

SURVEY OF HIGHWAY CONSTRUCTION MATERIALS
IN THE TOWN OF LOWELL, ORLEANS 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

January, 1975

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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 Division and Mapping Section and the Materials Division.
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, Federal Highway Administration.

History

The Materials Survey Project was formed in 1957 by the Vermont Department of Highways with the assistance of the Federal Highway Administration. Its prime objective was to compile an inventory of highway construction materials in the State of Vermont. Originally, investigations for highway construction materials were conducted only as the immediate situation required and only limited areas were surveyed; thus, no over-all picture of material resources was available. Highway contractors or resident engineers were required to locate the materials for their respective projects and samples were tested by the Materials Division. The additional cost of exploration for construction materials was passed on to the State bringing about higher construction costs. The Materials Survey Project was established to eliminate or minimize this factor by enabling the State and the contractors to proceed with information on available material sources and to project cost estimates. 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 are used 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 together.

Inclousures

Included in this report are two surface-geology maps, one defining the location of tests on bedrock, the other defining the location of tests on granular materials. These maps are based on 15-minute or 7-1/2-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 formations and types in the township. This information was obtained from: Vermont Geological Survey Bulletins, Vermont State Geologist Reports, United States Geological Survey Bedrock Maps, Centennial Geological Map of Vermont, the Surficial Geologic Map of Vermont and other references.

The granular materials map shows 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 mapped the glacial features of the State of Vermont during the summer months since 1956. Further information is obtained from the Soil Survey (Reconnaissance) of Vermont (conducted by the Bureau of Chemistry and Soils of the United States Department of Agriculture), 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.

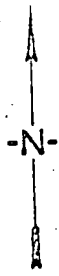
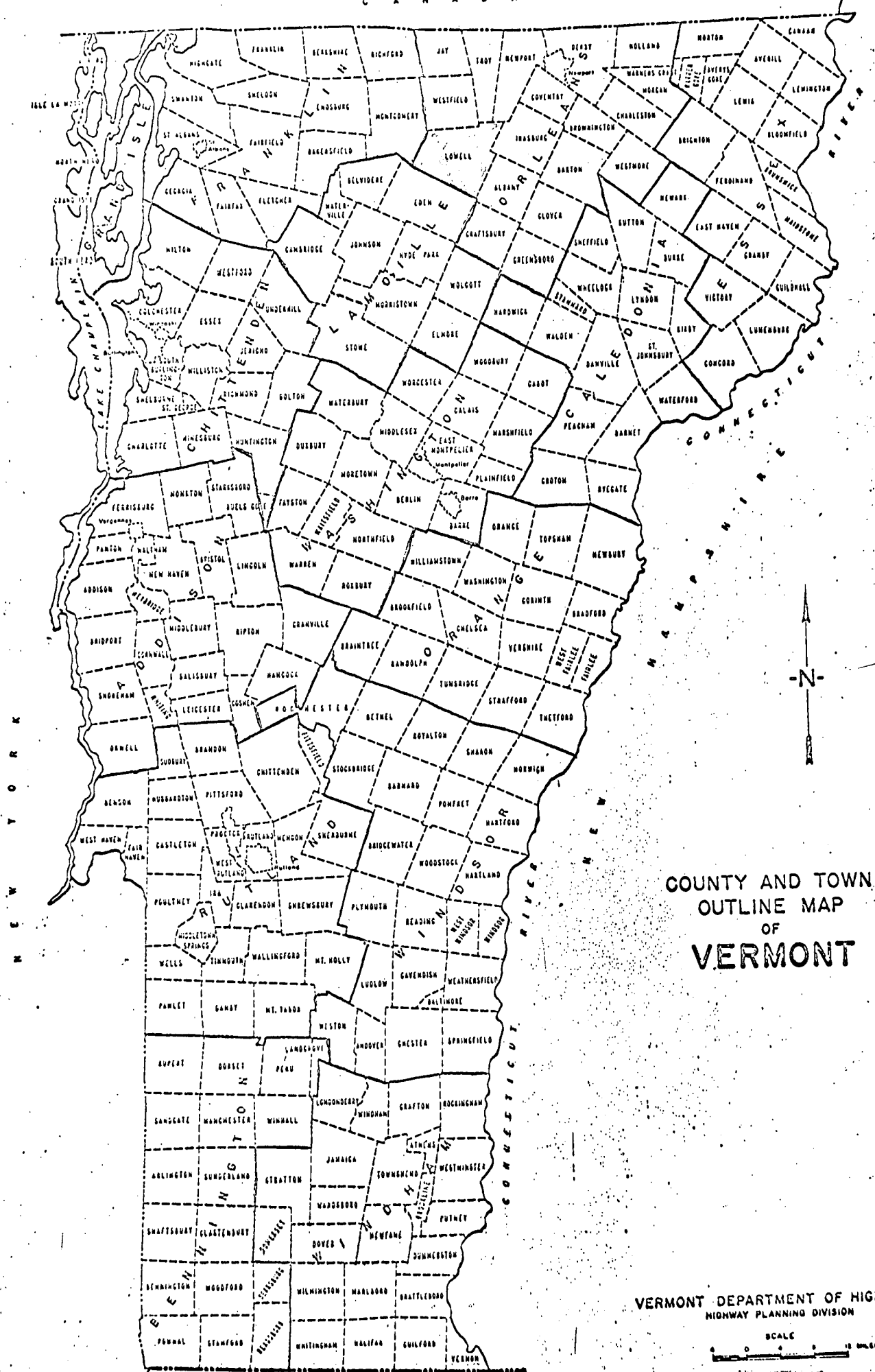
Also included in this report are data sheets for both the Bedrock and Granular Materials Survey, which contain detailed information for each test conducted by the Project as well as information obtained from other sources. Other sources include an active card file, compiled by the Materials Division 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 file, were plotted on the maps. However, some cards in the file were not used because of incomplete or unidentifiable information on the location of the deposit. Caution should be exercised wherever this information appears incomplete. This Project does not assume responsibility for the information taken from the card file.

Work sheets contain more detailed information on each test and a detailed sketch of the area represented by the Identification Number. The work sheets and laboratory reports are on file in the Materials Division of the Vermont Department of Highways.

LOCATION

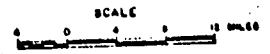
The Town of Lowell is located on the west side of Orleans County in northern Vermont. It is bounded on the north by Westfield, Troy and Newport; on the east by Irasburg and Albany; on the south by Eden and on the west by Montgomery. (See County and Town Outline Map of Vermont on the following page.) The western third of Lowell lies in the Green Mountain Physiographic Region and has rugged, steep-sided, mountainous terrain; the eastern two-thirds of town has broad valleys and rounded hills which are typical of the Central Plateau Region of the Vermont Piedmont Subdivision of the New England Upland. Elevations range from 3,360 feet at the summit of Belvidere Mountain to less than 780 feet on the east branch of the Missisquoi River where it crosses the Westfield Town Line.

Principal drainage is northward via the East Branch of the Missisquoi River (or its main tributary, the Burgess Branch) via Ace, LeClair, Lockwood and Truland Brooks. The northeast corner of town is drained by Mineral Spring Brook, a north-flowing tributary of the Missisquoi in Westfield.



COUNTY AND TOWN
 OUTLINE MAP
 OF
VERMONT

VERMONT DEPARTMENT OF HIGHWAYS
 HIGHWAY PLANNING DIVISION



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 primarily 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 obsolescence 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. 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 Materials Division for abrasion testing by the Deval Method (AASHTO T-3) and the Los Angeles Method (AASHTO 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 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 almost the entire lithology within the Town of Lowell.

The Hazens Notch Schist and Quartzite underlies most of the western half of town; however, due to inaccessibility, samples could not be obtained.

Slates, phyllites and schists comprise a large portion of the rocks underlying the eastern half of town. These were not sampled due to low relief or inaccessibility.

The schists, phyllites and slates do not yield construction material as favorable as the greenstones, ultramafics and amphibolites in town.

The Hazens Notch Gneiss and the Belvidere Mountain amphibolite and greenstone, in the west part of town, were not sampled but may yield favorable rock when these areas are made accessible.

Passing abrasion tests were obtained from the ultramafic rock masses of dunite, peridotite and serpentinite which were sampled at Map Identification Nos. 1, 2, 3 and 4. Map Identification No. 5 yielded two failing T-3 results and two passing T-96 results from the schistose graywacke of the Ottawaquechee Formation. All samples from the G.A.F. Mine waste pile at Map Identification No. 6 yielded good abrasion results. The rock varies from the Hazens Notch amphibolite to the ultramafic serpentinite, peridotite and dunite.

The rock sources in Lowell are listed from the most to least favorable: Map Identification Nos. 6, 4, 1, 2, 3 and 5.

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. The locations in which samples were taken by other individuals are noted and mapped.

The field investigation is begun by making a cursory survey of the entire town. All pits and areas that give evidence of glacial or fluvial deposition are noted and later investigated by obtaining samples of pit faces and other exposed materials. Test holes are dug in pit floors and extensions with a backhoe to a depth of approximately 11 feet. The samples are submitted to the Materials Division where they are sieved for gradation and tested for stone abrasion by the AASHTO T-4 method.

Discussion of Sand and Gravel Deposits

Granular deposition in Lowell occurs below 1,300 feet except for Map Identification Nos. 9 and 23 (both at 1,380 feet). Kamic features were formed during the

latest glacial recession of the Pleistocene. According to Stewart and Mac Clintock, kames were formed at six locations, two of which were not sampled.

The southwest end of a kame terrace near Tillotson Mill on State Aid Highway No. 3 was sampled at Map Identification Nos. 1 and 2. Another kame terrace, south and east of Lowell Village, was sampled at Map Identification Nos. 13 and 14.

Northeast of the junction of Vermont Route 100 with Vermont Route 58 is a small circular unsampled kame with houses and a cemetery bordering it. The hillside below and east of Town Highway No. 23 and west of Vermont Route 100 is an elongate kame which contains Map Identification Nos. 11 and 14. Two small circular kames are mapped southeast of Town Highway No. 16 near its junction with Town Highway No. 15. The southern one was sampled at Map Identification No. 3, but the owners refused permission to sample the other.

Map Identification Nos. 17 and 19 are located in a large oblong kame occurring east and west of Vermont Route 100 at its junction with Town Highways No. 15 and No. 54. The sixth kame, mapped from the Eden-Lowell Town Line along Vermont Route 100 to its junction with Town Highway No. 54, was sampled at Map Identification Nos. 19, 20, 21, 22 and 23.

A high level, post-glacial lake occupied the upper Missisquoi River Valley and probably accounted for the delta gravel, pebbly sand and lake sand deposition in Lowell. The delta gravel and the north end of the pebbly sand feature were sampled at Map Identification No. 6. In Lowell, lake sands are found in valleys below 1,100 feet elevation at Map Identification Nos. 4, 5 and 18; however, Map Identification No. 10, mapped as a lake sand, proved to be one of the better sources of subbase of gravel.

The Survey found three sources of acceptable subbase of gravel outside the mapped depositional features: Map Identification Nos. 9, 15 and 16.

Mention should be made of a large field north of Vermont Route 58 and southeast of its junction with State Aid Highway No. 3. The owner, John Vincent of New London, Connecticut, leases it to Gerard Pion who plants it in corn. The field slopes up from the road and its shoulders show pebbly sand. There was no permission granted to sample at time of survey, however, it should not be ruled out of future consideration.

SUMMARY OF ROCK FORMATIONS IN THE TOWN OF LOWELL

Belvidere Mountain Amphibolite Member of the Hazens Notch Formation - Coarse to fine-grained hornblende-epidote-albite rock; grades to epidote-chlorite-actinolite-albite greenstone where less metamorphosed.

Albite-actinolite-chlorite-epidote greenstone; locally hornblende-epidote-chlorite-albite amphibolite.

Hazens Notch Formation - Interbedded carbonaceous and noncarbonaceous quartz-sericite-albite-chlorite schist; grades to quartzite and gneiss.

Chiefly albite-actinolite-chlorite-epidote greenstone; locally hornblende-epidote-chlorite-albite amphibolite.

Moretown Member of the Missisquoi Formation - Quartzite and quartz-plagioclase granulite in layers one-eighth inch to several inches thick, separated by pin-stripe partings that contain muscovite, chlorite, epidote, biotite and locally garnet; also greenish quartz-sericite-chlorite phyllite and schist and minor carbonaceous phyllite.

Ottawaquechee Formation - Black carbonaceous phyllite or schist containing interbeds of massive quartzite commonly criss-crossed by veins of white quartz; quartzite is dark gray and carbonaceous, light gray or white; also includes light green quartz-sericite-chlorite phyllite or schist and sericitic quartzite.

Stowe Formation - Quartz-sericite (muscovite-paragonite) -chlorite phyllite and schist; porphyroblasts of albite, garnet, chloritoid, or kyanite are common locally; includes phyllitic graywacke north of Lamoille River. Schist contains abundant segregations of granular white quartz.

Carbonaceous schist and phyllite.

Greenstone and amphibolite - Epidote-albite-chlorite rocks contain actinolite and hornblende where more metamorphosed.

Umbrella Hill Member of the Missisquoi Formation - Quartz and slate pebble, phyllitic conglomerate with interbeds of slate and phyllite, chiefly quartz-sericite-magnetite-chloritoid rocks.

Ultramafic Rocks - Dunite, peridotite and serpentinite.

Serpentinite, carbonate rock, talc-carbonate rock and steatite.

GLOSSARY OF SELECTED GEOLOGIC TERMS

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

Albite: The light-colored, sodium end member of the plagioclase feldspar group, which is found in alkali rocks.

Amphibolite: A green-to-black metamorphic rock containing varying amounts of amphibole (i.e., tremolite, actinolite, hornblende or arfvedsonite) and having some schistose structure.

Bedding: The arrangement of rock or granular materials in layers.

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

Bedrock Control: Land features which show bedrock on, or close to, the surface; also used in describing part of the topography.

Biotite: A silicate mineral commonly known as black mica.

Chlorite: A general group of green hydrous silicates of magnesium and iron; they may or may not have aluminum.

Chloritoid: A brittle member of the mica group.

Conglomerate: The consolidated equivalent of gravel with varied grading and composition and a matrix of sand, silt or one of the common natural cementing materials (calcium carbonate, silica, clay or iron oxide).

Drainage: The manner by which water moves on the surface, in streams, rivers and brooks; or under the surface, in channels.

Drift: A deposit of earth, sand, gravel and boulders, carried by glaciers (glacial drift), or by water flowing from glaciers (fluvio-glacial drift). Large areas of North America and Europe are drift-covered in higher latitudes.

Dunite: An ultramafic igneous rock with granitic texture, composed of olivine and a little chromite or spinel.

Epidote: A calcium aluminum iron silicate found in rocks as grains or formless masses. It is usually some shade of green, pistachio-green or yellowish-green.

Fluvial: Pertaining to streams.

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

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

Gneiss: Originally meaning a more or less banded metamorphic rock with the mineral composition of granite. The term now designates a foliated metamorphic rock with no specific composition implied, but having layers that are mineralogically unlike and consisting of particles visible to the eye. Usually gneiss displays an alternation of granular minerals and schistose minerals with the rock tending to split along the schistose bands.

Graywacke: A loosely applied term covering dark, hard sandstone having angular grains of quartz, feldspar and rock fragments in a fine, compact matrix of micas, clay minerals and chlorite.

Hornblende: An amphibole usually forming prismatic masses in igneous and metamorphic rocks. It is black, dark green or brown.

Interbedded: Occurring between beds, or lying adjacent and parallel to other beds of a different nature.

Kame: A conical mound, or 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 water flowing between a glacier and an adjacent valley wall.

Kamic: Relating to stratified drift deposited by streams flowing in or on the ice at the sides or terminus of a glacier.

Kyanite: A blue, metamorphic, aluminum silicate which forms in thin-bladed crystals, or as crystalline aggregates.

Muscovite: An important member of the mica group of minerals, known also as white mica, potash mica or isinglass.

Olivine: An olive to grayish-green, or brown orthosilicate of the chrysolite group having a conchoidal fracture. Metamorphism alters olivine to serpentine and iron oxide.

Outcrop: A part of a body of rock that appears bare and exposed at the surface of the ground. Often, the term applies to areas where the rock formation occurs just below the surface, even though it is not actually exposed.

Outwash: Stratified sands and gravels deposited by meltwater streams flowing from the face of the glacier.

Paragonite: A mica, similar in appearance and composition to muscovite but containing sodium instead of potassium.

Peridotite: A low-silica, granitic-textured, igneous rock composed of olivine and some pyroxene, amphibole and mica. Feldspar can only be present in minor amounts. Peridotite characteristically alters to the dark green rock, serpentinite.

Phyllite: A fine-grained, foliated metamorphic rock intermediate between the mica schists and slates into which it may grade. The foliation is caused by large amounts of potash mica (sericite) which gives the rock a distinctive silvery appearance.

Plagioclase: The common rock-forming feldspar of the albite-anorthite isomorphous series.

Porphyroblasts: Large crystals formed in the fine-grained matrix of a metamorphic rock by heat, pressure and solutions. These crystals occur later than the parent rock.

Quartzite: The compact, metamorphic equivalent of sandstone composed of quartz grains so firmly bonded that fracture occurs across the grains instead of around them.

Scarp: A slope, usually steep, of any height.

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.

Sediments: All material deposited from water (streams, lakes or seas), wind or ice.

Sericite: A mineral very similar to muscovite mica, occurring as small flakes and scales, which often give metamorphic rocks a pearly luster on smooth surfaces.

Serpentinite: A metamorphic rock composed of serpentine which is derived from the alteration of magnesium-rich igneous rocks.

Shale: A general term for lithified muds, clays and silts that tend to split into thin sheets along the bedding planes or along cleavage planes. Shale differs from mudstone, claystone and siltstone by having the pronounced tendency to split (fissility).

Shoal: A sand or gravel bar that makes the water shallow; specifically an elevation which is not rocky and is covered by no more than six fathoms (36 feet) of water. Coarse material usually occurs over less coarse material.

Siliceous: Containing or pertaining to silica (silicon dioxide, SiO_2), or having some qualities or characteristics of silica.

Sillimanite: A brown, grayish or pale green aluminum silicate (Al_2SiO_5) metamorphic mineral occurring in long, slender, often fibrous crystals.

Siltstone: A rock composed of somewhat indurated silt. It is a shale if the cleavage is nearly parallel to the bedding.

Slate: The homogeneous, metamorphic equivalent of shale, but so fine-grained that no mineral grains are visible. Slate splits so perfectly that it yields slabs having smooth surfaces.

Sodic Plagioclase: The sodium-rich feldspar, albite.

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

Staurolite: A brown to black, iron aluminum silicate ($\text{HFeAl}_5\text{Si}_2\text{O}_{13}$) which often shows twinning in the form of a cross.

Steatite: An impure, massive to schistose talc, distinguished by its softness and greasy or soapy feel. Commonly known as soapstone.

Structural: Of, pertaining to or resulting from the effects of folding or faulting of the earth's crust; tectonic; as structural ridges or valleys.

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

Ultramafic: Low-silica igneous rocks having virtually no quartz and feldspar, but having a correspondingly high amount of iron, magnesium and calcium. These rocks may occur as individual bodies or as segregations in larger igneous masses.

Water Table: The upper surface of a zone of saturation except where the surface is formed by an impermeable body.

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PARTIAL SPECIFICATIONS FOR HIGHWAY CONSTRUCTION MATERIALS

Listed below are partial specifications for Highway Construction Materials as they apply to this report at date of publication. For a complete list of specifications see Standard Specifications for Highway and Bridge Construction, approved and adopted by the Vermont Department of Highways 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	100
No. 100		0- 30
No. 200		0- 12

703.05 Granular Borrow

Granular Borrow shall be obtained from approved sources, consisting of satisfactorily graded, free draining, hard, durable stone and coarse sand reasonably free from loam, silt, clay, 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	100
No. 200		0- 15

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

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 AASHTO T 4, or more than 40 when tested in accordance with AASHTO T 96.

704.06 Crushed Stone for Sub-base

Crushed Stone for Sub-base shall consist of clean, hard, crushed stone, uniformly graded, reasonably free from dirt, deleterious material, pieces which are structurally weak and shall meet the following requirements:

(a) Source

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

(b) Grading

This material shall meet the requirements of the following table:

Table 704.06A - Gradation Requirements

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves	
	Total Sample	
4 1/2"	100	
4"	90-100	
1 1/2"	25- 50	
No. 4	0- 15	

(c) Percent of Wear

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

(d) Thin and Elongated Pieces

Not more than 30 percent, by weight, of thin and elongated pieces will be permitted.

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

(e) Filler

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

(f) Leveling Material

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

This material shall meet the requirements of the following table:

Table 704.06B - 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
Coarse	4"	100	
	No. 4	25- 50	100
	No. 100		0- 20
	No. 200		0- 12
Fine	2"	100	
	1 1/2"	90-100	
	No. 4	30- 60	100
	No. 100		0- 20
	No. 200		0- 12

(b) Percent of Wear

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

(c) Fractured Faces

At least 30 percent, by weight, of the stone content shall have at least one fractured face.

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

704.09 Dense Graded Crushed Stone for Sub-base

Dense Graded Crushed Stone for Sub-base shall consist of clean, hard, crushed stone, uniformly graded, reasonably free from dirt, deleterious material and pieces which are structurally weak, and shall meet the following requirements:

(a) Source

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

(b) Grading

This material shall meet the requirements of the following table:

Table 704.09A - 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 MASHO T 3, or the crushed stone a percent of wear of not more than 40 when tested in accordance with MASHO 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

TABLE I

LOWELL GRANULAR DATA SHEET NO. 1

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Overburden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks
						2"	1-1/2"	1/2"	#4	#100	#200			
1	1	1974	1-5	0-1	Yes	100	82	79	68	35	21	---	---	Owner: Mrs. Lillis Warner. Area is field containing two small pits west of State Aid Highway No. 3, 0.7 mile north of its junction with Town Highway No. 5. Test No. 1 was on face of north-east pit. Material was: 1'-5', pebbly and silty sands; bottom, silt.
	2	1974	1-6	0-1	Yes	80	77	62	46	24	14	---	Gran. Borrow (Grav.)	Test No. 2 was in west face of west pit, 0.07 mile from State Aid Highway No. 3. Material was: 1'-6', stony silty sand; bottom, sloughed material.
2	1	1974	1-8	0-1	Yes	100	92	81	60	35	24	---	---	Owner: Mrs. Lillis Warner. Area is a small pit in tree plantings 210' west of State Aid Highway No. 3 and 0.75 mile north of its junction with Town Highway No. 5. Test No. 1 was in 14-foot south-west face. Material was: 1'-8', stony silty sand; bottom, sloughed material.
3	1	1974	1-10	0-1	Yes	100	100	97	87	3	2	---	Sand	Owner: Marjorie Thurston. Former Owner: Alvin Warner. Area is a small pit on the edge of the field near tree

LOWELL 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						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks
						2"	1-1/2"	1/2"	#4	#100	#200			
														line with 0.17 mile access road southeast of Town Highway No. 16 and 0.03 mile east of junction with Town Highway No. 15. Test No. 1 was in 14-foot east face. Material was: 1'-10', stony sand; bottom, sloughed material. Water was on floor of pit and owner said material was not available.
4	1A	1974	0-20	--	Yes	89	80	64	53	7	3	17.6%	Gravel	Owner: Marjorie Thurston. Former Owner: Alvin Warner. Area is a large pit southeast of Town Highway No. 16, 0.54 mile east of junction with Town Highway No. 15. Exposed face was 40' high and 150' long. Top of face had been stripped and pushed around by bulldozer. Test No. 1A was in upper part of face. Material was: 0-20', gravelly sand.
	1B	1974	20-35	--	Yes	93	91	77	63	6	3	17.6%	Gran. Borrow	Test No. 1B was below Test No. 1A. Material was: 20'-35', gravelly sand; bottom, sloughed material. Material is not available.
5	1	1974	0.5-5	0-0.5	Yes	96	89	60	36	7	5	30.4%	Gran. Borrow (Grav.)	Owner: Roger Wursthorn. Area is an inactive pit in old pasture northwest of Town Highway.

LOWELL GRANULAR DATA SHEET NO. 3

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Overburden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks
						2"	1-1/2"	1/2"	#4	#100	#200			
														No. 16, 0.32 mile southwest of its junction with State Aid Highway No. 1. Test No. 1 was in northeast face. Material was: 0.5'-4', sandy gravel; 4'-5', pebbly sand; bottom, sloughed material.
	2	1974	1.5-8	0-1.5	Yes	100	100	91	60	26	16	26.8%	---	Test No. 2 was in southeast face. Material was: 1.5'-2.5', fine sand; 2.5'-3.5', stony gravel; 3.5'-6', sandy gravel; 6'-8', pebbly sand and fine gravel; bottom, sloughed material.
	3	1974	1-10	0-1	Yes	100	100	100	99	6	3	---	Sand	Test No. 3 was in southeast face and floor. Material was: 1'-3', pebbly sand; 3'-7.5', sand; 7.5'-10', fine sand; bottom, bedrock.
	4	1974	0.5-8	0-0.5	Yes	100	100	100	92	22	9	---	Sand	Test No. 4 was in northeast floor. Material was: 0.5'-3', sand; 3'-8', fine sand with silt seams.
	5	1974	1-10	0-1	No	100	100	100	100	69	19	---	---	Test No. 5 was in extension, 45' northeast of Test No. 2. Material was: 1'-10', fine sand; bottom, same.
6	1	1974	1-12	0-1	Yes	80	74	68	57	8	3	11.9%	Gravel	Owner: Gerard Pion. Former Owner: Raymond Pion. Area is a large pit complex southwest of State Aid Highway No. 1 with 150' access road 0.15

TABLE I

LOWELL GRANULAR DATA SHEET NO. 4

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Overburden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks
						2"	1-1/2"	1/2"	#4	#100	#200			
														mile southeast of junction with Town Highway No. 17. Pits are in 700-foot long ridge northeast of a hayfield where permission to test was denied. Owner stipulated that material would be available only in large amounts.
	2	1974	1-20	0-1	Yes	100	100	96	90	14	4	---	Sand	Test No. 1 was in east face of diggings at west end of ridge. Material was: 1'-10', pebbly sand; 10'-12', fine sand; bottom, sloughed material.
	3A	1974	1-20	0-1	Yes	100	94	69	51	5	3	29.0%	Gran. Borrow (Grav.)	Test No. 3A was in northwest face of main pit. Material was: 1'-4', pebbly sand; 4'-5', fine sand; 5'-8', sand; 8'-18', sandy fine gravel; 18'-20', stony gravel; bottom, sloughed material.
	4	1974	0-10	---	Yes	100	100	100	100	30	9	---	Sand	Test No. 4 was in northeast floor of main pit. Material was: 0-4', sand; 4'-10', fine sand with silt seams; bottom, silt.
	5	1974	0-10	---	Yes	100	100	100	100	97	92	---	---	Test No. 5 was in southwest floor of main pit. Material was: 0-10', silty fine sand and clayey silt; bottom, same.

TABLE I

LOWELL GRANULAR DATA SHEET NO. 6

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Overburden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks										
						2"	1-1/2"	1/2"	#4	#100	#200													
9	1	1974	0.5-10	0-0.5	Yes	100	91	82	66	11	6	---	Sand	Owner: Rejean LaBlanc. Area is a small grassed over pit in a pasture 0.23 mile southeast of Vermont Route 58. Field drive access is 0.19 mile northeast of junction of Town Highway No. 41 with Vermont Route 58. Test No. 1 was dug in 6-foot northeast face and floor beneath it. Material was: 0.5'-4', fine gravel; 4'-5', fine sand to silt; 5'-10', pebbly sand; bottom, pebbly sand.										
	2	1974	1.5-11	0-1.5	No	54	51	38	26	6	4	15.3%	Gravel	Test No. 2 was in field 220' north of Test No. 1. Material was: 1.5'-11', gravel; bottom same. Additional screening for this sample was: <table style="margin-left: 20px;"> <tr> <td><u>Sieve Size</u></td> <td><u>% Passing</u></td> </tr> <tr> <td>4-1/2"</td> <td>100</td> </tr> <tr> <td>4"</td> <td>87</td> </tr> <tr> <td>3"</td> <td>76</td> </tr> <tr> <td>2-1/2"</td> <td>63</td> </tr> </table> This material appears to be suitable for crushing.	<u>Sieve Size</u>	<u>% Passing</u>	4-1/2"	100	4"	87	3"	76	2-1/2"	63
<u>Sieve Size</u>	<u>% Passing</u>																							
4-1/2"	100																							
4"	87																							
3"	76																							
2-1/2"	63																							
	3	1974	1-6	0-1	No	100	100	85	67	5	3	---	Sand	Test No. 3 was near fence in field north of excavated depression in use as farm dump and northwest of Test No. 1. Material was: 1'-2', fine gravel; 2'-6', pebbly sand; bottom, sand and water table.										

TABLE I

LOWELL GRANULAR DATA SHEET NO. 7

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Overburden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks
						2"	1-1/2"	1/2"	#4	#100	#200			
10	1	1974	0-10	--	Yes	100	97	81	45	4	3	8.6%	Gravel	Owner: Mrs. Marion Pudvah. Former Owner: Jennie Pope. Area is a large pit with access south of Town Highway No. 24, 0.16 mile west of its junction with Town Highway No. 23. Smaller, overgrown diggings lie between large pit and Town Highway No. 23. Test No. 1 was in the lower west face of the large pit. Material was: 0-10', stony fine gravel; bottom, same.
	2A	1974	2.5-30	0-2.5	Yes	100	97	76	56	10	5	10.3%	Gravel	Test No. 2A was in upper part of 40-foot east face of large pit. Material was: 2.5'-30', fine gravel, pebbly sand, stony gravel; bottom, sloughed material.
	2B	1974	30-42	--	Yes	91	89	76	46	12	9	6.4%	Gran. Borrow (Grav.)	Test No. 2B was below Test No. 2A. Material was: 30'-35', gravel with silt seams; 35'-42', fine gravel; bottom, fine gravel.
	3A	1974	1-20	0-1	Yes	100	100	86	69	14	6	---	Sand	Test No. 3A was in upper part of 35-foot south face of large pit. Material was: 1'-12', sand and fine sand; 12'-20', fine gravel. South face from 20'-28' was inaccessible.

TABLE I

LOWELL GRANULAR DATA SHEET NO. 8

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Overburden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks
						2"	1-1/2"	1/2"	#4	#100	#200			
	3B	1974	28-35	--	Yes	100	98	65	30	21	12	13.0%	Gran. Borrow (Grav.)	Test No. 3B was below Test No. 3A. Material was: 28'-35', fine gravel; bottom, same.
	4A	1974	1-25	0-1	Yes	100	98	92	70	9	4	---	Sand	Test No. 4A was in west face of large pit. Material was: 1'-6', fine gravel; 6'-10', sand and fine sand; 10'-25', fine gravel; bottom, sloughed material.
	4B	1974	20-28	--	Yes	100	91	83	68	53	34	---	---	Test No. 4B was in southwest face below Test No. 4A. Material was: 20'-22', black gravel; 22'-23', silt; 23'-24', sand; 24'-25', gravel; 25'-28', silt; bottoms in silt.
	5	1974	1-10	0-1	No	100	97	82	58	6	4	10.8%	Gravel	Test No. 5 was on knoll 180' southwest of large pit. Material was: 1'-7', fine gravel; 7'-9', pebbly sand; 9'-10', sand; bottom, sand.
	6	1974	1-11	0-1	No	100	100	100	100	50	28	---	---	Test No. 6 was in field 175' west of Test No. 5. Material was: 1'-11', sandy fine silt; bottom, same.
	7	1974	1-10	0-1	No	100	100	100	100	39	15	---	Gran. Borrow (Sand)	Test No. 7 was in field 100' east of Test No. 5 and 85' from large pit. Material was: 1'-10', silty sand; bottom, same.

TABLE I

LOWELL GRANULAR DATA SHEET NO. 9

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Overburden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks
						2"	1-1/2"	1/2"	#4	#100	#200			
	8	1974	1-11	0-1	No	100	100	100	100	88	57	---	---	Test No. 8 was near west end of Town Highway No. 24, 0.11 mile north of Test No. 5. Material was: 1'-11', silty sand; bottom, silty sand.
	9	1974	0-4	--	Yes	100	100	100	100	88	54	---	---	Test No. 9 was in floor of small pit south of Town Highway No. 24 and 0.07 mile west of Town Highway No. 23. Material was: 1'-4', silty sand; bottom, same.
	10	1974	1-7	0-1	Yes	100	100	100	100	35	17	---	---	Test No. 10 was in east face of lower pit south of Town Highway No. 24 and 0.03 mile west of Town Highway No. 23. Material was: 1'-3', stony fine sand; 3'-4', sand; 4'-5', fine sand; 5'-7', silty sand; bottom, silty sand.
11	1A	1974	4-8	0-4	Yes	100	100	100	100	80	46	---	---	Owner: Roland Pion. Former Owner: Paul Blanchard. Area is a large pit southwest of State Aid Highway No. 2 with 200-foot long access road 0.13 mile northwest of junction with Vermont Route 100. Southeast corner of the pit slopes down to the East Branch of the Missisquoi River and west side of pit extends into rolling field. Test No. 1A was in upper part of 55-foot northwest

TABLE I

LOWELL GRANULAR DATA SHEET NO. 10

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Overburden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks
						2"	1-1/2"	1/2"	#4	#100	#200			
	1B	1974	8-35	--	Yes	94	90	66	39	9	7	13.2%	Gravel	face. Material was: 4'-8', fine sand and silt. Test No. 1B was below Test No. 1A. Material was: 8'-35', sandy gravel; bottom, sloughed material.
	2	1974	0-8	--	Yes	100	97	87	68	26	13	13.3%	Gran. Borrow (Sand)	Test No. 2 was in lower level near south end of pit. Material was: 0-6', fine gravel; 6'-7', silty fine sand; 7'-8', fine gravel; bottom, silt.
	3	1974	10-25	0-10	Yes	89	87	59	35	9	4	20.0%	Gravel	Test No. 3 was in west face. Material was: 10'-25', sandy gravel with silt or fine sand seams; bottom, sloughed material.
	4	1974	2-25	0-2	Yes	96	89	68	39	16	8	18.0%	Gravel	Test No. 4 was in the southwest face. Material was: 2'-12', sandy gravel; 12'-16', sand; 16'-25', fine gravel or pebbly sand; bottom, sloughed material.
	5	1974	2-11	0-2	No	100	92	89	83	13	4	---	Sand	Test No. 5 was in extension 80' northwest of Test No. 1. Material was: 2'-5', pebbly fine sand; 5'-6', fine gravel; 6'-11', mixed fine and silty sands; bottom, silt.
	6	1974	2-11	0-2	No	100	100	100	100	37	20	---	---	Test No. 6 was in field 90' northwest of Test No. 3. Material was: 2'-6', fine sand;

LOWELL GRANULAR DATA SHEET NO. 11

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Overburden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks
						2"	1-1/2"	1/2"	#4	#100	#200			
	7	1974	3-8	0-3	No	100	100	100	100	88	78	---	---	6'-11', silt and fine sand; bottom, silt and fine sand. Test No. 7 was in woods 70' southwest of Test No. 4. Material was: 3'-8', sandy clay-silt; bottom, same.
12	1	1974	1-11	0-1	No	100	100	100	100	94	60	---	---	Owner: Phil Geoffroy, Sr.. Formerly was Town Poor Farm. Area is a field northeast of Town Highway No. 29, 0.61 mile southeast of Vermont Route 100. Test No. 1 was in field north of house. Material was: 1'-3', fine gravel; 3'-11', sandy silt; bottom, sandy silt.
	2	1974	1-5	0-1	No	100	100	100	100	94	86	---	---	Test No. 2 was 0.06 mile northeast of Test No. 1. Material was: 1'-5', sandy silt; bottom, bedrock.
13	1	1974	0.5-6	0-0.5	No	71	63	48	37	12	7	22.8%	Gravel	Owner: Phil Geoffroy, Sr.. Formerly was Town Poor Farm. Area is a large field southwest of Town Highway No. 29. Access was 0.61 mile southeast of junction with Vermont Route 100. Test No. 1 was 0.11 mile southwest of access. Material was:

TABLE I

LOWELL GRANULAR DATA SHEET NO. 12

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Overburden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks
						2"	1-1/2"	1/2"	#4	#100	#200			
	2	1974	1-10	0-1	No	100	96	92	89	61	36	---	---	0.5'-4', sandy coarse gravel; 4'-5', sand; 5'-5.5', fine sand; 5.5'-6', silty sand. Water was encountered at 2'. Test No. 2 was in field 450' west of Test No. 1. Material was: 1'-2.5', pebbly sand; 2.5'-10', fine sand; bottom, fine sand.
	3	1974	1-10	0-1	No	100	100	100	100	73	40	---	---	Test No. 3 was in field 0.08 mile south of Test No. 2. Material was: 1'-10', silty fine sand; bottom, same.
	4	1974	1-10	0-1	No	100	100	100	100	95	82	---	---	Test No. 4 was in field 0.09 mile southeast of Test No. 3. Material was: 1'-10', silty fine sand; bottom, same.
14	1A	1974	1-20	0-1	Yes	76	76	62	48	11	6	24.0%	Gravel	Owner: Roland Pion. Former Owner: Paul Blanchard. Area is a large pit face west of Vermont Route 100. 0.14 access road joins Vermont Route 100, 0.34 mile south of its junction with State Aid Highway No. 2. Access road needs a bridge or culvert over East Branch of Missisquoi River. Test No. 1A was in upper part of 80-foot face. Material was:

LOWELL GRANULAR DATA SHEET NO. 13

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks
						2"	1-1/2"	1/2"	#4	#100	#200			
	1B	1974	20-45	--	Yes	100	93	77	55	6	3	23.2%	Gravel	1'-2', fine gravel; 2'-4', sandy fine silt; 4'-9', gravel; 9'-14', sand and pebbly sand; 14'-19', sandy gravel; 19'-20', sand. Test No. 1B was in middle of face below Test No. 1A. Material was: 20'-25', sand and pebbly sand; 25'-35', gravel; 35'-40', sandy gravel; 40'-45', gravel.
	1C	1974	45-65	--	Yes	94	89	70	47	5	4	22.3%	Gravel	Test No. 1C was in lower part of face, below and south of Test No. 1B. Material was: 45'-50', sandy gravel; 50'-60', gravel; 60'-65', sand and pebbly and gravelly sands; bottom, sloughed material.
15	1	1974	0.5-9	0-0.5	Yes	87	82	54	31	9	8	18.8%	Gravel	Owner: Harry Gelo. Area is a large pit northeast of Town Highway No. 57 with access 0.11 mile northwest of Vermont Route 100. Test No. 1 was in floor. Material was: 0.5'-4', clean gravel; 4'-5', sandy silt; 5'-9', gravel; bottom, gravel.
	2A	1974	1.5-18	0-1.5	Yes	91	84	62	35	7	5	23.9%	Gravel	Test No. 2A was in upper part of 45-foot northeast face.

TABLE I

LOWELL GRANULAR DATA SHEET NO. 14

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Overburden (Ft)	Existing Pit	Sieve Analysis						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks
						% Passing								
						2"	1-1/2"	1/2"	#4	#100	#200			
	2B	1974	18-35	--	Yes	100	84	62	33	7	5	14.4%	Gravel	Material was: 1.5'-5', sandy gravel; 5'-12', coarse gravel; 12'-18', gravel. Test No. 2B was below Test No. 2A. Material was: 18'-35', gravel; bottom, sloughed material.
	3	1974	1-9	0-1	No	100	95	85	75	41	16	---	---	Test No. 3 was in field, southwest of pit and Town Highway No. 57. Material was: 1'-3.5', gravel; 3.5'-9', fine sand; bottom, fine sand.
	4	1974	3.5-8	0-3.5	No	85	74	45	26	20	15	24.6%	Gran. Borrow (Grav.)	Test No. 4 was in field northwest of pit at Map Identification No. 16 and 0.07 mile northeast of Town Highway No. 3. Material was: 3.5'-8', bouldery gravel; bottom, same.
	5	1974	3-11	0-3	No	89	89	79	73	9	6	---	Gran. Borrow (Sand)	Test No. 5 was in pasture northwest of large pit. Material was: 3'-5', gravel; 5'-11', sand; bottom, sand.
	6	1974	3-11	0-3	No	100	100	97	96	12	4	---	Sand	Test No. 6 was at northwest end of upper pasture and northwest of large pit. Material was: 3'-11', fine sand; bottom, same.
	7	1974	1-11	0-1	No	100	95	71	52	30	19	16.4%	---	Test No. 7 was at edge of pasture 310' southeast of Test No. 6. Material was: 1'-3', gravelly

LOWELL GRANULAR DATA SHEET NO. 15

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over- burden (Ft)	Exist- ing Pit	Sieve Analysis						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks
						% Passing								
						2"	1-1/2"	1/2"	#4	#100	#200			
	8	1974	1-11	0-1	No	100	100	95	93	27	18	---	---	sand; 3'-6', fine sand; 6'-11', sandy gravel; bottom, sandy gravel. Test No. 8 was at edge of pasture 130' southeast of Test No. 7. Material was: 1'-2', gravelly sand; 2'-10', silty sand; 10'-11', fine sand; bottom, fine sand.
	9	1974	1-11	0-1	No	100	100	99	98	12	8	---	Sand	Test No. 9 was in woods 320' southwest of Test No. 8. Material was: 1'-11', fine sand; bottom, same.
	10	1974	12-24	0-12	Yes	91	84	71	44	8	5	21.0%	Gravel	Test No. 10 was in 45' face behind owner's barn. Material was: 12'-24', gravel; bottom, sloughed material.
16	1	1974	0.5-22	0-0.5	Yes	100	100	97	88	12	6	---	Sand	Owner: John Finnegan. Area is a pit southwest of Town Highway No. 57, 0.11 mile from Vermont Route 100. Test No. 1 was in south face of pit. Material was: 0.5'-22', sand with stones; bottom, sloughed material.
	2	1974	0.5-15	0-0.5	Yes	100	79	66	52	14	9	16.8%	Gran. Borrow (Grav.)	Test No. 2 was in west face of pit 70' northwest of Test No. 1. Material was: 0.5'-10', silty gravel; 10'-13', pebbly

LOWELL GRANULAR DATA SHEET NO. 16

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks
						2"	1-1/2"	1/2"	#4	#100	#200			
														sand; 13'-14', red gravel; 14'-15', gravelly fine sand; bottom, sloughed material.
17	1	1974	1-10	0-1	No	100	100	100	99	85	61	---	---	Owner: Elroy Collins. Area is a large field east of Vermont Route 100 with access 0.10 mile south of junction with Town Highway No. 15. Test No. 1 was in southeast end of field. Material was: 1'-10', fine sand; bottom, same.
	2	1974	1-10	0-1	No	100	100	88	80	53	21	---	---	Test No. 2 was in top of small ridge 0.05 mile north of field access. Material was: 1'-3', gravel; 3'-10', fine sand; bottom, fine sand.
	3	1974	1-10	0-1	No	100	100	100	100	93	63	---	---	Test No. 3 was at north edge of field 0.17 mile north of Test No. 2. Material was: 1'-10', fine sand; bottom, same.
18	1	1974	1-10	0-1	Yes	100	100	100	99	30	8	---	Sand	Owner: William Shortsleeves. Area is a pit 0.25 mile west of the end of Town Highway No. 56 and west of depleted mink farm. Test No. 1 was in northwest face of pit. Material was: 1'-10', fine sand; bottom, sloughed material.

LOWELL GRANULAR DATA SHEET NO. 17

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Overburden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks
						2"	1-1/2"	1/2"	#4	#100	#200			
19	1A	1974	1.5-25	0-1.5	Yes	100	100	83	66	10	6	---	Sand	Owner: James Wagner. Former Owner: Stanford Gelo. Area has upper sand pit and lower gravel pit with large pasture extension northeast of Town Highway No. 54, 0.10 mile east of its junction with Town Highway No. 15. Test No. 1A was in upper part of east face of lower pit level. Material was: 1.5'-6', fine gravel; 6'-25', sand and pebbly sand.
	1B	1974	25-40	--	Yes	82	71	42	25	5	4	12.2%	Gravel	Test No. 1B was below Test No. 1A. Material was: 25'-40', gravel; bottom, same.
	2	1974	3-23	--	Yes	94	92	74	60	4	3	8.8%	Gravel	Test No. 2 was in upper part of north face of lower pit level. Material was: 3'-18', gravel; 18'-25', pebbly sand; bottom, sloughed material.
	3	1974	2-30	0=2	Yes	100	100	99	98	13	7	---	Sand	Test No. 3 was in northwest face of lower pit level. Material was: 2'-30', fine sand; bottom, sloughed material.
	4	1974	4-15	0-4	Yes	100	100	100	100	42	14	---	Gran. Borrow (Sand)	Test No. 4 was in north face of upper pit level. Material was: 4'-8', fine sand; 8'-15', sand; bottom, sand and sloughed material.

TABLE I

LOWELL GRANULAR DATA SHEET NO. 18

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Overburden (Ft)	Existing Pit	Sieve Analysis						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks
						% Passing								
						2"	1-1/2"	1/2"	#4	#100	#200			
	5	1974	0.5-10	0-0.5	Yes	96	83	66	51	6	4	8.6%	Gravel	Test No. 5 was in east floor of lower pit level. Material was: 0.5'-1.5', uniform stone layer (1/2 - 1-1/2" stone); 1.5'-4', gravel; 4'-10', sandy gravel; bottom, sandy gravel.
	6	1974	0-12	--	Yes	100	100	100	100	39	25	---	---	Test No. 6 was in middle of upper pit floor. Material was: 1'-8', fine sand; 8'-10', sand; 10'-12', fine sand; bottom, fine sand.
	7	1974	1-11	0-1	No	100	100	100	100	21	6	---	Sand	Test No. 7 was in pasture 220' east of Test No. 1. Material was: 1'-7', sand; 7'-11', fine sand; bottom, fine sand.
	8	1974	4-11	0-4	No	100	100	100	100	34	22	---	---	Test No. 8 was in pasture 380' north of Test No. 7. Material was: 4'-6', sand; 6'-9', fine sand; 9'-11', sand; bottom, sand.
	9	1974	1-11	0-1	No	100	100	100	99	26	8	---	Sand	Test No. 9 was in pasture 550' northeast of Test No. 8. Material was: 1'-11', fine sand; bottom, sand.
20	1	1974	2-12	0-2	Yes	100	100	96	93	8	7	---	Sand	Owner: Roger Stewart. Formerly: Fields' Pits. Area is a pit northwest of Vermont Route 100 with 0.13 mile access road nearly opposite the

LOWELL GRANULAR DATA SHEET NO. 19

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Overburden (Ft)	Existing Pit	Sieve Analysis % Passing						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks
						2"	1-1/2"	1/2"	#4	#100	#200			
	2	1974	0.5-10	0-0.5	No	87	75	59	39	5	4	17.8%	Gravel	<p>end of Town Highway No. 38. Test No. 1 was in floor. Material was: 2'-12', sand and pebbly sand; bottom, sand.</p> <p>Test No. 2 was 25' north of pit face. Material was: 0.5'-3', sand; 3'-10', gravel; bottom, gravel.</p>
21	1A	1974	2.5-20	0-2.5	Yes	81	71	54	34	7	5	15.2%	Gravel	<p>Owner: State of Vermont Former Owners: Leo Sterner, Roger Villeneuve. Known as "Fiddlers Elbow". Area is a pit with high face and ridge extension north-west of Vermont Route 100. Access is north of Town Highway No. 6, 0.06 mile from its south junction with Vermont Route 100. Test No. 1A was in upper part of 100-foot face. Material was: 2.5'-20', pebbly sand, fine gravel, sand, stony sand, silt traces and occasional cobbles.</p>
	1B	1974	20-45	--	Yes	100	100	86	73	5	4	14.6%	Sand	<p>Test No. 1B was in upper middle of face below Test No. 1A. Material was: 20'-30', fine gravel; 30'-40', well-graded gravel; 40'-45', stony gravel.</p>

TABLE I

LOWELL GRANULAR DATA SHEET NO. 20

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Overburden (Ft)	Existing Pit	Sieve Analysis						Abrasion AASHTO T-4	Passes VHD Spec.	Remarks
						% Passing								
						2"	1-1/2"	1/2"	#4	#100	#200			
	1C	1974	45-70	--	Yes	91	88	66	33	7	5	14.6%	Gravel	Test No. 1C was in lower middle of face below Test No. 1B. Material was: 45'-65', stony gravel; 65'-70', bouldery gravel.
	1D	1974	70-85	--	Yes	76	74	60	41	14	10	58.9%	Gran. Borrow (Grav.)	Test No. 1D was below Test No. 1C. Material was: 70'-85', stony gravel; bottom, sloughed material.
22	1	1974	2-10	0-2	No	100	100	100	100	7	4	---	Sand	Owner: Leo Jobien. Area is a large field south-east of Vermont Route 100 with access opposite Town Highway No. 6 junction. Test No. 1 was in knoll behind grown-in sand pit 0.07 mile northeast of access. Material was: 2'-10', sand; bottom, same.
	2	1974	2-10	0-2	No	100	100	100	100	85	56	---	---	Test No. 2 was in knoll 900' north of south end of field. Material was: 2'-10', silty fine sand; bottom, same.
23	1A	1971	1.5-14	0-1.5	Yes	73	58	47	33	6	4	17.6%	Gravel	Owner: Mrs. Alma Dolan. Area is a pit north of Vermont Route 100. Pit is intersected by Eden Town Line. Test No. 1A was in upper part of north face of pit. Material

TABLE I
SUPPLEMENT

LOWELL PROPERTY OWNERS - GRANULAR

	Map Identification No.
Collins, Elroy	17
Dolan, Alma	23
Finnegan, John	16
Gelo, Harry	15
Geoffroy, Phil	12, 13
Jobien, Leo	22
LaBlanc, Rejean	9
Pion, Gerard	6
Pion, Roland	11, 14
Powers, Archie	7
Pudvah, Marion	10
Raboin, Gerard	8
Shortsleeves, William	18
Stewart, Roger	20
Thurston, Marjorie	3, 4
Vermont, State of	21
Wagner, James	19
Warner, Lillis	1, 2
Wursthorn, Roger	5

TABLE II

LOWELL ROCK DATA SHEET NO. 1

Ident. No.	Field Test No.	Year Field Tested	Rock Type	Exist- ing Quarry	Method of Sampling	Abrasion AASHTO		Remarks
						T-3	T-96	
1	1A	1974	Ultra- mafic	No	Chip	4.4%	11.3%	Owner: Robert Raboin. Area is a series of wooded step-like outcrops which trend northeasterly and rise from east to northeast. Area is east of Vermont Route 100, 0.2 mile south of the West- field Town Line. Access is via old, steep, rough skidway which could be improved easily for a quarrying operation. The rock is ultramafic and grades from serpentinite to dunite to peridotite. There is no bedding, but the weathered surface suggests a hint of flow structure. Severe jointing has produced angular fragments. Mineral- ization produced colors ranging from blue to green to very dark (nearly black) green. Some zones of rock resembled (in color only) a "typical" gray limestone, but the hardness approached that of a quartzite. The weathered rock was soft and showed the brown, brownish- white or blue-green with brown streaks which are typical colors of weathered ultramafics. The slope had loose angular fragments which were treacherous. Test No. 1A was from the northern 150' of outcrop east of Vermont Route 100.
	1B	1974	Ultra- mafic	No	Chip	4.5%	15.6%	Test No. 1B was from the southern 150' of outcrop. There are ample reserves at this area.
2	1A	1974	Serpen- tinite	No	Chip	2.8%	11.6%	Owner: Sam Pion. Area is a large mass of serpentinite on the northwest side of "Brown's Ledges", south of the Westfield Town Line and east of Town Highway No. 17. Access was easier coming south from Westfield Town Highway No. 19; however, devel- oping the area may be easier by going north from the east end of Lowell Town Highway No. 19. The topography ranges from steep at the rock site, to

TABLE II

LOWELL ROCK DATA SHEET NO. 2

Ident. No.	Field Test No.	Year Field Tested	Rock Type	Exist- ing Quarry	Method of Sampling	Abrasion AASHTO		Remarks
						T-3	T-96	
	1B	1974	Serpen- tinite	No	Chip	3.9%	13.4%	<p>nearly flat in the woods near the sugar house. An improved access road would have to be built and right-of-way arranged with Maurice Audette, of North Troy, who rents to Ronald Pion.</p> <p>The rock was mostly a non-fibrous variety of serpentinite which seems good for construction purposes. It breaks from blocky to sub-angular and angular and is quite hard. Development could be started on west or northwest slope and proceed east or southeastward. A steep scarp is located on the east side of the hill, but access from Vermont Route 100 would need a bridge across the East Branch of the Lamoille river.</p> <p>There are not many nearby houses to complain about crushing operation noise.</p> <p>Test No. 1A was from the north 75' of exposure on west slope of wooded hill.</p> <p>Test No. 1B was from the south 75' of exposure on west slope of wooded hill. There are ample reserves in this area.</p>
3	1A	1974	Ultra- mafics	No	Chip	6.4%	19.3%	<p>Owner: Sam Pion.</p> <p>Area is a small rock knob in woods, one-half mile south of "Brown's Ledges", and was sampled to show the extent of material at Map Identification No. 2.</p> <p>The rock is dark green on fresh surfaces and weathers to dull buff which is a characteristic of most ultramafic rocks. The rock breaks from mostly sub-angular to nearly blocky and looks good for construction purposes. Some minor fibrous mineralization was noted.</p> <p>Test 1A was taken along the southwest base of rock knob.</p>
	1B	1974	Ultra- mafics	No	Chip	4.5%	18.8%	<p>Test No. 1B was taken along the southeast base of rock knob.</p>

TABLE II

LOWELL ROCK DATA SHEET NO. 3

Ident. No.	Field Test No.	Year Field Tested	Rock Type	Exist- ing Quarry	Method of Sampling	Abrasion AASHTO		Remarks
						T-3	T-96	
4	1A	1974	Serpen- tinite	Yes	Chip	3.4%	15.3%	Owner: Central Vermont Realty; Mineral Rights retained by Margaret Wright of Newport, Vermont. Area is a steep, south-facing rock slope that was an old mine prospect. Access is west from Vermont Route 100 via C.V.P.U. power line right-of-way and then northward on crude, overgrown haul road. Rock is serpentinite with a little fibrous mineralization but appears good for construction purposes. The south slope has good relief and would be the best place for a crushing operation. Access would be good after the haul road is improved; however, a right-of-way from Tatreault may be needed across the north edge of corn field. There is an ample reserve of easily accessible material. The rock breaks from nearly blocky to sub-angular. Test No. 1A was 75' along south wall of scarp.
	1B	1974	Serpen- tinite	Yes	Chip	5.1%	15.4%	Test No. 1B was the 75' interval east of Test No. 1A.
5	1A	1974	Schist- ose Gray- wacke	No	Chip	13.3%	35.6%	Owner: Roger Wursthorn. Area is a wooded hillside with outcrops rising east from Town Highway No. 16, 0.7 mile south of the junction of Vermont Route 58 with Town Highway No. 16. The rock is mapped as the Ottauquechee Schistose Graywacke; however, this survey concluded that the rocks are metamorphosed sediments and volcanics. This interpretation was based upon heavily weathered rock which had very obscure bedding or foliation. Obscure joint systems were noted and rock broke into sharp-edged angular, thin and elongate frag-ments which were not as platy as slate but appeared very

TABLE II

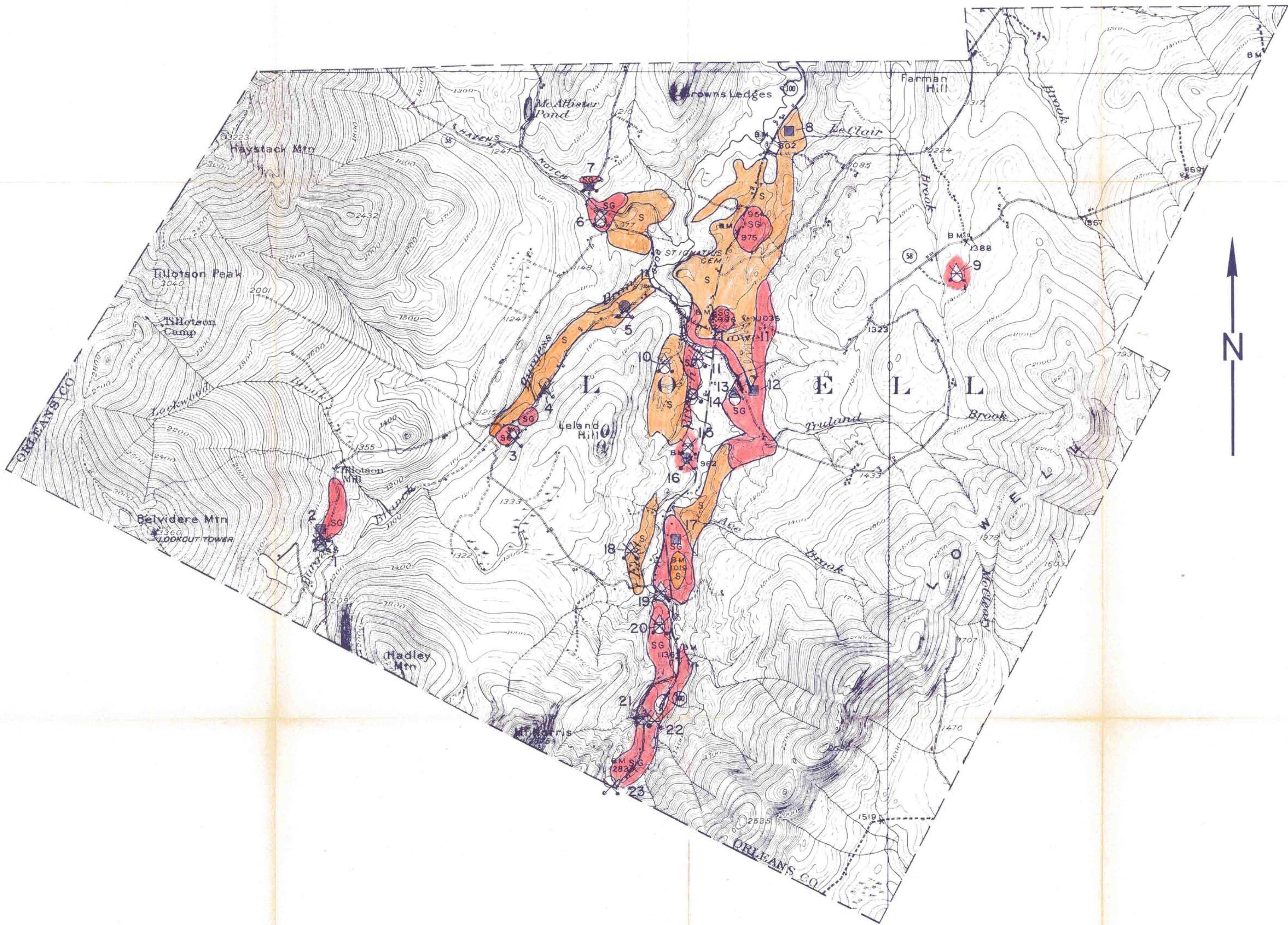
LOWELL ROCK DATA SHEET NO. 4

Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHTO		Remarks
						T-3	T-96	
	1B	1974	Schistose Graywacke	No	Chip	12.7%	37.3%	<p>soft and flaky. If the rock is suitable construction material, this area has a large reserve. The access is good, but the development would have to be away from the road side rock cut. Much of the bedrock is masked by woods.</p> <p>Test No. 1A was along northern part of road cut. The rock is a green-to-dark gray quartzose phyllite or schist with some thin quartz bands which parallel rudimentary flow structure. The rock weathers from a dull light brown to a dull sooty black.</p> <p>Test No. 1B was along south part of road cut. The rock was the same except it breaks easier and into thinner pieces.</p>
6	1A	1974	Ultra-basic	Yes	Chip (Random Blocks)	2.6%	15.7%	<p>Owner: G. A. F. Corp. (The miners are presently trying to buy property from G.A.F.). Area consists of large waste piles with large blocks which were sampled. Most of the waste was fairly fiber-free but there is the presence of tiny fibers which would be released by crushing or wear. Rock varies from gneiss and amphibolite, to graywacke and serpentinite. The rock is close to the contact between the Hazens Notch schist, quartzite and gneiss and the ultramafics, dunite, peridotite and serpentinite.</p> <p>Test No. 1A was along southeast base of upper level of waste pile (1,235' dump).</p>
	1B	1974	Ultra-basic	Yes	Chip (Random Blocks)	1.5%	9.4%	<p>Test No. 1B was north of Test No. 1A.</p>

TABLE II
SUPPLEMENT

LOWELL PROPERTY OWNERS - ROCK

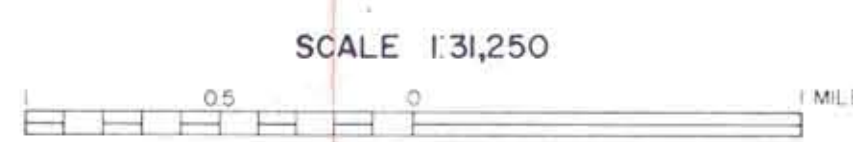
	Map Identification No.
Central Vermont Realty (Mineral rights retained by Margaret Wright)	4
General Analine Film Corporation	6
Pion, Sam	2, 3
Raboin, Robert	1
Wursthorn, Roger	5



LEGEND

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

LOWELL



CONTOUR INTERVAL 20 FEET

1974

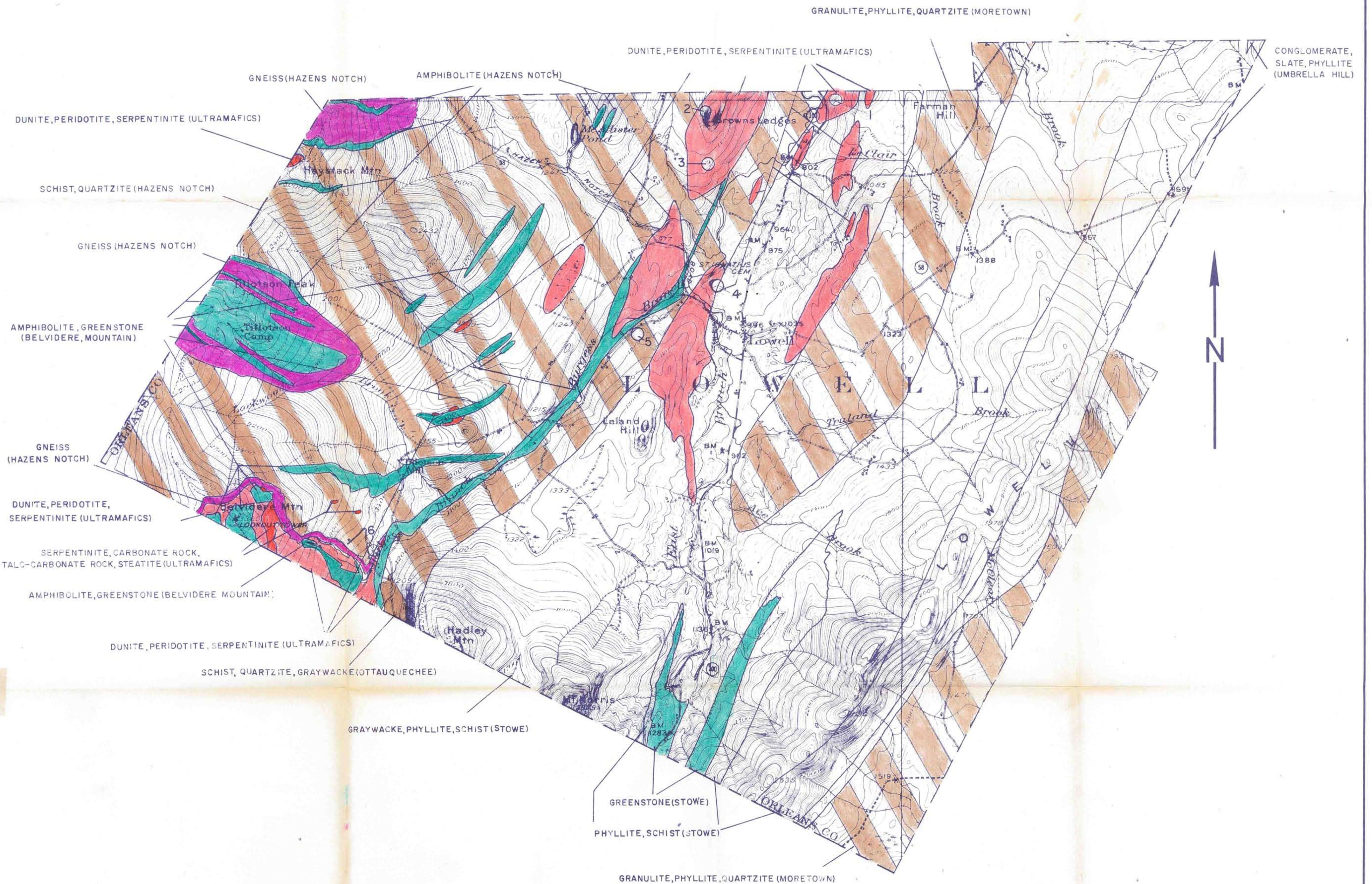
GRANULAR MATERIALS MAP

BY
VERMONT DEPARTMENT OF HIGHWAYS
IN COOPERATION WITH
U.S. BUREAU OF PUBLIC ROADS

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

REVISIONS

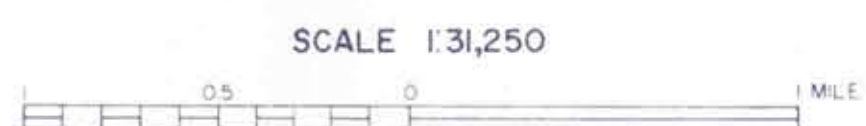
DATE					
BY					



LEGEND

- ROCK, ACCEPTABLE FOR ITEM 704.06 (crushed stone for sub-base)
- ⊗ ROCK, NOT ACCEPTABLE FOR ITEM 704.06
- ⊗ EXISTING QUARRY
- Orange box GRANITE TO DIORITE (light to intermediate igneous rocks)
- Green box AMPHIBOLITE, GABBRO, DIABASE, METADIABASE, GREENSTONE, TRAP DIKES (basic or dark igneous rocks)
- Red box PERIDOTITE, PYROXENITE, SERPENTINITE (ultra-basic igneous rocks)
- Purple box GNEISS
- Light purple box QUARTZITE
- Dark purple box DOLOMITE
- Blue box MARBLE, LIMESTONE
- White box SCHISTS, SLATES, PHYLLITES, SHALES, CONGLOMERATES
- 3 IDENTIFICATION NUMBER (refer to data sheets)

LOWELL



1974

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

REVISIONS

DATE				
BY				