1995

Pazzaglia Field Notebook: 8/95 - 7/98; OLY '97; Alb Basin; Alamogordo; Field Camp; OLY 4 and NM

Frank J. Pazzaglia

SOKKIA™ F. J. Pazzaglia

TRANSIT FIELD BOOK

8/95 →
7/98

OLY 97

NM [Alb basin
Alamogordo
Field Camp

OLY 4 and
NM

No. 8152-00

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uuu

INDEX

PETER WILKINSON
SURFACE WATER QUALITY BUREAU
NMED
P.O. BOX 26110
SANTA FE, NM 87503

Willie Lane w EPA

DONNA STORCH - CARSON NF
208 CRUZ ALTA RD
TAOS NM 87571

$\frac{7''}{1500\,m} = \frac{x''}{250\,m}$

$\frac{0.6''}{250\,m} = \frac{3.5''}{}$

$x = 1500\,m$

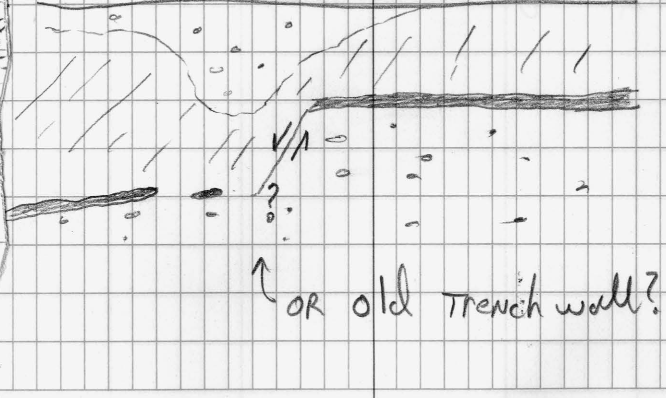
Oct 3RD, Tuesday, 1995

SUNNY, WARM
calm

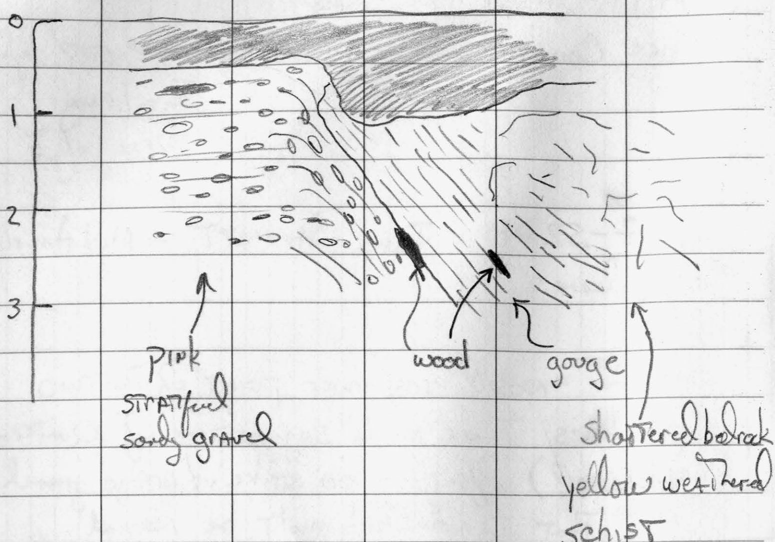
Field morning at King Ranch Pipeline exposure
RT. 14 - Sandia Park Quad.
Price Constitution - Bernalillo 2ND stop light
Thriftway
Turn left

Jim Barnett - Mid America
Pipeline.

At the exposed cross-over point of the two
pipelines there is the suggestion of Quaternary
(Holocene?) offset. - on strike w/ Arroyo gravel
offset that I now think might be Normal
South facing pit exposure.



North wall - right at pipe junction



Sample of "charcoal" or wood 95-1-103

10/17/95 Tuesday warm, clear, breezy.

In field, Sandia Park Quad w/ Karl, Charles, + Mike.

- Reasonably good evidence for a Laramide Reverse fault, reactivated as a normal fault through the La Madera area. Trend ~ 140°

10/24/95 cool, clear

SANDIA PARK Field w/ TOM BARONE.

- AREA NORTH of FROST ARROYO + SAN PEDRO ARROYO TODAY.

95-1-1024 BR exposure, FROST Rd. 240 55°NW Pa-Pm
265 20° NW Trc

95-2-1024 Pg -140 38° SW
Above 6900' - Qfo! L.S. clast-mottled "bird-foot" float - stratified med-fine brn sand w/ poorly-stratified L.S. gravel - sub ang. clasts. STAGE III $CaCO_3$.

95-3-1024 Pa 240 66° NW

10/25/95 warm, clear 13

SANDIA PARK Field w/ TOM BYRONE.

Km? east of Todilto Church on RT 14 070 54°SE
in Arroyo SAN ANTONIO - ~2-3m of dark
Holocene Alluvium over K bedrock.
TRACE of Tijeras fault?

downstream Km - 045 - 90°
Kmgh - 040 46°SE

95-1-1025 VALLECITOS ESTATES South of Frost Road
- shaly portions of Pm make Thick
residual soils - 1m Thick Bt horizon
underlain by STAGE III + $CaCO_3$ -
~1m Thick.

Pm 050 10°SE

95-2-1025 Psa 135° 25° SW San Pedro Spring.
Spring in San Pedro Creek
There are no less than 3 fill sequences
- all fine grained - in The San Pedro
Arroyo

Higher ridges east of San Pedro spring mantled w/ Qfy1 - pЄ clast fans. V. angular

95-3-1025 San Pedro Estates - Nice Qty along west side of San Pedro creek - pЄ + IPm clasts - subangular 3-5 m thick max.

95-4-1025 at end of "cowboy road" northern extent of map - pf arroyo
Qpf is all IPm clasts,
Qty is both IPm + pЄ clasts; Airphotos will discern some inset strains at lower elev. in arroyos.
Base of Qpf + Qty is very planar.
- looks like a buried pediment

Jemez Pueblo Land 3/12/96

Water survey - Zia SS

East of Pueblo - Jemez Pueblo Quad T16N, R2E

① fault - 300° 29° NE Section 26

② fault ~320° down to the SW

~3.1m offset.

West of the Cañada fault, we are lower in the Zia section - two very prominent opaline-carbonate beds cap the mesa. These are offset by the NW trending X-fault

Beds west of the Cañada dip off to the S + SW, ~10-30°

East of Cañada fault - beds dip to north and east - unknown stratigraphic separation.

③ 350° 19° NE

④ walking east - next amphitheater - abrupt transition to a massive gray S.S. - is this the lower gray member? If so there is a huge! fault

- if not - maybe we are looking at the upper gray.

⑤ 005 28° E - upper 85' thick reddish gray sand w/ 2' thick cemented ss beds.

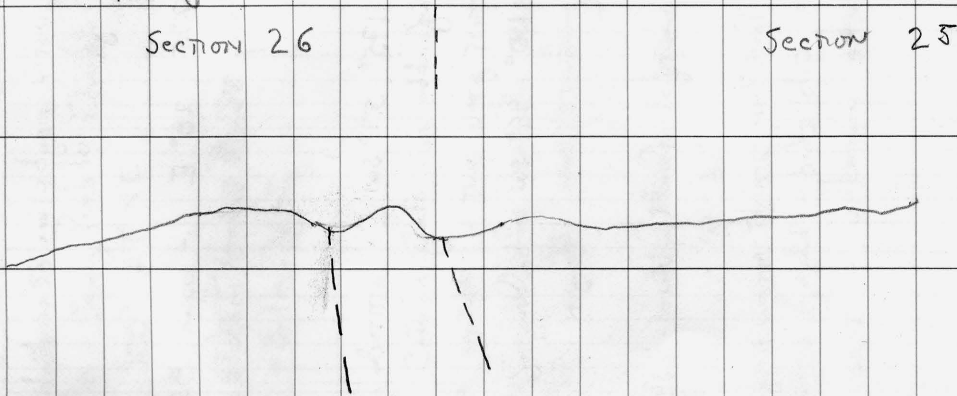
⑥ 175° 59° SW - attitude of small, curved fault.

⑦ 150° 46° SW - bedding of Tz - Tsf marker horizon.

⑧ beautiful fault plane - 345 60° sw dipslip

⑨ fault? in straight-arrow arroyo 340° 50° NE

View looking N



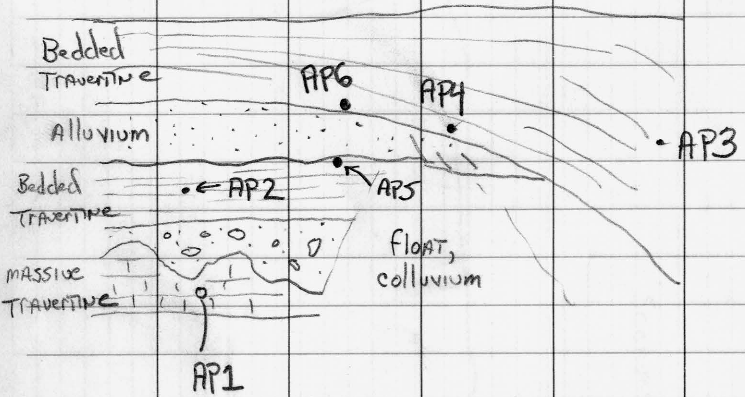
Saturday, May 4th 1996

Warm, sunny, slight breeze.

Field Trip for Caswell Silver Celebration
w/ ML, Lee, Field Group

Arroyo Penasco Drainage - Pajarito Fault outcrop.

- collected four travertine samples for U-series analysis...



Saturday, May 18th 1996 — partly cloudy, warm, breezy.

- Red River w/ M.L.
- Tony Woerndle Park, south side of town. We will begin a hike from here, up the ski lift trails to the Placer Creek drainage - looking for upland gravels of Lipman.

Upland gravels do outcrop - on float only - at the top of the ski lifts. Nice rounded gravels - a mix of vein qtz, granite, volcanics, + rare gneiss + k ss.?. Sizes range from 5 cm to 1 m. Found at elevations from ~ 9600 to 10200'. Nothing compelling as to why these are not glacial deposits.

← see insert (A)

- Bobcat pass Tsc - conglomeratic facies of Lipman - This deposit, in the road cut is very different than the upland gravels above Red River.
  - Ang. qtz fanglomerate
  - "grussy" matrix
  - v. well-developed + thick (>2m) red weathering profile.

Ⓐ Red, well-weathered, colluvial DIAMICTON exposed ~ 9600-9800' - ski lift Access road - see map. Well-rounded clasts in a red matrix - looks like a very old (>l. Pleistocene) colluvium. ~3m thick, overlies light-colored, weathered BR and is overlain by a gray, Holocene colluvium w/ roundstones.

- Moreno Valley - No less than 4 major geomorphic surfaces.
  - They are pediments with irregular straths, mantled w/ 1 to 5? m of gravel
  - Pediments are beheaded from Sangre mountain front - like v. large facets or flatirons.

- Cimmaron Canyon - Nothing! v. steep canyon walls, maybe 1 late Pleist. terrace preserved.

- Ute Park - Preservation of Pleistocene terraces. Tug of Eagle Nest map - has nice exposure + soils just downstream of USGS gaging station - South side of riverbank.

- Cimmaron + Philmont - several terrace levels - up to 4 major geomorphic surfaces. See 1:100,000 maps of Scott. Rather thin alluvial mantles on pediments.

- Springer - Pleistocene terraces of Canadian River. Nothing spectacular.

- Chicosa Lake State Park -
  - could write a book on this place - bats, badgers, cows, no water, no facilities, wind, you name it.
  - Local thick (>3m) Ogallala cover w/ stage V-VI carbonate.

(25)

Sunday, May 19th 1996 overcast, warm breezy.

Friday, July 19th   hot, muggy, bugs suck

Ojito Spring Quad. Map transect for MLFT
BLM wilderness, private land (~sec 12) of SE portion
of quad.

Stratigraphy:
Km
Kdp puate
Kdcm clay mesa
Kdc cubero
Kdoc oak canyon
Jmj
Jmbb
Jmsw
Js
Jt
Je

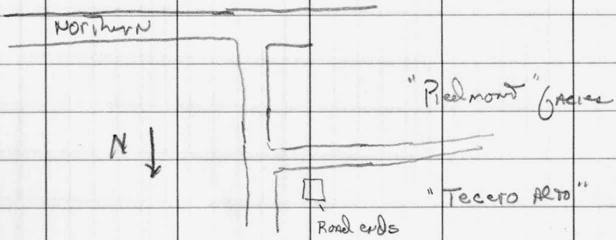
a. SS of the Jmbb 174° 17° SW
b. Archeic (late) site on Jmbb
c. SS of Jmbb 200° 10° W
d. possibly back into the Jmsw - buff SS w/
   1m x-sets. 205° 6° W
e. Jmsw 210° 13° W
f. Jmbb 170° 15° W   - possible N-S fault exposed
   50 m to east

9. Jmsw 165° ↑12° sw

Feb. 25, 1997 cool breezy, partly cloudy.

USGS Loma Machette quad Field Trip

STOP 1 - Just north of Northern Blvd.
Tecero Alto gravels - strath of ancestral Rio Grande - 70-75m above grade covered by 12 m of "piedmont" facies



Pedernal occurs in both Tecero Alto and in Piedmont facies

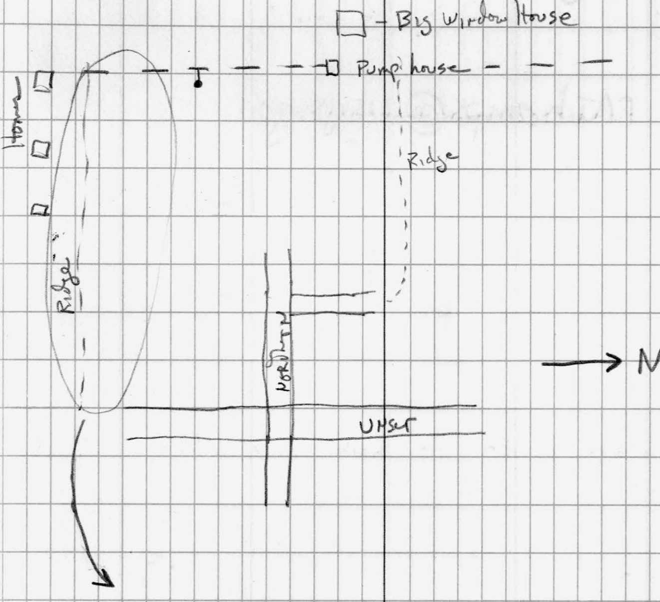
STOP 2 - fault through Santa Fe (upper)
- contains Pumice - maybe Tscoma Dome or San Antonio Mt. Age.

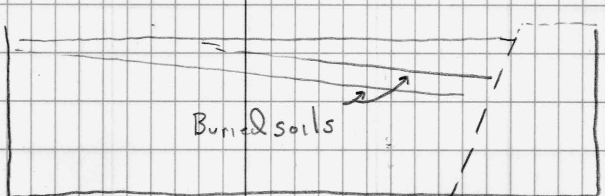
STOP 3 - Loma Colorado de Abajo
- fault in upper Santa Fe - at construction

Site for New School - major E-W road btwn Loma Colorado de Abajo and Arroyo Montoya.

STOP 4 - First Rt off of Northern BLVD west of Unser.

Star Heights fault





STOP 5.- North-central portion of the Quad - Section 12 Upper Santa Fe - capped by Llano? or first inset terrace/pediment.

Mariposa Ranch - owned by Albuquerque Academy - Martin is caretaker.

4/9/97 Ojito Springs w/ ML

cool, breezy, clear

- At Marquez wash - SW part of quad. Starting in K today and walking downsection will try to substantiate the Marquez wash "Fault".

- Start with stop(s) h

h. 140°/15° SW Sandbody of Kd1

i. Fault 195° 60°W offsets Kd1 SS 3-5m

j. at possible projection of i-fault on north side of Bernalitto Arroyo - very difficult to demonstrate offset - lots of intense brecciation and shattering of SS.

June 9, 1997 WArm, sunny SW breeze.

SACrAMENTO Mountain FrONT w/ DAN KONIG
DAN'S M.S. work

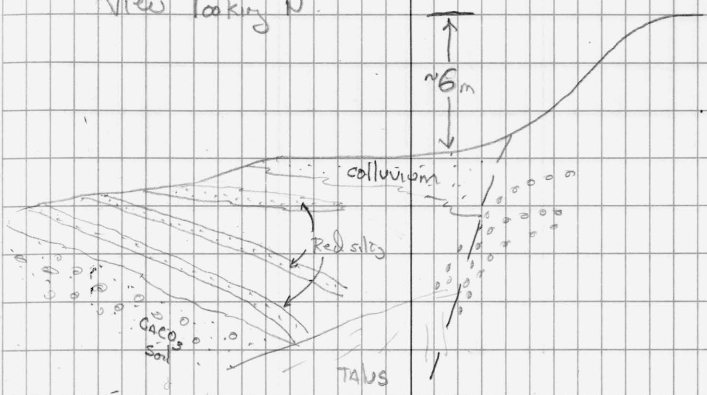
DAN has done A fine job pulling his map together

- 2 Pleistocenee surfaces P1, P2
- 3 Holocene surfaces H1, H2, H_3
- 1 modern surface H_m
- Large Basins / Fans do NOT preserve Pleistocene surfaces well
- medium-siged basins/fans do preserve deposits well
- only compelling evidence for fault offset is of the P1 surface.

Ex: Mule Canyon

• Inset relations @ The MF are reversed downfan as young deposits bury older ones.

Debris Flow Canyon - one canyon S. of Alamo Cny.
(★) Nice exposure of fault scarp in Q1.
View looking N



At least 3 syn-tectonic deposits denoted by the red silty soil horizons

June 16th, 1997

cool, partly cloudy w/ mid-day T-storms

Jemez Pueblo quad mapping w/ Chris Toya

- The plan/goals for the first few days is to cover the west side of the quad, south from Cerrito Negro up to Vallecito Creek.
- We need to find/substantiate a fault that will bring lower Zia Sand to the west up against a well-behaved section of upper Zia Sand in the east.

- Cerrito Negro 5927' - Debris-flow like snout deposit composed of subrounded boulders of Qbt; some clasts are up to 3-4 meters in diameter. The deposit is clast-supported but contains a matrix composed of well rounded, welded Qbt and Qbt pumice with minor Rio Guadalupe rock types. Deposit is ~ 3-5 m thick.

- 1-616 fairly convincing evidence of ~1m, down to the east offset of the base of the QT1 gravels.

- confirmation of N20°E fault N + W of Cerrito Negro in arroyo. This might be the main fault - Down to the SE

• The landscape east of the dump has virtually no exposure of Tz. There is a pervasive, virtually unbroken mantle of eolian sand 1-3 m thick. Sandy alluvium in the wide, shallow arroyo bottoms

June 17th, 1997 · clear, calm, cool morning, warm midday.

· Today we visit three areas
· mesas just south of Jemez-Zia line at Section 35
· "pass" on windmill road
· windmill road arroyo - find the fault!

· 1-617 There is a fault across the east side of the Section 35 mesa. The fault does not appear to have a great deal of offset - several meters? It juxtaposes Tzp against Tzp. Approximately 100-200 m to the east, in a broad valley, occurs the contact with Tzu. (Tzc)
☆ check that. I will map Tzc immediately exposed beneath the Qpl basalt gravels. That means that there is approximately 100' (30m) of down-to-the east offset across this fault zone.

2-617 Very impressive Qal fill in main west flowing arroyo @ the garbage dump. ~8m of fill is exposed. Very little if any Zia Fm is exposed. Several

45

overbank / paleosol? facies exposed in fill.

- 3-617 Beautiful vertical fractures (joints) ~ 70-80cm apart 320° orientation... Still Tz c as far as I can tell...

June 18th, 1997 warm, clear, calm hot midday.

Day 3 of Jemez Pueblo Quad mapping.
STOPS - Windmill Road pass
- Baseball field Arroyo
- Arroyos east of The Pueblo

• 1-618 North baseball field Arroyo - little to no exposure of Tz, but There is a wonderful alluvial stratigraphy exposed... good place to get a C-14 date - much charcoal / organic rich horizons.

• 2-618 Horseshoe spring on major Arroyo east of The Pueblo. Cemented ledge of QT4 gravels 1-2m Thick, Elev ~ 5680'
⊛ On strike with The fault, but no exposure of a fault plane.

June 23rd 1997 Clear, cool, slight breeze. Hot midday.

Today's objective will be the major Arroyo tributary to Rio Vallecito in the NW 1/4 of the quad.
- we will try to find several airphoto "faults" + lineaments.

- 1-623 Tributary to Rio Vallecito - Joel's confusion

Qe 1-2m ; Qt4 3-6m Qp ~1-2m
Qt4 ↓ has distinct, well-developed fine grained medial facies.

- 2-623 Charcoal (Hearth?) site in fine grained Qal overlying Qt5 or in Qt5 itself.

3-623 Charcoal, (Hearth) site in Qal overlying Tzc; At this location, we have passed into Tzc; approximately 200-300 m down-arroyo, I finally found an east-dipping fault with a well-developed red-clay gouge. This is the long-awaited fault that brings up the Tzp to the west.

4-623 Broad flat of Section 13, R2E, T16N - eolian. Beautiful sand sheet w/ well-developed soil. ~0.5m Red Bt; Stage II Bk. Overlying ~8m of fine-grained, locally sandy/gravelly, well-stratified fill.

June 24th, 1997 clear, calm; warm

Borrego Mesa day. Begin @ corral on Km, continue looking for faults on south side of Borrego Mesa and west of Pico Butte.

1-624 Galisteo Fm - Red beds - ss + conglomerate ~2m Thick.

2-624 Qs on ridge - very young. Arch site - lots of tools / points

Tzp - White - sand weathers into distinct badland topo
Tsf - Buff, sand, coarse w/ pebbles, beds of l.s. + silica, red, muddy interbeds.

3-624 Ash! Pumice. Not stratified w/ Tsf or Tz, Rather it is on surface, interbedded w/ surface units including Qs. My guess is that it is Qbt. Another possible outcrop of it lies on the ridge just east of the corral.

- Qp boulders "rest" on a bed of silt / sand ~0.5m Thick.

· The "hydlite" of Borrego Mesa is fine-grained Plag-rich, Qtz-poor. It is not vessicular + coarser-grained compared to the Basalt.

* It is locally vesicular with vesicles filled with pumaceous material.

Bug are like really bad today - excuse poor log entries!

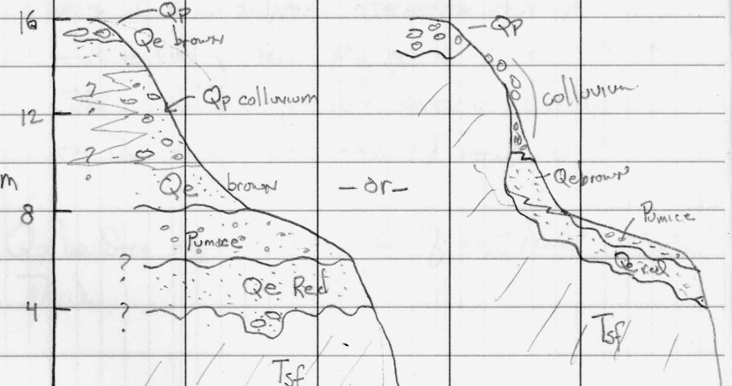
June 25, 1997 mostly clear, cool, breezy. East winds @ ~ 10-15 knots.

Back @ the corral of Pico and Borrego mesa

Three things to do to wrap this mapping up

- check out stratigraphic relationship of ash w/ surficial deposits, then ascend Qp mesa east of Corral to draw in map boundaries.
- Drive road south + east of Corral, check out Qp mesas south of Pico Butte
- return to Pueblo - look for a possible fault in Arroyo Chamisa (section 6) near where road crosses arroyo.

- I-625 Corral ash locality. There is a fine locality of Pumice + Ash - appears to be a bed, but that is unclear, a backhoe trench is necessary.



2-625 Intersection of corral road and Arroyo Chamisa.
Cannot substantiate the fault... but there is
more sandy ash on the mesatop, west side
of arroyo ↑ above the Tzc outcrops.
Qtb

June 26, 1997 — cool, EAST breeze @ ~10 knots; partly cloudy - Aft T-storms

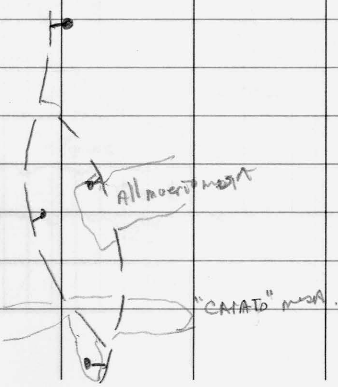
Zia Pueblo land today - Borrego Canyon Road

(1) check out Q fault from "Mangullo" mesa north to Zia / Jemez boundary

(2) Try to find Airphoto faults / lineaments in Tsf exposures at extreme eastern boundary of quad @ Borrego Rd

(3) Recon drive Borrego Canyon Rd into Loma Creston quad.

I have walk the fault from Arroyo Chamisa all the way north to "All muerto" mesa. It is rather well exposed south of "All muerto" mesa, but become obscured in and around the distinct down-to-the west escarpment of "All muerto" mesa. Best explanation is a graben geometry as shown on the map



Generally speaking... as is the case further north on Jemez Land, Tzc is exposed to the east of the fault zone while Tzp is to the west.

1-626 - Excellent location on "Cañato" mesa to show the stratified Qp gravels w/ a soil profile.

- Sample 1-626 Possible Ash in Qs/Qal just north of "All muerto" mesa.

Just missed a 3-foot rattlesnake by ~1 foot!!

- #53 on Tony's map is a rather inaccessible ash locality in Arroyo Chamisa. Definitely in the Tzc, Not in Alluvium. The ash is fine grained, blue-gray in color. It is in a big fluvial channel and mixed w/ heavy minerals + sand; reworked. There appears to be much biotite + hornblende mixed in... could this be an early Jemez ash?
Sample 2-626

· 3-626 Impressive fault, NW strike, down to the west, juxtapose Tzc to west against Tzp to east - likely southern continuation of east graben fault of Pederson. Exposed here in Arroyo "Candela."

June 27, 1997

mostly sunny, cool morn.
warm midday w/ T-storms

In Sky Village NE today.

- start Arroyo Ojito drainage

- This is wide, easily accessable country. Road into Arroyo Ojito is terrible beyond the windmill + corral. Best to park there and walk the arroyo. I could be easily convinced that the contact btwn Tzp and Tzc lies in the exposures immediately SW of the major fork in Arroyo Ojito. Rocks are striking NW, dip to the SW ~ 5-10°.

1-627. at the top of this ridge @ 5820' there are up to 3 m of coarse gravel.

composition: QTZ, SS, granite, gneiss, basalt, tuff, hornblende "tuff", andesite, pedernal chert, petrified wood, Kaz,

The lack of obvious l.s. + chert makes me think this is (a) ancestral Rio Puerco rather than Rio Jemez

(b) reworked from ancestral Rio Puerco deposits in La Ceja to the south.

Sampled on ash 40' below this stop. - changed to cherty-opaline material. Heavily altered.
Same ash appears to be thicker and exposed to the east, across east fork of Arroyo Ojito.
↳ Sample @ 2-627

July 7, 1997 hot, clear, breezy.

Recon of Jemez Pueblo + Sky Village quads w/ Joel, Dan + Raelynn.

Sample 1-71 @ top of Tzp @ 1-627. collected Ash - Distinct horizon ~ 40cm thick. Well exposed to the east, across Arroyo Ojito.

Payless - RT
- Industrial area - cross
- short Rd across tracks
- Frontage Rd
- Blue Roof

J+D Enterprises - Forks

Cindy

Dale Rotter - Clearwater Resources

OLY '97

Jeff Lehrkind →
Bob Meier

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Julie Dieu
Kalaloch R.S.
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Forks, WA 98331

 July 11, 1997 Partly sunny. Breezy.

Begin Olympic fieldwork 1997

· Twenty-six hr drive to Seattle. Went well. Finally arrived at Kalaloch at about 6:30 PM. Met up with Karl and his brother @ Coppermine Bottom. Tomorrow we head out in the canoe to check out some work/stops Karl has already looked at. It has rained hard in the earlier part of the week. But now a ridge of high pressure promises to bring a few days of sun + drier weather.

The water is up! Higher than I have seen it. And it is muddy - the result of many landslides.

July 12, 1997 overcast, cool, calm

River trip today. Karl is making good progress despite the poor weather.

We will put in at upper Clearwater Campground and map down to Coppermine Bottom.

- At about river mile 23, @ the "i" of Borrow Pits, the base of QT4 lies 10m above the channel. Rock type is hackly siltstone, poorly bedded.

- QT4 appears to be uniformly ~ 10m above the channel in the Manor Creek area.

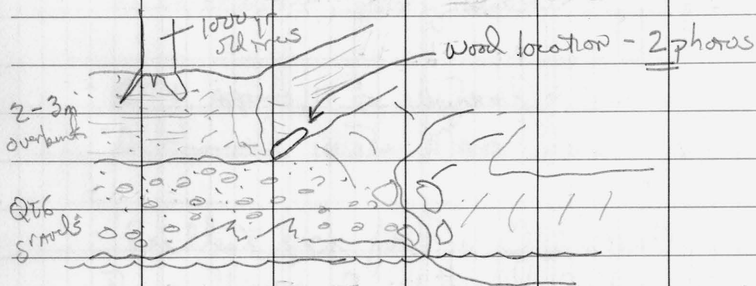
- Excellent pick for the QT4 strath at the confluence of Williams Creek, south bank. QT4 strath is right @ the 320' level.

- Crooks Creek area is problematic; there may be mappable, intermediate terraces between QT4 and QT5.

July 13, 1997 Warm, bright, sunny, calm

What a great morning! Yesterday, we mapped in detail from Upper Clearwater to Crooks Creek. This morning we will rapidly (and safely I hope) traverse that section and begin at the excellent exposures of Crooks Creek.

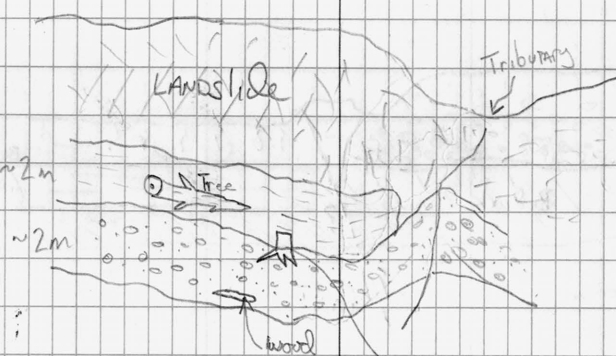
- Recap the Willimaud Creek site - right at the mouth of the Creek



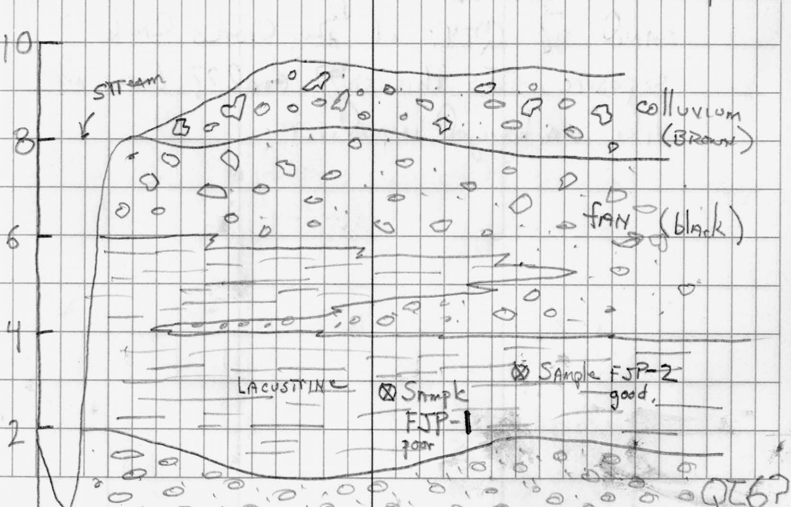
- River mile 20, south Bank. Excellent QT6 exposure - STRATH cut @ about current channel level. Collected 2 excellent chunks of wood - one clearly interbedded at base of gravels.

• still at River mile 20, ~100 m downstream of last stop.

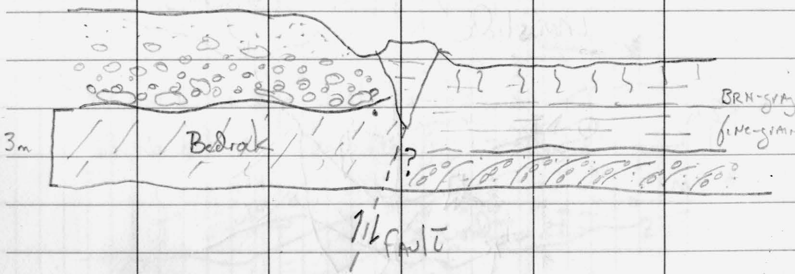
JACKPOT!! This is a QT6 dating extravaganza.



....several photos



• A QT5 (or older strath) is preserved opposite the Snahapish confluence - it is 3m above today's river level.
- The deposit has a QT5 weathering profile, v. nice A-horizon



• We collected charcoal from unweathered, stratified sand of QT4? at the Crooks Creek exposure. Is this stuff coal?? Looks alot like carbonized wood....

July 14, 1997

Overcast, Damp, Cool morn.
Warm, sunny, Bright mid-Day.

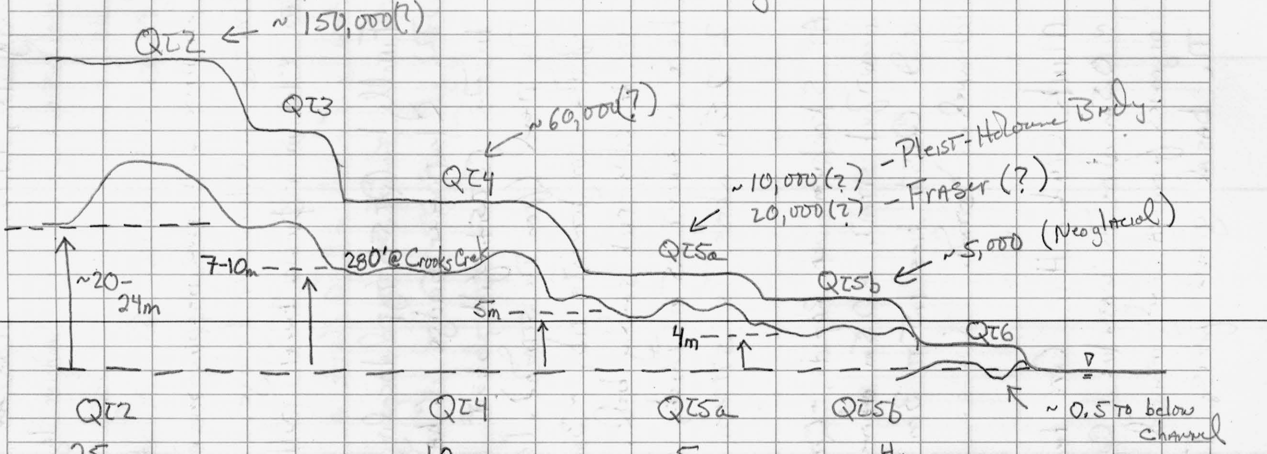
Today we start in the Crooks Creek area - on foot. We wish to work out the various surfaces + treads...

Then it is off, down river to about the Clearwater Bridge.

- QT5 terrace (QT5a) @ the channel strath downstream of Coppermine Bottom Wood!! @ the small tributary stream. ~0.5 m above the strath in a pebbly sand deposit. ... Several photos.
  This deposit has a QT5-like weathering profile.

- I am more confident than ever regarding the QT4 - QT2 stratigraphy.
  Between Coppermine Bottom and the Clearwater bridge, QT2 strath lies 20-24 m above the channel;
  QT4 lies 7 - 10 m above the channel
  QT5a lies ~5 m above the channel
  QT5b lies 3-5 m; 4 m Avg
  QT6 lies below channel to ~1 m above

Terraces btwn Coppermine Bottom and Clearwater Bridge.



QT2

$\frac{25m}{150000 \text{ yrs}}$

0.167 mm/yr

QT4

$\frac{10m}{60,000}$

0.167 mm/yr

QT5a

$\frac{5m}{10,000}$

0.5 mm/yr

$\frac{5m}{20,000}$

0.25 mm/yr.

QT5b

$\frac{4m}{5,000}$

0.8 mm/yR.

July 15, 1997, cool, damp, overcast morning, calm. marine layer @ ~500'

Continue with river mapping today. We will start @ the Clearwater bridge - work down to Clearwater picnic bench pull out.

- Finally! Qt5b type locality - at the Clearwater bridge. Charcoal! In the Qt5b fill, about half-way up to the tread (from the strath). Locality is downstream of the conglomerate rib, ~3m above the strath in a clay-rich sandy bed. Total fill here is about 5m thick; strath is @ 2-2.5m above the stream.

- At Skookumchuck Rapids, Qt6 sits on a beautiful strath ~0.5m above the stream and Qt5b lies 1.5 to 3m above the channel. ↘ strath

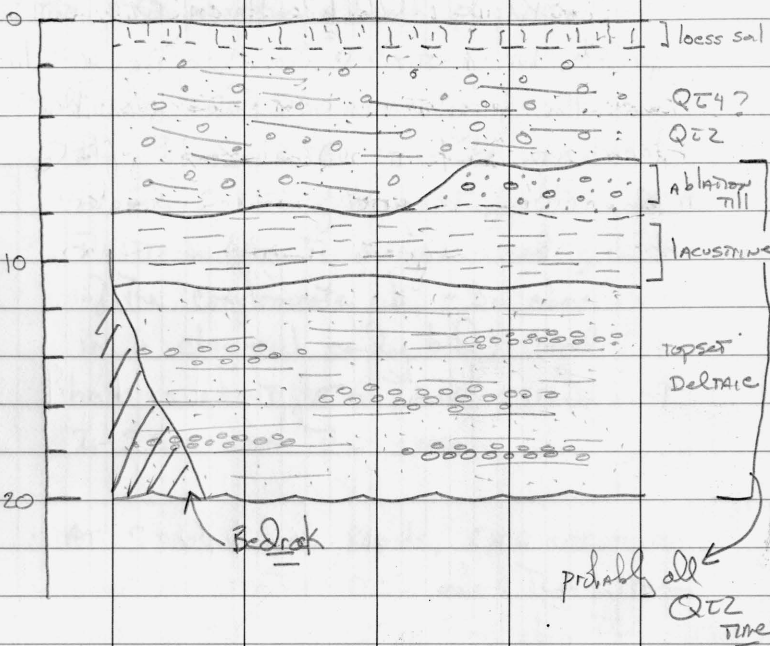
- Mink Creek. Here Qt6 lies on a strath ~0.5m above the waterline. Collected organics from a sandy interval <20cm above the basal gravel facies. Tread of Qt6 here is high... up to 6m above the waterline.

- Parsons Rapids. QT4 strath @ ~ 40-50', (12-14 m) above waterline

- Preacher Rapids: QT4 b? Has a QT4 weathering profile, but a strath @ 3m above the waterline and 4m of gravel above that just don't match up... Is it QT5a? Big flat @ 120-130' just downstream of Preacher

July 16, 1997 Bright, sunny, few high clouds

We will put in @ The Clearwater bridge again and take it down to Elkhorn Creek, where we ended yesterday.



Photos + Drawing of "Clearwater Lake Bed" stop
Collected more wood from topset deltaic unit

- Beginning of QT6(?) in Clearwater valley bottom. Great locality for wood within the gravel and at contact btwn gravel and cutbank.

- Oh my God! in the drink!!! only 100m from the take out point.
Before that - lots of great exposures + dates on QT6, QT7, and maybe QT5.
We are going to work on the maps now...
we lost some field copies to the river...

July 17, 1997 Calm, High overcast, Damp

Surveying day. We will start in upper basin, work down...

· Back at upper Clearwater Bridge on C 3700 (access from Solbucks) Gate combo 3161.

At strath terrace outcrop, east of upper Clearwater Bridge where gravels overlie red fill. This strath is 30 m above the stream. It has a Q25 or less weathering profile. → ~ 3-6 mm/yr incision rate.

Profile 1 Upper Clearwater @ upper Clearwater Bridge

Hdist on line with north

Station 0, 0, 0 ; Instrument + mirror height are not the same, ~~[illegible]~~.

Instrument = 0

Target = 1 m

entered into machine

	N	E	Z	
1	-75.03	9.6	-1.84	
2	-67.52	8.59	-1.6	
3	-62.1	8.22	-1.57	
4	-58.8	7.62	-2.29	
5	-56.68	7.36	-2.72	Channel edge

	N	E	Z	
6	-56.72	7.29	-2.72	
7	-55.15	7.36	-2.86	Channel edge.
8	-53.23	7.09	-2.72	
9	-52.2	7.23	-2.69	
10	-49.59	6.83	-2.83	
11	-48.45	6.54	-2.69	
12	-47.64	6.46	-2.79	
13	-46.75	6.34	-2.73	
14	-46.18	6.27	-2.81	
15	-45.07	6.03	-2.63	
16	-43.49	5.82	-2.51	
17	-41.54	2.99	-2.11	
18	-40.11	1.43	-1.93	
19	-38.42	-1.78	-2.72	Channel edge
20	-36.59	-1.95	-3.09	
21	-35.06	-1.76	-3.21	
22	-31.95	-1.94	-3.15	
23	-29.59	-2.01	-2.74	channel edge
24	-25.94	-2.57	-2.17	
25	-23.56	-9.09	-1.94	
26	-23.75	-11.55	-2.18	
27	-23.85	-15.39	-1.92	
28	-25.08	-18.43	-2.31	
29	-23.74	-19.89	-1.93	
30	-23.44	-23.44	-2.17	

31	-21.67	-28.49	-2.25	
32	-20.92	-33.12	-2.31	
33	-20.27	-37.57	-2.09	
34	-19.22	-41.30	-1.86	
35	-22.47	-44.51	-2.13	
36	-23.38	-47.25	-2.93	
37	-23.66	-49.4	-3.69	
38	-31.65	-63.43	-1.46	Bank edge - Q τ 67 ?

SLOPE of Channel - riffle section

1	-126.7	-110.92	-4.560	Downstream
2	-109.95	-85.105	-3.976	↓
3	-72.662	-44.238	-3.796	
4	-33.194	-15.147	-2.803	Upstream
5	-22.452	+34.760	-2.236	

Velocity of Channel

\# of clicks / ~~[illegible]~~ 30 sec

20	~~[illegible]~~ 53	50	= 51.5
21	115	117	= 116
22	100	99	= 99.5

Grainsize (in ~~inches~~ Inches. Tenths of inches) b-axis

2	0.75	2.0	0.6	3.5	10.6
5.6	5.8	2.8	1.2	0.6	
2.6	4.0	1.0	1.2	0.8	
1.0	3.6	1.6	0.6	0.25	
6.6	1.0	4.0	0.5	0.21	
7.2	1.2	0.8	0.9	0.7	
1.8	1.7	2.0	1.4	1.0	
3.6	3.6	0.9	1.4	1.6	
3.2	1.0	1.6	1.75	0.3	
3.2	4.8	4.2	1.0	2.2	
6.4	2.8	2.8	1.3	2.8	
1.0	2.2	0.6	0.9	1.2	
0.6	7.2	0.2	0.5	0.75	
1.2	1.8	2.0	0.7	0.4	
1.8	2.8	1.0	2.1	6.4	
4.2	2.2	0.9	0.9	0.5	
3.6	3.2	0.9	6.4	1.4	
0.6	1.0	3.2	0.3	2.1	
3.0	0.8	0.6	0.75	1.5	
– 3.4	1.15	1.2	0.8	1.1	

↖ These data are incorrect... move the decimal place one digit to the left – Actual measurements should be in tenths of feet...

Kunamatsk Creek

Instrument Hd st @ south line of sight

0,0,0 ; Instrument height @ 0

target height @ 0.5m

		N	E	Z	
	1	33.38	-17.84	1.57	Left bank QT6
	2	32.67	-17.43	1.53	
	3	29.89	-15.88	1.69	
	4	27.726	-14.79	1.531	Trend - QT7 b/f
	5	26.67	-14.34	1.36	
	6	25.33	-13.76	0.91	
	7	23.69	-12.69	0.41	
	8	22.07	-11.59	-0.002	
	9	21.097	-11.26	-0.19	left bank chanl
	10	20.13	-10.87	-0.45	
	11	19.23	-10.15	-0.503	
V	12	19.07	-8.41	-0.42	
	13	17.63	-8.45	-.597	
	14	16.84	-8.39	-0.315	
	15	15.25	-8.57	-0.72	
V	16	13.18	-7.17	-0.75	
	17	11.23	-6.15	-0.73	
	18	9.06	-4.96	-0.49	
	19	7.672	-4.16	-0.197	BAR

		N	E	Z	
V	20	5.0	-1.27	-0.621	
	21	3.13	1.32	-0.4	
	22	3.12	2.61	-0.29	
	23	1.17	4.34	0.685	QT7 bf
	24	0.94	6.79	2.37	QT6 read

SLOPE Measurement - Base station moved

all Parameters the same

- same south line of sight

	N	E	Z
1	95.9	149.86	-1.108
2	53.84	76.00	-0.447
3	35.26	24.59	-0.256
4	5.12	-18.57	+0.227
5	-30.9	-40.52	+0.414
6			
7			
8			

Velocity # clicks in 30 sec.

20	52,	48	=	50
16	117,	115	=	116
12	77,	75	=	76

grAINsize (IN Tenths of feet)

0.34	.66	.08	.10	.12
.16	.26	.08	.58	.66
.58	.04	.07	.08	.24
.08	.16	.10	.56	.16
.10	.94	.04	.01	.42
.06	.22	.28	.42	1.50
.14	.12	.06	.50	.08
.08	.06	.06	.18	.90
.26	.18	.16	.10	.66
.30	.24	.04	.18	.10
.06	.18	.06	.08	.26
.20	.14	.34	.20	.80
.24	.06	.14	.46	.04
.68	.58	.12	.22	.38
.10	.12	.36	.14	.24
.42	.04	.34	.50	.20
.10	.12	.38	.85	.22
.09	.10	.64	.06	.10
.28	.48	.32	.20	.10
.10	.06	.18	.45	.30

upper limit size = 2.2

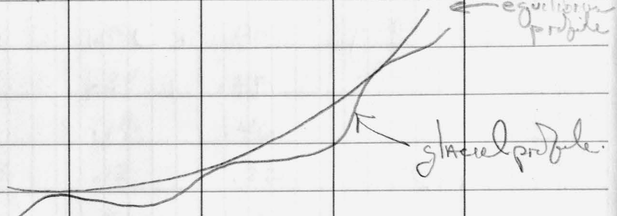
July 21, 1997

OVERCAST, damp, high morning fog

IN Clearwater basin w/ Mark and Sean

- For Three days we've had much to discuss, here are the conclusions...

  - Dosewallips - real problems, but likely can be modelled. Sean may want to treat the profile as a diffusion problem...



  - Clearwater -
    major rethinking on strath genesis...
    (1) Critical feature is valley bottom widening.
    (2) Widening can happen in alluvial or bedrock streams
    (3) Widening probably is driven by meandering,

meandering is favored by alluvium — tools for erosion, lateral corrasion.

(4) Clearwater is mixed bedrock/alluvial stream.

(5) Distinction btwn alluvial vs. bedrock is bedrock stream has tools that move in contact with the bedrock during bankfull.

(6) We need to distinguish strath "events" from complex-response terraces.

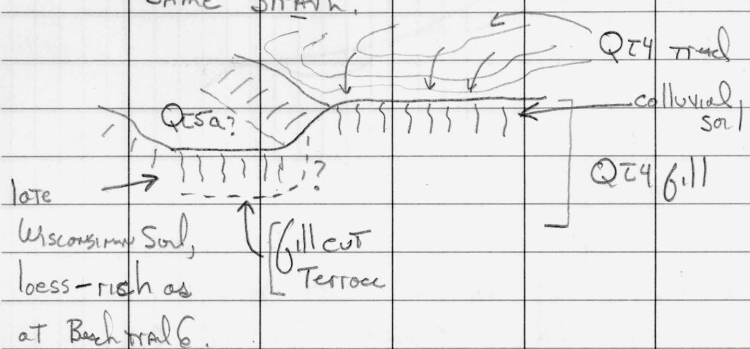
July 22, 1997 — sunny, warm, breezy, beautiful!!

· With Eric, showing off soils
  - several important conclusions...

· Moses Prairie soils @ 100 and 200 (e. Wisc. / Illinoian) are colluvial / reworked...

· Beach trail 6 soil is loess, much silt.

· Quinault Pit @ confluence of Clearwater - Queets has two treads on the same strath.



· Terraces along old County Road towards or leading NE to old County Bridge probably reflect treads of Qt3, Qt4, Qt5a, b, and QT6.

- Eric feels that there is a big difference btwn QT4, QT5 soils.

- Eric feels that the Clearwater lake bed landslide (QT4) soil, Elkhorn Pit (QT4) soil are correlative... and better developed than the Quinault Pit soil.

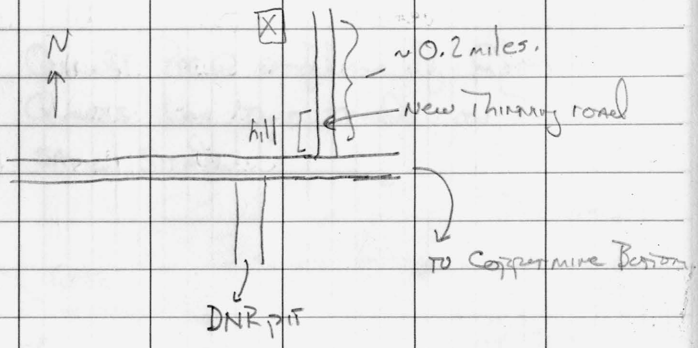
July 23, 1997

Cool, bright sun, slight breeze.

- With Eric, siting soil pits.

  - Qt2 - Peterson Creek Surface - DNR pit - Great! soil - back pit where we camped in 1992. - Red, deep. Eric feels that this is 100 ka +

  - Excellent Qt2 pit location



- At Entrance to Coppermine Bottom - at the triangle intersection ~ 0.2 miles from the paved highway.

  "Finley's Multiple Use Forest" Sign.

  This is Qt3. Actually, there are 3 Qt3

treads, Qt3a, b, and c that step down into the Snahapish drainage. There is ~4m of elevation on the terrace risers. Qt3a, at Finly's has a pit in it - it must be dug out. Easy to find... just beyond the old campsite & lots. Qt3 treads are easily reached by the Snahapish 2 Unit 4 road... right now it is blocked by a trench + mound.

- Qt4 - very nicely exposed tread - Crooks Creek Paleochannel. Just beyond the paleochannel - in the direction of the (~0.1 mile) campground, is an excellent Qt4 tread for a trench.

Clearwater Picnic Bench X-section

Target is 0.5m higher than instrument, that has been entered.

T = ~21°C, P = ~1000 hPa

Reference direction is north, we are on the NE ~~south~~ bank.

Slope

N	E	Z	
69.21	-115.95	-0.296	~~ups~~ upstream
23.5	-30.06	-0.287	
-26.11	32.41	-0.263	
-51.015	133.47	-0.289	

X-section

			START IN NE
25.14	8.39	2.34	
19.47	6.63	1.97	Top of bankful
15.68	5.00	0.74	
7.43	-2.54	0.31	
2.86	-8.27	-2.96 → ?	water's edge
-0.26	-12.33	-0.59	

-2.99	-15.84	-0.416	**V1**
-6.9	-20.73	-0.664	
-9.91	-24.5	-0.86	
-13.53	-28.3	-1.379	V2
-17.61	-32.04	-1.32	
-22.35	-38.15	-1.31	V3
-24.35	-42.05	-1.52	V4
-25.87	-48.82	-1.26	
-27.31	-52.67	-.289	water edge
-27.03	-57.97	2.28	bankful
-33.76	-51.07	3.60	top bank

Velocity

	# clicks / minute
V1	27
V2	34
V3	32
V4	21

Clast Size (in cm)

1.5	2.2	1.0	4.1	3.5
.6	1.5	3.5	5.5	2.4
3.4	3.1	0.9	3.0	5.0
1.5	2.1	1.5	4.5	7.5
1.3	2.5	7.2	3.6	2.9
1.7	1.8	1.6	1.7	2.4
2.4	3.4	0.8	6.0	5.4
3.2	2.4	1.7	2.4	4.2
4.8	3.6	6.5	5.0	2.0
5.0	4.7	1.5	8.9	3.0
1.6	2.5	1.9	2.0	4.2
3.0	1.9	1.2	1.9	12.0
1.8	2.6	2.7	3.2	3.5
5.0	2.4	2.8	1.6	6.5
1.6	1.8	2.3	2.7	2.5
7.0	12.5	2.7	1.5	1.3
1.9	2.5	2.4	6.0	2.0
1.4	1.4	1.1	1.8	4.1
3.6	2.4	2.5	5.5	3.7
11.5	1.3	3.4	3.0	4.0
2.1	6.5	2.2	1.2	2.1

July 24, 1997 High Fog, Damp morning. Beautiful sunny aft + eve.

At South Beach... with Eric

• Off to the Snahapish and South Fork Hoh Rivers. We will try to understand the late vs. early Wisconsinan soils today. Then it is off to Forks to try to meet with Rick Cahill.

• 97-1-724 Winfield Creek gravel Pits - Winfield Creek quad, Clearwater Road. QT4-like soil, but mapped as late Wisconsinan - Hoh Oxbow outwash ~30 ka (if really Hoh Oxbow I) but ~19 ka if Hoh Oxbow II as mapped.

• 97-2-724 S. Fork Hoh Campsite gravel pit. Owl Mt. Quad. Twin Creeks I ~ 14 ka? Much less well developed soil... looks like QT5, less well developed than the Winfield Creek Pits (97-1-724); Hoh Oxbow II? soil.

• 97-3-724 Virgil Falls Pit, Road H1065 off of South Fork Hoh Road. There are two exposures here - one in the pit, and the other along the S. Fork estates road ~0.5 mile to the east. In both cases, the weathering profiles are as at 97-2-724, i.e. Twin Creeks, latest Wisconsinan (Vashon) age. These profiles can be used for correlation.

• My impressions -

July 25, 1997

wet, damp, foggy morn, warm, sunny midday.

- Met with Rick Cahill. He has Okayed the sites.

- 97-1-725 QT5/QT4 riser in Quents drainage. Probably a QT5 soil. These pits take advantage of the riser. Best to put a pit on QT4 clearcut opposite Quets N.P. entrance road.

Sept 20th OLYMPICS

cool, sunny

w/Eric

Soil Pit Exposures

We have 3 pits open, (Qt3, Qt4, Qt5a)
Qt2 + Qt5b are existing exposures

Qt5b - @ the Clearwater bridge exposure
soil description is @ the location of
our carbon sample for Qt5b.

- We described 2 soils, and reconned a third today

Qt5b	Thin Bt	yellow color
Qt4	Thick (~1m) Bt	Reddish-Brown color
Qt3(a)	Thick, fine grained <u>red</u> + reddish-brown Bt	

These are real quantifiable differences.
The two most probable causes for the
chronofunctions → Time, did the soil see on

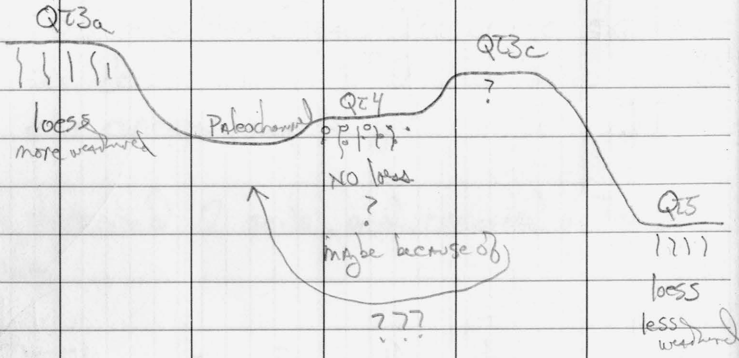
interglacial, and grainsize. Finer-grained deposits are better developed.

The Qt3a terrace soil likely received eolian fines from Qt4 outwash.

Sept. 21ST beautiful, clear, warm

• QT3 soil is very enigmatic - a thick loess ~~bar~~ cover with a QT4-looking early Wisc soil

? where is the buried soil !!!
what is going on ???



• There may be the roots of a truncated + buried weathering profile at ~ 100-120 cm down, just above the gravels

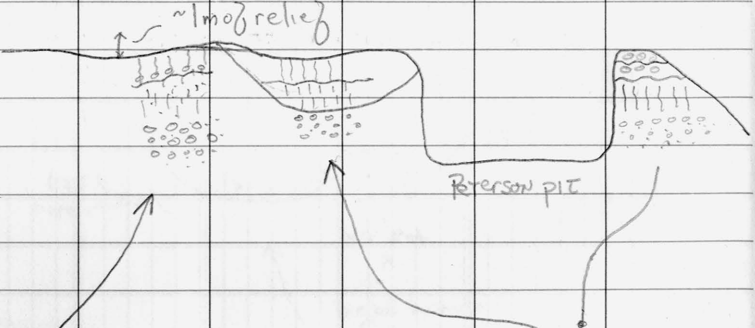
• Collected chunks of charcoal from ~100cm
CWT3a - charcoal.

Sept 22ND

Beautiful, clear, DAMP

Working on QT2 today

We observe 3 sites



well-drained sites
A QT3-like (early Wisconsinan)
Red + yellow loess over
weathered gravel; locally
appears to have a stone line

poorly-drained sites
2 loesses. A clear
buried soil. Clays,
silty clays. Gleyed
colors

Near natural riser
2 colluviums, buried soils
over a RED buried
loess

L. Wisc. colluvium
E. Wisc. colluvium
Illinoian loess

All indications finally support polygenetic soils -

- Locally-preserved buried Sangamon profile
- 2 loesses - buried soil
- 2 colluviums
- likely pervasive early Wisc. loess (Qt3 soil)

Huge difference btwn well + poorly-drained sites

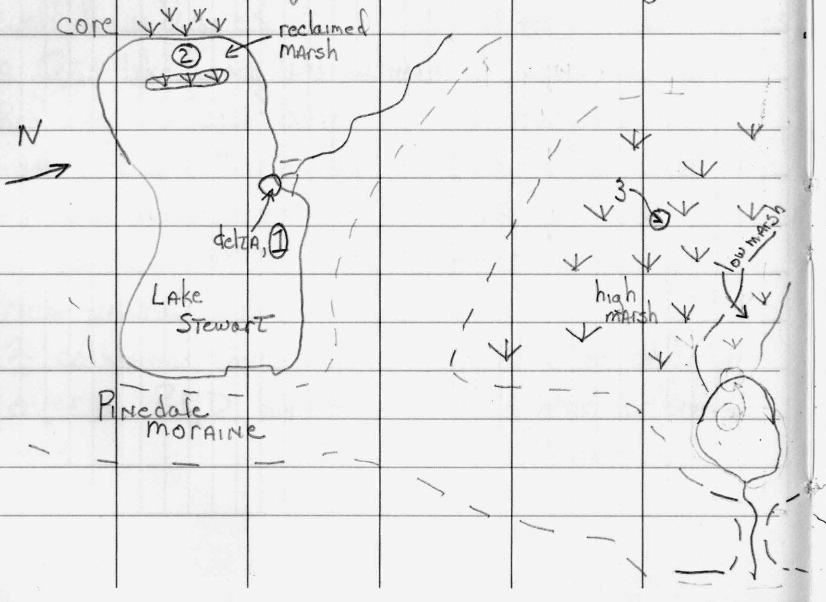
SATURDAY Sept. 27, 1997 Clear, Breezy cool

Pecos headwaters. Windsor Creek Trail, Lake Stewart.

w/ Jake Armour, Tom Loveland.

We are going to experiment with the Livingston square-rod piston corer to get cores of the eutrophied lakes around Lake Stewart.

We have identified three localities for core

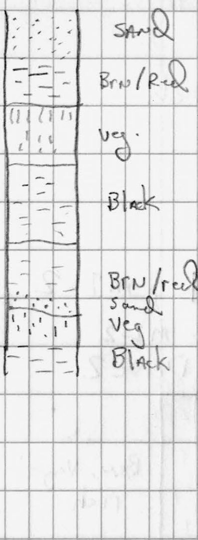


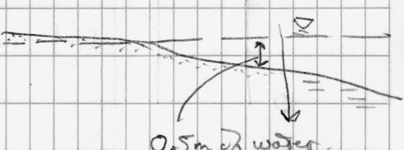
Core 1 at The Delta was a huge! success.

- we took 2 cores - ST 1-1 and ST 2-1 both were about 10m into the lake on the lower delta plain. We were right at the sedimentologic break btwn a sandy delta distal facies and a muddy, soft prodelta.

The second core is longer and more complete.

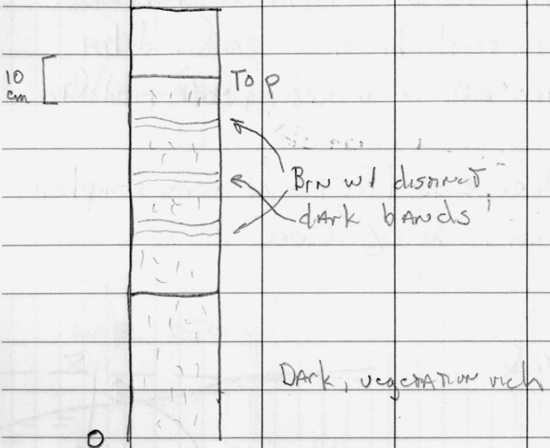
general color / sed of Core 2





• Site 2

Core ST3-1 - 75cm

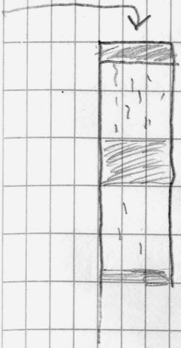


Rich in veg. Throughout,

Site 3 - Core M1-1, m1-2, m1-3

Site is ~ 0.5 km due NE of Stewart Lake.

MI-3 - Drive 3



Brn, veg poor

Black, veg poor

Brown veg. poor

Black veg poor

} Some clay.

4/18/98 SATURDAY warm, pt. cloudy
slight breeze

Alamogordo, Sacramento mt Front.
- Field check with Dan

STOP 1 - Mule Canyon
- excellent scarp across Qf1
  - Pavement
  - little relief
  - beginning to dissect
  - 20 cm eolian silt A
  - Bk, followed by By.
  - Buried, red Bt

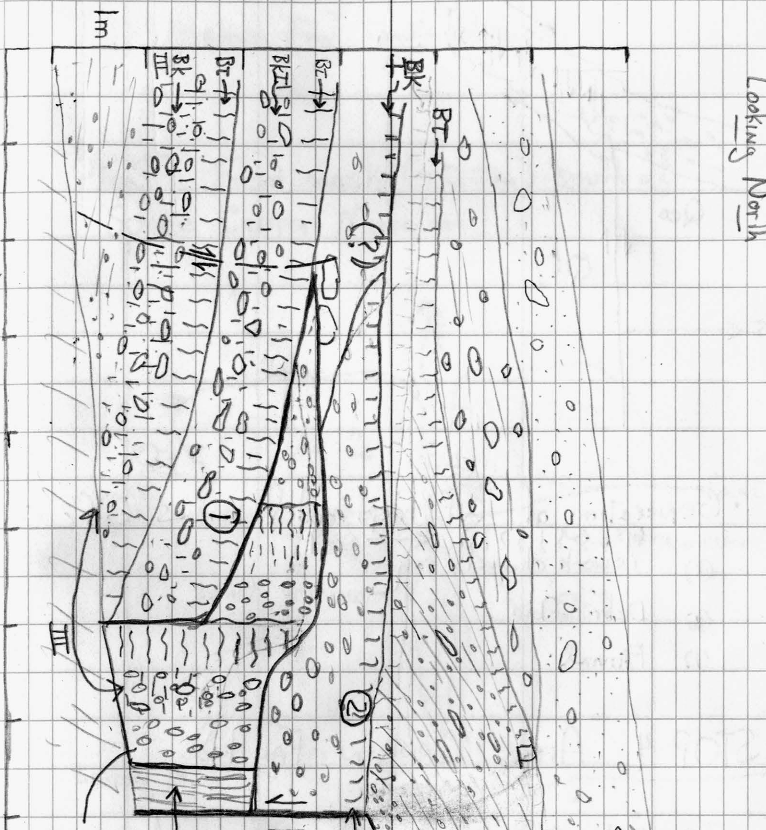
(many buried horizons)
- more Gypsum in soils to the north and in larger drainages that tap gypsifferous units.

- much of the bedrock incision in Mule Canyon was accomplished in Qt1 time a Qt2 occurs as an inset in the canyon walls.

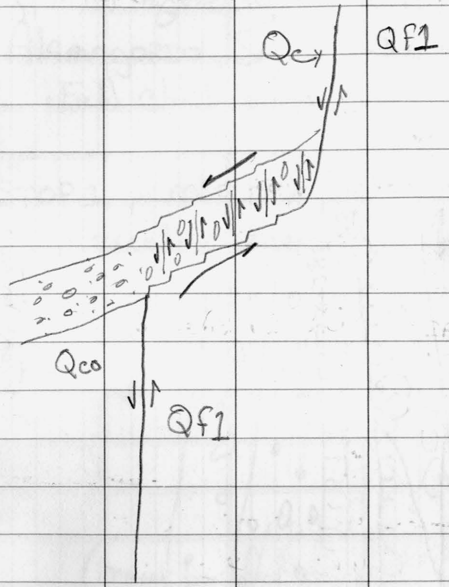
STOP 2 - Mule Canyon Fan, wash exposure on north side of channel.
- Excellent Qf2
  - debris flow top 1-3 m
  - stratified, pebbly middle 1-2 m
  - coarse base ~ 0.2-0.5 m

- Collected Charcoal!!

STOP 3 M-19 Exposure Btwn Alamo + Mule Canyon - First "major" canyon north of Mule Canyon.



Possible Kinematics to explain



• Generation of Qf1 depo model mimics Qf2

(3) rework channels ← winnow fines ← soil

(2) Debris flow

(1) Fluvial

STOP 4 Arrow Canyon Fan Head

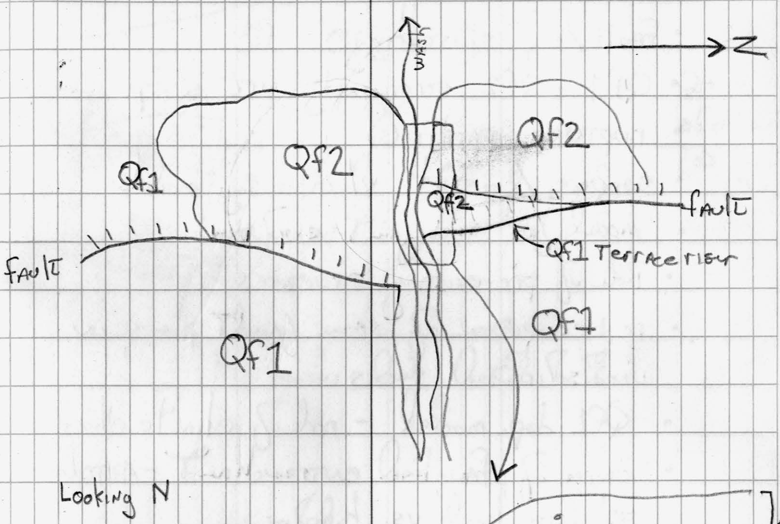
• 2, maybe 3 fluvial-debris flow cycles - not as "clean" as at STOP 3

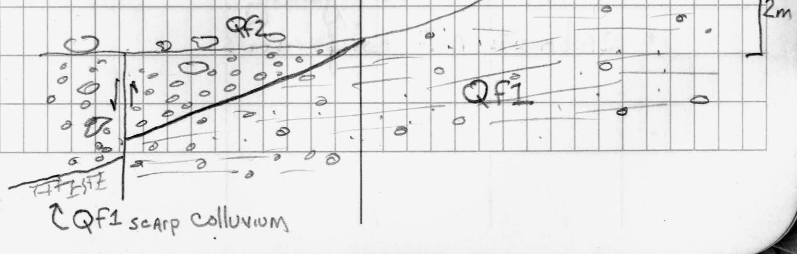
Sunday 4/19/98 clear, calm, warm

Day 2 - Alamogordo w/ Dan. Three stops planned

- Space Center
- Marble Canyon
- Alamo Fan Fault exposure.

STOP 5 First wash (~0.5km) south of Space Center Museum





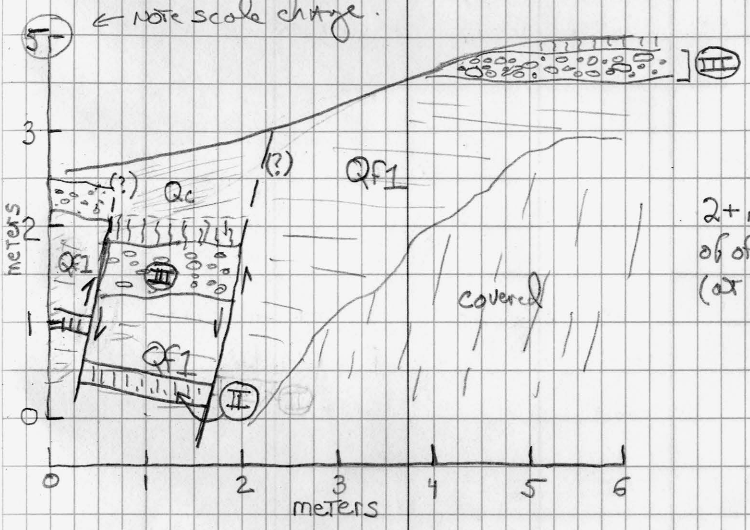
STOP 6 Qf2 over Qf1 IN next large wash to the south. Here Qf1 is fine-grained, dominated by silt + reddened paleosols - 41 KA date from charcoal horizon ~ 4m below Qf2. Argues for accumulation rates of ~1mm/yr.

Ideas to explore for a paper

- characteristic eq
- fault/eq clustering
- Qf1 -Qf2 stratigraphy wrt scarps
- rupture pattern(s)
- compare/contrast w/ other eq. models
- model for embayment evolution
- Role of pre-existing structures
- re-occupation of same fault plane in unconsolidated seds
- Qf1 dep. model - role of climate change.
- degree of fan-head entrenchment - attribute to base level vs. hydrology.
- Carbonate m.f. comparisons.

STOP 7. mouth of Marble Canyon
- lack of fault evidence - possible location of a segment boundary

STOP 8 First wash North of Alamo Canyon mouth



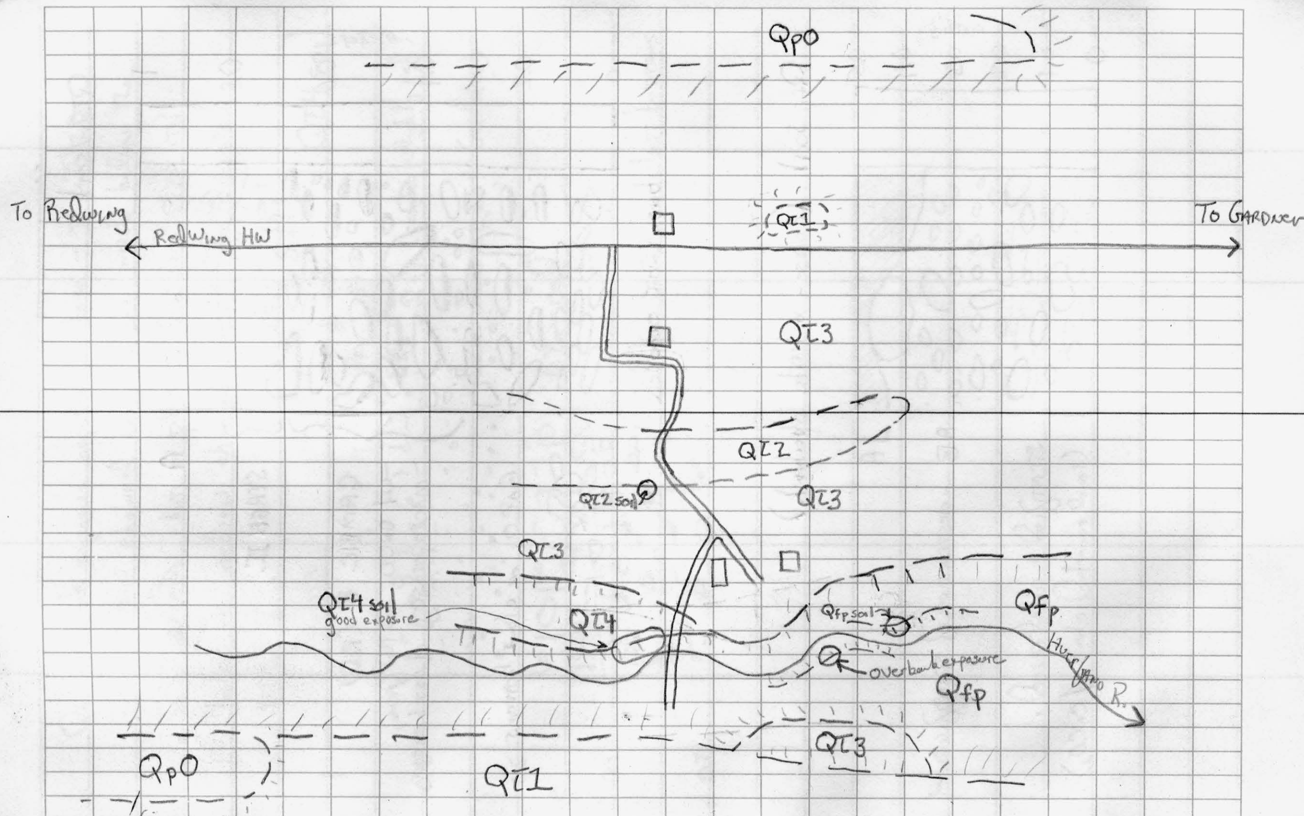
Saturday, May 30th, 1998 warm, clear, high clouds, breezy.

Huerfano Park, CO. with UNM field camp.

J. Geismann property, btwn Red Wing and Gardner.

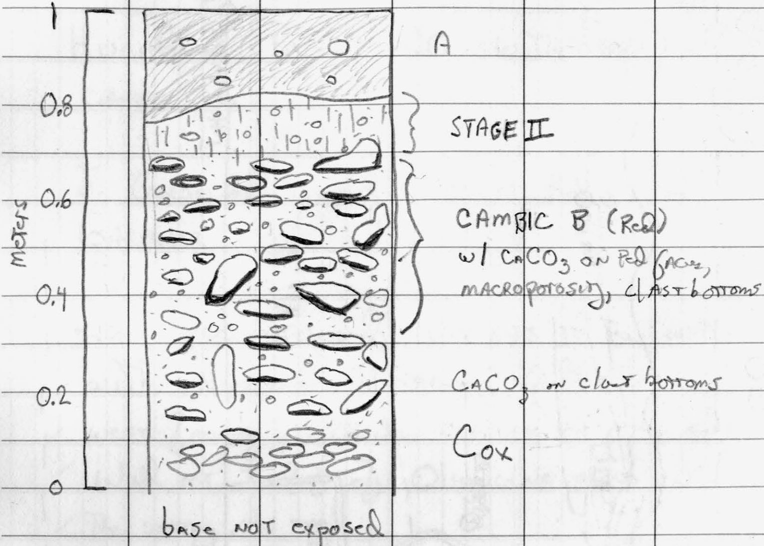
• Very nice views of Wet Mts to the east, with Neogene-Quaternary fault scarp (?) west-facing; "Eocene" erosion surface, and Wall Mt. tuff of Oligocene age in the snow, on top.....

Main goal today is to investigate terraces in imediate region of Huerfano Valley, west of Gardner.

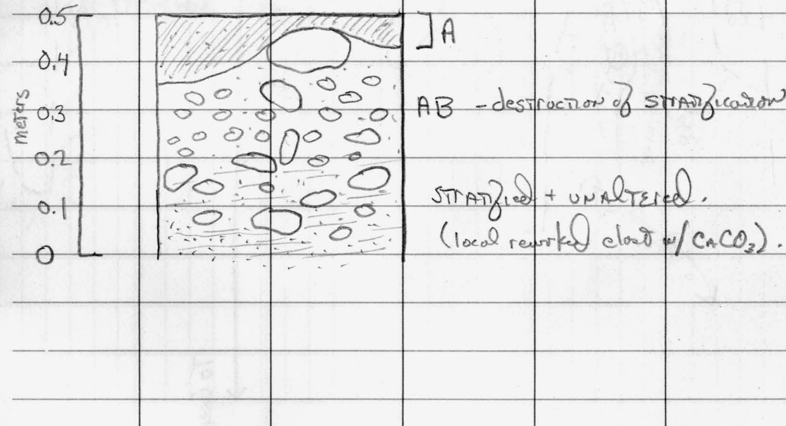


Qpo
To Redwing
Redwing HW
To Gardner
(Qt1)
Qt3
Qt2
Qt2 soil
Qt3
Qt3
Qt4 soil
good exposure
Qt4
Qfp soil
Qfp
overbank exposure
Qfp
Huerfano R.
Qpo
Qt1
Qt3

QT2 soil

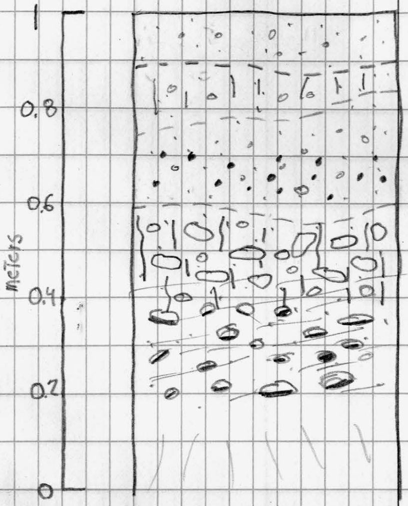


Qfp soil (coarse - v. little overbank)



Qfp overbank exposure opposite the house - I feel that the modern channel has in places incised below the QT3 strath, but in places, QT3 strath is still below the modern channel, as at the Qfp soil site.

Good Soil!. QT4 soil.



A dark

Bk1 grey (cambic - slightly red)

Bk2 STAGE II+ (Nodules)

BT - red

Bk $CaCO_3$ on clast bottoms.

C

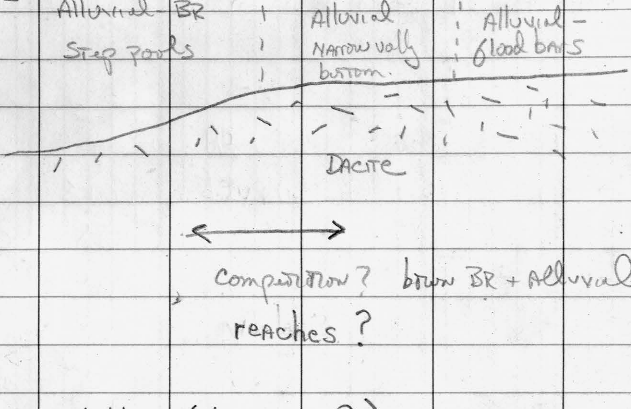
Tuesday, June 30th 1998 HOT, HUMID, AFT. T-STORMS

Arroyo Hondo recon w/ Dave M. + Sara.

Dave's M.S. Thesis

STOP 1 - IN Arroyo Hondo, collected Qbt(?) see David's notes

STOP 2 - at middle Dacite constriction immediately upstream of Arroyo Hondo

- 

competition? btwn BR + Alluvial reaches?

STOP 3 Valdez (discontinued) gage station
Clast count - modern stream bed (mm), every 10cm

44.6	61.5	44.0	57.6	126.5	45.5
26.1	19.1	130.8	28.7	40.3	190.0
29.1	14.1	71	59.2	92.9	56.3

70.3	83.7	14.3	28.7
91.8	15.4	55.6	145.8
42.7	14.2	150.0	35.7
99.1	66.7	42.6	60.5
67.4	67.5	46.3	52.9
36.5	95.1	116.3	72.0
21.1	89.4	56.4	60.0
41.6	35.2	20.6	45.4
53.1	72.4	98.4	72.2
40.8	45.5	83.8	63.3
102.4	39.0	132.0	58.4
121.6	28.3	51.5	48.7
48.1	21.5	122.3	47.9
20.1	47.4	101.1	16.4
15.1	21.9	110.7	44.5
65.6	15.7	100.6	28.3
92.3	28.7	23.1	21.7
92.6	210.0	101.5	21.3
93.2	36.4	112.6	29.8
13.9	11.5	110.0	33.1
		50.8	52.4
		98.6	42.5
		101.8	47.6
		76.2	33.6
		71.3	26.8

Wednesday July 1, 1998 HOT, Clear Morning
Huge T-storm w/ hail @ 3:30

On Red River ~1 km upstream of Rio Grande Confluence - with Dave + Sara

Dave's stop RR1A - channel is very much a bedrock channel w/ many boulders
we will -
- measure reach slopes
- count # of >1m clasts per 10m channel segments

Qualitatively, There are numerous scour/pothole features both in and above The channel.

Reach (m)	# of Boulders > 1m	Wc wrt down reach	
			W = wider, N = narrower
0-10	20	—	
10-20	28	W	
20-30	31	N	
30-40	26	N	
40-50	16	W	v. large boulders >3m
50-60	17	N	
60-70	9	W	distinct Pool] w/ gravel bed
70-80	8	NC	" "]
80-90	12	N	

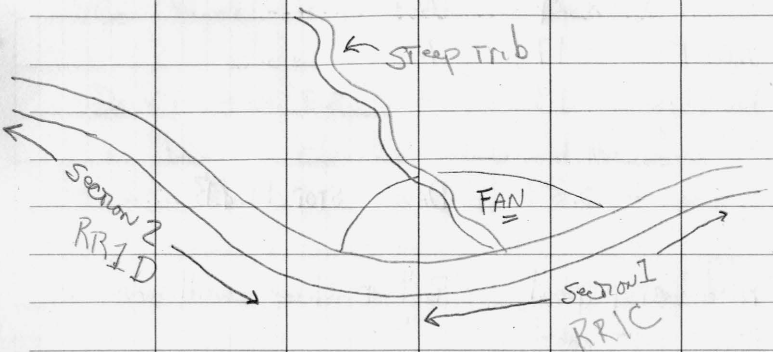
90-100	12	NC
100-110	14	N
110-120	9	N
120-130	17	N
130-140	13	W

Upstream ~ 0.5 km, Dave's STOP RR1B

Nice step-pool - Pool reaches - will survey and clast count again

Downstream "Pool" reach	# of Boulders > 1m	Wc wrt down reach	
0-10	16	—	
10-20	11	W	
20-30	10	N	v. large boulder
30-40	8	W	
40-50	22	W	
50-60	19	W	
60-70	30	W	
70-80	29	NC	
80-100	26	N	
100-110	15	N	Log jam
110-120	13	W	
120-130	18	N	
130-140	9	N	

RR1C El Aguaje shelter @ foot of El Aguaje Trail



RR1C

Reach (m)	# of Boulders > 1m	W_c wrt down reach
0-10	32	—
10-20	18	W
20-30	26	N
30-40	24	W
40-50	31	N
50-60	29	N
60-70	18	N
70-80	15	N
80-90	13	NC
90-100	24	W

lots of BR in channel (60-70)
" " " + cover? (70-80)

RR1D

Reach (m)	# of Boulders >1m	Wc WRT down reach	
0-10	17	–	@ a constriction, just upstream of fan
10-20	15	W	
20-30	11	W	becoming v. alluvial ↓
30-40	13	W	
40-50	8	W	
50-60	10	NC	
60-70	11	N	
70-80	10	N	
80-90	12	W	– lots of alluvium
90-100	11	W	most of the large clasts are on the banks
100-110	12	N	
110-120	11	W	
120-130	7	N	
130-140	15	N	

July 2, 1998 Thursday warm, clear

maybe AFT T-storm

On L. Gallegos Property - Questa
(Lawrence)

This is The site of FJP's 1988 QT6 + QT7 pits.

58.8	92.8	38.8	149.1	122.6	30.7
85.3	67.1	36.1	9.2	127.5	60.2
72.0	63.7	38.9	97.1	91.1	27.0
77.5	73.4	43.7	26.8	38.6	42.1
40.2	73.4	24.9	51.0	49.2	34.3
63.8	103.2	24.8	49.1	79.1	32.4
51.8	79.0	23.8	54.2	42.5	49.9
46.3	50.9	152.2	27.3	93.6	100.3
62.6	70.8	106.4	97.3	155	23.7
67.4	138.1	126.6	29.1	111.0	43.6
63.3	62.8	64.4	33.4	75.6	25.7
81.2	41.9	160.0	110.0	43.0	48.0
104.7	115.8	63.9	52.5	54.4	36.6
49.8	42.7	88.9	94.3	35.6	32.8
95.5	105.0	24.7	173.0	30.5	30.4
83.0	100.5	60.9	35.4	48.6	14.3
56.2	78.9	90.1	47.2	37.1	24.2
30.8	19.2	96.8	127.1	55.5	

Lawrence Gallegos
Highway 522
P.O. Box 76
Questa, NM 87556

Adorwore

Field Camp Suggestions

- have meetings w/ other instructors/TAs - Discuss Terms, etc.
- DEM maps of all three map areas
- STRAT COLS of all three map areas
- big posters
- New Jt - Js contact.
- better map bases for all maps - especially poster-sized maps.
- meetings at end of project w/ big poster of completed map.... + x-section
- must walk students through the section at Baca.
- Use Baca to teach volcanic stratigraphy - Ash flow tuffs
- nightly fireside chats - compile maps on big board nightly - discuss big picture
- Quat project @ Baca - 2 hr.
- Importance of Catamaring
- Geology btwn Alb + Huerfano Park.
- Carbonate classification scheme for Greenhorn
  - Maya's choice

  micrite → wackstone → packstone → grainstone
- Huerfano section needs to be better

  better section to measure.
- Glacial project at Huerfano
- Discussions @ Huerfano regarding Laramide Tectonics + "Eocene" erosion surface.

- VISIT Moly mine on way to Huerfano.
- get Carbonate petrology from Mag A
- all map units need thickness...
- too many "options" on a daily basis - no camp cohesiveness - no group learning.
- Do not grade "postage stamps" - Big campfire meeting to discuss. - correct in real time
- Group fieldtrips to N+S on Friday - students choose ≥ 2 critical stops + explain what is happening.

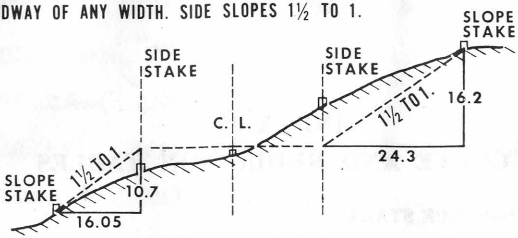
Clay Kilmer LTD.
Tim Kelley Geohydrology
Tim Decker Westwater
Bruce Thompson UNM
Gwynn Hall UNM student
Gary Richardson Metric Corp
Dirk Van Hart Gram
Neil Plummer

INDEX OF CURVE AND REDUCTION TABLES

TABLE I. SLOPE STAKE

DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING

ROADWAY OF ANY WIDTH. SIDE SLOPES 1½ TO 1.



Cut or Fill	Distance out from Side or Shoulder Stake. 0	.1	.2	.3	.4	.5	.6	.7	.8	.9	Cut or Fill
0	0.00	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	0
1	1.50	1.65	1.80	1.95	2.10	2.25	2.40	2.55	2.70	2.85	1
2	3.00	3.15	3.30	3.45	3.60	3.75	3.90	4.05	4.20	4.35	2
3	4.50	4.65	4.80	4.95	5.10	5.25	5.40	5.55	5.70	5.85	3
4	6.00	6.15	6.30	6.45	6.60	6.75	6.90	7.05	7.20	7.35	4
5	7.50	7.65	7.80	7.95	8.10	8.25	8.40	8.55	8.70	8.85	5
6	9.00	9.15	9.30	9.45	9.60	9.75	9.90	10.05	10.20	10.35	6
7	10.50	10.65	10.80	10.95	11.10	11.25	11.40	11.55	11.70	11.85	7
8	12.00	12.15	12.30	12.45	12.60	12.75	12.90	13.05	13.20	13.35	8
9	13.50	13.65	13.80	13.95	14.10	14.25	14.40	14.55	14.70	14.85	9
10	15.00	15.15	15.30	15.45	15.60	15.75	15.90	16.05	16.20	16.35	10
11	16.50	16.65	16.80	16.95	17.10	17.25	17.40	17.55	17.70	17.85	11
12	18.00	18.15	18.30	18.45	18.60	18.75	18.90	19.05	19.20	19.35	12
13	19.50	19.65	19.80	19.95	20.10	20.25	20.40	20.55	20.70	20.85	13
14	21.00	21.15	21.30	21.45	21.60	21.75	21.90	22.05	22.20	22.35	14
15	22.50	22.65	22.80	22.95	23.10	23.25	23.40	23.55	23.70	23.85	15
16	24.00	24.15	24.30	24.45	24.60	24.75	24.90	25.05	25.20	25.35	16
17	25.50	25.65	25.80	25.95	26.10	26.25	26.40	26.55	26.70	26.85	17
18	27.00	27.15	27.30	27.45	27.60	27.75	27.90	28.05	28.20	28.35	18
19	28.50	28.65	28.80	28.95	29.10	29.25	29.40	29.55	29.70	29.85	19
20	30.00	30.15	30.30	30.45	30.60	30.75	30.90	31.05	31.20	31.35	20
21	31.50	31.65	31.80	31.95	32.10	32.25	32.40	32.55	32.70	32.85	21
22	33.00	33.15	33.30	33.45	33.60	33.75	33.90	34.05	34.20	34.35	22
23	34.50	34.65	34.80	34.95	35.10	35.25	35.40	35.55	35.70	35.85	23
24	36.00	36.15	36.30	36.45	36.60	36.75	36.90	37.05	37.20	37.35	24
25	37.50	37.65	37.80	37.95	38.10	38.25	38.40	38.55	38.70	38.85	25
26	39.00	39.15	39.30	39.45	39.60	39.75	39.90	40.05	40.20	40.35	26
27	40.50	40.65	40.80	40.95	41.10	41.25	41.40	41.55	41.70	41.85	27
28	42.00	42.15	42.30	42.45	42.60	42.75	42.90	43.05	43.20	43.35	28
29	43.50	43.65	43.80	43.95	44.10	44.25	44.40	44.55	44.70	44.85	29
30	45.00	45.15	45.30	45.45	45.60	45.75	45.90	46.05	46.20	46.35	30
31	46.50	46.65	46.80	46.95	47.10	47.25	47.40	47.55	47.70	47.85	31
32	48.00	48.15	48.30	48.45	48.60	48.75	48.90	49.05	49.20	49.35	32
33	49.50	49.65	49.80	49.95	50.10	50.25	50.40	50.55	50.70	50.85	33
34	51.00	51.15	51.30	51.45	51.60	51.75	51.90	52.05	52.20	52.35	34
35	52.50	52.65	52.80	52.95	53.10	53.25	53.40	53.55	53.70	53.85	35
36	54.00	54.15	54.30	54.45	54.60	54.75	54.90	55.05	55.20	55.35	36
37	55.50	55.65	55.80	55.95	56.10	56.25	56.40	56.55	56.70	56.85	37
38	57.00	57.15	57.30	57.45	57.60	57.75	57.90	58.05	58.20	58.35	38
39	58.50	58.65	58.80	58.95	59.10	59.25	59.40	59.55	59.70	59.85	39
40	60.00	60.15	60.30	60.45	60.60	60.75	60.90	61.05	61.20	61.35	40

TABLE II. STADIA CORRECTION AND HORIZONTAL DISTANCES

STADIA REDUCTIONS FOR READING 100

Vertical Angle	Horizontal Correction	Difference in Elevation	Vertical Angle	Horizontal Correction	Difference in Elevation
2°—00′	0.1	3.5	18°—30′	10.1	30.1
3°—00′	0.3	5.3	19°—00′	10.6	30.8
4°—00′	0.5	7.0	19°—30′	11.2	31.5
5°—00′	0.8	8.7	20°—00′	11.7	32.1
6°—00′	1.1	10.4	20°—30′	12.3	32.8
7°—00′	1.5	12.1	21°—00′	12.8	33.5
8°—00′	1.9	13.8	21°—30′	13.4	34.1
9°—00′	2.5	15.5	22°—00′	14.0	34.7
10°—00′	3.0	17.10	22°—30′	14.7	35.4
10°—30′	3.3	17.9	23°—00′	15.3	36.0
11°—00′	3.6	18.7	23°—30′	15.9	36.6
11°—30′	4.0	19.5	24°—00′	16.5	37.2
12°—00′	4.3	20.3	24°—30′	17.2	37.7
12°—30′	4.7	21.1	25°—00′	17.9	38.3
13°—00′	5.1	21.9	25°—30′	18.6	39.0
13°—30′	5.5	22.7	26°—00′	19.2	39.4
14°—00′	5.9	23.4	26°—30′	19.9	39.9
14°—30′	6.3	24.2	27°—00′	20.6	40.5
15°—00′	6.7	25.0	27°—30′	21.3	41.0
15°—30′	7.2	25.8	28°—00′	22.0	42.0
16°—00′	7.6	26.5	28°—30′	22.8	41.9
16°—30′	8.1	27.2	29°—00′	23.5	42.4
17°—00′	8.5	28.0	29°—30′	24.3	42.9
17°—30′	9.0	28.7	30°—00′	25.0	43.3
18°—00′	9.5	29.4			

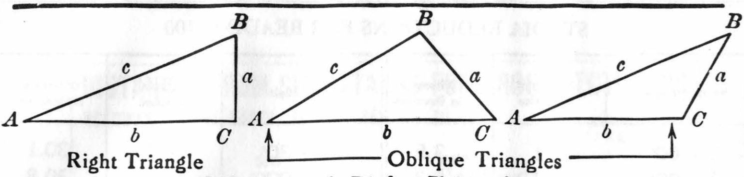
Chains to Feet

1	66
2	132
3	198
4	264
5	330
6	396
7	462
8	528
9	594
10	660

Feet to Chains

100	1.515
200	3.030
300	4.545
400	6.060
500	7.575
600	9.090
700	10.606
800	12.121
900	13.636
1,000	15.151

TABLE III. TRIGONOMETRIC FORMULAE



Solution of Right Triangles

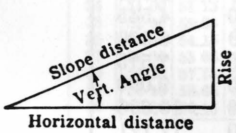
For Angle A. $\sin = \frac{a}{c}$, $\cos = \frac{b}{c}$, $\tan = \frac{a}{b}$, $\cot = \frac{b}{a}$, $\sec = \frac{c}{b}$, $\operatorname{cosec} = \frac{c}{a}$

Given	Required	
a, b	A, B, c	$\tan A = \frac{a}{b} = \cot B$, $c = \sqrt{a^2+b^2} = a\sqrt{1+\frac{b^2}{a^2}}$
a, c	A, B, b	$\sin A = \frac{a}{c} = \cos B$, $b = \sqrt{(c+a)(c-a)} = c\sqrt{1-\frac{a^2}{c^2}}$
A, a	B, b, c	$B = 90° - A$, $b = a \cot A$, $c = \frac{a}{\sin A.}$
A, b	B, a, c	$B = 90° - A$, $a = b \tan A$, $c = \frac{b}{\cos A.}$
A, c	B, a, b	$B = 90° - A$, $a = c \sin A$, $b = c \cos A$,

Solution of Oblique Triangles

Given	Required	
A, B, a	b, c, C	$b = \frac{a \sin B}{\sin A}$, $C = 180° - (A+B)$, $c = \frac{a \sin C}{\sin A}$
A, a, b	B, c, C	$\sin B = \frac{b \sin A}{a}$, $C = 180° - (A+B)$, $c = \frac{a \sin C}{\sin A}$
a, b, C	A, B, c	$A+B = 180° - C$, $\tan \frac{1}{2}(A-B) = \frac{(a-b)\tan\frac{1}{2}(A+B)}{a+b}$. $c = \frac{a \sin C}{\sin A}$
a, b, c	A, B, C	$s = \frac{a+b+c}{2}$, $\sin\frac{1}{2}A = \sqrt{\frac{(s-b)(s-c)}{bc}}$, $\sin\frac{1}{2}B = \sqrt{\frac{(s-a)(s-c)}{ac}}$, $C = 180° - (A+B)$
a, b, c	Area	$s = \frac{a+b+c}{2}$, area $= \sqrt{s(s-a)(s-b)(s-c)}$
A, b, c	Area	area $= \frac{bc \sin A}{2}$
A, B, C, a	Area	area $= \frac{a^2 \sin B \sin C}{2 \sin A}$

REDUCTION TO HORIZONTAL



Horizontal distance = Slope distance multiplied by the cosine of the vertical angle. Thus: slope distance = 319.4 ft. Vert. angle = 5° 10′. From Table, IV. cos 5° 10′ = .9959. Horizontal distance = 319.4 × .9959 = 318.09 ft. Horizontal distance also = Slope distance minus slope distance times (1 − cosine of vertical angle). With the same figures as in the preceding example, the following result is obtained. Cosine 5° 10′ = .9959. 1 − .9959 = .0041. 319.4 × .0041 = 1.31. 319.4 − 1.31 = 318.09 ft.

When the rise is known, the horizontal distance is approximately:—the slope distance less the square of the rise divided by twice the slope distance. Thus: rise = 14 ft., slope distance = 302.6 ft. Horizontal distance = $302.6 - \frac{14 \times 14}{2 \times 302.6} = 302.6 - 0.32 = 302.28$ ft.

TABLE IV. NATURAL TRIGONOMETRICAL FUNCTIONS

Angle	Sin	Tan.	Sec.	Cosec.	Cotg.	Cosin.		Angle	Sin.	Tan.	Sec.	Cosec.	Cotg.	Cosin.	
° ′								° ′							
0	0	0	1.	∞	∞	1.	**90**	**8**	.1392	.1405	1.0098	7.185	7.115	.99027	**82**
10	.0029	.0029		343.8	343.8	1.	50	10	.1421	.1435	1.0102	7.040	6.968	.98986	50
20	.0058	.0058		171.9	171.9	.99998	40	20	.1449	.1465	1.0107	6.900	6.827	.98944	40
30	.0087	.0087		114.6	114.6	.99996	30	30	.1478	.1495	1.0111	6.766	6.691	.98902	30
40	.0116	.0116	1.0001	85.94	85.94	.99993	20	40	.1507	.1524	1.0115	6.636	6.561	.98858	20
50	.0145	.0145	1.0001	68.76	68.75	.99989	10	50	.1536	.1554	1.0120	6.512	6.435	.98814	10
1	.0175	.0175	1.0002	57.30	57.29	.99985	**89**	**9**	.1564	.1584	1.0125	6.394	6.314	.98769	**81**
10	.0204	.0204	1.0002	49.11	49.10	.99979	50	10	.1593	.1614	1.0129	6.277	6.197	.98723	50
20	.0233	.0233	1.0003	42.98	42.96	.99973	40	20	.1622	.1644	1.0134	6.166	6.084	.98676	40
30	.0262	.0262	1.0003	38.20	38.19	.99966	30	30	.1650	.1673	1.0139	6.059	5.976	.98629	30
40	.0291	.0291	1.0004	34.38	34.37	.99958	20	40	.1679	.1703	1.0144	5.955	5.871	.98580	20
50	.0320	.0320	1.0005	31.26	31.24	.99949	10	50	.1708	.1733	1.0149	5.855	5.769	.98531	10
2	.0349	.0349	1.0006	28.65	28.64	.99939	**88**	**10**	.1736	.1763	1.0154	5.759	5.671	.98481	**80**
10	.0378	.0378	1.0007	26.45	26.43	.99929	50	10	.1765	.1793	1.0160	5.665	5.576	.98430	50
20	.0407	.0407	1.0008	24.56	24.54	.99917	40	20	.1794	.1823	1.0165	5.575	5.485	.98378	40
30	.0436	.0437	1.0010	22.93	22.90	.99905	30	30	.1822	.1853	1.0170	5.488	5.396	.98325	30
40	.0465	.0466	1.0011	21.49	21.47	.99892	20	40	.1851	.1883	1.0176	5.403	5.309	.98272	20
50	.0494	.0495	1.0012	20.23	20.21	.99878	10	50	.1880	.1914	1.0181	5.320	5.226	.98218	10
3	.0523	.0524	1.0014	19.11	19.08	.99863	**87**	**11**	.1908	.1944	1.0187	5.241	5.145	.98163	**79**
10	.0552	.0553	1.0015	18.10	18.07	.99847	50	10	.1937	.1974	1.0193	5.164	5.066	.98107	50
20	.0581	.0582	1.0017	17.20	17.17	.99831	40	20	.1965	.2004	1.0199	5.089	4.989	.98050	40
30	.0610	.0612	1.0019	16.38	16.35	.99813	30	30	.1994	.2035	1.0205	5.016	4.915	.97992	30
40	.0640	.0641	1.0020	15.64	15.60	.99795	20	40	.2022	.2065	1.0211	4.945	4.843	.97934	20
50	.0669	.0670	1.0022	14.96	14.92	.99776	10	50	.2051	.2095	1.0217	4.877	4.773	.97875	10
4	.0698	.0699	1.0024	14.34	14.30	.99756	**86**	**12**	.2079	.2126	1.0223	4.810	4.705	.97815	**78**
10	.0727	.0729	1.0027	13.76	13.73	.99736	50	10	.2108	.2156	1.0230	4.745	4.638	.97754	50
20	.0756	.0758	1.0029	13.23	13.20	.99714	40	20	.2136	.2186	1.0236	4.682	4.574	.97692	40
30	.0785	.0787	1.0031	12.75	12.71	.99692	30	30	.2164	.2217	1.0243	4.620	4.511	.97630	30
40	.0814	.0816	1.0033	12.29	12.25	.99668	20	40	.2193	.2247	1.0249	4.560	4.449	.97566	20
50	.0843	.0846	1.0036	11.87	11.83	.99644	10	50	.2221	.2278	1.0256	4.502	4.390	.97502	10
5	.0872	.0875	1.0038	11.47	11.43	.99619	**85**	**13**	.2250	.2309	1.0263	4.445	4.331	.97437	**77**
10	.0901	.0904	1.0041	11.10	11.06	.99594	50	10	.2278	.2339	1.0270	4.390	4.275	.97371	50
20	.0929	.0934	1.0043	10.76	10.71	.99567	40	20	.2306	.2370	1.0277	4.336	4.219	.97304	40
30	.0958	.0963	1.0046	10.43	10.39	.99540	30	30	.2334	.2401	1.0284	4.284	4.165	.97237	30
40	.0987	.0992	1.0049	10.13	10.08	.99511	20	40	.2363	.2432	1.0291	4.232	4.113	.97169	20
50	.1016	.1022	1.0052	9.839	9.788	.99482	10	50	.2391	.2462	1.0299	4.182	4.061	.97100	10
6	.1045	.1051	1.0055	9.567	9.514	.99452	**84**	**14**	.2419	.2493	1.0306	4.133	4.011	.97030	**76**
10	.1074	.1080	1.0058	9.309	9.255	.99421	50	10	.2447	.2524	1.0314	4.086	3.962	.96959	50
20	.1103	.1110	1.0061	9.065	9.010	.99390	40	20	.2476	.2555	1.0321	4.039	3.914	.96887	40
30	.1132	.1139	1.0065	8.834	8.777	.99357	30	30	.2504	.2586	1.0329	3.994	3.867	.96815	30
40	.1161	.1169	1.0068	8.614	8.556	.99324	20	40	.2532	.2617	1.0337	3.949	3.821	.96742	20
50	.1190	.1198	1.0072	8.405	8.345	.99290	10	50	.2560	.2648	1.0345	3.906	3.776	.96667	10
7	.1219	.1228	1.0075	8.206	8.144	.99255	**83**	**15**	.2588	.2679	1.0353	3.864	3.732	.96593	**75**
10	.1248	.1257	1.0079	8.016	7.953	.99219	50	10	.2616	.2711	1.0361	3.822	3.689	.96517	50
20	.1276	.1287	1.0082	7.834	7.770	.99182	40	20	.2644	.2742	1.0369	3.782	3.647	.96440	40
30	.1305	.1317	1.0086	7.661	7.596	.99144	30	30	.2672	.2773	1.0377	3.742	3.606	.96363	30
40	.1334	.1346	1.0090	7.496	7.429	.99106	20	40	.2700	.2805	1.0386	3.703	3.566	.96285	20
50	.1363	.1376	1.0094	7.337	7.269	.99067	10	50	.2728	.2836	1.0394	3.665	3.526	.96206	10
							82								**74**
							° ′								° ′
	Cosin	Cotg.	Cosec.	Sec.	Tan.	Sin.	Angle		Cosin.	Cotg.	Cosec.	Sec.	Tan.	Sin.	Angle

TABLE IV CONTD. NATURAL TRIGONOMETRICAL FUNCTIONS

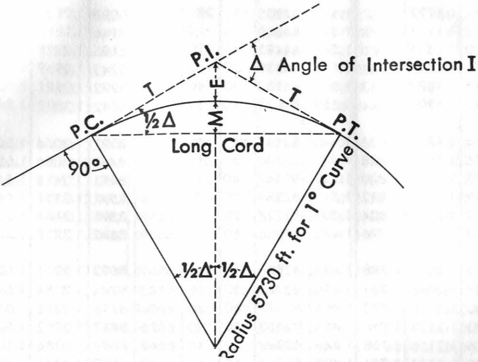
Angle	Sin.	Tan.	Sec.	Cosec.	Cotg.	Cosin.		Angle	Sin.	Tan.	Sec.	Cosec.	Cotg.	Cosin.	
° ′								° ′							
16	.2756	.2867	1.0403	**3.628**	**3.487**	.96126	**74**	**24**	.4067	.4452	1.0946	**2.459**	**2.246**	.91355	**66**
10	.2784	.2899	1.0412	3.592	3.450	.96046	50	10	.4094	.4487	1.0961	2.443	2.229	.91236	50
20	.2812	.2931	1.0423	3.556	3.412	.95964	40	20	.4120	.4522	1.0975	2.427	2.211	.91116	40
30	.2840	.2962	1.0429	3.521	3.376	.95882	30	30	.4147	.4557	1.0989	2.411	2.194	.90996	30
40	.2868	.2994	1.0438	3.487	3.340	.95799	20	40	.4173	.4592	1.1004	2.396	2.177	.90875	20
50	.2896	.3026	1.0448	3.453	3.305	.95715	10	50	.4200	.4628	1.1019	2.381	2.161	.90753	10
17	.2924	.3057	**1.0457**	**3.420**	3.271	.95630	**73**	**25**	.4226	.4663	1.1034	**2.366**	**2.145**	.90631	**65**
10	.2952	.3089	1.0466	3.388	3.237	.95545	50	10	.4253	.4699	1.1049	2.351	2.128	.90507	50
20	.2979	.3121	1.0476	3.357	3.204	.95459	40	20	.4279	.4734	1.1064	2.337	2.112	.90383	40
30	.3007	.3153	1.0485	3.326	3.172	.95372	30	30	.4305	.4770	1.1079	2.323	2.097	.90259	30
40	.3035	.3185	1.0495	3.295	3.140	.95284	20	40	.4331	.4806	1.1095	2.309	2.081	.90133	20
50	.3062	.3217	1.0505	3.265	3.108	.95195	10	50	.4358	.4841	1.1110	2.295	2.066	.90007	10
18	.3090	.3249	1.0515	3.236	3.078	.95106	**72**	**26**	.4384	.4877	1.1126	2.281	2.050	.89879	**64**
10	.3118	.3281	1.0525	3.207	3.048	.95015	50	10	.4410	.4913	1.1142	2.268	2.035	.89752	50
20	.3145	.3314	1.0535	3.179	3.018	.94924	40	20	.4436	.4950	1.1158	2.254	2.020	.89623	40
30	.3173	.3346	1.0545	3.152	2.989	.94832	30	30	.4462	.4986	1.1174	2.241	2.006	.89493	30
40	.3201	.3378	1.0555	3.124	2.960	.94740	20	40	.4488	.5022	1.1190	2.228	1.991	.89363	20
50	.3228	.3411	1.0566	3.098	2.932	.94646	10	50	.4514	.5059	1.1207	2.215	1.977	.89232	10
19	.3256	.3443	1.0576	3.072	2.904	.94552	**71**	**27**	.4540	.5095	1.1223	2.203	1.963	.89101	**63**
10	.3283	.3476	1.0587	3.046	2.877	.94457	50	10	.4566	.5132	1.1240	2.190	1.949	.88968	50
20	.3311	.3508	1.0598	3.020	2.850	.94361	40	20	.4592	.5169	1.1257	2.178	1.935	.88835	40
30	.3338	.3541	1.0608	2.996	2.824	.94264	30	30	.4617	.5206	1.1274	2.166	1.921	.88701	30
40	.3365	.3574	1.0619	2.971	2.798	.94167	20	40	.4643	.5243	1.1291	2.154	1.907	.88566	20
50	.3393	.3607	1.0631	2.947	2.773	.94068	10	50	.4669	.5280	1.1308	2.142	1.894	.88431	10
20	.3420	.3640	1.0642	2.924	2.747	.93969	**70**	**28**	.4695	.5317	1.1326	2.130	1.881	.88295	**62**
10	.3448	.3673	1.0653	2.900	2.723	.93869	50	10	.4720	.5354	1.1343	2.119	1.868	.88158	50
20	.3475	.3706	1.0665	2.878	2.699	.93769	40	20	.4746	.5392	1.1361	2.107	1.855	.88020	40
30	.3502	.3739	1.0676	2.856	2.675	.93667	30	30	.4772	.5430	1.1379	2.096	1.842	.87882	30
40	.3529	.3772	1.0688	2.833	2.651	.93565	20	40	.4797	.5467	1.1397	2.085	1.829	.87743	20
50	.3557	.3805	1.0700	2.811	2.628	.93462	10	50	.4823	.5505	1.1415	2.073	1.816	.87603	10
21	.3584	.3839	1.0711	2.790	2.605	.93358	**69**	**29**	.4848	.5543	1.1434	2.063	1.804	.87462	**61**
10	.3611	.3872	1.0723	2.769	2.583	.93253	50	10	.4874	.5581	1.1452	2.052	1.792	.87321	50
20	.3638	.3906	1.0736	2.749	2.560	.93148	40	20	.4899	.5619	1.1471	2.041	1.780	.87178	40
30	.3665	.3939	1.0748	2.729	2.539	.93042	30	30	.4924	.5658	1.1490	2.031	1.767	.87036	30
40	.3692	.3973	1.0760	2.709	2.517	.92935	20	40	.4950	.5696	1.1509	2.020	1.756	.86892	20
50	.3719	.4006	1.0773	2.689	2.496	.92827	10	50	.4975	.5735	1.1528	2.010	1.744	.86748	10
22	.3746	.4040	1.0785	2.670	2.475	.92718	**68**	**30**	.5000	.5774	1.1547	2.000	1.732	.86603	**60**
10	.3773	.4074	1.0798	2.650	2.455	.92609	50	10	.5025	.5812	1.1566	1.990	1.720	.86457	50
20	.3800	.4108	1.0811	2.632	2.434	.92499	40	20	.5050	.5851	1.1586	1.980	1.709	.86310	40
30	.3827	.4142	1.0824	2.613	2.414	.92388	30	30	.5075	.5890	1.1606	1.970	1.698	.86163	30
40	.3854	.4176	1.0837	2.595	2.394	.92276	20	40	.5100	.5930	1.1626	1.961	1.686	.86015	20
50	.3881	.4210	1.0850	2.577	2.375	.92164	10	50	.5125	.5969	1.1646	1.951	1.675	.85866	10
23	.3907	.4245	1.0864	2.559	2.356	.92050	**67**	**31**	.5150	.6009	1.1666	1.924	1.664	.85717	**59**
10	.3934	.4279	1.0877	2.542	2.337	.91936	50	10	.5175	.6048	1.1687	1.932	1.653	.85567	50
20	.3961	.4314	1.0891	2.525	2.318	.91822	40	20	.5200	.6088	1.1707	1.923	1.643	.85416	40
30	.3987	.4348	1.0904	2.508	2.300	.91706	30	30	.5225	.6128	1.1728	1.914	1.632	.85264	30
40	.4014	.4383	1.0918	2.491	2.282	.91590	20	40	.5250	.6168	1.1749	1.905	1.621	.85112	20
50	.4041	.4417	1.0932	2.475	2.264	.91472	10	50	.5275	.6208	1.1770	1.896	1.611	.84959	10
							66								**58**
							° ′								° ′
	Cosin.	Cotg.	Cosec.	Sec.	Tan.	Sin.	Angle		Cosin.	Cotg.	Cosec.	Sec.	Tan.	Sin.	Angle

TABLE IV CONTD. NATURAL TRIGONOMETRICAL FUNCTIONS

Angle	Sin.	Tan.	Sec.	Cosec.	Cotg.	Cosin.		Angle	Sin.	Tan	Sec.	Cosec.	Cotg.	Cosin.	
° ′							° ′	° ′							° ′
32	.5299	.6249	1.1792	1.887	1.600	.84805	**58**	**39**	.6293	.8098	1.2868	1.589	1.235	.77715	**51**
10	.5324	.6289	1.1813	1.878	1.590	.84650	50	10	.6316	.8146	1.2898	1.583	1.228	.77531	50
20	.5348	.6330	1.1835	1.870	1.580	.84495	40	20	.6338	.8195	1.2929	1.578	1.220	.77347	40
30	.5373	.6371	1.1857	1.861	1.570	.84339	30	30	.6361	.8243	1.2959	1.572	1.213	.77162	30
40	.5398	.6412	1.1879	1.853	1.560	.84182	20	40	.6383	.8292	1.2991	1.567	1.206	.76977	20
50	.5422	.6453	1.1901	1.844	1.550	.84025	10	50	.6406	.8342	1.3022	1.561	1.199	.76791	10
33	.5446	.6494	1.1924	1.836	1.540	.83867	**57**	**40**	.6428	.8391	1.3054	1.556	1.192	.76604	**50**
10	.5471	.6536	1.1946	1.828	1.530	.83708	50	10	.6450	.8441	1.3086	1.550	1.185	.76417	50
20	.5495	.6577	1.1969	1.820	1.520	.83549	40	20	.6472	.8491	1.3118	1.545	1.178	.76229	40
30	.5519	.6619	1.1992	1.812	1.511	.83389	30	30	.6494	.8541	1.3151	1.540	1.171	.76041	30
40	.5544	.6661	1.2015	1.804	1.501	.83228	20	40	.6517	.8591	1.3184	1.535	1.164	.75851	20
50	.5568	.6703	1.2039	1.796	1.492	.83066	10	50	.6539	.8642	1.3217	1.529	1.157	.75661	10
34	.5592	.6745	1.2062	1.788	1.483	.82904	**56**	**41**	.6561	.8693	1.3251	1.524	1.150	.75471	**49**
10	.5616	.6787	1.2086	1.781	1.473	.82741	50	10	.6583	.8744	1.3284	1.519	1.144	.75280	50
20	.5640	.6830	1.2110	1.773	1.464	.82577	40	20	.6604	.8796	1.3318	1.514	1.137	.75088	40
30	.5664	.6873	1.2134	1.766	1.455	.82413	30	30	.6626	.8847	1.3352	1.509	1.130	.74896	30
40	.5688	.6916	1.2158	1.758	1.446	.82248	20	40	.6648	.8899	1.3386	1.504	1.124	.74703	20
50	.5712	.6959	1.2183	1.751	1.437	.82082	10	50	.6670	.8952	1.3421	1.499	1.117	.74509	10
35	.5736	.7002	1.2208	1.743	1.428	.81915	**55**	**42**	.6691	.9004	1.3456	1.494	1.111	.74314	**48**
10	.5760	.7046	1.2233	1.736	1.419	.81748	50	10	.6713	.9057	1.3492	1.490	1.104	.74120	50
20	.5783	.7089	1.2258	1.729	1.411	.81580	40	20	.6734	.9110	1.3527	1.485	1.098	.73924	40
30	.5807	.7133	1.2283	1.722	1.402	.81412	30	30	.6756	.9163	1.3563	1.480	1.091	.73728	30
40	.5831	.7177	1.2309	1.715	1.393	.81242	20	40	.6777	.9217	1.3600	1.476	1.085	.73531	20
50	.5854	.7221	1.2335	1.708	1.385	.81072	10	50	.6799	.9271	1.3636	1.471	1.079	.73333	10
36	.5878	.7265	1.2361	1.701	1.376	.80902	**54**	**43**	.6820	.9325	1.3673	1.466	1.072	.73135	**47**
10	.5901	.7310	1.2387	1.695	1.368	.80730	50	10	.6841	.9380	1.3711	1.462	1.066	.72937	50
20	.5925	.7355	1.2413	1.688	1.360	.80558	40	20	.6862	.9435	1.3748	1.457	1.060	.72737	40
30	.5948	.7400	1.2440	1.681	1.351	.80386	30	30	.6884	.9490	1.3786	1.453	1.054	.72537	30
40	.5972	.7445	1.2466	1.675	1.343	.80212	20	40	.6905	.9545	1.3824	1.448	1.048	.72337	20
50	.5995	.7490	1.2494	1.668	1.335	.80038	10	50	.6926	.9601	1.3863	1.444	1.042	.72136	10
37	.6018	.7536	1.2521	1.662	1.327	.79864	**53**	**44**	.6947	.9657	1.3902	1.440	1.036	.71934	**46**
10	.6041	.7581	1.2549	1.655	1.319	.79688	50	10	.6967	.9713	1.3941	1.435	1.030	.71732	50
20	.6065	.7627	1.2577	1.649	1.311	.79512	40	20	.6988	.9770	1.3980	1.431	1.024	.71529	40
30	.6088	.7673	1.2605	1.643	1.303	.79335	30	30	.7009	.9827	1.4020	1.427	1.018	.71325	30
40	.6111	.7720	1.2633	1.636	1.295	.79158	20	40	.7030	.9884	1.4061	1.422	1.012	.71121	20
50	.6134	.7766	1.2661	1.630	1.288	.78980	10	50	.7050	.9942	1.4101	1.418	1.006	.70916	10
38	.6157	.7813	1.2690	1.624	1.280	.78801	**52**		.7071	1.	1.414	1.414	1.	.70711	**45**
10	.6180	.7860	1.2719	1.618	1.272	.78622	50								
20	.6202	.7907	1.2748	1.612	1.265	.78442	40								
30	.6225	.7954	1.2778	1.606	1.257	.78261	30								
40	.6248	.8002	1.2808	1.601	1.250	.78079	20								
50	.6271	.8050	1.2838	1.595	1.242	.77897	10								
	Cosin.	Cotg.	Cosec.	Sec.	Tan.	Sin.	Angle		Cosin.	Cotg.	Cosec.	Sec.	Tan.	Sin.	Angle

CURVE TABLE

Table of Tangent and External to a 1° Curve



To find Tangent and External for curve of any other degree, divide by degree of curve and add correction found in column of corrections.

Degree of curve with a given I may be found by dividing tangent, (or external), opposite I by given tangent, (or external).

The distance from a point on the tangent to the curve is very nearly the square of the tangent length divided by twice the radius.

CURVE FORMULAS

Radius: $R = \dfrac{50}{\sin \frac{1}{2} D}$

Length of Curve: $L = 100 \dfrac{\Delta}{D}$

also $L = .0174533 \times \Delta \times R$

Degree of Curve: $D = 100 \dfrac{\Delta}{L}$

Tangent: $T = R \tan \frac{1}{2} \Delta$

Long Cord: $LC = 2R \sin \frac{1}{2} \Delta$

Middle Ordinate: $M = R\ (1 - \cos \frac{1}{2} \Delta)$

External: $E = T \tan \frac{1}{4} \Delta$

TABLE V. TANGENTS AND EXTERNALS TO A 1° CURVE

I	T	E	I = 10°	I	T	E	I = 20°	I	T	E	I = 30°
1°	50.00	.218	+	11°	551.70	26.500	+	21°	1061.9	97.577	+
10′	58.34	.297	5° C.	10′	560.11	27.313	5° C.	10′	1070.6	99.155	5° C.
20′	66.67	.388		20′	568.53	28.137		20′	1079.2	100.75	
30′	75.01	.491	T	30′	576.95	28.974	T	30′	1087.8	102.35	T
40′	83.34	.606	.03	40′	585.36	29.824	.06	40′	1096.4	103.97	.10
50′	91.68	.733	E	50′	593.79	30.686	E	50′	1105.1	105.60	E
2°	100.01	.873	.001	12°	602.21	31.561	.006	22°	1113.7	107.24	.013
10′	108.35	1.024		10′	610.64	32.447		10′	1122.4	108.90	
20′	116.68	1.188		20′	619.07	33.347		20′	1131.0	110.57	
30′	125.02	1.364		30′	627.50	34.259		30′	1139.7	112.25	
40′	133.36	1.552		40′	635.93	35.183		40′	1148.4	113.95	
50′	141.70	1.752		50′	644.37	36.120		50′	1157.0	115.66	
3°	150.04	1.964	10° C.	13°	652.81	37.070	10° C.	23°	1165.7	117.38	10° C.
10′	158.38	2.188	T	10′	661.25	38.031	T	10′	1174.4	119.12	T
20′	166.72	2.425		20′	669.70	39.006		20′	1183.1	120.87	
30′	175.06	2.674	.06	30′	678.15	39.993	.13	30′	1191.8	122.63	.19
40′	183.40	2.934	E	40′	686.60	40.992	E	40′	1200.5	124.41	E
50′	191.74	3.207	.003	50′	695.06	42.004	.011	50′	1209.2	126.20	.025
4°	200.08	3.492		14°	703.51	43.029		24°	1217.9	128.00	
10′	208.43	3.790		10′	711.97	44.066		10′	1226.6	129.82	
20′	216.77	4.099		20′	720.44	45.116		20′	1235.3	131.65	
30′	225.12	4.421		30′	728.90	46.178		30′	1244.0	133.50	
40′	233.47	4.755		40′	737.37	47.253		40′	1252.8	135.35	
50′	241.81	5.100	15° C.	50′	745.85	48.341	15° C.	50′	1261.5	137.23	15° C.
5°	250.16	5.459	T	15°	754.32	49.441	T	25°	1270.2	139.11	T
10′	258.51	5.829	.09	10′	762.80	50.554	.19	10′	1279.0	141.01	.29
20′	266.86	6.211	E	20′	771.29	51.679		20′	1287.7	142.93	E
30′	275.21	6.606		30′	779.77	52.818	E	30′	1296.5	144.85	
40′	283.57	7.013	.004	40′	788.26	53.969	.017	40′	1305.3	146.79	.038
50′	291.92	7.432		50′	796.75	55.132		50′	1314.0	148.75	
6°	300.28	7.863		16°	805.25	56.309		26°	1322.8	150.71	
10′	308.64	8.307		10′	813.75	57.498		10′	1331.6	152.69	
20′	316.99	8.762		20′	822.25	58.699		20′	1340.4	154.69	
30′	325.35	9.230		30′	830.76	59.914		30′	1349.2	156.70	
40′	333.71	9.710	20° C.	40′	839.27	61.141	20° C.	40′	1358.0	158.72	20° C.
50′	342.08	10.202	T	50′	847.78	62.381	T	50′	1366.8	160.76	T
7°	350.44	10.707	.13	17°	856.30	63.634	.26	27°	1375.6	162.81	.39
10′	358.81	11.224	E	10′	864.82	64.900	E	10′	1384.4	164.86	E
20′	367.17	11.753	.006	20′	873.35	66.178	.022	20′	1393.2	166.95	.051
30′	375.54	12.294		30′	881.88	67.470		30′	1402.0	169.04	
40′	383.91	12.847		40′	890.41	68.774		40′	1410.9	171.15	
50′	392.28	13.413		50′	898.95	70.091		50′	1419.7	173.27	
8°	400.66	13.991		18°	907.49	71.421		28°	1428.6	175.41	
10′	409.03	14.582		10′	916.03	72.764		10′	1437.4	177.55	
20′	417.41	15.184	25° C.	20′	924.58	74.119	25° C.	20′	1446.3	179.72	25° C.
30′	425.79	15.799	T	30′	933.13	75.488	T	30′	1455.1	181.89	T
40′	434.17	16.426	.16	40′	941.69	76.869	.32	40′	1464.0	184.08	.49
50′	442.55	17.065	E	50′	950.25	78.264	E	50′	1472.9	186.29	E
9°	450.93	17.717	.007	19°	958.81	79.671	.028	29°	1481.8	188.51	.065
10′	459.32	18.381		10′	967.38	81.092		10′	1490.7	190.74	
20′	467.71	19.058		20′	975.96	82.525		20′	1499.6	192.99	
30′	476.10	19.746		30′	984.53	83.972		30′	1508.5	195.25	
40′	484.49	20.447		40′	993.12	85.431		40′	1517.4	197.53	
50′	492.88	21.161		50′	1001.7	86.904		50′	1526.3	199.82	
10°	501.28	21.887	30° C.	20°	1010.3	88.389	30° C.	30°	1535.3	202.12	30° C.
10′	509.68	22.624	T	10′	1018.9	89.888	T	10′	1544.2	204.44	T
20′	518.08	23.375	.19	20′	1027.5	91.399	.39	20′	1553.1	206.77	.59
30′	526.48	24.138		30′	1036.1	92.924		30′	1562.1	209.12	
40′	534.89	24.913	E	40′	1044.7	94.462	E	40′	1571.0	211.48	E
50′	543.29	25.700	.008	50′	1053.3	96.013	.034	50′	1580.0	213.86	.078

$T = R \tan \frac{1}{2} I$ $E = R \operatorname{exsec} \frac{1}{2} I$

TABLE V CONTD. TANGENTS AND EXTERNALS TO A 1° CURVE

I	T	E	I=40°
31°	1589.0	216.3	+
10′	1598.0	218.7	5° C.
20′	1606.9	221.1	
30′	1615.9	223.5	T
40′	1624.9	226.0	.13
50′	1633.9	228.4	E
32°	1643.0	230.9	.023
10′	1652.0	233.4	
20′	1661.0	235.9	
30′	1670.0	238.4	
40′	1679.1	241.0	
50′	1688.1	243.5	
33°	1697.2	246.1	10° C.
10′	1706.3	248.7	T
20′	1715.3	251.3	.26
30′	1724.4	253.9	
40′	1733.5	256.5	E
50′	1742.6	259.1	.046
34°	1751.7	261.8	
10′	1760.8	264.5	
20′	1770.0	267.2	
30′	1779.1	269.9	
40′	1788.2	272.6	
50′	1797.4	275.3	15° C.
35°	1806.6	278.1	T
10′	1815.7	280.8	.40
20′	1824.9	283.6	E
30′	1834.1	286.4	
40′	1843.3	289.2	.070
50′	1852.5	292.0	
36°	1861.7	294.9	
10′	1870.9	297.7	
20′	1880.1	300.6	
30′	1889.4	303.5	
40′	1898.6	306.4	
50′	1907.9	309.3	20° C.
37°	1917.1	312.2	T
10′	1926.4	315.2	.53
20′	1935.7	318.1	E
30′	1945.0	321.1	.093
40′	1954.3	324.1	
50′	1963.6	327.1	
38°	1972.9	330.2	
10′	1982.2	333.2	25° C.
20′	1991.5	336.3	
30′	2000.9	339.3	T
40′	2010.2	342.4	.67
50′	2019.6	345.5	E
39°	2029.0	348.6	.117
10′	2038.4	351.8	
20′	2047.8	354.9	
30′	2057.2	358.1	
40′	2066.6	361.3	
50′	2076.0	364.5	
40°	2085.4	367.7	30° C.
10′	2094.9	371.0	T
20′	2104.3	374.2	
30′	2113.8	377.5	.80
40′	2123.3	380.8	E
50′	2132.7	384.1	.141

I	T	E	I=50°
41°	2142.2	387.4	+
10′	2151.7	390.7	5° C.
20′	2161.2	394.1	
30′	2170.8	397.4	T
40′	2180.3	400.8	.17
50′	2189.9	404.2	E
42°	2199.4	407.6	.037
10′	2209.0	411.1	
20′	2218.6	414.5	
30′	2228.1	418.0	
40′	2237.7	421.4	
50′	2247.3	425.0	
43°	2257.0	428.5	10° C.
10′	2266.6	432.0	T
20′	2276.2	435.6	.34
30′	2285.9	439.2	
40′	2295.6	442.8	E
50′	2305.2	446.4	.075
44°	2314.9	450.0	
10′	2324.6	453.6	
20′	2334.3	457.3	
30′	2344.1	461.0	
40′	2353.8	464.6	
50′	2363.5	468.4	15° C.
45°	2373.3	472.1	T
10′	2383.1	475.8	.51
20′	2392.8	479.6	E
30′	2402.6	483.4	
40′	2412.4	487.2	.116
50′	2422.3	491.0	
46°	2432.1	494.8	
10′	2441.9	498.7	
20′	2451.8	502.5	
30′	2461.7	506.4	
40′	2471.5	510.3	20° C.
50′	2481.4	514.3	T
47°	2491.3	518.2	.68
10′	2501.2	522.2	E
20′	2511.2	526.1	.151
30′	2521.1	530.1	
40′	2531.1	534.2	
50′	2541.0	538.2	
48°	2551.0	542.2	
10′	2561.0	546.3	
20′	2571.0	550.4	25° C.
30′	2581.0	554.5	T
40′	2591.0	558.6	.85
50′	2601.1	562.8	E
49°	2611.2	566.9	.189
10′	2621.2	571.1	
20′	2631.3	575.3	
30′	2641.4	579.5	
40′	2651.5	583.8	
50′	2661.6	588.0	
50°	2671.8	592.3	30° C.
10′	2681.9	596.6	T
20′	2692.1	600.9	
30′	2702.3	605.3	1.02
40′	2712.5	609.6	E
50′	2722.7	614.0	.227

I	T	E	I=60°
51°	2732.9	618.4	+
10′	2743.1	622.8	5° C.
20′	2753.4	627.2	
30′	2763.7	631.7	T
40′	2773.9	636.2	.21
50′	2784.2	640.7	E
52°	2794.5	645.2	.056
10′	2804.9	649.7	
20′	2815.2	654.3	
30′	2825.6	658.8	
40′	2835.9	663.4	
50′	2846.3	668.0	
53°	2856.7	672.7	10° C.
10′	2867.1	677.3	T
20′	2877.5	682.0	.42
30′	2888.0	686.7	
40′	2898.4	691.4	E
50′	2908.9	696.1	.112
54°	2919.4	700.9	
10′	2929.9	705.7	
20′	2940.4	710.5	
30′	2951.0	715.3	
40′	2961.5	720.1	
50′	2972.1	725.0	15° C.
55°	2982.7	729.9	T
10′	2993.3	734.8	.63
20′	3003.9	739.7	E
30′	3014.5	744.6	.168
40′	3025.2	749.6	
50′	3035.8	754.6	
56°	3046.5	759.6	
10′	3057.2	764.6	
20′	3067.9	769.7	
30′	3078.7	774.7	20° C.
40′	3089.4	779.8	T
50′	3100.2	784.9	.84
57°	3110.9	790.1	E
10′	3121.7	795.2	.225
20′	3132.6	800.4	
30′	3143.4	805.6	
40′	3154.2	810.9	
50′	3165.1	816.1	
58°	3176.0	821.4	
10′	3186.9	826.7	
20′	3197.8	832.0	25° C.
30′	3208.8	837.3	T
40′	3219.7	842.7	1.05
50′	3230.7	848.1	E
59°	3241.7	853.5	.283
10′	3252.7	858.9	
20′	3263.7	864.3	
30′	3274.8	869.8	
40′	3285.8	875.3	
50′	3296.9	880.8	
60°	3308.0	886.4	30° C.
10′	3319.1	892.0	T
20′	3330.3	897.5	
30′	3341.4	903.2	1.27
40′	3352.6	908.8	E
50′	3363.8	914.5	.340

T = R tan ½I   E = R exsec ½I

TABLE V CONTD. TANGENTS AND EXTERNALS TO A 1° CURVE

I	T	E	I=70°	I	T	E	I=80°	I	T	E	I=90°
61°	3375.0	920.2	+	71°	4086.9	1308.2	+	81°	4893.6	1805.3	+
10′	3386.3	925.9	5° C.	10′	4099.5	1315.6		10′	4908.0	1814.7	
20′	3397.5	931.6		20′	4112.1	1322.9	5° C.	20′	4922.5	1824.1	5° C.
30′	3408.8	937.3	T	30′	4124.8	1330.3	T	30′	4937.0	1833.6	T
40′	3420.1	943.1	.25	40′	4137.4	1337.7	.30	40′	4951.5	1843.1	.36
50′	3431.4	948.9	E	50′	4150.1	1345.1	E	50′	4966.1	1852.6	E
62°	3442.7	954.8	.080	72°	4162.8	1352.6	.110	82°	4980.7	1862.2	.149
10′	3454.1	960.6		10′	4175.6	1360.1		10′	4995.4	1871.8	
20′	3465.4	966.5		20′	4188.5	1367.6		20′	5010.0	1881.5	
30′	3476.8	972.4		30′	4201.2	1375.2		30′	5024.8	1891.2	
40′	3488.3	978.3		40′	4214.0	1382.8		40′	5039.5	1900.9	
50′	3499.7	984.3		50′	4226.8	1390.4		50′	5054.3	1910.7	
63°	3511.1	990.2	10° C.	73°	4239.7	1398.0	10° C.	83°	5069.2	1920.5	10° C.
10′	3522.6	996.2	T	10′	4252.6	1405.7	T	10′	5084.0	1930.4	T
20′	3534.1	1002.3		20′	4265.6	1413.5		20′	5099.0	1940.3	
30′	3545.6	1008.3	.51	30′	4278.5	1421.2	.61	30′	5113.9	1950.3	.72
40′	3557.2	1014.4	E	40′	4291.5	1429.0	E	40′	5128.9	1960.2	E
50′	3568.7	1020.5	.159	50′	4304.6	1436.8	.220	50′	5143.9	1970.3	.299
64°	3580.3	1026.6		74°	4317.6	1444.6		84°	5159.0	1980.4	
10′	3591.9	1032.8		10′	4330.7	1452.5		10′	5174.1	1990.5	
20′	3603.5	1039.0		20′	4343.8	1460.4		20′	5189.3	2000.6	
30′	3615.1	1045.2		30′	4356.9	1468.4		30′	5204.4	2010.8	
40′	3626.8	1051.4		40′	4370.1	1476.4		40′	5219.7	2021.1	
50′	3638.5	1057.7	15° C.	50′	4383.3	1484.4	15° C.	50′	5234.9	2031.4	15° C.
65°	3650.2	1063.9	T	75°	4396.5	1492.4	T	85°	5250.3	2041.7	T
10′	3661.9	1070.2	.76	10′	4409.8	1500.5	.91	10′	5265.6	2052.1	1.09
20′	3673.7	1076.6	E	20′	4423.1	1508.6	E	20′	5281.0	2062.5	E
30′	3685.4	1082.9		30′	4436.4	1516.7		30′	5296.4	2073.0	
40′	3697.2	1089.3	.240	40′	4449.7	1524.9	.332	40′	5311.9	2083.5	.450
50′	3709.0	1095.7		50′	4463.1	1533.1		50′	5327.4	2094.1	
66°	3720.9	1102.2		76°	4476.5	1541.4		86°	5343.0	2104.7	
10′	3732.7	1108.6		10′	4489.9	1549.7		10′	5358.6	2115.3	
20′	3744.6	1115.1		20′	4503.4	1558.0		20′	5374.2	2126.0	
30′	3756.5	1121.7		30′	4516.9	1566.3		30′	5389.9	2136.7	
40′	3768.5	1128.2	20° C.	40′	4530.4	1574.7	20° C.	40′	5405.6	2147.5	20° C.
50′	3780.4	1134.8	T	50′	4544.0	1583.1	T	50′	5421.4	2158.4	T
67°	3792.4	1141.4	1.02	77°	4557.6	1591.6	1.22	87°	5437.2	2169.2	1.45
10′	3804.4	1148.0	E	10′	4571.2	1600.1	E	10′	5453.1	2180.2	E
20′	3816.4	1154.7	.321	20′	4584.8	1608.6	.445	20′	5469.0	2191.1	.603
30′	3828.4	1161.3		30′	4598.5	1617.1		30′	5484.9	2202.2	
40′	3840.5	1168.1		40′	4612.2	1625.7		40′	5500.9	2213.2	
50′	3852.6	1174.8		50′	4626.0	1634.4		50′	5517.0	2224.3	
68°	3864.7	1181.6		78°	4639.8	1643.0		88°	5533.1	2235.5	
10′	3876.8	1188.4		10′	4653.6	1651.7		10′	5549.2	2246.7	
20′	3889.0	1195.2	25° C.	20′	4667.4	1660.5	25° C.	20′	5565.4	2258.0	25° C.
30′	3901.2	1202.0	T	30′	4681.3	1669.2	T	30′	5581.6	2269.3	T
40′	3913.4	1208.9	1.28	40′	4695.2	1678.1	1.53	40′	5597.8	2280.6	1.83
50′	3925.6	1215.8	E	50′	4709.2	1686.9	E	50′	5614.2	2292.0	E
69°	3937.9	1222.7	.403	79°	4723.2	1695.8	.558	89°	5630.5	2303.5	.756
10′	3950.2	1229.7		10′	4737.2	1704.7		10′	5646.9	2315.0	
20′	3962.5	1236.7		20′	4751.2	1713.7		20′	5663.4	2326.6	
30′	3974.8	1243.7		30′	4765.3	1722.7		30′	5679.9	2338.2	
40′	3987.2	1250.8		40′	4779.4	1731.7		40′	5696.4	2349.8	
50′	3999.5	1257.9		50′	4793.6	1740.8		50′	5713.0	2361.5	
70°	4011.9	1265.0	30° C.	80°	4807.7	1749.9	30° C.	90°	5729.7	2373.3	30° C.
10′	4024.4	1272.1	T	10′	4822.0	1759.0	T	10′	5746.3	2385.1	T
20′	4036.8	1279.3	1.54	20′	4836.2	1768.2	1.84	20′	5763.1	2397.0	2.20
30′	4049.3	1286.5		30′	4850.5	1777.4		30′	5779.9	2408.9	
40′	4061.8	1293.6	E	40′	4864.8	1786.7	E	40′	5796.7	2420.9	E
50′	4074.4	1300.9	.485	50′	4879.2	1796.0	.671	50′	5813.6	2432.9	.910

T = R tan ½I   E = R exsec ½I

TABLE V CONTD. TANGENTS AND EXTERNALS TO A 1° CURVE

I	T	E	I=100°	I	T	E	I=110°	I	T	E	I=120°
91°	5830.5	2444.9	+ 5° C. T .43 E .200	**101°**	6950.6	3278.1	+ 5° C. T .51 E .268	**111°**	8336.7	4386.1	+ 5° C. T .62 E .360
10′	5847.5	2457.1		10′	6971.3	3294.1		10′	8362.7	4407.6	
20′	5864.6	2469.3		20′	6992.0	3310.1		20′	8388.9	4429.2	
30′	5881.7	2481.5		30′	7012.7	3326.1		30′	8415.1	4450.9	
40′	5898.8	2493.8		40′	7033.6	3342.3		40′	8441.5	4472.7	
50′	5916.0	2506.1		50′	7054.5	3358.5		50′	8468.0	4494.6	
92°	5933.2	2518.5		**102°**	7075.5	3374.9		**112°**	8494.6	4516.6	
10′	5950.5	2531.0		10′	7096.6	3391.2		10′	8521.3	4538.8	
20′	5967.9	2543.5		20′	7117.8	3407.7		20′	8548.1	4561.1	
30′	5985.3	2556.0		30′	7139.0	3424.3		30′	8575.0	4583.4	
40′	6002.7	2568.6		40′	7160.3	3440.9		40′	8602.1	4606.0	
50′	6020.2	2581.3		50′	7181.7	3457.6		50′	8629.3	4628.6	
93°	6037.8	2594.0	10° C. T .86 E .401	**103°**	7203.2	3474.4	10° C. T .103 E .536	**113°**	8656.6	4651.3	10° C. T 1.25 E .721
10′	6055.4	2606.8		10′	7224.7	3491.3		10′	8684.0	4674.2	
20′	6073.1	2619.7		20′	7246.3	3508.2		20′	8711.5	4697.2	
30′	6090.8	2632.6		30′	7268.0	3525.2		30′	8739.2	4720.3	
40′	6108.6	2645.5		40′	7289.8	3542.4		40′	8767.0	4743.6	
50′	6126.4	2658.5		50′	7311.7	3559.6		50′	8794.9	4766.9	
94°	6144.3	2671.6		**104°**	7333.6	3576.8		**114°**	8822.9	4790.4	
10′	6162.2	2684.7		10′	7355.6	3594.2		10′	8851.0	4814.1	
20′	6180.2	2697.9		20′	7377.8	3611.7		20′	8879.3	4837.8	
30′	6198.3	2711.2		30′	7399.9	3629.2		30′	8907.7	4861.7	
40′	6216.4	2724.5		40′	7422.2	3646.8		40′	8936.3	4885.7	
50′	6234.6	2737.9	15° C. T 1.30 E .604	50′	7444.6	3664.5	15° C. T 1.56 E .806	50′	8965.0	4909.9	15° C. T 1.93 E 1.09
95°	6252.8	2751.3		**105°**	7467.0	3682.3		**115°**	8993.8	4934.1	
10′	6271.1	2764.8		10′	7489.6	3700.2		10′	9022.7	4958.6	
20′	6289.4	2778.3		20′	7512.2	3718.2		20′	9051.7	4983.1	
30′	6307.9	2792.0		30′	7534.9	3736.2		30′	9080.9	5007.8	
40′	6326.3	2805.6		40′	7557.7	3754.4		40′	9110.3	5032.6	
50′	6344.8	2819.4		50′	7580.5	3772.6		50′	9139.8	5057.6	
96°	6363.4	2833.2		**106°**	7603.5	3791.0		**116°**	9169.4	5082.7	
10′	6382.1	2847.0		10′	7626.6	3809.4		10′	9199.1	5107.9	
20′	6400.8	2861.0		20′	7649.7	3827.9		20′	9229.0	5133.3	
30′	6419.5	2875.0		30′	7672.9	3846.5		30′	9259.0	5158.8	
40′	6438.4	2889.0	20° C. T 1.74 E .809	40′	7696.3	3865.2	20° C. T 2.08 E 1.08	40′	9289.2	5184.5	20° C. T 2.52 E 1.46
50′	6457.3	2903.1		50′	7719.7	3884.0		50′	9319.5	5210.3	
97°	6476.2	2917.3		**107°**	7743.2	3902.9		**117°**	9349.9	5236.2	
10′	6495.2	2931.6		10′	7766.8	3921.9		10′	9380.5	5262.3	
20′	6514.3	2945.9		20′	7790.5	3940.9		20′	9411.3	5288.6	
30′	6533.4	2960.3		30′	7814.3	3960.1		30′	9442.2	5315.0	
40′	6552.6	2974.7		40′	7838.1	3979.4		40′	9473.2	5341.5	
50′	6571.9	2989.2		50′	7862.1	3998.7		50′	9504.4	5368.2	
98°	6591.2	3003.8		**108°**	7886.2	4018.2		**118°**	9535.7	5395.1	
10′	6610.6	3018.4		10′	7910.4	4037.8		10′	9567.2	5422.1	
20′	6630.1	3033.1	25° C. T 2.18 E 1.02	20′	7934.6	4057.4	25° C. T 2.61 E 1.36	20′	9598.9	5449.2	25° C. T 3.16 E 1.83
30′	6649.6	3047.9		30′	7959.0	4077.2		30′	9630.7	5476.5	
40′	6669.2	3062.8		40′	7983.5	4097.1		40′	9662.6	5504.0	
50′	6688.8	3077.7		50′	8008.0	4117.0		50′	9694.7	5531.7	
99°	6708.6	3092.7		**109°**	8032.7	4137.1		**119°**	9727.0	5559.4	
10′	6728.4	3107.7		10′	8057.4	4157.3		10′	9759.4	5587.4	
20′	6748.2	3122.9		20′	8082.3	4177.5		20′	9792.0	5615.5	
30′	6768.1	3138.1		30′	8107.3	4197.9		30′	9824.8	5643.8	
40′	6788.1	3153.3		40′	8132.3	4218.4		40′	9857.7	5672.3	
50′	6808.2	3168.7		50′	8157.5	4239.0		50′	9890.8	5700.9	
100°	6828.3	3184.1	30° C. T 2.62 E 1.22	**110°**	8182.8	4259.7	30° C. T 3.14 E 1.63	**120°**	9924.0	5729.7	30° C. T 3.81 E 2.20
10′	6848.5	3199.6		10′	8208.2	4280.5		10′	9957.5	5758.6	
20′	6868.8	3215.1		20′	8233.7	4301.4		20′	9991.0	5787.7	
30′	6889.2	3230.8		30′	8259.3	4322.4		30′	10025.0	5817.0	
40′	6909.6	3246.5		40′	8285.0	4343.6		40′	10059.0	5846.5	
50′	6930.1	3262.3		50′	8310.8	4364.8		50′	10093.0	5876.1	

T = R tan ½I   E = R exsec ½I

USEFUL RELATIONS

Lineal feet	×.00019	=	miles
Lineal yards	×.0006	=	miles
Square inches	×.007	=	square feet
Square feet	×.111	=	square yards
Square yards	×.0002067	=	acres
Acres	×4840	=	square yards
Cubic inches	×.00058	=	cubic feet
Cubic feet	×.03704	=	cubic yards
Links	×.22	=	yards
Links	×.66	=	feet
Feet	×1.5	=	links

360° = 21600′ = 1296000″

Radius = arc of 57.2957790°

Arc of 1° (radius = 1) = .017453292

Arc of 1′ (radius = 1) = .000290888

Arc of 1″ (radius = 1) = .000004848

Curvature of Earth's surface = about 0.7 feet in 1 mile

Curvature in feet = 0.667 (Dist. in miles)²

Difference between arc and chord length, 0.05 feet in 11½ miles

Probable error of a single observation = $0.6754\sqrt{\frac{\Sigma v^2}{n-1}}$

Error in chaining of 0.01 feet in 100 feet:

Due to—

1. Length of tape error of 0.01 feet
2. Alignment. One end 1.4 feet out of line
3. Sag of tape at center of 0.61 feet.
4. Temperature difference of 15°
5. Difference of pull of 15 lbs.

SQUARE MEASURE

144 sq. inches = 1 sq. ft.
9 sq. ft. = 1 sq. yard
30¼ sq. yds. = 1 sq. rd.
40 sq. rds. = 1 rood.
4 roods = 1 acre
640 acres = 1 sq. mile.

SURVEYORS' MEASURE

7.92 inches = 1 link.
25 links = 1 rod.
4 rds. = 1 chain.
10 sq. chains or 160 sq. rods = 1 acre.
640 acres = 1 sq. mile.
36 sq. miles (6 miles sq.) = 1 township.

TABLE VI. INCHES TO DECIMALS OF A FOOT

In.	0	1	2	3	4	5	6	7	8	9	10	11	In.
0	Foot	.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167	0
1-32	.0026	.0859	.1693	.2526	.3359	.4193	.5026	.5859	.6693	.7526	.8359	.9193	1-32
1-16	.0052	.0885	.1719	.2552	.3385	.4219	.5052	.5885	.6719	.7552	.8385	.9219	1-16
3-32	.0078	.0911	.1745	.2578	.3411	.4245	.5078	.5911	.6745	.7578	.8411	.9245	3-32
1-8	.0104	.0938	.1771	.2604	.3438	.4271	.5104	.5938	.6771	.7604	.8438	.9271	1-8
5-32	.0130	.0964	.1797	.2630	.3464	.4297	.5130	.5964	.6797	.7630	.8464	.9297	5-32
3-16	.0156	.0990	.1823	.2656	.3490	.4323	.5156	.5990	.6823	.7656	.8490	.9323	3-16
7-32	.0182	.1016	.1849	.2682	.3516	.4349	.5182	.6016	.6849	.7682	.8516	.9349	7-32
1-4	.0208	.1042	.1875	.2708	.3542	.4375	.5208	.6042	.3875	.7708	.8542	.9375	1-4
9-32	.0234	.1068	.1901	.2734	.3568	.4401	.5234	.6068	.6901	.7734	.8568	.9401	9-32
5-16	.0260	.1094	.1927	.2760	.3594	.4427	.5260	.6094	.6927	.7760	.8594	.9427	5-16
11-32	.0286	.1120	.1953	.2786	.3620	.4453	.5286	.6120	.6953	.7786	.8620	.9453	11-32
3-8	.0313	.1146	.1979	.2813	.3646	.4479	.5313	.6146	.6979	.7813	.8646	.9479	3-8
13-32	.0339	.1172	.2005	.2839	.3672	.4505	.5339	.6172	.7005	.7839	.8672	.9505	13-32
7-16	.0365	.1198	.2031	.2865	.3698	.4531	.5365	.6198	.7031	.7865	.8698	.9531	7-16
15-32	.0391	.1224	.2057	.2891	.3724	.4557	.5391	.6224	.7057	.7891	.8724	.9557	15-32
1-2	.0417	.1250	.2083	.2917	.3750	.4583	.5417	.6250	.7083	.7917	.8750	.9583	1-2
17-32	.0443	.1276	.2109	.2943	.3776	.4609	.5443	.6276	.7109	.7943	.8776	.9609	17-32
9-16	.0469	.1302	.2135	.2969	.3802	.4635	.5469	.6302	.7135	.7969	.8802	.9635	9-16
19-32	.0495	.1328	.2161	.2995	.3828	.4661	.5495	.6328	.7161	.7995	.8828	.9661	19-32
5-8	.0521	.1354	.2188	.3021	.3854	.4688	.5521	.6354	.7188	.8021	.8854	.9688	5-8
21-32	.0547	.1380	.2214	.3047	.3880	.4714	.5547	.6380	.7214	.8047	.8880	.9714	21-32
11-16	.0573	.1406	.2240	.3073	.3906	.4740	.5573	.6406	.7240	.8073	.8906	.9740	11-16
23-32	.0599	.1432	.2266	.3099	.3932	.4766	.5599	.6432	.7266	.8099	.8932	.9766	23-32
3-4	.0625	.1458	.2292	.3125	.3958	.4792	.5625	.6458	.7292	.8125	.8958	.9792	3-4
25-32	.0651	.1484	.2318	.3151	.3984	.4818	.5651	.6484	.7318	.8151	.8984	.9818	25-32
13-16	.0677	.1510	.2344	.3177	.4010	.4844	.5677	.6510	.7344	.8177	.9010	.9844	13-16
27-32	.0703	.1536	.2370	.3203	.4036	.4870	.5703	.6536	.7370	.8203	.9036	.9870	27-32
7-8	.0729	.1563	.2396	.3229	.4063	.4896	.5729	.6563	.7396	.8229	.9063	.9896	7-8
29-32	.0755	.1589	.2422	.3255	.4089	.4922	.5755	.6589	.7422	.8255	.9089	.9922	29-32
15-16	.0781	.1615	.2448	.3281	.4115	.4948	.5781	.6615	.7448	.8281	.9115	.9948	15-16
31-32	.0807	.1641	.2474	.3307	.4141	.4974	.5807	.6641	.7474	.8307	.9141	.9974	31-32
	0	1	2	3	4	5	6	7	8	9	10	11	

TABLE VII. MINUTES IN DECIMALS OF A DEGREE

0′ 30″	.00833	10′ 30″	.17500	20′ 30″	.34167	30′ 30″	.50833	40′ 30″	.67500	50′ 30″	.84167
1 00	.01667	11 00	.18333	21 00	.35000	31 00	.51667	41 00	.68333	51 00	.85000
30	.02500	30	.19167	30	.35833	30	.52500	30	.69167	30	.85833
2 00	.03333	12 00	.20000	22 00	.36667	32 00	.53333	42 00	.70000	52 00	.86667
30	.04167	30	.20833	30	.37500	30	.54167	30	.70833	30	.87500
3 00	.05000	13 00	.21667	23 00	.38333	33 00	.55000	43 00	.71667	53 00	.88333
30	.05833	30	.22500	30	.39167	30	.55833	30	.72500	30	.89167
4 00	.06667	14 00	.23333	24 00	.40000	34 00	.56667	44 00	.73333	54 00	.90000
30	.07500	30	.24167	30	.40833	30	.57500	30	.74167	30	.90833
5 00	.08333	15 00	.25000	25 00	.41667	35 00	.58333	45 00	.75000	55 00	.91667
30	.09167	30	.25833	30	.42500	30	.59167	30	.75833	30	.92500
6 00	.10000	16 00	.26667	26 00	.43333	36 00	.60000	46 00	.76667	56 00	.93333
30	.10833	30	.27500	30	.44167	30	.60833	30	.77500	30	.94167
7 00	.11667	17 00	.28333	27 00	.45000	37 00	.61667	47 00	.78333	57 00	.95000
30	.12500	30	.29167	30	.45833	30	.62500	30	.79167	30	.95833
8 00	.13333	18 00	.30000	28 00	.46667	38 00	.63333	48 00	.80000	58 00	.96667
30	.14167	30	.30833	30	.47500	30	.64167	30	.80833	30	.97500
9 00	.15000	19 00	.31667	29 00	.48333	39 00	.65000	49 00	.81667	59 00	.98333
30	.15833	30	.32500	30	.49167	30	.65833	30	.82500	30	.99167
10 00	.16667	20 00	.33333	30 00	.500000	40 00	.66667	50 00	.83333	60 00	1.00000

TABLE VIII. MIDDLE ORDINATES OF RAILS

Length of Rail (feet)

C ° ′	R Feet	30 Inch	28 Inch	26 Inch	24 Inch	22 Inch	20 Inch	C °	R Feet	30 Inch	28 Inch	26 Inch	24 Inch	22 Inch	20 Inch
0–20	17189	.08	.07	.06	.05	.04	.03	8	716.8	1.88	1.64	1.42	1.20	1.01	.84
0–40	8594	.16	.14	.12	.10	.08	.07	9	637.3	2.12	1.84	1.60	1.35	1.14	.94
1–0	5730	.24	.20	.18	.15	.13	.10	10	573.7	2.36	2.05	1.78	1.50	1.27	1.04
1–20	4297	.31	.27	.23	.20	.17	.13	11	521.7	2.59	2.26	1.95	1.65	1.39	1.15
1–40	3438	.39	.34	.29	.25	.21	.17	12	478.3	3.83	2.47	2.15	1.81	1.54	1.26
2–0	2865	.47	.41	.35	.30	.25	.20	13	441.7	3.05	2.66	2.30	1.96	1.66	1.36
2–20	2456	.55	.48	.41	.35	.29	.23	14	410.3	3.30	2.87	2.48	2.10	1.78	1.46
2–40	2149	.63	.55	.47	.40	.33	.27	15	383.1	3.54	3.08	2.68	2.26	1.91	1.57
3–0	1910	.71	.62	.53	.45	.38	.31	16	359.3	3.76	3.28	2.83	2.40	2.04	1.67
3–20	1719	.78	.68	.59	.50	.42	.35	17	338.3	4.00	3.48	3.02	2.57	2.16	1.78
3–40	1563	.86	.75	.65	.55	.46	.38	18	319.6	4.21	3.67	3.18	2.70	2.28	1.87
4–0	1433	.94	.82	.71	.60	.50	.42	19	302.9	4.45	3.89	3.36	2.86	2.41	1.98
4–20	1323	1.02	.89	.77	.65	.55	.45	20	287.9	4.70	4.09	3.55	3.00	2.54	2.09
4–40	1228	1.10	.96	.83	.70	.59	.48	22	262.0	5.16	4.44	3.84	3.30	2.80	2.29
5	1146	1.18	1.03	.89	.75	.63	.52	24	240.5	5.64	4.92	4.20	3.59	3.04	2.50
6	955.3	1.41	1.23	1.06	.90	.76	.62	26	222.3	6.07	5.29	4.58	3.88	3.29	2.70
7	819.0	1.65	1.44	1.24	1.05	.89	.73								

TABLE IX. SHORT RADIUS CURVES

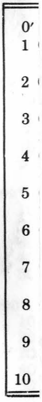
Radius Feet	Chord Feet	Central Angle	Deflection Angle	Deflection for 1 Foot
35	10	16-26	8-13	49.3
45	10	12-46	6-23	38.3
50	15	17-16	8-38	34.5
60	15	14-22	7-11	28.8
75	15	11-30	5-45	23.0
100	20	11-30	5-45	17.3
120	20	9-34	4-47	14.3
150	20	7-39	3-49	11.5
190	25	7-32	3-46	9.15
200	25	7-10	3-35	8.6
225	25	6-25	3-12	7.7
240	25	5-58	2-59	7.2
250	25	5-44	2-52	6.9
275	25	5-12	2-36	6.2
288	50	9-58	4-59	6.0
300	50	9-32	4-46	5.7
350	50	8-12	4-06	4.9
376	50	7-40	3-50	4.6
400	50	7-10	3-35	4.3
410	50	7-00	3-30	4.2

To find length of curve divide angle from P. C. to P. T. by central angle of chord, and multiply by length of chord.

TABLE X. RODS IN FEET, 10THS AND 100THS OF FEET

Rods	Feet	Rods	Feet	Rods	Feet	Rods	Feet	Rods	Feet
1	16.50	21	346.50	41	676.50	61	1006.50	81	1336.50
2	33.00	22	363.00	42	693.00	62	1023.00	82	1353.00
3	49.50	23	379.50	43	709.50	63	1039.50	83	1369.50
4	66.00	24	396.00	44	726.00	64	1056.00	84	1386.00
5	82.50	25	412.50	45	742.50	65	1072.50	85	1402.50
6	99.00	26	429.00	46	759.00	66	1089.00	86	1419.00
7	115.50	27	445.50	47	775.50	67	1105.50	87	1435.50
8	132.00	28	462.00	48	792.00	68	1122.00	88	1452.00
9	148.50	29	478.50	49	808.50	69	1138.50	89	1468.50
10	165.00	30	495.00	50	825.00	70	1155.00	90	1485.00
11	181.50	31	511.50	51	841.50	71	1171.50	91	1501.50
12	198.00	32	528.00	52	858.00	72	1188.00	92	1518.00
13	214.50	33	544.50	53	874.50	73	1204.50	93	1534.50
14	231.00	34	561.00	54	891.00	74	1221.00	94	1551.00
15	247.50	35	577.50	55	907.50	75	1237.50	95	1567.50
16	264.00	36	594.00	56	924.00	76	1254.00	96	1584.00
17	280.50	37	610.50	57	940.50	77	1270.50	97	1600.50
18	297.00	38	627.00	58	957.00	78	1287.00	98	1617.00
19	313.50	39	643.50	59	973.50	79	1303.50	99	1633.50
20	330.00	40	660.00	60	990.00	80	1320.00	100	1650.00

TABLE XI. LINKS IN FEET, 10THS AND 100THS OF FEET



Links	Feet	Links	Feet	Links	Feet	Links	Feet	Links	Feet	Links	Feet
1	0.66	18	11.88	35	23.10	52	34.32	69	45.54	86	56.76
2	1.32	19	12.54	36	23.76	53	34.98	70	46.20	87	57.42
3	1.98	20	13.20	37	24.42	54	35.64	71	46.86	88	58.08
4	2.64	21	13.86	38	25.08	55	36.30	72	47.52	89	58.74
5	3.30	22	14.52	39	25.74	56	36.96	73	48.18	90	59.40
6	3.96	23	15.18	40	26.40	57	37.62	74	48.84	91	60.06
7	4.62	24	15.84	41	27.06	58	38.28	75	49.50	92	60.72
8	5.28	25	16.50	42	27.72	59	38.94	76	50.16	93	61.38
9	5.94	26	17.16	43	28.38	60	39.60	77	50.82	94	62.04
10	6.60	27	17.82	44	29.04	61	40.26	78	51.48	95	62.70
11	7.26	28	18.48	45	29.70	62	40.92	79	52.14	96	63.36
12	7.92	29	19.14	46	30.36	63	41.58	80	52.80	97	64.02
13	8.58	30	19.80	47	31.02	64	42.24	81	53.46	98	64.68
14	9.24	31	20.46	48	31.68	65	42.90	82	54.12	99	65.34
15	9.90	32	21.12	49	32.34	66	43.56	83	54.78	100	66.00
16	10.56	33	21.78	50	33.00	67	44.22	84	55.44	101	66.66
17	11.22	34	22.44	51	33.66	68	44.88	85	56.10	102	67.32

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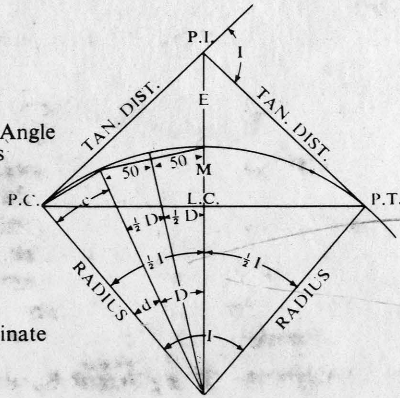
CURVE FORMULAE

D = Degree of Curve
1° = 1-Degree of Curve
2° = 2-Degree of Curve
P.C. = Point of Curve
P.T. = Point of Tangent
P.I. = Point of Intersection
I = Intersection of Angle, Angle between Two Tangents
L = Length of Curve, from P.C. to P.T.
T = Tangent Distance
E = External Distance
R = Radius
L.C. = Length of Chord
M = Length of Middle Ordinate
c = Length of Sub-Chord
d = Angle of Sub-Chord



$$R = \frac{L.C.}{2 \sin \frac{1}{2} I} \quad T = R \tan \tfrac{1}{2} I = \frac{L.C.}{2 \cos \frac{1}{2} I}$$

$$\frac{L.C.}{2} = R \sin \frac{I}{2}, D\,1° = R = 5730, D\,2° = \frac{5730}{2}, D = \frac{5730}{R}$$

$$M = R\,(1 - \cos \tfrac{1}{2} I), = R - R \cos \frac{I}{2}$$

$$\frac{E + R}{R} = \sec \frac{I}{2}, \frac{R - M}{R} = \cos \frac{I}{2}$$

$$c = 2\,R \sin \tfrac{1}{2} d, d = \frac{c}{2\,R}$$

$$L.C. = 2\,R \sin \tfrac{1}{2} I, E = R\,(\sec \tfrac{1}{2} I - 1), = R \sec \frac{I}{2} - R$$

Minutes in Decimals of a Degree

1′	·0167	11′	·1833	21′	·3500	31′	·5167	41′	·6833	51′	·8500
2	·0333	12	·2000	22	·3667	32	·5333	42	·7000	52	·8667
3	·0500	13	·2167	23	·3833	33	·5500	43	·7167	53	·8833
4	·0667	14	·2333	24	·4000	34	·5667	44	·7333	54	·9000
5	·0833	15	·2500	25	·4167	35	·5833	45	·7500	55	·9167
6	·1000	16	·2667	26	·4333	36	·6000	46	·7667	56	·9333
7	·1167	17	·2833	27	·4500	37	·6167	47	·7833	57	·9500
8	·1333	18	·3000	28	·4667	38	·6333	48	·8000	58	·9667
9	·1500	19	·3167	29	·4833	39	·6500	49	·8167	59	·9833
10	·1667	20	·3333	30	·5000	40	·6667	50	·8333	60	1·0000

Inches in Decimals of a Foot

$\frac{1}{16}$	$\frac{3}{32}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$
·0052	·0078	·0104	·0156	·0208	·0260	·0313	·0417	·0521	·0625	·0729
1	2	3	4	5	6	7	8	9	10	11
·0833	·1667	·2500	·3333	·4167	·5000	·5833	·6667	·7500	·8333	·9167

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