APPENDIX C

Ethnographic Study

REDACTED

APPENDIX D

Geological Coring Study

FIELD NOTES ON THE GEOLOGY OF THE ANDERSON & MIDDLETON AND THE ABERDEEN LOG YARD POTENTIAL PONTOON CONSTRUCTION SITES

by

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LOCATION:

The two sites lie on the northeast side of Grays Harbor. They are several miles apart with the Aberdeen Log Yard (ALY) site east of the Anderson and Middleton (A&M) site (figures 1& 2). The survey locations and elevations of the holes on the ALY site are in Table 1. There are no survey data from the A&M site. In addition to the boreholes planned and funded for this study, some information from geotechnical borings on the ALY site is included. The Landau geologists were kind enough to allow the examination and logging of some of their cores as they were processing them. This was done on a" time available " schedule, which is the reason for the unusual distribution of the bore holes used in the report. (Figure 1).

PREVIOUS STUDIES:

While there have been several geological studies of Grays Harbor the two best related to this work were authored by Brian Atwater and Hemphill-Haley (1996) and Elson Barnett (1997).

Atwater pioneered the concept of subduction earthquakes and the associated subsidence. He has studied and written about these earthquakes for at least two decades.From his studies along intertidal outcrops of several NW coastal estuaries he has been able to describe and date at least six subduction zone events in the top 10 feet (3.2 meters) of the estuary. Relative to this work the subsidence events at Johns River and Elliot Slough bracket the pontoon sites east and west. It is also notable that the depth of the subsidence events Atwater describes occurs within the tidal range or about 10 feet from the top of the modern marshes. It is notable that none of the shallow subsidence events described by Atwater (1997were seen in this study. There are, however, some deeper subsidence events, described using the criteria developed by Atwater (1996)

Barnett (1997) worked in Grays Harbor as well as other northwest estuaries measuring the relative elevations of the modern estuarine edge environments of forest floor, high marsh, low marsh and colonizing marsh. The latter is Barnett's (1997) term

for the edge of the barren tidal flat. He also noted that the amount of peat development increased as the water depth decreased. Thus the high marsh contains more peat than the low marsh. Using the amount of peat development as a proxy for the environments he was able to determine the amount of subsidence occurring during past earthquakes. (Figure 3).

REGIONAL SETTING

Eastern end of Grays Harbor has been receiving fine grained estuarine sediments for about the last 10,000 RCYBP, (Onat *et al* 2007 Peterson & Phipps 1992). Before that it was channeling huge water volumes and glacial outwash gravel to the sea which lay some miles further west than the present shoreline when glacial sea level was at least 150 to 180 feet lower than it is now. As the glaciers melted and sea level raised the valley of the Chehalis River began to drown

The Holocene sediments compare favorably with those that are being deposited in the bay today. The simplistic historical scenario of Grays Harbor is one of sea level rising to drown the valley, stopping the transport of gravel and sand through the ancestral Chehalis River valley and providing accommodation space for the fine grained estuarine sediments.

This scenario is complicated by the fact that the region is subject to large subduction zone earthquakes and their associated subsidence events. Such subsidence events are read by the land as an instantaneous rise in sea level and concomitant change in the sediments from shallower water materials to deeper water materials. Unfortunately only shallow water depositional environments actually record such events. At the edges of the estuary the flora and sediments record long term changes in mean tidal height as little as 1 or 2 feet. Thus a subsidence of 3-6 feet generated by a great earthquake is easily registered. On the other hand changes of 3-6 feet in mean sea level do not alter the depositional regime in the barren tide flat. Consequently such events go unrecorded, as is the case in this study.

The appearance of Europeans changed the edges of the bay by filling in the tidal flats allowing construction of mills and docks along the deeper channel. The tidal flats

also provided a convenient area to place the dredged material obtained by maintaining the channel depths.

Finally these "flats" were covered with basalt, quarried from nearby Miocene flows. The basalt provided a suitable surface on which to support the logs and the heavy machinery required to move them about as they are sorted for market.

METHODS:

The cores were acquired using a truck-mounted Sonicore drill rig shown in figure 4 that yielded cores in 5 or 10-foot lengths depending on the sediment consistency. If the recovery was anticipated to be poor, shorter lengths were used. In extreme cases 2 or 3 foot lengths were used to maximize recovery. Lexan core liners were used to maintain the integrity of the cores until they were examined.

Several times the rig was moved a few feet and the upper 30 feet or so of the core was drilled again in an attempt to get better cores of the critical upper part of the section. This was done in holes A&M 1, 3, 4 and ALY 1 and 5. In all cases the best record was selected and used to create the core log plots.

The cores were taken through the entire estuarine section down to the glacial outwash gravels. These depths amounted to about 140 feet at the A&M site and 115 feet at the ALY site

The drilling assistants carried the cores to the near-by worktable where they were cut in two with a skill saw (figure 4). The split cores were photographed, examined, and described. A few samples were taken for carbon content, carbon-14 dating and microscopic examination for volcanic ash or pumice. However most of the examinations consisted of visual descriptions at the drill site.

The sediments were then discarded.

DATA

Field Notes and Core logs: The handwritten field notes were first put on a excel format, then scaled core logs were constructed from these field notes which were then put into cross sections for each site. The notes and logs are included in Appendix A ,B and D while the cross sections are presented below (Figures 8 and 9).

C-14 Dates: The thirteen C-14 dates that were taken for this study are shown in table 2. The calibration data for these dates are included in Appendix C. In most of the cores the dates increase in an orderly fashion with increasing depth. There are two exceptions to this pattern: One is in the fill which shows dates that are out of order, because people dumped materials of different ages onto the tide flats. The other occurs in the upper gravel deposits where the ages vary in depth from core to core. This is probably due to sampling cut and fill structures formed as different stream channels deposit sediment at different time.

Volcanics: Several of the cores at the Aberdeen Log Yard site and one core at the A&M site contained sand sized pumice grains. The pumice was mixed with silicate grains and thus not air fall deposits but transported to the site in water. The Landau geologists who were good enough to collect samples from their cores and share them first noted these. Later on volcanics were also noted in the cores taken during this study. Examination of the samples with a microscope confirmed that they were pumice. Since the volcanic sediments are distributed over a 15 ft section they may be products of more than one eruptive event. See table 3.

SEDIMENTS AND OTHER MATERIALS

Basalt: Granted that the black volcanic rock that covers these sites, is not sediment in the normal sense of the word. However its omnipresence deserves mention here for it covers the entire surface of both sites.. It was trucked in from local quarries and placed directly on the woody debris or on the hydraulic fill as a road metal type surface used to support the heavy equipment used on these sites. It is commonly 3 to 6 feet thick.

Wood: Pieces of wood appear in two forms in the cores. Fragments are produced when the drill bit tears apart larger boards, sticks or logs. These may be milled boards or natural forms. Unfortunately they are easily pushed down the hole by the casing and drill bit. Thus they may be found in the core some depth away from their in-hole source. The other form of wooden sediment, detrital wood, behaves like extremely low density formed by the abrasion of trees and branches.

Environmentally boards and logs are characteristic of tidal deposits in modern Grays Harbor especially near the shoreline. Much of the milled material and detrital wood was discarded as scrap or sawdust from the mills that existed on these sites.

Hydraulic Fill: Both sites have been used for the disposal of dredged materials. This material is not surprisingly unlike the natural sediment deposits described below. The filling occurred over periods of several years sometimes allowing vegetation to develop on the sites between disposal episodes and it is indiscriminately mixed with logs and boards. Sometimes it can be distinguished from the natural sediments below by it's coarse grain size.

Mud, silt &very fine sand: The most common recent sediment in the eastern end of Grays Harbor consists of very dark gray (10YR3/1) mud, silts and sometimes very fine sand. These sediments appear in two forms. Most commonly they are blended together as a massive deposit. They also appear as finely bedded or laminae in which the mud forms a distinct layer, separating the silt or very fine sand into layers. These laminated deposits can be seen in outcrops along the Johns River, where they overlay subsided marsh surfaces. They are probably not an indication of subsidence events but rather the shallow tidal water that follows such events. In any case laminated deposits of mud, silt and very fine sand occur throughout the Holocene sediments at this site.

Visual core descriptions discriminate poorly between sediments like sandy mud and muddy sand or silty mud. This is not that critical because these sediments all occur in a similar tide flat environment, and represent deposition in the barren tide flats and below.

Mud with some peat content: This material is quite different from the estuarine mud, silt and very fine sand described above. It is dryer and thus stiffer and it has a brownish tint (Munsell very dark grayish brown or 10YR3/2). Previous work in Grays

Harbor (Barnett, 1997) demonstrated increasing an organic content with increasingly shallower water. He (Barnett, 1997) named the layers as slightly peaty mud, peaty mud and muddy peat, each denoting a slightly more shoal environment. Affirming this observation there is an increasing peat content up section in the peaty parts of the cores taken in this study. However here the single term, peaty mud, is used to describe this type of sediment.

As the peat content increases so does the intensity of the brown color of the sediment. The normal color for these intertidal muds and silts is very dark gray or Munsell 10YR3/1. When the sediment becomes slightly peaty the color becomes very dark grayish brown or Munsell 10YR 3/2. While this is an extremely slight difference in color, it is easily seen in the bright sunlight conditions where these cores were described. The changes in color of the sediment was used as a proxy for the peat content and a proxy for the environments of deposition. Figure 5 shows these contrasting colors very well.

Barnett's (1997) measurements of the modern environments at Elliot Slough and Johns River show the height difference between the colonizing marsh (mudflat edge) and the forest edge to be 1.79 m (5.9 ft) and 1.93 m (6.3 feet) respectively. Applying these data to this study would mean that the forest floor would be about 6 vertical feet above the low marsh environment found just beneath the fill in some of the cores.

Coarse sand and gravel: The gravel and coarse sand sediments at the bottom of all the cores and in the middle part of the ALY cores are fluvial. They range in size from medium sand to cobbles up to 3 inches in diameter. The gravel at the bottom of all the cores is glacial outwash, carried to the sites by the Chehalis River. The gravel that occurs in the upper portions of the cores is probably more local in origin. In both cases the gravel represents a high-energy environment generated by river currents.

Clay Pebbles: Clay pebbles or mud clasts are rounded to sub angular bits of clay that when hardened act like any other detrital sediment (figure 6). The description of their formation in the geologic record is as follows: A clay or mud layer is hardened by drying and then fragmented by as water washes over them; then they are transported (to round them) and deposited. This formation applies here as well. The clay pebbles are also a much lighter gray suggesting organics normally associated with them have been oxidized. Such a desiccating environment would also be a condition for the formation of

mud cracks like those found in core AM-3. The classic description of mud crack formation starts with the desiccation of mud followed by filling the cracks with sand or coarse grain material (figure 7). Both of these enigmatic features, clay pebbles and mud cracks require non-traditional situations to form, or environmental conditions not common of modern tide flats.

Fossils: Macro-plant fossils have been the main stay of the paleoseismic work in Grays Harbor (Atwater, 1996, Shennen *et al* (1996)) because there are such great environmental indicators. There were only a few such plants found. For example, rooted Carex and Triglochin plants were found in the fill in cores AB-1 and AM-3.. The only meaningful plant fossils were found in AM-2 at 40.9 feet at the top of the 5000 RCYBP zone. Again these were the low marsh plants, Carex and Triglochin.

Fossil shells were found throughout the 7700 to 5000 RCYBP. Most come were tiny Macoma shells. These shells are extremely thin and fragile and thus are almost always broken. Other identifiable shell fragments were Barnacles (Balanus spp) blue mussels (Mytilus edulus), and mud clams (Mya spp)

STRATIGAPHY

The sediments in the northeastern part of Grays Harbor can be divided into five units based on environments of deposition and age. These units are: fill; 0 to 150 calendar years before the present (CYBP); fluvial and intertidal sediment 150 CYBP to 5000 radiocarbon years before the present (RCYBP); peaty mud and intertidal sediments 5000 RCYBP to 7700 RCYBP,[peaty mud 7700 RCYBP to 10,000 RCYBP; and gravel which is older that 10,000 RCYBP. See the cross sections, figures 8 and 9 and table 4.

Fill ; 0 TO 150 CYBP

In the ALY a low marsh covered by dredged material forms the base of this unit. The marsh appears in H-4, H-42, H-38 as well as AB-1 at depths of approximately 15 feet. Mottled silts and muds mark this surface in other cores (AB-4 and AB-2.) Next, a layer of woody debris both natural and man-made covers the dredged material. The

woody debris is covered with a top dressing of uniformly crushed basalt from local quarries. The basalt is generally 5-8 feet thick and forms a surface suitable for use by heavy machinery.

The fill at the A&M site is similar to that described above at the ALY site with the notable exception that it is at least 10 feet deeper. The stratigraphy starts with basalt top dressing over woody debris, both natural and milled. Then a layer of hydraulic fill placed over more boards and woody debris

. At both sites, the bottom of fill was determined on the absence of milled wood or first appearance of silty mud w/ disappearance of coarse grained material.

150 CYBP to 5000 RCYBP

In the ALY the fine grain sediments, mud and silt, make-up the upper portions of the mud cap in all the holes except AB-3. The upper part of this core contains uncharacteristically coarse sediment and an unusually deep fill placed at 24 feet.

Towards the bottom of this unit, in all the cores but AB-1 the sediment coarsens to sand and gravel. Thus the lower 10 feet of this unit is coarse sand or gravel that lies in sharp contact with the peaty mud of the unit below. This marks an erosional unconformity of about 3300 RCY.

At the A&M site this upper unit is composed of very fine grain sand, mud and silt and can rightfully be called a mud cap as it was in the IDD#1 site next door. The site of the unconformity mentioned above is at the A&M site, marked only by a subtle changes. These are: clay pebbles, detrital wood and plant and shell fragments and in AM-3 coarse sand and gravel.

So there is a disturbed zone in both sites. But the A&M site has no peaty mud and no gravel in 3 of the 4 cores making the unconformity more difficult to detect. In fact there is a zone of coarse to medium sand at the 65 foot level in cores AM-1,AM-2, AM-3 that may mark the unconformity. The problem could be resolved by surveyed elevations and more C-14 dates.

5000 RCYBP to 7700 RCYBP

At the ALY site a peaty mud lies directly below the unconformity. The peat content was determined by visual estimates of the intensity of the brown color of the organics. It grades from 10%-20% at the top to 0% peat over the next 5-10 feet. Then it blends into the normal very dark gray estuarine sediments.

Near the bottom of this unit there is another slightly peaty mud. This one, however, grades from typical estuarine mud, silt and very fine sand to a peaty mud and then grades back, with no sharp contacts. This illustrates the dynamic between sedimentation rate and water depth or sea level rise. The two processes are continually at play in the estuary. When the sea level rise rate exceeds the sedimentation rate the water depth is greater and fine sediments are deposited. However when the reverse happens the area shoals and peaty muds develop.

Several boreholes at the ALY site contained sand sized bits of pumice. The grains are well rounded and colored white with black ferromagnesian specks. They are always associated with medium to coarse silicate sand, indicating water transport rather than direct air fall. The pumice found at the sites is noteworthy because it indicates the ability of the Cascade volcanoes to contribute sediment to these distal sites.

At the A&M there is no peaty mud and no gravel in contrast with the ALY site. As mentioned above the unconformable contact with the upper, younger unit is represented by clay pebbles, plant and shell fragments and in A&M –3 coarse sand.

There are two zones of clay pebbles at the A&M site. One at 70 feet that appears in three in of the holes, AM-1, AM-2, and AM-4 which correlates to a medium grain sand in AM-3 .The other zone of clay pebbles extends from 75 to 85 feet in the same three cores, AM-1, AM-2, and AM-4. There are also clay pebbles in AB-1, AB-2 on the ALY site.

At both ALY and A&M sites the lower–most sediments are silty muds and muddy silts which rest on a massive layer of peaty mud.

7700 to 10,000 RCYBP

At depths of about 100 –108 feet in the A&M cores there is another peaty mud horizon. This horizon is continuous from this site through the IDD#1 site to the ALY site where it found at 93 to 98 feet. It has been recognized by the Landau geologists (Landau, 2006, 2009) as unit # 3. The visual estimates of peat content range from a max of 20-30% at the top down to 0% near the bottom.

In figure 5 (AM-1 @ 108 feet) one can see the sequence of peaty mud, sand and deeper water silts and muds. This classic sequence implies sudden subsidence of a marsh overlain by a tsunami sand which is, in turn, overlain by deeper water muds.

. The sharp contacts indicate an abrupt change in paleo-depth is consistent with a rapid subsidence event. In all the AM cores the peaty mud is overlain by fine sand while in core AB-1 this contact is overlain by medium sand In several cores at both sites the contact is overlain silt with sand laminae. The latter stratigraphy is reminiscent of the sediments overlying the 300yr. event in the Johns River. The lateral continuity and the sharp contacts with the deep water silts and muds make this a good candidate for a subsidence event marker.

Under the peaty mud there is often a short interval of the more common very dark gray mud and silts. These lie in sharp contact with the coarse sediments underneath.

>10,000 RCYBP

All the cores bottom in coarse gravelly sand that grades to sandy gravel. These sediments contains rocks up to 2-3" in diameter indicating an extremely high energy environment.

. At the A&M site three cores have mud, fine sand or detrital wood resting on the gravel while one has silt with interbeds of medium sand resting on the gravel. The ALY site cores all have sands as transitional sediment between the peaty mud and the gravel.

In most cases the contact between the mud and the coarser sediment is sharp. If the change from high energy gravel to low energy estuarine mud were only the result of

drowning of the estuary by the post-glacial sea level rise the contact would not be sharp. The sharp contact implies a subsidence event may have hastened the drowning of the Chehalis River Valley

CONCLUSIONS

Ten thousand years ago the Chehalis River Valley was drown by a rising sea level and the deposition of the gravel ceased. Both sites were changed into tide flats that quickly became marshes. Measured by increasing peat content the sites shoaled to a high marsh environment by 7700 RCYBP. Then a large subsidence event turned both sites into barren tide flats. These tide flats vacillated back and forth between barren and low marsh environments as shoaling rates and sea level rise waxed and waned. By 5000 RCYBP the ALY site had regained its marsh environment but the A&M site plodded along as a barren tide flat.

The record for the next 3300 RC years is missing at the ALY. When the site is again able to accommodate sediments, they were fluvial sand and gravel and only 1600 to 1000 RCY old. The river that ran through the site may have eroded some of the record, or may have just kept it non-depositional. In any case when the sediments return, they do so as gravel and coarse sand.

There were no such exciting events at the A&M site. The unconformity that shouted out from the ALY barely whispered at the A&M site. This site looks like the same kind of sediments that were being deposited prior to 5000RCYB were also being deposited afterwards.

It's notable that the a gap of 3300 years in 10,000 years worth of sediment, (i.e. the entire column) means one third of the total sedimentary record is missing.

When sedimentation resumed after the hiatus the gravel at the ALY graded back into estuarine sediments, except in the SE corner (Core # AB-3) which maintained coarse sand and gravel deposition almost up to the time it was filled.

The A&M site continued normal estuarine sedimentation up until it was filled. by dumping logs, boards and dredged materials on each site. The frosting on the layer cake is 3-6 feet of basalt .

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Special thanks to Tait Elder and Keith Syda from Jones and Stokes who helped with the processing of the cores and to Landau geologist Brian Christianson, for sharing the samples and data.

Captions

Figure 1. Bore hole locations at the Aberdeen Log Yard (ALY) site. The holes labeled AB were drilled for this study. All the other holes were drilled by Landau.Associates.

Figure 2. Bore hole locations at the Anderson and Middleton (A&M) site.

Figure 3. The relationship of the peat content of the mud to the plant communities and thus to the mean tidal level. After Barnett (1997)

Figure 4. The Sonicore drill rig. (*above*). The split core on the examination table. (*below*)

Figure 5. The sequence of sub-tidal mud, tsunami (?) sand and muddy peat showing an abrupt change is paleodepth of several feet. This is from a depth of 108 feet in core AM-1.

Figure 6. Clay pebbles in a sandy matrix.

Figure 7. Mud cracks. These cracks are 2 to 3 inches long

Figure 8a. Stratigraphic cross-sections, lithologies and C-14 dates for the upper part of the cores from the A&M site.

Figure 8b. Stratigraphic cross-sections, lithologies and C-14 dates for the lower part of the cores from the A&M site

Figure 8c. Stratigraphic cross-sections, lithologies and C-14 dates for the bottom part of the cores from the A&M site

Figure 9a. Stratigraphic cross-sections, lithologies and C-14 date for the upper part of the cores from the ALY site.

Figure 9b. Stratigraphic cross-sections, lithologies and C-14 date for the lower part of the cores from the ALY site.

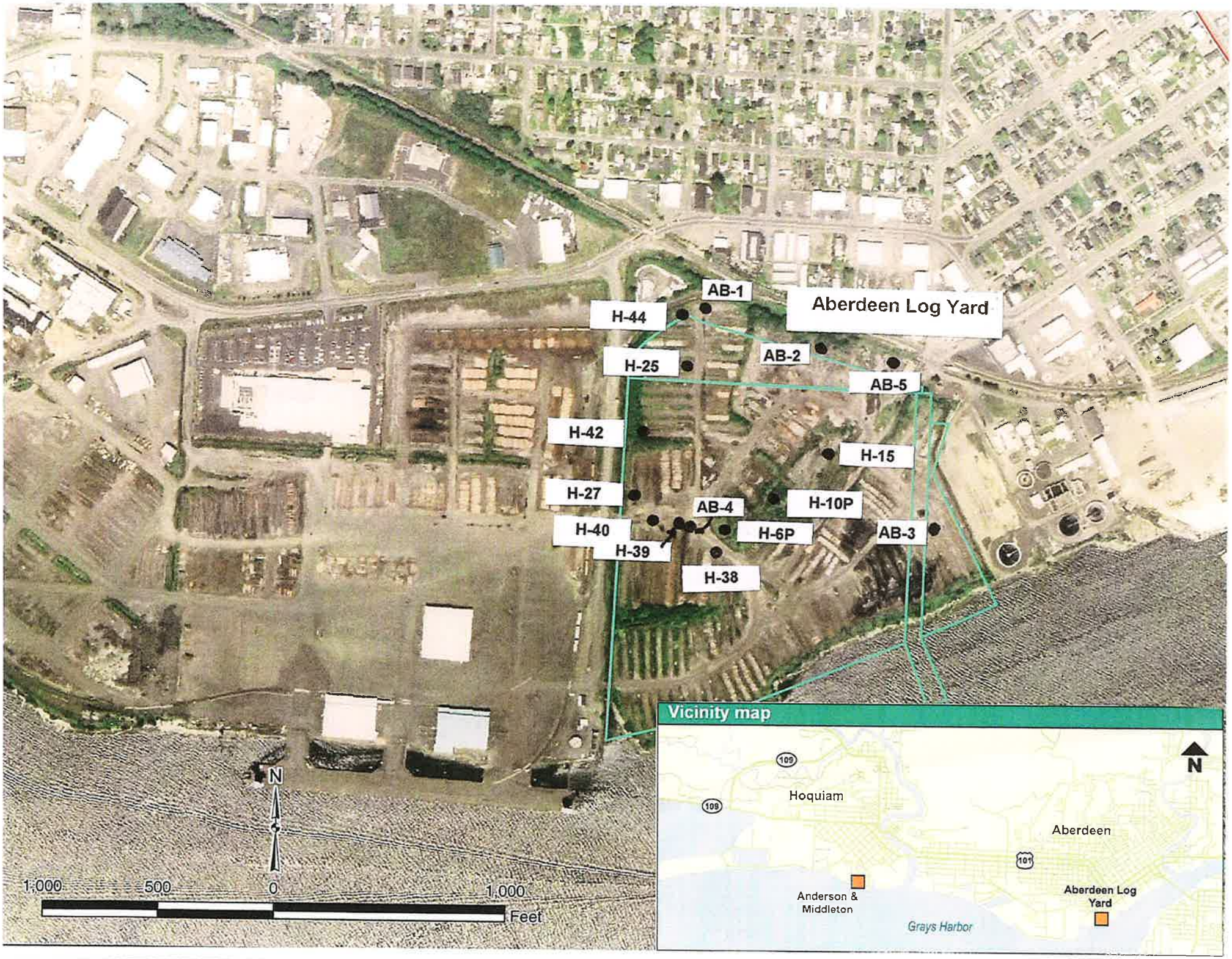
Table Captions

Table 1. WSDOT survey of the hole locations at the ALY site.

Table 2. Carbon –14 dates listed with the depth in the core and the stratigraphic interval

Table 3. The elevations of the volcanic sediments found on the ALY site.

Table 4. Stratigraphic tops at the A&M and ALY sites. Compare these with figures 5 & 6


Aberdeen Log Yard
AB-1
AB-2
AB-3
AB-4
AB-5
H-44
H-25
H-42
H-27
H-40
H-39
H-38
H-6P
H-10P
H-15
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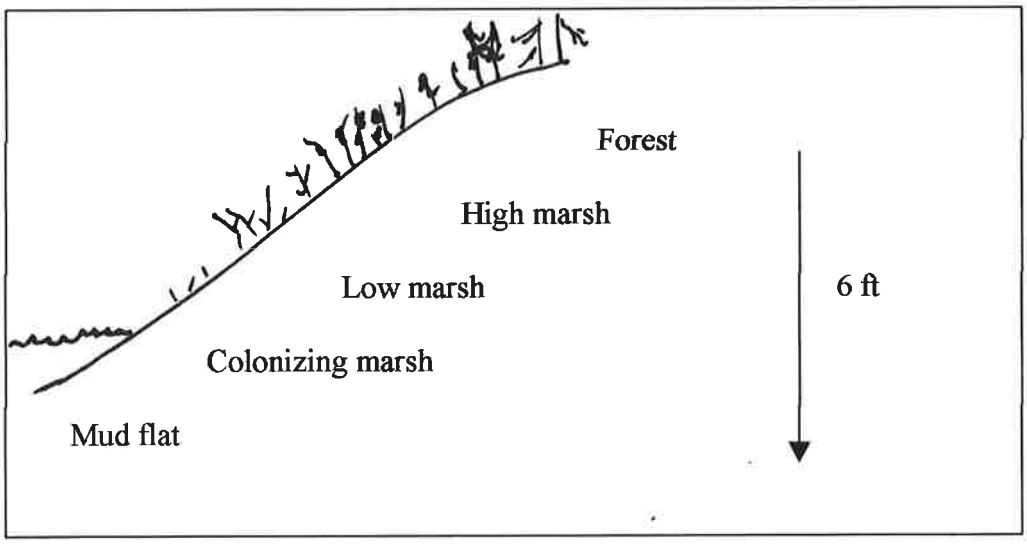
Feet
Vicinity map
N
109
Hoquiam
Aberdeen
101
Anderson &
Middleton
Aberdeen Log
Yard
Grays Harbor

Anderson & Middleton
A&M-1
A&M-2
A&M-3
A&M-4



Lithology	% Peat	Environment
Peat	<80%	High marsh/forest
muddy peat	50-80%	High marsh
peaty mud	20-50%	Low marsh
slightly peaty mud	5-20%	colonizing/low marsh
rooted mud	<5%	colonizing marsh

BOART LONGYEAR

5

Am-1
108 84

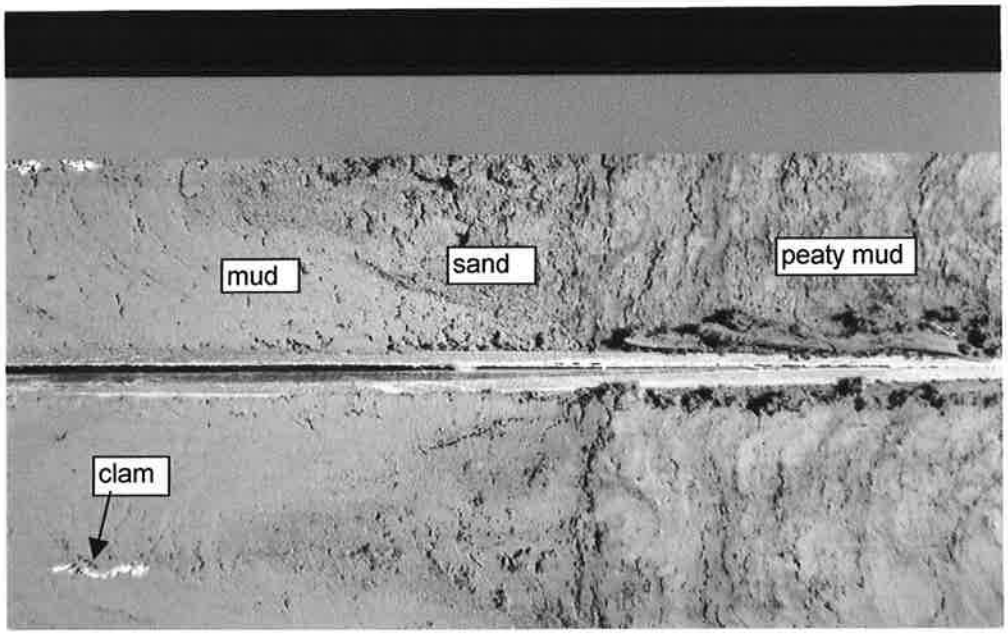


Fig 6

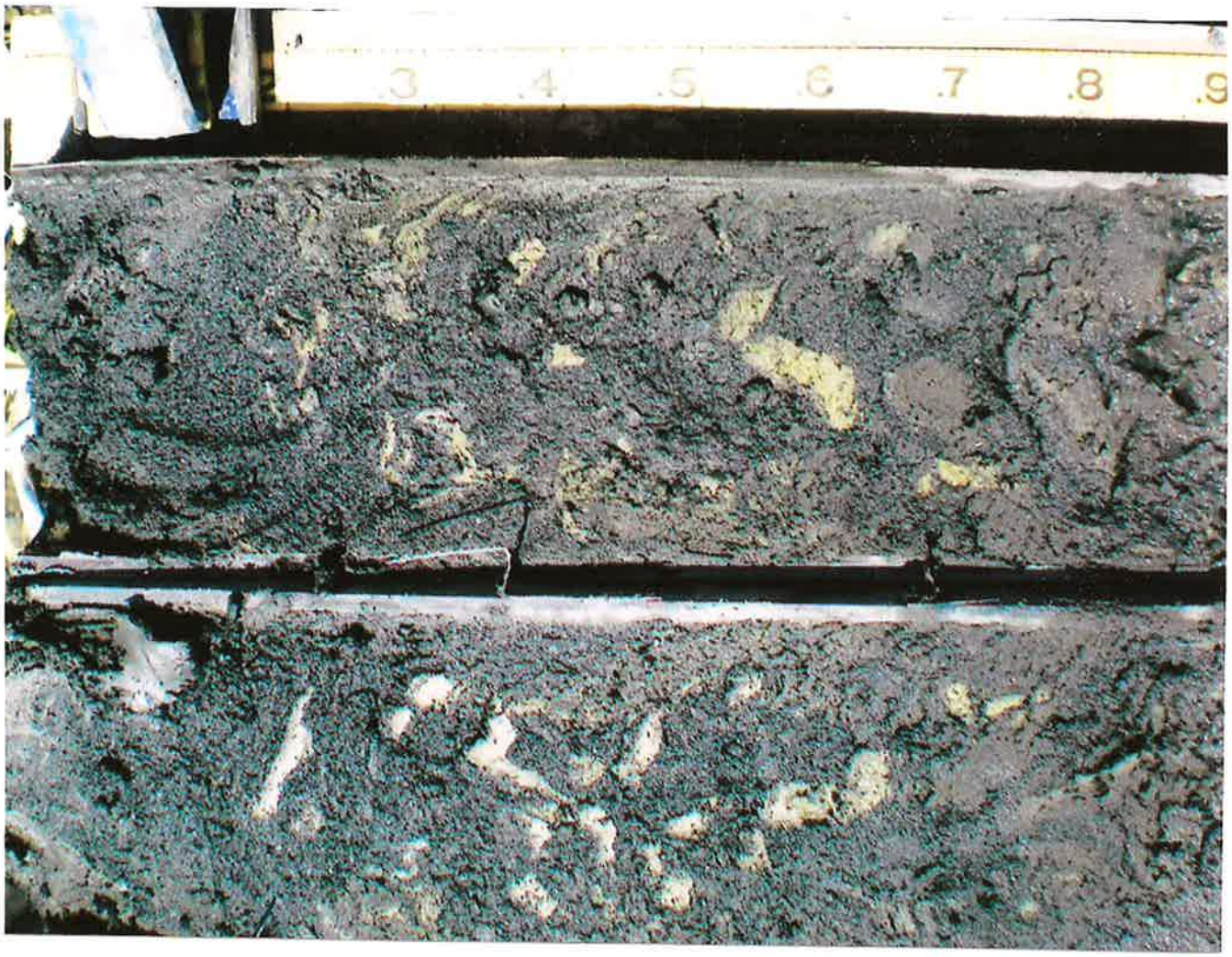
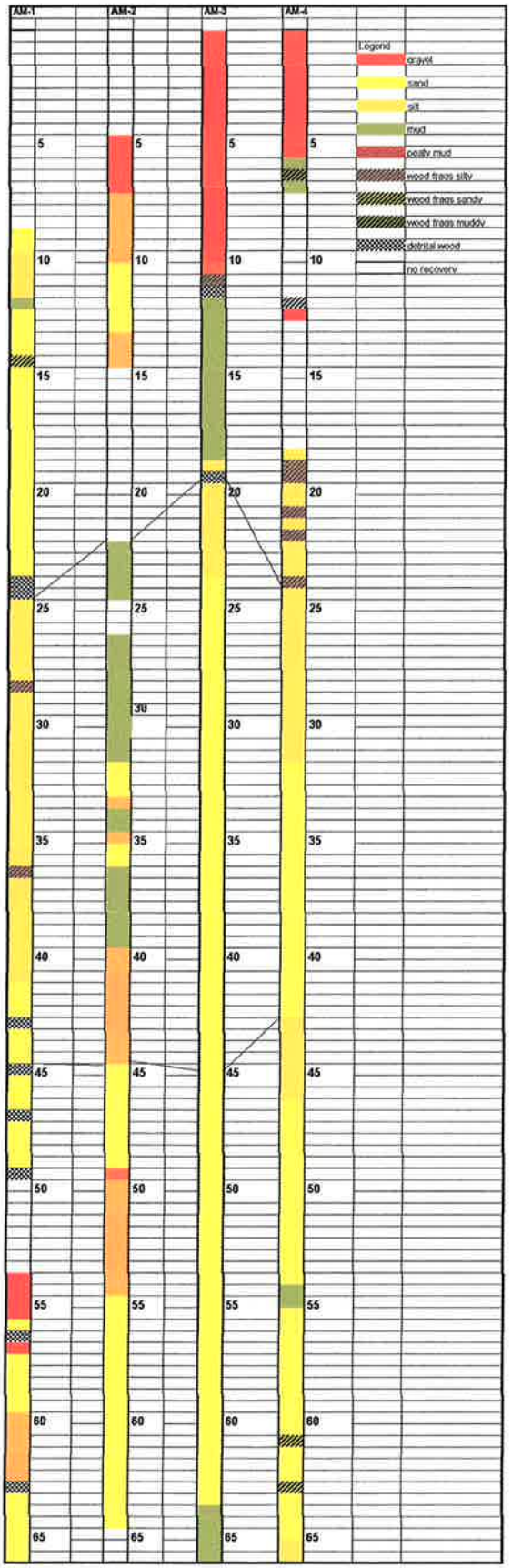


Fig 7


AM-1
AM-2
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wood frags sandy
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detrital wood
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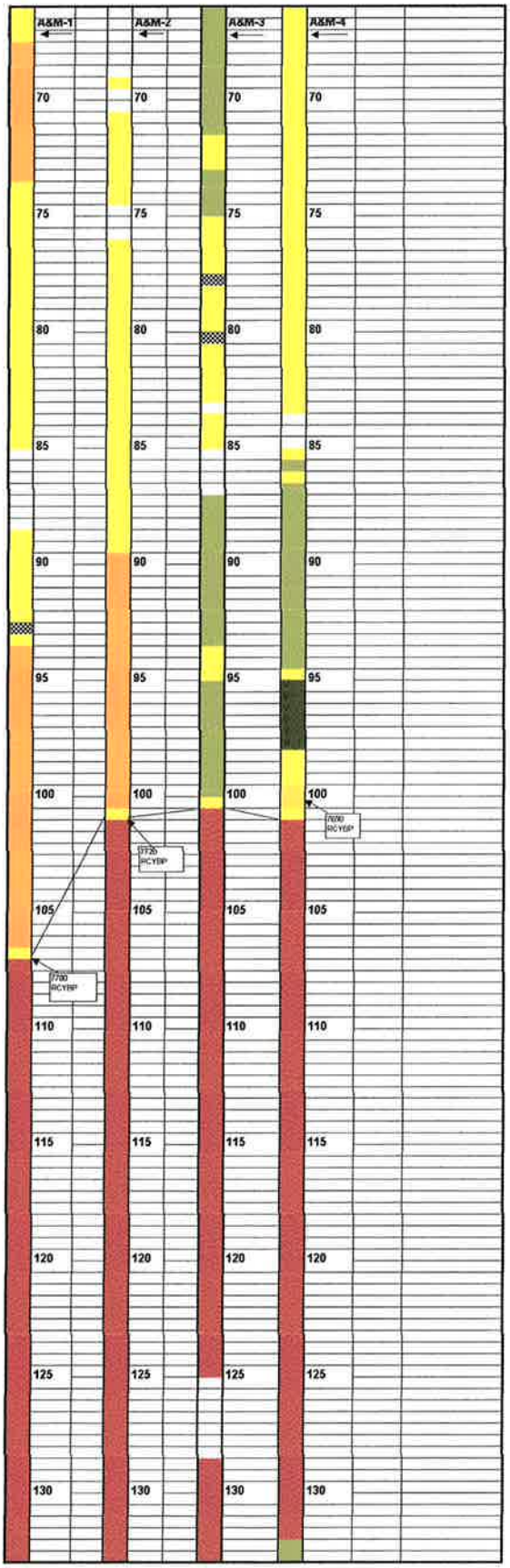
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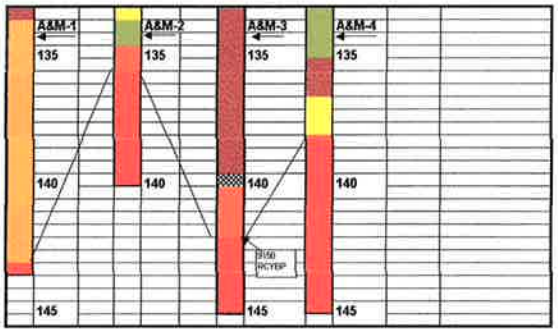
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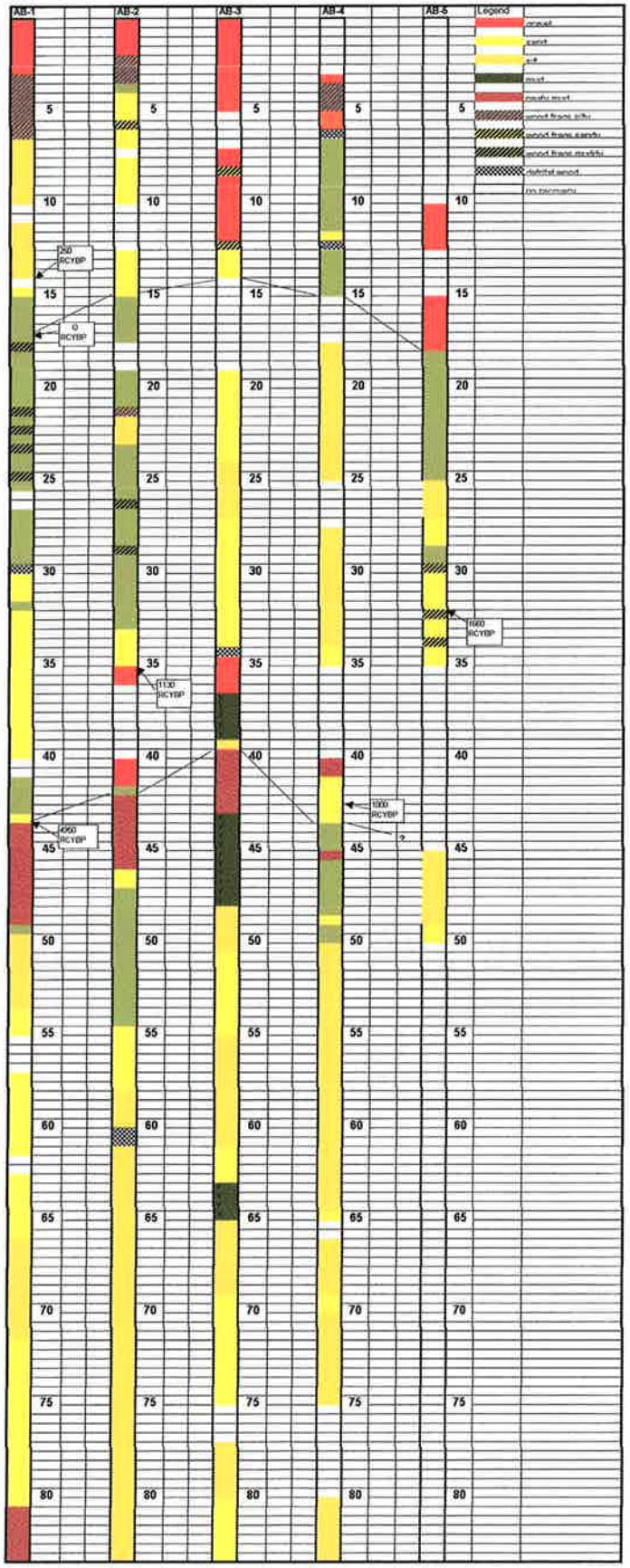
Fig 9a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80
250 RCYBP
0 RCYBP
1100 RCYBP
4000 RCYBP
1000 RCYBP
?

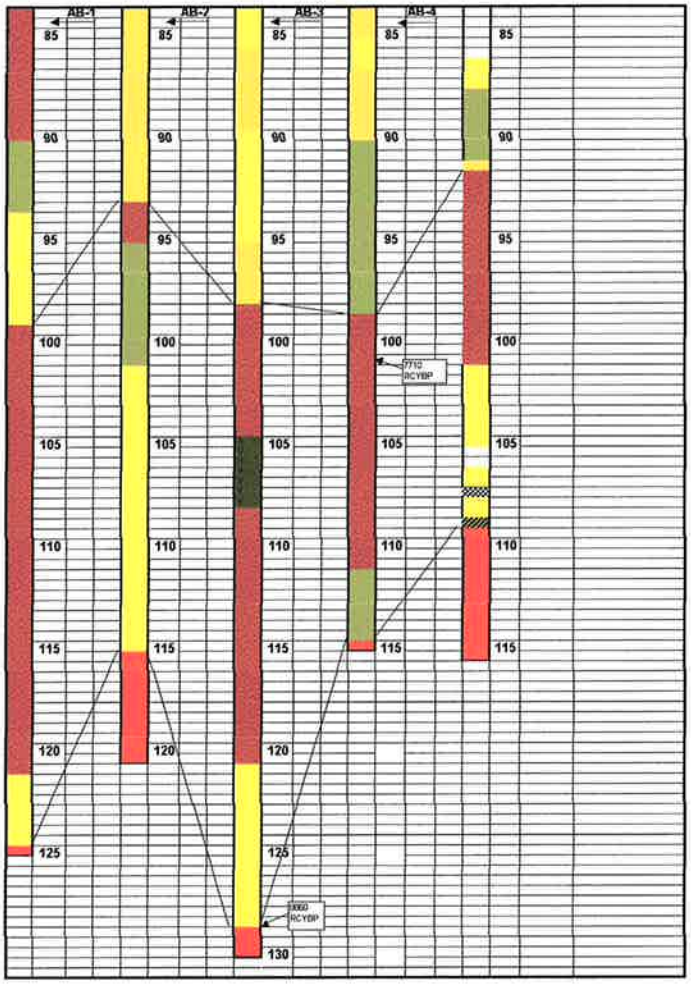
AB-1
AB-2
AB-3
AB-4
85
90
95
100
105
110
115
120
125
130
0712
RCYBP
3060
RCYBP

Table 1

WSDOT'S ABERDEEN LOG YARD SURVEYED HOLE LOCATIONS

Boring #	N	E	Z
Parametrix holes logged by Parametrix Geologist			
AB-1	613273.6	807989.5	16.7
AB-2	613042.9	808480.9	15.1
AB-3	612420.9	809001.6	12.6
AB-4	612221.5	808068.5	15.7
AB-5	613014.7	808787.2	11.7
Landau hole also logged by Parametrix Geologists			
H-38	612220.7	808064.2	16.0
H-39	612332.6	807944.4	16.3
H-40	612357.8	807760.3	15.6
H-42	612680.9	807701.0	17.3
H-44	613229.0	807849.9	20.9
.andau holes sampled for volcanics by Landau Geologists			
H-15P	612484.9	808426.8	14.7
H-25	613095.8	807912.2	18.8
H-10P	612386.8	808246.3	31.6
H-6P	612709.3	808370.0	17.2

Table 2

		C-14 DATA			
CORE	**DEPTH**	**BETA#**	**RCYBP**	**CYBP**	**NOTE**
AB-3	129	263292	8860+/-50	9900	lower gravel
AM-3b	142.6	263299	9150+/-50	10260	lower gravel
AM-2	102	263297	7720+/-50	8520	lower peaty mud
AM-1b	108	263296	7780+/-50	8440	lower peaty mud
AM-4	100.8	263300	7690+/-50	8450	lower peaty mud
AB-4	100.9	263294	7710+/-50	8510	lower peaty mud
AB-1b	43.2	263290	4950+/-40	5660	upper peaty mud
AB-2	35	263291	1130+/- 40	930	upper gravel
AB-5	31.8	263295	1660+/-40	1550	upper gravel
AB-4	42.1	264293	1000+/-40	930	upper gravel
AB-1a	14.3	263289	250+/- 40	300	Fill
AB-1a	16.4	263288	modern	0	Fill
AM-1	15.92	263298	7130+/-50	7960	Fill

Tbl 3

		Volcanics		
Core	Depth ft	Hole Elevation(ft)	Sample Elevation	Material
AB-3	69-71	12.6	56.4	pumice
AB-4	85.2	15.7	69.5	ash
AM-4	85.4			pumice &ash
H25 09	64-65.5	18.8	45.2	pumice
H10P-09	84-85.5	31.6	52.4	pumice
H6P-09	75-75.5	17.2	57.8	pumice
H15-09	65	14.7	50.3	pumice

Table A

STRATIGRAPHIC TOPS
Anderson Middleton site
feet

Unit		Material	Core	AM-1	AM-2	AM-3	AM-4
Top of fill		Fill		0	0	0	0
Bottom of fill		Mud cap		22	23	24	25
5000	RCYBP	Intertidal seds		45	41	44	43
7700	RCYBP	Lower peaty mud		108	102	100	101
10,000	RCYBP	Gravel		145	135	142	138

STRATIGRAPHIC TOPS
Aberdeen Log Yard Site
feet

			Core	AB-1	AB-2	AB-3	AB-4	AB-5
Top of fill		Fill		0	0	0	0	0
Bottom of fill		Mud cap		15	15	24	16	15
5000	RCYBP	Upper peaty muds		43	42	40	44	
7700	RCYBP	Lower peaty mud		98	93	98	99	92
10,000	RCYBP	Gravel		124	115	128	114	110

Appendix A: Field core logs

SOME ABBREVIATIONS

vfs	equals	very fine sand
fs	equals	fine sand
med	equals	medium sand
crse	equals	coarse sand
w/	equals	with
dw	equals	detrital wood
DW	equals	detrital wood
frags	equals	fragments
VDG	equals	very dark gray or Munsell 10YR33/1
VDGB	equals	very dark gray brown or Munsell 10YR3/2

AM-1a						
Depth	**Sediment Type**	**Bedding**	**Grain size**	**Thickness**	**Color**	**Notes**
10	Not Collected	-	-	-	-	
10.8	sand	massive	med sand	-	VDG	
12.1	silt	massive	silt	-	black	
12.3	detrital wood	-	-	-	-	Detrital wood
12.9	mud	massive	mud	-	VDGB	
13	sand	massive	fine sand	-	VDG	with roots (rooted soil)
18	sand	massive	fine to medium sand	-	VDG	with wood fragments, few shell fragments
22	sand	massive	medium to coarse sand	-	VDG	subangular, well sorted sand
25	sand, silty	numerous DW interbeds	silty fine grained sand	0.5"	VDGB	wood fragments, occasional shell fragments at bottom
26.3	detrital wood	-	-	-	-	Detrital wood
33	silt	massive	silt	-	VDG	large wood frags ' shell fragments 29-30. dw interbed at 31.5
42.7	silt	massive	silt	-	VDG	many sticks and shell fragments
45	sand	2 DW interbeds	fine sand	0.5" - 1.0"	VDG	detrital wood, many sticks
50	sand	massive	medium to coarse sand	-	VDG	much detrital wood
50.7	sand, mud	interbeds of mud	medium sand, mud	.25-1.25"	VDG	much detrital wood
51.1	detrital wood	-	-	-	-	detrital wood
55	No Recovery	-	-	-	-	core catcher broken
57	sand, gravels	massive	medium to coarse sand	-	VDG	
58.4	sand, mud	mud laminae	medium sand with mud	-	VDG	medium sand with mud laminae
59.5	gravels, detrital wood	massive	gravel with detrital wood	-	VDG	gravel with detrital wood
61.7	sand, silt	silt interbeds	coarse sand	3" - 4"	VDG	
64.1	silt	laminated	silt	-	VDG	shell fragments
65	sand, detrital wood	massive	fine sand and gravel	-	VDG	fine to gravelly sand with detrital wood
67	sand	massive	fine sand	-	VDG	with clay pebble inclusions
68.6	sand, mud	mud interbeds	fine sand and mud	1.0"	VDGB	fine sand with mud interbeds, dw at 68.3
75	silt	laminated	silt	-	VDGB	with mud pebbles, 3 sand interbeds at 74.4
87	sand, silt, mud	laminated silt and mud	fine sand	-	VDG	mud shell fragments, no strats in bag sample

AM-1b						
Depth	**Sediment Type**	**Bedding**	**Grain size**	**Thick**	**Color**	**Notes**
85	sand, silt	massive	silty fine sand	-	VDG	bagged sample, no strats
90	No recovery	-	-	-	-	
93.8	sand, mud	occasional mud beds	very fine sand, mud	.12"	VDG	
95	sand	detrital wood interbeds	fine sand	-	top VDGB, bottom VDG	DW interbed at 94.1, abundant shells
100	silt, sand	fine sand interbeds	silt with fine sand	-	VDG	silt with fine sand interbeds, shells, extremely fine laminae. Macoma spp. identified
108	silt, sand	very fine sand interbeds	silt with very fine sand	.25"	VDG	very fine laminae, silt with very fine sand interbeds some shells in-situ at 107.6
108.1	sand	massive	fine sand	-	VDGB	tsunami deposit?
110	mud, peaty	laminae of peat	peaty mud	-	VDGB	30% peat at top, 20% peat at bottom
115	mud, peaty	massive	peaty mud	-	VDGB	10% peat
125	mud, peaty	finely laminated	slightly peaty mud	-	VDGB	5% peat
135	mud, peaty	finely laminated	peaty mud	-	VDGB	almost not peat until 127, then abruptly increases to 15%
137.5	silt, sandy	massive	slightly sandy silt	-	VDGB	silts are moist
144.7	silt, sandy	occasional interbeds of sand	silt with medium to coarse sand	1" - 3"	VDG	woody inclusions
145	gravels, sand	massive	sandy gravels	-	VDG	sharp interfaces with silt from above, glacial till

AM-2						
Depth	Sediment Type	Bedding	Grain Size	Thick	Color	Notes
0						
5	basalt					fill, geo fabric at 2 ft.
5.2	basalt					
7.5	gravels, muddy					
9.2	mud	massive			VDG	fill
10	silt	massive			B	
10.4	silt					
10.7	clay				7.5YR4/2 Dark brown	soil
13.7	very fine to medium	sand			2.5YR 4 Dark Gray	
14	silt				2.5YR 3/3 Very Dark Gray	
14.4	silt	3 interbeds of detrital wood			VDG(very dark gray)	interbeds of detrital wood
14.8	clay				VDG	
15	milled wood					piece of milled wood
20	sandy					sediment slough
23.3	sandy					sediment slough
23.8	mud	laminated			VDG	
24.3	mud with silt lamina	coase silt laminae			VDG	mud with silty laminae
25	mud	laminated			VDG	
27						sediment slough
30	silty mud	laminated			VDG	mud with silty laminae, broken shells at 28 ft, very small
31.4	silty mud				VDG	with some wood fibers
33.2	very fine sand				VDG	
33.6	muddy				VDG	muddy with wood frags and many gravels
35	silty mud	massive			VDG	
35.5	silt					milled wood at 35 ft. Operator argues that it is not from above (casing to 25 feet.
36.3	sand	laminated			VDG	
37	muddy sand	1/2" bedding			VDG	mud with very fine sand laminae
38	silty myd	laminae			VDG	mud with silt laminae
38.4	sand	laminated			VDG	
40	mud	laminated			VDG	minute shell fragments
45	sandy silt	laminated			VDG	plant fragments @ 40.9, detrital wood at 44.5, abundnt tiny shell frags
49.2	sand	massive			VDG	
50	silty mud	interbedded			VDG	
55	sand	?				cone at 54.1 ft, few wood frags (very soupy) no clear bedding
59.5	silty fine sand	massive			VDG	few shell frags
60	fine sand with mud	massive			VDG	few small pebbles in strat
65	sand	massive			VDG	subround bepple @63.8 ft. Shell frags, occasionally silty, 2 inches of mud@ 64.7 to 64.9
69	No recovery	-	-	-	-	liquified
70	silty sand	shale pebbles	very fine graine	-	shale pebbles: 2.5Y6/2 (light	wood fragments recovred in interbeds at 69.5 ft, shale pebbles at 69.5 ft
71	no recovery	-	-	-	-	slough
75	sand with pebbles	massive	fine grained	-	pebbles: light grey brown	with brown shale pebbles, wood at 73.5-74.2, wood debris
76.6	no recovery	-	-	-	-	slough
78.3	sand	massive	medium	-	VDG	
78.9	sand with silt	interbeds	very fine	.25"	VDG	shell fragments
80	sand	massive	fine	-	VDG	
83.2	sand	massive	very fine	-	VDG	wood fragments throughout
85	sand	interbeds of c	very fine	.12"	VDG	with shells, with brown clay, wood fragments throughout
87.5	sand	massive	very fine	-	VDG	slough?
90	sand	massive	very fine	-	VDG	with clay pebbles, abundant shells
90.4	No recovery	-	-	-	-	slough
93.2	silt with sand	fine sand inte	silt and fine sar	.50"	VDG	
95	silt with sand	laminated	silt with fine sa	-	VDG	fine sand laminae, small wood frags presenta
96.9	No recovery	-	-	-	-	slough
99.3	silt with sand	interbeds	fine sand	1"	VDG	
100	silt with sand	laminated	silt and sand	1"	VDG	black silt @ 99.6 (organic decomposition_
101.9	silt with sand	interbedding	silt with sand	-	VDG	seashells and wood present, silt with sand interbeds

102	sand	-	fine sand	-	VDG	possibly tsunami deposits
105	mud, peat	laminae	peaty mud	-	2.5Y4/2 Dark grayish brown	radiocarbon sample taken at interface, 15% peat
107.9	mud, peat	massive	peaty mud	-	dark grayish brown	5% peat
110.6	mud, peat	massive	peaty mud	-	dark grayish brown	15% peat
112.2	mud, peat	massive	peaty mud	-	dark grayish brown	10% peat
115	mud, silt	massive	silty mud	-	dark grayish brown	
120	mud, peat	massive	peaty mud	-	dark grayish brown	5% peat
125	mud	massive	mud	-	very dark greyish brown	few flecks of organics, no mica
131	mud	massive	mud	-	very dark grayish brown	grades into slighty sandier material at bottom of interface
133	mud, sandy	massive	sandy mud	-	very dark grayish brown	
133.5	sand	laminated	fine sand	-	very dark grayish brown	interbeds of mud
135	mud	interbedded	fine sand	-	very dark grayish brown	occasional fine sandy interbeds
135.5	silt, sand	massive	very fine sand	-	very dark grayish brown	
140	gravel, sand	massive	sandy gravels	-	very dark grayish brown	hit gravels

AM-3a								
Depth	**Sediment Type**	**Bedding**	**Grain Size**	**Thick**	**Color**	**Notes**		
5	basalt	-	-	-	-	Basalt fill		
7	fill	-	basalt	-	-	angular basalt pebbles		
7.6	gravels, rounded	-	-	-	-	rounded gravels-fill		
9	mud, silty	layers of detr	silty mud	-	Dark gray	detrital wood layers		
23	-	-	-	-	-	no recovery		
25	sand, mud	laminae	fine sand with	-	very dark gray	fine sand with occasional mud laminae		

AM-3b						
Depth	Sediment Type	Bedding	Grain Size	Thick	Color	Notes
10	Not collected	-	-	-	-	no sample taken
10.9	silt with wood fra	massive	silt	-	Very dark gray	many wood fragments
11.1	silt, sandy	laminated	very fine sand lam	-	Very dark gray	silt with very fine sand laminae
11.4	detrital wood	-	-	-	-	washed in and deposited
12.5	mud, silt	laminae w/ occ dw beds	mud with silt lami	.12"	Very dark gray	occasional detrital wood layers, mud and silt laminae
15.4	mud	massive	mud	-	Very dark gray	mud 10YR3/1, VDG
15.9	mud, siltu	massive	silty mud	-	Black	occasional roots, carex (sample collected), potentially low marsh
16.2	mud, rooted	massive	rooted mud	-	Very dark gray	2.5Y 3/2VDGB, sample collected, wood frag (lath) found
18.3	mud, silty	massive	silty mud	-	Black	
19.2	silt, muddy	massive	muddy silt	-	Very dark gray	carex leaf at lower interface
19.5	detrital wood	-	-	-	-	with broken shell
23.9	mud, silty	laminated below 25 ft, massive	silty mud	-	Very dark gray	organics at 21.1 ft, shell frags in laminated deposit, angular rock at 21.5
27.6	sand	massive	fine sand	-	Very dark gray	
43	sand, mud	laminated	fine sand	-	Very dark gray	broken shells, sand with mud laminae, soupy from 35-41 ft
44.3	sand, mud	occasional mud interbeds	medium sand, mu	-	Black	very black, stains fingers, numerous wood fragments
45.4	sand to gravel	-	coarse sand	-	Black	Mytilus edulus-blue mussel identified
48.7	sand	mud interbeds	fine sand	-	Mixed VDG and Black	occasional mud interbeds
53.4	sand	massive	fine to medium sa	-	black	mytilus and balanus fragments, abundant
55	sand, mud	laminae	fine sand and muc	-	Mixed VDG and black	with occasional mud laminae, shell frags (mytilus)
57.5	sand	massive	fine to medium sa	-	Very dark gray	
63.4	sand, silty	silt laminae, occ dw interbeds	very fine sand anc	-	VDG, black	occaisonal detrital wood beds with shell fragments
63.8	mud	massive	mud	-	Very dark gray	mudcracks
71	mud, sandy	interbeds of sand	fine sand	1"	Very dark gray	mud with interbeds of sand and organics, single large sand interbed at 67
71.5	mud	massive	mud	-	Very dark grey brown	detrital wood layers
73.1	sand, mud	interbeds of mud laminated	fine to medium sand, mud		Very dark gray	abundant detrital wood layers
74.5	mud	massive	mud	-	Very dark gray	
75	mud, silty	massive	silty mud	-	Very dark gray	
85	sand, muddy	interbeds of mud, lamnated	fine sand, mud		Very dark gray	interbeds range from laminae to 2/10", abundant detrital wood
87	No Recovery	-	-	-	-	
94.8	mud, silty	massive	slightly silty mud	-	Very dark gray	
95	sand	massive	fine to medium sa	-	Very dark gray	
99	mud, silty	massive	silty mud	-	Very dark gray	
100	mud, sandy	massive	sandy mud	-	Very dark gray	from 99 to 99.6 feet, sand dike
100.3	sand, mud	mud laminae	fine sand with mu	-	Very dark gray	mud laminae in upper put (possible tsunami deposit)
105	mud, peaty	massive	peaty mud	-	Very dark gray brown	10% peat, subsided deposit
106	sand	massive	medium sand	-	Very dark gray brown	slough?
110.7	mud, silty	massive	silty mud	-	Very dark gray brown	occasional shell frags
112	mud, peaty	massive	peaty mud	-	Very dark gray brown	10-15% peat
125	mud, peaty	laminae of peat	peaty mud	-	Very dark gray brown	10% peat, peat content varies from 0-10% in zones
128.1	No Recovery	-	-	-	-	
136.4	mud, peaty	laminae of peat	peaty mud	-	Very dark gray brown	10% peat, varies over core
138.5	mud, sand	interbeds of mud	very fine sand witl	.50" - 2"	Very dark gray brown	
139.9	sand	massive	very fine sand	-	Very dark gray brown	
140	detrital wood	-	-	-	Very dark gray brown	detrital wood
140.6	mud	laminated	mud	-	Very dark gray brown	
142.6	silt, sand	interbeds of sand	fine sand	.50" - 1"	Very dark gray	organics at lower interface (radiocarbon sample taken)
145	gravel, sandy	massive	sandy gravels	-	Very dark gray	glacial till

AM-4a						
Depth	Sediment Type	Bedding	Grain Size	Thick	Color	Notes
1	No collection	-	-	-	-	
1.5	soil	-	sandy silt	-	10YR4/6 Dark yellow	fill
5.5	basalt	-	subangular pebbles and silt	-	5Y 3/1	fill, mottled at base, multiple episodes, filter fabric at 3 ft
6.3	soil	-	-	-	Multiple, as above	A and B horizons
6.8	mud, gravels	-	gravelly mud	-	Multiple, as above	with wood fragments and gravels
10	No collection	-	-	-	-	
15	No collection	-	-	-	-	log, mixed and distorted soils
19.5	No collection	-	-	-	-	
20	mud, silty	massive	silty mud	-	Very dark gray	
22.7	No collection	-	-	-	-	
24	mud	massive	mud	-	Very dark grey brown	
25	silt	laminated	silt	-	Very dark grey brown	log at interface (24.3-24.6)
28.5	No collection		-	-	-	
30	silt, pebbles	massive	pebbley silt	-	Very dark grey brown	probably distored and forced soil
31.8	No collection	-	-	-	-	slough
33.4	sand, clay	interbeds of c	fine sand	1"	Very dark grey brown	
35	sand, mud	inclusions of r	medium sand	-	Very dark grey brown	inclusions of mud, 2.5YR 5/2, light olive brown
40.5	sand	massive	medium sand	-	Very dark grey brown	some clamshells
43	sand	massive	medium sand	-	Very dark grey brown	clay pebbles and abundant shell
45.7	silt	interbeds	sand interbeds	-	Very dark grey brown	
54	sand, muddy	interbeds	fine sand with mud interbeds	0.5"	Very dark grey brown	occasional clay pebbles
55	mud, sandy	mssive	sandy mud	-	Very dark grey brown	
60	sand, silty	interbeds	fine sand with silt	0.5"	Very dark grey brown	badly distorted, interbeds of sand
63.8	sand, silty	massive	fine sand	-	Very dark grey brown	abundant clamshell and wood fragments
65	sand, clay	interbeds	fine sand with clay interbeds	.25"	Very dark grey brown	
66	silt, sand	massive	silty fine sand	-	Very dark grey brown	shell fragments
70	sand	massive	fine sand	-	Very dark grey brown	abundat shell fragments, occasional light brown pebbles
75	sand	massive	fine sand	-	Very dark grey brown	brown clay and pebble inclusions (angular, meaning closer to source)
79.4	sand	massive	fine to medium sand	-	Very dark grey brown	abundant shell
83.3	sand, clay	interbeds	medium sand with clay frags	.25"	Very dark grey brown	brown shale interbeds
85	No collection	-	-	-	-	
85.4	sand	massive	very fine sand	-	Very dark grey	white frags, ash?
85.6	mud	massive	mud	-	Very dark grey	
85.7	sand	massive	very fine sand	-	Very dark grey	
94.5	mud, sand	interbeds	very fine sand with mud	.25"	Very dark grey	occasional very fine sand interbeds
94.7	sand, mud	interbeds	very fine sand with mud inter	.12"	Very dark grey	very fine sand with mud interbeds
97.4	mud, sand	interbeds	mud with very fine sand inter	.25"	Very dark grey	mud with very fine sand interbeds, rare shell fragments
99.4	sand	massive	medium sand	-	Very dark grey	shell fragments
100.6	silt	massive	silt	-	Very dark grey	shells (mya or macoma)
100.7	sand	massive	fine sand	-	Very dark grey	
105	mud, peat	massive	peaty mud	-	2.5Y 4/2 (Dark greyis	peat percentage decreases from 30% to 15% with depth
122	mud	massive	mud	-	Dark greyish brown	becoming less brown and organic with depth
125	mud, peaty	massive	slightly peaty mud	-	Dark greyish brown	slighty peaty mud
128	mud, peaty	massive	slightly peaty mud	-	Very dark grey	slightly peaty mud
132	mud, peaty	massive	slightly peaty mud	-	very dark grey brown	trace to 15-2-% peat
135	mud	massive	mud	-	very dark grey	
136.3	mud, peaty	massive	peaty mud	-	very dark grey	slightly peaty mud
138	sand, mud	occasional mu	fine sand	.12"	very dark grey	sand with occasional mud interbeds
142	gravel, sandy	massive	coarse sand	-	very dark grey	gravels to pebbles (glacial till)
145	gravel	massive	pebbles to cobbles	-	very dark grey	pebbles to cobbles (glacial till)

AM-4b						
Depth	Sediment T	Bedding	Grain Size	Thick	Color	Notes
11.8	No recovery	-	-	-	-	
12	Fill	-	-	-	-	milled wood fragments and angular gravels
18.4	No recovery	-	-	-	-	
20	silt, detrital w	massive	silt	-	Very dark gray	silt with mixed detrital wood, milled wood and sawdust
23	silt	massive	silt	-	Very dark gray	many wood fragments, angular basalt fragments, sawdust, occasional shells
25	silt, mud	massive	silt, mud	-	Very dark gray	milled wood at 24.9 ft
27	silt, mud	mud laminae	silt , mud laminae	-	Very dark gray	silt with mud laminae
32	silt, sandy	massive	very fine sandy sil	-	Very dark gray	
33	silt, sand	mud laminae	very fine sandy sil	-	Very dark gray	very fine sandy silt with mud laminae

AB-1a						
Depth	Sediment T	Bedding	Grain Size	Thick	Color	Notes
3	basalt	-	-	-	-	fill
7	fill	-	-	-	-	wood debris, angular rocks, fill
10	silt, muddy	laminated-	muddy silt	-	mottled	black and dark grey brown, milled wood in core
11	sloguh	-	-	-	-	
14.2	silt, clayey	laminated and v	clayey silt	-	Very dark grey	brown
15	organic layer	-	-	-	-	rooted plants and mud, sample taken, subsided low marsh
15.5	sand	massive	fine sand	-	very dark grey	
20	clay, silty	massive	silty clay	-	very dark grey	wood fragments at 16.4-16.5 ft
24.2	mud, silty	massive	silty mud	-	Very dark grey	wood fragments
24.6	wood fragme	-	-	-	-	wood fragments and debris
25	mud, silty	massive	silty mud	-	Very dark grey	brown
26.5	slough	-	-	-	-	
30	mud, silty	massive	silty mud	-	Very dark grey	
31	sand	massive	very fine san	-	very dark grey	shells
35	silt, clay	sand interbeds	clayey silt	-	very dark grey	sand interbeds at 34.4-coarse with pebbles

AB-1b						
Depth	Sediment Type	Bedding	Grain Size	Thick	Color	Notes
25	Not collected	-	-	-	-	
26	slough	-	-	-	-	
29.7	silt, muddy	massive	muddy silt	-	very dark grey	sand interbeds at 29 ft - 2" thick
30	detrital wood	-	-	-	-	detrital wood
31.5	sand, silty	massive	silty fine sand	-	very dark grey	shell fragmetns
32.2	mud	massive	mud	-	very dark grey	
32.5	sand	massive	fine sand	-	very dark grey	
35	mud, silty	massive	silty myd	-	very dark grey	shell fragments and wood fragments
39.1	mud, silty, sand	laminated	silty mud med to crse sand	-	very dark grey	
40	mud, sand	sand laminae	mud with sand interbd	2"	very dark grey	interbed has wood fragments
41	slough	-	-	-	-	
42.8	mud, silty	massive	silty mud	-	very dark grey	
43	sand	massive	fine sand	-	very dark grey	
45.2	mud, peaty	massive	peaty mud	-	Very dark grey brown	20% peat, subsidance
49	mud, silty	massive	silty mud	-	Very dark grey brown	becomes laminated with depth at 48.4 ft
50	silt	massve	silt	-	Very dark grey	
53.5	silt, mud	mud interbed	silt and mud	-	very dark grey	silt with few mud interbeds
55	sand	massive	very fine sand	-	very dark grey	few interbeds of mud
57	No recovery	-	-	-	-	
58	sand, silty	massive	sandy silt	-	very dark grey	
60	sand, clay	interbeds of c	fine to very fine sand	.25"	very dark grey	lighter brown clay
62	sand	massive	fine to medium sand	-	very dark grey	clay pebbles
63	No recovery	-	-	-	-	
66	sand	massive	fine to medium sand	-	very dark grey	
71.5	silt	laminated	silt	-	very dark grey	occasional detrital wood beds, broken shell
80.2	sand, silty	massive	silty very fine sand	-	very dark grey	abundant shell, a few laminae at 74 ft and below
90.4	mud, silty, peaty	massive	slighty peaty silty mud	-	Very dark grey brown	slightly peaty, decreases to 0 by 90 ft
93.4	mud, silty	laminated	silty mud	-	Very dark grey brown	
95	sand, mud	mud interbed	medium sand and mud	.25"-1"	very dark grey	
98	sand	massive	medium to coarse sand	-	very dark grey	
108.6	mud, peaty	massive	peaty mud	-	Very dark grey brown	10% peat
109.1	mud, peaty	massive	peaty mud	-	Very dark grey brown	with sandy interbeds, fine grained
121.3	mud, peaty	massive	peaty myd	-	Very dark grey brown	very slightly laminated at base, peaty mud
124.4	sand, mud	mud laminae	very fine sand	-	very dark grey	
125	gravels	massive	gravels	-	very dark grey	up to around 2", glacial till

AB-2						
Depth	Sediment Type	Bedding	Grain Size	Thick	Color	Notes
2	basalt	-	-	-	-	Fill (basalt, sawdust)
4.2	refuse wood	-	-	-	-	Bark, shavings, sawdust
4.8	mud	massive	mud	-	Very dark grey brown	stiff
6	sand	massive	coarse sand	-	Very dark grey	
6.4	wood debris	-	-	-	-	with gravels, machine cut pieces
7	sand	massive	coarse sand	-	Very dark grey	
7.6	slough	-	-	-	-	sawdust and angular rocks
10	sand	massive	medium sand	-	Very dark grey	potentially slough
13	No recovery	-	-	-	-	
15	sand	massive	medium sand	-	Very dark grey	medium sand
18	mud, silty	massive	silty mud	-	Very dark grey and very dark grey b	mottled very dark grey brown and very dark grey
19	slough	-	-	-	-	mixed
20.5	mud, silty	massive	silty mud	-	Very dark grey brown	
23	silt, muddy	massive	muddy silt	-	Very dark grey brown	pieces of wood at 22 feet
32.1	mud, silty	massive	silty mud	-	Very dark grey brown	occasional shell and wood frags, organic silt
33	mud, silty, sandy	interbeds of s	silty mud w/ med sand	3"	Dark grey brown	clay pebble inclusions and wood
35	sand	massive	coarse sand	-	Very dark grey	wood fragments and cones at 35 feet
36	gravels	massive	granule sized	-	Dark grey	
40	no recovery	-	-	-	-	
41.8	gravel	massive	granule sized	-	Very dark grey	same as sand above
42	mud	massive	mud	-	Very dark grey brown	10YR 3/2
46	mud, peaty	massive	peaty mud	-	Very dark grey brown	15-20% peat
46.5	sand	massive	medium to coarse sand	-	Dark grey	
47	mud, silty	massive	slightly silty mud	-	Very dark grey	
54.6	silt, sandy	interbeds of s	very fine sandy silt	1-3"	Very dark grey	very fine sandy silt with sand interbeds and silt laminae
55	sand, silt	silt laminae	fine sand and silt	-	Very dark grey	upper interface Is light grayish brown, Atwater identifies these as subsidance events
57.6	sand	massive	fine sand	-	Very dark grey	with mud pebble inclusions. Detrital wood interbeds at 57.6
59.1	silt, sand	laminated wit	silt with fine sand	1"	Very dark grey	abundant shell and worm burrows
60.3	silt, sandy	massive	silty very fine sand	-	-	
61	detrital wood, silt	interbeds of s	detrital wood with silt	1"	Very dark grey	
75	silt	laminated	silt	-	Very dark grey	occasional clamshells
85	silt, sand	very fine sand	silt with very fine sand	-	Very dark grey	silt with very fine sand interbeds
88.1	silt, clayey	massive	clayey silt	-	Very dark grey	
90	silt, sand	interbeds of s	fine sand with silt	.25"	Very dark grey	
93.2	silt, sand	sand laminae	silt, sand	-	Very dark grey	occasional shell, no sand at lower interface
95	mud, peaty	massive	peaty mud	-	Very dark grey brown	10-15% peat
100.5	silt, mud	mud laminae	silt, mud	-	7.5YR 3/2 Very dark grey brown	sand at 97.8-98 feet, fine
104.6	sand, mud	mud laminae	very fine sand with mud	-	Very dark grey	with wood fragments at 104.9
105	sand	massive	fine to medium sand	-	Very dark grey	occasional pebbles
111.5	sand	massive	medium to coarse sand	-	Very dark grey	gravelly pebbles to 2 inches
115	gravel, sandy	massive	sandy gravel	-	Very dark grey	
118.5	sand, gravel	massive	gravelly coarse sand	-	Very dark grey	pebbles up to 2.5 inchs, till
120	gravel, sandy	massive	sandy gravel	-	Very dark grey	

AB-3						
Depth	**Sediment Type**	**Bedding**	**Sediment**	**Thick**	**Color**	**Notes**
5	Basalt	Massive	Gravels	-	Dark grey	Angular quarry gravels
7	No Recovery	-	-	-	-	
8	Basalt	Massive	Gravels	-	Dark grey	Angular quarry gravels
9	Wood	-	-	-	-	Milled wood fragments
12.6	Gravels, sandy	Massive	Sandy gravels	-	Very dark grey brown	
12.8	Wood	-	-	-	-	
14	Sand	Massive	Very coarse sand	-	Very dark grey	Hydrolic fill
19	No Recovery	-	-	-	-	
24	Sand	Massive	Very coarse sand	-	Very dark grey	Wood fragments throughout
27	Silt	massive	Silt	-	Very dark grey brown	
33.9	Sand	Massive	Coarse to very coarse sand	-	Very dark grey	Likely slough
34.5	Derital wood, clay	Interbeds of clay	Detrital wood with clay	-	-	Detrital wood with interbeds of clay
36.3	Gravel, sandy	Massive	Sandy gravel	-	Very dark grey	
39.7	mud, silty	Massive	Silty mud	-	Very dark grey	
39.8	Silt	Massive	Silt	-	Very dark grey	
43	Mud, peaty	Massive	Peaty mud	-	Very dark grey	Plant rhiozomes at 41.7 ft. Sample taken.
48	Mud, silty	Massive	Silty mud	-	Very dark grey	
50.5	Silt, sandy	Massive	Very fine sandy silt	-	Very dark grey	
55	Sand, mud	Interbeds of mud	Fine to very fine sand	1"	Very dark grey	Worm burrow at 51.9 ft. Some laminae, occasional broken shell, mud light brown.
61	Silt, muddy	Massive	Muddy silt	-	Very dark grey	Borken shells and few wood fragments
63.5	Sand, mud	Interbeds of mud	Very fine sand with mud	.25-2"	Very dark grey	Wood and shell fragments
65	Mud	Interbeds of mud	fine to medium sand	.25" - 2"	Very dark grey	Wood and shell fragments
69	Silt, sandy	Laminated with silt	sandy silt	-	Very dark grey	
75	Sand, silty	Clay laminae	silty medium sand	-	Very dark grey	Detrital wood interbeds, note 69 - 71 ash?
77	No Recovery	-	-	-	-	
80	Silt, sandy	Massive	Sandy silt	-	Very dark grey	Wood and shell fragments
81.5	Sand, silt	Silt interbeds	Very fine sandy silt	0.5	Very dark grey	
83.7	Sand, clay, mud	Laminated with clay and mud	fine sand with clay and mud	-	Very dark grey	Detrital wood at 83.6 ft, mud laminae are lighter
85.6	Sand, clay, mud	clay, mud, and dw laminae	fine sand with interbeds	-	Very dark grey	
89.3	Silt, mud	Massive	muddy silt	-	Very dark grey	
95	Sand, mud	Mud laminae	fine to medium sand with mud	-	Very dark grey	Broken shells and clay pebbles at 91 ft.
98	Silt, sandy	Massive	very fine sandy silt	-	Very dark grey	
104.5	Mud, peaty	Massive	peaty mud	-	Very dark grey brown	10-20% peat
105	Mud	Massive	mud	-	Very dark grey brown	
108.2	Mud, peaty	Massive	peaty mud	-	Very dark grey brown	
120.5	mud	Massive	mud	-	Very dark grey brown	With white wood stick at 13.8 ft.
123.5	Sand, pebbles	Massive	fine to coarse sand with small pebbles	-	Very dark grey	Becoming coarser with depth
128	Sand	Massive	coarse sand	-	Very dark grey	
130	Gravel, silty	Massive	silty gravel	-	Very dark grey	Till pebbles = 1/2" max
135	No Recovery	-	-	-	-	

AB-4						
Depth	**Sediment Type**	**Bedding**	**Grain size**	**Thick**	**Color**	**Notes**
3	No Recovery	-	-	-	-	
3.5	Basalt	-	-	-	-	Fill
5.5	Wood debris	-	-	-	-	Wood debris, fill
6.3	Silt, sand	Sand laminae	Silt with fine	-	Olive brown	
6.6	Detrital wood	-	-	-	-	Detrital wood
8	Clay, silty	Massive	Silty clay	-	Black and olive brown	Black between 7-7.6 feet, then olive brown, sharp contact
12.6	Mud, silty	Massive	Silty mud	-	Mottled	Mottled black and olive brown, interbedded with detrital wood. Single nail in gravel layer.
13	Sand	3 interbeds of detrital wood	Medium sand	1/2"	very dark grey	
15	Mud	Massive	Mud	-	Mottled	Mottled very dark grey brown and black
18	Slough	-	-	-	-	
22.5	Silt, muddy	Interbeds of detrital wood	Silty mud	-	Mottled very dark grey	interbed of wood fragments
25	Silt	Laminated	Silt	-	Dark grey	with shell, wood fragments at uper boundary
27	Slough	-	-	-	-	milled wood trimmings
30	Silt, muddy	Laminated	Slightly mudc	-	Mottled very dark grey	some organics, some shell
34.3	Silt	Laminated	Silt	-	Very dark grey	Increasing lamination at 33.2. Lookes lighter, but 10YR3/1 (very dark grey)
35	Sand, silt	Interbeds of silt	Coarse sandy	1"	Very dark grey	with small pebbles
40	Mo Recovery	-	-	-	-	
41	Mud, peaty	Massive	Peaty mud	-	Very dark grey brown	potentially slough (badly mixed)
43.6	Sand, pebbly	Massive	Coarse sand	-	very dark grey	few pebbles
45	Mud	Massive	Mud	-	Very dark grey brown	
45.2	Mud, peaty	Massive	Peaty mud	-	Very dark grey brown	No roots, slightly darker than underlying sediments
48	Mud, silty	Massive	Silty mud	-	Very dark grey brown	
48.3	Sand, pebbles	Massive	coarse sand	-	very dark grey	
50	Clay, silty	Laminated	Silty clay	-	Very dark grey brown	
55	Silt, sandy	Massive	Sandy silt	-	very dark grey	
61.2	Silt, clayey	Massive	Clayey silt	-	very dark grey	
64.8	Silt, sand	laminated, interbeds of sand	silt with fine	1/8"	very dark grey	occasional interbeds of detrital wood and very fine sand
65	Sand	Laminated	Very fine san	-	very dark grey	detrital wood fragments
66	No Recovery	-	-	-	-	
69.5	Silt	Massive	Silt	-	very dark grey	Shell and detrital wood fragments
70.6	Sand	Laminated	Very fine san	-	very dark grey	
75	Silt	Laminated	Silt	-	very dark grey	
80	No Recovery	-	-	-	-	
85	Silt, sandy	Massive	Sandy silt	-	very dark grey	
86	Sand, silt	Silt laminae	Very fine san	-	very dark grey	Possible ash collected
87	Silt, sand	Interbeds of sand	Silt with very	1/8" - 2"	very dark grey	
88.5	Silt	Laminated	Silt	-	very dark grey	
90	Silt	Massive	silt	-	very dark grey	
98.9	Clay, silty	Massive	silty clay	-	very dark grey	3 interbedded structures at 93-94 ft
111.5	Mud, peaty	Massive	peaty mud	-	Very dark grey brown	Multiple soils amples taken. Subsidance deposit.
114.4	Mud, silty	Verigated interbeds of mud	silty mud	1/4" - 1/2"	very dark grey	
115	Gravel, sandy	Massive	sandy gravel	-	very dark grey	Pebbles up to 1/2". Till

AB-5a						
Depth	**Sediment Type**	**Bedding**	**Grain size**	**Thick**	**Color**	**Notes**
10		-	-	-	-	
12		-	-	-	-	Fll
15	Not collected	-	-	-	-	
18	Basalt	Massive	Mud	-	Very dark grey	Some shell and plant fragments
22	No Recovery	Massive	Silty mud	-	Very dark grey	
23.5	Mud	Massive	Muddy silt	-	Very dark grey	
25	Mud, silty	Interbeds of mud	Fine sand with mud	-	Very dark grey	Abundant detrital wood and shell fragments
26.9	Silt, muddy	Massive	Silty mud	-	Very dark grey	
28	Sand, mud	Massive	Muddy silt	-	Very dark grey	
29.5	Mud, silty	Sand interbeds	Silt with fine sand	.25" - 1.25"	Very dark grey	Silt is laminated
30	Sand, clay	1 brown clay interbed	medium to coarse sand w	-	Very dark grey	Abundant wood fragments and a log at 30-30.2 ft.
31.4	Sand, pebbley	massive	pebbley sand	-	Very dark grey	
31.7	Sticks	-	-	-	-	
31.8	Sand, mud	Interbeds of mud	coarse sand with mud	.12"	Very dark grey	
32	Wood fragments	-	-	-	-	Wood fragments. Sample taken
35	Sand, mud	Mud interbeds	coarse sandy with mud	1"	Very dark grey	Interbeds of wood to 32.4 ft.
45	No Recovery	-	-	-	-	
49	Silt, muddy	occasional laminae	muddy silt	-	Very dark grey	
50	Mud, sand	Sand interbeds	mud with fine sand	.12"	Very dark grey	

AB-5b						
Depth	Sediment Type	Bedding	Grain size	Thick	Color	Notes
26	Not collected	-	-	-	-	Broken clam shells
27.2	Mud, silty	Laminate	Silty mud	-	Very dark grey	Wood fragments and broken clam shells
27.8	Silt, muddy	Massive	Muddy silt	-	Very dark grey	wood and shell fragments
28.2	Sand	Massive	Fine sand	-	Very dark grey	
29.1	Silt, muddy	Massive	Muddy silt	-	Very dark grey	
30	Silt, sand	Interbeds of sand	silt with medium sand	2"	Very dark grey	
33	Slough	-	-	-	-	
34.5	Silt, muddy, sand	Interbeds of sand	Muddy silt with sand	1" - 2"	Very dark grey brown	
35	Sand, pebbles	massive	Coarse sand to pebbles	-	Very dark grey	
37	Slough	-	-	-	-	
40	Gravel, sandy	Massive	Sandy gravel	-	Very dark grey	Pea sized gravels
45	No recovery	-	-	-	-	
50	Slough	-	-	-	-	
76	No Collection	-	-	-	-	
83.5	Silt, muddy	Laminated	Muddy silt	-	Very dark grey	
85	Sand, mud	Laminated with interbeds of mud	fine to medium sand	2"	Very dark grey	
86	Slough	-	-	-	-	
87.4	Sand mud	Laminated with interbeds of mud	fine to medium sand	-	Very dark grey	
91.5	Mud, silty with sand	Laminated with interbeds of sand	Silty mud with medium sand	2" - 3"	Very dark grey	2 interbeds of sand, shell and wood frags throughout
91.7	silt, sand	Massive	silt with fine sand	-	Very dark grey	
100	mud, peat	Massive	peaty mud	-	Very dark grey brown	10-20% peat, decreasing with depth
102.3	sand	Massive	fine to medium sand	-	Very dark grey	
103.3	sand	Laminated	fine to medium sand	-	Very dark grey	
105	sand, mud	Occasional mud interbeds	Medium sand with mud	-	Very dark grey	
106.5	Slough	-		-	-	
107	Sand	Massive	Medium sand	-	Very dark grey	
107.2	Mud	Massive	mud	-	Very dark grey brown	
107.6	Sand	Massive	medium sand	-	Very dark grey	Detrital wood between 7.6 and 7.7
108.5	Sand	Massive	coarse to very coarse sand	-	Very dark grey	
109	wood frags, sandy	Massive	sandy wood fragments	-	-	Wood fragments in sand
109.2	Mud	Massive	mud	-	Very dark grey brown	
115	Sand, pebbles	Massive	coarse sand with pebbles	-	Very dark grey	Coarse sand with occasional pebbles
115.2	Gravel, sandy	Massive	sandy gravel	-	Very dark grey	In drill bit, pebbles to 3 inches

Appendix B: Plotted core logs

Core # AM-1

Elevation _____ Date: 6/27/09

Depth plot	Feet actual	Lithology	Color	Notes
		No cores taken		
5				
10		sand, medium gr., massive	vdb	
	10.8			
		silt,massive,	blk	
	12.1			
	12.9	mud, massive,DW @12.3	vdb	
	13	sand,fine gr,massive	vdgb	rooted
15				
		sand,fine to med gr,massive	vdg	wood fragments,broken shells
	18			
20		sand,med to crse, massive	vdg	sub-angular, well sorted
	22			
		sand,silty,fine gr.	vdg	numerous dw beds
	25			
25		detrital wood (dw)		
	26.3			
		silt, massive	vdg	large wood frags & shell pieces 29-30
30				
	33			
35				
		silt,massive	vdg	sticks and shell frags
40				
	42.7			
		sand ,fine gr. massive	vdg	Dw interbeds 0.5 to 1.0"
45	45			
		sand,med to crs gr. massive	vdg	lots of dw
50	50	sand ,med	vdg	mud interbeds .25 to 1.5" thick

Legend

- gravel
- sand
- silt
- mud
- peaty mud
- wood frags silty
- wood frags sandy
- wood frags muddy
- detrital wood
- no recovery

				50.7	Detrital wood						
					no recovery						
			55								
					gravel with med to crse sand	vdg					
				57							
					sand,med ; mud laminae	vdg					
				58.4	gravel	vdg	much dw				
				59.5							
						vdg					
			60		sand,crse gr.		silt interbeds 3 to 4 " thick				
				61.7							
					silt, laminated	vdg	shell fragments				
				64.1							
			65		sand, crse to gravel, massive	vdg	dw				
				65							
				67	sand ,fine gr., massive	vdg	Clay pebbles				
					sand,fine gr.	vdg	mud interbeds1.0' thicj				
				68.6							
			70								
					silt, laminated	vdg	clay pebbles @ 74.3				
			75								
				75							
					sand,fine gr. Laminated	vdg	laminae are silty mud; shell frags				
			80								
			85								
				87							
					no recovery						
			90								
					sand veryf ine gr.	vdg	mud interbeds 0.12" thick				
				93.9							
					sand,fine gr.	vdg	dw @ 94.1 & abundant shell frags				
			95								
					silt,sandy,very fine gr.	vdg	extremely fine lamine;Macoma spp.				
			100								
					silt	vdg	with interbeds of v.f.sand 0.25"				

105					
		silt	vdg	with very fine laminae of sand; shell frags	
	108				
	108.1	sand fine gr ,massive	vdg	**TSU DEPOSIT ??**	
110		Mud,peaty	vdgb	30% @ top gading down to 20% @ bottom	
	110				
		mud, peaty	vdgb	10%peat	
115					
		mud,peaty	vdgb	5% peat	
120					
125					
				almost no peat until 127 then % jumps to 15%	
		mud peaty	vdgb	slightly laminated	
130					
135					
		silt, sandy massive	vdgb	very moist	
	137.5				
140		silt,sandy	vdg	interbeds of med to crse sand 1 to 3 "	
	144.7				
145		gravel, sandy,massive	vdg		
		TD 145'			
150					
155					
34					

Core #AM-2

Elevation _____ Dates: 6/22/09–6/23/09

Depth plot	Feet actual	Lithology	Color	Notes
		basalt fill		
5				
	5.2	Gravel,rounded muddy		
	7.2	silt		
	9.2	silt		
	10.0			
10		clay	rb	soil 7.5YR4/2
	10.7			
		sand,v.fine to medium gr.	rb	2.5YR4
	13.7	silt	rb	2.5YR3/3
	14.0			
	14.4	silt		3 interbeds of detrital wood
15		clay		
		no recovery		milled wood @15
20		no recovery		
	23.3	mud,laminated	vdg	
	23.8	mud w/silt laminae	vdg	
		mud laminated	vdg	
25				
		no recovery		
	27.0			
		Mud w/ silt laminae	vdg	shell frags
	30.0			
30				
		mud,silty	vdg	some wood fibers
	31.4			
		sand,v.fine gr.	vdg	m
	33.2			
	33.6	silt,muddy		with wood frags and gravel @33.6
35		mud,silt, massive	vdg	
		silt		milled wood driller says hole cased to 25 feet
	35.5			so wood couldn't be from above that
	36.3	sand,v.fine gr.		laminated
		mud		1/2 " interbeds of sand
	37.0			
		mud w/ silt laminae		
	38.0			
40		mud ,silty w/ sand & silt laminae		shell frags
		silt,sandy		plant frags @40.9 DW @44.5
				abundant shell frags
45	45.0			
		sand, f. to med gr. massive		
	49.2			
50		silt w/ interbeds of mud		

Legend	
	gravel
	sand
	silt
	mud
	peaty mud
	wood frags silty
	wood frags sandy
	wood frags muddy
	detrital wood
	no recovery

		sand med.gr massive		very soupy cone @54.1' few wood frags
55	55.0			
		sand, fine gr.silty		few shell frags
60	59.5	sand med.gr. Massive		few pebbles
		sand,med.gr.massive		shell frags, subrounded pebble @ 63.8
				silt interbeds at 64.7 to 64.9
65	65.0			
		no recovery		
	69.0			
70		sand,silty v.fine gr.		clay pebbles, wood frags
	70.0			
	71.0	no recovery		
		sand,fine gr., massive		clay pebbles,wood frags 73.5-74.5'
75	75.0			
		no recovery		
	76.6			
80				
		sand ,fine to v.fine gr. massive		clay pebbles @80'
				wood frags throughout unit
85				
90	90			
		silt w/ f.sand lamine		few sand, f.gr. Interbeds to 1/2'
	93.2			
95				
		silt /w f.to v.fine sand interbeds and laminae		
100				shells and wood @ 101.9'
	101.0			
	102.0	Sand fine gr.		
		mud,peaty	2.5Y4/2 dgb	est.15% peat at top

		105.0			
	105				
					peaty % grades to 5% by 108
					then back up to15% @ 110'
			mud,peaty	dgb	
	110				
		112.2			
	115				
	120	120.0			
			mud,massive	vdgb	very little to no peat
	125				
			mud, massive	vdgb	
	130				
		131.0			
			mud,sandy	vdgb	
		133.0			
		133.5	sand,f.gr. Laminated	vdgb	
			mud w/ fine sand interbeds		
	135		silt,sandy v.fine gr.	vdb	sharp contact
		135.5			
			gravel sandy massive	vdg	
	140	140.0			
			TD 140		

Core # AB-3

Elevation: 12.80

Date:7/ 07/ 09

Depth Plot	Feet Actual	Lithology	Color	Notes
			blk	
		basalt		
5	5			
		no recovery		
	7			
		basalt	blk	
	8			
		wood		
	9			
10				
		gravel ,sandy massive	vdg	
	12.6			
	12.8	wood		
		sand,v.crse	vdg	hydraulic fill
	14			
15				
		no recovery		
	19			
20				
		sand,crse -v.crse gr. ,massive	vdg	wood frag throughtout
	24			
25		silt,massive	vdg	
	27			
30		sand,crse -v. crse,massive	vdg	probably slough
	33.9			
		Detrital wood w/ interbeds of mud	vdgb	
	34.9			
35				
		gravel,sandy ,massive	vdg	
	36.3			
		mud,silty,massiv e	vdg	
	39.7			
40	39.8	silt,massiv e	vdg	
		mud ,peaty	vdg	plant rhizomes @ 41.7' sampled
	43			
45				
		mud,silty	vdg	
	48			
		silt,sandy v.fine gr.sand	vdg	
50				
	50.5			

Legend

- gravel
- sand
- silt
- mud
- peaty mud
- wood frags silty
- wood frags sandy
- wood frags muddy
- detrital wood
- no recovery

			sand,muddy v.fine to v.fine sand	vdg	interbeds of v.fine sand to 1"
					worm burrow @51.9 occ. Broken shell
					mud is lt brn
55		55			
			silt,muddy massive	vdg	broken shell & wood,frags
60					
		61			
			sand,v.fine gr. Interbeds o mud	vdg	interbeds 1/4" to 2" thick
					shell & wood frags
		63.5			
			mud,w/ intereds of sand, fine -med gr.	vdg	shell & wood frags
65		65			
			silt, sandy, laminated	vdg	
		69			
70					
			sand, med gr. mud laminae	vdg	debital wood interbeds Ash 69-71'
75		75			
			no recovery		
		77			
			silt, sand, massive	vdg	wood and shell frags
80		80			
			sand v.fine gr. W/ silt interbed	vdg	
		81.5			
			sand,fine gr., mud laminae	vdg	dw @ 83.6
85		85.6			
			silt,muddy, massi ve	vdg	
90		89.3			
			sand fine -med gr., w/ mud laminae		broken shell & clay pebbles at 91'
95		95			
			silt sandy,massive	vvdg	v.fine sand
		98			
100					
			mud,peaty,massi ve	vdgb	10-20% peat

		105	105							
				mud,massive	vdg					
			108							
		110								
				mud,peaty,massive	vdgb	white colored wooden stick @ 113.8				
		115								
		120								
			121							
				sand fine to crse to pebbles	vdg	becoming crser w/ depth				
			124							
		125								
				sand,crse gr. massive	vdg					
			128							
				gravel,silty,massive	vdg	pebbles to 1/2"				
		130	130							
				no recovery						
		135	135							
				TD 135						

Core # AM-4

Elevation _____ Date: 6/ 29/ 09

Depth Feet Plot	Actual	Lithology	Color	Notes
		soil		
	1.50			
		Basalt angular	mottled	
5				
	5.50			
		soil		
	6.30			
	6.80	mud	vdg	with wood frags and gravel
		no recovery		
10				
	11.80			
	12.00	milled wood frags and gravel	vdg	
15				
		no recovery		Data from 0 to 30 feet was inserted from hole AM-B
	18.40			
20		silt,massive	vdg	silt is mixed with dw ,milled wood & saw dust
	20.00			
				wood as above + basalt, occ.shell frag
	23.00			
		silt , muddy, massive		(log @ 24.6 in hole AM-4a) milled wood 24.9
25			vdg	
	25.00			
		silt w/ mud laminae	vdg	
	27.00			
		silt,sandy,massive	vdg	
30				
	30.00			
	31.80			
		Sand,fine gr. W/ 1" mud interbeds	vdg	
	33.40			
		sand,med. Gr.	vdg	inclusions of light brn mud
35				
	35.00			
		sand,med gr., massive	vdg	shell frags
40				
				clay pebbles at 43'
	43			
		silt w/ sand interbeds	vdg	
45				
	45.70			
50				

Legend

- gravel
- sand
- silt
- mud
- peaty mud
- wood frags silty
- wood frags sandy
- wood frags muddy
- detrital wood
- no recovery

			sand,fine gr.w/ 1/2 to 1"mud interbeds	vdg	few.clay pebbles
		54.00			
			mud,sandy ,massive	vdg	
	55	55.00			
			sand fine, gr. Wi 1/2" interbeds silt	vdg	
	60	60.00			
			sand,silty,fine gr., massive	vdg	abundant shel frags and wood frags
		63.80			
			sand,fine gr. W/ /4" mud interbeds	vdg	
	65	65.00	silt w/ fine gr.w/ sand interbeds 1/4 "	vdg	
		66.00			
			sand fine,gr. Massive	vdg	abundant shell frags & some clay pebbles
	70	70.00			
			sand, as above	vdg	angular clay pebbles
	75	75.00			
			sand,fine to med. gr. massive	vdg	abundant shell frags
		79.40			
	80				
			sand,med.gr.,brn clay intebeds 1/4"	vdg	mud interbeds are the same color as the clay pebbles
		83.30			
			no recovery		
	85	85.40	sand,v.fine gr.,massive	vdg	possible volcanic ash;sharp contact
		85.60	mud,massive	vdg	sharp contact
		85.70	sand,v.fine gr., massive	vdg	sharp contact
	90				
			mud w/ sand v.fine gr. Interbeds1/4"	vdg	
		94.50			
	95	94.70	sand,v.fine gr. W/ mud interbeds 1/8"	vdg	
			mud w/ sand v.fine gr. Interbeds1/4"	vdg	few shell frags
		97.40			
			sand,med.gr., massive	vdg	shell frags
		99.40			
	100		silt,massive	vdg	Mya spp or Macoma spp shell
		100.60			
		100.70	sand ,fine gr. Massive	vdg	

		mud,peaty	2.5Y4/2	Organics decrease from 30% to 15% qwith depth
105			vdgb	
	105.00			
110				
115				
		mud,peaty massive	vdgb	becoming less bm and less organic with depth
120				
125				
	125.00			
		mud, slightly peaty	vdg	note: color change
	128.00			
130		mud,peaty, massive	vdgb	15% to 20% peat
	132.00			
		mud,massive	vdg	
135				
	135.00			
		mud, slightly peaty massive	vdgb	
	136.30			
		sand,fine gr. few mud interbeds 1/4"	vdg	
	138.00			
140		gravel, sandy,	vdg	
	142.00			
		gravel	vdg	pebble to cobble size
145				
	145.00			
		TD 145		

AB-1

Elevation 16.69 | Date: 7/01/09-7/02/09

Depth Plot	Feet Actual	Lithology	Color	Notes
		Basalt		fill
	3			
5		wood debris		
	7			
		silt, muddy,laminated	blk,vdg	milled wood in core
10		Slough		
	11			
		Silt,clayey,varigated	vdgb	sharp contact
	14.2			
15	15	organic layer,muddy		rooted plants,low marsh:
		sand,fine gr.,massive	vdg	sample taken
	15.5			
		mud,silty,massive	vdg	wood frags 16.4-16.5
20	20			
		mud,silty massive	vdgb	wood frags
	24.2			
25	24.6	wood frags and debris		
	25	mud,silty	vdgb	
		slough		
	26.5			
		mud,silty, massive	vdg	
	29.7			
30		detrital wood		
	30			
		sand,silty,v.fine gr.,massive	vdg	shell frags
	31.5			
	32.2	mud,massive	vdg	
	32.5	sand,fine gr. Massive		
35				
		Mud,sandy w/ sand laminae & interbeds 2"	vdg	39' to 40'
40	40			
	41	slough		
		mud,silty, massive	vdg	sharp contact
	42.8		vdg	
	43	sand fine gr. massive		
				SUBSIDENCE EVENT????
45		mud, peaty	vdgb	20% peat
	45.2			
		mud,silty,	vdg	becomes laminated at 48.4
	49			
50		silt,massive	vdg	
	50			

0' to 30 from core AM-1.From 30 to TD is from AB1-b

Legend

- gravel
- sand
- silt
- mud
- peaty mud
- wood frags silty
- wood frags sandy
- wood frags muddy
- detrital wood
- no recovery

		silt w/ mud interbeds	vdg		
	53.5				
		sand, v.fine gr. massive	vdg		
55					
	55				
		no recovery			
	57				
		sand,silty massive			
	58				
		sand v.fine gr. interbeds clay 1/4"	vdg	clay is lighter brn	
60					
	60				
		sand,f to med. gr.	vdg	clay pebbles	
	62				
		no recovery			
	63				
65		sand,fine-medium massive	vdg		
	65				
		silt, laminated	vdg	occ. debital wood beds and broken shell	
70					
	71.5				
75					
				abundnt shell frags	
		sand,v.fine gr.massive	vdg	laminated after74'	
80					
	80.2				
85		mud, silty & slightly peaty	vdg	peat decrs to 0% by 90'	
90					
	90.4				
		mud,silty, laminated	vdgb		
	93.4				
		sand,med.gr w/ interbeds mud 1/4"-1"	vdg		
95					
	95				
		sand,med-crse gr. massive	vdg	sharp contact	
	98				
100					
		mud, peaty	vdgb	10% peat	

		105							
			108.6						
		110							
		115							
				mud,peaty,w/ intebeds of v.fine g. sand	vdgb	very slighty laminated at base of unit			
		120							
			121.3						
				sand,v.fine g.w/ mud laminae	vdg				
			124.4						
				Gravel	vdg	cobbles up to 2" diameter			
		125	125						

Core # AB-2

Elevation:15.10

Date: 6 /29 / 09

Depth Plot	Feet Actual	Lithology	Color	Notes
		basalt	blk	
	2			
		wood refuse		bark, shavings,sawdust
	4.2	mud,massive	vdg	stiff
	4.8			
5		sand crse,massive		
	6	wood debris		
	6.4	sand crse,massive	vdg	
	7	slough		
	7.6			
		sand med.gr	vdg	probably slough
10	10			
		no recovery		
	13			
		sand, med. gr., massive	vdg	
15	15			
		mud,silty	vdg	mottled vdgb to vdg
	18			
		slough		
	19			
20		mud,silty, massi e	vdg	
	21			
		silt muddy massive	vdg	pieces of wood at 22 '
	23			
25				
		mud,silty,massive	vdg	occ shell & wood frags,organic silt
30				
	32			
		mud,massive w/sand v.fine gr. interbed	vdg	clay pebble inclusions in 3" sand interbed
	33			
		sand crse.gr. Massiv e		wood frags & cones @ 35 '
35	35			
		gravel, massive granule size	vdg	
	38			
		no recovery		
40	40		vdg	
		gravel as abov e		
	41.8			
	42	mud,massive	vdgb	10YR3/2
		mud,peaty	vdgb	10yr 3/2
45				
	46.5			
		sand med.-crse gr. Massive	vdg	
	47			
		mud,silty	vdg	
50				

Legend

- gravel
- sand
- silt
- mud
- peaty mud
- wood frags silty
- wood frags sandy
- wood frags muddy
- detrital wood

55	54.8				
	55	sand fine gr., w/ silt laminae	vdg		
		sand.fine gr. massive	vdg	clay peb ble inclusions dww @ 57.6	
	58				
		silt,sandy laminated	vdg	abundant shell and worm burrows	
	59				
		silt, sandy	vdg		
60	60				
		Dw w/ silt interbeds	vdgb	interbeds 1" thick	
	61				
65					
		silt, laminated	vdg	occ. Clam shells	
70					
75	75				
80		silt w/ .fine gr. sand interbeds	vdg		
85	85				
		silt muddy	vdg		
	88				
		silt w/ interbeds of v.fine gr sand	vdg		
90	90				
		silt w/ sand laminae	vdg	occ. Shell	
	93				
		mud,peaty	vdgb	10-15% peat	
95	95				
		mud w/ silt laminae	vdgb	7.5 YR fine sand @97.8 -98'	
100					
	101				
		sand,v.fine gr., w/ mud laminae	vdg		

				104.6							
			105	105	sand, crse. gr.massive	vdg	wood frags @ 104.9				
					sand,fine to med.gr., massiv e	vdg	occ.pebbles				
			110								
				111.6							
					sand,med-crse gr.	vdg	random pebbles to 2"				
			115	115							
					gravel sandy,massive	vdg					
				118.5							
			120	120	gravel , sandy massive	vdg	pebbles to 2.5 "				
					TD 120						

Core # AB-3

Elevation: 12.60 | Date:7/ 07/ 09

Depth Plot	Feet Actual	Lithology	Color	Notes
			blk	
		basalt		
5	5			
		no recovery		
	7			
		basalt	blk	
	8			
		wood		
	9			
10				
		gravel ,sandy massive	vdg	
	12.6			
	12.8	wood		
		sand,v.crse	vdg	hydraulic fill
	14			
15				
		no recovery		
	19			
20				
		sand,crse -v.crse gr. ,massive	vdg	wood frag throughtout
	24			
25		silt,massive	vdg	
	27			
30		sand,crse -v. crse.massive	vdg	probably slough
	33.9			
		Detrital wood w/ interbeds of mud	vdgb	
	34.9			
35		gravel,sandy ,massive	vdg	
	36.3			
		mud,silty,massiv e	vdg	
	39.7			
40	39.8	silt,massiv e	vdg	
		mud ,peaty	vdg	plant rhizomes @ 41.7' sampled
	43			
45				
		mud,silty	vdg	
	48			
		silt,sandy v.fine gr.sand	vdg	
50				
	50.5			

Legend

- gravel
- sand
- silt
- mud
- peaty mud
- wood frags silty
- wood frags sandy
- wood frags muddy
- detrital wood
- no recovery

				sand,muddy v.fine to v.fine sand	vdg	interbeds of v.fine sand to 1"				
						worm burrow @51.9 occ. Broken shell				
						mud is lt brn				
		55	55							
				silt,muddy massive	vdg	broken shell & wood,frags				
		60								
			61	sand,v.fine gr. Interbeds o mud	vdg	interbeds 1/4" to 2" thick				
						shell & wood frags				
			63.5							
				mud,w/ intereds of sand, fine -med gr.	vdg	shell & wood frags				
		65	65							
				silt, sandy, laminated	vdg					
			69							
		70								
				sand, med gr. mud laminae	vdg	debital wood interbeds Ash 69-71'				
		75	75							
				no recovery						
			77							
				silt, sand, massive	vdg	wood and shell frags				
		80	80							
				sand v.fine gr. W/ silt interbed	vdg					
			81.5							
				sand,fine gr., mud laminae	vdg	dw @ 83.6				
		85	85.6							
				silt,muddy, massi ve	vdg					
		90	89.3							
				sand fine -med gr., w/ mud laminae		broken shell & clay pebbles at 91'				
		95	95							
				silt sandy,massive	vvdg	v.fine sand				
			98							
		100								
				mud,peaty,massi ve	vdgb	10-20% peat				

		105	105							
				mud,massive	vdg					
			108							
		110								
				mud,peaty,massive	vdgb	white colored wooden stick @ 113.8				
		115								
		120								
			121							
				sand fine to crse to pebbles	vdg	becoming crser w/ depth				
			124							
		125								
				sand,crse gr. massive	vdg					
			128							
				gravel,silty,massive	vdg	pebbles to 1/2"				
		130	130							
				no recovery						
		135	135							
				TD 135						

Core # AB-4

Elevation:15.70 | **Date: 6/ 30/ 09–7 /01/ 09**

Depth Plot	Feet Actual	Lithology	Color	Notes
		no recovery		
	3			
	3.5	basalt		
		wood debris		
5	5.5	silt w/ fine sand laminae	vdg	
	6.3			
		detrital wood		
	6.6			
		mud,silty,massive	vdg	blk between 7-7.6 then olive brn
	8			
10		mud,silty,massive,mottled	vdg	mottled blk &olive brn.DW interbeds and a single gravel layer containing a nail
	12.6			
	13	sand	vdg	3 interbeds of DW
15	15	mud	vdg	mottled vdgb & blk
		slough		
	18			
		silt, muddy	vdg	interbeds of wood frags & Dw
20				
	22.5			
		silt,laminated	vdg	shell & wood frags near upper boundry
25	25			
		slough		
	27			
		silt, muddy, laminated	vdg	mottled some organics & shell
30	30			
		silt, laminated	vdg	10YR 3/1
	34.3			
35	35	sand,crse gr. Pebbles w/ silt interbeds	vdg	
		no recovery		
40	40			
	41	mud,peaty		may be slough
			vdgb	
		sand,crse to pebbles	vdg	
	43.6			
		mud massive	vdgb	
45	45			
	45.2	mud ,peaty	vdgb	no roots slightly darker than underlying seds
		mud, silty	vdgb	
	48			
	48.3	sand,crse to pebbles	vdg	
50		mud, laminated	vdgb	
	50			

Legend

- gravel
- sand
- silt
- mud
- peaty mud
- wood frags silty
- wood frags sandy
- wood frags muddy
- detrital wood
- no recovery

				silt,sandy, massive	vdg				
	55	55							
				silt, muddy massiv e	vdg				
	60								
		61.2							
				silt laminated	vdg	interbeds of v. fine sand & dw			
		64.8							
				sand,v.fine gr. Laminated	vdg	dw			
	65	65		no rfecovery					
		66							
				silt, massiv e	vdg				
		69.5							
	70			sand,vfine gr., laminated	vdg	shell and DW			
		70.5							
				silt, laminated	vdg				
	75	75							
				no recovery					
	80	80							
				silt , sand, massive	vdg				
	85	85		sand v.fine gr. Silt laminae	vdg	pumice ?? Sampled			
		86		sand,v.fine gr. silty	vdg				
		87		silt,laminated	vdg				
		88.5							
				silt, massive	vdg				
	90	90							
				mud,silty massive	vdg				
	95								
		98.9							
	100								

		105							
				mud,peaty, massive	vdgb	took samples for LOI			
		110							
			111.5						
				Mud, w/ silt interbeds 1/4"	vdg				
			114.4						
		115	115	gravel sandy, massive	vdg	pebbles up to 1/2"			
				TD 115					

Core # AB-5

Elevation: 12.28 | **Date:7/ 09/ 09**

Depth Plot	Feet Actual	Lithology	Color	Notes
5		Fill not collected		
10	10	Basalt	blk	
	12	no recovery		
15	15	basalt	blk	some shell & plant frags
	18			
20		mud,silty,massive	vdg	
	22	mud,silty	vdg	
	23.5	mud,silty w/ intereds of fine sand	vdg	abundant detrital wood and shell
25	25	silt, muddy, massive	vdg	
	26.9	sand,fine gr. Muddy,massive	vdg	
	28	mud,silty w/ sand interbeds	vdg	interbeds 1/2" to 11/2" thick
30	29.5	sand ,med to crse gr.		
	30	sand , crse to pebbles	vdg	one brn clay interbed abundant wood frags log at 30-32' sticks @ 31.4
	31.8	sand, crse gr massive. Few mud interbeds	vdg	interbeds of wood to 34.5
35	35			
40		No recovery		
45	45	silt, muddy	vdg	
	49			
50	50	sand fine gr. With mud laminae	vdg	

Legend

- gravel
- sand
- silt
- mud
- peaty mud
- wood frags silty
- wood frags sandy
- wood frags muddy
- detrital wood
- no recovery

				Abandoned AB 5A @ 50' Drilled AB-5B Thru same section, w/ no better results. Drilled to 86 ' with no cores
55				
60				
65				
70				
75				
80				
85				
	86			
		sand,fine gr muddy laminae	vdg	
	87.4			
		mud,silty with two sand interbeds	vg	2" to 3" shell and wood frags throughout
90				
	91.5			
	91.7	silt sandy massive	vdg	
95		mud, peaty	vdgb	10-20% peaty decreasing with depth
100	100			
		sand fine to med.gr. massive	vdg	
	103.3			

			105								
				105	sand, muddy	vdg					
					slough						
				106.6							
				107	sand,med.gr., massive	vdg					
				107.6	sand,med.gr., massive	vdg	detrital wood between 107.6 & 107.7				
				108.5	sand,crse to v crse, massive	vdg					
				109	mud w/ wood frags	vdg					
			110								
					sand ,crse.gr. W/ pebbles	vdg					
			115								
				115							
				115.2	gravel, sandy	vdg	from the drill bit rocks to 3" in diameter				
					TD115.2						

Appendix C: C-14 Calibration Data

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Christopher Patrick
Deputy Directors

September 13, 2009

Mr. Danny Gilmour
ICF Jones & Stokes
317 SW Alder #800
Portland, OR 97204

RE: Radiocarbon Dating Results For Samples AB-1at 16.4 ft., AB-1A at 14.3 ft. , AB-1b at 43.2 ft., AB-2 at 35 ft., AB-3 at 129 ft., AB-4 at 42 ft., AB-4 at 100.9 ft., AB-5 at 31.8 ft., AM-1b at 108.1 ft., AM-2 at 102 ft., AM-3b at 15.9 ft., AM-3b at 142.6 ft., AM-4 at 100.8 ft., AM-21 at 15-23', AM-163 at 16-18', AML weir2, AML weir3

Dear Mr. Gilmour:

Enclosed are the radiocarbon dating results for 17 samples recently sent to us. They each provided plenty of carbon for accurate measurements and all the analyses proceeded normally. As usual, the method of analysis is listed on the report with the results and calibration data is provided where applicable.

You will notice that Beta-263288 (AB-1at 16.4 ft.) is reported with the units "pMC" rather than BP. "pMC" stands for "percent modern carbon". Results are reported in the pMC format when the analyzed material had more ^{14}C than did the modern (AD 1950) reference standard. The source of this "extra" ^{14}C in the atmosphere is thermo-nuclear bomb testing which on-set in the 1950s. Its presence generally indicates the material analyzed was part of a system that was respiring carbon after the on-set of the testing (AD 1950s). On occasion, the two sigma lower limit will extend into the time region before this "bomb-carbon" onset (i.e. less than 100 pMC). In those cases, there is some probability for 18th, 19th, or 20th century antiquity.

As always, no students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analyses. We analyzed them with the combined attention of our entire professional staff.

If you have specific questions about the analyses, please contact us. We are always available to answer your questions.

Thank you for prepaying the analyses. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

BETA

BETA ANALYTIC INC.

DR. M.A. TAMERS and MR. D.G. HOOD

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MIAMI, FLORIDA, USA 33155
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beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Mr. Danny Gilmour

Report Date: 9/13/2009

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 263293	1030 +/- 40 BP	-26.7 o/oo	1000 +/- 40 BP
SAMPLE : AB-4 at 42 ft.			
ANALYSIS : AMS-Standard delivery			
MATERIAL/PRETREATMENT : (wood): acid/alkali/acid			
2 SIGMA CALIBRATION : Cal AD 980 to 1060 (Cal BP 970 to 900) AND Cal AD 1080 to 1150 (Cal BP 870 to 800)			
Beta - 263294	7750 +/- 50 BP	-27.7 o/oo	7710 +/- 50 BP
SAMPLE : AB-4 at 100.9 ft.			
ANALYSIS : AMS-Standard delivery			
MATERIAL/PRETREATMENT : (peat): acid/alkali/acid			
2 SIGMA CALIBRATION : Cal BC 6640 to 6450 (Cal BP 8590 to 8400)			
Beta - 263295	1680 +/- 40 BP	-26.0 o/oo	1660 +/- 40 BP
SAMPLE : AB-5 at 31.8 ft.			
ANALYSIS : AMS-Standard delivery			
MATERIAL/PRETREATMENT : (wood): acid/alkali/acid			
2 SIGMA CALIBRATION : Cal AD 260 to 290 (Cal BP 1690 to 1660) AND Cal AD 320 to 440 (Cal BP 1630 to 1510) Cal AD 490 to 520 (Cal BP 1460 to 1430)			
Beta - 263296	7730 +/- 50 BP	-27.9 o/oo	7680 +/- 50 BP
SAMPLE : AM-1b at 108.1 ft.			
ANALYSIS : AMS-Standard delivery			
MATERIAL/PRETREATMENT : (peat): acid/alkali/acid			
2 SIGMA CALIBRATION : Cal BC 6620 to 6440 (Cal BP 8570 to 8390)			
Beta - 263297	7770 +/- 50 BP	-28.0 o/oo	7720 +/- 50 BP
SAMPLE : AM-2 at 102 ft.			
ANALYSIS : AMS-Standard delivery			
MATERIAL/PRETREATMENT : (peat): acid/alkali/acid			
2 SIGMA CALIBRATION : Cal BC 6640 to 6460 (Cal BP 8600 to 8410)			

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

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Mr. Danny Gilmour

Report Date: 9/13/2009

ICF Jones & Stokes

Material Received: 8/18/2009

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 263288	153.9 +/- 0.6 pMC	-27.7 o/oo	154.7 +/- 0.6 pMC

SAMPLE : AB-1at 16.4 ft.
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (peat): acid/alkali/acid
COMMENT: reported result indicates an age of post 0 BP and has been reported as a % of the modern reference standard, indicating the material was living within the last 50 years.

Beta - 263289	240 +/- 40 BP	-24.2 o/oo	250 +/- 40 BP

SAMPLE : AB-1A at 14.3 ft.
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (peat): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1520 to 1580 (Cal BP 430 to 370) AND Cal AD 1630 to 1680 (Cal BP 320 to 270)
Cal AD 1770 to 1800 (Cal BP 180 to 150) AND Cal AD 1940 to 1950 (Cal BP 10 to 0)

Beta - 263290	4950 +/- 40 BP	-25.0 o/oo	4950 +/- 40 BP

SAMPLE : AB-1b at 43.2 ft.
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (peat): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 3800 to 3650 (Cal BP 5740 to 5600)

Beta - 263291	1130 +/- 40 BP	-24.9 o/oo	1130 +/- 40 BP

SAMPLE : AB-2 at 35 ft.
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (peat): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 780 to 1000 (Cal BP 1160 to 950)

Beta - 263292	8860 +/- 50 BP	-27.7 o/oo	8820 +/- 50 BP

SAMPLE : AB-3 at 129 ft.
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (peat): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 8210 to 7730 (Cal BP 10160 to 9680)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

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Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 263298	7110 +/- 50 BP	-23.8 o/oo	7130 +/- 50 BP
SAMPLE : AM-3b at 15.9 ft.			
ANALYSIS : AMS-Standard delivery			
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid			
2 SIGMA CALIBRATION : Cal BC 6070 to 5970 (Cal BP 8020 to 7920) AND Cal BC 5950 to 5910 (Cal BP 7900 to 7860)			
Beta - 263299	9150 +/- 50 BP	-25.3 o/oo	9150 +/- 50 BP
SAMPLE : AM-3b at 142.6 ft.			
ANALYSIS : AMS-Standard delivery			
MATERIAL/PRETREATMENT : (peat): acid/alkali/acid			
2 SIGMA CALIBRATION : Cal BC 8530 to 8520 (Cal BP 10480 to 10460) AND Cal BC 8480 to 8280 (Cal BP 10430 to 10220)			
Beta - 263300	7730 +/- 50 BP	-27.7 o/oo	7690 +/- 50 BP
SAMPLE : AM-4 at 100.8 ft.			
ANALYSIS : AMS-Standard delivery			
MATERIAL/PRETREATMENT : (peat): acid/alkali/acid			
2 SIGMA CALIBRATION : Cal BC 6630 to 6450 (Cal BP 8580 to 8400)			
Beta - 263301	310 +/- 40 BP	+0.2 o/oo	720 +/- 40 BP
SAMPLE : AM-21 at 15-23'			
ANALYSIS : AMS-Standard delivery			
MATERIAL/PRETREATMENT : (shell): acid etch			
COMMENT: The result is outside of calibration range.			
Beta - 263302	290 +/- 40 BP	-1.6 o/oo	670 +/- 40 BP
SAMPLE : AM-163 at 16-18'			
ANALYSIS : AMS-Standard delivery			
MATERIAL/PRETREATMENT : (shell): acid etch			
COMMENT: The result is outside of calibration range.			

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

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Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 263303 SAMPLE : AML weir2 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1290 to 1420 (Cal BP 660 to 530)	560 +/- 40 BP	-22.9 o/oo	590 +/- 40 BP
Beta - 263304 SAMPLE : AML weir3 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1280 to 1400 (Cal BP 670 to 550)	590 +/- 40 BP	-21.8 o/oo	640 +/- 40 BP

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

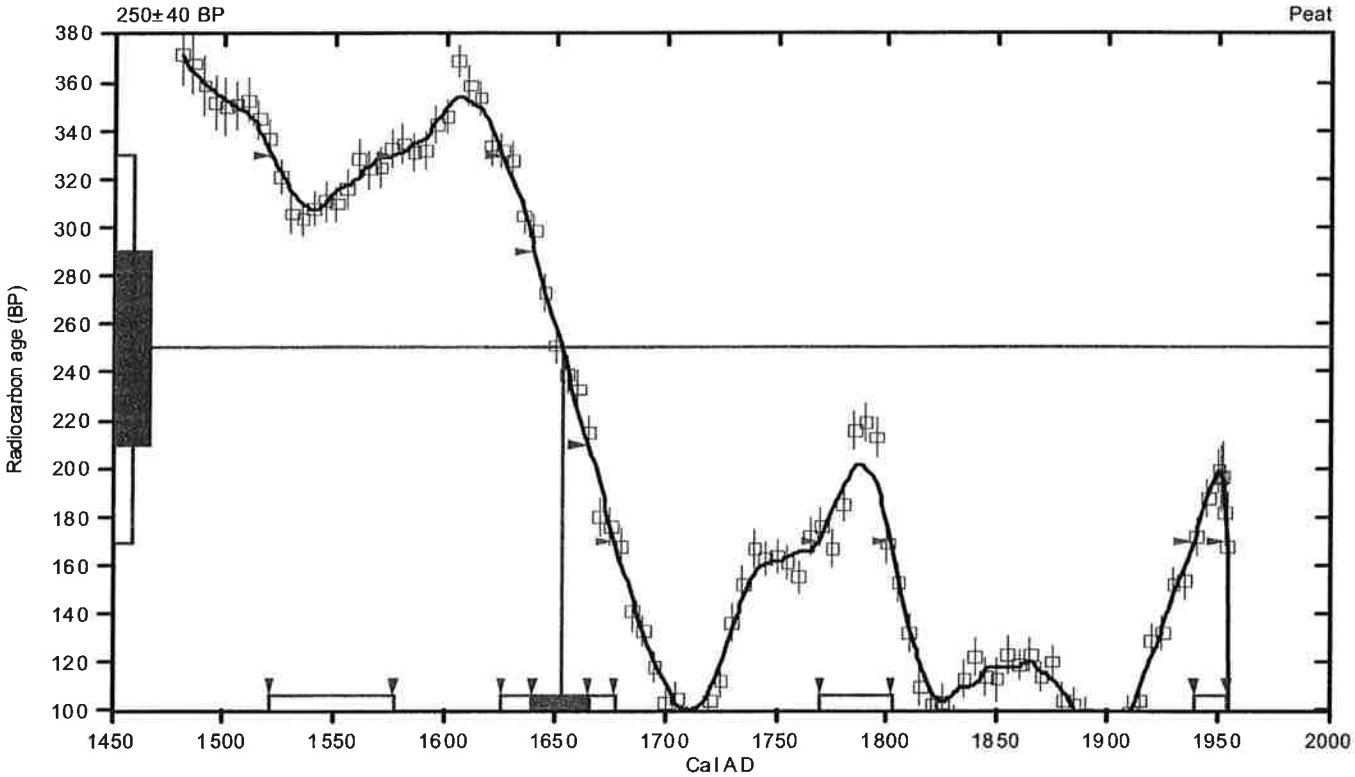
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.2:lab. mult=1)

Laboratory number:	**Beta-263289**
Conventional radiocarbon age:	**250±40 BP**
2 Sigma calibrated results: (95% probability)	**Cal AD 1520 to 1580 (Cal BP 430 to 370) and Cal AD 1630 to 1680 (Cal BP 320 to 270) and Cal AD 1770 to 1800 (Cal BP 180 to 150) and Cal AD 1940 to 1950 (Cal BP 10 to 0)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal AD 1650 (Cal BP 300)
1 Sigma calibrated result: (68% probability)	Cal AD 1640 to 1660 (Cal BP 310 to 280)



References:

Database used

INTCAL04

Calibration Database

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IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

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Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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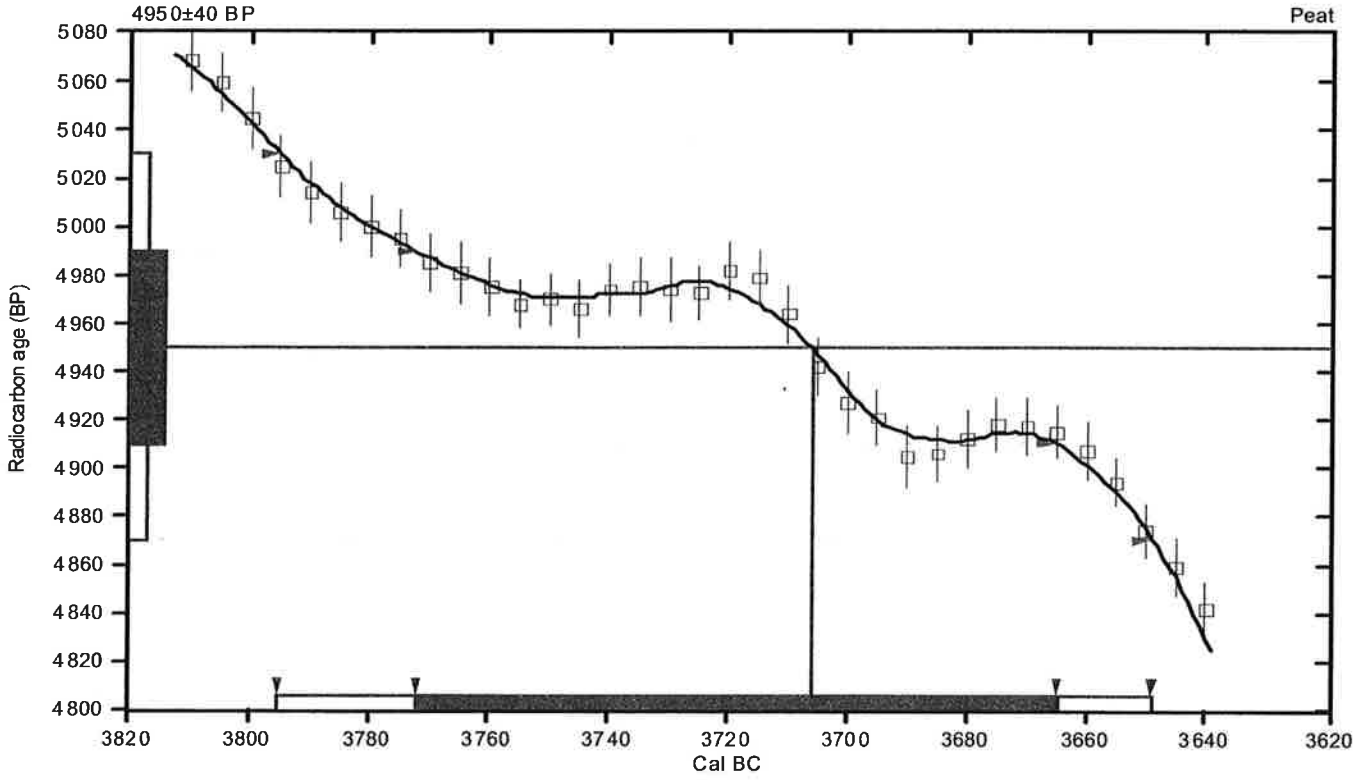
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25:lab. mult=1)

Laboratory number:	**Beta-263290**
Conventional radiocarbon age:	**4950±40 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 3800 to 3650 (Cal BP 5740 to 5600)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 3710 (Cal BP 5660)
1 Sigma calibrated result: (68% probability)	Cal BC 3770 to 3660 (Cal BP 5720 to 5620)



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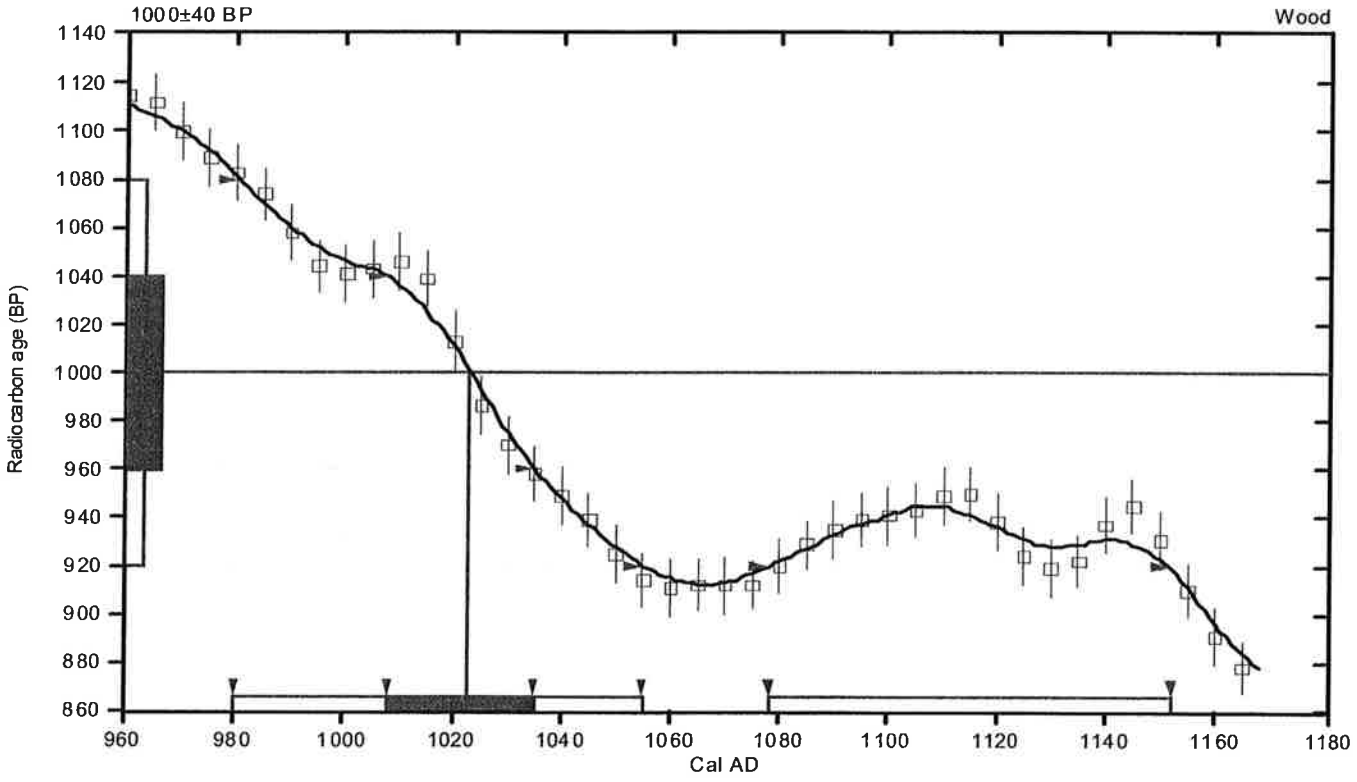
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26.7:lab. mult=1)

Laboratory number:	**Beta-263293**
Conventional radiocarbon age:	**1000±40 BP**
2 Sigma calibrated results: (95% probability)	**Cal AD 980 to 1060 (Cal BP 970 to 900) and Cal AD 1080 to 1150 (Cal BP 870 to 800)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal AD 1020 (Cal BP 930)
1 Sigma calibrated result: (68% probability)	Cal AD 1010 to 1040 (Cal BP 940 to 920)



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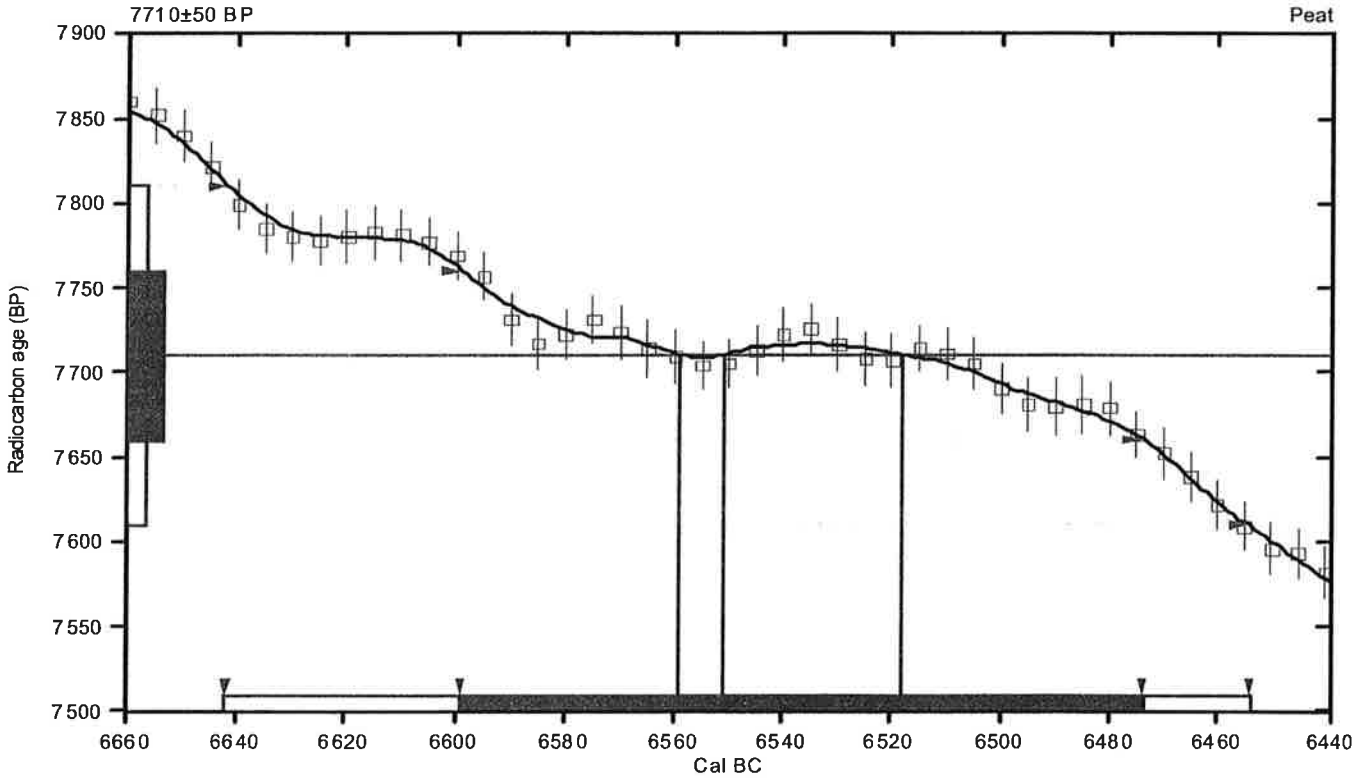
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-27.7:lab. mult=1)

Laboratory number:	**Beta-263294**
Conventional radiocarbon age:	**7710±50 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 6640 to 6450 (Cal BP 8590 to 8400)**

Intercept data

Intercepts of radiocarbon age with calibration curve:	Cal BC 6560 (Cal BP 8510) and Cal BC 6550 (Cal BP 8500) and Cal BC 6520 (Cal BP 8470)
1 Sigma calibrated result: (68% probability)	Cal BC 6600 to 6470 (Cal BP 8550 to 8420)



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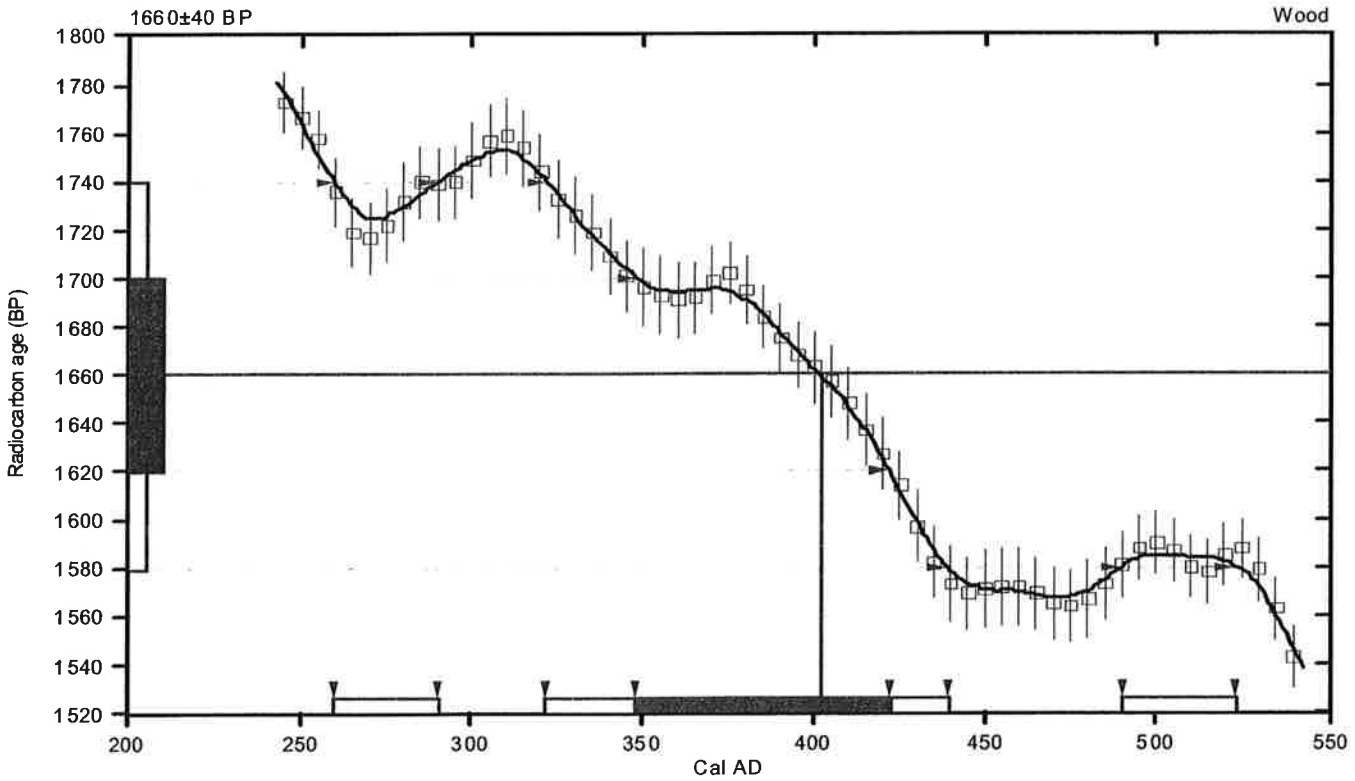
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26:lab. mult=1)

Laboratory number:	**Beta-263295**
Conventional radiocarbon age:	**1660±40 BP**
2 Sigma calibrated results: (95% probability)	**Cal AD 260 to 290 (Cal BP 1690 to 1660) and Cal AD 320 to 440 (Cal BP 1630 to 1510) and Cal AD 490 to 520 (Cal BP 1460 to 1430)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal AD 400 (Cal BP 1550)
1 Sigma calibrated result: (68% probability)	Cal AD 350 to 420 (Cal BP 1600 to 1530)



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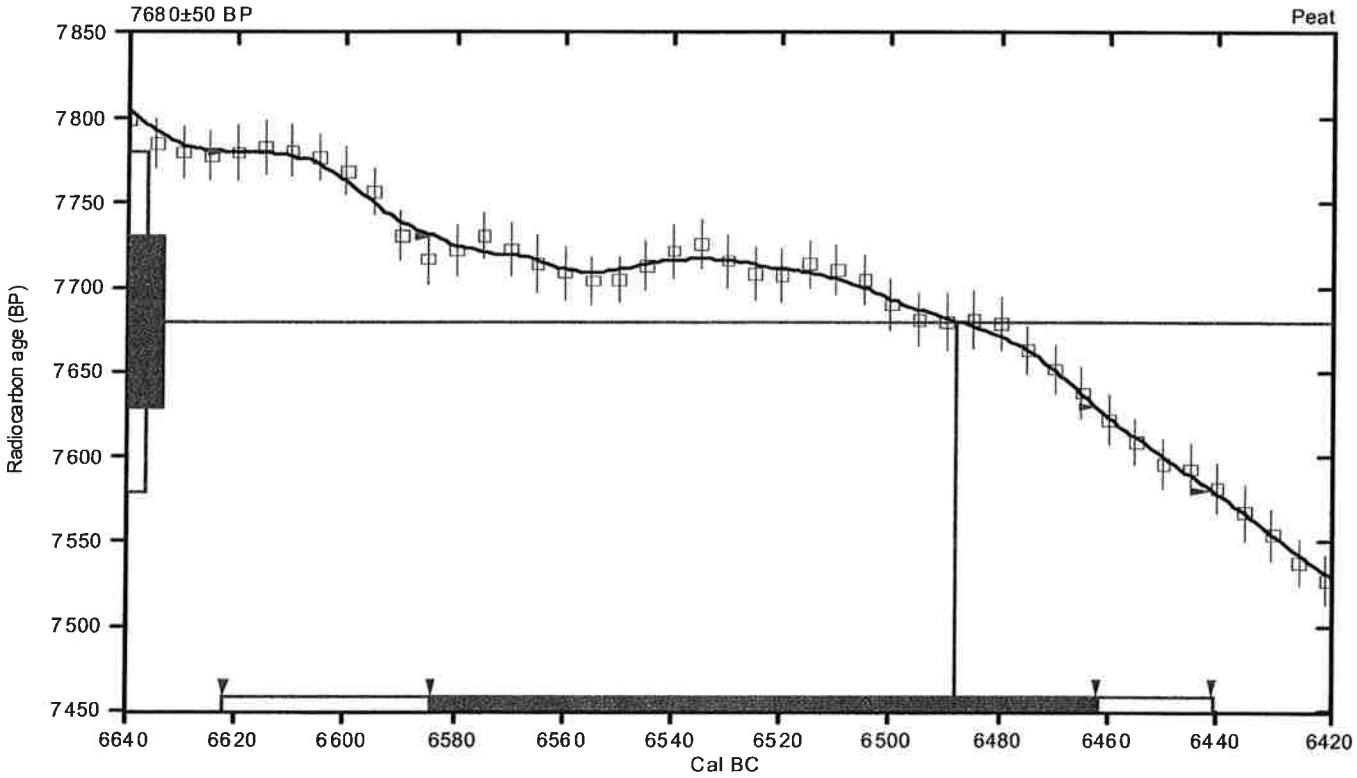
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-27.9:lab. mult=1)

Laboratory number:	**Beta-263296**
Conventional radiocarbon age:	**7680±50 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 6620 to 6440 (Cal BP 8570 to 8390)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 6490 (Cal BP 8440)
1 Sigma calibrated result: (68% probability)	Cal BC 6580 to 6460 (Cal BP 8530 to 8410)



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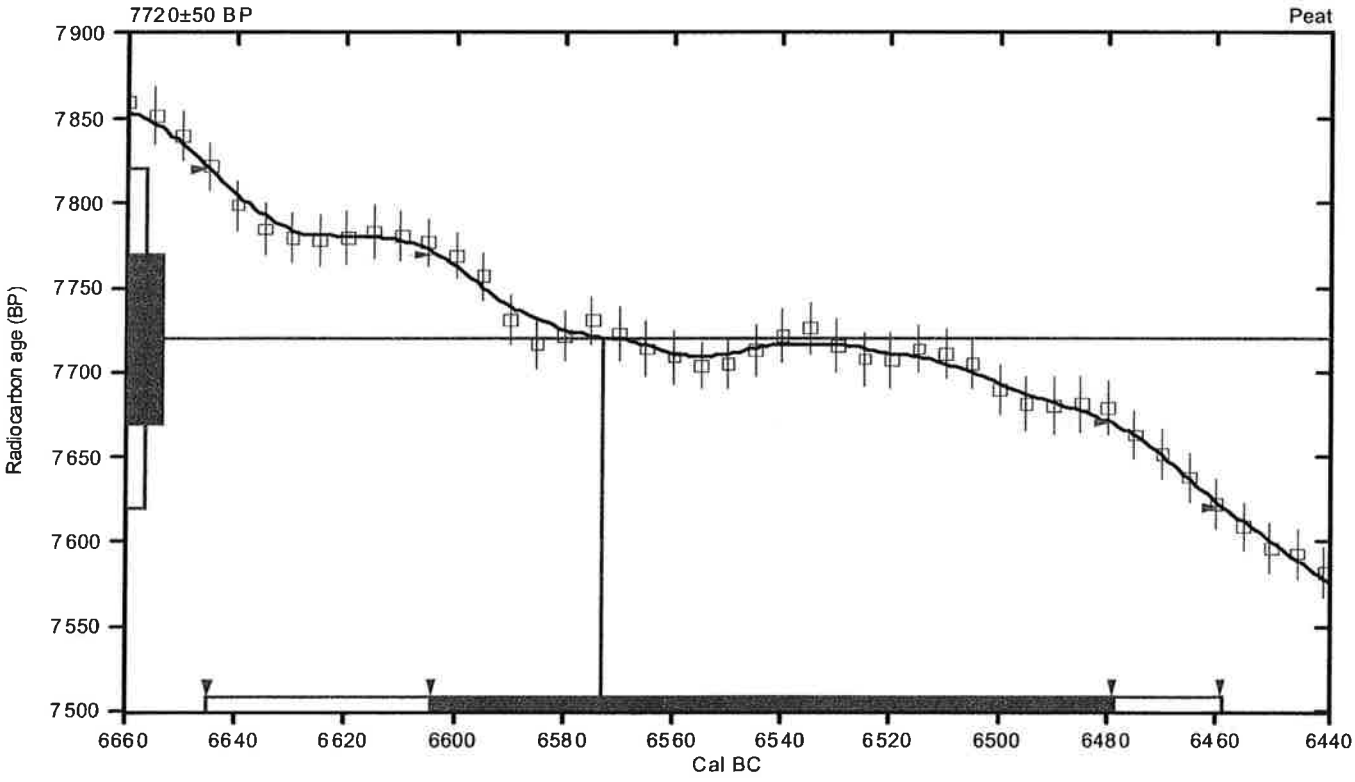
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-28:lab. mult=1)

Laboratory number:	**Beta-263297**
Conventional radiocarbon age:	**7720±50 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 6640 to 6460 (Cal BP 8600 to 8410)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 6570 (Cal BP 8520)
1 Sigma calibrated result: (68% probability)	Cal BC 6600 to 6480 (Cal BP 8550 to 8430)



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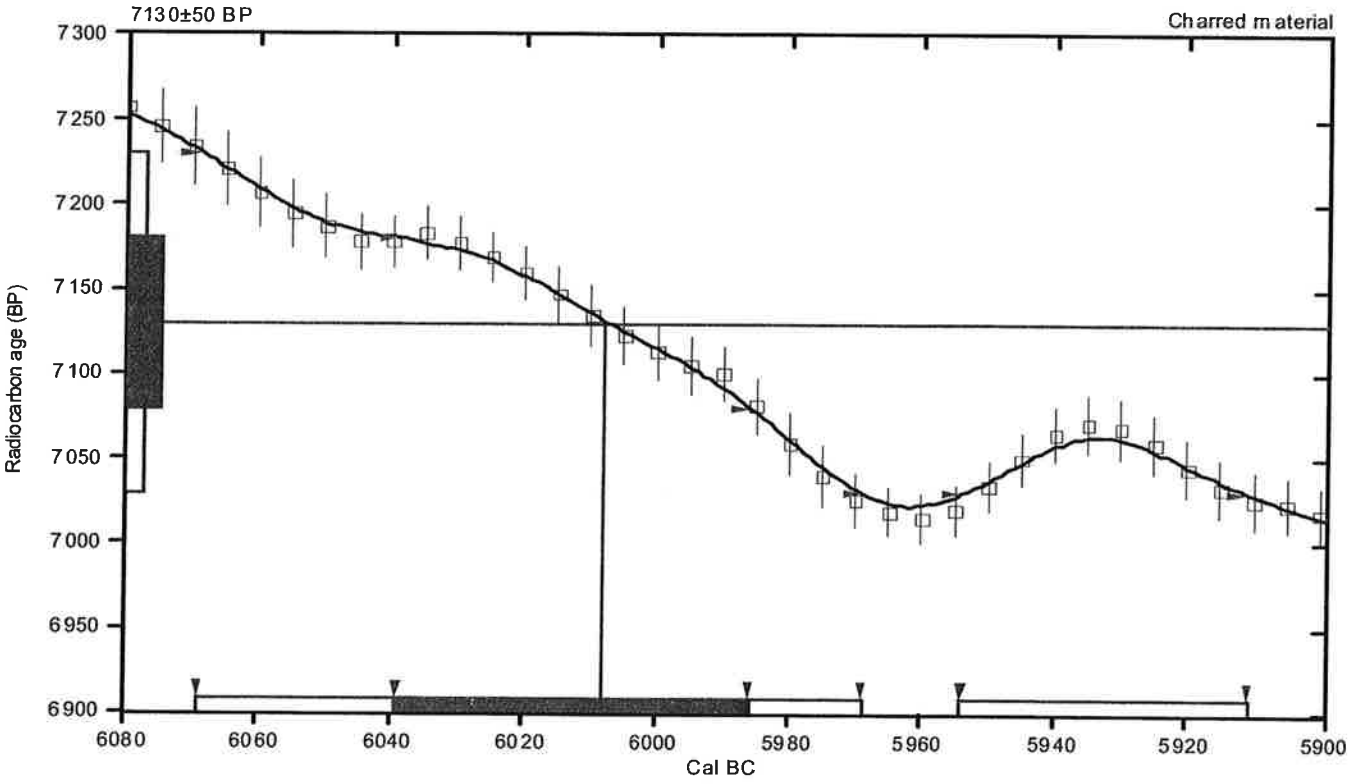
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.8:lab. mult=1)

Laboratory number:	**Beta-263298**
Conventional radiocarbon age:	**7130±50 BP**
2 Sigma calibrated results: (95% probability)	**Cal BC 6070 to 5970 (Cal BP 8020 to 7920) and Cal BC 5950 to 5910 (Cal BP 7900 to 7860)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 6010 (Cal BP 7960)
1 Sigma calibrated result: (68% probability)	Cal BC 6040 to 5990 (Cal BP 7990 to 7940)



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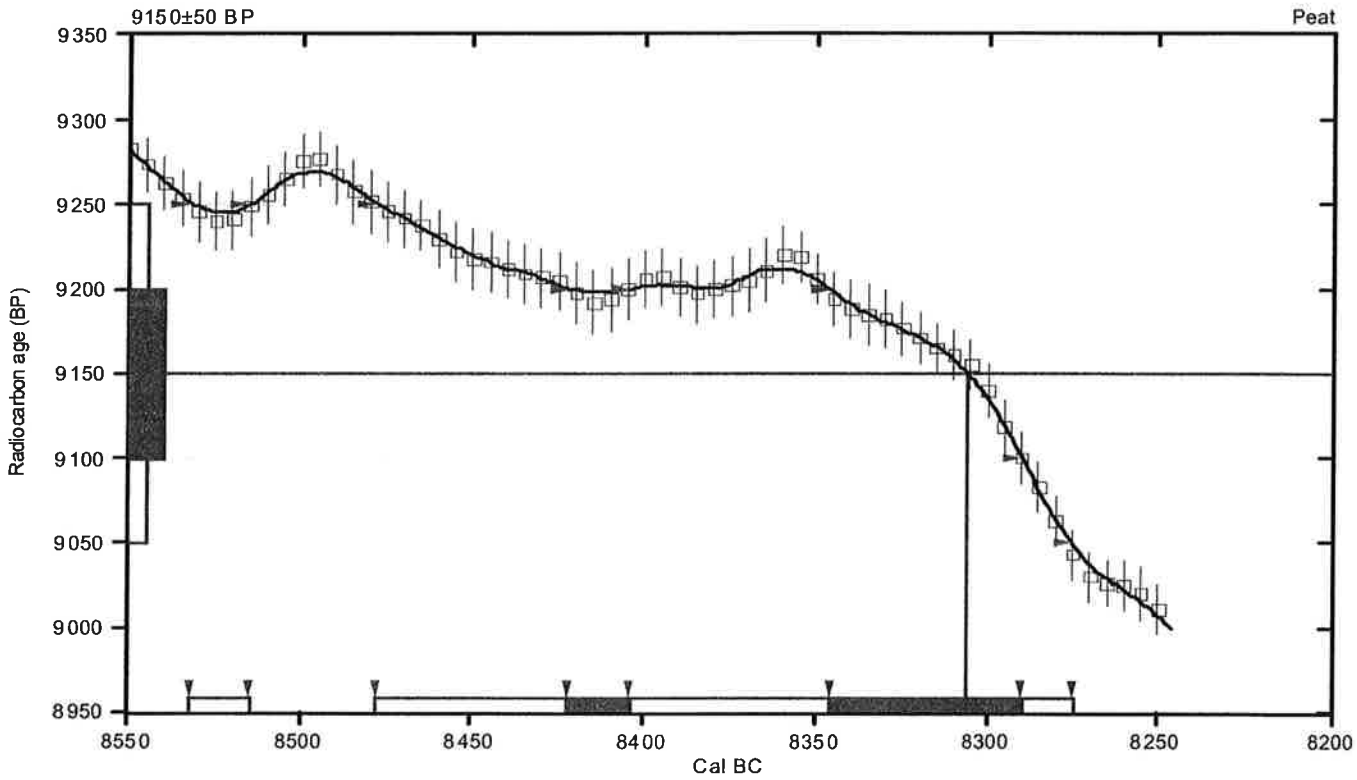
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.3:lab. mult=1)

Laboratory number:	**Beta-263299**
Conventional radiocarbon age:	**9150±50 BP**
2 Sigma calibrated results: (95% probability)	**Cal BC 8530 to 8520 (Cal BP 10480 to 10460) and Cal BC 8480 to 8280 (Cal BP 10430 to 10220)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 8310 (Cal BP 10260)
1 Sigma calibrated results: (68% probability)	Cal BC 8420 to 8400 (Cal BP 10370 to 10350) and Cal BC 8350 to 8290 (Cal BP 10300 to 10240)



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A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Beta Analytic Radiocarbon Dating Laboratory

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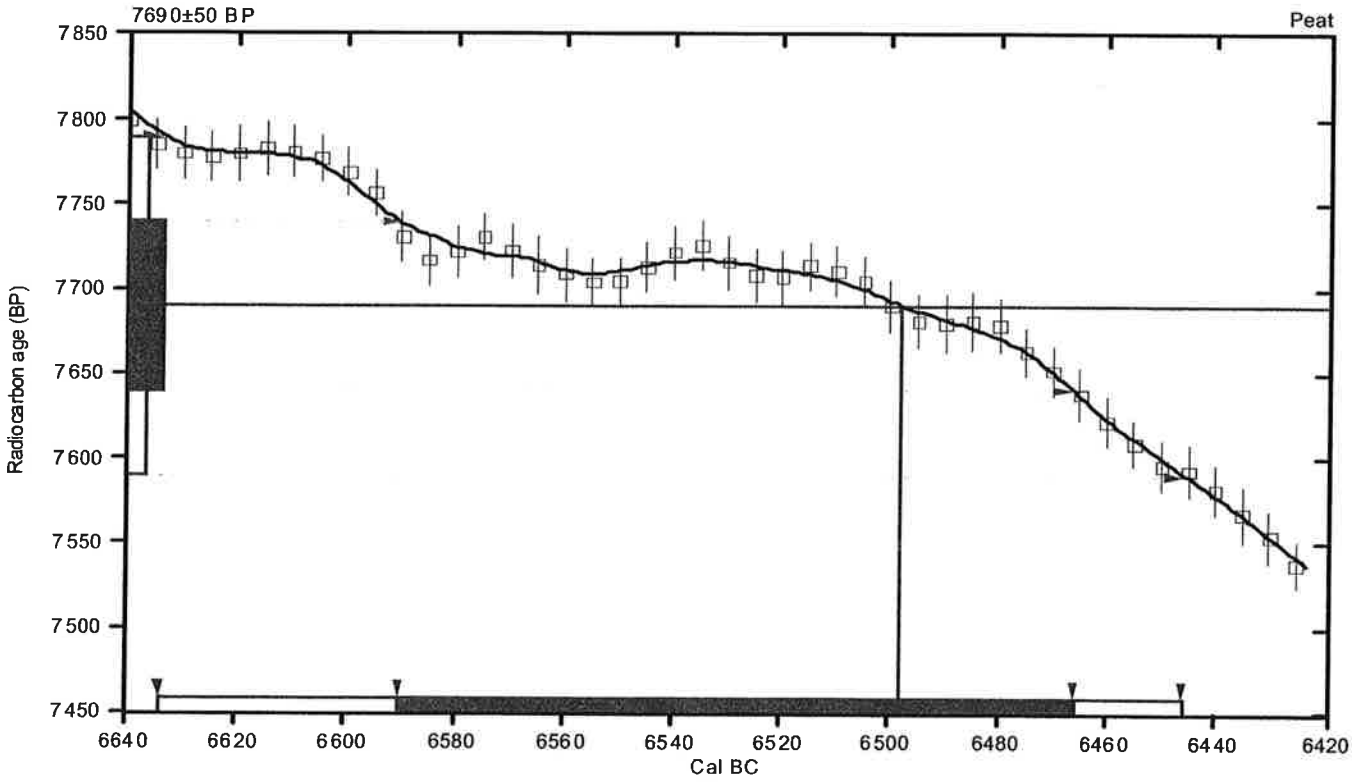
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-27.7:lab. mult=1)

Laboratory number:	**Beta-263300**
Conventional radiocarbon age:	**7690±50 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 6630 to 6450 (Cal BP 8580 to 8400)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 6500 (Cal BP 8450)
1 Sigma calibrated result: (68% probability)	Cal BC 6590 to 6470 (Cal BP 8540 to 8420)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

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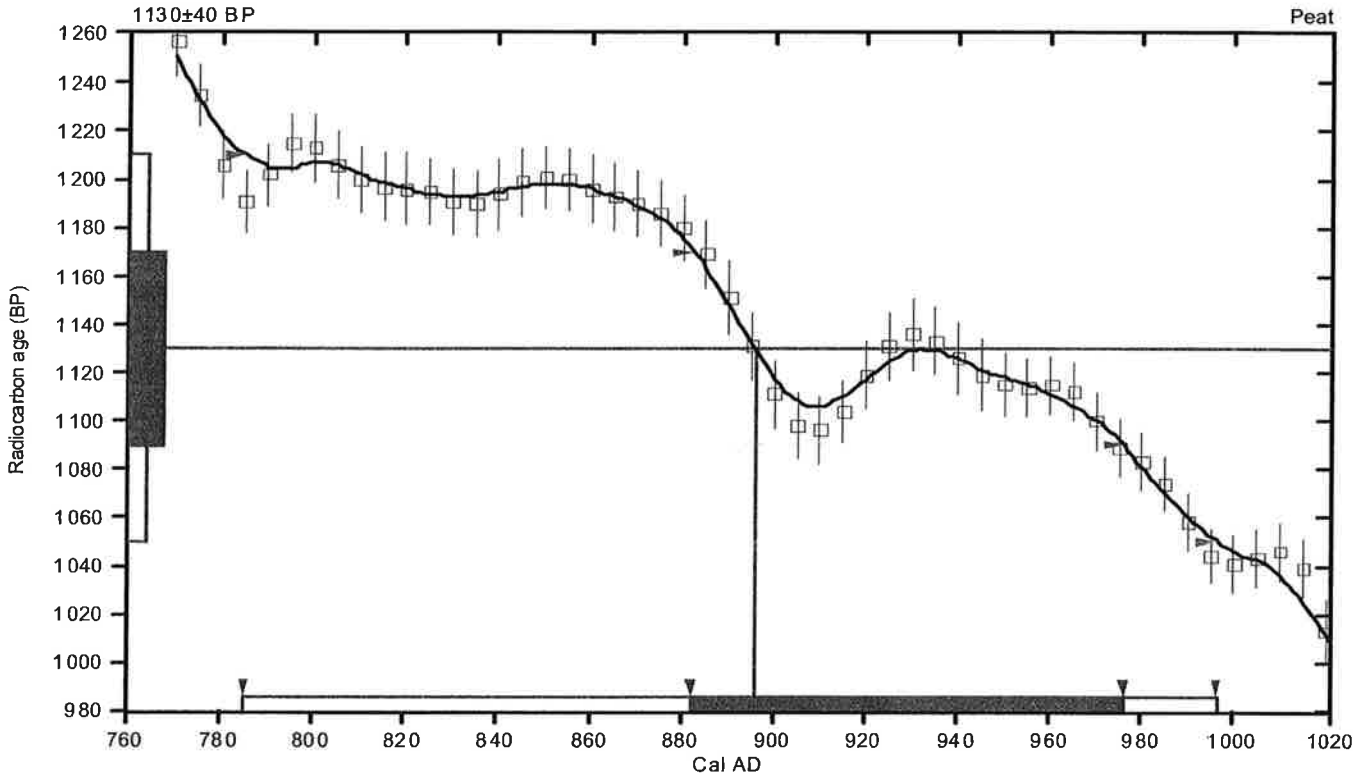
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.9:lab. mult=1)

Laboratory number:	**Beta-263291**
Conventional radiocarbon age:	**1130±40 BP**
2 Sigma calibrated result: (95% probability)	**Cal AD 780 to 1000 (Cal BP 1160 to 950)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal AD 900 (Cal BP 1050)
1 Sigma calibrated result: (68% probability)	Cal AD 880 to 980 (Cal BP 1070 to 970)



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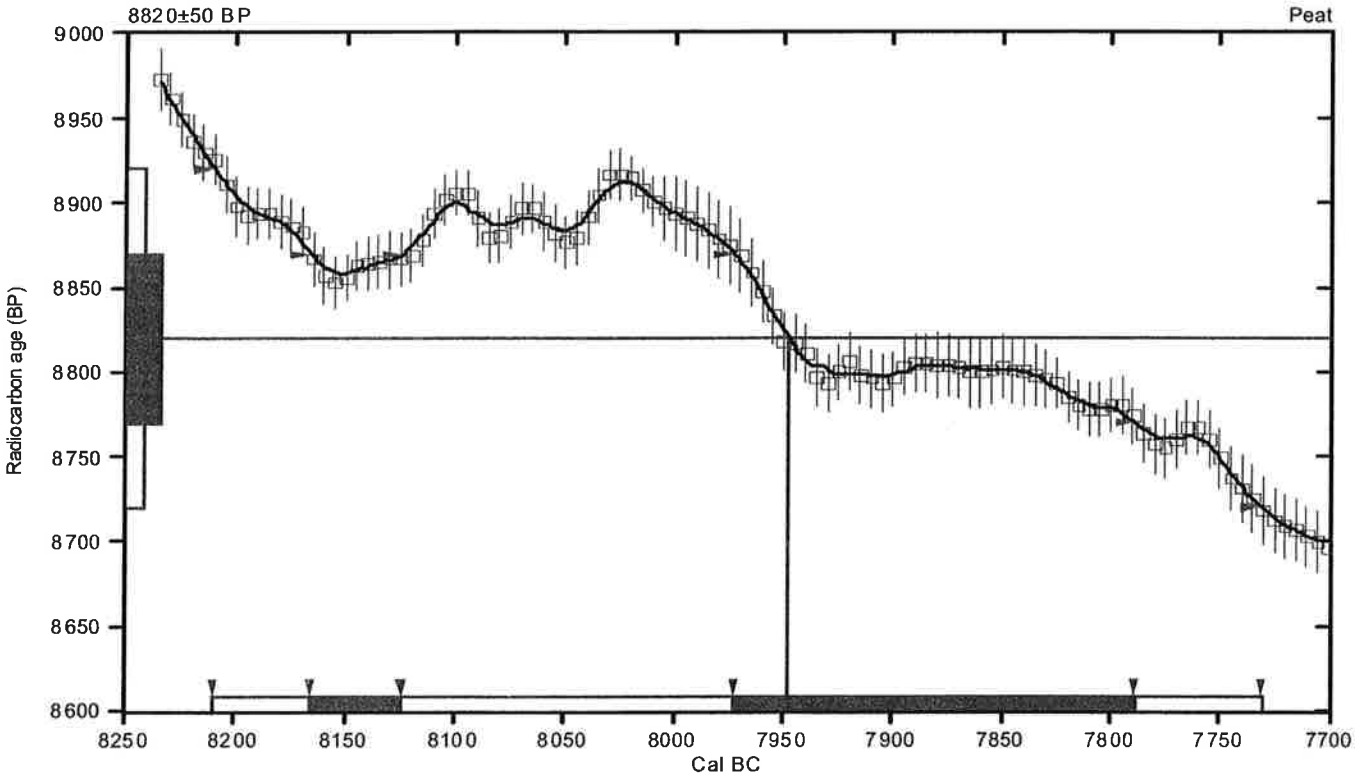
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-27.7:lab. mult=1)

Laboratory number:	**Beta-263292**
Conventional radiocarbon age:	**8820±50 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 8210 to 7730 (Cal BP 10160 to 9680)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 7950 (Cal BP 9900)
1 Sigma calibrated results: (68% probability)	Cal BC 8170 to 8120 (Cal BP 10120 to 10070) and Cal BC 7970 to 7790 (Cal BP 9920 to 9740)



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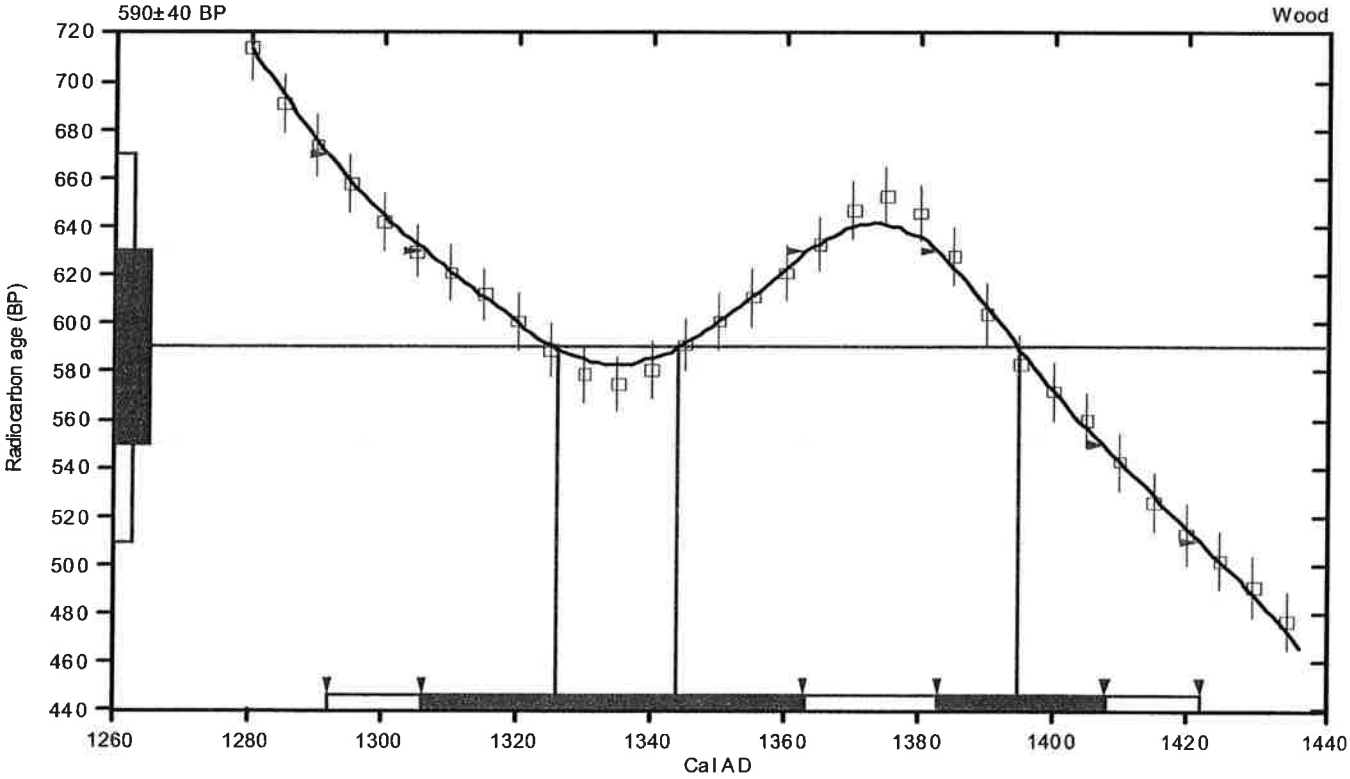
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-22.9:lab. mult=1)

Laboratory number:	**Beta-263303**
Conventional radiocarbon age:	**590±40 BP**
2 Sigma calibrated result: (95% probability)	**Cal AD 1290 to 1420 (Cal BP 660 to 530)**

Intercept data

Intercepts of radiocarbon age with calibration curve:	Cal AD 1330 (Cal BP 620) and Cal AD 1340 (Cal BP 610) and Cal AD 1400 (Cal BP 560)
1 Sigma calibrated results: (68% probability)	Cal AD 1310 to 1360 (Cal BP 640 to 590) and Cal AD 1380 to 1410 (Cal BP 570 to 540)



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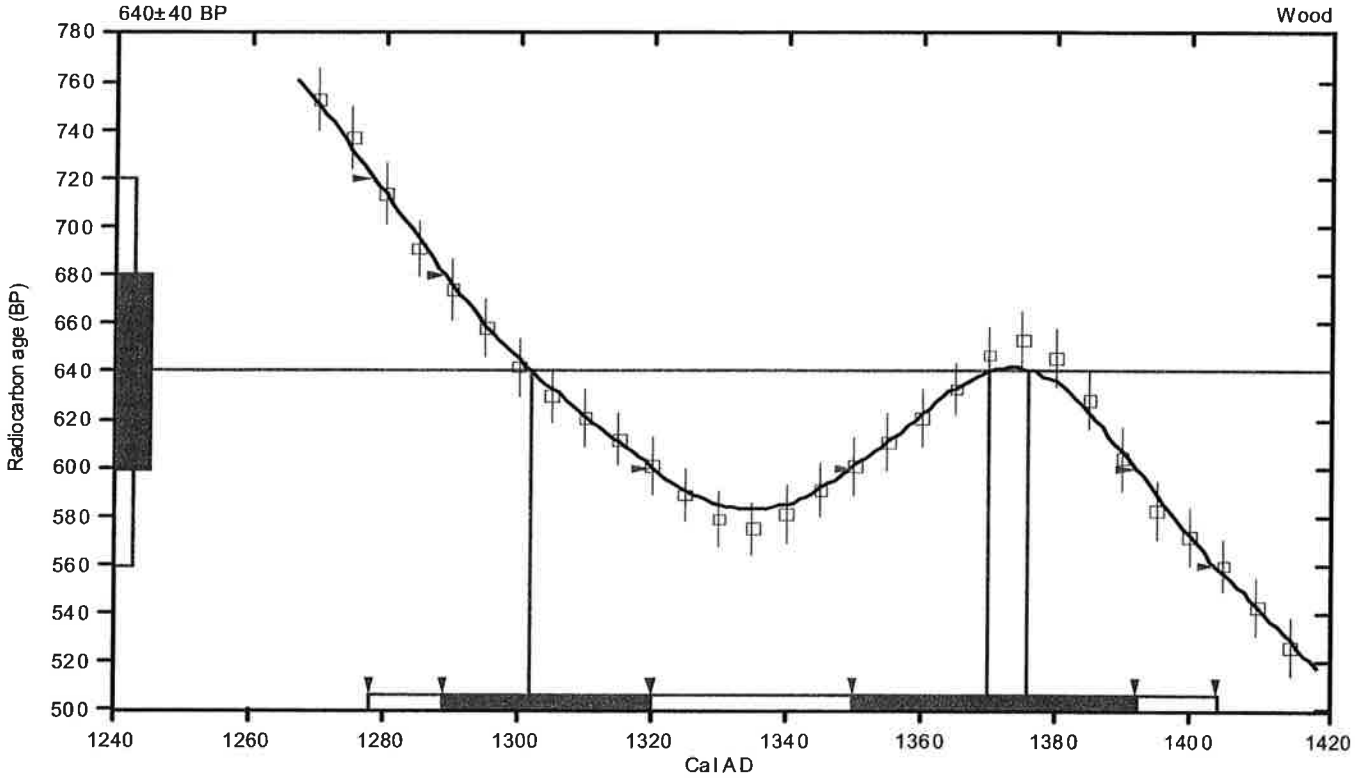
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-21.8:lab. mult=1)

Laboratory number:	**Beta-263304**
Conventional radiocarbon age:	**640±40 BP**
2 Sigma calibrated result: (95% probability)	**Cal AD 1280 to 1400 (Cal BP 670 to 550)**

Intercept data

Intercepts of radiocarbon age with calibration curve:	Cal AD 1300 (Cal BP 650) and Cal AD 1370 (Cal BP 580) and Cal AD 1380 (Cal BP 570)
1 Sigma calibrated results: (68% probability)	Cal AD 1290 to 1320 (Cal BP 660 to 630) and Cal AD 1350 to 1390 (Cal BP 600 to 560)



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Appendix D: Landau Logs

Landau Logs

depth ft	H40		H42		H39		H38
4	fill		basalt rock				wood debris
5.5			fill				wood debris
			no fill @ 6'				
7	fill		silt, blk		mud, lt gry		lt gry mud
8.5					mud dk gry		mud blk
9	mud,blk		silt blk		slough		blk mud
10.5	woody debris	10	wood debris		slough		lt gry mud
							woody debris
12	shelby		shelby		mud, silty		blk silty mud
13.5	shelby		shelby		OM 13' 12.7'		sand
							wood debris,alder cone
14	mud		silt,blk laminae				mud silty
15.5	woody debris		silt,bm, rhizomes		shelby	14.5	rooted plant
	mud		silt,gray				
17			silt laminae gray				shelby
19	woody debris @18			18	silt sandy		shelby
19	silty,mud		silt gray laminae	20	whole clam shell		silt,muddy
20.5			log in middle				

Landau Logs

	H44	H27	H27	
			Depth ft	
Depth ft	wood debris	Basalt	22	shelby
4	wood debris	basalt	24	shelby
5.5		end basalt @ 6'		
	wood debris	silt	24	silt,muddy
7	wood debris	debris covered surface	25.5	silt,muddy
8.5		lt streak		
		plant frags		
	wood debris	sand,med gr	27	sand, silty
9	wood debris	OM 1/2"	28.5	sand,silt laminae
10.5		mud,lk		
	organic wood	silt	29	sand
12	w/ intbd mud	wood debris	30.5	sand
13.5		blk mud		
		mud	34	gravel sandy
14	sand,fine gr.	mud	35.9	gravel sandy
15.5				
	shelby	mud, silty laminae	39	sand
17	shelby		40.5	mud,silty
19				organic frags
	silt,muddy	mud, silty laminae		
19	Plant fossils			
20.5	not rooted		44	shelby
			46.5	shelby
			49	mud silty
			50	in situ clam