SURVEY OF HIGHWAY CONSTRUCTION MATERIALS IN THE TOWN OF FAIR HAVEN, RUTLAND COUNTY, VERMONT

prepared by

Engineering Geology Section, Materials Division

Vermont Department of Highways

in cooperation with

United States Department of Commerce

Bureau of Public Roads

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Acknowledgments

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 were 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 eliminate this factor by enabling the State and its contractors to proceed with information

on material 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 being conducted by Professor D.P. Stewart of Miami University, Oxford, Ohio, who has been mapping the glacial features of the State 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 Agriculture, and from Vermont Geological Survey Bulletins, United States Geological Survey Quadrangles, aerial photographs, 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.

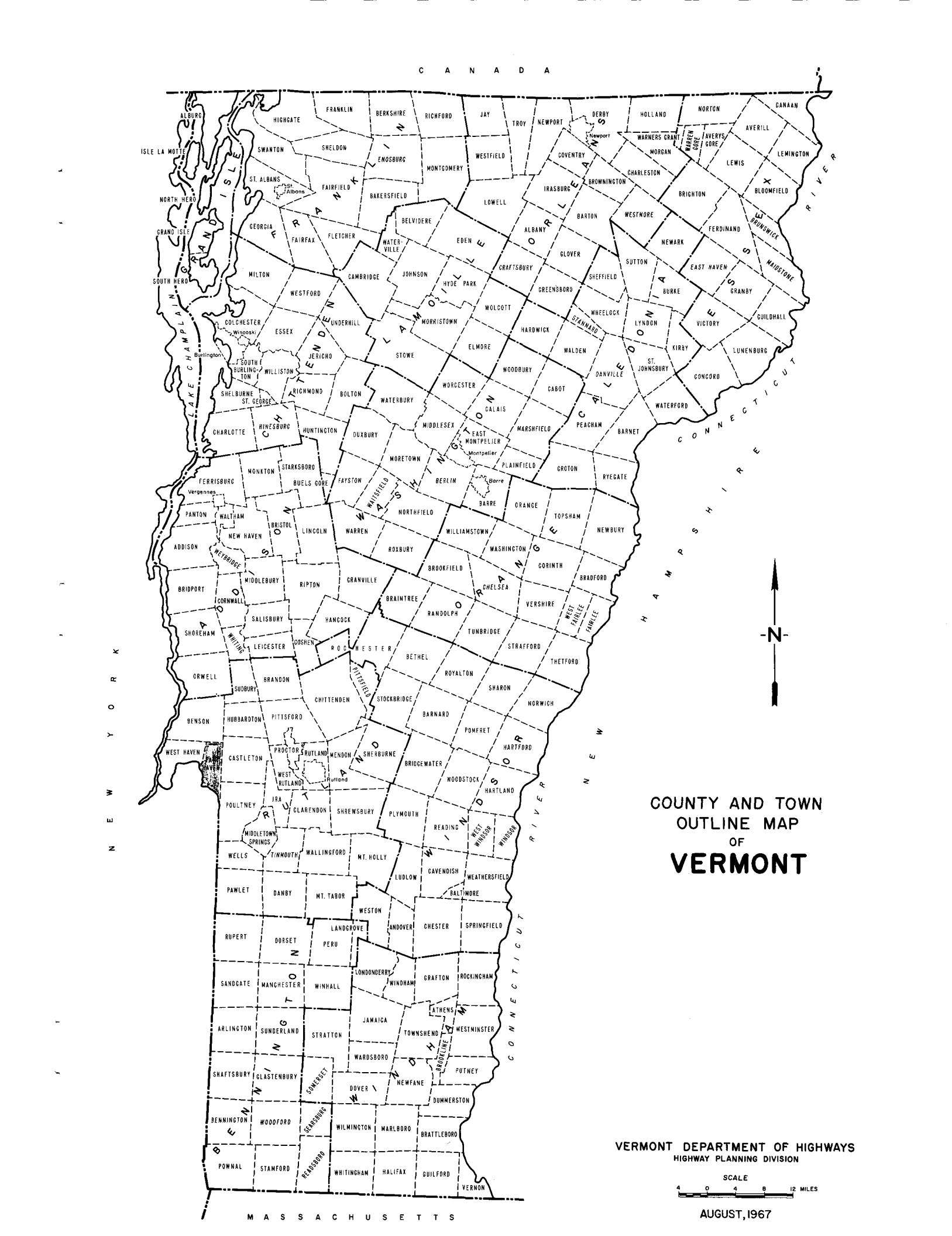
LOCATION

The town of Fair Haven is located in western Rutland County in the southwest part of the State. The town of Benson bounds it on the north, Castleton and Poultney lie to the east and southeast respectively, and the towns of Hampton, New York and West Haven, Vermont bound it on the west. (See County and Town Outline Map of Vermont on the following page).

Fair Haven is in the Champlain Lowland Physiographic Region of Vermont and has low, gently rolling to abrupt relief. Hills and ridges, consisting mainly of slates with minor amounts of quartzite, trend north-northeast and lie generally below 900 feet in elevation. About one-half the area of the Township, specifically its southwest and central portion, is flat to very gently rolling and occurs between 300 feet to 380 feet in elevation. This area appears to be the site of glacial lake deposition, since fine sands to silts and clays are prevalent.

These sediments have been eroded through by the west-flowing Castleton River and the northwest-flowing Poultney River, which forms the state boundary from Poultney Village to Lake Champlain.

Muddy Brook, a tributary of the Poultney River, drains the low hills in the north and northeast, and meanders sluggishly across the flat basin north of Fair Haven Village. Numerous gullies with rounded or flattened profiles attest to the fineness of the sediments.



COUNTY AND TOWN OUTLINE MAP OF VERMONT

VERMONT DEPARTMENT OF HIGHWAYS
HIGHWAY PLANNING DIVISION

SCALE
4 0 4 8 12 MILES

AUGUST, 1967

SURVEY OF ROCK SOURCES

Procedure for Rock Survey

The routine employed by the project in the survey of possible sources of rock for highway construction is divided into two main stages: office investigation and field investigation. The first is conducted primarily during the winter months and comprises the mapping of rock types as indicated in various reference sources. Many different sources of information were utilized, as indicated in the bibliography. These references differ considerably in dependability due to new developments and studies contributing to the obsolescense of a number of reports. In addition, the results of samples taken by other individuals are analyzed, and the location in 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 second stage of the investigation is begun in the field by making a cursory preliminary survey over the entire area. The information obtained in this survey, together with the information assimilated in the first stage of the investigation, is employed to determine the areas in which the testing and sampling will be concentrated. When a promising source is encountered as determined not only by rock type but also by volume, accessibility, and the existence of a good working face, chip samples are taken with a hammer and submitted to the Highway Testing Laboratory for testing by the Deval Method (AASHO T-3). It is kept in mind that the samples taken by the chip method are often in the weathered zone of the outcrop and consequently may show a less satisfactory test result than the fresh material deeper in the body of the rock structure. When deemed necessary, further samples are taken by drilling to a depth of approximately 3 feet and blasting across the strike or trend of the outcrop. When the material is uniform and satisfactory tests result from the chip samples, no further drilling, blasting, or sampling is done, and the material source is included as being satisfactory.

Discussion of Rock and Rock Sources

Rocks in the town of Fair Haven consist of slates, quartzite, arkose and graywacke, and minor amounts of limestone of the Taconic Sequence. The slates are unsatisfactory for Item 204, Sub-base of Crushed Rock, and generally, the quartzite is interbedded with the slates and is not thick enough to be quarried as highway construction material.

The Bomoseen Arkose and Graywacke Member of the St. Catherine Formation was sampled in two locations and merely observed in two others. This member was sampled in Castleton near Hydeville and met requirements for Item 204. There a large exposure seems promising as a source. (See Plate II and Table II of Castleton Materials Report). In Fair Haven, however, exposures of the Bomoseen were not extensive or thick enough to warrant consideration.

In Map Identification No. 1, a small exposure on Vermont Route 22A, one sample taken met requirements for Item 204. (See Plate II and Table II). Rock in this exposure was thin-bedded, but broke fairly angular with few thin sharp pieces. Other scattered exposures were observed in the vicinity of the test, but the area is too small for a quarry operation.

Map Identification No. 3 is a pasture where the St. Catherine slates are well exposed, and where a short test traverse across the strike encountered beds of thin quartzite or graywacke. The rock was platy, and broke very tabular and sharp. A 4 - to 6-foot thick bed of graywacke was the most satisfactory rock in the pasture, but was not extensive enough to produce a representative and acceptable sample.

A similar exposure was found in the woods on the north side of Town

Highway No. 16. There a 6-foot thick bed of graywacke occurs between beds of slate. Another exposure of the Bomoseen Member was observed in a wooded area in the vicinity of Station 1154+50 of the proposed Arterial Project. Only scattered, smooth exposures of graywacke, having little relief and covering only a small area were found.

A blue-gray-weathering black limestone was sampled in Map Identification No. 2. One test was taken in a small quarry where the limestone was highly fractured and in contact with thin slates. Another test was taken northwest of the quarry from outcrops exposed along a northeast-trending ridge. Both tests met requirements for Item 204, and test drilling is recommended in this area since the proposed location of the Arterial Project is only a short distance from the tests.

Dr. C. G. Doll's Centennial Geologic Map shows the St. Catherine Formation to outcrop in this area, but Plate II has been changed to show the Hatch Hill-West Castleton Formation, whose description (at least of the basal limestone beds) very closely resembles the rock sampled. The variegated slates characteristic of the St. Catherine were not found in this area.

SURVEY OF SAND AND GRAVEL SOURCES

Procedure for Sand and Gravel Survey

The method employed by the project in the survey of possible sources of sand and gravel for highway construction is divided into two main stages: office investigation and field investigation. 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 recognizing and locating physiographic features indicating glacial deposits and in studying drainage patterns. In addition, the location of existing pits are mapped when known. The locations in which samples were taken by other individuals are noted and mapped when possible.

The second stage of the investigation is begun in the field by making a cursory preliminary survey over the entire area noting area which show physiographic features giving evidence of glacial or fluvial deposits. These locations are later examined by digging test pits with a backhoe to a depth of approximately 11 feet and then sampling the material. The samples are submitted to the Highway Testing Laboratory where they are tested for gradation and stone wear, the latter by the Deval Method (AASHO T-4-35).

Discussion of Sand and Gravel Deposits

Granular materials in the town of Fair Haven consist of fine to pebbly coarse sands probably deposited in a glacial lake. The only coarse granular materials are silty and cobbly gravels poorly exposed in a nearly depleted pit located near the Michael Rose slate quarry south of River Street (State Aid Highway No. 7).

Two areas of glaciolacustrine sands were sampled near the proposed location of the Arterial Highway. Map Identification No. 2, near the Castleton Town Line, seems promising as a source of Sub-base of Sand, Item 202 and Granular Borrow, Item 105. It is not known, however, whether the owner would sell material. Map Identification No. 6, located a few hundred feet west of the proposed project on the south side of State Aid Highway No. 6, has a maximum of 4 feet of sand acceptable for Item 202 overlying silt to clay. Permission to sample fields on the north side of the highway was denied by two owners.

Other owners of property between the Castleton River and U. S. Route 4 near the State line refused to give permission to sample, as did the owners of two large areas south of U. S. Route 4 on either side of Town Highway No. 9. These features are within the area of lacustrine sands as mapped by Dr. D. P. Stewart, and are near the proposed project.

Only one area south of the Castleton River on the west side of town could be sampled. This was a large tract on the north side of U. S. Route 4 just west of Fair Haven Village. It was found that a maximum of 3½ feet of pebbly sand overlies silt to clay.

The remaining areas tested were Map Identification Numbers 8 and 9,

located northwest of Fair Haven Village on the south side of Vermont Route 22A. A nearly depleted sand pit (No. 9) has a south extension into a terrace (No. 8) that continues south about 700 feet to the Poultney River. The pit has been used for highway projects and little material remains. A floor test encountered fine sand acceptable only for Granular Borrow. A test on the terrace south of the pit found pebbly sand acceptable for Item 202 overlying silt at 8 feet.

SUMMARY OF ROCK FORMATIONS IN THE TOWN OF FAIR HAVEN

Hortonville-Glens Falls Formation (undifferentiated) - Combined where the formation contact is widely covered by surficial deposits. Thin beds of dark blue-gray, coarsely granular, and highly fossiliferous limestone (Glens Falls) are succeeded by beds of black, carbonaceous, and pyritic slate and phyllite, locally sandy. Brown-weathered limy beds are common in the slates (Hortonville).

Mount Hamilton Formation - White weathered black, gray, green, purple, and red hard slates, some interbedded with thin cherty-appearing quartzites and ribbon limestones a few inches apart; smooth, soft, red slate; beds of ankeritic quartzite a few inches to several feet thick, locally containing layers of edgewise conglomerate; and a polymict limestone conglomerate. Lithic features vary laterally and are in many places indistinguishable from those of the underlying Hatch Hill and West Castleton formations.

Hatch Hill-West Castleton Formation (undifferentiated) - The Hatch Hill, a relatively thin formation that succeeds the West Castleton, is characterized by rusty and spongy weathered gray calcareous quartzite traversed by numerous white-quartz veins. The West Castleton is a gray to black, siliceous, carbonaceous, and pyritiferous slate containing paper-thin white sandy laminae. Black slates are common to both formations. A blue-gray weathered black limestone is near the base of the West Castleton in a few places.

St. Catherine Formation - Purple, gray-green, and variegated slate and phyllite containing minor interbeds of white to green quartzite; locally albitic. Purple and green chloritoid-bearing slate and phyllite is in northern Taconic Range, but not separated farther south.

Bomoseen Member (of the St. Catherine Formation) - Green to olive-colored arkose and graywacke that weathers pale red to white; contains visible flakes of mica and rock fragments.

Zion Hill Member (of the St. Catherine Formation) - White weathered green, vitreous chloritic quartzite and graywacke spotted with limonite.

GLOSSARY OF SELECTED GEOLOGIC TERMS

Alluvial - Pertaining to material carried or deposited by running water.

Arkose - A variety of sandstone containing more than 25 or 30 percent of feldspar and usually derived from the disintegration of granite or other light colored granular rock.

Calcareous - Pertaining to or containing calcium carbonate.

Carbonaceous - Containing carbon.

Conglomerate - The consolidated equivalent of gravel. The constituent rock and mineral fragments may be of varied composition and of a wide size range. The matrix of fine material between the larger fragments may be sand, silt, or any of the common natural cementing materials such as calcium carbonate, silica, clay, or iron oxide.

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.

Esker - A long, narrow winding ridge of mixed sand and gravel deposited by a stream of meltwater flowing in a tunnel or crevasse in stagnant glacial ice.

Glaciolacustrine - A term used to denote formation by, or deposition in quiescent waters of glacial lakes.

Graywacke - An old rock name loosely applied. Most writers now apply it to a dark-colored, hard sandstone consisting of angular grains of quartz, feldspar, and rock fragments embedded in a fine, compact matrix composed of micas, clay minerals, and chlorite.

Ice Contact - Refers to sediments which have accumulated in contact with stagnant or wasting glacial ice. They assume the varied topographic forms expressed by eskers, kames, and kame terraces.

Kame - A conical hill of generally poorly stratified drift deposited in contact with glacial ice by streams flowing in or on the ice.

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

Limestone - A bedded sedimentary rock consisting chiefly of calcium carbonate. The most important and widely distributed of the carbonate rocks.

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

Phyllite - A fine-grained, foliated metamorphic rock intermediate between the mica schists and slates into which it may grade. The foliation is made possible by the development of a large amount of potash mica, sericite, which also gives the rock a distinctive silvery appearance.

Physiographic - Pertaining to the physical divisions of the earth.

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.

Slate - A very fine-grained homogeneous metamorphic rock which splits smoothly along parallel cleavage planes and yields roughly similar slabs.

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Appendix I

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 April, 1964.

Item 105, Granular Borrow

"Article 105.02 - Materials. The granular borrow shall be obtained from approved sources and shall consist of satisfactorily graded, free-draining, hard durable stone and coarse sand practically free from loam, silt, clay, and organic matter.

"The sand portion (material passing the No 4 screen) shall have not more than ten percent (10%) passing the No 270 mesh sieve and shall show a color of not more than three and one-half ($3\frac{1}{2}$) as determined by the colorimetric test described in AASHO Method of Test, Designation T-21.

"When used in connection with fine grading or in fills where piling is to be driven, the granular material shall all pass the nine-inch (9") square-opening screen."

Item 201, Sub-base of Gravel

"Article 201.02 - Materials. The gravel shall consist of material reasonably free from silt, loam, clay, or organic matter. It shall be obtained from approved sources and meet the following requirements:

"Not less than forty percent (40%) stone shall be retained on No. 4 sieve.

"The percent of wear shall be not more than twenty-five (25) when tested by laboratory methods using Method T-4 or more than forty (40) when tested by AASHO Method T-96.

"The stone portion of the gravel shall be uniformly graded from coarse to fine, and the maximum-size particles shall not exceed two-thirds (2/3) of the layer being spread.

"The sand portion, when tested by laboratory methods using Method AASHO T-27, shall meet the grading requirements set up in the following table:

Minimum Percent of Stone	Percent Passing Square Openings No. 100	Percent Passing Square Openings No. 270
40	0-15	0-3
50	0-15	0-4
60	0-15	0-5
70	0-15	0-6

"The sand shall show a color of not more than three and one-half (3½) as determined by the colorimetric test described in the AASHO Method of Test, Designation T-21."

Item 202, Sub-base of Sand

"Article 202.02 - Materials. The sand shall consist of material reasonably free from silt, loam, clay, or organic matter. It shall be obtained from approved sources and meet the following requirements:

"The sand, when tested by laboratory methods using Method AASHO T-27, shall meet the grading requirements set up in the following table:

Square Openings	Percent Passing
1½"	95-100
5/8"	80-100
No. 4	70-100
No. 100	0-18
No. 270	0-5

"The sand shall show a color of not more than three and one-half (3½) as determined by the colorimetric test described in the AASHO Method of Test, Designation T-21."

Item 204, Sub-base of Crushed Rock

"Article 204.02 - Materials. The materials for sub-base, filler, and

sand cushion shall be obtained from approved sources and meet the following requirements:

A - Crushed Rock. "The crushed rock shall be uniformly graded, crusher-run material and shall be free from dirt. The ledge from which this material is obtained shall be stripped and cleaned before blasting. Conical stockpiling, or any other method of stockpiling which causes segregation of aggregates, will not be permitted.

"The crushed rock, when tested by laboratory methods using Method AASHO T-27, shall meet the grading requirements set up in the following table:

Square Openings	Percent Passing
4"	95-100
1½"	25-50
No. 4	0-15

"The percent of wear shall not be more than eight (8) when tested by laboratory methods using Method AASHO T-3 or more than forty (40) when tested by AASHO Method T-96."

Item 205, Sub-base of Crushed Gravel

"Article 205.02 - Materials.

A - Crushed Gravel. "The crushed gravel shall consist of material reasonably free from silt, loam, clay, or organic matter. It shall be obtained from approved sources and produced by a crusher adjusted to deliver a product uniformly graded from coarse to fine.

"When tested by laboratory methods using Method AASHO T-27, it shall meet the grading requirements as set forth below:

		Square Openings	Percent Passing
Sub-base of Crushed Gravel	Coarse-Graded Item 205-A	4"	100
		No. 4	25-50
	Fine-Graded Item 205-B	1½"	95-100
		No. 4	30-60

"At least thirty percent (30%) by weight of the stone content of the crushed gravel, that is, the material retained on the No. 4 screen, shall have a minimum of one (1) fractured face as determined by

actual count from the sample submitted to the laboratory.

"The percent of wear shall not be more than twenty (20) when tested by laboratory methods using Method AASHO T-4 or more than thirty-five when tested by AASHO Method T-96.

B - Sand. "The sand content of the crushed gravel, that is, the material passing the No. 4 screen, when tested by laboratory methods using Method AASHO T-27, shall meet the grading requirements set up in the following table:

Square Openings	Percent Passing
No. 100	0-18
No. 270	0-8

"The sand shall show a color of not more than three and one-half ($3\frac{1}{2}$) as determined by the colorimetric test described in the AASHO Method of Test, Designation T-21."

TABLE I

FAIR HAVEN 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					Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
						1½"	5/8"	#4	#100	#270				
1	1	1967	1-7	0-1	No	100	100	100	86.0	27.0*	1	---	---	Owner: Milton Pritchard. Feature is old pasture land located on the north side of State Aid Highway No. 7 just west of the Castleton - Fair Haven Town Line. Area is probably site of glacial lake deposition. The pasture is rolling and slopes gently to north. Some pine trees and many poplars grow in places. Test #1 dug beside power line and old trolley line about 300' from the road. Test is at end of field drive and at the high point in the pasture. Material is a densely bedded, reddish brown to tan silty sand too fine for Item 105.
	2	1967	1.5-8	0-1.5	No	100	100	100	55.0	22.0*	1	---	---	Test #2 dug 170' northeast of and a few feet below elevation of test #1. This test is a few rods west of shallow, wooded swale. Material in test is a fine to silty brown sand with an occasional silt-clay seam. Goes to silt-clay at 8'.
	3	1967	1.5-7	0-1.5	No	100	100	100	91.0	66.0*	1	---	---	Test #3 was dug two powerline poles east of Test #1. Silt or silty clay was hit under 2' of sandy topsoil. Hole continued in silty clay to at least 7'. The glacial lake sediments mapped in this area are apparently very fine, offshore de-

*Percentage of Total Sample

TABLE I

FAIR HAVEN GRANULAR DATA SHEET NO. 2

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Existing Pit	Sieve Analysis % Passing					Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
						1½"	5/8"	#4	#100	#270				
														posits. Somewhat coarser sands do occur east of here in Castleton.
2	1	1967	1.5-11	0-1.5	No	100	100	100	25.0	7.0*	1	---	Gran. Borrow (Sand)	Owner: Gene Rayburn. Area is a terrace of glacial lake sands located just west of the Castleton Town Line on the north side of U. S. Route 4. Bedrock is exposed on the southwest corner of the terrace a few feet above the level of the highway, and again in the woods north of the terrace near the proposed location of the limited access Arterial Highway. The terrace becomes rolling and increases in elevation toward the northeast corner, where two test holes encountered clays and silt. Test #1 was sampled from hole dug in westerly field drive 275' north of buildings. Brown medium sand goes to fine sand at 3.5'. This sand continues, being interbedded with silt layers, to at least 11'. Sample had excess passing the #100 and #270 mesh sieves for Item 202, Sub-base of Sand.
	2	1967	2-11.5	0-2	No	100	100	100	31.0	3.0*	1	---	Gran. Borrow (Sand)	Test #2 dug in field road 150' south of Test #1. Material is mainly a tan-gray fine sand with a few silty layers at 3-5'. Below 6' sand is fine to medium.

*Percentage of Total Sample

TABLE I

FAIR HAVEN 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					Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
						1½"	5/8"	#4	#100	#270				
														Sample was too fine for Item 202.
	3	1967	2-11.5	0-2	No	100	100	100	17.0	2.5*	1	---	Sand	Test #3 was dug 140' north-northeast of Test #1 atop terrace scarp formed by small brook flowing south by southwest. Bank or scarp marks north limit of feature. Rough pasture to north across brook has a few outcrops and is non-granular. Test hole showed a fine to medium sand to depth of 11.5'. Meadow between westerly field road and west edge of feature is flat to gently rolling, and from uniformly thin crop of hay, it appears that the material would be uniform — probably acceptable for Item 105.
	4	1967	2-10.5	0-2	No	100	100	99.4	15.9	2.5*	1	---	Sand	Test #4 dug 140' north-northeast of Test #1 atop scarp of terrace. This test is on trace of very slight roll in meadow which continues eastward across the east meadow. Material down to 8' is a fine sand, becoming coarse below that.
	5	1967	2.5-11	0-2.5	No	100	100	99.3	9.9	1.5*	1	---	Sand	Test #5 dug on low broad ridge 140' northeast of Test #4. Top 2.5' is silt-clay and topsoil going to fine sand becoming medium to coarse below 7'.
	6	1967	2-9	0-2	No	100	100	100	90.0	36.0*	1	---	---	Test #6 dug about 650' northeast of Test #5 in northeast

*Percentage of Total Sample

TABLE I

FAIR HAVEN 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 1½"	5/8"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
														part of field. This corner is higher than remainder of meadow. Material in test hole is silty clay to sandy silt from top to about 7' and a silty sand below that. Material seems to get coarser with depth, but overall, is too fine for Granular Borrow.
	7	1967	0-5	0-2.5	N O T S A M P L E D									Test #7 dug in northeast corner of field 125' south of eastbound station 1167+50 of the Arterial Project. Stones and topsoil give way to clay at 2.5'. Did not sample. This test is about 5' above elevation of Test #6.
1	--	1967	---	---	Yes	N O T S A M P L E D								Owner: Possibly Michael Rose. Owner could not be contacted for permission to sample. Feature is a small, badly sloughed pit on the east side of Town Highway No. 19 south of State Aid Highway No. 7. Area may be of ice-contact origin, lying as it does at the edge of a broad, low valley next to a slate ridge. Material looks poorly sorted, and has some large stones. Its extension would be to the north under adjacent property. Material could probably be used as borrow, possibly Granular Borrow, Item 105.

*Percentage of Total Sample

TABLE I

FAIR HAVEN GRANULAR DATA SHEET NO. 5

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Existing Pit	Sieve Analysis % Passing					Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
						1½"	5/8"	#4	#100	#270				
4	1	1967	1.5-22.5	0-1.5	Yes	100	100	100	30.0	2.0*	1	---	Gran. Borrow (Sand)	Owner: Vermont Structural Slate Company. Area is a large, sprawling sand pit in a mapped glaciolacustrine deposit located between the railroad tracks and State Aid Highway No. 7. Access is 0.15 mile along a haul road running parallel to the tracks. The south faces in the central part of the pit area are being stripped, and the sands are in continuous use as a slate-finishing abrasive. About 100' remains between the south face and houses on the north side of State Aid Highway No. 7 (River Street). Test #1 was a composite sample on the south face, and included beds of fine sand, silty sand, and a silty clay layer taken from sloping stripped area and vertical face beneath. The superintendent of quarries for the slate company informed the materials survey party that the central portion of the pit was in continual use and could not be counted upon as a source of highway material.
	2	1967	0-12	Stripped	Yes	100	100	100	53.0	15.0*	1	---	---	Test #2 was taken on north face and represents a 40-foot by 200-foot island of fine sand on the north side of the cen-

*Percentage of Total Sample

TABLE I

FAIR HAVEN 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					Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
						1½"	5/8"	#4	#100	#270				
														tral pit area. Material is too fine for Item 105.
	3	1967	1-14	0-1	Yes	100	100	100	49.0	5.3*	1	---	Gran. Borrow (Sand)	Test #3 dug on 10-foot face at east end of pit area. Hole was continued for 4' below face. Fine sand with clay seams was encountered in the top 7'; fine gray sand occurs from 7'-14'. Extension is eastward and is wooded. Also a south extension is limited by buildings.
	4	1967	0-10.5	None (Floor)	Yes	100	100	100	95.0	14.5*	1	---	---	Test #4 dug in floor in east part of pit 180' from east face. Material is a silty sand with water entering at 10.5'. Pit might be source of granular borrow from east end.
5	1	1967	N O T S A M P L E D											Owner: Harold Gilmore. This is a large tract of land on the north side of U. S. Route 4 beyond the Factory Outlet Store in Fair Haven Village. Area is mapped as lake sand, as is much of the southwest portion of the town. Test #1 dug at north end of area atop river bank. About 3' of pebbly sand overlies clay. Hole was not sampled.
	2	1967	N O T S A M P L E D											Test hole #2 dug northwest of Test #1 in what looks like old test area. About 2.5' of pebbly sand goes to clay. Hole was not sampled.

*Percentage of Total Sample

TABLE I

FAIR HAVEN 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					Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
						1½"	5/8"	#4	#100	#270				
	3	1967	1-3.5	0-1	No	100	97.4	76.7	4.7	2.0 1.5*	1	---	Sand	Test #3 dug 270' west of Test #2 about 300' from northwest corner of area. About 3.5' of pebbly coarse sand overlies clay. Hole is 3'-5' above elevation of Test #2.
	4	1967	N O T S A M P L E D											Test #4 dug on west side of area about 300' south-southwest of Test #3. Material in top 3.5' is silty sand with pebbles overlying clay. Hole dug to 6' in clay and not sampled.
	5	1967	N O T S A M P L E D											Test #5 dug on west side of area 375' south of Test #4 near telephone line. Three feet of pebbly sand overlies clay. Did not sample.
	6	1967	1-7	0-1	No	100	100	96.6	28.9	16.0 15.6*	1	---	---	Test #6 dug on east edge of area atop river bank, 155' southeast of telephone line. Log of test hole: 1'-3'-sand; 3'-7' - clay. Composite material was too fine for Item 105. Entire area has only thin sands over a silt to clay material. Whether or not this would be true over the entire southwest part of town is not known since no other permissions to sample could be obtained.
6	1	1967	1-4	0-1	No	100	100	100	10.0	4.0*	1	---	Sand	Owner: Walter Wetherby(leased to son Ronald). Area is pasture beyond farm

*Percentage of Total Sample

TABLE I

FAIR HAVEN 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					Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
						1½"	5/8"	#4	#100	#270				buildings on south side of State Aid Highway No. 6 west of Fair Haven Village. Arterial Project as proposed, would cross the road about 500' east of where tests were taken. Pasture is small and a rounded scarp faces south and southwest toward the Castleton River. Dr. D. P. Stewart has mapped this area and fields and woodland extending to the northeast all the way to Vermont Route 22A as site of a glacial lake in which sands were deposited. Test hole #1 dug at roadside 300' west of barn. Fine to medium sand with one or two pebbles occurs from 1'-4'. Water enters at 4' above a clay or silty clay.
	2	1967	1-4.5	0-1	No	100	100	98.2	10.8	4.3 4.2*	1	---	Sand	Test #2 dug on east side of shallow swale near south edge of pasture. Swale reaches up to within about 110' of Test #1, and is wet in the bottom. Material in Test hole #2 is a pebbly fine sand going to clay at 4.5'. Pasture would be source of only very small quantity of sands because of shallow depth to wet clay.
7	1	1965	0.5-3	0-0.5	No	100	100	100	8.0	2.3*	1	---	Sand	Owner: Walter Wetherby(leased to son Ronald). This is small pasture on the

*Percentage of Total Sample

TABLE I

FAIR HAVEN 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					Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
						1½"	5/8"	#4	#100	#270				
														north side of State Aid Highway No. 6 west of Map Identification No. 6. Pasture represents western extension of fields through which the proposed Arterial Project will be constructed. The pasture ends on the west side in low bluffs above the Poultney River. Test #1 dug 170' from west end of field, about 180' north of road. Material is a reddish tan fine sand going to clay at 3'. Clay (or silty clay) continues to at least 8'.
	2	1967	0.5-4	0-0.5	No	100	100	97.9	33.3	17.0 16.6*	1	---	---	Test #2 dug atop bluffs at west end of pasture, 250' west of Test #1 and 95' north of road. Four feet of silty sand goes to a pebble layer resting on silty clay. Clay continues to at least 8'. Pasture would not be a source — sands are too thin. They may increase in thickness in the field to the east where permission to sample could not be obtained.
8	1	1967	2-8	0-2	No	100	100	90.9	10.9	1.0 0.9*	1	---	Sand	Owner: Edward J. Morris. Area is terrace whose south end stands above the Poultney River, and which overlooks a flat to rolling plain on its west side that is mapped as silt to clay deposition. Access to the terrace is via

*Percentage of Total Sample

TABLE I

FAIR HAVEN 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					Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
						1½"	5/8"	#4	#100	#270				
														field road leading south from Vermont Route 22A at owner's buildings. Test #1 dug on north end of terrace about 125' south of a pretty well depleted pit. Material is coarse sand with pebbles going to silt at 8'. South end of feature above the river bank shows pebbly sands exposed in places at the surface. The river bank shows fine sands or silty sands below the pebbly sands. The river bank to the west, below the lower fields shows silts and clays.
9	1	1967	0-8.5	None (Floor)	Yes	100	100	100	43.0	4.0*	1	---	Gran. Borrow (Sand)	Owner: Edward Morris. This is pit in north end of field tested in Map Identification No. 8. Material has been taken out in past and used on highway projects. Pit was filled in during 1966 and re-opened in 1967. At the time sampled, it was about depleted with a narrow extension along the slope to the north. Bedrock was exposed about 75' to the east. To the east, the deposit is probably limited by glacial till over bedrock. Extension of pit would be to south. One test dug in floor of pit to find out type of material in fields

*percentage of Total Sample

TABLE I

FAIR HAVEN GRANULAR DATA SHEET NO. 11

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing					Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
						1½"	5/8"	#4	#100	#270				
														lying below the terrace. Very fine stratified sand was encountered.

TABLE I
Supplement

FAIR HAVEN PROPERTY OWNERS - GRANULAR	Map Ident. No.
Gilmore, Harold	5
Morris, Edward J.	8, 9
Pritchard, Milton	1
Rayburn, Gene	2
Rose, Michael	3
Vermont Structural Slate Company	4
Wetherby, Walter	6, 7

TABLE II

FAIR HAVEN ROCK DATA SHEET NO. 1

Map Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHO T-3	Remarks
1	1	1967	Quartzite	No	Chip	3.9%	Owner: Mrs. Anna Mae Enos. This area is located north of Fair Haven Village, east across Vermont Route 22A from rest area. A small pine woods on the east side of a knoll has scattered exposures of reddish - to light gray-weathered greenish-gray-quartzite. About 100' of this quartzite was sampled and a gradational contact with greenish-gray slates of the St. Catherine Formation was observed. The quartzite, probably the Bomoseen Member of the St. Catherine, was mainly thin-bedded and broke angular to hackly. More small and scattered exposures of the Bomoseen were found southwest of the sampled area and were traced across the highway where they disappeared beneath a wooded slope on the top of which St. Catherine slates were exposed. No exposures covered an area large enough to be considered for a quarry site.
2	1	1967	Limestone	Yes	Chip	5.2%	Owner: Mrs. Cora Roberts. Area is pasture on the north side of U. S. Route 4 just east of the Fair Haven Village limits. A small quarry had been opened just east of the small lot owned by the Boughton Oil Company. The quarry is very narrow across the strike, extending mainly along the strike. The rock exposed here is a highly fractured limestone and limestone pebble conglomerate weathering blue-gray and is black on fresh surface. There are many calcite veins. At the foot of the quarry, at the east and west edges, beds of gray, paper-thin slates are exposed. Outcrops of the limestone were observed in the pasture northeast of the quarry on the apparent strike. A sample taken in the quarry met abrasion requirements for Item 204, Sub-base of Crushed Rock.
	2	1967	Limestone	No	Chip	4.4%	Test #2 was taken for 135' across the strike at a point a few hundred yards northwest of the quarry, and beneath a powerline. The east side and top of a northeast-trending low ridge was sampled. Rock exposed here is a thinly bedded, blue-gray weathering limestone, black on the fresh

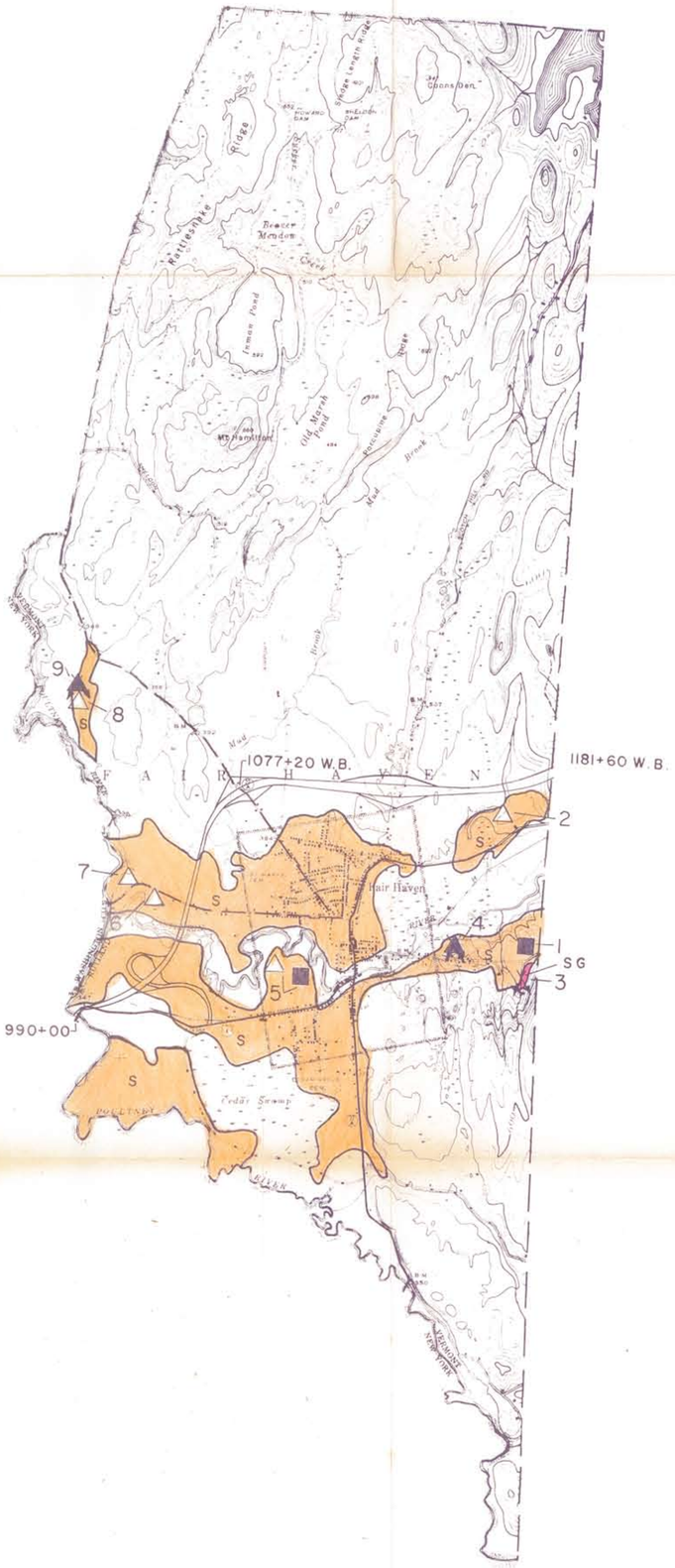
TABLE II

FAIR HAVEN ROCK DATA SHEET NO. 2

Map Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHO T-3	Remarks
							surface. The rock broke hackly to angular, was quartzitic in places, and contained many calcite veins. Also included in the sample was a thin bed of gray slate. There is probably 25'-35' of relief along sample traverse. To the west of Test #2 a ridge parallel to the one tested consists of thinly bedded calcareous quartzites and some slate. This area is mapped on C. G. Doll's Centennial Geologic Map as the St. Catherine Formation. However, it is shown on Plate II as the Hatch Hill - West Castleton Formation, undifferentiated, since the rock fits the lithologic description of the West Castleton more closely than it does the St. Catherine. Test drilling is recommended in the pasture north of the Boughton Oil Company lot (site of Test #2) to determine the extent, thickness, and type of rock, since this area is quite close to the proposed location of the Arterial Project.
3	1	1967	Quartzite	No	Chip	10.2%	Owner: Bernard Genier. Area is rock pasture on the north side of Town Highway No. 15 behind buildings. One test was taken west to east across beds of light-to dark-gray-weathering green fine quartzite. The rock breaks very hackly. At one place on the east edge of woods road near east end of test traverse a few feet of fairly massive quartzite is exposed. Rock is well exposed all along the pasture, but is too hackly and tabular to crush as Item 204. The rock is mapped as the Bomoseen Member of the St. Catherine Formation.

TABLE II
Supplement

FAIR HAVEN PROPERTY OWNERS - ROCK	Map Ident. No.
Enos, Anna Mae (Mrs.)	1
Genier, Bernard	3
Roberts, Cora (Mrs.)	2



N

LEGEND

- ○ GRAVEL, ACCEPTABLE FOR ITEM 201 (sub-base of gravel)
- ◉ GRAVEL, DEPLETED OR NOT ACCEPTABLE FOR ITEM 201
- △ SAND, ACCEPTABLE FOR ITEM 202 (sub-base of sand)
- ▲ SAND, DEPLETED OR NOT ACCEPTABLE FOR ITEM 202
- □ GRANULAR BORROW, ITEM 105
- ▩ MATERIAL NOT ACCEPTABLE FOR ITEM 105
- ⤫ EXISTING PIT
- (SG) SAND & GRAVEL DEPOSIT
- (S) SAND DEPOSIT
- 3 IDENTIFICATION NUMBER (refer to data sheets)

FAIR HAVEN

SCALE 1:31,250

0.5 0 1 MILE

CONTOUR INTERVAL 20 FEET

1968

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

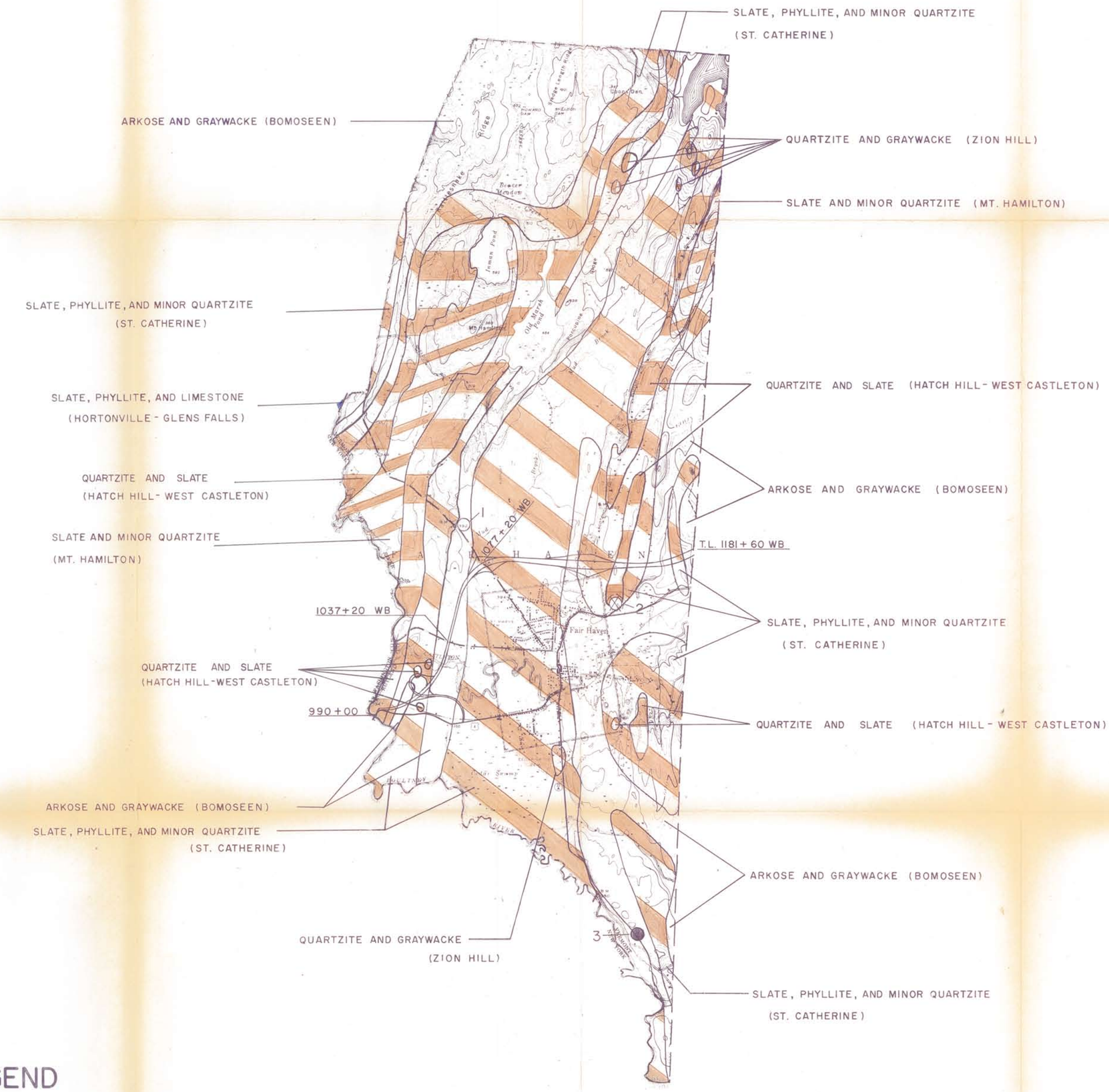
PLATE I

GRANULAR

RUTLAND COUNTY VT. HWY. DISTRICT NO. 3

REVISIONS

DATE							
BY							



LEGEND

- ROCK, ACCEPTABLE FOR ITEM 204 (sub-base of crushed rock)
- ROCK, NOT ACCEPTABLE FOR ITEM 204
- 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, ARKOSE, GRAYWACKE
- 3 IDENTIFICATION NUMBER (refer to data sheets)

FAIR HAVEN

SCALE 1:31,250

0.5 0 MILE

CONTOUR INTERVAL 20 FEET

1968

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

PLATE II

ROCK

RUTLAND COUNTY VT. HWY. DISTRICT NO. 3

REVISIONS

DATE							
BY							