# Surficial Geology of Lower Comb Wash, San Juan County, Utah

*By* Claire I. Longpré[1]

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[1]U.S. Geological Survey, 1201 Pacific Ave. Suite 600, Tacoma, WA 98402
clongpre@usgs.gov

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## INTRODUCTION

The surficial geologic map of lower Comb Wash was produced as part of a master's thesis for Northern Arizona University Quaternary Sciences program. The map area includes the portion of the Comb Wash alluvial valley between Highway 163 and Highway 95 on the Colorado Plateau in southeastern Utah. The late Quaternary geology of this part of the Colorado Plateau had not previously been mapped in adequate detail. The geologic information in this report will be useful for biological studies, land management and range management for federal, state and private industries.

Comb Wash is a south flowing ephemeral tributary of the San Juan River, flanked to the east by Comb Ridge and to the west by Cedar Mesa (Figure 1). The nearest settlement is Bluff, about 7 km to the east of the area. Elevations range from 1951 m where Highway 95 crosses Comb Wash to 1291 m at the confluence with the San Juan River. Primary vehicle access to lower Comb Wash is provided by a well-maintained dirt road that parallels the active channel of Comb Wash between Highway 163 and Highway 95. For much of the year this road can be traversed without the aid of four-wheel drive. However, during inclement weather such as rain or snow the road becomes treacherous even with four-wheel drive. The Comb Wash watershed is public land managed by the Bureau of Land management (BLM) office in Monticello, Utah.

The semi-arid climate of Comb Wash and the surrounding area is typical of the Great Basin Desert. Temperature in Bluff, Utah ranges from a minimum of –8° C in January to a maximum of 35° C in July with a mean annual temperature of 9.8° C (U.S. Department of Commerce, 1999). The difference between day and nighttime temperatures is as great as 20° C. Between 1928 and 1998, annual rainfall in Bluff averaged 178 mm per year (U.S. Department of Commerce, 1999). Annual rainfall in Comb Wash averaged 240 mm per year from 1991 to 1999 while Bluff received an average of 193 mm for the same 8 year period. Most precipitation is monsoonal, convective storms that bring moisture from the Gulf of Mexico beginning in early July and ending by October. Large frontal storms during December and January are responsible for most winter precipitation (Figure 2). The record from U.S. Geological Survey gauging station number 09379000 operated by the BLM from 1959 through 1968 indicates that Comb Wash flows in direct response to precipitation events. Most daily discharge and peak events occur in late July through September, coinciding with high intensity monsoon thunderstorms.

Comb Wash supports a variety of vegetation typical of the Great Basin Desert and the northern desert shrub zone as described by Fowler and Koch (1982). On the lower alluvial terraces, bushes and shrubs dominate the vegetation, including: sagebrush (*Artemesia tridentata*), rabbitbrush (*Chrysothamnus nauseosus*), fourwing saltbush (*Atriplex canescens*), winterfat (*Eurotia lanata*), greasewood (*Sarcobatus vermiculatus*), and shadscale (*Atriplex concertifolia*). Juniper trees (*Juniperus osteosperma*) can be found on the rocky colluvial slopes near Comb Ridge and on the higher terrace near Cedar Mesa. The floodplain contains an abundance of riparian vegetation including cottonwood (*Populus fremontii*), willow (*Salix exigua*), and tamarisk (*Tamarix ramosissima*). Tamarisk is one of 7 non-native species present in the lower Comb Wash watershed.

At least seven known species of noxious weeds have invaded the watershed, including Bermuda grass (*Cynodon dactylon*), field bindweed (*Convolvulus avensis*), Canada thistle (*Cirsium arvense*), Russian knapweed (*Centaurea repens*), tamarisk and camel thorn (*Alhagi pseudalhagi*). Of these, tamarisk or salt-cedar has most aggressively colonized the southwestern United States, including the San Juan watershed. Graf (1978) estimates that since the late 19$^{th}$ century, tamarisk has spread at a rate of 20 km per year. Tamarisk first appeared in Comb Wash during the mid to early 20$^{th}$ century based on photographs taken by Gregory in the early 1900's (Gregory, 1938).

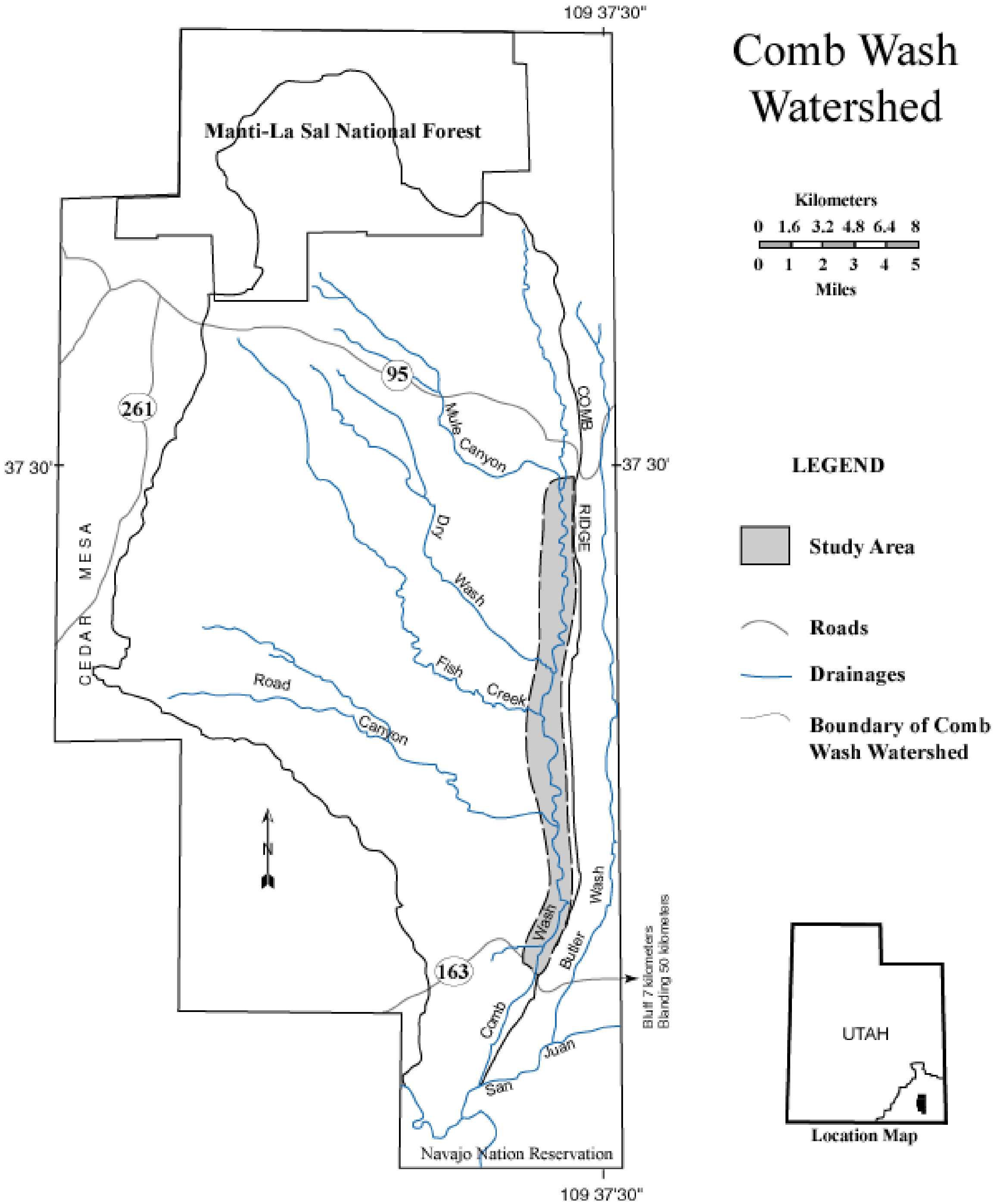


Figure 1. Map of Comb Wash watershed.

Figure 2. Comb Wash area with approaching winter storm. View south.

## PREVIOUS WORK

Captain J. N. Macomb of Topographic Engineers, U.S.A. led one of the earliest expeditions into southeastern Utah in 1859. Macomb and geologist Newberry of the expedition were the first to describe and sketch the geographic features. The Hayden Survey (1874-1876) published the first map depicting the geographic, archaeological and geological features of southeastern Utah, including key archaeological sites on “Epson Creek,” now known as Comb Wash. This map also named several other major tributaries of the San Juan River (Gregory, 1938). In 1884, P. Holman mapped additional topographic features and established the current names for Butler and Comb Wash (Gregory, 1938).

E. L. Goodridge and W. E. Mendenhall conducted additional mineral and oil explorations between 1894 and 1895. In 1910, 1915,1925 and from 1927-1929 H. E. Gregory (1938) conducted reconnaissance and geologic mapping of the southeastern portion of Utah. He hoped to gain information on unmapped portions of the Colorado Plateau, to develop a guide for development of lands bordering Glen Canyon and to create a basis for comparative regional studies in stratigraphy, physiography and structure of the region by mapping and interpreting geologic events. Sears (1956) added to Gregory’s study through detailed geologic mapping of Comb Ridge at a larger scale (1:62 500) than Gregory’s initial study (1:380 000). In the early 1980’s R. Hereford examined recent changes in floodplain alluvium and geomorphology in Comb Wash (Hereford, 1987).

## METHODS

This map was produced using 1:36,000-scale aerial photographs (1995). Many of the Quaternary alluvial deposits have similar lithology but different geomorphic and vegetation characteristics that are recognizable on aerial photographs. Photogeology was mapped on mylar overlays and transferred to stable topographic base maps at a 1:12,000 scale using a zoom transfer scope. Relative ages of Quaternary deposits were determined by stratigraphic and geomorphic position, soil development and surficial archaeological material. Geomorphic cross-sections were constructed using a Topcon total station that helped provide relative geomorphic position of fluvial terraces and channel morphology (Appendix A). Numerical ages were determined using radiocarbon analysis (Table 1) on in situ organic material and by dendrochronology (Table 2) of cottonwood and tamarisk.

Table 1. Radiocarbon dates obtained for lower Comb Wash. Material sampled is charcoal unless otherwise indicated. Radiocarbon ages corrected using CALIB HTML version 4.2 (Stuiver and Reimer, 1993).

| Sample # | Terrace | Stratigraphic location | $^{14}C$ Age | 1 σ | Calibrated Age (BP[5])[6] | Standard Deviation[7] | Calendar Age (A.D./B.C.) |
|---|---|---|---|---|---|---|---|
| CWR1b[1] | bct | CWP5-3 (Figure28) | 1,175 | 55 | 1,100 | 80 | A.D. 840 |
| CWR2[2] | t2 | CWP1-7 | 9,745 | 80 | 11,100 | 170 | B.C. 9,000 |
| CWR5 | t1 | CWP6-12 (Figure 23) | 11,110 | 440 | 13,100 | 700 | B.C. 11,000 |
| CWR8 | t3 | CWP7-6 (Figure 26) | 2,500 | 60 | 2,600 | 130 | A.D. 190 |
| CWR9[3] | t2 | n/a | 1,350 | 40 | 1,280 | 20 | A.D. 670 |
| CWR10[4] | t2 | n/a | 1,270 | 40 | 1,220 | 40 | A.D. 730 |
| CWR11 | t2 | n/a | 490 | 40 | 520 | 10 | A.D. 1430 |
| CWR12 | t1 | CWP6-13 (Figure 23) | 9,360 | 50 | 10,600 | 80 | 8600 B.C. |
| CWR13 | t3 | CWP10-15 (Figure 26) | 600 | 40 | 600 | 40 | A.D. 1350 |
| CWR14 | t3 | CWP10-14 (Figure 26) | 650 | 40 | 610 | 50 | A.D. 1340 |
| CWR15 | t3 | CWP10-14 (Figure 26) | 810 | 40 | 710 | 30 | A.D. 1240 |
| CWR16 | t3 | CWP10-16 (Figure 26) | 860 | 50 | 800 | 90 | A.D. 1150 |
| CWR18 | t3 | CWP10-20 (Figure 26) | 830 | 40 | 730 | 20 | A.D. 1220 |

[1]sample b taken after cleaning off face of profile
[2]mollusc shells
[3]charcoal from bottom of cultural layer
[4]charcoal from top of cultural layer
[5]BP=Before Physics (A.D. 1950)
[6]midpoint of age range at 1 σ
[7]calculated using half the calibrated age range at the 1 sigma level

Table 3. Dendrochronologic dates obtained for lower Comb Wash.

| Sample # | Species | Radius (cm) | Sample length (cm) | Number of rings counted | Total number of rings[1] | Germination date (A.D.) | Geomorphic position |
|---|---|---|---|---|---|---|---|
| CWD1 | *Artemesia tridentata* | 6 | n/a | 41 | 41 | 1957 | t3 |
| CWD2 | *Populus fremontii* | 29.8 | 28.5 | 83 | 87 | 1912 | bct |
| CWD3 | *Populus fremontii* | 64.0 | 25.8 | 74 | 184 | 1815 | bct |
| CWD4 | *Populus fremontii* | 61.4 | 27.5 | 82 | 183 | 1816 | bct |
| CWD5 | *Populus fremontii* | 29.0 | 20.3 | 58 | 83 | 1916 | bct |
| CWD6 | *Populus fremontii* | 29.6 | 28.5 | 75 | 78 | 1921 | bct |
| CWD7 | *Populus fremontii* | 21.4 | 29 | 54 | 54 | 1945 | ta |
| CWD8 | *Populus fremontii* | 65 | n/a | 120 | | 1880 | bct |
| CWD9 | *Populus fremontii* | 41.8 | 28 | 72 | 107 | 1892 | bct |
| CWD10 | *Populus fremontii* | 25.5 | 28 | 44 | 44 | 1955 | ta |
| CWD11 | *Populus fremontii* | 39.3 | 28.7 | 95 | 130 | 1870 | bct |
| CWD12 | *Populus fremontii* | 39.0 | 25 | 76 | 119 | 1881 | bct |
| CWD13 | *Populus fremontii* | 62.4 | 26.5 | | Poor | Preservation | bct |
| CWD14 | *Populus fremontii* | 69.1 | 26 | | Poor | Preservation | bct |
| CWD15 | *Populus fremontii* | 18.0 | 32.5 | 40 | 40 | 1961 | ta |
| CWD16 | *Populus fremontii* | 24.4 | 31.5 | | Poor | Preservation | ta |
| CWD17 | *Tamarix ramosissima* | 1.5 | n/a | 8 | 8 | 1993 | ta |
| CWD18 | *Tamarix ramosissima* | 2 | n/a | 13 | 13 | 1988 | ta |

[1]For *Populus* samples that did not contain the complete radius, number of rings per centimeter were calculated and number of rings in the missing segment extrapolated to estimate the total number of rings. The germination date on these samples is therefore only an estimate.

## GENERAL GEOLOGIC SETTING

Comb Wash flows south along the easternmost boundary of the Monument Upwarp and the western edge of the Blanding Basin Physiographic Province. The Monument Upwarp formed during late Cretaceous through early Tertiary Laramide Orogeny event and is generally characterized by a broad, nearly flat topped anticline that has a gentle westward slope, a steeper eastward slope and fairly moderate slopes at its northern and southern ends (Gregory, 1938). The eastern boundary of the Monument Upwarp is defined by the east-dipping Comb Monocline which extends along a north to south trend over 161 km. Comb Wash downcut through the strata of the Comb Monocline, forming cliffs as much as 300 m high on the eastern bank that formed and isolating Comb Ridge from the rest of the upwarp by cutting laterally across the easterly dipping slopes as it cut down through softer rocks until reaching the more resistant Cedar Mesa Sandstone member (Gregory, 1938; Sears, 1956). The course of Comb Wash is predominantly controlled by the strike of the Comb Monocline and underlying bedrock.

## PALEOZOIC AND MESOZOIC SEDIMENTARY ROCKS

Bedrock in Comb Wash range in age from the Pennsylvanian Halgaito Shale to the lower Jurassic Navajo Sandstone of the Glen Canyon Group, which forms Comb Ridge. The three lower units of the Cutler Group are well represented in the study area. The Halgaito Shale crops out near Road Canyon, Fish Creek and Dry Wash (Figure 1). In Comb Wash, the Halgaito shale is primarily composed of alternating hard and soft thin-bedded sandstone and alternating thin beds of red siltstones and mudstones (Sears, 1956). Overlying the Halgaito Shale is the Cedar Mesa Sandstone, a thick-bedded, massive gray and buff sandstone with thinner layers of sandstone and clay. The Cedar Mesa Sandstone flanks Comb Wash to the west, along the edge of Cedar Mesa. Overlying the Cedar Mesa Sandstone is the Organ Rock Shale. This unit is a weak, reddish brown sandstone and shale with grey-green mottled bedding that tends to weather into slopes “broken by steplike thin harder ledges” (Sears, 1956:188). The Triassic Moenkopi Formation unconformably overlies the Cutler Group and consists predominantly of steeply dipping “chocolate brown” shales and fine-grained sandstones that are easily eroded. The Moenkopi Formation is overlain by thick (> 15 m) deposits of late Quaternary alluvium throughout the study area with exposures along Comb Wash. The Chinle Formation (upper Triassic) is exposed at the base of Comb Ridge on the eastern side of Comb Wash. The Chinle is easily eroded, consisting of light colored mudstone, siltstone and sandstone. Exposures of the Chinle Formation are often obscured by overlying alluvial and colluvial deposits. Above the Chinle Formation on the east side of Comb Wash is the Kayenta Formation (Jurassic) overlain by Navajo Sandstone (Jurassic), which forms Comb Ridge.

## QUATERNARY SEDIMENTARY DEPOSITS

Late Quaternary surficial deposits are widely distributed throughout the study area and were the focus of this study, which include terrace gravel and sand, eolian deposited sand and colluvium. Stratigraphic relationships have revealed a sequence of four inset fill terraces and at least one cut-in-fill terrace (Figure 3). Inset terraces are depositional in origin, formed by aggradation, but separated in time by periods of degradation when the stream cut down through the older alluvium. Lower Comb Wash depositional and erosional events are summarized below (Table 3).

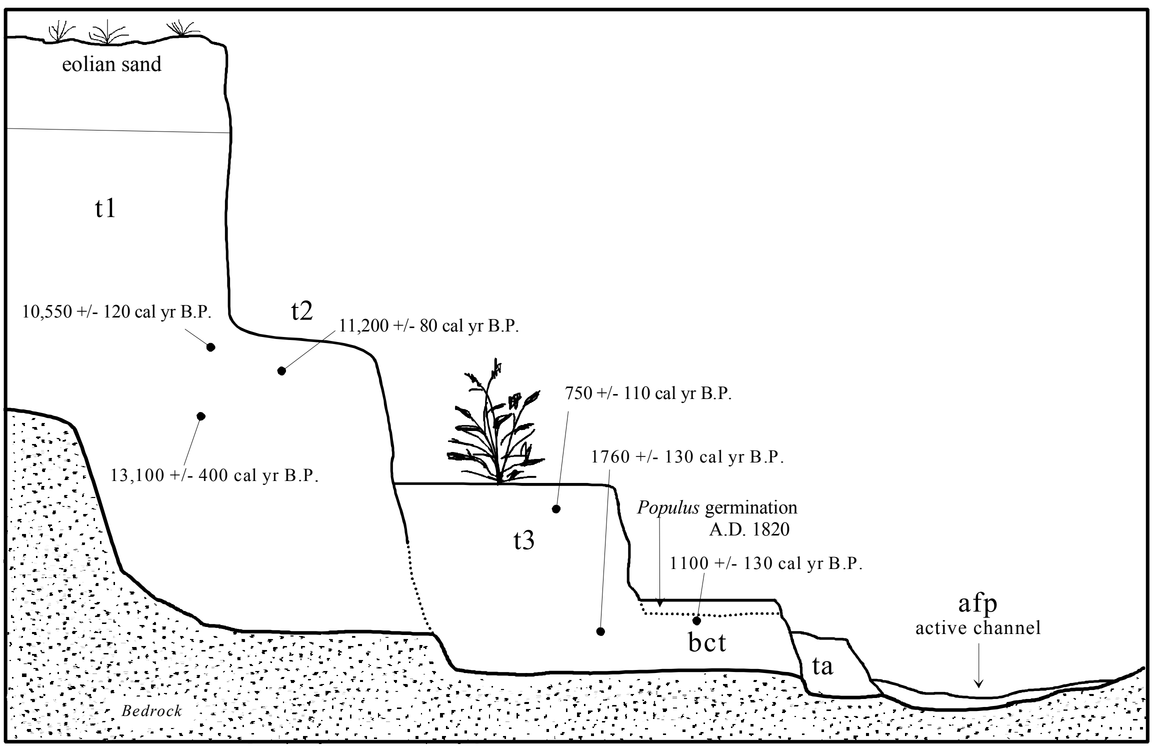


Figure 3. Schematic cross-section showing relationship between terraces and alluvial fill. Dates given in cal yr B.P. were obtained by calibrating radiocarbon ages. Contact dashed where approximate or uncertain. Not to scale.

## SUMMARY OF LATE QUATERNARY EVENTS IN LOWER COMB WASH

*Late Pleistocene*

The latest Pleistocene was a period of alluvial and eolian deposition in lower Comb Wash. Fluvial deposits forming terrace alluvium (t1) began aggrading before 13,000 B.P. Before 13,070 cal yr B.P., the preservation of cross-bedding, fining upward sequences and moderate to poor sorting of deposits indicate that fluvial deposition was dominant. The date of 13,070 cal yr B.P. was from charcoal in a 10 cm thick clay deposit. This clay contains little silt (based on a "taste test") and probably represents a period cienega development due to a higher water table.

Table 3. Generalized sequence of late Quaternary events in lower Comb Wash.

| Event | Timing |
|---|---|
| Erosion of bedrock underlying t1 alluvium | Late Pleistocene |
| Deposition of t1 fluvial deposits | Before 13,070 B.P. |
| Cienega deposit | 13,070 B.P. |
| Deposition of t1 eolian material 1 | began after 13,070 B.P. |
| Deposition of t1 fluvial | 10,550 B.P. |
| Deposition of t1 eolian material 2 | After 10,550 B.P. |
| t1 erosion to form t2 | Early Holocene |
| t2 erosion | Early to mid Holocene |
| t3 deposition | Before A.D. 100 |
| Establishment of prehistoric roads | Between A.D. 1100 and 1200 |
| Stability of t3 Surface | A.D. 1300 |
| t3 erosion | After A.D. 1300 |
| bct deposition | Before A.D. 1800. |
| Stability of bct surface | A.D. 1820 |
| bct erosion | A.D. 1900 |
| ta deposition | A.D. 1940 |
| ta erosion | A.D. 1980 |

After the cienega forming period, the deposition of weakly cross-bedded light brown sand began. This sediment probably represents a period of deposition, which corresponds temporally to the Midwestern "Folsom Drought" from 13,000 cal yr B.P. to 11, 600 cal yr B.P. (Holliday, 2000). Eolian deposition ended shortly before 11,100 cal yr B.P. based on radiocarbon analysis of snails in sediment overlying the eolian deposit. By 10,550 cal yr B.P. fluvial deposition continued with an increase in overbank deposits. Eolian deposition was renewed at the end of the Pleistocene. The upper eolian unit is more loosely consolidated with less pedogenic carbonate development, indicating that it is much younger than the lower eolian unit. Eolian activity on the t1 surface probably ended before prehistoric occupation, definitely by

A.D. 1100 since most surficial archaeological sites range in age from BM II to PIII, with PII and PIII sites most common.

Pleistocene lower Comb Wash may have had more a perennial water flow than at present, as indicated by cienega deposits found near Fish Creek and again near Road Canyon (Figure 1). This suggests that Pleistocene precipitation was greater than present with a lower occurrence of high frequency events. A lack of buried soil horizons in the t1 sediment suggests that depositional hiatuses between 13,000 B.P. and 10,000 B.P. were insufficient to allow for soil development.

*Early to Middle Holocene*

At least one period of early to middle Holocene erosion is preserved by the t1 and t2 terrace scarps. During formation of t2, Comb Wash cut down through about 5 to 8 m of alluvium. Terrace t1 formed as the result of 15 to 25 m of downcutting throughout the Holocene.

*Late Holocene*

The youngest episode of deposition began before A.D. 100. Terrace t3 is the remnant of the prehistoric floodplain deposited predominantly by a lateral accretion of sediment. Floods were again frequent based on the large number of fining-upward sequences. A buried soil horizon 4.5 m above the base of the profile suggests a depositional hiatus and period of surface stability for a substantial length of time. However, the timing of this event is poorly constrained due to radiocarbon dating discrepancies. During deposition of t3 alluvium, Anasazi occupation and use of Comb Wash also increased as evinced by the increase in Basketmaker II through Pueblo III sites. Crops of maize, beans and squash were planted on the floodplain. This suggests that water was sufficient to allow for floodwater farming, and that flood frequency was low and the growing season long enough to allow successful agriculture (Matson, 1991; Petersen, 1994). Deposition ended after A.D. 1300, coinciding with Anasazi migration and abandonment of the Four Corners area. Terrace t3 was formed shortly after the Anasazi migration, with renewed and probably rapid channel incision.

Deposition of bct sediment began before A.D. 1800, possibly as early as A.D. 1400, coincident with the beginning of the Little Ice Age (A.D. 1400-1880; Petersen, 1994). A lack of soil formation into and noncohesive nature of bct alluvium confirm the youthfulness of these deposits. bct deposits are slightly coarser than t3 deposits with fewer fining-upward sequences, suggesting a decrease in flood frequency and an increase in sediment deposition by vertical accretion (Leopold *et al*., 1992). By A.D. 1820, the surface had stabilized enough to allow the germination of cottonwood (Table 2). Deposition continued through the late 1800's, ending before A.D. 1920 based on the latest cottonwood germination date. Terrace bct developed as Comb Wash incised, concurrent with regional arroyo formation (e.g. Cooke and Reeves, 1976).

Modern floodplain deposition (ta) began after A.D. 1940, based on cottonwood and tamarisk dendrochronology. These deposits are generally coarser than those of bct or t3, indicating an increase in channel deposition over floodplain deposition.

## DESCRIPTION OF MAP UNITS

LATE QUATERNARY SEDIMENTARY DEPOSITS

af — **Alluvial fan deposits (post 1980?)** -- Roughly fan-shaped at base of steep cliffs of bedrock or Pleistocene alluvial deposits of poorly sorted, angular gravel and coarse sand. Overlies tamarisk terrace alluvium and modern alluvium. Less than 1 m thick

colluvium — **Colluvium (middle Holocene to present)**--Include poorly sorted angular cobbles of sandstone, chert and limestone interbedded with fine to medium sand. Overlies terrace 1 (t1) alluvium and bedrock. Sheetwash dominant depositional process. Mapped where thickness exceeds 2 m

afp — **Active floodplain and pointbar deposits (1980 to present)--**Interbedded gravel, sand, silt and clay. Thickness, 1 to 2 m ta **Tamarisk terrace (A.D. 1945-1980)**--Interbedded sand, silt and clay with basal gravel layer about 0.25 m thick. Upper horizons lack pedogenic calcium carbonate. Forms terraces 1.5 to 2 m above modern stream channel

mct **Medium cottonwood terrace (A.D. before 1820-1900?)**--Interbedded fine sand, silt and clay. Forms terraces 3 m above modern stream channel

bct **Big cottonwood terrace (before A.D. 1820-1900)**--Interbedded fine sand, silt and clay. Sand and silt often cross-bedded. Some pedogenic calcium carbonate. Distinguished from terrace 3 (t3) alluvium by presence of large cottonwood trees. Forms terrace 3 to 4 m above modern stream channel

t3 **Terrace 3 (before A.D. 100-1300)**--Interbedded sand, silt and clay; includes basal gravel overlying Cutler Group. Sand and silt layers are often cross-bedded. Calcium carbonate stage I+, nodules and filaments present, but small. Forms terrace 6 to 8 m above modern stream channel

t2 **Terrace 2 (early to middle Holocene)**--Erosional terrace cut into t1 alluvium, no sediment deposited

t1 **Terrace 1 (before 13,000 to 10,000 B.P.)**--Interbedded sand, silt and clay. Unconsolidated poorly sorted. Calcium carbonate stage II+. Includes cross-bedded units. Upper 4 m consist of massive, very fine sand and silt of probable eolian origin. Forms terraces 20-25 m above modern channel

## PALEOZOIC AND MESOZOIC SEDIMENTARY ROCKS

a f Eo **Chinle Formation (Upper Triassic)**--Brown-gray and orange-red sandstones, light-greenish clay and whitish to lavender calcareous mudstone and gray thin limestone. Shinarump conglomerate was not observed by the author or Sears (1956). Estimated thickness 290 m (Gregory, 1938; Sears, 1956)

a p Eo **Moenkopi Formation (Lower Triassic)**--Composed of chocolate-brown and brownish-red fine to medium-grained calcareous sandstone, siltstone and shale. Ripple marked. Greenish-gray and white bleached spots occur on occasion. Unit overlain by thick layers of Terrace 1 (t1) alluvium. Mapped where overlying alluvium and colluvium were less than 2 m thick. Thickness 60 m (Sears, 1956)

Pco **Organ Rock Shale of the Cutler Group (Permian)**--Middle member of the Cutler Formation. Brownish-red and orange-red calcareous sandy mudstone and fine-grained sandstones. Grayish-green mottling occurs in patches, spots and "stringers." Overlain by thick layers of Quaternary alluvium. Thin exposures are common near Comb Wash channel. About 180 m in study area (Sears, 1956)

## ACKNOWLEDGEMENTS

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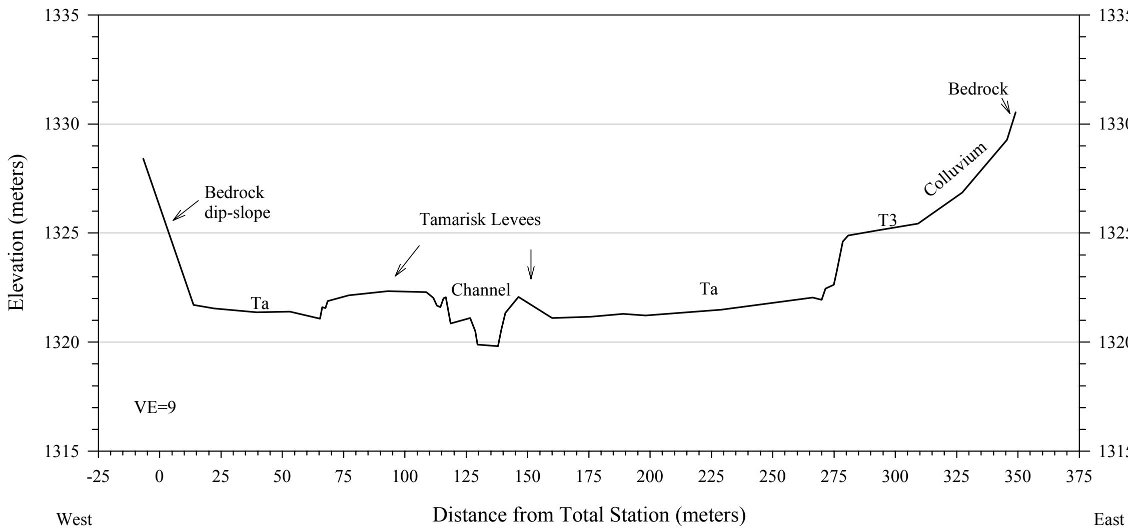
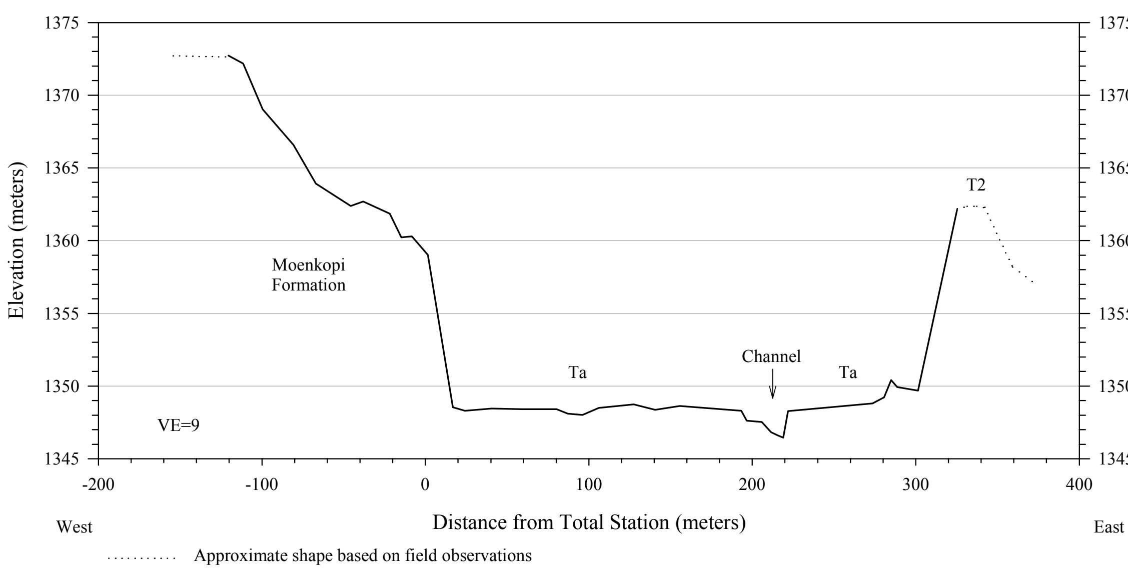
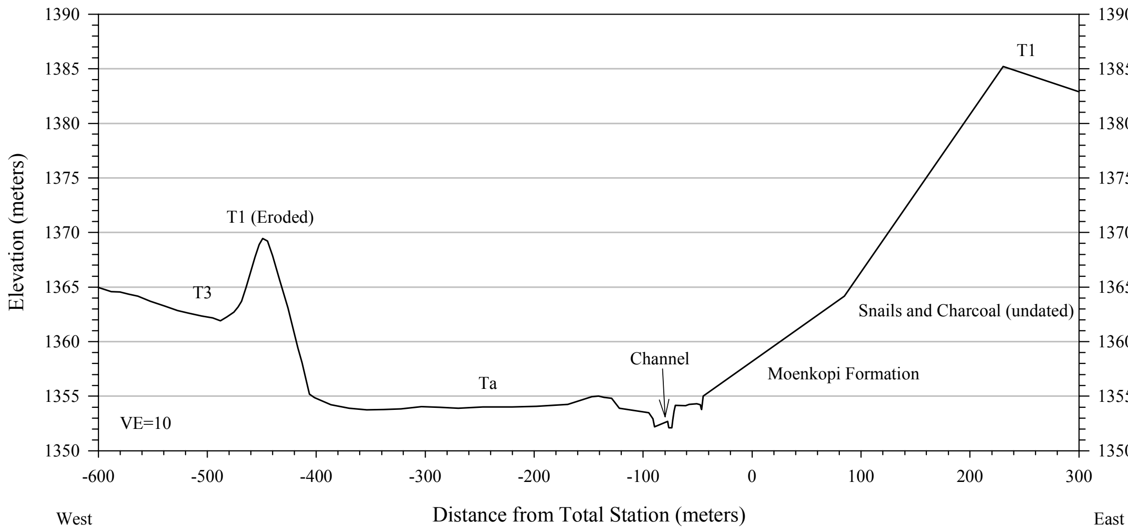
# APPENDIX A
# GEOMORPHIC CROSS SECTIONS OF LOWER COMB WASH


1335
1330
1325
1320
1315
Elevation (meters)
Bedrock
Bedrock
dip-slope
Tamarisk Levees
Channel
Ta
Ta
T3
Colluvium
VE=9
-25
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
West
Distance from Total Station (meters)
East

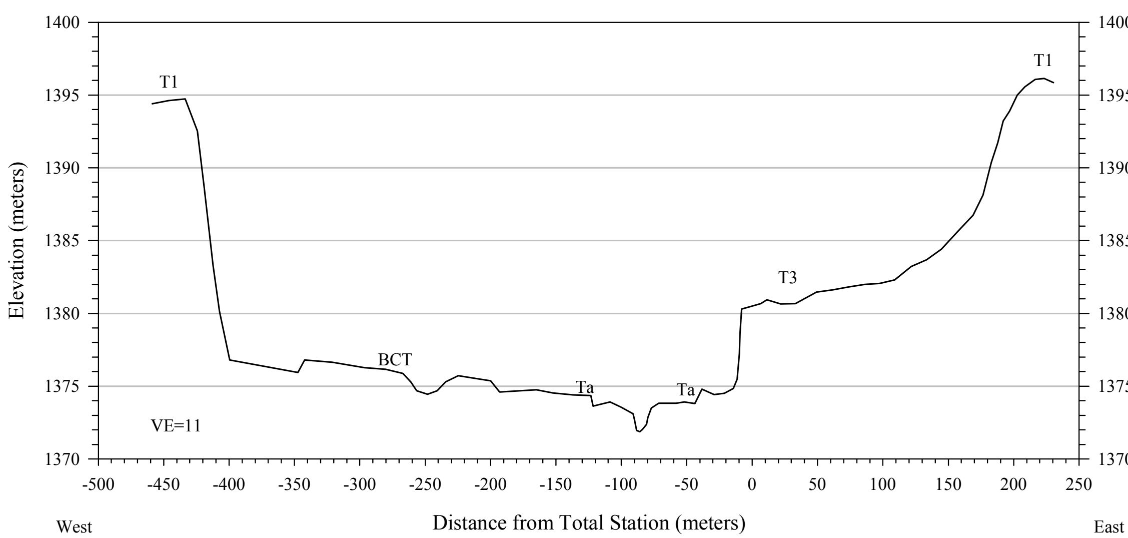
**CWX1**


1375
1370
1365
1360
1355
1350
1345
Elevation (meters)
Moenkopi
Formation
T2
Channel
Ta
Ta
VE=9
-200
-100
0
100
200
300
400
West
Distance from Total Station (meters)
East
Approximate shape based on field observations

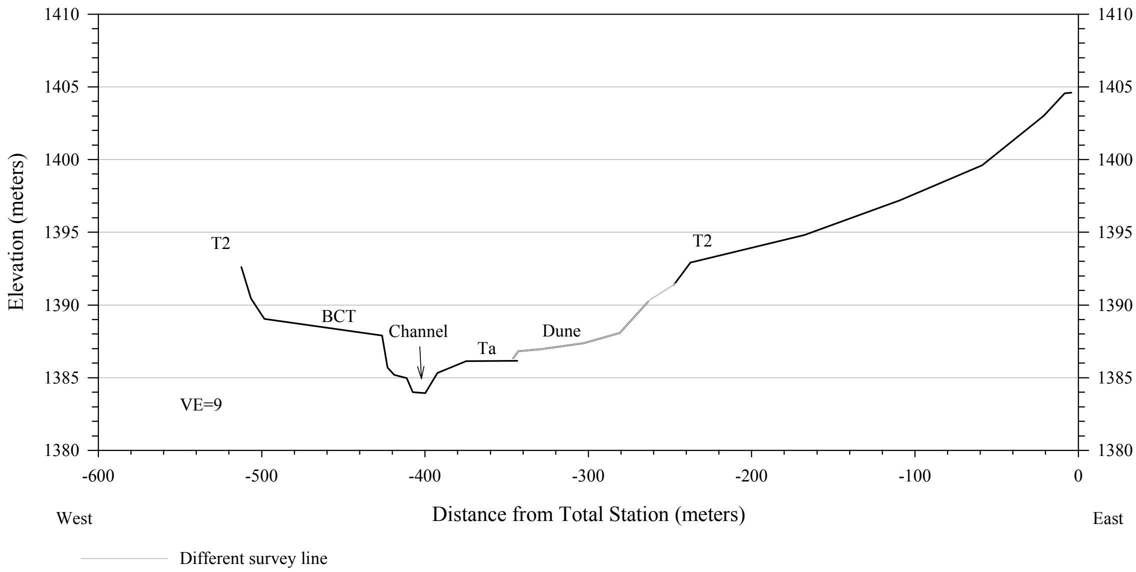
**CWX2**


T1
T1 (Eroded)
T3
Snails and Charcoal (undated)
Channel
Ta
Moenkopi Formation
VE=10
Elevation (meters)
Distance from Total Station (meters)
West
East

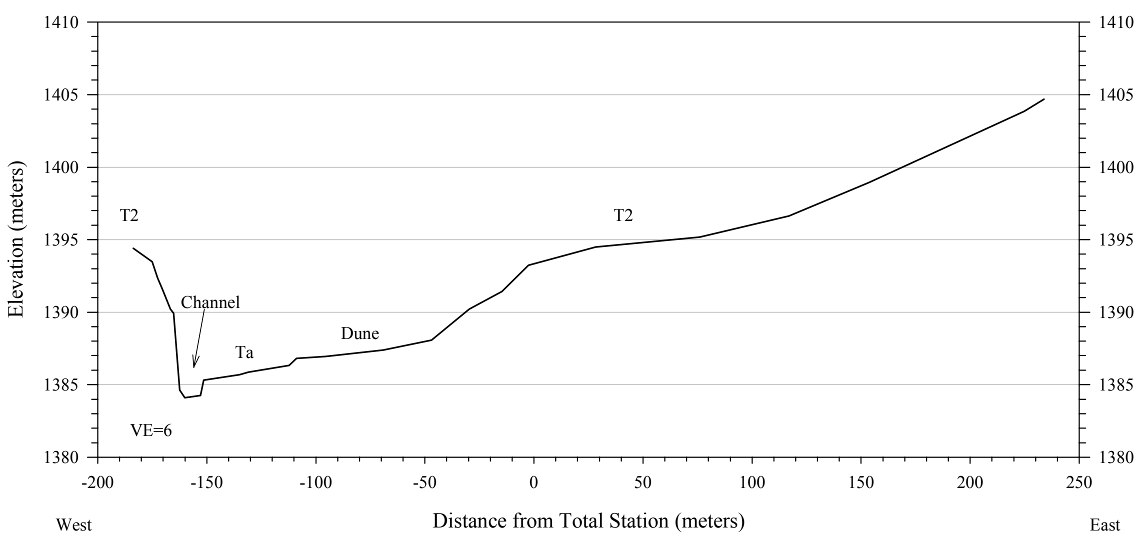
**CWX3**


T1
T1
T3
BCT
Ta
Ta
VE=11
Elevation (meters)
Distance from Total Station (meters)
West
East

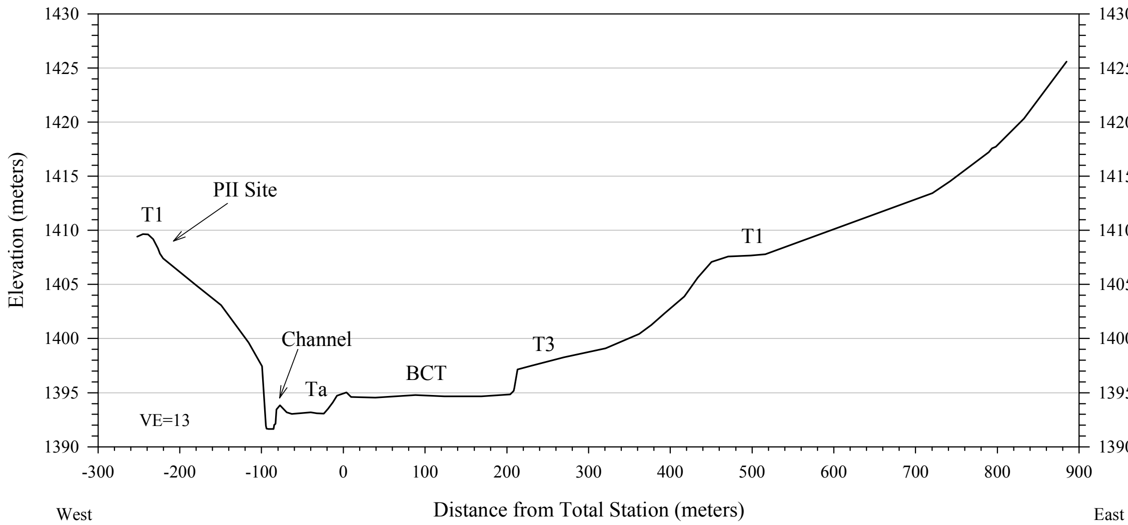
**CWX4**


Elevation (meters)
Distance from Total Station (meters)
West
East
T2
BCT
Channel
Ta
Dune
T2
VE=9
Different survey line

**CWX5**

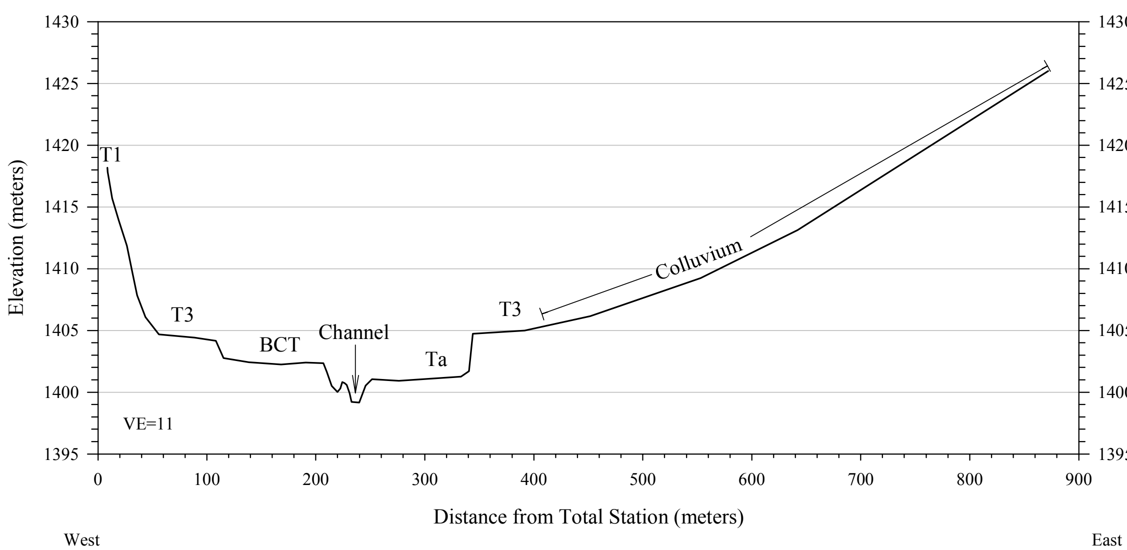

Elevation (meters)
Distance from Total Station (meters)
West
East
T2
Channel
Ta
Dune
T2
VE=6

**CWX6**



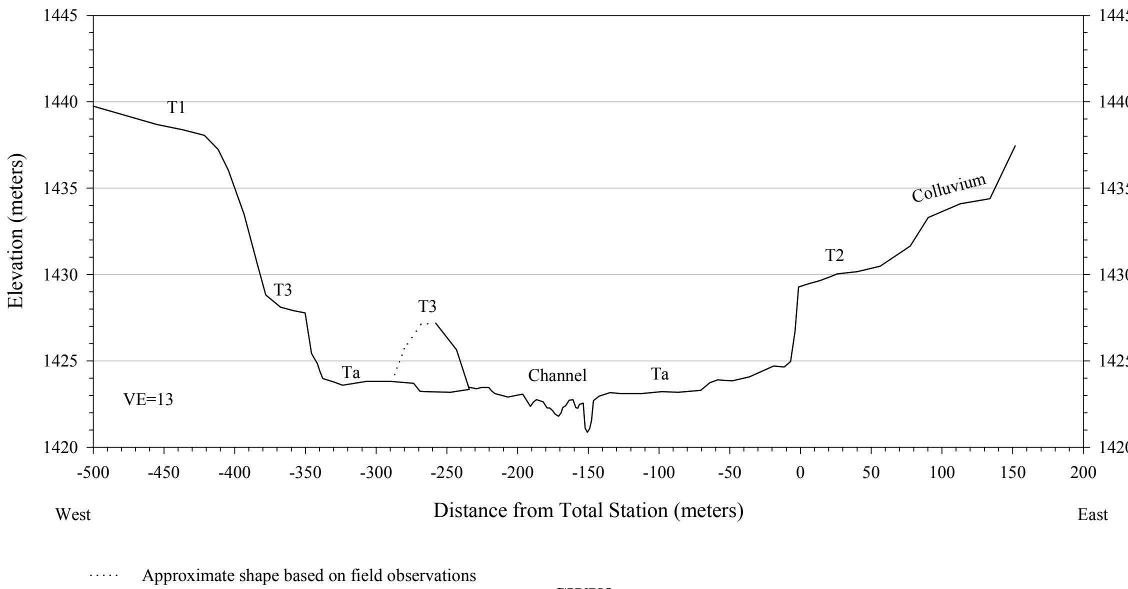
Elevation (meters)
T1
PII Site
Channel
Ta
BCT
T3
T1
VE=13
Distance from Total Station (meters)
West
East


**CWX7**



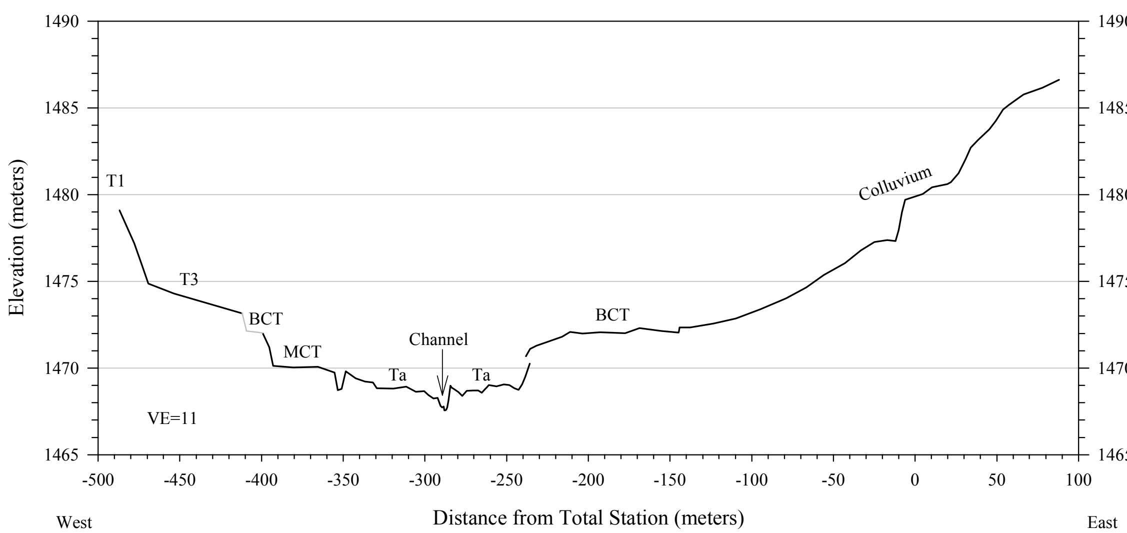
Elevation (meters)
T1
T3
BCT
Channel
Ta
T3
Colluvium
VE=11
Distance from Total Station (meters)
West
East


**CWX8**



1445
1440
1435
1430
1425
1420
Elevation (meters)
T1
T3
T3
Ta
Channel
Ta
T2
Colluvium
VE=13
-500
-450
-400
-350
-300
-250
-200
-150
-100
-50
0
50
100
150
200
West
Distance from Total Station (meters)
East
Approximate shape based on field observations


**CWX9**



1490
1485
1480
1475
1470
1465
Elevation (meters)
T1
T3
BCT
MCT
Channel
Ta
Ta
BCT
Colluvium
VE=11
-500
-450
-400
-350
-300
-250
-200
-150
-100
-50
0
50
100
West
Distance from Total Station (meters)
East


**CWX10**