SURVEY OF HIGHWAY CONSTRUCTION MATERIALS
IN THE TOWN OF MARSHFIELD, WASHINGTON COUNTY, VERMONT

prepared by

Engineering Geology Section, Materials Division

Vermont Department of Highways

in cooperation with

United States Department of Transportation

Federal Highway Administration

Montpelier, Vermont

March, 1973

TABLE OF CONTENTS

Acknowledgements

The work of this Project was greatly implemented by the cooperation and assistance of many groups and individuals. The following were particularly helpful in carrying out the Project's objectives.

1. Various departments and individuals of the Vermont State Department of Highways, notably the Planning and Mapping Division and the Highway Testing Laboratory.

2. Professor D. P. Stewart of Miami University, Oxford, Ohio.

3. Professor C. G. Doll, Vermont State Geologist, University of Vermont, Burlington, Vermont.

4. United States Department of Commerce, Bureau of Public Roads.

History

The Materials Survey Project was formed in 1957 by the Vermont State Department of Highways with the assistance of the United States Bureau of Public Roads. Its prime objective was to compile an inventory of highway construction materials in the State of Vermont. Prior to the efforts of the personnel of the Survey as described in this and other reports, searches for highway construction materials were conducted only as the immediate situation required. Thus only limited areas are surveyed, and no overall picture of material resources was available. Highway contractors or resident engineers are usually required to locate the materials for their respective projects and have samples tested by the Highway Testing Laboratory. The additional cost of exploration for construction materials is passed onto the State in the form of higher construction costs. The Materials Survey Project was established to minimize or elimate this factor by enabling the State and its contractors to proceed with information

on materials sources available beforehand. Prior knowledge of locations of suitable material is an important factor in planning future 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 for reporting the findings of the Project were designed with their intended use in mind. These maps and data sheets were devised to furnish information of particular use to the contractor or construction man. For maximum benefit, the maps, data sheets, and this report should be studied simultaneously.

Inclosures

Included in this folder are two surface-geology maps, one defining the location of tests conducted on bedrock sources, the other defining the location of tests conducted on granular materials. These maps are derived from 15-minute or 7½-minute quadrangles of the United States Geological Survey enlarged or reduced to 1:31250 or 1" = 2604'. Delineated on the Bedrock Map are the various rock types of the area. This information was obtained from numerous sources: Vermont Geological Survey Bulletins, Vermont State Geologist Reports, United States Geological Survey Bedrock Maps, and the Centennial Geological Map of Vermont, as well as other references.

The granular materials map depicts areas covered by various types of glacial deposits (outwash, moraines, kames, kame terraces, eskers, etc.) by which potential sources of gravel and sand may be recognized. This information was obtained primarily from a survey conducted by Professor D. P. Stewart of Miami University, Oxford, Ohio, who had been mapping the glacial features of Vermont during the summer months since 1956. Further

information was obtained from the Soil Survey (Reconnaissance) of Vermont conducted by the Bureau of Chemistry and Soils of the United States Department of Agricultrue, and from Vermont Geological Survey Bulletins, United States Geological Survey Quadrangles, aerial photographs, the Surficial Geologic Map of Vermont, and other sources. On both maps the areas tested are represented by Identification Numbers. Several tests are usually conducted in each area represented by an Identification Number, the number of such tests being more or less arbitrarily determined either by the character of the material or by the topography.

Also included in this folder are data sheets for both the Bedrock and Granular Materials Survey, which contain detailed information for each test conducted by the Project as well as information obtained from other sources, and including an active card file compiled by the Highway Testing Laboratory. The latter information was gathered over a period of years by many persons and consequently lacks the organized approach and detail required for effective use. The information on the cards varied widely in completeness. Transfer of information from the cards to the data sheets was made without elaboration or verification. When possible, the locations of the deposits listed in the card files have also been plotted on the maps; however, some cards in the file were not used because the information on the location of the deposit was incomplete or unidentifiable. Caution should be exercised wherever this information appears incomplete. This Project does not assume responsibility for the information taken from the card files.

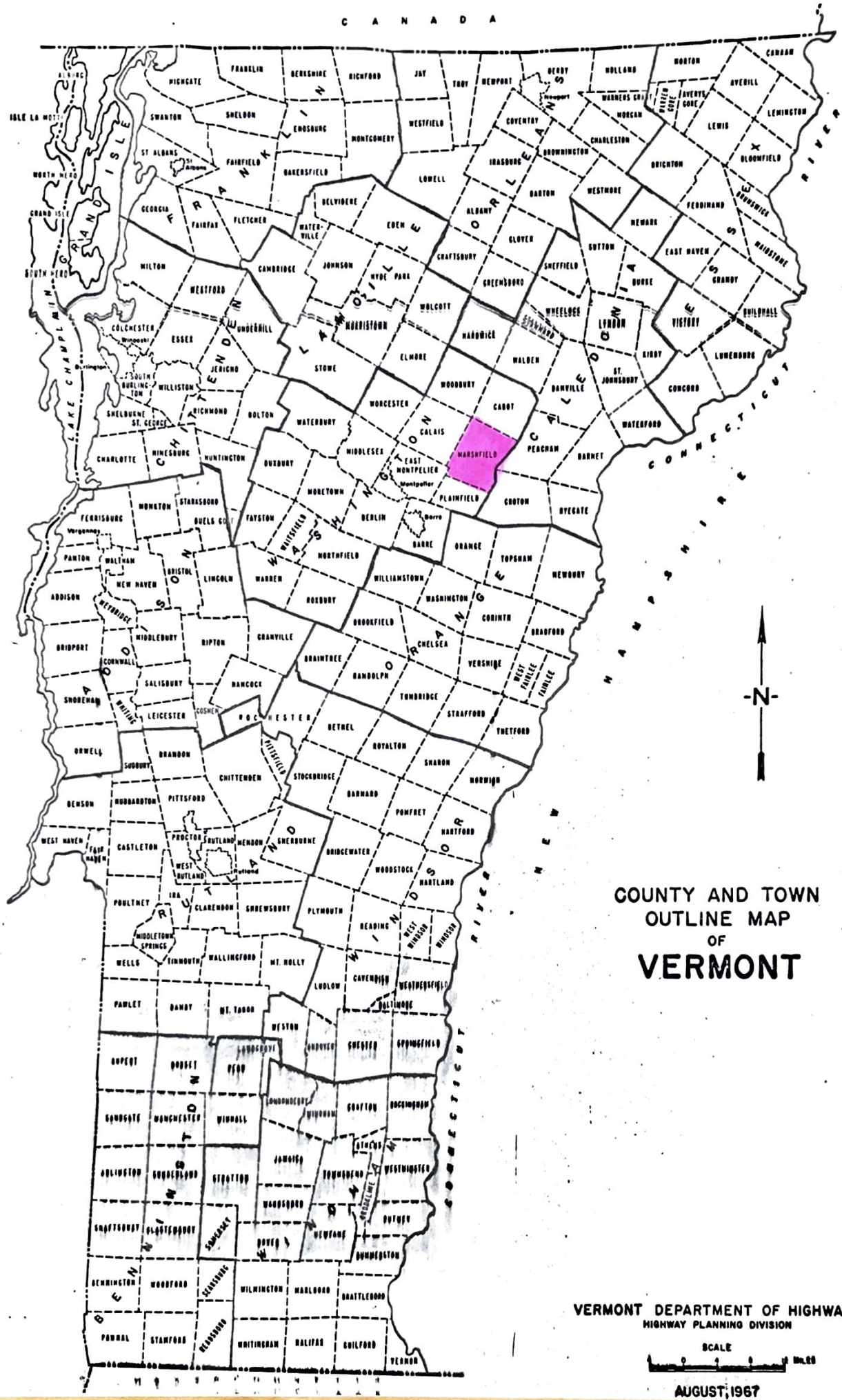
Work sheets contain more detailed information on each test and a detailed sketch of each identification Number Area. The work sheets and laboratory reports are on file in the office headquarters of this Project.

LOCATION

The town of Marshfield is situated in the eastern part of Washington County in the east-central part of the State. Marshfield is bounded on the northeast by Cabot, on the southeast by Peacham and Groton, on the southwest by Plainfield, on the west by East Montpelier, and on the northwest by Calais. (See County and Town Outline Map of Vermont on the following page.)

Marshfield is within the Vermont Piedmont subdivision of the New England Upland that can be described as a plateau dissected by streams and subdued by glaciation. Topography is undulating to rough because of numerous, steep-sided valleys. Elevations vary from 2,308 feet at the summit of an unnamed mountain in the southern corner of the town to less than 740 feet where the Winooski River crosses the Plainfield town line.

Principal drainage is to the west via the Winooski River and its tributary brooks which continues westward, entering Lake Chaplain at Burlington. Less than five percent of the drainage, in the vicinity of Kettle Pond on the Groton town line, flows southeastward and ultimately enters the Connecticut River at the village of Wells River in the town of Newbury.



COUNTY AND TOWN OUTLINE MAP OF VERMONT

VERMONT DEPARTMENT OF HIGHWAYS
HIGHWAY PLANNING DIVISION

SCALE

AUGUST, 1967

SURVEY OF ROCK SOURCES

Procedure for Rock Survey

The routine 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 primarilty during the winter months and comprises the mapping and description of rock types as indicated in various reference sources. Many different sources of information are utilized, as indicated in the bibliography. These references differ considerably in dependability due to new developments and studies that have contributed to the obsolescense of a number of reports. In addition, the results of samples taken by other individuals are analyzed, and the location at which these samples were taken is mapped when possible. In other words, as complete a correlation as possible is made of all the information available concerning the geology of the area under consideration.

The field investigation is begun by making a cursory preliminary survey of the entire area. The information obtained in the preliminary survey, together with the information assimilated in the office investigation, is employed to determine the areas where testing and sampling will be concentrated. When a promising source has been determined by rock type, volume of material, accessibility, and adequate exposure and relief, chip samples are taken with a hammer across the strike or trend of the rock. The samples are submitted to the Material Testing Laboratory for abrasion testing both by the Deval Method (AASHO T-3) and the Los Angeles Method (AASHO T-96). It should be kept in mind that the samples taken by the chip method are often within the weathered zone of the outcrop and consequently may give a less satisfactory test result than fresh material deeper in the rock structure. When the material is uniform and acceptable abrasion tests result from the chip samples, the material source is included in this report as being satisfactory.

Discussion of Rock and Rock Sources

It should be noted that information on the Rock Materials Map is somewhat simplified. (For a more detailed description of the respective rock formations, see the Summary included in this report) In the Summary it is apparent that complex metamorphic rocks comprise about half the lithology within the town of Marshfield.

Occasionally, rocks belonging to the same formation and exhibiting similar characteristics (i.e. color, texture, etc.) may produce different abrasion results owing to different physical and chemical properties. Therefore, in no case should satisfactory test results of an area be construed to mean that the same formation, even in the same area, will not later produce unsatisfactory material. This is especially true of metamorphic rocks.

In general, bedrock in the town of Marshfield can be classified into two different types. The eastern three-fifths of the town are underlain by undifferentiated granitic rock of the New Hampshire plutonic series that chiefly consists of Knox Mountain Granite. The western two-fifths are underlain by Lower Devonian metasediments of the Gile Mountain and Waits River formations. However, in the lower elevations the town is liberally covered by a mantle of glacial till that obscures the bedrock and interformational contacts.

The metasedimentary rocks in this region tend to be schistose and phyllitic, hence are usually unreliable as sources of crushed stone for subbase. Granitic rock where it is not in close proximity to the Gile Mountain formation appears to be favorable for future exploitation.

SURVEY OF SAND AND GRAVEL SOURCES

Procedure for Sand and Gravel Survey

The method employed by the project in a 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 primarily during the winter months and comprises the mapping of possible potentially productive areas as indicated from various references. Of these references, the survey of glacial deposits mapped by Professor Stewart proves to be valuable, particularly when used in conjunction with other references such as 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. In addition, the locations of existing pits are mapped when known. The locations in which samples were taken by other individuals are noted and mapped when possible.

The field investigation is begun by making a cursory preliminary survey of the entire town. All pits and other areas which show physiographic features that give evidence of glacial or fluvial deposition are noted. These locations are later investigated by obtaining samples of pit faces and other exposed materials. Test pits, dug with a backhoe to a depth of approximately 11 feet, are also sampled. The samples are submitted to the Materials Testing Laboratory where they are tested for gradation and stone abrasion, the latter by the Deval Method (AASHO T-4), and the Los Angeles Method (AASHO T-96).

Discussion of Sand and Gravel Deposits

With one exception, granular materials in the town of Marshfield are found only at elevations below 1,100 feet. The exception is a sand pit at 1,240 feet on Town Highway No. 31 at Map Identification No. 4. This material may have been emplaced as a small delta representing deposition at the edge of a proglacial lake when the glacier retreated down the Winooski River valley.

Stewart and MacClintock mapped a lake sand in this valley where the river crosses the Plainfield town line. Because this deposit is within the Plainfield Village urban district, it was not sampled. They also mapped several kamic features in the Winooski valley. These features are described in sequence from southwest to northeast.

A kame terrace occurs on the hillside behind Nelsons Family Drive-In about one half mile east of the junction of Town Highway No. 60 with U.S. Route No. 2. The survey found that silt predominated in an excavation within the feature. The owner was developing the hillside for motel units.

Another kame terrace occurs at the junction of Town Highway No. 56 with U.S. Route No. 2 and was sampled at Map Identification No. 12. Additional testing on property owned by Martin Johnson would be necessary to determine extent of this sand source.

A kame moraine is crossed by Town Highway No. 49 about 0.3 mile from its junction with U.S. Route No. 2 (See Map Identification Nos. 8 and 9 for materials occurring within the feature).

Another kame terrace northwest of U.S. Route No. 2 is about one quarter mile east of Town Highway No. 34. The pit at Map Identification No. 2 is within a kame terrace. The eastern end of the Marshfield Village urban zone lies on an additional kame terrace. Map Identification No. 1 is in Kame moraine.

Two additional sand sources are outside of the Stewart and MacClintock kamic areas (see Map Identification Nos. 3 and 7) and several granular borrow sources are not associated with them (see Map Identification Nos. 13 and 15). The pit at Map Identification No. 16 was above both 1,400 feet in elevation and the upper limit of glaciofluvial deposition.

SUMMARY OF ROCK FORMATION IN THE TOWN OF MARSHFIELD

Barton River Member (of the Waits River Formation): Interbedded siliceous crystalline limestone and sericite-quartz-chlorite phyllite in northern Vermont; diopsidic limestone and cordierite hornfels at contacts with granitic dikes and sills.

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

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.

Undifferentiated Granitic Rocks: Fine- to coarse-grained granitoid rocks including granodiorite and quartz monzonite occurring as sills and irregular bodies.

GLOSSARY OF SELECTED GEOLOGIC TERMS

Contact: The surface, often irregular, which constitutes the junction of two bodies of rock different in kind, age, or origin.

Delta: A predominantly alluvial deposit built by a stream entering the sea or other body of water. Usually it has the form of the Greek letter delta.

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

Granite: A granular, crystalline rock of predominantly interlocking texture, composed essentially of alkalic feldspars and quartz. Accessory minerals (chiefly micas, hornblende, or more rarely pyroxene) are commonly present.

Joint: A fracture or parting plane along which there has been little, if any, movement parallel with the walls.

Kame Moraine: An accumulation of material deposited directly from the frontal portion of the glacial ice and partly sorted by water action. Deposits may take the form of coalescent knolls, hummocks, ridges, etc.

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

Mantle: In a general sense, refers to the loose material at or near the surface, above bedrock.

Metamorphic Rocks: Rocks that owe their distinctive characteristics to the transformation of preexisting rocks, either through intense heat or pressure or both.

Metasediments: Partly metamorphosed sedimentary rocks.

Phyllitic: Pertaining to fine-grained, foliated metamorphic rock intermediate between the mica schists and slates, into which it may grade.

Proglacial Lake: A lake formed just outside the frontal moraine of a glacier.

Quartzite: A compact metamorphic rock composed of quartz grains so firmly cemented that fracture takes place across the grains and the cementing material with equal ease.

Schist: A crystalline rock with a secondary foliation or lamination based on parallelism of platy or needle-like grains. The name refers to the tendency to split along the foliation.

Till: An unsorted, unstratified and unconsolidated heterogeneous mixture of clay, silt, sand, gravel and boulders deposited directly by glacial ice.

Xenolith: An inclusion that has obviously been derived from some older formation genetically unrelated to the igneous rock itself.

Bibliography

A survey of the glacial geology of Vermont conducted by D.P. Stewart, the partial results of which were published in Vermont Geological Survey Bulletin No. 19; 1961.

The Surficial Geology and Pleistocene history of Vermont, David P. Stewart and Paul MacClintock; 1969; Vermont Geological Survey Bulletin No. 31.

Soil Survey (Reconnaissance) of Vermont, W.J. Latimer; 1930; Bureau of Chemistry and Soils, United States Department of Agriculture.

Soil Exploration and Mapping; 1950; Highway Research Board, Bulletin 28.

Survey of Highway Aggregate Materials in West Virginia; December, 1959; Engineering Station, West Virginia University, Morgantown, West Virginia.

Materials Inventory Bangor Quadrangle, South Half; September, 1959; University of Maine.

Glacial Geology and the Pleistocene Epoch, R.F. Flint; 1947; John Wiley and Sons, Inc.

A Handbook of Rocks, J.F. Kemp; June, 1946; D. Van Nostrand Company Inc.

Rock and Rock Minerals, L.V. Pirsson; June, 1949; John Wiley and Sons, Inc.

Glossary of Selected Geologic Terms; J.L. Stokes and D.J. Varnes; 1955; Colorado Scientific Proceedings; Vol. 16.

Centennial Geologic Map of Vermont, C.G. Doll; 1961.

Bedrock Geology of the East Barre Area, Vermont, Varanasi Rama Murthy; 1957; Vermont Geological Survey Bulletin No. 10.

Geology of the Plainfield Quadrangle, Vermont, Ronald H. Konig; 1961; Vermont Geological Survey Bulletin No. 16.

The Geology of the St. Johnsbury Quadrangle, Vermont and New Hampshire, Leo M. Hall; 1959; Vermont Geological Survey Bulletin No. 13.

East Barre Quadrangle, Vermont; Geological Survey, United States Department of the Interior, 1953.

Plainfield Quadrangle, Vermont; Geological Survey, United States Department of the Interior, 1953.

St. Johnsbury Quadrangle, Vermont-New Hampshire; Geological Survey, United States Department of the Interior, 1949.

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 in July, 1971.

DIVISION 700 - MATERIALS

Section 703, Soils and Borrow 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 - Gradation Requirements

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	
No. 100		100
No. 200		0- 30
		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, and organic material.

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

Table 703.05A - Gradation Requirements

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves	
	Total Sample	Sand Portion
No. 4	20-100	
No. 200		100
		0- 15

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

Section 704, Aggregate

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 - Gradation Requirements

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 AASHO T 4, or more than 40 when tested in accordance with AASHO 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 - Gradation Requirements

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 AASHO T 3, or the crushed stone a percent of wear of not more than 40 when tested in accordance with AASHO T 96.

(d) Thin and Elongated Pieces

Not more than 30 percent, by weight, of thin and elongated peices 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 - Gradation Requirements

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves Total Sample
1"	100
3/4"	90-100
1/2"	50- 90
No. 4	30- 70
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 - Gradation Requirements

Grading	Sieve Designation	Percentage by Weight Passing Square Mesh Sieves Total Sample	Sand Portion
	4"	100	
Coarse	No. 4	25- 50	100
	No. 100		0- 20
	No. 200		0- 12
	2"	100	
	1½"	90-100	
Fine	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 AASHO T 4, or the crushed gravel a percent of wear of not more than 35 when tested in accordance with AASHO 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 - Gradation Requirements

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 AASHO T 3, or the crushed stone a percent of wear of not more than 40 when tested in accordance with AASHO 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 - Gradation Requirements

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 - Gradation Requirements

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

MARSHFIELD GRANULAR DATA SHEET NO. 1

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing						Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
						2"	1½"	½"	#4	#100	#200			
1	1	1972	0.5-4.5	0-0.5	No	91	84	62	51	32	21	20.4%	---	Owner: Franklin Beaton. Area is a large field south of the Winooski River and east of Marshfield Village. Access is by field road from U.S. Route No. 2 about 0.23 mile east of Town Highway No. 28. Field formerly contained a pit near its northeast corner that has been smoothed over. Much wet silty material shows near pit site. Test No. 1 was at west end of knoll about 225'N 50°E of log bridge that crosses drainage ditch in field. Material is: 0-0.5, sod; 0.5-4, poorly sorted silty gravel; 4-4.5, sand; 4.5-9, silt-clay (not sampled).
2	1	1972	2-14	0-2	Yes	---	100	89	80	30	19	---	---	Owner: Tom McClay. Area contains a pit within Marshfield Village, about 100' northeast of Town Highway No. 25 and 0.07 mile from U.S. Route No. 2. Test No. 1 was in the center of the upper face where poorly stratified horizontal beds are exposed. Material is: 0-1, sod; 1-2, silt (not sampled); 2-4, silt and stones; 4-14, wet, coarse to fine silty sand.
	2	1972	1-15	0-1	Yes	81	64	56	51	40	25	---	---	Test No. 2 was in the northeast

MARSHFIELD GRANULAR DATA SHEET NO. 2

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1½"	½"	#4	#100	#200	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
														end of the lower face. Material is: 0-1, silt; 1-15, poorly sorted silty sand with stones that becomes less stony and siltier with depth.
3	1	1972	0.5-5	0-0.5	No	---	100	99	90	13	6	---	Sand	Owner: George Valentine. Area is long hayfield northeast of Town Highway No. 35 and south of the Winooski River. THIS MATERIAL WAS NOT AVAILABLE AT TIME OF SURVEY! Test No. 1 was at northeast end of field. Material is: 0-0.5, sod; 0.5-5, medium to coarse sand; bottom, clay.
	2	1972	1-4	0-1	No	---	---	100	92	18	13	---	Gran. Borrow (Sand)	Test No. 2 was at southwest end of field about 200' southeast of barn and 775' southwest of Test No. 1. Material is: 0-0.5, sod; 0.5-1, silt (not sampled); 1-2.5, silty fine sand; 2.5-4, coarse sand; 4-7, sandy silt (not sampled); bottom, clay.
	3	1972	1-7	0-1	No	---	---	---	100	16	6	---	Sand	Test No. 3 was in middle of field about 50'S 30°E of large elm tree and 400' southwest of Test No. 1. Material is: 0-1, sod and silt; 1-7, wet sand; bottom, clay.
4	1A	1972	2-11	0-2	Yes	---	100	91	82	6	3	---	Sand	Owner: Fred Jewett. Area is a field southwest of the

MARSHFIELD GRANULAR DATA SHEET NO. 3

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1½"	½"	#4	#100	#200	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
														junction of Town Highway Nos. 28, 30 and 31. Southwest end of field contains a pit.
														Test No. 1A was in upper south faze. Material is: 0-1, sod; 1-2, brown silt (not sampled); 2-7, sand that becomes gravelly with depth; 7-9, fine gravel; 9-11, coarse sand.
	1B	1972	11-15	---	Yes	---	---	100	94	40	17	---	---	Test No. 1B was in lower south face about 50'N 10°E of Test No. 1A. Material is: 11-15, sand with silt layers; bottom, sand.
	2	1972	0-3.5	---	Yes	---	---	---	100	77	41	---	---	Test No. 2 was in floor about 20' N 45°W of Test 1B. Material is: 0-3.5, fine sand; 3.5-4.5, cobble-stones and boulders.
	3A	1972	0.5-4.5	0-0.5	Yes	91	82	73	64	7	4	23.7%	Gran. Borrow (Sand)	Test No. 3A was in extension about 75' south of Test No. 1A. Material is: 0-0.5, sod; 0.5-4.5, sandy gravel; 4.5-7, sand.
	3B	1972	4.5-9.5	---	Yes	---	---	100	99*	91	59	---	---	Test 3B was below Test No. 3A. Material is: 4.9-9.5, sand that becomes silty with depth.
	4A	1972	1-4	0-1	No	59	59	44	37	25	13	22.6%	Gran. Borrow (Grav.)	Test 4A was in field about 220'N 55°E of Test No. 3A and 115' east of Utility Pole No. 11. Material is: 0-1, sod and silt; 1-4, coarse gravel with cobblestones.

MARSHFIELD GRANULAR DATA SHEET NO. 4

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1½"	½"	#4	#100	#200	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
	4B	1972	4-10.5	---	Yes	---	100	93	89	29	14	---	Gran. Borrow (Sand)	Test 4B was below Test No. 4A. Material is: 4-10.5, sand with a little silt.
5	1	1972	0.5-6	0-0.5	No	---	100	---	98	62	48	---	---	Owner: George Lafirira. Area is a hillside about ½ mile east of owner's barn at the end of Town Highway No. 38. Between hillside and barn was wet and slick field planted with corn at time of survey. Test No. 1 was about ½ mile east-southeast of barn. Material is: 0-0.5, sod; 0.5-6, sand and silt. An additional sieve analysis follows: Passing #10 96.6% Passing #40 81.3%
	2	1972	0.5-6	0-0.5	Yes	90	75	65	59	39	23	---	---	Test No. 2 was in face of small pit on woods road east of barn. Material is: 0-0.5, sod; 0.5-6, silty stony sand.
6	1	1972	1-5	0-1	No	---	---	---	100	89	81	---	---	Owner: Frank Bailey. Area is a large knoll S 75°E of the old Thompson place on U.S. Route No. 2. Access to field with knoll is about 0.63 mile north of junction of Town Highway No. 55 with U.S. Route No. 2. Test No. 1 was in high point on knoll. Material is: 0-1, sod;

MARSHFIELD GRANULAR DATA SHEET NO. 5

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1½"	½"	#4	#100	#200	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
														1-5, silt with a little sand. An additional sieve analysis follows: Passing #10 99.7 Passing #40 97.7
7	1A	1960	1.5-4	0-1.5	Yes	69	60	---	39	11	6	35.0%	Gran. Borrow (Grav.)	Owner: Frank Bailey (formerly Gordon Currier). Area consists of an open field east of a deserted farm at the end of Town Highway No. 48. This field was sampled in 1960 but not resampled in 1972 because little, if any, material had been removed during the interim. At the time of this survey field was planted with Christmas trees. Test No. 1A was near southeast corner of field overlooking Naismith Brook. Material was: 0-1.5, very stony overburden; 1.5-4, gravel.
	1B	1960	4-14	---	Yes	---	100		91	12	1.4	---	Sand	Test No. 1B was below Test No. 1A. Material was: 4-14, sand.
	2	1960	1-9	0-1	No	61	52	---	30	14	4	24.4%	Gravel	Test No. 2 was in the woods northeast of Test No. 1. Material is: 0-1, overburden; 1-9, gravel with many stones over 6" in diameter; bottom, clay.
	3	1960	1-4.5	0-1	No	100	80	---	69	---	18	---	---	Test No. 3 was on slope southwest of Test No. 1A. Material is: 0-1,

MARSHFIELD GRANULAR DATA SHEET NO. 6

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1½"	½"	#4	#100	#200	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
														overburden; 1-3, silt; 3-4.5, sand with stones.
	4A	1960	1.5-6	0-1.5	No	48	45	---	28	11	4	---	Grav. (grading only)	Test No. 4A was at south edge of field southwest of Test No. 1A. Material is: 0-1.5, overburden; 1.5-6, gravel.
	4B	1960	6-10	---	No	---	100	---	77	4.5	1.0	---	Sand	Test No. 4B was below Test No. 4A. Material is: 6-10, stony sand.
	5	1960	1-6	0-1	No		N O T		S A M	P L E	D			Test No. 5 was at northwest edge of field overlooking the Winooski River. Material is: 0-1, sod; 1-6, silt and clay; 6-8, clay.
	6	1960	1-10	0-1	No	---	---	---	100	---	30	---	---	Test No. 6 was taken at edge of woods at eastern side of field. Material is: 0-1, sod; 1-10, silt and sand.
8	1	1972	0.5-10	0-0.5	No	100	91	79	73	6	4	---	Sand	Owner: Robert Silverstein. Area is A field north of Town Pit east of Town Highway No. 49. Owner has contested withdrawal of material from Town Pit which abuts his land. Test No. 1 was at north edge of field 210' north of Town Pit. Material is: 0-0.5, sod; 0.5-10. clean gray sand with a few stones. Sand beds dip northwest.
9	1	1972	1-9	0-1	Yes	---	---	100	98	36	13	---	Gran. Borrow (Sand)	Owner: Town of Marshfield. Area

MARSHFIELD GRANULAR DATA SHEET NO. 7

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing						Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
						2"	1½"	½"	#4	#100	#200			
														is the Town Pit located north of the intersection of railroad grade with Town Highway No. 49. Test No. 1 was in west floor. Material is: 0-1, brown silty sand (not sampled); 1-9, moist fine gray sand; bottom, very wet clay.
10	1	1972	1-7	0-1	No	93	82	60	49	25	16	28.7%	---	Owner: Earl Jacobsen. Area is a field northeast of Town Highway . No. 49 about 0.12 mile from railroad grade. A ditch near the southwest end of the field showed many 4" - 6" cobblestones. Test No. 1 was at the edge of a terrace due north of the owner's house and about 90'S 55°E of two rock piles. Material is: 0-1, sod; 1-3, stony silty sand; 3-6, coarse gravel that becomes cobbly at the bottom; 6-7, stony silt; bottom, clay.
11	1	1972	0.5-10	0-0.5	Yes	---	---	---	100	74	28	---	---	Owner: Mrs. Ethel Wilson. Area is on the site of an excavation for the railroad trestle southwest of Town Highway No. 49. It is reached by driving along the railroad grade 1.48 miles north of its intersection with Town Highway No. 60. Site is in the woods southeast of the railroad grade.

MARSHFIELD GRANULAR DATA SHEET NO. 8

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1½"	½"	#4	#100	#200	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
														Test No. 1 was about 100' from the railroad grade. Material is: 0-0.5, moss and silt; 0.5-10, silty fine light gray sand.
12	1A	1972	1-4	0-1	Yes	100	95	75	65	17	8	12.6%	Sand	U.S. Route No. 2 right-of-way. Area is a 150' long pit which exposes material in a field belonging to Martin Johnson. Test No. 1A was in upper east face across U.S. Route No. 2 from the Cassady House. Material is: 0-1, sod; 1-4, gravelly sand.
	1B	1972	4-14	---	Yes	---	100	94	86	38	10	---	Gran. Borrow (Sand)	Test No. 1B was in east face below Test No. 1A. Material is: 4-8, fine sand; 8-10, gravelly sand; 10-14, fine sand; bottom, same.
13	1A	1972	1-3	0-1	Yes	84	70	51	43	15	8	19.4%	Gravel	Owner: Stanley Brown. Area is a field east of the Winooski River and south of the Twinfield High School. Owner has a campground at the southwest corner of the field. Test No. 1A was in the upper face of a small pit about 600' N 50°E of owner's house. Material is: 0-1, sod; 1-3, coarse gravel.
	1B	1972	3-5.5	---	Yes	100	94	90	79	7	4	---	Sand	Test No. 1B was in lower face below Test No. 1A. Material is: 3-5.5, coarse sand with a few stones.

MARSHFIELD GRANULAR DATA SHEET NO. 9

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1½"	½"	#4	#100	#200	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
	2	1972	2-6	0-2	No	87	85	68	57	18	10	---	Gran. Borrow (Grav.)	Test No. 2 was in field 350' N 30°E of Test No. 1A. Material is: 0-1.5, sod; 1.5-2.5, stony silt; 2.5-6, wet granitic gravel; bottom, silt.
14	1	1972	1-8	0-1	No	---	---	100	88	42	36	---	---	Owner: Stanley Brown. Area is a knoll against hillside south of house. Area is in pasture that contains excavations. Test No. 1 was in lower, north end of knoll. Material is: 0-1, sod and silt; 1-8, fine sand to silt; 8-10, silt to clay.
	2	1972	1-4	0-1	Yes		N O	T	S	A M	P L E	D		Test No. 2 was in an old excavatiom below and 40' west of Test No. 1. Material is: 0-1, sod; 1-4, sand and clay with boulders (not in place).
15	1	1972	0.5-2	0-0.5	No	---	86	---	80	21	14	---	Gran. Borrow (Sand)	Owner: Richard Wolverton. Area is an open field, reached by legal trail, about a mile north of Town Highway No. 60. Trail begins about 0.8 mile east of intersection or railroad grade with Town Highway No. 60. Owner would allow only one hand sample and does not wish to make material available. Test No. 1 was located 120' N 80°E of house that he was building.

MARSHFIELD GRANULAR DATA SHEET NO. 10

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing						Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
						2"	1½"	½"	#4	#100	#200			
														Material is: 0-0.5, sod; 0.5-2, silt and stones with vaguely horizontal bedding.
16	1	1972	1-9	0-1	Yes	---	---	---	100	81	56	---	---	Owner: Henry Boisse. Area is a pit south of Town Highway No. 61 about 1.29 miles east of Town Highway No. 60. Material is not available and owner would allow only hand sampling. Test No. 1 was in upper south face of pit about 115' N 55°E of house. Material is: 0-1, sod; 1-9, silt to fine sand; 9-17, sloughed over and not accessible.

TABLE I
Supplement

MARSHFIELD PROPERTY OWNERS - GRANULAR	Map Ident. No.
Bailey, Frank	6, 7
Beaton, Franklin	1
Boisse, Henry	16
Brown, Stanley	13, 14
Jacobsen, Earl	10
Jewett, Fred	4
Lafirira, George	5
McClay, Tom	2
Marshfield, Town of	9
Silverstein, Robert	8
U. S. Route No. 2	12
Valentine, George	3
Wilson, Ethel	11
Wolverton, Richard	15

MARSHFIELD ROCK DATA SHEET NO. 1

Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHO T-3	Remarks
1	1	1972	Granitic	No	Chip	3.5%	Owner: Leslie Brimblecomb. Area is a wooded hillside west of U.S. Route No. 2 about 0.44 mile south of Town Highway No. 34. Bedrock on the slope has been broken into large blocks by a vertical joint system. Rock has been named the Knox Mountain granite of the New Hampshire plutonic series. Test No. 1 started at the south end of the area near the southeast end of a barbed wire property line fence and extended at random from 0 to 77' N 15°W up the slope. An additional test (AASHO T 96) yielded an abrasion result of 56 4%
	2	1972	Granitic	No	Chip	6 0%	Test No 2 continued at random from 77' to 155' N 15°W up the slope. An additional test (AASHO T 96) yielded an abrasion result of 51.9% The best location for a quarry at this site would be northwestward from the foot of the slope
2	1	1972	Granite	No	Chip	4.1%	Owner: Peter Lipman. Area is in a wooded hillside on the southeast slope of Loveland Ledge. Access is via field road near the end of Town Highway No. 37 about 0 7 mile from its junction with Town Highway No 9. Bedrock is intermittently exposed along the lower hillside. Rock is the Knox Mountain granite of the New Hampshire plutonic series. Test No. 1 started about 50' west of break in stonewall at foot of slope and extended at random from 0 to 100' N 30°E along the foot of the slope. An additional test (AASHO T 96) yielded an abrasion result of 51.1%.
	2	1972	Granite	No	Chip	4.8%	Test No. 2 continued from 100' to 180' N 10°E along the foot of the slope.
3	1	1962	Granite	No	Blasted	4.2%	Owner: Caledonia Sand and Gravel Co Quarry is on property formerly owned by Charles Bickford

MARSHFIELD ROCK DATA SHEET NO. 2

Ident. No	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHO T-3	Remarks
							northwest of U.S. Route No. 2, 3.5 miles east of the Village of Plainfield.
							The face of the quarry is open to the west, approximately 20 feet in height and 60 feet in width, The granite face is interrupted by numerous folded fingers of schist one of which enters near the top of the face from the north and midway across the face attains a vertical dip, thus dividing the mass. To the north of the division, the face contains a large proportion of quartzite and schist; to the south the proportion of granite is greater.
							Apparently the quarry site is close to the contact of the Gile Mountain Formation as the granite is crowded with unaltered xenoliths of the adjacent metasedimentary rock. Because of the xenoliths present and the limited extent of unquarried rock to the east and south, this area is not recommended as a source of crushed stone for subbase
							Test #1 was a sample from test hole on the site prior to development.
	2	1963	Granite	Yes	Chip	4.2%	Test #2 was a chip sample from the face of the quarry.
	1-1	1964		Yes	Random	48.8%	In 1964 crushed rock from this quarry was tested in accordance with AASHO T 96. The tests that were performed on stockpiled material all failed to meet the requirements for Item 704 06. Of the 12 pieces taken at random two were granite and the others schist or quartzite.
	1-2	1964		Yes	Random	48.0%	
	1-3	1964		Yes	Random	55.8%	
	2-1	1964		Yes	Random	47.6%	
	2-2	1964		Yes	Random	48.0%	
	2-3	1964		Yes	Random	47.6%	
	3-1	1964		Yes	Random	56.4%	
	3-2	1964		Yes	Random	54.1%	
	3-3	1964		Yes	Random	53.8%	
	4-1	1964		Yes	Random	53.2%	
	4-2	1964		Yes	Random	55.8%	
	4-3	1964		Yes	Random	55.3%	

MARSHFIELD ROCK DATA SHEET NO. 3

Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHO T-3 T-96	Remarks
4	1	1972	Granite	No	Chip	6.0%	Owner: Unknown. Area is the sparsely wooded west ridge of Hardwood Mountain. It is reached via 0.3 mile of woods road from point on Town Highway No. 63 about 0.96 mile above its junction with Town Highway No. 62. Well exposed granite has a poorly developed joint system that follows the west-southwest trend of the ridge. Test #1 started at the northeast corner of the exposures and descended at random from 0 to 75' southwest. An additional test (AASHO T 96) yielded an abrasion result of 71.4%. Test #2 continued at random from 75' to 150' toward the southwest. An additional test (AASHO T 96) gave an abrasion result of 45.8%. Because of the limited relief in this area it would be more difficult to develop a quarry here than at Map Ident. Nos. 1 and 2.

TABLE II
Supplement

MARSHFIELD PROPERTY OWNERS - ROCK	Map Ident. No.
Brimblecomb, Leslie	1
Caledonia Sand and Gravel Company	3
Lipman, Peter	2
Unknown	4

N

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
- SAND & GRAVEL DEPOSIT
- SAND DEPOSIT
- 3 IDENTIFICATION NUMBER (refer to data sheets)

MARSHFIELD

SCALE 1:31,250

CONTOUR INTERVAL 20 FEET

1973

GRANULAR MATERIALS MAP

BY

VERMONT DEPARTMENT OF HIGHWAYS

IN COOPERATION WITH

U.S. BUREAU OF PUBLIC ROADS

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

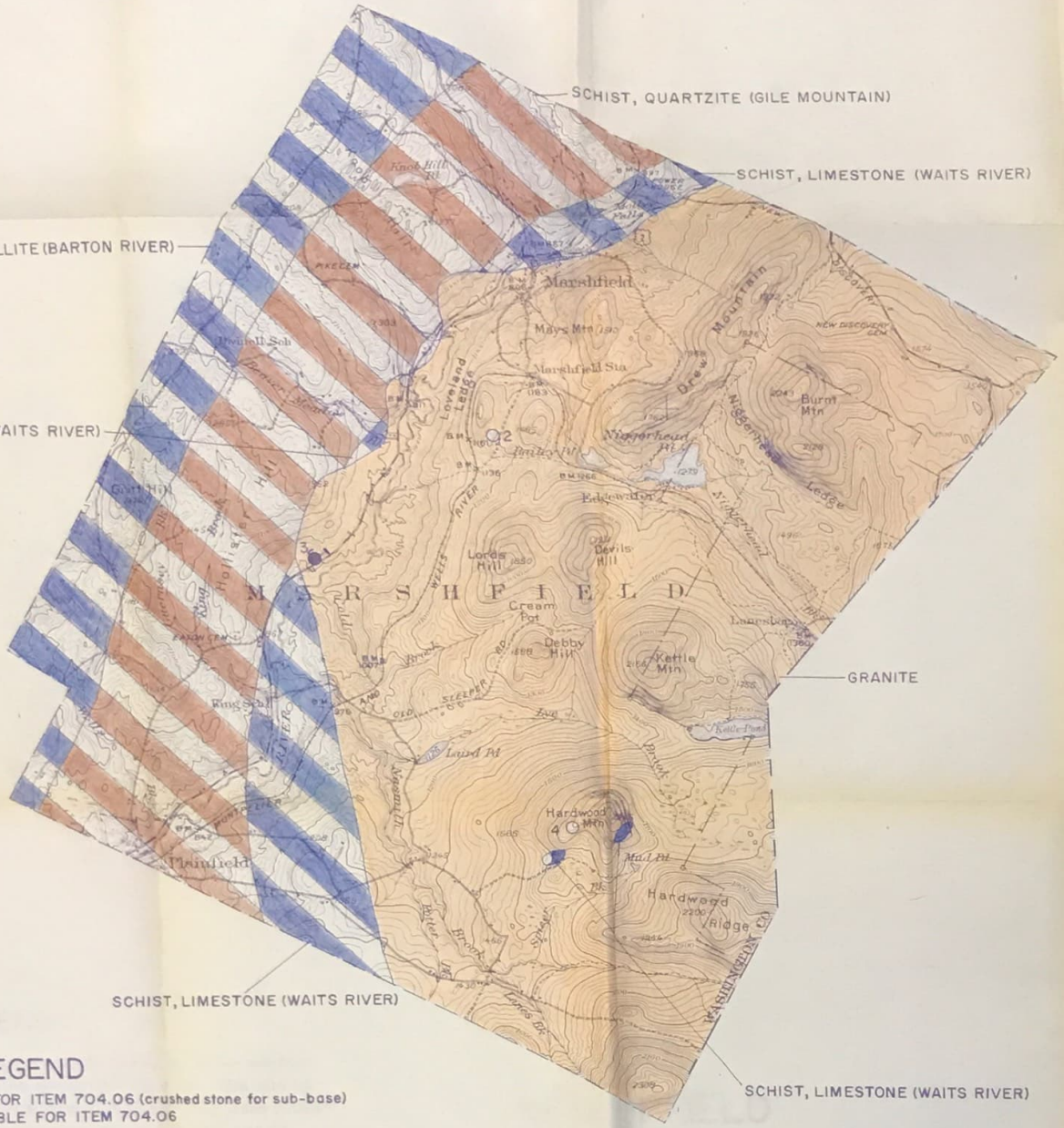
PLATE I

GRANULAR

WASHINGTON COUNTY VT. HWY. DISTRICT NO. 6

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 data sheets)

MARSHFIELD

SCALE 1:31,250

CONTOUR INTERVAL 20 FEET

1973

ROCK MATERIALS MAP

BY

VERMONT DEPARTMENT OF HIGHWAYS

IN COOPERATION WITH

U.S. BUREAU OF PUBLIC ROADS

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

WASHINGTON COUNTY VT HWY DISTRICT NO. 6

REVISIONS

DATE					