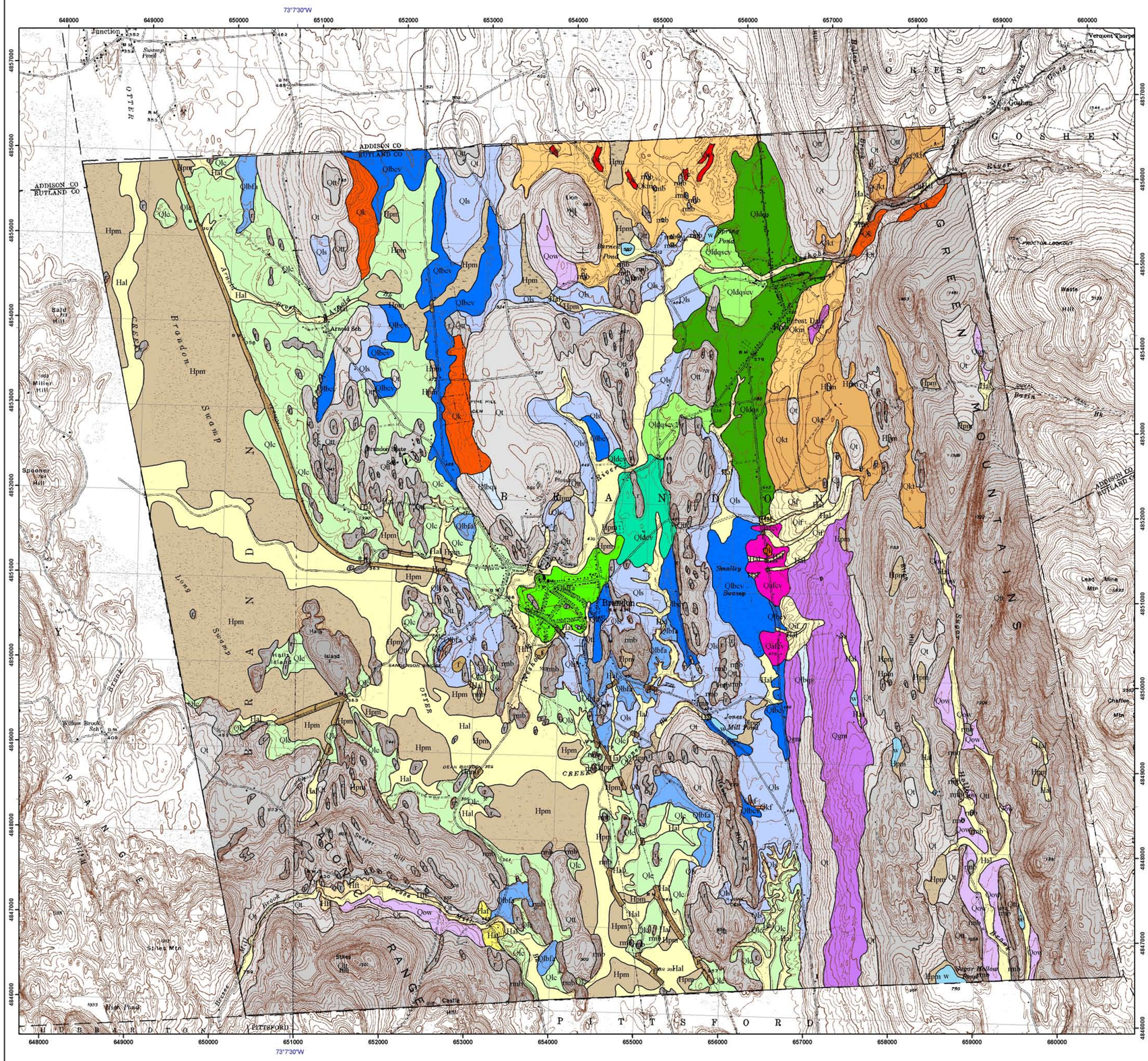

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Date: September 2008

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0 0.5 1 2 Miles

0 0.5 1 2 3 Kilometers

Contour Interval 20 Feet

MN N

Magnetic declination
15.5 degrees west, 1968

SURFICIAL GEOLOGIC MAP OF THE TOWN OF BRANDON, VERMONT

by
David DeSimone
2008

Research supported by the Vermont Geological Survey, Dept. of Environmental Conservation, VT ANR.
This geologic map was funded in part by the USGS National Cooperative Mapping Program.
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LEGEND

RECENT

f — Fill; variable materials used as artificial fill along rail beds, road beds, embankments and low lying areas.

Hpm — Peat & Muck.; organic sediment, mostly silt and clay in wetlands and swamps; low lying flat lands prone to flooding.

Hal — Alluvium; stream flood plains; fine sand, silt and gravel of river channnel, bar and bank areas; river bottom lands; variable permeability but usually intermediate to low; often wet sites and prone to flooding; can be good acquifer if sufficiently thick.

Haf — Alluvial Fan; tributary stream deposits; gravel, silt and sand, often poorly sorted; gently to moderately sloping lands located at the base of steep slopes and at stream junctions; variable permeability but usually intermediate to low; fair aquifer if sufficiently thick and permeable.

Hft — Fluvial Terrace

PLEISTOCENE

Qafcv — Lake Coveville Alluvial Fan

Qlbfa — Lake Fort Ann fan delta @420ft. Lake Beach. strandline or shoreline current and wave deposits of sand or gravel; well to poorly sorted sand or well to poorly sorted gravel; sands deposited in lower energy embayments, tombolos and as sand spits; gravels deposited in higher energy open beaches and offshore bars; permeable and well drained; poor aquifer only because of limited aerial extent and thickness.

Qlbcv — Lake Coveville beach features @470ft +/- 10ft. Lake Beach. strandline or shoreline current and wave deposits of sand or gravel; well to poorly sorted sand or well to poorly sorted gravel; sands deposited in lower energy embayments, tombolos and as sand spits; gravels deposited in higher energy open beaches and offshore bars; permeable and well drained; poor aquifer only because of limited aerial extent and thickness.

Qlbqs — Lake Quaker Springs beach features @580ft +/- 10ft. Lake Beach. strandline or shoreline current and wave deposits of sand or gravel; well to poorly sorted sand or well to poorly sorted gravel; sands deposited in lower energy embayments, tombolos and as sand spits; gravels deposited in higher energy open beaches and offshore bars; permeable and well drained; poor aquifer only because of limited aerial extent and thickness.

Qldfa — Lake Fort Ann fan delta @ 430 ft. Lake Delta; stream deposits of gravel and sand accumulated in a lake and topset and foreset beds marking lake level; all are fan deltas in the mapped region; well sorted stratified sand and gravel or sand; usually well drained and thick deposits which make good aquifers.

Qldcv — Lake Coveville fan delta @470ft. Lake Delta; stream deposits of gravel and sand accumulated in a lake and topset and foreset beds marking lake level; all are fan deltas in the mapped region; well sorted stratified sand and gravel or sand; usually well drained and thick deposits which make good aquifers.

Qldqscv — Transitional Quaker Springs to Coveville fan. Lake Delta; stream deposits of gravel and sand accumulated in a lake and topset and foreset beds marking lake level; all are fan deltas in the mapped region; well sorted stratified sand and gravel or sand; usually well drained and thick deposits which make good aquifers.

Qldqs — Lake Quaker Springs fan delta @580ft. Lake Delta; stream deposits of gravel and sand accumulated in a lake and topset and foreset beds marking lake level; all are fan deltas in the mapped region; well sorted stratified sand and gravel or sand; usually well drained and thick deposits which make good aquifers.

Qls — Lake Sand; well sorted laminated fine to medium sand underlying plains; prone to gullying and headward erosion; moderately good aquifer if thick, poor if then.

Qlc — Lake Clay and Silt; fine grained varved or thinly laminated deposits of silt and clay accumulated in the deeper portions of lake basins; gravel sand lenses may be present within the sequence but especially toward the bottom; prone to landsliding and gullying; poorly drained and a poor aquifer.

Qow — Outwash; glacial melt water deposits of well sorted gravel and sand typically greater than 5 meters thick; gently sloping to flat lands; intermediate to high permeability; high gravel-sand resource potential.

Qk — Kame, undifferentiated; glacial deposits from streams, slumps and deposition by ice; stratified and unstratified sand, gravel and boulders with variable silt; rolling, hilly lands; intermediate to high permeability; high gravel-sand resource potential.

Qkf — Kame Fan; sand and gravel deposits from melt water deposited into the bottom of a lake along or near an ice margin; subaqueous fan sediments are well sorted and well stratified; typically found in direct contact with bedrock; may be overlain by lacustrine silt, clay and sand; good aquifer if thick and aerially extensive.

Qe — Esker; subglacial/englacial melt water stream deposits of moderately well sorted gravel and sand with boulders; prominet elongated and curving narrow ridges with steep sides and heights reaching 60+ feet; intermediate to high permeability; high gravel-sand resource potential; steep slopes pose a major slope stability problem.

Qkm — Kame Moriane; ice contact melt water and sediment flow deposits of stratified and unstratified gravel and sand with silt and boulders; rolling hilly ridged lands with potential; local steep slopes pose slope stability problems.

Qm — Moraine; ice contact ice deposited, sediment flow and melt water materials of unstratified and stratified silt, sand, gravel and boulders; broad ridges and swales with rolling low hills; variable permeability; local slopes may pose a stability problem.

Qif — Inwash Fan; stratified fluvial sand, sand and gravel, or gravel deposited where uplands transition to lowlands and associated with other ice contact sediment or accumulated against an ice margin and having one ice contact side, typically the distal side of the fan; well drained and, if thick a good aquifer.

Qkt — Kame Terrace; ice contact melt water and sediment flow deposits of stratified and unstratified gravel, sand, boulders and some silt; flat to nearly flat lands; intermediate to high permeability; high gravel-sand resource potential; slopes at edges of these areas may pose a stability problem.

Qgm — Ground Moraine; ice contact sediment flow, melt water and ice deposited sediments of variable texture ranging from stratified and well sorted gravel and sand to unstratified and poorly sorted silt, sand gravel and boulders; thickness is variable and rock outcrops may protrude; low to high permeability; limited local slope stability problems; gently rolling hills and elongated smoothed hills are possible.

Qt — Till; ice derived deposits of hardpan silt, boulders, gravel and sand which are unsorted and unstratified and deposited beneath the glacier; thickness greater than 3 meters but rock outcrops may be common; surface boulders or erractics are common; smoothed and streamlined hills in the valley and gently undulating slopes on the lower mountain flanks; low permeability; unstable slopes may result in excavations.

Qtt — Till, thin; ice derived deposits of hardpan silt, boulders, gravel and sand which are unsorted and unstratified and deposited beneath the glacier; thickness less than 3 meters with rock outcrops or ledge frequent; surface boulders or erractics are common; moderate to steep mountain slopes and summit areas; low permeability; steep slopes are unstable and slides are common.

PRECAMBRIAN AND PALEOZOIC

r — Rock Outcrop. These include areas of predominately outcrop with patches of till or slump or slide debris. Outcrop areas serve to recharge the bedrock units with ground water. Poor sites for septic systems. Slopes are generally stable.

rmb — Rock Outcrop. Marble. These include areas of predominately outcrop with patches of till or slump or slide debris. Outcrop areas serve to recharge the bedrock units with ground water. Poor sites for septic systems. Slopes are generally stable.

w — Water.

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Vermont Geological Survey Open File Report VG08-1
Plate 7

Legend

Water Wells, located by E911 or GPS

Number of located wells: 307
Mean Yield: 23.36 GPM
Median Yield: 9 GPM
Mean Depth: 327.76'
Median Depth: 285'

Reported yield in gallons per minute (GPM)

- 0.0 - 2.0
- 2.01 - 10.0
- 10.01 - 20.0
- 20.01 - 100.0
- >100.0

Town Boundaries
Surface Water

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Digital Cartography by Marci Young and Marjorie Gale
Date: September 2008

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Contour Interval 20 Feet

MN N

Magnetic declination
15.5 degrees west, 1968

LOCATED WATER WELLS, BRANDON, VERMONT

by
Dave DeSimone
2008

VERMONT
AGENCY OF NATURAL RESOURCES
Vermont Geological Survey

Vermont Geological Survey Open File Report VG08-1
Plate 5

Legend

- Water wells with E911 or GPS location
- Depth to bedrock; Contour interval 40'
- Surface Water
- Town Boundaries

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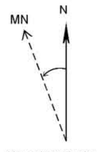

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Date: September 2008

0 0.5 1 2 Miles
0 0.5 1 2 Kilometers
SCALE 1:24,000 Contour Interval 20 Feet

DEPTH TO BEDROCK, BRANDON, VERMONT

by
David De Simone
2008

VERMONT
AGENCY OF NATURAL RESOURCES
Vermont Geological Survey

Vermont Geological Survey Open File Report VG08-1
Plate 8

Legend

- Gravel Wells, proven aquifer
- Extent of potential overburden (shallow) aquifer
- Surface water
- Town Boundaries

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Contour Interval 20 Feet

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OVERBURDEN AQUIFERS, BRANDON, VERMONT

by
Dave DeSimone
2008

Digital Cartography by Marci Young and Marjorie Gale

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VERMONT
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Vermont Geological Survey Open File Report VG08-1
Plate 6

Legend

- Town Boundaries
- Surface Water
- Piezometric surface, contour interval 50'

The static level of water in a well is a useful parameter as it is a factor in determining the amount of water that is stored in the well bore, and thus, available to be pumped into a house or other structure using the water. The elevation of the static water level in bedrock wells reported in the well log data was determined. These data were contoured using a 50ft contour interval.The contoured map shows the typical pattern of static levels that mimic the underlying topography.

Groundwater flows down the hydraulic gradient from a high potentiometric level to a low potentiometric level. Inferred directions or pathways of recharge would be from higher regions in an aquifer to regions of discharge in lower portions of an aquifer.

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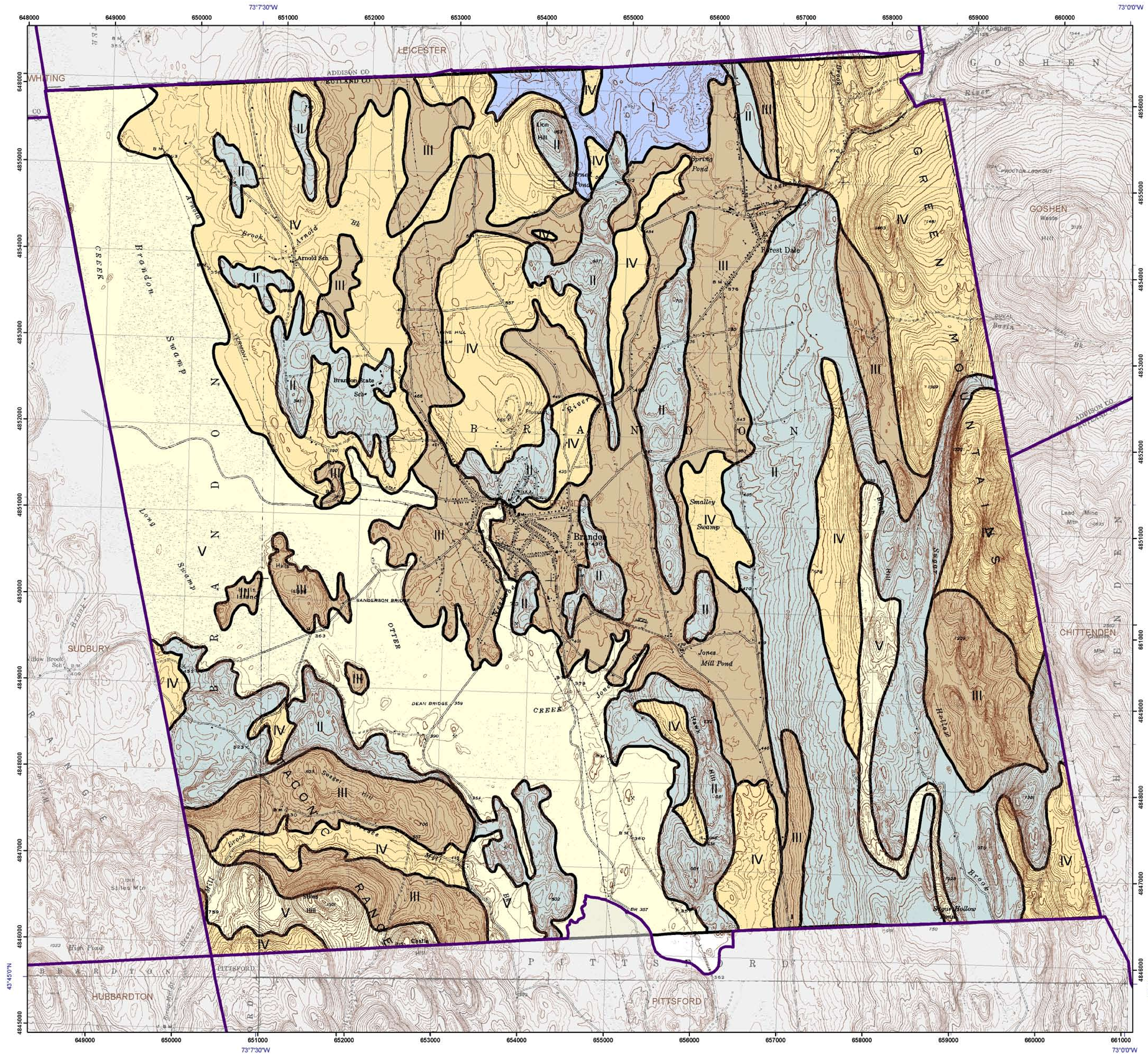
PIEZOMETRIC SURFACE, BRANDON, VERMONT

by
Dave DeSimone
September 2008

VERMONT
AGENCY OF NATURAL RESOURCES
Vermont Geological Survey

Vermont Geological Survey Open File Report VG08-1



Legend

Recharge potential to bedrock aquifer

- I — HIGHEST: Sand and gravel atop marble.
- II — HIGH: Exposed marble and quartz ridges; thin overburden atop marble in Sugar Hollow area; kame moraine, kame terrace, or ground moraine atop quartzite and marble on Green Mountain flank; thin overbuden atop marble, quartzite, or phyllite-marble.
- III — MODERATE: Bresee Hollow thin overburden, lake delta, lake sand, lake beach and small kame areas; thin till atop quartzite.
- IV — LOW: Thick till atop slate and phyllite; lake clay areas; alluvium and wetland areas in valley bottoms; aquifer discharge zones.
- V — LOWEST: Otter Valley alluvium and wetland areas; underlying bedrock is slate and phyllite; aquifer discharge zones
- Town Boundary

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Contour Interval 20 Feet

Magnetic declination
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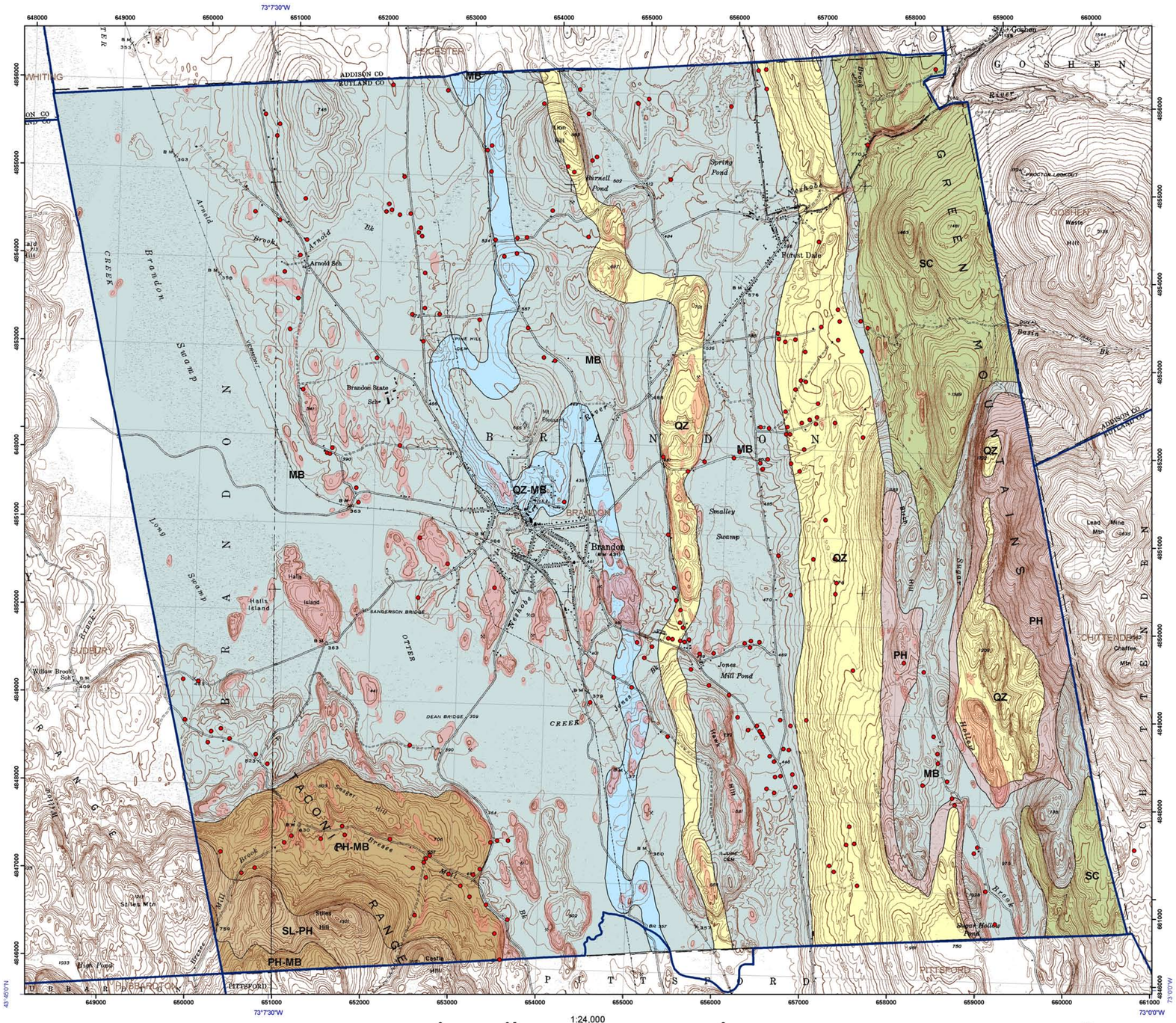
RECHARGE POTENTIAL TO BEDROCK AQUIFER, BRANDON, VERMONT

by
David DeSimone
September 2008

Vermont Geological Survey Open File Report VG08-1
Plate 10



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Contour Interval 20 Feet

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Magnetic declination
15.5 degrees west, 1968

LEGEND

Cambrian and Ordovician Bedrock Lithologies

- MB — Marble, limestone, dolostone and dolomitic marble.
- QZ — Quartzite of the Danby, Monkton & Cheshire formations.
- QZ-MB — Quartzite with interbedded carbonates, Danby Fm.
- PH — Phyllite
- PH-MB — Phyllite with interbedded marble, Breezee Fm.
- SL-PH — Slate and phyllite, St. Catherine Fm. .
- SC — Schist

Rock Outcrop
Bedrock wells with yield > 10 gallons per minute
Town Boundary

EXPLANATION

This map shows the extent of major bedrock litholigies in Brandon. The town is underlain by a bedrock aquifer developed in marble and quartzite lithologies. Yield and depth information is given in the table below. High yield bedrock wells tend to align with the approximate location of the contact between the Cheshire quartzite and the overlying marble. Higher yield wells also occur along the flank of the Otter Valley where a subdued marble ridge curves to form the eastern valley flank. Recharge enhancement from the ridge tops immediately east of these high yield wells is a possible explanation. A third area of higher yield occurs where there is a distinct folded pattern or kink in the exposure trace of the Danby quartzite-marble unit. Enhanced recharge from ridge tops may contribute and it is likely that the rock may be more highly fractured in the kink area. Lastly, higher yield wells occur in Sugar Hollow where marble and is ringed by surrounding mountain flanks. Recharge to the valley marble from the surrounding mountain flanks may be a viable explanation.

On Plate 5, the static levels of the bedrock wells in town were contoured using a 50ft interval to show the extent of the bedrock aquifer piezometric surface. The piezometric surface is the level water will rise to in a well bore penetrating bedrock. This surface is higher beneath the mountains and lowland ridges and hills; it is lower in the valleys.

Map Unit	# of Wells	Mean GPM	Standard Deviation	Mean Depth (ft)	Standard Deviation
MB	178	26	82	345	195
QZ	62	13	12	308	164
QZ-MB	9	11	15	468	216
PH-MB	28	11	19	380	191
SL-PH	0				
PH	2	18	3	248	38
SC	7	18	21	295	90

BEDROCK TYPE AND HYDROGEOLOGIC UNIT BRANDON, VERMONT

by
David DeSimone
2008

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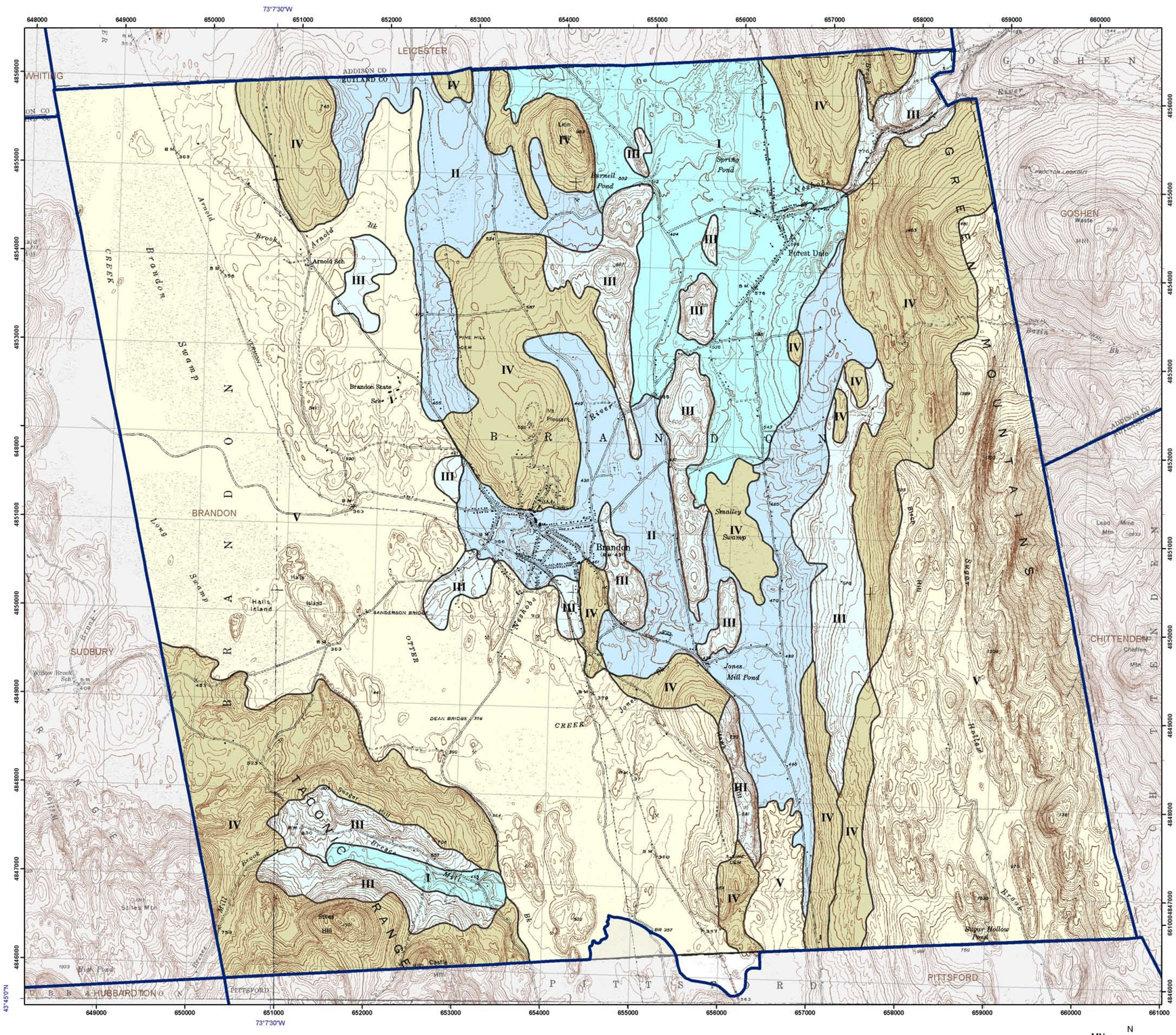

Legend

- I — **HIGHEST; Thick Delta and ice contact sand-gravel.**
- II — **HIGH; Thinner delta and ice contact sand-gravel. Lacustrine sand. Peripheral sand-gravel and sand.**
- III — **MODERATE; Ground moraine, exposed rock ridges within thick sand-gravel and sand areas. Perhipheral rock ridges, lacustrine sand, ground moraine and minor sand and sand-gravel.**
- IV — **LOW; Thin till areas within aquifer catchment, thick till areas, muck (presusumed aquifer discharge areas).**
- V — **LOWEST; Down gradient areas, lacustrine clay - silt areas**
- **Town Boundary**

EXPLANATION

SHALLOW AQUIFER

A shallow aquifer is a volume of porous and permeable sediment, either sand or gravel or a mixture of sand and gravel, which is exposed at the ground surface. Hydrologists refer to this as an unconfined aquifer because the aquifer is not sealed, capped or confined by an impermeable layer. Shallow aquifers are recharged by direct downward infiltration of surface water from precipitation, snow melt and possibly through the bottoms of stream channels.

RECHARGE POTENTIAL

Recharge potential is ranked from 1 being the highest to V being the lowest. The criteria for the rankings are based on knowledge of the surficial geology, overburden thickness and the stratigraphy of the overburden as determined from analysis of the well logs.

The recharge potentials are qualitative and no absolute values on rates of recharge through each of the surficial material types can be provided, especially because of the heterogeneous nature of most surficial materials deposited in glacial environments. Areas of the thickest and most permeable sediments are assigned the highest recharge potential while thinner permeable deposits are assigned a recharge potential of II. Moderate recharge potential is assigned to the most heterogeneous permeable deposits, specially ground moraine. Low to lowest potential recharge areas are found where the sediment is relatively impermeable such as till or lacustrine clay, to areas down the hydraulic gradient from the extent of the overburden aquifer, and to presumed aquifer discharge areas represented by wetlands.

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0 0.5 1 2 Miles

0 0.5 1 2 3 4 Kilometers

Contour Interval 20 Feet

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RECHARGE POTENTIAL TO SHALLOW (UNCONFINED OVERBURDEN) AQUIFERS BRANDON, VERMONT

by
David DeSimone
2008