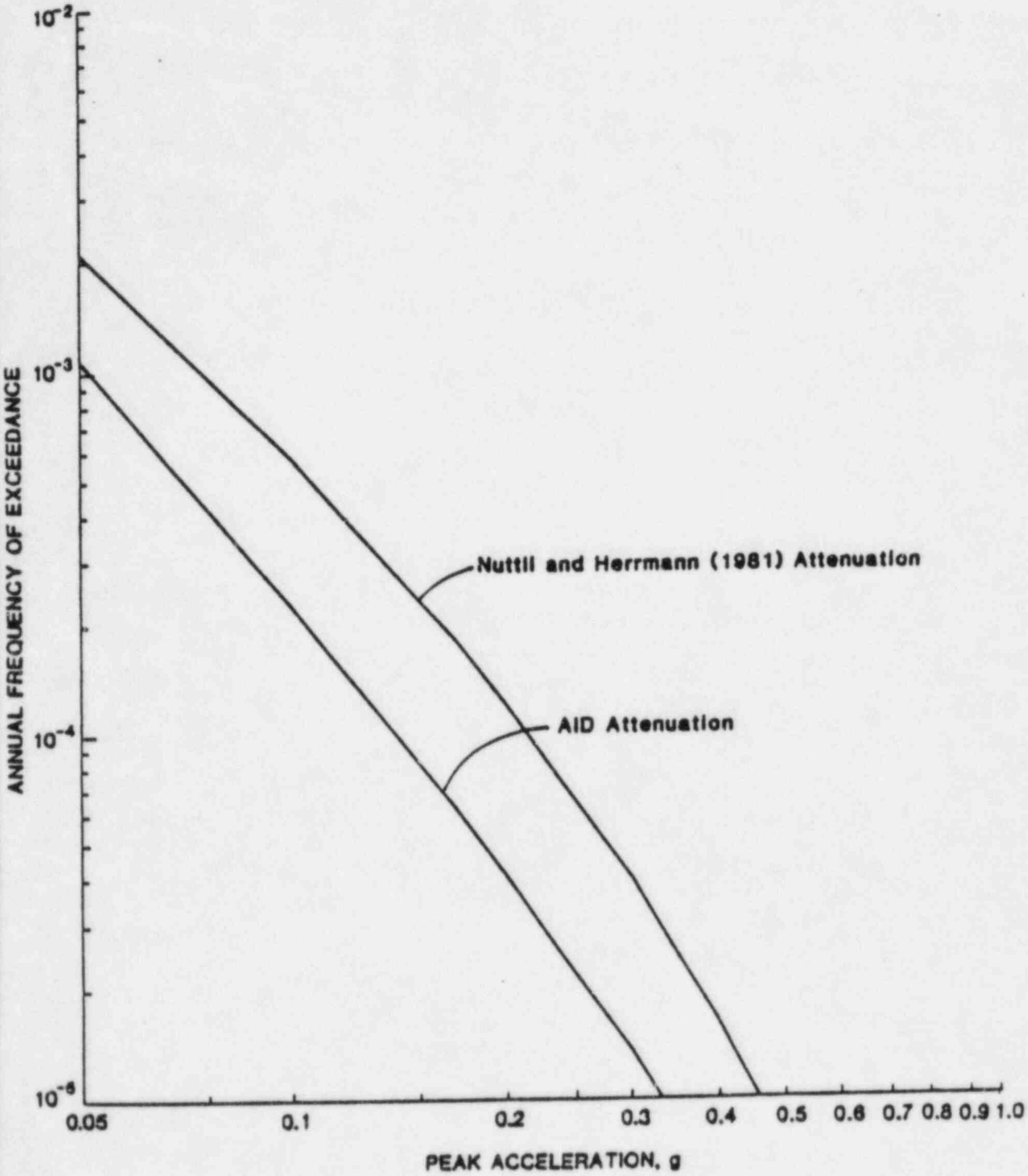
Nuttli and Herrmann (1981) Attenuation
Maximum Historical Magnitude +0.5

FIGURE A.3.6-E-3



Seismic Hazard: $m_{b,max}$ Sensitivity
Hadley and Devine (1974, Plate C) Seismic Source Zones
Nuttli and Herrmann (1981) Attenuation

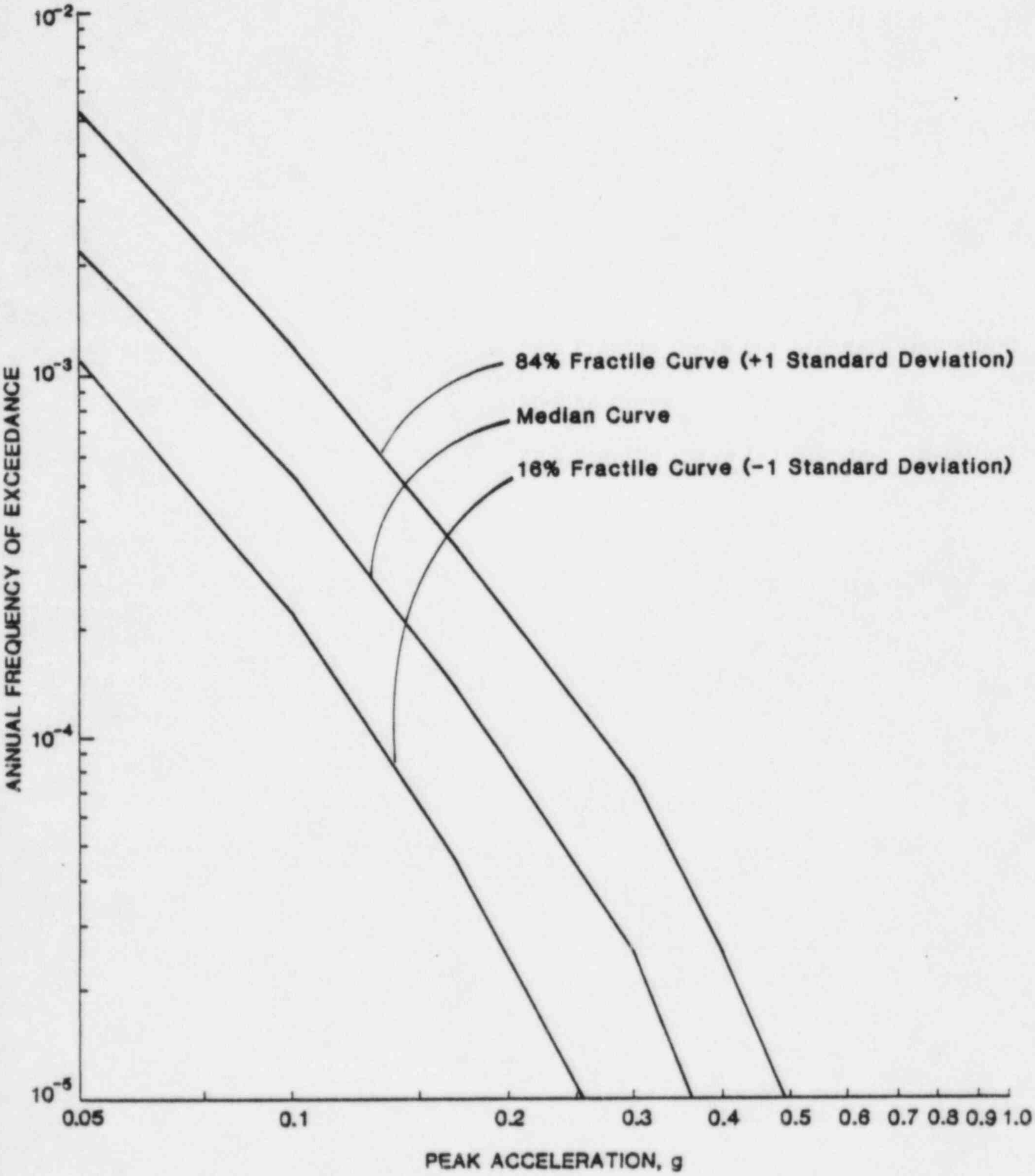
FIGURE A.3.6-E-4



Seismic Hazard: Attenuation Sensitivity

Hadley and Devine (1974, Plate C) Seismic Source Zones
Maximum Historical Magnitude +0.5

FIGURE A.3.6-E-5



Fractile Seismic Hazard Curves

FIGURE A.3.6-E-6

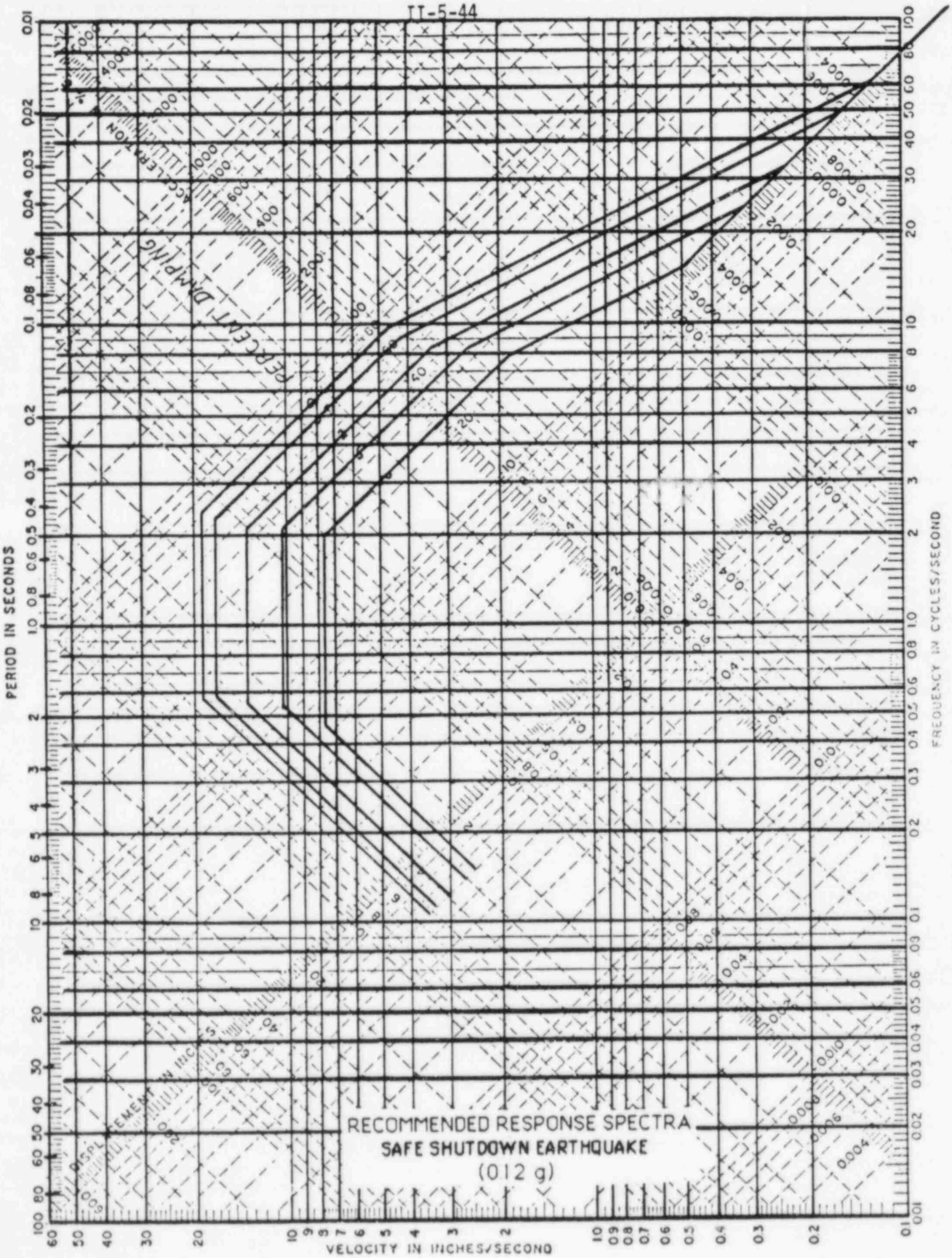
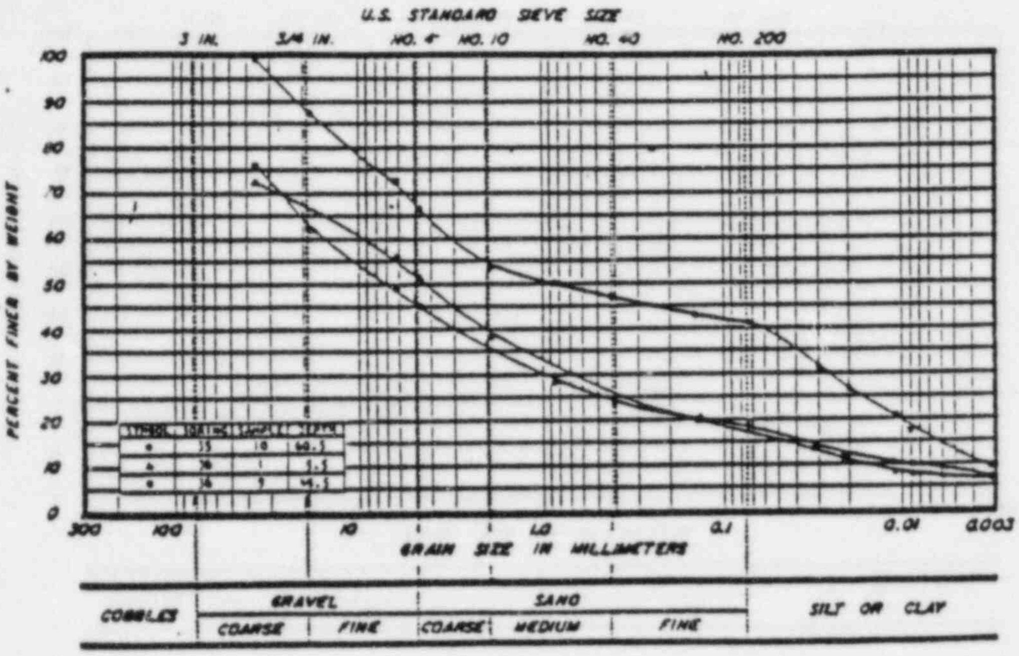


FIGURE A.3.6-E-7

SUPPLEMENT A.3.6-F

PARTICLE SIZE ANALYSES



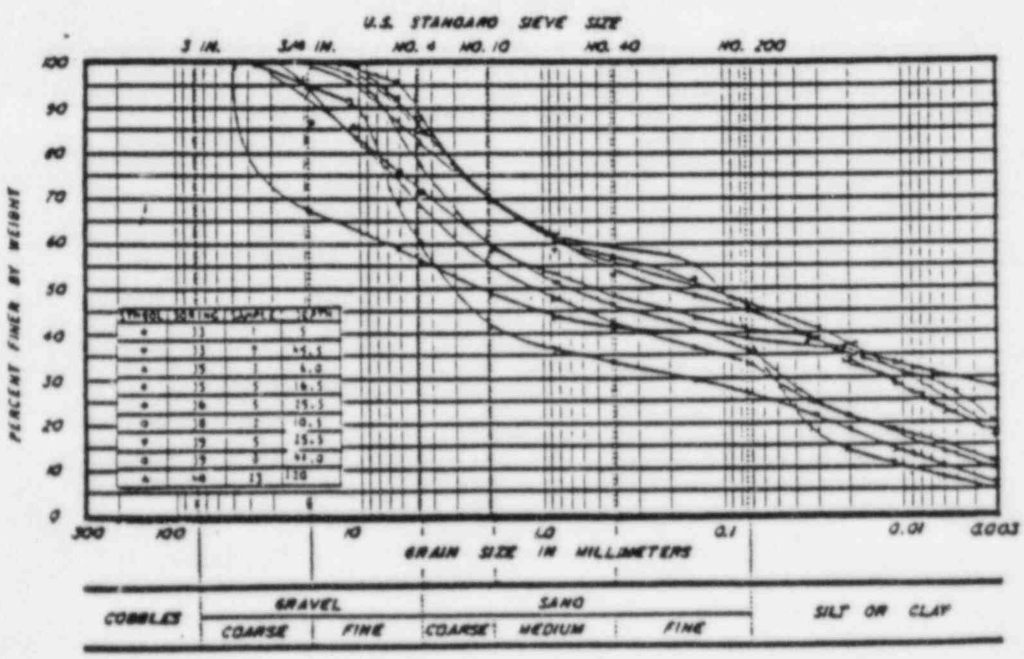
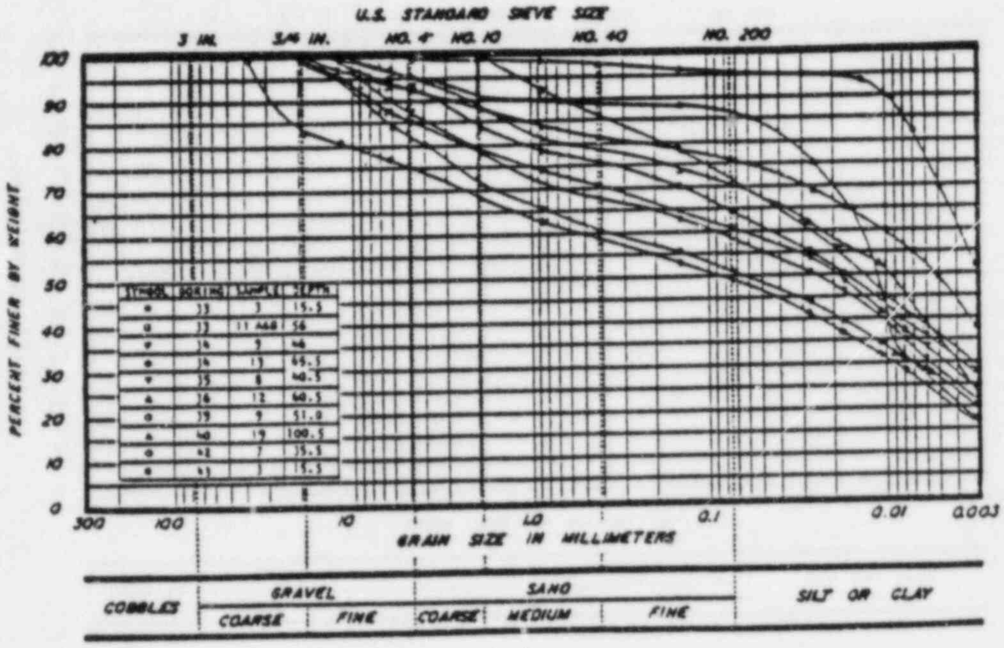


FIGURE A.3.6-F-1

GRADATION CURVE



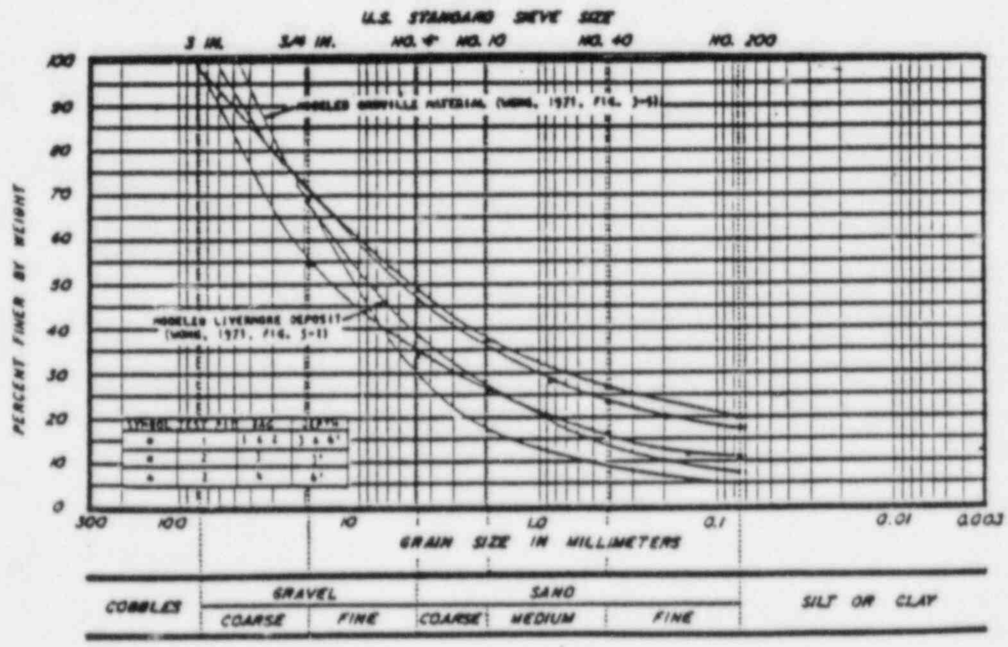
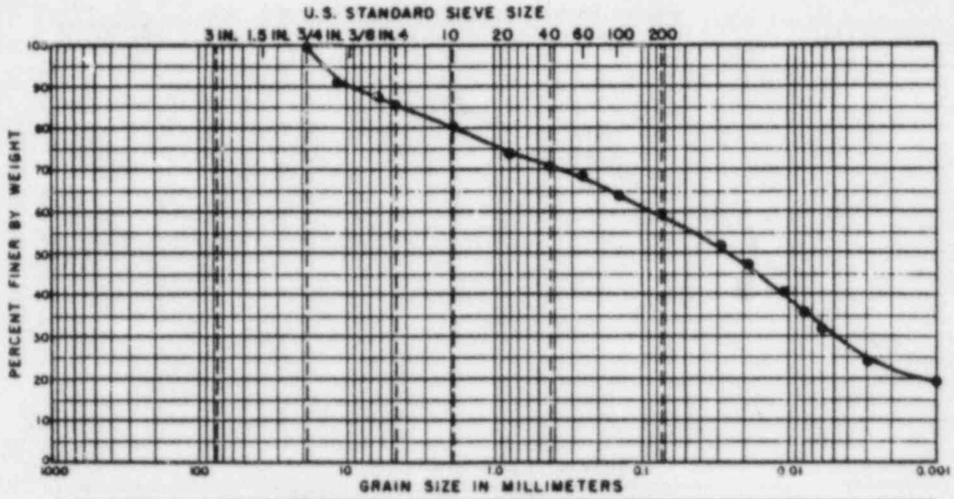


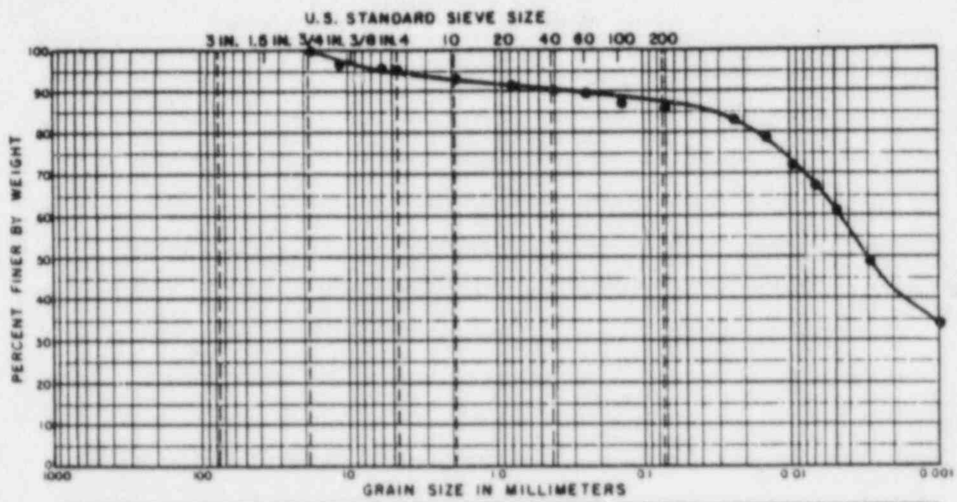
FIGURE A.3.6-F-2

GRADATION CURVE



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	DEPTH	CLASSIFICATION		NAT WC	LL	PL	PI	
82-1-0	60.0'-61.9'	ML	GRAVELLY SANDY CLAYEY SILT	11.8%				

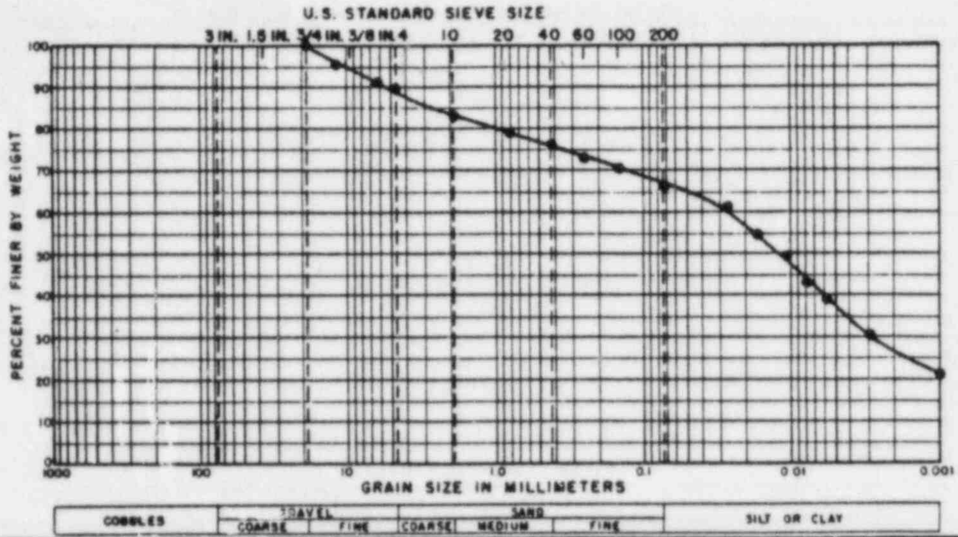


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

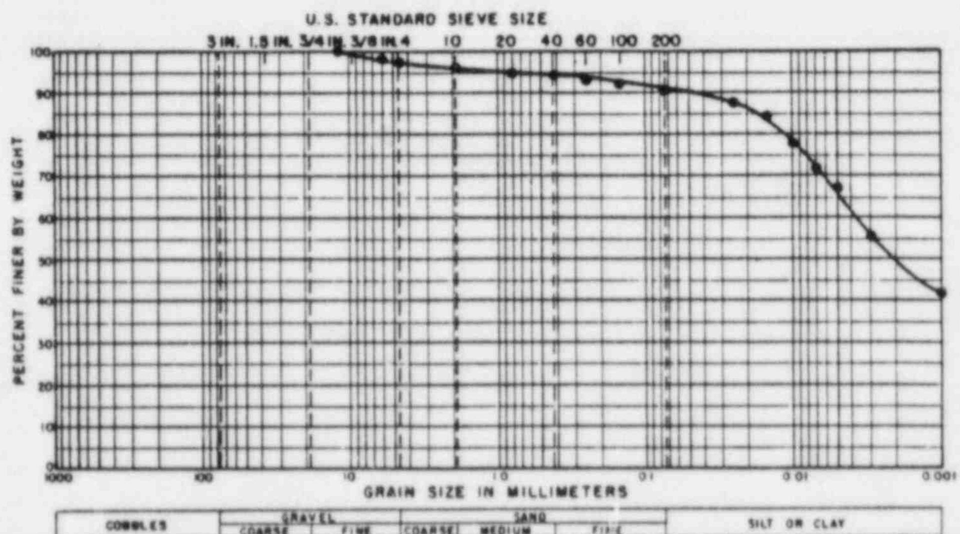
SAMPLE	DEPTH	CLASSIFICATION		NAT WC	LL	PL	PI	
82-1-0	50.0'-52.0'	ML	GRAVELLY SANDY SILT & CLAY	16.3%				

FIGURE A.3.6-F-3

GRADATION CURVE



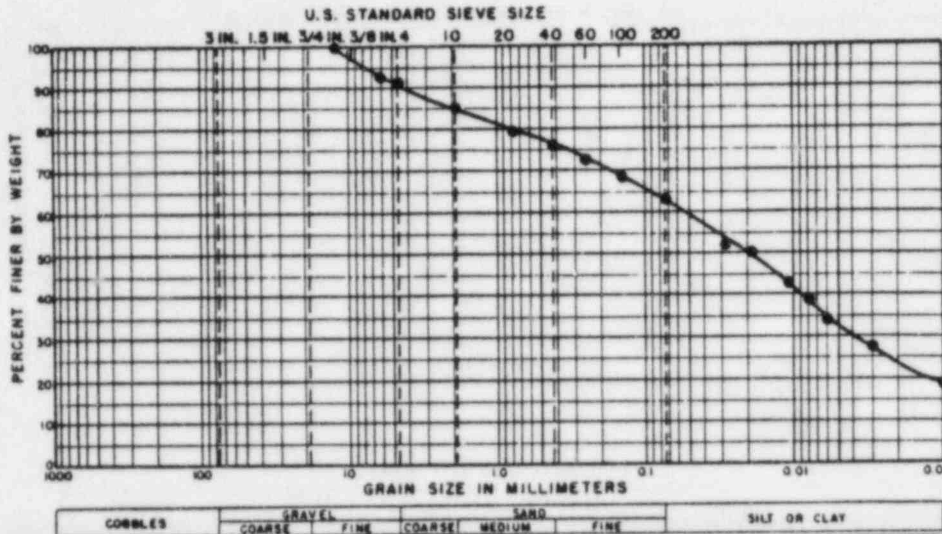
SAMPLE	DEPTH		CLASSIFICATION	NAT WC	LL	PL	PI	
82-1-0	69.9'-72.18'	ML	GRAVELLY SANDY CLAYEY SILT	13.7%				



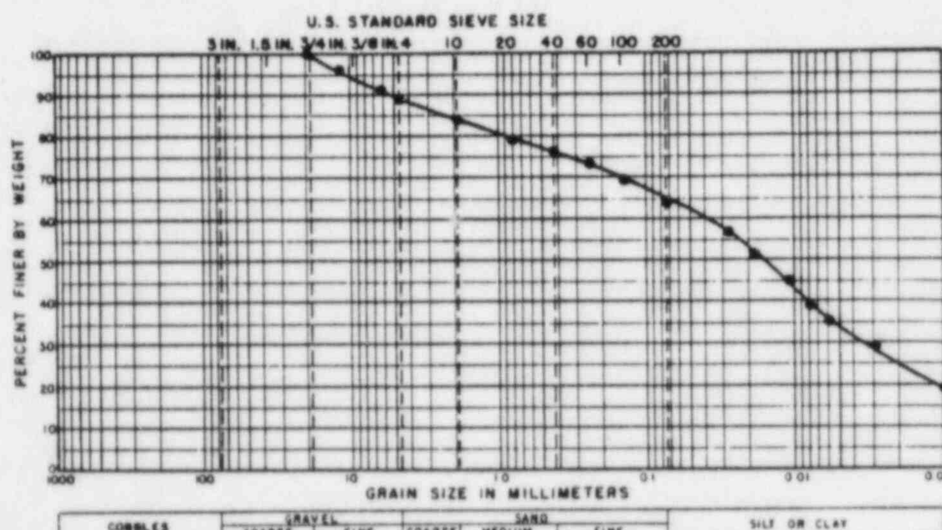
SAMPLE	DEPTH		CLASSIFICATION	NAT WC	LL	PL	PI	
82-1-0	79.7'-81.6'	ML	GRAVELLY SANDY SILT + CLAY	15%				

FIGURE A.3.6-F-4

GRADATION CURVE



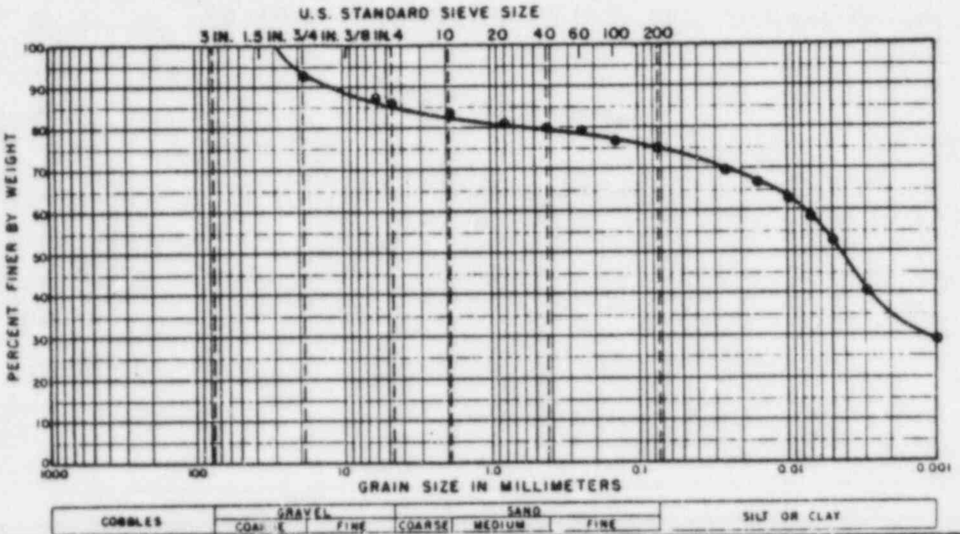
SAMPLE	DEPTH	CLASSIFICATION	NAT WC	LL	PL	PI	
82-3-D	52.5'-53.3'	ML GRAVELLY SANDY CLAYEY SILT	12.8%				



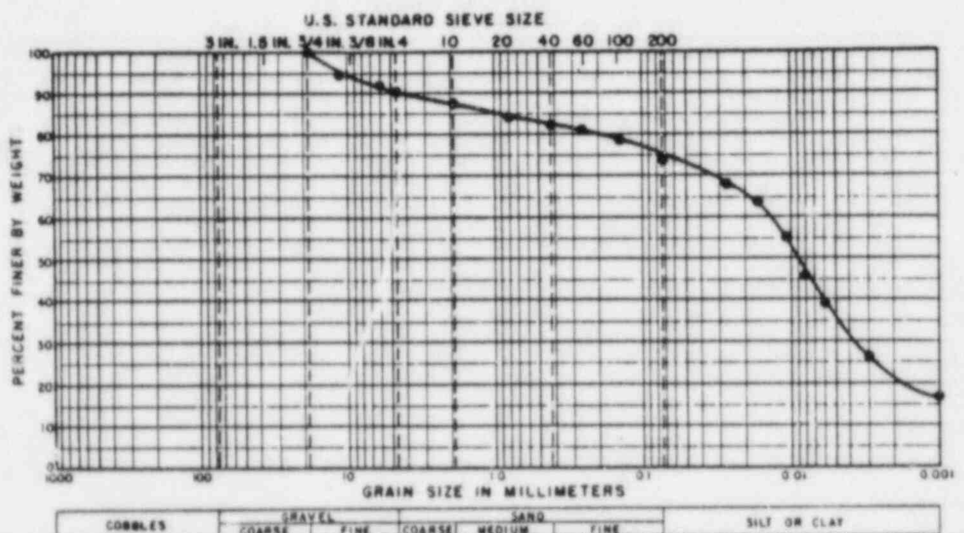
SAMPLE	DEPTH	CLASSIFICATION	NAT WC	LL	PL	PI	
82-3-D	60.0'-61.75'	ML GRAVELLY SANDY CLAYEY SILT	11.7%				

FIGURE A.3.6-F-5

GRADATION CURVE



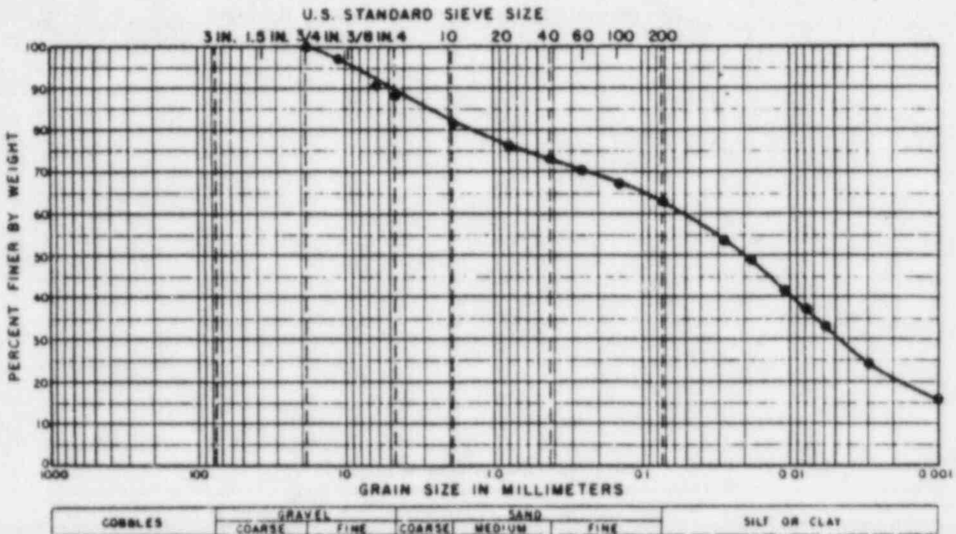
SAMPLE	DEPTH		CLASSIFICATION	NAT WC	LL	PL	PI	
03-1-E	10'-11.75'	ML	GRAVELLY SANDY CLAY AND SILT	13.4%				



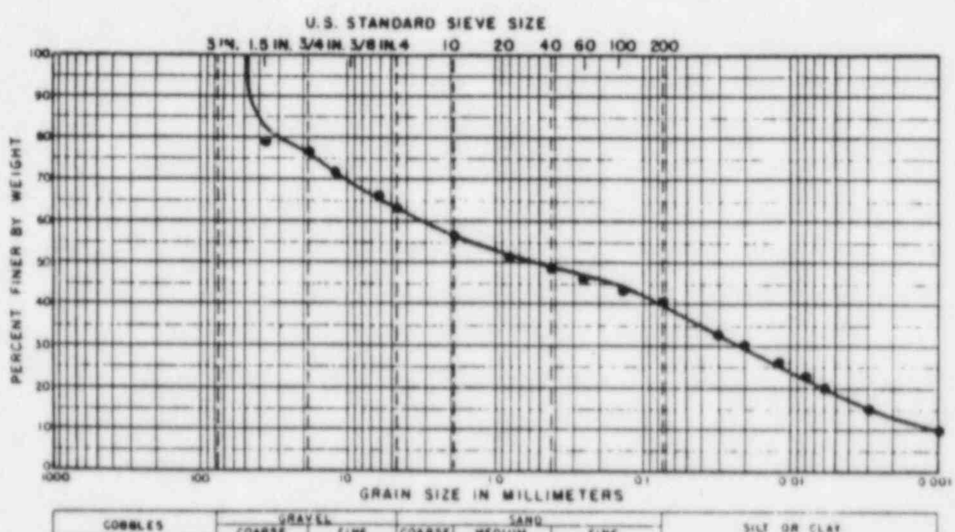
SAMPLE	DEPTH		CLASSIFICATION	NAT WC	LL	PL	PI	
02-3-0	82.0'-83.4'	ML	GRAVELLY SANDY CLAYEY SILT	25.4%				

FIGURE A.3.6-F-6

GRADATION CURVE



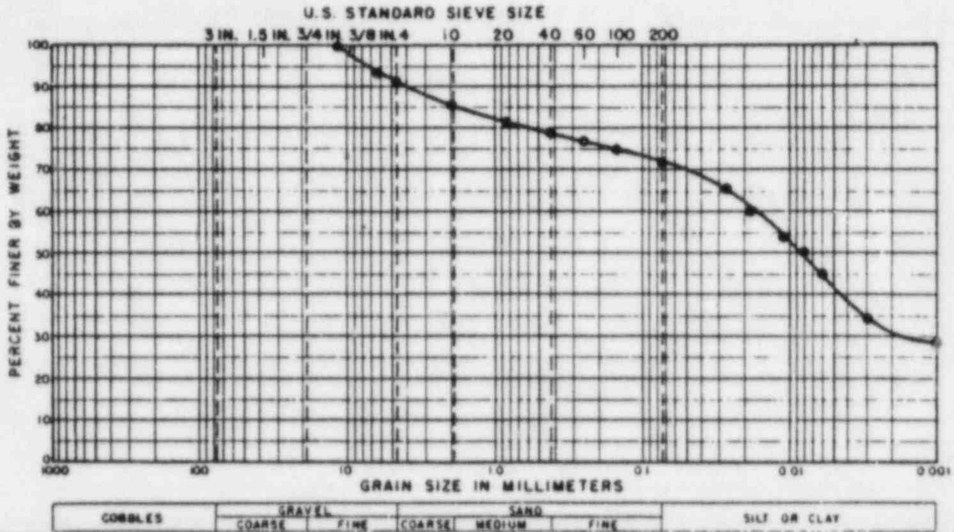
SAMPLE	DEPTH	CLASSIFICATION		NAT WC	LL	PL	PI	
83-1-6	21.1'-22'	ML	GRAVELLY SANDY CLAYEY SILT	12.14				



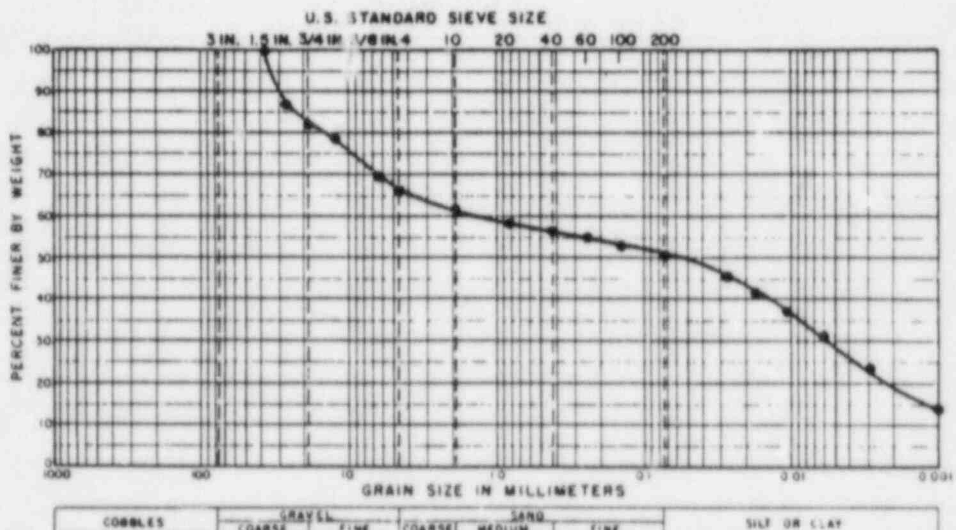
SAMPLE	DEPTH	CLASSIFICATION		NAT WC	LL	PL	PI	
83-1-6	30.55'-32.0'	GM-GC	CLAYEY SANDY SILTY GRAVEL	3.42				

FIGURE A.3.6-F-7

GRADATION CURVE



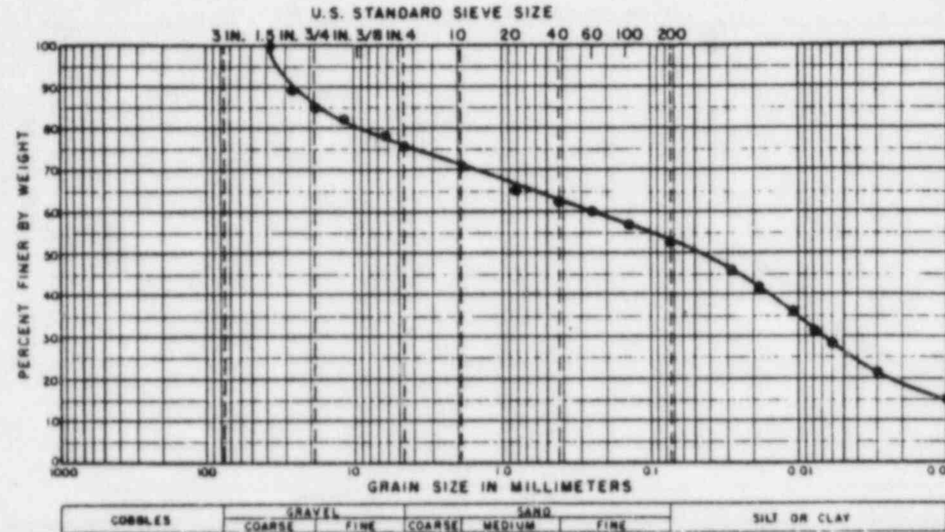
SAMPLE	DEPTH	CLASSIFICATION		NAT WC	LL	PL	PI	
33-1-E	44.6'-46.7'	ML	GRAVELLY SANDY CLAYEY SILT	17.3%				



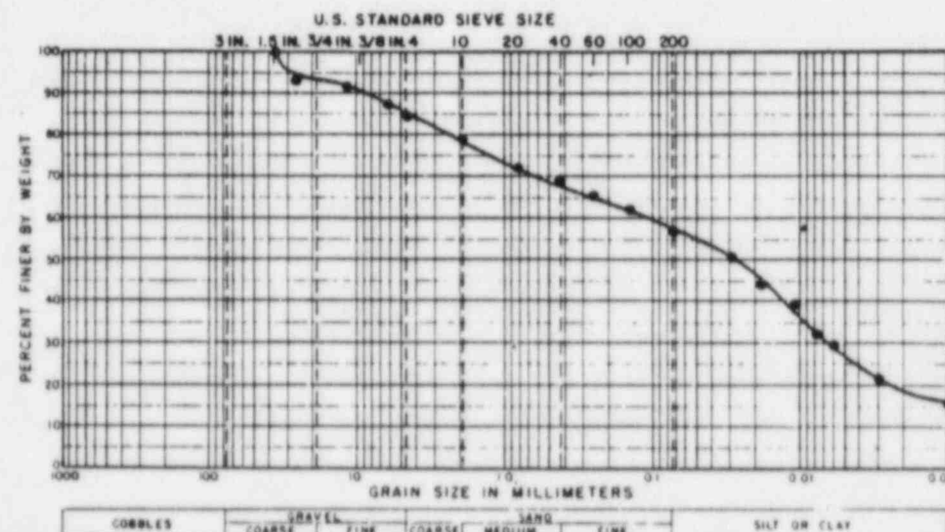
SAMPLE	DEPTH	CLASSIFICATION		NAT WC	LL	PL	PI	
33-2-E	9.55'-10.8'	GM GC	SANDY CLAYEY GRAVEL AND SILT	9.8%				

FIGURE A.3.6-F-8

GRADATION CURVE



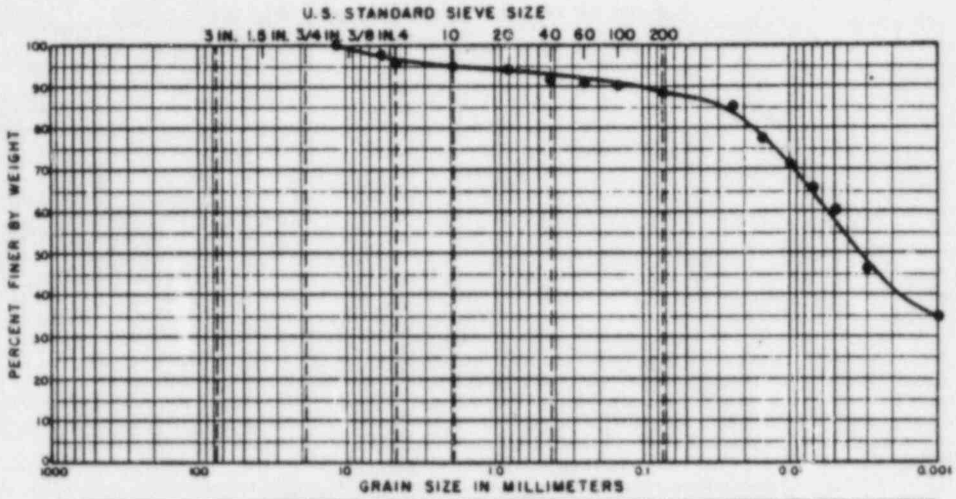
SAMPLE	DEPTH	CLASSIFICATION	NAT WC	LL	PL	PI
83-2-E	20'-21.1'	ML GRAVELLY SANDY CLAYEY SILT	9.8%			



SAMPLE	DEPTH	CLASSIFICATION	NAT WC	LL	PL	PI
83-2-E	30'-31.2'	ML GRAVELLY SANDY CLAYEY SILT	10.4%			

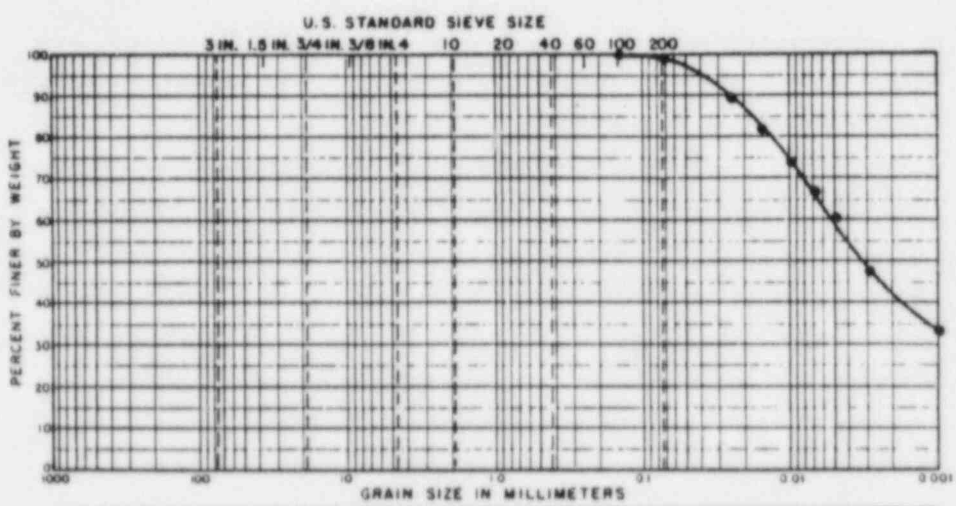
FIGURE A.3.6-F-9

GRADATION CURVE



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	DEPTH	CLASSIFICATION		NAT WC	LL	PL	PI	
83-2-E	40.36'-42'	ML	GRAVELLY SANDY SILT AND CLAY	16.1%				

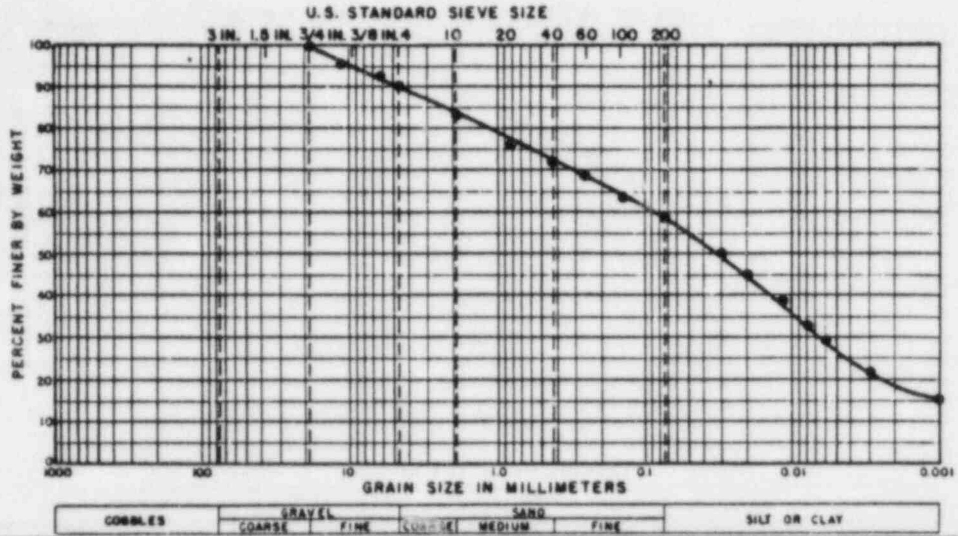


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

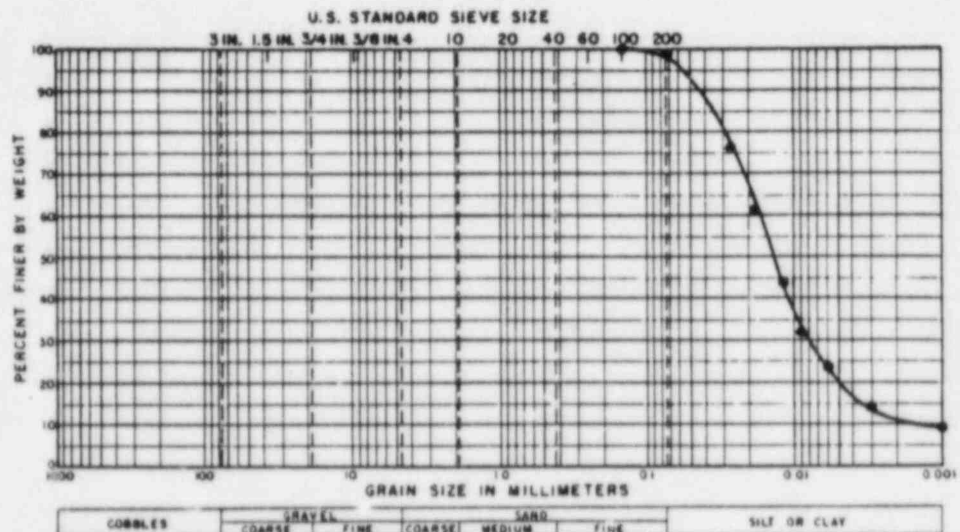
SAMPLE	DEPTH	CLASSIFICATION		NAT WC	LL	PL	PI	
83-2-E	50'-51.0'	ML	SILT AND CLAY	27.0%				

FIGURE A.3.6-F-10

GRADATION CURVE



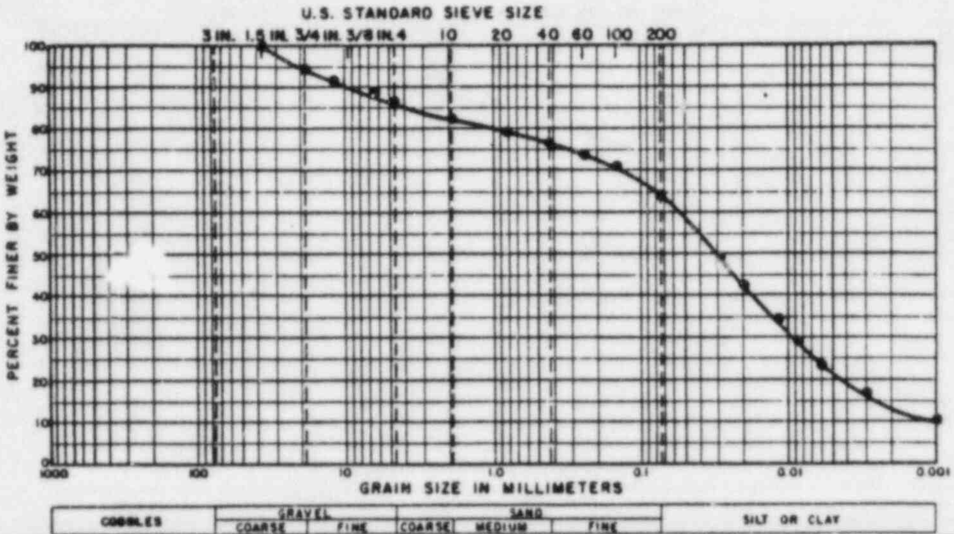
SAMPLE	DEPTH	CLASSIFICATION		NAT WC	LL	PL	PI	
83-2-E	62.6'-63.5'	ML	GRAVELLY SANDY CLAYEY SILT	10.8%				



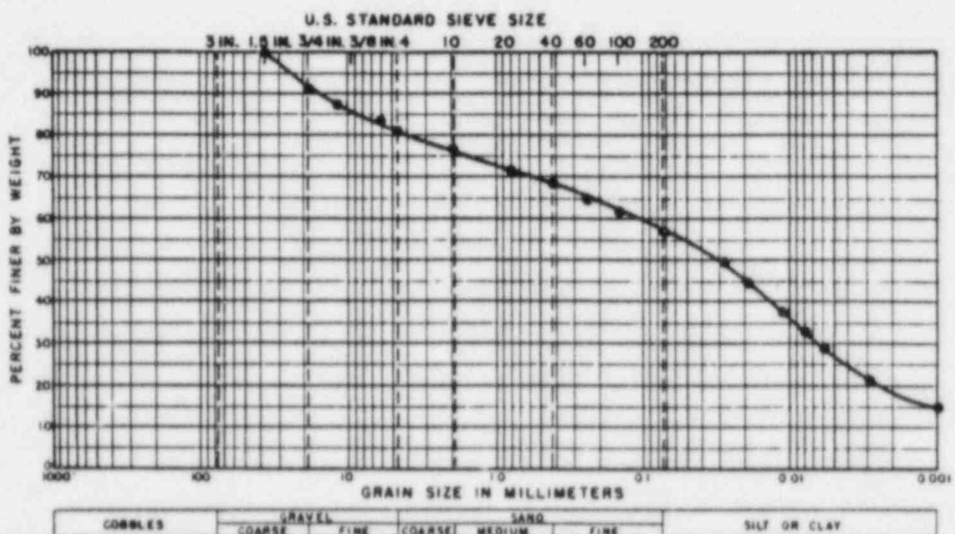
SAMPLE	DEPTH	CLASSIFICATION		NAT WC	LL	PL	PI	
83-2-E	70'-71.05'	ML	CLAYEY SILT	19.4%				

FIGURE A.3.6-F-11

GRADATION CURVE



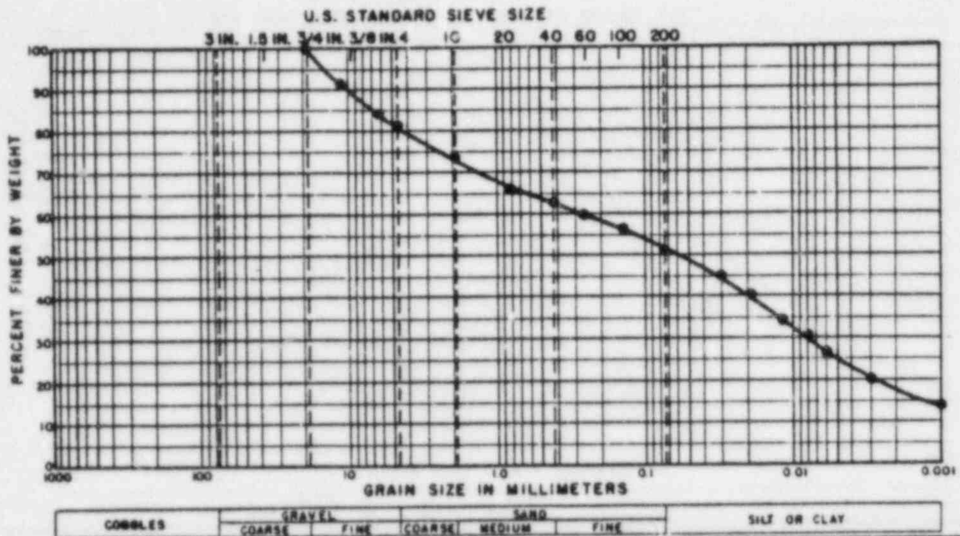
SAMPLE	DEPTH	CLASSIFICATION		NAT WC	LL	PL	PI	
83-3-E	10'-11.9'	ML	GRAVELLY SANDY CLAYEY SILT	12.7%				



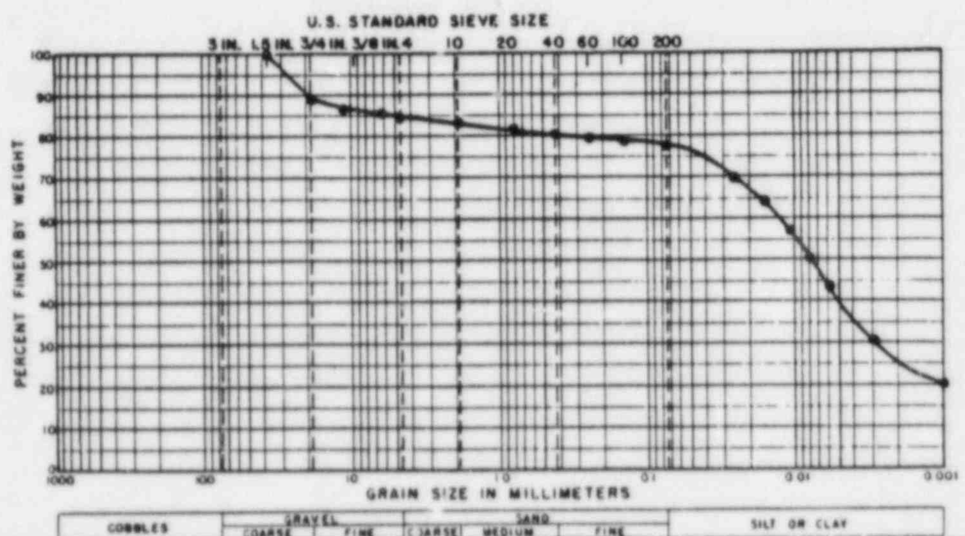
SAMPLE	DEPTH	CLASSIFICATION		NAT WC	LL	PL	PI	
83-3-E	20'-22'	ML	GRAVELLY SANDY CLAYEY SILT	11.3%				

FIGURE A.3.6-F-12

GRADATION CURVE



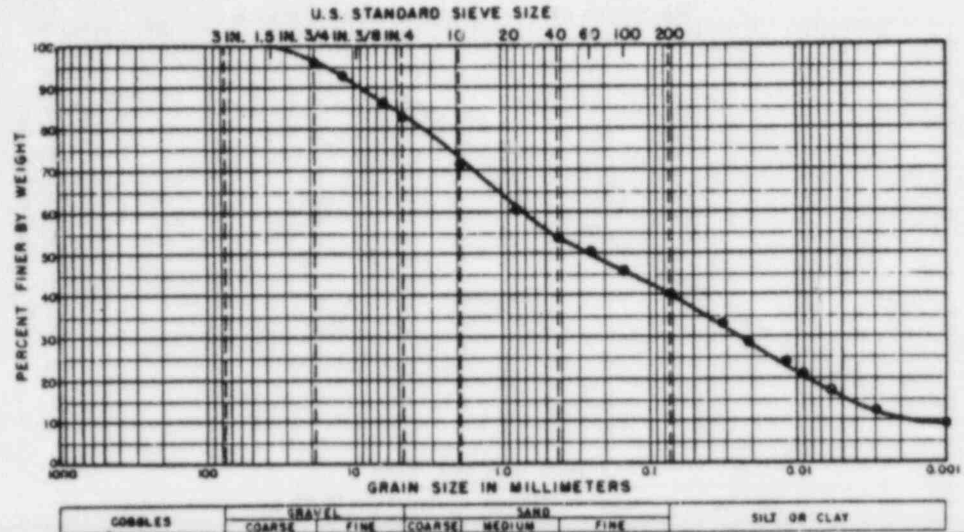
SAMPLE	DEPTH	CLASSIFICATION	NAT WC	LL	PL	PI	
83-3-E	30'-32'	ML GRAVELLY, SANDY, CLAYEY SILT	9.5%				



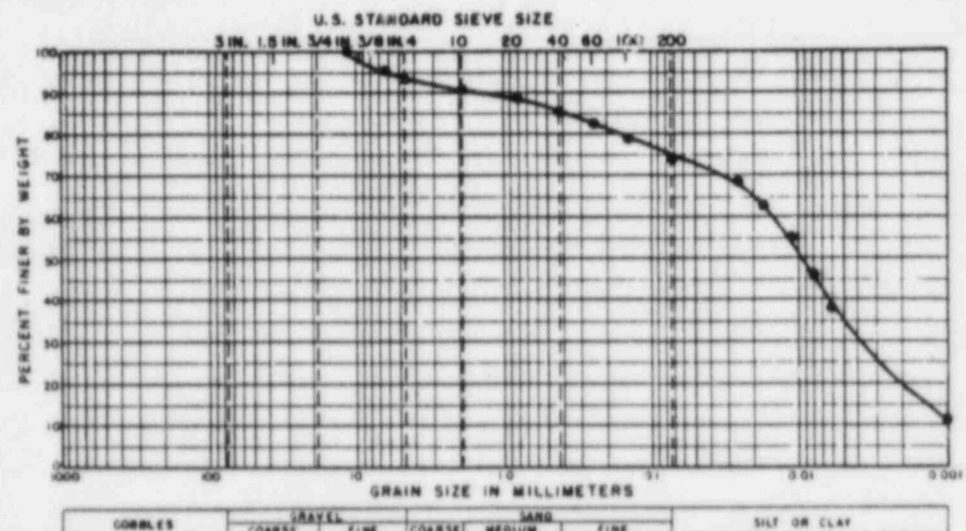
SAMPLE	DEPTH	CLASSIFICATION	NAT WC	LL	PL	PI	
83-3-E	40.9'-42.0'	ML GRAVELLY SANDY CLAYEY SILT	1[illegible].0%				

FIGURE A.3.6-F-13

GRADATION CURVE



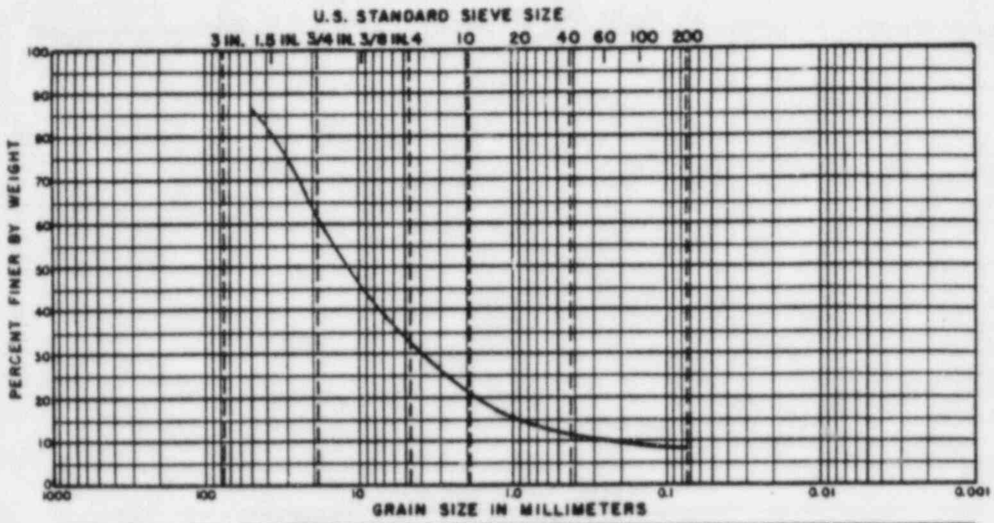
SAMPLE	DEPTH	CLASSIFICATION	NAT WC	LL	PL	PI
83-3-E	50'-51'	SM-SC GRAVELLY SILTY CLAYEY SAND	8.9%			



SAMPLE	DEPTH	CLASSIFICATION	NAT WC	LL	PL	PI
83-3-E	60'-61'	ML GRAVELLY SANDY CLAYEY SILT	30.2%			

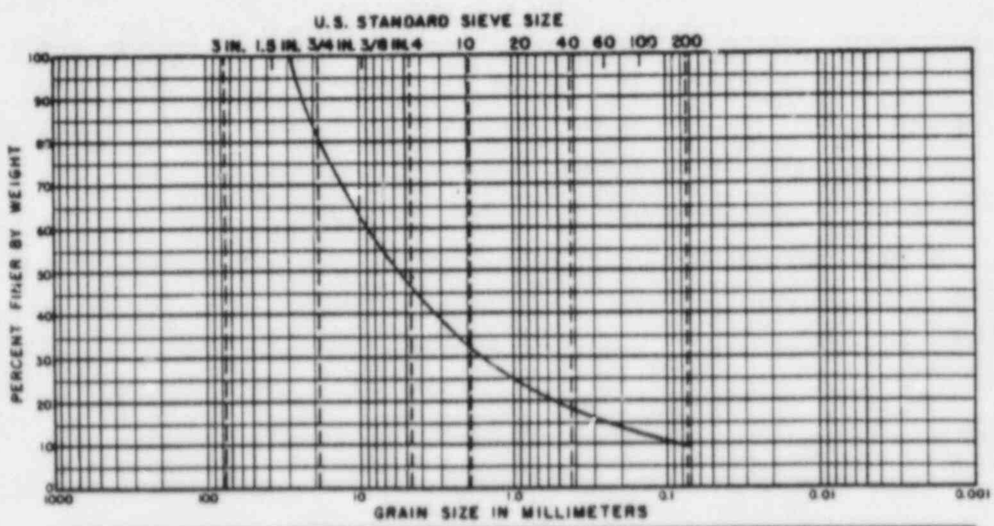
FIGURE A.3.6-F-14

GRADATION CURVE



COBBLES	GRAVEL COARSE	GRAVEL FINE	SAND COARSE	SAND MEDIUM	SAND FINE	SILT OR CLAY

BORING	DEPTH	CLASSIFICATION	NAT. WC	LL	PL	PI	
30	11'	SP/SC	N/A	N/A	N/A	N/A	



COBBLES	GRAVEL COARSE	GRAVEL FINE	SAND COARSE	SAND MEDIUM	SAND FINE	SILT OR CLAY

BORING	DEPTH	CLASSIFICATION	NAT. WC	LL	PL	PI	
31	18'	GP/GM	N/A	N/A	N/A	N/A	

FIGURE A.3.6-F-15

GRADATION CURVE

SUPPLEMENT A.3.6-G

CONSOLIDATION TEST DATA

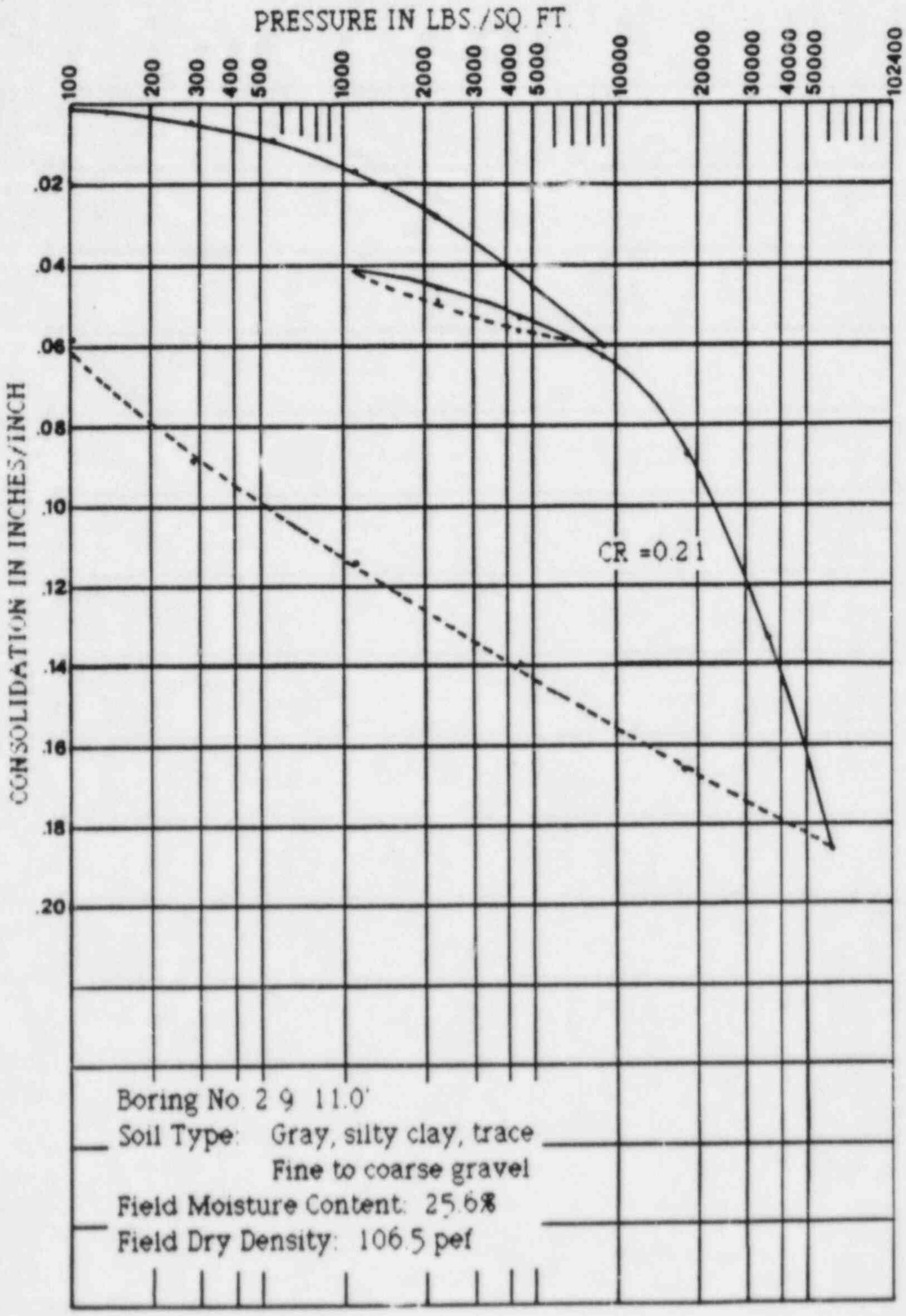


FIGURE A.3.6-G-1

CONSOLIDATION TEST DATA

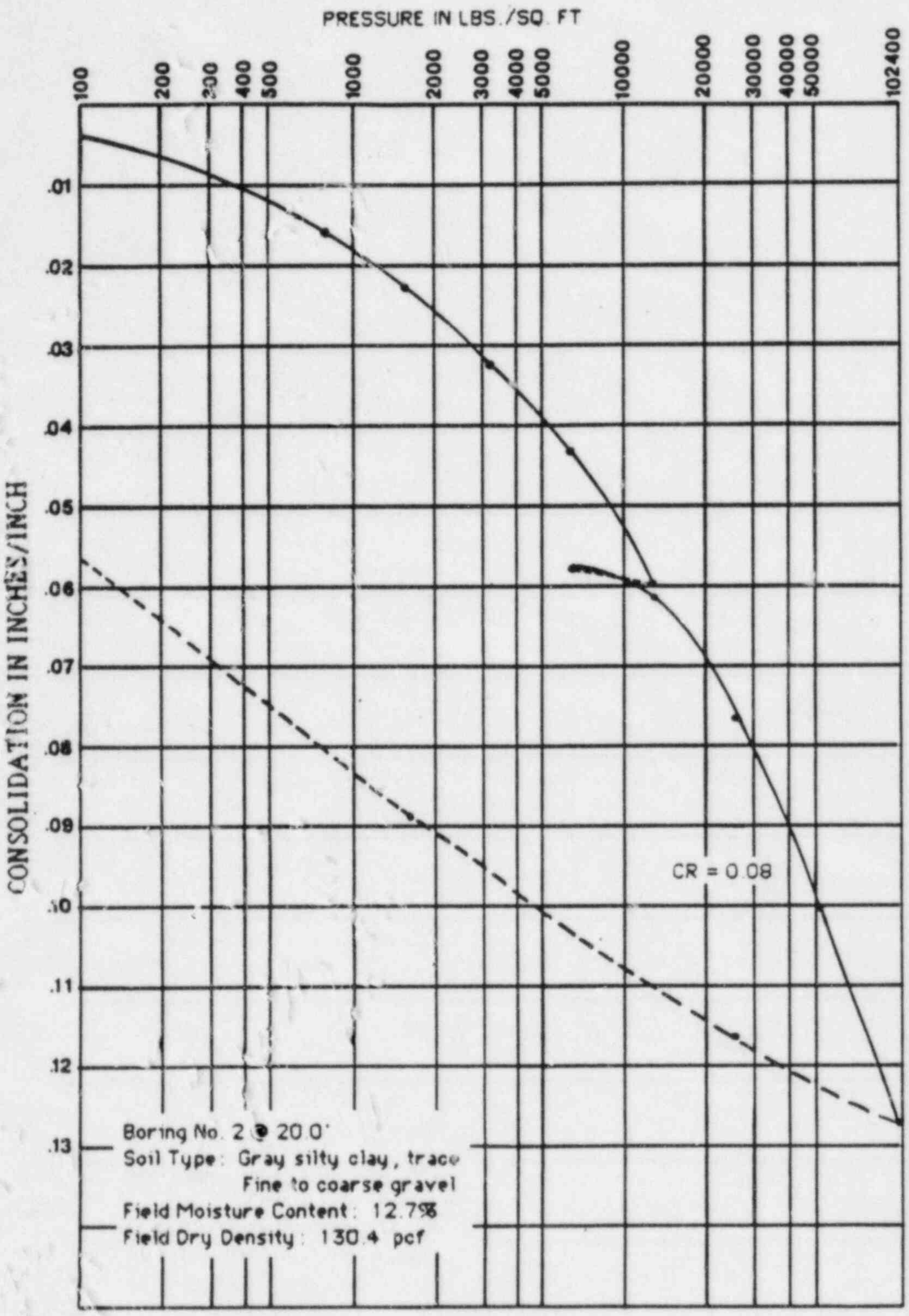


FIGURE A.3.6-G-2

CONSOLIDATION TEST DATA

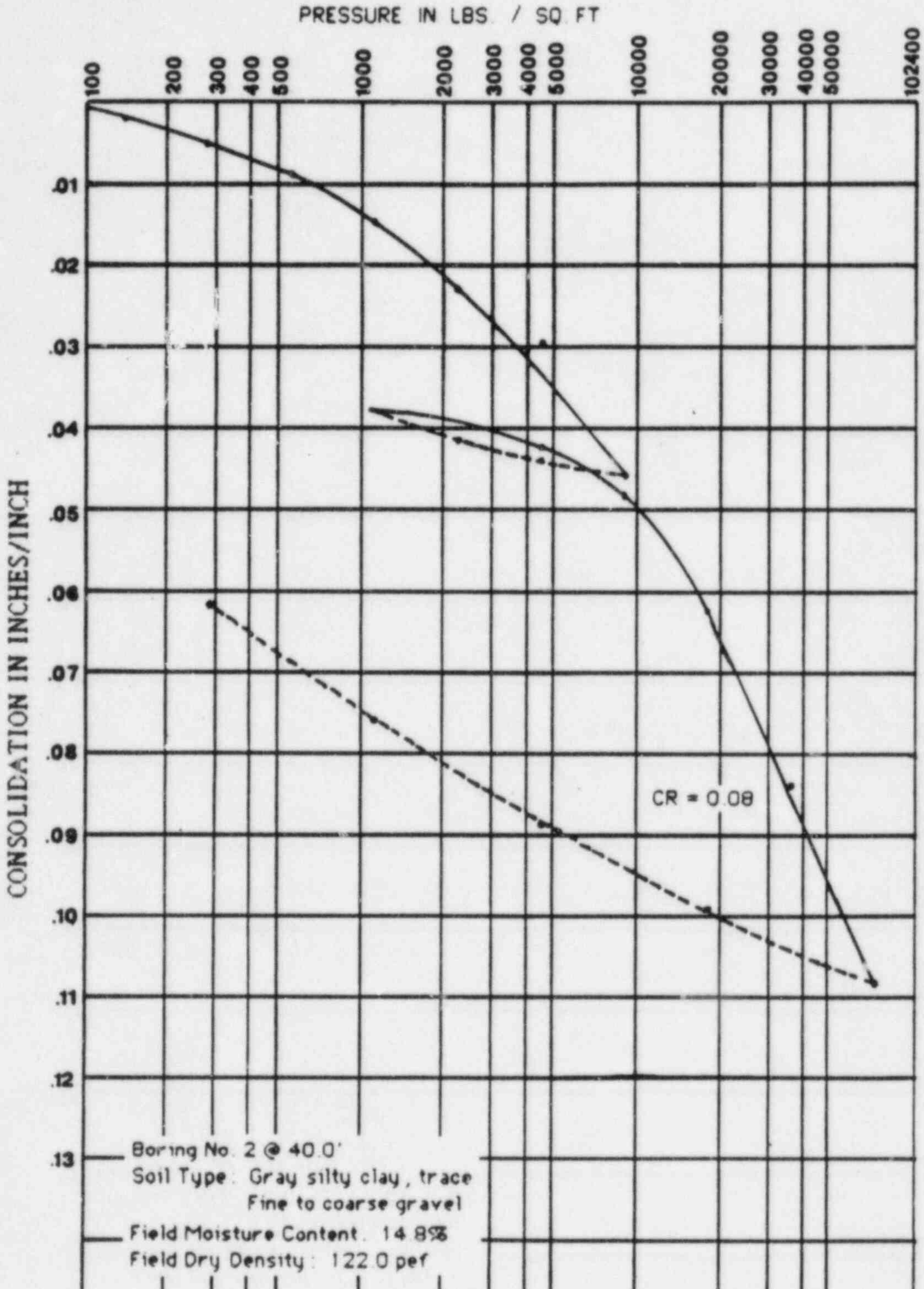


FIGURE A.3.6-G-3

CONSOLIDATION TEST DATA

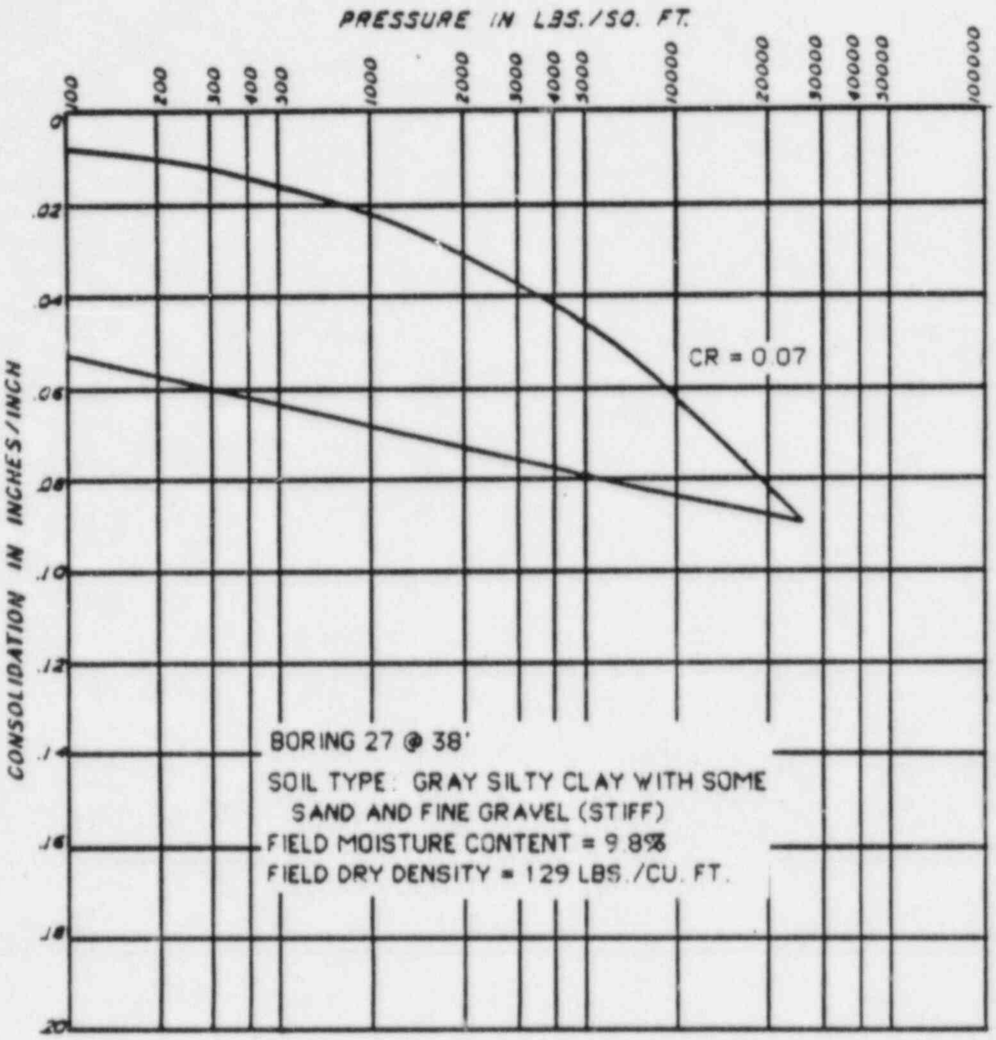


FIGURE A.3.6-G-4

CONSOLIDATION TEST DATA

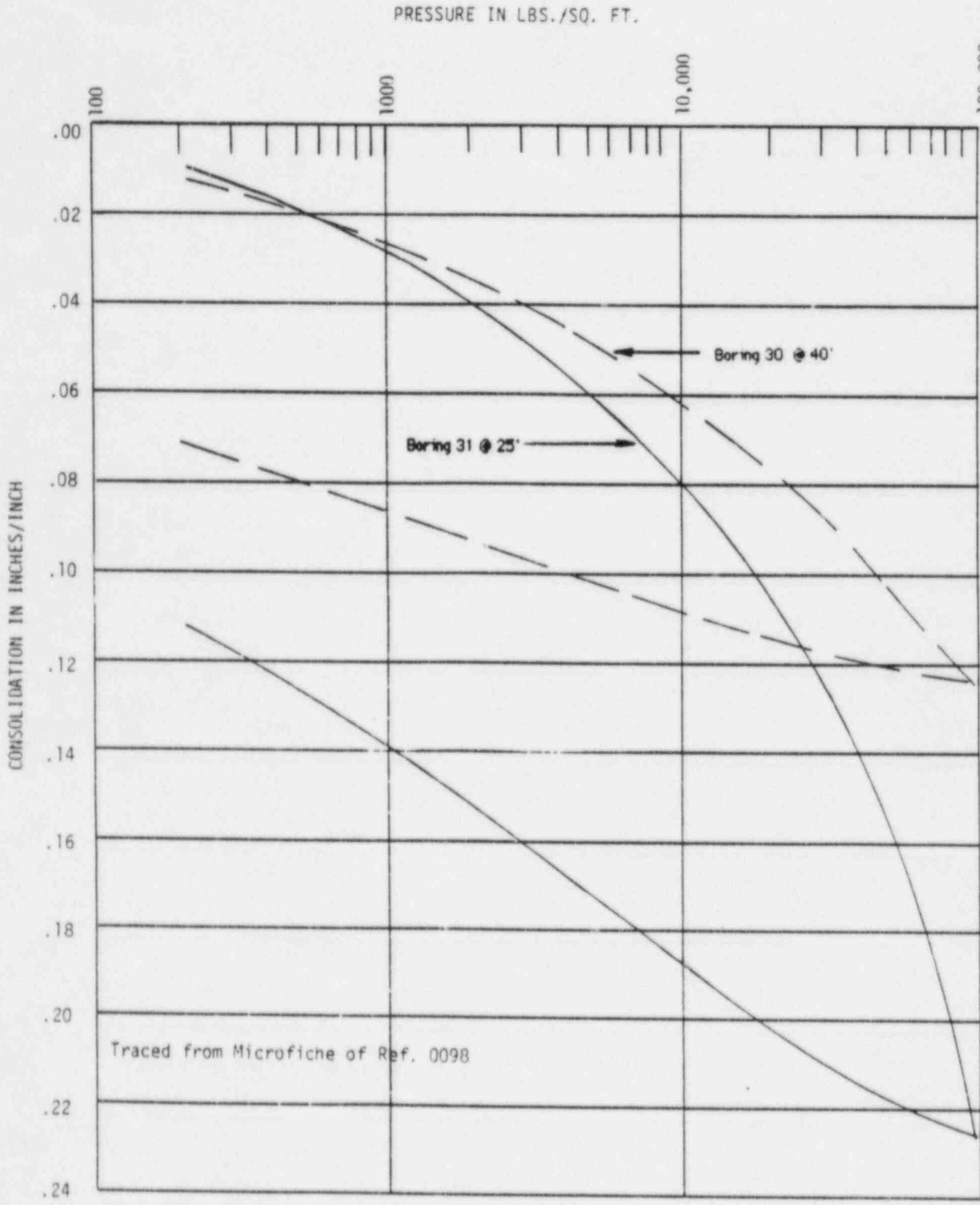


FIGURE A.3.6-G-5

CONSOLIDATION TEST DATA

SUPPLEMENT A.3.7-A

TERRESTRIAL ECOLOGY OF THE SITE

Vegetation Analysis

The exclusion area is approximately 1,335 ha and the protected area lies approximately in the middle of the exclusion area. The plant community composition of the exclusion area has been investigated by several groups since 1973. To prepare the present report, S/EA reviewed the existing data, contacted regional authorities, examined aerial photographs (both color and black-and white), and conducted qualitative field surveys of all major plant communities on the site. Figure A.3.7-A-1 shows the areas investigated during the 1982-83 survey. The main purpose of the field surveys was to update and/or verify the previously published data and to ground-truth the aerial photographs. Using this information, a vegetative cover map of the protected area was made, and the map of the exclusion area previously developed by Nuclear Fuel Services, Inc. (1974) was updated.

Regional Overview

The flora of the area has been very thoroughly studied, and many species lists have been made. Zenkert (1934) summarized the plant life of all of Western New York on the basis of data available at that time, and included many records from the area under construction. House and Alexander (1927) and Taylor (1928) presented lists of the flora of Allegany State Park, which covers much of southern Cattaraugus County, about 64 km south of the site. These lists were updated by Smith (in Schumacher, Smith and Stewart, 1961) as noted by Nuclear Fuel Services, Inc. (1974). Studies of plant distribution of the area, and specifically Allegany State Park, have been made by biologists at St. Bonaventure University. Listings of threatened and endangered species are maintained by the New York State Botanist, Dr. Robert Mitchell. Other studies of the Center and its immediate vicinity have been undertaken in the past. These include studies by Health Research, Inc., which are cited in several reports by Nuclear Fuel Services, Inc. (1962, 1971, 1973, and 1974) US EPA, (1977) and Davis and Fakundiny (1978) for the New York State Geological Survey and State Museum.

The Center lies in the northern hardwoods forest region (Bailey, 1980; Braun, 1950). These forests are characterized by the dominance of sugar maple, beech, and hemlock with frequent occurrence of basswood, red maple, black cherry, birch, northern red oak, and several other species. At present, as in the past, there is a good deal of admixture of these and other species, depending upon local conditions of soils, exposure, drainage and other ecological factors.

Before settlement it is likely that all of the site and most of Cattaraugus County was forested. With settlement, the better drained sites were cleared for farming. Regionally, much of the cleared land remains in agricultural production, but natural succession has occurred on many hundreds of abandoned hectares. At present, the approximate 1,335 ha Center is about equally divided between forestland and open land.

Vegetation of the Exclusion Area

The plant communities of the exclusion area (1,250 acres) were mapped by Nuclear Fuel Services, Inc. (1974). That map, with some changes in the legend, is presented in Figure A.3.7-A-1. These changes involve the nomenclature used to describe the various cover types found on-site (e.g., climax successional stage is now called mixed hardwood forest). The areal extent of the communities and their overall condition has not changed significantly since that report; however, this report gives a more detailed account of the composition and importance of those communities. Generally, the vegetation of the site appears to be undistributed and does not exhibit obvious signs of stressed conditions.

Mixed Hardwood Forest

Six mixed hardwood areas were checked in the exclusion area. The overstory species composition was similar at all locations. Most forested areas occur on the slopes of Buttermilk Creek and its tributaries with some wooded tracts on poorly drained upland slopes (Figure A.3.7-A-1). Overstory dominants were sugar maple, beech, hemlock, white ash, yellow birch, and black cherry. Also present, but less frequent, in the canopy were basswood, white pine (in one

stand), big-tooth aspen, white oak (on south facing slopes), shagbark hickory, arrowwood, maple-leaf viburnum, hop-hornbeam, ironwood, striped maple, spicebush, and saplings of the canopy species. For a list of plant species on the site, see Supplement A.3.7-D.

This overstory and understory composition is quite similar to that reported for other forested tracts in Western New York (e.g., the Lake Erie Generating Station by the Niagara Mohawk Power Corporation, 1976). Herbaceous vegetation in the forests at the Center varied considerably depending on slope exposure, soil moisture, and canopy closure. Common species were mayapple, hellborine orchid, Jack-in-the pulpit, Canada mayflower, enchanter's nightshade, Christmas fern, hayscented fern, New York fern, white baneberry, bedstraw, wild leek, hepatica, woodland sedge, herb-robert, partridgeberry, violet wood sorrel, blue cohosh, wood nettle and maidenhair fern. Less common and noteworthy are ginseng, goldthread, starflower, and clubmosses. Soggy wet areas in these woodlands contained sensitive fern, cinnamon fern, spotted jewelweed, golden ragwort, mad-dog skullcap, sedges, and woodland horsetail.

Of the slope and upland forests on the site, the more mature stands investigated occurred on the west slope of Buttermilk Creek just south of Thomas Corners Road and north of Buttermilk Road; along Frank's Creek and its tributaries; and the area between the two reservoirs, immediately south of the Baltimore and Ohio railroad. Overall, the mixed hardwood forested areas are probably either at maturity or are approaching it and are increasing in value as a timber resource. Also, since the exclusion area is not being farmed, the forested acreage can be expected to increase. Forest land is increasing at a rate of approximately 2.5 percent per year (US DOE, 1978) in the county.

Field-Meadows

Field-meadows and their associated edge areas along woodland borders make up approximately 50 percent of the exclusion area. These meadows are composed primarily of dense herbaceous growth. Farming is not currently practiced in this area, and if left undisturbed, these meadows will advance through a series of successional stages back to forest land.

The most common herbaceous plants in this community are goldenrod, Queen-Anne's lace, orchard grass, red and white clover, field milkwort, musk mallow, timothy, thistles, ox-eye daisy, bena, ragweed wild bergamot, aster, St. John's-wort, cinquefoil, yellow trefoil wild strawberry, wild mustard, common milkweek, and Joe-pye weed. The woody invader species are red-oiser dogwood, hawthorn, white ash, witchhazel, cottonwood, quaking aspen, staghorn sumac, black locust, fire cherry, red maple, willows, blackberry and black cherry.

Pine-Spruce Community

Figure A.3.7-A-1 shows a small area of pine and spruce northwest of the Project facilities. This area has been artificially planted and is of limited importance to the terrestrial ecology of the area, except that it provides habitat for bird species that typically favor coniferous forests.

Successional Creek Bank Communities

Such plant communities occur as narrow strips along Buttermilk Creek and in flat poorly drained areas in the creek floodplain. These communities have developed on areas that were once cleared and may have been farmed but have been abandoned. They are similar to the late oldfield successional areas discussed in the next section but have a slightly different woody species composition. The overstory species here are red maple, red osier dogwood, sycamore, willows, birch, quaking aspen, apple, chokecherry, and staghorn sumac. The ground cover is distinguished by the dominance of such moisture-loving plants as woodland horsetail, sedges, rush and cattails. These communities are considered palustrine wetlands (Cowardin et al, 1979) and are further discussed in the section on wetlands.

Late Oldfield Successional Areas

These are plant communities intermediate in successional stage from the open meadow areas and the completely forested areas. They are characterized by a generally dense sapling or pole-sized overstory woody growth, no recognizable understory stratum, and a dense ground cover of grasses and perennial weeds. The woody overstory is composed mainly of those invader species noted in the

discussion of meadows. Depending on the length of time since abandonment from farming, the overstory is in various stages of closure or complete canopy coverage. On the well drained upland areas, where most of this type of community occurs, it will probably develop into a maple ash forest community.

The Niagara Mohawk Power Corporation's Lake Erie Generating Station report (1976) identified oldfields on their Sheridan site as shrub communities dominated by staghorn sumac and American elm. Other common woody species there were southern arrowwood, silky dogwood, brambles, choke cherry, fire cherry, and red osier dogwood. This composition is quite similar to that found in oldfield communities on the Center.

These plant communities are quite important as wildlife shelter and feeding areas due to the abundance of food source and available cover.

Plant Communities of the Protected Area

The protected area is approximately 100 ha in size and is enclosed by chain-link fence. Figure A.3.7-A-2 shows the distribution of plant communities within this fenced area. The land not occupied by the facilities is mostly open land. Periodically mowed pasture and meadow land are the major plant communities. Meadow land species are the same as those observed on open areas in the exclusion area and discussed in the relevant section above. Similarly, the forested land in the protected area contains the same species as the mixed hardwood found in the exclusion area.

One small wetland area lies north of the facilities area (see Figure A.3.7-A-2). The wooded portion is composed of beech, red maple, hemlock, balsam fir, American elm, and wild cherry. The open area of wetland contains such plants as cattail, mud plantain, sensitive fern, spike rush, sedges, water milfoil, rush, and bulrush.

Wetlands

The Center contains three types of wetlands as defined by Cowardin et al (1979). They are all in the palustrine classification and are individually less than 12 ha in size. No wetlands on the site are regulated by the State of New York (Dietz, pers. comm. 1982). Regulated wetlands are 12 ha or greater in size or small connected wetlands occurring as small seepages in woodlands, wet meadows, and narrow strips along streams. This acreage was derived from a visual estimate of the size of all wetlands observed on the site. Figures A.3.7-A-1 and A.3.7-A-2 illustrate the locations of wetland observed during this study.

Forested wetlands occur on the site as small isolated areas where ground water surfaces as seepages (Figures A.3.7-A-1 and A.3.7-A-2). These are areas of spongy soil that support some hydrophilic herbaceous species such as sensitive fern, cinnamon fern, mad-dog skullcap, and several species of sedges.

Persistent emergent wetland areas occur along the margins of all ponds and small lakes (reservoirs) in the area and on poorly drained nonwooded areas best described as wet meadows which grade into a shrub-scrub wetland. The previously noted area south of Buttermilk Road and east of Buttermilk Creek is a good example. This area is dominated by widely scattered woody plants such as willows and cottonwood and other wetland plants such as cattail, horsetail, sedges, rush, bulrush, and arrow-leaf tearthumb. On slightly elevated areas, plants typical of drier meadow lands were present.

Small isolated wetlands such as those described above are common in Western New York. During this study, no unique or unusual plants were observed in these on-site wetlands. The importance of the site wetlands is an element of habitat diversity for plant species and area wildlife.

Threatened or Endangered Species

No plant species on either the State or Federal protected plant lists are known to occur in this study area (Mitchell, pers. comm. 1982). Futhermore, field studies by several groups since 1973 (including the current work) have failed to record any such species, and it is unlikely that any threatened or endangered plants occur on the site.

Wildlife Studies

The wildlife information on the Center was derived from in-house information, available literature on the site itself and of the region, on-site field surveys, and consultation with the New York State Department of Environmental Conservation (NYSDEC) and other knowledgeable authorities of the area including Dr. Steve Eaton of St. Bonaventure University and Dr. Robert Andrle of the Buffalo Museum of Science. The following discussions focus on the relationship between species and their major habitats. These discussions and matrices also:

- identify and discuss those populations that utilize habitat on the site for functions critical to the population's survival, such as breeding grounds and wintering areas;
- identify and discuss species that migrate through the site;
- identify any existing environmental stresses that may have had a substantial impact on regional biota; and
- identify the known or expected occurrence on-site of Federally or State protected species.

Generally, representative areas of all major habitats found on the Center were surveyed for wildlife species. The areas studied are shown on Figure A.3.7-A-3. They were selected for study because (1) they are representative of the major habitats on-site, (2) they are reasonably accessible, (3) they are dispersed throughout the Center, and (4) many are

along utility or railroad corridors or include other ecotones*. No strict quantitative surveys were undertaken; instead, abundance or frequency estimates were derived from existing information and local authorities. In both the autumn and winter surveys, an effort was made to perform a semi-quantitative estimate of the white-tailed deer population on the site.

All species shown in Tables A.3.7-A-1 through A.3.7-A-4 are listed in phylogenetic order.

Regional Overview

The animal life of Western New York has been almost as well studied as the plant life. Major works on the region include bulletins of the Roosevelt Wildlife Station, New York State College of Forestry; studies of Allegany State Park by the Buffalo Museum of Science and the New York State Museum and Science Service; bird studies developed by Beardslee and Mitchell (1965) and Eaton (1981); faunal lists by Dr. Willard F. Stanley of the State University College, Fredonia; ecological studies by St. Bonaventure University, Department of Biology; and game census, deer wintering area use and other studies by the NYSDEC, Region 9 biologists. Other studies of the Center and its immediate vicinity undertaken in the past include a 1966-67 study by Health Research, Inc., as noted in the 1973-74 studies sponsored by Nuclear Fuel Services, Inc.; US EPA studies conducted in 1978; and 1976 studies performed by Davis and Fakundiny (1978) for New York State Geological Survey and State Museum.

Fauna found on the Center are typical of those of Northeastern United States (Moore, pers. comm. 1982). The site area is within the northern hardwoods forest region and past clearing of the forest for agriculture has resulted in the the present patchy arrangement and existence of various cover types in the Cattaraugus and Allegany Counties area. While this clearing activity has reduced the habitat available to forest wildlife species, it has resulted in

* An ecotone is a transition area between two or more diverse communities which commonly contains many of the organisms of each of the overlapping communities as well as organisms restricted to the ecotone (Odum, 1971).

an increase of habitat for species associated with more open areas and with ecotones. Because of the lack of human occupation and the restrictions on development, the Center provides a sizable undisturbed sanctuary that permits and encourages establishment of a naturally balanced community of wildlife in the area.

Birds

Avian diversity (species composition) and population (numbers of individuals) of an area vary significantly from season to season due to bird migration habit and patterns. During the mid-winter and late spring-early summer seasons, populations are resident and only a few visitants occur irregularly. At other times of the year, the bird populations of an area are in nearly constant change due to migratory species.

Table A.3.7-A-1 lists all species known or expected to occur on the Center. This table also notes their relative frequency of observation, protected status, seasonal occurrence, and preferred habitats. Seasonal occurrence data have been divided into four categories as defined by Eaton (1981):

- o permanent residents - seldom or never migrate;
- o summer residents - breed on-site but migrate elsewhere for the winter season;
- o migrants, birds-of-passage, such as ducks, and warblers - regularly migrate through the area in either the spring, fall or both seasons; and
- o visitants - nonbreeding birds which occur as seasonal, less regular visitors.

Most of the birds noted on this table and in Cattaraugus County are summer resident species. All species recorded during the August 1982 surveys were permanent or summer residents. The most abundant species observed were black-capped chickadee, American goldfinch, and song and field sparrows which are typically found in fields. Fewer birds were noted in the hardwood or

coniferous forests. These included: red-bellied and hairy woodpecker, Eastern phoebe, wood thrush, and vireos. The only waterfowl observed in 1982 were a pair of black ducks and several other unidentified ducks. Other species were recorded during past studies as noted on Table A.3.7-A-1. However, autumn and spring surveys confirm that the site itself is not a significant area along the migration paths. Several great blue herons are known to breed on-site; two nests were observed on the shores of the easternmost reservoir during 1982 summer's field studies. However, the herons had already left the nests. One of these individuals was observed during the spring 1982 survey.

The site's relative proximity to Lake Erie makes it a potential utilization area for many migratory raptors, waterfowl, and songbirds because many species are known to travel the lakeshore and nearby land corridor. It has not been established that the area is used extensively by migrating birds; however, songbirds such as warblers probably use the on-site woodlands and are thus the most common. Andrle, (pers. comm. 1982) notes that the Center is not a particularly important area for waterfowl. Such nearby areas as Lime Lake (8 km east); Farmersville Pond and Marsh (16 km east); and Cuba Lake (32 km southeast) probably represent more attractive habitats (Andrle, pers. comm (1982). In one instance, a flock of Canada geese were seen on two large farm ponds adjacent to the site; during the same time the larger on-site reservoirs were not used by these migrating birds. The Iroquois National Wildlife Refuge located about 64 km to the north is the nearest area of major concentrations of waterfowl (Nuclear Fuel Services, Inc., 1974).

A number of upland game birds also occur on-site. These include turkey and ruffed grouse, which are permanent residents, and woodcock, which migrate through in spring and fall. Mallard, wood duck, and teal are common waterfowl species found in this part of Cattaraugus/Allegany Counties that may occur on-site. Hunting is not permitted on any part of the approximate 1,335 ha site.

Generally, the Center provides a diversity of habitats that are utilized by a wide variety of bird life. Many avian species prefer woodland ecotones, which are common along the many road, railroad, and utility line rights-of-way found within the exclusion area of the site. The protected area is inhabited

primarily by developed area or field species, such as sparrow, robin, and killdeer. The various oldfield, deciduous, and coniferous woodlands, marsh, reservoirs, and streams found within the exclusion zone provide the habitat for the 148 birds listed on Table A.3.7-A-1.

No protected species have been recorded on-site; however, an occasional protected raptor may frequent the site during migration. According to Dr. Andrle, (pers. comm. 1982), the peregrine falcon (Falco peregrinus) and bald eagle (Haliaeetus leucocephalus) may also pass through the site vicinity, but they are not included on Table A.3.7-A-1.

Mammals

Mammalian members of faunal communities are important for both ecological reasons and their popularity for hunting (which is a significant food-link to man). Ecologically, they function on several trophic levels, and thus comprise an important segment of community food webs. Unlike some animals such as birds, mammals have evolved a variety of behavioral patterns that aid in avoiding detection and capture. As a result, many species are difficult to trap or observe in numbers sufficient to correctly characterize their abundance or density within a given area. Variations in activity patterns between seasons also make statistical results difficult to develop. The numbers of individuals also change seasonally due to natality and mortality rates. For example, most populations increase during spring and summer as a result of reproduction activities. As a result, this report, like most studies, is qualitative or comparative based on estimated relative figures.

Table A.3.7-A-2 lists those mammals that have been recorded on-site or are considered to potentially occur on-site. Twenty-two of the fifty-four species listed have been recorded in either the 1973, 1976 or 1982-83 surveys. Mammals (or their signs) observed by S/EA's biologists include opposum, raccoon, striped skunk, gray fox, woodchuck, Eastern chipmunk, Eastern gray squirrel, red squirrel, beaver, Eastern cottontail and whitetail deer. Most sightings were made of deer; a maximum single evening count of 12 was made during February 1983.

Deer are noted as the most popular and abundant game species of the region, but hunting is not permitted on any part of the site. Based on site range records developed by the NYSDEC of five bucks per square mile (or 260 ha) in this area, and an estimated ratio of 6:1 female/male deer, the estimated deer population of the entire Center is about 150 individuals. Past estimates of deer populations have indicated a total of approximately 20,000 deer within a 32 kilometre radius of the site (Magno et al, 1974). Moore notes (pers. comm. 1982) that a problem of overpopulation on the Center, and particularly within the protected area, has existed over the past several years. The normal carrying capacity of this 100 ha enclosed area is 15-20 deer. In 1981, a population of 50-60 individuals was determined to be within this area. In June of 1981, in order to reduce the possibility of starvation, most of these deer were chased out of the protected area through the combined efforts of site personnel and the NYSDEC (NYSDEC, 1981b), a procedure which has been repeated occasionally as required by the size of the deer population within the protected area.

The high deer population on the site is also reflected in 1981 harvest records for the entire Town of Ashford and nearby communities (NYSDEC, 1981a). These populations are continuing to grow; records for the 1960s showed less than 2 bucks/square mile while current data show 5.5 bucks/square mile (Moore, pers. comm. 1982). Also, the entire 1,335 ha site is part of an approximate 1,600 ha wintering grounds area for deer on the NYSDEC's "critical habitat maps" (NYSDEC, 1974). Other similar wintering grounds are noted throughout the local region. Wintering grounds are important for the deer population because they represent favorable areas for feeding as well as protection from the harsh winter elements. Also, because the Center is a restricted area in which hunting is banned, it is an extremely attractive refuge for deer during the late autumn hunting season which generally coincides with their breeding season. These two factors combine to concentrate a large number of deer in a favored but limited wintering area. Problem situations can arise if the deer population exceeds the carrying capacity of the area. If this coincides with a severe winter, the population may be stressed, and starvation may ensue.

The primary emphasis of the autumn and winter mammal surveys was updating the population estimate of the whitetail deer herd on the site. The number of deer observed during the winter survey varied greatly depending upon the habitat and weather conditions as well as on the time of day when the observations were made. A total of 36 deer were observed during the three days of field activities; 17 deer were spotted within the protected area; 19 deer were observed on the remainder of the Center's acreage. In general, the greatest numbers of deer were observed after dark, during night-time surveys. The highest single count of 12 whitetail deer occurred during one such survey.

During winter walk-through surveys of representative habitat areas, the number of deer observed indicated a population density of roughly 0.25 deer per hectare or on the order of 300 deer on the entire 1,335 hectare site. However, according to NYSDEC officials, the average post-hunting season deer population for the Western New York region in which the Center is located is approximately 15 deer per square mile (260 ha). In addition, the whitetail deer population of wintering grounds is generally 2 to more than 2-1/2 times that of nonwintering ground areas (Moore, pers. comm. 1983). Thus, the winter population of the Center's 1,300 ha property is estimated to be on the order of 150-200 animals. This estimate agrees with the estimate of 150 deer calculated previously.

A major obstacle in extrapolating deer population estimates for the entire site is the herding behavior commonly practiced by the deer on wintering grounds during the mid-to-late winter season. As a result of this behavior, the site's deer population clusters in groups in various areas scattered throughout the property, thus making any population survey more difficult and uncertain.

In addition to whitetail deer, other common game and furbearer species include raccoon, red and gray fox, woodchuck, mink, Eastern cottontail and squirrels. Black bear are also noted as being occasionally taken from this general area. No abundance estimates were available from the NYSDEC or other sources; however, overall species abundance and diversity is considered to be normal for Western New York (Moore, pers. comm. 1982).

Three beaver dams were observed; one includes a lodge. One dam was noted in the stream connecting the two on-site reservoirs. A second dam and lodge were found in the marshy headwaters of the western-most reservoir. The third is located on a small tributary in the woodlands that border the eastern reservoir on its southern edge. Because family groups of parents, yearlings and kits may occupy a lodge, the beaver population of this single lodge could be as high as eight (assuming an average of three kits per litter).

In addition to noting on-site records and relative frequency of the species, Table A.3.7-A-2 also provides in matrix form the habitats or vegetative over types in which these mammals are most likely to be found. This information should be interpreted with care, however, since wildlife utilization of any vegetative community is strongly influenced by the nature of the adjacent communities. For example, animals frequently find cover in one cover type (e.g., woodland), but feed in adjacent open area (e.g., fields). Therefore, the presence or abundance of a species is dependent on the spatial arrangement of different habitat types. For this reason, ecotones generally have the highest species diversity.

In general, the vegetative communities found on-site provide good wildlife habitat. The diversity of habitat and ecotones on-site contributes to the value of these areas for wildlife. The nondisturbed nature of the approximate 3,300 ha site adds to the attractiveness of this area to mammals.

Amphibians and Reptiles

Herptiles, which include amphibians and reptiles, are permanent residents in any local area. Species composition of herpetofauna in an area does not change seasonally. However, community changes do occur in terms of numbers of individuals present, detectability, and in some cases, locations of primary activities. For example, following breeding in the spring, both amphibian and reptile populations will be higher in the summer and fall due to production of young, while spring populations will be the lowest. On the other hand, most species (particularly the anurans) are most easily observed and counted in the spring during breeding choruses. Most adult amphibians are also concentrated

in wet areas at this time. Because of these reasons and other seasonal variations in activity patterns of herptiles, even seasonal sampling of herpetofauna may not necessarily provide meaningful estimates of numbers of individuals, although such studies would provide information on locations of breeding activity and past-breeding habitat preference.

Table A.3.7-A-3 lists the amphibians that were observed on-site and also others that do or may occur based on range and habitat requirements. In addition to those noted on this table as recored on-site, several of these (including spotted salamander, American and Fowler's toad, and Northern leopard, green and wood frogs) were recorded as occurring within a 16 km radius of the site in 1966 by Health Research Inc. (Nuclear Fuel Service, Inc., 1974). All of these species are associated with aquatic or marsh habitats, although nearby cover types into which they may move are also noted. All species noted in this study were sighted either along a stream or at a reservoir edge. None are protected species, although two salamanders and one frog are noted as "special concern" species in the State, primarily because Western New York is at either the northern or southern limit of their range. These species, therefore, are less likely to be found on-site than other amphibians listed. The list of species noted on Table A.3.7-A-3 as potentially occurring on the Center site is comparable to those developed for other sites within the general area (Niagara Mohawk Power Corporation, 1976 and Nuclear Fuel Services, Inc., 1974 - Lists of Species of Allegany State Park).

The reptiles expected to inhabit the site are noted on Table A.3.7-A-4. No reptiles were observed during the 1982-83 field studies nor are any site specific records available from past studies. Reptiles are generally recognized as "secretive" species that for the most part escape detection. Both the Davis and Fakundiny (1978) and Nuclear Fuel Services, Inc. (1974) reports list those species observed within a 16-km radius of the site by Dr. Allen Benton in 1976; their site specificity is not clear, however. Species observed by Benton include snapping, spotted and Midland painted turtles, and red-bellied and Eastern garter snakes. The list of reptiles shown on Table A.3.7-A-4 is based on studies of nearby areas (previously referenced), consultation with local authorities, and habitat and range

requirements. This list may not be all-encompassing, but all of these reptiles are likely to occur on the Center with the possible exception of those listed as protected or of special concern; as indicated by their designation, they are uncommon in Western New York.

Table A.3.7-A-4 also identifies the habitats in which the reptiles are most likely to be found. Unlike amphibians, reptiles do not require aquatic environments to breed and therefore can also be found in the upland vegetation communities. Turtles spend much of their time in ponds because these areas provide their major food items (aquatic arthropods, amphibians and fish); however snakes, in general, are secretive and often are found under rocks, logs and other debris in a variety of plant communities.

Critical Habitats

The US Department of Interior, Fish and Wildlife Service maintains a file of specific locations designated as habitat critical to the survival of Federally listed endangered or threatened species. Based on a review of the most recent listings (US DI, 1982), no such designations were found for the State of New York.

"Critical habitat maps" are also developed by the NYSDEC, Bureau of Wildlife. Critical habitats are those areas found to be of significant importance to game and other important wildlife species. Such areas include wintering areas and breeding grounds. A 1,600 ha area (which includes the entire 1,335 ha site) has been mapped as such an area due to its extensive usage by whitetail deer as a wintering area. The 1,335 ha found on the Center represents about 15 percent of the available wintering area found within the County. Softwood shelter availability is considered to be intermediate, and food availability is considered good in this area (NYSDEC, 1974).

Threatened or Endangered Species

A review of the files of the Region 9 NYSDEC office and consultation with Dr. Steve Eaton of St. Bonaventure University and Dr. Robert Andrle of Buffalo Museum of Science was conducted for on-site records of Federal and State

threatened or endangered species. The NYSDEC list of protected species is provided in Table A.3.7-A-5. According to these sources, none of the species are known to occur nor is their presence considered to be likely at the Center.

As noted on Table A.3.7-A-1, the loggerhead shrike is a State endangered species that may occur on-site. Likewise, the red-shouldered hawk and marsh hawk, which are on the State threatened list (NYSDEC, 1983), are listed as possibly occurring on-site. This is based on the potential availability of suitable habitat on-site, and a listing of these birds as summer resident and migratory species within Cattaraugus County (Eaton, pers. comm. 1982). The NYSDEC also maintains a list of species of "special concern"; these are species under consideration for potential inclusion as endangered or threatened species but not yet afforded legal protection (Moore, pers. comm. 1982). Eight such bird species are included on Table A.3.7-A-1: least bittern, copper's hawk, upland sandpiper, barn owl, common nighthawk, shortbilled marsh wren, common loon, and the Eastern bluebird. None of the endangered or threatened species were observed on-site during the 1976 or 1982 surveys, and only one special concern species, the Eastern bluebird, was observed on-site.

The Indiana bat is the only Federally or State endangered mammal species that has been listed on Table A.3.7-A-2 as potentially occurring on-site. Although the Indiana Bat is not expected to occur due to the lack of caves and abandoned buildings, the site does provide some habitat used by this species and is within the range of this bat. The least, or small-footed bat, which is a State species of special concern, does have available habitat on-site, and according to Moore (pers. comm. 1982) may potentially be found on-site.

Two reptiles listed on the State list of protected species are the Eastern massasauga and timber rattlesnake. They are considered endangered and threatened, respectively, according to the NYSDEC list (Table A.3.7-A-5). Herptile species of special concern include the spotted turtle, Jefferson salamander, blue-spotted salamander and Southern leopard frog. The habitats in which these species are most commonly found in are noted on Table A.3.7-A-3 and A.3.7-A-4. All of these habitats are found on the Center.

It must be repeated that while suitable habitats exist at the Center for these rare and endangered species, similar habitats are available throughout the region. Therefore, the site is not ecologically unique, nor does it necessarily house these species.

TABLE A.3.7-A-1 (1 of 6)

BIRDS KNOWN TO OCCUR OR POTENTIALLY OCCURRING ON THE WNYNSC SITE

Common Name	On-site(1)	Frequency(2)	Status(3)	Season(4)	Habitats(5) WS	DF	CF	WF	DV	FD	FM	LP	ST	TH
Common Loon	74	R	SC	M		X						X		
Pied-Billed Grebe		R		M							X	X	X	
Great Blue Heron	76,83	R		SR							X	X		
Green Heron	76	R		SR							X	X	X	
Black-Crowned Night Heron		O		V	X						X		X	
American Bittern		I		SR							X	X		
Least Bittern		O	SC	V							X			
Canada Goose		R		SR, SFM								X		
Mallard		R		SR							X	X		
Black Duck	82	R		SR										
Blue-Winged Teal		R	SR								X	X		
Northern Shoveler		O		M							X			
Wood Duck		R		SR	X						X		X	
Lesser Scaup	74	R		M							X	X		
Bufflehead	74	R		M								X		
Common Merganser	74	R		M		X						X		
Turkey Vulture		R		SR		X		X						
Sharp-Shinned Hawk		R		SR		X	X							
Cooper's Hawk		R	SC	SR		X	X	X						
Red-Tailed Hawk	82,83	R		SR		X		X						
Red-Shouldered Hawk		R	ST	SR		X						X		
Broad-Winged Hawk		R		SR		X								
Marsh Hawk		O	ST	SR						X	X			
American Kestrel	76	R		SR					X	X				
Ruffed Grouse	76,82,83	R		PR		X		X		X				X
Ring-Necked Pheasant	76	S		PR				X		X				
Turkey	83	R		PR		X		X						
King Rail		I		SR							X			
Virginia Rail		O		SR							X			
Sora		R		SR							X	X		
Common Gallinule		C		V							X			

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BIRDS KNOWN TO OCCUR OR POTENTIALLY OCCURRING ON THE WNYNSC SITE

Common Name	On-site(1)	Frequency(2)	Status(3)	Season(4)	Habitats(5) WS	DF	CF	WF	DW	FD	FM	LP	ST	TH
American Coot		R		M							X	X		
Semipalmated Plover		R		M								X		
Killdeer	76,82,83	R		SR						X				
American Woodcock		R		SR	X	X		X						X
Common Snipe	76	R		SR							X	X		
Upland Sandpiper		R	SC	SR						X				
Spotted Sandpiper	76,83	R	SR							X				
Solitary Sandpiper		R		M	X							X	X	
Greater Yellowlegs		R		M								X		
Lesser Yellowlegs		R		M							X	X		
Least Sandpiper	83	R	SFM	SFM								X	X	
Rock Dove	76,82	R	PR						X	X				
Mourning Dove	76,82	R		SR					X	X				
Black-Billed Cuckoo		R		SR		X								X
Yellow-Billed Cuckoo	82	R		SR										X
Barn Owl		C	SC	V				X	X	X				
Screech Owl		R		PR		X		X	X			X		
Great Horned Owl		R		PR	X	X	X	X		X				
Barred Owl		R		PR	X	X								
Long-Eared Owl		O		SR		X	X							
Common Nighthawk		R	SC	SR					X	X				
Ruby-Throated Hummingbird		R		SR		X			X					
Belted Kingfisher	76,82,83	R		SR								X		
Common Flicker	76,82,83	R		SR					X	X				
Pileated Woodpecker	82,83	R		PR		X		X						
Red-Bellied Woodpecker	82,83	R		PR	X	X								
Hairy Woodpecker	76,82,83	R		PR		X								
Red-Headed Woodpecker		I		SR		X				X				
Yellow-Bellied Sapsucker		R		SR		X	X		X					
Downy Woodpecker	76,83	R		PR		X			X					
Eastern Kingbird	82,83	R		SR						X		X		

TABLE A.3.7-A-1 (3 of 6)

BIRDS KNOWN TO OCCUR OR POTENTIALLY OCCURRING ON THE WNYNSC SITE

Common Name	On-site[1]	Frequency[2]	Status[3]	Season[4]	Habitats[5] WS	DF	CF	WF	DV	FD	FM	LP	ST	TH
Great Crested Flycatcher	82,83	R		SR		X								
Eastern Phoebe	76,82	R		SR		X			X				X	
Yellow Bellied Flycatcher	83	R		SR	X	X		X						
Acadian Flycatcher		R		SR	X	X								
Alder Flycatcher		R		SR	X								X	X
Least Flycatcher		R		SR				X						
Eastern Wood Peewee	76,82	R		SR		X								
Horned Lark		R		SR						X				
Tree Swallow		R		SR							X	X	X	
Bank Swallow		R		SR								X	X	
Rough-Winged Swallow	82	R		SR									X	
Barn Swallow	76,82,83	R		SR					X	X	X	X		
Cliff Swallow		R		SR						X	X	X		
Blue Jay	76,82,83	R		PR		X		X	X					
Purple Martin		R		SR		X			X	X				
Common Crow	82,83	R		PR		X	X	X	X	X				
Black-Capped Chickadee	76,82,83	R		PR		X	X	X	X					
Tufted Titmouse	82,83	R		PR	X	X								
White-Breasted Nuthatch	82,83	R		PR		X	X							
Brown Creeper	83	R		PR	X	X	X							
House Wren	83	R		SR				X	X	X				
Carolina Wren	82	R		SR										X
Winter Wren		R		SR		X	X							X
Long-Billed Marsh Wren		R		V							X			
Short-Billed Marsh Wren		C	SC	M							X			
Mockingbird	83	I		PR					X	X				X
Gray Catbird	76,82,83	R		SR										X
Brown Thrasher	76,83	R		SR				X						X
American Robin	76,82,83	R		SR		X			X	X				
Wood Thrush	76,82,83	R		SR		X								X
Hermit Thrush		R		SR		X	X							X
Swainson's Thrush		R		SR			X							X

TABLE A.3.7-A-1 (4 of 6)

BIRDS KNOWN TO OCCUR OR POTENTIALLY OCCURRING ON THE WNYNSC SITE

Common Name	On-site[1]	Frequency[2]	Status[3]	Season[4]	Habitats[5] WS	DF	CF	WF	DV	FD	FM	LP	ST	TH
Gray-Cheeked Thrush		R		M			X							
Veery		R		SR		X								
Eastern Bluebird	82	R	SC	SR						X				
Blue-Gray Gnatcatcher		I		SR		X							X	X
Ruby-Crowned Kinglet	82	R		SR,SFM		X	X							X
Cedar Waxwing	76,82	R		SR,SFM		X		X						
Starling	76,82	R		PR					X	X				
White-Eyed Vireo	83	O		SM		X							X	X
Loggerhead Shrike		I	SE	SR						X				
Yellow-Throated Vireo	82	R		SR		X		X					X	
Solitary Vireo	82,83	R		SR		X	X							
Red-Eyed Vireo	76,82,83	R		SR		X								
Warbling Vireo		R		SR		X							X	
Black-and-White Warbler	83	R		SR		X			X					
Prothonotary Warbler		O		M	X								X	
Blue-Winged Warbler	83	R		SR				X		X				
Northern Parula		R		SR	X		X					X		
Nashville Warbler	83	R		SR		X	X							
Yellow Warbler	83	R		SR	X								X	X
Magnolia Warbler		R		SR			X							
Cape May Warbler		R		M		X	X		X					
Black-Throated Blue Warbler		R		SR		X	X							
Yellow-Rumped Warbler	83	R		SR		X	X							
Black-Throated Green Warbler	83	R		SR			X							
Blackburnian Warbler	83	R		SR		X	X							
Chestnut-Sided Warbler		R		SR										X
Bay-Breasted Warbler	83	R		M		X	X							
Blackpoll Warbler		R		M			X							
Pine Warbler	82	O		SR			X							
Prarie Warbler	83	R		SFM		X	X							
Ovenbird	83	R		SR		X								
Northern Waterthrush		R		SR	X	X						X		

BIRDS KNOWN TO OCCUR OR POTENTIALLY OCCURRING ON THE WNYNSC SITE

Common Name	On-site[1]	Frequency[2]	Status[3]	Season[4]	Habitats[5]									
					WS	DF	CF	WF	DV	FD	FM	LP	ST	TH
Louisiana Watherthrush		R		SR	X								X	
Common Yellowthroat		R		SR							X			X
Yellow-Breasted Chat		O		SR									X	X
Hooded Warbler		R		SR	X	X								
Wilson's Warbler	83	R		M		X							X	X
Canada Warbler	76	R		SR	X									
American Redstart	76,82,83	R		SR		X								X
House Sparrow		R		PR					X	X				
Bobolink		R		SR						X	X			
Eastern Meadowlark	83	R		SR						X				
Red-Winged Blackbird	76,82,83	R		SR,SFM						X	X			
Northern Oriole	83	R		SR		X			X					
Common Grackle	76,82	R		SR		X			X	X				
Brown-Headed Cowbird	76	R		SR				X	X	X				
Scarlet Tanager	83	R		SR		X	X							
Cardinal	76,82,83	R		PR	X			X						X
Rose-Breasted Grosbeak	76,83	R		SR		X		X						X
Indigo Bunting	82	R		SR				X		X				X
Snow Bunting	82	I		WV					X	X				
Dark-Eyed Junco	82,83	R		M				X						
Pine Siskin	83	R		WV,V				X		X				X
American Goldfinch	82,83	R		SR,SFM				X		X				X
Rufous-Sided Towhee	76,83	R		SR				X						X
Dark-Eyed Junco	82,83	R		M				X						
Tree Sparrow		R		V				X		X				X
Chipping Sparrow	82	R		SR				X	X					X
Field Sparrow	82,83	R		SR						X				
White-Crowned Sparrow	82	R		M										X
White-Throated Sparrow	82,83	R		SR			X		X					X
Fox Sparrow		R		M			X							X
Lincoln's Sparrow		I		M			X							X
Swamp Sparrow	82,83	R		SR	X					X	X			
Song Sparrow	82,83	R		SR					X	X				X
Snow Bunting	82	I		WV					X	X				

KEY TO TABLE A.3.7-A-1 (6 of 6)

(1) Onsite occurrence as noted in the following reports:
"74" Nuclear Fuel Services, Inc., 1974
"76" Davis and Fakundiny, March, 1978
"82" S/EA, August and November, 1982 field studies.
"83" S/EA, February and May, 1983 field studies.

(2) Frequency of sightings as noted by Eaton, 1981:
Key: R-Regular: recorded every year
I-Irregular: Recorded less than once every year, but no less than once in five years, on the average.
O-Occasional: recorded less than once in five years, but no less than once in ten years, on the average.
C-Casual: recorded less than once in twenty years, on the average.

(3) References include New York State Department of Environmental Conservation, February 9, 1983, and U.S. Department of Interior, Fish and Wildlife Service, July 2, 1982.
Key: FE-Federally Endangered
SE-State Endangered; ST-State Threatened
SC-State Special Concern.

(4) Seasonal occurrence as noted by Eaton, 1981.
Key: M-Migrant (spring, fall, or both)
SR-Summer Resident (may also migrate through in the spring and/or fall); V-Visitant
PR-Permanent Resident
WV-Winter Visitant.

(5) Habitat types in which most commonly found
Key: WS-Wooded Swamp
DF-Deciduous Forest; CF-Coniferous Forest
WF-Woodland/Field Edge
DV-Developed; FD-Fields
FM-Freshwater Marsh
LP-Lakes, Ponds
ST-Streams
TH-Thickets.

TABLE A.3.7-A-2 (1 of 3)

MAMMALS KNOWN TO OR POTENTIALLY OCCURRING AT THE WNYNSC

Common Name	On-site(1)	Frequency(2)	Status(3)	Habitats(4) WS	DF	CF	WF	DV	FD	FM	LP	ST
Opposum	82				X		X		X			X
Masked Shrew	73,76				X		X		X			
Smoky Shrew	73,76				X	X						
Water Shrew		R		X	X							X
Pigmy Shrew		R			X	X	X		X			
Least Shrew		R						X	X	X		
Shorttail Shrew	73,76				X	X	X	X	X	X		
Starnose Mole	76								X		X	X
Hairytail Mole		R			X	X	X		X			
Little Brown Myotis					X	X		X				
Keen's Bat				X	X	X			X			
Indiana Bat		R	FE,SE		X			X				
Least (small-footed) Bat		R	SC		X		X	X				
Silver-Haired Bat					X	X		X				
Pipistrelle Bat				X	X		X	X				X
Big Brown Bat				X	X		X	X				
Red Bat				X	X		X	X				
Hoary Bat					X	X	X					
Black Bear		R		X	X							
Raccoon	76,82				X	X	X				X	X
Shorttail Weasel					X	X	X				X	X
Least Weasel					X	X	X		X	X		
Longtail Weasel				X	X	X	X		X	X	X	X
Mink				X	X	X					X	X
Otter		R			X	X					X	X
Striped Skunk	82				X	X	X		X			X
Coyote		R			X	X	X		X			
Red Fox	83				X	X	X		X			

TABLE A.3.7-A-2 (2 of 3)

MAMMALS KNOWN TO OR POTENTIALLY OCCURRING AT THE WNYNSC

Common Name	On-site[(1)]	Frequency[(2)]	Status[(3)]	Habitats[(4)] WS	DF	CF	WF	DV	FD	FM	LP	ST
Gray Fox	82				X	X	X					
Bobcat		R		X	X	X						
Woodchuck	76,82,83											
Eastern Chipmunk	73,82				X		X					
Eastern Gray Squirrel	82				X		X					
Eastern Fox Squirrel		R			X	X	X					
Red Squirrel	82			X	X	X						
Southern Flying Squirrel					X	X	X					
Northern Flying Squirrel					X	X	X					
Beaver	82,83				X						X	X
Deer Mouse					X	X	X	X	X			
White-footed Mouse	73,76				X	X	X		X			
Southern Bog Lemming		R		X						X		
Red-backed Vole				X	X	X						
Pine Vole		R		X	X	X						
Meadow Vole	73,76,83			X	X				X		X	X
Muskrat	76									X	X	X
Norway Rat								X				
House Mouse								X	X			
Meadown Jumping Mouse	73			X	X		X			X		
Woodland Jumping Mouse	73			X	X		X					X
Porcupine		R			X	X	X					
Eastern Cottontail	82,83						X		X			
Snowshoe (Varying) Hare		R		X	X		X					
New England Cottontail	76	R	SC		X		X		X			
Whitetail Deer	76,82,83			X	X	X	X		X			

KEY TO TABLE A.3.7-A-2 (3 of 3)

(1) On-site occurrence as noted in the following reports:
"73"-Nuclear Fuel Services, Inc., June 20, 1974,
"76"-Davis and Fakundiny, March, 1978,
"82"-S/EA, August and November, 1982 field studies.
"83" S/EA, February and May, 1983 field studies.

(2) Unless noted as R (rare) these species probably occur on-site according to Davis and Fakundiny, March, 1978.

(3) Referenes include New York State Department of Environmental Conservastion, February 9, 1983 and U.S. Department of Interior, Fish and Wildlife Service, July, 1982.
Key: FE-Federally Endangered
SE-State Endangered
SC-State Special Concern

(4) Habitat types in which most commonly founds:

Key: WS-Wooded Swamp
DF-Deciduous Forest
CF-Coniferous Forest
WF-Woodland/Field Edge
DV-Developed; FD-Fields
FM-Freshwater Marsh
LP-Lakes, Ponds
ST-Streams.

TABLE A.3.7-A-3

AMPHIBIANS KNOWN TO OR POTENTIALLY OCCURRING AT THE WNYNSC

Common Name	On-site[1]	Status[3]	Habitats[3]							
			UW	WS	FD	DV	FM	LK	PD	ST
Jefferson Salamander		SC		X					X	
Blue-spotted Salamander		SC			X				X	X
Spotted Salamander		SC		X					X	
Red-spotted Newt				X				X	X	X
Northern Dusky Salamander	76,82			X						X
Mountain Dusky Salamander			X	X						X
Slimy Salamander				X						X
Northern Two-lined Salamander	76			X						X
American Toad	76,82				X	X			X	X
Fowler's Toad								X	X	X
Spring Peeper			X	X	X				X	
Gray Treefrog			X						X	X
Western Chorus Frog					X	X		X	X	X
Bullfrog				X			X	X	X	X
Green Frog								X	X	X
Wood Frog	76,82			X					X	
Northern Leopard Frog	82						X		X	
Southern Leopard Frog		SC			X		X	X	X	X
Pickerel Frog	82					X	X			X

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(1) On-site occurrences as noted in the following reports:
"76" Davis and Fakundiny, March, 1978,
"82" S/EA, August and November, 1982 field studies.
"83" S/EA, February and May 1983 field studies.

(2) References include New York State Department of Environmental Conservation, February, 9, 1983,
and U.S. Department of Interior Fish and Wildlife Service, July 2, 1982
Key: SC-State Special Concern

(3) Habitats in which most commonly found:
Key: UW-Upland Woodland; WS-Wooded Swamp; FD-Fields;
DV-Developed; FM-Freshwater March; LK-Lakes; PD-Ponds, ST-Streams.

TABLE A.3.7-A-4

REPTILES POTENTIALLY OCCURRING AT THE WNYNSC[1]

Common Name	Status[3]	Habitats[3] UW	WS	FD	DV	FM	LK	PD	ST
Snapping Turtle							X	X	X
Stinkpot							X	X	X
Spotted Turtle	SC		X			X		X	X
Wood Turtle	SC		X	X			X	X	
Midland Painted Turtle						X		X	X
Northern Water Snake			X			X	X	X	X
Northern Brown Snake			X		X	X			
Red-Bellied Snake		X							
Eastern Garter Snake		X	X		X				X
Northern Ribbon Snake			X					X	X
Northern Ringneck Snake			X						X
Northern Black Racer		X	X						
Smooth Green Snake		X							
Black Rat Snake		X		X					
Eastern Milk Snake		X		X					X
Eastern Massasauga	SE	X	X						
Timer Rattlesnake	ST	X	X						

---

(1) No reptiles were directly observed on-site during S/EA 1982-83 field studies nor are other site specific records available.

(2) References include New York State Department of Environmental Conservation, February 9, 1983 and U.S. Department of Interior Fish and Wildlife Service, July 2, 1982.
Key: SE-State Endangered; ST-State Threatened; SC-State Special Concern.

(3) Habitats in which most commonly found:
Key: UW-Upland Woodland, WS-Wooded Swamp; FD-Fields; DV-Developed; FM-Freshwater Marsh; LK-Lakes; PD-Ponds; ST-Streams.

-COM005206:158H

TABLE A.3.7-A-5 (1 of 3)

NEW YORK STATE PROTECTED SPECIES LIST(1)

I. ENDANGERED

** Chittenango Ovate Amber Snail	Succinea chittenangoensis
Karner Blue Butterfly	Lycaeides melissa
* Shortnose Sturgeon	Acipenser brevirostrum
* Longjaw Cisco	Coregonus alpenae
Round Whitefish	Prosopium cyclindraceum
Pugnose Shiner	Notropis anogenus
Eastern Sand Darter	Ammocrypta pellucida
Bluebreast Darter	Etheostoma camurum
Gilt Darter	Percina evides
* Blue Pike	Stizostedion vitreum glaucum
Spoonhead Sculpin	Cottus ricei
Deepwater Sculpin	Myoxocephalus thompsoni
Tiger Salamander	Ambystoma tigrinum
Bog Turtle	Clemmys muhlenbergi
* Leatherback Sea Turtle	Dermochelys coriacea
* Hawksbill Sea Turtle	Eretmochelys imbricata
* Atlantic Ridley Sea Turtle	Lepidochelys kempii
Massasauga Rattlesnake	Sistrurus catenatus
Golden Eagle	Aquila chrysaetos
* Bald Eagle	Haliaeetus leucocephalus
* Peregrine Falcone	Falco peregrinus
* Eskimo Curlew	Numenius borealis
Least Tern	Sterna albifrons
Roseate Tern	Sterna dougallii
Loggerhead Shrike	Lanius ludovicianus
* Indiana Bat	Myotis sodalis
* Sperm Whale	Physeter catodon
* Sei Whale	Balaenoptera borealis
* Blue Whale	Balaenoptera musculus
* Finback Whale	Balaenoptera physalus
* Humpback Whale	Megaptera novaeangliae
* Right Whale	Balaena glacialis
* Gray Wolf	Canis lupus
* Cougar	Felis concolor

II. THREATENED

Lake Sturgeon	Acipenser fulvescens
Mooneye	Hiodon tergisus
Lake Chubsucker	Erimyzon sucetta
Mud Sunfish	Acantharchus pomotis
Longear Sunfish	Lepomis megalotis

-COM005206:158H

TABLE A.3.7-A-5 (2 of 3)

NEW YORK STATE PROTECTED SPECIES LIST

II. THREATENED (Continued)

Cricket Frog	Acris crepitans
Mud Turtle	Kinosternon subrubrum
Blanding's Turtle	Emydoidea blandingi
** Loggerhead Sea Turtle	Caretta caretta
** Green Sea Turtle	Chelonia mydas
Timber Rattlesnake	Crotalus horridus
Osprey	Pandion haliaetus
Red-shouldered Hawk	Buteo lineatus
Northern Harrier	Circus cyaneus
Spruce Grouse	Dendragapus canadensis
Piping Plover	Charadrius melodus
Common Tern	Sterna hirundo
Eastern Woodrat	Neotoma floridana

* Indicates that the species is currently listed as "endangered" by the U.S. Department of the Interior.

** Indicates that the species is currently listed as "threatened" by the U.S. Department of the Interior.

III. SPECIAL CONCERN

Silver Chub	Hybopsis storeriana
Gravel Chub	Hybopsis x-punctata
Blackchin Shiner	Notropis heterodon
Black Redhorse	Moxostoma duquesnei
Longhead Darter	Percina macrocephala
Southern Leopard Frog	Rana sphenocephala
Hellbender	Cryptobranchus alleganiensis
Jefferson Salamander	Ambystoma jeffersonianum
Blue-spotted Salamander	Ambystoma laterale
Spotted Salamander	Ambystoma maculatum
Spotted Turtle	Clemmys guttata
Wood Turtle	Clemmys insculpta
Diamondback Terrapin	Malaclemys terrapin
Worm Snake	Carphophis amoenus
Eastern Hognose Snake	Heterodon platyrhinos
Common Loon	Gavia immer
Least Bittern	Ixobrychus exilis
Cooper's Hawk	Accipiter cooperii
Black Rail	Laterallus jamaicensis
Upland Sandpiper	Bartramia longicauda

TABLE A.3.7-A-5 (3 of 3)

NEW YORK STATE PROTECTED SPECIES LIST

III. SPECIAL CONCERN (Continued)

Black Tern	Chlidonias niger
Common Barn-Owl	Tyto alba
Short-eared Owl	Asio flammeus
Common Nighthawk	Chordeiles minor
Common Raven	Corvus corax
Sedge Wren	Cistothorus platensis
Eastern Bluebird	Sialia sialis
Henslow's Sparrow	Ammodramus henslowii
Grasshopper Sparrow	Ammodramus savannarum
Vesper Sparrow	Pooecetes gramineus
Small-footed Bat	Myotis leibii
New England Cottontail	Sylvilagus transitionalis
Harbor Porpoise	Phocoena phocoena

1. DEFINITIONS

Endangered Species are any species which meet one of the following criteria:

(1) Any native species in imminent danger of extirpation or extinction in New York
(2) Any species listed as endangered by the United States Department of the Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11.

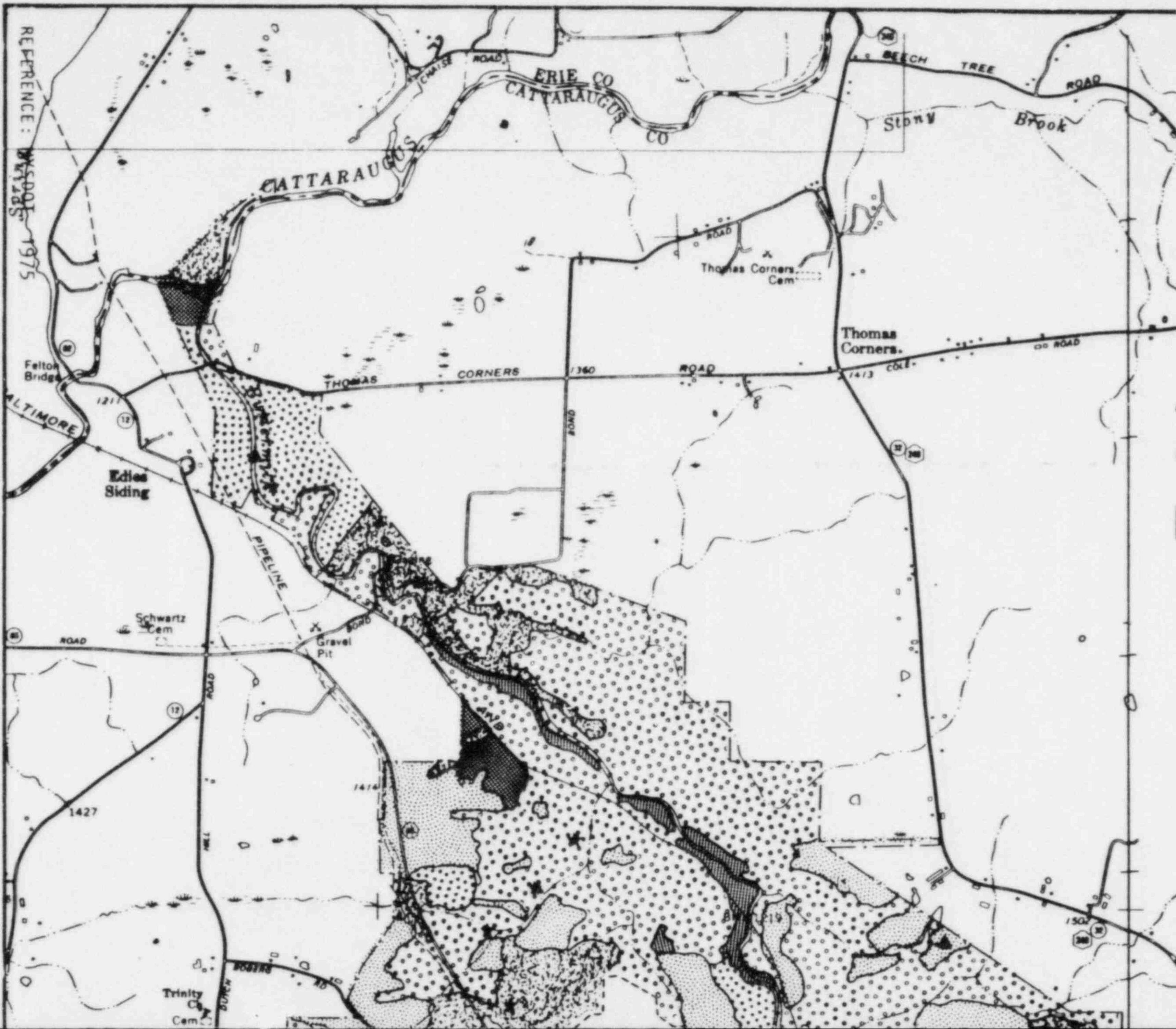
Threatened Species are any species which meet one of the following criteria:

(1) Any native species likely to become an endangered species within the foreseeable futue in New York.
(2) Any species listed as threatened by the United States Department of the Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11.

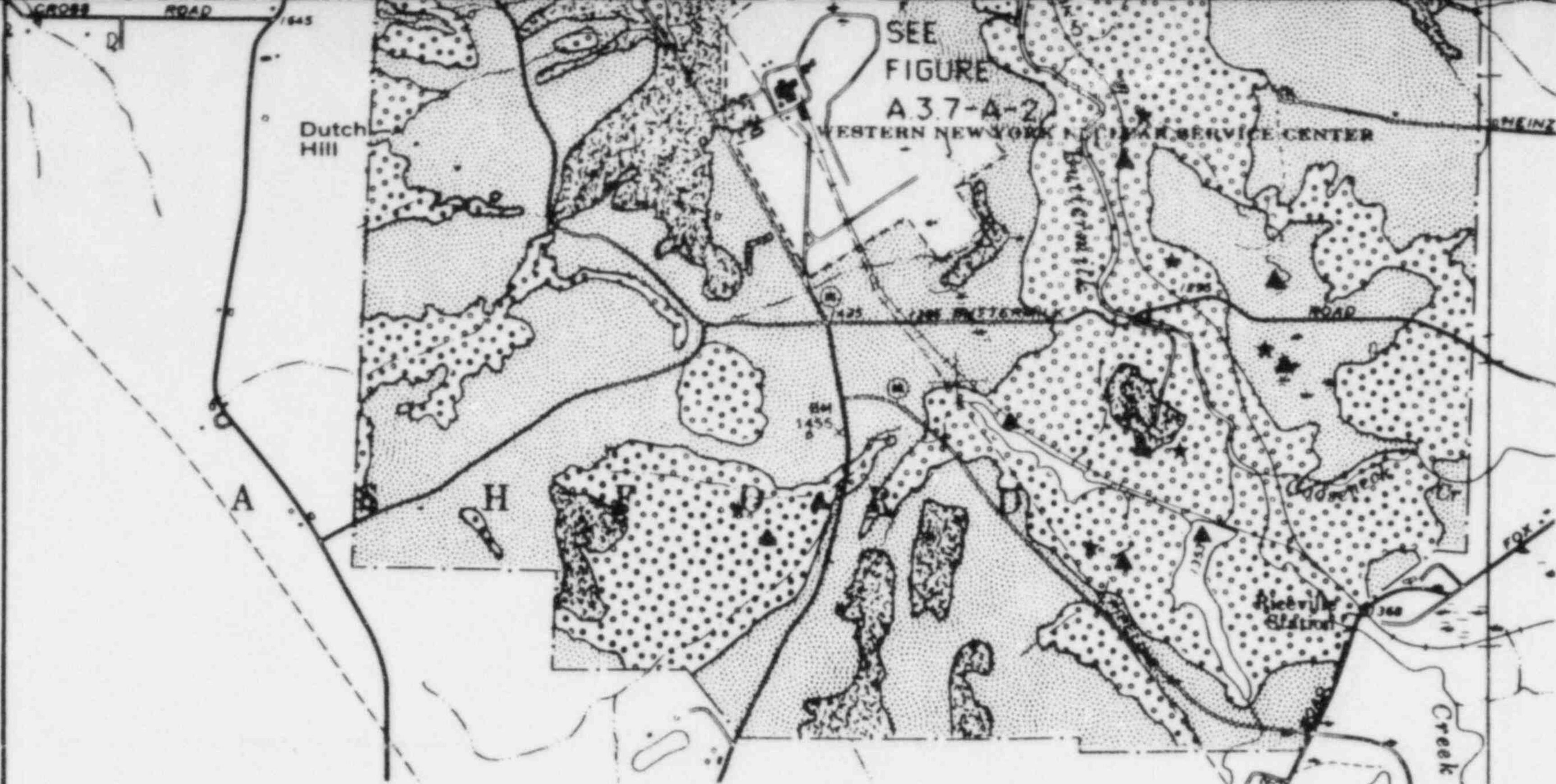
Special Concern Species are those native species which are not yet recognized as endangered or threatened, but for which documented concern exists for their continued welfare in New York. These species could become endangered or threatened in the future and should be more closely monitored. Unlike the first two categories, species of special concern receive no additional legal protection under Environmental Conservation Law Section 11-0535 (Endangered and Threatened Species). This category is presented primarily to enhance public awareness of this group of species which bear additional attention.

Reference: New York State, Department of Environmental Conservation, February 9, 1983.

-COM005206:158H



REFERENCE: NYSDOT 1975
ERIE CO
CATTARAUGUS CO
CATTARAUGUS
BEECH TREE ROAD
Stony Brook
CHAISE ROAD
Thomas Corners Cem
Thomas Corners
THOMAS CORNERS ROAD
COLE ROAD
Felton Bridge
BALTIMORE
Edies Siding
PIPELINE
Schwartz Cem
Gravel Pit
ROAD
Trinity Ch
Cem
1427
1360
1413
1211
1502
N



0 1000 2000 3000 FEET

KEY:

★ SURVEY SITES

▲ LOCATION OF WETLANDS

MIXED HARDWOOD FOREST

FIELD-MEADOWS

PINE-SPRUCE COMMUNITY

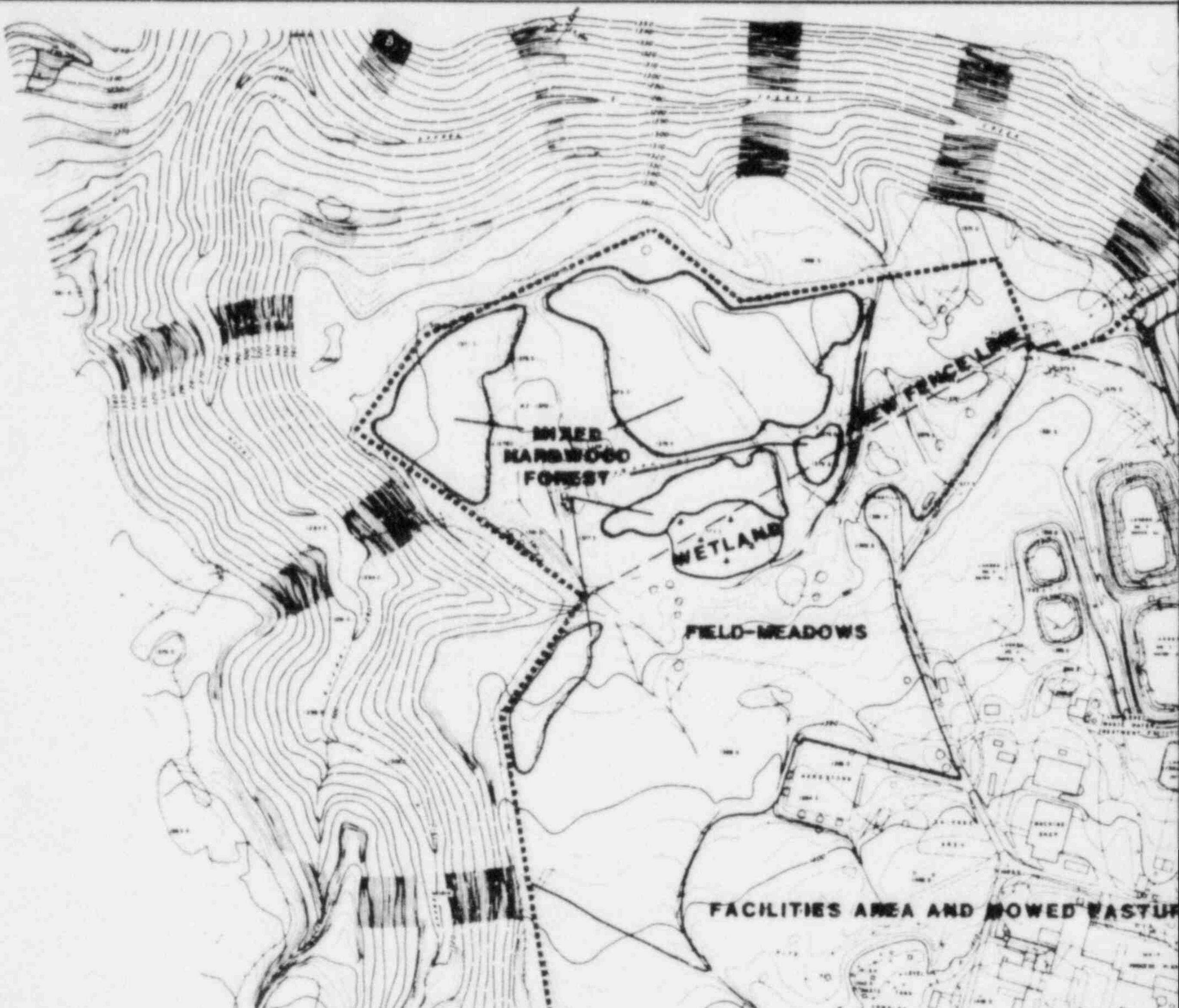
SUCCESSIONAL CREEK-BANK COMMUNITY

LATE OLD-FIELD

8507030448-14

VEGETATION COVER TYPES OF THE EXCLUSION AREA

FIGURE A.3.7-A-1



Also Available On
Aperture Card

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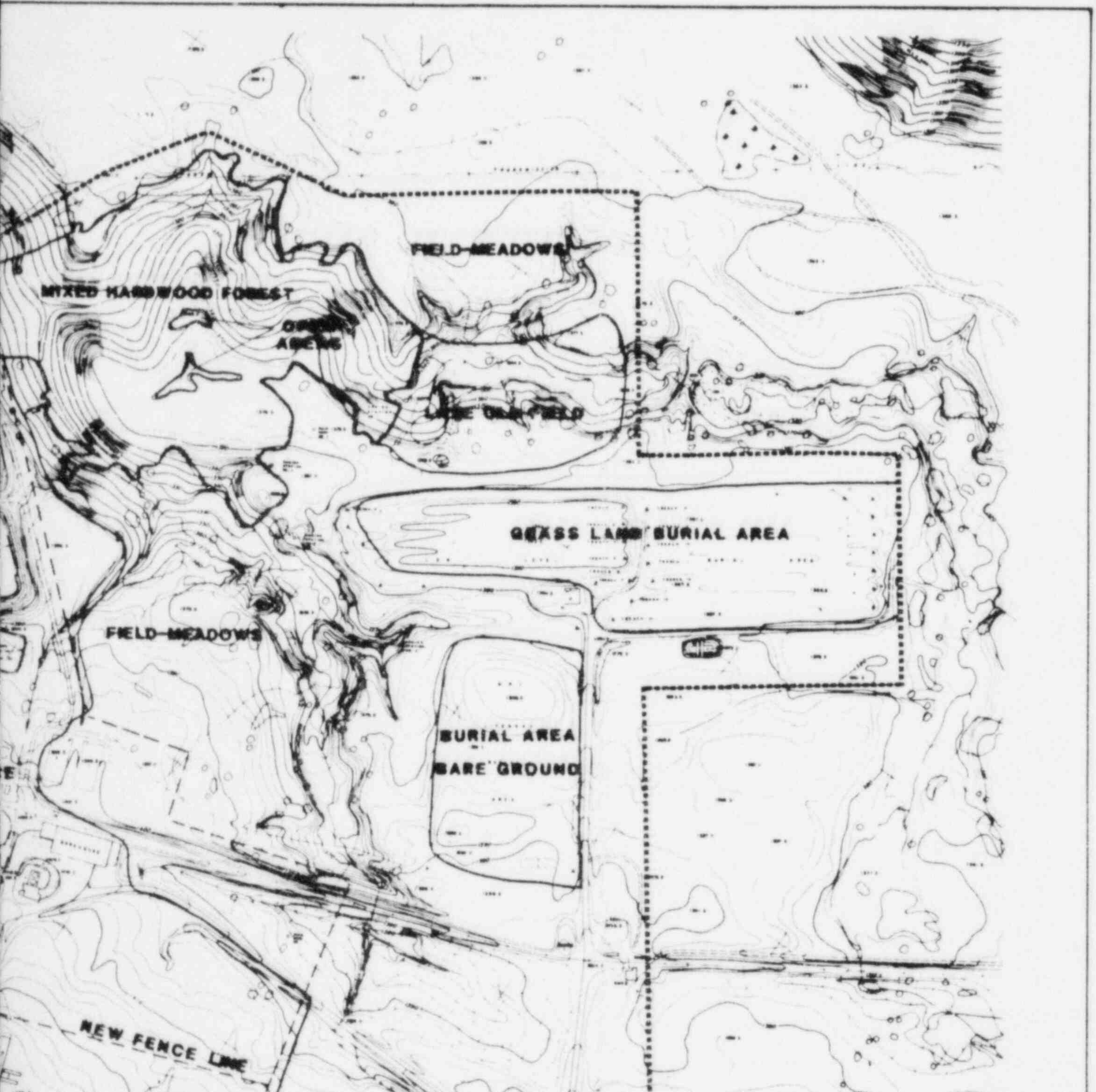
APERTURE
CARD

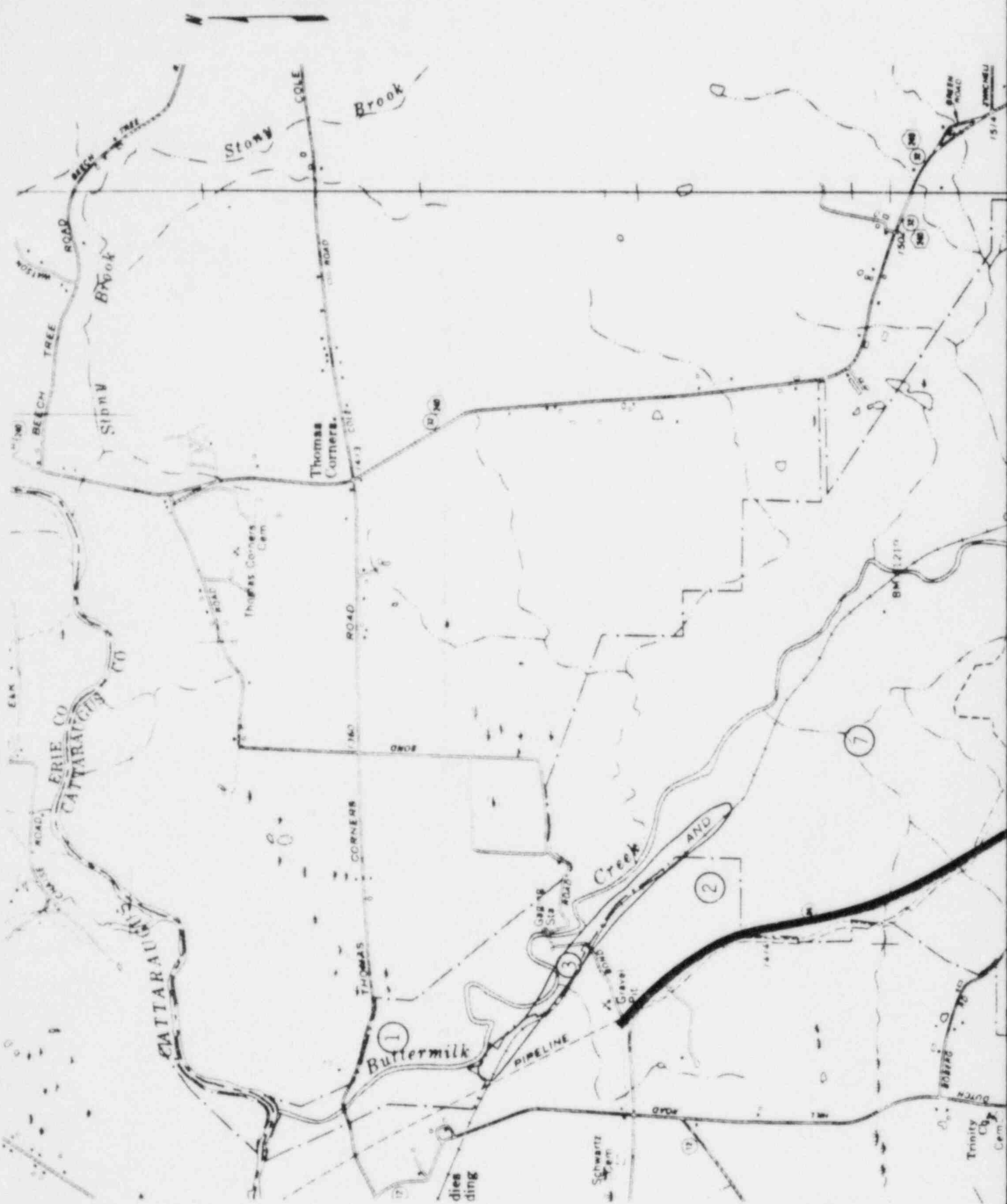
REFERENCE:
ENDMAN, ANTHONY & ASSOCIATES 1980



PLANT COMMUNITIES OF THE PROTECTED AREA

FIGURE A 3 7-A-2

8507030448 -15



REFERENCE: NYSDOT, 1975

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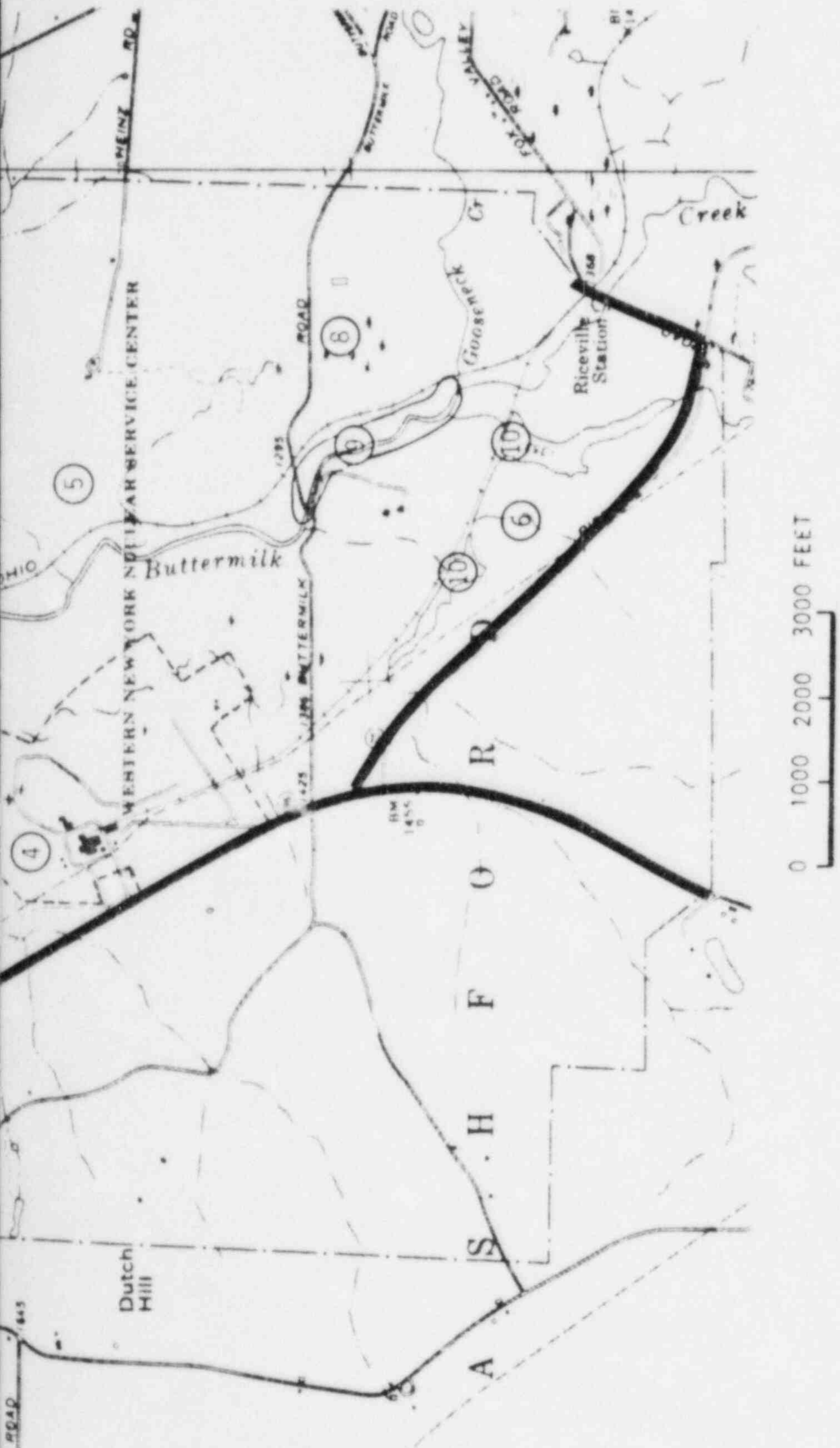

KEY:

ROADSIDE SURVEY (AVIAN & MAMMAL)

(1) - (9) AVIAN WALK-THROUGH STUDY AREAS

(10) WATERFOWL SURVEY AREAS

WILDLIFE
SURVEY AREAS

FIGURE A.3.7-A-3

8507030448 —16

SUPPLEMENT A.3.7-B

AQUATIC ECOLOGY

SUPPLEMENT A.3.7-B

AQUATIC ECOLOGY

Physical Description of Streams and Habitats

Erdman Brook

In the classification system of Horton, as described in Hynes (1970), Erdman Brook is a first order stream which does not branch or have tributaries. The channel originates as a very narrow (less than 0.5 m) drainage ditch with intermittent flow and gradually widens to approximately three metres as it courses by the New York State Licensed Burial Area into Frank's Creek. The stream bed contains mostly small, angular rocks, gravel and sand. There are a few areas of soft sediment (silts and clays), which are frequently innundated by spates. Water depth ranges from several centimetres in riffles up to approximately 30 cm in the few pools found in this channel. In several areas the stream bed consists solely of a dense, slippery gray till.

The drainage area for this stream is mostly grassy field, but grades into woodlands near the confluence with Frank's Creek. The creek flows near the New York State Licensed Low-Level Radioactive Waste Burial Ground, a potential source of contaminated runoff. In 1975, several trenches seeped contaminated water through their caps, contaminated the adjacent ground surface, and entered the nearby creeks (US EPA, 1977). Since this episode, remedial action has been performed on these trenches and no further contamination is known to have entered into the Erdman Brook drainage system. Because of this remedial action, it is not likely that Erdman Brook carries any appreciable amounts of contamination downstream at this time. More recent studies (Ragan et al, 1979) confirm this.

Quarry Creek

Quarry Creek, also a first order stream, originates on the Center but flows completely outside the protected area. It drains the northern and western portion of the protected area (which contains the plant facilities and burial areas). The channel runs through wooded areas and is characterized by a rocky bottom with large areas of nearly flat, smooth slate bottom. There are very few areas of soft sediments, and no areas where the till is exposed in the channel.

The stream is one to several metres wide, and water depth ranges from several to approximately 20 centimetres. The water is very clear; little organic debris was noted in the channel. There are few pools on this stream and a waterfall approximately 2 metres high is located on the section adjacent to the protected area. No data indicating contamination of the stream or its drainage basin have been located.

Frank's Creek

Frank's Creek is a second order stream which receives flow from both Erdman Brook and Quarry Creek. Its watershed includes those of Quarry Creek and Erdman Brook in addition to the area between these subwatersheds. This channel is wider than either of its tributaries, ranging from approximately two to five metres in width. Depth ranges from several centimetres in riffles to pools greater than 0.5 metres. The stream bed contains rocks ranging in size from gravel up to small boulders and areas of bare, exposed till. Like its tributaries, Frank's Creek has very few areas of soft sediment, and these are usually located on the inside of meanders; also like its tributaries, this creek is subject to spates which can innundate areas of sediment deposition. The water in Frank's Creek is more turbid than that of its tributaries, however, indicating a greater sediment load. Also unlike its tributaries, this creek receives discharge of treated effluent from process water treatment lagoons on the site as well as runoff from contaminated areas of the site. Contaminated water and sediments have been documented previously for this stream (Ragan et al, 1979; Kelleher, 1969).

Buttermilk Creek

Buttermilk Creek is a third order stream which receives inflow from Frank's Creek. Its drainage area incorporates the entire site in addition to adjacent farms and woodlands. The channel for Buttermilk Creek originates off-site, but once on-site it courses within site boundaries up to its confluence with Cattaraugus Creek. Two of its small tributaries were dammed to create small reservoirs which supply drinking and process water to the Center facilities. Some overflow from this dam still enters Buttermilk Creek via the old creek beds.

The Buttermilk Creek channel ranges between approximately 5 and 20 metres wide, and greater during periods of increased discharge. The creek bed is very rough, consisting of many small boulders and angular rocks. During periods of low flow, many braided gravel deposits are exposed, but are subject to rearrangement and downstream transport during periods of increased runoff (Boothroyd, Timson and Dana, 1979). Water depth ranges from 10 to 20 centimetres deep in riffles and up to approximately one metre in pools and outside areas of some meanders. There are many areas where the till is exposed, but relatively few areas of soft sediments.

Radiological analyses indicate that the softer sediments in Buttermilk Creek have absorbed contamination on the order of one to several times background from plant discharges and runoff (Ecker and Onishi, 1979).

Cattaraugus Creek

Cattaraugus Creek is a fourth order stream which flows westward to Lake Erie. It drains approximately 56,700 ha of predominantly farm and woodlands upstream from its confluence with Buttermilk Creek and 7,600 ha which is the Buttermilk drainage area (Dames and Moore, 1974). It is the largest of the streams within the survey area, with a width of approximately 30 metres and a depth ranging from 10-20 cm in riffles up to approximately one metre in the center of the channel and in several pools. The bed is characterized by many small to medium boulders and many braided sand and gravel bars. This creek has many small areas where silt and clays are deposited, but as with other

streams in the study areas, these pools are subject to frequent innundation by spates. Several miles downstream from its confluence with Buttermilk Creek, Cattaraugus Creek has been dammed by the Village of Springville to operate hydroelectrical generating facilities. The area behind this dam contains much of the sediment transported by the upper Cattaraugus, including its tributaries from the Center. These sediments were included in the study by Eker and Onishi (1979) and have been found to contain small amounts of radioactivity released from the site.

Aquatic Flora

The aquatic flora at the Center consists of those plant species which are found within the streams and do not extend beyond the stream banks. These plants include both free floating algae (phytoplankton) and algae attached to rocks and other substrates within the stream (periphyton), as well as the larger, rooted macrophyte species.

Aquatic macrophytes were not observed during these field investigations. Considering the rocky nature of most of the stream beds surveyed and the transience of soft sediments, a suitable habitat does not exist for a long enough period of time for rooted aquatic macrophytes to become established. The one notable exception to this was Cattaraugus Creek where several areas with apparently suitable habitat were noted; however, the only aquatic macrophytes observed were cattails. This finding may be attributed to fluctuations in water levels which sometimes leave these areas dry for extended periods.

Erdman Brook

The algae collected during the summer sampling (August 1982) from Erdman Brook (Figure A.3.7-B-2, Location 10) are indicated in Table A.3.7-B-1a. Of the planktonic genera, only diatoms were found at this station. The dominant diatom was Synedra, a long needle-like diatom common to streams and rivers. Much of the rocky bottom of this creek was covered with Lyngbya (as periphyton), a filamentous blue-green alga common to warm flowing waters. The presence of periphyton alters the substrate and creates habitats for other

types of algae (Hynes, 1970), which explains the increased number of genera in the periphyton, as compared to phytoplankton, for this station. Included among the periphyton were blue-greens, greens and diatoms; the free-floating algae consisted solely of diatoms. The Erdman Brook spring (May 1983) sample data are presented in Tables A.3.7-A-1b and c. As in the summer, the planktonic algae are again made up solely of diatoms, but the dominant genera are Nitzschia and Navicula.

The spring periphyton at this station consists of the green filamentous alga Microthamnion and an assortment of various diatoms (Table A.3.7-B-1b).

Quarry Creek

The results of algal surveys of Quarry Creek are summarized under sample Location 6 in Tables A.3.7-B-1a - c. As with Erdman Brook, the August sample shows that the free floating algae are composed totally of diatoms. The dominant genus is Cocconeis, a common stream-living diatom which is usually found attached to rocks and other substrates in alkaline waters (Blum, as reported in Hynes, 1970). Samples collected during the spring indicate a less diverse population of diatoms, consisting of only two genera, Nitzschia and Navicula. Additionally, the yellow-brown algae Chrysococcus was observed in this sample, but this genus was not observed in the summer sample.

Summer periphyton samples were not collected at this location but large, smooth areas of the stream bed (primarily slate) were covered with a thin layer of filamentous blue-green algae. These algae were most likely Oscillatoria and Lyngbya and undoubtedly support additional genera of epiphytic diatoms, similar to those described in the other periphyton samples.

Periphyton samples were collected from Quarry Creek during the May 1983 field sampling. These data (Table A.3.7-B-1c, Location 6) show that the periphyton consists solely of epilithic diatoms. The lack of either green or blue-green algae in the periphyton is probably due to the colder water temperature at this time of the year and other environmental factors which give the diatoms a competitive advantage.

Frank's Creek

Algal samples from Frank's Creek were collected at Locations 7 and 8 (Figure A.3.7-B-2). Sample 7 was taken at the site perimeter fence, whereas Sample 8 was collected at the discharge wier from the on-site waste water treatment facility, a reported source of low-level radioactive contamination. A periphyton sample was also collected from Location 8.

All three samples collected during August (Table A.3.7-B-1a) were dominated by diatoms, with many of the same genera found at each location. The dominant genus at Location 7 was Synedra, with an appreciable number of Cyclotella. At Location 8, the dominant genus was Cyclotella, with Synedra being the next most common species. The periphyton sample was dominated by Cladophora, a filamentous green alga common to the Great Lakes area, but also contained two filamentous blue-green algae, Lyngbya and Oscillatoria. Diatoms unique to the periphyton (for Frank's Creek samples) included Fragillaria (a planktonic colonial diatom) and Meridion. Attached green algae in the family Chlorococcales were also noted.

Interestingly, both water samples for 7 and 8 contained planktonic genera of green algae: Scenedesmus, from Location 8 and Volvox, a colonial green alga, from Location 7. It is most likely that these algae originated in lagoons on-site and were introduced into the stream during periods of discharge. This would also account for some of the planktonic diatoms (such as Asterionella and Fragilaria) which were also found in very small numbers at these locations.

The spring samples (May 1983) from Frank's Creek (Tables A.3.7-B-1b and A.3.7-B-1c) are notably different than the corresponding summer samples. The sample collected at the lagoon discharge, station 8, is overwhelmingly dominated by three genera of green algae. Two of these genera, Chodatella and Oocystis, are planktonic and most likely originated in the on-site lagoon system draining into the creek at this location. Several hundred feet downstream at Location 7, the dominance shifts back to the diatoms, particularly the genera Achnanthes and Gomphonema.

The spring periphyton samples from these two locations indicate a dominance of diatoms, particularly Meridion at Location 8 and Nitzschia, Navicula and Gomphonema at Location 7. Station 7 also had a dominant filamentous green algae, Microthamnion.

Buttermilk Creek

Buttermilk Creek algal samples were collected from Locations 2 (Thomas Corners Bridge-downstream from the protected area) and a Location 5 (outfall from the reservoirs-upstream from the protected area), The summertime data from these samples are presented in Table A.3.7-B-1a.

The upstream data (Location 5) show the typical dominance of diatoms over other algae; the presence of several planktonic genera (including Scenedesmus, Euglena, and Cosmarium, which do not normally occur as periphyton) reflects the influence of the reservoirs. Also collected were epiphytic and epilithic diatoms and the filamentous blue-green alga Lyngbya, which are characteristic of the periphyton community.

The downstream sample (Location 2) contained several more genera than found upstream, but conclusions about diversity between these locations cannot be drawn based on only one sample. Diatoms dominated the sample; Synedra was the dominant genus. Equal in number with Synedra were members of the family Chlorococcales (green algae). One individual of the genus Chrysococcus was also present in this sample. Periphyton were present at this location, but not collected. The periphyton community appeared to be similar to that previously described and probably supports a similar diatom community.

The spring sample data for Buttermilk Creek are presented in Tables A.3.7-B-1b and c. The upstream phytoplankton data (Location 5) are quite similar to the summer data showing the dominance of the diatoms over other families. The dominant genus at that time, as during the summer, was Navicula.

The corresponding periphyton sample again indicates the diatom dominance, although the filamentous green alga Ulothrix was observed, as was the flagellated euglena-like alga Trachelomonas.

The downstream phytoplankton sample (Location 2) was dominated by diatoms at the time of sampling in May 1983. The dominant genera were Navicula and Cymbella, whereas during the summer the dominant diatom is Synedra. There were no other nondiatom genera in this sample. There was a green filamentous alga, Ulothrix, in the corresponding periphyton sample. However, the dominant genera were still the diatoms.

Cattaraugus Creek

Cattaraugus Creek was sampled at Locations 1 (Felton Bridge) and 3 (Route 240 Bridge) which are downstream and upstream, respectively, of its confluence with Buttermilk Creek (which carries all streamflow from the site). The summertime upstream sample has a similar diatom composition as described for all the previous samples; the dominant genera are Synedra and Navicula. This sample also contained several individuals of the genus Chrysococcus as well as several genera of green algae. Also present but not collected were periphyton of a similar composition as samples described previously.

The downstream location contained the most genera of any of the samples collected; this may indicate increasing diversity as distance downstream increases. This phenomenon has been documented in several rivers and is discussed in Hynes (1970). This sample contained nearly all the genera of diatoms encountered, with the exception of several planktonic genera (Asterionella, Fragellaria) and one epilithic genus, Meridion (which may have been present in the unsampled periphyton). Also included in this sample were many of the genera of green algae (Chlorophyta) many of which were also collected elsewhere. The exceptions were Pediastrum and Staurastrum, which were collected only at this downstream station. It is certain that the periphyton community observed at this location contained the genera Cladophora, Lyngbya and Oscillatoria as well as epilithic and epiphytic diatoms, although these were not specifically sampled for.

Both the springtime phytoplankton and periphyton samples from this location are almost totally dominated by the diatoms, particularly the genus Navicula, which was also a summertime dominant. The springtime samples for the

downstream station (Location 3) are almost identical to the upstream sample, and demonstrate the typical dominance of diatoms that was observed during the summer.

Interestingly, the periphyton samples here and in all other streams sampled during the spring did not contain the filamentous green alga Cladophora, a genus which is quite common in the Great Lakes drainage area throughout the year. A possible explanation for its absence at this time is that it has yet to reestablish itself after a period of winter dormancy and removal by ice, scour, and freezing.

Threatened and Endangered Species

Throughout the field sampling and literature survey there has been no indication that any threatened or endangered aquatic flora exist in the reservoirs, ponds, or streams on or in the vicinity of the Center.

Aquatic Fauna

The aquatic fauna at the Center consists of fish and macroinvertebrates which spend part or all of their life cycle in streams or ponds. Fish data are presented in Tables A.3.7-B-2a and A.3.7-B-2b. Invertebrate data are found in Tables A.3.7-B-3a and A.3.7-B-3b. Amphibians are not presented in this section, but are discussed in the terrestrial ecology section of this report.

Erdman Brook

Invertebrate samples were collected from Erdman Brook at Location 10 (Figure A.3.7-B-2). The major families collected are summarized in Table A.3.7-B-3. Fish samples were not collected at this location because of the small size of this creek, but creek chub were observed. According to an earlier study by Davis and Fakundiny (1978), creek chub and blacknose dace were the only fish collected from Erdman Brook.

Invertebrate samples collected from this location in August 1982 indicate an abundance of mayflies, in the family Heptageniidae, and the caddis flies in the family Hydropsychidae. This finding is similar to earlier data reported by Davis and Fakundiny (1978). Several other taxa reported by Davis and Fakundiny to be present at the site were not collected in this sampling.

Unique to the Erdman Brook location were several flatworms (order Tricladida), which may also be present in other streams but may not have been collected due to their cryptic nature (Hynes, 1970).

The spring 1983 samples from Erdman Brook indicate the presence of several families in each of the Diptera (flies), Ephemeroptera (mayflies) and Plecoptera (stoneflies) orders. The stoneflies were both the most diverse and most numerous of the invertebrates collected here. Also collected here were several Collembella (springtails) and one fresh water clam.

In general, these data agree with early data reported by Davis and Fakundiny (1978).

Quarry Creek

Invertebrate samples were collected from Quarry Creek at Location 6, which is downstream from a small waterfall. Fish samples were not collected from this stream because it appeared that none were present and that there was little suitable habitat for fish in this shallow, heterotrophic stream. However, it is quite likely that a few individuals wander upstream from the confluence of Quarry Creek with Frank's Creek, but they would not be able to migrate further upstream than the waterfall.

Of the invertebrates collected during the August 1982 sampling, the Chironomidae were the most numerous with many individuals of the genus Polypedilium. Many of the other orders in Table A.3.7-B-3 were represented by several genera in this stream, indicating a greater diversity than is apparent from Table A.3.7-B-3 alone.

The May 1983 sample data indicate a similar diversity between the flies, mayflies, stoneflies and caddis flies. However, the dominance has shifted from the Chironomidae flies to the Ephemeroptera (mayflies). This is a result of varying times of emergence for different aquatic insects.

Frank's Creek

Frank's Creek was sampled at Locations 7 and 8 (Figure A.3.7-B-2). Invertebrate samples were collected at both locations and fish samples were collected at Location 7.

Fish samples were collected in both riffle and pool habitats. The only species collected in the August 1982 sample was the creek chub, a minnow capable of surviving in shallow, warm water streams. No minnows were observed at Location 8, and they probably cannot travel this far upstream under low flow conditions. The May 1983 sample contained a blacknose dace (another minnow) in addition to several creek chub.

The August 1982 invertebrate samples for both locations were quite similar; the Hydropsychidae (net-spinning caddis fly) was the most abundant. Other than Hydropsychidae, most other families were represented by genera at only one of the two sampling stations. These included the dipteran Heterotrissocladius, coleopterans Laccobius and Stenelmis (beetles), and a tubificid oligochate (segmented worm). Individuals of these genera were sparse and may have also been present at other locations before emergence.

The May 1983 invertebrate samples for both locations on Frank's Creek were similar in that they both showed dominance by the dipteran genera. This represents a shift of dominance from the caddis fly (Trichoptera) genera displayed in the previous summer which is again caused by the varying times for emergence of various aquatic insects.

Buttermilk Creek

Invertebrate samples were collected from Buttermilk Creek upstream from the protected area at Location 5 and also downstream from the protected area at Location 2 (Thomas Corners Road). Fish samples were also collected at the downstream location.

During August of 1982, six species of fish were collected; four were seined from pools and five were taken from riffles. Fish data are presented in Tables A.3.7-B-2a and A.3.7-B-2b. The only true riffle species collected at this time were the central stoneroller and the rainbow darter. These and the other species collected are common through the region in warm-water streams.

In May 1983, six fish species were also collected. This sample contained a johnny darter and a blacknose dace which were not observed in the August 1982 sample, but did not include the central stoneroller and the rainbow darter. Species collected in both samples included the common white sucker and the northern hogsucker, the common shiner and the creek chub.

Comparison of the upstream and downstream invertebrate data for August 1982 indicated similar compositions. Both stations had numerous Chironimidae and Heptageniidae and shared several other common genera in lesser but similar numbers. Both locations yielded Oligochaeta which were not common in most other locations. Several individuals of the dragonfly family Gomphidae were collected at both Buttermilk locations, whereas only one individual in this taxon was collected in the remainder of the study area (Location 3). It may be that unknown environmental conditions in Buttermilk Creek delayed emergence of these individuals.

The May 1983 invertebrate samples collected from Buttermilk Creek contained the most individuals of any sample. Both samples were dominated by Dipterans but also contained several different mayflies, stoneflies and caddis flies. Location 5 also produced one of only two dragonfly larva collected during this period.

Cattaraugus Creek

Invertebrate and fish samples were collected from Cattaraugus Creek in Locations 1 and 3 (Figure A.3.7-B-1). These represented downstream and upstream locations, respectively, of the confluence of Buttermilk and Cattaraugus Creeks.

Fish samples collected from the two locations on Cattaraugus Creek during both sampling periods contain a total of eight species, including a juvenile largemouth bass and a small brown trout. These two species are common in Cattaraugus Creek but are unusual to the stretch between Route 16 and the Springville Dam (the bounds of the study area). Trout are stocked into Cattaraugus Creek above Route 16, and both trout and salmon are stocked below the Springville Dam by the NYSDEC. However, no stocking is done between these points because the Cattaraugus is too warm and turbid to support a trout fishery (Shepard, 1982). Therefore, it is most likely that the single trout caught had migrated downstream.

The juvenile bass is another unusual catch because of the unsuitable habitat of this section of the channel. This individual probably migrated from upstream habitat, as was hypothesized for the trout. The only new species collected in the May 1983 samples was the green-sided darter. The remainder of the species collected at both locations are common to the region and have no specialized habitat requirements unique to Cattaraugus Creek.

The benthic macroinvertebrates collected from both locations during August 1982 are very similar to each other in taxonomic composition, but differ in abundance. The downstream sample was dominated by the fly family Chironomidae, whereas the dominant family in the upstream sample is the mayfly family, Baetidae. Many of the remaining taxa found at these stations were collected from other sampling locations and are not genera unique to the Cattaraugus Creek drainage system.

The corresponding macroinvertebrate samples collected during May 1983 are quite different than the August samples. The sample from Cattaraugus Creek at Felton Bridge (Location 1) was the least diverse of any sample collected

during this study; it yielded only six individuals of four separate Dipteran families. The upstream sample at Route 240 yielded only five individuals and included representatives of the mayflies and stoneflies in addition to the Dipteran flies. This lack of diversity is most likely a result of the high flow conditions in this creek during the sampling period which washed away many individuals and made sampling more difficult.

Threatened and Endangered Species

Throughout the field sampling, literature survey, and interviews with local experts there was no indication that any threatened or endangered aquatic fauna exist in the reservoirs, ponds or streams at or in the vicinity of the Center.

TABLE A.3.7-B-1a (1 of 2)

ALGAE COLLECTED FROM STREAMS ON OR NEAR THE WESTERN NEW YORK NUCLEAR CENTER - AUGUST 1982

PHYLUM		Genus	Locations 1	2	3	5	6	7	8	10	8P*	10*P	Total Stations Per Genus
CHRYSOPHYTA													
	Bacillariophyceae	Achnanthes	9	4	6	10		2					5
	(Diatoms)	Asterionella							5				1
		Cocconeis	5	5	3	7	51	16		12			7
		Cyclotella	x	9	x		6	20	68		x		6
		Cymbella	24	7	17	20		2	x		x	x	7
		Diatoma	4		x			2					3
		Fragilaria									x		1
		Gyrosigma	x					2			x	x	4
		Meridion									x		1
		Navicula	15	10	31	31	30	6	x	27	x	x	8
		Nitzschia	13	4	6	5	3	2	3	8	x	x	8
		Pinnularia	2	x	3			2				x	5
		Synedra	23	27	30	22	9	42	16	53	x	x	8
	Xanthophyceae												
		Chrysococcus		x	3								2
CHLOROPHYTA													
		Ankistrodesmus		x									1
		Chlorococcales**		27							x		2
		Cladophora									x		1
		Closterium			x								1
		Cosmarium	x	x		x							3
		Crucigenia			x								1
		Pediastrum	x										1
		Scenedesmus	x		x	x			3				4
		Staurastrum	x										1
		Volvox						2					1

TABLE A.3.7-B-1a (2 of 2)

ALGAE COLLECTED FROM STREAMS ON OR NEAR THE WESTERN NEW YORK NUCLEAR CENTER - AUGUST 1982

		Locations										
	Genus	**1**	**2**	**3**	**5**	**6**	**7**	**8**	**10**	**8P***	**10*P**	**Total Stations Per Genus**
EUGLENOPHYTA												
	Euglena	x	x		x							3
CYANOPHYTA												
	Lyngbya				x		2			x	x (underlined)	4
	Oscillatoria							x		x		1
TOTAL GENERA/STATION		15	13	13	10	5	12	8	4	11	7	

P* Indicates periphyton sample.

** Chlorococcales - organisms included here were identified only to Order, as positivie identification to lower taxonomic level was not possible.

- Numbers in charge are percent frequency, those underlined indicate dominant Genus.
- Genera present, but less than two percent, are indicated by "x".

TABLE A.3.7-B-1b

ALGAE COLLECTED FROM STREAMS ON OR NEAR THE WESTERN NEW YORK NUCLEAR CENTER - MAY 1983

PHYLUM	Genus	Locations 1	2	3	5	6	7	8	10	Total Stations Per Genus
Chlorophyta										
	Chodatella						x	41		2
	Oocystis							22		1
	Chlorell							35		1
Euglenophyta										
	Euglena						x	x		2
Chrysophyta										
Xanthophyceae	Chrysococcus	x		x		20	2			4
Bacillariophyceae	Nitzschia	6	4		7	20	2		34	6
	Navicula	63	28	56	52	40	28	2	31	8
	Achnanthes	7	7		3				6	4
	Cymbella	8	39	14	21				6	5
	Cyclotella	2								1
	Synedra	8	4	9	2		6	x	14	7
	Gomphonema	2	7	12	12		25	x	6	7
	Rhoicosphenia	x								1
	Eunotia		2		x					2
	Meridion	x	4	x	x					4
	Diatoma	x	2	9	x					4
	Fragilaria		x							1
Cyanophyta										
	Lyngbya						33			1
	Oscillatoria									0
TOTAL GENERA/STATION		11	10	7	9	3	8	7	6	

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TABLE A.3.7-B-1c

PERIPHYTON COLLECTED FROM STREAMS ON OR NEAR THE WESTERN NEW YORK NUCLEAR SERVICE CENTER - MAY 1983

	Station 1	Station 2	Station 3	Station 5	Station 6	Station 7	Station 8	Station 10
Chlorophyta								
Chodatella								
Oocystis								
Chlorella								
Ankistrodesmus			x					
Ulothrix	x	x	x	x				
Microthamnion						x		x
Closterium			x					
Euglenophyta								
Euglena								
Trachelomonas				x				
Chrysophyta								
Chrysococcus						x		
Bacillariophyta								
Nitzschia	x	x	x	x		x	x	x
Navicula	x	x	x	x	x	x	x	x
Achnanthes	x				x	x	x	x
Cymbella	x	x	x	x	x	x	x	x
Cyclotella	x							
Synedra	x	x	x	x	x	x	x	x
Gomphonema	x	x	x	x	x	x	x	x
Rhoicosphenia			x			x	x	x
Eunotia				x	x			x
Melosira		x						
Meridion	x	x	x	x	x	x	x	x
Diatoma	x	x	x	x		x	x	
Gyrosigma								
Unknown					x	x		x
Cyanophyta								
Lynbgya								
Oscillatoria	x	x				x	x	

-COM005206:158H

TABLE A.3.7-B-2a

FISH COLLECTED AT OR NEAR THE WESTERN NEW YORK NUCLEAR SERVICE CENTER - AUGUST 1982

Species	Common Name	Cattaraugus Creek (Felton Bridge)		Cattaraugus Creek (at Route 240)		Frank's Creek (at Lagoon discharge)		Buttermilk Creek (at Thomas Corner's Bridge)	
		pool	riffle	pool	riffle	pool	riffle	pool	riffle
Campostoma anomalum	Central Stoneroller				X				X
Catostomus commersoni	Common White Sucker	X	X	X	X			X	
Etheostoma blennioides	Green Sided Darter								
Etheostoma caeruleum	Rainbow Darter	X	X						X
Etheostoma nigrum	Johnny Darter	X	X	X	X				
Nocomis biguttatus	Hornyhead Chub			X					
Hypentelium nigricans	Northern Hogsucker			X	X			X	X
Micropterus salmoides	Largemouth Bass	X							
Notropis cornutus	Common Shiner	X	X	X	X			X	X
Rhinichthys atratulus	Blacknose Dace			X					
Salmo trutta fario	Brown Trout	X							
Semotilus atromaculatus	Creek Chub	X	X	X	X	X	X	X	X

-COM005206:158H

TABLE A.3.7-B-2b

FISH COLLECTED AT OR NEAR THE WESTERN NEW YORK NUCLEAR SERVICE CENTER - MAY 1983

Species	Common Name	Cattaraugus Creek (Felton Bridge)		Cattaraugus Creek (at Route 240)		Frank's Creek (at Lagoon discharge)		Buttermilk Creek (at Thomas Corner's Bridge)	
		pool	riffle	pool	riffle	pool	riffle	pool	riffle
Campostoma anomalum	Central Stoneroller				X				
Catostomas commersoni	Common White Sucker	X						X	
Etheostoma blennioides	Green Sided Darter				X				
Etheostoma caeruleum	Rainbow Darter								
Etheostoma nigrum	Johnny Darter								X
Nocomis biguttatus	Hornyhead Chub								
Hypentelium nigricans	Northern Hogsucker	X		X				X	
Micropterus salmoides	Largemouth Bass								
Notropis cornutus	Common shiner	X		X				X	X
Rhinichthys atratulus	Blacknose Dace					X		X	X
Salmo trutta fario	Brown Trout								
Semotilus atromaculatus	Creek Chub	X				X	X	X	

-COM005206:158H

TABLE A.3.7-B-3a

BENTHIC MACROINVERTEBRATES COLLECTED AT OR NEAR THE WESTERN NEW YORK NUCLEAR SERVICE CENTER - AUGUST 1982

Class	Order	Family	Locations/Individuals								Total Stations Per Taxon
			1	2	3	5	6	7	8	10	
Crustacea (phylum Arthropoda)											
	Decapoda (cray fish)										
		Astacidae	X	X	X		X		X	X	6
Oligochaeta (Phylum Annelida)			1	1		1		1			4
Turbellaria (Phylum Platyhelminthes)										4	1
Insecta (Phylum Arthropoda)											
	Diptera (Flies)										
		Chironomidae	15	11	5	55	42		2	7	7
		Rhagionidae			2						1
		Tipulidae	3		16	13	5	2		1	6
		Empidae		1		3				1	3
		Ceratopogonidae	2								1
	Coleoptera (Beetles)										
		Dytiscidae	1	1							2
		Miscellaneous		2	1			3	1		4
	Ephemeroptera (Mayflies)										
		Heptageniidae	1	34	6	21	9	5		22	7
		Baetidae		4	23	3		9	7		5
		Miscellaneous	3	8	3	12	3				5
	Hemiptera (Bugs)										
		Veliidae					1				1
		Gerridae*	X	X	X	X	X	X	X	X	8
	Odonata (Dragonflies)										
		Gomphidae		4	1	6					3
		Miscellaneous	1								1
	Plecoptera (Stoneflies)										
		Nemouridae					1				1
		Perlidae		1			8		1		3
		Miscellaneous					1			4	2
	Trichoptera (caddis flies)										
		Hydropsychidae	1	2	15	9	7	78	34	33	8
		Glossosomatidae						1	1		2
		Rhyacophilidae							1		1
		Miscellaneous						4	4	1	3
Total Taxa/Station**			14	19	17	23	20	12	11	14	

* Gerridae-water striders were noted at each location and tentatively assigned to this taxon (based on identification presented in Davis and Fakundiny, 1978). However none were collected for verification of identification.

** Includes several genera not presented on chart, which are categorized as miscellaneous.

NOTE: Numbers in chart are total number of organisms per 3 sq. ft.

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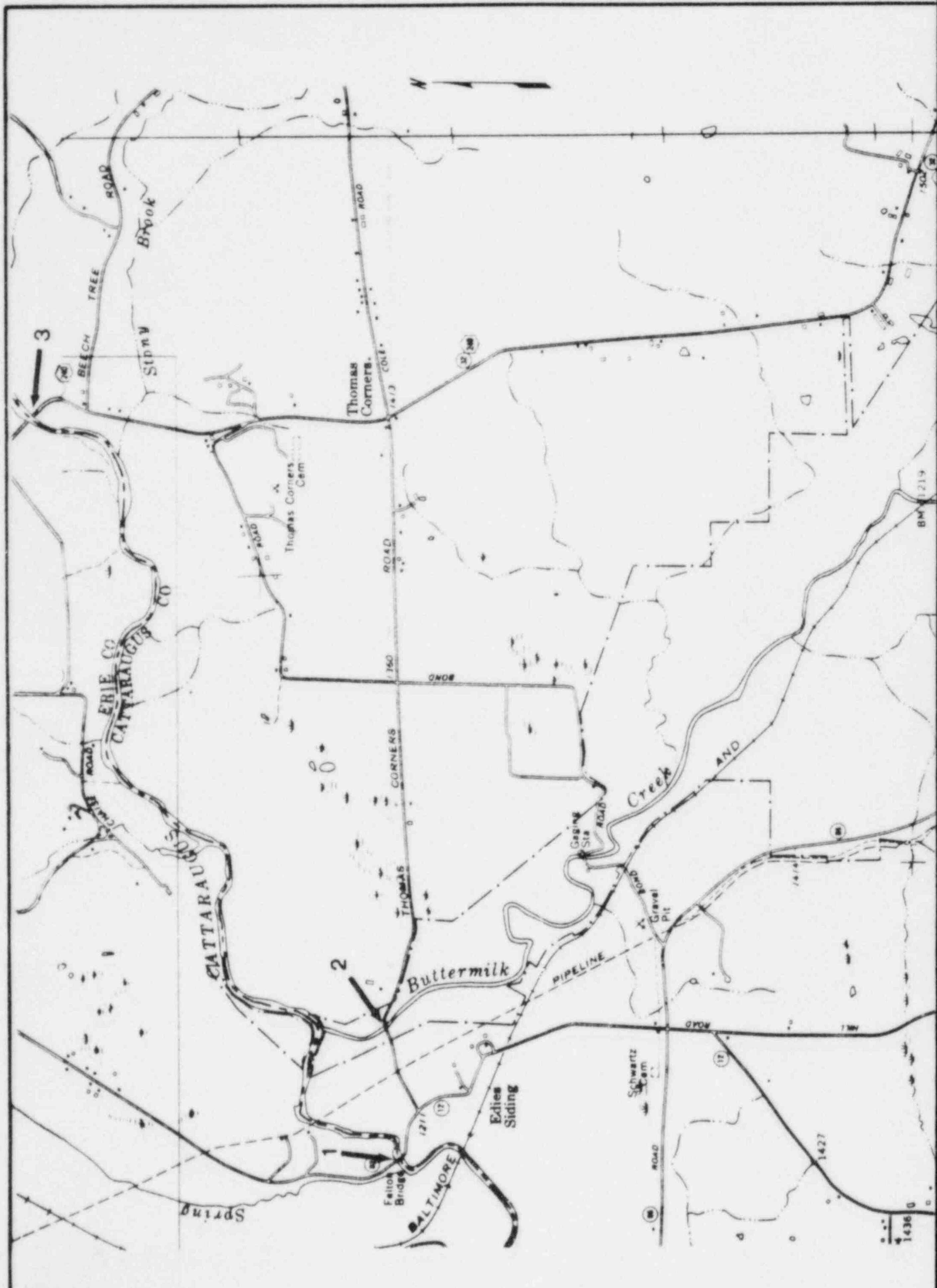
TABLE A.3.7 -8-3b

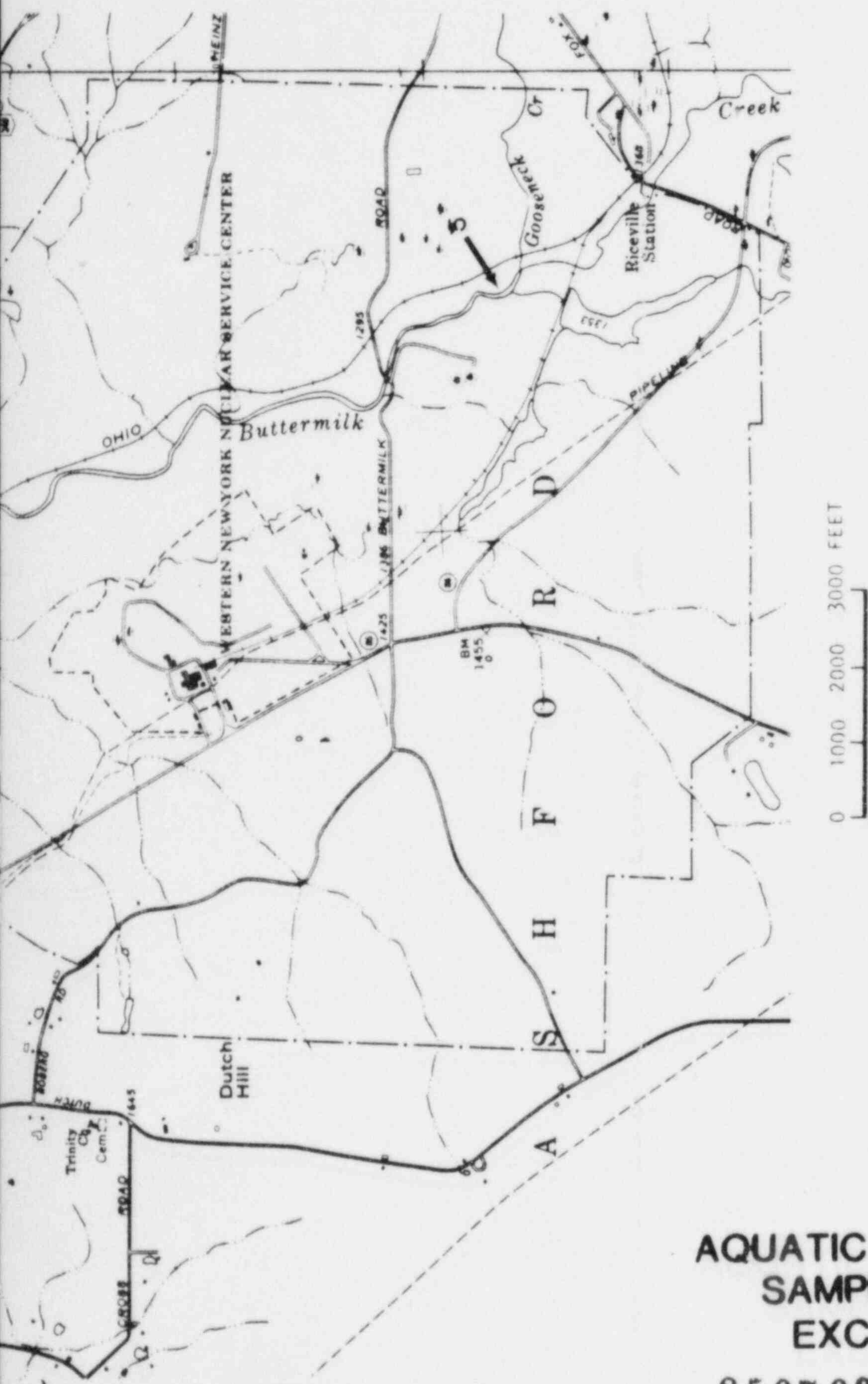
BENTHIC MACROINVERTEBRATES COLLECTED AT OR NEAR THE WESTERN NEW YORK NUCLEAR SERVICE CENTER - MAY 1983

Class	Order	Family	Locations/Individuals 1	2	3	5	6	7	8	10	Total Stations Per Taxon
Crustacea (phlum Arthropoda)											
	Decapoda (crayfish)										
		Astacidae	X	X	X			X			4
Nematoda (phylum)							1				1
Bivalvia (phylum Mollusca)										1	1
Insecta (phylum Arthropoda)											
	Diptera (flies)										
		Chironomidae	2	2		6		1	1	1	6
		Cladotanytarsus	2								1
		Tanytarsus	1			8	1				3
		Empididae	1			1					2
		Simulidae		1							1
		Microtendipes		3		1					2
		Diamesa		2		7		4			3
		Cryptochironomus		1							1
		Orthocladiinae		1		5		3	1		4
		Cardiocladius						2			1
		Pseudochironomus		1							1
		Tipulidae			1	1	1			1	4
		Parametriocnemus				1					1
		Polypedelium				5					1
		Zavrelia				7					1
		Micropsectra				1					1
		Phaenopsectra				1					1
		Microcricotopus				1					1
		Endochironomus				1					1
		Ablabesmyia				2	1				2
		Cricotopus						2	3		2
		Ceratopogonidae						1		2	2
	Ephemeroptera (Mayflies)						2		1	2	3
		Heptageniidae		1		5	8			4	4
		Paraleptophlebia		1							1
		Attenella		1							1
		Baetidae			1						1
		Ephemerella			1	6					2
		Ephermerellidae				2					1
		Epeorus					6				1
		Leptophlebiidae				4	5				2
	Plecoptera (Stoneflies)									1	1
		Chloroperlidae		2	2		5	3		1	5
		Perlodidae					1			2	2
		Neoperla		1							1
		Isoperla				1	1				2
		Nemouridae						3			1
		Amphineura								6	6
		Capniidae								1	1
	Trichoptera (Caddis Flies)						1	5		1	3
		Hydropsychidae		2		6		2			3
	Coleoptera (Beetles)										
		Dubiraphia				2	1				2
	Odonata (Dragonflies)			1							1
		Gomphidae				1					1
	Collembola (Springtails)									2	1
	Hemiptera										
		Gerridae (Water Striders)					X	X	X	X	4
	Total Taxa/Station		5	15	5	23	14	12	5	14	

-COM005206:158H



REFERENCE: NYSDOT, 1975



AQUATIC ECOLOGY SURVEY
SAMPLE LOCATIONS -
EXCLUSION AREA

8507030448 -17

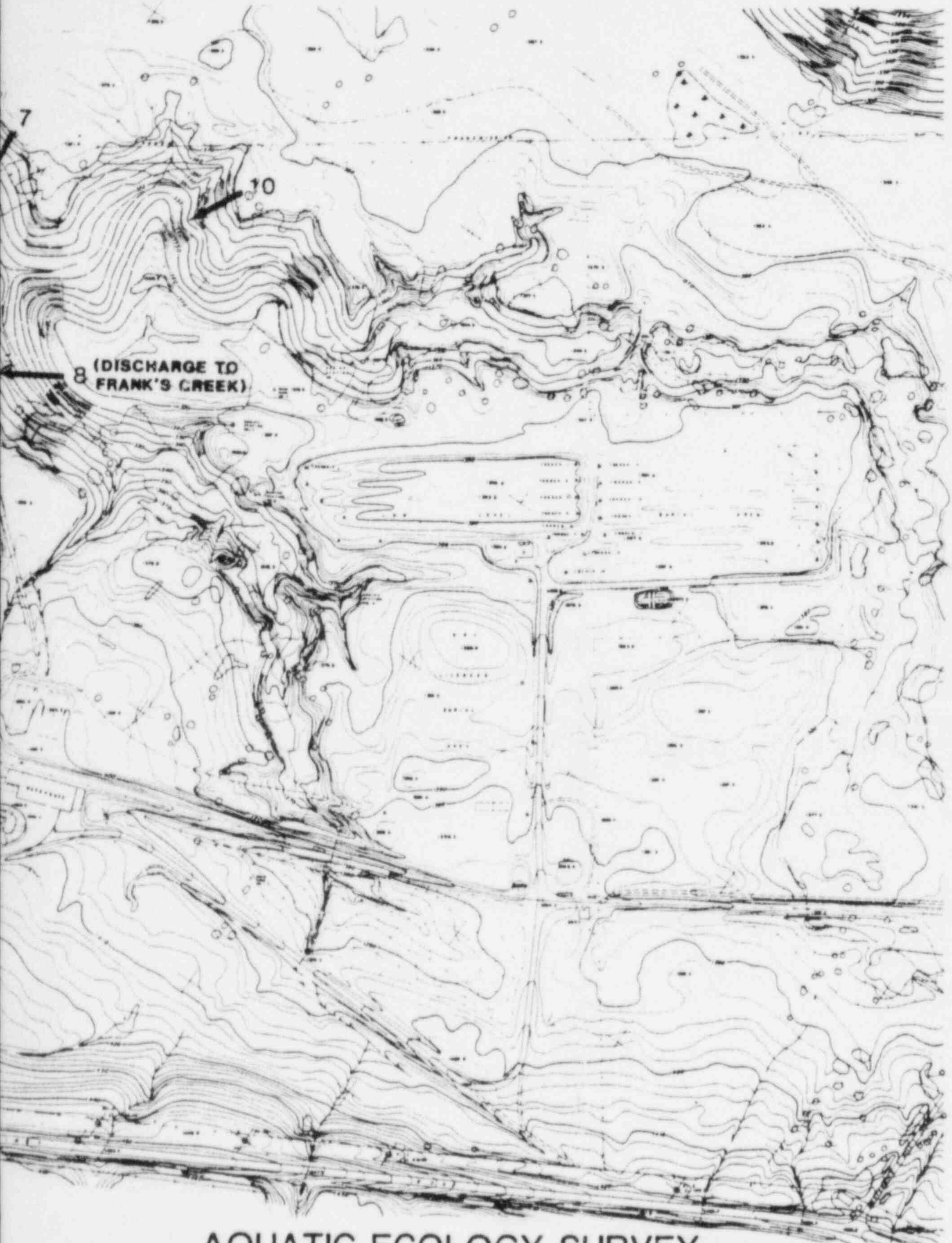
FIGURE A.3.7-B-1

Also Available On Aperture Card

TI APERTURE CARD

REFERENCE:
ENDMAN, ANTHONY & ASSOCIATES 1980

NOTE: LOCATIONS 4 AND 9 WERE DE



AQUATIC ECOLOGY SURVEY
SAMPLE LOCATIONS - PROTECTED AREA

LETED FROM SAMPLING PROGRAM.

FIGURE A.3.7-B-2

8507030448 -18

SUPPLEMENT A.3.7-C

PUBLICATIONS REVIEWED AND AUTHORITIES CONTACTED FOR PREPARATION OF SECTION A.3.7 AND SUPPLEMENT A.3.7-A AND A.3.7-B

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SUPPLEMENT A.3.7-D

SPECIES LISTS

SPECIES LISTS

A.3.7-D.1 PLANT SPECIES

A.3.7-D.1.1 Overstory Vegetation

Common Name	Scientific Name
American basswood	*Tilia americana*
American elm	*Ulmus americana*
Balsam fir	*Abies balsamea*
Beech	*Fagus grandifolia*
Big-tooth Aspen	*Populus grandidentata*
Birch	*Betula* sp.
Black cherry	*Prunus serotina*
Black locust	*Robinia pseudo-acacia*
Black oak	*Quercus velutina*
Butternut	*Juglans cinerea*
Chestnut oak	*Quercus prinus*
Choke-cherry	*Aronia* sp.
Cottonwood	*Populus deltoides*
Gray birch	*Betula populifolia*
Hemlock	*Tsuga canadensis*
Quaking aspen	*Populus tremuloides*
Red maple	*Acer rubrum*
Red oak	*Quercus rubra*
Shagbark hickory	*Carya ovata*
Sugar maple	*Acer saccharum*
Sycamore	*Plantanus occidentalis*
Tulip tree	*Liriodendron tuplipfera*
White ash	*Fraxinus americana*
White oak	*Quercus alba*
White pine	*Pinus strobus*
Wild cherry	*Prunus serotina*
Yellow birch	*Betula lutea*

A.3.7-D.1.2 Understory Vegetation

Common Name	Scientific Name
Fire cherry	Prunus pennsylvanica
Flowering dogwood	Cornus florida
Gooseberry	Ribes sp.
Hawthorn	Crataegus sp.
Hop hornbeam	Ostrya virginica
Ironwood	Carpinus coroliniana
Maple-leaft viburnum	Viburnum acerifolium
Red osier dogwood	Cornus stolonifera
Southern arrowwood	Viburnum dentatum
Spicebush	Lindera benzoin
Striped maple	Acer pennsylvanicum
Witch hazel	Hamamelis virginiana

A.3.7-D.1.3 Edge Vegetation

Common Name	Scientific Name
American elm	*Ulmus americana*
Apple	*Pyrus malus*
Brambles	*Rubus* sp.
Choke-cherry	*Aronia* sp.
Elderberry	*Sambucus canadensis*
Red osier dogowwd	*Cornus stanlonifera*
Silky dogwood	*Cornus amomum*
Southern arrowwood	*Viburnum acerifolium*
Staghorn sumac	*Rhus typhina*
Tree of heaven	*Ailanthes altissima*
Willow	*Salix hebbiana*
Willow	*Salix* sp.

A.3.7-D.1.4 Herbaceous Vegetation

Common Name	Scientific Name
Agrimony	*Agrimonia* sp.
Arrow-leaft tearthumb	*Polygonum sagittatum*
Aster	*Aster* sp.
Avens	*Geum virginianum*
Barnyard grass	*Echinocloa crus-gallia*
Bedstraw	*Galium* sp.
Beech fern	*Phegopteris hexagonoptera*
Blackberry	*Rubus allenghen iensis*
Black-eyed susan	*Rudbeckia hirta*
Blue cohosh	*Caulophyllum thalictroides*
Bracken	*Pteridium aquilinum*
Bugleweed	*Lycopus* sp.
Bulrush	*Juncus effusus*
Buttercup	*Ranunculus* sp.
Canada mayflower	*Maianthemum canadense*
Cattail	*Typha latifolia*
Cattail	*Typha* sp.
Christmas fern	*Polystichum aerostichoides*
Cinnamon fern	*Osmunda cinnomomea*
Cinquefoil	*Potentilla* sp.
Clubmoss	*Lycopodium annotinum*
Clubmoss	*Lycopodium clavatum*
Clubmoss	*Lycopodium complanatum*
Common grapefern	*Botrychium dissectum*
Common milkweed	*Asclepias syriaca*
Corralberry	*Symphoricanpos orbiculatus*
Daisy	*Chrysanthemum leucanthemum*
Dandelion	*Taraxacum officinale*
Downey woodmint	*Blephilia cilate*
Enchanter's nightshade	*Circaea* sp.
European buttersweet	*Solanum dulcamara*
False wood nettle	*Loportea canadensis*
Fancy wood fern	*Dryopteris intermedia*
Field milkwort	*Polygala sanguinea*
Forget-me-not	*Myosotia* sp.
Fred trillium	*Trillium erectum*
Ginseng	*Panax quinquefolium*
Golden ragwort	*Senecio dureus*
Goldenrod	*Solidago* sp.
Goldthread	*Coptis groenlandica*

Common Name	Scientific Name
Hayscented Fern	Dennstaedtia punctilobula
Hellborine orchid	Epipactis hellborine
Hepatica	Hepatica acutiluba
Herb-Robert	Geranium robertianum
Horsetail	Equisetum sp.
Indian pipe	Monotropa hypopithys
Indian tobacco	Lobelia inflata
Interrupted fern	Osmunda claytoniana
Jack-in-the-pulpit	Arisaema triphyllum
Joe-pye weed	Eupatorium fistulosum
Mad-dog skullcap	Scutellaria lateriflora
Madenhair fern	Adiantum pedatum
Mayapple	Podophyllum peltatum
Milkweed	Ascelepias sp.
Millfoil	Achillea milletolium
Mud plantain	Alisma subcordatum
Musk mallow	Malva muschata
Mustard	Brassica sp.
Narrow-leaved cattail	Typha angustifolia
Nettle	Urtica dioica
New York fern	Dryopteris novaboracensis
Orchard grass	Dactylis glomerata
Ox-eye daisy	Heliopsis helianthides
Partridgeberry	Mitchella repens
Purple deadnettle	Lamium purpureum
Queen Anne's Lace	Daucus carota
Ragweed	Ambrosia sp.
Red clover	Trifolium pratense
Rue anemone	Anemonella thalictroides
Rush	Juncus sp.
Sedge	Carex lupulina
Sedge	Carex lurida
Sedge	Carex vulpinoidea
Self heal	Prunella vulgaris
Sensitive ferns	Onoclea sensibilis
Skullcap	Scutellaria sp.
Smartweed	Persicaria muhlenbergii
Sphagnum moss	Sphagnum sp.
Spike rush	Eleocharis sp.
Spotted jewelweed	Impatiens capensis

Common Name	Scientific Name
Starflower	Linnaea borealis
St. John's wort	Hypericum sp.
Strawberry	Fragaria virginiana
Tall goldenrod	Solidago canadensis
Thistle	Cirsium sp.
Timothy	Phleum prutense
Verbena	Verbena hastata
Violet	Viola sp.
Violet wood sorrel	Oxalis violacea
Virginia creeper	Parthinocissus quinquefolia
Water milfoil	Myriophyllum sp.
White baneberry	Actaea alba
White clover	Trifolium repens
White sweet clover	Meliotus alba
Wild bergamot	Monarda fistulosa
Wild leek	Allium trioccum
Wild lettuce	Prenanthes sp.
Wollgrass	Scripus atrovirens
Wollgrass	Scripus cyperinus
Wood nettle	Laportea canadensis
Woodland horsetail	Equisetum sylvaticum
Woodland sedge	Carex plantaginea
Yellow sweet clover	Melilotus officinalis
Yellow trefoil	Lotus corniculatus

A.3.7-D.2 Bird Species

Common Name	Scientific Name
Acadian Flycatcher	Empidonax virescens
Alder Flycatcher	Empidonax alnorum
American Bittern	Botaurus lentiginosus
American Coot	Fulica americana
American Goldfinch	Carduelis tristis
American Kestrel	Falco sparverius
American Redstart	Setophaga ruticilla
American Robin	Turdus migratorius
American Woodcock	Philhela minor
Bank Swallow	Riparia riparia
Barn Owl	Tyto alba
Barn Swallow	Hirundo rustica
Barred Own	Strix varia
Bay-Brested Warbler	Dendroica castanea
Belter Kingfisher	Megaceryle alcyon
Black Duck	Anas rubripes
Black-and-White Warbler	Minotilta varia
Black-Billed Cuckoo	Coccyzus erythropthalmus
Black-Capped Chickadee	Parus atricapillus
Black-Crowned Night Heron	Nyciticorax nyciticorax
Black-Throated Blue Warbler	Dendroica caerulescens
Black-Throated Green Warbler	Dendroica virens
Blackburnian Warbler	Dendroica fusca
Blackpoll Warlber	Dendroica striata
Blue Jay	Cyanocitta cristata
Blue-Gray Gnatcatcher	Polioptila caerulea
Blue-Winged Teal	Anas discors
Blue-Winged Warbler	Vermivora pinus
Bobolink	Dolichonyx oryzivorus
Broad-Winged Hawk	Buteo platypterus
Brown Thrasher	Toxostoma rufum
Brown-Headed Cowbird	Molothrus ater
Bufflehead	Bucephala albeola
Canada Goose	Branta canadenis
Canada Warbler	Wilsonia canadensis
Cape May Warbler	Dendroica tigrina
Cardinal	Cardinalis cardinalis
Carolina Wren	Thryothorus ludovicianus
Cedar Waxwing	Bombycilla cedrorum
Chestnut-Sided Warbler	Dendroica pensylvanica
Chipping Sparrow	Spizella passerina
Cliff Swallow	Petrochelidon pyrrhonota
Common Crow	Corvus brachyrhynchos

Common Name	Scientific Name
Common Flicker	Colaptes auratus
Common Gallinule	Gallinula chloropus
Common Grackle	Quiscalus quiscula
Common Loon	Gavia immer
Common Merganser	Merqus merganser
Common Nighthawk	Chordeiles minor
Common Snipe	Capella gallinago
Common Yellowthroat	Geothlypis trichas
Cooper's Hawk	Accipiter cooperii
Dark Eyed Junco	Junco hyemalis
Downy Woodpecker	Picoides pubescens
Eastern Bluebird	Sialia sialis
Eastern Kingbird	Tyrannus tryrannus
Eastern Meadowlark	Sturnella magna
Eastern Phoebe	Sayornis phoebe
Eastern Wood Peewee	Contopus virens
Field Saprrow	Spizella pusilla
Fox Sparrow	Passerella iliaca
Gray Catbrid	Dumetella carolinensis
Gray-Cheeked Thrush	Catharus minimus
Great Blue Heron	Ardea herodias
Great Crested Flycatcher	Myiarchus crinitus
Great Horned Owl	Bubo virginianus
Greater Yellowlegs	Tringa melanoleuca
Green Heron	Butorides striatus
Hairy Woodpecker	Picoides villosus
Hermit Thrush	Catharus guttatus
Hooded Warbler	Wilsonia citrina
Horned Lark	Eremophila alpestris
House Sparrow	Passer domesticus
House Wren	Troglodytes aedon
Indigo Bunting	Passerina cyanea
Killdeer	Charadrius vociferus
King Rail	Rallus elegans
Least Bittern	Ixobrychus exilis
Least Flycatcher	Empidonax minimus
Least Sandpiper	Calidris minutilla
Lesser Scaup	Aythya affinis
Lesser Yellowlegs	Tringa flavipes
Lincoln's Sparrow	Melospiza lincolnii
Loggerhead Shrike	Lanius ludovicianus
Long-Billed Marsh Wren	Cistothorus palustris
Long-Eared Owl	Asio otus

Common Name	Scientific Name
Louisiana Waterthrush	Seiurus motacilla
Magnolia Warbler	Dendroica magnolia
Mallard	Anas platyrhynchos
Marsh Hawk	Circus cyaneus
Mockingbird	Mimus polyglottos
Mourning Dove	Zenaida macroura
Nashville Warbler	Vermivora ruficapilla
Northern Oriole	Icterus galbula
Northern Parula	Parula americana
Northern Shoveler	Anas clypeata
Northern Waterthrush	Seiurus noveboracensis
Ovenbird	Seiurus aurocapillus
Pied-Billed Grebe	Podilymbus podiceps
Pileated Woodpecker	Dryocopus pileatus
Pine Siskin	Spinus pinus
Pine Warbler	Dendroica pinus
Prarie Warbler	Dendroica discolor
Prothonotary Warbler	Protonotaria citrea
Purple Martin	Progne subis
Red-Bellied Woodpecker	Centurus carolinus
Red-Eyed Vired	Vireo olivaceus
Red-Headed Woodpecker	Melanerpes erythrocephalus
Red-Shouldered Hawk	Buteo lineatus
Red-Tailed Hawk	Buteo jamaicensis
Red-Winged Blackbird	Agelaius phoeniceus
Ring-Necked Pheasant	Phasianus colchicus
Rock Dove	Columba livia
Rose-Breasted Grosbeak	Pheucticus ludovicianus
Rough-Winged Swallow	Stelgidopteryx ruficollis
Ruby-Crowned Kinglet	Regulus calendula
Ruby-Throated Hummingbird	Archilochus colubris
Ruffed Grouse	Bonasa umbellus
Rufous-Sided Towhee	Pipilo erythrophthalmus
Scarlet Tanager	Piranga olivacea
Screech Owl	Otus asio
Semipalmated Plover	Charadrius semipalmatus
Sharp-Shinned Hawk	Accipiter striatus
Short-Billed Marsh Wren	Cistothorus platensis
Snow Bunting	Plectrophenax nivalis
Solitary Sandpiper	Tringa solitaria
Solitary Vireo	Vireo solitarius
Song Sparrow	Melospiza melodia
Sora	Porzana carolina

Common Name	Scientific Name
Spotted Sandpiper	Actitis macularia
Starling	Sturnus vulgaris
Swainson's Thrush	Catharus ustulatus
Swamp Sparrow	Melospiza georgiana
Tree Sparrow	Spizella arborea
Tree Swallow	Iridoprocne bicolor
Tufted Titmouse	Parus bicolor
Turkey	Meleagris gallopavo
Turkey Vulture	Cathartes aura
Upland Sandpiper	Bartramia longicauda
Veery	Catharus fuscescens
Virginia Rail	Rallus limicola
Warbling Vireo	Vireo gilvus
White-Breasted Nuthatch	Sitta carolinensis
White-Crowned Sparrow	Zonotrichia leucophrys
White-Eyed Vireo	Vireo griseus
White-Throated Sparrow	Zonotrichia albicollis
Wilson's Warbler	Wilsonia pusilla
Winter Wren	Troglodytes troglodytes
Wood Duck	Aix sponsa
Wood Thrush	Hylocichla mustelina
Yellow Warbler	Dendroica petechia
Yellow-Bellied Flycatcher	Empidonax flaviventris
Yellow-Bellied Sapsucker	Sphyrapicus varius
Yellow-Billed Cuckoo	Coccyzus americanus
Yellow-Breasted Chat	Icteria virens
Yellow-Rumped Warbler	Dendroica coronata
Yellow-Throated Vireo	Vireo flavifrons

A.3.7-D.3 Mammal Species

Common Name	Scientific Name
Beaver	Castor canadensis
Big Brown Bat	Eptesicus fuscus
Black Bear	Ursus americanus
Bobcat	Lynx rufus
Coyote	Canis latrans
Deer Mouse	Peromyscus maniculatus
Eastern Chipmunk	Tamias striatus
Eastern Cottontail	Sylvilagus floridanus
Eastern Fox Squirrel	Sciurus niger
Eastern Gray Squirrel	Sciurus carolinensis
Gray Fox	Urocyon cinereoargenteus
Hairytail Mole	Parascalops breweri
Hoary Bat	Lasiurus cinereus
House Mouse	Mus musculus
Indiana Bat	Myotis sodalis
Keen's Bat	Myotis keenii
Least Bat	Myotis liebii
Least Shrew	Cyrptotis parva
Least Weasel	Mustela nivalis
Little Brown Myotis	Myotis lucifugus
Longtail Weasel	Mustela frenata
Masked Shrew	Sorex cinereus
Meadow Jumping Mouse	Zapus hudsonius
Meadow Vole	Microtus pennsylvanicus
Mink	Mustela vison
Muskrat	Ondatra zibethica
New England Cottontail	Sylvilagus transitionalis
Northern Flying Squirrel	Glaucomys sabrinus
Norway Rat	Rattus norvegicus
Opposum	Didelphis marsupialis
Otter	Lutra canadensis
Pigmy Shrew	Microsorex hogi
Pine Vole	Microtus pinetorum
Pipistrelle Bat	Pipistrellus subflavus
Porcupine	Erethizon dorsatum
Raccoon	Procyon lotor
Shorttail Shrew	Blarina brevicauda
Shorttail Weasel	Mustela ermine
Silver-haired Bat	Lasionycteris noctivagans
Smoky Shrew	Sorex fumeus
Snowshoe Hare	Lepus americanus
Southern Bog Lemming	Snyaptomys cooperi
Southern Flying Squirrel	Glaucomys volans
Starnosed Mole	Condylura cristata
Striped Skunk	Mephitis mephitis

Common Name	Scientific Name
Red-Backed Vole	Clethrionomys gapperi
Red Bat	Lasiurus borealis
Red Fox	Vulpes fulva
Red Squirrel	Tamiasciurus hudsonicus
Water Shrew	Sorex paulustris
White-Footed Mouse	Peromyscus leucopus
Whitetail Deer	Odocoileus virginianus
Woodchuck	Marmot monax
Woodland Jumping Mouse	Napaeozapus insignis

Scientific names of species are taken from Burt and Grossenheider, 1964.

A.3.7-D.4 Amphibian Species

Common Name	Scientific Name
American Toad	Bufo americanus
Blue-spotted Salamander	Ambystoma laperale
Bull Frog	Rana catesbeiana
Fowler's Toad	Bufo woodhousei fowleri
Gray Treefrog	Hyla versicolor
Green Frog	Rana clamitans melanota
Jefferson Salamander	Ambystoma jeffersonianum
Mountain Dusky Salamander	Desmognathus ochrophaeus
Northern Dusky Salamander	Desmognathus fuscus f.
Northern Leopard Frog	Rana palustris
Northern Two-lined Salamander	Eurycea bislineata b.
Pickeral Frog	Rana palustris
Red-spotted Newt	Notophthalmus viridescens
Slimy Salamander	Plethodon glutinosus
Southern Leopard Frog	Rana utricularia
Spotted Salamander	Ambystoma maculatum
Spring Peeper	Hyla crucifer
Western Chorus Frog	Pseudacris triseriata t.
Wood Frog	Rana sylvatica

Reptiles

Common Name	Scientific Name
Black Rat Snake	Elaphe obsoleta o.
Eastern Garter Snake	Thamnophis sirtalis s.
Eastern Massasauga	Sistrurus catenatus
Eastern Milk Snake	Lampropeltis triangulum
Midland Painted Turtle	Chrysemys picta marginata
Northern Black Racer	Coluber constrictor c.
Northern Brown Snake	Storeria dekayi d.
Northern Ribbon Snake	Thamnophis sauritus s.
Northern Ringneck Snake	Diadophis punctatus p.
Northern Water Snake	Natrix sipedon s.
Red-Bellied Snake	Storeria occipitomaculata
Smooth Green Snake	Opheodrys vernalis
Snapping Turtle	Chelydra serpentina
Spotted Turtle	Clemmys guttata
Stinkpot	Sternotherus odoratus
Tibmer Rattlesnake	Crotalus horridus
Wood Turtle	Clemmys insculpta

Scientific names of species are taken from Conant, 1975.

A.3.7-D.5 Fish Species

Common Name	Scientific Name
Blacknose Dace	Rhinichthys atratulus
Brown Trout	Salmo trutta fario
Central Stoneroller	Campostoma anomalum
Common Shiner	Notropis cornutus
Common White Sucker	Catostomus commersoni
Creek Chub	Semotilus atromaculatus
Green Sided Darter	Etheostoma blennoides
Hornyhead Chub	Nocomis biguttatus
Jonnny Darter	Etheostoma nigrum
Largemouth Bass	Micropterus salmoides
Northern Hogsucker	Hypentelium nigricans
Rainbow Darter	Etheostoma caeruleum

Scientific names of species are taken from Eddy and Hodson, 1961.