



# MILLER ENGINEERING & TESTING INC.

GEOTECHNICAL / SOIL BORINGS / ENVIRONMENTAL / SOILS / CONCRETE / MASONRY / STEEL / ROOFING / ASPHALT INSPECTION

Via email: [gengler@s-e-b.com](mailto:gengler@s-e-b.com); [cquinn@allenmajor.com](mailto:cquinn@allenmajor.com)

July 29, 2020

Mr. Geoffrey Engler  
SLV SCHOOL STREET, LLC  
257 Hillside Avenue  
Needham, Massachusetts 02494

RE: Geotechnical Reconnaissance  
Proposed MBTS Apartments  
School Street  
Manchester-By-The-Sea, Massachusetts

Project No. 20.119.NH

Dear Mr. Engler:

Miller Engineering & Testing, Inc. is pleased to submit this geotechnical reconnaissance report for the development proposed for the Lot 18 property on School Street in Manchester-By-The-Sea, Massachusetts (referred to as the "Site" in this report). This evaluation was completed in general accordance with our proposal, dated July 7, 2020 (Ref. File 220-20). The contents of this report are subject to the limitations in Attachment A.

## 1.0 Site and Proposed Development

The MBTS Apartments development is proposed for the northerly portion of Manchester parcel 43-0-18, with a street address of 0 School Street, in the northern side of Manchester-By-The-Sea, Massachusetts. Figure 1 of this report is a Site Location Map depicting the location of the Site on a 7.5-minute topographic quadrangle. Our current understanding of the existing conditions and the proposed Site layout and grades is based on examination of:

- "Site Concept Plan (Sheet A00), MBTS Apartments, Lot 18 – School Street, Manchester-By-The-Sea, MA" (dated 04/15/2020), as prepared by EMBARC Studio, LLC. of Boston, Massachusetts;
- "Grading & Drainage Plan (Sheet C-103), Exploratory Test Pit Activities, 0 School Street, Manchester-By-The-Sea, MA" (undated), as prepared by Allen & Major Associates, Inc. of Woburn, Massachusetts; and
- "Existing Conditions, Sheet V-101, Assessors Map 43, Lot 18, School Street, Manchester-By-The-Sea, MA" (dated 04/15/2020), also prepared by Allen & Major Associates, Inc. of Woburn, Massachusetts.

Review of the design plans from EMBARC and Allen & Major indicates that the MBTS Apartments would be a 4-story apartment complex with a one-level below-grade parking garage. The proposed development would have roadway access from School Street on an access driveway that would rise from approximate elevation 50 feet above Mean Sea Level (MSL) at School Street to the ground floor of the building at approximate elevation 125 feet MSL and the parking garage (slab elevation of 114 feet MSL).



## 2.0 Historical Information

Allen & Major encountered undocumented fill materials (possibly construction and demolition debris) in some of their test pits along the northerly side of the Site property (Figure 2). In order to determine the approximate time frame that the Site was used as a source of sand and gravel, and possibly filling, we obtained aerial photographs and satellite images from EDR, Inc. of Shelton, Connecticut and on-line historical topographic maps from the U.S. Geological Survey. These are included as Attachment B of this report. Examination of the historical maps and aerial photographs indicates:

- The westerly portion of the Site appears to have been operated as a sand and gravel pit from the 1960s to the 1980s.
- During that period, the Site had direct access to School Street; however, it appears that the primary access was from Old School Street.
- The 1969 photograph appeared to depict the maximum extent of the sand and gravel workings.
- By the time of the 1986 photograph, it appears that the Site was no longer used to provide sand and gravel, but may have been in use for disposal.
- Older aerial photographs (from 1938 and 1956) suggest that the Site had been explored for sand and gravel resources, but extensive extraction had not yet begun.
- The maps and aerial photographs did not depict any equipment or facilities (temporary or permanent) during the time the Site was used as a sand and gravel operation.
- Since the 1985 and 1986 images and maps, the Site has been revegetating into today's woodlands.

## 3.0 Site Reconnaissance

We performed a reconnaissance of the Site on 17 July 2020. Our observations are:

- There is an area of fill materials in the north side of the Site. The fills consisted chiefly of boulders and blocks of bedrock, possibly up to 5 feet thick. We also observed automobile parts, a heating oil tank, fragments of concrete slabs and asphalt pavements, and concrete blocks. Electric power was supplied to the Site by an overhead line that was observed on the ground but still connected to a pole on-site (pole #1-56/2). The fills appeared to resemble debris and construction wastes from small-scale roadway improvement projects.
- Topsoil is very thin, and averaged about 6 to 12 inches across the Site.
- The surficial, unconsolidated deposits consist of sand and gravel, probably directly overlying bedrock. The sand and gravel deposit contains an abundance of boulders, and most of the boulders are 3 to 5 feet in longest dimension (with some even larger).
- The sand and gravel deposit appears to have been deposited below elevation 140 feet MSL, based on the topography of the Site, features depicted on Allen & Major's



Existing Conditions Plan, and the extent of the sand and gravel workings that we observed.

- We observed bedrock exposures at the top of the hill; Site elevations higher than approximately 140 feet MSL are bedrock with a very thin layer of topsoil. Bedrock was also exposed at the north (low) end of the hill, at approximate elevations 55 to 65 feet MSL.
- We observed bedrock exposures at several nearby properties and along Route 128. At each, the rock had been blasted and excavated to reveal the rock structure. The bedrock exhibits a number of dominant fracture orientations that could control the breaking of the rock during blasting and the stability of rock-cut slopes.
- We did not observe water, either as surface waters or as groundwater seeps or discharges, during our reconnaissance.

#### **4.0 Laboratory Testing**

We collected bulk samples of the sand and gravel deposit soils from two locations at the Site within the former sand and gravel workings. Laboratory analyses indicate that the sand and gravel deposit is a well-graded soil (Unified Soil Classification System designations SP and SW, with a fines content (silt and clay fractions combined) of approximately 18 percent). The soil texture is a gravelly loamy sand, as determined using Natural Resource Conservation Service protocols (Attachment C).

#### **5.0 Engineering Evaluation**

Our visual observations and review of Allen & Major's test pits indicate that the Site is formed of 6 to 12 inches of topsoil overlying silty sand and gravel with shallow bedrock. The northwestern portion of the Site property is an area of fill materials, composed largely of boulders with some construction debris, that could be 5 to 6 feet thick in localized areas.

The silty sand and gravel soils appear to be exposed at the lower elevation portions of the Site (areas below approximately 140 feet MSL). We observed no indications of marine clay on the Site property; however, the adjacent lower lying wetlands could be underlain by soft marine clay deposits.

The bedrock is a coarse-grained alkali feldspar granite, which has been designated the "Cape Ann Granite" formation. This bedrock typically forms strong, near-vertical cuts when properly blasted and excavated using controlled (pre-split) techniques. However, location specific joint-sets will dictate the safe bedrock face slope angle that will minimize wedge, planer, and toppling failures.

#### **6.0 Site Design Recommendations**

Based on our visual observations and review of Site civil engineering plans, we present the following preliminary recommendations for the design of the MBTS Apartments on Lot 18 in Manchester-By-The-Sea, Massachusetts.

##### **6.1 Site Grades and Slopes**

Examination of the Site grading plans indicates that cuts into the unconsolidated soil formations and the bedrock will be required to achieve the design elevations (Figure 3):



- Cuts of approximately 25 to 30 feet into the bedrock will be needed within the proposed building footprint.
- Cuts into the Site soil formations appear to be approximately 25 to 45 feet at the access driveway near School Street.
- Fills of up to about 15 feet will be needed to reach the driveway subgrade elevation along the Site westerly side.
- Higher sidehill fills will be needed east and west of the proposed building footprint.

Slopes constructed from the on-site silty sand and gravel soils (or from imported borrow soils) could be designed as unreinforced soil slopes at maximum slope angles of 2H:1V (26° from the horizontal) when constructed of engineered fills properly placed and compacted under observation of a geotechnical engineer. Steeper slopes, up to 1½H:1V (34° from the horizontal), could be constructed as reinforced soil slopes. The sidehill fills will need to be keyed into the existing slope soil and bedrock formations during placement and compaction of each lift of material. All final slope surfaces must be protected from erosion using a rip rap facing or an erosion control matting system.

## 6.2 *Rock Slopes*

If the final design includes rock-cuts, the design geotechnical report should include an analysis of the stability of proposed rock cuts that will be higher than 15 feet. Rock cuts will require rockfall catchments along the bottoms of the rock cuts; the width of the catchments will be controlled by the height of the cuts and the strength and stability of the rock. Note that it appears that the current preliminary Site design does not require permanent rock cut slopes.

## 6.3 *Foundation Conditions*

Based on the Allen & Major Grading & Drainage Plan (Sheet C-103), it appears that all, or most, of the building footprint would be founded in bedrock that will have to be blasted to achieve the design grades (Figure 3). These subsurface conditions should be confirmed with test borings advanced during the final design geotechnical investigation. The test borings will be used to determine the bearing capacity for the building foundation design.

## 6.4 *Groundwater and Drainage Considerations*

We did not observe any indications of groundwater seeps or springs. We expect that groundwater will not be encountered during the general Site grading and earthwork. However, the deep cuts within the proposed building footprint could encounter groundwater within the bedrock. This could require installation of foundation drains, vapor barriers, and/or subslab drains below the parking garage slab. Observation wells should be installed within the bedrock during the design phase geotechnical investigation that will allow for periodic measurements of the groundwater elevations that will be encountered in the bedrock during construction.

Stormwater management could potentially be accomplished with open or underground basins that infiltrate water into the underlying silty sand and gravel formation. The depth to bedrock and the infiltration capacity of the silty sand and gravel soils will need to be determined during the Site design phase. The potential for groundwater mounding within the Site soils (below the infiltration systems) could be a requirement of the design and permitting of the stormwater management systems.



## 6.5 Reuse of Site Materials

A preliminary assessment of the suitability of using the unconsolidated soils and the bedrock at the Site in the proposed construction is based on the soil classifications and observations at the Site. The suitability of these materials is summarized below.

1. The topsoil is not suitable for reuse except in landscaping areas and should be stripped completely from the roadway and building footprint areas, as well as areas proposed for engineered fills.
2. The Fill Materials appeared to consist chiefly of boulders and blasted ledge blocks, with frequent fragments of concrete slabs, concrete blocks, asphalt pavements, and refuse. After culling the metals and refuse, the remaining materials could potentially be processed and blended with the blasted bedrock and the silty sand and gravel soils to produce a suitable material for reuse in the engineered fills on-site.
3. The naturally occurring silty sand and gravel soils would likely be suitable for reuse as engineered fill materials with minimal processing. These soils do contain a significant number of large boulders that could be crushed and blended into the silty sand and gravel for reuse as raise-in-grade fills.
4. The granite bedrock could potentially be crushed and processed into a number of materials for reuse in the proposed construction (for example, engineered fills, crushed stone products, or riprap for slope facings). Samples of the rock should be tested for durability (using the Los Angeles Abrasion test method).

We appreciate the opportunity to provide these geotechnical engineering services to you and the MBTS project. If you have any questions or require additional information, please contact us at (603) 668-6016 or at [kmilender@millerengandtesting.com](mailto:kmilender@millerengandtesting.com).

Very truly yours,  
MILLER ENGINEERING & TESTING, INC.



Kenneth W. Milender, P.G., P.E.  
Senior Geotechnical Engineer

A handwritten signature in blue ink, likely of Frank K. Miller, P.E. The signature is stylized and written in cursive. To the right of the signature is the word "for" in a bold, italicized font.

Frank K. Miller, P.E.  
Executive Vice President

Attachments





Source: A portion of the U.S.G.S. Salem, MA 7½- x15-minute topographic quadrangle map (1985).

## GEOTECHNICAL RECONNAISSANCE

Proposed MBTS Apartments  
School Street  
Manchester-By-The-Sea, MA  
July, 2020  
Miller Project No. 20.119.NH

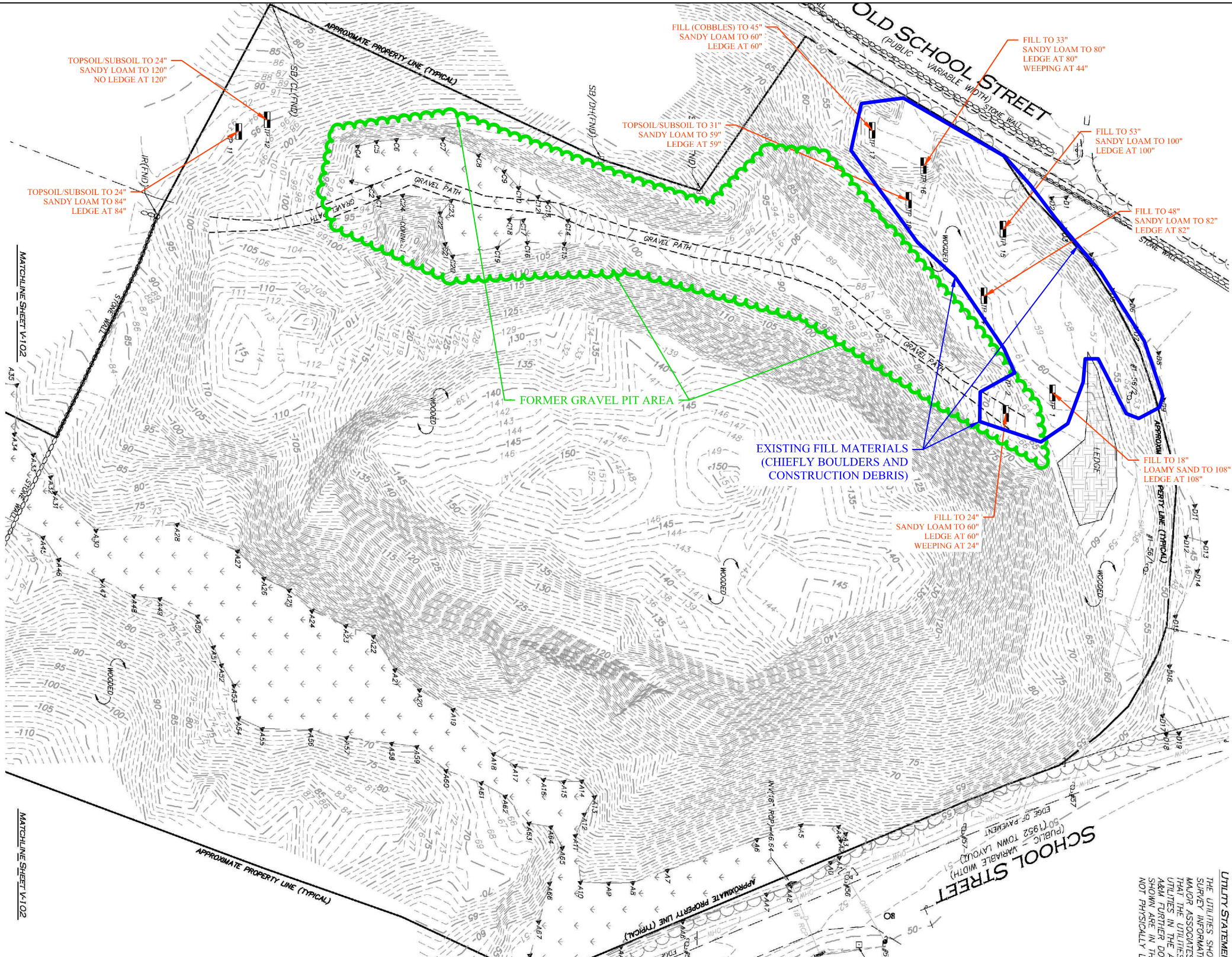
## SITE LOCATION MAP

# FIGURE 1



NOTES

- 1. This plan is a reproduction of portions of "Existing Conditions Plan, Manchester, MA", (dated April 15, 2020) by Allen & Major Associates, Inc. of Woburn, MA.
- 2. Fill boundaries are based on our visual observation and Allen & Major's Test Pits.



UTILITY STATEMENT  
THE UTILITIES SHOWN  
ON THIS PLAN ARE  
BASED ON THE  
INFORMATION  
PROVIDED BY  
THE OWNER AND  
ARE NOT  
GUARANTEED  
BY THE ENGINEER.

**MILLER ENGINEERING & TESTING, INC.**

100 SHEFFIELD ROAD - PO BOX 4776  
MANCHESTER, NEW HAMPSHIRE 03108  
TEL (603) 668-6016 // FAX (603) 668-8641

**MBTS Apartments**  
Manchester, MA  
July 2020  
Project No. 20.119.NH

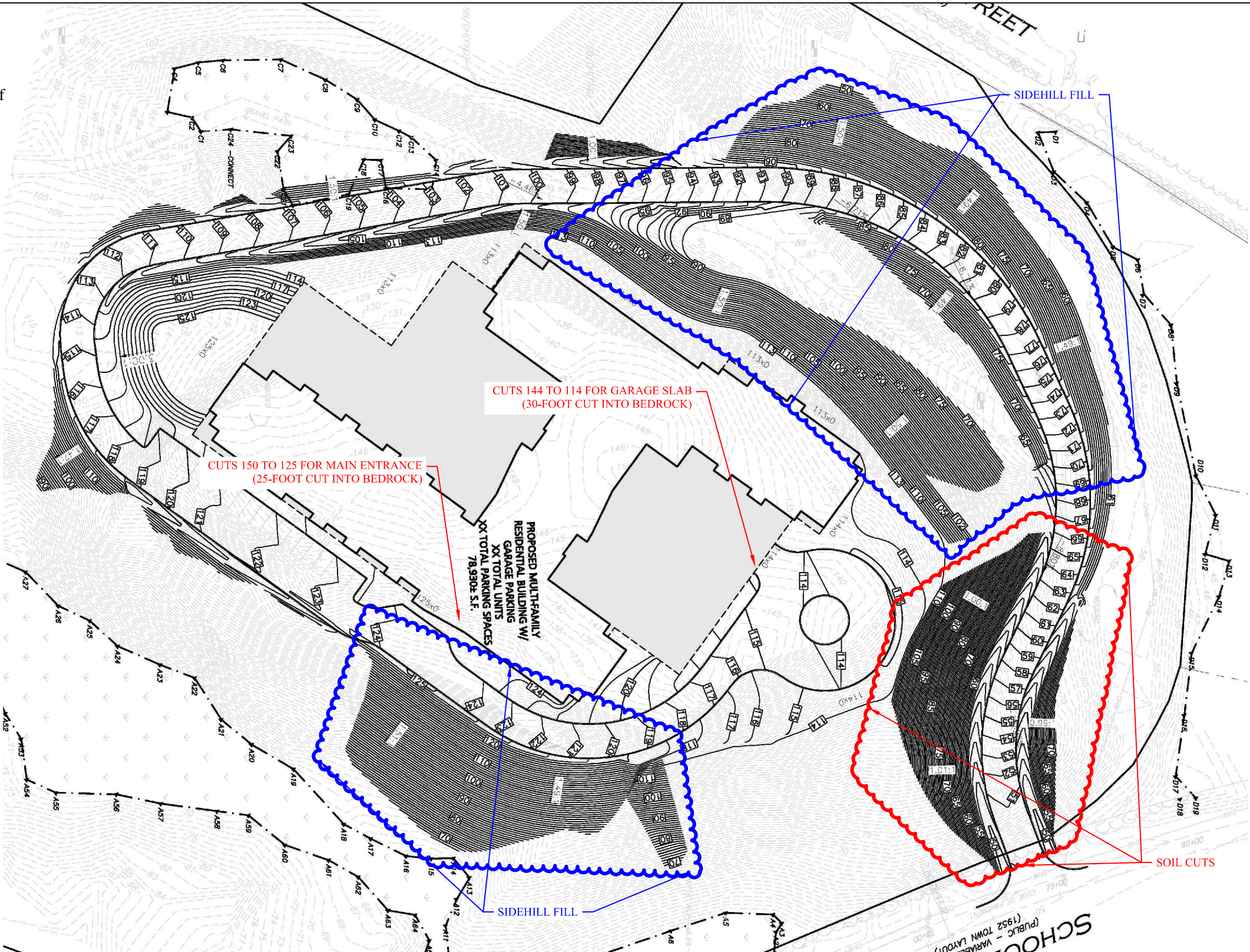
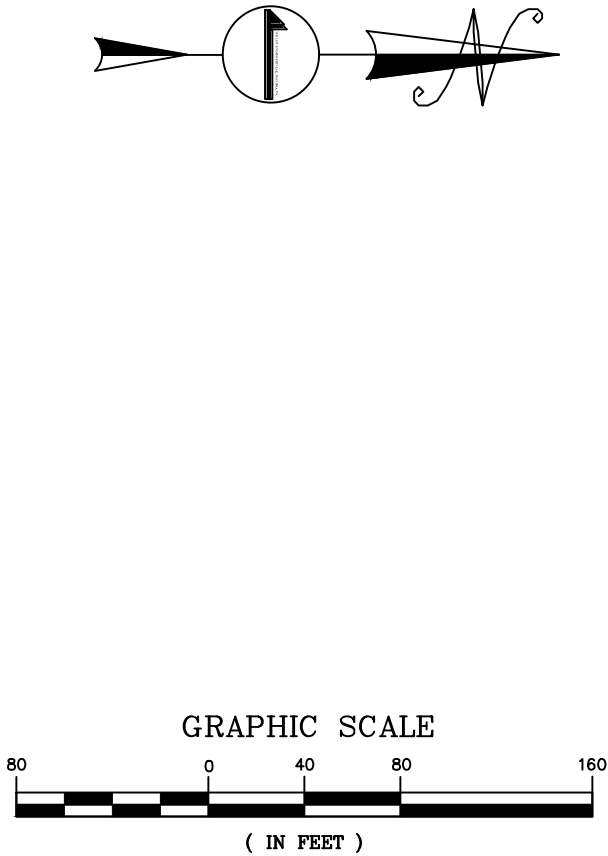
**EXISTING  
CONDITIONS AND  
TEST PIT LOCATIONS**


**FIGURE No.**  
**2**



NOTES

1. This plan is a reproduction of portions of "Grading & Drainage Plan, Manchester, MA", (not dated) by Allen & Major Associates, Inc. of Woburn, MA.



 MILLER ENGINEERING & TESTING, INC.

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MANCHESTER, NEW HAMPSHIRE 03108  
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MBTS Apartments  
Manchester, MA  
July 2020  
Project No. 20.119.NH

PROPOSED SITE  
LAYOUT

FIGURE No.  
3



## **ATTACHMENT A**

### **Limitations**



## **LIMITATIONS**

### Explorations

1. The analyses, recommendations and designs submitted in this report are based in part upon the data obtained from subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.
2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and have been developed by interpretation of widely spaced explorations and samples; actual soil transitions are probably more gradual. For specific information, refer to the boring logs.
3. Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors differing from the time measurements were made.

### Review

4. It is recommended that this firm be retained to review final design plans and specifications. In the event that any changes in the nature, design, or location of the structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of the report modified or verified in writing by Miller Engineering & Testing, Inc.

### Construction

5. It is recommended that this firm be retained to provide soils engineering services during the excavations and foundation construction phases of the work. This is to observe compliance with the design concepts, specifications, or recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

### Use of Report

6. This report has been prepared for the exclusive use of **SLV SCHOOL STREET, LLC** for the proposed **MBTS Apartments** at **School Street** in **Manchester-By-The-Sea, Massachusetts** in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.
7. This soil and foundation engineering report has been prepared for this project by Miller Engineering & Testing, Inc. This report was completed for design purposes and may be limited in its scope to prepare an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to design considerations only.



## **ATTACHMENT B**

Historical Maps and Aerial Photographs





## **MBTS Apartments**

School Street

Manchester, MA 01944

Inquiry Number: 6120693.1

July 14, 2020

# **The EDR Aerial Photo Decade Package**



6 Armstrong Road, 4th floor  
Shelton, CT 06484  
Toll Free: 800.352.0050  
[www.edrnet.com](http://www.edrnet.com)



## EDR Aerial Photo Decade Package

07/14/20

**Site Name:**

MBTS Apartments  
School Street  
Manchester, MA 01944  
EDR Inquiry # 6120693.1

**Client Name:**

Miller Engineering, Inc.  
100 Sheffield Road  
Manchester, NH 03108  
Contact: Ken Milender



Environmental Data Resources, Inc. (EDR) Aerial Photo Decade Package is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's professional researchers provide digitally reproduced historical aerial photographs, and when available, provide one photo per decade.

### Search Results:

<u>Year</u>	<u>Scale</u>	<u>Details</u>	<u>Source</u>
2016	1"=500'	Flight Year: 2016	USDA/NAIP
2012	1"=500'	Flight Year: 2012	USDA/NAIP
2008	1"=500'	Flight Year: 2008	USDA/NAIP
1995	1"=500'	Acquisition Date: March 29, 1995	USGS/DOQQ
1986	1"=500'	Flight Date: April 01, 1986	USDA
1978	1"=500'	Flight Date: April 23, 1978	USGS
1969	1"=500'	Flight Date: April 09, 1969	USGS
1960	1"=500'	Flight Date: May 19, 1960	USGS
1952	1"=500'	Flight Date: August 26, 1952	USDA
1938	1"=500'	Flight Date: November 10, 1938	USGS

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INQUIRY #: 6120693.1

YEAR: 2016

— = 500'







INQUIRY #: 6120693.1

YEAR: 2012

— = 500'







INQUIRY #: 6120693.1

YEAR: 2008

— = 500'







INQUIRY #: 6120693.1

YEAR: 1995

— = 500'







INQUIRY #: 6120693.1

YEAR: 1986

— = 500'







INQUIRY #: 6120693.1

YEAR: 1978

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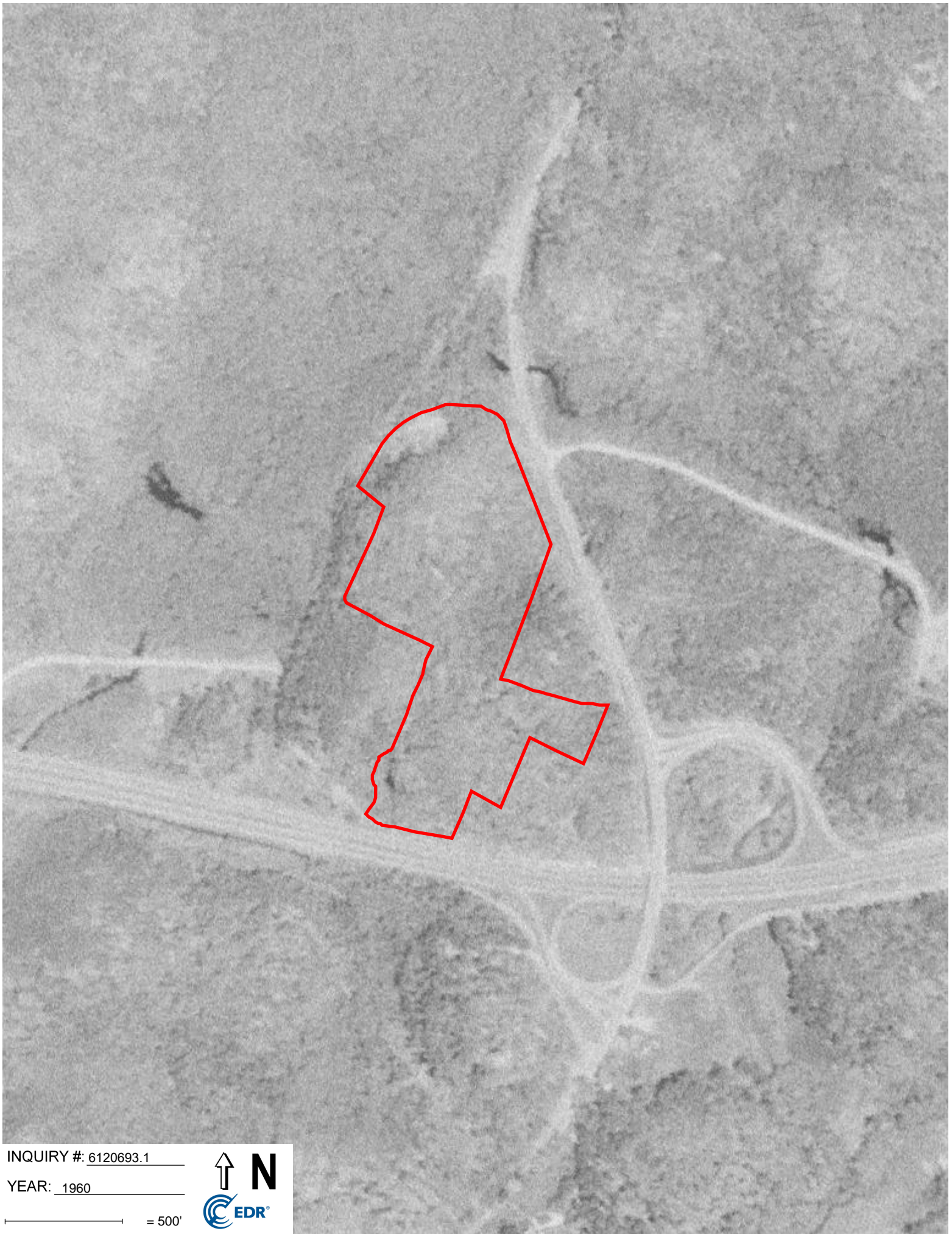
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YEAR: 1969

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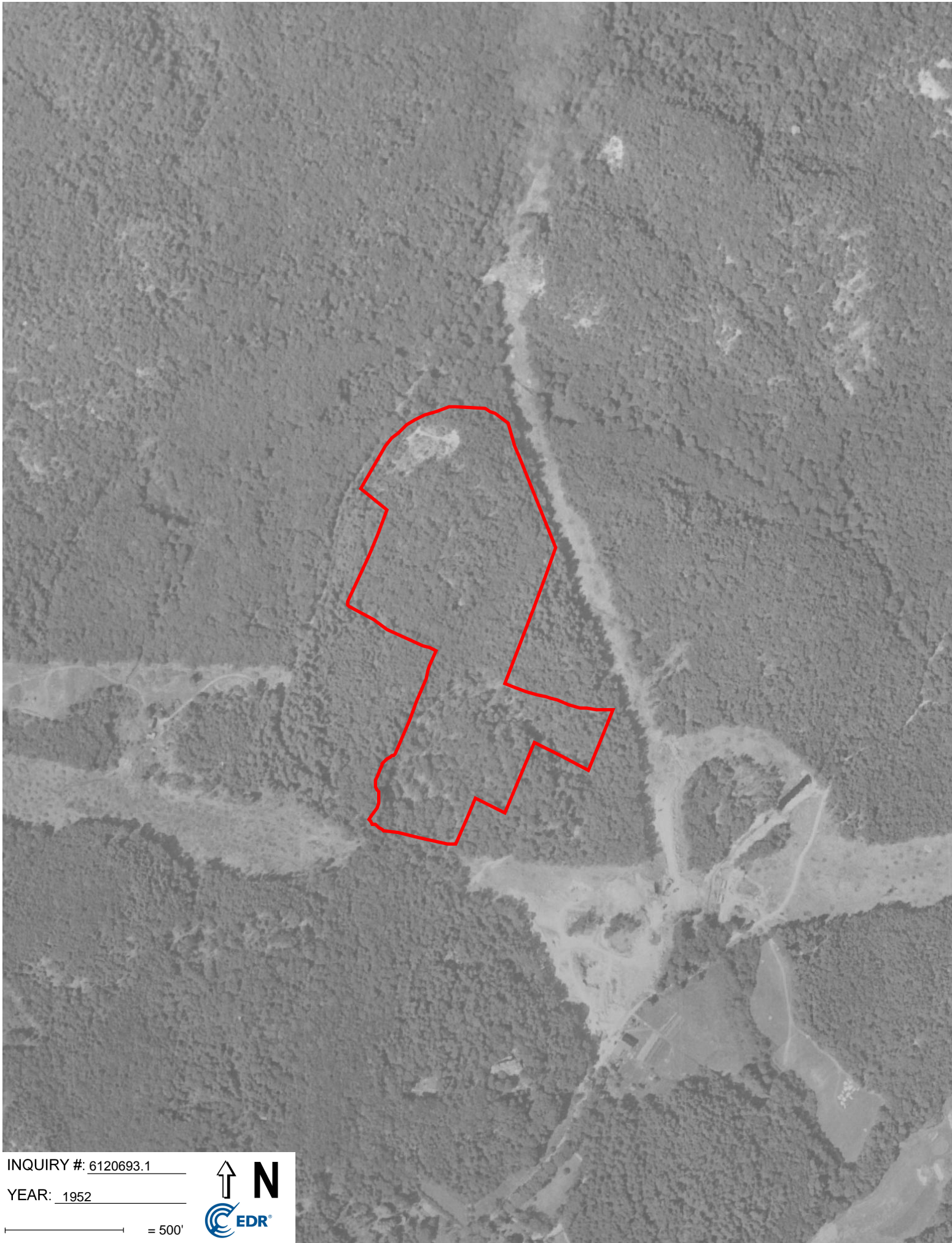
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YEAR: 1960

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INQUIRY #: 6120693.1

YEAR: 1952

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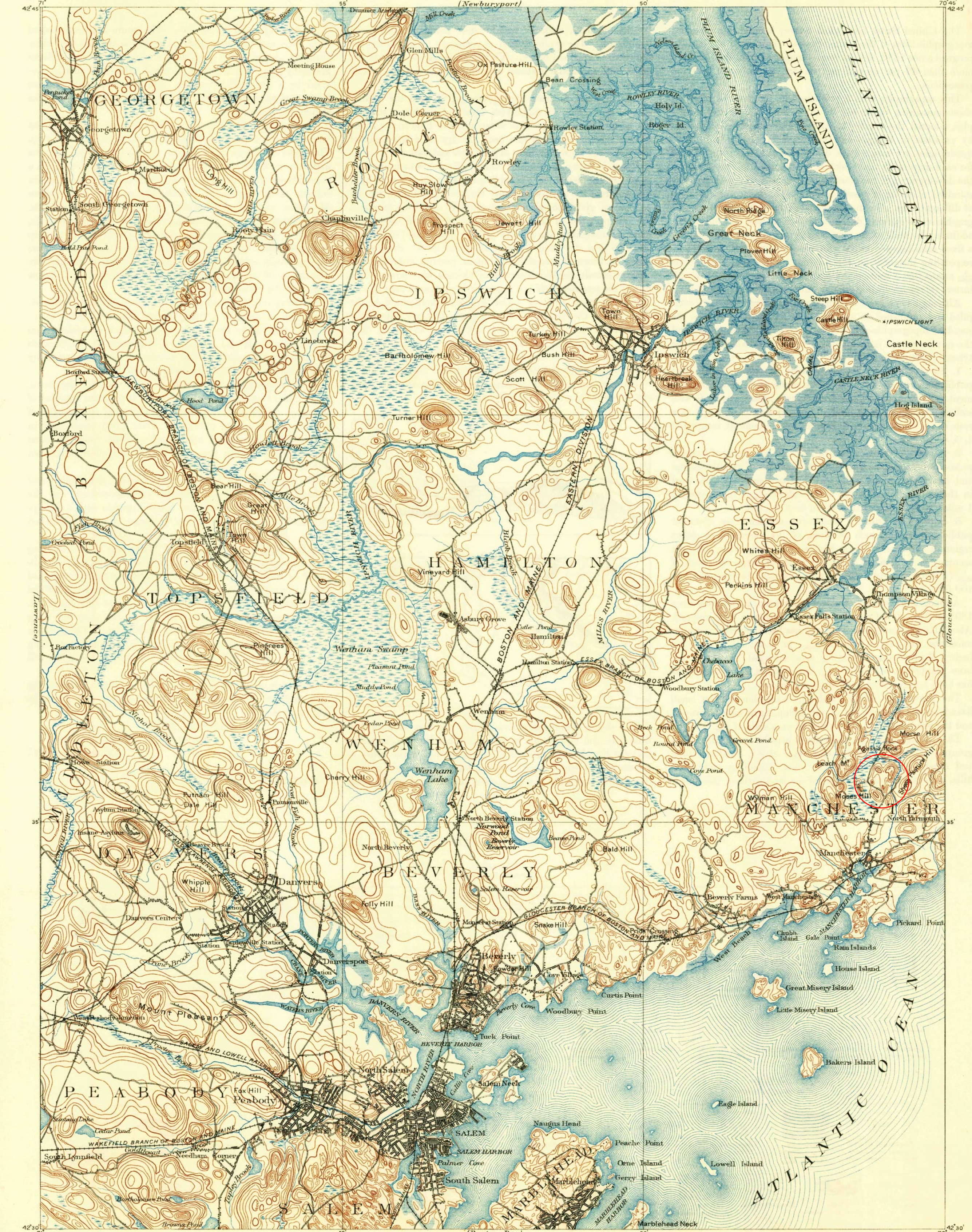
Henry Gannett, Chief Geographer.  
Marcus Baker, Geographer in charge.  
Triangulation by the U.S. Coast and Geodetic and Borden Surveys.  
Coast line by the U.S. Coast and Geodetic Survey.  
Topography by E.W.F. Natter.  
Surveyed in 1886.

U. S. G. S.  
**FILE COPY**  
Ed. Div. Topographic Maps.

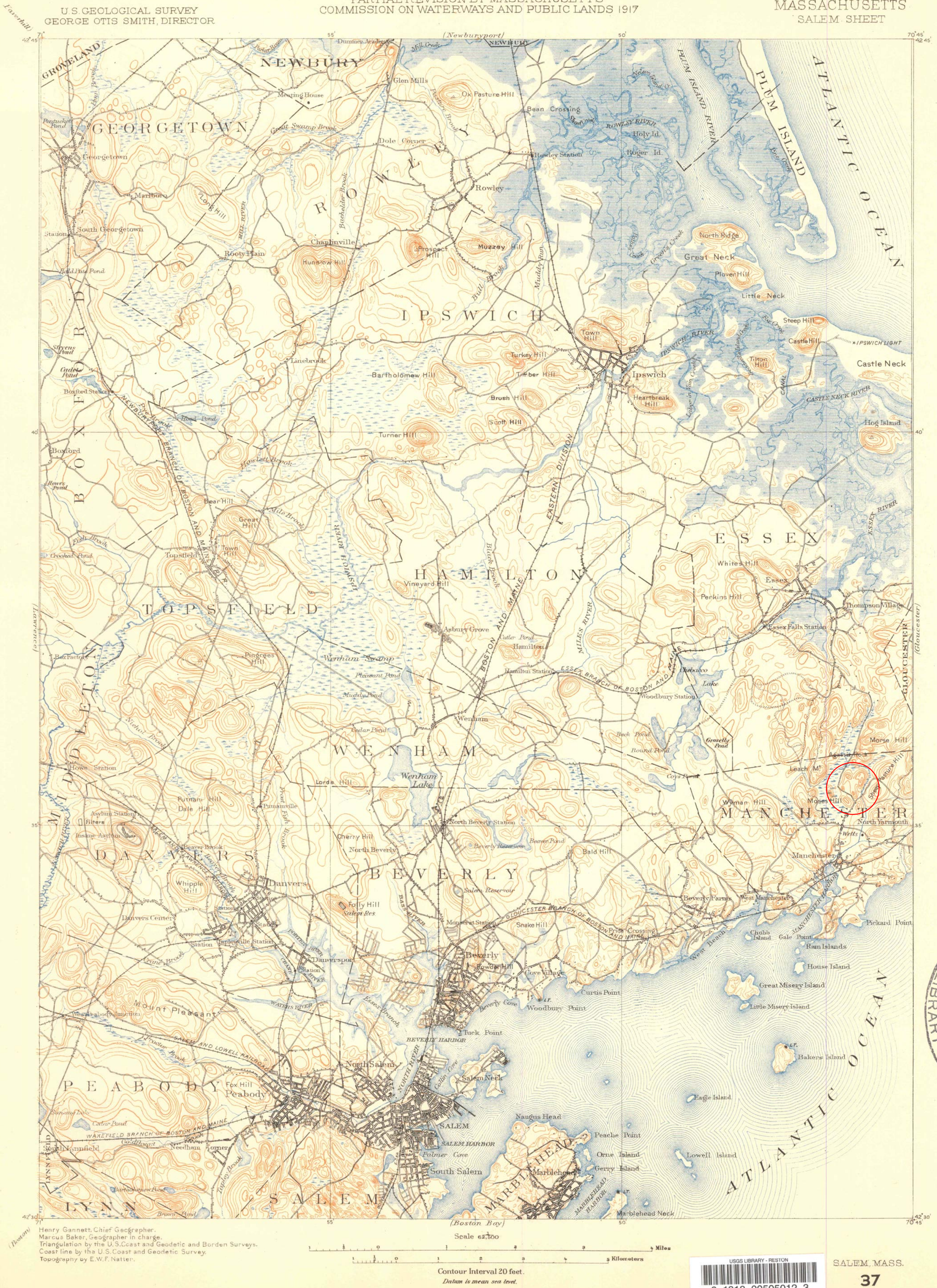
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Datum is mean Sea level.

U. S. G. S.  
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Cautious of Oct. 1888.  
350  
Salem Mass.









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Henry Gannett, Chief Geographer.  
Marcus Baker, Geographer in charge.  
Triangulation by the U.S. Coast and Geodetic and Borden Surveys.  
Coast line by the U.S. Coast and Geodetic Survey.  
Topography by E.W.F. Natter.

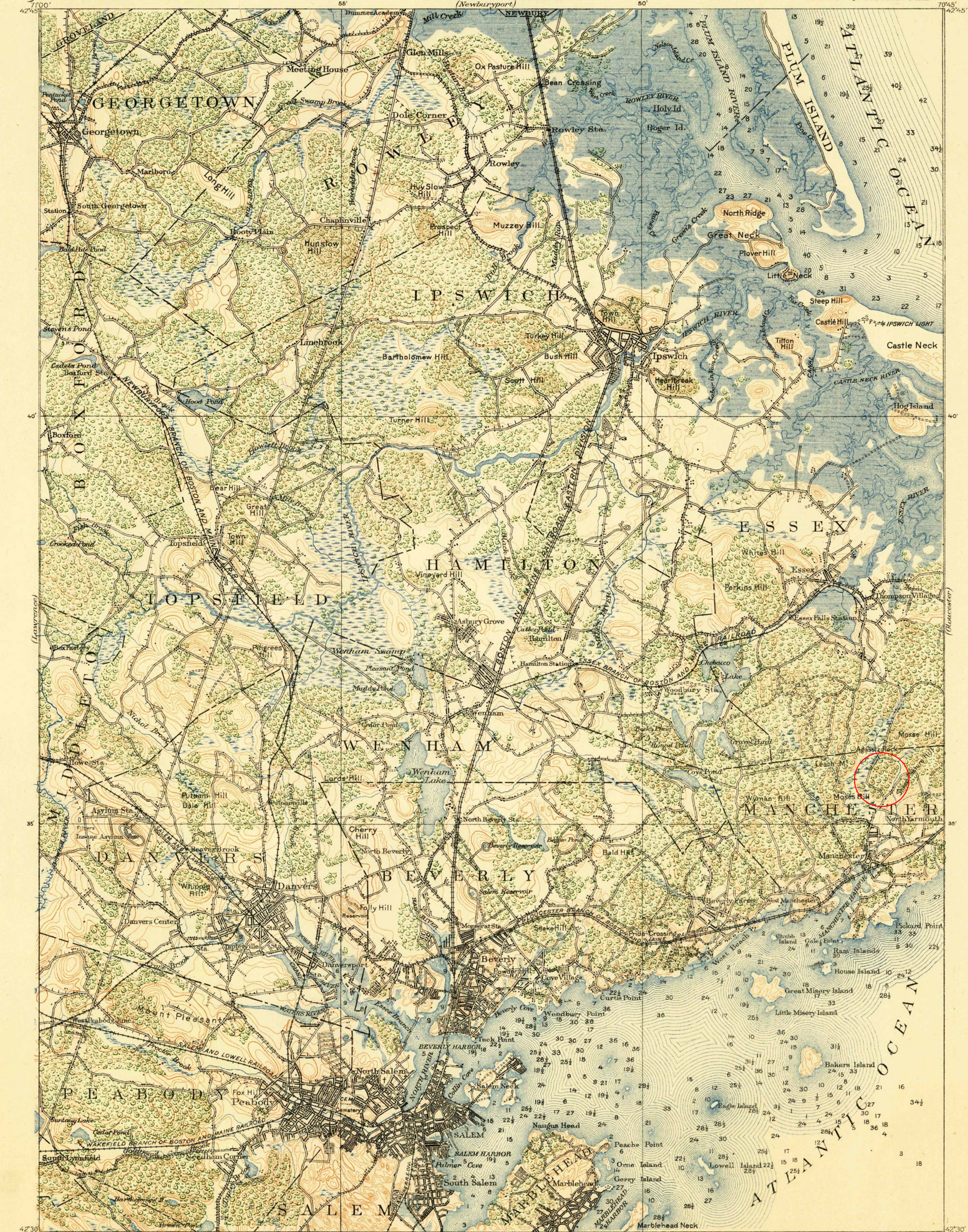
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Contour Interval 20 feet.  
Datum is mean sea level.

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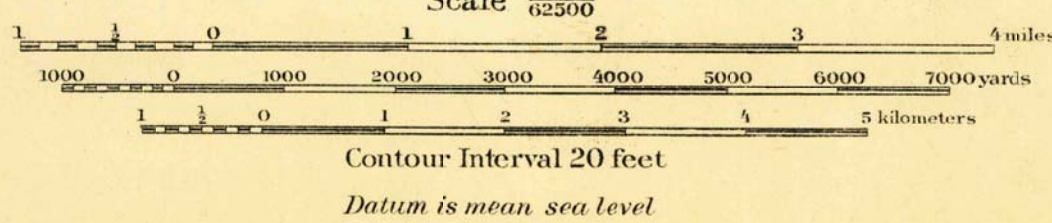


Field work and compilation under the direction of  
Col. W. M. Black, Corps of Engineers, U. S. A.  
Department Engineer, Eastern Department.  
Nov. 1915

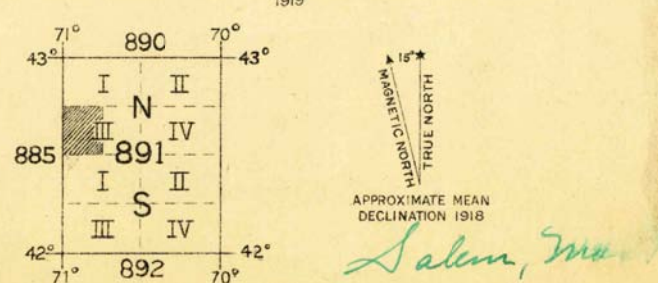
Field work under the immediate supervision of  
Capt. V. L. Peterson, Corps of Engineers, U. S. A.

Base map from U. S. G. S. engravings  
Corrections and additions by Department  
Engineer, Eastern Department.

Soundings expressed in feet and referred to mean  
low water, are from U. S. C. & G. S. Charts.  
Nos. 108 & 109.



NOTE: OFFICERS USING THIS MAP WILL MARK HEREON CORRECTIONS AND ADDITIONS WHICH COME  
TO THEIR ATTENTION AND MAIL DIRECT TO "THE CHIEF OF ENGINEERS, WASHINGTON, D. C."



*Salem, Mass.*  
*November, 1919*



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Inspection and Editing

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DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY

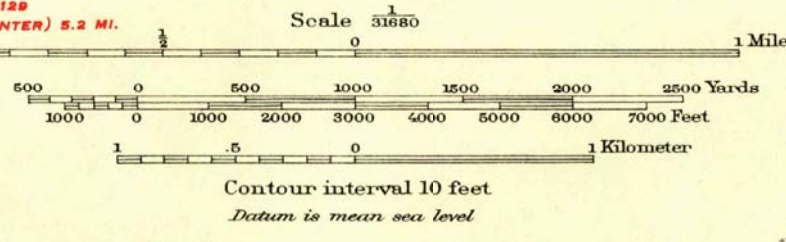
UNITED STATES  
DEPARTMENT OF THE ARMY  
CORPS OF ENGINEERS

MASSACHUSETTS  
(ESSEX COUNTY)  
MARBLEHEAD NORTH QUADRANGLE  
7 1/2-MINUTE SERIES



Topography by J.L. Farmer, B.H. Minnich, and L.D. Olsen  
Surveyed in 1942. Revised in 1950.  
Boundaries in tidewater areas from  
information furnished by Massachusetts  
Department of Public Works.  
Red tint indicates areas in which only  
landmark buildings are shown.

**ROAD CLASSIFICATION**  
HARD-SURFACE ALL WEATHER ROADS DRY WEATHER ROADS  
Heavy-duty ——— 2 LANE 1 LANE Improved dirt ———  
Medium-duty ——— 2 LANE 1 LANE Unimproved dirt ———  
Loose-surface, graded, or narrow hard-surface ———  
U. S. Route State Route



FOR SALE BY U. S. GEOLOGICAL SURVEY, WASHINGTON 25, D. C.  
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

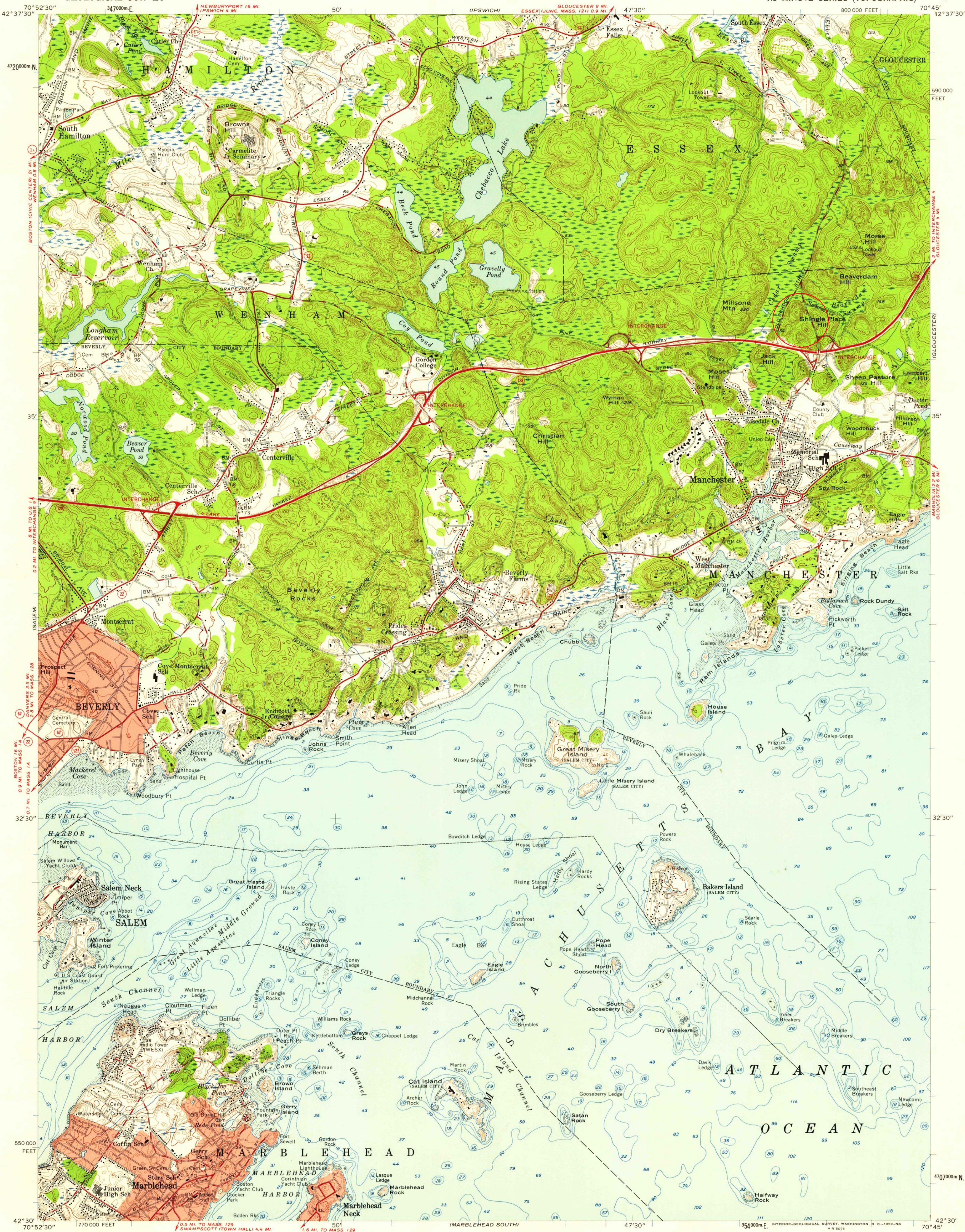
USGS  
Historical File  
Topographic Division

U.S.G.S.  
FILE COPY  
Inspection and Editing

Polyconic projection 1927 North American datum  
5000 yard grid based on U.S. zone system, A  
10000 foot grid based on Massachusetts (Mainland)  
rectangular coordinate system

MARBLEHEAD NORTH, MASS.  
Edition of 1945  
reprinted 1951 with corrections  
N4230-W7045/75





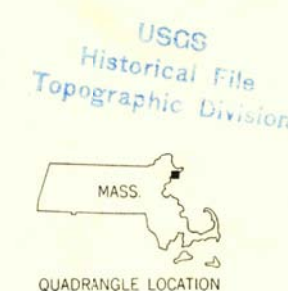
Mapped, edited, and published by the Geological Survey  
Control by USC&GS, Massachusetts Harbor and Land Commission,  
and Massachusetts Geodetic Survey  
Culture and drainage in part compiled from aerial photographs  
taken 1938. Topography by planimetric surveys 1942. Culture  
revised by photogrammetric methods from aerial photographs  
taken 1955. Field check 1956  
Hydrography compiled from USC&GS chart 240 (1956)  
Polyconic projection. 1927 North American datum  
10,000-foot grid based on Massachusetts (Mainland)  
coordinate system  
1000-meter Universal Transverse Mercator grid ticks,  
zone 19, shown in blue  
Red tint indicates areas in which only  
landmark buildings are shown  
Boundaries in tidewater areas from information supplied by  
Massachusetts Department of Public Works

APPROXIMATE MEAN  
DECLINATION, 1956

SCALE 1:24,000  
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100  
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET  
1 KILOMETER

CONTOUR INTERVAL 10 FEET  
DATUM IS MEAN SEA LEVEL  
DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS MEAN LOW WATER  
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER  
THE MEAN RANGE OF TIDE IS APPROXIMATELY 9 FEET

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS  
FOR SALE BY U. S. GEOLOGICAL SURVEY, WASHINGTON 25, D. C.  
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST



ROAD CLASSIFICATION  
Heavy-duty ——— Light-duty ———  
Medium-duty ——— Unimproved dirt ———  
State Route ———

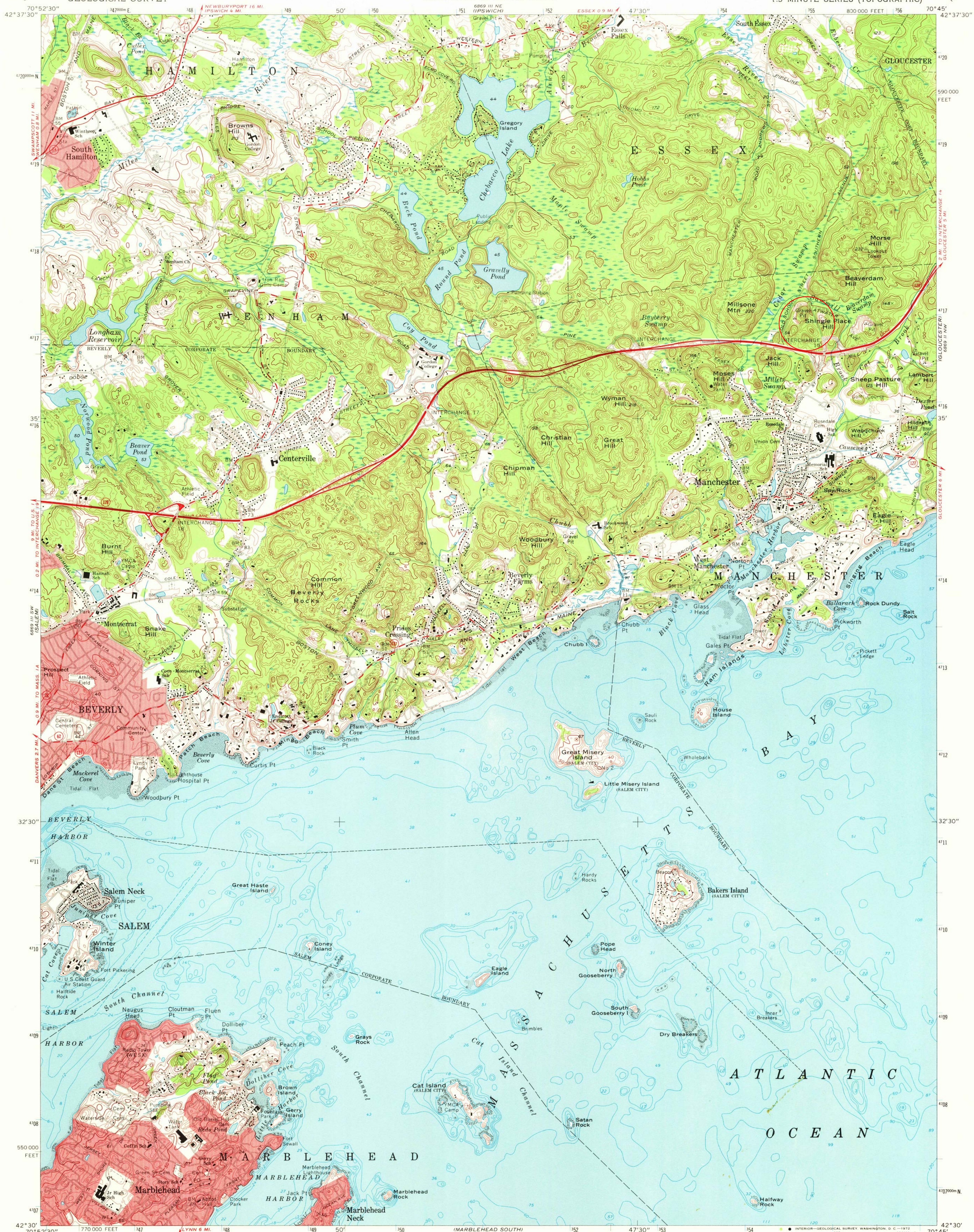
MARBLEHEAD NORTH, MASS.  
N4230—W7045/7.5

1956

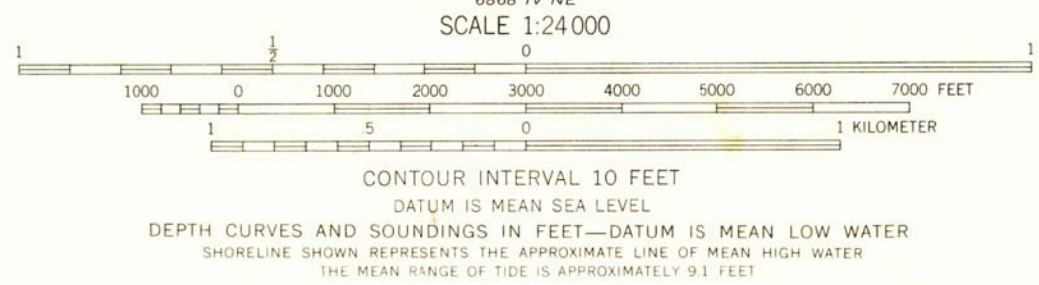
U.S.G.S.  
FILE COPY  
TOPOGRAPHIC DIVISION

DEC 11 1958  
3900





Mapped, edited, and published by the Geological Survey  
Control by USGS, USC&GS, and Massachusetts Geodetic Survey  
Planimetry by photogrammetric methods from aerial photographs  
taken 1938. Topography by planimetric surveys 1942. Revised  
from aerial photographs taken 1969. Field checked 1970.  
Selected hydrographic data compiled from USC&GS Charts 240 and  
241 (1970). This information is not intended for navigational purposes.  
Polyconic projection. 1927 North American datum  
10,000-foot grid based on Massachusetts coordinate system,  
mainland zone.  
1000-meter Universal Transverse Mercator grid ticks,  
zone 19, shown in blue.  
Boundaries in tidewater areas from information supplied  
by Massachusetts Department of Public Works.  
Red tint indicates areas in which only landmark buildings are shown.



ROAD CLASSIFICATION  
Primary highway, hard surface  
Secondary highway, hard surface  
Unimproved road  
Interstate Route  
U.S. Route  
State Route

MARBLEHEAD NORTH, MASS.  
N4230—W7045/7.5  
1970  
AMS 6669 III SE—SERIES V814

USGS  
HISTORICAL FILE  
TOPOGRAPHIC DIVISION

HISTORICAL  
TOPOGRAPHIC DIVISION

7957  
NOV 2 1972



6869 III NW  
(68045178)

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY

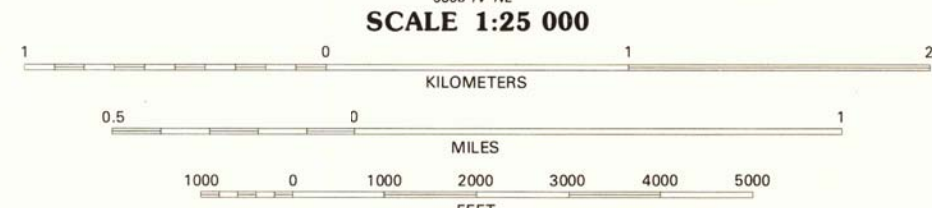
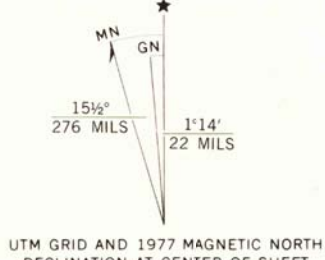
COMMONWEALTH OF MASSACHUSETTS  
DEPARTMENT OF PUBLIC WORKS

MARBLEHEAD NORTH QUADRANGLE  
MASSACHUSETTS  
7.5 MINUTE SERIES ORTHOPHOTOQUAD

6869 III NE  
(68045178)



Produced and published by the Geological Survey  
Orthophoto prepared from 1:80,000-scale  
aerial photograph taken April 1, 1977  
Projection and 10,000-foot grid ticks: Massachusetts  
coordinate system, mainland zone (Lambert conformal conic)  
1000-meter Universal Transverse Mercator grid,  
zone 19, 1927 North American datum  
Photomicroscopy rectified by optical scanning  
which may produce double or mismatched images;  
use the mean of image positions for map point



THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS  
FOR SALE BY U. S. GEOLOGICAL SURVEY, RESTON, VIRGINIA 22092



42070-E7-OQ-025

USGS  
Historical File  
Topographic Division

PRINCIPAL NUMBERED HIGHWAYS  
Interstate Route U. S. Route State Route

This quadrangle area also covered by  
1:25,000-scale topographic map  
MARBLEHEAD NORTH, MASS.  
N4230-W7045/7.5

1977  
DMA 6869 III SE-SERIES V014

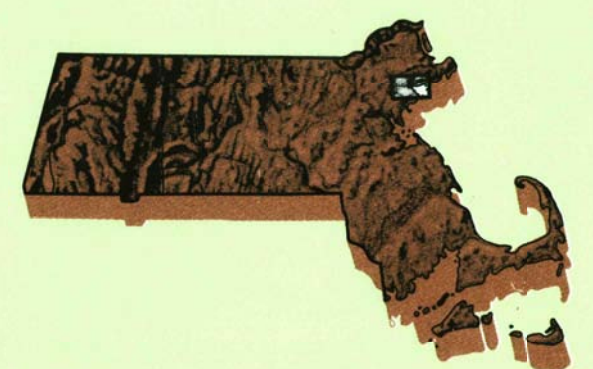
JUL 16 1980  
900



# Salem

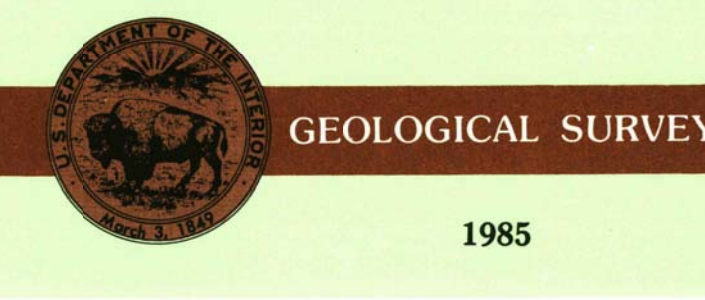
## MASSACHUSETTS

1:25 000-scale metric  
topographic map



7.5 X 15 MINUTE QUADRANGLE  
SHOWING

- Contours and elevations in meters
- Highways, roads and other manmade structures
- Water features
- Woodland areas
- Geographic names



Produced by the United States Geological Survey in cooperation with Massachusetts Department of Public Works  
Control by USGS, NOS/NOAA, and Commonwealth of Massachusetts agencies  
Compiled by photogrammetric methods from aerial photographs taken 1978. Field checked 1979. Map edited 1985  
Supersedes Salem and Marblehead North 1:25,000-scale maps dated 1970  
Selected hydrographic data compiled from NOS charts 13275 and 13276 (1981). This information is not intended for navigational purposes  
Projection and 1000-meter grid: Universal Transverse Mercator, zone 19  
10,000-foot grid ticks based on Massachusetts coordinate system, mainland zone  
1927 North American Datum  
To place on the predicted North American Datum 1983 move the projection lines 6 meters south and 42 meters west as shown by dashed corner ticks  
There may be private inholdings within the boundaries of the National or State reservations shown on this map

CONTOUR INTERVAL 3 METERS  
NATIONAL GEODETIC VERTICAL DATUM of 1929  
CONTROL ELEVATIONS SHOWN TO THE NEAREST 0.1 METER  
OTHER ELEVATIONS SHOWN TO THE NEAREST 0.5 METER  
DEPTH CURVES AND SOUNDINGS IN METERS  
DATUM IS MEAN LOW WATER  
THE RELATIONSHIP BETWEEN THE TWO DATUMS IS VARIABLE  
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER  
THE MEAN RANGE OF TIDE IS APPROXIMATELY 2.7 METERS

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS

CONVERSION TABLE		DECLINATION DIAGRAM		ADJOINING MAPS			
Meters	Feet			1	2	3	
1	3.2808						
2	6.5617						
3	9.8425						
4	13.1234						
5	16.4042						
6	19.6850						
7	22.9659						
8	26.2467						
9	29.5275						
10	32.8084						
To convert meters to feet multiply by 3.2808							
To convert feet to meters multiply by 0.3048							
				1	2	3	
				4	5		
				6	7	8	
				1	Lawrence		
				2	Ipswich		
				3	Rockport		
				4	Reading		
				5	Glooucester		
				6	Boston North		
				7	Lynn		
				8			



### Topographic Map Symbols

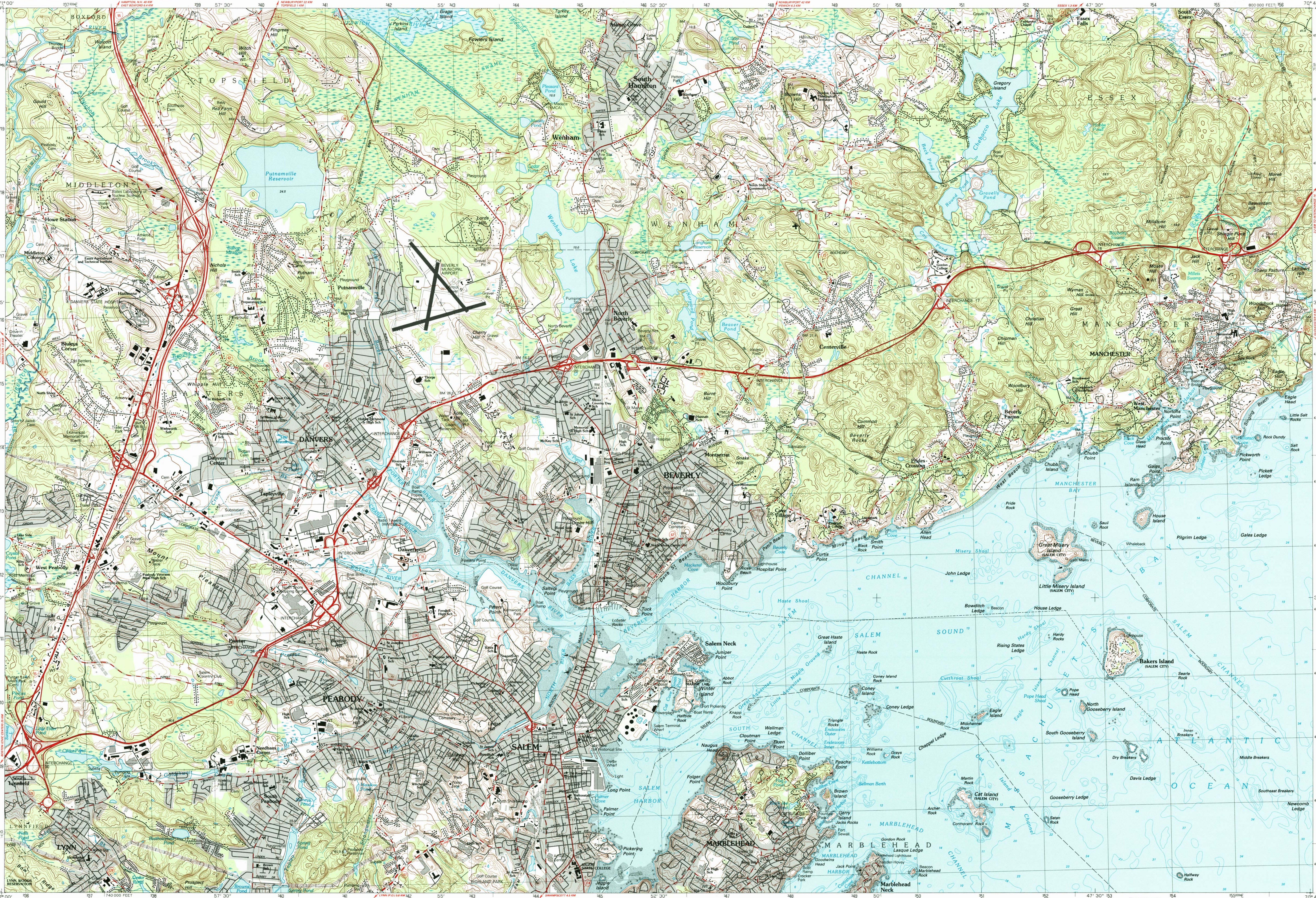
Primary highway, hard surface	.....
Secondary highway, hard surface	.....
Light-duty road, hard or improved surface	.....
Unimproved road, trail	.....
Route marker: intersection: U. S. State	.....
Railroad, standard gage, narrow gage	.....
Bridge, drawbridge	.....
Footbridge, overpass, underpass	.....
Built-up area: only selected landmark buildings shown	.....
House, farm, church, school, large structure	.....
Boundary	.....
National, with monument	.....
State	.....
County, parish	.....
Civil township, precinct, district	.....
Incorporated city, village, town	.....
National or State reservation; small park	.....
Land grant with monument; found section corner	.....
U. S. public lands survey; range, township, section	.....
Range, township; section line, location approximate	.....
Fence or field line	.....
Power transmission line, located tower	.....
Dam; dam with lock	.....
Cemetery, graves	.....
Campground, picnic area; U. S. location monument	.....
Windmill; water well; spring	.....
Mine shaft; prospect, adit or cave	.....
Control: horizontal station; vertical station; spot elevation	.....
Contours: index; intermediate; supplementary; depression	.....
Bathymetric contours: index; intermediate	.....
Perennial lake and stream; intermittent lake and stream	.....
Rapids, large and small; falls, large and small	.....
Submerged marsh; marsh, swamp	.....
Land subject to controlled inundation; woodland	.....
Scrub; mangrove	.....
Orchard; vineyard	.....

A pamphlet describing topographic maps is available on request  
FOR SALE BY U.S. GEOLOGICAL SURVEY  
P.O. BOX 23286, DENVER, COLORADO 80225



## SALEM, MASSACHUSETTS ESSEX COUNTY

7.5 X 15 MINUTE SERIES (TOPOGRAPHIC)

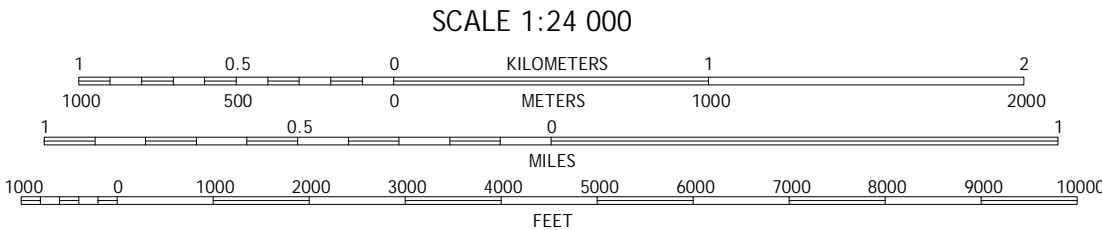
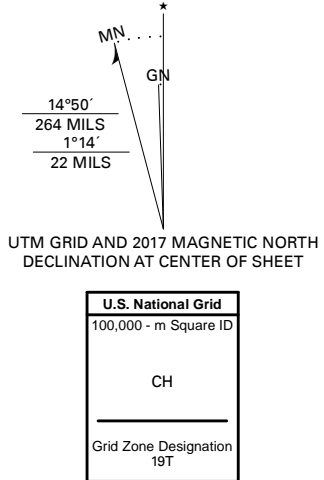






Produced by the United States Geological Survey  
North American Datum of 1983 (NAD83)  
World Geodetic System of 1984 (WGS84) - Projection and  
1 000-meter grid/Universal Transverse Mercator, Zone 19T  
This map is not a legal document. Boundaries may be  
generalized for this map scale. Private lands within government  
reservations may not be shown. Obtain permission before  
entering private lands.

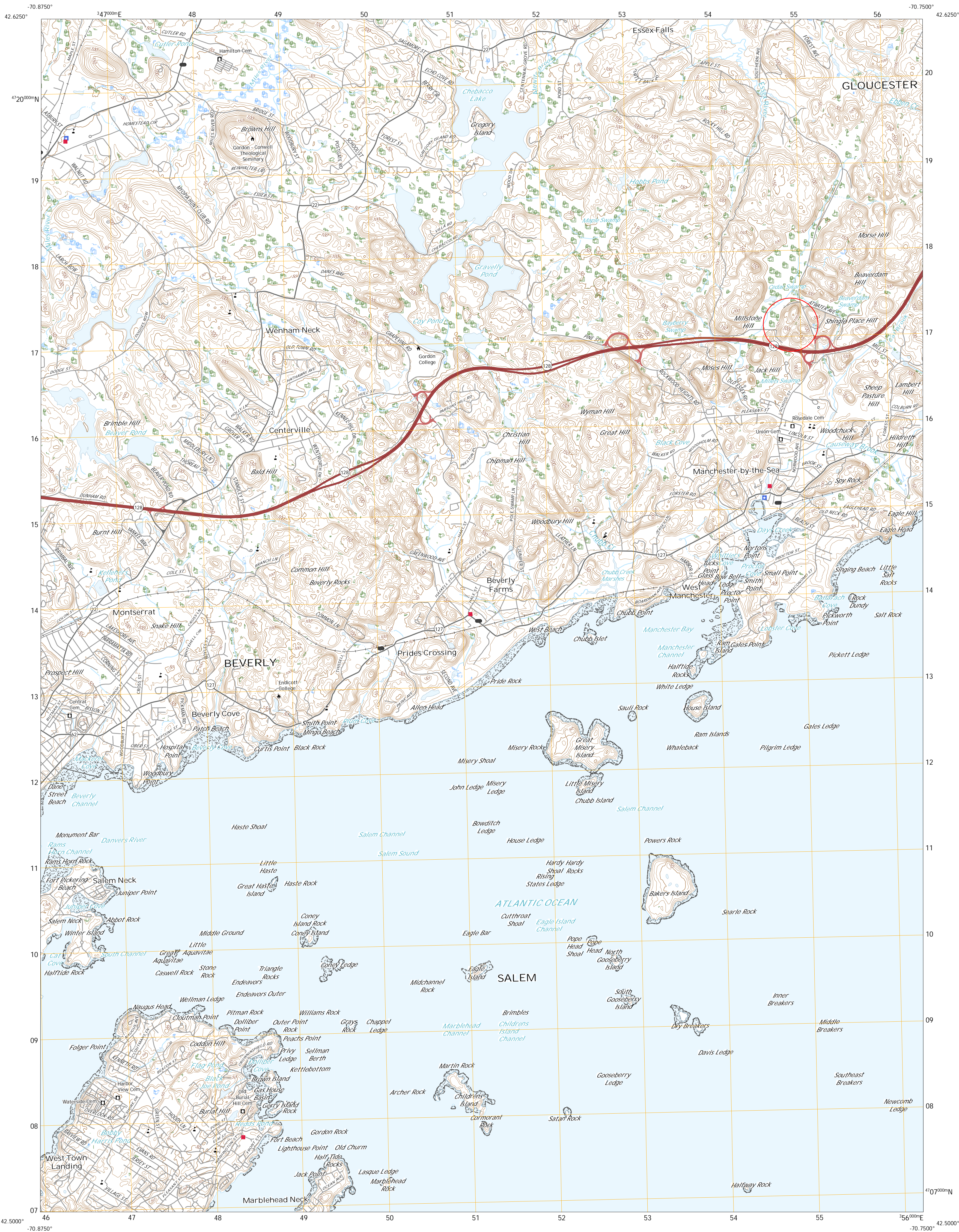
Imagery.....NAIP, July 2016 - September 2016  
Roads.....U.S. Census Bureau, 2016  
Names.....GNIS, 1974 - 2016  
Hydrography.....National Hydrography Dataset, 2005 - 2016  
Contours.....National Elevation Dataset, 2012  
Boundaries.....Multiple sources: see metadata file 2016 - 2017  
Wetlands.....FWS National Wetlands Inventory 1986 - 2011



1	2	3
4	5	6
7	8	9

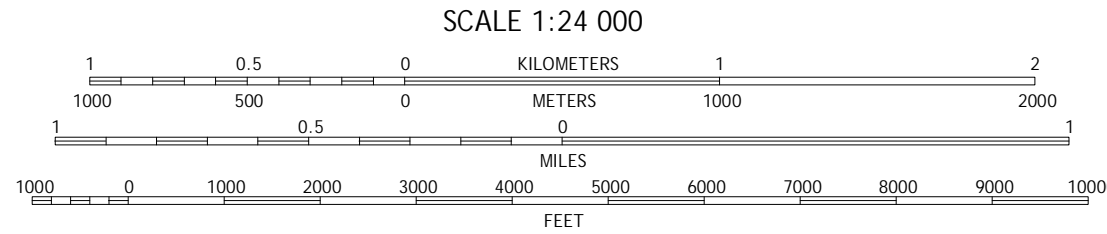
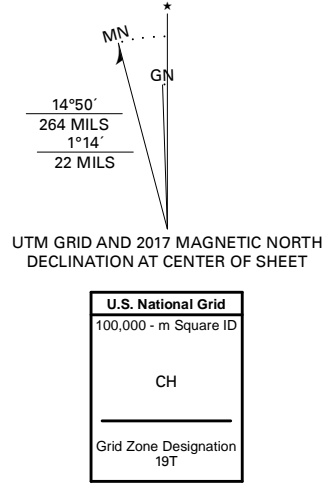
ROAD CLASSIFICATION  
Expressway  
Secondary Hwy  
Ramp  
Interstate Route  
Local Connector  
Local Road  
4WD  
US Route  
State Route





Produced by the United States Geological Survey  
North American Datum of 1983 (NAD83)  
World Geodetic System of 1984 (WGS84) Projection and  
1 000-meter grid/Universal Transverse Mercator, Zone 19T  
This map is not a legal document. Private lands within government  
reservations may not be shown. Obtain permission before  
entering private lands.

Imagery.....NAIP, July 2016 - September 2016  
Roads.....U.S. Census Bureau, 2016  
Names.....GNIS, 1974 - 2018  
Hydrography.....National Hydrography Dataset, 2005 - 2016  
Contours.....National Elevation Dataset, 2012  
Boundaries.....Multiple sources: see metadata file 2016 - 2017  
Wetlands.....FWS National Wetlands Inventory 1986 - 2011



1	2	3
4	5	6
7	8	9

1 Georgetown  
2 Ipswich  
3 Gloucester OE N  
4 Salem  
5 Gloucester  
6 Lynn  
7 Marblehead South

ROAD CLASSIFICATION	
Expressway	Local Connector
Secondary Hwy	Local Road
Ramp	4WD
Interstate Route	US Route
	State Route



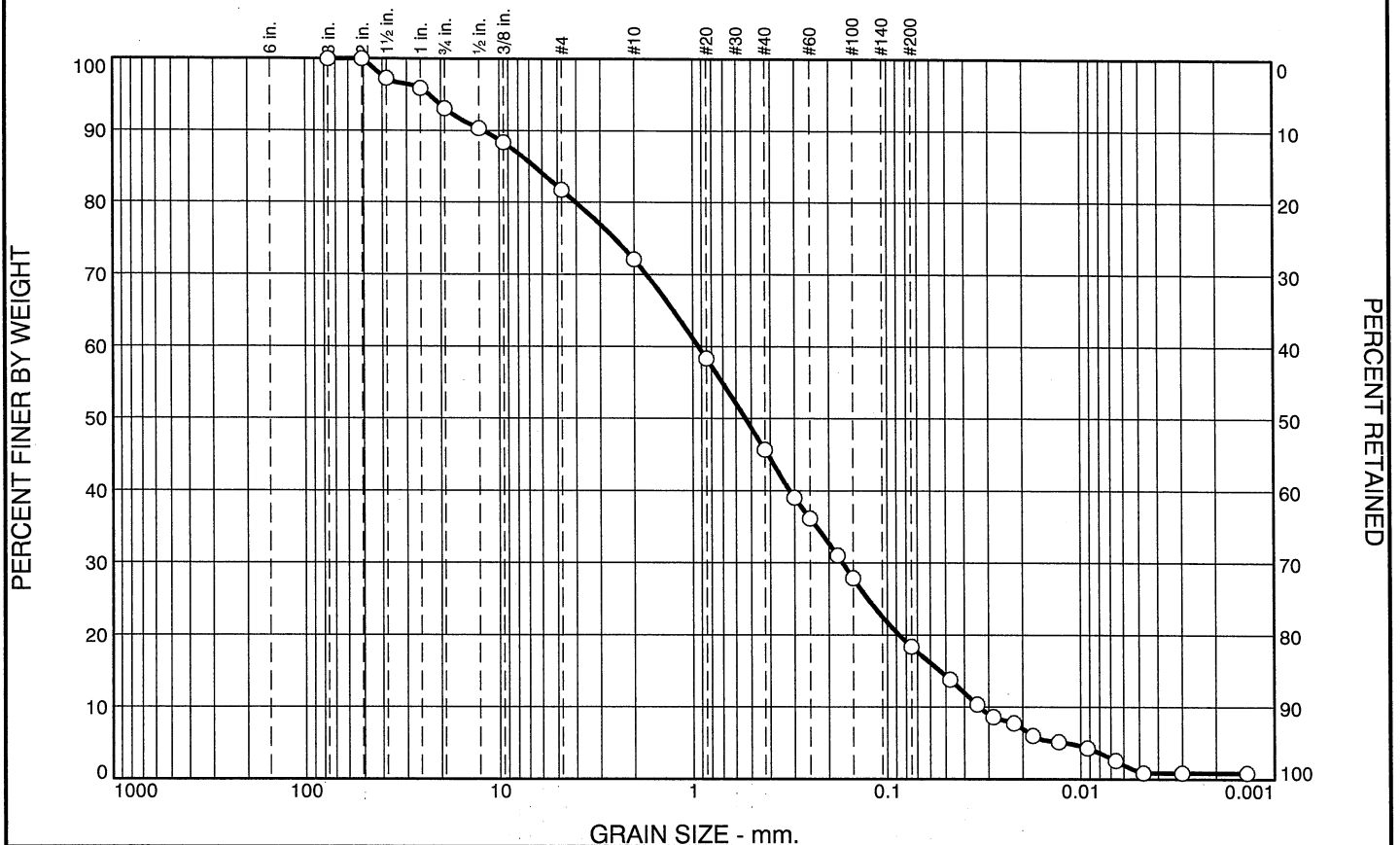


## **ATTACHMENT C**

### **Laboratory Gradation Report**



# GRAINSIZE DISTRIBUTION REPORT



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	7	11	10	26	28	17	1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100		
2"	100		
1.5"	97		
1"	96		
.75"	93		
.5"	90		
.375"	88		
#4	82		
#10	72		
#20	58		
#40	46		
#50	39		
#60	36		
#80	31		
#100	28		
#200	18		

\* (no specification provided)

**Material Description**  
SAND LITTLE GRAVEL.

**Atterberg Limits**  
 PL=      LL=      PI=

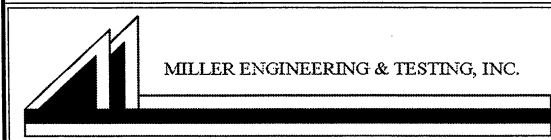
**Coefficients**  
 D<sub>90</sub>= 11.9882      D<sub>85</sub>= 6.5585      D<sub>60</sub>= 0.9333  
 D<sub>50</sub>= 0.5334      D<sub>30</sub>= 0.1693      D<sub>15</sub>= 0.0536  
 D<sub>10</sub>= 0.0333      C<sub>u</sub>= 28.00      C<sub>c</sub>= 0.92

**Classification**  
 USCS=      AASHTO=

**Remarks**

Source of Sample: N/A  
Sample Number: L20238

Date: 7-22-20



Client:  
Project: MBTS APARTMENTS

Project No: 20.119.NH


Figure L20238

Tested By: DM/BM



The diagram is a ternary plot with vertices at 100% Sand (bottom left), 100% Silt (bottom right), and 100% Clay (top). The axes are labeled: Percent Sand (bottom), Percent Silt (right), and Percent Clay (left). The plot is divided into regions for soil texture classification. A point is plotted in the 'sandy and silty sand' region, near the bottom left corner, at approximately 85% Sand, 10% Silt, and 5% Clay.

Soil Texture	Percent Sand	Percent Silt	Percent Clay
clay	0	0	100
silty clay	0	10	90
sandy clay	10	0	90
clay loam	10	10	80
silty clay loam	0	20	80
sandy clay loam	20	0	80
loam	20	20	60
silty loam	0	40	60
sandy loam	40	0	60
silt loam	0	60	40
silt	0	80	20
sandy and silty sand	100	0	0

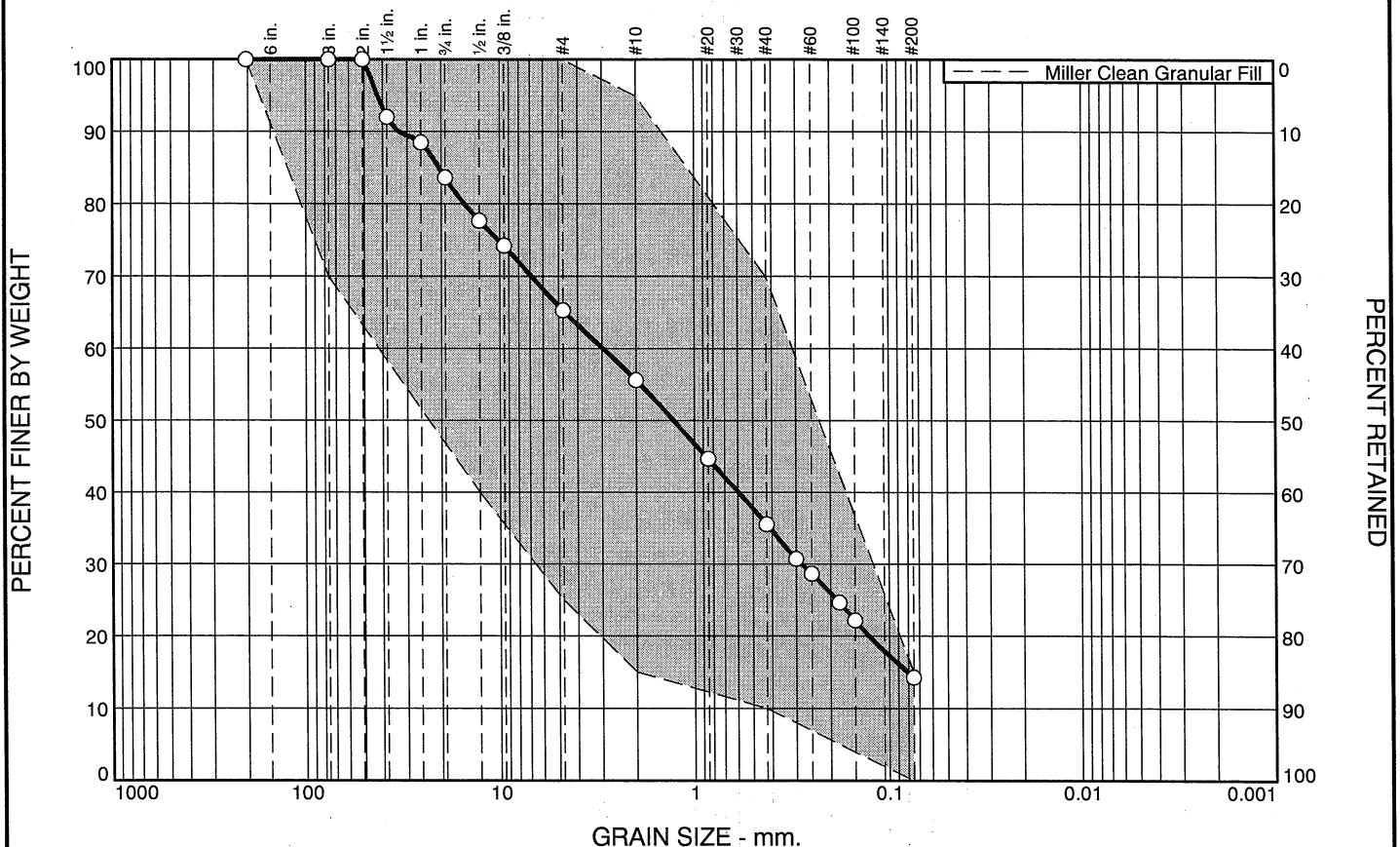


MILLER ENGINEERING & TESTING, INC.

**Figure** L20238



# GRAINSIZE DISTRIBUTION REPORT



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	16	19	9	20	22	14	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
8"	100	100	
3"	100	70 - 100	
2"	100		
1.5"	92		
1"	88		
.75"	84		
.5"	78	40 - 100	
.375"	74		
#4	65	25 - 100	
#10	56	15 - 95	
#20	45		
#40	36	10 - 70	
#50	31		
#60	29		
#80	25		
#100	22		
#200	14	0.0 - 15	

\* Miller Clean Granular Fill

**Material Description**

SAMPLE # 1

PL=      **Atterberg Limits**      LL=      PI=

**Coefficients**

D<sub>90</sub>= 32.8316      D<sub>85</sub>= 20.4908      D<sub>60</sub>= 2.9614

D<sub>50</sub>= 1.2742      D<sub>30</sub>= 0.2814      D<sub>15</sub>= 0.0806

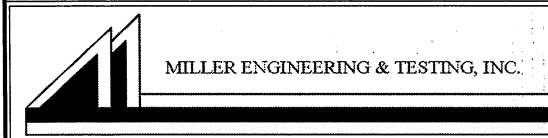
D<sub>10</sub>=      C<sub>u</sub>=      C<sub>c</sub>=

USCS=      **Classification**      AASHTO=

**Remarks**

Source of Sample: N/A  
Sample Number: L20232A

Date: 7-20-20



Client:  
Project: MBTS APARTMENTS

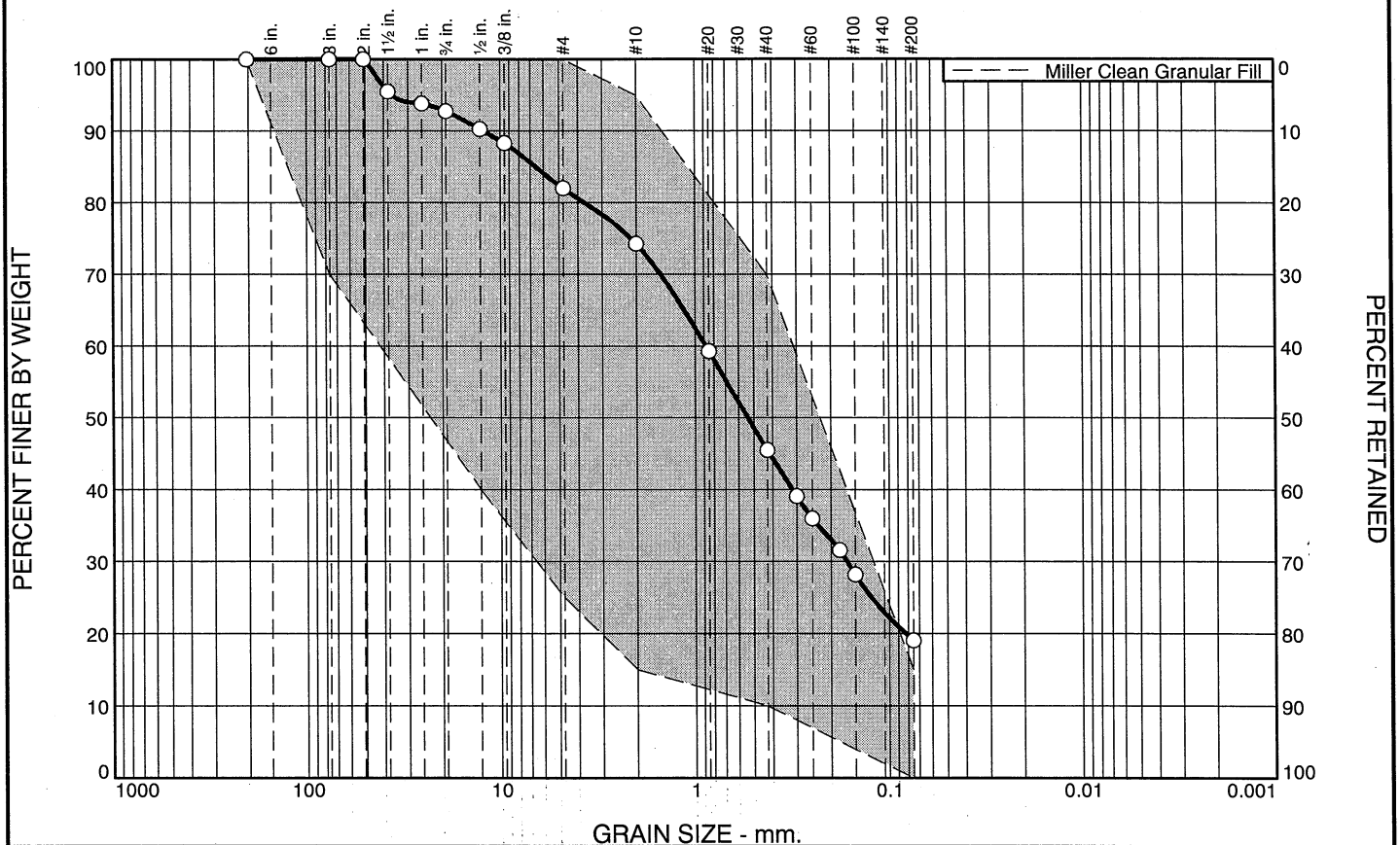
Project No: 20.119.NH

Figure L20232A

Tested By: DM/BM



# GRAINSIZE DISTRIBUTION REPORT



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	7	11	8	28	27	19	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
8"	100	100	
3"	100	70 - 100	
2"	100		
1.5"	96		
1"	94		
.75"	93		
.5"	90	40 - 100	
.375"	88		
#4	82	25 - 100	
#10	74	15 - 95	
#20	59		
#40	46	10 - 70	
#50	39		
#60	36		
#80	32		
#100	28		
#200	19	0.0 - 15	X

\* Miller Clean Granular Fill

**Material Description**

SAMPLE # 2

PL=      **Atterberg Limits**      LL=      PI=

**Coefficients**

D<sub>90</sub>= 12.1689      D<sub>85</sub>= 6.5538      D<sub>60</sub>= 0.8797

D<sub>50</sub>= 0.5356      D<sub>30</sub>= 0.1648      D<sub>15</sub>=

D<sub>10</sub>=      C<sub>u</sub>=      C<sub>c</sub>=

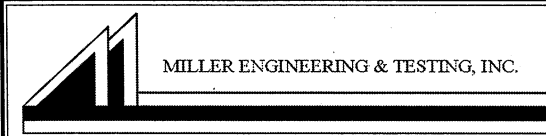
**Classification**

USCS=      AASHTO=

**Remarks**

Source of Sample: N/A  
Sample Number: L20232B

Date: 7-20-20



Client:  
Project: MBTS APARTMENTS

Project No: 20.119.NH

Figure L20232B

Tested By: DM/BM