Prepared in cooperation with the Office of the Massachusetts State Geologist

Hydrogeologic Investigation of the West Charlemont Aquifer, Charlemont, Massachusetts

Compiled by Stephen B. Mabee, Brandon Fleming and David Boutt

Prepared for the Franklin Regional Council of Governments

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Cover: View of rafters on the Deerfield River, fall 2006. Taken from Mohawk Trail State Forest.

Executive Summary

The University of Massachusetts Department of Geosciences and Office of the Massachusetts State Geologist were asked by the Franklin Regional Council of Governments to make an assessment of the extent, thickness and hydraulic properties of the West Charlemont aquifer located in valley fill deposits along the Deerfield River in the Town of Charlemont, Massachusetts. Previous work by Gay et al. (1974) mapped these fill deposits as a medium yield aquifer (51 gallons per minute, gpm, to 200 gpm). The purpose of this investigation is to evaluate further the potential of this medium yield aquifer as a viable groundwater resource for the Town of Charlemont.

Results from six new seismic refraction surveys, three new boreholes, analysis of grain size distribution curves and a review of previous borehole logs and geophysical surveys were compiled to build a conceptual 3-dimensional visualization of the aquifer system. These data were used to make a first-order estimate of potential yield.

Bedrock beneath the site forms three distinct basins separated by shallower bedrock highs; an East basin near Legate Hill Road, Middle Basin just west of the Route 2 rest stop and a West Basin west of the confluence of the Cold River with the Deerfield River in Mohawk Trail State Forest. Bedrock ranges from 0 to up to 140 feet below ground. It is deepest in the West Basin. The valley fill deposits that lie over the bedrock are comprised predominantly of fine-grained lake-bottom sands, silts and clays with occasional sands and some gravels that formed in a temporary glacial lake that occupied the valley at the end of the last glacial period. Accordingly, the site lacks extensive areas of highly permeable coarse sands and gravels needed to support high yield water wells.

The expected yield from these lake-bottom sediments is estimated to range from less than 1 gpm to 9 gpm with a median yield of 1-2 gpm. This is sufficient to sustain an individual home but is not suitable for development of a large high-yield water supply. Note that these values are estimates based on limited field data. In order to provide a more detailed and accurate estimate of yield, a comprehensive study of recharge including groundwater flow modeling (not part of this work) must be performed.

Two areas do warrant further investigation because they may contain coarser, more permeable sediments. The first area lies in the West Basin in Mohawk Trail State Forest. There is a deep bedrock valley west of the present course of the Deerfield River that may be filled with coarse sand and gravel that is tied to the ice contact deposits near Pelham Brook. The second area lies at the toe of the ice-contact delta deposits near Patch Brook west of Legate Hill Road. Here there is a relatively thick package of coarse sands at the toe of the delta that may extend part way into the East Basin. Additional work is needed in both these locations to confirm the extent and thickness of these deposits.

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INTRODUCTION

The Department of Geosciences and Office of the Massachusetts State Geologist were asked by the Franklin Regional Council of Governments to make an assessment of the extent, thickness and hydraulic properties of the West Charlemont aquifer. This aquifer is located in bedrock valley fill deposits along the Deerfield River in west Charlemont, Massachusetts.

Purpose and Scope

Previous work by Gay et al. (1974) mapped the fill deposits along the Deerfield River as a medium yield aquifer. This means the aquifer is extensive enough to support estimated yields of between 51 and 200 gallons per minute (gpm). In the interest of identifying and protecting future groundwater supplies, this area has received renewed interest as a potential site for future public water supply development.

The purpose of this investigation is to evaluate further the potential of this medium yield aquifer as a viable groundwater resource for the town of Charlemont. The objectives are to better define the extent and geometry of permeable water-bearing deposits, obtain an estimate of their hydraulic properties and provide an approximation of yield. The scope of work involved the following tasks: 1) compile an inventory of existing wells from various sources and integrate them into a database; 2) perform seismic refraction surveys to determine the depth to bedrock in areas that have no borehole control; 3) install 1 to 3 new boreholes to confirm the nature and thickness of subsurface materials; 4) develop a conceptual model of the geological and deglaciation history and relate this to the distribution of various sedimentary deposits in the valley; 5) perform grain size analyses on sediment samples to estimate hydraulic conductivity of the materials; 6) prepare a conceptual model of the subsurface geology to visualize the 3-dimensional geometry of the materials; and, 7) provide an estimate of yield for the aquifer, if practicable.

This report only seeks to clarify the extent of the aquifer mapped by Gay et al. (1974) and offers a first-order estimate of its yield potential. It does not provide a detailed hydraulic evaluation of the groundwater resource for the town as no pumping test or water quality monitoring was performed. More detailed site-specific analysis will still be required to verify the full potential of this resource for the town.

Location of the Study Area

The west Charlemont aquifer is located in Charlemont, Massachusetts in the Deerfield River basin (Figure 1). The Deerfield watershed is 665 square miles in area. It rises in south central Vermont and flows south into northwestern Massachusetts eventually turning east and draining into the Connecticut River. It is approximately 70 miles in length.

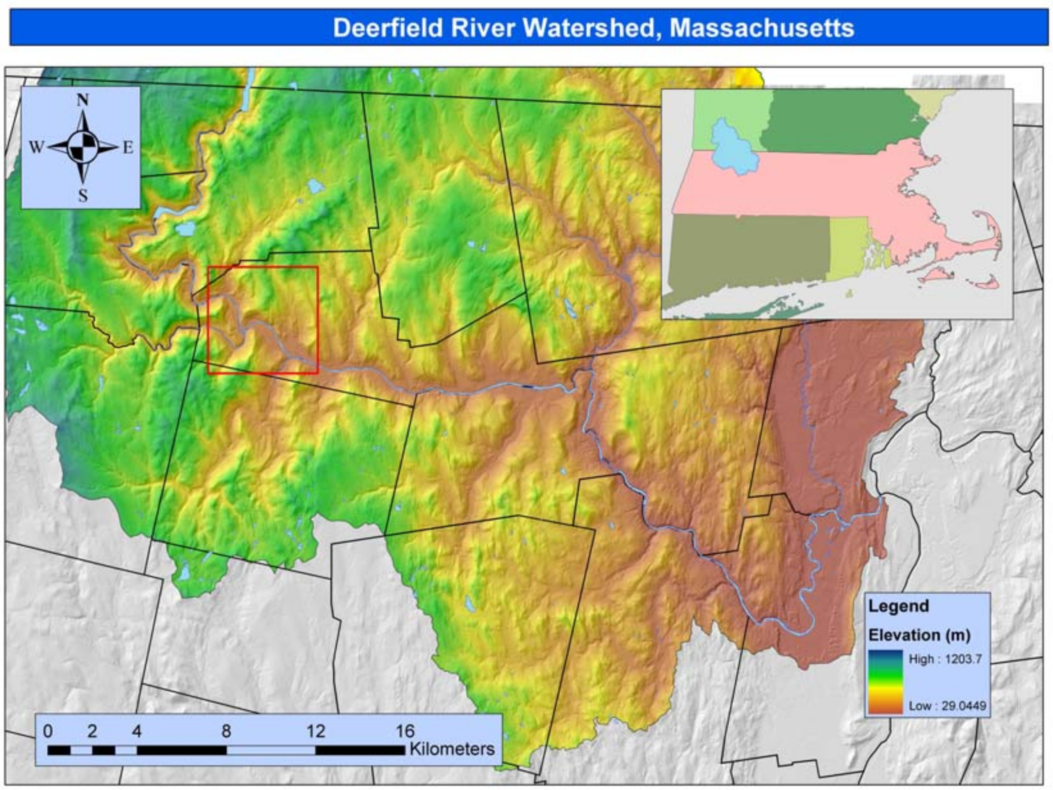


Figure 1. Map of the Deerfield River drainage basin. Red box shows the approximate location of the study area within the watershed.

The aquifer as mapped by Gay et al. (1974) extends from approximately the intersection of Legate Hill Road and Route 2 (Mohawk Trail) westward along the Deerfield River to Zoar near the confluence with Pelham Brook (Figure 2). The estimated area of the aquifer is 310 acres and it is about 0.5 miles across at its widest point.

BACKGROUND

Description of the Study Area

The study area lies in the Berkshires, a relatively high bedrock plateau dissected by narrow stream valleys bordered by steep hill slopes. Average elevation of the surrounding hills is about 1500 to 2000 feet above sea level. The valley floor maintains an elevation of approximately 570 to 630 feet above sea level.

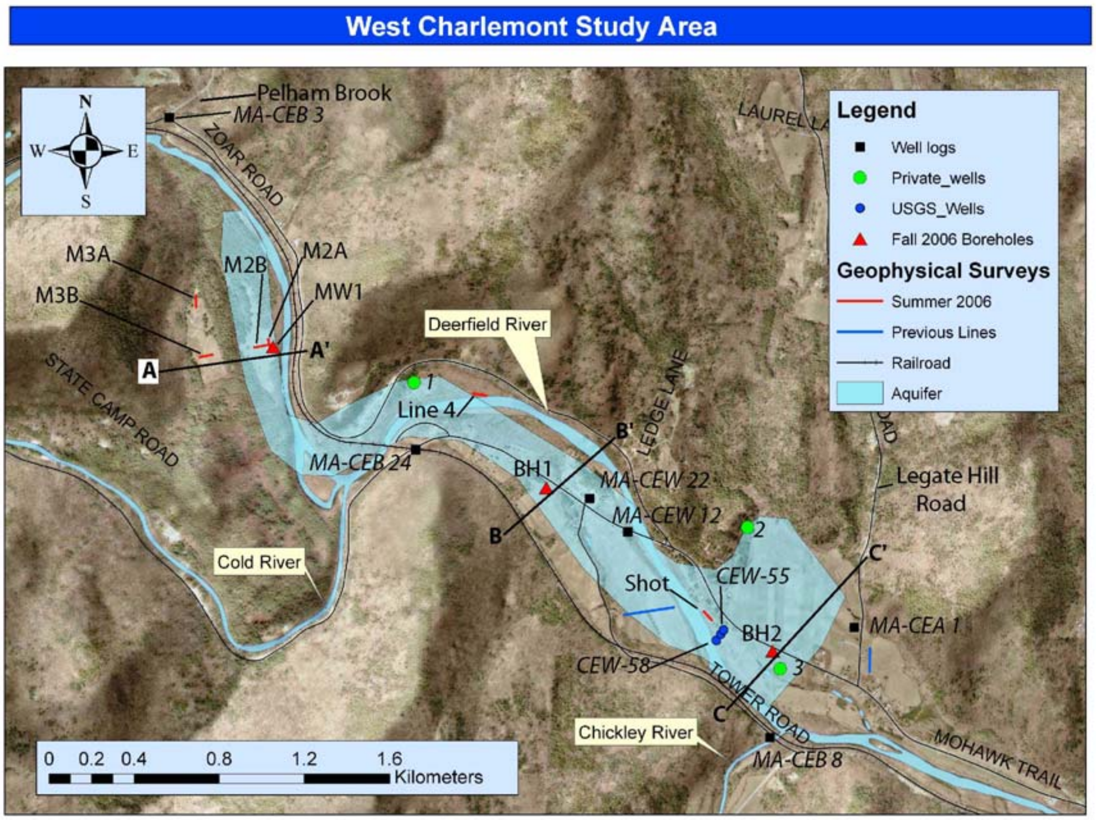


Figure 2. Map showing the approximate location of the aquifer (blue) mapped by Gay et al. (1974). The aquifer shown by Gay et al. (1974) was originally mapped at a scale smaller than 1:24,000 and subsequently digitized by MassGIS. Accordingly, the location of the aquifer may not coincide exactly with the location of valley fill deposits defined in this study. Also shown are the locations of wells and geophysical surveys. Black squares are well logs provided by the USGS (Hansen et al., 1973), green circles are logs from private wells, blue circles are research wells installed by the USGS (Friesz, 1996; have been removed) and red triangles (labeled) are new borings constructed as part of this study. Blue lines are seismic refraction surveys conducted by the USGS (Hansen et al., 1973) and red lines are seismic refraction surveys conducted as part of this study. Black lines with labels show the location of geologic cross sections referred to later in the report.

The Deerfield River is a regulated river and contains several dams used for hydroelectric power generation. Water released from the dams, specifically the Fife Brook Dam, cause daily fluctuations along the Deerfield River of about 1 to 2 feet. Several smaller tributaries discharge into the Deerfield including Legate Hill Brook, Chickley River, Cold River and Pelham Brook.

Geologic Setting

The bedrock underlying the west Charlemont area is metamorphic rock composed of the Moretown and Hawley Formations (Chidester et al., 1967; Zen et al., 1983). The western half of the study area is underlain by the Moretown formation (Figure 3). This is a light-gray-green to buff, fine- to medium-grained schist and granulite (even sized, interlocking granular minerals). The Hawley Formation, a schist and granulite rock interbedded with

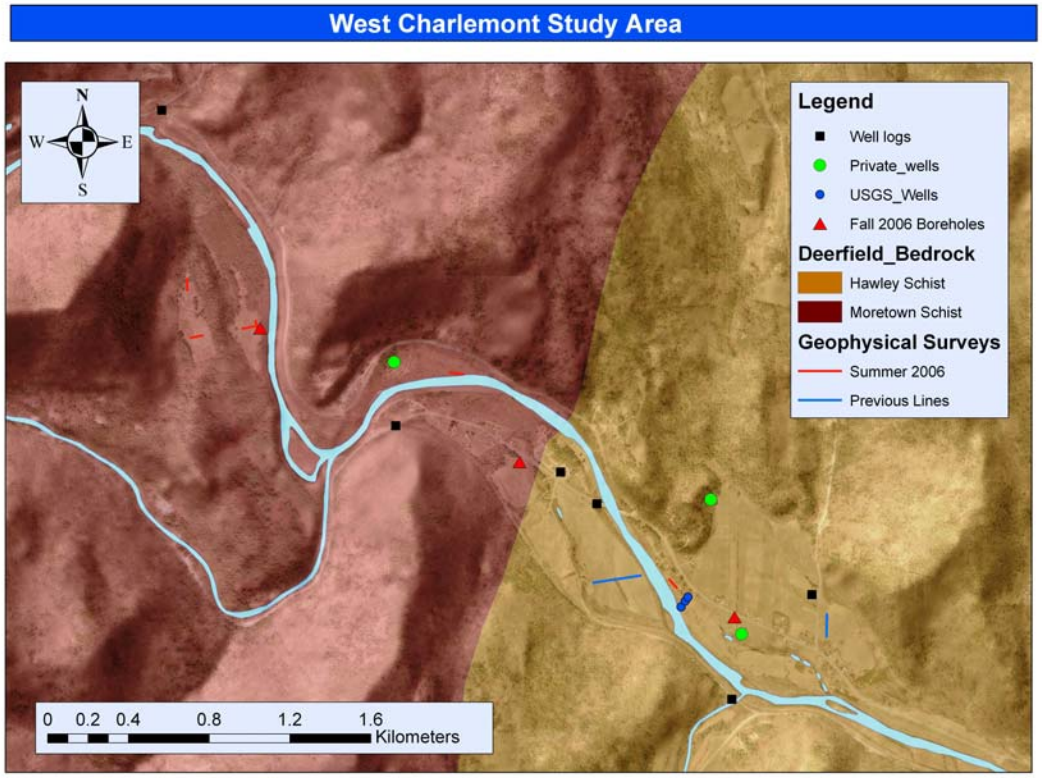


Figure 3. Bedrock geologic map of the study area (modified from Chidester et al.,1967).

darker colored amphibolite, underlies the eastern half. The Moretown formation contains a lens of round, reddish garnets, 2 to 5 mm in diameter, near its contact with the Hawley formation. All of these rocks are strongly foliated, meaning they are layered. The foliation is oriented north northeast and dips steeply to the east at about 70° to 80°.

The median yield of bedrock wells in metamorphic rocks in Massachusetts is 6 gpm (based on 3351 wells)(Hansen and Simcox, 1994). Water in metamorphic rocks is derived primarily from interconnected fractures and is sufficient typically to supply individual homes. Bedrock wells with yields exceeding 100 gpm do occur but are rare.

Sediments in the study area are primarily of glacial origin and consist of glacial till deposited directly by glacial ice and stratified deposits laid down by meltwater streams or in temporary glacial lakes formed during ice retreat. Glacial till is a poorly-sorted homogeneous mixture of boulders, cobbles, gravel, sand, silt and clay that was deposited beneath glacial ice as the ice advanced over the region. It generally forms a thin veneer over the entire landscape, thinner in the hills and thicker in valley bottoms. The till has low hydraulic conductivity and transmits little water so it is not capable of supporting wells with yields in excess of 20 to 40 gpm. However, many older farmhouses throughout Massachusetts relied on dug wells constructed in till as their primary source of water.

Stratified deposits generally consist of well-sorted, layered sediments deposited by glacial meltwater streams. Post-glacial stream terraces and modern floodplain deposits associated with the Deerfield River are also considered stratified deposits even though they were not laid down directly by glacial meltwater.

Stratified deposits can range in texture from coarse sand and gravel to clay depending on the depositional environment. Coarse-grained stratified deposits comprised of sand and gravel are most favorable for the development of high-yield water wells. Well yields ranging from 200 gpm to over 1000 gpm are possible. However, in areas containing thick deposits of clay or silty fine sands, the potential yield is greatly reduced and is unsuitable for the development of water wells with yields in excess of a few gallons per minute.

The bulk of the stratified deposits along the Deerfield River are restricted to the low-lying areas adjacent to the river. Aquifers associated with the coarser-grained, highly transmissive sands and gravels are typically located in areas where deeper and wider valleys were cut into the bedrock and are more or less isolated from one other.

In the west Charlemont area, the bedrock valley contains thick deposits of glacial and post-glacial sediments (Figure 4). The type, distribution and hydraulic characteristics of these sediments are controlled by three factors: the bedrock topography, depositional events and lake levels associated with ice retreat and the post-glacial alluvial processes associated with the Deerfield River.

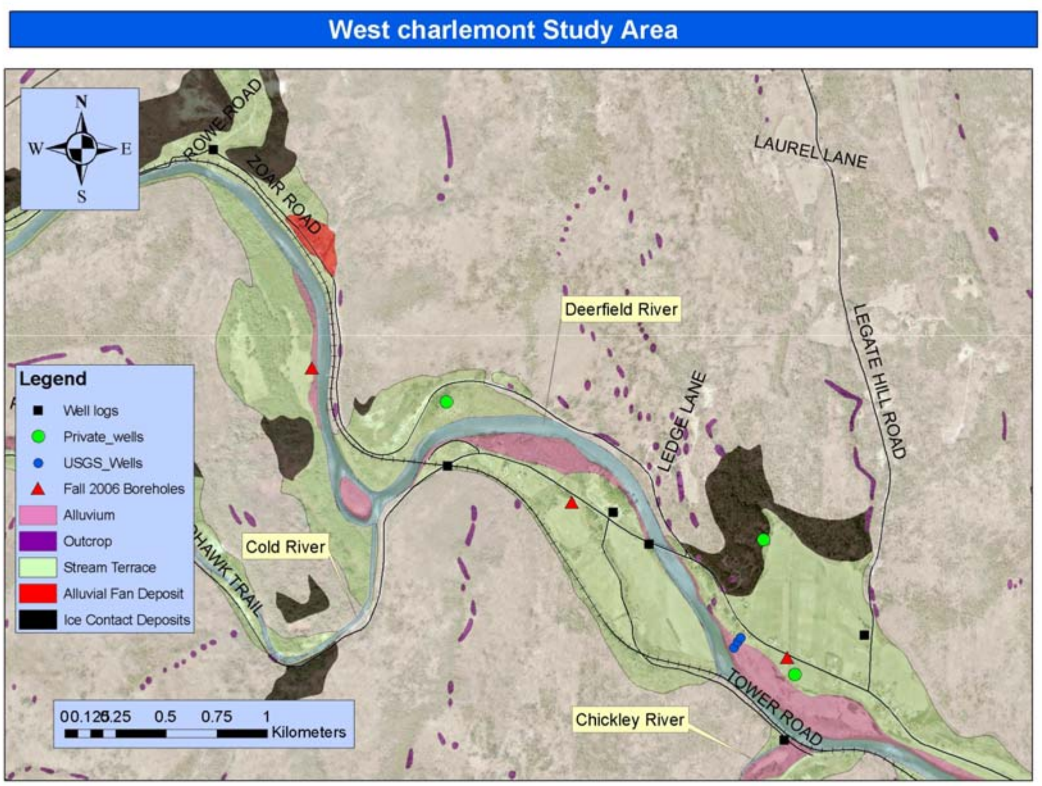


Figure 4. Surficial geologic map of the study area (modified from Chidester et al., 1967).

At the end of the last glacial maximum, the region was under several kilometers (km) of ice. During retreat of the ice the higher elevations and hilltops were exposed first followed later by the valleys. As the ice retreated up the Deerfield River valley, meltwater streams carried sediment out from the ice into the bedrock valley depositing the coarsest materials proximal to the ice margin and finer and finer materials at increasing distances from the ice margin. The coarse materials are often referred to as ice contact deposits and contain boulders, cobbles, pebbles, gravel and sand. They are very permeable and highly productive, if saturated. Several ice contact deposits are found in the study area at Legate Hill and at the confluence of the Deerfield River with Pelham Brook (Figure 4). These deposits are exposed in many of the local gravel pits.

As the ice kept retreating into Vermont, finer sediments were deposited on top of the coarser sediments creating a vertical sequence of materials that becomes finer in an upward direction. Clays and silts do occur at the site below the surface where the valley is wide and deep. These materials are not transmissive and are generally unsuitable for water wells. Clays and silts in this abundance usually correspond to a standing body of water. Therefore, it is likely that a temporary glacial lake occupied the area at some time during ice retreat. In the narrower parts of the valley the sediments are coarser and the fine silts and clays are typically absent.

More recently, alluvial processes driven by the Deerfield River reworked the glacial meltwater sediments forming several floodplain terraces. These terraces formed as the Deerfield River downcut into the meltwater sediments. It is likely that some of the fine-grained silts and clays that may have covered much of the valley floor immediately after deglaciation may have been eroded away during downcutting. At least three terraces are observed in the study area. These deposits are comprised of coarse sands and gravels with abundant subrounded cobbles. They are very conductive and will produce water if thick enough and saturated.

Previous Work

Hansen et al. (1973) prepared a hydrologic data report summarizing streamflow, general chemistry, geophysical and borehole data in the watershed. This formed the basis of a hydrologic atlas for the watershed that first identified the medium yield aquifer in west Charlemont (Gay et al., 1974). Friesz (1996) prepared a geohydrological study of parts of the Deerfield River basin to determine the hydraulic properties of the stratified deposits adjacent to the river, evaluate recharge and determine the thickness of stratified deposits in the Connecticut Valley lowlands. Friesz (1996) showed that the stratified deposits adjacent to the river in west Charlemont are hydraulically linked to the daily changes in stage along the river; an increase in stage on the river produces a concomitant rise in groundwater levels in the adjacent sediments that attenuates with depth and distance from the river. This suggests that water production from any aquifer adjacent to the river may induce infiltration and recharge to the aquifer from the river. Horizontal hydraulic conductivities determined from a groundwater model were 100 ft/day for well-sorted fine sand and medium sand and 25 ft/day for very fine sand with a trace of gravel (Friesz, 1996). In 2004, the Executive Office of Environmental Affairs prepared a

Deerfield River Watershed Assessment Report (EOEA, 2004). This report summarizes the environmental conditions in the basin and identifies key areas of concern and need critical to future watershed planning. Although the EOEA report identifies the west Charlemont aquifer as capable of yielding 100 to 300 gpm, the aquifer was not mapped as such by Gay et al. (1974). Gay et al. (1974) report an expected yield of 51 to 200 gpm.

METHODS

Well Inventory and Existing Subsurface Data

Subsurface information is essential to verify the type and thickness of deposits in the valley. For this project existing borehole information was collected from a variety of sources including Massachusetts Highway Department bridge borings, well completion reports from the Department of Conservation and Recreation and boreholes conducted for research purposes by the U.S. Geological Survey. Hansen (1973) summarized most of the older highway borings and water well data. An informational meeting for this project was held in Charlemont on February 21, 2006. At that time, a request for additional well data was made to homeowners interested in participating in the project. From all these sources, a total of 12 wells were identified in the aquifer area. These wells were located on a map and entered into a Geographic Information System (GIS) database (Figure 2, Appendix A).

In addition, Weston Geophysical performed seismic refraction surveys at two locations in west Charlemont in 1967 and the results included in the hydrologic data report prepared by Hansen et al. (1973). Seismic refraction data is useful for determining the thickness of surficial deposits lying on top of the bedrock. One survey line was completed along Legate Hill Road and a second one was done in a field on the south side of the river opposite the cemetery by the rest stop on Route 2 (Figure 2). The data acquired from these surveys (Hansen et al., 1973) is incorporated into this study.

Geophysical and Borehole Investigations

In an effort to augment existing geophysical and borehole data, six new seismic refraction lines were completed, each approximately 220 feet in length, and three new boreholes constructed (Figure 2). Four seismic refraction lines were run in the Mohawk Trail State Forest, one on the north side of the River off Zoar Road and one near the Route 2 rest stop. The three boreholes were constructed to verify subsurface materials in areas where existing borehole data is sparse. One borehole was located in Mohawk Trail State Park near the river and two along Route 2, one approximately 1 mile west of Legate Hill Road and the other 0.2 miles west of Legate Hill Road (Figure 2). These locations were selected to obtain representative subsurface information from the east, middle and west portions of the study area. Also there was some difficulty in gaining access to some of the preferred sites.

Boreholes were drilled to depths ranging from 76 feet to 90 feet using a driven casing and roller bit technique (Figure 5a). Split spoon samples were taken every 10 feet and stored in jars for subsequent grain size analysis (Figure 5b). Borehole logs are included in Appendix B. Seismic refraction surveys were completed using a 12-channel EG&G seismograph with geophones spaced every 20 feet (Figure 6a). A 20-pound sledge hammer and steel plate or 500 grain black powder blank cartridge detonated with a Betsy seisgun were used for the energy source (Figure 6b). First arrivals of p-waves were analyzed in the lab and used to determine the depth to bedrock and depth to the water table. All seismic refraction data are summarized in Appendix C.

Figure 5b (top). Sample of silty fine to medium sand in split spoon sampler. Samples were transferred to a jar for storage and analysis.

Figure 5a (bottom). Photograph of the drilling operation along Route 2.

Grain Size Analysis

Samples collected from a split spoon sampler were submitted to grain size analysis using standard sieves and Coulter Particle Counter. Data were plotted on cumulative probability plots to show the distribution of different grain size fractions. Grain size curves are provided in Appendix D. Estimates of hydraulic conductivity were determined from grain size curves using several techniques (Mazzaferro et al., 1979; Thomas et al., 1968; Shepherd, 1989) in order to obtain a range of estimates.

Figure 6a (top). Picking the arrivals times of p-waves on the seismograph.

Figure 6b (left). Energy for the seismic refraction method is introduced into the ground by hitting an aluminum plate with a 20-pound sledge hammer.

Aquifer Conceptualization and Visualization

Using available borehole logs, seismic refraction data and an understanding of the deglaciation sequence, a series of structure contour maps were constructed showing the surface contour and extent of each subsurface unit. This information was entered into ESRI ArcGIS 9.2 software so that the surfaces of each unit can be visualized in three dimensions. The software constructs a grid of the tops and bottoms of each subsurface layer and calculates the volume. The volume calculations are used with an estimate of porosity and hydraulic conductivity to approximate aquifer properties and yield. The three-dimensional visualizations of each subsurface unit can also be exported as images.

RESULTS

General Characteristics of the Site

Bedrock beneath the site forms three small basins separated by shallower bedrock highs (Figure 7). The easternmost basin (East Basin) lies under the large field located between the Route 2 rest stop and where the valley narrows east of Legate Hill Road before entering Charlemont center. Bedrock in this basin attains depths of 100 to 120 feet below land surface. The Middle Basin is located between the rest stop and the railroad bridge across the Deerfield River. Depths to bedrock in this basin are as much as 100 feet below land surface. A spine of shallow bedrock extends southeastward from the cemetery at the rest stop across the river and separates the east and middle basins. The bedrock depths at the rest stop area range from zero to about 70 feet below land surface. The deepest basin (West Basin) is located on the west side of the river in Mohawk Trail State Forest (Figure 7). The depths to bedrock in this basin are as much as 140 feet. This may indicate a former channel of the Deerfield River that is much further west than the present channel. This buried bedrock valley may be filled with saturated, permeable deposits.

The valley fill deposits that lie on top of the bedrock can be lumped into seven main units. These include glacial till, which forms a thin veneer, 5 to 10 feet thick, over most of the bedrock in the region, coarse sand and gravel associated with ice contact deposits, localized and limited areas of sand and gravel deposits in the deeper parts of the West Basin, medium sand, silty fine sand and silty clay associated with sediments formed in a temporary glacial lake and cobbly sand and gravel deposited in terraces by the modern-day Deerfield River.

In general, the glacial deposits in the valley show the following trends: a) a fining upward sequence meaning the coarsest sediments are found at the bottom of the valley and become increasingly finer in an upward direction (see borehole logs for BH-1, BH-2, MW-1 in Appendix B); b) the deposits become coarser in an upvalley direction meaning finer deposits of thinly bedded silty clay occur in the eastern third of the study area where the valley is widest and trend towards medium sands towards the west end of the study area where the valley becomes narrower (compare MW-1 with BH-2); c) deposits become coarser along the edges of the valley; fine grained silty clays are absent along the

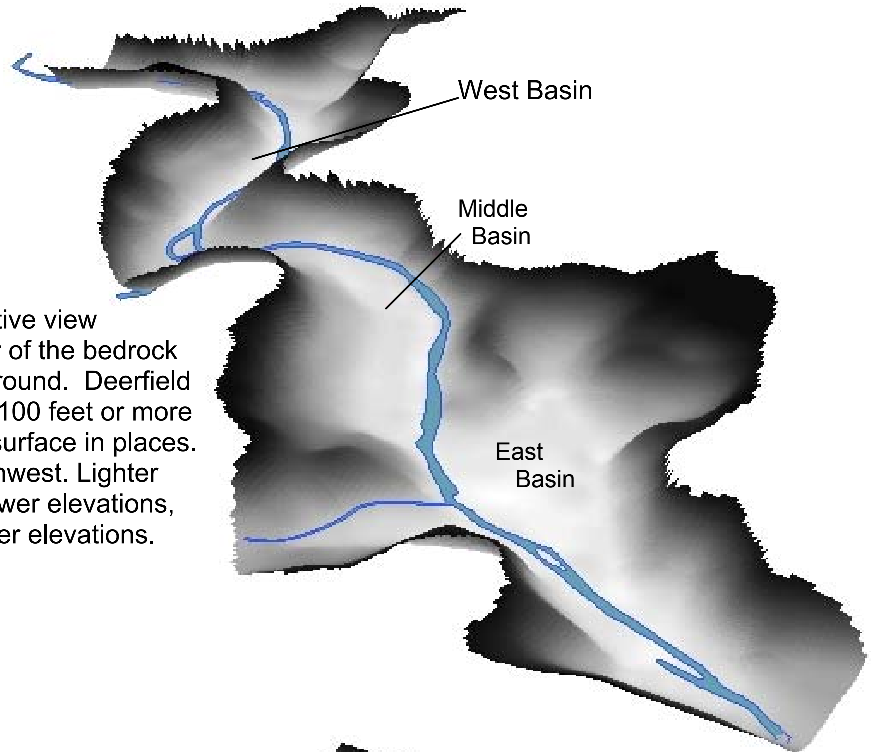


Figure 7a. Perspective view showing the contour of the bedrock surface below the ground. Deerfield River is suspended 100 feet or more above the bedrock surface in places. View is looking northwest. Lighter shading indicates lower elevations, darker shading higher elevations.

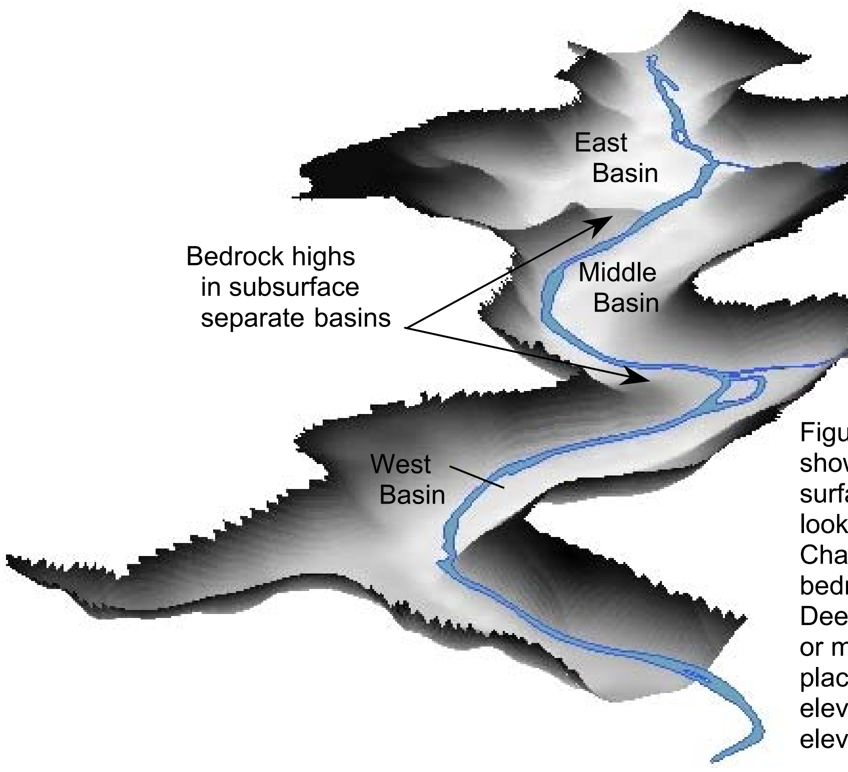


Figure 7b. Perspective view showing the contour of the bedrock surface below the ground. View is looking southeast toward the Charlemont town center. Note bedrock highs separating the basins. Deerfield River is suspended 100 feet or more above the bedrock surface in places. Lighter shading indicates lower elevations, darker shading higher elevations.

margins of the valley and where tributary streams enter the main valley from the sides. Figures 8a-b show schematic cross sections of the arrangement of sediments.

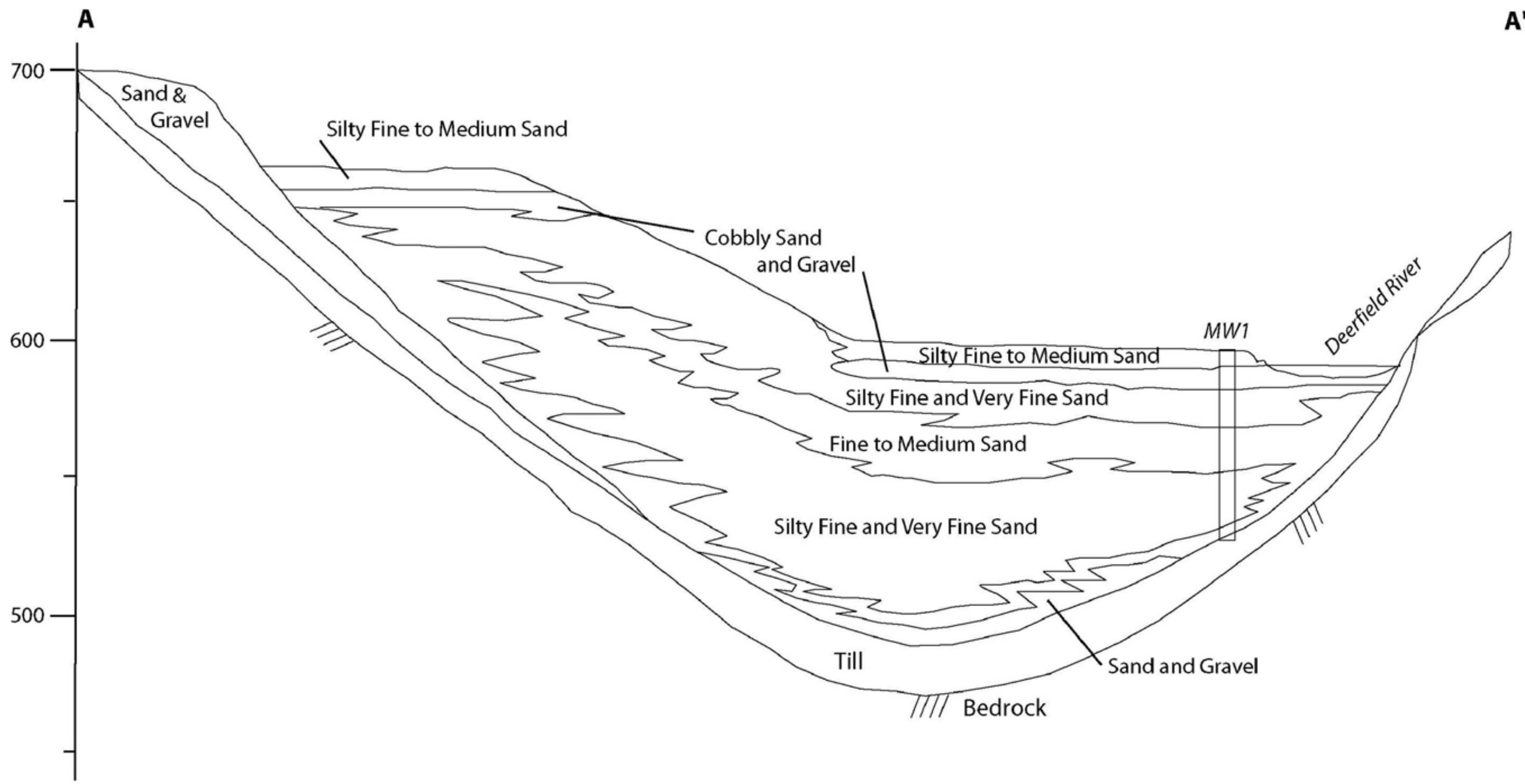


Figure 8a. Generalized cross section (AA') through the west basin showing the arrangement of sediments in the subsurface. Cross section passes through boring MW1. Location of cross section shown on Figure 2. Scale on left is depth below ground in feet. Note the deep basin west of the present position of the Deerfield River. Basin may represent an ancestral route of the river.

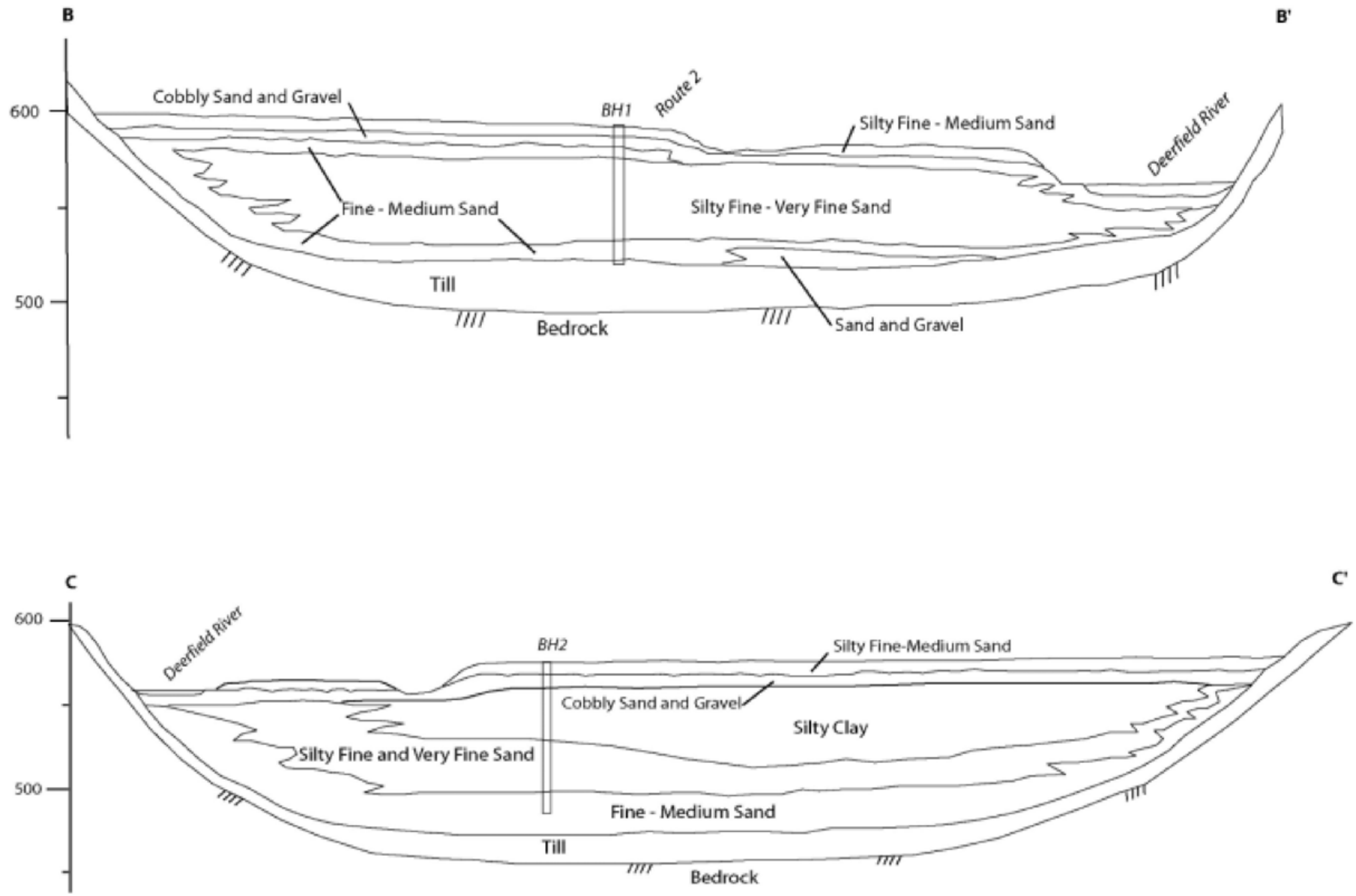


Figure 8b. Generalized cross sections through the middle basin (BB') and the east basin (CC') showing the arrangement of sediments in the subsurface. Location of cross sections shown on Figure 2. Scale on left is depth below ground in feet. Note the thick silty clay unit in cross section CC'. The silty clay unit is absent in cross section BB'.

These general patterns suggest that a temporary glacial lake followed the ice up the valley during ice retreat. The coarser sediments are always deposited first when the ice margin is nearby and are deposited near the edge of the valley where tributaries bring sediment into the lake. As the ice retreats further up the valley, finer and finer sediments are deposited on top of the coarser materials because only the fine silts and clays are carried out into the main body of the lake; the coarser sands can not be carried through the water column. There is not enough water velocity to keep them suspended. Eventually the silts and clays suspended in the lake precipitate out of the water column and are deposited on the lake bottom as thinly bedded silty clay. Borehole BH-2 contains nearly 50 feet of silty clay, one of the split samples at BH-1 showed less than 1 foot of silty clay and no silty clay is observed in MW-1. Clearly these fine deposits suggest the existence of a lake since that is the only environment in which they will form.

Other evidence for a lake is provided in the gravel pit adjacent to Pelham Brook on Rowe Road. The pit shows topset and foreset beds indicating that these ice contact deposits (Figure 4) are part of a glaciofluvial delta. Deltas only form in water bodies. Measuring the altitude of the topset and foreset intersection can approximate the elevation of the lake. It is estimated that lake level was 760 feet. Figure 9 shows a conceptual model of what the Deerfield River valley may have looked like as the ice retreated up the valley about 14,000 years ago.

After the ice left New England and the temporary glacial lake drained, flow in the Deerfield River resumed. The river began to cut into and erode the glacial deposits in the valley forming an erosional unconformity. Each epsiode of downcutting formed a stream terrace. Each terrace is comprised of 10 to 12 feet of alluvium; a cobbly, coarse sand and gravel lag deposit that is overlain by silty sand overbank deposits. The alluvium rests directly on top of the lake-bottom deposits. At least three stream terraces have been notched into the glacial valley fill deposits.

Depositional and Geologic History

The best way to visualize the complexity of the geology at the site is to examine a set of diagrams that demonstrate how the geological landscape evolved (Figure 10a-d). The following describes the geological history of the area.

1. Figure 10a – Approximately 18,000 years ago, glaciers covered the region scouring and deepening the underlying bedrock. The ice left a thin veneer of till on top of the bedrock. The estimated thickness of the till deposits is 5 to 10 feet.
2. Figure 10b – The ice began retreating up the Deerfield valley approximately 17,000 years ago. As the ice receded, a temporary glacial lake followed the ice up the valley. The ice made a temporary halt in its retreat when the ice was located in the vicinity of Patch Brook near Legate Hill Road. An ice contact delta began to form. Cobbly, coarse sand and gravel with occasional boulders was deposited in the delta. Medium to fine sands were carried into the East Basin filling the deeper portions of the basin.

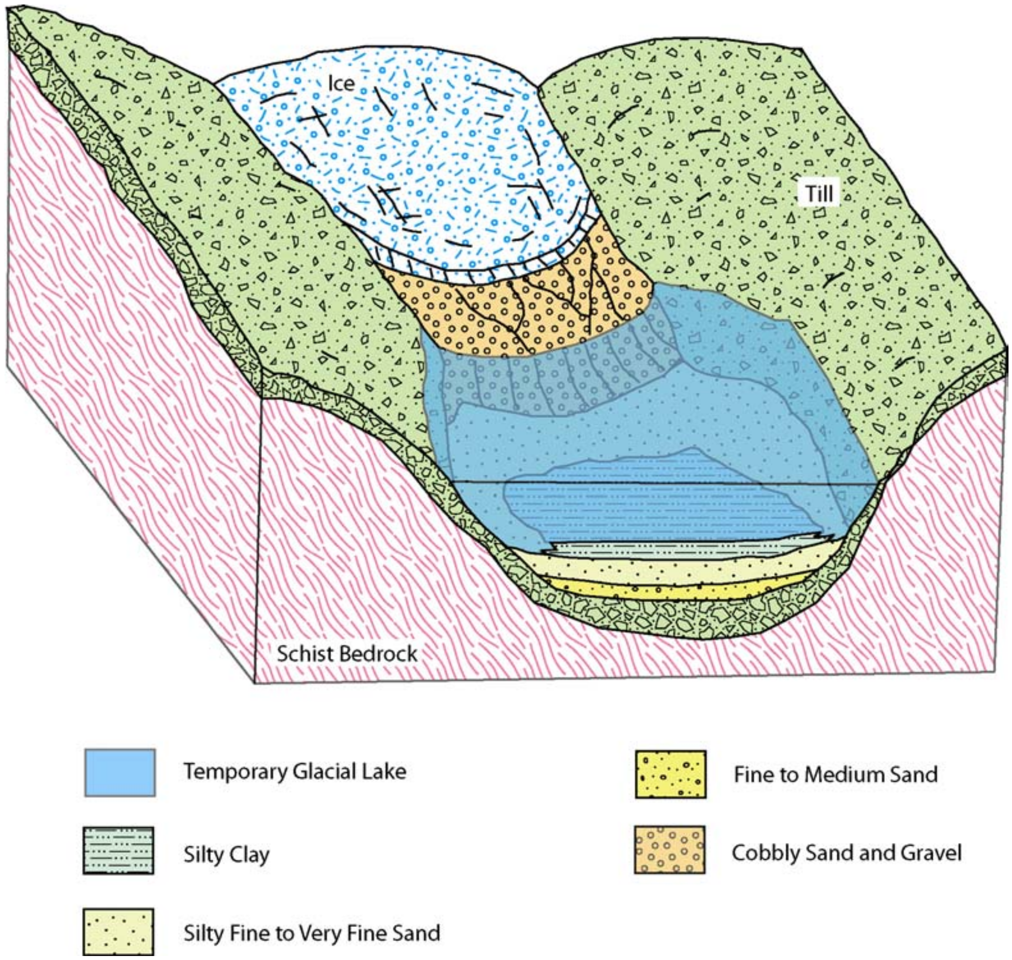


Figure 9. Conceptual block diagram showing how the Deerfield River valley may have looked as the ice retreated up the valley about 14,000 years ago. A glacial lake followed the ice margin up the valley. Coarser material (cobbly sand and gravel and fine to medium sand) were deposited directly on glacial till in the lower portions of the basin and proximal to the ice margin. Note the ice contact delta (cobbly sand and gravel) forming in the lake. Finer lake bottom material (silty fine sand, very fine sand and silty clay) were deposited farther away from the ice margin in the deeper, quieter parts of the lake basin.

3. Figure 10c – The ice continued to retreat up the valley halting again for a short while at the position of the ice contact delta at the confluence of the Deerfield River and Pelham Brook. Lake level was about 760 feet. Cobbly, coarse sand and gravel with occasional boulders was deposited in the delta. Coarse, medium and fine sands were carried into the West Basin (coarsest materials deposited proximal to the delta and finer materials deposited with increasing distance from the delta) and very fine sand deposited in the Middle Basin. In the East Basin, the lake was quiet enough to allow the silts and clays held in suspension to settle out on the bottom of the lake over the coarser sediments.

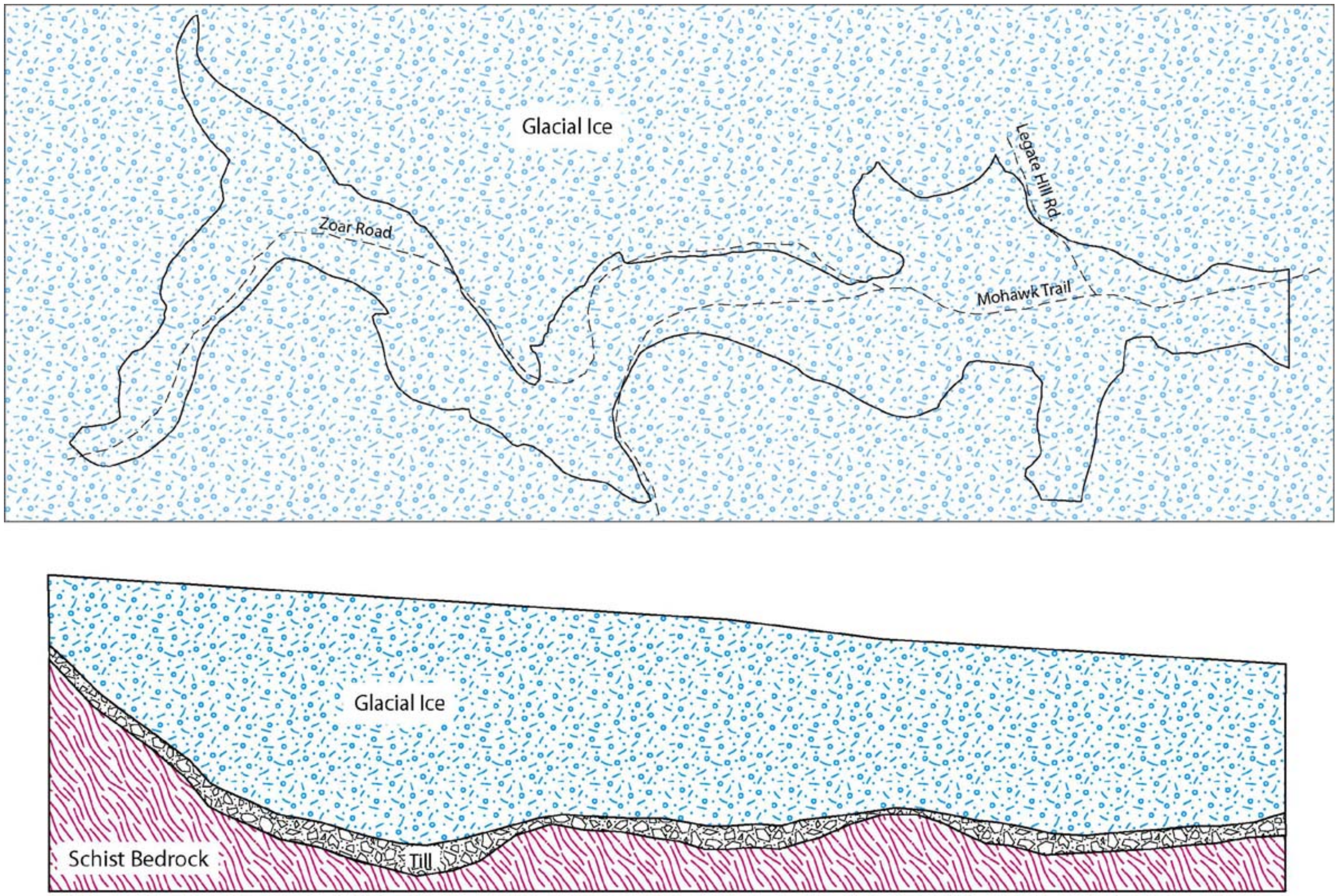


Figure 10a. Study area about 18,000 years ago. Area was completely covered by ice and a thin layer of till, 5 to 10 feet thick, was deposited over the landscape. Upper figure is a plan view with the study area outlined in black. Lower figure is a longitudinal profile or cross section transiting from left to right down the axis of the Deerfield River valley.

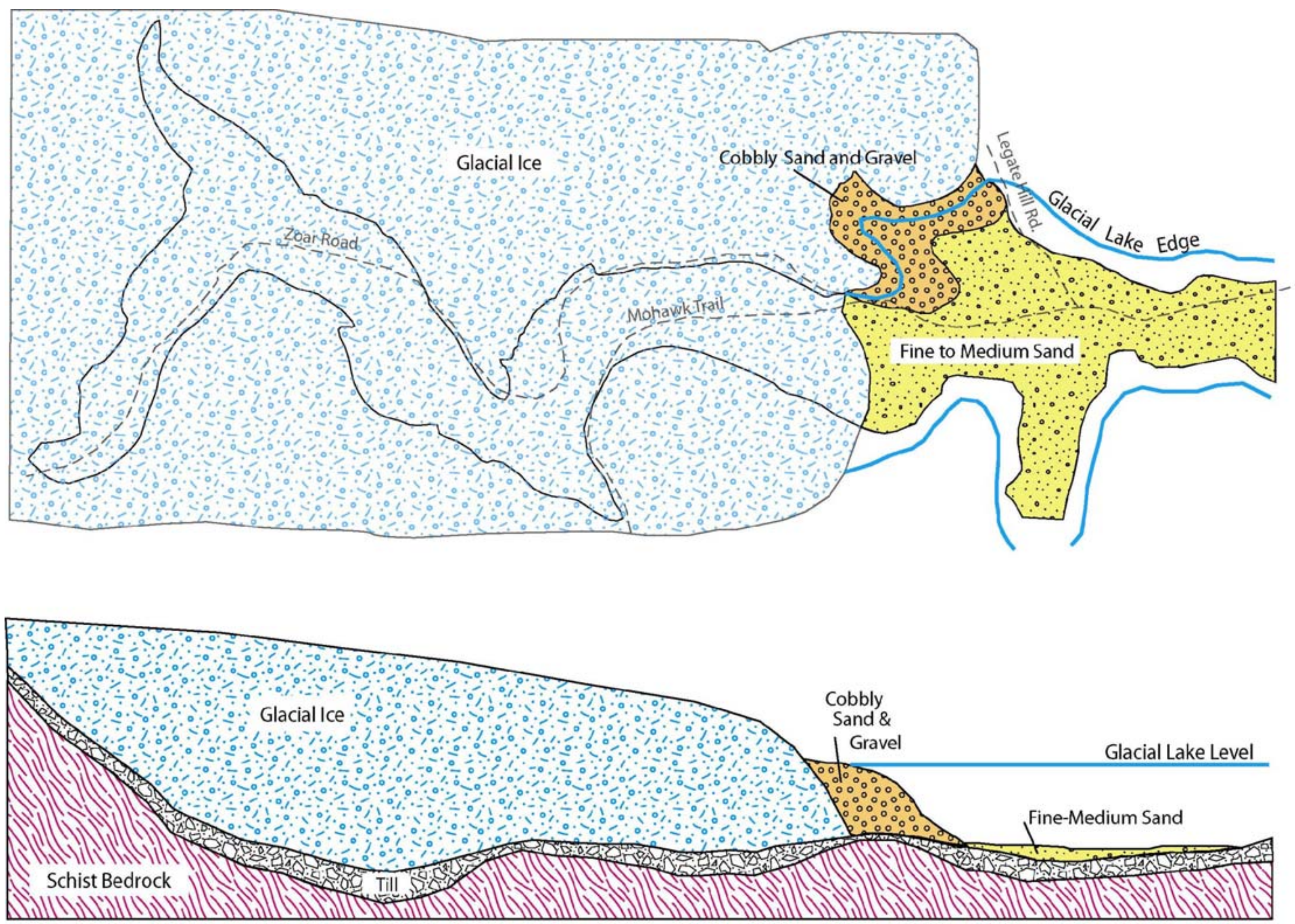


Figure 10b. Study area about 17,000 years ago. The ice was beginning to retreat up the valley and made a temporary stand in the vicinity of Patch Brook near Legate Hill Road. A small delta began to form in the temporary glacial lake depositing sediments in the lake basin. Upper figure is a plan view with the study area outlined in black. Lower figure is a longitudinal profile or cross section transiting from left to right down the axis of the Deerfield River valley.

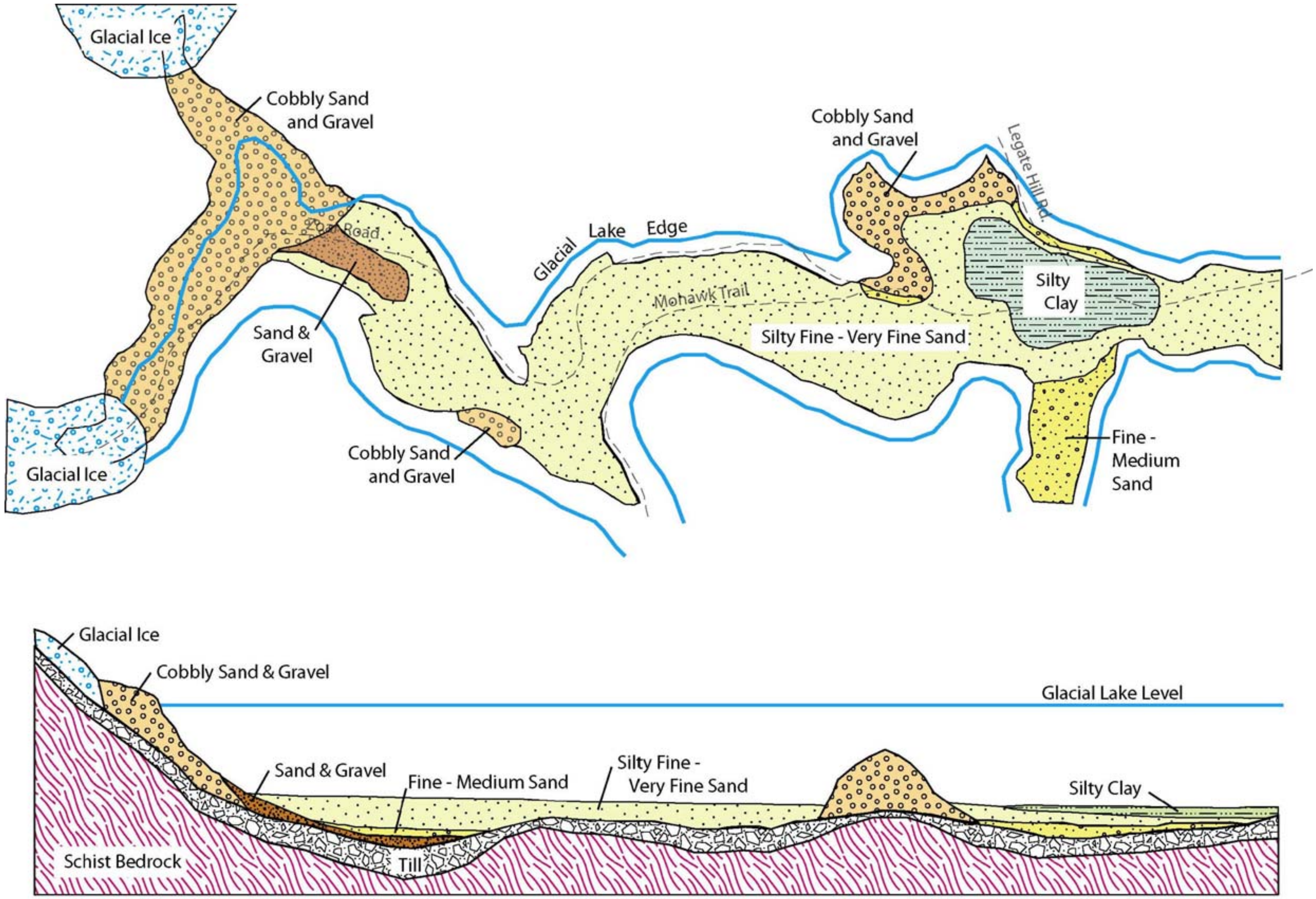


Figure 10c. The retreating ice made another still stand at the western end of the study area where Pelham Brook joins the Deerfield River. A large ice contact delta filled the valley. Coarse sand and gravel was deposited in portions of the basin nearest the ice margin and then became increasingly finer proceeding down valley with silty clay being deposited in the the easternmost basin. Upper figure is a plan view with the study area outlined in black. Lower figure is a longitudinal profile or cross section transiting from left to right down the axis of the Deerfield River valley.

4. Figure 10d – At some point the lake drains and the modern-day Deerfield River begins to erode the basin fill sediments. The river meanders forming flat terraces on either side of the valley. As the river continues to downcut, younger terraces are cut into the sediments eventually forming at least three preserved stream terraces plus the modern floodplain observed today.

Extent and Thickness of Meltwater Deposits

Based on the depositional and geologic history described above, seven stratigraphic units are defined in the basin with distinct spatial distributions and hydraulic properties. Table 1 summarizes the stratigraphic unit, geologic interpretation, and approximate volume (cubic feet). Units shaded in gray are units that have significant saturated thickness and are permeable enough to deliver economic amounts of water. Figure 11 shows the approximate extent of each unit.

Hydraulic Properties of Sediments

The hydraulic properties of the sediments were estimated from the grain size analyses presented in Appendix D. Table 2 summarizes key statistics from these curves. Grain size curves from interpreted units were collapsed onto single plots for ease in interpretation. From these plots an average d_{10} (defined as the sieve size that allows 10

Table 1. Estimated Volume and Porosity of Stratigraphic Units

Unit	Interpretation	Volume (ft^3)	Porosity	% Saturated	Water Stored (ft^3)	Exploitable Water
Cobbly Sand and Gravel	Modern Day Alluvium	1.4E+09	0.35	10	5.07E+07	no
Silty Clay	Lake Bottom Fines	5.9E+07	0.4	100	2.38E+07	no
Silty Fine Sand	Lake Bottom Fine Sands	8.6E+08	0.3	100	2.59E+08	yes
Medium Sand	Lake Bottom Sands, Proximal to Ice	1.3E+08	0.25	100	3.23E+07	yes
Coarse Sand	Lake Bottom Sands, Proximal to Ice	4.4E+07	0.25	100	1.09E+07	yes
Coarse Sand and Gravel	Ice Contact Deposits	6.9E+08	0.25	0	0.00E+00	no
Till	Ground Moraine	9.7E+08	0.3	90	2.62E+08	no

percent of soil mass to pass), d_{60}, and C_u (coefficient of uniformity) were determined. High values of C_u indicate poorly sorted sediments (means the sample contains a mixture of different sizes) whereas low values indicate well-sorted materials (sample dominated by one grain size). The very fine sand and medium sand units were fairly well sorted.

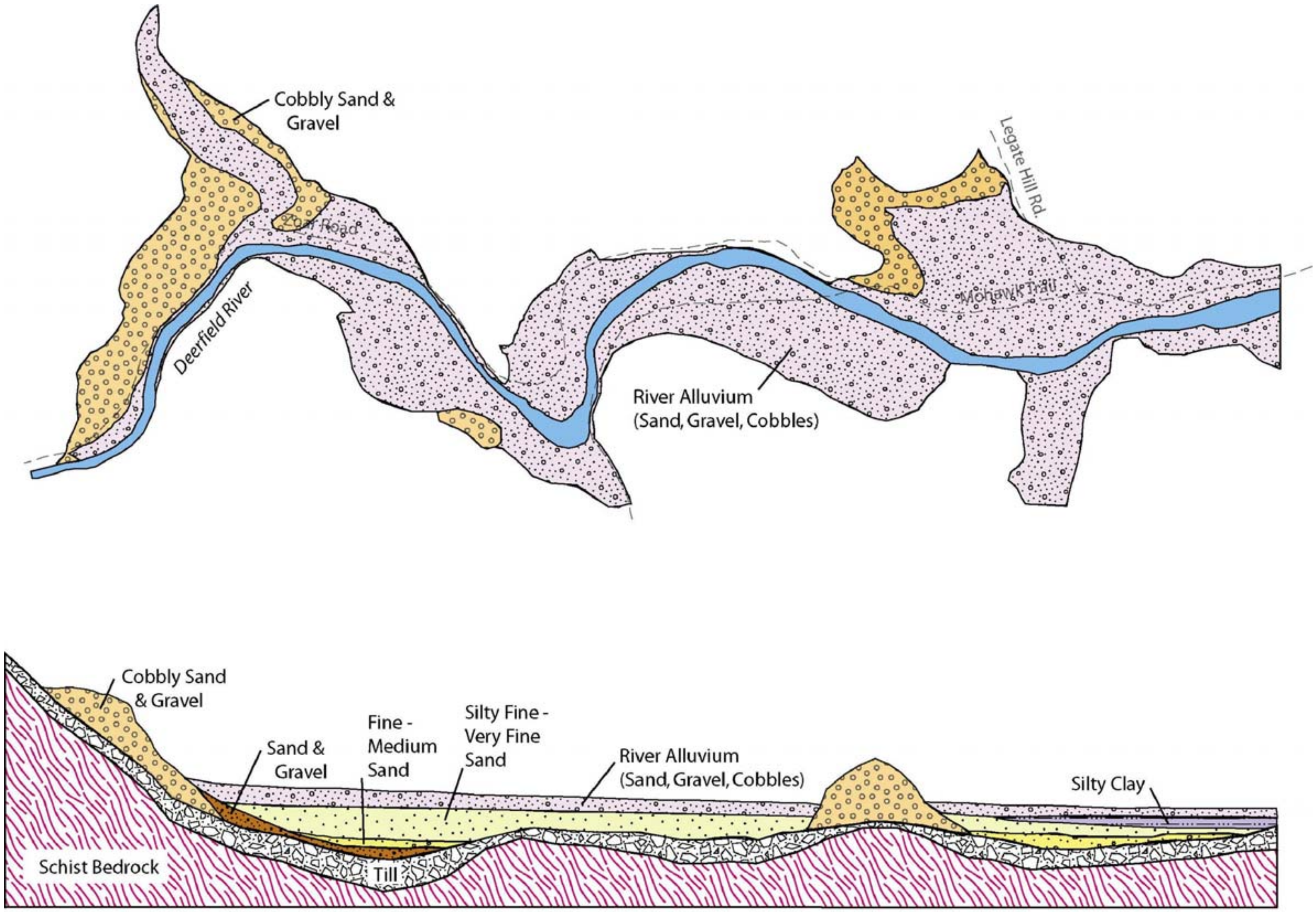


Figure 10d. After the ice disappeared, the modern-day Deerfield River began downcutting through the delta and glacial lake bottom deposits that filled the valley. The river cut into the glacial valley fill deposits leaving evidence of at least three river terraces. Upper figure is a plan view with the study area outlined in black. Lower figure is a longitudinal profile or cross section transiting from left to right down the axis of the Deerfield River valley.

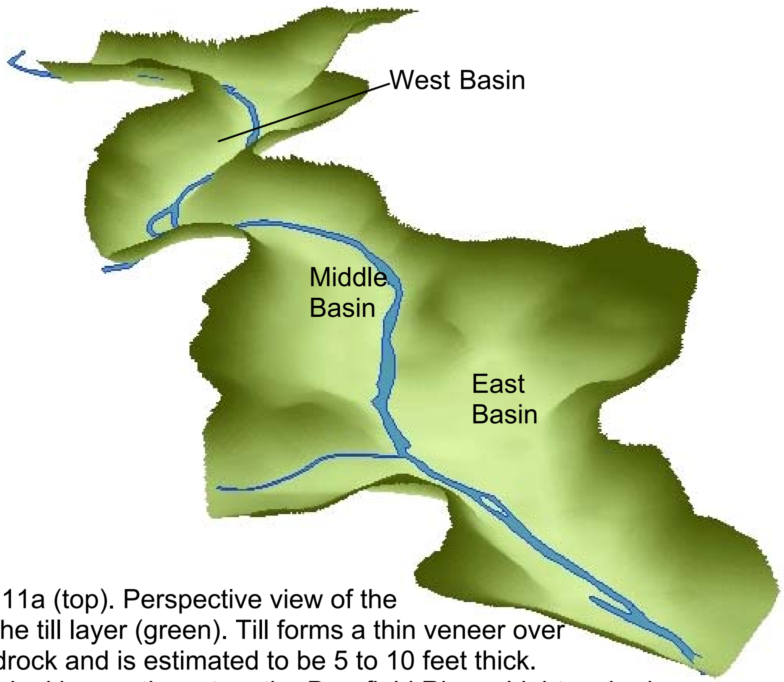
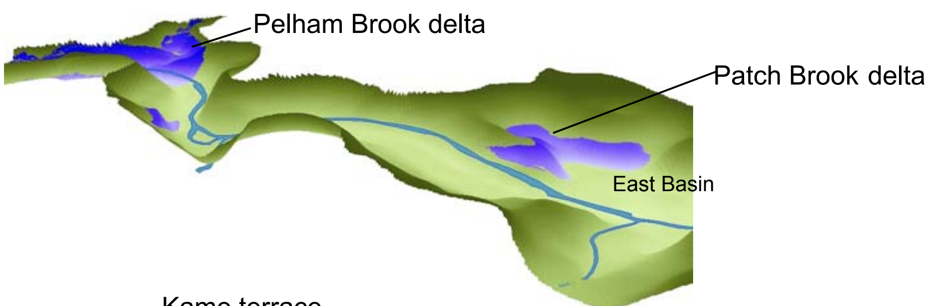


Figure 11a (top). Perspective view of the top of the till layer (green). Till forms a thin veneer over the bedrock and is estimated to be 5 to 10 feet thick. View is looking northwest up the Deerfield River. Lighter shades indicate lower elevations, darker shades higher elevations. Deerfield River shown for reference.



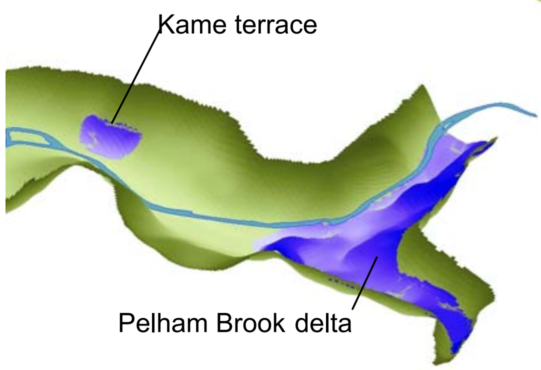


Figure 11b (left). Two views showing the extent of the cobbly sand and gravel sediments associated with ice contact deposits (purple). Upper figure shows the two ice-contact deltas, one at Patch Brook and the other to the west near Pelham Brook. Lower figure shows the Pelham Brook delta in more detail.

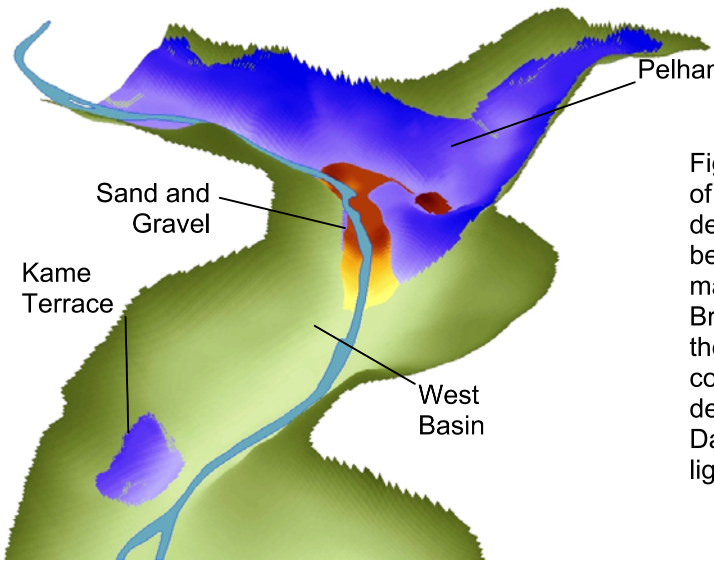


Figure 11c (left). A perspective view of the distribution of coarse sand deposits. Some minor gravel may also be present. A tongue of this material may extend partially from the Pelham Brook delta into the deeper portions of the west basin. Large extensive areas of coarse, highly permeable sand and gravel deposits are limited in the study area. Darker shades indicate higher elevations, lighter shades lower elevations.

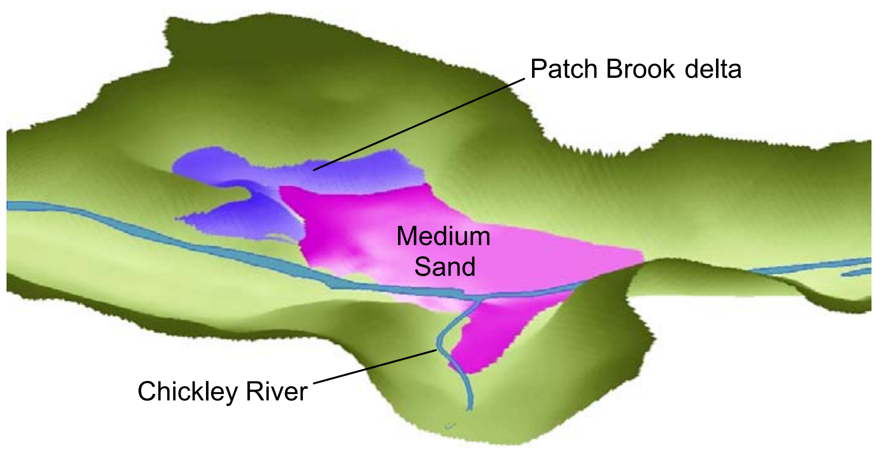


Figure 11d. A layer of medium sand (red) occurs in the east basin near Legate Hill Road. It is draped over the till (green) and laps up on to the toe of the delta (purple).

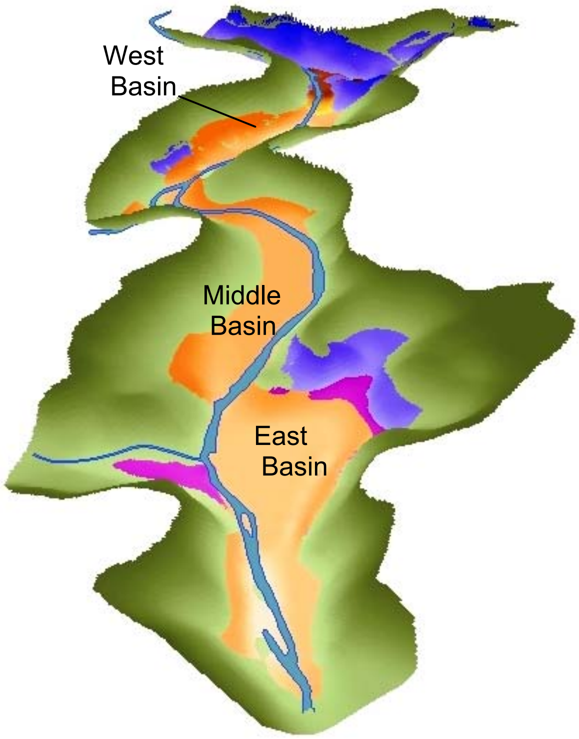


Figure 11e (left). The most dominant deposit is lake bottom fines consisting of fine sand and silty fine sand with a trace to a little medium sand (orange). This unit is extensive and has variable amounts of sand silt and often a trace of clay. It is several tens of feet thick in places and is not a very productive aquifer. Lighter shades indicate lower elevations, darker shades higher elevations.

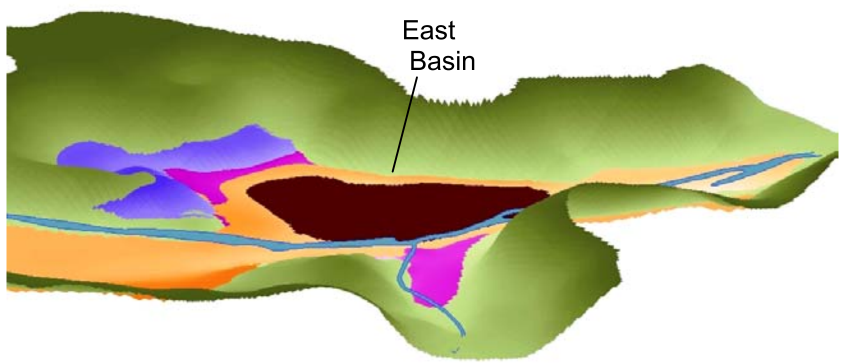


Figure 11f. In the east basin a layer of silty clay (dark brown) lies above the sandy lake bottom deposits (medium sand and silty fine sand). In places the silty clay is greater than 50 feet thick.

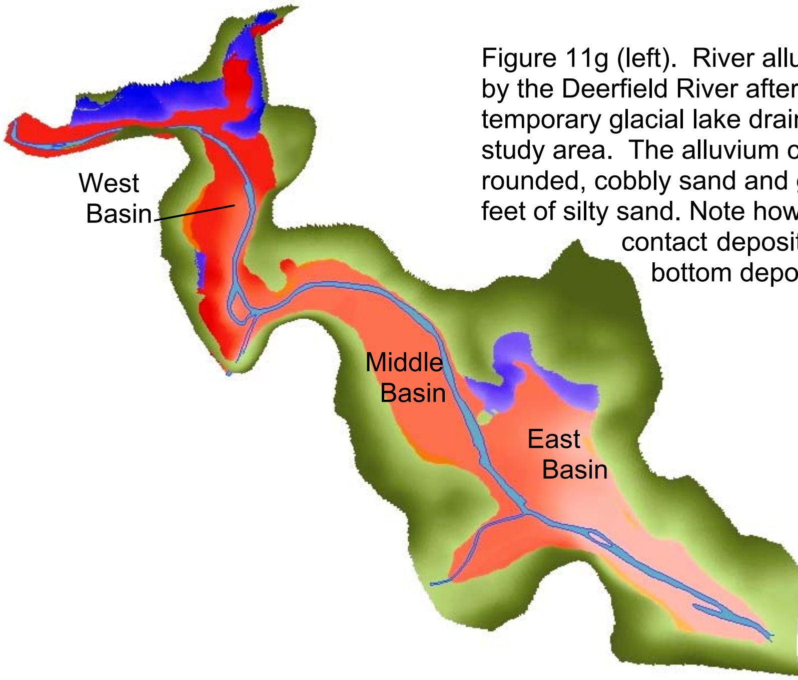


Figure 11g (left). River alluvium (red) deposited by the Deerfield River after the glaciers left and the temporary glacial lake drained covers most of the study area. The alluvium consists of 5 to 7 feet of rounded, cobbly sand and gravel overlain by 5 to 7 feet of silty sand. Note how the unit buries the ice contact deposits (purple) and all the lake bottom deposits (see Figure 11e and f).

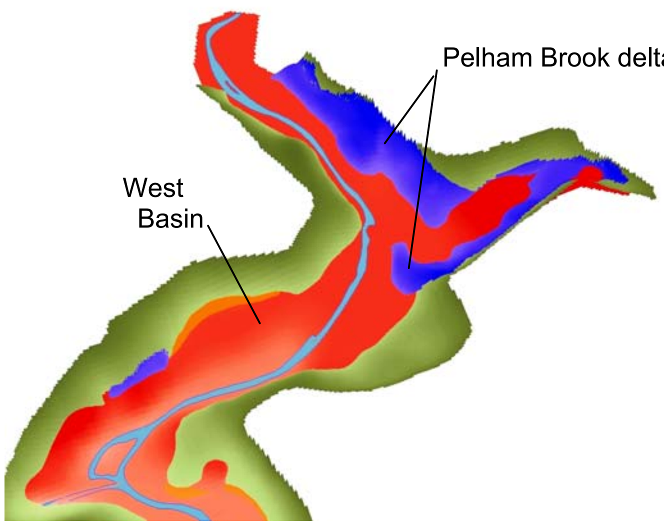


Figure 11h. Close up view of the west basin showing the distribution of river alluvium. Note how it partially buries the ice contact deposits and lake bottom deposits (compare with Figures 11c-f).

Hydraulic conductivities estimated from these statistics are presented in Table 2. Medium and coarse sand had the highest permeability of the saturated units and are similar in magnitude because of the difference in sorting between these units. The very fine sand unit was about an order magnitude lower and on the higher end of its range for this material because of the well-sorted nature of the lake bottom fines. It should be noted that these values are first-order estimates and should be treated as such. Dedicated aquifer tests or permeametry studies should be used to provide a more reliable estimate of hydraulic conductivity for use in more detailed water supply investigations. Friesz (1996) reports similar values for the medium sand (100 ft/day) and well-sorted very fine sand (20 ft/day) in his study of large-scale aquifer response to stream stage changes.

Table 2. Summary of sediment properties determined from grain size analyses. Hydraulic conductivities of gray units were approximated from [1]Thomas and others (1968), Mazzaferro et al (1979), [2]Shepard (1989)

Unit	d_{10} (mm)	d_{60} (mm)	C_u (-)	d_{50} (mm)	K (ft/day)[1]	K (ft/day)[2]
Alluvium	0.042	2	48	3	N/A	N/A
Lake Bottom Fines -Silty Clay	0.0025	0.02	8	0.02	N/A	N/A
Lake Bottom Fines - Very Fine Sand	0.02	0.07	4	0.09	7	2
Lake Bottom - Medium Sand	0.05	0.15	3	0.2	99	10
Lake Bottom - Coarse Sand	0.042	1	24	0.8	93	70
Ice-Contact	N/A	N/A	N/A	N/A	N/A	N/A
Till	0.042	0.8	19	0.8	N/A	N/A

Yield Potential of Aquifer

Hydraulic conductivity values calculated above were used to estimate the natural flow through cross-sections in the East, Middle, and West Basins (Figure 8). The cross-sectional area of the units at each cross-section location was estimated from the 3-dimensional aquifer visualization produced for the study. Flow in cubic feet per day was estimated using Darcy's law, the estimates of hydraulic conductivity (Table 2), area of each cross section, and assuming a hydraulic gradient normal to the plane of cross-section equal in magnitude to the gradient of the Deerfield River. This gradient is approximately 28 feet per mile or 0.005 feet per foot. Lacking detailed hydraulic head measurements in the aquifer, it is expected that the river gradient is a reasonable estimate of the gradient in the aquifer. Water levels were observed to be approximately 15 feet below ground.

These flows are presented in Table 3 for each cross-section. The highest natural flows in the aquifer are in the West Basin as it has a larger saturated thickness and higher hydraulic conductivity in the coarse sand. The East Basin has the largest volume of fine sediment of all the basins but it also has a larger cross-sectional area compared to the Middle Basin resulting in slightly larger flows. The amount of water flowing through each cross section under natural conditions (non-pumping conditions) using conservative assumptions is very low and ranges from 800 ft^3/day (4 gpm) to 18,000 ft^3/day (93 gpm). The median yield is approximately 2400 ft^3/day or 12 gpm.

Table 3. Yield calculations of the West Charlemont unconsolidated deposits at cross-sections in the East, Middle, and West Basin.

Unit	Area (ft^2)	K (ft/day)	Flow Through Cross Section[1] (ft^3/day)	Yield at 10% of Natural Flow (ft^3/day)
East Basin				
Medium Sand	22500	50	5600	560
Silty Fine Sand	56250	5	1400	140
Middle Basin				
Medium Sand	13475	50	3400	340
Silty Fine Sand	53900	5	1300	130
West Basin				
Coarse Sand	45150	80	18000	1800
Silty Fine Sand	30100	5	800	80

It should be noted that the above flows are natural yields and are not the same as exploitable yields or the amount of water that can be safely extracted from the aquifer. That number is substantially less and represents some percentage of the natural flow. We feel that a reasonable estimate of the yieldable quanitity of water is 10% of the natural flow. This percentage was selected for the following reasons: 1) the saturated thickness of the deposits is very limited indicating that drawdown of the water table must be kept to a minimum under pumping conditions; 2) the aquifer is very strongly connected to the river and any water removed from the aquifer will most likely result in induced infiltration of water from the stream or reduction in stream base-flow depending on season and hydrologic conditions; therefore, gradients must be minimized to reduce the propensity for induced infiltration; and, 3) this value does not exceed natural recharge. Based on a yield at 10% of natural flow the yieldable quantity of water ranges from 80 ft^3/day (0.4 gpm) to 1800 ft^3/day (9 gpm). Median yield is 240 ft^3/day or 1-2 gpm. This is sufficient to sustain an individual home but is not suitable for development of a large water supply. Note that these results are estimates based on limited field data. In order to provide a more detailed and accurate estimate of yield, a comprehensive study of recharge including groundwater flow modeling must be performed.

Potential Areas Requiring Additional Study

Based on the results there are two areas that warrant possible further investigation (Figure 12). The first area lies in the West Basin in Mohawk Trail State Forest. There is a deep bedrock valley west of the present course of the Deerfield that may be filled with coarse sand and gravel that is tied to the ice contact delta near Pelham Brook (Figure 12). Further work is needed to confirm the existence of this deposit.

The second area lies at the toe of the Patch Brook ice-contact delta deposits (Figure 12). Here there is a relatively thick package of coarse sands at the toe of the delta that may

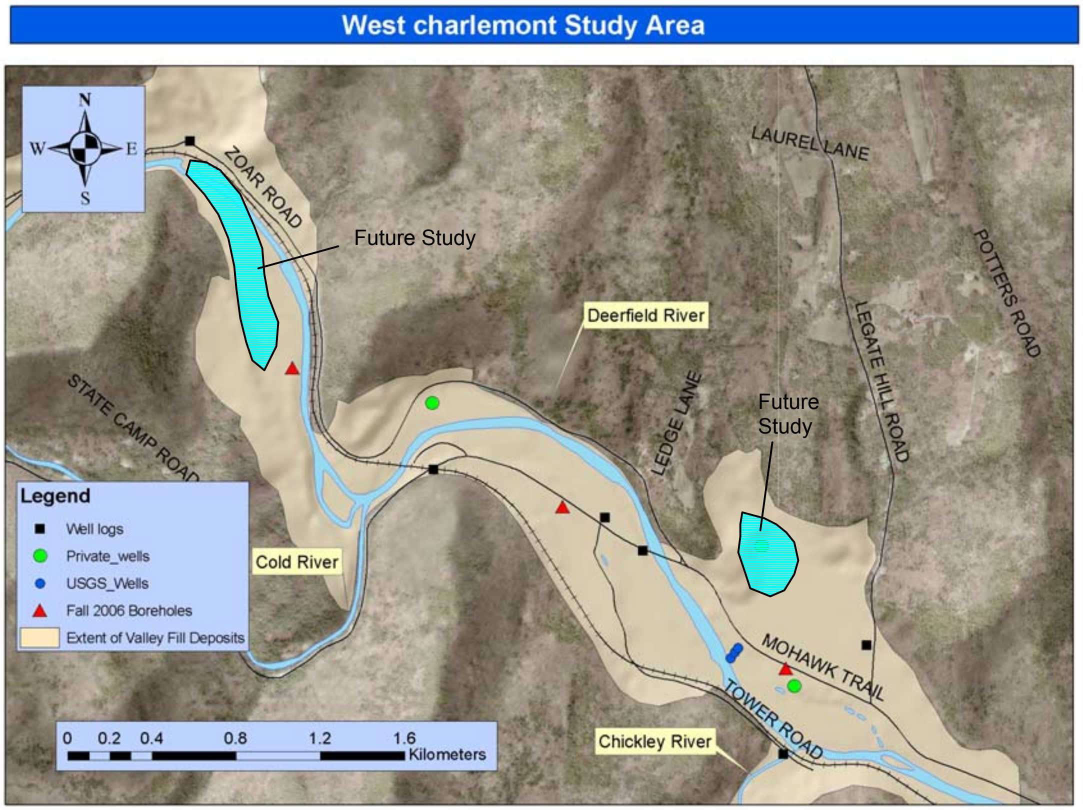


Figure 12. Map showing a more accurate delineation of the extent of the valley fill deposits in the west Charlemont region. Also shown are two areas (blue) that warrant possible future investigation to determine the extent of any sand and gravel deposits and their yield potential.

extend part way into the East Basin. The coarse sands are overlain by medium sands and are recharged to the west from the coarse-grained delta deposits. Additional work is needed to confirm the extent and thickness of these deposits.

Figure 12 also shows a more accurate delineation of the extent of the valley fill deposits in the west Charlemont region.

CONCLUSIONS AND RECOMMENDATIONS

Based on a review of existing conditions at the site the following conclusions and recommendations are offered:

1. The subsurface stratigraphy at the site is complex and consists generally of various glaciofluvial and glaciolacustrine (lake deposits) materials deposited in a deep bedrock valley capped by a thin veneer of post-glacial river alluvium deposited by the Deerfield River.

2. The grain size of the glacial sediments varies considerably across the site. In general, the finer grained silty clays are thickest in the far eastern part of the study area and the sediments tend to coarsen to fine to medium sands from east to west, toward the valley sides and with increasing depth.

3. The materials can be lumped into seven main types. From oldest to youngest, these include glacial till deposited over the entire landscape during ice advance, coarse sand and gravel associated with ice contact deposits, coarse sand and some gravel immediately downgradient of the ice contact deposits, fine to medium sand found in the deepest portions of the bedrock basins, along the margins of the valley and where tributary streams enter the valley, silty fine sands found in the middle portions of the basins, silty clay found in the easternmost basin near Legate Hill Road, and cobbly sand and gravel associated with modern-day river alluvium.

4. Bedrock is anywhere from 0 feet to 140 feet deep and forms three basins. The deepest basin, West Basin (140 feet), is located in Mohawk Trail State Forest. The Middle Basin lies between the railroad bridge across the Deerfield River and the Route 2 rest stop. The East Basin is located between the Route 2 rest stop and a point just east of Legate Hill Road.

5. The medium sands and coarse sands (with some gravel) are the only deposits found that may be suitable for development of a higher yielding well. However, their extent is limited to the East and West Basins, respectively, and may have limited saturated thickness to be of much use as a water supply. Further study may be warranted.

6. Potential yields of the valley fill deposits are very low ranging from 0.4 gpm to 9 gpm, with a median yield of 1-2 gpm. Any further evaluation of potential yield will require an evaluation of areal recharge and the construction of a three-dimensional groundwater flow model. The work done in this study does provide the foundation for a groundwater flow model.

7. Two areas are recommended for further investigation to determine their potential as possible sites for water supply development; the deep bedrock valley in the West Basin and the toe of the Patch Brook delta in the East Basin just west of Legate Hill Road.

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APPENDIX A

WELL DATABASE

Wells from Friesz (1996)

Station Name	Total Depth	From	To	Material Type	Color
MA-CEW 55	29	2	10	Sand, Gravel, cobbles…	
MA-CEW 55		10	12	Medium Sand, trace fine sand, coarse sand, fine pebbles	Light brown
MA-CEW 55		20	22	Fine sand, some pebbles	Light brown
MA-CEW 55		27	29	Very fine sand, some pebbles	Light grey-brown
MA-CEW 56	58	37	39	Very fine sand, some pebbles	Light grey-brown
MA-CEW 56		47	49	Fine sand, some silt	Light grey
MA-CEW 56		56	58	Very fine sand, trace pebbles	Light grey
MA-CEW 58	40.5	2	8.5	Sand, Gravel, cobbles…	
MA-CEW 58		8.5	10.5	Fine sand, trace medum sand to fine pebbles	Light brown
MA-CEW 58		20	22	Medium Sand, trace fine sand, coarse sand, fine pebbles	Light brown
MA-CEW 58		30	31	Medium Sand, trace fine sand, coarse sand, fine pebbles	Light brown
MA-CEW 58		31	32	Very fine sand, some pebbles	Light grey-brown
MA-CEW 58		38.5	40.5	Medium to coarse sand	Light brown
MA-CEW 59	74	47	49	Medium Sand, trace fine sand, coarse sand, fine pebbles	Light brown
MA-CEW 59		57	58.5	Fine sand, trace medum sand to fine pebbles	Light brown
MA-CEW 59		67	69	Medium Sand, trace fine sand, coarse sand, fine pebbles	Light brown
MA-CEW 59		73	73.5	Medium Sand, trace fine sand, coarse sand, fine pebbles	Light brown
MA-CEW 59		73.5	74	Very fine sand, trace pebbles	

Private Wells

Well No.	Comp-number	Depth to Bedrock	From5	To5	Low5	Clay5	Silt5	Sand5	Gravel5	Cobbles5	Boulders5	Other5	Rock Type5
1	118494	57	57	120	0	0	0	0	0	0	0		Gray Granite
1	118494	57	6	14	0	0	0	0	0	0	1		
1	118494	57	14	57	0	0	0	0	0	0	0		
1	118494	57	0	6	0	0	0	1	0	0	0		
3	20688	95	20	70	0	1	0	0	0	0	0		
3	20688	95	70	90	0	0	0	0	0	0	0		Hard Rock
3	20688	95	190	195	0	0	0	0	0	0	0		" "
3	20688	95	120	125	0	0	0	0	0	0	0		Gray-green Rock
3	20688	95	110	220	0	0	0	0	0	0	0		Hard Green Rock
3	20688	95	90	110	0	0	0	0	1	0	0		
3	20688	95			0	0	0	0	0	0	0		
3	20688	95	0	20	0	0	0	0	1	0	0		
2	122504	105	0	105	0	0	0	1	0	0	0		
2	122504	105	105	345	0	0	0	0	0	0	0		Bedrock

Wells from Hansen et al. (1973)

NWIS_Station Name	Hansen Logs_Station Name	Total Depth	From	To	Material Type	Color	Decimal Latitude	Decimal Longitude
MA-CEW 3	MA-CEW 3	54	0	21	Till		42.67147248	-72.89259718
MA-CEW 3	MA-CEW 3		21	50	Schist		42.67147248	-72.89259718
MA-CEW 3	MA-CEW 3		50	54	Shale		42.67147248	-72.89259718
MA-CEW 4	MA-CEW 4	54	0	54	Sand and Gravel		42.62758419	-72.87426288
MA-CEW 12	MA-CEW 12	55	0	5	Fine Silt	Brown	42.63786176	-72.90954179
MA-CEW 12	MA-CEW 12		5	10	Large Boulders and Gravel		42.63786176	-72.90954179
MA-CEW 12	MA-CEW 12		10	20	Sand and Gravel		42.63786176	-72.90954179
MA-CEW 12	MA-CEW 12		20	25	Medium to course sand, some silt and Gravel		42.63786176	-72.90954179
MA-CEW 12	MA-CEW 12		25	35	Medium to course sand, some fine sand and silt, minor clay, 1 in gravel lenses		42.63786176	-72.90954179
MA-CEW 12	MA-CEW 12		35	40	Find Sandy silt	Brown	42.63786176	-72.90954179
MA-CEW 12	MA-CEW 12		40	55	Medium to fine sand, some silt, some 1 inch pea gravel lenses		42.63786176	-72.90954179
MA-CEA 1	MA-CEA 1	92	0	1	Topsoil		42.63480627	-72.89704139
MA-CEA 1	MA-CEA 1		1	9	Fine to medium sand	Light Brown	42.63480627	-72.89704139
MA-CEA 1	MA-CEA 1		9	14	Gravel		42.63480627	-72.89704139
MA-CEA 1	MA-CEA 1		14	37	Clay	Gray	42.63480627	-72.89704139
MA-CEA 1	MA-CEA 1		37	47	Silt	Gray	42.63480627	-72.89704139
MA-CEA 1	MA-CEA 1		47	92	Very fine sand grading to fine to medium sand		42.63480627	-72.89704139
MA-CEB 3	MA-CEB 3	21	0	3	Sand and Gravel, loamy		42.655917	-72.93676498
MA-CEB 3	MA-CEB 3		3	9	Sand and Gravel, Cemented		42.655917	-72.93676498
MA-CEB 3	MA-CEB 3		9	11	coarse sand, Firm		42.655917	-72.93676498
MA-CEB 3	MA-CEB 3		11	14	Course sand and gravel, little clay		42.655917	-72.93676498
MA-CEB 3	MA-CEB 3		14	16	Course sand and gravel, hard	Gray	42.655917	-72.93676498
MA-CEB 3	MA-CEB 3		16	21	Sand and Gravel, Cemented		42.655917	-72.93676498
MA-CEB 7	MA-CEB 7	10	0	1	Coarse sand and gravel, Dirty		42.6275845	-72.736759
MA-CEB 7	MA-CEB 7		1	8	Sharp sand, firm	Yellow	42.6275845	-72.736759
MA-CEB 7	MA-CEB 7		8	10	Coarse sand and gravel, cememted		42.6275845	-72.736759
MA-CEB 7	MA-CEB 7		10		Refusal		42.6275845	-72.736759
MA-CEB 8	MA-CEB 8	40	0	8	Fine sand and gravel, loose		42.6300841	-72.9017637
MA-CEB 8	MA-CEB 8		8	17.5	course sand and gravel, boulders, firm		42.6300841	-72.9017637
MA-CEB 8	MA-CEB 8		17.5	24	Sharp sand and little fine gravel, loose		42.6300841	-72.9017637
MA-CEB 8	MA-CEB 8		24	35	fine sand and little fine gravel, compact		42.6300841	-72.9017637
MA-CEB 8	MA-CEB 8		35	40	fine sand and gravel, hard, little clay, few boulders.		42.6300841	-72.9017637
MA-CEB 10	MA-CEB 10	15	0	5	Sand and Gravel, Loose		42.6261953	-72.883152
MA-CEB 10	MA-CEB 10		5	15	Very fine sand, some clay, compact		42.6261953	-72.883152
MA-CEB 10	MA-CEB 10		15		Refusal, ledge		42.6261953	-72.883152
MA-CEB 11	MA-CEB 11	25	0	8	Coarse, dirty sand, loose		42.62786197	-72.87231838
MA-CEB 11	MA-CEB 11		8	10	Wood		42.62786197	-72.87231838
MA-CEB 11	MA-CEB 11		10	19	Coarse sand, firm		42.62786197	-72.87231838
MA-CEB 11	MA-CEB 11		19	25	Sand and very little fine gravel, hard, compact		42.62786197	-72.87231838
MA-CEB 12	MA-CEB 12	29	0	3	coarse sand and gravel and boulders, firm		42.63869508	-72.9100974
MA-CEB 12	MA-CEB 12		3	18	fine snad and mica, little fine gravel and clay, loose		42.63869508	-72.9100974
MA-CEB 12	MA-CEB 12		18	25	medium sand and gravel, hard		42.63869508	-72.9100974
MA-CEB 12	MA-CEB 12		25	29	coarse sand and gravel, clay, hard		42.63869508	-72.9100974
MA-CEB 12	MA-CEB 12			29	refusal		42.63869508	-72.9100974
MA-CEB 24	MA-CEB 24	10	0	10	fine sand and gravel, boulders, hard		42.64202834	-72.92231998
MA-CEB 24	MA-CEB 24			10	Refusual, ledge, or boulder		42.64202834	-72.92231998

APPENDIX B

BORING LOGS
OF UMASS BOREHOLES DRILLED
FALL 2006

Office of the State Geologist
Department of Geosciences
269 Morrill Science Center
University of Massachusetts
611 North Pleasant Street
Amherst, MA 01003-9297
(413) 545-4814

PROJECT: FRCOG
LOCATION: Charlemont, MA
Project No.:

BORING NO.: MW1
SHEET NO.: 1 of 1
DATE:

Drilling Co.: Seaboard Drilling
Geologist: Brandon Fleming

GROUNDWATER READINGS				CASING	SAMPLER	CORE BARREL
DATE	TIME	DEPTH	TYPE & I.D.			
			HAMMER WT.		split spoon	
			HAMMER FALL			

G.S. ELEVATION:
DATUM:
LOCATION:

DEPTH	CASING	BLOWS	NO.	TYPE	PEN./REC	DEPTH (ft)	Sample Depth	SAMPLE DESCRIPTION	WELL CONSTRUCTION	STRATUM DESCRIPTION
10										
20						20-22		Silty fine Sand, trace pebble		
30						30-32	Top	Medium Sand		
							Bottom	Fine sand, trace pebbles, trace organic, layering present		
40						40-42		fine to coarse sand, some gravel and pebble		
50						50-52		Fine sand, some med sand, litle gravel and pebble, trace to little silt		
60						60-62		Mix pebble and silt, poorly sorted		
70						70-72		Mix pebble and silt, poorly sorted		
80										
90										

LEGEND

REMARKS:

Top refers to the top portion of the split spoon

Botton refers to the bottom portion of the split spoon

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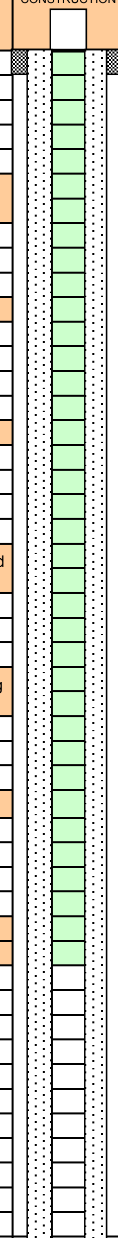
Department of Geosciences
269 Morrill Science Center
University of Massachusetts
611 North Pleasant Street
Amherst, MA 01003-9297
(413) 545-4814

PROJECT: FRCOG		BORING NO.: BH1
LOCATION: Charlemont, MA		SHEET NO.: 1 of 1
Project No.:		DATE:
Drilling Co.: Seaboard Drilling		Geologist: Brandon Fleming

GROUNDWATER READINGS				CASING	SAMPLER	CORE BARREL	
DATE	TIME	DEPTH	TYPE & I.D.				G.S. ELEVATION:
			HAMMER WT.		split spoon		DATUM:
			HAMMER FALL				LOCATION:

DEPTH	CASING	BLOWS	NO.	TYPE	PEN./REC	DEPTH (ft)	Sample Depth	SAMPLE DESCRIPTION	STRATUM DESCRIPTION
10						10-12		fine to med sand, little coarse sand, some gravel, trace silt	
20						20-22		fine sand, trace to little silt, trace clay	
30						30-32		fine sand, trace med sand, trace silt	
40						40-42		fine sand, trace silt, layering with 1-3mm red bands	
50						50-52		fine sand, trace silt, little med sand, layering with 1-3mm red bands	
60						60-62		fine sand, trace silt	
70						70-72	Top	med sand, trace fine sand	
							Bottom	poorly sorted, large clast	
80									
90									

WELL CONSTRUCTION



LEGEND

REMARKS:

Top refers to the top portion of the split spoon

Botton refers to the bottom portion of the split spoon

Office of the State Geologist
Department of Geosciences
269 Morrill Science Center
University of Massachusetts
611 North Pleasant Street
Amherst, MA 01003-9297
(413) 545-4814

PROJECT: FRCOG
LOCATION: Charlemont, MA
Project No.:

BORING NO.: BH2
SHEET NO.: 1 of 1
DATE:

Drilling Co.: Seaboard Drilling
Geologist: Brandon Fleming

GROUNDWATER READINGS				CASING	SAMPLER	CORE BARREL
DATE	TIME	DEPTH	TYPE & I.D.			
			HAMMER WT.		split spoon	
			HAMMER FALL			

G.S. ELEVATION:
DATUM:
LOCATION:

DEPTH	CASING BLOWS	NO.	TYPE	PEN./REC	DEPTH (ft)	Sample Depth	SAMPLE DESCRIPTION	WELL CONSTRUCTION	STRATUM DESCRIPTION
10									
20					20-22		silty clay		
30					30-32		silty clay		
40					40-42		silt, some fine sand, trace clay		
50					50-52		silt, some fine sand, trace clay		
60					60-62		fine sand, trace silt		
70					70-72		med sand, some fine sand, trace clay, layering		
80					80-82	Top	fine sand, some silt, trace clay		
						Bottom	fine sand, some med sand, trace pebble, coarse layers 2mm thick		
90					90-92		sand, some cobble, some silt, poorly sorted		

LEGEND

REMARKS:

Top refers to the top portion of the split spoon

Botton refers to the bottom portion of the split spoon

APPENDIX C

SEISMIC REFRACTION DATA

SIPT2 V-4.1 --- SEISMIC REFRACTION INTERPRETATION PROGRAM --- RIMROCK GEOPHYSICS, INC.

DATA FILE: SHOT.DAT PRINT FILE: C:\SIPT\SIPT\SHOT.OUT RUN DATE AND TIME: 05-08-2006 at 15:19

TITLE: Lower terrace mass highway shots

PROGRAM CONTROL DATA

				Printer	Plot	Scales	Datum	Plane	Control	Points	Plot Control		Special	Control	Parameters		
				Elev	Horiz	Time	Point 1		Point 2		Elevations				Trace	Off	L
Sprds	Exit	Layers	V-Over	ft/col	ft/row	ms/col	Elev	X-Loc	Elev	X-Loc	Top	Bottom	BLim	TLim	Print	SP	Dip
1	6	3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0.5	10.0	0	0	0

SHOTPOINT AND GEOPHONE INPUT DATA for SHOT.DAT

Spread A, 5 Shotpoints, 12 Geophones, X-Shift = 0.0, X-True = 1, Units: Feet.

SP	Elev	X-Loc	Y-Loc	Depth	UpHole T	Fudge T	End SP
A	100.0	0.0	0.0	0.0	0.0	0.0	0
B	100.0	45.0	0.0	0.0	0.0	0.0	1
C	100.0	160.0	0.0	0.0	0.0	0.0	0
D	100.0	275.0	0.0	0.0	0.0	0.0	2
E	100.0	320.0	0.0	0.0	0.0	0.0	0

Arrival Times + Fudge T and Layers represented

Geo	Elev	X-Loc	Y-Loc	SP A T	SP A L	SP B T	SP B L	SP C T	SP C L	SP D T	SP D L	SP E T	SP E L
1	100.0	50.0	0.0	59.50	2	43.00	1	69.00	2	82.50	3	84.00	3
2	100.0	70.0	0.0	62.75	2	58.25	2	66.50	2	81.50	3	84.75	3
3	100.0	90.0	0.0	64.50	2	59.75	2	64.00	2	81.50	3	87.25	3
4	100.0	110.0	0.0	66.00	2	63.50	2	60.00	2	79.00	2	84.75	2
5	100.0	130.0	0.0	67.75	2	67.25	2	56.00	2	76.50	2	81.50	2
6	100.0	150.0	0.0	71.25	2	69.75	2	51.00	1	73.25	2	78.00	2
7	100.0	170.0	0.0	71.75	2	73.00	2	51.25	1	69.50	2	76.50	2
8	100.0	190.0	0.0	72.25	2	73.75	2	55.50	2	66.75	2	71.75	2
9	100.0	210.0	0.0	75.00	2	76.75	3	59.50	2	63.25	2	69.50	2
10	100.0	230.0	0.0	77.25	3	76.00	3	62.75	2	58.75	2	65.50	2
11	100.0	250.0	0.0	77.75	3	76.50	3	65.25	2	54.50	2	61.00	2
12	100.0	270.0	0.0	78.75	3	77.00	3	68.00	2	46.50	1	57.50	2

Layer 1 Velocity from direct arrivals

Spread A	SP	Geo	DD	V	Avg V
	B	1	5.0	116	
					116
	C	6	10.0	196	
	C	7	10.0	195	
					196
	D	12	5.0	108	
					108

Wtd Avg Velocity computed for Layer 1 = 154

Layer 2 Velocity computed by regression of raw uncorrected arrivals

Spread A

V	Ti	Geos	<-SP->	Geos	Ti	V	Avg V	Avg Ti	Pts
			A	1 9	55.9	10884	10884	55.9	9
			B	2 8	54.4	7066	7066	54.4	7
6154	51.7	1 5	C	8 12	51.4	6504	6324	51.6	10
5734	51.1	4 11	D				5734	51.1	8
5926	49.8	4 12	E				5926	49.8	9
						Avg =	6812	for	43 Pts

Layer 2 Velocity computed by Hobson-Overton method

Spread A SPs	Geos	V	Avg TdSP	Std Err Overall	4 Highest Std Err at geophones Err	Geo	Err	Geo	Err	Geo	Err	Geo
A C	1 5	7656	-1.6	0.352	-0.500	3	0.475	2	0.300	5	-0.225	4
A D	4 9	8199	-6.2	0.755	1.148	6	-1.110	8	-0.724	5	0.519	7
A E	4 9	8434	-6.3	0.906	1.955	6	-0.788	7	-0.560	4	-0.302	5
B C	2 5	6038	1.4	1.027	-1.500	3	1.125	2	0.750	5	-0.375	4
B D	4 8	6926	-0.7	0.747	1.275	7	-1.000	8	-0.400	4	0.075	5
B E	4 8	6987	0.3	0.578	0.800	6	-0.750	4	0.525	5	-0.400	8
C D	8 11	5424	-1.0	0.234	0.375	10	-0.250	11	-0.125	8	-0.000	9
C E	8 12	5904	0.5	0.252	-0.375	9	0.325	11	-0.200	12	0.150	8

```
            ------
      Avg =   7075 for  40 Pts

---------------------------------------------
Wtd Avg Velocity computed for Layer 2 =   6983
-----------------------------------------------------------------------------

Layer 3 Velocity computed by regression of raw uncorrected arrivals

 Spread A
    V     Ti    Geos  <-SP->  Geos   Ti      V         Avg V  Avg Ti   Pts
 ------  ----  -----   ---   -----  ----  ------      ------  ------   ---
                        A    10 12  68.5   26667       26667    68.5     3
                        B     9 12  75.3  160000      160000    75.3     4
  40000  76.7   1  3    D                              40000    76.7     3
  12308 105.6   1  3    E                              12308   105.6     3
                                                      ------           ---
                                                Avg =  28493    for     13 Pts
```

Layer 3 Velocity computed by Hobson-Overton method

Not enough points.

Wtd Avg Velocity computed for Layer 3 = 28493

Arrival times Td corrected to datum. (Datum Elev = 100.000 + 0.000x) for SHOT.DAT

Spread A				SP A	SP B	SP C	SP D	SP E
Datum Elev				100.0	100.0	100.0	100.0	100.0
Geo	.	X-Loc	Cor T	0.0	0.0	0.0	0.0	0.0
---	.	-----	-----	--Td--	--Td--	--Td--	--Td--	--Td--
1	100.0	50.0	0.0	59.5	43.0	69.0	82.5	84.0
2	100.0	70.0	0.0	62.8	58.3	66.5	81.5	84.8
3	100.0	90.0	0.0	64.5	59.8	64.0	81.5	87.3
4	100.0	110.0	0.0	66.0	63.5	60.0	79.0	84.8
5	100.0	130.0	0.0	67.8	67.3	56.0	76.5	81.5
6	100.0	150.0	0.0	71.3	69.8	51.0	73.3	78.0
7	100.0	170.0	0.0	71.8	73.0	51.3	69.5	76.5
8	100.0	190.0	0.0	72.3	73.8	55.5	66.8	71.8
9	100.0	210.0	0.0	75.0	76.8	59.5	63.3	69.5
10	100.0	230.0	0.0	77.3	76.0	62.8	58.8	65.5
11	100.0	250.0	0.0	77.8	76.5	65.3	54.5	61.0
12	100.0	270.0	0.0	78.8	77.0	68.0	46.5	57.5

Arrival times Tc corrected to top of Layer 2 and Elev of top of Layer 2 for SHOT.DAT

Spread A				SP A	SP B	SP C	SP D	SP E
	Elev			0.0	95.7	95.8	96.1	0.0
	.							
Geo	.	X-Loc	Cor T	27.9	27.9	27.1	25.6	25.6
---	.	-----	-----	--Tc--	--Tc--	--Tc--	--Tc--	--Tc--
1	95.7	50.0	27.9	2.2	0.0	14.0	29.1	27.1
2	95.7	70.0	27.9	5.4	2.5	11.5	28.1	27.8
3	95.8	90.0	27.2	7.9	4.7	9.7	28.8	31.0
4	95.7	110.0	27.8	8.7	7.8	5.1	25.6	25.5
5	95.8	130.0	27.6	10.7	11.8	1.3	23.4	22.5
6	95.8	150.0	27.4	14.4	14.5	0.0	20.3	19.2
7	95.9	170.0	26.8	15.4	18.3	0.0	17.1	18.2
8	96.0	190.0	25.8	17.0	20.1	2.6	15.4	14.5
9	96.0	210.0	26.0	19.5	22.8	6.4	11.6	12.0
10	95.8	230.0	27.0	20.9	21.1	8.6	6.1	7.0
11	96.0	250.0	25.9	22.5	22.7	12.2	3.0	3.6
12	96.1	270.0	25.6	23.8	23.5	15.3	0.0	0.4

```
SHOT.DAT
  Lower terrace mass highway shots

  S                           Time-Distance Plot  --  Raw data with no corrections applied
  p  G                                                                                                                 D
  r  e  S                                                                                                              i
  e  o  P                                T i m e    ( m i l l i  s e c o n d s )                                       s
  a                                                                                                                    t
  d
          0        10        20        30        40        50        60        70        80        90       100
          +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
          -                                               :                                                   -
  A     B +         +         +         +         +         +   :     +         +         +         +         +       45.0
  A  1    +                                          1                2        2             33               +       50.0
          -                                              :            :       :             : :               -
          -                                                  :         :      :             : :               -
          -                                                     :       :    :              :  :              -
  A  2    +                                                          2    2   2             3  3              +       70.0
          -                                                           :   :  :              :  :              -
          -                                                           :    ::               :   :             -
          -                                                           :    ::               :    :            -
  A  3    +                                                            2   22               3    3            +       90.0
          -                                                             : : :              :     :            -
          -                                                              :  :             :     :             -
          -                                                             : :  :            :    :              -
  A  4    +                                                            2   2 2           2     2              +      110.0
          -                                                           :    : :          :     :               -
          -                                                          :      : :         :    :                -
          -                                                         :        ::        :    :                 -
  A  5    +                                                        2          22       2    2                 +      130.0
          -                                                       :            ::     :    :                  -
          -                                                      :              ::   :    :                   -
          -                                                    :                ::  :    :                    -
  A  6    +                                                   1                  22 2    2                    +      150.0
          -                          :                                            ::     :                    -
  A     C +         +         +         +         +         +         +         +::    :  +         +         +      160.0
          -                          :                                           : :    :                     -
  A  7    +                                                   1                  2 22   2                     +      170.0
          -                                                    :                :  :: :                       -
          -                                                     :              :   :::                        -
          -                                                      :            :    :::                        -
```

```
A  8    +                                                       2          2    # 2                         +      190.0
        -                                                        :        :    : : :                        -
        -                                                         :      :     :  ::                        -
        -                                                          :    :     :   : :                       -
A  9    +                                                           2  2      2    2 3                      +      210.0
        -                                                           : :      :      ::                      -
        -                                                            :      :       :                       -
        -                                                           : :    :        ::                      -
A 10    +                                                          2   2  2         33                      +      230.0
        -                                                         :    ::           ::                      -
        -                                                        :     ::           : :                     -
        -                                                       :     :  :          : :                     -
A 11    +                                                      2     2   2           33                     +      250.0
        -                                                    :      :     :          ::                     -
        -                                                  :       :       :         ::                     -
        -                                                :        :        :         : :                    -
A 12    +                                              1          2         2        3 3                    +      270.0
A     D +         +         +         +         +         + :       +         +         +         +         +      275.0
        -                                             :                                                     -
        +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
        0        10        20        30        40        50        60        70        80        90       100
```

```
 PRINTER PLOT SCALES
---------------------
 Time:   1.00 ms/col
 Dist:   5.00 ft/row
```

Lower terrace mass highway shots

Spread A   Points of emergence of refracted rays below target geophones for SHOT.DAT

Geo		SP A	SP B	SP C	SP D	SP E
---		----------L	----------L	----------L	----------L	----------L
1	X-Loc	49.9 2	--- 1	50.1 2	48.3 3	48.9 3
	Elev	95.7	---	95.7	50.4	67.2
2	X-Loc	69.9 2	69.9 2	70.1 2	69.0 3	69.2 3
	Elev	95.7	95.7	95.7	48.5	59.1
3	X-Loc	89.9 2	89.9 2	90.1 2	81.0 3	81.3 3
	Elev	95.8	95.8	95.8	41.5	43.4

4	X-Loc	109.9 2	109.9 2	110.1 2	110.1 2	110.1 2
	Elev	95.7	95.7	95.7	95.7	95.7
5	X-Loc	129.9 2	129.9 2	130.1 2	130.1 2	130.1 2
	Elev	95.8	95.8	95.8	95.8	95.8
6	X-Loc	149.9 2	149.9 2	--- 1	150.1 2	150.1 2
	Elev	95.8	95.8	---	95.8	95.8
7	X-Loc	169.9 2	169.9 2	--- 1	170.1 2	170.1 2
	Elev	95.9	95.9	---	95.9	95.9
8	X-Loc	189.9 2	189.9 2	189.9 2	190.1 2	190.1 2
	Elev	96.0	96.0	96.0	96.0	96.0
9	X-Loc	209.9 2	165.1 3	209.9 2	210.1 2	210.1 2
	Elev	96.0	20.5	96.0	96.0	96.0
10	X-Loc	188.6 3	186.7 3	229.9 2	230.1 2	230.1 2
	Elev	29.6	26.5	95.8	95.8	95.8
11	X-Loc	196.8 3	194.5 3	249.9 2	250.1 2	250.1 2
	Elev	26.7	23.8	96.0	96.0	96.0
12	X-Loc	232.6 3	232.0 3	269.9 2	--- 1	270.1 2
	Elev	15.6	14.2	96.1	---	96.1

Spread A   Points of entry of refracted rays below source shotpoints:

L=2	Right	X-Loc	45.1	45.1	160.1	---	---
		Elev	95.7*	95.7	95.8	---	---
L=2	Left	X-Loc	---	---	159.9	274.9	274.9
		Elev	---	---	95.8	96.1	96.1*
L=3	Right	X-Loc	37.4	43.8	---	---	---
		Elev	129.4?	64.9	---	---	---
L=3	Left	X-Loc	---	---	---	224.9	224.9
		Elev	---	---	---	-7.0	-7.0*

Lower terrace mass highway shots

Spread A   Depth and Elev of layers directly beneath SPs and Geos for SHOT.DAT

	Surface		Layer 2		Layer 3	
SP	X-Loc	Elev	Depth	Elev	Depth	Elev
---	-----	------	-----	------	-----	------
B	45.0	100.0	4.3	95.7	39.8	60.2
C	160.0	100.0	4.2	95.8	76.7	23.3
D	275.0	100.0	3.9	96.1	92.0	8.0

Geo						

1	50.0	100.0	4.3	95.7	41.8	58.2
2	70.0	100.0	4.3	95.7	49.6	50.4
3	90.0	100.0	4.2	95.8	59.9	40.1
4	110.0	100.0	4.3	95.7	65.1	34.9
5	130.0	100.0	4.2	95.8	70.3	29.7
6	150.0	100.0	4.2	95.8	75.6	24.4
7	170.0	100.0	4.1	95.9	77.9	22.1
8	190.0	100.0	4.0	96.0	76.2	23.8
9	210.0	100.0	4.0	96.0	83.5	16.5
10	230.0	100.0	4.2	95.8	92.0	8.0
11	250.0	100.0	4.0	96.0	92.0	8.0
12	270.0	100.0	3.9	96.1	92.0	8.0

SHOT.DAT

Velocities used, Spread A

	Layer 1	Layer 2	Layer 3
	-------	-------	-------
Vertical	154	6983	
Horizontal		6983	28493

SHOT.DAT
Lower terrace mass highway shots

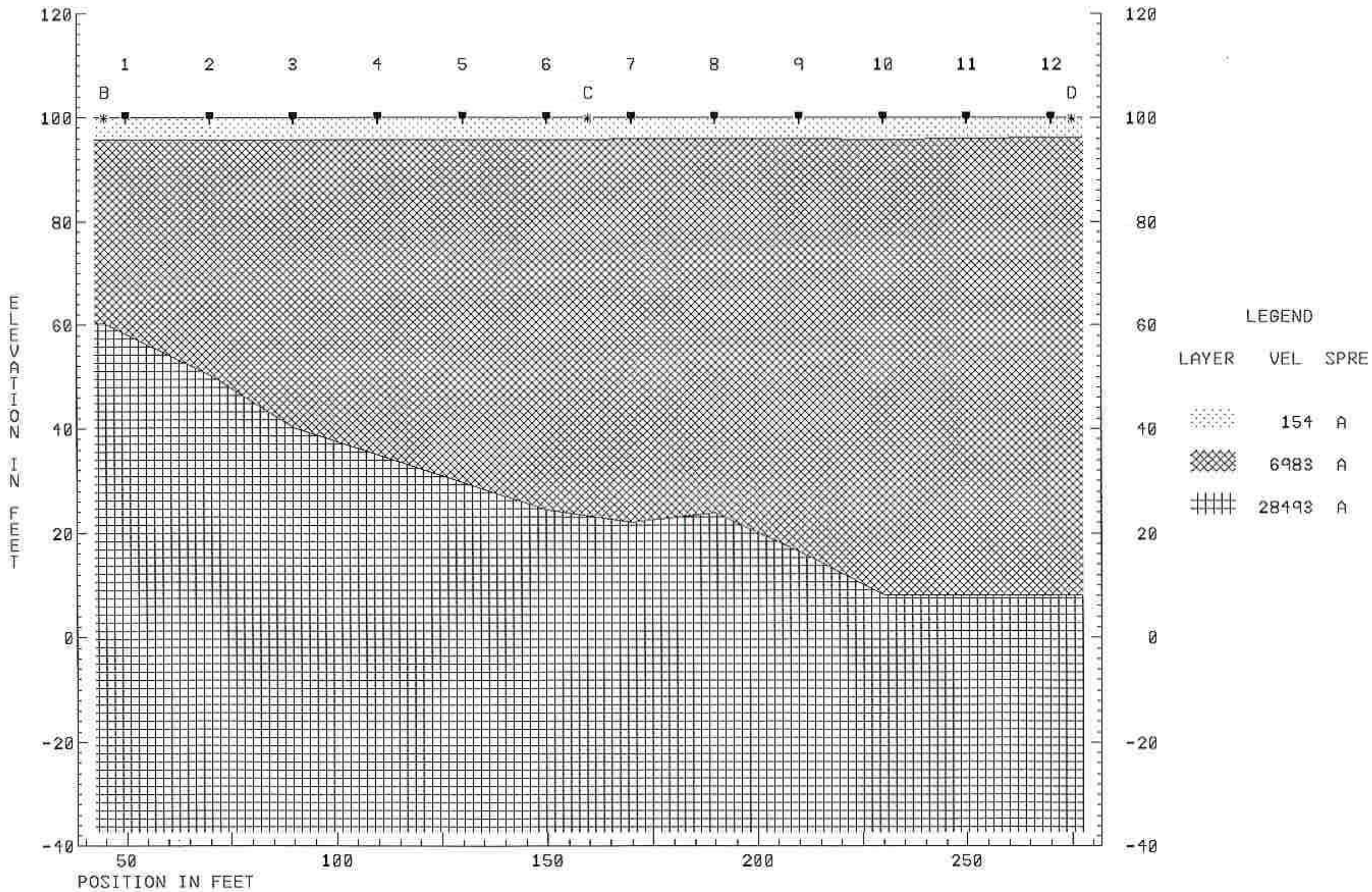
```
                                                                                                                         S
        D                                                                                                             G  p
        i                                                                                                          S  e  r
        s                                     E l e v a t i o n    ( f e e t )                                     P  o  e
        t                                                                                                                a
                                                                                                                         d
          -80       -60       -40       -20         0        20        40        60        80       100       120
            +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
            -                                                                          :            : :         -
     45.0   +         +         +         +         +         +         +         : s       +       s *         +  B     A
     50.0   +                                                                D   :    E             # :>        +     1  A
            -                                                                   :                   : :         -
            -                                                                  :                    : :         -
            -                                                                 :                     : :         -
```

```
   70.0   +                                                               D:    E                 # :>        +     2  A
          -                                                               :                       : :         -
          -                                                            DE:                        : :         -
          -                                                            :                          : :         -
   90.0   +                                                           :                           # :>        +     3  A
          -                                                          :                            : :         -
          -                                                          :                            : :         -
          -                                                         :                             : :         -
  110.0   +                                                        :                              # :>        +     4  A
          -                                                        :                              : :         -
          -                                                       :                               : :         -
          -                                                      :                                : :         -
  130.0   +                                                      :                                # :>        +     5  A
          -                                                     :                                 : :         -
          -                                                     :                                 : :         -
          -                                                    :                                  : :         -
  150.0   +                                                   :                                   # :>        +     6  A
          -                                                   :                                   : :         -
  160.0   +         +         +         +         +         + :       +         +         +       s *         +  C     A
          -                                                 B:                                    : :         -
  170.0   +                                                  :                                    # :>        +     7  A
          -                                                  :                                    : :         -
          -                                                  :                                    : :         -
          -                                                   :B                                  : :         -
  190.0   +                                                   :  A                                # :>        +     8  A
          -                                                  :BA                                  : :         -
          -                                                 :                                     : :         -
          -                                                :                                      : :         -
  210.0   +                                               :                                       # :>        +     9  A
          -                                              :                                        : :         -
          -                                             :                                         : :         -
          -                                   s        :                                          : :         -
  230.0   +                                           :  B                                        # :>        +    10  A
          -                                           :   A                                       : :         -
          -                                           :                                           : :         -
          -                                           :                                           : :         -
  250.0   +                                           :                                           # :>        +    11  A
          -                                           :                                           : :         -
          -                                           :                                           : :         -
          -                                           :                                           : :         -
  270.0   +                                           :                                           # :>        +    12  A
  275.0   +         +         +         +         +   :     +         +         +         +       s *         +  D     A
```

```
     -                                            :                                           : :         -
     +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
   -80       -60       -40       -20         0        20        40        60        80       100       120
                                                                                                                    S
 D                                                                                                               G  p
 i                                                                                                            S  e  r
 s                                        E l e v a t i o n   ( f e e t )                                     P  o  e
 t                                                                                                                  a
                                                                                                                    d

      PRINTER PLOT SCALES             L E G E N D
     ---------------------      ----------------------------------------
      Elev:   2.00 ft/col           >  Geophone Location
      Dist:   5.00 ft/row           *  Shotpoint Location
                                A,B,C  Emergent Ray; Source SP A,B,C,...
                                    ?  Questionable Emergent Ray
                                    s  Ray Entrypoint Beneath SP
                                    #  More Than One Symbol to Plot Here
                                    +  Grid Mark
```

FILE SHOT.DAT
LOWER TERRACE MASS HIGHWAY SHOTS

SPREAD A



SIPT2 V-4.1 --- SEISMIC REFRACTION INTERPRETATION PROGRAM --- RIMROCK GEOPHYSICS, INC.

DATA FILE: LINE4.DAT PRINT FILE: C:\SIPT\SIPT\BANKS.OUT RUN DATE AND TIME: 05-02-2007 at 11:12

TITLE: Line 4

PROGRAM CONTROL DATA

				Printer	Plot	Scales	Datum Plane		Control Points		Plot Control		Special	Control	Parameters		
				Elev	Horiz	Time	Point 1		Point 2		Elevations				Trace	Off	L
Sprds	Exit	Layers	V-Over	ft/col	ft/row	ms/col	Elev	X-Loc	Elev	X-Loc	Top	Bottom	BLim	TLim	Print	SP	Dip
1	6	3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0.5	10.0	0	0	0

SHOTPOINT AND GEOPHONE INPUT DATA for LINE4.DAT

Spread A, 5 Shotpoints, 12 Geophones, X-Shift = 0.0, X-True = 1, Units: Feet.

SP	Elev	X-Loc	Y-Loc	Depth	UpHole T	Fudge T	End SP
A	200.0	0.0	0.0	1.5	0.0	0.0	0
B	200.0	90.0	0.0	1.5	0.0	0.0	1
C	200.0	210.0	0.0	1.5	0.0	0.0	0
D	200.0	330.0	0.0	1.5	0.0	0.0	2
E	200.0	420.0	0.0	1.5	0.0	0.0	0

Arrival Times + Fudge T and Layers represented

Geo	Elev	X-Loc	Y-Loc	SP A T	SP A L	SP B T	SP B L	SP C T	SP C L	SP D T	SP D L	SP E T	SP E L
1	200.0	100.0	0.0	30.50	2	12.25	1	32.00	2	48.25	3	55.25	3
2	200.0	120.0	0.0	33.00	2	15.25	2	28.00	2	47.25	3	53.25	3
3	200.0	140.0	0.0	37.25	2	20.25	2	23.50	2	44.75	2	51.50	3
4	200.0	160.0	0.0	41.00	2	24.00	2	19.00	2	40.50	2	50.25	3
5	200.0	180.0	0.0	44.25	2	28.00	2	15.25	2	35.50	2	49.50	3
6	200.0	200.0	0.0	47.50	2	30.00	2	10.25	1	31.25	2	47.25	2
7	200.0	220.0	0.0	50.00	3	35.00	2	10.75	1	28.25	2	44.50	2
8	200.0	240.0	0.0	50.75	3	37.25	2	13.50	2	23.75	2	40.00	2
9	200.0	260.0	0.0	51.50	3	40.25	2	16.75	2	19.50	2	35.75	2
10	200.0	280.0	0.0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
11	200.0	300.0	0.0	54.75	3	48.50	3	25.50	2	14.50	2	31.25	2
12	200.0	320.0	0.0	56.00	3	50.25	3	29.00	2	9.00	1	28.75	0

Layer 1 Velocity from direct arrivals

Spread A	SP	Geo	DD	V	Avg V
	B	1	10.1	825	
					825
	C	6	10.1	987	
	C	7	10.1	941	
					964
	D	12	10.1	1124	
					1124

Wtd Avg Velocity computed for Layer 1 = 969

Layer 2 Velocity computed by regression of raw uncorrected arrivals

Spread A

V	Ti	Geos	<-SP->	Geos	Ti	V		Avg V	Avg Ti	Pts
			A	1 6	12.7	5714		5714	12.7	6
			B	2 9	11.2	5694		5694	11.2	8
4704	8.7	1 5	C	8 12	7.3	5030		4844	8.0	9
5174	7.0	3 11	D					5174	7.0	8
6010	10.5	6 11	E					6010	10.5	5
							Avg =	5380	for	36 Pts

Layer 2 Velocity computed by Hobson-Overton method

Spread A

SPs	Geos	V	Avg TdSP	Std Err Overall	4 Highest Std Err at geophones Err	Geo	Err	Geo	Err	Geo	Err	Geo
A C	1 5	5127	-0.0	0.510	-0.850	2	0.549	4	0.451	1	-0.249	5
A D	3 6	5031	2.5	0.168	0.275	5	-0.175	6	-0.075	3	-0.025	4
B C	2 5	4718	0.4	0.446	0.550	3	-0.475	2	-0.400	5	0.325	4
B D	3 9	5333	2.5	0.627	1.250	5	-0.750	3	-0.500	9	0.500	7
B E	6 9	5555	2.8	0.209	0.350	7	-0.200	6	-0.100	8	-0.050	9
C D	8 11	5669	0.5	0.193	0.268	9	-0.179	8	-0.089	11		
C E	8 11	5817	-0.5	0.271	0.376	9	-0.250	8	-0.125	11		

```
     Avg =   5288 for  30 Pts

----------------------------------------------
Wtd Avg Velocity computed for Layer 2 =   5323
------------------------------------------------------------------------------

Layer 3 Velocity computed by regression of raw uncorrected arrivals

 Spread A
    V     Ti    Geos  <-SP->  Geos   Ti      V        Avg V  Avg Ti   Pts
 ------  ----  -----   ---   -----  ----  ------     ------  ------   ---
                        A     7 12  35.8   15963      15963    35.8     5
                        B    11 12  30.1   11428      11428    30.1     2
  20000  36.7   1  2    D                             20000    36.7     2
  13793  31.6   1  5    E                             13793    31.6     5
                                                     ------           ---
                                               Avg =  14725    for     14 Pts

Layer 3 Velocity computed by Hobson-Overton method

        Not enough points.
----------------------------------------------
Wtd Avg Velocity computed for Layer 3 =  14725
------------------------------------------------------------------------------


Arrival times Td corrected to datum. (Datum Elev = 200.000 + 0.000x) for LINE4.DAT

Spread A                           SP A      SP B      SP C      SP D      SP E

 Datum Elev . . . . . . . . .     200.0     200.0     200.0     200.0     200.0
         .
 Geo     .       X-Loc  Cor T       0.0       1.5       1.5       1.5       0.0
 ---     .       -----  -----     --Td--    --Td--    --Td--    --Td--    --Td--
  1   200.0      100.0    0.0      30.5      13.8      33.5      49.8      55.3
  2   200.0      120.0    0.0      33.0      16.8      29.5      48.8      53.3
  3   200.0      140.0    0.0      37.3      21.8      25.0      46.3      51.5
  4   200.0      160.0    0.0      41.0      25.5      20.5      42.0      50.3
  5   200.0      180.0    0.0      44.3      29.5      16.8      37.0      49.5
  6   200.0      200.0    0.0      47.5      31.5      11.8      32.8      47.3
  7   200.0      220.0    0.0      50.0      36.5      12.3      29.8      44.5
  8   200.0      240.0    0.0      50.8      38.8      15.0      25.3      40.0
```

9	200.0	260.0	0.0	51.5	41.8	18.3	21.0	35.8
10	200.0	280.0	0.0	0.0	0.0	0.0	0.0	0.0
11	200.0	300.0	0.0	54.8	50.0	27.0	16.0	31.3
12	200.0	320.0	0.0	56.0	51.8	30.5	10.5	28.8

Arrival times Tc corrected to top of Layer 2 and Elev of top of Layer 2 for LINE4.DAT

Spread A

				SP A	SP B	SP C	SP D	SP E
	Elev			0.0	193.3	195.4	194.5	0.0
Geo	.	X-Loc	Cor T	5.4	5.4	3.1	4.1	4.1
---	.	-----	-----	--Tc--	--Tc--	--Tc--	--Tc--	--Tc--
1	193.4	100.0	6.8	1.2	0.0	22.1	37.3	37.8
2	194.0	120.0	6.2	4.3	3.7	18.7	37.0	36.5
3	193.8	140.0	6.4	8.3	8.4	13.9	34.2	34.5
4	194.1	160.0	6.1	12.4	12.5	9.7	30.2	33.5
5	194.5	180.0	5.7	16.0	16.9	6.4	25.7	33.2
6	195.4	200.0	4.8	20.2	19.8	0.0	22.4	22.1
7	195.5	220.0	4.6	34.0	25.0	0.0	19.5	19.5
8	195.9	240.0	4.2	35.1	27.6	6.1	15.4	15.3
9	196.4	260.0	3.7	36.4	31.1	9.9	11.6	11.6
10	195.4	280.0	4.8	0.0	0.0	0.0	0.0	0.0
11	194.4	300.0	5.8	37.5	37.3	16.5	4.6	5.0
12	194.6	320.0	5.5	39.1	39.3	20.3	0.0	0.0

LINE4.DAT
Line 4 Banks 247 Zoar Road

```
S                            Time-Distance Plot  --  Raw data with no corrections applied
p  G                                                                                                          D
r  e  S                                                                                                       i
e  o  P                                T i m e   ( m i l l i  s e c o n d s )                                s
a                                                                                                             t
d
        0                   7                   22                  37                  52                  67
        +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
        -                                 :                                                                 -
A     B +         +         +         +     :  +         +         +         +         +         +         +       90.0
        -       :                          :                                                                -
```

```
A  1    +               1                        2 2                    3         3                         +      100.0
        -                ::                       ::                     :        :                          -
        -                 :                     :  :                      :       :                           -
        -                  :                   :   :                   :        :                           -
A  2    +                   2                2      2                  3       3                            +      120.0
        -                     :             :        :                :       :                             -
        -                       :         :            :             :        :                             -
        -                        :       :              :            :       :                              -
A  3    +                          2   2                  2         2        3                              +      140.0
        -                           : :                    :      :         :                               -
        -                           : :                     :    :          :                               -
        -                          :   :                     : :           :                                -
A  4    +                        2      2                     22           3                                +      160.0
        -                       :        :                  :   :          :                                -
        -                      :           :               :     :         :                                -
        -                     :             :            :        :       :                                 -
A  5    +                   2                2         2           2      3                                 +      180.0
        -                  :                  :       :             :    :                                  -
        -                :                     :     :               :   :                                  -
        -              :                       :   :                  : :                                   -
A  6    +             1                         2 2                    #                                    +      200.0
        -      :                                 ::                   : :                                   -
A     C +         +         +         +         +  :      +         +:   :    +         +         +         +      210.0
        -      :                               :     :              :     :                                 -
A  7    +             1                       2        2           2       3                                +      220.0
        -              :                    :          :          :        :                                -
        -               :                  :            :       :          :                                -
        -                :               :               :     :           :                                -
A  8    +                 2             2                 2  2              3                               +      240.0
        -                  :          :                    ::               :                               -
        -                   :        :                     ::               :                               -
        -                    :     :                     :   :              :                               -
A  9    +                     2   2                     2     2              3                              +      260.0
        -                       ::                     :       :             :                              -
        -                       ::                    :         :             :                             -
        -                       :  :                 :            :           :                             -
A 10    +                      :    :                :             :           :                            +      280.0
        -                     :       :             :                :         :                            -
        -                    :         :           :                  :         :                           -
        -                   :            :        :                    :        :                           -
A 11    +                  2              2       2                      3       3                          +      300.0
        -                 :                :     :                       :       :                          -
```

```
        -               :                   :   :                         :       :                         -
        -             :                       ::                          :       :                         -
A 12    +           1                         02                           3       3                        +      320.0
        -     :                             :                                                               -
A     D +         +         +         +    :    +         +         +         +         +         +         +      330.0
        -                                :                                                                  -
        +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
        0                   7                  22                  37                  52                  67
```

PRINTER PLOT SCALES

Time: 0.75 ms/col
Dist: 5.00 ft/row

Line 4 Banks 247 Zoar Road

Spread A Points of emergence of refracted rays below target geophones for LINE4.DAT

Geo		SP A	SP B	SP C	SP D	SP E
---		----------L	----------L	----------L	----------L	----------L
1	X-Loc	98.8 2	--- 1	101.5 2	148.9 3	149.5 3
	Elev	193.4	---	193.4	131.5	130.8
2	X-Loc	119.2 2	119.2 2	121.0 2	162.1 3	160.8 3
	Elev	194.0	194.0	194.0	129.6	131.6
3	X-Loc	138.9 2	138.9 2	141.3 2	141.3 2	166.4 3
	Elev	193.8	193.8	193.8	193.8	132.6
4	X-Loc	158.9 2	158.9 2	161.2 2	161.2 2	183.9 3
	Elev	194.0	194.0	194.1	194.1	131.7
5	X-Loc	178.9 2	178.9 2	181.2 2	181.2 2	205.1 3
	Elev	194.4	194.4	194.5	194.5	128.9
6	X-Loc	199.2 2	199.2 2	--- 1	200.8 2	200.8 2
	Elev	195.4	195.4	---	195.5	195.5
7	X-Loc	193.0 3	219.0 2	--- 1	221.0 2	221.0 2
	Elev	128.4	195.5	---	195.5	195.5
8	X-Loc	212.9 3	239.3 2	239.3 2	240.8 2	240.8 2
	Elev	129.1	195.9	195.9	195.9	195.9
9	X-Loc	238.7 3	259.4 2	259.4 2	260.7 2	260.7 2
	Elev	130.3	196.4	196.4	196.4	196.4
10	X-Loc	--- 0	--- 0	--- 0	--- 0	--- 0

		Elev	---	---	---	---	---
11		X-Loc	277.4 3	277.1 3	299.0 2	301.2 2	301.2 2
		Elev	134.3	133.5	194.3	194.3	194.3
12		X-Loc	289.4 3	288.3 3	319.0 2	--- 1	--- 0
		Elev	133.7	131.5	194.7	---	---

Spread A   Points of entry of refracted rays below source shotpoints:

L=2	Right	X-Loc	91.2	91.2	210.6	---	---
		Elev	193.2*	193.2	195.5	---	---
L=2	Left	X-Loc	---	---	209.5	329.2	329.2
		Elev	---	---	195.5	194.7	194.7*
L=3	Right	X-Loc	130.9	130.9	---	---	---
		Elev	121.6*	121.6	---	---	---
L=3	Left	X-Loc	---	---	---	308.5	308.5
		Elev	---	---	---	132.5	132.5*

Line 4 Banks 247 Zoar Road

Spread A   Depth and Elev of layers directly beneath SPs and Geos for LINE4.DAT

	Surface		Layer 2		Layer 3	
SP	X-Loc	Elev	Depth	Elev	Depth	Elev
---	-----	------	-----	------	-----	------
B	90.0	200.0	6.9	193.1	78.4	121.6
C	210.0	200.0	4.6	195.4	70.3	129.7
D	330.0	200.0	5.5	194.5	67.5	132.5
Geo						

1	100.0	200.0	6.6	193.4	78.4	121.6
2	120.0	200.0	6.0	194.0	78.4	121.6
3	140.0	200.0	6.2	193.8	73.6	126.4
4	160.0	200.0	5.9	194.1	69.7	130.3
5	180.0	200.0	5.5	194.5	69.6	130.4
6	200.0	200.0	4.6	195.4	70.1	129.9
7	220.0	200.0	4.5	195.5	70.5	129.5
8	240.0	200.0	4.1	195.9	69.1	130.9
9	260.0	200.0	3.6	196.4	67.6	132.4
10	280.0	200.0	4.6	195.4	66.8	133.2
11	300.0	200.0	5.6	194.4	67.3	132.7

```
 12      320.0   200.0       5.4   194.6      67.5   132.5
```

LINE4.DAT

Velocities used, Spread A

	Layer 1	Layer 2	Layer 3
Vertical	969	5323	
Horizontal		5323	14725

LINE4.DAT
Line 4 Banks 247 Zoar Road

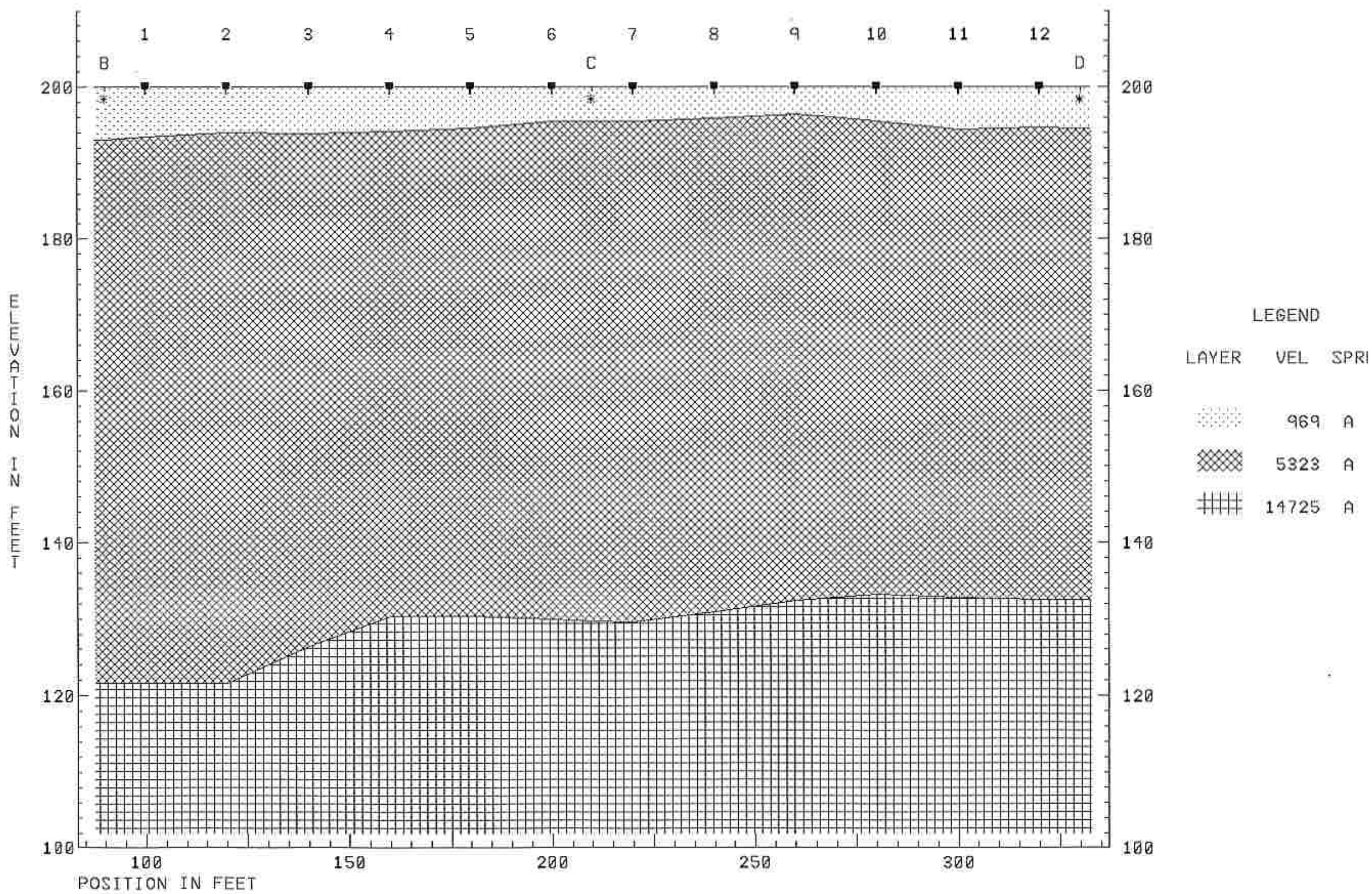
```
                                                                                                                         S
        D                                                                                                             G  p
        i                                                                                                          S  e  r
        s                                     E l e v a t i o n    ( f e e t )                                     P  o  e
        t                                                                                                                a
                                                                                                                         d
          110       120       130       140       150       160       170       180       190       200       210
            +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
            -                                                                                         :         -
     90.0   +         + :       +         +         +         +         +         +         +  s     *:         +  B     A
            -           :                                                                      :      :         -
    100.0   +           :                                                                      #      :>        +     1  A
            -           :                                                                       :     :         -
            -           :                                                                       :     :         -
            -           :                                                                       :     :         -
    120.0   +           :                                                                       #     :>        +     2  A
            -            :                                                                      :     :         -
            -           s :                                                                     :     :         -
            -              :                                                                    :     :         -
    140.0   +               :                                                                   #     :>        +     3  A
            -                :                                                                  :     :         -
            -                 :  ED                                                             :     :         -
            -                  :                                                                :     :         -
    160.0   +                   D E                                                             #     :>        +     4  A
            -                   :  E                                                            :     :         -
            -                   :                                                               :     :         -
            -                   :                                                               :     :         -
```

```
180.0   +                   :                                                               ##    :>        +     5  A
        -                   : E                                                              :    :         -
        -                   :                                                                :    :         -
        -                 A :                                                                :    :         -
200.0   +                   :                                                                #    :>        +     6  A
        -                  E:                                                                :    :         -
210.0   +         +         :         +         +         +         +         +         +    s   *:         +  C     A
        -                  A:                                                                :    :         -
220.0   +                  :                                                                 #:   :>        +     7  A
        -                   :                                                                 :   :         -
        -                   :                                                                 :   :         -
        -                    :                                                                :   :         -
240.0   +                   A:                                                                #   :>        +     8  A
        -                    :                                                                :   :         -
        -                     :                                                               :   :         -
        -                     :                                                               :   :         -
260.0   +                     :                                                               #   :>        +     9  A
        -                      :                                                              :   :         -
        -                      :                                                              :   :         -
        -                      BA                                                             :   :         -
280.0   +                      :                                                             :    :>        +    10  A
        -                      :                                                             :    :         -
        -                    B :A                                                            :    :         -
        -                      :                                                             :    :         -
300.0   +                      :                                                            #     :>        +    11  A
        -                      :                                                            :     :         -
        -                      s                                                             :    :         -
        -                      :                                                             :    :         -
320.0   +                      :                                                             C    :>        +    12  A
        -                      :                                                             :    :         -
330.0   +         +         +  :      +         +         +         +         +         +    s   *:         +  D     A
        -                      :                                                            :     :         -
        +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
      110       120       130       140       150       160       170       180       190       200       210
                                                                                                                     S
    D                                                                                                             G  p
    i                                                                                                          S  e  r
    s                                     E l e v a t i o n    ( f e e t )                                     P  o  e
    t                                                                                                                a
                                                                                                                     d

         PRINTER PLOT SCALES                 L E G E N D
```

```
---------------------      ----------------------------------------
 Elev:   1.00 ft/col             >  Geophone Location
 Dist:   5.00 ft/row             *  Shotpoint Location
                             A,B,C  Emergent Ray; Source SP A,B,C,...
                                 ?  Questionable Emergent Ray
                                 s  Ray Entrypoint Beneath SP
                                 #  More Than One Symbol to Plot Here
                                 +  Grid Mark
```

FILE LINE4.DAT
LINE 4

SPREAD A



SIPT2 V-4.1 --- SEISMIC REFRACTION INTERPRETATION PROGRAM --- RIMROCK GEOPHYSICS, INC.

DATA FILE: MOHAWK1.DAT PRINT FILE: C:\SIPT\SIPT\MOHAWK1.OUT RUN DATE AND TIME: 05-02-2007 at 11:23

TITLE: Mohawk Trail State Forest lower meadow line1

PROGRAM CONTROL DATA				Printer	Plot	Scales	Datum Plane		Control Points		Plot Control		Special Control Parameters				
				Elev	Horiz	Time	Point 1		Point 2		Elevations				Trace	Off	L
Sprds	Exit	Layers	V-Over	ft/col	ft/row	ms/col	Elev	X-Loc	Elev	X-Loc	Top	Bottom	BLim	TLim	Print	SP	Dip
1	6	3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0.5	10.0	0	0	0

SHOTPOINT AND GEOPHONE INPUT DATA for MOHAWK1.DAT

Spread A, 5 Shotpoints, 12 Geophones, X-Shift = 0.0, X-True = 1, Units: Feet.

SP	Elev	X-Loc	Y-Loc	Depth	UpHole T	Fudge T	End SP
A	100.0	0.0	0.0	0.0	0.0	0.0	0
B	100.0	90.0	0.0	0.0	0.0	0.0	1
C	100.0	210.0	0.0	0.0	0.0	0.0	0
D	100.0	330.0	0.0	0.0	0.0	0.0	2
E	100.0	420.0	0.0	0.0	0.0	0.0	0

Arrival Times + Fudge T and Layers represented

Geo	Elev	X-Loc	Y-Loc	SP A T	SP A L	SP B T	SP B L	SP C T	SP C L	SP D T	SP D L	SP E T	SP E L
1	100.0	100.0	0.0	42.00	2	15.25	1	43.25	2	62.50	3	73.00	3
2	100.0	120.0	0.0	47.50	2	27.25	2	40.75	2	61.75	3	72.75	3
3	100.0	140.0	0.0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
4	100.0	160.0	0.0	55.75	2	36.75	2	33.25	2	55.25	2	67.75	2
5	100.0	180.0	0.0	60.00	2	40.00	2	24.50	2	50.50	2	64.00	2
6	100.0	200.0	0.0	64.25	2	42.75	2	14.50	1	47.00	2	62.25	2
7	100.0	220.0	0.0	66.75	2	48.25	2	13.25	1	44.50	2	58.50	2
8	100.0	240.0	0.0	70.50	2	51.50	2	25.75	2	42.00	2	54.75	2
9	100.0	260.0	0.0	72.75	2	56.00	2	32.25	2	37.25	2	51.50	2
10	100.0	280.0	0.0	77.50	2	57.75	2	37.50	2	32.50	2	48.25	2
11	100.0	300.0	0.0	81.25	3	61.25	3	40.00	2	28.25	2	45.75	2
12	100.0	320.0	0.0	82.00	3	63.25	3	44.75	2	18.00	1	43.25	2

Layer 1 Velocity from direct arrivals

Spread A	SP	Geo	DD	V	Avg V
	B	1	10.0	656	
					656
	C	6	10.0	690	
	C	7	10.0	755	
					722
	D	12	10.0	556	
					556

Wtd Avg Velocity computed for Layer 1 = 664

Layer 2 Velocity computed by regression of raw uncorrected arrivals

Spread A

V	Ti	Geos	<-SP->	Geos	Ti	V	Avg V	Avg Ti	Pts
			A	1 10	24.6	5242	5242	24.6	9
			B	2 10	22.3	5178	5178	22.3	8
4444	19.7	1 5	C	8 12	20.0	4372	4404	19.9	9
5406	23.7	4 11	D				5406	23.7	8
6391	26.9	4 12	E				6391	26.9	9
						Avg =	5248	for	43 Pts

Layer 2 Velocity computed by Hobson-Overton method

Spread A			Avg	Std Err	4 Highest Std Err at geophones							
SPs	Geos	V	TdSP	Overall	Err	Geo	Err	Geo	Err	Geo	Err	Geo
A C	1 5	4482	0.3	1.501	-2.300	4	1.775	5	0.725	1	-0.200	2
A D	4 10	5693	3.3	1.147	1.634	6	1.277	10	-1.196	9	-1.170	8
A E	4 10	5957	5.3	0.544	-0.821	9	0.786	5	-0.500	4	0.464	10
B C	2 5	4211	0.2	1.080	-1.500	4	1.000	5	0.500	2		
B D	4 10	5504	-0.2	0.622	-1.196	8	0.786	9	0.607	5	-0.411	6
B E	4 10	5751	1.6	0.966	-1.973	6	1.161	9	-0.795	10	0.482	5
C D	8 11	4255	-1.1	1.147	1.425	10	-1.225	11	-1.025	8	0.825	9
C E	8 12	5369	0.4	1.208	1.900	10	-1.450	8	0.850	9	-0.750	12

```
            ------
      Avg =   5335 for  44 Pts

----------------------------------------------
Wtd Avg Velocity computed for Layer 2 =   5307
------------------------------------------------------------------------------

Layer 3 Velocity computed by regression of raw uncorrected arrivals

 Spread A
    V     Ti    Geos  <-SP->  Geos   Ti      V         Avg V  Avg Ti   Pts
 ------  ----  -----   ---   -----  ----  ------      ------  ------   ---
                        A    11 12  70.0   26667       26667    70.0     2
                        B    11 12  40.3   10000       10000    40.3     2
  26667  53.9   1  2    D                              26667    53.9     2
  80000  69.0   1  2    E                              80000    69.0     2
                                                      ------           ---
                                                Avg =  21333    for      8 Pts

Layer 3 Velocity computed by Hobson-Overton method

        Not enough points.
----------------------------------------------
Wtd Avg Velocity computed for Layer 3 =  21333
------------------------------------------------------------------------------


Arrival times Td corrected to datum. (Datum Elev = 100.000 + 0.000x) for MOHAWK1.DAT

Spread A                           SP A      SP B      SP C      SP D      SP E

 Datum Elev . . . . . . . . .     100.0     100.0     100.0     100.0     100.0
         .
 Geo     .       X-Loc  Cor T       0.0       0.0       0.0       0.0       0.0
 ---     .       -----  -----     --Td--    --Td--    --Td--    --Td--    --Td--
  1   100.0      100.0    0.0      42.0      15.3      43.3      62.5      73.0
  2   100.0      120.0    0.0      47.5      27.3      40.8      61.8      72.8
  3   100.0      140.0    0.0       0.0       0.0       0.0       0.0       0.0
  4   100.0      160.0    0.0      55.8      36.8      33.3      55.3      67.8
  5   100.0      180.0    0.0      60.0      40.0      24.5      50.5      64.0
  6   100.0      200.0    0.0      64.3      42.8      14.5      47.0      62.3
  7   100.0      220.0    0.0      66.8      48.3      13.3      44.5      58.5
```

8	100.0	240.0	0.0	70.5	51.5	25.8	42.0	54.8
9	100.0	260.0	0.0	72.8	56.0	32.3	37.3	51.5
10	100.0	280.0	0.0	77.5	57.8	37.5	32.5	48.3
11	100.0	300.0	0.0	81.3	61.3	40.0	28.3	45.8
12	100.0	320.0	0.0	82.0	63.3	44.8	18.0	43.3

Arrival times Tc corrected to top of Layer 2 and Elev of top of Layer 2 for MOHAWK1.DAT

Spread A				SP A	SP B	SP C	SP D	SP E
	Elev			0.0	92.3	92.6	91.3	0.0
Geo	.	X-Loc	Cor T	11.6	11.6	11.1	13.2	13.2
---	.	-----	-----	--Tc--	--Tc--	--Tc--	--Tc--	--Tc--
1	92.4	100.0	11.5	-0.4	0.0	20.7	37.9	37.6
2	92.1	120.0	11.9	4.6	3.7	17.7	36.6	36.9
3	92.2	140.0	11.8	0.0	0.0	0.0	0.0	0.0
4	92.3	160.0	11.6	13.2	13.6	10.6	30.5	28.6
5	93.0	180.0	10.5	18.6	17.9	2.9	26.8	25.9
6	92.8	200.0	10.9	22.4	20.3	0.0	22.9	23.7
7	92.5	220.0	11.3	24.5	25.4	0.0	20.0	19.6
8	92.4	240.0	11.5	28.1	28.4	3.1	17.3	15.6
9	92.2	260.0	11.8	30.0	32.6	9.4	12.3	12.1
10	92.1	280.0	11.8	34.7	34.3	14.6	7.5	8.8
11	91.9	300.0	12.2	38.1	37.5	16.7	2.9	6.0
12	91.4	320.0	13.0	38.0	38.6	20.6	0.0	2.6

MOHAWK1.DAT
Mohawk Trail State Forest lower meadow line1

```
S                            Time-Distance Plot  --  Raw data with no corrections applied
p  G                                                                                                    D
r  e  S                                                                                                 i
e  o  P                                 T i m e   ( m i l l i  s e c o n d s )                          s
a                                                                                                       t
d
         0         10        20        30        40        50        60        70        80        90       100
         +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
         -                                   :                                                              -
A     B  +         +         +         +       : +         +         +         +         +         +         +      90.0
```

```
        -       :                               :                                                           -
A  1    +              1                          22                   3         3                          +      100.0
        -                 :                        :                  :          :                          -
        -                    :                    :  :                :          :                          -
        -                       :                :    :               :          :                          -
A  2    +                          2             2      2             3          3                          +      120.0
        -                           :           :        :           :          :                           -
        -                             :        :          :         :           :                           -
        -                              :      :            :       :           :                            -
A  3    +                               :    :              :      :          :                             +      140.0
        -                                :  :                :    :           :                             -
        -                                 ::                  :  :           :                              -
        -                                 : :                  ::           :                               -
A  4    +                                2   2                 22           2                               +      160.0
        -                              :      :               :  :         :                                -
        -                            :        :              :    :       :                                 -
        -                          :           :            :      :     :                                  -
A  5    +                         2              2         2        2   2                                   +      180.0
        -                      :                  :        :          :  :                                  -
        -                    :                    :       :            ::                                   -
        -                 :                        :     :              :                                   -
A  6    +              1                           2   2              2 2                                   +      200.0
        -      :                                    : :              :   :                                  -
A     C +         +         +         +         +     :   +         +     :   +         +         +         +      210.0
        -      :                                     : :           :      :                                 -
A  7    +            1                               2  2          2       2                                +      220.0
        -               :                           :    :        :         :                               -
        -                   :                      :      :      :           :                              -
        -                      :                   :       :    :             :                             -
A  8    +                         2               2         2  2               2                            +      240.0
        -                          :             :           ::                :                            -
        -                            :          :            ::                 :                           -
        -                              :      :             :  :                :                           -
A  9    +                               2    2              2   2                2                          +      260.0
        -                                 : :              :    :                 :                         -
        -                                  :              :      :                 :                        -
        -                                 : :            :       :                  :                       -
A 10    +                                2    2         2         2                   2                     +      280.0
        -                              :      :         :          :                  :                     -
        -                             :        :       :            :                  :                    -
        -                            :         :      :             :                   :                   -
A 11    +                           2           2     2              3                   3                  +      300.0
```

```
        -                         :              :   :                :                  :                  -
        -                      :                  :  :                :                   :                 -
        -                    :                      :                  :                  :                 -
A 12    +                 1                        2 2                 3                  3                 +      320.0
        -        :                               :                                                          -
A     D +         +         +         +        :+         +         +         +         +         +         +      330.0
        -                                    :                                                              -
        +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
        0        10        20        30        40        50        60        70        80        90       100
```

PRINTER PLOT SCALES

Time: 1.00 ms/col
Dist: 5.00 ft/row

Mohawk Trail State Forest lower meadow line1

Spread A Points of emergence of refracted rays below target geophones for MOHAWK1.DAT

Geo		SP A	SP B	SP C	SP D	SP E
---		----------L	----------L	----------L	----------L	----------L
1	X-Loc	99.2 2	--- 1	101.0 2	153.4 3	151.0 3
	Elev	92.4	---	92.4	14.9	18.5
2	X-Loc	119.1 2	119.1 2	121.1 2	166.5 3	165.1 3
	Elev	92.1	92.1	92.1	16.4	18.8
3	X-Loc	--- 0	--- 0	--- 0	--- 0	--- 0
	Elev	---	---	---	---	---
4	X-Loc	158.9 2	158.9 2	161.1 2	161.1 2	161.1 2
	Elev	92.3	92.3	92.3	92.3	92.3
5	X-Loc	179.4 2	179.4 2	180.7 2	180.7 2	180.7 2
	Elev	93.0	93.0	93.0	93.0	93.0
6	X-Loc	199.1 2	199.1 2	--- 1	200.9 2	200.9 2
	Elev	92.8	92.8	---	92.7	92.7
7	X-Loc	218.9 2	218.9 2	--- 1	221.0 2	221.0 2
	Elev	92.5	92.5	---	92.5	92.5
8	X-Loc	239.0 2	239.0 2	239.0 2	241.1 2	241.1 2
	Elev	92.4	92.4	92.4	92.3	92.3
9	X-Loc	258.9 2	258.9 2	258.9 2	261.0 2	261.0 2
	Elev	92.2	92.2	92.2	92.2	92.2

10		X-Loc	279.1 2	279.1 2	279.1 2	280.9 2	280.9 2
		Elev	92.2	92.2	92.2	92.1	92.1
11		X-Loc	270.0 3	269.4 3	298.9 2	300.9 2	300.9 2
		Elev	30.7	29.5	91.9	91.9	91.9
12		X-Loc	286.0 3	283.5 3	318.8 2	--- 1	321.1 2
		Elev	33.3	28.9	91.3	---	91.3

Spread A   Points of entry of refracted rays below source shotpoints:

L=2	Right	X-Loc	91.0	91.0	210.8	---	---
		Elev	92.4*	92.4	92.6	---	---
L=2	Left	X-Loc	---	---	209.1	328.9	328.9
		Elev	---	---	92.6	91.2	91.2*
L=3	Right	X-Loc	132.4	132.4	---	---	---
		Elev	6.5*	6.5	---	---	---
L=3	Left	X-Loc	---	---	---	311.6	311.6
		Elev	---	---	---	24.2	24.2*

Mohawk Trail State Forest lower meadow line1

Spread A   Depth and Elev of layers directly beneath SPs and Geos for MOHAWK1.DAT

	Surface		Layer 2		Layer 3	
SP	X-Loc	Elev	Depth	Elev	Depth	Elev
---	-----	------	-----	------	-----	------
B	90.0	100.0	7.4	92.6	93.5	6.5
C	210.0	100.0	7.4	92.6	77.1	22.9
D	330.0	100.0	9.0	91.0	75.8	24.2
Geo						

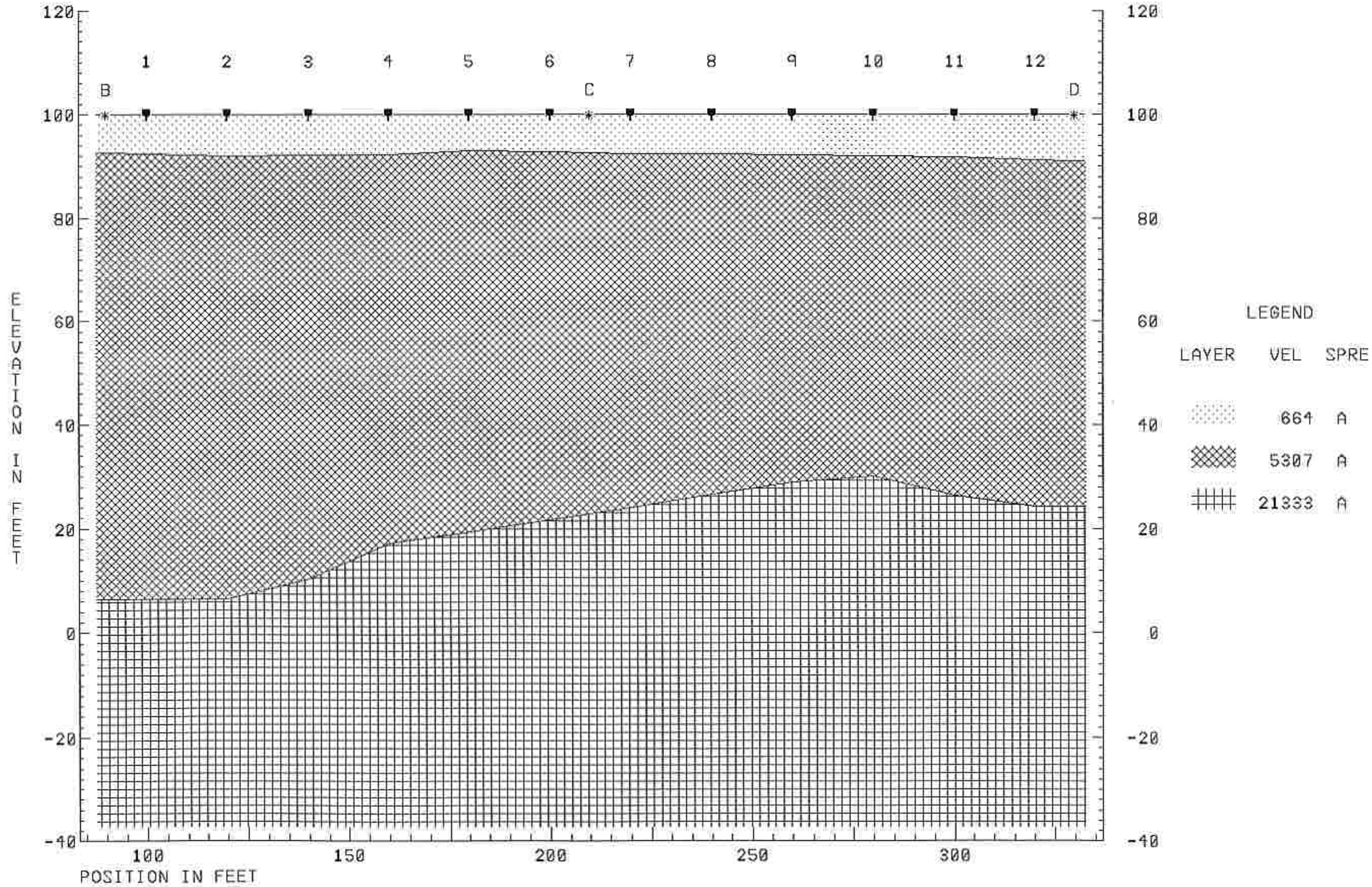
1	100.0	100.0	7.6	92.4	93.5	6.5
2	120.0	100.0	7.9	92.1	93.5	6.5
3	140.0	100.0	7.8	92.2	89.6	10.4
4	160.0	100.0	7.7	92.3	82.8	17.2
5	180.0	100.0	7.0	93.0	80.7	19.3
6	200.0	100.0	7.2	92.8	78.3	21.7
7	220.0	100.0	7.5	92.5	75.9	24.1
8	240.0	100.0	7.6	92.4	73.5	26.5
9	260.0	100.0	7.8	92.2	71.1	28.9
10	280.0	100.0	7.9	92.1	69.9	30.1

```
 11      300.0   100.0       8.1    91.9      73.7    26.3
 12      320.0   100.0       8.7    91.3      75.8    24.2


MOHAWK1.DAT

Velocities used, Spread A

                 Layer 1           Layer 2           Layer 3
                 -------           -------           -------
       Vertical      664              5307
     Horizontal                       5307             21333


MOHAWK1.DAT
 Mohawk Trail State Forest lower meadow line1
                                                                                                                         S
        D                                                                                                             G  p
        i                                                                                                          S  e  r
        s                                     E l e v a t i o n    ( f e e t )                                     P  o  e
        t                                                                                                                a
                                                                                                                         d
          -80       -60       -40       -20         0        20        40        60        80       100       120
            +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
            -                                                                                         :         -
     90.0   +         +         +         +         +  :      +         +         +         +     s   *         +  B     A
            -                                          :                                          :   :         -
    100.0   +                                          :                                          #   :>        +     1  A
            -                                          :                                          :   :         -
            -                                          :                                          :   :         -
            -                                          :                                          :   :         -
    120.0   +                                          :                                          #   :>        +     2  A
            -                                           :                                         :   :         -
            -                                          s:                                         :   :         -
            -                                            :                                        :   :         -
    140.0   +                                            :                                        :   :>        +     3  A
            -                                             :                                       :   :         -
            -                                              : E                                    :   :         -
            -                                              D:                                     :   :         -
    160.0   +                                                :                                    #   :>        +     4  A
            -                                               DE                                    :   :         -
            -                                                :                                    :   :         -
```

```
        -                                                :                                    :   :         -
180.0   +                                                 :                                    #  :>        +     5  A
        -                                                 :                                   :   :         -
        -                                                 :                                   :   :         -
        -                                                  :                                  :   :         -
200.0   +                                                  :                                  #   :>        +     6  A
        -                                                  :                                  :   :         -
210.0   +         +         +         +         +         +:        +         +         +     s   *         +  C     A
        -                                                   :                                 :   :         -
220.0   +                                                   :                                 #   :>        +     7  A
        -                                                   :                                 :   :         -
        -                                                    :                                :   :         -
        -                                                    :                                :   :         -
240.0   +                                                    :                                #   :>        +     8  A
        -                                                     :                               :   :         -
        -                                                     :                               :   :         -
        -                                                     :                               :   :         -
260.0   +                                                     :                               #   :>        +     9  A
        -                                                      :                              :   :         -
        -                                                      #                              :   :         -
        -                                                      :                              :   :         -
280.0   +                                                      :                              #   :>        +    10  A
        -                                                     B: A                            :   :         -
        -                                                     :                               :   :         -
        -                                                     :                               :   :         -
300.0   +                                                    :                                #   :>        +    11  A
        -                                                    :                                :   :         -
        -                                                   s:                                :   :         -
        -                                                   :                                 :   :         -
320.0   +                                                   :                                 #   :>        +    12  A
        -                                                   :                                 :   :         -
330.0   +         +         +         +         +         + :       +         +         +     s   *         +  D     A
        -                                                   :                                :    :         -
        +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
      -80       -60       -40       -20         0        20        40        60        80       100       120
                                                                                                                     S
    D                                                                                                             G  p
    i                                                                                                          S  e  r
    s                                     E l e v a t i o n    ( f e e t )                                     P  o  e
    t                                                                                                                a
                                                                                                                     d
```

```
 PRINTER PLOT SCALES                L E G E N D
---------------------      ----------------------------------------
 Elev:   2.00 ft/col             >  Geophone Location
 Dist:   5.00 ft/row             *  Shotpoint Location
                           A,B,C  Emergent Ray; Source SP A,B,C,...
                                 ?  Questionable Emergent Ray
                                 s  Ray Entrypoint Beneath SP
                                 #  More Than One Symbol to Plot Here
                                 +  Grid Mark
```

FILE MOHAWK1.DAT
MOHAWK TRAIL STATE FOREST LOWER MEADOW LINE1
SPREAD A



SIPT2 V-4.1 --- SEISMIC REFRACTION INTERPRETATION PROGRAM --- RIMROCK GEOPHYSICS, INC.

DATA FILE: MOHAWK2B.DAT PRINT FILE: C:\SIPT\SIPT\MOHAWK2B.OUT RUN DATE AND TIME: 05-02-2007 at 11:23

TITLE: line2bmohawk

PROGRAM CONTROL DATA

				Printer	Plot	Scales	Datum	Plane	Control	Points	Plot Control		Special	Control	Parameters		
				Elev	Horiz	Time	Point 1		Point 2		Elevations				Trace	Off	L
Sprds	Exit	Layers	V-Over	ft/col	ft/row	ms/col	Elev	X-Loc	Elev	X-Loc	Top	Bottom	BLim	TLim	Print	SP	Dip
1	6	3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0.5	10.0	0	0	0

SHOTPOINT AND GEOPHONE INPUT DATA for MOHAWK2B.DAT

Spread A, 5 Shotpoints, 12 Geophones, X-Shift = 0.0, X-True = 1, Units: Feet.

SP	Elev	X-Loc	Y-Loc	Depth	UpHole T	Fudge T	End SP
A	200.0	0.0	0.0	0.0	0.0	0.0	0
B	200.0	90.0	0.0	0.0	0.0	0.0	1
C	200.0	210.0	0.0	0.0	0.0	0.0	0
D	200.0	330.0	0.0	0.0	0.0	0.0	2
E	200.0	420.0	0.0	0.0	0.0	0.0	0

Arrival Times + Fudge T and Layers represented

Geo	Elev	X-Loc	Y-Loc	SP A T	SP A L	SP B T	SP B L	SP C T	SP C L	SP D T	SP D L	SP E T	SP E L
1	200.0	100.0	0.0	43.50	2	13.25	1	45.75	2	65.00	2	76.00	3
2	200.0	120.0	0.0	46.00	2	23.00	2	41.75	2	61.75	2	78.50	3
3	200.0	140.0	0.0	51.00	2	32.75	2	39.25	2	60.75	2	78.00	3
4	200.0	160.0	0.0	53.75	2	36.25	2	33.00	2	53.00	2	72.50	2
5	200.0	180.0	0.0	57.50	2	40.25	2	27.50	2	48.75	2	68.75	2
6	200.0	200.0	0.0	62.25	2	44.00	2	20.75	1	46.00	2	64.00	2
7	200.0	220.0	0.0	65.75	2	48.25	2	20.25	1	42.00	2	60.75	2
8	200.0	240.0	0.0	68.50	2	51.50	2	29.25	2	37.25	2	56.25	2
9	200.0	260.0	0.0	72.25	2	55.25	2	32.50	2	32.00	2	53.00	2
10	200.0	280.0	0.0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
11	200.0	300.0	0.0	82.25	3	61.75	2	39.50	2	23.25	2	47.75	2
12	200.0	320.0	0.0	83.25	3	63.75	2	42.75	2	15.75	1	43.00	1

Layer 1 Velocity from direct arrivals

Spread A

SP	Geo	DD	V	Avg V
B	1	10.0	755	
				755
C	6	10.0	482	
C	7	10.0	494	
				488
D	12	10.0	635	
				635
E	12	100.0	2326	
				2326

Wtd Avg Velocity computed for Layer 1 = 938

Layer 2 Velocity computed by regression of raw uncorrected arrivals

Spread A

V	Ti	Geos	<-SP->	Geos	Ti	V	Avg V	Avg Ti	Pts
			A	1 9	24.8	5442	5442	24.8	9
			B	2 12	21.8	5193	5193	21.8	10
4420	21.6	1 5	C	8 12	24.1	5882	4969	22.9	9
4710	17.7	1 11	D				4710	17.7	10
5525	24.7	4 11	E				5525	24.7	7
						Avg =	5125	for	45 Pts

Layer 2 Velocity computed by Hobson-Overton method

Spread A

SPs	Geos	V	Avg TdSP	Std Err Overall	4 Highest Std Err at geophones Err	Geo	Err	Geo	Err	Geo	Err	Geo
A C	1 5	4938	-1.3	0.849	-1.150	3	1.050	1	0.900	5	-0.550	2
A D	1 9	5101	2.3	1.017	-2.289	3	1.644	1	0.661	9	0.528	5
A E	4 9	5239	0.8	0.675	1.276	6	-0.631	9	-0.588	5	-0.452	4
B C	2 5	3837	-2.3	0.732	1.025	3	-0.800	2	-0.575	5	0.350	4
B D	2 11	4757	2.0	1.507	-2.873	2	2.308	4	2.149	5	-1.306	11
B E	4 11	5495	-0.6	1.103	-1.829	11	1.260	8	-1.121	4	0.981	9

```
C D  8 11    4967   4.3  0.193   0.268   9  -0.179   8  -0.089  11
C E  8 11    6418  -3.5  0.116   0.161   9  -0.107   8  -0.054  11
           ------
     Avg =   5061 for  46 Pts

----------------------------------------------
Wtd Avg Velocity computed for Layer 2 =   5082
------------------------------------------------------------------------------

Layer 3 Velocity computed by regression of raw uncorrected arrivals

 Spread A
    V     Ti    Geos  <-SP->  Geos   Ti      V         Avg V  Avg Ti   Pts
 ------  ----  -----   ---   -----  ----  ------      ------  ------   ---
                        A    11 12  67.3   20000       20000    67.3     2
  20000  92.5   1  3    E                              20000    92.5     3
                                                      ------           ---
                                                Avg =  20000    for      5 Pts

Layer 3 Velocity computed by Hobson-Overton method

        Not enough points.
----------------------------------------------
Wtd Avg Velocity computed for Layer 3 =  20000
------------------------------------------------------------------------------


Arrival times Td corrected to datum. (Datum Elev = 200.000 + 0.000x) for MOHAWK2B.DAT

Spread A                           SP A      SP B      SP C      SP D      SP E

 Datum Elev . . . . . . . . .     200.0     200.0     200.0     200.0     200.0
         .
 Geo     .       X-Loc  Cor T       0.0       0.0       0.0       0.0       0.0
 ---     .       -----  -----     --Td--    --Td--    --Td--    --Td--    --Td--
  1   200.0      100.0    0.0      43.5      13.3      45.8      65.0      76.0
  2   200.0      120.0    0.0      46.0      23.0      41.8      61.8      78.5
  3   200.0      140.0    0.0      51.0      32.8      39.3      60.8      78.0
  4   200.0      160.0    0.0      53.8      36.3      33.0      53.0      72.5
  5   200.0      180.0    0.0      57.5      40.3      27.5      48.8      68.8
  6   200.0      200.0    0.0      62.3      44.0      20.8      46.0      64.0
  7   200.0      220.0    0.0      65.8      48.3      20.3      42.0      60.8
```

8	200.0	240.0	0.0	68.5	51.5	29.3	37.3	56.3
9	200.0	260.0	0.0	72.3	55.3	32.5	32.0	53.0
10	200.0	280.0	0.0	0.0	0.0	0.0	0.0	0.0
11	200.0	300.0	0.0	82.3	61.8	39.5	23.3	47.8
12	200.0	320.0	0.0	83.3	63.8	42.8	15.8	43.0

Arrival times Tc corrected to top of Layer 2 and Elev of top of Layer 2 for MOHAWK2B.DAT

Spread A				SP A	SP B	SP C	SP D	SP E
	Elev			0.0	189.0	189.9	191.4	0.0
Geo	.	X-Loc	Cor T	11.7	11.7	10.7	9.1	9.1
---	.	-----	-----	--Tc--	--Tc--	--Tc--	--Tc--	--Tc--
1	189.1	100.0	11.6	1.9	0.0	23.4	44.2	50.1
2	189.8	120.0	10.9	5.2	0.4	20.1	41.7	53.4
3	188.2	140.0	12.6	8.4	8.4	15.9	39.0	51.2
4	189.6	160.0	11.1	12.7	13.4	11.1	32.8	32.2
5	190.1	180.0	10.6	17.0	17.9	6.2	29.1	28.9
6	190.0	200.0	10.7	21.6	21.6	0.0	26.2	24.1
7	189.9	220.0	10.8	25.0	25.7	0.0	22.1	20.7
8	190.4	240.0	10.3	28.3	29.5	8.2	17.9	16.7
9	190.7	260.0	9.9	32.4	33.6	11.8	12.9	13.8
10	190.7	280.0	9.9	0.0	0.0	0.0	0.0	0.0
11	190.7	300.0	9.9	56.0	40.1	18.9	4.3	8.7
12	191.3	320.0	9.3	57.6	42.8	22.8	0.0	0.0

MOHAWK2B.DAT
line2bmohawk

```
 S                            Time-Distance Plot  --  Raw data with no corrections applied
 p  G                                                                                                          D
 r  e  S                                                                                                       i
 e  o  P                                 T i m e   ( m i l l i  s e c o n d s )                             s
 a                                                                                                             t
 d
         0         10        20        30        40        50        60        70        80        90       100
         +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
         -                                    :                                                             -
 A     B +         +         +         +        :+         +         +         +         +         +         +       90.0
```

```
        -      :                                 :                                                          -
A  1    +            1                              2 2                  2          3                       +      100.0
        -               :                           ::                  :            :                      -
        -                 :                         ::                 :             :                      -
        -                    :                     : :                 :              :                     -
A  2    +                      2                  2   2               2                3                    +      120.0
        -                         :               :     :              :                :                     -
        -                            :            :       :           :                :                     -
        -                              :         :         :          :                :                     -
A  3    +                                2     2           2         2                3                     +      140.0
        -                                 :   :             :      :                 :                      -
        -                                  ::               :    :                 :                        -
        -                                  :                 : :                  :                         -
A  4    +                                2  2                22                  2                          +      160.0
        -                               :    :              :  :                :                           -
        -                             :       :            :    :              :                            -
        -                            :         :          :      :            :                             -
A  5    +                           2           2        2        2          2                              +      180.0
        -                         :              :      :          :        :                               -
        -                       :                 :    :            :     :                                 -
        -                     :                    :   :             :   :                                  -
A  6    +                    1                      2 2               2 2                                   +      200.0
        -         :                                  :                 :                                    -
A     C +         +         +         +         +   : :   +         + : :     +         +         +         +      210.0
        -         :                                :   :              :  :                                  -
A  7    +                   1                     2     2            2    2                                 +      220.0
        -                      :                 :       :          :     :                                 -
        -                        :              :         :        :       :                                -
        -                          :          :            :     :          :                               -
A  8    +                            2       2              2   2            2                              +      240.0
        -                             :     :               :  :             :                              -
        -                              :   :                 : :              :                             -
        -                               ::                    :                :                            -
A  9    +                               22                   2 2                2                           +      260.0
        -                              : :                  :   :                 :                         -
        -                             :   :                 :    :                 :                        -
        -                            :     :               :      :                 :                       -
A 10    +                           :       :             :        :                 :                      +      280.0
        -                          :         :            :        :                   :                    -
        -                        :            :          :          :                   :                   -
        -                       :              :        :            :                   :                  -
A 11    +                      2                2       2             2                   3                 +      300.0
```

```
         -                    :                  :      :              :                    :                -
         -                   :                    :   :                 :                   :                -
         -                 :                       : :                  :                   :                -
 A 12    +               1                          #                    2                  3                +      320.0
         -       :                                :                                                          -
 A     D +         +         +         +        :+         +         +         +         +         +         +      330.0
         -                                    :                                                              -
         +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
         0        10        20        30        40        50        60        70        80        90       100

          PRINTER PLOT SCALES
         ---------------------
          Time:   1.00 ms/col
          Dist:   5.00 ft/row
```

line2bmohawk

Spread A Points of emergence of refracted rays below target geophones for MOHAWK2B.DAT

Geo		SP A	SP B	SP C	SP D	SP E
---		----------L	----------L	----------L	----------L	----------L
1	X-Loc	98.0 2	--- 1	102.5 2	102.5 2	132.3 3
	Elev	189.0	---	189.1	189.1	118.6
2	X-Loc	118.2 2	118.2 2	120.8 2	120.8 2	143.6 3
	Elev	189.8	189.8	189.8	189.8	109.4
3	X-Loc	136.5 2	136.5 2	143.4 2	143.4 2	151.7 3
	Elev	188.2	188.2	188.1	188.1	111.0
4	X-Loc	159.0 2	159.0 2	162.3 2	162.3 2	162.3 2
	Elev	189.6	189.6	189.7	189.7	189.7
5	X-Loc	178.0 2	178.0 2	182.1 2	182.1 2	182.1 2
	Elev	190.1	190.1	190.1	190.1	190.1
6	X-Loc	198.1 2	198.1 2	--- 1	202.2 2	202.2 2
	Elev	190.0	190.0	---	189.9	189.9
7	X-Loc	218.0 2	218.0 2	--- 1	222.2 2	222.2 2
	Elev	189.8	189.8	---	189.9	189.9
8	X-Loc	238.1 2	238.1 2	238.1 2	242.0 2	242.0 2
	Elev	190.3	190.3	190.3	190.4	190.4
9	X-Loc	258.2 2	258.2 2	258.2 2	261.8 2	261.8 2
	Elev	190.7	190.7	190.7	190.7	190.7

10		X-Loc	--- 0	--- 0	--- 0	--- 0	--- 0
		Elev	---	---	---	---	---
11		X-Loc	199.1 3	298.4 2	298.4 2	302.0 2	302.0 2
		Elev	76.8	190.7	190.7	190.8	190.8
12		X-Loc	228.9 3	318.7 2	318.7 2	--- 1	--- 1
		Elev	65.3	191.3	191.3	---	---

Spread A Points of entry of refracted rays below source shotpoints:

L=2	Right	X-Loc	92.1	92.1	211.8	---	---
		Elev	188.9*	188.9	189.9	---	---
L=2	Left	X-Loc	---	---	208.2	328.3	328.3
		Elev	---	---	189.9	191.5	191.5*
L=3	Right	X-Loc	117.9	117.9	---	---	---
		Elev	84.5*	84.5	---	---	---
L=3	Left	X-Loc	---	---	---	293.8	293.8
		Elev	---	---	---	55.7	55.7*

line2bmohawk

Spread A Depth and Elev of layers directly beneath SPs and Geos for MOHAWK2B.DAT

	Surface		Layer 2		Layer 3	
SP	X-Loc	Elev	Depth	Elev	Depth	Elev
---	-----	------	-----	------	-----	------
B	90.0	200.0	11.3	188.7	115.5	84.5
C	210.0	200.0	10.1	189.9	127.4	72.6
D	330.0	200.0	8.6	191.4	144.3	55.7
Geo						

1	100.0	200.0	10.9	189.1	115.5	84.5
2	120.0	200.0	10.2	189.8	113.1	86.9
3	140.0	200.0	11.8	188.2	89.9	110.1
4	160.0	200.0	10.4	189.6	97.9	102.1
5	180.0	200.0	9.9	190.1	110.8	89.2
6	200.0	200.0	10.0	190.0	123.5	76.5
7	220.0	200.0	10.1	189.9	131.3	68.7
8	240.0	200.0	9.6	190.4	136.4	63.6
9	260.0	200.0	9.3	190.7	139.3	60.7
10	280.0	200.0	9.3	190.7	142.3	57.7

11	300.0	200.0	9.3	190.7	144.3	55.7
12	320.0	200.0	8.7	191.3	144.3	55.7

MOHAWK2B.DAT

Velocities used, Spread A

	Layer 1	Layer 2	Layer 3
Vertical	938	5082	
Horizontal		5082	20000

MOHAWK2B.DAT
 line2bmohawk

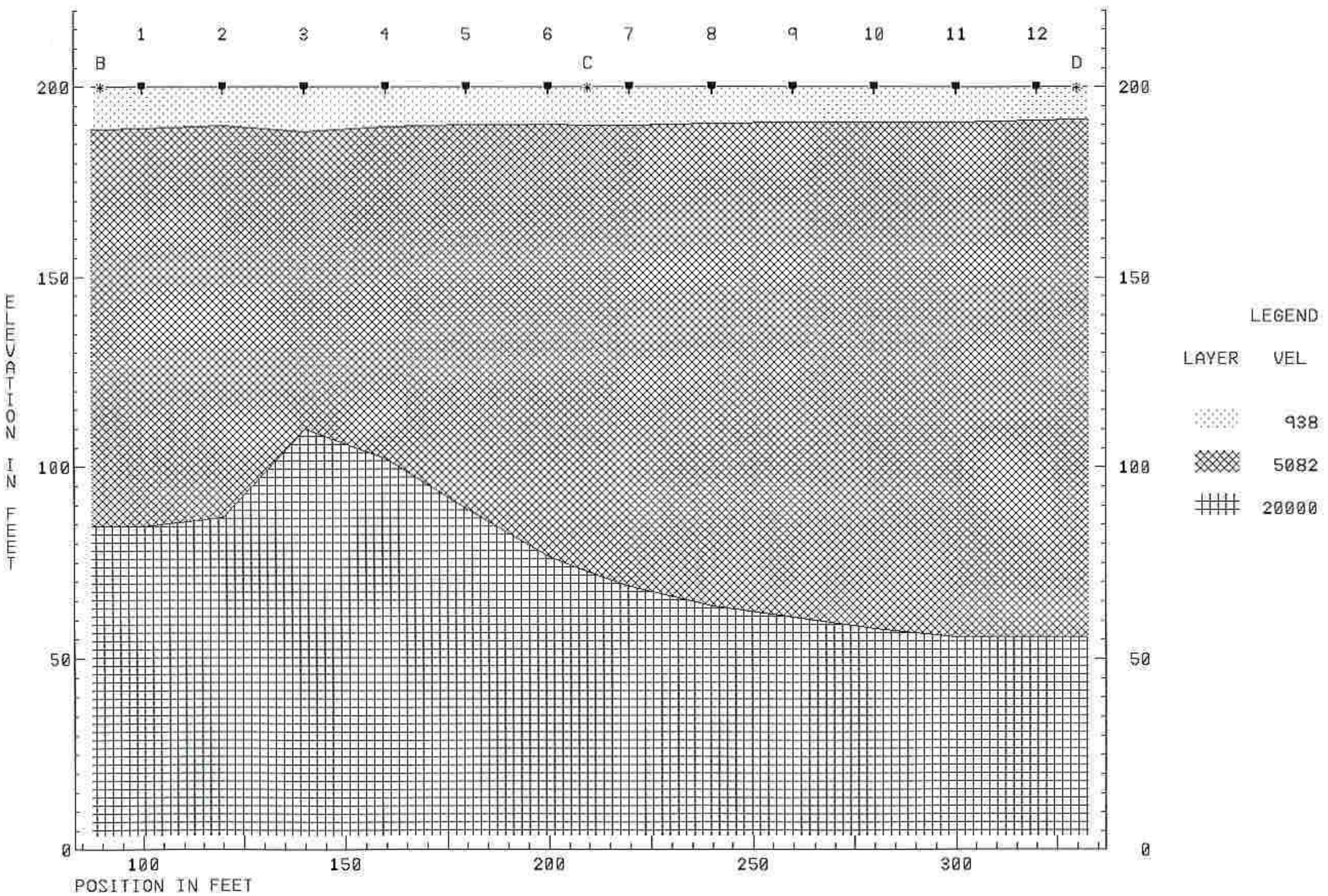
```
                                                                                                                         S
        D                                                                                                             G  p
        i                                                                                                          S  e  r
        s                                    E l e v a t i o n    ( f e e t )                                      P  o  e
        t                                                                                                                a
                                                                                                                         d
           20        40        60        80       100       120       140       160       180       200       220
            +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
            -                                                                                         :         -
     90.0   +         +         +         + :       +         +         +         +         +   s     *         +  B     A
            -                               :                                                   :     :         -
    100.0   +                               :                                                   A:    :>        +     1  A
            -                                :                                                   #    :         -
            -                                :                                                   :    :         -
            -                                :                                                   :    :         -
    120.0   +                               s:                                                   #    :>        +     2  A
            -                                   :                                                :    :         -
            -                                      :         E                                  :     :         -
            -                                         :                                         #     :         -
    140.0   +                                            :                                      :     :>        +     3  A
            -                                           :E                                      #     :         -
            -                                          :  E                                     :     :         -
            -                                         :                                          :    :         -
    160.0   +                                        :                                           #    :>        +     4  A
            -                                      :                                             :    :         -
            -                                     :                                              :    :         -
```

```
        -                                   :                                                :    :         -
180.0   +                                  :                                                 #    :>        +     5  A
        -                                :                                                   :    :         -
        -                              :                                                     :    :         -
        -                             :                                                      :    :         -
200.0   +                           A                                                        #    :>        +     6  A
        -                          :                                                         :    :         -
210.0   +         +         +     :   +         +         +         +         +         +    s    *         +  C     A
        -                        :                                                           :    :         -
220.0   +                       :                                                            #    :>        +     7  A
        -                       :                                                            :    :         -
        -                      A                                                             :    :         -
        -                     :                                                              :    :         -
240.0   +                     :                                                              #    :>        +     8  A
        -                    :                                                               :    :         -
        -                    :                                                               :    :         -
        -                    :                                                               :    :         -
260.0   +                   :                                                                #    :>        +     9  A
        -                   :                                                                :    :         -
        -                   :                                                                :    :         -
        -                  :                                                                 :    :         -
280.0   +                  :                                                                 :    :>        +    10  A
        -                  :                                                                 :    :         -
        -                 :                                                                  :    :         -
        -                 s                                                                  :    :         -
300.0   +                 :                                                                  #    :>        +    11  A
        -                 :                                                                  :    :         -
        -                 :                                                                   :   :         -
        -                 :                                                                   :   :         -
320.0   +                 :                                                                   #   :>        +    12  A
        -                 :                                                                   :   :         -
330.0   +         +       : +         +         +         +         +         +         +     s   *         +  D     A
        -                 :                                                                   :   :         -
        +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
       20        40        60        80       100       120       140       160       180       200       220
                                                                                                                     S
    D                                                                                                         G  p
    i                                                                                                      S  e  r
    s                                     E l e v a t i o n   ( f e e t )                                  P  o  e
    t                                                                                                                a
                                                                                                                     d
```

```
 PRINTER PLOT SCALES                 L E G E N D
---------------------      ----------------------------------------
 Elev:   2.00 ft/col           >  Geophone Location
 Dist:   5.00 ft/row           *  Shotpoint Location
                           A,B,C  Emergent Ray; Source SP A,B,C,...
                               ?  Questionable Emergent Ray
                               s  Ray Entrypoint Beneath SP
                               #  More Than One Symbol to Plot Here
                               +  Grid Mark
```

FILE MOHAWK2B.DAT
LINE2BMOHAWK

SPREAD A



SIPT2 V-4.1 --- SEISMIC REFRACTION INTERPRETATION PROGRAM --- RIMROCK GEOPHYSICS, INC.

DATA FILE: MOHAWK3A.DAT PRINT FILE: C:\SIPT\SIPT\MOHAWK3A.OUT RUN DATE AND TIME: 05-02-2007 at 11:24

TITLE: upper meadow lines3a3b

PROGRAM CONTROL DATA

				Printer	Plot	Scales	Datum Plane		Control Points		Plot Control		Special Control Parameters				
				Elev	Horiz	Time	Point 1		Point 2		Elevations				Trace	Off	L
Sprds	Exit	Layers	V-Over	ft/col	ft/row	ms/col	Elev	X-Loc	Elev	X-Loc	Top	Bottom	BLim	TLim	Print	SP	Dip
1	6	3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0.5	10.0	0	0	0

SHOTPOINT AND GEOPHONE INPUT DATA for MOHAWK3A.DAT

Spread A, 5 Shotpoints, 12 Geophones, X-Shift = 0.0, X-True = 1, Units: Feet.

SP	Elev	X-Loc	Y-Loc	Depth	UpHole T	Fudge T	End SP
A	200.0	0.0	0.0	0.0	0.0	0.0	0
B	200.0	90.0	0.0	0.0	0.0	0.0	1
C	200.0	210.0	0.0	0.0	0.0	0.0	0
D	200.0	330.0	0.0	0.0	0.0	0.0	2
E	200.0	420.0	0.0	0.0	0.0	0.0	0

Arrival Times + Fudge T and Layers represented

Geo	Elev	X-Loc	Y-Loc	SP A T	SP A L	SP B T	SP B L	SP C T	SP C L	SP D T	SP D L	SP E T	SP E L
1	200.0	100.0	0.0	50.50	2	12.25	1	55.00	2	72.50	3	83.25	3
2	200.0	120.0	0.0	59.25	2	20.25	2	46.50	2	70.50	3	82.00	3
3	200.0	140.0	0.0	63.00	2	29.00	2	40.25	2	68.75	3	79.75	3
4	200.0	160.0	0.0	65.75	2	38.00	2	31.25	2	66.00	2	78.00	3
5	200.0	180.0	0.0	67.50	2	45.25	2	22.00	2	63.25	2	75.50	3
6	200.0	200.0	0.0	71.00	2	56.00	2	15.25	1	58.75	2	75.00	3
7	200.0	220.0	0.0	74.25	2	63.00	2	16.75	1	50.50	2	74.50	3
8	200.0	240.0	0.0	78.00	2	67.00	2	25.00	2	42.00	2	70.00	2
9	200.0	260.0	0.0	79.50	3	69.25	3	32.25	2	33.00	2	65.50	2
10	200.0	280.0	0.0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
11	200.0	300.0	0.0	84.25	3	74.00	3	46.00	2	19.75	2	55.00	2
12	200.0	320.0	0.0	86.25	3	75.75	3	57.25	2	9.25	1	45.50	2

Layer 1 Velocity from direct arrivals

Spread A	SP	Geo	DD	V	Avg V
	B	1	10.0	816	
					816
	C	6	10.0	656	
	C	7	10.0	597	
					626
	D	12	10.0	1081	
					1081

Wtd Avg Velocity computed for Layer 1 = 788

Layer 2 Velocity computed by regression of raw uncorrected arrivals

Spread A

V	Ti	Geos	<-SP->	Geos	Ti	V	Avg V	Avg Ti	Pts
			A	1 8	36.5	5729	5729	36.5	8
			B	2 8	9.1	2475	2475	9.1	7
2462	10.6	1 5	C	8 12	12.7	2556	2503	11.7	9
2859	10.1	4 11	D				2859	10.1	7
3361	17.4	8 12	E				3361	17.4	4

Avg = 3054 for 35 Pts

Layer 2 Velocity computed by Hobson-Overton method

Spread A

SPs	Geos	V	Avg TdSP	Std Err Overall	Err	Geo	Err	Geo	Err	Geo	Err	Geo
					4 Highest Std Err at geophones							
A C	1 5	3285	0.9	1.695	2.725	2	-2.350	1	-1.050	5	0.550	3
A D	4 8	4348	-0.9	2.309	2.950	4	-2.950	6	2.400	8	-1.750	5
B C	2 5	2402	-1.9	0.627	-1.050	3	0.600	2	0.300	4	0.150	5
B D	4 8	2930	4.6	1.286	-2.100	5	1.550	4	1.100	7	-0.500	6
C D	8 11	2800	5.2	0.849	1.179	9	-0.786	8	-0.393	11		
C E	8 12	2904	5.2	2.601	-3.900	11	3.075	12	1.425	8	-0.600	9

Avg = 3171 for 26 Pts

```
---------------------------------------------
Wtd Avg Velocity computed for Layer 2 =   3124
-----------------------------------------------------------------------------

Layer 3 Velocity computed by regression of raw uncorrected arrivals

 Spread A
    V     Ti    Geos  <-SP->  Geos   Ti      V         Avg V  Avg Ti   Pts
 ------  ----  -----   ---   -----  ----  ------      ------  ------   ---
                        A     9 12  50.1    8819        8819    50.1     3
                        B     9 12  50.7    9106        9106    50.7     3
  10667  50.9   1  3    D                              10667    50.9     3
  12584  57.6   1  7    E                              12584    57.6     7
                                                      ------           ---
                                                Avg =  10616    for     16 Pts

Layer 3 Velocity computed by Hobson-Overton method

        Not enough points.
---------------------------------------------
Wtd Avg Velocity computed for Layer 3 =  10616
-----------------------------------------------------------------------------


Arrival times Td corrected to datum. (Datum Elev = 200.000 + 0.000x) for MOHAWK3A.DAT

Spread A                           SP A      SP B      SP C      SP D      SP E

 Datum Elev . . . . . . . . .     200.0     200.0     200.0     200.0     200.0
         .
 Geo     .       X-Loc  Cor T       0.0       0.0       0.0       0.0       0.0
 ---     .       -----  -----     --Td--    --Td--    --Td--    --Td--    --Td--
  1   200.0      100.0    0.0      50.5      12.3      55.0      72.5      83.3
  2   200.0      120.0    0.0      59.3      20.3      46.5      70.5      82.0
  3   200.0      140.0    0.0      63.0      29.0      40.3      68.8      79.8
  4   200.0      160.0    0.0      65.8      38.0      31.3      66.0      78.0
  5   200.0      180.0    0.0      67.5      45.3      22.0      63.3      75.5
  6   200.0      200.0    0.0      71.0      56.0      15.3      58.8      75.0
  7   200.0      220.0    0.0      74.3      63.0      16.8      50.5      74.5
  8   200.0      240.0    0.0      78.0      67.0      25.0      42.0      70.0
  9   200.0      260.0    0.0      79.5      69.3      32.3      33.0      65.5
```

10	200.0	280.0	0.0	0.0	0.0	0.0	0.0	0.0
11	200.0	300.0	0.0	84.3	74.0	46.0	19.8	55.0
12	200.0	320.0	0.0	86.3	75.8	57.3	9.3	45.5

Arrival times Tc corrected to top of Layer 2 and Elev of top of Layer 2 for MOHAWK3A.DAT

Spread A				SP A	SP B	SP C	SP D	SP E
	Elev			0.0	190.9	193.5	193.4	0.0
Geo	.	X-Loc	Cor T	11.6	11.6	8.3	8.4	8.4
---	.	-----	-----	--Tc--	--Tc--	--Tc--	--Tc--	--Tc--
1	191.2	100.0	11.2	4.8	0.0	35.5	52.9	52.5
2	191.6	120.0	10.6	14.2	-2.0	27.6	51.5	51.9
3	191.9	140.0	10.3	18.2	7.1	21.7	50.1	50.0
4	193.1	160.0	8.7	22.6	17.7	14.2	48.9	49.8
5	193.7	180.0	8.0	25.1	25.7	5.7	46.9	48.1
6	193.4	200.0	8.4	28.1	36.0	0.0	41.9	47.1
7	193.5	220.0	8.2	31.6	43.2	0.0	33.9	46.8
8	194.3	240.0	7.3	36.3	48.2	9.4	26.3	22.4
9	194.4	260.0	7.1	50.5	50.6	16.8	17.5	18.1
10	194.0	280.0	7.6	0.0	0.0	0.0	0.0	0.0
11	193.7	300.0	8.0	54.3	54.4	29.7	3.3	6.7
12	193.4	320.0	8.4	56.0	55.8	40.6	0.0	-3.2

MOHAWK3A.DAT
upper meadow lines3a3b

```
 S                           Time-Distance Plot  --  Raw data with no corrections applied
 p  G                                                                                                                 D
 r  e  S                                                                                                              i
 e  o  P                                T i m e    ( m i l l i  s e c o n d s )                                       s
 a                                                                                                                    t
 d
         0        10        20        30        40        50        60        70        80        90       100
         +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
         -                                          :                                                        -
 A     B +         +         +         +         +    :    +         +         +         +         +         +       90.0
         -     :                                         :                                                   -
 A  1    +           1                                      2   2                 3         3                +      100.0
```

```
        -             :                                      :                  :          :                -
        -               :                                  :   :                :          :                -
        -                 :                              :       :             :          :                 -
A  2    +                   2                          2           2           3          3                 +      120.0
        -                     :                      :              :         :          :                  -
        -                        :                 :                 :        :          :                  -
        -                          :              :                   :      :          :                   -
A  3    +                            2          2                      2     3          3                   +      140.0
        -                              :      :                         :   :          :                    -
        -                                 : :                           :  :           :                    -
        -                                 : :                            : :          :                     -
A  4    +                              2      2                           #           3                     +      160.0
        -                            :          :                        ::          :                      -
        -                          :              :                      : :         :                      -
        -                       :                  :                    :  :        :                       -
A  5    +                     2                      2                 2    2       3                       +      180.0
        -                   :                           :             :     :      :                        -
        -                  :                               :         :       :     :                        -
        -                :                                   :      :         :    :                        -
A  6    +              1                                        2  2           2   3                        +      200.0
        -       :                                                ::             :  :                        -
A     C +         +         +         +         +         +    :    +         +  : :    +         +         +      210.0
        -       :                                            :       :           : :                        -
A  7    +                1                                 2           2          23                        +      220.0
        -                  :                            :               :        : :                        -
        -                    :                        :                  :      :   :                       -
        -                      :                    :                     :    :     :                      -
A  8    +                        2                2                        2  2       2                     +      240.0
        -                          :            :                           ::        :                     -
        -                            :        :                             :          :                    -
        -                             :    :                               : :         :                    -
A  9    +                               22                                2  3          3                   +      260.0
        -                              :  :                             :     :         :                   -
        -                             :     :                          :      :          :                  -
        -                           :        :                        :        :         :                  -
A 10    +                         :            :                    :           :         :                 +      280.0
        -                        :               :                 :            :         :                 -
        -                      :                   :              :              :         :                -
        -                    :                      :           :                :          :               -
A 11    +                   2                         2        2                  3         3               +      300.0
        -                :                               :   :                    :          :              -
        -              :                                  : :                      :         :              -
```

```
        -          :                                    :     :                    :          :             -
A 12    +        1                                     2          2                  3          3             +       320.0
        -    :                                     :                                                        -
A     D +         +         +         +         +:         +         +         +         +         +         +       330.0
        -                                      :                                                            -
        +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
        0        10        20        30        40        50        60        70        80        90       100
```

```
 PRINTER PLOT SCALES
---------------------
 Time:   1.00 ms/col
 Dist:   5.00 ft/row
```

upper meadow lines3a3b

Spread A Points of emergence of refracted rays below target geophones for MOHAWK3A.DAT

Geo		SP A		SP B		SP C		SP D		SP E	
---		----------L		----------L		----------L		----------L		----------L	
1	X-Loc	98.0	2	---	1	102.5	2	133.7	3	132.9	3
	Elev	191.1		---		191.2		149.9		150.8	
2	X-Loc	117.9	2	117.9	2	122.3	2	145.4	3	145.5	3
	Elev	191.6		191.6		191.7		149.0		148.8	
3	X-Loc	138.3	2	138.3	2	142.7	2	154.0	3	153.9	3
	Elev	191.8		191.8		192.0		147.5		148.2	
4	X-Loc	158.3	2	158.3	2	162.2	2	162.2	2	171.6	3
	Elev	193.1		193.1		193.2		193.2		145.7	
5	X-Loc	178.5	2	178.5	2	181.6	2	181.6	2	188.2	3
	Elev	193.7		193.7		193.7		193.7		145.1	
6	X-Loc	198.3	2	198.3	2	---	1	201.8	2	206.4	3
	Elev	193.3		193.3		---		193.3		142.2	
7	X-Loc	218.3	2	218.3	2	---	1	221.8	2	229.7	3
	Elev	193.4		193.4		---		193.5		137.5	
8	X-Loc	238.6	2	238.6	2	238.6	2	241.8	2	241.8	2
	Elev	194.2		194.2		194.2		194.3		194.3	
9	X-Loc	232.3	3	230.9	3	258.6	2	261.2	2	261.2	2
	Elev	136.7		133.9		194.4		194.4		194.4	
10	X-Loc	---	0	---	0	---	0	---	0	---	0
	Elev	---		---		---		---		---	

11		X-Loc	276.9 3	275.8 3	298.4 2	301.7 2	301.7 2
		Elev	134.0	131.2	193.7	193.7	193.7
12		X-Loc	295.3 3	294.3 3	318.3 2	--- 1	321.9 2
		Elev	133.6	131.2	193.5	---	193.4

Spread A   Points of entry of refracted rays below source shotpoints:

L=2	Right	X-Loc	92.3	92.3	211.8	---	---
		Elev	191.0*	191.0	193.4	---	---
L=2	Left	X-Loc	---	---	208.3	328.5	328.5
		Elev	---	---	193.4	193.3	193.3*
L=3	Right	X-Loc	108.8	108.8	---	---	---
		Elev	139.0*	139.0	---	---	---
L=3	Left	X-Loc	---	---	---	310.1	310.1
		Elev	---	---	---	133.3	133.3*

upper meadow lines3a3b

Spread A   Depth and Elev of layers directly beneath SPs and Geos for MOHAWK3A.DAT

	Surface		Layer 2		Layer 3	
SP	X-Loc	Elev	Depth	Elev	Depth	Elev
B	90.0	200.0	9.1	190.9	61.0	139.0
C	210.0	200.0	6.5	193.5	59.6	140.4
D	330.0	200.0	6.7	193.3	66.7	133.3
Geo						
1	100.0	200.0	8.9	191.1	61.0	139.0
2	120.0	200.0	8.4	191.6	57.9	142.1
3	140.0	200.0	8.1	191.9	52.3	147.7
4	160.0	200.0	6.9	193.1	52.6	147.4
5	180.0	200.0	6.3	193.7	54.8	145.2
6	200.0	200.0	6.6	193.4	57.7	142.3
7	220.0	200.0	6.5	193.5	61.4	138.6
8	240.0	200.0	5.7	194.3	64.2	135.8
9	260.0	200.0	5.6	194.4	66.0	134.0
10	280.0	200.0	6.0	194.0	67.2	132.8
11	300.0	200.0	6.3	193.7	66.9	133.1
12	320.0	200.0	6.5	193.5	66.7	133.3

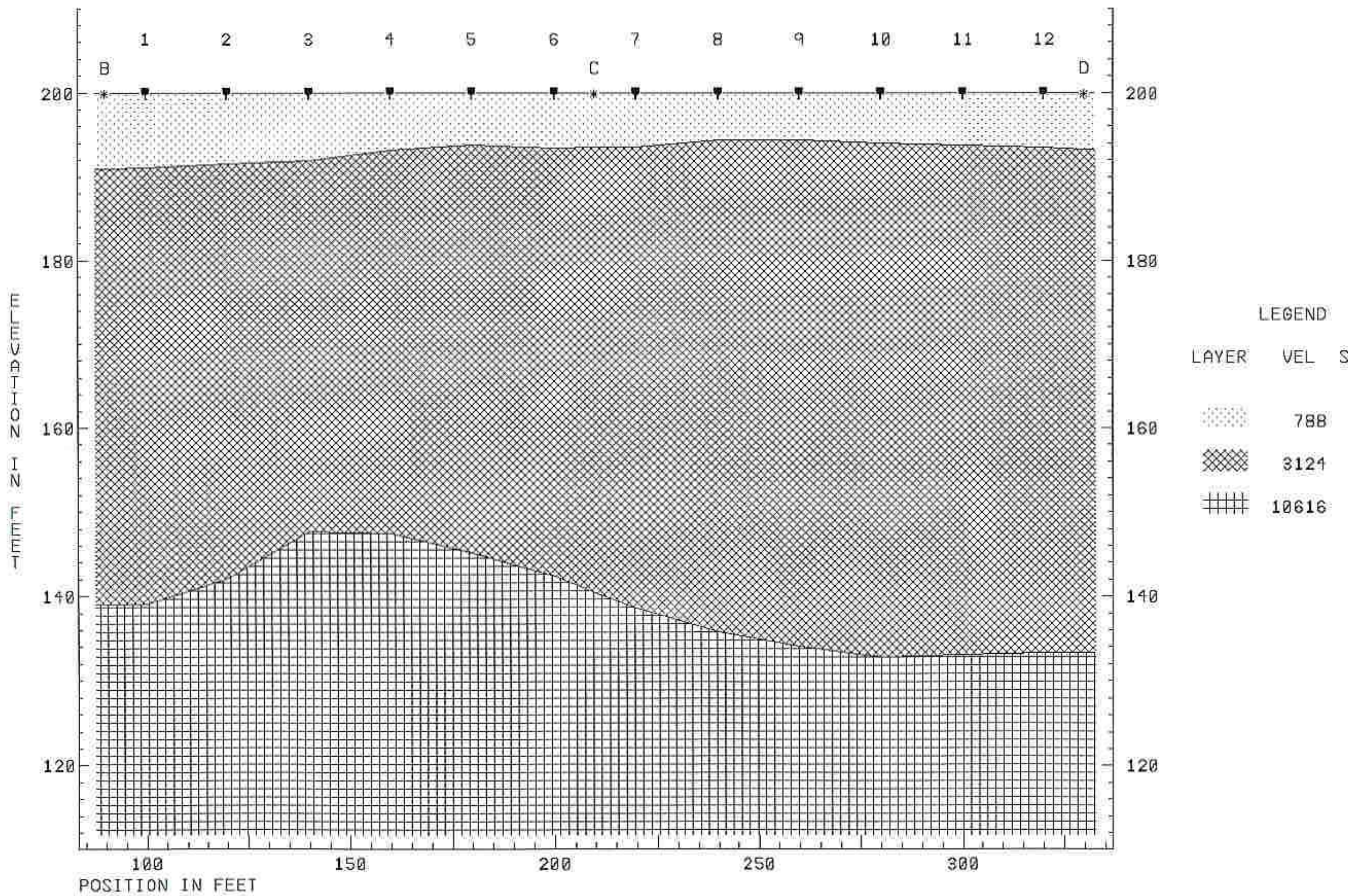
```
MOHAWK3A.DAT

Velocities used, Spread A

                 Layer 1           Layer 2           Layer 3
                 -------           -------           -------
       Vertical      788              3124
     Horizontal                       3124              10616


MOHAWK3A.DAT
 upper meadow lines3a3b
                                                                                                                         S
        D                                                                                                             G  p
        i                                                                                                          S  e  r
        s                                     E l e v a t i o n    ( f e e t )                                     P  o  e
        t                                                                                                                a
                                                                                                                         d
          110       120       130       140       150       160       170       180       190       200       210
            +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
            -                                                                                         :         -
     90.0   +         +         +        :+         +         +         +         +         +s        *         +  B     A
            -                            :                                                   :        :         -
    100.0   +                            :                                                   #        :>        +     1  A
            -                             :                                                  :        :         -
            -                            s :                                                 :        :         -
            -                              :                                                  :       :         -
    120.0   +                               :                                                 #       :>        +     2  A
            -                                 :                                               :       :         -
            -                                  :                                              :       :         -
            -                                   :   DE                                        :       :         -
    140.0   +                                     :                                           #       :>        +     3  A
            -                                     :#                                          C       :         -
            -                                     :                                            :      :         -
            -                                    :#                                            :      :         -
    160.0   +                                    :                                             #      :>        +     4  A
            -                                    :                                             :      :         -
            -                                   E                                              :      :         -
            -                                   :                                               :     :         -
    180.0   +                                  :                                                #     :>        +     5  A
```

```
        -                                 :                                                 :     :         -
        -                                 :E                                                :     :         -
        -                                :                                                 :      :         -
200.0   +                               :                                                  #      :>        +     6  A
        -                              :E                                                  :      :         -
210.0   +         +         +         :         +         +         +         +         +  s      *         +  C     A
        -                            :                                                     :      :         -
220.0   +                            :                                                     #D     :>        +     7  A
        -                           :                                                       :     :         -
        -                       B  #                                                        :     :         -
        -                         :                                                         :     :         -
240.0   +                         :                                                         #     :>        +     8  A
        -                        :                                                          :     :         -
        -                        :                                                          :     :         -
        -                       :                                                           :     :         -
260.0   +                       :                                                           #     :>        +     9  A
        -                       :                                                           :     :         -
        -                      :                                                            :     :         -
        -                    B :A                                                           :     :         -
280.0   +                      :                                                            :     :>        +    10  A
        -                      :                                                            :     :         -
        -                      :                                                            :     :         -
        -                    B :A                                                           :     :         -
300.0   +                      :                                                            #     :>        +    11  A
        -                      :                                                            :     :         -
        -                      s                                                            :     :         -
        -                      :                                                            :     :         -
320.0   +                      :                                                           #      :>        +    12  A
        -                      :                                                           :      :         -
330.0   +         +         +  :      +         +         +         +         +         +  s      *         +  D     A
        -                      :                                                           :      :         -
        +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
      110       120       130       140       150       160       170       180       190       200       210
                                                                                                                     S
    D                                                                                                             G  p
    i                                                                                                          S  e  r
    s                                     E l e v a t i o n   ( f e e t )                                      P  o  e
    t                                                                                                                a
                                                                                                                     d

         PRINTER PLOT SCALES                 L E G E N D
        ---------------------      ----------------------------------------
```

```
Elev:   1.00 ft/col            >  Geophone Location
Dist:   5.00 ft/row            *  Shotpoint Location
                           A,B,C  Emergent Ray; Source SP A,B,C,...
                               ?  Questionable Emergent Ray
                               s  Ray Entrypoint Beneath SP
                               #  More Than One Symbol to Plot Here
                               +  Grid Mark
```

FILE MOHAWK3A.DAT
UPPER MEADOW LINES3A3B

SPREAD A



SIPT2 V-4.1 --- SEISMIC REFRACTION INTERPRETATION PROGRAM --- RIMROCK GEOPHYSICS, INC.

DATA FILE: MOHAWK3B.DAT PRINT FILE: C:\SIPT\SIPT\MOHAWK3B.OUT RUN DATE AND TIME: 05-02-2007 at 11:24

TITLE: mohawk3b

PROGRAM CONTROL DATA

				Printer Scales			Datum Plane Control Points				Plot Control Elevations		Special Control Parameters				
				Elev	Plot Horiz	Time	Point 1		Point 2						Trace	Off	L
Sprds	Exit	Layers	V-Over	ft/col	ft/row	ms/col	Elev	X-Loc	Elev	X-Loc	Top	Bottom	BLim	TLim	Print	SP	Dip
1	6	3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0.5	10.0	0	0	0

SHOTPOINT AND GEOPHONE INPUT DATA for MOHAWK3B.DAT

Spread A, 5 Shotpoints, 12 Geophones, X-Shift = 0.0, X-True = 1, Units: Feet.

SP	Elev	X-Loc	Y-Loc	Depth	UpHole T	Fudge T	End SP
A	200.0	-100.0	0.0	0.0	0.0	0.0	0
B	200.0	-10.0	0.0	0.0	0.0	0.0	1
C	200.0	110.0	0.0	0.0	0.0	0.0	0
D	200.0	230.0	0.0	0.0	0.0	0.0	2
E	206.0	320.0	0.0	0.0	0.0	0.0	0

Arrival Times + Fudge T and Layers represented

Geo	Elev	X-Loc	Y-Loc	SP A ---T---L	SP B ---T---L	SP C ---T---L	SP D ---T---L	SP E ---T---L
1	200.0	0.0	0.0	52.50 2	9.75 1	50.75 2	78.50 3	97.25 3
2	200.0	20.0	0.0	52.75 2	17.25 2	45.00 2	77.75 3	95.75 3
3	200.0	40.0	0.0	57.00 2	25.50 2	40.50 2	75.50 3	94.00 2
4	200.0	60.0	0.0	59.25 2	32.75 2	32.75 2	73.75 3	90.00 2
5	200.0	80.0	0.0	57.25 2	41.00 2	26.75 2	70.00 3	84.50 2
6	200.0	100.0	0.0	58.50 2	47.00 2	19.25 1	67.25 3	81.50 2
7	200.0	120.0	0.0	58.50 2	48.50 3	19.00 1	64.00 2	76.75 2
8	200.0	140.0	0.0	58.75 2	51.25 3	27.00 2	54.75 2	73.50 2
9	200.0	160.0	0.0	61.50 3	54.25 3	36.25 2	45.50 2	71.50 2
10	200.0	180.0	0.0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0
11	200.0	200.0	0.0	62.50 3	56.25 3	48.75 2	36.75 2	66.75 2
12	200.0	220.0	0.0	64.00 3	59.25 3	49.75 2	19.00 1	60.50 2

Layer 1 Velocity from direct arrivals

Spread A	SP	Geo	DD	V	Avg V
	B	1	10.0	1026	
					1026
	C	6	10.0	519	
	C	7	10.0	526	
					523
	D	12	10.0	526	
					526

Wtd Avg Velocity computed for Layer 1 = 649

Layer 2 Velocity computed by regression of raw uncorrected arrivals

Spread A

V	Ti	Geos	<-SP->	Geos	Ti	V	Avg V	Avg Ti	Pts
			A	1 8	49.2	22400	22400	49.2	8
			B	2 6	6.5	2667	2667	6.5	5
3320	18.1	1 5	C	8 12	20.1	3448	3376	19.1	9
2966	25.0	7 11	D				2966	25.0	4
5681	43.2	3 12	E				5681	43.2	9
						Avg =	4469	for	35 Pts

Layer 2 Velocity computed by Hobson-Overton method

Spread A

SPs	Geos	V	Avg TdSP	Std Err Overall	Err	Geo	Err	Geo	Err	Geo	Err	Geo
					4 Highest Std Err at geophones							
A C	1 5	5246	3.3	1.317	2.275	4	-1.350	5	-1.225	2	0.400	1
A D	7 8	4211	-31.6	0.000	-0.000	7	-0.000	8				
A E	3 8	9149	-20.8	0.601	0.974	4	-0.905	3	-0.512	8	0.359	7
B C	2 5	2837	-7.1	0.503	-0.825	3	0.525	2	0.225	5	0.075	4
B E	3 6	3455	-1.7	0.987	1.650	5	-0.925	6	-0.525	4	-0.200	3
C D	8 11	3107	-6.2	2.430	3.375	9	-2.250	8	-1.125	11		
C E	8 12	4505	-12.1	1.018	1.249	9	-1.124	8	-0.874	12	0.749	11

Avg =   5073 for 28 Pts

Wtd Avg Velocity computed for Layer 2 =   4841

Layer 3 Velocity computed by regression of raw uncorrected arrivals

Spread A

V	Ti	Geos	<-SP->	Geos	Ti	V	Avg V	Avg Ti	Pts
			A	9 12	51.1	25455	25455	51.1	3
			B	7 12	36.2	10058	10058	36.2	5
8615	52.9	1 6	D				8615	52.9	6
13328	73.2	1 2	E				13328	73.2	2
						Avg =	10948	for	16 Pts

Layer 3 Velocity computed by Hobson-Overton method

Not enough points.

Wtd Avg Velocity computed for Layer 3 = 10948

Arrival times Td corrected to datum. (Datum Elev = 200.000 + 0.000x) for MOHAWK3B.DAT

Spread A				SP A	SP B	SP C	SP D	SP E
Datum Elev				200.0	200.0	200.0	200.0	200.0
Geo	.	X-Loc	Cor T	0.0	0.0	0.0	0.0	0.0
---	.	-----	-----	--Td--	--Td--	--Td--	--Td--	--Td--
1	200.0	0.0	0.0	52.5	9.8	50.8	78.5	97.3
2	200.0	20.0	0.0	52.8	17.3	45.0	77.8	95.8
3	200.0	40.0	0.0	57.0	25.5	40.5	75.5	94.0
4	200.0	60.0	0.0	59.3	32.8	32.8	73.8	90.0
5	200.0	80.0	0.0	57.3	41.0	26.8	70.0	84.5
6	200.0	100.0	0.0	58.5	47.0	19.3	67.3	81.5
7	200.0	120.0	0.0	58.5	48.5	19.0	64.0	76.8
8	200.0	140.0	0.0	58.8	51.3	27.0	54.8	73.5

9	200.0	160.0	0.0	61.5	54.3	36.3	45.5	71.5
10	200.0	180.0	0.0	0.0	0.0	0.0	0.0	0.0
11	200.0	200.0	0.0	62.5	56.3	48.8	36.8	66.8
12	200.0	220.0	0.0	64.0	59.3	49.8	19.0	60.5

Arrival times Tc corrected to top of Layer 2 and Elev of top of Layer 2 for MOHAWK3B.DAT

Spread A				SP A	SP B	SP C	SP D	SP E
	Elev			0.0	191.8	192.2	188.5	0.0
Geo	.	X-Loc	Cor T	12.6	12.6	12.1	17.7	17.7
---	.	-----	-----	--Tc--	--Tc--	--Tc--	--Tc--	--Tc--
1	191.9	0.0	12.5	3.1	0.0	26.1	48.2	48.6
2	192.7	20.0	11.3	4.6	-6.6	21.6	48.7	48.4
3	191.7	40.0	12.8	7.4	0.1	15.7	45.0	41.6
4	192.0	60.0	12.3	10.1	7.8	8.4	43.7	38.1
5	192.8	80.0	11.1	9.3	17.3	3.6	41.1	33.8
6	192.5	100.0	11.5	10.1	22.9	0.0	38.0	30.4
7	191.8	120.0	12.6	9.0	23.2	0.0	33.6	24.5
8	191.8	140.0	12.7	9.2	26.0	2.3	24.3	21.2
9	189.1	160.0	16.8	26.0	24.9	7.4	11.0	15.1
10	188.4	180.0	17.9	0.0	0.0	0.0	0.0	0.0
11	187.6	200.0	19.1	24.7	24.5	17.6	-0.1	8.0
12	188.9	220.0	17.1	28.2	29.5	20.5	0.0	3.8

MOHAWK3B.DAT
mohawk3b

```
 S                            Time-Distance Plot  --  Raw data with no corrections applied
 p  G                                                                                                   D
 r  e  S                                                                                                i
 e  o  P                                 T i m e   ( m i l l i  s e c o n d s )                        s
 a                                                                                                      t
 d
         0        10        20        30        40        50        60        70        80        90       100
         +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
         -                                          :                                                      -
 A     B +         +         +         +         +     :   +         +         +         +         +         +      -10.0
         -    :                                            :                                               -
```

```
A  1    +         1                                        2 2                         3                 3  +        0.0
        -           :                                    :   :                        :                  :  -
        -             :                                 :    :                        :                  :  -
        -              :                              :      :                        :                 :   -
A  2    +                2                           2       2                        3                 3   +       20.0
        -                  :                        :         :                      :                 :    -
        -                    :                     :           :                     :                 :    -
        -                      :                  :             :                   :                 :     -
A  3    +                         2              2               2                  3                 2     +       40.0
        -                          :           :                  :                :                 :      -
        -                            :       :                    :                :                :       -
        -                              :   :                       :              :                :        -
A  4    +                                #                         2              3               2         +       60.0
        -                              :   :                       :             :               :          -
        -                             :      :                    :             :              :            -
        -                           :          :                  :            :              :             -
A  5    +                          2             2               2            3              2              +       80.0
        -                        :                 :              :          :              :               -
        -                      :                    :             :          :             :                -
        -                    :                        :           :         :             :                 -
A  6    +                  1                           2           2       3              2                 +      100.0
        -         :                                    :           :      :             :                   -
A     C +         +         +         +         +       : +        :+     :   +        :+         +         +      110.0
        -         :                                     :          :     :            :                     -
A  7    +                  1                             3         2    2            2                      +      120.0
        -                    :                           :         :  :             :                       -
        -                      :                          :        :               :                        -
        -                        :                         :     : :              :                         -
A  8    +                          2                       3   2   2              2                         +      140.0
        -                            :                      :      :             :                          -
        -                               :                 :  :      :            :                          -
        -                                 :             :     :      :          :                           -
A  9    +                                   2         2       3       3         2                           +      160.0
        -                                     :     :          :      :        :                            -
        -                                      :   :           :      :       :                             -
        -                                        ::            :      :       :                             -
A 10    +                                        : :           :      :      :                              +      180.0
        -                                       :   :           :     :      :                              -
        -                                      :      :         :     :     :                               -
        -                                     :        :        :     :    :                                -
A 11    +                                    2           2      3      3   2                                +      200.0
        -                               :                :       :     : :                                  -
```

```
        -                           :                    :        :    ::                                   -
        -                      :                          :        :  : :                                   -
A 12    +                  1                              2        3 2  3                                   +     220.0
        -         :                                              :                                          -
A     D +         +         +         +         +         +   :     +         +         +         +         +     230.0
        -                                                  :                                                -
        +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
        0        10        20        30        40        50        60        70        80        90       100
```

```
PRINTER PLOT SCALES
--------------------
Time:   1.00 ms/col
Dist:   5.00 ft/row
```

mohawk3b

Spread A   Points of emergence of refracted rays below target geophones for MOHAWK3B.DAT

Geo		SP A	SP B	SP C	SP D	SP E
1	X-Loc	-1.2 2	--- 1	1.4 2	-0.0 3	0.0 3
	Elev	191.9	---	192.0	135.1	148.5
2	X-Loc	19.2 2	19.2 2	20.9 2	19.5 3	19.5 3
	Elev	192.7	192.7	192.7	104.9	120.2
3	X-Loc	38.8 2	38.8 2	41.3 2	75.6 3	41.3 2
	Elev	191.7	191.7	191.7	92.1	191.7
4	X-Loc	59.1 2	59.1 2	61.0 2	158.7 3	61.0 2
	Elev	192.0	192.0	192.0	114.2	192.0
5	X-Loc	79.3 2	79.3 2	80.9 2	141.6 3	80.9 2
	Elev	192.8	192.8	192.8	108.3	192.8
6	X-Loc	98.9 2	98.9 2	--- 1	156.4 3	100.6 2
	Elev	192.6	192.6	---	115.9	192.6
7	X-Loc	118.7 2	119.7 3	--- 1	121.0 2	121.0 2
	Elev	191.7	156.8	---	191.7	191.7
8	X-Loc	138.8 2	139.4 3	138.8 2	140.5 2	140.5 2
	Elev	191.9	159.7	191.9	191.8	191.8
9	X-Loc	148.5 3	150.2 3	157.0 2	161.4 2	161.4 2
	Elev	158.7	164.1	189.4	189.0	189.0
10	X-Loc	--- 0	--- 0	--- 0	--- 0	--- 0

		Elev	---	---	---	---	---
11		X-Loc	196.3 3	196.9 3	198.0 2	202.6 2	202.6 2
		Elev	176.0	178.6	187.5	187.6	187.6
12		X-Loc	212.7 3	212.1 3	219.3 2	--- 1	221.4 2
		Elev	174.3	172.9	188.9	---	188.8

Spread A Points of entry of refracted rays below source shotpoints:

L=2	Right	X-Loc	-9.2	-9.2	110.8	---	---
		Elev	191.4*	191.4	192.1	---	---
L=2	Left	X-Loc	---	---	108.6	228.5	228.5
		Elev	---	---	192.2	189.6	189.6*
L=3	Right	X-Loc	-10.2	-10.2	---	---	---
		Elev	192.9*	192.9	---	---	---
L=3	Left	X-Loc	---	---	---	186.9	186.9
		Elev	---	---	---	120.8	120.8*

mohawk3b

Spread A Depth and Elev of layers directly beneath SPs and Geos for MOHAWK3B.DAT

	Surface		Layer 2		Layer 3	
SP	X-Loc	Elev	Depth	Elev	Depth	Elev
---	-----	------	-----	------	-----	------
B	-10.0	200.0	8.4	191.6	64.9	135.1
C	110.0	200.0	7.8	192.2	62.5	137.5
D	230.0	200.0	10.6	189.4	36.1	163.9
Geo						

1	0.0	200.0	8.1	191.9	64.9	135.1
2	20.0	200.0	7.3	192.7	79.1	120.9
3	40.0	200.0	8.3	191.7	89.4	110.6
4	60.0	200.0	8.0	192.0	99.8	100.2
5	80.0	200.0	7.2	192.8	101.4	98.6
6	100.0	200.0	7.5	192.5	73.0	127.0
7	120.0	200.0	8.2	191.8	51.9	148.1
8	140.0	200.0	8.2	191.8	54.4	145.6
9	160.0	200.0	10.9	189.1	60.0	140.0
10	180.0	200.0	11.6	188.4	49.3	150.7
11	200.0	200.0	12.4	187.6	36.1	163.9

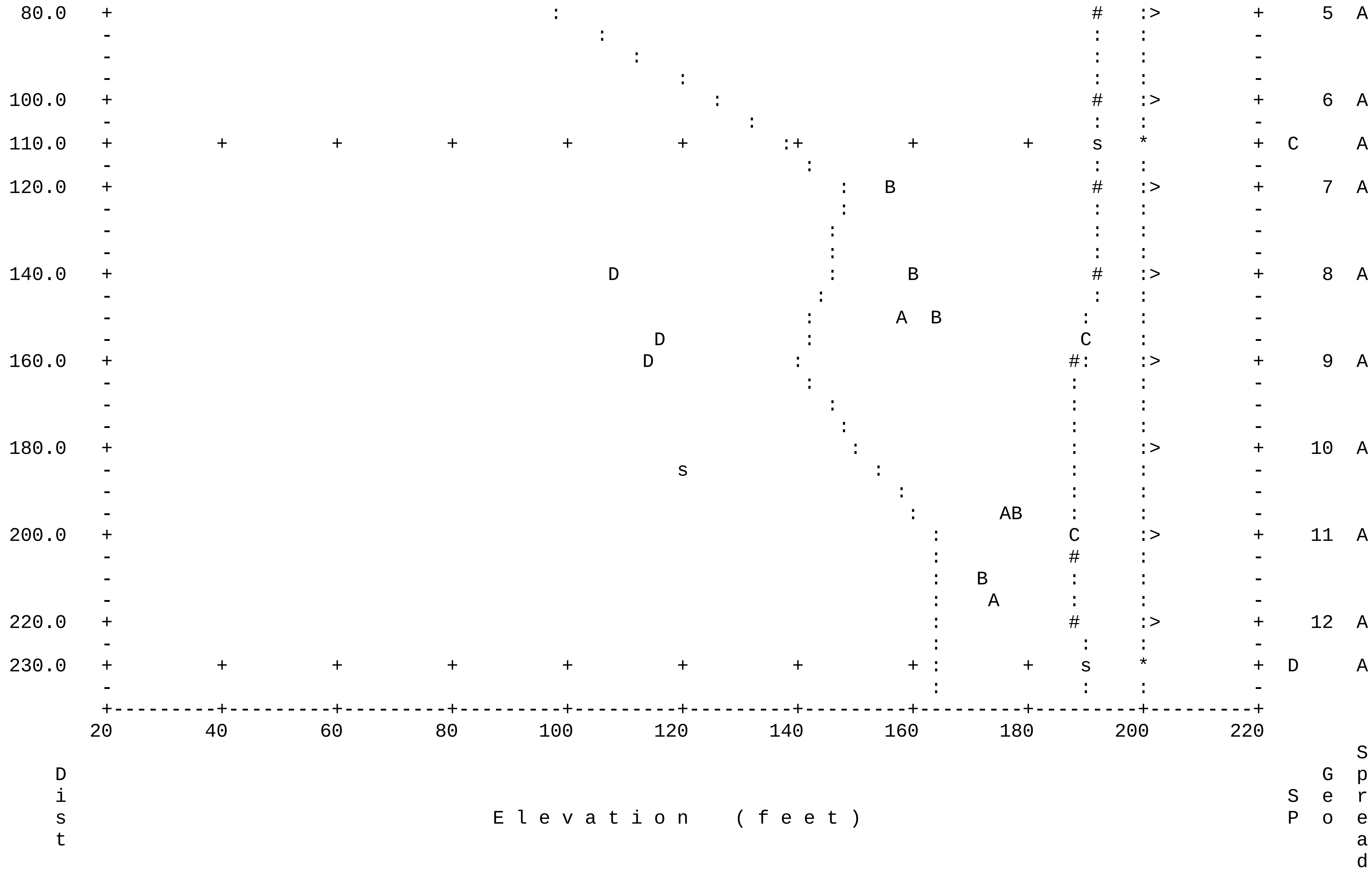
```
 12      220.0   200.0      11.2   188.8      36.1   163.9
```

MOHAWK3B.DAT

Velocities used, Spread A

	Layer 1	Layer 2	Layer 3
Vertical	649	4841	
Horizontal		4841	10948

```
MOHAWK3B.DAT
 mohawk3b
                                                                                                                         S
        D                                                                                                             G  p
        i                                                                                                          S  e  r
        s                                     E l e v a t i o n    ( f e e t )                                     P  o  e
        t                                                                                                                a
                                                                                                                         d
           20        40        60        80       100       120       140       160       180       200       220
            +---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+
            -                                                         :                           :   :         -
    -10.0   +         +         +         +         +         +       : +         +         +     s   *         +  B     A
            -                                                         :                           :   :         -
      0.0   +                                                         D     E                     #   :>        +     1  A
            -                                                       :                             :   :         -
            -                                                     :                               :   :         -
            -                                                   :                                 :   :         -
     20.0   +                                         D       E                                   #   :>        +     2  A
            -                                                :                                    :   :         -
            -                                               :                                     :   :         -
            -                                              :                                      :   :         -
     40.0   +                                            :                                        #   :>        +     3  A
            -                                           :                                         :   :         -
            -                                          :                                          :   :         -
            -                                        :                                            :   :         -
     60.0   +                                       :                                             #   :>        +     4  A
            -                                       :                                             :   :         -
            -                                       :                                             :   :         -
            -                                   D   :                                             :   :         -
```

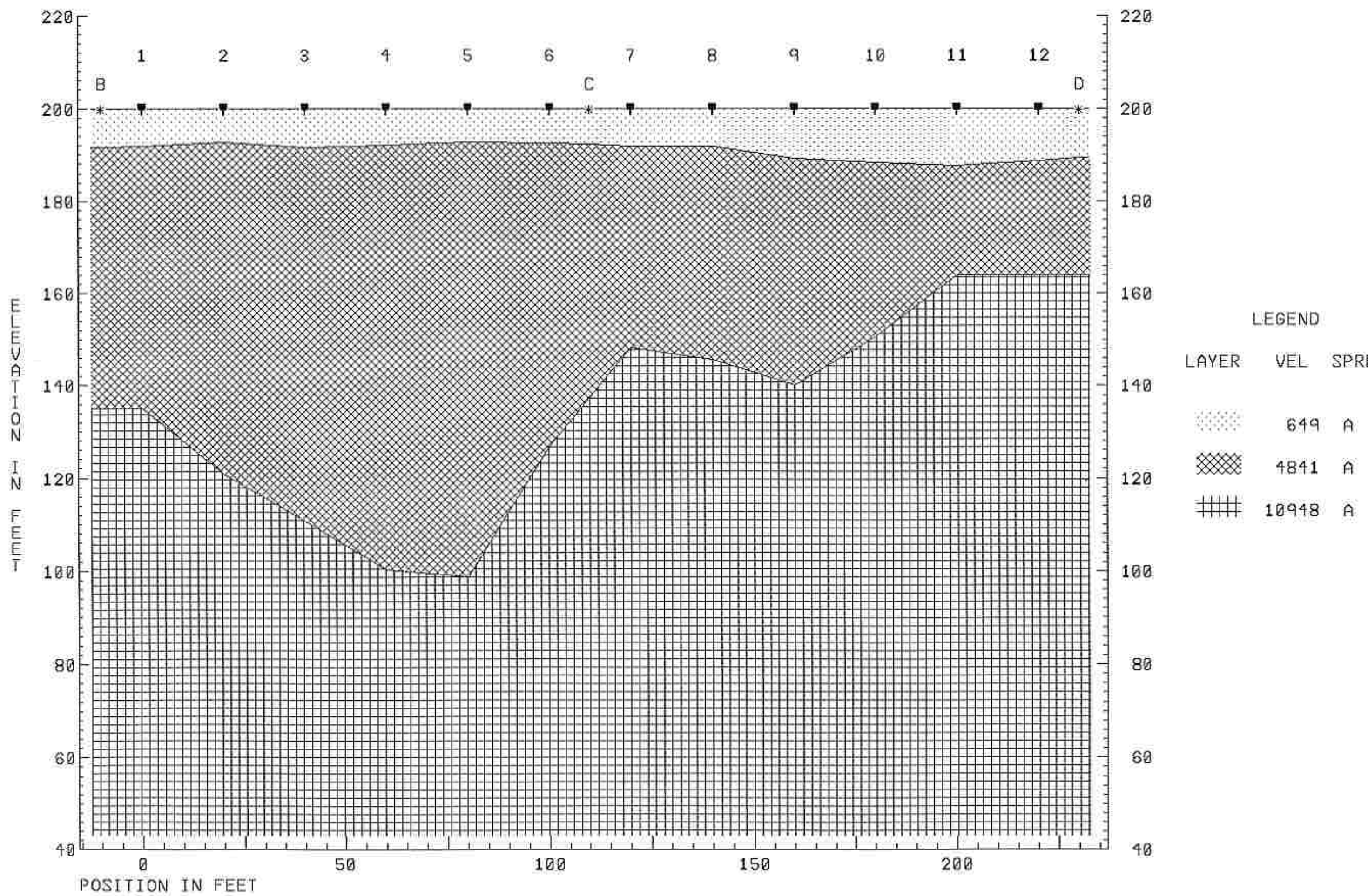


PRINTER PLOT SCALES LEGEND

```
---------------------      ----------------------------------------
 Elev:   2.00 ft/col           >  Geophone Location
 Dist:   5.00 ft/row           *  Shotpoint Location
                           A,B,C  Emergent Ray; Source SP A,B,C,...
                               ?  Questionable Emergent Ray
                               s  Ray Entrypoint Beneath SP
                               #  More Than One Symbol to Plot Here
                               +  Grid Mark
```

FILE MOHAWK3B.DAT
MOHAWK3B

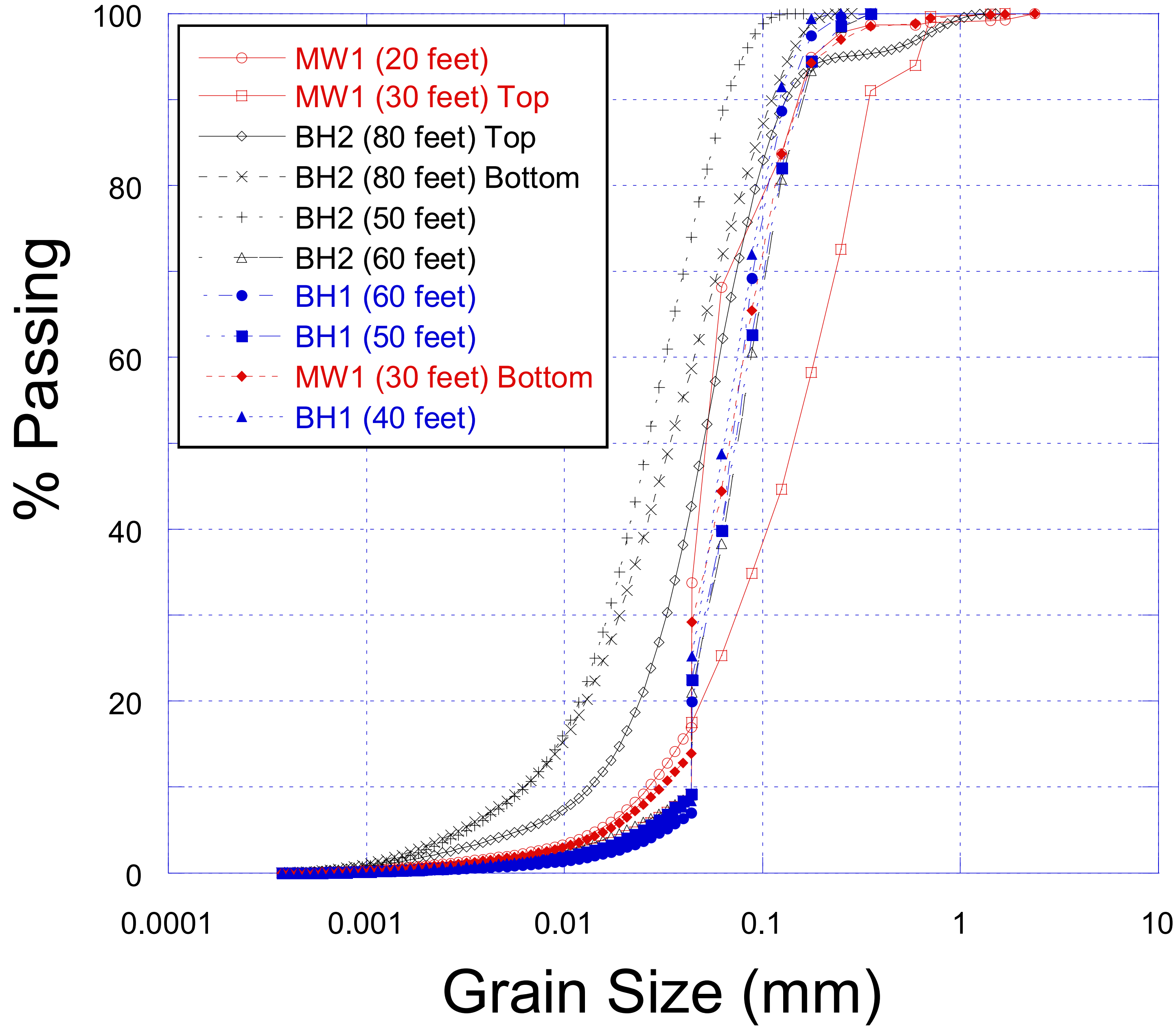
SPREAD A

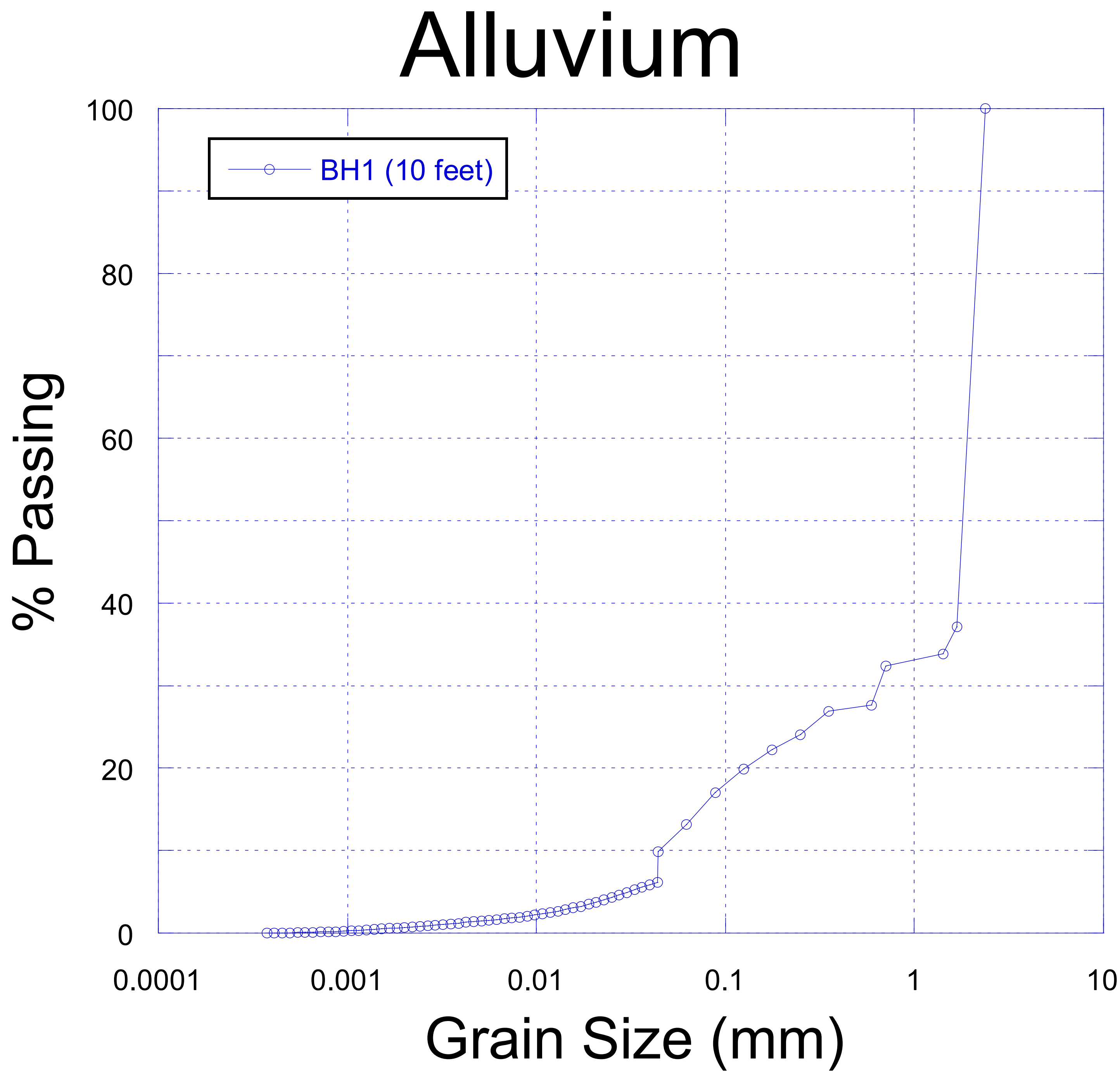


APPENDIX D

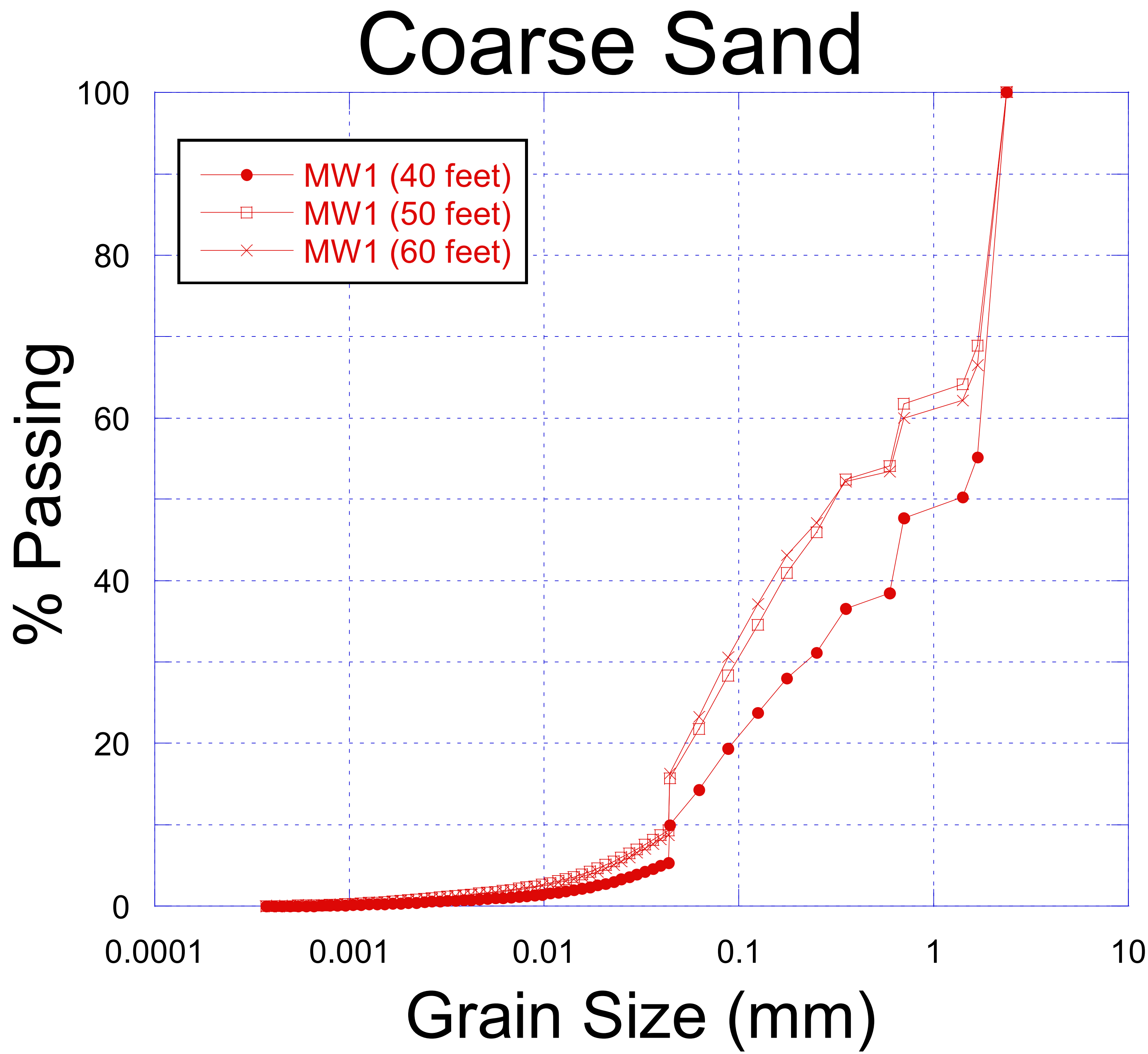
GRAIN SIZE CURVES

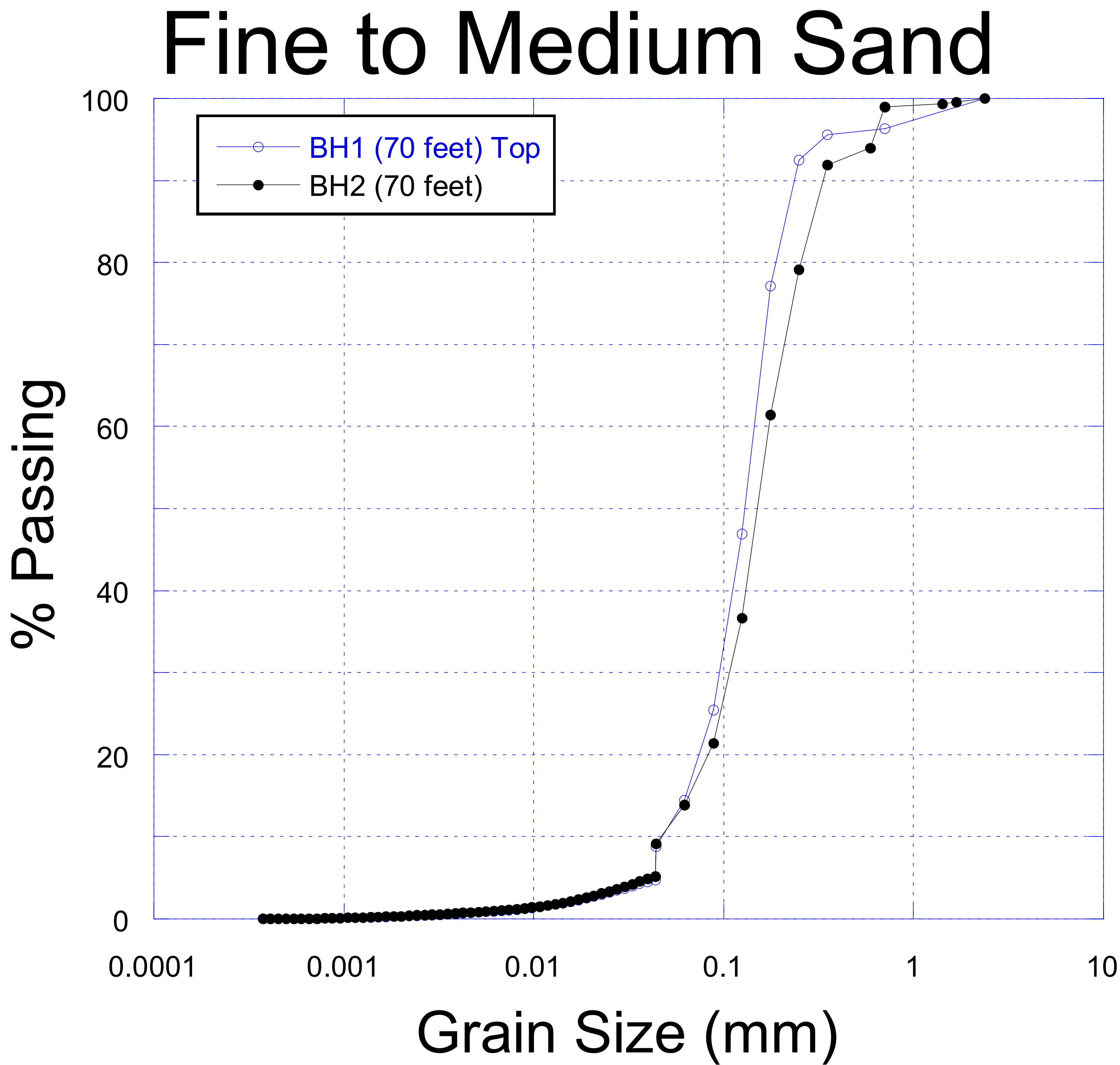
Very Fine Sand

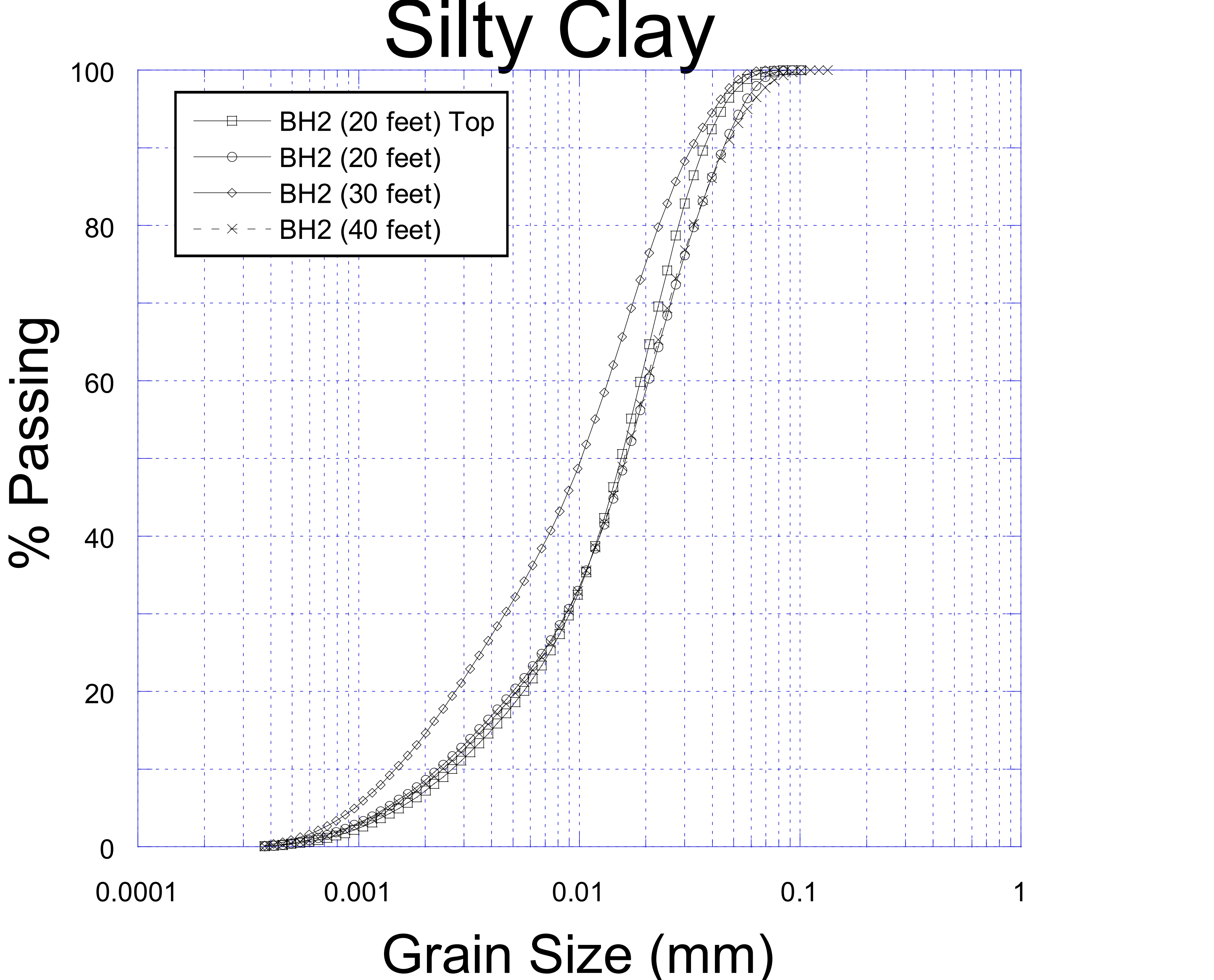




Alluvium
BH1 (10 feet)
100
80
60
40
20
0
% Passing
0.0001
0.001
0.01
0.1
1
10
Grain Size (mm)

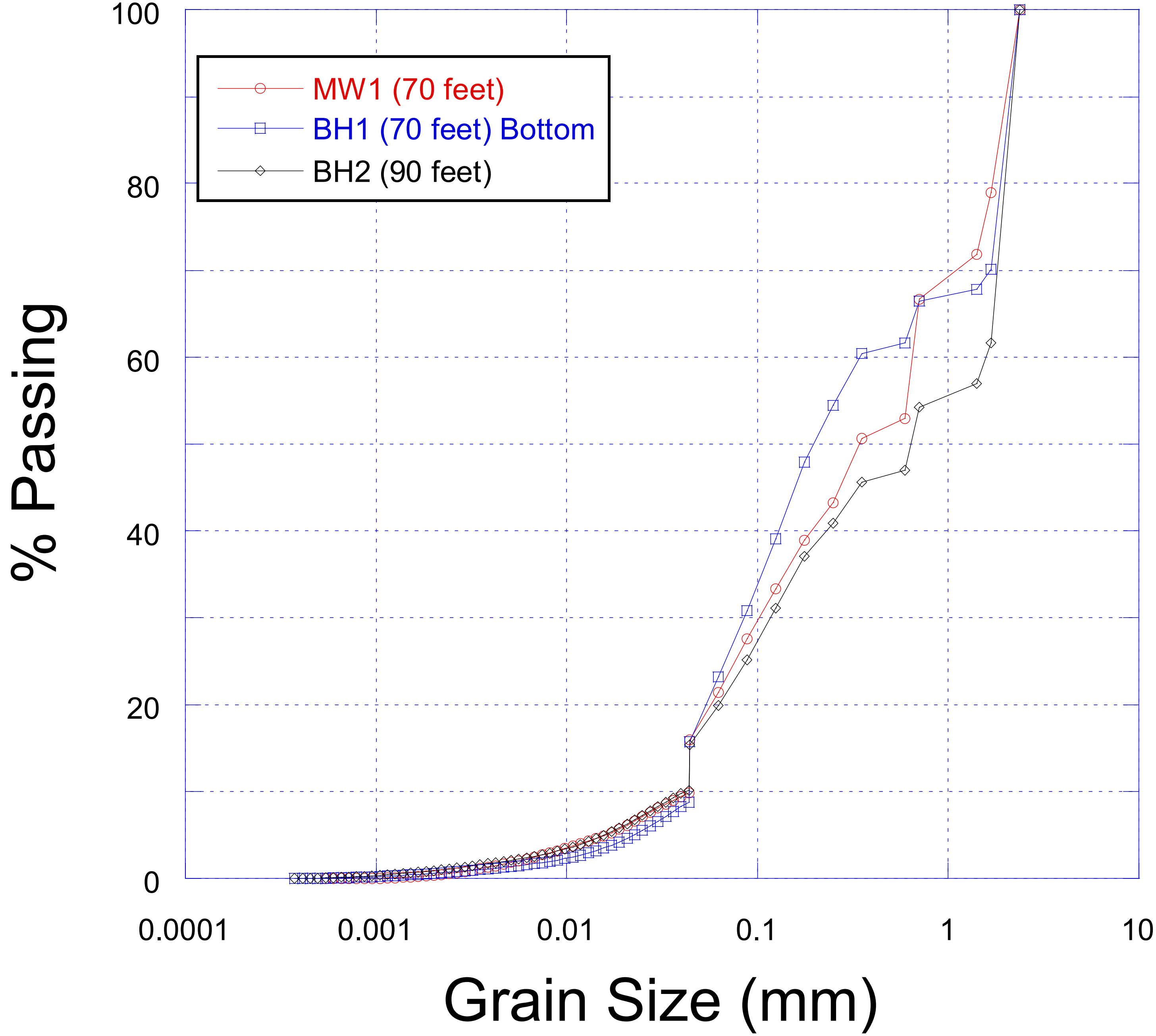

Coarse Sand
MW1 (40 feet)
MW1 (50 feet)
MW1 (60 feet)
% Passing
100
80
60
40
20
0
0.0001
0.001
0.01
0.1
1
10
Grain Size (mm)


Fine to Medium Sand
BH1 (70 feet) Top
BH2 (70 feet)
100
80
60
40
20
0
% Passing
0.0001
0.001
0.01
0.1
1
10
Grain Size (mm)



Silty Clay
BH2 (20 feet) Top
BH2 (20 feet)
BH2 (30 feet)
BH2 (40 feet)
% Passing
Grain Size (mm)
0
20
40
60
80
100
0.0001
0.001
0.01
0.1
1

Till



MW1 (70 feet)
BH1 (70 feet) Bottom
BH2 (90 feet)
% Passing
0
20
40
60
80
100
0.0001
0.001
0.01
0.1
1
10
Grain Size (mm)