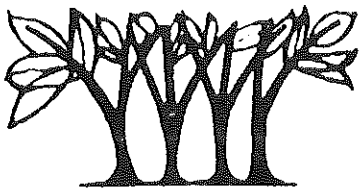

NUCLEAR LAKE
A RESOURCE IN QUESTION

January 18, 1982

Prepared by:
Nuclear Lake Management Site Clearance Subcommittee
in cooperation with
The Appalachian Trail Conference
Dutchess County Cooperative Extension

NUCLEAR LAKE MANAGEMENT

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ACKNOWLEDGEMENTS

On behalf of the members of the Nuclear Lake Site Clearance Sub-Committee, I offer sincere thanks to all those who provided time from their busy schedules to assist in the preparation of this publication.

During the past two years a great number of individuals helped bring this study into being, including those who gave the study its impetus and helped formulate the initial concepts. In mentioning some, I run the risk of omitting others, whose forgiveness I hearby request.

In the course of preparing this report we have received invaluable assistance and cooperation from the following individuals, organizations and agencies: Eugenia M. Barnaba, Manager of Technical Services, Resource Information Lab, Cornell University; Arlynn Ingram, Research Support Specialist, Resource Information Lab, Cornell University; Dr. Ervin J. Fenyves, Acting Director, Center for Environmental Studies, The University of Texas at Dallas; Dr. Thomas Cashman, Chief of Toxics and Radiation, NYS Department of Environmental Conservation; Robert Vrana, Engineer, Dutchess County Department of Health; William Hogan, Cooperative Extension Agent, Dutchess County Cooperative Extension Association.

Sincere thanks is extended to Representatives of the Harlem Valley Alliance, U.S. Nuclear Regulatory Commission, NYS Department of Interior, National Park Service, and NYS Department of Health who so quickly responded to written communications and requests for information.

The Sub Committee is especially indebted to the following personnel of Dutchess County Cooperative Extension Association: Mrs. Barbara Mallen, Commercial Artist for preparing the graphics and study layout, Mrs. Joyce Sampson, Compugraphic operator for typesetting; Mrs. Dana Matlock and Mrs. Emmy Germond for typing and proof reading all drafts; Mr. Gordon VanderMark for printing and Mrs. Betty Stowe for collating this study.

Financial assistance for printing by the National Park Service, Appalachian Trail Project office.

Finally, a special acknowledgment to all those who remain anonymous from our lack of ability to recall numerous occasions that someone offered a critical piece of information or advice at just the right moment.

Despite all this fine assistance, any errors and ommissions, of course, are the responsibility of the Site Clearance Sub Committee.

Charles P. Shaw, Chairman
Site Clearance Sub Committee

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Introduction

Nuclear Lake is 1137 acres of property located on the boundary between the towns of Pawling and Beekman in Dutchess County, New York. The Site contains a 50 acre lake and is noted locally for its scenic beauty and diversity of plant life. From 1958 to 1972, the property housed a nuclear fuels processing and research facility and thus received the name "Nuclear Lake".

In 1979, the 1137 acre parcel was acquired by the National Park Service for the purpose of relocating the Appalachian Trail. The purchase was made upon the recommendation of the Dutchess County Appalachian Trail Relocation Committee; a group formed by the Park Service in 1976, to help identify suitable parcels of land in southern and eastern Dutchess County, through which the Appalachian Trail could be rerouted. The Relocation Committee, composed of local government agencies, private citizens and groups, and individuals interested in recreation, open space and hiking, identified the Nuclear Lake property for its strong scenic appeal and its potential for local and regional recreational use.

Upon purchase of the land, the National Park Service formed a local citizens committee called the Nuclear Lake Management Committee. This committee was comprised of representatives from local and state government, recreation, environmental groups and educational institutions. Its function was to study the Nuclear Lake site and develop management plans for its future use by hikers and the community at large. At its first meeting in July of 1979, the Nuclear Lake Management Committee constituted two subcommittees to plan individually for the site's short and long term uses.

At the August 1979 meeting of the Long Range Planning Committee, representatives from the Harlem Valley Alliance, a regional public interest group, requested that the committee investigate past industrial practices and the potential for radioactive contamination at the site. Although the property had been cleared for unrestricted use by all government agencies involved in decommissioning the facility, concerns raised by the HVA, local government and others, made it apparent that additional review was needed. In response to that need, the Site Clearance Subcommittee was formed and charged with investigating the site's safety for future public use.

Although some members of the Site Clearance Subcommittee have scientific training, most are concerned citizens and lack the expertise to technically review and evaluate the available data. The members determined that the most appropriate role for the Subcommittee would be to prepare a report that would abstract all available information which could be obtained from government agency and facility records. The report would objectively reconstruct activities and conditions on the site. This information would then be presented in a manageable form to the scientific community and the public for their review. This study, "Nuclear Lake - A Resource In Question" represents the efforts of the

Subcommittee to prepare such a report. Work began in August 1979 and ended in September 1981.

Once the study has been reviewed by the scientific community and the general public, the Site Clearance Subcommittee will assemble all comments and formulate recommendations which will be passed on to the Nuclear Lake Management Committee.

NUCLEAR LAKE MANAGEMENT COMMITTEE & SUBCOMMITTEES

In August 1979, the Nuclear Lake Management Committee was formed by request of the National Park Service, to provide guidance on the management of the Nuclear Lake property located in Pawling, New York.

The 34 member Nuclear Lake Management Committee has representation from the following groups:

1) Dutchess County Department of Parks Recreation Conservation
2) Dutchess County Department of Planning and Transportation
3) National Park Service
4) NYS Office of Parks and Recreation
5) Dutchess County Environmental Management Council
6) Dutchess County Cooperative Extension Association
7) Town of Beekman Conservation Advisory Council
8) Town of Pawling Conservation Commission
9) Town of Beekman Recreation Commission
10) Town of Pawling Recreation Commission
11) Supervisors from towns of Beekman and Pawling
12) County Legislators from Beekman and Pawling
13) Dutchess Community College
14) NY/NJ Trail Conference
15) Cary Arboretum of the NYS Botanical Gardens
16) Appalachian Trail Conference
17) Dutchess County Legislature Recreation Subcommittee
18) New York State Department of Environmental Conservation
19) Federation of Dutchess County Fish & Game Clubs, Inc.
20) Private citizens and organizations.

Three Subcommittees were established by the members of the Nuclear Lake Management Committee; the Long Range Planning Committee, Short Range Planning Committee, and the Site Clearance Subcommittee.

The function of the Long Range Planning Committee is to develop a Natural Resource Inventory and Management Plan for the Nuclear Lake property. The Management Plan would:

1) state community goals as they affect the Nuclear Lake property;
2) be consistent with the objectives of the relocation of the Appalachian Trail;
3) define a rational boundary between the Appalachian Trail uses and commercial areas;
4) define fiscal responsibilities for prospective improvements and their maintenance costs;
5) would provide a definition of management responsibilities;
6) fit in with the recreational needs, potential land use pattern and resource pattern of the southern Dutchess County area;

7) would provide guidance for the National Park Service Appalachian Trail Conference and other groups;
8) propose uses that do not exceed the carrying capacity of the site;
9) encourage the consistency of local planning efforts with the use of the property.

The Short Range Planning Committee was organized as a management group to make recommendations to the National Park Service regarding:

1) the security and/or disposal of chemicals, waste materials, laboratory equipment and miscellaneous debris located in the buildings or on the property;
2) the temporary control of use and access to the property such as the management of hunting, fishing and woodcutting activities;
3) temporary security of the property which includes the posting signs, placing locks on the buildings and the front gate, and maintaining a caretaker for the property.

The Site Clearance Subcommittee which is part of the Long Range Planning Committee, was established to investigate the past operations of the United Nuclear Corporation for the purpose of determining the site's safety for public use. The Subcommittee's functions include:

1) gathering available information and data and assembling this information into the study, "Nuclear Lake - A Resource In Question";
2) determines if further studies or testing on the site are needed and the extent of such studies;
3) forming Study Review Teams who would evaluate the study and make recommendations as to whether the property poses a health risk to the public.

SITE CLEARANCE SUBCOMMITTEE PROGRAM PROCEDURES

The Site Clearance Subcommittee activities include the following:

1) inventory, define and prioritize potential problems;
2) determine the goals and objectives of the Subcommittee;
3) research and abstract information for incorporation into the study;
4) present the study to the Study Review Teams and the public for their comments and recommendation;
5) review and assemble the recommendations from the Review Teams and public, and present them to the Nuclear Lake Management Committee.

RESOURCES UTILIZED BY THE SUBCOMMITTEE FOR PREPARATION OF THIS STUDY INCLUDE:

1) Certain records concerning United Nuclear Corporation (UNC) operations - these include daily operation log books, operation manuals, health and safety memos, test results and other reports;

2) certain records from the New York State Department of Environmental Conservation, which include health and safety memos, field inspection reports, inter-office and inter-agency memos, various permits and results of radiological tests on environmental conditions at the site;
3) certain records from the Nuclear Regulatory Commission (formerly known as U.S. Atomic Energy Commission) - which include operating permits and licenses for UNC and radiological test data;
4) ATCOR Corporation - reports on decontamination procedures;
5) New York State Health Department and Dutchess County Health Department - records, including permits, inter-office and inter-agency memos and radiological test results;
6) miscellaneous local government memos and correspondence from the towns of Beekman and Pawling.

ADDITIONAL STUDIES AND TESTS:

Additional studies and tests were undertaken during the year and a half in which the Site Clearance Subcommittee conducted its work. The results of these studies have been incorporated into this document and include:

1) Gamma Analysis of Soil, Water and Vegetation from Nuclear Lake, New York - performed by University of Texas at Dallas, October - December 1979.
2) Aerial Radiologic Survey of the United Nuclear Facility at Nuclear Lake near Pawling, New York, conducted by EG & G Inc. in May 1980.
3) Sequential Photographic Analysis of Nuclear Lake, Dutchess County, conducted by the Resource Information Laboratory, Cornell University, Ithaca, New York, July 1980.
4) Nuclear Lake Radiological Fish Sampling, conducted by New York State Department of Health, April 17, 1980.
5) Chemical Analysis of Nuclear Lake Water Samples, conducted by the Dutchess County Department of Health, January 1980.

DOCUMENT PREPARATION PROCEDURES:

Since August 1979, the Subcommittee has been meeting on an average of twice a month in an effort to prepare this study. The document preparation procedures were as follows:

1. Determine the resources and data available to the committee;
2. determine how the data would be organized and assembled into the study;
3. develop a format to be used throughout the study;
4. designate research responsibilities to committee members;
5. each section researched and written by the committee members;
6. each section reviewed and edited for objectivity and content by the entire committee;

7) assemble and print the study;
8) form Study Review Teams to review the study, analyze the information and make comments and recommendations;
9) Present and distribute the study to the public and encourage their review.

STUDY REVIEW TEAMS:

Study Review Teams were formed by the Site Clearance Subcommittee. Their function is to review this study "Nuclear Lake - A Resource In Question" and to make recommendations as to the site's safety for unrestricted public use. The teams are comprised of scientists and individuals from government agencies, academic institutions, business and private organizations located throughout the country. Below is a list of teams that have been approached and asked to review this document. Additionally, the study will be presented to the public. Any requests (from organizations not listed here) to comment on this study are encouraged and will be acknowledged.

Suggested List of Study Review Teams*

Government Agencies
- N.Y.S. Dept of Environmental Conservation - Toxics and Radiation Section and Division of Solid Waste
- Nuclear Regulatory Commission - Branch I
- National Parks Service - North Atlantic Region
- N.Y.S. Department of Health
- N.Y.S. Labor Dept.
- Environmental Protection Agency - Region 2
- Dutchess County Environmental Management Council
- U.S. Geological Survey - Water Resources Division, N.Y. District
- New York State Attorney Generals Office - Environmental Protection Bureau

Academic Institutions
- Cornell University - Resource Information Laboratory and Department of Natural Resources.
- Massachusetts Institute of Technology
- Science Institute for Public Information
- University of Texas - Center for Environmental Studies
- Dutchess Community College - Natural Resources Conservation Program
- New York University Medical Center - Institute of Environmental Medicine
- State University of New York at Stonybrook.
- University of Pittsburgh
- Trinity-Pawling School

Private Organizations / Individuals
- Environmental Defense Fund
- Environmental Action Foundation
- New York Public Interest Research Group
- Cary Arboretum of the N.Y. Botanical Gardens
- Sierra Club - Mid-Hudson Group, - Atlantic Chapter
- Coalition for Conservation Justice
- Union of Concerned Scientists
- Appalachian Trail Conference
- Committee for Nuclear Responsibility
- Harlem Valley Alliance
- Critical Mass
- Mount Kisco Medical Group
- Natural Resource Defense Council
- Center for Farm and Food Research Inc.

- Numerous individual scientists representing several corporations in Dutchess County, N.Y.

*For information about the specific make-up of each study review team contact Site Clearance Committee Chairman, Charles Shaw at (area code 914-677-3488) or write Dutchess County Cooperative Extension, Farm and Home Center, Millbrook, N.Y. 12545.

I. History of Lake Development

DAM & LAKE DEVELOPMENT

Cn October 20, 1936, Mr. Herbert M. Teets, owner of the property commonly known as Nuclear Lake, applied to the Department of Public Works for permission to construct a small dam on a stream which meandered through a large wetland and eventually flowed into Whaley Lake Stream, in the town of Beekman, New York. (See Figure 1-1, 1948 USGS Topographic Map "Poughquag" Quadrangle), (1). Though the application was approved, the dam was not built at that time.

Mr. Teets' 1936 Application for Construction (2) indicated that:

1. The watershed areas above the proposed dam drains entirely into the "Nuclear Lake Swamp" area and is 1.6 square miles;
2. The natural material of the bed on which the proposed dam would rest consists of "granite";
3. Facing downstream the nature of material composing the right and left banks of the stream consists of "granite";
4. The proposed dam would have been 15' high, creating a lake area at spillcrest elevation of 54 acres impounding 23,500,000 cubic feet of water.

Analysis of October 26, 1941 aerial photographs (3) points out some earlier natural features of the "Nuclear Lake Property" (see Figure IV-1). The area was originally composed of a large wooded wetland located within hilly irregular wooded terrain. The large wetland is part of a series of wooded wetlands interconnected by a network of streams. The northern portion of the large wetland was higher in elevation, suggesting that this wetland drained generally toward its central section and emptied out at the most southerly point.

During dry periods it appeared that vehicular traffic was possible through the NW corner of the wetland, as a portion of what appeared to be an underdeveloped narrow road was clearly visible cutting across this corner.

Several intermittent and perennial streams flowed directly into the various wetlands on the property. One main stream originating at the higher elevations of the eastern side of the property flowed across the large wooded wetland eventually feeding into one of the smaller wetland areas. Surface runoff occurring from the hillsides in combination with the flow from the intermittent streams, forms the "Nuclear Lake" property watershed.

In general all stream flow is in a southerly direction through inter-connected wetlands, eventually joining Whaley Lake Stream. Whaley Lake Stream flows westward to Garden Hollow Brook, combining with Fishkill Creek. (See Figure 1-1); Fishkill Creek flows into the Hudson River.

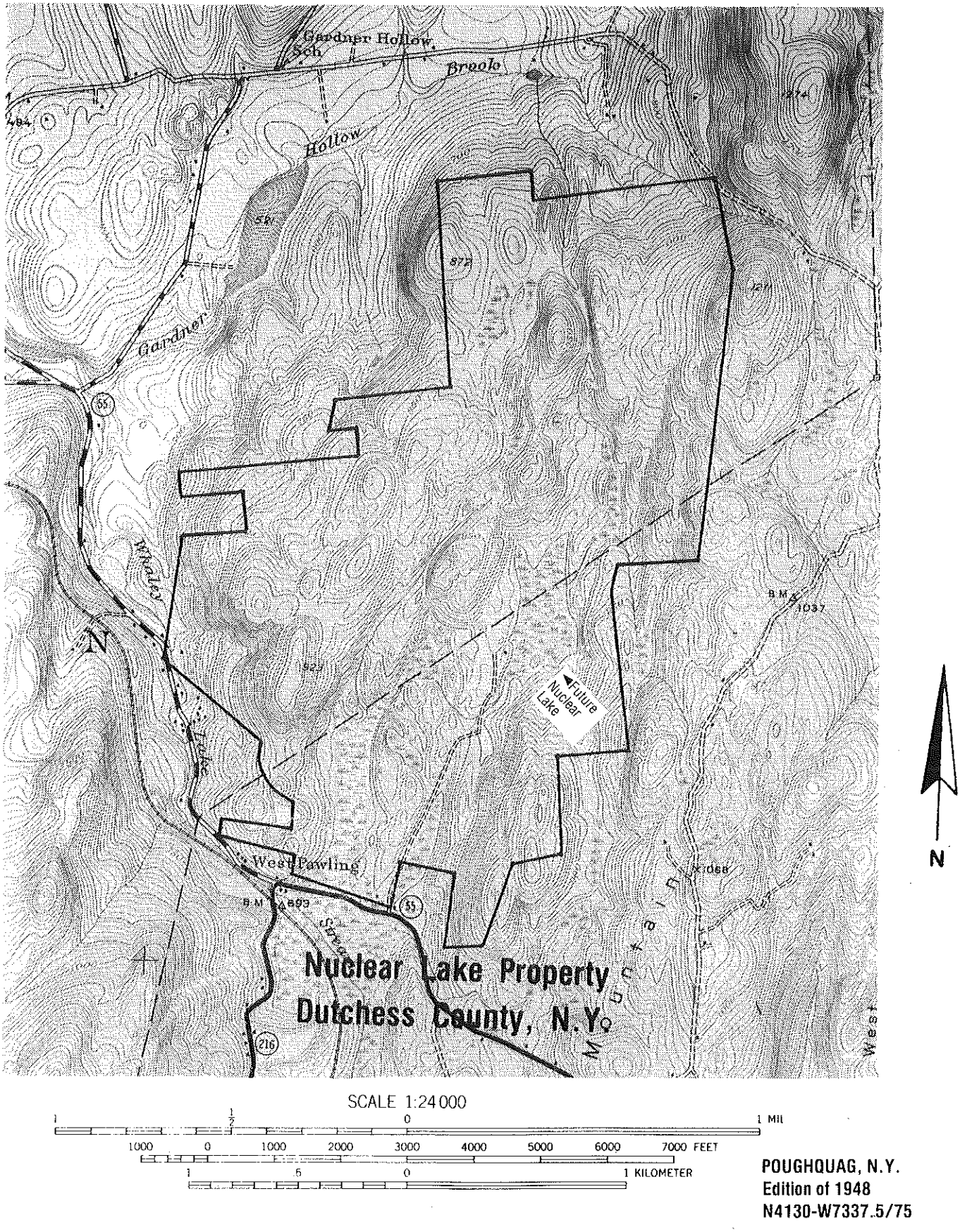

Figure I-1 - A segment of 1948 USGS Topographic Map, Poughquag Quadrangle, showing Nuclear Lake as a large wetland prior to construction of the dam which formed the lake. Superimposed is the boundary of the Nuclear Lake Property owned by the National Park Service.

The 1941 aerial photograph analysis also points out that narrow dirt roads accessed the property from north and south and that the entire area was thickly wooded with deciduous trees predominating.

In March 1946, Mr. Milton Chazen and Mr. L. Ryder, new owners of the property, applied to the State of New York Department of Public Works, to construct a dam in the same location as the 1936 Teets' proposal. The Chazen-Ryder Application for Construction (4) indicated that:

1. The watershed area above the proposed dam is 1.5 square miles.
2. The natural material on which the proposed dam would rest consists of hard yellow clay down to bedrock.
3. Facing downstream, the nature of the material composing the right and left banks of the stream consists of rock.
4. The proposed dam was to be 20' long, 16' high, made of concrete and constructed on an apron of reinforced concrete, 30' wide and 6" thick. This dam would create a lake area at spillcrest elevation of 52 acres, impounding 18,000 cubic feet of water.
5. The dam would also contain a built-in spillway constructed of 24" box culvert or 24" cast iron pipe with a suitable gate valve. The spillway was designed to discharge 181 cubic feet per second.

The Application for Construction was approved on March 23, 1946 (5). The dam was subsequently built. However, rather than being a concrete dam, it was an "earthen type dam" possibly containing a concrete core wall (6). There was no spillway in the dam itself, but to the east of the dam an overflow channel was cut through natural ground. (See Figure I-2). Along the channel, a small "lock type" dam was constructed and used to raise or lower the level of the lake by three or four feet. The water impounded originally created a lake to be used for recreational pruposes. Earlier records show the lake to have the name, "Pawling Pond".

An analysis of October 16, 1948 aerial photographs (3), verifies that a dam had been constructed across an outlet on the southern end of the main wetland area. (See Figure IV-2). The lake formed by the dam measured approximately 50 acres as seen previously on the 1941 photography. Wetland vegetation disappeared under water except for three small "islands". Lake boundary vegetation thickened and filled in to some extent along the northern and western shorelines. There existed some marshy beach along the northern boundary, but generally the wooded shoreline met the waterline directly. The photography showed the main dam clearly, but the overflow channel was not visible beneath the heavy tree canopy.

April 11, 1955, aerial photographs were also analyzed (3). This analysis clearly shows details of the dam, control structure, stream patterns, access roads and two structures near the lake. (See Figure IV-3). The water level in the lake appeared higher. No beach area was evident. Two of the three small islands that appeared in the 1948 photographs have disappeared and the marsh area that was once present along the northern shoreline, is gone.

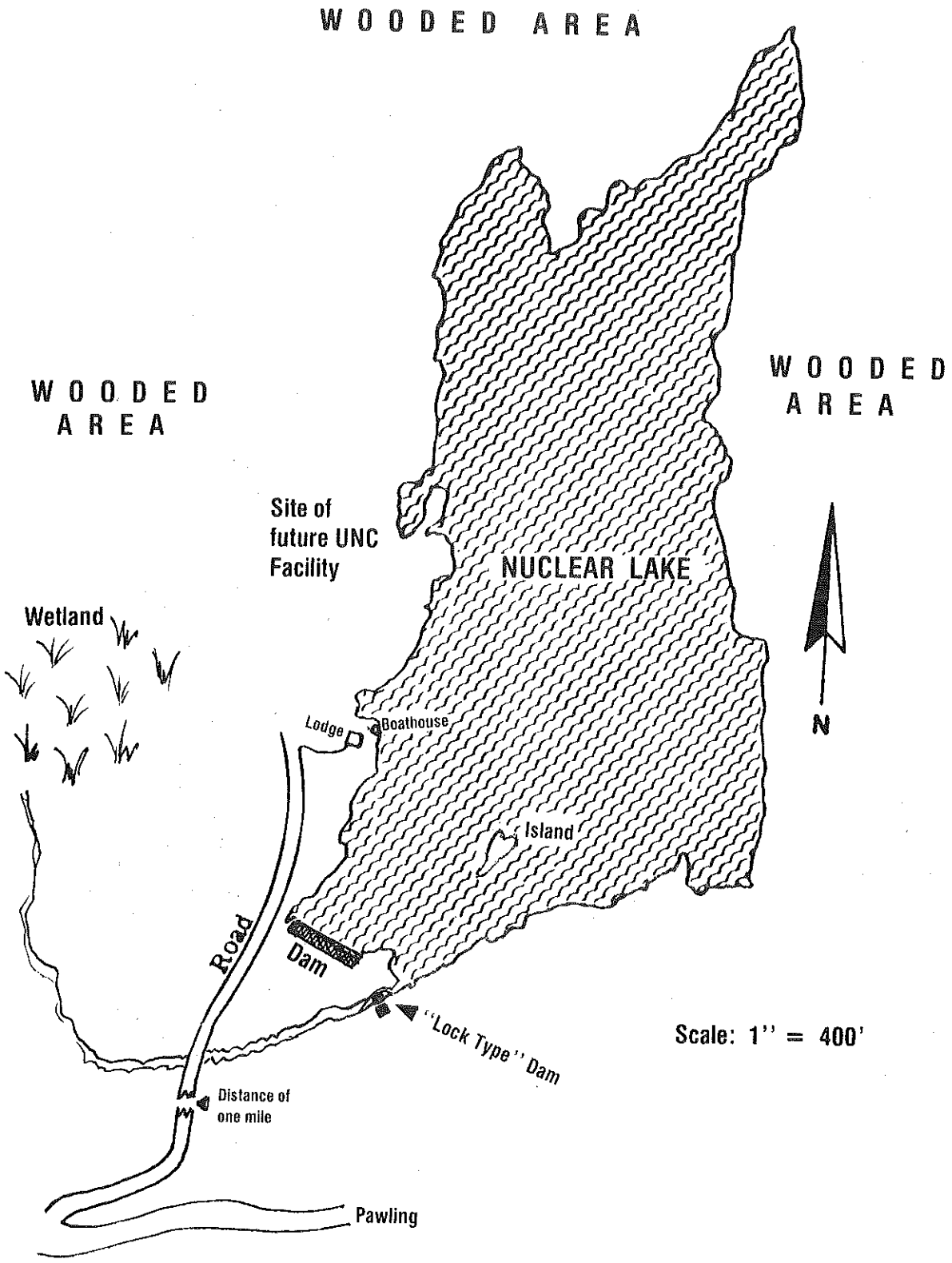

Figure 1-2 - Shows Nuclear Lake, location of both main dam and "lock-type" dam, and surrounding land area after dam construction, 1948

Wetlands around the lake are still present as in earlier photographs but some have dried up, some have become smaller and some have changed configuration. Two structures are present along the western shoreline approximately a fourth of the distance up the lake from the dam. These structures appear to be the hunting lodge mentioned in other background information, and the other, by its location directly on the lake, a boathouse.

On November 28, 1979, the dam was field inspected by Mr. Norman Benson, District Manager of the Dutchess County Soil and Water Conservation District, to ascertain if the existing structure was safe and free from danger of failure. Mr. Benson's inspection report showed the dam to be sound and not likely to fail, though some recommendations to improve its strength were made. Mr. Benson's report in its entirety is found below.

Mr. Charles Shaw, Environmental Specialist
Dutchess County Cooperative Extension
Nuclear Lake Management Committee
Site Clearance Sub-Committee Chairman

Dear Mr. Shaw:

At your request I examined the dam on Nuclear Lake in the Township of Pawling and found it to be sound and in no immediate danger of failure. However, I have a few recommendations that will improve the safety of the dam and further diminish the chances of dam failure.

Number one is to remove the water height control structure in the outlet stream east of the dam to keep the lake at its present level and to allow for more flow capacity at times of heavy runoff. The stream channel should be cleaned of debris from the water control structure back to the lake outlet to allow for a free flow of water, especially in times of heavy runoff. The lower lake level takes pressure off the top of the dam and allows for more free board.

Number two, remove the two culvert pipes from the top of dam and fill the dtches that are left when the pipes are removed with a tight clay material to the top height of the present pipes and pack it well, then seed with a grass mixture and mulch. These two culvert pipes are not equipped with anti-seep collars and, therefore, have some soil erosion around them. Should these culverts become plugged at a time of high water on the dam, these culverts could wash out causing a dam failure.

Number three is to fill an eroded area on the top of the dam east of where the present culvert pipes are. Fill this area with a tight clay material the width of the top of the dam and west to the point where the culvert pipes were removed and at that same depth. This tight clay material should be packed as tight as possible and then grass seeded and mulched. Lime and fertilizer should also be added for better results. The eastern end of the dam should not be disturbed as it has a heavy grass cover and, because of its somewhat lower elevation, will act as a safe emergency spillway in case of an extra heavy runoff storm when the stream could not handle all the lake overflow.

The dam appears to have a concrete core and well tied in at both ends into the bedrock. There appears to be no leaks in the dam. The dam is a solid 20 feet wide on top and 32 plus feet wide just below the water line except for the one eroded spot on top, the dam is only 9 feet wide at this point and was mentioned above as a spot to be repaired.

If you have any further questions or comments feel free to write or call me.

Sincerely yours,

Norman F. Benson

Norm Benson
District Manager
Dutchess County Soil & Water Conservation District

REFERENCES

1. 1948 USGS Topographic Map - Poughquag Quadrangle.
2. State of New York, Department of Public Works, Division of Engineering; Application for the Con struction of a Dam; Dam No. 230-1097; October 20.
3. Cornell University, Resource Information Lab; Sequential Air Photo Analysis of Nuclear Lake; July 1980.
4. State of New York, Department of Public Works; Application for the Construction or Reconstruction of a Dam; Dam No. 230-1097; March 20, 1946.
5. Inter-office Memo from the State of New York Department of Public Works, to Mr. J. S. Bixby, District Engineer, Poughkeepsie, New York, March 23, 1946.
6. Inter-office Memo from the State of New York Department of Public Works, to Mr. J. S. Bixby, District Engineer, Poughkeepsie, New York, July 8, 1953.
7. Memo from Mr. Norman Benson, District Manager, Dutchess County Soil and Water Conservation District, to Charles P. Shaw, Executive Director, Dutchess County Environmental Management Council; November 28, 1979.

II. Environmental Conditions of Site

"This chapter was compiled from available information without recourse to detailed field surveys."

Geology

Major bedrock types on the 1137 acre Nuclear Lake property are schist and gneiss; in addition, quartzite, phyllite and carbonates (limestone and dolostone) could be present in small areas, TABLE 1 (1). Gneiss surrounds the lake and extensive schist occurs a little east of the lake.

A fault divides the gneiss and the schist just east of the lake (1). The fault comes up from the south (SSW-NNE) and at a point approximately east of the lake it forks at an angle of about 25°, one branch continuing NNW, the other NNE. The fault shows as a distinct pair of small escarpments on the topographic map (2).

The gneiss and schist have low background gamma radiation counts (3). Not far off the property younger pegmatite dikes with slightly higher counts occur; such dikes might also be present on the property. Phyllite, if present, might have slightly higher counts than the gneiss and schist.

Occasional crystals of galena, chalcopyrite, or other minerals may also be present in the bedrock and if present would contribute some lead, copper or silver to the environment.

TABLE 1. Geological formations, Nuclear Lake property and vicinity. From Geological Map of New York 1970 (1).

Symbol	Formation	Age
bg	Biotite granitic gneiss	Precambrian
€ev	Everett Schist - locally with minor meta-graywacke lenses	Cambrian
€pg	Poughquag quartzite - locally conglomeratic	Cambrian
OCw	Wappinger Group - limestone, dolostone	Cambrian-Ordovician
Owl	Walloomsac Formation: phyllite, schist, meta-graywacke	Ordovician

Topography

The lowest point on the property is about 600 feet above sea level - in the west - and the highest point about 1,050 feet in the northeast (2). However, the local relief of small valleys and adjacent hilltops on the property is mostly 50-100 feet. The trend of the valleys and ridges is mostly SSW-NNE (Figure II -1). Steep slopes (over 15%) and bedrock at or very near the ground surface characterize much of the property (4). Lake surface elevation is 758 ft. (2).

Hydrology

Nuclear Lake is artificial; the dam was built in 1946-47 (5). The pre-existing wetland was not dredged, but simply flooded during lake construction. The lake's surface areas has been reported as 38 acres (4), 0.06 square miles (about 38 acres) (14); 45 acres (10), 29 acres (Chapter I, page 2), and 50 acres (Chapter I, page 2). Estimates from the 1960 Topographic Map (2) indicate it to be 37-38 acres. Shoreline is about 1.3 miles (14).

The entire watershed of Nuclear Lake is in the extreme eastern end of the Fishkill Creek drainage basin, tributary to the Hudson River estuary at Beacon, New York. Although some areas less than one-half mile east of Nuclear Lake drain east to the Housatonic River, no part of the Nuclear Lake property drains eastward and there are no apparent surface water connections between the two drainage basins.

The waters and wetlands of the property are shown in Fig. II - 2 (21). Most of the watershed of Nuclear Lake is on the property. However, the west and north edges of the property drain into Gardner Hollow Brook (6). Note: Tributary 2 of Gardner Hollow Brook is not continuous with the inlet at the northeast corner of Nuclear Lake as was shown in Planning Guidelines for Dutchess County Drainage, Plate 1 (6).

The Nuclear Lake outlet stream leaves the south end of the lake, swings west and passes through a series of wetlands into which the small stream west of the lake also drains. These wetlands are continuous with wetlands along Whaley Lake Stream which flows out of Whaley Lake (1½ miles to the south) and swings west (leaving the wetlands) at Rt. 55. The entire wetland complex between Nuclear Lake and Whaley Lake is between 690 and 700 ft. elevation, excepting the small wetland just SW of Nuclear Lake which is between 700 and 710 ft - still 50 feet below Nuclear Lake. The wetland formerly occupying the lake site was between 740 and 750 ft. (2).

For additional detailed information concerning changes in the drainage patterns and wetlands on and around the Nuclear Lake Property refer to Chapter IV - Sequential Air Photo Analysis, of this report.

It is not known if there are any springs on the property. The groundwater of the general area is soft, often tainted with hydrogen sulfide, and yields about 16 gallons per minute from drilled wells (4).

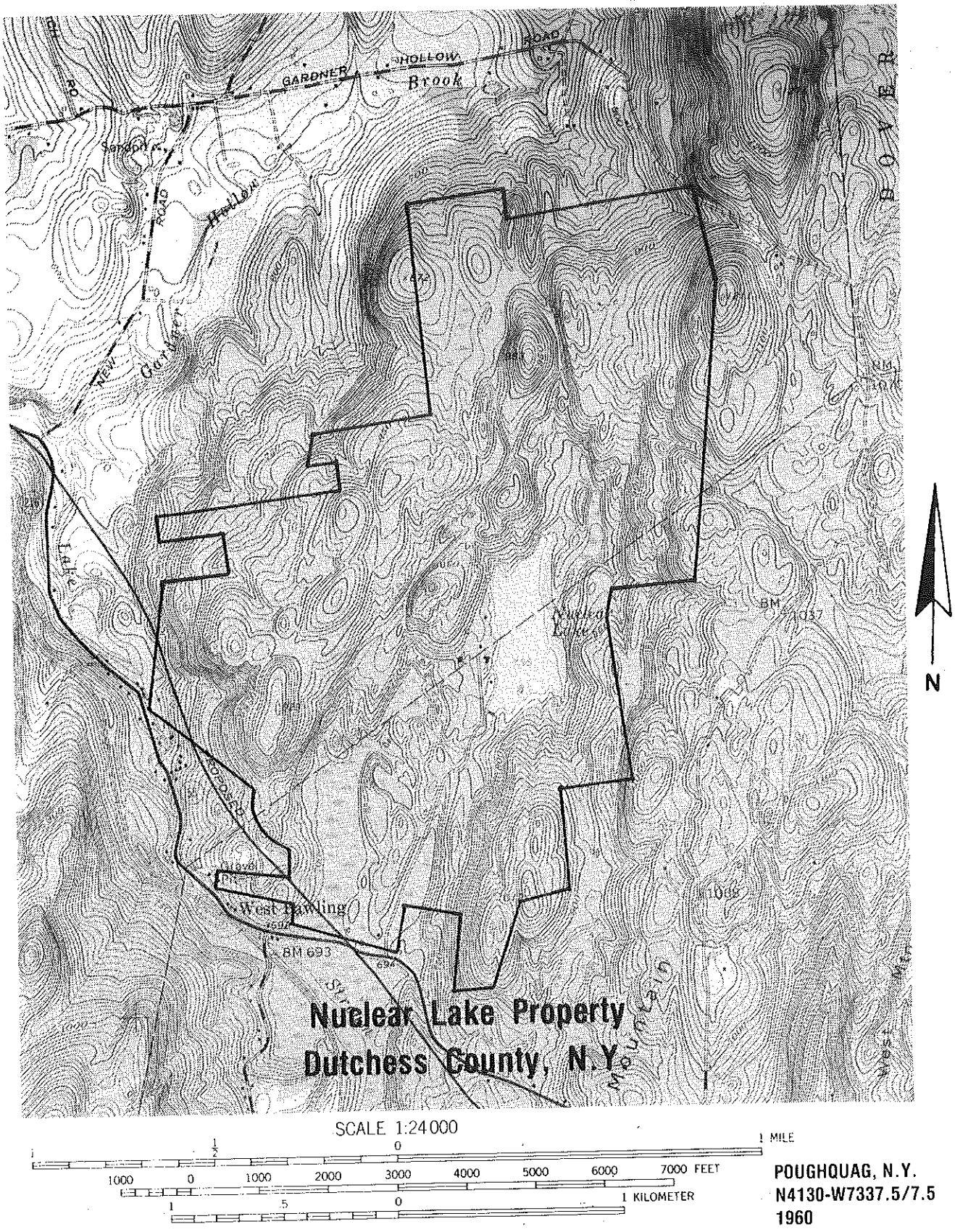

Figure II-1 - A segment of the 1960 USGS Topographic map. Poughquag Quadrangle showing elevation and slope data for the Nuclear Property. Superimposed is the boundary of the Nuclear Lake Property owned by the National Park Service.

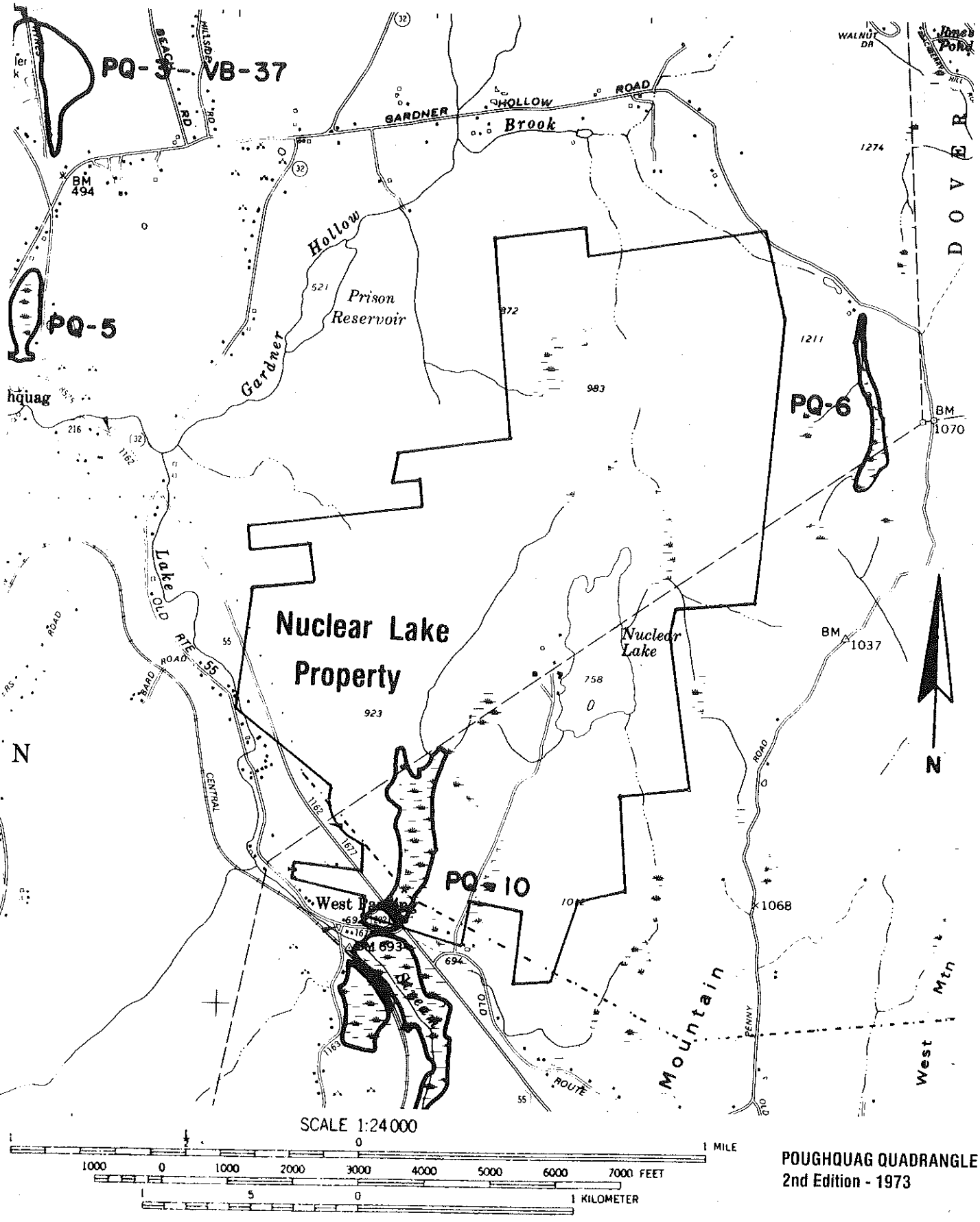

Figure II-2 - A segment of 1973, Poughquag Quadrangle showing surface waters and wetlands on the Nuclear Lake Property. Superimposed is the boundary of the Nuclear Lake Property owned by the National Park Service.

Soils

Fig. II - 3 is a generalized soil map of the property. The soils are derived predominantly from glacial till (ground-up rock materials of various particle sizes and diverse origins). These soils are acidic (8); exceptions being wetland and calcareous soils. The wetland soils consist of fine material and contain more organic matter from plants than do the till soils. Small areas of calcareous (limy) soils derived from carbonate rock outwash occur near the southwest corner of the property (Fig. II - 4); these soils are alkaline. Soil mapping of this type (8) is not finely detailed and it is likely that small areas of wetland or calcareous soils occur on the property but are not mapped.

The depth of wetland sediment in the lake basin was not recorded when Nuclear Lake was built (5). However, a boring in the wetland about 0.7 mile north of Whaley Lake and 300 ft. south of Rt. 55, revealed much from the surface to a depth of 2 ft. and silt below that (13), but no borings were reported from the Nuclear Lake property.

All soil types of the Nuclear Lake property and vicinity are listed in TABLE 2.

TABLE 2. Soil types, Nuclear Lake property and vicinity. According to Soil Survey Dutchess County New York (8).

Symbol	Soil; Parent material	Slope %
Ch	Chatfield stony loam: ledgy hilly phase; glacial till, chiefly granite & gneiss	15-30
Cp	Copake gravelly loam: nearly level & undulating phase;	0-8
Cs	Copake gravelly loam: steep phase; glacial outwash, chiefly calcareous sandstone, limestone & slate	25-45
Gc	Gloucester gravelly loam: rolling phase; glacial till, chiefly granite & gneiss	5-15
Gl	Glouster stony loam: rolling phase; glacial till, chiefly granite & gneiss	5-15
Hd	Hollis Channery loam: rolling phase; glacial till, chiefly schist	5-15
Rd	Rough stony land; variable	25-60
Sk	Stockbridge gravelly loam: gently sloping & sloping phases; glacial till, chiefly limestone & slate	0-15
Wl	Whitman stony silt loam; glacial till, chiefly schist, granite & gneiss	0-3

Vegetation

The terrestrial vegetation is predominantly hardwood forest (4, 17, 18). An evaluation of color aerial photographs taken in May 1980, (see Chapter VIII) gives an impression of extensive rocky, thin-soiled, dry hardwood forest of small to moderate tree size, broken by small pockets of other plant communities in wetlands and other sheltered sites. This impression was borne out by the limited information available, at least for the areas along the driveway and around the buildings (16-17), which support an oak woods (white oak is the commonest tree) with scattered hemlock, red oak, tulip, black birch, flowering dogwood, witch-hazel, mountain-laurel, and other trees and shrubs. Lichens (crustose or foliose species) are present on tree trunks.

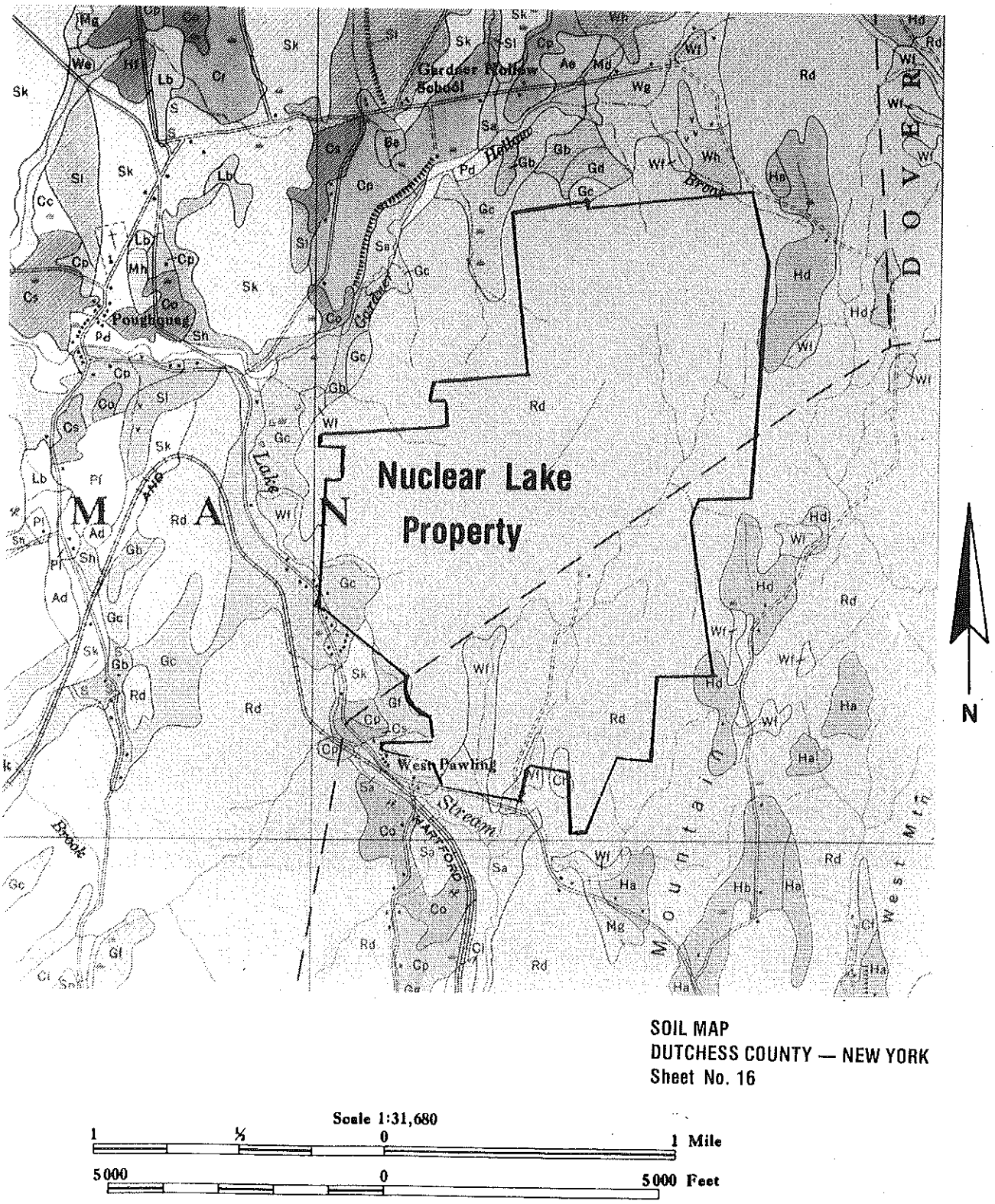

Figure II-3 - Segment of Soils map, Poughquag Quad showing generalized soils types found on the Nuclear Lake Property. Superimposed is the Nuclear Lake Property owned by the National Park Service.

The wetlands, largely wooded, have numerous red maples mostly of small size, also yellow birch, alder, royal fern, skunk cabbage, tussock sedge and other species (16). No spagnum moss has been noted. Purple loosetrifle, cattail and alder are among the species of the lake shoreline. A list of the observed flora is in Table 3.

At the time of lake construction (1946-47), shrubs and small trees covered the wetland on the lake site (5). The wetland has been described as a "boggy swamp", at the bases of woody plants. At this time, the lake's surroundings were "second growth" forest, including "poplar, shrub oak, some maple" (5). The trees were not large because the American Brass Company had cut over the whole area for charcoal at an unreported date (5). As is common elsewhere in eastern Dutchess County, charcoal production pits may be present on the Nuclear Lake property.

TABLE 3. Plants observed on the Nuclear Lake property (4, 16, 17)

TREES	HERBS	FERNS AND ALLIES
Red maple	Sedge	Horsetail
Black birch	Tussock sedge	Christmas fern
Yellow birch	Strawberry	Sensitive fern
American chestnut	Grasses	Cinnamon fern
Flowering dogwood	Purple loosestrife	Royal fern
Beech	Orchids	
Red ash	Skunk-cabbage	**SHRUBS**
Red cedar	Coltsfoot	
Tulip	Cattail	Alder
White oak		Witch-hazel
Red oak		Mountain-laurel
Willow		Bramble
Sassafras		Blueberry
Hemlock		Viburnum

Animals

A list of species reported on the property is in TABLE 4. This was compiled from a number of sources but should not be considered complete.

The area was listed as "United Nuclear Corporation" (UNC) in Where to Bird in Dutchess County (10) which stated that migrant waterfowl used the lake in early spring and late fall. Typical woodland birds may be seen on the property. The Ralph T. Waterman Bird Club visited the property on 19 March and 26 October 1977, 18 March, 24 June, and 14 October 1978, and 31 January 1979. Mr. Benson, former caretaker of the property, operated bird feeders there (9).

Whaley Lake had a breeding pair of bald eagles until at least 1891 (11) and perhaps into the early 1900's (12).

TABLE 4. Animals observed on or near the Nuclear Lake property, 1977-80 (9, 16, 18, 19, 20).

MAMMALS

Beaver *
Eastern chipmunk
Woodchuck
Bobcat *
Whitetail deer

BIRDS

Great blue heron
Canada goose
Greater scaup
Turkey vulture
Goshawk
Sharp-shinned hawk
Ruffed grouse
Mourning dove
Chimney swift
Belted kingfisher
Common flicker
Pileated woodpecker
Hairy woodpecker
Eastern kingbird
Great crested flycatcher
Eastern phoebe
Least flycatcher
Eastern wood pewee
Tree swallow
Blue jay
Common crow
Black-capped chickadee
Tufted titmouse
White-breasted nuthatch
Brown creeper
House wren
Grey catbird
American robin
Wood thrush
Veery
Blue-gray gnatcatcher
Ruby-crowned kinglet
Starling
Red-eyed vireo
Warbling vireo
Black-and-white warbler
Worm-eating warbler
Blue-winged warbler
Yellow warbler
Yellow-rumped warbler
Black-throated green warbler
Chestnut-sided warbler
Prairie warbler
Ovenbird
Northern waterthrush
Louisiana waterthrush
Common yellowthroat
Canada warbler
American redstart
Red-winged blackbird
Northern oriole
Common grackle
Scarlet tanager
Cardinal
Rose-breasted grosbeak
Indigo bunting
American goldfinch
Rufous-sided towhee
Dark-eyed junco
Chipping sparrow
White-throated sparrow
Swamp sparrow
Song sparrow
Black-throated blue warbler

REPTILES

Snapping turtle
Painted turtle

AMPHIBIANS

Spring peeper

FISHES

Brown trout*
Brook trout *
Northern pike +
Chain pickerel
Creek chubsucker
Brown bullhead
White perch
Pumpkinseed
Bluegill
Largemouth bass
Yellow perch

***Reported near the Nuclear Lake property and probably occurs there.**
+ Two were liberated in Nuclear Lake in 1979 (Charles Shaw, pers. comm.).

Many UNC documents refer to testing "Salamanders" from the stream and "perch" and "catfish" from the lake, for radioactivity (15). During October 1956, the NYS Conservation Department stocked Nuclear Lake with several fish species taken from Kurk Lake in Putnam County, New York (22). A list of these fish species can be found in TABLE 5.

TABLE 5. New York State Conservation Department Fish Stocking Report For Nuclear Lake (22).

Fish Species	Number Stocked	Weight (lbs.)	Average Size (Inches)
Bullheads	2773	2773	12
Yellow Perch	1915	1315	10
Sunfish	815	220	8
Rock Bass	485	95	5
White Perch	284	340	13
Chub Suckers	62	62	12
Golden Shinners	120	60	9

In December 1979, the New York State Department of Conservation, using gill nets, collected 122 fish samples for radiological testing. All samples were reported to be in good condition (no sores or lesions noted). Most were under five years old except for a few perch estimated to be 6-7 years old. TABLE 6 lists these species collected.

TABLE 6. New York State Department of Environmental Conservation Records of fish collected for radiological testing.

Species	Number	Weight
Yellow perch	93	1/2 - 1 lb. each
Pumpkin seed	4	
Chain pickeral	6	
Large mouth bass	3	
White perch	3	
Brown bullhead	4	4 lb. 1 oz. - Total

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III. UNC History and Operations

OWNERSHIP

Between 1934 and 1942, Herbert Teets acquired approximately ten parcels in the towns of Beekman and Pawling, which comprise the large majority of the present 1137 acre Nuclear property (1).

In 1945 the property was sold to Joseph Chazen and Leland Rider. The dam creating the lake was constructed shortly after this, and in 1953, Chazen sold his interest in the property to Ryder (1).

In April 1955, Leland Ryder sold the property to Southern Dutchess Corporation. During the next few years Nuclear Development Corporation of America (NDA) obtained several construction permits and licenses for development of the Remote Experimental Station at Pawling. (See figure III-1). In March 1958, the property was transferred from Southern Dutchess Corporation to NDA (1).

In May 1961, Nuclear Development Corporation of America (NDA) assets, personnel and licenses to operate were transferred to United Nuclear Corporation (UNC). During the next few years, portions of the UNC operations were conducted under a contract with the United States Atomic Energy Commission. Also during this period several parcels were acquired by New York State for realignment of Route 55 (2).

In April 1962, United Nuclear Corporation merged with Sabre-Pinon, which subsequently changed its corporate name to United Nuclear Corporation (UNC). Through the merger a "new" UNC was formed and licensed (3).

In July 1971, United Nuclear Corporation (UNC) signed a lease agreement with Gulf United Nuclear Fuels Corporation (GUNFC), which made the operation of the Remote Experimental Station a joint venture. UNC retained ownership of the property and facilities, and GUNFC held the licenses to operate. The new corporation was called Gulf United Nuclear Corporation (GUNC) (4).

GUNC requested termination of its License SNM-871 on March 11, 1974, and by July 14, 1975, when the license was terminated by the Nuclear Regulatory Commission, the company was known as General Atomic Company (15)

In November 1977, United Nuclear Corporation sold the property to Harpoon, Inc. (5).

In June 1979, Harpoon, Inc. sold the 1137 acre parcel to the United States of America (USA), Department of the Interior, National Park Service for relocation of the Appalachian National Scenic Trail (6).

FACILITY DEVELOPMENT AND USE

The property currently contains a number of structures, access road, parking lots and utilities. A plan of the UNC Remote Experimental Station showing all structures is provided as Figure III-2. Following is a description of each structure's construction and function while the site was used as a nuclear research facility. The description has been taken from available information.

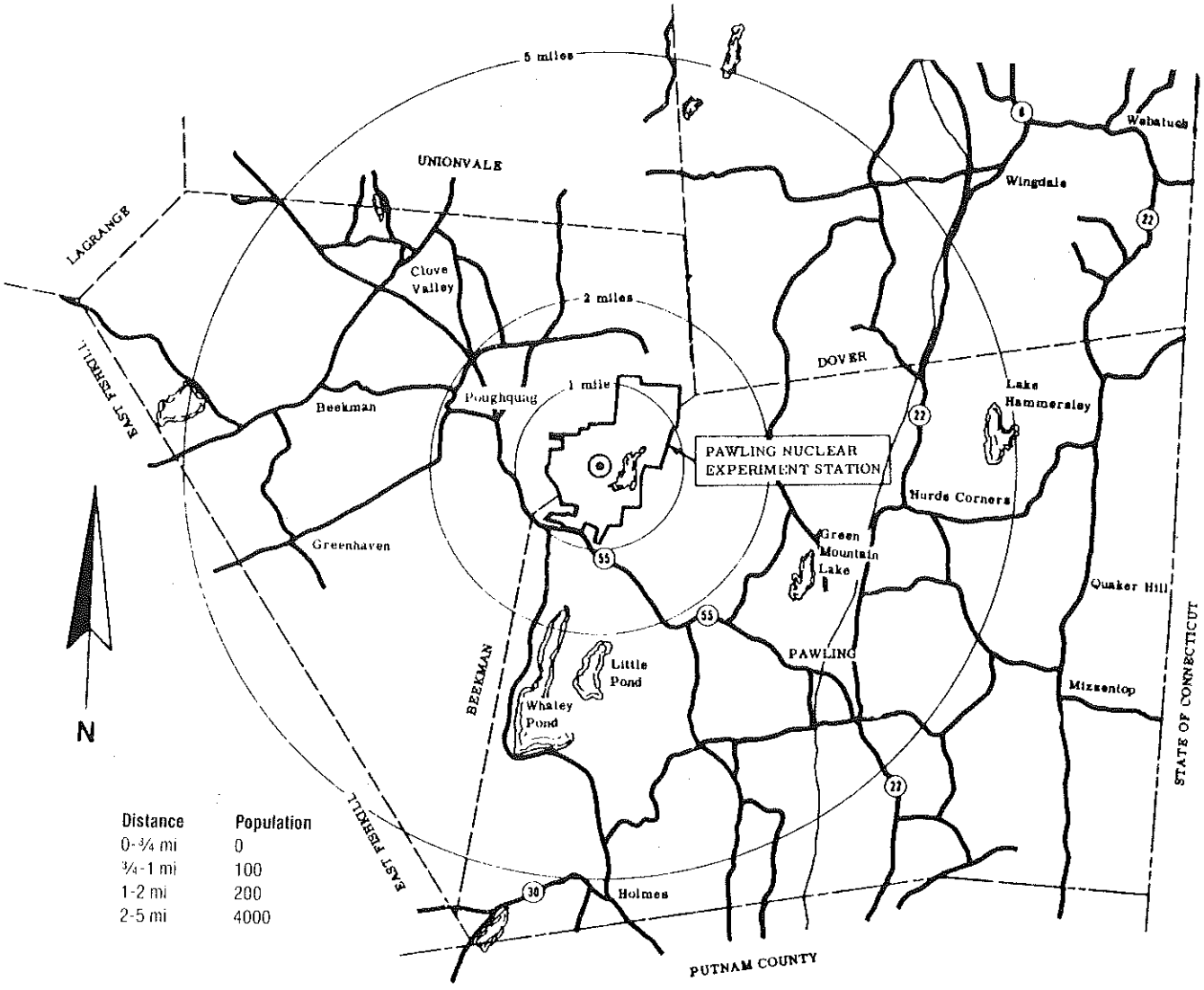

Figure III-1 - Remote Nuclear Experiment Station at Pawling

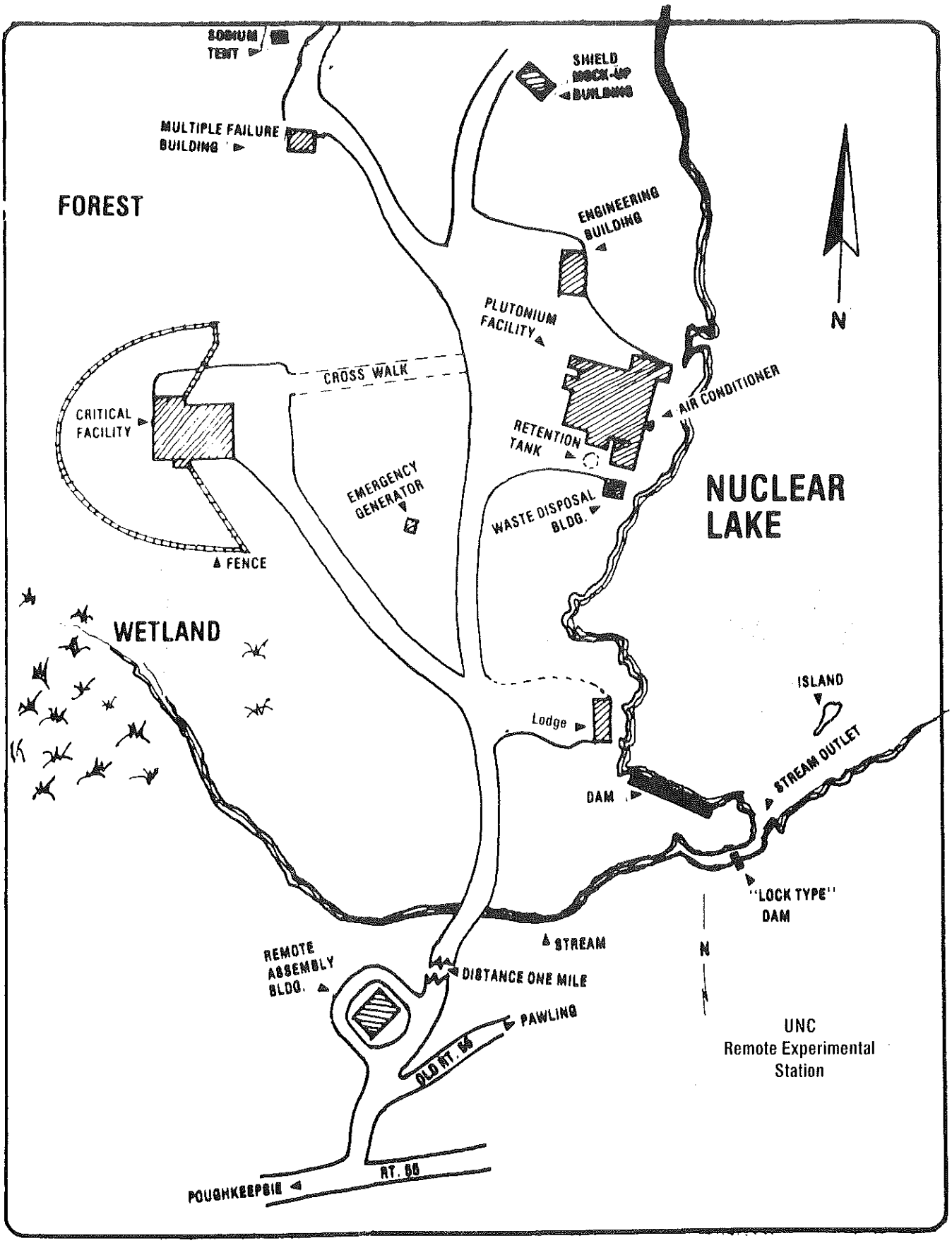

Figure III-2 - Remote Experimental Station - Plant Layout

A. LODGE (Figure III-3)

Location and Construction:
This single story "wooden hunting lodge" existed prior to 1955 (7). It has a stone foundation, stone fireplace, and is located near the lake shore south of the Plutonium Facility.

Function and Uses:
In 1963 and 1967 it was being used for storage.

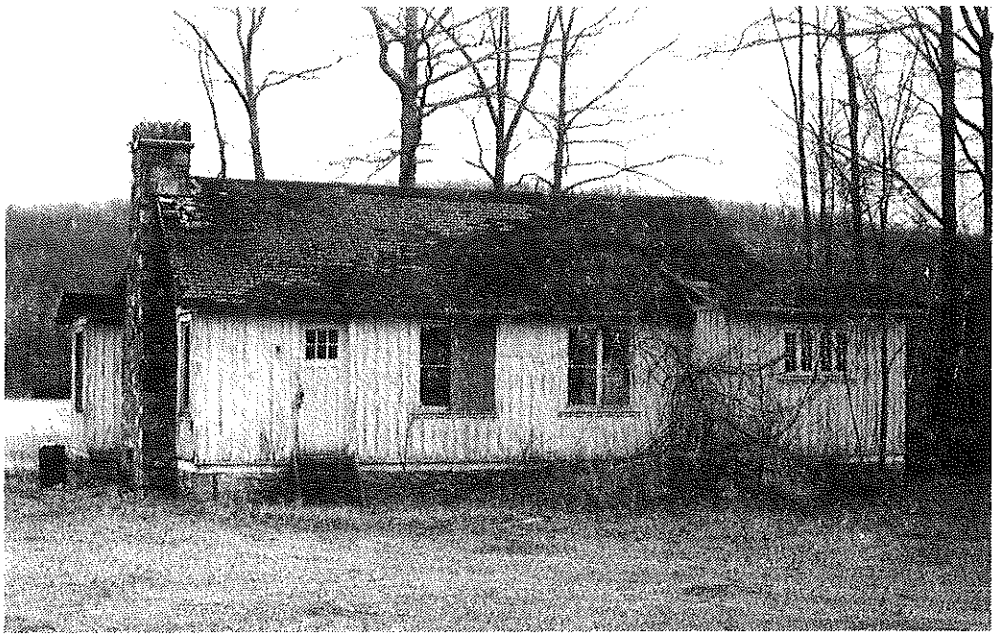

Figure III-3 - The Lodge (1981 Photo)

B. BOATHOUSE

Location and Construction:
A small wood frame structure was located on the lake shore near the lodge prior to 1955 (7). It was also called garage.

Function and Uses:
The building was converted for storage of the fire trailer which held a 300 gallon tank, hoses and a pump used for fire protection within the complex (8). A "pond plug" was installed in the floor to permit rapid filling of the trailer tank (9). In 1970, all employees were warned that the building was collapsing (10). The structure does not now exist although a portion of its stone foundation is visible below the lake surface.

2. PLUTONIUM FACILITY (Figure III-4)

Location and Construction:
The building is located close to the west edge of the lake, north of the Waste Storage Building and east of the Engineering Building. It was one of the initial "testing and experimental labs" constructed in 1956 (7, 11, 12). Between 1966 and 1971, portions of the building were removed and other sections added. The present structure contains 8800 square feet. It is partially one story and partially 1½ stories, made of concrete block with two additions on the south side.

Several plans for alterations were reviewed between 1963 and 1966. During 1967, the detached Gas House on the northwest corner was removed and replaced by a 24' by 36' concrete block addition to the main structure. At the same time a 30' by 50' concrete block addition was constructed on the southwest corner. This required reconstruction of the sub-surface sewage disposal system (13, 14). Plans for this system were approved by the Dutchess County Department of Health in February 1967. It was constructed on the south side of the building, by June 1967, and included a 900 gallon tank and a leach field 5-7' deep (15, 16). After 1970, a 28' by 32' metal addition was constructed on the southeast corner of the facility.

Figure III-4 - The Plutonium Facility (1981 Photo)

Function and Uses:
The building was one of the two locations in which the use and storage of Special Nuclear Material was authorized. Much of the waste products discussed in Chapter V were generated in this building. The "Operating Manual" for this facility is available (8). The entire building was called the "Hot Laboratory" for several years and contained separate "Alpha Lab" and "Gramma Lab" sections (7, 9, 17, 24). Figure III-5 shows the floor plan for the building.

The Alpha Lab contained "a large number of interconnected glove boxes connected to very extensive gas handling facilities" and by 1961, the activities included the use of "unirradiated Pu and natural uranium both in the metallic and dissolved form" (25). It was within this portion of the building that the explosion occurred in 1972. (See Chapter VI).

The Gamma Lab had "several shielded caves" for work on irradiated fuel elements and handled small amounts of Special Nuclear Material (24, 26). Other portions of the building contained the Change Room, Decontamination Room, storage area and safe, bathrooms, offices and a small chemistry lab/dark room (7, 8, 27). (See figure III-5). In July 1966, the Gamma Lab facility was being dismantled (28).

The handling of plutonium in this building was discussed in 1957, and the "Plutonium Laboratory was first operated in August 1961" (29, 30). Use of plutonium and uranium-235 (U-235) in a proposed fuel fabrication process was discussed in March 1964. The major product produced in the fabrication process was uranium oxide - Plutonium Oxide (UO_2-PuO_2) in the form of pellets (7, 76).

In 1970, two amendments to this license were requested. One involved "Non-destruction assay operations" in a shielded area to be constructed on the south side of the building. This is the concrete block addition to the existing structure and was to have interior walls of concrete on three sides ranging in thickness from 18 to 36 inches. The second request was for an additional "6 gloves boxes and a continuous sintering furnace" which did not require building expansion. (32, 33).

NDA Dwg. TR12396

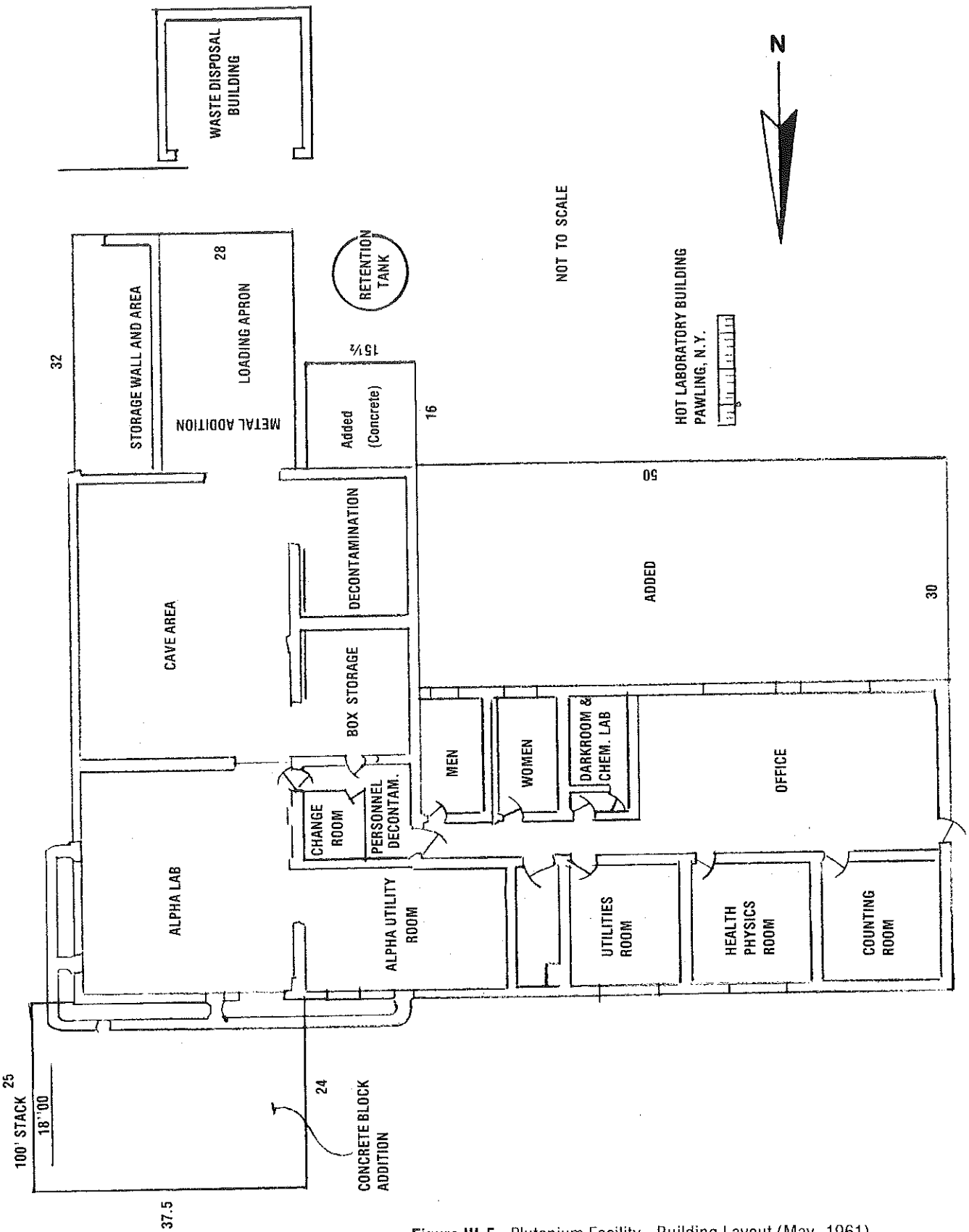

Figure III-5 - Plutonium Facility - Building Layout (May, 1961)

3. CRITICAL FACILITY (Figure III-6)

Location and Construction:
This 6000 square foot building is located on the edge of the complex, approximately 400 feet west of the Plutonium Facility. It has a separate parking area on the west side and the other sides of the building are surrounded by an 8 foot chain link radiation exclusion fence designed to keep people and animals from wandering too close to the building during operation. A large wetland system is adjacent on the southwest.

Construction began in 1956 and there have been no apparent exterior additions. The building was constructed of "structural steel with non-load-bearing masonry walls". The west end of the building consisted of the 25' by 60' by 38' high reactor room. It had provisions for two reactor locations and had two concrete pits in the floor. These measured 10' by 20' by 10' deep and 8' in diameter by 8' deep, and both were constructed without drains. A 4 foot thick poured concrete shield wall separated the reactor room from the other parts of the building. The remainder of the building is one story concrete block. Both sections have flat reinforced roofs (24, 34).

Figure III-6 - Critical Facility (1981 Photo)

Function and Uses:
This building housed two test reactors and later the Proof Test Facility, all of which were critical assemblies. It was operated under Facility License R-49 and was the other authorized location for the storage and use of Special Nuclear Material. Like the other facilities it was subject to Industrial Code Rule No. 38 of the New York State Labor Law (34, 37). By October 1957, some 2,000 gallons of borated water had been accumulated in one of the pits in the reactor room. It was noted that the water would not be needed after a short period of time, although it was stored here until at least 1965 and is discussed in Chapter V (30, 35, 36).

In June 1956, Nuclear Development Corporation of America (NDA) received a Construction Permit to build the Critical Experimental Facility. In 1958, NDA received another permit for the construction of a low power, heavy water "Pawling Research Reactor" to be housed in the Critical Facility Building. Later in October 1958, a "License to Operate" the Pawling Research Reactor was issued to NDA by the United States Atomic Energy Commission (USAEC). Subsequent amendments to this license in 1960-62, refer to the operation of another "low power, tank-type critical assembly" called the "Pawling Lattice Test Pig (PLATR)" (7, 18, 19, 38, 39, 46). PLATR utilized Polonium-Berylium (PlBe) and RadonBerylium (RaBe) as neutron sources.

In February 1963, a United Nuclear Corporation preliminary report on expansion of the Critical Facility structure and operation was prepared. Although the expansion did not occur, the report detailed the existing uses within the building. These included the Pawling Research Reactor in one of the two reactor positions and noted that the other position was vacant. The accompanying plan labelled the reactor as "PLATR" rather than the Pawling Research Reactor. Other portions of the building included a control room, accountable fuel storage vault, machine shop, electronics shop, counting room, bathrooms and office space. (See Figure III-8 for floor plan to the Critical Facility). "Split Bed Critical Assembly" and "Shield Mock-Up Reactor" and although the Construction Permits were issued, the necessary additions to the building were not constructed (7, 17).

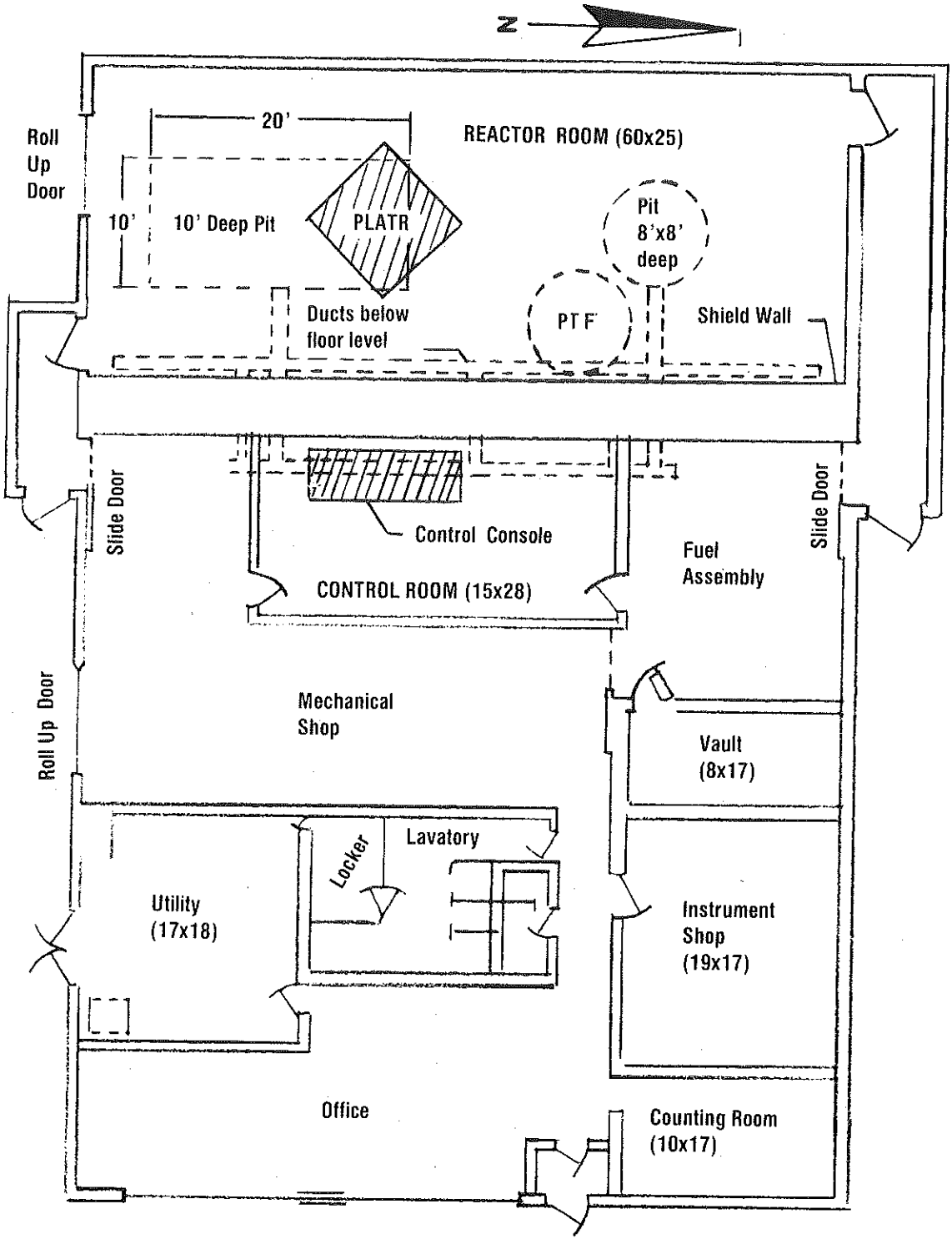

Figure III-7 - Critical Facility - Building Layout (April, 1967)

In April 1967, USAEC reviewed the UNC proposal to construct "a light water moderated, zero power critical assembly which would be used for the purpose of providing a final reactivity test for manufactured assemblies", known as the Proof Test Facility (PTF). It was located in the reactor room within a new 4 foot diameter by 14' high aluminum tank, and involved UO2 pellets fabricated in the Plutonium Facility (24, 76). The PTF operated initially in December 1967, operating changes were made in 1968, and it was mentioned again as being in operation in 1969. Operation of the PTF was authorized by USAEC License CX-25 (41, 42).

In March 1964, it was noted that "enriched fuel" was stored in the vault and "natural fuel: was stored in the reactor room (26). In September 1965, the facility was considered for use "as a Cobalt-60 (CO-60) irradiation site" and the borated water was still being stored there (36). In 1965-67 several Special Nuclear Material License and Facility License amendments were issued regarding increased storage limits for Uranium-235 (U-235), Uranium Oxide-2 (UO-2), fuel rods, Plutonium-239 (PU-239) and sealed source Plutonium-Berelyum (PuBe) in the Critical Facility Building (37, 69, 72, 73).

4. ENGINEERING BUILDING (Figure III-8)

Location and Construction:
The building is a 2400 square foot, single story concrete block structure with a flat roof. It is located north of the Plutonium Facility about 350 feet northeast of the Critical Facility Building (7). The date of construction is uncertain although it was occupied by November 1957 (7, 12). No additions to this structure were noted. It was also referred to as the Experimental Engineering Building and Engineering Services Building (7, 46, 47).

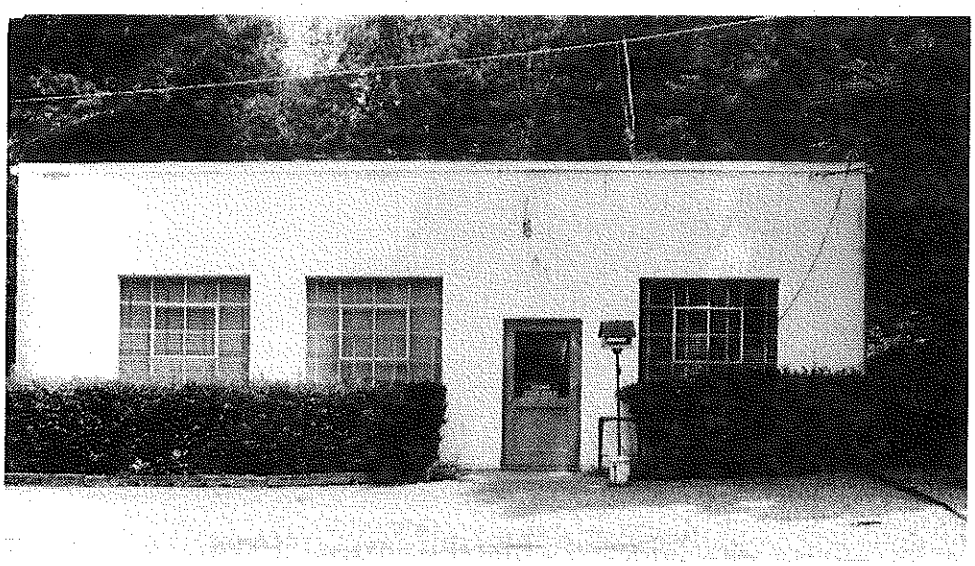

Figure III-8 - Engineering Building (1981 photo)

Function and Uses:
Through 1963, it was used partially for storage and partially for housing the site maintenance department, shop and garage: (7). In late 1957, and early 1958, single failure equipment and sodium were stored here while work continued on the Multiple Failure Building, the Shield Mock-Up Building and the Sodium Storage Tent (46, 47). The building contained bathrooms and in April 1958, the ladies room was converted to a Health and Safety room (48). four employees worked in the building on a regular basis in 1960 (49). Staff training courses were held in the "Conference Room" in early 1967. A description of existing facilities in April 1967, included a dark room, a chemistry laboratory and the Health Physics and Safety department (24, 50).

5. MULTIPLE FAILURE BUILDING (Figure III-9)

Location and Construction:
This is a 20' by 20' pre-fabricated steel building on a concrete slab, located 440' north-northeast of the Critical Facility Building. The building was in place by 1957, and a 15' by 20' loading platform was added in November 1957 (7, 51).

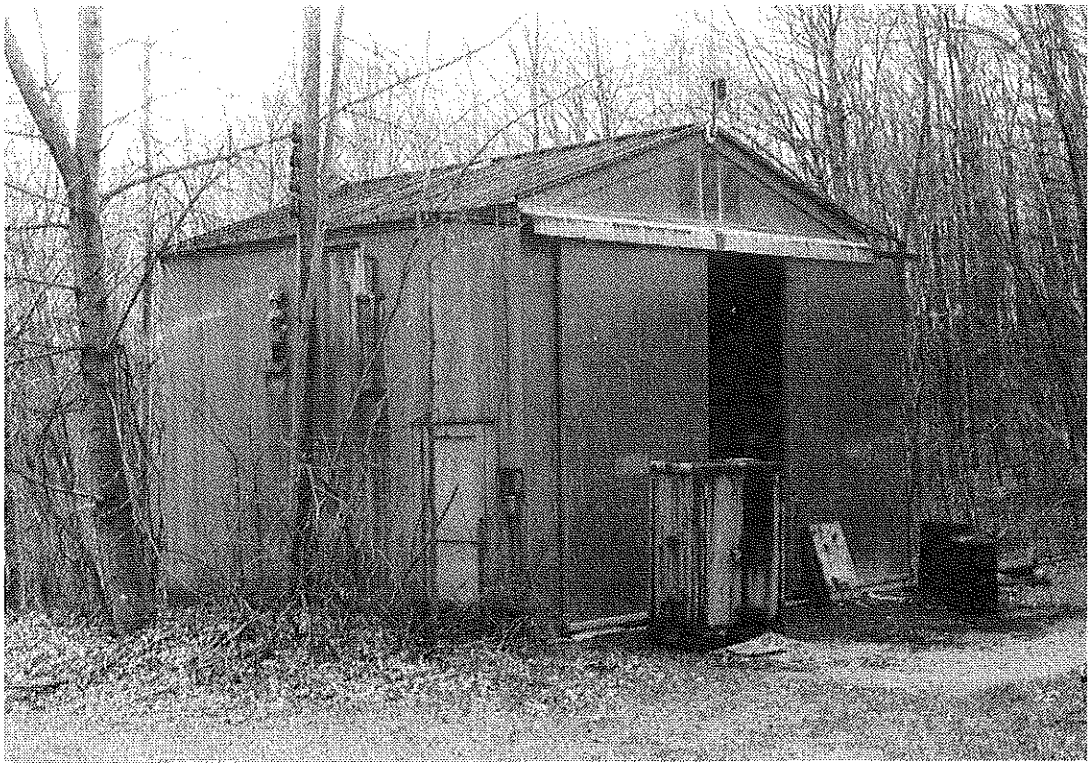

Figure III-9 - Multiple Failure Building (1980 photo)

Function and Uses:
In early 1958, multiple failure experiments utilizing sodium were begun in the building. A drum outside collected drained water and the used sodium was returned to the Sodium Storage Tent in the original container (48, 52). Like the Shield Mock-Up Building, other experiments with lithium were conducted here and it was noted that "no radioactive materials were involved in these experiments at any time" (53). The building was being used for storage in 1963.

6. SHIELD MOCK-UP BUILDING (Figure III-10)

Location and Construction:
This is a 20' by 30' by 20' high pre-fabricated steel building on a concrete slab, located at the outer edge of the complex. It is 720' north-northeast of the Critical Facility Building and was constructed in late 1957 (7, 20, 46).

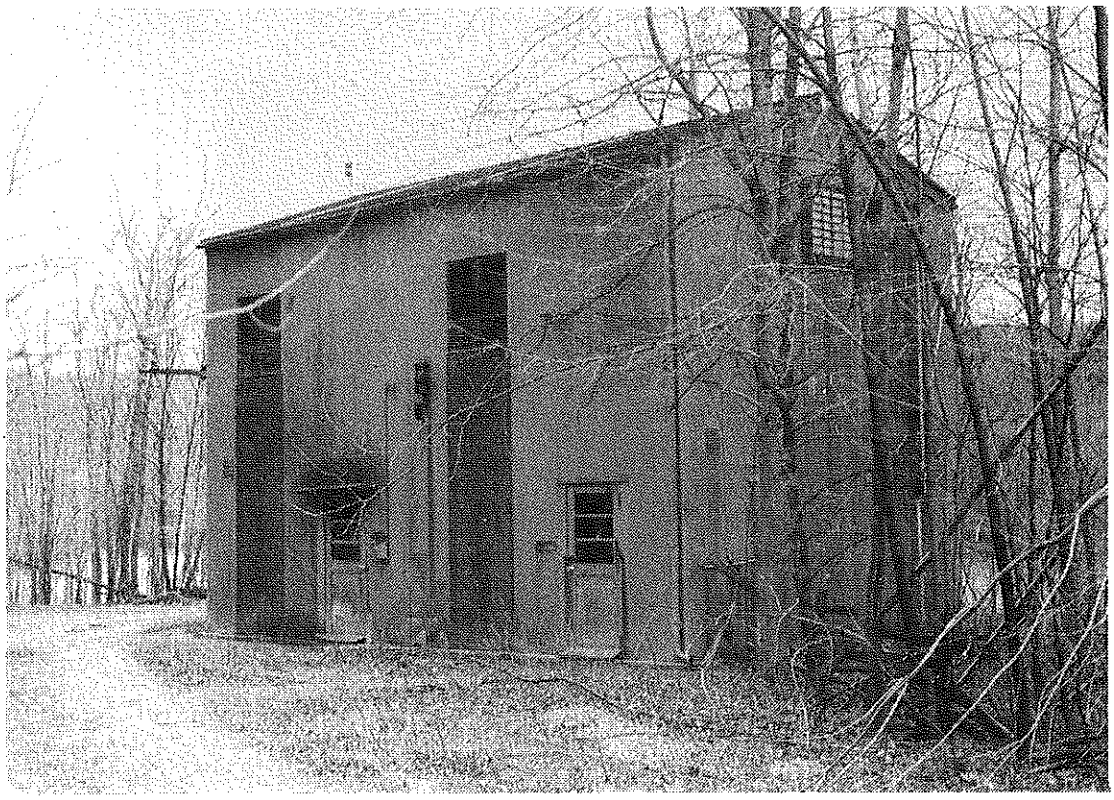

Figure III-10 - Shield Mock-Up Building (1980 photo)

Function and Uses:
The building was referred to as one of two "Liquid Metal experiment building" and was operational in April 1958. Experiments with stable sodium and lithium were conducted here until about 1963 (7, 24, 48, 53). After this the building was used for storage. In 1971, it was noted that the building was authorized for the storage of up to "250 grams of solid waste" (54). Following the accident in 1972, the building was used for "storage of drums containing contaminated waste resulting from the clean-up of the Plutonium Facility" (55).

7. SODIUM STORAGE TENT (Figure III-11)

Location and Construction:
The sodium tent is a 15' by 15' concrete pad on a concrete block foundation, located about 1000 feet north of the Critical Facility Building. The floor was sheet steel with a tent erected over it and wood railing along the sides. It was constructed in 1958, and required considerable clearing of vegetation around it to reduce the fire hazard (47, 56).

Figure III-11 - Sodium Storage Tent (1980 photo)

Function and Uses:
Containers of sodium and used sodium from the operations in the Multiple Failure Building were stored here (48).

8. WASTE STORAGE BUILDING AND RETENTION TANK (Figure III-12)

Location and Construction:
The Waste Storage Building is a 20' by 20' two story prefabricated galvanized steel "Armco" located on a concrete block foundation (7). It is located immediately adjacent to the Plutonium Facility. The Retention Tank is an in-ground concrete tank having a capacity of approximately 4,500 gallons and is located directly in front of the Waste Storage Building (57).

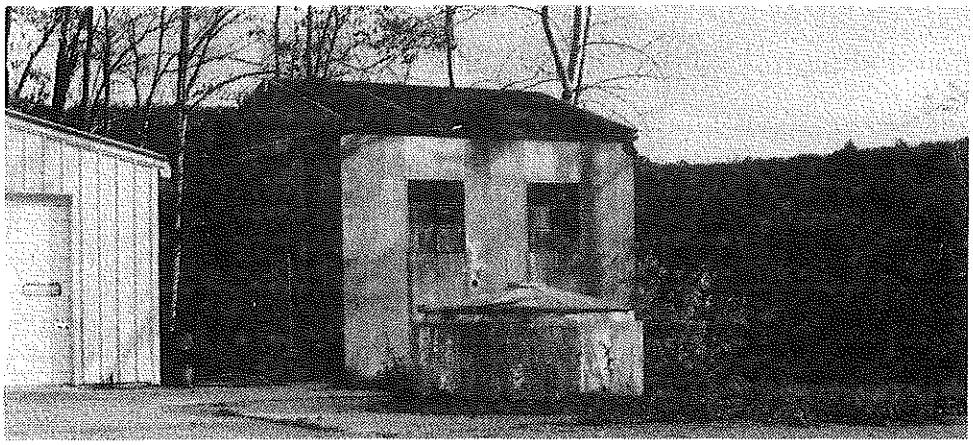

Figure III-12 Waste Storage Building and Retention Tank (1980 photo)

Function and Uses:
The Retention Tank is shown in a 1956 aerial photograph of the complex. In May 1957, the "retention tank at the Hot Laboratory" contained 4,000 gallons of low level radioactive waste water (34). (See Chapter IV and V).

The Waste Storage Building was also constructed early in the development of the property. In the 1959 application for a permit to discharge radioactive liquid wastes below the maximum permissable concentrations, the procedure included the use of this building. Liquid wastes from the Plutonium Facility laundry, shower and several sinks were carried by a pipe to the Waste Storage Buiding, where they were stored in 55 gallon drums. The drums were analyzed, diluted if necessary in the lower level of the building, then discharged to the lake through a 2" PVC pipe. The point of discharge was approximately 50 feet off shore in about 12 feet of water. The discharge pipe was held three feet below the surface and secured by a series of floats and anchors (8, 12, 49, 58). The permit for the described discharges was issued in November 1960 (58).

In 1964, a request to store a "hot" Sectioning Box in the building was denied until the box was decontaminated (17). In 1968, the building was being used to store valuable equipment and a sprinkler system was proposed. It was called the "Equipment Storage Building" at that time (59).

9. MAIN PARKING LOT (Refer to Sequential Analysis. Chapter IV)

10. EMERGENCY GENERATOR BUILDING

Location and Construction:
This 8' by 16' concrete block building has a steel garage-type door, concrete floor and corrugated metal roof. It is located near the road within the complex and was in place by late 1957. (45).

Function and Uses:
This housed a diesel emergency electric generator which provided back-up power for the facility (7, 24).

15. REMOTE ASSEMBLY BUILDING (See Figure III-13)

Location and Construction:
This is a 24' by 28' two story wood frame structure with a full basement which existed prior to 1955. It is located at the vehicular entrance to the site on Old Route 55, approximately one mile from the lake and building complex. A well on the north serves the building and a septic system is located on the south side. A wood garage is located slightly to the southeast.

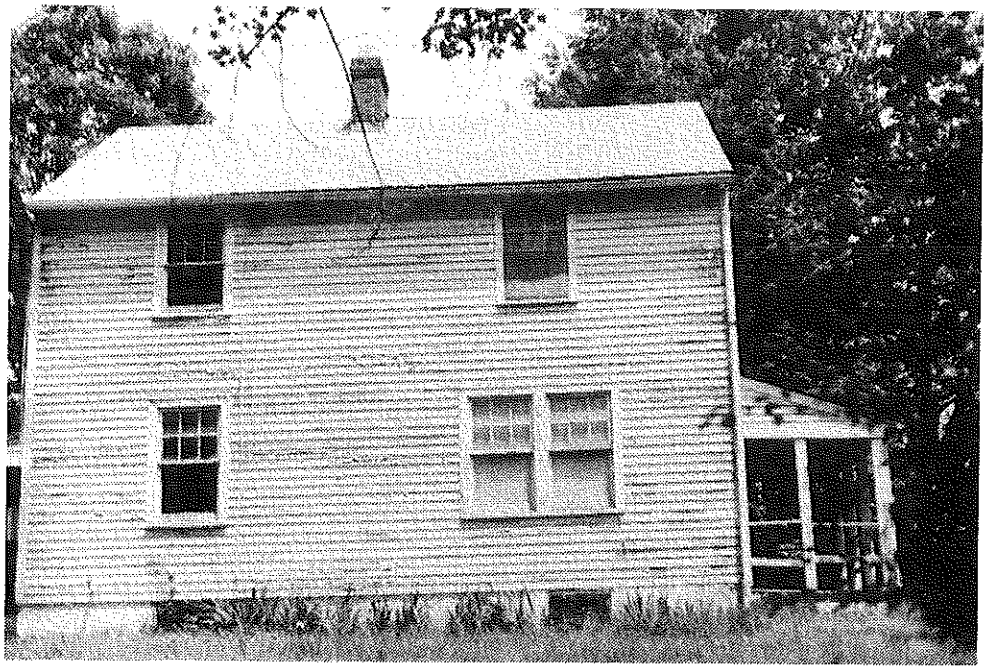

Figure III-13 - Remote Assembly Building (1980 photo)

Function and Uses:
This "company-owned house" was occupied as a dwelling at least during 1963 and was vacant by 1967 (7, 24). As part of the facility's emergency procedures, this building was designated as the "Remote Assembly Building" in 1967. Various equipment including meters, air-samplers, protective clothing, bedding, operating manuals, and a telephone was stored here for use in an emergency (60-63). The building was used for drills and for the evacuation during the December 1972 accident. Site personnel were decontaminated in this building on that occasion (55, 81). A system to collect water from the shower and wash facility was not in place until November 1973. (64).

The building is currently occupied as a dwelling under Special Use Permit from the National Park Service (65).

APPLICATIONS, PERMITS AND LICENSES

The following is a compilation of information relating to permits and licenses requested by, or issued to the various corporations involved in the Pawling Remote Experimental Station. Attempt has been made to organize the available information by subject rather than strict chronology.

A. DAM CONSTRUCTION

1. Herbert M. Teets to New York State Department of Public Works (NYSDPW):
"Application for the Construction or Reconstruction of a Dam", submitted by Ralph L. MacDonald, dated October 14, 1936 (66).
2. Milton Chazen to NYSDPW:
"Application for the Construction or Reconstruction of a Dam", dated March 21, 1946 (66).
3. NYSDPW to Milton Chazen:
Approval of plans for dam construction with stipulations, dated March 23, 1946 (66).

B. CRITICAL EXPERIMENT FACILITY

1. Nuclear Development Corporation of America (NDA) to United States Atomic Energy Commission (USAEC):
Application for a Class 104 license to construct, possess and operate a critical experiment facility, dated March 5, 1956: amended April 13 and May 10, 1956, and November 26, 1957 (67).

2. USAEC to NDA:
Construction Permit No. CPCX-3 issued for construction of the critical experiment facility, dated June 11, 1956 (67).
3. USAEC to NDA:
License No. CX-8, Docket No. 50-23, to possess the critical experiment facility issued expiration date of June 11, 1966 (67).
4. NDA to USAEC:
Application for a Class 104 license authorizing the construction and operation of a heavy water-moderated and reflected training and research nuclear reactor, dated April 2, 1958; amended June 30, 1958 and refers to the Pawling Research Reactor (68).
5. USAEC to NDA:
Construction Permit No. CPRR-29 issued for construction of the Pawling Research Reactor, dated October 7, 1958 (68).
6. Facility License No. R-49
   a. Issued by USAEC for operation of the Pawling Research Reactor in the Critical Facility Building, dated October 22, 1958 (7).
   b. R-49 Amendment #1 issued for operation of the Pawling Lattice Test Rig in the Critical Facility Building, dated February 25, 1960 (7).
   c. R-49, Amendment #2, Docket No. 50-101, issued for revisions in the operation of the Pawling Research Reactor and the Pawling Lattice Test Rig, dated July 13, 1961 (66).
   d. R-49, Amendment #3, issued for revision of the Pawling Lattice Test Rig experimental program, dated January 29, 1962 (7).
   e. NOTE: By June 1967, this License was revised again to permit 150 kg of U-235 in the Reactor Room of the Critical Facility Building (69).
7. United Nuclear Corporation to USAEC:
Application for a class 104 license authorizing Construction and operation of a Split Bed Critical Assembly in an addition to the Critical Facility Building, dated March 4, 1963; amended June 20 and August 20, 1963 (40).
8. USAEC to UNC:
Construction Permit No. CPCX-22, Docket No. 50-207, issued for construction of Split Bed Critical Assembly, dated October 30, 1963 (40).
9. UNC to USAEC:
Application for a Class 104 license authorizing con-construction and operation of Shield Mock-Up Reactor (SMR) Critical Assembly in an addition to the Critical Facility Building, dated March 4, 1963 (40).
10. USAEC to UNC:
Construction Permit No. CPRR-76, Docket No. 50-207, issued for construction of Shield Mock-Up Reactor dated October 30, 1963 (40).

C. LOW LEVEL RADIOACTIVE DISCHARGES

1. Nuclear Development Corporation of America (NDA) to New York State Department of Health (NYSDOH): "Application for the Approval of Plans and for a Permit to Discharge Refuse or Waste Matter from an Industrial Establishment into the Waters of the State", dated December 23, 1959; supplemented April 12 and September 23, 1960; for discharges from the Plutonium Facility (66).
2. NYSDOH to NDA: "Permit to Discharge Sewage or Wastes Into the Waters of the State" issued November 11, 1960 (5B).
3. NYSDOH to United Nuclear Corporation (UNC): "Permit to Discharge Sewage or Wastes Into the Waters of the State" issued January 11, 1962; supersedes #12 above and increased the permitted alpha activity limit (66).
4. UNC to US ARMY CORPS of ENGINEERS: "Application for Permit to Discharge or Work in Navigable Water and their Tributaries". dated June 30, 1971; for scrub water discharges from the Plutonium Facility (66).

D. SEWAGE TREATMENT

1. UNC to NYSDOH: "Application for Approval of Plans and/or for Permit to Construct and Operate Waste Treatment Works and to Discharge Wastes into the Waters of the State", dated January 5, 1967; sewage from the Plutonium Facility to a new sub-surface disposal system (66).
2. Dutchess County Department of Health to UNC: Approval of sewage disposal plans, dated February 2, 1967 (70).

E. SPECIAL NUCLEAR MATERIAL

1. United States Atomic Energy Commission (USAEC) to Nuclear Development Corporation of America: Special Nuclear Material License issued January 31, 1956 "to receive and possess" for storage only at the White Plains location, 500 grams of enriched uranium. Upon completion of the facility at Pawling, permission to proceed was to be issured. (71).
2. United Nuclear Corporation to USAEC: Application for Special Nuclear Material License, dated January 25, 1965, supplemented June 17, September 14, October 29, November 29, 1965, and January 14, May 25, July 11, and August 19, 1966 (72).

3. USAEC to UNC:
Special Nuclear Material License No. SNM-871 issued December 27, 1965 (72).
4. UNC to USAEC:
Request for revision of License SNM-871 for temporary Storage of increased amounts of U-235 and Pu-239 in the Critical Facility Building, dated November 29, 1965 (37).
5. UNC to USAEC:
Request for revision of license SNM-871 for an in the amount of U-235 and plutonium authorized to be stored in the Critical Facility, dated January 14, 1966 (73).
6. USAEC to UNC:
Special Nuclear Material License SNM-871, Amendment No. 3, issued September 1, 1966, changing authorized places of use and/or storage of U-235 and plutonium; locations are the Plutonium Lab, Gamma Lab, and Critical Facility (storage) (72).
7. USAEC to UNC:
Special Nuclear Material License No. SNM-993 issued January 16, 1967 ro 83.5 kg. of U-235 contained in UO_2 fuel rods for storage only in the Reactor Room of the Critical Facility; to expire on June 30, 1967 or upon amendment to Facility License R-49 (66).

NOTE: By June 1967, License SNM-871, Amendment NO. 4, was in effect and specified amounts authorized in the Critical Facility vault (storage only) and Critical Facility (PuBe sealed source) (69).

8. UNC to USAEC:
Request for revision of license SNM-871 for non-destructive assay operations in a shielded area to be added to the Plutonium Facility, dated October 7, 1970 (32).
9. UNC to USAEC:
Request for revision of license SNM-871, Docket No. 70-903, for six glove boxes and a continous sintering furnace in the Plutonium Facility, dated December 24, 1970 (33, 74).
10. GULF NUCLEAR FUELS COMPANY to US NUCLEAR REGULATORY COMMISSION:
Request for termination of Special Nuclear Material License #SNM-871, dated March 11, 1974 (75).
11. NUCLEAR REGULATORY COMMISSION to GENERAL ATOMIC COMPANY:
Termination of Special Nuclear Material License #SNM-871 and release of site for unrestricted use, dated July 14, 1975 (66, 75).

F. PROOF TEST FACILITY:

1. UNC to USAEC:
"Application for permission to consturct and operate the Proof Test Facility (PTF) within the Critical Facility Building, dated April 28, 1967; amended June 9, 1967 (76,77).

2. USAEC to UNC:
Construction Permit No. (missing), Docket No. 50-207, issued for construction of the Proof Test Facility, dated August 4, 1967 (78).
3. USAEC to UNC:
License CX-25 issued for Proof Test Facility; date and License are not available (42).

G. RADIOACTIVE MATERIALS LICENSE:

1. UNC to NEW YORK STATE DEPARTMENT OF LABOR (NYSDOL):
Application for Radioactive Materials License, dated March 29, 1963, pursuant to Industrial Code Rule No. 38, "Radiation Protection: (79).
2. NYSDOL to UNC:
Radioactive Materials License No. 289-1460 issued August 19, 1966; superceded License No. 289-0355, Reference No. 4 (79).
3. NEW YORK STATE DEPARTMENT OF LABOR to UNITED NUCLEAR CORPORATION:
Radioactive Materials License No. 289-1460, Reference No. 2, issued October 28, 1966; referenced only, revision is not available (79).

4. NYSDOL to UNC:
Radioactive Materials License No. 289-1460, Reference No. 2, Amendment No. 2, issued April 19, 1967 for use of Sr90, sealed source, not to exceed 1.5 millicuries (66).
5. NYSDOL to UNC:
Radioactive Materials License No. 289-1460, Reference No. 3, issued September 6, 1968 (80).

H. OTHER:

1. UNC to NEW YORK STATE DEPARTMENT OF CONSERVATION:
"Application for Fishing Preserve License", dated September 14, 1970 (66).

UNC MATERIALS USE

Table 7 is a revised summary of the various licenses authorrizing the use and storage of radioactive materials at UNC's Remote Experimental Station. The licenses were in effect in 1964 and were amended several times during the Corporations operating years. Detailed information relating to storage capabilities, form of storage use and handling may be found in Reference Nos., 69, 71, 72 and 73.

Table 7. UNC Radioactive Materials Use

A. Facility License No. R-49 (7)

Location	Material	Quantity
1. Critical Facility (Reactor Room)	Uranium 235	150 Kg.

B. Special Nuclear Material License No. SNM-871 (69)

Location	Material	Quantity
1. Plutonium Facility	Plutonium or Uranium 235	Pu = 30 Kg — U-235 + 4 Kg
2. Critical Facility Vault (Storage only)	Pu-Be Sealed Source	Pu 0.080 Kg

C. N.Y. State Radioactive Materials License No. 289-1460 (66)

Materials	Form	Quantity
1. Polonium 210	1. Sealed sources (Po-Be Mound Laboratory or Isotope Specialists Inc. Type)	1. 100 curies
2. Cobalt 60	2. Sealed sources (Atomic Energy of Canada, Ltd. and ORNL design)	2. 400 millicuries
3. Strontium 90	3. Sealed source (Jordan Electronics Co. Model)	3. 15 microcuries
4. Uranium, Natural	4. Any	4. 5000 kilograms (1.7 curies)
5. Thorium	5. Any	5. 20,000 grams (2.3 millicuries)
6. Hydrogen 3 (Tritium)	6. Any	6. 1 curie
7. Carbon 14	7. Any	7. 20 millicuries
8. Caesium 137	8. Any	8. 100 millicuries
9. Iron 59	9. Any	9. 20 curies
10. Strontium 90	10. Sealed Source	10. 1.5 millicurie
11. Promethium 147	11. Any	11. 15 microcuries
12. Chromium 51	12. Any	12. 20 curies
13. Tungsten 185	13. Any	13. 15 microcuries
14. Ruthenium 106	14. Any	14. 15 microcuries
15. Zirconium 95	15. Any	15. 300 curies
16. Phosphorus 32	16. Any	16. 5 curies
17. Iodine 131	17. Any	17. 30 curies
18. Gold 198	18. Any	18. 60 millicuries
19. Cobalt 60	19. Any	19. 10 millicuries
20. Cobalt 58	20. Any	20. 10 millicuries
21. Iridium 192	21. Any	21. 20 curies
22. Uranium, Depleted	22. Any	22. 5000 kilograms (1.7 curies)
23. Any radioactive material with atomic number between Z = 3 and Z = 83 inclusive	23. Unsealed solids	23. Not to exceed 100 curies of any radionuclide nor a total of 2000 curies
24. Kytpton 85	24. Gas	24. 10 curies
25. Xenon 133	25. Gas	25. 10 curies
26. Cobalt 58	26. Unsealed Solid	26.) Total not to exceed 20
27. Cobalt 60	27. Unsealed solid	27.) curies
28. Niobium 95	28. Unsealed solid	28.)
29. Tantalum 182	29. Unsealed solid	29.)
30. Zinc 65	30. Sealed source (Numec or Monsanto manufacture)	30. One (1) source of 32 millicuries One (1) source of 5 millicuries One (1) source of 1.5 millicuries Total - 38.5 millicuries

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3. UNC - Inter-Office memo; May 1, 1962.
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8. UNC-Development Division-NDA, NDA Pawling Hot Laboratory Operating Manual; revision of May 10, 1961.
9. H&S - 266; 8/13/65.
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11. Town of Beekman to Dut. Co. Dept. of Health; 3/5/56.
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15. Dut. Co. Dept. of Health to UNC; 2/2/67.
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21. H&S - 208; 2/28/63.
22. H&S - 245; 6/14/63.
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24. UNC-5175, Proof Test Facility (PTF) Safety Analysis Report; 4/28/67.
25. Dut. Co. Dept. of Health Inter-Office Memo; 6/24/60.
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29. H&S - 2460; 5/25/75.
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31. H&S - 313; 3/06/64.
32. UNC (H&S-2353) To USAEC; 10/07/70.
33. UNC (H&S-2395) To USAEC; 12/24/70.
34. NYS Dept. of Health; Inter-Office Memo; 10/06/58.
* 35. HSW - 121; 10/02/57.
36. H&S - 527; 9/10/65.
37. H&S - 564; 11/29/65.
38. USAEC, Docket No. 50-23 To NDA; Jan. 1957.
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41. H&S - 2285; 4/14/70.
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43. H&S - 2286; 4/16/70.
44. H&S - 1143; 10/15/68.
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47. HSP - 179; 01/17/58.

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50. H&S - 765; 2/20/67.
51. HSP - 152; 11/08/57.
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55. USAEC Directorate of Regulatory Operations; RO Inspection Report No. 70-903/74-01, 50-101/74-02, 50-270/74-02; 4/24/74.
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76. USAEC, Safety Evaluation By The Division Of Reactor Licensing In The Matter Of United Nuclear Corporation Proof Test Facility, Docket No. 50-290; (Date Missing).
77. UNC To USAEC; 6/09/67.
78. USAEC, Construction Permit (No. Missing) Docket No. 50-207; 8/04/67.
79. NYS Dept. of Labor To UNC, New York State "Radioactive Materials License No. 289-1460, Ref. No. 1; 8/19/66.
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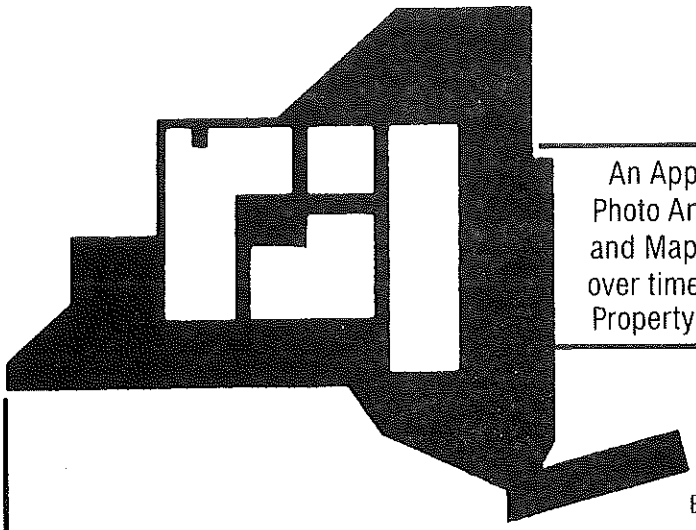
81. H&S - 803; 5/18/67.

* H&S, HSP, HSW and PS refer to Health and Safety Reports written by UNC personnel.

IV. Sequential Air-Photo Analysis



An Application of Sequential Air Photo Analysis to the Identification and Mapping of Land use Changes over time on the Nuclear Lake Property. Dutchess County, N.Y.

by
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December 17, 1980

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ITHACA, NEW YORK

Ernest E. Hardy, Director

INTRODUCTION

At the request of the Nuclear Lake Site Clearance Committee the Resource Information Laboratory undertook a project to prepare a series of map overlays illustrating the sequential changes in land use over time of the Nuclear Lake area in Dutchess County, using aerial photographs.

The following years of black and white aerial photographs were used in developing the documented history:

October 26, 1941	Scale 1:28,800
October 16, 1948	1:15,840
April 11, 1955	1:20,000
June 10, 1960	1:20,000
March 24, 1962	1:15,840
1966 (undated)	1:21,192
April 28, 1968	1:24,000
April 12, 1970	1:12,000
April 20, 1971	1:21,200
February 24, 1974	1:17,664

In addition to the use of photographs, supplementary background information was collected and incorporated into the analysis through auxiliary reports and personal conversations with members of the Site Clearance Committee.

While aerial photographs have received wide use since the 1930's it must be recognized that there are certain limitations to the kinds and extent of information which can be extracted. For example, air photo interpretation is not pure science; much inference based on photographic observations and known data enters into the decision-making process.

In addition, interpretation is totally dependent upon the quality of the available photography. Properties of film and camera and skill of the photographer are factors. Time of day and season of the year aid or inhibit interpretation through presence or absence of tree canopy, depth of shadow, and extent of light reflectance. Late fall or early spring, 10:00 a.m. to 2:00 p.m. on a cloudless day, provide the best possible conditions for optimum aerial photo quality as regards nature's input.

As far as this study is concerned, photographic observations recorded on map overlays and almost all the written documentation are based on photography of varying quality.

Hopefully this information when assessed carefully, will contribute significantly to a better understanding of the overall history and present condition of Nuclear Lake.

DESCRIPTION OF TECHNIQUE

Stereopairs of black and white aerial photography taken of Nuclear Lake and surrounding terrain, beginning in 1941 and ending in 1974, were analyzed for successive changes over that period of time. A two-power stereoviewer was used for general overview and a four-power stereoviewer for detailed analysis. Differentiation of activity, natural or man-made, is detected through changes in pattern, texture and tone.

Wetlands can be located and boundaries delineated using standard black and white prints. However, wetland boundaries are detected best with infrared photography which was not available.

Wetland vegetation on standard prints is reflected in mixtures of tones of gray, and in differences of texture and vegetative height. Differing vegetative heights are clearly discernible whether trees, shrubs, emergents, floating vegetation or bog mats. Textures generally are irregular because of the intermix of species within the wetland itself and/or in contrast with surrounding land cover.

At the same time that the imagery is reviewed and items identified, boundaries are traced and point items are marked in pencil directly on one of the stereopairs. All the information is therefore reserved directly on the photography ready for transfer to a map overlay.

Usually a collection of several years of photography of a given area over a period of time includes photography at several different scales. Each year of photography is accomodated to a single fixed scale, usually that of a base map. The use of the Bausch and Lomb Zoom Transfer Scope allows scale differences, photograph to base map, to be resolved mechanically. The adjusted image on the photograph is reflected onto the overlay placed over the base map. Detail is then traced directly onto the overlay.

In the Nuclear Lake study, ten years of photography were analyzed. A set of ten overlays were produced on a base map at the scale of 1:7,200 or 1"=600'. The overlays paired with the documentation provide a history of the development of the UNC property over a 33 year time span.

GLOSSARY

Dam — as defined by secondary data

Depression — a unique characteristic denoting a hollow

Disposal pit — as defined by secondary data

Forest land — Fn. These are natural stands having at least 50 percent or more of the land covered, with trees in excess of 30 feet in height, regardless of age, species, or diameter. The natural progression from **Fc** is to **Fn.** It is therefore often difficult to consistently identify an accurate boundary between these two units. (As defined by the N.Y.S. LUNR INVENTORY.)

Rubble, rubbly — A miscellaneous confused mass or group of broken or worthless things. (As defined by Webster's New Collegiate Dictionary.)

Streams — perennial: contain water throughout the year except for infrequent periods of severe drought.
— intermittent: contain water only part of the year

Vegetated — vegetation established in or on (As defined by Webster's New Collegiate Dictionary.)

Wetlands — Two basic categories of wetlands are used, condensing the several types of inland and coastal wetlands that could be defined. (See the wetlands survey of New York State by the Fish and Wildlife Service of the U.S. Department of the Interior.) For the most part, wetlands are confined to relatively level lands and may cross only one contour line in 1000 feet. However, some may be found on slopes where, due to rock structure or underlying clay hardpan, the surface soils are perennialy wet and soggy. In either case, wetlands may have varying water levels and should not be thought of as just "swamps."

Due to the spring photography from which wetlands were mapped, clear distinction could not be made between those areas seasonally wet and those permanently wet. As a result, for some purposes, the amount of wetlands mapped may be considered somewhat exaggerated.

Some examples are:

Wb — Marshes, shrub wetlands, and bogs. These are areas ranging from those waterlogged but with no standing water to those with as much as 3 feet of water. Vegetation is predominantly shrub-size and smaller and trees do not exceed 30 feet in height. The vegetative cover corresponds to the definition of brushland, **Fc.** The area, however, is a wetland area.

Ww — Wooded wetlands. Distinction between **Wb** and **Ww** is made on the basis of vegetative cover. **Ww** is covered by trees at least 30 feet in height — corresponding to the definition of **Fn.** The area may be waterlogged with no standing water or may have standing water of varying depth.

AIR PHOTO INTERPRETATION *(For a summary of 10 years of air photo interpretation, see Tables 8 and 9.)*

1. October 26, 1941 — Sunday
Map #1 (See Figure IV-1)
Scale of Photography: 1:28, 800

The photography is somewhat blurred so the imagery does not stand out clearly. The study area is thickly wooded with deciduous trees predominating and the fall photography shows the trees still in full leaf although changing color. Stream flow patterns, narrow roads, trails , and changes in topography tend to be lost under the trees.

This photography shows the future Nuclear Lake as a large wooded wetland located within hilly, irregular terrain, part of a series of wetlands interconnected by a network of streams. This particular wetland typically reveals its boundary through contrast of darker gray tones and vegetative texture to the lighter gray tones and vegetative texture of the surrounding terrain. Four finger-like indentations along the west boundary at "a" display subtle differences of lighter tone and texture suggesting conditions here are different from the main body of the wetland and surrounding terrain. The northern portion of the wetland at "b" has a similar appearance. This suggests higher, drier conditions along the shoreline here and that the wetland drains generally toward its central section and empties out the most southerly point at "c". Some dissection by small channels along the western shore is present at "d". One such channel connects the main wetland with one of the finger-like indentations.

During dry periods it appears that vehicular traffic was possible through the NW corner of the wetlands, as a portion of what appears to be an undeveloped narrow road is clearly visible cutting across this corner.

Other streams flow directly into the main wetland. One stream is clearly visible as it crosses the wetland in a southwesterly direction. Other runoff occurs from hillsides surrounding the site. Generally all stream flow is in a southerly direction through interconnected wetlands eventually joining Whaley Lake Stream. Whaley Lake Stream flows westward to Gardner Hollow Brook combining with Fishkill Creek.

Narrow dirt roads access the area from the north and the south.

Structures present on both sides of the property access road and along Route 55, appear to be residential.

2. October 16, 1948 — Saturday
Map #2 (See Figure IV-2)
Scale of Photography: 1:15, 840

The quality of photography is good, but again, dense tree canopy prohibits thorough analysis of drainage patterns, narrow rods, trails, and wetland edges. However, the angle of photography allows the west shoreline, north shoreline and damsite at "e" excellent exposure. Trees and tree shadows obscure sections of remaining shoreline and such delineations may not be reliable. Further, finish

on the photograph will not accept pencil, making detailed delineation impossible.

A dam at "e" has been constructed on the southern end of the site wetland obstructing the natural outlet. Wetland vegetation has disappeared under water except for a small island and two other small vegetated spots. According to available background information, the dam was constructed sometime between March 1946, when application was made to the Department of Public Works for permission for construction, and October 1948, date of photography.

According to reports, there is a small "lock-type" dam on the overflow channel which is used to raise or lower the level of the lake by three or four feet. The photography shows the main dam clearly at "e", but the overflow channel and lock-type dam is lost beneath heavy tree canopy.

The lake formed by the dam has almost completely covered the entire wetland area as seen previously on the 1941 photography.

Wetland indentations at "a" have all but disappeared and have filled in with thick, tall vegetation; only a remnant remains. Marshy beach is present along the north shore with some deposits of debris, possibly decaying wetland vegetation. Otherwise wooded shoreline meets waterline directly.

Structures along the property access road remain as before. Three more residences have been added along Route 55.

3. April 11, 1955 — Monday
Map = 3 (See Figure IV-3)
Scale of Photography: 1:20,000

Stereopairs are not available for 1955. Analysis is based on single photos and whatever stereo properties can be obtained using two unpaired photos from two separate flight lines.The season of photography is early spring. Trees have not yet leafed out. Although stereo imagery is limited, some details such as the dam, control structure, hunting lodge, stream patterns and access road stand out clearly.

The water level in the lake is higher because the marsh formerly present along the northern shoreline has disappeared and is now under the water of the lake.

The cove at "d" appears to have developed through channel erosion and changes in lake level.

Wetlands are still present as before, but some identifed earlier have dried up, become smaller or changed configuration. A wetland has developed below the dam at "e".

Two structures are present along the western shoreline approximately a fourth of the distance up the lake from the dam. One of these structures appears to be the hunting lodge (la.) mentioned in the draft report, Nuclear Lake -- A Resource in Question, March 12, 1980. The structure north of the

lodge on the edge of the lake (1b), by its location and smaller size suggests it functions as a boathouse.

The narrow dirt access road is present as before in 1941 and 1948. Other trails are faintly detectable and are probably no more than footpaths.

Trails are detected by breaks in vegetation and loose soil reflecting to camera angle. Trails or segments of trails are not visible consistently on each year of photography analyzed. They may have been abandoned long enough to have lost camera reflectance. The sun angle at the moment of exposure may expose a trail that existed all along, but during previous photographing was hidden in shadow. A trail abandoned long enough will tend to fill in with brush or become covered over with canopy from adjacent vegetation.

4. June 10, 1960 — Friday
Map = 4 (See Figure IV-4)
Scale: 1:20,000

The quality of the photography is good. However, June photography shows the trees well leafed out covering much of the ground detail. Shadows fall to the west and are quite pronounced, eliminating from view anything within the shadow range. Fortunately, the west shoreline is well exposed.

The Remote Experimental Station (UNC) complex has been constructed and is composed of six main structures:

Site 1. a. Lodge
b. Boathouse
Site 2. Plutonium Lab.
Site 3. Critical Experimental Facility
Site 4. Engineering Facility (Shop)
Site 5. Multiple Failure Building
Site 6. Shield Mock-up Building

Also present within the complex grounds are:

Site 7. Small clearing
Site 8. Storage building
Site 9. Main parking lot
Site 10. Emergency generator

Present along the main access road just off Route 55:

Site 11. Remote Assembly Building

All site structures are displayed well within cleared areas. The cleared areas adjacent to the Plutonium Lab and the Remote Assembly Building are larger compared to the clearings around the other buildings and probably are reserved for parking area.

The Plutonium Lab at Site #2 has five distinct segments with correspondingly different flat roof levels; the Critical Experimental Facility at Site #3 has two segments with two flat roof levels; the Engineering Building at Site $4 has one segment with one flat roof; the two remaining buildings within the main complex, Multiple Failure Building at Site #5 and Mock-up Building at Site #6, are composed of one segment each with pitched roof.

There is an object within the clearing at Site #7, but tree shadow prevents a well exposed view. The little that can be seen is rectangular more than square, larger and taller than a car.

At Site #8, only the waste storage building is visible; if the storage pit is there, it is hidden under tree canopy. (Reference to back-up information.)

The generator is visible at Site #10.

The Lodge is shielded by tree canopy, but the boathouse is well exposed at water's edge and traffic patterns, which are quite pronounced here, indicate this area is well used.

The main access road from Route 55 has been improved up to a point just before entering complex. From this point the road appears to narrow. Traffic patterns within the complex are present but appear unimproved.

An indistinct trail is inferred by detection of a break through the trees and glimpses of the trail on the ground through the break where lack of shadows and presence of reflectance permit. It begins on the northern edge of the complex at the lake's western shore and just touches the clearing at Site #7. Continuing on southerly in a wide loop around the main complex, it joins the access road approximately where it enters the complex. This trail may be the fire lane mentioned in company records. Not enough of the trail itself is visible to determine its width. Segments of other trails are visible and inferred on the same basis. More trails may be present but not enough visual evidence is present to justify inclusion.

There is a depression adjacent to and south of the Multiple Failure Building at Site #5 which may have been created by moving earth around during construction activity. The tones are varied shades of light gray which indicates recent disturbance.

The structures present as the Remote Assembly Building at Site #11 appear to be the original structures constructed at that site. They are at the same locations and do not appear to be newly constructed. The second structure present probably is a garage or storage building.

Small depressions are visible in areas where wetlands were present before. Tree canopy and shadow do not allow a delineation of precise boundaries or detection of degree of wetness. A small wetland has dveloped between Plutonium Facility at Site #2 and shoreline. It may be a reappearance of a remnant of the original wetland indentation.

Tree canopy covers the stream pattern well, eliminating any possibility of accurate study. The western shoreline shows some minor fill-in.

5. March 24, 1962 — Sunday
Map = 5 (See Figure IV-5)
Scale of Photography: 1:15, 840

The lake is frozen, but thawed at outlet near dam. There is light snow cover which is detectable in depressions and on north-facing slopes. Streams, wetlands and ponds are thawed. Shoreline is well exposed. Tree canopy does not hinder analysis of activity, shadows present minor problems, and photographic quality is excellent. Drainage patterns are well established as mapped. A major highway construction project is underway along the south border of the property.

From this point on in documentation, each site as numbered will be dealt with in numerical sequence, year by year, after a general description.

1. **Lodge** is visible
2. No detectable change in **Plutonium Facility** itself, but the small wetland present in 1960 is no longer visible, suggesting it has been filled. The land surface at this location is bare of vegetation; the dulled gray tone shows soil has settled and compacted somewhat. Two or three vehicles are in the parking lot.
3. The fence around the **Critical Facility** is visible; a small parking area is visible bordered along its eastern edge by a small pond. A footpath connects this facility to the main parking area. There is a tank on the roof with a connecting pipe and two other barely detectable objects, possibly vents. A **gate** is visible at the beginning of the driveway to this building.
5. **Loose material** present west of building and downslope behind **Multiple Failure Building** (See 12, Map #5) gives land surface here a "rubbly" look.
6. The land surface along the western edge of this clearing is disturbed. One spot, somewhat rounded & slightly concave appears as though the land surface here in relation to the surrounding area is to some extent sunken compacted. Other **depressions** or **pits** may also be present along this clearing but they are not readily detectable.
7. Reports indicate that this **clearing** contains a **cement slab;** the structure present here is the **Sodium Tent.** All the land surface in the clearing appears disturbed loose surface material responds to the camera in very light tones. A trail from the complex crosses the clearing along its eastern edge and continues uphill to the north.
8. The **Retention Tank** is just visible west of the **Waste Storage Building** at the edge of a shadow. Loose material is visible behind the Waste Storage Building down the unvegetated bank to the edge of the lake.
9. **Main Parking lot** — undefined; doesn't appear to have a hard surface as yet.
10. No Detectable Change.
11. The **Remote Assembly Building** appears to be the original structure present in 1941 along the second smaller structure behind it — probably a garage or storage building. The power line clearing is north of the main structure.A small excavation is present in the power line clearing.
12. A large **man-made depression** is visible here composed of loose material; there is no vegetation and water is ponded in the lowest part.

6. 1966 — (Photographs Undated)
Map #6 (See Figure IV-6)
Scale of Photography[0] 1:21, 192

1. No Detectable Change - except for 2 vehicles parked in circular drive.
2. No Detectable Change
3. Ponded area adjacent to clearing has become smaller in area and is almost dry.
4. No Detectable Change
5. No Detectable Change
6. No Detectable Change
7. No Detectable Change
8. No Detectable Change
9. Parking lot has been enlarged and defined. Several vehicles present (4-5)
10. No Detectable Change
11. Excavation in clearing has been covered over. It is still, however, detectable as a depression, having darker tone than surrounding area indicates some settling of soil. No vegetation is detectable. One vehicle can be seen near the main structure.
12. Some settling of loose material is evident; vegetation has begun to appear and the pond present before appears smaller.

7. April 28, 1968 — Sunday
Map #7 (See Figure IV-7)
Scale of Photography: 1:24,000

1. No Detectable Change - except for development of a small wetland just below the south side of the lodge at ''la''.
2. The Plutonium Facility has expanded at its southwest corner. A single story addition has been constructed. Another section of the original structure at the northeast corner has been enlarged. A section at the southeast corner has been removed.
3. No Detectable Change.
4. Small objects about the size of 55 gallon barrels are present at edge of clearing in front of Engineering Facility at ''B''.
5. Several rectangular objects at least the size of cars are stacked in front of the Multiple Failure Building at the edge of the clearing; small objects the size of barrels can be seen upslope and slightly west of building at ''B''.
6. The pit seen in 1962 photos is still detectable. Lack of vegetation in this vicinity may indicate presence of other pits.
7. No Detectable Change.
8. Two objects smaller than the 6ft. diameter of the Retention Tank are present near the tank at ''B''. Loose material evidenced by light tones and no vegetation is present down the bank behind the Storage Building. This unconsolidated material has been seen on previous photos.

8. April 12, 1970 — Sunday
Map #8 (See Figure IV-8)
Scale of Photography: 1:12,000

1. No Detectable Change.
2. No Detectable Change.
3. No Detectable Change.
4. There are 3 or 4 small miscellaneouus objects under the trees at the edge of clearing in front of Engineering Facility about the size of 55 gallon barrels.
5. The number of rectangular objects stacked at this location have increased. The small objects unslope are still present.
6. Piles of material of different sizes and shapes are present within the clearing around the Mock-Up Building. Depression seen on earlier photo is no longer detectable. The land surface west of building is unvegetated.
7. The clearing around Sodium Tent displays light tones with darker mottling, indicating presence of loose material.
8. At least 3 objects resembling barrels, smaller than Retention Tank, are present at "B". A small depression has appeared in the embankment just below Storage Building. The bank continues to be unvegetated.
9. Light tones and no vegetation indicates a fill-in of a depressed area west of the parking lot addition at "P".
10. No Detectable Change.
11. No Detectable Change.
12. Vegetation has grown on the slope of the depression and the pond is showing some vegetation.

9. April 20, 1971 — Tuesday
Map #9, (See Figure IV-9)
Scale of Photography: 1:21, 200

1. The boathouse is no longer present, although activity in the vicinity of the boathouse has continued.
2. A new addition to the Plutonium Facility has been constructed at the southeast corner.
3. The pond adjacent to the clearing used as a small parking area is no longer present.
4. No Detectable Change.
5. No Detectable Change.
6. Miscellaneous debris is detectable in the clearing and the land surface east of building is unvegetated indicating some type of recent disturbance.
7. The Sodium Tent is visible as a dulled gray toned spot. This may indicate the tent has been removed and only the platform remains. The general tone of the clearing has changed, become darker and duller, indication that the activity here has also changed, possibly demonstrating a lack of activity.
8. Objects identified on earlier photos are no longer present. The small depression is no longer detectable and loose material is present on the slope. As before, vegetation is not growing on this slope.
9. Several vehicles are present.
10. N Detectable Change.
11. No Detectable change.
12. The pond and/or wetland are no longer present. The slope and depression are well vegetated.

10. February 24, 1974 — Sunday
Map #10 (See Figure IV-10)
Scale of Photography: 1:17,6664

1. What appears to be miscellaneous debris is present down the bank near the location of the former boathouse and in the former wetland below lodge.
2. Miscellaneous objects in a pile are visible just north of building evidenced by a mix of very light tones (relfectance of objects) with very dark tones (shadows of objects). Detection is inconclusive here because of the shadow of the building. There is a pronounced lack of vegetation at the NE corner of building similar in location to that detected on '62 photography, indicating recently disturbed land surface.
3. No Detectable Change.
4. No Detectable Change.
5. No Detectable Change
6. The clearing adjacent to the building appears clear of debris except for under bordering trees. A depression not seen on previous photos is present at edge of clearing. The land surface around it appears disturbed. Two trails lead from clearing down the slope to the lake.
7. The clearing at this location appears somewhat vegetated. An object is still visible here - it may be part of former stucture.
8. The bank shows vegetation not visible before. The pit is still present as in 1970.
9. No Detectable Change.
10. No Detectable Change
11. No Detectable Change.
12. No Detectable Change.
13. A small amount of miscellaneous debris is present below the dam.

NOTE: For a summary of air phot interpretation data on all 10 years of photography, see the matrices Tables 8 and 9.

Table 8. Air Photo Interpretation **General Data Summary Matrix** for 10 years of Photography.

	Map #1 October 26, 1941 Sunday	**Map #2 October 16, 1948 Saturday**	**Map #3 April 11, 1955 Monday**	**Map #4 June 19, 1960**	**Map #5 March 24, 1962 Sunday**	
Photo Quality and Limitations	Scale 1:28,800 Photos slightly blurred Dense tree canopy limits display of ground patterns. Back-up data used.	Scale 1:15,840 Photo quality good. Dense tree canopy (as above)	Scale 1:20,000 No stereopairs available Two dimensional detail good. No leaf cover. Lack of good stereo imagery limits extent of analysis.	Scale 1:20,000 Photo quality good. Dense tree canopy (as above). Pronounced shadows. West shoreline well exposed for reasons cited in Map #2.	Scale 1:15,840 Photo quality excellent. No tree canopy. Minor shadow problems. Small amounts of snow in depressions and on north facing slopes. (Note: This is the best photograph to date.)	
Property in General	Hilly, irregular terrain deciduous cover predominant. Series of interconnected wetlands. Structures at "11" are present.	One large wetland now a lake. Smaller wetlands W of lake, present area heavily wooded.	Area heavily wooded. Some wetlands have disappeared, become smaller or changed shape. New wetland S of dam.	UNC complex constructed. Clearing around bldgs. Wetlands in complex appear as disappears.	Fencing, gates and other development within main complex. Remainder of property is unchanged. Power line cut passes N of buildings at #11. Highway construction S edge of property.	
Lake Site	Appears as a large wetland. Shoreline indented in 4 places, different tones & textures here suggest higher-drier wetland conditions. Area on N portion shows similar characteristics. Small section of W shoreline dissected by small streams at "d".	Lake and dam at "e" retain water covering most of large wetland. One wooded island present. Shoreline indentations at "a" has disappeared. Small marshy areas with deposits of debris present along N shore. Tree growth is generally up to lake edge. Lake covers stream bed on east.	Water level in lake higher. Lake expanded in size; marsh along N shoreline now part of lake. A cove at "d" is created by erosion and changes in lake level. No sign of former SW streambed.	W shoreline shows minor filling in. New small wet spot between bldg. at #2 and lake.		
Road-Trails	Narrow dirt roads enter site from N and S. Road along W shore crosses NW corner of future lake.	Narrow dirt road remains as above; road across former wetland corner now under water. A segment of a trail is visible.	Narrow dirt road remains as above. Other faintly detectable **trails*** are probably footpaths; width not determinable.	Main access road has been improved from Rt. 55 N to complex; Inimproved roadways within complex. Indistrict trail, possibly the fire lane borders the complex. Segments of other trails visible;	Parking area expanded. Paths within complex present. New trail from bldg. at #4 to lake. Trail from complex - N present	
Drainage Pattern	Interconnected Perennial streams generally run N to S.	Dam construction at "e" caused changes in wetland. Streams on site not mapplble due to heavy tree canopy.	Pre-lade NE to SW stream gone. Stream present in SW wetland flows under Rt. 55. Mappable observations for stream SE of Lake Site.	Obscured	Drainage patterns well established as cited above (Map #3). New Rt. 55 and culvert constructed.	
Precipitation (Inches)**	Aug: 2.39 Sept: .87 Year: 27:17	Aug: 2.35 Sept: .78 Year: 50:50	Feb: 3.00 Mar: 4.30 Year: 50.90	Apr: 3.38 May: 3.32 Year: 39:41	Jan: 3.21 Feb: 4.66 Year: 37.55	

***Trails may not be visible in each year of photography because of photgraphic limitations.**

****Source: U.S. Environmental Data Service Climatological Data, New York.**

	Map #6 1966	Map #7 April 28, 1968 Sunday	Map #8 April 12, 1970 Sunday	Map #9 April 20, 1971 Tuesday	Map #10 February 24, 1974 Sunday
	Scale 1:21,192 Photo undated. Photo quality fair. Season is early spring or late fall with no leaf cover. Little shadow problem.	Scale 1:24,000 Photo quality good. Light canopy. Terrain visible.	Scale 1:12,000 Photo quality excellent. No tree canopy.	Scale 1:21,200 Photo quality fair. No tree canopy. Finish on print will not accept pencil.	Scale 1:17,664 Photo quality excellent No tree canopy. Finish on print will not accept pencil.
	Property remains unchanged. Highway construction completed. Gate leading to critical facility not seen.	Property in general remains unchanged. Gate appears on road leading to main complex.	Property in general remains unchanged.	Property in general remains unchanged.	Property in general remains unchanged.
	Lake has charged configuration especially at the NE corner & E edge, where stream enters lake. An island appears on the W.	Main island is slightly smaller. Shoreline on S appears altered; Another island may be developing. '66 island on W shows shallow connection to shoreline.	Major island remains smaller as in '68. Shoreline on S shows more indentation. Cove area changed in shape.	Slight shoreline changes along S edge of lake. Cove in E shoreline has decreased slightly in size & changed shape. "Island" off W shore is again a peninsula.	Season is late winter. Lake is frozen; partially thawed along the shore & around island. Shoreline again shows changes.
	Trails through woods present as mapped. Trail from complex - N connects with another intersecting a stream N and edge of lake S.	Trail from complex - N well established. Segment extend trail farther N. Two new walkways N&S of building #2 to edge of lake. Other trails present	Roads and most trails previously cited present. Walkways N&S of bldg. #2 not detectable. Trail S of lake extends E uphill, turns S, descends to a small wet depression.	Roads show no change. Observable trails mapped.	Access road has deteriorated needs repair. Observable traisl mapped.
	Wetland along access road narrow part is a pond. Other drainage patterns well established.	Wetlands W of lake larger than in '66. Wetlands along access road has enlarged, pond is gone. Drainage disrupted by road construction is establishing a new pattern.	Drainage patterns in general as previously cited. Small wetland S of dam reappears. Wetland along access road is slightly smaller; stream visible; ponding has reoccured.	Drainage patterns in general continue as previosly cited.	Drainage patterns continue as previously cited.
	Undated Photo Year: 51.6	Feb: .83 Mar: 3.48 Year: 40.06	Feb: 2.83 Mar: 1.85 Year: 32.59	Feb: 3.58 Mar: 3.05 Year: 46.11	Dec: 8.65 Jan: 4:20 Year: 43.95

Table 9. Air Photo Interpretation **Site Specific Data Matrix** for 10 years of Photography on 12 selected sites.

	Site #1 Lodge/Boathouse	Site #2 Plutonium Lab	Site#3 - Critical Experiment Facility	Site #4 Engineering Facility	Site #5 — Multiple Failure Bldg.	Site #6 Mock-Up Bldg.	
1941							
1948							
1955	"Hunting Lodge" and "Boathouse" constructed at the SE lake shore.						
1960	Lodge hidden under trees. Boathouse visible. Site well trafficed.	Facility has been constructed. Five-segmented building, each with a flat roof. Small wet spot between building and lake. Minor filling along west shore of lake.	Facility has been constructed. A two-segment building, each with flat roof.	Facility has been constructed. One-segment building with a flat roof.	Bldg. has been constructed. One-segment bldg. with a pitched roof.	Bldg. has been constructed. One segment bldg. with a pitched roof.	
1962	Same	Small wet spot is gone. Surrounding area bare of vegetation. Soil has settled and compacted.	Fence erected on the site. Small parking area front of bldg. Small pond is east of parking area. Pathway to main parking lot appears. Tank and pipes on roof. Gate is at driveway entrance.	Objects of various sizes north side of bldg. Trail north of bldg. to shore of lake.	Loose material west of bldg. and downslope behind bldg.	Land surface western edge of clearing disturbed. A "pit-like" depression is barely visible.	
1966	Same	Same	Pond smaller & nearly dry. Gate no longer visible.	Same	Same	Same	
1968	Small wet spot appears below the lodge.	Building additions added along SW & NE sides of lab. A section at SW corner has been removed.	Same	Barrel-size objects are near bldg.	Rectangular car-sized objects stacked in front of bldg.	Depression is still visible. Other areas unvegetated, may indicate presence of other pits.	
1970	Same	Same	Same	3-4 misc. barrel-size objects at edge of site.	Barrel-size object west of bldg. Smaller objects still visible.	Piles of objects of misc. sizes & shapes visible. Pit-like depression has disappeared. Vegetation missing east of bldg.	
1971	Boathouse is gone. Site still in active use.	Building addition added at SE corner.	The pond is gone.	Misc. objects are no longer detectable.	Same	Misc. debris in clearing east of bldg.	
1974	Misc. debris visible near boathouse and in former wet spot below lodge.	Misc. objects piled north of building. Vegetation missing at the same location (NE corner) as in '62	Same	Same	Same	Debris removed from clearing. A depression visible at edge of clearing. Two footpaths from clearing lead to lake.	

	Site #7 Small Clearing	Site #8 Waste Storage Bldg.	Site #9 Main Parking Lot	Site #10 Emergency Generator	Site #11 - Remote Assembly Bldg.	Site #12 Depression
					House/Garage is visible at Rt. 55.	
					Same	
					Same	
	Rectangular object larger than a car visible.	Bldg. is visible.	A cleared area is visible adjacent to the Plutonium Lab, unimproved.	Generator is visible near driveway to Site #3	Large clearing around bldg.	Depression is located behind bldg. at Site#5, possibly created during construction.
	Structure present is the Sodium Tent.* Land surface in clearing is disturbed. *Referred to in secondary data sources.	Retention tank is visible. Loose material behind the storage bldg down the bank to the edge of the lake.	Same	Same	The clearing and excavation north of bldg's. are associated with power line construction.	Loose material is visible. Ponding has occurred in deepest part of depression.
	Same	Same	The cleared area is enlarged and more defined.	Same	Excavation is covered over, clearing still bare of vegetation.	Some vegetation has established. The pond is smaller.
	Same	Same, plus: Two small objects are near the retention tank.	The parking area has expanded to the west, across the road. Walkways are well defined.	Same	A trail, probably a footpath, leads from clearing north into woods.	Loose material is stil visible. The pond is slightly larger.
	Same	Three barrel-size objects near tank. Small pit in embankment below tank. Loose material is visible as before.	Fill is visible west of newer parking lot.	Same	Same	Depression no longer visible. More vegetation established. Pond shows vegetation.
	Site shows lack of use. Tent structure may have been removed.	Barrel-size objects gone. Loose material visible & the slope continues bare. Pit-like depression not visible.	Same	Same	Same	The pond is gone; The area appears vegetated.
	Area shows vegetation. Some object still visible - may be part of former structure. No longer a cleared area.	The slope shows some vegetation. The pit in embankment is visible again.	Same	Same	Same	Same

LEGEND

Map Legend to be used with Air Photo Interpretation Maps Nos. 1-10 (Figures IV-1 to IV-10)

- Land Use Boundary
- Roads - improved
- - unimproved
- Trails
- Buildings
- Small Structures
- Abandoned (a)
- Parking Lot
- Gate
- Fence
- Powerline Right-of-Way
- Disposal Pit/Retention Tank
- Barrels B
- Dam
- Cleared Areas C_L
- Natural Forest Cover F_n
- Streams - perennial
- - intermittent
- Wetlands - perennial
- - intermittent
- Wet Spots
- Shoreline
- Shallow Areas
- Water W
- Depression
- Identifier (1)
- **Pit-Like Depressions**

Figure IV-1 - October 26, 1941 Aerial Photographic Interpretation Map of The Nuclear Lake Property

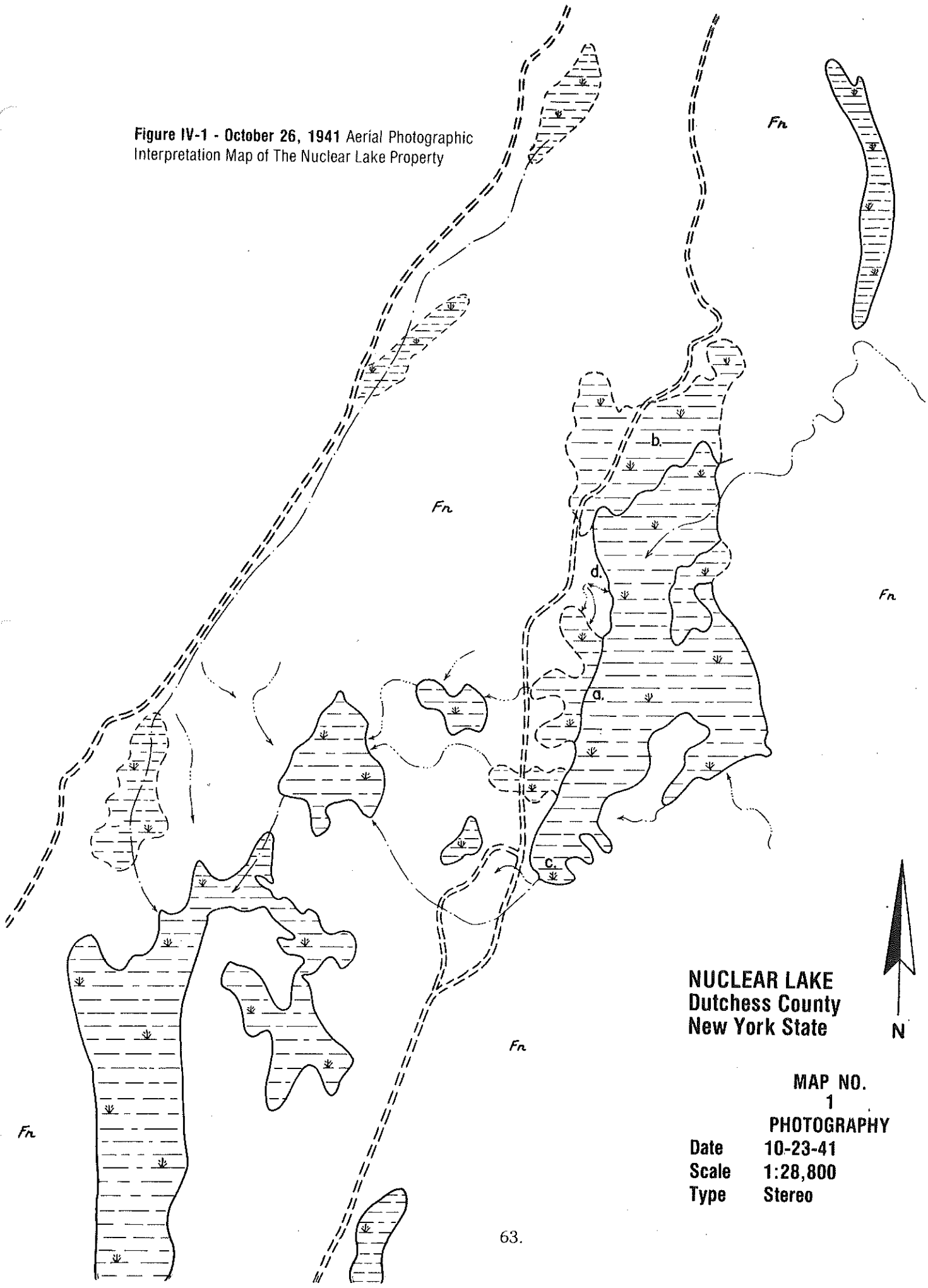


Figure IV-2 - October 16, 1948 Aerial Photographic Interpretation Map of The Nuclear Lake Property

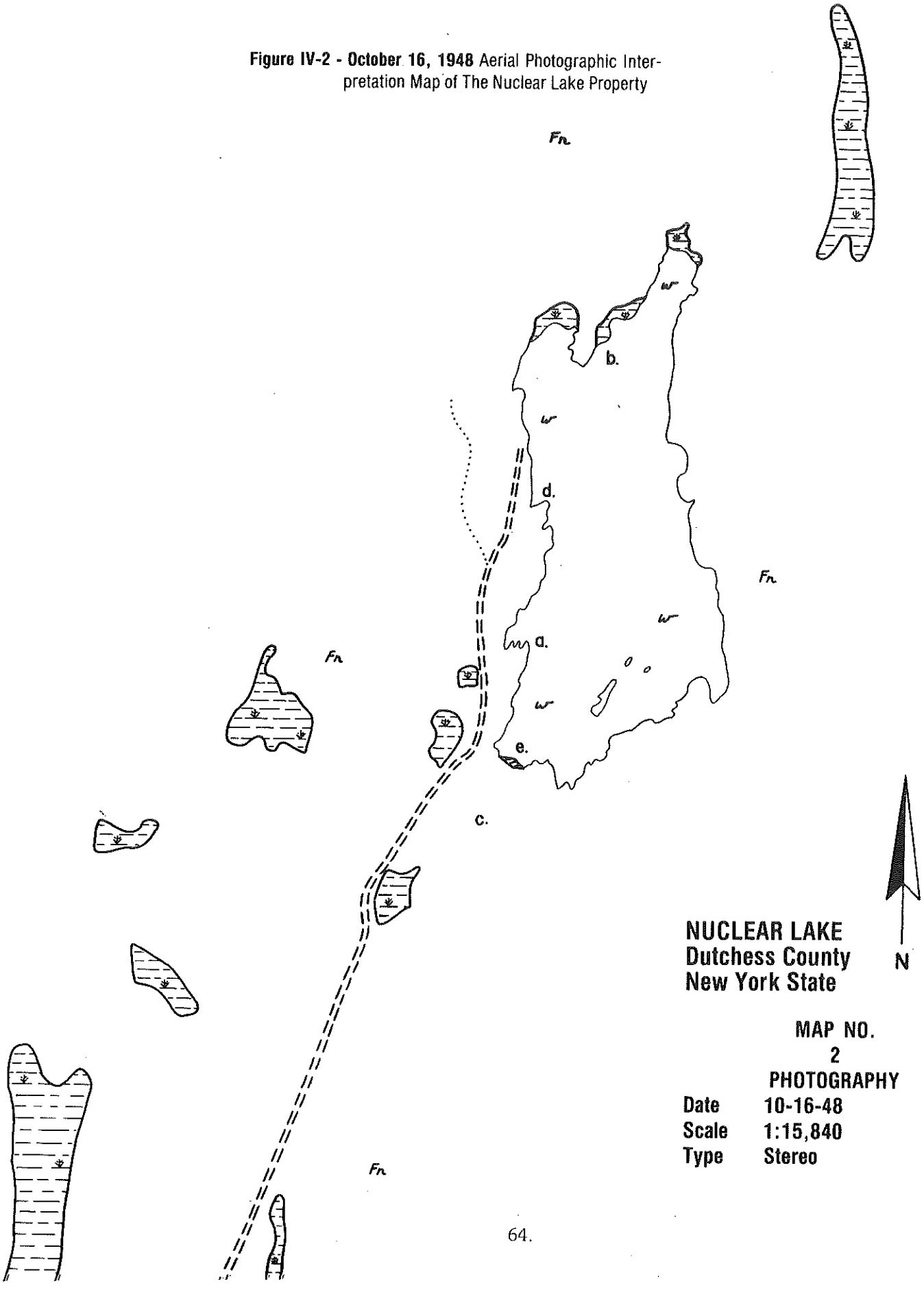


Figure IV-3 - April 11, 1955 Aerial Photographic Interpretation Map of The Nuclear Lake Property

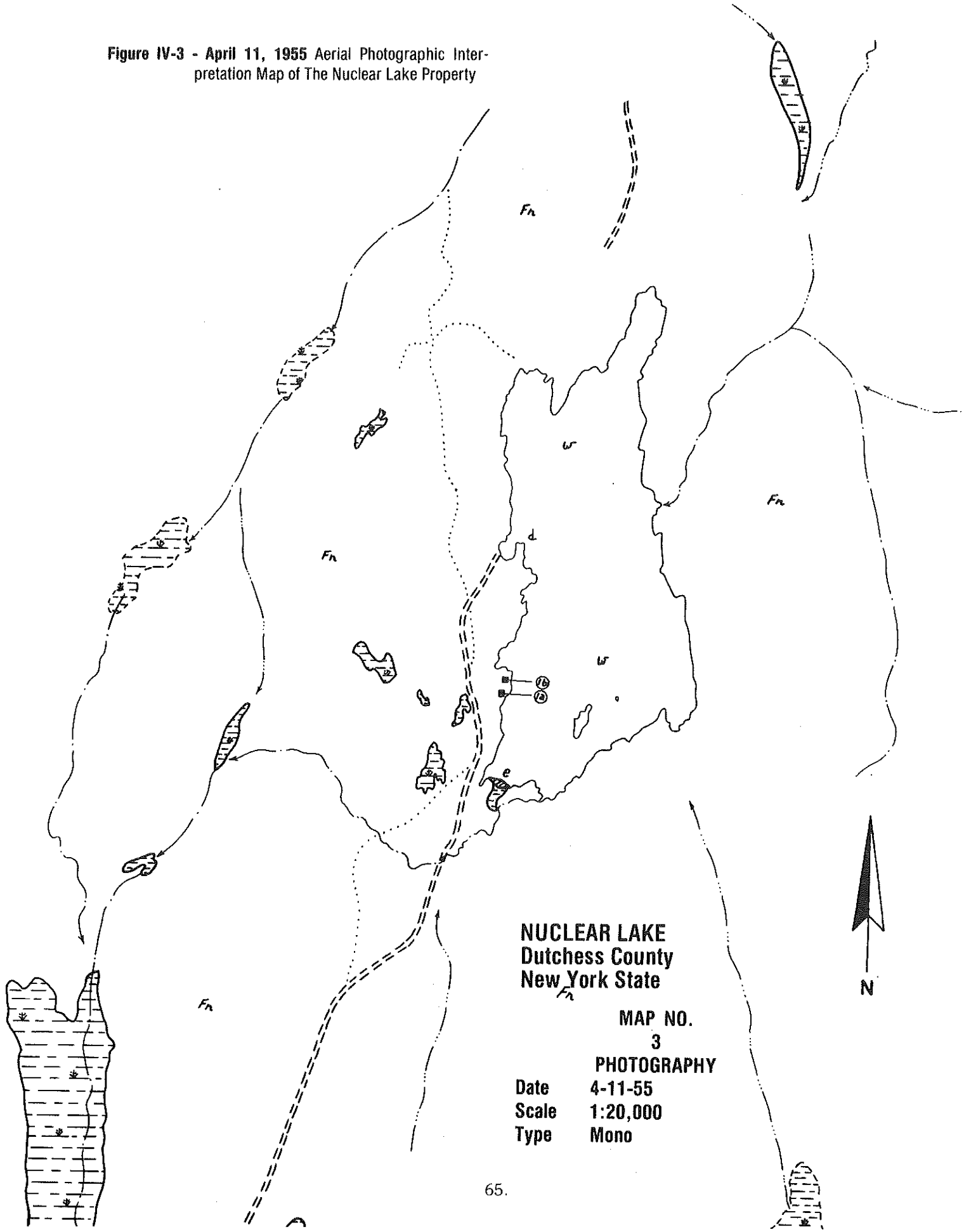


Figure IV-4 - June 10, 1960 Aerial Photographic Interpretation Map of The Nuclear Lake Property

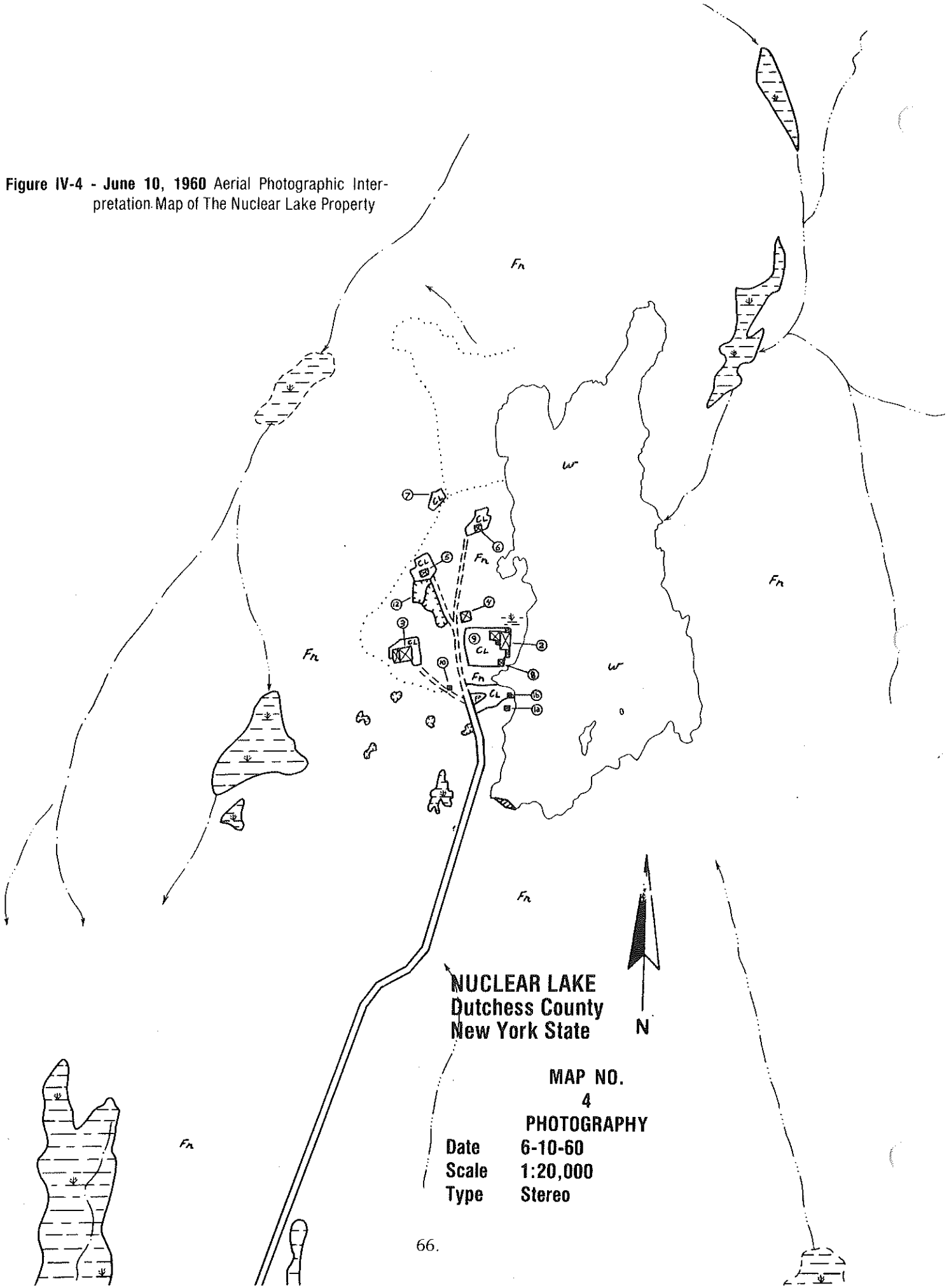


Figure IV-5 - March 24, 1962 Aerial Photographic Interpretation Map of The Nuclear Lake Property

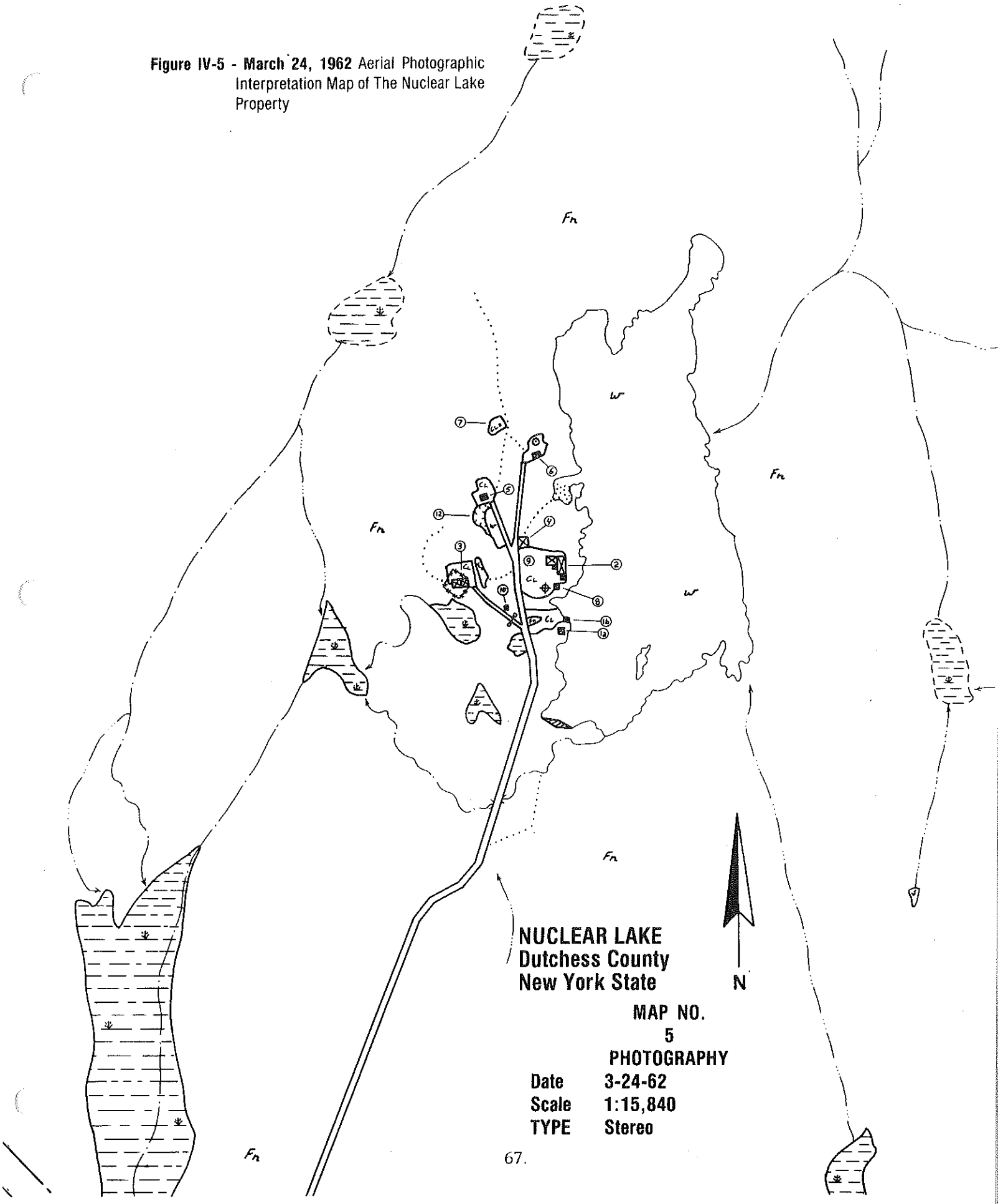


Figure IV-6 - 1966 Aerial Photographic Interpretation Map of The Nuclear Lake Property

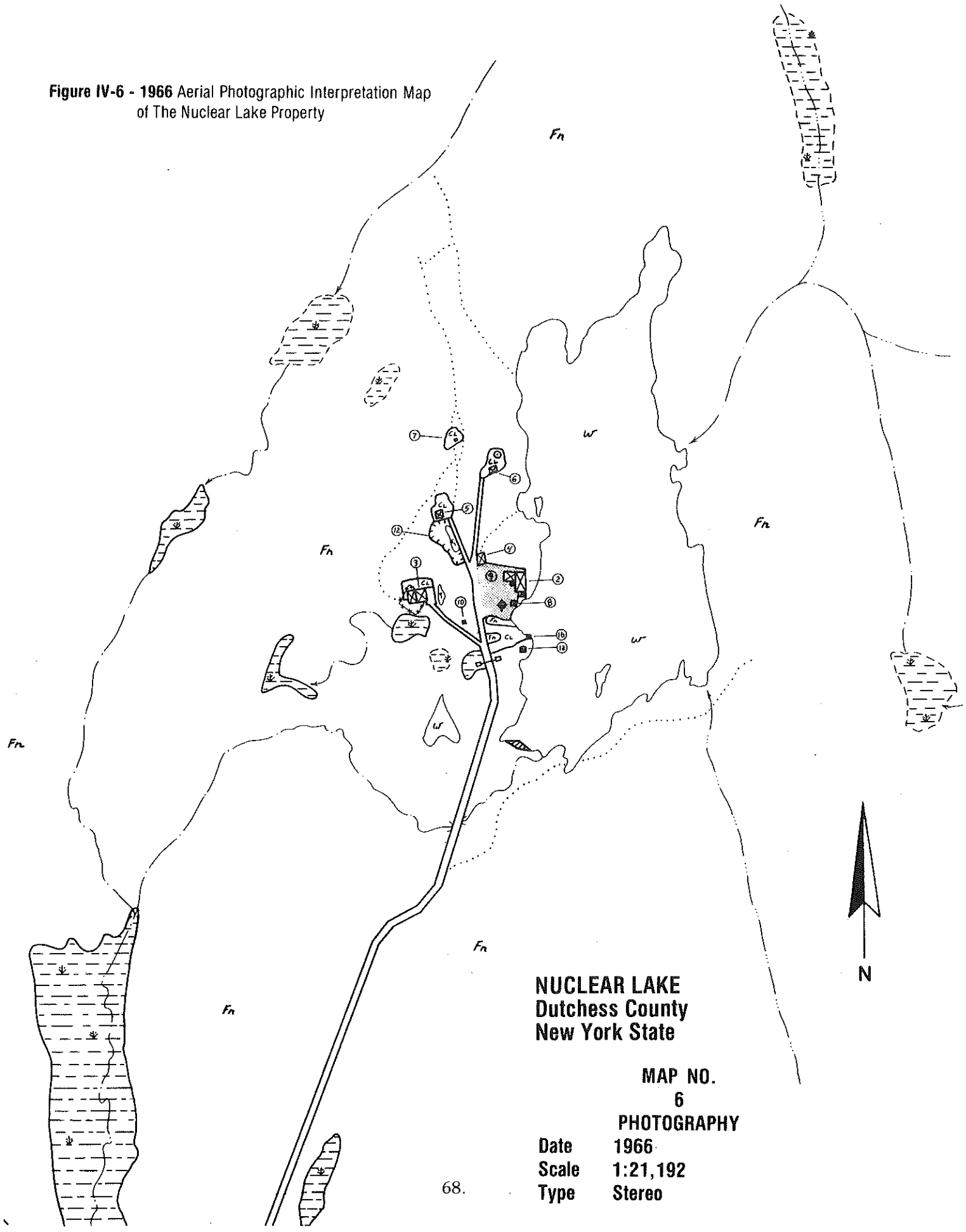


Figure IV-7 - April 28, 1968 Aerial Photographic Interpretation Map of The Nuclear Lake Property

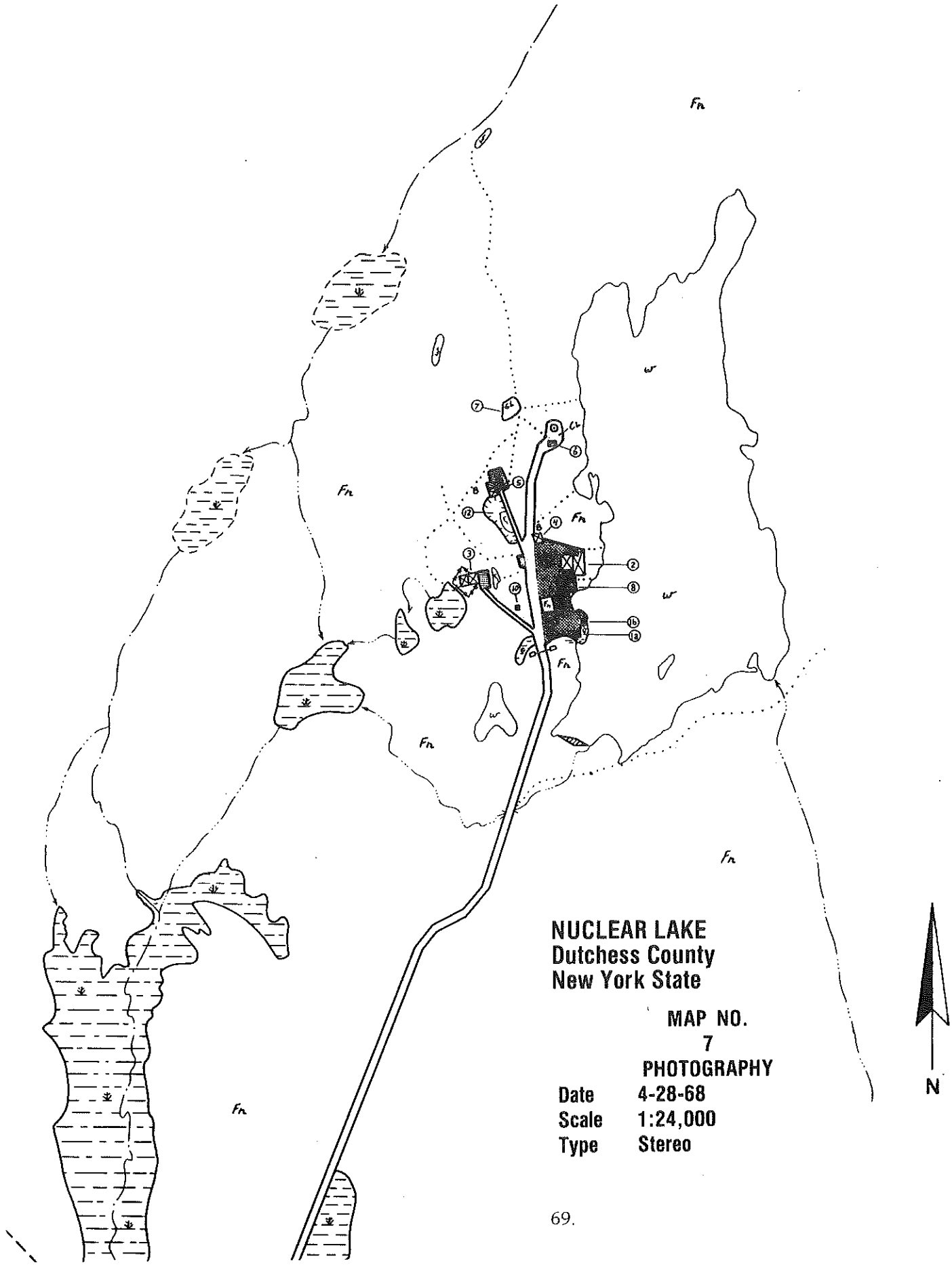


Figure IV-8 - April 12, 1970 Aerial Photographic Interpretation Map of The Nuclear Lake Property

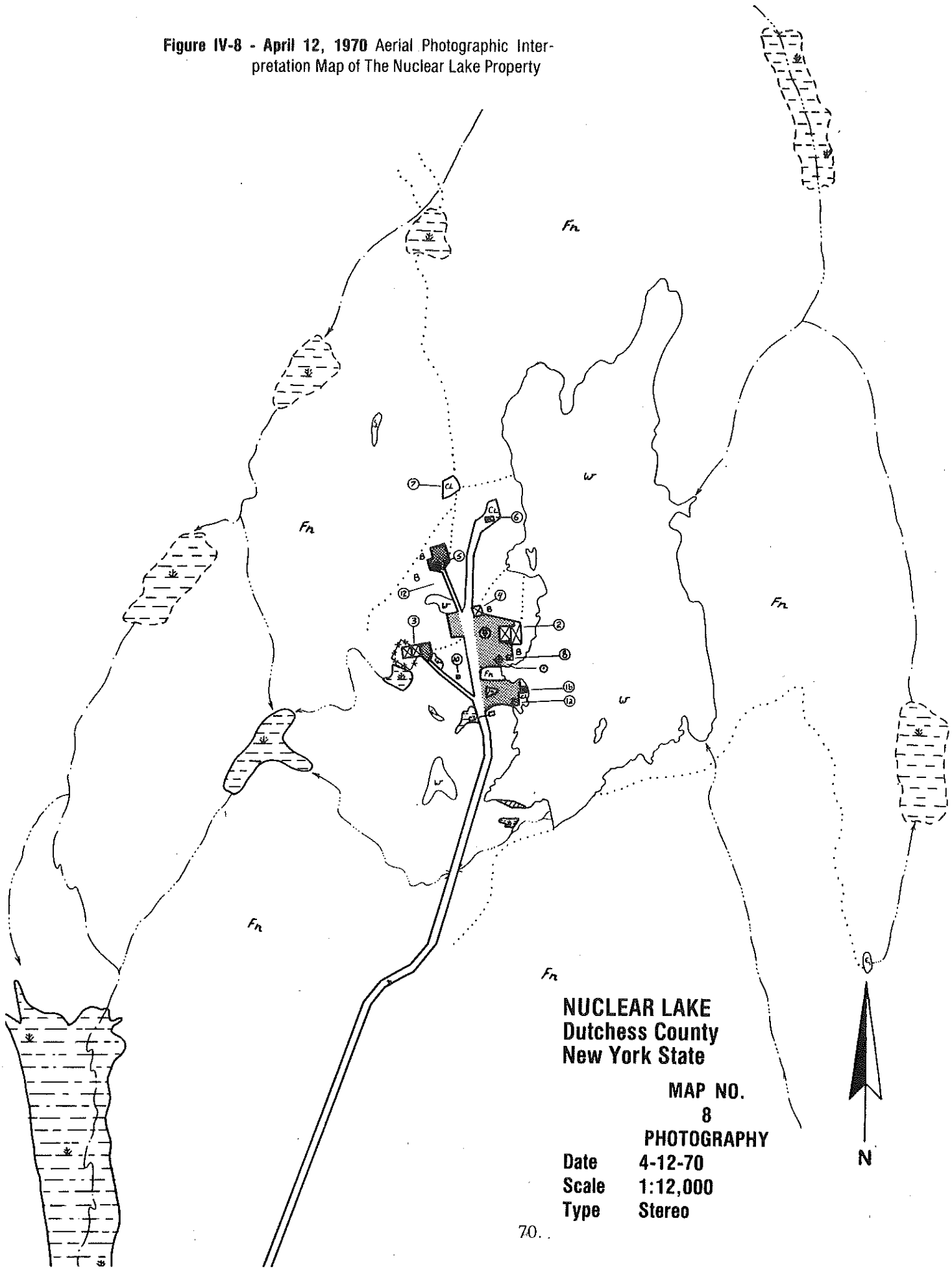


Figure IV-9 - April 20, 1971 Aerial Photographic Interpretation Map of The Nuclear Lake Property

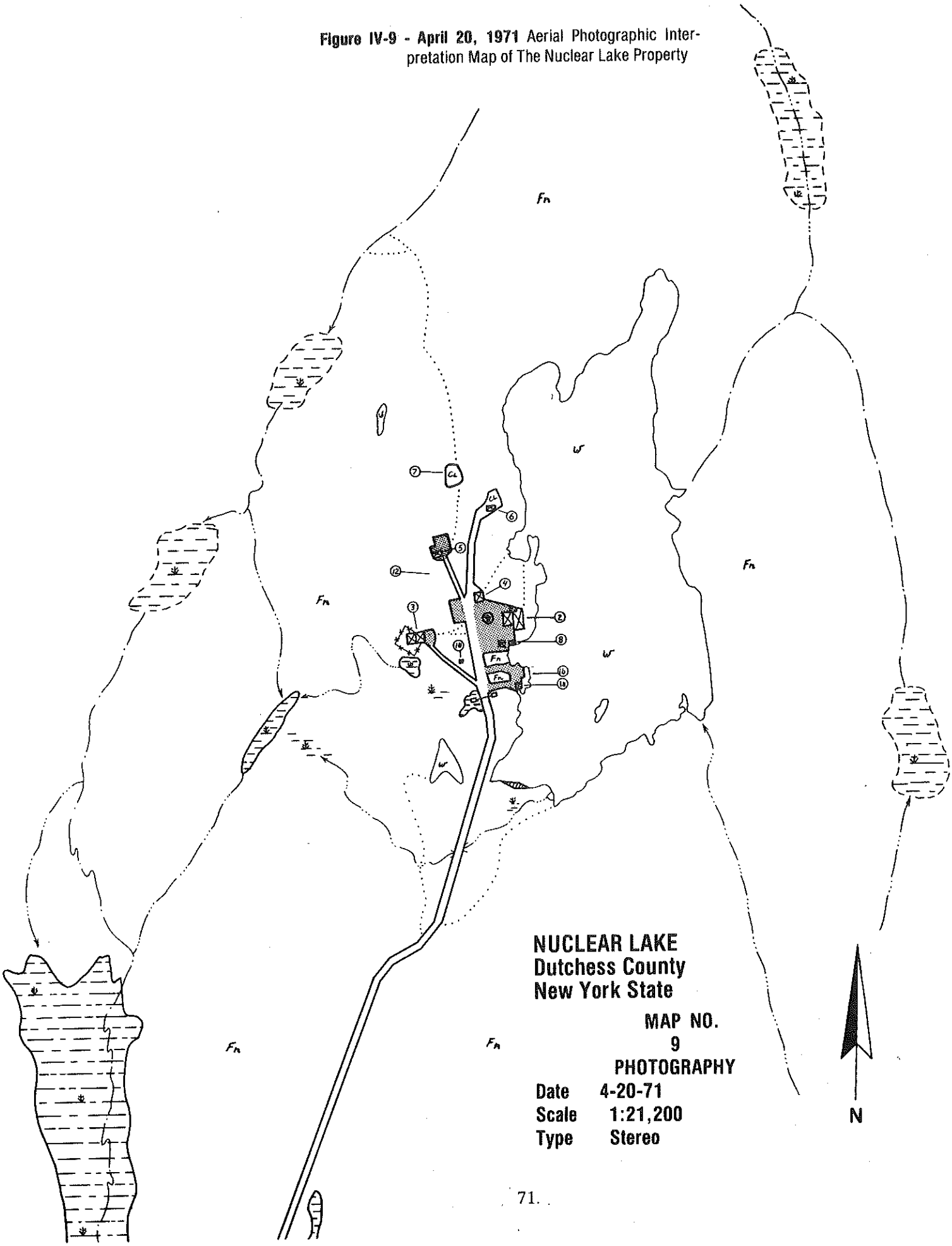
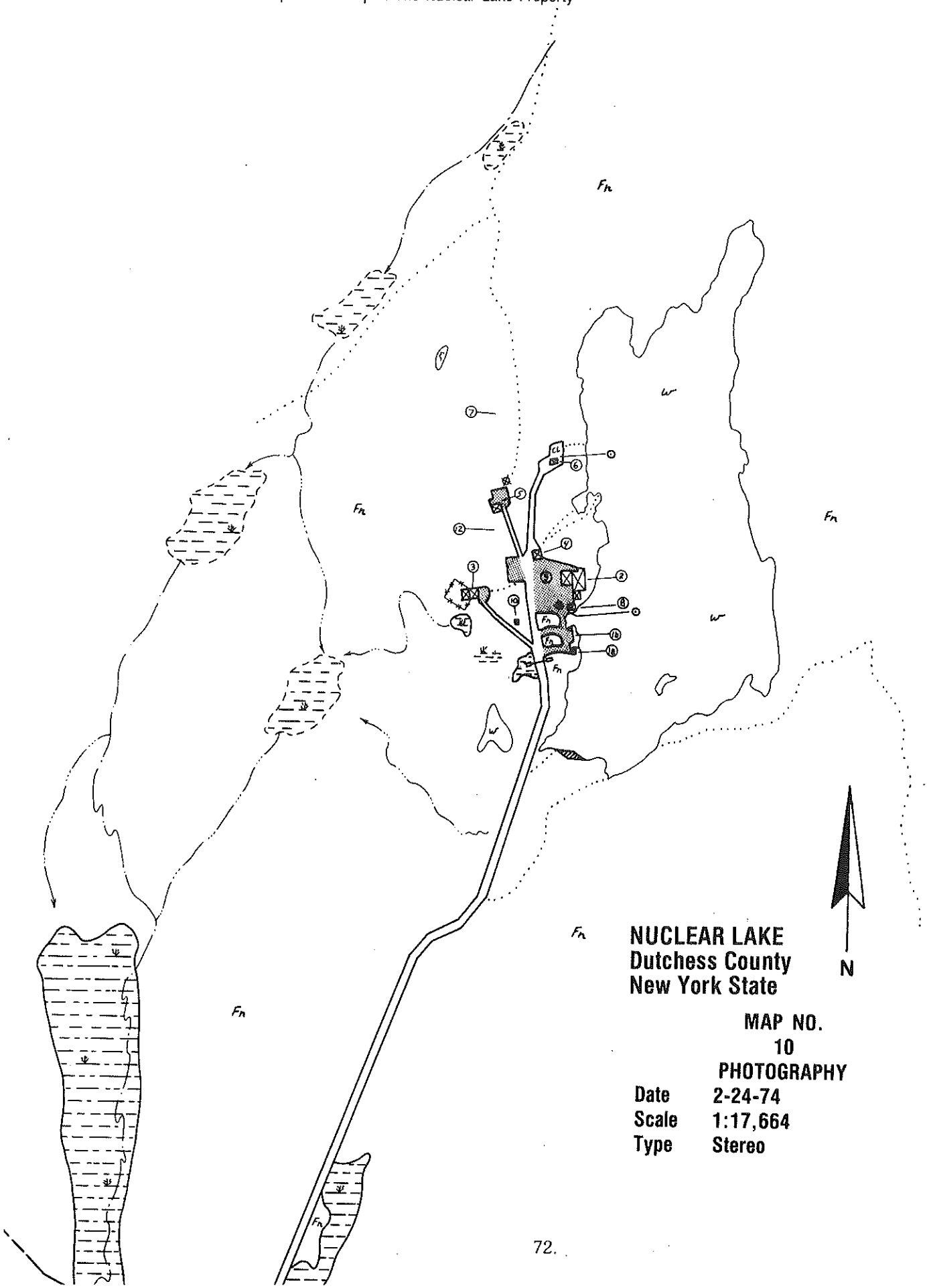


Figure IV-10 - February 24, 1974 Aerial Photographic Interpretation Map of The Nuclear Lake Property



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1. Dames and Moore, 1966. Report of the Foundation Investigation-Proposed Alpha Laboratory Expansion. Pawling, New York.

2. Site Clearance Subcommittee, The Nuclear Lake Management, 1980. Nuclear Lake - A Resource in Question, Draft.

   Chapter V - Waste and Waste Disposal Problems, Final Draft.

   Chapter VI - Accident - 1972, Final Draft.

3. Map: Lake and UNC Complex

4. Sketch: Pawling Plant Layout
   Complex with Fire Lane

5. U.S.G.S. Topographic Map (several years) 1901 reprinted 1909, 1928 inaccurate, 1948, 1960.

6. Appalachian National Scenic Trail - Segment 269, Dutchess County, New York.

V. Waste and Waste Water

PLUTONIUM FACILITY - WASTE WATER

From 1957 to 1971 UNC faced problems in disposing of low-level radioactive waste water generated at the Plutonium Lab during its operating years. This liquid effluent resulted from water used in decontamination operations and came from several sources which included:

1. Laundry Waste Water (31) - primarily laundry water from washing machines used to wash laboratory uniforms contaminated with radioactive material.
2. Sink and Shower Waste Water (31) - discharge from some sinks and one shower in the Plutonium facility.
3. Scrub Waste Water (47) - water from washing the laboratory floor.

Following is a summary of UNC's disposal solutions for these wastes.

May 1957 - UNC considered several solutions to the problem of disposing certain amounts of low level radioactive waste water generated at the Plutonium Lab during normal operations. In Feb. 1958, it was estimated (22) that:

> "5-10 gallons of sink water and 50 gallons of laundry water will be generated per month. This is a total of 60 gallons of slightly contaminated waste water per month."

The Retention Tank (refer to Chapter III, page 37) with a capacity of 4500 gallons was used to store some of the waste water as it was generated (1). By the end of 1957 approximately 4000 gallons was in storage waiting to be analyzed and disposed of (8). A waste water analysis made in April and May 1957, showed (1):

	April 8, 1957 cu/ml	May 9, 1957 cu/ml
Top sample	118,000 x 10 -15	669 x 10 -15
Middle sample	858 x 10 -15	890 x 10 -15
Bottom sample	1,552 x 10 -15	1250 x 10 -15

The May 1957 Report (1) stipulated that if there was no or low strontium present, dilution might offer an easy solution to disposal.

July 1957 - UNC personnel expressed concern (2) that draining low level waste water into the retention tank created a handling problem out of proportion to the amount of waste generated. A new system for handling these wastes in the future was being looked at. During this time two alternative disposal solutions were considered:

1. Hire an outside firm to handle the waste water (6).
2. Hire a local sewage disposal company to haul the wastes to private sewage disposal pits (7).

Both of these options were eventually ruled out.

November 1957 - an assay of the waste water (8) showed:

Gross Beta	**6.76 x 10 -7 uc/ml**
Cesium 137	**0.21 x 10 -7 uc/ml**
Sr. 90	**1.26 x 10 -7 uc/ml**

Sr 90 accounts for 18.7% of the activity and Ce 137 accounts for 3.1% of the activity.

Mid-November 1957 - The Dutchess County Department of Health assisted UNC in finding a sewage disposal plant along the Hudson River that would take the waste water (10) (11). A Health Department memo (12) indicated:

> "The water could be discharged into pits on the property but for public relation reasons the corporation does not desire to follow this practice. It has been suggested and approved by our Central Office to discharge the water into the Hudson River. It is our desire that this be done south of Poughkeepsie so as not to influence the water supply of the City of Poughkeepsie."

In December 1957 the City of Beacon's Disposal Plant turned down a request to have their plant used (15) (16) (17).

December 1957 - another disposal scheme was considered by UNC. This included several alternative approaches to disposing retention tank waste water at the Pawling site (18). The solutions considered were to:

1. Pump the waste from the tank to the middle of the lake, where the moving stream would enhance mixing and assure carrying the liquid to the overflow, preventing accumulation of the wastes (18);
2. Pump the water from the retention tank directly into the stream that flows out of the lake (18).
3. Wait until the lake freezes over and spread the liquid over the surface of the lake resulting in a phenomenally large dilution (18);
4. Purchase an evaporating system and evaporate the liquid (18).

January 1958 - the wastes were still being stored (19) (20) and UNC felt they should consider:

1. "...some method of disposal which will not involve the Health Department" (21).
2. "...not writing any request for solution of this problem to any official agency since the amount and cost of disposing the waste is low in comparison to the unfavorable publicity" (21).

February 1958 - three additional methods of disposal were considered (22):

1. Evaporation
2. Ion Exchange
3. a) Indefinite storage at present site.
   b) Indefinite storage in a similar pit located somewhere in the woods at Pawling.

After a cost benefit analysis of each method, it was concluded that the ion exchange method was the most feasible and should be used (22) (23).

November 1959 - UNC advised the Dutchess County Health Department (27):

> "that approximately 500 gallons of liquid waste had been passed through ion exchange units. The filtered effluent was collected in 55 gallon drums and, if an assay showed a concentration less than the maximum permissible concentration, these wastes were discharged to the lake. Difficulties were experienced with the ion exchange units apparently due to suspended material in the wastes."

In the meantime laundry and sink waste water continued to be generated in Plutonium Facility. The water was collected in barrels and assayed to determine if the content was below the Maximum Permissible concentrations (MPC). Based on decay calculations, a schedule for dumping the barrels into the lake was determined. Between July 22, 1959, and October 16, 1959, at least 45 barrels were scheduled for dumping in this manner (28).

One analysis (28) of the laundry water samples conducted on May 29, 1959 on a 100 channel analyzer showed the samples varied from 200 x to 10 x above MPC.

During 1959 the option of obtaining an industrial waste discharge permit from the N.Y.S. Department of Health was discussed with UNC employees (29,30). Following is a brief summary of UNC permit application procedures:

December 22, 1959 (31) - UNC (then NDA) applies to the N.Y.S. Health Department to discharge from 400-1000 gallons per month of laundry, sink and shower waste water. The discharge would be through a pipe leading from the Waste Storage Building to the Lake (See Figure V-1).

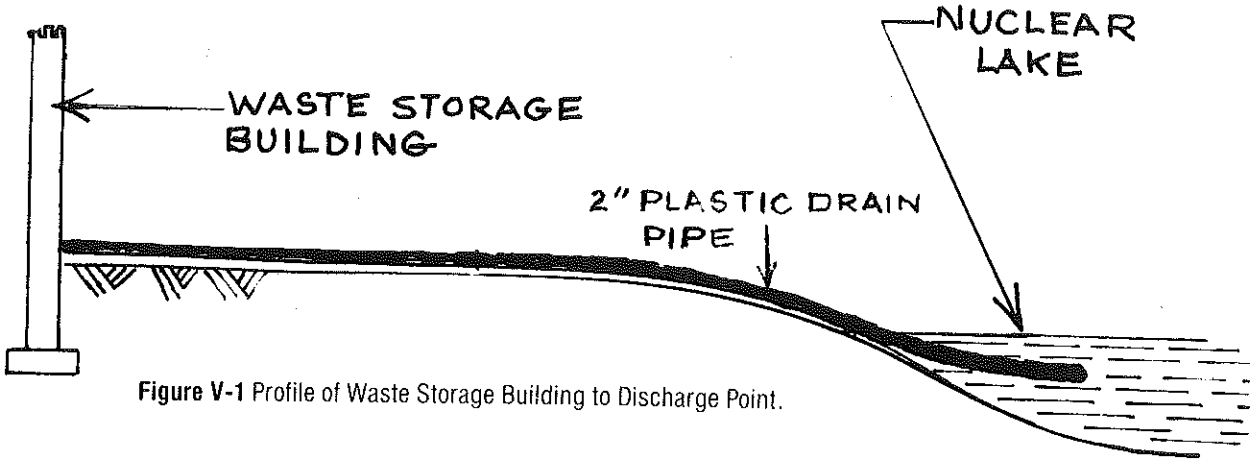

Figure V-1 Profile of Waste Storage Building to Discharge Point.

Jan. 26, 1960 - N.Y.S. Health Department asks UNC for supplemental Information for the Application (32) to include:

1. Estimates of amount of radioactive isotope to be discharged.
2. Methods of sampling.
3. Method of dilution to reduce the waste below MPC.

April 12, 1960 - UNC responds to the request for supplemental information (33):

"In response to your three questions:

1. It is estimated that the maximum amount of radioactive material discharged per year will be 1 milligram of plutonium (60 Microcuries) and 4 microcuries of gross fission products....
2. The waste liquid will be collected in 55 gallon tanks. The liquid will be agitated by hand, a sample will be taken and an aliquot of this will be analyzed.
3. If a tank is above the MPC it will be diluted before discharge. Dilution will be accomplished by mixing the contaminated liquid with tap water in a 55 gallon tank. This liquid will then be analyzed and released for discharge if it is below the MPC. The water supply is an artesian well, approximately 200 feet deep, which delivers over 14 gallons per minute."

November 23, 1960 - N.Y.S. Health Department issues UNC their discharge permit (36).

October 26, 1961 - UNC waste disposal records (38) indicate that 200 gallons of alpha emittings waste have been dumped into the lake. The wastes were contained in 4-50 gallon drums and had the following concentrations:

Drum 1	**1.09 x 10 -9 uc/ml**
Drum 2	**1.8 x 10 -10 uc/ml**
Drum 3	**Background**
Drum 4	**Background**

Six more drums or about 300 gallons of alpha emitting waste had not been analyzed. It was estimated (38) that about 10 gallons per day of alpha wastes were generated at the site at this time.

Late 1961 - UNC requests (101) to modify their permits to increase the allowable discharge concentration of Plutonium-239 from 1.5×10^{-6} uc/ml to 5×10^{-6} uc/ml. Based upon 10,000 gal./yr. the maximum amount of Plutonium to be discharged would be 20 uc.

January 11, 1962 - UNC's request is approved by the N.Y.S. Department of Health (39)

June 6, 1968 - A dramatic increase in lake water radiation levels occurs (see Chapter VII, Table 22) (42).

June 30, 1971 - UNC applied to the Department of the Army Corps of Engineers for a permit (47) to discharge 20 gal./mo. of scrub water from washing laboratory floors in the Plutonium Facility. The scrub water was to be collected, analyzed and if found to be within allowable limits discharged directly into the lake via a pipe (see Figure V-1).

No further references relating to Plutonium Facility Waste Water were available.

BORATED WASTE WATER DISPOSAL

Between October 1957 and April 1970, seven available UNC Health and Safety memos relate to the disposal of borated waste water. The water (2000 gallons) was generated in 1957 and was stored in pits (concrete tanks) in the Critical Facility Building for over 13 years. Following is a summary of UNC's borated waste water disposal solution:

October 1957 - UNC noted three disposal alternatives (48) (49):

1. Removal by tank truck for dumping in the Hudson River or the Ocean;
2. Evaporation and disposal of the borate as a solid;
3. Removal from the site by a private company.

July 1965 the 2,000 gallon quantity of borated water in storage was analyzed (50). It was found to be neutral (pH 7) when collected and to contain 0.083 grams/ml of boron (this amounted to 732 Kg of boron). The Dutchess County Department of Health informed UNC that the water could be dumped on the site. UNC staff felt, however, that this would create a fire hazard. Again, removal of the water from the site and evaporation were suggested. The latter proposal involved digging "several holes in remote areas at Pawling," filling them with the borated water, allowing the water to evaporate, then covering the holes (50). Later in 1965, the borated waste water was still in the Critical Facility Building (51,52).

June 1968 - a piping change in the "Poison Water System" in the Critical Facility Building was made to prevent the stored waste water from mixing with other water (53).

April 1970 - UNC stated that "...three (3) years ago, we disposed of approximately 800 gallons of borated water that had been lying dormant in the Critical Facility" (54).

No other references are available concerning borated water.

SODIUM WASTE

Between September 1957 and May 1974, several memos and reports refer to the problems of disposing heavily oxidized waste liquid sodium. Heavily oxidized waste sodium resulted when clean sodium was used in research and development work (SDR) at the Pawling Facility. Following is a summary of the problems UNC encountered in dealing with this waste.

September 12, 1957 - faced with the problem of disposing of 100 pound lots of waste sodium related to SDR development work, UNC sought suggestions from Knolls Atomic Power laboratory (KAPL) relating to sodium disposal methods (56).

February 24, 1958 - UNC considered selling the used sodium back to the supplier, Ethyl Corporation.

May 1958 - after a site visit, an Ethyl Corporation representative decided they "were not set up to take back used sodium" (61).

May 26, 1958 - UNC had, at this time, 50 gallons of waste sodium on hand with a probable accumulation of an additional 60 gallons within a month. This sodium had a large oxide content which made it useless for reclamation. The cost of shipping the waste was comparable with the cost of disposing of it at Pawling. UNC decided to carry out a disposal program on site; several approaches were considered: (61)

1. Burning
2. Aging
3. Reacting with water
4. Reacting with iso-propyl alcohol
5. Reacting with steam

July 2, 1958 - UNC personnel decided that burning and aging were economically feasible methods for disposal at the Pawling site.

1. Burning involved "preparing a pit (hole in the ground) one foot deep and five feet by five feet in cross section. The woods would be cleared 50 feet around the pit and a small fence placed around the hole. Kerosene soaked rags would be used as fuel, with the sodium placed on top of the burning rags" (62).
2. Aging involved "digging a hole in the ground six feet deep and ten feet by ten feet in cross section. The bottom of the hole would be lined with rocks. A steel grating or screen would be placed across the hole, five feet below ground level. The hole would be fenced in and a roof placed over it to prevent rain from coming in directly. The land would be cleared for at least 50 feet around the hole" (62).

It was estimated that by the end of 1958 more than 200 gallons (1400 pounds) of sodium waste would need to be disposed of.

July 3, 1958 - February 24, 1970 - No information on sodium disposal available.

February 25, 1970 - UNC disposed of a small quantity of sodium at Pawling. Two experiments using a heavily oxidized piece of sodium - weighing approximately one pound, were tried. In one, a pound of sodium was ignited with kerosene. In the second, a pound of sodium was thrown into a large tank of water.

> "The purpose of our experiment was to determine if we could dispose of waste liquid metal without arousing the concern of our Pawling neighbors" (63).

As a result of the experiments UNC concluded:

1. "We cannot dispose of large quantities of sodium by burning at Pawling. The smoke would be so dense that we would arouse unnecessarily the concern of our Pawling neighbors. We can burn small quantities (one pound) without any problems, but the manhours involved would be significant" (63).

2. "Water is out for sodium disposal." "Approximately five seconds after entering the water, it reacted as expected - with a bang" (63).

May 16, 1974 - A representative of the Bureau of Radiation of the NYS department of Environmental Conservation, interviewed a former UNC Site Director (Director during 1950's and early 1960's) concerning disposal of sodium wastes, and in a memo (64) states that the former Director...

> "...had witnessed the placing of small cans (about the size of a gallon paint can) into the lake containing sodium wastes. The cans were then punctured with a 22 caliber rifle and a considerable explosion resulted" and that "small amounts of sodium were disposed of in the lake by the above mentioned method but there were never any barrel quantities of sodium disposed of at the NDA Facility."

No further references to waste sodium disposal were available.

AIR CONDITIONER WASTE WATER

June 1965 - The air conditioners in the Plutonium Lab generated water at the approximate rate of 45 gallons per day (65). This water had to be analyzed before it could be disposed of. This presented a problem for the operating people at UNC because they could not get the samples analyzed fast enough to prevent a storage build-up. In an attempt to solve the problem consideration was given to the following methods of analysis and disposal (65):

1. Have UNC Chemistry Section of the Materials Department perform the analysis and store the water in 55 gallon drums in the Waste Disposal Building while awaiting results;

2. Run the water directly into the Retention Tank (capacity 4500 gal.) and when a significant volume (2000-3000 gal.) was built up, have the analysis performed by the Materials Department;

3. Have a commercial vendor perform the analysis and store the water as in item #1 or #2;

4. Train a technician at Pawling to perform the analysis as water is generated;

5. Turn off the air conditioner.

August 1965 - it was decided that UNC's Health and Safety Department would collect the samples and the Materials Department would analyze them (66).

No further references related to disposal of air conditioner waste water were available.

LITHIUM WASTE

January 1962 - it was noted in the UNC daily log book (67) that two UNC employees "disposed of some lithium in a 55 gallon drum down near the lodge - big explosions while AEC here."

March 6, 1970 - in a memo (68), a UNC Health and Safety Officer referred to lithium as being the most abundant waste.

> "While preparing for this exercise I noted that most of the waste at Pawling is lithium. This can be disposed of in water without a violent reaction, but again the time required would be significant."

No other references concerning lithium waste disposal are available.

SEWAGE WASTES

Plutonium Facility: During its initial operating years, 1957-1967, the Pu Facility had an 800 gallon septic tank and a leach field located under the main parking lot, south of the facility (see Figure V-2) (75). By 1966, it was estimated that the system received 300 gallons per day of septic wastes from the 10-12 people working at the facility.

1966 - Plans for expansion of the Plutonium Facility required that the earlier system be removed and replaced (see Chapter III, page 27 for details).

February 27, 1967 - The Dutchess County Department of Health approved UNC plans for the construction of a new system (77). The new system was located south of the earlier system (see Figure V-2) and served 20 employees with an estimated sewage waste flow of 600 gallons per day (78). The system consisted of a 900 gallon concrete tank with 8 laterals in the leach field and is 110 feet from the nearest well (76).

Biological wastes, water from a sump sink and drinking fountain and effluent from a face bowl were discharged into the system (80).

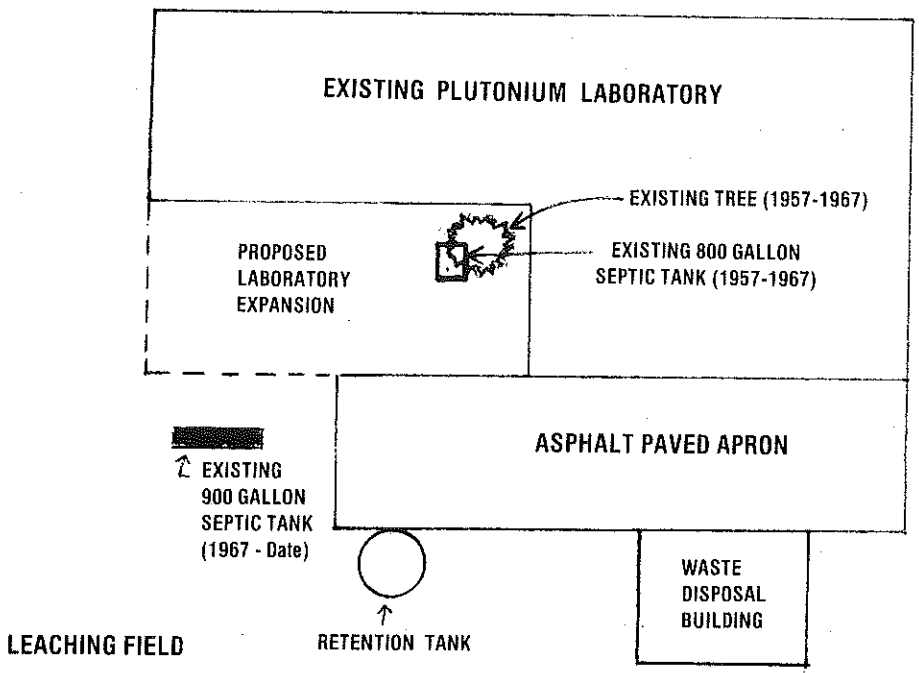

Figure V-2 Location of Plutonium Facility Septic Systems 1957 - Date

June 1970 - UNC personnel looked into the possibility of having soil near the drain fields of the septic system serving the Pu Lab, tested for radioactivity (82-84):

> "It would cost approximately $250 to obtain a soil sample near the drain fields of the septic system serving the Plutonium Laboratory. The fields are approximately five to seven feet deep and run under the parking area and the road. This would require a drilling rig to obtain a soil sample in order to prevent too much damage to the paved area."

The sampling idea was ultimately abandoned (84) because "the cost of doing these things would be prohibitive:..."

Critical Facility: The Critical Facility had its own separate septic system. No reference information relating to the system's location, size, type, waste, etc. were available.

Engineering Facility: The Engineering Facility had its own separate septic system (see chapter III, page 34). No reference information relating to the systems location, size, type, waste, etc. was available.

Remote Assembly Building: After the 1972 Pu Facility accident, site personnel were decontaminated in the Remote Assembly Building (55) (81). No provisions were incorporated to collect radioactive liquid wastes for analysis prior to their release into the septic system. In 1973, a waste system was installed to collect and analyze the waste wash water prior to release.

No further information relating to any of the facilities septic systems location, size, type, waste, etc., was available.

COOLING WATER

March 1956 - Reference was made to the use of lake water by UNC for cooling purposes. Residents along the stream draining the lake were concerned that the stream's water might become radioactive and requested information on the matter from the Dutchess County Department of Health. A reply, (87) in the form of a memo from the Department of Health to the Beekman Town Supervisor indicated:

"...The Health Department is responsible for the proper disposal of any radioactive wastes from the plant." "You can be assured this office would not knowingly permit any operations where such danger might occur. I believe the information as to the amount of water to be used from the Lake is exaggerated for if such water is used, it is for cooling purposes only and would not be made radioactive or contain any radioactive waste material."

1958 - 1965 - during the expansion of the Plutonium Facility, consideration was given to installing a Cooling Water System. Two alternative proposals were considered.

June 1958 - A proposal to withdraw lake water, use it as a heat exchanger, then discharge the water back into the lake (89) was made. It was noted that "lake water if used for such purposes only, would not be made radioactive or contain any radioactive waste material." Concern was expressed over what the effect of an increase in the temperature of the lake would have on fish and algal populations (88).

August 1966 - Plans were developed to pipe cooling water up from underground sources, use it as a cooling water supply then return it underground (90).

No further information concerning the use of cooling water was available.

SOLID WASTE DISPOSAL

Reference (80) dated April 16, 1970, discusses the disposal of solid waste generated at the Plutonium Facility.

"Solid waste generated in the Plutionium Laboratory may be placed in three catagories, (a) waste generated in the process operation, (b) bulk waste generated in the laboratory operations outside of the glove boxes and hoods, and (c) paper waste generated in the engineers' offices located in the laboratory. Items (a) and (b) are treated as contaminated, and are packaged and shipped out for land burial. The paper waste, item (c) is treated as the remaining Pawling solid waste is treated. That is, it is either burned in our incinerator, or it is transported to a local dump and used as landfill."

Reference (40) June 7, 1965, mentions that "All solid waste is shipped out for land burial at Oak Ridge and/or Nuclear Fuels Services in West Valley, N.Y."

ALLEGED DUMPING OF BARRELS OF UNKNOWN WASTES

Around 1959, while fishing, a resident of the Town of Pawling reported (102) that he had noticed a number of black barrels marked "Danger, Radioactive Wastes" on the Nuclear Lake property. When the resident asked a UNC employee (guard) how the barrels were disposed of, he indicated that they were loaded into a row boat, at night, taken to the center of the lake and then dumped. A summary of that report can be found in the insert.

In 1974 (15 years later) the NYS DEC requested that its Bureau of Radiation investigate the incident (64). The resident of the Town of Pawling was contacted on May 14, 1974. He indicated that he had personally seen the barrels standing by the side of the lake but did not actually see anyone take them out and dump them in the middle of the lake. Three former UNC employees were also contacted by the Bureau of Radiation during May 1974. One indicated that at no time were barrels containing radioactive wastes taken to the middle of the lake and dumped. He further stated that all disposal of such wastes was accomplished by dumping the liquids below MPC value into the lake from the shoreline. A second employee said that he had never heard of or seen any such actions. The third employee said he had never disposed of any radioactive material in the lake by using a row boat, and that the only wastes disposed of in the lake were those below MPC value, and they were released from shore. Based on the foregoing investigation, the Bureau of Radiation concluded that "no radioactive materials were ever disposed of by dumping the wastes, barrels and all, into the center of the lake from a row boat."

A Pawling resident reported that (102):

Years ago, while fishing he noticed a number of black barrels marked "Danger — Radioactive Waste" at the entrance to the UNC property. The resident asked the guard how these barrels were disposed of. According to the resident, the guard indicated that they were loaded into a row boat, one at a time, and rowed at night to the center of Nuclear Lake and dumped there.

The resident contacted NYS Department of Environmental Conservation in White Plains, N.Y.. Their advice was that if the barrels were at the bottom of the lake they were best left undisturbed to rust and leak slowly.

The resident also notified the Dutchess County Department of Health and spoke to an engineer regarding sodium dumping in the lake. He questioned the engineer on the legality of the Health Department's permit to UNC which permitted them to dump sodium into the lake. The resident reported that the engineer "became very mad."

EXHAUST SYSTEMS - STACK EMMISSIONS

Few references describing the structure and operation of UNC's exhaust systems were available. However, several memos generally describe the system serving the Plutonium Facility. A summary of these references are listed below.

February 28, 1963 (91) - Stack Blowers -
"The existing blowers may not have the capacity to serve the Alpha Lab and the new facility."

August 5, 1963 (92) - Gamma Lab Exhaust System -
"Health and Safety recommends a minimum linear velocity of 100 feet per minute at a window height of thirteen inches for the Hood in the existing Decon Room of the Gamma Lab. We also recommend a minimum of five room air changes per hour in this room. In the event a similar exhaust system is included in the new decontamination room, the above specifications will apply also."

October 30, 1964 - Plutonium Lab Exhaust System -
"From a Health and Safety point of view, a good exhaust system is a necessity in operations such as this; and we have a good system."

- Gamma Lab Exhaust System -
"This system should be replaced. It was adequate when operations started in this Lab; but it is marginal at this time."

August 25, 1970 - Plutonium Lab Exhaust System -
"We are continually adding to this exhaust system without determining if the system can handle the additional load. In the Performance Test Program we require a single glove break test. J. Andersen has stated that he will perform two (2) simultaneous glove break tests. This will give some indication about the adequacy of the exhaust system."

During 1969 and 1970 - air samples of the gaseous effluents in the stack serving the Plutonium Facility were collected and analyzed. The results reported were (97):

	Average Yearly Activity Recorded	Pu-239 Permissible Concentration for Occupational Exposure	Pu-239 Permissible Concentration for The General Public
1969	2 x 10 -14 uCi/ml	6 x 10 -13 uCi/ml	6 x 10 -14 uCi/ml
1970	3 x 10 -15 uCi/ml	6 x 10 -13 uCi/ml	6 x 10 -14 uCi/ml

Other gaseous effluent analysis can be found in the data tables, Chapter VII.

No further references concerning Exhaust Systems and Stack Emmissions were available.

BUILDING CONTENTS

An inventory of items remaining in each of the buildings on the Nuclear Lake property has been compiled and listed here. The inventory resulted from several field inspections of the property by members of the Nuclear Lake Site Clearance Committee; the last field inspection was made on Tuesday, August 25, 1981 (100). (See Chapter III for building structures, floor plans and photographs.)

Plutonium Facility (See Figures III-4 and III-5) - This concrete building has been stripped of most materials, debris and fixtures. Items remaining include:

- 3 sealed barrels marked "UNC - Radioactive - fissile material - Empty"
- sealed plastic bag of paper wastes
- three work benches
- miscellaneous electronic equipment
- a locked concrete vault used to store Radioactive material
- plumbing and appliances from two bathrooms, the "decontamination room" and boiler room remain.

Critical Facility (See Figures III-6 and III-7) - This concrete building contains numerous pieces of equipment miscellaneous items and scattered debris, including:

- work benches, desks, locks and filing cabinets
- electronic equipment
- an open concrete vault used for Uranium storage
- bathroom plumbing and appliances
- miscellaneous paper wastes and scattered material.

Engineering Building or Shop (See Figure III-8) - This building contains materials, debris and equipment including such items as:

- miscellaneous office debris (paper wastes, literature, paperclips, ets.)
- numerous bottles of chemicals (many types)
- a shop full with work benches, parts, paint, equipment, tools and miscellaneous debris and materials.
- several rooms containing electronic equipment and office equipment.

Multiple Failure Building (See Figure III-9) - Many items still reamin in this-one room metal building, including:

- 33 light fixtures (4' x 2') wrapped and sealed in clear plastic bags. (taped closed)
- an empty wooden cabinet
- 5 filing cabinets, 1 desk, 1 locker (all empty)
- miscellaneous equipment and scattered debris.

Shield Mock-Up Building (See Figure III-10) - Few materials remain in this one-room metal building, including:

- heaters and wall fixtures
- electrical wiring and some miscellaneous scattered debris.

Waste Storage Building (See Figure III-2) - Both the upstairs and downstairs of this two-room structure contains miscellaneous items including the following:

- UPSTAIRS - 6 bottles of boric acid, several large air filters, gutter connections, miscellaneous small bottles of chemicals, boxes of respirator filters for masks, 2 large boxes of empty freond cans, several bottles of penetrant dye and octail, insulation peeling off the walls and miscellaneous debris.

- DOWNSTAIRS - small autoclave, florescent light fixture, empty drums, exhaust hood, graphite pipes, barrel carriers and piping from the waste disposal system (still intact).

Emergency Generator Building (See Chapter III, page 38) - This small 8' x 16' structure is empty except for several miscellaneous items and bits of depris.

Retention Tank (See Figure III-12) - This 8' diameter 14' deep concrete structure contains approximately 1' of water.

Lodge (See Figure III-3) - This wood frame structure contains such items as:

- 3 barrels marked "UNC - Radioactive - fissile material"
- several cartons of unused empty cans
- electical equipment
- glove box glass
- photographic equipment
- numerous "bats" (animals).
- wall lockers
- miscellaneous equipment and materials.

Remote Assembly Building (See Figure III-13) - This building is presently a residence. No materials associated with UNC operations are present.

OUTSIDE BUILDING CONTENTS

Several areas on the Nuclear Lake Property contain miscellaneous debris and materials left over from the plant's operating years. Following is an inventory of those materials. The inventory was compiled after members of the Site Clearance Committee made several field investigations of the property (100).

Behind the Engineering Facility - A number of empty barrels, pieces of metal, wooden skids, equipment parts and barrels containing trash and miscellaneous debris remain scattered behind this building (See Figure V-3).

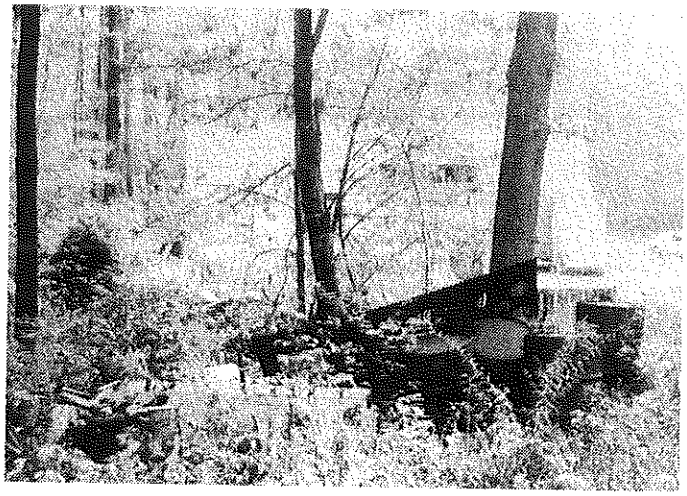

Figure V-3 Materials behind the Engineering Building

Near the Sodium Tent - A large pile of 6' to 8' diameter piping and several metal ducts have been placed in a wooded area near the Sodium Tent (See Figure V-4).

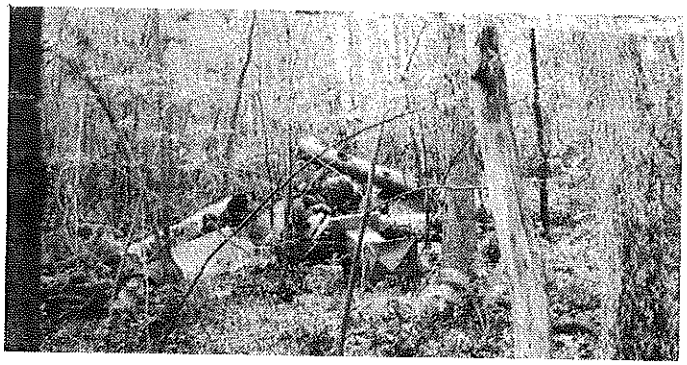

Figure V-4 Piping and Ducts in the Woods near the Sodium Tent

Behind the Dam - Several empty 5 gallon chemical containers, small drums, miscellaneous brush, wood and debris have been left here.

Outside the Multiple Failure Building - Barrels containing trash and debris, a metal safe (cut open) and miscellaneous objects, still remain (see Figure V-5). Also, four barrels connected to the building by a system of pipes are buried in the ground behind the building (see Figure V-6).

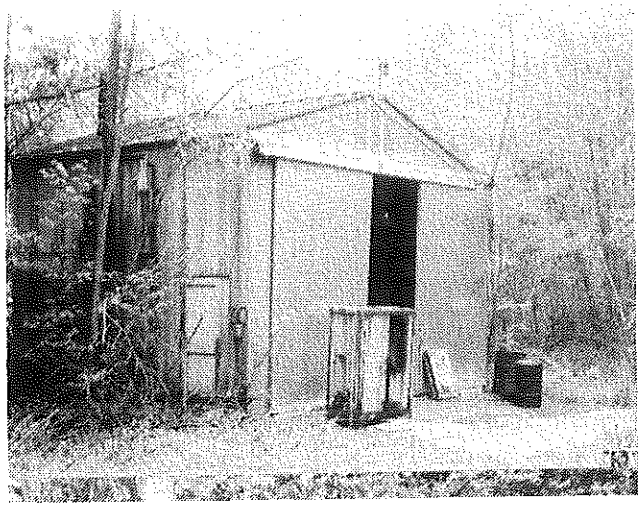

Figure V-5 Materials outside the Multiple Failure Building

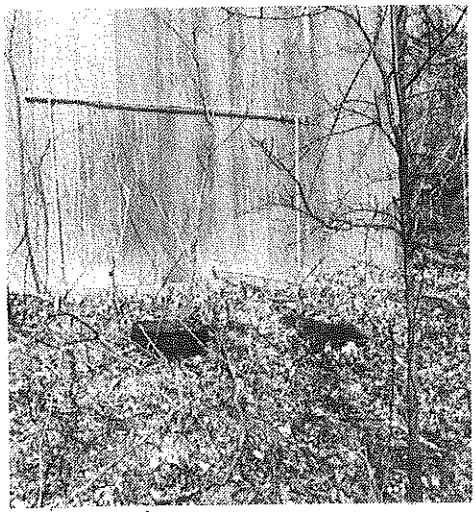

Figure V-6 Barrels buried behind the Multiple Failure Building

Outside the Plutonium Facility - A large airconditioning unit, a system of piping, gutters and drain pipes still remain attached to the building. Two buried pipes connected to the gutter system (one leading to woods on the north, the other to the cove on the south of the building) still remain. One barrel of trash, a car hood and miscellaneous debris are found scattered about the building (see Figure V-7).

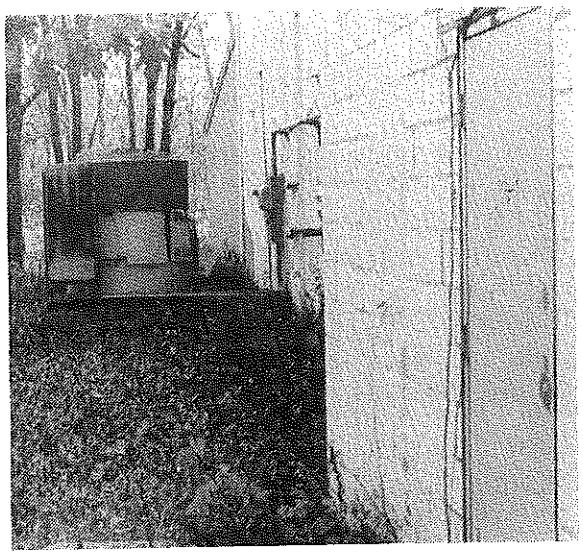

Figure V-7 Air Conditioning unit behind the Plutonium Facility.

Outside the Critical Experimental Facility - Several empty barrels, large steel plates and miscellaneous debris are located about the building. Gutters and drain pipes remain attached to the building. Two buried pipes connected to the gutter system leading to the wetland southeast of the building remain. A system of piping and airconditioning units remain on the roof. Surrounding the building on three sides is a 6' high chain link fence.

Outside the Shield Mock-Up Building - A stack of wooden skids, pieces of metal and some miscellaneous debris remains. A buried drain pipe leading from the building to the woods and one pipe leading from the building directly into the ground is present.

Area North of Multiple Failure Building - Twentysix concrete slabs (6' X 12' X 6'), two concrete slabs (6' X 4' X 1') (see Figure V-8) and ten large concrete blocks (4' X 5' X 2') containing holes (4' to 6' diameter) (see Figure V-9) have been placed here.

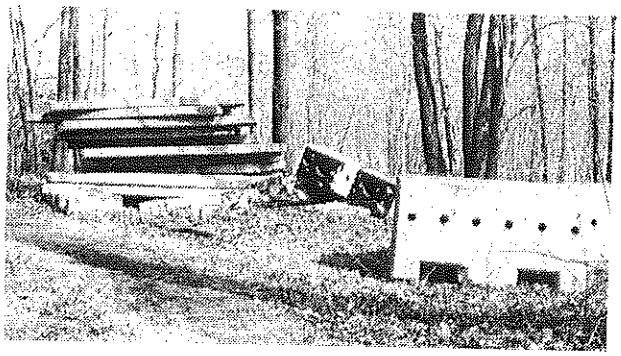

Figure V-8 Concrete Slabs north of the Multiple Failure Building

Figure V-9 Concrete Blocks north of the Multiple Failure Building

Wells and Septic System - The piping and well casing for the wells of the Critical Facility and Plutonium and Engineering Facility remain intact. The septic systems for each of these facilities also remain.

Outside Waste Disposal Building - A buried 2' plastic pipe leading from near the building to the "cove" area of the lake reamins (see Figure V-1).

Outside the Lodge - Three large concrete blocks 4' X 5' X 2' containing 6" diameter holes (see Figure V-9) have been placed here. Some miscellaneous debris is scattered about the building.

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VI Accident, Clean-Up and Decommissioning

SUMMARY OF THE ACCIDENT

On December 21, 1972, at approximately 2:55 pm, a chemical explosion occurred at the Plutonium (Pu) facility releasing solid and particulate plutonium oxide to the lab area. The explosion took place in a plexiglass glove box in the metallography line which consisted of three such boxes used to prepare and examine fuel pellets. Air leaking into the box, volatile material, and the absence of a gas analyzer used to monitor the atmosphere were believed to collectively cause the explosion (1), (2,) and (25).

At the time of the incident, 2 grams of two high fixed oxide sintered pellets were being prepared for ceramographic examination. An analysis of the material can be found in Table 10.

Table 10. Analysis of Oxide Pellets in the Pu Facility during the Dec. 21, 1972 accident.

		Pellet S-617	Pellet S-618
Plutonium	238	.0335%	.0324%
	239	87.289%	87.266%
	240	11.224%	11.247%
	241	1.332%	1.323%
	242	.1322%	.1311%
Uranium	234	.3157%	.3820%
	235	40.022%	48.87%
	236	.1273%	.1546%
	238	59.535%	50.59%

Note: The americium-241 contribution was .080 ugr/30 ugr. of total Pu. Americium-243 contribution was .006 ugr/20 of total Pu. The licensee stated and the analysis records confirmed that the ratio of plutonium to uranium was 17% to 83 %, respectively. (1).

The employee working directly with the box sustained facial cuts and radiation exposure at 3860 MPC/hr, (maximum permissible concentration / hour). Another employee in the lab sustained exposure at 350 MPC/hr. All twelve employees on site at the time gathered in the Remote Assembly Building approximately .9 miles from the Plutonium Facility to undergo decontamination procedures.

After all employees had evacuated the building, a second explosion took place. The fire that was believed to follow the initial explosion may have caused a bottle of flammable solvent to heat up, rupture and disperse, thereby fueling the second explosion. (25)

The latter explosion is suspected of having blown out two exterior windows on the north side of the building and two exterior doors on the south, spreading radioactive contamination to the outside environment. (See Figure VI-1.) The following day, the area was re-entered. Windows and doors were sealed. Extensive damage to the metallography line was found.

Immediately following the accident, United Nuclear Corporation (UNC) supplemented its routine environmental monitoring program and took special samples to determine levels of contamination. Samples of air, snow, ice, watershed and soil were included. Sampling results are listed in Table 11.

Weather data for the night of the accident can be found in the insert on the next page (28).

Table 11. Results of Environmental Sampling Following the Dec. 21, 1972 Accident

Sample	Location	Max. Conc. Pu-239/240
Snow & Ice	About the Pu Facility	6.3 x 10 -7 uCi/ml
Lake Water	Nuclear Lake - West Shore	No detectable activity
Soil	About the Pu Facility	From .00 dpm/gram to .53 dpm/gram
Direct Surveys	Outside - immediate area of broken windows	5000 dpm
Direct Surveys	Outside - immediate area of door	Less than 200 dpm
Direct Surveys	Other outside areas about	Below detection limit of 100 dpm.

Stack sample records prior to and subsequent to the accident, were reviewed. The sample results obtained are shown in Table 12, below. UNC stated that approximately 5.6 uCi of activity was released from the Pu Facility via the stack.

Table 12. Stack sample results prior to and subsequent to the Dec. 21, 1972 accident

#	Start Date	Time	Stop Date	Time	Results uCi/m1*
1	12/19/72	4:50 pm	12/22	6:45 am	5.94 x 10 -12
2	12/22/72	6:45 am	12/22	2:45 pm	No Sample
3	12/22/72	2:45 pm	12/22	7:30 pm	7.4 x 10-12
4	12/22/22	7:30 pm	12/22	8:30 pm	No Sample
5	12/22/72	8:30 pm	12/23	10:15 am	7.5 x 10-13
6	12/23/72	10:15 am	12/23	8:00 pm	No Sample
7	12/23/72	8:00 pm	12/24	4:30 pm	1.81 x 10-14
8	12/24/72	4:30 pm	12/26	2:00 pm	8.15 x 10-15
9	12/26/72	2:00 pm	12/27	4:00 pm	4.0 x 10-14

***minimum of 24 hour decay**

Note: According to the United Nuclear Corporation, sample numbers 2, 4, and 6 were not obtained because of inability to restart the sample pump and improper installation of sampling paper.

WEATHER DATA
DUTCHESS COUNTY AIRPORT — POUGHKEEPSIE, NY
SURFACE WEATHER OBSERVATIONS

December 21, 1972
Time 1500 hours: Fog, Visibility 2½ miles.
Wind direction 070°, Velocity 4 knots/hour
Freezing drizzle, Barometric Pressure 29.94, Temp 32°
Time 1600 hours: Visibility 2½ miles.
Wind direction 080°, Velocity 6 knots/hour
Ceiling; 3000/ft (balloon reading at 1700 hours)
Barometric Pressure 29.96, Temp 32°

STEWART AIRPORT — NEWBURGH, NEW YORK
SURFACE WEATHER OBSERVATIONS

Time 1550; Indefinite ceiling - partially obscured,
Visibility 1/8 mile. Freezing drizzle, Fog.
Wind: calm, no reading; remained calm all day.
Barometric Pressure 29.580, Temp. 31°

SUMMARY

The accident occurred on Dec. 21, 1972 at 2:55 pm. The prevailing weather conditions that entire day were fog, freezing drizzle, little or no wind. At 1500 hours (3:00 pm) the Surface Weather Observation recorded at Dutchess County Airport was as follows: vilibility 2½ miles, wind direction 070° (equivalent to out of the NE, heading SW, towards Green Haven), velocity 4 knots/hour (equivalent to 4.6/MPH). There was fog and freezing drizzle. The barometric pressure was 29.94 and the temperature was 30° F.

At 1600 hours (4:00 pm) the same record indicates a very slight shift in wind direction to 080° and a slight increase in wind velocity to 6 knots/hr (7 MPH). At about midnight of Dec. 21, the wind direction changed to 030° (out of the N, NE) speed increased to 8 knots/hour. There were slight changes in weather conditions until Dec. 22, at 1900 hours; the wind became calmer yet and a high temperature of 39° was recorded at 1500 hours.

Conditions recorded at Stewart Airport (Newburgh, NY) were essentially the same. Winds were even calmer.

Dutchess County Airport has the nearest weather station to Nuclear Lake. It is located about 12 miles in a westerly direction from Nuclear Lake and is about 165 ft above sea level. The Nuclear Lake Property ranges in elevation from 600 ft. to 1050 ft. The lake surface elevation is 758 ft.

Ref: Surface Weather Observations from Poughkeepsie, NY and Stewart Airport, NY, from the National Climatic Control Center, NOAA, Environmental Data Service.

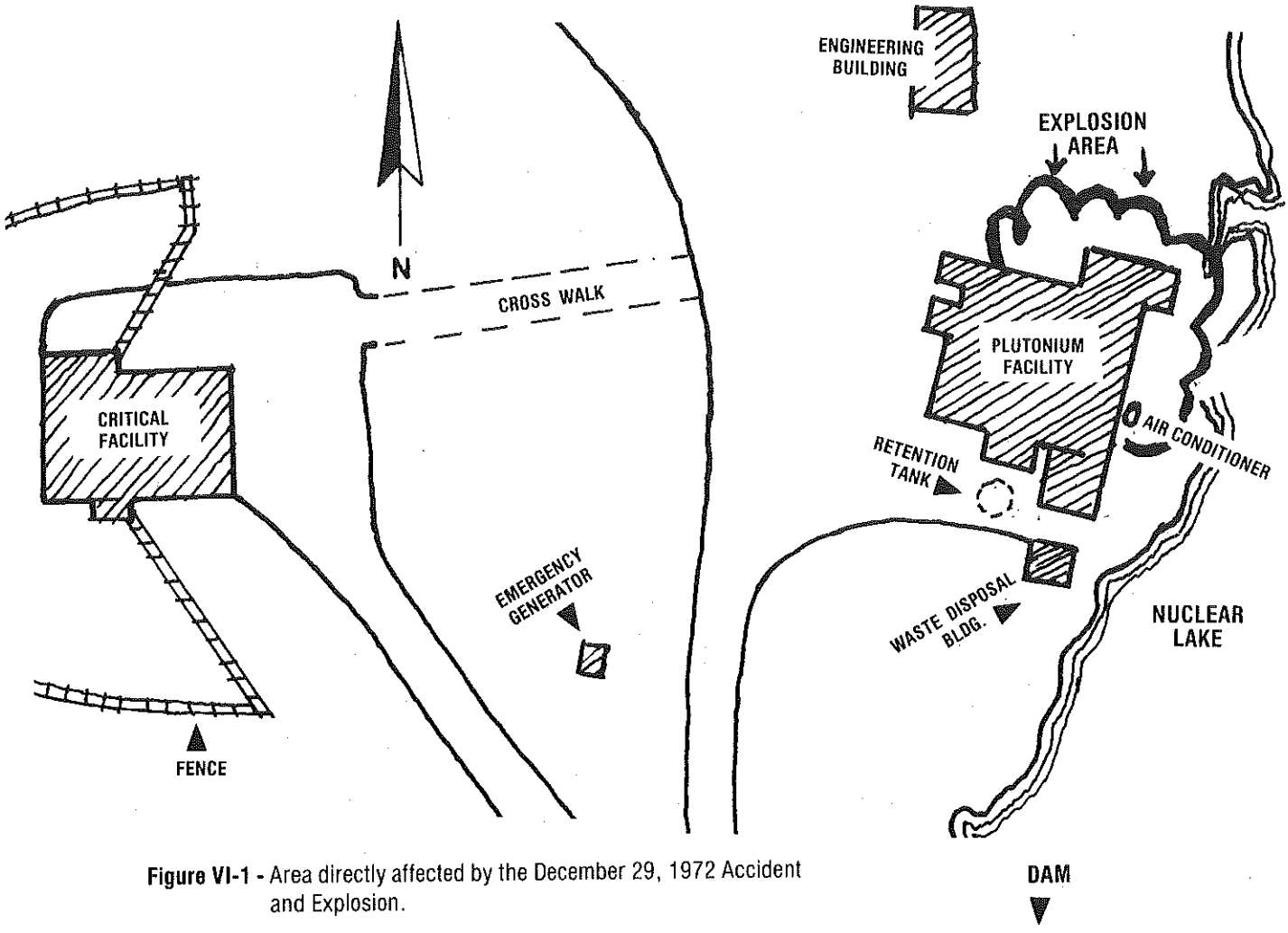


Figure VI-1 - Area directly affected by the December 29, 1972 Accident and Explosion.

Air samples taken daily at 13 locations within the Pu Facility between December and March 1973, indicated levels of alpha activity to range from 10^{-9} uci/ml to 10^{-13} uci/ml. (2)

Subsequent decontamination of the facility was conducted by UNC both independently and under contract to ATCOR, Inc. The decontamination procedure involved soil removal outside the Pu Facility, removal of ceilings and walls in contaminated areas and the reported packaging, shipment, and burial of 360 drums and 40 boxes of contaminated waste in "approved locations".

Throughout the decontamination procedures many references specifically characterize radionuclide concentration in air, soil, and wipes of the physical plant as "excessive". These references include USAEC inspection reports for December 21, 1972 (1) - March 27, 1973 (2) - October 30, 1973 (6) and April 9, 1974 (7).

Sampling of the fish, air, water, soil and buildings was conducted over a period of two years (1972-1974). These tests were carried out by United Nuclear Corporation, ATCOR Inc., NYS Department of Environmental Conservation (DEC), NYS Department of Health, NYS Department of Labor, NYS Atomic Energy Council (NYSAEC), and U.S. Atomic Energy Commission (USAEC) subsequently called Nuclear Regulatory Commission (NRC). Results of these tests are found in data tables throughout this study.

In October 1973, UNC requested permission to terminate its facility license. Approval of the request rested in part upon a determination that the soils affected by the accident were decontaminated to acceptable levels.

However, at that time no federal or New York State standards existed for plutonium in soil. The development of ad hoc standards became an issue for DEC and NYSAEC, with both agencies differing in their approach to sampling and determining what constituted permissable levels.

NYSAEC favored the application of an ad hoc standard (2dpm/gm Pu in dry soil) which had been developed by the Colorado State Health Department. DEC questioned the application of this standard for New York's less arid climate and opposed the analytical techniques that AEC used to arrive at concentration levels. A detailed discussion of the applicability of Colorado's standard of 2 dpm/gm can be found in references 11 and 12.

DEC argued that only the minus 35 mesh portion of the screen should have been used to collect soil samples. NYSAEC supported the use of both the minus 35 and plus 35 mesh portions. DEC and NYSAEC also differed in the interpretation of the data. In order to define the level of plutonium concentrations in the area, NYSAEC averaged the results of all the soil samples. DEC objected to this approach and was supported by the Colorado State Health Department and the NYS Health Department in its contention that the figure for Pu concentration should reflect the maximum amount of the substance found in a single sample. Based on this approach, DEC insisted that further soil removal was necessary to bring Pu contamination down to acceptable levels.

While NYSAEC stated that DEC was ultimately responsible for setting clearance criteria for the site, the agency firmly maintained that no additional work was needed at UNC. Believing it had no legal support for its position, DEC relaxed its stand and the site was cleared for unrestricted use by the AEC on July 14, 1975.

CLEAN-UP AND DECOMMISSIONING (1972-1974)

Below is a chronological summary of clean-up activities following the accident:

7/23/73 A U.S. Atomic Energy Commission inspection report (3) noted:

> "Quite an amount of **low specific activity waste** (containing less than 0.1 grams Pu is being collected in plastic lined 55 gallon drums during decontamination. The waste is ultimately buried...") - (71 drums of waste are being improperly stored outside building.) Proper procedures for preparing containers for shipment were not followed."

8/21/73 The drums of waste being "improperly stored" were prepared for shipment to a licensed burial site and moved into the "Transition Building" (known as Waste Storage Building) where they awaited shipment (4).

10/23/73 UNC requests permission from the U.S. Atomic Energy Commission to dismantle the Pawling Lattice Test Rig (PLATR) and the Pawling Test Facility (PTF) located in the Critical Facility Building (5). A dismantling plan was submitted and a Radiation Survey of the Critical Facility was made. (See Table 13 for survey results. Additional detailed radiological survey results of the inside of the Critical Facility can be found in Reference (5).

Table 13 Results of Critical Facility Radiation Survey*

	Mr/Hr
Outdoors by Reactor Room	0.02 - 0.05
Control Room	0.02
PLATR Area	0.01 - 0.05
PTF Area**	0.12 - 0.15

*** Measurements made with a Texas Nuclear Model 2650.**

**** Measurements in PTF Area affected by a nearby fuel bundle (5mr/hr 1/).**

10/30/73 USAEC report (6) states:

UNC contracts ATCOR Inc., Park Mall, Peekskill, New York, to complete decontamination of Pu Facility. The report confirms drums of waste previously stored in the "Transition Building", are gone.

UNC is sampling stacks daily. Three environmental samples are being taken on a weekly basis (near generator shack, critical facility, and mock-up facility).

ATCOR Inc., plans to remove glove boxes, hoods, ventilation system and stack for burial at "approved locations". The Pu Facility floors were painted to fix contamination. Decontamination proceeds under ATCOR "By-product Materials License #31-11640-02".

11/26/73 USAEC inspection report (8) states that:

"Although the plutonium is in the oxide form (MPC = 4x10 -11 uCi/m1) the licensee used the MPC for soluable plutonium -239 (2x1; -12 uCi/m1) for controlling exposure to employees. Review of air sample records from March 23 to October 26, 1973 showed that subsequent to September 25, 1973 no air sample station showed more than 2x10 - 12 uCi/m1 Pu 239/m1. Prior to June 1, 1973 air sample concentrations in the vicinity of the research laboratory where the explosion involving plutonium occurred, exceeded 4x10 -11 uCi/m1 during decontamination activity. The maximum concentration measured was 9.8x10 -10 uCi Pu-239/m1 at the 1.5 station on March 29, 1973."

2. Stack air sampling from March 25 to November 22, 1973, showed that the air sample filter had been changed daily except on weekends. The MPC for insoluble plutonium-239 discharged to unrestricted area is $1x10^{-12}$ uCi/ml.

"Although the plutonium processed in the facility was in the oxide form and assumed to be insoluble, the licensee controlled the discharge via the stack so that it would comply with the MPC for soluble plutonium-239 (6x10 -14 uCi/m1). The record showed that for the period from March 28 to May 23, 1973 twenty daily samples were in excess of 6x10 -14 uCi/m1. The maximum was 2.5 x10 -13 uCi/m1. In all these cases each sample was counted after only 24 hour delay rather than after a longer period. The average concentration of insoluble plutonium-239 discharged from the stack for the period examined was less than 6x10 -14 uCi/m1."

3. Three environmental air samples were operated within the plant area. The filter paper for each sampler was changed weekly. Sampler locations were near the Generator Shack, the Critical Facility and the Mock-up Facility.

"Records of air sampler results were examined for the period from March 2 to November 14, 1973. The maximum plutonium-239 concentration noted was 9.6x10 -15 uCi/m1 (MPC = 1x10 -12 uCi/m1."

4. Fifteen soil samples were taken from various sections of the plant property on October 26, 1973. The results of these samples had not yet been received from the vendor to whom they were sent for analysis.

5. Contamination surveys conducted by taking wipes and making direct reading instrument surveys for the period from March 26 to October 26, 1973, were examined.

"The records showed that contamination levels up to several hundred thousand dpm per 100 cm 2 (both wipe and direct reading) were measured in the vicinity of the explosion location. Measurements were generally below 100 dpm/100 cm 2 in areas which were remote from the area of the explosion."

1/21/74 A DEC report (26) indicated Pu levels in air are 10 - 1000 x higher than normal for other areas of New York State.

1/25/74 ATCOR Inc., releases final survey results after decontamination procedures are completed. Their Report (27) Final Survey Results After Decontamination, stated that the Plutonium Facility and environs have levels of contamination that are below the limits for release for unrestructed use. The report further states that in order to reach these levels it was necessary to:

"Remove and dispose of as radioactive waste all glove boxes, hoods, exhaust ducts, filters, piping manifolds, exhaust blowers, exhaust stack and floor tiles. In addition, certain concrete block walls were found to be internally contaminated and had to be removed, disposed of and replaced, as well as certain sections of roof edge and rain gutters."

A summary of ATCOR Inc's final survey results in graphically divided areas of 10 square meters where contamination of the environment may have existed can be found in Table 14. Survey results of all areas of the Pu Facility have not been reported here. However, all radiological survey results have been documented in the ATCOR Radiological Survey Logs Project 892A.

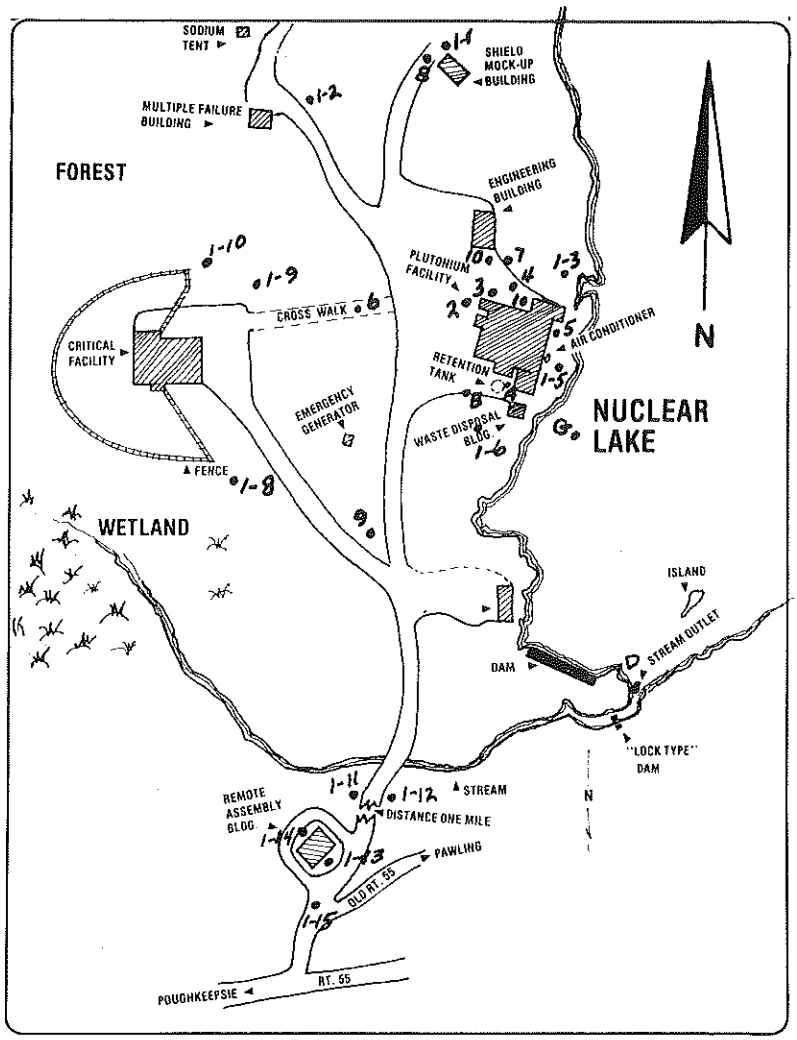
TABLE 14: A SUMMARY OF ATCOR INC'S FINAL SURVEY RESULTS TAKEN JANUARY 22 and 24, 1974 (27).

Sample No.**	Location	SOIL SAMPLE RESULTS — IN dPM/gm (dry) * Pu 238	Pu 239	U 234	U 235	U 238
1.	Front of "Gas House"	0.34	0.87			
2.	Entrance to Pu Facility	0.00	0.93			
3.	Driveway to "Gas House"	0.07	1.01			
4.	N. of E-Spec Lab	0.00	0.18			
5.	Rear of Research Lab.	0.06	0.05 ±	0.16	0.00	0.00
6.	Foot Path to Critical Fac.	0.45	0.27	0.21	0.00	0.00
7.	Between Eng. & Pu Fac.	0.00	0.00	0.34	0.00	0.00
8.	Front of Mock-up Door	0.00	0.00	0.00	0.00	0.00
9.	Jct. of CF & Pu Fac. Road	0.05	0.03	0.18	0.00	0.16
10	Front Eng. Bldg.	0.00	0.00	0.75	0.00	0.45
1-1	N-E. of Mock-up Ent.	1.92	0.43	0.00	0.00	0.00
1-2	N-E. of MF Bldg.	3.40	1.35	0.00	0.00	0.00
1-3	N. of Gas House Ent.	2.29	0.56	0.18	0.00	0.00
1-5	Between Pu Fac. & Lake	4.05	0.49	0.00	0.00	0.00
1-6	S. of Pu Fac.	0.68	0.37	0.2	0.0	0.1
1-8	S.E. of CF Parking Lot	4.47	2.57	0.1	0.00	0.1
1-9	N.E. of CF Parking Lot	0.68	0.16	0.1	0.0	0.1
1-10	N.W. of CF Parking Lot	1.82	0.59	0.2	0.00	0.1
1-11	50' from Rd. - ½ to RAA (N)	0.81	0.41	0.1	0.0	0.1
1-12	50' from Rd. ½ to RAA (S)	1.46	0.44	0.0	0.0	0.1
1-13	Front Lawn - Remote Assembly	0.13	0.00	0.9	0.00	0.5
1-14	Back lawn - Remote Assembly	0.36	0.08	1.7	0.3	0.1
1-15	Near GUNFC Sign (old Rt. 55)			0.00	0.00	0.27
A	Pu Facility Septic Tank	68 ± 2 dpm/l	0.56 dpm/l	0.00 dpm/l	0.00 dpm/l	0.00 dpm/l
A	Pu Facility Septic Tank (Rerun)	0.45 dpm/l	0.82 dpm/l			
B	Waste Pit - S. of Pu Fac.	0.79	0.05			

*All Results in dpm/gm (dry) unless otherwise indicated

**See Figure VI-2 for location plotted on a map of the area.

Figure VI—2 Location of ATCOR Inc., and U.S.A.E.C. sampling stations.



4/24/74 The USAEC confirms (7) that ATCOR Inc.,

"carried out all work necessary to reduce contamination levels to below those specified in the **Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of License for By-product, Source or Special Nuclear Material** as issued by the Directorate of Licensing".

In effect the USAEC considers that site acceptable for unrestricted use.

9/16/74 The Radiological Health Section of the State of New York Department of Labor, based on its own survey, confirms that decontamination of the Pawling Site is in compliance with Section 38.29. "Vacation Installations and Property" of Industrial Code Rule 38 and subsequently cancelled UNC's license to operate (9).

11/26/74 USAEC and NYS Radiological Science Laboratory data on soil and mud samples taken near the Plutonium Facility before (see Table 15) and after (see Table 16) the soil was removed from the vicinity of the laboratory is released. (10).

Table 15 Results of Analyses of Samples Taken by the U.S. AEC and New york State at Gulf-United Nuclear Corporation (Pawling, New York) Before Removal of Soil in the Vicinity of the Plutonium Laboratory.

Sample Identification and location*	Analysis Performed By	239/240 Pu (dpm/g dry soil)	238 Pu (dpm/g dry soil)
1. Under window blown out during Pu glove box explosion	U.S. AEC**	12.2 ± .3	.76 ± .02
4. Across driveway from window	NYS	.644 ± .088	.022 ± .007
7. Across driveway from window, farther from the Laboratory than Sample B	U.S. AEC	.11 ± .01	.001 ± .003
5. Between Plutonium Laboratory and the Lake	U.S. AEC*	5.3 ± .1	.34 ± .02
	NYS	.290 ± .044	.088 ± .066
1-2. North East of the Multiple Failure Bldg.	U.S. AEC	.30 ± .01	.28 ± .004
— Near the critical facility (not shown on the sketch)	NYS	.198 ± .044	.015 ± .011
C. Mud Sample at Shoreine near the Plutonium Laboratory	NYS	.044 ± .013	.013 ± .007
D. Mud Sample near the dam at the Late outlet	NYS	.046 ± .015	.029 ± .013
— Mud Sample from the lake outlet stream near Route 55 (not shown)	NYS	.029 ± .006	.009 ± .004

***See figure VI-2 for sampling points.**
****Four of five soil samples taken, mixed together, and analyzed for plutonium**

Table 16 Results of analyses of Soil Samples Taken by the AEC at Gulf-United Nuclear Corp. (Pawling, N.Y.) after Removal of Soil in the Vicinity of the Plutonium Laboratory

Sample Identification and Location*	Analysis Performed By	239/240 Pu (dpm/g dry soil)	238 Pu (dpm/g dry soil)
1. Under window blown out during Pu glove box explosion	U.S. AEC**	.49 ± .02	.036 ± .005
5. Between Plutonium Laboratory and the Lake	U.S. AEC	2.65 ± .2	.17 ± .03
— Near the parking lot between the Plutonium Laboratory and the Engineering Bldg; Sample taken at a low spot (precise sample location not indicated on sketch)	U.S. AEC	1.18 ± .06	.086 ± .01
— Control sample taken along the roadside several miles from the Pawling site	U.S. AEC	.001 ± .001	.001 ± .003

***See figure VI-2 for sketch of sampling points.**
****Six samples taken, mixed together, and analyzed for plutonium**

11/26/74 Forty five (55 gallon) drums of contaminated soil (approximately 330 cu. ft.) were removed from vicinity of the Pu lab. According to USAEC (10) this included the top six inches of soil (3' x 35') between the wall which contained the window that blew out and the driveway, and the removal of low spots in the vicinity of Plutonium Lab.

The USAEC offers NYS DEC the opportunity to challenge USAEC's "Licenses termination" and "site release for unrestructed use" criteria. "The primary responsibility for establishing the State's environmental criteria for the Pawling site rests with the DEC." (10).

12/11/74 DEC waits for U.S. Environmental Protection Agency standards for plutonium levels in soil before it clears the site for unrestructed public use.

DEC considers using the standards set by the State of Colorado (2 DPM of Pu/gr dry soil) but is unclear about how these standards were calculated and wants to know if the limit is an average limit or a maximum for an individual sample. DEC also questioned the standards relative to climate. Colorado has an arid climate. "Would there be a higher limit for areas of higher precipitation such as in New York State?" (11)(14).

12/30/74 Colorado Health Department responds to DEC inquiries, indicating the arbitrary nature of the standards for Pu in soil (12).

FALL 1974 Residual levels of Plutonium 238 and 239 were detected in the soil immediately adjacent to the Plutonium Facility onsite. Prior to release of the land for unrestructed use DEC recommended to the Nuclear Regulatory Commission (NRC) (formerly USAEC) that further decontamination of areas containing the higher concentrations of plutonium be conducted. (13). Table 17 summarizes 1974 radiation levels for tests conducted by NYS DEC on soil and mud. Other 1974 sample results on air, fish and water can be found in Chapter VII.

1/13/75 NYS Department of Health comments (10) to DEC on Plutonium standards for Soil Contamination:

"It would appear that an interim standard of 2 dpm/gm dry soil should be adequately conservative, particularly when one considers all the inherent difficulties in establishing a measured value. Questions such as depth of collection, inclusion of vegetation, total area of collection, etc. can cause errors of one or two orders of magnitude. I would suggest that for the sake of conservation, the standard should specify 2 dpm/gm dry soil as a maximum value, not as an average vaue."

Table 17. N.Y.S. Department of Environmental Conservation 1974 Summary of Radiation Levels in soil and mud at Nuclear Lake, Pawling, NY (13)

Soil and Mud - pCi/kg

Station-Location Dutchess County	Sample	Site	Pu-238	Pu-239,240
Pawling	Soil	#1.3	10±3	290±38
General Atomic	Soil	#1.5	4.0±3.0	130± 20
Company (UNC)	Soil	#1.8	7.0±5.0	90±20
Laboratory	Mud	Lake near		
(all samples		Point	6.0±3.0	20±6
taken on	Mud	Dam	< 2	17±6
5/29/74)	Mud	at Route 55	2.7±1.7	13±3

1/23/75 DEC plans to resample an area 20' x 60' located on the east side of the plutonium faculty between the facility and the lake. (See Figure VI-3) (15).

The results of the resampling are listed in Table 18.

Table 18. Results of NYSDEC soil resampling from a 20'x60' area east of the Pu Facility (21).

	Results(dpm/gms)			
Area*	PU-238	PU-239	Wgt. +35 mesh (gms)	Wgt. -35 mesh (gms) **
1.	1.63	24.0	2384	503
2.	.08	1.55	2526	593
3.	.06	1.13	2608	666
4.	.2	3.4	2438	722
5.	.04	.83	2420	598
6.	.02	.33	47	688

***Samples were taken on the east side of the Plutonium Facility (see Figure VI-3). Each sample consists of three cores approximately 3''x3''x2'' deep.**

**** Only Minus 35 mesh analyzed.**

2/04/75 DEC report states maximum value of 12.2 dpm/gm Pu 239 in soil sample under blown out window before clean-up. After clean-up Pu 239 concentrations ranged from 0.49 - 2.65 dpm/gm.

3/31/75 NYS Labor Department confiirms to DEC its support for 2.0 dpm on Pu/gm dry soil as an "ad hoc standard for the Pawling site".(22)

Results from the January 1975 DEC resampling effort (Table 18) shows that one small 10' X 10' portion, areas 1 & 4 of the site has a level of 24 dpm Pu/gm of dry soil. DEC plans to have this section further decontaminated and resampled. (17).

5/06/75 DEC receives results of further soil analysis, conducted by the Idaho Health Services Laboratory for areas 1, 4 and 4A (see Table 19), (Reference 18 and 19).

Table 19. Results of April 25, 1975 soil sampling representing a 500 square foot area on the Nuclear Lake Property

Area*	-35 Mesh Fraction			+35 Mesh Fraction			Weighted Average	
	238 Pu (dpm/gm)	239 Pu (dpm/gm)	Weight (gms)	238 Pu (dpm/gm)	239 Pu (gms)	Weight (dpm/gm)	238 Pu (dpm/gm)	239 Pu (dpm/gm)
1	0.42±0.02	1±0.1	187	0.016±0.002	0.208±0.005	1138	0.073±0.005	1.04±0.02
4	0.19±0.01	2.66±.07	253	0.017±0.002	0.245±0.005	808	0.058±0.004	0.82±0.02
4A	0.20±0.01	3.52±.08	345	0.007±0.001	0.065±0.002	788	0.066±0.004	1.12±0.03

* See Figure VI-4 for sampling location.

6/19/75 DEC recommends to NRC that further decontamination of areas 1, 4, 4A by removal of 4-6 inches of soil (550 sq. ft.) be carried out. (20).

DEC - NRC controversy regarding sampling techniques using different portions of mesh screens results. DEC will accept results on soil samples that were sufficiently fine to filter through a - 35 mesh screen. NRC wants to average results of samples from - 35 and +35 portions (20).

DEC also requests that background levels for Pu be established for Pawling site.

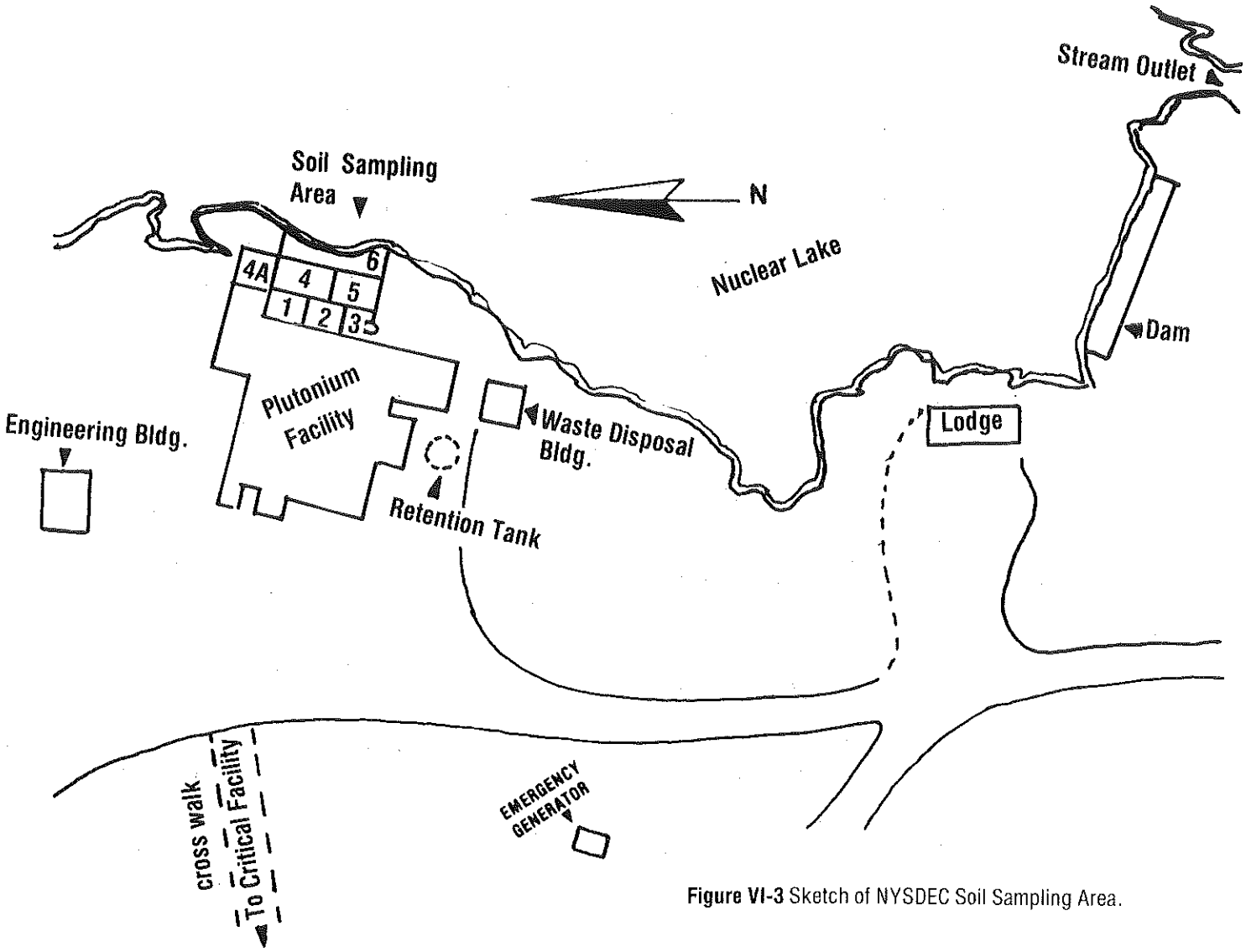


Figure VI-3 Sketch of NYSDEC Soil Sampling Area.

7/14/75 NRC states (13) (23):

"The area of contamination has been narrowed down by removing soil over the past year until the last set of samples met the NYS referenced criteria of 2 dpm/gm of samples — and feel the Pawling site represents an insignificant risk to the public and see no reason the licensees' request should not be approved."

The NRC subsequently terminated UNC's licenses, deleted the Pawling site as an authorized place of use for special nuclear materials and released it for unrestricted use.

7/16/75 DEC feels it has no legal or scientific grounds to contest NRC decision. (24).

There is no indication that any further decontamination was carried out.

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1. U.S. Atomic Energy Commissions (AEC) Directorate of Regulatory Operations, Reg. 1, RO Inspection Report No. 70-903; Inspection Dates, 12/21,22,26,27,29/72.

2. USAEC, Directorate of Regulatory Operations, RO Inspection Report No. 70-903/73-01; Docket No. 70-903; Inspection Dates 3/27-30/73.

3. USAEC, Directorate of Regulatory Operations; RO Inspecspection Report No. 70-903/73-02; Docket No. 70-903; Inspection Dates 6/28,29/73.

4. Memo from GUNC (UNC), to Mr. Robert T. Carlson, USAEC, Directorate of Regulatory Operations, Reg. 1; 8/21/73.

5. GUNC (UNC), Report No. RA:LM-73-111 - 10/23/73.

6. USAEC, Directorate of Regulatory Operations, Reg. 1; RO Inspection Report No. 70-903/73-03; Docket No. 70-903; Inspection Dates 10/30,31/73.

7. USAEC, Directorate of Regulatory Operations, Reg. 1; RO Inspection Report Nos. 70-903/74-01; Docket No. 70-903; 50-101-/74-02, Docket No. 50-101; 50-290/74-02, Docket No. 50-290; Inspection Dates 4/9-11, 15-16/74.

8. USAEC, Directorate of Regulatory Operations, Reg 1. RO Inspection Report No. 70-903/74-17; Docket #70-903; Inspection Dates 9/05/74.

9. Memo from State of New York Department of Labor to Dr. Fred Strnisa, NYS Department of Commerce Atomic Energy Council, 9/16/74.

10. Memo from NYS Department of Commerce Atomic Energy Council to Thomas Cashman, Director of Bureau of Radiation, NYS DEC; 11/26/74.

11. Memo from NYS DEC Bureau of Radiation, to Mr. A. J. Hazle, Division of Occupational and Radiological Health, Colorado Department of Health, 12/11/74.

12. Memo from Colorado Department of Health to NYS DEC, Bureau of Radiation; 12/30/74.

13. 1974 Annual Report of Environmental Radiation in NYS; NYS Department of Environmental Conservation; pp 61-63.

14. Memo from NYS Department of Health Division of Laboratories and Research, to Mr. Cashman, NYS DEC Bureau of Radiation; 1/13/75.

15. Inter-office Memo; NYS DEC; from Mr. Kelleher to Mr. Cashman; 1/23/75.

16. Inter-Office Memo; NYS DEC; from Mr. Prins; 1/27/75.

17. Inter-office Memo; NYS DEC; from Mr. Strnisa to Mr. Cashman; 3/31/75.

18. Memo from US NRC Reg. 1 to NYS Atomic Energy Council, NYS Department of Commerce; 5/06/75.

19. Memo from US NRC Reg. 1 to NYS Atomic Energy Council, NYS Department of Commerce; 6/09/75.

20. Inter-office Memo; NYS DEC; from Mr. Cashman to Dr. Strnisa; 6/19/75.

21. Memo from Mr. Richard Cunningham, Acting Director of Materials and Fuel Cycle Facility Licensing, NRC, Washington, D.C.; 7/07/75.

22. Memo from Dr. Bradley, NYS Department of Labor to Tom Cashman, NYS DEC Bureau of Radiation; 3/07/75.

23. Memo from Mr. W. T. Crow, Fuel Cycle Licensing Branch 1, Division of Materials and Fuel Cycle Facility Licensing, NRC to Mr. D. T. Farney, UNC (General Atomic Company); 7/14/75.

24. Memo from Mr. Perrinian to Mr. Cashman; 7/16/75.

25. Report of Incident At Gulf United's Plutonium Facility At Pawling, New York; Gulf United Nuclear Fuels Corporation, Elmsford, New York; 1/19/73.

26. USAEC, Directorate of Regulatory Operations; RO Inspection Report No. 70-903/73-04, Docket No. 70-903; Dates of Inspection 10/30-31/73.

27. Final Survey Results After Decontamination Gulf United Nuclear Fuels Corporation Plutionuim Facility, Pawling, New York, January, 1974; ATCOR, Inc. Park Mall, Peekskill, N.Y.

28. Surface Weather Observations, Poughkeepsie and Newburgh, N.Y. December 21, 1972 - January, 20, 1973. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Asheville, N.C. 28801.

RADIOACTIVITY LEVELS IN LAKE AND STREAM WATER

Tables 20-24 summarizes all available data for radioactive material in surface lake and stream water on the Nuclear Lake property from 1956 - 1980.

Table 20 - summarizes data taken from NDA (UNC) Chemistry Section Analytical Laboratory Reports (1). Lake water samples were routinely prepared and analyzed by NDA during this time, 1956 - 1957.

Table 20 RADIOACTIVITY LEVELS IN NUCLEAR LAKE WATER — Nuclear Development Corporation of America* — Test results 1956 - 1957 (1)

Sampling Date	Sampling Location**	Results Gross Beta (curies/ml)
11/23/56	Lake Water	7.8 x 10 -15
11/30/56	Lake Water	6.8 x 10 -15
12/06/56	Lake Water	6.8 x 10 -15
12/12/56	Lake Water	0.3 x 10 -15
12/19/56	Lake Water	5.11 x 10 -15
12/27/56	Lake Water	6.80 x 10 -15
1/03/57	Lake Water	7.60 x 10 -15
1/18/57	Lake Water	4.86 x 10 -15
1/23/57	Lake Water	7.78 x 10 -15
1/30/57	Lake Water	9.76 x 10 -15
2/06/57	L-1	5.4 x 10 -15
2/18/57	L-2	4.88 x 10 -15
2/26/57	Lake Water	6.06 x 10 -15
3/13/57	L-1	5.56 x 10 -15

*Nuclear Development Corporation of America later known as United Nuclear Corporation.

**See Figure VII-1 Sample Location Map - for location of sampling points

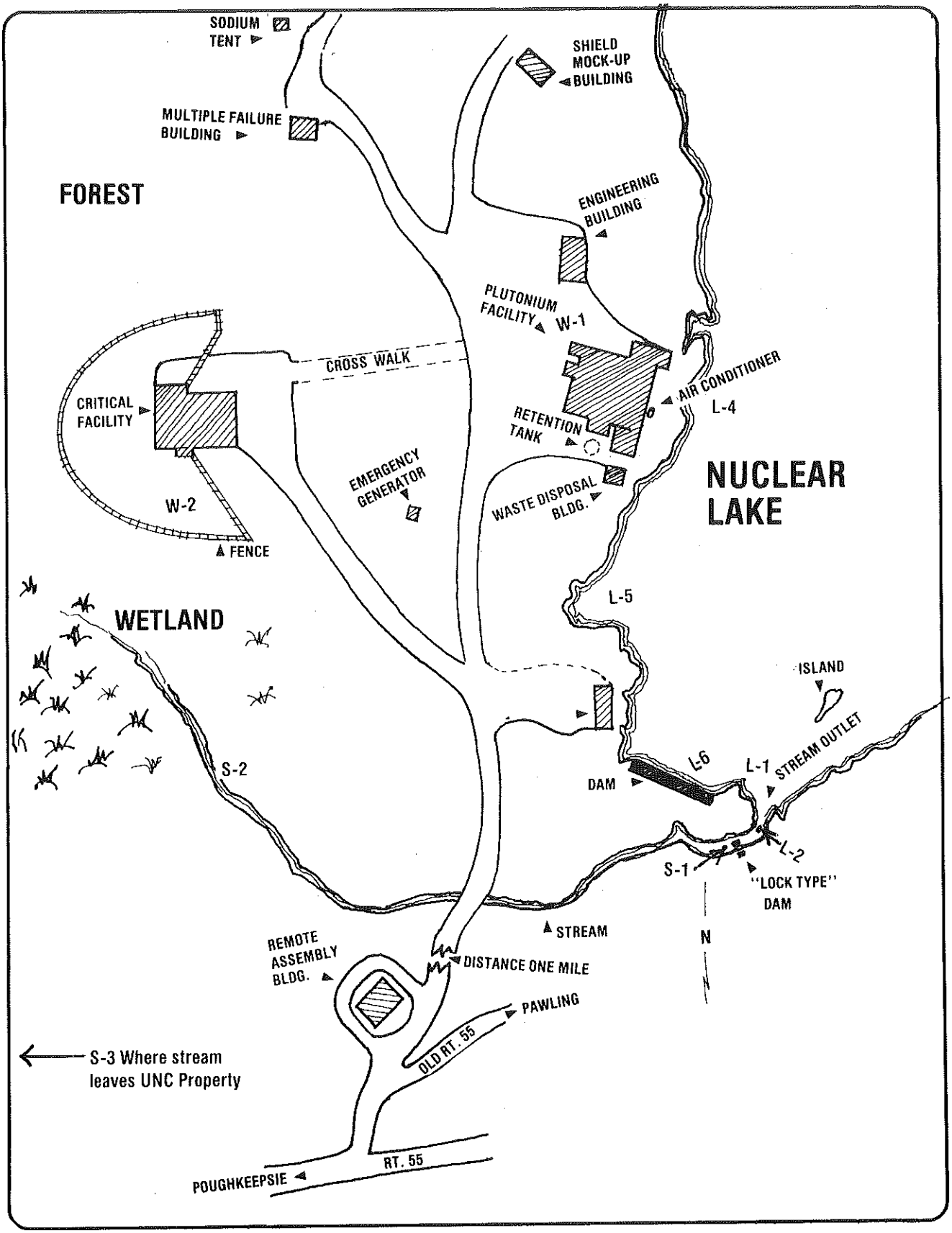

Figure VI-1 Sample Location Map for sampling points from tables 20 - 27.

Table 21 - summarizes data taken from N.Y.S. Department of Health, Radiologic Laboratory Determination Reports (2). From 1964 - 1965 Dutchess County Department officials routinely collected lake water samples and had them analyzed for a number of radioactive materials.

TABLE 21 RADIOACTIVITY LEVELS IN NUCLEAR LAKE WATER — NYS Department of Health — Test results. Monthly samples 1963 - 1965 (2)

Test Results - (pc/liter unless otherwise noted)***

Date*	Samp. Loc.**	Gross Beta	Gross Gamma	Cs-137	I-131	ZrNb-95	Bala-140	Mm-54
3/11/63	L-2	0.023	21	< 20	< 20	< 20	< 20	—
4/08/63	L-2	0.032	< 20	< 20	< 20	< 20	< 20	—
5/08/63	L-2	0.019	< 20	< 20	< 20	< 20	< 20	—
6/07/63	L-2	0.009	< 20	< 20	< 20	< 20	< 20	—
7/09/63	L-2	0.054	24	< 20	< 20	22	< 20	—
8/09/63	L-2	0.049	22	< 20	< 20	27	< 20	—
9/05/63	L-2	0.014	< 20	< 20	< 20	< 20	< 20	—
10/07/63	L-2	0.022	< 20	< 20	< 20	< 20	< 20	—
11/08/63	L-2	0.025	< 20	< 20	< 20	< 20	< 20	—
12/09/63	L-2	0.019	< 20	< 20	< 20	< 20	< 20	—
1/06/64	L-2	0.007	< 20	< 20	< 20	< 20	< 20	—
2/10/64	L-2	0.016	59	< 20	< 20	< 20	< 20	—
3/09/64	L-2	0.020	34	< 20	< 20	< 20	< 20	—
4/06/64	L-2	0.006	< 20	< 20	< 20	< 20	< 20	—
5/11/64	L-2	0.012	< 20	< 20	< 20	< 20	< 20	—
6/03/64	L-2	0.008	42	< 20	< 20	< 20	< 20	—
7/14/64	L-2	0.004	41	< 20	< 20	< 20	< 20	—
8/10/64	L-2	0.008	< 20	< 20	< 20	< 20	< 20	—
9/15/64	L-2	0.008	< 20	< 20	< 20	< 20	< 20	—
10/19/64	L-2	0.003	32	< 20	< 20	< 20	< 20	—
11/16/64	L-2	0.005	< 20	< 20	< 20	< 20	< 20	—
12/15/64	L-2	I.S. ****	70	< 20	< 20	< 20	< 20	< 20
1/14/65	L-2	0.005	43	< 20	< 20	< 20	< 20	< 20
2/15/65	L-2	0.007	20	< 20	< 20	< 20	< 20	< 20
3/10/65	L-2	0.005	< 20	< 20	< 20	< 20	< 20	< 20
4/23/65	L-2	0.007	31 ± 11	0 ± 13	12 ± 16	0 ± 11	0 ± 14	8 ± 11
5/11/65	L-2	0.005	42 ± 11	0 ± 15	13 ± 19	0 ± 14	0 ± 21	3 ± 13
6/16/65	L-2	0.006	0 ± 10	0 ± 15	2 ± 20	0 ± 15	0 ± 21	0 ± 13
7/12/65	L-2	0.005	0 ± 8	0 ± 14	0 ± 15	3 ± 14	0 ± 38	0 ± 10
8/16/65	L-2	0.005	7 ± 8	4 ± 15	3 ± 16	0 ± 13	18 ± 39	0 ± 11

9/65 - 12/66 — No test results located in Health Department Records

1/67 - 12/69 For test results see Table - 22

*Refers to date sample was collected — In all cases sample was a "surface water grab."

In all cases sample was taken at outlet of Nuclear Lake - **See Figure VII—I Sample Location Map - for location of sampling points

***Gross Beta results reported in pc/ml - in all cases sample volume was 500 ml or less. All other results reported in pc/liter - in all cases sample volume was approximately 2 liters.

****I.S. — Insufficient Sample

Note: No test results for lake water between January 1965 and December 1966 were available.

Table 22 - summarizes data taken from N.Y.S. Department of Health memoranda (3) (18) and Radiologic Laboratory Determination Reports (4). From January 1967 - December 1969 Dutchess County Department of Health officials routinely collected lake water samples and had them analyzed for Gross Beta Activity.

TABLE 22 RADIOACTIVITY LEVELS IN NUCLEAR LAKE WATER — NYS Dept. of Health Test Results 1967 - 1969 (3), (4), (18).

Sampling Date	Sampling Location*	Results Gross Beta (pCi/L)**
1/10/67	Lake Water	4
3/17/67	Lake Water	5
4L17/67	Lake Water	4
8/14/67	Lake Water	4
9/12/67	Lake Water	3
9/18/69	Lake Water	2
11/15/67	Lake Water	3
12/19/67	Lake Water	2
1/15/68	Lake Water	7
2/01/68	Lake Water	32
3/19/68	Lake Water	88
4/10/68	Lake Water	4
5/07/68	Lake Water	3
7/16/68	Lake Water	4
8/05/68	L-3	4
8/20/68	L-6	2
9/16/68	Lake Water	3
10/14/68	Lake Water	3
11/13/68	Lake Water	3
12/09/68	Lake Water	3

***See Figure VII-1 Sample Location Map** for location of Sampling points

**Margin of error ± 1/50 piCi/l.

March 6, 1968 - a Department of Health Analysis (3) for the February 1, 1968 test results indicated:

> **"... that the level of gross beta activity is approximately ten times higher than the average value found throughout 1967." This may have resulted from fallout from the Chinese test on Christmas Day, however, I would like to verify this fact by taking another sample from the same spot for radiological analysis."**

April 25, 1968 - a Department of Health Analysis (18) of the February 1, and March 19, 1968 test results noted:

> "... that there has been a rather dramatic rise in the gross beta concentrations in the pond at United Nuclear. I understand from Mr. Czerwinskyj that you have already looked into the matter and that the company maintains that they have not released any beta activity. I suggest that once we have the result for the sample taken in the middle of April, and if it is high compared to 4 or 5 pCi/1 we undertake an investigation to determine where the activity originates and what radionuclides are involved. For the time being, however, I suggest that we wait."

Table 23 - lists the N.Y.S. Department of Environmental Conservations (N.Y.S. DEC) summary of radioactivity levels in Nuclear Lake water from 1970 - 1975. More detailed information on sampling procedures and results can be found in the N.Y.S. DEC Annual Report of Environmental Radiation in New York State (5a - 5g) for each year represented in the table.

The N.Y.S. DEC 1974 Annual Report (5c) noted:

> "Although operations at the General Atomic Company, (UNC) Pawling, New York site ceased in 1973, the Department of Environmental Conservation continued to monitor the air and water. Soil and fish samples were also collected in 1974 after the plant shutdown. No contribution from past plant operations could be found in the air, water or fish."

Table 24a - summarizes the test results from stream water sampled on UNC property. Results for 1957 samples were taken from NDA (UNC) Chemistry Section Analytical Laboratory Reports (6). Results for 1959 - 1975 samples are from N.Y.S. Department of Health Radiologic Laboratory Determination Reports (7).

Table 24b - summarizes the test results from stream water sampled off UNC property, all results are from N.Y.S. Department of Health Radiologic Laboratory Determination Reports (7).

Table 23 RADIOACTIVITY LEVELS IN NUCLEAR LAKE WATER — NYS Department of Environmental Conservation — Yearly Summary 1970 - 1975 (5)

			Results (in pCi/L)			
Sampling Year	**No. of Samples**		**Gross Beta**	**H-3**	**Gross Alpha**	**Sampling Location ****
1970	16	Avg.	3			Lake Water
		Max	7			
		Min.	2			
1971	12	Avg.	4			Lake Water
		Max.	11			
		Min.	2			
	2	Avg.		N.D.*		
		Max.		N.D.		
		Min.		N.D.		
1972	9	Avg.	3			Lake Water
		Max.	5			
		Min.	2			
	8	Avg.			N.D.	
		Max.			N.D.	
		Min.			N.D.	
1973	11	Avg.	3			Lake Water
		Max.	6 ± 2			
		Min.	N.D.			
	7	Avg.			N.D.	
		Max.			N.D.	
		Min.			N.D.	
1974	6	Avg.	< 4			Lake Water
		Max.	6 ± 3			
		Min.	< 3			
	6	Avg.			< 1	
		Max.			< 1.1	
		Min.			< 0.7	
1975	5.	Avg.	< 4			Lake Water
		Max.	7 ± 2			
		Min.	< 3			
	5	Avg.			< 1	
		Max.			< 1	
		Min.			< 1	

*N.D. — None Detected

****See Figure VII-1 Sample Location Map** for location of sampling points.

Table 24 a — RADIOACTIVITY LEVELS IN STREAM WATER — on the Nuclear Lake Property — Test Results 1957 - 1975 (6, 7)

Sampling Date	Test Facility	Sampling Location *	Sample Type **	Gross Beta
3/05/57	NDA (UNC)	Stream	——	20.2 x 10 -15 curies/ml
3/25/57	NDA (UNC)	S-3	3 day composite	3.75 x 10 -15
4/08/57	NDA (UNC)	Stream	5 day composite	38.8 x 10 -15
4/17/57	NDA	Stream	3 day composite	6.47 x 10 -15
4/22/57	NDA	S-3	2 day composite	3.58 x 10 -15
4/24/57	NDA	S-3	2 day composite	4.81 x 10 -15
5/01/57	NDA	Stream	2 day composite	3.94 x 10 -15
5/03/57	NDA	S-3	4 day composite	1.98 x 10 -15
5/14/57	NDA	S-3	4 day composite	3.85 x 10 -15
5/21/57	NDA	S-3	2 day composite	4.20 x 10 -15
6/14/57	NDA	S-3	——	4.61 x 10 -15
7/08/57	NDA	S-2	——	3.99 x 10 -15
7/18/57	NDA	S-2	——	3.94 x 10 -15
7/25/57	NDA	S-2	——	6.93 x 10 -15
8/22/57	NDA	S-2	——	8.47 x 10 -15
1/19/59	NYS Dept of Health	S-1	Surface Grab	1.2 ± 0.2 x 10 -8 uc/ml
11/16/61	NYS Dept. of Health	S-1	Surface Grab	0.009 uuc/ml
8/13/69	NYS Dept. of Health	S-3	Surface Grab	4 ± 1 pCi/l
9/09/69	NYS Dept of Health	S-3	Surface Grab	4 ± 1 pCi/l
12/16/69	NYS Dept of Health	S-3	Surface Grab	2 ± 1 Ci/l
1/12/70	NYS Dept of Health	S-3	Surface Grab	2 ± 1 pCi/l
4/22/75	NYS Dept of Health	S-3	Surface Grab	4 ± 2 pCi/l

***See Figure VII - 1 Sample Location Map** for location of sampling points

****** Test results are recorded into the same units reported in the data sources.**

Table 24b - RADIOACTIVITY LEVELS IN STREAM WATER — off the Nuclear Lake Property - Test Results 1959 - 1961 - (7)

Sampling Date	Test Facility	Sampling Location *	Sample Type	Gross Beta
1/19/59	NYS Dept of Health	Whaley Lake Stream at Rt. 216	Surface Grab	3.7 ± 1.6 x 10 -9 uc/ml
	NYS Dept of Health	Whaley Lake Stream	Surface Grab	9.9 ± 1.9 x 10 -9 uc/ml
11/16/61	NYS Dept. of Health	Whaley Lake Stream at Rt. 216	Surface Grab	0.003 uuc/ml
	NYS Dept. of Health	Whaley Lake Stream	Surface Grab	0.002 uuc/ml

***See Chapter II, Figure II - 1 for sampling location**

CHEMICAL, PHYSICAL AND BIOLOGICAL DATA FOR LAKE AND WELL WATER

Tables 25 and 26 summarize all available data for chemical, physical and biological parameters of lake and well water from the UNC property.

Table 25 - summarizes chemical and physical test data for lake water. During 1956 - 1957 data was gathered by the N.Y.S. DEC Bureau of Fish and Wildlife (8). In January 1980, Camo Pollution Control, Inc. (at the request of the Dutchess County Department of Health) conducted a series of tests on the chemical constiuents of the lake water.

Feburary 14, 1980 - an analysis (9) of the January 1, 1980 test by Camo Pollution Control Inc. indicated:

"In our estimation that area of the State is classified as Class D surface water. In comparison to the discharge standards to GA groundwaters the three (3) Nuclear Lake samples appear to be within compliance except for iron (L-5, L-6) and pH (L-5, L-6). Not knowing the origin of the three (3) samples (i.e. discharges to the lake or actual lake samples) this comparison is for reference purposes only. The samples do not appear to be those from a hazardous source, for the parameters investigated, of course no organic constituents were requested for analysis."

TABLE 25 CHEMICAL AND PHYSICAL DATA FOR NUCLEAR LAKE WATER — (8-9)

Test Date	Test Fac.	Samp. Loc.**	Depth	Water Temp.	O 2	PARAMETERS AND RESULTS* pH (in units)	Zinc	Na	Pb	Hg (in ppb)	Chrome + 6	Chrome	Iron	Grease Oil	Toc.	Cl	Cd	Spec. Cond. (in micramhos /cm)
8/08/56	DEC	Lake	1'	79°F	4.0	——												
			10'	71°F	0.5	——												
1/24/57	DEC	L-4	1'	32°F	——	——												
			5'	34°F	10.4	6.0												
2/06/57	DEC	L-4	1'	32°F	——	——												
			5'	39°F	——	——												
			10'	39°F	——	——												
			14'	40°F	9.8	——												
1/18/80	Camo Pollution Control Inc.	L-5	1m		——	5.7	0.11	3.1	0.05	1.3	<0.03	< 0.03	9.01	<0.2	58	42	< 0.01	66
		L-1	1m		——	5.5	0.22	4.5	0.07	3.3	<0.03	< 0.03	20.8	10.0	55	50	< 0.01	69
		L-6	1m		——	6.0	0.06	3.5	0.02	<1.0	<0.03	<0.03	0.50	3.2	23	42	<0.01	65

*All results are expressed in mg/L unless noted otherwise.
**All sampling locations are plotted on FIGURE VII-1 SAMPLE LOCATION MAP

Table 26 - summarizes the chemical, physical and biological data on the Plutonium Facility and Critical Facility well water. Most tests were conducted by NDA (UNC) Chemistry Section (10) (13) and the N.Y.S. Department of Health (11) (12).

TABLE 26 WELL WATER (CHEMICAL PHYSICAL, BIOLOGICAL) DATA; for wells on the Nuclear Lake Property, 1956 - 1959. (10-14)

Sampling or Testing Date	Testing Facility	Sampling Location *	Parameters and Results		
9/13/56	NYS Dept. of Health	(W-1) Pu Lab. Well	Well depth		175 ft.
			Dist. from septic tank		125 ft.
			Dist. from leach field		90 ft.
		(W-2) - Critical Facility (CF) Well	Well depth		167 ft.
			Dist. from septic tank		70 ft.
			Dist. from leach field		85 ft.
11/02/56	UNC (NDA) Chemistry section	(W-1) Pu Lab	Sample 1. pH		6.75
				non-volatiles	129 ppm
				non-volatiles on ignition	54 ppm
11/12/56	UNC (NDA) Chemistry section	(W-1) - Pu Lab	Sample 2. pH		7.0 units
				non-volatiles	66 ppm
				non-volatiles	52 ppm
11/28/56	UNC (NDA) Chemistry section	(W-2) - CF	Sample 1. pH		7.35 units
				non-volatiles	132 ppm
				non-volatiles on ignition	54 ppm
			Sample 2.	non-volatiles	111 ppm
				non-volatiles on ignition	92 ppm
11/19/56	UNC (NDA) Chemistry section	(W-1) - Pu Lab	Sample 1.	Total Hardness	4.3 ppm Ca Co3 or 2.15 grains/gal
			Sample 2.	Total Hardness	4.2 ppm Ca CO3 or 2.10 grains/gal.
		W-2, CF	Sample 1.	Total Hardness	u.1 ppm Ca CO3 or 3.55 grains/gal
			Sample 2.	Total Hardness	7.1 ppm Ca CO3 or 3.55 grains/gal
11/20/56	NYS Dept. of Health	W-2, CF Fountain	Agar Plate Count		> 5000 per m1
			MPN Cof		< 2.2 per 100 m1
1/02/57	UNC (NDA) chemistry section	(W-1) Pu Lab	Sample 1. pH		6.97
				Total Hardness	2.50 grains Ca CO3/gal.
				non-volatiles	26 ppm
			Sample 2.	Total Hardness	2.59 grains Ca CO3/gal
				non-volatiles	18.4 ppm
1/07/57	UNC (NDA) chemistry section	(W-1) Pu Lab	Sample A.	Major Constituents in decreasing amts.	Mg, Ca, Si
				Minor Constituents in decreasing amts.	Cu, Zm, Mm, Fe, Al (trace) Cr none, Ni none
		(W-1) Pu Lab	Sample B.	Major constituents in decreasing amts.	Mg, Ca, Fe, Si, Ni
				Minor Constituents in decreasing amts.	Cu, Zm, Mm, Al, Cr. (trace)
			Sample B	in all cases had more of each element present	

Table 26 Well Water continued on next page

Table 26 Well Water Continued

Sampling or Testing Date	Testing Facility	Sampling Location*	Parameters and Results	
7/24/62	Dut. Co. Dept. of Health	W-1, Pu Lab. Tap in Pump Room - Deep sink	Agar Plate Count	58 per ml
			MPN of Colofirm group	< 2.2 per 100 ml
			Turbidity	7 units
			Color	20 units
			Chlorides	2 ppm
			Nitrates	0 ppm
			Manganese	0.05 ppm
			pH	6.5 units
			Alkalinity	67 ppm
			Hardness	68 ppm
			Copper	< 0.05 ppm
			Odor	0 units
			Taste	0 units
			Carbon Dioxide	44 ppm
			Iron	0.6 ppm
			Conductance	140 micramhos/cm
			Fluorides	< 0.05 ppm
			Ammonia, Free	0.01 ppm
			Nitrites	0.001 ppm
5/01/67	Dut. Co. Dept. of Health	W-1, Pu Lab.	Agar Plate Count	18 per ml
			MPN of Coliform Group	< 2.2 per 100 ml
		W-2, CF	Agar Plate Count	120 per ml
			MPN of Coliform Group	< 2.2 per 100 ml
		(W-1)-Eng Facility (EF)	Agar Plate Count	0 per ml
			MPN of Coliform Group	< 2.2 per 100 ml
9/29/69	Dut. Co. Dept. of Health	(W-1) - Pu Lab. Bathroom sink	Agar Plate Count	12 per ml
			MPN of Coliform Group	< 2.2 per 100 ml
10/10/69	UNC - Assoc. Analytical Lab	(W-1) - Pu Lab	Identification of Residue From Well	iron oxide - Lg. amts. iron sulfides - Lg. amts. Acid-unsoluable siliceous matter - lesser amts.

***All sample locations are plotted on the sample location map (Figure VII- 1)**

A Department of Health analysis (12) of the bacteriological content (Agar Plate Count - MPN Col.) in well water samples taken on 11/20/56, 7/24/62, 5/01/67 and 9/29/69 noted that:

"The bacteriologic examination of the sample of water shows the absence of bacteria of the coliform group and therefore the absence of pollution of animal of human origin and therefore of satisfactory sanitary quality when sample was collected."

RADIOACTIVITY LEVELS IN VEGETATION, FISH AND WILDLIFE

Table 27 - summarizes radioactive test results from 1956 - 1979 on a variety of organisms collected on the UNC property. Results from 1956 - 1957 are from NDA (UNC) Chemistry Section Alalytical Laboratory Reports (15). Results from 1970 - 1979 are from N.Y.S. DEC Annual Reports of Environmental Radiation in N.Y.S. (16) and a special N.Y.S. DEC Nuclear Lake Fish Sampling Report (17).

TABLE 27. RADIOACTIVITY LEVELS IN VEGETATION, FISH AND WILDLIFE FROM NUCLEAR LAKE PROPERTY — Test Results 1956 - 1979 (15, - 17)

Type of Organism	Sampling Date	Sampling Loc. *	Test Facility	Gross Beta (d/m/qm of Body wgt.)	Gross Beta (d/m/gm of ashed material)	Sr-70 (d/m/qm of ashed material)	Other (pCi/kg)
Vegetation	2/24/56	CF and Pu Lab Area	UNC (NDA)	——	690	——	
Land Vegetation	10/25/56	360° Around Building	UNC (NDA)	——	806	——	
Aquatic Plants	10/26/56	Lake	UNC (NDA)	——	557	——	
1-Catfish	1/21/57	Lake	UNC (NDA)	——	110		
1-Fish	2/26/57	Lake	UNC (NDA)	21	601	——	
1-Fish	2/26/57	Lake	UNC (NDA)	——	——	100	
Reeds	3/21/57	Cove Area(L-5)	UNC (NDA)	——	7509	——	
3-Perch 1.	3/22/57	Lake	UNC (NDA)	5	102	——	
2.				5	86	——	
3.				4	78	——	
1-Perch	4/11/57	Lake	UNC (NDA)	64	148	Conc	
Land Vegetation		?	UNC (NDA)	——	429	——	
3 Samples 1.	4/23/57	?	UNC (NDA)	——	429	——	
2.	(2/24/56)			——	393	——	
3.				——	546	——	
Salamanders	4/23/57	?	UNC (NDA)	3	58	——	
Reeds	4/30/57	Cove Area(c-1)	UNC (NDA)	——	139	——	
2-Baby Catfish 1.	5/01/57	Lake	UNC (NDA)	7	135	——	
2.				3	55		
Catfish	5/18/57	Lake	UNC (NDA)	4	118	——	
3-Catfish	7/24/57	Lake	UNC (NDA)	4	69	——	
Bass	6/14/70	Lake	NYS DEC	——	——	——	Cs-137...791 Co-60 ... N.D. Ru-106 ...N.D. Cs-134...N.D. Sr-90 ...177
Flesh-Bass, Bluegill, Pickerel	5/29/74	Lake	NYS DEC	——	——	——	Pu-238 < 0.03 Pu-239 240. < 0.02
Bone - Bass, Bluegill, Pickerel	5/29/74	Lake	NYS DEC	——	——	——	Pu-238...0.6
Bullheads	12/13/79	Lake	NYS DEC	——	——	——	Cs-134 < 10 Cs-137..390 Ru-106..50 K- 40..2800 Pu-238... < 4 Pu-239, 240 < .019

***See Figure VII-1 Sample Location Map** - for location of sampling points.

A N.Y.S. DEC analysis (5a) of the 6/14/70 test result on bass noted:

> "A bass was collected from the pond on the United Nuclear property and analyzed for gamma emitters and strontium-90. The pond receives a small discharge from United Nuclear but mainly receives run-off from precipitation and would be expected to have strontium-90 and cesium-137 from weapons testing fallout. The fish indicates slightly higher results for cesium-137 than some of the larger lakes.

Another N.Y.S. DEC analysis (5c) of 5/29/74 test data indicated that:

> "Although operations at the General Atomic Company, Pawling, New York site ceased in 1973, the Department of Environmental Conservation continued to monitor the air and water. Soil and fish samples were also collected in 1974 after the plant shutdown. No contribution from past plant operations could be found in the air, water or fish."

A third N.Y.S. DEC analysis (17) for samples collected on 12/13/79 reported that:

> "The report indicates that plutonium-238; plutonium-239, 240; cesium-134 and ruthenium-106 were not detected in the sample tested. The 390 picocuries/kg of cesium-137 is considered to be normal for a lake supplied principally by surface drainage and haying very little silt loading. Potassium-40 is a naturally occurring isotope and the value reported is normal. The lab has indicated that there were problems with the perch samples and the tests are being re-run. The results will be available at a later date."

RADIOACTIVITY LEVELS IN AIR

From 1956 - 1969 routine analysis of air samples and fallout activity of the UNC facility were conducted by the UNC personnel. During the late 1950's and early 1960's records (19) show that UNC performed daily background counts on air samples and analyzed fallout papers every 24 to 48 hours. In later years fallout samples from several locations on the UNC property were analyzed on a weekly and monthly basis. The test results for these years of analysis are too extensive to include in this study but are readily available.

Table 28 - summarizes data taken from N.Y.S. DEC, Annual Reports of Environmental Radiation in New York State (5a - 5g) from 1970 - 1976.

Table 28 — Radioactivity Levels in Air Samples From Nuclear Lake Property — Test Results 1970-1974. 1970 - 1974 (5a - 5e)

Sampling Date	No. of Samples		Results (In pCi/m3) Gross Beta	Pu-238	Pu-239, 240
1970	36	Avg.	0.21		
		Max.	0.51		
		Min.	0.06		
1971	49	Avg.	0.27		
		Max.	0.79		
		Min.	0.03		
1972	44	Avg.	0.09		
		Max.	0.30		
		Min.	0.02		
1973					
2/23 - 3/02				1.6×10^{-4}	$< 8 \times 10^{-5}$
3/23 - 3/30				1.1×10^{-4}	1.9×10^{-3}
4/20 - 5/18				$4 \pm 2 \times 10^{-5}$	1.3×10^{-4}
5/18 - 6/18				$< 9 \times 10^{-6}$	$< 7 \times 10^{-6}$
6/18 - 7/13				$< 4 \times 10^{-5}$	$< 9 \times 10^{-6}$
7/13 - 8/03				1.1×10^{-4}	$9 \pm 4 \times 10^{-5}$
9/07 - 10/12				$< 5 \times 10^{-5}$	$< 6 \times 10^{-5}$
10/12 - 11/09				$< 2 \times 10^{-5}$	1.0×10^{-4}
11/09 - 11/30				$< 2 \times 10^{-5}$	$< 1 \times 10^{-5}$
11/30 - 1/04				$< 1 \times 10^{-5}$	$< 2 \times 10^{-5}$
1974	10	Avg.	0.05		
		Max.	0.10		
		Min.	0.03		
1/04/74-2/01/74				$< 2 \times 10^{-5}$	$< 4 \times 10^{-5}$
2/01/74-3/22/74				$< 6 \times 10^{-6}$	1.5×10^{-5}

A N.Y.S. DEC analysis of their 1973 test data indicates:

> "The results indicate plutonium in the on-site air samples that may be due to operations at the site. The yearly average concentation of plutonium, including that from weapons testing, was 0.2% of the allowable USAEC limit.
>
> The small air flow rate used for the air particulate sampler, approximately one cubic foot per minute, does not provide the necessary sensitivity to clearly distinguish between plutonium in weapons testing fallout and low levels of plutonium originating on-site. The installation of a high volume sampler to provide the improved sensitivity was being considered but was not installed as the plant operation was discontinued in 1973.
>
> Decommissioning of the site was started in October 1973. Buildings and grounds have been decontaminated. The State is evaluating levels of plutonium in soil samples before releasing the site for general use."

Additional data relating to air sampling can be found in Chapter V, page 89 and Chapter VI, pages 98 and 102.

RADIOACTIVITY LEVELS IN SOIL AND MUD

All available data on radioactivity levels in soil and mud samples collected on the Nuclear Lake property can be found in the text of Chapter VI and Tables 14, 15, 16, 17, 18, and 19.

A N.Y.S. DEC analysis (5c) of the data in Table 17 indicated:

> "Residual levels of plutonium-238 and plutonium-239 were detected in the soil immediately adjacent to the plutonium facility onsite. Prior to release of the land for unrestricted use, the Department recommended to the Nuclear Regulatory Commission the decontamination of areas containing the higher concentrations of plutonium. Decontamination was carried out by the General Atomic Company and the land was released for unrestricted use by the Nucelar Regulatory Commission on July 14, 1975.

REFERENCES

1. NDA - Nuclear Development Corporation of America, Chemistry Section, Analytical Reports; nine separate reports. Source; NDA Log Book.

2. NYS Dept. of Health, Radiologic Laboratory Determination Reports; thirty-five separate reports; dated from 1963 - 1965. Source: Dutchess County Dept. of Health.

3. NYS Dept. of Health memo; March 6, 1968.

4. NYS Dept. of Health Radiologic Laboratory Determination Reports; ten separate reports; dated from January 1968 - December 1968.

5. Annual Report of Environmental Radiation in New York State; NYS Dept. of Environmental Conservation:

5a - 1970	Annual Report;	56 pp.	06/18/71
5b - 1971	Annual Report;	45 pp.	07/07/72
5c - 1972	Annual Report;	50 pp.	RAD-P3 (04/74)
5d - 1973	Annual Report;	64 pp.	RAD-P3 (8c-09/74)
5e - 1974	Annual Report;	67 pp.	RAD-P3 (800-03/76)
5f - 1975	Annual Report;	66 pp.	RAD-P3 (600-07/77)
5g - 1976	Annual Report;	60 pp.	RAD-P3 (06/79)

6. NDA - Nuclear Development Corporation of America, Chemistry Section, Analytical Laboratory Reports; fifteen separate reports dated from 03/05/57 - 08/22/57. Source: NDA Log Book.

7. NYS Dept. of Health Radiologic Laboratory Determination Reports; seven separate reports; dated from 01/19/59 - 04/22/75. Source: Dutchess County Dept. of Health.

8. NYS Dept. of Environmental Conservation Fish Stocking Report; Bureau of Fish and Wildlife; 10/31/56.

9. Analysis of Nuclear Lake Samples - Camo Pollution Control Inc., Hyde Park, N.Y. 02/14/80.

10. NYS Dept. of Health Water Supply Information Reports; 09/13/56 and 11/20/56. Source: Dutchess County Dept. of Health.

11. Dutchess County Dept. of Health; Bacteriological Examination of Water Reports; six separate reports; dated from 07/24/62 - 09/29/69.

12. Analysis of Water Supply for United Nuclear Corporation - Dutchess County; City of Kingston Laboratory, Kingston, N.Y.; 07/30/62.

13. NDA - Weekly Report for the General Chemistry Group; 10/05/56.

14. NDA - Nuclear Development Corporation of America, Chemistry Section, Analytical Laboratory Reports; four separate reports; dated Jaunuary 1957. Source: NDA Log Book.

15. NDA - Nuclear Development Corporation of America, Chemistry Section, Analytical Laboratory Reports; sixteen separate reports; dated 02/24/56 - 07/24/57. Source: NDA Log Book.

16. Same as Reference 5a and 5c.

17. NYS Dept. of Health memo and Radiologic Laboratory Determination Report; 04/21/80.

18. NYS Dept. of Health memo; 04/25/68.

VIII. The Aerial Radiologic Survey

EG&G
Energy Measurements Group

Summary Report
The Aerial Radiologic Survey
Of
The United Nuclear Facility
At
Nuclear Lake Near Pawling, New York
Date of Survey: May 1980

Approved For Publication

J. Robert Mueller, EG&G, Inc.

Herbert F. Hahn, Department of Energy

Performed by EG&G, Inc. Under
Contract No. De-AM-80-76Nvoii83
with the United States Department of Energy

WAMD - 011
September 5, 1980

METHOD

The aerial Measurements System operated by EG&G, Inc., for the United States Department of Energy, was used to conduct an Aerial Radiologic Survey over the decommissioned United Nuclear Corporation facility near Pawling, New York, in May 1980. The purpose of this survey was to establish if any fixed gamma photon emitting material(s) was present at this site and if so, to affect precise location and quantification of such material(s).

To this end, a Boeing 105 helicopter, fitted with gamma radiation detection equipment, was flown in routinely employed, standard operative manner (in re height, speed, navigational parameters, etc.) over the area shown in Figure VIII-I.

For this particular survey, two distinct operative modes of gamma detection were employed; Mode 1 (M_1 -- high energy (50 KEV-3000 KEV) and Mode 11 (M_{11}) -- low energy (12 KEV-300-KEV). M_1 represents that region of energy where most man-made gamma emitting radionuclides would normally be detected. M_{11} represents that energy region where gamma radiation indicative of most transuranic activity would be detected. Since Plutonium activity was the major activity of interest, and indirect method of detection was necessary. Plutonium is primarily an alpha (a) emitter; thus direct detection and quantification with the airborne system used was not feasible. Therefore, the M_{11} mode was utilized in an effort to detect ^{241}Americium, a gamma photon emitting daughter product of the Plutonium activity. Furthermore, an effort was made to enhance the detectability of low energy gamma emitting radioactivity by having the helicopter hover over the formerly used laboratory buildings near the lake. This was done to increase the counting time over the locations most likely to be the site of a possible radioactive source, thus increasing the probability of detection. In analyzing the gamma radiation activity data thus obtained, normal environmental (natural background) gamma radiation was subtracted rendering an accurate assay of any fixed gamma radioactivity.

ANALYSIS

Subsequent analysis of collected data clearly indicate that no man-made gamma photon activity (M_1) above normal environmental background levels was detected. Additionally, the airborne system employed detected no evidence of transuranic activity (M_{11}).

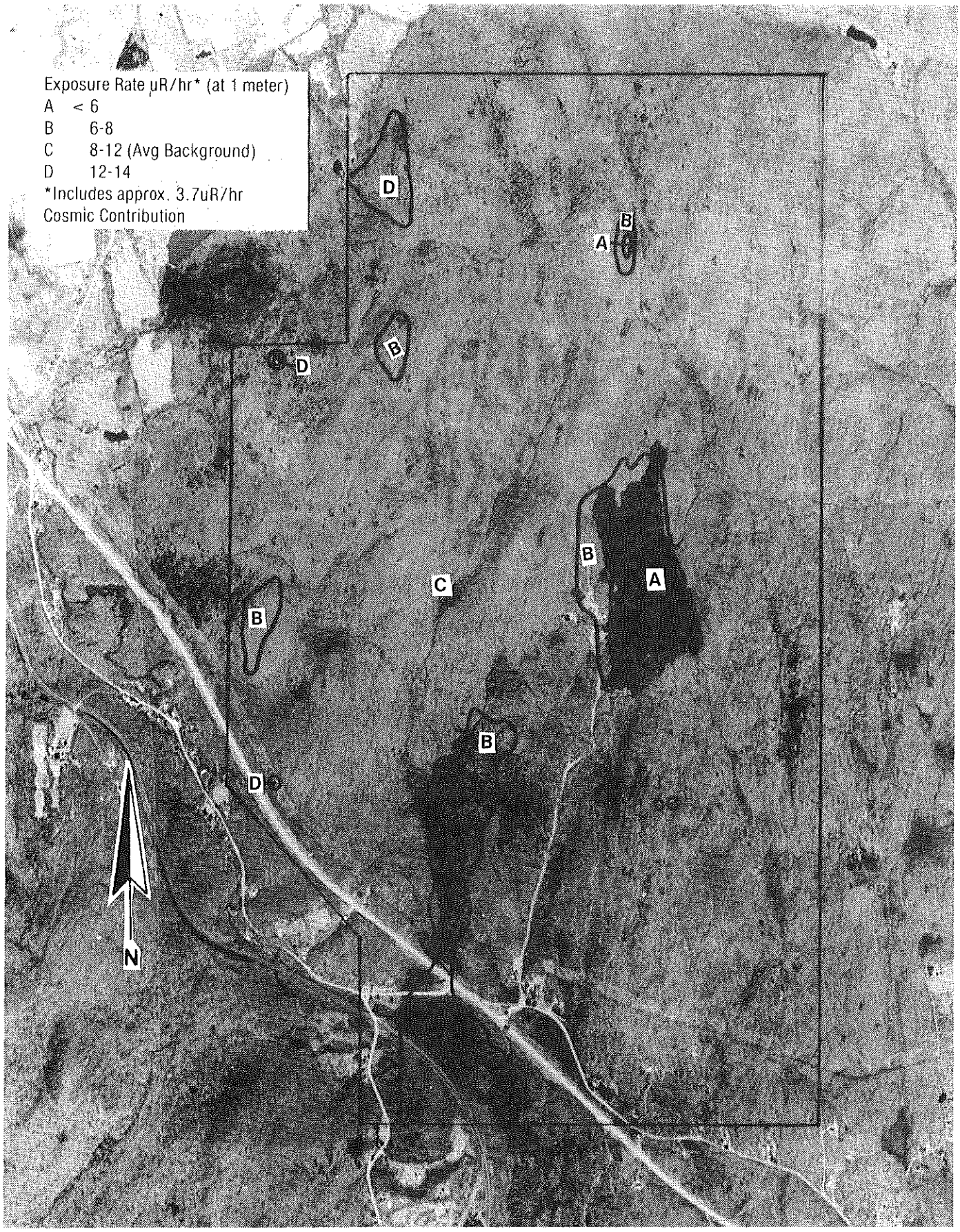

Figure VIII-1. Aerial Radiologic Survey Area

IN ADDENDUM:

Gamma radiation exposure levels* within the survey area vary from approximately 6 μR/hour (A level) over submerged regions to a maximum of 14 μR/hour (D level) over other areas. These variations are reasonable and compatible with the geology of the survey area. Terrestrial gamma radiation emanating from the lake bottom has been absorbed or attenuated by the lake water (A level) while higher activity (D level) is characteristic of the outcroppings of strata that occur in the area.

The average (C level) exposure rate range measured for the overall survey areas is 8 - 12 μR/hour. These levels are in reasonable agreement for the state average of 12 μR/hour.

(*) All exposure rates are normalized for one (1) meter above ground level.