SURVEY OF HIGHWAY CONSTRUCTION MATERIALS

IN THE TOWN OF WOODSTOCK, WINDSOR COUNTY, VERMONT

Prepared by

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

ENGINEERING GEOLOGY SUBDIVISION

Montpelier, Vermont

February, 1980

State of Vermont
Agency of Transportation
Materials & Research Division
February, 1980

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Acknowledgments

This project acknowledges the surficial geological information obtained from Professor D. P. Stewart of Miami University, Oxford, Ohio and the bedrock information from the Centennial Geologic Map of Vermont, C. G. Doll.

History

The Materials Survey Project was initiated in 1957 by the Vermont Department of Highways with the assistance of the Bureau of Public Roads to compile an inventory of highway construction materials in the State of Vermont. Previously, investigations for highway construction materials were conducted only as the immediate situation required and only limited areas were surveyed. Since no overall picture of material resources was available, highway contractors or resident engineers were required to locate the materials for their respective projects and the samples were tested by the Materials & Research Division. The additional expense of exploration for construction materials resulted in higher construction costs being paid by the State. The Materials Survey Project was formed to minimize this factor by enabling the State and the contractors to use available information on material resources and to project cost estimates. Knowledge of locations of suitable materials is an important factor in planning highways.

The sources of construction materials are located by this Project through ground reconnaissance, study of maps and aerial photographs, and geological and physiographic interpretation. Maps, data sheets and work sheets furnish information of particular use to contractors and construction personnel, and should be studied together for maximum benefit.

Enclosures

Included in this report are two surface-geology maps, one defining the location of tests on bedrock, the other defining the location of tests on

granular materials. These maps are based on 15-minute or 7-½-minute quadrangles of the United States Geological Survey enlarged or reduced to 1:31250 or 1" = 2604'. The various rock formations and types are delineated on the Bedrock Map of the township. This information is obtained from: Vermont Geological Survey Bulletins, Vermont State Geologist Reports, United States Geological Survey Bedrock Maps, Centennial Geologic Map of Vermont, the Surficial Geologic Map of Vermont and other references.

The granular materials map shows areas of various types of glacial deposits (outwash, moraines, kames, kame terraces, eskers, etc.) which are potential sources of gravel and sand. This information was obtained primarily from a survey conducted by Professor D. P. Stewart of Miami University, Oxford, Ohio, who mapped the glacial features of the State of Vermont during the summer months from 1956 to 1966. Further information is obtained from the Soil Survey (Reconnaissance) of Vermont (conducted by the Bureau of Chemistry and Soils of the United States Department of Agriculture), available Soil Surveys of individual counties (by the Soil Conservation Service of the United States Department of Agriculture), Vermont Geological Survey Bulletins, United States Geological Survey Quadrangles, aerial photographs and other sources. The location of each test area is represented by a Map Identification Number.

This report contains data sheets with detailed information on each test taken in the Granular and Bedrock areas. Data is also used from an active card file compiled by the Materials & Research Division over a period of years. Some cards are not used because they are incomplete or have unusable information on the location of the deposit.

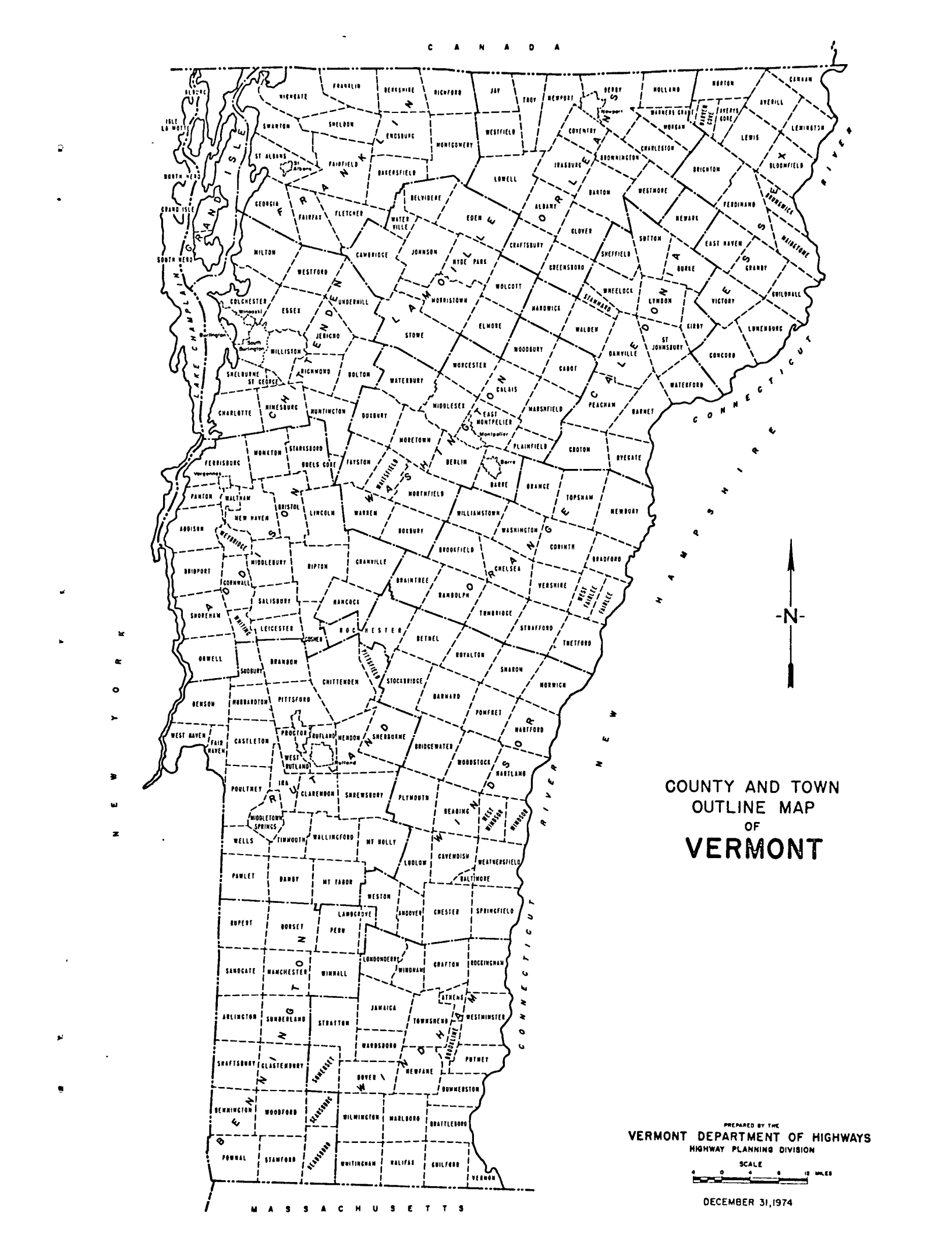
Work sheets containing more detailed information and a field sketch of the area, and laboratory test results are on file in the Materials & Research Division of the Agency of Transportation, State of Vermont.

LOCATION

The town of Woodstock is in the center of Windsor County in east-central Vermont. It is bounded on the north by Pomfret, the northeast by Hartford, the east by Hartland, the south by Reading, and the west by Bridgewater. (See County and Town Outline Map of Vermont on the following page.

Woodstock lies in the Vermont Piedmont Physiographic subdivision of the New England Upland, a stream-dissected plateau with undulating-to-rough topography. Elevations vary from 2,240 feet atop an unnamed mountain east of Curtis Hollow (0.4 mile from the Reading town line), to less than 660 feet where the Ottauquechee River crosses the Hartland town line.

Woodstock is in the Ottauquechee River drainage basin. Principal tributaries to the eastward-flowing Ottauquechee are Gulf Stream from the northwest, and Beaver, Kedron, and Happy Valley Brooks from the south. There are no lakes of significant size in the town.


CANADA
MASSACHUSETTS
NEW YORK
NEW HAMPSHIRE
CONNECTICUT RIVER
LAKE CHAMPLAIN
GRAND ISLE
FRANKLIN
ORLEANS
ESSEX
LAMOILLE
CALEDONIA
WASHINGTON
ORANGE
WINDSOR
WINDHAM
BENNINGTON
RUTLAND
ADDISON
CHITTENDEN
-N-
COUNTY AND TOWN
OUTLINE MAP
OF
VERMONT
PREPARED BY THE
VERMONT DEPARTMENT OF HIGHWAYS
HIGHWAY PLANNING DIVISION
SCALE
DECEMBER 31, 1974

SURVEY OF ROCK SOURCES

Procedure for Rock Survey

The method employed by the project in a survey of possible sources of rock for highway construction is divided into two main stages: office and field investigations.

The office investigation is conducted during the winter months and comprises the mapping and description of rock types perused from many reference sources, as acknowledged in the bibliography. These references differ considerably in dependability due to subsequent developments and studies that have contributed to the obsolescence of a number of reports. The results of samples taken by other individuals are analyzed, and their location is mapped when possible. As complete a correlation as possible is made of the available geological information concerning the area under consideration.

The field investigation is begun by making a cursory survey of the entire town. The information obtained from the preliminary survey, and that from the office investigation, is used to determine where sampling will be concentrated. When a promising source has been determined by rock type, volume of material, accessibility, adequate exposure and relief, chip samples are taken with a hammer across the strike or trend of the rock, and are submitted to the Materials & Research Division for abrasion testing by the Deval Method (AASHTO T-3) and the Los Angeles Method (AASHTO T-96). Samples taken by the chip method are often within the weathered zone of the outcrop and thus may give a less satisfactory test result than fresh material from unweathered rock. When the rock is uniform, and the chip samples yield acceptable abrasion test results, the material source is listed in this report as being satisfactory.

Discussion of Rock and Rock Sources

The information on the Rock Materials Map (Plate II) is a cartographic simplification. A more detailed description of the respective rock formations is included in the Summary of Rock Formations in this report.

Occasionally, rocks belonging to the same formation and exhibiting similar characteristics (i.e., color and texture) produce different abrasion test results owing to differing physical properties or chemical compositions. Therefore, in no case should satisfactory test results obtained in one area be construed to mean that the same formation, even in the same area, will not later produce unsatisfactory materials; this is particularly true with metamorphic rocks.

Complex metamorphic rocks comprise all of the formations within Woodstock, except for limestone interbeds in the Waits River Formation. Most bedrock is overlain by glacial drift and vegetation which limits sampling to sporadic outcrops. From west to east outcropping rock was sampled in the Waits River Formation (Map Identification Nos. 1 and 5), Standing Pond amphibolite (Map Identification Nos. 2 and 3), and Gile Mountain Formation (Map Identification No. 4).

Probably the best site for development of a quarrying operation would be in the Standing Pond Amphibolite at Map Identification No. 3. It is recommended that further testing should be undertaken if this area is considered as a possible source for rock aggregate.

SURVEY OF SAND AND GRAVEL SOURCES

Procedure for Sand and Gravel Survey

The method used for conducting the survey of possible sources of sand and gravel for highway construction is divided into two main stages: office and field investigations.

The office investigation is conducted during the winter months and comprises the mapping of potentially productive areas from various references. Of these references, the survey of glacial deposits mapped by Professor Stewart is particularly helpful when used with soil-type maps, aerial photographs, and United States Geological Survey Quadrangles. The last two are used in the recognition and location of physiographic features indicating glacial deposits, and in the study of drainage patterns. The locations of existing pits are mapped, as are the locations in which samples were taken by other individuals.

The field investigation is begun by making a cursory survey of the entire town. All pits, and any areas that show evidence of glacial or fluvial deposition are noted, and later investigated by obtaining samples from pit faces and other exposed surfaces. Test holes in pit floors and extensions are later dug with a backhoe to a depth of approximately 11 feet to obtain material which is submitted to the Materials & Research Division for gradation, sieve analysis and AASHTO T-4 Method stone abrasion test.

Discussion of Sand and Gravel Deposits

Granular materials in Woodstock are glaciofluvial or glaciolacustrine in origin according to the Surficial Geologic Map of Vermont. The glaciofluvial deposition is kamic in terraces marginal to larger valleys, or outwash in valley floodplains at lower elevations.

No permission to sample a kame moraine west of the junction of Town Highway No. 18 and Vermont Route 12 at English Mills was given by the two principal property owners.

Map Identification No. 1 was in the western part of a kame terrace north of Town Highway No. 53 (between Town Highway No. 44 and Vermont Route 12). A second kame terrace west of State Aid Highway No. 3 north of its junction with Town Highway No. 31 was tested at Map Identification No. 3. Permission to test a third kame terrace adjacent to, and at the Woodstock Agency of Transportation district garage on U. S. Route 4 was denied. A fourth kame terrace north of U. S. Route 4 and west of the "Iron Bridge" junction of Town Highway No. 24 was tested at Map Identification No. 4. A fifth kame terrace north of U. S. Route 4 between Town Highway No. 13 and the Bridgewater town line was tested at Map Identification No. 5. Finally, a sixth kame terrace was tested at Map Identification No. 8 in South Woodstock.

Spillway outwash north and west of the junction of Town Highway No. 1 (Class 2), and Vermont Route 12 was tested at Map Identification No. 2.

Stewart and MacClintock believe that a high-level glacial lake occupied the Ottauquechee River valley west of Woodstock village and the Kedron Brook valley. That lake left deposits of pebbly sands and lake gravels.

A lake gravel south of Town Highway No. 10 at the Bridgewater town line was tested at Map Identification No. 6.

Discussion of Sand and Gravel Deposits (Continued)

A pebbly sand feature west of West Woodstock is undergoing urban development, and the property owner whose dwelling was located on the extension of a former sand pit (Now the site of a factory) refused permission to test.

No lake sediments were tested.

SUMMARY OF ROCK FORMATIONS IN THE TOWN OF WOODSTOCK

Green Mountain Sequence

Eastern Vermont Group

Waits River Formation: Gray quartzose and Micaceous crystalline limestone weathered to distinctive brown earthy crust; interbedded and intergradational with gray quartz-muscovite phyllite or schist. Where more metamorphosed the limestones contain actinolite, hornblende, zoisite, diopside, wollastonite, and garnet, and the phyllite and schist, biotite, garnet, and locally andalusite, kyanite, or sillimanite.

Waits River Formation (Standing Pond volcanic member): Amphibolite, garnet amphibolite, coarse garnet schist with fasciculitic hornblende, and hornblende maculite; contains pillow lavas near St. Johnsbury and passes eastward into actinolitic greenstone and greenstone south of Windsor.

Gile Mountain Formation: Gray quartz-muscovite phyllite or schist, interbedded and intergradational with gray micaceous quartzite, calcareous mica schist, and locally, quartzose and micaceous crystalline limestone like that of the Waits River Formation. The phyllite and schist commonly contain porphyroblasts of biotite, garnet, or staurolite, and locally kyanite, andalusite, or sillimanite.

Northfield Formation: Dark gray to black quartz-sericite slate or phyllite with fairly widely-spaced interbeds a few inches thick of siltstone and silty crystalline limestone like that of the Waits River Formation; phyllite passes into gray quartz-sericite schist containing abundant porphyroblasts of biotite and garnet in southern Vermont.

Southern Vermont Group

Shaw Mountain Formation: Quartzite, quartz conglomerate, cummingtonite schist, amphibolite, and quartz-sericite schist with porphyroblasts of biotite and garnet.

Missisquoi Formation (Barnard volcanic member): Fine - to medium-grained biotite gneiss, hornblende gneiss, and amphibolite.

GLOSSARY OF SELECTED GEOLOGIC TERMS

Actinolite: A variety of amphibole occurring in greenish bladed crystals or masses.

Amphibolite: A green-to-black, schistose, metamorphic rock consisting mostly of amphibole (i.e., tremolite, actinolite, hornblende, or arfvedsonite).

Andalusite: A variously colored, metamorphic, orthorhombic aluminum silicate mineral.

Bedding: The arrangement of rock in layers, strata, or beds.

Bedrock: The more or less solid, undisturbed rock in place at the surface, or beneath superficial deposits of gravel, sand, or soil.

Biotite: A dark, tabular, silicate mineral commonly known as black mica.

Conglomerate: The consolidated equivalent of gravel. There may be considerable range in the size and composition of constituent fragments. The finer material between the larger fragments may be fine particulate matter or natural cement such as calcium carbonate, clay, iron oxide, or silica.

Cummingtonite: A variety of amphibole similar to anthophyllite, but richer in iron.

Diopside: A mineral of the pyroxene group having the composition $CaMg(SiO_3)_2$. It is especially characteristic of contact metamorphic zones, but also occurs in gneisses and schists.

Dip: The downward inclination of a vein or stratum relative to a horizontal plane.

Drainage Basin: A part of the surface of the earth that is occupied by a drainage system or contributes surface water to that system.

Fasciculitic: Occurring in bundles.

Garnet: An important group of minerals in which aluminum, calcium, chromium, ferric and ferrous iron, magnesium, and manganese combine with a silicate. They are commonly deep red, brown, or black, but may be any color except possibly blue.

Glacial Drift: The term embraces all rock material in transport by glacial ice, all deposits made by glacial ice, and all deposits predominantly of glacial origin made in the sea or in bodies of glacial meltwater. It includes till and rock fragments.

Glaciofluvial: A term denoting formation by, or relation to, streams within, upon, or emerging from glacial ice.

Glaciolacustrine: A term denoting formation by, or pertaining to, deposition in the quiet water of a glacial lake.

Gneiss: A metamorphic rock of alternating bands of light minerals (rich in feldspar and quartz), and dark minerals (rich in hornblende and mica).

Greenstone: A field name for rocks that have been so metamorphosed or otherwise so altered that they have assumed a distinctive color owing to the presence of chlorite, epidote, or actinolite. Greenstone is usually derived from dark-colored igneous rocks. Normally tough and hard, it can be crushed to form good to excellent aggregate.

Hornblende: The common, dark variety of amphibole.

Interbeds: Occur between, or lie adjacent and parallel to, other beds of a usually different nature.

Joint Set: A group of joints (fractures or parting planes) that remain parallel in strike and dip for a considerable distance.

Kame Moraine: An accumulation of material deposited directly from the frontal portion of glacial ice and partly sorted by water. The deposits may occur as coalescent knolls, hummocks, ridges, etc.

Kame Terrace: Stratified sands and gravels deposited by streams between a glacier and an adjacent valley wall.

Kyanite: A metamorphic, aluminum silicate mineral usually occurring as blue, thin-bladed crystals, or crystalline aggregates.

Ledge: A shelf-like projection of rock, usually horizontal and much longer than high.

Limestone: A bedded, sedimentary deposit containing from 40% to more than 98% calcium carbonate; common impurities are clay and sand. It is the most important and widespread of carbonate rocks.

Maculite: A spotted, gnarled, or knotted group of contact metamorphic rocks.

Metamorphic Rocks: Rocks formed from pre-existing rocks by pressure, heat or the infiltration of gases or liquids below the zones of weathering and cementation. Metamorphic rocks are reconstructed in place while remaining essentially solid.

Mica: Any of a group of tabular, rock-making minerals having perfect cleavage in one direction which yields thin, tough, elastic plates or flakes.

Muscovite: An important mica mineral known also as white mica, potash mica, and isinglass.

Outcrop: A part of a body of rock that is bare and exposed at the surface of the ground. More generally, it applies also to areas where the rock formation is just below the mantle, even though not actually exposed.

Phyllite: A fine-grained, foliated, metamorphic rock with a distinctive silvery appearance caused by the mineral sericite. Nearly all phyllites are derived from fine-grained sedimentary rocks by deformation and recrystallization.

Piedmont: An area lying at the foot of mountains.

Porphyroblasts: Large crystals which form in place within the fine-grained matrix of a metamorphic rock. They are caused by heat, pressure, and infiltrating solutions, and occur in pre-existing rocks.

Quartz: The most common mineral (SiO_2). It occurs as hexagonal crystals or amorphous masses. It is transparent, translucent, or opaque, or colored depending on impurities.

Quartzite: A common siliceous rock composed of quartz grains so firmly bonded that fracture occurs with equal ease across the grains and cement.

Relief: A term designating the relative difference in elevation between the summits and lowlands of a particular region.

Schist: A crystalline metamorphic rock with secondary foliation or lamination based on the parallelism of platy or needlelike grains; it has the tendency to split along the foliation.

Sediments: All materials deposited from the waters of streams, lakes, seas, or more generally, deposits of wind or ice.

Sericite: A mineral very similar to muscovite that occurs in minute flakes or scales in schists, gneisses, and phyllites.

Sillimanite: A brown, gray, or pale green metamorphic mineral (Al_2SiO_5) occurring as long, slender, and often fibrous crystals.

Spillway Outwash: Outwash material deposited in a valley that was a spillway for a melting glacier.

Staurolite: A brown to black metamorphic mineral ($HFeAl_5Si_2O_{13}$), occurring as prismatic crystals which are often twinned in the form of a cross.

Stream-Dissected: Cut by erosion into hills and valleys, or into flat divides and valleys.

Wollastonite: A metamorphic mineral ($CaSiO_3$) occurring in groups of needlelike or fibrous crystals; usually associated with marble.

Zoisite: A metamorphic mineral ($Ca_2Al_3(SiO_4)_3(OH)$) which commonly accompanies an amphibole in crystalline schists.

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PARTIAL SPECIFICATIONS FOR HIGHWAY CONSTRUCTION MATERIALS

Listed below are partial specifications for Highway Construction Materials as they apply to this report at date of publication. For a complete list of specifications see Standard Specifications for Highway and Bridge Construction, approved and adopted by the Vermont Department of Highways, March, 1976.

DIVISION 700 - MATERIALS

703.03 SAND BORROW AND CUSHION. Sand borrow shall consist of material reasonably free from silt, loam, clay, or organic matter. It shall be obtained from approved sources and shall meet the requirements of the following table:

TABLE 703.03A - SAND BORROW AND CUSHION

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE	SAND PORTION
2"	100	
1½"	90-100	
½"	70-100	
No. 4	60-100	100
No. 100		0- 30
No. 200		0- 12

703.05 GRANULAR BORROW. Granular borrow shall be obtained from approved sources, consisting of satisfactorily graded, free draining, hard, durable stone and coarse sand reasonably free from loam, silt, clay, or organic material.

The Granular Borrow shall meet the requirements of the following table:

TABLE 703.05A - GRANULAR BORROW

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE	SAND PORTION
No. 4	20-100	100
No. 200		0- 15

The maximum size stone particles of the Granular Borrow shall not exceed 2/3 of the thickness of the layer being spread.

704.05 GRAVEL FOR SUB-BASE. Gravel for Sub-base shall consist of material reasonably free from silt, loam, clay, or organic matter. It shall be obtained from approved sources and shall meet the following requirements:

(a) Grading. The gravel shall meet the requirements of the following table:

TABLE 704.05A - GRAVEL FOR SUB-BASE

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE	SAND PORTION
No. 4	20-60	100
No. 100		0- 18
No. 200		0- 8

The stone portion of the gravel shall be uniformly graded from coarse to fine, and the maximum size stone particles shall not exceed 2/3 the thickness of the layer being placed.

(b) Percent of Wear. The percent of wear of the gravel shall be not more than 25 when tested in accordance with AASHTO T-4, or more than 40 when tested in accordance with AASHTO T-96.

704.06 CRUSHED STONE FOR SUB-BASE. Crushed stone for sub-base shall consist of clean, hard, crushed stone, uniformly graded, reasonably free from dirt, deleterious material, pieces which are structurally weak and shall meet the following requirements:

(a) Source. This material shall be obtained from approved sources and the area from which this material is obtained shall be stripped and cleaned before blasting.

(b) Grading. This material shall meet the requirements of the following table:

TABLE 704.06A - CRUSHED STONE FOR SUB-BASE

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE
4½"	100
4"	90-100
1½"	25- 50
No. 4	0- 15

(c) Percent of Wear. The percent of wear of the parent rock shall be not more than 8 when tested in accordance with AASHTO T-3, or the crushed stone a percent of wear of not more than 40 when tested in accordance with AASHTO T-96.

(d) Thin and Elongated Pieces. Not more than 30 percent, by weight, of thin and elongated pieces will be permitted.

Thin and elongated pieces will be determined on the material coarser than the No. 4 sieve.

(e) Filler. The filler shall be obtained from approved sources and shall meet the requirements as set up for Sand Cushion, Subsection 703.03.

(f) Leveling Material. The leveling material shall be obtained from approved sources and may be either crushed gravel or stone screening produced by the crushing process. The material shall consist of hard durable particles, reasonably free from silt, loam, clay or organic matter.

This material shall meet the requirements of the following table:

TABLE 704.06B - LEVELING MATERIAL

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE
3/4"	100
1/2"	70-100
No. 4	50- 90
No. 100	0- 20
No. 200	0- 10

704.07 CRUSHED GRAVEL FOR SUB-BASE. Crushed gravel for sub-base shall consist of material reasonably free from silt, loam, clay or organic matter. It shall be obtained from approved sources and shall meet the following requirements:

(a) Grading. The crushed gravel shall be uniformly graded from coarse to fine and shall meet the requirements of the following table:

TABLE 704.07A - CRUSHED GRAVEL FOR SUB-BASE

GRADING	Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE	SAND PORTION
COARSE	4"	100	
	No. 4	25- 50	100
	No. 100		0- 20
	No. 200		0- 12
FINE	2"	100	
	1½"	90-100	
	No. 4	30- 60	100
	No. 100		0- 20
	No. 200		0- 12

(b) Percent of Wear. The percent of wear of the parent gravel shall be not more than 20 when tested in accordance with AASHTO T-4, or the crushed gravel a percent of wear of not more than 35 when tested in accordance with AASHTO T-96.

(c) Fractured Faces. At least 30 percent, by weight, of the stone content shall have at least one fractured face.

Fractured faces will be determined on the material coarser than the No. 4 sieve.

704.09 DENSE GRADED CRUSHED STONE FOR SUB-BASE. Dense graded crushed stone for sub-base shall consist of clean, hard, crushed stone, uniformly graded, reasonably free from dirt, deleterious material and pieces which are structurally weak, and shall meet the following requirements:

(a) Source. This material shall be obtained from approved sources and the area from which this material is obtained shall be stripped and cleaned before blasting.

(b) Grading. This material shall meet the requirements of the following table:

TABLE 704.09A - DENSE GRADED CRUSHED STONE FOR SUB-BASE

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE
3½"	100
3"	90-100
2"	75-100
1"	50- 80
½"	30- 60
No. 4	15- 40
No. 200	0- 10

(c) Percent of Wear. The percent of wear of the parent rock shall be not more than 8 when tested in accordance with AASHTO T-3, or the crushed stone a percent of wear of not more than 40 when tested in accordance with AASHTO T-96.

(d) Thin and Elongated Pieces. Not more than 30 percent, by weight, of thin or elongated pieces will be permitted.

Thin and elongated pieces will be determined on the material coarser than the No. 4 sieve.

704.10 GRAVEL BACKFILL FOR SLOPE STABILIZATION. Gravel backfill for slope stabilization shall be obtained from approved sources, consisting of satisfactorily graded, free draining, hard, durable stone and coarse sand reasonably free from loam,

silt, clay, and organic material.

The gravel backfill shall meet the requirements of the following table:

TABLE 704.10A - GRAVEL BACKFILL FOR SLOPE STABILIZATION

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE	SAND PORTION
No. 4	20-50	100
No. 100		0- 20
No. 200		0- 10

The stone portion of the gravel backfill shall be uniformly graded from coarse to fine, and the maximum size stone particles shall not exceed 2/3 the thickness of the layer being placed.

704.11 GRANULAR BACKFILL FOR STRUCTURES. Granular backfill for structures shall be obtained from approved sources, consisting of satisfactorily graded, free draining granular material reasonably free from loam, silt, clay, and organic material.

The granular backfill shall meet the requirements of the following table:

TABLE 704.11A - GRANULAR BACKFILL FOR STRUCTURES

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE	SAND PORTION
3"	100	
2½"	90-100	
No. 4	50-100	100
No. 100		0- 18
No. 200		0- 8

TA 404 2C Rev. 2/79

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION - GEOLOGY SUB-DIVISION

WOODSTOCK GRANULAR DATA SHEET NO. 1

TABLE I

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-Burden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4-35	Passes AOT Spec.	Remarks
						2 "	1-1/2"	1/2"	#4	#100	#200			
1	1	1979	1-8	0-1	No	86	79	58	49	23	12	-	Granular Borrow (Gravel)	Owner: Carl Taylor, Jr. Former owner: Frederick Billings. Area is a 1,300' X 900' field on a terrace that was formerly a golf course, 0.2 mile northwest of Town Highway No. 53, and 0.28 mile northeast of Vermont Route 12 junction. Tests were in uncut meadow at west end of field. Test No. 1 was at northwest end of terrace near woods on a high bank overlooking the Gulf Stream. Material is: 0-1', overburden; 1'-8', sandy coarse-medium gravel with boulders and silt; bottom, same.
	2	1979	1-4	0-1	No	100	100	79	62	23	11	-	Sand	Test No. 2 was on west side of terrace, 500' S20°E of Test No. 1. Material is: 0-1', overburden; 1'-4', pebbly fine gravel; bottom, fine sand and silt-clay.
	3	1979	1-9	0-1	No	91	91	66	52	18	9	23.2%	Granular Borrow (Gravel)	Test No. 3 was just west of a tree line, 285' S60°E of Test No. 2. Material is: 0-1', overburden; 1'-9', sandy coarse-medium gravel; bottom, same.

TA 404 2C Rev. 2/79

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION - GEOLOGY SUB-DIVISION

WOODSTOCK GRANULAR DATA SHEET NO. 2

TABLE I

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-Burden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4-35	Passes AOT Spec.	Remarks
						2 "	1-1/2"	1/2"	#4	#100	#200			
2	1	1979	1.5-4.5	0-1.5	Yes	92	85	67	55	16	8	-	Gravel (Grading only)	Owner: Albert E. Conklin. Area is an inactive, 120' X 80' pit near Barnard Brook, 450-feet west of Woodstock Town Highway No. 1, (class 2), and 0.32 mile north of Town Highway No. 33 junction. Overgrown pit is in the southeast corner of a meadow on a terrace. Faces and floor were overgrown with brush. Farm equipment was stored in pit. Test No. 1 was in 11-foot high north face. Material is: 0'-1.5', overburden; 1.5'-3', fine-medium silty gravel; 3'-3.5', coarse gravel; 3.5'-4.5', fine-medium gravel; bottom, same. Coarse gravel shows in floor in pit.
3	1	1979	5-8	0-5	Yes	100	100	100	96	43	15	-	Granular Borrow (Sand)	Owner: John Remington. Area is a pit southwest of Woodstock Town Highway No. 3 (class 2) and 0.93 mile north of U. S. Route 4. The nearly depleted pit is 130' X 30' with a 19-foot high northeast extension. Floor is overgrown with brush. Access is through a gateless fence at southeast corner.

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AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION - GEOLOGY SUB-DIVISION

WOODSTOCK GRANULAR DATA SHEET NO. 3

TABLE I

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-Burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4-35	Passes AOT Spec.	Remarks
						2 "	1-1/2"	1/2"	#4	#100	#200			
														Test No. 1 was near southeast end of east face. Material is: 0-5', overburden; 5'-8', gray silty fine sand; bottom, silty fine sand.
4	1A	1979	0.5-3.5	0-0.5	Yes	100	100	100	100	55	34	-	-	Owner: Edwin J. Thompson. Area is a tiny, (15' X 10') pit in edge of high terrace 0.28 mile north of U. S. Route 4 and 0.31 mile west of Town Highway No. 24 junction. Test No. 1A was in north face. Material is: 0-0.5', overburden; 0.5'-3.5', hard-packed, clean, fine sand; bottom, pebbly sand (Test No. 1-B).
	1B	1979	3.5-7.5	-	Yes	92	86	76	64	12	7	-	Granular Borrow (Sand)	Test No. 1B was below and 9-feet east of Test No. 1A. Material is: 3.5'-7.5', sand with stones; bottom, sand and cobbles.
	2	1979	0.5-3.5	0-0.5	No	94	94	76	69	10	6	-	Granular Borrow (Gravel)	Test No. 2 was in pasture on crest of terrace, 265' N 85° W of Test No. 1A. Material is: 0-0.5', overburden; 0.5-3.5', silty fine-medium gravel; bottom, bouldery silty coarse gravel.

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STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION - GEOLOGY SUB-DIVISION

WOODSTOCK GRANULAR DATA SHEET NO. 4

TABLE I

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-Burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4-35	Passes AOT Spec.	Remarks
						2 "	1-1/2"	1/2"	#4	#100	#200			
5	1	1979	2-5	0-2	Yes	100	100	100	97	11	6	-	Sand	Owner: Kenneth Raymond. Area is an inactive pit 0.09 mile north of U. S. Route 4, and 0.4 mile west of Town Highway No. 13 junction. Pit is near the center of a planted red pine grove and is used to store bricks and concrete blocks. Extension of the 270' X 150' pit is to north. Test No. 1 was in north face of pit. Material is: 0-2', overburden; 2'-5', silty to clean fine-medium gray sand; bottom sand.
6	1A	1979	0.5-3.5	0-0.5	Yes	100	91	86	82	7	5	-	Sand	Owner: John DeNeufville. Former owner: Carroll Taylor. Area is a 250' X 155' pit complex just southwest of the junction of Town Highway No. 7 with Town Highway No. 10. Access to inactive, overgrown area is from Town Highway No. 7 and 0.08 mile south of junction. Standing water was on east floor, and a brook divides the pit into south and north segments. All tests were taken in north half.

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STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION - GEOLOGY SUB-DIVISION

WOODSTOCK GRANULAR DATA SHEET NO. 5

TABLE I

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-Burden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4-35	Passes AOT Spec.	Remarks
						2 "	1-1/2"	1/2"	#4	#100	#200			
														Test No. 1A was in northwest face. Material is: 0-0.5', overburden; 0.5'-3.5', tan intergradational silty sand and stony sand layers; bottom, Test No. 1B.
	1B	1979	3-5.7	-	Yes	100	85	82	78	6	4	-	Granular Borrow (Sand)	Test No. 1B was 30-feet north of Test No. 1A. Material is: 3.5'-5.5', stony sand; 5.5'-7', loosely consolidated fine-medium sand; bottom, same
	2	1979	0.5-8	0-0.5	Yes	100	85	76	62	11	6	-	Granular Borrow (Sand)	Test No. 2 was in west extension south of corn field, 85' S35°W of Test No. 1A. Material is: 0-0.5', overburden; 0.5'-5.5', stony sand; 5.5'-8.0', south-dipping sand layers; bottom, same.
	3	1979	0.5-3.5	0-0.5	Yes	100	100	100	98	63	26	-	-	Test No. 3 was in floor, 110' S75°E of Test No. 1A. Material is: 0-0.5', overburden; 0.5'-3.5' fine sand; bottom, gray silt-clay.
	4	1979	0-1.5	-	Yes	(NOT SAMPLED)								Test No. 4 was 200' east of, and 16' below Test No. 3. Material is: 0-1.5', stones and sand; bottom, silt-clay (not sampled).

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AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION - GEOLOGY SUB-DIVISION

WOODSTOCK GRANULAR DATA SHEET NO. 6

TABLE I

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-Burden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4-35	Passes AOT Spec.	Remarks
						2 "	1-1/2"	1/2"	#4	#100	#200			
7	1	1979	2-5	0-2	Yes	93	87	75	58	20	11	-	Granular Borrow (Sand)	Owners: Charles and Vivian Archer. Area is an inactive overgrown, 60' X 35' pit, 135 feet north of Town Highway No. 37, and 1.15 miles west of Vermont Route 106. Pit has boulders on the floor. The 100' extension to west is partly overgrown with white birches and small maples. Test No. 1 was in north face. Material is: 0-2', overburden; 2'-5', silty sand with stones and much phyllitic material; bottom, same.
8	1A	1979	1-8	0-1	Yes	100	100	100	96	25	8	-	Sand	Owner: Dorothy M. Pinney. Area is a 500'-long pit complex, 0.09 mile south of Vermont Route 106, and 0.06 mile east of Town Highway No. 4 junction in the village of South Woodstock. Active pit has clean floor. Major extension is west of 50-foot west face with a minor extension southwest of 22-foot face. Test No. 1A was in upper central southwest face below upper

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION - GEOLOGY SUB-DIVISION

WOODSTOCK GRANULAR DATA SHEET NO. 7

TABLE I

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-Burden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4-35	Passes AOT Spec.	Remarks
						2 "	1-1/2"	1/2"	#4	#100	#200			
														floor. Material is: 0-1', overburden; 1'-8', dusty fine sand with a few pebbles; bottom, silt-clay.
	1B	1979	8-14	-	Yes	100	100	99	93	34	14	-	Granular Borrow (Sand)	Test No. 1B was below, and 20' east of Test No. 1A. Material is: 8'-12', silt-clay lenses; 12'-14', medium sand.
	2	1979	2-15	0-2	Yes	100	100	98	88	13	6	-	Sand	Test No. 2 was in upper central south face, 65' east of Test No. 1B. Material is: 0-2', overburden; 2'-15', sand/pebbly sand/fine gravel with a 2" silt seam; bottom, same.
	3	1979	39-45	0-39	Yes	94	94	85	67	10	6	-	Granular Borrow (Sand)	Test No. 3 was in lower southeast face, 125' east of Test No.2A. Material is: 0-39', interbedded stones, sand and silt lenses (inaccessible); 39'-43.5', sand and fine gravel; 43.5'-45', fine to medium gravel; bottom, same.
	4	1979	3-9	0-3	Yes	100	100	94	84	8	4	-	Sand	Test No. 4 was in north face of a 10-foot deep excavation in middle floor, 60' north of Test No. 2A. Material is: 0-3',overburden; 3'-9', sand and fine gravel layers; bottom, same.

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STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION - GEOLOGY SUB-DIVISION

WOODSTOCK GRANULAR DATA SHEET NO. 8

TABLE I

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-Burden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4-35	Passes AOT Spec.	Remarks
						2 "	1-1/2"	1/2"	#4	#100	#200			
	5	1979	0.5-8	0-0.5	Yes	100	96	73	51	13	8	-	Gravel (Grading only)	Test No. 5 was in southwest face above lower floor. Material is: 0-0.5', overburden; 0.5'-8', coarse sand/fine gravel/stony layers; bottom, same.
	6A	1979	0.5-2.5	0-0.5	Yes	100	100	100	97	7	4	-	Sand	Test No. 6A was in east end of middle floor, 60' NW of Test No. 3. Material is: 0-0.5', overburden; 0.5'-2.5', unconsolidated clean medium sand.
	6B	1979	2.5-8.5	-	Yes	91	87	75	56	9	5	23.6%	Gravel	Test No. 6B was below Test No. 6A. Material is: 2.5'-8.5', loosely consolidated, medium to coarse gravel; bottom, same.
	7	1979	1-7.5	0-1	Yes	100	100	100	97	38	23	-	-	Test No. 7 was in upper west floor. Material is: 0-1', overburden; 1'-2.5', silt-clay; 2.5'-4.5', fine sand; 4.5'-7.5', silt-clay; bottom, same.
9	1	1979	1-8	0-1	No	100	100	100	100	90.5	54.5	-	-	Owner: Mrs. Susan Putnam. Area is a fenced-in horse-pasture east of owner's farm buildings, south of Town Highway No. 61 and 0.15 mile east of Town Highway No. 4 junction.

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STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION - GEOLOGY SUB-DIVISION

WOODSTOCK GRANULAR DATA SHEET NO. 9

TABLE I

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-Burden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4-35	Passes AOT Spec.	Remarks
						2 "	1-1/2"	1/2"	#4	#100	#200			
														Test No. 1 was in knoll at center of field. Material is: 0-1', overburden; 1'-8', gray to brown silt-clay; bottom, same. Material is designated as silt.
10					Yes		NOT	SAMPLED						Owner: Olin Maxham. Area is a high (58') overgrown and heavily sloughed pit with farm equipment on floor. Pit is 0.18 mile north of Town Highway No. 66 (next to, and east of Kedron Brook). Owner refused permission to sample because the steep east face had been a threat to slide and block the brook and he was compelled to lower the slope.

TABLE I
SUPPLEMENT

WOODSTOCK PROPERTY OWNERS - GRANULAR	Map Identification No.
Archer, Charles and Vivian	7
Conklin, Albert	2
DeNeufville, John	6
Maxham, Olin	10
Pinney, Dorothy	8
Putnam, Susan	9
Raymond, Kenneth	5
Remington, John	3
Taylor, Carl, Jr	1
Thompson, Edwin	4

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION
ENGINEERING GEOLOGY SUB-DIVISION

WOODSTOCK ROCK DATA SHEET NO. 1

TABLE II

Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHTO T-3	Abrasion AASHTO T-96	Remarks
1	1	1979	phyllite	No	Chip	-	46.6%	Owner: Robert B. Crean. Former Owner: Kenneth MacKenzie. Area is northeast of Town Highway No. 17 and 0.84 mile northwest of its junction with Town Highway No. 16. Phyllite outcrops occur on a steep hillside, 47 feet above the road. Test No. 1 was for 145' along crest of the slope, 125' east of the road and parallel to it. There is ample room for development between the Town Highway and base of the hillside; however, material might not be available.
2	1	1979	schist	No	Chip	-	35.9%	Owner: Tom Bourne. Area is northeast of Town Highway No. 44 and 0.39 mile north of its junction with Town Highway No. 53. Hornblende schist outcrops next to the road and extends 190' along the crest of a ridge 58 feet above the road. Test No. 1 was sampled across the strike for 75' from southeast to northwest. Two joint sets occur, dipping 83° N 30°E and 81° N25°W. There is ample room for a quarrying operation between the Town Highway and the Pomfret Town Line (northwest of foot of slope), but rock is not available.
3	1	1979	amphibolite	No	Chip	-	63.9%	Owner: Willard C. Norman. Area is 0.35 mile west of Town Highway No. 73, and 0.42 mile south of its junction with Town Highway No. 72. Amphibole maculite occurs in a steep (34°) escarpment near the top. There are many massive, detached blocks below. Development would require a 1,850-foot long access road, and levelling of a staging area at

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION
ENGINEERING GEOLOGY SUB-DIVISION

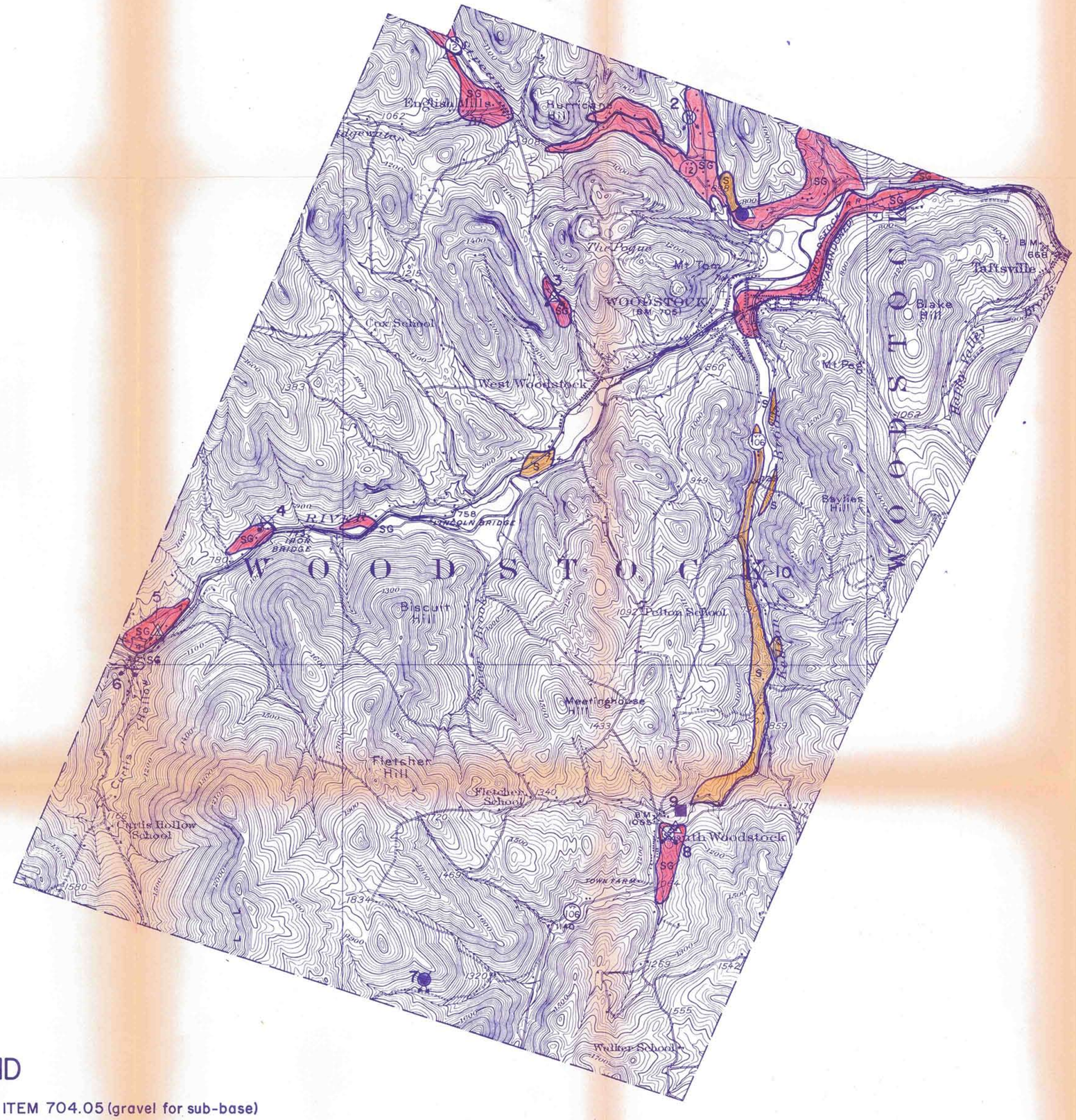
WOODSTOCK ROCK DATA SHEET NO. 2

TABLE II

Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHTO T-3	Abrasion AASHTO T-96	Remarks
								bottom of slope. Escarpment is 230' long and 30' wide. Bedding dips 30°WSW. Two joint sets occur, dipping 81° S10°W and 8°W. Test No. 1 was taken at random along foot of escarpment. Material might be available.
4	1	1979	schist	No	Chip	-	41.9%	Owners: David and Sally Laughlin. Area is east of Town Highway No. 96, and 0.42 mile north of Town Highway No. 73 junction. Garnetiferous schist and quartzite outcrop sporadically along the bank above road for 235', and extend up hillside for 35'. There is 20 feet of relief. One major joint set dips 89° S20°E. This area is poorly located for development as there is no room for a staging area next to road. Test No. 1 was a random sample taken along the north 150' or outcrops. Material might not be available.
5	1	1979	schist	No	Chip	-	62.3%	Owner: Rockwell Stephens. Area is west of Town Highway No. 70 and 0.35 mile north of its junction with Town Highway No. 66. North-south trending ledges of schist outcrop for 650' along a 70-foot high wooded hillside. Area was sampled at random across the trend for 110' to highest outcrop southwest of Power line pole No. 7. There is ample room for a staging area between road and bottom of slope.

TABLE II
SUPPLEMENT

WOODSTOCK PROPERTY OWNERS - ROCK	Map Identification No.
Bourne, Thomas.....	2
Crean, Robert.....	1
Laughlin, David and Sally	4
Norman, Willard.....	3
Stephens, Rockwell.....	5



LEGEND

- ○ GRAVEL, ACCEPTABLE FOR ITEM 704.05 (gravel for sub-base)
- ● GRAVEL, DEPLETED OR NOT ACCEPTABLE FOR ITEM 704.05
- △ SAND, ACCEPTABLE FOR ITEM 703.03 (sand borrow and cushion)
- ▲ SAND, DEPLETED OR NOT ACCEPTABLE FOR ITEM 703.03
- □ GRANULAR BORROW, ITEM 703.05
- ■ MATERIAL NOT ACCEPTABLE FOR ITEM 703.05
- ⚔ EXISTING PIT
- SG SAND & GRAVEL DEPOSIT
- S SAND DEPOSIT
- 3 IDENTIFICATION NUMBER (refer to data sheets)

WOODSTOCK

SCALE 1:31,250

0.5 0 1 MILE

CONTOUR INTERVAL 20 FEET

1979

GRANULAR MATERIALS MAP

BY

VERMONT AGENCY OF TRANSPORTATION

MATERIALS AND RESEARCH DIVISION

NOTE: BASED ON U.S.G.S. TOPOGRAPHIC MAPS

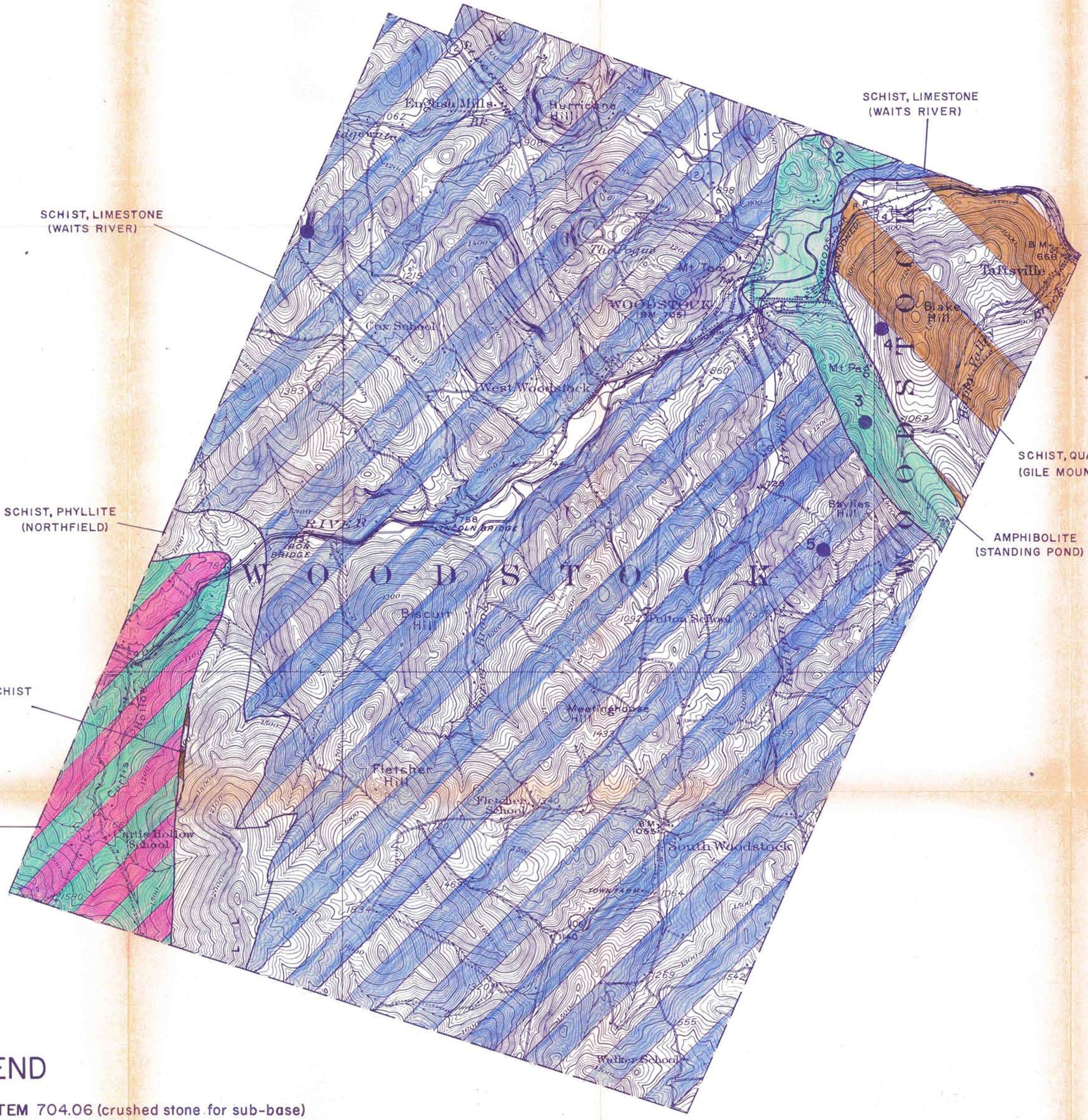
PLATE I

GRANULAR

WINDSOR COUNTY VT. HWY. DISTRICT NO. 4

REVISIONS

DATE							
BY							



LEGEND

- ○ ROCK, ACCEPTABLE FOR ITEM 704.06 (crushed stone for sub-base)
- ● ROCK, NOT ACCEPTABLE FOR ITEM 704.06
- ⚒ EXISTING QUARRY

- GRANITE TO DIORITE (light to intermediate igneous rocks)
- AMPHIBOLITE, GABBRO, DIABASE, METADIABASE, GREENSTONE, TRAP DIKES (basic or dark igneous rocks)
- PERIDOTITE, PYROXENITE, SERPENTINITE (ultra-basic igneous rocks)
- GNEISS
- QUARTZITE
- DOLOMITE
- MARBLE, LIMESTONE
- SCHISTS, SLATES, PHYLLITES, SHALES, CONGLOMERATES
- 3 IDENTIFICATION NUMBER (refer to text)

WOODSTOCK

SCALE 1:31,250

0.5 0 1 MILE

CONTOUR INTERVAL 20 FEET

1979

ROCK MATERIALS MAP

BY

VERMONT AGENCY OF TRANSPORTATION

MATERIALS AND RESEARCH DIVISION

NOTE: BASED ON U.S.G.S. TOPOGRAPHIC MAPS

PLATE II

ROCK

WINDSOR COUNTY VT. HWY. DISTRICT NO. 4

REVISIONS

DATE							
BY							