# POST-GLACIAL FLUVIAL TERRACES IN THE WINOOSKI DRAINAGE BASIN, VERMONT

A Thesis Presented

by

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# ABSTRACT

I have surveyed, trenched, and dated flights of river terraces in the Huntington, Little, and Mad River Valleys of the Winooski Drainage Basin. The survey data are used to correlate the terraces with proglacial lake levels and with each other. Combined with previously dated baselevels, previously dated alluvial fans, and new terrace dates, the survey data were used to produce dated terrace chronologies for each valley.

The terrace chronologies imply that following the deposition of the first terrace which caps the glaciolacustrine fill in each valley, incision was first controlled by proglacial lake lowerings and then possibly by widespread climate changes. The terrace chronologies are used to place the terraces within a five stage model of postglacial valley evolution.

Terrace gradients have continued to increase through the Holocene. Baselevel lowerings and migration of knickpoints, coupled with climate changes, resulted in incision and increases in the river gradients along the Huntington, Little, and Mad Rivers. The terraces in the Winooski Drainage Basin are unsuitable for studying the crustal movements associated with glacio-isostatic rebound because there is no consistent river gradient from which to make measurements.

# ACKNOWLEDGMENTS

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To all of the geology graduate and undergraduate students whose support and friendship have kept me going the past three years, I say thanks. A big thanks goes to (in alaphabetical order): Mike Abbott, Beth Nadeau Astley, Amy Church, Lin Li, Laura Mallard, Kim Marsella, Todd Martin, Nilah Mazza, Jessica Murray, Alexis Richardson, Adam Schoonmaker, Dave Shaw, Tanya Unger, Chris Valin, and Paul Zehfuss.

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# CHAPTER 1: INTRODUCTION

## STATEMENT OF PROBLEM

Studies of post-glacial landforms in Vermont have focused primarily on interpreting the style and chronology of deglaciation and therefore have examined the features associated with ice positions and proglacial lake levels. Few studies have attempted to quantify the geomorphic changes that have occurred since the Laurentide ice sheet retreated from Vermont.

Flights of river terraces are present in nearly every river valley in Vermont, making them a significant feature of the landscape. Early geomorphologists in New England recognized river terraces and theorized on their formation. For example, Davis (1902) held the view that "the terracing rivers have slowly degraded their aggraded valleys while swinging from side to side, in combined response to a northerly uplift and a gradual decrease in load, and in spite of a probable decrease of volume." Several important observations were made by Davis, including: 1) initially river valleys had aggraded to some level; 2) differential uplift was a potential force to initiate incision; 3) the sediment load had decreased since deglaciation; and 4) the volume of water carried by the river may have decreased over time. However, none of Davis' interpretations are specific enough to warrant a model of terrace formation in New England. What is lacking from Davis' statements, and from the literature since his time, is a quantitative and systematic approach to when, how, and why river terraces developed in New England.

In recent years, archaeologists have been the primary workers to investigate river terraces in New England. Because river terraces are former flood plains and are ubiquitous in river valleys, they make excellent sites for

locating paleo-indian occupation surfaces. Archaeologists may even date some of the occupation surfaces, but because these ages usually indicate only the presence of humans on the terrace, the limiting ages may poorly bracket when the terraces formed. Furthermore, an archaeological investigation is not primarily concerned with the sedimentology of the terrace deposit (how the river behaved while the terrace formed) or with the processes that initiated river incision (why the terrace formed). Therefore, although river terraces have been investigated in Vermont, no study has completely addressed when, how, and why Vermont river terraces formed.

The purposes of this thesis are threefold: 1) to establish a dated river terrace chronology for tributaries in the Winooski Drainage Basin; 2) to use this chronology to infer the timing and cause of river incision; and 3) to develop a conceptual model of landscape evolution which considers how changing baselevels, glacio-isostatic rebound, changing climate regimes, and human land use have influenced landscape development in Vermont since deglaciation.

## OVERVIEW OF THESIS

I have structured this thesis to provide sufficient background information about rivers and their responses to the different factors which may have influenced valley evolution in Vermont since deglaciation so that my data are placed in context. The remaining section of Chapter 1 describes the physical setting of the field area. In Chapter 2, I first present the previous research pertaining to deglaciation, glacio-isostatic rebound, and climate change in north-central Vermont and the Northeast before reviewing ideas about fluvial dynamics and the formation of river terrraces. Next in Chapter

3, I describe my methods and present my three data sets (survey data, trench logs, and radiocarbon dates). In Chapter 4, I synthesize my data with results from previous research to establish dated terrace chronologies for the three studied valleys, and I calculate gradients for different reaches. In Chapter 5, I discuss my results in terms of a model for postglacial valley evolution that accounts for my observations and interpretations of river terrace development. I also evaluate the validity of using river terraces for interpreting crustal movements in formerly glaciated regions and provide a discussion of the link between river terraces and alluvial fans in Vermont. Chapter 6 presents the conclusions of my study.

## FIELD AREA

My field area is composed of three valleys of the Winooski Drainage Basin, located in north-central Vermont (Figure 1.1). I chose to study the north-flowing Huntington and Mad Rivers and the south-flowing Little River. These three valleys have similar lithologic and structural controls as well as similar drainage area, relief, and climate, and land use. By choosing rivers with nearly identical physical properties, I expected that they display similar responses to disturbances and therefore similar terrace histories.

The orientation of the valleys is controlled by the Green Mountain Anticlinorium, a NNE-SSW trending belt of folded metamorphic rocks in which anticlines and synclines, coupled with ductile shear zones, control the topography (Stanley, personal communication, 1997). The Huntington River Valley rests in a syncline on the west limb of the Green Mountain Axial Anticline. The Mad River and Little River Valleys lie in a ductile shear zone.

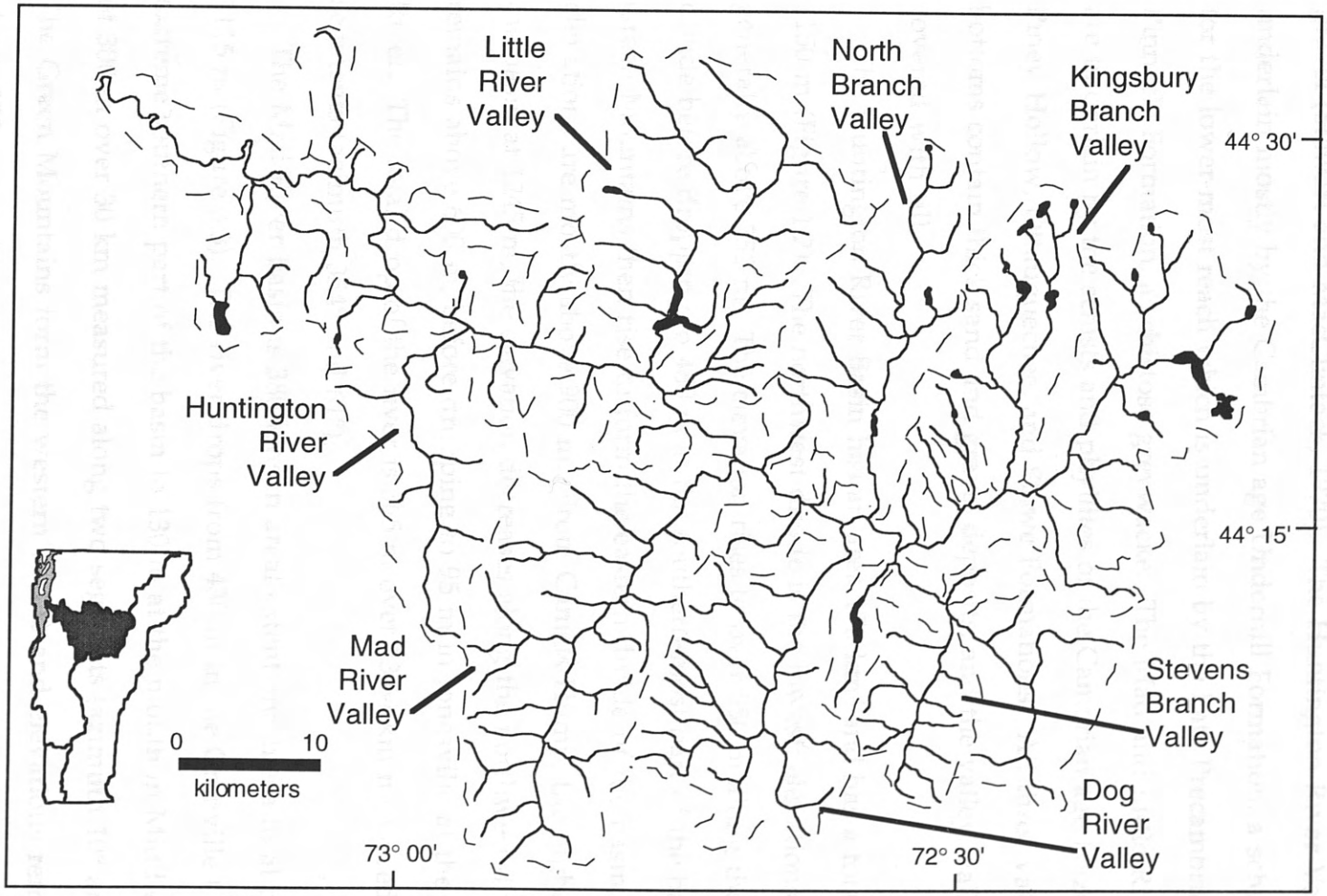



Figure 1.1: Map of Winooski Drainage Basin. Major tributray basins are labeled. Base from USGS 1:250,000 Lake Champlain Sheet.

The geology of all three valleys is similar; the bedrock consists of schists and phyllites (Doll et al., 1961) and the surficial deposits contain till, sand, and gravel (Stewart and MacClintock, 1970). The Huntington River Valley is underlain mostly by the Cambrian age Underhill Formation, a schist, except for the lower-most reach which is underlain by the Late Precambrian age Pinnacle Formation, a schistose greywacke. The Mad and Little River Valleys are underlain by the schists and phyllites of the Cambrian age Hazens Notch, Piney Hollow, Ottauquechee, and Stowe Formations. All three valley bottoms contain thick sand and gravel deposits, and the valley walls are covered with till.

The Huntington River Basin has an area 175 $km^2$ and has a total relief of 1150 m (Figure 1.2). The northwest divide is the lowest; elevations are generally above 350 m. The elevation rises to over 550 m along the southwest divide before dropping to 460 m at the southern-most part of the basin. The Green Mountains then rise to form the eastern divide of the basin, where elevations are mostly above 900 m. From Camels Hump, the highest peak in the basin at 1245 m, the elevation decreases along the northwest divide, but remains above 600 m, before dropping to 95 m in Jonesville at the Winooski River. The total drop of the river is 365 m over 23.64 km measured along two segments (azimuth 354° and 61°).

The Mad River Basin is 380 $km^2$ in areal extent and has a total relief of 1115 m (Figure 3.3). The river drops from 430 m in the Granville Gulf at the extreme southern part of the basin to 130 m at the mouth in Middlesex, a total of 300 m over 30 km measured along two segments (azimuth 10° and 40°). The Green Mountains form the western divide and elevations remain mostly above 850 m, reaching 1245 m on Mt. Ellen. The Northfield Mountains

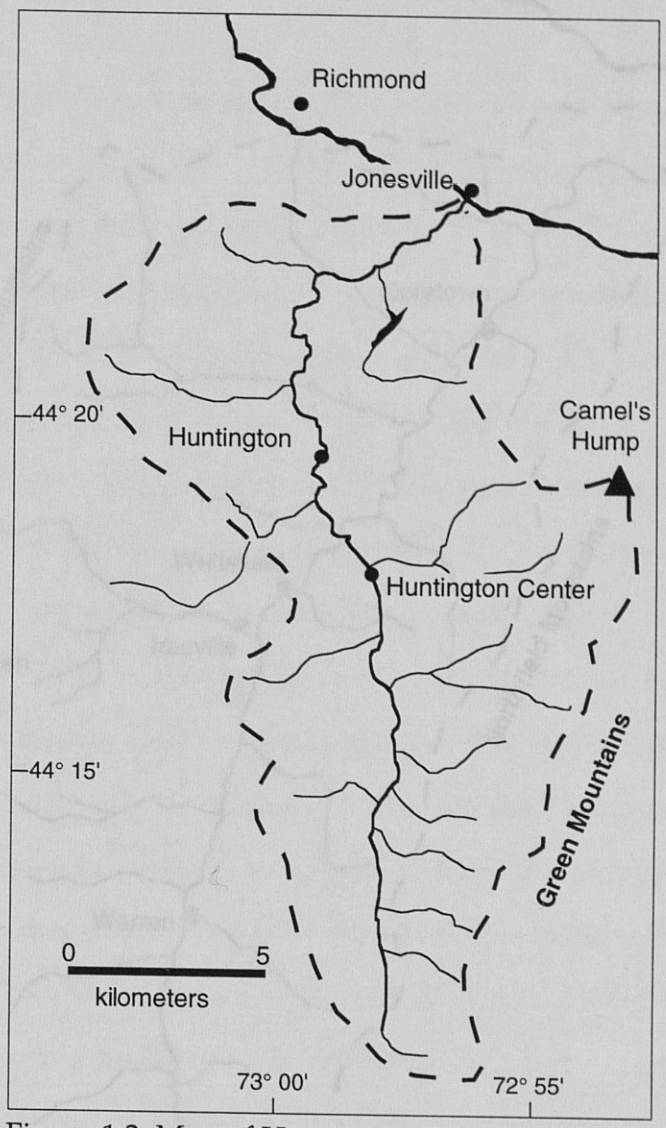



Figure 1.2: Map of Huntington River Basin. Base map from USGS 1:100,00 sheet.

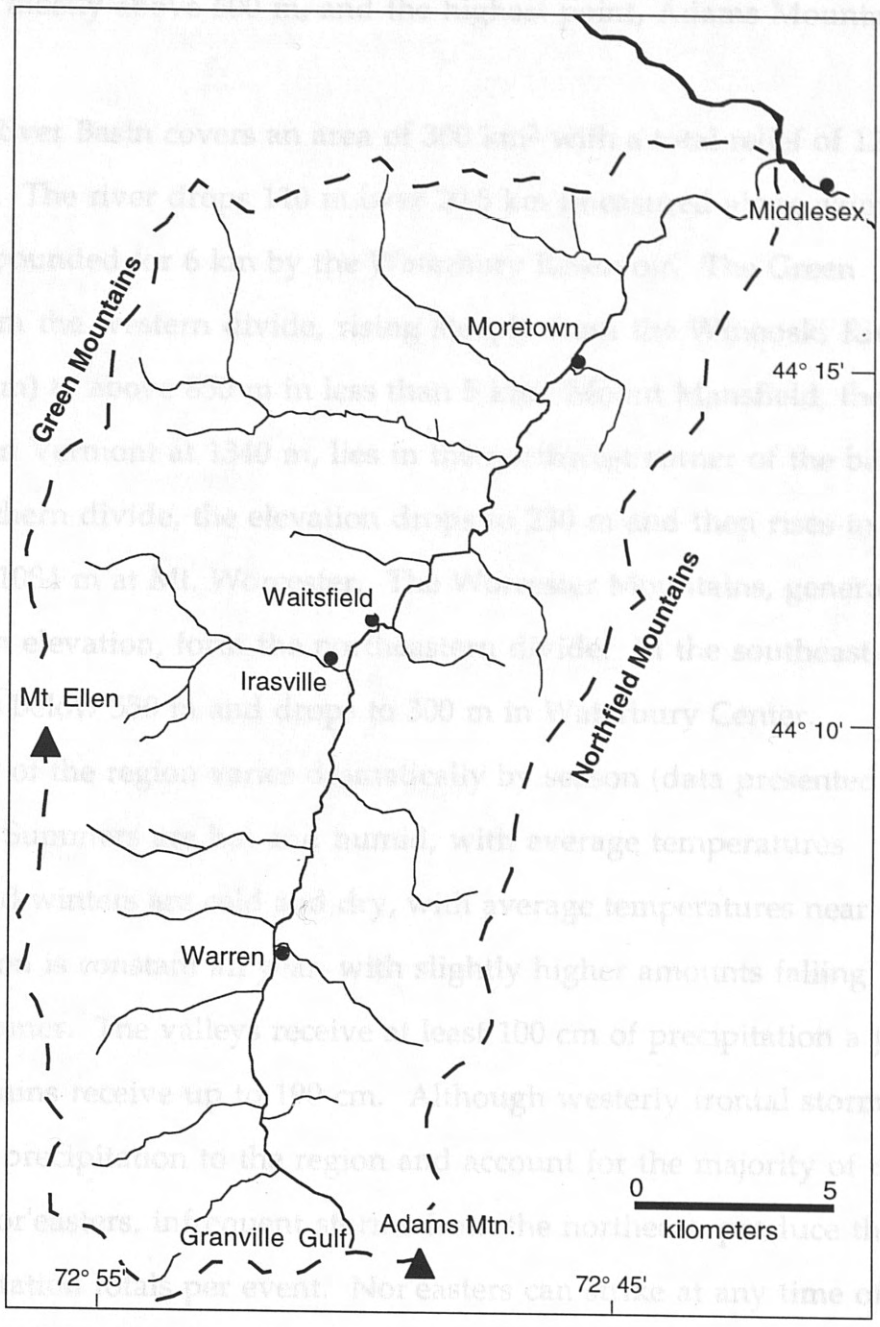



Figure 1.3: Map of Mad River Basin. Base map from USGS 1:100,00 sheet.

define the eastern divide and they are lower than the Green Mountains. Elevations are mostly above 600 m, and the highest point, Adams Mountain, is 987 m.

The Little River Basin covers an area of 300 $km^2$ with a total relief of 1220 m (Figure 1.4). The river drops 110 m over 20.5 km (measured along azimuth 30°) and is impounded for 6 km by the Waterbury Reservoir. The Green Mountains form the western divide, rising steeply from the Winooski River (elevation 120 m) to above 850 m in less than 5 km. Mount Mansfield, the highest point in Vermont at 1340 m, lies in the northwest corner of the basin. Along the northern divide, the elevation drops to 230 m and then rises to the east, reaching 1084 m at Mt. Worcester. The Worcester Mountains, generally above 750 m in elevation, form the northeastern divide. In the southeast, the divide remains below 550 m and drops to 300 m in Waterbury Center.

The climate of the region varies dramatically by season (data presented in Meeks, 1986). Summers are hot and humid, with average temperatures above 20 °C and winters are cold and dry, with average temperatures near -8 °C. Precipitation is constant all year, with slightly higher amounts falling during the summer. The valleys receive at least 100 cm of precipitation a year and the mountains receive up to 190 cm. Although westerly frontal storms bring frequent precipitation to the region and account for the majority of the yearly total, Nor'easters, infrequent storms from the northeast, produce the highest precipitation totals per event. Nor'easters can strike at any time of year, bringing significant amounts of rain or snow to the region. Convective thunderstorms, which form during the summer, may rival the precipitation totals of Nor'easters for a location, but are limited in their extent. Hurricanes

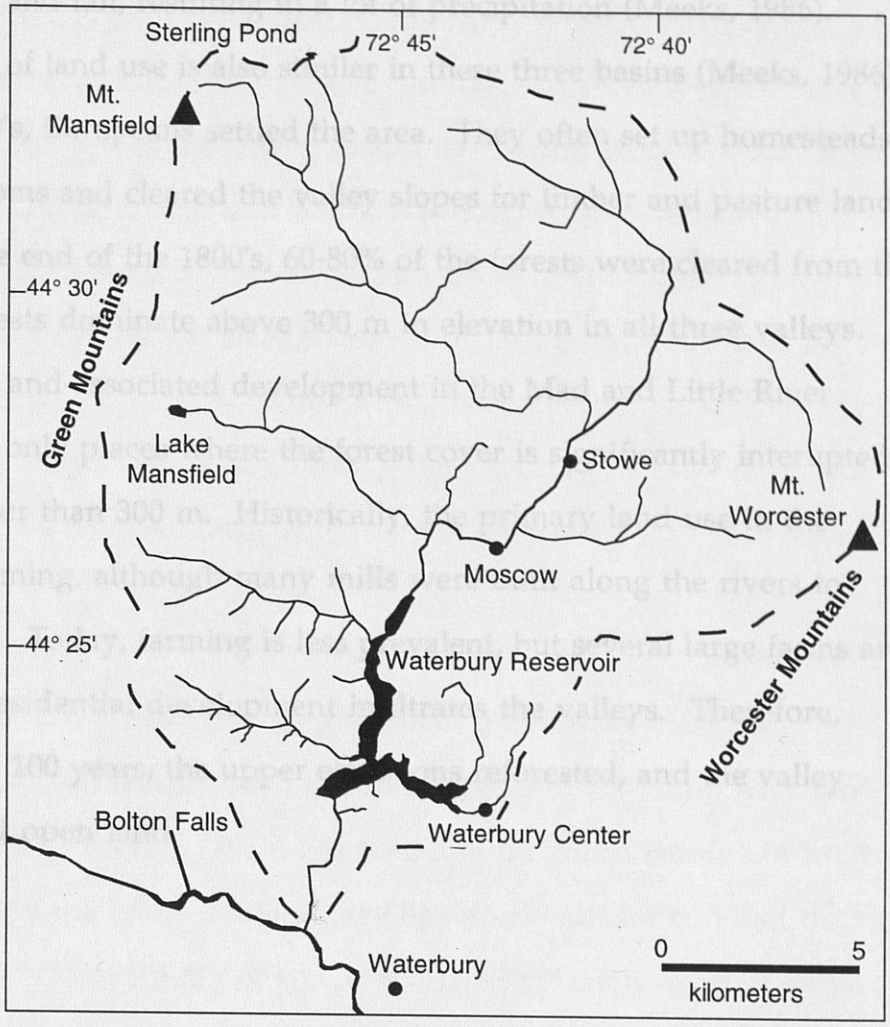



Figure 1.4: Map of Little River Basin. Base map from USGS 1:100,00 sheet.

and lesser tropical storms are infrequent, but may sometimes enter the region in the summer and fall, resulting in a lot of precipitation (Meeks, 1986).

The history of land use is also similar in these three basins (Meeks, 1986). In the late 1700's, Europeans settled the area. They often set up homesteads in the valley bottoms and cleared the valley slopes for timber and pasture land. Although at the end of the 1800's, 60-80% of the forests were cleared from the area, today forests dominate above 300 m in elevation in all three valleys. Large ski areas and associated development in the Mad and Little River Valleys are the only places where the forest cover is significantly interupted at elevations higher than 300 m. Historically, the primary land use in the valleys was farming, although many mills were built along the rivers to process lumber. Today, farming is less prevalent, but several large farms are still active as residential development infiltrates the valleys. Therefore, during the past 100 years, the upper elevations reforested, and the valley floors remained open land.

# CHAPTER 2: PREVIOUS RESEARCH

## DEGLACIATION OF THE CHAMPLAIN AND WINOOSKI VALLEYS

The deglacial record of the Champlain and Winooski Valleys is one of northwestward ice retreat, ice lowering, and decreasing proglacial lake levels. As the Hudson-Champlain lobe of the Laurentide ice sheet retreated, proglacial lakes developed in the valleys and left behind a scattered record of deltas and shorelines. As the lakes withdrew from the valleys, rivers began to incise the lake deposits. The purpose of this section is to review the history of the glacial lakes in the Winooski Drainage Basin and to identify when the transition occurred between lacustrine and fluvial processes in each valley.

### Winooski Valley

Early work in the Winooski Valley by Merwin (1908) established a chronology of lake levels that has been modified relatively little with more recent work. Only Fairchild (1916) has disputed the interpretation of multiple proglacial lakes in the Winooski Drainage Basin. He attributed all of the shoreline deposits to one body of water, a marine invasion which isolated New England from the rest of the continent via the Hudson and Champlain Valleys. More recent work by Larsen (1972, 1987a & b), and Wagner (1972) has generally supported Merwin's (1908) chronology of lake levels.

Stewart and MacClintock (1969) present a different sequence of lake levels. Instead of attributing the delta and shoreline deposits found in the Winooski Valley to local, high level lakes, Stewart and MacClintock interpreted some of these deposits to be formed by waters confluent with Lake Quaker Springs in the Champlain Valley. Deltas and terraces in the Huntington, Mad, and Winooski Valleys do occur near elevations of Lake Quaker Springs as defined

by Stewart and MacClintock, but other workers (Connally and Sirkin, 1973) placed the northern limit of Lake Quaker Springs south of the Winooski Drainage Basin. Therefore, these deposits are best explained by high level lakes. Table 2.1 shows the correlations of Winooski Valley lake levels from previous studies used to construct the history presented below.

Larsen (1972, 1987a & b) produced the most complete chronology of proglacial lakes in the eastern Winooski Valley, and his five stages of lake development are presented here as a model for the entire region. Work in the Huntington Valley (Wagner, 1972; Bryan, 1995) and in the Little River Valley (Merwin, 1908; Connally, 1972) also demonstrates that the chronology of lake levels in the Winooski Valley follows a five stage evolution (Table 2.2). Stage I lakes were limited to single north-draining valleys because they were bordered to the north by the retreating ice. These lakes drained over southern divides at different elevations into other drainage basins. During Stage II, the individual lakes coalesced, from southeast to northwest in a time-transgressive manner following the retreating ice, into a single lake whose elevation was controlled by the lowest Stage I outlet. Stage III began when the lake drained over a threshold at Gillett Pond west through the Huntington Valley into the Champlain Valley. During Stage IV, the lake continued to drain into the Champlain Valley, but the controlling threshold switched to the Hollow Brook divide. Stage IV ended when the ice retreated from where the Winooski Valley exits the Green Mountains. During Stage V, the proglacial lake waters from the Champlain Valley extended into the Winooski Basin and then withdrew to the Green Mountain Front by the close of Stage V.

Table 2.1: Winooski Valley Lake Level Correlations

| Merwin, 1908 | Stewart and MacClintock, 1969 | Connally, 1972 | Larsen,1972; 1987 a&b | Wagner, 1972 | This Study | Elevation |
|---|---|---|---|---|---|---|
| Lake Winooski I | Lake Quaker Springs | - | Lake Winooski | - | Stage II | 279 m at Williamstown Divide |
| Lake Mansfield | Lake Quaker Springs | Lake Mansfield | Lake Mansfield I | Lake Gillett | Stage III | 229 m at Gillett Pond Threshold |
| Lake Mansfield | Lake Quaker Springs | Lake Mansfield | Lake Mansfield II | Lake Huntington | Stage IV | 204 m at Hollow Brook Divide |
| Lake Coveville | Lake Coveville | Lake Coveville | Lake Coveville | Lake Hollow Brook & Lake Jericho | Stage V | 195 m at North Williston Hill |

Table 2.2: Winooski Valley Lake Levels and Ice Positions

| Stage | Winooski River | Huntington River | Little River | Mad River | Dog River | Stevens Branch |
|---|---|---|---|---|---|---|
| I | Ice Retreats to Valley Mouths | Lake Jerusalem to Southern Divide | Ice and Local Lakes | Lake Granville to Granville Gulf Divide | Lake Roxbury to Roxbury Divide | Lake Williamstown to Williamstown Divide |
| II | Ice Retreats to Jonesville | Lake Huntington to Hollow Brook Divide | Lake Winooski above Divide | Lake Winooski to Warren | Lake Winooski to South Northfield | Lake Winooski to Williamstown Divide |
| III | Ice Retreats to Richmond | Lake Huntington to Hollow Brook Divide | Lake Mansfield I above Divide | Lake Mansfield I to Moretown | Fluvial | Fluvial |
| IV | Ice Retreats to Green Mountain Front | Lake Mansfield II to Hollow Brook Divide | Lake Mansfield II to Stowe | Fluvial | Fluvial | Fluvial |
| V | Lake Coveville to Waterbury | Lake Coveville to Huntington | Lake Coveville to Moscow | Fluvial | Fluvial | Fluvial |

The lake positions are cited as the farthest upvalley location and ice positions as farthest downvalley location during the stage.

*Stage I* Stage I lakes in the Winooski Basin formed separately in the presently north-draining Huntington River, Mad River, Dog River, and Stevens Branch Valleys (Figure 2.1). These lakes, bounded by ice to the north, were forced to drain through southern spillways that were at different elevations. During Stage I, the lakes expanded to the north, following the retreating ice margin. The south-draining Little River Valley was still occupied by ice. No river terraces formed in the main river valleys during Stage I because the lakes extended to the southern divides of each valley, but lacustrine and ice-contact sediments began to fill the valleys.

The lakes in the eastern Winooski Valley, named by Larsen (1972) for the town nearest the spillway, drained into the White River Valley and eventually into Lake Hitchcock, the proglacial lake that occupied the Connecticut River Valley. The highest of these lakes, Lake Granville in the Mad River Valley, flowed over a threshold at 430 m in the Granville Gulf and the lowest, Lake Williamstown in the Steven Branch Valley, emptied over a 279 m spillway north of the Williamstown Gulf. A previously unnamed Huntington Valley lake, suggested by Bryan (1995) as draining over the southern divide at an elevation of 460 m, would have flowed into Hollock Brook in the Champlain Valley. Following Larsen's criteria for naming Stage I lakes, the name Lake Jerusalem is suggested.

*Stage II* As the ice withdrew northwestward down the main Winooski Valley, the eastern lakes sequentially coalesced into Lake Winooski (Figure 2.2). Lake Winooski drained south through the 279 m spillway near Williamstown into the Connecticut River Valley. Larsen (1987a) contended that Lake Hitchcock drained when Lake Winooski was in existence based on the presence of longitudinal gravel bars south of the Williamstown spillway.

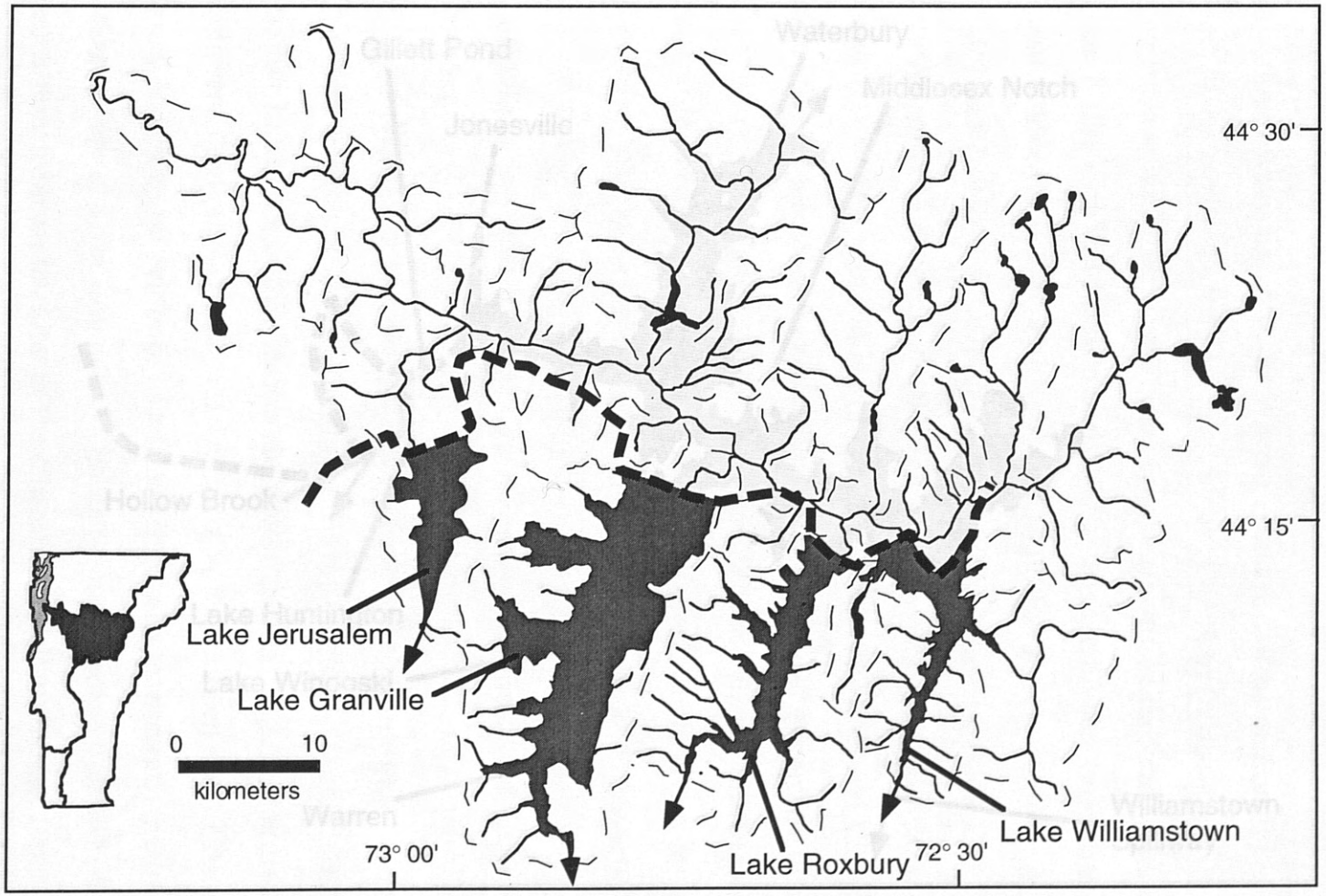



Figure 2.1: Extent of Stage I Lakes in the Winooski Drainage Basin. Proglacial lakes (shaded), controlled by southern spillways (arrows) and bounded by ice to the north (dashed line) formed in north-draining valleys during Stage I. The approximate ice margin is shown for the end of the stage. (After Larsen, 1987b and Valin, 1997). Base from USGS 1:250,000 Lake Champlain Sheet.

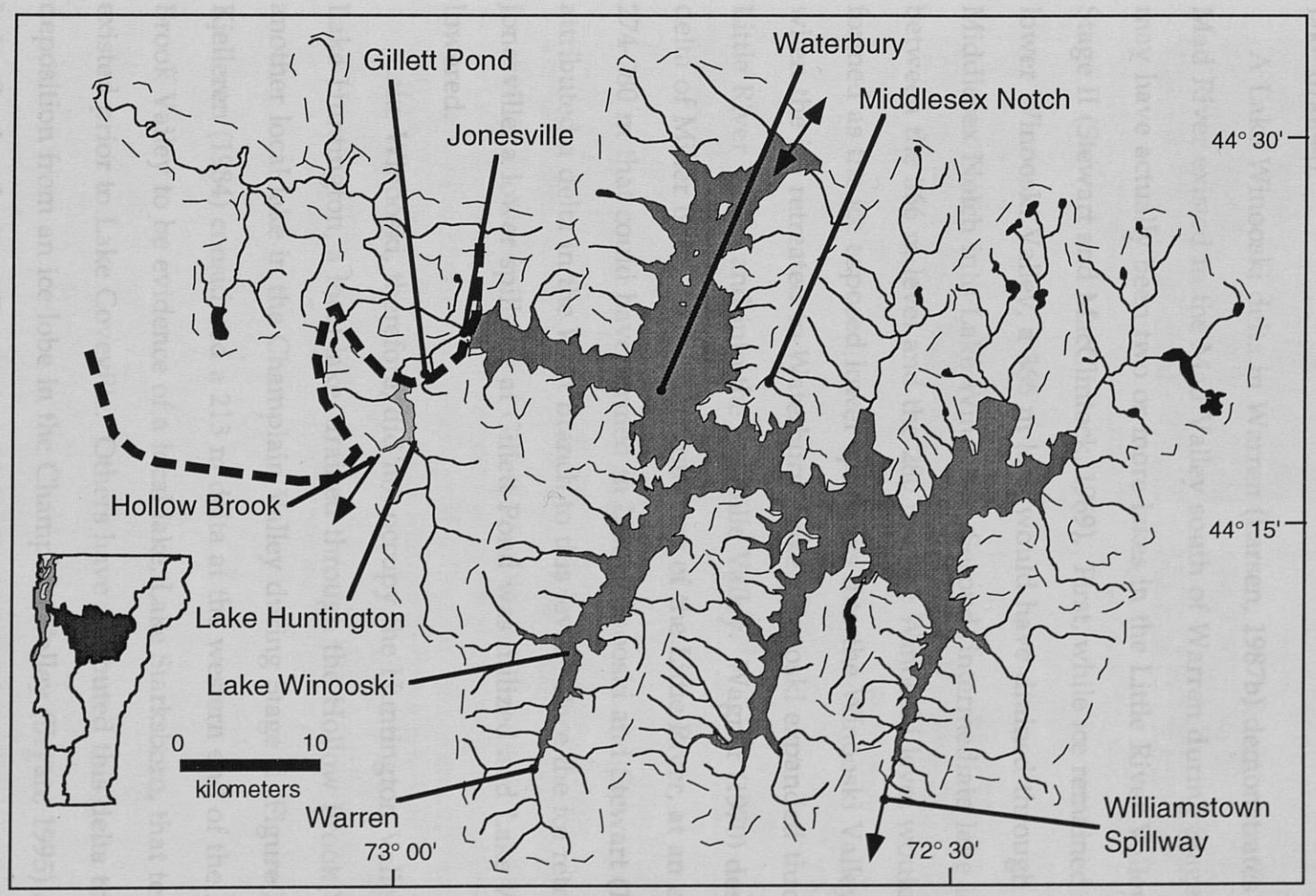



Figure 2.2: Extent of Stage II Lakes in the Winooski Drainage Basin. Lake Winooski, which drained over the Williamstown Spillway, expanded down the Winooski Valley during Stage II. Lake Huntington utilized the Hollow Brookspillway. The approximate ice margin (dashed line) is shown for the end of the stage. (After Larsen, 1987b and Valin, 1997). Base from USGS 1:250,000 Lake Champlain Sheet.

The elevation of the gravel bars is below the minimum projected elevation for Lake Hitchcock, implying that these fluvial features developed after that lake drained.

A Lake Winooski delta in Warren (Larsen, 1987b) demonstrates that the Mad River existed in the Mad Valley south of Warren during Stage II. There may have actually been two or more lakes in the Little River Valley during Stage II (Stewart and MacClintock, 1969). First, while ice remained in the lower Winooski Valley, a 366 m lake would have drained through the Middlesex Notch into Lake Winooski. Second, intermediate lake levels between the 366 m level and the 280 m Lake Winooski level would have formed as the ice exposed lower spillways into the Winooski Valley. Finally, when the ice retreated to Waterbury, Lake Winooski expanded through the Little River Valley and into the Lamoille Valley. Wagner (1970) described a delta of Miller Brook, a western tributary of the Little River, at an elevation of 274-280 m that could have formed in Lake Winooski and Stewart (1961) attributed a delta in the West Branch to this level. Once the ice retreated to Jonesville, a lower spillway at Gillett Pond was utilized and Lake Winooski lowered.

Lake Winooski, therefore, did not occupy the Huntington Valley. Instead, Lake Huntington, a local lake, drained through the Hollow Brook Valley into another local lake in the Champlain Valley during Stage II (Figure 2.3). Kjelleren (1984) considered a 213 m delta at the western end of the Hollow Brook Valley to be evidence of a local lake, Lake Starksboro, that temporarily existed prior to Lake Coveville. Others have attributed this delta to deposition from an ice lobe in the Champlain Valley (Bryan, 1995) and to Lake Quaker Springs (Stewart and MacClintock, 1969).

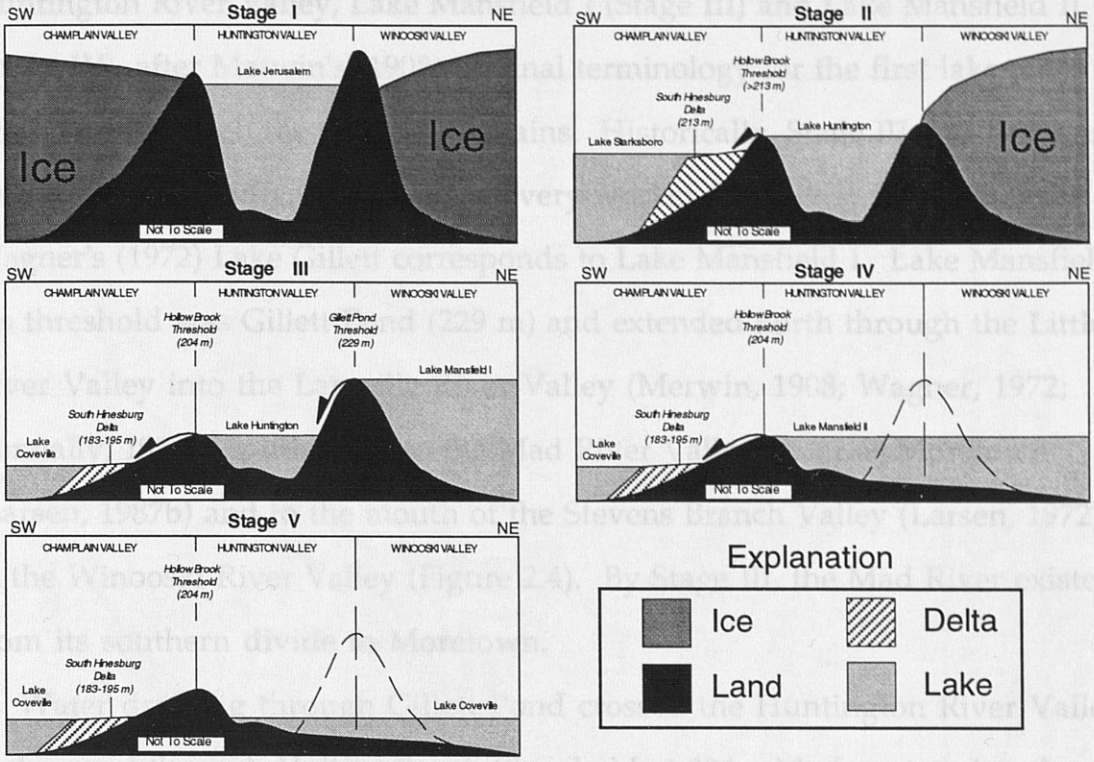



Figure 2.3: Schematic Cross Sections Through the Huntington Valley During Stages I-V. Stage I depicts Lake Jerusalem bounded by ice to the northeast and southwest; its spillway was the southern divide. By Stage II, ice had retreated north of Hollow Brook Valley and Lake Huntington first utilized the spillway there, draining into the local Lake Starksboro. When the Gillett Pond spillway was first free of ice at the beginning of Stage III, Lake Mansfield I emptied into Lake Huntington, and eventually into Lake Coveville in South Hinesburg. Lake Mansfield II extended through the Huntington Valley once the mouth of the Huntington River became ice-free (Stage IV). Finally at Stage V, the ice retreated past the Winooski River and Lake Coveville extended into the Winooski Valley.

*Stage III* Larsen (1987b) named the lakes that drained through the Huntington River Valley, Lake Mansfield I (Stage III) and Lake Mansfield II (Stage IV), after Merwin's (1908) original terminology for the first lake to drain west through the Green Mountains. Historically, Stage III and IV lakes have been given different names by every worker (Table 2.1). For instance, Wagner's (1972) Lake Gillett corresponds to Lake Mansfield I. Lake Mansfield I 's threshold was Gillett Pond (229 m) and extended north through the Little River Valley into the Lamoille River Valley (Merwin, 1908; Wagner, 1972; Connally, 1972), southeast into the Mad River Valley as far as Moretown (Larsen, 1987b) and to the mouth of the Stevens Branch Valley (Larsen, 1972) in the Winooski River Valley (Figure 2.4). By Stage III, the Mad River existed from its southern divide to Moretown.

Water draining through Gillett Pond crossed the Huntington River Valley and passed through Hollow Brook (threshold at 204 m) before entering the Champlain Valley in South Hinesburg. Since Lake Mansfield I eventually drained through the Hollow Brook Valley, it would be expected that some type of deposit would be present in the main Huntington Valley to link Gillett Pond to one of the deltas in South Hinesburg. As Lake Winooski lowered to the Gillett Pond threshold and during Stage III, the waters may have passed through Lake Huntington, controlled by the Hollow Brook threshold (204 m), before reaching the delta in South Hinesburg (Figure 2.3). Because it shares its spillway with later lakes, Lake Huntington has never been independently documented.

There are other possible pathways for the Lake Mansfield I water to reach Hollow Brook. A remnant ice tongue, filling the present Huntington River Valley just west of Gillett Pond, must have existed during Stage III to

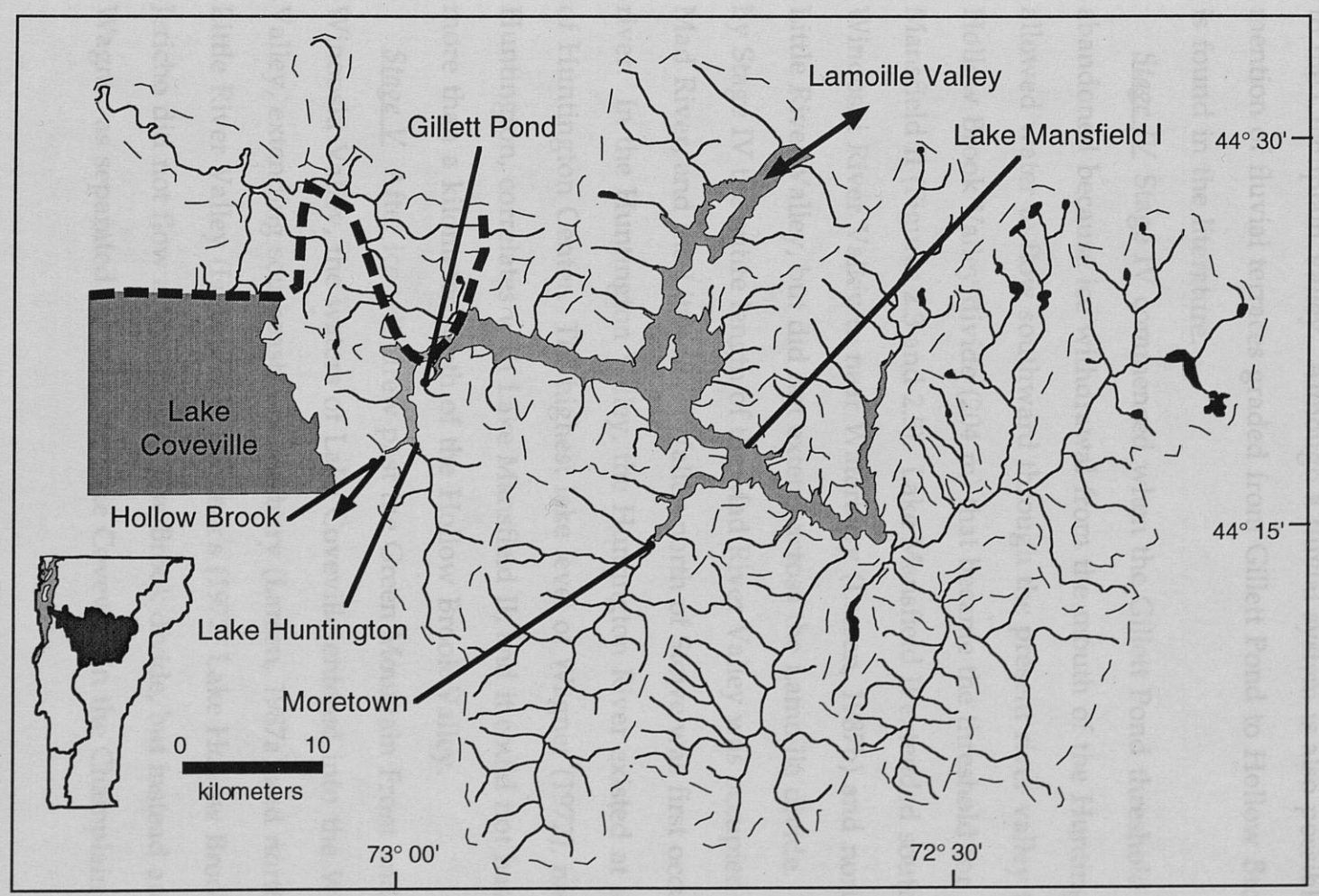



Figure 2.4: Extent of Stage III Lakes in the Winooski Drainage Basin. Lake Mansfield I drained into the Huntington Valley through the Gillett Pond spillway. The water in the Huntington Valley then drained through Hollow Brook into Lake Champlain. The approximate ice margin(dashed line) is shown for the end of the stage. (After Larsen, 1987b and Valin, 1997). Base from USGS 1:250,000 Lake Champlain Sheet.

maintain the Gillett threshold. It is possible that this ice extended south to near the Hollow Brook Valley, providing the waters with a supraglacial route to the Champlain Valley. Although a fluvial system is also possible, no mention of fluvial terraces graded from Gillett Pond to Hollow Brook Valley is found in the literature.

*Stage IV* Stage IV commenced when the Gillett Pond threshold was abandoned because ice withdrawal from the mouth of the Huntington River allowed water to flow southward through the present river valley to the Hollow Brook Valley divide (204 m) that became the threshold for Lake Mansfield II (Figures 2.3 and 2.5). Lake Mansfield II extended southeast in the Winooski River Valley to near Waterbury (Larsen, 1987b) and north into the Little River Valley, but did not extend across the Lamoille divide. Therefore, by Stage IV the entire length of the Mad River Valley was occupied by the Mad River, and the Little River Valley north of Stowe was first occupied by a river. In the Huntington Valley, the Huntington River existed at least south of Huntington Center. The highest lake level of Wagner (1972), named Lake Huntington, correlates with Lake Mansfield II, and it could not have extended more than a kilometer south of the Hollow Brook Valley.

*Stage V* After ice withdrew past the Green Mountain Front and out of the Winooski Valley, the waters of Lake Coveville entered into the Winooski Valley, extending southeast to Waterbury (Larsen, 1987a) and north into the Little River Valley (Figure 2.6). Wagner's (1972) Lake Hollow Brook and Lake Jericho did not flow across the Hollow Brook divide, but instead are shown by Wagner as separated by ice from Lake Coveville in the Champlain Valley.

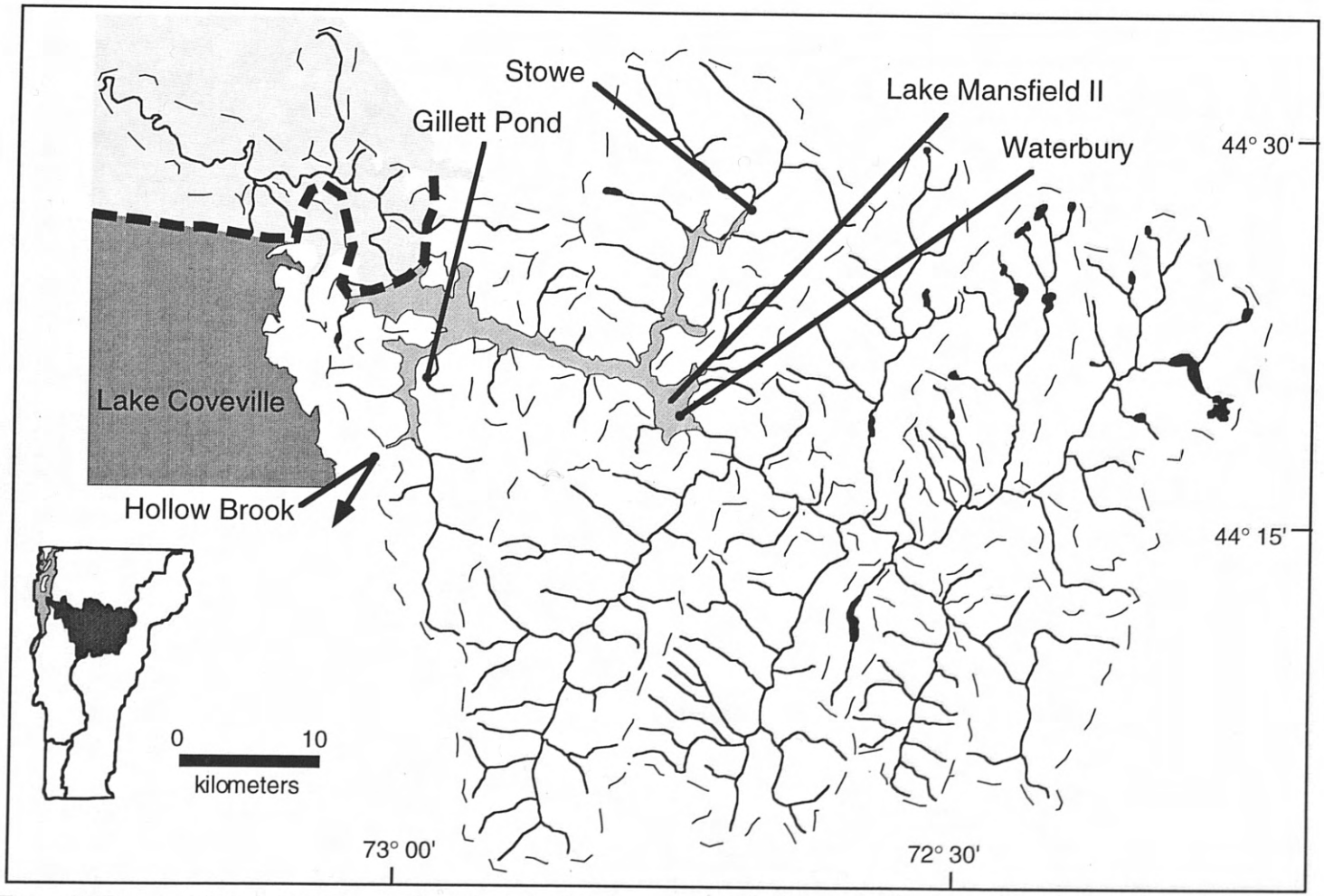



Figure 2.5: Extent of Stage IV Lakes in the Winooski Drainage Basin. The ice retreted past the Huntington Valley mouth, and Lake Mansfield II then drained through Hollow Brook. The approximate ice margin (dashed line) is shown for the end of the stage. (After Larsen, 1987b and Valin, 1997). Base from USGS 1:250,000 Lake Champlain Sheet.

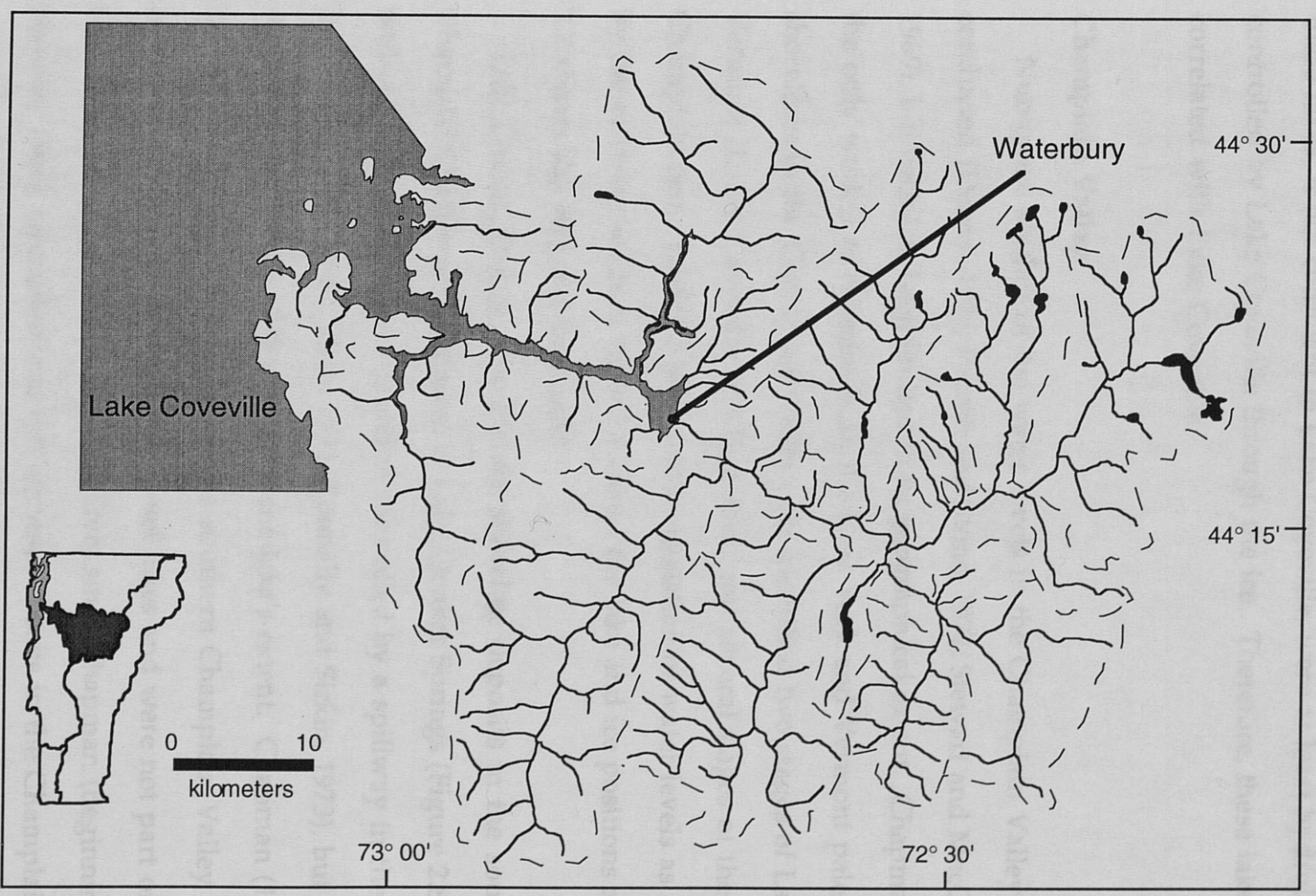



Figure 2.6: Extent of Stage V Lakes in the Winooski Drainage Basin. Once ice moved from the Green Mountain Front, Lake Coveville expanded into the Winooski Basin and the Hollow Brrookspillway was abandoned. The approximate ice margin (dashed line) is shown for the end of the stage. (After Larsen, 1987b and Valin, 1997). Base from USGS 1:250,000 Lake Champlain Sheet.

Because the elevations of Lakes Hollow Brook and Jericho are similar to the elevation of Lake Coveville (Chapman, 1937) at the Green Mountain Front, these lakes, if not confluent to Lake Coveville, were at least hydrologically controlled by Lake Coveville through the ice. Therefore, these lakes are correlated with Lake Coveville.

**Champlain Valley**

Numerous studies of the water levels in the Champlain Valley have been conducted (Denny, 1974; Parrott and Stone, 1972; Stewart and MacClintock, 1969), but each has been limited in its geographical extent. Chapman (1937) is the only worker to examine both the New York and Vermont paleo-shorelines in the Champlain Valley. He identified two stages of Lake Vermont (Lakes Coveville and Fort Ann) and several stages of the Champlain Sea. Table 2.3 shows the correlation of water levels as identified by the different studies, Table 2.4 shows the lake and ice positions and Figure 2.7 shows the regional moraines.

*Lake Quaker Springs* The highest shoreline deposits in the southern Champlain Valley are attributed to Lake Quaker Springs (Figure 2.8), a lake with a northern limit near Brandon controlled by a spillway in the Hudson Valley (Connally and Calkin, 1972; Connally and Sirkin, 1973), but historically there has been some confusion as to the lake's extent. Chapman (1937) thought the highest shorelines in the southern Champlain Valley were constructed along individual, high-level lakes and were not part of the same regional lake. However, several workers since Chapman (beginning with Stewart, 1961) concluded that the highest deposits in the Champlain Valley were associated with an extensive lake, Lake Quaker Springs. Stewart and

Table 2.3: Champlain Valley Water Level Correlations

| Chapman, 1937 | Stewart and MacClintock, 1969 | Connally and Sirkin, 1973 | Denny, 1974 | Clark and Karrow, 1984 | DiSimone and LaFleur,1985 | This Study | Elevation * |
|---|---|---|---|---|---|---|---|
| High Local Lakes | Quaker Springs Stage | Lake Quaker Springs | - | - | Lake Quaker Springs | Lake Quaker Springs | - |
| Coveville Stage | Coveville Stage | Lake Coveville | Coveville Stage | - | Lake Coveville | Lake Coveville | Shoreline at 195 m at North Williston Hill |
| Fort Ann Stage | Fort Ann Stage | Fort Ann | Fort Ann Stage | Upper Fort Ann | Fort Ann I | Lake Fort Ann I | Delta at 152 m in Richmond |
| Fort Ann Stage | Fort Ann Stage | Fort Ann | Fort Ann Stage | Upper Fort Ann | Fort Ann II | Lake Fort Ann I | Delta at 152 m in Richmond |
| Fort Ann Stage | Fort Ann Stage | Fort Ann | Fort Ann Stage | Lower Fort Ann | Fort Ann III | Lake Fort Ann II | 132 m in Richmond ** |
| Upper Marine | Champlain Sea | Champlain Sea | Champlain Sea | Champlain Sea | Champlain Sea | Upper Marine | Delta at 104 m in Essex |

* Elevations measured by Chapman (1937), except ** estimated from Clark and Karrow (1984).

Table 2.4: Champlain Valley Water Levels and Ice Positions

| Water Level | Threshold | Ice Position | Winooski Valley Extent |
|---|---|---|---|
| Lake Quaker Springs | Across Hudson Divide | Brandon | - |
| Lake Coveville | Across Hudson Divide | Lamoille Valley | Waterbury |
| Lake Fort Ann I | Fort Edward | International Border ? | Richmond |
| Lake Fort Ann II | Fort Edward | Highland Front Moraine | Richmond |
| Upper Marine | Sea Level | St. Narcisse Moraine | Essex |

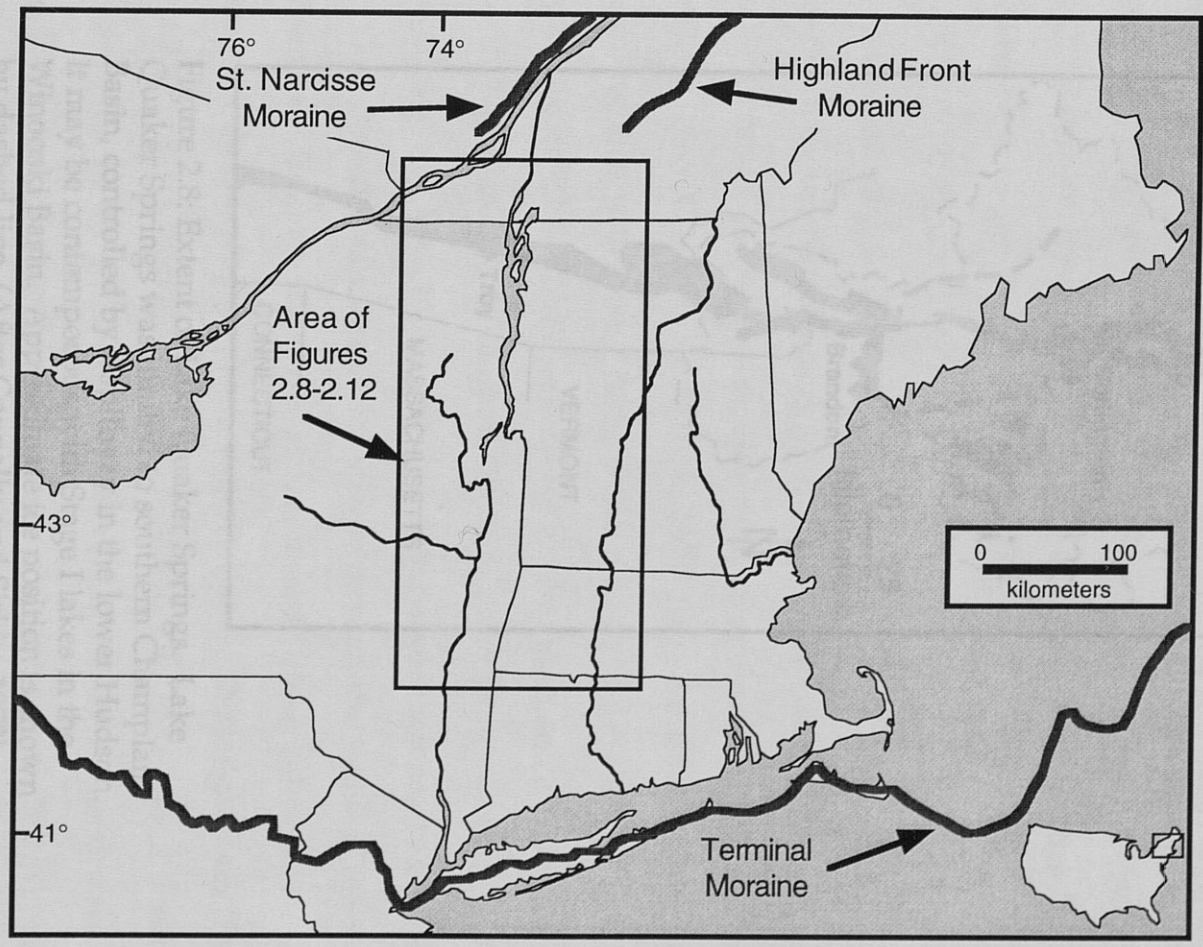



Figure 2.7: Location of Major Moraines in the Northeast. The Terminal Moraine delineates the maximum extent of the Laurentide ice sheet about 18,000 $^{14}$C yr B. P. The Highland Front Moraine marks the northern extent Lake Fort Ann, 12,600 $^{14}$C yr B. P., and the Saint Narcisse Moraine delineates the ice position during the Upper Marine Phase of the Champlain Sea (11,700-10,800 $^{14}$C yr B. P.).

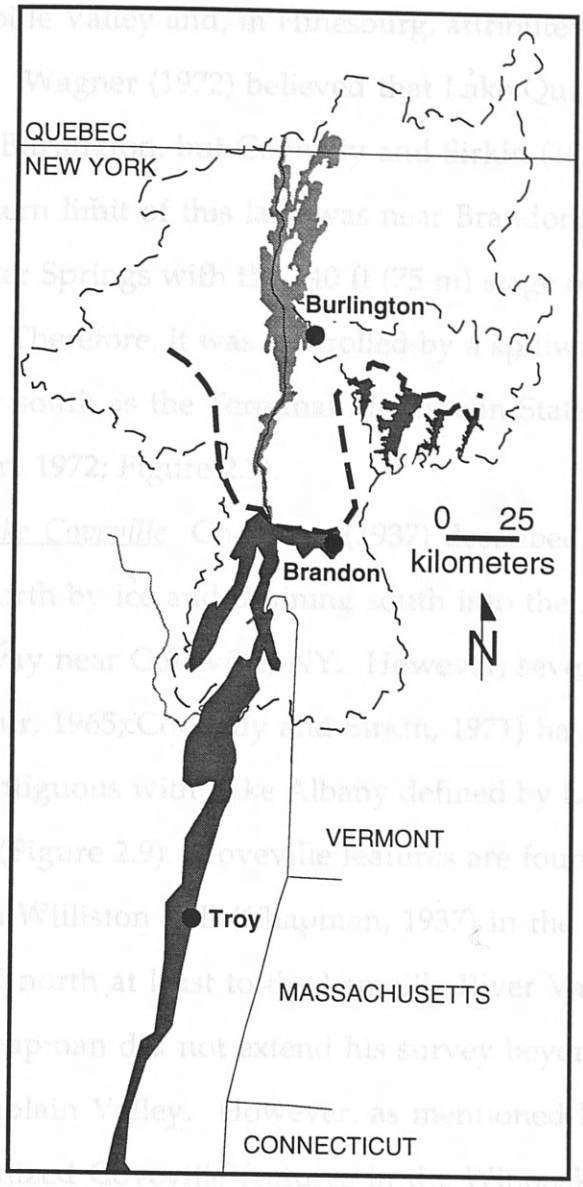



Figure 2.8: Extent of Lake Quaker Springs. Lake Quaker Springs was limited to southern Champlain Basin, controlled by a spillway in the lower Hudson. It may be contemporous with Stage I lakes in the Winooski Basin. Approximate ice position is shown by dashed line. (After Connally and Sirkin, 1973).

MacClintock (1969) described Lake Quaker Springs features as far north as the Lamoille Valley and, in Hinesburg, attributed a delta at 213 m to this lake level. Wagner (1972) believed that Lake Quaker Springs extended north to near Burlington, but Connally and Sirkin (1973) later claimed that the northern limit of this lake was near Brandon. LaFleur (1965) correlated Lake Quaker Springs with the 240 ft (75 m) stage of Lake Albany (elevation in Troy, NY). Therefore, it was controlled by a spillway in the Hudson Valley, possibly as far south as the Terminal Moraine in Staten Island, NY (Connally and Calkin, 1972; Figure 2.7).

*Lake Coveville* Chapman (1937) described Lake Coveville as bounded to the north by ice and draining south into the Hudson Valley through a spillway near Coveville, NY. However, several workers since Chapman (e.g., LaFleur, 1965; Connally and Sirkin, 1971) have considered Lake Coveville to be contiguous with Lake Albany defined by LaFleur (1965) as 180 ft (55 m) in Troy (Figure 2.9). Coveville features are found at an elevation of 195 m at North Williston Hill (Chapman, 1937) in the Burlington area, and can be traced north at least to the Lamoille River Valley (Connally and Sirkin, 1973).

Chapman did not extend his survey beyond the walls of the main Champlain Valley. However, as mentioned before, other workers have recognized Coveville features in the Winooski Drainage Basin (Figures 2.6 and 2.9). Lake Coveville (Stage V) reportably extended southward to Huntington in the Huntington Valley (Wagner, 1972), northward to Stowe in the Little River Valley (Merwin, 1908), and eastward to Waterbury in the Winooski Valley (Larsen 1987a).

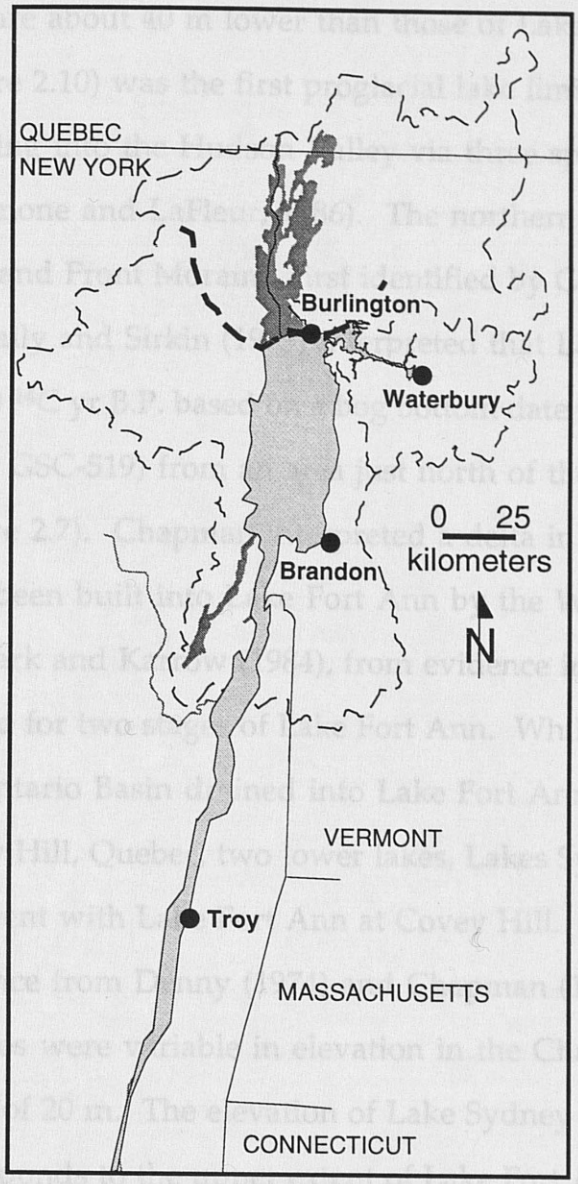



Figure 2.9: Extent of Lake Coveville. Lake Coveville was controlled by a spillway in the Hudson Valley south of Troy. Approximate ice position (dashed line) is shown during Stage V in the Winooski Basin. (After Chapman, 1937 and Connally and Sirkin, 1973).

*Lake Fort Ann* Chapman stated that the strandline features of Lake Fort Ann are about 40 m lower than those of Lake Coveville. Lake Fort Ann (Figure 2.10) was the first proglacial lake limited to the Champlain Valley, draining into the Hudson Valley via three spillways near Fort Ann, NY (DiSimone and LaFleur, 1986). The northern limit of Lake Fort Ann was the Highland Front Moraine, first identified by Gadd (1964), in southern Quebec. Connally and Sirkin (1973) interpreted that Lake Fort Ann existed before 12,600 $^{14}C$ yr B.P. based on a bog bottom date reported by Terasmae and LaSalle (1968; GSC-519) from an area just north of the Highland Front Moraine (Figure 2.7). Chapman interpreted a delta in Richmond (elevation 152 m) to have been built into Lake Fort Ann by the Winooski River.

Clark and Karrow (1984), from evidence in the St. Lawrence Lowlands, argued for two stages of Lake Fort Ann. While two stages of Lake Iroquois in the Ontario Basin drained into Lake Fort Ann through different thresholds at Covey Hill, Quebec, two lower lakes, Lakes Sydney and Belleville, were confluent with Lake Fort Ann at Covey Hill. Clark and Karrow cited evidence from Denny (1974) and Chapman (1937) that the Fort Ann shoreline features were variable in elevation in the Champlain Valley, existing over a range of 20 m. The elevation of Lake Sydney features at Covey Hill corresponds to the upper extent of Lake Fort Ann features cited by Denny and Chapman and the elevation of Lake Belleville features corresponds with the lower limit of the features, implying that there were two distinct levels of Lake Fort Ann. The next highest shoreline examined by Clark and Karrow correlates with the highest extent of the Champlain Sea in both the Ontario and Champlain Basins.

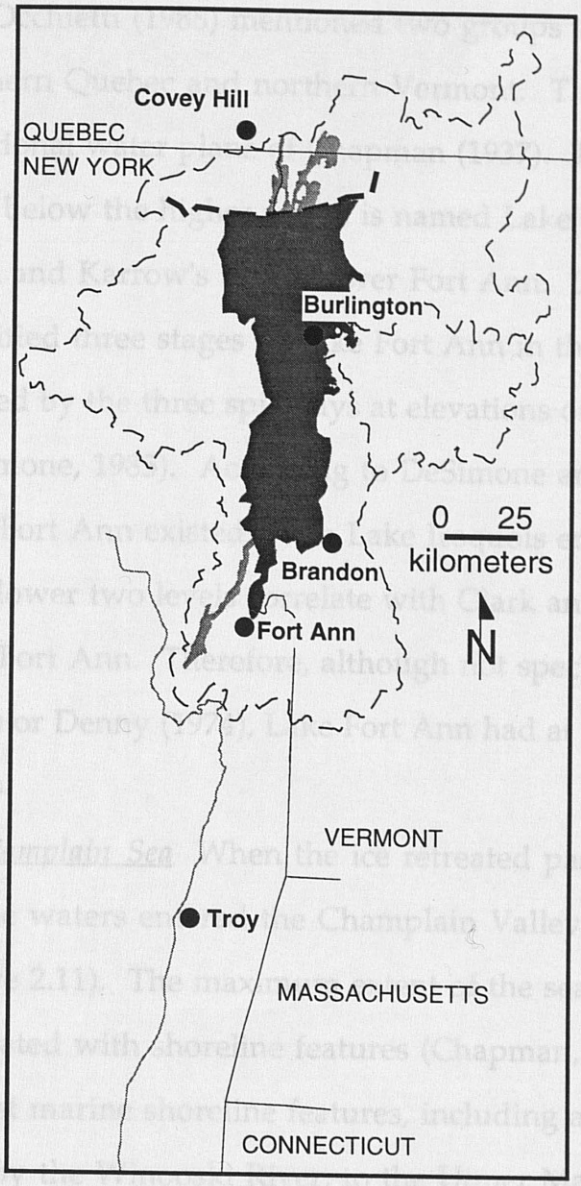



Figure 2.10: Extent of Lake Fort Ann I. Fort Ann I was the first lake to be controlled by a spillway within the Champlain Basin. It existed until the ice retreated past the international border at which point in time the lakes in the Ontario Basin became confluent with Champlain Basin waters. (After Chapman, 1937).

Others workers also identified multiple levels of Lake Fort Ann. Parent and Occhietti (1988) mentioned two groups of Fort Ann shoreline features in southern Quebec and northern Vermont. The highest corresponds with the traditional water plane of Chapman (1937). The second group, which lies 10-15 m below the higher plane, is named Lake Candona and correlates with Clark and Karrow's (1984) lower Fort Ann. DeSimone and LaFleur (1986) identified three stages of Lake Fort Ann in the Hudson Valley of New York, defined by the three spillways at elevations of 61 m, 52 m and 43 m (DiSimone, 1985). According to DeSimone and LaFleur (1986), their highest Lake Fort Ann existed when Lake Iroquois emptied into Lake Fort Ann and their lower two levels correlate with Clark and Karrow's (1984) two stages of Lake Fort Ann. Therefore, although not specifically defined by Chapman (1937) or Denny (1974), Lake Fort Ann had at least two, maybe three, distinct levels.

*Champlain Sea* When the ice retreated past the St. Lawrence Valley, marine waters entered the Champlain Valley to form the Champlain Sea (Figure 2.11). The maximum extent of the sea is well defined by marine fauna associated with shoreline features (Chapman, 1937). Chapman attributed the highest marine shoreline features, including a large delta in Essex (104 m) built by the Winooski River, to the Upper Marine stage of the Champlain Sea. Additional sets of water-line features were cut and deposited as the sea withdrew from the Champlain Valley.

Parent and Occhietti (1988) describe a three phase evolution of the Champlain Sea based on the timing of ice retreat. Phase I existed to the northeast of the Champlain Valley, in the mouth of the St. Lawrence, and was separated from Lake Fort Ann by ice. When the ice retreated from the

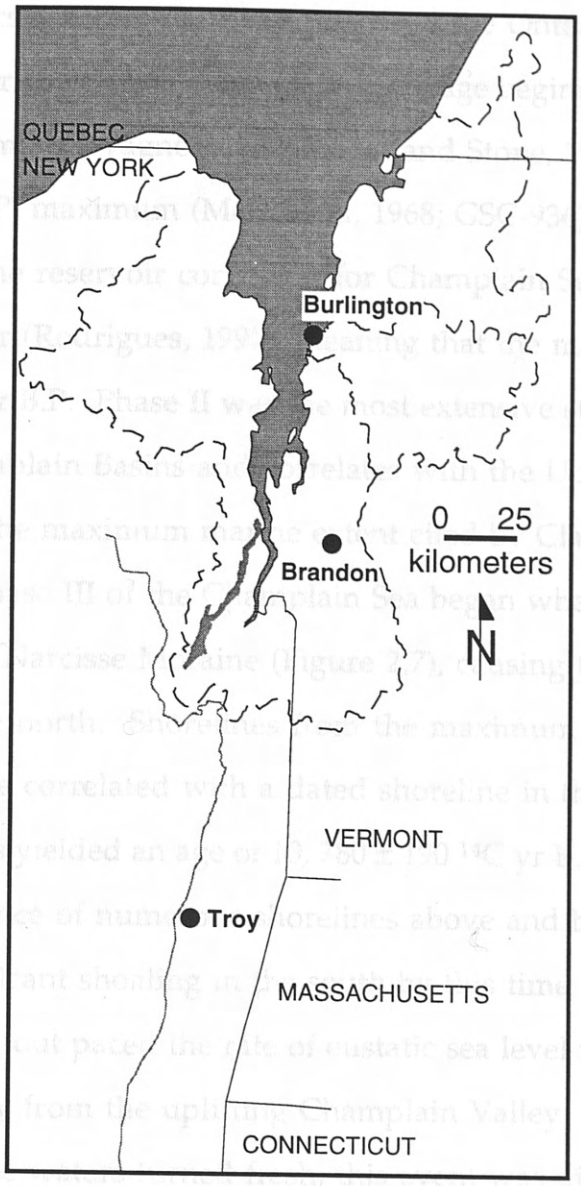



Figure 2.11: Extent of Upper Marine. The Upper Marine represents the farthest extent of Champlain Sea waters into the Champlain Basin. (After Chapman, 1937).

Highland Front Moraine to the Saint Narcisse Moraine (Figure 2.7), marine waters invaded the Champlain and the Ontario Valleys (Phase II). Uncorrected shell dates place this stage beginning at 11,740 ± 200 $^{14}$C yr B.P. minimum (Wagner, 1972; Parrot and Stone, 1972; I-4489) and 12,000 ± 230 $^{14}$C yr B.P. maximum (McDonald, 1968; GSC-936) in the Champlain Valley. A marine reservoir correction for Champlain Sea shells is cited as minus 400-500 yr (Rodrigues, 1992), meaning that the marine invasion occurred by 11,200 $^{14}$C yr B.P. Phase II was the most extensive stage in the Ontario and Champlain Basins and correlates with the Upper Marine of Chapman (1937) and the maximum marine extent cited by Clark and Karrow (1984).

Phase III of the Champlain Sea began when the ice retreated from the Saint Narcisse Moraine (Figure 2.7), causing the further expansion of the sea to the north. Shorelines from the maximum extent of the sea in the north can be correlated with a dated shoreline in the southern basin where marine fossils yielded an age of 10, 780 ± 190 $^{14}$C yr B.P. (Parent, 1987; UQ-298). The presence of numerous shorelines above and below the dated level suggests significant shoaling in the south by this time as the rate of glacio-isostatic tilting out paced the rate of eustatic sea level rise, causing the sea to withdraw slowly from the uplifting Champlain Valley. Phase III ended when the marine waters turned fresh; this event was diachronic across the basin as evident by the numerous radiocarbon dates cited by Parent and Occhietti ranging from 10,300 $^{14}$C yr B.P. near Ottawa to 9,300 $^{14}$C yr B.P. near Quebec City.

*Lake Champlain* Chapman noted that the marine interval ended when the present day threshold of the Richileu River rose, due to glacio-isostatic rebound, above the level of the Champlain Sea. Lake Champlain's present

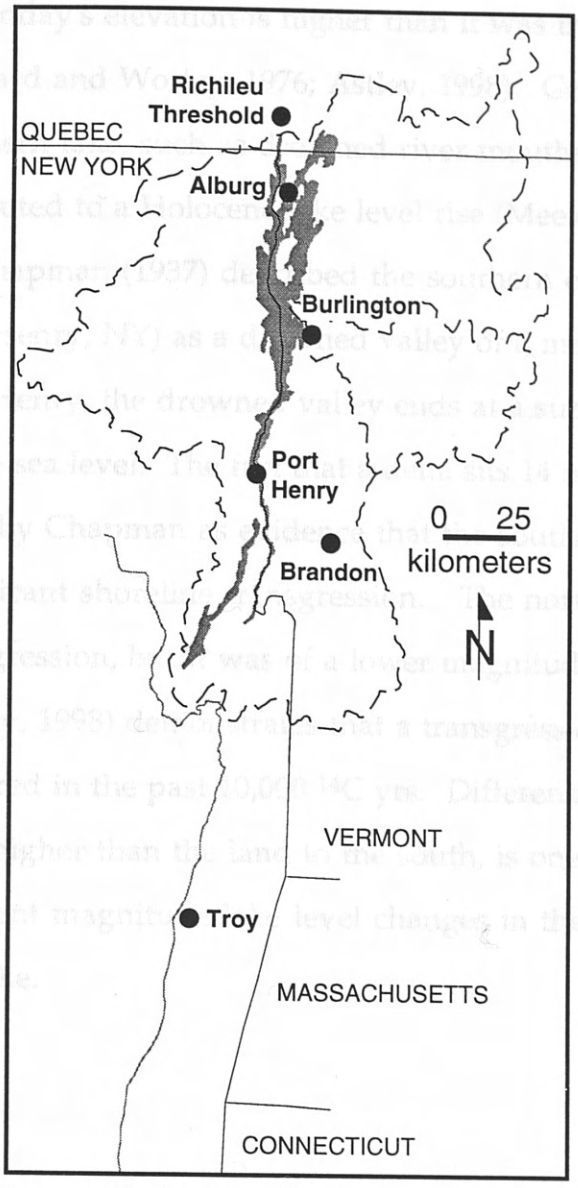



Figure 2.12: Extent of Lake Champlain. Drainage boundary after Vermont State Planning Office maps. Base map from Connally and Sirkin (1973).

average elevation is 29 m above sea level (Figure 2.12), but evidence suggests that today's elevation is higher than it was in the past (Chapman, 1937; Howard and Worley, 1976; Astley, 1998). Geomorphic evidence in the southern lake, such as drowned river mouths and lack of deltas, has been attributed to a Holocene lake level rise (Meeks, 1986).

Chapman (1937) described the southern end of the lake (from Whitehall to Port Henry, NY) as a drowned valley of a meandering river. Northeast of Port Henry, the drowned valley ends at a submerged delta, elevation 15 m above sea level. The fact that a delta sits 14 m below today's lake level was cited by Chapman as evidence that the southern lake has experienced significant shoreline transgression. The northern lake also has experienced a transgression, but it was of a lower magnitude. Recent work in Alburg (Astley, 1998) demonstrates that a transgression on the order of 8 m has occurred in the past 10,000 $^{14}C$ yrs. Differential uplift, where land to the north rises higher than the land to the south, is one of the only ways to have different magnitude lake level changes in the northern and southern parts of the lake.

**Summary**

The deglacial record of the Winooski and Champlain Drainage Basins is one of lowering proglacial lake levels. Figures 2.13 and 2.14 illustrate the temporal and spatial relations of the water bodies occupying northern Vermont and surrounding areas. Due to the time-transgressive manner of ice retreat and lake histories, the histories of the southern and northern portions of the Champlain Basin are shown separately. In the Winooski Drainage Basin, the lakes lowered in five stages as the ice retreated northwestward down-valley and lower spillways progressively opened. As the lakes lowered, river incision was initiated. After the ice retreated from the Green Mountain Front, the lakes in the Winooski Valley were directly connected to the Champlain Valley. The mouth of the Winooski River migrated westward as the Champlain Valley lakes lowered and the sea invaded. Finally, Lake Champlain was established when the threshold at Richileu separated the basin from the ocean. Table 2.5 reports the timing and elevations of baselevel controls specific to the Winooski Valley.

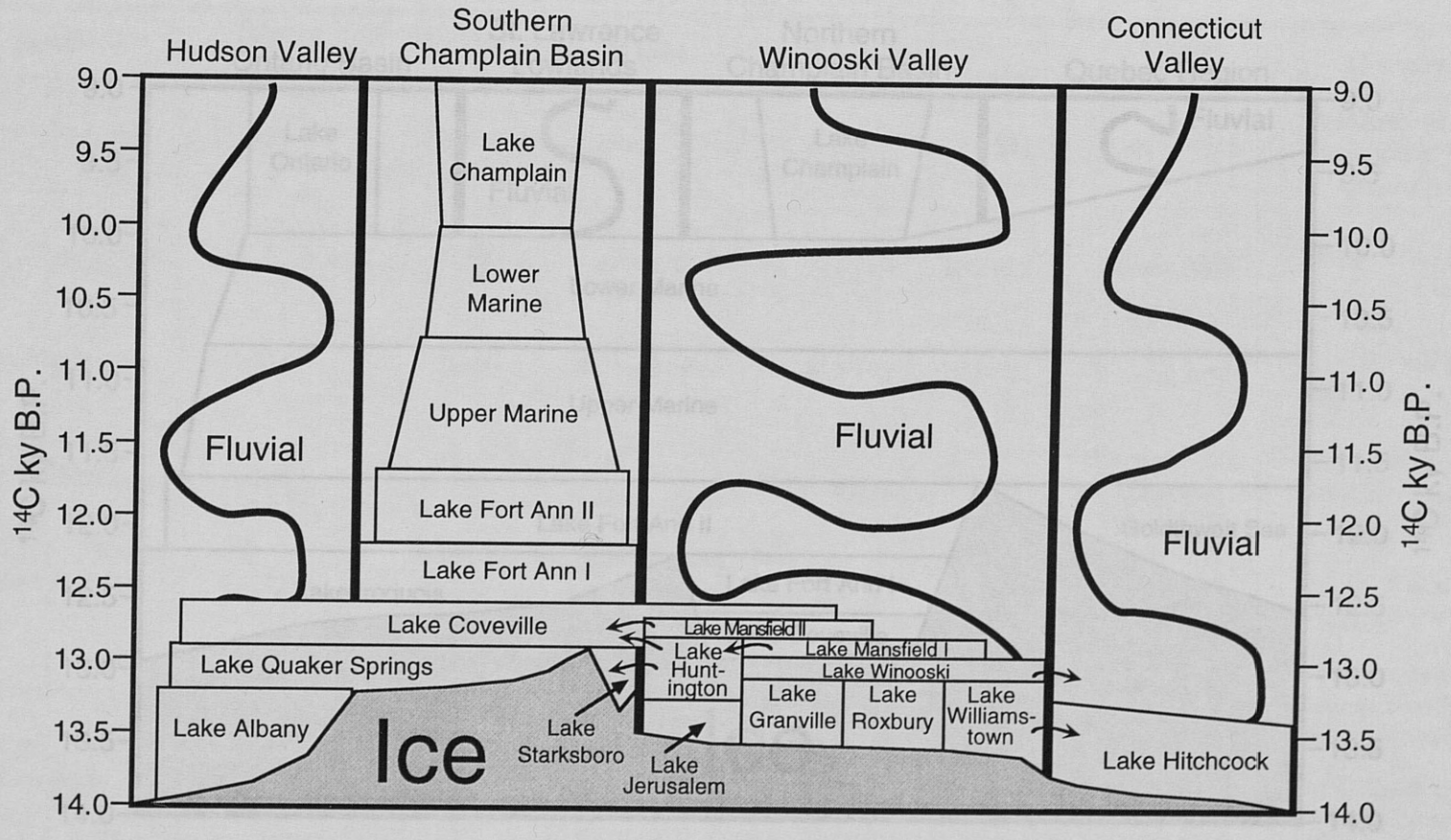



Figure 2.13: Correlation Diagram of Deglacial Events within the Southern Champlain Valley. Shown are the spatial and temporal extent of post-glacial water bodies in an approximate transcect across the Southern Champlain Basin. Width of boxes indicate relative size of water bodies. Radiocarbon dates are presented in Table 2.5.

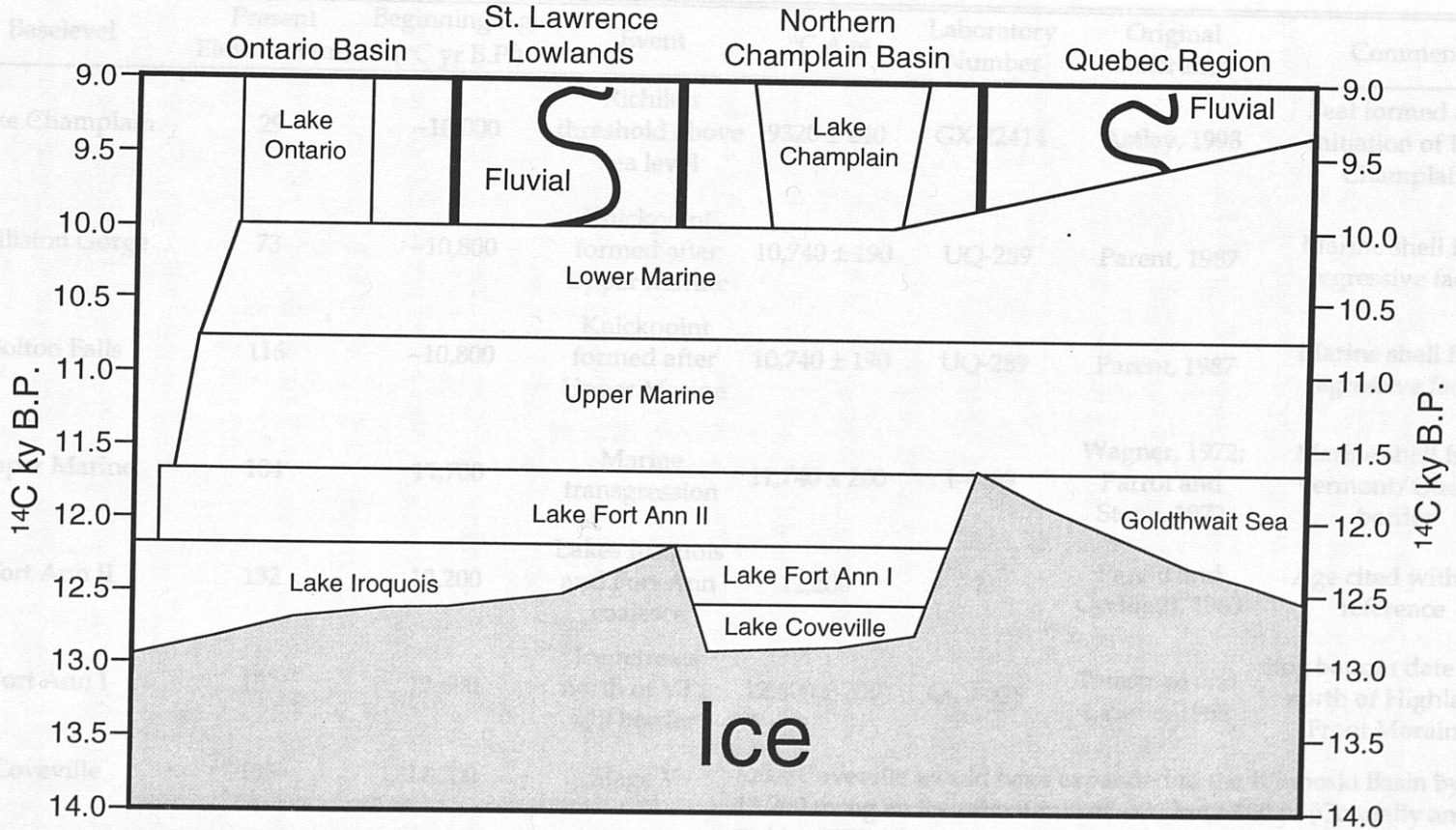



Figure 2.14: Correlation Diagram of Deglacial Events within the Northern Champlain Valley. Shown are the spatial and temporal extent of post-glacial water bodies in an approximate transcect across the Northern Champlain Basin. Width of boxes indicate relative size of water bodies. Radiocarbon dates are presented in Table 2.5.

Table 2.5: Baselevel Controls in the Winooski Basin

| Baselevel | Present Elevation (m) | Beginning Age ($^{14}$C yr B.P.) | Event | $^{14}$C Age | Laboratory Number | Original Reference | Comment |
|---|---|---|---|---|---|---|---|
| Lake Champlain | 29 | ~10,000 | Richileu threshold above sea level | 9320 ± 240 | GX-22414 | Astley, 1998 | Peat formed after initiation of Lake Champlain |
| Williston Gorge | 73 | ~10,800 | Knickpoint formed after Upper Marine | 10,740 ± 190 | UQ-289 | Parent, 1987 | Marine shell from regressive facies |
| Bolton Falls | 116 | ~10,800 | Knickpoint formed after Upper Marine | 10,740 ± 190 | UQ-289 | Parent, 1987 | Marine shell from regressive facies |
| Upper Marine | 104 | 11,700 | Marine transgression | 11,740 ± 200 | I-4489 | Wagner, 1972; Parrot and Stone, 1972 | Marine shell from Vermont/Quebec border |
| Fort Ann II | 132 | 12,200 | Lakes Iroquois and Fort Ann coalesce | 12,200 | ? | Parent and Occhietti, 1988 | Age cited with no reference |
| Fort Ann I | 152 | 12,600 | Ice retreats north of VT/ QE border | 12,600 ± 200 | GCS-519 | Terasmae and LaSalle, 1968 | Bog bottom date from north of Highland Front Moraine |
| Coveville | 195 | 12,700 | Stage V | Lake Coveville would have expanded to the Winooski Basin by 12,700 using an ice retreat rate of ~ 30 km/ 100 yr (Connally and Sirkin, 1973). Using the same retreat rate in the Winooski Basin, deglaciation (Stages 1-4) would have taken ~ 200 years. With less of an ice front calving into the lakes, the retreat rate in the more mountainous Winooski Basin could have been slower. Therefore, the retreat rate is halved for the Winooski Basin and the time for deglaciation is equally divided so that each stage lasts 100 years. | | | |
| Mansfield II | 204 | 12,800 | Stage IV | | | | |
| Mansfield I | 229 | 12,900 | Stage III | | | | |
| Winooski | 279 | 13,000 | Stage II | | | | |

## GLACIO-ISOSTATIC REBOUND

### Background

Glacio-isostatic rebound is the result of land, once depressed under the weight of the ice sheet, rising to return to its original position when the load is removed. The additional weight of the ice on the crust is compensated isostatically; the mantle flows away from the region. Assuming that the crust remains rigid, a reasonable assumption over a small region, a given ice thickness will displace a column of mantle by an amount predicted by Archimedes Principle:

$$M_d = H_{ice} [\rho_{ice}/(\rho_m - \rho_{ice})]$$

where $M_d$ is the height of displaced mantle, $H_{ice}$ is the thickness of ice, and $\rho_i$ and $\rho_m$ are the densities of ice and mantle, respectively. However, the mantle is a viscous fluid and its response to the increasing thickness of ice will not be instaneous or uniform over time. Therefore, in the ideal case where the mantle is in equilibrium with the ice load at the glacial maximum, $M_d$ represents an upper limit, and can be defined as $M_{dmax}$.

The thickness of the ice ($H_{ice}$) is dependent on the distance from the center of the ice sheet. Ice reconstructions presented by Hughes (1987) show the Laurentide ice sheet centered over Hudson Bay, NNW of Vermont. At the glacial maximum, 18,000 $^{14}C$ yr B.P., the ice thickness decreased from about 4 km over Hudson Bay, to about 2 km over the Winooski Drainage Basin, and to 0 km at the terminus at Long Island. If $H_{ice}$ equals 2 km, then $M_{dmax}$ equals 720 m for northwestern Vermont (see Appendix A for calculations).

Ice flow indicators in northwestern Vermont point to a NW to SE flow direction (Stewart and MacClintock, 1970), implying that ice thickness increased to the NW. Thicker ice to the northwest means isostatic

compensation increased to the northwest, evidenced by the differential uplift of coeval features in Vermont (Chapman, 1937). To understand differential uplift, the uplift histories at two locations must be modeled.

Andrews (1968, 1970) presented a model, derived from published uplift curves from Arctic Canada, which predicts uplift at a location as a function of time using exponential growth. The amount of total potential uplift ($U_t$) after deglaciation will equal a percentage of $M_{dmax}$. At time t, the present uplift, $U_p$, or amount of uplift accomplished is defined by:

$$U_p = U_t ( 1 - e^{-kt})$$

where $U_t$ is the total potential uplift, t is the time since uplift began, and k is the relaxation constant. The relaxation constant is a function of the mantle's viscosity that describes the "return" of the displaced mantle (Figure 2.15). Some authors describe the relaxation constant in terms of the relaxation time, $\tau$, which equals 1/k. Additionally, the relaxation constant is described by the half life, the time for half of the displaced mantle to return. The important concept to note is that because uplift is a result of an exponential decay of the displaced mantle, the rate of rebound decreases with time.

Differential uplift between two locations results from different uplift histories. Coeval shoreline features from a water body are often used to measure the differential uplift by measuring the gradient of the tilt plane. Features formed at one time are subsequently uplifted by different amounts because 1) uplift began later at one location, 2) one location was initially displaced more, or 3) a combination of 1) and 2). As shown in Figures 2.16 and 2.17, as long as two locations have the same initial displacement (scenarios a and b), the final gradient of the tilt plane will equal zero.

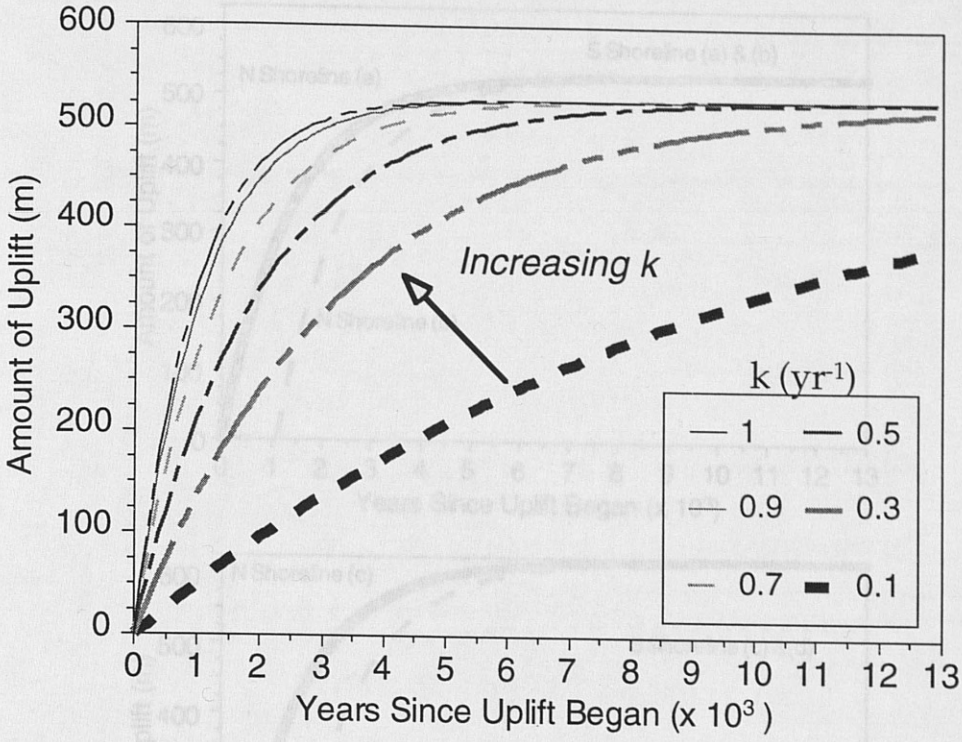



Figure 2.15: Graph of Effect of k on Rate of Rebound. The relaxation constant controls the rate of rebound; the higher the value, the faster uplift progresses. A value of approximately 0.7 $yr^{-1}$ has been suggested for the Northeast (Barnhardt et al., 1995).

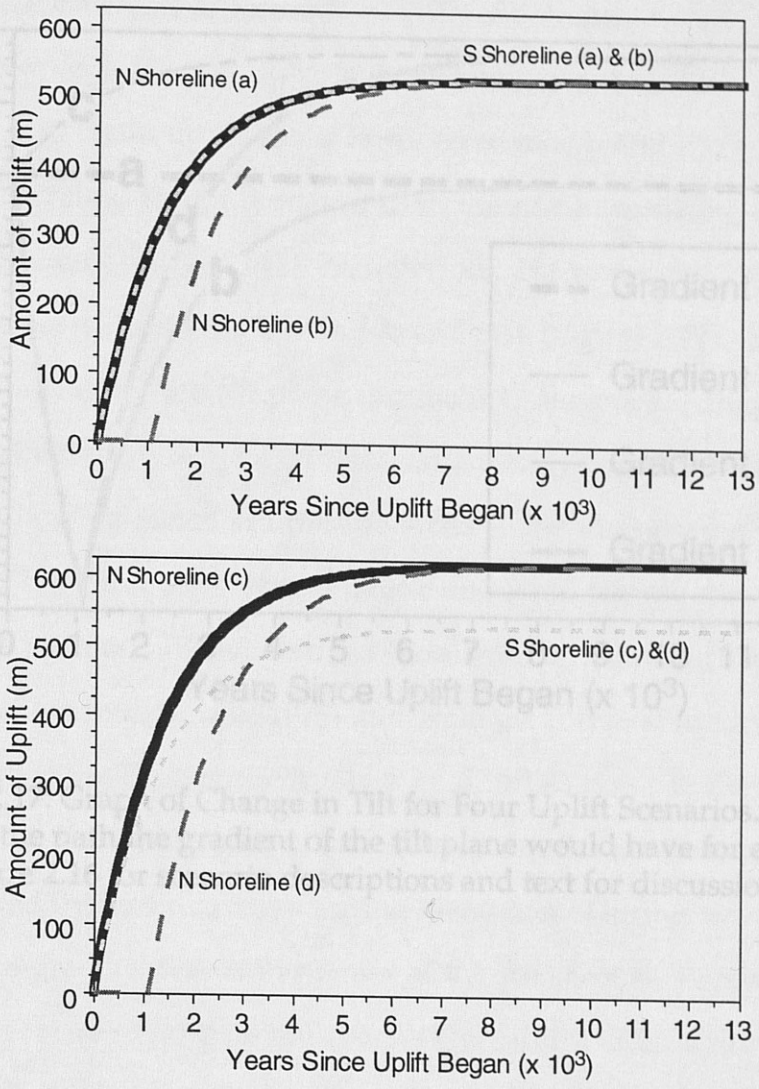



Figure 2.16: Graph of Different Rebound Scenarios. The amount of uplift is shown for the north and south shorelines of a lake for four different scenarios: a) Rebound begins at the same time in both north and south, and the amount of displacement is the same; b) Rebound is delayed by 1000 years in the north and the amount of initial displacement is the same; c) Rebound begins at the same time in both north and south, but the north is displaced by 50 meters more; d) Rebound is delayed and the north is initially displaced more.

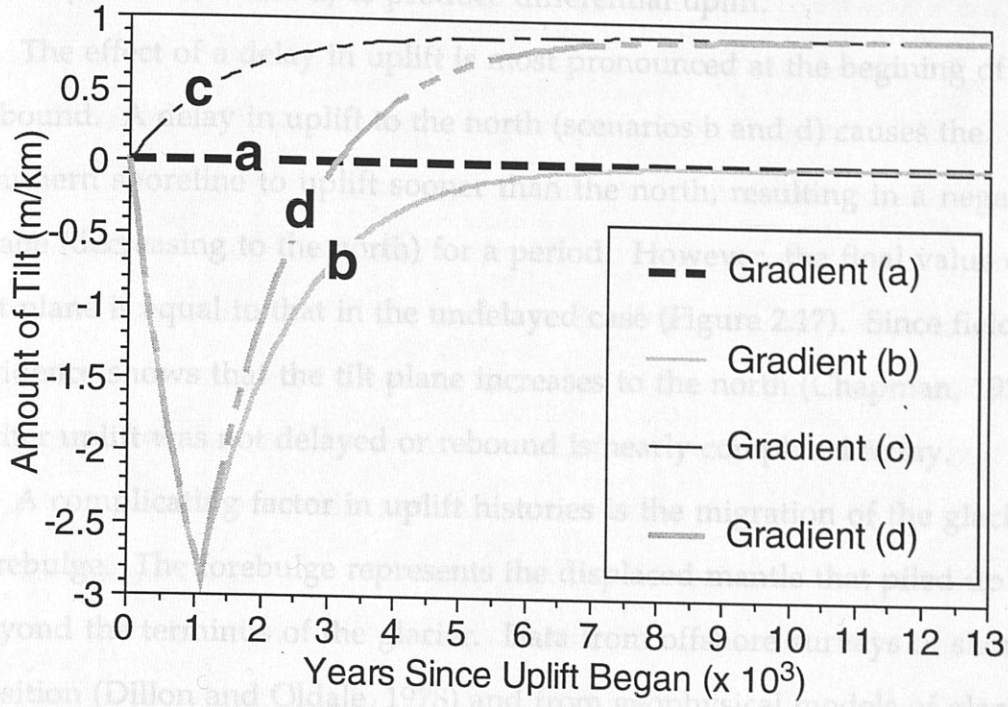



Figure 2.17: Graph of Change in Tilt for Four Uplift Scenarios. Each curve follows the path the gradient of the tilt plane would have for each scenario. See Figure 2.16 for scenario descriptions and text for discussion.

Therefore, the initial displacement must be greater in the north than the south (scenarios c and d) to produce differential uplift.

The effect of a delay in uplift is most pronounced at the begining of rebound. A delay in uplift to the north (scenarios b and d) causes the southern shoreline to uplift sooner than the north, resulting in a negative tilt plane (decreasing to the north) for a period. However, the final value of the tilt plane is equal to that in the undelayed case (Figure 2.17). Since field evidence shows that the tilt plane increases to the north (Chapman, 1937), either uplift was not delayed or rebound is nearly completed today.

A complicating factor in uplift histories is the migration of the glacial forebulge. The forebulge represents the displaced mantle that piled up beyond the terminus of the glacier. Data from offshore surveys of shoreline position (Dillon and Oldale, 1978) and from geophysical models of glacio-isostatic dynamics (Peltier, 1994; Clark et al., 1994) point to the presence of a peripheral glacial forebulge. Its presence causes the land beyond the ice sheet to be uplifted by tens of meters during glaciation. During rebound, the glacial forebulge migrates towards the center of the ice sheet as a wave superposed on the uplift curve and then collapses. The land will be uplifted temporarily by a magnitude dependent on the forebulge amplitude at that point (several meters to tens of meters) and then lowered as it passes. The effect of the forebulge is most prominent in the relative sea level histories along the coast (Peltier, 1994), but has also been studied in inland lakes (Balco, 1997; Astley, 1998) and modeled for the Great Lakes Region (Clark et al., 1994). Based on the lake level curve for Lake Champlain, Astley (1998) suggests that the glacial forebulge passed through the region between 7500-5000 $^{14}C$ yr B.P.

**Northeast Rebound Studies**

The glacio-isostatic rebound pattern has been interpreted across the Northeast from once-level water-line indicators, such as deltas and shorelines, for both coastal and inland regions (e.g., Chapman, 1937; Koteff et al., 1993). The orientation of the maximum tilt defines the direction toward the center of the ice sheet and necessarily varies across the region. I present the most recent studies for the region as they have the best altitudinal control. Table 2.6 is a summary of the gradient of the tilt plane, timing of initiation of tilting, and evidence for isostatic rebound from eastern New York to the Maine Coast as reported by several recent studies (Figure 2.18).

*Eastern New York* As mentioned earlier, the valleys in eastern New York north and south of the Adirondacks contained postglacial water bodies. Numerous wave-cut terraces, deltas and shorelines were formed in these lakes. Therefore, successful studies of isostatic rebound have been performed in the Hudson and Ontario Valleys.

LaFleur (1965) studied shorelines from three stages of Lake Albany in the Hudson Valley from Troy to the Hudson-Champlain divide. By plotting the shorelines on a N-S line, he found that the features of the highest Lake Albany stage had a gradient of 0.47 m/km and the features of the lower two stages both had gradients of 0.28 m/km. LaFleur correlated his lowest two stages of Lake Albany with Lakes Quaker Springs and Coveville in the Champlain Valley and proposed his slopes were lower than Chapman's (1937) slope of 0.95 m/km because of the presence of a hingeline in the latitude of Glens Falls. A hingeline is a theoretical line that separates two areas of different mantle dynamics. It was first proposed to explain the apparent vertical stability of the shorelines in the southern Great Lakes

Table 2.6: Summary of Glacio-isostatic Rebound Studies Across the Northeast

| Reference | Clark and Karrow, 1984 | Clark and Karrow, 1984 | LaFleur, 1965 | DiSimone and LaFleur, 1985 | Chapman, 1937 | Denny, 1974 |
|---|---|---|---|---|---|---|
| Location on Figure 2.18 | 1 | 2 | 3a | 3b | 4a | 4a |
| Region | Ontario Basin | St. Lawrence Lowlands | Hudson River | Hudson River | Champlain Basin | Champlain Basin |
| Direction* | N 20 E | N 0 E | N-S | N-S | N 14 W | N-S |
| Gradient | 1.14 m/km | 1.13 m/km | 0.47 m/km | 0.51 m/km | 0.95 m/km | 0.93 m/km |
| Water Plane | Lake Iroquois | Lake Iroquois | Lake Albany | Lake Albany | Upper Marine | Upper Marine |
| Rebound Begins** | Post-Lake Iroquois | Post-Lake Iroquois | Post-Lake Albany | Post-Lake Albany | Post-Upper Marine | - |
| Rebound Ends** | - | - | - | - | Still continuing? | - |

| Reference | Parent and Occhietti, 1988 | Brakenridge et al., 1988 | Koteff and Larsen, 1989 | Koteff et al., 1993 | Thompson et al., 1989 | Barnhardt et al., 1995 |
|---|---|---|---|---|---|---|
| Location on Figure 2.18 | 4b | 4b | 5 | 6 | 7 | 8 |
| Region | Champlain Basin | Missisquoi River, Champlain Basin | Connecticut Valley | Coastal central New England | Coastal Maine | Western Gulf of Maine |
| Direction* | N 5 W-N 35 W | - | N 20.5 W-N 21 W | N 28.5 W | N 30 W-N 80 W | - |
| Gradient | 1.0 m/km | - | 0.9 m/km | 0.85 m/km | 0.5 m/km | - |
| Water Plane | Lake Fort Ann | - | Lake Hitchcock | Sea Level | Sea Level | Sea Level |
| Rebound Begins** | - | - | After 14,000 | After 14,000 and before 13,300 | After 14,000 and before 13,300 | Before 13,000 |
| Rebound Ends** | - | By 8000 | - | - | - | By 6000 |

Notes: * If a true direction were cited, the orientation is given; otherwise, the plane of projection is given.

** Ages are in radiocarbon years before present.

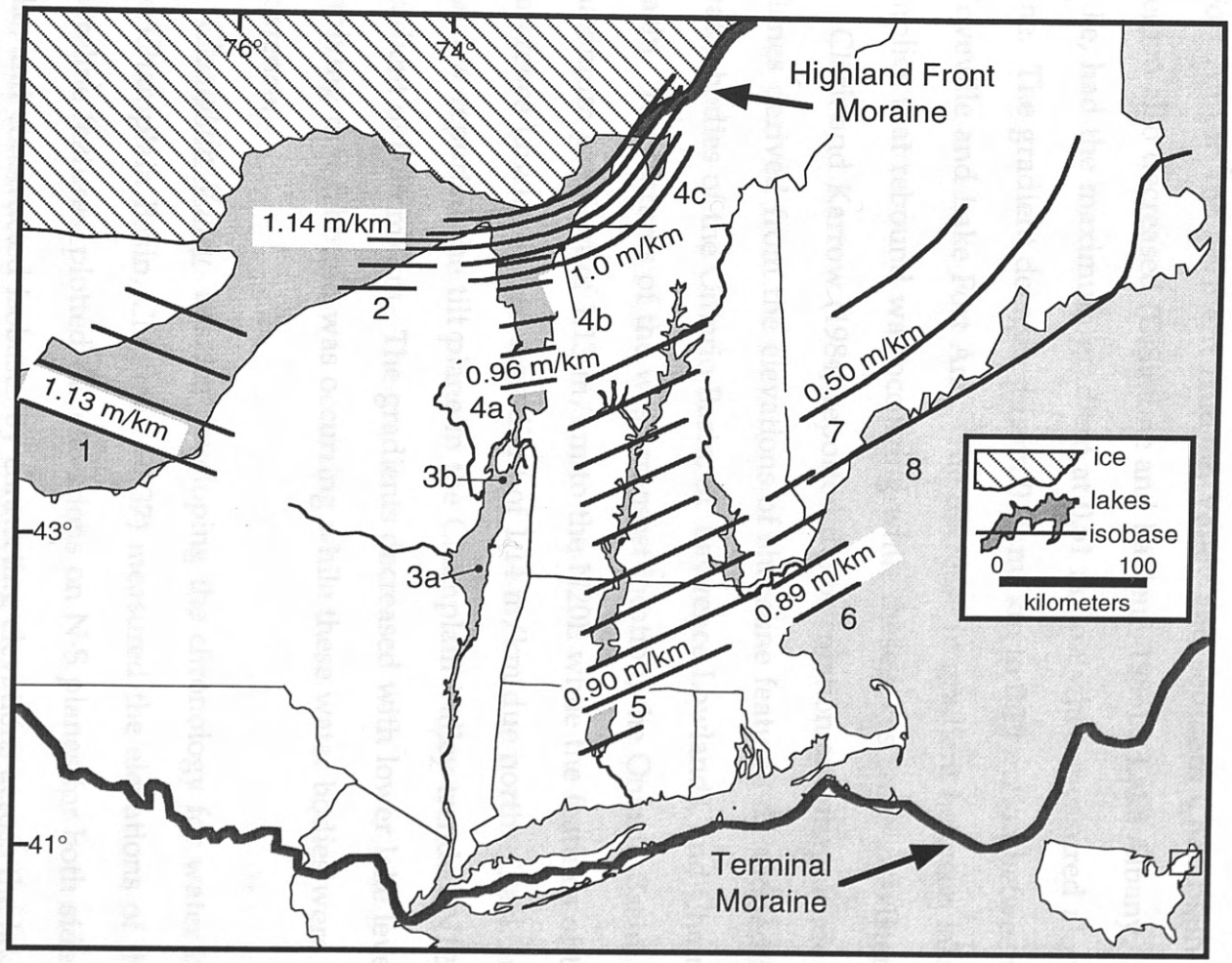



Figure 2.18 Location of Glacio-isostatic Rebound Studies in the Northeast. Orientation and gradient of isobases is shown with extent of water plane. Numbers refer to studies described in Table 2.6. (Modified from Balco, 1997)

Region relative to the shorelines to the north. Geophysical models have since discounted the hingline concept (Clark et al., 1994) and instead point to improper correlations as the explanation for the original hingeline idea.

The gradients measured for the lakes existing from Lake Albany to Lake Fort Ann in the northern Hudson Valley and southern Champlain Valley region also decreased (DiSimone and LaFleur, 1986). Lake Albany, the oldest lake, had the maximum gradient at 0.51 m/km when measured along a N-S line. The gradient decreased from 0.30 m/km to 0.19 m/km between Lake Coveville and Lake Fort Ann. The decrease in gradient between lake levels implies that rebound was occurring while these lakes were in existence.

Clark and Karrow (1984) reported the orientation and magnitude of the tilt planes derived from the elevations of shoreline features developed in the water bodies of the Ontario Basin, St. Lawrence Lowlands, and Champlain Basin. The features of the western-most location, the Ontario Basin, had a maximum gradient of 1.13 m/km to the N20E while the features of the St. Lawrence Lowlands had a gradient of 1.14 m/km due north. Clark and Karrow reported the tilt plane in the Champlain Valley trended N12W with a gradient of 0.95 m/km. The gradients decreased with lower lake levels, implying that rebound was occurring while these water bodies were in existence.

*Champlain Valley* Besides developing the chronology for water bodies in the Champlain Basin, Chapman (1937) measured the elevations of the shoreline features, plotted the elevations on N-S planes for both sides of the lake, and constructed isobases by connecting elevations across the lake of coeval features. The gradient of the maximum tilt plane was 0.95 m/km, rising to the north at N14W. By analyzing the gradient of the tilt planes,

Chapman found that the Upper Marine, Fort Ann, and Coveville water planes were almost parallel and he interpreted this to mean that rebound began after the Upper Marine interval of the Champlain Sea. According to Chapman's interpretations, rebound would have started in the Champlain Valley at about 10,800 $^{14}C$ yr B.P. based on dates presented in Parent and Occhietti (1988).

However, Chapman acknowledged that uplift was occurring prior to and during the early development of Lake Coveville. In the more recent studies in New York mentioned above, the gradient of the tilt planes decreased with each successively lower lake level, beginning with Lake Albany. Therefore, it seems plausible that Chapman was unable to discern different gradients for his highest tilt planes because of poor elevation control and that uplift was occurring while the Champlain Valley was occupied with proglacial lakes.

Denny (1974), working in the northeast Adirondacks on the western margin of the northern Champlain Valley, also had difficulty measuring a gradient for the tilt planes. When measured along a N-S line, the Lake Fort Ann shorelines had a gradient of 0.85 m/km while the Upper Marine had a gradient of 0.93 m/km. These gradients must have an error of at least 0.08 m/km because the younger shoreline can not have a steeper inclination than the older shoreline. In addition, when measured along the true direction of tilt, reported by Denny as between N10W and N15W, the gradients will increase about 0.02-0.03 m/km. Therefore, while Denny's results are similar to Chapman's, they do not help to clear up the discrepancy of gradients decreasing in the Hudson Valley (LaFleur, 1965; DiSimone and LaFleur, 1985) for the same lake levels that have unchanging gradients in the Champlain Valley (Chapman, 1937).

Parent and Occhietti (1988) presented an isobase construction (Figure 2.18) for northern Vermont and southern Quebec compiled from previous sources, including Chapman (1937), McDonald (1968), Wagner (1972), and Parent (1987). The isobases trend from E-W in the west to NE-SW in the east. Their compilation is the only one to reflect the expected variable trend in isobases from east to west. The average gradient represented by the isobases is about 1.0 m/km and therefore the magnitude is consistent with the other studies in the area.

While these studies show that rebound began during deglaciation, none reported evidence of when rebound might have ended. Chapman (1937) suggested that uplift may still be occurring, but had no evidence to support his claim. The study of Brakenridge et al. (1988) on the Missisquoi River in the northern Champlain Basin found that the incision rate, initially high following deglaciation, decreased by 8000 $^{14}C$ yr B.P. They suggested that river incision was a response to vertical glacio-isostatic movements and concluded that rebound had ended by 8000 $^{14}C$ yr B.P. Therefore, rebound rates probably decreased in the Holocene and Brakenridge et al.'s conclusions can be tested in other rivers in the region.

*Winooski Valley* Larsen (1987b) used the tilt plane measured for the Connecticut Valley by Koteff and Larsen (1989) to predict the elevations of uplifted shoreline features of the lakes in the Winooski Drainage Basin. Using the elevation of the spillway for each lake as the starting point, Larsen constructed maps of where the shorelines would be if the area had been tilted N21W at 0.9 m/km. Larsen cited several instances where the projection adequately predicted the elevations of known shoreline features in the Winooski Valley and therefore believed that the tilt plane should be extended

westward from the Connecticut Valley to the Champlain Valley.

While the magnitude of the tilt plane is similar to that measured by Chapman (1937) in the Champlain Valley, the orientation differs by 7°. Larsen did not discuss this discrepancy, but in order for isobases to connect from the Champlain Valley to the Connecticut Valley, the orientation must change across central Vermont as illustrated by the isobases presented by Parent and Occhietti (1988) for southern Quebec and northern Vermont (Figure 2.18).

*Connecticut Valley* Koteff and Larsen (1989) presented an uplift plane for the Connecticut Valley based on topset-foreset contacts in deltas. They found that a single plane rising N20.5W-N21W at 0.9 m/km fit the elevations to within a meter of all the deltas built into the 245 km long Lake Hitchcock. The stability of the tilt plane over the entire distance of the lake was interpreted to mean that rebound did not begin until after Lake Hitchcock drained.

The threshold for Lake Hitchcock, a bedrock spillway in New Britain, CT, has long been regarded as stable during the entire time the lake existed. The present course of the Connecticut River passes through surficial material that presumably was incised during the drainage of Lake Hitchcock, implying that rebound was necessary to initiate drainage of Lake Hitchcock. Dated plant fragments from lacustrine bottom sediments north of the threshold, Windsor, CT, are 13,540 ± 90 $^{14}$C yr B.P. (Beta 59094/CAMS #4875; Stone and Ashley, 1995). These fragments, stratigraphically associated with a delta that was built below the elevation of the Hitchcock threshold, represent post-Lake Hitchcock deposition. Stone and Ashley interpret that by 13,500 $^{14}$C yr B.P. Lake Hitchcock was draining because rebound had begun.

*Central Coastal New England* Koteff et al. (1993) studied glaciomarine deltas from northeastern Massachusetts to southwestern Maine. These deltas were deposited sequentially into the ocean at the margin of the ice sheet as the ice retreated northward through this region between 15,000 and 14,000 $^{14}C$ yr B.P. Koteff et al. measured the topset/foreset contacts of the deltas which were taken to represent eustatic sea level within a meter. Because the deltas described a single plane rising N28.5W ± 1.9° at 0.85 ± 0.02 m/km , two interpretations were made: 1) baselevel (eustatic sea level) remained nearly stable during this period; 2) differential uplift was delayed until after the deposition of all these features. Alternatively, the rate of eustatic sea-level rise equaled the rate of rebound and there was no net differential uplift during the deposition of the glacio-marine features.

Koteff et al. (1993) compared the stability, the magnitude, and the orientation to the tilt plane to the study of Koteff and Larsen (1989) and concluded that the style of uplift was similar in these two locations. Since the stability of the tilt plane in both studies was interpreted to mean delay of rebound and the timing of deglaciation was the same in both locations, Koteff et al. placed the beginning of differential rebound between 14,000 and 13,300 $^{14}C$ yr B.P. for the region. The date later proposed by Stone and Ashley (1995) of 13,500 $^{14}C$ yr B.P. for initiation in the Connecticut Valley fits the delay model as well and may be used to represent the timing of the initiation of differential rebound across the Northeast.

The magnitude and orientation of the tilt planes of Koteff et al. (N28.5W at 0.85 m/km) and Koteff and Larsen (N20.5W at 0.9 m/km) are very close. The difference in orientations was attributed to the expected variations based on position of the studies relative to the center of the ice sheet. The

difference in magnitude of the tilt plane, although not significant, could be explained by a lowering of sea level during the deposition of the later glaciomarine deltas or by variations in the lithosphere between the locations (Koteff et al., 1993).

*Maine* Thompson et al. (1989) presented the results of a comprehensive survey of glaciomarine deltas in Maine. The elevation of the topset-foreset contacts were surveyed and the stratigraphy of the deltas was described. The > 100 deltas included in the study were deposited at the margin of the Laurentide ice sheet, directly into the ocean, between 14,000 and 13,000 $^{14}C$ yr B.P. Because the land was isostaically depressed at deglaciation, the ocean transgressed into Maine following the retreating ice. The seaward deltas were deposited first, and later deltas were deposited progressively further inland. The farthest inland deltas represent the extent of the transgression. After that time, the rate of rebound exceeded the rate of sea level rise and the sea regressed.

During the regression, the shoreline passed over the deltas and fluvial or wave erosion modified many of the delta surfaces. Close examination of the stratigraphy and contacts was able to differentiate true topset-foreset contacts from those contacts where the foreset beds were truncated by later fluvial or marine sediments. The elevation of the topset-foreset contacts represents the relative sea level. However, due to the time-transgressive nature of ice retreat, deltas formed at the same relative sea level but at different times may not record the same amount of uplift, if uplift was occuring during ice retreat.

The orientation of reported isobases varies by 35° across Maine. Thompson et al. correlate the change in orientation with the direction of ice flow. Maximum uplift is parallel to the ice flow indicators, and the gradient

is 0.50 m/km across much of coastal Maine (Figure 2.18). Unlike Koteff et al. (1993), Thompson et al. did not conclude that the deltas were deposited during a stable sea level or that rebound began after the delta sequence was deposited. Therefore, the gradient of the deltas is a minimum of the total rebound, explaining why the magnitude is the lowest of all the Northeast. Since the transgression ended about 13,000 $^{14}C$ yr B.P., uplift was occurring by that time.

Barnhart et al. (1995) interpreted the uplift history of the coast by examining the relative sea level. They constructed their relative sea level curve for the western Gulf of Maine on the basis of 20 radiocarbon dates of floura and fauna recovered from vibracores and peat samples. By subtracting the relative sea level curve from the eustatic sea level curve of Fairbanks (1989), Barnhardt et al. derived an uplift curve for the area. The uplift curve flattened out after 6000 $^{14}C$ yr B.P., suggesting that rebounded ended by that time. The uplift curve also showed a strong peak (magnitude ~ 25 m) between 11,000 and 10,500 $^{14}C$ yr B.P., corresponding to a relative sea level lowstand, that the authors interpreted as the passage of the glacial forebulge. Studies of the relative sea level in the St. Lawerence Estuary, Quebec (Dionne, 1988) have also found evidence of the glacial forebulge migration, and based on these results, Barnhardt et al. estimate the rate of forebulge migration to be between 7-11 km/100 yr.

**Summary**

The previous studies of glacio-isostatic rebound in the Northeast establish: 1) the maximum gradient of the rebounded features is about 1 m/km; 2) the orientation of maximum rebound varies across the region, but generally it is to the northwest; 3) the date of initiation of rebound in the Connecticut Valley, 13,550 $^{14}C$ yr B.P., fits with the other regional data, implying that rebound was progressing during the deglaciation of the Winooski Drainage Basin; and 4) the rate of rebound decreased during the Holocene and has been low for at least the past several thousand years.

## CLIMATE HISTORY OF THE NORTHEAST

### Background

The climate of the Northeast is controlled by the circumpolar vortex, an upper air circulation pattern in which air flows from west to east (Lamb, 1995). It consists of two components, zonal flow (west to east) and meridional flow (north-south), which form a meandering pattern (Figure 2.19). The sinuosity of the circumpolar vortex controls the severity of the weather. Along the meridonal flow, warm wet air is brought north and cool dry air is carried south. The collision of these air masses causes severe cyclonal storms that may stagnate, bringing abundant precipitation to an area. Along the zonal flow, the two air masses meet, but since the contact length is not great and the contrast between the air masses is less, the storms are not severe and move swiftly through the area (Lamb, 1995).

The path of the circumpolar vortex is controlled by areas of high pressure, anticyclones. Circulation around anticyclones is clockwise, a pattern which steers the frontal systems away from the high pressure area. Therefore, where high pressure dominates, storm activity is deflected and the climate is rather dry because most large storms, including hurricanes, do not enter the region. Adjacent low pressure areas are inundated with the deflected storms and in warm areas dominated by low pressure, the frequency and magnitude of convective thunderstorms may increase due to surface heating. Therefore, where low pressure dominates, the climate is relatively wetter.

Seasonal variations in insolation or heating by the sun shift the latitudinal position of the circumpolar vortex. In the winter, it moves southward, subjecting New England to cold arctic air, and during the summer, it moves northward, bringing humid tropical air to the region. The

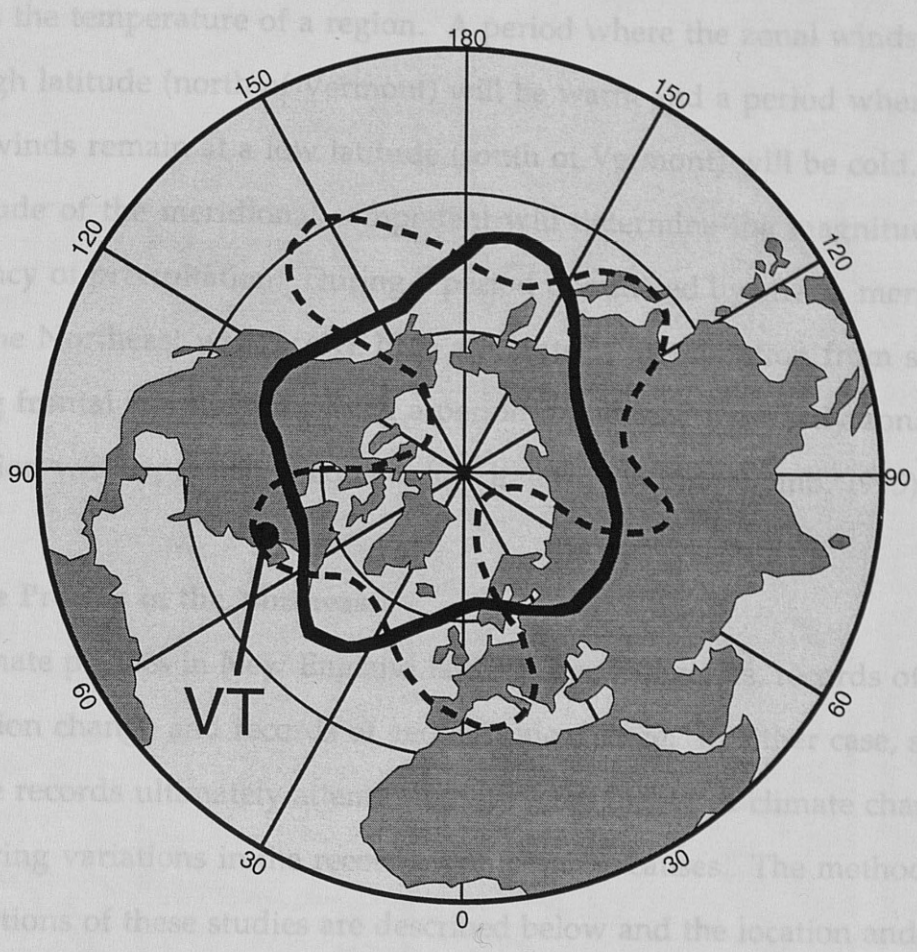



Figure 2.19: Upper Atmosphere Circulation Patterns. Two hypothetical paths for the circumpolar vortex are shown. The heavy solid line represents high-latitude zonal flow which would lead to a warm period with small, but frequent storms. The fine dashed line represents strong meridional flow which would bring long-lasting, severe storms to Vermont. The location of Vermont is shown for reference. (After Lamb, 1995).

long term average position of the zonal component of the circumpolar vortex defines the temperature of a region. A period where the zonal winds remain at a high latitude (north of Vermont) will be warm and a period where the zonal winds remain at a low latitude (south of Vermont) will be cold. The amplitude of the meridional component will determine the magnitude and frequency of precipitation. During a period dominated by strong meridional flow, the Northeast will receive high amounts of precipitation from slow moving frontal storms, but during a period dominated by mostly zonal flow, the region will experience frequent, low intensity storms (Lamb, 1995).

**Climate Proxies in the Northeast**

Climate proxies in New England fall into two categories, records of vegetation change and records of geomorphic change. In either case, studies of these records ultimately attempt to define the timing of climate changes by associating variations in the records with climatic causes. The methods and assumptions of these studies are described below and the location and results of the studies are presented in Figures 2.20 and 2.21 respectively.

*Pollen and Macrofossil Records* Studies of pollen and macrofossils extracted from pond sediments are the most widely used climate proxy in New England. Pollen from trees and other plants is transported by wind to ponds where it is deposited in pond sediments. Macrofossils are presumed to be deposited directly from vegetation adjacent to the pond. Cores of pond sediments are extracted, macrofossils and other organic material are dated, and the pollen grains of different species are counted to construct the pollen record. The abundance of different species of pollen for a given horizon is used to deduce the vegetation in the region and and the occurrence of

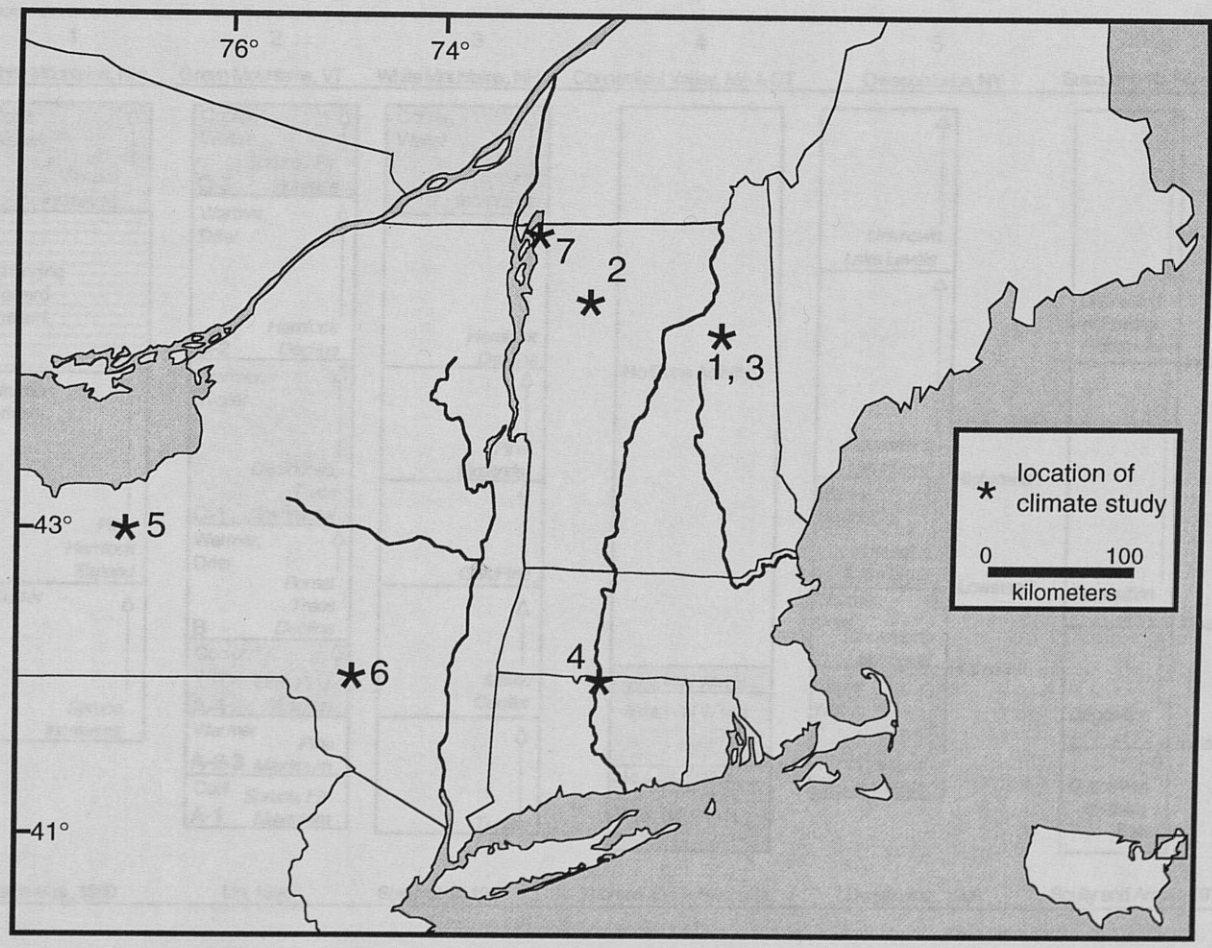



Figure 2.20: Location of Climate Studies in the Northeast. Number refer to studies described in the text and illustrated in Figure 2.21.

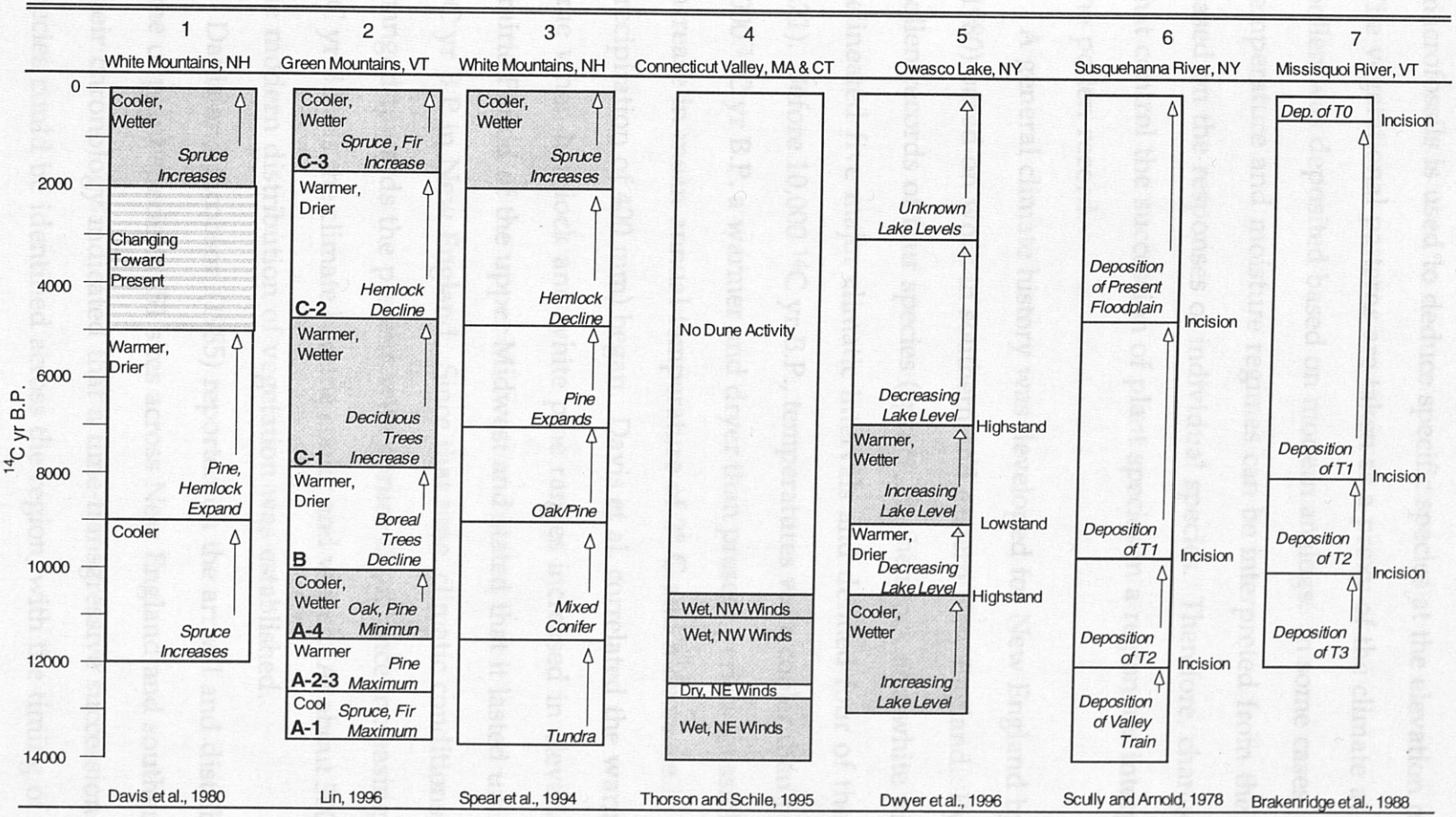



Figure 2.21: Results from Climate Studies Across the Northeast. Periods designated as wetter by the authors are greyed. Locations of the studies are shown on Figure 2.20. See text for descriptions.

macrofossils is used to deduce specific species at the elevation of the pond. The vegetational patterns are taken as a proxy of the climate at the time the pollen was deposited based on modern analogs. In some cases, past temperature and moisture regimes can be interpreted from the pollen records based on the responses of individual species. Therefore, changes in climate that control the succession of plant species in a region are interpreted from the pollen record.

A general climate history was developed for New England by Davis et al. (1980) based on work in southern and eastern New England. By analyzing the pollen records of four species (spruce, fir, hemlock and white pine), they delineated five major climatic intervals and defined four of them (Figure 2.21). Before 10,000 $^{14}C$ yr B.P., temperatures were cooler than present, and by 9000 $^{14}C$ yr B.P. a warmer and dryer than present period (possibly with an increase in mean annual temperature of 2° C and a decrease in mean annual precipitation of 400 mm) began. Davis et al. correlated the warmer period, a time when hemlock and white pine ranges increased in elevation, with the Prairie Period of the upper Midwest and stated that it lasted until at least 5000 $^{14}C$ yr B.P in New England. Since that time, climatic conditions gradually changed towards the present, with spruce abundance increasing around 2000 $^{14}C$ yr B.P. as the climate became cooler and wetter. At about 500 $^{14}C$ yr B.P., the modern distribution of vegetation was established.

Davis and Jacobson (1985) reported on the arrival and distribution over time of plant species at 51 sites across New England and southern Quebec. Their chronology indicated that a time-transgressive succession of plants species could be identified across the region, with the timing of arrival and subsequent changes in species abundance dependent on factors such as

elevation and latitude. Therefore, although Davis et al. (1980) provide some insight into the climatic changes in New England since deglaciation, the work of Davis and Jacobson demonstrates that in order to address the timing of climate changes locally, site-specific studies are needed. Three sites in northeastern Vermont were included in Davis and Jacobson's study, but all three were poorly dated. The timing of climate changes in northwestern Vermont remained unstudied until Lin (1996).

Lin (1996) studied and dated the pollen stratigraphy of two ponds in the Green Mountains. Sterling Pond (elevation 917 m) is located at the northern edge of the Winooski Drainage Basin and Ritterbush Pond (elevation 317 m) is 25 km northeast of Sterling Pond. Because of its proximity to the Winnoski Drainage Basin and the similarity of its elevation to the headwater elevations for the rivers in the basin, the Sterling Pond pollen record represents the best proxy for climate changes affecting the rivers in the Winooski Drainage Basin.

Following the divisions made by previous workers in the Northeast, Lin defined seven pollen zones in the Sterling Pond core (Figure 2.21). The climate changes inferred from these pollen zones reflect an overall warming of temperatures as well as fluctuations in precipitation since deglaciation. Zone A-4 may represent the Younger-Dryas climate reversal, a period when the climate suddenly became colder and returned to near glacial conditions. Lin interpreted the oak and pine minimum during Zone A-4 to represent a cooler and moister climate than immediately prior, which is consistent with the return towards glacial conditions. Zones C-1 and C-2 correspond well with the timing of the mid-Holocene warming identified in the other regional studies.

In another interpretation of pollen stratigraphy, Spear et al. (1994) studied the pollen record of several ponds, both of high and low elevation, in the White Mountains of New Hampshire (Figure 2.21). Their climate interpretations were summarized in a qualitative diagram (Figure 2.22) which compared three factors (past temperature and precipitation, disturbances near today's treeline, and disturbances on lower slopes) relative to today's conditions. Although Spear et al.'s interpretations pertain specifically to New Hampshire, they may also be applicable to Vermont, at least in terms of the change in regimes from one dominated by the presence of the Laurentide ice to one periodically disturbed by hurricanes.

For the period from deglaciation to 8000 $^{14}C$ yr B.P., slope disturbances due to frost action, avalanches, and tree blow downs would have been more frequent. During this period, the valley slopes would have had a greater potential for failure and therefore could have delivered more sediment to the rivers. Spear et al. show with some uncertainty that the yearly precipitation was less than today's; however, with an increased sediment supply and a decreased discharge, there would be limited transportation of sediment in rivers.

In the time since 8.0 $^{14}C$ yr B.P., the most important change is in the frequency of tropical hurricanes. Spear et al. anticipated an increase of hurricanes to coincide with the waning northeastern cyclonic winds associated with the retreating Laurentide ice mass. Hurricanes, with their strong winds and heavy rainfall, could have also contributed to the sediment supply in rivers. Hurricane winds have the ability to down trees, exposing more soil to erosion, and a hurricane's rainfall would significantly increase river discharge, potentially transporting large volumes of sediment.

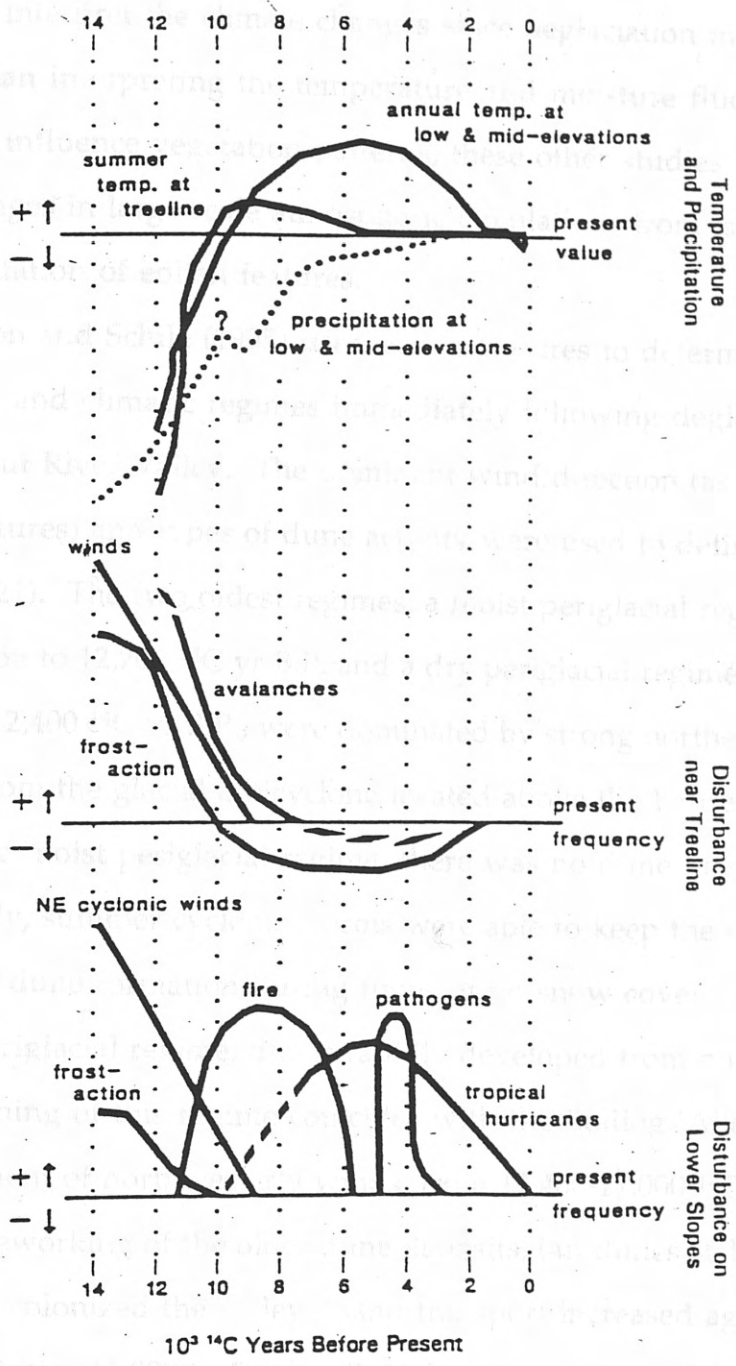



Figure 2.22: Schematic Diagram of Changes in Conditions in the White Mountains. The diagram illustrates how disturbances could have changed since deglaciation. See text for discussion. (After Spear et al., 1994)

*Other Northeast Records* Several studies have used other records beside pollen to interpret the climate changes since deglaciation in the Northeast. Rather than interpreting the temperature and moisture fluctuations over time that influence vegetation patterns, these other studies have attempted to infer changes in large scale atmospheric circulations from lake level records and orientation of eolian features.

Thorson and Schile (1995) used eolian features to determine paleowind directions and climatic regimes immediately following deglaciation in Connecticut River Valley. The dominant wind direction (as recorded by the eolian features) and types of dune activity were used to define five regimes (Figure 2.21). The two oldest regimes, a moist periglacial regime existing from deglaciation to 12,700 $^{14}$C yr B.P. and a dry periglacial regime existing from 12,700 to 12,400 $^{14}$C yr B.P., were dominated by strong northeasterly winds derived from the glacial anticyclone located above the Laurentide ice sheet. During the moist periglacial regime, there was no dune development. Presumably, summer cyclonic storms were able to keep the sand moist and prevented dune formation during times of no snow cover. However during the dry periglacial regime, dunes rapidly developed from northeasterly winds. The beginning of this regime coincides with the Bolling/Allerod period. Establishment of northwesterly winds, from 12,400-11,000 $^{14}$C yr B.P., first caused a reworking of the older dune deposits, but dunes stabilized as vegetation colonized the valley. Sand transport increased again during the Younger Dryas (11,000-10,500 $^{14}$C B.P.), but the moist conditions of that period inhibited dune growth. Instead, deposition of a mantle of eolian sand and silt occurred under high wind intensities for a time before ending abruptly. Finally, during the Holocene dunes were inactive until historic times when

agriculture and forestry practices were responsible for their reactivation.

The study by Dwyer et al. (1996), which examined the relative lake level of Owasco Lake in New York, used another climate proxy. In this study, sediment cores from the dry lake valley were dated and described to produce a relative lake level chronology (Figure 2.21). Highstands occurred at 10,500 $^{14}C$ yr B.P. and at 6900 $^{14}C$ yr B.P. and a lowstand occurred at 9000 $^{14}C$ yr B.P. The variations in lake level are interpreted to reflect different moisture balance situations. The highstands are attributed to increased precipitation and decreased evaporation during the Killarney-Younger Dryas cold interval (11,200-10,000 $^{14}C$ B.P.) and during the Hypsithermal (8500-5500 $^{14}C$ yr B.P.). The lowstand is attributed to the period of maximum summer solar insolation around 9000 $^{14}C$ yr B.P. which may have increased evaporation to lower lake level.

Dwyer et al. (1996) suggest their results support Forman et al.'s (1995) interpretation that changes in solar insolation caused latitudinal shifts in the circumpolar vortex during the Holocene. During the Hypsithermal the eastern United States would have experienced increased precipitation because the jet stream shifted to the north and the Bermuda high shifted to the northeast. Moist tropical air, responsible for carrying the precipitation to the Northeast, would have been able to enter the region. Despite the warmer temperatures, the additional precipitation could have caused an increase in Owasco Lake's level.

**Summary**

The diverse climatic data point to several widespread climatic changes. Prior to 12,400 $^{14}C$ yr B.P., the climate was strongly influenced by the Laurentide ice sheet and northeasterly winds brought cold, dry air to the Northeast. After that time, the anticyclone above the ice sheet waned, and west-northwesterly winds brought warmer, yet still cool air to the region until at least 11,000 $^{14}C$ yr B.P. Coinciding with the Younger Dryas period (11,000-10,500 $^{14}C$ yr B.P.), the air became cooler and precipitation increased in the Northeast. Between 10,500 and 9000 $^{14}C$ yr B.P., the climate was warmer and drier as the region was dominated by zonal flow located to the north. Then between 9000 and 8000 $^{14}C$ yr B.P., a period of increased precipitation and warmer temperatures developed when meridional flow dominated, lasting until about 5000 $^{14}C$ yr B.P. Next, the region became warmer and drier with a return to northern zonal flow. Since about 2000 $^{14}C$ yr B.P., the climate, under influence of meridional flow, has been colder and wetter.

# RIVER TERRACES

## Conditions for Development of Terraces

*Introduction* River terrace formation is the result of floodplain abandonment by incision. A forcing, a input of energy into the river system, results in a change of the river dynamics that is accommodated by incision and the establishment of a new, lower floodplain. The forcing may either originate from changes in baselevel and tectonics that cause changes in the stream's potential energy or from changes in climate and human activity that produces changes in vegetation, water discharge, and sediment yield from hillslopes. As a dynamic system, some intrinsic threshold in the river system may need to be exceeded before incision and terrace formation can proceed.

The formation of terraces requires degradation, a decrease in the channel elevation. Therefore, determining the reason for the channel elevation changes is important. Rivers are thought of as open systems which are controlled by self-arresting and self-enhancing feedback mechanisms (Knighton, 1984). Essentially, a river is either in equilibrium or else in a transitory state, attempting to obtain equilibrium. A river will remain in equilibrium, being controlled by self-arresting feedback mechanisms, until a threshold is exceeded. Thresholds are points in time that separate periods of aggradation or degradation (Bull, 1991). At that time when the threshold is reached, the river will, through self-enhancing feedback mechanisms, adjust to the new conditions and obtain a new equilibrium by either raising or lowering its channel. Therefore, terraces are formed when thresholds are exceeded. In order to understand why thresholds are exceeded, a review of fluvial system dynamics and equilibrium concepts is presented.

*Fluvial Dynamics and Equilibrium* Models of fluvial behavior were first developed through empirical analyses of factors affecting the fluvial morphology. Gilbert's (1880) original concepts of fluvial behavior, compiled from qualitative observations in the Henry Mountains of Utah, were the first to view the river as a system, where variables such as discharge, gradient, and sediment size were intimately related (Schumm, 1972). Gilbert's ideas laid the foundation for the later work of both geologists and engineers who used quantitative measurements from canals and rivers to develop the empirical relationships that are now widely accepted. For instance, Leopold and Maddock (1953) were able to show that at a given station, a river's width, depth, and velocity are related to its instaneous discharge by power functions, a relationship described as the hydraulic geometry. Implicit in such a empirical relationship is the concept of equilibrium.

The hydraulic geometry represents either steady-state or dynamic equilibrium conditions. Steady-state equilibrium is the result of a fluctuation or oscillation about a mean equilibrium state (Figure 2.23). The mean annual discharge does not control the hydraulic geometry, but instead, floods with a return interval of about 2 years are responsible for the channel dimensions (Leopold and Wolman, 1957). In steady-state equilibrium, fluctuations may occur in the interdependent variables (width, depth, etc.), but the mean state of the system, the hydraulic geometry, remains constant. In dynamic equilibrium, the system constantly changes because incision is occurring, but the hydraulic geometry remains fairly constant.

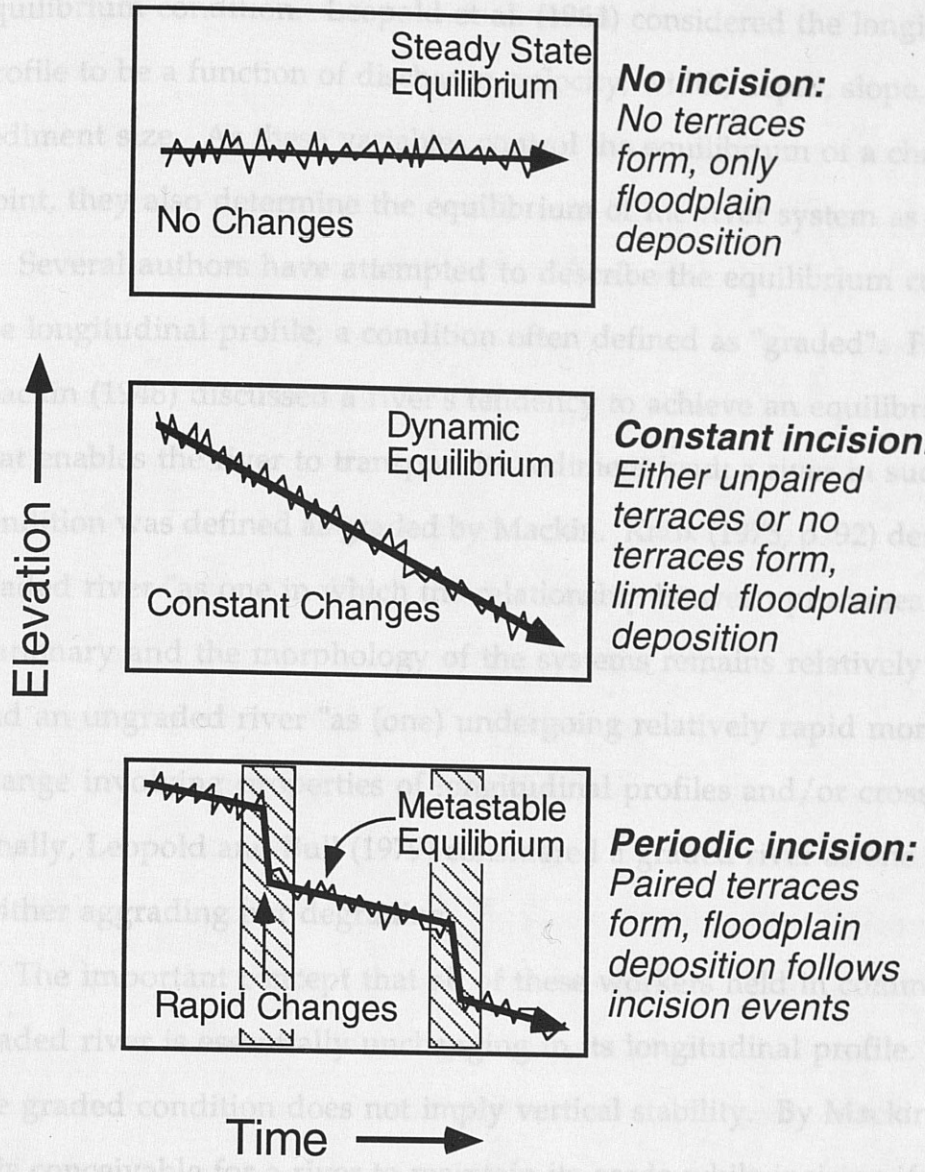



Figure 2.23: Types of Equilibria in River Systems. Equilibrium in rivers can be defined as steady-state, dynamic, or meta-stable, depending on the rate that the channel elevation changes. (Adapted from Knighton, 1985).

*Longitudinal Profile* The longitudinal profile of a river also exhibits an equilibrium condition. Leopold et al. (1964) considered the longitudinal profile to be a function of discharge, velocity, width, depth, slope, and sediment size. As these variables control the equilibrium of a channel at a point, they also determine the equilibrium of the river system as a whole.

Several authors have attempted to describe the equilibrium condition of the longitudinal profile, a condition often defined as "graded". For instance, Mackin (1948) discussed a river's tendency to achieve an equilibrium slope that enables the river to transport its sediment load; a river in such a condition was defined as graded by Mackin. Knox (1975, p. 92) defined a graded river "as one in which the relationship between processes and form is stationary and the morphology of the systems remains relatively constant" and an ungraded river "as (one) undergoing relatively rapid morphological change involving properties of longitudinal profiles and/or cross sections." Finally, Leopold and Bull (1979) considered a graded river as one that is neither aggrading nor degrading.

The important concept that all of these workers held in common is that a graded river is essentially unchanging in its longitudinal profile. However, the graded condition does not imply vertical stability. By Mackin's definition, it is conceivable for a river to maintain its grade while incising if the slope remains sufficient to transport the sediment load. Since Knox requires rapid adjustments for a river to be ungraded, gradual changes involving the longitudinal profile or cross section, such as a slowly incising river, would allow a river to remain graded. Knox associates a slow rate of change with a graded condition, but states that the ungraded condition may develop (p. 195) "after the cumulative effects of slowly changing environmental conditions

result in the breaking of a threshold of channel stability." Surpassing the threshold of channel stability leads to rapid adjusments and an ungraded condition.

Leopold and Bull's (1979) definition is much narrower because they do not allow an incising river to be at grade; any changes in the channel elevation are characteristics of an ungraded river. Unlike Mackin, they do not equate slope with grade but instead believe that "changes in slope account for only a small part of the adjustment needed to achieve the balance necessary to transport the incoming load (p. 194; Leopold and Bull, 1979)." However, like Knox (1976), Leopold and Bull invoke exceeding thresholds as the cause of an ungraded river (p. 195): "the threshold of critical power is passed and the stream is not graded when the volume of load supplied is insufficient or is too large to be transported, and the channel bed aggrades or degrades."

Bull (1979) originally defined the threshold of critical power as the ratio of stream power to resisting power. Stream power is a measure of the energy available to transport material and is proportional to the discharge and slope of the river. Therefore, as either factor increases, the river is more capable of transporting sediment. Resisting power is a measure of the energy needed to transport the sediment delivered to the river and is proportional to the sediment size, sediment volume, and channel roughness. As any of these factors increase, the river will be less capable of transporting sediment.

If the threshold of critical power equals 1 (stream power = resisting power), the river will be in steady-state equilibrium, in the same sense it was with the hydraulic geometry, and the river is at grade by Leopold and Bull's definition. Although fluctuations may occur, the hydraulic variables adjust accordingly to transport the sediment supplied with the water available. However, Bull

(1991; p. 16) points out that a river "at the threshold of critical power or equilibrium may be highly susceptible to accelerated downcutting or alluviation resulting from climatic, tectonic, or human-use perturbations that affect discharges of water and bedload." Therefore, while this threshold represents the equilibrium condition, the stability of equilibrium is tenuous.

The ungraded condition occurs when the ratio of stream power to resisting power does not equal 1. If the ratio is less than 1 (stream power < resisting power), the river will aggrade because the load can not be transported. Rather than be transported through the system, the sediments will accumulate in the channel, raising the elevation of the channel. When the ratio is greater than 1 (stream power > resisting power), the river will incise because there is insufficient load. To compensate for the sediment deficit, the river will erode its bed and lower the elevation of the channel. In either case, once the channel establishes a new gradient where the stream power equals the resisting power, the river will return to steady-state equilibrium. Rivers in dynamic equilibrium are always ungraded.

If the self-enhancing feedback mechanisms responsible for returning the river to steady-state equilibrium change non-linearly with time, they represent a different type of equilibrium, meta-stable equilibrium (Figure 2.23; Knighton, 1984; Bull, 1991). In meta-stable equilibrium, once a threshold is exceeded in the dynamic system, the system adjusts to a new equilibrium state by rapid change. When the new equilibrium is established, the system returns to steady-state equilibrium. Therefore, if over time a river is in meta-stable equilibrium, it will be graded during the periods of steady-state equilibrium and ungraded during the intervening periods. These cycles will result in alternating periods of incision and floodplain aggradation and hence

terrace formation. The concept of meta-stable equilibrium satisfies all the definitions of grade previously described and provides a conceptual framework in which to consider terrace formation in Vermont.

*Forcings* There are no models that predict a river's response to changes and determine when the river will become ungraded. However by studying the river's aggradation and incision record, it is possible to determine when thresholds were exceeded and the mode of operation of the river changed. The next step, defining what caused the threshold to be exceeded, is accomplished by analyzing the variables in the threshold of critical power. For instance, consider the slope factor in the stream power. An increase in slope will cause an increase in the stream power and lead to incision while a decrease in slope will cause a decrease in the stream power and lead to aggradation. The magnitude and rate of the slope change is important in determing if a threshold was exceeded. Slope changes are the result of changes of the longitudinal profile and are triggered by changes in the relief of a basin due to baselevel, tectonic, and human forcings.

Baselevel is defined as the lowest elevation to which a river may erode. There are three types of baselevels: ultimate, basin-wide, and local. Ultimate baselevel is the elevation of eustatic sea level. Basin-wide baselevel is the elevation to which a basin-scale drainage network is graded and refers to the elevation of a lake or another river. A local baselevel, one contained within a drainage basin, is the elevation of a knickpoint. A bedrock knickpoint is often expressed as a waterfall and represents a sharp increase in the river's gradient.

An ultimate or basin-wide baselevel drop will initiate incision and knickpoint formation. The knickpoint will migrate upstream and diffuse at a rate determined by the erodibility of the river bed. Alluvium or other

unconsolidated sediments erode easily, and incision into these materials allows the knickpoint to proceed upstream unimpeded. Assuming homogenous material, the knickpoint will migrate a distance proportional to the amount of baselevel drop, with the amount of incision decreasing upstream. If the migrating knickpoint encounters resistant materials such as bedrock, the migration rate dramatically decreases and the knickpoint becomes the controlling baselevel for areas upstream.

Both tectonic and human forcings have the same affect as baselevel changes. Tectonic forcings are the result of vertical movements of the land which cause an increase or decrease of relief in the basin and change the river's slope. Aggradation will occur when the mouth rises relative to the headwaters and incision will occur when the headwaters rise relative to the river mouth. Humans also change the slope of the river by either lowering or raising the baselevel and by altering the sediment supply. The construction of a dam creates an artificially high baselevel and causes aggradation upstream, and channel modifications, such as channel straightening or channel dredging, create artificially low baselevels and cause incision upstream.

Knox (1975) viewed tectonic and baselevel forcings as low intensity and long duration processes which would not in themselves initiate an ungraded condition. With a constant uplift rate, the river would remain in steady-state (dynamic) equilibrium and the channel would constantly adjust to the changing gradient by altering its hydraulic geometry. For example, a meandering river would increase its sinousity to maintain a constant slope during uplift. Eustatic sea level changes, lake level changes, and knickpoint migration also normally occur at slow rates, allowing the river to make the

necessary adjustments to remain graded. Therefore, while changes in slope may make a river tend toward disequilibrium, the dynamic nature of the system may be able to absorb the forcing without crossing a threshold. Therefore, it is necessary to examine the other factors in the threshold of critical power to determine what causes a threshold to be exceeded.

The discharge factor (stream power) and the sediment supply and channel roughness factors (resisting power) are intimately related. They depend on the response of the drainage basin's hillslope subsystems to climate change and human activities. Climate change and human activities both affect the sediment yield and river discharge by altering vegetation patterns and hillslope stability. For instance, under a new climatic regime that may be characterized as wetter than the previous period, the discharge of the river could increase, thereby increasing the stream power and possibly causing incision. However, increases in the frequency and magnitude of storms may also cause the hillslopes to shed more sediments and in the end, increase the resisting power. The river-hillslope may easily adjust to climate changes without exceeding any thresholds if the frequency of bankful discharges does not increase.as previously mentioned, climate changes in the Northeast consist of more than a simple change in total precipitation. It is possible that Therefore, the nature of the climate change is an important factor in determining whether a threshold is exceeded.

Shifts in the upper atmospheric circulation patterns that Nevertheless over time, the vegetation stabilizes the slopes by increasing root mass and lowers the discharge by intercepting more rainfall and increasing evapotranspiration. The rate of response of the hillslope system is crucial to whether or not thresholds are exceeded.

According to Knox (1975), a river system will be stable or graded during a consistent climatic regime; once the climate regime changes, the river system will be unstable until it adjusts to the sediment yield and river discharge associated with the new dominant climate factors. Since channel morphology is controlled by the magnitude of moderate floods with ~ 2 year recurrence interval (Leopold and Wolman, 1957), a series of moderate to large floods, rather than a single flooding event, are needed for the channel to adjust to the new climatic conditions. Therefore, a climatic regime with an increase in the frequency and magnitude of storms is necessary for the stream power to increase, the threshold to be exceeded, and terraces to form.

Given that each basin is unique, each will have an individual response to the floods. The subsytems in the basin will all respond by varying degrees to a single storm; sediment or water will not be delivered to the river uniformally. The same storm may not affect all rivers in the same manner, but over time the net effect will be the same. Therefore, rivers' response to climate changes will likely appear synchronous across a region on longer time scales.

**Terrace Classification**

Terraces are classified according to the genesis of the floodplain and the rate of incision. Three types of river terraces (fill, fill-cut, and strath terraces) are recognized and can be separated into either depositional or erosional terraces (Figure 2.24). A fill terrace is a depositional terrace. If a river aggrades to fill its valley with alluvium (vertical accretion deposits) and then incises, a fill terrace will be formed. The surface of depositional terraces represents the highest extent of aggradation. Fill-cut and strath terraces are erosional

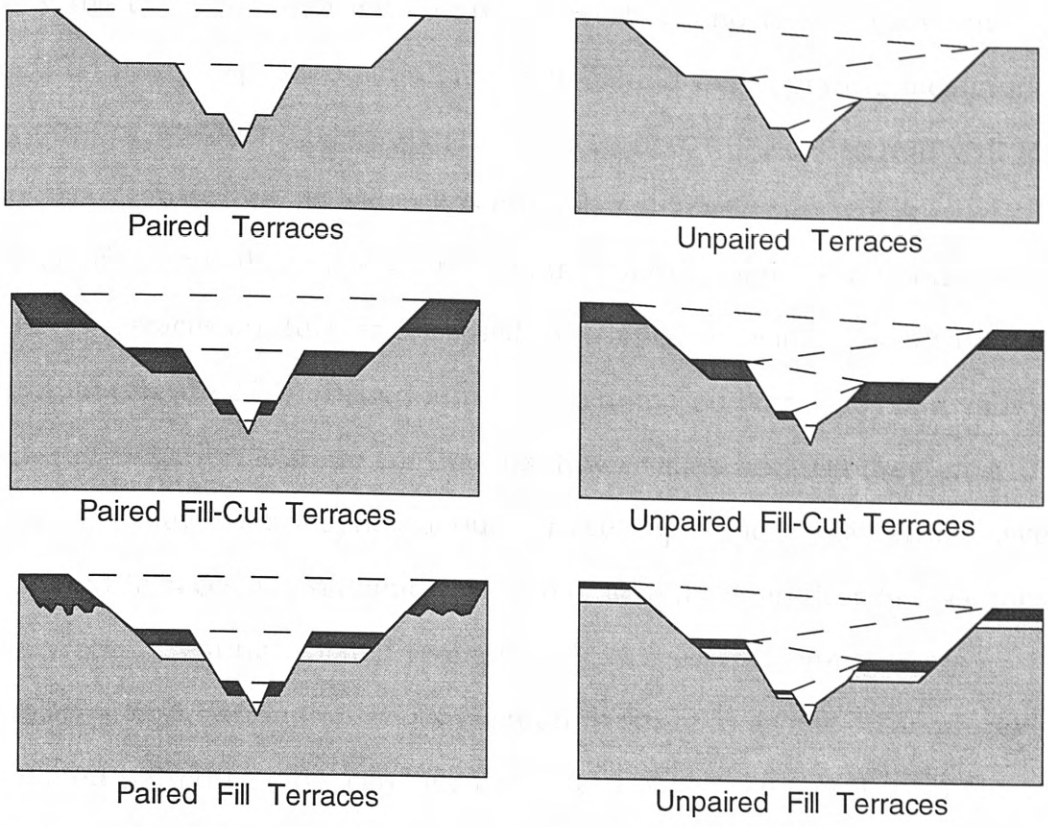



Figure 2.24: Types of River Terraces. Paired terraces are found on both sides of a valley at the same elevation. Unpaired terraces do not have an equivalent on the other side of the valley. Paired fill-cut terraces form during steady-state periods in meta-stable equilibrium while unpaired fill-cut terraces form during dynamic eqilibrium. Both paired and unpairedfill terraces occur when aggradation temporarily becomes the dominant process.

terraces. Both develop when a river erodes laterally and cuts a planar surface below the channel, often with alluvium (vertical and lateral accretion deposits) being deposited simultaneously behind the migrating meanders. If alluvium or unconsolidated materials are eroded, a fill-cut terrace will form once the river incises. If bedrock is eroded, a strath terrace will formed. The surface of erosional terraces represents the former height of a floodplain.

River terraces are further classified by whether incision was episodic or continual (Figure 2.24). Paired terraces are found on both sides of a valley at the same elevation and are continuous down valley because they once formed a valley floor, a synchronous surface. Episodic downcutting carves the paired terraces, subsequent lateral river activity often destroys sections of the terraces, creating isolated remnants. However, the remnants are correlative and define the river's position in space at a time. Therefore, correlated paired terraces can be used to reconstruct the river's gradient and represent a time marker in landscape development. Unpaired terraces do not have a correlative terrace on the other side of a valley because they are produced between periods of continuous incision and lateral channel migration (dynamic equilibrium). Presumably, the pauses in valley degradation occur independent of one another along a river. Since unpaired terraces are isolated surfaces that never formed a synchronous valley floor, they are inappropriate for reconstructing the river's gradient.

Development of both erosional and depositional terraces can be understood within the framework of meta-stable equilibrium. Fill-cut and strath terraces are interpreted to develop during periods of steady-state equilibrium, where the threshold of critical power equals 1, the river maintains an equilibrium profile, channel elevation does not change, and the

river migrates laterally. If the river erodes alluvium and builds a floodplain, a fill-cut terrace develops, and if the river bevels bedrock, a strath terrace forms. The thickness of the terrace deposits should not exceed the expected scouring depth of the river. Once a threshold is exceeded, the river will incise until a new level, one at which the threshold of critical power equals 1, is reached, and the river will once again be in steady-state equilibrium. Bull (1990) considered strath and fill-cut terraces to be primarily a tectonic landform.

Fill terraces are interpreted to develop between periods of steady-state or dynamic equilibrium, where stream power < resisting power. A change in river dynamics allows aggradation to occur in a previously equilibrated system. Aggradation will continue until a new level, one at which the threshold of critical power equals 1, is reached. The thickness of the deposits are not related to the present channel scouring depth because the mode of operation is different. Additionally, the terrace deposits may overlie an irregular surface because the river has not beveled the valley bottom. Bull (1990) considered fill terraces to be primarily a climatic landform.

**Interpretation of Terrace Remnants as Related to Tilting**

River terrace remnants have been utilized to document and measure active and recent tilting at the Mendicino triple junction of California (Merrits and Vincent, 1989; Merrits et al., 1994), the domal uplifts in the lower Mississippi River Valley, (Burnett and Schumm, 1983) and the Adirondack uplift in the Champlain Basin (Treadwell and Kneupfer, 1988). The river terrace surface is taken as a time marker that represents the gradient of the river at the time of formation. Once a terrace is formed (i.e., the river incises

and the surface no longer receives deposition), it becomes available to record vertical land movements. If the magnitude of uplift is constant across a region, the terrace gradient will remain constant. However, if there is differential uplift, such as in glacio-isostatic rebound, the terrace gradient will change over time. As tilting progresses, the river terrace is "warped" and the terrace gradient will increase or decrease by an amount equal to component of tilting in the direction of the river (Figure 2.25). By surveying river terrace elevations and plotting their longitudinal profiles, terrace gradients can be measured and taken as a means to quantify crustal tilting if an initial river profile, often the present river gradient, is assumed.

**Interpretation of Terrace Remnants as Related to Environmental Changes**

Comparisons of river terrace and pollen records (e.g., Brakenridge, 1980; Scully and Arnold, 1981; Knox, 1983; Arbogast and Johnson, 1994) show that the periods of incision or aggradation often occur coincident with the climate changes interpreted from the pollen records.

Brakenridge (1980) defined periods of floodplain stability (deposition) and instability (erosion) for the Pomme de Terre River in Missouri during the Holocene based on the distribution of 21 radiocarbon dates in six alluvial units. When the Pomme de Terre data were compared to alluvial chronologies from North America and Europe, Brakenridge found several intervals during the past 5000 $^{14}C$ yrs. where erosion was synchronous across the Northern Hemisphere. These episodes of erosion were also coincident with the advance of alpine glaciers. Brakenridge concluded that the increase in precipitation that lead to the advance of glaciers also caused widespread stream erosion. A strong meridional component of the circumpolar vortex

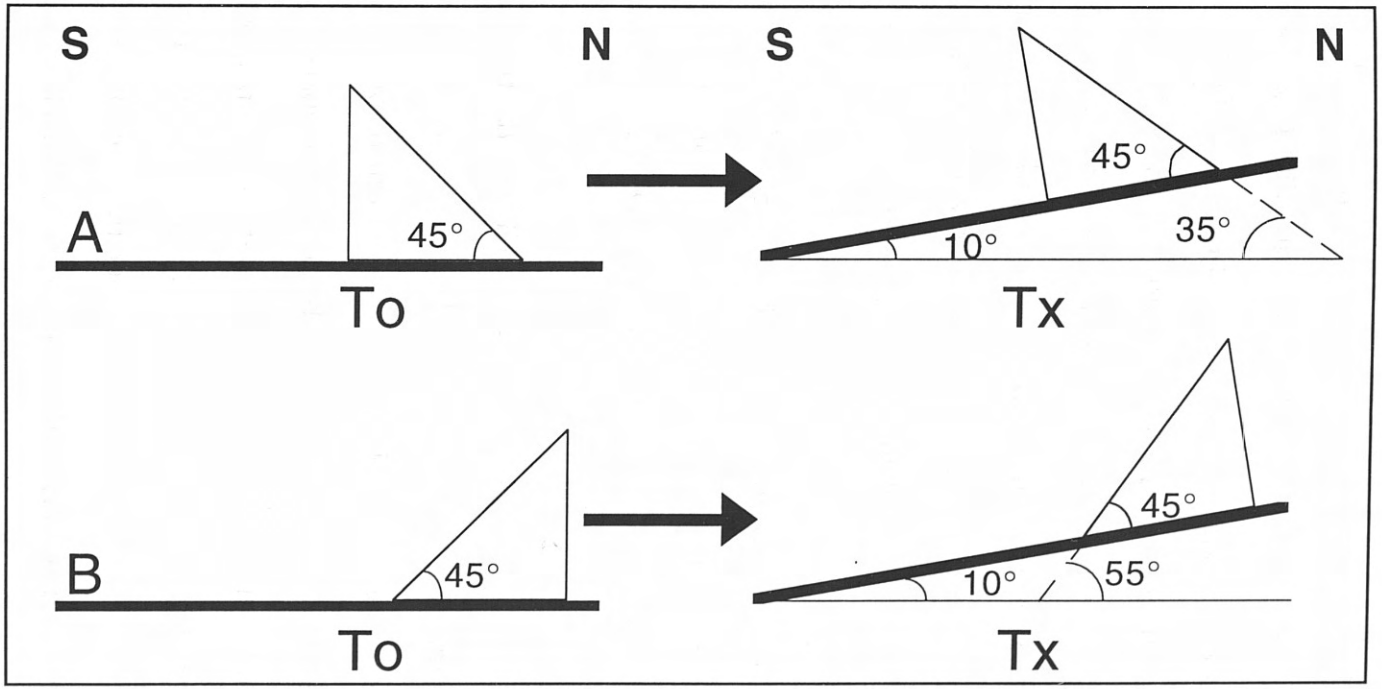



Figure 2.25: Effect of Glacio-isostatic Rebound on Terrace Gradients. Inital terrace/river gradient at To is differentially tilted at Tx. A) A north-flowing stream's gradient will decrease. B) A south-flowing stream's gradient will increase. Knowing the inital gradient allows the tilt to be measured.

could create the cooler and wetter conditions necessary to cause glacial advances in the mountains and stream erosion in the lowlands. This is the same mechanism first proposed by Knox (1975) to explain climate-controlled periods of erosion.

Knox (1975) subdivided the Holocene into fluvial episodes beginning at 9800, 8500, 4600, and 2500 $^{14}C$ yr B.P. based on a statistical analysis of radiocarbon dates from alluvial deposits in the northern hemisphere mid lattitudes. The logic behind these divisions was based on the premise that periods of alluviation should preserve organic matter whereas periods of stability or incision should contain little organic matter. Knox found that timing of his fluvial episodes was similar to that of climatic episodes proposed by Wendland and Bryson (1974), beginning at 10,030, 9300, 8490, 5060, and 2760 $^{14}C$ yr B.P. Therefore, it is reasonable to assume that terraces which formed at the same time as climate changes are probably formed because the new climatic regime changed the river dynamics.

**Local Studies of River Terraces**

The results of two local studies, one examining terrace tilting due to the recent doming of the Adirondacks and one examining river incision due to glacio-isostatic rebound, suggest that river terraces can be used to interpret crustal movements in the Champlain Basin. The terrace chronologies provided by these studies also present an opportunity to test the synchroniety of area terrace chronologies.

Treadwell and Knuepfer (1988) established a dated terrace chronology for the Ausable River, western Champlain Basin, and used their chronology to measure the recent tectonic tilt. The Adirondack Mountains are a NE-SW

trending domal structure that is believed to be actively uplifting (Barnett and Isachsen, 1980). The Ausable River flows northeast down the northeastern flank of the uplift and therefore is oriented parallel to the maximum tectonic tilt. Up to eight postglacial terraces of the Ausable River were surveyed and correlated along the river. The longitudinal profile of the terraces showed that the terraces diverged upstream from each other and from today's river profile. This is the expected result if the upstream reaches were uplifted higher than the downstream reaches, as would be the case in domal uplift for this river.

In addition to domal uplift, the Adirondacks have been uplifted due to glacio-isostatic rebound similar to the surrounding regions (i.e. Clark and Karrow, 1984). Chapman (1937) presented a glacio-isostatic uplift plane for the Champlain Valley based on the elevations of the shoreline features which formed in proglacial lakes following deglaciation. Treadwell and Knuepfer considered this plane to represent the tilt of the oldest terraces and calculated the expected glacio-isostatic tilt for the younger terraces based on an exponential decay model of glacio-isostatic rebound.

In order to measure the magnitude and rate of domal uplift, Treadwell and Knuepfer subtracted the calculated component of glacio-isostatic rebound for a terrace of a given age from today's river gradient to yield the amount and direction of tilting since each terrace formed. By using the ages of the terraces, long term average rates of tilting were calculated to be 0.05 mm/km per year, a result similar to the result obtained from geodetic surveys of 0.06 mm/km per year. Treadwell and Knuepfer concluded that post-glacial river terraces are sensitive to tectonic tilting.

In another local study, Brakenridge et al. (1988), studying a site along the

Missisquoi River in the northern Champlain Basin, delineated three terrace surfaces above the modern flood plain. The deposits of the terraces were distinguished by the soil development, grain size, and archeological materials. On the basis of 14 radiocarbon dates, Brakenridge et al. determined that T2 was deposited prior to 8000 $^{14}$C yr B.P., T1 was deposited between 6400 and 500 $^{14}$C yr B.P., and T0 was deposited since A. D. 1860. The highest terrace, T3, was not dated, but it was interpolated to be deposited around 10,000 $^{14}$C yr B.P.

The history of this site is characterized by a period of rapid incision prior to 8000 $^{14}$C yr B.P. and a period of slow, but episodic, lateral migration, floodplain construction, and valley widening since 8000 $^{14}$C yr B.P. until European settlement. During historic times, incision followed by the deposition of T0 occurred. By plotting the distance of the radiocarbon samples from the present channel, Brakenridge et al. demonstrated that the lateral migration rate varied from 0-4 m/100 yr since 8000 $^{14}$C yr B.P. A similar plot of elevation of the channel versus age showed that the average incision rate decreased by 8000 $^{14}$C yr B.P. Both incision and lateral migration rates increased after European settlement.

Brakenridge et al. considered the decrease in incision rate at 8000 $^{14}$C yr B.P. to be evidence that glacio-isostatic rebound had ended by that time, similar to a time frame proposed by Hutchison et al. (1981) based on an undeformed or horizontal unconformity in the sediments of nearby Lake George that was formed before 7000 $^{14}$C yr B.P. Several lateral unconformities were present in T1, suggesting that the lateral migration of the channel was episodic; the distribution of the radiocarbon dates supports this interpretation. The change of land cover in the basin, from forest to agriculture, was cited by

Brakenridge et al. as a probable cause of increases in sedimentation and lateral migration during historic times.

**Summary**

Rivers are dynamic systems which exist in a steady state over time as long as the threshold of critical power is satisfied (stream power = resisting power). A river in steady-state equilibrium is also at grade. Over a longer time scale, the river is in meta-stable equilibrium if it periodically and episodically becomes ungraded. A river will become ungraded when forcings cause the stream power to increase or decrease relative to the resisting power. Paired strath and fill-cut terraces form during periods of steady-state equilibrium separated by periods of incision and fill terraces form between periods of steady-state or dynamic equilibrium. Unpaired terraces form during periods of dynamic equilibrium.

# CHAPTER 3: METHODS AND DATA

My field work defined the position of river terraces in space through time. It involved surveying, trenching, and dating river terraces. In this chapter, I describe my three methods and present my results.

## SURVEYING

### Methods

Pentax total station survey equipment was used to provide the spatial control because elevations of terraces can be measured quickly, precisely and accurately. Elevations and X-Y coordinates (easting and northing) were measured for each point and recorded by a data collector connected to the total station. Each location was measured independently, with the first point given an arbitrary designation of 1000, 1000, 100 (northing, easting and elevation in meters). Surveyed elevations were later reconciled to known datums as described below.

Several measurements were taken in order to define the river terrace surface. In general, the inner and outer edges of each terrace, as defined by the breaks in slope, and several intra-terrace points were measured along profile lines. Ideally, a cross-valley profile, normal to the valley trend, would be sufficient to measure the terrace elevations. However, the areal extent of the terraces is variable because of the past and present meandering patterns of the rivers. Therefore, several survey lines were needed to adequately sample the terraces at any one site.

All measurements were correlated either to established benchmarks or to prominent contour lines. When a benchmark was located nearby a location, it was surveyed. Later, the elevations of the survey data were adjusted to the

elevation of the benchmark, with the elevations of the benchmarks taken either from USGS 7 1/2' quadrangles or from the United States Coastal and Geodetic Survey database. If no benchmarks were available, then the elevations were tied to a prominent contour line on the USGS 7 1/2' quadrangle. Usually, the chosen contour line lay on a wide terrace with little variation in elevation. Therefore, the accuracy of the final or "true" elevation differs by location, but for a given location, the relative elevations of terraces are internally consistent.

Terraces were surveyed along transects that best captured the terrace remnants, without respect to valley orientation. Therefore, the transect lines rarely were perpendicular or parallel to valley trend or even in a constant orientation. In order to standardize the survey data, the elevations were projected to a best fit plane along each survey line to construct the cross valley profiles. The cross valley profiles show the vertical relief and horizontal extent of terraces (Figure 3.1). Exaggerated ten times to accentuate the relief between terraces, the profiles also illustrate the relief of the terrace surface and the difficulty of assigning an average elevation to a given terrace.

The cross valley profiles are used to correlate the terraces between locations to construct the longitudinal profiles. The number of terraces, elevation above river, and relief between terraces were the main criteria used to correlate the terraces.

Longitudinal profiles of the terraces and the present river were constructed for each valley. Longitudinal profiles are used to measure the gradients of river terraces. Elevations of the river, taken from USGS 7 1/2' Quadrangles, and elevations of the terraces, compiled from the survey data and cross valley profiles, were projected onto a plane of the valley trend.

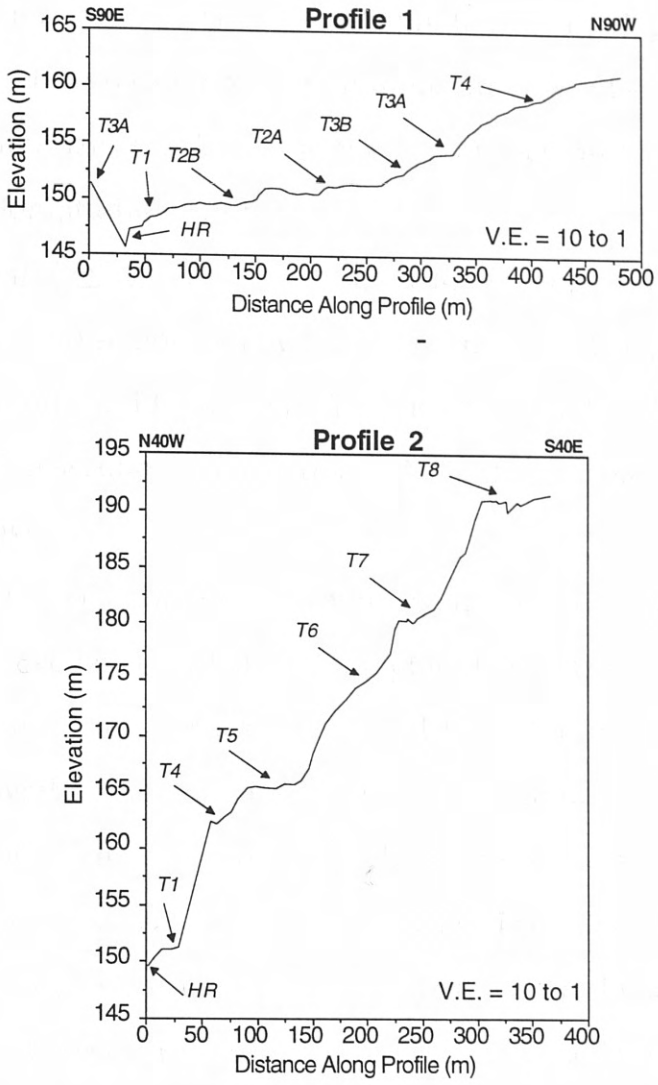



Figure 3.1: Examples of Cross-valley Profiles. Both profiles are from the Huntington Valley. Profile 1 shows a section of low-relief terraces that developed just downstream of the terraces in Profile 2.

**Survey Data: Huntington River**

*Cross Valley Profiles* Forty-five cross valley profiles were constructed from the 21 survey locations in the Huntington Valley (Figure 3.2). The survey data and profiles for all the locations are presented in Appendix B. Table 3.1 summarizes the data from the cross valley profiles and is used to generate the longitudinal profile.

*Longitudinal Profiles* The Huntington River longitudinal profile (Figure 3.3) consists of two segments (Figure 3.2). The longest segment trends N6W from the southern divide in Buels Gore north to the Moultrop Property in Richmond. The second segment trends N61E from there to the Winooski River in Jonesville.

The longitudinal profile shows both the measured terrace elevations and the projected lake levels of Lake Huntington, Lake Mansfield II, and Lake Coveville. The highest terraces, T10 and T9, south of the Hollow Brook Valley are fluvial terraces grading into the lakes controlled by the Hollow Brook threshold. The elevations at Hollow Brook are minimas due to incision which likely occurred at the spillway. These highest terraces north of Hollow Brook are lacustrine shoreline deposits from the same lake levels. The first fluvial terrace to extend to the mouth of the Huntington Valley is T8, where it intersects the projected elevation of Lake Coveville.

Below T8 are a series of terraces that grade into the Winooski River in Jonesville. The elevations of T7 and T6 at the river's mouth are the interpolated elevations of fluvial terraces grading into Lakes Fort Ann I and II, respectively. T5 in Jonesville corresponds well with the interpolated elevation of fluvial terraces grading into the Upper Marine.

Table 3.1: Terrace and River Elevations for Huntington River Longitudinal Profile

| Survey Location | Distance Upstream (km) | T10 | T9 | T8 | T7 | T6 | T5 | T4A | T3A | T2A | T1A | River |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MOUTH | 0.00 | | 210.60 | 188.00 | 153.00 | 143.00 | | | | | | 94.48 |
| JON-2 | 0.38 | | | | | | | | 108.17 | 104.21 | | |
| JON-1 | 0.59 | | | | | | 126.57 | 122.43 | 108.81 | | | |
| 320 | 0.97 | | | | | | | | | | | 97.53 |
| 340 | 1.51 | | | | | | | | | | | 103.63 |
| 360 | 2.03 | | | | | | | | | | | 109.72 |
| 380 | 2.29 | | | | | | | | | | | 115.82 |
| PAQ | 2.53 | | | | 176.72 | 170.66 | 137.14 | 133.22 | 129.92 | 125.21 | | 118.49 |
| 400 | 2.64 | | | | | | | | | | | 121.91 |
| PARO | 2.80 | | | | | | | 138.73 | 136.06 | 129.08 | | |
| 420 | 2.87 | | | | | | | | | | | 128.01 |
| 440 | 2.94 | | | | | | | | | | | 134.11 |
| 460 | 3.44 | | | | | | | | | | | 140.20 |
| ALD2 | 3.82 | | | | | | | 158.81 | 153.89 | 151.07 | 147.05 | |
| ALD1/3 | 4.05 | | | | | | | 161.10 | | 152.17 | 149.53 | 145.86 |
| 480 | 4.21 | | | | | | | | | | | 146.30 |
| ALD1-1 | 4.25 | | | 190.98 | 180.44 | 176.25 | 165.57 | 162.50 | | | 151.25 | |
| ALMO | 4.27 | | 209.53 | 191.10 | 180.68 | 175.10 | 165.93 | 162.12 | 158.70 | 155.11 | 151.75 | |
| ROAD | 4.38 | | | 191.46 | | | | | | | | |
| MOULA | 4.48 | | | | | | 166.84 | 162.80 | | 157.81 | 154.20 | |
| 500 | 4.63 | | | | | | | | | | | 152.39 |
| 500 | 4.63 | | | | | | | | | | | 152.39 |
| MOULB | 4.96 | 217.98 | 206.36 | 192.49 | | | 171.65 | | | | | |
| 520 | 5.06 | | | | | | | | | | | 158.49 |
| TOWR | 5.37 | | | 192.65 | | 182.06 | 172.64 | | 167.66 | 164.17 | | |
| AUD1A | 5.52 | | | | | | | 171.04 | 167.97 | 165.16 | 162.74 | |
| AUD1B | 5.74 | | | | | | 173.49 | | 170.79 | 167.33 | 165.26 | 163.89 |
| 540 | 5.86 | | | | | | | | | | | 164.58 |
| AUD2/3 | 6.00 | | | | | | 174.86 | 173.58 | | 168.72 | | |
| 560 | 6.80 | | | | | | | | | | | 170.68 |
| HR2-1 | 7.55 | | 206.35 | | 191.98 | | 183.55 | 181.21 | 180.29 | 177.30 | 176.40 | |
| HR2-2 | 8.00 | 215.45 | 204.95 | | 193.83 | | | | | | | |
| 580 | 8.08 | | | | | | | | | | | 176.78 |
| 600 | 8.89 | | | | | | | | | | | 182.87 |
| 620 | 9.95 | | | | | | | | | | | 188.97 |
| HB | 10.20 | 213.00 | 204.00 | 201.70 | 199.70 | 196.00 | | | | | | |
| 640 | 10.72 | | | | | | | | | | | 195.06 |
| 660 | 11.21 | | | | | | | | | | | 201.16 |
| SAAL | 11.42 | 224.74 | 216.24 | 213.92 | 212.08 | 208.74 | | | | 206.84 | 206.21 | |
| 680 | 12.44 | | | | | | | | | | | 207.25 |
| 700 | 13.24 | | | | | | | | | | | 213.35 |
| HR4 | 13.93 | 238.86 | 231.57 | 227.86 | 226.52 | 220.99 | | | | 218.57 | 216.56 | 214.30 |
| 720 | 14.58 | | | | | | | | | | | 219.45 |
| 740 | 15.01 | | | | | | | | | | | 225.54 |
| 760 | 15.45 | | | | | | | | | | | 231.64 |
| 780 | 15.93 | | | | | | | | | | | 237.73 |
| 800 | 16.41 | | | | | | | | | | | 243.83 |
| 820 | 16.72 | | | | | | | | | | | 249.92 |
| 840 | 17.01 | | | | | | | | | | | 256.02 |
| 860 | 17.29 | | | | | | | | | | | 262.12 |
| 880 | 17.37 | | | | | | | | | | | 268.21 |
| 900 | 17.53 | | | | | | | | | | | 274.31 |
| 920 | 17.80 | | | | | | | | | | | 280.40 |
| 940 | 17.90 | | | | | | | | | | | 286.50 |
| 960 | 18.09 | | | | | | | | | | | 292.59 |
| 980 | 18.49 | | | | | | | | | | | 298.69 |
| 1000 | 18.85 | | | | | | | | | | | 304.79 |
| 1020 | 19.04 | | | | | | | | | | | 310.88 |
| HR3 | 19.11 | 335.41 | 323.13 | | | | | | | | 315.38 | |
| 1040 | 19.38 | | | | | | | | | | | 316.98 |
| 1060 | 19.81 | | | | | | | | | | | 323.07 |
| 1080 | 20.20 | | | | | | | | | | | 329.17 |
| 1200 | 21.39 | | | | | | | | | | | 365.74 |
| 1300 | 22.20 | | | | | | | | | | | 396.22 |
| 1400 | 22.92 | | | | | | | | | | | 426.70 |
| 1500 | 23.59 | | | | | | | | | | | 457.18 |
| DIVIDE | 23.64 | | | | | | | | | | | 460.23 |

Survey locations (ALMO) correspond to cross valley profiles and survey locations (640) correspond to river elevations from USGS 7.5' quadrangles. See Figure 3.2 for survey locations and Figure 3.3 for longitudinal profile.

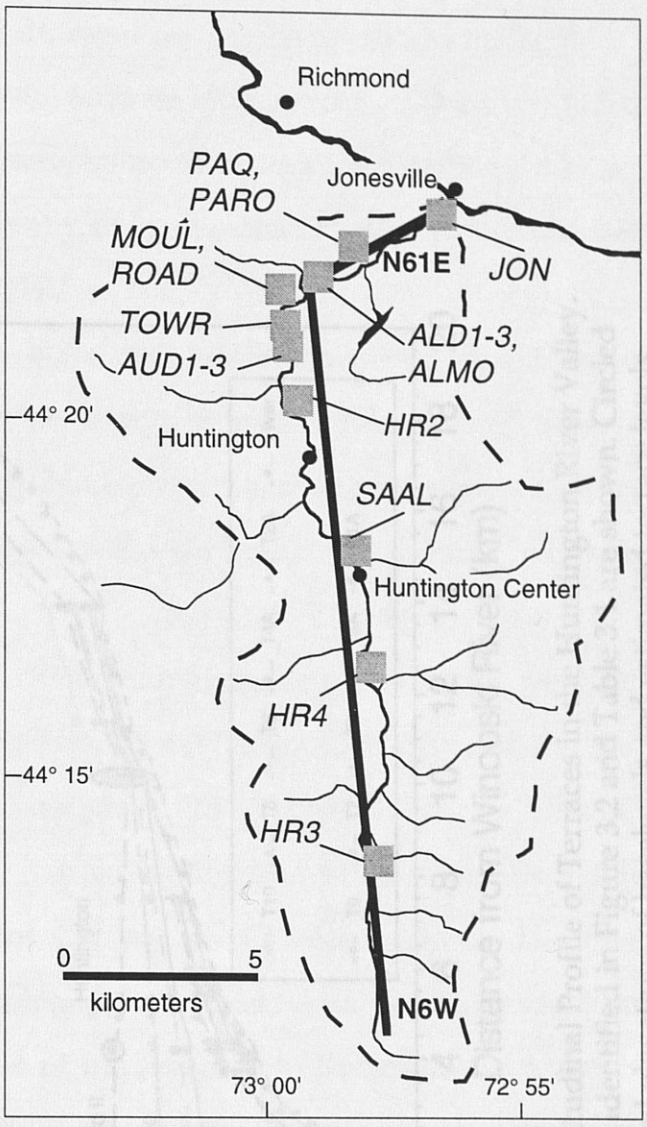



Figure 3.2: Map of Survey Locations and Longitudinal Profile in the Huntington River Basin. Base map from USGS 1:100,00 sheet.

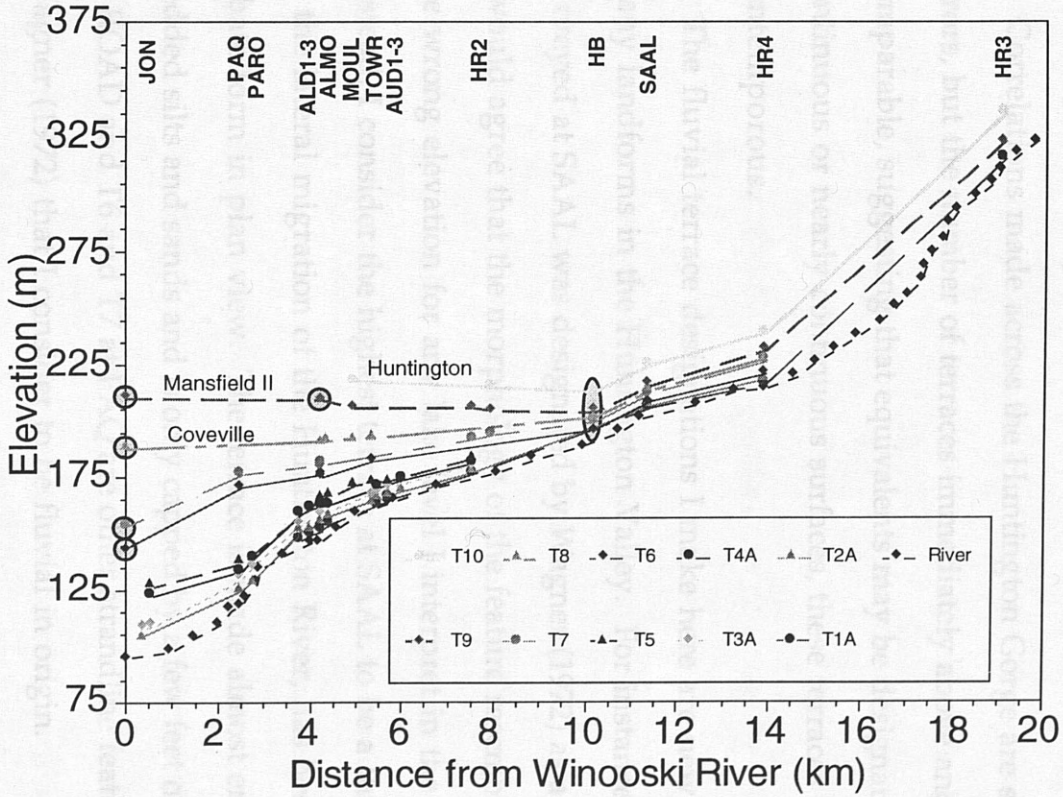



Figure 3.3: Longitudinal Profile of Terraces in the Huntington River Valley. Survey locations identified in Figure 3.2 and Table 3.1 are shown. Circled areas are projected elevations of baselevels and estimated terrace levels. See text for discussion.

The number of terraces at a location varied with positon in the basin. At the farthest station upstream, HR3, four terrace levels were appearent and presumably represent different periods of formation throughout postglacial times. In contrast are the terraces found at the ALD survey locations. Several minor terraces are present, so up to 12 levels are distinguishable. These minor terraces appearently merge upstream and they become nearly undistinguishable by HR2.

Correlations made across the Huntington Gorge are subject to the most errors, but the number of terraces immediately above and below the gorge is comparable, suggesting that equivalents may be designated. If not once continuous or nearly continuous surfaces, these terraces may at least be contemporous.

The fluvial terrace designations I make here are new interpretations of many landforms in the Huntington Valley. For instance, the highest terrace I surveyed at SAAL was designated by Wagner (1972) as a delta of Brush Brook. I would agree that the morphology of the feature resembles a delta, but it is at the wrong elevation for any lake level I interpret in the Huntington Valley. Instead, I consider the highest terrace at SAAL to be a fluvial terrace that, due to the lateral migration of the Huntington River, has been carved into a lobate form in plan view. The terrace is made almost entirely of rhythmically bedded silts and sands and is only capped by a few feet of fluvial deposits. T8 at ROAD and T6 and T7 at PAQ are other strandline features designated by Wagner (1972) that I consider to be fluvial in origin.

**Survey Data: Little River**

*Cross Valley Profiles* Twenty-two cross valley profiles were constructed from the six surveys locations in the Little River Valley (Figure 3.4). The profiles and survey data are presented in Appendix C. Table 3.2 summarizes the data from the cross valley profiles and is used to generate the longitudinal profile.

*Longitudinal Profile* The Little River longitudinal profile (Figure 3.5) is a single line trending N30E from the Winooski River northwest of Waterbury to the northern divide northeast of Stowe (Figure 3.4). More than six kilometers of the profile is obscured by the presence of the Waterbury Dam. The dam was one of several built during the 1930's for flood control along the Winooski River and has impounded the river nearly to the Lake Coveville level.

Bathymetry maps were not located for Waterbury Reservoir, but a pre-dam USGS 15' quadrangle was. The difference between the current river profile and the old river profile on the longitudinal profile (taken from the 15' quadrangle) implies that significant river adjustments occurred since the dam was built. Although the old profile may be somewhat in error due to poor elevation control, it does reveal that upstream of the dam, the river has aggraded and immediatley downstream of the dam, the river had incised. The aggradation at the north end of the reservoir has likely buried several terrace levels. Presently, the former T4 surface likely receives deposition during flooding events. In contrast, the old river profile below the dam is almost coincident with the lowest terrace. I have designated the lowest terrace as T0, younger than T1, to account for the fact that it has been incised in the past 60 years.

Table 3.2: Terrace and River Elevations for Little River Longitudinal Profile

| Survey Location | Distance Upstream (km) | T9 | T8 | T7 | T6 | T5A | T5B | T4 | T3 | T2 | T1 | T0 | River | Old River |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mouth | 0.00 | 224.85 | 201.92 | 179.32 | | | | | | | | | 119.90 | |
| LR2-5 | 0.16 | | | | | | | | | | 128.93 | 124.96 | | |
| LR2-4 | 0.22 | | | | | | | | 142.52 | | | 124.70 | 121.45 | |
| LR2-3 | 0.59 | | | | | 156.03 | | | | | | 125.64 | | |
| LR2-2 | 0.81 | | | | | | 155.23 | | | | | | | |
| 400 | 0.85 | | | | | | | | | | | | 121.95 | |
| 400 | 0.85 | | | | | | | | | | | | | 121.95 |
| LR2-1 | 0.98 | | | | | 157.50 | 155.77 | 148.44 | | | | | | |
| LR1.3-8 | 1.20 | | | | | | | | | 130.86 | 130.03 | 126.23 | | |
| LR1.3-7 | 1.47 | | | | | 158.32 | | 149.65 | | | | 129.19 | 125.61 | |
| LR1.3-4,5,6 | 1.64 | | | | | | 156.98 | | | 135.41 | 131.59 | 129.22 | 128.54 | |
| 420 | 1.75 | | | | | | | | | | | | 128.05 | |
| LR1.3-3 | 1.89 | | | | | | 158.07 | | | | 133.14 | | 129.35 | |
| LR1.3-2 | 2.04 | | | | 163.99 | 160.17 | 158.39 | | | | 133.47 | | 130.01 | |
| 420 | 2.08 | | | | | | | | | | | | | 128.05 |
| LR1.3-1 | 2.36 | | | | | | | | 147.43 | | 135.51 | 134.16 | | |
| 440 | 2.36 | | | | | | | | | | | | | 134.15 |
| LR1.2-1 | 2.64 | | | | | | | | | | | | | |
| LR1.2-2 | 2.69 | | | | | | | | | 139.63 | 138.10 | 136.23 | | |
| LR1.1-3 | 2.73 | | | | | 161.07 | | | | 140.19 | | 136.93 | | |
| LR1.1-2 | 2.90 | | | | | | 159.90 | | 148.61 | 140.47 | 138.35 | | | |
| LR1.1-1 | 3.00 | | | | 164.69 | 161.40 | 160.40 | 154.78 | | | 139.39 | 138.22 | | |
| 440 | 3.11 | | | | | | | | | | | 138.96 | 134.15 | |
| LR7 | 3.19 | | | | 164.97 | | | | | | | | | |
| 460 | 3.21 | | | | | | | | | | | | 140.24 | |
| 480 | 3.22 | | | | | | | | | | | | 146.34 | |
| 500 | 3.25 | | | | | | | | | | | | 152.44 | |
| 520 | 3.27 | | | | | | | | | | | | 158.54 | |
| 540 | 3.29 | | | | | | | | | | | | 164.63 | |
| 560 | 3.31 | | | | | | | | | | | | 170.73 | |
| 580 | 3.36 | | | | | | | | | | | | 176.83 | |
| Reservoir | 3.40 | | | | | | | | | | | | 179.70 | |
| 460 | 3.65 | | | | | | | | | | | | | 140.24 |
| 480 | 4.11 | | | | | | | | | | | | | 146.34 |
| 500 | 4.87 | | | | | | | | | | | | | 152.44 |
| 520 | 6.04 | | | | | | | | | | | | | 158.54 |
| 540 | 7.03 | | | | | | | | | | | | | 164.63 |
| 560 | 8.24 | | | | | | | | | | | | | 170.73 |
| LR6 | 9.33 | | | 188.12 | 185.71 | 182.68 | 182.68 | 180.95 | | | | | 179.70 | |
| 580 | 9.81 | | | | | | | | | | | | | 176.83 |
| 600 | 10.09 | | | | | | | | | | | | 182.93 | |
| 620 | 11.13 | | | | | | | | | | | | 189.02 | |
| 600 | 11.45 | | | | | | | | | | | | | 182.93 |
| 620 | 11.57 | | | | | | | | | | | | | 189.02 |
| 640 | 11.57 | | | | | | | | | | | | | 195.12 |
| 640 | 12.49 | | | | | | | | | | | | 195.12 | |
| LR3-2 | 12.57 | | | 207.76 | 205.72 | | | 198.11 | | | | | | |
| LR3-1 | 12.70 | | | | 205.78 | | | 199.00 | | | | | 196.31 | |
| 660 | 14.15 | | | | | | | | | | | | 201.22 | |
| Lake Mansfield II | 14.32 | 234.44 | 211.52 | | | | | | | | | | | |
| 680 | 14.50 | | | | | | | | | | | | 207.32 | |
| 700 | 15.33 | | | | | | | | | | | | 213.41 | |
| 720 | 18.12 | | | | | | | | | | | | 219.51 | |
| 740 | 19.35 | | | | | | | | | | | | 225.61 | |
| LR4 | 19.51 | 236.94 | 228.99 | 227.80 | 226.76 | | | | | | | | 226.00 | |
| Divide | 20.53 | 238.59 | | | | | | | | | | | 230.00 | |

Survey locations (LR2-1) correspond to cross valley profiles and survey locations (640) correspond to river elevations from USGS 7.5' quadrangles. Old river is from USGS 15' quadrangle. See Figure 3.4 for survey locations and Figure 3.5 for longitudinal profile.

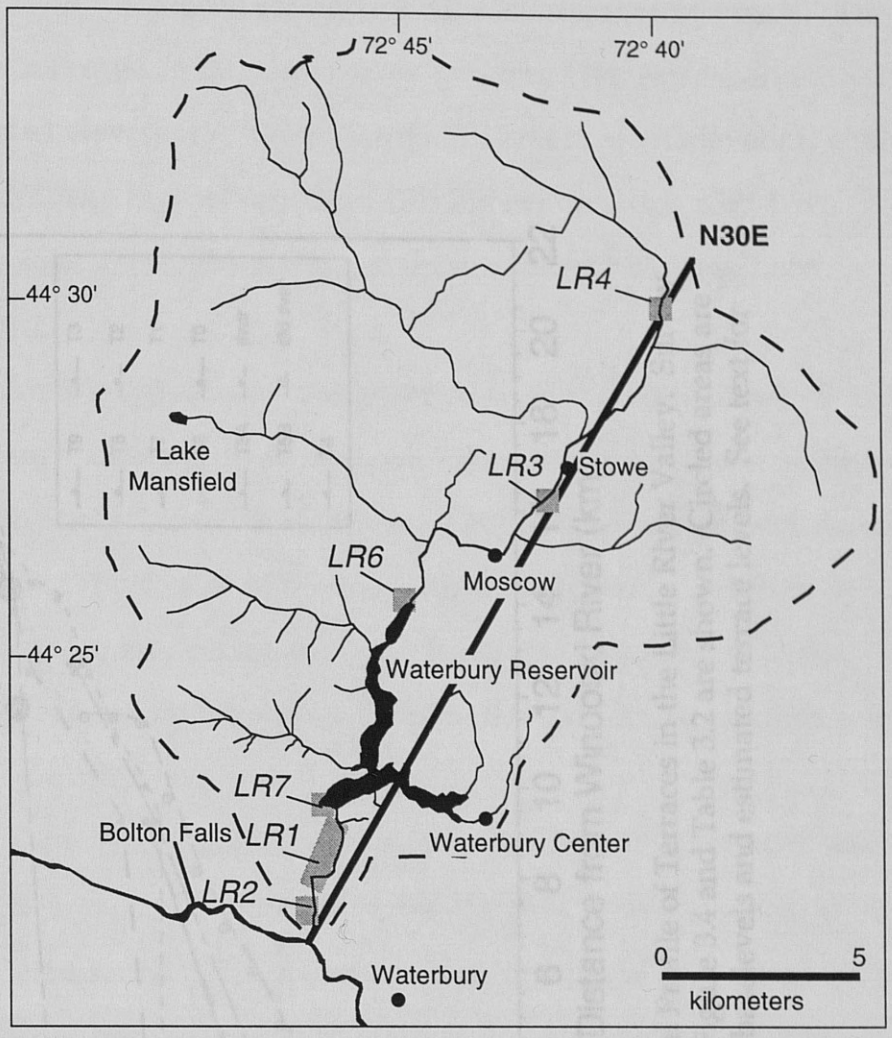



Figure 3.4: Map of Survey Locations and Longitudinal Profile Location in the Little River Basin. Base map from USGS 1:100,00 sheet.

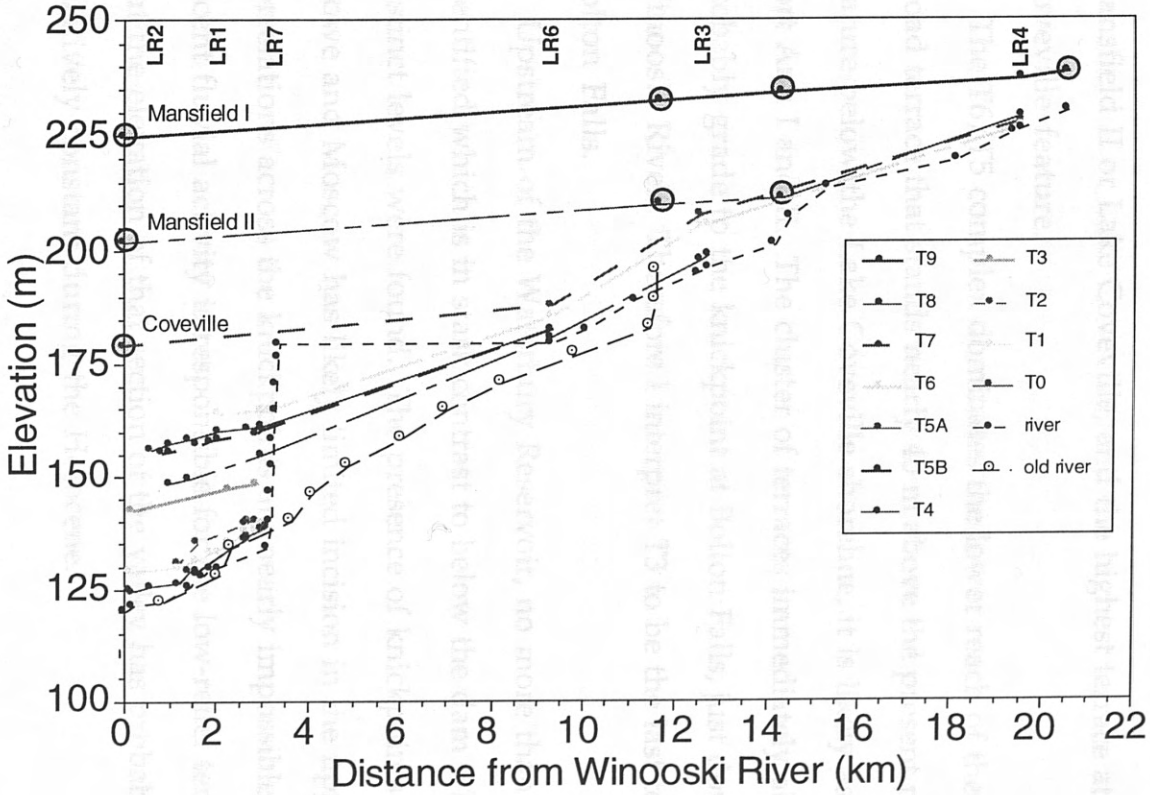



Figure 3.5: Longitudinal Profile of Terraces in the Little River Valley. Survey locations identified in Figure 3.4 and Table 3.2 are shown. Circled areas are projected elevations of baselevels and estimated terrace levels. See text for discussion.

The projected elevations of Lake Mansfield I, Lake Mansfield II, and Lake Coveville shown on the profile correlate well with measured terraces. The highest feature surveyed at the upper-most location, LR4, corresponds well with the projected elevation of Lake Mansfield I and is at an elevation well above the divide. The highest terrace at LR3 either correlates with Lake Mansfield II or Lake Coveville, and the highest terrace at LR6 is a Lake Coveville feature.

The T6/T5 complex dominates the lower reach of the Little River. It is a broad terrace that stands nearly 40 m above the present river. As it is the first feature below the Lake Coveville shoreline, it is likely associated with Lake Fort Ann I and II. The cluster of terraces immediately above the river probably grade to the knickpoint at Bolton Falls, just downstream in the Winooski River. Therefore I interpret T3 to be the last terrace to grade over Bolton Falls.

Upstream of the Waterbury Reservoir, no more than four terraces were identified which is in stark contrast to below the dam where as many as eight distinct levels were found. The presence of knickpoints in the villages of Stowe and Moscow has likely limited incision in the upper valley, and correlations across the knickpoints are nearly impossible below T7. Likely recent fluvial activity is responsible for the low-relief terraces found at LR4, but the elevation of that section of the valley has probably remained relatively constant during the Holocene.

**Survey Data: Mad River**

The surveying of the Mad River was performed with Chris Valin, in conjunction with his Senior Theis research. The results, first presented in his thesis (Valin, 1997), are also presented here so that they may be compared with the results from the other valleys.

*Cross Valley Profiles* Sixteen cross valley profiles were plotted with the survey data from thirteen locations (Figure 3.6). The Mad River data are presented in Appendix D and in Valin (1997). Table 3.3 summarizes the data from the cross valley profiles and is used to generate the longitudinal profile.

*Longitudinal Profiles* The Mad River longitudinal profile consists of two segments (Figure 3.7). The first segment trends N10E from the southern divide in Granville north to the Irasville (Figure 3.6), and the second segment trends N40E from there to the Winooski River in Middlesex.

In contrast to the other studied valleys, most of the terraces in the Mad River Valley can be traced along the entire length. Two exceptions are T9 and T8. The highest terrace, T9, is only present in the town of Warren and presumably can be found south of there as well. It correlates with the shoreline elevation of Lake Winooski previously identified in Warren by Larsen (1987b) and is probably part of a delta complex. T8 can be traced from Warren to Moretown, where it grades into Lake Mansfield I.

Several of the lowest terraces were not surveyed closer to the mouth of the Mad River because of limited access to the river. As in the Huntington and Little River Valleys, the presence of knickpoints complicates the correlations of the lowest terraces. Valin (1997) correlated terraces across the gorge in Moretown, but again, these correlations represent time equivalents rather than continuous surfaces.

| Table 3.3: Terrace and River Elevations for Mad River Longitudinal Profile | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Survey Location | Upstream Distance (km) | T9 | T8 | T7 | T6 | T5 | T4 | T3 | T2 | T1 | River |
| MR17 | 0.00 | | | 190.15 | 177.89 | 166.02 | 152.82 | | 141.38 | | 133.23 |
| 440 | 0.33 | | | | | | | | | | 134.15 |
| 460 | 0.84 | | | | | | | | | | 140.24 |
| 480 | 1.62 | | | | | | | | | | 146.34 |
| 500, 520 | 1.85 | | | | | | | | | | 161.00 |
| 540 | 3.21 | | | | | | | | | | 164.63 |
| MR13 | 4.20 | | | 203.41 | | 187.09 | | 173.35 | 170.50 | 168.86 | 166.84 |
| MR14 | 5.88 | | | 205.04 | 198.54 | | 179.32 | 174.81 | 172.34 | 170.28 | 168.82 |
| 560 | 7.34 | | | | | | | | | | 170.73 |
| 580 | 7.42 | | | | | | | | | | 176.83 |
| MR15 | 8.30 | | 212.28 | 207.67 | 203.39 | 199.00 | 195.22 | 193.06 | 191.28 | 190.52 | 188.00 |
| 600 | 8.48 | | | | | | | | | | |
| 620 | 9.79 | | | | | | | | | | |
| MR12 | 10.18 | | 214.32 | 210.64 | 206.22 | 201.12 | | 193.66 | 192.05 | 190.61 | 190.00 |
| 640 | 11.56 | | | | | | | | | | 191.50 |
| MR18 | 11.66 | | 216.09 | 212.30 | 207.55 | | 201.29 | 197.69 | 196.34 | 195.34 | 193.00 |
| 660 | 13.06 | | | | | | | | | | 201.22 |
| 680 | 15.30 | | | | | | | | | | 207.32 |
| MR10 | 15.84 | | 232.36 | 230.09 | 226.71 | | 219.19 | | 213.60 | 212.54 | 210.00 |
| 700 | 16.42 | | | | | | | | | | 213.41 |
| MR7 | 18.48 | | 238.72 | | | 229.15 | 226.27 | | 222.40 | 221.41 | 219.00 |
| 720 | 18.48 | | | | | | | | | | 219.51 |
| MR5 | 19.54 | | 243.90 | | | | | 230.38 | 228.60 | 226.87 | 225.51 |
| 740 | 20.14 | | | | | | | | | | 225.61 |
| 760 | 20.76 | | | | | | | | | | 231.71 |
| 780 | 21.79 | | | | | | | | | | 237.80 |
| 800 | 22.85 | | | | | | | | | | 243.90 |
| MR8 | 23.02 | 291.65 | 263.32 | 259.84 | 258.30 | 257.05 | 254.56 | 252.67 | 251.81 | 249.08 | 247.00 |
| MR4 | 23.75 | 292.68 | 266.00 | 262.90 | | 260.06 | 257.47 | | 254.68 | 253.05 | 250.00 |
| 820 | 24.07 | | | | | | | | | | 253.00 |
| 840 | 24.40 | | | | | | | | | | 256.10 |
| 860 | 24.82 | | | | | | | | | | 262.20 |
| 880 | 24.94 | | | | | | | | | | 268.29 |
| 900 | 25.56 | | | | | | | | | | 274.39 |
| Survey locations (MR4) correspond to cross valley profiles and survey locations (640) correspond to river elevations from USGS 7.5' quadrangles. See Figure 3.6 for survey locations and Figure 3.7 for longitudinal profile. | | | | | | | | | | | |

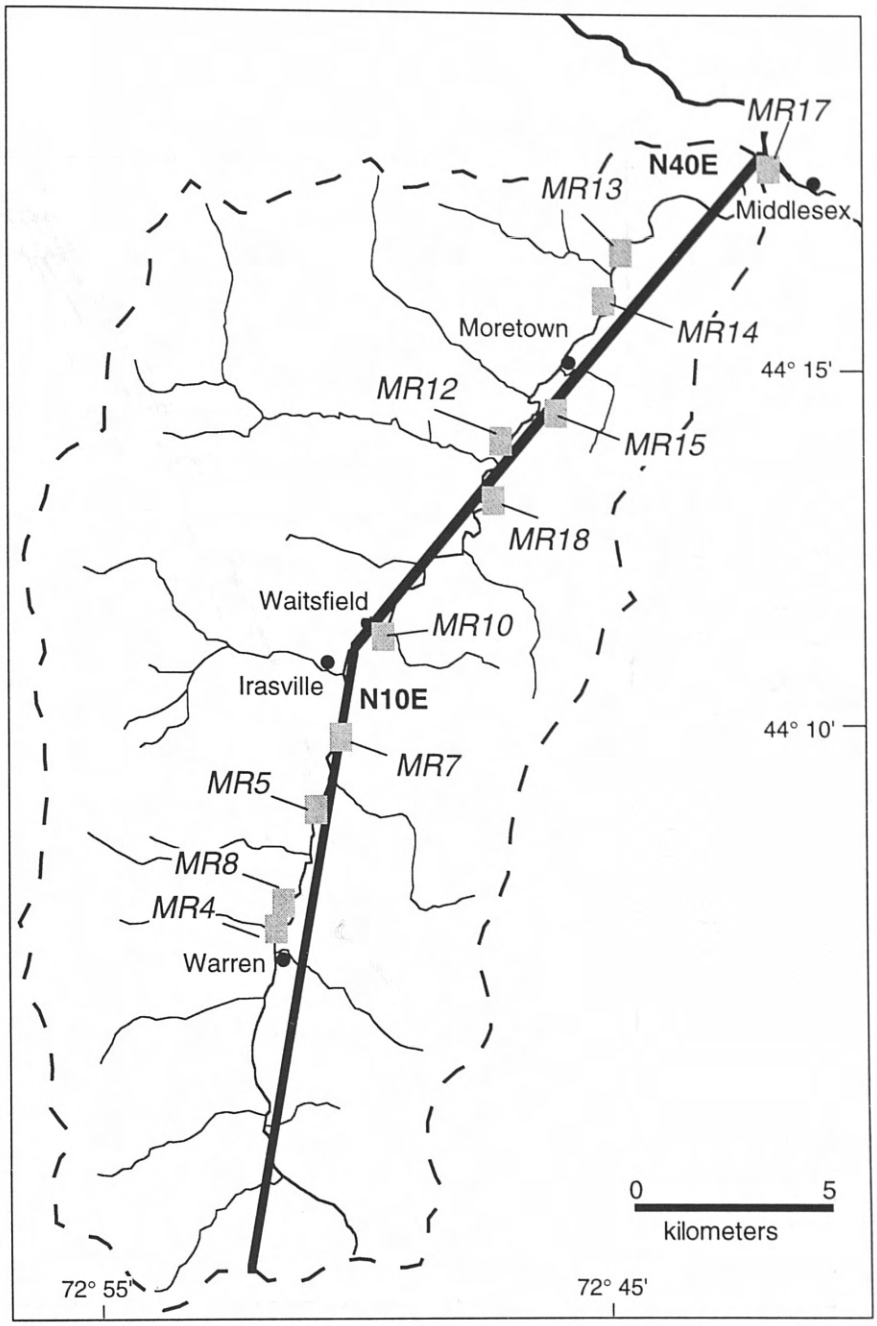



Figure 3.6: Map of Survey Locations and Longitudinal Profile in the Mad River Basin. Base map from USGS 1:100,00 sheet.

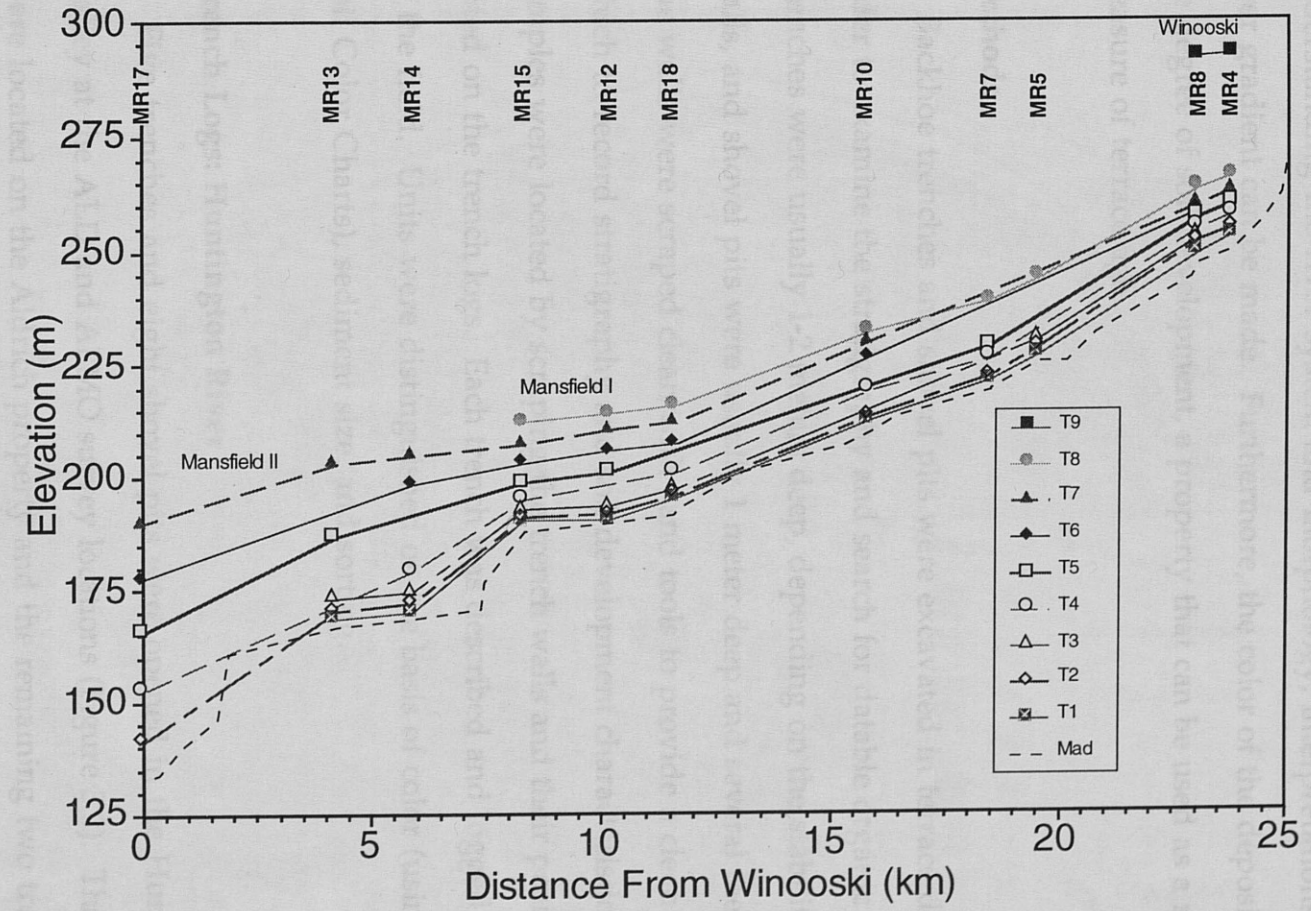



Figure 3.7: Longitudinal Profile of Terraces in the Mad River Valley. Survey locations identified in Figure 3.6 and Table 3.3 are shown. See text for discussion.

## TRENCHING

Trench logs are important for interpreting the stratigraphy of the terrace deposits in order to classify the river system and river morphology. By understanding the river system and morphology, interpretations of initial river gradient can be made. Furthermore, the color of the deposits indicates the degree of soil development, a property that can be used as a relative measure of terrace age.

### Methods

Backhoe trenches and shovel pits were excavated in terrace deposits in order to examine the stratigraphy and search for datable organic matter. Trenches were usually 1-2 meters deep, depending on the stability of the walls, and shovel pits were usually 1 meter deep and several meters wide. The walls were scraped clean with hand tools to provide a clean face from which to record stratigraphy and soil development characteristics. Charcoal samples were located by scraping the trench walls and their positions were noted on the trench logs. Each trench was described and logged individually in the field. Units were distinguished on the basis of color (using Munsell Soil Color Charts), sediment size, and sorting.

### Trench Logs: Huntington River

Five trenches and eight shovel pits were opened in the Huntington River Valley at the ALD and ALMO survey locations (Figure 3.2). Three trenches were located on the Aldrich property and the remaining two trenches and all the shovel pits were on the Moultrop property (Figure 3.8). With the assistance of the Geomorphology class, eight shovel pits were dug in October

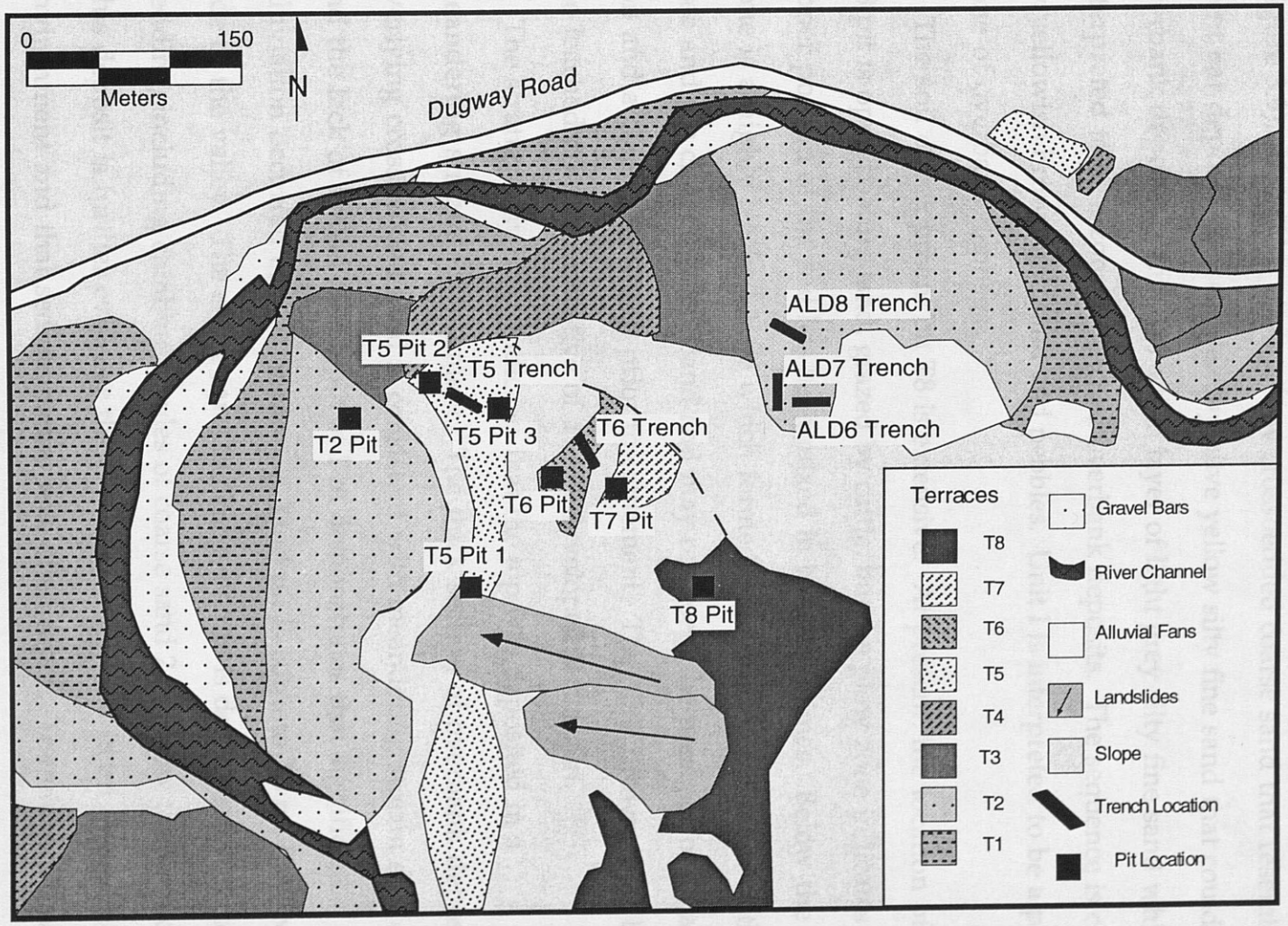


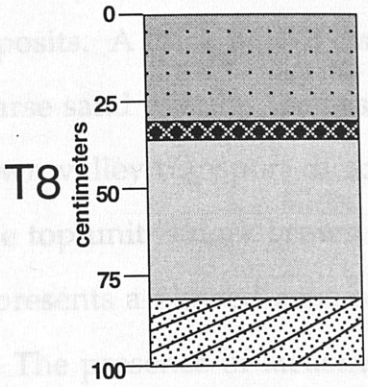

Figure 3.8: Location Map of Trenches and Pits in the Huntington Valley

1995. The trench logs will be described in chronological order from oldest to youngest.

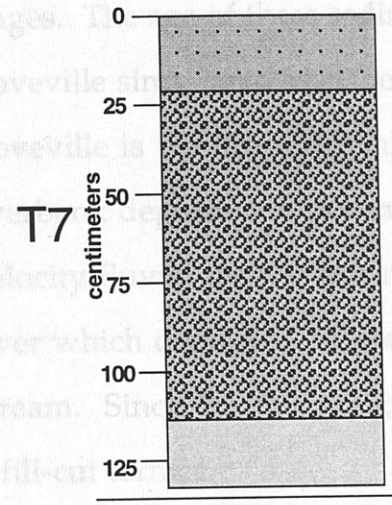
*T8-Elevation 191.1 m* The T8 pit is 1 m deep and contains four units (Figure 3.9). Unit IV is olive yellow crossbedded coarse sand that resembles a point bar deposit. It is overlain by olive yellow silty fine sand that could be overbank deposits. Unit II is a thin layer of light grey silty fine sand which is interpreted to be a zone of leached overbank deposits. The sequence is capped by yellowish brown fine sand and pebbles. Unit I is interpreted to be a plowed zone of overbank deposits.

The soil development on T8 is extensive. At present, the location of the T8 pit is open pasture land, grazed by cattle, but the plow zone indicates the upper portion of the soil has been mixed in historical times. Below the plow zone is a highly leached zone which formed prior to the settlement of the area and the clearing of the land and may represent the presence of an acidic soil and a coniferous forest prior to settlement. The olive brown color below the leached zone is indicative of a well developed B-horizon.

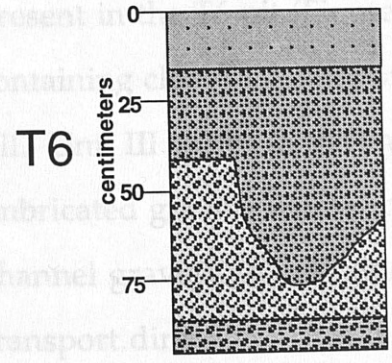
The stratigraphy of T8 indicates that the top was deposited in a meandering stream environment. The thick section of overbank deposits overlying crossbedded sand is consistent with meandering stream deposits and the lack of gravel at a depth of 1 m demonstrates that significant alluviation occurred on this terrace. A sand pit is cut into T8 on the opposite side of the valley. The entire sand thickness of 5 m is dominated by cross bedding, including climbing ripples of coarse sand 2 m below the surface. This deposit is further evidence that T8 was constructed in an aggrading environment and that sedimentation was often rapid. Therefore, T8 was formed as a fill terrace.




| Unit | Sediment | Color | Interpretation |
|---|---|---|---|
| I | Fine Sand with Pebbles | Yellowish Brown 10YR 5/6 | Plow Zone |
| II | Silty Fine Sand | Light Grey 10YR 7/1 | Leached Overbank Deposits |
| III | Silty Fine Sand | Olive Yellow 2.5Y 6/6 | Overbank Deposits |
| IV | Cross Bedded Coarse Sand | Olive Yellow 2.5Y 6/6 | Point Bar Deposits |




| Unit | Sediment | Color | Interpretation |
|---|---|---|---|
| I | Fine Sand with Pebbles | Dark Brown 10YR 3/3 | Plow Zone |
| II | Imbricated Gravels with Coarse Sand Matrix | N/A | Channel Deposits |
| III | Silty Fine Sand | Pale Olive 5Y 6/4 | Lacustrine Deposits |




| Unit | Sediment | Color | Interpretation |
|---|---|---|---|
| I | Silty Sand with Pebbles | Olive Brown 2.5Y 4/4 | Plow Zone |
| II | Pebbles in a Silty Sand Matrix | Yellowish Brown 10YR 5/8 | Longitudinal Bar Deposits |
| III | Coarse Sand and Imbricated Pebbles | N/A | Channel Deposits |
| IV | Diamicton: Clayey Silt and Pebbles | Pale Olive 5Y 6/3 | Glacial Till |

Figure 3.9: T8-T6 Pits-Huntington River. See text for discussion.

*T7-Elevation 180.5 m* The T7 pit consists of three units (Figure 3.9). The lowest unit is a pale olive coarse sand that is interpreted to be glaciolacustrine deposits. A thick unit of clast supported imbricated gravels up to 10 cm and coarse sand overlies the basal sand. The orientation of the clasts indicates a down valley transport direction. This unit was deposited as channel gravels. The top unit is dark brown silty fine sand with random pebbles and represents a plowed zone of overbank deposits.

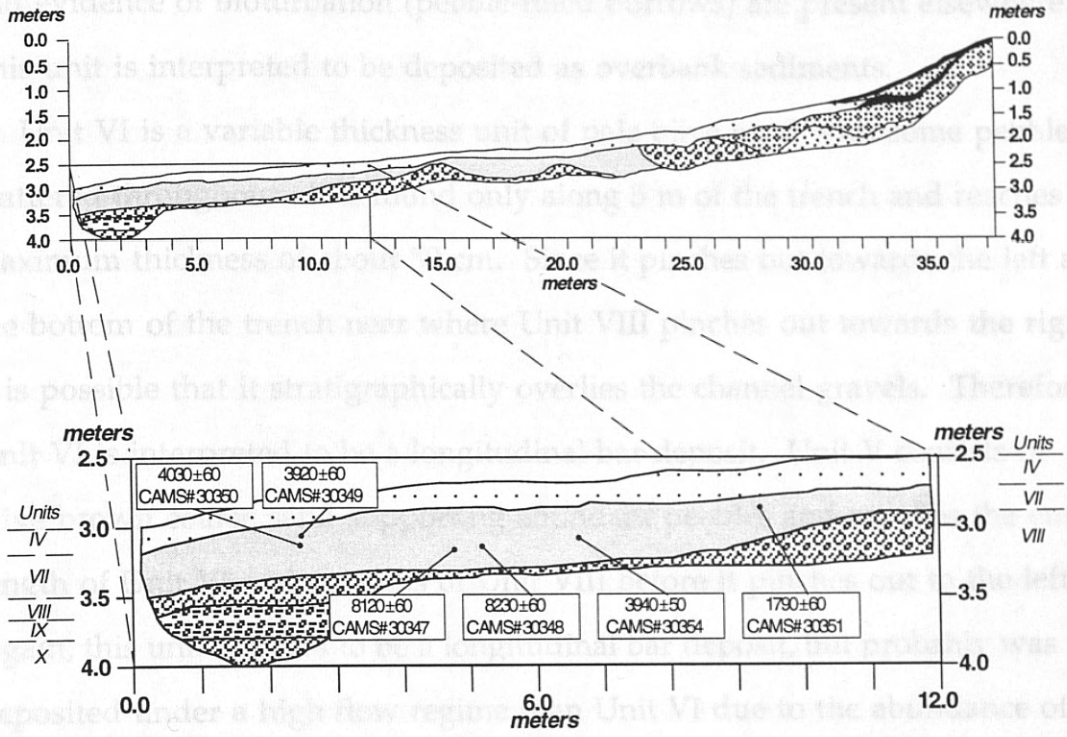
The presence of lacustrine sediments at this elevation in the valley demonstrates that significant valley filling occurred during the proglacial lake stages. The age of these sediments is probably Lake Mansfield II or Lake Coveville since Lake Mansfield II is the first lake to occupy this area and Lake Coveville is the last. The thick unit of channel gravels and the thin unit of overbank deposits are in contrast to the deposits of T8 and indicate a higher velocity fluvial regime was responsible for depositing T7. It is likely that the river which deposited T7 was a sediment-laden, high discharge braided stream. Since the channel gravels are cut into the lacustrine sediments, T7 is a fill-cut terrace.

*T6-Elevation 175.1* A pit and a trench were opened on T6. Four units are present in the T6 pit (Figure 3.9). The lowest unit is a pale olive diamicton containing clayey silt supporting pebbles. Unit IV is interpreted to be glacial till. Unit III varies in thickness from 10-50 cm and consists of clast supported imbricated gravels with a coarse sand matrix. This unit was deposited as channel gravels and the orientation of the gravels indicates a downvalley transport direction. Unit II is a section of yellowish brown silty sand supporting pebbles up to 5 cm in diameter that forms an irregular contact with the unit below and a planar contact with the top unit. Unit II was

deposited as longitudinal bar deposits on top of the channel gravels. The uppermost 15 cm is olive brown fine sand with random pebbles and is interpreted to be a plowed zone of overbank deposits.

The 38 m long T6 trench was opened about 15 m downstream of the T6 pit. Six charcoal samples, collected from one end of the trench, were dated and are discussed in the Dating section. The stratigraphy of the T6 trench is similar to that of the T6 pit, but due to the length of the trench, several additional units were encountered and lateral variations in the units were observed (Figure 3.10).

Ten units are present in the T6 trench. Unit X is clast supported imbricated gravels with a matrix of coarse sand and is interpreted to be channel gravels. It is overlain by about 25 cm of an olive grey diamicton. This diamicton (Unit IX) is similar to the one found in the T6 pit, as it consists of a clayey silt matrix supporting pebbles, and it appears to have a horizontal layering, evident by the orientation of the clasts. Therefore, although the diamicton probably originated as glacial till, its stratigraphic position (above channel gravels) and its layering indicate that it has since been transported, most likely as a gravity flow, into the channel. It is possible that the river, eroding laterally into a bank of till, destabilized the till and caused it to flow into the channel. Consistent with this interpretation is the presence of more channel gravels, Unit VIII, immediately overlying the diamicton. Unit VIII is present along two thirds of the length of the trench, but briefly pinches out at 22 m where Unit VII extends down to the floor of the trench. Unit VII is a section of fining upwards olive brown fine sand and silt, often reddening towards the top. All of the charcoal samples were found within this unit, surrounded by the predominately massive fine sand;




T6 Trench - Huntington River

| Unit | Pattern | Sediment | Color | Interpretation |
|---|---|---|---|---|
| I | | Organic Layer | Reddish Black 2.5YR 3/1 | Top Soil |
| II | | Coarse Sand and Pebbles | Yellowish Brown 10YR 4/4 | Colluvium |
| III | | Organic Layer | Reddish Black 2.5YR 3/1 | Buried Soil Horizon |
| IV | | Silty Sand and Pebbles | Dark Brown 10YR 3/3 | Plow Zone |
| V | | Pebbles with Coarse Sand Matrix | Olive Brown 2.5Y 4/4 | Longitudinal Bar Deposit |
| VI | | Coarse Sand and Pebbles | Pale Olive 5Y 6/3 | Longitudinal Bar Deposit |
| VII | | Fining Upwards Fine Sand and Silt | Olive Brown 2.5Y 4/4 | Overbank Deposits |
| VIII | | Imbricated Gravels with Coarse Sand Matrix | N/A | Channel Gravels |
| IX | | Diamicton | Olive Grey 5Y 5/2 | Glacial Till Flow |
| X | | Imbricated Gravels with Coarse Sand Matrix | N/A | Channel Gravels |

Figure 3.10: T6 Trench - Huntington River. See text for discussion.

however, horizontal laminations are found in some locations, and mottling and evidence of bioturbation (pebble-filled burrows) are present elsewhere. This unit is interpreted to be deposited as overbank sediments.

Unit VI is a variable thickness unit of pale olive sand with some pebbles scattered throughout. It is found only along 5 m of the trench and reaches a maximum thickness of about 50 cm. Since it pinches out towards the left at the bottom of the trench near where Unit VIII pinches out towards the right, it is possible that it stratigraphically overlies the channel gravels. Therefore, Unit VI is interpreted to be a longitudinal bar deposit. Unit V consists of olive brown coarse sand supporting abundant pebbles and overlies the entire length of Unit VI and portions of Unit VIII before it pinches out to the left. Again, this unit appears to be a longitudinal bar deposit, but probably was deposited under a high flow regime than Unit VI due to the abundance of pebbles.

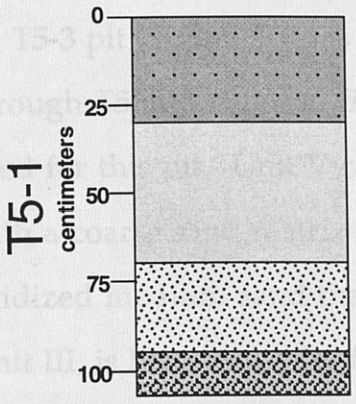
Unit IV is dark brown silty sand with random pebbles that forms the near-level terrace surface for most of the length of the trench; therefore, it probably represents a plowed zone of the units it overlies. It overlies the entire extent of Unit VII and portions of Units VIII and V, before pinching out to the right as it becomes covered. Unit III is a 10 cm thick reddish black organic layer that begins where Unit IV pinches out and extends to near the surface at the far right end of the trench. Because it is an organic layer, it is probably a soil horizon buried by Unit II. Unit II a chaotic mixture of yellowish brown coarse sand and pebbles. It only lies above the buried soil horizon and pinches out both up- and downslope; therefore it is interpreted to be a colluvial wedge with T7 as a source. Unit I is a 5 cm thick reddish black organic layer that has developed above the entire length of Unit II and overlies Unit III at the right

end of the trench. Because it is undisturbed, it formed since the colluvial wedge of Unit II was deposited and has never been plowed.

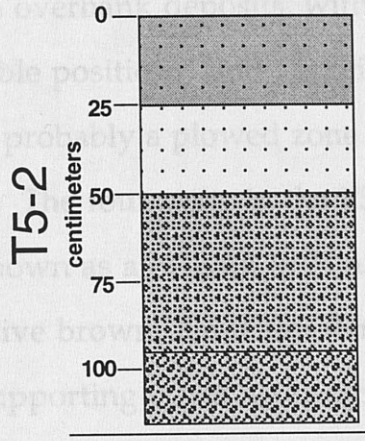
The pit and trench on T6 show the same characteristics as the T7 trench. The channel gravels of trench Units X and VIII and pit Unit III are identical to those in the T7 trench, and although the overbank deposits generally are thicker than those on T7, in places the overbank deposits are absent or are only represented by the plow zone. Therefore, like T7, T6 was probably deposited by a sediment-laden braided river. Glacial till probably underlies the river deposits. The full glacial till section (Unit IV) of the T6 pit was not uncovered or studied in detail; so, it is not known whether it represents a till flow into the river like trench Unit IX or *in situ* till. The bottom contact of Unit X was not exposed either, but from the interpretation that Unit IX is a till flow into the river, it follows that the river had incised vertically through till and was either flowing across bedrock and/or till. Therefore, T6 was deposited as a fill-cut terrace.

*T5 -Elevation 165.9* Three shovelpits and one trench were opened on T5. Four units are found in the T5-1 pit (Figure 3.11). Unit IV, imbricated gravel with a coarse sand matrix, is interpreted to be channel deposits. It is overlain by three units of overbank deposits. Unit III is fining upwards olive grey fine sand that grades into the olive silty fine sand of Unit II. The top unit, Unit I, is light olive brown fine sand with evidence of burrowing and is interpreted to be a plowed zone of overbank deposits.

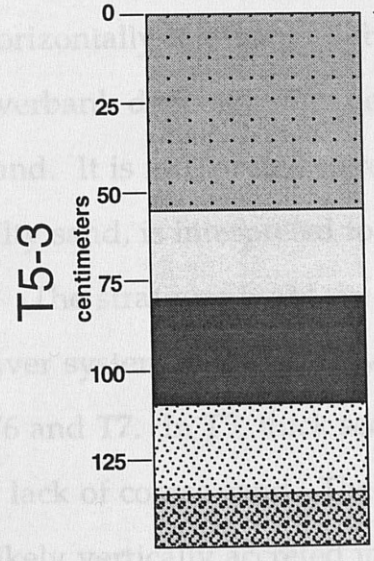
T5-2 pit (Figure 3.11) has four units. The lowest unit, Unit IV, is imbricated gravels with a coarse sand matrix and is interpreted to be channel gravel deposits. It is overlain by coarse sand and pebbles (Unit III) that were probably deposited at the edge of the channel, perhaps on the edge of a point




| Unit | Sediment | Color | Interpretation |
|---|---|---|---|
| I | Fine Sand with Pebbles | Light Olive Brown 2.5Y 5/4 | Plow Zone |
| II | Silty Fine Sand | Olive 5Y 5/3 | Overbank Deposits |
| III | Fining Upwards Fine Sand | Olive Grey 5Y 5/2 | Overbank Deposits |
| IV | Imbricated Gravels with Coarse Sand Matrix | N/A | Channel Deposits |




| Unit | Sediment | Color | Interpretation |
|---|---|---|---|
| I | Fine Silty Sand with Pebbles | Light Olive Brown 2.5Y 5/4 | Plow Zone |
| II | Silty Fine Sand | Olive 5Y 5/3 | Overbank Deposits |
| III | Coarse Sand and Pebbles | Olive Grey 5Y 5/2 | Point Bar Deposits |
| IV | Imbricated Gravels with Coarse Sand Matrix | N/A | Channel Deposits |




| Unit | Sediment | Color | Interpretation |
|---|---|---|---|
| I | Fine Silty Sand with Pebbles | Olive Brown | Plow Zone |
| II | Silty Fine Sand | Olive | Overbank Deposits |
| III | Fining Upwards Fine Sand | Blue Grey | Overbank Deposits |
| IV | Medium Sand | Blue Grey | Point Bar Deposits |
| V | Imbricated Gravels with Coarse Sand Matrix | N/A | Channel Deposits |

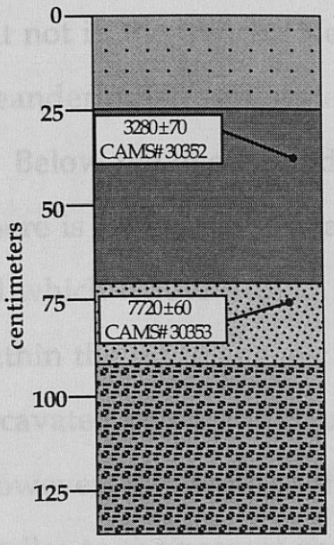
Figure 3.11: T5 Pits 1-3-Huntington River. See text for discussion.

bar. Unit II is an olive silty fine sand that likely represents the vertical accretion deposits of point bar deposits.

T5-3 pit (Figure 3.11) is an exposure along the side of a gully which cut through T5 and exposed five units. The Munsell Soil Color Charts were not used for this pit. Unit V contains imbricated gravels, up to 20 cm in diameter, with a coarse sand matrix and is interpreted to be channel gravels. Unit IV is oxidized medium sand that could represent point bar deposits. The next unit, Unit III, is blue-grey silty fine sand and is overlain by olive silty fine sand containing abundant charcoal (Unit II). Both of these units are interpreted to be overbank deposits, with the soil color representive of the average water table position. Unit I is olive brown silty fine sand which is highly mixed. It is probably a plowed zone of overbank deposits.

The four units in the T5 trench did not vary laterally; therefore, they are shown as a column in Figure 3.12. The lowest unit is a thick (> 1.5 m) light olive brown diamicton (Unit IV), consisting of a silt and sand matrix supporting clasts up to 5 cm in diameter. Since no structures are present, this massive diamicton is interpreted to be *in situ* glacial till. Unit III is horizontally laminated light olive brown fine sand that was deposited as overbank deposits. The next unit, Unit II, is massive olive brown silty fine sand. It is interpreted to represent overbank deposition. Unit I, a dark brown silty sand, is interpreted to be a plowed zone of overbank deposits.

The stratigraphy of the pits and the trench on T5 demonstrates that the river system is remarkably different than the one responsible for depositing T6 and T7. In T5, thick sections of overbank deposits are present and there is a lack of coarse sand. The bulk of the deposit is fine sand and silt, which most likely vertically accreted in flood stage. Coarse and medium sand were found




| Unit | Sediment | Color | Interpretation |
|---|---|---|---|
| I | Silty Sand with Pebbles | Dark Brown 10YR 3/3 | Plow Zone |
| II | Silty Fine Sand | Olive Brown 2.5Y 4/4 | Overbank Deposits |
| III | Fine Sand | Light Olive Brown 2.5Y 5/3 | Point Bar Deposits |
| IV | Cobbles in a Clay Matrix | Light Olive Brown 2.5Y 4/3 | Glacial Till |

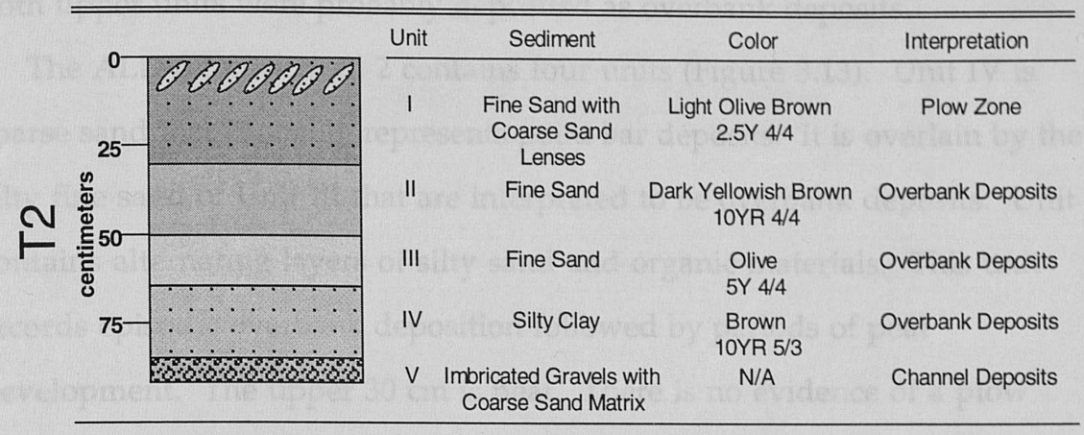
Figure 3.12: T5 Trench-Huntington River. See text for discussion.

in two of the pits and suggest that there may have point bars accreting in sections of the channels. Channel gravels were uncovered in the three pits, but not in the trench. Nevertheless, the stratigraphy of T5 best resembles a meandering stream system.

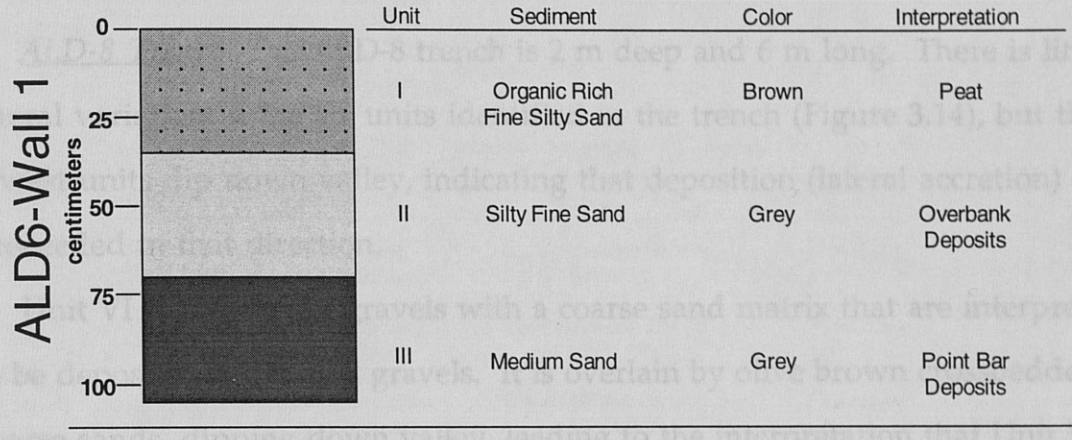
Below the overbank deposits in the trench is a thick section of glacial till. There is no evidence of a cutting tool, such as channel gravels, overlying the till which would explain how it was beveled, but there is also no structures within the till to suggest it flowed in to the channel. None of the pits were excavated below the channel gravel; so the scour depth is not known. However, the depth to the gravel is over a meter in all three pits and is similar to the present river. Therefore, it is likely that the terrace deposits were laid down as a fill-cut terrace. Immediately across the valley, there is another terrace with the same elevation which implies that T5 is also a paired terrace.

*T2 -Elevation 152.2 m* Three trenches and one pit were opened in T2. Five units are found in the T2 pit (Figure 3.13). The lowest unit is imbricated gravels with a coarse sand matrix and is interpreted to be a channel deposit. The remaining units were deposited as overbank deposits. Unit IV, brown silty clay, grades into the fine olive sand of Unit III. Unit II is distinguished from Unit III by its color. It is dark yellowish brown fine sand and it grades into Unit I, light olive brown fine sand with coarse sand lenses. The shape of the lenses resembles furrows and a nail was found in Unit I; therefore, Unit I is interpreted to be a plowed zone of overbank deposits.

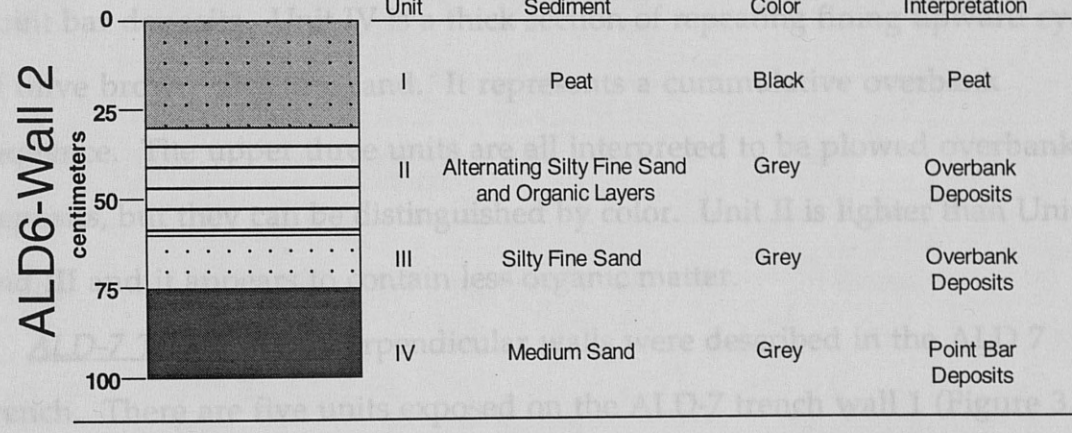
*ALD-6 Trench* Two walls of the ALD-6 trench, located on perpendicular walls, were described. Wall 1 contains three units (Figure 3.13). The lowest unit is grey medium sand that is interpreted to be a point bar deposit. It is




| Unit | Sediment | Color | Interpretation |
|---|---|---|---|
| I | Fine Sand with Coarse Sand Lenses | Light Olive Brown 2.5Y 4/4 | Plow Zone |
| II | Fine Sand | Dark Yellowish Brown 10YR 4/4 | Overbank Deposits |
| III | Fine Sand | Olive 5Y 4/4 | Overbank Deposits |
| IV | Silty Clay | Brown 10YR 5/3 | Overbank Deposits |
| V | Imbricated Gravels with Coarse Sand Matrix | N/A | Channel Deposits |




| Unit | Sediment | Color | Interpretation |
|---|---|---|---|
| I | Organic Rich Fine Silty Sand | Brown | Peat |
| II | Silty Fine Sand | Grey | Overbank Deposits |
| III | Medium Sand | Grey | Point Bar Deposits |




| Unit | Sediment | Color | Interpretation |
|---|---|---|---|
| I | Peat | Black | Peat |
| II | Alternating Silty Fine Sand and Organic Layers | Grey | Overbank Deposits |
| III | Silty Fine Sand | Grey | Overbank Deposits |
| IV | Medium Sand | Grey | Point Bar Deposits |

Figure 3.13: T2 Pit, ALD6-1, and ALD6-2-Huntington River. See text for discussion.

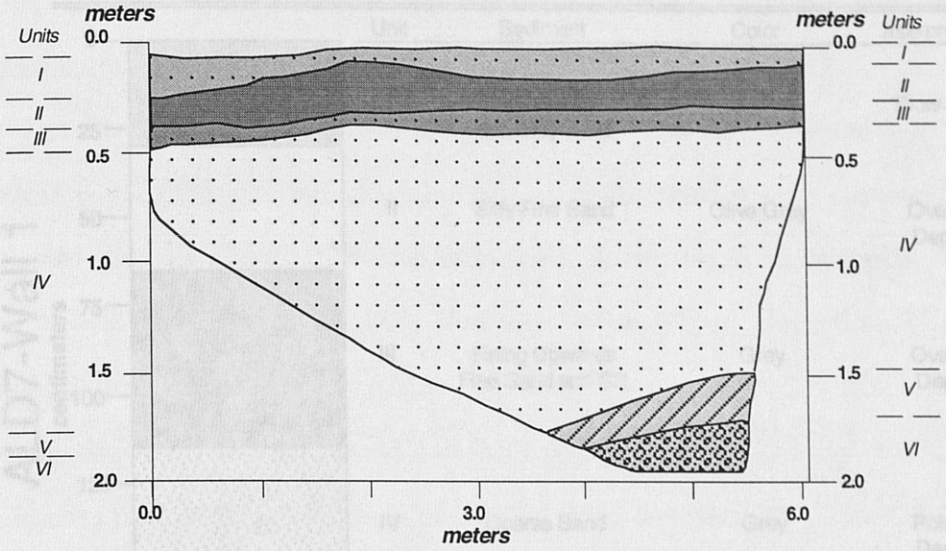
overlain by grey silty fine sand (Unit II) and organic rich silty clay (Unit I). Both upper units were probably deposited as overbank deposits.

The ALD-6 trench wall 2 contains four units (Figure 3.13). Unit IV is coarse sand that probably represents point bar deposits. It is overlain by the silty fine sand of Unit III that are interpreted to be overbank deposits. Unit II contains alternating layers of silty sand and organic materials. This unit records episodic overbank deposition followed by periods of peat development. The upper 30 cm is peat. There is no evidence of a plow horizon in this trench.

*ALD-8 Trench* The ALD-8 trench is 2 m deep and 6 m long. There is little lateral variation in the six units identified in the trench (Figure 3.14), but the lowest units dip down valley, indicating that deposition (lateral accretion) proceeded in that direction.

Unit VI is imbricated gravels with a coarse sand matrix that are interpreted to be deposited as channel gravels. It is overlain by olive brown crossbedded coarse sands, dipping down valley, leading to the interpretation that Unit V is point bar deposits. Unit IV is a thick section of repeating fining upward cycles of olive brown silty fine sand. It represents a cummulative overbank sequence. The upper three units are all interpreted to be plowed overbank deposits, but they can be distinguished by color. Unit II is lighter than Units I and III and it appears to contain less organic matter.

*ALD-7 Trench* Two perpendicular walls were described in the ALD 7 trench. There are five units exposed on the ALD-7 trench wall 1 (Figure 3.15). The lowest unit is imbricated gravels with a coarse sand matrix and is interpreted to be channel gravels. The next unit, Unit IV, is grey coarse sand that possibly was deposited as a point bar. It is overlain by a fining upward




ALD-8 Trench- Huntington River

| Unit | Pattern | Sediment | Color | Interpretation |
|---|---|---|---|---|
| I | | Fine Sand with Pebbles | Dark Yellowish Brown 10YR 3/3 | Plow Zone |
| II | | Burrowed Silty Fine Sand | Dark Yellowish Brown 10YR 4/3 | Plow Zone |
| III | | Coarse Sand and Pebbles | Dark Yellowish Brown 10YR 3/3 | Plow Zone |
| IV | | Fining Upwards Silty Fine Sand | Olive Brown 2.5Y 4/4 | Overbank Deposits |
| V | | Crossbedded Coarse Sand | Olive Brown 2.5Y 4/4 | Point Bar Deposits |
| VI | | Imbricated Gravels with Coarse Sand Matrix | N/A | Channel Gravels |

Figure 3.14: ALD-8 Trench-Huntington River. See text for discussion.

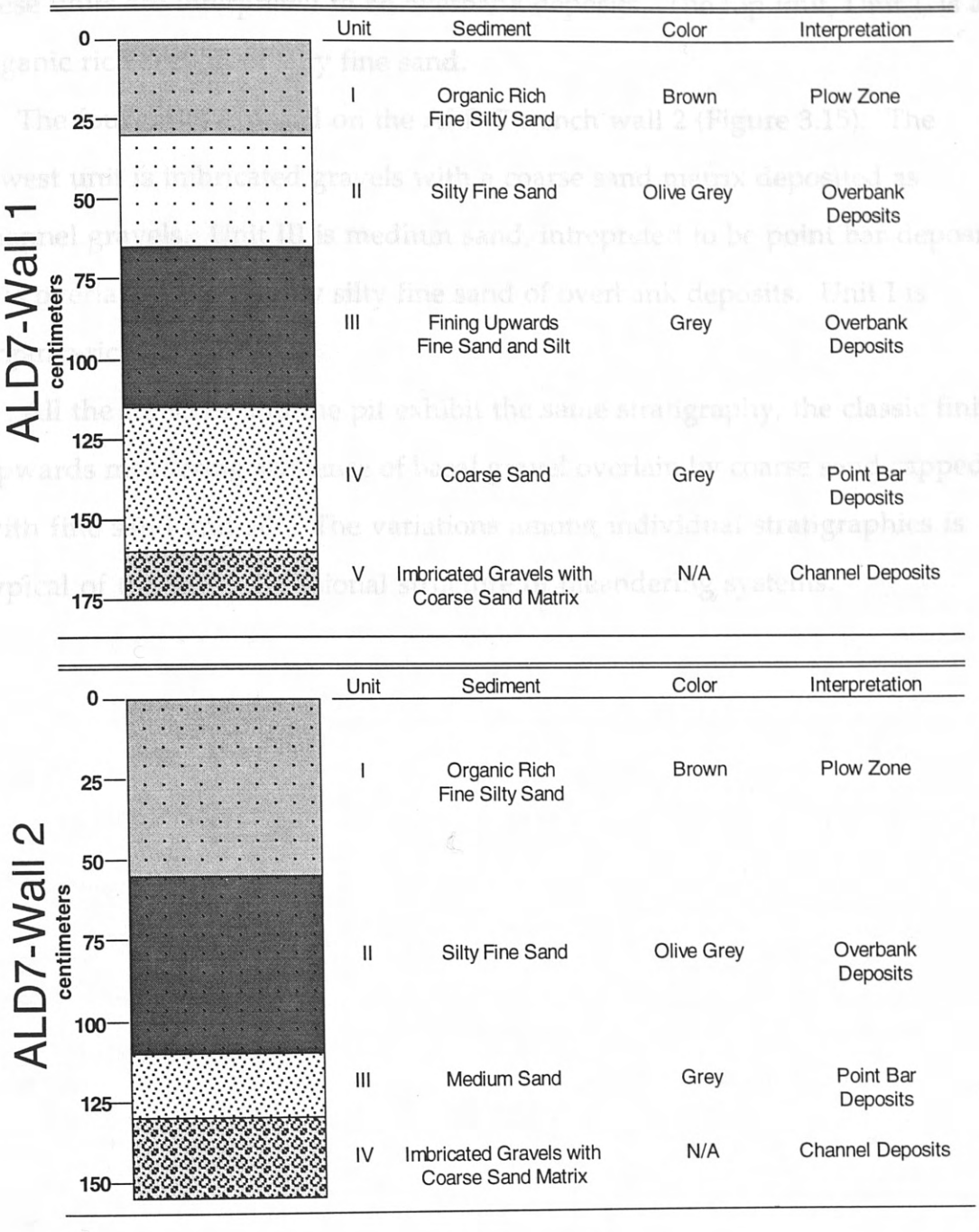



Figure 3.15: ALD-7 Trench Walls-Huntington River.
See text for discussion.

section of grey fine sand and silt. Unit II is olive grey silty fine sand. Both of these units are interpreted to be overbank deposits. The top unit, Unit I, is an organic rich section of silty fine sand.

The four units exposed on the ALD-7 trench wall 2 (Figure 3.15). The lowest unit is imbricated gravels with a coarse sand matrix deposited as channel gravels. Unit III is medium sand, intrepreted to be point bar deposits. It is overlain by olive grey silty fine sand of overbank deposits. Unit I is organic-rich silty clay.

All the trenches and the pit exhibit the same stratigraphy, the classic fining upwards meadering sequence of basal gravel overlain by coarse sand capped with fine sand and silt. The variations among individual stratigraphies is typical of the three dimesional structure of meandering systems.

**Trench Logs: Mad River**

Three backhoe trenches were opened in the Mad River Valley in the town of Warren (Figure 3.16). The trench logs will be described in order from oldest to youngest, beginning with the highest trench on T8.

*T8-Elevation 263.3 m* The T8 trench is 100 m long and contains several lateral variations (Figure 3.17). This trench was excavated to replace a water line on the property and in most places is less than 1.5 m deep. However, three deeper sections were dug to 2 m. In several locations the stratigraphy was obscurred due to previous trenching. The lowest unit (Unit VI) is light grey fine sand and silt that is interpreted to be lacustrine deposits and is found only between meters 93-98 in the trench. Unit V is in the bottom of the other two deep excavations, meters 23-30 and meters 60-65. It is at least 1 m of imbricated cobbles that probably were deposited as channel gravels. Unit IV extends from meter 35 to the end of the trench and consists of imbricated cobbles in a coarse sand matrix. It distinguished from Unit V by the smaller clast size, but also is interpretted to be channel deposits. The first 45 m of the trench expose Unit III, a 40 cm thick unit of coarse sand and gravel. It is overlain by two units which extend along the entire length of the trench. Unit II is 40 cm of olive brown silty sand and pebbles, interpreted to be vertically accreted overbank deposits and Unit I is a 15 cm thick dark yellow brown silty sand unit that represents a plowed zone of overbank deposits.

The fluvial deposits seen in the T8 trench unconformably overlie lacustrine sands and silt. It is likely that the river eroded into the lacustrine deposits before the fluvial deposits were laid down. Therefore, the T8 terrace is a fill-cut terrace. The lateral variations in the thickness of the gravels indicates there were multiple, small channels to carry the water. The finer-

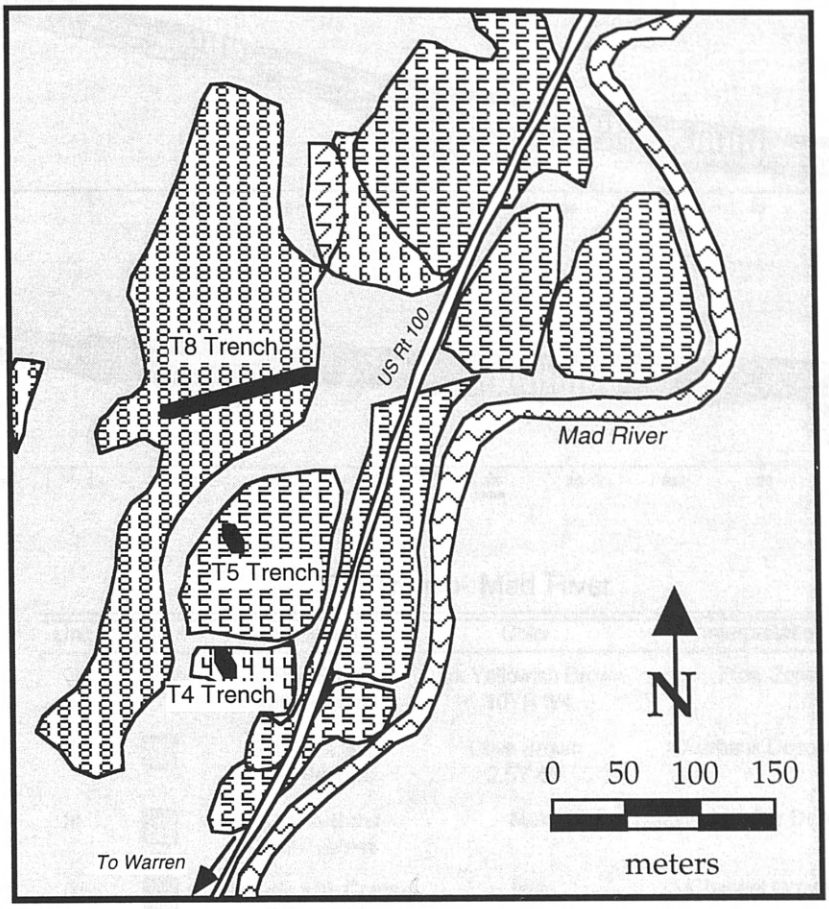
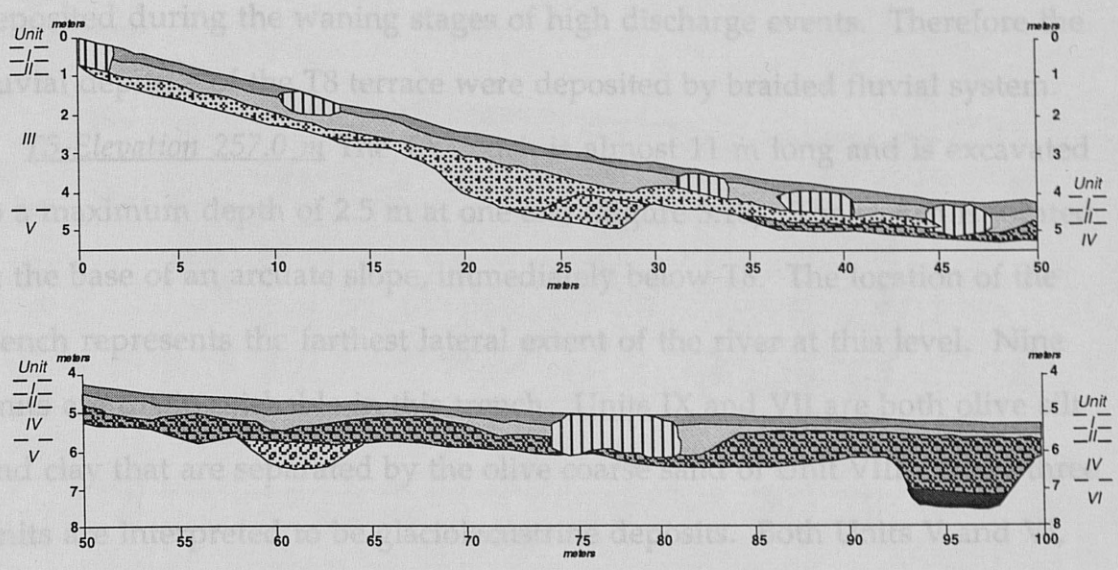



Figure 3.16: Location Map of Mad River Trenches. Trenches were opened at survey location MR8. See Figure 3.6 for location. Numbers in fill pattern refer to terrace numbers.




T8 Trench- Mad River

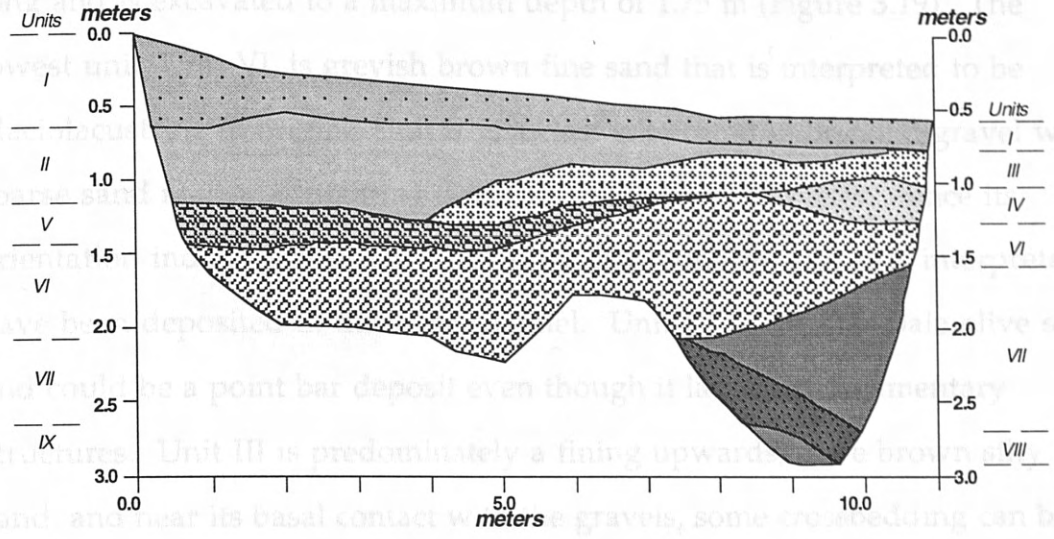
| Unit | Pattern | Sediment | Color | Interpretation |
|---|---|---|---|---|
| I | | Fine Sand with Pebbles | Dark Yellowish Brown 10YR 3/4 | Plow Zone |
| II | | Silty Fine Sand and Pebbles | Olive Brown 2.5Y 4/4 | Overbank Deposits |
| III | | Coarse Sand and Pebbles | N/A | Longitudinal Bar Deposits |
| IV | | Gravels with Coarse Sand Matrix | N/A | Channel Gravels |
| V | | Imbricated Gravels with Coarse Sand Matrix | N/A | Channel Gravels |
| VI | | Silts and Clays | Olive 5Y 5/4 | Lacustrine Sediments |
| | | Disturbed sediment due to previous trenching | | |

Figure 3.17: T8 Trench-Mad River. See text for discussion.

grained deposits toward the upper part of the sequence were probably deposited during the waning stages of high discharge events. Therefore the fluvial deposits of the T8 terrace were deposited by braided fluvial system.

*T5-Elevation 257.0 m* The T5 trench is almost 11 m long and is excavated to a maximum depth of 2.5 m at one end (Figure 3.18). The trench is located at the base of an arcuate slope, immediately below T8. The location of the trench represents the farthest lateral extent of the river at this level. Nine units are distinguishable in this trench. Units IX and VII are both olive silt and clay that are separated by the olive coarse sand of Unit VIII. These three units are interpreted to be glaciolacustrine deposits. Both Units V and VI, pebbles and gravels in a coarse sand matrix, are interpreted to be channel deposits, with Unit V deposited under a slightly lower flow regime. Unit IV is a coarse olive brown sand and Unit III is a coarse olive brown sand with pebbles. Charcoal pieces are found in both units. These sandy units could be longitudinal bar deposits. Unit II is a fining upwards, olive brown fine sand and probably was deposited as overbank material under waning flow conditions. Unit I is dark yellowish brown fine sand with random pebbles and is interpreted to be a plowed zone of overbank deposits.

The sedimentology of the T5 deposits suggests deposition by a braided river system. The abundance of coarse material as well as the lateral variations in unit thickness points toward a fluvial system which, by lacking the fine-grained sediment neccesary for cohesive banks, flowed within wide, shallow channels. The lower-most gravels in the T5 trench, Units V and VI, cut into the lacustrine deposits below, indicating that it is a fill-cut terrace.



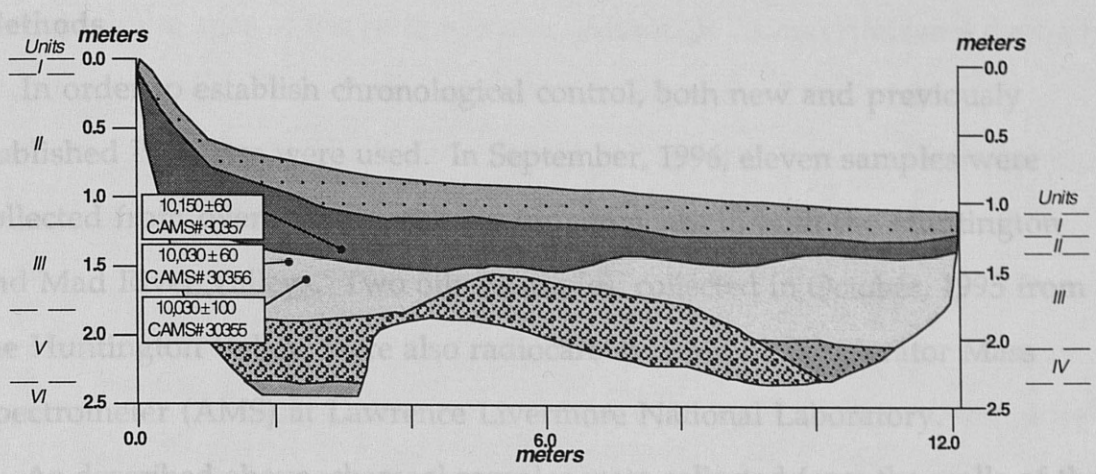

T5 Trench- Mad River

| Unit | Pattern | Sediment | Color | Interpretation |
|---|---|---|---|---|
| I | | Fine Sand with Pebbles | Dark Yellowish Brown 10YR 3/4 | Plow Zone |
| II | | Burrowed Silty Fine Sand | Olive Brown 2.5Y 4/4 | Overbank Deposits |
| III | | Coarse Sand and Pebbles | Olive Brown 2.5Y 4/4 | Longitudinal Bar Deposits |
| IV | | Coarse Sand | Olive Brown 2.5Y 4/4 | Longitudinal Bar Deposits |
| V | | Pebbles with Coarse Sand Matrix | N/A | Channel Gravels |
| VI | | Imbricated Gravels with Coarse Sand Matrix | N/A | Channel Gravels |
| VII | | Silts and Clays | Olive 5Y 5/4 | Lacustrine Sediments |
| VIII | | Coarse Sand | Olive 5Y 5/4 | Lacustrine Sediments |
| IX | | Silts and Clays | Olive 5Y 5/4 | Lacustrine Sediments |

Figure 3.18: T5 Trench-Mad River. See text for discussion.

*T4-Elevation 254.5 m* Six units are present in the T4 trench which is 12 m long and is excavated to a maximum depth of 1.75 m (Figure 3.19). The lowest unit, Unit VI, is greyish brown fine sand that is interpreted to be glaciolacustrine in origin. Unit V is a clast supported imbricated gravel with a coarse sand matrix, containing clasts up to 30 cm in diameter. Since its orientation indicates a down valley flow direction, the gravel is interpreted to have been deposited in the river channel. Unit IV is a coarse pale olive sand and could be a point bar deposit even though it lacks any sedimentary structures. Unit III is predominately a fining upwards, olive brown silty fine sand, and near its basal contact with the gravels, some crossbedding can be observed and charcoal can be found. Unit II also consists of fine sand and silt, but is distinguishable from Unit III by its redder color and burrows. Therefore, both of these units are interpreted to be overbank deposits, with Unit II exhibiting a well-developed B horizon. Unit I is dark brown fine sand with random pebbles and is interpreted to be a plowed zone.

As with the higher terraces, T4 is underlain by lacustrine deposits which again indicates that it is a fill-cut terrace, consisting of lateral accretion deposits laid down after the river incised. The stratigraphy of T4 is consistent with a meandering river deposit. Like T5, it is located at the inside of a meander bend and probably represents the farthest lateral extent of the river. The channel was probably abandoned due to a meander cutoff, but still received some overbank deposition during flood stage.




T4 Trench- Mad River

| Unit | Pattern | Sediment | Color | Interpretation |
|---|---|---|---|---|
| I | | Fine Sand with Pebbles | Dark Brown 10YR 3/3 | Plow Zone |
| II | | Burrowed Silty Fine Sand | Strong Brown 7.5YR 4/6 | Overbank Deposits |
| III | | Fining Upwards Silty Fine Sand | Olive Brown 2.5Y 4/3 | Overbank Deposits |
| IV | | Coarse Sand | Pale Olive 5Y 6/3 | Point Bar Deposits |
| V | | Imbricated Gravels with Coarse Sand Matrix | N/A | Channel Gravels |
| VI | | Fine Sand | Greyish Brown 5Y 5/2 | Lacustrine Sediments |

Figure 3.19: T4 Trench-Mad River. See text for discussion.

## DATING

### Methods

In order to establish chronological control, both new and previously published $^{14}C$ dates were used. In September, 1996, eleven samples were collected from overbank deposits in four trenches in both the Huntington and Mad River Valleys. Two other samples, collected in October, 1995 from the Huntington Valley, were also radiocarbon dated by Accelerator Mass Spectrometer (AMS) at Lawrence Livermore National Laboratory.

As described above, charcoal samples were collected from the walls of the backhoe trenches for dating. The charcoal was found as isolated pieces in the overbank deposits at a depth of $< 1$ m and it was usually $< 5$ mm in diameter and subangular. The species of the charcoal was not identified.

Charcoal samples were brought to Lawrence Livermore National Laboratory in Livermore, California, and dated by AMS. The samples were cleaned using a series of acid (HCl) and base washes (NaOH) to remove any rootlets or humic and fulvic acids and then burned to produce $CO_2$ and other gases. The $CO_2$ was isolated using cryogenic techniques on a vacuum line and then was converted to graphite. The graphite was packed into targets and John Southon measured $^{14}C$ on the AMS. The radiocarbon ages were calculated assuming a $\partial\ ^{13}C$ value of -25 per mil, appropriate for terrestrial organic matter.

The radiocarbon ages were converted to calibrated ages using the CALIB 3.0.3A program of Stuvier and Riemer (1993). Because the amount of $^{14}C$ in the atmosphere varies over time, the $^{14}C$ age must be calibrated to reflect sidereal years. The CALIB program uses a data base of radiocarbon-dated tree rings to convert the $^{14}C$ ages to calibrated years.

Radiometric dating the organic matter collected from the terrace deposits constrains the ages of the river terraces. Although the river terraces deposits are directly dated, these dates represent limiting ages. A river terrace is deposited, as a floodplain, both vertically and laterally over an extended time period. As a time-transgressive deposit, there is no single age for a terrace. Dating organic matter that was deposited along with the terrace deposits demonstrates that section of the terrace is at least that old, but there may be sections of the terrace that are either older or younger. Therefore, the oldest charcoal age provides a minimum age for the terrace formation and a minimum age for abandonment of the previous terrace.

There are two post-deposition mechanisms which can complicate the interpretaion of radiocarbon ages: bioturbation and redeposition of the charcoal. Any time after deposition, young charcoal or other organic material may be stirred into the terrace by bioturbation. Unless there is a clear indication that the charcoal was deposited coevally with the deposits (i.e., charcoal is found within undisturbed cross beds), the age of the terrace must be considered a minimum. It is also possible that charcoal or wood stored within a terrace deposit may be subsequently eroded from the terrace, transported by the river, and redeposited downstream in a younger deposit. In this case, the organic matter would be older than the new terrace deposit. However, it seems unlikely that the small charcoal pieces would remain intact through two deposition cycles.

Table 3.4: Huntington River Basal Fan Radiocarbon Ages

| Terrace | Sample | Laboratory # | Material | Depth (m) | $^{14}C$ Age | Calibrated Date (yr B.P.) | 1 Sigma Range (yr B.P.) | 2 Sigma Range (yr B.P.) |
|---|---|---|---|---|---|---|---|---|
| T1 | Ald 2-2* | GX-21329 | Wood | 4.00 | < 100 | 62-0 | 128-0 | 238-0 |
| T2 | Ald 5-2* | CAMS# 22994 | Wood | 4.00 | 2500±60 | 2708-2402 | 2735-2363 | 2746-2352 |
| T5 | Af-45** | GX-20276 | Wood | 4.00 | 7835±105 | 8555 | 8713-8430 | 8981-8375 |
| T5 | Df-1** | CAMS# 20901 | Wood | 2.50 | 8530±100 | 9486 | 9531-9436 | 9819-9275 |
| T5 | Df-8** | CAMS# 20963 | Wood | 1.30 | 8060±60 | 8981 | 8993-8764 | 9194-8662 |

Note: Fan dates from *Zehfuss (1996), and **Church (1997). Calibrations by CALIB 3.0.3A (Stuvier and Reimer, 1993).

Table 3.5: Huntington River Terrace Radiocarbon Ages

| Terrace | Sample# | CAMS# | Material | Depth (m) | $^{14}$C Age | Calibrated Date (yr B.P.) | 1 Sigma Range (yr B.P.) | 2 Sigma Range (yr B.P.) |
|---|---|---|---|---|---|---|---|---|
| T2 | ALD4-8 | 30359 | Wood | 2.30 | 1800±80 | 1804, 1760 | 1871-1636 | 1946-1560 |
| T2 | ALD4-7 | 30358 | Wood | 3.60 | 1900±50 | 1830 | 1879-1751 | 1939-1710 |
| T5 | TW6 | 30352 | Charcoal | 0.33 | 3280±70 | 3471 | 3576-3400 | 3684-3359 |
| T5 | TW7 | 30353 | Charcoal | 0.75 | 7790±60 | 8424 | 8541-8407 | 8565-8367 |
| T6 | TW5 | 30351 | Charcoal | 0.28 | 1790±60 | 1706 | 1805-1615 | 1863-1542 |
| T6 | TW3 | 30349 | Charcoal | 0.32 | 3920±60 | 4404, 4361,4358 | 4418-4263 | 4518-4150 |
| T6 | TW8 | 30354 | Charcoal | 0.55 | 3940±50 | 4408 | 4424-4295 | 4518-4232 |
| T6 | TW4 | 30350 | Charcoal | 0.36 | 4030±60 | 4512, 4473, 4449 | 4562-4416 | 4810-4354 |
| T6 | TW2 | 30348 | Charcoal | 0.46 | 8230±60 | 9210 | 9362-900 | 9380-8988 |
| T6 | TW1 | 30347 | Charcoal | 0.49 | 8120±60 | 8991 | 9189-8980 | 9240-8736 |

Note: Locations of radiocarbon samples for T6 and T5 are shown on Figures 3.10 and 3.14, respectively, and locations for T2 are presented in Zehfuss (1996) and shown on Figure 3.7. Calibration using CALIB 3.0.3A (Stuvier and Reimer, 1993).

**Radiocarbon Dates: Huntington River**

Previous studies of alluvial fans (Zehfuss, 1996; Church, 1997) have begun to establish a chronology of landform development in the Huntington River Valley. Limiting ages are assigned to three river terraces on the basis of basal dates from four alluvial fans (Table 3.4). For this study, terrace deposits have been directly dated (Table 3.5): six samples from T6, and two samples from T5 (Figures 3.10, 3.12). There are two additional basal fan samples from T2.

The two dates from T2 are from two different organic-rich layers, possibly paleosols, buried beneath an alluvial fan. The ages for these horizons are 1830 cal yr B.P. for the older horizon, 3.6 m below the fan surface and 1804-1760 cal yr B.P. for the younger horizon, 2.3 m below the fan surface. These ages constrain the age of T2 because T2 must have been present as a surface by 1830 cal yr B.P. to receive the deposition from the fan that separates these two horizons. When compared with the date of 2708-2402 cal yr B.P. (Zehfuss, 1996) from wood in point bar sands below a second fan built on T2 just upstream, it appears that these dates demonstrate the time-transgressive nature of river deposits. The age of this terrace is interpreted to be at least 2402 cal yr B.P.

The samples from T5 and T6 have a wide range of ages. The range of ages in T5 is 3471 cal yr B.P. for a sample 0.33 m below the surface to 8424 cal yr B.P. for a sample 0.75 m below the surface, at the base of the overbank deposits. In T6, the age range is even larger. The highest sample, 0.33 m below the surface, has an age of 1706 cal yr B.P., the lowest sample, 0.55 m below the surface, has an age of 4408 cal yr B.P., and the oldest sample, 0.46 m below the surface, has an age of 9210 cal yr B.P.

All dates represent limiting ages. The samples could be from charcoal that

was once sitting on the surface and subsequently was stirred in to the overbank deposits from biological activity. Therefore, the age of the oldest sample implies that the overbank deposits must be at least that old for the charcoal to have been deposited there. Charcoal deposition by the river is not necessarily implied for the oldest samples in this interpretation because the same processes could have introduced both the younger and older samples in the overbank deposits. However, the proper age relationship between the limiting ages of T5 and T6 does not eliminate the possibility that the oldest samples were deposited by the river. Although there is plenty of evidence of soil stirring (root cast, animal burrows), there are no sedimentary structures to prove deposition by the river.

**Radiocarbon Dates: Mad River**

The AMS dates presented here (Table 3.6), from a trench on T4 (Figure 3.19), are the first radiocarbon dates from the Mad River Valley. The three dates are from samples taken at about the same depth from overbank deposits in the same part of the trench. The ages are in close agreement, ranging from 11,837 to 11,138 cal yr B.P.

Although these may be samples that have been stirred in by biological activity, the similarity in age may point toward these samples being deposited directly by the river. However, there is no sedimentological evidence to support charcoal deposition by the river as the samples were removed from massive overbank deposits. Therefore, these dates must be considered limiting ages and are interpreted to mean that T4 had formed by 11,138 cal yr B.P.

Table 3.6: Mad River Terrace Radiocarbon Ages

| Terrace | Sample# | CAMS# | Material | Depth (m) | $^{14}C$ Age | Calibrated Date (yr B.P.) | 1 Sigma Range (yr B.P.) | 2 Sigma Range (yr B.P.) |
|---|---|---|---|---|---|---|---|---|
| T5 | TW12 | 30357 | Charcoal | 0.63 | 10150±80 | 11837 | 12069-11265 | 12238-11083 |
| T5 | TW10 | 30355 | Charcoal | 0.68 | 10030±100 | 11330, 11294, 11250, 11248, 11217, 11171, 11138 | 11830-11007 | 12097-10994 |
| T5 | TW11 | 30356 | Charcoal | 0.70 | 10030±60 | 11330, 11294, 11250, 11248, 11217, 11171, 11138 | 11730-11045 | 11970-11002 |

Note: Locations of radiocarbon samples are shown on Figure 3.25. Calibration using CALIB 3.0.3A (Stuvier and Reimer, 1993).

# CHAPTER 4: RESULTS AND CALCULATIONS

## DATED TERRACE CHRONOLOGY

The dated terrace chronologies are derived for each valley by combining the relative chronology presented in the longitudinal profiles (Figures 3.3, 3.5, and 3.7) with the limiting ages of terrraces and alluvial fans (Tables 3.1-3.3) and the ages of dated baselevels (Table 2.5). The dated terrace chronology is best constrained for the Huntington Valley due to the abundance of dated landforms, but the terrace ages can be estimated for the other valleys as well. The Huntington River Valley chronology is carried to the other valleys as a first-order approach using the assumption that the processes responsible for the terraces in the Huntington may also have led to terrace development in the other valleys. The validity of this assumption is evaluated below where the chronology for each valley is discussed independently.

### Terrace Chronology: Huntington River Valley

To construct the Huntington River Valley terrace chronology, the data are compiled in Table 4.1. The baselevel, terrace, and fan ages previously presented are assigned to the terraces correlated in the longitudinal profile.

*Baselevel Ages* The three highest terraces, T10-T8, are correlated based on the terrace elevations to the three highest baselevels in the lower part of the Huntington Valley, Lakes Huntington, Mansfield II, and Coveville. Lake Coveville is estimated to have expanded into the Winooski Drainage Basin by 12,700 $^{14}C$ yr B.P. and the other two baselevels are estimated each to span about 100 $^{14}C$ yrs (Table 2.5). Lakes Fort Ann I and II are correlated with T7 and T6, respectively, based on the assumed mutuality of the baselevel and terrace records. In addition, the difference in elevation between Lakes Fort

Tabel 4.1 Huntington River Terrace Chronology

| Terrace | Baselevel | Baselevel Age ($^{14}$C ky B.P.)* | Fan/Terrace Age ($^{14}$C ky B.P.)† | Age ($^{14}$C ky B.P.) |
|---|---|---|---|---|
| T10 | Lake Huntington | 13.0-12.8 | - | 13.0-12.8 |
| T9 | Lake Mansfield II | 12.8-12.7 | - | 12.8-12.7 |
| T8 | Lake Coveville | 12.7-12.6 | - | 12.7-12.6 |
| T7 | Lake Fort Ann I | 12.6-12.2 | - | 12.6-12.2 |
| T6 | Lake Fort Ann II | 12.2-11.7 | >8.2 | 12.2-11.7 |
| T5 | Upper Marine | <11.7 | 8.5-7.8 | 11.7-7.8 |
| T4 | Local Knickpoints | - | <7.8 | 7.8-5.2(?) |
| T3 | Local Knickpoints | - | >2.5 | 5.2(?)-2.5 |
| T2 | Local Knickpoints | - | 2.5-1.8 | 2.5-0.2 |
| T1 | Local Knickpoints | - | <0.10 | 0.2-Today |

* Dates from Table 2.5

† Dates from Tables 3.4 and 3.5

Ann I and II is relatively small and the amount of incision between T7 and T6 is small. T5 formed after Lake Fort Ann II.

*Radiocarbon Ages* Radiocarbon-dated deposits from T6, T5, T2, and T1 constrain the ages of the those terraces. The age of >8200 $^{14}$C yr B.P. for T6 is consistent with assigning T6 to Lake Fort Ann II. The oldest basal fan age and the terrace deposit age from T5 suggest that T5 was present by 8500 $^{14}$C yr B.P. and limit the formation of T4 to after 7800 $^{14}$C yr B.P. The basal fan age of 2500 $^{14}$C yr B.P. from T2 implies that T3 was formed before then and the basal fan age of <100 $^{14}$C yr B.P. points to T1 being of historic age.

*Other Ages* Presently there is no constraint on when T4/T3 incision took place. The estimated age of 5200 $^{14}$C yr B.P. is simply the median age between the two limiting radiocarbon ages.

**Terrace Chronology: Little River Valley**

To construct the Little River Valley terrace chronology, the data are compiled in Table 4.2. The baselevel ages previously presented are assigned to the terraces correlated in the longitudinal profile. Since no radiocarbon dates were obtained from the Little River Valley, the Huntington River terrace chronology is used to assign the ages of the youngest terraces.

*Baselevel Ages* The highest three terraces in the Little River Valley (T9-T7) have been correlated with Lakes Mansfield I, Mansfield II, Coveville based on elevation. The next three terraces, T6 and T5A/B, are assigned to Lakes Fort Ann I and II. The age of T4 is interpretted as younger than Lake Fort Ann II.

*Other Ages* The lower limiting age of T5 and the upper limiting age of T2 in the Huntington Valley mark the ending and beginning respectively of synchronous fan and terrace formation. Although there is no evidence to suggest that the Little River Valley responded to the same forcings which initiated landform development in the Huntington Valley before 7800 and after 2500 $^{14}C$ yr B.P., it is likely that the hillslope and river systems in the Little River Basin would have responded similarly if the forcings were regional in scale, like climate changes. Therefore these ages are used to bracket the formation of T4-T2 in the Little River Valley. T1 is assumed to be formed during historical times as it was in the Huntington River Valley.

Table 4.2: Little River Terrace Chronology

| Terrace | Baselevel | Baselevel Age ($^{14}$C ky B.P.)* | Age ($^{14}$C ky B.P.) |
|---|---|---|---|
| T9 | Lake Mansfield I | 12.9-12.8 | 12.9-12.8 |
| T8 | Lake Mansfield II | 12.8-12.7 | 12.8-12.7 |
| T7 | Lake Coveville | 12.7-12.6 | 12.7-12.6 |
| T6 | Lake Fort Ann I | 12.6-12.2 | 12.6-12.2 |
| T5A, 5B | Lake Fort Ann II | 12.2-11.7 | 12.2-11.7 |
| T4 | Upper Marine | <11.7 | 11.7-7.8 |
| T3 | Local Knickpoints | - | 7.8-2.5 ¥ |
| T2 | Local Knickpoints | - | 2.5-0.2 ¥ |
| T1 | Local Knickpoints | - | 0.2-Today ¥ |

* Dates from Table 2.5

¥ Dates extended from Huntington Valley, Table 4.1

**Terrace Chronology: Mad RiverValley**

*Baselevel Ages* The baselevels assigned to the Mad River Valley terraces are based on correlated elevations as in the other valleys (Table 4.3). Beginning with Lake Winooski and T9, the baselevels and terraces are correlated through Lake Fort Ann I. One difference between the Mad and the other valleys is no terrace is attributable to Lake Fort Ann II. As the Mad Valley is farther away from the Fort Ann shorelines and the amount of incision between the two levels is low, it is possible that the incision never propagated to the Mad River Valley. Therefore, T5 in the Mad River Valley is assumed to represent both levels and was formed between 12,600 and 11,700 $^{14}C$ yr B.P. T4 was formed sometime later.

*Radiocarbon Ages* The T4 terrace is the only dated landform in the Mad River Valley. The limiting age of 10,100 $^{14}C$ yr B.P. is consistent with T4 being formed after 11,700 $^{14}C$ yr B.P.

*Other Ages* The Huntington River Valley fan and terrace ages are again used to place limiting ages on the terraces after T5 in the Mad River based on the assumption that the same regional forcings caused terrace formation at the same time. Since the ages of post-baselevel terraces from the Huntington River Valley are extended to both the Mad and Little River terraces, both valleys appear to have identical chronologies during the Holocene. However, both chronologies are unconstrained by radiocarbon ages and therefore, the similarity of terrace ages among the three valleys is an untested correlation.

Table 4.3: Mad River Terrace Chronology

| Terrace | Baselevel | Baselevel Age ($^{14}$C ky B.P.)* | Terrace Age ($^{14}$C ky B.P.)† | Age ($^{14}$C ky B.P.) |
|---|---|---|---|---|
| T9 | Lake Winooski | 13.0-12.9 | - | 13.0-12.9 |
| T8 | Lake Mansfield I | 12.9-12.8 | - | 12.9-12.8 |
| T7 | Lake Mansfield II | 12.8-12.7 | - | 12.8-12.7 |
| T6 | Lake Coveville | 12.7-12.6 | - | 12.7-12.6 |
| T5 | Lake Fort Ann I | 12.6-12.2 | - | 12.6-12.2 |
| T5 | Lake Fort Ann II | 12.2-11.7 | - | 12.2-11.7 |
| T4 | Upper Marine | <11.7 | 10.1 | 11.7-10.1 |
| T3 | Local Knickpoints | - | - | 7.8-2.5 ¥ |
| T2 | Local Knickpoints | - | - | 2.5-0.2 ¥ |
| T1 | Local Knickpoints | - | - | 0.2-Today ¥ |

* Dates from Table 2.5

† Dates from Tables 3.6

¥ Dates extended from Huntington Valley, Table 4.1

## TERRACE GRADIENTS

The gradients of the terraces are calculated using the longitudinal profiles. Each river is divided into reaches based on the orientation of the profile, the location of knickpoints, and similar geomorphic criteria. A best-fit line is drawn through the plotted elevations of the terraces within a reach (Figure 4.1) and the slope of that line defines the present terrace gradient for that reach. The accuracy of the measured gradients for each reach depends on the number of survey locations within the reach; the line is better constrained with more survey locations. Each best-fit line had a correlation coefficient ($R^2$) value above 0.9, suggesting that gradient of the terraces within a reach can be defined reasonably by a line. The present gradients are presented for the Huntington and Mad Rivers below.

The present terrace gradient has been deformed from its original gradient because river terraces are tilted with the rest of the land during glacio-isostatic rebound. Therefore to define the initial gradient of the river, the terrace gradients must be retrodeformed using previously published estimates of the magnitude and timing of tilting in the Champlain Basin. From the ages and present gradients of the terraces and the rate of glacio-isostatic rebound, an initial gradient can be estimated. As noted before, the Winooski Drainage Basin lies between two areas where the gradient of the maximum tilt plane has been measured: the Champlain Valley (Chapman, 1937) and the Connecticut Valley (Koteff and Larsen, 1989). The magnitude of the tilt plane decreased through time as the rate of rebound decreased; therefore younger terraces were tilted less. I have tried to correct for glacio-isostatic tilting by using the exponential decay model I presented in Chapter 2 to determine the magnitude of tilting that would have occured since the end of the time period

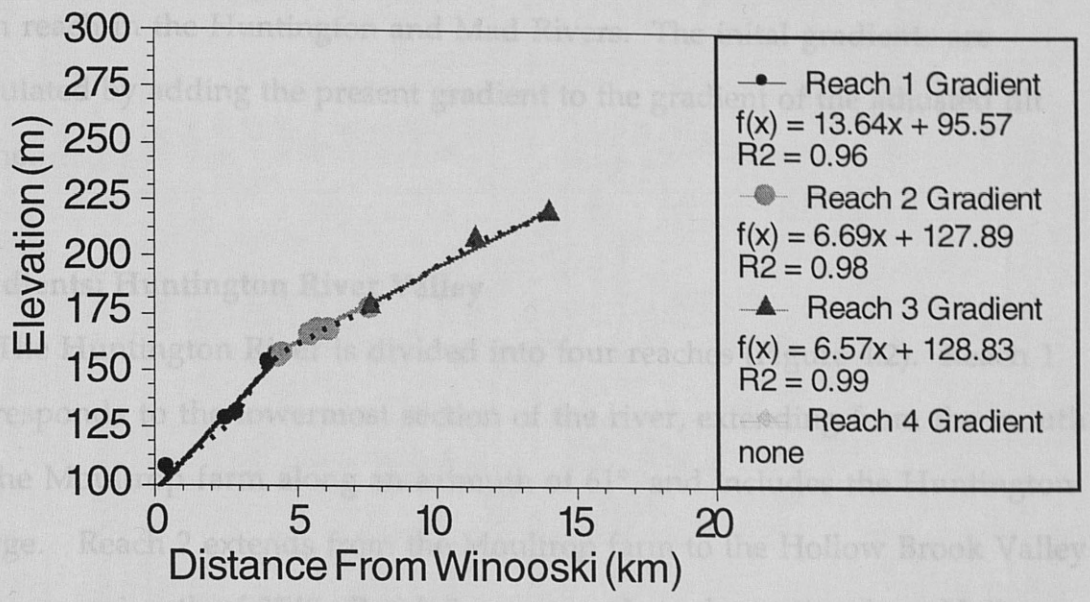



Figure 4.1: Example of Best-fit Lines for Terrace Elevations. Best-fit lines of terrace elevations are generated for esch reach. The slope of the line is the terrace gradient. The dotted line is the terrace elevations from the longitudinal profile.

when a terrace was formed. The magnitude of tilting is reported for both the Chapman (1937) and Koteff and Larsen (1989) tilt planes in the orientation of each reach in the Huntington and Mad Rivers. The inital gradients are calculated by adding the present gradient to the gradient of the adjusted tilt plane.

**Gradients: Huntington River Valley**

The Huntington River is divided into four reaches (Figure 4.2). Reach 1 corresponds to the lowermost section of the river, extending from the mouth to the Moultrop farm along an azimuth of 61°, and includes the Huntington Gorge. Reach 2 extends from the Moultrop farm to the Hollow Brook Valley along an azimuth of 354°. Reach 3 corresponds to the section from Hollow Brook to HR4, and Reach 4 continues from there to the HR3, comprising the steepest section of the river.

The Huntington Valley terrace gradients are reported in Table 4.4 and in Figure 4.3. The present river gradient is steepest in Reach 4. The river gradient in Reaches 2 and 3 is nearly identical. Since the formation of T10, the terrace gradients have progressively became steeper in Reaches 1, 2, and 4, while the gradient in Reach 3 has changed very little. When the gradients are plotted versus time (Figure 4.4), it appears that initially the gradient changed rapidly and although the gradient has continued increase toward the present, the rate of change is slower.

The shape of the curve in Figure 4.4 is similar to exponential decay and at first glance may appear to be a function of glacio-isostatic rebound. This premise can be tested by examining the corrected gradients. If the magnitude of the gradient change were similar to the magnitude of glacio-isostatic

Table 4.4: Huntington Valley Terrace Gradients

| Terrace | Reach 1: N61E | | | | | Reach 2: N6W | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Chapman (1937) | | Koteff and Larsen (1989) | | | Chapman (1937) | | Koteff and Larsen (1989) | |
| | Gradient (m/km) | Tilt Plane (m/km) | Initial Gradient (m/km) | Tilt Plane (m/km) | Initial Gradient (m/km) | Gradient (m/km) | Tilt Plane (m/km) | Initial Gradient (m/km) | Tilt Plane (m/km) | Initial Gradient (m/km) |
| 10 | - | - | - | - | - | -0.94 | 0.94 | 0.00 | 0.86 | -0.08 |
| 9 | -0.25 | 0.24 | -0.01 | 0.12 | -0.13 | -0.67 | 0.92 | 0.25 | 0.84 | 0.17 |
| 8 | 0.70 | 0.21 | 0.91 | 0.11 | 0.81 | 1.77 | 0.82 | 2.59 | 0.75 | 2.52 |
| 7 | 6.68 | 0.19 | 6.87 | 0.09 | 6.77 | 3.01 | 0.71 | 3.72 | 0.65 | 3.66 |
| 6 | 8.06 | 0.14 | 8.20 | 0.07 | 8.13 | 3.33 | 0.53 | 3.86 | 0.49 | 3.82 |
| 5 | 10.53 | 0.10 | 10.63 | 0.05 | 10.58 | 5.21 | 0.37 | 5.58 | 0.33 | 5.54 |
| 4 | 11.82 | 0.00 | 11.82 | 0.00 | 11.82 | 5.98 | 0.01 | 5.99 | 0.01 | 5.99 |
| 3 | 13.21 | 0.00 | 13.21 | 0.00 | 13.21 | 6.47 | 0.01 | 6.48 | 0.01 | 6.48 |
| 2 | 13.64 | 0.00 | 13.64 | 0.00 | 13.64 | 6.69 | 0.00 | 6.69 | 0.00 | 6.69 |
| 1 | - | - | - | - | - | 7.46 | 0.00 | 7.46 | 0.00 | 7.46 |
| River | 14.30 | 0.00 | 14.30 | 0.00 | 14.30 | 6.92 | 0.00 | 6.92 | 0.00 | 6.92 |

| Terrace | Reach 3: N6W | | | | | Reach 4: N6W | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Chapman (1937) | | Koteff and Larsen (1989) | | | Chapman (1937) | | Koteff and Larsen (1989) | |
| | Gradient (m/km) | Tilt Plane (m/km) | Initial Gradient (m/km) | Tilt Plane (m/km) | Initial Gradient (m/km) | Gradient (m/km) | Tilt Plane (m/km) | Initial Gradient (m/km) | Tilt Plane (m/km) | Initial Gradient (m/km) |
| 10 | 6.65 | 0.94 | 7.59 | 0.86 | 7.51 | 18.62 | 0.94 | 19.56 | 0.86 | 19.48 |
| 9 | 7.17 | 0.92 | 8.09 | 0.84 | 8.01 | 17.66 | 0.92 | 18.58 | 0.84 | 18.50 |
| 8 | 6.70 | 0.82 | 7.52 | 0.75 | 7.45 | - | - | - | - | - |
| 7 | 6.98 | 0.71 | 7.69 | 0.65 | 7.63 | - | - | - | - | - |
| 6 | 6.43 | 0.53 | 6.96 | 0.49 | 6.92 | - | - | - | - | - |
| 5 | - | - | - | - | - | - | - | - | - | - |
| 4 | - | - | - | - | - | - | - | - | - | - |
| 3 | - | - | - | - | - | - | - | - | - | - |
| 2 | 6.57 | 0.00 | 6.57 | 0.00 | 6.57 | - | - | - | - | - |
| 1 | 6.42 | 0.00 | 6.42 | 0.00 | 6.42 | 19.06 | 0.00 | 19.06 | 0.00 | 19.06 |
| River | 6.50 | 0.00 | 6.50 | 0.00 | 6.50 | 20.42 | 0.00 | 20.42 | 0.00 | 20.42 |

Notes: Gradient is measured for each terrace in each reach. Initial gradient is calculated for each terrace in each reach based on the magnitude of rebound at time of terrace formation in the direction of the reach using Chapman (1937) and Koteff and Larsen (1989) tilt planes (Table 2.6) and rebound model in Appendix A.

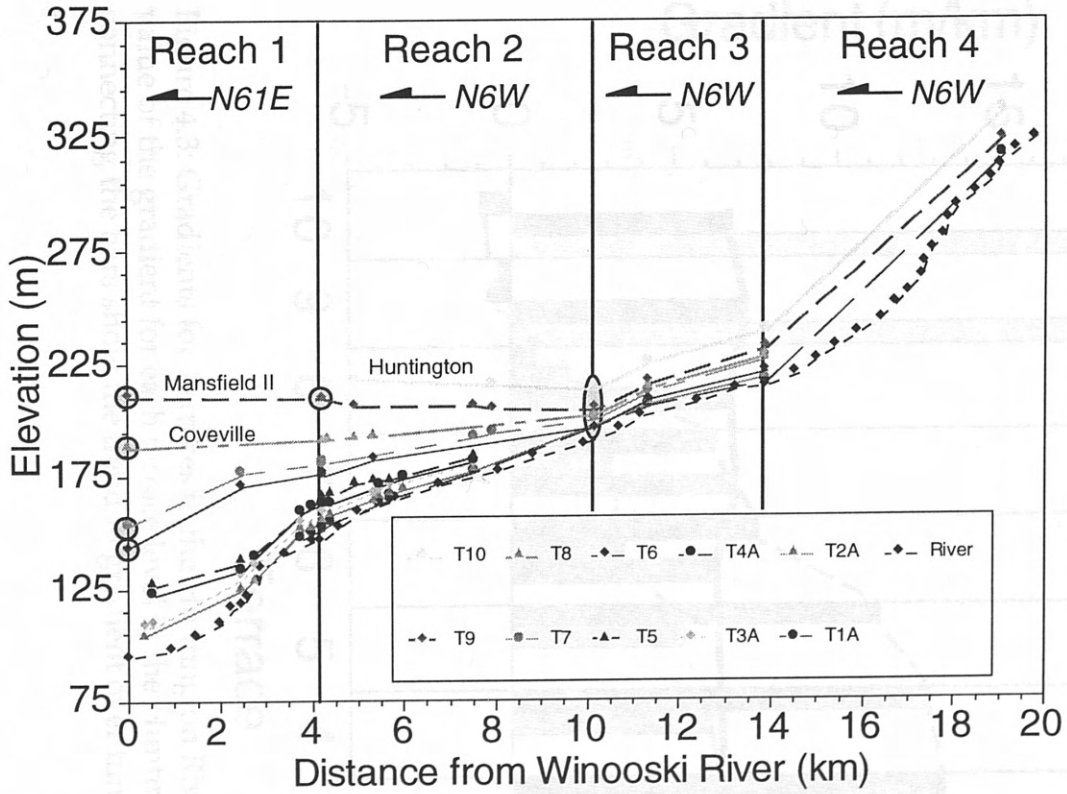



Figure 4.2: Reaches of the Huntington River. Terrace gradients are computed for each reach and presented in Table 4.4.

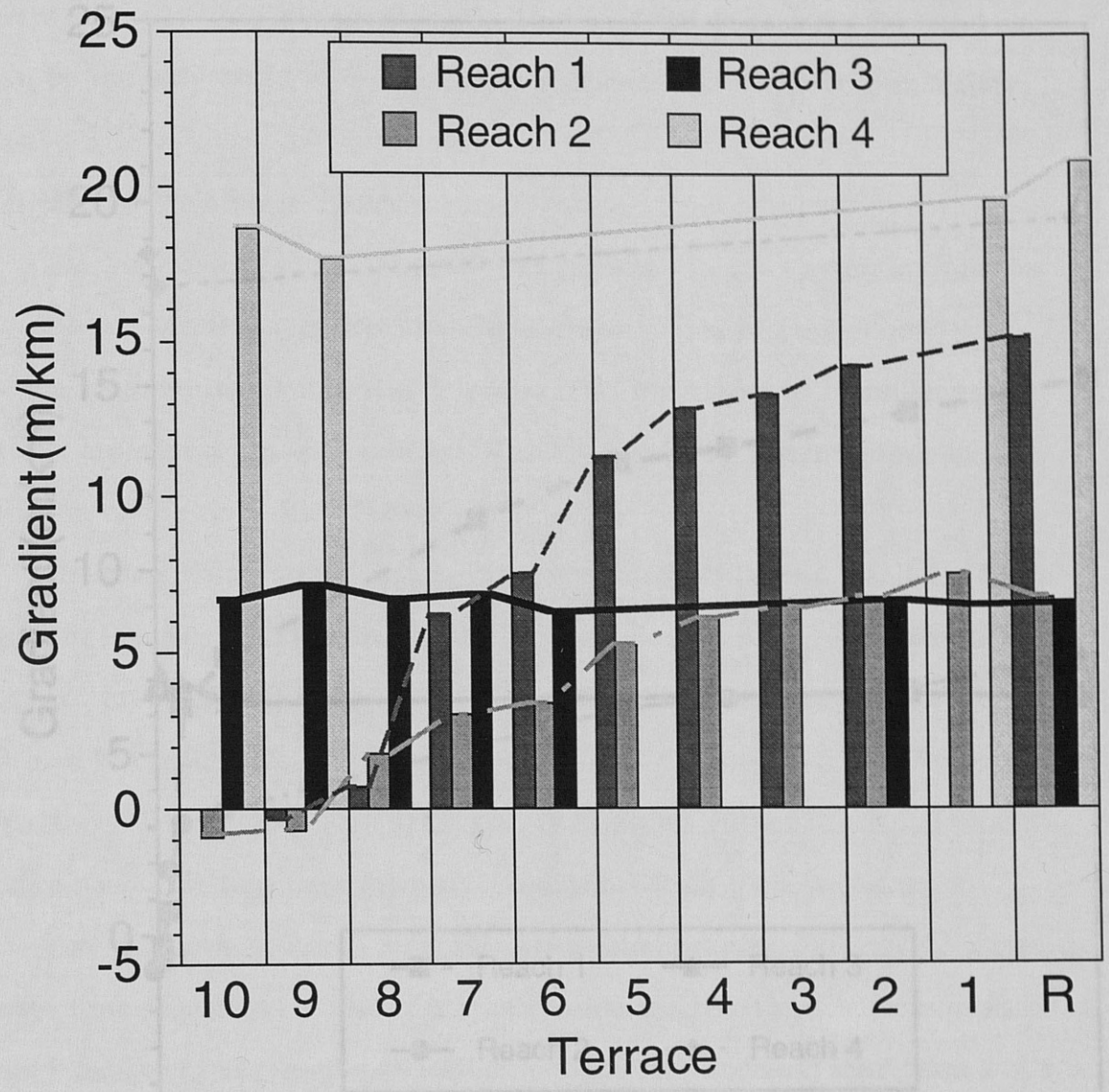



Figure 4.3: Gradients for Terraces in the Huntington River. The bars show the value of the gradient for each terrace level in the Huntington River. The lines connecting the bars show the trend in gradient over time.

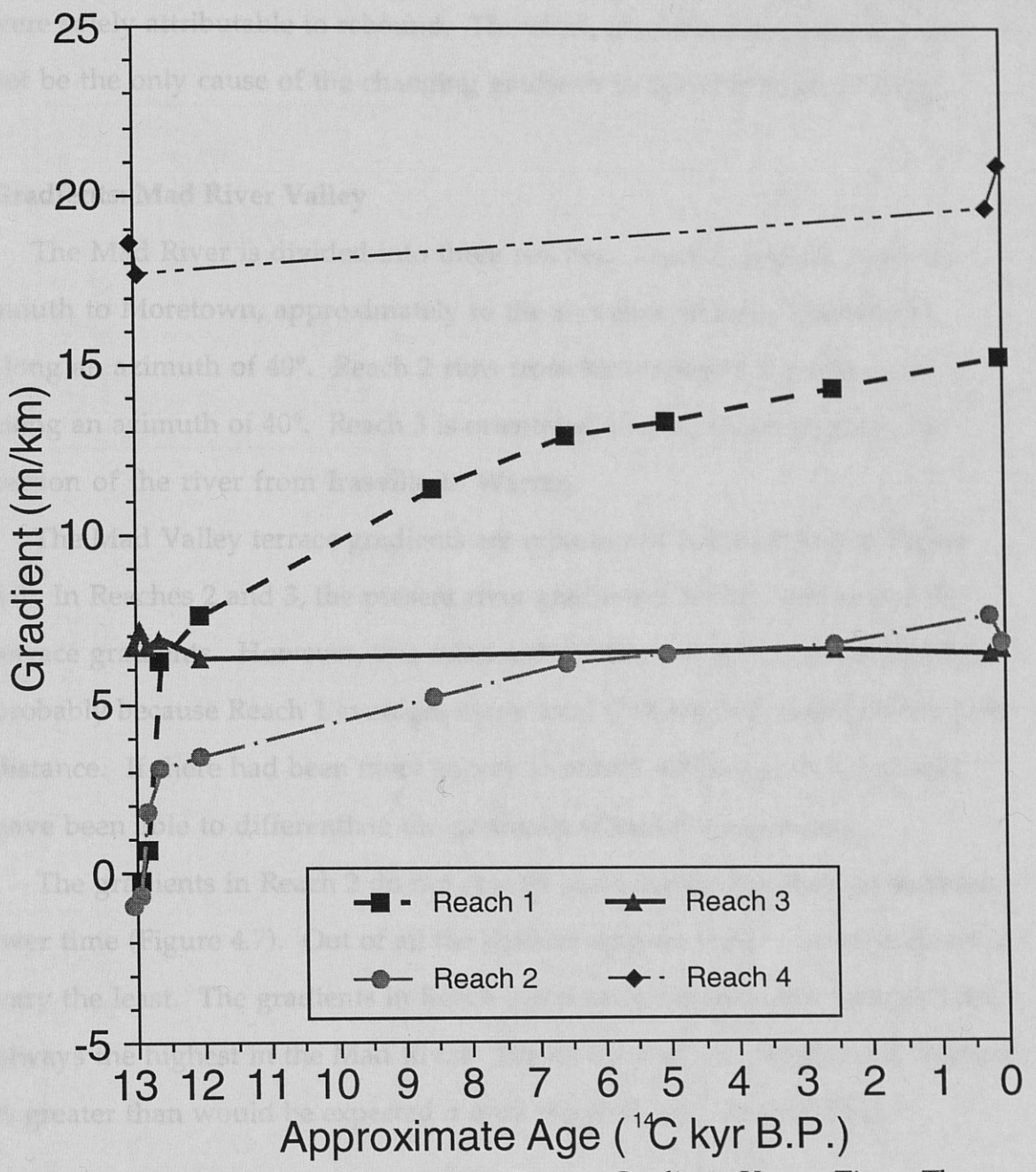



Figure 4.4: Graph of Huntington River Terrace Gradients Versus Time. The gradients for each reach are plotted by their approximate age.

rebound, then there might be a valid correlation. However, the change in gradient is often several times greater than would be expected if the change were solely attributable to rebound. Therefore, glacio-isostatic rebound can not be the only cause of the changing gradients in the Huntington Valley.

**Gradients: Mad River Valley**

The Mad River is divided into three reaches. Reach 1 extends from the mouth to Moretown, approximately to the shoreline of Lake Mansfield I, along an azimuth of 40°. Reach 2 runs from Moretown to Irasville, again along an azimuth of 40°. Reach 3 is orientated 10° and corresponds to the section of the river from Irasville to Warren.

The Mad Valley terrace gradients are reported in Table 4.5 and in Figure 4.6. In Reaches 2 and 3, the present river gradient is higher than any of the terrace gradients. However, this relationship does not hold true for Reach 1, probably because Reach 1 averages many local changes in gradient over a long distance. If there had been more survey locations within Reach 1, I would have been able to differentiate the gradients within these sections.

The gradients in Reach 2 do not change significantly, but they do increase over time (Figure 4.7). Out of all the studied reaches, the gradients in Reach 2 vary the least. The gradients in Reach 3 generally increase over time and are always the highest in the Mad River. For all the reaches, the gradient increase is greater than would be expected if only rebound were responsible.

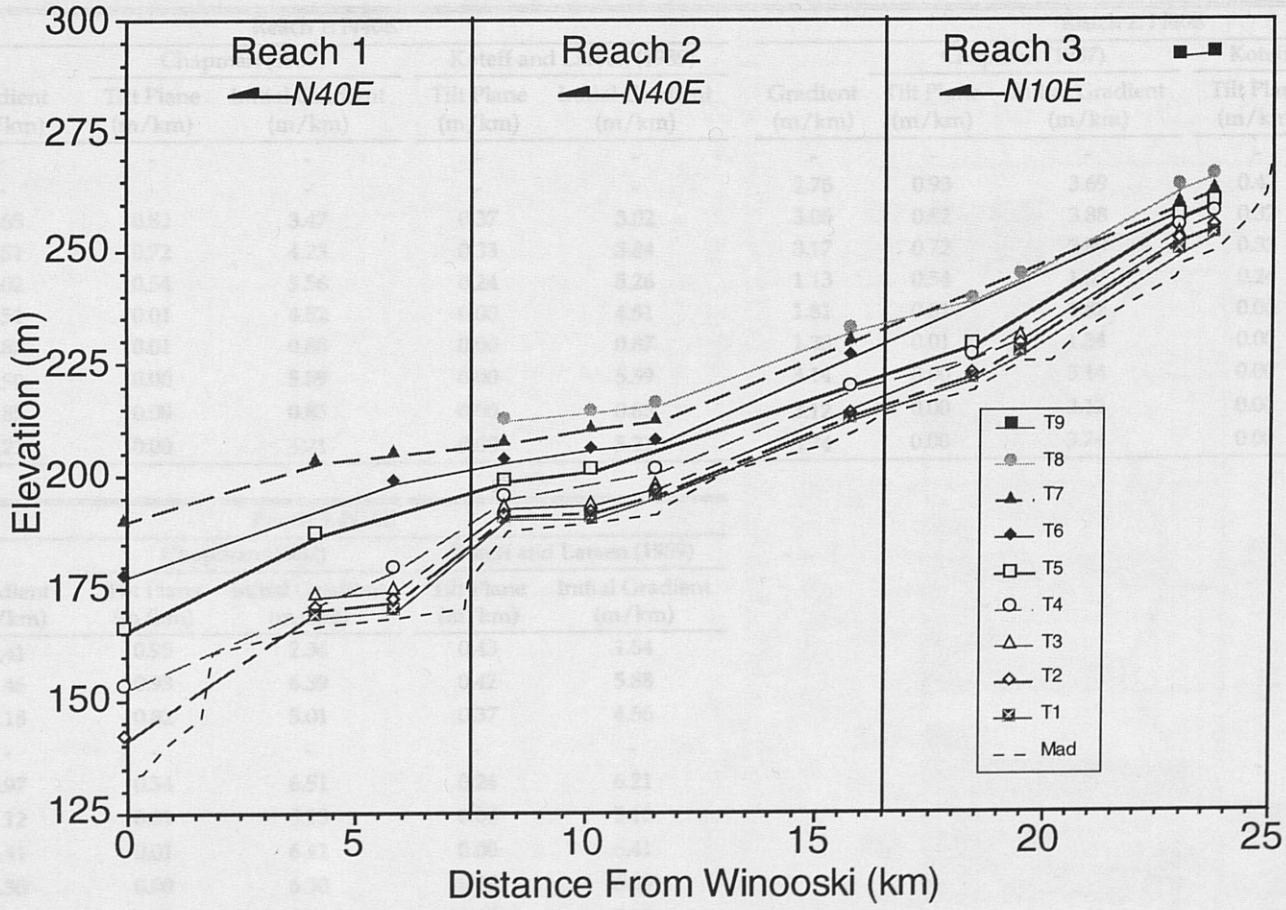



Figure 4.5: Reaches of the Mad River. The terrace gradients computed for each reach are presented in Table 4.5.

Table 4.5: Mad Valley Terrace Gradients

| Terrace | Reach 1: N40E | | | | | Reach 2: N40E | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Chapman (1937) | | Koteff and Larsen (1989) | | | Chapman (1937) | | Koteff and Larsen (1989) | |
| | Gradient (m/km) | Tilt Plane (m/km) | Initial Gradient (m/km) | Tilt Plane (m/km) | Initial Gradient (m/km) | Gradient (m/km) | Tilt Plane (m/km) | Initial Gradient (m/km) | Tilt Plane (m/km) | Initial Gradient (m/km) |
| 9 | - | - | - | - | - | - | - | - | - | - |
| 8 | - | - | - | - | - | 2.76 | 0.93 | 3.69 | 0.42 | 3.18 |
| 7 | 2.65 | 0.82 | 3.47 | 0.37 | 3.02 | 3.06 | 0.82 | 3.88 | 0.37 | 3.43 |
| 6 | 3.51 | 0.72 | 4.23 | 0.33 | 3.84 | 3.17 | 0.72 | 3.89 | 0.33 | 3.50 |
| 5 | 5.02 | 0.54 | 5.56 | 0.24 | 5.26 | 1.13 | 0.54 | 1.67 | 0.24 | 1.37 |
| 4 | 4.51 | 0.01 | 4.52 | 0.00 | 4.51 | 1.81 | 0.01 | 1.82 | 0.00 | 1.81 |
| 3 | 0.87 | 0.01 | 0.88 | 0.00 | 0.87 | 1.33 | 0.01 | 1.34 | 0.00 | 1.33 |
| 2 | 5.59 | 0.00 | 5.59 | 0.00 | 5.59 | 3.14 | 0.00 | 3.14 | 0.00 | 3.14 |
| 1 | 0.85 | 0.00 | 0.85 | 0.00 | 0.85 | 3.12 | 0.00 | 3.12 | 0.00 | 3.12 |
| River | 5.21 | 0.00 | 5.21 | 0.00 | 5.21 | 3.74 | 0.00 | 3.74 | 0.00 | 3.74 |

| Terrace | Reach 3: N10E | | | | |
|---|---|---|---|---|---|
| | | Chapman (1937) | | Koteff and Larsen (1989) | |
| | Gradient (m/km) | Tilt Plane (m/km) | Initial Gradient (m/km) | Tilt Plane (m/km) | Initial Gradient (m/km) |
| 9 | 1.41 | 0.95 | 2.36 | 0.43 | 1.84 |
| 8 | 5.46 | 0.93 | 6.39 | 0.42 | 5.88 |
| 7 | 4.18 | 0.82 | 5.01 | 0.37 | 4.56 |
| 6 | - | - | - | - | - |
| 5 | 5.97 | 0.54 | 6.51 | 0.24 | 6.21 |
| 4 | 5.12 | 0.01 | 5.13 | 0.00 | 5.12 |
| 3 | 6.41 | 0.01 | 6.42 | 0.00 | 6.41 |
| 2 | 6.30 | 0.00 | 6.30 | 0.00 | 6.30 |
| 1 | 6.12 | 0.00 | 6.12 | 0.00 | 6.12 |
| River | 7.16 | 0.00 | 7.16 | 0.00 | 7.16 |

Notes: Gradient is measured for each terrace in each reach. Initial gradient is calculated for each terrace in each reach based on the magnitude of rebound at time of terrace formation in the direction of the reach using Chapman (1937) and Koteff and Larsen (1989) tilt planes (Table 2.6) and rebound model in Appendix A.

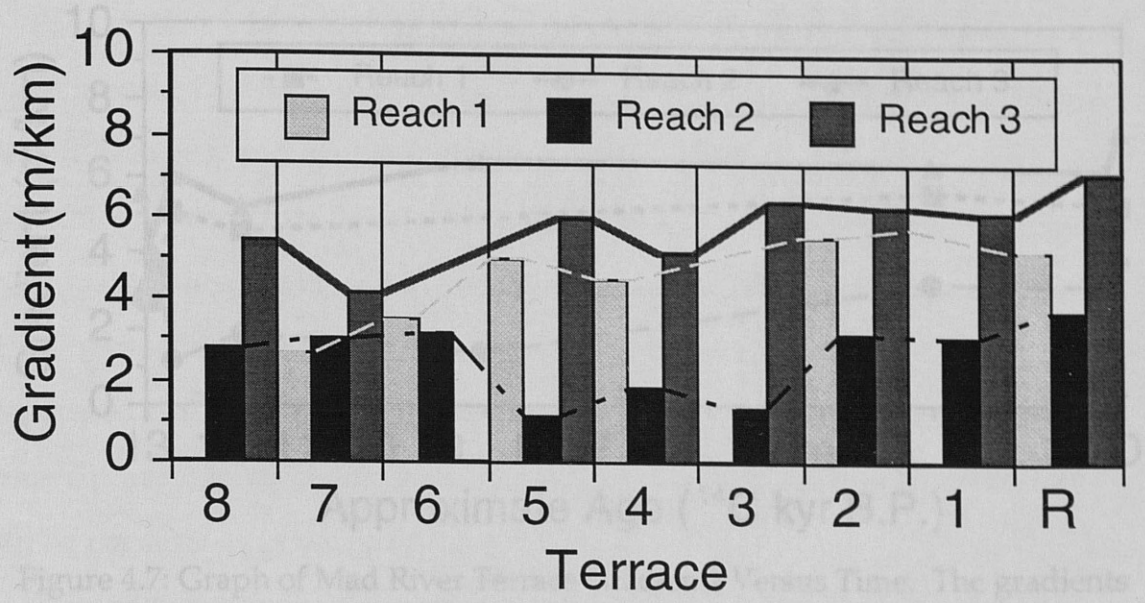



Figure 4.6: Gradients for Terraces in the Mad River.The bars show the value of the gradient for each terrace level in the Mad River. The lines connecting the bars show the trend in gradient over time.

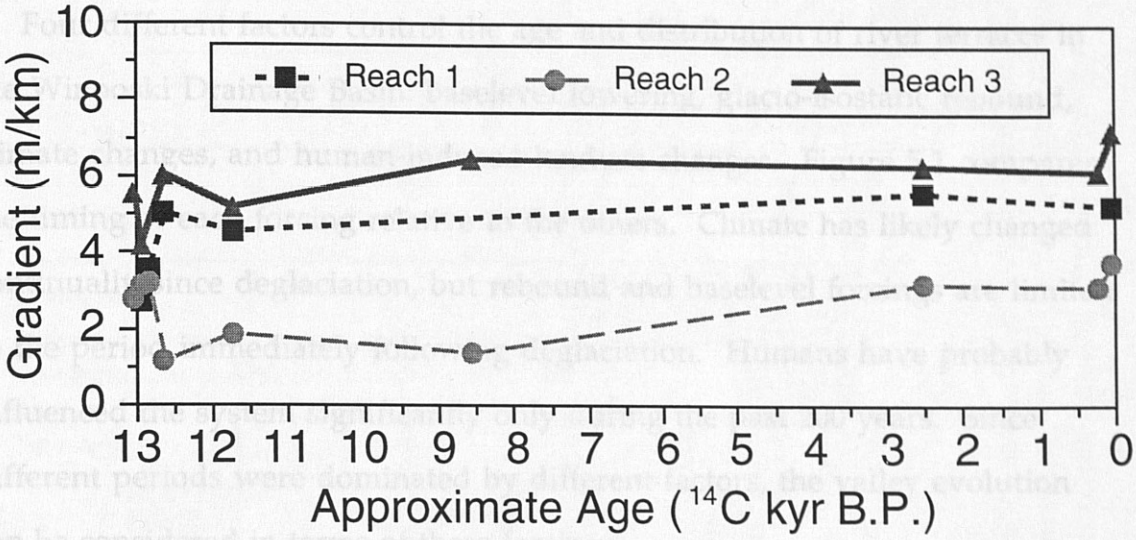



Figure 4.7: Graph of Mad River Terrace Gradients Versus Time. The gradients for each reach are plotted by their approximate age.

# CHAPTER 5: DISCUSSION

## TERRACE FORMATION IN THE WINOOSKI DRAINAGE BASIN

Four different factors control the age and distribution of river terraces in the Winooski Drainage Basin: baselevel lowering, glacio-isostatic rebound, climate changes, and human-induced landuse changes. Figure 5.1 compares the timing of each forcing relative to the others. Climate has likely changed continually since deglaciation, but rebound and baselevel forcings are limited to the period immediately following deglaciation. Humans have probably influenced the system significantly only during the past 200 years. Since different periods were dominated by different factors, the valley evolution can be considered in terms of these forcings.

Rebound rates were the highest during the period of many baselevel changes and several climate changes (Figure 5.1). Although tilting may have changed slightly the magnitude of present-day terrace gradients, it is an unlikely cause for incision because the baselevel changes associated with the lowering of proglacial lakes were episodic and essentially instaneous as ice withdrew and progressively lower spillways were exposed. The relatively slow rate of glacio-isostatic tilting, versus the instaneous baselevel changes, and the low magnitude of glacio-isostatic tilting, versus the higher magnitude of changes in terrace gradients over time, both point to baselevel controlling the timing of incision. When the proglacial lakes existed in the Winooski Drainage Basin, they formed basin-wide baselevels for the tributary rivers. During the Champlain Sea interval, the Winooski River was controlled by the ultimate baselevel, the ocean. Once Lake Champlain formed, it became the basin-wide baselevel for all the rivers in its basin. Glacio-isostatic rebound was in part responsible for baselevel changes, but from the

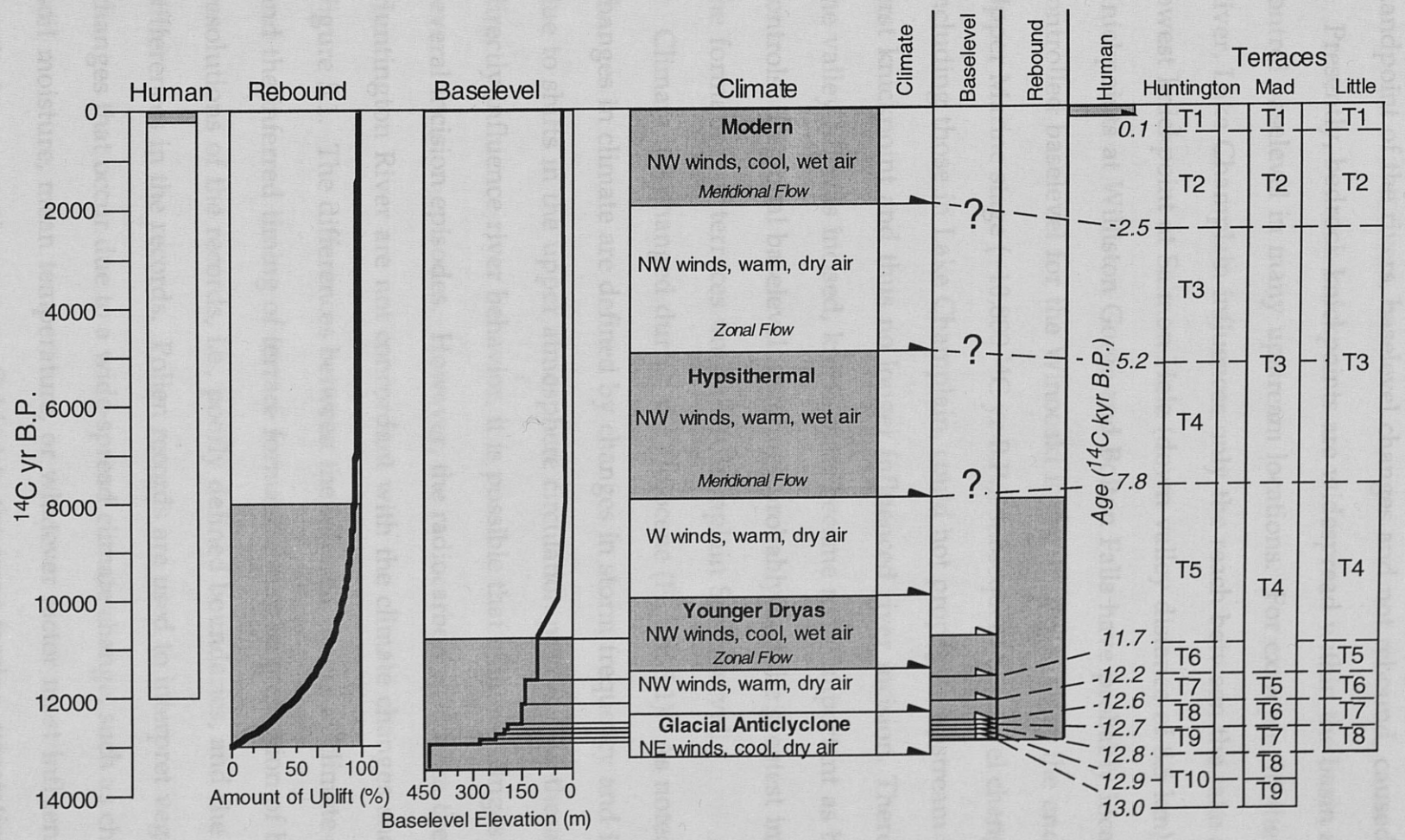



Figure 5.1: Comparision of Forcings on River Terrace Formation. Shown are the summary data complield from the previous research and the terrace chronologies. Shaded areas represent periods when a forcing would be dominant. Arrows show interpretted correlations between forcings and terrrace formation.

standpoint of the rivers, baselevel changes and not rebound, caused incision.

Presently, bedrock knickpoints are widespread within the basin and control baselevel in many upstream locations. For example, in the Winooski River, Lake Champlain influences only the reach between the lake and the lowest knickpoint at Salmon Hole (down-valley distance of 8.5 km). Knickpoints at Williston Gorge and Bolton Falls have probably locally controlled baselevel for the Winooski River upstream since the end of the Upper Marine stage (~10,800 $^{14}C$ yr B.P.); subsequent baselevel changes, including those in Lake Champlain, could not propagate upstream past the first knickpoint and thus no longer influenced river incision. Therefore, as the valley fill was incised, knickpoints became more important as baselevel controls. Regional baselevel lowerings probably had the greatest impact on the formation of terraces until the Champlain Sea interval.

Climate has changed during the Holocene (Figure 5.1). As noted earlier, changes in climate are defined by changes in storm frequency and intensity due to shifts in the upper atmosphere circulation pattern. As these changes directly influence river behavior, it is possible that climate changes triggered several incision episodes. However, the radiocarbon ages from the Huntington River are not concordant with the climate changes shown in Figure 5.1. The differences between the inferred timing of climate changes and the inferred timing of terrace formation may be a function of both the resolutions of the records, i.e., poorly defined boundaries, and the inherent differences in the records. Pollen records are used to interpret vegetation changes that occur due to a wide-spread climate change, such as changes in soil moisture, mean temperature, or whatever factor most influences the particular vegetation proxy. Subject to the same forcing, vegetation changes

may occur at a different time than terrace formation simply because the two different systems respond at different rates. The resolution of the climate and terrace records is such that this discrepancy can not be resolved.

The human influence is a potential factor since the first Native Americans settled northern New England after 11,000 $^{14}C$ yr B.P. (Bonnichsen et al., 1985). Native Americans living in the basin may have modified the land cover through the use of fire to keep open woodlands (Pyne, 1982). However, early human influence is probably minimal on a basin-wide scale, especially when compared to the Europeans. Therefore, significant human forcings are limited to the past 200 years.

## GENERAL MODEL FOR VALLEY EVOLUTION

The valley evolution occurred in 5 stages (Figure 5.2). Each stage is time transgressive and is defined by periods when specific depositional and erosional processes occur. However, the general valley evolution consists of late glacial deposition followed by Holocene erosion. During the first two stages the valley is filled with sediments and during the last three stages the sediments are periodically and episodically eroded from the valley, leaving terraces.

Several modes of deposition during the first two stages produced the valley fill. Actively retreating lobes of the Laurentide ice sheet are responsible for Late Glacial Stage deposition. Till and ice-contact deposits that mantle the glacially scoured bedrock valley walls form the foundation of the valley fill. The Proglacial Lake Stage begins with the transition to lacustrine deposition and ends with the transition to fluvial deposition. Deep water deposits of rhythmically bedded silt and clay and shallow water deposits of fine to coarse

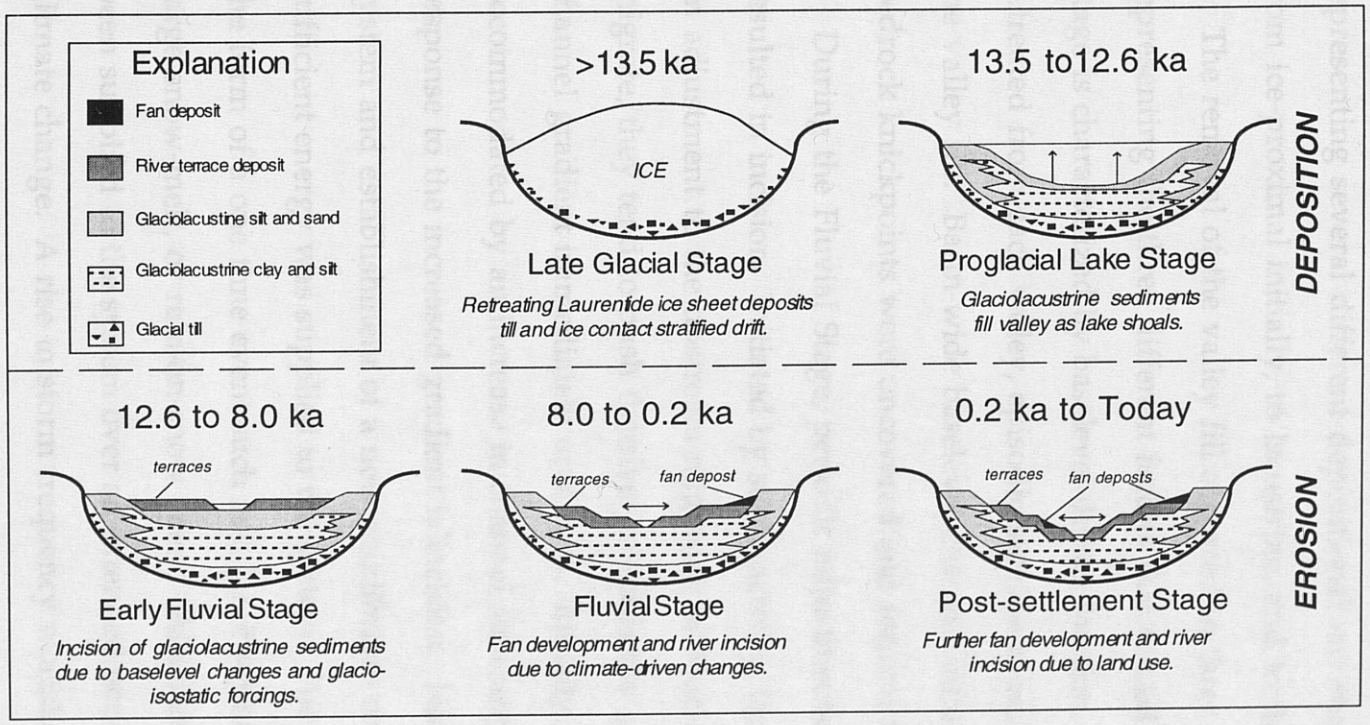



Figure 5.2: Schematic valley evolution. The evolution of the valley is represented by 5 stages. The Late Glacial and Proglacial Lake Stages are times of valley filling. Since Early fluvial times, incision has continually occurred. Ages are approximate, as the valley evolution is time-transgressive. (Modified from Church, 1997).

sand and gravel filled the valley. The highest extent of valley filling at a location occurred after the highest proglacial lake shoaled. At this point in time, fluvial processes capped the fill sequence with the first fluvial deposits. Therefore, the highest terrace in a valley is a composite fill terrace, representing several different depositional environments that may range from ice-proximal initially, to lacustrine, and to fluvial ultimately.

The removal of the valley fill occurred in three distinct stages, representing the three different factors that caused incision. The Early Fluvial Stage is characterized by baselevel-driven incision. As the proglacial lakes retreated from each valley, episodic incision removed significant portions of the valley fill. Basin-wide baselevel changes influenced the river until bedrock knickpoints were uncovered and formed the first local baselevels.

During the Fluvial Stage, periodic adjustments of fluvial behavior resulted in incision. Initiated by storm activity, incision occurred possibly as an adjustment to the upstream migration of knickpoints. As knickpoints migrate, they tend to push the river towards disequilibrium by steepening the channel gradient immediately upstream. Initially, the steeper gradient can be accommodated by an increase in channel sinuosity, but ultimately the likely response to the increased gradient is incision. However, adjustment of the system and establishment of a new equilibrium could only occur when sufficient energy was supplied to the system. The energy may have been in the form of a one time event such as a large storm, a local thunderstorm, a large snow-melt, or rain-on-snow event. Alternatively, the energy may have been supplied to the system over an extended period due to a large-scale climate change. A rise in storm frequency would increase the frequency of channel-modifying river discharges (Leopold and Wolman, 1957; Knox,1975),

altering the river dynamics until the system, including the hillslopes, vegetation, and river, adjusted to the new precipitation/runoff conditions.

The Post-settlement Stage represents the historic period of valley evolution, a time when humans have been the dominant forcing. Beginning in the 1700's, Europeans settling the area cleared land for pastures and crops, deforesting up to 80% of Vermont (Meeks, 1986). The response of the hillslopes to deforestation is well documented. All of the alluvial fans trenched by Church (1997) and Zehfuss (1996) were capped by 0.5 to 4 m of post-settlement sediment, implying that European land use mobilized hillslope sediment and lead to fan aggradation (Bierman et al., 1997). The response of the lower Winooski River during deforestation is documented by aggradation and an increase in river migration rates during the early 1800's (Thomas, 1985) and by the progradation of the delta (Severson, 1991).

As forests returned to the region during the later half of the 1800's, landslides along tributaries in the lower Winooski River stablized, evident by the age of trees growing on landslide scars (Baldwin et al., 1995; Bierman et al., 1997), the Winooski delta retreated (Severson, 1991), and the river incised the historic alluvium (Thomas, 1985). A similar river response, aggradation followed by incision, is reported for the lower Mississquoi River during historic times (Brakenridge et al., 1988). Therefore, since European settlement of the area, measurable hillslope and river activity coincided with changes in land use. If the amount of alluvial fan deposition is used as a proxy for the relative magnitude of hillslope activity and subsequent river activity, then river activity during historic times has been at least as great as during any time in the past 8500 $^{14}$C yrs (Church, 1997; Bierman, et al., 1997).

## GRADIENT

The gradient of the Huntington and Mad Rivers, represented by the present gradient of their terraces, changed since deglaciation (Figures 4.3 and 4.6). The valley evolution model provides the context in which to examine the mechanisms of gradient change and to propose possible longer term forcings on river gradients. The magnitude of gradient changes between terraces is significantly higher than would be expected if glacio-isostatic rebound were the only factor influencing river gradients. If the system were in steady-state equilibrium, then each incision event would return the system to its equilibrium gradient and the difference between today's gradient and the initial gradient would be the gradient of the glacio-isostatic tilt plane. Instead, terrace and therefore river gradients increase through time, punctuated by periods of temporary equilibrium that are represented by floodplain construction. Therefore, the river system is best described as being in meta-stable equilibrium. Meta-stable equilibrium implies that there is a larger, long-term forcing on the river's gradient in addition to the forcings identifiable on shorter time scales.

The increasing gradient with time of the Huntington and Mad Rivers is a direct result of the baselevel changes and knickpoint migration that dominated the Early Fluvial and Fluvial Stages. The close of the Proglacial Lake Stage marks the transition between lacustrine and fluvial processes. Initially, the river flowed atop the lacustrine fill terrace and the lake margin (the baselevel) was relatively close to the valley (if not within the valley). At this time, the river gradient was at its lowest in nearly every segment studied (Figures 4.3 and 4.6). As is shown schematically in Figure 5.3A, valley evolution during the Early Fluvial Stage is controlled by baselevel drops.

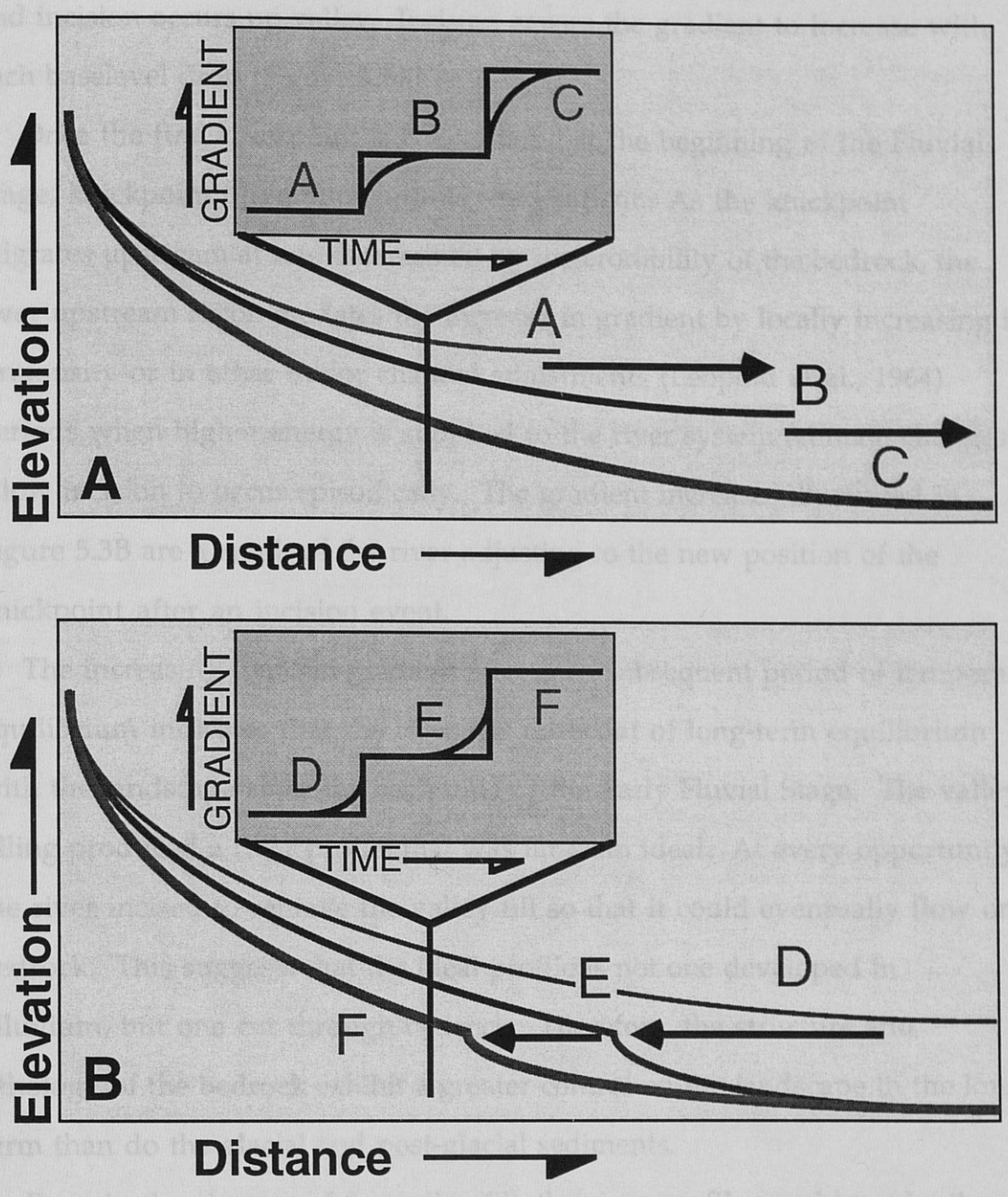



Figure 5.3: Schematic Graphs of Terrace Gradients over Time. The large graphs show the longitudinal profile of several terrace levels and the inset graphs show the change in gradient at a station. In A, the gradient increases over time due to baselevel changes. In B, the gradient increases over time due to upstream knickpoint migration. Once the knickpoint passes the station, the gradient will decrease.

With each subsequent baselevel change, the lake margin moves down valley and incision occurs up valley. Incision causes the gradient to increase with each baselevel drop (Figure 5.3A).

Once the first knickpoint is encountered at the beginning of the Fluvial Stage, knickpoint migration controls the gradient. As the knickpoint migrates upstream at rate determined by the erodibility of the bedrock, the river upstream accommodates the increase in gradient by locally increasing its sinuousity or in other minor channel adjustments (Leopold et al., 1964). Periods when higher energy is supplied to the river system (climate changes?) allow incision to occur episodically. The gradient increases illustrated in Figure 5.3B are a result of the river adjusting to the new position of the knickpoint after an incision event.

The increasing trend in gradient after each subsequent period of temporary equilibrium indicates that the river has been out of long-term equilibrium with the landscape since the beginning of the Early Fluvial Stage. The valley filling produced a river profile that was far from ideal. At every opportunity, the river incised to remove the valley fill so that it could eventually flow on bedrock. This suggests that the ideal profile is not one developed in alluvium, but one cut through bedrock. Therefore, the structure and lithology of the bedrock exhibit a greater control on the landscape in the long term than do the glacial and post-glacial sediments.

Even in the absence of the valley fill, the river profile would not be the smooth curve indicative of an ideal profile. There are multiple knickpoints presently exposed in each tributary as well as in the Winooski so that the valley floors of the tributaries lie at higher elevations than that of the main stem river. In order to achieve the ideal profile, the river requires not only

the removal of all of the valley fill, but also the removal of all bedrock knickpoints along its profile. Therefore, the initial fill terrace and fill-cut terraces that developed between periods of disequilbrium represent very transient steady-state equilibrium conditions. The entire system is moving towards strath development, with each fill-cut terrace signifying a step in the long-term meta-stable equilibrium. The alluvium-dominated system is moving toward a bedrock-controlled system.

## IMPLICATIONS OF TERRACE GRADIENTS IN GLACIATED REGIONS

River gradients change between each temporary period of steady-state equilibrium in the Winooski Drainage Basin, making the present terrace gradients unreliable indicators of tectonic tilting. Not only is there is no consistent initial gradient from which to calculate the tilt, but the magnitude of the gradient change over time (Tables 4.4 and 4.5) is significantly higher than the magnitude of glacio-isostatic rebound. This brings in to question the results of Treadwell and Knuepfer (1988) and Brakenridge et al. (1988) which interpret crustal movements based on terrace gradients and river channel elevation, respectively, in the Champlain Basin.

Treadwell and Knuepfer (1988) calculated recent tilt rates of the Adirondack Mountains using the measured gradients of post-glacial fluvial terraces in the Ausable River Valley, Champlain Basin. The deglacial history of the Ausable Valley is similar to that of the Winooski Drainage Basin; proglacial lakes developed in the north-flowing valley before the baselevel was controlled by proglacial lakes in the Champlain Valley. By assuming that the initial terrace gradient equaled the present river gradient, Treadwell and Knuepfer were able to calculate tilt rates comparable to those measured from

repeated geodetic surveys.

If the Ausable Valley evolution was similar to that in the Winooski Drainage Basin, then the results of Treadwell and Knuepfer are fortuitous rather than indicative of any recent tilt. It is likely that inital terrace gradients were not similar to that of the present river and that the change in gradient that they attribute to recent tilting is in fact controlled by baselevel changes and fluvial adjustments associated with climate changes. Although Treadwell and Knuefper (1988) imply that the terraces in formerly glaciated regions are sensitive to tectonic tilting, I would argue that one is not able to discern tilting from terrace gradients because the rivers' responses to longer term changes (metastable equilibrium) overpower the tectonic signal.

The conclusions of Brakenridge et al. (1988) are also questionable. Their study found that the long term incision rate of the Mississquoi River decreased by 8000 $^{14}$C yr B.P. They attributed the incision to the river's adjustments associated with glacio-isostatic rebound and concluded that this reach of the river was no longer incising by 8000 $^{14}$C yr B.P. because glacio-isostatic rebound had ended. The lake-level curves for Lake Champlain presented by Astley (1998) shows that tilting continued throughout the Holocene, decreasing to 0.046 m/km by 7500 $^{14}$C yr B.P. and 0.029 m/km by 2000 $^{14}$C yr B.P. The slow rate of tilt supports Brakenridge et al.'s assertion that rebound did not cause incision after 8000 $^{14}$C yr B.P. However, it does not prove that the more rapid initial uplift associated with glacio-isostatic rebound directly caused incision.

Based on my interpretation of the Winooski Draingae Basin terrace record, I would argue that the decrease in incision rate is due to knickpoint formation and the fact that the incision rate decreased at about the same time

that the rate of rebound significantly decreased is only a coincidence. Like the rivers in the Winooski Basin, the studied reach of the Mississquoi River would have initially incised as a response to baselevel lowerings, in this case the regressing Champlain Sea. Despite baselevel rising more than 4 m between 10,000 and 8000 $^{14}C$ yr B.P., after the initation of Lake Champlain (Astley, 1998), incision still occurred. While a rising baselevel during a period of incision strengthens the interpretion of Brakenridge et al. that vertical crustal movements were controlling incision, I suggest instead that incision proceeded because the post-glacial landscape was, and continues to be, out of equilibrium due to presence of glacial sediments. The rate of incision decreased when the downstream reach of the Missisquoi River encountered a resistant bedrock knickpoint at Highgate Falls.

In conclusion, glacio-isostatic and active tectonic movements do not appear to be discernible using river terracess as the indicator in the formerly glaciated Champlain Basin. The numerous baselevel lowerings caused the gradient to change so that initial river gradients can not be reliably inferred and once fill is removed, bedrock-dominated reaches control the gradient and long term incision rate. Therefore, it is unlikely that the studies of Treadwell and Knuefper (1988) and Brakenridge et al. (1988), which used inital gradients and long term incision rates, respectively, were able to indicate true crustal movements. All of the local studies of rivers, including my own, focused on higher-order reaches where rapid incision kept pace with baselevel changes to remove post-glacial fill. However, using higher-order reaches may introduce a sampling bias. Merritts and Vincent (1989) suggest that tectonic tilting is best recorded by first-order streams because they do not have sufficient stream power to respond to baselevel changes downstream. Perhaps any future

attempts at identifying and measuring tilting as recorded by rivers in the formerly glaciated Northeast should be centered on the low-order mountain streams.

## RELATIONSHIP BETWEEN ALLUVIAL FANS AND RIVER TERRACES

One question that has plagued the recent researchers in the Huntington Valley is: what controls the distribution of alluvial fans in space and through time? The oldest basal age obtained is approximately 8000 $^{14}C$ yr B.P. (Church, 1997) from a fan built on T5 while the youngest is < 100 $^{14}C$ yr B.P. (Zehfuss, 1996) from a fan built on T1. Fans are built on nearly every terrace below T5, but none have yet been found on the terraces above T5. The basal fan ages and the ages of terrace deposits are generally contemporary, suggesting that fan activity and terrace development occur during the same time periods rather than terraces predating the fans. Therefore, the same factors which lead to river incision, whether storms or human activities, might be responsible for initiation of fan activity.

In order to evaluate the assumption that river incision and fan deposition are triggered by the same factors, the question as to why there are no fans on terraces above T5 must be addressed. Not only are there no basal ages from alluvial fans in any other valleys to test if alluvial fan development occurred before 8000 $^{14}C$ yr B.P., but I did not observe any fans on the upper terraces (those formed during the Early Fluvial Stage). Were no fans deposited because there was not sufficient relief above the terraces for gullys to develop? Were the proper sediment types unavailable for transport? Were the transportation processes not occuring? Or has subsequent river action simply destroyed the older fans? Identifying what ultimately triggers fan depostion

may help in answering these questions.

In order to understand the mechanisms for the initiation of fan deposition, consider two end member cases. Activity in the fan's source area can be initiated at any time when the river undercuts the valley fill, leading to gully development on the hillslope (Case 1). Alternatively, activity in the source area may be the result of a change in the hillslope conditions, such as removal of groundcover by fire or humans or increase in overland flow from large precipitation events (Case 2). Fan deposition, however, will not occur unless there is a terrace upon which to build a fan. Therefore, if the river initiates gullying (Case 1), hillslope sediments may be carried into the river without any fan deposition. In Case 2, where the disturbance is from within the source area, fan deposition is almost certain, and the fan deposit will likely record all the erosion from the basin.

Headward erosion of the gullys will continue until the hillslope system reaches equilibrium. In Case 1, equilibrium may be reached before fan deposition while the river is still receiving the sediment or after significant amounts of sediment are carried away by the river. Therefore, while the initial pulse of fan deposition may be a significant portion of the present volume of the fan, it may represent only a fraction of total hillslope erosion in that drainage. The volume of initial fan deposition does not necessarily correspond with the magnitude of the initial disturbance and thus is evidence of activity, and a minimum limiting measure of activity, in the fan's drainage basin.

The sensitivity of a fan's drainage basin or source area to future disturbances was demonstrated in the studies by Church (1997) and Zehfuss (1996), especially in the case of historic land use. Subsequent to the inital fan

deposition, fan aggradation continued episodically throughout the Holocene. However, neither study provided a strong linkage of fan deposition to a specific disturbance except in the case of historic land use. Indeed, basal fan ages, representing the timing of fan preservation, cluster around periods of widespread climate changes (Bierman et al., 1997), but that fact does not mandate that the climate changes, by disturbing the drainage basin, directly initated fan activity. It is just as likely that widespread climate changes, by causing an increase in river activity through incision or lateral channel migration, indirectly initiated or preserved fan activity. In either case, the proximity of the river channel to the fan basin ulimately controls fan preservation.

Another study has addressed the relationship between terraces and fans by examining fire and alluvial activity in Yellowstone National Park (Meyer et al., 1995). The abundance of radiocarbon dates (> 50) allowed Meyer et al. to define specific periods of fan formation and overbank deposition. They found that floodplain incision coincided with fan formation, occuring during dry periods punctuated by convective storms and fires. Periods of floodplain development and overbank deposition were usually characterized by a wetter climate and lacked significant fan activity. I mention this study as an example of the scope of investigation that is needed to discern the relationship between alluvial fans and terraces in Vermont.

In conclusion, the formation and preservation of alluvial fans and the formation of river terraces appear to be linked. The question remains if the linkage is one of mutual cause or one of cause and effect. Deciphering the mechanisms which trigger the formation of these landforms first requires identifying whether the alluvial fans develop independently of river terraces

or whether the river activity initates fan activity and terracing allows fan preservation. A better alluvial fan chronology would not only help to define periods of fan formation, it would improve the terrace chronology since datable material is often found in the terrace deposits below alluvial fans.

# CHAPTER 6: CONCLUSIONS

Postglacial river terrace development in the Winooski Drainage Basin has been controlled by different forcings. The first fluvial terrace capped glaciolacustrine fill deposits and was associated with the withdrawl of lake waters from the valleys. Later, river incision was driven by proglacial lake baselevel lowerings until knickpoints developed in the river channels. Since that time, river incision has most likely coincided with large-scale climate changes. The river terrace chronologies are compatible with the deglacial chronologies developed by other workers and can be used to develop a five stage model of valley evolution.

The gradients of terraces have continued to increase with each incision event. Since the mechanisms of incision (baselevel lowerings, knickpoint migration) caused a step-wise increase in the gradients over time, the rivers appear to be in meta-stable equilibrium. Throughout their history, the rivers have removed portions of valley fill to expose bedrock knickpoints. Therefore, it seems likely that the river systems are moving toward strath development in order to produce a channel carved into bedrock, without knickpoints.

Since the river gradients of the Huntington and Mad Rivers continued to increase during the Holocene, they are inappropriate to study crustal movements. There is no baseline initial river gradient from which to compare present gradients of terraces. The present-day terrace gradients must include a component of glacio-isostatic tilting, but the magnitude of the tilting is much less and indecipherable from the overall gradient change. Although baselevel changes are associated with glacio-isostatic tilting, crustal movements did not directly cause river incision.

The river terraces and alluvial fans in the Huntington River Valley appear to have formed at similar times. Without additional radiocarbon dates, it is difficult to discern whether the mechanisms that initiated terrace formation directly caused alluvial fan development. Since datable organic material is often found within alluvial fan deposits and immediatley below fans in the terrace deposits, further study of their mutal histories will better constrain landform development in the Winooski Drainage Basin.

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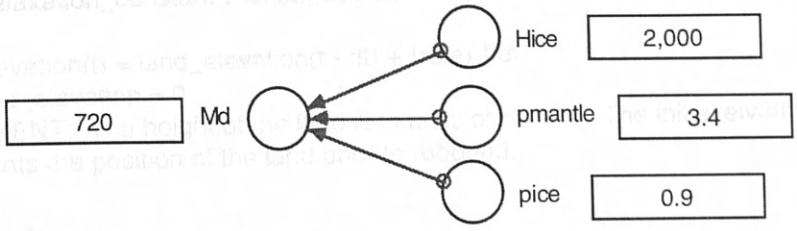
# APPENDIX A: STELLA MODEL

## MODEL 1: MANTLE DISPLACEMENT




MODEL 1 DOCUMENTATION

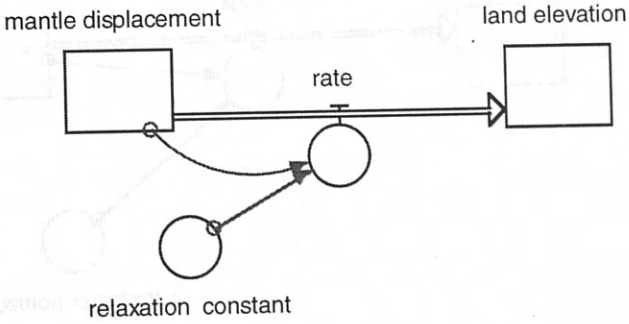
Hice = 2000
DOCUMENT: Ice thicknes is in meters.

Md = Hice*(pice/(pmantle-pice))
DOCUMENT: Displaced mantle is in units of meters and represents the amount of mantle displaced by the ice load.

pice = 0.9
DOCUMENT: Density of ice is in g/cm^3

pmantle = 3.4
DOCUMENT: Density of mantle is in g/cm^3.

## MODEL 2: REBOUND AT A LOCATION



## MODEL 2 DOCUMENTATION

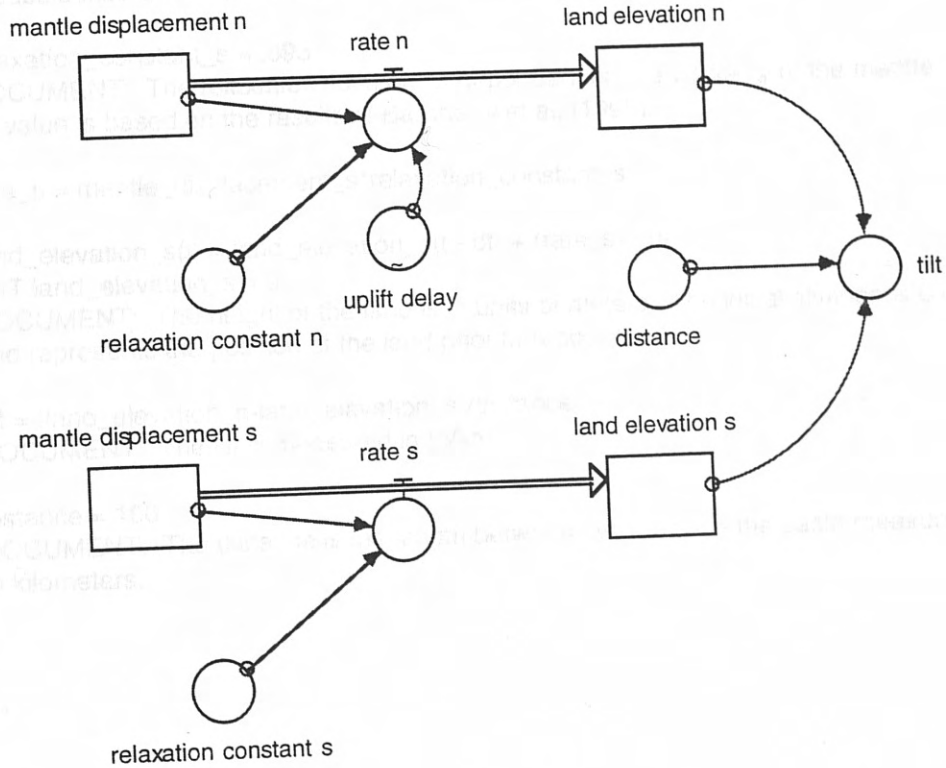
mantle_displacement(t) = mantle_displacement(t - dt) + (- rate) * dt
INIT mantle_displacement = Md
DOCUMENT: The initial mantle displacement is in meters and represents the amount of subsidense based on the ice load.

relaxation_constant = .693
DOCUMENT: The relaxation constant is dependent on the viscosity of the mantle. Its value is based on the results of Barnhardt et al. (1995).

rate = relaxation_constant*mantle_displacement

land_elevation(t) = land_elevation(t - dt) + (rate) * dt
INIT land_elevation = 0
DOCUMENT: The height of the land is in units of meters. The initial elvation is 0 m and represents the position of the land prior to rebound.

## MODEL 3: DIFFERENTIAL REBOUND



## MODEL 3 DOCUMENTATION

mantle_displacement_n(t) = mantle_displacement_n(t - dt) + (- rate_n) * dt
INIT mantle_displacement_n = Md+90
DOCUMENT: The initial mantle displacement is in meters and represents the amount of subsidense based on the ice load. An additional 90 m is added to produce the tilt of 0.9 m/km.

relaxation_constant_n = .693
DOCUMENT: The relaxation constant is dependent on the viscosity of the mantle. Its value is based on the results of Barnhardt et al. (1995).

uplift_delay = GRAPH(time)
DOCUMENT: The uplift delay will delay the beginning of uplift in the north using the graph. The value of the graph is set at zero for the length of time of the delay.

rate_n = mantle_displacement_n*relaxation_constant_n*uplift_delay

land_elevation_n(t) = land_elevation_n(t - dt) + (rate_n) * dt
INIT land_elevation_n = 0
DOCUMENT: The height of the land is in units of meters. The initial elvation is 0 m and represents the position of the land prior to rebound.

mantle_displacement_s(t) = mantle_displacement_s(t - dt) + (- rate_s) * dt
INIT mantle_displacement_s = Md
DOCUMENT: The initial mantle displacement is in meters and represents the amount of subsidense based onthe ice load.

relaxation_constant_s = .693
DOCUMENT: The relaxation constant is dependent on the viscosity of the mantle. Its value is based on the results of Barnhardt et al. (1995).

rate_s = mantle_displacement_s*relaxation_constant_s

land_elevation_s(t) = land_elevation_s(t - dt) + (rate_s) * dt
INIT land_elevation_s = 0
DOCUMENT: The height of the land is in units of meters. The initial elvation is 0 m and represents the position of the land prior to rebound.

tilt = (land_elevation_n-land_elevation_s)/distance
DOCUMENT: The tilt is measured in m/km.

distance = 100
DOCUMENT: The distance is the length between two points in the basin measured in kilometers.

# APPENDIX B: HUNTINGTON RIVER DATA

## HUNTINGTON RIVER SURVEY DATA

The Huntington River survey data are presented in the following tables beginning with the location closest to the mouth. See Figure 3.2 for survey locations.

| Huntington River Location Jonesville | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 26.75 | 126.75 | ± 0.20 | T5 |
| 2 | 1000.000 | 1000.000 | 100.000 | 26.75 | 126.75 | ± 0.20 | T5 |
| 3 | 978.450 | 956.800 | 100.231 | 26.75 | 126.98 | ± 0.20 | T5 |
| 4 | 983.726 | 966.250 | 100.423 | 26.75 | 127.17 | ± 0.20 | T5 |
| 5 | 990.198 | 978.182 | 100.164 | 26.75 | 126.91 | ± 0.20 | T5 |
| 6 | 990.197 | 978.178 | 100.164 | 26.75 | 126.91 | ± 0.20 | T5 |
| 7 | 997.497 | 990.248 | 100.044 | 26.75 | 126.79 | ± 0.20 | T5 |
| 8 | 1035.983 | 980.856 | 99.700 | 26.75 | 126.45 | ± 0.20 | T5 |
| 9 | 1027.147 | 985.592 | 99.774 | 26.75 | 126.52 | ± 0.20 | T5 |
| 10 | 1016.763 | 993.368 | 99.611 | 26.75 | 126.36 | ± 0.20 | T5 |
| 11 | 1006.859 | 998.930 | 99.888 | 26.75 | 126.64 | ± 0.20 | T5 |
| 12 | 997.360 | 1001.950 | 99.981 | 26.75 | 126.73 | ± 0.20 | SLOPE |
| 13 | 995.498 | 1002.715 | 98.312 | 26.75 | 125.06 | ± 0.20 | SLOPE |
| 14 | 994.430 | 1004.543 | 97.235 | 26.75 | 123.98 | ± 0.20 | SLOPE |
| 15 | 988.377 | 1008.082 | 95.696 | 26.75 | 122.44 | ± 0.20 | SLOPE |
| 16 | 984.114 | 1025.677 | 95.745 | 26.75 | 122.49 | ± 0.20 | ROAD |
| 17 | 973.163 | 1042.916 | 95.650 | 26.75 | 122.40 | ± 0.20 | ROAD |
| 18 | 958.805 | 1052.116 | 95.594 | 26.75 | 122.34 | ± 0.20 | ROAD |
| 19 | 944.094 | 1057.020 | 94.949 | 26.75 | 121.70 | ± 0.20 | ROAD |
| 20 | 935.573 | 1044.270 | 95.953 | 26.75 | 122.70 | ± 0.20 | T4 |
| 21 | 925.451 | 1045.924 | 95.438 | 26.75 | 122.19 | ± 0.20 | T4 |
| 22 | 920.729 | 1047.085 | 93.672 | 26.75 | 120.42 | ± 0.20 | SLOPE |
| 23 | 916.247 | 1046.687 | 92.140 | 26.75 | 118.89 | ± 0.20 | SLOPE |
| 24 | 908.496 | 1046.669 | 89.672 | 26.75 | 116.42 | ± 0.20 | SLOPE |
| 25 | 899.326 | 1045.721 | 88.076 | 26.75 | 114.82 | ± 0.20 | SLOPE |
| 26 | 888.424 | 1045.895 | 86.318 | 26.75 | 113.07 | ± 0.20 | SLOPE |
| 27 | 870.203 | 1044.535 | 84.050 | 26.75 | 110.80 | ± 0.20 | ROAD |
| 28 | 846.092 | 1043.815 | 82.008 | 26.75 | 108.76 | ± 0.20 | ROAD |
| 29 | 828.768 | 1045.785 | 81.106 | 26.75 | 107.85 | ± 0.20 | ROAD |
| 30 | 944.062 | 1057.017 | 94.965 | 26.75 | 121.71 | ± 0.20 | ROAD |
| 31 | 870.952 | 1029.689 | 86.226 | 26.75 | 112.97 | ± 0.20 | SLOPE |
| 32 | 878.947 | 1026.391 | 87.782 | 26.75 | 114.53 | ± 0.20 | SLOPE |
| 33 | 874.292 | 1028.464 | 86.888 | 26.75 | 113.64 | ± 0.20 | SLOPE |
| 34 | 870.059 | 1030.568 | 85.821 | 26.75 | 112.57 | ± 0.20 | SLOPE |
| 35 | 863.509 | 1032.428 | 83.653 | 26.75 | 110.40 | ± 0.20 | SLOPE |
| 36 | 857.975 | 1036.089 | 82.114 | 26.75 | 108.86 | ± 0.20 | SLOPE |
| 37 | 788.909 | 1046.084 | 79.874 | 26.75 | 106.62 | ± 0.20 | T3B |
| 38 | 748.334 | 1045.904 | 79.821 | 26.75 | 106.57 | ± 0.20 | T3B |
| 39 | 688.021 | 1050.636 | 80.311 | 26.75 | 107.06 | ± 0.20 | T3A |
| 40 | 730.706 | 1160.523 | 77.912 | 26.75 | 104.66 | ± 0.20 | T2A |
| 41 | 828.656 | 1045.736 | 81.146 | 26.75 | 107.89 | ± 0.20 | T3A |
| 42 | 840.852 | 1171.110 | 81.419 | 26.75 | 108.17 | ± 0.20 | T3A |
| 43 | 832.445 | 1170.309 | 79.673 | 26.75 | 106.42 | ± 0.20 | SLOPE |
| 44 | 816.178 | 1168.732 | 78.544 | 26.75 | 105.29 | ± 0.20 | T3B |
| 45 | 786.774 | 1168.249 | 78.742 | 26.75 | 105.49 | ± 0.20 | T3B |
| 46 | 689.596 | 1169.555 | 77.261 | 26.75 | 104.01 | ± 0.20 | SLOPE |
| 47 | 663.653 | 1187.046 | 76.146 | 26.75 | 102.89 | ± 0.20 | T2B |
| 48 | 617.270 | 1215.041 | 75.620 | 26.75 | 102.37 | ± 0.20 | T2B |
| 49 | 531.830 | 1266.254 | 75.466 | 26.75 | 102.21 | ± 0.20 | T2B |
| 50 | 451.854 | 1314.925 | 74.651 | 26.75 | 101.40 | ± 0.20 | T2B |

| Huntington River Location Jonesville | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 51 | 730.674 | 1160.540 | 77.664 | 26.75 | 104.41 | ± 0.20 | T2A |
| 52 | 390.368 | 1377.920 | 76.070 | 26.75 | 102.82 | ± 0.20 | T2B |
| 53 | 368.125 | 1437.323 | 74.076 | 26.75 | 100.82 | ± 0.20 | T2B |
| 54 | 384.379 | 1492.180 | 73.391 | 26.75 | 100.14 | ± 0.20 | T2B |
| Note: These elevations are tied to the Benchmark north of the Jonesville bridge | | | | | | | |

| Huntington River Location Paquette | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 200.000 | 22.88 | 177.12 | ± 1.0 | T7 |
| 2 | 1000.000 | 1000.000 | 200.000 | 22.88 | 177.12 | ± 1.0 | T7 |
| 3 | 997.113 | 999.576 | 199.903 | 22.88 | 177.02 | ± 1.0 | T7 |
| 4 | 991.898 | 998.346 | 199.697 | 22.88 | 176.81 | ± 1.0 | T7 |
| 5 | 983.260 | 996.348 | 199.296 | 22.88 | 176.41 | ± 1.0 | T7 |
| 6 | 975.403 | 994.092 | 198.867 | 22.88 | 175.98 | ± 1.0 | T7 |
| 7 | 979.000 | 1002.773 | 198.557 | 22.88 | 175.67 | ± 1.0 | SLOPE |
| 8 | 977.325 | 1007.096 | 197.478 | 22.88 | 174.60 | ± 1.0 | SLOPE |
| 9 | 975.746 | 1014.046 | 196.209 | 22.88 | 173.33 | ± 1.0 | SLOPE |
| 10 | 975.757 | 1014.038 | 196.211 | 22.88 | 173.33 | ± 1.0 | SLOPE |
| 11 | 977.166 | 1021.298 | 195.681 | 22.88 | 172.80 | ± 1.0 | SLOPE |
| 12 | 975.242 | 1029.260 | 194.728 | 22.88 | 171.85 | ± 1.0 | SLOPE |
| 13 | 971.532 | 1036.492 | 193.942 | 22.88 | 171.06 | ± 1.0 | T6 |
| 14 | 962.865 | 1043.152 | 193.414 | 22.88 | 170.53 | ± 1.0 | T6 |
| 15 | 955.500 | 1050.535 | 193.350 | 22.88 | 170.47 | ± 1.0 | T6 |
| 16 | 947.219 | 1056.913 | 193.148 | 22.88 | 170.27 | ± 1.0 | T6 |
| 17 | 937.264 | 1062.837 | 192.162 | 22.88 | 169.28 | ± 1.0 | SLOPE |
| 18 | 932.227 | 1067.204 | 190.761 | 22.88 | 167.88 | ± 1.0 | SLOPE |
| 19 | 949.146 | 1047.672 | 193.167 | 22.88 | 170.28 | ± 1.0 | T6 |
| 20 | 969.352 | 1028.901 | 194.260 | 22.88 | 171.38 | ± 1.0 | T6 |
| 21 | 991.882 | 1013.103 | 198.477 | 22.88 | 175.59 | ± 1.0 | SLOPE |
| 22 | 993.761 | 994.703 | 199.454 | 22.88 | 176.57 | ± 1.0 | T7 |
| 23 | 988.390 | 989.339 | 198.196 | 22.88 | 175.31 | ± 1.0 | SLOPE |
| 24 | 991.557 | 984.614 | 195.713 | 22.88 | 172.83 | ± 1.0 | SLOPE |
| 25 | 993.855 | 967.250 | 190.412 | 22.88 | 167.53 | ± 1.0 | SLOPE |
| 26 | 1000.717 | 957.859 | 190.263 | 22.88 | 167.38 | ± 1.0 | SLOPE |
| 27 | 1007.354 | 945.995 | 190.399 | 22.88 | 167.52 | ± 1.0 | SLOPE |
| 28 | 1018.200 | 932.556 | 190.610 | 22.88 | 167.73 | ± 1.0 | SLOPE |
| 29 | 1030.701 | 923.630 | 190.741 | 22.88 | 167.86 | ± 1.0 | SLOPE |
| 30 | 1047.395 | 917.429 | 191.080 | 22.88 | 168.20 | ± 1.0 | SLOPE |
| 31 | 1061.887 | 919.908 | 191.088 | 22.88 | 168.21 | ± 1.0 | SLOPE |
| 32 | 1076.712 | 903.656 | 188.566 | 22.88 | 165.68 | ± 1.0 | ROAD |
| 33 | 1086.467 | 891.658 | 186.246 | 22.88 | 163.36 | ± 1.0 | ROAD |
| 34 | 1097.466 | 879.323 | 184.532 | 22.88 | 161.65 | ± 1.0 | ROAD |
| 35 | 1097.460 | 879.330 | 184.533 | 22.88 | 161.65 | ± 1.0 | ROAD |
| 36 | 1110.032 | 861.781 | 183.114 | 22.88 | 160.23 | ± 1.0 | ROAD |
| 37 | 1111.085 | 860.666 | 182.968 | 22.88 | 160.09 | ± 1.0 | ROAD |
| 38 | 1115.513 | 846.914 | 180.987 | 22.88 | 158.10 | ± 1.0 | ROAD |
| 39 | 1122.078 | 828.107 | 177.830 | 22.88 | 154.95 | ± 1.0 | ROAD |
| 40 | 1130.000 | 809.878 | 174.917 | 22.88 | 152.03 | ± 1.0 | ROAD |
| 41 | 1134.443 | 798.041 | 173.216 | 22.88 | 150.33 | ± 1.0 | ROAD |
| 42 | 1136.821 | 789.576 | 172.030 | 22.88 | 149.15 | ± 1.0 | ROAD |
| 43 | 1146.643 | 769.216 | 168.531 | 22.88 | 145.65 | ± 1.0 | ROAD |
| 44 | 1158.651 | 740.230 | 163.941 | 22.88 | 141.06 | ± 1.0 | ROAD |
| 45 | 1163.012 | 702.659 | 160.406 | 22.88 | 137.52 | ± 1.0 | ROAD |
| 46 | 1113.845 | 729.760 | 159.841 | 22.88 | 136.96 | ± 1.0 | T5 |
| 47 | 1100.222 | 742.941 | 160.385 | 22.88 | 137.50 | ± 1.0 | T5 |
| 48 | 1079.445 | 764.446 | 159.839 | 22.88 | 136.96 | ± 1.0 | T5 |
| 49 | 1056.102 | 791.177 | 158.608 | 22.88 | 135.73 | ± 1.0 | SLOPE |
| 50 | 1046.339 | 791.941 | 156.870 | 22.88 | 133.99 | ± 1.0 | SLOPE |

| Huntington River Location Paquette | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 51 | 1039.145 | 781.794 | 155.572 | 22.88 | 132.69 | ± 1.0 | T4 |
| 52 | 1048.682 | 762.426 | 155.874 | 22.88 | 132.99 | ± 1.0 | T4 |
| 53 | 1065.539 | 735.301 | 156.277 | 22.88 | 133.39 | ± 1.0 | T4 |
| 54 | 1076.737 | 704.773 | 156.688 | 22.88 | 133.81 | ± 1.0 | T4 |
| 55 | 1069.379 | 691.473 | 154.563 | 22.88 | 131.68 | ± 1.0 | SLOPE |
| 56 | 1059.943 | 679.442 | 153.101 | 22.88 | 130.22 | ± 1.0 | T3 |
| 57 | 1037.629 | 697.172 | 152.669 | 22.88 | 129.79 | ± 1.0 | T3 |
| 58 | 1027.518 | 713.428 | 151.917 | 22.88 | 129.03 | ± 1.0 | T3 |
| 59 | 1027.546 | 734.254 | 151.027 | 22.88 | 128.14 | ± 1.0 | SLOPE |
| 60 | 1038.191 | 750.816 | 153.538 | 22.88 | 130.66 | ± 1.0 | T3 |
| 61 | 1013.498 | 744.782 | 149.039 | 22.88 | 126.16 | ± 1.0 | SLOPE |
| 62 | 999.008 | 748.037 | 148.381 | 22.88 | 125.50 | ± 1.0 | T2 |
| 63 | 996.424 | 763.069 | 148.295 | 22.88 | 125.41 | ± 1.0 | T2 |
| 64 | 984.058 | 765.009 | 147.486 | 22.88 | 124.60 | ± 1.0 | T2 |
| 65 | 975.193 | 761.448 | 141.372 | 22.88 | 118.49 | ± 1.0 | RIVER |
| 66 | 993.928 | 777.515 | 147.817 | 22.88 | 124.93 | ± 1.0 | T2 |
| 67 | 1004.191 | 791.957 | 147.847 | 22.88 | 124.96 | ± 1.0 | T2 |
| 68 | 1016.208 | 807.059 | 148.302 | 22.88 | 125.42 | ± 1.0 | T2 |
| 69 | 992.213 | 749.555 | 148.493 | 22.88 | 125.61 | ± 1.0 | T2 |
| Note: These elevations are tied to a contour line (460 ft = 140.24 m) via PAQ1 Pt 44 = PARO Pt 3 | | | | | | | |

| Huntington River Location Paquette-Road | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 38.21 | 138.21 | ± 1.0 | T4 |
| 2 | 1000.000 | 1000.000 | 100.000 | 38.21 | 138.21 | ± 1.0 | T4 |
| 3 | 1015.488 | 1030.425 | 102.847 | 38.21 | 141.06 | ± 1.0 | ROAD |
| 4 | 987.438 | 1010.502 | 98.657 | 38.21 | 136.87 | ± 1.0 | SLOPE |
| 5 | 1068.248 | 942.233 | 101.899 | 38.21 | 140.11 | ± 1.0 | ROAD |
| 6 | 1000.017 | 999.985 | 100.150 | 38.21 | 138.36 | ± 1.0 | T4 |
| 7 | 1058.251 | 935.807 | 101.309 | 38.21 | 139.52 | ± 1.0 | T4 |
| 8 | 1055.995 | 934.074 | 100.998 | 38.21 | 139.21 | ± 1.0 | T4 |
| 9 | 1053.546 | 932.233 | 100.801 | 38.21 | 139.01 | ± 1.0 | T4 |
| 10 | 1051.050 | 930.489 | 100.647 | 38.21 | 138.86 | ± 1.0 | T4 |
| 11 | 1048.489 | 928.774 | 100.484 | 38.21 | 138.70 | ± 1.0 | T4 |
| 12 | 1046.279 | 927.207 | 100.200 | 38.21 | 138.41 | ± 1.0 | T4 |
| 13 | 1044.240 | 925.364 | 99.678 | 38.21 | 137.89 | ± 1.0 | SLOPE |
| 14 | 1041.745 | 923.520 | 98.950 | 38.21 | 137.16 | ± 1.0 | SLOPE |
| 15 | 1039.540 | 921.472 | 98.333 | 38.21 | 136.54 | ± 1.0 | T3 |
| 16 | 1037.122 | 919.650 | 97.990 | 38.21 | 136.20 | ± 1.0 | T3 |
| 17 | 1034.944 | 917.432 | 97.856 | 38.21 | 136.07 | ± 1.0 | T3 |
| 18 | 1032.858 | 915.107 | 97.936 | 38.21 | 136.15 | ± 1.0 | T3 |
| 19 | 1030.664 | 913.120 | 97.953 | 38.21 | 136.16 | ± 1.0 | T3 |
| 20 | 1028.489 | 911.104 | 97.915 | 38.21 | 136.13 | ± 1.0 | T3 |
| 21 | 1026.074 | 908.962 | 97.821 | 38.21 | 136.03 | ± 1.0 | T3 |
| 22 | 1024.161 | 906.447 | 97.589 | 38.21 | 135.80 | ± 1.0 | T3 |
| 23 | 1022.409 | 904.011 | 97.308 | 38.21 | 135.52 | ± 1.0 | SLOPE |
| 24 | 1020.719 | 901.472 | 96.889 | 38.21 | 135.10 | ± 1.0 | SLOPE |
| 25 | 1019.058 | 898.764 | 96.332 | 38.21 | 134.54 | ± 1.0 | SLOPE |
| 26 | 1015.890 | 897.313 | 96.030 | 38.21 | 134.24 | ± 1.0 | SLOPE |
| 27 | 1014.249 | 894.608 | 95.844 | 38.21 | 134.06 | ± 1.0 | SLOPE |
| 28 | 1000.167 | 867.098 | 91.183 | 38.21 | 129.39 | ± 1.0 | T2 |
| 29 | 994.774 | 863.096 | 91.062 | 38.21 | 129.27 | ± 1.0 | T2 |
| 30 | 992.965 | 860.546 | 90.583 | 38.21 | 128.79 | ± 1.0 | T2 |
| 31 | 990.685 | 857.662 | 90.639 | 38.21 | 128.85 | ± 1.0 | T2 |
| 32 | 1006.633 | 919.418 | 97.485 | 38.21 | 135.70 | ± 1.0 | T3 |
| 33 | 1017.302 | 923.748 | 97.257 | 38.21 | 135.47 | ± 1.0 | SLOPE |
| 34 | 1026.119 | 926.580 | 97.630 | 38.21 | 135.84 | ± 1.0 | T3 |
| 35 | 1041.610 | 932.070 | 100.085 | 38.21 | 138.30 | ± 1.0 | T4 |
| 36 | 1056.580 | 938.012 | 101.046 | 38.21 | 139.26 | ± 1.0 | T4 |
| 37 | 1116.336 | 876.964 | 102.033 | 38.21 | 140.24 | ± 1.0 | ROAD |
| Note: These elevations are tied to a contour line (460 ft = 140.24 m) via Pt 37. | | | | | | | |

| Huntington River Location Aldrich 2 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 49.21 | 149.21 | ± 0.20 | T2B |
| 2 | 1000.000 | 1000.000 | 100.000 | 49.21 | 149.21 | ± 0.20 | T2B |
| 3 | 1016.963 | 977.196 | 102.409 | 49.21 | 151.62 | ± 0.20 | T2A |
| 4 | 1019.279 | 973.093 | 102.560 | 49.21 | 151.77 | ± 0.20 | T2A |
| 5 | 1016.815 | 969.554 | 102.639 | 49.21 | 151.85 | ± 0.20 | T2A |
| 6 | 1016.813 | 969.557 | 102.639 | 49.21 | 151.85 | ± 0.20 | T2A |
| 7 | 1012.200 | 967.123 | 102.753 | 49.21 | 151.97 | ± 0.20 | T2A |
| 8 | 1012.198 | 967.126 | 102.753 | 49.21 | 151.97 | ± 0.20 | T2A |
| 9 | 1010.468 | 972.385 | 102.398 | 49.21 | 151.61 | ± 0.20 | T2A |
| 10 | 1010.469 | 972.381 | 102.398 | 49.21 | 151.61 | ± 0.20 | T2A |
| 11 | 1012.999 | 972.332 | 102.418 | 49.21 | 151.63 | ± 0.20 | T2A |
| 12 | 1013.002 | 972.326 | 102.418 | 49.21 | 151.63 | ± 0.20 | T2A |
| 13 | 1015.024 | 974.179 | 102.417 | 49.21 | 151.63 | ± 0.20 | T2A |
| 14 | 1010.180 | 977.918 | 101.950 | 49.21 | 151.16 | ± 0.20 | T2A |
| 15 | 1007.945 | 979.440 | 101.475 | 49.21 | 150.69 | ± 0.20 | T2A |
| 16 | 1006.378 | 980.401 | 101.092 | 49.21 | 150.31 | ± 0.20 | T2A |
| 17 | 1006.375 | 980.408 | 101.092 | 49.21 | 150.31 | ± 0.20 | T2A |
| 18 | 999.945 | 972.728 | 100.626 | 49.21 | 149.84 | ± 0.20 | T2B |
| 19 | 994.218 | 967.220 | 100.402 | 49.21 | 149.62 | ± 0.20 | T2B |
| 20 | 989.438 | 959.009 | 100.593 | 49.21 | 149.81 | ± 0.20 | T2B |
| 21 | 987.342 | 950.420 | 100.782 | 49.21 | 150.00 | ± 0.20 | T2B |
| 22 | 984.425 | 944.806 | 100.819 | 49.21 | 150.03 | ± 0.20 | T2B |
| 23 | 984.427 | 944.814 | 100.819 | 49.21 | 150.03 | ± 0.20 | T2B |
| 24 | 980.914 | 946.367 | 100.718 | 49.21 | 149.93 | ± 0.20 | T2B |
| 25 | 978.016 | 947.378 | 100.383 | 49.21 | 149.60 | ± 0.20 | T2B |
| 26 | 978.814 | 953.097 | 100.308 | 49.21 | 149.52 | ± 0.20 | T2B |
| 27 | 984.874 | 966.268 | 100.219 | 49.21 | 149.43 | ± 0.20 | T2B |
| 28 | 984.878 | 966.279 | 100.219 | 49.21 | 149.43 | ± 0.20 | T2B |
| 29 | 978.484 | 957.990 | 100.276 | 49.21 | 149.49 | ± 0.20 | T2B |
| 30 | 976.394 | 958.170 | 99.854 | 49.21 | 149.07 | ± 0.20 | SLOPE |
| 31 | 974.980 | 958.806 | 99.550 | 49.21 | 148.76 | ± 0.20 | SLOPE |
| 32 | 972.102 | 958.741 | 99.150 | 49.21 | 148.36 | ± 0.20 | SLOPE |
| 33 | 970.449 | 964.046 | 98.773 | 49.21 | 147.99 | ± 0.20 | T1A |
| 34 | 970.382 | 970.646 | 98.664 | 49.21 | 147.88 | ± 0.20 | T1A |
| 35 | 970.901 | 979.399 | 98.560 | 49.21 | 147.77 | ± 0.20 | T1A |
| 36 | 971.844 | 984.783 | 98.541 | 49.21 | 147.76 | ± 0.20 | T1A |
| 37 | 974.181 | 993.387 | 98.441 | 49.21 | 147.65 | ± 0.20 | T1A |
| 38 | 977.180 | 1001.462 | 98.181 | 49.21 | 147.39 | ± 0.20 | T1A |
| 39 | 974.712 | 1003.075 | 97.923 | 49.21 | 147.14 | ± 0.20 | T1A |
| 40 | 971.366 | 1004.635 | 97.513 | 49.21 | 146.73 | ± 0.20 | T1A |
| 41 | 966.300 | 1008.294 | 97.427 | 49.21 | 146.64 | ± 0.20 | T1A |
| 42 | 959.728 | 1014.543 | 97.599 | 49.21 | 146.81 | ± 0.20 | T1A |
| 43 | 953.778 | 1021.151 | 97.773 | 49.21 | 146.99 | ± 0.20 | T1A |
| 44 | 953.769 | 1021.155 | 97.773 | 49.21 | 146.99 | ± 0.20 | T1A |
| 45 | 962.144 | 1028.180 | 97.565 | 49.21 | 146.78 | ± 0.20 | T1A |
| 46 | 969.973 | 1034.625 | 97.254 | 49.21 | 146.47 | ± 0.20 | T1A |
| 47 | 979.144 | 1040.000 | 97.177 | 49.21 | 146.39 | ± 0.20 | T1A |
| 48 | 988.727 | 1047.537 | 96.897 | 49.21 | 146.11 | ± 0.20 | T1A |
| 49 | 994.255 | 1050.497 | 96.706 | 49.21 | 145.92 | ± 0.20 | T1A |
| 50 | 954.665 | 1007.194 | 97.782 | 49.21 | 147.00 | ± 0.20 | T1A |

| Huntington River Location Aldrich 2 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 51 | 950.459 | 999.563 | 97.804 | 49.21 | 147.02 | ± 0.20 | T1A |
| 52 | 945.986 | 991.985 | 97.779 | 49.21 | 146.99 | ± 0.20 | T1A |
| 53 | 942.409 | 984.676 | 97.959 | 49.21 | 147.17 | ± 0.20 | T1A |
| 54 | 940.152 | 978.846 | 98.047 | 49.21 | 147.26 | ± 0.20 | T1A |
| 55 | 940.153 | 978.846 | 98.047 | 49.21 | 147.26 | ± 0.20 | T1A |
| 56 | 935.028 | 976.788 | 97.462 | 49.21 | 146.68 | ± 0.20 | T1A |
| 57 | 930.036 | 973.559 | 96.260 | 49.21 | 145.47 | ± 0.20 | SLOPE |
| 58 | 930.029 | 973.556 | 96.260 | 49.21 | 145.47 | ± 0.20 | SLOPE |
| 59 | 929.303 | 973.987 | 96.070 | 49.21 | 145.28 | ± 0.20 | T1B |
| 60 | 927.919 | 973.183 | 95.932 | 49.21 | 145.15 | ± 0.20 | T1B |
| 61 | 925.115 | 972.382 | 95.712 | 49.21 | 144.93 | ± 0.20 | T1B |
| 62 | 924.173 | 971.498 | 95.696 | 49.21 | 144.91 | ± 0.20 | T1B |
| 63 | 951.987 | 1072.159 | 98.470 | 49.21 | 147.68 | ± 0.20 | T1A |
| 64 | 933.910 | 1053.399 | 97.633 | 49.21 | 146.85 | ± 0.20 | T1A |
| 65 | 1036.265 | 946.179 | 102.687 | 49.21 | 151.90 | ± 0.20 | T2A |
| 66 | 1024.065 | 923.513 | 102.582 | 49.21 | 151.80 | ± 0.20 | T2A |
| 67 | 1018.041 | 923.624 | 102.299 | 49.21 | 151.51 | ± 0.20 | T2A |
| 68 | 1012.470 | 928.137 | 102.405 | 49.21 | 151.62 | ± 0.20 | T2A |
| 69 | 1000.354 | 935.349 | 102.733 | 49.21 | 151.95 | ± 0.20 | T2A |
| 70 | 1116.056 | 852.268 | 105.044 | 49.21 | 154.26 | ± 0.20 | T3A |
| 71 | 1110.413 | 861.935 | 104.643 | 49.21 | 153.86 | ± 0.20 | T3A |
| 72 | 1106.600 | 868.939 | 104.353 | 49.21 | 153.57 | ± 0.20 | T3A |
| 73 | 1101.896 | 874.753 | 103.997 | 49.21 | 153.21 | ± 0.20 | SLOPE |
| 74 | 1097.143 | 880.119 | 103.495 | 49.21 | 152.71 | ± 0.20 | T3B |
| 75 | 1091.775 | 885.771 | 103.441 | 49.21 | 152.65 | ± 0.20 | T3B |
| 76 | 1085.181 | 889.528 | 103.433 | 49.21 | 152.65 | ± 0.20 | T3B |
| 77 | 1082.344 | 892.330 | 103.333 | 49.21 | 152.55 | ± 0.20 | T3B |
| 78 | 1079.426 | 895.312 | 102.989 | 49.21 | 152.20 | ± 0.20 | SLOPE |
| 79 | 1077.053 | 897.608 | 102.390 | 49.21 | 151.60 | ± 0.20 | T2A |
| 80 | 1074.742 | 899.870 | 102.043 | 49.21 | 151.26 | ± 0.20 | T2A |
| 81 | 1071.520 | 903.342 | 101.716 | 49.21 | 150.93 | ± 0.20 | T2A |
| 82 | 1069.317 | 908.987 | 101.578 | 49.21 | 150.79 | ± 0.20 | T2A |
| 83 | 1069.320 | 908.984 | 101.577 | 49.21 | 150.79 | ± 0.20 | T2A |
| 84 | 1059.942 | 919.519 | 101.739 | 49.21 | 150.95 | ± 0.20 | T2A |
| 85 | 1055.846 | 924.679 | 101.717 | 49.21 | 150.93 | ± 0.20 | T2A |
| 86 | 1044.993 | 936.822 | 102.157 | 49.21 | 151.37 | ± 0.20 | T2A |
| 87 | 1042.108 | 939.854 | 102.227 | 49.21 | 151.44 | ± 0.20 | T2A |
| 88 | 1070.668 | 934.276 | 101.970 | 49.21 | 151.18 | ± 0.20 | T2A |
| 89 | 1093.148 | 932.940 | 102.127 | 49.21 | 151.34 | ± 0.20 | T2A |
| 90 | 1099.201 | 934.730 | 101.982 | 49.21 | 151.20 | ± 0.20 | T2A |
| 91 | 1104.072 | 944.354 | 101.436 | 49.21 | 150.65 | ± 0.20 | T2A |
| 92 | 1103.714 | 954.660 | 101.304 | 49.21 | 150.52 | ± 0.20 | T2A |
| 93 | 1103.481 | 965.705 | 101.243 | 49.21 | 150.46 | ± 0.20 | T2A |
| 94 | 1102.888 | 978.040 | 101.090 | 49.21 | 150.30 | ± 0.20 | T2A |
| 95 | 1102.126 | 990.688 | 101.139 | 49.21 | 150.35 | ± 0.20 | T2A |
| 96 | 1101.902 | 1004.008 | 100.873 | 49.21 | 150.09 | ± 0.20 | T2A |
| 97 | 1101.151 | 1020.544 | 100.694 | 49.21 | 149.91 | ± 0.20 | T2B |
| 98 | 1101.838 | 1033.682 | 100.965 | 49.21 | 150.18 | ± 0.20 | T2A |
| 99 | 1102.810 | 1048.993 | 101.481 | 49.21 | 150.69 | ± 0.20 | T2A |
| 100 | 1106.353 | 1064.784 | 101.229 | 49.21 | 150.44 | ± 0.20 | T2A |

| Huntington River Location Aldrich 2 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 101 | 1106.353 | 1064.842 | 101.228 | 49.21 | 150.44 | ± 0.20 | T2A |
| 102 | 1047.964 | 1139.048 | 109.155 | 49.21 | 158.37 | ± 0.20 | T4A |
| 103 | 1046.061 | 1140.600 | 109.151 | 49.21 | 158.36 | ± 0.20 | T4A |
| 104 | 1049.222 | 1140.557 | 109.073 | 49.21 | 158.29 | ± 0.20 | T4A |
| 105 | 1045.765 | 1142.394 | 109.041 | 49.21 | 158.25 | ± 0.20 | T4A |
| 106 | 1045.130 | 1141.078 | 109.131 | 49.21 | 158.34 | ± 0.20 | T4A |
| 107 | 1049.205 | 1137.442 | 109.055 | 49.21 | 158.27 | ± 0.20 | T4A |
| 108 | 1053.277 | 1134.248 | 106.864 | 49.21 | 156.08 | ± 0.20 | SLOPE |
| 109 | 1055.937 | 1130.702 | 103.845 | 49.21 | 153.06 | ± 0.20 | SLOPE |
| 110 | 1062.206 | 1127.222 | 100.910 | 49.21 | 150.12 | ± 0.20 | T2A |
| 111 | 1059.928 | 1094.121 | 100.961 | 49.21 | 150.17 | ± 0.20 | T2A |
| 112 | 1063.064 | 1080.716 | 100.367 | 49.21 | 149.58 | ± 0.20 | T2B |
| 113 | 1177.984 | 1050.514 | 110.250 | 49.21 | 159.46 | ± 0.20 | T4A |
| 114 | 1173.881 | 1046.010 | 110.138 | 49.21 | 159.35 | ± 0.20 | T4A |
| 115 | 1170.075 | 1035.063 | 110.731 | 49.21 | 159.95 | ± 0.20 | T4A |
| 116 | 1152.802 | 1021.178 | 110.193 | 49.21 | 159.41 | ± 0.20 | T4A |
| 117 | 1095.220 | 1052.881 | 100.990 | 49.21 | 150.20 | ± 0.20 | T2A |
| 118 | 1088.018 | 1041.809 | 101.219 | 49.21 | 150.43 | ± 0.20 | T2A |
| 119 | 1076.910 | 1034.552 | 101.680 | 49.21 | 150.89 | ± 0.20 | T2A |
| 120 | 1065.228 | 1031.379 | 101.989 | 49.21 | 151.20 | ± 0.20 | T2A |
| 121 | 1054.581 | 1028.392 | 101.839 | 49.21 | 151.05 | ± 0.20 | T2A |
| 122 | 1045.406 | 1022.364 | 101.713 | 49.21 | 150.93 | ± 0.20 | T2A |
| 123 | 1045.028 | 1012.589 | 102.053 | 49.21 | 151.27 | ± 0.20 | T2A |
| Note: These elevations are tied to the Benchmark MAYOAZMK (160.75 m ± 0.05 m) on the bridge south of here via: ALD2 Pt 65 = ALD3 Pt 49; ALD3 Pt 48 = ALD1 Pt 1; ALD1 Pt 130 = ALMO Pt 87; ALMO Pt 87 = MOUL Pt 249; MOUL Pt 3 = TOM2 Pt 16; TOM2 Pt 3 = Benchmark | | | | | | | |

| Huntington River Location Aldrich 1 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 48.15 | 148.15 | ± 0.20 | T1 |
| 2 | 1000.000 | 1000.000 | 100.000 | 48.15 | 148.15 | ± 0.20 | T1 |
| 3 | 1005.394 | 1014.656 | 97.592 | 48.15 | 145.74 | ± 0.20 | RIVER |
| 4 | 1003.553 | 1011.742 | 99.178 | 48.15 | 147.32 | ± 0.20 | T1 |
| 5 | 1006.449 | 1002.281 | 99.432 | 48.15 | 147.58 | ± 0.20 | T1 |
| 6 | 1006.621 | 998.126 | 99.786 | 48.15 | 147.93 | ± 0.20 | T1 |
| 7 | 1005.652 | 993.809 | 100.201 | 48.15 | 148.35 | ± 0.20 | T1 |
| 8 | 1006.075 | 987.741 | 100.347 | 48.15 | 148.49 | ± 0.20 | T1 |
| 9 | 1006.006 | 983.689 | 100.532 | 48.15 | 148.68 | ± 0.20 | T1 |
| 10 | 1005.580 | 980.796 | 100.712 | 48.15 | 148.86 | ± 0.20 | T1 |
| 11 | 1006.194 | 976.080 | 101.058 | 48.15 | 149.21 | ± 0.20 | T2B |
| 12 | 1006.759 | 968.070 | 101.123 | 48.15 | 149.27 | ± 0.20 | T2B |
| 13 | 1007.854 | 960.194 | 101.355 | 48.15 | 149.50 | ± 0.20 | T2B |
| 14 | 1007.229 | 951.948 | 101.442 | 48.15 | 149.59 | ± 0.20 | T2B |
| 15 | 1007.053 | 948.116 | 101.565 | 48.15 | 149.71 | ± 0.20 | T2B |
| 16 | 1007.490 | 943.200 | 101.440 | 48.15 | 149.59 | ± 0.20 | T2B |
| 17 | 1007.557 | 936.107 | 101.437 | 48.15 | 149.58 | ± 0.20 | T2B |
| 18 | 1008.008 | 929.105 | 101.593 | 48.15 | 149.74 | ± 0.20 | T2B |
| 19 | 1008.007 | 929.109 | 101.593 | 48.15 | 149.74 | ± 0.20 | T2B |
| 20 | 1008.081 | 919.860 | 101.386 | 48.15 | 149.53 | ± 0.20 | T2B |
| 21 | 1008.119 | 913.936 | 101.352 | 48.15 | 149.50 | ± 0.20 | T2B |
| 22 | 1007.450 | 908.215 | 101.679 | 48.15 | 149.83 | ± 0.20 | T2B |
| 23 | 1007.950 | 900.525 | 101.703 | 48.15 | 149.85 | ± 0.20 | T2B |
| 24 | 1007.350 | 897.048 | 101.937 | 48.15 | 150.08 | ± 0.20 | T2B |
| 25 | 1007.089 | 894.040 | 102.335 | 48.15 | 150.48 | ± 0.20 | SLOPE |
| 26 | 1007.255 | 889.026 | 102.847 | 48.15 | 150.99 | ± 0.20 | SLOPE |
| 27 | 1007.069 | 882.839 | 102.937 | 48.15 | 151.08 | ± 0.20 | T2A |
| 28 | 1007.734 | 874.654 | 102.832 | 48.15 | 150.98 | ± 0.20 | T2A |
| 29 | 1008.427 | 866.681 | 102.565 | 48.15 | 150.71 | ± 0.20 | T2A |
| 30 | 1008.707 | 858.884 | 102.468 | 48.15 | 150.61 | ± 0.20 | T2A |
| 31 | 1007.884 | 851.900 | 102.546 | 48.15 | 150.69 | ± 0.20 | T2A |
| 32 | 1008.591 | 844.790 | 102.450 | 48.15 | 150.60 | ± 0.20 | T2A |
| 33 | 1008.599 | 840.789 | 102.439 | 48.15 | 150.59 | ± 0.20 | T2A |
| 34 | 1008.268 | 834.636 | 102.962 | 48.15 | 151.11 | ± 0.20 | T2A |
| 35 | 1008.123 | 831.148 | 103.143 | 48.15 | 151.29 | ± 0.20 | T2A |
| 36 | 1008.084 | 824.149 | 103.026 | 48.15 | 151.17 | ± 0.20 | T2A |
| 37 | 1006.891 | 817.617 | 103.265 | 48.15 | 151.41 | ± 0.20 | T2A |
| 38 | 1006.869 | 810.288 | 103.300 | 48.15 | 151.45 | ± 0.20 | T2A |
| 39 | 1006.460 | 802.520 | 103.224 | 48.15 | 151.37 | ± 0.20 | T2A |
| 40 | 1005.294 | 794.410 | 103.226 | 48.15 | 151.37 | ± 0.20 | T2A |
| 41 | 1005.593 | 787.415 | 103.212 | 48.15 | 151.36 | ± 0.20 | T2A |
| 42 | 1006.930 | 783.182 | 103.276 | 48.15 | 151.42 | ± 0.20 | T2A |
| 43 | 1007.437 | 779.693 | 103.607 | 48.15 | 151.75 | ± 0.20 | SLOPE |
| 44 | 1007.371 | 774.511 | 103.938 | 48.15 | 152.08 | ± 0.20 | T3B |
| 45 | 1007.371 | 774.511 | 103.938 | 48.15 | 152.08 | ± 0.20 | T3B |
| 46 | 1008.200 | 769.040 | 104.073 | 48.15 | 152.22 | ± 0.20 | T3B |
| 47 | 1008.871 | 763.709 | 104.259 | 48.15 | 152.41 | ± 0.20 | T3B |

| Huntington River Location Aldrich 1 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 48 | 1009.141 | 759.919 | 104.625 | 48.15 | 152.77 | ± 0.20 | T3B |
| 49 | 1009.484 | 755.450 | 104.913 | 48.15 | 153.06 | ± 0.20 | T3A |
| 50 | 1009.744 | 750.314 | 105.234 | 48.15 | 153.38 | ± 0.20 | T3A |
| 51 | 1010.658 | 744.820 | 105.468 | 48.15 | 153.61 | ± 0.20 | T3A |
| 52 | 1010.732 | 740.027 | 105.690 | 48.15 | 153.84 | ± 0.20 | T3A |
| 53 | 1010.660 | 735.720 | 105.957 | 48.15 | 154.10 | ± 0.20 | T3A |
| 54 | 1009.988 | 728.700 | 106.062 | 48.15 | 154.21 | ± 0.20 | T3A |
| 55 | 1009.988 | 728.703 | 106.062 | 48.15 | 154.21 | ± 0.20 | T3A |
| 56 | 1010.474 | 718.454 | 106.168 | 48.15 | 154.32 | ± 0.20 | T3A |
| 57 | 1011.073 | 715.177 | 106.690 | 48.15 | 154.84 | ± 0.20 | SLOPE |
| 58 | 1009.750 | 710.121 | 107.250 | 48.15 | 155.40 | ± 0.20 | SLOPE |
| 59 | 1008.171 | 704.912 | 107.866 | 48.15 | 156.01 | ± 0.20 | SLOPE |
| 60 | 1007.637 | 699.438 | 108.289 | 48.15 | 156.44 | ± 0.20 | SLOPE |
| 61 | 1007.064 | 692.324 | 108.888 | 48.15 | 157.03 | ± 0.20 | SLOPE |
| 62 | 1005.724 | 684.357 | 109.209 | 48.15 | 157.36 | ± 0.20 | T4 |
| 63 | 1002.762 | 677.264 | 109.649 | 48.15 | 157.80 | ± 0.20 | T4 |
| 64 | 1001.361 | 669.675 | 110.028 | 48.15 | 158.18 | ± 0.20 | T4 |
| 65 | 999.877 | 661.305 | 110.488 | 48.15 | 158.63 | ± 0.20 | T4 |
| 66 | 999.188 | 650.961 | 110.664 | 48.15 | 158.81 | ± 0.20 | T4 |
| 67 | 996.750 | 644.413 | 110.873 | 48.15 | 159.02 | ± 0.20 | T4 |
| 68 | 994.623 | 637.601 | 110.977 | 48.15 | 159.12 | ± 0.20 | T4 |
| 69 | 995.883 | 629.981 | 111.423 | 48.15 | 159.57 | ± 0.20 | T4 |
| 70 | 995.883 | 630.029 | 111.421 | 48.15 | 159.57 | ± 0.20 | T4 |
| 71 | 996.259 | 624.562 | 111.909 | 48.15 | 160.06 | ± 0.20 | T4 |
| 72 | 995.998 | 617.837 | 112.446 | 48.15 | 160.59 | ± 0.20 | T4 |
| 73 | 995.924 | 608.084 | 112.660 | 48.15 | 160.81 | ± 0.20 | T4 |
| 74 | 1001.304 | 607.384 | 112.138 | 48.15 | 160.29 | ± 0.20 | T4 |
| 75 | 1013.292 | 608.769 | 111.514 | 48.15 | 159.66 | ± 0.20 | T4 |
| 76 | 1017.880 | 618.296 | 111.239 | 48.15 | 159.39 | ± 0.20 | T4 |
| 77 | 1023.965 | 626.173 | 110.972 | 48.15 | 159.12 | ± 0.20 | T4 |
| 78 | 1024.154 | 634.733 | 110.625 | 48.15 | 158.77 | ± 0.20 | T4 |
| 79 | 1026.532 | 641.910 | 110.274 | 48.15 | 158.42 | ± 0.20 | T4 |
| 80 | 1028.807 | 649.296 | 110.051 | 48.15 | 158.20 | ± 0.20 | T4 |
| 81 | 1030.366 | 655.511 | 109.752 | 48.15 | 157.90 | ± 0.20 | T4 |
| 82 | 1031.520 | 659.956 | 109.506 | 48.15 | 157.65 | ± 0.20 | T4 |
| 83 | 1032.283 | 663.788 | 109.066 | 48.15 | 157.21 | ± 0.20 | T4 |
| 84 | 1032.916 | 667.865 | 108.586 | 48.15 | 156.73 | ± 0.20 | SLOPE |
| 85 | 1033.819 | 673.204 | 107.910 | 48.15 | 156.06 | ± 0.20 | SLOPE |
| 86 | 1035.646 | 678.691 | 107.501 | 48.15 | 155.65 | ± 0.20 | SLOPE |
| 87 | 1037.659 | 685.806 | 107.243 | 48.15 | 155.39 | ± 0.20 | T3A |
| 88 | 1038.729 | 693.367 | 106.984 | 48.15 | 155.13 | ± 0.20 | T3A |
| 89 | 1041.255 | 702.747 | 106.679 | 48.15 | 154.83 | ± 0.20 | T3A |
| 90 | 1043.301 | 711.079 | 106.417 | 48.15 | 154.56 | ± 0.20 | T3A |
| 91 | 1044.535 | 719.303 | 106.243 | 48.15 | 154.39 | ± 0.20 | T3A |
| 92 | 1045.831 | 727.221 | 106.304 | 48.15 | 154.45 | ± 0.20 | T3A |
| 93 | 1047.144 | 734.928 | 106.018 | 48.15 | 154.17 | ± 0.20 | T3A |
| 94 | 1048.567 | 742.660 | 105.714 | 48.15 | 153.86 | ± 0.20 | T3A |

| Huntington River Location Aldrich 1 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 95 | 1050.059 | 748.911 | 105.363 | 48.15 | 153.51 | ± 0.20 | SLOPE |
| 96 | 1051.157 | 752.882 | 104.999 | 48.15 | 153.15 | ± 0.20 | SLOPE |
| 97 | 1052.908 | 756.747 | 104.768 | 48.15 | 152.91 | ± 0.20 | T3B |
| 98 | 1053.114 | 764.207 | 104.834 | 48.15 | 152.98 | ± 0.20 | T3B |
| 99 | 1054.111 | 769.875 | 104.551 | 48.15 | 152.70 | ± 0.20 | T3B |
| 100 | 1054.432 | 773.395 | 104.300 | 48.15 | 152.45 | ± 0.20 | T3B |
| 101 | 1054.782 | 784.930 | 103.675 | 48.15 | 151.82 | ± 0.20 | T3B |
| 102 | 1054.463 | 791.722 | 103.554 | 48.15 | 151.70 | ± 0.20 | T3B |
| 103 | 1053.559 | 800.464 | 103.651 | 48.15 | 151.80 | ± 0.20 | T3B |
| 104 | 1053.873 | 809.918 | 103.492 | 48.15 | 151.64 | ± 0.20 | T2A |
| 105 | 1053.322 | 820.993 | 103.500 | 48.15 | 151.65 | ± 0.20 | T2A |
| 106 | 1053.481 | 825.540 | 103.216 | 48.15 | 151.36 | ± 0.20 | T2A |
| 107 | 1054.187 | 829.655 | 103.177 | 48.15 | 151.32 | ± 0.20 | T2A |
| 108 | 1053.827 | 836.324 | 103.158 | 48.15 | 151.30 | ± 0.20 | T2A |
| 109 | 1053.797 | 845.914 | 103.336 | 48.15 | 151.48 | ± 0.20 | T2A |
| 110 | 1053.749 | 854.546 | 103.369 | 48.15 | 151.52 | ± 0.20 | T2A |
| 111 | 1051.996 | 863.598 | 103.383 | 48.15 | 151.53 | ± 0.20 | T2A |
| 112 | 1051.350 | 871.968 | 103.124 | 48.15 | 151.27 | ± 0.20 | T2A |
| 113 | 1050.336 | 876.938 | 102.843 | 48.15 | 150.99 | ± 0.20 | T2A |
| 114 | 1048.088 | 883.185 | 102.386 | 48.15 | 150.53 | ± 0.20 | T2A |
| 115 | 1048.155 | 889.302 | 102.172 | 48.15 | 150.32 | ± 0.20 | T2A |
| 116 | 1049.488 | 896.743 | 102.451 | 48.15 | 150.60 | ± 0.20 | T2A |
| 117 | 1049.707 | 903.866 | 102.613 | 48.15 | 150.76 | ± 0.20 | T2A |
| 118 | 1049.780 | 909.659 | 102.126 | 48.15 | 150.27 | ± 0.20 | T2B |
| 119 | 1049.586 | 913.917 | 101.686 | 48.15 | 149.83 | ± 0.20 | T2B |
| 120 | 1048.468 | 921.515 | 101.794 | 48.15 | 149.94 | ± 0.20 | T2B |
| 121 | 1048.456 | 932.227 | 101.840 | 48.15 | 149.99 | ± 0.20 | T2B |
| 122 | 1049.427 | 941.260 | 101.610 | 48.15 | 149.76 | ± 0.20 | T2B |
| 123 | 1049.902 | 947.503 | 101.364 | 48.15 | 149.51 | ± 0.20 | T2B |
| 124 | 1050.071 | 950.004 | 101.040 | 48.15 | 149.19 | ± 0.20 | T2B |
| 125 | 1050.874 | 953.378 | 100.659 | 48.15 | 148.81 | ± 0.20 | T2B |
| 126 | 1054.953 | 958.796 | 100.075 | 48.15 | 148.22 | ± 0.20 | T2B |
| 127 | 1060.628 | 964.240 | 99.638 | 48.15 | 147.79 | ± 0.20 | T1 |
| 128 | 1068.282 | 970.190 | 97.830 | 48.15 | 145.98 | ± 0.20 | RIVER |
| 129 | 1011.902 | 1046.130 | 103.197 | 48.15 | 151.34 | ± 0.20 | T2A |
| 130 | 1004.724 | 566.021 | 113.239 | 48.15 | 161.39 | ± 0.20 | T4 |
| 131 | 1078.689 | 550.138 | 101.499 | 48.15 | 149.65 | ± 0.20 | RIVER |
| 132 | 1072.133 | 551.052 | 102.232 | 48.15 | 150.38 | ± 0.20 | RIVER |
| 133 | 1063.605 | 551.313 | 103.080 | 48.15 | 151.23 | ± 0.20 | T1 |
| 134 | 1054.314 | 553.799 | 103.059 | 48.15 | 151.21 | ± 0.20 | T1 |
| 135 | 1047.542 | 555.756 | 103.181 | 48.15 | 151.33 | ± 0.20 | T1 |
| 136 | 1010.006 | 563.624 | 113.392 | 48.15 | 161.54 | ± 0.20 | T4 |
| 137 | 1003.080 | 548.058 | 114.316 | 48.15 | 162.46 | ± 0.20 | T4 |
| 138 | 995.553 | 547.160 | 114.062 | 48.15 | 162.21 | ± 0.20 | T4 |
| 139 | 987.730 | 547.292 | 114.692 | 48.15 | 162.84 | ± 0.20 | T4 |
| 140 | 979.321 | 546.457 | 115.136 | 48.15 | 163.28 | ± 0.20 | T4 |
| 141 | 973.585 | 543.414 | 115.516 | 48.15 | 163.66 | ± 0.20 | SLOPE |
| 142 | 967.673 | 543.146 | 116.275 | 48.15 | 164.42 | ± 0.20 | SLOPE |
| 143 | 957.246 | 541.816 | 117.333 | 48.15 | 165.48 | ± 0.20 | SLOPE |
| 144 | 955.672 | 553.084 | 117.371 | 48.15 | 165.52 | ± 0.20 | T5 |

| Huntington River Location Aldrich 1 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 145 | 952.839 | 564.633 | 117.343 | 48.15 | 165.49 | ± 0.20 | T5 |
| 146 | 950.739 | 575.373 | 117.245 | 48.15 | 165.39 | ± 0.20 | T5 |
| 147 | 947.829 | 586.387 | 117.656 | 48.15 | 165.80 | ± 0.20 | T5 |
| 148 | 946.932 | 598.144 | 117.603 | 48.15 | 165.75 | ± 0.20 | T5 |
| 149 | 946.164 | 607.552 | 117.976 | 48.15 | 166.12 | ± 0.20 | T5 |
| 150 | 944.243 | 614.164 | 118.985 | 48.15 | 167.13 | ± 0.20 | SLOPE |
| 151 | 943.015 | 619.711 | 120.349 | 48.15 | 168.50 | ± 0.20 | SLOPE |
| 152 | 941.151 | 625.137 | 121.674 | 48.15 | 169.82 | ± 0.20 | SLOPE |
| 153 | 938.175 | 631.248 | 123.090 | 48.15 | 171.24 | ± 0.20 | SLOPE |
| 154 | 931.888 | 638.063 | 124.222 | 48.15 | 172.37 | ± 0.20 | SLOPE |
| 155 | 925.181 | 645.218 | 125.273 | 48.15 | 173.42 | ± 0.20 | SLOPE |
| 156 | 919.052 | 650.809 | 126.259 | 48.15 | 174.41 | ± 0.20 | SLOPE |
| 157 | 912.014 | 657.832 | 126.838 | 48.15 | 174.98 | ± 0.20 | T6 |
| 158 | 905.045 | 665.449 | 127.629 | 48.15 | 175.78 | ± 0.20 | T6 |
| 159 | 900.022 | 671.528 | 128.661 | 48.15 | 176.81 | ± 0.20 | T6 |
| 160 | 897.557 | 674.858 | 129.289 | 48.15 | 177.44 | ± 0.20 | T6 |
| 161 | 897.691 | 676.760 | 130.351 | 48.15 | 178.50 | ± 0.20 | SLOPE |
| 162 | 896.835 | 682.344 | 132.177 | 48.15 | 180.32 | ± 0.20 | SLOPE |
| 163 | 896.799 | 682.354 | 132.184 | 48.15 | 180.33 | ± 0.20 | T7 |
| 164 | 896.811 | 682.347 | 132.183 | 48.15 | 180.33 | ± 0.20 | T7 |
| 170 | 895.032 | 679.154 | 131.502 | 48.15 | 179.65 | ± 0.20 | SLOPE |
| 171 | 891.115 | 679.707 | 132.294 | 48.15 | 180.44 | ± 0.20 | T7 |
| 172 | 881.860 | 681.403 | 132.476 | 48.15 | 180.62 | ± 0.20 | T7 |
| 173 | 872.339 | 683.416 | 132.464 | 48.15 | 180.61 | ± 0.20 | T7 |
| 174 | 863.962 | 688.008 | 133.049 | 48.15 | 181.20 | ± 0.20 | T7 |
| 175 | 858.456 | 690.633 | 133.264 | 48.15 | 181.41 | ± 0.20 | T7 |
| 176 | 853.758 | 694.367 | 134.280 | 48.15 | 182.43 | ± 0.20 | SLOPE |
| 177 | 849.502 | 698.165 | 135.560 | 48.15 | 183.71 | ± 0.20 | SLOPE |
| 178 | 845.926 | 703.437 | 136.792 | 48.15 | 184.94 | ± 0.20 | SLOPE |
| 179 | 842.275 | 708.008 | 137.868 | 48.15 | 186.02 | ± 0.20 | SLOPE |
| 180 | 838.821 | 710.285 | 138.324 | 48.15 | 186.47 | ± 0.20 | SLOPE |
| 181 | 834.400 | 712.710 | 139.670 | 48.15 | 187.82 | ± 0.20 | SLOPE |
| 182 | 830.359 | 715.135 | 141.141 | 48.15 | 189.29 | ± 0.20 | SLOPE |
| 183 | 824.724 | 717.851 | 142.930 | 48.15 | 191.08 | ± 0.20 | T8 |
| 184 | 819.093 | 721.951 | 142.990 | 48.15 | 191.14 | ± 0.20 | T8 |
| 185 | 814.804 | 725.214 | 142.971 | 48.15 | 191.12 | ± 0.20 | T8 |
| 186 | 807.061 | 712.210 | 142.867 | 48.15 | 191.01 | ± 0.20 | T8 |
| 187 | 826.841 | 721.227 | 142.830 | 48.15 | 190.98 | ± 0.20 | T8 |
| 188 | 827.691 | 732.709 | 142.856 | 48.15 | 191.00 | ± 0.20 | T8 |
| 189 | 826.050 | 742.844 | 142.696 | 48.15 | 190.84 | ± 0.20 | T8 |
| 190 | 820.312 | 746.939 | 142.883 | 48.15 | 191.03 | ± 0.20 | T8 |
| 191 | 815.451 | 756.407 | 142.838 | 48.15 | 190.99 | ± 0.20 | T8 |
| 192 | 808.834 | 772.391 | 143.178 | 48.15 | 191.33 | ± 0.20 | T8 |
| 193 | 806.675 | 792.603 | 143.429 | 48.15 | 191.58 | ± 0.20 | T8 |
| 194 | 823.499 | 770.283 | 142.512 | 48.15 | 190.66 | ± 0.20 | T8 |
| 195 | 826.976 | 756.612 | 141.892 | 48.15 | 190.04 | ± 0.20 | T8 |
| 196 | 892.185 | 692.543 | 132.272 | 48.15 | 180.42 | ± 0.20 | T7 |
| 197 | 893.520 | 704.761 | 132.138 | 48.15 | 180.28 | ± 0.20 | T7 |
| 198 | 903.023 | 713.943 | 132.094 | 48.15 | 180.24 | ± 0.20 | T7 |
| 199 | 917.039 | 707.167 | 131.910 | 48.15 | 180.06 | ± 0.20 | T7 |

| Huntington River Location Aldrich 1 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| Note: These elevations are tied to the Benchmark MAYOAZMK (160.75 m ± 0.05 m) on the bridge south of here via: ALD1 Pt 130 = ALMO Pt 87; ALMO Pt 87 = MOUL Pt 249; MOUL Pt 3 = TOM2 Pt 16; TOM2 Pt 3 = Benchmark | | | | | | | |

| Huntington River Location Aldrich 3 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 51.31 | 151.31 | ± 0.20 | T2A |
| 2 | 1000.000 | 1000.000 | 100.000 | 51.31 | 151.31 | ± 0.20 | T2A |
| 3 | 983.367 | 968.029 | 94.840 | 51.31 | 146.15 | ± 0.20 | RIVER |
| 4 | 982.717 | 966.343 | 95.979 | 51.31 | 147.29 | ± 0.20 | T1 |
| 5 | 980.901 | 963.065 | 96.130 | 51.31 | 147.44 | ± 0.20 | T1 |
| 6 | 980.027 | 961.546 | 96.469 | 51.31 | 147.78 | ± 0.20 | T1 |
| 7 | 977.877 | 957.147 | 96.880 | 51.31 | 148.19 | ± 0.20 | T2B |
| 8 | 974.709 | 950.645 | 97.065 | 51.31 | 148.37 | ± 0.20 | T2B |
| 9 | 972.746 | 945.380 | 97.107 | 51.31 | 148.41 | ± 0.20 | T2B |
| 10 | 970.567 | 940.744 | 97.221 | 51.31 | 148.53 | ± 0.20 | T2B |
| 11 | 969.582 | 938.129 | 97.438 | 51.31 | 148.75 | ± 0.20 | SLOPE |
| 12 | 967.691 | 933.725 | 97.853 | 51.31 | 149.16 | ± 0.20 | SLOPE |
| 13 | 964.912 | 929.178 | 98.191 | 51.31 | 149.50 | ± 0.20 | T2B |
| 14 | 959.081 | 918.287 | 97.908 | 51.31 | 149.22 | ± 0.20 | T2B |
| 15 | 953.447 | 903.420 | 97.952 | 51.31 | 149.26 | ± 0.20 | T2B |
| 16 | 944.291 | 886.991 | 98.137 | 51.31 | 149.44 | ± 0.20 | T2B |
| 17 | 935.151 | 867.530 | 97.833 | 51.31 | 149.14 | ± 0.20 | T2B |
| 18 | 923.464 | 844.629 | 98.022 | 51.31 | 149.33 | ± 0.20 | T2B |
| 19 | 913.756 | 816.490 | 98.393 | 51.31 | 149.70 | ± 0.20 | T2B |
| 20 | 901.221 | 786.413 | 98.620 | 51.31 | 149.93 | ± 0.20 | T2B |
| 21 | 893.658 | 769.282 | 99.052 | 51.31 | 150.36 | ± 0.20 | SLOPE |
| 22 | 893.347 | 765.955 | 99.308 | 51.31 | 150.62 | ± 0.20 | SLOPE |
| 23 | 892.650 | 760.343 | 99.637 | 51.31 | 150.94 | ± 0.20 | SLOPE |
| 24 | 892.644 | 760.345 | 99.637 | 51.31 | 150.94 | ± 0.20 | SLOPE |
| 25 | 890.905 | 752.941 | 99.548 | 51.31 | 150.86 | ± 0.20 | T2A |
| 26 | 888.789 | 743.501 | 99.620 | 51.31 | 150.93 | ± 0.20 | T2A |
| 27 | 886.297 | 730.171 | 100.270 | 51.31 | 151.58 | ± 0.20 | T2A |
| 28 | 861.176 | 820.939 | 101.867 | 51.31 | 153.17 | ± 0.20 | FAN |
| 29 | 864.638 | 827.797 | 101.365 | 51.31 | 152.67 | ± 0.20 | FAN |
| 30 | 875.467 | 835.967 | 99.930 | 51.31 | 151.24 | ± 0.20 | FAN |
| 31 | 892.222 | 850.310 | 98.806 | 51.31 | 150.11 | ± 0.20 | FAN |
| 32 | 900.321 | 862.109 | 98.350 | 51.31 | 149.66 | ± 0.20 | T2B |
| 33 | 910.338 | 876.099 | 98.061 | 51.31 | 149.37 | ± 0.20 | T2B |
| 34 | 932.459 | 907.651 | 97.634 | 51.31 | 148.94 | ± 0.20 | T2B |
| 35 | 937.988 | 915.743 | 97.664 | 51.31 | 148.97 | ± 0.20 | T2B |
| 36 | 945.565 | 925.423 | 97.712 | 51.31 | 149.02 | ± 0.20 | T2B |
| 37 | 951.936 | 932.602 | 97.864 | 51.31 | 149.17 | ± 0.20 | T2B |
| 38 | 954.627 | 936.627 | 97.704 | 51.31 | 149.01 | ± 0.20 | SLOPE |
| 39 | 956.859 | 940.285 | 97.497 | 51.31 | 148.80 | ± 0.20 | SLOPE |
| 40 | 959.393 | 943.920 | 97.137 | 51.31 | 148.44 | ± 0.20 | SLOPE |
| 41 | 962.696 | 948.100 | 97.040 | 51.31 | 148.35 | ± 0.20 | T2B |
| 42 | 967.449 | 954.208 | 97.021 | 51.31 | 148.33 | ± 0.20 | T2B |
| 43 | 971.248 | 959.494 | 96.889 | 51.31 | 148.20 | ± 0.20 | SLOPE |
| 44 | 971.250 | 959.498 | 96.887 | 51.31 | 148.19 | ± 0.20 | SLOPE |
| 45 | 974.596 | 964.649 | 96.546 | 51.31 | 147.85 | ± 0.20 | SLOPE |
| 46 | 976.694 | 968.411 | 96.060 | 51.31 | 147.37 | ± 0.20 | T1 |
| 47 | 979.105 | 971.250 | 94.735 | 51.31 | 146.04 | ± 0.20 | RIVER |
| 48 | 935.329 | 956.931 | 96.840 | 51.31 | 148.15 | ± 0.20 | T2B |
| 49 | 1020.050 | 1017.850 | 100.594 | 51.31 | 151.90 | ± 0.20 | T2A |
| 50 | 990.665 | 1015.463 | 100.618 | 51.31 | 151.93 | ± 0.20 | T2A |

| Huntington River Location Aldrich 3 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 51 | 988.914 | 1020.959 | 100.616 | 51.31 | 151.92 | ± 0.20 | T2A |
| 52 | 988.912 | 1020.962 | 100.616 | 51.31 | 151.92 | ± 0.20 | ROAD |
| 53 | 1015.116 | 1037.690 | 101.005 | 51.31 | 152.31 | ± 0.20 | ROAD |
| 54 | 1008.295 | 1030.196 | 101.153 | 51.31 | 152.46 | ± 0.20 | ROAD |
| 55 | 1008.992 | 1016.178 | 101.028 | 51.31 | 152.34 | ± 0.20 | ROAD |
| 56 | 1015.590 | 1016.837 | 100.855 | 51.31 | 152.16 | ± 0.20 | ROAD |
| 57 | 1018.910 | 1003.246 | 100.614 | 51.31 | 151.92 | ± 0.20 | ROAD |
| 58 | 1011.796 | 1001.949 | 100.959 | 51.31 | 152.27 | ± 0.20 | ROAD |
| Note: These elevations are tied to the Benchmark MAYOAZMK (160.75 m ± 0.05 m) on the bridge south of here via: ALD3 Pt 48 = ALD1 Pt 1; ALD1 Pt 130 = ALMO Pt 87; ALMO Pt 87 = MOUL Pt 249; MOUL Pt 3 = TOM2 Pt 16; TOM2 Pt 3 = Benchmark | | | | | | | |

| Huntington River Location Aldrich-Moultrop | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 66.01 | 166.01 | ± 0.20 | T5 |
| 2 | 1000.000 | 1000.000 | 100.000 | 66.01 | 166.01 | ± 0.20 | T5 |
| 3 | 1070.833 | 979.843 | 99.368 | 66.01 | 165.38 | ± 0.20 | T5 |
| 4 | 1065.883 | 987.753 | 99.425 | 66.01 | 165.43 | ± 0.20 | T5 |
| 5 | 1064.237 | 994.816 | 99.330 | 66.01 | 165.34 | ± 0.20 | T5 |
| 6 | 1058.278 | 1000.930 | 99.460 | 66.01 | 165.47 | ± 0.20 | T5 |
| 7 | 1051.638 | 1013.071 | 99.852 | 66.01 | 165.86 | ± 0.20 | T5 |
| 8 | 1049.074 | 1019.324 | 99.838 | 66.01 | 165.85 | ± 0.20 | T5 |
| 9 | 1043.023 | 1027.450 | 99.990 | 66.01 | 166.00 | ± 0.20 | T5 |
| 10 | 1032.830 | 1026.135 | 100.091 | 66.01 | 166.10 | ± 0.20 | T5 |
| 11 | 1023.186 | 1026.843 | 100.211 | 66.01 | 166.22 | ± 0.20 | T5 |
| 12 | 1014.268 | 1025.786 | 100.434 | 66.01 | 166.44 | ± 0.20 | T5 |
| 13 | 1005.920 | 1023.983 | 100.511 | 66.01 | 166.52 | ± 0.20 | T5 |
| 14 | 992.904 | 1015.990 | 100.362 | 66.01 | 166.37 | ± 0.20 | T5 |
| 15 | 981.886 | 1016.264 | 100.504 | 66.01 | 166.51 | ± 0.20 | T5 |
| 16 | 985.026 | 1028.120 | 101.798 | 66.01 | 167.81 | ± 0.20 | SLOPE |
| 17 | 985.196 | 1034.713 | 102.775 | 66.01 | 168.78 | ± 0.20 | SLOPE |
| 18 | 986.110 | 1042.358 | 104.024 | 66.01 | 170.03 | ± 0.20 | SLOPE |
| 19 | 987.357 | 1052.869 | 105.996 | 66.01 | 172.01 | ± 0.20 | SLOPE |
| 20 | 990.173 | 1062.805 | 107.575 | 66.01 | 173.58 | ± 0.20 | SLOPE |
| 21 | 990.173 | 1062.812 | 107.576 | 66.01 | 173.59 | ± 0.20 | SLOPE |
| 22 | 991.644 | 1071.373 | 108.735 | 66.01 | 174.74 | ± 0.20 | T6 |
| 23 | 982.033 | 1073.364 | 108.877 | 66.01 | 174.89 | ± 0.20 | T6 |
| 24 | 989.537 | 1079.982 | 109.387 | 66.01 | 175.40 | ± 0.20 | T6 |
| 25 | 995.512 | 1078.697 | 109.171 | 66.01 | 175.18 | ± 0.20 | T6 |
| 26 | 1005.837 | 1078.723 | 108.916 | 66.01 | 174.93 | ± 0.20 | T6 |
| 27 | 1004.567 | 1086.862 | 109.460 | 66.01 | 175.47 | ± 0.20 | T6 |
| 28 | 1002.894 | 1092.291 | 110.110 | 66.01 | 176.12 | ± 0.20 | SLOPE |
| 29 | 1000.949 | 1098.141 | 111.214 | 66.01 | 177.22 | ± 0.20 | SLOPE |
| 30 | 1000.949 | 1098.149 | 111.215 | 66.01 | 177.22 | ± 0.20 | SLOPE |
| 31 | 989.749 | 1095.161 | 111.735 | 66.01 | 177.74 | ± 0.20 | SLOPE |
| 32 | 980.767 | 1097.357 | 114.259 | 66.01 | 180.27 | ± 0.20 | T7 |
| 33 | 978.976 | 1107.217 | 114.729 | 66.01 | 180.74 | ± 0.20 | T7 |
| 34 | 987.420 | 1111.986 | 114.653 | 66.01 | 180.66 | ± 0.20 | T7 |
| 35 | 987.416 | 1111.997 | 114.654 | 66.01 | 180.66 | ± 0.20 | T7 |
| 36 | 978.208 | 1110.325 | 114.872 | 66.01 | 180.88 | ± 0.20 | T7 |
| 37 | 978.206 | 1110.333 | 114.873 | 66.01 | 180.88 | ± 0.20 | T7 |
| 38 | 957.722 | 1125.597 | 118.009 | 66.01 | 184.02 | ± 0.20 | SLOPE |
| 39 | 957.725 | 1125.589 | 118.008 | 66.01 | 184.02 | ± 0.20 | SLOPE |
| 40 | 925.011 | 1129.247 | 121.396 | 66.01 | 187.41 | ± 0.20 | SLOPE |
| 41 | 928.141 | 1141.897 | 125.073 | 66.01 | 191.08 | ± 0.20 | T8 |
| 42 | 913.013 | 1143.170 | 125.082 | 66.01 | 191.09 | ± 0.20 | T8 |
| 43 | 917.360 | 1146.604 | 125.122 | 66.01 | 191.13 | ± 0.20 | T8 |
| 44 | 1060.810 | 964.874 | 99.505 | 66.01 | 165.51 | ± 0.20 | T5 |
| 45 | 1112.045 | 990.519 | 95.377 | 66.01 | 161.39 | ± 0.20 | SLOPE |
| 46 | 1105.814 | 974.761 | 96.219 | 66.01 | 162.23 | ± 0.20 | T4 |
| 47 | 1105.381 | 967.514 | 96.267 | 66.01 | 162.28 | ± 0.20 | T4 |
| 48 | 1105.479 | 963.723 | 95.852 | 66.01 | 161.86 | ± 0.20 | T4 |
| 49 | 1105.654 | 961.025 | 95.145 | 66.01 | 161.15 | ± 0.20 | SLOPE |
| 50 | 1105.823 | 958.210 | 94.566 | 66.01 | 160.57 | ± 0.20 | SLOPE |

| Huntington River Location Aldrich-Moultrop | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 51 | 1106.434 | 955.988 | 93.796 | 66.01 | 159.81 | ± 0.20 | SLOPE |
| 52 | 1107.346 | 955.264 | 93.471 | 66.01 | 159.48 | ± 0.20 | SLOPE |
| 53 | 1108.039 | 952.629 | 93.072 | 66.01 | 159.08 | ± 0.20 | T3A |
| 54 | 1108.438 | 948.697 | 92.873 | 66.01 | 158.88 | ± 0.20 | T3A |
| 55 | 1108.493 | 944.072 | 92.734 | 66.01 | 158.74 | ± 0.20 | T3A |
| 56 | 1108.161 | 940.973 | 92.375 | 66.01 | 158.38 | ± 0.20 | SLOPE |
| 57 | 1108.140 | 940.984 | 92.378 | 66.01 | 158.39 | ± 0.20 | SLOPE |
| 58 | 1107.896 | 937.568 | 91.876 | 66.01 | 157.89 | ± 0.20 | SLOPE |
| 59 | 1108.478 | 934.588 | 91.590 | 66.01 | 157.60 | ± 0.20 | T3B |
| 60 | 1108.273 | 930.777 | 91.502 | 66.01 | 157.51 | ± 0.20 | T3B |
| 61 | 1108.850 | 927.541 | 91.508 | 66.01 | 157.52 | ± 0.20 | T3B |
| 62 | 1109.815 | 923.484 | 91.444 | 66.01 | 157.45 | ± 0.20 | T3B |
| 63 | 1110.380 | 918.489 | 91.291 | 66.01 | 157.30 | ± 0.20 | T3B |
| 64 | 1111.242 | 915.466 | 91.155 | 66.01 | 157.16 | ± 0.20 | T3B |
| 65 | 1103.933 | 911.764 | 91.392 | 66.01 | 157.40 | ± 0.20 | T3B |
| 66 | 1104.621 | 909.483 | 91.174 | 66.01 | 157.18 | ± 0.20 | T3B |
| 67 | 1105.664 | 907.968 | 90.902 | 66.01 | 156.91 | ± 0.20 | SLOPE |
| 68 | 1106.896 | 906.034 | 90.686 | 66.01 | 156.70 | ± 0.20 | SLOPE |
| 69 | 1106.906 | 906.020 | 90.686 | 66.01 | 156.70 | ± 0.20 | SLOPE |
| 70 | 1107.472 | 904.673 | 90.520 | 66.01 | 156.53 | ± 0.20 | SLOPE |
| 71 | 1108.097 | 903.202 | 90.414 | 66.01 | 156.42 | ± 0.20 | T2A |
| 72 | 1108.762 | 900.557 | 90.293 | 66.01 | 156.30 | ± 0.20 | T2A |
| 73 | 1109.371 | 896.580 | 90.362 | 66.01 | 156.37 | ± 0.20 | T2A |
| 74 | 1109.153 | 892.781 | 90.207 | 66.01 | 156.22 | ± 0.20 | T2A |
| 75 | 1109.604 | 888.213 | 89.971 | 66.01 | 155.98 | ± 0.20 | T2A |
| 76 | 1110.672 | 884.949 | 89.624 | 66.01 | 155.63 | ± 0.20 | T2B |
| 77 | 1089.764 | 916.678 | 91.638 | 66.01 | 157.65 | ± 0.20 | T3B |
| 78 | 1087.495 | 916.776 | 91.401 | 66.01 | 157.41 | ± 0.20 | T3B |
| 79 | 1084.420 | 917.041 | 91.042 | 66.01 | 157.05 | ± 0.20 | SLOPE |
| 80 | 1083.860 | 915.558 | 90.508 | 66.01 | 156.52 | ± 0.20 | SLOPE |
| 81 | 1081.310 | 914.109 | 89.451 | 66.01 | 155.46 | ± 0.20 | T2B |
| 82 | 1079.094 | 913.236 | 88.898 | 66.01 | 154.91 | ± 0.20 | T2B |
| 83 | 1075.576 | 911.347 | 88.569 | 66.01 | 154.58 | ± 0.20 | T2B |
| 84 | 1053.227 | 908.049 | 88.514 | 66.01 | 154.52 | ± 0.20 | T2B |
| 85 | 1032.619 | 906.670 | 88.755 | 66.01 | 154.76 | ± 0.20 | T2B |
| 86 | 1032.619 | 906.672 | 88.755 | 66.01 | 154.76 | ± 0.20 | T2B |
| 87 | 946.599 | 903.313 | 89.211 | 66.01 | 155.22 | ± 0.20 | T2B |
| 88 | 996.145 | 1001.997 | 99.790 | 66.01 | 165.80 | ± 0.20 | T5 |
| 89 | 994.506 | 998.021 | 98.264 | 66.01 | 164.27 | ± 0.20 | SLOPE |
| 90 | 993.263 | 996.414 | 96.894 | 66.01 | 162.90 | ± 0.20 | SLOPE |
| 91 | 992.626 | 994.585 | 95.834 | 66.01 | 161.84 | ± 0.20 | SLOPE |
| 92 | 991.066 | 992.848 | 94.482 | 66.01 | 160.49 | ± 0.20 | SLOPE |
| 93 | 989.955 | 989.678 | 93.165 | 66.01 | 159.17 | ± 0.20 | SLOPE |
| 94 | 988.034 | 983.966 | 92.494 | 66.01 | 158.50 | ± 0.20 | T3A |
| 95 | 984.022 | 979.138 | 92.429 | 66.01 | 158.44 | ± 0.20 | T3A |
| 96 | 972.571 | 977.829 | 92.549 | 66.01 | 158.56 | ± 0.20 | T3A |
| 97 | 967.373 | 971.802 | 92.240 | 66.01 | 158.25 | ± 0.20 | SLOPE |
| 98 | 962.981 | 966.822 | 91.810 | 66.01 | 157.82 | ± 0.20 | SLOPE |
| 99 | 959.798 | 963.636 | 91.119 | 66.01 | 157.13 | ± 0.20 | SLOPE |
| 100 | 955.217 | 958.649 | 90.538 | 66.01 | 156.55 | ± 0.20 | SLOPE |

| Huntington River Location Aldrich-Moultrop | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 101 | 951.215 | 952.375 | 90.095 | 66.01 | 156.10 | ± 0.20 | T2A |
| 102 | 948.160 | 945.877 | 89.461 | 66.01 | 155.47 | ± 0.20 | T2A |
| 103 | 937.856 | 937.321 | 89.143 | 66.01 | 155.15 | ± 0.20 | T2A |
| 104 | 926.831 | 933.937 | 89.368 | 66.01 | 155.38 | ± 0.20 | T2A |
| 105 | 916.510 | 931.979 | 89.977 | 66.01 | 155.99 | ± 0.20 | T2A |
| 106 | 901.659 | 931.712 | 89.774 | 66.01 | 155.78 | ± 0.20 | T2A |
| 107 | 887.807 | 927.853 | 89.759 | 66.01 | 155.77 | ± 0.20 | T2A |
| 108 | 875.779 | 932.286 | 89.784 | 66.01 | 155.79 | ± 0.20 | T2A |
| 109 | 864.985 | 936.961 | 90.270 | 66.01 | 156.28 | ± 0.20 | T2A |
| 110 | 838.182 | 921.283 | 89.608 | 66.01 | 155.62 | ± 0.20 | T2B |
| 111 | 822.705 | 921.884 | 89.351 | 66.01 | 155.36 | ± 0.20 | T2B |
| 112 | 807.248 | 922.171 | 89.061 | 66.01 | 155.07 | ± 0.20 | T2B |
| 113 | 792.814 | 923.442 | 88.884 | 66.01 | 154.89 | ± 0.20 | T2B |
| 114 | 777.773 | 924.508 | 88.848 | 66.01 | 154.86 | ± 0.20 | T2B |
| 115 | 758.007 | 931.157 | 89.174 | 66.01 | 155.18 | ± 0.20 | T2B |
| 116 | 774.557 | 911.146 | 88.368 | 66.01 | 154.38 | ± 0.20 | T2B |
| 117 | 788.658 | 906.120 | 88.430 | 66.01 | 154.44 | ± 0.20 | T2B |
| 118 | 797.238 | 899.184 | 88.374 | 66.01 | 154.38 | ± 0.20 | T2B |
| 119 | 808.351 | 893.868 | 88.365 | 66.01 | 154.37 | ± 0.20 | T2B |
| 120 | 819.259 | 886.118 | 88.426 | 66.01 | 154.44 | ± 0.20 | T2B |
| 121 | 830.551 | 873.667 | 88.328 | 66.01 | 154.34 | ± 0.20 | T2B |
| 122 | 841.797 | 865.570 | 88.390 | 66.01 | 154.40 | ± 0.20 | T2B |
| 123 | 855.802 | 866.036 | 88.212 | 66.01 | 154.22 | ± 0.20 | T2B |
| 124 | 867.845 | 865.923 | 88.197 | 66.01 | 154.21 | ± 0.20 | T2B |
| 125 | 880.810 | 866.954 | 87.932 | 66.01 | 153.94 | ± 0.20 | T1 |
| 126 | 896.431 | 867.699 | 87.788 | 66.01 | 153.80 | ± 0.20 | T1 |
| 127 | 914.677 | 872.143 | 87.476 | 66.01 | 153.48 | ± 0.20 | T1 |
| 128 | 933.567 | 876.524 | 88.001 | 66.01 | 154.01 | ± 0.20 | T1 |
| 129 | 944.461 | 876.916 | 88.097 | 66.01 | 154.11 | ± 0.20 | SLOPE |
| 130 | 944.040 | 874.324 | 87.747 | 66.01 | 153.76 | ± 0.20 | T1 |
| 131 | 943.942 | 872.714 | 87.400 | 66.01 | 153.41 | ± 0.20 | T1 |
| 132 | 944.038 | 871.331 | 86.721 | 66.01 | 152.73 | ± 0.20 | T1 |
| 133 | 943.687 | 869.870 | 86.001 | 66.01 | 152.01 | ± 0.20 | T0 |
| 134 | 943.806 | 867.442 | 85.672 | 66.01 | 151.68 | ± 0.20 | T0 |
| 135 | 942.655 | 861.259 | 86.032 | 66.01 | 152.04 | ± 0.20 | T0 |
| 136 | 954.804 | 853.040 | 86.154 | 66.01 | 152.16 | ± 0.20 | T0 |
| 137 | 966.740 | 847.292 | 86.135 | 66.01 | 152.14 | ± 0.20 | T0 |
| 138 | 976.452 | 853.456 | 86.084 | 66.01 | 152.09 | ± 0.20 | T0 |
| 139 | 987.599 | 850.578 | 85.907 | 66.01 | 151.92 | ± 0.20 | T0 |
| 140 | 997.183 | 846.581 | 85.955 | 66.01 | 151.96 | ± 0.20 | T0 |
| 141 | 1013.152 | 845.897 | 85.907 | 66.01 | 151.92 | ± 0.20 | T0 |
| 142 | 1021.070 | 837.401 | 85.844 | 66.01 | 151.85 | ± 0.20 | T0 |
| 143 | 1023.199 | 825.213 | 85.914 | 66.01 | 151.92 | ± 0.20 | T0 |
| 144 | 1027.523 | 820.836 | 85.356 | 66.01 | 151.36 | ± 0.20 | T0 |
| 145 | 1031.426 | 816.846 | 85.322 | 66.01 | 151.33 | ± 0.20 | T0 |
| 146 | 1034.248 | 814.246 | 85.023 | 66.01 | 151.03 | ± 0.20 | T0 |
| 147 | 1042.649 | 805.463 | 85.614 | 66.01 | 151.62 | ± 0.20 | T0 |
| 148 | 1055.838 | 791.356 | 85.574 | 66.01 | 151.58 | ± 0.20 | T0 |
| 149 | 1063.052 | 783.765 | 85.108 | 66.01 | 151.12 | ± 0.20 | T0 |
| 150 | 1070.035 | 778.336 | 84.641 | 66.01 | 150.65 | ± 0.20 | RIVER |

| Huntington River Location Aldrich-Moultrop | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 151 | 1018.819 | 770.384 | 85.338 | 66.01 | 151.35 | ± 0.20 | T0 |
| 152 | 1013.007 | 781.540 | 85.461 | 66.01 | 151.47 | ± 0.20 | T0 |
| 153 | 1004.820 | 798.111 | 85.786 | 66.01 | 151.79 | ± 0.20 | T0 |
| 154 | 998.609 | 809.211 | 85.877 | 66.01 | 151.89 | ± 0.20 | T0 |
| 155 | 985.132 | 821.252 | 86.131 | 66.01 | 152.14 | ± 0.20 | T0 |
| 156 | 980.390 | 831.377 | 86.322 | 66.01 | 152.33 | ± 0.20 | T1 |
| 157 | 960.311 | 829.421 | 86.454 | 66.01 | 152.46 | ± 0.20 | T1 |
| 158 | 966.268 | 745.806 | 86.695 | 66.01 | 152.70 | ± 0.20 | T1 |
| 159 | 967.083 | 736.020 | 86.592 | 66.01 | 152.60 | ± 0.20 | T1 |
| 160 | 968.056 | 724.442 | 86.953 | 66.01 | 152.96 | ± 0.20 | T1 |
| 161 | 969.018 | 714.403 | 86.772 | 66.01 | 152.78 | ± 0.20 | T1 |
| 162 | 970.856 | 701.553 | 86.851 | 66.01 | 152.86 | ± 0.20 | T1 |
| 163 | 972.075 | 689.095 | 86.863 | 66.01 | 152.87 | ± 0.20 | T1 |
| 164 | 975.633 | 662.462 | 87.000 | 66.01 | 153.01 | ± 0.20 | T1 |
| 165 | 978.400 | 650.303 | 87.066 | 66.01 | 153.08 | ± 0.20 | T1 |
| 166 | 979.269 | 640.766 | 87.108 | 66.01 | 153.12 | ± 0.20 | T1 |
| 167 | 980.938 | 628.929 | 87.133 | 66.01 | 153.14 | ± 0.20 | T1 |
| 168 | 983.085 | 618.115 | 86.911 | 66.01 | 152.92 | ± 0.20 | T1 |
| 169 | 983.086 | 618.104 | 86.911 | 66.01 | 152.92 | ± 0.20 | T1 |
| 170 | 983.353 | 600.762 | 87.046 | 66.01 | 153.06 | ± 0.20 | T1 |
| 171 | 987.302 | 586.737 | 87.006 | 66.01 | 153.02 | ± 0.20 | T1 |
| 172 | 988.155 | 574.109 | 87.064 | 66.01 | 153.07 | ± 0.20 | T1 |
| 173 | 990.671 | 564.303 | 87.231 | 66.01 | 153.24 | ± 0.20 | T1 |
| 174 | 990.768 | 556.321 | 87.693 | 66.01 | 153.70 | ± 0.20 | T1 |
| 175 | 863.663 | 726.542 | 87.228 | 66.01 | 153.24 | ± 0.20 | T1 |
| 176 | 857.707 | 713.141 | 87.003 | 66.01 | 153.01 | ± 0.20 | T1 |
| 177 | 851.218 | 699.401 | 87.678 | 66.01 | 153.69 | ± 0.20 | T1 |
| 178 | 783.117 | 648.446 | 95.047 | 66.01 | 161.06 | ± 0.20 | T4A |
| Note: These elevations are tied to the Benchmark MAYOAZMK (160.75 m ± 0.05 m) on the bridge south of here via: ALMO Pt 87 = MOUL Pt 249; MOUL Pt 3 = TOM2 Pt 16; TOM2 Pt 3 = Benchmark | | | | | | | |

| Huntington River Location Road | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 77.65 | 177.65 | ± 0.20 | ROAD |
| 2 | 1000.000 | 1000.000 | 100.000 | 77.65 | 177.65 | ± 0.20 | ROAD |
| 3 | 865.534 | 1112.620 | 90.364 | 77.65 | 168.01 | ± 0.20 | ROAD |
| 4 | 880.304 | 1102.070 | 91.033 | 77.65 | 168.68 | ± 0.20 | ROAD |
| 5 | 876.439 | 1096.421 | 90.830 | 77.65 | 168.48 | ± 0.20 | ROAD |
| 6 | 918.276 | 1061.379 | 93.833 | 77.65 | 171.48 | ± 0.20 | ROAD |
| 7 | 923.775 | 1065.580 | 93.781 | 77.65 | 171.43 | ± 0.20 | ROAD |
| 8 | 953.364 | 1031.535 | 96.244 | 77.65 | 173.89 | ± 0.20 | ROAD |
| 9 | 958.624 | 1035.888 | 96.215 | 77.65 | 173.86 | ± 0.20 | ROAD |
| 10 | 980.324 | 1012.048 | 98.544 | 77.65 | 176.19 | ± 0.20 | ROAD |
| 11 | 984.695 | 1017.771 | 98.351 | 77.65 | 176.00 | ± 0.20 | ROAD |
| 12 | 1003.308 | 1007.562 | 99.844 | 77.65 | 177.49 | ± 0.20 | ROAD |
| 13 | 1034.156 | 993.723 | 102.687 | 77.65 | 180.33 | ± 0.20 | ROAD |
| 14 | 1030.103 | 988.087 | 102.723 | 77.65 | 180.37 | ± 0.20 | ROAD |
| 15 | 1072.748 | 969.384 | 106.794 | 77.65 | 184.44 | ± 0.20 | ROAD |
| 16 | 1075.086 | 975.868 | 106.788 | 77.65 | 184.44 | ± 0.20 | ROAD |
| 17 | 1109.670 | 961.122 | 110.041 | 77.65 | 187.69 | ± 0.20 | ROAD |
| 18 | 1106.027 | 955.303 | 110.016 | 77.65 | 187.66 | ± 0.20 | ROAD |
| 19 | 1130.836 | 943.593 | 112.068 | 77.65 | 189.72 | ± 0.20 | ROAD |
| 20 | 1134.158 | 949.306 | 112.190 | 77.65 | 189.84 | ± 0.20 | ROAD |
| 21 | 1148.997 | 940.761 | 113.386 | 77.65 | 191.03 | ± 0.20 | ROAD |
| 22 | 1163.455 | 929.929 | 114.148 | 77.65 | 191.80 | ± 0.20 | ROAD |
| 23 | 1022.867 | 1026.485 | 113.970 | 77.65 | 191.62 | ± 0.20 | T8 |
| 24 | 1170.057 | 925.832 | 114.190 | 77.65 | 191.84 | ± 0.20 | T8 |
| 25 | 1170.163 | 925.987 | 114.165 | 77.65 | 191.81 | ± 0.20 | T8 |
| 26 | 1000.018 | 999.992 | 99.879 | 77.65 | 177.53 | ± 0.20 | T8 |
| 27 | 1172.018 | 936.865 | 113.621 | 77.65 | 191.27 | ± 0.20 | T8 |
| 28 | 1180.704 | 986.197 | 113.818 | 77.65 | 191.47 | ± 0.20 | T8 |
| 29 | 1182.903 | 998.015 | 113.709 | 77.65 | 191.36 | ± 0.20 | T8 |
| 30 | 1185.983 | 1013.536 | 113.609 | 77.65 | 191.26 | ± 0.20 | T8 |
| 31 | 1203.639 | 914.877 | 113.407 | 77.65 | 191.05 | ± 0.20 | T8 |
| 32 | 1228.307 | 906.078 | 113.563 | 77.65 | 191.21 | ± 0.20 | T8 |
| 33 | 1254.415 | 897.017 | 113.906 | 77.65 | 191.55 | ± 0.20 | T8 |
| 34 | 1281.602 | 890.133 | 113.904 | 77.65 | 191.55 | ± 0.20 | T8 |
| 35 | 1302.132 | 882.566 | 113.855 | 77.65 | 191.50 | ± 0.20 | T8 |
| 36 | 1324.880 | 874.131 | 113.959 | 77.65 | 191.61 | ± 0.20 | T8 |
| 37 | 1360.761 | 861.483 | 113.765 | 77.65 | 191.41 | ± 0.20 | T8 |
| 38 | 1381.918 | 859.514 | 113.842 | 77.65 | 191.49 | ± 0.20 | T8 |
| 39 | 1166.415 | 918.574 | 113.774 | 77.65 | 191.42 | ± 0.20 | ROAD |
| 40 | 1203.256 | 877.973 | 114.151 | 77.65 | 191.80 | ± 0.20 | ROAD |
| 41 | 1208.677 | 882.404 | 114.255 | 77.65 | 191.90 | ± 0.20 | ROAD |
| 42 | 1242.928 | 842.349 | 114.283 | 77.65 | 191.93 | ± 0.20 | ROAD |
| 43 | 1236.642 | 838.952 | 114.253 | 77.65 | 191.90 | ± 0.20 | ROAD |
| 44 | 1277.636 | 790.302 | 114.106 | 77.65 | 191.75 | ± 0.20 | ROAD |
| 45 | 1283.104 | 794.306 | 114.295 | 77.65 | 191.94 | ± 0.20 | ROAD |
| 46 | 1331.547 | 735.070 | 114.292 | 77.65 | 191.94 | ± 0.20 | ROAD |
| 47 | 1331.550 | 735.066 | 114.292 | 77.65 | 191.94 | ± 0.20 | ROAD |
| 48 | 1325.487 | 731.579 | 114.244 | 77.65 | 191.89 | ± 0.20 | ROAD |
| 49 | 1272.761 | 697.502 | 113.673 | 77.65 | 191.32 | ± 0.20 | T8 |
| 50 | 1241.887 | 672.377 | 113.731 | 77.65 | 191.38 | ± 0.20 | T8 |

| Huntington River Location Road | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 51 | 1207.724 | 652.277 | 113.408 | 77.65 | 191.06 | ± 0.20 | T8 |
| 52 | 1165.119 | 709.298 | 113.624 | 77.65 | 191.27 | ± 0.20 | T8 |
| 53 | 1176.277 | 754.476 | 114.007 | 77.65 | 191.66 | ± 0.20 | T8 |
| 54 | 1176.277 | 754.478 | 114.007 | 77.65 | 191.66 | ± 0.20 | T8 |
| 55 | 1164.282 | 800.327 | 114.049 | 77.65 | 191.70 | ± 0.20 | T8 |
| 56 | 1091.372 | 780.215 | 113.924 | 77.65 | 191.57 | ± 0.20 | T8 |
| 57 | 1059.284 | 822.233 | 114.404 | 77.65 | 192.05 | ± 0.20 | T8 |
| 58 | 1083.350 | 843.552 | 113.846 | 77.65 | 191.49 | ± 0.20 | T8 |
| 59 | 1106.760 | 863.953 | 114.120 | 77.65 | 191.77 | ± 0.20 | T8 |
| 60 | 1147.029 | 856.433 | 113.874 | 77.65 | 191.52 | ± 0.20 | T8 |
| Note: These elevations are tied to the Benchmark MAYOAZMK (160.75 m ± 0.05 m) on the bridge south of here via: ROAD Pt 3 = TOM2 Pt 16; TOM2 Pt 3 = Benchmark | | | | | | | |

| Huntington River Location Moultrop | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 62.97 | 162.97 | ± 0.20 | T4 |
| 2 | 1000.000 | 1000.000 | 100.000 | 62.97 | 162.97 | ± 0.20 | T4 |
| 3 | 1099.345 | 844.941 | 105.046 | 62.97 | 168.01 | ± 0.20 | ROAD |
| 4 | 1140.138 | 868.293 | 104.248 | 62.97 | 167.21 | ± 0.20 | T5 |
| 5 | 1139.422 | 871.006 | 103.905 | 62.97 | 166.87 | ± 0.20 | T5 |
| 6 | 1137.373 | 876.116 | 103.319 | 62.97 | 166.29 | ± 0.20 | T5A |
| 7 | 1137.375 | 876.114 | 103.319 | 62.97 | 166.29 | ± 0.20 | T5A |
| 8 | 1135.939 | 883.177 | 102.751 | 62.97 | 165.72 | ± 0.20 | T5A |
| 9 | 1134.318 | 891.269 | 102.509 | 62.97 | 165.48 | ± 0.20 | T5A |
| 10 | 1134.088 | 897.440 | 102.263 | 62.97 | 165.23 | ± 0.20 | T5 |
| 11 | 1134.069 | 902.782 | 101.859 | 62.97 | 164.83 | ± 0.20 | T5 |
| 12 | 1135.762 | 911.761 | 101.535 | 62.97 | 164.50 | ± 0.20 | T5 |
| 13 | 1137.218 | 921.304 | 101.170 | 62.97 | 164.14 | ± 0.20 | T5 |
| 14 | 1137.225 | 921.300 | 101.170 | 62.97 | 164.14 | ± 0.20 | T5 |
| 15 | 1140.655 | 931.933 | 100.913 | 62.97 | 163.88 | ± 0.20 | T5 |
| 16 | 1143.604 | 941.989 | 100.905 | 62.97 | 163.87 | ± 0.20 | T5 |
| 17 | 1148.777 | 955.530 | 100.693 | 62.97 | 163.66 | ± 0.20 | T5 |
| 18 | 1149.017 | 960.361 | 100.557 | 62.97 | 163.52 | ± 0.20 | SLOPE |
| 19 | 1149.311 | 965.094 | 100.271 | 62.97 | 163.24 | ± 0.20 | T4 |
| 20 | 1149.550 | 969.596 | 99.815 | 62.97 | 162.78 | ± 0.20 | T4 |
| 21 | 1149.311 | 974.329 | 99.420 | 62.97 | 162.39 | ± 0.20 | T4 |
| 22 | 1149.272 | 978.515 | 99.141 | 62.97 | 162.11 | ± 0.20 | T4 |
| 23 | 1146.834 | 987.964 | 99.054 | 62.97 | 162.02 | ± 0.20 | T4 |
| 24 | 1141.832 | 998.136 | 98.896 | 62.97 | 161.86 | ± 0.20 | T4 |
| 25 | 1136.461 | 1008.240 | 99.208 | 62.97 | 162.17 | ± 0.20 | T4 |
| 26 | 1130.126 | 1019.505 | 99.346 | 62.97 | 162.31 | ± 0.20 | T4 |
| 27 | 1123.579 | 1029.406 | 99.683 | 62.97 | 162.65 | ± 0.20 | T4 |
| 28 | 1118.229 | 1039.193 | 100.033 | 62.97 | 163.00 | ± 0.20 | T4 |
| 29 | 1118.181 | 1039.177 | 100.033 | 62.97 | 163.00 | ± 0.20 | T4 |
| 30 | 1110.881 | 1047.591 | 100.015 | 62.97 | 162.98 | ± 0.20 | T4 |
| 31 | 1104.935 | 1051.745 | 99.818 | 62.97 | 162.79 | ± 0.20 | T4 |
| 32 | 1100.558 | 1054.201 | 99.468 | 62.97 | 162.44 | ± 0.20 | T4 |
| 33 | 1095.985 | 1057.209 | 98.887 | 62.97 | 161.85 | ± 0.20 | SLOPE |
| 34 | 1092.159 | 1059.918 | 98.284 | 62.97 | 161.25 | ± 0.20 | T4B |
| 35 | 1092.160 | 1059.919 | 98.284 | 62.97 | 161.25 | ± 0.20 | T4B |
| 36 | 1080.399 | 1067.609 | 98.024 | 62.97 | 160.99 | ± 0.20 | T4B |
| 37 | 1080.080 | 1071.729 | 98.150 | 62.97 | 161.12 | ± 0.20 | T4B |
| 38 | 1076.788 | 1083.154 | 98.068 | 62.97 | 161.04 | ± 0.20 | T4B |
| 39 | 1073.533 | 1094.363 | 98.129 | 62.97 | 161.10 | ± 0.20 | T4B |
| 40 | 1068.701 | 1105.426 | 97.819 | 62.97 | 160.79 | ± 0.20 | T3A |
| 41 | 1065.752 | 1117.315 | 97.669 | 62.97 | 160.64 | ± 0.20 | T3A |
| 42 | 1062.933 | 1129.327 | 97.542 | 62.97 | 160.51 | ± 0.20 | T3A |
| 43 | 1059.758 | 1141.085 | 97.229 | 62.97 | 160.20 | ± 0.20 | T3A |
| 44 | 1058.672 | 1153.469 | 96.921 | 62.97 | 159.89 | ± 0.20 | T3B |
| 45 | 1053.698 | 1165.482 | 96.681 | 62.97 | 159.65 | ± 0.20 | T3B |
| 46 | 1048.138 | 1176.418 | 96.963 | 62.97 | 159.93 | ± 0.20 | T3B |
| 47 | 1043.121 | 1186.449 | 97.374 | 62.97 | 160.34 | ± 0.20 | T3A |
| 48 | 1038.421 | 1196.614 | 97.251 | 62.97 | 160.22 | ± 0.20 | T3A |
| 49 | 1033.703 | 1207.672 | 97.276 | 62.97 | 160.24 | ± 0.20 | T3A |
| 50 | 1029.241 | 1217.939 | 97.180 | 62.97 | 160.15 | ± 0.20 | T3A |

| Huntington River Location Moultrop | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 51 | 1025.109 | 1229.476 | 97.006 | 62.97 | 159.97 | ± 0.20 | T3A |
| 52 | 1009.738 | 1232.471 | 96.948 | 62.97 | 159.92 | ± 0.20 | T3B |
| 53 | 999.054 | 1235.061 | 96.911 | 62.97 | 159.88 | ± 0.20 | T3B |
| 54 | 984.475 | 1233.999 | 96.993 | 62.97 | 159.96 | ± 0.20 | SLOPE |
| 55 | 983.721 | 1223.309 | 97.069 | 62.97 | 160.04 | ± 0.20 | T3A |
| 56 | 983.910 | 1218.809 | 97.256 | 62.97 | 160.22 | ± 0.20 | T3A |
| 57 | 983.617 | 1214.273 | 97.499 | 62.97 | 160.47 | ± 0.20 | T3A |
| 58 | 983.450 | 1207.457 | 97.710 | 62.97 | 160.68 | ± 0.20 | T3A |
| 59 | 982.179 | 1196.137 | 97.594 | 62.97 | 160.56 | ± 0.20 | T3A |
| 60 | 982.079 | 1196.236 | 97.569 | 62.97 | 160.54 | ± 0.20 | T3A |
| 61 | 981.754 | 1184.980 | 97.585 | 62.97 | 160.55 | ± 0.20 | T3A |
| 62 | 981.304 | 1173.432 | 97.683 | 62.97 | 160.65 | ± 0.20 | T3A |
| 63 | 980.692 | 1161.892 | 97.526 | 62.97 | 160.49 | ± 0.20 | T3A |
| 64 | 980.257 | 1150.473 | 97.461 | 62.97 | 160.43 | ± 0.20 | T3A |
| 65 | 979.946 | 1144.472 | 97.475 | 62.97 | 160.44 | ± 0.20 | T3A |
| 66 | 980.021 | 1139.966 | 97.638 | 62.97 | 160.61 | ± 0.20 | T3A |
| 67 | 979.904 | 1135.186 | 97.817 | 62.97 | 160.78 | ± 0.20 | T3A |
| 68 | 979.900 | 1135.186 | 97.817 | 62.97 | 160.78 | ± 0.20 | T3A |
| 69 | 978.922 | 1119.068 | 97.567 | 62.97 | 160.53 | ± 0.20 | T3A |
| 70 | 978.416 | 1107.855 | 97.485 | 62.97 | 160.45 | ± 0.20 | T3A |
| 71 | 977.838 | 1096.570 | 97.468 | 62.97 | 160.43 | ± 0.20 | T3A |
| 72 | 977.869 | 1096.596 | 97.465 | 62.97 | 160.43 | ± 0.20 | T3A |
| 73 | 977.266 | 1090.487 | 97.613 | 62.97 | 160.58 | ± 0.20 | T3A |
| 74 | 976.995 | 1083.963 | 97.887 | 62.97 | 160.85 | ± 0.20 | SLOPE |
| 75 | 976.476 | 1076.373 | 98.307 | 62.97 | 161.27 | ± 0.20 | T4B |
| 76 | 976.323 | 1068.694 | 98.716 | 62.97 | 161.68 | ± 0.20 | T4B |
| 77 | 975.727 | 1062.047 | 98.877 | 62.97 | 161.84 | ± 0.20 | T4B |
| 78 | 974.983 | 1050.948 | 98.866 | 62.97 | 161.83 | ± 0.20 | T4B |
| 79 | 973.654 | 1041.693 | 98.820 | 62.97 | 161.79 | ± 0.20 | T4B |
| 80 | 971.792 | 1028.908 | 98.835 | 62.97 | 161.80 | ± 0.20 | T4B |
| 81 | 971.792 | 1028.908 | 98.834 | 62.97 | 161.80 | ± 0.20 | T4B |
| 82 | 978.159 | 1020.576 | 98.531 | 62.97 | 161.50 | ± 0.20 | T4B |
| 83 | 983.348 | 1014.213 | 98.668 | 62.97 | 161.64 | ± 0.20 | T4B |
| 84 | 983.344 | 1014.217 | 98.668 | 62.97 | 161.63 | ± 0.20 | T4B |
| 85 | 986.696 | 1010.183 | 98.813 | 62.97 | 161.78 | ± 0.20 | T4B |
| 86 | 989.765 | 1007.140 | 99.187 | 62.97 | 162.15 | ± 0.20 | T4 |
| 87 | 992.748 | 1003.414 | 99.628 | 62.97 | 162.59 | ± 0.20 | T4 |
| 88 | 999.789 | 990.316 | 99.957 | 62.97 | 162.92 | ± 0.20 | T4 |
| 89 | 999.789 | 990.298 | 99.957 | 62.97 | 162.92 | ± 0.20 | T4 |
| 90 | 1001.226 | 982.701 | 99.855 | 62.97 | 162.82 | ± 0.20 | T4 |
| 91 | 1002.609 | 977.496 | 100.231 | 62.97 | 163.20 | ± 0.20 | T4 |
| 92 | 1003.778 | 971.050 | 100.525 | 62.97 | 163.49 | ± 0.20 | T4 |
| 93 | 1005.880 | 959.464 | 100.450 | 62.97 | 163.42 | ± 0.20 | T4 |
| 94 | 1008.766 | 946.512 | 100.096 | 62.97 | 163.06 | ± 0.20 | T4 |
| 95 | 1010.367 | 940.380 | 100.192 | 62.97 | 163.16 | ± 0.20 | T4 |
| 96 | 1013.885 | 928.492 | 100.062 | 62.97 | 163.03 | ± 0.20 | T4 |
| 97 | 1014.948 | 916.878 | 100.242 | 62.97 | 163.21 | ± 0.20 | T4 |
| 98 | 1015.405 | 905.192 | 100.503 | 62.97 | 163.47 | ± 0.20 | T4 |
| 99 | 1017.410 | 892.867 | 100.918 | 62.97 | 163.89 | ± 0.20 | T5 |
| 100 | 1018.161 | 879.041 | 102.375 | 62.97 | 165.34 | ± 0.20 | T5A |

| Huntington River Location Moultrop | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 101 | 1017.582 | 871.160 | 102.393 | 62.97 | 165.36 | ± 0.20 | T5A |
| 102 | 1017.213 | 868.711 | 102.115 | 62.97 | 165.08 | ± 0.20 | T5 |
| 103 | 1015.807 | 857.615 | 101.792 | 62.97 | 164.76 | ± 0.20 | T5 |
| 104 | 1015.812 | 845.934 | 101.551 | 62.97 | 164.52 | ± 0.20 | T5 |
| 105 | 1014.536 | 835.008 | 101.771 | 62.97 | 164.74 | ± 0.20 | T5 |
| 106 | 1012.541 | 825.169 | 102.069 | 62.97 | 165.04 | ± 0.20 | T5 |
| 107 | 1011.350 | 812.260 | 102.307 | 62.97 | 165.27 | ± 0.20 | T5A |
| 108 | 1004.611 | 770.558 | 107.780 | 62.97 | 170.75 | ± 0.20 | APEX |
| 109 | 1024.476 | 786.736 | 103.570 | 62.97 | 166.54 | ± 0.20 | T5 |
| 110 | 1036.284 | 793.462 | 103.172 | 62.97 | 166.14 | ± 0.20 | T5A |
| 111 | 1045.601 | 797.926 | 103.525 | 62.97 | 166.49 | ± 0.20 | T5 |
| 112 | 1045.582 | 798.011 | 103.524 | 62.97 | 166.49 | ± 0.20 | T5 |
| 113 | 1056.085 | 803.420 | 103.836 | 62.97 | 166.80 | ± 0.20 | T5 |
| 114 | 1067.375 | 812.188 | 103.909 | 62.97 | 166.88 | ± 0.20 | T5 |
| 115 | 1077.340 | 819.287 | 104.046 | 62.97 | 167.01 | ± 0.20 | T5 |
| 116 | 1086.864 | 826.746 | 104.191 | 62.97 | 167.16 | ± 0.20 | T5 |
| 117 | 1094.447 | 834.891 | 104.280 | 62.97 | 167.25 | ± 0.20 | T5 |
| 118 | 1098.557 | 845.652 | 105.018 | 62.97 | 167.98 | ± 0.20 | ROAD |
| 119 | 1070.981 | 839.823 | 103.224 | 62.97 | 166.19 | ± 0.20 | T5A |
| 120 | 1048.572 | 844.810 | 102.420 | 62.97 | 165.39 | ± 0.20 | T5A |
| 121 | 1026.460 | 850.681 | 101.890 | 62.97 | 164.86 | ± 0.20 | T5 |
| 122 | 1004.595 | 855.447 | 101.599 | 62.97 | 164.57 | ± 0.20 | T5 |
| 123 | 983.440 | 858.821 | 101.485 | 62.97 | 164.45 | ± 0.20 | T5 |
| 124 | 961.972 | 864.825 | 101.416 | 62.97 | 164.38 | ± 0.20 | T5 |
| 125 | 940.509 | 871.364 | 101.381 | 62.97 | 164.35 | ± 0.20 | T5 |
| 126 | 940.510 | 871.367 | 101.381 | 62.97 | 164.35 | ± 0.20 | T5 |
| 127 | 990.965 | 1047.945 | 98.680 | 62.97 | 161.65 | ± 0.20 | T4B |
| 128 | 973.833 | 1042.073 | 98.816 | 62.97 | 161.78 | ± 0.20 | T4B |
| 129 | 957.666 | 1041.194 | 98.595 | 62.97 | 161.56 | ± 0.20 | T4B |
| 130 | 950.612 | 1041.797 | 97.885 | 62.97 | 160.85 | ± 0.20 | SLOPE |
| 131 | 950.611 | 1041.799 | 97.885 | 62.97 | 160.85 | ± 0.20 | SLOPE |
| 132 | 941.803 | 1041.906 | 96.895 | 62.97 | 159.86 | ± 0.20 | T3B |
| 133 | 934.750 | 1041.400 | 95.710 | 62.97 | 158.68 | ± 0.20 | SLOPE |
| 134 | 925.171 | 1047.860 | 94.913 | 62.97 | 157.88 | ± 0.20 | T2A |
| 135 | 912.761 | 1042.977 | 94.870 | 62.97 | 157.84 | ± 0.20 | T2A |
| 136 | 891.600 | 1043.083 | 94.709 | 62.97 | 157.68 | ± 0.20 | T2A |
| 137 | 874.409 | 1043.500 | 94.839 | 62.97 | 157.81 | ± 0.20 | T2A |
| 138 | 853.761 | 1043.603 | 94.527 | 62.97 | 157.49 | ± 0.20 | T2A |
| 139 | 836.696 | 1044.063 | 95.156 | 62.97 | 158.12 | ± 0.20 | SLOPE |
| 140 | 817.163 | 1042.935 | 94.253 | 62.97 | 157.22 | ± 0.20 | T2B |
| 141 | 800.100 | 1042.885 | 94.478 | 62.97 | 157.44 | ± 0.20 | T2B |
| 142 | 790.991 | 1042.977 | 94.066 | 62.97 | 157.03 | ± 0.20 | T2B |
| 143 | 774.826 | 1042.971 | 94.203 | 62.97 | 157.17 | ± 0.20 | T2B |
| 144 | 759.345 | 1043.397 | 94.492 | 62.97 | 157.46 | ± 0.20 | T2B |
| 145 | 742.908 | 1042.516 | 94.282 | 62.97 | 157.25 | ± 0.20 | T2B |
| 146 | 742.907 | 1042.517 | 94.282 | 62.97 | 157.25 | ± 0.20 | T2B |
| 147 | 736.350 | 1042.597 | 93.739 | 62.97 | 156.71 | ± 0.20 | T1 |
| 148 | 728.677 | 1042.374 | 94.021 | 62.97 | 156.99 | ± 0.20 | T2B |
| 149 | 724.457 | 1042.862 | 94.078 | 62.97 | 157.04 | ± 0.20 | T2B |
| 150 | 729.123 | 1059.205 | 93.970 | 62.97 | 156.94 | ± 0.20 | T2B |

| Huntington River Location Moultrop | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 151 | 736.426 | 1078.846 | 94.544 | 62.97 | 157.51 | ± 0.20 | T2A |
| 152 | 741.356 | 1099.032 | 94.508 | 62.97 | 157.47 | ± 0.20 | T2B |
| 153 | 744.890 | 1114.859 | 94.248 | 62.97 | 157.21 | ± 0.20 | T2B |
| 154 | 745.790 | 1120.315 | 94.006 | 62.97 | 156.97 | ± 0.20 | T2B |
| 155 | 746.573 | 1125.527 | 93.863 | 62.97 | 156.83 | ± 0.20 | T2B |
| 156 | 750.030 | 1145.876 | 93.874 | 62.97 | 156.84 | ± 0.20 | T2B |
| 157 | 753.656 | 1165.684 | 93.846 | 62.97 | 156.81 | ± 0.20 | T2B |
| 158 | 753.634 | 1165.698 | 93.846 | 62.97 | 156.81 | ± 0.20 | T2B |
| 159 | 757.294 | 1186.731 | 93.942 | 62.97 | 156.91 | ± 0.20 | T2B |
| 160 | 761.508 | 1208.274 | 93.966 | 62.97 | 156.93 | ± 0.20 | T2B |
| 161 | 767.033 | 1228.714 | 93.803 | 62.97 | 156.77 | ± 0.20 | T2B |
| 162 | 775.346 | 1247.349 | 93.722 | 62.97 | 156.69 | ± 0.20 | T2B |
| 163 | 779.814 | 1254.514 | 93.677 | 62.97 | 156.64 | ± 0.20 | T2B |
| 164 | 784.545 | 1260.633 | 93.179 | 62.97 | 156.15 | ± 0.20 | T2B |
| 165 | 790.819 | 1268.007 | 92.903 | 62.97 | 155.87 | ± 0.20 | T1 |
| 166 | 795.175 | 1273.671 | 92.790 | 62.97 | 155.76 | ± 0.20 | T1 |
| 167 | 800.780 | 1280.603 | 93.008 | 62.97 | 155.98 | ± 0.20 | T1 |
| 168 | 806.087 | 1288.724 | 93.465 | 62.97 | 156.43 | ± 0.20 | T1 |
| 169 | 811.157 | 1297.665 | 93.753 | 62.97 | 156.72 | ± 0.20 | T1 |
| 170 | 821.252 | 1328.870 | 92.668 | 62.97 | 155.63 | ± 0.20 | T1 |
| 171 | 855.569 | 1335.791 | 92.884 | 62.97 | 155.85 | ± 0.20 | T1 |
| 172 | 875.043 | 1340.056 | 92.868 | 62.97 | 155.83 | ± 0.20 | T1 |
| 173 | 875.036 | 1340.075 | 92.868 | 62.97 | 155.83 | ± 0.20 | T1 |
| 174 | 893.789 | 1343.583 | 92.798 | 62.97 | 155.77 | ± 0.20 | T1 |
| 175 | 865.333 | 1336.456 | 92.918 | 62.97 | 155.89 | ± 0.20 | T1 |
| 176 | 866.388 | 1331.952 | 92.973 | 62.97 | 155.94 | ± 0.20 | T1 |
| 177 | 866.795 | 1326.636 | 93.304 | 62.97 | 156.27 | ± 0.20 | T1 |
| 178 | 865.435 | 1320.619 | 93.813 | 62.97 | 156.78 | ± 0.20 | SLOPE |
| 179 | 863.926 | 1309.231 | 93.898 | 62.97 | 156.86 | ± 0.20 | T2B |
| 180 | 868.562 | 1299.090 | 94.258 | 62.97 | 157.22 | ± 0.20 | T2B |
| 181 | 872.487 | 1289.472 | 94.440 | 62.97 | 157.41 | ± 0.20 | T2B |
| 182 | 874.561 | 1281.173 | 94.491 | 62.97 | 157.46 | ± 0.20 | T2B |
| 183 | 876.230 | 1276.673 | 94.680 | 62.97 | 157.65 | ± 0.20 | T2A |
| 184 | 878.329 | 1271.398 | 94.881 | 62.97 | 157.85 | ± 0.20 | T2A |
| 185 | 888.611 | 1268.530 | 94.954 | 62.97 | 157.92 | ± 0.20 | T2A |
| 186 | 900.338 | 1264.271 | 94.974 | 62.97 | 157.94 | ± 0.20 | T2A |
| 187 | 914.381 | 1250.291 | 94.715 | 62.97 | 157.68 | ± 0.20 | T2A |
| 188 | 914.377 | 1250.302 | 94.709 | 62.97 | 157.68 | ± 0.20 | T2A |
| 189 | 922.856 | 1242.617 | 94.538 | 62.97 | 157.50 | ± 0.20 | T2A |
| 190 | 925.123 | 1237.519 | 94.826 | 62.97 | 157.79 | ± 0.20 | T2A |
| 191 | 927.113 | 1231.717 | 95.454 | 62.97 | 158.42 | ± 0.20 | SLOPE |
| 192 | 929.914 | 1223.760 | 96.356 | 62.97 | 159.32 | ± 0.20 | T3B |
| 193 | 933.384 | 1217.890 | 96.564 | 62.97 | 159.53 | ± 0.20 | T3B |
| 194 | 937.759 | 1210.759 | 96.463 | 62.97 | 159.43 | ± 0.20 | T3B |
| 195 | 942.133 | 1204.744 | 96.472 | 62.97 | 159.44 | ± 0.20 | T3B |
| 196 | 944.696 | 1200.458 | 96.940 | 62.97 | 159.91 | ± 0.20 | T3B |
| 197 | 947.348 | 1193.384 | 97.410 | 62.97 | 160.38 | ± 0.20 | T3A |
| 198 | 950.853 | 1180.492 | 97.665 | 62.97 | 160.63 | ± 0.20 | T3A |
| 199 | 955.609 | 1160.206 | 97.654 | 62.97 | 160.62 | ± 0.20 | T3A |
| 200 | 962.396 | 1140.860 | 97.791 | 62.97 | 160.76 | ± 0.20 | T3A |

| Huntington River Location Moultrop | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 201 | 714.748 | 1229.075 | 93.472 | 62.97 | 156.44 | ± 0.20 | T2B |
| 202 | 704.513 | 1205.953 | 93.346 | 62.97 | 156.31 | ± 0.20 | T2B |
| 203 | 696.522 | 1162.033 | 93.478 | 62.97 | 156.44 | ± 0.20 | T2B |
| 204 | 692.305 | 1142.483 | 93.572 | 62.97 | 156.54 | ± 0.20 | T2B |
| 205 | 689.125 | 1216.970 | 93.107 | 62.97 | 156.07 | ± 0.20 | T2B |
| 206 | 674.562 | 1226.689 | 93.395 | 62.97 | 156.36 | ± 0.20 | T2B |
| 207 | 656.034 | 1240.388 | 93.418 | 62.97 | 156.38 | ± 0.20 | T2B |
| 208 | 647.221 | 1246.573 | 93.531 | 62.97 | 156.50 | ± 0.20 | T2B |
| 209 | 642.625 | 1249.643 | 95.287 | 62.97 | 158.25 | ± 0.20 | SLOPE |
| 210 | 638.344 | 1252.777 | 97.519 | 62.97 | 160.49 | ± 0.20 | T3A |
| 211 | 630.479 | 1257.356 | 100.600 | 62.97 | 163.57 | ± 0.20 | SLOPE |
| 212 | 630.416 | 1257.306 | 100.600 | 62.97 | 163.57 | ± 0.20 | SLOPE |
| 213 | 619.797 | 1265.508 | 103.541 | 62.97 | 166.51 | ± 0.20 | T5 |
| 214 | 613.501 | 1270.867 | 106.613 | 62.97 | 169.58 | ± 0.20 | SLOPE |
| 215 | 609.225 | 1274.726 | 108.419 | 62.97 | 171.39 | ± 0.20 | T5 |
| 216 | 590.906 | 1267.039 | 108.776 | 62.97 | 171.74 | ± 0.20 | T5 |
| 217 | 630.652 | 1296.418 | 108.841 | 62.97 | 171.81 | ± 0.20 | T5 |
| 218 | 593.799 | 1318.900 | 115.703 | 62.97 | 178.67 | ± 0.20 | SLOPE |
| 219 | 531.213 | 1331.766 | 124.587 | 62.97 | 187.55 | ± 0.20 | SLOPE |
| 220 | 500.326 | 1336.154 | 129.337 | 62.97 | 192.30 | ± 0.20 | T8 |
| 221 | 449.386 | 1292.082 | 128.652 | 62.97 | 191.62 | ± 0.20 | T8 |
| 222 | 425.200 | 1281.229 | 128.887 | 62.97 | 191.85 | ± 0.20 | T8 |
| 223 | 359.551 | 1280.897 | 129.821 | 62.97 | 192.79 | ± 0.20 | T8 |
| 224 | 338.460 | 1286.903 | 130.940 | 62.97 | 193.91 | ± 0.20 | T8 |
| 225 | 393.172 | 1366.423 | 143.064 | 62.97 | 206.03 | ± 0.20 | T9 |
| 226 | 411.415 | 1378.268 | 143.644 | 62.97 | 206.61 | ± 0.20 | T9 |
| 227 | 426.575 | 1384.720 | 143.478 | 62.97 | 206.44 | ± 0.20 | T9 |
| 228 | 426.591 | 1384.751 | 143.444 | 62.97 | 206.41 | ± 0.20 | T9 |
| 229 | 479.727 | 1429.558 | 143.154 | 62.97 | 206.12 | ± 0.20 | T9 |
| 230 | 479.891 | 1429.762 | 143.565 | 62.97 | 206.53 | ± 0.20 | T9 |
| 231 | 477.283 | 1454.836 | 147.642 | 62.97 | 210.61 | ± 0.20 | SLOPE |
| 232 | 498.314 | 1508.740 | 155.012 | 62.97 | 217.98 | ± 0.20 | T10 |
| 233 | 690.501 | 1023.347 | 91.839 | 62.97 | 154.81 | ± 0.20 | T1 |
| 234 | 703.465 | 1054.699 | 91.816 | 62.97 | 154.78 | ± 0.20 | T1 |
| 235 | 715.800 | 1131.971 | 91.485 | 62.97 | 154.45 | ± 0.20 | T1 |
| 236 | 718.938 | 1164.331 | 91.369 | 62.97 | 154.34 | ± 0.20 | T1 |
| 237 | 722.916 | 1182.001 | 91.430 | 62.97 | 154.40 | ± 0.20 | T1 |
| 238 | 715.289 | 1222.774 | 91.077 | 62.97 | 154.04 | ± 0.20 | T1 |
| 239 | 715.110 | 1260.393 | 91.078 | 62.97 | 154.05 | ± 0.20 | T1 |
| 240 | 717.950 | 1280.414 | 90.966 | 62.97 | 153.93 | ± 0.20 | T1 |
| 241 | 723.656 | 1294.935 | 90.652 | 62.97 | 153.62 | ± 0.20 | T1 |
| 242 | 731.039 | 1304.645 | 90.662 | 62.97 | 153.63 | ± 0.20 | T1 |
| 243 | 780.545 | 1276.017 | 93.388 | 62.97 | 156.35 | ± 0.20 | T2A |
| 244 | 777.541 | 1277.784 | 92.572 | 62.97 | 155.54 | ± 0.20 | T2A |
| 245 | 770.703 | 1284.453 | 92.848 | 62.97 | 155.81 | ± 0.20 | T2A |
| 246 | 759.778 | 1293.988 | 92.588 | 62.97 | 155.55 | ± 0.20 | T2A |
| 247 | 1078.778 | 1369.562 | 92.868 | 62.97 | 155.83 | ± 0.20 | T2A |
| 248 | 1237.138 | 1340.721 | 92.224 | 62.97 | 155.19 | ± 0.20 | T2A |
| 249 | 1236.956 | 1340.670 | 92.253 | 62.97 | 155.22 | ± 0.20 | T2A |
| Note: These elevations are tied to the Benchmark MAYOAZMK (160.75 m ± 0.05 m) on the bridge | | | | | | | |

| Huntington River Location Moultrop | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| south of here via: MOUL Pt 3 = TOM2 Pt 16; TOM2 Pt 3 = Benchmark | | | | | | | |

| Huntington River Location Moultrop-Tower | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 55.22 | 155.22 | ± 0.20 | T2A |
| 2 | 1000.000 | 1000.000 | 100.000 | 55.22 | 155.22 | ± 0.20 | T2A |
| 3 | 723.031 | 690.997 | 107.736 | 55.22 | 162.96 | ± 0.20 | T4 |
| 4 | 999.982 | 999.980 | 100.051 | 55.22 | 155.27 | ± 0.20 | T2A |
| 5 | -17.599 | 731.793 | 116.008 | 55.22 | 171.23 | ± 0.20 | T5 |
| 6 | -75.242 | 754.894 | 117.754 | 55.22 | 172.97 | ± 0.20 | T5 |
| 7 | 296.501 | 662.086 | 102.814 | 55.22 | 158.03 | ± 0.20 | T2A |
| 8 | 297.958 | 668.937 | 102.639 | 55.22 | 157.86 | ± 0.20 | T2A |
| Note: These elevations are tied to the Benchmark MAYOAZMK (160.75 m ± 0.05 m) on the bridge south of here via: MOTO Pt1 = MOUL Pt 249; MOUL Pt 3 = TOM2 Pt 16; TOM2 Pt 3 = Benchmark | | | | | | | |

| Huntington River Location Tower-Moultrop 2 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000 | 1000 | 100 | 72.78 | 172.78 | ± 0.20 | T5 |
| 2 | 1000 | 1000 | 100 | 72.78 | 172.78 | ± 0.20 | T5 |
| 3 | 1433.327 | 936.634 | 87.9692 | 72.78 | 160.75 | ± 0.20 | ROAD |
| 4 | 1483.523 | 931.125 | 89.61542 | 72.78 | 162.40 | ± 0.20 | ROAD |
| 5 | 1532.541 | 925.512 | 90.82258 | 72.78 | 163.60 | ± 0.20 | ROAD |
| 6 | 1532.515 | 925.515 | 90.82304 | 72.78 | 163.60 | ± 0.20 | ROAD |
| 7 | 1532.265 | 918.724 | 90.98021 | 72.78 | 163.76 | ± 0.20 | ROAD |
| 8 | 1574.178 | 914.957 | 92.06385 | 72.78 | 164.84 | ± 0.20 | ROAD |
| 9 | 1574.642 | 921.908 | 91.97252 | 72.78 | 164.75 | ± 0.20 | ROAD |
| 10 | 1648.398 | 918.615 | 92.04746 | 72.78 | 164.83 | ± 0.20 | ROAD |
| 11 | 1649.753 | 918.637 | 92.03113 | 72.78 | 164.81 | ± 0.20 | ROAD |
| 12 | 1649.759 | 918.636 | 92.03105 | 72.78 | 164.81 | ± 0.20 | ROAD |
| 13 | 1710.029 | 909.411 | 92.00081 | 72.78 | 164.78 | ± 0.20 | ROAD |
| 14 | 1850.917 | 898.2 | 93.01982 | 72.78 | 165.80 | ± 0.20 | ROAD |
| 15 | 1853.532 | 897.32 | 93.16454 | 72.78 | 165.95 | ± 0.20 | ROAD |
| 16 | 1895.13 | 886.301 | 95.23166 | 72.78 | 168.01 | ± 0.20 | ROAD |
| 17 | 1877.034 | 895.679 | 94.2621 | 72.78 | 167.04 | ± 0.20 | ROAD |
| 18 | 1746.112 | 1051.3 | 89.06746 | 72.78 | 161.85 | ± 0.20 | ROAD |
| 19 | 1781.883 | 1016.7 | 90.02771 | 72.78 | 162.81 | ± 0.20 | ROAD |
| 20 | 982.0442 | 1034.89 | 100.76292 | 72.78 | 173.54 | ± 0.20 | ROAD |
| 21 | 1048.388 | 961.635 | 94.95318 | 72.78 | 167.73 | ± 0.20 | ROAD |
| Note: These elevations are tied to the Benchmark MAYOAZMK (160.75 m ± 0.05 m) on the bridge north of here via: TOM2 Pt 3 = Benchmark | | | | | | | |

| Huntington River Location Tower-Moultrop 1 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 72.71 | 172.71 | ± 0.20 | T5 |
| 2 | 1000.000 | 1000.000 | 100.000 | 72.71 | 172.71 | ± 0.20 | T5 |
| 3 | 1054.849 | 971.606 | 95.007 | 72.71 | 167.71 | ± 0.20 | ROAD |
| 4 | 1053.639 | 974.036 | 95.303 | 72.71 | 168.01 | ± 0.20 | ROAD |
| 5 | 1048.663 | 978.863 | 95.420 | 72.71 | 168.13 | ± 0.20 | ROAD |
| 6 | 1051.210 | 965.448 | 94.999 | 72.71 | 167.71 | ± 0.20 | ROAD |
| 7 | 1049.493 | 967.493 | 95.283 | 72.71 | 167.99 | ± 0.20 | ROAD |
| 8 | 1045.823 | 973.255 | 95.422 | 72.71 | 168.13 | ± 0.20 | ROAD |
| 9 | 1022.005 | 961.247 | 95.515 | 72.71 | 168.22 | ± 0.20 | ROAD |
| 10 | 1025.636 | 955.282 | 95.361 | 72.71 | 168.07 | ± 0.20 | ROAD |
| 11 | 1064.393 | 974.839 | 95.262 | 72.71 | 167.97 | ± 0.20 | ROAD |
| 12 | 1104.409 | 990.666 | 94.249 | 72.71 | 166.96 | ± 0.20 | ROAD |
| 13 | 1105.088 | 1005.099 | 94.594 | 72.71 | 167.30 | ± 0.20 | ROAD |
| 14 | 1105.082 | 1005.098 | 94.594 | 72.71 | 167.30 | ± 0.20 | ROAD |
| 15 | 1092.620 | 1008.549 | 94.974 | 72.71 | 167.68 | ± 0.20 | ROAD |
| 16 | 1092.606 | 1008.548 | 94.972 | 72.71 | 167.68 | ± 0.20 | ROAD |
| 17 | 1092.117 | 999.792 | 94.930 | 72.71 | 167.64 | ± 0.20 | ROAD |
| 18 | 1023.720 | 1021.061 | 99.093 | 72.71 | 171.80 | ± 0.20 | ROAD |
| 19 | 1018.277 | 1015.989 | 99.234 | 72.71 | 171.94 | ± 0.20 | ROAD |
| 20 | 976.400 | 1025.641 | 100.153 | 72.71 | 172.86 | ± 0.20 | ROAD |
| 21 | 978.601 | 1031.151 | 100.119 | 72.71 | 172.83 | ± 0.20 | ROAD |
| 22 | 979.378 | 1033.449 | 100.733 | 72.71 | 173.44 | ± 0.20 | ROAD |
| 23 | 903.066 | 1056.294 | 101.473 | 72.71 | 174.18 | ± 0.20 | ROAD |
| 24 | 901.540 | 1050.300 | 101.380 | 72.71 | 174.09 | ± 0.20 | ROAD |
| 25 | 900.369 | 1048.003 | 101.448 | 72.71 | 174.15 | ± 0.20 | ROAD |
| 26 | 1090.824 | 1003.811 | 95.008 | 72.71 | 167.72 | ± 0.20 | ROAD |
| 27 | 1122.809 | 1000.697 | 93.597 | 72.71 | 166.30 | ± 0.20 | ROAD |
| 28 | 1148.676 | 991.915 | 92.023 | 72.71 | 164.73 | ± 0.20 | ROAD |
| 29 | 1149.221 | 998.568 | 92.172 | 72.71 | 164.88 | ± 0.20 | ROAD |
| 30 | 1196.813 | 991.235 | 91.130 | 72.71 | 163.84 | ± 0.20 | ROAD |
| 31 | 1192.792 | 984.465 | 91.236 | 72.71 | 163.94 | ± 0.20 | ROAD |
| 32 | 1252.140 | 975.796 | 88.412 | 72.71 | 161.12 | ± 0.20 | ROAD |
| 33 | 1253.021 | 982.473 | 88.397 | 72.71 | 161.10 | ± 0.20 | ROAD |
| 34 | 1302.469 | 976.291 | 86.599 | 72.71 | 159.31 | ± 0.20 | ROAD |
| 35 | 1375.288 | 970.830 | 86.407 | 72.71 | 159.11 | ± 0.20 | ROAD |
| 36 | 1487.217 | 967.924 | 89.689 | 72.71 | 162.40 | ± 0.20 | ROAD |
| Note: These elevations are tied to the Benchmark MAYOAZMK (160.75 m ± 0.05 m) on the bridge north of here via:TOMO PT 36 = TOM2 PT 4; TOM2 PT 3 = Benchmark | | | | | | | |

| Huntington River Location Tower | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000 | 1000 | 100 | 72.49 | 172.49 | ± 0.20 | T5 |
| 2 | 1000 | 1000 | 100 | 72.49 | 172.49 | ± 0.20 | T5 |
| 3 | 1114.4345 | 1246.325 | 119.81005 | 72.49 | 192.30 | ± 0.20 | T8 |
| 4 | 1114.44 | 1246.321 | 119.80998 | 72.49 | 192.30 | ± 0.20 | T8 |
| 5 | 1138.8782 | 1254.368 | 120.06378 | 72.49 | 192.55 | ± 0.20 | T8 |
| 6 | 1098.645 | 1243.73 | 120.95359 | 72.49 | 193.44 | ± 0.20 | T8 |
| 7 | 1097.0752 | 1230.98 | 116.71252 | 72.49 | 189.20 | ± 0.20 | SLOPE |
| 8 | 1095.9694 | 1224.635 | 114.48704 | 72.49 | 186.98 | ± 0.20 | T7 |
| 9 | 1092.9499 | 1214.424 | 111.30938 | 72.49 | 183.80 | ± 0.20 | SLOPE |
| 10 | 1055.9145 | 1214.233 | 110.99476 | 72.49 | 183.48 | ± 0.20 | SLOPE |
| 11 | 1052.1896 | 1230.827 | 112.37795 | 72.49 | 184.87 | ± 0.20 | SLOPE |
| 12 | 1049.5922 | 1203.136 | 110.22661 | 72.49 | 182.72 | ± 0.20 | SLOPE |
| 13 | 1046.9759 | 1196.55 | 109.74143 | 72.49 | 182.23 | ± 0.20 | T6 |
| 14 | 1044.9518 | 1189.462 | 109.29692 | 72.49 | 181.79 | ± 0.20 | T6 |
| 15 | 1042.3929 | 1180.625 | 109.09309 | 72.49 | 181.58 | ± 0.20 | T6 |
| 16 | 1040.2129 | 1171.467 | 109.14157 | 72.49 | 181.63 | ± 0.20 | T6 |
| 17 | 1038.9786 | 1162.375 | 108.51387 | 72.49 | 181.00 | ± 0.20 | SLOPE |
| 18 | 1037.131 | 1153.173 | 107.63028 | 72.49 | 180.12 | ± 0.20 | SLOPE |
| 19 | 1035.1317 | 1144.359 | 106.80357 | 72.49 | 179.29 | ± 0.20 | SLOPE |
| 20 | 1033.109 | 1135.376 | 105.36391 | 72.49 | 177.85 | ± 0.20 | SLOPE |
| 21 | 1031.2207 | 1126.525 | 103.86516 | 72.49 | 176.35 | ± 0.20 | SLOPE |
| 22 | 1029.6439 | 1119.648 | 102.49341 | 72.49 | 174.98 | ± 0.20 | SLOPE |
| 23 | 1029.1057 | 1116.966 | 101.78074 | 72.49 | 174.27 | ± 0.20 | SLOPE |
| 24 | 1027.9912 | 1113.355 | 101.26388 | 72.49 | 173.75 | ± 0.20 | SLOPE |
| 25 | 1025.6944 | 1105.536 | 100.94474 | 72.49 | 173.43 | ± 0.20 | SLOPE |
| 26 | 1023.1584 | 1097.282 | 100.52876 | 72.49 | 173.02 | ± 0.20 | SLOPE |
| 27 | 1020.7365 | 1088.555 | 100.21063 | 72.49 | 172.70 | ± 0.20 | T5 |
| 28 | 1018.5556 | 1079.984 | 100.0717 | 72.49 | 172.56 | ± 0.20 | T5 |
| 29 | 1016.173 | 1071.194 | 100.25246 | 72.49 | 172.74 | ± 0.20 | T5 |
| 30 | 1013.7864 | 1062.387 | 100.14939 | 72.49 | 172.64 | ± 0.20 | T5 |
| 31 | 1011.2595 | 1053.501 | 100.01398 | 72.49 | 172.50 | ± 0.20 | T5 |
| 32 | 1008.7228 | 1044.33 | 99.56753 | 72.49 | 172.06 | ± 0.20 | T5 |
| 33 | 1006.5281 | 1035.376 | 99.99692 | 72.49 | 172.49 | ± 0.20 | T5 |
| 34 | 1004.3996 | 1026.92 | 100.00008 | 72.49 | 172.49 | ± 0.20 | T5 |
| 35 | 1002.6123 | 1017.537 | 100.08608 | 72.49 | 172.57 | ± 0.20 | T5 |
| 36 | 1000.7174 | 1008.462 | 100.34429 | 72.49 | 172.83 | ± 0.20 | T5 |
| 37 | 1000.7162 | 1008.448 | 100.34374 | 72.49 | 172.83 | ± 0.20 | T5 |
| 38 | 749.00773 | 1225.159 | 115.38699 | 72.49 | 187.88 | ± 0.20 | T7 |
| 39 | 749.03004 | 1225.139 | 115.38562 | 72.49 | 187.87 | ± 0.20 | T7 |
| 40 | 762.7404 | 1213.338 | 113.93312 | 72.49 | 186.42 | ± 0.20 | SLOPE |
| 41 | 776.77976 | 1201.626 | 112.50767 | 72.49 | 185.00 | ± 0.20 | SLOPE |
| 42 | 789.76146 | 1189.91 | 111.01757 | 72.49 | 183.51 | ± 0.20 | SLOPE |
| 43 | 801.68965 | 1177.518 | 110.20241 | 72.49 | 182.69 | ± 0.20 | T6 |
| 44 | 815.93374 | 1167.178 | 109.9366 | 72.49 | 182.43 | ± 0.20 | T6 |
| 45 | 829.8382 | 1156.373 | 109.58936 | 72.49 | 182.08 | ± 0.20 | T6 |
| 46 | 843.54419 | 1145.063 | 108.7762 | 72.49 | 181.26 | ± 0.20 | SLOPE |
| 47 | 856.00482 | 1132.275 | 107.2414 | 72.49 | 179.73 | ± 0.20 | SLOPE |
| 48 | 869.09947 | 1120.281 | 105.24299 | 72.49 | 177.73 | ± 0.20 | SLOPE |
| 49 | 882.29363 | 1107.937 | 103.66516 | 72.49 | 176.15 | ± 0.20 | SLOPE |
| 50 | 882.2929 | 1107.937 | 103.66518 | 72.49 | 176.15 | ± 0.20 | SLOPE |

| Huntington River Location Tower | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 51 | 896.18341 | 1095.911 | 102.90894 | 72.49 | 175.40 | ± 0.20 | SLOPE |
| 52 | 909.24982 | 1083.681 | 102.03 | 72.49 | 174.52 | ± 0.20 | SLOPE |
| 53 | 917.92195 | 1068.136 | 101.41419 | 72.49 | 173.90 | ± 0.20 | SLOPE |
| 54 | 868.17107 | 1075.393 | 103.18007 | 72.49 | 175.67 | ± 0.20 | SLOPE |
| 55 | 868.26402 | 1075.34 | 103.17783 | 72.49 | 175.67 | ± 0.20 | SLOPE |
| 56 | 898.17197 | 1054.924 | 101.34783 | 72.49 | 173.84 | ± 0.20 | SLOPE |
| 57 | 913.54145 | 1045.501 | 100.91947 | 72.49 | 173.41 | ± 0.20 | SLOPE |
| 58 | 929.22035 | 1036.224 | 100.24129 | 72.49 | 172.73 | ± 0.20 | T5 |
| 59 | 944.63092 | 1027.784 | 100.3614 | 72.49 | 172.85 | ± 0.20 | T5 |
| 60 | 960.80982 | 1019.798 | 100.33782 | 72.49 | 172.83 | ± 0.20 | T5 |
| 61 | 976.16632 | 1011.804 | 100.44135 | 72.49 | 172.93 | ± 0.20 | T5 |
| 62 | 991.90705 | 1003.997 | 100.24635 | 72.49 | 172.73 | ± 0.20 | T5 |
| 63 | 998.4796 | 985.5344 | 99.14549 | 72.49 | 171.63 | ± 0.20 | SLOPE |
| 64 | 998.40906 | 980.6605 | 99.14768 | 72.49 | 171.64 | ± 0.20 | SLOPE |
| 65 | 998.00119 | 977.7621 | 98.47916 | 72.49 | 170.97 | ± 0.20 | SLOPE |
| 66 | 999.05377 | 970.3482 | 96.41408 | 72.49 | 168.90 | ± 0.20 | SLOPE |
| 67 | 1000.1499 | 966.3953 | 95.7498 | 72.49 | 168.24 | ± 0.20 | T3 |
| 68 | 1002.7565 | 961.5315 | 95.78337 | 72.49 | 168.27 | ± 0.20 | T3 |
| 69 | 1042.6948 | 960.1245 | 95.24549 | 72.49 | 167.73 | ± 0.20 | T3 |
| 70 | 1050.8585 | 955.9946 | 94.87939 | 72.49 | 167.37 | ± 0.20 | T3 |
| 71 | 1063.5613 | 950.1566 | 94.95173 | 72.49 | 167.44 | ± 0.20 | T3 |
| 72 | 1071.9966 | 946.6091 | 94.65428 | 72.49 | 167.14 | ± 0.20 | T3 |
| 73 | 1076.0996 | 953.46 | 95.11172 | 72.49 | 167.60 | ± 0.20 | T3 |
| 74 | 1069.2213 | 945.8508 | 94.51926 | 72.49 | 167.01 | ± 0.20 | SLOPE |
| 75 | 1077.7962 | 942.4397 | 93.78716 | 72.49 | 166.28 | ± 0.20 | SLOPE |
| 76 | 1085.3122 | 938.7252 | 93.08459 | 72.49 | 165.57 | ± 0.20 | SLOPE |
| 77 | 1092.9068 | 934.215 | 92.24335 | 72.49 | 164.73 | ± 0.20 | SLOPE |
| 78 | 1101.043 | 929.8495 | 91.54632 | 72.49 | 164.03 | ± 0.20 | T2 |
| 79 | 1108.1328 | 927.3492 | 91.49688 | 72.49 | 163.99 | ± 0.20 | T2 |
| 80 | 1134.7361 | 916.4736 | 91.10077 | 72.49 | 163.59 | ± 0.20 | T2 |
| 81 | 1125.4853 | 871.017 | 91.48427 | 72.49 | 163.97 | ± 0.20 | T2 |
| 82 | 1124.3464 | 840.5971 | 92.00304 | 72.49 | 164.49 | ± 0.20 | T2 |
| 83 | 1123.0857 | 829.9551 | 92.03241 | 72.49 | 164.52 | ± 0.20 | T2 |
| 84 | 1102.0476 | 839.6029 | 91.82053 | 72.49 | 164.31 | ± 0.20 | T2 |
| 85 | 1097.8211 | 837.0015 | 91.41 | 72.49 | 163.90 | ± 0.20 | T2 |
| 86 | 1091.7764 | 832.6849 | 90.51441 | 72.49 | 163.00 | ± 0.20 | T2 |
| 87 | 1085.9608 | 828.4545 | 90.13133 | 72.49 | 162.62 | ± 0.20 | T2 |
| 88 | 1079.8053 | 824.2515 | 90.14763 | 72.49 | 162.64 | ± 0.20 | T2 |
| 89 | 1062.9902 | 815.2024 | 90.9119 | 72.49 | 163.40 | ± 0.20 | T2 |
| 90 | 1055.8067 | 812.8665 | 91.09506 | 72.49 | 163.58 | ± 0.20 | T2 |
| 91 | 1049.1722 | 813.3412 | 91.13216 | 72.49 | 163.62 | ± 0.20 | T2 |
| 92 | 1007.4193 | 812.44 | 91.16254 | 72.49 | 163.65 | ± 0.20 | T2 |
| 93 | 994.56802 | 810.3098 | 90.76569 | 72.49 | 163.25 | ± 0.20 | T2 |
| 94 | 981.36576 | 807.3572 | 89.8763 | 72.49 | 162.36 | ± 0.20 | T2 |
| 95 | 969.35172 | 804.8414 | 90.44417 | 72.49 | 162.93 | ± 0.20 | T2 |
| 96 | 957.38519 | 801.431 | 90.84199 | 72.49 | 163.33 | ± 0.20 | T2 |
| 97 | 944.70035 | 798.2429 | 91.19627 | 72.49 | 163.68 | ± 0.20 | T2 |
| 98 | 933.2093 | 794.7103 | 90.98809 | 72.49 | 163.48 | ± 0.20 | T2 |
| 99 | 933.20806 | 794.7065 | 90.98793 | 72.49 | 163.48 | ± 0.20 | T2 |
| 100 | 921.53879 | 790.703 | 90.92395 | 72.49 | 163.41 | ± 0.20 | T2 |

| Huntington River Location Tower | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 101 | 900.32826 | 782.3677 | 91.2443 | 72.49 | 163.73 | ± 0.20 | T2 |
| 102 | 901.70021 | 825.6547 | 91.25678 | 72.49 | 163.75 | ± 0.20 | T2 |
| 103 | 846.73467 | 855.7994 | 93.48027 | 72.49 | 165.97 | ± 0.20 | T2 |
| 104 | 846.76339 | 855.775 | 93.4744 | 72.49 | 165.96 | ± 0.20 | T2 |
| 105 | 795.84658 | 860.8219 | 95.03469 | 72.49 | 167.52 | ± 0.20 | T3 |
| Note: These elevations are tied to the Benchmark MAYOAZMK (160.75 m ± 0.05 m) on the bridge north of here via: TOWR Pt 69 = TOM2 Pt 21; TOM2 Pt 3 = Benchmark | | | | | | | |

| Huntington River Location Audubon 1 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 71.21 | 171.21 | ± 0.20 | T3 |
| 2 | 1000.000 | 1000.000 | 100.000 | 71.21 | 171.21 | ± 0.20 | T3 |
| 3 | 971.703 | 971.895 | 102.010 | 71.21 | 173.22 | ± 0.20 | T4 |
| 4 | 974.071 | 974.260 | 100.415 | 71.21 | 171.62 | ± 0.20 | SLOPE |
| 5 | 984.606 | 986.198 | 100.023 | 71.21 | 171.23 | ± 0.20 | T3 |
| 6 | 1000.107 | 992.330 | 99.833 | 71.21 | 171.04 | ± 0.20 | T3 |
| 7 | 1015.869 | 999.835 | 99.534 | 71.21 | 170.74 | ± 0.20 | T3 |
| 8 | 1024.889 | 1009.400 | 99.325 | 71.21 | 170.53 | ± 0.20 | T3 |
| 9 | 1029.308 | 1014.780 | 99.424 | 71.21 | 170.63 | ± 0.20 | T3 |
| 10 | 1031.243 | 1017.343 | 98.767 | 71.21 | 169.97 | ± 0.20 | SLOPE |
| 11 | 1034.825 | 1021.400 | 97.559 | 71.21 | 168.76 | ± 0.20 | T2 |
| 12 | 1045.570 | 1029.329 | 97.298 | 71.21 | 168.50 | ± 0.20 | T2 |
| 13 | 1057.599 | 1037.808 | 97.126 | 71.21 | 168.33 | ± 0.20 | T2 |
| 14 | 1070.100 | 1043.431 | 96.896 | 71.21 | 168.10 | ± 0.20 | T2 |
| 15 | 1081.525 | 1051.829 | 96.467 | 71.21 | 167.67 | ± 0.20 | T2 |
| 16 | 1097.176 | 1061.037 | 96.622 | 71.21 | 167.83 | ± 0.20 | T2 |
| 17 | 1112.816 | 1071.657 | 96.351 | 71.21 | 167.56 | ± 0.20 | T2 |
| 18 | 1130.899 | 1078.773 | 95.477 | 71.21 | 166.68 | ± 0.20 | T1 |
| 19 | 1145.175 | 1089.147 | 95.531 | 71.21 | 166.74 | ± 0.20 | T1 |
| 20 | 1164.465 | 1103.558 | 95.326 | 71.21 | 166.53 | ± 0.20 | T1 |
| 21 | 1183.214 | 1115.973 | 95.085 | 71.21 | 166.29 | ± 0.20 | T1 |
| 22 | 1205.612 | 1128.800 | 94.500 | 71.21 | 165.71 | ± 0.20 | T1 |
| 23 | 1225.723 | 1138.715 | 94.290 | 71.21 | 165.50 | ± 0.20 | T1 |
| 24 | 1245.919 | 1139.079 | 94.164 | 71.21 | 165.37 | ± 0.20 | T1 |
| 25 | 1283.739 | 1130.172 | 94.029 | 71.21 | 165.23 | ± 0.20 | T1 |
| 26 | 1289.628 | 1133.001 | 93.780 | 71.21 | 164.99 | ± 0.20 | T1 |
| 27 | 1295.640 | 1135.060 | 93.657 | 71.21 | 164.86 | ± 0.20 | T1 |
| 28 | 1300.952 | 1137.302 | 93.352 | 71.21 | 164.56 | ± 0.20 | SLOPE |
| 29 | 1305.540 | 1139.368 | 93.251 | 71.21 | 164.46 | ± 0.20 | SLOPE |
| 30 | 1309.892 | 1141.834 | 92.778 | 71.21 | 163.98 | ± 0.20 | RIVER |
| 31 | 1314.027 | 1143.948 | 92.680 | 71.21 | 163.89 | ± 0.20 | RIVER |
| 32 | 1315.982 | 1144.770 | 92.635 | 71.21 | 163.84 | ± 0.20 | RIVER |
| 33 | 1315.952 | 1144.867 | 92.635 | 71.21 | 163.84 | ± 0.20 | RIVER |
| 34 | 1319.308 | 1146.472 | 92.079 | 71.21 | 163.28 | ± 0.20 | RIVER |
| 35 | 1323.387 | 1148.286 | 91.970 | 71.21 | 163.18 | ± 0.20 | RIVER |
| 36 | 1327.208 | 1149.769 | 91.790 | 71.21 | 163.00 | ± 0.20 | RIVER |
| 37 | 1205.201 | 1062.557 | 95.829 | 71.21 | 167.03 | ± 0.20 | T2 |
| 38 | 1200.072 | 1059.520 | 95.851 | 71.21 | 167.06 | ± 0.20 | T2 |
| 39 | 1130.260 | 976.255 | 99.196 | 71.21 | 170.40 | ± 0.20 | T3 |
| 40 | 1141.004 | 983.622 | 99.305 | 71.21 | 170.51 | ± 0.20 | T3 |
| 41 | 1145.559 | 986.016 | 99.111 | 71.21 | 170.32 | ± 0.20 | T3 |
| 42 | 1149.788 | 986.914 | 98.371 | 71.21 | 169.58 | ± 0.20 | SLOPE |
| 43 | 1149.784 | 986.908 | 98.371 | 71.21 | 169.58 | ± 0.20 | SLOPE |
| 44 | 1164.723 | 987.923 | 97.729 | 71.21 | 168.93 | ± 0.20 | T2 |
| 45 | 1164.721 | 987.920 | 97.729 | 71.21 | 168.93 | ± 0.20 | T2 |
| 46 | 1178.634 | 990.183 | 97.500 | 71.21 | 168.71 | ± 0.20 | T2 |
| 47 | 1190.150 | 991.824 | 97.528 | 71.21 | 168.73 | ± 0.20 | T2 |
| 48 | 1196.418 | 994.326 | 96.963 | 71.21 | 168.17 | ± 0.20 | T2 |
| 49 | 1201.834 | 996.810 | 96.170 | 71.21 | 167.38 | ± 0.20 | T2 |
| 50 | 1206.635 | 1001.770 | 95.571 | 71.21 | 166.78 | ± 0.20 | T2 |
| 51 | 1207.722 | 1012.309 | 95.920 | 71.21 | 167.13 | ± 0.20 | T2 |
| 52 | 1205.349 | 1024.773 | 95.942 | 71.21 | 167.15 | ± 0.20 | T2 |
| 53 | 1204.251 | 1038.350 | 95.588 | 71.21 | 166.79 | ± 0.20 | SLOPE |
| 54 | 1101.599 | 968.075 | 102.557 | 71.21 | 173.76 | ± 0.20 | T4 |

| Huntington River Location Audubon 1 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 55 | 1194.086 | 985.621 | 97.499 | 71.21 | 168.70 | ± 0.20 | T2 |
| 56 | 1187.286 | 997.021 | 96.938 | 71.21 | 168.14 | ± 0.20 | T2 |
| 57 | 1182.372 | 1001.406 | 95.988 | 71.21 | 167.19 | ± 0.20 | T2 |
| 58 | 1176.613 | 1006.685 | 95.482 | 71.21 | 166.69 | ± 0.20 | T2 |
| 59 | 1163.492 | 1019.708 | 95.571 | 71.21 | 166.78 | ± 0.20 | T2 |
| 60 | 1148.711 | 1034.154 | 95.308 | 71.21 | 166.51 | ± 0.20 | T2 |
| 61 | 1130.591 | 1051.136 | 94.490 | 71.21 | 165.70 | ± 0.20 | T1 |
| 62 | 1120.450 | 1062.040 | 94.591 | 71.21 | 165.80 | ± 0.20 | T1 |
| 63 | 1112.345 | 1069.270 | 93.923 | 71.21 | 165.13 | ± 0.20 | T1 |
| 64 | 1106.060 | 1075.527 | 93.755 | 71.21 | 164.96 | ± 0.20 | T1 |
| 65 | 1100.205 | 1080.988 | 94.345 | 71.21 | 165.55 | ± 0.20 | T1 |
| 66 | 1098.912 | 1079.790 | 94.343 | 71.21 | 165.55 | ± 0.20 | T1 |
| 67 | 1115.515 | 1094.684 | 94.064 | 71.21 | 165.27 | ± 0.20 | T1 |
| 68 | 1114.168 | 1098.406 | 93.537 | 71.21 | 164.74 | ± 0.20 | T1 |
| 69 | 1135.320 | 1088.423 | 93.507 | 71.21 | 164.71 | ± 0.20 | T1 |
| 70 | 1138.469 | 1084.218 | 93.592 | 71.21 | 164.80 | ± 0.20 | T1 |
| 71 | 1142.262 | 1078.629 | 94.132 | 71.21 | 165.34 | ± 0.20 | T1 |
| 72 | 1148.683 | 1069.533 | 94.431 | 71.21 | 165.64 | ± 0.20 | T1 |
| 73 | 1152.501 | 1064.134 | 94.916 | 71.21 | 166.12 | ± 0.20 | T2 |
| 74 | 1164.746 | 1044.205 | 95.206 | 71.21 | 166.41 | ± 0.20 | T2 |
| 75 | 1176.325 | 1022.027 | 95.315 | 71.21 | 166.52 | ± 0.20 | T2 |
| 76 | 1184.013 | 1007.840 | 96.071 | 71.21 | 167.28 | ± 0.20 | T2 |
| 77 | 1188.269 | 998.065 | 97.060 | 71.21 | 168.27 | ± 0.20 | T2 |
| 78 | 1191.944 | 989.601 | 97.504 | 71.21 | 168.71 | ± 0.20 | T2 |
| 79 | 1199.302 | 1018.997 | 96.952 | 71.21 | 168.16 | ± 0.20 | T2 |
| 80 | 1199.384 | 1023.071 | 97.436 | 71.21 | 168.64 | ± 0.20 | T2 |
| 81 | 1199.229 | 1025.607 | 98.573 | 71.21 | 169.78 | ± 0.20 | SLOPE |
| 82 | 1199.848 | 1028.394 | 99.678 | 71.21 | 170.88 | ± 0.20 | T3 |
| 83 | 1130.358 | 1094.940 | 93.887 | 71.21 | 165.09 | ± 0.20 | T1 |
| 84 | 1194.075 | 985.640 | 97.292 | 71.21 | 168.50 | ± 0.20 | T2 |
| 85 | 1192.245 | 1142.655 | 94.458 | 71.21 | 165.66 | ± 0.20 | T1 |
| 86 | 1193.399 | 1119.958 | 99.992 | 71.21 | 171.20 | ± 0.20 | T4 |
| 87 | 1189.817 | 1115.817 | 100.380 | 71.21 | 171.59 | ± 0.20 | T4 |
| 88 | 1188.508 | 1119.673 | 99.949 | 71.21 | 171.15 | ± 0.20 | T4 |
| 89 | 1186.971 | 1117.444 | 100.335 | 71.21 | 171.54 | ± 0.20 | T4 |
| 90 | 1182.539 | 1117.008 | 99.838 | 71.21 | 171.04 | ± 0.20 | T4 |
| 91 | 1180.346 | 1120.181 | 98.496 | 71.21 | 169.70 | ± 0.20 | T4 |
| 92 | 1181.382 | 1122.723 | 97.310 | 71.21 | 168.51 | ± 0.20 | SLOPE |
| 93 | 1183.777 | 1125.718 | 95.771 | 71.21 | 166.98 | ± 0.20 | T2 |
| 94 | 1183.734 | 1128.437 | 94.879 | 71.21 | 166.08 | ± 0.20 | SLOPE |
| 95 | 1188.039 | 1132.148 | 94.736 | 71.21 | 165.94 | ± 0.20 | T2 |
| 96 | 1186.330 | 1136.026 | 94.522 | 71.21 | 165.73 | ± 0.20 | T2 |
| 97 | 1165.718 | 1123.030 | 93.206 | 71.21 | 164.41 | ± 0.20 | T2 |
| 98 | 1249.353 | 1212.840 | 93.563 | 71.21 | 164.77 | ± 0.20 | T2 |
| 99 | 1249.339 | 1212.823 | 93.563 | 71.21 | 164.77 | ± 0.20 | T2 |
| 100 | 1243.990 | 1207.623 | 93.703 | 71.21 | 164.91 | ± 0.20 | T2 |
| 101 | 1240.479 | 1202.771 | 93.798 | 71.21 | 165.00 | ± 0.20 | T2 |
| 102 | 1235.576 | 1197.026 | 94.009 | 71.21 | 165.21 | ± 0.20 | T2 |
| 103 | 1235.564 | 1197.012 | 94.009 | 71.21 | 165.21 | ± 0.20 | T2 |
| 104 | 1231.647 | 1192.244 | 94.071 | 71.21 | 165.28 | ± 0.20 | T2 |
| 105 | 1227.338 | 1186.508 | 94.113 | 71.21 | 165.32 | ± 0.20 | T2 |
| 106 | 1223.587 | 1180.456 | 94.156 | 71.21 | 165.36 | ± 0.20 | T2 |

| Huntington River Location Audubon 1 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 108 | 1212.074 | 1166.835 | 94.184 | 71.21 | 165.39 | ± 0.20 | T2 |
| 109 | 1206.795 | 1160.254 | 94.258 | 71.21 | 165.46 | ± 0.20 | T2 |
| 110 | 1201.307 | 1153.368 | 94.335 | 71.21 | 165.54 | ± 0.20 | T2 |
| 111 | 1173.810 | 1168.173 | 89.923 | 71.21 | 161.13 | ± 0.20 | RIVER |
| 112 | 1170.707 | 1174.157 | 90.442 | 71.21 | 161.65 | ± 0.20 | RIVER |
| 113 | 1168.692 | 1179.824 | 90.568 | 71.21 | 161.77 | ± 0.20 | RIVER |
| 114 | 1166.704 | 1187.777 | 90.679 | 71.21 | 161.88 | ± 0.20 | RIVER |
| 115 | 1164.556 | 1196.070 | 90.639 | 71.21 | 161.84 | ± 0.20 | RIVER |
| 116 | 1160.217 | 1204.303 | 90.660 | 71.21 | 161.87 | ± 0.20 | RIVER |
| 117 | 1159.693 | 1212.662 | 90.556 | 71.21 | 161.76 | ± 0.20 | RIVER |
| 118 | 1157.487 | 1225.307 | 90.375 | 71.21 | 161.58 | ± 0.20 | RIVER |
| 119 | 1147.552 | 1236.466 | 90.327 | 71.21 | 161.53 | ± 0.20 | RIVER |
| 120 | 1148.865 | 1247.938 | 89.931 | 71.21 | 161.14 | ± 0.20 | RIVER |
| 121 | 1140.783 | 1257.466 | 89.975 | 71.21 | 161.18 | ± 0.20 | RIVER |
| 122 | 1139.241 | 1267.666 | 88.737 | 71.21 | 159.94 | ± 0.20 | RIVER |
| 123 | 1139.137 | 1262.046 | 89.416 | 71.21 | 160.62 | ± 0.20 | RIVER |
| 124 | 1138.074 | 1272.499 | 88.780 | 71.21 | 159.98 | ± 0.20 | RIVER |
| 125 | 1135.238 | 1279.679 | 89.109 | 71.21 | 160.31 | ± 0.20 | RIVER |
| 126 | 1133.608 | 1285.922 | 89.236 | 71.21 | 160.44 | ± 0.20 | RIVER |
| 127 | 1133.100 | 1292.483 | 88.790 | 71.21 | 159.99 | ± 0.20 | RIVER |
| 128 | 1132.286 | 1299.681 | 88.788 | 71.21 | 159.99 | ± 0.20 | RIVER |
| 129 | 1132.096 | 1305.500 | 88.775 | 71.21 | 159.98 | ± 0.20 | RIVER |
| 130 | 1129.583 | 1310.575 | 89.369 | 71.21 | 160.57 | ± 0.20 | RIVER |
| 131 | 1129.182 | 1321.026 | 89.063 | 71.21 | 160.27 | ± 0.20 | RIVER |
| 132 | 1127.971 | 1327.917 | 88.585 | 71.21 | 159.79 | ± 0.20 | RIVER |
| 133 | 1127.946 | 1343.825 | 88.415 | 71.21 | 159.62 | ± 0.20 | RIVER |
| 134 | 1120.992 | 1350.207 | 88.387 | 71.21 | 159.59 | ± 0.20 | RIVER |
| 135 | 1123.721 | 1364.647 | 88.543 | 71.21 | 159.75 | ± 0.20 | RIVER |
| 136 | 1122.439 | 1368.199 | 89.140 | 71.21 | 160.35 | ± 0.20 | RIVER |
| 137 | 1121.438 | 1370.944 | 89.868 | 71.21 | 161.07 | ± 0.20 | RIVER |
| 138 | 1121.444 | 1370.905 | 89.869 | 71.21 | 161.07 | ± 0.20 | RIVER |
| 139 | 1120.800 | 1376.196 | 91.645 | 71.21 | 162.85 | ± 0.20 | T1 |
| 140 | 1117.796 | 1377.759 | 91.427 | 71.21 | 162.63 | ± 0.20 | T1 |
| 141 | 1117.328 | 1377.890 | 91.334 | 71.21 | 162.54 | ± 0.20 | T1 |
| 142 | 1115.127 | 1380.665 | 91.389 | 71.21 | 162.59 | ± 0.20 | T1 |
| 143 | 1113.497 | 1382.361 | 91.302 | 71.21 | 162.51 | ± 0.20 | T1 |
| 144 | 1111.823 | 1382.391 | 90.694 | 71.21 | 161.90 | ± 0.20 | RIVER |
| 145 | 1114.859 | 1374.291 | 90.076 | 71.21 | 161.28 | ± 0.20 | RIVER |
| 146 | 1117.115 | 1370.862 | 89.431 | 71.21 | 160.64 | ± 0.20 | RIVER |
| 147 | 1132.884 | 1297.093 | 88.724 | 71.21 | 159.93 | ± 0.20 | RIVER |
| 148 | 1130.731 | 1296.633 | 89.597 | 71.21 | 160.80 | ± 0.20 | RIVER |
| 149 | 1129.868 | 1295.355 | 90.406 | 71.21 | 161.61 | ± 0.20 | RIVER |
| 150 | 1129.886 | 1295.312 | 90.407 | 71.21 | 161.61 | ± 0.20 | RIVER |
| 151 | 1128.912 | 1294.884 | 91.024 | 71.21 | 162.23 | ± 0.20 | SLOPE |
| 152 | 1127.671 | 1295.697 | 92.134 | 71.21 | 163.34 | ± 0.20 | SLOPE |
| 153 | 1126.934 | 1295.753 | 93.025 | 71.21 | 164.23 | ± 0.20 | T1 |
| 154 | 1126.169 | 1294.740 | 93.252 | 71.21 | 164.46 | ± 0.20 | T1 |
| 155 | 1123.452 | 1298.169 | 93.328 | 71.21 | 164.53 | ± 0.20 | T1 |
| 156 | 1192.750 | 1184.957 | 92.289 | 71.21 | 163.49 | ± 0.20 | T1 |
| 157 | 1194.925 | 1180.689 | 92.921 | 71.21 | 164.13 | ± 0.20 | T1 |

| Huntington River Location Audubon 1 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 158 | 1196.090 | 1178.059 | 93.386 | 71.21 | 164.59 | ± 0.20 | T1 |
| 159 | 1196.088 | 1178.063 | 93.386 | 71.21 | 164.59 | ± 0.20 | T1 |
| 160 | 1196.488 | 1174.152 | 94.242 | 71.21 | 165.45 | ± 0.20 | T1 |
| 161 | 1104.149 | 1325.742 | 91.993 | 71.21 | 163.20 | ± 0.20 | SLOPE |
| 162 | 1108.970 | 1319.783 | 92.296 | 71.21 | 163.50 | ± 0.20 | SLOPE |
| 163 | 1111.242 | 1313.815 | 92.153 | 71.21 | 163.36 | ± 0.20 | SLOPE |
| 164 | 1112.865 | 1308.868 | 92.830 | 71.21 | 164.04 | ± 0.20 | T2 |
| 165 | 1115.655 | 1304.578 | 93.361 | 71.21 | 164.57 | ± 0.20 | T2 |
| 166 | 1115.668 | 1304.567 | 93.361 | 71.21 | 164.57 | ± 0.20 | T2 |
| 167 | 1111.786 | 1296.452 | 93.139 | 71.21 | 164.34 | ± 0.20 | T2 |
| 168 | 1103.891 | 1285.509 | 93.007 | 71.21 | 164.21 | ± 0.20 | T2 |
| 169 | 1091.808 | 1272.743 | 92.705 | 71.21 | 163.91 | ± 0.20 | T2 |
| 170 | 1082.260 | 1260.258 | 92.871 | 71.21 | 164.08 | ± 0.20 | T2 |
| 171 | 1078.273 | 1256.814 | 93.380 | 71.21 | 164.59 | ± 0.20 | T2 |
| 172 | 1072.504 | 1252.491 | 93.862 | 71.21 | 165.07 | ± 0.20 | T2 |
| 173 | 1064.362 | 1243.923 | 93.824 | 71.21 | 165.03 | ± 0.20 | T2 |
| 174 | 1055.649 | 1241.941 | 93.821 | 71.21 | 165.03 | ± 0.20 | T2 |
| 175 | 1041.830 | 1237.973 | 93.628 | 71.21 | 164.83 | ± 0.20 | T2 |
| 176 | 1028.897 | 1235.168 | 93.491 | 71.21 | 164.70 | ± 0.20 | T2 |
| 177 | 1020.457 | 1233.001 | 94.247 | 71.21 | 165.45 | ± 0.20 | T2 |
| 178 | 1017.160 | 1232.240 | 95.366 | 71.21 | 166.57 | ± 0.20 | T2 |
| 179 | 1013.483 | 1230.992 | 96.971 | 71.21 | 168.18 | ± 0.20 | T3 |
| 180 | 1010.714 | 1228.423 | 96.812 | 71.21 | 168.02 | ± 0.20 | T3 |
| 181 | 1015.458 | 1221.098 | 95.956 | 71.21 | 167.16 | ± 0.20 | T3 |
| 182 | 1019.012 | 1219.411 | 94.581 | 71.21 | 165.79 | ± 0.20 | T2 |
| 183 | 1023.141 | 1216.373 | 93.714 | 71.21 | 164.92 | ± 0.20 | T2 |
| 184 | 1024.930 | 1207.471 | 93.770 | 71.21 | 164.97 | ± 0.20 | T2 |
| 185 | 1024.891 | 1207.436 | 93.770 | 71.21 | 164.98 | ± 0.20 | T2 |
| 186 | 1013.461 | 1181.658 | 93.600 | 71.21 | 164.81 | ± 0.20 | T2 |
| 187 | 1008.195 | 1158.066 | 93.847 | 71.21 | 165.05 | ± 0.20 | T2 |
| 188 | 978.729 | 1133.118 | 93.972 | 71.21 | 165.18 | ± 0.20 | T2 |
| 189 | 994.672 | 1190.672 | 96.732 | 71.21 | 167.94 | ± 0.20 | T3 |
| 190 | 995.140 | 1211.784 | 96.658 | 71.21 | 167.86 | ± 0.20 | T3 |
| 191 | 993.099 | 1221.784 | 96.643 | 71.21 | 167.85 | ± 0.20 | T3 |
| 192 | 979.734 | 1243.993 | 96.441 | 71.21 | 167.65 | ± 0.20 | SLOPE |
| 193 | 977.954 | 1248.578 | 95.724 | 71.21 | 166.93 | ± 0.20 | T3 |
| 194 | 976.701 | 1253.683 | 94.075 | 71.21 | 165.28 | ± 0.20 | T2 |
| 195 | 975.021 | 1261.580 | 92.509 | 71.21 | 163.71 | ± 0.20 | T2 |
| 196 | 987.197 | 1268.826 | 92.585 | 71.21 | 163.79 | ± 0.20 | T2 |
| 197 | 1010.833 | 1277.296 | 93.087 | 71.21 | 164.29 | ± 0.20 | T2 |
| 198 | 1030.332 | 1281.812 | 92.977 | 71.21 | 164.18 | ± 0.20 | T2 |
| 199 | 1043.793 | 1285.156 | 92.465 | 71.21 | 163.67 | ± 0.20 | T2 |
| 200 | 1034.616 | 1295.579 | 91.639 | 71.21 | 162.84 | ± 0.20 | T1 |
| 201 | 1039.804 | 1308.229 | 91.437 | 71.21 | 162.64 | ± 0.20 | T1 |
| 202 | 1049.313 | 1312.800 | 91.547 | 71.21 | 162.75 | ± 0.20 | T1 |
| 203 | 1062.864 | 1311.062 | 91.768 | 71.21 | 162.97 | ± 0.20 | T1 |
| 204 | 1075.114 | 1309.515 | 91.370 | 71.21 | 162.58 | ± 0.20 | T1 |
| 205 | 1083.159 | 1305.466 | 91.734 | 71.21 | 162.94 | ± 0.20 | T1 |
| 206 | 1096.161 | 1294.393 | 92.976 | 71.21 | 164.18 | ± 0.20 | T2 |
| 207 | 1087.536 | 1322.717 | 91.776 | 71.21 | 162.98 | ± 0.20 | T1 |

| Huntington River Location Audubon 1 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 208 | 1092.432 | 1317.030 | 91.634 | 71.21 | 162.84 | ± 0.20 | T1 |
| 209 | 987.764 | 1219.644 | 96.357 | 71.21 | 167.56 | ± 0.20 | SLOPE |
| 210 | 951.109 | 1255.247 | 94.758 | 71.21 | 165.96 | ± 0.20 | T2 |
| Note: These elevations are tied to the Benchmark MAYOAZMK (160.75 m ± 0.05 m) on the bridge north of here via: AUD1 Pt 210 = TOWR Pt 104; TOWR Pt 69 = TOM2 Pt 21; TOM2 Pt 3 = Benchmark | | | | | | | |

| Huntington River Location Audubon 2 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 75.23 | 175.23 | ± 0.20 | T5 |
| 2 | 1000.000 | 1000.000 | 100.000 | 75.23 | 175.23 | ± 0.20 | T5 |
| 3 | 1012.956 | 1000.177 | 100.144 | 75.23 | 175.37 | ± 0.20 | T5 |
| 4 | 1016.731 | 1000.175 | 98.934 | 75.23 | 174.17 | ± 0.20 | SLOPE |
| 5 | 1053.825 | 1009.217 | 95.975 | 75.23 | 171.21 | ± 0.20 | T3 |
| 6 | 951.842 | 996.387 | 101.142 | 75.23 | 176.37 | ± 0.20 | T5 |
| 7 | 947.814 | 999.576 | 101.361 | 75.23 | 176.59 | ± 0.20 | T5 |
| 8 | 960.195 | 996.907 | 100.187 | 75.23 | 175.42 | ± 0.20 | T5 |
| 9 | 963.085 | 996.531 | 99.902 | 75.23 | 175.13 | ± 0.20 | T5 |
| Note: These elevations are tied to the Benchmark MAYOAZMK (160.75 m ± 0.05 m on the bridge north of here via: AUD2 Pt 5 = AUD1 Pt 1; AUD1 Pt 210 = TOWR Pt 104; TOWR Pt 69 = TOM2 Pt 21; TOM2 Pt 3 = Benchmark | | | | | | | |

| | Huntington River Location Audubon 3 | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 75.23 | 175.23 | ± 0.20 | T5 |
| 2 | 1000.000 | 1000.000 | 100.000 | 75.23 | 175.23 | ± 0.20 | T5 |
| 3 | 1033.904 | 931.349 | 98.272 | 75.23 | 173.50 | ± 0.20 | T4 |
| 4 | 1023.067 | 913.744 | 98.833 | 75.23 | 174.06 | ± 0.20 | SLOPE |
| 5 | 1015.808 | 891.714 | 99.085 | 75.23 | 174.32 | ± 0.20 | T5 |
| 6 | 1012.183 | 850.526 | 98.426 | 75.23 | 173.66 | ± 0.20 | T4 |
| 7 | 1018.135 | 799.870 | 98.168 | 75.23 | 173.40 | ± 0.20 | T4 |
| 8 | 1018.134 | 799.877 | 98.173 | 75.23 | 173.40 | ± 0.20 | T4 |
| 9 | 999.535 | 786.844 | 98.207 | 75.23 | 173.44 | ± 0.20 | T4 |
| 10 | 987.916 | 817.466 | 98.612 | 75.23 | 173.84 | ± 0.20 | T4 |
| 11 | 978.514 | 853.761 | 99.244 | 75.23 | 174.47 | ± 0.20 | T5 |
| 12 | 978.514 | 853.764 | 99.244 | 75.23 | 174.47 | ± 0.20 | T5 |
| 13 | 975.837 | 885.790 | 98.545 | 75.23 | 173.78 | ± 0.20 | T4 |
| 14 | 975.836 | 885.786 | 98.545 | 75.23 | 173.78 | ± 0.20 | T4 |
| 15 | 995.162 | 943.966 | 98.096 | 75.23 | 173.33 | ± 0.20 | T4 |
| 16 | 990.827 | 945.807 | 98.489 | 75.23 | 173.72 | ± 0.20 | T4 |
| 17 | 986.650 | 947.312 | 99.104 | 75.23 | 174.33 | ± 0.20 | T5 |
| 18 | 978.291 | 948.021 | 99.720 | 75.23 | 174.95 | ± 0.20 | T5 |
| 19 | 978.311 | 948.033 | 99.727 | 75.23 | 174.96 | ± 0.20 | T5 |
| 20 | 945.486 | 936.175 | 99.630 | 75.23 | 174.86 | ± 0.20 | T5 |
| 21 | 925.367 | 909.828 | 99.606 | 75.23 | 174.84 | ± 0.20 | T5 |
| 22 | 920.327 | 896.272 | 99.575 | 75.23 | 174.81 | ± 0.20 | T5 |
| 23 | 914.526 | 888.603 | 99.282 | 75.23 | 174.51 | ± 0.20 | T5 |
| 24 | 910.098 | 881.242 | 99.144 | 75.23 | 174.38 | ± 0.20 | T5 |
| 25 | 903.001 | 864.276 | 99.600 | 75.23 | 174.83 | ± 0.20 | T5 |
| 26 | 898.031 | 852.989 | 100.546 | 75.23 | 175.78 | ± 0.20 | FANTOE |
| 27 | 875.734 | 834.427 | 109.008 | 75.23 | 184.24 | ± 0.20 | APEX |
| 28 | 900.252 | 866.211 | 99.761 | 75.23 | 174.99 | ± 0.20 | T5 |
| 29 | 901.531 | 896.568 | 99.045 | 75.23 | 174.28 | ± 0.20 | T5 |
| 30 | 909.650 | 924.053 | 98.764 | 75.23 | 173.99 | ± 0.20 | SLOPE |
| 31 | 921.823 | 950.600 | 99.171 | 75.23 | 174.40 | ± 0.20 | T5 |
| 32 | 953.622 | 958.099 | 99.826 | 75.23 | 175.06 | ± 0.20 | T5 |
| 33 | 989.847 | 1019.937 | 99.909 | 75.23 | 175.14 | ± 0.20 | T5 |
| 34 | 980.888 | 1042.728 | 100.020 | 75.23 | 175.25 | ± 0.20 | T5 |
| 35 | 973.487 | 1054.320 | 100.762 | 75.23 | 175.99 | ± 0.20 | T5 |
| 36 | 973.492 | 1054.299 | 100.763 | 75.23 | 175.99 | ± 0.20 | T5 |
| 37 | 973.439 | 1049.995 | 100.797 | 75.23 | 176.03 | ± 0.20 | T5 |
| 38 | 970.311 | 1050.954 | 101.277 | 75.23 | 176.51 | ± 0.20 | SLOPE |
| 39 | 967.569 | 1051.180 | 101.786 | 75.23 | 177.02 | ± 0.20 | SLOPE |
| 40 | 963.958 | 1046.858 | 101.947 | 75.23 | 177.18 | ± 0.20 | SLOPE |
| 41 | 953.721 | 1049.370 | 102.119 | 75.23 | 177.35 | ± 0.20 | SLOPE |
| 42 | 965.020 | 1052.958 | 101.529 | 75.23 | 176.76 | ± 0.20 | SLOPE |
| 43 | 963.289 | 1056.284 | 99.364 | 75.23 | 174.60 | ± 0.20 | T5 |
| 44 | 960.184 | 1059.013 | 97.325 | 75.23 | 172.56 | ± 0.20 | SLOPE |
| 45 | 955.186 | 1061.223 | 95.757 | 75.23 | 170.99 | ± 0.20 | SLOPE |
| 46 | 956.695 | 1064.554 | 94.680 | 75.23 | 169.91 | ± 0.20 | T2 |
| 47 | 966.506 | 1066.411 | 94.548 | 75.23 | 169.78 | ± 0.20 | T2 |
| 48 | 979.179 | 1068.948 | 94.916 | 75.23 | 170.15 | ± 0.20 | T2 |
| 49 | 988.923 | 1079.949 | 93.488 | 75.23 | 168.72 | ± 0.20 | T2 |
| Note: These elevations are tied to the Benchmark MAYOAZMK (160.75 m ± 0.05 m on the bridge | | | | | | | |

| | Huntington River Location Audubon 3 | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| north of here via: AUD3 Pt 1 = AUD2 Pt 1; AUD2 Pt 5 = AUD1 Pt 1; AUD1 Pt 210 = TOWR Pt 104; | | | | | | | |
| TOWR Pt 69 = TOM2 Pt 21; TOM2 Pt 3 = Benchmark | | | | | | | |

| Huntington River Location 2 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 106.48 | 206.48 | ± 1.0 | T9 |
| 2 | 1100.000 | 1000.000 | 100.000 | 106.48 | 206.48 | ± 1.0 | T9 |
| 3 | 959.993 | 1190.534 | 113.026 | 106.48 | 219.51 | ± 1.0 | T10 |
| 4 | 911.151 | 1191.385 | 113.398 | 106.48 | 219.88 | ± 1.0 | T10 |
| 5 | 862.555 | 1189.427 | 112.846 | 106.48 | 219.33 | ± 1.0 | T10 |
| 6 | 815.194 | 1193.614 | 112.622 | 106.48 | 219.11 | ± 1.0 | T10 |
| 7 | 745.880 | 1191.880 | 111.352 | 106.48 | 217.84 | ± 1.0 | T10 |
| 8 | 661.911 | 1183.334 | 108.970 | 106.48 | 215.45 | ± 1.0 | T10 |
| 9 | 624.808 | 1127.198 | 100.327 | 106.48 | 206.81 | ± 1.0 | T9 |
| 10 | 618.781 | 1062.921 | 96.609 | 106.48 | 203.09 | ± 1.0 | T9 |
| 11 | 624.012 | 1037.934 | 94.778 | 106.48 | 201.26 | ± 1.0 | T9 |
| 12 | 675.617 | 1014.967 | 88.156 | 106.48 | 194.64 | ± 1.0 | T7 |
| 13 | 697.509 | 983.191 | 86.522 | 106.48 | 193.01 | ± 1.0 | T7 |
| 14 | 994.129 | 1031.202 | 100.166 | 106.48 | 206.65 | ± 1.0 | T9 |
| 15 | 976.887 | 983.308 | 99.437 | 106.48 | 205.92 | ± 1.0 | T9 |
| 16 | 965.530 | 820.908 | 86.251 | 106.48 | 192.74 | ± 1.0 | T7 |
| 17 | 968.881 | 788.411 | 84.722 | 106.48 | 191.21 | ± 1.0 | T7 |
| 18 | 1000.000 | 1000.002 | 100.073 | 106.48 | 206.56 | ± 1.0 | T9 |
| 19 | 976.436 | 639.123 | 74.925 | 106.48 | 181.41 | ± 1.0 | T4 |
| 20 | 968.882 | 788.399 | 84.750 | 106.48 | 191.23 | ± 1.0 | T7 |
| 21 | 963.161 | 732.627 | 77.673 | 106.48 | 184.16 | ± 1.0 | T5 |
| 22 | 968.261 | 710.268 | 76.449 | 106.48 | 182.93 | ± 1.0 | T5 |
| 23 | 973.506 | 697.651 | 75.058 | 106.48 | 181.54 | ± 1.0 | T4 |
| 24 | 1010.266 | 633.686 | 74.528 | 106.48 | 181.01 | ± 1.0 | T4 |
| 25 | 1013.062 | 627.024 | 73.883 | 106.48 | 180.37 | ± 1.0 | T3 |
| 26 | 1016.180 | 619.073 | 73.722 | 106.48 | 180.21 | ± 1.0 | T3 |
| 27 | 1042.686 | 615.659 | 72.730 | 106.48 | 179.21 | ± 1.0 | T3 |
| 28 | 1053.845 | 607.520 | 72.614 | 106.48 | 179.10 | ± 1.0 | T3 |
| 29 | 1060.103 | 591.974 | 70.596 | 106.48 | 177.08 | ± 1.0 | T2 |
| 30 | 1120.808 | 449.665 | 70.605 | 106.48 | 177.09 | ± 1.0 | T2 |
| 31 | 1126.648 | 443.344 | 69.433 | 106.48 | 175.92 | ± 1.0 | T2 |
| 32 | 1089.588 | 528.209 | 71.483 | 106.48 | 177.97 | ± 1.0 | T2 |
| 33 | 1100.029 | 514.181 | 70.587 | 106.48 | 177.07 | ± 1.0 | T2 |
| 34 | 1122.849 | 379.400 | 69.128 | 106.48 | 175.61 | ± 1.0 | T1 |
| 35 | 1146.739 | 256.168 | 70.292 | 106.48 | 176.78 | ± 1.0 | T1 |
| 36 | 1211.297 | 298.814 | 69.472 | 106.48 | 175.96 | ± 1.0 | T1 |
| 37 | 1217.955 | 305.342 | 70.370 | 106.48 | 176.85 | ± 1.0 | T1 |
| 38 | 1035.781 | 299.481 | 70.896 | 106.48 | 177.38 | ± 1.0 | T1 |
| 39 | 1023.032 | 287.827 | 69.856 | 106.48 | 176.34 | ± 1.0 | T1 |
| 40 | 1016.497 | 278.979 | 70.269 | 106.48 | 176.75 | ± 1.0 | T1 |
| 41 | 1016.734 | 273.299 | 69.214 | 106.48 | 175.70 | ± 1.0 | T1 |
| 42 | 1020.542 | 253.180 | 68.822 | 106.48 | 175.31 | ± 1.0 | RIVER |
| Note: Elevations at this site are tied to a contour line, elevation 720.00 ft or 219.51 m via Pt 3. | | | | | | | |

| Huntington River Location Sarah-Al | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 124.61 | 224.61 | ± 0.20 | T9 |
| 2 | 960.121 | 908.296 | 100.000 | 124.61 | 224.61 | ± 0.20 | T9 |
| 3 | 851.394 | 658.275 | 80.326 | 124.61 | 204.94 | ± 0.20 | T0 |
| 4 | 864.563 | 672.577 | 81.715 | 124.61 | 206.32 | ± 0.20 | T1 |
| 5 | 872.246 | 691.427 | 81.499 | 124.61 | 206.11 | ± 0.20 | T1 |
| 6 | 877.526 | 705.352 | 81.516 | 124.61 | 206.13 | ± 0.20 | T1 |
| 7 | 882.998 | 718.439 | 81.455 | 124.61 | 206.06 | ± 0.20 | T1 |
| 8 | 884.229 | 721.211 | 81.618 | 124.61 | 206.23 | ± 0.20 | T1 |
| 9 | 884.235 | 721.208 | 81.618 | 124.61 | 206.23 | ± 0.20 | T1 |
| 10 | 885.667 | 725.408 | 81.677 | 124.61 | 206.29 | ± 0.20 | T1 |
| 11 | 890.413 | 737.327 | 81.518 | 124.61 | 206.13 | ± 0.20 | T1 |
| 12 | 893.077 | 744.913 | 81.548 | 124.61 | 206.16 | ± 0.20 | T1 |
| 13 | 893.482 | 749.042 | 81.799 | 124.61 | 206.41 | ± 0.20 | SLOPE |
| 14 | 894.301 | 752.889 | 81.841 | 124.61 | 206.45 | ± 0.20 | SLOPE |
| 15 | 896.664 | 760.343 | 81.985 | 124.61 | 206.59 | ± 0.20 | T2 |
| 16 | 898.295 | 765.364 | 82.149 | 124.61 | 206.76 | ± 0.20 | T2 |
| 17 | 899.208 | 767.470 | 82.309 | 124.61 | 206.92 | ± 0.20 | T2 |
| 18 | 902.174 | 777.322 | 82.192 | 124.61 | 206.80 | ± 0.20 | T2 |
| 19 | 904.132 | 783.634 | 82.212 | 124.61 | 206.82 | ± 0.20 | T2 |
| 20 | 905.552 | 787.396 | 82.513 | 124.61 | 207.12 | ± 0.20 | T2 |
| 21 | 906.712 | 791.506 | 82.876 | 124.61 | 207.48 | ± 0.20 | SLOPE |
| 22 | 911.074 | 809.671 | 83.179 | 124.61 | 207.79 | ± 0.20 | SLOPE |
| 23 | 915.844 | 822.045 | 83.787 | 124.61 | 208.40 | ± 0.20 | T5 |
| 24 | 923.369 | 834.986 | 83.896 | 124.61 | 208.50 | ± 0.20 | T5 |
| 25 | 933.701 | 851.478 | 84.044 | 124.61 | 208.65 | ± 0.20 | T5 |
| 26 | 940.415 | 865.106 | 84.374 | 124.61 | 208.98 | ± 0.20 | T5 |
| 27 | 943.037 | 870.567 | 85.217 | 124.61 | 209.83 | ± 0.20 | ROAD |
| 28 | 946.223 | 876.715 | 85.349 | 124.61 | 209.96 | ± 0.20 | ROAD |
| 29 | 928.810 | 878.011 | 85.051 | 124.61 | 209.66 | ± 0.20 | ROAD |
| 30 | 923.537 | 892.411 | 85.188 | 124.61 | 209.80 | ± 0.20 | ROAD |
| 31 | 967.124 | 866.628 | 84.660 | 124.61 | 209.27 | ± 0.20 | ROAD |
| 32 | 948.133 | 879.695 | 84.520 | 124.61 | 209.13 | ± 0.20 | T5 |
| 33 | 953.637 | 892.890 | 84.295 | 124.61 | 208.90 | ± 0.20 | T5 |
| 34 | 971.680 | 873.001 | 83.982 | 124.61 | 208.59 | ± 0.20 | T5 |
| 35 | 1034.740 | 826.296 | 87.013 | 124.61 | 211.62 | ± 0.20 | SLOPE |
| 36 | 1074.224 | 803.022 | 86.926 | 124.61 | 211.53 | ± 0.20 | ROAD |
| 37 | 1067.223 | 822.956 | 87.394 | 124.61 | 212.00 | ± 0.20 | T6 |
| 38 | 1058.068 | 847.247 | 88.501 | 124.61 | 213.11 | ± 0.20 | SLOPE |
| 39 | 1058.069 | 847.244 | 88.501 | 124.61 | 213.11 | ± 0.20 | SLOPE |
| 40 | 1044.498 | 879.302 | 90.124 | 124.61 | 214.73 | ± 0.20 | SLOPE |
| 41 | 1039.153 | 894.029 | 90.919 | 124.61 | 215.53 | ± 0.20 | SLOPE |
| 42 | 1034.225 | 907.257 | 92.193 | 124.61 | 216.80 | ± 0.20 | SLOPE |
| 43 | 1030.131 | 918.991 | 93.217 | 124.61 | 217.83 | ± 0.20 | SLOPE |
| 44 | 1026.194 | 931.259 | 93.920 | 124.61 | 218.53 | ± 0.20 | SLOPE |
| 45 | 1026.195 | 931.253 | 93.917 | 124.61 | 218.53 | ± 0.20 | SLOPE |
| 46 | 1022.723 | 941.240 | 94.720 | 124.61 | 219.33 | ± 0.20 | SLOPE |
| 47 | 1019.375 | 951.037 | 95.955 | 124.61 | 220.56 | ± 0.20 | SLOPE |
| 48 | 1015.717 | 961.480 | 96.920 | 124.61 | 221.53 | ± 0.20 | SLOPE |
| 49 | 1011.804 | 971.365 | 97.732 | 124.61 | 222.34 | ± 0.20 | SLOPE |
| 50 | 1007.727 | 981.035 | 98.903 | 124.61 | 223.51 | ± 0.20 | SLOPE |

| Huntington River Location Sarah-Al | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 51 | 1003.780 | 991.661 | 99.647 | 124.61 | 224.26 | ± 0.20 | T9 |
| 52 | 1003.917 | 1011.387 | 100.286 | 124.61 | 224.90 | ± 0.20 | T9 |
| 53 | 1006.995 | 1027.695 | 100.606 | 124.61 | 225.22 | ± 0.20 | T9 |
| 54 | 1010.435 | 1043.455 | 100.953 | 124.61 | 225.56 | ± 0.20 | T9 |
| 55 | 1012.947 | 1061.380 | 101.608 | 124.61 | 226.22 | ± 0.20 | T9 |
| 56 | 1012.847 | 1061.386 | 101.594 | 124.61 | 226.20 | ± 0.20 | T9 |
| 57 | 1017.017 | 1080.907 | 102.356 | 124.61 | 226.96 | ± 0.20 | T9 |
| 58 | 1022.629 | 1101.607 | 102.630 | 124.61 | 227.24 | ± 0.20 | T9 |
| 59 | 1029.723 | 1122.872 | 102.777 | 124.61 | 227.39 | ± 0.20 | T9 |
| 60 | 1029.722 | 1122.871 | 102.777 | 124.61 | 227.39 | ± 0.20 | T9 |
| 61 | 1040.739 | 1166.695 | 103.740 | 124.61 | 228.35 | ± 0.20 | T9 |
| 62 | 1046.995 | 1187.845 | 104.127 | 124.61 | 228.74 | ± 0.20 | T9 |
| 63 | 1053.364 | 1210.315 | 104.603 | 124.61 | 229.21 | ± 0.20 | T9 |
| 64 | 1058.357 | 1233.359 | 105.015 | 124.61 | 229.62 | ± 0.20 | T9 |
| 65 | 1062.104 | 1255.678 | 105.384 | 124.61 | 229.99 | ± 0.20 | T9 |
| 66 | 1065.185 | 1279.197 | 106.047 | 124.61 | 230.66 | ± 0.20 | T9 |
| 67 | 1070.791 | 1300.638 | 106.649 | 124.61 | 231.26 | ± 0.20 | T9 |
| 68 | 1078.570 | 1323.878 | 107.038 | 124.61 | 231.65 | ± 0.20 | T9 |
| 69 | 1063.196 | 1337.142 | 107.385 | 124.61 | 231.99 | ± 0.20 | T9 |
| 70 | 1208.561 | 419.064 | 81.651 | 124.61 | 206.26 | ± 0.20 | T1 |
| 71 | 1208.547 | 419.104 | 81.652 | 124.61 | 206.26 | ± 0.20 | T1 |
| 72 | 1208.548 | 419.103 | 81.652 | 124.61 | 206.26 | ± 0.20 | T1 |
| 73 | 1209.256 | 419.344 | 81.652 | 124.61 | 206.26 | ± 0.20 | T1 |
| 74 | 1198.383 | 375.038 | 81.160 | 124.61 | 205.77 | ± 0.20 | TERRACE1 |
| 75 | 1241.860 | 1031.335 | 88.072 | 124.61 | 212.68 | ± 0.20 | SLOPE |
| 76 | 1233.541 | 1010.945 | 87.679 | 124.61 | 212.29 | ± 0.20 | T6 |
| 77 | 1226.669 | 989.096 | 87.373 | 124.61 | 211.98 | ± 0.20 | T6 |
| 78 | 1220.594 | 968.998 | 87.519 | 124.61 | 212.13 | ± 0.20 | T6 |
| 79 | 1208.742 | 949.173 | 87.398 | 124.61 | 212.01 | ± 0.20 | T6 |
| 80 | 1192.615 | 933.970 | 87.462 | 124.61 | 212.07 | ± 0.20 | T6 |
| 81 | 1177.764 | 922.301 | 87.964 | 124.61 | 212.57 | ± 0.20 | SLOPE |
| 82 | 1162.581 | 912.881 | 89.046 | 124.61 | 213.66 | ± 0.20 | T7 |
| 83 | 1147.490 | 903.847 | 90.311 | 124.61 | 214.92 | ± 0.20 | SLOPE |
| 84 | 1125.086 | 913.910 | 91.259 | 124.61 | 215.87 | ± 0.20 | T8 |
| 85 | 1114.834 | 920.629 | 91.486 | 124.61 | 216.09 | ± 0.20 | T8 |
| 86 | 1107.460 | 912.726 | 91.375 | 124.61 | 215.98 | ± 0.20 | T8 |
| 87 | 1084.044 | 886.144 | 89.922 | 124.61 | 214.53 | ± 0.20 | T7 |
| 88 | 1071.597 | 871.863 | 89.457 | 124.61 | 214.07 | ± 0.20 | T7 |
| 89 | 1058.422 | 856.702 | 88.885 | 124.61 | 213.49 | ± 0.20 | T7 |
| 90 | 1045.360 | 840.852 | 88.299 | 124.61 | 212.91 | ± 0.20 | SLOPE |
| 91 | 1034.843 | 826.309 | 87.069 | 124.61 | 211.68 | ± 0.20 | SLOPE |
| 92 | 1033.624 | 854.324 | 88.919 | 124.61 | 213.53 | ± 0.20 | T7 |
| 93 | 1022.650 | 867.085 | 89.237 | 124.61 | 213.85 | ± 0.20 | T7 |
| 94 | 1037.406 | 869.118 | 89.509 | 124.61 | 214.12 | ± 0.20 | T7 |
| 95 | 1046.270 | 874.542 | 89.802 | 124.61 | 214.41 | ± 0.20 | T7 |
| 96 | 1030.803 | 826.512 | 86.983 | 124.61 | 211.59 | ± 0.20 | ROAD |
| 97 | 1026.817 | 828.859 | 86.988 | 124.61 | 211.60 | ± 0.20 | ROAD |
| 98 | 1024.584 | 821.309 | 86.917 | 124.61 | 211.53 | ± 0.20 | ROAD |
| 99 | 1039.085 | 853.308 | 89.159 | 124.61 | 213.77 | ± 0.20 | T7 |
| 100 | 1042.003 | 852.017 | 89.135 | 124.61 | 213.74 | ± 0.20 | T7 |

| Huntington River Location Sarah-Al | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 101 | 1059.170 | 889.360 | 90.480 | 124.61 | 215.09 | ± 0.20 | SLOPE |
| 102 | 1056.515 | 891.030 | 90.621 | 124.61 | 215.23 | ± 0.20 | SLOPE |
| 103 | 1091.768 | 945.578 | 91.960 | 124.61 | 216.57 | ± 0.20 | T8 |
| 104 | 1089.146 | 947.274 | 92.051 | 124.61 | 216.66 | ± 0.20 | T8 |
| 105 | 958.674 | 1040.912 | 99.598 | 124.61 | 224.21 | ± 0.20 | T9 |
| 106 | 1000.004 | 999.996 | 99.986 | 124.61 | 224.60 | ± 0.20 | T9 |
| 107 | 792.739 | 950.624 | 87.138 | 124.61 | 211.75 | ± 0.20 | ROAD |
| 108 | 776.226 | 960.019 | 87.207 | 124.61 | 211.82 | ± 0.20 | ROAD |
| 109 | 803.199 | 946.732 | 86.901 | 124.61 | 211.51 | ± 0.20 | ROAD |
| 110 | 806.972 | 952.865 | 86.931 | 124.61 | 211.54 | ± 0.20 | ROAD |
| 111 | 818.207 | 953.134 | 86.049 | 124.61 | 210.66 | ± 0.20 | TERRACE2 |
| 112 | 832.261 | 967.890 | 85.963 | 124.61 | 210.57 | ± 0.20 | TERRACE2 |
| 113 | 843.651 | 978.698 | 86.193 | 124.61 | 210.80 | ± 0.20 | TERRACE2 |
| 114 | 854.548 | 990.718 | 86.053 | 124.61 | 210.66 | ± 0.20 | TERRACE2 |
| 115 | 865.939 | 1001.953 | 86.306 | 124.61 | 210.92 | ± 0.20 | TERRACE2 |
| 116 | 872.965 | 1016.056 | 86.471 | 124.61 | 211.08 | ± 0.20 | TERRACE2 |
| 117 | 887.853 | 1021.293 | 86.708 | 124.61 | 211.32 | ± 0.20 | TERRACE2 |
| 118 | 894.243 | 1024.708 | 86.791 | 124.61 | 211.40 | ± 0.20 | TERRACE2 |
| 119 | 899.541 | 1027.246 | 87.191 | 124.61 | 211.80 | ± 0.20 | SLOPE |
| 120 | 904.610 | 1030.192 | 88.312 | 124.61 | 212.92 | ± 0.20 | SLOPE |
| 121 | 910.144 | 1031.231 | 88.997 | 124.61 | 213.61 | ± 0.20 | SLOPE |
| 122 | 915.707 | 1032.443 | 89.332 | 124.61 | 213.94 | ± 0.20 | TERRACE3 |
| 123 | 915.521 | 1034.963 | 89.539 | 124.61 | 214.15 | ± 0.20 | TERRACE3 |
| 124 | 912.054 | 1037.155 | 89.445 | 124.61 | 214.05 | ± 0.20 | TERRACE3 |
| 125 | 874.568 | 1034.262 | 86.937 | 124.61 | 211.55 | ± 0.20 | TERRACE2 |
| 126 | 863.789 | 1082.059 | 85.684 | 124.61 | 210.29 | ± 0.20 | RIVER |
| 127 | 869.177 | 1079.599 | 85.712 | 124.61 | 210.32 | ± 0.20 | RIVER |
| 128 | 872.378 | 1078.044 | 87.054 | 124.61 | 211.66 | ± 0.20 | TERRACE1 |
| 129 | 880.719 | 1074.410 | 86.886 | 124.61 | 211.50 | ± 0.20 | TERRACE1 |
| 130 | 886.769 | 1072.573 | 86.644 | 124.61 | 211.25 | ± 0.20 | TERRACE1 |
| 131 | 889.170 | 1071.677 | 86.991 | 124.61 | 211.60 | ± 0.20 | SLOPE |
| 132 | 892.441 | 1070.279 | 86.718 | 124.61 | 211.33 | ± 0.20 | TERRACE1A |
| 133 | 894.185 | 1069.242 | 87.189 | 124.61 | 211.80 | ± 0.20 | SLOPE |
| 134 | 899.660 | 1067.162 | 87.316 | 124.61 | 211.93 | ± 0.20 | TERRACE1B |
| 135 | 906.665 | 1063.469 | 87.550 | 124.61 | 212.16 | ± 0.20 | TERRACE1B |
| 136 | 914.043 | 1064.280 | 87.587 | 124.61 | 212.20 | ± 0.20 | TERRACE1B |
| 137 | 917.352 | 1062.997 | 87.825 | 124.61 | 212.43 | ± 0.20 | SLOPE |
| 138 | 920.189 | 1062.065 | 87.770 | 124.61 | 212.38 | ± 0.20 | SLOPE |
| 139 | 933.743 | 1063.390 | 87.159 | 124.61 | 211.77 | ± 0.20 | T2 |
| 140 | 926.419 | 1059.058 | 87.332 | 124.61 | 211.94 | ± 0.20 | T2 |
| 141 | 904.392 | 1134.333 | 87.431 | 124.61 | 212.04 | ± 0.20 | TERRACE1 |
| 142 | 905.671 | 1132.005 | 88.082 | 124.61 | 212.69 | ± 0.20 | TERRACE1 |
| 143 | 909.356 | 1126.711 | 87.929 | 124.61 | 212.54 | ± 0.20 | TERRACE1 |
| 144 | 913.831 | 1120.427 | 87.861 | 124.61 | 212.47 | ± 0.20 | TERRACE1 |
| 145 | 914.447 | 1119.287 | 88.236 | 124.61 | 212.85 | ± 0.20 | SLOPE |
| 146 | 915.458 | 1117.885 | 88.688 | 124.61 | 213.30 | ± 0.20 | SLOPE |
| 147 | 921.198 | 1111.081 | 88.599 | 124.61 | 213.21 | ± 0.20 | T2 |
| 148 | 923.005 | 1100.968 | 88.589 | 124.61 | 213.20 | ± 0.20 | T2 |
| 149 | 931.092 | 1098.405 | 88.114 | 124.61 | 212.72 | ± 0.20 | T2 |
| 150 | 935.075 | 1112.031 | 88.162 | 124.61 | 212.77 | ± 0.20 | T2 |

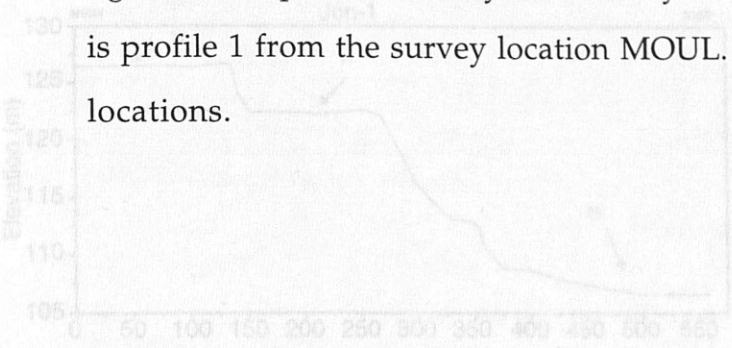
| Huntington River Location Sarah-Al | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 151 | 944.556 | 1112.879 | 87.804 | 124.61 | 212.41 | ± 0.20 | T2 |
| 152 | 947.082 | 1110.951 | 88.280 | 124.61 | 212.89 | ± 0.20 | SLOPE |
| 153 | 948.890 | 1110.627 | 88.663 | 124.61 | 213.27 | ± 0.20 | SLOPE |
| 154 | 955.398 | 1110.276 | 88.784 | 124.61 | 213.39 | ± 0.20 | T3 |
| 155 | 956.170 | 1102.841 | 88.722 | 124.61 | 213.33 | ± 0.20 | T3 |
| 156 | 954.193 | 1123.642 | 89.081 | 124.61 | 213.69 | ± 0.20 | T3 |
| 157 | 954.171 | 1123.645 | 89.080 | 124.61 | 213.69 | ± 0.20 | T3 |
| 158 | 954.739 | 1135.349 | 89.237 | 124.61 | 213.85 | ± 0.20 | T3 |
| 159 | 953.803 | 1135.216 | 89.206 | 124.61 | 213.81 | ± 0.20 | T3 |
| 160 | 951.964 | 1134.899 | 88.330 | 124.61 | 212.94 | ± 0.20 | T2 |
| 161 | 944.794 | 1137.327 | 88.320 | 124.61 | 212.93 | ± 0.20 | T2 |
| 162 | 946.434 | 1155.467 | 88.550 | 124.61 | 213.16 | ± 0.20 | T2 |
| 163 | 945.704 | 1177.838 | 88.992 | 124.61 | 213.60 | ± 0.20 | T2 |
| 164 | 973.822 | 1329.424 | 91.907 | 124.61 | 216.52 | ± 0.20 | T2 |
| 165 | 974.527 | 1373.140 | 93.115 | 124.61 | 217.72 | ± 0.20 | T2 |
| 166 | 963.151 | 1408.050 | 93.537 | 124.61 | 218.15 | ± 0.20 | T2 |
| 167 | 949.944 | 1408.701 | 93.721 | 124.61 | 218.33 | ± 0.20 | T2 |
| 168 | 946.065 | 1408.897 | 93.778 | 124.61 | 218.39 | ± 0.20 | T2 |
| 169 | 948.551 | 1440.840 | 94.187 | 124.61 | 218.80 | ± 0.20 | T2 |
| 170 | 945.318 | 1466.570 | 94.870 | 124.61 | 219.48 | ± 0.20 | T2 |
| 171 | 943.557 | 1500.305 | 95.944 | 124.61 | 220.55 | ± 0.20 | T2 |
| 172 | 950.552 | 1517.463 | 96.121 | 124.61 | 220.73 | ± 0.20 | T2 |
| 173 | 950.618 | 1537.625 | 96.515 | 124.61 | 221.12 | ± 0.20 | T2 |
| 174 | 952.416 | 1544.086 | 97.281 | 124.61 | 221.89 | ± 0.20 | T3 |
| Note: These elevations are tied to the Benchmark BAMBI (206.26 m ± 0.05 m) on the bridge north of here via: SAAL Pt 70 = Benchmark | | | | | | | |

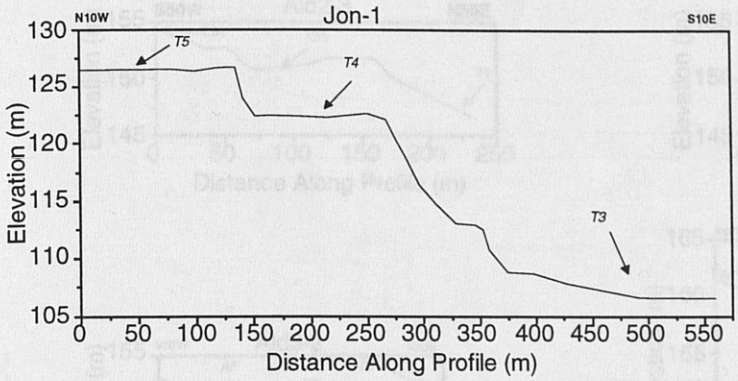
| Huntington River Location 4-Landslide | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 126.60 | 226.60 | ± 1.0 | T7 |
| 2 | 1100.000 | 1000.000 | 100.000 | 126.60 | 226.60 | ± 1.0 | T7 |
| 3 | 937.016 | 1185.780 | 105.451 | 126.60 | 232.05 | ± 1.0 | T9 |
| 4 | 950.141 | 1130.416 | 104.483 | 126.60 | 231.08 | ± 1.0 | T9 |
| 5 | 995.165 | 1027.709 | 101.265 | 126.60 | 227.87 | ± 1.0 | T8 |
| 6 | 995.166 | 1027.707 | 101.265 | 126.60 | 227.86 | ± 1.0 | T8 |
| 7 | 995.671 | 1007.795 | 100.423 | 126.60 | 227.02 | ± 1.0 | T8 |
| 8 | 1004.824 | 977.755 | 99.332 | 126.60 | 225.93 | ± 1.0 | T7 |
| 9 | 923.716 | 882.409 | 94.527 | 126.60 | 221.13 | ± 1.0 | T6 |
| 10 | 835.742 | 679.816 | 94.260 | 126.60 | 220.86 | ± 1.0 | T6 |
| 11 | 898.977 | 635.312 | 92.293 | 126.60 | 218.89 | ± 1.0 | T2 |
| 12 | 876.338 | 697.016 | 91.637 | 126.60 | 218.24 | ± 1.0 | T2 |
| 13 | 925.929 | 629.873 | 90.628 | 126.60 | 217.23 | ± 1.0 | T1 |
| 14 | 1087.518 | 614.008 | 90.020 | 126.60 | 216.62 | ± 1.0 | T1 |
| 15 | 1196.146 | 490.130 | 111.205 | 126.60 | 237.80 | ± 1.0 | T10 |
| 16 | 1179.661 | 452.127 | 113.308 | 126.60 | 239.91 | ± 1.0 | T10 |
| 17 | 1194.474 | 720.535 | 87.697 | 126.60 | 214.30 | ± 1.0 | RIVER |
| 18 | 1205.632 | 721.596 | 88.451 | 126.60 | 215.05 | ± 1.0 | RIVER |
| 19 | 1178.054 | 742.404 | 88.396 | 126.60 | 215.00 | ± 1.0 | RIVER |
| 20 | 1147.153 | 785.468 | 89.223 | 126.60 | 215.82 | ± 1.0 | RIVER |
| Note: Elevations at this site are tied to a contour line, elevation 780.00 ft or 237.80 m via Pt 15. | | | | | | | |

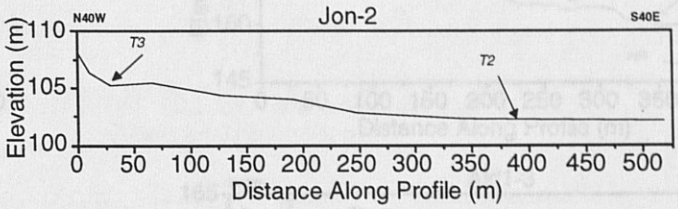
| Huntington River Location 3-Cemetery | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 222.82 | 322.82 | ± 1.0 | T9 |
| 2 | 1100.000 | 1000.000 | 100.000 | 222.82 | 322.82 | ± 1.0 | T9 |
| 3 | 983.543 | 966.020 | 91.073 | 222.82 | 313.89 | ± 1.0 | RIVER |
| 4 | 981.059 | 968.264 | 92.257 | 222.82 | 315.08 | ± 1.0 | T1 |
| 5 | 996.161 | 983.012 | 92.861 | 222.82 | 315.68 | ± 1.0 | T1 |
| 6 | 994.323 | 996.181 | 99.960 | 222.82 | 322.78 | ± 1.0 | T9 |
| 7 | 989.426 | 1007.970 | 100.486 | 222.82 | 323.31 | ± 1.0 | T9 |
| 8 | 997.758 | 1019.940 | 100.636 | 222.82 | 323.46 | ± 1.0 | T9 |
| 9 | 1004.315 | 1039.273 | 100.640 | 222.82 | 323.46 | ± 1.0 | T9 |
| 10 | 1034.680 | 1014.098 | 102.359 | 222.82 | 325.18 | ± 1.0 | SLOPE |
| 11 | 999.981 | 999.992 | 100.010 | 222.82 | 322.83 | ± 1.0 | T9 |
| 12 | 1124.978 | 1008.109 | 112.545 | 222.82 | 335.37 | ± 1.0 | T10 |
| 13 | 1134.384 | 1004.926 | 112.627 | 222.82 | 335.45 | ± 1.0 | T10 |
| Note: Elevations at this site are tied to a contour line, elevation 1100.00 ft or 335.37 m via Pt. 12. | | | | | | | |

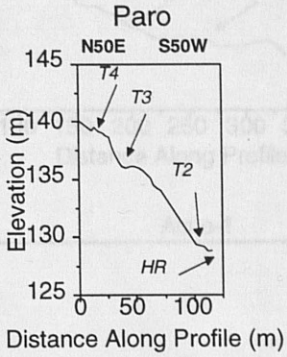
## HUNTINGTON RIVER CROSS-VALLEY PROFILES

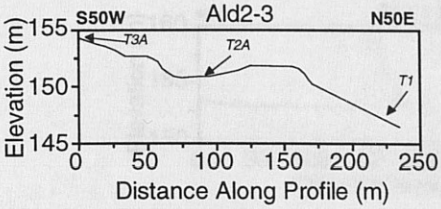
The Huntington River cross-valley profiles are presented in the following figures. The profiles are keyed to survey data by name. For instance MOUL-1 is profile 1 from the survey location MOUL. See Figure 3.2 for survey locations.

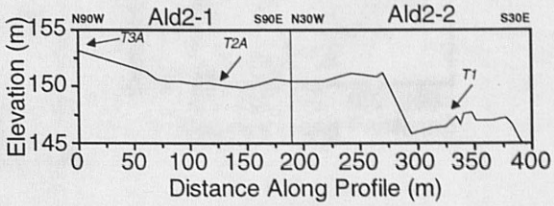


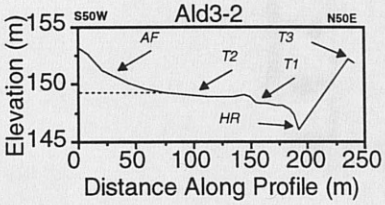

Jon-1
N10W
S10E
T5
T4
T3
Elevation (m)
130
125
120
115
110
105
0 50 100 150 200 250 300 350 400 450 500 550
Distance Along Profile (m)

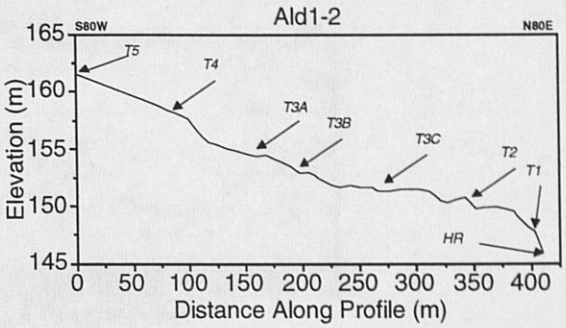

Jon-2
N40W
S40E
T3
T2
Elevation (m)
110
105
100
0 50 100 150 200 250 300 350 400 450 500
Distance Along Profile (m)

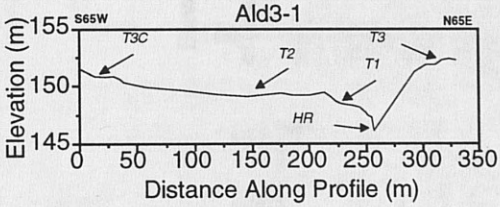

Paro
N50E
S50W
T4
T3
T2
HR
Elevation (m)
145
140
135
130
125
0 50 100
Distance Along Profile (m)

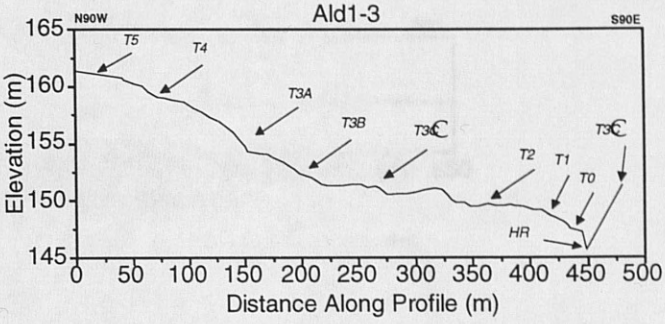

Ald2-3
S50W
N50E
T3A
T2A
T1
Elevation (m)
155
150
145
0 50 100 150 200 250
Distance Along Profile (m)

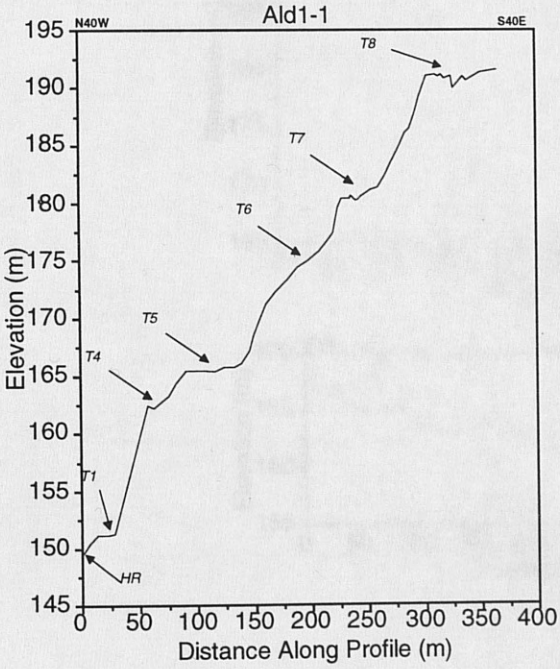

Ald2-1
Ald2-2
N90W
S90E
N30W
S30E
T3A
T2A
T1
Elevation (m)
155
150
145
0 50 100 150 200 250 300 350 400
Distance Along Profile (m)

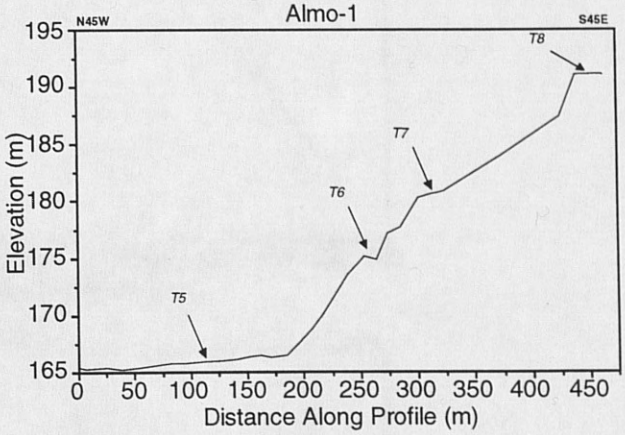

Ald3-2
S50W
N50E
AF
T3
T2
T1
HR
Elevation (m)
155
150
145
0 50 100 150 200 250
Distance Along Profile (m)

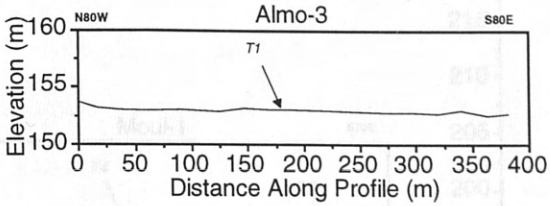

Ald1-2
S80W
N80E
T5
T4
T3A
T3B
T3C
T2
T1
HR
Elevation (m)
165
160
155
150
145
0 50 100 150 200 250 300 350 400
Distance Along Profile (m)

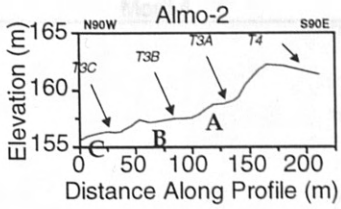

Ald3-1
S65W
N65E
T3C
T2
T3
T1
HR
Elevation (m)
155
150
145
0 50 100 150 200 250 300 350
Distance Along Profile (m)

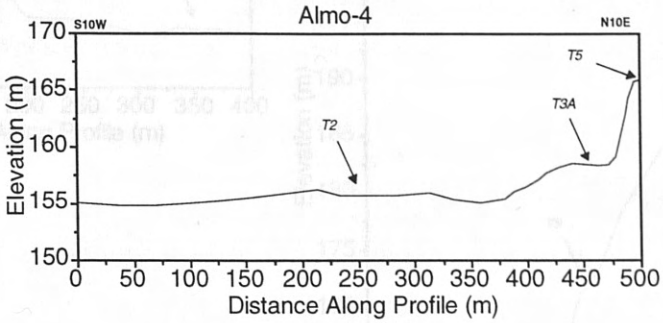

Ald1-3
N90W
S90E
T5
T4
T3A
T3B
T3C
T2
T1
T0
HR
Elevation (m)
165
160
155
150
145
0 50 100 150 200 250 300 350 400 450 500
Distance Along Profile (m)

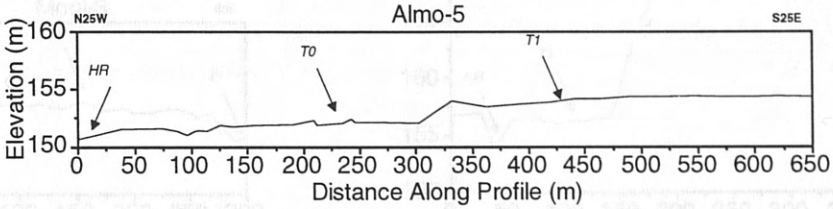

Ald1-1
N40W
S40E
T8
T7
T6
T5
T4
T1
HR
Elevation (m)
195
190
185
180
175
170
165
160
155
150
145
0 50 100 150 200 250 300 350 400
Distance Along Profile (m)

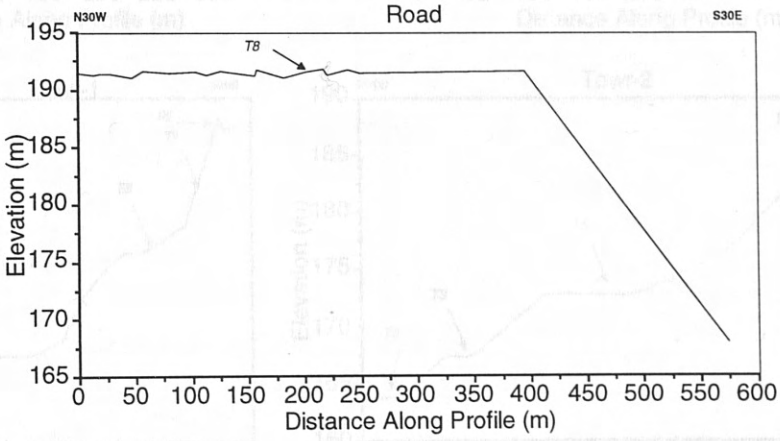

Almo-1
N45W
S45E
T8
T7
T6
T5
Elevation (m)
195
190
185
180
175
170
165
0 50 100 150 200 250 300 350 400 450
Distance Along Profile (m)

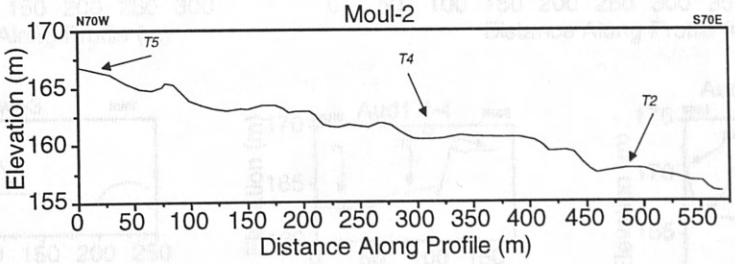

Almo-3
N80W
S80E
T1
Elevation (m)
160
155
150
0 50 100 150 200 250 300 350 400
Distance Along Profile (m)

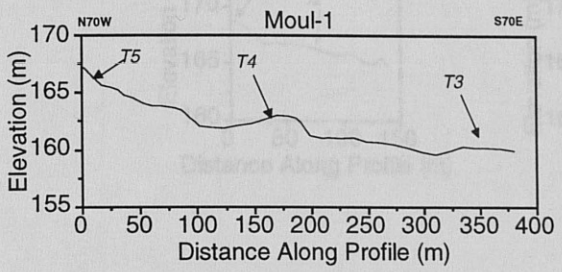

Almo-2
N90W
S90E
T3C
T3B
T3A
T4
A
B
C
Elevation (m)
165
160
155
0 50 100 150 200
Distance Along Profile (m)

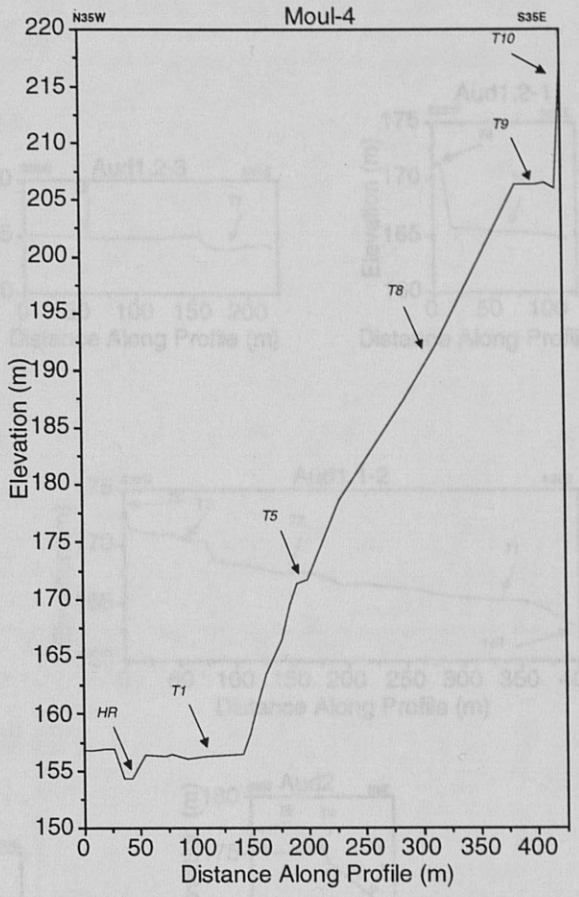

Almo-4
S10W
N10E
T5
T3A
T2
Elevation (m)
170
165
160
155
150
0 50 100 150 200 250 300 350 400 450 500
Distance Along Profile (m)

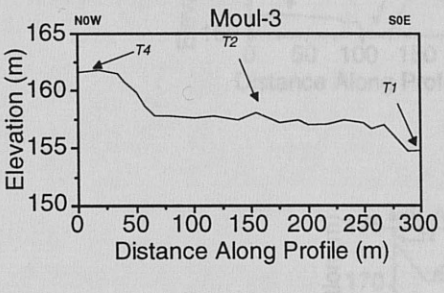

Almo-5
N25W
S25E
HR
T0
T1
Elevation (m)
160
155
150
0 50 100 150 200 250 300 350 400 450 500 550 600 650
Distance Along Profile (m)

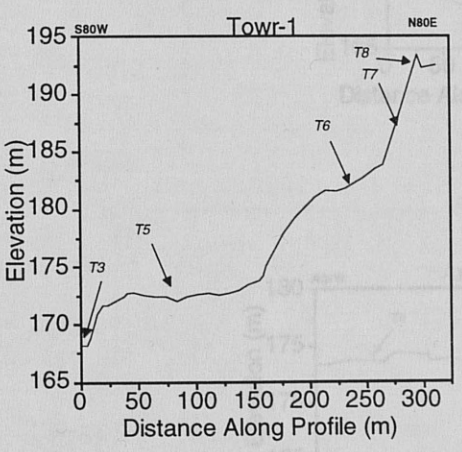

Road
N30W
S30E
T8
Elevation (m)
195
190
185
180
175
170
165
0 50 100 150 200 250 300 350 400 450 500 550 600
Distance Along Profile (m)

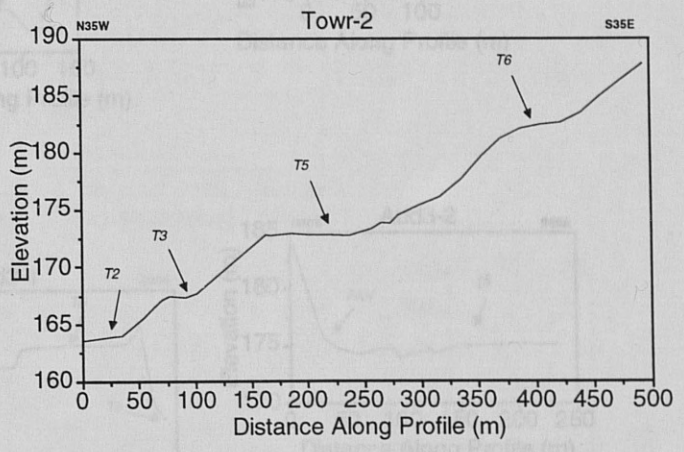

Moul-2
N70W
S70E
T5
T4
T2
Elevation (m)
170
165
160
155
0 50 100 150 200 250 300 350 400 450 500 550
Distance Along Profile (m)

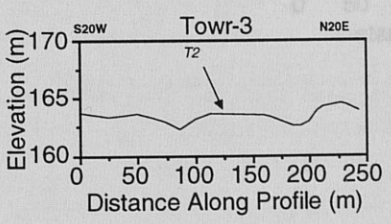

Moul-1
N70W
S70E
T5
T4
T3
Elevation (m)
Distance Along Profile (m)

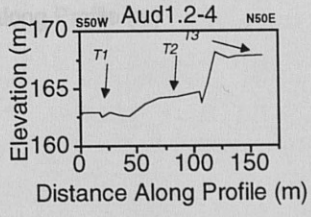

Moul-4
N35W
S35E
T10
T9
T8
T5
T1
HR
Elevation (m)
Distance Along Profile (m)

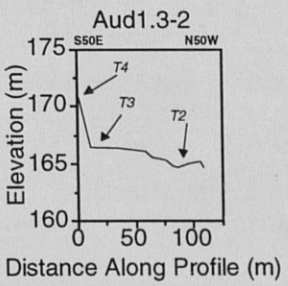

Moul-3
N0W
S0E
T4
T2
T1
Elevation (m)
Distance Along Profile (m)

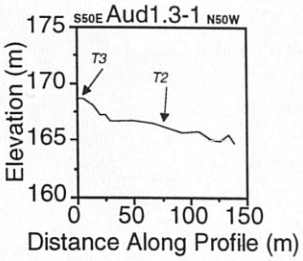

Towr-1
S80W
N80E
T8
T7
T6
T5
T3
Elevation (m)
Distance Along Profile (m)

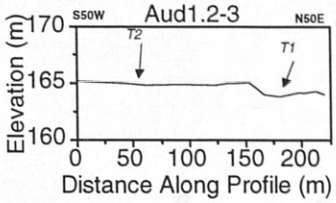

Towr-2
N35W
S35E
T6
T5
T3
T2
Elevation (m)
Distance Along Profile (m)

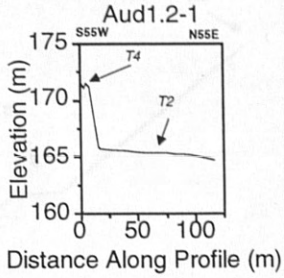

Towr-3
S20W
N20E
T2
Elevation (m)
Distance Along Profile (m)

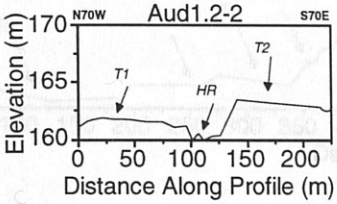

Aud1.2-4
S50W
N50E
T1
T2
T3
Elevation (m)
Distance Along Profile (m)

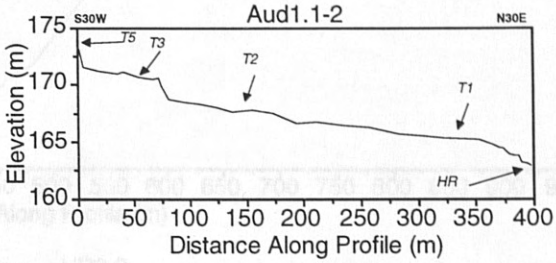

Aud1.3-2
S50E
N50W
T4
T3
T2
Elevation (m)
Distance Along Profile (m)

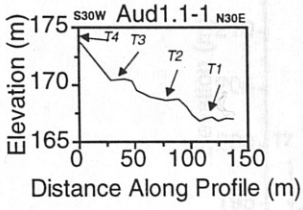

S50E Aud1.3-1 N50W
T3
T2
Elevation (m)
175
170
165
160
0 50 100 150
Distance Along Profile (m)

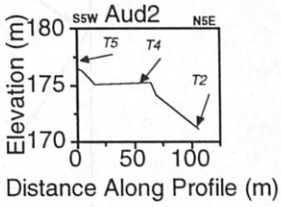

S50W Aud1.2-3 N50E
T2
T1
Elevation (m)
170
165
160
0 50 100 150 200
Distance Along Profile (m)

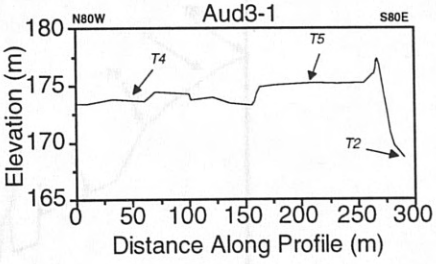

Aud1.2-1
S55W N55E
T4
T2
Elevation (m)
175
170
165
160
0 50 100
Distance Along Profile (m)

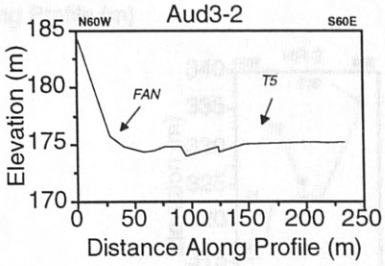

N70W Aud1.2-2 S70E
T1
HR
T2
Elevation (m)
170
165
160
0 50 100 150 200
Distance Along Profile (m)

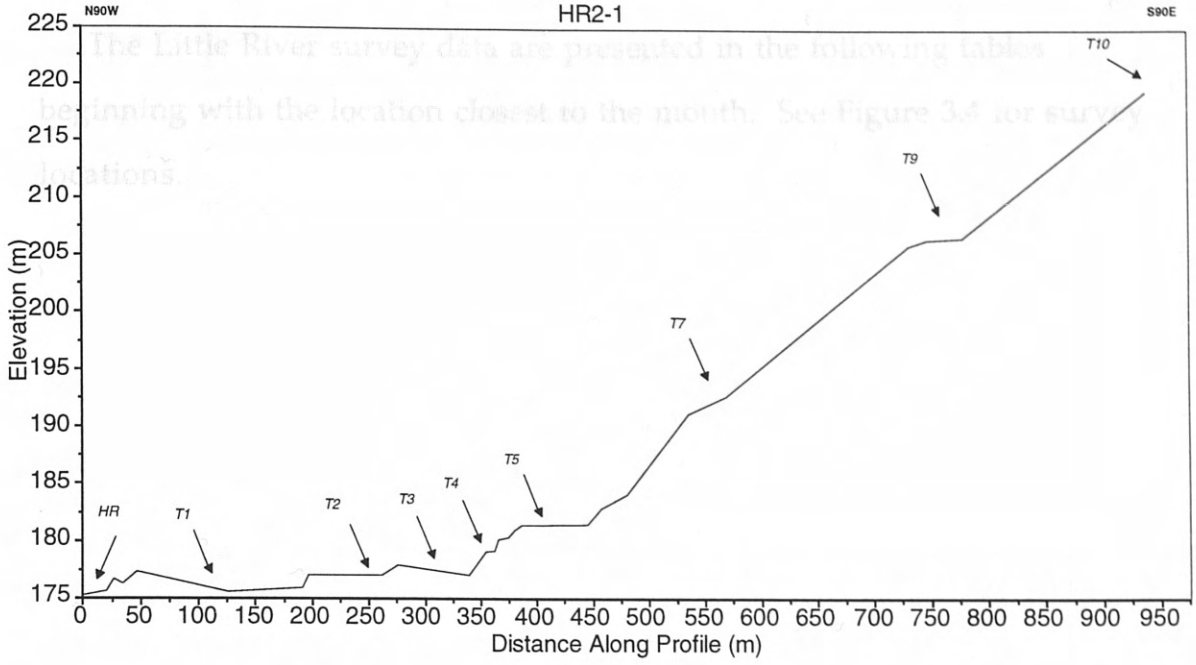

S30W Aud1.1-2 N30E
T5
T3
T2
T1
HR
Elevation (m)
175
170
165
160
0 50 100 150 200 250 300 350 400
Distance Along Profile (m)

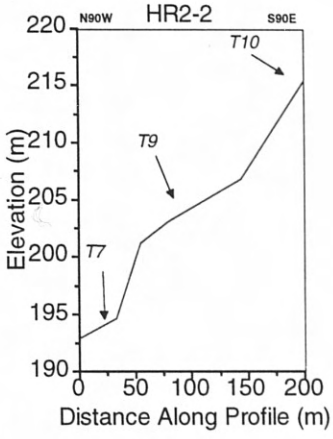

S30W Aud1.1-1 N30E
T4
T3
T2
T1
Elevation (m)
175
170
165
0 50 100 150
Distance Along Profile (m)

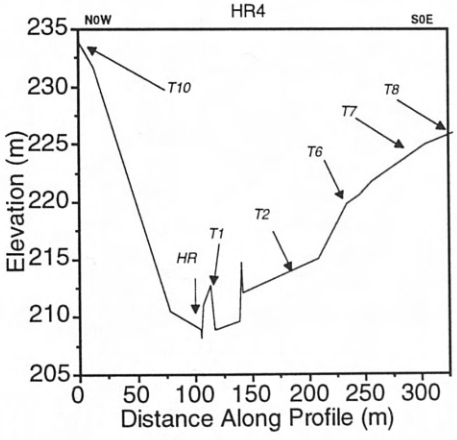

S5W Aud2 N5E
T5
T4
T2
Elevation (m)
180
175
170
0 50 100
Distance Along Profile (m)

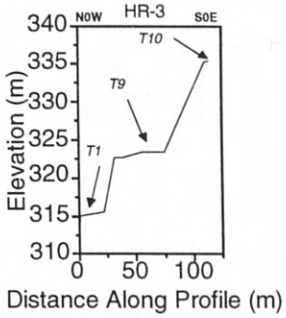

N80W Aud3-1 S80E
T4
T5
T2
Elevation (m)
180
175
170
165
0 50 100 150 200 250 300
Distance Along Profile (m)


N60W Aud3-2 S60E
FAN
T5
Elevation (m)
185
180
175
170
0 50 100 150 200 250
Distance Along Profile (m)


HR2-1
N90W
S90E
Elevation (m)
Distance Along Profile (m)
HR
T1
T2
T3
T4
T5
T7
T9
T10


HR2-2
N90W
S90E
Elevation (m)
Distance Along Profile (m)
T7
T9
T10


HR4
N0W
S0E
Elevation (m)
Distance Along Profile (m)
HR
T1
T2
T6
T7
T8
T10


HR-3
N0W
S0E
Elevation (m)
Distance Along Profile (m)
T1
T9
T10

# APPENDIX C: LITTLE RIVER DATA

## LITTLE RIVER SURVEY DATA

The Little River survey data are presented in the following tables beginning with the location closest to the mouth. See Figure 3.4 for survey locations.

| Little River Location 2-Mouth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 57.25 | 157.25 | ± 0.30 | T5A |
| 2 | 1100.000 | 1000.000 | 100.000 | 57.25 | 157.25 | ± 0.30 | T5A |
| 3 | 1049.067 | 1045.352 | 88.566 | 57.25 | 145.82 | ± 0.30 | SLOPE |
| 4 | 1015.459 | 1038.322 | 100.369 | 57.25 | 157.62 | ± 0.30 | T5A |
| 5 | 1015.454 | 1038.308 | 100.369 | 57.25 | 157.62 | ± 0.30 | T5A |
| 6 | 993.538 | 1038.626 | 100.499 | 57.25 | 157.75 | ± 0.30 | T5A |
| 7 | 985.030 | 1030.633 | 98.564 | 57.25 | 155.82 | ± 0.30 | T5B |
| 8 | 945.001 | 1012.168 | 98.509 | 57.25 | 155.76 | ± 0.30 | T5B |
| 9 | 944.802 | 1012.212 | 98.503 | 57.25 | 155.75 | ± 0.30 | T5B |
| 10 | 936.901 | 1014.021 | 97.887 | 57.25 | 155.14 | ± 0.30 | T5B |
| 11 | 1000.036 | 999.992 | 100.020 | 57.25 | 157.27 | ± 0.30 | T5A |
| 12 | 920.852 | 1005.674 | 98.487 | 57.25 | 155.74 | ± 0.30 | T5B |
| 13 | 900.960 | 1010.100 | 92.922 | 57.25 | 150.17 | ± 0.30 | T4 |
| 14 | 845.598 | 1020.646 | 91.196 | 57.25 | 148.45 | ± 0.30 | T4 |
| 15 | 883.659 | 1015.400 | 92.295 | 57.25 | 149.55 | ± 0.30 | T4 |
| 16 | 874.477 | 1016.708 | 91.159 | 57.25 | 148.41 | ± 0.30 | T4 |
| 17 | 838.100 | 1037.535 | 91.195 | 57.25 | 148.45 | ± 0.30 | T4 |
| 18 | 835.891 | 991.007 | 92.191 | 57.25 | 149.44 | ± 0.30 | T4 |
| 19 | 845.605 | 1020.668 | 91.271 | 57.25 | 148.52 | ± 0.30 | T4 |
| 20 | 779.025 | 972.259 | 97.977 | 57.25 | 155.23 | ± 0.30 | T5B |
| 21 | 796.774 | 978.255 | 92.897 | 57.25 | 150.15 | ± 0.30 | T4 |
| 22 | 808.982 | 985.209 | 92.627 | 57.25 | 149.88 | ± 0.30 | T4 |
| 23 | 835.888 | 991.007 | 92.259 | 57.25 | 149.51 | ± 0.30 | T4 |
| 24 | 835.871 | 991.003 | 92.249 | 57.25 | 149.50 | ± 0.30 | T4 |
| 25 | 701.011 | 1031.040 | 78.012 | 57.25 | 135.26 | ± 0.30 | ROAD |
| 26 | 808.974 | 985.212 | 92.753 | 57.25 | 150.01 | ± 0.30 | T4 |
| 27 | 655.387 | 1051.432 | 73.317 | 57.25 | 130.57 | ± 0.30 | ROAD |
| 28 | 700.994 | 1031.050 | 78.056 | 57.25 | 135.31 | ± 0.30 | ROAD |
| 29 | 532.236 | 1019.003 | 68.715 | 57.25 | 125.97 | ± 0.30 | T0 |
| 30 | 485.950 | 1099.361 | 68.057 | 57.25 | 125.31 | ± 0.30 | T0 |
| 31 | 482.986 | 996.615 | 71.326 | 57.25 | 128.58 | ± 0.30 | T1 |
| 32 | 488.349 | 942.805 | 98.777 | 57.25 | 156.03 | ± 0.30 | SLOPE |
| 33 | 316.624 | 1001.528 | 73.771 | 57.25 | 131.02 | ± 0.30 | ROAD |
| 34 | 483.005 | 996.614 | 71.390 | 57.25 | 128.64 | ± 0.30 | T1 |
| 35 | 210.359 | 923.310 | 72.824 | 57.25 | 130.08 | ± 0.30 | ROAD |
| 36 | 316.621 | 1001.526 | 73.778 | 57.25 | 131.03 | ± 0.30 | ROAD |
| 37 | 123.366 | 802.197 | 71.682 | 57.25 | 128.93 | ± 0.30 | T1 |
| 38 | 210.357 | 923.307 | 72.897 | 57.25 | 130.15 | ± 0.30 | ROAD |
| 39 | 67.757 | 981.563 | 69.005 | 57.25 | 126.26 | ± 0.30 | T0 |
| 40 | 123.348 | 802.256 | 71.736 | 57.25 | 128.99 | ± 0.30 | T1 |
| 41 | 90.088 | 803.965 | 68.892 | 57.25 | 126.14 | ± 0.30 | T0 |
| 42 | 28.637 | 953.308 | 66.516 | 57.25 | 123.77 | ± 0.30 | T0 |
| 43 | 8.168 | 1019.128 | 70.730 | 57.25 | 127.98 | ± 0.30 | T1 |
| 44 | 67.749 | 981.568 | 69.033 | 57.25 | 126.28 | ± 0.30 | T0 |
| 45 | 72.667 | 1036.344 | 67.446 | 57.25 | 124.70 | ± 0.30 | T0 |
| 46 | 64.004 | 1040.431 | 64.560 | 57.25 | 121.81 | ± 0.30 | T0 |
| 47 | 53.251 | 1044.522 | 63.831 | 57.25 | 121.08 | ± 0.30 | T0 |
| 48 | -19.316 | 1131.025 | 85.264 | 57.25 | 142.52 | ± 0.30 | T3 |
| 49 | -83.935 | 882.736 | 63.393 | 57.25 | 120.64 | ± 0.30 | RIVER |

| Little River Location 2-Mouth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| Note: Elevations at this site are tied to the Waterbury Dam (elevation 633.00 ft or 192.99 m) via: | | | | | | | |
| LR2 Pt 3 = LR1 Pt172. | | | | | | | |

| Little River Location 1-State Park | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 64.65 | 164.65 | ± 0.30 | T6 |
| 2 | 1099.369 | 1011.219 | 100.000 | 64.65 | 164.65 | ± 0.30 | T6 |
| 3 | 1579.524 | 1065.431 | 128.339 | 64.65 | 192.99 | ± 0.30 | Dam |
| 4 | 982.107 | 1002.110 | 100.256 | 64.65 | 164.90 | ± 0.30 | T6 |
| 5 | 983.891 | 1010.078 | 100.083 | 64.65 | 164.73 | ± 0.30 | T6 |
| 6 | 978.707 | 1018.923 | 97.444 | 64.65 | 162.09 | ± 0.30 | T5A |
| 7 | 992.185 | 1049.079 | 96.796 | 64.65 | 161.44 | ± 0.30 | T5A |
| 8 | 988.794 | 1078.642 | 96.457 | 64.65 | 161.11 | ± 0.30 | T5A |
| 9 | 984.755 | 1093.937 | 96.319 | 64.65 | 160.97 | ± 0.30 | T5A |
| 10 | 985.025 | 1135.976 | 95.844 | 64.65 | 160.49 | ± 0.30 | T5B |
| 11 | 983.214 | 1129.593 | 95.843 | 64.65 | 160.49 | ± 0.30 | T5B |
| 12 | 1000.002 | 999.988 | 99.994 | 64.65 | 164.64 | ± 0.30 | T6 |
| 13 | 1000.003 | 999.977 | 100.010 | 64.65 | 164.66 | ± 0.30 | T6 |
| 14 | 978.361 | 1150.313 | 95.626 | 64.65 | 160.27 | ± 0.30 | T5B |
| 15 | 978.089 | 1158.025 | 90.429 | 64.65 | 155.08 | ± 0.30 | T4 |
| 16 | 978.362 | 1160.920 | 89.834 | 64.65 | 154.48 | ± 0.30 | T4 |
| 17 | 986.999 | 1188.227 | 75.594 | 64.65 | 140.24 | ± 0.30 | T1 |
| 18 | 1000.381 | 1212.129 | 74.291 | 64.65 | 138.94 | ± 0.30 | T0 |
| 19 | 1001.759 | 1234.582 | 73.528 | 64.65 | 138.18 | ± 0.30 | T0 |
| 20 | 1004.336 | 1208.892 | 74.331 | 64.65 | 138.98 | ± 0.30 | T0 |
| 21 | 978.332 | 1150.249 | 95.560 | 64.65 | 160.21 | ± 0.30 | T5B |
| 22 | 1012.058 | 1250.790 | 73.607 | 64.65 | 138.26 | ± 0.30 | T0 |
| 23 | 848.856 | 1186.183 | 76.510 | 64.65 | 141.16 | ± 0.30 | T1 |
| 24 | 999.789 | 1142.404 | 74.090 | 64.65 | 138.74 | ± 0.30 | T0 |
| 25 | 874.179 | 1123.666 | 95.247 | 64.65 | 159.90 | ± 0.30 | T5B |
| 26 | 883.915 | 1141.995 | 87.215 | 64.65 | 151.86 | ± 0.30 | SLOPE |
| 27 | 885.501 | 1149.924 | 84.388 | 64.65 | 149.04 | ± 0.30 | T3 |
| 28 | 888.067 | 1156.780 | 83.539 | 64.65 | 148.19 | ± 0.30 | T3 |
| 29 | 890.476 | 1164.957 | 78.733 | 64.65 | 143.38 | ± 0.30 | SLOPE |
| 30 | 892.500 | 1169.853 | 77.713 | 64.65 | 142.36 | ± 0.30 | SLOPE |
| 31 | 893.105 | 1172.378 | 75.755 | 64.65 | 140.40 | ± 0.30 | T2 |
| 32 | 895.845 | 1180.973 | 75.890 | 64.65 | 140.54 | ± 0.30 | T2 |
| 33 | 895.711 | 1187.340 | 74.020 | 64.65 | 138.67 | ± 0.30 | T1 |
| 34 | 872.670 | 1264.708 | 73.385 | 64.65 | 138.03 | ± 0.30 | T1 |
| 35 | 691.251 | 1144.828 | 77.596 | 64.65 | 142.24 | ± 0.30 | SLOPE |
| 36 | 848.843 | 1186.179 | 76.269 | 64.65 | 140.92 | ± 0.30 | T2 |
| 37 | 709.879 | 1135.372 | 79.124 | 64.65 | 143.77 | ± 0.30 | SLOPE |
| 38 | 693.271 | 1140.339 | 78.420 | 64.65 | 143.07 | ± 0.30 | SLOPE |
| 39 | 650.470 | 1168.436 | 77.648 | 64.65 | 142.30 | ± 0.30 | SLOPE |
| 40 | 643.734 | 1156.759 | 77.743 | 64.65 | 142.39 | ± 0.30 | SLOPE |
| 41 | 610.659 | 1147.646 | 76.405 | 64.65 | 141.05 | ± 0.30 | SLOPE |
| 42 | 691.247 | 1144.836 | 77.524 | 64.65 | 142.17 | ± 0.30 | SLOPE |
| 43 | 640.499 | 1098.732 | 96.418 | 64.65 | 161.07 | ± 0.30 | T5A |
| 44 | 616.284 | 1137.239 | 76.824 | 64.65 | 141.47 | ± 0.30 | T2 |
| 45 | 611.525 | 1148.330 | 76.432 | 64.65 | 141.08 | ± 0.30 | T2 |
| 46 | 611.409 | 1151.055 | 75.559 | 64.65 | 140.21 | ± 0.30 | T2 |
| 47 | 609.093 | 1159.839 | 75.521 | 64.65 | 140.17 | ± 0.30 | T2 |
| 48 | 607.844 | 1167.417 | 72.375 | 64.65 | 137.02 | ± 0.30 | T1 |
| 49 | 599.647 | 1226.132 | 72.184 | 64.65 | 136.83 | ± 0.30 | T1 |
| 50 | 666.159 | 1145.656 | 75.010 | 64.65 | 139.66 | ± 0.30 | T2 |

| Little River Location 1-State Park | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 51 | 673.035 | 1145.272 | 74.960 | 64.65 | 139.61 | ± 0.30 | T2 |
| 52 | 759.965 | 1172.713 | 72.353 | 64.65 | 137.00 | ± 0.30 | T1 |
| 53 | 610.673 | 1147.648 | 76.361 | 64.65 | 141.01 | ± 0.30 | SLOPE |
| 54 | 717.587 | 1243.078 | 95.510 | 64.65 | 160.16 | ± 0.30 | T5A |
| 55 | 747.997 | 1188.903 | 73.007 | 64.65 | 137.66 | ± 0.30 | T1 |
| 56 | 751.003 | 1180.952 | 72.861 | 64.65 | 137.51 | ± 0.30 | T1 |
| 57 | 745.196 | 1162.914 | 70.990 | 64.65 | 135.64 | ± 0.30 | T0 |
| 58 | 749.336 | 1107.608 | 71.144 | 64.65 | 135.79 | ± 0.30 | T0 |
| 59 | 748.382 | 1101.197 | 69.425 | 64.65 | 134.07 | ± 0.30 | T0 |
| 60 | 748.266 | 1088.678 | 69.454 | 64.65 | 134.10 | ± 0.30 | T0 |
| 61 | 742.849 | 1015.586 | 69.525 | 64.65 | 134.17 | ± 0.30 | T0 |
| 62 | 746.051 | 1013.905 | 71.460 | 64.65 | 136.11 | ± 0.30 | T1 |
| 63 | 747.935 | 1011.303 | 71.599 | 64.65 | 136.25 | ± 0.30 | T1 |
| 64 | 747.667 | 1002.658 | 74.820 | 64.65 | 139.47 | ± 0.30 | T2 |
| 65 | 610.678 | 1147.642 | 76.331 | 64.65 | 140.98 | ± 0.30 | T2 |
| 66 | 740.446 | 994.411 | 75.053 | 64.65 | 139.70 | ± 0.30 | T2 |
| 67 | 740.860 | 987.402 | 74.986 | 64.65 | 139.63 | ± 0.30 | T2 |
| 68 | 741.987 | 987.605 | 74.932 | 64.65 | 139.58 | ± 0.30 | T2 |
| 69 | 741.961 | 987.617 | 74.932 | 64.65 | 139.58 | ± 0.30 | T2 |
| 70 | 725.495 | 1172.873 | 72.420 | 64.65 | 137.07 | ± 0.30 | T2 |
| 71 | 765.626 | 948.635 | 95.005 | 64.65 | 159.65 | ± 0.30 | T5B |
| 72 | 765.630 | 948.633 | 95.009 | 64.65 | 159.66 | ± 0.30 | T5B |
| 73 | 610.664 | 1147.617 | 76.314 | 64.65 | 140.96 | ± 0.30 | T2 |
| 74 | 676.597 | 1137.991 | 74.236 | 64.65 | 138.88 | ± 0.30 | T1 |
| 75 | 676.583 | 1137.986 | 74.289 | 64.65 | 138.94 | ± 0.30 | T1 |
| 76 | 683.605 | 1132.871 | 72.664 | 64.65 | 137.31 | ± 0.30 | T1 |
| 77 | 694.168 | 1123.389 | 71.892 | 64.65 | 136.54 | ± 0.30 | T0 |
| 78 | 694.166 | 1123.385 | 71.892 | 64.65 | 136.54 | ± 0.30 | T0 |
| 79 | 696.377 | 1120.083 | 71.274 | 64.65 | 135.92 | ± 0.30 | T0 |
| 80 | 981.447 | 1218.115 | 70.813 | 64.65 | 135.46 | ± 0.30 | T0 |
| 81 | 759.923 | 1172.704 | 72.265 | 64.65 | 136.91 | ± 0.30 | T0 |
| 82 | 872.802 | 1306.068 | 96.906 | 64.65 | 161.55 | ± 0.30 | T5A |
| 83 | 893.885 | 1298.543 | 92.989 | 64.65 | 157.64 | ± 0.30 | T5B |
| 84 | 901.158 | 1288.279 | 83.742 | 64.65 | 148.39 | ± 0.30 | T3 |
| 85 | 906.516 | 1284.150 | 82.867 | 64.65 | 147.52 | ± 0.30 | T3 |
| 86 | 926.572 | 1287.302 | 81.749 | 64.65 | 146.40 | ± 0.30 | T3 |
| 87 | 936.756 | 1270.911 | 76.348 | 64.65 | 141.00 | ± 0.30 | SLOPE |
| 88 | 950.471 | 1255.703 | 75.560 | 64.65 | 140.21 | ± 0.30 | SLOPE |
| 89 | 957.355 | 1243.944 | 70.757 | 64.65 | 135.41 | ± 0.30 | T2 |
| 90 | 986.012 | 1194.140 | 71.067 | 64.65 | 135.72 | ± 0.30 | T2 |
| 91 | 985.605 | 1190.837 | 69.672 | 64.65 | 134.32 | ± 0.30 | T2 |
| 92 | 985.800 | 1189.065 | 69.353 | 64.65 | 134.00 | ± 0.30 | T2 |
| 93 | 1187.347 | 1242.308 | 94.092 | 64.65 | 158.74 | ± 0.30 | T5B |
| 94 | 1187.921 | 1242.294 | 94.202 | 64.65 | 158.85 | ± 0.30 | T5B |
| 95 | 981.444 | 1218.115 | 70.751 | 64.65 | 135.40 | ± 0.30 | T2 |
| 96 | 1265.186 | 1255.118 | 93.876 | 64.65 | 158.52 | ± 0.30 | T5B |
| 97 | 1187.901 | 1242.291 | 94.248 | 64.65 | 158.90 | ± 0.30 | T5B |
| 98 | 1253.309 | 1278.839 | 93.322 | 64.65 | 157.97 | ± 0.30 | T5B |
| 99 | 1252.344 | 1280.653 | 93.852 | 64.65 | 158.50 | ± 0.30 | T5B |
| 100 | 1217.643 | 1344.611 | 93.925 | 64.65 | 158.57 | ± 0.30 | T5B |

| Little River Location 1-State Park | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 101 | 1214.165 | 1355.910 | 95.330 | 64.65 | 159.98 | ± 0.30 | T5A |
| 102 | 1212.401 | 1359.513 | 95.535 | 64.65 | 160.18 | ± 0.30 | T5A |
| 103 | 1214.792 | 1351.418 | 95.407 | 64.65 | 160.06 | ± 0.30 | T5A |
| 104 | 1199.439 | 1380.356 | 95.819 | 64.65 | 160.47 | ± 0.30 | T5A |
| 105 | 1196.948 | 1384.358 | 96.789 | 64.65 | 161.44 | ± 0.30 | T5A |
| 106 | 1218.271 | 1391.347 | 96.924 | 64.65 | 161.57 | ± 0.30 | T5A |
| 107 | 1218.451 | 1393.077 | 97.206 | 64.65 | 161.85 | ± 0.30 | T5A |
| 108 | 1222.198 | 1412.197 | 98.234 | 64.65 | 162.88 | ± 0.30 | T5A |
| 109 | 1223.194 | 1418.054 | 99.342 | 64.65 | 163.99 | ± 0.30 | T6 |
| 110 | 1217.740 | 1344.224 | 93.826 | 64.65 | 158.47 | ± 0.30 | T5B |
| 111 | 1330.796 | 1217.735 | 68.445 | 64.65 | 133.09 | ± 0.30 | T1 |
| 112 | 1274.188 | 1267.680 | 93.862 | 64.65 | 158.51 | ± 0.30 | T5B |
| 113 | 1317.334 | 1228.444 | 69.194 | 64.65 | 133.84 | ± 0.30 | T1 |
| 114 | 1330.890 | 1219.614 | 68.859 | 64.65 | 133.51 | ± 0.30 | T1 |
| 115 | 1331.819 | 1213.968 | 66.383 | 64.65 | 131.03 | ± 0.30 | T0 |
| 116 | 1339.059 | 1194.954 | 64.341 | 64.65 | 128.99 | ± 0.30 | RIVER |
| 117 | 1392.174 | 1196.836 | 68.476 | 64.65 | 133.12 | ± 0.30 | T1 |
| 118 | 1330.760 | 1217.747 | 68.345 | 64.65 | 132.99 | ± 0.30 | T1 |
| 119 | 1379.521 | 1200.882 | 65.140 | 64.65 | 129.79 | ± 0.30 | T0 |
| 120 | 1361.745 | 1180.365 | 64.257 | 64.65 | 128.91 | ± 0.30 | T0 |
| 121 | 1398.143 | 1205.052 | 68.501 | 64.65 | 133.15 | ± 0.30 | T1 |
| 122 | 1438.451 | 1233.689 | 93.419 | 64.65 | 158.07 | ± 0.30 | T5B |
| 123 | 1452.225 | 1167.497 | 70.831 | 64.65 | 135.48 | ± 0.30 | T2 |
| 124 | 1452.231 | 1167.467 | 70.819 | 64.65 | 135.47 | ± 0.30 | T2 |
| 125 | 1392.177 | 1196.835 | 68.499 | 64.65 | 133.15 | ± 0.30 | T1 |
| 126 | 1540.718 | 1218.327 | 66.353 | 64.65 | 131.00 | ± 0.30 | T0 |
| 127 | 1540.712 | 1218.324 | 66.353 | 64.65 | 131.00 | ± 0.30 | T0 |
| 128 | 1452.231 | 1167.459 | 70.935 | 64.65 | 135.58 | ± 0.30 | T2 |
| 129 | 1677.921 | 1421.479 | 66.448 | 64.65 | 131.10 | ± 0.30 | T1 |
| 130 | 1540.716 | 1218.329 | 66.080 | 64.65 | 130.73 | ± 0.30 | T1 |
| 131 | 1605.630 | 1430.562 | 92.335 | 64.65 | 156.98 | ± 0.30 | T5B |
| 132 | 1650.276 | 1435.146 | 71.572 | 64.65 | 136.22 | ± 0.30 | T2 |
| 133 | 1662.455 | 1432.258 | 69.956 | 64.65 | 134.60 | ± 0.30 | T2 |
| 134 | 1668.648 | 1430.267 | 66.747 | 64.65 | 131.40 | ± 0.30 | T1 |
| 135 | 1680.904 | 1432.598 | 66.778 | 64.65 | 131.43 | ± 0.30 | T1 |
| 136 | 1690.015 | 1435.793 | 63.969 | 64.65 | 128.62 | ± 0.30 | RIVER |
| 137 | 1707.478 | 1438.218 | 63.808 | 64.65 | 128.46 | ± 0.30 | RIVER |
| 138 | 1683.906 | 1479.251 | 66.402 | 64.65 | 131.05 | ± 0.30 | T1 |
| 139 | 1677.917 | 1421.436 | 66.489 | 64.65 | 131.14 | ± 0.30 | T1 |
| 140 | 1669.731 | 1480.684 | 66.950 | 64.65 | 131.60 | ± 0.30 | T1 |
| 141 | 1665.829 | 1480.849 | 66.926 | 64.65 | 131.57 | ± 0.30 | T1 |
| 142 | 1609.919 | 1497.822 | 88.877 | 64.65 | 153.53 | ± 0.30 | SLOPE |
| 143 | 1637.095 | 1539.659 | 77.558 | 64.65 | 142.21 | ± 0.30 | SLOPE |
| 144 | 1642.841 | 1539.925 | 76.743 | 64.65 | 141.39 | ± 0.30 | SLOPE |
| 145 | 1661.167 | 1525.613 | 67.044 | 64.65 | 131.69 | ± 0.30 | T1 |
| 146 | 1676.177 | 1527.059 | 66.328 | 64.65 | 130.98 | ± 0.30 | T1 |
| 147 | 1680.478 | 1528.172 | 64.572 | 64.65 | 129.22 | ± 0.30 | T0 |
| 148 | 1668.286 | 1558.752 | 66.635 | 64.65 | 131.28 | ± 0.30 | T1 |
| 149 | 1685.039 | 1587.428 | 65.135 | 64.65 | 129.78 | ± 0.30 | T0 |
| 150 | 1683.906 | 1479.262 | 66.436 | 64.65 | 131.08 | ± 0.30 | T1 |

| Little River Location 1-State Park | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 151 | 1634.698 | 1639.193 | 93.673 | 64.65 | 158.32 | ± 0.30 | T5A |
| 152 | 1687.760 | 1601.901 | 64.870 | 64.65 | 129.52 | ± 0.30 | T0 |
| 153 | 1698.882 | 1591.172 | 64.542 | 64.65 | 129.19 | ± 0.30 | T0 |
| 154 | 1702.541 | 1588.028 | 63.521 | 64.65 | 128.17 | ± 0.30 | T0 |
| 155 | 1729.284 | 1582.917 | 62.361 | 64.65 | 127.01 | ± 0.30 | T0 |
| 156 | 1731.575 | 1583.155 | 61.093 | 64.65 | 125.74 | ± 0.30 | RIVER |
| 157 | 1734.682 | 1583.189 | 60.826 | 64.65 | 125.47 | ± 0.30 | RIVER |
| 158 | 1807.404 | 1675.320 | 64.653 | 64.65 | 129.30 | ± 0.30 | T0 |
| 159 | 1807.403 | 1675.319 | 64.653 | 64.65 | 129.30 | ± 0.30 | T0 |
| 160 | 1685.043 | 1587.431 | 65.171 | 64.65 | 129.82 | ± 0.30 | T0 |
| 161 | 1812.534 | 1717.043 | 85.000 | 64.65 | 149.65 | ± 0.30 | T4 |
| 162 | 1906.846 | 1665.990 | 65.181 | 64.65 | 129.83 | ± 0.30 | T1 |
| 163 | 1906.892 | 1665.985 | 65.181 | 64.65 | 129.83 | ± 0.30 | T1 |
| 164 | 1807.442 | 1675.315 | 64.619 | 64.65 | 129.27 | ± 0.30 | T1 |
| 165 | 2113.389 | 1533.352 | 64.794 | 64.65 | 129.44 | ± 0.30 | T1 |
| 166 | 2033.741 | 1635.517 | 66.207 | 64.65 | 130.86 | ± 0.30 | T2 |
| 167 | 2041.812 | 1624.602 | 65.306 | 64.65 | 129.95 | ± 0.30 | T1 |
| 168 | 2072.077 | 1570.677 | 65.461 | 64.65 | 130.11 | ± 0.30 | T1 |
| 169 | 2081.361 | 1555.133 | 64.960 | 64.65 | 129.61 | ± 0.30 | T1 |
| 170 | 2081.603 | 1548.591 | 61.688 | 64.65 | 126.34 | ± 0.30 | T0 |
| 171 | 2083.207 | 1532.064 | 61.480 | 64.65 | 126.13 | ± 0.30 | T0 |
| 172 | 2195.060 | 1564.880 | 81.169 | 64.65 | 145.82 | ± 0.30 | SLOPE |
| Note: Elevations at this site are tied to the Waterbury Dam, elevation 633.00 ft or 192.99 m. | | | | | | | |

| Little River Location 7-Waterbury Dam | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 106.251 | 86.74 | 192.99 | ± 0.30 | dam |
| 2 | 1100.000 | 1000.000 | 106.251 | 86.74 | 192.99 | ± 0.30 | dam |
| 3 | 1035.566 | 1034.950 | 92.965 | 86.74 | 179.70 | ± 0.30 | water |
| 4 | 1035.558 | 1034.950 | 92.967 | 86.74 | 179.70 | ± 0.30 | water |
| 5 | 911.623 | 1071.290 | 79.544 | 86.74 | 166.28 | ± 0.30 | T6 |
| 6 | 888.176 | 1127.499 | 76.933 | 86.74 | 163.67 | ± 0.30 | T6 |
| Note: Elevation of dam is 633.00 ft or 192.99 m | | | | | | | |

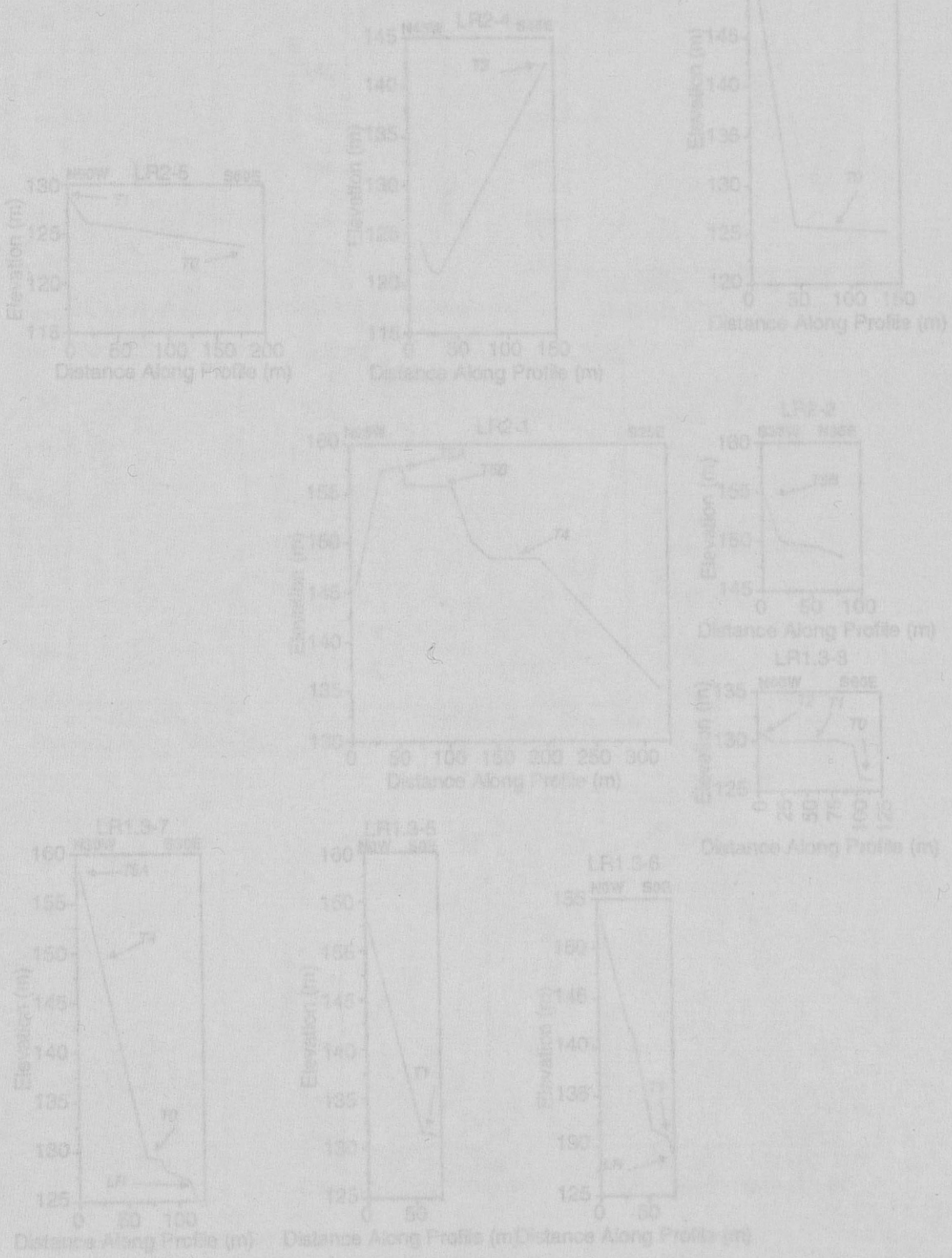
| Little River Location 6-Canoe Access | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 88.09 | 188.09 | ± 0.30 | T7 |
| 2 | 1100.000 | 1000.000 | 100.000 | 88.09 | 188.09 | ± 0.30 | T7 |
| 3 | 1008.949 | 978.410 | 100.152 | 88.09 | 188.25 | ± 0.30 | T7 |
| 4 | 992.776 | 1006.500 | 99.926 | 88.09 | 188.02 | ± 0.30 | T7 |
| 5 | 973.197 | 1024.873 | 97.593 | 88.09 | 185.69 | ± 0.30 | T6 |
| 6 | 931.929 | 1069.687 | 97.747 | 88.09 | 185.84 | ± 0.30 | T6 |
| 7 | 1000.006 | 999.994 | 100.057 | 88.09 | 188.15 | ± 0.30 | T7 |
| 8 | 896.785 | 1074.710 | 97.521 | 88.09 | 185.62 | ± 0.30 | T6 |
| 9 | 931.943 | 1069.685 | 97.792 | 88.09 | 185.89 | ± 0.30 | T6 |
| 10 | 862.905 | 1099.378 | 97.068 | 88.09 | 185.16 | ± 0.30 | T6 |
| 11 | 896.757 | 1074.730 | 97.553 | 88.09 | 185.65 | ± 0.30 | T6 |
| 12 | 766.795 | 1075.633 | 94.596 | 88.09 | 182.69 | ± 0.30 | T5 |
| 13 | 862.812 | 1099.355 | 97.099 | 88.09 | 185.19 | ± 0.30 | T6 |
| 14 | 828.356 | 1087.521 | 97.096 | 88.09 | 185.19 | ± 0.30 | T6 |
| 15 | 789.108 | 1083.013 | 94.761 | 88.09 | 182.86 | ± 0.30 | T5 |
| 16 | 763.483 | 1069.994 | 94.399 | 88.09 | 182.49 | ± 0.30 | T5 |
| 17 | 745.054 | 1059.773 | 93.112 | 88.09 | 181.21 | ± 0.30 | T4 |
| 18 | 636.525 | 999.856 | 92.608 | 88.09 | 180.70 | ± 0.30 | T4 |
| 19 | 634.129 | 998.944 | 91.609 | 88.09 | 179.70 | ± 0.30 | Water Level |
| 20 | 757.181 | 1080.746 | 91.533 | 88.09 | 179.63 | ± 0.30 | Water Level |
| Note: Elevations at this site are tied to the water elevation in reservoir at LR7. | | | | | | | |
| Water level measured at179.70 m at dam so correction is 88.09 m. | | | | | | | |

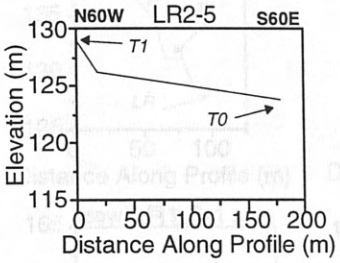
| Little River Location 3-Stowe Farm | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 105.71 | 205.71 | ± 0.20 | T6 |
| 2 | 1100.000 | 1000.000 | 100.000 | 105.71 | 205.71 | ± 0.20 | T6 |
| 3 | 1058.685 | 1085.502 | 100.065 | 105.71 | 205.78 | ± 0.20 | T6 |
| 4 | 1068.932 | 1062.061 | 93.763 | 105.71 | 199.47 | ± 0.20 | T4 |
| 5 | 1117.582 | 928.447 | 92.820 | 105.71 | 198.53 | ± 0.20 | T4 |
| 6 | 1087.349 | 901.415 | 90.597 | 105.71 | 196.31 | ± 0.20 | T4 |
| 7 | 1032.363 | 832.422 | 92.275 | 105.71 | 197.99 | ± 0.20 | T4 |
| 8 | 1011.922 | 832.081 | 92.527 | 105.71 | 198.24 | ± 0.20 | T4 |
| 9 | 1006.973 | 838.488 | 93.876 | 105.71 | 199.59 | ± 0.20 | T4 |
| 10 | 974.915 | 808.386 | 96.824 | 105.71 | 202.54 | ± 0.20 | SLOPE |
| 11 | 963.027 | 815.390 | 100.009 | 105.71 | 205.72 | ± 0.20 | T6 |
| 12 | 843.011 | 969.895 | 101.876 | 105.71 | 207.59 | ± 0.20 | T7 |
| 13 | 820.807 | 1182.596 | 106.302 | 105.71 | 212.01 | ± 0.20 | SLOPE |
| 14 | 999.997 | 1000.003 | 99.988 | 105.71 | 205.70 | ± 0.20 | T6 |
| 15 | 868.018 | 1108.512 | 102.215 | 105.71 | 207.93 | ± 0.20 | BM |
| 16 | 839.689 | 1207.684 | 111.313 | 105.71 | 217.02 | ± 0.20 | SLOPE |
| Note: Elevations at this site are tied to Benchmark 57 HBC 1967 (elevation 682.00 ft or 207.93 m) via: LR3 Pt 15 = Benchmark. | | | | | | | |

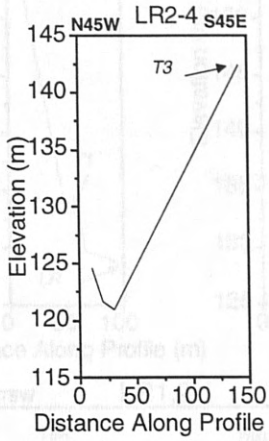
| Little River Location 4-Moulton Lane | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 130.07 | 230.07 | ± 1.0 | T8 |
| 2 | 1100.000 | 1000.000 | 100.000 | 130.07 | 230.07 | ± 1.0 | T8 |
| 3 | 1064.644 | 868.207 | 109.393 | 130.07 | 239.46 | ± 1.0 | T9 |
| 4 | 1061.995 | 883.759 | 108.352 | 130.07 | 238.42 | ± 1.0 | T9 |
| 5 | 1042.830 | 915.333 | 101.615 | 130.07 | 231.69 | ± 1.0 | T8 |
| 6 | 1038.690 | 961.140 | 100.460 | 130.07 | 230.53 | ± 1.0 | T8 |
| 7 | 1035.611 | 968.739 | 100.765 | 130.07 | 230.84 | ± 1.0 | T8 |
| 8 | 1048.187 | 1015.312 | 100.819 | 130.07 | 230.89 | ± 1.0 | T8 |
| 9 | 1036.613 | 1025.963 | 99.465 | 130.07 | 229.54 | ± 1.0 | T7 |
| 10 | 1019.160 | 1118.079 | 99.414 | 130.07 | 229.49 | ± 1.0 | T7 |
| 11 | 1017.891 | 1046.595 | 98.671 | 130.07 | 228.74 | ± 1.0 | T6 |
| 12 | 940.007 | 1052.458 | 97.929 | 130.07 | 228.00 | ± 1.0 | RIVER |
| 13 | 956.946 | 1040.195 | 98.703 | 130.07 | 228.77 | ± 1.0 | T6 |
| Note: Elevations at this site are tied to a contour line, elevation 960.00 ft or 228.00 m. | | | | | | | |

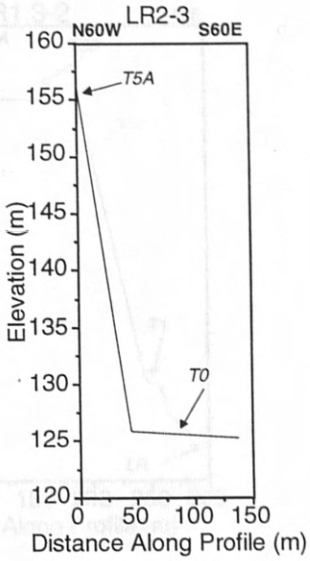
## LITTLE RIVER CROSS-VALLEY PROFILES

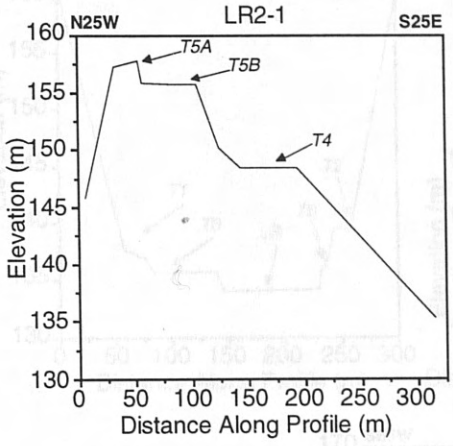
The Little River cross-valley profiles are presented in the following figures. The profiles are keyed to survey data by name. For instance LR3-1 is profile 1 from the survey location LR3. See Figure 3.4 for survey locations.

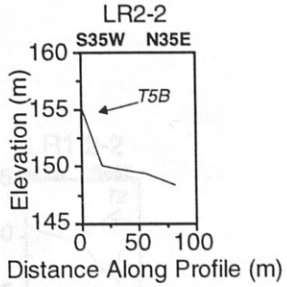


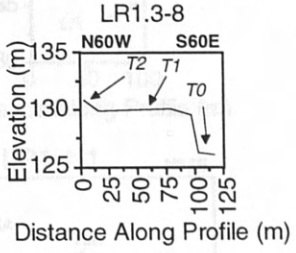

LR2-5
N60W
S60E
T1
T0
Elevation (m)
130
125
120
115
0 50 100 150 200
Distance Along Profile (m)

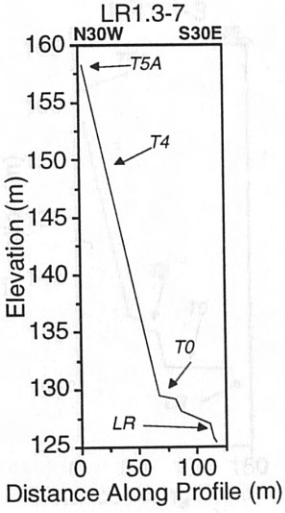

LR2-4
N45W
S45E
T3
Elevation (m)
145
140
135
130
125
120
115
0 50 100 150
Distance Along Profile (m)

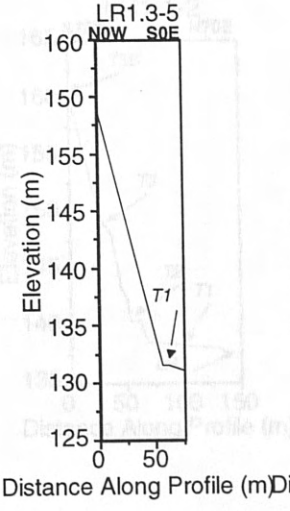

LR2-3
N60W
S60E
T5A
T0
Elevation (m)
160
155
150
145
140
135
130
125
120
0 50 100 150
Distance Along Profile (m)

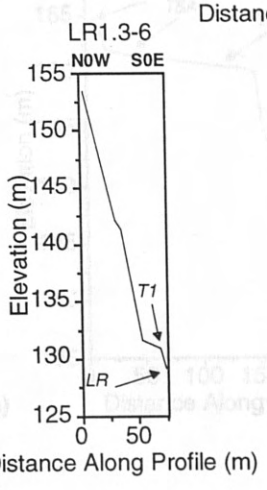

LR2-1
N25W
S25E
T5A
T5B
T4
Elevation (m)
160
155
150
145
140
135
130
0 50 100 150 200 250 300
Distance Along Profile (m)

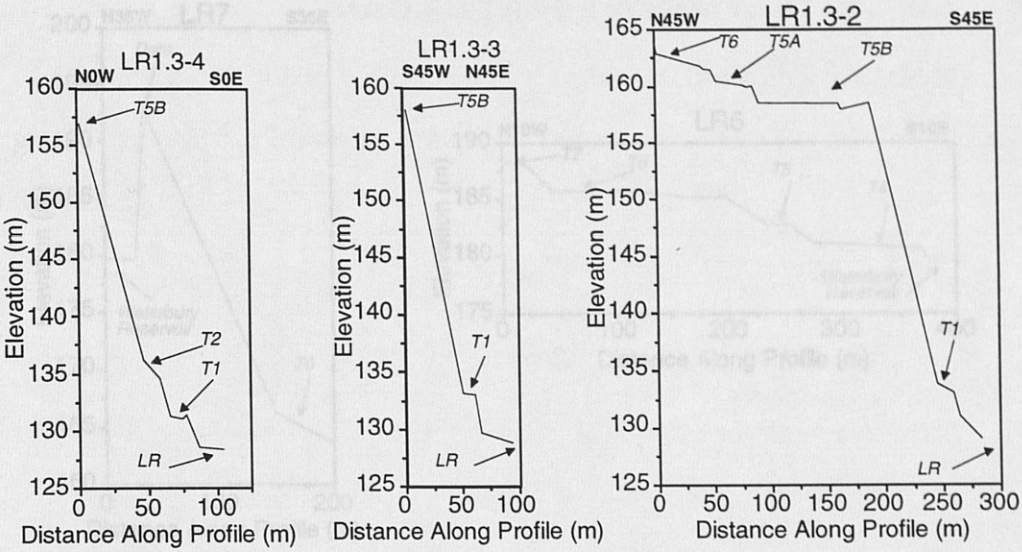

LR2-2
S35W
N35E
T5B
Elevation (m)
160
155
150
145
0 50 100
Distance Along Profile (m)

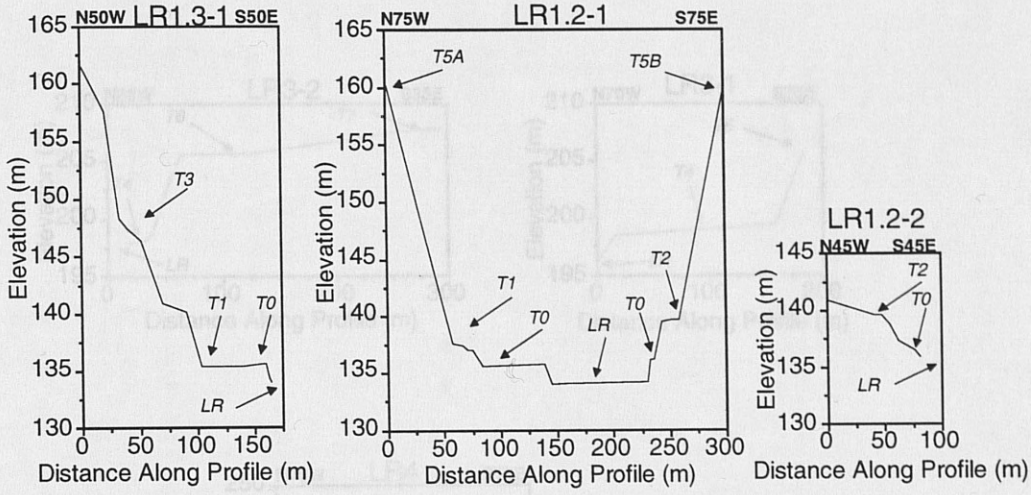

LR1.3-8
N60W
S60E
T2
T1
T0
Elevation (m)
135
130
125
0 25 50 75 100 125
Distance Along Profile (m)

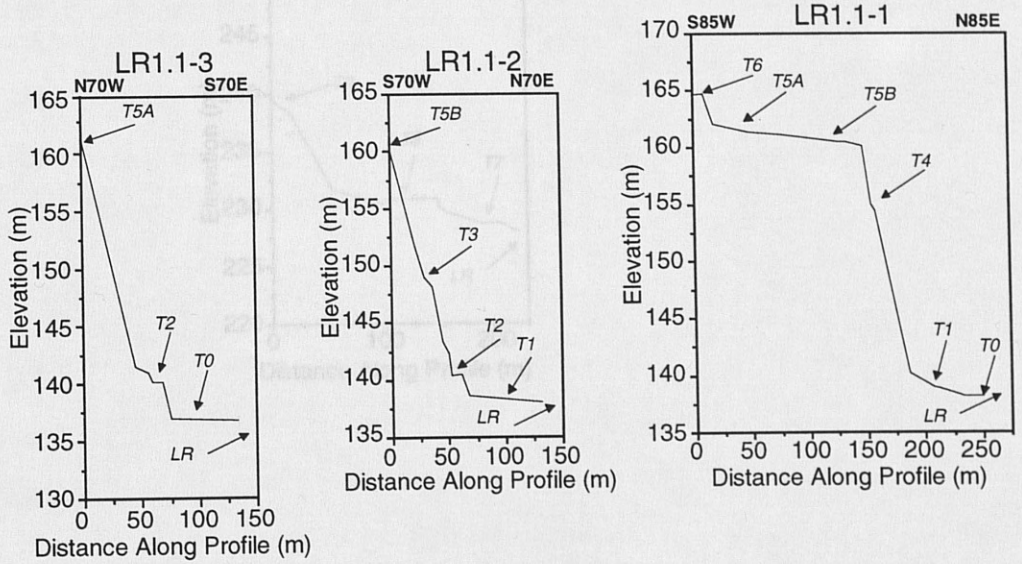

LR1.3-7
N30W
S30E
T5A
T4
T0
LR
Elevation (m)
160
155
150
145
140
135
130
125
0 50 100
Distance Along Profile (m)

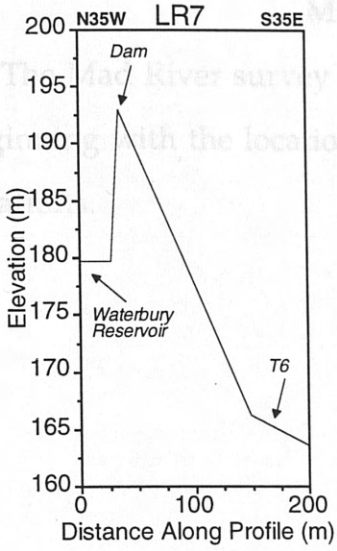

LR1.3-5
N0W
S0E
T1
Elevation (m)
160
155
150
145
140
135
130
125
0 50
Distance Along Profile (m)

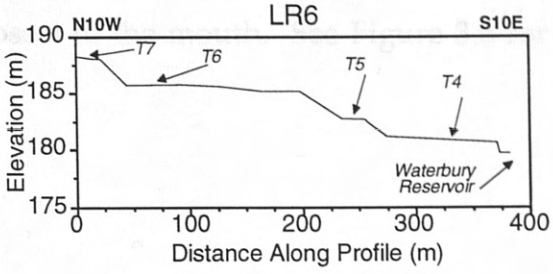

LR1.3-6
N0W
S0E
T1
LR
Elevation (m)
155
150
145
140
135
130
125
0 50
Distance Along Profile (m)

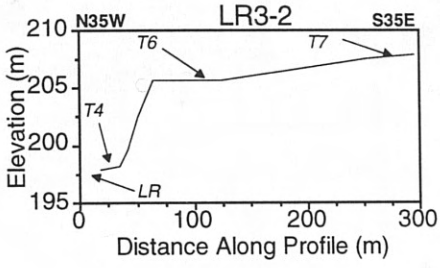

LR1.3-4
N0W
S0E
T5B
T2
T1
LR
Elevation (m)
Distance Along Profile (m)
LR1.3-3
S45W
N45E
T5B
T1
LR
Elevation (m)
Distance Along Profile (m)
LR1.3-2
N45W
S45E
T6
T5A
T5B
T1
LR
Elevation (m)
Distance Along Profile (m)

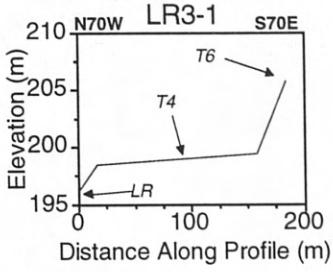

LR1.3-1
N50W
S50E
T3
T1
T0
LR
Elevation (m)
Distance Along Profile (m)
LR1.2-1
N75W
S75E
T5A
T5B
T1
T0
LR
T0
T2
Elevation (m)
Distance Along Profile (m)
LR1.2-2
N45W
S45E
T2
T0
LR
Elevation (m)
Distance Along Profile (m)

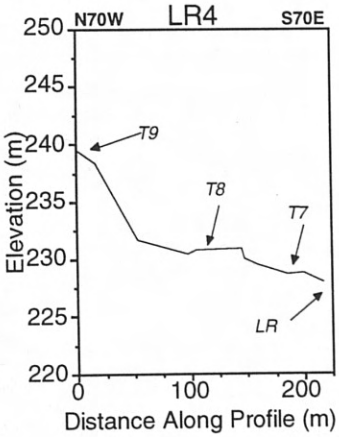

LR1.1-3
N70W
S70E
T5A
T2
T0
LR
Elevation (m)
Distance Along Profile (m)
LR1.1-2
S70W
N70E
T5B
T3
T2
T1
LR
Elevation (m)
Distance Along Profile (m)
LR1.1-1
S85W
N85E
T6
T5A
T5B
T4
T1
T0
LR
Elevation (m)
Distance Along Profile (m)


N35W
LR7
S35E
Dam
Waterbury
Reservoir
T6
Elevation (m)
Distance Along Profile (m)


N10W
LR6
S10E
T7
T6
T5
T4
Waterbury
Reservoir
Elevation (m)
Distance Along Profile (m)


N35W
LR3-2
S35E
T6
T7
T4
LR
Elevation (m)
Distance Along Profile (m)


N70W
LR3-1
S70E
T6
T4
LR
Elevation (m)
Distance Along Profile (m)


N70W
LR4
S70E
T9
T8
T7
LR
Elevation (m)
Distance Along Profile (m)

# APPENDIX D: MAD RIVER DATA

## MAD RIVER SURVEY DATA

The Mad River survey data are presented in the following tables beginning with the location closest to the mouth. See Figure 3.6 for survey locations.

| Mad River Location 17-Mouth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 86.63 | 186.63 | ± 0.20 | T7 |
| 2 | 1100.000 | 1000.000 | 100.000 | 86.63 | 186.63 | ± 0.20 | T7 |
| 3 | 993.575 | 1012.309 | 100.342 | 86.63 | 186.97 | ± 0.20 | T7 |
| 4 | 1007.614 | 1014.119 | 100.075 | 86.63 | 186.70 | ± 0.20 | T7 |
| 5 | 1102.934 | 1017.477 | 87.879 | 86.63 | 174.50 | ± 0.20 | T6 |
| 6 | 1128.934 | 1021.236 | 88.006 | 86.63 | 174.63 | ± 0.20 | T6 |
| 7 | 1784.340 | 1133.326 | 77.854 | 86.63 | 164.48 | ± 0.20 | T5 |
| 8 | 1777.744 | 1140.951 | 76.656 | 86.63 | 163.28 | ± 0.20 | T5 |
| 9 | 1000.044 | 1000.008 | 99.807 | 86.63 | 186.43 | ± 0.20 | T7 |
| 10 | 1231.360 | 901.136 | 76.078 | 86.63 | 162.70 | ± 0.20 | T5 |
| 11 | 1205.919 | 916.695 | 79.902 | 86.63 | 166.53 | ± 0.20 | T5 |
| 12 | 1266.920 | 1078.983 | 62.258 | 86.63 | 148.88 | ± 0.20 | T4 |
| 13 | 1233.475 | 1074.417 | 63.495 | 86.63 | 150.12 | ± 0.20 | T4 |
| 14 | 1215.298 | 1054.131 | 66.143 | 86.63 | 152.77 | ± 0.20 | T4 |
| 15 | 1406.383 | 950.529 | 51.435 | 86.63 | 138.06 | ± 0.20 | T2 |
| 16 | 1828.707 | 1203.592 | 79.468 | 86.63 | 166.09 | ± 0.20 | T5 |
| 17 | 1819.454 | 1197.113 | 79.361 | 86.63 | 165.99 | ± 0.20 | T5 |
| 18 | 1839.401 | 1200.874 | 81.058 | 86.63 | 167.68 | ± 0.20 | T5 |
| 19 | 1785.545 | 1130.635 | 78.117 | 86.63 | 164.74 | ± 0.20 | T5 |
| 20 | 1860.189 | 1080.389 | 77.941 | 86.63 | 164.57 | ± 0.20 | T5 |
| Note: Elevations at this site are tied to Benchmark Westover (elevation 550.00 ft or 167.68 m) via: | | | | | | | |
| MR17 Pt 18 = Benchmark. | | | | | | | |

| Mad River Location 13-Horse Farm | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 70.40 | 170.40 | ± 0.30 | T2 |
| 2 | 1100.000 | 1000.015 | 100.000 | 70.40 | 170.40 | ± 0.30 | T2 |
| 3 | 1002.287 | 1041.332 | 96.441 | 70.40 | 166.84 | ± 0.30 | RIVER |
| 4 | 1001.887 | 1047.959 | 98.426 | 70.40 | 168.82 | ± 0.30 | T1 |
| 5 | 1002.575 | 1105.999 | 98.494 | 70.40 | 168.89 | ± 0.30 | T1 |
| 6 | 979.883 | 1073.227 | 99.930 | 70.40 | 170.33 | ± 0.30 | T2 |
| 7 | 958.669 | 1086.339 | 100.288 | 70.40 | 170.68 | ± 0.30 | T2 |
| 8 | 952.042 | 1093.875 | 103.001 | 70.40 | 173.40 | ± 0.30 | T3 |
| 9 | 897.738 | 1106.928 | 104.212 | 70.40 | 174.61 | ± 0.30 | T3 |
| 10 | 798.978 | 1085.674 | 114.599 | 70.40 | 185.00 | ± 0.30 | T5 |
| 11 | 693.174 | 1061.527 | 133.627 | 70.40 | 204.02 | ± 0.30 | T7 |
| 12 | 593.358 | 1165.166 | 136.427 | 70.40 | 206.82 | ± 0.30 | T7 |
| 13 | 617.704 | 1124.195 | 134.814 | 70.40 | 205.21 | ± 0.30 | T7 |
| 14 | 693.359 | 1061.474 | 133.607 | 70.40 | 204.00 | ± 0.30 | T7 |
| 15 | 1111.688 | 1312.839 | 131.823 | 70.40 | 202.22 | ± 0.30 | T7 |
| 16 | 1072.595 | 1246.437 | 116.488 | 70.40 | 186.88 | ± 0.30 | T5 |
| 17 | 1123.962 | 1235.171 | 116.907 | 70.40 | 187.30 | ± 0.30 | T5 |
| 18 | 1120.732 | 1218.907 | 114.050 | 70.40 | 184.45 | ± 0.30 | T5 |
| 19 | 1043.595 | 1149.919 | 101.650 | 70.40 | 172.05 | ± 0.30 | T3 |
| 20 | 998.813 | 1003.347 | 100.334 | 70.40 | 170.73 | ± 0.30 | BM 560 ft |
| Note: Elevations at this site are tied to Benchmark 44 HBC 1967 (elevation 560.00 ft or 170.73 m) via: MR13 Pt 20 = Benchmark. | | | | | | | |

| Mad River Location 14-Pink House | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 77.17 | 177.17 | ± 0.20 | T4 |
| 2 | 1100.000 | 1000.005 | 100.000 | 77.17 | 177.17 | ± 0.20 | T4 |
| 3 | 770.825 | 1069.641 | 129.622 | 77.17 | 206.80 | ± 0.20 | T7 |
| 4 | 777.307 | 1059.601 | 129.134 | 77.17 | 206.31 | ± 0.20 | T7 |
| 5 | 786.725 | 1036.647 | 128.106 | 77.17 | 205.28 | ± 0.20 | T7 |
| 6 | 790.834 | 1029.572 | 127.426 | 77.17 | 204.60 | ± 0.20 | T7 |
| 7 | 835.395 | 1081.293 | 119.278 | 77.17 | 196.45 | ± 0.20 | SLOPE |
| 8 | 824.273 | 998.748 | 117.721 | 77.17 | 194.90 | ± 0.20 | SLOPE |
| 9 | 939.157 | 990.666 | 103.942 | 77.17 | 181.12 | ± 0.20 | T4 |
| 10 | 920.128 | 955.650 | 103.417 | 77.17 | 180.59 | ± 0.20 | T4 |
| 11 | 939.430 | 957.185 | 101.104 | 77.17 | 178.28 | ± 0.20 | T4 |
| 12 | 978.090 | 961.609 | 100.514 | 77.17 | 177.69 | ± 0.20 | T4 |
| 13 | 984.077 | 967.930 | 100.366 | 77.17 | 177.54 | ± 0.20 | T4 |
| 14 | 1036.713 | 1063.960 | 96.902 | 77.17 | 174.08 | ± 0.20 | T3 |
| 15 | 1022.906 | 1052.891 | 97.439 | 77.17 | 174.61 | ± 0.20 | T3 |
| 16 | 1011.459 | 1038.857 | 99.010 | 77.17 | 176.18 | ± 0.20 | T4 |
| 17 | 1012.396 | 994.709 | 97.039 | 77.17 | 174.21 | ± 0.20 | T3 |
| 18 | 1014.901 | 994.434 | 96.913 | 77.17 | 174.09 | ± 0.20 | T3 |
| 19 | 1100.450 | 1105.289 | 93.399 | 77.17 | 170.57 | ± 0.20 | T1 |
| 20 | 1103.765 | 1107.421 | 94.864 | 77.17 | 172.04 | ± 0.20 | T2 |
| 21 | 1106.753 | 1106.371 | 96.324 | 77.17 | 173.50 | ± 0.20 | T2 |
| 22 | 1249.473 | 1238.842 | 98.192 | 77.17 | 175.37 | ± 0.20 | T4 |
| 23 | 1245.236 | 1250.938 | 95.118 | 77.17 | 172.29 | ± 0.20 | T2 |
| 24 | 1287.162 | 1284.391 | 97.414 | 77.17 | 174.59 | ± 0.20 | T3 |
| 25 | 1301.061 | 1316.545 | 97.289 | 77.17 | 174.46 | ± 0.20 | T3 |
| 26 | 1185.749 | 918.784 | 127.260 | 77.17 | 204.43 | ± 0.20 | T7 |
| 27 | 1186.889 | 976.777 | 123.012 | 77.17 | 200.19 | ± 0.20 | T7 |
| 28 | 1195.602 | 1001.347 | 123.229 | 77.17 | 200.40 | ± 0.20 | T7 |
| 29 | 1197.906 | 1037.454 | 118.665 | 77.17 | 195.84 | ± 0.20 | SLOPE |
| 30 | 1143.706 | 1036.341 | 107.387 | 77.17 | 184.56 | ± 0.20 | SLOPE |
| 31 | 1093.541 | 1037.967 | 99.364 | 77.17 | 176.54 | ± 0.20 | T4 |
| 32 | 1180.257 | 1112.686 | 104.350 | 77.17 | 181.52 | ± 0.20 | SLOPE |
| 33 | 1168.055 | 1108.546 | 102.367 | 77.17 | 179.54 | ± 0.20 | T4 |
| 34 | 1192.612 | 1157.854 | 99.976 | 77.17 | 177.15 | ± 0.20 | T4 |
| 35 | 1190.927 | 1157.481 | 100.876 | 77.17 | 178.05 | ± 0.20 | T4 |
| Note: Elevations at this site are tied to Benchmark (elevation 584.00 ft or 178.05 m) via Pt 35 | | | | | | | |

| Mad River Location 15-Austin | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 5000.000 | 5000.000 | 100.000 | 111.13 | 211.13 | ± 0.20 | T8 |
| 2 | 4936.373 | 4922.853 | 100.000 | 111.13 | 211.13 | ± 0.20 | T8 |
| 3 | 4536.580 | 4125.367 | 89.682 | 111.13 | 200.81 | ± 0.20 | T5 |
| 4 | 4073.236 | 3721.162 | 82.925 | 111.13 | 194.06 | ± 0.20 | T3 |
| 5 | 4838.450 | 3962.771 | 98.931 | 111.13 | 210.06 | ± 0.20 | T8 |
| 6 | 5091.609 | 4865.735 | 97.896 | 111.13 | 209.03 | ± 0.20 | T7 |
| 7 | 5084.326 | 4836.388 | 97.403 | 111.13 | 208.53 | ± 0.20 | T7 |
| 8 | 5075.195 | 4779.535 | 93.584 | 111.13 | 204.71 | ± 0.20 | T6 |
| 9 | 5065.692 | 4728.922 | 93.170 | 111.13 | 204.30 | ± 0.20 | T6 |
| 10 | 4970.759 | 4637.663 | 80.030 | 111.13 | 191.16 | ± 0.20 | T1 |
| 11 | 4962.147 | 4613.948 | 80.312 | 111.13 | 191.44 | ± 0.20 | T1 |
| 12 | 4806.321 | 4682.148 | 81.000 | 111.13 | 192.13 | ± 0.20 | T2 |
| 13 | 4853.823 | 4727.445 | 80.000 | 111.13 | 191.13 | ± 0.20 | T2 |
| 14 | 4862.797 | 4739.037 | 81.336 | 111.13 | 192.47 | ± 0.20 | T3 |
| 15 | 4879.733 | 4765.231 | 81.195 | 111.13 | 192.33 | ± 0.20 | T3 |
| 16 | 4946.320 | 4903.114 | 84.888 | 111.13 | 196.02 | ± 0.20 | T4 |
| 17 | 4949.397 | 4910.620 | 85.519 | 111.13 | 196.65 | ± 0.20 | T4 |
| 18 | 4902.847 | 4995.494 | 102.259 | 111.13 | 213.39 | ± 0.20 | T8 |
| Note: Elevations at this site are tied to Benchmark Goodwin (elevation 645.00 ft or 196.65 m) via: MR 15 Pt 4 = MR 16 Pt 3; MR16 Pt 4 = Benchmark. | | | | | | | |

| Mad River Location 16- Austin to Goodwin | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 97.30 | 197.30 | ± 0.20 | ROAD |
| 2 | 1030.666 | 1095.182 | 100.000 | 97.30 | 197.30 | ± 0.20 | ROAD |
| 3 | 1743.872 | 1157.060 | 96.756 | 97.30 | 194.06 | ± 0.20 | Pt 4 on MR15 |
| 4 | 982.982 | 981.105 | 99.351 | 97.30 | 196.65 | ± 0.20 | Goodwin |
| Note: Elevations at this site are tied to Benchmark Goodwin (elevation 645.00 ft or 196.65 m) via: | | | | | | | |
| MR16 Pt 4 = Benchmark. | | | | | | | |

| Mad River Location 12-Turner Farm | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 113.33 | 213.33 | ± 0.20 | T8 |
| 2 | 1100.000 | 1000.000 | 100.000 | 113.33 | 213.33 | ± 0.20 | T8 |
| 3 | 662.690 | 1935.704 | 106.462 | 113.33 | 219.79 | ± 0.20 | T8 |
| 4 | 1066.504 | 695.020 | 103.541 | 113.33 | 216.87 | ± 0.20 | T8 |
| 5 | 943.417 | 951.281 | 100.679 | 113.33 | 214.01 | ± 0.20 | T8 |
| 6 | 946.723 | 958.182 | 98.890 | 113.33 | 212.22 | ± 0.20 | T7 |
| 7 | 942.161 | 1003.463 | 97.965 | 113.33 | 211.29 | ± 0.20 | T7 |
| 8 | 933.333 | 1028.520 | 94.482 | 113.33 | 207.81 | ± 0.20 | T6 |
| 9 | 949.185 | 1044.477 | 93.534 | 113.33 | 206.86 | ± 0.20 | T6 |
| 10 | 1009.897 | 1068.024 | 89.374 | 113.33 | 202.70 | ± 0.20 | T5 |
| 11 | 997.103 | 1086.197 | 88.452 | 113.33 | 201.78 | ± 0.20 | T5 |
| 12 | 997.136 | 1085.949 | 88.447 | 113.33 | 201.77 | ± 0.20 | T5 |
| 13 | 980.237 | 1101.868 | 82.506 | 113.33 | 195.83 | ± 0.20 | T4 |
| 14 | 963.225 | 1116.557 | 81.319 | 113.33 | 194.65 | ± 0.20 | T3 |
| 15 | 955.890 | 1129.122 | 81.070 | 113.33 | 194.40 | ± 0.20 | T3 |
| 16 | 943.006 | 1168.181 | 80.391 | 113.33 | 193.72 | ± 0.20 | T3 |
| 17 | 941.310 | 1178.858 | 79.735 | 113.33 | 193.06 | ± 0.20 | T3 |
| 18 | 910.004 | 1247.318 | 79.942 | 113.33 | 193.27 | ± 0.20 | T3 |
| 19 | 907.832 | 1260.778 | 78.731 | 113.33 | 192.06 | ± 0.20 | T2 |
| 20 | 927.187 | 1348.746 | 78.409 | 113.33 | 191.74 | ± 0.20 | T2 |
| 21 | 969.185 | 1391.905 | 78.060 | 113.33 | 191.39 | ± 0.20 | T1 |
| 22 | 967.405 | 1420.277 | 76.853 | 113.33 | 190.18 | ± 0.20 | T1 |
| 23 | 966.539 | 1430.228 | 76.850 | 113.33 | 190.18 | ± 0.20 | T1 |
| 24 | 956.616 | 1146.280 | 80.717 | 113.33 | 194.04 | ± 0.20 | T3 |
| 25 | 1000.000 | 1000.000 | 99.974 | 113.33 | 213.30 | ± 0.20 | T7 |
| 26 | 698.318 | 1005.257 | 83.756 | 113.33 | 197.08 | ± 0.20 | T4 |
| 27 | 956.615 | 1146.280 | 80.682 | 113.33 | 194.01 | ± 0.20 | T3 |
| 28 | 679.691 | 991.471 | 83.323 | 113.33 | 196.65 | ± 0.20 | T4 |
| Note: Elevations at this site are tied to Benchmark Goodwin (elevation 645.00 ft or 196.65 m) via: MR12 Pt 28 = Benchmark. | | | | | | | |

| Mad River Location 18-Neil Farm | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 99.34 | 199.34 | ± 1.0 | T4 |
| 2 | 1100.000 | 1000.000 | 100.000 | 99.34 | 199.34 | ± 1.0 | T4 |
| 3 | 423.810 | 952.854 | 116.653 | 99.34 | 215.99 | ± 1.0 | T8 |
| 4 | 447.671 | 955.561 | 116.849 | 99.34 | 216.19 | ± 1.0 | T8 |
| 5 | 479.892 | 958.204 | 113.233 | 99.34 | 212.57 | ± 1.0 | T7 |
| 6 | 576.807 | 969.356 | 112.696 | 99.34 | 212.04 | ± 1.0 | T7 |
| 7 | 584.850 | 956.346 | 109.939 | 99.34 | 209.28 | ± 1.0 | T6 |
| 8 | 617.473 | 959.776 | 108.094 | 99.34 | 207.43 | ± 1.0 | T6 |
| 9 | 679.358 | 963.326 | 104.303 | 99.34 | 203.64 | ± 1.0 | T4 |
| 10 | 692.182 | 954.713 | 103.590 | 99.34 | 202.93 | ± 1.0 | T4 |
| 11 | 647.482 | 1018.423 | 112.053 | 99.34 | 211.39 | ± 1.0 | T7 |
| 12 | 666.599 | 1017.586 | 107.722 | 99.34 | 207.06 | ± 1.0 | T7 |
| 13 | 697.458 | 1005.868 | 107.234 | 99.34 | 206.57 | ± 1.0 | T7 |
| 14 | 710.806 | 998.822 | 103.744 | 99.34 | 203.08 | ± 1.0 | T4 |
| 15 | 993.042 | 1011.327 | 99.923 | 99.34 | 199.26 | ± 1.0 | T4 |
| 16 | 1030.064 | 966.164 | 99.892 | 99.34 | 199.23 | ± 1.0 | T4 |
| 17 | 1037.851 | 956.721 | 98.882 | 99.34 | 198.22 | ± 1.0 | T3 |
| 18 | 1136.922 | 892.113 | 97.819 | 99.34 | 197.16 | ± 1.0 | T3 |
| 19 | 1146.197 | 883.153 | 97.105 | 99.34 | 196.45 | ± 1.0 | T2 |
| 20 | 1227.676 | 718.760 | 96.895 | 99.34 | 196.23 | ± 1.0 | T2 |
| 21 | 1221.044 | 710.596 | 95.727 | 99.34 | 195.07 | ± 1.0 | T1 |
| 22 | 1218.925 | 707.268 | 95.782 | 99.34 | 195.12 | ± 1.0 | T1 |
| 23 | 1285.816 | 701.085 | 99.138 | 99.34 | 198.48 | ± 1.0 | Bridge |
| Note: Elevations at this site are tied to a countour line (elevation 640.00 ft or 195.12 m) via: | | | | | | | |
| MR18 Pt 22 = contour line. | | | | | | | |

| Mad River Location 10- Waitsfield | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 130.30 | 230.30 | ± 0.20 | T7 |
| 2 | 988.381 | 1099.323 | 100.000 | 130.30 | 230.30 | ± 0.20 | T7 |
| 3 | 981.496 | 1158.181 | 102.374 | 130.30 | 232.67 | ± 0.20 | T8 |
| 4 | 994.165 | 1123.920 | 101.741 | 130.30 | 232.04 | ± 0.20 | T8 |
| 5 | 996.001 | 1110.310 | 101.292 | 130.30 | 231.59 | ± 0.20 | T8 |
| 6 | 1001.238 | 1011.789 | 99.582 | 130.30 | 229.88 | ± 0.20 | T7 |
| 7 | 991.810 | 941.300 | 98.490 | 130.30 | 228.79 | ± 0.20 | SLOPE |
| 8 | 1090.982 | 867.997 | 95.907 | 130.30 | 226.20 | ± 0.20 | T6 |
| 9 | 999.991 | 999.992 | 100.008 | 130.30 | 230.31 | ± 0.20 | T7 |
| 10 | 1061.046 | 904.451 | 96.006 | 130.30 | 226.30 | ± 0.20 | T6 |
| 11 | 1095.881 | 861.380 | 95.708 | 130.30 | 226.01 | ± 0.20 | T6 |
| 12 | 1119.079 | 860.973 | 94.565 | 130.30 | 224.86 | ± 0.20 | T5 |
| 13 | 1141.112 | 847.194 | 93.465 | 130.30 | 223.76 | ± 0.20 | T5 |
| 14 | 1259.062 | 760.506 | 83.355 | 130.30 | 213.65 | ± 0.20 | T2 |
| 15 | 1090.981 | 867.998 | 95.878 | 130.30 | 226.18 | ± 0.20 | T5 |
| 16 | 1149.391 | 830.382 | 89.373 | 130.30 | 219.67 | ± 0.20 | T4 |
| 17 | 1165.386 | 822.089 | 88.399 | 130.30 | 218.70 | ± 0.20 | T4 |
| 18 | 1200.009 | 805.078 | 83.907 | 130.30 | 214.20 | ± 0.20 | T2 |
| 19 | 1175.909 | 766.193 | 81.886 | 130.30 | 212.18 | ± 0.20 | T1 |
| 20 | 1331.208 | 673.734 | 82.597 | 130.30 | 212.89 | ± 0.20 | T1 |
| 21 | 1230.364 | 623.110 | 83.412 | 130.30 | 213.71 | ± 0.20 | T2 |
| 22 | 1353.680 | 706.971 | 82.503 | 130.30 | 212.80 | ± 0.20 | T1 |
| Note: Elevations at this site are tied to Benchmark 693 (elevation 693.00 ft or 212.80 m) via: | | | | | | | |
| MR10 Pt 22 = Benchmark. | | | | | | | |

| Mad River Location 7-Hap | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 125.61 | 225.61 | ± 1.0 | T4 |
| 2 | 1100.000 | 1000.000 | 100.000 | 125.61 | 225.61 | ± 1.0 | T4 |
| 3 | 766.809 | 1211.136 | 115.699 | 125.61 | 241.31 | ± 1.0 | T8 |
| 4 | 789.973 | 1166.208 | 113.112 | 125.61 | 238.72 | ± 1.0 | T8 |
| 5 | 835.270 | 1115.262 | 103.441 | 125.61 | 229.05 | ± 1.0 | T5 |
| 6 | 843.707 | 1084.473 | 103.640 | 125.61 | 229.25 | ± 1.0 | T5 |
| 7 | 865.505 | 1066.598 | 100.626 | 125.61 | 226.24 | ± 1.0 | T4 |
| 8 | 923.510 | 1012.526 | 100.703 | 125.61 | 226.31 | ± 1.0 | T4 |
| 9 | 887.702 | 995.689 | 96.956 | 125.61 | 222.57 | ± 1.0 | T3 |
| 10 | 875.536 | 946.666 | 97.131 | 125.61 | 222.74 | ± 1.0 | T3 |
| 11 | 882.509 | 936.859 | 96.362 | 125.61 | 221.97 | ± 1.0 | T1 |
| 12 | 1002.574 | 734.517 | 96.705 | 125.61 | 222.31 | ± 1.0 | T2 |
| 13 | 1002.901 | 731.041 | 95.840 | 125.61 | 221.45 | ± 1.0 | T1 |
| 14 | 1008.355 | 724.576 | 96.079 | 125.61 | 221.69 | ± 1.0 | T1 |
| 15 | 1008.635 | 722.439 | 95.604 | 125.61 | 221.21 | ± 1.0 | T1 |
| 16 | 956.810 | 714.978 | 95.604 | 125.61 | 221.21 | ± 1.0 | T1 |
| 17 | 960.402 | 733.542 | 95.866 | 125.61 | 221.48 | ± 1.0 | T1 |
| 18 | 962.767 | 744.082 | 96.194 | 125.61 | 221.80 | ± 1.0 | T1 |
| 19 | 963.872 | 746.988 | 96.636 | 125.61 | 222.25 | ± 1.0 | T2 |
| 20 | 1014.412 | 1025.130 | 100.582 | 125.61 | 226.19 | ± 1.0 | T4 |
| Note: Elevations at this site are tied to a contour line (elevation 740.00 ft or 225.61 m) via: | | | | | | | |
| MR7 Pt 1 = contour line. | | | | | | | |

| Mad River Location 5-Guys | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 131.60 | 231.60 | ± 1.0 | T4 |
| 2 | 1100.000 | 1000.007 | 100.000 | 131.60 | 231.60 | ± 1.0 | T4 |
| 3 | 924.107 | 1049.642 | 93.906 | 131.60 | 225.51 | ± 1.0 | RIVER |
| 4 | 930.245 | 1050.858 | 95.270 | 131.60 | 226.87 | ± 1.0 | T1 |
| 5 | 960.399 | 1052.813 | 96.518 | 131.60 | 228.12 | ± 1.0 | T2 |
| 6 | 982.072 | 1070.243 | 96.225 | 131.60 | 227.83 | ± 1.0 | T1 |
| 7 | 986.959 | 1075.369 | 97.244 | 131.60 | 228.85 | ± 1.0 | T2 |
| 8 | 1020.846 | 1111.885 | 96.730 | 131.60 | 228.33 | ± 1.0 | T2 |
| 9 | 1038.035 | 1108.830 | 97.624 | 131.60 | 229.23 | ± 1.0 | T2 |
| 10 | 1058.959 | 1148.881 | 97.939 | 131.60 | 229.54 | ± 1.0 | T2 |
| 11 | 1059.358 | 1163.231 | 98.670 | 131.60 | 230.27 | ± 1.0 | T3 |
| 12 | 1077.351 | 1200.604 | 98.567 | 131.60 | 230.17 | ± 1.0 | T3 |
| 13 | 1082.602 | 1206.519 | 99.385 | 131.60 | 230.99 | ± 1.0 | T3 |
| 14 | 1099.352 | 1239.251 | 99.064 | 131.60 | 230.67 | ± 1.0 | T3 |
| 15 | 983.930 | 1301.867 | 112.296 | 131.60 | 243.90 | ± 1.0 | T8 |
| 16 | 993.583 | 1266.802 | 99.262 | 131.60 | 230.87 | ± 1.0 | T3 |
| 17 | 982.181 | 1242.813 | 99.191 | 131.60 | 230.80 | ± 1.0 | T3 |
| 18 | 982.912 | 1234.020 | 98.419 | 131.60 | 230.02 | ± 1.0 | T3 |
| 19 | 980.623 | 1186.097 | 98.576 | 131.60 | 230.18 | ± 1.0 | T3 |
| 20 | 978.392 | 1172.698 | 96.705 | 131.60 | 228.31 | ± 1.0 | T2 |
| 21 | 980.231 | 1082.668 | 97.304 | 131.60 | 228.91 | ± 1.0 | T2 |
| 22 | 979.284 | 1073.269 | 96.193 | 131.60 | 227.80 | ± 1.0 | T1 |
| 23 | 986.652 | 1027.517 | 96.084 | 131.60 | 227.69 | ± 1.0 | T1 |
| 24 | 994.568 | 1009.140 | 99.601 | 131.60 | 231.21 | ± 1.0 | T4 |
| 25 | 1014.055 | 986.648 | 99.540 | 131.60 | 231.14 | ± 1.0 | T4 |
| 26 | 1036.435 | 954.409 | 94.572 | 131.60 | 226.18 | ± 1.0 | T1 |
| Note: Elevations at this site are tied to a contour line, elevation 800.00 ft or 243.90 m. | | | | | | | |
| MR5 Pt 15 = contour line. | | | | | | | |

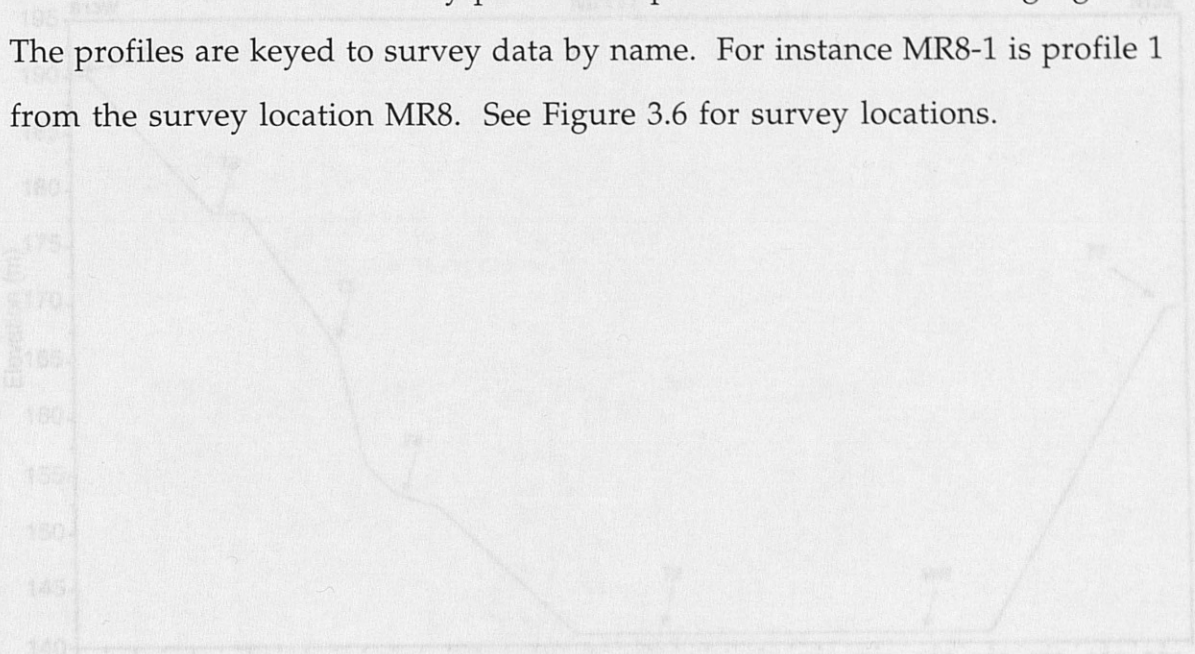
| Mad River Location 8- Rodger | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 161.88 | 261.88 | ± 1.0 | T8 |
| 2 | 1100.000 | 1000.000 | 100.000 | 161.88 | 261.88 | ± 1.0 | T8 |
| 3 | 1006.766 | 958.469 | 100.504 | 161.88 | 262.38 | ± 1.0 | T8 |
| 4 | 1012.486 | 1001.615 | 100.206 | 161.88 | 262.09 | ± 1.0 | T8 |
| 5 | 1000.232 | 1017.793 | 96.704 | 161.88 | 258.58 | ± 1.0 | T7 |
| 6 | 996.379 | 1039.403 | 96.682 | 161.88 | 258.56 | ± 1.0 | T7 |
| 7 | 977.844 | 1047.134 | 96.675 | 161.88 | 258.56 | ± 1.0 | T7 |
| 8 | 976.060 | 1053.483 | 96.738 | 161.88 | 258.62 | ± 1.0 | T7 |
| 9 | 965.389 | 1060.127 | 95.269 | 161.88 | 257.15 | ± 1.0 | T6 |
| 10 | 956.940 | 1077.882 | 95.475 | 161.88 | 257.36 | ± 1.0 | T6 |
| 11 | 962.237 | 1091.149 | 94.381 | 161.88 | 256.26 | ± 1.0 | T5 |
| 12 | 985.784 | 1142.077 | 94.875 | 161.88 | 256.76 | ± 1.0 | T5 |
| 13 | 988.128 | 1183.931 | 95.093 | 161.88 | 256.97 | ± 1.0 | T5 |
| 14 | 1000.000 | 999.998 | 100.018 | 161.88 | 261.90 | ± 1.0 | T8 |
| 15 | 919.733 | 1140.724 | 90.092 | 161.88 | 251.97 | ± 1.0 | T3 |
| 16 | 898.993 | 1170.665 | 90.322 | 161.88 | 252.20 | ± 1.0 | T3 |
| 17 | 908.348 | 1188.626 | 87.314 | 161.88 | 249.19 | ± 1.0 | T2 |
| 18 | 897.997 | 1210.945 | 87.463 | 161.88 | 249.34 | ± 1.0 | T2 |
| 19 | 895.382 | 1221.157 | 86.472 | 161.88 | 248.35 | ± 1.0 | T1 |
| 20 | 879.533 | 1259.857 | 87.002 | 161.88 | 248.88 | ± 1.0 | T1 |
| 21 | 867.730 | 1258.545 | 85.933 | 161.88 | 247.81 | ± 1.0 | RIVER |
| 22 | 853.088 | 1248.197 | 85.782 | 161.88 | 247.66 | ± 1.0 | RIVER |
| 23 | 851.020 | 1248.474 | 85.411 | 161.88 | 247.29 | ± 1.0 | RIVER |
| 24 | 841.921 | 1248.002 | 85.555 | 161.88 | 247.44 | ± 1.0 | RIVER |
| 25 | 886.224 | 1154.825 | 89.673 | 161.88 | 251.55 | ± 1.0 | T2 |
| 26 | 874.521 | 1151.194 | 89.842 | 161.88 | 251.72 | ± 1.0 | T2 |
| 27 | 651.029 | 1000.361 | 90.022 | 161.88 | 251.90 | ± 1.0 | T2 |
| 28 | 988.128 | 1183.931 | 94.991 | 161.88 | 256.87 | ± 1.0 | T5 |
| 29 | 866.167 | 1126.526 | 87.495 | 161.88 | 249.38 | ± 1.0 | T1 |
| 30 | 840.837 | 1117.037 | 87.678 | 161.88 | 249.56 | ± 1.0 | T1 |
| 31 | 865.013 | 1146.597 | 86.931 | 161.88 | 248.81 | ± 1.0 | T1 |
| 32 | 850.428 | 1147.826 | 87.022 | 161.88 | 248.90 | ± 1.0 | T1 |
| 33 | 619.699 | 1049.714 | 86.135 | 161.88 | 248.02 | ± 1.0 | RIVER |
| 34 | 623.070 | 1047.124 | 87.370 | 161.88 | 249.25 | ± 1.0 | T1 |
| 35 | 635.180 | 1019.238 | 87.583 | 161.88 | 249.46 | ± 1.0 | T1 |
| 36 | 640.827 | 1011.812 | 89.603 | 161.88 | 251.48 | ± 1.0 | RT 1OO |
| 37 | 647.883 | 1003.534 | 89.235 | 161.88 | 251.12 | ± 1.0 | RT100 |
| 38 | 654.935 | 993.699 | 90.177 | 161.88 | 252.06 | ± 1.0 | T3 |
| 39 | 656.923 | 989.753 | 91.039 | 161.88 | 252.92 | ± 1.0 | T3 |
| 40 | 668.673 | 974.795 | 91.722 | 161.88 | 253.60 | ± 1.0 | T4 |
| 41 | 678.426 | 964.646 | 92.702 | 161.88 | 254.58 | ± 1.0 | T4 |
| 42 | 685.703 | 949.253 | 92.655 | 161.88 | 254.54 | ± 1.0 | T4 |
| 43 | 706.771 | 946.181 | 95.622 | 161.88 | 257.50 | ± 1.0 | T5 |
| 44 | 721.080 | 933.830 | 95.783 | 161.88 | 257.66 | ± 1.0 | T5 |
| 45 | 724.705 | 903.223 | 101.809 | 161.88 | 263.69 | ± 1.0 | T8 |
| 46 | 349.992 | 853.626 | 98.702 | 161.88 | 260.58 | ± 1.0 | T8 |
| 47 | 651.014 | 1000.354 | 90.136 | 161.88 | 252.02 | ± 1.0 | T4 |
| 48 | 220.259 | 852.104 | 104.263 | 161.88 | 266.14 | ± 1.0 | T8 |
| Note: Elevations at this site are tied to a contour line (elevation 960.00 ft or 292.68 m) via: MR8 Pt 48 = MR4 Pt 20; MR4 Pt 18 = contour line. | | | | | | | |

| Mad River Location 8- Rodger 2 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 164.78 | 264.78 | ± 1.0 | T8 |
| 2 | 966.012 | 1094.047 | 100.000 | 164.78 | 264.78 | ± 1.0 | T8 |
| 3 | 938.721 | 1093.132 | 87.123 | 164.78 | 251.90 | ± 1.0 | T2 |
| 4 | 995.566 | 1008.187 | 99.733 | 164.78 | 264.51 | ± 1.0 | T8 |
| 5 | 1011.910 | 973.872 | 100.307 | 164.78 | 265.09 | ± 1.0 | T8 |
| 6 | 1031.401 | 925.714 | 126.729 | 164.78 | 291.51 | ± 1.0 | T9 |
| 7 | 1000.001 | 999.998 | 100.035 | 164.78 | 264.82 | ± 1.0 | T8 |
| 8 | 1038.873 | 874.618 | 127.012 | 164.78 | 291.79 | ± 1.0 | T9 |
| 9 | 1046.640 | 803.989 | 127.044 | 164.78 | 291.82 | ± 1.0 | T9 |
| 10 | 1031.398 | 925.740 | 126.717 | 164.78 | 291.50 | ± 1.0 | T9 |
| 11 | 1177.533 | 941.387 | 126.759 | 164.78 | 291.54 | ± 1.0 | T9 |
| 12 | 1158.838 | 922.358 | 126.289 | 164.78 | 291.07 | ± 1.0 | T9 |
| 13 | 1067.413 | 811.956 | 126.766 | 164.78 | 291.55 | ± 1.0 | T9 |
| 14 | 1062.092 | 818.420 | 126.696 | 164.78 | 291.48 | ± 1.0 | T9 |
| 15 | 1046.341 | 840.693 | 123.224 | 164.78 | 288.00 | ± 1.0 | TRIBUTARY |
| 16 | 1051.295 | 864.056 | 122.771 | 164.78 | 287.55 | ± 1.0 | TRIBUTARY |
| Note: Elevations at this site are tied to a contour line (elevation 960.00 ft or 292.68 m) via: | | | | | | | |
| MR8-2 Pt 3 = MR8 Pt 27; MR8 Pt 48 = MR4 Pt 20; MR4 Pt 18 = contour line | | | | | | | |

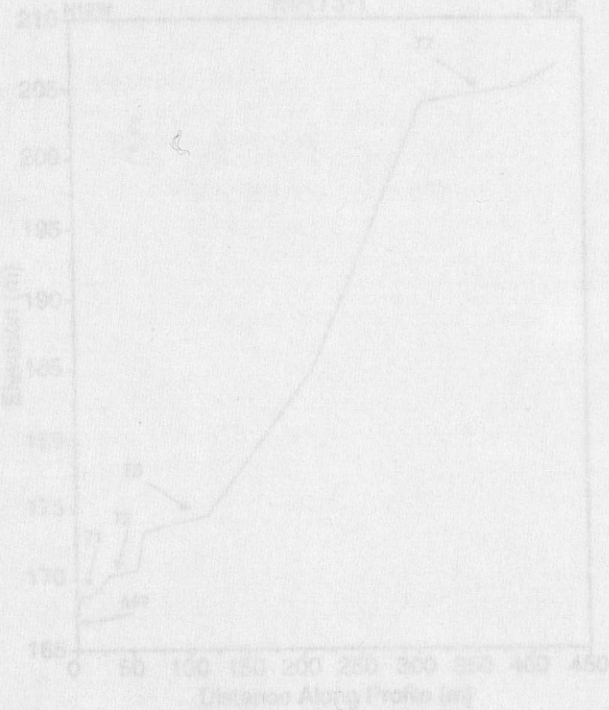
| Mad River Location 4-Seasons | | | | | | | |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (m) | Easting (m) | Measured Elevation (m) | Correction (m) | Final Elevation (m) | Error (m) | Point Description |
| 1 | 1000.000 | 1000.000 | 100.000 | 165.80 | 265.80 | ± 1.0 | T8 |
| 2 | 1029.483 | 904.445 | 100.000 | 165.80 | 265.80 | ± 1.0 | T8 |
| 3 | 1014.058 | 954.503 | 100.257 | 165.80 | 266.06 | ± 1.0 | T8 |
| 4 | 995.702 | 1014.702 | 97.107 | 165.80 | 262.91 | ± 1.0 | T7 |
| 5 | 991.434 | 1029.074 | 97.090 | 165.80 | 262.89 | ± 1.0 | T7 |
| 6 | 989.135 | 1041.525 | 94.426 | 165.80 | 260.23 | ± 1.0 | T5 |
| 7 | 987.172 | 1048.460 | 94.078 | 165.80 | 259.88 | ± 1.0 | T5 |
| 8 | 991.364 | 1063.114 | 91.921 | 165.80 | 257.72 | ± 1.0 | T4 |
| 9 | 991.513 | 1073.336 | 91.415 | 165.80 | 257.22 | ± 1.0 | T4 |
| 10 | 977.615 | 1075.765 | 88.952 | 165.80 | 254.76 | ± 1.0 | T2 |
| 11 | 969.383 | 1105.961 | 88.810 | 165.80 | 254.61 | ± 1.0 | T2 |
| 12 | 967.047 | 1111.495 | 87.492 | 165.80 | 253.30 | ± 1.0 | T1 |
| 13 | 961.904 | 1126.235 | 87.020 | 165.80 | 252.82 | ± 1.0 | T1 |
| 14 | 960.712 | 1128.205 | 85.627 | 165.80 | 251.43 | ± 1.0 | RIVER |
| 15 | 957.996 | 1134.138 | 85.509 | 165.80 | 251.31 | ± 1.0 | RIVER |
| 16 | 1015.560 | 950.725 | 102.296 | 165.80 | 268.10 | ± 1.0 | RT 100 |
| 17 | 1018.259 | 934.689 | 102.228 | 165.80 | 268.03 | ± 1.0 | RT 100 |
| 18 | 1090.209 | 899.705 | 126.877 | 165.80 | 292.68 | ± 1.0 | T9 |
| 19 | 941.543 | 920.521 | 106.025 | 165.80 | 271.83 | ± 1.0 | RT 100 |
| 20 | 1025.485 | 981.809 | 100.340 | 165.80 | 266.14 | ± 1.0 | T8 |
| Note: Elevations at this site are tied to a contour line (elevation 960.00 ft or 292.68 m) via: Pt 18 | | | | | | | |

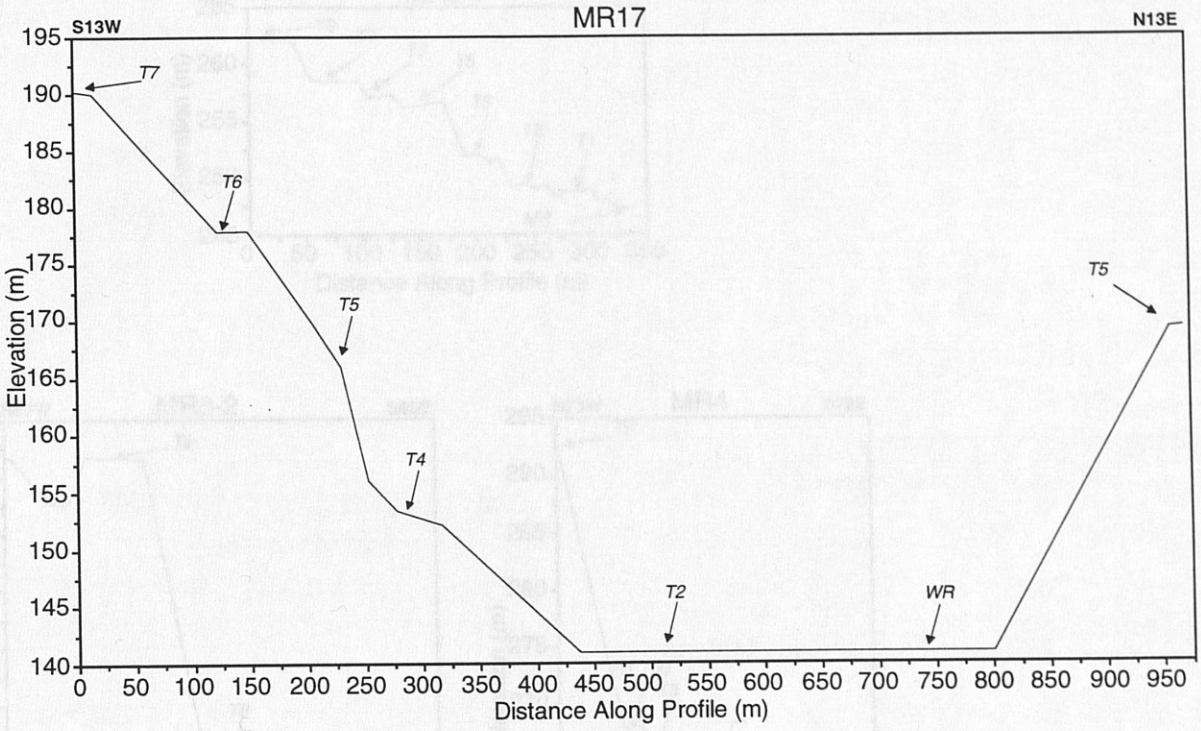
## MAD RIVER CROSS-VALLEY PROFILES

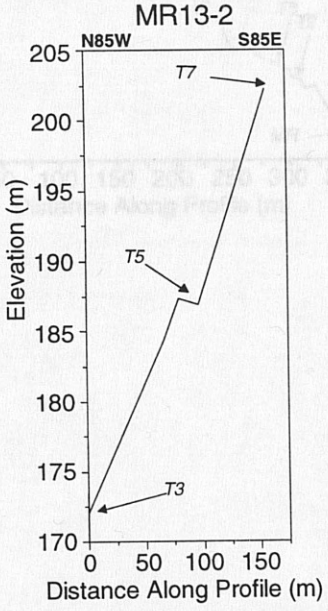
The Mad River cross-valley profiles are presented in the following figures. The profiles are keyed to survey data by name. For instance MR8-1 is profile 1 from the survey location MR8. See Figure 3.6 for survey locations.

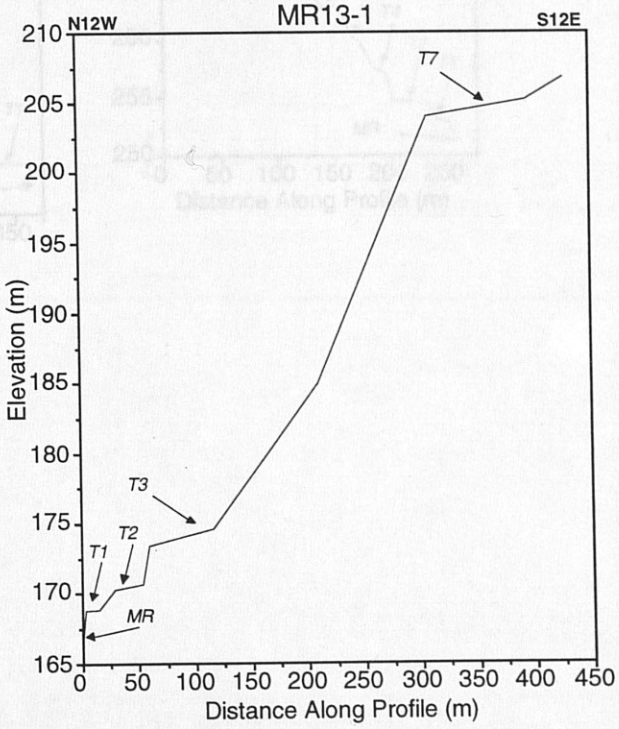


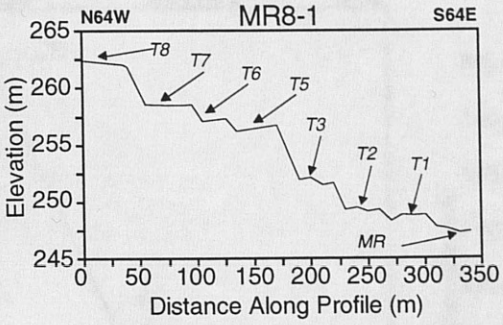


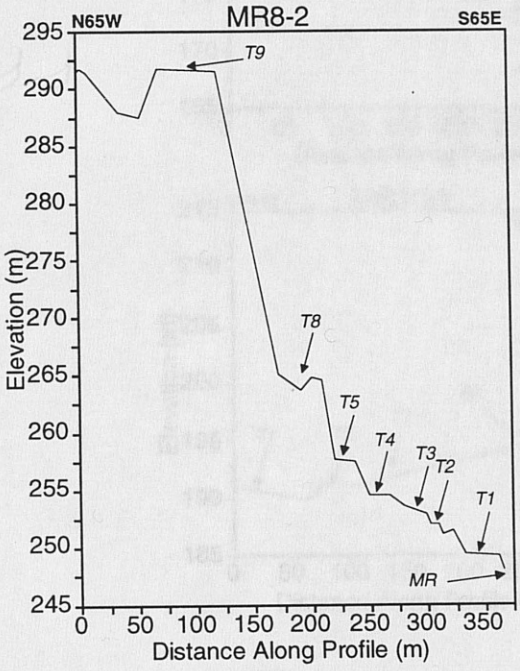


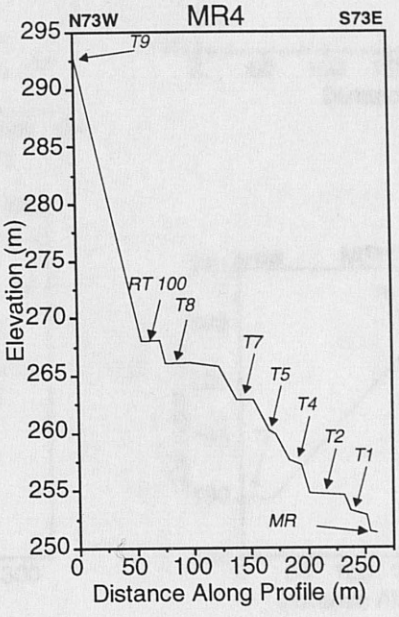

MR17
S13W
N13E
Elevation (m)
Distance Along Profile (m)
T7
T6
T5
T4
T2
WR
T5

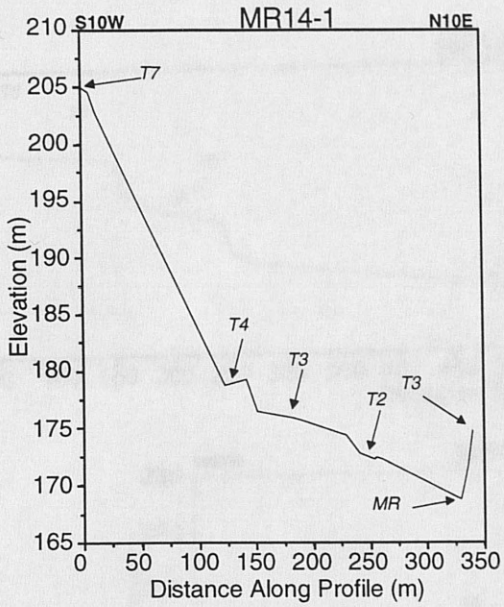

MR13-2
N85W
S85E
Elevation (m)
Distance Along Profile (m)
T7
T5
T3

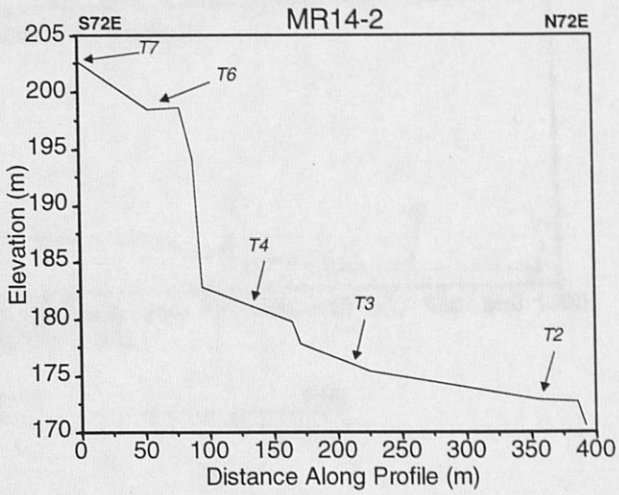

MR13-1
N12W
S12E
Elevation (m)
Distance Along Profile (m)
T7
T3
T2
T1
MR

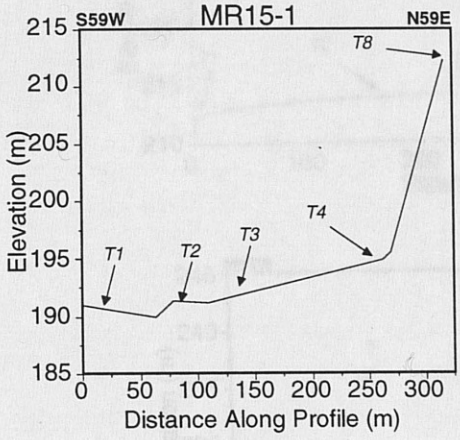

N64W
MR8-1
S64E
T8
T7
T6
T5
T3
T2
T1
MR
Elevation (m)
265
260
255
250
245
0
50
100
150
200
250
300
350
Distance Along Profile (m)

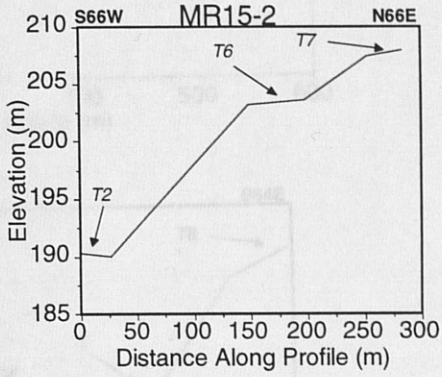

N65W
MR8-2
S65E
T9
T8
T5
T4
T3
T2
T1
MR
Elevation (m)
295
290
285
280
275
270
265
260
255
250
245
0
50
100
150
200
250
300
350
Distance Along Profile (m)

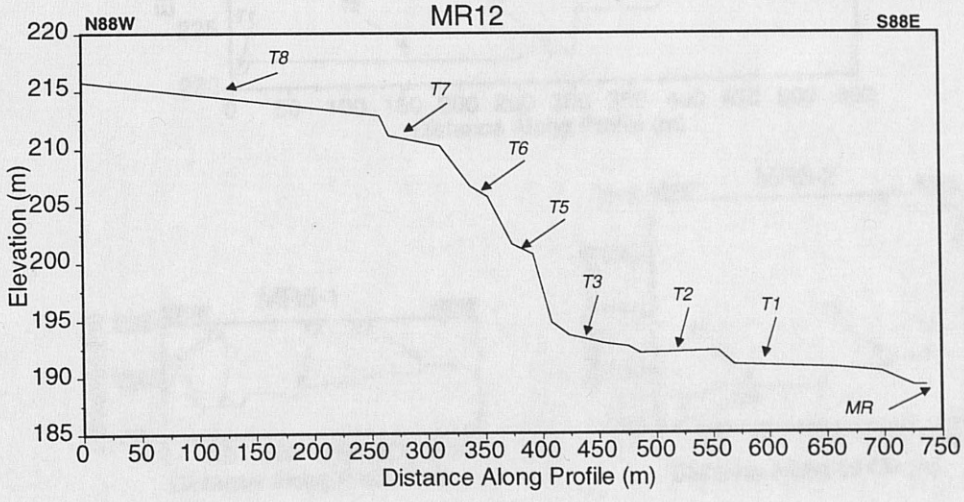

N73W
MR4
S73E
T9
RT 100
T8
T7
T5
T4
T2
T1
MR
Elevation (m)
295
290
285
280
275
270
265
260
255
250
0
50
100
150
200
250
Distance Along Profile (m)

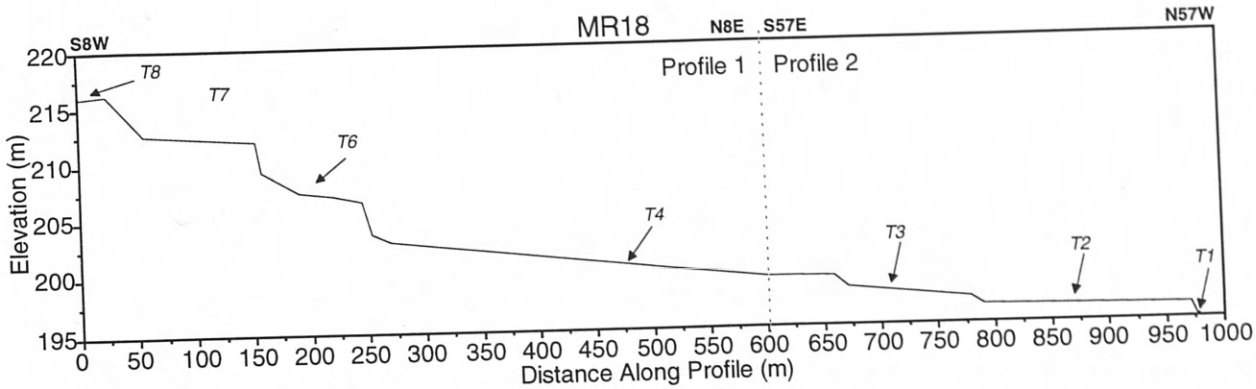

MR14-1
S10W
N10E
T7
T4
T3
T2
T3
MR
Elevation (m)
Distance Along Profile (m)

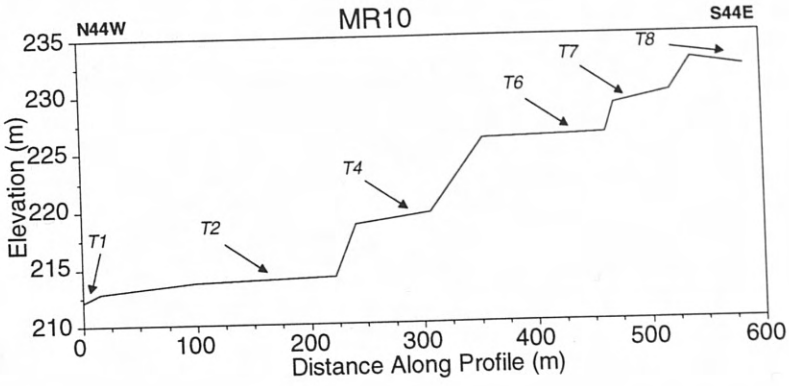

MR14-2
S72E
N72E
T7
T6
T4
T3
T2
Elevation (m)
Distance Along Profile (m)

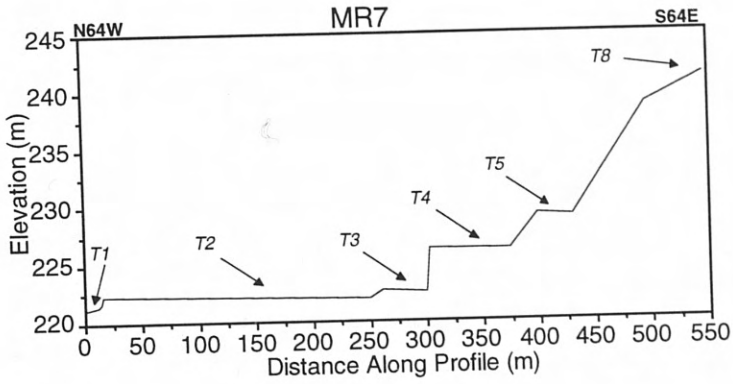

MR15-1
S59W
N59E
T8
T1
T2
T3
T4
Elevation (m)
Distance Along Profile (m)

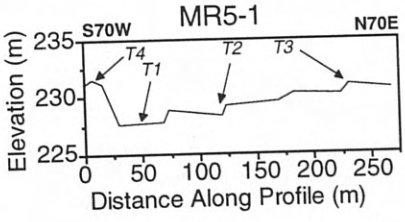

MR15-2
S66W
N66E
T6
T7
T2
Elevation (m)
Distance Along Profile (m)

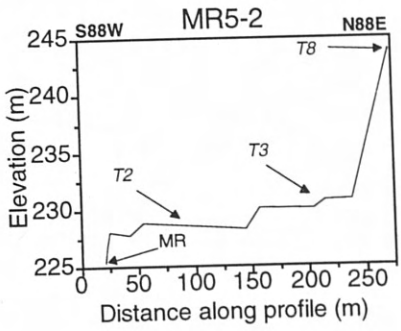

MR12
N88W
S88E
T8
T7
T6
T5
T3
T2
T1
MR
Elevation (m)
Distance Along Profile (m)


MR18
S8W
N8E
S57E
N57W
Profile 1
Profile 2
T8
T7
T6
T4
T3
T2
T1
Elevation (m)
Distance Along Profile (m)


MR10
N44W
S44E
T8
T7
T6
T4
T2
T1
Elevation (m)
Distance Along Profile (m)


MR7
N64W
S64E
T8
T5
T4
T3
T2
T1
Elevation (m)
Distance Along Profile (m)


MR5-1
S70W
N70E
T4
T1
T2
T3
Elevation (m)
Distance Along Profile (m)


MR5-2
S88W
N88E
T8
T3
T2
MR
Elevation (m)
Distance along profile (m)