ARCHAEOLOGICAL SURVEY AND TESTING IN THE WILLAPA RIVER VALLEY OF SOUTHWEST WASHINGTON

By

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OF SOUTHWEST WASHINGTON

Abstract

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Modern studies of site distribution, utilization of near-coastal riverine resources, and the development of cultural complexity during the Holocene in southwestern Washington are hampered by the limited amount of data from previous archaeological investigations. This study of Willapa River Valley archaeology provides a context in which to interpret southern Northwest Coast near-coastal pre-contact archaeological sites.

Three areas for investigation became evident during the initial research phase and directed subsequent inquiries. The first dealt with prehistoric site distribution in the Willapa region landscape, the potential for locating sites, and site distribution patterns on the Willapa River Valley alluvial terraces. Bayesian GIS modeling and geomorphologic-based survey techniques identified a new sample of 26 localities representing approximately 10,000 years of occupation. Eustatic sea level rise, seismic movement, tsunamis, and fluvial processes formed the Willapa region's landscape, and promoted natural *redox* reaction formation processes within submerged archaeological contexts.

The second involved the pre-contact utilization of lithic, floral, and faunal natural resources, and how these adaptations relate to what we know from past work at coastal-adjacent midden sites. Excavation at the Forks Creek terrace site revealed a detailed chronology of a 2700 BP Willapa River Valley camp oriented toward the seasonal hazelnut, bitter cherry, elk,

deer, and salmon resources of a fire-maintained prairie "garden" and the Willapa River. Microblades were manufactured for their technological qualities, illustrating similarities to Salish Sea "Locarno Beach" assemblages.

The third encompassed the archaeology of the Athabaskan Kwalhioqua, and addressed the potential for recognizing cultural enclaves in the archaeological record through the study of exotic obsidian and blueschist artifacts. Obsidian "wealth blades," blueschist clubs, and nephrite adze artifacts define a pattern of late prehistoric long-distance trade and exchange. The "Pacific Athabaskan coastal trade network" hypothesis poses that *direct* sea-going canoe trade occurred between Athabaskan cultures of the southern Northwest Coast within a counter-seismic ceremonial dance network prior to the great earthquake of AD 1700.

New insights into the prehistory of the Willapa River Valley are provided with consideration given to site location, age of occupation, cultural landscapes, and the position of the Willapa River Valley prehistoric occupation within the Pacific Northwest.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Dedication

Dedicated to my Dad

and the beautiful Chinook that pulled us around Clallam Bay.

CHAPTER ONE

INTRODUCTION

This document describes the environment and landscape of the prehistoric Willapa River Valley (Figure 1), providing an ecological context to interpret a newly documented set of southern Northwest Coast archaeological assemblages from pre-contact Willapa River strath terrace lithic scatter sites. The archaeological sites, assemblages, and collections examined in this study were identified during a multi-year (2006-2011) reconnaissance survey of the Willapa River Valley, and through archaeological excavations at prehistoric site 45PC175 (2013).

This archaeological study of the Willapa River Valley posed three sets of research questions. The first research area focused on the potential for locating prehistoric sites, accounting for the geographic distribution of prehistoric archaeological sites in the Willapa landscape, and identifying patterns in the distribution of archaeological sites on the alluvial terraces of the Willapa River Valley. The second research domain was oriented towards exploring how pre-contact cultures of the Willapa River Valley utilized the lithic, floral, and faunal natural resources of the region, and how these adaptations relate to what we know from past excavations at the large shell midden and coastal-adjacent sites of the southern Northwest Coast. The third stemmed from the archaeological and ethnographic research work of Welch (1970, 1983) in the Boistfort Valley of southwestern Washington. This avenue of research examined the archaeology of the late prehistoric Willapa River Valley Athabaskan Kwalhioqua culture, and addressed the potential for recognizing expressions of cultural enclaves in the archaeological record through the study of exotic obsidian and blueschist trade artifacts.

Pre-Contact Site Distribution

Archaeological data from the Willapa River Valley have been unavailable because so few sites have been identified (Figure 2). Willapa River Valley artifacts had never been illustrated or even described beyond short lists of basic tool forms such as "small projectile points" and "thumb-nail scrapers." In the tidal Lower Willapa River Valley, A. L. Brian and Gerald Gould produced a single page reconnaissance survey site form for the "Arrowhead Beach" site (45PC22) in 1954. In 1965 and 1966 Harold Nelson revisited the same site and produced another single page reconnaissance-survey form and added a simple site sketch map. Pursuing information provided by local informants, Nelson also produced brief form-based site descriptions for the Middle Willapa River Valley Green Creek site (45PC39), and the Upper Willapa River Valley Forks Creek Pit site (45PC40). Thirty years later in 1995, Dr. Brian Atwater and Dr. Madonna Moss briefly described the tide zone fish weir and midden site 45PC103 (Figure 2) on a reconnaissance survey site form. They described fire cracked rock, charcoal, fish vertebrae, and wood stakes at the site. The 45PC103 site wood stake fish weir feature was dated to 380 +/- 50 BP (Beta 74541) and 710 +/- 70 BP (Beta 76290) (Atwater and Hemphill-Hailey 1997).

The archaeological studies by Welch (1970, 1983) in the rain shadow protected Boistfort Valley, and Minor (1983) in the Lower Columbia River Valley, are the two primary detailed landscape-scale archaeological investigations that have been used as proxy data to characterize the entire prehistory of the southwest Washington Willapa Hills region. The Martin site (45PC7) (Alexander 1948; Brown 1978; Kidd 1960, 1967; Shaw 1977) and North Nemah River site (45PC102) (DePuydt 1994) excavations have excellent documentation and express the archaeological character of the late prehistoric Lower Chinook cultural pattern in the coastal and estuary zone of the Willapa Bay region.

Clearly, sophisticated archaeological questions about the pre-contact cultures of the Willapa River Valley could not be developed from barely six pages of reconnaissance survey field notes, a single site sketch map, and two late prehistoric radiocarbon dates from a tide-zone fish weir. One of the most fundamental research questions addressed by this study was: how do we locate prehistoric archaeological sites in the Willapa River Valley? Where are the prehistoric sites? This basic question was quickly expanded and developed during the early phase of the study to determine if there were patterns of archaeological site distribution across the different alluvial terrace landforms and ecological zones within the Willapa River Valley. This emphasis on site distribution and landscape oriented inquiry further led me to ask how Willapa region landscapes and archaeological deposits were formed, and how they change over time.

The only apparent available existing data that was available to help identify a new sample of prehistoric archaeological sites in the Willapa River Valley consisted of the regional ethnographic literature, the geographic location data for of all of the pre-existing prehistoric sites in the southwest Washington Willapa Bay region (Figure 2), and topographic and environmental data integrated into a geographic information system (GIS). The available data was suitable for a GIS predictive site location model that utilized an “inductive” Bayesian technique in which the locations of existing Willapa region pre-contact sites acted as “training points” within multiple “layers” of GIS *raster* environmental and landscape data (slope, aspect, distance to water, geology, elevation, etc.) to rank unexplored Willapa region landforms by their similarities to loci with known pre-contact archaeological sites.

In addition to Bayesian GIS predictive modeling, I utilized Woods Hole Oceanographic Institute side-scan sonar survey and sea-level elevation curve derived GIS data (Twichell and Cross 2002) to map and explore changes to the southern Washington Willapa region coastline during the Late Pleistocene and Early Holocene. The Late Pleistocene and Early Holocene post-glacial eustatic sea level rise and resultant marine transgression resulted in significant changes to the southern Washington Coast and the Lower Willapa River Valley that this modeling helped visualize. Investigation of the changing landforms needed to be completed in order to identify the potential locations of past coastal shorelines and the Late Pleistocene and Early Holocene sites that may be associated with them. The mouth of the Willapa River today, for example, is far inland from where it was ten thousand years ago.

A multi-year (2006-2011) reconnaissance survey of the Willapa River Valley was initiated in an effort to test the GIS predictive site location model and increase the sample of Willapa River Valley pre-contact archaeological sites. The Bayesian GIS model was initially quite useful and directed our survey efforts to landforms that contained important pre-contact archaeological sites. Once the archaeological field survey focused on the alluvial terraces of the Willapa River Valley, our discoveries revealed data resolution issues that were preventing the predicative model from differentiating between the subtle differences in elevation between culture rich alluvial terraces, and modern flood terraces without archaeological materials. To compensate for this weakness of the predicative model, a series of different field survey site location strategies were employed on the terraces of the Willapa River Valley. Complete 100% intensive coverage grid-based surveys were conducted, as well as surveys that followed the channel-incised margins of the middle and upper alluvial terrace treads, the margins and banks of abandoned paleo-channels of the meandering Willapa River, and the boundaries of ox-bow swamp features.

As part of the Willapa River Valley survey I assembled and studied scientific literature addressing the most significant geomorphologic processes at work in the region, and tried to identify loci in the Willapa River Valley where these processes were expressed in the natural and archaeological landscapes. The geomorphology research was specifically initiated to help develop an understanding of the chronology and formation process of the culture-rich alluvial terraces of the Willapa River Valley. Field reconnaissance maps of the archaeologically productive middle and upper alluvial terrace landforms in the Willapa River Valley were produced during the course of the surveys. Radiocarbon dates obtained from the project's excavation at the Forks Creek site (45PC175) also directly contributed to the development of a detailed chronology of a Late Holocene Willapa River Valley middle terrace landform.

The geomorphic based survey methodology utilized in the Willapa River Valley led to the identification of 26 pre-contact sites and isolated finds in the Willapa and North River Valleys. These sites illustrate a pattern of prehistoric occupation on middle and upper terrace landforms adjacent to extinct paleo-channels of the Willapa River, and at loci that were once at the peripheries of fire-maintained prairie "gardens." In addition to locating a new sample of pre-contact sites, the Willapa project initiated the development of an alluvial terrace chronology.

The coastal geomorphology investigations also included an exploration of post-depositional natural site formation *redox* and sulfate reduction processes that frequently occur within organic-rich archaeological deposits that have been co-seismically submerged within the anoxic tide zone contexts of Willapa estuary marshes. Similar *redox* processes are likely occurring within potential as-yet undiscovered Late Pleistocene sites now submerged under the Pacific Ocean far off the modern southern Washington State coastline.

Pre-Contact Resource Utilization

One of the goals of the Willapa archaeological survey was to identify the range and spectrum of lithic, floral, and faunal resources that would have been available to pre-contact Willapa cultures. Nelson's 1966 description of the Lower Willapa River Valley "Arrowhead Beach" site (45PC22) noted the presence of deer bone, bear bone, oyster shell, and snail shell eroded onto the tide zone beach. Atwater and Moss's 45PC103 site form described the presence of salmon vertebrae within the tide zone bank of the lower Willapa River. Unfortunately, these initial "trait list" site form descriptions of archaeological bone from the Lower Willapa River Valley estuary zone remain the best descriptions of identifiable archaeological faunal materials in the Willapa River Valley. It is exceptionally rare for any bone to be preserved in the highly acidic sediments of the Middle and Upper Willapa River Valley alluvial terraces where most of this project's survey and testing efforts were focused.

There has been a similar dearth of archaeological information regarding the use of floral resources in the Willapa River Valley. In his 1965 description of the Forks Creek Pit site (45PC40), Nelson mentions the presence of burned cedar wood. In their 45PC103 site form, Atwater and Moss describe the presence of wood branches with bark used as stakes in a fish weir feature.

Even less information had been gathered about the lithic resources available and utilized by pre-contact Willapa River Valley cultures. The Willapa Bay sand-spit Martin site (45PC7) (Alexander 1948; Brown 1978; Kidd 1960, 1967; Shaw 1977) and coastal estuary North Nemah River site (45PC102) (DePuydt 1994) were notable because of their abundance of chipped stone lithic tools and debitage. Still, only cursory information is presently available regarding the lithic debitage assemblage recovered from the Martin site. The artifact samples from these local Willapa region excavations were recovered utilizing 1/4 inch screens, meaning the artifact assemblages likely do not include most of the small lithic debris and tools produced at the sites.

With such limited pre-existing data available, the open ended research question of how prehistoric Willapa River Valley cultures utilized the local natural resources seemed actually quite focused and pertinent. Extensive hypothesis-building data acquisition and descriptive analysis was required in the Willapa River Valley, and is still needed in every watershed valley of the Pacific Coast of Washington State and northern Oregon. After several years of survey and discovery it finally became possible to ask more sophisticated questions regarding the pre-contact utilization of Willapa's natural resources. I thus began to explore ways to address the question of whether there were differences in resource utilization between pre-contact sites in the Willapa River Valley, and sites in the Lower Columbia River (Minor 1983) and Pacific coast sand spit region environments (Alexander 1948; Brown 1978; Connolly et al. 1992; Kidd 1960, 1967; Phebus and Drucker 1979; Roll 1974; Shaw 1977). The Willapa River Valley archaeological survey and the excavations at Forks Creek were designed to gather data about the Willapa environment and the use of faunal, floral, and lithic resources by pre-contact Willapa River Valley cultures. The survey resulted in the characterization of the lower, middle, and upper environmental and landscape zones within the Willapa River Valley, and identified the distribution and sources of lithic raw materials across the Willapa region landscape. Through the use of fine mesh screens, the excavation methodology at the Forks Creek site was specifically designed to capture small artifacts and samples, such as seeds, in order to create a complete sample of much-needed environmental data.

Harold Nelson, in his 1965 Willapa River Valley Forks Creek Pit (45PC40) site form, observed that local collectors "follow plows around like vultures." The Willapa survey utilized ethnographic techniques (informant interviews) to locate four large old Willapa River Valley family artifact collections, and multiple small artifact collections. The artifact collectors, or living relatives of the collectors, were interviewed within an ongoing dialogue, and the owners of four of the largest private artifact collections graciously allowed them to be borrowed by the author for almost two years of classification, documentation, and analysis. Many smaller collections were also documented in the field. The largest of the collections consists of approximately 1500 formalized chipped-stone lithic and ground stone tools, representing at least 9000 years of cultural occupation in the Willapa River Valley.

Most of the Willapa River Valley collections artifacts did not retain detailed context information needed to perform accurate spatial distribution research. Informal regionally based artifact seriation and patina observations provided the only clues to the temporal origins of the Willapa collection artifacts. The collections also contained a remarkably diverse variety of chipped stone and ground stone artifact technologies made primarily of locally available lithic materials. Lacking consistent detailed context information, the Willapa family artifact collections could not provide the same type of distribution data that was being gathered by the project's archaeological survey and excavation, but the family collections were a boon to the study of pre-contact Willapa resource utilization and technology. Microlith "sideblade" and bifacial "rotated scraper" chipped stone tool forms novel to the southern Northwest coast were identified in the process of developing a regional Willapa artifact classification from the local artifact collections.

In addition to providing hypothesis building data on the utilization of Willapa River Valley technology and resource utilization, the Willapa River Valley family collections contained relatively large numbers of exotic obsidian artifacts, as well as artifacts made of exotic trade good blueschist and nephrite materials. Multiple Willapa family artifact collections contained fragments of large obsidian bifaces made from black and mahogany (red) obsidian, fragments of "lozenge form" blueschist clubs, and adzes/celts made of exotic green nephrite. X-ray fluorescence (XRF) obsidian provenience analyses are used to identify pre-contact Willapa trade networks that extended to the estuaries of the southern Oregon and the northern California Pacific coast.

Archaeology of the Kwalhioqua Athabaskan Enclave

At the turn of the twentieth century, Boas (1902) outlined a series of "Problems in North American Archaeology." One of the primary research questions posed by Boas (1902) involved exploring the origins and relationships between the dispersed Athabaskan tribes of the Pacific Coast. More than a century later, the Willapa River Valley project has built on the work of Welch (1970, 1983) to begin to explore these relationships using the archaeological culture of the Willapa Kwalhioqua. Welch's (1970, 1983) fieldwork and research were focused in the Upper Chehalis River Boistfort Valley, a mountain-isolated wide terraced landscape located on the far eastern flank of the Willapa Hills above the Puget Trough.

Prior to the excavations at Layser Cave and Judd Peak Rockshelters (Daugherty et al. 1987a, 1987b), Welch (1983) had examined the possibility that microblade technology in the Upper Chehalis River Valley could have been introduced to the region by the Athabaskans from their northern homeland. Daugherty's (1987a, 1987b) work at Layser Cave and Judd Peak Rockshelters clearly showed microblade core technology in deposits far older than the introduction of Athabaskan languages to the Pacific Coast. This pattern was also reflected in the excavations at the Willapa River Forks Creek site (45PC175).

This research domain addresses the potential for recognizing cultural enclaves within the archaeological record. If microblade technology is *not* diagnostic of the Athabaskan archaeological culture of the Willapa River Valley, is it possible to differentiate between Athabaskan, Penutian, or Salishan archaeological sites? Are there "signatures" of the Kwalhioqua Athabaskan culture in the archaeological deposits of the Willapa River Valley terraces?

Rather than looking solely for specific "tell-tale" artifact varieties or "vestigial" technologies from the northern Athabaskan "homeland," the Willapa project explored the archaeological visibility of the Kwalhioqua Athabaskan enclave though the use of X-ray fluorescence (XRF) obsidian provenience studies that were graciously performed by Craig Skinner of the Northwest Research Obsidian Studies Laboratory. The Willapa project sourced exotic trade obsidian artifacts from the Willapa River Valley family collections, from the surfaces of sites identified by the Willapa archaeological survey, and from the excavations at the Forks Creek site (45PC175).

In the northwest California Pacific Athabaskan region, Richard Hughes (1978, 1990) and Whitaker et al. (2007) used XRF provenience studies to explore patterns of late prehistoric Athabaskan obsidian procurement with respect to distance, status, and linguistic enclaves. In the "Gunther Island" assemblages, Hughes (1978) observed a "distance-status" pattern expressed in the differential treatment of obsidian from distant and close source quarries. Important ceremonial biface artifacts were made from distant southeast Oregon obsidian sources, while utilitarian artifacts tended to be made from more easily accessible obsidian quarries closer to the site. Whitaker et al. (2007) identified a preference for intra-Athabaskan obsidian trade by observing a variance from the obsidian "distance-decay" model at three "Gunther Pattern" (AD 1706 to 1771, AD 885 to 1690, and AD 1757) sites within the northwest California Pacific Coast Athabaskan territory. At Whitaker's (2007) northwest California Pacific Athabaskan coastal sites, distant northeast California Medical Lake Highlands obsidian appears to have been used more than obsidian from much closer quarry sources within territories controlled by Pomo and Yuki linguistic and cultural groups. Whitaker et al. (2007) observed a positive relationship between quarry distance and flake weight; the opposite of what one would expect. Whitaker et al. (2007) attributed this deviation from the "distance-decay" model to preferential trade through Athabaskan-friendly cultural and linguistic channels, and to the prestige associated with ownership of the distant obsidian.

The obsidian procurement and use patterns observed by Hughes (1978, 1990) and Whitaker et al. (2007) are discussed with respect to the Kwalhioqua Athabaskan enclave and the "suspiciously anomalous" diversity of obsidian sources indentified in the Willapa River Valley collections. Obsidian artifacts from northwest Oregon, Idaho, southeast Oregon, northeast California, the California Coast Range, and east California entered the Willapa River Valley through multiple prehistoric trade networks. I will illustrate how elements of the Willapa collections obsidian assemblage appear to violate Hughes' "distance-status" procurement model. I will also show how the Willapa Kwalhioqua displayed obsidian preferences similar to northern California coast Athabaskan cultures. I postulate that these similarities are a result of late prehistoric Pacific Coast sea-going canoe *direct* trade and the counter-seismic ceremonial dance network that existed between the northern Californian Pacific Athabaskan "Gunther Island cultures" and the Kwalhioqua Athabaskan enclave of the Willapa River Valley.

To compliment to the XRF obsidian provenience analysis, this exploration of the "archaeology of enclaves" and trade networks expands on the work of Harlan Smith (1907, 1910), Franz Boas (Smith 1907), and L. L. Loud (1918), in the discussion of the distribution of late prehistoric "lozenge form" blueschist stone clubs and "schist" artifacts within the southern Northwest Coast, Lower Columbia River, and Salish Sea regions. Geologic, ethnographic, distribution, and context data is used to generate fresh hypotheses regarding the manufacture and trade of ceremonial blueschist "lozenge form" club artifacts within the Pacific Athabaskan coastal trade network prior to the great earthquake of AD 1700 (Atwater et al. 2005).

The Willapa project identified archaeological evidence of at least 10,000 years of cultural occupation within a southern Washington State Pacific Coastal river valley. This study illustrates how post-glacial eustatic sea level change, long-term trends of tectonic uplift, and punctuated seismic earthquakes have shaped the near-coastal landscape and contributed to archaeological site formation processes throughout the Late Pleistocene and Holocene. Chapter Two of this study summarizes the existing ethnographic and archaeological data of the Willapa region, while Chapter Three outlines the floral, faunal, geologic, and environmental resources and processes that have shaped the Willapa region's archaeological landscape and assemblages.

Chapter Four focuses on the site discovery and survey techniques that were developed to locate a fresh sample of archaeological sites. The Willapa project survey identified 26 new pre-contact sites and isolated finds in the Willapa River Valley and North River Valley, revealing a pattern of prehistoric occupation on middle and upper terrace landforms adjacent to extinct paleo-channels of the Willapa River, and at loci that were once at the peripheries of fire-maintained prairie "gardens." The pre-contact culturally-maintained prairies were occupied by Euro-American farms in the early historic homestead period.

Chapter Five is a detailed description and analysis of the excavation at the prairie-adjacent 2700 year old middle terrace Forks Creek site (45PC175). This excavation revealed the first details of pre-contact resource utilization at an Upper Willapa River Valley prairie and river-adjacent camp site. Multilingual Penutian, Salish, and Athabaskan task groups manufactured and maintained lithic tools made from pebbles and cobbles of locally available high quality fossiliferous CCS, jasper, and siltstone raw materials, processed animal hides, utilized bitter cherry and hazelnut summer-season resources from the prairie "garden," and likely processed locally-procured salmon with microlith blade tools similar to those used at the northern Washington Pacific Coast Hoko River site (Croes 1995). In the Late Holocene Willapa River Valley, microblades appear to have been used for their technological qualities, rather than as an adaptive response to any type of raw material scarcity or unpredictable availability.

Chapter Six summarizes the results of the multi-year classification and analysis of multiple large plow zone pre-contact artifact collections. This work identified the spectrum and range of activities that occurred within the Willapa River Valley, and contributed to the identification of regionally novel bifacial "rotated scraper" tool forms, asymmetrical triangular "side blade" microlith biface tool forms, and local microblade core technology. The Forks Creek site assemblage and the Willapa plow zone artifact collections suggest that lanceolate form projectile points were produced and utilized throughout the Holocene in the Willapa River Valley.

Chapter Seven intertwines geomorphologic, archaeological, and ethnographic data in an analysis and discussion of late prehistoric Willapa River Valley obsidian, blueschist, and nephrite trade and exchange. Obsidian XRF provenience data is coupled with natural and cultural glaucophane blueschist distribution data to develop the hypothesized "Pacific

Athabaskan coastal trade network" model. Patterns of late prehistoric Willapa River Valley obsidian use are shown to conform closely to the obsidian preferences of Athabaskan enclave cultures of the southern Oregon and northern California near-coastal estuaries. A brief discussion of sea-going canoes is included in Chapter Seven.

Chapter Eight provides an overview of the Willapa River Valley study and a context for comparison to Pacific Northwest regional prehistoric cultural phase chronologies. The Willapa River Valley project's contributions to the studies of geomorphology, natural site formation processes, site distribution, pre-contact landscape use, and subsistence are summarized. I briefly address the potential for continued investigation of the archaeology of Pacific Coast Athabaskan enclaves, and the advancement of our understanding of southern Northwest Coast trade networks. Trajectories of future Willapa region fieldwork, research, and analysis are outlined in Chapter Eight.

CHAPTER TWO

LOCATION, ETHNOGRAPHY, AND PREVIOUS ARCHAEOLOGY

Location

The Willapa River Valley empties into the northeast corner of Willapa Bay in the southwest corner of Washington State (Figure 1). Willapa Bay is located north of the mouth of the Columbia River, and south of Gray's Harbor and the mouth of the Chehalis River (Figure 2). "P and E" Ridge, the North River Valley, and the Doty Hills form the northern boundary of the Willapa River Valley watershed. South of the Willapa River Valley the Willapa Hills are incised by a series of river valleys that drain into Willapa Bay (Bone, Palix, Nemah, Naselle, and Bear Rivers) and the Lower Columbia River (Deep and Grays Rivers). The Willapa River channel meanders northwesterly down its valley for more than 41.4 river-miles, originating from upland Willapa Hills springs and seeps located approximately twenty-three miles inland from the Pacific Ocean at just over 2,000 feet above sea level. The headwaters of the adjacent Chehalis River descend from the east slope of the Willapa Hills uplands and the Boistfort Valley to the north. The lowest 17 river-miles of the Willapa River are tidally affected by saltwater. Elk Prairie and Swiss Park are meadow areas in the upper reaches of the Willapa River Valley. Ward, Wilson, Mill, Green, Trap, Forks, Half Moon, Fern, and Falls Creeks are the largest tributaries of the Willapa River. South Bend, Raymond, Willapa, Menlo, and Lebam, Washington are the largest communities in the Willapa River Valley.

The initial reconnaissance fieldwork (2006 to 2008) included the entire Willapa region, but the Willapa River Valley became the focus of the project's survey (2008 to 2011) and testing efforts (2013). After surveying a dispersed sample of Willapa River Valley acreages, the Willapa River Valley project area was divided into three zones based on significant differences I observed in the character of the modern landscapes and environments. The Lower Willapa River Valley zone is affected by the tidal waters of the Pacific Ocean and Willapa Bay. Twice a day, the Lower Willapa River Valley channel is flooded with saltwater to the approximate location of Camp One Road and the Burkhalter Dairy Farm (45PC173). The terraces in the lowest reaches of the Willapa River Valley close to Willapa Bay tend to be disturbed by historic and modern housing development and infrastructure. There are cross-bedded tidal "muck" terraces in this area that include co-seismically buried soils that can contain occupation surfaces. Further upstream, the Middle Willapa River Valley gently rises southwest from the vicinity of Mill Creek up to the wide valley below Trap Creek. The Middle Willapa River is not presently affected by tidal flooding, and is an approximately one-mile wide valley with multiple alluvial terraces used for dairy agriculture. The Willapa River channel has a pronounced meander through the Middle Willapa River Valley and there are many ox-bow marshes and paleo-channel remnants. The Upper Willapa River Valley is a much narrower canyon, has sections of incised bedrock channel, and lies within a generally steeper terrain. In Figure 2 are illustrated the general divisions between the Lower (tidal), Middle (wide valley and meander), and Upper (steep valley with bedrock) Willapa River Valley zones that are referred to throughout the study.

Figure 1. Location of the Willapa River Valley study area.

Figure 2. Detail map of the Willapa Region.

Ethnography and Culture-History of the Willapa Region

Bruno de Hezeta sailed past the mouth of Willapa Bay in 1775 (Beals 1985). John Mears moored off of Willapa Bay in 1788, traded otter pelts with a local father and son who canoed out to them, and named the place Shoalwater Bay (Hazeltine 1957). George Vancouver also viewed the mouth of Willapa Bay in 1792, but did not enter the bay or explore the landscape. Lewis and Clark finally arrived at the mouth of the Columbia River in 1805, but even these iconic American explorers only documented the southern reaches of Willapa Bay and its Pacific Ocean barrier spit (Moulton ed. 2002). It is likely that information about the Willapa River and the northern extent of Willapa Bay was conveyed to the Corps of Discovery by Chinook peoples living at Baker's Bay during their visit, but the Willapa River Valley was not explored, mapped, or described by the expedition. Traders and trappers associated with the Pacific Fur Company reached the (now) Astoria Oregon region by 1811, followed by the Northwest Fur Company in 1813, which eventually merged with the Hudson's Bay Company in 1821 (Wessen 2008). I presume that Willapa Bay and the Willapa River Valley were periodically explored by employees/agents of the fur trade industry, but the study area had not yet been documented, mapped, or described. The 1824 survey between Astoria and Puget Sound by the Hudson's Bay Company (Allen 2004), and the 1841 U.S. Exploring Expedition survey led by Lt. Wilkes (Wilkes 1845) from Puget Sound to Astoria, both traveled overland routes from Gray's Harbor to the north end of Willapa Bay- a route that bypassed the Willapa River Valley further east.

The first published documentation of the Willapa River Valley consists of a survey map produced by the U. S. Coast Survey's Lt. James Alden in 1852 (Alden 1856). Alden's 1852 map is the first accurate representation of northern Willapa Bay and is likely the first map of the lowest reaches of the Lower Willapa River's tidal estuary and this project's research area. The

1852 map accurately depicts many Willapa Bay shoreline landscapes where there are known archaeological sites or ethnographic occupation areas (Wessen 2008). However, the only cultural features marked on this earliest map are Oysterville (a pre-contact Chinook and early Historic occupation site), and a trail in the approximate location of the modern Bay Avenue in Ocean Park, WA. The simultaneity of the 1849 California gold rush and the 1850 Donation Land Act contributed to a rapid influx of Euro-American settlers into the Willapa region in the 1850s. This period is best known through the journals of James G. Swan (1857), but C. J. W. Russell was the first Euro-American recorded to settle in Willapa Bay. Russell established a Willapa Bay oyster business to supply San Francisco in 1851. Swan followed Russell from San Francisco to Willapa Bay to further develop the oyster industry and began working and living with the Chinook people.

One of the first descriptions of the Willapa River Valley appears in an 1854 letter composed by C. J. W. Russell (Russell 1855) and printed in *The California Farmer and Journal of Useful Science*, a periodical read by his oyster clients in San Francisco. In his letter, Russell (1855) describes ascending the Willapa River Valley with a small group of Willapa homesteaders, and Dr. J. G. Cooper (Suckley and Cooper 1860), to establish a trail between Willapa Bay and Olympia. The group, with a guide of unknown tribal affiliation, left from the home of H. K. Woodward at the juncture of Wilson Creek and Willapa River, now the community of Willapa. They traveled by boat up river to the home of Job Bullard, located below the mouth of Mill Creek near the upper extent of tidal influence to the Willapa River channel. Russell’s party borrowed a horse from Bullard to carry their provisions and traveled overland up the Willapa to a location likely around Trap Creek, where they camped in the woods.

Russell (1855) describes this location as the “head of steam navigation on this river,” suggesting their camp may have been near the boundary between the Middle and Upper Willapa Valley, where incised bedrock channels, outcrops, and steps, change the character of the river making it much more difficult to navigate by boat. The following morning, Russell and his traveling companions followed the river to Elk Prairie, where they encountered a small party of Native American men that had arrived at the lower river valley’s Woodward’s Landing at the same time as some members of Russell’s group, but had departed before Russell himself had arrived. The party of Native Americans at Elk Prairie were “smoking and drying the meat of a number of elk.” Russell (1855) describes the uplands of the Willapa River Valley as having large productive prairies suitable for homesteading with abundant elk. He describes the Willapa River Valley upland landscape as “crossed and re-crossed with their (Elk) paths, many of which were as well beaten as any Indian trail in the country” (Russell 1855:27). In spite of the fact that Russell observed Native American peoples from Willapa Bay hunting and processing elk in Elk Prairie, Russell (1855:27) states, “ According to our guide, not a living soul had passed through this portion of country for more than thirty years -the tribe who formerly occupied it having long since become extinct.” The guide was likely describing the Pacific Athabaskan Kwalhioqua who occupied the Upper Willapa Valley (Krauss 1990, Welch 1983). Russell’s group continued up the Willapa Valley and cut their way through downed timber to the headwaters of the Chehalis, with a goal to reach the settlements in the Boistfort Valley and Olympia.

Dr. J.G. Cooper had ascended the Willapa as part of the Northern Pacific Railroad Survey prior to traveling the route with Russell’s party. Dr. Cooper described the Willapa prairies in his notes from a 26 March 1854 boat journey up the Willapa River Valley: “For ten or twelve miles meadows, covered even now with fine green grass, occur alternately on either side, with intervening points of higher land covered with trees. Above the limits of the tide-water is a change in the vegetation and surface, the upper valley being composed chiefly of the richest prairies, surrounded by the usual dense forests." (Suckley and Cooper 1860:16-17).

The 1883 General Land Office (GLO) map of the Upper Willapa River Valley (Figure 3) illustrates four large prairies: Forks Creek, Half Moon, Fern, and Elk prairies. Dr. Cooper (Suckley and Cooper 1860) noted at least *ten* prairie meadows within the Willapa Valley with the lowest meadow beginning at the high-tide line (near Burkhalter Farm, Fort Willapa area). Dr. Cooper (Suckley and Cooper 1860) described the Willapa Valley prairies as varying between a quarter of a mile and a mile in extent, and as becoming richer as one ascended the Willapa River Valley. He described the meadows within the Willapa and Chehalis valleys as being maintained by indigenous people using fire to specifically promote the growth of camas, and notes the presence of "shrubs" in addition to grasses and flowers.

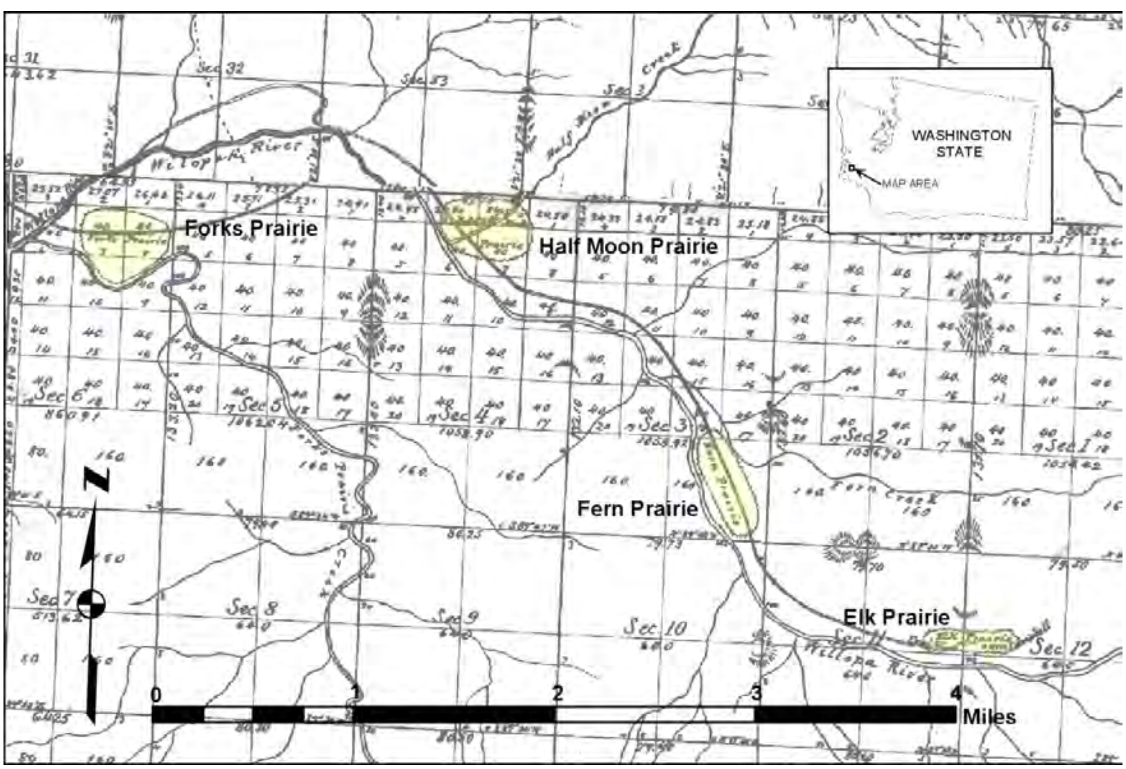

Figure 3. 1883 GLO Survey Map of the Upper Willapa River Valley (BLM 2014).

A historic memoir of Van Marion Bullard (Bullard 1974) describes Native Americans in the Middle Willapa River Valley in the late 1800s. Bullard states:

> The rather nomadic Indians were an important part of the economy of the Willapa Valley. At harvest time, great numbers of them came to the valley to help with the work, and to hunt and fish . . . The Indian women also washed for the busy housewives in that season, taking clothes to 'the washing place', where they used round 'washing sticks' to get them very clean by stiffing and punching . . . Mostly they (Native Americans) camped on what later became known as the 'Lilly Place', where tons of deer and elk meat were smoked for the winter and for trade. Since the river teemed with fish, the Indians caught, smoked, and dried them in huge quantities. (Bullard 1974:51-52)

The "Lilly Place" corresponds to the locations of sites 45PC186, 45PC180, and several pre-contact and ethnographic-era isolated artifact finds located at the Martin Family Dairy farm. The early historic period observations of Native American people within the Willapa River Valley suggest that salmon fishing and elk hunting and processing were dominant activities in the early historic period.

James G. Swan (1957) is considered the premier Historic era journalist in the Willapa Bay region, but he did not arrive in the Willapa region as an ethnographer. Swan met and wrote about native people because he was in the oyster business and needed to survive in the Willapa Bay region by fishing, hunting, and trading. Swan became an ethnographer while living in Willapa Bay, and the value of his work lies in the fact that he documented his participation in a variety of Native American Willapa Bay activities over several years. Unfortunately, Swan does not describe the Willapa River Valley in detail as he did for Willapa Bay, Bakers Bay, and the Lower Columbia River.

Hale (1846), Gibbs (1855), Wickersham (1888), Boas (1894, 1901) Teit (1910), Curtis (1913), and Frachtenberg (1910) represent the initial wave of cultural researchers with specific goals of ethnography and delineation of the languages and boundaries of the Lower Columbia and Willapa Region. Boas (1894, 1901) collected Chinook and Cathlamet stories from Charles

Cultee in Bay Center, Washington, located on Willapa Bay approximately 7 miles south of the mouth of the Willapa River. Cultee's matriline (grandmother) spoke a dialect of Lower Chinook Penutian, his patriline (grandfather) spoke the Willapa dialect of Pacific Athabaskan, and his wife and child spoke a Chehalis dialect of Salish. Cultee communicated with Boas in the Chinook Language. A second period of professional ethnography is represented in the works of Ray (1937, 1938). Ray's work focused on the Willapa Bay region rather than the Willapa River Valley. His ethnography includes descriptions of the locations of many local native settlements (Wesson 2008). Modern ethnographic research regarding traditional use of Willapa Bay's Long Island has been conducted by the Chinook Tribe and Sobel (2008).

The Willapa River Valley and Willapa Bay region was home to diverse group of cultures and language groups in pre-contact times. At the end of the 18th century, there were at least three distinct indigenous languages spoken by native peoples of the Willapa region, and the early traders, settlers, and ethnographers seem to have ascribed landscapes to groups based on incomplete, indirect, or temporally-isolated observations and data. The Willapa River valley and northern Willapa Bay are located within the boundary zone of two major language groups consisting of Columbia River region Lower Chinook, and the Upper and Lower Chehalis River region Salish. A cultural and linguistic enclave of Athabaskan Kwalhioqua settled within this boundary zone, likely within the past 800 to 1,500 years (Golla 2011; Workman 1974, 1979). In the early ethnographic period Penutian Lower Chinook (Boas 1894, 1911; Boyd 2013; Gibbs 1863; Hale 1846; Silverstein 1974, 1978), Salishan Upper and Lower Chehalis (Gibbs 1877, Hajda 1990) and "Lower Columbia River" Pacific Athabaskan Kwalhioqua-Clatskanai (Krauss 1990; Miller 2012; Thompson and Kinkade 1990) languages were spoken by families in Willapa Bay and the Willapa River Valley.

Spier (1936) suggests that people of the Willapa region were “bilingual,” with mixed Chinook and Salish families utilizing both Chinookan and Salishan vocabularies. The Columbia River was the heart of the Chinook territory. As such, Willapa River Valley peoples were influenced by Chinook cultural elements from the nearby southern region. The southern portions of Willapa Bay closest to the ethnographic swampy-channel portages from the Columbia River’s Baker Bay likely had families that were more closely oriented to the Chinook language and Lower Columbia River life-way than those living in the foothills at northern reaches of the bay where their northern neighbors were Salishan Lower Chehalis peoples of Grays Harbor. Middle and Upper Willapa River Valley peoples would have utilized overland trails to access watersheds descending south into Lower Chinook territory on the north bank of the Columbia River, and east and north into Chehalis and Puget Trough Salish territories. Spier (1936) used the term “Shoalwater Chinook” to denote the dialect used by Penutian Chinook speakers in Willapa Bay and the Willapa River Valley, and to differentiate them from speakers of the Lower Chinook dialect in the Lower Columbia River. Middle and Upper Willapa River Valley Peoples would have had Salishan Upper Chehalis speaking neighbors to the east and north. Ethnographic data suggests that one (of five) Upper Chehalis family group occupied the landscape surrounding the community of Pe Ell, Washington in the Upper Willapa River Valley (Curtis 1913; Hajda 1990).

The “Lower Columbia River” Pacific Athabaskan Kwalhioqua-Clatskanie language enclave in the Willapa River Valley contributed to the complexity of the Shoalwater Chinook and Salishan Chehalis “bilingualism” noted by Spier (1936). Prior to being decimated by contact-period smallpox, two groups of Kwalhioqua occupied the Willapa River Valley (Boas and Goddard 1924; Golla 2011; Hale 1846; Krauss 1990; Miller 2012; Wickersham 1888). The “Willapa” branch of the Kwalhioqua occupied the Lower Willapa River Valley, while the

“Suwal” occupied the wooded and prairie regions in the Upper Willapa River Valley. The Clatskanie occupied the forested mountain foothills on the south side of the Columbia River west of the Willamette Valley deep within Lower Chinook Territory, but likely once utilized landscapes of the Skookumchuck River east of the Chehalis River Valley (Gibbs 1877; Krauss 1990; Miller 2012).

The last native speakers of the Kwalhioqua-Clatskanie language died in the decade after 1910 (Golla 2011). Hale (1846) and Wickersham (1888) suggest that the Kwalhioqua-Clatskanie had connections to the Upper Umpqua Athabaskan culture in the southern Oregon Coast Range. Linguistic analysis (Krauss 2005; Golla 2011) of the extinct Kwalhioqua-Clatskanie language and the Pacific Coast Athabaskan languages of southern Oregon and northern California suggests that they originated from northwest Canada, but that the languages became isolated and divergent as enclaves after a southerly migration 1000 to 1500 years ago (Workman 1974, 1979).

The material culture of the Kwalhioqua in the Upper Chehalis Boistfort Valley was one of the primary research interests of Jeanne Welch (Paul Frick, personal communication 2012). Welch (1983) hypothesized that the microblade technology present in the upland headwaters of the Chehalis River, and the uplands of the Willapa River, could be cultural markers of the Athabaskan Kwalhioqua Culture. Daugherty’s (1987a) findings of microblade cores and microblades in Middle to Late Holocene strata at Layser Cave shows that microblade technology was present in Southwest Washington, perhaps many thousands of years before the earliest southern migration of Athabaskan speakers. This project also revealed the presence of microblades at the Willapa River Valley Forks Creek site (45PC175) in archaeological deposits older than the hypothesized 1,000 to 1,500 year-old introduction of Pacific “Lower Columbia

River" Athabaskan languages. If microblade technology actually is an accurate indicator of Athabaskan culture in Southwest Washington State, the Kwalhioqua-Clatskanie enclave would be far older than linguistic evidence (Golla 2011) suggests, and would represent the earliest expansion of Athabaskans outside of their northern origins. The inequitable distribution of microblades observed by Welch (1983) between the Upper Chehalis Kwalhioqua region (abundant microblades), and Lower Chehalis Salish region (no microblades), may be the result of differences in site use, raw-material availability, or archaeological sampling techniques (1/4 inch screens), rather than ethnicity.

Previous Archaeological Studies in the Willapa Region

Richard Daugherty's (Daugherty 1948; Wessen 2011) 1947 survey was the first systematic examination of large pre-contact archaeological sites located along the Pacific Coast of Washington State. Daugherty recorded a number of sites in the Willapa Bay region, including two sites that were excavated by University of Washington and Washington State University teams. The large shell midden Martin site (45PC7) (Alexander 1948; Brown 1978; Kidd 1960, 1967, Shaw 1977), located on the Long Beach Peninsula, and the shell midden site 45PC9 (Alexander 1948), situated at the south end of Long Island in Willapa Bay, have typically been used as the "type sites" for the Willapa Bay region. Two components at the Martin site (45PC07) have been dated to 1860±100 BP radiocarbon years: AD 90 (WSU-1534), and 1440±100 BP radiocarbon years: AD 510 (WSU 1535) (Brown 1978; Shaw 1977). There are no radiocarbon dates from site 45PC9 at the south end of Long Island, but surface deposits I observed appear to potentially be contemporaneous with the later period of the Martin site.

Kidd (1967) and Shaw (1977) characterize the Martin site (45PC7) tool assemblage as consisting primarily of: small chipped stone triangular projectile points with rounded bases, small pentagonal projectile points, scrapers, knives, hammer stones, abraders, weights, bone splinter awls/barbs, serrated bone points, antler wedges, and ground mussel shell. Microblades, blades, and blade-cores are not represented in the reported Martin site assemblage. It is possible that small lithic tools and micro-debris passed through the archaeological screens and were not recovered for analysis. Lithic debitage was only intermittently collected during these excavations (Wessen 2008). Roll's (1974) comparison of large shell midden sites of the Washington Coast notes a high volume of lithic tools present at the Martin site (45PC7), setting it apart from the Minard site 45GH15 on Grays Harbor to the north. The difference in lithic tool abundance between the Martin site (many lithic tools) and the Minard site (few lithic tools) has been hypothesized to potentially be reflective of differences in ethnicity (Roll 1974) between Salish (Minard) and Chinook (Martin) cultural groups. The age difference (Matson and Coupland 1995) between of the Martin site (older) and Minard site (younger) has also been proposed as an explanation for the differences in stone tool utilization and richness between the two locations.

Having surveyed the landscape surrounding the Martin site, I attribute the differences in lithic tool abundance between the Martin and Minard sites to the abundant and easily accessible lithic raw-material resources present in the Willapa Bay region close (by canoe) to the Martin site. At the north end of Long Island (4.6 kilometers east-southeast of the Martin site) is a gravel beach shore that contains dense beds of pebbles and small cobbles consisting of the full spectrum of locally available raw-lithic materials that are represented at the Martin site: fossiliferous agate, indurated siltstone, "jaspers," and high-quality basalt. Diamond City beach is actually the closest landform by boat from the mouth of Espy Creek, the slough which drains the freshwater ponds and marsh on the east side of the Minard site's Late Holocene foredune ridge. There is a pre-contact archaeological site (45PC11) present at the Long Island "Diamond City" gravel beach and associated terraces. Nearly half of Dr. Daugherty's 1947 Willapa Bay coastal survey sites are located on shorelines that consist of raw-material rich gravel and cobbles rather than on sandy and silty shorelines that dominate much of the Willapa "Shoalwater" Bay shoreline. Site 45PC9 (the habitation site at the south end of Long Island), and site 45PC12 (on the north bank of the lower Naselle River) are both situated adjacent to beaches with natural agate, jasper, siltstone, and basalt raw materials. Approximately 500 meters east of site 45PC9 there is a deposit of naturally-perforated "net sinker" Glendonite concretion cobbles (Boggs 1975).

The bay-adjacent shell midden sites 45PC7 and 45PC9 are different types of pre-contact sites than the terrace lithic tool and debris deposits located by this survey of the Willapa River Valley. Willapa River Valley terrace sites lack the shell and bone deposits of sites 45PC7 and 45PC9, both seemingly oriented toward utilization of the lowland estuary shorelines, freshwater marshes, and Pacific shore. Generally, the site formation processes at work in the bay and within valley are quite different. Cultural deposition and cultural stratigraphy are seemingly dominant at shell midden sites 45PC7 and 45PC9, while in the Willapa River Valley natural overbank alluvial flooding, alluvial slope wash, and aeolian deposition appear to be the primary agents that have contributed to the formation of buried archaeological contexts. The acidic sediments of the Willapa River Valley dissolve bone artifacts and natural bone within a century, contrasting sharply with the abundant bone tool and faunal resource processing assemblages preserved within bay-side shell midden sites. Human bone remains have been associated with the middens at both sites 45PC7 and 45PC9.

While excavation testing was undertaken intermittently at the Willapa Bay coastal site 45PC7 in the 1960s and 1970s, Jeanne Welch was exploring the headwaters of the Chehalis

River and the uplands of the eastern Willapa Hills from her home base in the Boistfort Valley (Paul Frick, personal communication 2012). Welch's (1983) decades-long survey in the upper Chehalis watershed included work at more than 63 sites and examination of more than 15 private artifact collections. Welch identified a breadth of prehistoric terrace lithic-dominated sites in the upper and lower Chehalis Valley. Welch (1983) proposed a division in the character of archaeological assemblages between the upper and lower Chehalis River Valley. Upper Chehalis River Valley sites display a greater time-depth (to at least 9000 BP) and are generally larger than the lower Chehalis River Valley sites (Welch 1983). The upper Chehalis River Valley sites include microblade cores, blade cores, microblades, blades, micro-flake tools, and burin lithic technology that Welch (1983) did not note on the surface at sites in the lower Chehalis River Valley. Welch found the majority of prehistoric sites in the upper Chehalis River Valley tend to be located on the uppermost terraces of the river, in natural prairie areas, or within former forest landscapes. In the lower Chehalis River Valley, Welch identified junctures of feeder streams with the Chehalis River as having been the most favored landscapes for pre-contact sites.

Leaf-shaped lanceolate bifaces were the most numerous projectile point form identified by Welch in the Chehalis River Valley. Lanceolate projectile points were represented ubiquitously throughout Welch's undated multi-site test excavation levels (from the deepest to the shallowest), suggesting continuous use throughout the Holocene. Welch suggested that pentagonal, triangular, and corner-notched projectile point forms may be more dominant in the lower Chehalis Valley. Welch described a lithic tool spectrum in the Chehalis River Valley that included lanceolate projectile points, side-notched points, ovoid knives, scrapers, blades and microblades (upper valley), burins, polyhedral and conical cores, Levallois-like flakes, edge-rounded cobbles, cobble choppers, spall tools, and hammerstones. Large stemmed and lanceolate projectile point forms resembling Agate Basin-type points, Lind-Coulee-like points, and Windust-type points are thought to represent the oldest archaeological materials documented in the upper Chehalis River Valley (Welch 1970, 1983).

Kelly's (1984) work on microblade technology from the upper Chehalis River region represents an extension of Welch's research and testing in the upper valley. Kelly analyzed lithic materials from three sites (45LE123, 45LE88, and 45LE96) excavated by Welch in 1973. The Narvestad site (45LE123) assemblage was the focus of Kelly's work, where micro-cores and micro-debitage from the site were compared to experimentally produced stage-based micro-core and bifacial lithic reduction sequences in an effort to learn about potential pre-contact micro-core lithic reduction phases and technology. Kelly's Chehalis River microblade lithic analysis did not directly address Welch's observations of blade distribution between the upper and lower Chehalis River Valley, nor did it propose a temporal span for blade technology in Southwest Washington. Kelly's lithic analysis was focused on the technological aspects of Chehalis blade cores and blades. Kelly's (1984) work is important for Willapa River Valley archaeological research because microblades, microblade cores, blade cores, blade-like flakes, and micro-flake tools are represented in Middle and Upper Willapa River Valley assemblages. Daugherty's (1987a, 1987b) work at Layser Cave and Judd Peak Rockshelters confirmed the presence of microblade core technology in Middle to Late Holocene assemblages in southwest Washington, and also confirmed a continuous utilization of lanceolate-style projectile point forms through the Late Holocene in Southwest Washington. The Late Holocene large lanceolate and large stemmed biface tools were interpreted by Daugherty (1987a, 1987b) to represent large “dispatching” stabbing or even cutting tools that were not necessarily part of a projectile point hunting system.

Inspired by the archaeological phase development efforts of Pettigrew (1981) in the Willamette Valley, and noting a lack of sampling and interpretation in the western-most reaches of the Lower Columbia River corridor, Rick Minor (1983) excavated a series of six Lower Columbia River sites dispersed through four different environmental zones. Minor’s (1983) survey and testing work in the Lower Columbia River explored a much wider variety of site types and feature types than had previously been explored in the region.

The Fishing Rocks site (45PC35) is a small Pacific Ocean coastal shoreline shell midden site located at the base of the bluffs north of Cape Disappointment outside of the mouth of the Columbia River (Minor 1983). Representing the coastal environmental zone, the Fishing Rocks site (45PC35) had fire cracked rock and hearth features within it’s midden, and displayed a lithic tool, bone tool, and faunal remains assemblage similar to that encountered at the Martin site (45PC07) located approximately 24 kilometers north on the Long Beach Peninsula. The marine shell midden, mollusk roasting hearths, sea-bird faunal remains, ground shell artifacts, and a toggling harpoon valve, sets this site apart from sites in the Middle and Upper Willapa Valley. The Fishing Rocks site has been dated radiocarbon dated to 970± 100 BP (GaK-8121; Feature 4) to 50± 100 BP (GaK-8120; Feature 2), and includes historic metal and Chinese porcelain in its more recent levels. Microblade technology was not identified at the Fishing Rocks site. Archaeological sediments were passed through 1/4 inch mesh that would have likely allowed lithic microblades and small faunal and floral samples to evade detection. My reconnaissance visit to the Fishing Rocks site in 2006 unfortunately revealed significant erosion of the local coastal shoreline-adjacent sediments, and no artifacts or debris were located on the surface.

The Eddy Point 35CLT33 and Ivy Station 35CLT34 sites are pre-contact and ethnographic era village occupations representing the estuarine zone within the Lower Columbia River (Minor 1983). Like the Fishing Rocks (45PC35) coastal zone site, the estuarine zone sites exhibited shell midden deposits and tool forms characteristic of marine resource utilization. The Eddy Point site 35CLT33 dates from 3130± 130 BP (GaK 8115) to 890± 120 BP (GaK 8112), while the Ivy Station site dates from the ethnographic period to at least 1370± 100 BP (GaK 8103). Toggling harpoons, bilaterally barbed harpoons, a perforated net sinker, salt-water bivalves, fish bone, and seal bone in the assemblages illustrate an orientation toward the tidal saltwater estuary and environments farther downstream in the Columbia mouth. The abundance of deer and elk faunal materials, however, coupled with projectile point, biface, and scraper dominated formalized lithic tool assemblages shows that terrestrial game was also an important resource for pre-contact occupants of the Eddy Point and Ivy Station sites. Mauls, bone wedges, bone chisels, a digging stick handle, an incised beaver tooth, and a zoomorphic figurine illustrate a diversity of past activities and behaviors at the sites. The artifacts, spatial scale, landscape context, and resource diversity present at the Eddy Point and Ivy Station sites are indicative of village-type occupations. The marine resources and tools present at the sites suggest heavy utilization of marine environments located farther downstream than the location of the villages, while the presence of terrestrial mammals in the faunal assemblage reveals a similar reliance on interior resources.

The Knappa Docks site 35CLT37 is an ethnographic period Kathlamet village within Minor's (1983) riverine zone, located just above the maximum upstream boundary of the tidal influence within the Lower Columbia River. Minor (1983) identified historic-era artifacts throughout the cultural deposit, and indicates that significant disturbance processes had occurred at the site. Bone preservation was very poor at the site due to acidic sediments. The site features consist of layered burned floors with lithic tools and fire-cracked-rock (FCR) within an approximately 80 cm deep house pit depression. A diversity of projectile point forms, biface knives, scrapers, cores, cobble tools, perforated and minimally altered cobble net sinkers, an unfinished maul, manos, and a pipe were identified in the fill deposits. Marine shell was present at the site, but not as much as was present at the estuary zone sites. Oddly, razor clam (a coastal clam species) is represented at the riverine zone site, suggestive of utilization of fresh food resources from distant marine localities. Long-distance canoe journeys were commonplace during the ethnographic period in Willapa Bay and the Lower Columbia River (Swan 1857). Glendonite concretion (Boggs 1975) naturally "perforated" net sinker artifacts are present at the site, as they are at Willapa Bay and Willapa River Valley sites located on Lincoln Creek, and Astoria Formation marine siltstones from cold methane seep areas.

The Burkhalter site 45WK51 and Reith site 35CLT36 represent Minor's (1983) inland zone. These sites are in environments most similar to those identified in the Middle and Upper Willapa River Valley. There is a "Burkhalter" site in the Willapa River Valley, but it is simply named after the same extended family, and is not the same archaeological site location. The Grays River Burkhalter site 45WK51 has two dates ranging from 2660± 130 BP (Gak 8124; Feature 2) to 2080± 110 BP (Gak 8537; Feature 3). The Lewis and Clark River Reith site 35CLT36 had historic materials within every excavation level and was likely occupied in the ethnographic era. Neither of the inland zone sites had bone preservation. Acidic sediments (4.3 to 5.8 pH) at the inland terrace sites dissolved the bone completely away, even from the early historic era archaeological deposits at the Reith site (Minor 1983). The Burkhalter site had the most lithic debris and cores of all of Minor's (1983) research sites, despite not being the largest or most intensively occupied site. Formalized lithic tools at the site are dominated by bifaces, scrapers, and projectile points.   Forty percent of the projectile points at the Burkhalter site were made of obsidian, in addition to five lithic debitage flakes larger than the 1/4 inch screens utilized by the excavators. A single pestle was identified at the historic-era Reith site 35CLT36. No microblade technology was identified associated with the two inland sites, though the 1/4 inch screen size used would not have been conducive to recovery of micro-debitage. Of all of Minor's (1983) tested Lower Columbia River archaeological sites, the "inland zone" Burkhalter site 45WK51 is most similar to the Forks Creek (45PC175) archaeological site in the Willapa River Valley, appearing to have a similar artifact assemblage in a context created by similar natural and cultural site formation processes. Minor (1983) interpreted the Burkhalter site as a hunting camp.

The most recent large-scale archaeological project in the Willapa Region has been excavations conducted in 1991 by Eastern Washington University near the mouth of the North Nemah River at site (45PC101) (DePuydt 1994). The project was initiated to mitigate local department of transportation Highway 101 bridge construction work, and portions of the site that were not tested have likely been extensively disturbed by infrastructure development. The 45PC101 excavation documented layered groups of pre-contact hearth features and recovered a lithic-dominated tool assemblage. The 45PC101 site was dated to span the age range from 2140 ± 60 BP (Beta 48563) to 190 ± 80 BP (Beta 49972).

The North Nemah River site (45PC101) and the Willapa River Valley's Forks Creek site (45PC175) share the characteristic of containing layered oxidized hearth and roasting pit features surrounded by activity areas. The 45PC101 chipped stone tool assemblage is dominated by small triangular form projectile points and fragments of biface "knife" tools. Unifacial "keeled" scrapers, modified flakes, drills, and informal cores are represented in the 45PC101 assemblage. The same spectrum of locally abundant fossiliferous crypto-crystalline silicates (CCS), jasper, indurated siltstone, and basalt lithic raw materials that were available to Willapa River Valley peoples were utilized by the occupants of site 45PC101. Significant numbers of battered, flaked, pecked, and ground cobbles were identified at the North Nemah River mouth site (45PC101). Sophisticated ground stone implements including pestles, a pecked bowl, and a girdled maul were used at 45PC101. There was poor preservation of faunal materials at 45PC101. The majority of the recovered bone was calcined, burned, and fragmented. Bone tools, ubiquitous at the large shell midden Martin and Minard sites, were not recovered from 45PC101 at the mouth of the North Nemah River. Acidic sediments at site 45PC101 simply dissolved-away most of the bone materials- including bone tools (DePuydt 1994). Similar acidic sediment conditions on the terraces of the Willapa River Valley resulted in a near-absence of bone material at the slightly older Forks Creek site (45PC175) (see Chapter Five).

Seemingly more similar in character to the lithic dominated terraces sites of the Willapa River Valley than to the large shell midden Martin site of Willapa Bay, the 45PC101 assemblage exhibits some distinct differences from the assemblages encountered by Welch (1983) in the Upper Chehalis River Valley, and from the assemblage this project recovered from the Forks Creek site (45PC175). Lanceolate projectile point forms and microblade technology are not represented at the North Nemah River site (45PC101). The lack of microblade technology in the artifact assemblage may be attributable to the fact that 1/4 inch screens were used to classify and sift the majority of the archeological sediments, and only a sample was screened through 1/8 inch mesh screens.

North Nemah River site (45PC101) has been interpreted as a temporary camp where fish and mammals were processed (DePuydt 1994). The conclusions of the 45PC101 report (DePuydt 1994) suggest that the "encampment" lacked formal tool morphologies (i.e. lacking highly stylized tools) and points out that the assemblage is characterized by a high percentage of expedient tools. I suggest that the pestles, stone bowl, grinding stones, girdled maul, drills, knives, and the diverse sample of finely worked projectile points (including an obsidian specimen) at the North Nemah River site (45PC101) represent more than an "expedient" assemblage at a temporary camp. The North Nemah River mouth archaeological site was more likely the location of a year-round Shoalwater Chinook family lodge compound, and site 45PC101 represents an "open air" activity area located close to a lodge where a diversity of tool maintenance and resources processing activities were undertaken seasonally. The flattened areas, post holes, and potential structural elements uncovered by the 45PC101 excavation team suggest that the site had significant architectural elements and was potentially utilized as a year-round occupation.

Finally, a University of Washington team conducted archaeological sampling at the tidal marsh Niawiakum site (45PC102) on the east side of Willapa Bay. Their fieldwork did not include formal archaeological excavation units, but profile sampling and collection of cultural materials from the surface of the eroding Niawiakum River channel was undertaken (Cole et al. 1996). This 630 ± 90 BP (Beta 49195) to 250 ± 60 BP (Beta 63220) site consists of a buried 10 to 40 cm thick band of heat stained sediment, wood charcoal, organic debris, fragmented shell and bone, and fire cracked rock, that is exposed in the eroding wall of the Niawiakum River tidal channel . The cultural materials are situated directly under thin band of tsunami sands and silts dated to AD 1700. The tsunami deposits, diatom studies, and site dates suggest that site 45PC102 was a terrestrial estuary shoreline location occupied up until the point when it became a sunken tidal landform during the AD 1700 co-seismic earthquake event (Atwater et al. 1991; Cole et al 1996). A single lozenge-form ground stone club fragment was identified at the Niawiakum River site in deflated contexts on the bank of the river, just downstream of cultural deposits exposed in an eroding channel wall (45PC102 site Form; Burke Museum Cat. No.: 45PC102-1). The Niawiakum club fragment artifact (Burke Museum Cat. No. 45PC102-1) is related in form and material to other blueschist club fragments located at Willapa River Valley and Willapa River Mouth (45PC196) archaeological sites. Blueschist lozenge-form clubs are addressed further in Chapter Seven within the context of pre-contact trade and exchange within the Willapa River Valley. The tidal zone Niawiakum site clearly illustrates the fact that there are co-seismic sunken archaeological sites along the shoreline of Willapa Bay. This principle presumably applies to Late Pleistocene and Early Holocene shoreline contexts now deeply submerged many kilometers off of the modern Pacific Coast on the flooded ravinement surface and within the in-filled paleo-channels of the continental shelf.

CHAPTER THREE

THE WILLAPA ENVIRONMENT

Flora and Fauna

The Willapa River Valley is within the coastal Pacific Northwest rain forest biome (Franklin and Dryness 1988; Sayce 2010). The Lower Willapa River Valley (as delineated by the author) is that section of the River which is affected by the influence of the Pacific Ocean tides and is subjected to the direct, but usually mild, weather of the coastal region. The lowest forested sections of the Willapa River Valley belong to Franklin and Dryness' (1988) *Picea sitchensis* Zone. Sayce (2010) has effectively used a holistic landscape based approach to describe the botany of the *Swala-lahos Floristic Area* in northwest Oregon and southwest Washington, and her work most accurately describes the floral communities and floral ecology of the Lower Willapa River Valley. Recent archeobotanical work on materials from the 10,700 year old Kilgii Gwaay wet site in southern Haida Gwaii, British Columbia (Cohen 2014) has identified a sample of the early Holocene coastal floral community that is surprisingly similar to that which exists in the modern Lower Willapa River Valley. The Willapa River Valley may have experienced long-term general stability of plant communities throughout the Holocene. Evidence from the Kilgii Gwaay site also seems to suggest that cedar was an important Northwest Coast species much earlier than suggested by Hebda and Matthews (1984).

In the Lower Willapa River Valley, the *Picea sitchensis* Zone is characterized by forested slopes and terraces of lodgepole pine *(Pinus contorta)*, Sitka spruce *(Picea sitchensis*), western hemlock *(Tsuga heterophylla*), western red cedar *(Thuja plicata*), Douglas fir (*Pseudotsuga menziesii*), and grand fir *(Abies grandis*). On the margins of the heavily forested areas are thick stands of red alder *(Alnus rubra*), vine maple *(Acer circinatum*), big-leaf maple

(*Acer macrophyllum*), Oregon ash (*Fraxinus latifolia*), black cottonwood (*Populus trichocarpa*), and red osier dogwood (*Cornus stolonifera*). In the Lower Willapa River Valley, thick understory communities of salal (*Gaultheria shallon*) and evergreen huckleberry (*Vaccinium ovatum*) can completely cover the ground surface. Bearberry (*Arctostaphylos uva-ursi*) is represented as a groundcover from the dunes of the Pacific coast all the way up to the crest of the Willapa Hills. There is an increase in willows such as Columbia River willow (*Salix fluviatilis*) and Pacific willow (*Salix lasiandra*) closer to the river and its brackish tide water sloughs. The tidal flats and sloughs in the Lower Willapa River Valley include: pickleweed (*Salicornia virginica*), marsh jaumea (*Jaumea carnosa*), bulrush sedge (*Scirpus americanus*), Lyngby's sedge (*Carex lynbyei*), sea plantain (*Plantago maritima*), Douglases Aster (*Aster subspicatus*), tufted hair grass (*Deschampsia* c*espitosa*), and Pacific silverweed (*Potentilla pacifica*). There are too many ethnobotanically important ferns, mosses, and lichens that thrive in the Willapa River Valley to summarize them in this archaeological study.

Important edible plants in this tidal Lower Willapa Valley include: camas (*Camassia quamash*), cow parsnip (*Heracleum maximum*), stinging nettle (*Urtica dioica*), dock (*Rumex occidentalis*), salmonberry (*Rubus spectabilis*), salal (*Gaultheria shallon*), red elderberry (*Sambucus racemosa*), and wild coastal strawberry (*Fragaria chiloensis*). Oregon white oak (*Quercus garryana*) typically does not grow wild in the lower Willapa River Valley, as it is presently too wet for the species to succeed (Sayce 2010). The author has observed a rain shadow effect on the eastern slope of the Willapa Hills and within the more-distant Puget trough that may create more favorable dryer conditions for natural patches of *Quercus garryana* to grow in the vicinity of Oakville, WA., Boistfort Valley, the Lower Chehalis River Valley, and in the vicinity of Satsop, WA. Boistfort Valley is reported to have been named after the French pronunciation of the Chehalis word for “oak tree.” The name was apparently alluding to the fact that the Boistfort Valley is the western-most boundary for healthy patches of Oregon white oak (Suckley and Cooper 1860). The author has identified intact seasonably fresh *Quercus garryana* acorns while surveying in the Upper Willapa River Valley in the vicinity of Forks Creek, but has not yet identified natural stands of oak in the Willapa River Valley. Isolated patches of *Quercus garryana* are present around the mouth of the Columbia River and the lower Willapa Bay region, but most Willapa region oak trees appear to have been intentionally planted on historic homestead properties, rather than forming wild groves of naturally propagated trees.

The Middle and Upper Willapa River Valley lack the tidal influx of brackish saltwater, and as such lack the halophyte tidal marsh plants that thrive in the Lower Valley and Willapa River Mouth area. While the Lower Valley has been significantly altered by Euro-American occupation, industry, and infrastructure development, the Middle and Upper Valley have been altered significantly by logging, agriculture, and dairy farm field maintenance. The valley slope and surrounding hills of the Middle Willapa River Valley can be classified as part of Franklin and Dryness’s (1988) *Tsuga heterophylla* Zone. Exhibiting the same spectrum of coniferous and deciduous trees as the Lower Valley, noble fir (*Abies procera*) and Pacific silver fir (*Abies amabilis*) are included in the higher elevation landscapes in the Upper Willapa River Valley. Native rhododendron has not been observed by the author in the Willapa region where salal (*Gaultheria shallon*) seems to be the dominant understory ground covering species. Harvesting fern heads, cascara bark, chanterelles, and cedar boughs are part of the modern cottage industry of the Middle and Upper River Valley.

The four historic prairies in the Upper Willapa River Valley (Figure 3) have been plowed for a century and the landscapes are presently used as dairy cattle grass feed fields. The original plant communities of these Upper River Valley prairies are not known, but may have resembled other *Picea sitchensis* Zone and *Tsuga heterophylla* Zone prairies to the north at Quillayute, the Tacoma, Wier, and Ebey's Landing prairies. The historic Willapa River Valley prairies may have contained braken fern (*Pteridium aquilinum*), yarrow (*Achillea millefolium*), wild strawberry (*Fragaria vesca*), sweet vernal grass (*Anthoxanthum odoratum*), meadow soft grass (*Holcus lanatus*), self heal (*Prunella vulgaris*), steeplebush *(Spiraea douglasii*), camas (*Camassia quamash*), hazelnut (*Corylus cornuta*), bitter cherry (*Prunus emarginata*), Nootka rose (*Rosa nutkana*), black hawthorn (*Crataegus douglasii*), Indian plum (*Oemleria cerasiformis*), Saskatoon berry (*Amelanchier alnifolia*), and crabapple (*Malus fusca*)(Franklin and Dryness 1988, Lepofsky et.al 2003, Weiser 2006, 2009). Ethnographic data suggests that in the pre-contact era fire was used to maintain prairies and alter forested landscapes in the Willapa region and Willapa River Valley (Suckley and Cooper 1860; Swan 1859).

Roll (1974), Kidd (1980), Fancher (2001), and Bovy (2005) have completed faunal analyses of archaeological materials from the coastal Martin and Minard sites on Willapa Bay and Grays Harbor. Faunal remains are exceptionally rare in Willapa River Valley archaeological deposits. Shell midden sites in the lowest reaches of the tidally-influenced Willapa Valley would have the potential to contain bone preservation similar to the Martin (45PC07) and Minard (45GH15) sites, but the sediments of the valley's alluvial strath terraces are predominately too acidic for preservation of bone. There is no visible evidence of modern-age (80 years) salmon and cattle bones which were dumped and incorporated into the plow zone of Middle and Upper Willapa River Valley terraces in the vicinity of the Forks Creek site (45PC175) (Dale Rutherford, personal communication July 2013).

With the exception of only a few saltwater clam species, fish species, and perhaps insects, the diversity of fauna is ubiquitous throughout the Willapa River Valley, Willapa Hills, and Willapa Bay region. Black tail deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), Roosevelt elk (*Cervus canadensis roosevelti*), black bear (*Ursus americanus*), raccoon (*Procyon lotor*), coyote (*Canis Latrans*), porcupine (*Erethizon dorsatum*), muskrat (*Ondatra sp.*), mountain beaver (*Aplodontia rufa*), and squirrels (*Scirius sp.*) are common terrestrial fauna within the Willapa River Valley. Animals that are likely to be found within the Willapa River itself include: beaver (*Castor Canadensis*), sea otter (*Enhydra lutris*), river otter (*Lutra Canadensis*), northern fur seal (*Callorhinus ursinus*), and harbor seal (*Phoca vitulina*).

Bovy's (2005) analysis of faunal materials recovered from the Minard site illustrates the diversity of avian resources that were utilized by Willapa region peoples. In the Willapa River Valley, waterfowl were likely one of the primary pre-contact avian food resources. Ducks (*Anas* sp., *Aythya* sp. and *Aix* sp.), geese (*Branta* sp. and *Chen* sp.), swan (*Cygnus* sp.), and mergansers (*Mergus* sp. and *Lophodytes* sp.) are all represented in the modern Willapa region. Loons (*Gavia* sp.), grebes (*Podiceps* sp.), cormorants (*Phalacrocorax* sp.), and herons (*Ardea* sp.) are common in the Willapa estuary and lowest reaches of the Willapa River, their long bones ideal for making tubes, beads, or even whistles. Grouse (*Bonasa* sp) and Turkey (*Meleagris* sp.) are available throughout the valley, while pheasant (*Phasianus* sp.), an introduced species, are often seen in coastal adjacent dune lands. Gulls (*Larus* sp.) are not uncommon in the Willapa River Valley, along with crow and raven (*Corvus* sp.), hawk (*Buteo* sp.), eagle (*Haliaeetus leucocephalus*), and owl (*Tyto* sp., and Bubo sp.). Hummingbirds (*Calypte* sp. and *Selasphorus* sp.) thrive in the Willapa River Valley, where some species reside year round. American dipper (*Cinclus* sp.)

birds entertained the Willapa team with many riverside dances during breaks from survey and excavation at the Forks Creek Site (45PC175).

The Lower Willapa River has an influx of salt water with the tide, and as such has significant populations of northern anchovies (*Engraulis mordax*), Pacific herring (*Clupea pallasi*), longfin smelt (*Spirinchus thaleichthys*), American shad (*Alosa sapidissima*), and the now rare eulachon smelt (*Thaleichthys pacificus*). The Lower Willapa River Valley also hosts the much larger white sturgeon (*Acipenser transmontanus*) and rarely a green sturgeon (*Acipenser medirostris*). Pacific lamprey (*Lampetra tridentata*), river lamprey (*Lampetra tridentate*), and western brook lamprey (*Lampetra richardsonii*) are present throughout the watershed.

One of the most important resources utilized by pre-contact Willapa native peoples, salmon were once abundant in the Willapa River. Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*), chum salmon (*Oncorhynchus keta*), steelhead (*Oncorhynchus mykiss*), pink salmon (*Oncorhynchus gorbuscha*), and cutthroat trout (*Oncorhynchus clarki clarki*) all can still be found within the Willapa River Valley. Mr. Dale Rutherford's (personal communication July 2013) father was the manager of the Forks Creek state salmon hatchery in 1926. Mr. Rutherford mentioned that salmon populations in the Willapa and its tributaries experienced a significant crash in the mid-1930's after the feeder creeks and river channel turned bright green. I speculate that eutrophication may have occurred in the Willapa River watershed in the mid-1930's in response to experimental high-level fertilization for newly developed pulpwood forest crops in the Willapa Hills. Freshwater tributaries of the Willapa River contain great numbers of crayfish (*Pacifastacus sp.*), frogs, and salamanders. Toads are now quite rare.

Geology

Late Pliocene to Middle Eocene Crescent Formation basalt is the oldest bedrock exposed within the Willapa River Valley and surrounding Southwest Washington region. The Crescent Formation basalts exposed in the Willapa Hills display pillow structures in places, but exhibit a great variety in texture and quality throughout the region. Miocene Era intrusive dikes of Grande Ronde flow and Saddle Mountains flow basalt are also present in the Willapa Hills. The Willapa River Valley consists of a series of strath terraces down-cut through massive beds of fossilized uplifted Late Eocene and Oligocene Era near-shore seabed silts and sands that overlie the Crescent Formation basalts. The marine origin of the Willapa Valley's sedimentary siltstone and sandstone bedrock is undeniably demonstrated by the presence of fossilized pelecypods (Schenck 1936; Squires and Goedert 1991), gastropods, cephalopods (nautiloid), crustacean (Rathbun 1926; Tucker 1998), microscopic diatoms (Rau 1951), and Glendonite concretions (Boggs 1975; Smith 2004). The McIntosh Formation (Moothart 1992), Lincoln Creek Formation (Armentrout 1973; Beikman et al. 1967; Smith 2004), and overlying Astoria Formation (Cooper 1980; Moore 1963) consist of ancient marine sediments that form the terrestrial landscape in the Willapa River Valley and along the eastern edge of Willapa Bay. The Palix River and Fall River (a tributary of the North River) cut through large expanses of basalt rather than Lincoln Creek sedimentary rock, setting these watersheds distinctly apart from the Willapa River, Naselle River, and the other Willapa Hills drainages that descend into Willapa Bay primarily through soft siltstone bedrock deposits, and only occasionally through hard basaltic bedrock landscapes.

There is no evidence of glaciation occurring in the Willapa Hills during the Wisconson episode, nor are there reports of Late Pleistocene Puget Lobe melt-water gravel deposits as exist in the Chehalis River Valley (Bretz 1913). The Willapa Hills mountainous landscape is generally smooth and rounded, as one would expect from an area that had been glaciated, but the siltstone and sandstone bedrock of the McIntosh, Lincoln Creek, and Astoria Formations are smooth because they are generally soft and have been weathered for millions of years. The Crescent Formation basalts are not as soft and erode differently than the massive beds of ancient marine sedimentary stone. While no masses of glacial ice or subsequent floodwaters directly affected the Willapa River Valley landscape in the Pleistocene, eustatic and isostatic processes linked to glaciations have resulted in significant landscape change in the Willapa Hills. The smooth cobbles and pebbles that can be found in some sediments of the Upper Willapa River Valley and within the channels of the Willapa River tributaries do not originate from Late Pleistocene glacial outwash- they are far more likely to have originated in Early or Middle Pleistocene high-stand marine terraces or Late Eocene and Oligocene uplifted seabed deposits that also contain fossilized seabed animals. Similarly, outwash gravels from the great Bonneville and Missoula flood events do not appear to have affected the Willapa Hills beyond their southern boundary with the Columbia River. Late Pleistocene post-glacial flood gravels from Puget Sound and the Columbia River did not enter the Willapa River Valley.

Strath Terraces in the Willapa River Valley

The majority of the prehistoric archaeological sites identified by this Willapa study were located on alluvial terraces within the Willapa River Valley. The study of Willapa River Valley terraces has only just begun. Schanz and Montgomery’s (2013) ongoing mapping and dating efforts in the Upper Willapa River Valley, and Schanz’s anticipated study of Upper Willapa River Valley strath terrace formation, represent the first detailed geomorphological research addressing terrace chronology and formation processes in the region. At present, there are no published maps of the terrace systems within the Willapa River Valley. Schanz and Montgomery

(2013) have dated two extensive terrace sets in the Upper Willapa Valley that are approximately 10,000 and 150 years old. Our archaeological excavations at the Forks Creek site (45PC175, Chapter Five) occurred on a middle-level alluvial terrace. We identified two distinct strata within the terrace. Stratum 2 was a culturally-sterile yellow clay loam resting directly on a bedrock strath above the incised bedrock channel of the Willapa River. Stratum 1 was an artifact and feature rich brown clay loam accreted over Stratum 2. The base of Stratum 1 was dated to approximately 2700 years old. The terrace's Stratum 2 basal sediments are more than 2700 years old, and could potentially be much older. The age of the culturally-sterile Stratum 2 deposits is presently undetermined.

Many coastal river valleys of the Pacific Coast Range and the Olympic Mountains contain strath terraces (Personius et al. 1993; Wegmann and Pazzaglia 2002). Strath terraces usually consist of thin beds of alluvial sediments that rest on stepped and beveled bedrock unconformity surfaces called "straths" (Bull 1991; Wegmann and Pazzaglia 2002). The flat "occupation surfaces" of the alluvial terraces are referred to as "treads." The strath of a terrace represents the bedrock base of a paleo-valley bottom, while the tread represents the surface of the paleo-floodplain (Wegmann and Pazzaglia 2002). Valleys with strath terraces tend to have limited or punctuated periods of sediment aggradation, displaying overall long-term trends of incision and planation. Valleys with "fill and cut" terraces tend to have alternating periods of aggradation and incision, with the level of the channel trending both up and down over the long term through thick beds of alluvium. Strath and "fill and cut" terraces are illustrated in Figure 4. The incision of new straths can occur as a result of tectonic movement, but the dates of many strath terraces in the Coast Range and Olympic Mountains cluster around periods of significant climate change (Hancock and Anderson 2002; Personius et al. 1993; Wegmann and Pazzaglia

2002). There is not a set convention for numbering the ages/levels of strath terraces, but the studies referenced by this author tend to number the oldest and highest terrace first, followed in number by terraces in order of age/elevation (Figure 4). The highest elevation and oldest “upper” terrace in the Willapa River Valley would be “Terrace one” (T1), while the “middle” terrace would be (T2), etc.

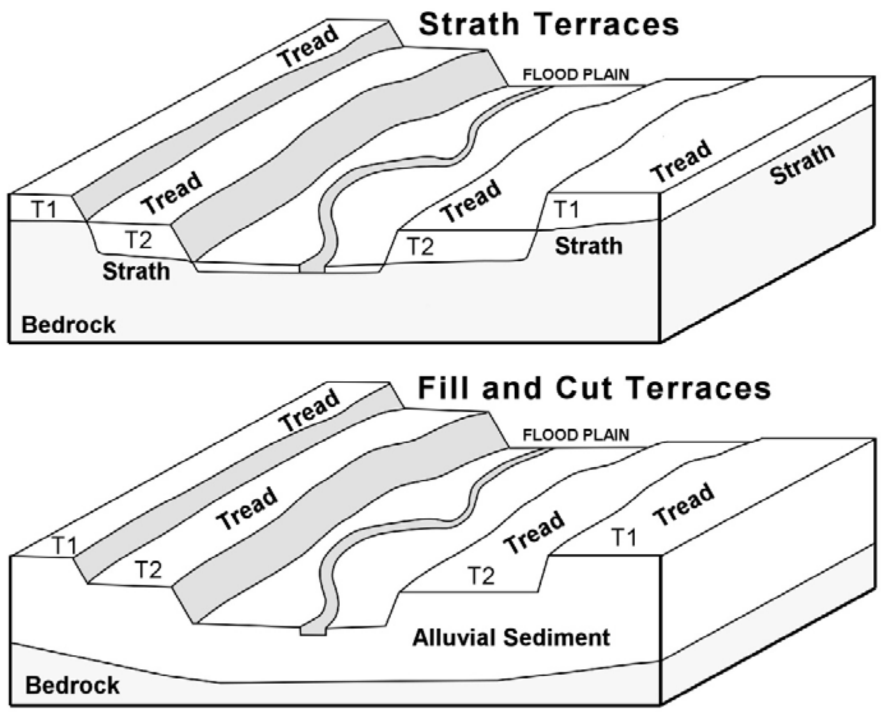

Figure 4. Strath terraces vs. fill and cut terraces (adapted from Wegmann and Pazzaglia 2002).

At the onset of survey in the Middle Willapa River Valley, the author immediately recognized the presence of a discontinuous “upper terrace” that had remnants located along the outermost margins of the valley. These highest elevation Middle Willapa River Valley alluvial terraces were recognized at locations including: the NE1/4, Sec. 11, T13N R8W WM (Newman Family), the E1/4, Sec. 46, T13N R8W WM (King Family), and the N1/2, Sec. 26, T13N R8W WM (Wildhaber Family).

The Middle Willapa River “upper terraces” are positioned at approximately the 150-foot elevation level, the same approximate elevation as the 125,000 year old Pleistocene high stand marine terrace (Ardoin 2002). Some of the uppermost Middle Willapa River Valley alluvial terraces could potentially be resting on straths consisting of 125,000 year old Pleistocene marine high-stand terrace soft “bedrock” sediments. The alluvial sediments forming the treads of the Middle Willapa River Valley “upper terrace” remnants may correspond in age to the approximately 10,000 year-old Upper Willapa River Valley terraces dated by Schanz and Montgomery (2013).

With assistance from Mr. Jack Burkhalter, Mr. Robert Zieroth, and Marlene Martin, the author soon recognized “middle terraces” below the “upper terraces” in the Middle Willapa River Valley. The “middle terraces” of the Middle Willapa River Valley are seemingly more varied in elevation than the “upper terraces,” and are distributed in a more complex array throughout the valley. The “middle terraces” likely consist of multiple alluvial treads that share the same strath. Years of erosion and plowing have smoothed the stepped facies of the middle terraces making some more difficult to recognize than others. Most of the “middle terrace” landforms are positioned at the base of eroded “upper terrace” facies slopes, while others exist as isolated remnants that escaped the meandering planation sweeps of the Willapa River. The youngest alluvial landforms below the “middle terrace” are seasonal flood plains. Figure 5 illustrates the approximate locations of “upper” and “middle” alluvial terraces in the Willapa River Valley. The terraces in Figure 5 are mapped based on the field reconnaissance and map observations of the archaeologist author, and not on detailed strath facies mapping and radiocarbon sampling that should be undertaken by a geomorphologist. Some “middle terrace” treads contain prehistoric archaeological artifacts suggestive of Late Holocene occupation, while many of the lowest treads apparently contain no pre-contact materials. Based on the radiocarbon dating and artifact assemblages at the Forks Creek site (45PC175), the author speculates that many of the "middle terrace" landforms of the Middle Willapa River Valley with archaeological sites could be as much as 2,700-years old. Dating a larger sample of pre-contact sites on a variety of terrace landforms within the Willapa River Valley is a future goal of the project.

By the time the author's archaeological survey had reached the Upper Willapa River Valley, the team was looking specifically for "upper" and "middle" terrace landforms. In the Upper Willapa River Valley, the author identified "upper" terrace landforms in the W1/2NE1/4, Sec. 1, T12N R8W WM (DRN Land), the N1/2SE1/4, Sec. 1, T12N R8W WM (Priest family) southeast of the historically diverted Willapa River channel, the SW1/4NW1/4, Sec. 6, T12N R7W WM (Portmann family), the N1/2N1/2, Sec. 4, T12N R7W WM(Camenzind family) around Lebam, and the SW1/4NW1/4, Sec. 3, T12N R7W WM (Habersetzer family) at Globe Field (Figure 5). The "middle terraces" in the Upper Willapa River Valley are not as distinct as they are in the Middle Willapa River Valley, making it more difficult for the author to differentiate between "upper" and "middle" terraces. The Globe Field landform east of Lebam has a distinct "upper terrace" with archaeological artifacts and debris, as well as what the author has interpreted as a "middle terrace" that also contains archaeological materials. Professional geomorphologists need to continue mapping and dating the Willapa River Valley terraces. The ongoing work of Schanz and Montgomery (2013) in the Upper Willapa Valley will undoubtedly help clear up the inaccuracies of the archaeological reconnaissance observations presented here.

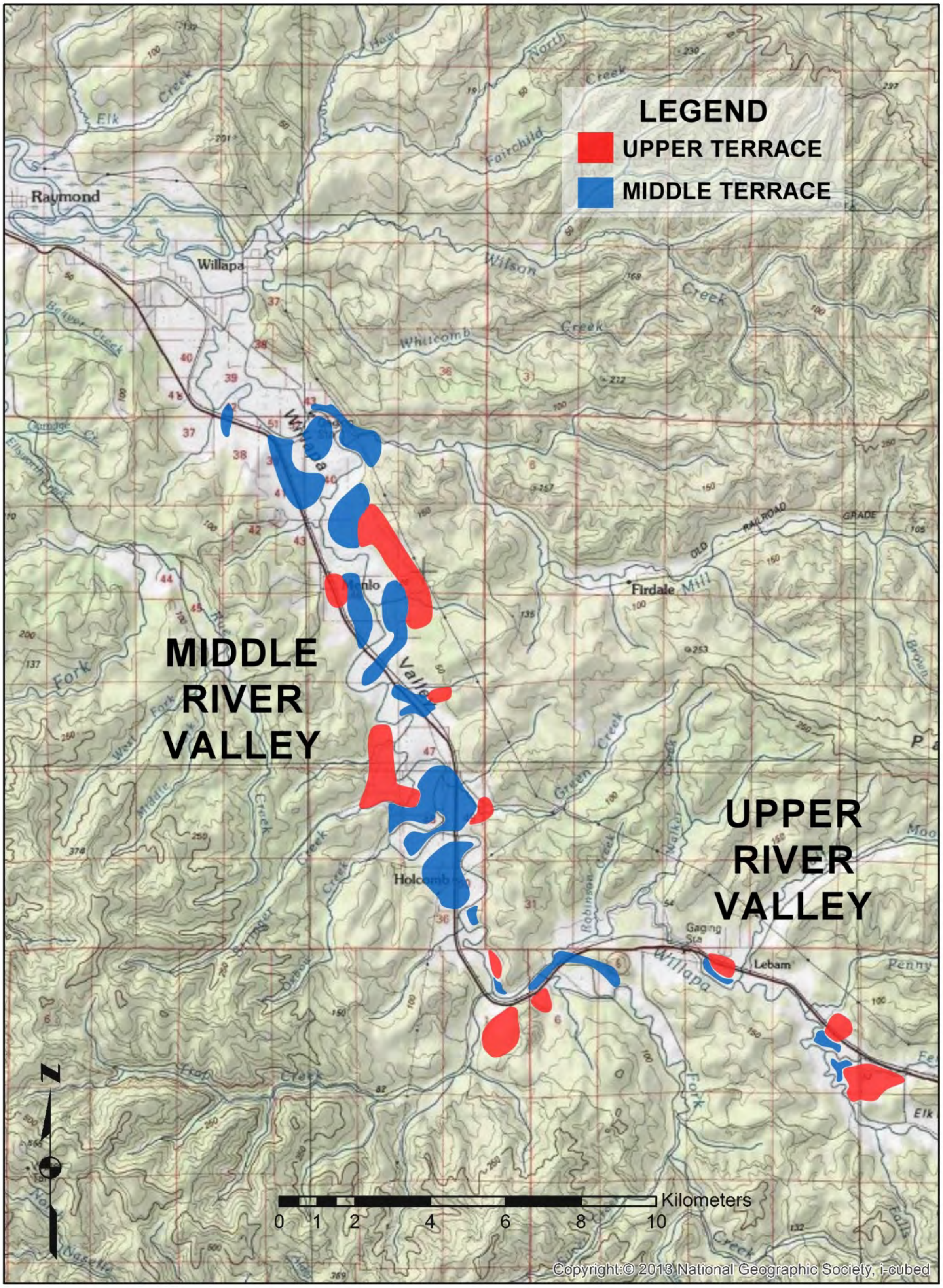

Figure 5. Approximate locations of “upper” and “middle” terraces in the Willapa River Valley.

Tectonics, Pleistocene Sea Level, and Landscape Formation

Tectonics and climate change are the two overriding systems that have contributed to the formation of the Willapa Valley landscape. Tectonic uplift (Ardoin 2002) and co-seismic movement associated with the Cascadia subduction zone margin (Atwater 1987; Atwater and Hemphill-Haley 1997) has resulted in a steady incision trend for the Willapa River that contributed to the creation of a series of strath terraces in the Holocene. Schanz and Montgomery (2013) have measured strath terrace incision occurring at a rate of 0.4 ± 0.1 mm/yr in the Upper Willapa River Valley. The Willapa region's slow and consistent tectonic uplift trend is markedly interrupted by periodic co-seismic "slipping" subduction earthquake events that occur approximately every 500 years and can result in the flooding of terrestrial shorelines. The author has observed deeply buried surfaces at the mouth of the Willapa River that have dropped more than two meters into the Bay and estuary during large earthquake events.

Multiple trajectories of landscape formation were initiated by climate change during the Pleistocene and Pleistocene/Holocene transition. Post-glacial eustatic changes in sea-level (Atwater and Hemphill-Haley 1997; Baker et al. 2010; Peterson and Phipps 1992; Shennan 1996; Twitchell and Cross 2001) caused significant changes to the Willapa region shoreline over the last 16,000 years. If the Willapa River Valley has behaved like other strath terrace alluvial systems of the Pacific Northwest Coast, the trend towards warmer and dryer conditions after the Late Pleistocene/Early Holocene transition likely contributed to changes in the sediment holding capacity of Willapa Hills upland slopes resulting in the aggradation of alluvial sediment terraces within the interior Willapa River Valley (Personius et al. 1993). The Pleistocene/Holocene transition period between 11,000 and 9,000 thousand years ago likely represents one of the punctuated instances of sediment aggradation within the Willapa Valley strath terrace alluvial system's long term trend of incision and planation.

The earliest terraces in the Willapa Region are marine terraces rather than alluvial flood terraces. Ardoin (2002) identified three uplifted Pleistocene marine terraces on the western slope of the Willapa Hills that represent high stands of the paleo-sea level. The three marine terraces date to 320,000 years before present (560 feet above sea level), 125,000 years before present (150 feet above sea level), and 83,000 years before present (50-85 feet above sea level). Ardoin's (2002) uplift rates of 0.49 ± 0.04 mm/yr for the northern Willapa Hills are presently being refined for the Willapa River Valley where *incision* appears to be occurring at a rate of 0.4 ± 0.1 mm/yr (Schanz and Montgomery 2013). Landform uplift has been causing the Willapa River to down-cut into the relatively soft siltstone and sandstone bedrock, creating a series of strath terraces forming the valley floor. Schanz and Montgomery (2013) dated two terrace sets in the Upper Willapa Valley that are approximately 10,000 and 150 years old.

The three ancient paleo-marine terraces (83 ka/50-85 feet elevation, 125 ka/150 feet elevation and 320 ka/560 feet elevation) of the Willapa Hills were formed during eustatic high-stand sea-level events (Ardoin 2002). The regional uplift trend has preserved remnants of the high-stand marine terraces in the Willapa Hills, the most obvious being the lowest 83ka year-old terrace that forms the flat-topped cliff eastern shoreline of Willapa Bay. The stratigraphy of the lowest Pleistocene high-stand marine terrace exposed in the sea-cliffs along the margin of Willapa Bay displays a long-wavelength syncline which trends to the west-northwest with measured uplift rates of 0.34 ± 0.02 mm/yr in the south, and 0.49 ± 0.04 mm/yr in the north (Ardoin 2002). The northern half of the Willapa Bay region is rising faster than the southern half. This is a trend that Dr. Daugherty noticed at a different scale with respect to the entire coast of Washington State, where shoreline sites were sinking in Willapa Bay, and rising near Cape Alava (Strong 1973). The lowest Pleistocene marine terrace stratigraphy also displays the sedimentological characteristics of at least five different estuarine subenvironments that are common in the *modern* Willapa estuary (Gringas et al. 1999).

The mid-level Pleistocene high-stand marine terrace (125 ka./150 feet elevation) is less obvious than the bay-adjacent marine terrace, as it is not openly exposed along the actively eroding Willapa Bay shoreline. The author has identified what he believes to be an exposure of a remnant of the mid-level Pleistocene marine terrace located in the channel bank of the Willapa River at approximately 150 feet elevation near the Middle Willapa River Valley "Oxbow" field (River Mile 25.7). The exposure (Figure 6) consists of grey cross-bedded fine silts that may have originated within an inner-estuary upper tidal channel (Smith 1987). While detailed investigations have yet to occur, there does not appear to be significant bioturbation within the grey fine silt laminated sediments. There are rounded cobbles imbricated with laminations of the cross-bedded fine silt sediments. Some laminations are stained with rusted iron (Fe) that is presumed to have originated from alluvium-capped organic-rich surfaces that underwent anoxic sulfide processes (Berner 1980; Frankel 2003; Sundby et al. 1998). The flat strath unconformity surface of what may be the Pleistocene middle marine "fill" terrace remnant is capped with a thin layer of reddish-brown alluvium that is likely at least 2700 years old. This date is based on the presence of pre-contact archaeological materials at site 45PC214, located on a laterally continuous terrace remnant across the Willapa River from the exposure. The archaeological artifacts at site 45PC214 are similar to the artifacts from the Forks Creek site (Chapter Five). The retreat of the125 ka year-old shoreline may have allowed the paleo-Willapa River to resume its planation and incision trend into the terraced marine sediments that had in-filled the valley below the 150-feet elevation level at approximately River Mile 26.

The 125 ka year-old 150-foot elevation Pleistocene marine “fill” terrace sediments appear to have behaved in the same manner as a soft bedrock, allowing the Willapa River to create “stepped” straths capped with treads of relatively thin layers of Holocene alluvial terrace sediment. The author believes that remnants of the 125 ka year old 150-foot elevation Pleistocene marine terrace (Ardoin 2002) may form the underlying “bedrock” straths of the highest and earliest Holocene alluvial terraces abutting the walls of the Middle Willapa River Valley below 150-feet elevation. It is perhaps significant that Willapa Falls (near the remote upland headwaters of the Willapa River) is located at approximately 550 feet elevation, nearly the same elevation as the oldest and highest 320,000 year-old, 560-foot elevation Pleistocene high-stand marine terrace. Perhaps Willapa Falls is related to the margin of the 320,000 year old marine terrace. The author plans to survey the Willapa Falls area in the future.

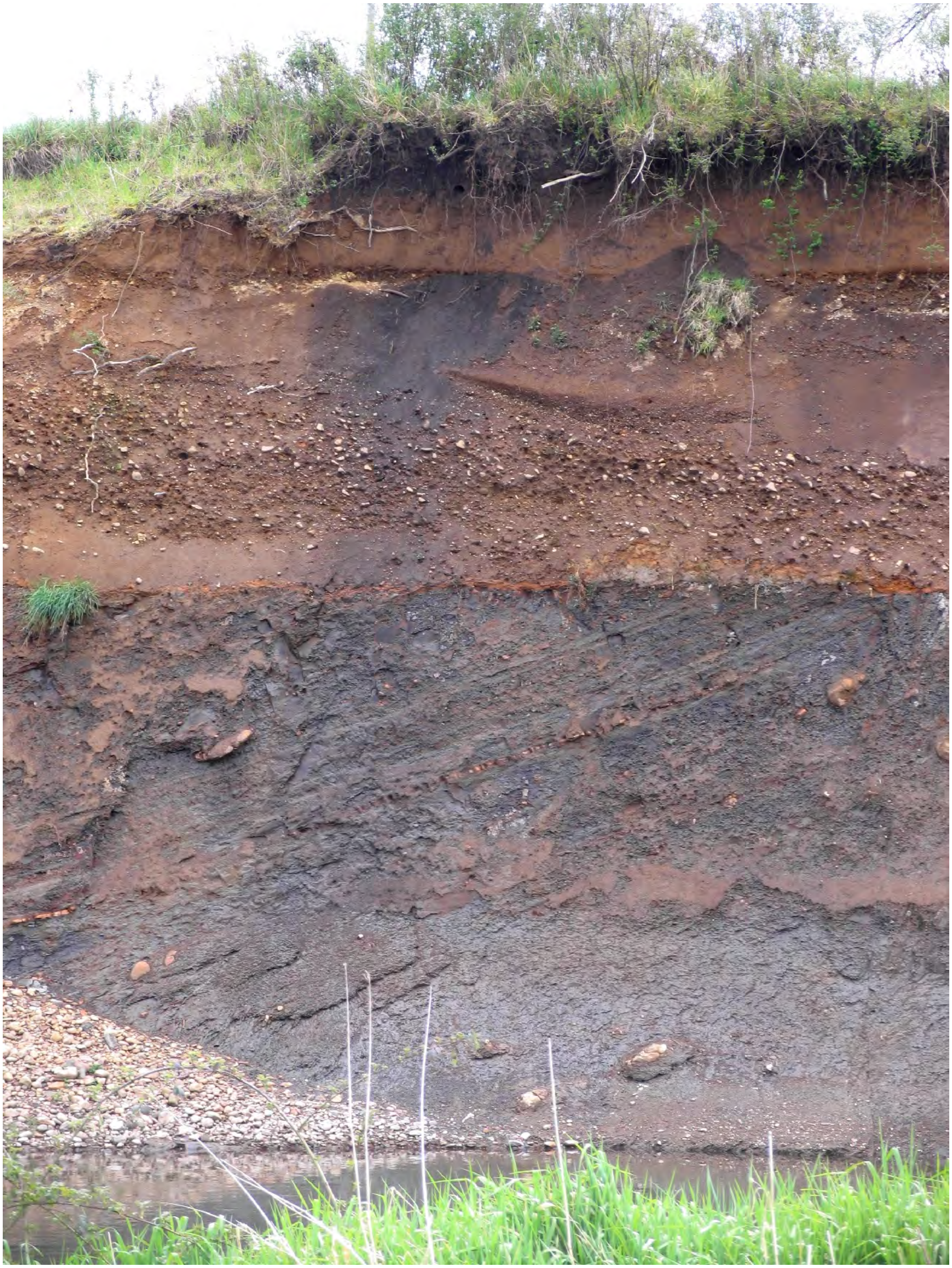

Figure 6. Cross bedded marine terrace “strath” at 150 feet elevation in the Willapa River Valley.

Climate Change and Terrace Formation in the Early Holocene

Studies of strath terraces within Pacific Northwest Coast watersheds from southern Oregon to northern Washington have shown that there was a significant and punctuated period of sediment aggradation between 9,000 11,000 years ago during the Pleistocene/Holocene transition period (Personius et al. 1993; Wegmann and Pazzaglia 2002). Personius et al. (1993) suggest that increases in storms during this period caused sediment movement from coastal range hill slopes leading to deposition of new flood plains and channels. Fires, vegetative loss, and earthquakes (Wegmann and Pazzaglia 2002) have been suggested as alternative processes that could lead to increases in movement of sediments from the slopes of mountains into the coastal river drainages. Climate change driven aggradation during the Pleistocene/Holocene transition created a set of similar alluvial strath terraces in the Pacific coastal watersheds of Oregon and Washington that all date to the same 9,000 to 11,000 year old period (Personius et al. 1993). The 10,000 year old upper terraces dated by Schanz and Montgomery (2013) in the Upper Willapa River Valley seem to correspond to this Pleistocene/Holocene transition period of regional aggradation.

The 11,000 to 9,000 year-old period of aggradation that resulted in strath terrace formation in many Pacific Northwest coastal range valleys is also reflected as changes within the deep stratified deposits from the paleo-valley of the Lower Columbia River (Baker et al. 2010). Deep drilled core sample sediments *older* than approximately 11,000 years old within the 112-meter deep, 16,000 year old, paleo-Lower Columbia River Valley, are dominated by sediments from the interior metamorphic basins of the Columbia River and Snake River watershed (Baker et al. 2010). The Bonneville (Jarret and Mauld 1987; Mauld 1968) and Missoula flood (Bretz 1923, 1969) sediment terraces of the interior Columbia and Snake Rivers are representative of this interior metamorphic sediment. Sediments *younger* than approximately 11,000 years old (buried less than approximately 70 meters deep) within the paleo-Lower Columbia River Valley are dominated by volcanic Cascade arc sediments from the mountain and foothill tributaries of the Cascade range (Baker et al. 2010). Glacial meltwater and flooding had already carried much of the “surplus” sediments of the metamorphic interior though the Columbia and Snake watershed (reducing the relative contribution of interior sediments to the load) while the Cascade arc sediment sources were increasing rapidly until approximately 10,000 years ago, when the deposition rates had stabilized (Baker et al. 2010).

The climatic changes that had triggered slope erosion and the aggradation of sediments on strath terraces within many Coast Range drainages 11,000 to 9,000 years ago had also begun to contribute to the in-filling of the large paleo-canyon of the Lower Columbia River. The paleo-canyon of the Lower Columbia River (incised when the eustatic sea level was more than 100 meters lower than present) was rapidly filling up with the discharge sediments from the Cascade arc in consort with the formation of the 11,000 to 9,000 year old alluvial terraces in the drainages of the Pacific Coast Range. As the paleo-canyon in-filled with both Cascade arc mountain discharge and tidal sediment deposits (from the rising sea level) the Lower Columbia River became a much less efficient “sediment trap” and allowed more sediments to “bypass” through the canyon to accrete on the continental shelf (Baker et al. 2010). Once sea level stabilized near its modern level, these “bypassed” sediments moving through the Lower Columbia River would begin to form the spit landforms of the Long Beach Peninsula, Clatsop Spit, and barrier spits of Grays Harbor and the Chehalis River.

The 11,000 year old Lower Columbia River Valley’s initial Late Pleistocene estuary is buried approximately 70 meters below the modern surface. The Late-Pleistocene Pacific shoreline is deeply submerged many kilometers off the modern coastline. Mt. Mazama tephra deposits are buried approximately 21 meters below the modern surface (Baker et al. 2010; Twitchell and Cross 2001). What does this mean for the potential to discover Late Pleistocene archaeological sites? Punke and Davis' (2004, 2006) work in near-coastal southern Oregon river valleys suggests that Late Pleistocene and Early Holocene surfaces can be deeply buried and essentially inaccessible under alluvium, but that the specific tectonic behaviors of the local landscape can either preserve ancient landforms and sites through uplift, or contribute to the process of sites becoming buried and hidden under massive beds of sediment. Ackerman (1968, 1996) has been presenting the same principle of localized tectonic variability as a caveat to his students with respect to uplifted Early Holocene marine shorelines in the Ground Hog Bay region of southwest Alaska. Unfortunately, terminal Pleistocene and Early Holocene eustatic sea-level rise has greatly outpaced the tectonic uplift trends along the Willapa region coastline, and there are simply not terrestrial uplifted Late Pleistocene shoreline bluffs, facies, or beaches to explore. The Willapa region displays a long-term trend of uplift (Ardoin 2002), with the striking exception of the immediate late prehistoric coastline where cultural sites cyclically sink into the tide zone in consort with co-seismic earthquake events (Atwater 1987; Atwater and Hemphill-Haley 1997; Strong 1973). Tectonic movement has not buried ancient archaeological sites deeply underground in the Willapa region. Marine transgression has covered the ancient shoreline sites with water, and early Holocene erosion has covered the ancient inland sites with alluvial and colluvial sediments.

It is probable that the approximately 10,000 year-old increase in slope erosion that contributed to the creation of the terraces on the valley straths of the Coast Range and the Olympics (Personius et al. 1993; Wegmann and Pazzaglia 2002) also resulted in the destruction or deep-burial of Late Pleistocene cultural sites that may have existed on valley terrace treads prior to glacial retreat and marine transgression. While the Late Pleistocene and Early Holocene Pacific coastline is submerged off of the coast of the modern Willapa shore, there should be near-coastal landforms where the punctuated period of slope erosion and associated terrace aggradation approximately 10,000 years ago did not result in the erosion of ancient landforms. I believe that the treads of the Pleistocene marine terraces (Ardoin 2002) have the potential to contain Late Pleistocene and Early Holocene archaeological deposits that could be shallow enough to be discoverable. The contexts of potential Early Holocene finds in the near-coastal region of the Columbia need to be analyzed carefully, a point highlighted by the fact that Mt. Mazama tephra is buried 21 meters below the surface in the vicinity of Warrenton, Oregon, not far from the terrace fields where the Youngs River Complex (Minor 1984) materials were identified. The early-style large stemmed and lanceolate projectile points from the upper Willapa and upper Chehalis rivers described by Welch (1970, 1983), and documented by this Willapa survey at isolate 45PC222, seem plausible given the fact that there are 10,000 year old alluvial terraces in the Upper Willapa River Valley (Schanz and Montgomery 2013).

Eustatic Sea Level in the Late Pleistocene and Early Holocene

Sixteen thousand years ago, prior to the onset of the Late Pleistocene marine transgression, the floor of the Columbia River Valley was 112 meters below its present level (Baker et al. 2010) and the Pacific Ocean coastline was close to the edge of the now submerged continental shelf (Twitchell and Cross 2001). Figure 7 illustrates the Early Holocene evolution of the Willapa region coastline as marine transgression occurred between 11,000 and 5,000 years ago (created from GIS data released by Twitchell and Cross 2001).

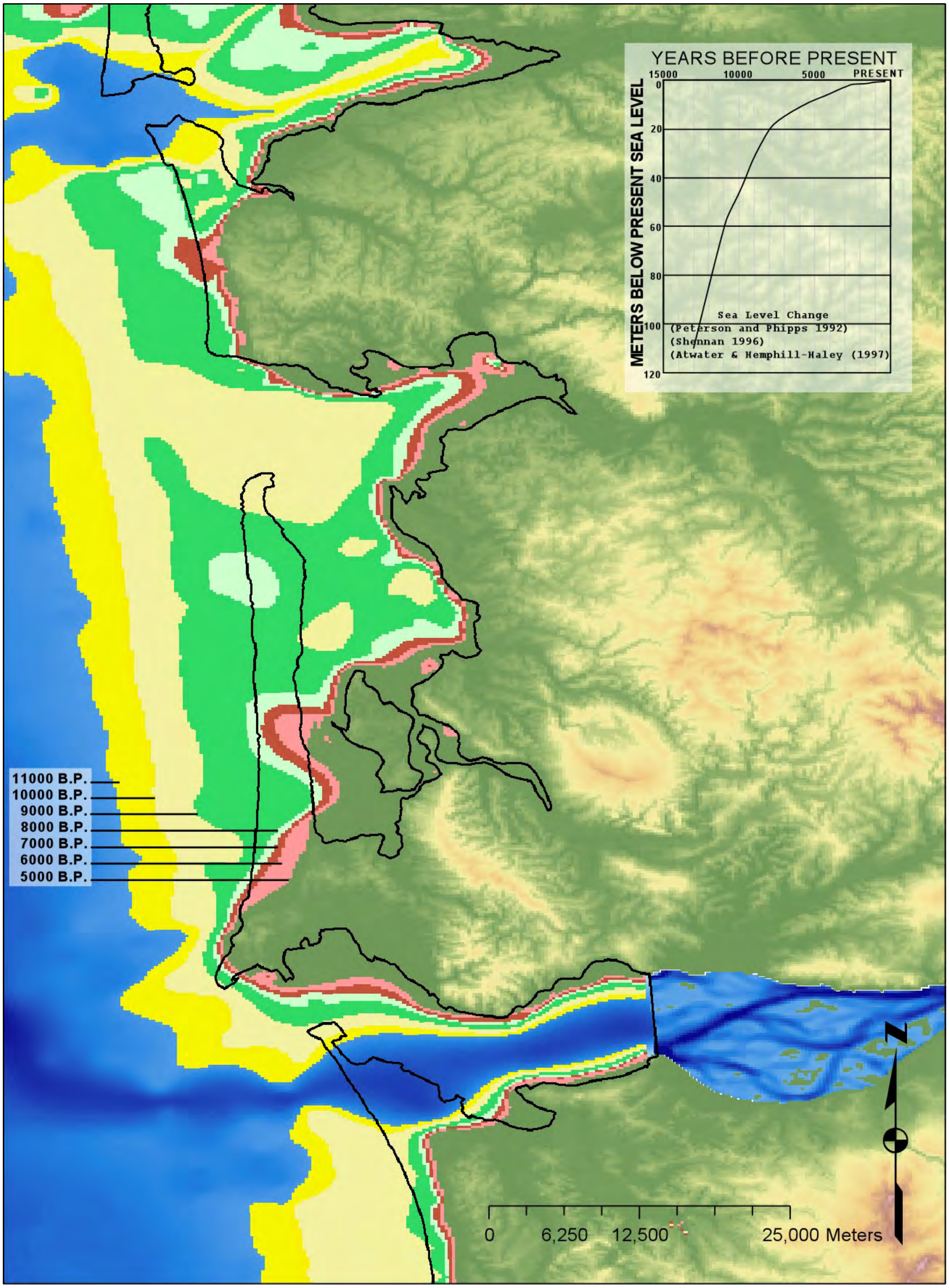

Figure 7. Early Holocene Shoreline Evolution of the Willapa region (created using GIS data from Twitchell and Cross 2001).

By 11,500 years ago sea level had risen to the point were the first evidence of estuary diatoms appear 70 meters below the modern surface at the mouth of the Columbia River (Baker et al. 2010). By 10,000 years ago the pacific shoreline was approximately 47 meters below its modern level, and Grays Harbor was likely beginning to be tidally flooded (Twitchell and Cross 2001). The northern reaches of what would become Willapa Bay were likely flooded by tidal waters by 8,000 years ago.

Sonar surveys (Twitchell and Cross 2001) did not identify a distinct submerged and in-filled paleo-Willapa River Canyon on the submerged continental shelf. Sixteen thousand years ago, the "Lower Willapa River Valley" was several kilometers longer than it is today, and the tide zone was 112 meters lower. Marine transgression would have significantly changed the shoreline and tidal reaches of the valley, but the eustatic rise did not likely have a great direct-affect on the alluvial system far inland above the tidal maximum (Personius 1993).

Late Holocene Landscape Formation

By 5,000 years ago, the rate of marine transgression had slowed, and the modern Willapa coastal landscape was beginning to form. The deep paleo-canyon of the Columbia had been in-filled with river transported and tidal sediments, and the river was passing materials out to the continental shelf. The Altithermal (mid-Holocene) drying trend likely reduced the amount of sediment capturing vegetation in the interior Columbia watershed, providing extra materials for shoreline spit development beyond what had already been passed to the continental shelf during the Early Holocene. By approximately 5,000 years ago, the bypassed sediments had begun to form the Clatsop plains (Connolly 1995; Connolly et al. 1992; Rankin 1983), Long Beach Peninsula (Peterson et al. 2002, 2010), the Grayland and North Beach barriers, and their shoreline plains to the north. The oldest dates from these Middle to Late Holocene sand and silt accretionary landforms is from the eastern base of the Long Beach Peninsula, where beach progradation had been initiated approximately 5,000 year ago (Peterson 2002). Pre-contact site 45PC26, located at the southeast base of the Long Beach Peninsula, has the potential to contain some of the oldest coastal terrestrial archaeological deposits in the region, as it may be located on one of the earliest foredunes of the "proto-peninsula" which began to form between 5,000 and 4,000 years ago. Site 45PC26 would likely be a good candidate for archaeological testing to address early cultural adaptations to the "new" Middle Holocene-formed sand spit Pacific shoreline landscapes in southwest Washington and Northwest Oregon. The earliest cultural layers of the site could potentially be buried below the tide zone.

The process of beach progradation that has continued for approximately 5,000 years created a series of temporally distinct foredune beach ridges on the Long Beach Peninsula (Mason 1993). While there have been as many as 15 foredune beach ridges identified in places, there are three primary foredune beach ridges that are apparent across the entire Columbia River Littoral region: the 4,200 year old "Old Dune-Ridge," the 2,500 year-old "Mid-Dune-Ridge," and the 1000 to 300 year old "Big Dune-Ridge" (Peterson et al. 2002). There are 10 buried scarps associated with old shorelines on the Long Beach Peninsula that were identified using ground penetrating radar (GPR) (Peterson et al. 2002). The Martin site (Kidd 1960, 1967; Shaw 1975, 1977) is situated directly behind scarp "G," on the 2,500 year old "Mid-Dune-Ridge" (Peterson et al. 2002). Some of the shoreline scarps on the Pacific side of the foredune structures of the Late Holocene Long Beach Peninsula have disturbances which represent catastrophic beach retreat, undercutting, and collapse events associated with co-seismic subduction earthquakes (Atwater and Hemphill-Haley 1997; Meyers 1996; Peterson et al. 2002).

Iron-capturing Bacteria and Redox Reactions within Tide Zone Sites

Significant changes can occur to the sediments of archaeological sites when they sink into the tide zone. Willapa Bay and Lower Willapa River Valley sites that have been inundated within the tide zone are subjected to an interesting set of post-depositional environmental processes that often alter the archaeological context. The diagenic processes that occur within tidal marshes are different than the eluvial and illuvial processes that formed soil horizons in the local terrestrial alluvial sediment terraces. In Willapa, post-depositional sediment horizonation is commonly created through reduction and oxidation (*redox*) chemical reactions driven by marsh microorganisms (bacteria and algae). Anoxic bacterial sulfate reduction is responsible for the "rotten" odor, dark-black oxidized-pyrite staining, and rust (oxidized iron) concretions that are encountered within many Willapa tide zone archaeological sites (Berner 1969, 1970, 1980, 2013; Howarth 1979; Mann and Fyfe 1989; Saunders 1997). The sulfate reduction process is initiated in Willapa Bay and Lower Willapa River Valley shoreline sites after they sink into the tide zone during coseismic subduction earthquake events.

When the AD 1700 earthquake (Atwater and Hemphill-Hailey 1997) caused Willapa sites 45PC102 (Niawiakum site) and 45PC196 (Que-lap′ton-lilt Village) to sink into the bay, their forest floor duff and shoreline vegetation (soil "Y") were submerged in the tide zone and quickly capped by sands and tidal silts, creating a "sealed" organic-rich anoxic environment. Within such sunken and "sealed" decomposing contexts, bacterial sulfate reduction of the organic duff results in the release of organic sulfurs and the creation of H_2S (hydrogen sulfide). Residual dissolved Fe^{+2} ferrous iron from the sea-water and ground water diffuses to the hydrogen sulfide within the organic rich layer, forming insoluble iron sulfides. The anoxic bacteria actually initiate a process (diagenesis) whereby the organic materials are consumed and replaced by a spectrum of metallic pyrite precursors, pyrite, and organic sulfur compounds.

Rusty non-soluble aggregates of ferric (Fe^{+3}) oxides can be formed when oxygen is introduced to this natural marshland chemical reaction (Jacobson 1994). Anoxic iron-aggregating bacteria and algae are also responsible for the "rusting" process that has tinted some of the local Willapa Pleistocene marine terrace sediments a light rusty orange. Similarly, iron-aggregating anoxic microorganisms are most likely responsible for the rust-orange color of "Red Lake" near the base of the Long Beach Peninsula. When a hole is dug into the beach at Que-lap′ton-lilt Village site (45PC196), the black sunken culture-bearing organic-rich duff layer is exposed to oxygen and actually begins to weep rusty orange fluids. The biotic-captured iron within the AD 1700 subducted "Y" soil duff layer oxidizes during the exposure, and changes to a stable form of insoluble rust. The same type of "iron capturing" anoxic microorganism driven iron and sulfate reduction *"redox"* reactions are responsible for "bog ore" or "bog iron" formation throughout the world (Dake and Rolla 1916).

The Willapa region has its own "bog-iron" deposits. Archaeological shovel tests on the accretionary late Holocene Long Beach Peninsula will often encounter a rust-orange one to four cm thick iron-cemented "bog ore" band within the top 20 to 50 centimeters of sandy sediments. These sulfate and iron reducing reactions can occur very quickly (Howarth 1979). Over a four year period following the removal of a segment of Sea Haven Dike northeast of site 45PC196 (Nakonechny 2008), I observed a microbial-aggregated iron oxide "film" form on the recently flooded restored tide-land that had been an organic-rich vegetated terrestrial field for the last 120 years.

I have also observed black and orange-rust stained stone and bone artifacts from tidal-zone sites throughout the Willapa Bay region. The stains come from being within the anoxic iron and sulfur reducing contexts of organic-rich tidal estuary marsh. It can be somewhat confusing to find deflated archaeological fire cracked rock (FCR) in a tide zone context which is stained jet-black and orange from anoxic bacterial reduction, rather than (or in addition to) being stained black and orange from the heat of a hearth. Iron aggregating bacteria in the sediments of the Upper Willapa River Valley Forks Creek site (45PC175) have used essentially the same process to create bright orange iron-rich and grey stained root casts, while sulfate reducing biotic processes have contributed to the transformation of ancient marine siltstone cobbles dissolving into dark black "ghost cobble" stains within archaeological contexts less than 2,000 years old.

The Que-lap′ton-lilt Village site (45PC196) beach is littered with natural 0.5 to 2 cm long rusty-red iron root-cast concretions that have been wave-tumbled in the pebble and sand beach to form tubular bead-like segments. These natural tubular iron oxide "beads" formed around the roots of terrestrial and estuary plants after they were catastrophically submerged and began to decompose within the anoxic environment suited to iron-capturing bacteria. The natural rusty root-casts can be observed in-situ at site 45PC196 within the deflating tidal "muck" bed underlying the "Y" soil band, their rhiso-concretionary structure preserved in the thick tidal sediments. Sundby et al. (1998) describe somewhat similar iron-rich "tubular" concretions on roots of marsh plants in Portugal. The original 1954 form for the Lower Willapa River site 45PC22 at "the narrows" (not yet re-visited) includes a brief description of the cultural materials that consistently places quotation marks around the word "*beads.*" Believing this to be odd, I wonder if these natural iron-rich tubular bead-like root-cast concretions may also be present at site 45PC22.

The upper beach at Que-lap′ton-lilt Village (45PC196), and most other Willapa shoreline sites capped with sands, displays surficial and buried bands of wind-sorted ferromagnetic black sands. Similar wind-sorted bands of black sands are ubiquitous on the barrier spit beach of the Long Beach Peninsula. In the early 1900's, Dr. Day, of the mining division of the U.S. Geologic Survey, was studying the black sands and promoting the development of a refinery in Hoquiam to create steel from the "unlimited" deposits they had located (Day 1907a-d; Edman 1907; San Francisco Call 1905). Dr. Day's team may have identified massive contiguous beds of the black sands submerged 70 feet-deep off the Willapa region coast. Young (2014) utilized scanning electron microscopy (SEM), x-ray microanalysis, and x-ray powder diffraction to describe and classify the Holocene deposited beach sands of the northern Oregon coast's Netarts Bay region. Young (2014) identified three different types of sand being sorted on the beaches: a light tan quartz and feldspar sand, a dull brown "mixed bag" (pargasite, augite, diopside, and magnesiohornblend) sand, and a significantly heavier blue-black sand made from small spherical nodules of the titanium and iron oxide mineral ilmenite ($Fe^{+2}TiO_3$). The "unlimited" beds of black sands explored by Dr. Day (1907) are most likely iron and titanium-rich ilmenite sands.

Anoxic acidophilic "metal capturing" bacteria and algae can form aggregates of magnetic iron minerals, which, in aggregation, can form beds of magnetic black sand. Mann and Fyfe (1989) have observed high-concentrations of dissolved metal ions in polluted mine tailings made highly acidic through the oxidation of pyrite and other sulfide minerals by acidophilic bacteria and algae. These "iron-capturing" microorganisms aggregate dissolved metal ions into their cell walls and intracellular sites, essentially creating bio-metallic concretions. Mann and Fyfe (1989:2731) describe a biotic sequence through which amorphous iron (Fe) and titanium (Ti) are concentrated around acidophilic microorganisms (Bower et al. 2011). Metallic crystals aggregate on the bacteria and algae cellular walls, and then undergo a process of progressively transforming to, “microcrystalline aggregates of goethite, ferrihydrite, maghemite, magnetite, haematite, lepidocrocite, and ilmenite.” Ilmenite, the major constituent of the northern Oregon and southern Washington magnetic black beach sands (Young 2014), can form as part of a biotic sulfate process (Mann and Fyfe 1989). The formation of black sand magnetite crystals and other pyrite precursors through bacterial sulfate reduction and *redox* reaction is more widely documented than the formation of ilmenite (Cummings 2000; Hilgenfeldt 2000; Lee and Jin 1995; Lovely 1987; McKenzie 1991; Nowaczyk 2011; Perez-Gonzalez 2011; Sakaguchi 1993).

Berner (1982) has expanded and applied the principles of sulfate reduction systems to a larger context and scale than his original experiment with a jar of sand, rotten fish, and seawater. Berner applied the principle to the entire continental shelf and the entire Pacific Ocean, rather just an isolated organic-rich mud flat within a single tidal bay. Following Berner’s (1982) extension of scale, I considered the possibility that the same processes which are occurring within the organic-rich coseismically sunken anoxic shoreline of Que-lap′ton-lilt Village, may also be occurring at much larger scales on the continental shelf as a result of eustatic sea-level rise. If biotic iron and pyrite can form in a 300 year-old earthquake subducted organic duff soil, then perhaps massive beds of ilmenite, pseudorutile, and magnetite sands can form over thousands of years when an entire Pleistocene organic-rich estuary is submerged by Ocean progradation during eustatic sea-level rise. I propose that some of the Willapa black sands explored by Dr. Day in 1905 may have been formed *in-situ* from an ancient ocean-submerged organic-rich estuary that underwent diagenetic *redox* processes involving anoxic bacteria and sulfate reduction. The micro-organism driven redox processes can create aggregates of pyrite precursors, iron oxides, and titanium oxides from the ocean water.

The black ilmenite sand has been traditionally attributed solely to wave and current density-sorting of Columbia River alluvial placer sediments that eroded from ilmenite-rich volcanic bedrock areas of the Coast Range (Bostrom and Komar 1997; Komar 1997). The majority of Willapa region ilmenite black sands *are* likely from coastal range volcanic sediment sources, but some of the sands may have formed through the sulfate reduction process.

There is a tremendous amount of work yet to be done interpreting the Willapa landscape and refining the chronology of landscape change. Much of this future work will have to be conducted in the tide zone and underwater. The Willapa landscapes that have received the most attention from scientists also happen to be the most dynamic, malleable, and modern landforms in the region. For those interested in ancient cultural deposits, the focus needs to be on landforms that have remained stable for long periods of time. The uppermost strath terraces of the Willapa River Valley and the flat tread of the 83,000 year old marine terrace forming the eastern bluffs of Willapa Bay are two of the best options. While there are some shallow tide zone areas that may have Early Holocene estuary-adjacent deposits, these archaeological assemblages will likely be significantly disturbed by the natural wave disturbance process of shoreline advancement, and the biotic disturbances associated with burrowing clams, shrimp, worms, and other tidal estuary biota. Willapa tide zone archaeological sites will also undergo post-depositional diagenic changes brought about by anoxic bacteria and the sulfate reduction process.

CHAPTER FOUR

THE WILLAPA SURVEY

The ongoing archaeological survey has been the most time-consuming and rewarding element of the Willapa research project. The survey has been a process of becoming familiar with the scope and variety of archaeological landscapes and contexts in the Willapa region, and of assessing which Willapa archaeological landscapes, sites, and materials had the potential to generate original data that would contribute to the research themes of the southern Northwest Coast and keep me interested and excited about the work. One of the goals of the survey was to identify sites that were different from the Martin site (45PC7) and Long Island site 45PC9, both Late Holocene shell-midden localities. In particular, the early efforts of the Willapa survey focused on exploring landscapes that had a potential to contain archaeological deposits older than those that had been analyzed previously. At the time, Oregon State University's "Oregon Coast Project" (Hall et al. 2002) had been successful in identifying very early coastal sites at bluff localities on the southern Oregon Coast. Despite differences in landform uplift rates and coastal formation process between the Willapa region and southern Oregon (discussed in Chapter Three), the success of the Oregon Coast Project encouraged me to attempt to identify archaeological sites in the Willapa region older than the Late Holocene. The potential for older sites in the Willapa region also seemed to be high given the identification of the Youngs River Complex (Minor 1984) near the mouth of the Columbia River and Welch's (1983) identification of lanceolate and stemmed projectile point technologies in the Upper Chehalis River Valley and Boistfort Valley. The author was resolved to explore a great variety of different Willapa landscapes looking for new types of archaeological sites and fresh information.

The Willapa Survey began in 2005 with a widespread reconnaissance survey visiting previously recorded sites throughout the Willapa Bay, Long Beach Peninsula, and Willapa Hills regions. Austin Ivers, Beth Horton, and Robert Ackerman, assisted me with portions of the Willapa survey. The vast archaeological landscape in Southwest Washington needed to be narrowed down into a manageable study area, and the author needed to explore a spectrum of local archaeological contexts to generate meaningful trajectories of research and fresh hypotheses. In the Willapa River Valley, the team utilized "intensive" 10 meter spaced transect pedestrian survey techniques, and geography-based survey techniques that focused on the margins of alluvial terraces, the paths of extinct meandering river paleo-channels, and on old ox-bow landscape features.

The fieldwork was initiated by visiting a sample of known archaeological sites in the Willapa Region (see Figure 2). On the Long Beach Peninsula, I visited a sample of known archaeological sites: 45PC7 (Martin site), 45PC5 (Oysterville), 45PC46, 45PC26, and 45PC35 (Fishing Rocks site). At the base of the Peninsula, large portions of the Cape Disappointment landform were surface-surveyed, in addition to landscapes surrounding the mouth of the Chinook River and Fort Columbia. At the south end of Willapa Bay, segments of the lower, middle, and upper, Bear River watershed were surveyed, but extreme vegetation cover made pedestrian survey exceptionally difficult, as thick beds of organic duff cover prevented the surveyors from observing any "mineral sediments" during fieldwork. The fossiliferous limestone outcroppings in the lower reaches of the Bear River valley did not contain any tool-stone quality chert. A canoe-based survey of the Bear River channel would likely result in identification of new cultural resources in the sediment exposures of the channel banks.

The following season, the survey shifted to Long Island in Willapa Bay (Figure 2). Long Island is of interest because it is an old landform, consisting of a remnant of the approximately 83,000 year old (Ardoin 2002) lower marine terrace. In the Early Holocene, when the sea level was significantly lower, Long Island was most likely a near-coastal marine terrace landscape feature that was backed on the east by the paleo-estuary channel of the Naselle River. The survey team visited sites 45PC9, 45PC10, 45PC11 (Diamond City), 45PC31 (Sunshine Point), 45PC32, 44PC33, the vicinity of 45PC8, and the vicinity of pre-contact isolated find 45PC104. On Long Island members of the survey identified an abundance of lithic raw materials and cultural debris associated with actively eroding shell midden deposits. Selected materials were documented *in situ*, but not collected. Long Island is essentially ringed by a band of deflated artifacts and cultural debris within the tide zone, presumably from eroded shorelines that sunk into the bay during co-seismic earthquake events (see Chapter Two). Unlike the majority of the Willapa Bay shoreline, Long Island has intermittent pebble and cobble beaches. The pebble and cobble beaches contain fossiliferous CCS, jasper, petrified wood, basalt, and indurated siltstone lithic raw materials. The shoreline gravels have eroded directly out of the Pleistocene marine terrace remnant that forms the landform, illustrated by the fact that the lithic raw materials are also present within the island's inland drainage channels. Long Island pre-contact sites 45PC11 and 45PC9 are located adjacent to shorelines with abundant amounts of high-quality pebble and cobble lithic raw materials. Other major Long Island sites, such as the not-yet formally recorded midden at the Lewis Slough Wildlife Refuge primitive campground locality, are located adjacent to silt dominated tidal channels without abundant pebble and cobble lithic raw materials. The Lewis Slough campground pre-contact shell midden locality would have had close-proximity easy access by canoe and would have offered semi-protected moorage. Many of the Willapa region shoreline archaeological sites recorded by Dr. Daugherty's 1947 survey (Wessen 2011) are located on shoreline terraces adjacent to cobble and pebble beaches, and have shorelines with convenient access for canoes.

Field examination of lithic debris associated with the deflated sites ringing Long Island suggests heavy utilization of a "pebble tool" oriented lithic technology, with many bi-polar split pebbles and bipolar pebble cores represented. At the south end of Long Island are siltstone bedrock outcrops that contain naturally perforated (square hole) glendonite concretions (Boggs 1975). Exceptionally lush ground-covering vegetation made it more than difficult to survey interior Long Island landscapes away from the immediate shoreline, but survey efforts did penetrate into drainages at the north end of the Island into landscapes away from the shoreline.

Fall and winter surveys were undertaken on the east side of Willapa Bay. Sites 45PC12, 45PC47, and the vicinity of site 45PC34 were visited within the Naselle River Valley. It was in the Naselle River Valley that I first encountered large flat alluvial river terraces in the Willapa region, though much of the terraced Naselle River Valley landscape is still heavily timbered, and the majority of the terrace treads are capped with thick layers of organic duff. The North Nemah River site (45PC101) was revisited during this survey.

Near Bay Center, WA., the survey team visited site 45PC15 and explored the vicinity of site 45PC23. There is great potential for archaeological discovery in the vicinity of Palix River site 45PC23. Unlike most of the other Willapa Hills drainages, the Palix River cuts through basalt flows which give it a distinct character apart from the other east-shore Willapa Hills foothill watersheds. The Palix River channel has basalt-incised pools, and has a waterfall feature that is mentioned in the ethnographic record (Swan 1857). Private artifact collections from sites near the mouth of the Palix River have much higher frequencies of basalt tools and debris than in the Willapa River Valley.

Fall River, a tributary of the North River, also passes through basalt dominant landscapes. Fall River has a section which passes through a deep basalt channel that resembles a collapsed lava tube in the vicinity of Sec. 6, T14N R6W WM. There are erosional rockshelters (site 45PC228) in the walls of the Fall River basalt channel that Willapa River Valley informants report once contained archaeological materials and animal bones. Informants have also located fossiliferous CCS artifacts in the channel of Fall River in uplands southeast of the deep basalt channel and waterfalls.

The mouth of the Bone River (45PC28), near James Swan's old residence, was visited during the survey, but no significant pre-contact archaeological deposits were identified. The site of Bruceville (45PC16 and 45PC57) was also visited. While significant archaeological materials were identified on the surface, the site has a strong historical component that was assessed as being too recent for further investigation by this project.

By early 2007, the Willapa survey team had reached the Willapa River Valley (Figure 9). Multiple attempts were made to visit site 45PC22 at the Willapa River "narrows" between South Bend and Raymond, Washington, but landowner permission could not be attained to visit the private property shoreline site. The survey team moved up the river to locate sites 45PC39, at the juncture of Green Creek and the Willapa River, and 45PC40, a pre-contact pit feature located in the upper river valley near Forks Creek. At the time, the surveyors did not locate archaeological materials at either of these localities. However, the site forms and their location maps were somewhat generalized, and the landscape changed significantly since the sites were originally recorded, with houses, roads, ponds, and even forests and fields. Tree-fall resulting from the severe wind storms during the winter of 2007 had modified the landscape around site 45PC40. Local informants who visited the site within the past 15 years could not re-locate the site's pit feature during multiple visits with the me between 2008 and 2013. The survey team identified a lithic tool and debris scatter at the 45PC40 site location, but the pit described in the original form has yet to be relocated.

I was immediately attracted to the Willapa River Valley because of its wide-open plowed dairy farm alluvial terrace fields. After two years of fighting the salal, blackberry, and alder thickets surrounding Willapa Bay, it was refreshing to be able to walk upright, unencumbered, and on landforms that were not covered by significant beds of organic duff. The Willapa River Valley had not yet been archaeologically-productive, but I felt that this area had the best potential to identify new archaeological sites, in contexts that had been minimally explored, and without having to perform extensive sub-surface sampling under seemingly endless tracts of organic duff. The subsequent year's survey season continued to explore the Willapa River Valley, and also ventured into the northern Willapa region's North River Watershed. I anticipated that pedestrian survey of the terrace fields after the early spring plowing period would be productive for identifying pre-contact sites in the Willapa River Valley. The early spring plowing period is an ideal time to survey the agricultural and dairy industry dominated coastal valleys of Washington and Oregon.

Weights of Evidence GIS Predictive Modeling

While the Willapa region reconnaissance survey fieldwork was underway, additional efforts were being exerted in the lab to narrow down the geographic scope and focus of the project. In addition to studying regional ethnographies, reading Willapa associated environmental papers, and reviewing the pre-existing archaeological site forms and excavation reports, I developed an ArcGIS geographic information system (GIS) map to assist with making decisions about where to direct and focus the field efforts. Working in a landscape in which vegetation slows overland-travel, and where thick beds of organic duff cover much of the ground surface, every effort was made narrow down those areas that could potentially have pre-contact archaeological sites. I chose to use the Weights of Evidence (WofE) method, part of the ArcSDM software package (Kemp et al. 2001), to create a predictive map to help guide the survey to previously unidentified pre-contact archaeological sites.

The WofE method is based on Bayes' Theorem and can assign weights to raster landscape data based on a set of training points (Bonham-Carter 1989). The Willapa region analysis utilized evidential landscape data including: topological derived data (slope, aspect, and elevation), hydrology data, and soils data. I used the locations of pre-recorded pre-contact sites in the Willapa Region as training points to drive the WofE model. The WofE method was performed for each of the evidential GIS layers to determine which environmental features had the greatest significance for predicting site location. All of the significant weighed environmental variables were then combined into a single site probability map (Figure 8) that ideally illustrates landforms that have a high potential to contain pre-contact archaeological sites.

The WofE method had been used primarily for mineral prospecting (Agrerberg 1993; Boleneus 2001), but has been successfully employed for archaeological predictive modeling

(Drews 2004; Hansen 2000). Utilizing a 100-meter² raster grid, the Willapa WofE predictive model map was not designed to identify the location of any particular type or age of pre-contact site, as the locations of all of the known pre-contact sites were used as training points. There was simply not enough data about the nature and age of the pre-contact Willapa archaeological site "training points" to develop a more sophisticated model able to target specific types of occupation or periods of use. The Willapa WofE model map does provide basic information about which landforms may have been generally desirable for pre-contact utilization.

In the Willapa WofE predictive model (Figure 8), the highest posterior probability levels (red) correspond to the highest probability for the landform to contain a pre-contact site. At the time the WofE model was designed and executed, the upper reaches of the Willapa River Valley were simply excluded from analysis because I did not anticipate the survey extending into that upland near-coastal landscape. The real-world strength of the Willapa WofE predictive model has not been thoroughly tested because of the monumental effort involved in surveying a sample of the high probability landscape. Surveys conducted during the approximately seven year period after the development of the WofE Willapa predictive model have resulted in the discovery of new pre-contact archaeological sites within high-probability zones. In particular, the Willapa WofE model accurately predicted the location of pre-contact site 45PC196 (Figure 9), located just south of the mouth of the Willapa River. Future attempts at GIS modeling in the Willapa region will likely provide higher resolution data to work with, and will benefit from the inclusion of a greater number of known prehistoric site locations.

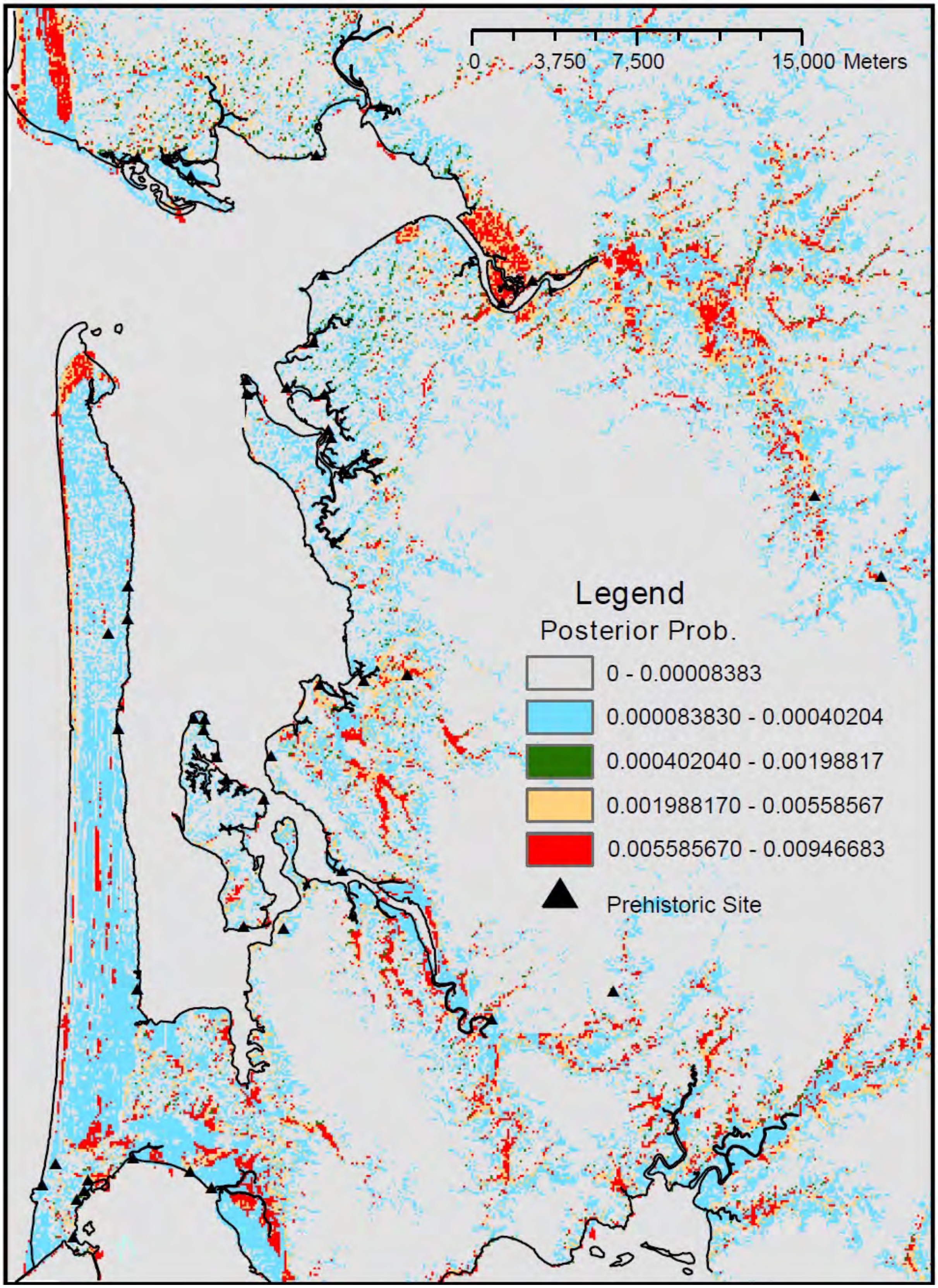

Figure 8. Weights of Evidence pre-contact site predictive model map.

Landform Based Survey in the Willapa River Valley

The focus of the 2008 early spring survey efforts was to explore the edges of the "middle" and "upper" terrace treads, and on following meandering shoreline paths of extinct Holocene channels and land-locked oxbow features. The survey methodology was modified to focus on the "marginal" landscapes of terrace edges, with the assumption that these areas were once the shorelines of prehistoric river channels. Ten-meter spaced pedestrian transects were employed in recently plowed terrace fields that had 100% exposed ground visibility.

The extinct Willapa River channels and "middle" terrace tread margins that the survey was focusing on were not landscape features that had already been mapped and used within an exploratory GIS model. Existing 10-meter digital elevation maps (10-Meter DEM) do not have the resolution to capture the important distinctions between Late Holocene terraces with archaeological sites and modern flood terraces with modern cultural debris. The National Resource Conservation Service (NRCS) soil maps of the Willapa River Valley are the closest proxy map that outlines the shapes of some of the different terrace landforms within the Valley, but these maps did not consistently illustrate the distinctions between terrace levels that were used to identify archaeological sites in the field. An interesting element of local Willapa "folk-wisdom" was related to me by Mr. Jack Burkhalter. Mr. Burkhalter said that most of the old (1940s to 1970s) artifact collectors in the valley would only walk the plowed fields with "brown soil" and wouldn't bother looking in plowed fields with "red" soil. While not entirely consistent, the lowest historic and modern flood terrace sediments do tend to be redder than adjacent "middle" terrace and "upper" terrace landforms. Isolated pre-contact artifacts have been located in fields with "red soil," but the "brown" versus "red" sediment "folk- wisdom" model was more effective for identifying Middle Willapa River Valley landforms with pre-contact deposits in the field, than the author's Willapa Region WofE Bayesian GIS predictive model map. The WofE GIS model was not designed specifically for the Willapa River Valley, and raw data with the resolution required to differentiate between modern and pre-contact age terrace landforms did not exist to use within the GIS model.

River-oriented canoe survey was undertaken in the Middle Willapa River Valley in 2008 in an attempt to view cut-bank exposures and to access somewhat remote areas that were difficult to reach over land. While the canoe-oriented survey allowed examination of many cut-bank exposures, no new pre-contact archaeological sites were discovered from the waterside. The vegetation on the bank of the Willapa River is simply too verdant, especially in the summer months when the river-channel canoe surveys were undertaken. There are also significant modern sandy sediment and vegetation flood deposits on the active terrace of the Willapa River that tend to obscure the basal sediments of older river-adjacent terraces. The canoe was a good tool for accessing remote locations, but did not provide an effective "survey perspective" for identifying pre-contact archaeological sites in the Middle Willapa River Valley as I was hoping it would. The following sections describe important pre-contact archaeological sites identified by the Willapa survey efforts. Figure 9 illustrates the locations of the Willapa River Valley sites and isolates discussed in this study. Table 1 summarizes the pre-contact Willapa River Valley sites and isolates discussed in this study.

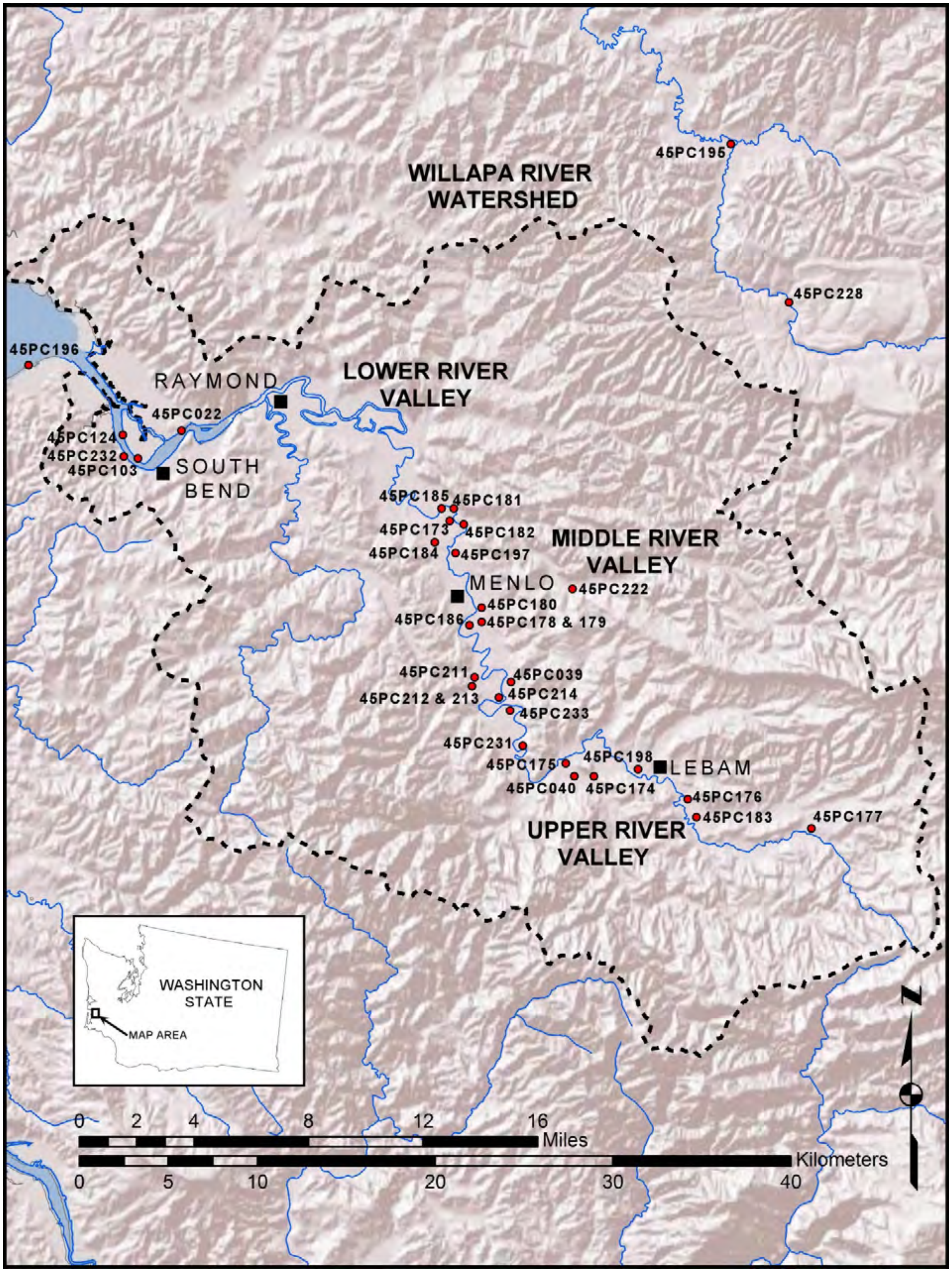

Figure 9. Known pre-contact sites in the Willapa River Valley.

Table 1. Pre-contact Archaeological Sites in the Willapa River Valley

Site Name	Site Number	T. N	R. W	Section	River Zone
Que-lap'ton-lilt Village, Capt. Stevens' Claim	45PC00196	14	9 & 10	13 & 18	Lower
S. Bend Fishing Weir and Campsite	45PC00103	14	9	28	Lower
Willapa River Fish Trap Complex	45PC00124	14	9	28	Lower
Arrowhead Beach, Willapa Narrows Site	45PC00022	14	9	27	Lower
Waldref Willapa River Flake Isolate	45PC00185	14	8	43	Middle
McAllister Willapa River Projectile Point	45PC00181	14	8	35	Middle
Burkhalter Dairy Willapa River Site	45PC00173	13	8	40	Middle
Mill Creek Willapa River Site	45PC00182	13	8	2	Middle
Kudasik Mill Creek Stemmed Point Isolate	45PC00222	13	7	8	Middle
Taylor Field Willapa River Site	45PC00184	13	8	40	Middle
Newman Farm Willapa River Site	45PC00197	13	8	40	Middle
Martin Dairy Willapa River Site	45PC00180	13	8	14	Middle
Zieroth Dairy Lilly Farm Site	45PC00186	13	8	14	Middle
Martin Dairy Willapa Biface Isolate	45PC00178	13	8	14	Middle
Martin Dairy Willapa P. Point Isolate	45PC00179	13	8	14	Middle
Green Creek Village Site	45PC00039	13	8	25	Middle
Kaech Oxbow Willapa River Biface Isolate	45PC00233	13	8	49	Middle
Oxbow Breach Willapa River Site	45PC00214	13	8	49	Middle
Wildhaber Terrace Edge Site	45PC00211	13	8	23	Middle
Wildhaber Field Site 01	45PC00212	13	8	26	Middle
Wildhaber Field Site 02	45PC00213	13	8	26	Middle
Smith Field Willapa River Site	45PC00232	13	8	36	Upper
Forks Creek Willapa River Site	45PC00175	12	7	6	Upper
Forks Creek Pit Site	45PC00040	12	7	6	Upper
Delanoy Forks Creek Site	45PC00174	12	7	5	Upper
Camenzind LeBam Willapa River Site	45PC00198	12	7	4	Upper
Globe Field Site	45PC00176	12	7	3	Upper
Swiss Scatter Willapa River Site	45PC00183	12	7	3	Upper
Kaech Willapa River Biface Isolate	45PC00177	12	6	6	Upper
Jenkins Farm North River Site (North River)	45PC00195	15	7	23	North River Valley

Lower Willapa River Valley Archaeological Sites

The Lower Willapa River Valley received the least amount of attention from the Willapa archaeological survey. The discrepancy in attention occurred partly because of access issues, but primarily because I have not yet had the time to examine the landforms. The landscape of the Lower Willapa River is significantly more developed than the Middle and Upper reaches, and there is a much higher density of property owners from which to seek permissions to survey contiguous blocks of land. Most tidal segments of the Lower Willapa River Valley channel can be most efficiently accessed using a boat. The 45PC22 site at the Lower Willapa River "narrows," first recorded by A.L. Bryan and Gerald Gould in 1954, has not yet been re-visited, but not for lack of trying. Access permission simply could not be acquired.

Atwater and Hemphill-Haley (1997) have identified several sub-tidal buried archaeological sites exposed on the northern bank of the Willapa River Valley that have yet to be formally recorded on archaeological site forms or included in the Washington State archaeological site register. These sites are located on the north shore of the channel of the Willapa River near Atwater and Hemphill-Haley 's (1997) "Sewer" and "Jensen" localities, and appear to be associated with the "Y" soil group they identified throughout the northern Willapa Bay estuary shoreline. The "Y" soil group is a co-seismically sunken terrestrial layer capped by the 300-year old AD 1700 earthquake tsunami deposits that was identified throughout the Lower Willapa River Valley tidal zone and within the tidal sloughs of northern Willapa Bay (Atwater and Hemphill-Haley 1997). The landform where Atwater's co-seismically sunken archaeological sites are located is a large marshy point bar that has been incised by tidal sloughs. The treeless estuary landform has been flooded as recently as 2007, and is presently used as dairy cattle pasture. Prior to the AD 1700 earthquake related subsidence, the landform could have been as much as two meters higher, was likely much dryer with some patches of Sitka spruce (*Picea sitchensis)* and lodgepole pine (*Pinus contorta*). I have observed a tsunami-sand capped shoreline surface that is likely contemporaneous with the "Y" soil group buried two meters under tidal muck on the south bank of the Willapa River just inside the river mouth (Nakonechny 2008). The tsunami-sand capped Niawiakum site's (45PC102) cultural materials were also deposited within the "Y" soil group (Atwater and Hemphill-Haley 1997; Cole et al. 1996). The submerged estuary shoreline site 45PC196 that the Willapa survey identified at the mouth of the Willapa River also appears to be a deposit within the "Y" soil group.

Que-lap'ton-lilt Village Site (45PC196)

The Que-lap′ton-lilt Village site (45PC196) is a good representation of Lower Willapa River Valley late prehistoric shoreline occupation loci, and displays post-depositional processes that are at work throughout the tidal-zone of the Lower Willapa River Valley and Willapa Bay. The Willapa WofE predictive model classified the landscape surrounding site 45PC196 as a high-probability landform (Figure 8). I identified the pre-contact site 45PC196 (Figure 9) while surveying the southern shore of the mouth of the Willapa River, and have been periodically monitoring the site over a five-year period documenting the artifacts that erode from the shoreline beach. Site 45PC196 has yet to be radiocarbon dated, but the site most likely sunk into the tidal zone during the AD 1700 earthquake and tsunami event (Atwater 1987; Atwater et al. 1991).

Site 45PC196 is most likely the pre-contact village of Que-lap′ton-lilt (Curtis 1911, 1913; Ray 1937; Spier 1936; Swan 1857; Swanton 1952; Wessen 2008), and the historic location of Captain Charles Stewart's house (Swan 1857: 211; 1856 GLO survey map, BLM 2014). Ethnographic data suggests that the site location was likely occupied by "trilingual" Chinook, Salish, and Athabaskan families. Curtis' (1913) informant *Tlo'loh* (born in 1832) indicated the site "*Qĭláptĭhl*" (Wessen 2008), which refers to a type of grass (Curtis 1913:173), was the location of four houses under Chief Hli‘t. The sunken shoreline site's late pre-contact cultural materials appear to be eroding from a layer that corresponds to Atwater and Hemphill-Haley's "Y" soil group, and date to the period just prior to the AD 1700 earthquake and coseismic subduction event. A sample of the diverse tide-zone surface-collection assemblage of late pre-contact archaeological materials associated with Que-lap′ton-lilt Village (45PC196) is described in Chapter Seven and illustrated in Appendix C. The exotic blueschist club fragments, nephrite adze, and obsidian trade artifacts from the site are discussed in Chapter Seven.

There is a concentration of middle to late historic 1800's-era debris located at the south end of the Que-lap′ton-lilt Village shoreline site. These historic materials are likely associated with the occupation of Captain Charles Stewart (Swan 1857, 1856 GLO map, BLM 2014) during the last half of the 1800's. Bottle fragments, Chinese porcelain fragments, rusted iron fragments, lead fragments, coal, and some sparse brick debris are exposed on the beach and in the tide flats. Stewart's compound was likely damaged during the 1889 Potter Dike construction project.

The pre-contact component of the Que-lap′ton-lilt Village site (45PC196) consists of fire-cracked rock (FCR), chipped stone artifacts and debris, cobble tools, and ground stone artifacts. Artifacts are buried in an organic-rich soil under the pebble, sand, and silt beach, and are exposed as a deflated scatter extending across the silty off-shore tide zone. Artifacts were dispersed within a tidal-current and wave deflated sunken forest floor with in-situ eroded Sitka spruce root structures, fallen logs, limbs, and organic forest duff (Figure 10).

The 300-year old previously terrestrial forested terrace margin and saltwater estuary shoreline are washed by the tides twice a day, exposing new artifacts from the deflating "Y" soil horizon. The culture-bearing "Y" soil continues inland where it is buried under a sand and pebble beach. The site and "Y" soil layer are also presumably overlain by the historic 1889 Potter Dike and adjacent dairy field. The dairy field behind (east) the dike was likely partially in-filled with historic-era and early modern river-channel dredge-spoils, further capping potentially buried archaeological materials.

Figure 10. Overview of the 45PC196 shoreline with in-situ Sitka spruce roots and deflated cultural materials associated with an AD 1700 tidally inundated forest floor (View to the south).

In the tidally incised channel of Carruthers Slough (located north of the primary tide zone site area where the in-situ spruce tree roots are exposed) the buried "Y" soil layer consists of a thin, one to two centimeter thick, band of organic-rich material that appears to be a compressed forest floor duff with sporadic cultural lithic debris. Near the mouth of Carruthers Slough, and within the root exposure area of the site, the band of "Y" soil exposure consists of jet-black oxidized-pyrite stained conifer-cones, needles, and leafy debris that is eroding onto a bed of grey tidal clay "muck." Rust-orange oxidized iron root-cast concretions extend into the tidal clays. The catastrophically sunken 300 year old sulfate reduction stained organic-rich and culture-rich "Y" soil layer is capped by a sand and pebble beach deposit.

Middle Willapa River Valley Archaeological Sites

The Middle Willapa River Valley begins where the tidal influence of Willapa Bay ends, and our focus shifts from the sinking anoxic shorelines and silty tidal channels of the lowlands to the alluvial strath terraces of the Willapa River. The river-bank and channel within the Middle Willapa River Valley is much "cleaner" than downstream, as there is not a twice daily influx of tidal silts. The silty loam and sandy loam alluvial sediments of the Middle Willapa River Valley terraces are highly acidic and contain aggregates of iron oxides, but do not typically display a distinct eluviated E horizon typical of conifer forest spodosols. There are clay-rich illuviated B horizons typically buried between 40 to 60 cm below the surface in most "middle" and "upper" terrace landforms. Inceptisols and older mollisols appear to dominate the near-surface soil orders in the Middle Willapa River Valley. Distinct differences between the soils of the ethnographic prairies and terrace dairy fields that were presumably timbered prior to Euro-American settlement have not yet been recognized. Detailed sedimentological studies focusing on the history of fire in the ethnographic meadow areas would likely identify cultural maintenance patterns. The gross sub-surface shovel sampling techniques utilized by the Willapa survey team pragmatically focused on locating cultural materials and identifying soil horizonation. As previously discussed in Chapter Three, some Middle Willapa River Valley "middle" and "upper" alluvial terraces appear to be formed on Pleistocene-era tidal clay and silt marine terrace straths, as well as straths formed within the local indurated siltstone bedrock.

Burkhalter Dairy Willapa River Site (45PC173) and Mill Creek Willapa River Site (45PC182)

Not to be confused with the Youngs River region "Burkholder site" (35CLT31) (Minor 2004), or the Grays River "Burkhalter site" (45WK51) (Minor 1983), the Burkhalter Dairy Willapa River site (45PC173) is a prehistoric lithic debris and FCR scatter site located on the margin of a "middle" terrace landform adjacent to an extinct Willapa River meander channel. A century of plowing has smoothed the terrace facies slope of the "middle" terrace on which the site is situated (Figure 11). Fossiliferous CCS, indurated siltstone, and jasper artifacts and debris are exposed in the terrace's facies slope and on the lightly rolling terrace tread surface. The site overlooks a wide lower flood terrace and the mouth of Mill Creek Valley. The Mill Creek Willapa River site (45PC182) and the Taylor Field Willapa River site (45PC184) are visible from the (45PC173) site location. The Burkhalter Dairy Willapa River site (45PC173) appears be located at approximately the same "middle" terrace level as the Taylor Field Willapa River site (45PC184), and Newman Farm Willapa River site (45PC197), suggesting that they may be temporally related. These middle terrace sites are likely late Holocene in age and may potentially be 2,700 years old, based on formalized lithic artifacts that were held by Mr. Burkhalter which resemble materials from the approximately 2700 BP Forks Creek site (45PC175). There are historic-age oyster shell fragments mixed into some site sediments that were once used to stabilize muddy ground around a small barn that used to stand at the north end of the site area (Jack Burkhalter, personal communication June 2009).

Mr. Burkhalter brought the Mill Creek Willapa River site (45PC182) to my attention stating that kids used to collect "cigar boxes" full of pre-contact artifacts from the site area located on the tread's near-surface of a "middle" terrace landform above the Willapa River near the mouth of Mill Creek. The "middle" terrace association of the Mill Creek Willapa River site (45PC182) is not as clear as the Burkhalter Dairy site (45PC173), as discharge from Mill Creek has contributed to alluvial fan-like sediment accretion in addition to terraced deposits.

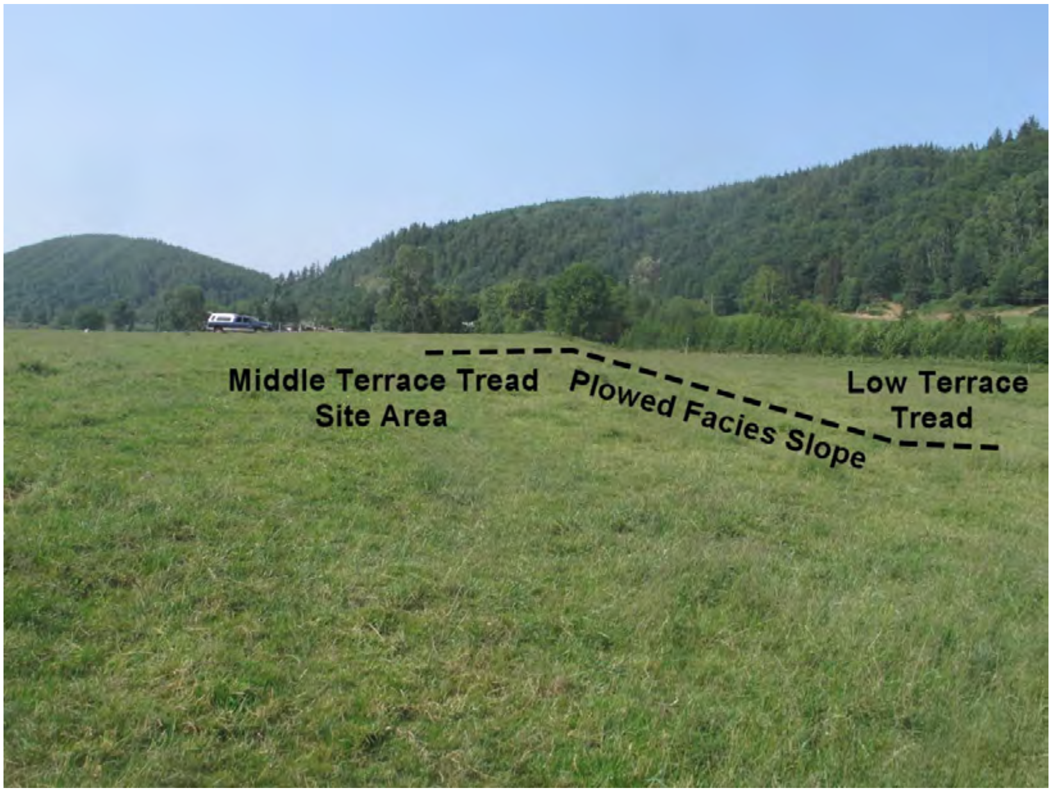

Figure 11. The Burkhalter Dairy Willapa River site (45PC173). View to the north.

Taylor Field Willapa River Site (45PC184) and Newman Farm Willapa River Site (45PC197)

The Taylor Field Willapa River site (45PC184) is a prehistoric lithic debris scatter located on a "middle" terrace adjacent to an extinct meander channel of the Willapa River. The site contains a sparse assemblage of chalcedony flakes as well as flakes and cores of indurated siltstone. While no formalized tools have been located at the site, the terrace is at approximately the same elevation as the Burkhalter Dairy site (45PC173).

The Newman Farm Willapa River Prehistoric site (45PC197) is a lithic flake and thermally-altered cobble scatter located on the eroding edge of a mid-level terrace of the Willapa River. Indurated siltstone and chalcedony artifacts are eroding from the terrace slope. The site terrace is approximately 3.5 meters higher than the next lower terrace, which was partially flooded during the 2007 and 2008 "100-year" flood events. The site terrace was not flooded during these events. Flakes were located eroding out of the terrace slope, likely from within the top one-meter of sediment. There are large old trees growing on the terrace edge north of the site area, suggesting at least a century of terrace edge stability.

The Mill Creek Kudasik Projectile Point Isolate (45PC222)

The Mill Creek Kudasik projectile point isolate (45PC222) is a large obsidian stemmed projectile point with slightly convex margins, rounded shoulders, and a rounded stem base. The large stemmed projectile point (Figure 12) is manufactured from semi-translucent black obsidian with faint internal "swirled-ribbon" banding of black to grayish black color-variation. The obsidian may have a very slight greenish-black tint. The obsidian artifact appears to have a light patina, displaying a slightly resinous luster, and generally has matte surface texture. Portions of the blade and stem margin exhibit flake scars with a slightly more vitreous luster. Using X-ray fluorescence (XRF) trace element characterization techniques, the obsidian was sourced to Obsidian Cliffs, Oregon (NWROSL BO-13-56, Kudasik01, Mill Creek; Appendix D). The location where the projectile point was found has been heavily disturbed by roadway construction and landscape development.

The Mill Creek Kudasik obsidian projectile point isolate is similar to forms associated with the "Western Stemmed Point Tradition" (Beck and Jones 2010), the "Lind Coulee Tradition" (Daugherty 1956), the "Cooper's Ferry Cache" (Davis 2001; Davis and Schweger 2004), and even the recently identified stemmed projectile point forms from the Paisley Caves in Oregon (Jenkins et al. 2013). The obsidian projectile point could date to the Late Pleistocene or Early Holocene, and may be representative of the technology utilized in the Willapa region during the approximately 11,000 to 9,000 year period of alluvial terrace formation in the Coast Range and Olympic Mountains coastal valleys (Personius et al. 1993; Schanz and Montgomery

2013; Wegmann and Pazzaglia 2002). The obsidian projectile point could conversely represent a Middle to Late Holocene “status blade” that was exchanged as part of a Columbia River trading network. Large biface knives of this sort are “lightly” represented in Marpole Phase assemblages within the Salish Sea region. Chatters et al. (1990) have remarked on the similarities of Puget Sound region Marpole Phase biface tools to Olcott Phase artifacts, and suggested that long-term retention of lanceolate biface technology has complicated the process of creating western Washington projectile point chronologies. Given that this projectile point may reflect an early occupation of the Willapa River Valley, a brief description follows.

The projectile point has a maximum length of 117.9 mm, a maximum width of 32.5 mm, and a maximum thickness of 9.6 mm. The projectile point stem has a maximum shoulder width of 32.4 mm, a basal-shoulder width of 18.7 mm, and a maximum stem length of 24.6 mm. The projectile point weighs approximately 32.88 grams (including <0.5 grams of bituminous tar flecks adhering to one surface). The projectile point exhibits collateral flake scars that appear to be made from either percussive soft-hammer technique or from large-flake pressure flaking. There are some small shaping pressure-flake (or micro-flake) scars on the tool form margin. The smallest flake scars are present on the rounded base of the stem and stem shoulders. There is no significant hafting-related edge grinding on the stem margin or stem base, though magnified examination of the artifact margin revealed that edge grinding was employed as part of the manufacturing process. The tip of the projectile point (the proximal 39 mm) had been re-sharpened (marginal narrowing coupled with reduction in flake size) in the distant past. There are no distinct differences in patina between the artifact’s tip and base.

Figure 12. The Mill Creek Kudasik obsidian projectile point (45PC222).

Martin Dairy Willapa River Site (45PC180) and Zieroth Dairy Lilly Farm Site (45PC186)

The Martin Dairy Willapa River site is a pre contact campsite located on a “middle” alluvial terrace landform situated at the base of an “upper” alluvial terrace landform (Figure 13). The west edge of the “middle” terrace dairy field is a steep sediment-cliff facies that is being slowly incised by a wide meander-bend of Willapa River far below. No lower flood terrace exists directly west of the “middle terrace,” but there is a “low” flood terrace south of this site, on the opposite side of an ephemeral drainage. The low terrace to the south appears to be part of an extinct ox-bow channel of the Willapa River that has been subject to multiple flooding planation events.

Pre-contact fossiliferous CCS, siltstone, jasper, basalt, and obsidian lithic materials are present on the plowed tread surface of the “middle terrace,” and are eroding downs the facies slope into the drainage and Willapa River. The site is located where cows move between the floodplain "low" terrace and the "middle" terrace site area. The site consists of a sparse lithic debris and tool scatter with cobbles and fire-modified rock. Projectile points, bifaces, scrapers, cores, and FCR are eroding out of the high terrace bank. A black translucent obsidian stemmed projectile point (Figure 14) that I found eroding down the facies slope of the 45PC195 terrace was provenienced to Obsidian Cliffs, Oregon using XRF trace element characterization techniques (NWROSL 45PC186 Specimen 1, Cat.1). While the obsidian stemmed projectile point resembles Early Holocene technology, the "middle" terrace context is suggestive of a Late Holocene occupation no more than perhaps 2,700 or 3,000 years old. The obsidian projectile point measured 48.9 mm long, 16.7 mm wide, and 5.9 mm thick. A small fragment of polished slate-like material observed in the same slope erosion context is also suggestive of Late Holocene occupation. Archaeological excavations were planned at site 45PC180, but have not yet been initiated.

Figure 13. Martin Dairy site (45PC180) on the "middle" terrace. View to the northwest.

Figure 14. Martin Dairy site (45PC180) obsidian (Obsidian Cliffs, OR) projectile point.

The Zieroth Dairy Lilly Farm (45PC186) is a pre-contact, ethnographic, and early historic site located on a terraced point bar of the Willapa River west of the Marin Dairy site (45PC180). The point bar appears to have at least two stable "middle" terraces as well as a "low" flood terrace. There is a clay enriched B Horizon within both the Zieroth and Martin middle terrace fields. Our work at Forks Creek site (45PC175) suggests that similar clay-rich horizons can form in 2700-year old local alluvial terrace sediments.The highest ground in the site area appears be at the same terrace level as the Martin Dairy site (45PC180). Obtaining radiocarbon assays from "middle" and "upper" terraces in the vicinity of these sites is a future goal of this project. Radiocarbon dates from the Upper Willapa River Valley Forks Creek site (45PC175) (Chapter Five) suggest that "middle" terrace cultural occupations extend to at least 2700 years BP.

The Zieroth Dairy Farm property is the location of the historical Lilly family homestead, a farm where family memoirs record the presence of a significant mid 1800's Native American camp (Bullard 1974). The 45PC186 surface finds consists primarily of robust projectile points with corner notched haft elements, lanceolate form bifaces, and "*skreblos*" biface knives (Figure 15). Scrapers, lithic debitage, pestles, ground stone, and fire cracked rock, have also been identified at the site (Figures 15 and 16). The pre-contact lithic artifacts from the 45PC186 collection assemblage are likely associated with a Middle to Late Holocene occupation.

The metric attributes of chipped stone tools from the Lilly Farm site (45PC186) are presented in Table 2. The artifacts were held near the site as part of the Zieroth Family plow zone collection. The artifacts in the site collection suggest a diversity of processing activities occurred in addition to processing elk and salmon as indicated by the ethnographic report.

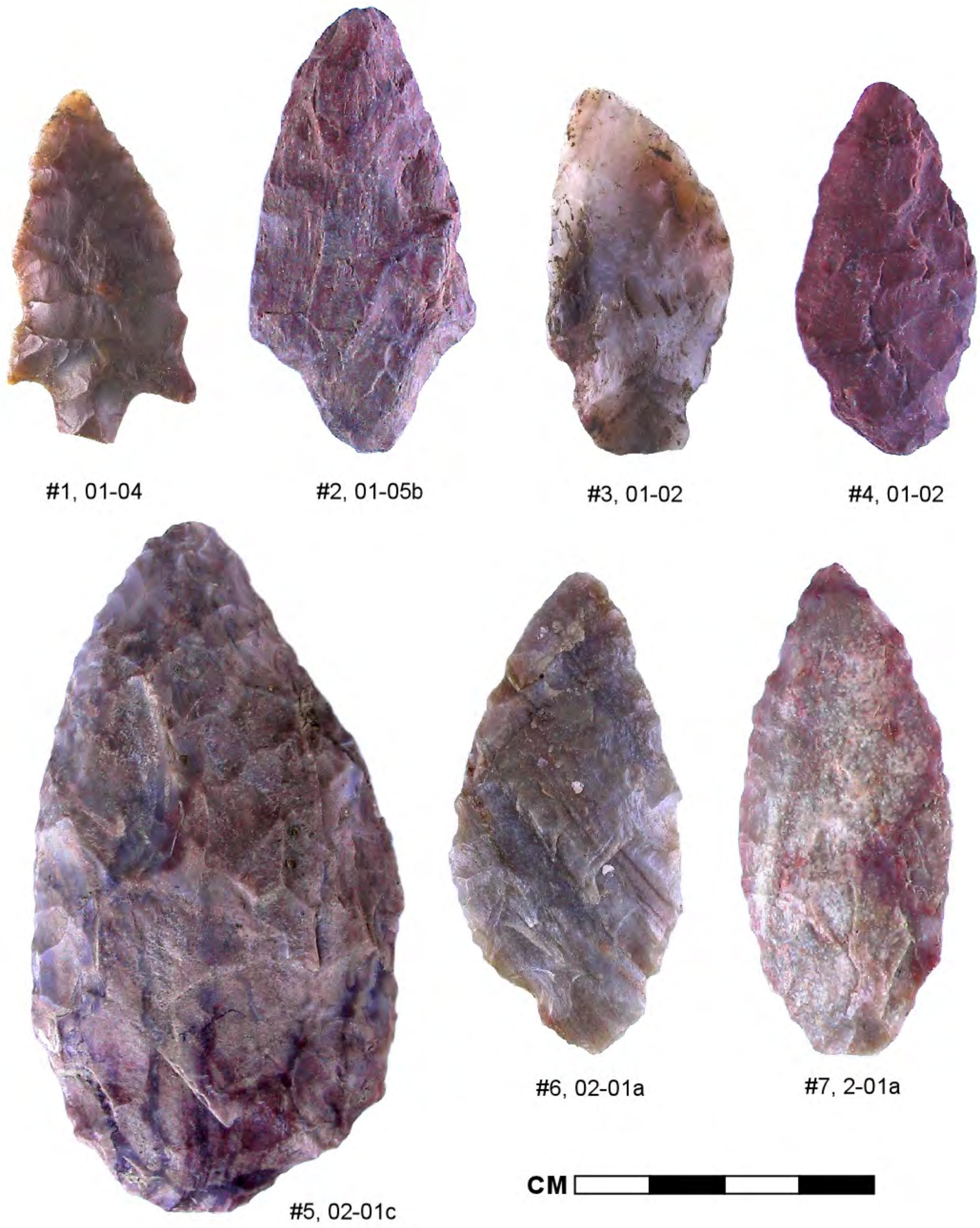

Figure 15. Projectile point and biface knife artifacts from the Lilly Farm site (45PC186).

Figure 16. Ground stone artifacts from the Lilly Farm site (45PC186).

Table 2. Metric Attributes of Lilly Farm Site (45PC186) Chipped Stone Artifacts.

Artifact #	Type	Length, mm	Width, mm	Thickness, mm	Neck Width,	Material
Zieroth #1	01-04	48.42	25.37	6.08	11.09	Misc. CCS
Zieroth #2	01-05b	59.15	30.22	9.08	16.28	Misc. CCS
Zieroth #3	01-02	50.15	26.9	10.7	16.39	Fossil CCS
Zieroth #4	01-02	54.85	23.27	8.3	15.01	Jasper
Zieroth #5	02-01c	92.78	49.7	13.9	-	Banded CCS
Zieroth #6	02-01a	64.00	30.54	12.63	-	P. Wood
Zieroth #7	02-01a	64.07	29.6	9.2	-	Misc. CCS

While small triangular shouldered and barbed projectile points have been found in the surrounding landscape, the Lilly Farm site lithic assemblage is dominated by larger stemmed and corner notched projectile points, and lanceolate bifaces that could have served as projectiles or knives. Most of the chipped stone artifacts were thinned and shaped with fine pressure flaking, but no distinct patterned pressure flaking was evident on the tool forms. Few of the artifacts in the family plow zone surface collection were manufactured of indurated siltstone materials, despite cobbles of the material readily available in the local gravels of the Willapa River. Sharp-tipped and thin lanceolate-form bifaces from the site (Figure 15, #6 and #7) could have easily served as projectile points for hunting elk, deer, and possibly even the occasional seal following fish above the tide zone.

The Martin Dairy and Zieroth Dairy Lilly Farm localities yielded several significant ethnographic period artifacts that illustrate the Willapa peoples' use of Euro-American global-trade network materials to produce traditional technologies and art. These materials consist of an incised-bone "black" *lahal* game piece with cork and nails (Figure 17), and a projectile point manufactured from Chinese export porcelain (Figure 18).

The ethnographic period projectile point manufactured from Chinese export porcelain appears older than mid-19th century Canton ware trade porcelain. The Lilly Farm site (45PC186) porcelain is similar to the Chinese export porcelain recovered from the Nehalem, Oregon assemblage (Woodward 1986), and may represent late 17th century Kraak Chinese porcelain (Bob Cromwell, Scott Williams, and Jessica Lally Tuning, personal communications February 2011). The projectile point porcelain paste is off white in color with fine inclusions. The exterior is hand painted with blue glaze, displaying a cloud motif on one side and a running pattern on the opposite face. The porcelain, blue glaze, and clear glaze are completely bonded and display no layer separation. The porcelain fragment may have been part of a ginger jar, or other large piece, rather than a small dish or bowl. The porcelain projectile point is flat, except for the edges where it has been bifacially pressure flaked to create the distinct form. The projectile point is symmetrical, with slightly convex blade margins. The base is corner-notched to form a thin hafting stem with a convex stem base. The pressure flake scars do not travel across the face of the projectile point, as the maker likely wanted to preserve the thin decorative glaze designs on the tool face. The projectile point is 48.25 mm long, 14.08 mm wide, 4.25 mm thick, and has a neck width of 6.30 mm. Other examples of flaked Chinese porcelain projectile points have been found associated with the Beeswax Wreck site at Nehalem Beach (Woodward 1986).

Figure 17. *Lahal* "black" game piece from the vicinity of Lilly Farm site (45PC186).

Figure 18. Chinese porcelain projectile point from the vicinity of the Lilly Farm site (45PC186).

Wildhaber Terrace Edge Site (45PC211) and Wildhaber Field Sites (45PC212 and 45PC213)

The three Wildhaber sites are concentrations of prehistoric lithic tools (projectile points, scrapers, debitage, cobble spalls, and fire cracked rock) located on the western “upper” terrace of the Willapa River Valley. The Wildhaber Field sites (45PC212 and 45PC213) are “centrally” located within an agricultural plowed terrace field and may be related to the seemingly larger prehistoric Wildhaber Terrace Edge site (45PC211; Figures 19 and 20). Artifacts from the 45PC211 and 45PC212 on-site family collection are illustrated in Figure 21. The metric attributes of the illustrated chipped stone artifacts are presented in Table 3. The Terrace Edge site (45PC211) is located approximately 400 meters northeast of the field loci near the edge of the “upper” terrace facies slope to the Willapa River. The 45PC211 chipped stone and percussive/ground stone artifact assemblage is eroding from the plowed terrace surface and steep exposure descending to the Willapa River. A moderate-sized scatter of local siltstone, fossiliferous CCS, and red/orange jasper flakes are present on the plowed terrace tread surface. I identified a single multidirectional chert core, a split elongated pebble with possible edge polish, and a unifacial petrified wood end scraper (type 03-03) on the surface of the site.

The Wildhaber Terrace Edge site (45PC211) is within the alluvial terrace tread of the “upper” terrace landform on the west side of the Willapa Valley (Figures 19 and 20). At the base of the “upper” terrace landform, south of the site, is a meander-bend eroded bedrock channel wall that likely represents an exposure of the strath upon which the upper terrace has been preserved. The opposite side of the Willapa River from the site is a “low” terrace subject to frequent flooding. The “upper” terrace landform could potentially contain deeply buried archaeological sites that extend in age to the Middle or Early Holocene, but such early prehistoric archaeological sites have not yet been definitively identified or dated on the landform.

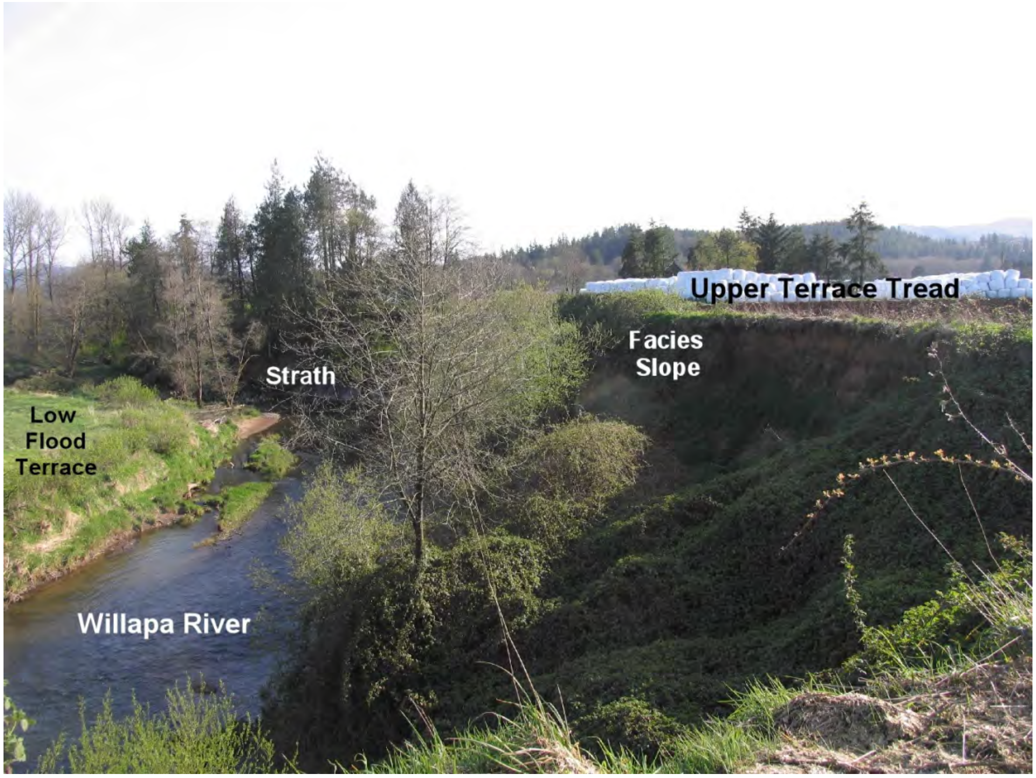

Figure 19. Wildhaber Terrace Edge site (45PC211) “upper” terrace. View to south-southwest.

Figure 20. Wildhaber Terrace Edge site (45PC211) on the “upper” terrace. View to the north.

Figure 21. Wildhaber Field sites 45PC212 and 45PC213 “upper” terrace lithic artifacts.

Table 3. Metric Attributes of 45PC212 and 45PC213 Chipped Stone Artifacts.

Artifact #	Type	Length, mm	Width, mm	Thickness, mm	Neck Width, mm	Material
Wldhbr #1	01-06a	48.0	25.3	8.5	-	Misc. CCS
Wldhbr #2	01-05b	56.1	29.4	9.5	6.5	Fossil CCS
Wldhbr #3	01-02	32.3	18.4	6.5	13.0	Misc. CCS
Wldhbr #4	01-02	41.2	21.2	9.0	12.2	Obsidian
Wldhbr #5	02-01a	69.2	38.2	9.3	-	Fossil CCS
Wldhbr #6	02-01a	66.7*	35.6	7.2	-	Basalt
Wldhbr #7	02-01a	61.0	40.0	17.0	-	Siltstone
Wldhbr #8	02-01a	42.0	20.7	9.6	-	P. Wood
Wldhbr #9	02-01a	43.2	24.0	9.0	-	Fossil CCS
Wldhbr #10	03-18	36.1	20.5	8.1	-	Misc. CCS
Wldhbr #11	03-08	30.6	29.7	7.8	-	Misc. CCS

Robust shouldered and notched projectile points, ovate and lanceolate bifaces, and scrapers are represented in the Wildhaber Field 45PC212 and 45PC213 sites collection (Figure 21). A black semi-translucent obsidian shouldered projectile point (Figure 21, #4, 01-02) from 45PC212 was provenienced with XRF techniques to Obsidian Cliffs, Oregon (NWROSL 45PC212 Specimen 14, Cat.1). This thick projectile point has a large 12.2 mm neck width and is likely a variant of the “Columbia Corner-notched” form (Lohse and Schou 2008). A second similar projectile point from the site (Figure 21, #3, 01-02) also exhibits a large neck width of 13.0 mm.

One biface from the Wildhaber Field sites collection (Figure 21, #9, 02-01a) exhibits differential marginal re-sharpening between the reduced tip and once-hafted minimally altered base ovate. It is possible the artifact was a projectile point with a non-symmetrical stem, and not a maintenance-reduced hafted biface knife tool. The fossiliferous CCS biface (Figure 21, #9, 02-01a) is typical of Willapa ovate biface forms manufactured from fossilized clam cores. Its size and shape are very similar to the size and shape of fossilized clams known to be abundant in the gravels of the Green Creek.

There is a large andesitic-basalt “leaf-shaped” biface fragment (Figure 21, #6) in the 45PC212 and 45PC213 collection. Artifacts from both localities are held together “on-site” without differentiation by the Wildhaber Family. The basalt biface fragment displays a heavy patina that may be indicative of significant age. The form of the artifact is consistent with 10,000 to 8,000 year old “Cascade” and “Olcott” technologies in the Pacific Northwest. The landform context of the “leaf shaped” biface fragment, located on the plowed tread of the “upper” terrace of the Middle Willapa Valley, may also be suggestive of an age that extends to the Early Holocene. The artifact has several modern edge-damage flake scars consistent with battering from a plow. The artifact’s modern plow-scars are dark-grey, while the remainder of the pre-contact flaked artifact body is light-gray with a distinctly different and degraded patina (Figure 21, #6, 02-01a). Local calcic-indurated siltstone flakes and artifacts degrade at an accelerated rate in the Willapa River Valley’s acidic sediments, but the silicate-rich andesitic-basalt material is quite hard and is somewhat resistant to patination. Andesitic basalt artifacts found in local Late Holocene salt-water tide zone and beach contexts usually have not developed any significant patinas and have sharp distinct flake scars (under a film of biotic algae). The andesitic basalt is likely from local Crescent Formation exposures in the Palix River and Fall River watersheds.

Oxbow Breach Site (45PC214)

The Oxbow Breach site is a pre-contact camp with a lithic tool and debris scatter. The site is located on a "middle" terrace landform of the Willapa River within an agricultural field. There is a "low" flood terrace below the site adjacent to the Willapa River that does not appear to have artifacts. The pragmatic utility of the "folk wisdom" site location model in the Valley is apparent at this location, as the artifact-rich "middle" terrace has distinctly "brown" soil, while the "low" flood terrace without artifacts has "red" soil.

I observed approximately sixty-five CCS, siltstone, jasper, and basalt lithic flakes and ten battered/ split river cobbles on the terrace tread surface. Additionally, I located an indurated siltstone multi-directional core, a milky white translucent CCS scraper with multiple convex lobes, and a gray/purple biface base fragment. The scraper had multiple steep-angle unifacially pressure flaked "lobes" around its margin, creating an undulating scraper edge with both concave and convex segments.

There is an approximately 10 to 12 meter high clean cut-bank exposure located south of the site across the Willapa River (Figure 6). The basal layers of the cut bank appear to be ancient meso-tidal estuary point-bar deposits that I believe are associated with the 150-foot elevation, 125,000 year old Pleistocene high stand marine terrace (Ardoin 2002). Modern stratigraphy similar to these deeply buried cross-bedded clay deposits has been described by D.G. Smith (1987) in the Willapa River's meso-tidal zone near Raymond, WA. The basal sediment bed is gray clay, similar to the sticky massive gray clay beds one encounters near the Willapa River mouth. These ancient compact tidal sediments are thought to represent a strath upon which Holocene alluvial sediments have formed terraces.

Middle Willapa River Valley Pre-Contact Isolates

The Kaech Oxbow Biface Isolate (45PC233) was found on a “middle” terrace landform located southeast of the distinct “Oxbow Road” meander of the Willapa River. The biface is notable because it is large, and has unusual haft-element notches situated high on the basal blade margins, creating a slight “turkey tail” form (Figure 22). The notches are similar to those from the ethnographic and early historic status obsidian blades found in northern Californian cultures (Rust 1905). The notches on the Californian obsidian status blades were likely used to tether the blades to the wrists of their bearers with cordage. Similarly styled notches are present on the “Black Lake biface,” a large biface recovered in the vicinity of Olympia, Washington (Croes et al. 2008). The Kaech Oxbow biface is much smaller at 91 mm long, 40 mm wide, and approximately 6.5 mm thick. The biface is 32.2 mm wide between the “tether notches.” The tan, brown, and orange biface is made out of CCS that may be petrified wood.

The McAllister Willapa River Projectile Point Isolate (45PC181) consists of a single milky white semi-translucent fossiliferous chalcedony corner-notched projectile point. The Waldref Willapa River Flake Isolate (45PC185) consists of a single milky white semi-translucent chalcedony flake. The isolated flake is unremarkable save for its context. The flake is located on a “middle” terrace adjacent to an extinct Willapa River channel.

The Martin Dairy Willapa River Biface Isolate (45PC178) consists of a single non-symmetrical ovate-lanceolate biface made from tan, orange, and red jasper that is locally available. The Martin Dairy Willapa River Projectile Point Isolate (45PC179) consists of a single fragmented corner notched projectile point made from translucent white and orange fossiliferous chalcedony. These isolated artifact surface finds are likely related to the nearby larger sites.

Figure 22. The Middle Willapa River Valley Kaech Oxbow biface (45PC233).

Upper Willapa River Valley Archaeological Sites

The Upper Willapa River Valley extends upstream from a distinct bend in the valley where Trap Creek and Forks Creek merge with the Willapa River from the south. The Upper Willapa River Valley is smaller and steeper than the valley below. The river does not form wide meander paths, tending to flow insted within a channel that is often incised into siltstone or sandstone bedrock. Distinguishing between the “middle” and “upper” terrace landforms in the Upper Willapa River Valley is quite easy in some places, such as the vicinity of Globe Field or Forks Creek, but is much more difficult in other locations; particularly in the uppermost reaches where there are many small feeder creeks and side-canyons merging into the valley. An overview photograph of the “upper” alluvial terrace (opposite Trap Creek) within the Upper Willapa River Valley is illustrated in Figure 23. The Upper Willapa River Valley is less commercially developed than its lower reaches and more of the landscape is still forested. Few of the ridge-crests, mid-slope benches, or spring areas in the Willapa River’s mountainous headwaters have been professionally surveyed. The Washington Department of Natural Resources has been actively making advances in recording historic logging and railroad sites within the forested uplands of the Willapa Hills. There are historic Elk hunting camps and trail systems in the forested uplands of the Willapa Hills that are likely residual features of pre-contact occupation. These remote upland locations, and many others, still need to be explored.

The upper Willapa River Valley is similar to the Upper Chehalis River Valley where Welch (1983, 1970) focused her research efforts. The Willapa River Valley uplands receive slightly more rainfall than the Upper Chehalis River Valley, being on the Pacific slope of the Willapa Hills, but otherwise the two watersheds have similar environmental and archaeological contexts. Welch located numerous large Early Holocene style lanceolate and stemmed projectile points in the Upper Chehalis River Valley, and identified a Middle to Late Holocene utilization of microblade core and microblade technology in upland archaeological assemblages.

Figure 23. “Upper” terrace landform in the Upper Willapa River Valley. View to the south.

Smith Field Willapa River Site (45PC231)

The Smith Field Willapa River site (45PC231) is “middle” terrace site located in the transition zone between the Lower and Upper Willapa River Valley. The sparse scatter of lithic debris, lithic tools, fire cracked rock, and cobble tools was identified in the isolated plowed dairy field east of the Willapa River. The Willapa survey team located a jasper scraper (type 03-01), and a siltstone scraper (type 03-03) at the “middle” terrace landform site. The terrace landform is likely at least 2700 years old. The Smith Field site is likely related in age to the Forks Creek site (45PC175).

Forks Creek Willapa River Site (45PC175)

The Forks Creek Willapa River site is an approximately 2700 year old camp located on a "middle" terrace landform immediately upstream from the juncture of the Willapa River and Forks Creek- an area known locally as a good fishing spot. There are many pebble and cobble-eroded *kolk* bowls and pockets in the siltstone bedrock channel of the Willapa River in the vicinity of the site. There are older "upper" terrace alluvial landforms located south and southwest of the 45PC175 landform (Figure 5). The pre-contact locality was a summer camp where hazelnuts were roasted, and salmon, elk, and deer were procured and processed. The Forks Creek Willapa River site (45PC175) and the Forks Creek Pit site (45PC40) were both likely seasonal camps for families that maintained and utilized the resources of the Forks Creek Prairie (Figure 3) while also engaging in faunal procurement and processing. This important pre-contact site has been the focus of the Willapa project's archaeological excavation efforts. A complete and detailed description and analysis of the site's context and content is presented in Chapter Five of this report.

Mr. Dale Rutherford (personal communication July 2013), whose father became the manager of the Forks Creek fish hatchery in the mid-1920s, said that he remembers the Forks Creek site (45PC175) area as being an agricultural field in the middle 1930s. Mr. Rutherford said that the "old-timers" told him the old Willapa wagon trail from Boistfort and Lebam descended into the Forks Creek Valley through a notch in the hills in the NE1/4NW1/4, Sec. 5, T12N R7W WM, and passed through "Forks Prairie" on the east side of Forks Creek. There was a farm in Forks Prairie in the vicinity of the modern Portmann Dairy that offered lodging and supplies to wagon travelers. The trail crossed to the west side of Forks Creek, and followed Forks Creek north to its juncture with the Willapa River, west of site 45PC175 and north of the

Forks Creek fish hatchery. At the mouth of Forks Creek, the wagon trail crossed the incised siltstone bedrock channel of the Willapa River and ascended a dangerous road-cut up the steep slope to the crest of the ridge north of the river. The trail descended again to the upper reaches of the Middle Willapa River north of the significant river bend. The wagon road cut is still visible on the slope.

The wagon trail ascended the ridge across from the mouth of Forks Creek because there were several landscape barriers located between Forks Creek and Trap Creek (the boundary region between the Middle and Upper valley) that have subsequently been eliminated in modern times by railroad and roadway construction. Outcrops of McIntosh Volcanic series basaltic sandstone (Moothart 1993) at the Willapa River bend formed a steep canyon that was impassable by wagons. The southern overland route bypassing the cliffs was not ideal. Prior to construction of the railroad grade and modern roadway, the Willapa River merged with Trap Creek far up the Trap Creek valley from its present location.

Mr. Rutherford indicated that the 45PC175 site area was a dairy grass meadow that had not experienced significant disturbance, other than plowing, since he could remember in the middle 1930s. He has been locating artifacts at the site area since childhood. He indicated that there was a log chute (to deposit and float logs into the Willapa River) and log pond located just upstream from the site area in the 1930s, but that the flooding and logging disturbance did not impact the site's terrace tread. It has apparently been a productive dairy field since the homestead era. Mr. Rutherford indicated that many hundreds of dead salmon from the hatchery had periodically been dumped onto the field and plowed into the soil; he was interested to learn that we had not located any fish vertebrae in our testing. The acidic sediments quickly destroy even modern-era bone.

Forks Creek Pit Site (45PC40)

Originally recorded as a "salmon roasting pit" by Harold Nelson in 1965, the Willapa survey located a pre-contact lithic artifact and debris scatter at the site location, but no evidence of the pit, or concentrations of FCR, have been located after multiple visits. The survey team visited the site location with local informants who had observed the pit on multiple occasions over the past twenty years, but the pit reported in 1965 has still not been positively re-identified. The site was well known in the 1970s. Local informants variably described the feature as a "lodge," a "platform," and a "pit." The storm of 2007 dislodged trees and changed the surface of the site area. There is now a dense thicket of blackberry covering much of the site area- likely obscuring the reported depression. This survey located a fossiliferous CCS shouldered projectile point with a contracting stem (type 01-10), and a jasper scraper (type 03-01) on the surface at the 45PC40 site location. Similar artifact forms are present at Forks Creek Willapa River site (45PC175). The two sites appear to be located on approximately the same "middle" terrace level, though are on opposite sides of Forks Creek and at least 460 meters apart. There is an "upper" alluvial terrace located west of Forks Creek Pit site (45PC40) that has only been partially surveyed by the team. Other related "upper" terrace remnants are present downstream above Trap Creek (Priest Family), and on the opposite side of the Willapa River on Department of Natural Resources (DNR) managed land (Figure 23). Upper Willapa River Valley informants have indicated that archaeological materials were located in the "upper" terrace tread margin of the DNR managed landform in the 1950s. Sub-surface testing on this "upper" terrace margin is one of the future research goals of the Willapa survey.

Delanoy Forks Creek Site (45PC174)

The Delanoy Forks Creek site is a prehistoric lithic scatter that likely represents a seasonal camp. The site is located on a "middle" terrace of Forks Creek, at the foot of an "upper" alluvial terrace. The site is located near an old wagon trail described by Mr. Rutherford. Like sites 45PC40 and 45PC175, the Delanoy Forks Creek site (45PC174) was likely oriented towards the floral and faunal resources of Forks Prairie, and the salmon of Forks Creek.

Artifacts and debris associated with the site were located on the surface, within molehill piles, and below a terrace facies road-cut. The site sediments consist of silty loam alluvium with pebbles and cobbles. The 2007 winter floods completely inundated the "low" terrace immediately below the site area and flooded much of the plowed field located west of the site. It is likely that Forks Creek flood events have washed much of the site away. The local landowner described multiple flood events in the lower field over the past 50 years.

Camenzind Lebam Willapa River Site (45PC198)

The Camenzind Lebam Willapa River site (45PC198) is one of the few localities surrounding the community of Lebam that has been surveyed by this project. The pre-contact camp site is on an "upper" terrace landform north of the Willapa River. In this stretch of the Upper Willapa River Valley, the Willapa River channel follows a straight path along the south side of the valley at the base of a bedrock slope. The sediment discharge from Half Moon Creek, located just upstream of site 45PC198, may have contributed to the formation of the "upper" terrace in the vicinity of Lebam, WA. Fire cracked rock, and lithic debris are scattered along the margin of the "upper" terrace. Large and small projectile points, an ovate biface knife, and a fragmented cobble wedge or adze from the "upper" terrace site are illustrated in Figure 24.

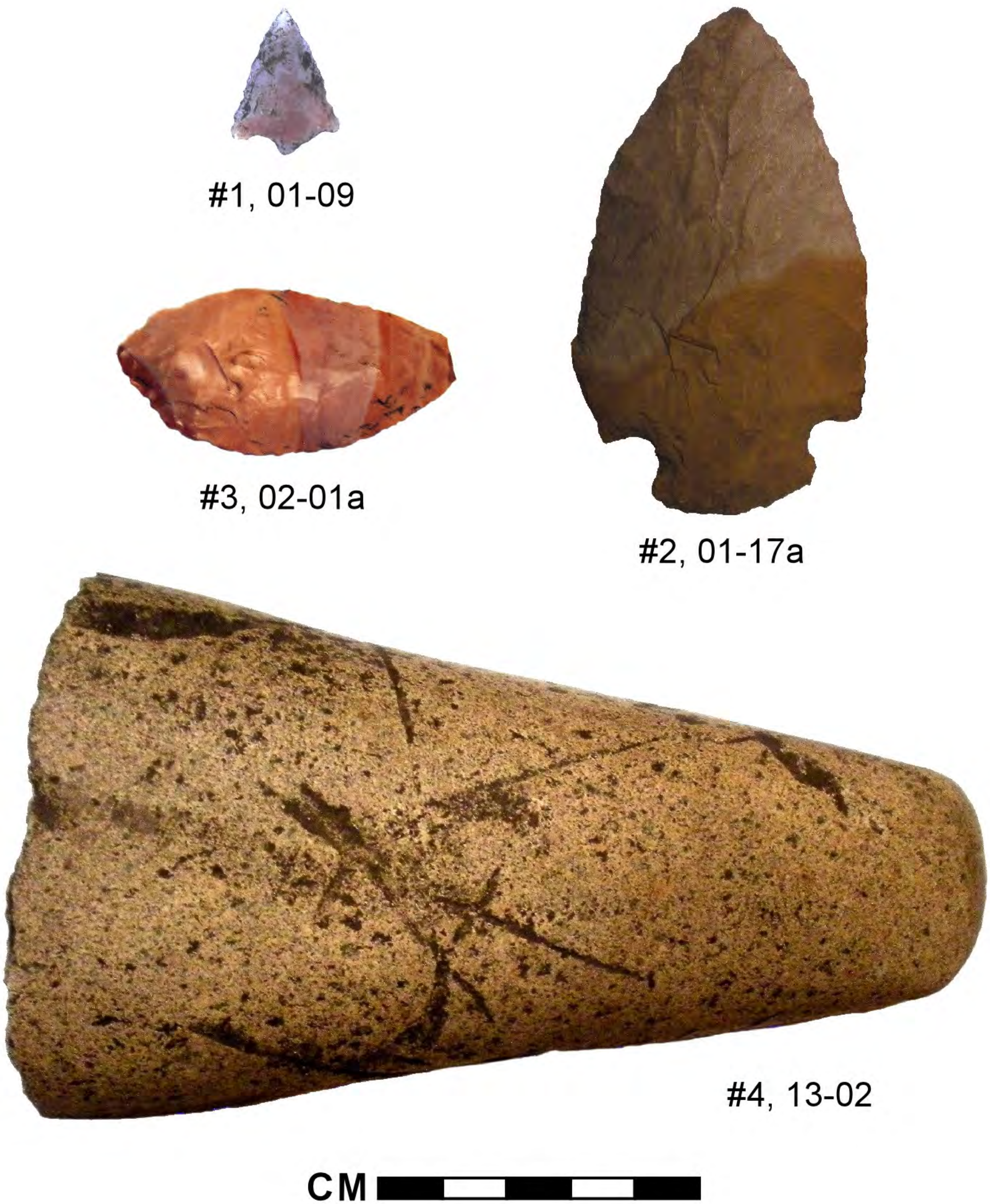

Figure 24. Artifacts from the Camenzind Lebam Willapa River site (45PC198).

Globe Field Site (45PC176)

The Globe Field site consists of multiple pre-contact artifact and debris scatters located on the “upper” and “middle” terrace of the Willapa River. The upper terrace of Globe Field is likely the same upper terrace landform that was dated to approximately ten thousand years ago by Schanz and Montgomery (2013). Globe Field has been visited by local artifact collectors for many decades. Local Upper Willapa River Valley informants have described the amateur excavation of a significant prehistoric cultural feature on the site’s middle terrace landform more than 50 years ago. The feature was described as a four to five foot deep “inverted cone” of black stained soil and charcoal with flakes and tools. The feature was likely an oven or roasting pit.

A large indurated siltstone biface knife (Kaech Family collection) was located on the “upper” terrace at the north end of the site (Figure 25). The large biface has developed a significant patina, with the arises of the bifacial flake scars eroded to smooth contours, rather than sharp delineated ridges. The artifact has been etched by acidic sediments. While such acidic patination is suggestive of significant age on a basaltic artifact, such as on the leaf-shaped biface from the Middle Willapa River Wildhaber Field sites (45PC212 and 45PC213) (Figure 21, #6), the degradation of indurated siltstone can occur quickly in acidic sediments of the Willapa River Valley. The Globe Field Kaech Family biface (Figure 25) is likely a late Holocene artifact, but could represent an earlier tool that somehow escaped the acids of the valley. At the 2,700 year old Forks Creek Willapa River site (45PC175), the team encountered many fully-disintegrated indurated siltstone cobbles associated with occupation layers. The once solid indurated siltstone cobbles can quickly become soft dark oxidized pyrite-stained “ghost cobbles as part of a post-depositional process.

Figure 25. The Globe Field site (45PC176) indurated siltstone biface.

Globe Field site (45PC176) has great potential for additional archaeological discoveries. There is a bog-like area located in the northwest corner of the site area on the “upper” terrace that needs to be investigated further. The high terrace of the Globe Field site (45PC176) is the type of landform that Jeanne Welch (1983) specifically notes as being heavily utilized by pre-contact cultures in the Upper Chehalis River Valley region.

The Globe Field biface (Figure 25) is likely too big to be part of a projectile hunting system. The large biface could have been part of a long spear or a “dagger” like tool. Daugherty (1987a, 1987b) suggests that large Middle to Late Holocene bifaces at southwest Washington sites may represent animal “dispatching” dagger-like implements. I suspect that the Globe Field biface (Figure 25) was manufactured large as an expressive symbol of skill and prestige to display while dancing and feasting, rather than being manufactured for a specific resource-related task requiring a giant stone dagger.

Swiss Scatter Willapa River Site (45PC183)

The Swiss Scatter Willapa River site (45PC183) consists of a large scatter of prehistoric lithic debris and tools on the tread surface of an agricultural field near the juncture of Fern Creek and the Willapa River. The site, situated just downstream of Elk Prairie, likely represents a large upland camp. The dairy field site location is likely a “middle” or “upper” terrace landform. There does not appear to be a local alluvial terrace of higher elevation than the one on which site 45PC183 is situated. Exotic trade-good obsidian (see Chapter Seven) formalized projectile points located in the plowed terrace field suggest the site occupation extends back at least 2700 years (artifacts held in the Zieroth Family collection). The site may contain archaeological assemblages that extend to the Middle Holocene or earlier.

Kaech Willapa River Biface Isolate (45PC177)

The Kaech Willapa River Biface Isolate (45PC177) consists of an indurated siltstone lanceolate form biface that may have been a projectile point. The biface was located on an "upper" terrace of the Willapa River. The artifact is representative of the archaeological potential of the terrace in the uppermost reaches of the Willapa River Valley. These regions have not yet been explored by the Willapa survey, but are known to be rich in archaeological resources. There are alluvial terrace margin landscapes located to the south and west of the 45PC177 isolated find that likely contain significant archaeological resources. Several local informants have indicated that there are many dispersed pre-contact archaeological sites around springs in the upland headwaters of the Willapa River. Tool-stone quality chert nodules have reportedly been located on some of the upland ridge-crest landscapes far-above and the north of isolated find 45PC177.

Jenkins Farm North River Site (45PC195), North River Valley

On rare occasions, I ventured outside of the Willapa River Valley study area to test the terrace margin landform-based discovery techniques that had been productive along the Willapa River. The North River Valley is the next major watershed located north of the Willapa River. There are pre-contact lowland archaeological sites located near the mouth of the North River on Willapa Bay (Figure 2), but none have been documented within the inland near-coastal North River Valley. I inspected the upper alluvial terraces at the Fall River and North River junction during a day-long discovery effort in "fresh territory" outside of the Willapa River Valley.

The Jenkins Farm North River site (45PC195) is a pre contact campsite located on an "upper" alluvial terrace southwest of the juncture of the North River and Fall River. The site area is located on a terrace that was not inundated in the 2007 or 2009 flood events. The site area terrace is approximately two meters higher than the next lower terrace that *was* flooded in 2009 flood event.

The site contains lithic tools and debris made from chalcedony, jasper, siltstone, basalt, and obsidian. One red jasper scraper (type 03-01) was found on the terrace slope surface. Fire cracked rock and utilized cobbles are also present at the site. The landowner reported encountering lithic flakes at least one meter underground when repairing a fence post. I recovered a small obsidian biface thinning flake in a mole-hole pile near the base of an active and humming wooden beehive. Craig Skinner provenienced the small flake to Obsidian Cliffs, Oregon using X-ray fluorescence (XRF) trace element characterization techniques (NWROSL 45PC195 Specimen 49, Cat.1; Appendix D).

The site is located near the confluence of the North River and Fall River. Fall River is unusual, as a segment of it flow through a seemingly incised basalt sheer-walled canyon with eroded rockshelter formations (site 45PC228). Mr. Lance Jenkins (personal communication March 2010) has suggested that this section of the river's path may be within a collapsed lava tube, and my limited observations of the area could not dispute this hypothesis. Bone tools and fragments of cedar wood are reported (several independent informants) to have been found at the Fall River Rockshelter Complex site (45PC228) more than 50 years ago. The shelter area (45PC228) is located approximately 3.5 miles upstream from the Fall River/North River confluence. It is possible that the natural rock ledge overhangs and hollows at site 45PC228 were used as burial shelters in a similar tradition to pre-contact Oregon coast-range cultures (Minor 1987). It is also possible that the shelters were utilized as storage features. Rockshelter features such as these are not known to be present in the Willapa River Valley.

Future survey in the Willapa Region

The Willapa survey project has only explored a minute sample of the southwest Washington Willapa region landscape. The project's initial reconnaissance was dedicated to figuring out where to focus the majority of the survey and testing efforts, and we were quickly overwhelmed with options. I decided to focus on a coastal watershed landscape that had only been minimally explored and documented. The North River Valley, Naselle River Valley, and Palix River Valley could each consume a lifetime of archaeological research and exploration. In the Willapa River Valley, there are "upper" and "middle" terrace locations that the author still wishes to test. Datable Early Holocene prehistoric sites will likely eventually be identified on these "upper" terrace landforms.

Only a small fraction of the shoreline of Willapa Bay has been surveyed. There are actually multiple shorelines that still require examination, though most are deeply submerged on the continental shelf. Future tide zone surveys in Willapa Bay will undoubtedly identify many interesting late prehistoric archaeological sites that sank into the bay during earthquake events.

The Willapa Hills are subject to significant modern disturbance from logging and the timber industry. The Forest Practices Act (Title 222 WAC; WAC 222-20-120) has established protections for cultural resources in Washington's forests, but in Willapa few modern professional intensive surveys have been conducted in the mostly corporate-owned forested foothills. Willapa artifact collectors find artifacts in the forested uplands of the Willapa Hills; within clear-cuts, road-cuts, upturned tree root-wads, on ridge-crests, around springs, and in drainage channels. The Washington Department of Natural Resources has been performing archaeological surveys in the Willapa Hills, and have identified many important historic archaeological sites related to the logging industry, the railroad, and early historic settlement. Hopefully these efforts will continue.

The Willapa survey was biased in favor of identifying and documenting pre-contact and ethnographic period archaeological sites, but the survey did encounter many historic sites while traversing the landscape. There are still intact structural remnants (creameries, barns, fields) of the early Washington State dairy industry in the Willapa River Valley, and a few living individuals who still remember the specific details of the dairy features.

Communication with knowledgeable elders in the Willapa River Valley communities was the key to identifying the majority of significant archaeological sites. Ethnography became a critical component of the project, and one of the most enjoyable and rewarding aspects of research. The results of the Willapa River Valley survey truly do represent a synthesis of knowledge and stories from many different individuals and families.

CHAPTER FIVE

THE FORKS CREEK SITE (45PC175)

The Late Holocene Forks Creek site (45PC175) is located on a middle alluvial terrace landform on the south side of the Willapa River, upstream (east) from the juncture of the Willapa River and Forks Creek (Figure 9). In the vicinity of site 45PC175, the Willapa River and Forks Creek flow through approximately two-meter deep incised channels of upper Eocene age McIntosh Volcanics Member (Moothart 1992) basaltic sandstone, tuff, and breccia bedrock. There is a large bedrock outcrop on the north side of the Willapa River directly across from the site terrace. The site features are buried within alluvial deposited sediments resting upon a bedrock strath terrace of the Willapa River (Figure 26).

Figure 26. The 45PC175 alluvial terrace, incised Willapa River bedrock channel, and bedrock outcrop (View downstream to the southwest).

Local informants reported many hollow “bowl” *kolk* formations in the bedrock channel of the Willapa River near the site location (Figure 27), and a single pestle in the Zieroth Family collection was found in the site field in the last decade while it was being plowed. This information led the survey team to the 45PC175 site location. Survey and presence-absence shovel testing confirmed the existence of a buried pre-contact lithic tool and debris component.

Figure 27. Bedrock “bowl” *kolk* formations in the Willapa River bedrock channel adjacent to site 45PC175.

45PC175 Excavation Planning

The owners of the private property site were interested and supportive of archaeological testing. The Thompson family recognized the archaeological and cultural significance of the site location, and they were interested in learning more about the artifacts and formation processes of their home's landscape. A Washington State Department of Archaeology and Historic Preservation (DAHP) archaeological excavation permit application was prepared in conjunction with communications with the Chehalis, Chinook, and Shoalwater Tribes. The Confederated Tribes of the Chehalis were interested and supportive of the project, and agreed to curate the archaeological materials collected from the site 45PC175 excavations. The Confederated Tribes of the Chehalis curate several important regional archaeological excavation assemblages in Oakville, WA. Once the excavation permit was granted, systematic mapping and auger testing of the site area was initiated. While a temporary storage shelter tent was erected at the site field, the excavated archaeological materials were processed and analyzed in my lab in Nahcotta, Washington.

45PC175 Mapping and Auger Testing

The site excavation datum (consisting of a threaded stainless steel rod encased in grey PVC pipe driven into the ground) was established at the south-central periphery of the site field, and was assigned an arbitrary coordinate of 200-meters north (N200), 200-meters east (E200). The datum was established at a location where a true-north bearing "primary grid line" would pass through one of the highest-density concentrations of surface artifacts and cultural debris at the site. Austin Ivers and I "staked-out" a ten-meter grid over the site area field from the datum using an optical transit, measuring tapes, and a survey rod.

Auger testing (Figure 28) was used to assess the depth and density of cultural materials within the approximate northeast and southwest quadrants of the site area (Figures 29 and 30). The auger testing utilized twenty-centimeter arbitrary levels and all sediments were screened through 1/8” mesh. The auger tests were off-set from the ten-meter site grid by half-meter increments to preserve the integrity and accuracy of the installed grid stakes. In Figures 29 and 30, the auger testing results are summarized using stacked “fractional notations” that illustrate the number of lithic flakes (numerator) within the buried levels (denominator) of the auger test holes. There is a fractional notation for each auger test level that contained cultural lithic debris and artifacts, and/or the deepest level that was tested. A “tall stack” of fractional notations is indicative of a deep culture-rich auger test location. Figures 29 and 30 also illustrate the locations of the 45PC175 excavation units.

Figure 28. L. Nakonechny auger testing at site 45PC175.

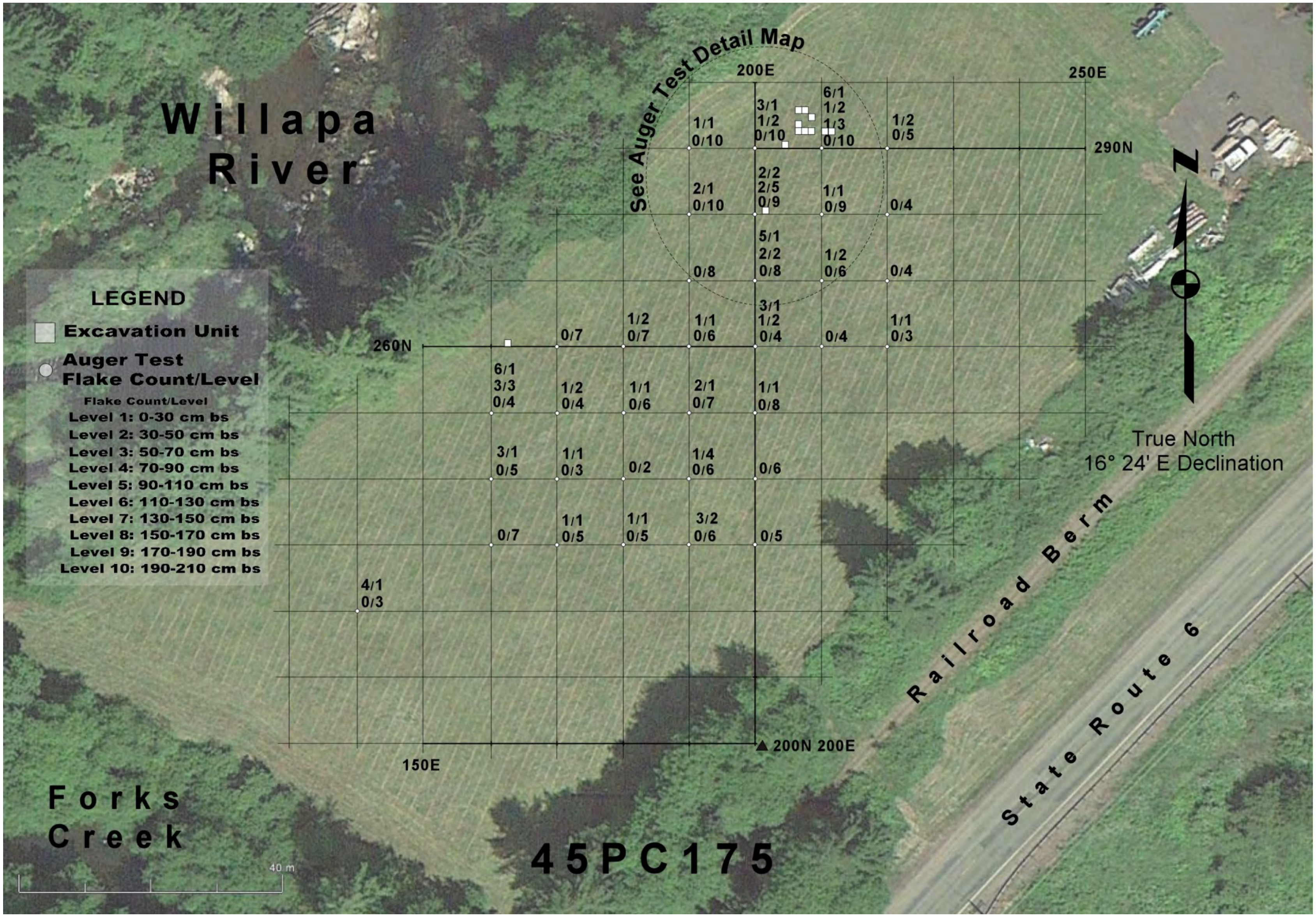

Figure 29. 45PC175 Site map with auger test and excavation unit locations.

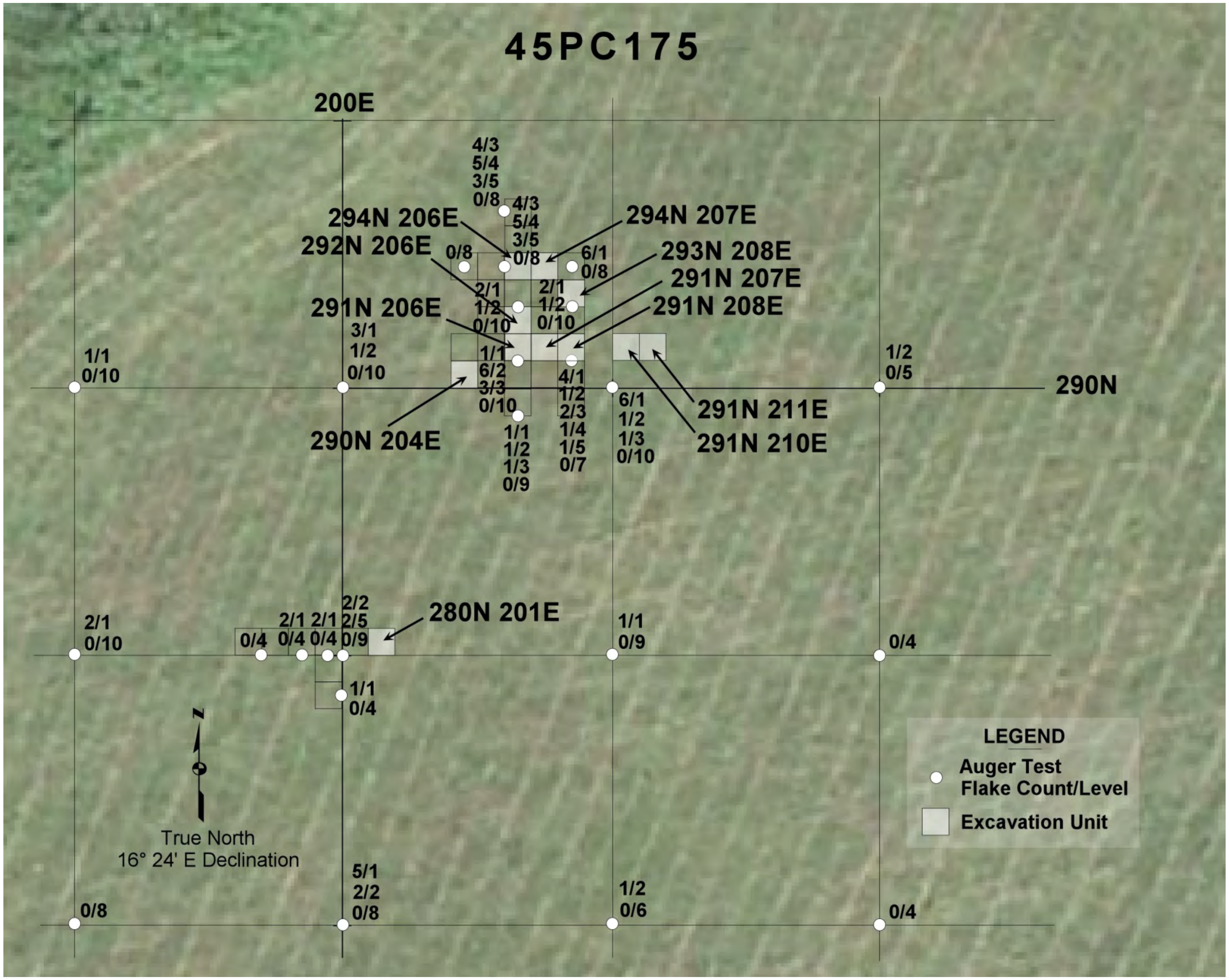

Figure 30. 45PC175 Site excavation and auger testing detail map.

45PC175 Archaeological Excavation

Auger testing revealed a significant and deep concentration of cultural materials and heat-stained sediments in the northeast quarter of the site area field (N290 to N294). I chose to focus the excavation efforts on this interesting culture-rich area of the large lithic scatter site (Figures 30 and 31). A remote "satellite" unit (N260E162) was excavated away from the primary site excavation area where there was also a significant surface scatter artifacts and lithic debris. Several elevation datum were established in the excavation areas using the transit and rod.

The excavation team consisted of Lyle Nakonechny, Austin Ivers, Serah Timm, and Matthew Shelley. The excavation fieldwork began with deep auger testing on March 2nd 2013, and was concluded when the excavation units were backfilled on July 31st 2013. A total of 13.3 cubic meters of sediments were excavated at site 45PC175 (Table 4; Figures 29 - 31). The excavation represents far less than 1% of the total volume of cultural deposits at the site. The excavation units were placed pragmatically within the site's grid to expose potential features that were identified by the auger testing.

Table 4. 45PC175 Excavation Volumetrics.

m^2 Excavation Unit	Depth, cm	Volume, m^3
N260E162	120	1.2
N280E201	50	0.5
N290E204	160	1.6
N291E206	65	0.65
N291E207	178	1.7
N291E208	153	1.2
N291E210	45	0.45
N291E211	55	0.55
N292E206	120	1.2
N293E208	95	0.95
N294E206	200	1.8
N294E207	175	1.5
Total:		**13.3**

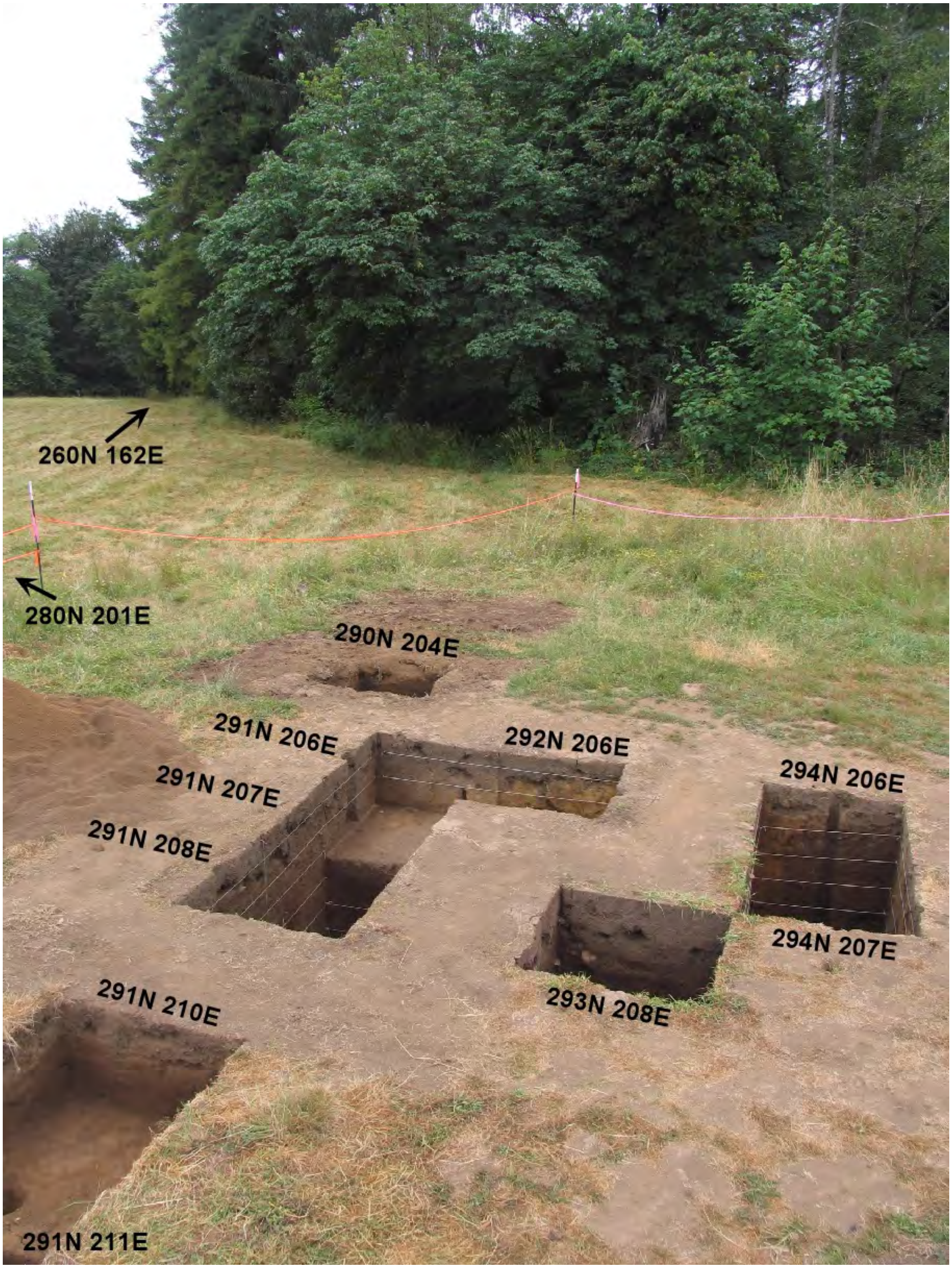

Figure 31. Excavation Units at 45PC175 (View to the west-southwest).

Excavation Methods

The Willapa team utilized rigorous field excavation techniques to gather as much data as possible about the cultural occupation of the site and the formation of the landform. No controlled excavations had ever occurred in the Willapa River Valley prior to our testing at Forks Creek. As such, the excavation was performed slowly and carefully with hand trowels, allowing the excavation team to become quite familiar with the subtleties of the site's sediments, occupation layers, and formation processes.

All excavated sediments were passed through nested 1/4-inch and 1/8-inch screens hanging from adjustable tripods. One-liter volume samples from each "screen load" of excavated sediment (the volume of a five-gallon bucket) were water-screened in custom nested-bucket 1/16-inch mesh classifiers that allowed us to recover lithic micro-flakes and microblades. The nested-bucket 1/16-inch mesh classifiers allowed us to water-screen a sample of the site sediments without adding any excavated sediments into the Willapa River. The 1/8-inch screening and fine-mesh screening was time consuming, but contributed to the recovery of exotic trade obsidian micro-flakes, and to the definitive identification of lithic microblade technology.

Line-level and measuring tape techniques were used to control excavation elevation from several metal stake elevation datum that were placed using the optical transit and survey rod. Excavation was initially performed utilizing arbitrary ten-centimeter levels from the surface to the base of the unit (sterile levels and/or basal yellow clays). Once it was clear that there was at least a fifteen centimeter thick historic and modern aged plow-zone throughout the site's field, the team excavated the top fifteen-centimeters of sediment as a single disturbed "cultural layer." Ten-centimeter arbitrary levels were excavated below the top fifteen-centimeters of plow-zone disturbance. The majority of metal, glass, clay pigeon, and other historic and modern materials were identified in the plow-zone level. The plow zone level also appeared to contain the most active and abundant krotovina (filled in mole burrows).

"Level forms" were produced for each excavated level. The floors of the excavation units were cleaned, mapped, and photographed (digitally) at the base of each level. The north, east, and depth coordinates (centimeter-scale) of all artifacts and samples that were identified *in-situ* were recorded. Formalized tools and modified lithics that were identified *in-situ* were bagged separately from the debris and artifacts recovered from within the 1/4-inch, 1/8-inch, and 1/16-inch screens. Archaeological features were assigned unique numeric and alpha-numeric designators, and were excavated in ten-centimeter levels segregated from the surrounding level(s) matrix. Feature levels were described on "feature level forms." Radiocarbon samples were collected and stored within aluminum foil "bindles"- in keeping with tradition and habit.

Fire cracked rock (FCR) was mapped on the level forms, and the FCR count and total weight (kg) for each level was recorded. FCR was "platformed" while excavating the levels, with the expectation that some of the FCR could have been dispersed in a pattern (such as a ring or line), or concentrated in a pit or cobble pile "oven" feature. It is important to note that many of the siltstone cobbles that were utilized at the site dissolved into "ghost cobble" stains within the highly acidic (4.7 to 5.3 pH) sediments. The dissolved siltstone "ghost cobbles" were not included in the count and weight summaries for each level. Their black and rust-orange staining is indicative of the oxidized pyrite and Fe aggregates associated with *redox* sulfate processes.

Sediment colors were described using a Munsell Book of Color, and sediment textures were described, in group consultation, utilizing standard pedological conventions. Sediment samples were collected from mapped locations within each unit level below the plow zone.

45PC175 Strata and Soils

There are two strata of alluvial sediments at site 45PC175 (Figures 32 and 33). Stratum 2, the deepest and earliest sediment deposit, is a buried terrace deposit of culturally-sterile "yellow" 10YR 5/6 loamy clay with areas of sandy loam. Stratum 2 is resting directly on a bedrock strath. Following archaeological convention, Stratum 1 overlies Stratum 2. Stratum 1 consists of "brown" silt loam and clay loam sediments that were deposited by overbank flooding events from the Willapa River and Forks Creek. Cultural artifacts and features are suspended throughout Stratum 1. I could not differentiate the subtle vertically accreted layers of silt loam and clay loam over-bank flood sediments that formed Stratum 1. Discontinuous patches (perhaps small puddles) of pebble-rich "laminated" sediment indicative of flood deposition were encountered while excavating through Stratum 1, but the natural patterned-layering of periodic over-bank flooding is simply exceptionally difficult to detect in the silt loam and clay loam alluvial sediments. The only visible layering in Stratum 1 occurs at the boundaries of FCR and charcoal-rich buried cultural occupation features, at the base of the historic-era and modern plow zone, and as a result of post-depositional soil horizon development. Bioturbation and process of soil development have likely contributed to the lack of distinct flood-layering within Stratum 1.

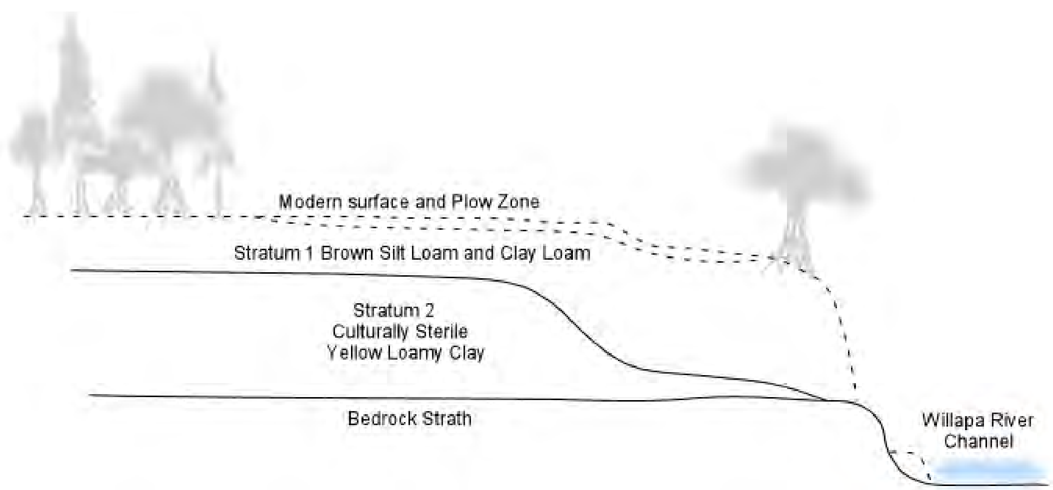

Figure 32. Strata of alluvial sediment at site 45PC175.

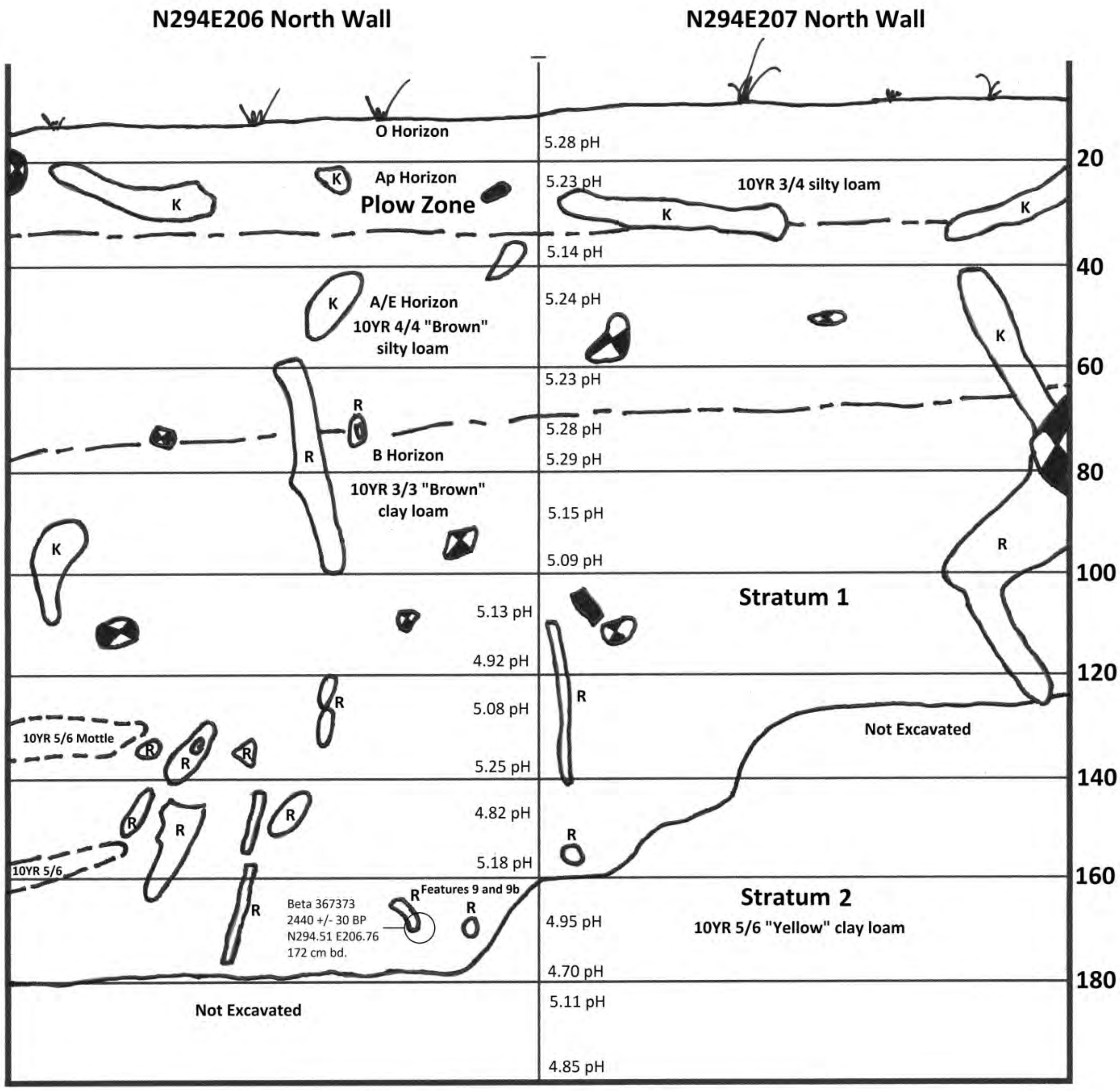

Figure 33. 45PC175 profile (N294E206 and N294E207 north wall) illustrating the strata, soil horizons, and level pH measurements.

Stratum Two

Auger testing and excavation revealed a basal layer (Stratum 2) of culturally-sterile "yellow" 10YR 5/6 loamy clay resting directly on top of a bedrock strath. The dispersed auger testing revealed slight textural variability within Stratum 2. In places, Stratum 2 consisted of beds of sandy loam. We did not identify any buried soil horizons, surfaces, or depositional layering within Stratum 2 while auger testing or excavating. A post-hole digger was used at the base of excavation unit N294E206 to explore the basal sediments of the yellow clay stratum and the bedrock strath 240 centimeters below the surface. The bottom ten centimeters of Stratum 2 grades quickly from a compact clay to an unconsolidated gravel of decomposing siltstone nodules, pebbles, and sands. It appears that surface-seepwater has potentially transported clay sediments away from the decomposing siltstone basal gravels resting directly on the bedrock strath. The bedrock strath may be acting as a "hard pan" that channels water toward the Willapa River. Pebbles, cobbles, and other stone clasts were not found suspended within the Stratum 2 sediments during excavation, but some of the initial auger testing sample holes may have been halted by large cobbles within the culturally sterile yellow clay stratum. *Redox* process Fe mineral aggregates were ubiquitous throughout Stratum 2, as were non-cultural black oxidized-pyrite stained flecks of wood and organic material. No artifacts, soil horizons, or buried stable surfaces were identified within Stratum 2. The team excavated two levels into the sterile stratum within several excavation units, but after finding no evidence of cultural materials anywhere in the stratum, the focus shifted to sediments with archaeological contexts.

The Stratum 2 buried alluvial terrace has a distinct tread surface and facies slope. Its alluvial parent material is likely derived from the ancient Pleistocene marine terrace sediments that form significant portions of the local Willapa Hills. Similar yellow loamy clay and sandy loam sediments are exposed in road-cuts of the Willapa Hills 200 to 300 feet above the terraces of the Willapa River and Forks Creek. There is a distinct boundary between Stratum 2 and Stratum 1. There are many intrusive Fe-oxide stained and clay-lined root casts within Stratum 2 that originate from the basal culture-rich levels of Stratum 1. The facies slope surface of Stratum 2 is very uneven with what could be alluvial erosion channels, or the surface depressions left from large tree roots (such as from a large spruce or maple tree).

The basal age of Stratum 2 is not known. The only sizable fragments of charcoal and organic material located within Stratum 2 were segments of intrusive roots from Stratum 1. A fragment of cultural charcoal resting approximately two centimeters above the distinct boundary of Stratum 2 had a conventional radiocarbon date of 2584 +/- 31 BP (UW D-AMS 004837). No acceptable (non-intrusive) carbon samples were identified or collected from *within* Stratum 2 for conventional or AMS radiocarbon dating. The team collected a sediment sample from 240 centimeters below the surface at the boundary of Stratum 2 and the basal bedrock strath. A bulk sediment radiocarbon sample of this sediment has not yet been attempted. There is likely more than enough organic material within the sediment for an assay. Unfortunately, the sources of the organic material in the bulk sediment sample from the base of Stratum 2 would be difficult to contextualize and interpret. Much of the organic material that would be recovered could represent re-deposited materials from the erosion of ancient terrace sediments up-stream of Forks Creek. Schanz and Montgomery (2013) have dated Upper Willapa River Valley high-terrace landforms upstream of the site to approximately 10,000 BP. There is likely a mix of many different sources of old and new organic material within the flood-deposited sediments. If the Stratum 2 sediments represent rapidly re-deposited mudslide material, the bulk sample carbon sample could reveal the age of the parent material and not the date of re-deposition.

Stratum 2 could be a 10,000 BP terrace landform, or it could be a landform deposited not long before the deepest radiocarbon date of 2584 +/- 31 BP (UW D-AMS 004837). The deepest radiocarbon sample (UW D-AMS 004837) was "calendar calibrated" to Cal. BP 2768 to Cal. BP 2725 using OxCal 4.2 (IntCal13 curve; Bronk Ramsey 2009a). The period of time over which Stratum 2 was deposited is not clear because there are not yet any basal, nor interstitial, radiocarbon dates. What can be said is that the top of Stratum 2 was a clean flood-scoured surface not long before being occupied by Willapa peoples before approximately Cal. BP 2700.

I believe it is possible that an earthquake may have contributed to the formation of the Stratum 2 buried "yellow" loamy clay and sandy loam alluvial terrace. The oldest and deepest radiocarbon dates associated with this initial cultural occupation are 2584 +/- 31 BP (UW D-AMS 004837) and 2440 +/- 30 BP (Beta 367373). Radiocarbon dates associated with the earthquake-buried "Soil N" at Atwater and Hemphill-Hailey's (1997:87) "Redtail" locality in the Willapa Bay estuary's Niawiakum River include: 2475 +/- 23 BP (QL 4715), 2510 +/- 80 BP (Beta 22371), 2530 +/- 100 BP (Beta 21826), and 2590 +/- 60 BP (Beta 22370).

It is possible that the same earthquake that resulted in the subduction of "Soil N" in the Niawiakum River (Atwater and Hemphill-Haley 1997), also contributed to the flood-scouring of the surface of the Stratum 2 basal sediments. It is even possible that that the entire sediment bed of Stratum 2 was deposited quickly after significant landslides and flooding following a large earthquake. The principles of earthquake-triggered erosion and terrace development discussed by Personius et al. (1993) and Wegmann and Pazzaglia (2002) may have been at work within the Late Holocene Willapa River Valley. The "Soil N" earthquake may have caused slope erosion, landslides, tree-blockages, and floods within the Upper Willapa River Valley that resulted in the formation or surface-scouring of the Stratum 2 buried alluvial terrace. The same co-seismic events that caused significant landscape change for coastal peoples may have also caused significant landscape change for near-coastal valley inhabitants. If an earthquake occurred in the winter when the mountain slopes were saturated with water, significant sediment movement could occur. Such erosion could potentially be exacerbated by the unstable conditions left by large forest fires.

Stratum One

Stratum 1 consists of indistinguishable beds of vertically accreted “brown” silt loam and clay loam overbank flood deposits from the Willapa River and Forks Creek. While individual accretionary layers are not visible within Stratum 1, texturally distinct soil horizons have developed within the sediment. The NRCS Soil Survey (websoilsurvey.sc.egov.usda.gov) maps the site within the Arta silt loam unit. The Arta silt loam unit consists of terraced old alluvium derived from sandstone and siltstone parent materials. Radiocarbon dates from the base of Stratum 1 suggest that it is likely no more than 2700 years old.

Stratum 1 is capped by a three to four-centimeter thick grassy O horizon. An historic to modern-era Ap horizon “plow zone” extends as much as thirty-five centimeters below the surface, but is typically fifteen to twenty-five centimeters thick. A brown (10YR 4/4) silt loam A/E horizon extends below the Ap horizon “plow zone” to approximately fifty to fifty-five centimeters below the surface, where a distinct clay loam B horizon has formed. The illuviated clay loam sediments continue to the base of Stratum 1, becoming only more compact and clay-rich without a distinct C horizon of pedologically-unmodified alluvial parent material.

There are pre-contact, historic, and modern krotovina within the A/E horizon. The silt loam sediments contain fine root intrusions; including one to two centimeter diameter clay “plaque-skin” lined root hollows without significant associated oxidized Fe aggregates. The friable sediment exhibits a moderate to weak structure, tending toward a fine to medium sub angular crumb of one to five millimeters. The structure is not consistent across the entire site. The A/E horizon is highly acidic (pH 5.24). The sediment contains small rounded, oblong, and sub-angular pebbles (siltstone, igneous, CCS) two to three millimeters in maximum dimension. There is a charcoal mottle in the horizons sediments from pre-contact cultural occupations. There is not a visually distinct E horizon in Stratum 1, but the friable, easily trowel-cut, texture of the sediment appears to be partially the result of eluvial leaching of clays and minerals. The fine clays that would have otherwise cemented the sediments particles together have migrated into the underlying B horizon, making it significantly more dense and sticky. Root intrusion and rodent bioturbation have also contributed to the weak and comparatively crumbly structure of the A/E horizon.

The A/E horizon quickly grades to a brown (10YR 4/4) clay loam B horizon approximately fifty centimeters below the surface. The brown (10YR 4/4) clay loam B horizon is a hard, texturally distinct, clay-enriched zone of illuviation. The clay loam sediments contain fine root intrusions, and there are rust-orange Fe and grey clay "plaque skin" root cast structures present in the highly acidic sediments (pH 5.29 - 4.82). The sticky clay sediment can exhibit a weak structure that is perhaps residual of earlier stages of pedogenisis. There is a ubiquitous charcoal mottle in the B horizon that is likely from fires associated with intensive pre-contact cultural occupation. There are far fewer modern krotovina within the B horizon, but hollow and in-filled mole burrows are present.

Redox Processes at 45PC175

Redox reaction processes in the highly acidic sediments have contributed to the transformation of manuport calcic-indurated siltstone cobbles and manuport clay segments into jet-black, orange, gray, and yellow stained "ghost cobble" sediment features. "Ghost cobbles" can be easily cut with a trowel. Figure 34 illustrates a bisected dark black siltstone manuport "ghost cobble" that has been altered into simply a textured stain within the acidic silt and clay loam sediment matrix. Figure 35 illustrates what is likely a mass of pebble-rich organic mud that was transformed into a jet-black pyrite-precursor stained pebble-flecked greasy sediment mass. Figure 36 illustrates a natural root cast with an oxidized iron (Fe) rust rind, grey clay "plaque-skin," and dark organic filling. These transformations are attributable to the highly acidic soil matrix which has also completely dissolved all of the non-carbonized bone at the site. Table 5 and Figure 33 show the sediment pH levels at site 45PC175 measured using a freshly calibrated "Hanna Checker" pH meter submerged in a 5:1 distilled water and sediment slurry.

Table 5. Sediment pH at Site 45PC175.

Excavation Unit	cm below Datum	Level	pH
N292E206	10-20	2	5.28
N292E206	20-30	3	5.23
N294E206	35-45	4	5.14
N294E206	45-55	5	5.24
N294E206	55-65	6	5.23
N294E206	65-75	7	5.28
N294E206	75-85	8	5.29
N294E206	85-95	9	5.15
N294E206	95-105	10	5.09
N294E206	105-115	11	5.13
N294E206	115-125	12	4.92
N294E206	125-135	13	5.08
N294E206	135-145	14	5.25
N294E206	145-155	15	4.82
N294E206	155-165	16	5.18
N294E206	165-175	17	4.95
N294E206	175-185	18, South	4.7
N294E206	175-185	18, Northwest	5.11
N294E206	230-240	24	4.85

Figure 34. A bisected dark black “ghost cobble.”

Figure 35. A pebble-flecked mass of mud altered by heat and pyrite precursors in Feature 2.

Figure 36. Root cast with oxidized Fe rind, grey clay "plaque skin," and dark fill.

45PC175 Radiocarbon Dating

Seven culturally-deposited charcoal samples that were collected *in-situ* from site 45PC175 were submitted to Beta Analytic and Direct-AMS (University of Washington) for accelerator mass spectrometry (AMS) dating (Table 6; Appendix A). Sarah Schanz and Dr. David Montgomery kindly sponsored the Direct-AMS samples, and will be incorporating the data into their ongoing Willapa Valley landscape studies at the University of Washington. The oldest conventional radiocarbon assays from 45PC175 are: 2584 +/- 31 BP (UW D-AMS 004837), 2490 +/- 30 BP (Beta 367371), and 2440 +/- 30 BP (Beta 367373). The 2-sigma "calendar calibrated" dates provided by Beta Analytic are: Cal. BP 2720 to 2460 (Beta 367371), and Cal. BP 2550 to 2360 (Beta 367373) (Appendix A). The Beta 367373 and UW D-AMS 004837 charcoal samples were recovered from a deeply buried brown clay loam occupation surface (Features 9 and 9b) directly overlying the surface of the culturally-sterile Stratum 2 yellow loamy clay basal terrace. The Direct-AMS radiocarbon dates were calendar calibrated using OxCal 4.2 (IntCal13 curve; Bronk Ramsey 2009). The deepest radiocarbon sample (UW D-AMS 004837) "calendar calibrated" to Cal. BP 2768 to Cal. BP 2725.

The youngest radiocarbon date from the site was 1750 +/- 30 BP (Beta 367372). This sample was collected from the hearth of intrusive pit Feature 4. The shallowest radiocarbon sample, collected *in-situ* from within the Feature 5 FCR accumulation, returned a date of 1970 +/- 26 BP (UW D-AMS 004836). The OxCal 4.2 (IntCal13 curve) application calibrated this radiocarbon date to Cal. BP 1990 to Cal. BP 1871. The Feature 5 charcoal sample was collected beneath the plow zone from within an archaeological context that I perceived as being minimally disturbed by plowing, krotovina, and roots. The plow zone has mixed cultural deposits from approximately the last 1700 years to modern times

Table 6. Radiocarbon Assays from site 45PC175.

Excavation Unit	Level	Collect Date	North cm	East cm	Depth cm	Sample Type	Wt. grams	Conventional Radiocarbon Age BP	Calendar Calibrated Dates (Cal BP)	Radiocarbon Laboratory
N293E208	4	7/8/2013	25	83	43	charcoal	1.4	1970 +/- 26 BP	Cal BP 1990 to 1871	UW D-AMS 004836
N291E208	6	4/29/2013	52	11	60	charcoal	0.85	1930 +/- 30 BP	Cal BP 1930 to 1820	Beta 367370
N291E207	11	6/2/2013	65	10	99-112	charcoal	5.35	1750 +/- 30 BP	Cal BP 1720 to 1570	Beta 367372
N291E208	10	5/15/2013	32	15	100	charcoal	0.41	2490 +/- 30 BP	Cal BP 2720 to 2460	Beta 367371
N291E207	14	7/29/2013	82	-1	144	charcoal	3.79	2030 +/- 30 BP	Cal BP 1910 to 1900	Beta 367374
N294E206	17	7/27/2013	51	76	172	charcoal	0.91	2440 +/- 30 BP	Cal BP 2550 to 2360	Beta 367373
N294E206	19	7/29/2013	60	-1	190	charcoal	0.66	2584 +/- 31 BP	Cal BP 2768 to 2725	UW D-AMS 004837

45PC175 Site Formation Narrative

The earliest level of the culture-rich Stratum 1 is just over 2700 years old. Repetitive low-energy overbank flooding from Forks Creek and the Willapa River between approximately Cal. BP 2700 and Cal. BP 200 vertically accreted loam sediments over the Stratum 2 alluvial terrace, resulting in the formation of Stratum 1 (Figure 37). The over-bank flood events that formed Stratum 1 were more significant than the “100-year” floods that recently impacted the Willapa and Chehalis River valleys. The site area terrace surface was not subject to overbank flooding or sedimentation during the “100-year” flood events of 2006, 2007, and 2009. Forks Creek and the Willapa River likely flooded together (barring a breached blockage flood event from just one), re-depositing sediments sloughed from upstream alluvial terraces. The alluvial sediments that have buried site features and artifacts over the past 2700 years appear to have been primarily deposited by relatively low energy flood waters. The only naturally deposited rocks in the sediment are small rounded and sub-angular pebbles (siltstone, igneous, and CCS) that are rarely more than two millimeters in maximum dimension.

The age of the initial deposition of Stratum 2 on the bedrock strath is uncertain, but the culturally-sterile Stratum 2 surface had been freshly shaped and scoured by the flow of water before being occupied by Willapa peoples approximately 2700 years ago. Cultural artifacts and charcoal are resting approximately one to two centimeters above the distinct Stratum 2 boundary. I believe the entire bed of Stratum 2 sediments could have been deposited quite quickly as a result of significant valley slope erosion and flooding caused an earthquake. Stratum 2 could have potentially been deposited as part of a massive mud and sediment flow event from the Willapa River and Forks Creek.

The reason our auger testing displayed an increase in depth of cultural materials towards the Willapa River in the excavation area (Figure 9) was because we were testing over the in-filled facies slope of the Stratum 2 terrace that originally descended to the channel of the Willapa River. Our excavations were centered over the landform's initial alluvial tread and facies slope margin- the "lip" or edge of the approximately 2700 year old buried terrace surface. Pre-contact peoples were utilizing the terrace tread margin as a summer-season camp and resource processing area with hearths and roasting pits. The buried facies slope descending to the Willapa channel appears to have been primarily used as a dumping area where ashes, charcoal, FCR, and sediments from the hearths and flat occupation surface above were pushed and dumped.

By approximately 1700 BP, the vertically aligned culture-rich Stratum 1and sterile Stratum 2 sediments appear to have been locally truncated by the Willapa River, forming a steep erosion prone cut-bank that sloughed silty loam sediments into the re-exposed remnants of the Stratum 2 facies slope (Figure 37). The same type of sloughing cut-bank is common along the modern riverbank. This cut bank exposure was subsequently fronted and in-filled by a massive bed of culturally-sterile alluvial yellow loamy sand sediment. A vertical unconformity exists between the cut-bank of the vertically aligned site strata (Stratum 1 and 2), and the post-1700 BP yellow loamy sand in-fill sediment (Figure 37). While technically a distinct "Stratum," the late prehistoric or early historic culturally sterile in-fill yellow loamy sand sediment was only encountered in auger probes and excavation units close the Willapa River in the vicinity of the primary excavation area. The top of the sandy yellow unconformity has been truncated by the plow zone near the primary excavation area. Artifacts above the sandy unconformity are incorporated into the disturbed plow zone.

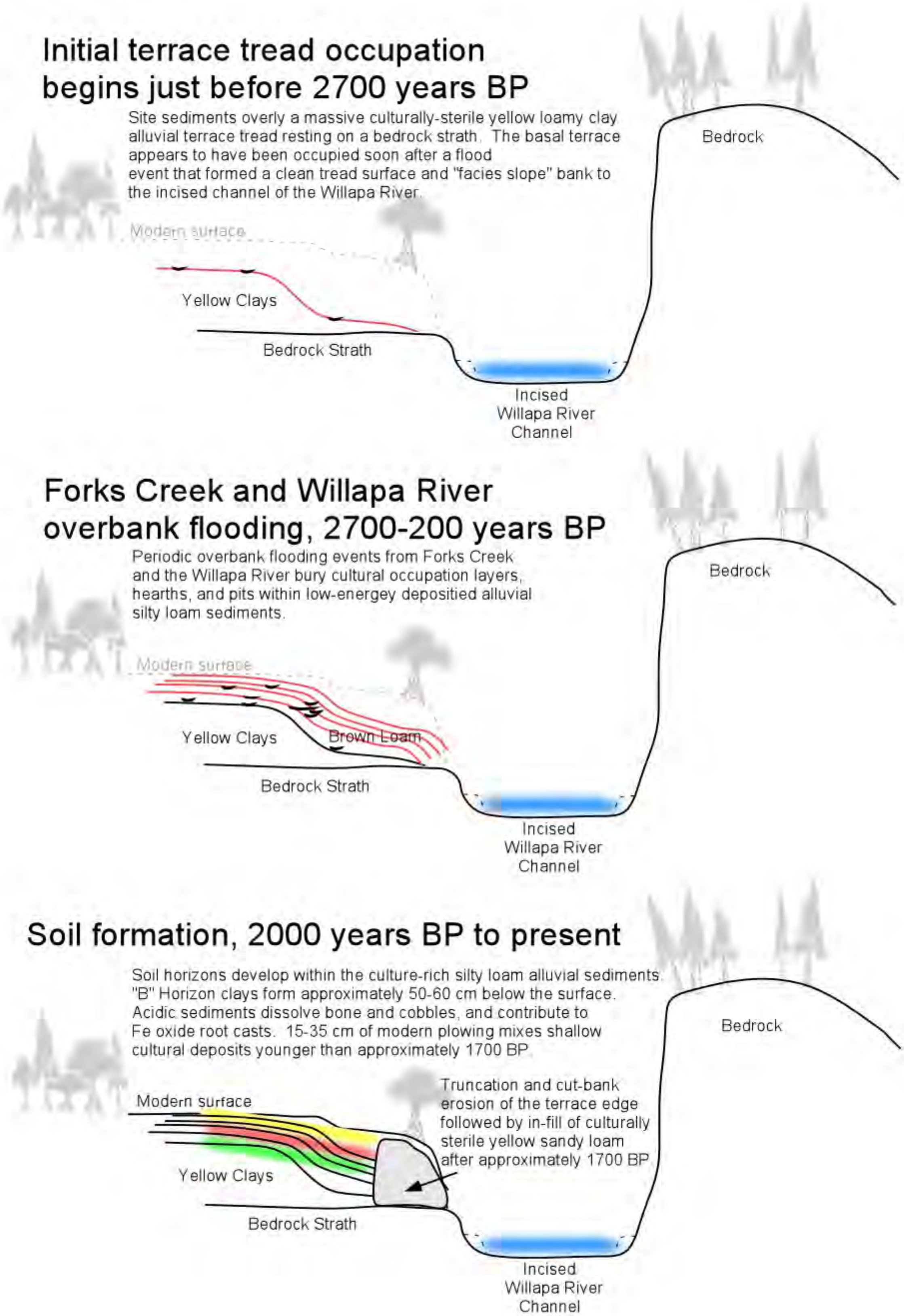

Figure 37. Terrace formation processes at site 45PC175.

45PC175 Features

Twelve pre-contact cultural features were found buried in Stratum 1 under the historic and modern plow zone (Table 7, Figure 38). With the exception of the disturbed plow zone, all of the pre-contact features at the site date to between approximately Cal. BP 2700 and Cal. BP 1700. Pre-contact sediments, artifacts, and debris more recent than approximately Cal. BP 1700 have been mixed together with historic and modern materials in the plow zone.

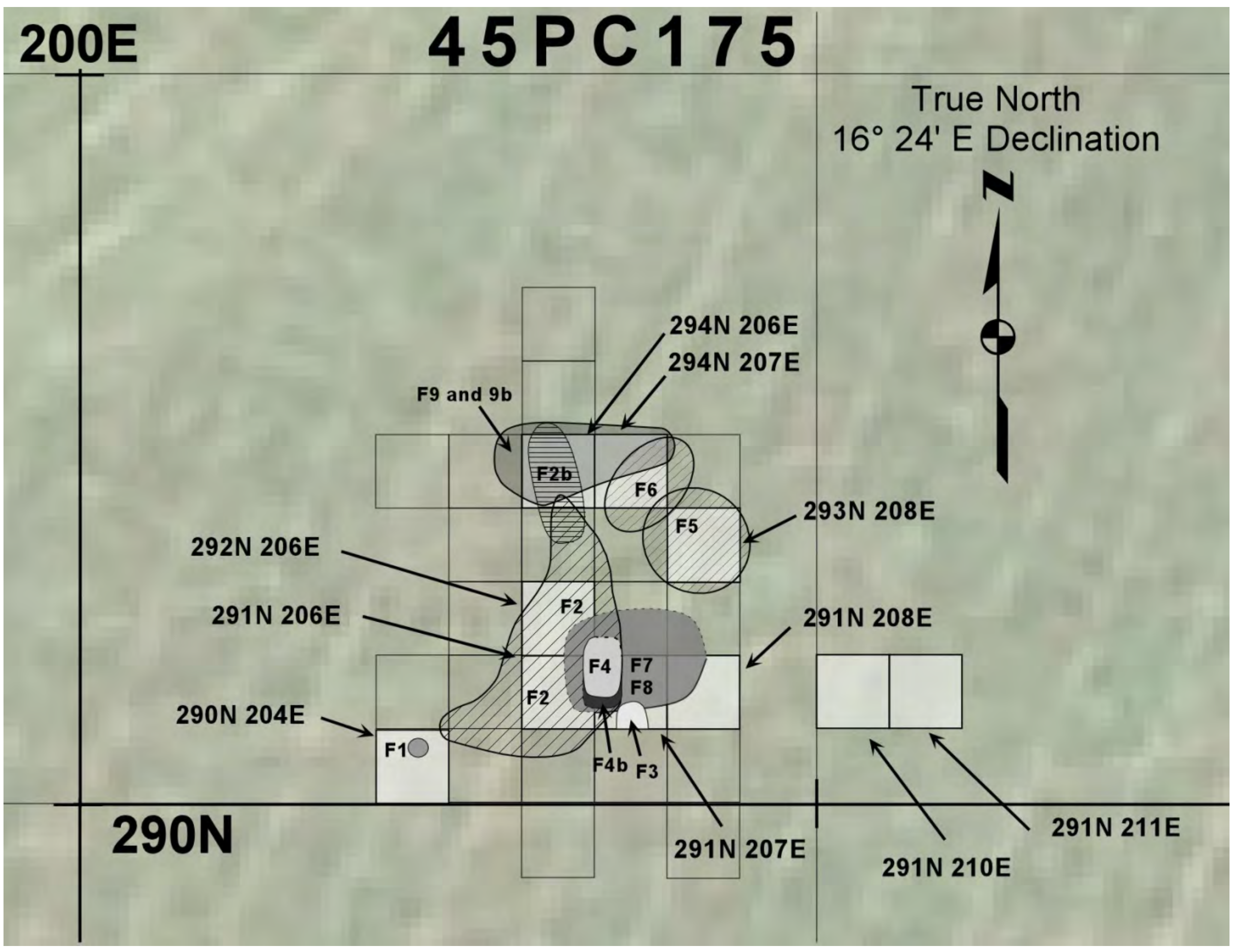

Figure 38. Plan-view map of the 45PC175 cultural features.

Table 7. Cultural Features at Site 45PC175.

Feature Name	Excavation Unit(s)	Depth	C14 Date	Description
Plow Zone	All	0-35 cm	-	Mixed pre-contact and historic artifacts and debris
Feature 5	N293E208	35-53 cm	1970 +/- 26 BP	A pre-contact FCR and charcoal concentration
Feature 6	N294E207	68-96 cm	-	A pre-contact FCR, tool, and charcoal concentration
Feature 3	N291E207	89-108 cm	-	A pre-contact FRC and charcoal at near the rim of F4 pit
Feature 4	N291E207 N292E206	80-135 cm 80-120+ cm	1750 +/- 30 BP	A steep-walled bowl-shaped cooking pit with charcoal, FCR, and artifacts, intrusive into pit Features 4b and 7
Feature 4b	N291E207	90-155 cm	2030 +/- 30 BP	A funnel-shaped cooking pit with charcoal, FCR, and artifacts, intrusive into pit Feature 7
Feature 2	N292E206 N294E206 N290E204	70-120+ cm 45-70 cm 95-105 cm	-	Dispersed charcoal, FCR, and heat stained sediment dumped from the Feature 4 and Feature 4b pits. Deeply buried lens of charcoal in N290E204
Feature 7	N291E207 N291E208	112-161 cm 116-130 cm	- 2490 +/- 30 BP	A heat-stained concave dish-shaped cooking pit with dissolved FCR. The deepest pit below F4 and F4b
Feature 2b	N294E206 N290E204	90-120 cm 105-137 cm	-	A 2-3 cm thick dispersed charcoal, FCR, and heat stained sediment layer cleaned and dumped from Feature 7
Feature 1	N290E204	140-150	-	A deep pre-contact FCR and charcoal concentration
Feature 8	N291E207	160-178 cm	-	A deep cultural surface with FCR and flakes related to F9
Feature 9	N294E207	143-165 cm	-	A deep cultural surface with FCR and flakes related to F8
Feature 9b	N294E206	161-174 cm	2440 +/- 30 BP 2584 +/- 31 BP	A deep cultural surface with FCR and flakes related to Features 8 and 9

The features were numbered in the order that they were identified while excavating. The feature numbers *do not* indicate the chronological order of the features. The original feature numbers assigned during fieldwork were preserved so there would be continuity between the field notes and the analysis. The order of the features that is presented in Table 7 is based on my analysis of the depositional chronology: the oldest and deepest feature (Feature 9b) is located on the bottom of the table, while the newest and shallowest feature (the plow zone) is located at the top of the table. This trend is partially expressed in the “depth” and “C14 date” columns of Table 7, but the order is based on multiple sources of data drawn from the team’s field-note observations and my comparative profile analysis efforts in the lab.

Analysis and comparison of the profile illustrations, profile photographs, field notes, and level form data, led me to assemble sets of spatially and temporally related features together into three groups that represent three consecutive general temporal periods. Features 5, 6, 3, 4, 4b, and 2 are elements of a more than three-hundred year long “late period” cultural occupation that began at approximately Cal. BP 1910 BP (the base of the Feature 4b hearth), and extended into the disturbed plow zone. Features 7 and 2b were grouped together within an older “middle” period dating from approximately 2500 BP to 1900 BP calendar years ago. The “early period” includes Features 1, 8, 9 and 9b. These earliest and deepest site features date from Cal. BP 2768 (Feature 9b) to approximately Cal. BP 2500.

The “late period” Features 5 and 6 represent concentrations of FCR, charcoal, and lithic artifacts that were exposed within two distinct “open camp” occupation surfaces buried under the plow zone (Table 7). Feature 5 was the shallowest non-plow disturbed occupation surface at the site. Feature 6 was a similar, but older, occupation surface buried slightly deeper than Feature 5. Feature 3 was a concentration of FCR, charcoal, and burned sediment located near the rim of “cooking pit” Feature 4b. Features 4 and 4b represent two temporally-distinct “nested” cooking pits that were intrusive into a deeper and older “middle period” pit, Feature 7. The most recent pit, Feature 4, was intrusive into Feature 4b. Charcoal from Feature 4b was dated to 2030 +/- 30 BP (Beta 367374), while the intrusive Feature 4 pit was approximately 300 years younger, dating to 1750 +/- 30 BP (Beta 367372). The Feature 4 pit appeared to be slightly younger than the Feature 5 occupation surface. The Feature 5 occupation surface was more likely related to the Feature 4b pit. The FCR and charcoal concentration recorded as Feature 3 initially appeared to be situated on the rim of the Feature 4 pit, but the feature was more likely associated with the slightly older Feature 4b pit and the Feature 5 occupation surface. The Feature 4 and 4b cooking pit “ovens” were periodically cleaned-out; resulting in the charcoal, FCR, burned sediments, and cultural debris they contained to be dispersed down the facies slope towards the river below. Feature 2 represents the scatter of FCR, charcoal, artifacts, and heat-stained sediments associated with pit Features 4 and 4b.

The “middle period” Feature 2b represents a similar scatter of dispersed “oven cleaning” cultural debris, but it was buried under Feature 2. Feature 2b was likely associated with the earliest, deepest, and widest cooking pit Feature 7, but could potentially have been related to the “middle” cooking pit Feature 4b, or a different pit that was not uncovered by our excavation.

The “early period” Features 8, 9, and 9b, were elements of the same deeply buried initial occupation surface at site 45PC175. Dating from approximately 2700 to 2400 years BP, the features consisted of a scatter of FCR, charcoal, and artifacts deposited near the surface of the Stratum 2 basal terrace. Feature 8 underlies the heat stained sediments of Feature 7 in excavation unit N921E207. The relationship between Features 9 and 9b, and the deepest pit Feature 7 is unclear. Features 8, 9, and 9b appeared to be older than Feature 7.

The Plow Zone

The excavation identified the distinct soil scar patterns of historic and modern plowing and disking. Mr. Robert Zieroth is the last individual to have plowed the site field, identifying a ground-shaft pestle while working the field in the recent past (Figure 87). Following the pattern of the tractor-mower lines visible in the aerial photograph of the site’s field (Figure 8), the plow scars discovered in the top 35 cm of excavations were primarily oriented parallel to the Willapa River, following the long axis of the field. The historic and modern era plow scars identified by testing were oriented at approximately 40 to 45 degrees off of true north. The direction of the plow scars followed the roughly rectangular shaped outline of the terrace field, meaning the angle of buried archaeological plow scars changes near the field corners and along the short axis of the field. A photograph of intact modern plow scars is illustrated in Figure 39. In the plow zone, historic and modern cultural materials such as broken vessel glass, broken window glass, light bulb glass, wire nails, rusted metal fragments, bullets, broken ceramics, broken clay pigeon fragments, and plastic twelve-gauge wads were mixed with pre-contact lithic artifacts, debris, FCR, and charcoal from approximately the last 1700 years.

Many diagnostic pre-contact projectile point and scraper tool forms were present in the plow zone. There was a significant amount of lithic debitage, cobble tools, and FCR dispersed within the plow zone throughout the entire site field, extending southwest all the way to Forks Creek. Nine (34.6%) of the twenty-six exotic material obsidian flakes recovered from site 45PC175 were incorporated into the disturbed plow zone. Screening plow zone sediments through 1/8" mesh could potentially return an average of two obsidian flakes for every cubic meter of sediment processed, and yield a diverse artifact assemblage from the past 1700 years.

Figure 39. Plow scars and krotovina in N290E204 (30 cm b.d.).

Late Period Features 5 and 6

Features 5 and 6 were occupation surfaces located on the terrace tread east of the pit features. Feature 5 was a concentration of FCR, charcoal, and lithic debris buried thirty-five to fifty-five centimeters below the surface in excavation unit N293E208 (Figure 40). Feature 5 was the shallowest non-plowed occupation surface found at the site. The shallowest cultural charcoal radiocarbon sample (1970 +/- 26 BP, UW D-AMS 004836) was collected *in-situ* 43 cm below the surface from within the Feature 5 FCR accumulation. While Feature 5 was the shallowest intact occupation surface below the plow zone, intrusive pit Feature 4 was slightly younger than Feature 5, likely originating from a surface that had been destroyed by plowing.

The excavation team counted 111 FCR cobbles weighing a total of 26.25 kg within the Feature 5 concentration in excavation unit N293E208. A jasper projectile point tip (Cat. 1497), a siltstone core (Cat. 1499), and a hammerstone (Cat. 1512) were located within Feature 5. In addition to the lithic artifacts, several *Prunis emarginata* (Bitter Cherry) seeds (Cat 1509) were recovered from within Feature 5.

Feature 6 (Figures 41 and 42) was a similar, but older, occupation surface buried slightly deeper than Feature 5. Feature 6 was situated sixty-eight to ninety-six centimeters below the near-surface datum of excavation unit N294E207. No radiocarbon samples were submitted from Feature 6. Twenty-one FCR cobbles weighing a total of eighteen kilograms were part of the Feature 6 concentration within excavation unit N294E207. A jasper biface fragment (Cat. 367), and a banded CCS flake scraper (Cat. 337) were identified within Feature 6. A siltstone blade scraper (Cat. 326), and a fossiliferous CCS microblade-core fragment (Cat. 318), were located in sediments immediately above Feature 6. Feature 6 may be temporally related to pit Feature 4b.

Figure 40. Feature 5 in N293E208.

Figure 41. Top of Feature 6 in N294E207 at approximately 75 cm below datum.

Figure 42. Feature 6 in N294E207 at approximately 91 cm below datum.

Late Period Features 3, 4, 4b, and 2

Feature 3 (Figures 43, 44, and 47) was an elongated ten to fifteen centimeter thick lens of cultural charcoal and FCR that was located south of the margin of intrusive cooking pit Features 4 and 4b (Figures 45 - 49, and 51 - 54). In excavation unit N291E207, Feature 3 was located 89 to 108 centimeters below the surface datum. Feature 3 was visible in the south wall profile of N291E207 (Figures 43 and 44), and appeared to extend into the unexcavated units of N290E207, and perhaps N290E208. Feature 3 and Feature 4b were likely related cultural deposits. Intrusive pit Feature 4 was likely slightly younger than Feature 3.

Feature 4 (Figures 45 - 49, and 51 - 54) was an approximately forty-centimeter deep nearly rectangular shaped charcoal-rich pit. A charcoal hearth with intact limb fragments, and associated FCR and lithic flakes, was suspended just above the pit's curved base. The Feature 4 hearth was resting on a charcoal-rich heat-stained sediment matrix that appeared to have been mixed multiple times in prehistory (Figure 46). A burned one-centimeter thick limb in the Feature 4 hearth was dated to 1750 +/- 30 BP (Beta 367372). Wood charcoal, FCR, decomposed siltstone "ghost cobbles," and lithic debris were identified within the excavated pit feature's fill sediments. Feature 4 contains decomposed siltstone flakes that could not be easily excavated, preserved, or classified because of their moist chalky texture. Feature 4 was intrusive into deeper pit Feature 4b. Both Features 4 and 4b were within Feature 7, the earliest and deepest pit.

Feature 4b (Figures 45 - 47, and 49) was a wide "funnel" shaped (inverted cone) cooking pit filled with charcoal-rich silty loam sediment, heat-stained sediment, FCR, and a sparse scatter of lithic debris. Charcoal from the base of Feature 4b was dated to 2030 +/- 30 BP (Beta 367374). Feature 4b was excavated within the partially in-filled depression of the largest, earliest, and deepest pit, Feature 7.

Feature 2 was exposed within excavation units N292E206, N294E206, and N290E204, and is situated between 45 and 120 cm below the surface. Feature 2 is illustrated in Figures 50-56, 62, and 63. No radiocarbon samples were submitted from Feature 2, but it appears to be stratigraphically associated with pit Features 4b and 4.

Feature 2 was a dispersed layer of fragmented burned wood charcoal, FCR, jet-black stained organic rich concretions with pebbles, acid-decomposed siltstone "ghost cobbles," and surprisingly few lithic flakes and tool fragments. Feature 2 represented burned sediments and FCR that was cleaned from the gently sloping western margin of the Features 4b and 4 pits, and dumped down the now-buried slope to the Willapa River. The charcoal and burned sediment rich Feature 2 materials extended up over the western and northern margins of pit Features 4b and 4, and were spread out in a nearly four-meter long irregular fan. The Feature 2 staining and charcoal mottle was as much as forty-centimeters thick in the southwest corner of unit N292E206. The underlying Feature 2b represents the same type of debris and burned sediment scatter, but is associated with the oldest and deepest pit Feature 7.

The greasy, jet-black stained, pebble-flecked mass illustrated in Figure 35 was representative of many similar inclusions within Feature 2. These elements of Feature 2 may have represented heat and acid-transformed segments of pebble-rich organic mud from the active terrace of the Willapa River channel that were utilized within the Feature 4b and 4 cooking pits. Irregular “blocks” of organic-rich active-terrace sediments from the river’s edge could have formed temporary hearth walls, or have been used to cover and cook food resources within a pit.

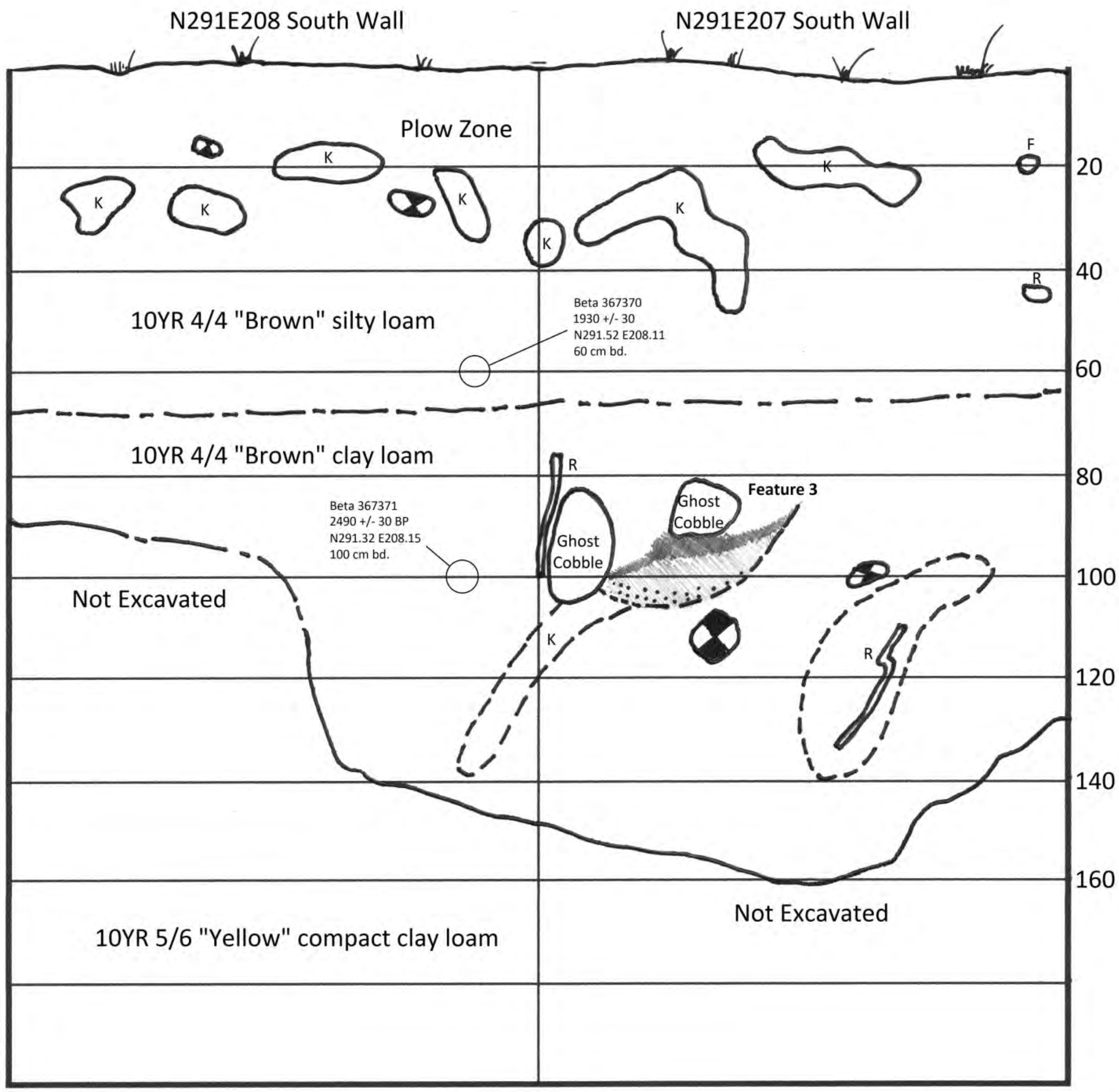

Figure 43. 45PC175 profile illustration (N291E208 and N291E207 south wall). Feature 3 is exposed in the south wall of N291E207.

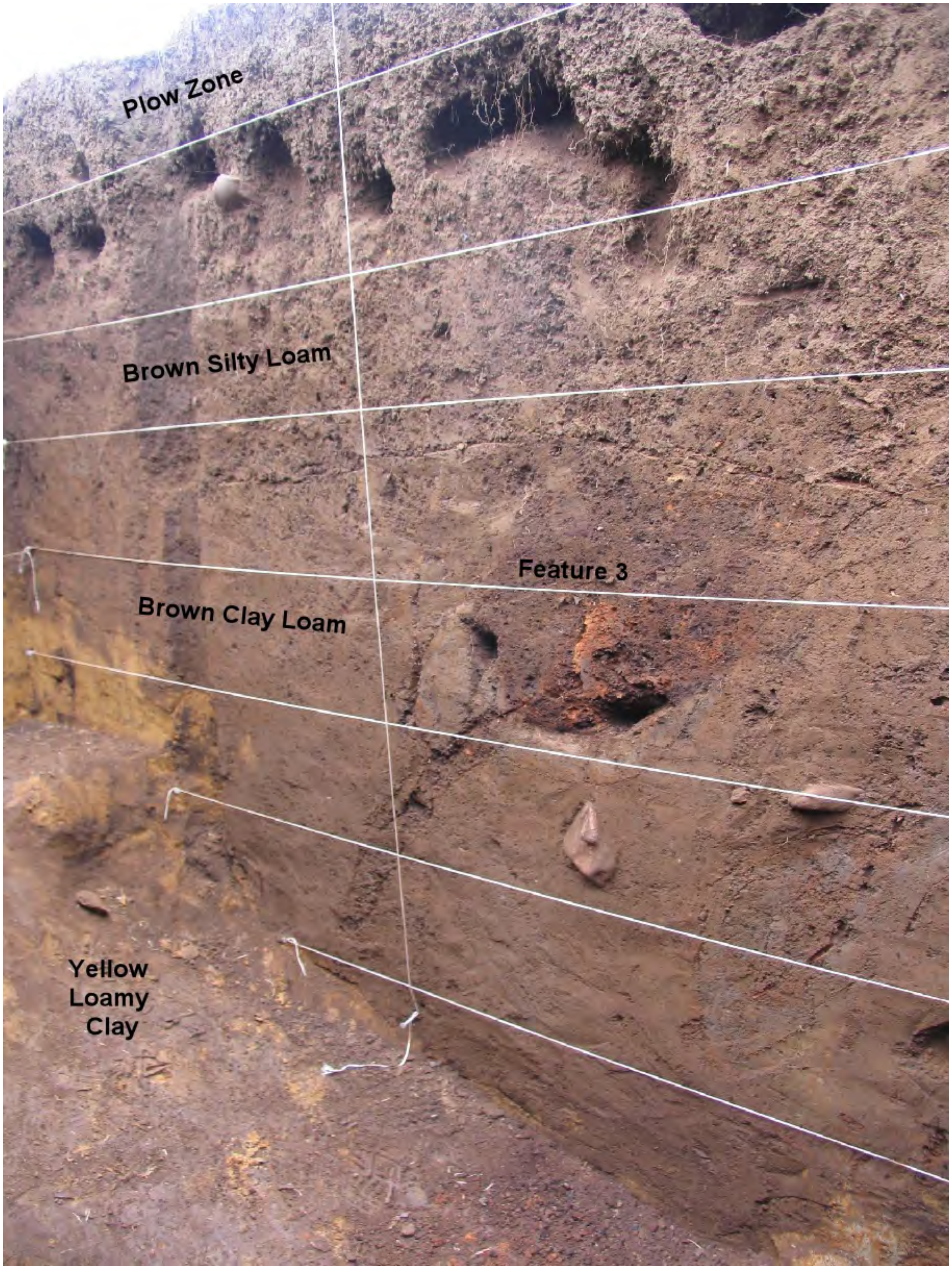

Figure 44. 45PC175 profile photograph (N291E208 and N291E207 south wall). Feature 3 is exposed in the south wall of N291E207.

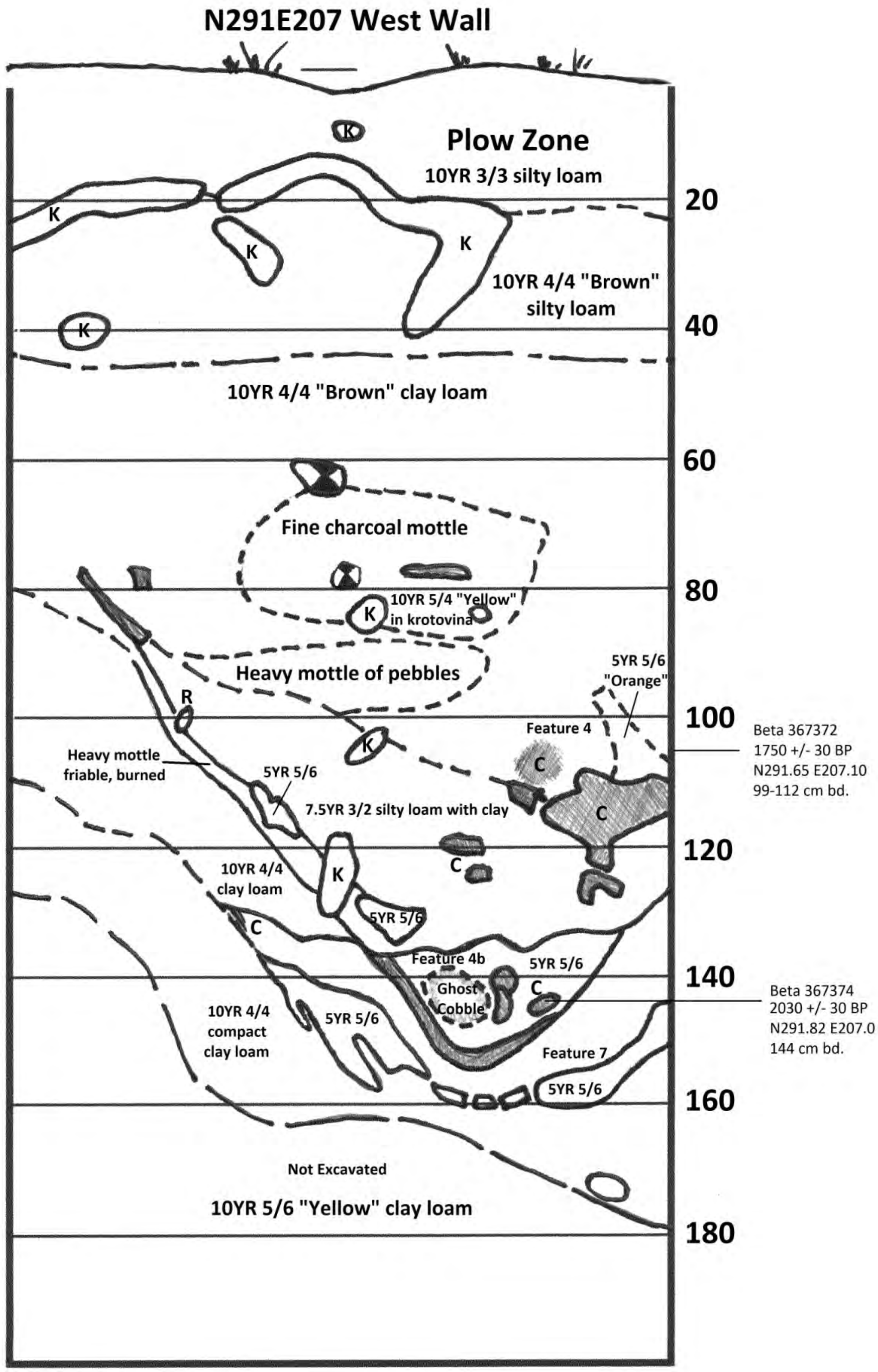

Figure 45. 45PC175 profile illustration (N291E207 west wall). Features 4, 4b, and 7.

Figure 46. 45PC175 profile photograph (N291E207 west wall base). Features 4, 4b, and 7.

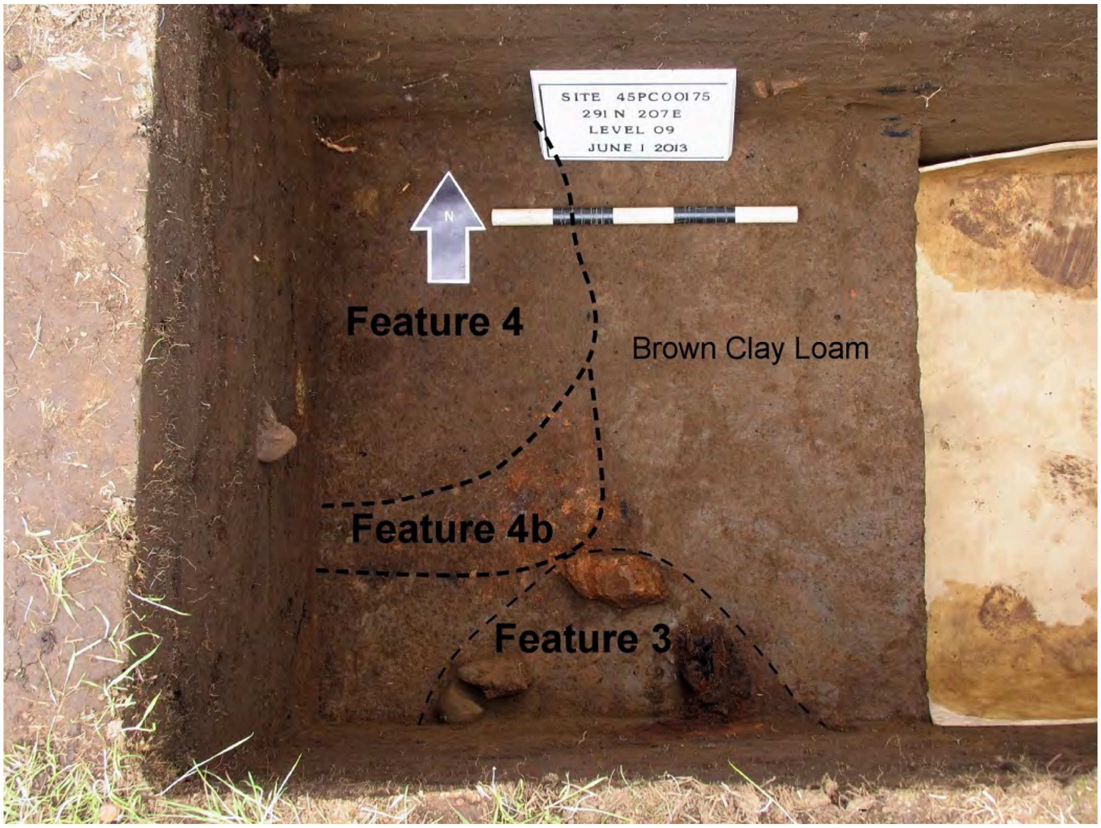

Figure 47. Features 3, 4b, and 4 in N291E207.

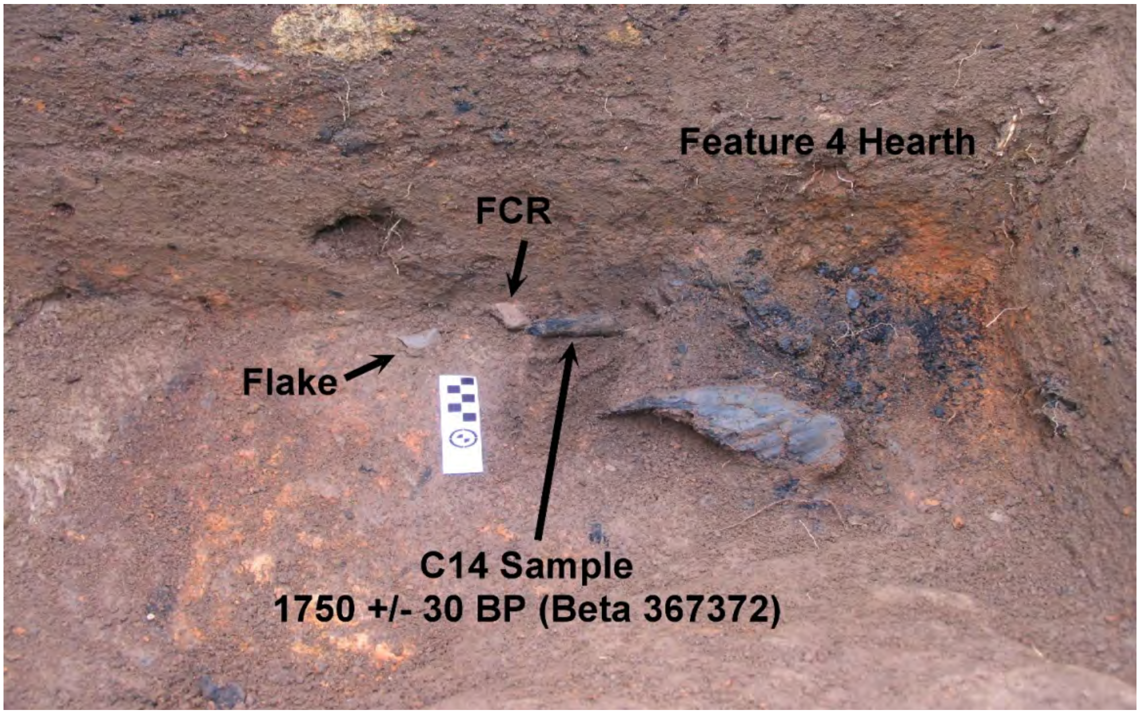

Figure 48. Feature 4 hearth details: a basalt flake, FCR, and the charcoal sample in N291E207.

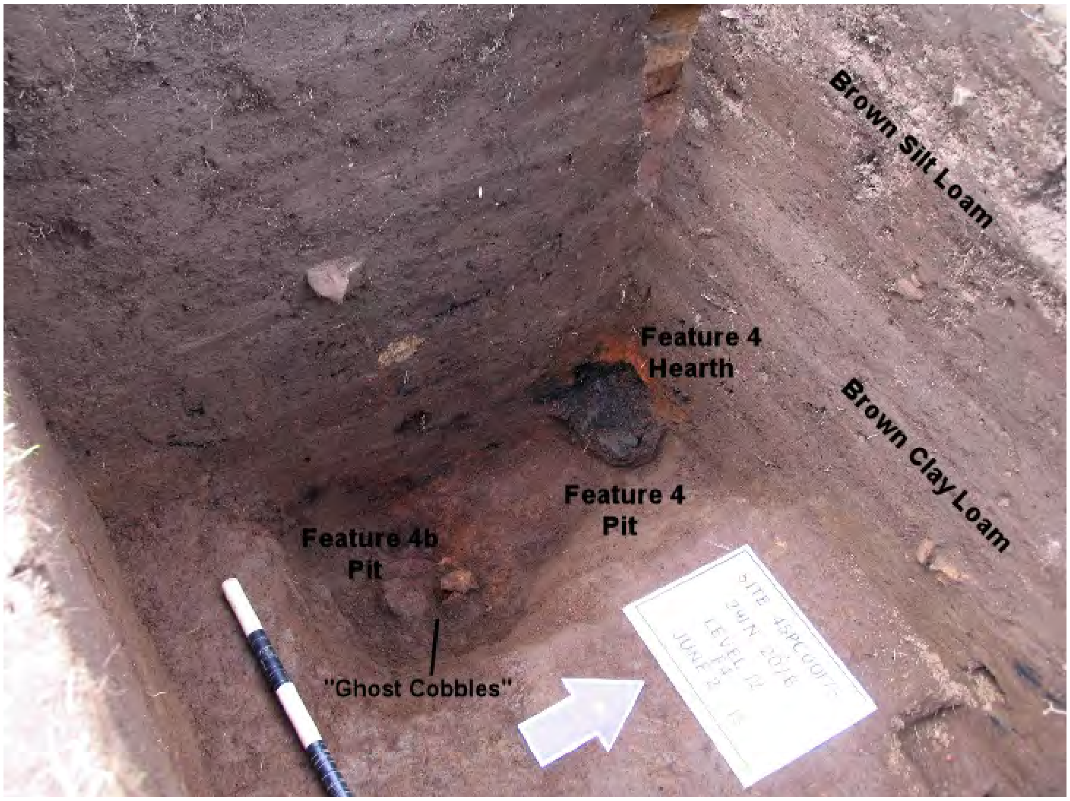

Figure 49. Feature 4 pit, charcoal, and “ghost cobble” FCR in N291E207.

Figure 50. Feature 2 in N292E206 (100 cm below datum).

Figure 51. View of N292E206 (with sign and arrow), N292E207 (with F4 pit and hearth), and N293E206 (with F2 burn staining). View to the W-NW.

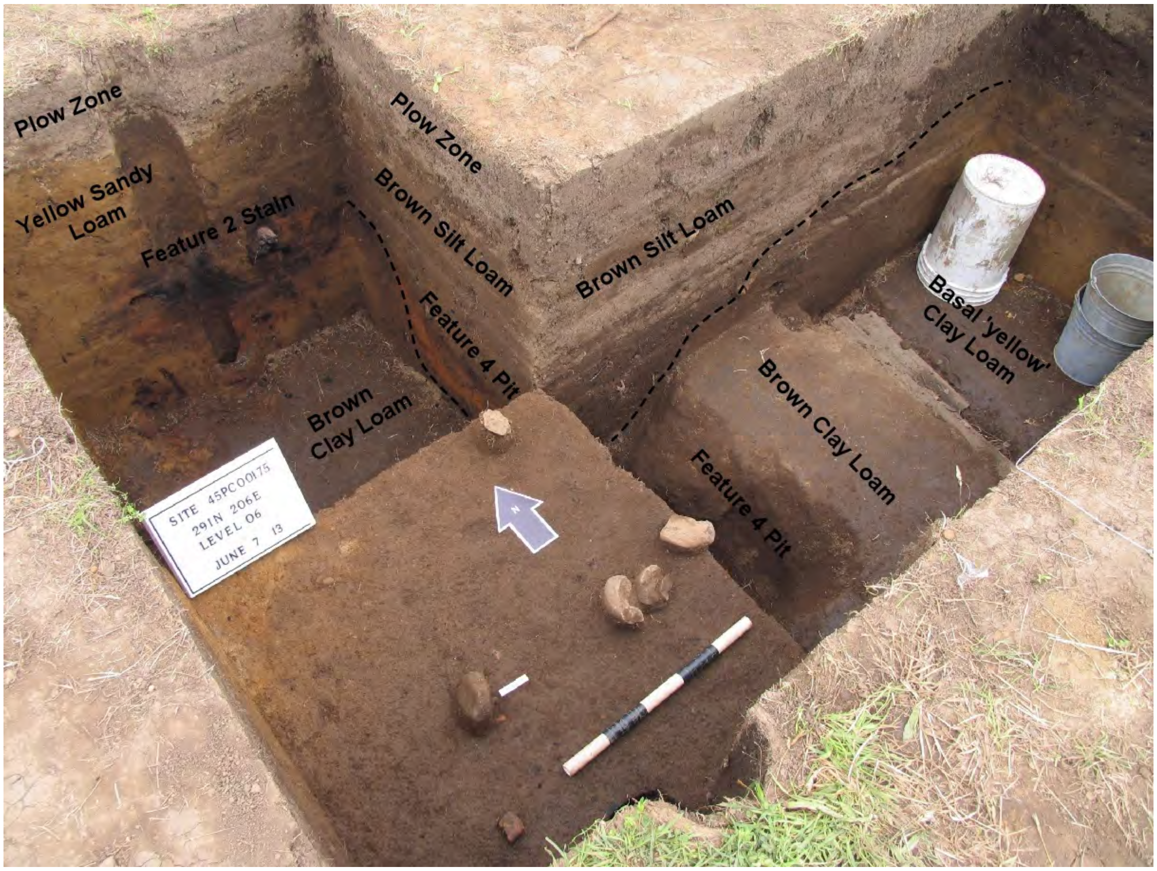

Figure 52. View of N291E206 (with sign and arrow), N291E207 (with F4 pit), and N292E206 (with F2 burn staining, and yellow sandy loam in-fill caped by the plow zone). View to the NE.

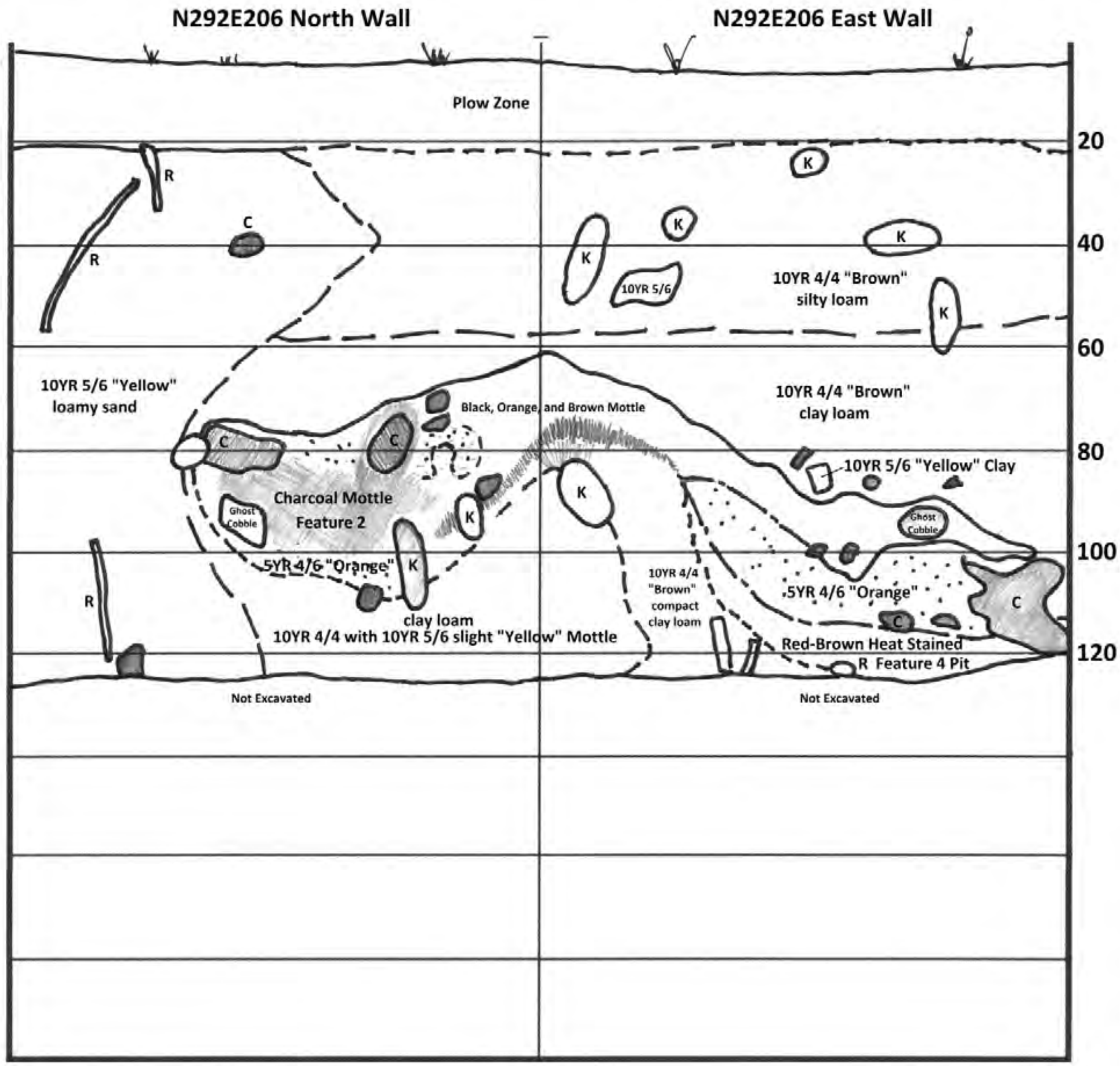

Figure 53. 45PC175 profile illustration (N292E206 north wall and N292E206 east wall). Feature 2 merging with the Feature 4 and 4b pit in the east wall of N292E206.

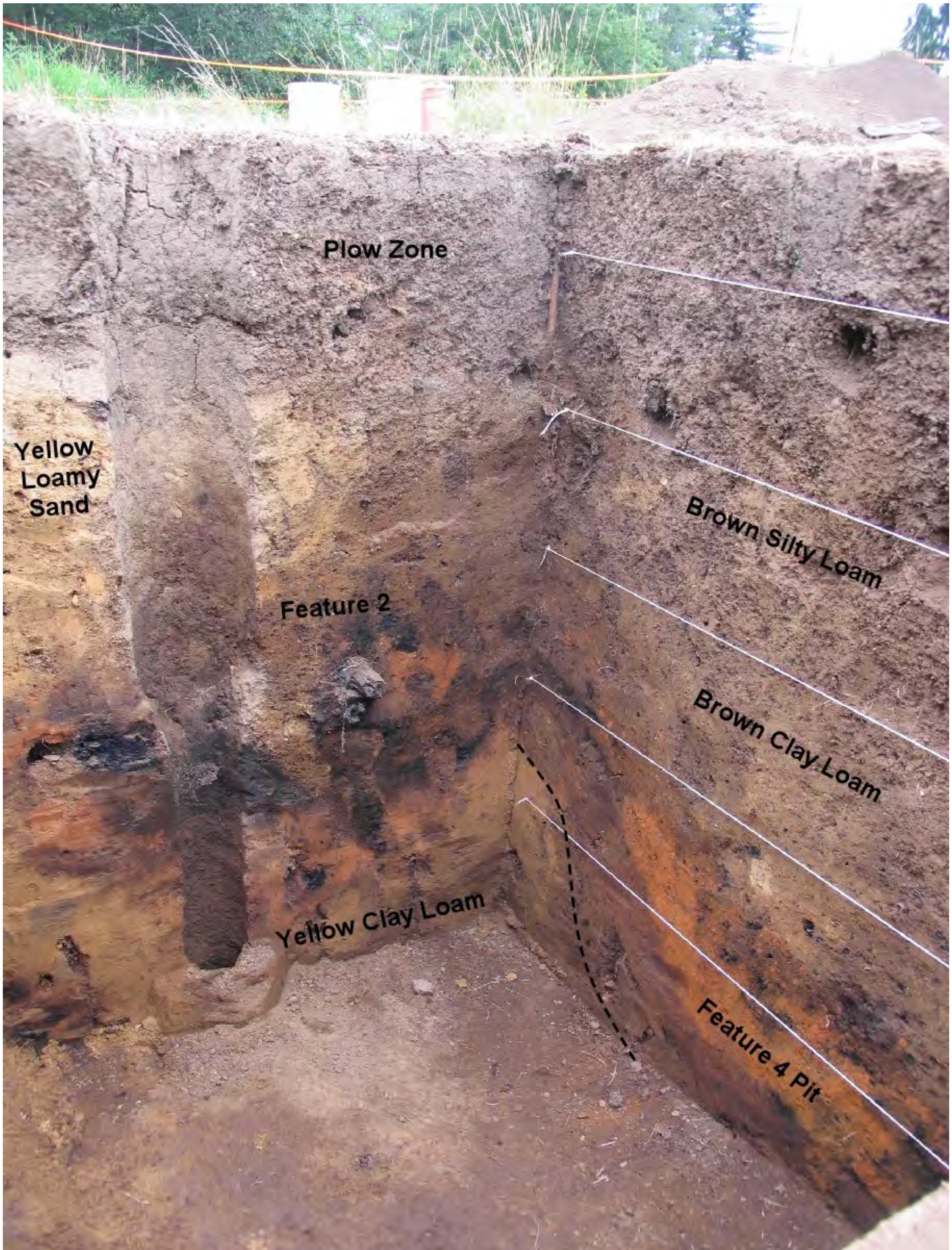

Figure 54. 45PC175 profile photograph (N292E206 north wall and N292E206 east wall). Feature 2 was exposed in the north wall of N292E206, merging with the Feature 4 pit in the east wall of N292E206. A soil core was taken from the north wall during site auger testing.

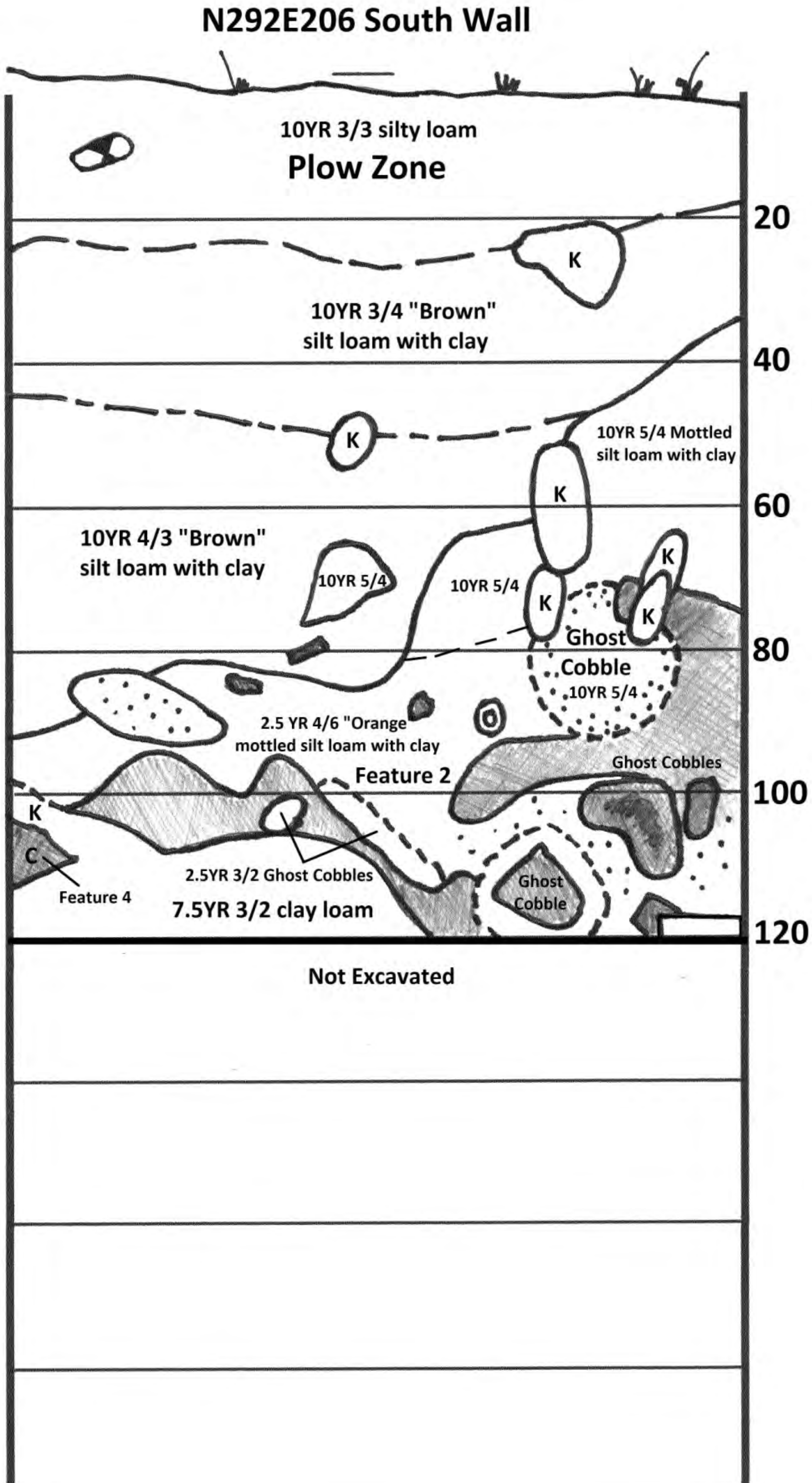

Figure 55. 45PC175 profile illustration showing Features 2 and 4 (N292E206 south wall).

Figure 56. 45PC175 profile photograph with Features 2 and 4 (N292E206 south wall).

Middle Period Features 7 and 2b

Feature 7 was the deepest, oldest, and largest pit feature exposed in excavation unit N291E207. Feature 7 was a dish-shaped pit feature that was larger than Features 4b and 4. Feature 7 was approximately two meters long (east-west) and one and a half meters wide (north-south). Feature 7 is shown in Figures 45 and 46, and Figures 57 - 59. No radiocarbon sample was submitted from the central base of Feature 7, as was for Features 4 and 4b, but a radiocarbon sample from the brown clay loam approximately fifteen centimeters above the eastern margin of Feature 7 was dated at a 2490 +/- 30 BP (Beta 367371) (Figure 57). The base of Feature 7 consisted of brick-red heat-stained sediment (Figure 59), but did not contain large fragments of charcoal suitable for radiocarbon dating. The charcoal-rich base of pit Feature 4b was separated from the heat-stained (5YR 5/6) base of Feature 7 by a two to four centimeter thick band of non-charcoal stained clay loam sediments that were likely overbank flood deposits (Figures 45 and 46). The Feature 7 pit was dug into culture-rich brown clay loam older than 2490 +/- 30 BP.

Feature 2b (Figures 60, 61, and 63) was a dispersed scatter of FCR, charcoal, heat-stained soil, and a few lithic flakes. Feature 2b is deeper, older, and thinner, than the overlying Feature 2, but it represents the same type of hearth debris “pit cleaning” scatter from Feature 7, rather than from Features 4b and 4. Feature 2b was exposed between 90 and 120-centimneters below the surface datum in unit N294E206, and between 105 and 137-centimeters below the surface datum in unit N290E204 (Figures 61 and 63). Feature 2b was a one to four-centimeter thick discontinuous band of “hearth cleaning” materials, rather than a thick deposit such as Feature 2. Feature 2b is believed to have been related to the Feature 7 pit. Radiocarbon samples have not yet been submitted from Feature 2b.

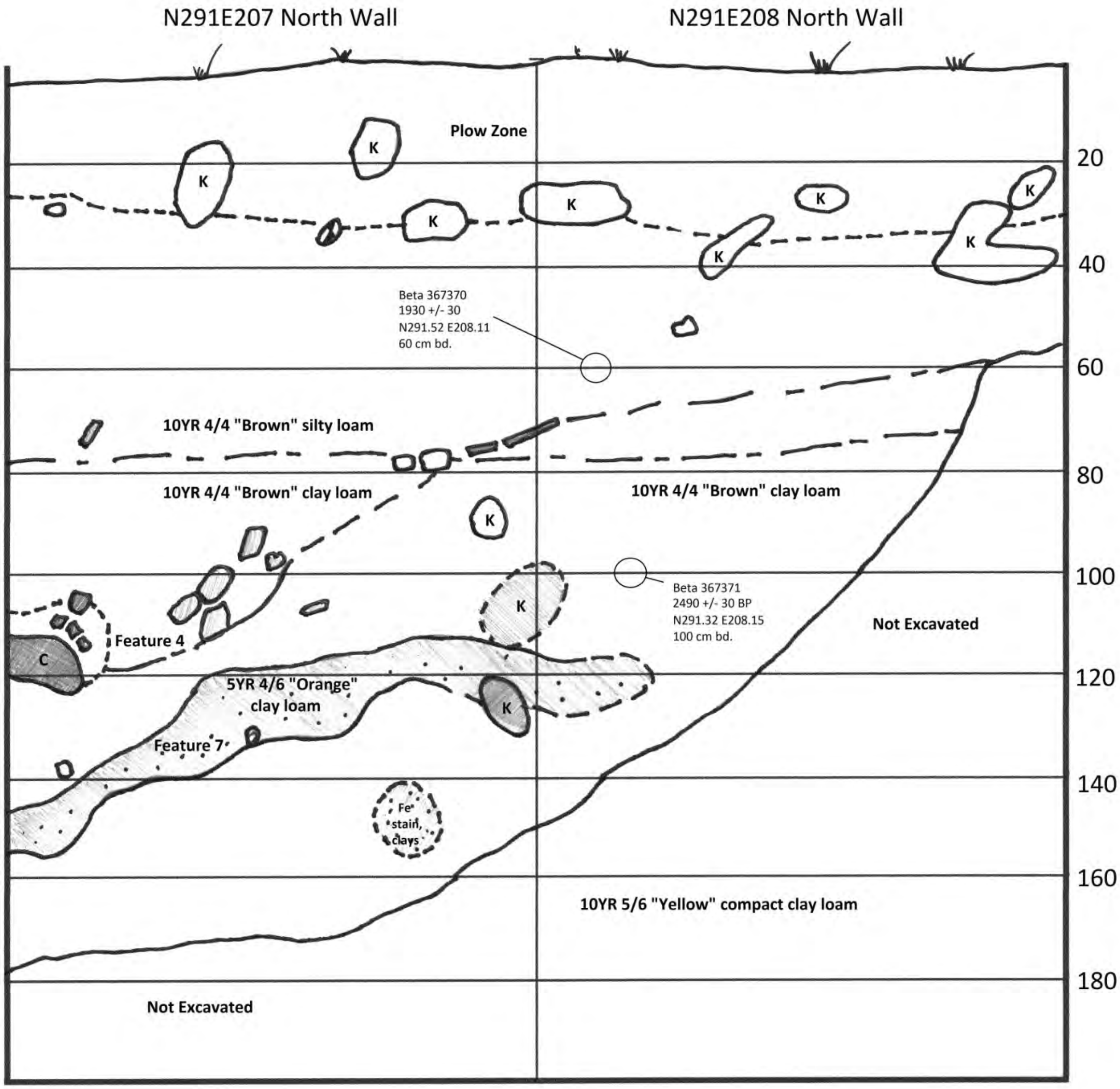

Figure 57. 45PC175 profile illustration with Features 4 and 7 (N291E207 and N291E208 north wall).

Figure 58. 45PC175 profile photograph (N291E207 and N291E208 north wall).
Features 4 and 7 are exposed in the north wall.

Figure 59. Heat-stained pit Feature 7 and the nested pit Features 4 and 4b in N291E207.

Figure 60. Feature 2b in N294E206 (90-120 cm below datum).

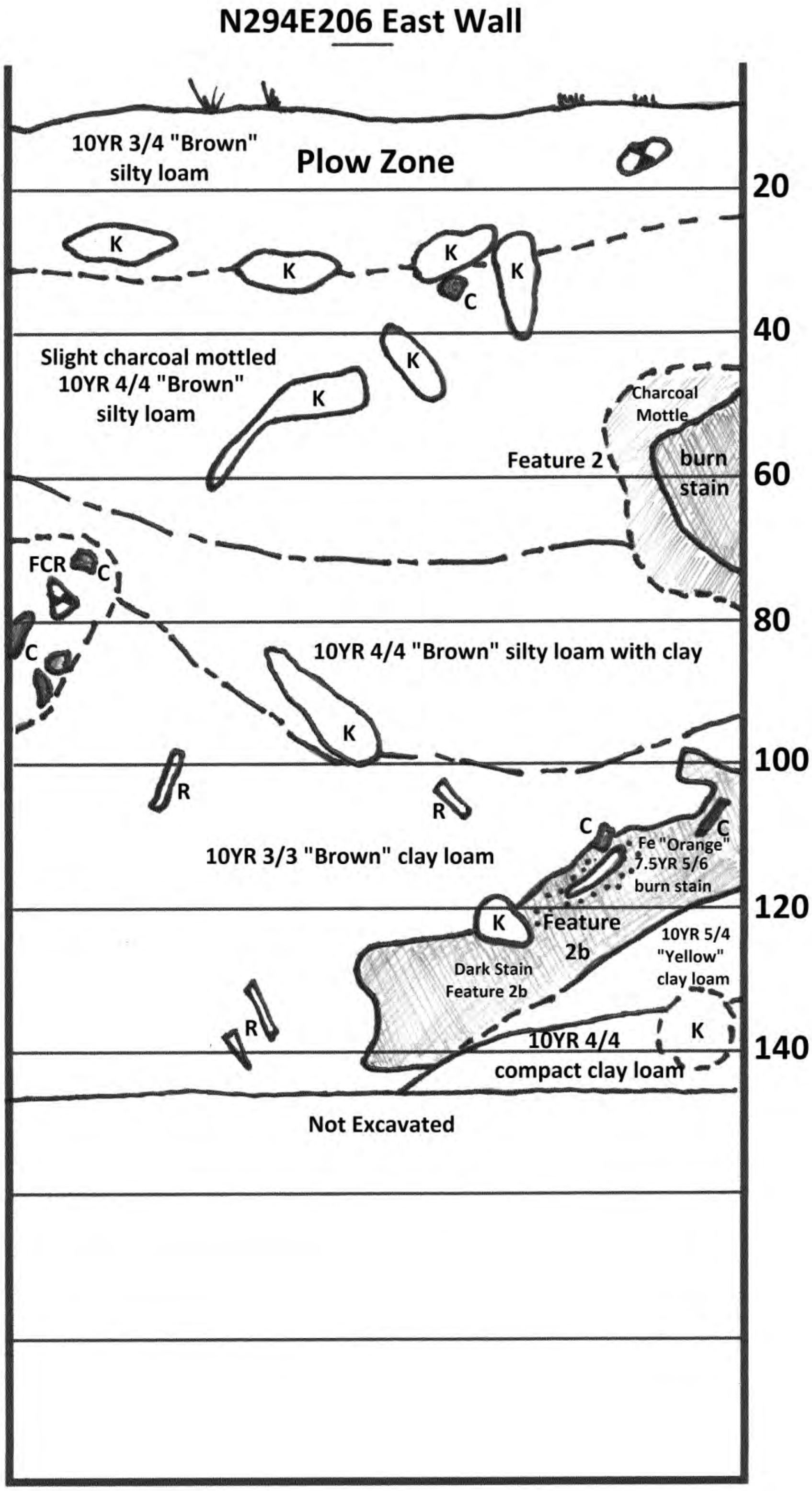

Figure 61. 45PC175 profile illustration (N294E206 east wall). Features 2 and 2b are exposed in the profile.

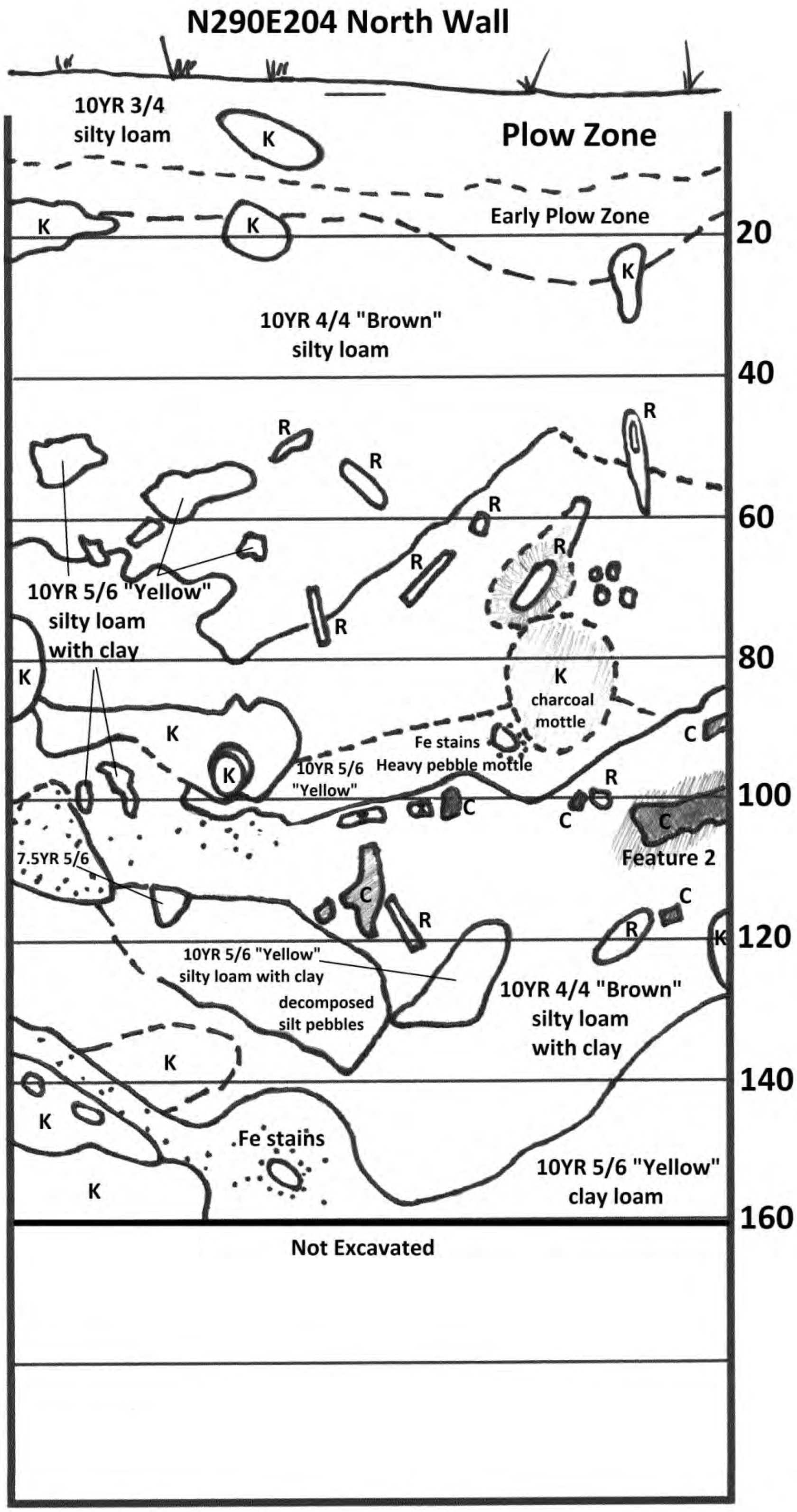

Figure 62. 45PC175 profile illustration (N290E204 north wall).

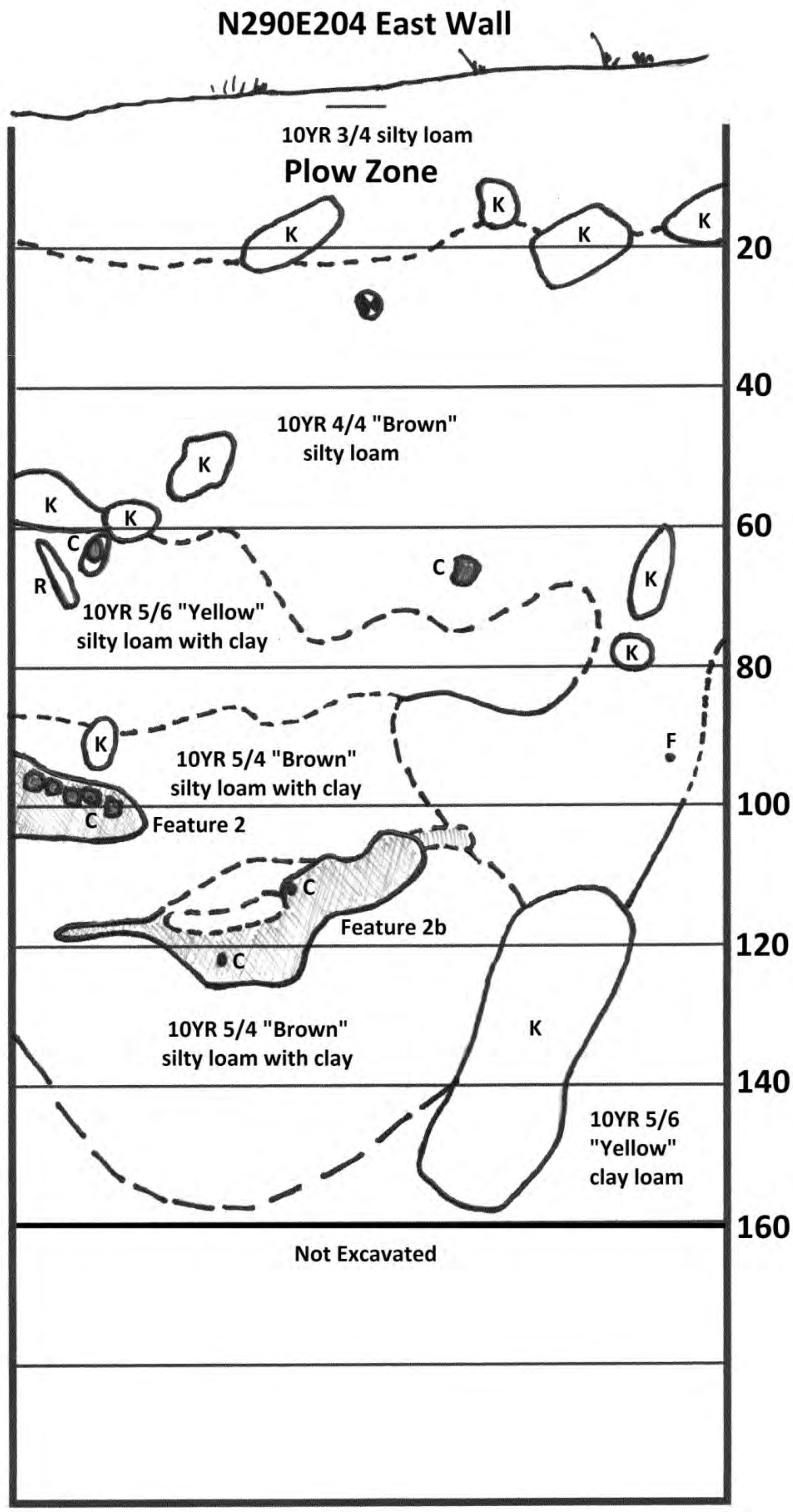

Figure 63. 45PC175 profile illustration (N290E204 east wall).

Early Period Features 8, 9, and 9b

Features 8, 9, and 9b were temporally related surfaces resting in brown clay loam sediments approximately one to ten centimeters above the disctinct surface of the culturally-sterile Stratum 2. Feature 8 was exposed in unit N291E207 (Figure 64), Feature 9 in unit N294E207 (Figure 65), and Feature 9b in unit N294E206 (Figures 66, and 68 - 70). These combined features represt the deepest and oldest occupation surface at the site. These "early period" features are situated under Features 7 and 2b. The five to twenty-centimeter thick deeply buried occupation surface descended toward the channel of the Willapa River, following the terrace bank facies slope of the Stratum 2 basal yellow clays that it was resting on,. The occupation surface was buried between 143 to 178 centimeters below the surface. Cultural charcoal recovered *in-situ* (Figure 66) near a siltstone flake and cobble grouping within Feature 9b was found to have a conventional radiocarbon date of 2440 +/- 30 BP (Beta 367373). The best 2-sigma "calendar calibrated" date provided by Beta Analytic for the single sample from Feature 9b was Cal. BP 2550 to Cal. BP 2360 (Beta 367373) (Appendix A). The deepest radiocarbon sample from the base of Feature 9b closest to the Stratum 2 boundary dated to 2584 +/- 31 BP (UW D-AMS 004837; Figures 67 - 69). The radiocarbon date "calendar calibrated" to Cal. BP 2768 to Cal. BP 2725 (OxCal 4.2, IntCal13 curve; Bronk Ramsey 2009).

Feature 8 had two FCR cobble fragments weighing a total of one-kilogram. Features 9 and 9b had a combined total of thirteen FCR cobbles weighing a total of 13.6-kilograms. A fragment of a fossileferous CCS scraper (Cat. 183), and a jasper biface base fragment (Cat. 184) were found within the Feature 9b occupation surface. The highly acidic matrix of the basal levels (Table 5) contributed to the formation of "ghost cobbles" and soft decomposed siltstone lithic flakes within Features 8, 9, and 9b.

Figure 64. Feature 8 in N291E207 (156 cm below datum).

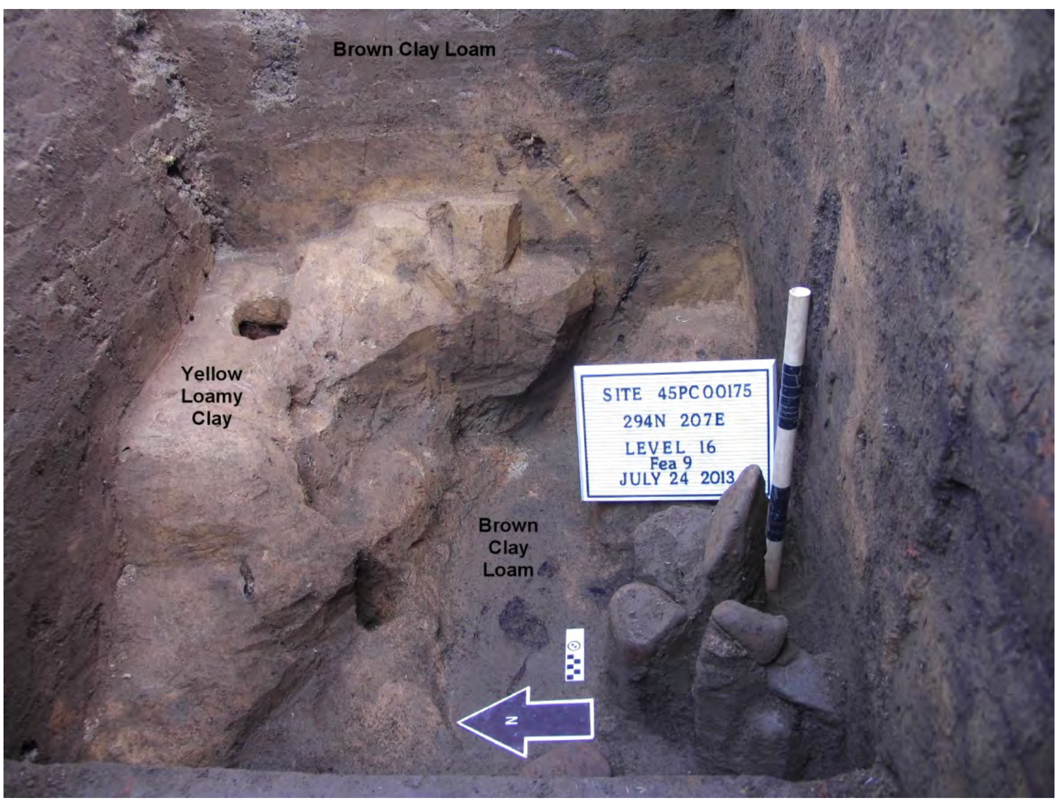

Figure 65. Feature 9 in N294E207 (143-165 cm below datum).

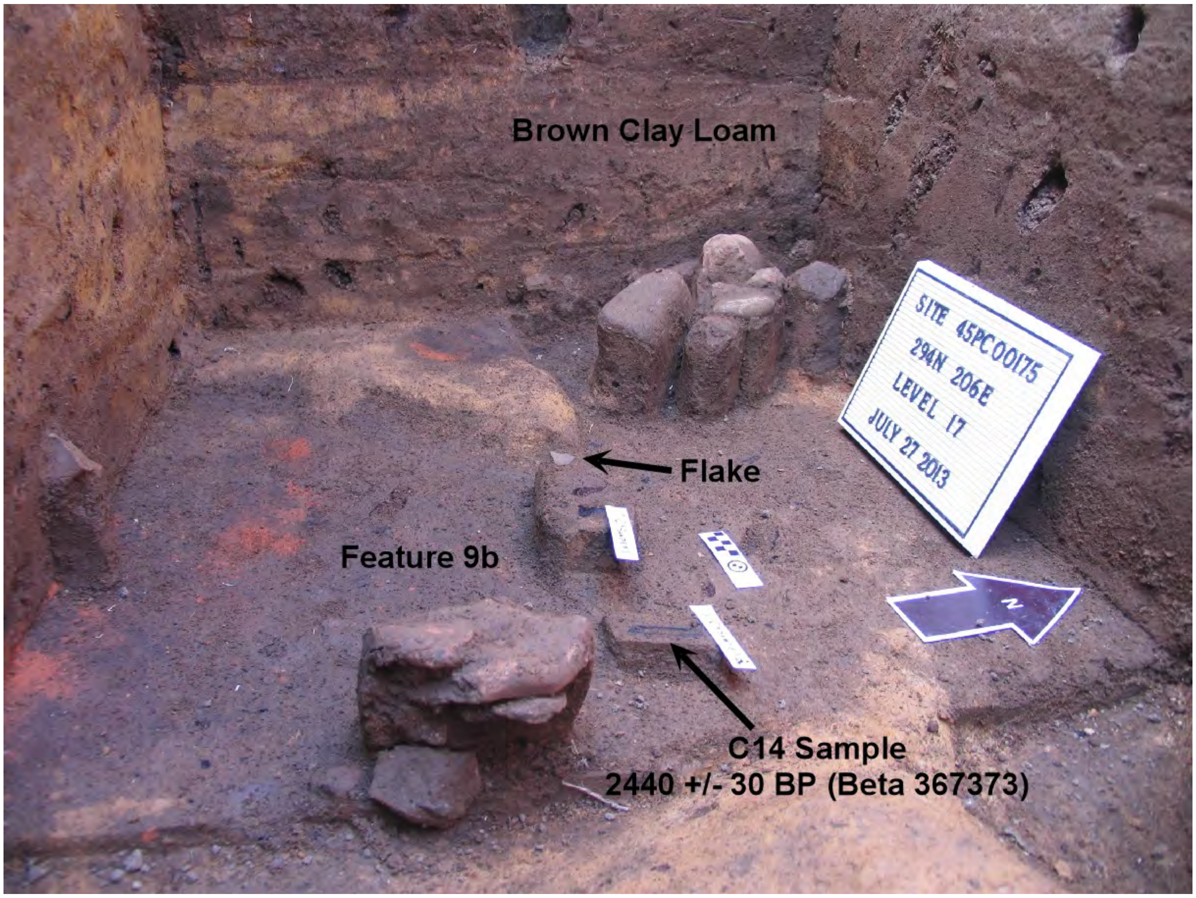

Figure 66. Feature 9b in N294E206 (161-174 cm below datum).

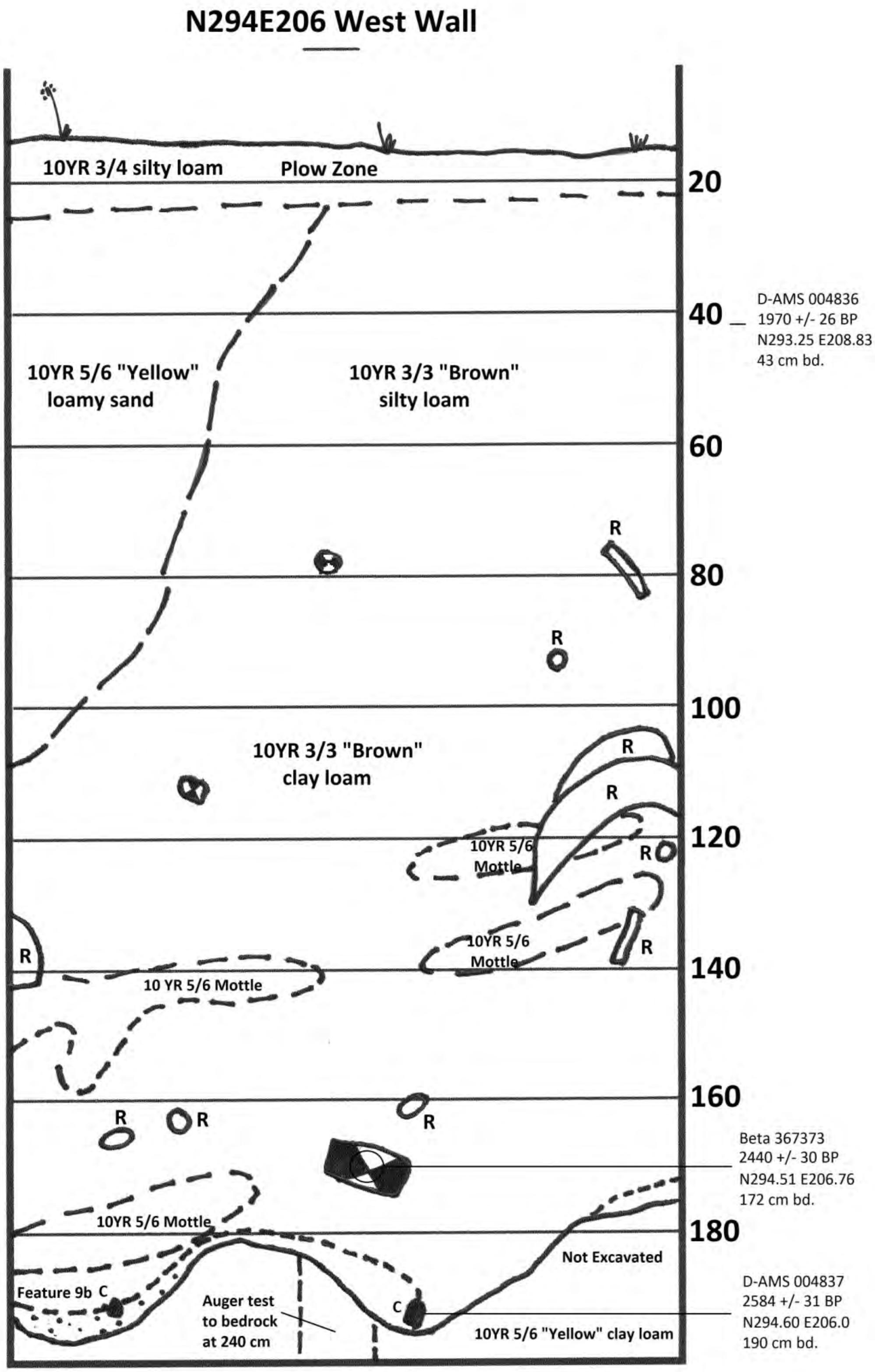

Figure 67. 45PC175 profile illustration (N294E206 west wall).

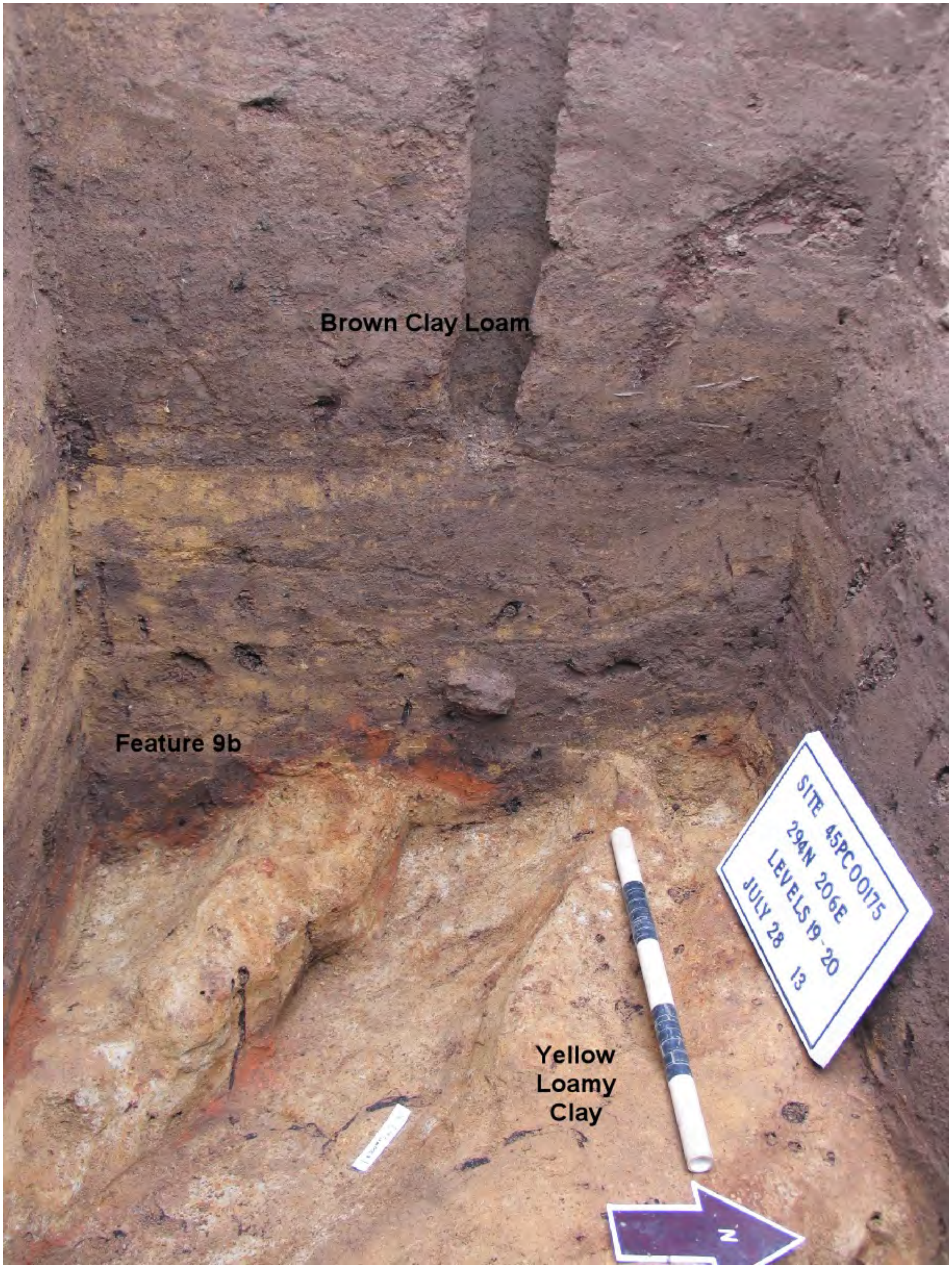

Figure 68. 45PC175 profile photograph (N294E206 west wall base).
Soil core sample taken from the east wall.

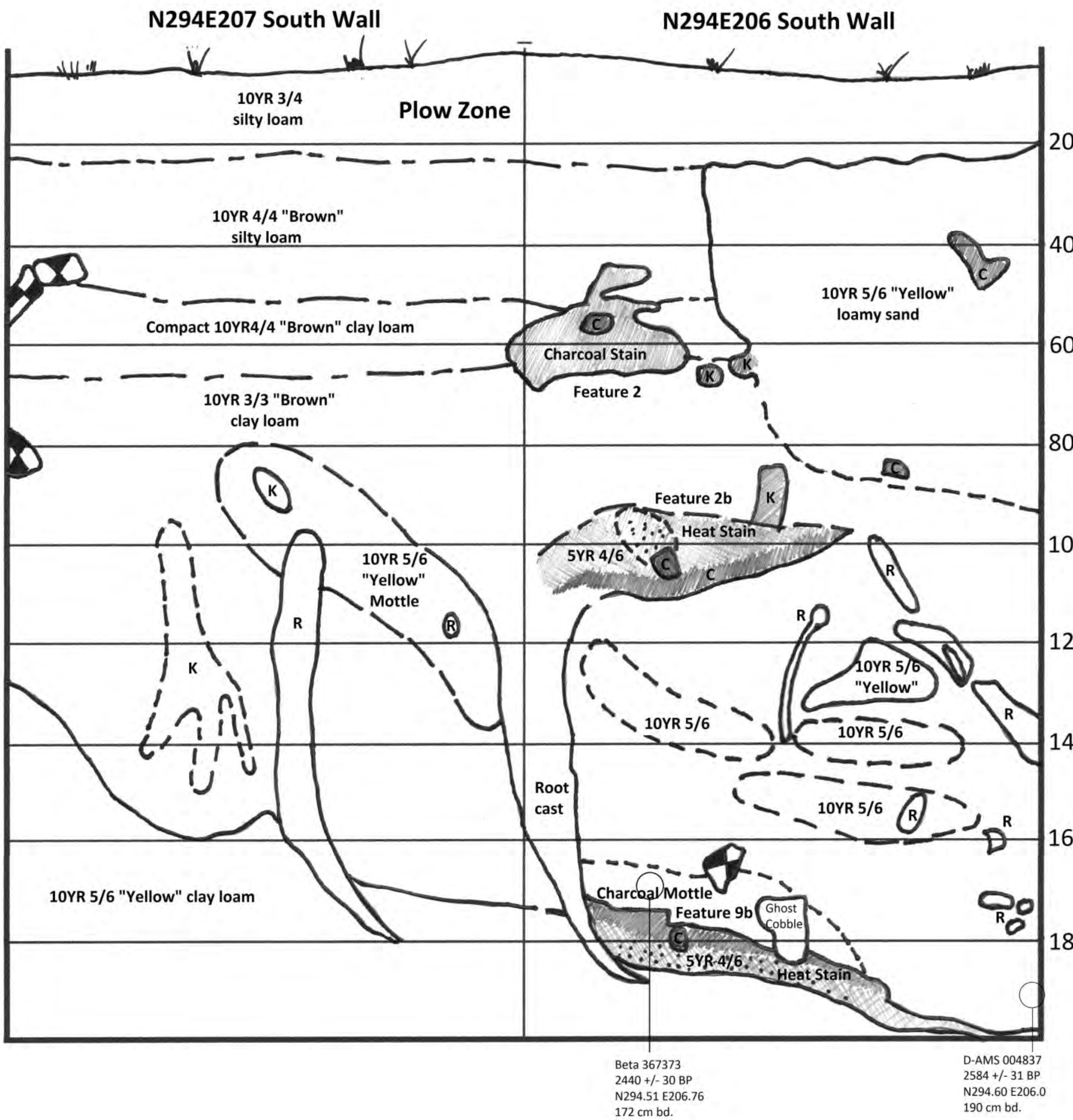

Figure 69. 45PC175 profile illustration (N294E207 and N294E206 south wall). Features 2, 2b, and 9b.

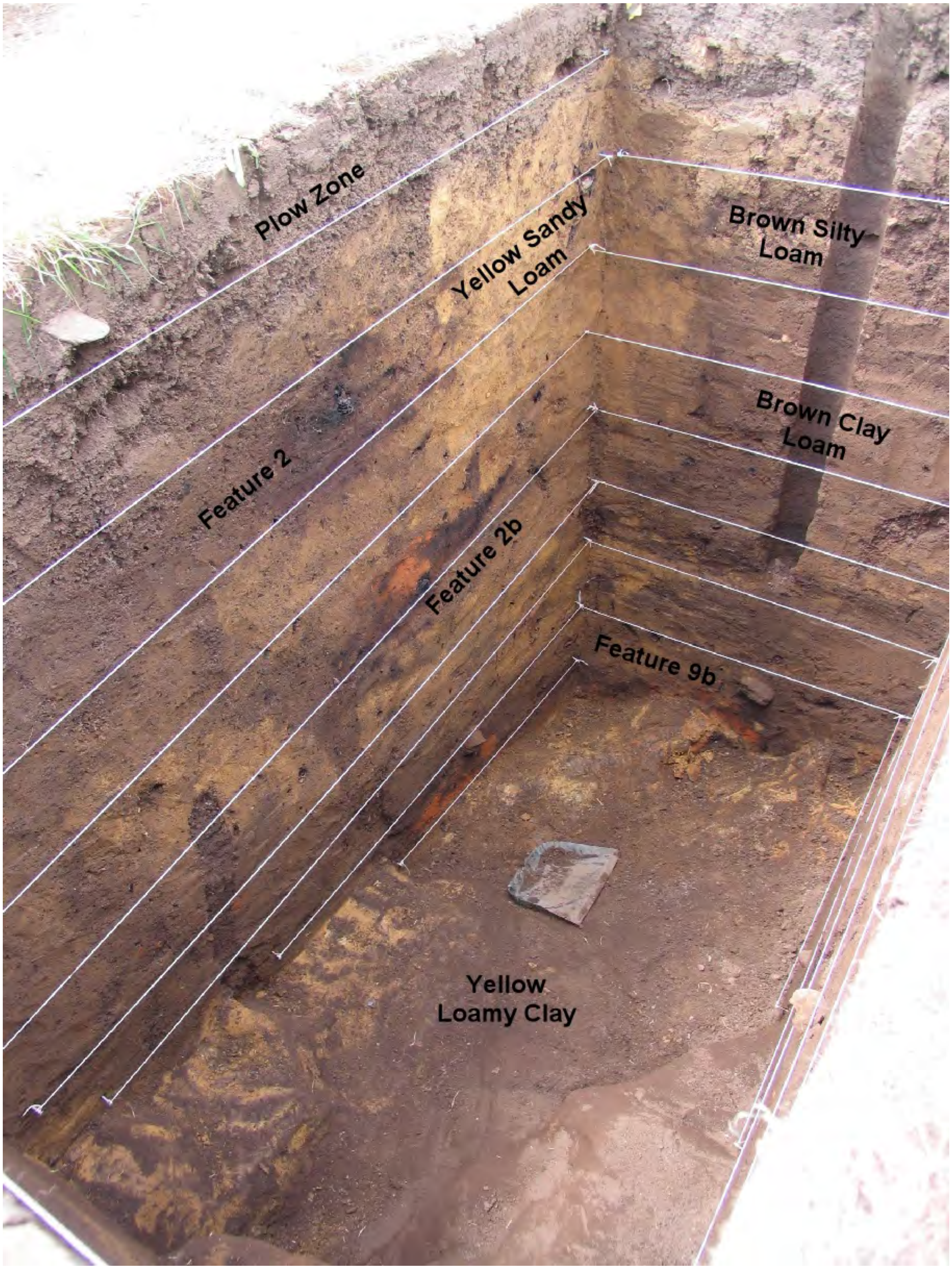

Figure 70. 45PC175 profile photograph (N294E207 and N294E206 south wall). Features 2, 2b, and 9b.

Early Period Feature 1

Feature 1 was a “clover shaped” concentration of cultural wood charcoal located at the base of excavation unit N290E204 between 140 and 150 cm below the surface (Figure 71). A single lithic flake was found within the heavily charcoal-flecked sediments of the feature. The feature was resting directly above the culturally-sterile yellow loamy clay Stratum 2 basal terrace sediments. Feature 1 may have represented an early hearth related to Features 8, 9, and 9b. It could potentially have been related to the more recent large charcoal scatters of Features 2b and 2 were located above, and approximately 1.5 to 3 meters to the north-northeast. There were several three to four-centimeter thick charcoal lenses in the east wall of N290E204 (Figures 62 and 63) that were likely related to Features 2b and 2. The Feature 1 charcoal-rich shallow “lobed pit” did not appear to be connected to the charcoal lenses in the east wall and northwest corner of unit N290E204.

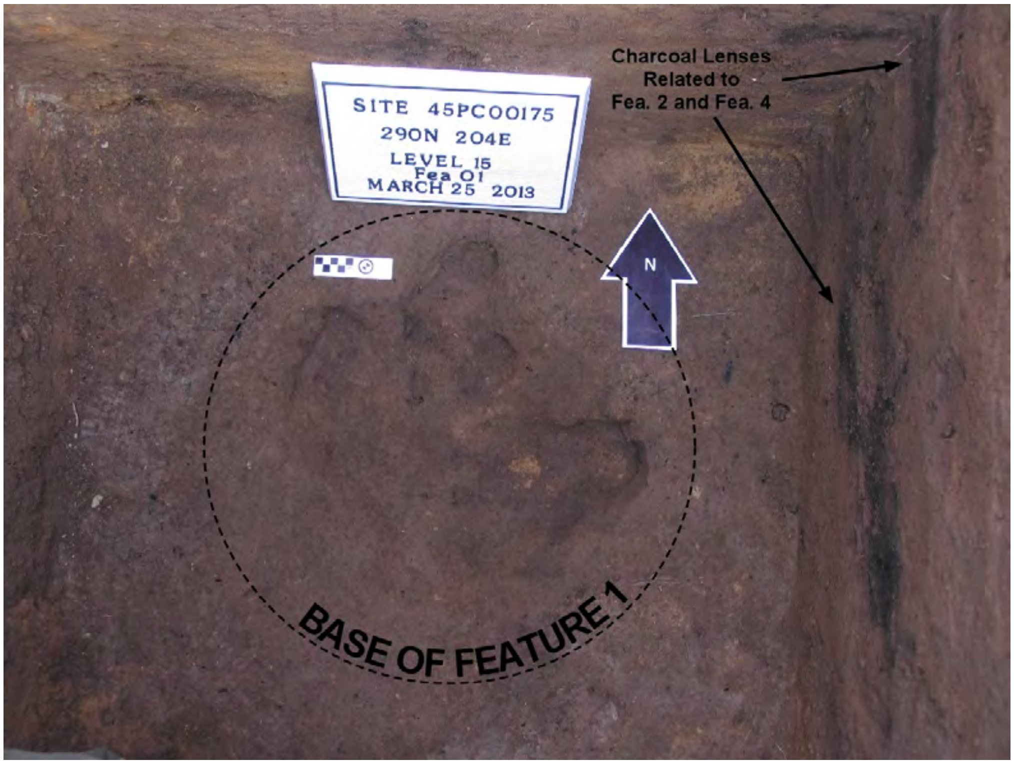

Figure 71. Base of Feature 1, 150 cm below the surface in N290E204.

Excavation Units Without Features

No cultural features were identified in either of the "satellite" excavation units that were dug away from the primary excavation area, but cultural debris and artifacts were present. Unit N260E162 (Figure 72) had an approximately seventy-centimeter thick bed of culture-rich Stratum 1 silt and clay loam resting on culturally-sterile Stratum 2 sediments. The margin between Stratum 1 and Stratum 2 in unit N260E162 was highly irregular due to tree root intrusions. The Stratum 2 sediments in unit N260E162 were far more sandy than in the primary excavation area to the northeast, but were not sand dominant as in the post-1700 BP discontinuous "unconformity" in-fill stratum encountered in portions of the primary site excavation closest to the Willapa River channel. Distinct *redox* process mineral staining is present in the extra-sandy Stratum 2 sediments.

In unit N280E201 (Figure 73), Stratum 1, including the A/E and B soil horizons, was completely incorporated into the plow zone. Early plowing and field leveling may have reduced the thickness of Stratum 1 in this location, where it may have already been thin to begin with. Unit N280E201 may have also been placed in an area where there was some kind of rise or high-point of the basal Stratum 2 sediments.

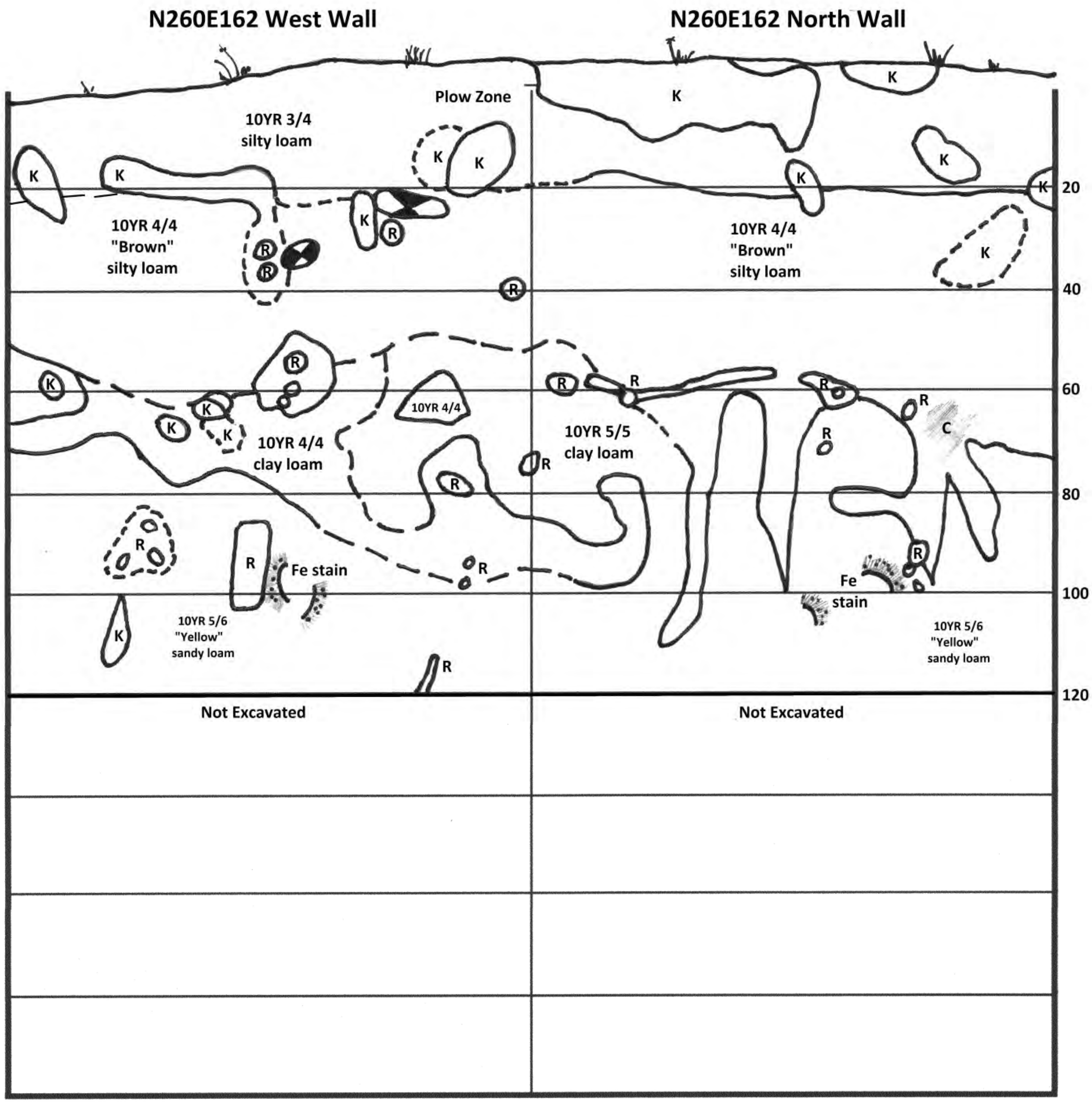

Figure 72. 45PC175 profile illustration (N260E162 west wall and N260E163 north wall).

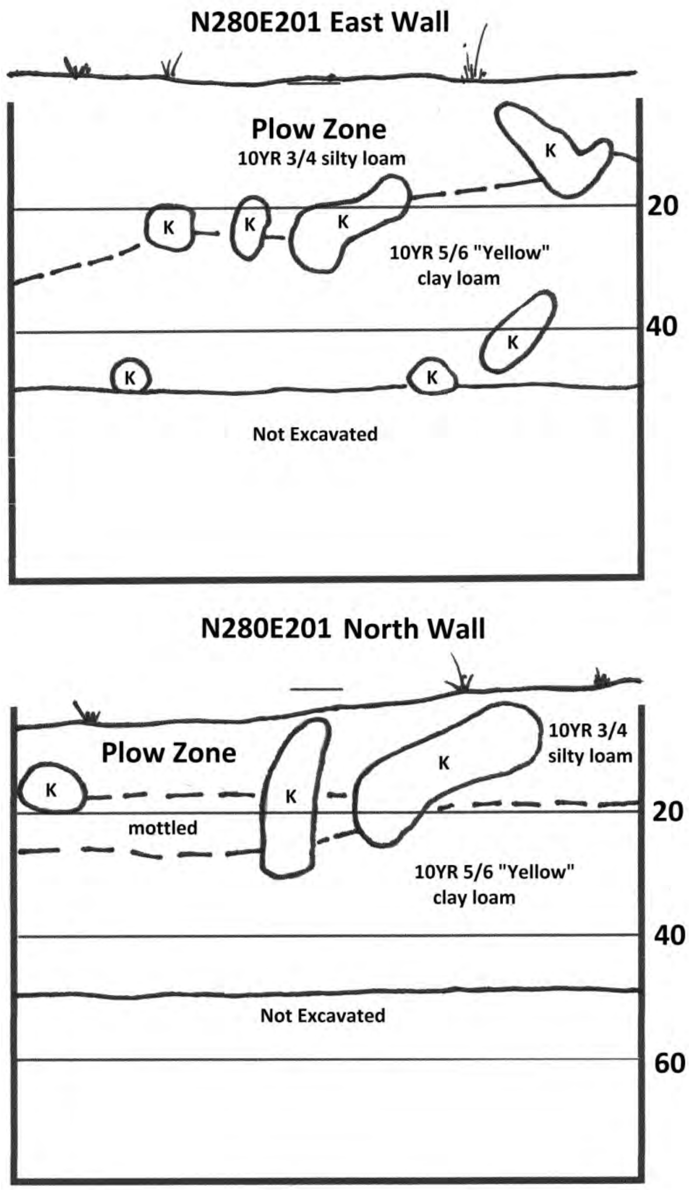

Figure 73. 45PC175 profile illustration (N280E201 east and north wall).

45PC175 Artifacts and Cultural Debris

Artifacts and Cultural Debris were present throughout Stratum 1. Only a small percentage of the artifacts and debris were clearly associated with buried features and their associated occupation surfaces. Most of the artifacts and debris were suspended within the sediment matrix between the obvious features and distinct cultural layers. The uninterrupted cultural deposition at the Forks Creek site is characteristic of long-term continuous use of the terrace landform throughout the Late Holocene.

Fourteen cobble tools and 112 chipped stone tools were recovered from the 2013 excavation (Table 8). In addition to the 126 total chipped stone and cobble tools, the team recovered 3421 pieces of lithic flaking debitage. There was an average of approximately 9.4 lithic tools, and 257.2 lithic flakes, within each cubic meter of excavated sediment. No bone tools were recovered, and only three irregular fragments of shiny black fire-carbonized interior spongy bone were found, the largest weighing only 1.6 grams. The interior spongy bone fragments had no intact morphological surface features, but likely came from an animal of the same size class range as a deer or elk. No marine or freshwater shell artifacts or debris were recovered from the site. Bone and shell were not preserved within the highly acidic depositional context of the site terrace. Within the B soil horizon of Stratum 1, the team frequently encountered partially dissolved indurated siltstone flakes that had turned into a soft-clay or chalky texture that would easily crumble, hindering preservation. Similarly, some of the “ghost cobble” mineral stains that represented dissolved siltstone cobbles may had once been hammer stones, choppers, cores, or grinding tools. No wood tools or pre-contact ceramic/clay artifacts were recovered, but burned wood charcoal debris was abundant. No ground slate or nephrite tools or debris was located. Fortunately, a sample of identifiable seeds and small botanical remains were recovered from the 1/4 inch, 1/8th inch, and 1/16th inch screens. Sediment samples were collected from each level below the plow zone, but flotation studies have not been initiated. A database that includes all of the artifacts and debris from site 45PC175 is in included in Appendix B.

Artifact Classification and Typology

All of the chipped stone tools (112) and unmodified lithic debitage (3421) were initially sorted using the morphological typology flow chart developed by Andrefsky (2005). This method was selected primarily for its strength in replication, for its speed, and for the efficiency it offers in creating further classification to address a diversity of technological or behavioral hypotheses. Additionally, all artifacts and debris were classified into one of four ordinal size-classes assigned using square-mesh classifying screens (01: >1/2 inch, 02: > 1/4 inch, 03: > 1/8 inch, 04: < 1/8 inch), and by material type. All artifacts and debris were weighed in grams on a digital scale with an accuracy of two decimal places. Formalized chipped stone and cobble tools were measured in millimeters using analog calipers accurate to two decimal places.

Several large family collections of Willapa River Valley artifacts were documented and studied over several years prior to the excavation at Forks Creek (Chapter Six of this study). The preliminary collection artifact analysis resulted in the development of a near-complete typology of formalized Willapa artifacts that lacked a temporal context beyond what could be inferred from informal seriation of artifact forms based on regional trends, and rarely from artifact cortical patination suggestive of either significant age, or recent manufacturing or maintenance. This preliminary Willapa artifact typology was based on the works of Pettigrew (1981) in the Portland Basin, and Minor (1984), in the Lower Columbia River. Comparative efficiency and cultural relevancy were the primary factors that led to the adoption of these classifications as the foundation upon which to develop a Willapa River Valley typology. The Willapa projectile point and knife typology adheres closest to the Pettigrew (1981) and Minor (1984) classification forms, while the diverse group of classified Willapa scraper tools does not closely conform to the Portland Basin or Lower Columbia River classifications.

Artifact Distribution

The highest density of lithic tools and debris within the site was encountered in the plow zone. Radiocarbon samples from near-surface minimally disturbed FCR features suggest that the past 1700 years of history and pre-history has been thoroughly mixed into the single historic and modern disturbed plow-zone feature. The context for more than half of the temporal span of pre-contact cultural occupation of the site terrace was disturbed by plowing at the onset of the middle 19th century agricultural era, when *Forks Prairie* became the agricultural *Forks Field*, and the wagon road crossed the Willapa River downstream from the site near the mouth of Forks Creek.

Basic trends in lithic reduction intensity and tool disposal at Forks Creek were explored by plotting the frequency of lithic debris and formalized artifacts found within the site's excavation levels (Figures 74 and 75). In these figures, the plow-zone, level one, and level two have been combined and averaged into columns of identical value. The context and detail of these near-surface layers has been lost to cultural disturbance processes. There appears to be a weak bimodal distribution of lithic debris frequency at the site (Figure 74). An early increase in lithic debris production between 110 and 140 centimeters below the surface was followed by a reduction of lithic intensity around 100 centimeters below the surface. A steep increase in lithic production intensity was evident into shallower levels, extending into the plow zone.

A bar-plot illustrating only formalized artifacts by level (Figure 75) does not display the subtle increase in lithic intensity during the early period like the larger lithic debris sample. An examination of the distribution of specific tool forms by level is much more revealing (Table 8), allowing one to discriminate which tool forms are represented in each level, and what types of tool forms were responsible for the irregularities in tool frequency illustrated in Figure 75.

Table 8 helps us interpret the details of the minor “spikes” in formalized artifacts within levels six, twelve, and the plow zone (levels one and two) that are illustrated in Figure 75. There were slightly more cores and “microblade” cores recovered in level six. Biface fragments were contributing to the rise in tool frequency in level twelve. The artifact rich plow zone had an abundance of projectile points, unimarginally retouched flakes, and the only distinct graver tool form recovered from the relatively small excavation.

The weak bimodal pattern in the frequency of lithic debris within the site’s levels (Figure 74) may be reflected in the vertical distribution of grouped cultural features. The cultural features at the Forks Creek site can be generally grouped into the deeply buried middle and early period (Features 7, 2b, 1, 8, 9, and 9b), and the shallow late period (Features 4b, 4, 2, 3, 6, 5, and the plow zone). The early period of lithic reduction intensity (levels eleven to fourteen) may have been associated with the deepest and widest pit Feature 7, and the related debris scatter Feature 2b. The later period of lithic intensity (levels one through nine) may have been associated with the intrusive pit Features 4b, and 4, the related “hearth cleaning” debris scatter Feature 2, and the most recent undisturbed FCR and charcoal Features 3, 6, and 5.

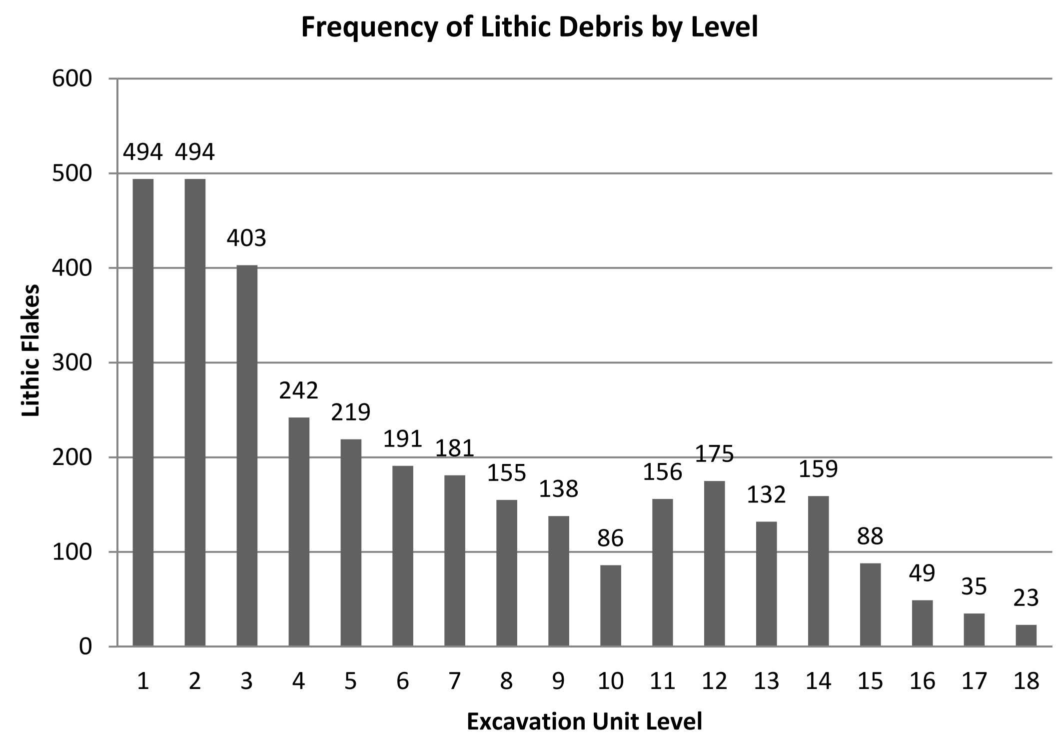

Figure 74. Frequency of 45PC175 lithic debris by level.

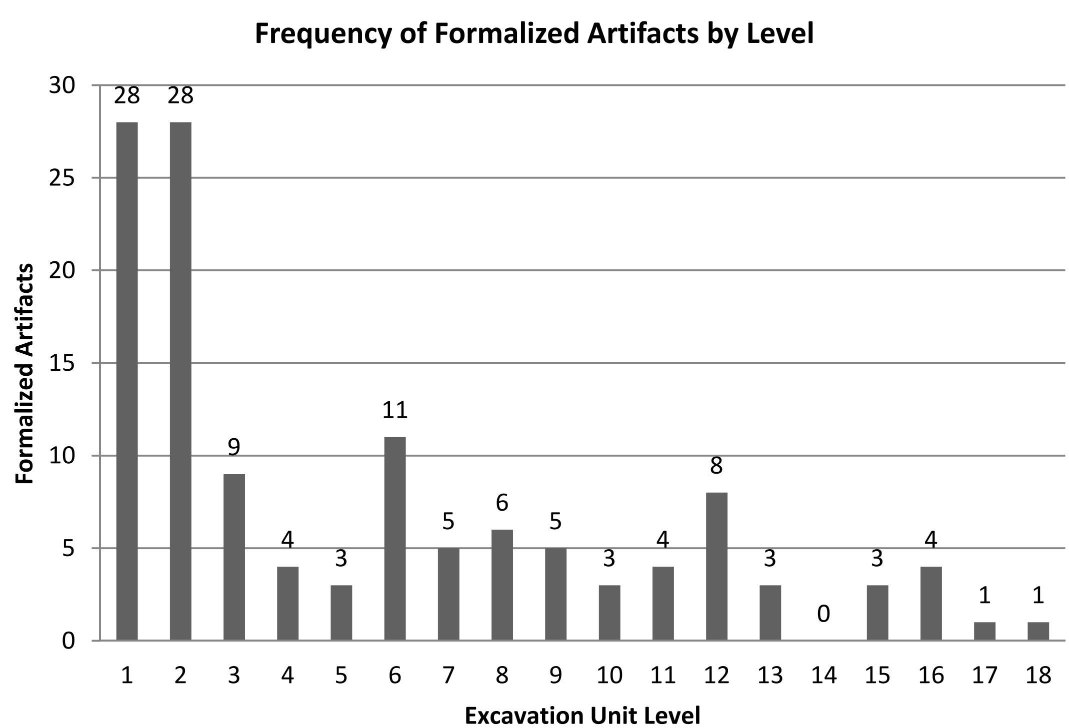

Figure 75. Frequency of 45PC175 formalized artifacts by level.

Table 8. Frequency of 45PC175 Formalized Artifacts by Level.

	LEVEL																		
Artifact Class	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**Totals**
Projectile Points																			
Type 01-05a	1																		1
Type 01-05b							1												1
Type 01-06a	1																		1
Type 01-09	2																		2
Type 01-10	2																		2
Type 01-14									1										1
point fragments	2	1		1		1		1											6
Biface Knives																			
Type 02-01a		1	1																2
biface fragments	5	1	2		1				1		1	3			1	2			17
Scrapers																			
Type 03-01	2	1						2				2							7
Type 03-02									1				1						2
Type 03-03	2																		2
Type 03-04									1										1
Type 03-07	1															1			2
Type 03-08	2	1					1												4
Type 03-09		1																	1
Type 03-14					1														1
Type 03-17	1	1																	2
Type 03-18	1		1	1	1	1	1				1								7
Type 03-19	1					1													2
Scraper fragments	1																		1
Gravers																			
Type 04-01	1																		1
Modified Flakes																			
Unimarginal	7	2	2			1	1	1	1	1	1	1	1		2	1	1		23
Bimarginal	1									1									2
Cores																			
Type 06-01	5	1		1		3	1			1	1		1					1	15
Microblades																			
06-02a Cores		1				2													3
06-02b Blades	1		1			1													3
Cobble Tools																			
Chopper 06-04	1		1																2
H. Stone 08-01	1	1	1	1				2				1							7
E. G. Cob. 09-01						1						1							2
Cob. Mortar 09-02	1																		1
Pestle Frag. 10-03	1																		1
Misc. Stone 20-01		1																	1
Total	43	13	9	4	3	11	5	6	5	3	4	8	3	0	3	4	1	1	126

The vertical distribution of projectile points (Table 8) is notable in that no projectile points were recovered from the site below level nine. This period is represented by the early subtle rise in lithic debris production illustrated in Figure 74. Biface knife fragments and scrapers were still represented below level nine. Microblade cores and microblade flakes were not recovered below level six.

The horizontal distribution of formalized artifacts is summarized in Table 9, and a plan view map of formalized artifacts that were recovered *in-situ* from within the excavation units surrounding the cultural features is shown in Figure 76. A map illustration of the frequency of all of the formalized tools recovered (*in-situ* and from the 1/4 inch and 1/8 inch screens) from within the excavation units surrounding the cultural features is illustrated in Figure 77.

Figures 76 and 77 illustrate the distinct lack of formalized artifacts within excavation units N291E206, N292E206, and the west half of excavation unit N291E207. Excavation units N291E206, N292E206 were situated over Feature 2 and the buried terrace facies slope of Stratum 1 (Figure 76). Feature 2 was a scatter of heat-stained sediments, dissolved and partially dissolved FCR, and charcoal fragments associated with the “cleaning” of “hearth” or “oven” pits of Features 4, 4b, and 7. The Feature 2 hearth debris was strewn over the residual terrace facies slope below the western rims of pit Features 7, 4, and 4b. The east half of excavation unit N291E206, and the west half of unit N291E207 were situated directly over the pit and hearth Features 4, 4b, and 7 (Figure 76). The east side of excavation unit N291E207, and the entirety of excavation unit N291E208, were situated over the flat terrace tread directly east of hearth pit Features 4b and 4, and over the rim of the earlier and wider Feature 7 pit (Figure 76). The high density of formalized artifacts in the eastern (N291E208) and northern (N294E206, N294E207, and N293E208) excavation units situated over the flat terrace tread directly east of the terrace-margin hearth and pit features is suggestive of continuous use of these spaces as activity areas for cooking and processing tasks.

The distinct separation between Feature 2 and the deeper hearth debris scatter Feature 2b was not detectable within the western pit feature margin area in excavation units N291E206 and N292E206. Feature 2b was only clearly identified within unit N294E206 (Figure 60). An element of Feature 2b may have been exposed as a thin lens of charcoal stained sediment in the east wall of N290E204 (Figure 63). The possible element of Feature 2b in unit N290E204 is not illustrated in the feature map (Figure 76) because the relationship between the charcoal stained layers could not be reliably determined over three meters of unexcavated sediments. The boundary of Feature 2b in Figure 76 could possibly extend under Feature 2 all the way to unit N290E204. Several scrapers were recovered from sediments above Feature 2b in unit N294E206, but no formalized artifacts were directly associated with Feature 2b, and no distinct activity areas were identified at its periphery. Features 8, 9, and 9b are deeper than Feature 2b.

A fragment of a fossileferous CCS scraper (Cat. 183), and a jasper biface base fragment (Cat. 184) were recovered *in-situ* from within the Feature 9b occupation surface . While not enough formalized artifacts were recovered from within the deepest occupation layers Features 8, 9, and 9b to develop hypotheses regarding early activity areas, these deeply buried features were clearly located outside of any possible deeply buried contemporaneous hearth or pits that have not yet been identified.

High frequencies of scrapers were recovered from units N294E206 and N291E208 (Table 9, Figures 76 - 77). These units were located immediately east of the of the hearth pit features. These two concentrations of scrapers may be suggestive of repetitive use of the flat terrace tread immediately east of the hearth pits as a hide processing, wood “carving,” and bone shaping activity area. It is interesting to note that the highest frequency of obsidian lithic debitage was recovered from scraper-rich unit N291E208 (Table 10, Figure 77). The other scraper-rich unit, N294E206, is directly adjacent to the unit that had the second highest frequency of obsidian lithic debitage, excavation unit N294E207 (Table 10, Figure 77).

Unit N293E208 had the highest frequency of projectile points. There were more than twice as many projectile points in unit N293E208 than in the other artifact-rich excavation units adjacent to the hearth features. Two intact projectile points (Figure 78, Cat. 1431 and Cat. 1432) and a projectile point tang fragment were recovered from within the plow zone in unit N293E208. Two projectile point tip fragments were located in deeper undisturbed contexts within levels 4 and 6. The tip fragments were likely associated with Features 5 and 6. Unit N293E208 displayed similar lithic core frequencies to units N294E206 and N294E207.

The horizontal distribution of lithic debris surrounding the site features is illustrated in Figure 77 and summarized in Table 10. The pattern of high artifact frequencies located immediately east of the hearth features is also reflected in the horizontal distribution of lithic debris. Unit N291E207 had the highest frequency of lithic debris, while the units within the hearth pits had the lowest frequencies of lithic debris (Figure 77, Table 10).

Table 9. Frequency of 45PC175 Formalized Artifacts by Excavation Unit.

Artifact Class (North / East)	260 162	280 201	290 204	291 206	292 206	294 206	291 207	294 207	291 208	293 208	291 210	291 211	Plow Zone	Totals
	← west					Excavation Unit			east →					
Projectile Points														
Type 01-05a										1				1
Type 01-05b									1					1
Type 01-06a													1	1
Type 01-09								1					1	2
Type 01-10							1			1				2
Type 01-14							1							1
point fragments				1	1				1	3				6
Biface Knives														
Type 02-01a		1			1									2
biface fragments					1	4	1	3	3	1			4	17
Scrapers														
Type 03-01			1			4			1	1				7
Type 03-02			1			1								2
Type 03-03						1			1					2
Type 03-04									1					1
Type 03-07						1							1	2
Type 03-08				1			1		1				1	4
Type 03-09									1					1
Type 03-14										1				1
Type 03-17					1								1	2
Type 03-18					1		1	3	1				1	7
Type 03-19	1							1						2
Scraper fragments											1			1
Gravers														
Type 04-01													1	1
Modified Flakes														
Unimarginal			2			8		9	2	2				23
Bimarginal						1		1						2
Cores														
Type 06-01	1	1	1	1		3	1	2	1	3			1	15
Microblades														
Cores 06-02a			1				1	1						3
Blades 06-02b	1		1		1									3
Cobble Tools														
Chopper 06-04				1			1							2
Hammerstone 08-01			1			1	1	2	1	1				7
E. Ground Cob. 09-01				1		1								2
Cob. Mortar 09-02													1	1
Pestle Frag. 10-03										1				1
Misc. Ground 20-01					1									1
Total	3	2	8	5	7	25	9	23	15	15	1	0	23	126

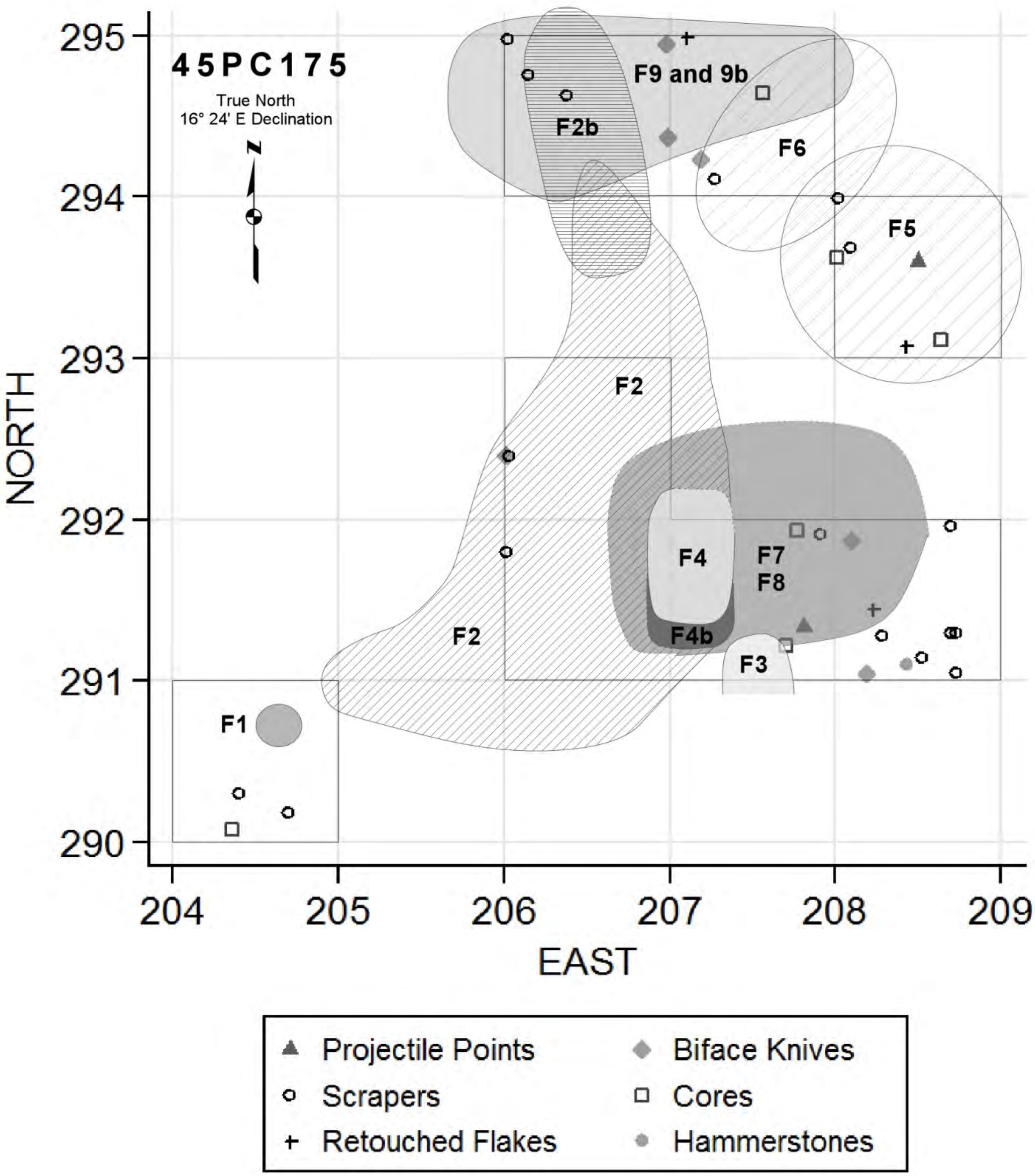

Figure 76. Plan view map of *in-situ* formalized artifacts surrounding the 45PC175 features.

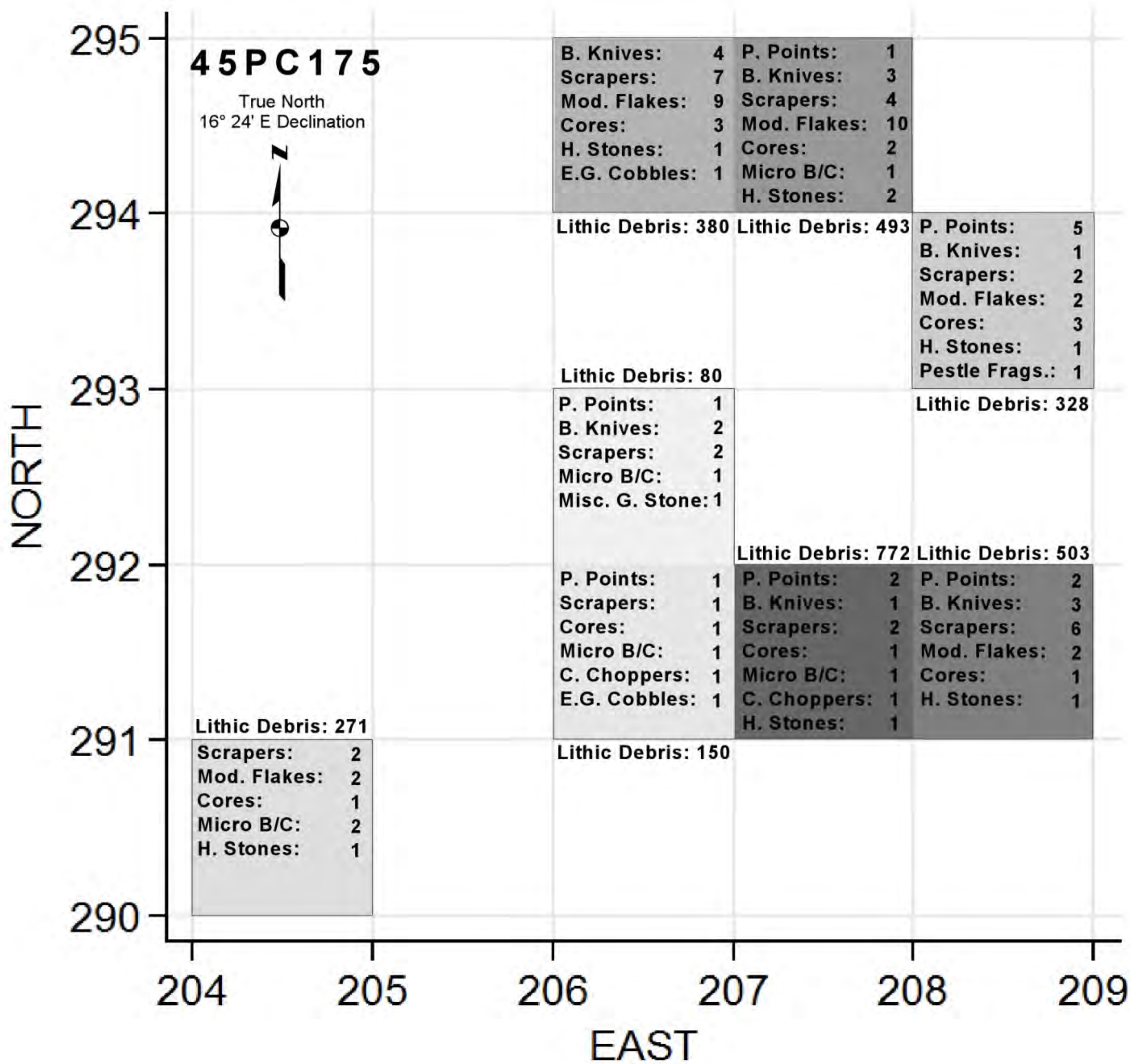

Figure 77. Map illustrating the frequency of all formalized artifacts and lithic debris surrounding the 45PC175 features. The shade of the unit illustrates the frequency of lithic debris. Darker squares have more lithic debris than the lighter squares.

Table 10. Frequency of 45PC175 Lithic Debris by Excavation Unit.

	← west					Excavation Unit				east →			
Lithic Debris North / East	**260 162**	**280 201**	**290 204**	**291 206**	**292 206**	**294 206**	**291 207**	**294 207**	**291 208**	**293 208**	**291 210**	**291 211**	**Totals**
Siltstone	46	53	148	95	55	269	469	323	330	202	109	84	2183
Fossil CCS	28	8	49	17	13	40	175	66	83	58	15	18	570
Jasper	8	6	54	23	8	21	57	38	55	39	23	13	345
M. CCS	5	4	16	11	2	43	62	49	22	21	7	7	249
Obsidian	1	2	1	0	0	2	1	5	6	3	4	1	26
B. CCS	0	0	2	3	2	2	5	2	6	1	0	0	23
Basalt	0	0	0	1	0	2	1	7	0	2	0	0	13
P. Wood	0	0	1	0	0	1	2	2	1	2	2	0	11
Crystal	0	0	0	0	0	0	0	1	0	0	0	0	1
Total	88	73	271	150	80	380	772	493	503	328	160	123	3421

Projectile Points

A sample of 45PC175 projectile points and projectile point fragments are illustrated in Figure 78. Descriptions of the six different Forks Creek site point types that include their metric attributes follow:

01-05a Broad-necked, shouldered, non-diverging stem, small variety

Broad-necked and shouldered projectile points with non-diverging stems. This type represents the delicate, or *gracile*, variety of the projectile point form. This projectile point type represents a variant of the Type 05 Pettigrew (1981) and Minor (1984) classification.

N Sample: 1 Illustrated in Figure 78, Cat. 1431

Intact Artifact:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	35.1	mm	-	mm	-	1
Width	20.5	mm	-	mm	-	1
Thickness	5.5	mm	-	mm	-	1
Neck width	7.5	mm	-	mm	-	1
Weight	3.75	g	-	g	-	1

Material (N) Fossiliferous cryptocrystalline: 1

01-05b Broad-necked, shouldered, non-diverging stem, large variety

Broad-necked and shouldered projectile points with non-diverging stems. This type represents the heavy, or *robust*, variety of the projectile point form. This projectile point type represents a variant of the Type 05 Pettigrew (1981) and Minor (1984) classification. This form resembles Rabbit Island Stemmed B type projectile points from the interior Plateau (Greengo 1982; Lohse and Schou 2008).

N Sample: 1 Illustrated in Figure 78, Cat. 965

Intact Artifact:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	56.2	mm	-	mm	-	1
Width	17.3	mm	-	mm	-	1
Thickness	9.9	mm	-	mm	-	1
Neck width	7.6	mm	-	mm	-	1
Weight	6.21	g	-	g	-	1

Material (N) Siltstone: 1

01-06a Ovate or bipointed, unnotched, unstemmed, small variety

Ovate or bipointed projectile points that are unnotched and unstemmed. This type represents the delicate, or *gracile*, variety of the projectile point form. Much larger and thicker leaf-shaped projectiles are present in the Willapa River Valley surface collections. The projectile point form can be described as *lanceolate* or *leaf-shaped*. This artifact type represents a variant of the Type 06 Pettigrew (1981) and Minor (1984) classification.

N Sample: 1 Illustrated in Figure 78, Cat. 1648

Intact Artifact:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	47.4	mm	-	mm	-	1
Width	19.9	mm	-	mm	-	1
Thickness	10.7	mm	-	mm	-	1
Weight	6.65	g	-	g	-	1

Material (N) Siltstone: 1

01-09 Narrow-necked, barbed, non-diverging stem

Narrow-necked and barbed projectile points with diverging stems (Minor1984; Pettigrew 1981). This projectile point form is similar to Columbia Stemmed A type projectile points from the interior Plateau (Greengo 1982; Lohse and Schou 2008).

N Sample: 2 Illustrated in Figure 78, Cat. 1647

Intact Artifact:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	13.4* - 35.6	mm	-	mm	-	1
Width	16.4 – 27.0	mm	-	mm		1
Thickness	2.9 – 6.3	mm	-	mm	-	1
Neck width	4.5 – 6.5	mm	-	mm	-	1
Weight	4.05	g	-	g	-	1
Broken Artifact:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	13.4* no tip	mm	-	mm	-	1
Width	16.4	mm	-	mm	-	1
Thickness	2.9	mm	-	mm	-	1
Neck width	4.5	mm	-	mm	-	1
Weight	.65	g	-	g	-	1

Material (N) Fossiliferous cryptocrystalline: 1 (broken)
Jasper: 1

01-10 Narrow-necked, shouldered, non-diverging stem

Narrow-necked and shouldered projectile points with non-diverging stems (Minor1984; Pettigrew 1981). At Forks Creek, the length of the stem of these forms varies considerably, and both convex and concave blade margins are represented in the small sample.

N Sample: 2 Illustrated in Figure 78, Cat. 467 and 1432

Intact Artifacts:	*Range*		*Mean*		*SD*	*Measured (N)*
Length	28.2 – 29.8	mm	29.0	mm	1.13	2
Width	13.2 – 20.6	mm	16.9	mm	5.23	2
Thickness	4.7 – 6.1	mm	5.4	mm	.99	2
Neck width	4.7 – 6.0	mm	5.35	mm	.92	2
Weight	1.88 – 1.88	g	1.88	g	0	2

Material (N) Fossiliferous cryptocrystalline: 2

01-14 Triangular blade, unstemmed, unnotched

Triangular blade unstemmed projectile points without notches (Minor1984; Pettigrew 1981). These artifacts are often referred to as projectile point “preforms” in regional literature.

N Sample: 1 Not Illustrated

Intact Artifact:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	19.9* broken	mm	-	mm	-	1
Width	11.7	mm	-	mm	-	1
Thickness	3.5	mm	-	mm	-	1
Weight	.62* broken	g	-	g	-	1

Material (N) Basalt: 1

01-00 Projectile point fragments: tips, mid-sections, tangs

Fragments of projectile points that do not have form-diagnostic stem or haft elements. One midsection fragment from a small triangular point exhibits distinct serration (Cat. 1197).

N Sample: 6 Illustrated in Figure 78, Cat. 810 and 1197

Tips:	*Range*		*Mean*		*SD*	*Measured (N)*
Length	11.6 – 19.2	mm	16.1	mm	3.99	4
Width	6.8 – 15.6	mm	12.36	mm	4.84	4
Thickness	2.8 – 6.8	mm	5.13	mm	2.08	4
Weight	.15 – 1.2	g	.67	g	.58	4
Mid-section:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	25.3	mm	-	mm	-	1
Width	15.2	mm	-	mm	-	1
Thickness	4	mm	-	mm	-	1
Weight	1.09	g	-	g	-	1
Tangs:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Weight	.07	g	-	g	-	1

Material (N) Siltstone: 1
Fossiliferous cryptocrystalline: 2
Jasper: 2
Banded cryptocrystalline: 1

The earliest projectile point was a fragment of a triangular, unstemmed, and unnotched form (Type 01-14; not illustrated) recovered from level nine. Similar simple triangular forms are sometimes classified as projectile point “preforms.” The earliest projectile point with a distinct hafting element (Type 01-05b) was located in level seven (Figure 78, Cat. 965). The large broad-necked and shouldered projectile point with a diverging stem (01-05b) was made from high-quality local siltstone and had a pressure-retouch blade margin. The artifact was not located directly associated with a dated carbon sample, but surrounding radiocarbon samples suggest that the projectile point (01-05b, Cat. 965) is likely between 2000 and 2400 years old.

The majority (75%) of intact projectile points were recovered from within the plow zone.

The materials and contexts associated with the most intensive occupation at 45PC175 after approximately1700 years BP have been mixed within the plow zone. A broad-necked, shouldered, non-diverging stem form (01-05a, Cat. 1431), a lanceolate unnotched, unstemmed point with a flattened base (01-06a, Cat. 1648), two narrow-necked, barbed, non-diverging stem projectile points (01-09, Cat. 230 and Cat. 1647), and two narrow-necked, shouldered, non-diverging stem projectile points (01-10, Cat. 467 and Cat. 1432) were located in the plow zone.

The siltstone and CCS projectile points exhibit pressure retouch, though the siltstone material is typically not fine-grained or brittle enough to create the fine pressure retouch scars that can be created on the high-quality local CCS materials. One projectile point fragment (Figure 78, Cat. 1197) exhibits distinct serration along its flat triangular blade margin.

Of the fourteen total intact and fragmented projectile points at site 45PC175, six (43%) were made of milky-white translucent fossiliferous CCS, three (21.5 %) were made from red/orange jasper, three (21.5 %) were made from indurated siltstone, one (7%) was made of banded CCS, and one (7%) was made of basalt. All of the projectile points were made of lithic materials locally available in the gravels of the Willapa River, and from within the Pleistocene marine terrace landforms of the Willapa Hills. While many obsidian projectile points have been located in the Willapa River Valley, none were recovered at site 45PC175, despite there being abundant obsidian micro-debitage consistent with maintenance of obsidian bifacial tools.

Biface Knives

A sample of 45PC175 biface “knives” and biface fragments are illustrated in Figure 79. Bifacial knives were manufactured, utilized, maintained, and disposed throughout the approximate 2700 years of occupation at Forks Creek. Unlike projectile points, biface knife fragments were represented throughout the site occupation, with two biface fragments (fossiliferous CCS and jasper) located as deep as level sixteen (Table 10). Only one biface knife type (02-01a) was identified within the excavation assemblage, but there were many knife fragments. A description of the Forks Creek biface knifes with their metric attributes follows:

02-01a Ovate bifaces

Ovate form chipped stone bifacial tools with retouched blade margins suitable for cutting. The form exhibits no distinct evidence of use as a projectile, and can exhibit a sharp or blunt point. The general bifacial form could potentially be used as projectile point technology, as well as for general cutting and abrading activities.

N Sample: 19 Illustrated in Figure 79

Intact Artifacts:	*Range*		*Mean*		*SD*	*Measured (N)*
Length	49.5 – 49.5	mm	49.5	mm	0	2
Width	25.9 – 26.7	mm	26.3	mm	0.57	2
Thickness	8 – 9.5	mm	8.75	mm	1.06	2
Weight	11.54-12.0	g	11.77	g	.33	2
Base Fragments:	*Range*		*Mean*		*SD*	*Measured (N)*
Length* broken	11.8 *– 32.2*	mm	23.73	mm	7.37	8
Width	11.6 – 35.1	mm	24.22	mm	7.59	8
Thickness	5.1 – 10.6	mm	7.13	mm	1.91	8
Weight	1.24 – 8.01	g	3.92	g	2.37	8
Mid-sections:	*Range*		*Mean*		*SD*	*Measured (N)*
Length* broken	14.5* – 24.1*	mm	19.3	mm	6.79	6
Width	6.9 – 26.4	mm	18.56	mm	10.30	6
Thickness	3.5 – 10.9	mm	6.72	mm	3.15	6
Weight	.2 – 11.54	g	3.54	g	4.11	6
Tip Fragments:	*Range*		*Mean*		*SD*	*Measured (N)*
Length* broken	8.2* – 22.2*	mm	14.56	mm	7.09	3
Width	9.3 – 19.4	mm	13.66	mm	5.19	3
Thickness	3.6 – 7.3	mm	5.7	mm	1.9	3
Weight	0.23 – 2.26	g	1.09	g	1.05	3

Material (N)
Siltstone: 4 (3 base fragments, 1 midsection fragment)
Fossiliferous cryptocrystalline: 2 (1 intact artifact, 1 base fragment)
Jasper: 7 (2 base fragments, 3 midsection fragments, 2 tip fragments)
Miscellaneous cryptocrystalline: 5 (1 intact artifact, 1 base fragment, 2 mid-section fragments, 1 tip fragment)
Basalt: 1 (base fragment)

Nineteen (two intact and seventeen fragments) biface knife artifacts were recovered from the excavations (Table 8). The two mostly-intact biface knifes were ovate forms (02-01a), while the seventeen fragments represent tips, midsections, and bases from bifacially worked tools. Most of the fragments appear to be from ovate or leaf-shaped bifaces, but not enough elements were present to assign the specimens to specific biface knife types. All of the biface knives, intact and fragmented, tend to exhibit lenticular cross-sections. Flattened and rounded bases were both represented in the assemblage of biface fragments. There were no distinct “triangular” (02-02) form biface knifes at 45PC175, though one tip fragment (Cat. 641; Figure 79) has exceptionally flat blade margins, and basic triangular forms are common in local surface artifact collections.

A salmon-color CCS biface knife found near the base of the plow zone (Figures 79 and 80, Cat. 1583) exhibits a slightly wavy fine pressure-flake retouch “walked” blade margin, and has large pressure flake scars that travel more than halfway across the biface. The base of the biface (Cat. 1583) retains the original cortical platform surface of the “parent flake” (Figure 80). The preservation of the initial cortical platform of the “parent flake” throughout the manufacturing, use, and maintenance processes was the clear intent of the maker/user; no other cortex is present on the artifact. The author has observed similar intentional preservation of the original cortical platform surface on otherwise fully-worked Early-Holocene era “Cascade” style lanceolate projectile points in the Snake River and Blue Mountain regions of the Plateau Culture Area. Utilization of “Cascade” style technologies into the Middle and Late Holocene is not unusual in Southwest Washington.

The preservation of the original cortical platform striking surface on the otherwise fully pressure-flaked biface may have been intended to convey a sophisticated ensemble of *artistic, creative,* or *skill* related meaning rather than being residual of a functional variable involving hafting friction or tensile strength. The preserved platform base is essentially the initial “point of creative intent”; the location of the hammer impact that initiated the creation of the biface. Preserving the original flake platform could be viewed as sympathetically transferring the power and accuracy of the initial hammer strike, to the intended function of the biface tool.

A fossiliferous CCS biface knife with significant re-sharpening related dissymmetry was located in the plow zone (Figures 79 and 80, Cat. 1191). The artifact may represent an ovate-form biface knife that was extensively re-sharpened while hafted into a protective wood, bone, or other organic (such as sinew) handle (not located). It is also possible that the artifact was actually an early stage, or reworked, projectile point with a crooked base.

The basal portions of the biface that may have been protected by a hafting element exhibit convex evenly re-touched margins and a pressure-flake flattened base. The blade portions of the biface that were exposed outside of the hafting element appear to have been extensively re-worked by bifacial pressure retouch to form a “bell-curve” shaped “cutting bit” nib with a width that is approximately sixty-five percent of the maximum width biface form. The boundary between the basal element and the re-sharpened cutting nib is not oriented straight across the ovate form perpendicular to the long axis of the biface. The possible hafting “line” is oriented at approximately twenty-five degrees off of the perpendicular axis. I believe the artifact was a heavily utilized hafted cutting/processing tool that was used and maintained at the 45PC175 camp site, rather than a stemmed projectile point form that was abandoned or lost in a state of transformation.

Of the nineteen total intact and fragmented biface knives at site 45PC175, seven (37%) were made of red and orange jasper, five (26%) were made of miscellaneous CCS, four (21%) were made of indurated siltstone, two (11%) were made of fossiliferous CCS, and one (5%) was made of basalt.

Large “status knife,” or “wealth blade,” ceremonial bifaces were not identified in our small sample from the Forks Creek site, but exotic obsidian lithic micro-debitage consistent with the sharpening of obsidian biface tools was located in the fine 1/8 inch screens.

Scrapers

A sample of excavated scrapers and scraper fragments are illustrated in Figure 82. Thirty-two scrapers and scraper fragments were recovered from the Forks Creek site. Scrapers were the dominant formalized lithic tool class at the site, and exhibited a great deal of formal variability. This variability may be exaggerated by my own predisposition towards "splitting" rather than "lumping" within this class of artifacts. A description of the scraper types with their metric attributes are as follows:

03-01 Convex scrapers, unifacial, "thumb-nail scrapers"

A chipped stone tool with a distinct convex unifacial pressure-retouched steep-angle edge. The steep unifacial edge is the objective element of the tool, and would have been useful for scraping and carving hides, bone, and wood. The form usually exhibits slight percussive and pressure retouch shaping of the body to accentuate the convex unifacial "bit." The tool form could be used hafted or held in the hand.

N Sample: 8 — 7 intact, 1 fragmentary

Illustrated in Figure 82, Cat. 125, 1057, 1107, 1267, and 1554

Intact Artifacts:	*Range*		*Mean*		*SD*	*Measured (N)*
Length	19.8 – 37.9	mm	26.42	mm	6.61	7
Width	16.2 – 34.6	mm	24.55	mm	5.97	7
Thickness	4.3 – 11.6	mm	7.37	mm	2.57	7
Weight	2.12 – 7.97	g	4.58	g	2.4	7
Fragments:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length* broken	15.2*	mm	-	mm	-	1
Width * broken	11.2*	mm	-	mm	-	1
Thickness	6.3	mm	-	mm	-	1
Weight	1.01	g	-	g	-	1

Material (N)
- Siltstone: 1
- Fossiliferous cryptocrystalline: 2
- Jasper: 2
- Banded cryptocrystalline: 1
- Miscellaneous cryptocrystalline: 2 (1 intact artifact, 1 scraper fragment)

03-02 Convex scrapers, unifacial, "thumb scrapers," small variety

A chipped stone tool with a distinct convex unifacial pressure-retouched steep-angle edge. This type represents a small and delicate, or *gracile*, form of the basic "thumb-nail" scraper. The steep unifacial edge is the objective element of the tool, and would have been useful for scraping hides, and carving bone and wood. The form usually exhibits slight percussive and pressure retouch shaping of the body to accentuate the convex unifacial "bit." This small artifact would likely have been most effective as a hafted tool, rather than being used while held in the hand.

N Sample: 2 — 1 intact, 1 fragmentary
Illustrated in Figure 82, Cat. 1400

Intact Artifacts:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	26.3	mm	-	mm	-	1
Width	16.6	mm	-	mm	-	1
Thickness	7	mm	-	mm	-	1
Weight	3.17	g	-	g	-	1
Fragments:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	15.7	mm	-	mm	-	1
Width* broken	7.8*	mm	-	mm	-	1
Thickness	2.0	mm	-	mm	-	1
Weight	0.3	g	-	g	-	1

Material (N) Fossiliferous cryptocrystalline: 2 (1 intact artifact, 1 scraper fragment)

03-03 Convex scrapers, unifacial, minimally retouched body

A chipped stone tool with a distinct convex unifacial pressure-retouched steep-angle edge. The form exhibits no shaping or pressure retouch of the body beyond the formed convex working edge. The steep unifacial edge is the objective element of the tool, and would have been useful for scraping hides and carving bone and wood. The tool form could be used hafted or held in the hand.

N Sample: 2 — Illustrated in Figure 82, Cat. 862

Intact Artifacts:	*Range*		*Mean*		*SD*	*Measured (N)*
Length	33.5 - 49	mm	41.25	mm	10.96	2
Width	16.8 – 18.2	mm	17.5	mm	.99	2
Thickness	5.1 – 7.9	mm	6.5	mm	1.98	2
Weight	2.58 – 8.53	g	5.55	g	4.21	2

Material (N) Fossiliferous cryptocrystalline: 1
Banded cryptocrystalline: 1

03-04 Convex scrapers, unifacial, minimally retouched body, large variety

A chipped stone tool with a distinct convex unifacial pressure-retouched steep-angle edge. This type is a large and *robust* variety of the form that exhibits no shaping or pressure retouch of the body beyond the formed convex working edge. The steep unifacial edge is the objective element of the tool, and would have been useful for scraping hides, and carving bone and wood. The tool form could be used hafted, but can easily be held in the hand.

N Sample: 1 — Illustrated in Figure 82, Cat. 1005

Intact Artifact:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	36.1	mm	-	mm	-	1
Width	32.4	mm	-	mm	-	1
Thickness	11.4	mm	-	mm	-	1
Weight	14.27	g	-	g	-	1

Material (N) Fossiliferous cryptocrystalline: 1

03-07 Unifacial scrapers with 100% marginal retouch, discoidal scrapers

A round to rectangular form with unifacial steep-angle edge retouch flaking that extends around 100% of the tool margin. There is no distinct proximal or distal element of the tool form, as the entire margin has a convex unifacial steep-angled working edge. The tool form was likely used unhafted.

N Sample: 2 — 1 intact, 1 fragmentary
Illustrated in Figure 82, Cat. 183 and 1653

Intact Artifact:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	21.9	mm	-	mm	-	1
Width	20	mm	-	mm	-	1
Thickness	6.5	mm	-	mm	-	1
Weight	3.88	g	-	g	-	1
Fragments:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length* broken	24.3*	mm	-	mm	-	1
Width* broken	12.4*	mm	-	mm	-	1
Thickness	6.5	mm	-	mm	-	1
Weight	2.03	g	-	g	-	1

Material (N) Fossiliferous cryptocrystalline: 1 (fragment)
Miscellaneous cryptocrystalline: 1 (intact artifact)

03-08 Unifacial scrapers with corners, squared and triangular, "spurred scrapers"

A scraper form with a squared or triangular shaped unifacial pressure-flaked bit. The symmetrical artifact has distinct corners. The form usually exhibits slight percussive and pressure retouch shaping of the body to accentuate the squared corners of the "bit." The tool form could be used hafted or held in the hand.

N Sample: 4 — 3 intact, 1 fragmentary
Illustrated in Figure 82, Cat. 499 and 1654

Intact Artifacts:	*Range*		*Mean*		*SD*	*Measured (N)*
Length	16.5 – 64.3	mm	33.13	mm	27.01	3
Width	17.4 – 39.5	mm	26.23	mm	11.70	3
Thickness	4.4 – 14.8	mm	8.43	mm	5.58	3
Weight	1.55 – 29.51	g	11.16	g	15.89	3
Fragments:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length* broken	13.0*	mm	-	mm	-	1
Width	17.3	mm	-	mm	-	1
Thickness	5.0	mm	-	mm	-	1
Weight	1.62	g	-	g	-	1

Material (N) Fossiliferous cryptocrystalline: 3 (2 intact artifacts, 1 fragment)
Jasper: 1 (intact artifact)

03-09 Unifacial scrapers with angled bits

A unifacially-flaked form with an angled pressure-flaked bit. The non-symmetrical artifact has distinct corners. The form usually exhibits slight percussive and pressure retouch shaping of the body to accentuate the squared corners of the angled "bit." The tool form could be used hafted or held in the hand.

N Sample: 1 — Illustrated in Figure 82, Cat. 875

Intact Artifact:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	20.5	mm	-	mm	-	1
Width	24.6	mm	-	mm	-	1
Thickness	7.8	mm	-	mm	-	1
Weight	3.6	g	-	g	-	1

Material (N) Fossiliferous cryptocrystalline: 1

03-14 End-scrapers, special petrified wood type

These scrapers forms are made from elongated fragments of petrified wood. The forms display the distinctly layered remnants of the original wood rings, and one end of the elongated "woodchip" body has been unifacially reduced with percussion and pressure flaking. These scrapers take advantage of the natural fracture tendencies and steep layered edges of petrified wood gravels eroding from the local marine terraces.

N Sample: 1 Illustrated in Figure 82, Cat. 1514

Intact Artifact:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	53.3	mm	-	mm	-	1
Width	19.6	mm	-	mm	-	1
Thickness	15.2	mm	-	mm	-	1
Weight	21.09	g	-	g	-	1

Material (N) Petrified Wood: 1

03-17 Beaked end-scrapers

A chipped stone tool with a pronounced bird beak-like convex unifacial pressure-retouched projection and a steep-angled working edge. The protruding unifacial "beak" is the objective element of the tool, and could have been useful for scraping hides, and carving bone and wood. This form would be useful for scraping within grooves or narrow trenches, such as the concave marrow-rich interior of split long-bones. The form usually exhibits slight percussive and pressure retouch shaping of the body to accentuate the beaked "bit" and improve the hafted or handheld base.

N Sample: 2 Illustrated in Figure 82, Cat. 1657

Intact Artifacts:	*Range*		*Mean*		*SD*	*Measured (N)*
Length	30.0 – 57.8	mm	43.9	mm	19.66	2
Width	20.3 – 36.0	mm	28.15	mm	11.10	2
Thickness	7.0 – 12.5	mm	9.75	mm	3.89	2
Weight	4.03 - 24.9	g	14.46	g	14.76	2

Material (N) Fossiliferous cryptocrystalline: 1
Jasper: 1

03-18 Flake scrapers

These scraper forms consist of otherwise unmodified flakes that have steep edge-angle unifacial retouch along segments of the flake margin. These forms have no shaping of the flake body. The only modification to the parent flake is the unifacial scraper edge.

N Sample: 7 6 intact, 1 fragmentary
Illustrated in Figure 82, Cat. 299 and 584

Intact Artifacts:	*Range*		*Mean*		*SD*	*Measured (N)*
Length	19.8 – 44.2	mm	29.46	mm	8.57	6
Width	12.6 – 25.1	mm	19.25	mm	4.01	6
Thickness	3.4 – 16.0	mm	6.31	mm	4.84	6
Weight	1.06 – 17.47	g	4.95	g	6.21	6
Fragments:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length* broken	25.4*	mm	-	mm	-	1
Width* broken	12.1*	mm	-	mm	-	1
Thickness	6.1	mm	-	mm	-	1
Weight	1.55	g	-	g	-	1

Material (N) Fossiliferous cryptocrystalline: 2
Jasper: 2 (1 intact artifact, 1 fragment)
Banded cryptocrystalline: 1
Miscellaneous cryptocrystalline: 2

03-19 Blade-flake end-scrapers

This scraper type is made from blade-like flakes (with aris ridges) that have unifacial pressure retouch on either the proximal or distal blade end that forms a convex steep angled sharp working edge. The opposite end consists of an unmodified blade-flake platform or fracture surface. One blade like flake may have been removed from a small bipolar pebble core, as it has a slight bulb on both the proximal and distal ends of the smooth ventral face of the blade-like flake. The form could be hafted or used while held in the hand.

N Sample: 2 Illustrated in Figure 82, Cat. 1605

Intact Artifacts:	*Range*		*Mean*		*SD*	*Measured (N)*
Length	28.0 – 29.6	mm	28.8	mm	1.13	2
Width	14.1 – 16.5	mm	15.3	mm	1.7	2
Thickness	5.2 – 6.2	mm	5.7	mm	.71	2
Weight	2.46 – 2.54	g	2.5	g	.06	2
Material (N)	Siltstone: 1 Jasper: 1					

Scrapers were likely used for a variety of different tasks including hide scraping, wood/bark/root scraping, bone and wood carving, and even cutting and chopping. Ethnographic reports suggest that intensive hide processing activities were carried out at camps in the Middle Willapa River Valley in the early historic period (Bullard 1974). It is important to remember that acidic sediment conditions in the Willapa Valley have dissolved most of the archaeological bone materials at the site, leaving scant direct evidence of any faunal processing. The high frequency of biface knife and scraper tools may be one of the few proxy measures of faunal resource processing behaviors at the site. The abundance of scrapers present at site 45PC175 is also reflected in family surface collections from throughout the Willapa Valley, and in my own observations of regional plow zone artifact scatters.

The earliest and deepest (level sixteen) scraper located at Forks Creek was a split fragment of a unifacial 100% marginal retouch “discoidal” scraper (03-07, Cat. 183; Figure 82). The same form of scraper was also located in level one of the plow zone (03-07, Cat. 1653; Figure 82).

The eight unifacial “thumb-nail” scrapers with convex forward edges (03-01, Cat. 125, 1057, 1107, 1267, 1554; Figure 82) represent the most abundant scraper type at the site. Seven minimally altered flake scrapers (03-18, Cat. 299, 337, and 584; Figure 82) were recovered from the excavation. These forms have steep-angle unifacial retouched along the edge of an otherwise unmodified lithic flake or shatter fragment. Four squared or triangular “spurred scrapers” (03-08, Cat. 499 and 1654; Figure 82) were recovered. Only two specimens each of small unifacial convex scraper forms (03-02, not illustrated), minimally retouched body unifacial convex scrapers (03-03, Cat. 862; Figure 82), 100% marginally retouched discoidal unifacial scrapers (03-07, Cat. 1653; Figure 82), “beaked” end scrapers (03-17, Cat. 1657; Figure 82), and blade-flake end scrapers (03-19, Figure 82) were recovered from the excavation. Single examples of large minimally retouched unifacial convex scrapers (03-04. Cat. 1005; Figure 82), angled bit unifacial scrapers (03-09, Cat. 857; Figure 92), and petrified wood fragment type end-scrapers (03-14, Cat. 1514; Figure 82), were located at the site.

Fourteen (44%) of the scrapers were made of fossiliferous CCS. Seven (22%) were made of red and orange jasper. Four (12.5%) scrapers were made of banded CCS, and four (12.5%) were made of miscellaneous CCS. Two (6%) scrapers were made of indurated siltstone, and one (3%) was made of petrified wood.

Some of the small thin CCS blade-like pressure flakes recovered in the 1/8 inch and 1/16 inch screen could have resulted from the process of manufacturing and maintaining the numerous steep-edge unifacial scrapers. These small pressure flakes were differentiated from “microblades” primarily by their short length, lack of multiple parallel flake arises on their dorsal faces, and minimal platform grinding. The functional edge of a unifacial scraper tool should remain sharp for the tool to perform effectively, while the platform edge of a microblade core will often function best with significant grinding and preparation of the platform surface. While morphologically similar, the technological and manufacturing details of steep-domed unifacial scrapers and microblade cores are significantly different.

Gravers

Only a single graver was identified at the Forks Creek site. A description of the fossil CCS graver (not illustrated) with its metric attributes follows:

04-01 Gravers

A flake with a single bifacial pressure-flaked sharp pointed projection. The thin “spur” projection element could have been used to produce a groove in bone, wood, or soft stone.

N Sample: 1 Not Illustrated

Intact Artifact:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	30.2	mm	-	mm	-	1
Width	18.9	mm	-	mm	-	1
Thickness	7.9	mm	-	mm	-	1
Weight	4.43	g	-	g	-	1

Material (N) Fossiliferous cryptocrystalline: 1

Cores

A sample of Forks Creek site multidirectional cores (06-01, Cat. 317, 712, 1268, 1546, 1566, and 1658) and a cobble core/chopper (06-04, Cat. 522) are illustrated in Figure 83. Fifteen multidirectional cores (06-01) were recovered from the Forks Creek excavation. A description of the multi-directional core type follows:

06-01 Multidirectional cores

Cobbles, nodules, or fragments of tool-quality stone that have had multiple flakes removed from multiple directions. The size of cores is dependent on the nature of the raw material. Most fossiliferous cores are large pebbles or small cobbles, while siltstone and basalt cores tend to be much larger. Cores are both a source of flakes, and a multipurpose tool that can be used to chop, pound, abrade, etc. . . .

N Sample: 15 Illustrated in Figure 83

Intact Artifacts:	*Range*		*Mean*		*SD*	*Measured (N)*
Length	29.1 – 73.3	mm	48.82	mm	14.1	15
Width	18.5 – 51.2	mm	36.22	mm	9.89	15
Thickness	9.3 – 29.2	mm	19.82	mm	5.73	15
Weight	10.48 – 72.57	g	31.86	g	21.2	15

Material (N)
Siltstone: 6
Fossiliferous cryptocrystalline: 4
Jasper: 2
Banded cryptocrystalline: 1
Petrified wood: 1
Metamorphic stone: 1

The CCS and siltstone cores were primarily made from pebbles and small cobbles that were likely collected from the local gravel bars of the Willapa River. A great diversity of cobble materials erode from the local Pleistocene marine terrace deposits. Six (40%) of the multidirectional cores were made from the locally abundant indurated siltstone. Four (26%) of the multidirectional cores were made of milky white and orange translucent fossiliferous CCS that is locally available as clam and nautiloid fossils in the gravels of the Willapa River- particularly from the gravel deposits of Green Creek. Two (13%) of the 06-01 cores were made of locally available red and orange jasper. One (7%) banded CCS, one petrified wood (7%), and one (7%) brittle metamorphic stone multidirectional core were recovered.

Two indurated siltstone cobble core/chopper artifacts (06-04) were recovered from the excavation. These artifacts were both a source of lithic flakes and spalls, and were suitable for use as a roughly edged chopping tool. It is possible that additional cobble chopper/cores and spalls made from indurated siltstone dissolved away into “ghost cobble” textures and staining within the highly acidic post-depositional context. The team did not identify specific stains thought to represent cobble core/choppers, but several instances of the team inadvertently slicing through soft dissolved indurated siltstone flakes with our sharpened trowels were noted.

Microblade Cores and Microblades

A sample of Forks Creek site microblade core fragments (06-02a, Cat. 318, 1323) and microblades (06-02b, Cat. 1207, 1330, 1603) are illustrated in Figure 84. Descriptions of the microblade cores and microblades that include their metric attributes follow:

06-02a Micro-cores, microblade cores, micro-core rejuvenation flakes

Nodules and pebbles of high quality material that exhibit patterned removal of long microblade flakes, leaving pattered faces of blade-scar arises. The platform edge of the micro-cores exhibits significant grinding. No fully intact specimens have been recovered, but large sections of microblade core rejuvenation flakes with intact sections of platform and termination are present. The microblade cores are not bi-polar pebble cores; most blade scars end in pointed feathered terminations, rather than as crushed secondary (anvil) platforms. Welch (1970, 1983), Kelly (1984) and Daugherty et al. (1987a, 1987b).

N Sample: 3 — 1 micro-core, 2 core face rejuvenation flakes
Illustrated in Figure 84, Cat. 318 and 1323

Micro-core:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	23.2	mm	-	mm	-	1
Width	31.6	mm	-	mm	-	1
Thickness	6.8	mm	-	mm	-	1
Weight	4.52	g	-	g	-	1
Core face flake:	*Range*		*Mean*		*SD*	*Measured (N)*
Length	13.5 – 16.8	mm	15.15	mm	2.33	2
Width	9.4 – 12.1	mm	10.75	mm	1.91	2
Thickness	2.7 – 5.0	mm	3.85	mm	1.63	2
Weight	.68 - .71	g	.69	g	.02	2

Material (N) — Fossiliferous cryptocrystalline: 2 (1 micro-core, 1 micro-core face rejuvenation flake)
Miscellaneous cryptocrystalline: 1 (micro-core face rejuvenation flake)

06-02b Microblade flakes, small blade-like flakes

Long thin flakes systematically removed from prepared micro-cores. The flakes have a smooth ventral surface with a bulb of force below the pressure reduction platform. The dorsal surface has one or more aris that travel from the proximal to the distal end (previous blade removals). The platforms and terminations are frequently missing. The blade terminations tend to be feathered or stepped.

N Sample: 3 — Illustrated in Figure 84, Cat. 1207, 1330, and 1603

Intact blade:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	15.6	mm	-	mm	-	1
Width	6.4	mm	-	mm	-	1
Thickness	2.1	mm	-	mm	-	1
Weight	0.2	g	-	g	-	1
Midsection:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length* broken	6.8	mm	-	mm	-	1
Width	4.2	mm	-	mm	-	1
Thickness	1.2	mm	-	mm	-	1
Weight	.04	g	-	g	-	1
No termination:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length* broken	12.8	mm	-	mm	-	1
Width	5.9	mm	-	mm	-	1
Thickness	1.0	mm	-	mm	-	1
Weight	.08	g	-	g	-	1

Material (N) — Fossiliferous cryptocrystalline: 1 (1 intact microblade, 1 microblade midsection)
Jasper: 2 (1 microblade with no termination)

Two microblade core fragments (06-02a, Cat. 318 and 1323; Figure 84) and one microblade (06-02b, Cat. 1330; Figure 84) were recovered in level six, but no microblade technology was recovered below this level. A radiocarbon sample located *in-situ* at sixty centimeters below the surface within level six dated to 1930 +/- 30 BP (Beta 367370). Microblade technology was also recovered from the younger levels three, two, and one.

Prior to the excavations at Layser Cave (Daugherty et al. 1987), Welch (1970, 1983) had hypothesized that microblade artifacts and debris present in the Upper Chehalis River region (Kelly 1984) could potentially have been a technological indicator of the influx of Kwalhioqua Athabaskan peoples migrating from the north. Their subsequent work at Layser Cave showed that microblade cores and microblades occurred within the deepest and oldest stratum that dated to older than 6650 +/- 120 BP (WSU 3593), and were utilized at the site until likely 3400 BP (Daugherty et al. 1987). The excavations at Layser Cave and Forks Creek show that microblade technology was present in Southwest Washington long before Athabaskan cultures were thought to have arrived within approximately the last 1000 years. The microblades at Forks Creek may have been utilized in a similar manner to the split and bent wooden handle side-hafted and end-hafted microlith knives recovered from the Hoko River wet site 45CA213 (Croes 1995).

One fossiliferous CCS microblade core (Cat. 318), was made on an angular fragment of shatter, while another fossiliferous microblade core fragment (Cat. 1323) represents a large rejuvenation flake removed from the aris-scarred face of a microblade core. Both of these microblade core fragments exhibit significant platform preparation and grinding. Microblades at the site were intact (Cat. 1270), had a snapped termination (Cat. 1603), or were missing both ends (Cat. 1330).

Modified Flakes

Descriptions and metric attributes of the unimarginal and bimarginal retouched flakes recovered from the site (not illustrated) are presented below:

07-01a Unimarginal retouched flakes

Unimarginal retouched flakes have retouch on either the ventral or dorsal surface, but not both surfaces (at the same location on the flake). Only a small sample of these modified flakes was measured.

N Sample: 23 — 7 complete, 16 fragmentary

Not Illustrated

Sample:	*Range*		*Mean*		*SD*	*Measured (N)*
Length	12.9 – 33.2	mm	24.02	mm	7.39	7
Width	3.6 – 26.4	mm	14.47	mm	6.66	7
Thickness	3.0 – 32.1	mm	4.58	mm	1.21	7
Weight	.21 – 7.43	g	2.19	g	1.73	21

Material (N)
Siltstone: 4
Fossiliferous cryptocrystalline: 7
Jasper: 4
Banded cryptocrystalline: 2
Miscellaneous cryptocrystalline: 6

07-01b Bimarginal retouched flakes

Bimarginal retouched flakes have retouch on both their ventral and dorsal surfaces (at the same location on the flake). Only one of these modified flake artifacts was measured.

N Sample: 2 — 1 complete, 1 fragmentary

Not Illustrated.

Sample:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	20.6	mm	-	mm	-	1
Width	16.7	mm	-	mm	-	1
Thickness	4.2	mm	-	mm	-	1
Weight	.60 – 1.62	g	1.11	g	.72	2

Material (N)
Fossiliferous cryptocrystalline: 1
Jasper: 1

Figure 78. 45PC175 Projectile points.

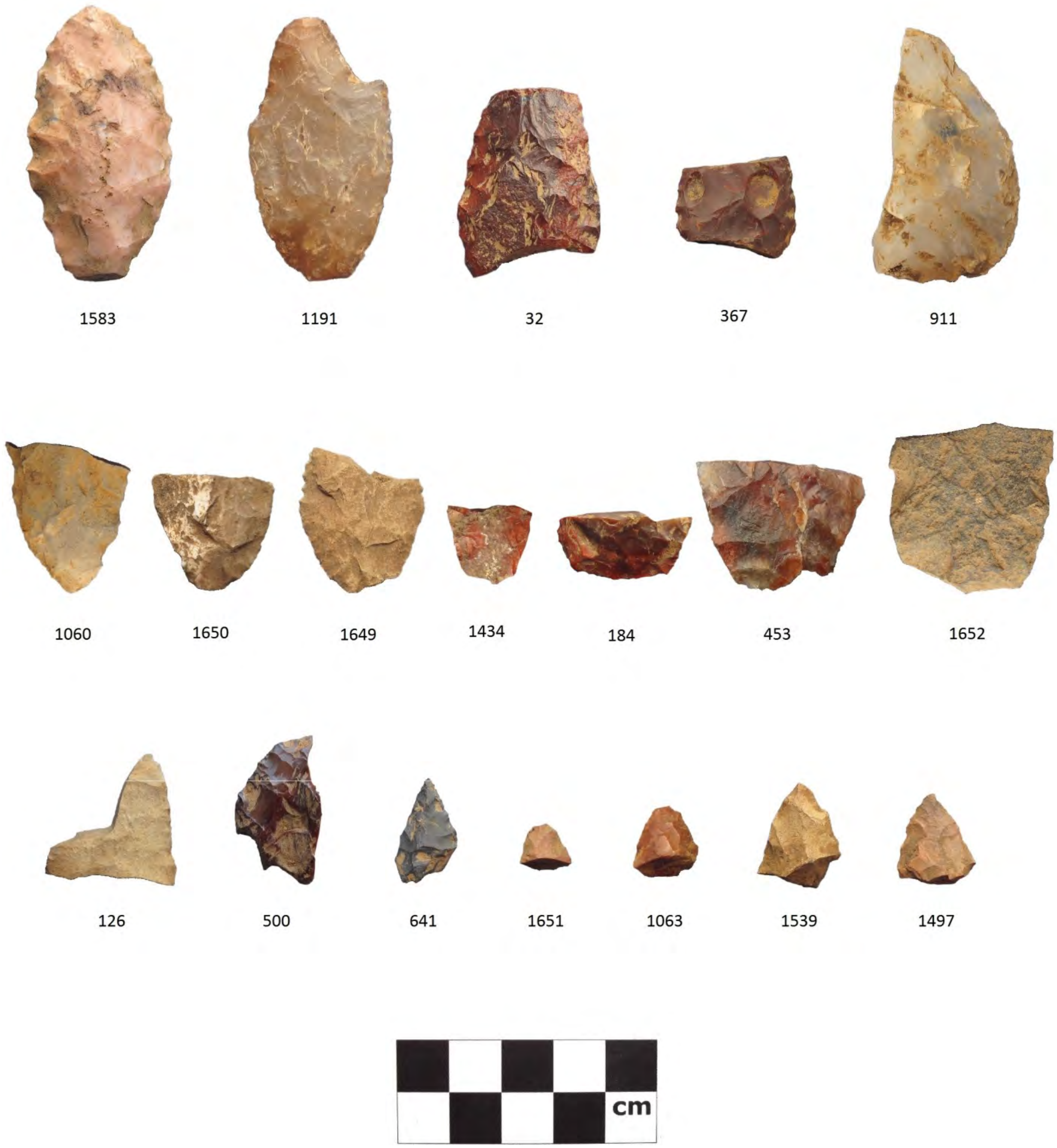

Figure 79. 45PC175 Biface knives.

Figure 80. Intact cortical platform of the parent flake on the biface knife base (Cat. 1583).

Figure 81. 45PC175 Sharpened biface knife, fossiliferous CCS (Cat. 1191).

Figure 81. 45PC175 Sharpened biface knife, fossiliferous CCS (Cat. 1191).

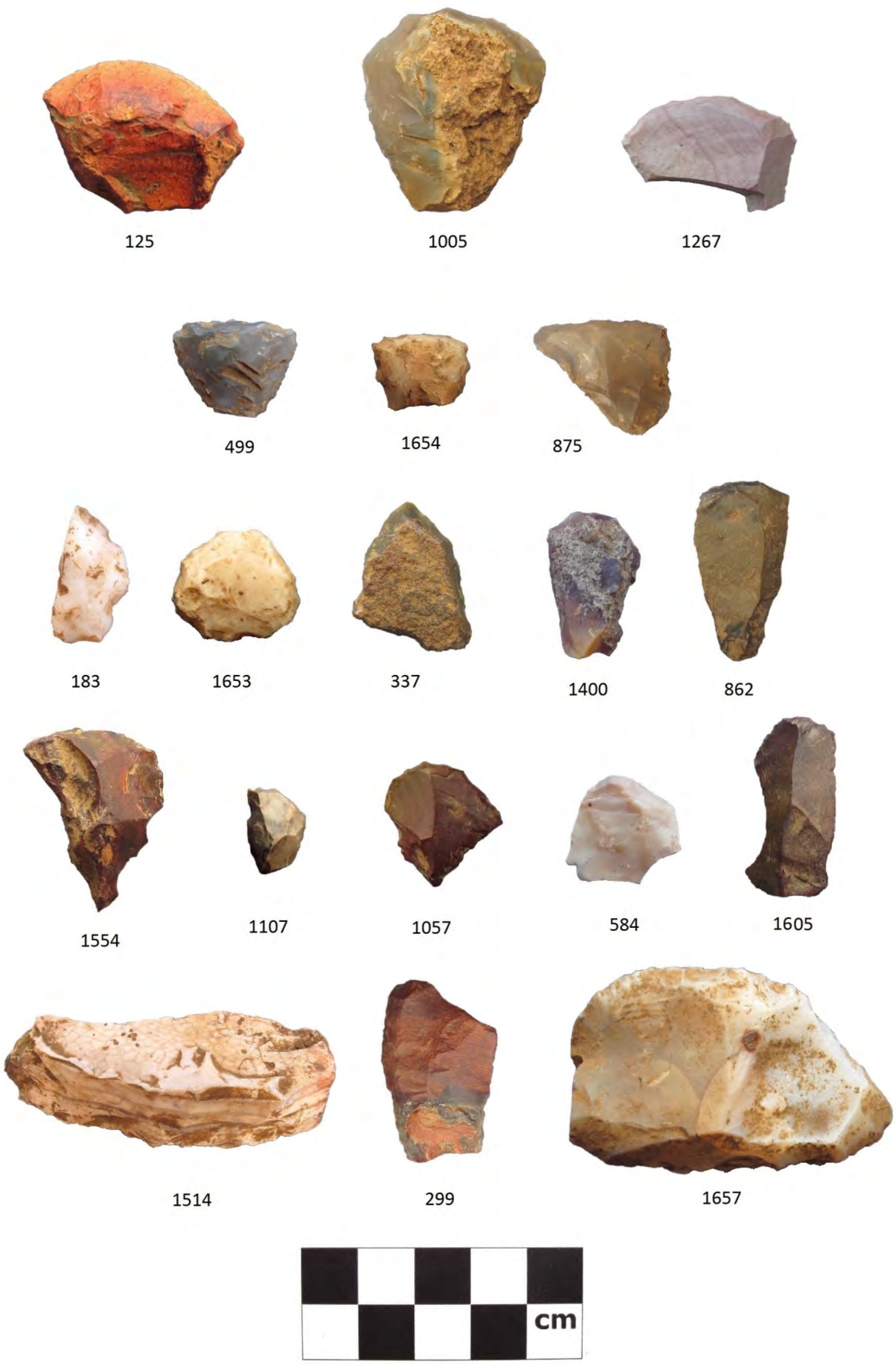

Figure 82. 45PC175 Scrapers.

Figure 83. 45PC175 Cores.

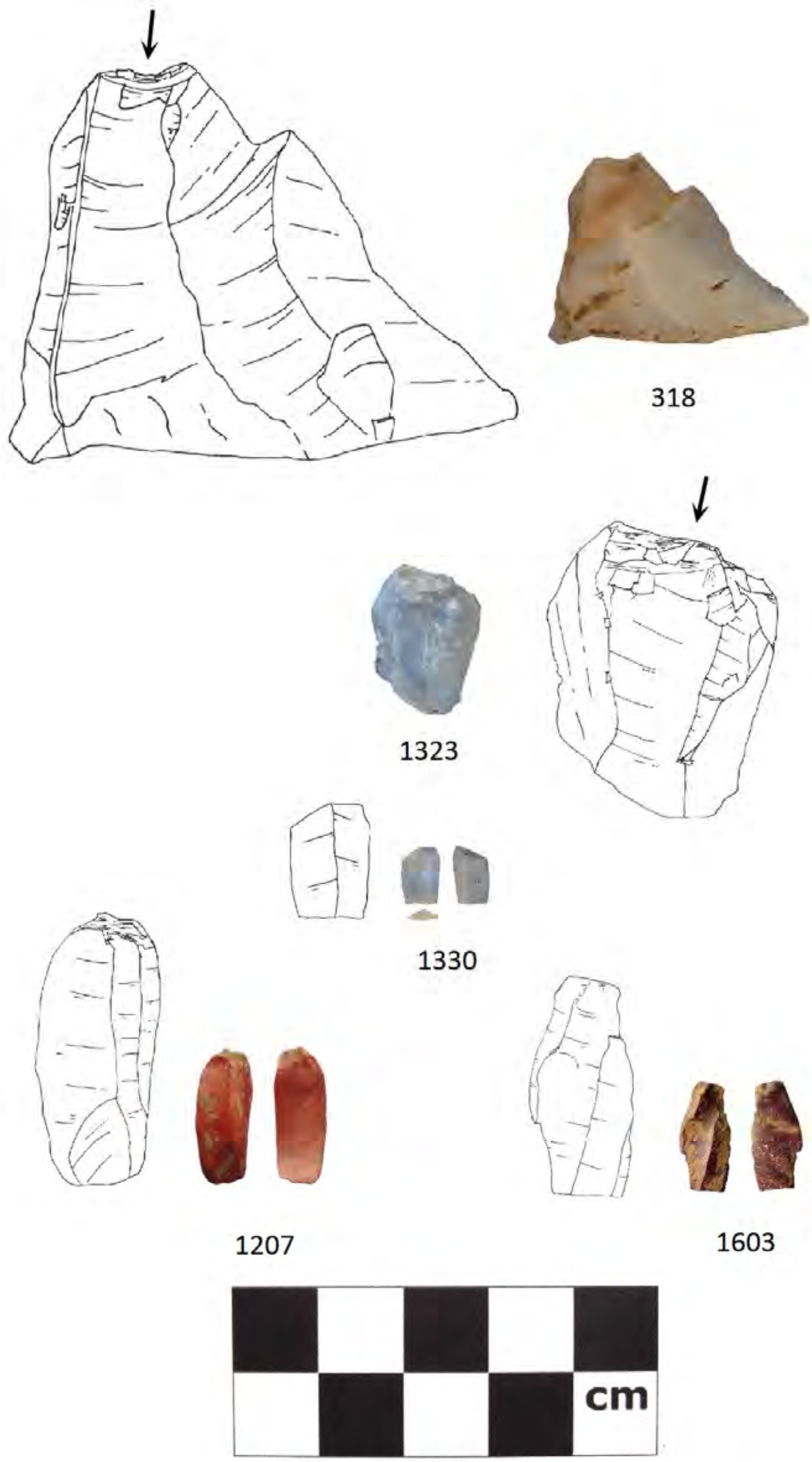

Figure 84. 45PC175 Blade cores and blades.

Hammerstones and Ground Stone

A sample of Forks Creek hammerstones (08-01, Cat. 258, 501, 1061, 1353) are illustrated in Figure 85. The description and metric attributes of the site's hammerstone type follow:

08-01 Hammerstones

River rounded cobbles (or marine terrace cobbles) with pecked, ground, and /or percussive wear on one or more ends or faces. Five of the seven hammerstones weighed more than 200 grams.

N Sample: 7 Illustrated in Figure 85

Sample:	*Range*		*Mean*		*SD*	*Measured (N)*
Length	44.6 – 134.5	mm	90.04	mm	35.03	7
Width	36.9 – 92.2	mm	59.07	mm	19.61	7
Thickness	30.2 – 77.5	mm	44.5	mm	18.57	7
Weight	71.41 - >200	g	73.84	g	3.44	2

Material (N) Siltstone: 4
Volcanic or Metamorphic stone: 3

The hammerstones at 45PC175 were mostly rounded river cobbles made of a range of different density stone materials. Siltstone and basaltic sandstone were the primary hammerstone materials at the site, and both are abundantly available within the local channels of the Willapa River and Forks Creek. The hammerstones tend to exhibit percussive flattening on their ends and on any significant lobes where impact occurred. There is abrasive wear on some of the hammerstone bodies that is indicative of use of the cobbles for edge-grinding and platform preparation grinding. Hammerstones were located as deeply as level twelve at the site.

A fragment of edge-ground stone (09-01, Cat. 854) and the proximal end of a roughly worked (early stage?) pestle (10-03, Cat. 1441) from Forks Creek are illustrated in Figure 86. Descriptions and metric attributes of the Forks Creek excavation edge-ground stone and pestle fragment follow:

09-01 Edge ground cobbles, edge-polished cobbles

River rounded cobbles (or marine terrace cobbles) with flat or curved areas of pecked and ground wear along one or more edge or face.

N Sample: 2 — 1 complete, 1 fragmentary

Illustrated in Figure 86, Cat. 854

Sample:	*Range*		*Mean*		*SD*	*Measured (N)*
Length	89.7 – 114.54	mm	102.12	mm	17.56	2
Width	52.1 – 71.5	mm	61.8	mm	13.72	2
Thickness	8.8 – 50.4	mm	29.6	mm	29.42	2
Weight	52.54- 560	g	306.27	g	358.83	2

Material (N) Siltstone: 1
Basaltic Sandstone: 1

10-03 Pestles, planar body

A single fragment of a roughly square shaped pestle with grinding wear on the four planes of the body. The pestle was made on an elongated cobble that was naturally four sided. The partially intact end of the pestle fragment has percussive and grinding wear that is indicative of repetitive pounding on a hard surface. This pestle fragment may have come from a pestle that was broken early in its manufacturing process. The planes of the pestle body are not yet smoothly ground, and retain significant amounts of the natural cobble surface.

N Sample: 1 — Illustrated in Figure 86, Cat. 1441

Pestle fragment:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	62.8* broken	mm	-	mm	-	1
Width	46.2	mm	-	mm	-	1
Thickness	47	mm	-	mm	-	1
Weight	170.5	g	-	g	-	1

Material (N) Basalt: 1

The edge-ground stone (09-01, Cat. 854) appears to be made of a medium-hard siltstone/sandstone cobble fragment that has abrasive grinding wear on its planes and ridges. The ground cobble fragment was likely a multi-purpose tool used in lithic reduction, for pecking stone, for food grinding activities, and for other pecking and abrasive tasks. The proximal end of the "early stage" pestle is a fragment of a naturally "squared" hard basaltic cobble that exhibits grinding and percussive wear on its end, and grinding and slight pecking on its four "shaft" faces. Grinding and shaping of the artifact surfaces had been initiated prior to breakage.

Figure 87 illustrates a complete pestle (not catalogued with the 45PC175 excavation assemblage in Appendix B) that was recovered in the last decade from the site area by Mr. Zieroth while he was plowing the field. The pestle was created from an elongated basaltic cobble, and has a pecked and ground "bullet shaped" round shaft with a smooth domed proximal tip. The pestle has a subtle raised ring encircling the widest part of the body at the transition to the pestle base. The base of the pestle is a slightly convex grinding and pounding surface. The Forks Creek pestle in the Zieroth collection is approximately 23 cm long, 10 cm wide, and 9 cm thick.

Figure 88 illustrates a "cobble mortar" (09-02, Cat. 1685); a tablet-like sandstone river cobble that has six round shallow pecked and ground areas of wear (2-3 mm deep) on one face that are indicative of repetitive pounding and grinding with a pestle or cobble. The opposite face of the cobble mortar is exceptionally flat, and may have been utilized as a flat metate-like grinding surface. The portable cobble mortar was located on the terrace facies slope to the Willapa River, tangled in a mat of exposed spruce-tree roots. It may have eroded from the terrace bank, but could have been pushed over the terrace edge by past plowing events. There is a sparse scatter of lithic artifacts in the channel of the Willapa River adjacent to the site, an indication that site terrace erosion has occurred. The description of the cobble mortar, with its metric attributes, is presented below:

09-02 Cobble mortars

These tool forms are made on somewhat flat river cobbles. The cobbles exhibit flattened ground areas on their margins, and also have pecked and ground circular depressions (approximately 1-3 mm deep) on their flat face(s). The circular depressions are indicative of repetitive use of the cobbles as mortar stones. The ground cobble "portable mortars" are differentiated from the large cobble mortars (Type 12-01) found in the Stanley Niemcziek Willapa Valley surface collection because they are much smaller (easily carried under an arm, or in a strong hand), and have planar grinding use wear in addition to percussive wear from a pestle-type artifact. The "portable mortars" have slight depressions, while the 12-01 large cobble mortars have deep bowl-like percussive-wear concavities.

N Sample: 1 Illustrated in Figure 88, Cat. 1685

Intact mortar:	*Measurement*		*Mean*		*SD*	*Measured (N)*
Length	27	cm	-	cm	-	1
Width	22	cm	-	cm	-	1
Thickness	7	cm	-	cm	-	1
Weight	>4	kg	-	kg	-	1
Material (N)	Sandstone: 1					

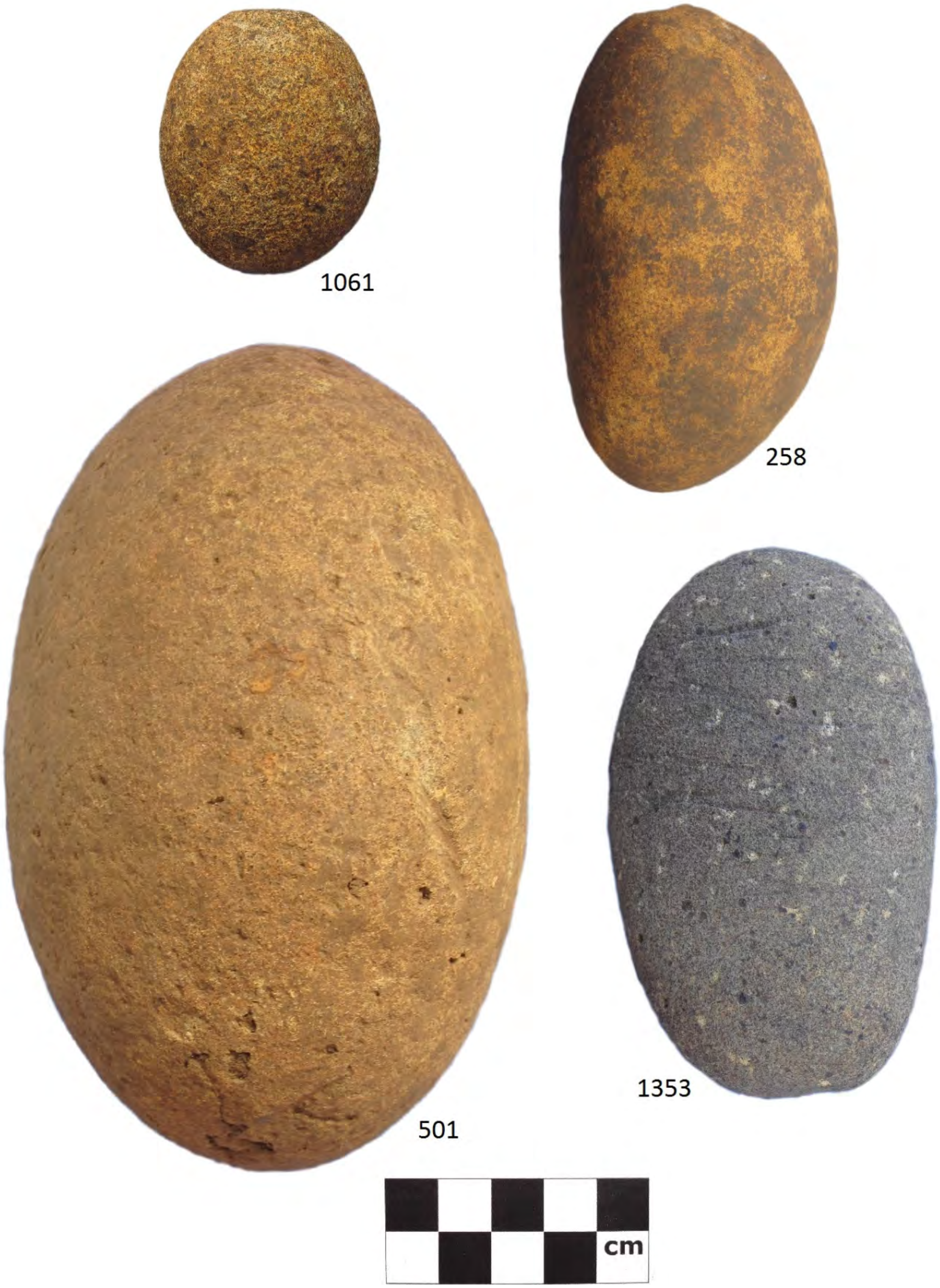

Figure 85. 45PC175 Hammerstones.

1441

854

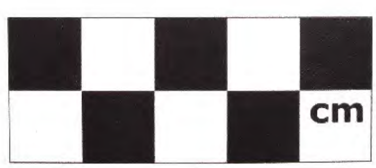

Figure 86. 45PC175 Ground stone.

Figure 87. 45PC175 Pestle (from the Zieroth Family collection).

Figure 88. 45PC175 Mortar base.

Lithic Debris

A detailed and complete lithic analysis has not yet been undertaken on the 45PC175 lithic reduction debitage, but I have attempted to provide a descriptive and replicable basic analysis for the sites lithic assemblage. The lithics recovered in the 1970s from the Martin site (45PC07) are only now being cleaned and sorted from their original level bags by the Burke Museum. The important excavation at the North Nemah River site (45PC101) recovered 754 pieces of lithic debitage within 136 square meter units excavated 40 to 50 cm deep (DePuydt et al. 1994), amounting to an excavated volume estimate of perhaps fifty-five cubic meters. The excavation of 13.3 cubic meters at Forks Creek generated a sample of 3421 pieces of lithic debitage (not including worked flakes). Excavation sampling techniques, as well as differences in behavioral and environmental contexts, have likely contributed to the significant difference in lithic debris density.

This work aims to present an accurate and replicable characterization of the lithic debris assemblage, and explores intra-site lithic vertical distribution patterns and anomalies using variables of size class, basic morphological class, and raw material type. Additional flake attribute data (such as length/width/thickness ratios, platform morphology, and cortex percentages) have not yet been gathered for the 45PC175 lithic debris assemblage. The exploratory analysis of lithic debris presented here is quite basic, but it presents a description of the basic trends of procurement, production, use, and disposal of lithic raw materials and stone tools in the Upper Willapa River Valley, and offers a suite of hypotheses to explore further. Tables 11 through 13 show the *frequencies* of lithic debris within each excavation level for the variables of size class, material type, and morphological class. Tables 14 through 16 show the *percentages* of lithic debris within each excavation level for the variables of size class, material type, and morphological class. The horizontal distribution of lithic debris surrounding the site features is summarized in Table 10, and illustrated in Figure 77.

Size class is an ordinal variable with four different ranked states. Graduated metal mesh screens with square openings were used as size-classifiers for all lithic materials at the site. An artifact was grouped in size class “01” if it could not pass through a 1/2 inch screen. Size class “02” signifies the artifact passed through the 1/2 inch screen, but could not pass through a 1/4 inch screen. Size class “03” signifies the artifact could pass through the 1/4 inch screen, but could not pass through the 1/8 inch screen. The smallest size class “04” was reserved for artifacts and lithic debris that could pass through the 1/8 inch screen. The “04” size class artifacts and samples were primarily recovered within the 1/16 inch wet screen.

Raw material type is a nominal variable with nine different lithic material classes represented at the site. The lithic materials utilized at Forks Creek in descending order of abundance were: indurated siltstone (code 06), fossiliferous CCS (code 01), red/orange jasper (code 02), miscellaneous CCS (code 05), obsidian (code 09), banded CCS (code 03), basalt (code 07), petrified wood (code 04), and quartz crystal (code 11). A descriptive key to the raw materials encountered in the Willapa River Valley is included with the site database in Appendix B. The material type code is utilized in the site database (Appendix B).

Morphological class is a nominal variable borrowed directly from Andrefsky’s (1994, 2005) morphological typology. Proximal flakes with intact platforms were classified as “4e” lithic debris. Flake shatter fragments with no intact platforms were classified as “4f” lithic debris. Angular shatter, non-flake, debitage was classified as “4g” lithic debris.

Table 11. Frequency of 45PC175 Lithic Debitage Size Classes by Level.

	LEVEL																		
Size	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**Total**
01 1/2	51	5	20	32	30	20	14	11	19	6	19	14	11	13	7	4	4	2	570
02 1/4	411	63	173	119	105	95	89	90	73	45	64	76	57	75	42	36	21	12	345
03 1/8	360	57	189	79	82	67	73	51	44	34	64	74	55	58	25	9	10	8	23
04<1/8	34	8	21	12	2	9	5	3	2	1	9	11	9	13	14	0	0	1	11
Total	856	133	403	242	219	191	181	155	138	86	156	175	132	159	88	49	35	23	3421

Table 12. Frequency of 45PC175 Lithic Debitage Raw Material Type by Level.

	LEVEL																		
Material	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**Total**
Siltstone	530	77	259	144	146	140	117	103	101	52	99	104	76	101	60	33	28	13	2183
F. CCS	138	26	61	42	25	21	25	28	15	17	28	39	30	44	16	8	2	5	570
Jasper	98	17	41	33	26	15	22	13	12	6	18	13	11	7	8	1	1	3	345
M. CCS	68	12	32	17	14	13	13	8	9	8	9	15	10	6	4	5	4	2	249
Obsidian	9	0	5	2	4	1	1	0	0	2	0	1	1	0	0	0	0	0	26
B. CCS	4	1	3	1	4	1	2	1	1	1	0	1	1	1	0	1	0	0	23
Basalt	5	0	2	1	0	0	0	1	0	0	1	0	2	0	0	1	0	0	13
P. Wood	3	0	0	2	0	0	1	1	0	0	1	2	1	0	0	0	0	0	11
Crystal	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	856	133	403	242	219	191	181	155	138	86	156	175	132	159	88	49	35	23	3421

Table 13. Frequency of 45PC175 Lithic Debitage Morphological Classes by Level.

	LEVEL																		
Class	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**TOTAL**
4e	232	38	107	71	70	54	48	57	44	26	57	51	39	43	24	17	7	9	994
4f	435	69	220	125	110	106	97	70	63	40	76	99	75	81	43	28	26	12	1775
4g	189	26	76	46	39	31	36	28	31	20	23	25	18	35	21	4	2	2	652
Total	856	133	403	242	219	191	181	155	138	86	156	175	132	159	88	49	35	23	3421

Table 14. Percentage of 45PC175 Lithic Debitage Size Classes by Level.

	LEVEL																		
Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Site
01 1/2”	5.96	3.76	4.96	13.22	13.70	10.47	7.74	7.10	13.77	6.97	12.18	8.00	8.33	8.18	7.95	8.16	11.43	8.70	8.24
02 1/4”	48.01	47.37	42.93	49.17	47.95	49.74	49.17	58.06	52.90	52.33	41.02	43.43	43.18	47.17	47.73	73.47	60.00	52.17	48.12
03 1/8”	42.06	42.86	46.90	32.65	37.44	35.08	40.33	32.90	31.88	39.54	41.02	42.29	41.67	36.47	28.41	18.37	28.57	34.78	39.14
04 < 1/8”	3.97	6.01	5.21	4.96	.91	4.71	2.76	1.94	1.45	1.16	5.77	6.28	6.82	8.18	15.91	0	0	4.35	4.50

Table 15. Percentage of 45PC175 Lithic Debitage Raw Material Type by Level.

	LEVEL																		
Material	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Site
Siltstone	61.92	57.90	64.27	59.50	66.67	73.30	64.64	66.45	73.19	60.46	63.46	59.43	57.58	63.52	68.18	67.35	80.00	56.52	63.65
Fossil CCS	16.12	19.55	15.14	17.36	11.41	11.00	13.81	18.07	10.87	19.77	17.95	22.29	22.73	27.67	18.18	16.33	5.71	21.74	16.71
Jasper	11.45	12.78	10.17	13.64	11.87	7.85	12.15	8.39	8.70	6.98	11.54	7.43	8.33	4.40	9.09	2.04	2.86	13.04	10.12
Misc CCS	7.94	9.02	7.94	7.02	6.39	6.81	7.18	5.16	6.52	9.30	5.77	8.57	7.57	3.77	4.55	10.20	11.43	8.70	7.36
Obsidian	1.05	0	1.24	0.83	1.83	0.52	0.55	0	0	2.33	0	0.57	0.76	0	0	0	0	0	0.76
Banded CCS	0.47	0.75	0.74	0.41	1.83	0.52	1.11	0.64	0.72	1.16	0	0.57	0.76	0.63	0	2.04	0	0	0.67
Basalt	0.58	0	0.50	0.41	0	0	0	0.64	0	0	0.64	0	1.51	0	0	2.04	0	0	0.38
Petrified Wood	0.35	0	0	0.83	0	0	0.55	0.64	0	0	0.64	1.14	0.76	0	0	0	0	0	0.32
Quartz Crystal	0.12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<.01

Table 16. Percentage of 45PC175 Lithic Debitage Morphological Classes (Andrefsky 1994, 2005) by Level.

	LEVEL																		
Class	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Site
4e	27.02	28.57	26.55	29.55	31.96	28.27	26.52	36.78	31.89	30.23	36.54	29.14	29.54	27.05	27.27	34.69	20.00	39.13	29.05
4f	50.82	51.88	54.59	51.65	50.23	55.50	53.59	45.16	45.65	46.51	48.72	56.57	56.82	50.94	48.87	57.15	74.29	52.17	51.89
4g	22.08	19.55	18.86	19.01	17.81	16.23	19.89	18.06	22.46	23.26	14.74	14.29	13.64	22.01	28.41	8.16	5.71	8.70	19.06

Size Class

The Forks Creek project was the first excavation in the region to pass all excavated sediments through 1/8 inch screens. The Martin site (45PC07) and The North Nemah River site (45PC101) were excavated using 1/4 inch screens in the field. Approximately 44% (43.64%) of the lithic debitage recovered from Forks Creek passed through the 1/4 inch screen. In level three, more than half of the lithic debris was recovered in the 1/8 inch and 1/16 inch screens (Table 14). Even if the differences in debris recovery are taken into account, there is still a notable difference in the density of lithic debris between Forks Creek and the North Nemah River site (45PC101).

Size class percentages for all lithic debris are illustrated in Figure 89. Lithic debris larger than 1/2 inch (01) constituted 8% of the total lithic debris sample. The 1/4 inch (02) size class dominates the lithic assemblage at 48%. The 1/8 inch (03) size class represents 39% of the total lithic debris, and the tiny lithic debris smaller than 1/8 inch (04) constitutes just 5% of the sample. Small samples of each level's sediment were wet-screened through 1/16 inch mesh.

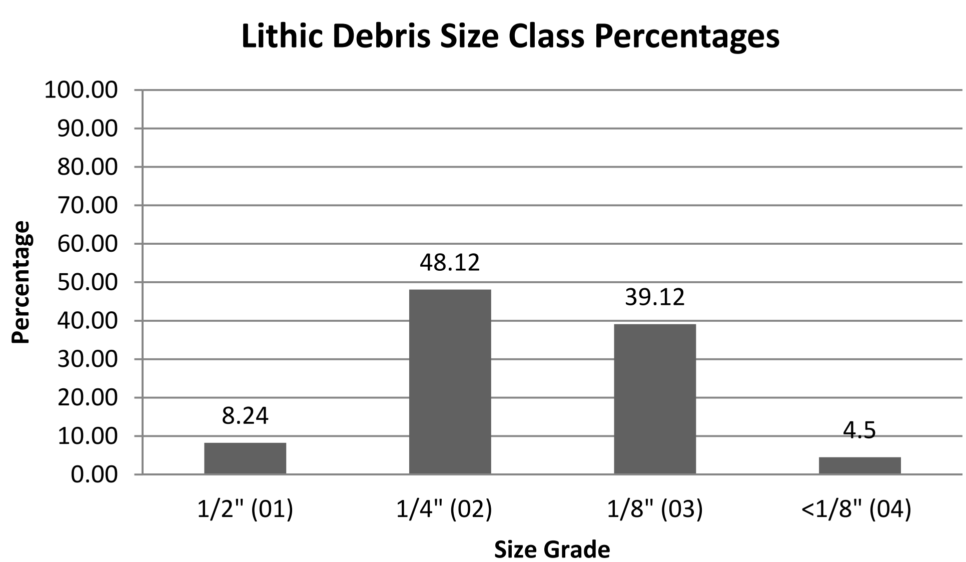

Figure 89. Lithic debris size class percentages at 45PC175.

An examination of the percentages of the lithic debris size classes within each of the site's eighteen levels reveals a moderately consistent pattern throughout the entire occupation span of the site, with an increase in size class at the lowest levels that is likely attributable to the small sample size (Figure 90; Table 14). There is a slight increase in the percentage of 1/4 inch (02) size class materials above level ten. This subtle increase in flake size appears to occur in consort with the later period of lithic reduction intensity that is revealed in the distribution plot of flake frequency by level (Figure 74). The slight increase in lithic debris size above level ten may be the result of a slight increase in primary reduction and tool manufacturing occurring at the site, rather than lithic tool maintenance. The highest percentages of very small size <1/8 inch (04) flakes were present between levels fourteen and ten, the same period in which the early slight increase of lithic frequency debris frequency occurred (Figure 74). There were slightly fewer large flakes represented in the plow zone. This size reduction was likely a cultural pattern, rather than the result of the plow breaking large flakes into smaller flakes.

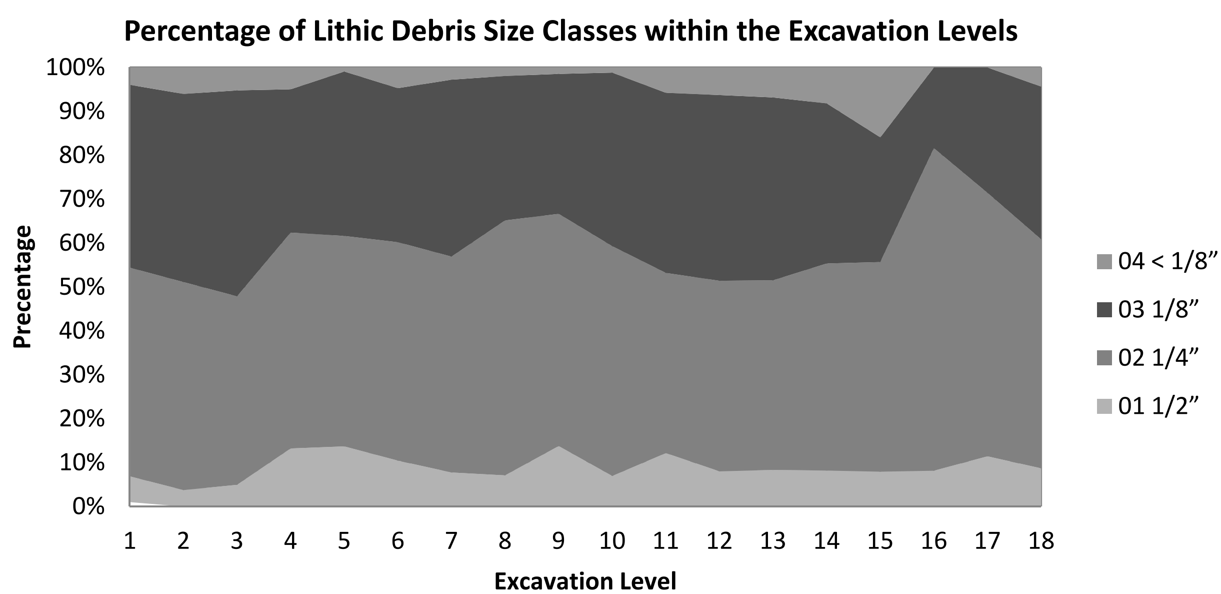

Figure 90. Percentage of lithic debris size classes within the 45PC175 excavation levels.

An examination of the size classes with respect to the lithic debitage morphological classes shows consistency throughout the size classes, except within the largest 1/2 inch (01) size class (Table 17, Figure 91). In the largest 1/2 inch (01) size class there was an increase in complete flakes with intact platforms (4e) and a reduction of flake shatter (4f) without platforms (Figure 91). This pattern may simply be reflective of the technological characteristics for larger flakes to remain intact with their platforms, but it may be reflective of lithic core reduction behaviors at the site. It is notable that there were high percentages of complete flakes with platforms (4e) even in the smallest (04) size class. The small intact debris appeared to be from unifacial and bifacial retouch associated with tool maintenance and late-stage production.

Table 17. Frequency and Percentage of 45PC175 Lithic Debitage Morphological Classes (Andrefsky 2005) within Size Classes.

	Debitage Class			
Size Class	**4e**	**4f**	**4g**	**Total**
01 1/2"	127 (45.03%)	93 (32.98 %)	62 (21.99 %)	282 (100 %)
02 1/4"	483 (29.34 %)	827 (50.24 %)	336 (20.42 %)	1646 (100 %)
03 1/8"	343 (25.62 %)	769 (57.43 %)	227 (16.95 %)	1339 (100 %)
04 <1/8"	41 (26.62 %)	86 (55.84 %)	27 (17.54 %)	154 (100 %)
Total	994	1775	652	3421

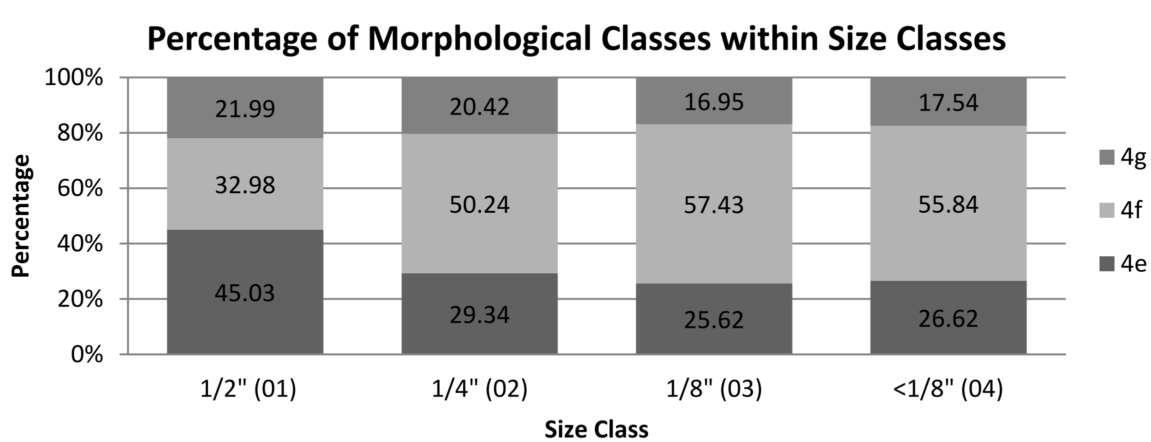

Figure 91. Percentage of lithic morphological classes (Andrefsky 2005) within the lithic size classes.

A percentage plot of raw material types within the size classes (Table 18; Figure 92) illustrates a tendency for the largest flakes to be made from indurated siltstone and banded CCS, while the smallest flakes tend to be made of obsidian and fossil CCS. While obscured by the scale of the Figure 92 cumulative percentage plot, Table 18 shows that none of the smallest <1/8 inch (04) size class flakes recovered were made of basalt, petrified wood, or quartz crystal.

Table 18. Frequency and Percentage of 45PC175 Raw Materials within Size Classes.

Material	1/2" (01)	1/4" (02)	1/8" (03)	<1/8" (04)	Total
Siltstone	204 (72%)	1118 (68%)	780 (58.25 %)	81 (53 %)	2183
Fossil CCS	31 (11 %)	229 (14 %)	273 (20.4 %)	37 (24 %)	570
Jasper	25 (9 %)	157 (9 %)	149 (11.13 %)	14 (9 %)	345
Misc CCS	11 (4 %)	110 (7 %)	111 (8.3 %)	17 (11 %)	249
Obsidian	0	1 (.05 %)	20 (1.5 %)	5 (3 %)	26
Banded CCS	8 (3 %)	13 (.8 %)	2 (.15 %)	0	23
Basalt	1 (.35%)	11 (.7 %)	1 (.07 %)	0	13
Petrified Wood	2 (.65%)	6 (.4 %)	3 (.2 %)	0	11
Quartz Crystal	0	1 (.05 %)	0	0	1
Total:	100%	100%	100%	100%	3421

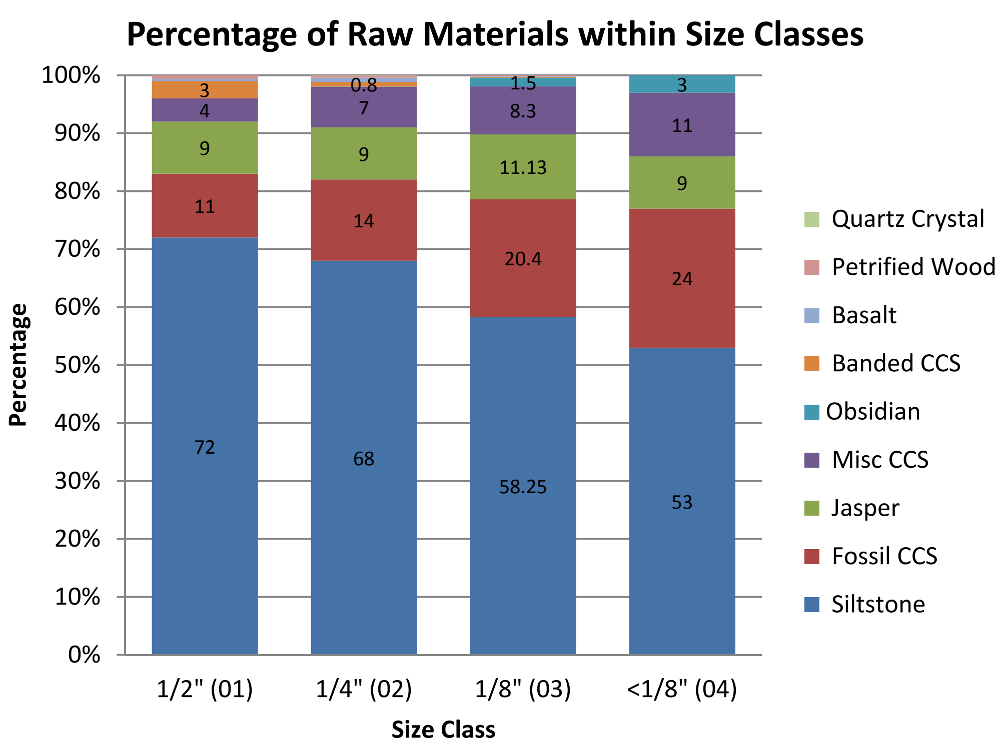

Figure 92. Percentage of raw materials within the lithic size classes.

Material Type

Material type percentages for all of the Forks Creek lithic debitage are illustrated in Figure 93. Indurated siltstone, the most abundant locally available lithic resource, represented more than 63% of the total lithic debris assemblage. The indurated siltstone would have been available in a range of qualities as river cobbles eroded from the local Lincoln Creek, McIntosh, and Astoria Formation. Indurated siltstone was the most abundant medium to high quality local lithic resource. Cobbles of medium and high quality indurated siltstone are available throughout the entire upper and middle Willapa River channel. The cobbles are present in the Lower Willapa River Valley, but tend to be covered in tidal silts. The calcic indurated siltstone raw material has a violent effervescent reaction to sulfuric acid. Clay-like and chalk-like dissolved cultural flakes of indurated siltstone were encountered within the Fork Creek site's clay-rich B horizon.

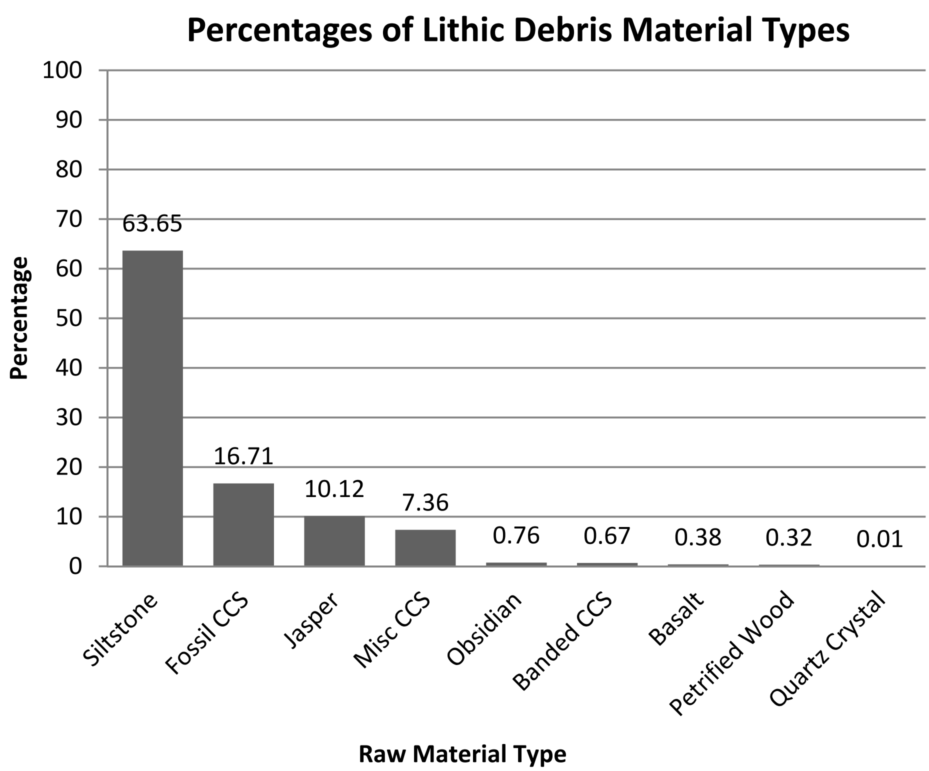

Figure 93. Percentages of lithic debris material types.

The local bedrock basalts in the vicinity of the Forks Creek site are not tool-stone quality, but cobbles and pebbles of tool-stone quality andesitic-basalt material is present in the Willapa River gravels. Tool-stone quality Crescent Formation bedrock basalt is available in the Fall River region north of the Willapa River Valley, and in the Palix River region south of the Willapa River Valley. Basalt is greatly under-represented in the lithic debris assemblage at Forks Creek, constituting only .38 % of all the lithic debris. I would attribute the discrepancy between abundance and use of andesitic basalt to the presence of inexhaustible amounts of easily accessible tool-stone quality indurated siltstone, and to the great abundance of exceptionally high quality, but small, clam and nautiloid fossiliferous CCS nodules, and pebbles and small cobbles of red and orange jasper.

The local milky white and red/orange translucent fossiliferous CCS material does not tend to naturally occur in the form of large cobbles. Fossiliferous CCS is available in the form of intact and fractured fossilized Oligocene Era clams, nautiloid segments, tube worms, and other sea-bed biota. The fossilized clams and sea-bed animals are often found worn into "agate" pebbles within the Willapa Valley and Willapa Bay gravels. The red and orange jasper materials do not often occur as large cobbles, but the material is abundant as pebbles in nearly all of the gravels of the Willapa River Valley and Willapa Bay. I have observed a bipolar reduction "pebble tool" technology employed on these pebble-sized CCS and jasper materials at prehistoric sites located adjacent to gravel beaches throughout Willapa Bay. No distinct bi-polar reduction cores were recovered from the Forks Creek excavation, but there was a small sample of flakes that appeared to display characteristics of being removed from a bipolar core. The blade-like "parent flake" of a dark red/brown jasper blade-flake end-scraper artifact recovered from the excavation may have been removed from a bipolar pebble core (Figure 82, Cat. 1605). Fossil

CCS microblade cores and microblades were recovered from the site, but these artifacts do not appear to have employed anvil and hammer bipolar reduction techniques.

Figure 94 is a cumulative percentage plot of lithic debris raw material types within the site levels. This plot allows us to explore the general trends of lithic material utilization through time. As in the other plots, the small sample size of lithic debris in the lowest levels creates anomalies that would likely not be maintained if the sample size were increased through additional excavation. The Figure 94 plot is useful for examining the trends in the major lithic debris raw material types of indurated siltstone, fossil CCS, jasper, and miscellaneous CCS, but the trends of the relatively small percentages of obsidian, banded CCS, basalt, petrified wood, and quartz crystal flakes are difficult to interpret. Table 15 can be consulted for the distribution details of these important, but underrepresented, raw materials.

The use of jasper and miscellaneous CCS appears to have remained fairly consistent throughout the occupation of the site. There is an apparent rise in the percentage of indurated siltstone between levels ten and four. This increase corresponds to the onset of the late period of lithic production intensity illustrated in the distribution of total lithic debitage frequency by level (Figure 74).

The horizontal distribution of lithic debris surrounding the site features is illustrated in Figure 77. Table 10 summarizes the distribution of lithic debris raw material types within the excavation units. As previously discussed, the highest percentages of lithic debris were encountered in the units that were outside of, and adjacent to, the hearth features. Table 10 also reveals concentrations of exotic obsidian lithic debris in the hearth adjacent activity areas.

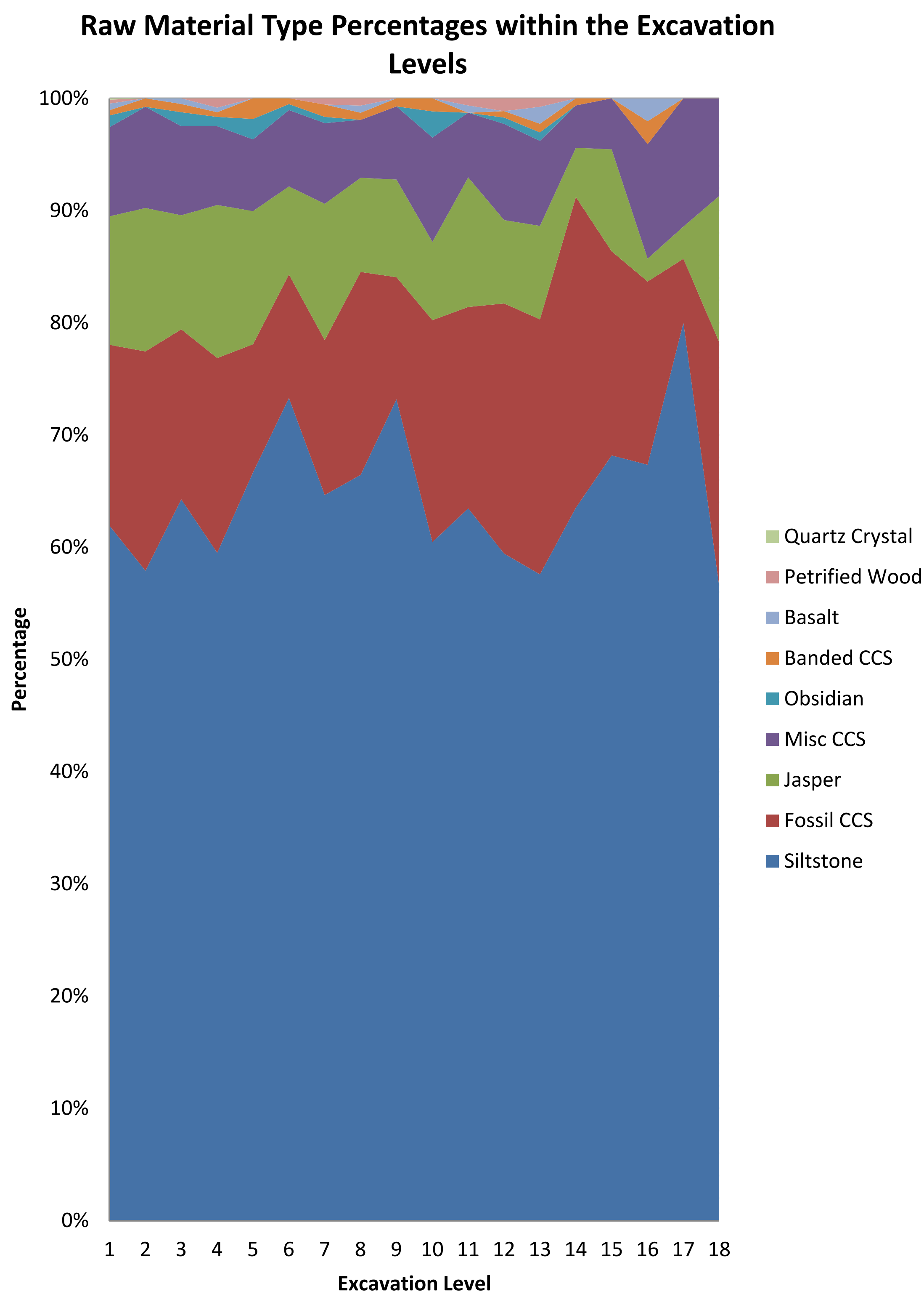

Figure 94. A cumulative graph of raw material type percentage within the excavation levels.

The apparent increase in the use of locally abundant and easily available indurated siltstone may correspond to a period of more intensive site utilization when a greater number of expedient and task-specific siltstone tools were being produced at the site for on-site use. The highest percentages of fossiliferous CCS materials were displayed in levels ten through fourteen, below the rise in indurated siltstone debris percentage.

Examining lithic material types with respect to size class may reveal technological and cultural behavioral patterns (Table 19; Figure 95). There were no basalt flakes in the 04 size class (less than 1/8 inch), and only 3.72% (81 pieces) of the siltstone lithic debris was so small. The basalt and siltstone materials tended to not be of a high-enough quality (with macro-crystalline or particulate structure, bedding planes, or inclusions) to produce the types of fine pressure flakes, and microblades, that were produced from fossiliferous CCS, jasper, obsidian, and other high-quality cryptocrystalline materials. Artifacts made from the locally abundant siltstone material may also have been discarded rather than being retouched, as the material is so widely available. It is notable that the majority of fossil CCS, miscellaneous CCS, and obsidian lithic debris is smaller than 1/4 inch (Table 19; Figure 95). Only a single (3.85%) obsidian flake was in the 1/4 inch size class (Table 19).

Banded CCS size class trends do not follow the same trends as jasper, as I expected it would. The differences may be due to the small sample size of banded CCS lithic debris. The material is texturally identical to jasper, but exhibits a spectrum of colors beyond the red and orange hues. Many formalized tools in Willapa valley private farm surface collections were made of the banded CCS material, and I have found naturally occurring fragments of the material in the gravels of the Middle Willapa River valley. At Forks Creek, there is a tendency for banded CCS debitage to be large (Figure 95).

Table 19. Frequency and Percentage of 45PC175 Size Classes Within Raw Material Type.

	Size Class				
Material	**01 ½"**	**02 ¼"**	**03 1/8"**	**04 <1/8"**	**Total**
Siltstone	204 (9.34 %)	1118 (51.21 %)	780 (35.73%)	81 (3.72 %)	2183 (100 %)
Fossil CCS	31 (5.44 %)	229 (40.17 %)	273 (47.89 %)	37 (6.5 %)	570 (100 %)
Jasper	25 (7.25 %)	157 (45.51 %)	149 (43.19 %)	14 (4.05 %)	345 (100 %)
Misc CCS	11 (4.42 %)	110 (44.18 %)	111 (44.58 %)	17 (6.82 %)	249 (100 %)
Obsidian	0	1 (3.85 %)	20 (76.92 %)	5 (19.23%)	26 (100 %)
Banded CCS	8 (34.78 %)	13 (56.52 %)	2 (8.7 %)	0	23 (100 %)
Basalt	1 (7.69 %)	11 (84.62 %)	1 (7.69 %)	0	13 (100 %)
Petrified Wood	2 (18.18 %)	6 (54.55 %)	3 (27.27 %)	0	11 (100 %)
Quartz Crystal	0	1 (100 %)	0	0	1 (100 %)
Total	282	1646	1339	154	3421

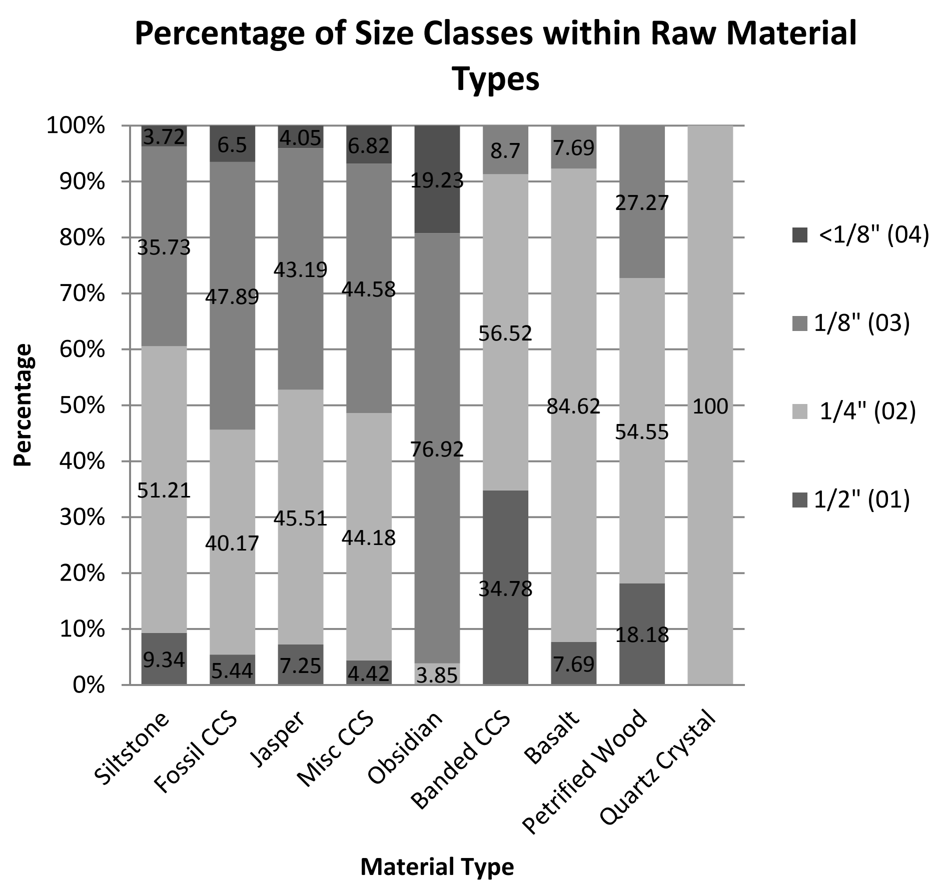

Figure 95. Percentage of size classes within raw material types.

Figure 95 illustrates that 34.78% of the banded CCS lithic debris was larger than our 1/2 inch (01) size classifying screen. This may be indicative of early core reduction episodes of the banded CCS material at Forks Creek, but no cores of banded CCS were recovered. It is possible that banded CCS materials occur in larger natural fragments and cobbles than the common red and orange jasper. The natural pieces of the red and orange jasper I have observed tend to grade to the pebble and small cobble size. Banded CCS may tend to occur naturally as larger cobbles that could produce larger reduction debris.

Material type with respect to morphological debris class data is presented in Table 20, and illustrated in Figure 96. Siltstone had high percentages of flake shatter (4f) and blocky shatter (4g), and the lowest percentage of flakes with complete platforms (4e). Obsidian displayed the opposite tendency, and was dominated by small complete flakes with intact platforms (4e). Basalt had the highest percentages of blocky shatter (4g), followed by siltstone. The only piece of quartz crystal recovered from the excavation was a fragment of blocky shatter (4g). Fossil CCS and jasper materials appear to have been reduced in a similar fashion.

Table 20. Frequency and Percentage of Lithic Debitage Material Type by Morphological Class (Andrefsky 2005).

	Debitage Class			
Material	**4e**	**4f**	**4g**	**Total**
Siltstone	504 (23.09 %)	1221 (55.93 %)	458 (20.98 %)	2183
Fossil CCS	252 (44.21 %)	244 (42.81 %)	74 (12.98 %)	570
Jasper	132 (38.26 %)	165 (47.83%)	48 (13.91 %)	345
Misc CCS	72 (28.91 %)	113 (45.38 %)	64 (25.7 %)	249
Obsidian	15 (57.69 %)	11 (42.31 %)	0	26
Banded CCS	11 (47.83 %)	9 (39.13 %)	3 (13.04 %)	23
Basalt	5 (38.46 %)	4 (30.77 %)	4 (30.77 %)	13
Petrified Wood	3 (27.27 %)	8 (72.73 %)	0	11
Quartz Crystal	0	0	1 (100 %)	1
Total	994	1775	652	3421

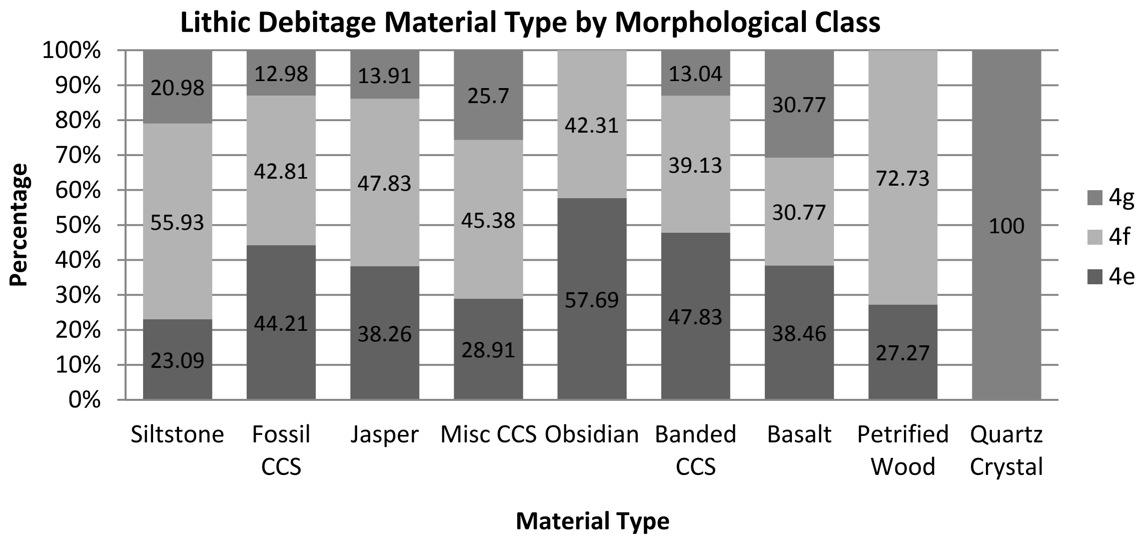

Figure 96. Percentage of morphological classes (Andrefsky 2005) within raw material types.

Morphological Class

The level of classification undertaken with the Forks Creek lithic debitage represents only the initial steps of an in-depth lithic analysis where procurement preferences, reduction trajectories, and technological patterning can be explored further. The lithic flakes with intact platforms (4e) potentially have significant amounts of embedded cultural information derivable from formal variables that have yet to be populated with data.

Morphological class (Andrefsky 2005) has already been considered in its relationship to lithic debris size class and material types. Figure 97 illustrates the percentage of morphological classes by excavation level. The small sample size of the lowest levels has created anomalies that do not likely reflect the trends of the population. Figure 97 shows that there was not any significant change through time in the overall distribution of basic types of lithic debris classified to this basic morphological level. A larger set of diverse variable data would reveal more information.

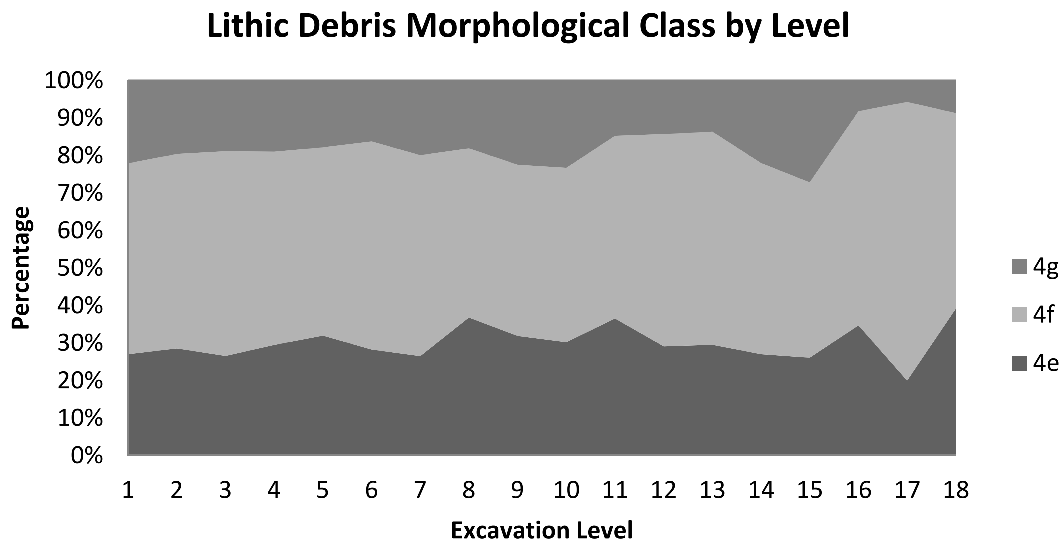

Figure 97. Percentage of morphological classes (Andrefsky 2005) by excavation level.

The lithic debitage assemblage consists of a mix of debris from many different reduction events and tool production/maintenance trajectories. The lithic debitage was deposited around a series of terrace-edge cooking pits over a period of approximately 2600 years. No lithic debris feature representing a special preserved "*Pompeii*" isolated lithic reduction sequence was identified in the excavation area, but such instructive and rare features could potentially still be buried at the site, or at other camp and occupation sites nearby. The fifteen multi-directional cores and lithic debitage sample suggest that the raw materials used at Forks Creek were primarily derived from small cobbles and pebbles procured locally from the Willapa River. The lithic debris at the site appears to be consistent with the production and maintenance of the same forms of lithic tools and tool fragments located at the site. Maintenance of knives, scrapers, and projectile points at the camp and processing site has left many small intact flakes of high quality materials that must be recovered in fine mesh screens. Later periods of intensive site utilization were associated with increased production of medium quality locally abundant siltstone flakes and flake shatter larger than 1/4 inch. This material likely represents debris produced though the manufacture of expedient flake tools and basic early stage bifaces.

Forks Creek Obsidian Provenience Studies

One of the goals of the excavation project was to recover obsidian artifacts and debitage that could be provenienced using XRF. Craig Skinner and the Northwest Research Obsidian Studies Laboratory graciously provided their expertise to test obsidian artifacts and debris from the Forks Creek site and the Willapa River Valley family surface collections. The detailed results of the XRF and PCA analyses are included in Appendix D.   A discussion of trade and exchange in Chapter Seven addresses the unexpected diversity of obsidian identified within the Willapa family surface collections. Obsidian artifacts in the family collections originated in central Oregon, southeast Oregon, Idaho, northern California, and east Central California. Exotic Californian obsidian was not identified at Forks Creek, but a diverse range of Pacific Northwest obsidian sources were represented at the site.

Twenty-six obsidian flakes were recovered from the Forks Creek excavation (Table 21). Within the approximately 13.3 cubic meter excavation, there was an average of approximately two obsidian flakes in every cubic meter of sediment. The obsidian flakes were exceptionally small. Only one obsidian flake could not pass through the 1/4 inch screen. Most (57%) of the obsidian flakes are very small biface "rejuvenation" maintenance pressure flakes with intact platforms. The diminutive physical size of eight (31%) of the Forks Creek obsidian flakes was detrimental to provenience studies; their small scale excluded them from the measuring capabilities of the available XRF technology, even with the exceptional techniques and experience of the Northwest Research Obsidian Studies Laboratory.

The deepest and oldest obsidian from levels thirteen and twelve came from Newberry Volcano, Oregon, and Timber Butte, Idaho sources (Table 21). The level twelve Timber Butte, Idaho specimen may be one of the most distantly traded occurrences of the material, traveling an equivalent distance to artifacts found in southern British Columbia, Canada. The important central Oregon Obsidian Cliffs obsidian source was represented in levels 10, 6, 5, 3, and the plow zone. Whitewater Ridge, Oregon, obsidian was present in levels 5 and 4, and Newberry Volcano, Oregon obsidian was present in levels 13, 7, 4, and 3. All of the Forks Creek obsidian was provenienced to Oregon, with the exception of the single specimen provenienced to Timber Butte, Idaho. The most recent obsidian from the plow zone was provenienced to the Glass Buttes 1, Oregon source (Table 21). Six miniscule obsidian samples that could not presently be provenienced were recovered from the plow zone, a testament to the excavation team's mindful recovery efforts and excavation technique standards.

Table 21. Obsidian Lithic Debitage from 45PC175.

45PC175 OBSIDIAN							
Catalog #	Unit	Level	Size Class	Class	Count	Source	NROSL Sample #
001666	N294E207	1	4	4e	1	Glass Buttes 1 *	294207-01A
001667	N294E207	1	3	4e	1	Glass Buttes 1? *	294207-01B
001672	N291E210	1	3	4e	1	Glass Buttes 1 *	291210-01
001677	N280E201	1	3	4e	1	too small for XRF	-
001678	N280E201	1	4	4e	1	too small for XRF	-
001679	N294E207	1	4	4e	1	too small for XRF	-
001680	N293E208	1	4	4f	1	too small for XRF	-
001681	N290E204	1	3	4f	1	too small for XRF	-
001682	N260E162	1	3	4f	1	too small for XRF	-
001659	N294E206	3	3	4e	1	Glass Buttes 1 *	294206-03
001668	N293E208	3	3	4f	1	Obsidian Cliffs *	293208-03A
001669	N293E208	3	4	4e	1	Glass Buttes 1? *	293208-03B
001675	N291E210	3	3	4f	1	Newberry Volcano	291210-3b
001684	N291E210	3	3	4e	1	too small for XRF	-
001661	N291E208	4	3	4e	1	Whitewater Ridge *	291208-04
001676	N291E210	4	3	4f	1	Newberry Volcano	291210-04
001660	N294E206	5	3	4e	1	Whitewater Ridge *	294206-05
001670	N294E207	5	3	4e	1	Obsidian Cliffs *	294207-05b
001674	N291E211	5	3	4f	1	Obsidian Cliffs *	291211-05
001683	N294E207	5	3	4e	1	too small for XRF	-
001664	N291E208	6	3	4e	1	Obsidian Cliffs *	291208-06
001665	N291E208	7	3	4e	1	Newberry Volcano	291208-07
001662	N291E208	10	3	4f	1	Obsidian Cliffs *	291208-10A
001663	N291E208	10	3	4f	1	Obsidian Cliffs *	291208-10B
001671	N291E207	12	2	4f	1	Timber Butte *	291207-12
001673	N291E208	13	3	4f	1	Newberry Volcano	291208-13
				Total	26	*Asterisk indicates a small sample	

Seeds

Beyond charred wood fragments and limbs, the only identifiable non-microscopic organic artifact samples recovered from the Forks Creek excavations were seeds, nuts, and pits. Most of these organic materials would not have been recovered if only 1/4 inch screens had been utilized, and the seeds represent the only direct macroscopic evidence of floral resource utilization from the excavations. The seeds can reveal information about the natural and culturally-maintained environment surrounding Forks Creek, and the seasonality of site use. The ensemble of seeds at the site confirms the presence in the past of a semi-open landscape with medicinally and nutritionally useful water-loving shrubs that thrived in fire disturbed areas. Early maps (1883 GLO map, BLM 2014) illustrate "Forks Prairie" near the site location. The ensemble of shrubs represented by seeds at the Forks Creek site would have flourished at the periphery of a prairie. Table 22 summarizes the frequencies of seeds within the site levels. Table 23 summarizes the frequencies of seeds within the excavation units. Figure 98 illustrates a sample of archaeological seeds recovered from the excavation. The 45PC175 seeds were identified with the assistance of Willapa botanist Kathleen Sayce.

Table 22. Frequency of 45PC175 Seed Species by Level.

	LEVEL																		
Seed Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**Total**
Bitter Cherry	4	0	2	4	4	1	3	1	2	0	0	0	0	0	0	0	0	0	21
Hazelnut	1	0	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	5
Cascara	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Maple	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
Unknown	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total:	5	0	4	5	4	1	3	1	2	0	2	0	1	0	1	1	0	0	30

Table 23. Frequency of 45PC175 Seed Species by Excavation Unit.

	← west					Excavation Unit			east →				
Seed Species / North East	260 162	280 201	290 204	291 206	292 206	294 206	291 207	294 207	291 208	293 208	291 210	291 211	Totals
Bitter Cherry					1	3	8			5	2	2	21
Hazelnut	1	1				1	2						5
Cascara						1							1
Maple									2				2
Unknown								1					1
													30

Twenty-one (70% of the total seeds) *Prunus emarginata* (bitter cherry) pits were recovered. The burned and non-burned bitter cherry pits were only recovered from sediments above level nine. The deposits above level ten fall within the late period of lithic production that is reflected in the distribution of flake debitage frequency by level (Figure 74).

Gunther (1973), Turner (1975), and Pojar et al. (1994) all state that the fruit of *Prunus emarginata* is too bitter to be consumed. Gunther (1973) and Turner (1975) discuss the use of the bark (fresh and ash) as a medicine, and Pojar et al (1994) describes the use of bitter cherry bark as cedar basketry overlay. *Prunus emarginata* thrives along streams, in damp disturbed areas as "pioneer" shrubs, and in open woods (Pojar et al. 1994; Turner 1975). Pits of a similarly bitter and seemingly inedible species, *Prunus virginiana ssp. demissa* (western choke cherry), were common in the Fraser River Milliken site deposits dating to the Early Holocene (Mitchell and Pokotylo 1996). I believe bitter cherry was harvested near the site in the boundary zone of the fire-maintained Forks Prairie. It appears that the berries of *Prunus emarginata* were used as a local resource despite the ethnobotanical data to the contrary. The fruit need not have been consumed unaltered on its own; it could have been used as a single element in an ensemble of ingredients. Bitter cherries would be ripe and edible in late summer.

Five (17% of the total seeds) intact and fragmented *Corylus cornuta* (hazelnut) nutshells were recovered. The hazelnut shells were burned and partially burned. Initially confused with acorns, the hazelnuts were positively identified by the existence of circular voids within their double-layer pericarp “shell” (http://pages.wustl.edu/peblabguide/articles/1761). The earliest hazelnuts were present within level fifteen, and they extend to the late prehistoric plow zone.

Like bitter cherry, hazelnut would have been successful in the margins of Forks Prairie. Unlike bitter cherry, hazelnut is savory and delicious. Pojar et al. (1994) and Turner (1975) suggest the hazelnuts were typically harvested in the late summer and autumn and stored for fall and winter consumption. The productivity of pre-contact hazelnut groves was increased by cultural burning treatments (Pojar et al. 1994). Hazelnuts were consumed raw, cooked, and “pickled.”

In the Willapa River Valley, hazelnuts would have been ready to harvest by the peak of summer, and would have had a short “window of availability” due to intense foraging competition from animals. The burned nature of some of the hazelnut specimens at Forks Creek suggest they may have been roasted in the site’s pits and hearths. The pit and hearth Features 4, 4b, and 7 could have been used to roast hazelnuts, but they do not contain high densities of the hazelnut pericarp “nut shell” material. Two specimens of hazelnut were located within unit N291E207 at levels 13 and 15. These hazelnut shells were likely associated with the pit and hearth Features 4b and 7. The pit features were not specialized hazelnut roasting pits, though hazelnuts were likely one of the primary floral resources procured and processed at the site.

Figure 98. 45PC175 Seeds.

Unlike acorns, hazelnuts do not require leaching to make them palatable. There are bowl-shaped erosion hollow *kolk* formations in the shallow bedrock channel of the Willapa River adjacent to the Forks Creek site (Figure 27). These deep and smooth hollows would be ideal for water-leaching organic resources in the river. No archaeological acorns (*Quercus*) were identified.

The earliest seed at the site was identified within level 16 of excavation unit N294E206. The single (3%) seed came from a *Rhamnus purshiana* "cascara" berry. Cascara shares the same habitat as hazelnut and bitter cherry. Most widely known for the laxative effect of the bark, Gunther (1973) and Turner (1979) indicate that the northern Washington Coast Makah consumed the berries during the peak of summer. The single seed recovered from our excavations does not suggest intensive cascara utilization, but it shows that cascara may have been a supplemental nutritional or medicinal resource.

Two (7%) *Acer sp.* (Maple) seeds were recovered from unit N291E208 level eleven. I do not suspect that maple seeds were being harvested and processed as a food resource at the site. The maple seeds suggest that there were maple trees in the vicinity of the site in pre-contact times, as there are now. A single (3%) as-yet unidentified melon-shaped seed was located in unit N294E207 level three (Figure 98, Cat. 281).

Summary and Discussion of 45PC175

The Forks Creek site is an approximately 2700 year old Upper Willapa River Valley camp and resource processing area situated on a "middle" terrace landform overlooking the Willapa River and Forks Creek. The Willapa River and Forks Creek are non-tidal waterways that are seasonally rich with salmon and a diversity of riverine floral and faunal resources. The Forks Creek camp and resource processing site appears to have potentially been located at the margin of a fire-maintained prairie landscape (Forks Prairie) that likely supported culturally-maintained groves of bitter cherry and hazelnut shrubs that were harvested by site occupants during the peak of summer. The excavations did not reveal any direct evidence of camas processing or use at the site, but a moist prairie could have successfully supported a camas garden. There are isolated patches of camas present in the Willapa Bay region, and an antler digging stick handle was recovered from the Martin site (45PC07) (Shaw 1977). An open prairie landscape would have attracted elk and deer that could have been hunted and processed by family and task groups using the Forks Creek camp. Highly acidic soil conditions have dissolved away *all* of the residual bone that was not completely carbonized by fire, leaving only fire-pit features and a relatively large assemblage of biface knife and scraper tools as indicators of intensive processing activities. The acidic sediment conditions also resulted in the post-depositional dissolution of flakes and cobbles made of calcic-indurated siltstone (the most abundant local raw lithic resource), resulting in textured "ghost cobble" stains within the sediment matrix.

Our excavations were focused around a terrace-edge cooking pit area, where at least three "nested" pits dated between approximately 2490 +/- 30 BP (Beta 367371) and 1750 +/- 30 BP (Beta 367372). Charcoal and FCR "oven cleaning" debris scatters surround the cooking pit features, and extend down the buried terrace facies slope. There are likely additional buried features at the large site that our grid-based auger-test sampling did not identify. Lanceolate projectile points and smaller barbed, stemmed, and shouldered varieties typical of the Lower Columbia River (Minor 1984) were used at the site. The earliest projectile point fragment recovered from the site came from the clay-rich "B horizon" sediments of level nine, and likely dates to a period slightly more recent than 2400 BP. The earliest intact projectile point with a hafting element, a broad-necked, shouldered, siltstone form with a diverging stem (Figure 78, Cat. 965, 01-05B), came from the "B horizon" sediments of level seven. The intact projectile point likely dates to a period between 2000 and 2400 BP. With a neck-width of 7.6 mm, the projectile point could have easily been part of either a bow-and-arrow or atlatl hunting system.

Formalized lithic tools at the site were made from locally abundant and easily accessible raw materials available from the gravels of the Willapa River. The early occupants of the site appear to have used a higher percentage fossiliferous CCS materials than the people who utilized the terrace during its later periods. I have suggested that this difference may be related to an increase in site utilization during the later period, in which the locally abundant indurated siltstone was increasingly utilized to manufacture "expedient" flakes and biface tools on-site to accommodate a growing scale of processing activities, and perhaps extended periods of occupation. No slate, nephrite, bone, shell, or wood artifacts were recovered from the small excavation sample.

No distinct macroscopic evidence of the utilization of specific coastal or salt-water estuary resources was identified by our excavation. Shell and bone tools that may have been illustrative of the use of coastal or estuary resources did not survive the highly acidic natural post-depositional site context. The projectile point assemblage from Forks Creek is similar to the sample recovered from the near-coastal North Nemah River site (45PC101) (DePuydt et al. 1994), and the Martin site (45PC07) (Kidd 1960, 1967; Shaw 1977). The 1860 +/- 100 BP (WSU 1534) Martin site was noted as having a lack of stemmed and notched forms (Kidd 1960:76; Shaw 1977: 36). The slightly older Forks Creek projectile point assemblage includes stemmed and barbed projectile point forms, suggesting the relative scarcity of these forms at the Martin site is not due to its "early" age.

The presence of microblades and fragments of microblade cores at Forks Creek is consistent with the observations of Welch (1970, 1983) and Kelly (1984) in the headwaters of the Chehalis River. While confined to the later periods of occupation at Forks Creek, microblade technology in the Willapa Hills is definitively older than the hypothesized introduction of the Athabaskan language no more than one-thousand years ago (Krauss et al. 2005). The choice to use microblades within a context of virtually unlimited high and medium quality raw lithic materials seems as though it would be based on a technological preference rather than a necessity based on materials scarcity or a context of unpredictable availability. Microblade cores were not likely produced because of their inherent efficiency in raw material consumption, but due to their desired end-products. Microblades were likely desired and produced because of the technological traits that are inherent in blades; exceptionally sharp and flat edged flakes that can be reproduced in a highly consistent and predictive manner. The microblade technology at the Forks Creek site is nearly contemporaneous with the use of side and tip-hafted microblades and microliths at the northern Washington Coast Hoko River site (Croes 1995).

A similar ensemble of raw materials appears to have been utilized between the Willapa Bay estuary and Upper Valley, but indurated siltstone appears to have been utilized far more in the Upper Willapa River Valley than at the North Nemah River site (45PC101) located near the mouth of the North Nemah River on Willapa Bay. Fossiliferous CCS, basalt, and quartzite materials appear to dominate the lithic debitage at site 45PC101. These materials are abundantly available within the gravels of the Willapa Bay shoreline, and from within the near-shore drainages that cut through ancient marine terraces. This project's reconnaissance survey work in the Willapa Bay region identified some of the heaviest use of high-quality andesitic basalt at archaeological sites closest to the mouth of the Palix River. The Palix River watershed flows through a distinct basaltic landscape. The lithic debitage assemblages from all of the sites tested by Minor (1984) in the Lower Columbia River (coastal, estuary, and inland) were dominated by CCS materials, followed by basalt. Some contained small numbers of obsidian flakes. At Forks Creek, the obsidian lithic debitage consists mostly of very small intact pressure-retouch flakes that were likely produced during tool maintenance and sharpening. The varieties of obsidian that have been provenienced at Forks Creek are consistent with the ensemble of materials that would have been available to a group participating in a Lower Columbia River trade network. There appears to have been an increase in the use of Glass Buttes 1 obsidian during the late site occupation that may be related to participation within a complicated social trade network extending to the south as far as Central California (discussed in Chapter Seven).

The Forks Creek Pit site (45PC40) (Chapter Four) is located just over 500 meters southeast of 45PC175. We should keep this contextual information in mind; 45PC175 is just one of a network of multiple camp and processing sites in the immediate region. The Forks Creek Valley has never even been surveyed for archaeological materials above the Delanoy Forks Creek site (45PC174) (Figure 9). Significantly more archaeological excavation testing is needed to develop accurate environmental, technological, and cultural phase chronologies that span the Late Pleistocene and Holocene.

CHAPTER SIX

THE WILLAPA VALLEY ARTIFACT CLASSIFICATION

The ongoing Willapa survey has located hundreds of lithic tools at archaeological sites throughout the Willapa Bay and Willapa River Valley region. The many seasons of fieldwork the survey team spent exploring Willapa shorelines and following plows over dairy field terraces represents a small and punctuated sample in comparison to the amount of time and effort that multiple generations of Willapa families have spent exploring, collecting, and learning from the artifacts found in their own local plowed terrace fields and tide flats. I was lucky enough to meet some of these Willapa families, and will always be grateful for their hospitality, their willingness to share local knowledge, and for their interest in Willapa's past. Several of the local families hold extensive prehistoric artifact collections from the fields they have plowed for generations. These families graciously granted me access to the collections so they could be documented and described. More than 2200 prehistoric Willapa River Valley *formalized* artifacts made of chipped stone, ground stone, and bone/antler were examined and documented prior to performing any ground-disturbing archaeological testing. The Willapa Valley artifact classification was developed from the extensive Willapa River Valley family collections.

When I began surveying in the Lower Willapa River Valley, I met several adults in their 50's who relayed stories of being shown artifacts from a large local collection when they were children. The artifacts that multiple individuals had reported being shown at Scout meetings or at the Menlo School were part of the collection of the late Mr. Stanley Niemcziek. Mr. Niemcziek enjoyed showing the artifact collection to groups of students. Mr. Niemcziek was born in Wisconsin in 1904, but as a young adult moved his family to the Willapa River Valley and began to collect artifacts from plowed fields and the channels of the Willapa River. He collected from fields while he worked and as an evening and weekend-hobby from the mid 1930s through the late 1970s. Mr. Niemcziek also had a farm in the Upper Chehalis River Valley near Adna, from which he had collected many small and delicate projectile points and scrapers. Mr. Manley Niemcziek, his son, continued his father's tradition by sharing the artifact collection with this project.

Victor Niemcziek Sr., and Lawrence and Phillip Aust were contemporaries, and perhaps friendly competitors, of Stanley Niemcziek. Their families had been assembling artifact collections from plowed fields in the Boistfort Valley, the headwaters of the Chehalis River, and the uppermost reaches of the Willapa River throughout the middle of the 20th Century. The Niemcziek and Aust families shared these collections with Welch and Daugherty in the course their early surveys in the headwaters of the Chehalis River (Welch 1983).   I have not seen these collections, but Welch (1983) has described their most important elements.

The Kaech family, of the Upper Willapa River Valley, also shared their interesting collection of local prehistoric artifacts. The late Mr. Edward Kaech had begun to assemble his Willapa artifact collection in the 1950s, and many of the specimens in the Kaech Family collection originated from near their home in the Elk Prairie region of the Upper Willapa River Valley. Mr. Edward Kaech had artifacts from throughout the Willapa River Valley, as well as artifacts from the Boistfort Valley and the Upper Chehalis River Valley.

In the lower reaches of the Middle Willapa River Valley, the Martin and Zieroth families (neighbors) live on the old Lilly Homestead farm. These family collections contained artifacts from the prehistoric and ethnographic component of the Lilly Homestead (Chapter Four) area, as well as artifacts from several dairy fields in the Upper Willapa River Valley that have been managed by the Zieroth Family.

I was also fortunate to meet members of the Rubey Family in the Lower Willapa River Valley. They helped me document and contextualize their late father's interesting collection of archaeological artifacts found in shoreline and tide-zone areas surrounding the mouths of the Willapa, Palix, and North Rivers, as well as from the uplands of the Fall River. This diverse family collection included many important specimens from site 45PC196, and clearly illustrates the hypothesized increase in use of high-quality andesitic basalt materials at sites within the Palix River watershed.

The Willapa River classification was developed from the decades-old artifact collections of the Niemcziek, Kaech, Martin, Zieroth, Wildhaber, and Rubey families. Many other friendly individuals and families contributed to the breadth and spectrum of the classification by sharing individual artifacts or small assemblages from the valley. Collectively, these old family collections contained nearly the full spectrum of lithic and ground stone technology that was expected to be represented in a large valley adjacent to the Lower Columbia River.

Bone artifacts are greatly under-represented in the family collections. This was not surprising, as the family artifact collections represent samples of the local archaeological assemblages. The few bone and antler tools in the collections appear to be late prehistoric or mid-19th Century ethnographic period artifacts that somehow escaped the generally acidic conditions of the valley sediments. Some bone artifacts were found in the Middle Willapa River Valley (such as the *lahal* game piece from the Lilly Homestead, Chapter Four). Some of the bone artifacts were likely collected from the tidal-influenced Lower Willapa River Valley where there may have been more alkaline depositional contexts (such as cultural shell midden) contributing to bone preservation.

The Willapa family artifact collections represent more than eighty years of multi-generational opportunistic surface finds, and while they have been stored with care, shared with the community, and treated as important items, very few had been *curated* with written provenience information. Thankfully, a great deal of this information had been transferred through the family in the form of story. This was particularly true of some of the most interesting and impressive artifacts in the collection that had their own individual stories. Needless to say, a great variety of different levels of context information was available for many of the artifacts in the different family collections. Some artifacts could be pin-pointed to an exact location, some to a specific field, some to an area in the valley (such as the mouth of a named creek), and many to only the context of the Willapa River Valley.

Contamination was always considered and discussed with the collection-holding families. In every case, the families could immediately pick-out two to three artifacts that were gifts or trinkets not located in the field. These few contaminants were quite obvious; a shard of southwest pottery, a modern copper-tool knapped obsidian point, a single Northwest Coast toggling harpoon valve, etc. None of the Willapa collectors were involved in buying and selling artifacts; they enjoyed the process of locating artifacts and learning about the local types. It is oddly reassuring to note that Mr. Stanley Niemcziek, who assembled one of the largest collections, didn't ever travel far from the Willapa Valley after he arrived. He reportedly never looked for artifacts beyond the Upper Chehalis River and a few shorelines in Willapa Bay. The attribution of local context for the Willapa Valley family collection artifacts is unquestionably trust-based. The artifacts were not formally excavated from gridded sites by professional archaeologists. The artifacts were located in plowed fields, river gravel bars, and tide-zones, by hard-working history enthusiasts and their families over the last eighty years.

Collector bias must also be considered in addition to collection contamination, the family collections do not include significant numbers of "unattractive" artifacts such as cobble choppers, edge-ground cobbles, and modified flakes. The collections do not include the thousands of unmodified flakes and FCR fragments that would be present if the collections were complete assemblages from excavated sites. The family artifact collections consist of only the artifacts the collectors wished to keep, and not all of the artifacts that were located in the fields. Collector bias could possibly account for the fact that there were no burin-type lithic tool forms, as burins tend not to exhibit elaborate retouch or formal modifications which would encourage collection. My own bias is displayed by my negligence in recording the important historic homestead, railroad, logging, and dairy related sites, structures, and artifacts encountered during the pre-contact focused survey and study.

Classification Methods

The Willapa River Valley artifact classification is included with this study as an appendix (Appendix C). Forks Creek site artifacts are not included in Appendix C. The Willapa River Valley classification groups artifacts into "traditional" morphological and technological artifact classes that have been utilized throughout the Columbia River watershed. The classification divides the pre-contact artifacts into three industries: chipped stone, ground/pecked stone, and bone/antler tools. There were no pre-contact wood or ceramic artifacts in the family collections or in the excavated assemblage from 45PC175. The artifacts have been sorted into "traditional" classes within each industry, and each class has been assigned a numeric code. The artifact classes within the chipped stone industry include: projectile points (01), biface knives (02), scrapers (03), gravers (04), drills (05), cores (06), and flakes (07). Cobble "chopper" type tools are classified as a type of core (06-04). The artifact classes within the ground/pecked stone industry include: hammerstones (08), edge-ground cobbles (09), pestles (10), mauls (11), mortars (12), adzes/celts (13), clubs (14), bolas stone (15), pipes (16), ornaments (17), net weights (18), and miscellaneous (20) ground and pecked stone artifacts. The artifact classes within the bone and antler industry include: bone points (24), serrated harpoons (25), foreshafts (26), awls (27), tines (28), matting needles (29), wedges (30), and net gauges (31). The artifact classes are further divided into types. The type is designated by a second numeric code following the artifact class code (i.e. projectile point types 01-01 and 01-02). Variation within the types has been indicated by adding an alphanumeric code, as with biface knife types 02-01a (ovate bifaces), 02-01b (large ovate bifaces), and 02-01c (large non-symmetrical *skreblos* bifaces)

Morphological characteristics of nearly all of the artifacts were gathered in the field or in the lab (if the collection was graciously loaned out), and entered into a Microsoft Excel database. The metric system was utilized for measurements. Several artifacts were opportunistically shown to me in informal and rushed contexts in which I could only photograph the artifacts, and not spend the time gathering morphological data; thankfully very few artifacts were recorded this way. The maximum length, maximum width, and maximum thickness of all the chipped stone, ground stone, and bone/antler artifacts were recorded. If projectile points had stems and "necks" the neck-width of the artifact was measured immediately below the shoulder or notch near the top of the stem. Plastic metric analog-dial calipers were used to measure chipped stone artifacts in millimeters to one decimal place. Metric tape-measures were used on large ground stone artifacts. The weight was recorded from chipped stone projectile points and many of the ground stone artifacts that were allowed to be borrowed for analysis in a lab context. An "Ohaus Scout Pro" digital scale was used to weigh artifacts less than 200 grams (to two decimal places). Artifacts weighing more than 200 grams were weighed on a variety of analog and digital scales that were available at the time and place of use. There was a “late” group of chipped stone artifacts borrowed after completing the initial database that were pragmatically classified and segregated by class, type, and material type, but bagged in bulk as types of the same material without gathering numeric morphological attributes. The weights of scrapers, knives, and other non-projectile artifacts were not systematically gathered for considerations of time.

The metric variables presented in Appendix C to describe the artifacts are maximum length (length), maximum width (width), maximum thickness (thickness), neck width, and weight. Metric variables were gathered from all intact and broken specimens, but the data in Appendix C was assembled from only those artifacts that were intact enough to measure the intended variable. The length of projectile points or biface knives broken in half were not included in the summary of ranges. Only intact variable measurements were used to calculate the mean and standard deviation of the artifact types. The weights of broken artifacts were not included in the range distribution for mean calculations. The number of artifacts measured to describe the range, mean, and standard deviation measurements of the artifact types is indicated in the last column.

It is important to remember that the artifacts constituting the Willapa River Valley classification represent a pooled sample of artifacts from the entire Willapa River Valley. They are from many different sites spanning the entire Holocene, and possibly the Late Pleistocene. Temporally unrelated artifacts that have undergone diverse patterns of procurement, use, curation, and disposal have been lumped together into one large watershed sample. Nothing can be done about the variable quality of context data within the collections. The Willapa collections illustrate the diversity and breadth of prehistoric artifact types in the valley, and continue to be a source for the development of archaeological and environmental hypotheses.

Unusual Artifacts in the Willapa River Valley

In the Willapa collections there are six examples of unusually shaped chipped stone bifacial artifacts that have been termed “rotated scrapers” (03-12; Appendix C, Figures 42 - 44), and thirty-three examples of acute and obtuse scalene triangle shaped delicate “side blade” bifaces (03-12; Appendix C, Figure 28). These two interesting Willapa River Valley classes of chipped stone artifact types do not appear to have been identified at near-coastal sites in the Lower Columbia River (Minor 1984), or the northern Oregon coast (Connolly 1992; Phebus and Drucker 1979). A single “rotated scraper” tool may be present in the Martin site (45PC7) lithic tool assemblage that is presently being examined by the Burke Museum (Laura Phillips, personal communication October 2010). One similar “rotated scraper” specimen may also have been recovered from a Sauvie Island village site (Ken Ames, personal communication March 2010).

The morphology of the Willapa rotated scrapers is difficult to describe, but a simplified illustration of the basic tool shape is shown in Figure 99. These bifacially and bimarginally worked bit-like tools have 90 degree offset scraping planes that are formed by opposite unidirectional pressure flaking, such that the scraping edge on one side is far below the central plain of the tool, while it is far above on the perpendicular edge (with opposite flaking). The tool margin edge forms a transverse wave-like path that appears to “modulate” between a positive and negative “amplitude” as the tool rotates in 90 degree increments. The path of the bifacial edge between the “dorsal” and “ventral” faces on these forms topologically resembles the binding/stitching of a flattened two-piece leather baseball or softball. The function(s) of these tool forms is not clear, though the working edges are sharpened using unidirectional pressure retouch consistent with scraper technology. Their size is consistent with the size of thumb-nail scrapers and bifacially worked scrapers. The “bit-like” artifacts may represent the blade component of a composite bone or wood adze tool, where the bit could have potentially fit into a tubular socket or deep groove of a bone or wood implement. Pictures of Willapa rotated scrapers are included in Appendix C (Figures 42 - 44).

Figure 99. Simplified illustration of a Willapa rotated scraper.

I initially classified the acute and obtuse scalene triangle shaped delicate "sideblade" bifaces (02-06; Appendix C, Figure 28) as unnotched and unstemmed projectile points (or "preforms"). As more of these odd nonsymmetrical forms were encountered in the collections, I decided that they likely belonged to a distinct artifact type, rather than being mid-production projectile point "preforms" or projectile points. Some of the "sideblade" biface artifacts exhibited a distinct "spur" extending from the "basal" corner of the longest side of the roughly scalene triangular forms (Appendix C, Figure 28). These "spurs" effectively lengthen the long side of the form, and create a steeper angle (or sub-angular convexity) on the opposite side.

To me, these small biface tools display technological similarities to the "sideblade" technology of late prehistoric Norton related complexes in southern Alaska (Dummond 1987), but it is possible that they only represent small nonsymmetrical unnotched projectile points rather than any type of in-set "side blade" technology. The inset sideblade technology of the northern Pacific Coast involved embedding small, thin, nonsymmetrical bifaces into grooved antler, bone, and wood harpoon points. No artifacts in Willapa have been found with grooves or sockets to receive "sideblades." Composite toggling harpoons of the Locarno Beach Phase in Puget Sound and the Salish Sea could hold lithic, shell, and bone "end-blades" between the bound valves (Matson and Coupland 1995), but the asymmetrical "sideblades" of the Willapa River Valley do not seem suited to this application. The use of a microlith end-blade technology actually tends to decline during the following Marpole Phase, when antler and bone unilaterally barbed harpoon heads appear to have become the preferred style. The Willapa sideblades may be an expression of a southern northwest coast region "small tool tradition" that was contemporaneous with the Locarno Beach Phase of the interior Puget Sound and Salish Sea regions. The abundance of these tool forms in the Willapa River Valley may be indicative of intensive salmon processing (Croes and Blinman 1980).

The Willapa "sideblade" asymmetrical bifaces were most likely hafted "scalpel-style" in a similar manner to the preserved split and bent wooden handle side hafted microlith knives recovered from the Hoko River wet site 45CA213 (Croes 1995). The distinct small "spur" that extend out from the widest end of some of the Willapa specimens could have aided in securing the microlith to a split or bent wood handle with wrapped loops of organic "cordage" in a similar fashion to the Hoko River 34CA213 site artifacts. Edge re-touch indices studies (Andrefsky 2005) have not yet been performed on the Willapa artifacts.

Prehistoric Chipped Stone Tools

Projectile Points

Willapa River Valley collection projectile points are described in Appendix C and illustrated in Appendix C Figures 1 – 21. The projectile point classification is based on the Pettigrew (1981) and Minor (1984) classification for the Portland Basin and Lower Columbia River. This methodology was chosen primarily to facilitate comparative efforts between regional assemblages. It seems clear that a similar breadth of projectile point diversity exists between the Willapa region and the Late Holocene of the interior Columbia and Snake Rivers. There doesn’t seem to be a decline in the quality or quantity of chipped stone lithic projectile points despite the Willapa River Valley’s close proximity to the coast. There is a great abundance of high-quality (fossiliferous CCS and jasper) and medium quality lithic raw material (siltstone and basalt) available to produce projectile in the Willapa River Valley and in the dispersed gravel beaches of Willapa Bay. Welch (1983) noted the abundance of lanceolate form biface projectile points in the Upper Chehalis River Valley, and this trend holds true in the Willapa River Valley.

The presence of “oversized” large barbed (01-17a) and stemmed (01-17b) projectile point forms in the collections is notable. Some of the large stemmed varieties (01-17b) likely represent Early Holocene or Late Pleistocene technology. It is unclear if the large barbed varieties (01-17a) were parts of a functional projectile or lance weapon system, or if they represent late prehistoric “display” items used in ceremony and/or dance.

Biface Knives

Willapa River Valley collection biface knives are described in Appendix C and illustrated in Appendix C Figures 22 – 30. While these artifact forms were certainly used for cutting, the term "knife" is not used to suggest the artifact had a limited set of technological functions; it is a "traditional" bifacial tool class of the Columbia River, Puget Sound, and the coast. There is little difference between lanceolate knives and lanceolate projectile points, and an individual tool could cycle through multiple used during its use life. Some of the smaller ovate form knives (02-01a) were likely used as projectile points, and some of the ovate or bi-pointed projectile points (01-06a) were likely used as knives. The artifacts classified as biface knives tend to exhibit wide or blunt tips, and their bifacial bodies can be quite unbalanced in weight distribution, hindering a predictable ballistic trajectory. The artifacts classified as knives can exhibit differential wear or retouch along one or more margins, contributing to flight-prohibitive mass-dissymmetry. The ovate and lanceolate biface form artifacts classified as projectile points tend to have sharp pointed tips that would aid in penetration and thin symmetrical bodies with even flake reduction. No crescent-form knife or scraper tools have been seen in the Willapa collections.

Large nonsymmetrical bifaces (02-01c) are widespread throughout the Willapa River Valley and may represent large butchery tools for elk and deer. The Siberian term "*skreblos"* is borrowed for these large knives with one margin significantly more convex than the other (Derev'anko et al. 1998). It is possible that these large bifacial forms were hafted along one margin (like large sideblades), but they are large enough to be held in the hand, and do not tend to exhibit obvious differential flaking retouch along one margin as might be expected from a hafted tool form.

Bifacial sideblades (02-06) have already been discussed as an unusual artifact form in the region. These small acute and obtuse scalene triangle shaped bifaces could have been used as projectile points, or may be unfinished “preforms.” No slotted or notched bone or wood artifacts that would receive “sideblades” have been identified in the region. Post-depositional highly acidic sediment conditions in the Willapa River Valley have destroyed most prehistoric bone.

Status bifaces (02-08; Status, ceremonial, and wealth bifaces) are exceptionally large bi-pointed, uni-pointed, ovoid, and stemmed forms that tend to have straight or convex margins. The bifaces tend to exhibit finely executed patterned oblique and “collateral” parallel flaking. One intact (broken and glued together) bipointed obsidian status biface (Appendix C, Figure 29), and three obsidian tip fragments of large “fancy” bifaces (Appendix D, Figure XX) were present in the Stanley Niemcziek collection. As Niemcziek family stories attest, Mr. Niemcziek saw one half of the large freshly broken obsidian biface artifact from his tractor, at which point his priorities shifted from plowing the field to successfully finding the other half of the impressive artifact. A large and wide obsidian biface in the Rubey family collection was located in tidal shoreline contexts in northern Willapa Bay. The obsidian status bifaces in the Willapa region do not exhibited the proximal and distal flaring that can be distinct in some of the obsidian ceremonial and wealth blades of northern California and southern Oregon (Hughes and Bettinger 1984; Rust 1905).

Status bifaces found in the Upper Willapa River Valley were also made of materials other than exotic obsidian. Large status bifaces from the Upper Willapa River Valley in the Kaech Family collection are made of siltstone and reddish brown CCS (Appendix C, Figure 30). The exceptionally large 45PC176 dagger-like biface (Figure 25 and Appendix C Figure 30) is made of indurated siltstone that has been degraded by acidic sediments. Another exceptionally large shouldered and stemmed siltstone knife from the Upper Willapa River Valley is uncharacteristically thin for a siltstone biface, and its body exhibits scars from the removal of unusually wide and thin soft-hammer flakes (Appendix C Figure 30). The large red/brown CCS status biface in the Kaech Family collection (Appendix C Figure 30) has small marginal notches near its base that are similar to the notches used to tether northern California pre-contact and ethnographic obsidian status blades to the wrists of the biface bearers during dances and episodes of status item display. Similar "wrist tether" notches were present on the exceptionally large undated "Black Lake" biface (Croes et al. 2008) located near Olympia, Washington. Status bifaces will be discussed within a context of trade and exchange networks in Chapter Seven.

Scrapers

There was a very large sample of scraper tools in the Willapa family collections. The large sample and morphological diversity of the scrapers undeniably amplified my "splitter" tendencies, and I created twenty different types of chipped stone scraper artifacts. Willapa River Valley collection scrapers are described in Appendix C and illustrated in Appendix Figures 31 – 51.

I sorted scrapers into types based on the shape of their objective edges, the nature of their haft, their size, and into "special" types such as "Willapa rotated scrapers" (03-12) and "petrified wood end scrapers" (03-14). The "special" petrified wood end-scrapers (03-14; Appendix C, Figure 46) have convex unifacially retouched scraping edges made on the ends of elongated woodchip-shaped fragments of locally occurring distinctly layered petrified wood. No crescent-type scraper or knife tools have been seen in the Willapa collections.

It is possible that the great variety in scraper form is a reflection of the great diversity of different tasks that were accomplished using unifacial steep edge-angle scraper technology. Willapa scraper technologies are believed to have been utilized for hide processing, bone processing, antler-working, woodworking, and spoke-shaving activities. Like projectile points, the same breadth of scraper formal diversity that is present in the Pacific Northwest Columbia and Snake River watersheds appears to also be present in the near coastal Willapa region.

Gravers and Drills

Willapa River Valley collection gravers and drills are described in Appendix C and illustrated in Appendix C Figures 52 – 53. The graver and drill technology of the Willapa River Valley is indistinguishable from the technology of the Columbia and Snake Rivers. It is likely that many gravers were left uncollected in the fields, as they tend to consist of small worked points or spurs made on otherwise minimally altered CCS flakes. Drills do exhibit extensive retouch that likely encouraged collection.

Cores and Micro-Cores

Willapa River Valley collection cores and micro-cores are described in Appendix C and illustrated in Appendix C Figures 54 – 62. Most of the multi-directional cores in the family collections are made of attractive translucent fossiliferous CCS, but siltstone cores were collected. There is a variety of multidirectional core in the family collections that is made on a fossil clam (06-01, Appendix C Figure 55). The fossil clams are suited to the creation of biface tools as they naturally resemble an ovate “preform” with a thin edge and lenticular cross-section.

A multidirectional pebble micro-core and a fragment of a formalized microblade core were present in the Willapa family collections. No microblades were identified in the Willapa family collections, but specimens were identified at the Forks Creek site (Figure 84). The small cores and blade flakes were apparently not frequently collected from the fields. Microblades were likely too small for the collectors to desire them or to recover them easily.

Thankfully, there is one very informative microblade core "rejuvenation" flake in the Stanley Niemcziek collection (Appendix C, Figures 56 – 59). The microblade core facial "rejuvenation" flake has intact portions of a flat fracture-plane platform surface with a heavily ground edge. The heavily ground platform edge exhibits fine platform preparation shaping flakes. The ventral face of the core-face rejuvenation flake is smooth and unaltered. The dorsal face is covered with microblade flake scars that originate from the proximal ground platform remnant and feather-terminate in a convergent point at what was the distal base of the core. There are multiple small step and hinge fractures immediately below the platform remnant, and a "hangar" microblade on the face of the fragment that has fractured from the main body, but has not yet detached from the core. The step fractures below the platform edge were likely the reason the core face "rejuvenation" flake was removed.

Prehistoric Pecked and Ground Stone Artifacts

Hammerstones

A Willapa River Valley collection hammerstone is described in Appendix C and illustrated in Appendix C Figure 63. Natural river and ocean rounded cobbles made of a great diversity of hard and soft stone materials eroded from the ancient marine terraces of the Willapa Hills and were redeposited by the Willapa River. There is a nearly inexhaustible supply of hard, hand-sized, cobbles present in the Willapa River channel to use as hammerstones. Cobbles trapped within driftwood tree root-wads, or attached to storm-dislodged bull kelp holdfast "roots," are the only naturally occurring cobbles on the Middle to Late Holocene coastal sand spit landforms where the Martin and Minard sites are situated.

Edge-Ground Cobbles and Edge-Ground Cobble Mortars

A Willapa River Valley collection edge-ground cobble is described in Appendix C and illustrated in Appendix C Figure 64. The rounded basaltic cobble has multiple ground planes on its body that are indicative of repetitive use as a grinding or abrasive stone.

A Willapa River Valley collection edge-ground "cobble mortar" is described in Appendix C and illustrated in Appendix C Figure 65. This wide, flat, cobble artifact has ground planes on its margins, and a distinct ground and pecked circular concavity (approximately 2 mm deep) on one of its faces. The artifact appears to have been used as both a "cobble mano/pestle" and an easily portable "cobble mortar."

Pestles and Mauls

Willapa River Valley collection pestles and mauls are described in Appendix C and illustrated in Appendix C Figures 66 though 69. There are minimally modified elongated river cobbles with flat battered and ground end wear (10-01a), minimally modified tabular cobble pestles (10-01b), fully ground and pecked pestles with cylindrical bodies (10-02), and ground and pecked pestles with patterned flat ground planes on their otherwise ground cylindrical bodies (10-03). No "nipple-top" or phallic-design pestles were observed anywhere in the valley. The Forks Creek pestle in the Zieroth Family collection (Figure 87) exhibits a subtle raised ring element at the transition to its basal thickening, and its tip has been ground into a smooth domed cone. A different pestle-like artifact classified as a "hammerhead" club (14-02; Appendix C Figure 77) displays two thin parallel grooves that appear to have encircled one of its fractured ends. The "hammerhead" club may represent a "fancy" pestle with the double groove design encircling its fractured base.

There are two distinct forms of mauls in the Stanley Niemcziek collection; those that have a distinct handle element that can be grasped in the hand (11-01; Appendix C Figure 70), and large cobble girdled forms (11-02; Appendix C Figure 71) that exhibit annular pecked and ground grooves around their rounded bodies. The widest end of these forms is heavily battered and ground.

Mortars

Willapa River Valley collection mortars are described in Appendix C and illustrated in Appendix C Figure 72. These are large (32 and 47 kg) likely basaltic cobbles that have deep ground and pecked bowl-like concavities. A pollen wash analysis was graciously performed on the largest mortar by Dr. John Jones and Nichole Bettencourt M.A., Ph.C. Their work identified modern *Acer* (maple) pollen on the mortar, consistent with it being outside in the modern Willapa River Valley. The Willapa mortars are similar to the acorn processing mortars of the northern California and southern Oregon Coast Range.

Adzes

Willapa River Valley collection adzes, or celts, are described in Appendix C and illustrated in Appendix C Figure 73. The adze/celts are exotic trade items that were likely introduced to the Willapa River Valley through Columbia River and Puget Trough trade networks. All of the adzes in the collections are made of green, blue-green, and brown-black cut and polished nephrite. The nephrite likely originated in British Columbia, Canada (Darwent 1998; Morin 2012). The Willapa region represents an area where northern nephrite adze technology and southern clam and mussel shell adze technology (Shaw 1974) were both utilized.

Clubs

Willapa River Valley collection clubs are described in Appendix C and illustrated in Appendix C Figures 75 - 77. There are four known fragments of “lozenge form” (Smith 1907) clubs in the Willapa region. There is one mid-section fragment of a similar-style club style that displays a prominent medial "spine." All of the clubs are made of what is likely glaucophane blueschist. Glaucophane blueschist is abundant in the coastal range of northern California and southern Oregon. All of the glaucophane blueschist clubs are likely exotic trade items that were introduced to the Willapa River Valley through Pacific Coast trade networks. Three club fragments are from site 45PC196 (Chapter Four). One club tip fragment from the Middle Willapa River Valley is part of the Stanley Niemcziek collection. One club midsection fragment was collected by J. Stein, B. Atwater, and S. Cole, from the Niawakium site (45PC102) in 1991 (Burke Museum Catalog # 45PC102-1). Glaucophane blueschist lozenge-form clubs are discussed within the context of trade and exchange in Chapter Seven.

Bolas Stones, Girdled Concretions

Willapa River Valley collection girdled concretions are described in Appendix C and illustrated in Appendix C Figure 78. Two spherical concretions of soft tan siltstone that were girdled by incised lines are in the Stanley Niemcziek collection. These stone concretions are soft and sensitive to acidic sediments; their good condition does not suggest a great age. The girdled concretions are likely Late Holocene artifacts, rather than technologies associated with an early stemmed point tradition on the coast.

Pipestones, Stone Tubes, Ornamental Stone, Miscellaneous Ground Stone

A variety of Willapa River Valley collection finely made ground stone artifacts are described in Appendix C, and are illustrated in Appendix C Figures 79 - 81, and 84. One of the few examples of ground-slate or argillite type technology was present as a fragment of a small ornament, or perhaps an element of a composite tool (Appendix C Figure 80).

Cobble Net Weights

Lower Willapa River Valley cobble net weights are described in Appendix C, and illustrated in Appendix C Figures 82 and 83. Girdled and notched cobble net weights were not present in the Middle and Upper Willapa River Valley, but their absence may reflect collector bias. The flaked cobble variety of net sinker is more prevalent that the girdled variety.

Prehistoric Bone Artifacts

Willapa River Valley collection prehistoric bone artifacts are described in Appendix C and illustrated in Appendix C Figures 86 - 93. Pre-contact bone is greatly underrepresented in the collections. I attribute this to the highly acidic sediment conditions that quickly dissolve bone. Bone points (24-01a), single piece serrated harpoons (25-01a), harpoon foreshafts (26-01a), and net gauge (31-01) may represent marine (Willapa Bay) or riverine oriented bone procurement tools. The awls (27-01), tines (28-01), and matting needles (29-01), are perhaps indicative of more terrestrial oriented production and processing activities. The wedge-shape and crushed platforms of the wedges (30-01) is indicative of their use as a woodworking tools for removing planks from logs, and other wedge-facilitated activities. One wedge (Figure 92) appears to be made of whale bone.

Historic Artifacts

Willapa River Valley collection historic artifacts are described in Appendix C, and illustrated in Appendix C Figures 94 - 101. This study focused on the pre-contact sites and materials of the Willapa River Valley and not on the historic materials. Time constraints have greatly limited my descriptions and interpretation of the historic materials of the Willapa River Valley.

CHAPTER SEVEN

LATE PREHISTORIC TRADE AND EXCHANGE

The Willapa River Valley family surface and tide zone collections were dominated by chipped stone tools made from locally available CCS, siltstone, and basaltic lithic materials. I was pleasantly surprised to also observe the presence of exotic imported obsidian, blueschist, and nephrite artifacts within most of the large Willapa family collections. The obsidian bifaces and projectile points, blueschist lozenge-form club fragments, and cut and polished nephrite "jade" adze/celt artifacts in the surface and tide zone collections represent the acid-resistant lithic material residues of complicated social trade and exchange networks that were active in the Willapa region throughout the Holocene, and likely the Late Pleistocene. Nephrite adze artifacts located in the Willapa River Valley have not been quantitatively provenienced, but are visually, texturally, and formally similar to the spectrum of adze/celt artifacts known to originate from the Fraser River region of British Columbia, Canada (Darwent 1998; Morin 2012). The notably uniform group of blueschist club fragments that have been recovered from the Willapa region conform closely to the "lozenge form" clubs described by Smith and Boas (1907, 1910). I believe the blueschist raw material originated from the mélange of the Franciscan Complex of the Coast Range of northwest California and southwest Oregon. Craig Skinner, and the Northwest Research Obsidian Laboratory, graciously performed X-ray fluorescence (XRF) provenience analyses for all of the Willapa region obsidian artifacts I could borrow, locate, or excavate (Appendix D). The XRF and principal component analyses of the Willapa family collections obsidian artifacts revealed a suspiciously anomalous and uniquely diverse spectrum of obsidian raw material sources that extended from northwest Oregon and Idaho, all the way to regionally unprecedented source localities in the California Coast Range and eastern California.

This chapter introduces a set of exploratory late-prehistoric (800 AD to 1700 AD) trade and exchange hypotheses that I have been developing from studying the obsidian, blueschist, and nephrite trade items in the Willapa family surface and tide zone collections. This facet of late-prehistoric Willapa research is related to Jeanne Welch's work (1970, 1983) in the Upper Chehalis River Valley, and is oriented toward the Athabaskan Kwalhioqua and Clatskanie cultures (Golla 2011; Krauss 1990; Miller 2012; Thompson and Kinkaid 1990).

The following set of exploratory early-stage hypotheses pose that late prehistoric Pacific Athabaskan cultures of the estuaries and coastal river valleys in southwest Oregon and northwest California were exporting locally manufactured blueschist clubs and obsidian artifacts originating from sources in southeast Oregon, northeast California, the Coast Range, and east California, to the late prehistoric Kwalhioqua Athabaskan enclave in the Willapa River Valley. From the Willapa River Valley, elk clamons armor, dentalium, and nephrite were potential commodities of reciprocal exchange (Figure 100). I further propose that sea-going canoes (Gould 1968) could have been used to quickly shuttle trade goods, parties of dancers, and potential spouses north and south along the margin of the Pacific coast.

This chapter explores the possibility that world-regenerative dances could have been the primary social mechanism within which the hypothesized “Pacific Athabaskan coastal trade network” operated. The ethnographic southern coast Athabaskans, and some neighboring Penutian and Algic cultures, participated in two-year cyclical “world-renewal” dances involving the display of obsidian biface “wealth blades,” dentalium, fine pelts, bird-bone whistles, and other ceremonial items. This social mechanism would have essentially necessitated periodic direct ceremonial contact between the Willapa Athabaskan enclave and parties of dancers and long-distance sea-going canoe traders from the southern Oregon and northern California coast.

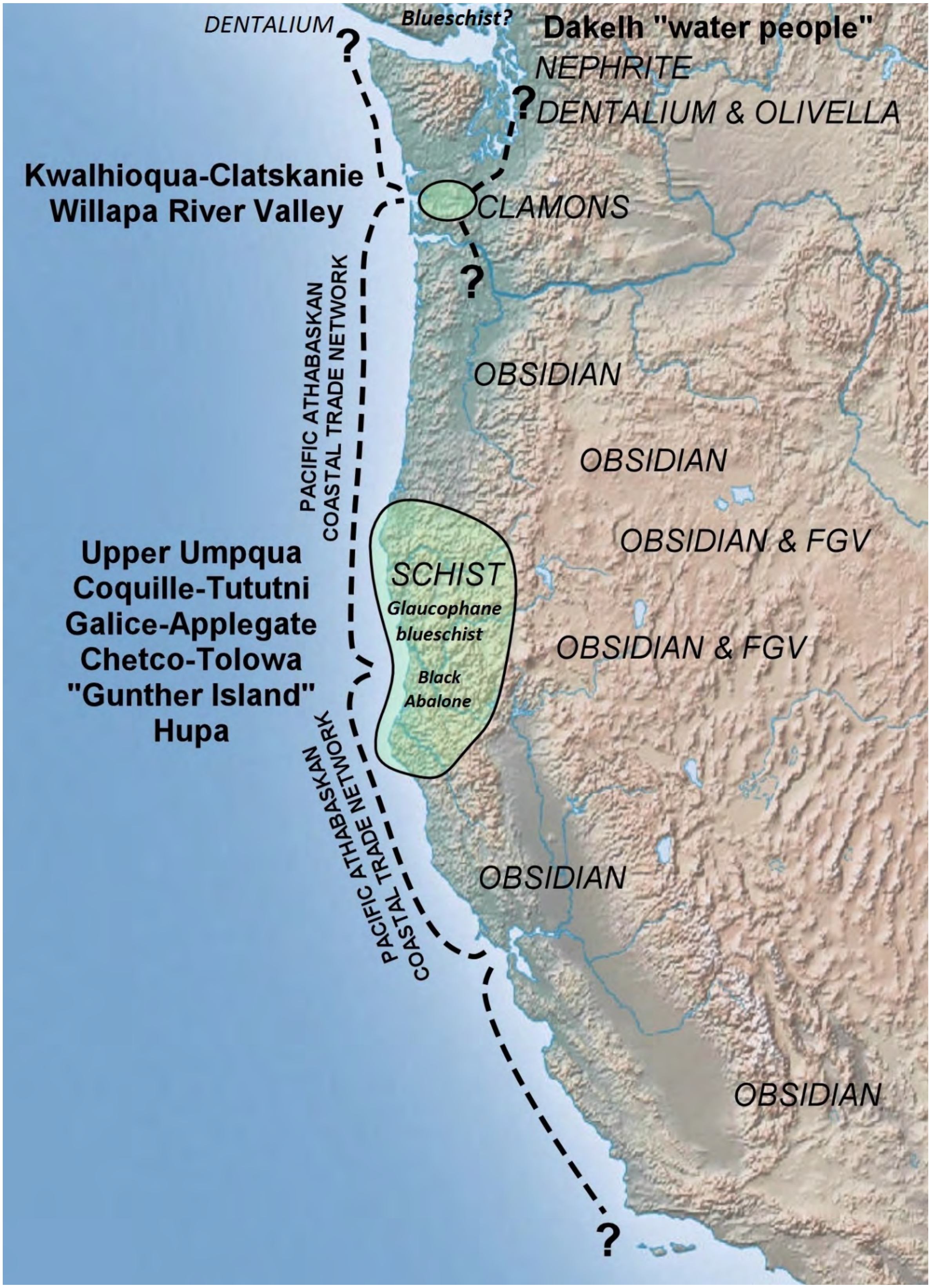

Figure 100. Theoretical “Pacific Athabaskan coastal trade network” map.

Exploring Connections between Pacific Coast Athabaskan Cultures

Incomplete records of the Willapa Kwalhioqua language make it difficult to determine if it was more closely related to the “Northern Athabaskan” languages of British Columbia, or to the “Pacific Athabaskan” languages of southern Oregon and northern California (Krauss 2005). The few remaining families from the Kwalhioqua and Clatskanie cultures were absorbed into the local Salish and Chinook groups in the early twentieth century. The Willapa Athabaskans may have been descendant of the so-called “Carrier" cultures of southern British Columbia; the *Dakelh*, or "people who travel upon water" (www.carriersekani.ca/culture-heritage).

The ethnographic Kwalhioqua and Clatskanie occupied the uplands of the Willapa Hills and the northwest Oregon Coast Range, but prior to the ethnographic period their populations were greater and their ranges likely included estuary, bay, and ocean landscapes. James Teit stated in a 1910 letter to Franz Boas (Miller 2012; Teit 1910):

> The tribe on the Willapa River was called wElapakoteli by the Su’wal. They spoke the same language as themselves but with slight variations. They used at one time to go right to the mouth of the Willapa at certain seasons but made their headquarters up the river in the mountains. (Miller 2012; Teit 1910)

Teit’s (1910) description suggests that Willapa Athabaskan groups periodically utilized sites near the mouth of the Willapa River. The Que-lap′ton-lilt Village site (45PC196, Chapter Four) is located directly outside of the mouth of the Willapa River. The Rubey Family tide zone artifact collection from Que-lap′ton-lilt Village contained exotic eastern Californian obsidian, Coast Range glaucophane blueschist lozenge-form club fragments, and a polished nephrite adze that likely originated in the Fraser River region of British Columbia, Canada.

The earliest reports of the Willapa Kwalhioqua by Hale (1846) and Wickersham (1899) suggest that there were connections that included marriage between the Kwalhioqua and Clatskanie Athabaskans, and the Upper Umpqua Athabaskans of southwest Oregon (Krauss

1990). The reported marriages between the Clatskanie and Umpqua Athabaskans could have been embedded within sophisticated pre-contact cultural systems of dance, trade, and exchange. At the turn of the century, Hale (1846) and Wickersham (1899) were likely using the term “Umpqua” for all of the Athabaskan cultures of southern Oregon and northwest California.

Hale's (1846) early United States Exploring Expedition map of the Pacific Northwest actually included an interior coastal mountain-crest extension of the southern Oregon "Umpqua" Tribe that extended to the Lower Columbia River region (Figure 101). This extension is suggestive of the "grease trail" routes of the ethnographic Athabaskans in B.C. (Hirch 2003).

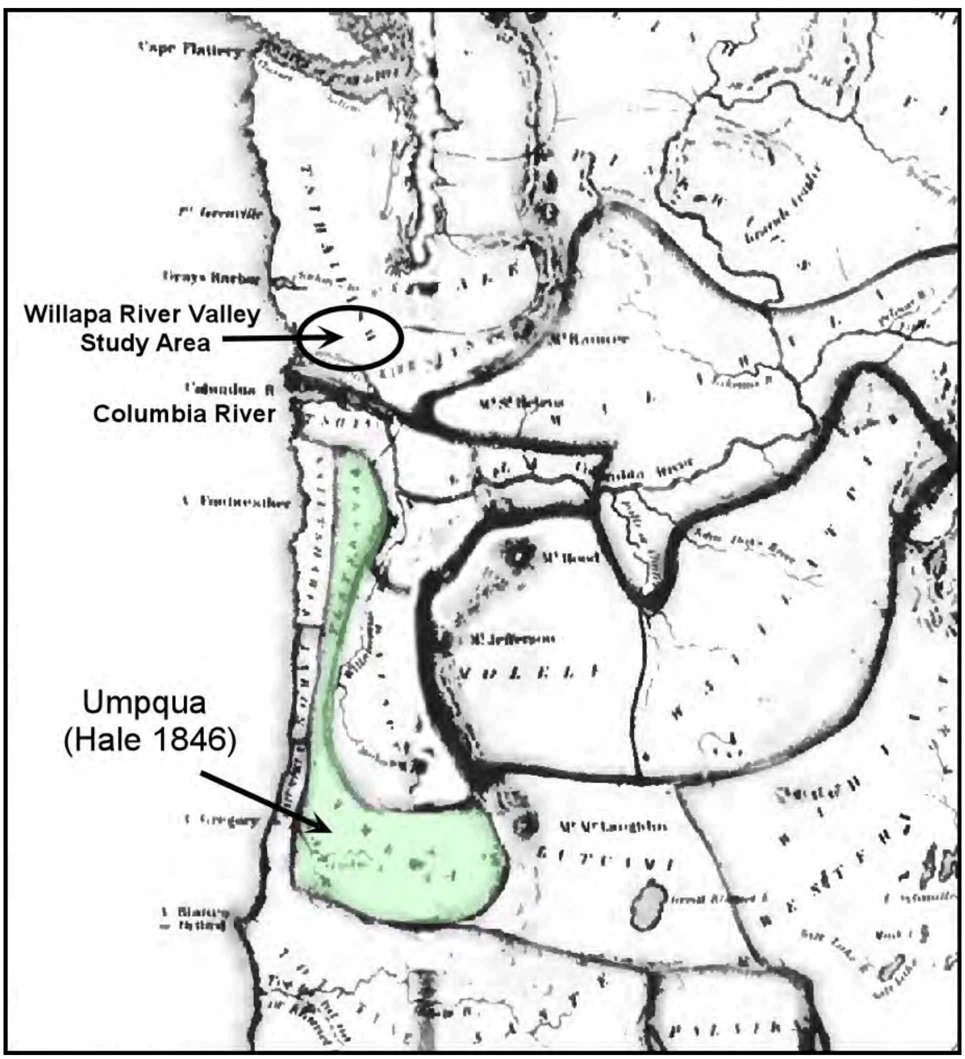

Figure 101. Annotated version of Hale’s 1846 map of Pacific Northwest culture areas.

The trade network hypothesis explored here essentially shifts Hale's montane "Umpqua extension" west, to the actual Pacific Coast, and replaces the traditional overland terrestrial obsidian trade routes with a fast, near-shore continental shelf route using long-distance sea-going canoe technology (Gould 1968). It is inclusive of all of the Athabaskan cultures (and some closely affiliated Penutian cultures) of Washington, Oregon, and northern California. The proposed “Pacific Athabaskan coastal trade network” links the Willapa Kwalhioqua and Clatskanie cultures with the Tolowa, Hupa, Coquille, and other southwest Oregon and northwest California Athabaskan “estuary” cultures (including “Gunther Island Culture”), within a late prehistoric (800 AD to 1700 AD) system of obsidian and blueschist exchange (Figure 100).

The 800 AD White River ash-fall has been suggested as a contributing factor to the initial southern migrations of the Athabaskan peoples (Workman 1974, 1979) and likely contributed to the development of Pacific Athabaskan world regenerative dance traditions. In Willapa and northwest California, world-regenerative dances may have been focused on the prevention of earthquakes, co-seismic subduction, and tsunamis (Ludwin 2005). As illustrated in the Kathlamet story “The TkilXiyogoā′îkc” (Boas 1901:187–195; Miller 2012) and the Yurok story, “The Inland Whale” (Kroeber, T. 1959; Spott and Kroeber 1942), the Willapa Kwalhioqua and California Yurok shared an “inland whale” myth. In these related myths, thunderbird (interpreted as an earthquake) deposits a whale onto an inland meadow or lake; just as a tsunami could theoretically strand a sea mammal on a near-coastal terrace. Within this contextual framework, the ethnographic semi-subterranean Willapa lodge dances (Boas 1901:187–195; Miller 2012) may be seen as reiterative of seismic movement; dances performed to answer and quell the periodic jumping of the earth. These were world-renewal dances tailored specifically for Athabaskans living on the tectonically active margin of the Pacific Plate.

T. Kroeber's (1959:25) presentation of the northern California region Yurok "Inland Whale" myth clearly illustrates this relationship between tectonic movement and ceremonial dance:

> To a world in balance, the flat earth's rise and fall, as it floats on Underneath Ocean, is almost imperceptible, and nothing is disturbed by it. Doctors know that to keep this balance, the people must dance the World Renewal dances, bringing their feet down strong and hard on the earth. If they are careless about this, it tips up, and if it tips more than a very little, there are strange and terrible misplacements. One of the worst of these occurred before Nenem's grandparents' time . . .
>
> This was the time when the earth tipped so far that the Downriver Ocean came over the bar and flowed up the river, filling and overflowing the canyon, carrying its waters and its fish and other sea life far inland, past even the Center of the World- farther than it had ever penetrated before. With prayers and dancing, balance was eventually restored and the ocean flowed back down the canyon and outside the bar, carrying the fish and other sea life with it, except for a young female whale who had been washed all the way into Fish Lake and was left stranded there (T. Kroeber 1959:25)

Compare the elements of the Yurok "Inland Whale" myth (Kroeber, T. 1959; Spott and Kroeber 1942) to the Kathlamet story "The TkilXiyogoā'îkc" (Boas 1901:194–195) as told by Charles Cultee in 1894 at the Willapa Bay Chinook community of Bay Center:

> At night the Thunderbird thundered. Then that person was startled. . . Early the next morning it was calm. When the sun arose, a person looked out on the prairie. There was something lying right in the middle of the prairie. It was shining. The person entered the house and said: "something is lying in the prairie" The people went out to see it. . . . There was a man from the coast among them, who was living in his wife's village for a time. He knew it and said: "it is a whale." Then the people cut it, but part of them were afraid. Then that chief made a potlatch. He made a long ditch. He put planks on top of the ditch and covered them with dirt. He made a door at the entrance of the ditch. It was a long hole. There the people went in to dance. They disappeared in the hole underground. They came out again at the door of the ditch. The people from all around went there. Then he became a chief. . . (Boas 1901:194–195)

The "renewal" ceremonies are preserved in the White Deerskin Dance, the Boat Dance, and the Jumping Dance traditions of northern Californian native peoples (Goldschmidt and Driver 1940). There is both beauty and irony in the fact that we will be discussing some trade-good artifacts that were located in coseismic catastrophically-submerged tide zone contexts.

Obsidian

Prior to initiating fieldwork in the Willapa River Valley and Willapa Bay, I had a preconceived notion that obsidian was exceptionally rare in the Lower Columbia River region and in southwest Washington. Obsidian has actually been recovered from a wide spectrum of sites of the Lower Columbia River (Minor 1984), Willapa Bay (DePuydt 1994), Grays Harbor (Roll 1974), and the northern Oregon Coast (Connolly 1992). Obsidian debitage was recovered from five of the six Lower Columbia River sites tested by Rick Minor (1984). No obsidian was recovered from the coastal-adjacent Fishing Rocks site (45PC35). It is unclear if there is obsidian in the curated assemblage from the Martin site 45PC7. The Martin site artifacts are presently being assessed and curated by the University of Washington Burke Museum in Seattle. The Martin site is quite large, and only a small portion of the cultural deposit has been excavated. Most of the early archaeological excavations in the Willapa region utilized 1/4 inch screens that would not have captured much of the obsidian debitage (Chapter Five).

Obsidian tools have been found on the northern Long Beach Peninsula. The Kemmer Family loaned this project a small stemmed barely-translucent black obsidian projectile point (Type 01-05a; not illustrated) that was found in a garden on the shore of Willapa Bay in the community and site area of Oysterville (45PC5). The 45PC5 Oysterville obsidian projectile point from the Kemmer Family collection was provenienced to Cougar Mountain, Oregon (Table 24).

The patterns of obsidian procurement at the 2700 year old Forks Creek site have been discussed in Chapter Five. At Forks Creek, northwest Oregon and western Idaho obsidian sources were represented in the early deposits, while southeast Oregon Glass Buttes obsidian appeared in the late deposits and plow zone, along with a sample of small obsidian pressure flakes that are presently too small to measure accurately with the available XRF technology (Table 21). The Forks Creek site illustrated the great potential for obsidian recovery at Willapa region sites, but was ultimately a small excavation with a small artifact and debris sample. Of the 13.3 cubic meters of sediment excavated at Forks Creek, likely less than two cubic meters were of plow-disturbed sediments containing artifacts dating to later than 1700 BP. Two cubic meters of sediments from one site is not a large enough sample to capture the spectrum of late prehistoric obsidian trade within the Willapa River Valley. Significantly more fine-screen testing of late prehistoric age shallow and plow-zone site sediments throughout the Willapa River Valley is part of the Willapa Project's future research strategy and goals.

At this point, we have sourced a total of 105 Willapa obsidian artifacts from private collections, site surface collections, and two excavations (45PC101 and 45PC175). A single obsidian (Glass Buttes 6, Oregon) biface fragment from the Minard site (45GH15) in Grays Harbor, and an obsidian fragment (Massacre Lake/Guano Valley, OR) from an Onalaska, Washington garden of the Kaech Family have also been sourced (Table 24).

No obsidian from the southern Washington State Cascades "Elk Pass" quarry area was identified in any of Willapa collections or assemblages, despite there being similarities between the archaeological cultures of the Willapa River Valley and the southern Cascades foothills (Daugherty et al. 1987a and b).

Table 24. Provenienced Obsidian from Willapa Region Surface and Tide Zone Collections, and Excavated Site 45PC175.

			Family Collections, Site Surface Collections, and an Excavated Site (PC175)												
SOURCE	**State**	**km**	**Niemcziek**	**PC175**	**PC183/186**	**PC183**	**PC196**	**Kaech**	**PC5**	**PC222**	**PC212**	**PC195**	**PC180**	**PC101**	**GH15**	**TOTAL**
Inman Creek A	OR	160	2													**2**
Clackamas River	OR	211	1													**1**
Obsidian Cliffs	OR	307	3	6	4			1		1	1	1	1	1		**19**
Newberry Volcano	OR	375	1	4												**5**
Big Obsidian Flow	OR	376	1													**1**
Cougar Mountain	OR	420							1							**1**
Glass Buttes 1	OR	447	2	5												**7**
Glass Buttes 3	OR	447	1													**1**
Glass Buttes 6	OR	447													1	**1**
Glass Buttes 7	OR	447	7					1								**8**
Silver Lk./Sycan Marsh	OR	450	1													**1**
Spodue Mountain	OR	468			1											**1**
Whitewater Ridge	OR	470	3	2												**5**
Tank Creek	OR	481	1													**1**
Drews Crk./Butcher Flat	OR	538			2											**2**
Gregory Creek	OR	546						1								**1**
Cougar Butte	CA	580			1											**1**
Venator FGV	OR	583	2					1								**3**
GF/LIW/RS	CA	597			3											**3**
Cowhead Lake	CA	600			1											**1**
Buck Mountain	CA	608			2											**2**
Massacre Lk./Guano V.	OR/NV	610				1		1**								**1**
Alturas Unknown A FGV	CA	621			1											**1**
Timber Butte	ID	647		1												**1**
Browns Bench	ID	689				1										**1**
Borax Lake	CA	854	1													**1**
Napa Valley	CA	905	31													**31**
Annadel	CA	914	2													**2**
Coso (West Sugarloaf)	CA	1282					2									**2**
															TOTAL	**107**

** from Onalaska, not Willapa. km column indicates approximate distance from Menlo, WA.

Status/Wealth Bifaces

After several years of surveying and examining Willapa artifact collections, it became clear that there was an obsidian biface ("wealth blade") complex present in the Willapa River Valley and Willapa Bay estuary. The most obvious example was a large bi-pointed black obsidian biface (Figure 102) found in the Middle Willapa River Valley by Stanley Niemcziek (Chapter Six). The impressively large obsidian artifact was provenienced to Glass Buttes 1, OR (Appendix D). A wide obsidian knife with a short shouldered stem element held in the Rubey Family collection was located in a tide zone context in northern Willapa Bay (Figure 103). The large grey/black obsidian biface has not yet been provenienced, but appears to perhaps be made of a different variety of obsidian than the S. Niemcziek status knife artifact (Figure 102). Large Willapa bifaces made from locally available materials that may have also been used in ceremonial contexts are illustrated in Appendix C (Figure 30).

Three large biface tip fragments from the Willapa River Valley collections appear to have broken off of large obsidian status/wealth bifaces. These "mahogany" red and black biface fragments were provenienced to Newberry Volcano, Glass Buttes, and Whitewater Ridge, Oregon. The Washington State University Museum of Anthropology, and Mary Collins, assisted with the logistics of sourcing a single black-flecked "mahogany" red Glass Buttes 6 obsidian biface tip fragment (Figure 104; Appendix D) from the Minard site (45GH15; Roll 1974). The color of the obsidian bifaces may have had cultural significance. Sets of large red and black bifaces were utilized in multiple dances within the White Deerskin Dance ceremony (Goldschmidt and Driver 1940). The Willapa obsidian status bifaces do not conform to the classic ethnographic era end-widened forms curated by the northern California and southern Oregon tribes, but they are large forms that appear to be intended for ceremonial use and display.

Figure 102. Middle Willapa River Valley obsidian biface from the S. Niemcziek collection.

Figure 103. Lower Willapa River Valley obsidian biface from the Rubey Family collection.

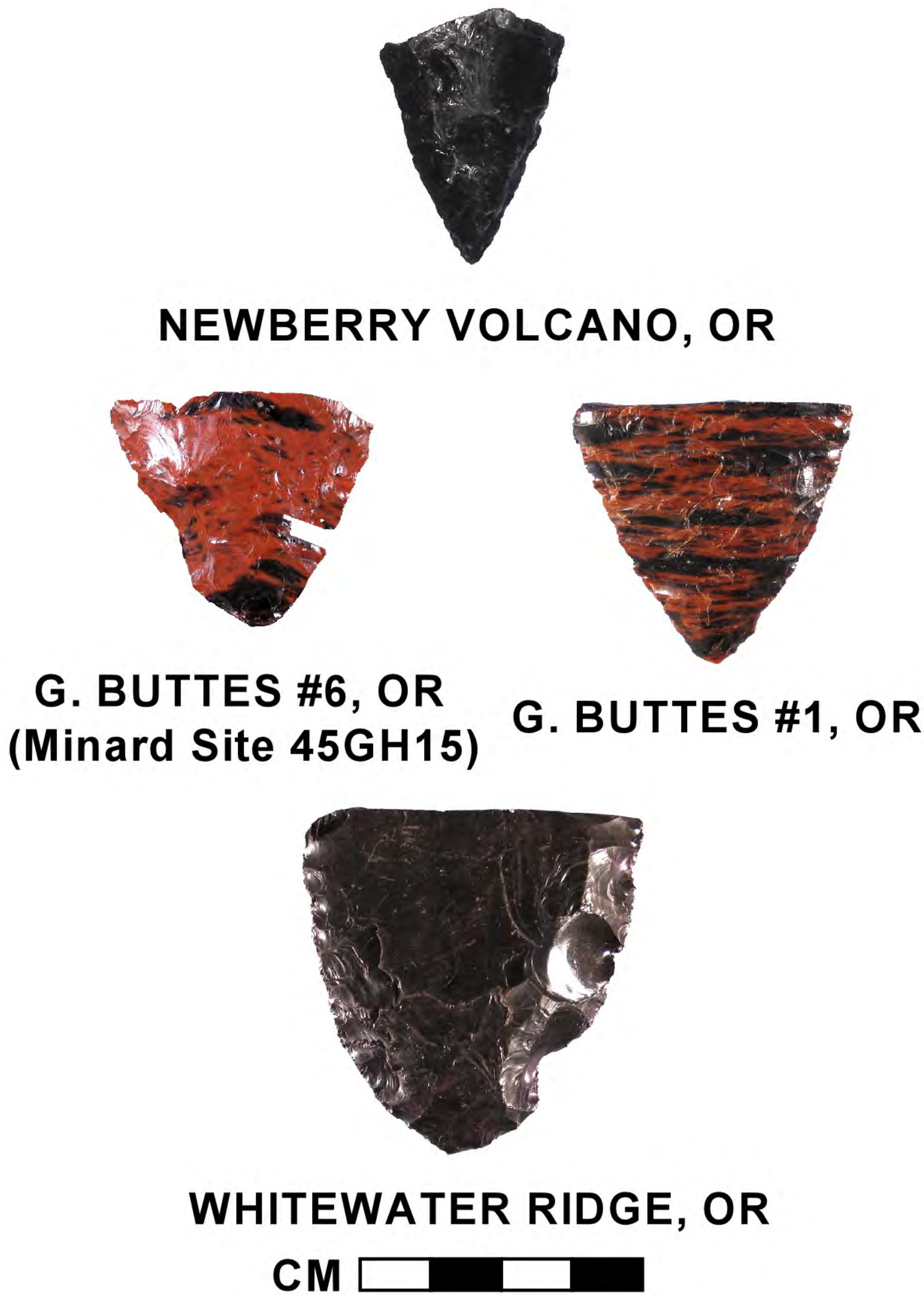

Figure 104. Willapa River Valley and southern Washington Coast (45GH15) tip and base fragments from large obsidian bifaces.

Northwest Oregon and Idaho Obsidian in the Willapa Collections

Northwest Oregon appears to have been the primary obsidian source area for the Willapa region during most of the Holocene, and possibly during the late Pleistocene (Figure 12). Obsidian Cliffs, Inman Creek, Clackamas River, Newberry Volcano, and the Big Obsidian flow sources are represented in the Willapa collections (Figures105 and 106; Appendix D).

The Mill Creek biface Isolate 45PC222 (Chapter Four; Figure 12) is a large stemmed Obsidian Cliffs, Oregon obsidian projectile point that is reminiscent of "Lind Coulee" (Daugherty 1956) and "Windust" (Leonhardy and Rice 1970) phase technology. A side-notched, concave base black obsidian projectile point from the North Nemah River site (45PC101), graciously made available by Eastern Washington University, was sourced to Obsidian Cliffs, Oregon (Figure 106). A variety of notched, stemmed, shouldered, ovate, and lanceolate Willapa Valley obsidian projectile points were made from Obsidian Cliffs, Oregon material.

A side-notched basally concave projectile point with a long blade from Upper Willapa River Valley site 45PC183 (Zieroth Family collection) was sourced to Browns Bench Idaho (Figure 106, Table 24). A single Forks Creek site (45PC175, Table 21) obsidian micro-flake that was recovered from contexts older than the initial Athabaskan occupation was provenienced to Timber Butte, Idaho. The Forks Creek site (45PC175) flake is potentially one of the most distant known occurrences of Timber Butte, Idaho obsidian. The Idaho obsidian artifacts are interpreted as being introduced to the Willapa River Valley via ancient Snake River and Columbia River trade networks active long before the influx of Athabaskan peoples.

A tip fragment of what may have been a status biface was made out of black Newberry Volcano, Oregon obsidian. Willapa "wealth blade" bifaces appear to have been preferentially manufactured from southeast Oregon obsidian rather than northwest Oregon obsidian.

Southeast Oregon Obsidian in the Willapa Collections

Obsidian and fine grained volcanic (FGV) artifacts from the Willapa River Valley have been provenienced to southeast Oregon sources including: Cougar Mountain, Glass Buttes, Silver Lake, Spodue Mountain, Whitewater Ridge, Tank Creek, Drews Creek, Gregory Creek, Venator FGV, and Massacre Lake/Guano Valley sources (Figures 107 and 108; Appendix D).

The variety of southeast Oregon obsidian artifacts from the Willapa River Valley (Figure 108) is not dissimilar to the collection of Willapa obsidian artifacts provenienced to more northerly sources (Figure 106), but there are more obsidian biface artifacts that I characterize as wealth, status, and display items utilized for ceremony and display, rather than as utilitarian tools. These "wealth" artifacts include the S. Niemczyk Glass Buttes 1 obsidian biface (Figure 102), a Glass Buttes 1 "mahogany" red (with black "rice" inclusions) tip or base fragment from a large biface (Figure 108; S. Niemczyk collection), and a fragment of a large ovate-form Whitewater Ridge obsidian biface (Figure 108). A red and black speckled "status" biface end-fragment recovered from the Minard site (45GH15; Roll 1974) was provenienced as part of this examination of southwest Washington trade and exchange. The Minard site (45GH15) obsidian biface fragment was provenienced to Glass Buttes 6 (Figure 108; Appendix D).

While the obsidian from southeast Oregon could have easily been traded to the Willapa region via inland trade routes leading to the Columbia River, it is conceivable that some of the artifacts could have first been traded west and southwest to the southeast Oregon and northwest California Pacific Coast estuaries, and later transported to the Willapa region up the Pacific Coast by dance and trade parties in sea-going canoes. The small Forks Creek sample displays an increase in the use of southeast Oregon obsidian in the late prehistoric period (Table 21).

Obsidian from the southern Oregon Silver Lake/Sycan Marsh, Spodue Mountain, and Drews Creek/Butcher Flat sources have been recovered from the Clahclellah Village site (45SA11) in the Columbia River Gorge (Sobel 2004). Obsidian from the Lower Columbia River Valley Cathlapotle site (45CL1) has been provenienced to the distant northeast California Grasshopper Flat/Lost Iron Well/Red Switchback (GF/LIW/RS) quarry source area.

Northeast California Obsidian in the Willapa Collections

Seven obsidian projectile point artifacts from the Willapa River Valley collections were provenienced to northeast California quarry areas (Figure 109; Appendix D). The northeast California obsidian and fine grained volcanic material sources represented by Willapa collection artifacts include: the Grasshopper Flat/Lost Iron Well/Red Switchback (GF/LIW/RS) group (3), Cowhead Lake (1), Buck Mountain (2), and the Alturas region (FGV, 1). The Willapa River Valley projectile points made from northeast California obsidian are not exactly large “fancy” status chipped stone items. Small corner notched, barbed, and shouldered projectile point forms with straight, expanding, and concave narrow stems are present in the Willapa collections.

Richard Hughes’ (1978) study of northern California’s late prehistoric Gunther Island obsidian artifact assemblage revealed a trend of red and mottled red status bifaces made from the distant Glass Buttes Oregon material, while utilitarian projectile points were made from much closer northeast California obsidian sources. A similar pattern of “distance-status” obsidian use is reflected in multiple assemblages within the northwest California and southwest Oregon Pacific Athabaskan culture area (Hughes 1978, 1990).

If the Gunther Island obsidian patterning observed by Hughes (1978) is reflected in Willapa assemblages, despite the reversal of distances, it would perhaps suggest direct trade was occurring between northern California and Willapa. Wealth bifaces from Willapa collections and the Minard site tend to be made of Glass Buttes obsidian, and 30% have been mottled red. Willapa obsidian collections seem to mirror the preferences of northern California Gunther Island cultures, in violation of Hughes' "distance-status" model. The status obsidian preferences of the northern California Wiyot are perhaps echoed in the Willapa collections as a result of direct coastal trade and shared belief systems; side-stepping Hughes' "distance-status" principle.

There is data to suggest that northwest California Athabaskans concentrated trade within their own linguistic and cultural enclaves around the time of the great 1700 AD earthquake (Atwater et al. 2005) Whitaker et al. (2007) observed a variance from the obsidian "distance-decay" model at three "Gunther Pattern" (AD 1706-1771, AD 885-1690, and AD 1757) sites within the Athabaskan territory of coastal Humboldt County, California. They suggest that obsidian was preferentially acquired from the distant Medicine Lake Highlands through linguistically and ethnically related groups, rather than from closer obsidian sources to the south that were controlled by linguistically-distinct Pomo and Yuki cultures. They found a *positive* relationship between artifact size and distance from the source (Whitaker et al. 2007).

Northeast California obsidian has likely been located outside of Willapa on the extreme northern Oregon Coast, and in southern British Columbia. Connolly et al. (1992:77 and 196) recovered a small piece of obsidian (Specimen No. 13-2(2) b) from their 1988 excavation at the northern Oregon coast Avenue Q site (35CLT13) that may have come from the Buck Mountain, northeast California source. The sample was not large enough for Richard Hughes to attribute a definitive provenience to Buck Mountain, California, but the results of the XRF analysis were consistent with the source. The Avenue Q site obsidian sample also exhibited macroscopic properties that were consistent with the Buck Mountain source (Connolly et al. 1992).

The Scowlitz site (Blake 2004; Fraser 1994; James 1995, 2003; Lepofsky et al 2000) is located at the juncture of the Fraser River and Harrison River in southern British Columbia. The latest component of the approximately 3000 BP to 1000 BP site consists of an expansive burial mound complex with graves, stone and organic features, and "wealth" items including: dentalium shells, abalone disk forms, nephrite celts, copper, and obsidian tools and flakes.

Blake (2004) reports the presence of a single obsidian flake from the Scowlitz site (No. 6848) that was sourced to the northeast California "Sugar Mountain 2" source. The "Sugar Mountain 2" source is mapped (Blake 2004) in a location close to the quarry that Craig Skinner maps as "Sugar Hill" (March 12, 2009 NE California obsidian source map). The "Sugar Hill" or "Sugar Mountain 2" source (not mapped here) is located approximately ten kilometers north of the Buck Mountain source (Figure 109). Blake (2004:106) further describes the occurrence of northeast California Obsidian at the Fraser River Canyon Milliken and Esilao sites:

> . . .Milliken (DjRi 3) and Esilao (DjRi 5), located very close to each other, 70 km upriver from Scowlitz in the Fraser Canyon near Yale. . . James and his colleagues studied 54 artifacts from these two sites and found the following pattern, reminiscent of the distribution at Scowlitz: ten from Yukon, five from British Columbia, one from Washington, 18 from Oregon, 14 from Northern California, and six from Wyoming.

Blake (2004) also reports the recovery of three *Haliotis cracherodii* (California black abalone) shell disk pendants associated with a single 1400 BP Scowlitz burial (Mound 1). Griswold (1954) suggests that Chinook canoe traders from the mouth of the Columbia (and possibly Willapa Bay) acted as "middlemen" in the northerly flow of California black abalone to northern Washington Coast Makah cultures, in return for dentalium shell and perhaps nephrite. The Makah could have potentially exchanged sea-going canoe transported California black abalone and northeast Californian obsidian to the Salish (Blake 2004), and Haida (Sloan 2003) cultures located to the north and northeast.

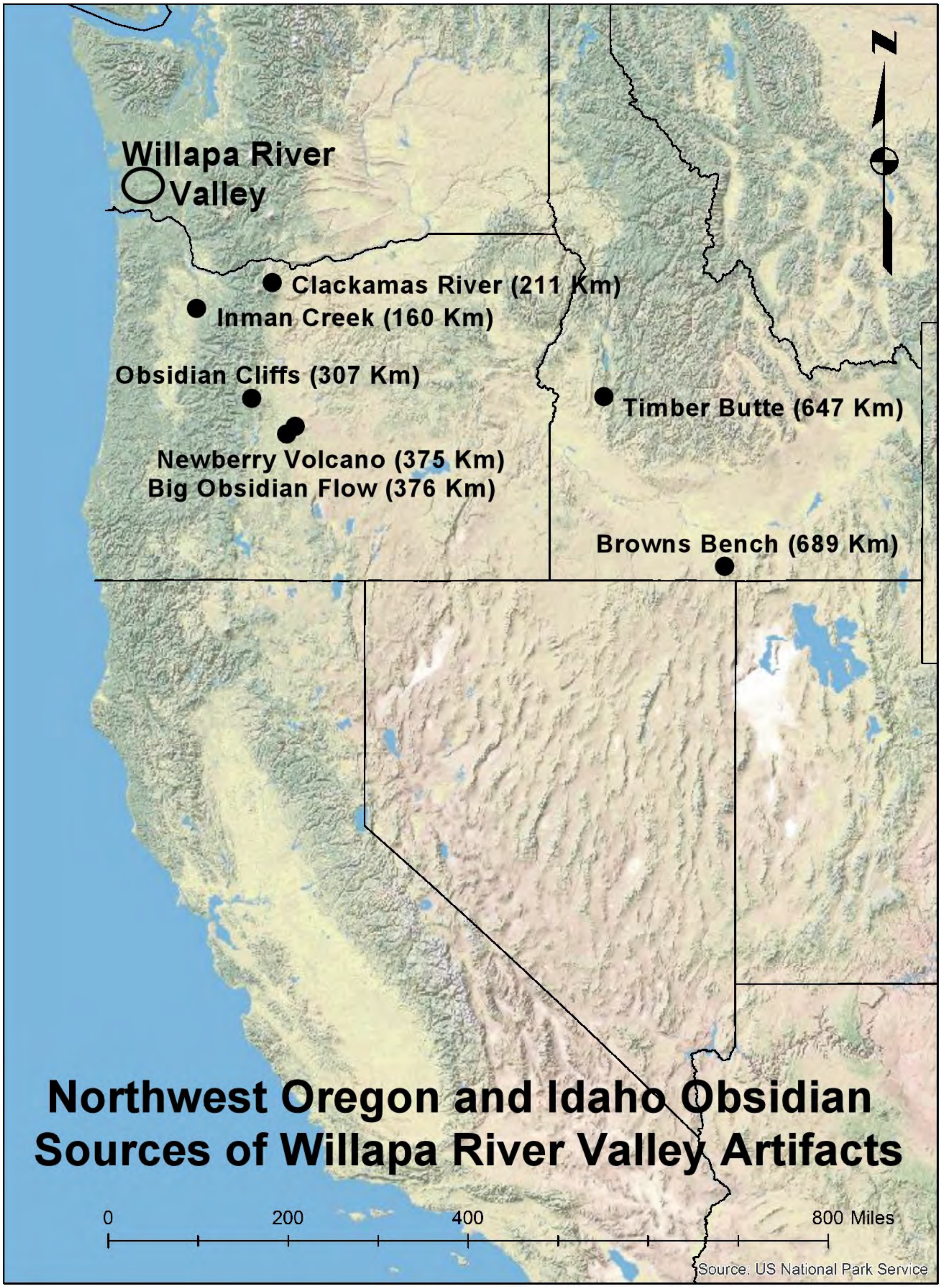

Figure 105. Map of northwest Oregon and Idaho obsidian sources for Willapa artifacts.

Figure 106. Willapa collection obsidian artifacts provenienced to northwest Oregon and Idaho sources.

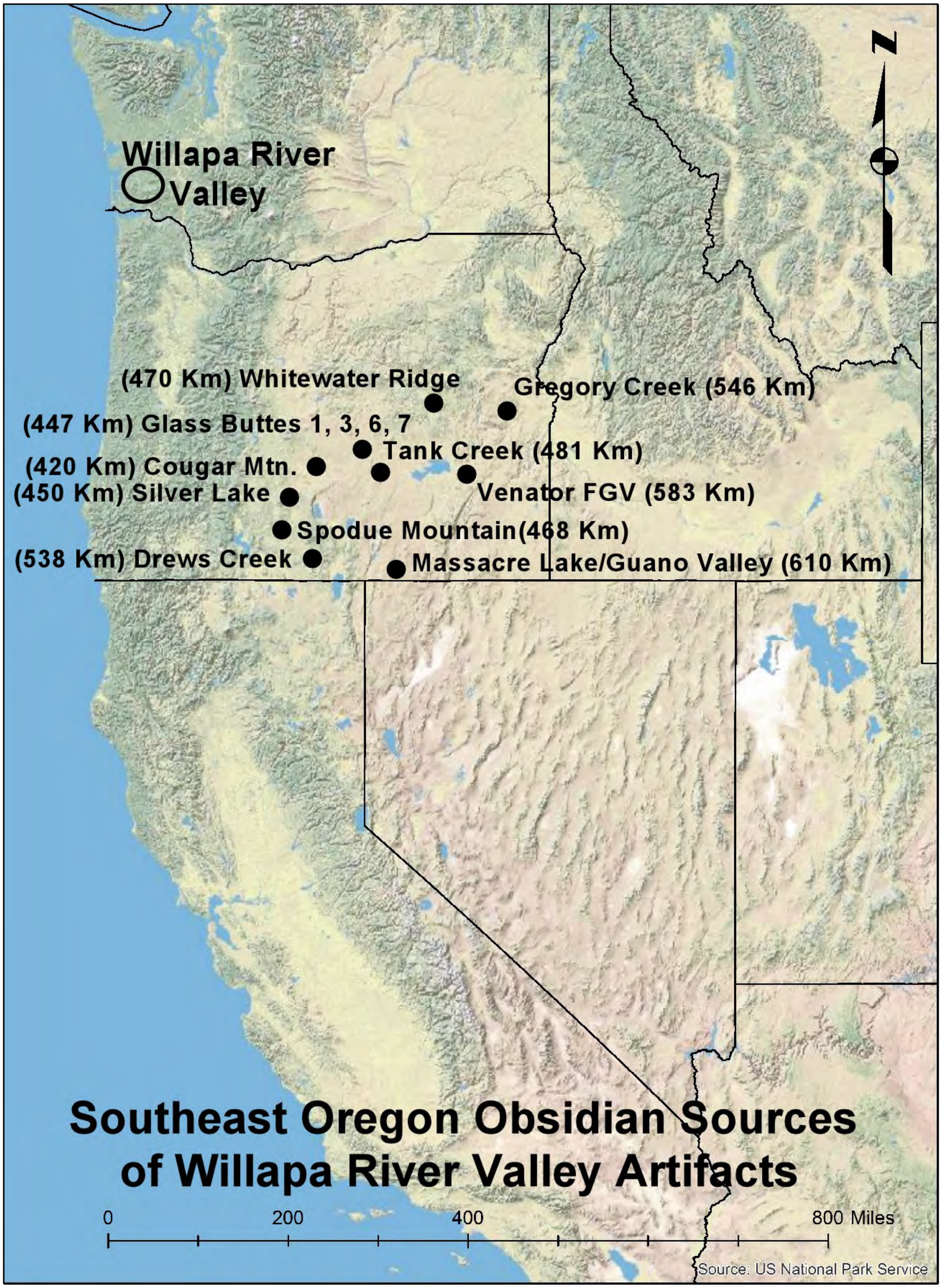

Figure 107. Map of southeast Oregon obsidian sources represented by Willapa artifacts.

Figure 108. Willapa collection obsidian artifacts provenienced to southeast Oregon sources.

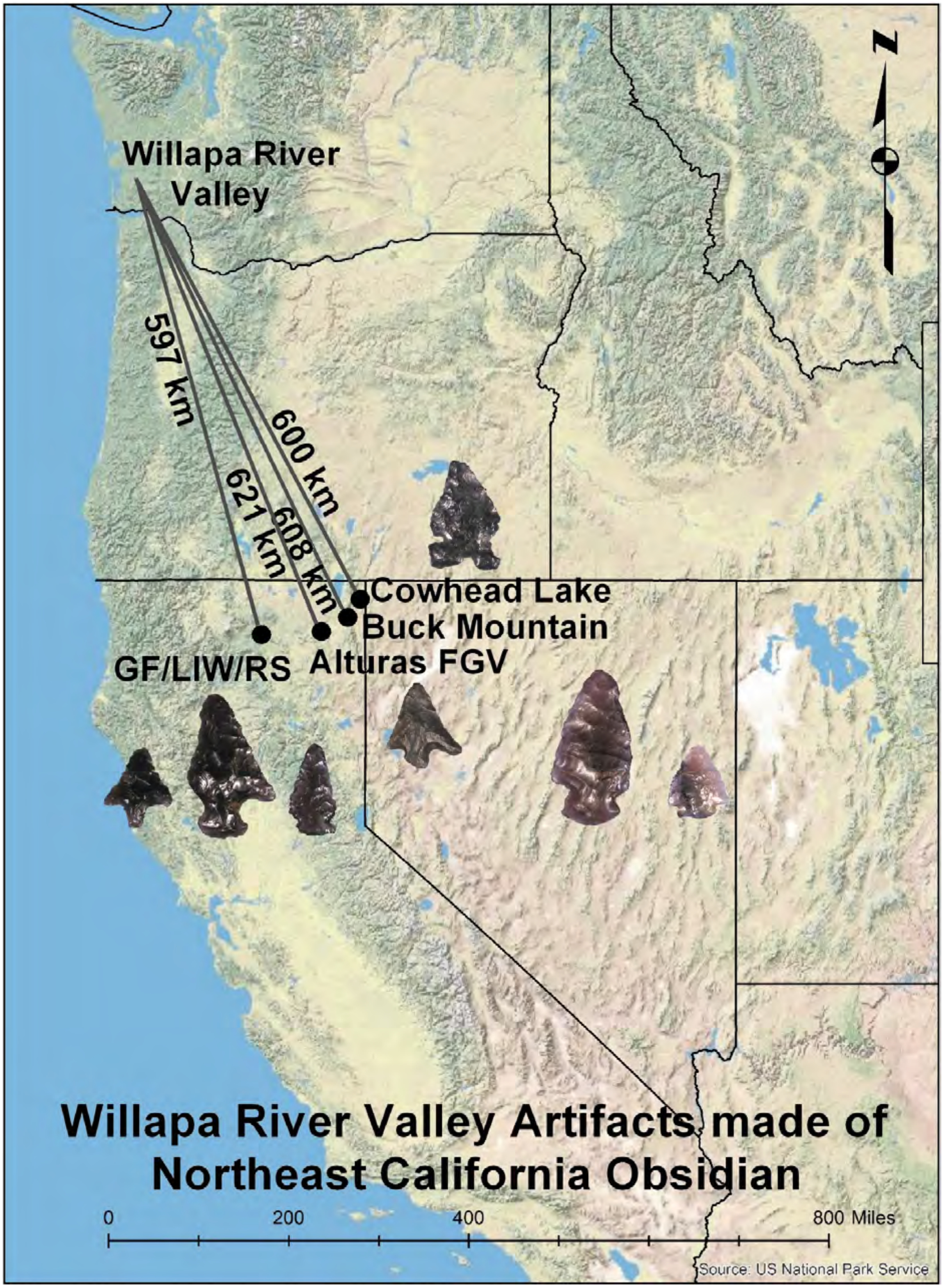

Figure 109. Map of northeast California obsidian sources represented by Willapa artifacts.

California Coast Range Obsidian in the Willapa Collections

It was entirely a surprise to learn that thirty-four of the obsidian bifaces in the S. Niemczиek collection (Chapter Six) were provenienced to sources in the California Coast Range (Figures 110 and 111). The Coast Range obsidian sources represented by biface artifacts in the S. Niemczиek collection include: Borax Lake (1), Napa Valley (31), and Annadel (2).

The Willapa collection artifacts provenienced to the California Coast Range are *definitively* different from those sourced to the north. The obsidian artifacts from the Coast Range region are simple ovate biface forms made using delicate-percussion and rough pressure flaking. When examined collectively (Figures 110 and 111), it is not hard to imagine the Coast Range obsidian assemblage from the S. Niemczиek collection as representing a cache of semi-standardized early-stage trade good bifaces. While large status bifaces appear to have been preferentially manufactured from southeast Oregon obsidian, the Coast Range obsidian sources appear to have supplied the Willapa region with sets of small early-stage ovate “trade bifaces.”

The assemblage of Napa California obsidian bifaces from the S. Niemczиek collection is believed to have been found piecemeal on a stretch of a Middle Willapa River Valley gravel bar. Some of the bifaces exhibit 100% abrasive alluvial polish, while others are unworn. Two of the bifaces are cortical (Figure 111). I would not be surprised if their uniform size corresponds to the length of a “value class” of northwest coast dentalium-shell trade currency (Griswold 1954).

It is hypothesized that the California Coast Range artifacts were traded up the Pacific Coast by canoe as part of a Pacific Athabaskan coastal trade and dance network, rather the being traded inland through multiple cultural and linguistic channels, and over so many landscape obstacles. The San Francisco estuary seems like the most reasonable coastal distribution point for the Borax Lake, Napa Valley, and Annadel obsidian (Jackson 1974, 1986).

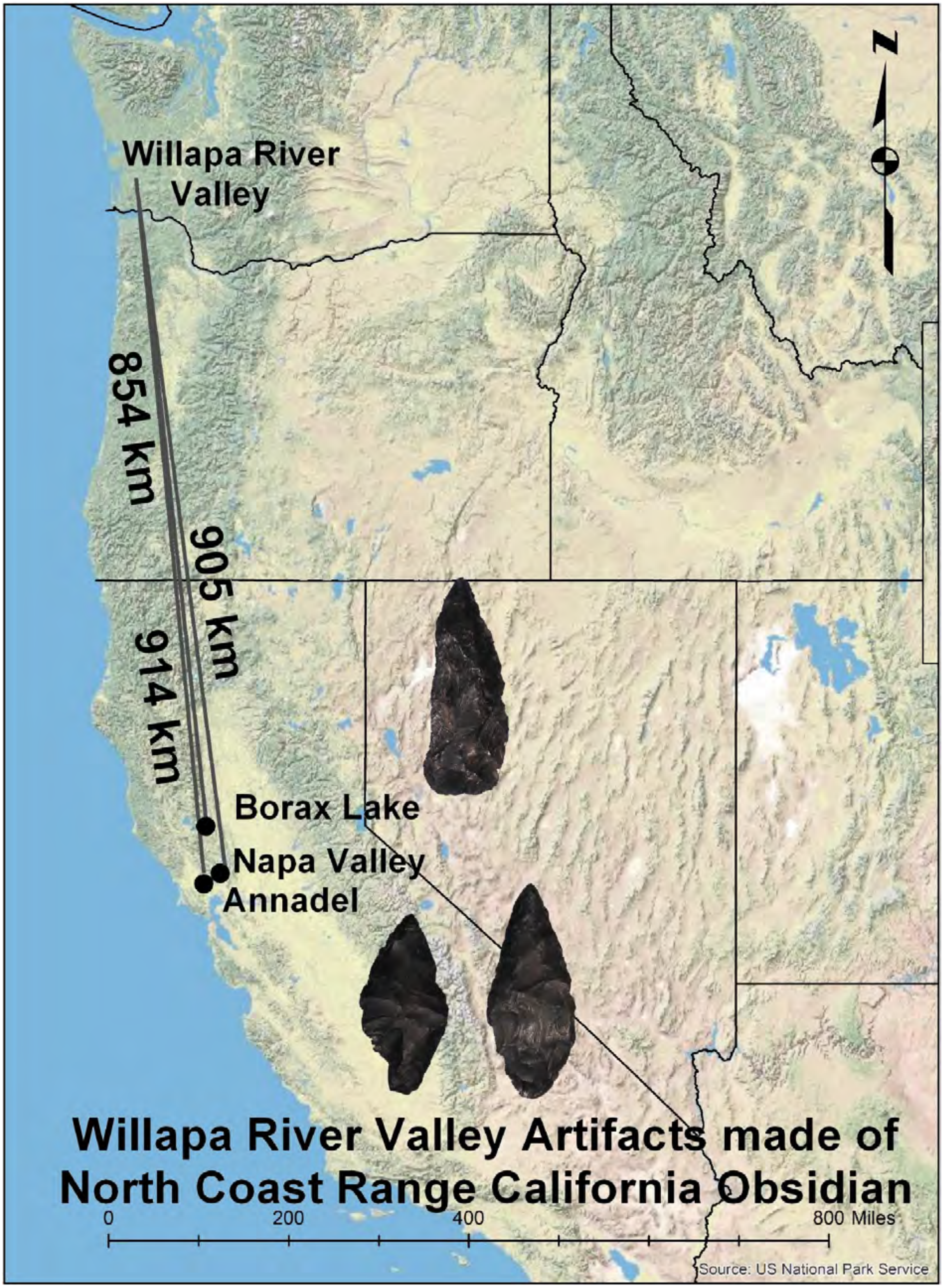

Figure 110. Map of California Coast Range obsidian sources represented by Willapa artifacts.

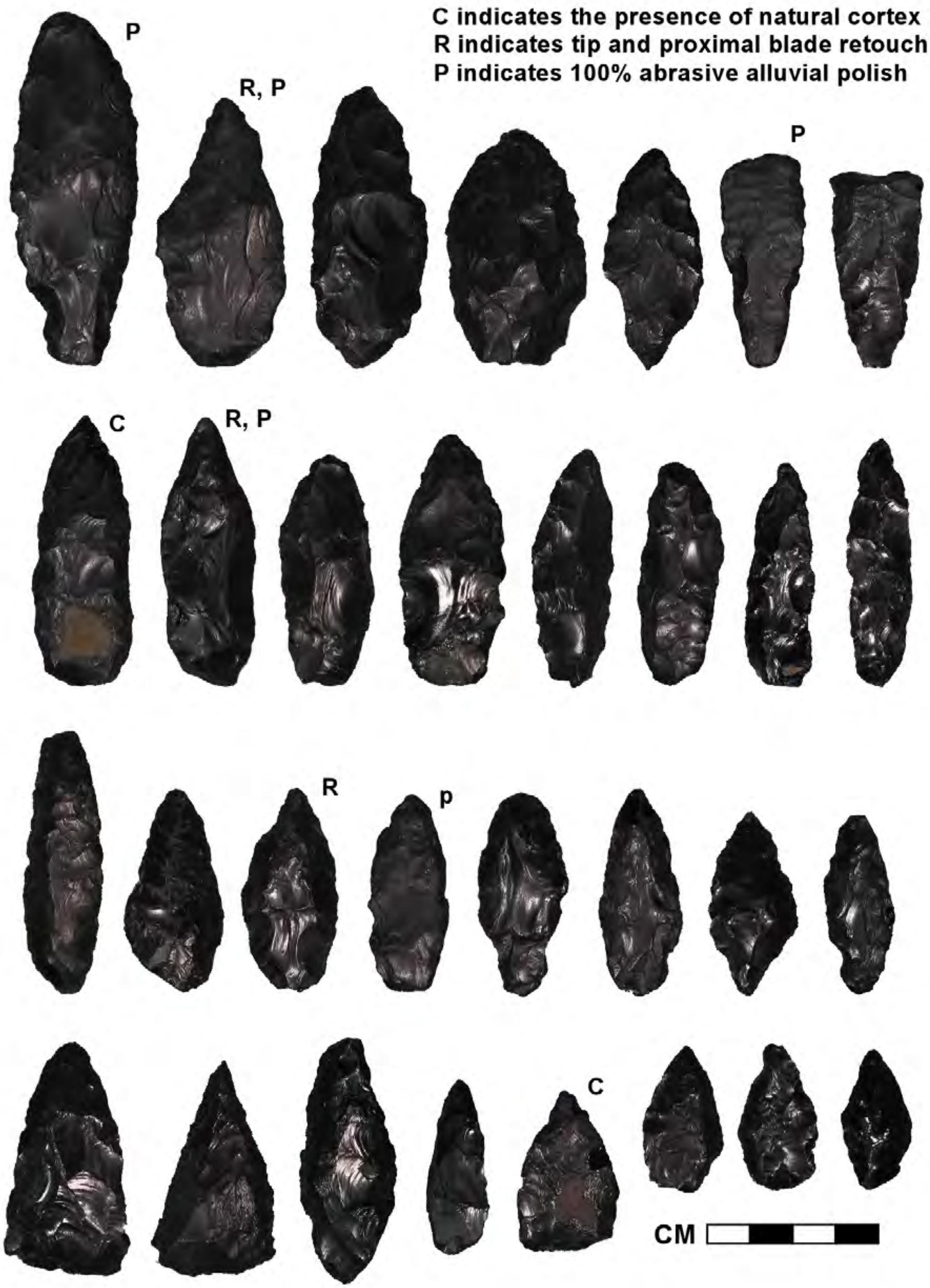

Figure 111. Napa Valley California obsidian bifaces in the S. Niemcziek Willapa collection.

While late prehistoric Gunther Island (Hughes 1978) and Willapa River Valley collections artifacts (Figure 109) provenienced to northeast California sources tended to consist of formed utilitarian tools rather than large ceremonial “wealth” bifaces, the cache-like collection of minimally retouched and remarkably consistent Willapa River Valley collection obsidian bifaces sourced to the Napa, Borax Lake, and Annadel Coast Range quarries are suggestive of an export-focused trade-good industry (Figures 110 and 111). In the Coast Range region, there appears to have been a pattern of large “matching” trade and/or ceremonial biface caches being produced from the Borax Lake (Figure 110), Mt. Konocti (Not mapped), and Napa obsidian sources beginning around approximately 2500 BP (Gary and McLear-Gary 1990; Rick and Jackson 1992), and extending to beyond 1331 BP, 1269 BP and 1069 BP (Paston and Walsh 1989).

The Great Blades Cache site (Rick and Jackson 1992) was located approximately sixty-kilometers north of the Borax Lake obsidian source and was dated to approximately 2400 BP using obsidian hydration analysis. The cache consisted of sixty-nine mid-stage bifaces made from Borax Lake obsidian. These large bifaces averaged 11 cm in length.

The Caballo Blanco Biface Cache site (Gary and McLear-Gary 1990) was located approximately forty-five kilometers west of the Borax Lake obsidian source and was dated to approximately 2500 BP using obsidian hydration analysis. The entire cache of sixteen large (17.1 cm average length) bifaces was sourced to the Mount Konocti source located approximately ten kilometers west of the Borax Lake quarry area.

The Mazzone site (CA-SCl-131), located thirty kilometers south of San Francisco, contained two assemblages of “cemetery goods” obsidian bifaces consisting of eleven (8.35 cm average length) and eighteen (7.12 cm average length) serrated biface forms made from the Napa and Borax Lake obsidian sources (Paston and Walsh 1989). The Mazzone site bifaces were dated to approximately 1331 BP, 1269 BP and 1069 BP using obsidian hydration techniques. The two Mazzone site obsidian biface "groupings" were not associated with individual graves, but were thought to represent assemblages of artifacts left at the cemetery as an offerings to the place. Paston and Walsh (1989) do not refer to the matching assemblages of bifaces as "caches" because the artifacts were thought to be in their final intended location, and were not being stored for future use or distribution among the living. It is significant to note that a single east California Coso (West Sugarloaf) obsidian flake was identified at the CA-SCl-131 cemetery site (Paston and Walsh 1989:84). Coso (West Sugarloaf) obsidian was present at the mouth of the Willapa River in the Que-lap′ton-lilt Village site (45PC196) tide zone collection (Table 24).

The collection of nearly matching Napa, Borax Lake, and Annadel obsidian bifaces in the Stanley Niemcziek Willapa River Valley collection (Figures 110 and 111) also appears to represent a "cache" or "grouping" of related bifaces, but they are much different than any of the 2500 BP to 1069 BP "caches" recovered in the California Coast Range region; the Willapa collection artifacts are tiny in comparison. It is as if the "cache" bifaces of the California Coast Range (Gary and McLear-Gary 1990; Paston and Walsh 1989; Rick and Jackson 1992) lost their serration and were shrunken into "travel-size" or "sample-size" biface collections. The 2500 year-old Coast Range California obsidian cache specimens vary between approximately seven and seventeen cm long. The thirty-four Willapa River Valley collection Napa, Borax Lake, and Annadel biface artifacts have an average length of 5.0 cm, an average width of 2.2 cm, and an average thickness of 0.8 cm. The Willapa artifacts are not at all serrated like many of the large Coast Range "cache" bifaces, but they do exhibit a similar level of mid-stage percussive thinning and pressure-flake marginal shaping.

East California Obsidian in the Willapa Collections

Finally, the most perplexing source of Willapa obsidian artifacts is the eastern California Coso (West Sugarloaf) quarry (Figure 112). Two obsidian artifacts in the Rubey Family Que-lap′ton-lilt Village site (45PC196) tide zone collection were provenienced to the Coso, California source (Figure 113). The Coso (West Sugarloaf) obsidian source (Erickson and Glascock 2004) is 1280 km away from the sunken site at the mouth of the Willapa River. The Pacific Athabaskan coastal trade network hypothesis would support a scenario in which this distant Coso, California obsidian was exchanged up the Pacific Coast (likely from the San Francisco estuary) to northern California, and then ultimately to the mouth of the Willapa River through direct ocean-going canoe world-renewal dance and trade network channels.

The gravel-worn translucent black obsidian Coso California artifacts consisted of a bifacial thinning flake and a unifacially pressure-retouched bifacial shatter fragment. The bifacial thinning flake had multiple facets on its dorsal face, and a smooth ventral face. It had a feathered termination and a thin platform. The unifacially pressure-retouch obsidian fragment appears to have been an irregular fragment of a biface that was recycled into a small scraper-type tool. The Coso obsidian artifacts were found within the gravels surrounding a sunken shoreline forest of Sitka spruce tree roots at Que-lap′ton-lilt Village site (45PC196, Figure 10), a co-seismically submerged multiuse camp located not far from localities where Atwater and Hemphill-Hailey (1997) developed their Willapa earthquake and tsunami chronology. The Coso obsidian biface thinning flake and unifacially retouched fragment from Que-lap′ton-lilt Village site (45PC196) could potentially be some the most distantly traded prehistoric lithic artifacts in the Pacific Northwest. I have not yet located additional obsidian in the deflated site gravels.

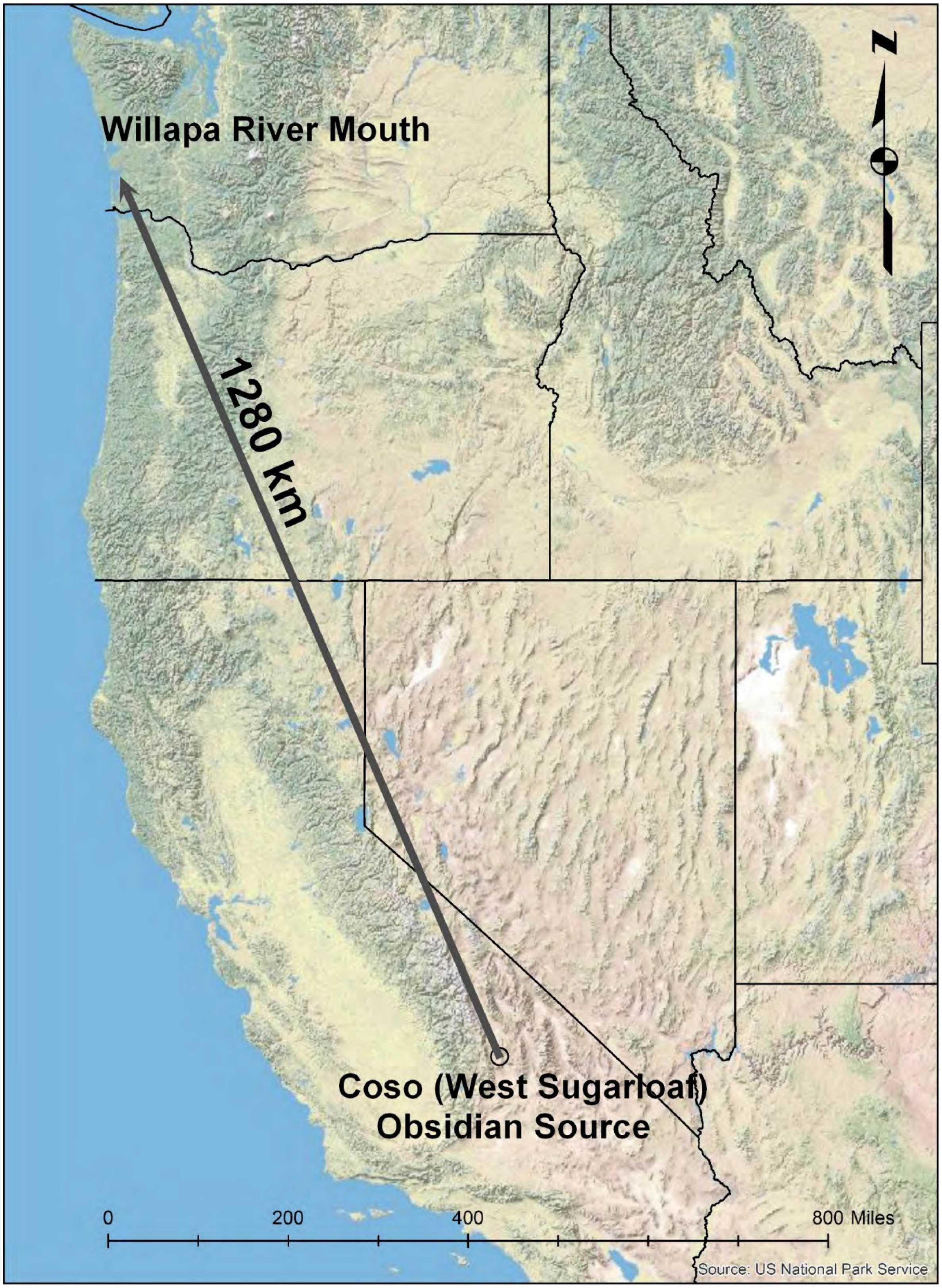

Figure 112. Map of the east California Coso obsidian source.

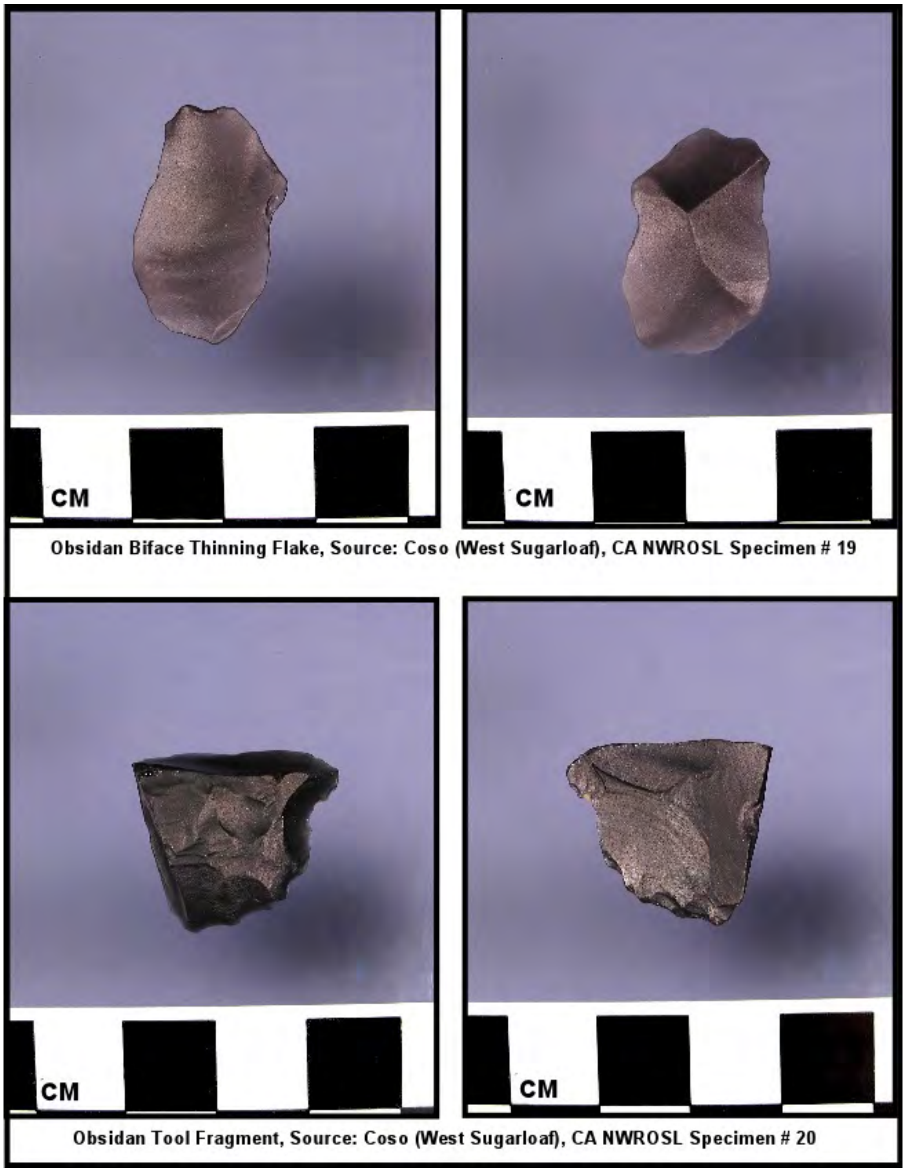

Figure 113. Coso (West Sugarloaf), California obsidian artifacts from the Que-lap′ton-lilt Village site (45PC196) tide zone collection.

A biface "cache" industry appears to have been active in east California during the late prehistoric Athabaskan-era. Twenty-seven large ovoid Coso (West Sugarloaf) obsidian biface cores were recovered from the Little Lake Biface Cache in Inyo County, California (Garfinkel et al. 2004). Obsidian hydration analysis on the cache dated it to approximately 650 BP to 800 BP, within the period when the hypothesized Pacific Athabaskan coastal trade network could have been engaged in long-distance sea-going canoe trade and ceremonial dances.

Blueschist

There are presently five known ground stone blueschist club fragments from the Willapa River Valley and northern Willapa Bay region. Three blueschist club fragments (Figure 114; one handle, one mid-section, and one tip) were recovered from the tide zone of the earthquake-sunken Que-lap′ton-lilt Village (45PC196; Chapter Four), and were held as part of the Rubey Family collection. One blueschist club tip fragment from the Middle Willapa River Valley (Figure 114) was identified within the Stanley Niemcziek collection (Chapter Six). The fifth blueschist club fragment (Figure 115) was collected by J. Stein, S. Cole, and B. Atwater in 1996 at the north Willapa Bay region tide zone Niawiakum site (45PC102; Figure 2).

The Niawiakum site (45PC102) is a co-seismic earthquake-sunken cultural midden exposed in the bank of the Niawiakum River tidal channel. The Niawiakum site was occupied as early as 1000 AD, and was likely utilized until the earthquake and tsunami of 1700 AD (Cole et al. 1996). The Niawiakum site blueschist lozenge club fragment (Figure 115; Burke Museum Cat. 45PC102-1) was recovered from the surface of the Niawiakum River tidal channel directly below the eroding midden cut-bank. It is likely that the midden-sloughed Niawiakum site blueschist club fragment dates to the same pre-1700 AD era as the tide zone midden. The three blueschist club fragments from the Que-lap′ton-lilt Village site (45PC196) were also recovered from the tide zone and likely date to the same period just prior to the 1700 AD earthquake and tsunami (Atwater et al. 2005).

Natural exposures of blueschist do not appear to exist in the Willapa region. The survey did not identify any similar stone, and informants were unaware of any local natural exposures. Blueschist is not distinctly platy like most *"schist"* stone. The Willapa blueschist has blue, green, grey, and tan colors. Some are iron-oxide (rust) stained from their tide zone contexts.

Figure 114. Blueschist club fragments from 45PC196 and the Middle Willapa River Valley.

Figure 115. Blueschist club midsection fragment from Niawiakum River site 45PC102.

Geologic maps illustrate the fact that exposures of schist-like rock are rare in Washington and northwest Oregon, where schist-type rocks are deeply buried under much younger volcanic and sedimentary marine deposits. Late Jurassic age subduction-fault formed glaucophane blueschist is abundant in the northwest California and southwest Oregon Coast Range (Figure 116). There are extensive exposures of glaucophane blueschist in the Franciscan Complex of the northern California Coast Range. Tupper Rock, near the mouth of the Coquille River, was one of the closest exposures of glaucophane blueschist to the Willapa Region on the southern Pacific coast (Blake et al. 1967; Coleman 1974). Schist and blueschist are also present in the Nooksak River region, the Cascades of B.C., the San Juan Islands, and along the west coast of Vancouver Island, where many of the dentalium shells were likely harvested (Griswold 1954). Morin (2012) describes the manufacture of "amphibolite" glaucophane celts in Central B.C.

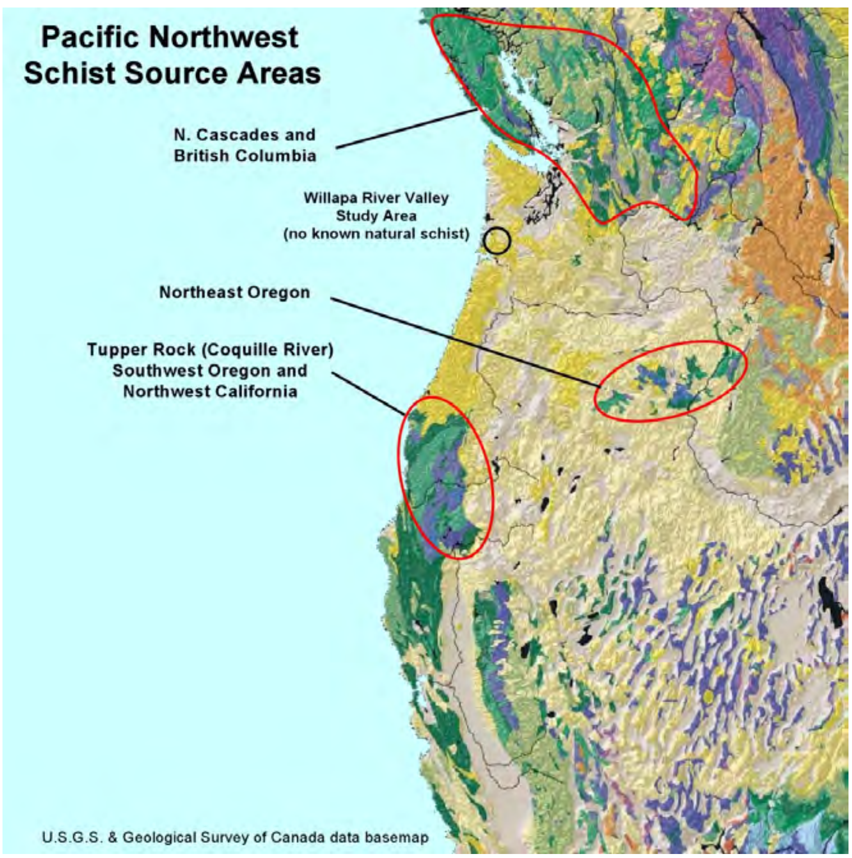

Figure 116. Geological map illustrating natural exposures of schist-like rock.

The iron-oxide stained light-blue, grey, and tan colored Niawiakum site (45PC102) blueschist club midsection fragment (Figure 115) is speckled with lighter “crystalline” mineral patterning that may perhaps be euhedral lawsonite (Coleman 1974). All of the blueschist club fragments are flecked with what appears to be mica, allowing them to sparkle slightly in the sun. Glaucophane blueschist only forms in extreme high-pressure, low temperature, metamorphic contexts usually associated with tectonic subduction zones. A future goal of the project is to use near infrared spectroscopy (NIR), X-Ray diffusion, or energy dispersive spectroscopy-scanning electron microscopy (EDS SEM) to definitively establish if the Willapa blueschist club fragments contain glaucophane minerals. It will then be revealing to determine if the lozenge club blueschist materials are more similar to northern California and southern Oregon Coast Range Franciscan mélange blueschist, or blueschist materials from Vancouver Island, within the Fraser River canyon, or perhaps form the “Northern Interior” of British Columbia where Athabaskan Carrier cultures manufactured amphibolite celts (Morin 2012). At this early stage, I can confidently say that the blueschist material imported into the Willapa River Valley *looks* indistinguishable from prehistoric glaucophane blueschist artifacts recovered from the estuary regions of the southern Oregon coast. It is possible that blueschist from both northern California and Central British Columbia sources was utilized to make lozenge-form clubs.

If there is sufficient mineralogical diversity between the regional exposures (or perhaps even between local archaeological quarry areas) of blueschist it might be possible to eventually develop a quantitative source catalog that could be used to help provenience stone club artifacts from throughout the Pacific Northwest.

Harlan Smith (1907, 1910), Boas (Smith 1907), and Loud (1918) described a widespread late prehistoric whalebone and stone club complex that extended from the Coast Range of northern California, up the Columbia River, and north throughout western British Columbia. The Willapa and Oregon Coast blueschist lozenge clubs appear to be a type that is distinct from the anthropomorphic and decorated forms of the Salish Sea northern coastal cultures (Smith 2007). A nearly identical artifact to the basally lobed and bi-conically perforated handle lozenge-form club from Que-lap′ton-lilt Village (Figure 114) was documented by Smith (1907:415) near the Siuslaw River estuary community of Florence, Oregon.

Kroeber's (1909) description of the ethnographic period of northwest California suggests how the lozenge-form stone clubs may have been utilized there. Kroeber (1909:21) stated:

> In northwestern California there is some record of short, sword-like stone war-clubs, and a few pieces have been found which seem to answer this description. They are of the general type of the slave-killers and one-piece edged clubs of the Pacific coast farther north. . .

A review of the Washington, Oregon, and northern California coast archaeological literature revealed a pattern of sword-like lozenge blueschist clubs and “schist” adze artifacts that extended up the coast from northern California to the Fraser River (Figure 117). The sword-like “lozenge” stone clubs appear to have been the dominant type on the Washington and Oregon Pacific coast.

Coast Range schist was used to create tools other than just “lozenge-form” and “*slave-killer*” clubs. Schist artifacts were recovered by Phebus and Drucker at the north Oregon Pacific coast Avenue Q site (35CLT13) (Connolly et al 1992:75), and by Connolly et al. (1992) at the nearby Palmrose site (45CLT47). Phebus and Drucker recovered one fragment of bi-conically perforated schist and one unmodified piece of schist in the third level of their Avenue Q site test unit (Connolly et al.1992:75). The lobed base of the blueschist club handle from Willapa’s Que-lap′ton-lilt Village tide zone site was also bi-conically perforated (Figure 114). The third level of the Avenue Q site was dated to 1675 +/- 125 BP (Lab No. SI-661; corrected calendar years 230

AD to 540 AD; Connolly et al. 1992). This radiocarbon assay suggests that the Avenue Q site schist was likely deposited just prior to the emergence of Athabaskan languages on the Pacific Coast. At the nearby Palmrose site, Connelly et al. (1992) recovered two small tabular pieces of unmodified "manuport" schist.

On the southern Oregon coast, adze artifacts tended to be manufactured out of schist, sandstone, and basalt (Byram 2006; Leatherman and Krieger 1940; Lyman 1991; Minor and Nelson 2004; Nelson 2000), whereas in the Fraser River Valley and Salish Sea region, adze technology is clearly dominated by nephrite materials that are locally available in southern British Columbia (Darwent 1998; Morin 2012). Morin (2012) reports the presence of flaked and ground glaucophane "amphibolite" celt forms within the "Northern Interior interaction sphere" of Central B.C. Morin (2012) used NIR spectroscopy and spectral reference library data to identify glaucophane "amphibolite" artifacts in assemblages from the Golden Ears site (DhRp52), Milliken site (DjRi3), FlSa1, FlSa2, GaS Y, GaSd 1, 2, 3, and 6, and site GR Y.

It seems likely that there was a late prehistoric blueschist adze and club industry in the southwest Oregon and northwest California coast region. There are close similarities between the northern California Gunther Island site's "*slave-killer*" clubs and "*slave-killer*" clubs of the lower Columbia River. Loud (1918:374) remarked:

> Some of the specimens from the Gunther island resemble so closely specimens from the Columbia river that they can be said to be practically identical; yet the form is so frequent both in California and in Oregon that it would be unwarranted to infer that the pieces were made in a northern locality and carried to California in trade, or vice versa..

The similarities between the sword-like lozenge clubs of the southern Oregon coast estuaries and the Willapa Valley are just as notable.

There shouldn't have been a blueschist industry centered in a region where there is no natural occurring blueschist. I believe the late prehistoric "lozenge" club and "*slave killer*" industry was centered in the southwest Oregon and northwest California Coast Range where glaucophane blueschist materials were abundantly available, rather than in the basalt-covered Columbia River region. There could also have potentially been a blueschist club industry in southern British Columbia and the west coast of Vancouver Island, where whale bone clubs appear to be far more dominant in the archaeological record than stone clubs (Smith 1907). Loud (1918) did not have the benefit of complete, accurate, and high-resolution continental-scale geologic maps when considering the sources of nearly identical Gunther Island and Columbia River region ground stone club artifacts.

I am proposing that the same social mechanism that was responsible for the introduction of exotic southeast Oregon, northeast California, Coast Range, and eastern California obsidian to the Willapa region was also responsible for the introduction and exchange of lozenge-form sword-like glaucophane blueschist clubs. I believe that parties of northwest California coast "Gunther Island culture" Athabaskan long-distance canoe wealth-traders included the Willapa Kwalhioqua enclave within their cycle of counter-seismic world-regenerative dances prior to the great earthquake of 1700 AD (Atwater et al. 2005).

It should be instructive to us that blueschist clubs have been located at tide zone sites in both Coos Bay and Willapa Bay (Figure 117). We should be looking for these exotic trade goods in late prehistoric coseismic sunken tide zone sites, and in shallow or plow zone near-coastal terrace deposits of the last 1200 years. Blueschist club fragments and exotic Coso (West Sugarloaf) east California obsidian debitage co-occurred in the Rubey Family tide zone collection from the Que-lap′ton-lilt Village (45PC196) site. I believe there is a similar potential for the co-occurrence of exotic California obsidian with the blueschist club fragment at the pre-1700 AD tide zone Niawiakum site (45PC102).

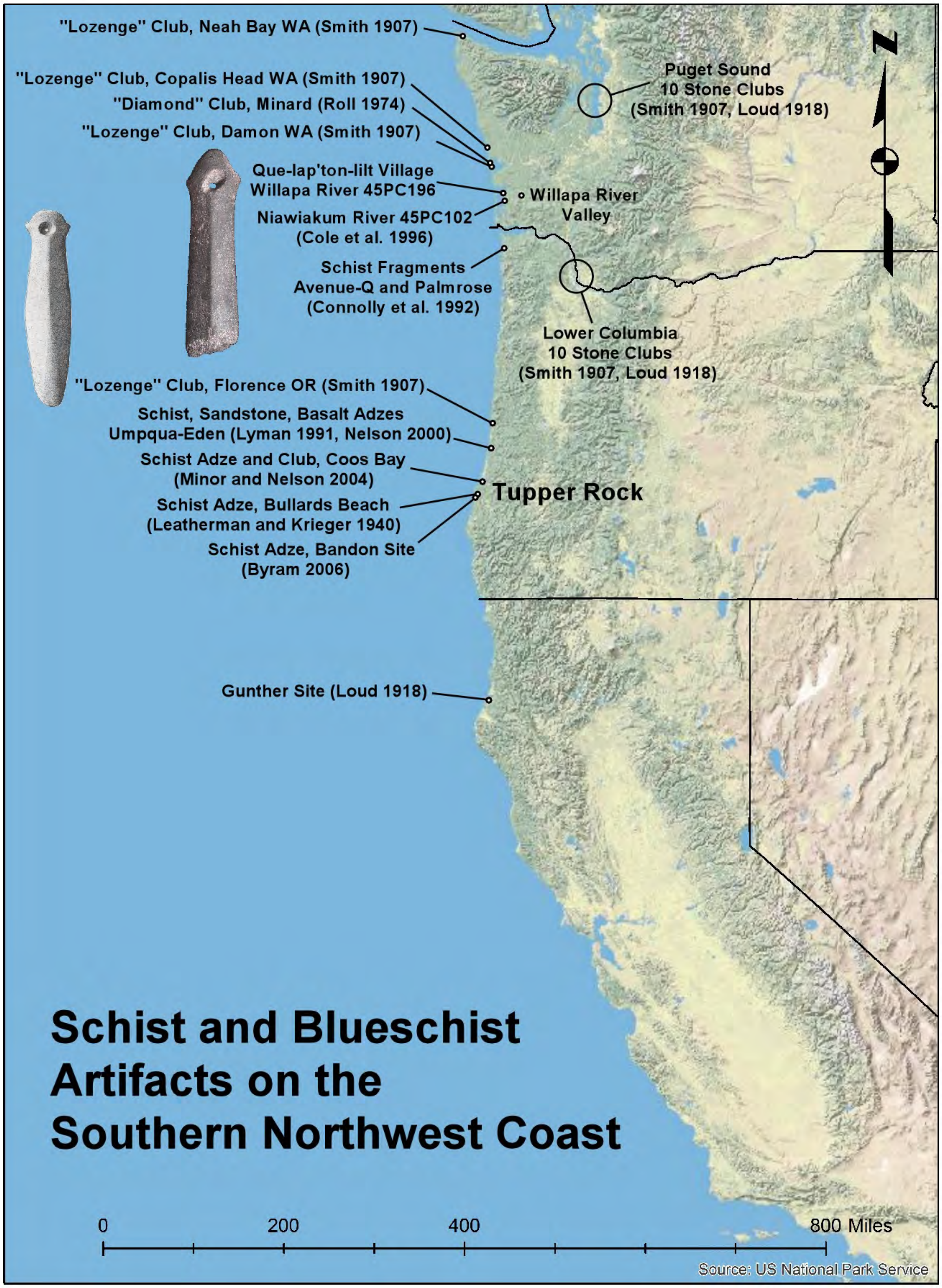

Figure 117. Map of schist club and adze artifacts from the Pacific Northwest coast region.

Nephrite

Nephrite adzes, otherwise known as *celts*, have been located in plowed fields throughout the Willapa River Valley and Boistfort Valley (Figure 118). These artifact forms are typically (cross-continentally) associated with wood-working reduction, carving, and canoe manufacturing. The jade-like bits were securely hafted onto wood or bone handles with peeled-bark, cordage, and perhaps pitch. Willapa Valley adze handles have not yet been recovered. Short “D-handle” hafts, straight “chisel” type end-hafts, and long “angled-end axe-handle style” adze hafts (Olson 1927) all could have occurred in the Willapa region. A straight whale bone “chisel” type adze handle was recovered from the Par-Tee site (Phebus and Drucker 1979).

In addition to containing blueschist and exotic obsidian, the Que-lap′ton-lilt Village (45PC196) tide zone collection included a beautiful dark green, blue, and red-tone nephrite adze (Figure 118). Nephrite adze fragments were also present in the S. Niemcziek collection from the Middle Willapa River Valley and in the Kaech Family collection from the Upper Willapa River Valley and Boistfort Valley. The Kaech Family collection included three nephrite adzes from the Boistfort Valley of the Upper Chehalis River (Figure 118). Several of the nephrite adze specimens in the Willapa family collections exhibit distinct residual groove scars from the separation of the blank from a larger nephrite core. The Kwalhioqua and Chinook shared boundaries with Salish peoples and had access to the Columbia River trade networks. It is assumed that nephrite was acquired through these sources, rather than through direct trade from the Fraser River Valley. Quantitative sourcing of Willapa nephrite has not yet been attempted. Morin (2012) has successfully utilized near-infrared (NIR) spectrometer technology to characterize British Columbia and northern Washington State nephrite materials, and has provenience a large sample of prehistoric nephrite artifacts to their source cores and regions.

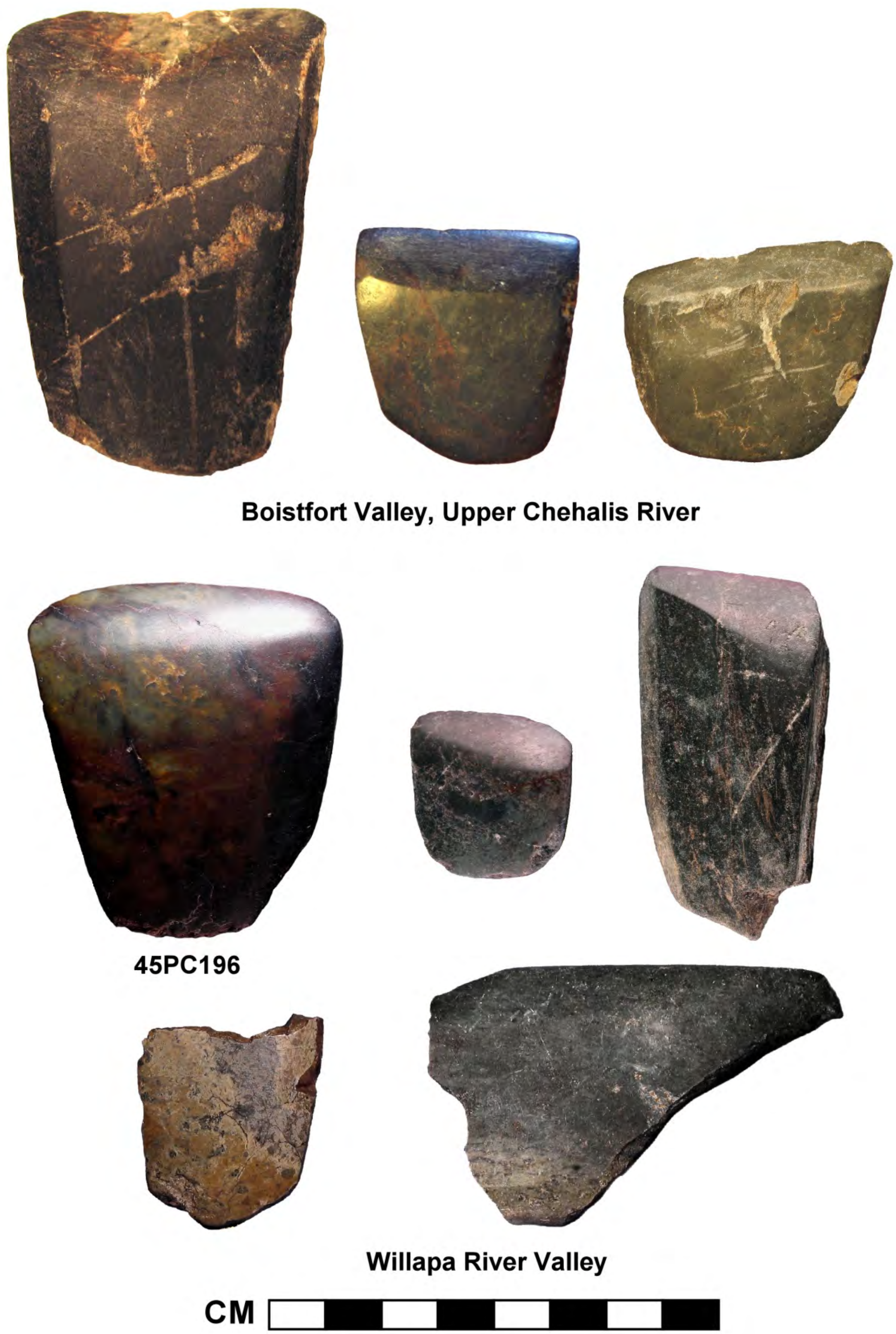

Figure 118. Nephrite adze artifacts from the Boistfort Valley and Willapa River Valley.

Reciprocal Trade Goods from the Willapa River Valley

The Willapa Kwalhioqua may have been involved in the clamons elk hide armor industry with the Chinook people (Boyd et al. 2013; Ruby and Brown 1976). Dentalium shell, clamons armor, and fine deer and elk hides, could have been exchanged for exotic California obsidian and Coast Range blueschist artifacts. Kroeber asserts that armor was an "extra-Californian" industry which was isolated to the northern California region. Kroeber (1922:299) stated:

> Armor enters the state at the other end, also as an extension from a great extra-Californian culture. It is either of elk hide, or of rods twined with string in waistcoat shape. The rod type is reported from the northwestern tribes, the Achomawi, and the northern mountain Maidu. Elk skin armor has been found among the same groups, as well as the Modoc, Shasta, northern valley Maidu, and Wailaki. Theses closely coincident distributions indicate that the two armor types are associated, not alternative; and that, confined to the northernmost portion of the state, they are to be understood as the marginal outpost of the extension of an idea that probably originated in the eastern hemisphere and for America centers in the culture of the North Pacific coast. (Kroeber 1922:299).

There is again a touch of both irony and beauty in the fact that I have not been able to definitively determine if a smooth elongated bone rod with rounded ends from the S. Niemcziek collection (Appendix C Figure 100) was an early historic corset rod, or a preserved bone rod from an ethnographic suit of armor. The artifact was ultimately assigned to the historic era based primarily on the relatively intact condition of the bone material. It is exceptionally unlikely that any organic elements of late prehistoric or ethnographic era clamons armor would be preserved in the highly acidic post-depositional sediment contexts of the Willapa River Valley terraces.

I have had no success in identifying occurrences of nephrite artifacts at archaeological sites on the coast of Oregon. In the late prehistoric period, nephrite artifacts were used throughout the Penutian dominant Willamette Valley and Lower Columbia River regions, in the Athabaskan enclave that occupied Willapa River, Upper Chehalis, and Boistfort Valleys, and in the Salishan landscapes of the Puget trough and Cascade foothills. By the end of the Middle

Holocene, nephrite adzes/celts were ubiquitous throughout the Gulf of Georgia (Grier 2003; Morin 2012), the British Columbia Plateau (Darwent 1998), and the Columbia Plateau (Galm 1994). The question we should perhaps be asking is: why haven't nephrite adze artifacts from the Fraser River region been recovered from late Holocene estuary sites of the southern Oregon and northern California coast? Mussel and clam shell ground adze blades were demonstrably effective tools in these regions, but polished nephrite adze blades would likely be exceptionally useful to any canoe manufacturing or wood carving culture on the Pacific Coast, regardless of the social status they could also potentially imbue.

In the Willapa region, both nephrite and ground shell adze technology were used in the Late Holocene. Shaw (1977) reports three ground shell adze blades from the Martin site (45PC7), and Connolly et al. (1992) describe a ground clam shell adze from the north Oregon coast Palmrose site (45CLT47).

Sea-going Canoes

Sea-going canoes were introduced to this set of trade hypotheses in an effort to account for the presence of exotic Californian obsidian in the near-coastal Willapa River Valley, in spite of the absence of these materials at northern Oregon archaeological sites where provenience data from large lithic assemblages illustrate participation in "traditional" inland prehistoric obsidian trade networks throughout the Holocene. The northeast California, Coast Range, and east California obsidian artifacts in the Willapa River Valley are "suspiciously anomalous" because there is *not* a continuous diminishing "trail" of obsidian from these sources at terrestrial archaeological sites in central and northern Oregon. Obsidian from these distant obsidian sources has *not* been identified at archaeological sites in the Willamette Valley, the Cascade foothills, The Dalles region, the Puget Trough, or Puget Sound. If northeast, Coast Range, and east Californian exotic obsidian artifacts were being traded north up the interior of Oregon, we would expect to see small percentages of these materials in the lithic assemblages from archaeological sites located within the trade route corridors. Instead, there is a distinct discontinuity of northeast, Coast Range, and east Californian obsidian between southern Oregon and the Willapa River Valley region. The distribution of obsidian artifacts from these source areas closely mirrors the distribution of Late Holocene Athabaskan speaking enclave cultures of the Pacific Coast.

There is no direct prehistoric material evidence of sea-going canoes in the Willapa River Valley, or anywhere in the Pacific Northwest at the moment. Sea-going canoes are undeniably a "just-so story" element of the Pacific Athabaskan coastal trade network hypothesis. Lyman (1991:89) states:

> It suffices here to note there is no good *archaeological* evidence for oceangoing canoes between the Columbia River mouth and Cape Mendocino California. . . To argue the ethnohistoric evidence indicated the presence of such craft during the prehistoric times seems unwarranted in light of the major changes Northwest Coast cultures underwent during the 17th, 18th, and early 19th centuries.

Lyman (1991:95-96) continues:

> Perhaps the proper spatial location in sites, particularly villages, has not been archaeologically sampled. That is, perhaps excavation strategies have not intentionally or probabilistically been planned to sample loci where canoes, paddles, and bailer were deposited. In any case, while the presence of canoes and canoe-related equipment would signify the use of such craft, the absence of these remains from sites cannot be taken as evidence that human occupants of the site did not have or use canoes.

There are many ethnographic accounts of large dugout canoes being used on the Pacific Coast and in the Salish Sea (Drucker 1937; Gould 1968; Griswold 1954; Heizer and Massey 1953; Nomland 1938; Olson 1927; Waterman 1920a, 1920b). Griswold (1954:90) noted the fact that all of the reported initial trading events between Northwest Coast native cultures and voyaging European cultures occurred from canoes and ships that were afloat off the coast or within near-coastal waterways. There is one early report noting that canoes were not used by native people in open water south of Tillamook Bay primarily because of psychological barriers, rather than any technological obstacles. Sometimes a canoe is just a canoe. Albert Lewis (1906:193) stated:

> There was a considerable amount of coasting trade, especially from the mouth of the Columbia northward, carried on chiefly by the Chinook and the Makah. South of the Tillamook, along the Oregon coast, there are no records of such traffic, and we have already noted that south of the Columbia area the canoes were not fitted for ocean voyages. While the timber may not have been so favorable for canoe making, the reason must have been psychological rather than physical, as is also indicated by the fact of their somewhat different culture.

In Willapa Bay, there are ethnographic accounts of abandoned pre-contact canoes (Swan 1857:211-212), and old ethnographic era canoes used for burials (Swan 1857:185-187). Swan (1857:79) describes the purchase of his own “Chinook” canoe from Chief Kape of the Quinault tribe. Swan (1857:79) states:

> She was *forty-six feet long* and *six feet wide*, and had thirty Indians in her when she crossed the bar at the mouth of the Bay. She was the largest canoe that had been brought up the coast, although the Indians round Vancouver’s and Queen Charlotte’s Islands have canoes capable of carrying one hundred warriors. Their canoes are beautiful specimens of naval architecture. Formed of a single log of cedar. . .

In the North Nemah River estuary of Willapa Bay, Harold Nelson recorded a late prehistoric or ethnographic period canoe manufacturing site (45PC41; Figure 2) reported to have two unfinished cedar dug-out canoes located adjacent to large cedar stumps (Harold Nelson, Aug 29 1965 site form). In the middle 1970s, a fragment of a dugout canoe that was likely from the late prehistoric or ethnographic period was dislodged by machinery in a marsh adjacent to the Martin site 45PC175 (Wessen 2008:62-63). In southwest Washington, “marshy” sloughs and portage areas may be good landscapes in which to locate additional archaeological evidence of canoe technology. Processes of decomposition have likely destroyed most of the ethnographic and early historic period dugout canoes. It could be possible that elements of large prehistoric canoes may still be preserved encased in the tidal muck of Willapa Bay or Grays Harbor, or submerged within anoxic contexts of the Pacific Ocean, Ozette Lake, or Lake Crescent of the Olympic Peninsula.

Despite the near-absence of any complete or fragmentary prehistoric canoes in the Pacific Coast archaeological record, “processual” debates on the technological qualities, capabilities, and risk potentials of prehistoric sea-going canoes emerged in the early 1980’s (Jobson and Hildebrandt 1980; Hudson 1981). Jobson and Hildebrandt (1980) suggested that exceptionally large canoes were used to minimize the risks involved with open-water travel more than a few kilometers off the Pacific Coast, while Hudson (1981) argued that large canoes were not less risky, but could carry more weight and volume. Recently, evidence of composite sea-going *balsa* type canoes may have been identified in late prehistoric archaeological deposits (Des Lauriers 2005).

I have no reservations regarding the ability of Pacific Northwest prehistoric cultures to have used sea-going canoes for long distance journeys. I believe North American native peoples have been navigating the Pacific Coast by boat for at least the last 15,000 years. I do not believe that *giant* redwood or cedar canoes were necessary to travel along the Pacific Ocean coastline. I believe that canoes of the size that were common during the early ethnographic period (Swan 1857:79) could have been utilized for long-distance coastal travel in calm weather. It would not be difficult for a small party to create “outrigger” configurations with multiple canoes, planks, or poles, but there does not appear to be any ethnographic or archaeological evidence of this type of technology. I believe pre-contact peoples traveling in the ocean would stay within one to two kilometers of the shore outside of the surf zone.

An interesting and relevant environmental consideration that does not appear to have been introduced to the sea-going canoe archaeological discussion involves the natural near-shore wind and surface currents of the Pacific Northwest Coast. In the winter months, the natural wind and surface currents of the near-shore Pacific Coast move from the south to the north, while in the summer months, the wind and surface currents of the near-shore Pacific Coast move from the north to the south (Frederick 1967). It would likely require less work to travel north along the Pacific Coast in a canoe in the winter, and south along the Pacific Coast in the summer. A hypothetical months-long canoe journey with dance and trade stops along the Pacific Coast could potentially be planned in the fall or spring to coincide with the seasonal change in near-shore wind and surface current direction, allowing a vessel to travel *with* the surface winds and currents for both the trip out and the return voyage.

An Overview of the Pacific Athabaskan Coastal Trade Network

The Pacific Athabaskan coastal trade network hypothesis postulates that obsidian and glaucophane blueschist artifacts from distant Californian sources were being transported by sea-going canoe directly up the Pacific Coast to the Willapa region by southwest Oregon and northwest Californian Athabaskan estuary peoples who practiced cyclical "counter-seismic" world-rejuvenation dances. This network is thought to have existed from approximately 800 AD to 1700 AD. Prior to the 1700 AD earthquake (Atwater et al. 2005), northern California coastal cultures may have built large sea-going trade and dance party canoes similar to those used by the ethnographic Tolowa people (Gould 1965). Large parties of dancers and traders could have potentially traveled from northern California to the Willapa region in sea-going canoes in as little as five to seven days. A direct ocean-route trade network would have bypassed the dentalium “middle-man"(Griswold 1954), while allowing the Athabaskan enclaves cyclical opportunities to communicate, intermarry, and perform world-renewal ceremony together.

Canoe journeys of this magnitude have likely been part of Puget Sound and Salish Sea cultural traditions for thousands of years. Similar endeavors are undertaken as part of the revitalized Pacific Northwest “Tribal Journey” events (Lincoln 1990; Neel 1995). These “paddle team” gatherings involve long-distance multi-day canoe journeys and feasting. The hypothesized Pacific Athabaskan coastal trade network may have dissolved in-consort with the demise of the Willapa Kwalhioqua peoples and the arrival of European ships. It could also be possible that counter-seismic dance and trade networks were substantially modified as a result of the great earthquake and tsunami of 1700 AD (Atwater et al. 2005).

The future of prehistoric Willapa trade and exchange research is dependent upon the continued recovery and source identification of obsidian and blueschist artifacts from archaeological contexts. Exotic Californian obsidian, Coast Range blueschist, and Fraser River region nephrite artifacts co-occurred at the pre 1700 AD tide zone Que-lap′ton-lilt Village site. I believe there is a good possibility that exotic canoe-transported obsidian could also co-occur with the blueschist club fragment at the 1000 AD to 1700 AD Niawiakum site (Cole et al. 1996). Future excavation testing at the tide zone midden Niawiakum site could potentially recover a diverse sample of obsidian micro-debitage if fine mesh (1/8 inch or smaller) screens are utilized. In the Upper Chehalis River watershed, Welch (12-2-1969 site form) reported the collection of a stone club handle from the Boistfort Valley site 45LE102. It is possible that a sample of obsidian debitage could also be recovered from the plowed site 45LE102.

CHAPTER EIGHT

CONCLUSIONS

The ongoing Willapa archaeological project has been successful in addressing the three research domains it set out to explore. Site distribution studies were initiated by designing a predicative site location model for the Willapa region that was tested through extensive archaeological field reconnaissance surveys. In the Willapa River Valley, I developed a more focused geomorphology-based site location strategy tailored specifically to the alluvial terraces of the near-coastal watershed. As a result of this work, the project identified a fresh sample of pre-contact near-coastal lithic scatter sites spanning the entire Holocene, and possibly the Late Pleistocene. The Willapa archaeological survey identified the spectrum and range of lithic, faunal, and floral resources that were available to pre-contact Willapa region cultures. Pre-contact resource utilization strategies were explored within a range of different Willapa River Valley landscapes and archaeological sites.

The nature of the archaeological inquiry grew more sophisticated once these foundational archaeological studies began to generate fresh information. The Willapa project used obsidian XRF provenience studies and glaucophane blueschist club distribution data to indentify an archaeological expression of the Willapa Kwalhioqua Athabaskan enclave culture that thrived in the Willapa River Valley prior to AD 1700. This research led to the development of a novel set of hypotheses that unite the Athabaskan cultures of the southern Pacific Coast estuaries within a *direct* trade and counter-seismic dance network. The "Pacific Athabaskan coastal trade network" hypothesis explores pre-contact connections between archaeological cultures of the southern Northwest Coast; research that was initiated by early anthropologists (Boas, Smith, Loud, and Kroeber) at the beginning of the 20th century.

The pre-contact archaeology of an entire southwestern Washington landscape has been explored using ethnography, informant interview, survey, excavation, and analysis of surface collections in the tradition of Smith (1906, 1907), Daugherty (Wessen 2011), Kidd (1960), Rice (1964, 1969), Dancey (1968), Welch (1970), Wessen (1978), Pettigrew (1981), and Minor (1983). The process of identifying and interpreting archaeological sites has been initiated in the Middle and Upper Willapa River Valley after a hiatus of more than sixty-years.

Under my direction the first professional excavations at the Forks Creek site (45PC175) were conducted, providing the first radiocarbon dates from stratified cultural deposits in the Willapa River Valley, and the first from an alluvial river terrace site on the southern Washington Pacific Coast. The Forks Creek site excavation was the first Willapa River Valley project to document a sequence of Late Holocene occupation surfaces, the first to recover and interpret a sample of culturally significant seeds from a prairie-adjacent site, and the first to utilize fine-mesh screens to recover and describe a near-complete sample of chipped stone lithic debitage.

The Willapa project has been the first to identify microblade technology in a near-coastal watershed south of the Hoko River, suggesting the technology may be present along the entire Washington coast. I also identified and described a distinct chipped stone bifacial “rotated” scraper form, and may have been the first to identify chipped stone microlith “sideblade” technologies in the Willapa River Valley surface collections. Environmental observations, specific survey techniques, and maps that can be used to continue the process of identifying pre-contact sites in the Pacific Coast river valleys of Washington and Oregon have been provided as a result of this ongoing research.

Contributions to Pre-Contact Site Distribution Studies

The Willapa River Valley archaeological survey successfully identified prehistoric archaeological sites by utilizing geography-based survey techniques that focused on the margins of Middle and Upper alluvial terraces, the paths of extinct meandering river paleo-channels, and the margins of old ox-bow features. While the project's early Bayesian site location modeling efforts did lead to landscapes that contained important prehistoric archaeological sites, I found it was not effective for locating prehistoric archaeology on the alluvial terraces in the Willapa River Valley. The ten-meter digital elevation data (10-meter DEM) did not have sufficient resolution to differentiate between the archaeologically-rich Middle alluvial terrace treads, and the Low alluvial terrace treads that were often culturally-sterile. A future predictive model that utilizes high-resolution (two-meter or better) elevation data for discriminating between alluvial terrace levels would likely be a very powerful tool for locating archaeological sites. High-resolution "Light Detecting and Ranging" (LiDAR) elevation data does already exist for the Lower Chehalis River Valley.

The principles of prehistoric site distribution discussed by Welch (1970, 1983) in the Upper Chehalis River Valley and Boistfort Valley also generally apply to the site distribution within the Upper Willapa River Valley. The upper terraces of the Willapa River Valley have the potential to contain Early Holocene archaeological sites and artifacts, as do the Pleistocene marine terraces that form the west slope of the Willapa Hills, Long Island, and the eastern boundary of Willapa Bay. Large patinated lanceolate-form projectile points characteristic of Snake River "Cascade Phase" or north Puget Sound "Olcott" technology are part of collections from the Upper terraces of the Willapa River Valley and Boistfort Valley. Large lanceolate projectile points also appear to be present within Middle and Late Holocene age middle terrace assemblages in the Willapa and Boistfort Valleys. Many of the archaeological sites the Willapa River Valley survey identified on “middle” terrace landforms appear to be as early as 2700 years old, the earliest approximate date of the Forks Creek site (45PC175). It is possible that some of the Upper terraces of the Willapa River Valley have the potential to contain Early Holocene archaeological materials. Upper terrace landforms in the Willapa River Valley have been dated to approximately 10,000 year old (Schanz and Montgomery 2013).

Ongoing Processes of Landscape Change

A detailed interpretation of the Willapa region’s geomorphology has been provided in which I discussed the soil chemistry of anoxic bacterial driven *redox* processes within earthquake-subsided tide zone archaeological sites. I explored the potential for these diagenic processes to have occurred at much larger spatial and temporal scales when eustatic sea-level rise inundated and sealed entire organic-rich coastal estuary landscapes under the Pacific Ocean. The processes of landscape change in the Willapa region should be considered at multiple scales of observation. The prehistoric occupants of the Willapa River Valley made many of their stone tools from fossilized clams, nautiloid, and petrified wood eroding from uplifted deposits of ancient grey sea-bed silts. An understanding of the cyclical nature of the earth-moving processes responsible for these natural elements is clearly expressed in the mythology and ceremonialism of Willapa region ethnographic cultures. It is necessary to again look briefly at these orogenic processes that continue to alter the Willapa region’s landscape and archaeological sites.

The Willapa landscape has undergone significant changes through the Late Pleistocene and Holocene. The epochs-long trend of tectonic uplift, the falling and rising of eustatic sea level, fluctuations in sediment output from the Columbia River, and cyclical “sudden” coseismic subsidence and tsunami events have been the primary ongoing processes of landscape change.

The Late Pleistocene advance and retreat of glacial-ice did not directly scar the Willapa landscape, as it did in the Puget Trough, though subtle isostatic and micro-climatic changes likely occurred during the last glaciation. The trend in tectonic uplift ultimately contributed to the formation of the Willapa Hills from ancient marine terrace sediments and Crescent Formation basalts. The relatively fast rise in eustatic sea level and the resultant transgression of the Pacific Ocean that occurred in-consort with the last glacial retreat resulted in the inundation of miles of Late Pleistocene and Early Holocene Pacific coastline estuary environments, and presumably early coastal archaeological sites. Eustatic sea level movement along the southern Washington coast also resulted in the capping of massive deposits of estuary sediments by seawater, creating an organic-rich anoxic context in which microorganism-driven sulfate reduction processes have occurred over thousands of years. The sediment output of the Columbia River changed through the Late Pleistocene and Holocene in consort with significant changes in climate. The sand spit landforms of the Long Beach Peninsula and Clatsop Spit began to form from these Columbia River sediments in the Middle Holocene, and have accreted over the past four-thousand years. Middle Holocene age archaeological sites should exist in the dunes near the inland bases of these spits, while progressively younger archaeological sites should be present on, and behind, the consecutive accretionary landform dunes. Earthquake subsidence events and tsunami flooding are responsible for punctuated cyclical changes to the Willapa shoreline landscape that have occurred within readily-observable contexts of temporal scale. Holocene earthquakes may have also contributed to the formation of the alluvial terraces of the Upper and Middle Willapa River Valley. The most powerful earthquakes sank Willapa Bay shorelines occupied by multilingual communities that appear to have participated in counter-seismic dance ceremonies with distant Pacific coast trading partners prior to 1700 AD.

Contributions to Pre-Contact Resource Utilization Research

Just as Minor (1983) recognized ecological zones within the Lower Columbia River, over the course of the survey I observed three general ecological zones within the Willapa River Valley. The tidal "Lower Valley," the wide meandering "Middle Valley," and the steep and channeled "Upper Valley" each exhibited slightly different landscapes, environments, and resources.

Willapa ethnographies suggest that upland valley populations utilized Willapa Bay and coastal environments. At this point, I have identified no direct evidence of the utilization of coastal saltwater resources at Willapa River Valley archaeological sites located above the tide zone. The lack of bone and shell harpoon and fishing technology in the Middle and Upper Willapa River Valley is likely attributable to the highly acidic sediment conditions in which even siltstone cobbles dissolve into "ghost cobble" sediment stains. Completely carbonized burned bone *can* survive within the acidic sediments. It will be difficult to locate a Middle or Upper Willapa River Valley alluvial terrace prehistoric site that has intact faunal materials, bone artifacts, antler artifacts, or marine shell artifacts. All of the concentrations of oyster shell I have observed on Willapa River Valley alluvial terraces have been associated with modern or historic Euro-American occupations. Dairy farmers occasionally used oyster shells within and around their barns to mitigate mud and ammonia. Oyster shell was also used to fill-in muddy spots in terrace farm roads. I have not observed any pre-contact archaeological marine shell above the tidal Lower Willapa River Valley.

The entire Willapa River Valley is a region of lithic raw material abundance. The gravels of Willapa Bay, the Willapa River, and many of the other local watersheds, contain high-quality CCS and basalt pebbles and cobbles. In addition to the high quality CCS available from marine gravels, there was an inexhaustible supply of medium to high-quality indurated siltstone raw material available throughout the Willapa region. High quality andesitic basalt was abundantly available within the Palix and Fall River watersheds, and as cobbles and pebbles at all of the Willapa Bay graveled shoreline areas.

The chipped stone and ground stone technologies of the Willapa River Valley and Willapa Bay appear to be similar. Differences in the intensity of lithic debitage recovery between the Forks Creek site and previous regional excavations make it difficult to compare the patterns of raw material procurement and use. The Martin site (45PC7), Minard site (45GH15), Par-Tee site (35CLT20), and Palmrose site (35CLT47), were also all situated on Middle to Late Holocene coastal sand spit landforms that lack the lithic raw material rich gravels of the coastal valleys. The utilization of 1/4 inch screens at past excavations in the Willapa Bay and Lower Columbia River regions may have resulted in an unintentional failure to notice the presence of microlith technologies; they were not recovered in the field. With nearly all of the bone missing in the Willapa River Valley assemblages, it is critical that future excavations recover better samples of lithic reduction debitage and artifacts. This is particularly important when potential phase-diagnostic lithic tools are exceptionally small. The majority of obsidian recovered from future excavations at sites like Forks Creek will likely be micro-debitage smaller than 1/4 inch in size.

Ethnographic data and early 1883 GLO maps (Figure 3) indicate there were a series of open prairies within the Willapa River Valley. These prairie landscapes were likely fire-maintained horticultural “gardens” in which hazelnut, bitter cherry, and camas was tended, harvested, and propagated by Middle and Late Holocene Willapa family groups. The prairie areas would also likely have been exceptionally attractive feeding areas for elk and deer. There are clusters of prehistoric archaeological sites located in the vicinities of where the Willapa prairies once existed. The Late Holocene Forks Creek camp site was used to process floral and faunal resources from the adjacent prairie and river, and to maintain and rejuvenate chipped stone hunting and processing artifacts. While no evidence of salmon or fish bone was identified at the Forks Creek site, the microlith blade technology in the later deposits may have been associated with salmon processing (Croes and Blinman 1980). Hundreds of dead salmon from the Forks Creek Fish Hatchery were plowed into the Forks Creek site field in the 1920's and 1930's, but the excavation did not recover a single fish bone in the 1/8 inch or fine mesh water-screens.

Contributions to the Study of Archaeological Enclaves and Pacific Coast Athabaskan Cultures

I was particularly gratified to find evidence of late prehistoric cultural interaction between the Athabaskan enclave cultures of coastal California, Oregon, and southwestern Washington, through the analysis of obsidian procurement patterns, the discovery of a late prehistoric "wealth blade" obsidian biface complex, and exploration of a related pattern of trade-good "lozenge-form" blueschist ground stone clubs. As part of the Willapa project, I assembled the first sample of southern Washington coast region prehistoric obsidian artifacts to be provenienced using XRF. My analysis and interpretation of Craig Skinner's Willapa obsidian XRF studies provided new insights into Northwest Coast pre-contact aboriginal trade networks, ceremonialism, and the expressions of cultural enclaves within the archaeological record.

The Forks Creek site excavation focused on intact cultural deposits that were older than the hypothesized introduction of the Athabaskan language. Most of the large flat alluvial terraces in the Willapa River Valley have been plowed for at least a century. Plowing has disturbed shallow late prehistoric terrace contexts that date to the Athabaskan occupation. In the

Willapa River Valley there are frequently intact older occupation layers below the plow zone.

Near-shore and tide zone midden sites in the Lower Willapa River Valley, the Willapa River mouth region, and northern Willapa Bay, may be the best localities to look for minimally-disturbed Athabaskan period shallow archaeological sites. Upland spring areas and the terraces of the Willapa River side canyons could also potentially contain late prehistoric site sediments that have not been thoroughly plowed, though the vegetation and organic ground cover in these areas can make survey exceptionally difficult and slow.

Development of Cultural Phase Chronologies

There is a paucity of modern archaeological data available for the Pacific Coast of Washington. The late prehistoric Ozette site (Ames 2005; Kirk and Daugherty 2007), the Martin site (Alexander 1948; Brown 1978; Kidd 1960, 1967; Shaw 1977), the Minard site (Roll 1974) and several Late Holocene raised-beach sites in the north coast Waatch Valley (Gary Wessen, personal communication 2011) have been the only coastal and near-coastal sites to be excavated using modern archaeological techniques. The Toleak Point (Newman 1959), and White Rock Village (Guinn 1963) excavation strategies did not utilize screens and only meager chipped stone tool assemblages were recovered and described. Archaeologist have only investigated a limited sample of different types of archaeological sites on the Washington Coast; late prehistoric coastal-adjacent shell midden and occupation sites with whale hunting assemblages in the north.

There has not been sufficient consideration of the variety of different site types dispersed across the cultural landscape. A pre-contact family group could have potentially produced distinct archaeological assemblages at multiple task-specific localities within a variety of different environmental zones. This principle, coupled with the limited sample, has complicated the development of cultural phase chronologies on the Washington Coast (Abbott 1972).

The ongoing Willapa survey and the excavation at Forks Creek represent the beginning of the process leading to the development of a cultural phase chronology for the Willapa River Valley. Minor's (1983) important work in the Lower Columbia River explored a diversity of site types within several different ecological zones, and offered a preliminary four-phase progression of cultural change during the Holocene.

The "Youngs River Complex," the earliest Lower Columbia River cultural adaptation proposed by Minor (1983, 1984), was based on a seriation of surface-find collections of lanceolate and stemmed bifaces from alluvial terraces in the Youngs River region south of Astoria, Oregon. While lanceolate and stemmed projectile points with similar formal attributes to the Youngs River artifacts *were* likely used for hunting in the region during the Early Holocene, it has not been established that the artifacts and sites used to develop the hypothesized complex actually are of Early Holocene age. Lanceolate and stemmed projectile points, naturally perforated glendonite concretions, and a great variety of end-scrapers are represented at Willapa River Valley sites believed to date to the Middle and Late Holocene. When describing the variety of projectile point forms recovered from the Boistfort Valley of the Upper Chehalis River, Welch (1970:53-54) stated, "Leaf-shaped lanceolate points are the most numerous projectile points found in surface collections and in thirteen out of the fifteen private collections; they persist from the lower levels in the test pits." Daugherty's (1987a, 1987b) projects at Layser Cave and Judd Peak Rockshelters clearly illustrated the regional persistence of lanceolate projectile point technology through the Middle Holocene. The pattern of continuous use of lanceolate projectile point forms appears to extend into the near-coastal river valleys of Oregon. Nisbet's (1981) work describes the use of lanceolate biface projectile points in southwest Oregon during the Middle and Late Holocene.

Minor's (1983) Middle and Late Holocene phase hypotheses are much stronger, based on his own excavations and radiocarbon sample assays. The Seal Island Phase (4000 BC to AD 0), Ilwaco 1 Subphase (AD 0 to AD 1050), Ilwaco 2 Subphase (AD 1050 to AD 1775), and the Ethnographic Phase (AD 1775 to AD 1881) were proposed. The Seal Island Phase was dominated by wide-necked projectile point forms. In the Ilwaco 1 Subphase, wide necked projectile points were still present, but narrow necked projectile points were the dominant form. In Minor's (1983) Ilwaco 2 Subphase, wide-necked projectile points were no longer encountered, nor were single piece non-toggling harpoon heads; an artifact type present in both the hypothesized Seal Island Phase and Ilwaco 1Subphase. Composite toggling harpoons were utilized from the Seal Island Phase through the Ethnographic Phase.

Elements of the Forks Creek site (45PC175) that were preserved under the plow zone correspond with the proposed Seal Island Phase. The early Forks Creek site deposits lack narrow-necked projectile points, and fall within the temporal range of Minor's (1983) Burkhalter (45KW51) type-site. Phase-diagnostic bone-tool artifacts are rarely encountered in Willapa River Valley archaeological deposits because of the highly acidic sediments. Forks Creek site artifacts associated with the Ilwaco and Ethnographic Phase time periods were found incorporated into the plow zone. Lithic artifacts characteristic of each of Minor's (1983) phases are well represented in the Willapa surface collections (Chapter Five).

The Willapa family collections contained numerous examples of "microlith" sideblade technology, and one good example of microblade core technology. At the Forks Creek site (45PC175), several micro-core face rejuvenation flakes and a small assemblage of microblades were recovered from the later levels. This type of "microlith" technology is reminiscent of the hafted microliths from the Hoko River Wet Site 45CA213 (Croes 1995).

The 3000 to 2400 BP Hoko River site 45CA213 (Croes 1897, 1995) appears to be temporally and technologically related to Salish Sea (Gulf of Georgia) sites of the Locarno Beach culture (Mitchell 1971). While the 2700 BP Forks Creek site and the Hoko River site share similar microlith technologies (Croes 1987), the Forks Creek site is completely lacking in ground slate tools of any kind. I have never seen or located a ground slate point in the Willapa River Valley. One informant reported finding (more than 30 years ago) a smooth ground slate spear point in the east bank of the Willapa River opposite the "Mallis Landing" slough (and road) in the tidal Lower Willapa River Valley. Ground slate is rare in the region and only a few local end-ground fragments have been recovered from the Martin site (Kidd 1960) and Minard site (Roll 1974). No ground slate projectile points, sideblades, or endblades have been documented in the Willapa region. Ground slate and ground/pecked stone appear to be the dominant lithic industries at the northern Washington Pacific Coast Ozette (Ames 2005; Kirk and Daugherty 2007) and White Rock Village (Guinn 1963) sites.

Ground shell artifacts appear within Willapa Bay and Grays Harbor near coastal site assemblages, but not in the form and style of faceted ground slate projectile points and knives from the northern Washington Coast, Gulf of Georgia, and northern Northwest Coast culture areas. Ground and polished adzes/celts, also indicative of the Locarno Beach cultural adaptation, are well represented within the Willapa River Valley collections. Exceptionally poor bone preservation in the Willapa Hills and Upper Chehalis River Valley has contributed to the obfuscation of important technological elements that have been used to differentiate and interpret cultural phases in the Lower Columbia River and Salish Sea.

At the Forks Creek site (45PC175) I was not able to recognize the individual accretionary flood events in the silty loam and clay loam sediments of Stratum 1, but there were distinctly layered cultural occupation surfaces associated with "nested" hearth pit features. The fact that Willapa River Valley alluvial terrace sites have been shown to contain distinct cultural layers and occupation surfaces means that there is a potential to develop accurate cultural phase chronologies. The multiple "nested" hearth pit features at the Forks Creek site illustrate the fact that Late Holocene Willapa River Valley groups were systematically using the same localities to perform similar tasks over long periods of time. The uninterrupted concentration of artifacts and debris from the base of Stratum 1 to the surface at the Forks Creek site suggests that the landform and site area were not abandoned for extended periods after overbank flooding events. Similar patterns of site use persisted through the late Holocene.

Unfortunately, the last 1700 years of cultural deposition were mixed within the Forks Creek site plow zone. Small narrow-necked projectile points entered the Willapa artifact assemblage during the time period incorporated into the Forks Creek plow zone. The early pattern of northwest Oregon Obsidian Cliffs obsidian utilization below the Forks Creek site plow zone appears to have been abandoned in favor of southeast Oregon Glass Buttes material at some point within the late prehistoric plow zone period. The increase of Glass Buttes obsidian in the late prehistoric plow zone could potentially be associated with the onset of a Pacific Athabaskan coastal trade network.

Future Fieldwork and Research

A greater variety of sites need to be excavated to develop accurate phase chronologies in the Willapa region. More sites need to be identified on the oldest upper terrace landforms. The upper terrace landform remnants around Trap Creek, located just downstream from the Forks Creek site, are high-probability areas for early archaeological deposits. The upper terrace of the Globe Field site (45PC176, Figure 9) is also an intriguing landform. In the Middle Willapa

River Valley, the high terrace landform (Figure 5) at Stringer and Highland Creeks surrounding sites 45PC211, 45PC212, and 45PC213 (Figure 9) may also have the potential to contain Early and Middle Holocene archaeological materials. The Willapa River Valley side canyons of Ward Creek, Mill Creek, Highland Creek, Stringer Creek, Green Creek, Trap Creek, Forks Creek, Half Moon Creek, and Fern Creek have great potential for future discoveries. Upper Willapa River Valley informants have reported the presence of historic-age elk-hunting camps in the southern Willapa Hills uplands. It is possible that the reported historic upland elk-camps were developed at exiting pre-contact hunting camp localities. Locating and testing some of these remote upland camp areas is one of the future goals of the ongoing Willapa archaeological survey. The Naselle River and North River valleys have been minimally explored and hold great potential for the identification of prehistoric archaeological sites. Of the many smaller rivers feeding Willapa Bay, the Palix River exhibits a locally unique basaltic environment.

Significantly more fieldwork and analysis needs to be conducted to test and refine the trade and exchange hypotheses developed from the Willapa collections obsidian sample and the distribution of “lozenge form” blueschist stone club artifacts. More obsidian needs to be recovered and provenienced from pre-1700 AD Willapa region tide zone and shallow plow zone archaeological sites. Kroeber’s (1976:47) northwest California Yurok (Algic) informant “Lame Billy of Weitspus” related the story of the last time obsidian spoke to man. The obsidian said:

> I shall be about the world. Sometimes I shall not live in a town. Sometimes I shall live in a rich town, just one of me, or perhaps two. There will not be many towns where there are two of me; they will be few. But I shall be all over the world. This is the last time that I shall talk to men. You will keep me. I shall endure as long as human beings dance. I shall be beautiful and valuable. I shall be worth much even if I am only a little piece. I do not like to tell you where I come from. (Kroeber 1976:47)

The Willapa region “lozenge form” blueschist stone clubs still need to be tested for the presence of the mineral glaucophane. Experimentation with quantitative characterization techniques (such as XRF and principal component analysis) should be initiated for Pacific Northwest blueschist trade items. Such work could potentially lead to the quantitative characterization of natural blueschist quarry regions in the northern California Franciscan mélange, and in central and southern British Columbia, Canada. Future work in Willapa region trade and exchange studies should include an analysis of nephrite trade items using the sourcing techniques that have been developed for Fraser River nephrite core source areas (Morin 2012).

There are clearly many avenues for future fieldwork and research in the Willapa region. Investigating the archaeology of the Willapa River Valley changed our perspective of the pre-contact estuary cultures of the central and southern Northwest Coast. The Willapa project also illustrated the importance of a holistic ecological approach to archaeology that explores multiple hypotheses by drawing information from a great diversity of different disciplines and voices.

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APPENDIX A

2013-2014 Radiocarbon Analyses for the Forks Creek Site (45PC175)

by

Beta Analytic (Miami, Florida)

and

DirectAMS (Seattle, Washington)

BETA
Consistent Accuracy . . .
. . . Delivered On-time

Beta Analytic Inc.
4985 SW 74 Court
Miami, Florida 33155 USA
Tel: 305 667 5167
Fax: 305 663 0964
Beta@radiocarbon.com
www.radiocarbon.com

Darden Hood
President

Ronald Hatfield
Christopher Patrick
Deputy Directors

December 30, 2013

Lyle Nakonechny
Transect Archaeology
P.O. Box 500
Ocean Park, WA 98640
USA

RE: Radiocarbon Dating Results For Samples 0429N291E208, 0515N291E208, 0602N291E207, 0727N294E206, 0729N291E207

Dear Mr. Nakonechny:

Enclosed are the radiocarbon dating results for five samples recently sent to us. They each provided plenty of carbon for accurate measurements and all the analyses proceeded normally. The report sheet contains the dating result, method used, material type, applied pretreatment and two-sigma calendar calibration result (where applicable) for each sample.

All results (excluding some inappropriate material types) which are less than about 42,000 years BP and more than about ~250 BP include a calendar calibration page (also digitally available in Windows metafile (.wmf) format upon request). Calibration is calculated using the newest (2009) calibration database with references quoted on the bottom of the page. Multiple probability ranges may appear in some cases, due to short-term variations in the atmospheric 14C contents at certain time periods. Examining the calibration graph will help you understand this phenomenon. Don’t hesitate to contact us if you have questions about calibration.

We analyzed these samples on a sole priority basis. 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.

The cost of the analysis was charged to the MASTERCARD card provided. Thank you. As always, if you have any questions or would like to discuss the results, don’t hesitate to contact me.

Sincerely,

Darden Hood
Digital signature on file

BETA BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD

4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Lyle Nakonechny — Report Date: 12/30/2013

Transect Archaeology — Material Received: 12/12/2013

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 367370	1920 +/- 30 BP	-24.4 o/oo	1930 +/- 30 BP

SAMPLE : 0429N291E208
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 10 to 10 (Cal BP 1940 to 1940) AND Cal AD 20 to 130 (Cal BP 1930 to 1820)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 367371	2480 +/- 30 BP	-24.3 o/oo	2490 +/- 30 BP

SAMPLE : 0515N291E208
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 770 to 510 (Cal BP 2720 to 2460)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 367372	1740 +/- 30 BP	-24.1 o/oo	1750 +/- 30 BP

SAMPLE : 0602N291E207
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 230 to 380 (Cal BP 1720 to 1570)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 367373	2500 +/- 30 BP	-28.4 o/oo	2440 +/- 30 BP

SAMPLE : 0727N294E206
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 750 to 680 (Cal BP 2700 to 2630) AND Cal BC 670 to 610 (Cal BP 2620 to 2560)
Cal BC 600 to 400 (Cal BP 2550 to 2360)

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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beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Lyle Nakonechny

Report Date: 12/30/2013

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 367374	2010 +/- 30 BP	-23.5 o/oo	2030 +/- 30 BP

SAMPLE : 0729N291E207
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 110 Cal AD 30 (Cal BP 2060 to 1920) AND Cal AD 40 to 50 (Cal BP 1910 to 1900)

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.

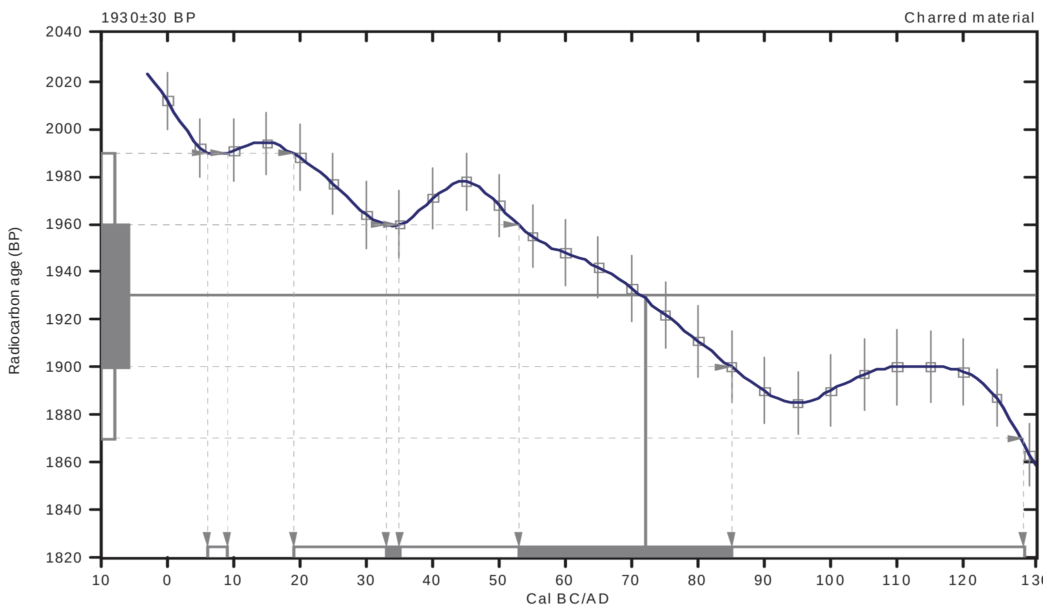
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.4:lab. mult=1)

Laboratory number:	**Beta-367370**
Conventional radiocarbon age:	**1930±30 BP**
2 Sigma calibrated results: (95% probability)	**Cal AD 10 to 10 (Cal BP 1940 to 1940) and Cal AD 20 to 130 (Cal BP 1930 to 1820)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal AD 70 (Cal BP 1880)
1 Sigma calibrated results: (68% probability)	Cal AD 30 to 40 (Cal BP 1920 to 1920) and Cal AD 50 to 80 (Cal BP 1900 to 1860)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton,et.al.,2009, Radiocarbon 51(4):1151-1164, Reimer,et.al, 2009, Radiocarbon 51(4):1111-1150, Stuiver,et.al,1993, Radiocarbon 35(1):1-244, Oeschger,et.al.,1975,Tellus 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

Beta Analytic Radiocarbon Dating Laboratory

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.3:lab. mult=1)

Laboratory number: **Beta-367371**

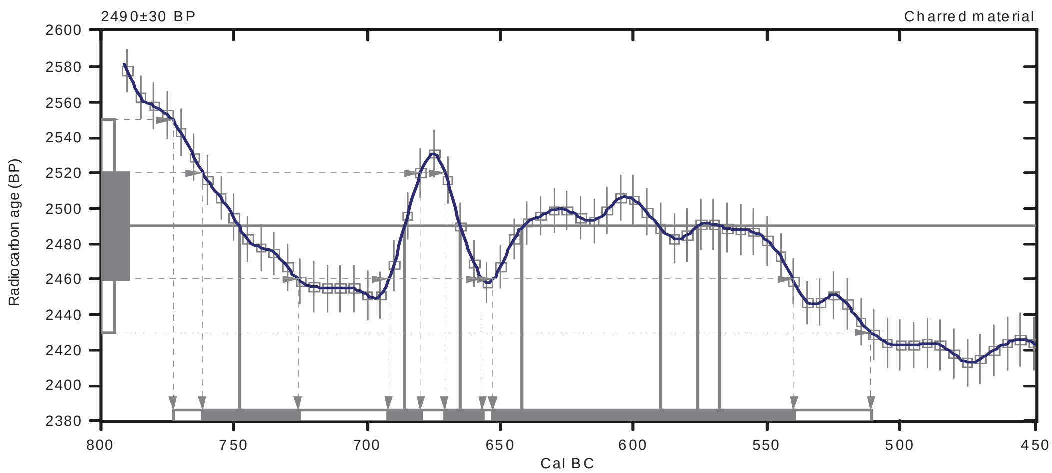
Conventional radiocarbon age: **2490±30 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 770 to 510 (Cal BP 2720 to 2460)**

Intercept data

Intercepts of radiocarbon age with calibration curve: Cal BC 750 (Cal BP 2700) and
Cal BC 690 (Cal BP 2640) and
Cal BC 660 (Cal BP 2620) and
Cal BC 640 (Cal BP 2590) and
Cal BC 590 (Cal BP 2540) and
Cal BC 580 (Cal BP 2530) and
Cal BC 570 (Cal BP 2520)

1 Sigma calibrated results: (68% probability) Cal BC 760 to 730 (Cal BP 2710 to 2680) and
Cal BC 690 to 680 (Cal BP 2640 to 2630) and
Cal BC 670 to 660 (Cal BP 2620 to 2610) and
Cal BC 650 to 540 (Cal BP 2600 to 2490)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton,et.al.,2009, Radiocarbon 51(4):1151-1164, Reimer,et.al, 2009, Radiocarbon 51(4):1111-1150, Stuiver,et.al,1993, Radiocarbon 35(1):1-244, Oeschger,et.al.,1975,Tellus 27:168-192

Mathematics used for calibration scenario

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.1:lab. mult=1)

Laboratory number: **Beta-367372**

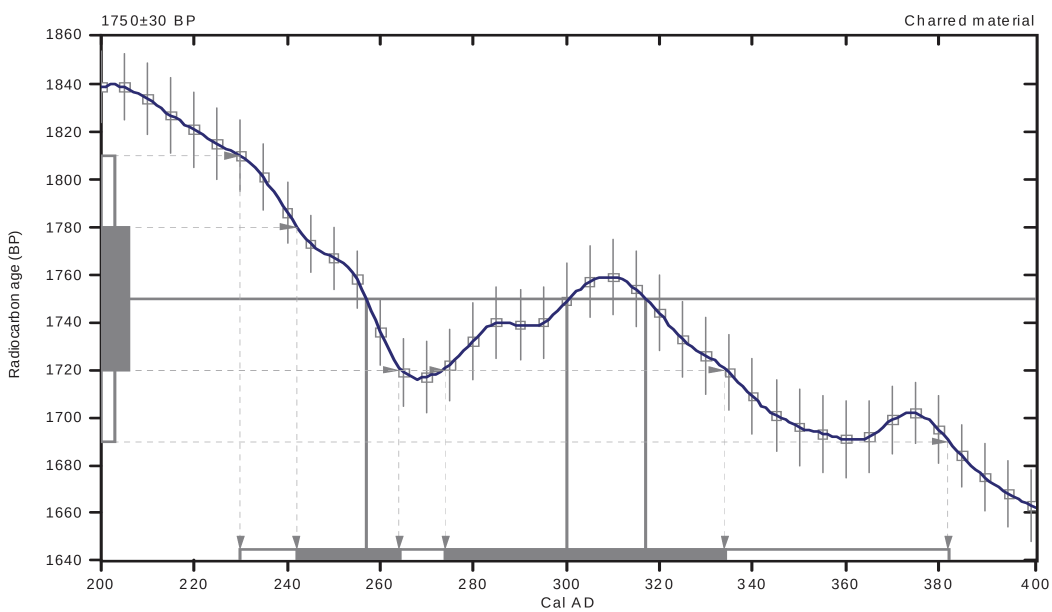
Conventional radiocarbon age: **1750±30 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 230 to 380 (Cal BP 1720 to 1570)**

Intercept data

Intercepts of radiocarbon age with calibration curve: Cal AD 260 (Cal BP 1690) and
Cal AD 300 (Cal BP 1650) and
Cal AD 320 (Cal BP 1630)

1 Sigma calibrated results: (68% probability) Cal AD 240 to 260 (Cal BP 1710 to 1690) and
Cal AD 270 to 330 (Cal BP 1680 to 1620)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton,et.al.,2009, Radiocarbon 51(4):1151-1164, Reimer,et.al, 2009, Radiocarbon 51(4):1111-1150, Stuiver,et.al,1993, Radiocarbon 35(1):1-244, Oeschger,et.al.,1975,Tellus 27:168-192

Mathematics used for calibration scenario

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Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-28.4:lab. mult=1)

Laboratory number: **Beta-367373**

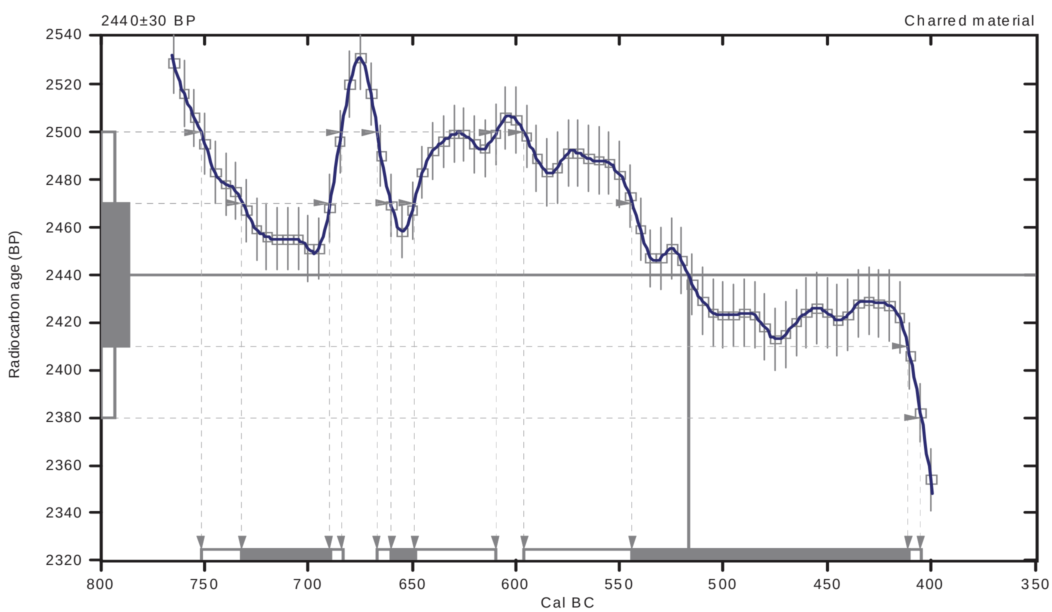
Conventional radiocarbon age: **2440±30 BP**

2 Sigma calibrated results: (95% probability) **Cal BC 750 to 680 (Cal BP 2700 to 2630) and Cal BC 670 to 610 (Cal BP 2620 to 2560) and Cal BC 600 to 400 (Cal BP 2550 to 2360)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 520 (Cal BP 2470)

1 Sigma calibrated results: (68% probability) Cal BC 730 to 690 (Cal BP 2680 to 2640) and Cal BC 660 to 650 (Cal BP 2610 to 2600) and Cal BC 540 to 410 (Cal BP 2490 to 2360)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton,et.al.,2009, Radiocarbon 51(4):1151-1164, Reimer,et.al, 2009, Radiocarbon 51(4):1111-1150, Stuiver,et.al,1993, Radiocarbon 35(1):1-244, Oeschger,et.al.,1975,Tellus 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.5:lab. mult=1)

Laboratory number: **Beta-367374**

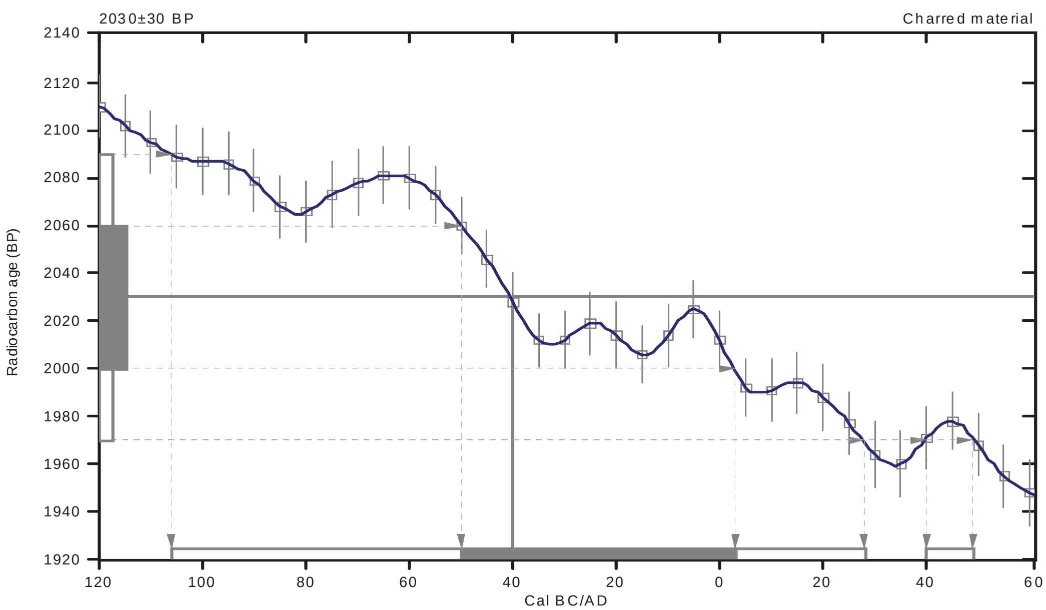
Conventional radiocarbon age: **2030±30 BP**

2 Sigma calibrated results: (95% probability) **Cal BC 110 Cal AD 30 (Cal BP 2060 to 1920) and Cal AD 40 to 50 (Cal BP 1910 to 1900)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 40 (Cal BP 1990)

1 Sigma calibrated result: (68% probability) Cal BC 50 Cal AD 0 (Cal BP 2000 to 1950)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton,et.al.,2009, Radiocarbon 51(4):1151-1164, Reimer,et.al, 2009, Radiocarbon 51(4):1111-1150, Stuiver,et.al,1993, Radiocarbon 35(1):1-244, Oeschger,et.al.,1975,Tellus 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

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Dr. Ugo Zoppi
Director, Accelerator Mass Spectrometry Lab

10 January 2014

Sarah Schanz
University of Washington
Box 351310, 4000 15th Avenue NE
ESS Department (Geology)
Seattle, WA 98195-1310

Dear Sarah,

Your samples submitted for radiocarbon dating have been processed and measured by AMS. Following results were obtained:

DirectAMS code	Submitter ID	$\delta(^{13}C)$	Fraction of modern		Radiocarbon age	
		per mil	pMC	1σ error	BP	1σ error
D-AMS 004836	293N208E	-17.8	78.25	0.25	1970	26
D-AMS 004837	294N206E	-25.5	72.49	0.28	2584	31

All results have been corrected for isotopic fractionation with $\delta^{13}C$ values measured on the prepared graphite using the AMS spectrometer. These $\delta^{13}C$ values provide the most accurate radiocarbon ages but cannot be used to investigate environmental conditions.

Best regards,

Ugo Zoppi

550 17th Avenue, Suite 550, Seattle WA 98122
Tel (206) 258-8857 – Fax (206) 281-5916 – www.directAMS.net

APPENDIX B

The Forks Creek Site (45PC175) Database

and database code descriptions for

Willapa River Valley Raw Material Types

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
000001	294	206	1		6/7/2013	20	294.75	206.13	1	1	5c	1	03-03	8.53	49	18.2	7.9		Scraper
000002	294	206	1		6/7/2013				1	1	5c	1	03-01	2.93	21.1	22.6	6.2		Scraper
000003	294	206	1		6/7/2013				1	1	5c	1	07						Edge modified flake
000004	294	206	1		6/7/2013				1	3	5c	1	07						Edge modified flake
000005	294	206	1		6/7/2013				1	6	5f	1	06-01	26.14	55	38.3	22.9		Core
000006	294	206	1		6/7/2013				1	6	5c	1	03-01	2.35	25.2	16.2	4.3		Scraper
000007	294	206	1		6/7/2013				1	6	4e	1	07	25.25					
000008	294	206	1		6/7/2013				1	6	4f	3	07	7.44					
000009	294	206	1		6/7/2013				2	1	4f	3	07	1.1					
000010	294	206	1		6/7/2013				2	2	4e	2	07	0.75					
000011	294	206	1		6/7/2013				2	2	4e	1	07	0.19					
000012	294	206	1		6/7/2013				2	2	4f	1	07	0.12					
000013	294	206	1		6/7/2013				2	5	4f	1	07	0.14					
000014	294	206	1		6/7/2013				2	5	4g	1	07	1.27					
000015	294	206	1		6/7/2013				2	6	4e	7	07	2.68					
000016	294	206	1		6/7/2013				2	6	4f	8	07	2.67					
000017	294	206	1		6/7/2013				2	6	4g	7	07	6.29					
000018	294	206	1		6/7/2013				2	7	4e	1	07	0.22					
000019	294	206	1		6/7/2013				3	2	4f	1	07	0.08					
000020	294	206	1		6/7/2013				3	1	4e	3	07	0.17					
000021	294	206	1		6/7/2013				3	1	4f	2	07	0.11					
000022	294	206	1		6/7/2013				3	5	4e	1	07	0.05					
000022	294	207	1		6/22/2013				1	1	5c	1	07	4.62					Edge modified flake
000023	294	206	1		6/7/2013				3	5	4g	2	07	0.29					
000024	294	206	1		6/7/2013				3	6	4f	10	07	0.84					
000025	294	206	1		6/7/2013				3	6	4g	4	07	0.86					
000026	294	206	1		6/7/2013				4	1	4e	1	07	0.02					
000027	294	206	1		6/7/2013				4	5	4e	1	07	0.02					
000028	294	206	1		6/7/2013				4	6	4f	1	07	0.01					
000029	294	206	1		6/7/2013				4	6	4g	1	07	0.01					
000030	294	206	3		6/15/2013				1	1	4e	1	07	1.6					
000031	294	206	3		6/15/2013				1	2	4e	1	07	7.02					
000032	294	206	3		6/15/2013				1	2	5b	1	02-01a	11.54	34.8*	26.4	10.9		Biface midsection fragment
000033	294	206	3		6/15/2013				1	6	4e	1	07	1.46					
000034	294	206	3		6/15/2013				1	6	4f	1	07	2.14					
000035	294	206	3		6/15/2013				1	seed	seed	1	seed	0.56	14	12.6	11.7		Hazelnut
000036	294	206	3		6/15/2013				2	1	4f	1	07	0.09					
000037	294	206	3		6/15/2013				2	1	4g	1	07	0.52					
000038	294	206	3		6/15/2013				2	2	4f	1	07	0.18					
000039	294	206	3		6/15/2013				2	5	4e	1	07	0.2					
000040	294	206	3		6/15/2013				2	5	4f	3	07	1.02					
000041	294	206	3		6/15/2013				2	6	4e	3	07	0.58					
000042	294	206	3		6/15/2013				2	6	4f	6	07	1.96					
000043	294	206	3		6/15/2013				2	6	4g	6	07	3.49					
000044	294	206	3		6/15/2013				3	1	4e	2	07	0.1					
000045	294	206	3		6/15/2013				3	1	4f	2	07	0.08					
000046	294	206	3		6/15/2013				3	2	4f	1	07	0.01					
000047	294	206	3		6/15/2013				3	5	4f	2	07	0.11					
000048	294	206	3		6/15/2013				3	6	4e	1	07	0.06					
000049	294	206	3		6/15/2013				3	6	4f	8	07	0.52					
000050	294	206	3		6/15/2013				4	5	4e	1	07	0.01					
000051	294	206	3		6/15/2013				4	6	4f	1	07	0.01					
000052	294	206	4		6/15/2013				1	6	4f	2	07	35.75					
000053	294	206	4		6/15/2013				1	6	4g	1	07	4.94					
000054	294	206	4		6/15/2013				2	6	4e	1	07	1.84					
000055	294	206	4		6/15/2013				3	6	4f	1	07	0.06					
000056	294	206	5		6/16/2013				1	3	4e	1	07	5.08					
000056	294	206	5		6/16/2013				1	5	4g	1	07	2.66					
000057	294	206	5		6/16/2013				2	2	4e	1	07	0.64					
000058	294	206	5		6/16/2013				2	5	4g	2	07	2.93					
000059	294	206	5		6/16/2013				2	6	4f	4	07	1.07					
000060	294	206	5		6/16/2013				2	6	4g	1	07	0.84					
000061	294	206	5		6/16/2013				3	6	4f	1	07	0.03					
000062	294	206	6		6/16/2013				1	2	4e	1	07	2.6					
000063	294	206	6		6/16/2013				1	6	4e	2	07	27.58					
000064	294	206	6		6/16/2013				1	6	4f	1	07	1					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
000065	294	206	6		6/16/2013				1	6	4g	1	07	4.86					
000066	294	206	6		6/16/2013				2	5	4f	1	07	0.27					
000067	294	206	6		6/16/2013				2	6	4e	2	07	1.05					
000068	294	206	6		6/16/2013				2	6	4f	2	07	1.08					
000069	294	206	6		6/16/2013				2	6	4g	1	07	2.67					
000070	294	206	6		6/16/2013				3	5	4f	1	07	0.01					
000071	294	206	6		6/16/2013				3	6	4f	1	07	0.22					
000072	294	206	6		6/16/2013				3	seed	seed	1	seed	0.03					Bitter cherry
000073	294	206	7		6/17/2013				2	2	4f	1	07	0.24					
000074	294	206	7		6/17/2013				2	5	4f	1	07	0.64					
000075	294	206	7		6/17/2013				2	5	5c	1	07	0.55	12.9	12.8	3		Edge modified flake
000076	294	206	7		6/17/2013				2	6	4e	1	07	0.3					
000077	294	206	7		6/17/2013				2	6	4f	5	07	2.15					
000078	294	206	7		6/17/2013				2	6	4g	1	07	2.56					
000079	294	206	7		6/17/2013				3	5	4g	1	07	0.26					
000080	294	206	7		6/17/2013				3	6	4f	2	07	0.24					
000081	294	206	7		6/17/2013				4	5	4e	1	07	0.01					
000082	294	206	8		6/17/2013				1	1	5c	1	03-01	7.46	37.9	24.8	7.3		Scraper
000083	294	206	8		6/17/2013				1	6	4e	1	07	3.37					
000084	294	206	8		6/17/2013				2	5	4g	1	07	1.27					
000085	294	206	8		6/18/2013				2	1	4f	1	07	0.35					
000086	294	206	8		6/17/2013				2	6	4e	2	07	1.25					
000087	294	206	8		6/17/2013				2	6	4f	9	07	2.35					
000088	294	206	8		6/17/2013				2	6	4g	4	07	1.89					
000089	294	206	8		6/17/2013				3	6	4f	2	07	0.13					
000090	294	206	8		6/17/2013				1	6	0	1	08-01	>200*	134.5	77.6	63.9		Hammerstone
000091	294	206	9		6/18/2013				1	6	4e	1	07	0.85					
000092	294	206	9		6/18/2013				1	6	4f	2	07	4.02					
000093	294	206	9		6/18/2013				1	6	4g	2	07	4.33					
000094	294	206	9		6/18/2013				2	1	5c	1	03-02	0.3	15.7	7.8*	2		Scraper fragment
000095	294	206	9		6/18/2013				2	6	4e	4	07	1.88					
000096	294	206	9		6/18/2013				2	6	4f	1	07	0.12					
000097	294	206	9		6/18/2013				2	6	4g	2	07	2.02					
000098	294	206	9		6/18/2013				3	6	4e	1	07	0.03					
000099	294	206	9		6/18/2013				3	6	4f	2	07	0.24					
000100	294	206	9		6/18/2013				3	seed	seed	2	seed	0.04					Bitter cherry
000101	294	206	10		6/18/2013				1	1	4f	1	07	3.31					
000102	294	206	10		6/18/2013				1	3	5c	1	07	1.45	24.2	15.6	4.5		Edge modified flake
000103	294	206	10		6/18/2013				1	5	4f	1	07	1.24					
000104	294	206	10		6/18/2013				1	6	4e	1	07	3.68					
000105	294	206	10		6/18/2013				1	6	4f	1	07	1.3					
000106	294	206	10		6/18/2013				2	1	4f	1	07	0.24					
000107	294	206	10		6/18/2013				2	2	4e	1	07	0.39					
000108	294	206	10		6/18/2013				2	5	4f	1	07	0.18					
000109	294	206	10		6/18/2013				2	6	4e	2	07	1.3					
000110	294	206	10		6/18/2013				2	6	4f	1	07	0.41					
000111	294	206	10		6/18/2013				2	6	4g	2	07	1.38					
000112	294	206	10		6/18/2013				3	5	4g	1	07	0.03					
000113	294	206	10		6/18/2013				3	6	4e	2	07	0.16					
000114	294	206	10		6/18/2013				3	6	4g	2	07	0.16					
000115	294	206	11		6/19/2013				1	6	4e	2	07	9.54					
000116	294	206	11		6/19/2013				1	6	5c	1	07	2.39	27.8	3.6	3.5		Edge modified flake
000117	294	206	11		6/19/2013				1	6	5f	1	06-01	72.57	59.1	45.3	27.2		Core
000118	294	206	11		6/19/2013				2	5	4f	1	07	0.19					
000119	294	206	11		6/19/2013				2	6	4e	4	07	3.06					
000120	294	206	11		6/19/2013				2	6	4f	4	07	1.57					
000121	294	206	11		6/19/2013				2	organic	organic	3	organic	1.08					Organic limb
000122	294	206	11		6/19/2013				3	2	4f	1	07	0.06					
000123	294	206	11		6/19/2013				3	5	4g	1	07	0.24					
000124	294	206	11		6/19/2013				3	6	4f	2	07	0.23					
000125	294	206	12		6/19/2013	124	294.98	206.02	1	5	5c	1	03-01	7.97	26	34.6	11.6		Scraper
000126	294	206	12		6/19/2013	125	294.37	206.99	1	5	5b	1	02-01	2.74	24.1	23.7*	7.1		Biface midsection fragment
000127	294	206	12		6/19/2013				1	6	0	1	09-01	52.54	89.7	52.1	8.8		Edge-burnished flatstone
000128	294	206	12		6/19/2013				1	6	4g	1	07	2.65					
000129	294	206	12		6/19/2013				2	4	4e	1	07	0.1					
000130	294	206	12		6/19/2013				2	5	4g	1	07	1.15					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
000131	294	206	12		6/19/2013				2	6	4e	2	07	1.01					
000132	294	206	12		6/19/2013				2	6	4f	4	07	0.84					
000133	294	206	12		6/19/2013				3	2	4e	2	07	0.06					
000134	294	206	12		6/19/2013				3	2	4g	1	07	0.09					
000135	294	206	12		6/19/2013				3	5	4e	2	07	0.21					
000136	294	206	12		6/19/2013				3	5	4g	1	07	0.05					
000137	294	206	12		6/19/2013				3	6	4e	2	07	0.14					
000138	294	206	12		6/19/2013				3	6	4f	2	07	0.12					
000139	294	206	13		6/20/2013				1	1	4e	1	07	1.77					
000140	294	206	13		6/20/2013				1	6	4e	1	07	17.11					
000141	294	206	13		6/20/2013				1	6	4g	1	07	4.31					
000142	294	206	13		6/20/2013				2	1	4f	3	07	0.48					
000143	294	206	13		6/20/2013				2	2	4f	1	07	0.32					
000144	294	206	13		6/20/2013				2	6	4e	2	07	0.36					
000145	294	206	13		6/20/2013				2	6	4f	4	07	0.81					
000146	294	206	13		6/20/2013				2	6	4g	1	07	0.43					
000147	294	206	13		6/20/2013				3	6	4e	1	07	0.13					
000148	294	206	13		6/20/2013				3	6	4g	1	07	0.1					
000149	294	206	14		6/20/2013				1	6	4e	2	07	2.37					
000150	294	206	14		6/20/2013				1	6	4f	2	07	1.44					
000151	294	206	14		6/20/2013				1	6	4g	2	07	6.31					
000152	294	206	14		6/20/2013				2	1	4e	2	07	1.11					
000153	294	206	14		6/20/2013				2	1	4f	2	07	0.63					
000154	294	206	14		6/20/2013				2	3	4e	1	07	0.94					
000155	294	206	14		6/20/2013				2	5	4e	1	07	0.48					
000156	294	206	14		6/20/2013				2	5	4f	1	07	0.95					
000157	294	206	14		6/20/2013				2	6	4e	2	07	0.37					
000158	294	206	14		6/20/2013				2	6	4f	8	07	1.72					
000159	294	206	14		6/20/2013				2	6	4g	2	07	0.62					
000160	294	206	14		6/20/2013				3	1	4e	1	07	0.03					
000161	294	206	14		6/20/2013				3	1	4g	1	07	0.07					
000162	294	206	14		6/20/2013				3	5	4f	1	07	0.12					
000163	294	206	14		6/20/2013				3	5	4g	1	07	0.31					
000164	294	206	14		6/20/2013				3	6	4f	7	07	0.39					
000165	294	206	14		6/20/2013				3	6	4g	2	07	0.03					
000166	294	206	14		6/20/2013				4	6	4f	2	07	0.01					
000167	294	206	15		7/26/2013				1	6	4g	1	07	10.76					
000168	294	206	15		7/26/2013				1	bone	bone	1	bone	1.62					Carbonized bone
000169	294	206	15		7/26/2013				2	1	4f	1	07	0.59					
000170	294	206	15		7/26/2013				2	2	5c	1	07	1.12					Edge modified flake
000171	294	206	15		7/26/2013				2	5	4e	1	07	0.24					
000172	294	206	15		7/26/2013				2	5	5b	1	02-01	0.7	17.2*	8.6*	5.6*		Biface midsection fragment
000173	294	206	15		7/26/2013				2	6	4e	3	07	1.39					
000174	294	206	15		7/26/2013				2	6	4f	4	07	3.44					
000175	294	206	15		7/26/2013				3	5	4f	1	07	0.06					
000176	294	206	15		7/26/2013				3	6	4e	2	07	0.16					
000177	294	206	15		7/26/2013				3	6	4f	2	07	0.14					
000178	294	206	15		7/26/2013				3	6	4g	1	07	0.18					
000179	294	206	15		7/26/2013				4	1	4g	1	07	0.01					
000180	294	206	16		7/26/2013				1	1	4g	1	07	1.53					
000181	294	206	16		7/26/2013				1	6	4e	1	07	2.31					
000182	294	206	16		7/26/2013				2	1	4g	1	07	0.83					
000183	294	206	16		7/26/2013	162	294.63	206.38	2	1	5c	1	03-07	2.03	24.3*	12.4*	6.5		Scraper fragment
000184	294	206	16		7/26/2013	160	294.95	206.98	2	2	5b	1	02-01	2.25	11.8*	11.6*	8.1		Biface base fragment
000185	294	206	16		7/26/2013				2	5	4f	2	07	0.27					
000186	294	206	16		7/26/2013				2	5	5c	1	07	1.07					Edge modified flake
000187	294	206	16		7/26/2013				2	6	4e	4	07	1.59					
000188	294	206	16		7/26/2013				2	6	4f	8	07	2.96					
000189	294	206	16		7/26/2013				2	6	4g	1	07	1.06					
000190	294	206	16		7/26/2013				2	7	4e	1	07	0.91					
000191	294	206	16		7/26/2013				3	1	4e	1	07	0.09					
000192	294	206	16		7/26/2013				3	seed	seed	1	seed	0.02					Cascara
000193	294	206	17		7/27/2013				1	1	4e	1	07	4.45					
000194	294	206	17		7/27/2013				1	6	4e	1	07	1.74					
000195	294	206	17		7/27/2013				1	6	4f	1	07	5.23					
000196	294	206	17		7/27/2013				1	0	bone	1	bone	2.03					Burned bone

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
000197	294	206	17		7/27/2013				2	1	5c	1	07	1.39					Edge modified flake
000198	294	206	17		7/27/2013				2	2	4f	1	07	0.3					
000199	294	206	17		7/27/2013				2	6	4e	4	07	0.93					
000200	294	206	17		7/27/2013				2	6	4f	8	07	1.62					
000201	294	206	17		7/27/2013				2	6	4g	2	07	0.7					
000202	294	206	17		7/27/2013				3	5	4f	2	07	0.19					
000203	294	206	17		7/27/2013				3	6	4f	7	07	0.5					
000204	294	206	18		7/27/2013				1	2	4g	1	07	5.66					
000205	294	206	18		7/27/2013				1	6	4f	1	07	3.52					
000206	294	206	18		7/27/2013				1	0	5f	1	06-01	47.7	58	51.2	29.2		Metamorphic stone
000207	294	206	18		7/27/2013				2	1	4e	1	07	1.09					
000208	294	206	18		7/27/2013				2	1	4f	1	07	0.17					
000209	294	206	18		7/27/2013				2	5	4e	2	07	0.82					
000210	294	206	18		7/27/2013				2	6	4e	4	07	1.53					
000211	294	206	18		7/27/2013				2	6	4f	3	07	1.75					
000212	294	206	18		7/27/2013				2	organic	organic	1	organic	0.4					Stick, limb
000213	294	206	18		7/27/2013				3	1	4f	2	07	0.1					
000214	294	206	18		7/27/2013				3	2	4f	1	07	0.06					
000215	294	206	18		7/27/2013				3	6	4e	1	07	0.08					
000216	294	206	18		7/27/2013				3	6	4f	3	07	0.17					
000217	294	206	18		7/27/2013				3	organic	organic	1	organic	0.19					Root cast
000218	294	206	18		7/27/2013				4	1	4g	1	07	0.06					
000219	294	206	18		7/28/2013				2	6	4e	1	07	1.84					
000220	294	206	18		7/28/2013				3	2	4f	1	07	0.14					
000221	294	207	1		6/22/2013				1	1	4e	1	07	9.56					
000223	294	207	1		6/22/2013				1	2	4e	1	07	1.12					
000224	294	207	1		6/22/2013				1	2	4f	1	07	1.94					
000225	294	207	1		6/22/2013				1	3	4f	1	07	2.4					
000226	294	207	1		6/22/2013				1	6	4f	1	07	4.47					
000227	294	207	1		6/22/2013				1	6	0	1	08-01	71.41	51.9*	42.4	32.4		Hammerstone
000228	294	207	1		6/22/2013				1	7	4e	1	07	4.94					
000229	294	207	1		6/22/2013				2	1	4e	1	07	0.18					
000230	294	207	1		6/22/2013				2	1	5a	1	01-09	0.65	13.4*	16.4	2.9	4.5	Projectile point base fragment
000231	294	207	1		6/22/2013				2	2	4f	3	07	0.42					
000232	294	207	1		6/22/2013				2	2	4g	2	07	0.91					
000233	294	207	1		6/22/2013				2	5	4e	1	07	0.43					
000234	294	207	1		6/22/2013				2	5	4f	1	07	0.28					
000235	294	207	1		6/22/2013				2	5	5c	2	07	1.23					Edge modified flake
000236	294	207	1		6/22/2013				2	6	4e	3	07	0.91					
000237	294	207	1		6/22/2013				2	6	4f	15	07	4.41					
000238	294	207	1		6/22/2013				2	6	4g	6	07	2.61					
000239	294	207	1		6/22/2013				2	7	4g	1	07	0.72					
000240	294	207	1		6/22/2013				2	11	4g	1	07	0.39					Quartz crystal fragment
000241	294	207	1		6/22/2013				3	1	4e	3	07	0.07					
000242	294	207	1		6/22/2013				3	1	4f	7	07	0.33					
000243	294	207	1		6/22/2013				3	1	5c	1	07	0.21					Edge modified flake
000244	294	207	1		6/22/2013				3	2	4f	1	07	0.11					
000245	294	207	1		6/22/2013				3	5	4e	3	07	0.18					
000246	294	207	1		6/22/2013				3	5	4f	1	07	0.07					
000247	294	207	1		6/22/2013				3	5	4g	1	07	0.01					
000248	294	207	1		6/22/2013				3	6	4e	3	07	0.2					
000249	294	207	1		6/22/2013				3	6	4f	15	07	1.15					
000250	294	207	1		6/22/2013				3	6	4g	5	07	0.35					
000251	294	207	1		6/22/2013				3	seed	seed	1	seed	0.04					Bitter cherry
000252	294	207	1		6/22/2013				3	0	beetle	1	organic	0.01					Beetle abdomen
000253	294	207	1		6/22/2013				4	5	4f	1	07	0.01					
000254	294	207	1		6/22/2013				4	6	4f	5	07	0.03					
000255	294	207	3		6/23/2013				1	5	5c	1	03-18	2.83	31.6	18.5	3.5		Scraper, flake
000256	294	207	3		6/23/2013				1	6	4e	3	07	23.55					
000257	294	207	3		6/23/2013				1	6	5b	1	02-01	2.11	26.7*	35.1	6		Biface base fragment
000258	294	207	3		6/23/2013				1	6	0	1	08-01	>200	83.7	49.7	35.1		Hammerstone
000259	294	207	3		6/23/2013				2	1	4e	4	07	1.69					
000260	294	207	3		6/23/2013				2	1	4g	2	07	1.28					
000261	294	207	3		6/23/2013				2	3	4f	1	07	0.69					
000262	294	207	3		6/23/2013				2	5	5c	2	07	1.5					Edge modified flake
000263	294	207	3		6/23/2013				2	6	4e	3	07	1.35					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
000264	294	207	3		6/23/2013				2	6	4f	10	07	5.49					
000265	294	207	3		6/23/2013				2	2	4e	1	07	0.77					
000266	294	207	3		6/23/2013				2	7	4g	1	07	0.67					
000267	294	207	3		6/23/2013				3	1	4e	4	07	0.42					
000268	294	207	3		6/23/2013				3	1	4f	1	07	0.01					
000269	294	207	3		6/23/2013				3	1	4g	3	07	0.56					
000270	294	207	3		6/23/2013				3	2	4e	3	07	0.13					
000271	294	207	3		6/23/2013				3	2	4f	3	07	0.37					
000272	294	207	3		6/23/2013				3	5	4f	3	07	0.24					
000273	294	207	3		6/23/2013				3	6	4e	5	07	0.35					
000274	294	207	3		6/23/2013				3	6	4f	30	07	2.61					
000275	294	207	3		6/23/2013				3	6	4g	10	07	1.34					
000276	294	207	3		6/23/2013				3	seed	seed	1	seed	0.01					Bitter cherry
000277	294	207	3		6/23/2013				4	1	4e	2	07	0.02					
000278	294	207	3		6/23/2013				4	5	4g	1	07	0.03					
000279	294	207	3		6/23/2013				4	6	4f	4	07	0.1					
000280	294	207	3		6/23/2013				4	6	4g	2	07	0.05					
000281	294	207	3		6/23/2013				4	seed	seed	1	seed	0.01					Unidentified
000282	294	207	4		7/9/2013				1	6	4e	3	07	21.23					
000283	294	207	4		7/9/2013				1	6	4f	3	07	6					
000284	294	207	4		7/9/2013				1	bone?	bone	1	bone	0.97					Burned bone?
000285	294	207	4		7/9/2013				2	1	4e	1	07	0.15					
000286	294	207	4		7/9/2013				2	5	4f	2	07	0.57					
000287	294	207	4		7/9/2013				2	6	4e	3	07	0.66					
000288	294	207	4		7/9/2013				2	6	4f	5	07	1.09					
000289	294	207	4		7/9/2013				2	6	4g	1	07	0.36					
000290	294	207	4		7/9/2013				3	1	4e	2	07	0.19					
000291	294	207	4		7/9/2013				3	1	4f	1	07	0.04					
000292	294	207	4		7/9/2013				3	5	4e	1	07	0.07					
000293	294	207	4		7/9/2013				3	5	4f	1	07	0.07					
000294	294	207	4		7/9/2013				3	5	4g	1	07	0.09					
000295	294	207	4		7/9/2013				3	6	4e	1	07	0.06					
000296	294	207	4		7/9/2013				3	6	4f	3	07	0.45					
000297	294	207	4		7/9/2013				3	seed	seed	1	seed	0.02					Bitter cherry
000298	294	207	4		7/9/2013				4	6	4g	1	07	0.01					
000299	294	207	5		7/11/2013				1	3	5c	1	03-18	3.92	31	20	5.9		Scraper, flake
000300	294	207	5		7/11/2013				1	6	4e	1	07	2.56					
000301	294	207	5		7/11/2013				1	6	4f	2	07	4.96					
000302	294	207	5		7/11/2013				1	6	4g	1	07	2.24					
000303	294	207	5		7/11/2013				2	2	4e	1	07	0.19					
000304	294	207	5		7/11/2013				2	2	4g	1	07	0.93					
000305	294	207	5		7/11/2013				2	5	4e	1	07	0.29					
000306	294	207	5		7/11/2013				2	5	4f	2	07	2.68					
000307	294	207	5		7/11/2013				2	6	4e	7	07	2.51					
000308	294	207	5		7/11/2013				2	6	4f	5	07	2.92					
000309	294	207	5		7/11/2013				2	6	4g	2	07	1.64					
000310	294	207	5		7/11/2013				3	1	4e	1	07	0.08					
000311	294	207	5		7/11/2013				3	2	4e	1	07	0.06					
000312	294	207	5		7/11/2013				3	5	4e	1	07	0.03					
000313	294	207	5		7/11/2013				3	6	4e	1	07	0.09					
000314	294	207	5		7/11/2013				3	6	4f	6	07	0.27					
000315	294	207	5		7/11/2013				3	6	4g	2	07	0.37					
000316	294	207	5		7/11/2013				3	seed	seed	2	seed	0.05					Bitter cherry
000317	294	207	6		7/11/2013	64	294.65	207.56	1	1	5f	1	06-01	38.27	45.6	40.2	20.5		Core
000318	294	207	6		7/11/2013				1	1	5f	1	06-02	4.52	23.2	31.6	6.8		Micro core
000319	294	207	6		7/11/2013				1	6	4e	5	07	29.8					
000320	294	207	6		7/11/2013				1	6	4f	1	07	1.19					
000321	294	207	6		7/11/2013				2	1	4e	2	07	1.65					
000322	294	207	6		7/11/2013				2	2	4f	1	07	0.22					
000323	294	207	6		7/11/2013				2	6	4e	3	07	0.94					
000324	294	207	6		7/11/2013				2	6	4f	8	07	2.89					
000325	294	207	6		7/11/2013				2	6	4g	6	07	7.06					
000326	294	207	6		7/11/2013				2	6	5c	1	03-19	2.54	28	16.5	6.2		Scraper, blade
000327	294	207	6		7/11/2013				3	1	4e	1	07	0.03					
000328	294	207	6		7/11/2013				3	1	4f	1	07	0.03					
000329	294	207	6		7/11/2013				3	5	4f	1	07	0.02					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
000330	294	207	6		7/11/2013				3	5	4f	1	07	0.04					
000331	294	207	6		7/11/2013				3	6	4e	2	07	0.07					
000332	294	207	6		7/11/2013				3	6	4f	8	07	0.86					
000333	294	207	6		7/11/2013				3	bone?	bone?	1	bone?	0.06					Burned bone?
000334	294	207	6		7/11/2013				4	5	4f	1	07	0.01					
000335	294	207	7		7/13/2013				1	1	4g	1	07	4.38					
000336	294	207	7		7/13/2013				1	2	4e	1	07	1.33					
000337	294	207	7		7/13/2013	73	294.11	207.27	1	3	5c	1	03-18	2.79	27.5	20.1	5.1		Scraper, flake
000338	294	207	7		7/13/2013				1	6	4e	1	07	1					
000339	294	207	7		7/13/2013				1	6	4f	1	07	1.38					
000340	294	207	7		7/13/2013				2	2	4f	1	07	0.3					
000341	294	207	7		7/13/2013				2	5	4e	1	07	0.11					
000342	294	207	7		7/13/2013				2	6	4e	2	07	1.7					
000343	294	207	7		7/13/2013				2	6	4f	2	07	0.55					
000344	294	207	7		7/13/2013				2	6	4g	4	07	3.22					
000345	294	207	7		7/13/2013				3	1	4e	3	07	0.19					
000346	294	207	7		7/13/2013				3	2	4e	1	07	0.11					
000347	294	207	7		7/13/2013				3	2	4g	1	07	0.06					
000348	294	207	7		7/13/2013				3	1	4e	1	07	0.08					Odd ccs material
000349	294	207	7		7/13/2013				3	6	4f	3	07	0.29					
000350	294	207	7		7/13/2013				3	seed	seed	3	seed	0.08					Bitter cherry
000351	294	207	8		7/15/2013				1	2	4e	1	07	1.96					
000352	294	207	8		7/15/2013				1	2	4f	1	07	0.6					
000353	294	207	8		7/15/2013				1	6	4e	1	07	1.11					
000354	294	207	8		7/15/2013				1	6	4f	1	07	5.9					
000355	294	207	8		7/15/2013				1	6	4g	1	07	5.72					
000356	294	207	8		7/15/2013				2	1	4f	1	07	0.32					
000357	294	207	8		7/15/2013				2	4	4f	1	07	0.14					
000358	294	207	8		7/15/2013				2	5	4f	1	07	0.39					
000359	294	207	8		7/15/2013				2	6	4e	1	07	0.54					
000360	294	207	8		7/15/2013				2	6	4f	4	07	1.45					
000361	294	207	8		7/15/2013				2	7	4e	1	07	0.18					
000362	294	207	8		7/15/2013				3	1	4e	1	07	0.05					
000363	294	207	8		7/15/2013				3	1	4f	2	07	0.09					
000364	294	207	8		7/15/2013				3	6	4f	2	07	0.11					
000365	294	207	8		7/15/2013				4	2	4e	1	07	0.01					
000366	294	207	8		7/15/2013				4	6	4f	1	07	0.02					
000367	294	207	9		7/15/2013	91	294.23	207.19	1	2	5b	1	02-01a	3.04	19.3*	22.4	5.4		Biface midsection fragment
000368	294	207	9		7/15/2013				1	2	4e	1	07	6.15					
000369	294	207	9		7/15/2013				1	6	4g	1	07	2.21					
000370	294	207	9		7/15/2013				2	2	4e	1	07	0.71					
000371	294	207	9		7/15/2013				2	5	4f	1	07	1.17					
000372	294	207	9		7/15/2013				2	6	4e	4	07	0.67					
000373	294	207	9		7/15/2013				2	6	4f	9	07	4.71					
000374	294	207	9		7/15/2013				2	6	4g	3	07	1.26					
000375	294	207	9		7/15/2013				3	1	4e	1	07	0.04					
000376	294	207	9		7/15/2013				3	1	4f	1	07	0.03					
000377	294	207	9		7/15/2013				3	5	4e	1	07	0.1					
000378	294	207	9		7/15/2013				3	5	4f	2	07	0.19					
000379	294	207	9		7/15/2013				3	6	4e	2	07	0.16					
000380	294	207	9		7/15/2013				3	6	4f	2	07	0.23					
000381	294	207	10		7/16/2013				1	1	5d	1	07	1.62	20.6	16.7	4.2		Edge modified flake
000382	294	207	10		7/16/2013				1	3	5f	1	06-01	10.48	29.1	18.5	16.1		Core
000383	294	207	10		7/16/2013				1	6	4f	1	07	1.1					
000384	294	207	10		7/16/2013				2	1	4e	1	07	0.14					
000385	294	207	10		7/16/2013				2	1	4f	1	07	0.11					
000386	294	207	10		7/16/2013				2	1	4g	3	07	3.51					
000387	294	207	10		7/16/2013				2	2	4g	1	07	0.57					
000388	294	207	10		7/16/2013				2	5	4e	2	07	0.95					
000389	294	207	10		7/16/2013				2	5	4f	1	07	0.21					
000390	294	207	10		7/16/2013				2	6	4e	1	07	0.18					
000391	294	207	10		7/16/2013				2	6	4f	3	07	0.72					
000392	294	207	10		7/16/2013				2	6	4g	2	07	1.06					
000393	294	207	10		7/16/2013				3	1	4e	1	07	0.03					
000394	294	207	10		7/16/2013				3	5	4e	1	07	0.21					
000395	294	207	10		7/16/2013				3	6	4f	1	07	0.13					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
000396	294	207	11		7/22/2013				1	2	4g	1	07	4.73					
000397	294	207	11		7/22/2013				1	6	4e	1	07	1.56					
000398	294	207	11		7/22/2013				1	6	4f	2	07	3.01					
000399	294	207	11		7/22/2013				1	6	4g	1	07	1.86					
000400	294	207	11		7/22/2013				2	5	4e	1	07	0.11					
000401	294	207	11		7/22/2013				2	6	4e	4	07	1.18					
000402	294	207	11		7/22/2013				2	6	4f	3	07	2.07					
000403	294	207	11		7/22/2013				2	6	4g	1	07	0.18					
000404	294	207	11		7/22/2013				2	7	4f	1	07	0.22					
000405	294	207	11		7/22/2013				3	2	4e	1	07	0.06					
000406	294	207	11		7/22/2013				3	6	4f	2	07	0.21					
000407	294	207	12		7/23/2013				1	1	4f	1	07	2.28					
000408	294	207	12		7/23/2013				1	5	4g	1	07	3.45					
000409	294	207	12		7/23/2013				1	6	4e	1	07	24.54					
000410	294	207	12		7/23/2013				2	1	4e	1	07	0.14					
000411	294	207	12		7/23/2013				2	1	5c	1	07	1.71					Edge modified flake
000412	294	207	12		7/23/2013				2	2	4e	1	07	0.43					
000413	294	207	12		7/23/2013				2	4	4f	1	07	0.37					
000414	294	207	12		7/23/2013				2	5	4e	2	07	0.46					
000415	294	207	12		7/23/2013				2	6	4f	5	07	2.22					
000416	294	207	12		7/23/2013				2	6	4g	2	07	0.68					
000417	294	207	12		7/23/2013				3	1	4e	1	07	0.06					
000418	294	207	12		7/23/2013				3	1	4f	1	07	0.06					
000419	294	207	12		7/23/2013				3	6	4f	1	07	0.1					
000420	294	207	12		7/23/2013				4	1	4e	1	07	0.01					
000421	294	207	12		7/23/2013				4	1	4f	1	07	0.01					
000422	294	207	13		7/23/2013				1	6	4e	1	07	2.5					
000423	294	207	13		7/23/2013				1	6	4f	2	07	2.99					
000424	294	207	13		7/23/2013				2	5	4e	1	07	0.14					
000425	294	207	13		7/23/2013				2	5	4f	1	07	0.05					
000426	294	207	13		7/23/2013				2	6	4e	2	07	0.58					
000427	294	207	13		7/23/2013				2	6	4f	2	07	0.6					
000428	294	207	13		7/23/2013				2	6	5c	1	07	2.3	33.2	15.1	6		Edge modified flake
000429	294	207	13		7/23/2013				2	7	4f	2	07	0.2					
000430	294	207	13		7/23/2013				3	1	4e	1	07	0.07					
000431	294	207	13		7/23/2013				3	2	4f	1	07	0.18					
000432	294	207	13		7/23/2013				3	5	4e	1	07	0.03					
000433	294	207	13		7/23/2013				3	5	4f	2	07	0.16					
000434	294	207	13		7/23/2013				3	6	4f	2	07	0.41					
000435	294	207	14		7/23/2013				1	6	4e	1	07	0.99					
000436	294	207	14		7/23/2013				2	1	4e	1	07	0.3					
000437	294	207	14		7/23/2013				2	1	4g	2	07	1.95					
000438	294	207	14		7/23/2013				2	6	4e	1	07	0.14					
000439	294	207	14		7/23/2013				2	6	4f	7	07	1.88					
000440	294	207	14		7/23/2013				2	6	4g	2	07	0.89					
000441	294	207	14		7/23/2013				3	6	4f	2	07	0.28					
000442	294	207	15		7/24/2013				1	2	4g	1	07	1.75					
000443	294	207	15		7/24/2013				1	5	4f	1	07	1.1					
000444	294	207	15		7/24/2013	151	294.99	207.1	1	6	5c	1	07	3.01	31.2	26.4	6		Edge modified flake
000445	294	207	15		7/24/2013				1	6	4e	1	07	2.97					
000446	294	207	15		7/24/2013				1	6	4f	1	07	3.9					
000447	294	207	15		7/24/2013				2	1	4f	1	07	0.58					
000448	294	207	15		7/24/2013				2	2	4f	1	07	0.55					
000449	294	207	15		7/24/2013				2	2	4g	2	07	2.09					
000450	294	207	15		7/24/2013				2	6	4e	3	07	1.67					
000451	294	207	15		7/24/2013				2	6	4f	3	07	1.98					
000452	294	207	15		7/24/2013				3	6	4f	2	07	0.2					
000453	294	207	16		7/25/2013				1	1	5b	1	02-01a	6.31	23.6*	29	10.6		Biface base fragment
000454	294	207	16		7/25/2013				1	6	4e	1	07	1.67					
000455	294	207	16		7/25/2013	162	294.72	207.41	2	5	4f	2	07	0.76					
000456	294	207	16		7/25/2013				2	6	4e	1	07	0.18					
000457	294	207	16		7/25/2013				2	6	4f	4	07	3.58					
000458	294	207	16		7/25/2013				3	1	4e	1	07	0.06					
000459	294	207	16		7/25/2013				3	6	4f	1	07	0.02					
000460	294	207	16	9	7/25/2013				2	6	4e	2	07	0.71					
000461	294	207	16	9	7/25/2013				2	6	4f	2	07	0.59					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
000462	294	207	16	9	7/25/2013				3	2	4f	1	07	0.01					
000462	294	207	16	9	7/25/2013				3	5	4e	1	07	0.02					
000463	294	207	17		7/25/2013				1	6	4e	1	07	22.76					
000464	294	207	17		7/25/2013				2	5	4f	1	07	0.33					
000465	294	207	17		7/25/2013				2	6	4f	3	07	1.86					
000466	294	207	17		7/25/2013				3	5	4f	1	07	0.01					
000467	291	207	1		5/18/2013	9	291.33	207.81	1	1	5a	1	01-10	1.88	28.2	20.6	4.7	6	Projectile point
000468	291	207	1		5/18/2013				1	2	4g	1	07	2.18					
000469	291	207	1		5/18/2013				1	4	4f	1	07	6.23					
000470	291	207	1		5/18/2013	15	291.72	207.16	1	5	4g	1	07	2.61					
000471	291	207	1		5/18/2013				2	1	4e	2	07	0.35					
000472	291	207	1		5/18/2013				2	1	4f	2	07	0.18					
000473	291	207	1		5/18/2013				2	1	4g	1	07	0.52					
000474	291	207	1		5/18/2013				2	2	4e	1	07	0.45					
000475	291	207	1		5/18/2013				2	2	4f	2	07	0.47					
000476	291	207	1		5/18/2013				2	2	4g	1	07	0.68					
000477	291	207	1		5/18/2013				2	5	4e	1	07	0.14					
000478	291	207	1		5/18/2013				2	5	4f	4	07	1.19					
000479	291	207	1		5/18/2013				2	6	4e	10	07	3.15					
000480	291	207	1		5/18/2013				2	6	4f	13	07	3.22					
000481	291	207	1		5/18/2013				2	6	4g	9	07	3.68					
000482	291	207	1		5/18/2013				2	7	4e	1	07	0.27					
000483	291	207	1		5/18/2013				3	1	4e	2	07	0.16					
000484	291	207	1		5/18/2013				3	1	4f	7	07	0.25					
000485	291	207	1		5/18/2013				3	2	4e	3	07	0.13					
000486	291	207	1		5/18/2013				3	2	4f	2	07	0.04					
000487	291	207	1		5/18/2013				3	2	4g	2	07	0.13					
000488	291	207	1		5/18/2013				3	5	4f	7	07	0.39					
000489	291	207	1		5/18/2013				3	5	4g	1	07	0.02					
000490	291	207	1		5/18/2013				3	6	4e	2	07	0.23					
000491	291	207	1		5/18/2013				3	6	4f	15	07	1.24					
000492	291	207	1		5/18/2013				3	6	4g	6	07	0.44					
000493	291	207	1		5/18/2013				4	1	4f	1	07	0.01					
000494	291	207	1		5/18/2013				4	2	4f	1	07	0.01					
000495	291	207	1		5/18/2013				4	5	4f	2	07	0.01					
000496	291	207	1		5/18/2013				4	5	4g	1	07	0.01					
000497	291	207	1		5/18/2013				4	6	4f	1	07	0.01					
000498	291	207	1		5/18/2013				4	6	4g	1	07	0.01					
000499	291	207	2		5/19/2013	18	291.91	207.91	1	1	5c	1	03-08	2.44	16.5	21.8	6.1		Scraper
000500	291	207	2		5/19/2013				1	2	5b	1	02-01	3.06	18.2*	28.4*	7*		Biface midsection fragment
000501	291	207	2		5/19/2013				1	0	0	1	08-01	0	132	92.2	77.5		Hammerstone
000502	291	207	2		5/19/2013				2	1	4e	2	07	0.81					
000503	291	207	2		5/19/2013				2	1	4f	3	07	0.46					
000504	291	207	2		5/19/2013				2	5	4e	1	07	0.53					
000505	291	207	2		5/19/2013				2	5	4f	1	07	0.27					
000506	291	207	2		5/19/2013				2	5	4g	1	07	0.63	13.1	9.1	5.3		
000507	291	207	2		5/19/2013				2	5	5e	1	06-02	0.71	13.5	9.4	5		Microblade core rejuv?
000508	291	207	2		5/19/2013				2	6	4e	2	07	0.52					
000509	291	207	2		5/19/2013				2	6	4f	8	07	2.81					
000510	291	207	2		5/19/2013				2	6	4g	1	07	0.79					
000511	291	207	2		5/19/2013				3	1	4e	2	07	0.09					
000512	291	207	2		5/19/2013				3	1	4f	4	07	0.31					
000513	291	207	2		5/19/2013				3	2	4f	2	07	0.25					
000514	291	207	2		5/19/2013				3	5	4e	1	07	0.02					
000515	291	207	2		5/19/2013				3	6	4f	12	07	0.83					
000516	291	207	2		5/19/2013				3	6	4g	4	07	0.39					
000517	291	207	2		5/19/2013				4	1	4e	1	07	0.05					
000518	291	207	2		5/19/2013				4	5	4g	1	07	0.06					
000519	291	207	3		5/19/2013				1	2	4f	1	07	1.01					
000520	291	207	3		5/19/2013				1	6	4e	2	07	4.87					
000521	291	207	3		5/19/2013				1	6	4f	1	07	0.93					
000522	291	207	3		5/19/2013	26	291.22	207.7	1	6	5e	1	06-01	151.92	98.1	63.9	29.5		Core
000523	291	207	3		5/19/2013				2	1	4e	1	07	0.15					
000524	291	207	3		5/19/2013				2	1	4f	1	07	0.45					
000525	291	207	3		5/19/2013				2	1	4g	2	07	0.45					
000526	291	207	3		5/19/2013				2	2	4f	1	07	0.23					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
000527	291	207	3		5/19/2013				2	5	4g	1	07	0.41					
000528	291	207	3		5/19/2013				2	6	4e	2	07	0.71					
000529	291	207	3		5/19/2013				2	6	4f	9	07	2.64					
000530	291	207	3		5/19/2013				2	6	4g	3	07	1.67					
000531	291	207	3		5/19/2013				3	1	4e	3	07	0.29					
000532	291	207	3		5/19/2013				3	1	4f	4	07	0.24					
000533	291	207	3		5/19/2013				3	2	4e	1	07	0.02					
000534	291	207	3		5/19/2013				3	2	4f	1	07	0.07					
000535	291	207	3		5/19/2013				3	5	4e	1	07	0.11					
000536	291	207	3		5/19/2013				3	5	4f	3	07	0.23					
000537	291	207	3		5/19/2013				3	6	4e	2	07	0.14					
000538	291	207	3		5/19/2013				3	6	4f	9	07	0.67					
000539	291	207	3		5/19/2013				4	1	4f	1	07	0.01					
000540	291	207	3		5/19/2013				4	6	4f	2	07	0.04					
000541	291	207	4		5/20/2013				1	1	4e	1	07	0.99					
000542	291	207	4		5/20/2013				1	5	4f	1	07	3.27					
000543	291	207	4		5/20/2013				1	6	4e	2	07	5.14					
000544	291	207	4		5/20/2013				1	6	4f	3	07	3.93					
000545	291	207	4		5/20/2013				2	1	4e	2	07	0.54					
000546	291	207	4		5/20/2013				2	1	4f	4	07	1.12					
000547	291	207	4		5/20/2013				2	2	4e	2	07	0.61					
000548	291	207	4		5/20/2013				2	2	4f	2	07	0.26					
000549	291	207	4		5/20/2013				2	5	4e	1	07	0.66					
000550	291	207	4		5/20/2013				2	5	4f	1	07	0.65					
000551	291	207	4		5/20/2013				2	6	4e	1	07	0.06					
000552	291	207	4		5/20/2013				2	6	4f	9	07	2.54					
000553	291	207	4		5/20/2013				2	6	4g	4	07	1					
000554	291	207	4		5/20/2013				3	1	4e	1	07	0.13					
000555	291	207	4		5/20/2013				3	2	4e	1	07	0.07					
000556	291	207	4		5/20/2013				3	2	4g	1	07	0.21					
000557	291	207	4		5/20/2013				3	5	4f	1	07	0.03					
000558	291	207	4		5/20/2013				3	6	4e	1	07	0.15					
000559	291	207	4		5/20/2013				3	6	4f	5	07	0.4					
000560	291	207	4		5/20/2013				3	6	4g	4	07	0.36					
000561	291	207	4		5/20/2013				3	organic	organic	2	organic	0.52					Root cast
000562	291	207	4		5/20/2013				4	1	4e	2	07	0.02					
000563	291	207	4		5/20/2013				4	5	4e	1	07	0.01					
000564	291	207	4		5/20/2013				4	5	4f	1	07	0.01					
000565	291	207	5		5/21/2013				1	1	4g	1	07	2.63					
000566	291	207	5		5/21/2013				1	2	4f	1	07	1.46					
000567	291	207	5		5/21/2013				1	5	4f	1	07	1.49					
000568	291	207	5		5/21/2013				1	6	4e	4	07	26.96					
000569	291	207	5		5/21/2013				1	6	4f	2	07	12.49					
000570	291	207	5		5/21/2013				1	6	4g	1	07	2.31					
000571	291	207	5		5/21/2013				2	2	4e	3	07	0.85					
000572	291	207	5		5/21/2013				2	6	4e	4	07	1.65					
000573	291	207	5		5/21/2013				2	6	4f	9	07	2.42					
000574	291	207	5		5/21/2013				2	6	4g	4	07	0.75					
000575	291	207	5		5/21/2013				2	0	4g	1	07	3.85					
000576	291	207	5		5/21/2013				3	1	4e	2	07	0.11					
000577	291	207	5		5/21/2013				3	1	4f	1	07	0.01					
000578	291	207	5		5/21/2013				3	1	4g	2	07	0.32					
000579	291	207	5		5/21/2013				3	2	4e	1	07	0.06					
000580	291	207	5		5/21/2013				3	2	4f	2	07	0.16					
000581	291	207	5		5/21/2013				3	5	4e	1	07	0.13					
000582	291	207	5		5/21/2013				3	6	4f	5	07	0.51					
000583	291	207	5		5/21/2013				4	2	4e	1	07	0.01					
000584	291	207	6		5/22/2013				1	1	5c	1	03-18	1.68	19.8	19.2	4		Scraper, flake
000585	291	207	6		5/22/2013				1	5	4e	1	07	1.18					
000586	291	207	6		5/22/2013				1	6	4e	1	07	1.22					
000587	291	207	6		5/22/2013				2	1	4e	1	07	0.2					
000588	291	207	6		5/22/2013				2	1	4f	1	07	0.1					
000589	291	207	6		5/22/2013				2	1	4g	1	07	0.36					
000590	291	207	6		5/22/2013				2	3	4f	1	07	0.13					
000591	291	207	6		5/22/2013				2	5	4g	1	07	0.71					
000592	291	207	6		5/22/2013				2	6	4e	4	07	3.33					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
000593	291	207	6		5/22/2013				2	6	4f	13	07	2.86					
000594	291	207	6		5/22/2013				2	6	4g	2	07	1.96					
000595	291	207	6		5/22/2013				3	1	4e	1	07	0.04					
000596	291	207	6		5/22/2013				3	1	4g	1	07	0.11					
000597	291	207	6		5/22/2013				3	2	4e	1	07	0.09					
000598	291	207	6		5/22/2013				3	5	4g	1	07	0.1					
000599	291	207	6		5/22/2013				3	6	4f	7	07	0.41					
000600	291	207	6		5/22/2013				3	6	4g	3	07	0.29					
000601	291	207	7		5/23/2013				1	2	4e	2	07	8.63					
000602	291	207	7		5/23/2013				1	6	4e	2	07	2.45					
000603	291	207	7		5/23/2013				1	6	4g	2	07	5.19					
000604	291	207	7		5/23/2013				2	1	4e	1	07	0.27					
000605	291	207	7		5/23/2013				2	3	4e	1	07	0.12					
000606	291	207	7		5/23/2013				2	3	4g	1	07	0.88					
000607	291	207	7		5/23/2013				2	4	4f	1	07	0.22					
000608	291	207	7		5/23/2013				2	5	4g	1	07	1.34					
000609	291	207	7		5/23/2013				2	6	4e	1	07	0.16					
000610	291	207	7		5/23/2013				2	6	4f	11	07	2.94					
000611	291	207	7		5/23/2013				2	0	4g	1	07	0.85					Odd striated ccs?
000612	291	207	7		5/23/2013				3	1	4f	1	07	0.01					
000613	291	207	7		5/23/2013				3	1	4g	1	07	0.14					
000614	291	207	7		5/23/2013				3	2	4f	1	07	0.12					
000615	291	207	7		5/23/2013				3	5	4e	1	07	0.05					
000616	291	207	7		5/23/2013				3	5	4f	1	07	0.02					
000617	291	207	7		5/23/2013				3	5	4g	1	07	0.05					
000618	291	207	7		5/23/2013				3	6	4e	1	07	0.04					
000619	291	207	7		5/23/2013				3	6	4f	11	07	0.82					
000620	291	207	7		5/23/2013				3	6	4g	1	07	0.15					
000621	291	207	8		5/24/2013				1	6	4e	1	07	8.89					
000622	291	207	8		5/24/2013				2	1	4e	1	07	1.04					
000623	291	207	8		5/24/2013				2	1	4f	1	07	0.1					
000624	291	207	8		5/24/2013				2	1	4g	2	07	1.26					
000625	291	207	8		5/24/2013				2	3	4e	1	07	0.31					
000626	291	207	8		5/24/2013				2	5	4e	1	07	0.5					
000627	291	207	8		5/24/2013				2	5	4g	1	07	1.7					
000628	291	207	8		5/24/2013				2	6	4e	3	07	1.65					
000629	291	207	8		5/24/2013				2	6	4e	3	07	1.05					
000630	291	207	8		5/24/2013				2	6	4e	3	07	2.05					
000631	291	207	8		5/24/2013				3	2	4f	2	07	0.04					
000632	291	207	8		5/24/2013				3	5	4f	1	07	0.04					
000633	291	207	8		5/24/2013				3	6	4e	3	07	0.31					
000634	291	207	8		5/24/2013				3	6	4f	2	07	0.1					
000635	291	207	9		6/1/2013				1	6	4f	2	07	2.58					
000636	291	207	9		6/1/2013				1	6	4g	2	07	6.5					
000637	291	207	9		6/1/2013				2	1	4e	2	07	0.95					
000638	291	207	9		6/1/2013				2	1	4f	1	07	0.08					
000639	291	207	9		6/1/2013				2	6	4e	2	07	0.53					
000640	291	207	9		6/1/2013				2	6	4f	3	07	1					
000641	291	207	9		6/1/2013				2	7	5b	1	01-14	0.62	19.9*	11.7	3.5		Projectile point base fragment
000642	291	207	9		6/1/2013				3	6	4e	1	07	0.1					
000643	291	207	9		6/1/2013				3	6	4f	5	07	0.39					
000644	291	207	9		6/1/2013				3	6	4g	1	07	0.18					
000645	291	207	9	3	6/1/2013				4	1	4e	1	07	0.01					
000646	291	207	10		7/11/2013				2	1	4f	1	07	2.98					
000647	291	207	10		7/11/2013				2	6	4e	1	07	0.31					
000648	291	207	10		7/11/2013				2	6	4f	1	07	0.34					
000649	291	207	10		7/11/2013				3	1	4e	1	07	0.06					
000650	291	207	10		7/11/2013				3	2	4e	1	07	0.08					
000651	291	207	10		7/11/2013				3	2	4g	1	07	0.08					
000652	291	207	10		7/11/2013				3	6	4e	1	07	0.03					
000653	291	207	10		7/11/2013				3	6	4f	3	07	0.32					
000654	291	207	10		7/11/2013				3	6	4g	4	07	0.39					
000655	291	207	10		7/11/2013				4	6	4g	1	07	0.02					
000656	291	207	10		6/1/2013	4			2	1	4e	1	07	0.21					
000657	291	207	10		6/1/2013	4			2	6	4f	2	07	1.16					
000658	291	207	10		6/1/2013	4			3	1	4f	1	07	0.02					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
000659	291	207	10		6/1/2013	4			3	6	4e	1	07	0.09					
000660	291	207	10		6/1/2013	4			3	6	4f	1	07	0.04					
000661	291	207	11		7/12/2013				1	1	4e	1	07	3					
000662	291	207	11		7/12/2013				1	1	4f	1	07	0.65					
000663	291	207	11		7/12/2013				1	6	4e	3	07	5.44					
000664	291	207	11		7/12/2013				2	1	4e	1	07	0.08					
000665	291	207	11		7/12/2013				2	1	4f	2	07	0.61					
000666	291	207	11		7/12/2013				2	1	4g	2	07	1.84					
000667	291	207	11		7/12/2013				2	5	4f	1	07	0.09					
000668	291	207	11		7/12/2013				2	6	4e	1	07	0.19					
000669	291	207	11		7/12/2013				2	6	4f	4	07	1.33					
000670	291	207	11		7/12/2013				2	6	4g	2	07	1.15					
000671	291	207	11		7/12/2013				3	1	4e	1	07	0.07					
000672	291	207	11		7/12/2013				3	1	4f	3	07	0.22					
000673	291	207	11		7/12/2013				3	2	4e	2	07	0.05					
000674	291	207	11		7/12/2013				3	5	4e	1	07	0.01					
000675	291	207	11		7/12/2013				3	5	4g	1	07	0.05					
000676	291	207	11		7/12/2013				3	6	4e	3	07	0.2					
000677	291	207	11		7/12/2013				3	6	4f	9	07	0.49					
000678	291	207	11		7/12/2013				3	6	4g	4	07	0.2					
000679	291	207	11		7/12/2013				4	1	4f	1	07	0.01					
000680	291	207	11		7/12/2013				4	1	4g	1	07	0.02					
000681	291	207	11	4	6/2/2013				2	1	4e	1	07	0.16					
000682	291	207	11	4	6/2/2013				2	6	4e	1	07	3.34					
000683	291	207	11	4	6/2/2013				2	6	4g	1	07	0.33					
000684	291	207	11	4	6/2/2013				3	5	4f	1	07	0.09					
000685	291	207	11	4	6/2/2013				3	6	4f	1	07	0.11					
000686	291	207	12		7/14/2013				1	1	4e	1	07	2.4					
000687	291	207	12		7/14/2013				1	6	4e	2	07	3.28					
000688	291	207	12		7/14/2013				1	6	4f	4	07	10.42					
000689	291	207	12		7/14/2013				2	1	4e	5	07	2.26					
000690	291	207	12		7/14/2013				2	1	4f	7	07	5.12					
000691	291	207	12		7/14/2013				2	2	4f	1	07	0.69					
000692	291	207	12		7/14/2013				2	5	4e	1	07	0.77					
000693	291	207	12		7/14/2013				2	5	4f	2	07	0.26					
000694	291	207	12		7/14/2013				2	6	4e	4	07	1.24					
000695	291	207	12		7/14/2013				2	6	4f	8	07	1.58					
000696	291	207	12		7/14/2013				2	6	4g	3	07	2					
000697	291	207	12		7/14/2013				3	1	4e	2	07	0.2					
000698	291	207	12		7/14/2013				3	1	4f	9	07	0.41					
000699	291	207	12		7/14/2013				3	1	4g	2	07	0.19					
000700	291	207	12		7/14/2013				3	2	4e	1	07	0.08					
000701	291	207	12		7/14/2013				3	5	4e	1	07	0.17					
000702	291	207	12		7/14/2013				3	5	4f	1	07	0.13					
000703	291	207	12		7/14/2013				3	6	4e	2	07	0.2					
000704	291	207	12		7/14/2013				3	6	4f	20	07	1.49					
000705	291	207	12		7/14/2013				3	6	4g	5	07	0.43					
000706	291	207	12		7/14/2013				4	6	4f	4	07	0.07					
000707	291	207	12		7/14/2013				4	6	4g	1	07	0.02					
000708	291	207	12	4	6/2/2013				2	2	4f	1	07	0.45					
000709	291	207	12	4	6/2/2013				3	1	4f	1	07	0.02					
000710	291	207	13		7/15/2013				1	6	4e	1	07	2.21					
000711	291	207	13		7/15/2013				1	6	4f	1	07	2.33					
000712	291	207	13		7/15/2013	129	291.93	207.77	1	6	5f	1	06-01	12.69	39.9	25.9	17.4		Core
000713	291	207	13		7/15/2013				2	1	4e	3	07	1.65					
000714	291	207	13		7/15/2013				2	1	4f	5	07	1.98					
000715	291	207	13		7/15/2013				2	1	4g	2	07	1.17					
000716	291	207	13		7/15/2013				2	2	4f	1	07	0.45					
000717	291	207	13		7/15/2013				2	5	4g	2	07	1.91					
000718	291	207	13		7/15/2013				2	6	4e	3	07	0.6					
000719	291	207	13		7/15/2013				2	6	4f	7	07	1.63					
000720	291	207	13		7/15/2013				2	6	4g	3	07	1.26					
000721	291	207	13		7/15/2013				3	1	4e	5	07	0.35					
000722	291	207	13		7/15/2013				3	1	4f	3	07	0.24					
000723	291	207	13		7/15/2013				3	1	4g	1	07	0.17					
000724	291	207	13		7/15/2013				3	2	4e	1	07	0.02					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
000725	291	207	13		7/15/2013				3	5	4e	1	07	0.04					
000726	291	207	13		7/15/2013				3	5	4f	1	07	0.06					
000727	291	207	13		7/15/2013				3	6	4e	1	07	0.06					
000728	291	207	13		7/15/2013				3	6	4f	9	07	0.48					
000729	291	207	13		7/15/2013				3	6	4g	4	07	0.44					
000730	291	207	13		7/15/2013				3	seed	seed	1	seed	0.03					Hazelnut
000731	291	207	13		7/15/2013				4	6	4f	5	07	0.13					
000732	291	207	14		7/15/2013				1	1	4g	2	07	4.54					
000733	291	207	14		7/22/2013				1	6	4e	1	07	1.87					
000734	291	207	14		7/22/2013				2	1	4e	5	07	2.61					
000735	291	207	14		7/22/2013				2	1	4f	4	07	1.76					
000736	291	207	14		7/22/2013				2	1	4g	2	07	1.78					
000737	291	207	14		7/22/2013				2	2	4f	1	07	0.14					
000738	291	207	14		7/22/2013				2	2	4g	1	07	0.35					
000739	291	207	14		7/22/2013				2	5	4g	1	07	0.39					
000740	291	207	14		7/22/2013				2	6	4e	3	07	0.66					
000741	291	207	14		7/22/2013				2	6	4f	8	07	1.3					
000742	291	207	14		7/22/2013				2	6	4g	2	07	0.46					
000743	291	207	14		7/22/2013				3	1	4e	3	07	0.25					
000744	291	207	14		7/22/2013				3	1	4f	3	07	0.14					
000745	291	207	14		7/22/2013				3	1	4g	2	07	0.22					
000746	291	207	14		7/22/2013				3	2	4e	1	07	0.07					
000747	291	207	14		7/22/2013				3	2	4g	1	07	0.08					
000748	291	207	14		7/22/2013				3	6	4e	1	07	0.03					
000749	291	207	14		7/22/2013				3	6	4f	10	07	0.43					
000750	291	207	14		7/22/2013				3	6	4g	3	07	0.08					
000751	291	207	14		7/22/2013				4	1	4e	2	07	0.03					
000752	291	207	14		7/22/2013				4	1	4g	1	07	0.03					
000753	291	207	14		7/22/2013				4	6	4f	2	07	0.04					
000754	291	207	14		7/22/2013				4	6	4g	3	07	0.04					
000755	291	207	14	7	7/16/2013				1	6	4e	1	07	1.07					
000756	291	207	14	7	7/16/2013				2	2	4e	1	07	0.36					
000757	291	207	14	7	7/16/2013				2	6	4f	1	07	0.27					
000758	291	207	15		7/23/2013				1	6	4e	1	07	1.02					
000759	291	207	15		7/23/2013				2	1	4e	3	07	0.76					
000760	291	207	15		7/23/2013				2	1	4f	2	07	0.58					
000761	291	207	15		7/23/2013				2	1	4g	1	07	2.68					
000762	291	207	15		7/23/2013				2	2	4e	1	07	0.18					
000763	291	207	15		7/23/2013				2	2	4f	2	07	1.07					
000764	291	207	15		7/23/2013				2	6	4e	3	07	0.7					
000765	291	207	15		7/23/2013				2	6	4f	7	07	1.8					
000766	291	207	15		7/23/2013				2	6	4g	3	07	0.66					
000767	291	207	15		7/23/2013				3	1	4e	1	07	0.05					
000768	291	207	15		7/23/2013				3	1	4f	3	07	0.14					
000769	291	207	15		7/23/2013				3	1	4g	1	07	0.05					
000770	291	207	15		7/23/2013				3	2	4g	1	07	0.07					
000771	291	207	15		7/23/2013				3	6	4e	2	07	0.15					
000772	291	207	15		7/23/2013				3	6	4f	3	07	0.07					
000773	291	207	15		7/23/2013				3	6	4g	3	07	0.18					
000774	291	207	15		7/23/2013				3	seed	seed	1	seed	0.03					Hazelnut
000775	291	207	15		7/23/2013				4	1	4e	1	07	0.03					
000776	291	207	15		7/23/2013				4	1	4f	1	07	0.01					
000777	291	207	15		7/23/2013				4	5	4g	1	07	0.02					
000778	291	207	15		7/23/2013				4	6	4e	1	07	0.01					
000779	291	207	15		7/23/2013				4	6	4f	6	07	0.09					
000780	291	207	15		7/23/2013				4	6	4g	3	07	0.05					
000781	291	207	15	7	7/16/2013				3	6	4f	1	07	0.09					
000782	291	207	15	7	7/16/2013				3	6	4g	1	07	0.05					
000783	291	207	16		7/25/2013				1	1	4e	1	07	0.89					
000784	291	207	16		7/25/2013				2	1	4g	1	07	1.17					
000785	291	207	16		7/25/2013				2	3	4e	1	07	0.7					
000786	291	207	16		7/25/2013				2	6	4e	1	07	0.32					
000787	291	207	16		7/25/2013				2	6	4f	2	07	0.38					
000788	291	207	16	8	7/25/2013				2	6	4f	1	07	0.39					
000789	291	207	16		7/25/2013				3	6	4f	2	07	0.03					
000790	291	207	17	8	7/25/2013				2	1	4f	1	07	0.41					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
000791	291	207	17	8	7/25/2013				2	6	4f	1	07	0.11					
000792	291	206	1		6/4/2013	24	291.8	206.01	1	2	5d	1	03-08	1.55	18.6	17.4	4.4		Scraper
000793	291	206	1		6/4/2013				1	2	4g	1	07	7.6					
000794	291	206	1		6/4/2013				1	6	5f	1	06-01	27.43	65.6	44.4	10		Core flake
000795	291	206	1		6/4/2013	22			1	6	5e	1	06-04	89.68	67.4	59.8	16.5		Cobble chopper
000796	291	206	1		6/4/2013				2	1	4e	1	07	0.18					
000797	291	206	1		6/4/2013				2	1	4f	1	07	0.12					
000798	291	206	1		6/4/2013				2	2	4e	1	07	0.35					
000799	291	206	1		6/4/2013				2	2	4f	5	07	1.49					
000800	291	206	1		6/4/2013				2	3	4e	1	07	0.14					
000801	291	206	1		6/4/2013				2	3	4f	1	07	1.33					
000802	291	206	1		6/4/2013				2	5	4g	3	07	1.44					
000803	291	206	1		6/4/2013				2	6	4e	8	07	3.24					
000804	291	206	1		6/4/2013				2	6	4f	12	07	4.14					
000805	291	206	1		6/4/2013				2	6	4g	10	07	7.11					
000806	291	206	1		6/4/2013				2	7	4g	1	07	0.78					
000807	291	206	1		6/4/2013				3	1	4e	4	07	0.31					
000808	291	206	1		6/4/2013				3	1	4f	5	07	0.18					
000809	291	206	1		6/4/2013				3	1	4g	1	07	0.08					
000810	291	206	1		6/4/2013	20			3	1	5a	1	01	0.15	11.6*	6.8	2.8		Projectile point tip fragment
000811	291	206	1		6/4/2013				3	2	4e	5	07	0.33					
000812	291	206	1		6/4/2013				3	2	4f	3	07	0.43					
000813	291	206	1		6/4/2013				3	5	4e	1	07	0.06					
000814	291	206	1		6/4/2013				3	5	4f	1	07	0.06					
000815	291	206	1		6/4/2013				3	6	4e	2	07	0.1					
000816	291	206	1		6/4/2013				3	6	4f	13	07	1.13					
000817	291	206	1		6/4/2013				3	6	4g	5	07	1					
000818	291	206	1		6/4/2013				4	1	4e	1	07	0.01					
000819	291	206	1		6/4/2013				4	5	4g	1	07	0.01					
000820	291	206	1		6/4/2013				4	6	4f	1	07	0.01					
000821	291	206	3		6/4/2013				1	6	4e	1	07	4.19					
000822	291	206	3		6/4/2013				2	2	4f	1	07	0.25					
000823	291	206	3		6/4/2013				2	5	4e	1	07	0.95					
000824	291	206	3		6/4/2013				2	6	4f	5	07	1.34					
000825	291	206	3		6/4/2013				3	2	4e	1	07	0.06					
000826	291	206	3		6/4/2013				3	2	4g	1	07	0.1					
000827	291	206	3		6/4/2013				3	5	4e	1	07	0.13					
000828	291	206	3		6/4/2013				3	6	4e	1	07	0.04					
000829	291	206	3		6/4/2013				3	6	4f	5	07	0.28					
000830	291	206	3		6/4/2013				4	1	4e	1	07	0.01					
000831	291	206	3		6/4/2013				4	6	4f	2	07	0.02					
000832	291	206	4		6/6/2013				1	6	4e	1	07	1.28					
000833	291	206	4		6/6/2013				1	6	4g	2	07	19.17					
000834	291	206	4		6/6/2013				2	2	4f	2	07	0.77					
000835	291	206	4		6/6/2013				2	5	4f	1	07	0.13					
000836	291	206	4		6/6/2013				2	6	4e	2	07	0.81					
000837	291	206	4		6/6/2013				2	6	4f	1	07	0.19					
000838	291	206	4		6/6/2013				2	6	4g	1	07	0.63					
000839	291	206	4		6/6/2013				2	0	root cast	1	root	0.49					
000840	291	206	4		6/6/2013				3	1	4e	1	07	0.14					
000841	291	206	4		6/6/2013				3	2	4e	2	07	0.12					
000842	291	206	4		6/6/2013				3	2	4f	1	07	0.1					
000843	291	206	4		6/6/2013				3	6	4f	4	07	0.19					
000844	291	206	5		6/6/2013				1	3	4f	1	07	3.53					
000845	291	206	5		6/6/2013	50	291.16	206.49	1	6	4e	1	07	3.35					
000846	291	206	5		6/6/2013				1	6	4g	1	07	6.05					
000847	291	206	5		6/6/2013				2	6	4e	3	07	1.89					
000848	291	206	5		6/6/2013				2	6	4f	2	07	0.51					
000849	291	206	5		6/6/2013				3	1	4f	2	07	0.31					
000850	291	206	5		6/6/2013				3	6	4f	3	07	0.36					
000851	291	206	5		6/6/2013				3	1	fossil	1	fossil	0.29					Fossil
000852	291	206	5		6/6/2013				3	root cast	root cast	2	root	0.33					
000853	291	206	6		6/7/2013				1	6	4f	1	07	1.04					
000854	291	206	6		6/7/2013				1	0	0	1	09-01	560	114.54	71.5	50.4		E.G. cobble, basaltic sndstn.
000855	291	206	6		6/7/2013				2	6	4e	2	07	1.28					
000856	291	206	6		6/7/2013				2	6	4f	2	07	0.52					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
000857	291	206	6		6/7/2013				3	5	4f	1	07	0.07					
000858	291	206	6		6/7/2013				3	6	4e	1	07	0.02					
000859	291	206	6		6/7/2013				3	6	4f	3	07	0.14					
000860	291	206	6		6/7/2013				4	5	4g	1	07	0.02					
000861	291	208	1		4/25/2013				1	1	4e	1	07	3.21					
000862	291	208	1		4/25/2013	9.5	291.96	208.7	1	3	5c	1	03-03	2.58	33.5	16.8	5.1		Scraper
000863	291	208	1		4/25/2013				1	6	4e	1	07	3.2					
000864	291	208	1		4/25/2013				1	6	4f	1	07	1.66					
000865	291	208	1		4/25/2013				2	1	4e	1	07	0.22					
000866	291	208	1		4/25/2013				2	1	4f	2	07	0.36					
000867	291	208	1		4/25/2013				2	2	4e	1	07	0.29					
000868	291	208	1		4/25/2013				2	2	4g	1	07	0.84					
000869	291	208	1		4/25/2013	12	291.44	208.23	2	2	5c	1	07	1.85	21.9	14.5	5.3		Edge modified flake
000870	291	208	1		4/25/2013				2	6	4e	3	07	1.1					
000871	291	208	1		4/25/2013				2	6	4f	9	07	1.78					
000872	291	208	1		4/25/2013				2	6	4g	2	07	1.21					
000873	291	208	1		4/25/2013				3	1	4g	1	07	0.22					
000874	291	208	1		4/25/2013				3	6	4f	1	07	0.1					
000875	291	208	2		4/26/2013	24	291.3	208.73	1	1	5d	1	03-09	3.6	20.5	24.6	7.8		Scraper
000876	291	208	2		4/26/2013				1	2	5c	1	07	3.61					Edge modified flake
000877	291	208	2		4/26/2013				1	6	4f	3	07	13.96					
000878	291	208	2		4/26/2013				1	6	4g	1	07	1.14					
000879	291	208	2		4/26/2013				2	1	4e	1	07	0.45					
000880	291	208	2		4/26/2013				2	2	4e	1	07	0.42					
000881	291	208	2		4/26/2013				2	2	4f	1	07	0.17					
000882	291	208	2		4/26/2013				2	5	4e	1	07	0.22					
000883	291	208	2		4/26/2013				2	6	4e	4	07	1.45					
000884	291	208	2		4/26/2013				2	6	4f	5	07	1.79					
000885	291	208	2		4/26/2013				2	6	4g	5	07	3.23					
000886	291	208	2		4/26/2013				3	1	4e	2	07	0.26					
000887	291	208	2		4/26/2013				3	1	4f	1	07	0.1					
000888	291	208	2		4/26/2013				3	2	4f	1	07	0.08					
000889	291	208	2		4/26/2013				3	2	4g	2	07	0.19					
000890	291	208	2		4/26/2013				3	5	4e	2	07	0.19					
000891	291	208	2		4/26/2013				3	6	4f	5	07	0.38					
000892	291	208	2		4/26/2013				4	1	4e	1	07	0.01					
000893	291	208	2		4/26/2013				4	6	4f	3	07	0.04					
000894	291	208	3		4/26/2013				1	5	4f	1	07	1.65					
000895	291	208	3		4/26/2013				1	6	4e	3	07	4.14					
000896	291	208	3		4/26/2013				2	1	4e	1	07	0.15					
000897	291	208	3		4/26/2013				2	1	4f	1	07	0.19					
000898	291	208	3		4/26/2013				2	1	4g	2	07	0.65					
000899	291	208	3		4/26/2013				2	2	4e	1	07	0.63					
000900	291	208	3		4/26/2013				2	2	4f	3	07	1.08					
000901	291	208	3		4/26/2013				2	5	4e	1	07	0.1					
000902	291	208	3		4/26/2013				2	5	4f	2	07	1.14					
000903	291	208	3		4/26/2013				2	5	4g	1	07	0.89					
000904	291	208	3		4/26/2013				2	6	4e	2	07	0.52					
000905	291	208	3		4/26/2013				2	6	4f	3	07	0.97					
000906	291	208	3		4/26/2013				2	6	4g	4	07	3.22					
000907	291	208	3		4/26/2013				3	1	4e	1	07	0.03					
000908	291	208	3		4/26/2013				3	1	4f	1	07	0.04					
000909	291	208	3		4/26/2013				3	6	4f	4	07	0.39					
000910	291	208	3		4/26/2013				3	6	4g	1	07	0.16					
000911	291	208	4		4/28/2013	40	291.14	208.52	1	1	5c	1	03-18	17.47	44.2	25.1	16		Scraper, flake
000912	291	208	4		4/28/2013				1	2	4e	1	07	1.28					
000913	291	208	4		4/28/2013				1	6	4e	1	07	7.84					
000914	291	208	4		4/28/2013				1	6	4g	1	07	11.33					
000915	291	208	4		4/28/2013				2	1	4f	1	07	0.16					
000916	291	208	4		4/28/2013				2	2	4e	1	07	0.26					
000917	291	208	4		4/28/2013				2	2	4f	2	07	0.46					
000918	291	208	4		4/28/2013				2	3	4g	1	07	1.16					
000919	291	208	4		4/28/2013				2	6	4e	6	07	2					
000920	291	208	4		4/28/2013				2	6	4f	9	07	3.83					
000921	291	208	4		4/28/2013				2	6	4g	3	07	0.79					
000922	291	208	4		4/28/2013				3	1	4f	3	07	0.26					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
000923	291	208	4		4/28/2013				3	2	4e	1	07	0.06					
000924	291	208	4		4/28/2013				3	6	4e	1	07	0.27					
000925	291	208	4		4/28/2013				3	6	4f	3	07	0.19					
000926	291	208	4		4/28/2013				3	6	4g	1	07	0.24					
000927	291	208	4		4/28/2013				4	2	4e	1	07	0.01					
000928	291	208	4		4/28/2013				4	2	4f	1	07	0.01					
000929	291	208	4		4/28/2013				4	1	4e	1	07	0.01					
000930	291	208	4		4/28/2013				4	6	4f	1	07	0.01					
000931	291	208	5		4/28/2013				1	1	4e	1	07	3.58					
000932	291	208	5		4/28/2013				1	1	4f	1	07	18.52					
000933	291	208	5		4/28/2013				1	2	4e	1	07	1.34					
000934	291	208	5		4/28/2013	54	291.29	208.91	1	6	4f	1	07	1.57					
000935	291	208	5		4/28/2013				2	1	4g	1	07	1.07					
000936	291	208	5		4/28/2013				2	2	4e	3	07	1					
000937	291	208	5		4/28/2013				2	2	4f	1	07	0.51					
000938	291	208	5		4/28/2013				2	6	4e	3	07	1.79					
000939	291	208	5		4/28/2013				2	6	4f	11	07	2.8					
000940	291	208	5		4/28/2013				2	6	5d	1	02	0.2	14.5	6.9	3.5		Biface midsection fragment
000941	291	208	5		4/28/2013				3	1	4e	1	07	0.16					
000942	291	208	5		4/28/2013				3	2	4e	2	07	0.2					
000943	291	208	5		4/28/2013				3	3	4f	2	07	0.05					
000944	291	208	5		4/28/2013				3	5	4e	1	07	0.07					
000945	291	208	5		4/28/2013				3	5	4f	1	07	0.02					
000946	291	208	5		4/28/2013				3	6	4e	2	07	0.22					
000947	291	208	5		4/28/2013				3	6	4f	7	07	0.5					
000948	291	208	5		4/28/2013				3	6	4g	2	07	0.25					
000949	291	208	5		4/28/2013				4	6	4g	1	07	0.04					
000950	291	208	6		4/29/2013				1	1	5f	1	06-01	12.04	30.5	27.2	17.4		Core, crystals in ccs
000951	291	208	6		4/29/2013				1	6	4g	1	07	2.67					
000952	291	208	6		4/29/2013				2	1	4e	1	07	0.17					
000953	291	208	6		4/29/2013				2	1	4f	2	07	0.46					
000954	291	208	6		4/29/2013				2	2	4e	1	07	0.08					
000955	291	208	6		4/29/2013				2	5	4f	1	07	0.09					
000956	291	208	6		4/29/2013				2	6	4e	6	07	2.75					
000957	291	208	6		4/29/2013				2	6	4f	6	07	0.81					
000958	291	208	6		4/29/2013				2	6	4g	1	07	0.89					
000959	291	208	6		4/29/2013				3	1	4e	1	07	0.12					
000960	291	208	6		4/29/2013				3	1	4f	1	07	0.05					
000961	291	208	6		4/29/2013				3	6	4f	4	07	0.31					
000962	291	208	7		4/30/2013	66	291.05	208.73	1	1	5c	1	03-08	29.51	64.3	39.5	14.8		Scraper
000963	291	208	7		4/30/2013				1	6	4e	1	07	2.35					
000964	291	208	7		4/30/2013				1	6	4f	1	07	5.47					
000965	291	208	7		4/30/2013	65			1	6	5a	1	01-05b	6.21	56.2	17.3	9.9	7.6	Projectile point
000966	291	208	7		4/30/2013				2	1	4e	2	07	1.59					
000967	291	208	7		4/30/2013				2	1	4f	1	07	0.25					
000968	291	208	7		4/30/2013				2	1	4g	1	07	0.85					
000969	291	208	7		4/30/2013				2	2	4e	1	07	0.3					
000970	291	208	7		4/30/2013				2	2	4f	1	07	0.47					
000971	291	208	7		4/30/2013				2	5	4e	1	07	0.13					
000972	291	208	7		4/30/2013				2	6	4e	4	07	1.23					
000973	291	208	7		4/30/2013				2	6	4f	10	07	2.16					
000974	291	208	7		4/30/2013				2	6	4g	4	07	2.15					
000975	291	208	7		4/30/2013				3	1	4e	2	07	0.11					
000976	291	208	7		4/30/2013				3	1	4f	2	07	0.04					
000977	291	208	7		4/30/2013				3	1	4g	2	07	0.23					
000978	291	208	7		4/30/2013				3	2	4e	1	07	0.09					
000979	291	208	7		4/30/2013				3	2	4f	2	07	0.1					
000980	291	208	7		4/30/2013				3	5	4f	1	07	0.06					
000981	291	208	7		4/30/2013				3	5	4g	1	07	0.29					
000982	291	208	7		4/30/2013				3	6	4e	2	07	0.15					
000983	291	208	7		4/30/2013				3	6	4f	8	07	0.86					
000984	291	208	7		4/30/2013				3	6	4g	4	07	0.53					
000985	291	208	7		4/30/2013				4	2	4e	1	07	0.03					
000986	291	208	7		4/30/2013				4	6	4f	3	07	0.02					
000987	291	208	8		5/2/2013				1	6	4e	1	07	1.12					
000988	291	208	8		5/2/2013				1	6	4g	1	07	9.6					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
000989	291	208	8		5/2/2013				2	1	4e	4	07	1.2					
000990	291	208	8		5/2/2013				2	1	4f	1	07	0.15					
000991	291	208	8		5/2/2013				2	2	4e	1	07	0.62					
000992	291	208	8		5/2/2013				2	2	4f	1	07	0.2					
000993	291	208	8		5/2/2013				2	3	5a	1	01	0.2					Projectile point tip fragment
000994	291	208	8		5/2/2013				2	5	4e	1	07	0.31					
000995	291	208	8		5/2/2013				2	6	4e	7	07	3.45					
000996	291	208	8		5/2/2013				2	6	4f	5	07	0.99					
000997	291	208	8		5/2/2013				2	6	4g	2	07	0.94					
000998	291	208	8		5/2/2013				3	1	4f	2	07	0.08					
000999	291	208	8		5/2/2013				3	1	4g	1	07	0.06					
001000	291	208	8		5/2/2013				3	2	4f	1	07	0.07					
001001	291	208	8		5/2/2013				3	5	4g	1	07	0.1					
001002	291	208	8		5/2/2013				3	6	4e	3	07	0.21					
001003	291	208	8		5/2/2013				3	6	4f	6	07	0.36					
001004	291	208	8		5/2/2013				3	6	4g	4	07	0.46					
001005	291	208	9		5/4/2013	93	291.28	208.28	1	1	5c	1	03-04	14.27	36.1	32.4	11.4		Scraper
001006	291	208	9		5/4/2013				1	2	4e	1	07	1.87					
001007	291	208	9		5/4/2013				1	2	4f	1	07	1.95					
001008	291	208	9		5/4/2013				1	6	4e	3	07	9.04					
001009	291	208	9		5/4/2013				1	6	4g	2	07	17.92					
001010	291	208	9		5/4/2013				2	1	4e	2	07	0.74					
001011	291	208	9		5/4/2013				2	1	4f	2	07	0.31					
001012	291	208	9		5/4/2013				2	2	4e	2	07	0.4					
001013	291	208	9		5/4/2013				2	2	4f	1	07	0.96					
001014	291	208	9		5/4/2013				2	5	4e	1	07	0.46					
001015	291	208	9		5/4/2013				2	6	4e	6	07	2.47					
001016	291	208	9		5/4/2013				2	6	4f	9	07	2.59					
001017	291	208	9		5/4/2013				2	6	4g	6	07	1.83					
001018	291	208	9		5/4/2013				3	1	4e	2	07	0.34					
001019	291	208	9		5/4/2013				3	1	4f	2	07	0.15					
001020	291	208	9		5/4/2013				3	2	4f	1	07	0.05					
001021	291	208	9		5/4/2013				3	2	4g	1	07	0.14					
001022	291	208	9		5/4/2013				3	5	4g	1	07	0.12					
001023	291	208	9		5/4/2013				3	6	4e	2	07	0.14					
001024	291	208	9		5/4/2013				3	6	4f	4	07	0.2					
001025	291	208	9		5/4/2013				3	6	4g	6	07	0.66					
001026	291	208	9		5/4/2013				4	1	4g	1	07	0.05					
001027	291	208	10		5/16/2013				1	3	4e	1	07	1.2					
001028	291	208	10		5/16/2013				2	1	4f	1	07	0.53					
001029	291	208	10		5/16/2013				2	2	4f	2	07	0.23					
001030	291	208	10		5/16/2013				2	5	4g	1	07	0.22					
001031	291	208	10		5/16/2013				2	6	4e	2	07	0.74					
001032	291	208	10		5/16/2013				2	6	4f	5	07	1.19					
001033	291	208	10		5/16/2013				2	6	4g	1	07	1.12					
001034	291	208	10		5/16/2013				3	1	4e	2	07	0.35					
001035	291	208	10		5/16/2013				3	1	4f	2	07	0.28					
001036	291	208	10		5/16/2013				3	6	4e	2	07	0.13					
001037	291	208	10		5/16/2013				3	6	4f	3	07	0.22					
001038	291	208	10		5/16/2013				3	6	4g	1	07	0.14					
001039	291	208	11		5/17/2013				1	6	4e	2	07	19.7					
001040	291	208	11		5/17/2013				1	6	4f	1	07	1.54					
001041	291	208	11		5/17/2013				2	1	4e	2	07	0.56					
001042	291	208	11		5/17/2013				2	1	4f	3	07	1.17					
001043	291	208	11		5/17/2013				2	2	4e	2	07	0.9					
001044	291	208	11		5/17/2013				2	2	4f	1	07	0.18					
001045	291	208	11		5/17/2013				2	2	4g	1	07	0.1					
001046	291	208	11		5/17/2013				2	6	4e	2	07	0.69					
001047	291	208	11		5/17/2013				2	6	4f	5	07	0.86					
001048	291	208	11		5/17/2013				2	6	4g	4	07	2.48					
001049	291	208	11		5/17/2013				3	1	4e	2	07	0.17					
001050	291	208	11		5/17/2013				3	2	4e	2	07	0.05					
001051	291	208	11		5/17/2013				3	2	4f	2	07	0.21					
001052	291	208	11		5/17/2013				3	6	4e	5	07	0.2					
001053	291	208	11		5/17/2013				3	6	4f	10	07	0.71					
001054	291	208	11		5/17/2013				3	seed	seed	2	seed	0.09					Acer

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
001055	291	208	11		5/17/2013				4	1	4e	2	07	0.04					
001056	291	208	11		5/17/2013				4	6	4f	2	07	0.03					
001057	291	208	12		7/26/2013	122	291.3	208.7	1	2	5c	1	03-01	2.12	22.3	21.3	5.1		Scraper
001058	291	208	12		7/26/2013				1	3	4e	1	07	2.66					
001059	291	208	12		7/26/2013				1	6	4e	1	07	1.14					
001060	291	208	12		7/26/2013	119	291.04	208.19	1	6	5b	1	02-01	5.34	31.7*	25	9		Biface base fragment
001061	291	208	12		7/26/2013	123	291.1	208.43	1	0	0	1	08-01	76.27	44.6	36.9	32.5		Hammerstone
001062	291	208	12		7/26/2013				2	1	4f	1	07	0.16					
001063	291	208	12		7/26/2013	125	291.87	208.1	2	2	5b	1	02-01	0.8	13.3*	12.3	6.2		Biface tip fragment
001064	291	208	12		7/26/2013				2	5	4f	1	07	0.15					
001065	291	208	12		7/26/2013				2	6	4e	2	07	0.8					
001066	291	208	12		7/26/2013				2	6	4f	6	07	2.65					
001067	291	208	12		7/26/2013				3	1	4e	2	07	0.19					
001068	291	208	12		7/26/2013				3	1	4g	1	07	0.09					
001069	291	208	12		7/26/2013				3	2	4f	1	07	0.09					
001070	291	208	12		7/26/2013				3	6	4e	2	07	0.15					
001071	291	208	12		7/26/2013				3	6	4f	6	07	0.48					
001072	291	208	12		7/26/2013				3	6	4g	2	07	0.27					
001073	291	208	12		7/26/2013				4	1	4g	1	07	0.08					
001074	291	208	12		7/26/2013				4	2	4e	1	07	0.01					
001075	291	208	12		7/26/2013				4	6	4f	1	07	0.01					
001076	291	208	13		7/26/2013				1	1	4f	1	07	1.48					
001077	291	208	13		7/26/2013				1	3	4e	1	07	2.37					
001078	291	208	13		7/26/2013				2	4	4f	1	07	0.49					
001079	291	208	13		7/26/2013				2	6	4e	1	07	0.15					
001080	291	208	13		7/26/2013				2	6	4f	1	07	0.22					
001081	291	208	13		7/26/2013				3	5	4e	1	07	0.07					
001082	291	208	13		7/26/2013				3	6	4e	1	07	0.03					
001083	291	208	13		7/26/2013				3	6	4f	6	07	0.22					
001084	291	208	13		7/26/2013				3	6	4g	2	07	0.1					
001085	291	208	13		7/26/2013				4	2	4e	1	07	0.01					
001086	291	208	13		7/26/2013				4	6	4f	3	07	0.05					
001087	291	208	14		7/27/2013				2	1	4e	2	07	1					
001088	291	208	14		7/27/2013				2	5	4e	1	07	0.33					
001089	291	208	14		7/27/2013				2	6	4e	1	07	0.12					
001090	291	208	14		7/27/2013				2	6	4f	2	07	0.7					
001091	291	208	14		7/27/2013				3	1	4e	2	07	0.08					
001092	291	208	14		7/27/2013				3	1	4f	2	07	0.1					
001093	291	208	14		7/27/2013				3	6	4e	1	07	0.11					
001094	291	208	14		7/27/2013				3	6	4f	6	07	0.24					
001095	291	208	14		7/27/2013				3	6	4g	3	07	0.14					
001096	291	208	14		7/27/2013				4	6	4f	2	07	0.05					
001097	291	208	14		7/27/2013				4	6	4g	1	07	0.01					
001098	291	210	1		7/28/2013				1	1	4g	1	07	3.14					
001099	291	210	1		7/28/2013				1	6	4e	2	07	3.4					
001100	291	210	1		7/28/2013				1	6	4f	2	07	4.95					
001101	291	210	1		7/28/2013				2	1	4e	4	07	2.64					
001102	291	210	1		7/28/2013				2	1	4g	2	07	1					
001103	291	210	1		7/28/2013				2	2	4e	3	07	0.29					
001104	291	210	1		7/28/2013				2	2	4f	4	07	0.75					
001105	291	210	1		7/28/2013				2	2	4g	2	07	0.9					
001106	291	210	1		7/28/2013				2	5	4g	2	07	2.31					
001107	291	210	1		7/28/2013				2	5	5c	1	03-01	1.01	15.2*	11.2*	6.3		Scraper fragment
001108	291	210	1		7/28/2013				2	6	4e	8	07	2.24					
001109	291	210	1		7/28/2013				2	6	4f	18	07	4.22					
001110	291	210	1		7/28/2013				2	6	4g	11	07	5.54					
001111	291	210	1		7/28/2013				3	1	4e	4	07	0.16					
001112	291	210	1		7/28/2013				3	1	4f	1	07	0.02					
001113	291	210	1		7/28/2013				3	2	4e	1	07	0.01					
001114	291	210	1		7/28/2013				3	2	4f	7	07	0.5					
001115	291	210	1		7/28/2013				3	2	4g	1	07	0.1					
001116	291	210	1		7/28/2013				3	5	4e	3	07	0.28					
001117	291	210	1		7/28/2013				3	5	4f	1	07	0.03					
001118	291	210	1		7/28/2013				3	6	4e	12	07	0.95					
001119	291	210	1		7/28/2013				3	6	4f	24	07	1.31					
001120	291	210	1		7/28/2013				3	6	4g	6	07	0.74					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
001121	291	210	1		7/28/2013				3	4	4e	1	07	0.03					
001122	291	210	1		7/28/2013				3	seed	seed	1	seed	0.01					Bitter cherry
001123	291	210	1		7/28/2013				4	6	4f	1	07	0.02					
001124	291	210	3		7/30/2013				2	1	4e	1	07	0.58					
001125	291	210	3		7/30/2013				2	1	4g	1	07	2.02					
001126	291	210	3		7/30/2013				2	2	4g	1	07	0.49					
001127	291	210	3		7/30/2013				2	6	4e	3	07	0.67					
001128	291	210	3		7/30/2013				2	6	4f	5	07	1.64					
001129	291	210	3		7/30/2013				2	6	4g	1	07	0.14					
001130	291	210	3		7/30/2013				3	2	4e	1	07	0.14					
001131	291	210	3		7/30/2013				3	6	4e	4	07	0.34					
001132	291	210	3		7/30/2013				3	6	4f	4	07	0.28					
001133	291	210	3		7/30/2013				3	6	4g	1	07	0.05					
001134	291	210	3		7/30/2013				3	seed	seed	1	seed	0.03					Bitter cherry
001135	291	210	4		7/30/2013				2	2	4f	3	07	0.81					
001136	291	210	4		7/30/2013				2	6	4e	2	07	0.25					
001137	291	210	4		7/30/2013				2	6	4f	2	07	0.61					
001138	291	210	4		7/30/2013				2	6	4g	1	07	1.25					
001139	291	210	4		7/30/2013				3	1	4f	1	07	0.09					
001140	291	210	4		7/30/2013				3	5	4f	1	07	0.12					
001141	291	210	4		7/30/2013				3	4	4f	1	07	0.05					
001142	291	210	4		7/30/2013				3	6	4e	1	07	0.16					
001143	291	210	4		7/30/2013				4	6	4f	1	07	0.01					
001144	291	211	1		7/28/2014				1	1	4f	1	07	2.21					
001145	291	211	1		7/28/2014				1	0	4e	1	07	2.06					
001146	291	211	1		7/28/2014				1	6	4e	1	07	2.08					
001147	291	211	1		7/28/2014				1	6	4f	2	07	2.84					
001148	291	211	1		7/28/2014				1	6	4g	2	07	8.63					
001149	291	211	1		7/28/2014				2	1	4e	2	07	0.46					
001150	291	211	1		7/28/2014				2	1	4f	2	07	0.9					
001151	291	211	1		7/28/2014				2	2	4e	4	07	1.89					
001152	291	211	1		7/28/2014				2	2	4f	1	07	0.54					
001153	291	211	1		7/28/2014				2	5	4f	1	07	0.49					
001154	291	211	1		7/28/2014				2	5	4g	1	07	0.32					
001155	291	211	1		7/28/2014				2	6	4e	13	07	8.21					
001156	291	211	1		7/28/2014				2	6	4f	17	07	4.58					
001157	291	211	1		7/28/2014				2	6	4g	12	07	4.32					
001158	291	211	1		7/28/2014				3	1	4e	1	07	0.11					
001159	291	211	1		7/28/2014				3	1	4f	5	07	0.36					
001160	291	211	1		7/28/2014				3	1	4g	2	07	0.14					
001161	291	211	1		7/28/2014				3	2	4e	1	07	0.1					
001162	291	211	1		7/28/2014				3	2	4f	3	07	0.16					
001163	291	211	1		7/28/2014				3	5	4f	1	07	0.19					
001164	291	211	1		7/28/2014				3	5	4g	1	07	0.05					
001165	291	211	1		7/28/2014				3	6	4e	5	07	0.52					
001166	291	211	1		7/28/2014				3	6	4f	12	07	1.04					
001167	291	211	1		7/28/2014				3	6	4g	8	07	1.3					
001168	291	211	1		7/28/2014				3	seed	seed	2	seed	0.1					Bitter cherry
001169	291	211	1		7/28/2014				4	6	4f	1	07	0.03					
001170	291	211	3		7/28/2014				1	1	4f	1	07	2.26					
001171	291	211	3		7/28/2014				1	2	4f	1	07	2.18					
001172	291	211	3		7/28/2014				2	1	4e	2	07	0.35					
001173	291	211	3		7/28/2014				2	2	4f	1	07	0.56					
001174	291	211	3		7/28/2014				2	6	4e	4	07	1.3					
001175	291	211	3		7/28/2014				2	6	4f	1	07	0.33					
001176	291	211	3		7/28/2014				2	6	4g	1	07	0.47					
001177	291	211	3		7/28/2014				3	1	4f	1	07	0.04					
001178	291	211	3		7/28/2014				3	2	4e	2	07	0.17					
001179	291	211	3		7/28/2014				3	5	4g	1	07	0.06					
001180	291	211	3		7/28/2014				3	6	4f	2	07	0.02					
001181	291	211	4		7/29/2013				2	6	4f	2	07	0.24					
001182	291	211	4		7/29/2013				4	5	4f	1	07	0.01					
001183	291	211	5		7/29/2013				2	1	4f	1	07	0.12					
001184	291	211	5		7/29/2013				2	6	4e	1	07	0.12					
001185	292	206	1		4/11/2013				1	6	4g	1	07	3.73					
001186	292	206	1		4/11/2013				2	1	4f	1	07	0.12					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
001187	292	206	1		4/11/2013				2	6	4e	3	07	0.93					
001188	292	206	1		4/11/2013				2	6	4f	3	07	1.3					
001189	292	206	1		4/11/2013				2	6	4g	3	07	2.18					
001190	292	206	1		4/11/2013				3	6	4f	2	07	0.25					
001191	292	206	2		4/11/2013	15	292.4	206.01	1	1	5a	1	02-01a	12	49.5	26.7	8	16.6	Biface knife with "nib"
001192	292	206	2		4/11/2013	13	292.39	206.03	1	2	5c	1	03-17	4.03	30	20.3	7		Scraper
001193	292	206	2		4/11/2013				1	3	4e	1	07	1.64					
001194	292	206	2		4/11/2013				2	1	4e	2	07	0.27					
001195	292	206	2		4/11/2013				2	1	4f	2	07	1.92					
001196	292	206	2		4/11/2013				2	2	4f	3	07	0.73					
001197	292	206	2		4/11/2013				2	2	5a	1	01	1.09	25.3*	15.2*	4		Projectile point base fragment
001198	292	206	2		4/11/2013				2	6	4e	1	07	0.23					
001199	292	206	2		4/11/2013				2	6	4f	4	07	1.3					
001200	292	206	2		4/11/2013				2	6	4g	2	07	2.11					
001201	292	206	2		4/11/2013				2	0	0	1	20-01	3.79	22.8*	12	10.2		Ground stone
001202	292	206	3		4/27/2013				2	1	4f	1	07	0.39					
001203	292	206	3		4/27/2013				2	6	4e	1	07	0.19					
001204	292	206	3		4/27/2013				2	6	4f	3	07	1.37					
001205	292	206	3		4/27/2013				2	6	4g	1	07	0.51					
001206	292	206	3		4/27/2013				3	1	4e	1	07	0.09					
001207	292	206	3		4/27/2013				3	2	4e	1	06-02b	0.2	15.6	6.4	2.1		Microblade, intact
001208	292	206	3		4/27/2013				3	6	4e	1	07	0.08					
001209	292	206	3		4/27/2013				3	6	4f	1	07	0.01					
001210	292	206	3		4/27/2013				3	6	4g	1	07	0.2					
001211	292	206	3		4/27/2013				4	2	4e	1	07	0.01					
001212	292	206	4		4/27/2013				1	1	4e	1	07	5.6					
001213	292	206	4		4/27/2013				2	2	4g	1	07	0.59					
001214	292	206	4		4/27/2013				2	6	4f	2	07	0.58					
001215	292	206	5		4/30/2013				2	6	4e	1	07	1.26					
001216	292	206	5		4/30/2013				2	6	4f	2	07	0.67					
001217	292	206	5		4/30/2013				2	6	4g	1	07	0.49					
001218	292	206	5		4/30/2013				3	6	4f	1	07	0.04					
001219	292	206	6		5/1/2013				2	6	4e	1	07	0.18					
001220	292	206	6		5/1/2013				2	6	4f	1	07	0.3					
001221	292	206	6		5/1/2013				2	6	4g	1	07	0.59					
001222	292	206	6		5/1/2013				3	1	fossil	1	fossil	0.16	11.1	3.2	2.8		Fossil
001223	292	206	6		5/1/2013				3	6	4f	1	07	0.04					
001224	292	206	7		5/2/2013				1	6	4f	1	07	1.3					
001225	292	206	7		5/2/2013				2	1	4f	1	07	0.2					
001226	292	206	7		5/2/2013				2	2	4f	1	07	0.14					
001227	292	206	7		5/2/2013				2	6	4f	4	07	1.2					
001228	292	206	7		5/2/2013				2	6	4g	2	07	1.04					
001229	292	206	7		5/2/2013				3	1	4e	1	07	0.01					
001230	292	206	7		5/2/2013				3	1	4f	1	07	0.06					
001231	292	206	7		5/2/2013				3	6	4f	2	07	0.18					
001232	292	206	8		5/4/2013				2	1	4f	1	07	0.1					
001233	292	206	8		5/4/2013				3	1	4f	1	07	0.22					
001234	292	206	8		5/4/2013				3	seed	seed	1	seed	0.01					Bitter cherry
001235	292	206	8	2	5/4/2013				3	6	4g	1	07	0.12					
001236	292	206	9		5/15/2013				2	3	4f	1	07	1.06					
001237	292	206	9		5/15/2013				3	6	4f	1	07	0.02					
001238	292	206	11		5/17/2013				1	5	5b	1	02-01	2.26	22.2	19.4	7.3		Biface tip fragment
001239	292	206	11		5/17/2013				1	6	4e	1	07	7.19					
001240	292	206	11		5/17/2013				1	6	4f	1	07	1.46					
001241	292	206	11		5/17/2013				2	2	5c	1	03-18	1.55	25.4*	12.1*	6.1		Scraper, flake fragment
001242	292	206	12		5/17/2013				2	2	4g	1	07	0.95					
001243	292	206	12		5/17/2013				2	5	4e	1	07	0.18					
001244	292	206	12		5/17/2013				2	5	4g	1	07	0.29					
001245	292	206	12		5/17/2013				2	6	4e	1	07	0.4					
001246	292	206	12		5/17/2013				2	6	4f	2	07	0.53					
001247	292	206	12		5/17/2013				2	6	4g	1	07	0.28					
001248	292	206	12		5/17/2013				3	2	4e	1	07	0.06					
001249	290	204	1		3/7/2013				1	6	4f	2	07	3.07					
001250	290	204	1		3/7/2013				2	1	4e	1	07	0.09					
001251	290	204	1		3/7/2013				2	2	4f	1	07	0.13					
001252	290	204	1		3/7/2013				2	5	4e	1	07	1.06					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
001253	290	204	1		3/7/2013				2	5	4f	1	07	0.39					
001254	290	204	1		3/7/2013				2	6	4e	1	07	0.15					
001255	290	204	1		3/7/2013				2	6	4f	3	07	1.11					
001256	290	204	1		3/7/2013				2	6	4g	1	07	1.03					
001257	290	204	1		3/7/2013				3	1	4e	3	07	0.22					
001258	290	204	1		3/7/2013				3	1	4f	4	07	0.22					
001259	290	204	1		3/7/2013				3	2	4f	1	07	0.01					
001260	290	204	1		3/7/2013				3	2	4g	1	07	0.02					
001261	290	204	1		3/7/2013				3	5	4e	1	07	0.07					
001262	290	204	1		3/7/2013				3	6	4e	1	07	0.08					
001263	290	204	1		3/7/2013				3	6	4f	2	07	0.12					
001264	290	204	1		3/7/2013				4	1	4e	1	07	0.01					
001265	290	204	1		3/7/2013				4	2	4f	1	07	0.01					
001266	290	204	1		3/7/2013				4	6	4e	1	07	0.01					
001267	290	204	2		3/7/2013	13	290.3	204.4	1	2	5c	1	03-01	3.9	19.8	29.6	7.3		Scraper
001268	290	204	2		3/7/2013	18	290.08	204.36	1	2	5f	1	06-01	20.1	49.3	36.1	19.2		Core
001269	290	204	2		3/7/2013				1	6	5c	1	07	4.02					Edge modified flake
001270	290	204	2		3/7/2013				2	1	4e	1	07	0.13					
001271	290	204	2		3/7/2013				2	2	4e	1	07	0.34					
001272	290	204	2		3/7/2013				2	5	4f	2	07	0.43					
001273	290	204	2		3/7/2013				2	5	4g	1	07	0.64					
001274	290	204	2		3/7/2013				2	6	4e	3	07	2.69					
001275	290	204	2		3/7/2013				2	6	4f	2	07	0.95					
001276	290	204	2		3/7/2013				2	6	4g	2	07	0.92					
001277	290	204	2		3/7/2013				3	1	4e	1	07	0.03					
001278	290	204	2		3/7/2013				3	1	4f	2	07	0.15					
001279	290	204	2		3/7/2013				3	2	4e	3	07	0.25					
001280	290	204	2		3/7/2013				3	2	4f	2	07	0.15					
001281	290	204	2		3/7/2013				3	2	4g	1	07	0.09					
001282	290	204	2		3/7/2013				3	5	4e	1	07	0.06					
001283	290	204	2		3/7/2013				3	6	4e	2	07	0.2					
001284	290	204	2		3/7/2013				3	6	4f	2	07	0.12					
001285	290	204	2		3/7/2013				3	6	4g	5	07	0.65					
001286	290	204	2		3/7/2013				4	1	4e	1	07	0.01					
001287	290	204	2		3/7/2013				4	6	4f	1	07	0.02					
001288	290	204	3		3/8/2013				2	1	4e	1	07	0.15					
001289	290	204	3		3/8/2013				2	2	4e	1	07	0.14					
001290	290	204	3		3/8/2013				2	3	4f	1	07	0.17					
001291	290	204	3		3/8/2013				2	3	4g	1	07	0.13					
001292	290	204	3		3/8/2013				2	6	4e	2	07	0.34					
001293	290	204	3		3/8/2013				2	6	4f	2	07	0.89					
001294	290	204	3		3/8/2013				2	6	4g	1	07	0.87					
001295	290	204	3		3/8/2013				3	2	4e	1	07	0.15					
001296	290	204	3		3/8/2013				3	2	4f	3	07	0.15					
001297	290	204	3		3/8/2013				3	5	4e	1	07	0.05					
001298	290	204	3		3/8/2013				3	5	4g	1	07	0.1					
001299	290	204	3		3/8/2013				3	6	4e	1	07	0.09					
001300	290	204	3		3/8/2013				3	6	4f	4	07	0.3					
001301	290	204	3		3/8/2013				3	6	4g	4	07	0.06					
001302	290	204	3		3/8/2013				4	2	4f	1	07	0.01					
001303	290	204	3		3/8/2013				4	6	4f	1	07	0.01					
001304	290	204	4		3/8/2013				1	6	4e	1	07	2					
001305	290	204	4		3/8/2013				2	1	4e	1	07	0.12					
001306	290	204	4		3/8/2013				2	2	4f	1	07	0.18					
001307	290	204	4		3/8/2013				2	6	4f	2	07	0.47					
001308	290	204	4		3/8/2013				3	1	4e	2	07	0.11					
001309	290	204	4		3/8/2013				3	6	4e	2	07	0.16					
001310	290	204	4		3/8/2013				3	6	4f	1	07	0.04					
001311	290	204	5		3/8/2013				2	2	4e	1	07	0.33					
001312	290	204	5		3/8/2013				2	2	4f	1	07	0.2					
001313	290	204	5		3/8/2013				2	2	4g	1	07	1.57					
001314	290	204	5		3/8/2013				2	6	4f	4	07	0.95					
001315	290	204	5		3/8/2013				2	6	4g	1	07	0.27					
001316	290	204	5		3/8/2013				3	1	4e	1	07	0.04					
001317	290	204	5		3/8/2013				3	6	4e	1	07	0.01					
001318	290	204	5		3/8/2013				3	6	4f	2	07	0.19					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
001319	290	204	5		3/8/2013				1	6	4e	1	07	4.52					
001320	290	204	5		3/8/2013				2	1	4f	1	07	0.1					
001321	290	204	6		3/10/2013				1	6	4g	1	07	5.93					
001322	290	204	6		3/10/2013				2	1	4e	1	07	0.14					
001323	290	204	6		3/10/2013				2	1	5e	1	06-02	0.68	16.8	12.1	2.7		Microblade rejuv. flk.
001324	290	204	6		3/10/2013				2	2	4e	1	07	0.46					
001325	290	204	6		3/10/2013				2	2	4f	2	07	0.33					
001326	290	204	6		3/10/2013				2	6	4e	2	07	0.67					
001327	290	204	6		3/10/2013				2	6	4f	4	07	0.58					
001328	290	204	6		3/10/2013				2	6	4g	3	07	0.97					
001329	290	204	6		3/10/2013				3	1	4e	1	07	0.06					
001330	290	204	6		3/10/2013				3	1	4f	1	06-02b	0.04	6.8	4.2	1.2		Microblade midsection
001331	290	204	6		3/10/2013				3	1	4g	1	07	0.06					
001332	290	204	6		3/10/2013				3	2	4e	1	07	0.02					
001333	290	204	6		3/10/2013				3	2	4f	1	07	0.05					
001334	290	204	6		3/10/2013				3	2	4g	1	07	0.07					
001335	290	204	6		3/10/2013				3	5	4f	1	07	0.01					
001336	290	204	6		3/10/2013				3	5	4g	1	07	0.12					
001337	290	204	6		3/10/2013				3	6	4f	3	07	0.12					
001338	290	204	6		3/10/2013				4	1	4f	1	07	0.01					
001339	290	204	6		3/10/2013				4	2	4f	1	07	0.02					
001340	290	204	7		3/16/2013				1	2	4e	1	07	1.46					
001341	290	204	7		3/16/2013				2	1	4e	1	07	0.23					
001342	290	204	7		3/16/2013				2	2	4e	1	07	0.16					
001343	290	204	7		3/16/2013				2	2	4f	2	07	0.3					
001344	290	204	7		3/16/2013				2	6	4f	7	07	2.49					
001345	290	204	7		3/16/2013				3	1	4e	2	07	0.13					
001346	290	204	7		3/16/2013				3	2	4e	1	07	0.02					
001347	290	204	7		3/16/2013				3	2	4f	1	07	0.02					
001348	290	204	7		3/16/2013				3	6	4e	2	07	0.23					
001349	290	204	7		3/16/2013				3	6	4f	3	07	0.04					
001350	290	204	7		3/16/2013				3	6	4g	1	07	0.07					
001351	290	204	8		3/16/2013				1	2	5c	1	07	7.43					Edge modified flake
001352	290	204	8		3/16/2013				1	6	4e	1	07	2.52					
001353	290	204	8		3/16/2013				1	0	0	1	08-01	0	97.3	58.5	30.2		Hammerstone
001354	290	204	8		3/16/2013				2	1	4e	2	07	0.24					
001355	290	204	8		3/16/2013				2	1	4f	1	07	0.14					
001356	290	204	8		3/16/2013				2	2	4e	2	07	0.61					
001357	290	204	8		3/16/2013				2	5	4f	1	07	0.09					
001358	290	204	8		3/16/2013				2	6	4f	6	07	0.9					
001359	290	204	8		3/16/2013				2	6	4g	4	07	1.64					
001360	290	204	8		3/16/2013				3	1	4e	1	07	0.09					
001361	290	204	8		3/16/2013				3	2	4e	1	07	0.1					
001362	290	204	8		3/16/2013				3	6	4f	2	07	0.25					
001363	290	204	8		3/16/2013				3	6	4g	1	07	0.23					
001364	290	204	8		3/16/2013				4	2	4e	1	07	0.02					
001365	290	204	9		3/16/2013				1	6	4e	1	07	3.8					Acid worn flake
001366	290	204	9		3/16/2013				2	2	4f	1	07	0.17					
001367	290	204	9		3/16/2013				2	5	4e	1	07	0.06					
001368	290	204	9		3/16/2013				2	5	4g	1	07	1.08					
001369	290	204	9		3/16/2013				2	6	4f	4	07	0.96					
001370	290	204	9		3/16/2013				2	6	4g	1	07	0.27					
001371	290	204	9		3/16/2013				3	2	4e	1	07	0.11					
001372	290	204	9		3/16/2013				3	6	4f	1	07	0.07					
001373	290	204	10		3/18/2013				2	6	4e	1	07	0.15					
001374	290	204	10		3/18/2013				2	6	4f	3	07	1.21					
001375	290	204	11		3/18/2013				1	6	4e	1	07	1.33					
001376	290	204	11		3/18/2013				1	6	4f	1	07	0.57					
001377	290	204	11		3/18/2013				2	2	4e	1	07	0.22					
001378	290	204	11		3/18/2013				2	2	4f	1	07	0.15					
001379	290	204	11		3/18/2013				2	6	4e	1	07	0.36					
001380	290	204	11		3/18/2013				2	6	4f	4	07	0.75					
001381	290	204	11		3/18/2013				2	6	4g	2	07	0.67					
001382	290	204	11		3/18/2013				3	1	4e	1	07	0.09					
001383	290	204	11		3/18/2013				3	1	4f	1	07	0.09					
001384	290	204	11		3/18/2013				3	2	4e	1	07	0.03					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
001385	290	204	11		3/18/2013				3	2	4f	1	07	0.09					
001386	290	204	11		3/18/2013				3	5	4e	1	07	0.02					
001387	290	204	11		3/18/2013				3	5	4f	1	07	0.02					
001388	290	204	11		3/18/2013				3	4	4f	1	07	0.04					
001389	290	204	11		3/18/2013				3	6	4e	1	07	0.1					
001390	290	204	11		3/18/2013				3	6	4f	1	07	0.06					
001391	290	204	11		3/18/2013				4	1	4e	2	07	0.04					
001392	290	204	11		3/18/2013				4	1	4f	1	07	0.01					
001393	290	204	12		3/19/2013				1	6	4f	1	07	1.16					
001394	290	204	12		3/19/2013				2	1	4f	1	07	0.16					
001395	290	204	12		3/19/2013				2	2	4e	1	07	0.61					
001396	290	204	12		3/19/2013				2	6	4e	2	07	0.55					
001397	290	204	12		3/19/2013				2	6	4f	2	07	0.53					
001398	290	204	12		3/19/2013				3	6	4f	2	07	0.09					
001399	290	204	12		3/19/2013				4	2	4e	1	07	0.02					
001400	290	204	13		3/19/2013	126	290.18	204.7	1	1	5c	1	03-02	3.17	26.3	16.6	7		Scraper
001401	290	204	13		3/19/2013				1	2	4f	1	07	1.2					
001402	290	204	13		3/19/2013				2	1	4f	1	07	1.59					
001403	290	204	13		3/19/2013				2	1	4e	1	07	0.53					
001404	290	204	13		3/19/2013				2	6	4e	3	07	1.19					
001405	290	204	13		3/19/2013				2	6	4f	3	07	1.1					
001406	290	204	13		3/19/2013				2	6	4g	1	07	0.42					
001407	290	204	13		3/19/2013				3	1	4e	2	07	0.05					
001408	290	204	13		3/19/2013				3	1	4f	1	07	0.05					
001409	290	204	13		3/19/2013				3	2	4e	2	07	0.14					
001410	290	204	13		3/19/2013				3	2	4f	3	07	0.19					
001411	290	204	13		3/19/2013				3	6	4f	1	07	0.04					
001412	290	204	14		3/25/2013				1	1	4e	1	07	1.25					
001413	290	204	14		3/25/2013				1	1	4f	1	07	1.89					
001414	290	204	14		3/25/2013				2	1	4e	2	07	0.26					
001415	290	204	14		3/25/2013				2	2	4f	1	07	0.25					
001416	290	204	14		3/25/2013				2	6	4e	1	07	0.43					
001417	290	204	14		3/25/2013				2	6	4f	4	07	0.79					
001418	290	204	14		3/25/2013				3	1	4e	1	07	0.07					
001419	290	204	14		3/25/2013				3	2	4f	1	07	0.02					
001420	290	204	14		3/25/2013				3	6	4e	1	07	0.08					
001421	290	204	14		3/25/2013				3	6	4f	1	07	0.04					
001422	290	204	14		3/25/2013				3	6	4g	1	07	0.1					
001423	290	204	15		3/25/2013				2	6	4f	1	07	0.16					
001424	290	204	15		3/25/2013				3	6	4e	1	07	0.14					
001425	290	204	15		3/25/2013				1	6	4g	1	07	1.98					
001426	290	204	16		3/25/2013				2	1	4e	1	07	0.12					
001427	290	204	16		3/25/2013				2	6	4f	1	07	0.31					
001428	290	204	16		3/25/2013				3	1	4f	1	07	0.05					
001429	290	204	16		3/25/2013				3	6	4f	1	07	0.07					
001430	293	208	1		6/23/2013				1	1	4e	2	07	1.92					
001431	293	208	1		6/23/2013	15	293.6	208.5	1	1	5a	1	01-05a	3.75	35.1	20.5	5.5	7.5	Projectile point
001432	293	208	1		6/23/2013				1	1	5a	1	01-10	1.88	29.8	13.2	6.1	4.7	Projectile point
001433	293	208	1		6/23/2013				1	1	5f	1	06-01	55.05	73.3	45.7	16		Core
001434	293	208	1		6/23/2013				1	2	5b	1	02	1.24	15.2*	16	5.1		Biface base fragment
001435	293	208	1		6/23/2013				1	3	4e	1	07	7.68	39.5955556				
001436	293	208	1		6/23/2013				1	4	4e	1	07	3.01					
001437	293	208	1		6/23/2013				1	5	4g	1	07	2.95					
001438	293	208	1		6/23/2013				1	6	4e	2	07	12.19					
001439	293	208	1		6/23/2013				1	6	4f	2	07	4.43					
001440	293	208	1		6/23/2013				1	6	4g	2	07	7.42					
001441	293	208	1		6/23/2013				1	7	0	1	10-03	170.5	62.8*	46.2	47		Pestle fragment
001442	293	208	1		6/23/2013				2	1	4e	5	07	2.48					
001443	293	208	1		6/23/2013				2	1	4f	4	07	0.55					
001444	293	208	1		6/23/2013				2	2	4e	1	07	0.43					
001445	293	208	1		6/23/2013				2	2	4f	4	07	1.28					
001446	293	208	1		6/23/2013				2	2	4g	2	07	1.3					
001447	293	208	1		6/23/2013				2	2	5d	1	07	0.6					Edge modified flake
001448	293	208	1		6/23/2013				2	5	4e	1	07	0.38					
001449	293	208	1		6/23/2013				2	5	4f	2	07	0.33					
001450	293	208	1		6/23/2013				2	6	4e	7	07	2.46					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
001451	293	208	1		6/23/2013				2	6	4f	22	07	8.81					
001452	293	208	1		6/23/2013				2	6	4g	7	07	4.2					
001453	293	208	1		6/23/2013				3	1	4e	6	07	0.37					
001454	293	208	1		6/23/2013				3	1	4f	2	07	0.06					
001455	293	208	1		6/23/2013				3	1	4g	2	07	0.24					
001456	293	208	1		6/23/2013				3	2	4e	4	07	0.4					
001457	293	208	1		6/23/2013				3	2	4f	3	07	0.18					
001458	293	208	1		6/23/2013				3	2	4g	2	07	0.18					
001459	293	208	1		6/23/2013				3	1	5a	1	01	0.07					Projectile point tang fragment
001460	293	208	1		6/23/2013				3	5	4e	1	07	0.11					
001461	293	208	1		6/23/2013				3	5	4f	4	07	0.21					
001462	293	208	1		6/23/2013				3	6	4e	3	07	0.26					
001463	293	208	1		6/23/2013				3	6	4f	15	07	1.17					
001464	293	208	1		6/23/2013				3	6	4g	8	07	1.2					
001465	293	208	1		6/23/2013				4	1	4e	1	07	0.01					
001466	293	208	1		6/23/2013				4	6	4f	2	07	0.03					
001467	293	208	3		7/7/2013				2	1	4e	2	07	0.37					
001468	293	208	3		7/7/2013				2	1	4f	1	07	0.71					
001469	293	208	3		7/7/2013				2	2	4e	1	07	0.38					
001470	293	208	3		7/7/2013				2	2	4f	3	07	1.01					
001471	293	208	3		7/7/2013				2	5	4f	1	07	0.66					
001472	293	208	3		7/7/2013				2	6	4e	5	07	3.69					
001473	293	208	3		7/7/2013				2	6	4f	12	07	4.29					
001474	293	208	3		7/7/2013				2	6	4g	10	07	4.75					
001475	293	208	3		7/7/2013				2	7	4f	1	07	0.63					
001476	293	208	3		7/7/2013				3	1	4e	1	07	0.1					
001477	293	208	3		7/7/2013				3	1	4f	5	07	0.55					
001478	293	208	3		7/7/2013				3	2	4f	2	07	0.44					
001479	293	208	3		7/7/2013				3	5	4f	2	07	0.1					
001480	293	208	3		7/7/2013				3	5	4g	3	07	0.48					
001481	293	208	3		7/7/2013				3	6	4e	3	07	0.27					
001482	293	208	3		7/7/2013				3	6	4f	10	07	1					
001483	293	208	3		7/7/2013				3	6	4g	3	07	0.53					
001484	293	208	4		7/8/2013				1	2	4g	1	07	4.08					
001485	293	208	4		7/8/2013				1	6	4f	2	07	7.26					
001486	293	208	4		7/8/2013				1	6	4g	3	07	17.05					
001487	293	208	4		7/8/2013				2	1	4e	1	07	0.17					
001488	293	208	4		7/8/2013				2	1	4f	2	07	0.28					
001489	293	208	4		7/8/2013				2	2	4f	3	07	0.64					
001490	293	208	4		7/8/2013				2	4	4f	1	07	0.48					
001491	293	208	4		7/8/2013				2	5	4g	1	07	0.13					
001492	293	208	4		7/8/2013				2	6	4e	4	07	1.16					
001493	293	208	4		7/8/2013				2	6	4f	4	07	1.66					
001494	293	208	4		7/8/2013				2	6	4g	9	07	6.39					
001495	293	208	4		7/8/2013				2	2	4e	1	07	0.22					
001496	293	208	4		7/8/2013				2	2	4g	1	07	0.24					
001497	293	208	4		7/8/2013				2	2	5b	1	01	1.14	17.5*	14.7*	6.8		Projectile point tip fragment
001498	293	208	4		7/8/2013				1	6	4e	1	07	1.07					
001499	293	208	4		7/8/2013	36	293.12	208.64	1	6	5f	1	06-01	45.39	54.3	36.8	24.3		Core
001500	293	208	4		7/8/2013				3	1	4e	1	07	0.08					
001501	293	208	4		7/8/2013				3	1	4f	6	07	0.47					
001502	293	208	4		7/8/2013				3	1	4g	1	07	0.06					
001503	293	208	4		7/8/2013				3	2	4e	1	07	0.04					
001504	293	208	4		7/8/2013				3	2	4f	1	07	0.04					
001505	293	208	4		7/8/2013				3	5	4e	2	07	0.13					
001506	293	208	4		7/8/2013				3	6	4f	1	07	0.03					
001507	293	208	4		7/8/2013				3	6	4g	2	07	0.14					
001508	293	208	4		7/8/2013				3	7	4g	1	07	0.18					
001509	293	208	4		7/8/2013				3	seed	seed	3	seed	0.08					Bitter cherry
001510	293	208	4		7/8/2013				4	6	4f	1	07	0.01					
001511	293	208	4	5	7/8/2013	41	293.17	208.91	1	6	4g	1	07	1.86					
001512	293	208	4	5	7/8/2013				1	6	0	1	08-01	0	86.3	56.2	39.9		Hammerstone
001513	293	208	5		7/11/2013				1	1	4e	1	07	1.31					
001514	293	208	5		7/11/2013	51	293.99	208.02	1	4	5c	1	03-14	21.09	53.3	19.6	15.2		Scraper
001515	293	208	5		7/11/2013				1	6	4e	2	07	3.55					
001516	293	208	5		7/11/2013				1	6	4f	2	07	4.56					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
001517	293	208	5		7/11/2013				1	6	4g	1	07	1.21					
001518	293	208	5		7/11/2013				2	1	4e	1	07	0.08					
001519	293	208	5		7/11/2013				2	1	4f	1	07	0.16					
001520	293	208	5		7/11/2013				2	1	4g	2	07	0.76					
001521	293	208	5		7/11/2013				2	2	4f	2	07	0.43					
001522	293	208	5		7/11/2013				2	6	4e	4	07	0.79					
001523	293	208	5		7/11/2013				2	6	4f	6	07	0.74					
001524	293	208	5		7/11/2013				2	6	4g	1	07	0.44					
001525	293	208	5		7/11/2013				3	1	4e	2	07	0.09					
001526	293	208	5		7/11/2013				3	1	4f	2	07	0.26					
001527	293	208	5		7/11/2013				3	2	4f	1	07	0.06					
001528	293	208	5		7/11/2013				3	5	4f	2	07	0.12					
001529	293	208	5		7/11/2013				3	6	4f	3	07	0.35					
001530	293	208	5		7/11/2013				3	6	4g	3	07	0.32					
001531	293	208	5		7/11/2013				3	seed	seed	2	seed	0.05					Bitter cherry
001532	293	208	6		7/12/2013				1	6	4e	2	07	16.47					
001533	293	208	6		7/12/2013				1	6	4g	2	07	6.02					
001534	293	208	6		7/12/2013				2	1	4g	1	07	0.5					
001535	293	208	6		7/12/2013	60	293.08	208.43	2	1	5c	1	07	0.77	17	13.3	3.8		Edge modified flake
001536	293	208	6		7/12/2013				2	2	4f	1	07	0.37					
001537	293	208	6		7/12/2013				2	6	4e	2	07	0.27					
001538	293	208	6		7/12/2013				2	6	4f	3	07	0.4					
001539	293	208	6		7/12/2013				2	6	5b	1	01	1.2	19.2	15.6	5.8		Projectile point tip fragment
001540	293	208	6		7/12/2013				3	2	4e	1	07	0.04					
001541	293	208	6		7/12/2013				3	2	4f	2	07	0.15					
001542	293	208	6		7/12/2013				3	6	4e	2	07	0.13					
001543	293	208	6		7/12/2013				3	6	4f	7	07	0.45					
001544	293	208	6		7/12/2013				4	1	4f	1	07	0.03					
001545	293	208	6		7/12/2013				4	6	4f	4	07	0.12					
001546	293	208	7		7/13/2013	74	293.63	208.01	1	4	5f	1	06-01	11.91	32.2	27.4	9.3		Core, small
001547	293	208	7		7/13/2013				2	1	4g	1	07	0.34					
001548	293	208	7		7/13/2013				2	2	4f	1	07	0.39					
001549	293	208	7		7/13/2013				2	5	4g	1	07	0.56					
001550	293	208	7		7/13/2013				2	6	4e	1	07	0.35					
001551	293	208	7		7/13/2013				2	6	4f	1	07	0.34					
001552	293	208	7		7/13/2013				2	6	4g	2	07	1.48					
001553	293	208	7		7/13/2013				3	6	4e	1	07	0.14					
001554	293	208	8		7/14/2013	82	293.69	208.09	1	3	5c	1	03-01	5.38	32.7	22.8	9.8		Scraper
001555	293	208	8		7/14/2013				1	6	4g	1	07	1.77					
001556	293	208	8		7/14/2013				2	6	4e	2	07	0.47					
001557	293	208	8		7/14/2013				2	6	4f	5	07	0.91					
001558	293	208	8		7/14/2013				3	1	4e	3	07	0.45					
001559	293	208	8		7/14/2013				3	1	4g	1	07	0.2					
001560	293	208	8		7/14/2013				3	2	4f	1	07	0.05					
001561	293	208	8		7/14/2013				3	6	4e	1	07	0.12					
001562	293	208	8		7/14/2013				3	6	4f	2	07	0.52					
001563	293	208	8		7/14/2013				3	6	4g	1	07	0.32					
001564	293	208	9		7/16/2013				2	1	5c	1	07	1.44					Edge modified flake
001565	280	201	1		5/20/2013				1	6	4g	1	07	3.32					
001566	280	201	1		5/20/2013				1	6	5f	1	06-01	20.07	38.8	36.6	25.7		Core
001567	280	201	1		5/20/2013				2	2	4e	1	07	0.25					
001568	280	201	1		5/20/2013				2	2	4g	3	07	1.09					
001569	280	201	1		5/20/2013				2	5	4e	1	07	0.11					
001570	280	201	1		5/20/2013				2	5	4f	1	07	0.25					
001571	280	201	1		5/20/2013				2	5	4g	2	07	0.51					
001572	280	201	1		5/20/2013				2	6	4e	3	07	1.1					
001573	280	201	1		5/20/2013				2	6	4f	4	07	1.25					
001574	280	201	1		5/20/2013				2	6	4g	7	07	1.75					
001575	280	201	1		5/20/2013				2	seed	seed	1	seed	0.3					Hazelnut
001576	280	201	1		5/20/2013				3	1	4e	4	07	0.25					
001577	280	201	1		5/20/2013				3	1	4f	3	07	0.09					
001578	280	201	1		5/20/2013				3	2	4e	1	07	0.08					
001579	280	201	1		5/20/2013				3	6	4e	3	07	0.1					
001580	280	201	1		5/20/2013				3	6	4f	12	07	0.83					
001581	280	201	1		5/20/2013				3	6	4g	3	07	0.28					
001582	280	201	1		5/20/2013				3	6	4f	3	07	0.05					

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
001583	280	201	3		5/20/2013	25	280.76	201.26	1	5	5b	1	02-01	11.54	49.5	25.9	9.5		Biface knife with platform
001584	280	201	3		5/20/2013				1	6	4f	1	07	1.19					
001585	280	201	3		5/20/2013				1	6	4g	1	07	1.52					
001586	280	201	3		5/20/2013				2	1	4e	1	07	0.2					
001587	280	201	3		5/20/2013				2	2	4f	1	07	0.2					
001588	280	201	3		5/20/2013				2	6	4f	5	07	1.39					
001589	280	201	3		5/20/2013				2	6	4g	2	07	1.36					
001590	280	201	3		5/20/2013				3	6	4f	2	07	0.13					
001591	280	201	3		5/20/2013				3	6	4g	1	07	0.07					
001592	280	201	4		5/22/2013				2	6	4f	2	07	0.83					
001593	280	201	4		5/22/2013				2	6	4g	1	07	2.41					
001594	280	201	5		5/22/2013				3	6	4e	1	07	0.14					
001595	280	201	5		5/22/2013				3	6	4f	1	07	0.02					
001596	260	162	1		3/22/2013				1	1	4f	1	07	4.17					
001597	260	162	1		3/22/2013				1	1	4g	1	07	5.09					
001598	260	162	1		3/22/2013				1	6	4e	2	07	3.08					
001599	260	162	1		3/22/2013				1	6	4f	2	07	7.34					
001600	260	162	1		3/22/2013				1	6	4g	1	07	13.2					
001601	260	162	1		3/22/2013				2	1	4e	3	07	1.4					
001602	260	162	1		3/22/2013				2	1	4f	8	07	3.02					
001603	260	162	1		3/22/2013				2	2	4e	1	06-02b	0.08	12.8	5.9	1		Microblade, no termination
001604	260	162	1		3/22/2013				2	2	4f	2	07	0.41					
001605	260	162	1		3/22/2013				2	2	5c	1	03-19	2.46	29.6	14.1	5.2		Scraper
001606	260	162	1		3/22/2013				2	5	4f	1	07	0.18					
001607	260	162	1		3/22/2013				2	5	4g	1	07	2.7					
001608	260	162	1		3/22/2013				2	6	4e	4	07	2.21					
001609	260	162	1		3/22/2013				2	6	4f	6	07	3.88					
001610	260	162	1		3/22/2013				2	6	4g	7	07	3.32					
001611	260	162	1		3/22/2013				3	1	4e	2	07	0.21					
001612	260	162	1		3/22/2013				3	1	4f	4	07	0.36					
001613	260	162	1		3/22/2013				3	2	4f	1	07	0.03					
001614	260	162	1		3/22/2013				3	5	4f	1	07	0.03					
001615	260	162	1		3/22/2013				3	6	4f	1	07	0.1					
001616	260	162	1		3/22/2013				3	6	4g	1	07	0.1					
001617	260	162	1		3/22/2013				4	1	4f	1	07	0.01					
001618	260	162	1		3/22/2013				4	5	4f	1	07	0.01					
001619	260	162	4		3/22/2013				2	6	4e	1	07	0.49					
001620	260	162	4		3/22/2013				2	6	4f	1	07	0.17					
001621	260	162	4		3/22/2013				2	6	4g	1	07	0.65					
001622	260	162	4		3/22/2013				3	1	4e	2	07	0.1					
001623	260	162	4		3/22/2013				3	1	4f	4	07	0.29					
001624	260	162	4		3/22/2013				3	2	4f	2	07	0.04					
001625	260	162	4		3/22/2013				3	6	4f	2	07	0.27					
001626	260	162	4		3/22/2013				3	seed	seed	1	seed	0.09					Hazelnut
001627	260	162	5		3/22/2013				2	6	4g	1	07	0.37					
001628	260	162	5		3/22/2013				3	2	4g	1	07	0.1					
001629	260	162	5		3/22/2013				3	6	4f	4	07	0.31					
001630	260	162	5		3/22/2013				3	6	4g	3	07	0.46					
001631	260	162	6		3/23/2013	59	260.75	162.37	1	2	5f	1	06-01	11	35.9	22.6	20.2		Core
001632	260	162	6		3/23/2013				3	1	4f	1	07	0.09					
001633	260	162	6		3/23/2013				3	6	4f	1	07	0.03					
001634	260	162	7		3/23/2013				2	6	4g	1	07	0.66					
001635	260	162	7		3/23/2013				3	6	4f	1	07	0.06					
001636	260	162	8		3/23/2013				2	1	4f	1	07	0.34					
001637	260	162	8		3/23/2013				2	6	4g	1	07	1.57					
001638	260	162	8		3/23/2013				3	6	4e	1	07	0.13					
001639	260	162	8		3/23/2013				3	6	4f	1	07	0.05					
001640	260	162	9		3/24/2013				2	5	4f	1	07	0.42					
001641	260	162	9		3/24/2013				2	6	4f	1	07	0.25					
001642	260	162	9		3/24/2013				3	2	4f	1	07	0.13					
001643	260	162	9		3/24/2013				3	6	4f	1	07	0.02					
001644	260	162	9		3/24/2013				3	6	4g	1	07	0.02					
001645	260	162	9		3/24/2013				3	6	root cast	1	root	0.49					Root cast, rust
001646	260	162	11		3/24/2013				3	2	4g	1	07	0.13					
001647	surface	surface	0		3/2/2013	0			1	2	5a	1	01-09	4.05	35.6	27	6.3	6.5	Projectile point
001648	266	187	0		4/8/2013	0			1	6	5a	1	01-06a	6.65	47.4	19.9	10.7		Projectile point

Catalog #	Unit, North	Unit, East	Level	Feature	Date	B.D. *in-situ*	N. *in-situ*	E. *in-situ*	Size Class	Material	Morp. Class	Count	Willapa Class	Weight g	Length mm	Width mm	Thick mm	N. Width mm	Description
001649	0	0	0		3/19/2013	0			1	6	5a	1	02-01a	2.88	27.5*	23.8	5.6		Biface base fragment
001650	0	0	0		3/3/2013	0			1	5	5a	1	02-01a	3.22	21.2*	23.3	6.5		Biface base fragment
001651	0	0	0		3/2/2013	0			3	2	5b	1	02-01a	0.23	8.2*	9.3*	3.6		Biface tip fragment
001652	0	0	0		3/4/2013	0			1	7	5b	1	02-01a	8.01	32.2*	30	6.2		Biface base fragment
001653	0	0	0		7/10/2013	0			1	5	5d	1	03-07	3.88	21.9	20	6.5		Scraper
001654	0	0	0		7/7/2013	0			2	1	5d	1	03-08	1.62	13*	17.3	5		Scraper fragment
001655	0	0	0		7/31/2013	0			2	2	5d	1	03-18	1.06	22.7	12.6	3.4		Scraper, flake
001656	0	0	0		3/3/2013	0			1	1	5b	1	04-01	4.43	30.2	18.9	7.9		Graver
001657	0	0	0		3/2/2013	0			1	1	5d	1	03-17	24.9	57.8	36	12.5		Scraper
001658	0	0	0		3/3/2013	0			1	1	5f	1	06-01	67.12	65.7	47.2	22		Core
001659	294	206	3		6/15/2013				3	9	4e	1	07						Glass Buttes 1 *, 294206-03
001660	294	206	5		6/6/2013				3	9	4e	1	07						Whitewater Ridge *, 294206-05
001661	291	208	4		4/28/2013				3	9	4e	1	07						Whitewater Ridge *, 291208-04
001662	291	208	10		4/15/2014	101	51	18	3	9	4f	1	07						Obsidian Cliffs *, 291208-10A
001663	291	208	10		4/15/2013	98	84	33	3	9	4f	1	07						Obsidian Cliffs *, 291208-10B
001664	291	208	6		4/29/2013				3	9	4e	1	07						Obsidian Cliffs *, 291208-06
001665	291	208	7		4/29/2013				3	9	4e	1	07						Newberry Volcano, 291208-07
001666	294	207	1		6/21/2013				4	9	4e	1	07						Glass Buttes 1 *, 294207-01A
001667	294	207	1		6/21/2013				3	9	4e	1	07						Glass Buttes 1? *, 294207-01B
001668	293	208	3		7/7/2013				3	9	4f	1	07						Obsidian Cliffs *, 293208-03A
001669	293	208	3		7/7/2013	29	37	97	4	9	4e	1	07						Glass Buttes 1? *, 293208-03B
001670	294	207	5		7/11/2013				3	9	4e	1	07						Obsidian Cliffs *, 294207-05b
001671	291	207	12		7/13/2013				2	9	4f	1	07						Timber Butte *, 291207-12
001672	291	210	1		7/25/2013				3	9	4e	1	07						Glass Buttes 1 *, 291210-01
001673	291	208	13		7/26/2013				3	9	4f	1	07						Newberry Volcano, 291208-13
001674	291	211	5		7/29/2013				3	9	4f	1	07						Obsidian Cliffs *, 291211-05
001675	291	210	3		7/30/2013				3	9	4f	1	07						Newberry Volcano, 291210-3b
001676	291	210	4		7/30/2013				3	9	4f	1	07						Newberry Volcano, 291210-04
001677	280	201	1		5/19/2013				3	9	4e	1	07						Too small
001678	280	201	1		5/19/2013				4	9	4e	1	07						Too small
001679	294	207	1		6/22/2013				4	9	4e	1	07						Too small
001680	293	208	1		6/23/2013				4	9	4f	1	07						Too small
001681	290	204	1		3/3/2013				3	9	4f	1	07						Too small
001682	260	162	1		3/5/2013				3	9	4f	1	07						Too small
001683	294	207	5		7/9/2013				3	9	4e	1	07						Too small
001684	291	210	3		7/30/2013				3	9	4e	1	07						Too small
001685	surface	surface	0		7/30/2013					cobble		1	09-02						Cobble mortar, terrace slope

Willapa River Valley Lithic Raw Material Types:

01 Fossiliferous cryptocrystalline silicate
The translucent and opaque cryptocrystalline silicate (ccs) is locally available in the form of Oligocene clams, intact and segmented nautiloid, and other fossilized marine biota. The material is most often translucent milky white. It can be opaque white to translucent tan, and have translucent orange patches. The material can have cloudy, opaque, or crystal inclusions. Green Creek has many fossil clams.

02 Orange and red "jasper".
The opaque red and orange ccs is locally available as pebbles and cobbles from Willapa River gravels. The material varies in quality from possessing a waxy/glassy luster to exhibiting a very fine particulate grain. The material can exhibit thin bands/veins of translucent chalcedony. The red and orange ccs can be speckled.

03 Banded cryptocrystalline silicate
The opaque and transparent ccs with banded and swirled colors of green, olive, brown, burgundy, and red is locally available in the gravels of the Willapa River. Most fragments of the material have bands or patches with distinct texture, color, and transparency. The material exhibits widely varying swirled and banded patterns but exhibits cohesive color and texture combinations.

04 Petrified wood
The petrified wood chalcedony materials exhibit structural elements of the original living plant: growth rings, epidermis, or other structured vegetal tissues. Color and texture varies. Petrified wood is locally available in the gravels of the Willapa River Valley.

05 Misc. cryptocrystalline silicate
A great diversity of ccs and chert of variable color and texture is available from the local marine terrace gravels. Some of this material may have been acquired through exchange networks or travel. The full spectrum of colors is represented with a variety of striped, speckled, solid, and cloudy patterns.

06 Indurated siltstone
Indurated siltstone material forms the bedrock of most of the Willapa River Valley. High Quality cobbles are abundantly available in the Willapa River gravels. Colors of indurated siltstone include: gray, tan, brown, red/burgundy, & slightly purple. Variable textures from glossy to chalky. Color banding is not uncommon. The material has a strong effervescent reaction to sulfuric acid, and is likely indurated with calcium-rich minerals. The material develops a distinct cortical rind

07 Basalt/Andesite
Basalt, Andesite, Andesitic Basalt, etc. . . .
High quality andesitic materials are available from the Crescent Formation within the Willapa Hills and the North River watershed. The Palix River is a source of high-quality andesitic materials. There are high quality andesitic materials available in the vicinity of Fall River in the North River watershed.

08 Dacite
There are rare occurrences of this high quality igneous volcanic rock in the Willapa Valley. The material is opaque. The color is dark gray to black. The dacite is discernibly more brittle and fine-grained than the highest quality andesite. The material may be locally available in glacial and marine gravels, but could also have been introduced through exchange or travel, possibly from the Salish Sea region.

09 Obsidian / fine grained volcanic
The imported obsidian volcanic glass and fine grained volcanic materials (FGV) vary from opaque to transparent; solid color to banded and speckled. The obsidian imported to the Willapa region has been black, gray/black, and "mahogany" red. The FGV has mostly been lustrous opaque grey. Obsidian and FGV must have been acquired through trade or travel, as there are no known local natural sources.

10 Quartzite
Quartzite materials range in color from white to red/orange and are minimally translucent. The mineral structure is visible and the material is of generally poor quality for chipped stone lithic production. The material is locally available from marine terrace gravels.

11 Quartz crystal
Clear quartz crystal materials with cleavage planes. The crystals are likely exotic materials as they are not known to be locally available. Quartz crystals could be present in marine terrace gravels.

APPENDIX C

The Willapa River Valley Artifact Classification

PREHISTORIC CHIPPED STONE TOOLS

Willapa River Valley Projectile Points

01-01 Broad-necked, barbed, diverging stem (corner notched)

Broad-necked and barbed projectile points with diverging stems (Minor 1983; Pettigrew 1981).

N Sample: 12 Illustrated in Appendix C, Figure 1

	Range		*Mean*		*SD*	*Measured (N)*
Length	25.0 – 54.1	mm	37.62	mm	10.59	8
Width	18.2 – 32.6	mm	26.29	mm	3.87	11
Thickness	3.7 – 10.0	mm	6.54	mm	1.65	12
Neck width	9.2 – 20.2	mm	14.26	mm	3.51	12
Weight	5.61 – 15.87	g	9.09	g	5.87	3

Material (N)
Fossiliferous cryptocrystalline: 5
Jasper: 1
Banded cryptocrystalline: 1
Petrified Wood: 3
Miscellaneous cryptocrystalline: 2

01-02 Broad-necked, shouldered, diverging stem (side notched and corner notched forms as well as stemmed)

Broad-necked and shouldered projectile points with diverging stems (Minor 1983; Pettigrew 1981).

N Sample: 51 Illustrated in Appendix C, Figure 2

	Range		*Mean*		*SD*	*Measured (N)*
Length	26.4 – 75.8	mm	38.2	mm	9.45	42
Width	12.9 – 31.2	mm	23.03	mm	3.96	51
Thickness	4.5 – 13.1	mm	7.99	mm	1.81	51
Neck width	6.9 – 20.5	mm	14.28	mm	3.34	51
Weight	2.61 – 9.03	g	5.09	g	1.78	24

Material (N)
Siltstone: 4
Fossiliferous cryptocrystalline: 14
Jasper: 7
Banded cryptocrystalline: 1
Petrified Wood: 3
Miscellaneous cryptocrystalline: 17
Basalt: 4
Obsidian: 1 (Obsidian Cliffs Oregon)

01-03 Broad-necked, incurvate stem (side and corner notched, concave base)

Broad-necked projectile points with incurvate stems (Minor 1983; Pettigrew 1981).

N Sample: 5 Illustrated in Appendix C, Figure 3

	Range		*Mean*		*SD*	*Measured (N)*
Length	28.6 – 55.9	mm	41.96	mm	12.17	5
Width	17 – 32.8	mm	25.36	mm	6.3	5
Thickness	4.5 - 18	mm	9.44	mm	5.11	5
Neck width	13.3 – 24.6	mm	18.76	mm	4.71	5
Weight	-	g	-	g	-	0

Material (N)
Fossiliferous cryptocrystalline: 1
Jasper: 1
Miscellaneous cryptocrystalline: 3

01-04 Broad-necked, barbed, non-diverging stem (corner notched, basal notched, barbed)

Broad-necked and barbed projectile points with non-diverging stems (Minor 1983; Pettigrew 1981).

N Sample: 36 Illustrated in Appendix C, Figure 4

	Range		*Mean*		*SD*	*Measured (N)*
Length	23.5 – 56.5	mm	38.3	mm	9.38	28
Width	17.8 – 41.3	mm	27.31	mm	5.98	34
Thickness	4.7 - 11	mm	7.19	mm	1.58	36
Neck width	6.1 – 14.8	mm	9.8	mm	2.29	35
Weight	1.91 – 10.7	g	4.98	g	2.77	17

Material (N)
Siltstone: 2
Fossiliferous cryptocrystalline: 12
Jasper: 7
Banded cryptocrystalline: 3
Miscellaneous cryptocrystalline: 12
Basalt: 2

01-05a Broad-necked, shouldered, non-diverging stem, small variety (stemmed)

Broad-necked and shouldered projectile points with non-diverging stems. This type represents the delicate, or *gracile*, form of the artifact. . This artifact type represents a variant of the Type 05 Pettigrew (1981) and Minor (1983) classification.

N Sample: 55 Illustrated in Appendix C, Figure 5

	Range		*Mean*		*SD*	*Measured (N)*
Length	23.2 – 61.3	mm	39.07	mm	9.9	47
Width	12.6 – 34.1	mm	20.71	mm	4.91	55
Thickness	3.5 – 12.3	mm	7.35	mm	2.05	55
Neck width	6.3 – 17.6	mm	10.65	mm	2.64	55
Weight	1.25 – 7.2	g	3.47	g	1.5	31

Material (N)
Siltstone: 4
Fossiliferous cryptocrystalline: 7
Jasper: 16
Banded cryptocrystalline: 4
Petrified Wood: 9
Miscellaneous cryptocrystalline: 13
Obsidian: 2 (Napa Valley, California)

01-05b Broad-necked, shouldered, non-diverging stem, large variety

Broad-necked and shouldered projectile points with non-diverging stems. This type represents the heavy, or *robust*, form of the artifact. This artifact type represents a variant of the Type 05 Pettigrew (1981) and Minor (1983) classification.

N Sample: 26 Illustrated in Appendix C, Figure 6

	Range		*Mean*		*SD*	*Measured (N)*
Length	33.6 – 57.3	mm	46.59	mm	5.44	22
Width	15 – 27.3	mm	21.62	mm	3.29	25
Thickness	5.8 – 12.3	mm	8.64	mm	1.66	26
Neck width	9.1 – 19.7	mm	13.6	mm	2.76	26
Weight	3.83 – 15.79	g	8.05	g	3.2	22

Material (N)
Siltstone: 5
Jasper: 3
Banded cryptocrystalline: 1
Petrified Wood: 1
Miscellaneous cryptocrystalline: 3
Basalt: 3
Quartzite: 1
Obsidian: 9 (6 Napa Valley, CA., 2 Annadel, CA., 1 unknown FGV)

01-06a Ovate or bipointed, unnotched, unstemmed, small variety

Small variety of ovate or bipointed projectile points that are unnotched and unstemmed. This type represents the delicate, or *gracile*, form of the artifact. The projectile point form can be described as *lanceolate* or *leaf-shaped*. This artifact type represents a variant of the Type 06 Pettigrew (1981) and Minor (1983) classification.

N Sample: 97 Illustrated in Appendix C, Figure 7

	Range		*Mean*		*SD*	*Measured (N)*
Length	18.7 – 43.1	mm	30.42	mm	7.11	23
Width	11.9 – 20.6	mm	15.18	mm	2.11	26
Thickness	3.4 – 8.1	mm	5.32	mm	1.21	26
Weight	.69 – 6.0	g	2.51	g	1.36	22

Material (N)
Siltstone: 4
Fossiliferous cryptocrystalline: 24
Jasper: 11
Banded cryptocrystalline: 6
Petrified Wood: 6
Miscellaneous cryptocrystalline: 37
Basalt: 7
Quartzite: 1
Obsidian: 1 (Obsidian Cliffs, OR.)

01-06b Ovate or bipointed, unnotched, unstemmed, large variety

Large variety of ovate or bipointed projectile points that are unnotched and unstemmed. This type represents the heavy, or *robust*, form of the artifact. The projectile point form can be described as *lanceolate* or *leaf-shaped*. This artifact type represents a variant of the Type 05 Pettigrew (1981) and Minor (1983) classification.

N Sample: 33 Illustrated in Appendix C, Figure 8

	Range		*Mean*		*SD*	*Measured (N)*
Length	40.3 – 70.3	mm	54.27	mm	8.49	23
Width	15.4 – 30.1	mm	20.93	mm	3.23	32
Thickness	4.6 – 13.1	mm	8.14	mm	1.87	33
Weight	5.5 – 14.08	g	9.39	g	2.69	10

Material (N)
Siltstone: 8
Fossiliferous cryptocrystalline: 2
Jasper: 3
Banded cryptocrystalline: 1
Petrified Wood: 2
Miscellaneous cryptocrystalline: 8
Basalt: 3
Obsidian: 7 (Napa Valley, CA.)

01-07 Narrow-necked, barbed, diverging stem

Narrow-necked and barbed projectile points with diverging stems (Minor 1983; Pettigrew 1981).

N Sample: 28 Illustrated in Appendix C, Figure 9

	Range		*Mean*		*SD*	*Measured (N)*
Length	15.1 – 46.4	mm	24.78	mm	7.69	26
Width	10.6 – 23.8	mm	15.18	mm	3.27	27
Thickness	2.0 – 6.7	mm	4.02	mm	1.02	28
Neck width	3.4 – 8.4	mm	5.47	mm	1.29	28
Weight	.86 – 2.54	g	1.7	g	1.19	2

Material (N)
Siltstone: 1
Fossiliferous cryptocrystalline: 5
Jasper: 6
Banded cryptocrystalline: 1
Petrified Wood: 2
Miscellaneous cryptocrystalline: 12
Obsidian: 1 (Obsidian Cliffs, OR.)

01-08 Narrow-necked, shouldered, diverging stem

Narrow-necked and shouldered projectile points with diverging stems (Minor 1983; Pettigrew 1981).

N Sample: 8 Illustrated in Appendix C, Figure 10

	Range		*Mean*		*SD*	*Measured (N)*
Length	22.5 – 34.6	mm	26.52	mm	4.19	7
Width	9.8 – 26.9	mm	14.85	mm	5.59	8
Thickness	2.4 – 7.5	mm	4.05	mm	1.66	8
Neck width	4.2 – 9.5	mm	6.3	mm	1.82	8
Weight	1.36	g	-	g	-	1

Material (N)
Fossiliferous cryptocrystalline: 4
Jasper: 1
Miscellaneous cryptocrystalline: 2
Obsidian: 1 (Whitewater Ridge, OR.)

01-09 Narrow-necked, barbed, non-diverging stem

Narrow-necked and barbed projectile points with non-diverging stems (Minor 1983; Pettigrew 1981).

N Sample: 98 Illustrated in Appendix C, Figure 11

	Range		*Mean*		*SD*	*Measured (N)*
Length	13.2 – 44.3	mm	25.26	mm	6.03	84
Width	6.7 – 29.7	mm	15.58	mm	3.37	92
Thickness	2.0 – 7.7	mm	4.24	mm	1.14	98
Neck width	2.8 – 9.1	mm	4.94	mm	1.18	97
Weight	.24 – 2.84	g	1.21	g	.72	14

Material (N)
Siltstone: 2
Fossiliferous cryptocrystalline: 22
Jasper: 25
Banded cryptocrystalline: 1
Petrified Wood: 5
Miscellaneous cryptocrystalline: 37
Basalt: 2
Obsidian: 4 (2 Inman Creek A, OR., 1 Clackamas River, OR., 1 Venator FGV, OR.)

01-10 Narrow-necked, shouldered, non-diverging stem

Narrow-necked and shouldered projectile points with non-diverging stems (Minor 1983; Pettigrew 1981).

N Sample: 83 Illustrated in Appendix C, Figure 12

	Range		*Mean*		*SD*	*Measured (N)*
Length	14.9 – 47.1	mm	26.49	mm	6.78	80
Width	9.8 – 24.6	mm	14.26	mm	2.86	83
Thickness	2.5 – 12.3	mm	4.63	mm	1.34	83
Neck width	2.4 – 12.5	mm	5.56	mm	1.55	83
Weight	0.4 – 2.41	g	1.12	g	0.49	24

Material (N)
Fossiliferous cryptocrystalline: 29
Jasper: 16
Banded cryptocrystalline: 6
Petrified Wood: 2
Miscellaneous cryptocrystalline: 26
Basalt: 3
Obsidian: 1 (Glass Buttes 7, OR.)

01-11 Ovate, side-notched

Ovate projectile points with slight side notches (a variant of Type 11 from Pettigrew (1981) and Minor (1983).

N Sample: 1 Illustrated in Appendix C, Figure 13

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	38.5	mm	-	mm	-	1
Width	16.1	mm	-	mm	-	1
Thickness	4.3	mm	-	mm	-	1
Neck width	4.2	mm	-	mm	-	1
Weight	3.11	g	-	g	-	1

Material (N) Miscellaneous cryptocrystalline: 1

01-12a Triangular blade, side notched, flat or convex base

Triangular blade side-notched projectile points with convex bases (variant of Minor 194; Pettigrew 1981).

N Sample: 11 Illustrated in Appendix C, Figure 14

	Range		*Mean*		*SD*	*Measured (N)*
Length	15.4 – 49.7	mm	26.59	mm	10.62	11
Width	11.5 – 21.3	mm	15.16	mm	3.3	10
Thickness	3.2 – 7.4	mm	4.7	mm	1.45	11
Neck width	5.7 – 17.5	mm	10.80	mm	3.83	11
Weight	0.54 - 0.76	g	0.65	g	0.16	2

Material (N)
Siltstone: 1
Fossiliferous cryptocrystalline: 4
Banded cryptocrystalline: 1
Miscellaneous cryptocrystalline: 3
Basalt: 1
Obsidian and Fine Grained Volcanic: 1 (Unknown FGV)

01-12b Triangular blade side-notched projectile points with concave base. This artifact type represents a variant of the Type 12 Pettigrew (1981) and Minor (1983) classification. This variant has a distinct concave base.

N Sample: 2 Illustrated in Appendix C, Figure 15

	Range		*Mean*		*SD*	*Measured (N)*
Length	18.8 – 23.9	mm	21.35	mm	3.61	2
Width	14.0 – 17.5	mm	15.75	mm	2.47	2
Thickness	3.8 – 4.5	mm	4.15	mm	0.49	2
Neck width	8.3 – 8.7	mm	8.5	mm	.28	2

Material (N) Fossiliferous cryptocrystalline: 2

01-13 Unnotched, unstemmed, incurvate (concave) base

Unnotched and unstemmed projectile points with incurvate (concave) bases (Minor 1983; Pettigrew 1981).

N Sample: 37 Illustrated in Appendix C, Figure 16

	Range		*Mean*		*SD*	*Measured (N)*
Length	16.3 – 56.5	mm	23.96	mm	9.17	36
Width	9.0 – 27.5	mm	15.45	mm	3.65	37
Thickness	2.0 – 11.8	mm	4.5	mm	1.80	37
Weight	.52	g	3.86	g	1.06	17

Material (N) Fossiliferous cryptocrystalline: 10
Jasper: 5
Banded cryptocrystalline: 1
Petrified Wood: 2
Miscellaneous cryptocrystalline: 16
Basalt: 3

01-14 Triangular blade, unstemmed, unnotched

Triangular blade unstemmed projectile points without notches (Minor 1983; Pettigrew 1981). Both faces of these forms have been thinned by pressure flaking. The tool forms exhibit bifacial retouch around their entire the blade margin and base. These artifacts are often referred to as projectile point "preforms" in regional literature. The early-stage triangular and ovate Type 01-16 projectile points do not exhibit the high level of blade-face and marginal pressure retouch as the Type 01-14 projectile point forms.

N Sample: 224 Illustrated in Appendix C, Figure 17

	Range		*Mean*		*SD*	*Measured (N)*
Length	15.8 – 37.4	mm	24.89	mm	5.52	82
Width	11.2 – 24.4	mm	16.95	mm	3.07	82
Thickness	2.8 - 7	mm	4.59	mm	.95	85
Weight	.58 – 4.12	g	1.83	g	.86	79

Material (N) Siltstone: 3
Fossiliferous cryptocrystalline: 78
Jasper: 51
Banded cryptocrystalline: 14
Petrified Wood: 17
Miscellaneous cryptocrystalline: 48
Basalt: 12
Obsidian: 1 (Silver Lake/Sycan Marsh, OR.)

01-15 Side notched and stemmed

Side notched and stemmed projectile points (Minor 1983; Pettigrew 1981).

N Sample: 1 Illustrated in Appendix C, Figure 18

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	53.2* broken	mm	-	mm	-	1
Width	31.1	mm	-	mm	-	1
Thickness	12.1	mm	-	mm	-	1
Neck width	22.5	mm	-	mm	-	1
Weight	21.66	g	-	g	-	1
Material (N)	Miscellaneous cryptocrystalline: 1					

01-16 Triangular to ovate blade, unstemmed, unnotched, minimal retouch

Unstemmed projectile points without notches that are minimally retouched (Minor 1983; Pettigrew 1981). The Type 01-16 projectile point forms do not exhibit the level of "finished" shaping, thinning, and fine pressure retouch that is characteristic of the Type 01-14 projectile point forms. The Type 01-16 "simple" projectile points exhibit the lowest level of modification of all the projectile point forms observed in the Willapa collections.

N Sample: 51 Illustrated in Appendix C, Figure 19

	Range		*Mean*		*SD*	*Measured (N)*
Length	14.4 – 28.0	mm	19.29	mm	2.97	50
Width	5.7 – 16.3	mm	12.7	mm	2.21	49
Thickness	1.7 – 12.9	mm	3.95	mm	1.61	51
Weight	.22 – 1.69	g	.78	g	.29	48
Material (N)	Siltstone: 3 Fossiliferous cryptocrystalline: 10 Jasper: 6 Petrified Wood: 6 Miscellaneous cryptocrystalline: 28 Dacite: 1					

01-17a Large barbed

Large barbed projectile point "dart heads" or "lance heads". This form is not represented in the Pettigrew (1981) and Minor (1983) classifications. Projectile point forms 01-17a and 01-17b are distinctly different than most of the projectile point forms in that they are much larger and more robust.

N Sample: 3 Illustrated in Appendix C, Figure 20

	Range		*Mean*		*SD*	*Measured (N)*
Length	55.3 – 74.2	mm	64.76	mm	9.45	3
Width	31.7 – 41.9	mm	36.53	mm	5.12	3
Thickness	10.0 – 12.3	mm	10.93	mm	1.21	3
Neck width	14.5 – 21.4	mm	16.9	mm	3.9	3
Weight	18.79 – 25.74	g	21.79	g	3.57	3
Material (N)	Jasper: 1 Miscellaneous cryptocrystalline: 2					

01-17b Large stemmed

Large stemmed projectile point shaped “dart heads” or “lance heads”. This specific form is not represented in the Pettigrew (1981) and Minor (1983) classifications. Windust-style stemmed projectile points tend to be classified within this type. Projectile point forms 01-17a and 01-17b are distinctly different than most of the projectile point forms in that they are much larger and more robust.

N Sample: 9 Illustrated in Appendix C, Figure 21

	Range		*Mean*		*SD*	*Measured (N)*
Length	45.9 - 85	mm	70.76	mm	13.96	9
Width	20.7 – 36.3	mm	29.32	mm	5.25	9
Thickness	7.2 – 13.0	mm	10.51	mm	1.99	9
Neck width	9.9 – 21.3	mm	16.24	mm	3.83	9
Weight	12.69 – 36.57	g	25.37	g	12.01	3

Material (N)
Siltstone: 1
Fossiliferous cryptocrystalline: 3
Jasper: 1
Banded cryptocrystalline: 1
Petrified Wood: 1
Miscellaneous cryptocrystalline: 1
Basalt: 1

Willapa River Valley Biface Knives

02-01a Ovate bifaces

Ovate form chipped stone bifacial tools with retouched blade margins suitable for cutting. The form exhibits no distinct evidence of use as a projectile, and can exhibit a sharp or blunt point. The general bifacial form could potentially be used as projectile point technology, as well as for general cutting and abrading activities.

N Sample: 88 Illustrated in Appendix C, Figure 22

	Range		*Mean*		*SD*	*Measured (N)*
Length	45.9 - 85	mm	70.76	mm	13.96	9
Width	20.7 – 36.3	mm	29.32	mm	5.25	9
Thickness	7.2 – 13.0	mm	10.51	mm	1.99	9
Neck width	9.9 – 21.3	mm	16.24	mm	3.83	9
Weight	12.69 – 36.57	g	25.37	g	12.01	3

Material (N)
Siltstone: 5
Fossiliferous cryptocrystalline: 14
Jasper: 11
Banded cryptocrystalline: 10
Petrified Wood: 4
Miscellaneous cryptocrystalline: 22
Basalt: 5
Quartz Crystal: 1
Obsidian: 16 (14 Napa Valley CA., 1 Borax Lake, CA., 1 Big Obsidian Flow, OR.)

02-01b Ovate bifaces, large variety

A large *robust* variety of the ovate form chipped stone bifacial tools with retouched blade margins suitable for cutting or chopping. The large form exhibits no distinct evidence of use as a projectile, and can exhibit a sharp or blunt point.

N Sample: 24 Illustrated in Appendix C, Figure 23

	Range		*Mean*		*SD*	*Measured (N)*
Length	49.3 – 115.8	mm	68.47	mm	14.65	22
Width	27 - 50	mm	35.98	mm	6,08	24
Thickness	9.2 – 19.6	mm	13.98	mm	2.95	24

Material (N)
Siltstone: 7
Fossiliferous cryptocrystalline: 3
Jasper: 3
Banded cryptocrystalline: 2
Petrified Wood: 1
Miscellaneous cryptocrystalline: 6
Basalt: 1
Obsidian: 1 (Whitewater Ridge, OR.)

02-01c Skreblos, large non-symmetrical bifaces

Non-symmetrical, large "side-blade" form of bifacial chipped stone tools with retouched margins suitable for cutting and chopping. One side of the artifact form is more convex than the opposite.

N Sample: 4 Illustrated in Appendix C, Figure 24

	Range		*Mean*		*SD*	*Measured (N)*
Length	73.9 – 117.3	mm	94	mm	19.09	4
Width	38.1 – 54.1	mm	42.87	mm	7.59	4
Thickness	12.5 – 23.9	mm	18.17	mm	5.32	4

Material (N)
Siltstone: 4

02-02 Triangular bifaces, flat or convex base

Triangular shaped (three sided) chipped stone bifacial tools with retouched margins suitable for cutting. The form exhibits no distinct evidence of use as a projectile, and need not have a sharply pointed tip.

N Sample: 31 Illustrated in Appendix C, Figure 25

	Range		*Mean*		*SD*	*Measured (N)*
Length	27 – 69.9	mm	39.87	mm	9.91	31
Width	20.7 – 53.6	mm	30.3	mm	5.97	31
Thickness	5.8 – 15.7	mm	8.99	mm	2.22	31

Material (N)
Fossiliferous cryptocrystalline: 3
Jasper: 7
Banded cryptocrystalline: 1
Petrified Wood: 5
Miscellaneous cryptocrystalline: 6
Basalt: 2
Obsidian: 3 (Napa Valley, CA.)

02-03 Concave base bifaces

Concave base chipped stone bifacial tools with retouched margins suitable for cutting. The form exhibits no distinct evidence of use as a projectile, and need not have a sharply pointed tip.

N Sample: 9 Illustrated in Appendix C, Figure 26

	Range		*Mean*		*SD*	*Measured (N)*
Length	30.5 – 54.5	mm	39.31	mm	7.72	7
Width	27 – 46.3	mm	33.97	mm	6.53	9
Thickness	5.2 – 12.7	mm	9.33	mm	2.28	9

Material (N)
Fossiliferous cryptocrystalline: 2
Jasper: 2
Banded cryptocrystalline: 1
Miscellaneous cryptocrystalline: 3

02-04 Odd shaped bifaces (discoidal forms)

Non-symmetrical diversely-shaped chipped stone bifacial tools with retouched margins suitable for cutting. The form exhibits no distinct evidence of use as a projectile, and do not always have a sharply pointed tip.

N Sample: 30 Illustrated in Appendix C, Figure 27

	Range		*Mean*		*SD*	*Measured (N)*
Length	19.6 – 59.9	mm	32.59	mm	9.78	30
Width	16.3 – 38.6	mm	25.85	mm	6.18	30
Thickness	5.1 – 12.1	mm	8.32	mm	1.87	30

Material (N)
Fossiliferous cryptocrystalline: 14
Jasper: 2
Banded cryptocrystalline: 3
Petrified Wood: 3
Miscellaneous cryptocrystalline: 8

02-05 Early stage bifaces

Bifacial chipped stone tools that exhibit minimal amounts of fine shaping and retouch.

N Sample: 86 Not illustrated

Material (N)
Siltstone: 2
Fossiliferous cryptocrystalline: 14
Jasper: 19
Banded cryptocrystalline: 6
Petrified Wood: 7
Miscellaneous cryptocrystalline: 37
Basalt: 1

02-06 Bifacial sideblades

Non-symmetrical bifacially retouched triangular chipped stone tools that resemble in-set side blades of the late prehistoric Alaskan coastal cultures. These odd forms may represent "performs" or unfinished artifacts. No artifacts with "in-set" blades, such as harpoons, have been identified in the Willapa region.

N Sample: 33 Illustrated in Appendix C, Figure 28

	Range		*Mean*		*SD*	*Measured (N)*
Length	19.6 – 59.9	mm	32.59	mm	9.78	30
Width	16.3 – 38.6	mm	25.85	mm	6.18	30
Thickness	5.1 – 12.1	mm	8.32	mm	1.87	30

Material (N)
Fossiliferous cryptocrystalline: 8
Jasper: 7
Banded cryptocrystalline: 2
Petrified Wood: 1
Miscellaneous cryptocrystalline: 11
Basalt: 3
Obsidian: 1(Glass Buttes 3, OR.)

02-07a Biface base fragments

Basal fragments of bifacially worked chipped stone artifacts; convex, flat, and concave included.

N Sample: 39 Not illustrated

Material (N)
Fossiliferous cryptocrystalline: 9
Jasper: 7
Banded cryptocrystalline: 4
Petrified Wood: 3
Miscellaneous cryptocrystalline: 16

02-07b Biface midsection fragments

Mid-section fragments of bifacially worked chipped stone artifacts; convex, flat, and concave included.

N Sample: 8 Not illustrated

Material (N)
Fossiliferous cryptocrystalline: 3
Banded cryptocrystalline: 5

02-07c Biface tip fragments

Tip fragments of bifacially worked chipped stone artifacts.

N Sample: 91 Not illustrated

Material (N)
Fossiliferous cryptocrystalline: 18
Jasper: 17
Banded cryptocrystalline: 4
Petrified Wood: 7
Miscellaneous cryptocrystalline: 43
Basalt: 2

02-08 Status bifaces

Large bi-pointed and ovate biface forms likely meant for display rather than function. Tending to be made of exotic obsidian, the biface “blades” were likely used in conjunction with dance and ceremony, rather than procurement or processing. The metric attributes below are only for the obsidian artifacts only, and do not the siltstone and ccs artifacts illustrated in Figure 30. The longest dagger-like siltstone artifact in Figure 30 is 19 cm long, 3.73 cm wide, and 1.42 cm thick. The side-notched ovate-form ccs biface in Figure 30 is 91 mm long, 40 mm wide, and approximately 6.5 mm thick. The biface is 32.2 mm wide between the “tether notches”. The large siltstone stemmed form in Figure 30 is 98 mm long, 46.4 mm wide, and approximately 7 mm thick.

N Sample: 4 — One obsidian bipointed biface specimen is Illustrated in Appendix C, Figure 29. Siltstone and ccs bifaces are Illustrated in Figure 30

	Range		*Mean*		*SD*	*Measured (N)*
Length	148.2	mm	-	mm	-	1
Width	24.8 – 37.0	mm	29.45	mm	5.64	4
Thickness	7.9 – 12.3	mm	9.57	mm	2.05	4
Weight	67.89	g	-	g	-	1

Material (N) Obsidian: 4(2 Glass Buttes 1, OR., 1 Newberry Volcano, OR., 1 Venator FGV, OR.)

Willapa River Valley Scrapers

03-01 Convex scrapers, “thumb-nail scraper”

A chipped stone tool with a distinct convex unifacial pressure-retouched steep-angle edge. The steep unifacial edge is the objective element of the tool, and would have been useful for scraping hides, and carving bone and wood. The form usually exhibits slight percussive and pressure retouch shaping of the body to accentuate the convex unifacial “bit”. The tool form could be used hafted or held in the hand.

N Sample: 134 — Illustrated in Appendix C, Figure 31

	Range		*Mean*		*SD*	*Measured (N)*
Length	18.8 – 35.8	mm	26.34	mm	3.75	39
Width	14.7 – 27.4	mm	22.55	mm	2.86	39
Thickness	4.9 – 12.8	mm	7.75	mm	1.82	39

Material (N)
- Siltstone: 1
- Fossiliferous cryptocrystalline: 33
- Jasper: 28
- Banded cryptocrystalline: 9
- Petrified Wood: 5
- Miscellaneous cryptocrystalline: 57

03-02 Convex scrapers, small variety

A chipped stone tool with a distinct convex unifacial pressure-retouched steep-angle edge. This type represents a delicate, or *gracile*, form of the basic “thumb-nail scraper”. The steep unifacial edge is the objective element of the tool, and would have been useful for scraping hides, and carving bone and wood. The form usually exhibits slight percussive and pressure retouch shaping of the body to accentuate the convex unifacial “bit”. This small artifact would likely have been most effective as a hafted tool, rather than being used while held in the hand.

N Sample: 40 — Illustrated in Appendix C, Figure 32

	Range		*Mean*		*SD*	*Measured (N)*
Length	12.2 – 25.6	mm	18.81	mm	2.92	31
Width	12.2 – 19.0	mm	15.47	mm	1.69	31
Thickness	2.7 – 7.7	mm	5.80	mm	1.31	31

Material (N)
- Siltstone: 1
- Fossiliferous cryptocrystalline: 14
- Jasper: 2
- Banded cryptocrystalline: 1
- Petrified Wood: 1
- Miscellaneous cryptocrystalline: 21

03-03 Convex scrapers, minimally retouched body

A chipped stone tool with a distinct convex unifacial pressure-retouched steep-angle edge. The form exhibits no shaping or pressure retouch of the body beyond the formed convex working edge. The steep unifacial edge is the objective element of the tool, and would have been useful for scraping hides, and carving bone and wood. The tool form could be used hafted or held in the hand.

N Sample: 59 Illustrated in Appendix C, Figure 33

	Range		*Mean*		*SD*	*Measured (N)*
Length	23.8 - 41	mm	32.85	mm	3.93	28
Width	18.5 - 32	mm	24.41	mm	3.82	28
Thickness	4.8 – 12.2	mm	8.62	mm	2.2	28

Material (N)
Siltstone: 1
Fossiliferous cryptocrystalline: 5
Jasper: 16
Banded cryptocrystalline: 4
Petrified Wood: 5
Miscellaneous cryptocrystalline: 28

03-04 Convex scrapers, minimally retouched, large variety

A chipped stone tool with a distinct convex unifacial pressure-retouched steep-angle edge. This type is a large and *robust* variety of the form that exhibits no shaping or pressure retouch of the body beyond the formed convex working edge. The steep unifacial edge is the objective element of the tool, and would have been useful for scraping hides, and carving bone and wood. The tool form could be used hafted, but can easily be held in the hand.

N Sample: 16 Illustrated in Appendix C, Figure 34

	Range		*Mean*		*SD*	*Measured (N)*
Length	30.7 – 55.4	mm	39.45	mm	5.57	16
Width	27.2 - 44	mm	33.99	mm	4.37	16
Thickness	7 – 16.5	mm	12.68	mm	3.03	16

Material (N)
Siltstone: 1
Fossiliferous cryptocrystalline: 6
Jasper: 2
Banded cryptocrystalline: 1
Miscellaneous cryptocrystalline: 6

03-05 Large flake and cobble spall "hand scrapers"

Large flakes and spalls with convex steep-angle unifacially worked edges. The unifacially flaked edge is made with percussive and large-pressure flaking.

N Sample: 12 Illustrated in Appendix C, Figure 35

	Range		*Mean*		*SD*	*Measured (N)*
Length	48.7 – 94.6	mm	67.6	mm	13.47	12
Width	36.1 – 81.0	mm	53.22	mm	14.42	12
Thickness	7.7 – 32.3	mm	17.51	mm	6.76	12

Material (N)
Siltstone: 11
Basalt: 1

03-06 Steep domed scrapers, exaggerated convexity

A distinctly convex and dome-shaped form with a protruding convex unifacial pressure-retouched steep-angle edge.

N Sample: 19 Illustrated in Appendix C, Figure 36

	Range		*Mean*		*SD*	*Measured (N)*
Length	21.2 – 39.2	mm	29.31	mm	5.54	19
Width	17.8 – 32.3	mm	24.11	mm	3.33	19
Thickness	8.9 – 15.3	mm	12.03	mm	1.85	19

Material (N)
Siltstone: 1
Fossiliferous cryptocrystalline: 1
Jasper: 5
Banded cryptocrystalline: 2
Miscellaneous cryptocrystalline: 10

03-07 100% marginal retouch Scrapers (discoidal scrapers)

A round to rectangular form with unifacial steep-angle edge retouch flaking that extends around 100% of the tool margin. There is no distinct proximal or distal element of the tool form, as the entire margin has a convex unifacial steep-angled working edge.

N Sample: 23 Illustrated in Appendix C, Figure 37

	Range		*Mean*		*SD*	*Measured (N)*
Length	18.7 – 33.1	mm	24.31	mm	3.55	23
Width	15.5 – 31.3	mm	22.1	mm	3.67	23
Thickness	6.0 – 11.4	mm	8.81	mm	1.66	23

Material (N)
Siltstone: 2
Fossiliferous cryptocrystalline: 2
Jasper: 5
Banded cryptocrystalline: 3
Petrified Wood: 2
Miscellaneous cryptocrystalline: 10

03-08 Scrapers with corner bits, squared and triangular (spurred scrapers)

A form with a squared or triangular shaped unifacial pressure-flaked bit. The symmetrical artifact has distinct corners. The form usually exhibits slight percussive and pressure retouch shaping of the body to accentuate the squared corners of the “bit”. The tool form could be used hafted or held in the hand.

N Sample: 125 Illustrated in Appendix C, Figure 38

	Range		*Mean*		*SD*	*Measured (N)*
Length	11.4 – 30.3	mm	20.57	mm	4.57	51
Width	14.0 – 30.0	mm	20.22	mm	3.32	51
Thickness	3.0 – 12.0	mm	6.65	mm	1.93	51

Material (N)
Fossiliferous cryptocrystalline: 33
Jasper: 21
Banded cryptocrystalline: 8
Petrified Wood: 2
Miscellaneous cryptocrystalline: 61

03-09 Angle bit scrapers

A unifacially-flaked form with an angled pressure-flaked bit. The non-symmetrical artifact has distinct corners. The form usually exhibits slight percussive and pressure retouch shaping of the body to accentuate the squared corners of the angled "bit". The tool form could be used hafted or held in the hand.

N Sample: 21 Illustrated in Appendix C, Figure 39

	Range		*Mean*		*SD*	*Measured (N)*
Length	13.9 – 29.0	mm	21.32	mm	4.33	21
Width	16.3 - 30.0	mm	22.25	mm	3.99	21
Thickness	4.3 – 10.4	mm	7.03	mm	1.71	21

Material (N) Fossiliferous cryptocrystalline: 8
Jasper: 2
Banded cryptocrystalline: 2
Petrified Wood: 1
Miscellaneous cryptocrystalline: 8

03-10 Angle bit scrapers, large variety

A large *robust* variety of a unifacially-flaked form with an angled pressure-flaked bit. The non-symmetrical artifact has distinct corners. The form usually exhibits slight percussive and pressure retouch shaping of the body to accentuate the squared corners of the angled "bit". The tool form could be used hafted or held in the hand.

N Sample: 2 Illustrated in Appendix C, Figure 40

	Range		*Mean*		*SD*	*Measured (N)*
Length	35.7 – 37.1	mm	36.4	mm	0.99	2
Width	32.4 – 36.1	mm	34.25	mm	2.62	2
Thickness	9.8 – 12.8	mm	11.3	mm	2.12	2

Material (N) Banded cryptocrystalline: 1
Petrified Wood: 1

03-11 Bifacial scrapers

A biface that has been shaped into the form of a scraper with a unidirectional pressure-retouched steep-angle edge. The steep unidirectional retouched edge is the objective element of the tool, and would have been useful for scraping hides, and carving bone and wood. The tool form could be used hafted or held in the hand.

N Sample: 31 Illustrated in Appendix C, Figure 41

	Range		*Mean*		*SD*	*Measured (N)*
Length	15.5 – 36.8	mm	25.14	mm	4.54	31
Width	16.1 – 29.6	mm	22.55	mm	3.23	31
Thickness	4.3 – 12.8	mm	8.19	mm	1.66	31

Material (N) Fossiliferous cryptocrystalline: 7
Jasper: 1
Banded cryptocrystalline: 4
Petrified Wood: 3
Miscellaneous cryptocrystalline: 16

03-12 Willapa rotated scrapers

These bit-like tools have 90 degree offset scraping planes that are formed by opposite pressure flaking, such that the scraping edge on one side is far below the central plain of the tool, while it is far above on the perpendicular edge (with opposite flaking). The tool margin edge forms a transverse wave-like path which appears to "modulate" between a positive and negative "amplitude" as the tool rotates in 90 degree increments. The bifacial edge between the "dorsal" and "ventral" faces on these forms topologically resembles the binding/stitching of a flattened two-piece leather baseball or softball. The function(s) of these tool forms is not clear, though the working edges are sharpened using unidirectional pressure retouch. The "bit-like" artifacts may have been the blade component of a composite bone or wood adze tool.

N Sample: 6 Illustrated in Appendix C, Figures 42 – 44

	Range		*Mean*		*SD*	*Measured (N)*
Length	20.2 – 27.4	mm	23.28	mm	3.05	6
Width	19.2 - 24	mm	21.55	mm	1.85	6
Thickness	6.3 – 9.9	mm	8.4	mm	1.29	6

Material (N) Fossiliferous cryptocrystalline: 2
Banded cryptocrystalline: 2
Petrified Wood: 1
Miscellaneous cryptocrystalline: 1

03-13 Concave bit scrapers

A chipped stone tool with a distinct concave unifacial pressure-retouched steep-angle edge. The steep unifacial edge is the objective element of the tool, and would have been useful for scraping and carving cylindrical items such as long bones and branches. The tool form was likely held in the hand, and could have been used as a "spoke-shave" type tool.

N Sample: 4 Illustrated in Appendix C, Figure 45

	Range		*Mean*		*SD*	*Measured (N)*
Length	35.0 – 48.8	mm	42.22	mm	7.19	4
Width	20.3 – 30.0	mm	25.17	mm	4.25	4
Thickness	6.4 – 9.1	mm	7.67	mm	1.11	4

Material (N) Jasper: 1
Miscellaneous cryptocrystalline: 3

03-14 Petrified wood end-scrapers

These scrapers types are made from elongated fragments of petrified wood, with the distinct remnants of the original wood rings that have been unifacially reduced with percussion and pressure flaking on one end. These scrapers take advantage of the natural fracture tendencies of marine-gravel petrified wood.

N Sample: 5 Illustrated in Appendix C, Figure 46

	Range		*Mean*		*SD*	*Measured (N)*
Length	27.5 – 69.9	mm	43.78	mm	15.78	5
Width	21.5 – 29.3	mm	25.7	mm	3.5	5
Thickness	10.3 – 18.1	mm	13.7	mm	3.77	5

Material (N) Petrified Wood: 5

03-15 Hafted bifacial scrapers

Hafted bifacial scrapers are unifacially and bifacially worked convex scrapers that have distinct hafting elements. The hafted bifacial scraper forms exhibit a convex working edge with unidirectional steep-edge angle retouch on their dorsal ends. These scrapers appear to have been recycled from broken stemmed, shouldered, and notched projectile points.

N Sample: 10 Illustrated in Appendix C, Figure 47

	Range		*Mean*		*SD*	*Measured (N)*
Length	24.9 – 45.7	mm	35.02	mm	5.57	10
Width	22.2 – 35.2	mm	27.94	mm	4.20	10
Thickness	6.2 – 11.7	mm	8.85	mm	2.03	10

Material (N) Fossiliferous cryptocrystalline: 2
Jasper: 2
Petrified Wood: 1
Miscellaneous cryptocrystalline: 5

03-16 Biface tip fragment scrapers

This scraper form consists of fragments of biface tips that have been recycled into scrapers. The exposed broken faces of the proximal biface fragments have been unidirectionally pressure re-touched to form a steep-angle flat working-edge.

N Sample: 6 Illustrated in Appendix C, Figure 48

	Range		*Mean*		*SD*	*Measured (N)*
Length	26.2 – 33.0	mm	29.71	mm	2.78	6
Width	17.0 – 25.3	mm	20.05	mm	2.85	6
Thickness	4.5 – 8.0	mm	6.31	mm	1.14	6

Material (N) Fossiliferous cryptocrystalline: 2
Jasper: 2
Miscellaneous cryptocrystalline: 2

03-17 Beaked scrapers

A chipped stone tool with a pronounced bird beak-like convex unifacial pressure-retouched projection and a steep-angled working edge. The protruding "beaked" unifacial edge is the objective element of the tool, and could have been useful for scraping hides, and carving bone and wood. This form would be useful for scraping within grooves or narrow trenches, such as the concave marrow-rich interior of split long-bones. The form usually exhibits slight percussive and pressure retouch shaping of the body to accentuate the beaked "bit" and improve the hafted or handheld base.

N Sample: 5 Illustrated in Appendix C, Figure 49

	Range		*Mean*		*SD*	*Measured (N)*
Length	17.1 – 44.1	mm	34.14	mm	11.6	5
Width	21.6 – 31.5	mm	25. 64	mm	4.75	5
Thickness	7.0 – 8.7	mm	8.12	mm	.65	5

Material (N) Siltstone: 1
Jasper: 2
Miscellaneous cryptocrystalline: 1
Petrified Wood: 1

03-18 Flake scrapers

These scraper forms consist of otherwise unmodified flakes that have steep edge-angle unifacial retouch along segments of the flake margin. These forms have no shaping of the flake body. The only modification to the parent flake is a unifacial scraper edge.

N Sample: 25 Illustrated in Appendix C, Figure 50

	Range		*Mean*		*SD*	*Measured (N)*
Length	19.0 – 43.5	mm	26.66	mm	6.04	25
Width	12.4 – 33.3	mm	21.72	mm	5.68	25
Thickness	2.5 – 12.4	mm	4.90	mm	2.16	25

Material (N)
Siltstone: 1
Fossiliferous cryptocrystalline: 4
Jasper: 3
Banded cryptocrystalline: 2
Petrified Wood: 2
Miscellaneous cryptocrystalline: 13

03-19 Blade flake end scrapers

This scraper type is made from blade-like flakes (with aris ridges) that have unifacial pressure retouch on either the proximal or distal end that forms a convex steep angled sharp working edge. The proximal end consists of an unmodified blade-flake platform or fracture surface. The form could be hafted or used while held in the hand.

N Sample: 11 Illustrated in Appendix C, Figure 51

	Range		*Mean*		*SD*	*Measured (N)*
Length	21.1 – 75.5	mm	37.74	mm	15.03	11
Width	13.8 – 28.8	mm	19.63	mm	4.24	11
Thickness	3.8 – 10.4	mm	7.23	mm	2.41	11

Material (N)
Siltstone: 2
Fossiliferous cryptocrystalline: 4
Jasper: 1
Miscellaneous cryptocrystalline: 4

03-20 Scrapers made on flake shatter

These scraper forms consist of otherwise unmodified blocky fragments of lithic shatter that have steep edge-angle unifacial retouch along one or more marginal segments. These forms have no shaping of the blocky shatter body, and the only modification to the parent shatter fragment is on the unifacial scraper edge.

N Sample: 21 Not illustrated

Material (N)
Fossiliferous cryptocrystalline: 13
Jasper: 1
Miscellaneous cryptocrystalline: 7

Willapa River Valley Gravers

04-01 Gravers

Flakes and lithic shatter fragments that have a single pressure -flaked sharp projection. The thin "spur" projection element could be used to produce a groove in bone or wood. There is no modification of the flake or shatter to shape a body or base.

N Sample: 18 Illustrated in Appendix C, Figure 52

	Range		*Mean*		*SD*	*Measured (N)*
Length	13.4 – 54.3	mm	32.39	mm	11.93	18
Width	12.3 – 43.0	mm	20.7	mm	7.59	18
Thickness	2.8 – 18.7	mm	7.31	mm	3.92	18

Material (N)
Siltstone: 1
Fossiliferous cryptocrystalline: 4
Jasper: 3
Petrified Wood: 2
Miscellaneous cryptocrystalline: 9

04-02 Gravers with haft-elements

Retouched flakes that have a single pressure-flaked sharp projection and have a modified expanded base. The thin "spur" projection element could be used to produce a groove in bone or wood. The formed body and base is suggestive that the form could have been hafted.

N Sample: 4 Illustrated in Appendix C, Figure 52

	Range		*Mean*		*SD*	*Measured (N)*
Length	35.4 – 47.8	mm	40.02	mm	5.49	4
Width	12.4 – 22.1	mm	15.22	mm	4.63	4
Thickness	5.5 - 10.5	mm	7.52	mm	2.38	4

Material (N)
Siltstone: 1
Jasper: 1
Petrified Wood: 2

Willapa River Valley Drills

05-01 Drills

A traditional tool form common in the Columbia River watershed, these artifacts exhibit a bifacial or minimally altered base, and a thin elongated knapped bit that is typically more than three times longer than it is wide. The long drill "bit" can have a rounded lenticular cross-section, or may be pressure flaked into a three faced tool with a "triangular" cross-section. Suitable for creating perforations, boring holes, or even acting as projectile points, these forms were likely multi-purpose tools that could have been used hafted or unhafted in the hand.

N Sample: 6 Illustrated in Appendix C, Figure 53

	Range		*Mean*		*SD*	*Measured (N)*
Length	28.8 – 51.3	mm	42.63	mm	12.11	3
Width	9.6 – 22.4	mm	13.91	mm	4.82	6
Thickness	5.7 – 12.4	mm	8.2	mm	2.91	6

Material (N)
Siltstone: 1
Fossiliferous cryptocrystalline: 1
Jasper: 1
Miscellaneous cryptocrystalline: 3

Willapa River Valley Cores, Micro-Cores, Micro-blades

06-01 Multi-directional cores

Cobbles, nodules, or fragments of tool-quality stone that have had multiple flakes removed from multiple directions. The size of cores is dependent on the nature of the raw material. Most fossiliferous cores are large pebbles or small cobbles, while siltstone and basalt cores tend to be much larger. One core is made of a fossilized clam shell (Fig. 55). Cores are both a source of flakes, and a multipurpose tool that can be used to chop, pound, abrade, etc. . . .

N Sample: 11 Illustrated in Appendix C, Figures 54 and 55

	Range		*Mean*		*SD*	*Measured (N)*
Length	24.9 – 79.4	mm	60.35	mm	18.63	11
Width	15.7 – 70.0	mm	45.63	mm	16.66	11
Thickness	6.8 – 33.3	mm	20.60	mm	7.24	11

Material (N) Siltstone: 3
Fossiliferous cryptocrystalline: 7
Miscellaneous cryptocrystalline: 1

06-02 Micro-cores, microblade cores, microblade core rejuvenation flakes

Nodules and pebbles of high quality material (all have been cryptocrystalline) that exhibit patterned removal of long microblade flakes, leaving pattered faces of blade-scar arises. The platform edge of the microcores exhibits significant grinding and preparation. No fully intact specimens have been recovered, but large sections of microblade core rejuvenation flakes with intact sections of platform and termination are present. No microblades (06-02b) are present in the collections, but they have been recovered at the Forks Creek site 45PC175. The technology is similar to that described by Welch (1970, 1983), Kelly (1984) and Daugherty et al. (1987a, 1987b). The microblade cores are not bi-polar pebble cores, and most blade scars end in pointed feathered terminations, rather than as crushed secondary (anvil) platforms.

N Sample: 2 Illustrated in Appendix C, Figures 56-60

	Range		*Mean*		*SD*	*Measured (N)*
Length	25.7 – 39.1	mm	32.4	mm	9.48	2
Width	21.7 – 22.1	mm	21.9	mm	0.28	2
Thickness	8.1 – 18.0	mm	13.05	mm	7.0	2

Material (N) Miscellaneous cryptocrystalline: 2

06-03 Blade cores

A unidirectional andesitic basalt blade core in the Rubey Family collection. The blade core was located in the vicinity of the mouth of the Palix River.

N Sample: 1 Illustrated in Appendix C, Figure 61

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	76.5	mm	-	mm	-	1
Width	51.7	mm	-	mm	-	1
Thickness	25.5	mm	-	mm	-	1
Weight	130.2	g	-	g	-	1

Material (N) Andesitic Basalt: 1

06-04 Cobble cores/ choppers

River rounded cobbles that have multiple unifacial or bifacial flake removals along one or more margins creating a sharp edge suitable for chopping activities. These artifacts are both cores and multi-purpose tools.

N Sample: 2 Illustrated in Appendix C, Figure 62

	Range		*Mean*		*SD*	*Measured (N)*
Length	140.0 – 307.0	mm	223.5	mm	118.09	2
Width	75.2 – 104.2	mm	89.7	mm	20.51	2
Thickness	46.5 – 69.5	mm	58.0	mm	16.26	2

Material (N) Siltstone: 2

PREHISTORIC PECKED AND GROUND STONE ARTIFACTS

Willapa River Valley Hammerstones

08-01 Hammerstones

River rounded cobbles (or marine terrace cobbles) with pecked, ground, and /or percussive wear on one or more ends or faces.

N Sample: 6 Illustrated in Appendix C, Figure 63

	Range		*Mean*		*SD*	*Measured (N)*
Length	41.4 - 131	mm	83.5	mm	43.45	6
Width	28.7 – 87.8	mm	57.28	mm	24.67	6
Thickness	17.4 – 76.4	mm	41.71	mm	23.7	6

Material (N) Miscellaneous stone: 6

09-01 Edge-ground cobbles

River rounded cobbles (or marine terrace cobbles) with flat or curved areas of pecked and ground wear along one or more edge or face.

N Sample: 1 Illustrated in Appendix C, Figure 64

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	96.8	mm	-	mm	-	1
Width	83.0	mm	-	mm	-	1
Thickness	83.0	mm	-	mm	-	1

Material (N) Miscellaneous stone: 1

09-02 “Portable mortar” ground cobbles,

These tool forms are made on somewhat flat river cobbles. The cobbles exhibit flattened ground areas on their margins, and also have pecked and ground circular depressions (approximately 1-3 mm deep) on their flat face(s). The circular depressions are indicative of repetitive use of the cobbles as mortar stones. The ground cobble “portable mortars” are differentiated from the large cobble mortars (Type 12-01) because they are much smaller (easily carried under an arm, or in a strong hand), and have planar grinding use wear in addition to percussive wear from a pestle-type artifact. The “portable mortars” have slight depressions, while the 12-01 large cobble mortars have deep bowl-like percussive-wear concavities.

N Sample: 2 Illustrated in Appendix C, Figure 65

	Range		*Mean*		*SD*	*Measured (N)*
Length	145.8 – 155.0	mm	150.4	mm	6.51	2
Width	87.7 – 88.7	mm	88.2	mm	0.71	2
Thickness	54.0 – 60.1	mm	57.05	mm	4.31	2

Material (N) Miscellaneous stone: 2

Willapa River Valley Pestles

10-01a Pestles, unmodified (natural cobble) body, end wear

Long, cylinder-like, river cobbles (or marine terrace cobbles) that display flattened areas of percussive and grinding wear on one or both ends that is indicative of repetitive pounding on a hard surface. The rounded cobble body of the form may display evidence of slight abrasive use-wear, but is otherwise unmodified and unshaped. The 01-10a "cobble pestle" form ends tend to be worn to a flattened plane, while the ends of heavily utilized elongated lithic reduction oriented hammerstones tend to remain convex.

N Sample: 2 Illustrated in Appendix C, Figure 66

	Range		*Mean*		*SD*	*Measured (N)*
Length	195 – 216	mm	205.5	mm	14.85	2
Width	96 - 98	mm	97	mm	1.41	2
Thickness	65 - 93	mm	79	mm	19.80	2

Material (N) Miscellaneous stone: 2

10-01b Pestles, unmodified tabular body, end wear

Long and flat river cobbles (or marine terrace cobbles) that display flattened areas of percussive and grinding wear on one or both ends that is indicative of repetitive pounding on a hard surface. The flat rounded cobble body of the form may display evidence of slight abrasive use-wear, but is otherwise unmodified and unshaped. The 01-10b "tabular cobble pestle" form ends tend to be worn to a flattened plane, while the ends of heavily utilized elongated lithic reduction oriented flat-cobble hammerstones tend to remain convex.

N Sample: 2 Illustrated in Appendix C, Figure 67

	Range		*Mean*		*SD*	*Measured (N)*
Length	180 - 220	mm	200	mm	28.28	2
Width	80 - 117	mm	98.5	mm	26.16	2
Thickness	31 - 34	mm	32.5	mm	2.12	2

Material (N) Miscellaneous stone: 2

10-02 Pestles, ground cylindrical body

Long river cobbles (or marine terrace cobbles) that have ground and pecked cylindrical bodies, and display flattened areas of percussive and grinding wear on one or both ends that is indicative of repetitive pounding on a hard surface. The majority of the original cobble cortex of the body (shaft) is ground and pecked away to form a columnar or slightly conical body. The pestle body may exhibit ornamental ground/pecked rings, collars, curves, or grooves, but the cross section tends to remain circular.

N Sample: 1 Illustrated in Appendix C, Figure 68

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	185	mm	-	mm	-	1
Width	80	mm	-	mm	-	1
Thickness	34	mm	-	mm	-	1

Material (N) Miscellaneous stone: 1

10-03 Pestles, ground planar body

Long river cobbles (or marine terrace cobbles) that have ground and pecked planar and cylindrical bodies, and display flattened areas of percussive and grinding wear on one or both ends that is indicative of repetitive pounding on a hard surface. The majority of the original cobble cortex of the body (shaft) is ground and pecked away to form a combination of flat planes and rounded-columnar body. The pestle body tends to be primarily circular, but also has ornamental planes ground on four sides. The cross section of the form can be circular, sub-angular, or polygonal.

N Sample: 1 Illustrated in Appendix C, Figure 69

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	236	mm	-	mm	-	1
Width	72	mm	-	mm	-	1
Thickness	63	mm	-	mm	-	1

Material (N) Miscellaneous stone: 1

Willapa River Valley Mauls

11-01 Hand mauls

Pecked and ground cylindrical cobbles that exhibit distinct handle elements, and bulbous flared bases. The specimen in the Stanley Niemcziek collection has a slight flared tip, but does not exhibit other sculptural design elements as is known to occur in the Lower Columbia River and Puget Sound regions.

N Sample: 1 Illustrated in Appendix C, Figure 70

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	190	mm	-	mm	-	1
Width	90	mm	-	mm	-	1
Thickness	49	mm	-	mm	-	1

Material (N) Miscellaneous stone: 1

11-02 Girdled mauls

Pecked and ground large blocky spherical and ovoid cobbles that exhibit a distinct annular pecked ring (located at approximately 1/3rd of the length of the form), and bulbous convex objective surfaces with grinding, pecking, and battering wear. These are large cobble tools capable transferring large amounts of force (as in separating a large wood plank from a log with wedges), or sustaining their momentum (as in a pendulum or spinning wheel). The annular groove could have been used as both a hafting element and a "grip" for the hand.

N Sample: 2 Illustrated in Appendix C, Figure 71

	Range		*Mean*		*SD*	*Measured (N)*
Length	170 - 186	mm	178	mm	11.31	2
Width	116 - 133	mm	124.5	mm	12.02	2
Thickness	97 - 108	mm	102.5	mm	7.78	2

Material (N) Miscellaneous stone: 2

Willapa River Valley Mortars

12-01 Large cobble mortars

The large cobble mortars are heavy rounded river cobbles have a single deep bowl-like concavity that was created through repetitive percussive and grinding with smaller stones (pestles, cobbles, etc. . .), or wood with stone grit (wooden pestles, mashing sticks, etc. . .). These artifact forms do not appear to be portable tools (weighing 32 and 49 kilograms), and likely remained close to a long-term processing area. The large cobble mortars are similar to implements used to process acorns on the southern Oregon and northern California Coast Range slope.

N Sample: 2 Illustrated in Appendix C, Figure 72

	Range		*Mean*		*SD*	*Measured (N)*
Length	343 - 438	mm	390.5	mm	67.18	2
Width	330 - 400	mm	365	mm	49.5	2
Thickness	241 - 318	mm	279.5	mm	54.45	2
Weight	32 - 49	kg	40.5	kg	12.02	2

Material (N) Basaltic stone: 2

Willapa River Valley Adzes

13-01 Nephrite adzes, celts

Wedge-shaped cut and polished implements of green, blue-green, black-green, and multicolor-green nephrite stone. These are exotic trade item artifacts presumably introduced to the Willapa River Valley through Puget Sound/Trench Salish trade networks, and Columbia River/Coastal Chinook trade networks. These tool forms likely originate from British Columbia, Canada (Darwent 1998; Morin 2012).

N Sample: 4 Illustrated in Appendix C, Figure 73

	Range		*Mean*		*SD*	*Measured (N)*
Length	35.0 – 73.8	mm	52.77	mm	18.83	4
Width	32.2 – 45.3	mm	35.62	mm	6.46	4
Thickness	8.8 – 17.5	mm	12.55	mm	3.78	4
Weight	16.5 – 68.3	g	37.35	g	23.87	4

Material (N) Nephrite: 4

13-02 Cobble adzes

A single wedge-shaped specimen of a split cobble that has a sharp blade-like termination on one end that is polished through repetitive percussive use. The sharp end appears to have polish consistent with oblique strikes. The tool form could have been used as a wedge or chopping type tool. The single known specimen is in the Rubey Family collection, and was found in the tide flats outside of the mouth of the North River.

N Sample: 4 Illustrated in Appendix C, Figure 74

	Range		*Mean*		*SD*	*Measured (N)*
Length	35.0 – 73.8	mm	52.77	mm	18.83	4
Width	32.2 – 45.3	mm	35.62	mm	6.46	4
Thickness	8.8 – 17.5	mm	12.55	mm	3.78	4
Weight	16.5 – 68.3	g	37.35	g	23.87	4

Material (N) Nephrite: 4

Willapa River Valley Clubs

14-01 Blueschist lozenge form clubs

Blueschist lozenge-form clubs are sword-like ground-stone implements with rounded "diamond" cross sections, smooth pointed tips, and tend to exhibit lobed and perforated handles. The club form has been described by Boas and Harlan Smith (1907, 1910). These forms are believed to represent exotic trade goods from northern California and Southern Oregon, where raw glaucophane blueschist can be found in the coastal range. There is one tip fragment from the Middle Willapa River Valley in the Stanley Niemcziek collection (described below), one club tip fragment and one club handle fragment from site 45PC196 (from the Rubey Family Collection; described in Chapter 7 of the this work), and one mid-section collected from site 45PC102 (Burke Museum #45PC102-1; described in Chapter 7 of this work).

N Sample: 1 Illustrated in Appendix C, Figures 75 and 76

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	105.9* broken tip	mm	-	mm	-	1
Width	49.9	mm	-	mm	-	1
Thickness	36	mm	-	mm	-	1
Weight	229.7	g	-	g	-	1
Material (N)	Blueschist: 1					

14-02 "Hammer head" clubs

A ground cobble tool form that may represent a fancy version of a 10-03 ground planar body pestle. A single specimen is present in the Zieroth Family collection. The pestle-like tool is fattest just off its center, tapering in rounded ground planes to slightly square shaped flat battered and pecked ends. There are a pair of incised grooves that are scribed around the body on one end of the tool. It is possible that the tool was bound and hafted at its fat center, and used as a hammer-type club weapon. It is also possible that the tool represents a highly polished planar pestle with a grooved design element on one end.

N Sample: 1 Illustrated in Appendix C, Figure 77

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	105.9* broken tip	mm	-	mm	-	1
Width	49.9	mm	-	mm	-	1
Thickness	36	mm	-	mm	-	1
Weight	229.7	g	-	g	-	1
Material (N)	Blueschist: 1					

Willapa River Valley Bolas Stones, Girdled Concretions

15-01 Bolas stones, girdled concretions

These artifact forms are spherical siltstone concretions that display scraped grooves which travel around their circumference. The shallow grooves (no more than 2mm deep) could potentially allow cordage to be more effectively wrapped around the incised siltstone pebbles. These types of spherical concretions often have cores of fossilized sea creatures (such as crabs).

N Sample: 2 Illustrated in Appendix C, Figure 78

	Range		*Mean*		*SD*	*Measured (N)*
Diameter	27 – 44.5	mm	35.75	mm	12.37	2
Weight	18.1 – 61.9	g	40	g	30.97	2
Material (N)	Siltstone Concretions (fossil core): 2					

Willapa River Valley Pipestones, Stone Tubes

16-01 Pipestones, stone tubes

A single example of a columnar stone tube (perhaps a pipe stem?) is within the Stanley Niemcziek collection. The soft, 12 mm diameter, waxy stone artifact is burnished smooth on its exterior surface, and is bored-out with a 6 mm round hole that is off-set from the center of the columnar artifact. The perforation travels all the way through the segment, and there is no visible taper within the bore-hole. There is no distinct tar-like residue within the bored hole. There are no design elements on the exterior of the artifact.

N Sample: 1 Illustrated in Appendix C, Figure 79

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	48.5	mm	-	mm	-	1
Outside Diam.	12	mm	-	mm	-	1
Inside Diam.	6	mm	-	mm	-	1
Weight	11.2	g	-	g	-	1

Material (N) Pipestone, Soft-stone: 1

Willapa River Valley Ornamental Stone

17-01 Ornamental stones

Miscellaneous examples of carved and decorated soft stone. There are two examples in the Stanley Niemcziek collection. One (17-01a, Appendix C Figure 80) is an argillite/slate type stone with a perforation and beveled edges. This ornament fragment may have been part of a complicated composite tool rather than a decorative element. It is the only technology reminiscent of a "slate tool" industry that I have seen in the Willapa Valley, though slate projectile points have been described by informants. The second (17-01b, Appendix C Figure 81) is a clearly artistic perforated flat siltstone pebble ornament with an incised "X" on one face and incised lines on the other. The perforated "head" of the ornament is delineated from the body by slight notches, creating a neck. There are two partially incised perforations (one on each side of the hole) on the head. The ornament could have been strung on cordage to hang like an amulet. The artistic form is reminiscent of a stylized Northwest Coast or Chinook human figure.

N Sample: 2 Illustrated in Appendix C, Figures 80 and 81

	Range		*Mean*		*SD*	*Measured (N)*
Length	20.0 – 33.6	mm	26.8	mm	9.62	2
Width	14.4 – 17.8	mm	16.1	mm	2.40	2
Thickness	2.9 – 4.4	mm	3.65	mm	1.06	2
Weight	1.6 - 2.6	g	2.1	g	.71	2

Material (N) Siltstone and Argillite type stone: 2

Willapa River Valley Cobble Net Weights

18-01 Notched cobble net weights

Rounded river and beach cobbles that have been shaped with flake removals so that they can presumably be secured to organic cordage. One example from the 45PC196 Rubey Family collection used opposing paired spall flake removals to allow a large egg-shaped cobble to be shaped into a blocky form with parallel oblique angled ends that could be secured with a wrap of cordage far more effectively. "Traditional" notched flat cobble net sinkers are also represented in the Willapa River Valley collections.

N Sample: 2 Illustrated in Appendix C, Figure 82

	Range		*Mean*		*SD*	*Measured (N)*
Length	69 – 98.5	mm	83.75	mm	20.86	2
Width	23.3 – 82.6	mm	52.95	mm	41.93	2
Thickness	16.9 – 30.0	mm	23.45	mm	9.26	2

Material (N) Miscellaneous stone: 2

18-02 Girdled cobble net weights

Rounded river and beach cobbles that have a single pecked and ground annular groove. A 1 to 2 mm deep, 8 to 15 mm wide, pecked and ground groove encircles the smallest circumference of the single specimen in the Rubey Family Collection. The groove would allow the cobble to be efficiently secured by cordage. The single known specimen is in the Rubey Family collection, and was found in the tide flats outside of the mouth of the North River.

N Sample: 1 Illustrated in Appendix C, Figure 83

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	9	cm	-	mm	-	1
Width	5	cm	-	mm	-	1
Thickness	5	cm	-	mm	=	1

Material (N) Miscellaneous stone: 1

Willapa River Valley Miscellaneous Ground Stone

20-01 Ornamental stone, ground stone net weight?

An elongated fragment of sandstone that has a dull pointed tip that has a linear groove that was incised by linear grinding- somewhat resembling the tip of a short straight bird's beak. The function of the fragment is not known, but the groove may have been created to secure or bind the object with cordage.

N Sample: 1 Illustrated in Appendix C, Figure 84

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	69	mm	-	mm	-	1
Width	23.3	mm	-	mm	-	1
Thickness	16.9	mm	-	mm	-	1

Material (N) Miscellaneous stone: 1

20-03 Perforated cobble, digging stick handle or weight? Pipe?

A single specimen of this type is held in a private collection on the farm where it was located. The artifact was located on a cow-pasture terrace in the Upper Willapa River Valley in the vicinity of Globe Field. The artifact is spherical indurated siltstone cobble that has been completely perforated by a bored round hole. The cobble resembles a large stone bead. The interior of the perforation is ground and smooth, tapering inward from both sides of the cobble. The artifact may have been created from a naturally perforated Glendonite concretion, though there is no remaining evidence of the diagnostic squared-hole walls. Only photographs were obtained. The spherical soft stone cobble was approximately 7 cm in diameter, and the bore hole was approximately just under 1 cm wide.

N Sample: 1 Illustrated in Appendix C, Figure 85

Material (N) Miscellaneous stone: 1

PREHISTOIC BONE ARTIFACTS

Willapa River Valley Single Piece Serrated Harpoons

24-01 Bone points, no serration or barbs, rake teeth?

A cylindrical segment of antler or bone that has been ground into a point on one end.

N Sample: 1 Illustrated in Appendix C, Figure 86

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	131.2	mm	-	mm	-	1
Width	21.8	mm	-	mm	-	1
Thickness	7.2	mm	-	mm	-	1
Weight	18.3	g	-	g	-	1
Material (N)	Bone/Antler: 1					

25-01 Single piece serrated harpoons

A large "splinter" fragment of large mammal long bone (deer or elk likely) that has one end edge-ground into a point, and the other slightly convex and smooth. Flake-tool grooving was used to score and snap-remove two barbed serrations on one site of the blade, and one on the opposite.

N Sample: 1 Illustrated in Appendix C, Figure 87

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	131.2	mm	-	mm	-	1
Width	21.8	mm	-	mm	-	1
Thickness	7.2	mm	-	mm	-	1
Weight	18.3	g	-	g	-	1
Material (N)	Bone/Antler: 1					

Willapa River Valley Harpoon Foreshafts

26-01 Cylindrical harpoon foreshafts

A ground bone cylindrical shaft, foreshaft, or projectile point-type artifact with a long tapered body and a tang for insertion into a shaft.

N Sample: 1 Illustrated in Appendix C, Figure 88

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	136.7	mm	-	mm	-	1
Max. Diameter	13.2	mm	-	mm	-	1
Tine Diameter	7.0	mm	-	mm	-	1
Weight	14.8	g	-	g	-	1
Material (N)	Bone/Antler: 1					

Willapa River Valley Awls

27-01 Awls

Splinters of bone and pieces of antler that have sharp ground tips, but little to no modification of the body. These are simple bone and antler pointed tools.

N Sample: 3 Illustrated in Appendix C, Figure 89

	Range		*Mean*		*SD*	*Measured (N)*
Length	46.0 – 72.2	mm	63.26	mm	14.96	3
Width	17.6 – 27.3	mm	22.13	mm	4.88	3
Thickness	7.3 – 17.6	mm	10.8	mm	5.89	3
Weight	5.3 – 13.1	g	8.1	g	4.34	3
Material (N)	Bone/Antler: 3					

Willapa River Valley Tines

28-01 Tines

A long pencil-like ground fragment of antler? The thin body of the tine has been extensively shaped by grinding, unlike a simple bone splinter awl.

N Sample: 1 Illustrated in Appendix C, Figure 90

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	67.2	mm	-	mm	-	1
Width	9.6	mm	-	mm	-	1
Thickness	7.8	mm	-	mm	-	1
Weight	6.2	g	-	g	-	1
Material (N)	Bone/Antler: 1					

Willapa River Valley Matting Needles

29-01 Matting needles

A tapered pointed ground antler? implement similar to the “matting needles” of the Columbia River and Snake River Late Holocene villages. The smooth body has been completely formed by grinding.

N Sample: 1 Illustrated in Appendix C, Figure 90

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	63* broken	mm	-	mm	-	1
Width	18.1	mm	-	mm	-	1
Thickness	5.5	mm	-	mm	-	1
Weight	5.8	g	-	g	-	1
Material (N)	Bone/Antler: 1					

Willapa River Valley Bone/Antler Wedges

30-01 Antler wedges

A thick elk antler wedge that has distinct cut-mark sharpening scars on its beveled proximal blade end. The wide flat distal “hammered” end exhibits crushing use-wear. This form is characteristic of the Middle to Late Holocene technology of the Columbia and Snake Rivers.

N Sample: 1 Illustrated in Appendix C, Figure 91

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	104.5	mm	-	mm	-	1
Width	44.6	mm	-	mm	-	1
Thickness	16	mm	-	mm	-	1
Weight	60.4	g	-	g	-	1

Material (N) Antler: 1

30-01 Whale bone wedges

A sub-type of bone/antler wedges. A single specimen of a wedge-shaped whale bone artifact that that may be fossilized bone. The flat end of the wedge-shaped artifact exhibits crushing percussive wear, as does the blade-like end of the artifact which is also partially fractured. The artifact appears to have been used as wedge type tool, perhaps for separating planks from cedar logs.

N Sample: 1 Illustrated in Appendix C, Figure 92

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	98.5	mm	-	mm	-	1
Width	82.6	mm	-	mm	-	1
Thickness	30.0	mm	-	mm	-	1

Material (N) Miscellaneous stone (Fossil bone or layered schist?): 1

Willapa River Valley Bone Net Gauges

31-01 Net gauges

A polished and ground straight segment of large mammal long bone that has smoothly pointed and ground ends. A possible net gauge, but the function is not known.

N Sample: 1 Illustrated in Appendix C, Figure 93

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	109.9	mm	-	mm	-	1
Width	13.6	mm	-	mm	-	1
Thickness	9.1	mm	-	mm	-	1
Weight	18.6	g	-	g	-	1

Material (N) Bone: 1

HISTORIC ARTIFACTS

Willapa River Valley Historic Musket Balls

50-01a Lead musket balls

Cast lead spherical musket balls with scars from the removal of their casting mold "spur".

N Sample: 3 Illustrated in Appendix C, Figure 94 (a-c)

	Range		*Mean*		*SD*	*Measured (N)*
Length	10 – 13.7	mm	11.93	mm	1.86	3
Width	10 – 13.7	mm	11.93	mm	1.86	3
Thickness	9.7 – 12.7	mm	11.36	mm	1.53	3
Weight	6.0 – 14.1	g	10.3	g	4.07	3
Material (N)	Lead: 3					

50-01b Lead musket ball mold-spurs

Cylindrical lead segment cut from a cast musket ball.

N Sample: 1 Illustrated in Appendix C, Figure 94 (d)

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	8.0	mm	-	mm	-	1
Width	5.5	mm	-	mm	-	1
Thickness	5.5	mm	-	mm	-	1
Weight	1.7	g	-	g	-	1
Material (N)	Lead: 1					

Willapa River Valley Coins and Tokens

55-01 Sales tax tokens

A State of Washington tax commission sales tax token (1935-1940). Tax tokens were used between 1935 and 1951. The aluminum tokens tend to be older than the plastic tokens.

N Sample: 1 Illustrated in Appendix C, Figure 95

	Measurement		*Mean*		*SD*	*Measured (N)*
Outside Diam.	22.7	mm	-	mm	-	1
Inside Diam.	4.1	mm	-	mm	-	1
Thickness	1.5	mm	-	mm	-	1
Material (N)	Aluminum: 1					

Willapa River Valley Buttons

56-01 Two-hole metal button. J.S. & Co. San Francisco

A two-hole circular metal button with a concave center and the name " J.S. & Co. San Francisco" in raised letters arcing with the circumference of the circular shape.

N Sample: 1 Illustrated in Appendix C, Figure 96

	Measurement		*Mean*		*SD*	*Measured (N)*
Outside Diam.	16.9	mm	-	mm	-	1
Material (N)	Metal: 1					

Willapa River Valley Glass Beads

56-01 Round glass beads

Multiple varieties of perforated spherical (round) glass beads. The glass in the collection exhibits hues of blue and turquoise. Variables of each bead were not recorded, and a great variety of forms have been lumped into this general type. There are many different varieties that have not been differentiated.

N Sample: 13 Illustrated in Appendix C, Figure 97 (a-c)

	Range		*Mean*		*SD*	*Measured (N)*
Outside Diam.	4.2 – 17.8	mm	-	mm	-	13
Hole Diam.	1.0 – 1.6	mm	-	mm	-	3
Thickness	2.9 – 4.7	mm	-	mm	-	3

Material (N) Turquoise and Blue Glass: 13

56-01d Tubular glass beads

Multiple varieties of perforated tubular glass beads. The glass in the collection exhibits hues of blue and turquoise. Variables of each bead were not recorded, and a great variety of forms have been lumped into this general type. There are many different varieties that have not been differentiated.

N Sample: 3 Illustrated in Appendix C, Figure 97 (d-f)

	Range		*Mean*		*SD*	*Measured (N)*
Length	5.8 – 14.0	mm	11.1	mm	4.6	3
Width	4.5 – 8.3	mm	6.43	mm	1.9	3
Thickness	4.5 – 8.3	mm	6.4	mm	2.69	2
Hole Diameter	1.4 – 2.5	mm	1.8	mm	.61	3

Material (N) Blue Glass: 3

Willapa River Valley Porcelain Projectile Points

70-01 Chinese porcelain projectile points

The blue and white glazed porcelain projectile point is flat, except for its edges where it has been bifacially pressure flaked to create the distinct form. The projectile point is symmetrical, with slightly convex blade margins. The base is corner notched to form a thin hafting stem with a convex stem base. The pressure flake scars do not travel across the face of the projectile point, preserving the thin decorative glaze designs on the tool face. The ethnographic period Chinese glazed porcelain appears older than mid-19th century Canton Ware, and may be a type of late 17th century Kraak porcelain. (Woodward 1986)

N Sample: 1 Illustrated in Appendix C, Figure 98

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	48.25	mm	-	mm	-	1
Width	14.08	mm	-	mm	-	1
Thickness	4.25	mm	-	mm	-	1
Neck Width	6.30	mm	-	mm	-	1

Material (N) Chinese porcelain : 1

Willapa River Valley Clay Marbles

75-01 Clay marbles

Fired clay glazed and unglazed marbles. Tan color clay. Glaze appears to be iron-oxide based (reddish brown), clear glass, and white glass. Clay marbles were found in plowed fields.

N Sample: 9 Illustrated in Appendix C, Figure 99

	Range		*Mean*		*SD*	*Measured (N)*
Diameter	13- 17	mm	-	mm	-	9
Material (N)	Clay: 9					

Willapa River Valley Bone Corset Rods

80-01 Corset rods?

A long flat ground and polished bone rod with smooth curved ends. This artifact may represent a corset rod. It could also potentially represent an insert element of early historic period clamons armor.

N Sample: 1 Illustrated in Appendix C, Figure 100

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	222.4	mm	-	mm	-	1
Width	22.4	mm	-	mm	-	1
Thickness	3.8	mm	-	mm	-	1
Material (N)	Bone: 1					

Willapa River Valley Lahal Game Pieces

85-01 Lahal game piece, Slahal game piece ("stick game" of the Plateau region)

The artifact is an early historic "Black" game piece from the game of Lahal. The polished bone shaft is inscribed with five lines that travel the circumference of the game piece. The five lines are inscribed over lighter inscribed "compass circles". The etching is darker than the rest of the bone body, and may have been stained with dye. The ends of the polished long-bone piece have been filled with cork that was cut flush with the straight cut bone end. There is a small bent metal tack in the cork on each end of the game piece, perhaps a tactile sign that the piece is the "black" game piece, rather than the accompanying "white" game piece.

N Sample: 1 Illustrated in Appendix C, Figure 101

	Measurement		*Mean*		*SD*	*Measured (N)*
Length	7.8	cm	-	mm	-	1
Width	2.5	cm	-	mm	-	1
Thickness	2.4	cm	-	mm	-	1
Material (N)	Bone, cork, metal nail: 1					

Willapa River Valley
Prehistoric Artifact Classification

CHIPPED STONE PROJECTILE POINTS

01-01 Broad-necked, barbed, diverging stem
01-02 Broad-necked, shouldered, diverging stem
01-03 Broad-necked, incurvate stem base
01-04 Broad-necked, barbed, non-diverging stem
01-05a Broad-necked, shouldered, non-diverging stem, small
01-05b Broad-necked, shouldered, non-diverging stem, large
01-06a Ovate or bipointed, unnotched, unstemmed, small
01-06b Ovate or bipointed, unnotched, unstemmed, large
01-07 Narrow-necked, barbed, diverging stem
01-08 Narrow-necked, shouldered, diverging stem
01-09 Narrow-necked, barbed, non-diverging stem
01-10 Narrow-necked, shouldered, non-diverging stem
01-11 Ovate, side-notched
01-12a Triangular blade, side notched, flat or convex base
01-12b Triangular blade, side notched, incurvate (concave) base
01-13 Unnotched, unstemmed, incurvate (concave) base
01-14 Triangular blade, unstemmed, unnotched
01-15 Side notched and stemmed
01-16 Triangular to ovate blade, unstemmed, minimal retouch
01-17a Large barbed
01-17b Large stemmed

Figure 1. 01-01 Broad-necked, barbed, diverging stem

Figure 2. 01-02 Broad-necked, shouldered, diverging stem

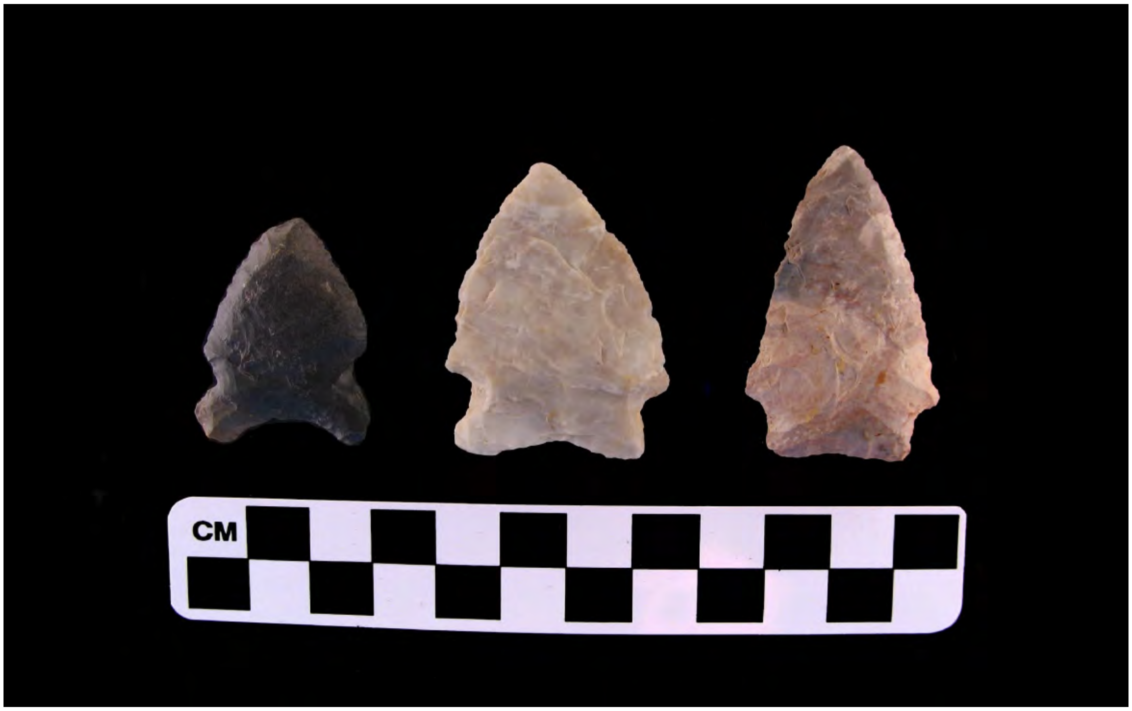

Figure 3. 01-03 Broad-necked, incurvate stem base

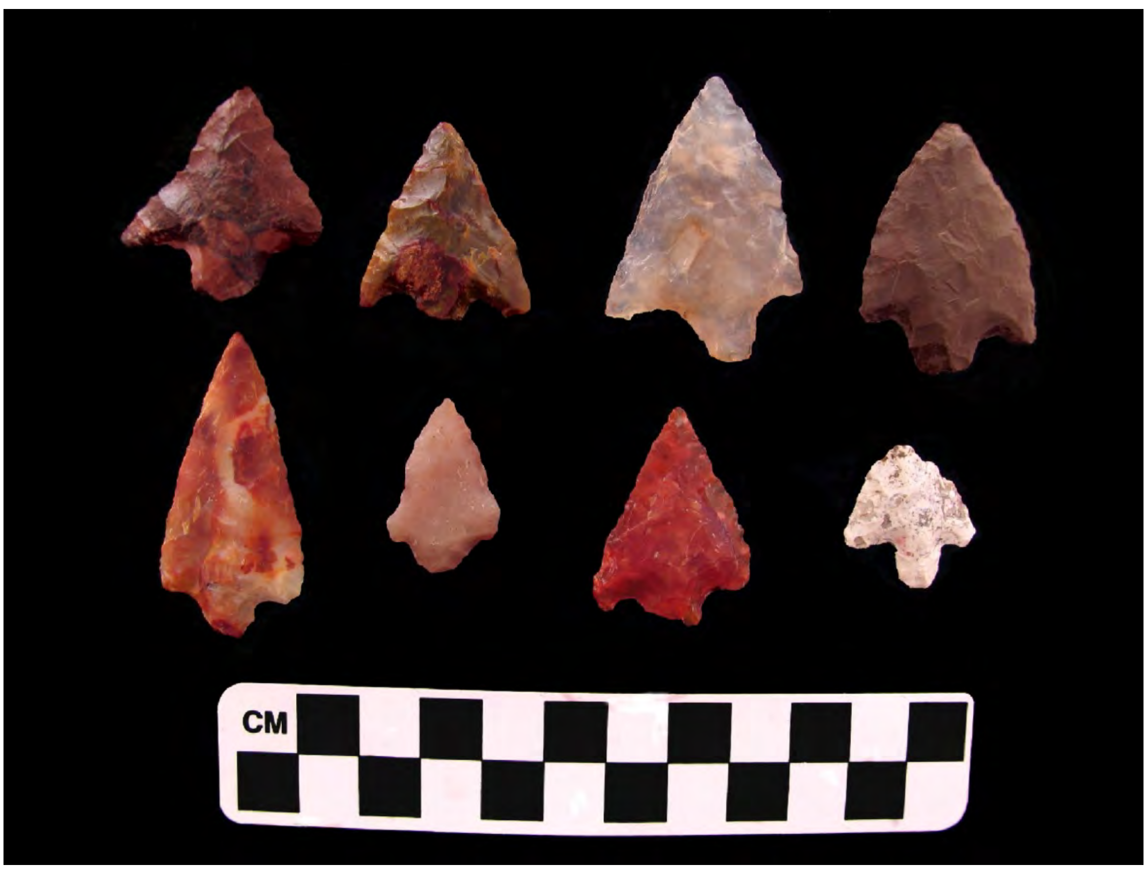

Figure 4. 01-04 Broad-necked, barbed, non-diverging stem

Figure 5. 01-05a Broad-necked, shouldered, non-diverging stem, small

Figure 6. 01-05b Broad-necked, shouldered, non-diverging stem, large

Figure 7. 01-06a Ovate or bipointed, unnotched, unstemmed, small

Figure 8. 01-06b Ovate or bipointed, unnotched, unstemmed, large

Figure 9. 01-07 narrow-necked, barbed, diverging stem

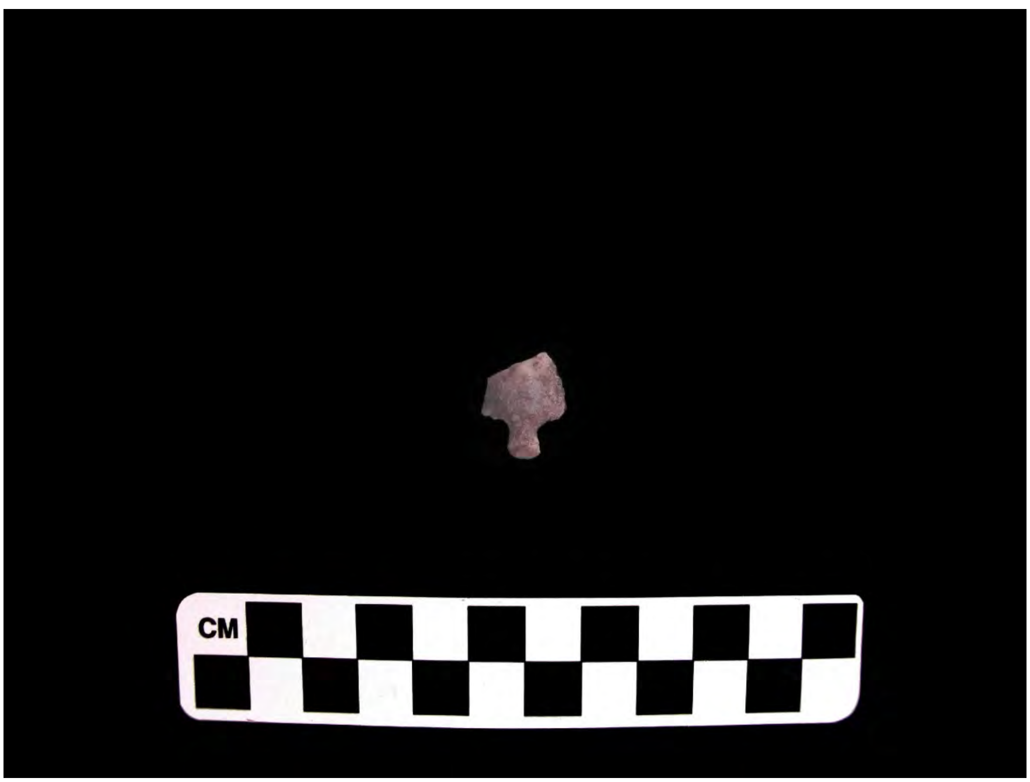

Figure 10. 01-08 narrow-necked, shouldered, diverging stem

Figure 11. 01-09 narrow-necked, barbed, non-diverging stem

Figure 12. 01-10 narrow-necked, shouldered, non-diverging stem

Figure 13. 01-11 Ovate, side-notched

Figure 14. 01-12a Triangular blade, side notched, flat or convex base

Figure 15. 01-12b Triangular blade, side notched, incurvate (concave) base

Figure 16. 01-13 Unnotched, unstemmed, incurvate (concave) base

Figure 17. 01-14 Triangular blade, unstemmed, unnotched

Figure 18. 01-15 Side notched and stemmed

Figure 19. 01-16 Triangular to ovate blade, unstemmed, minimal retouch

Figure 20. 01-17a Large barbed

Figure 21. 01-17b Large stemmed

Willapa River Valley
Prehistoric Artifact Classification

CHIPPED STONE BIFACE KNIVES

02-01a Ovate bifaces
02-01b Large ovate bifaces
02-01c *Skreblos*, large non-symmetrical bifaces
02-02 Triangular bifaces, flat or convex base
02-03 Concave base bifaces
02-04 Miscellaneous shaped bifaces, discoidal
02-06 Small non-symmetrical bifaces, side blades
02-08 Status bifaces

Figure 22. 02-01a Ovate bifaces

Figure 23. 02-01b Large ovate bifaces

Figure 24. 02-01c *Skreblos*, Large non-symmetrical bifaces

Figure 25. 02-02 Triangular bifaces, flat or convex base

Figure 26. 02-03 Concave base bifaces

Figure 27. 02-04 Miscellaneous shaped bifaces, discoidal form bifaces

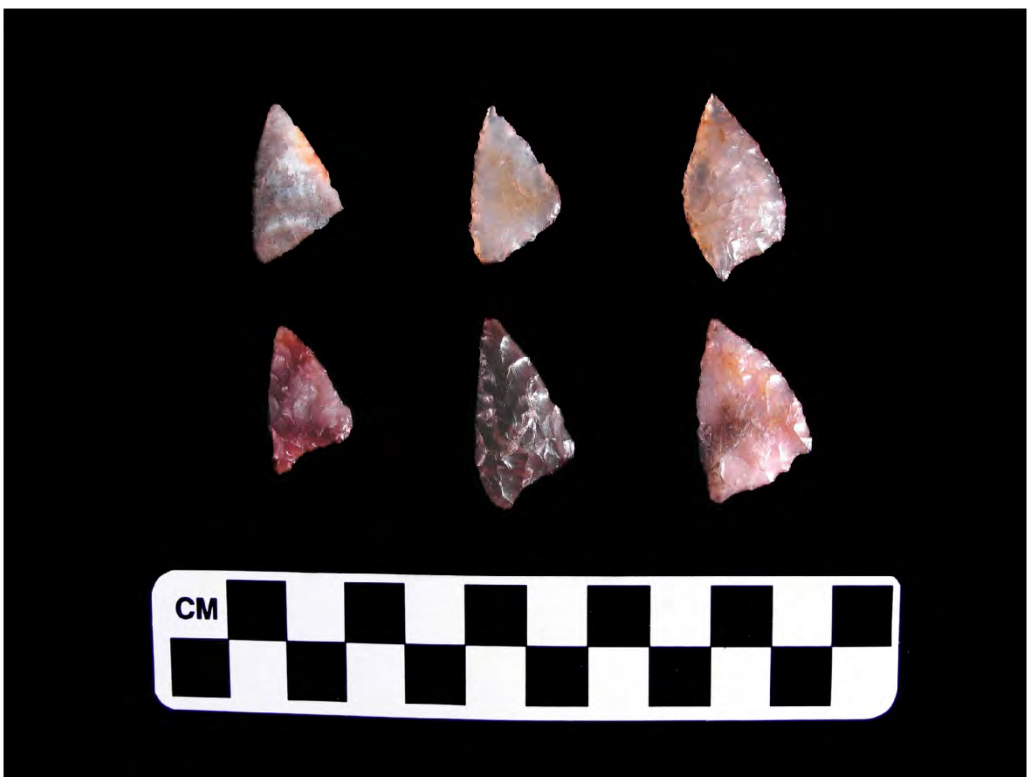

Figure 28. 02-06 Small non-symmetrical bifaces, side blades

Figure 29. 02-08 Status biface, S. Niemcziek collection

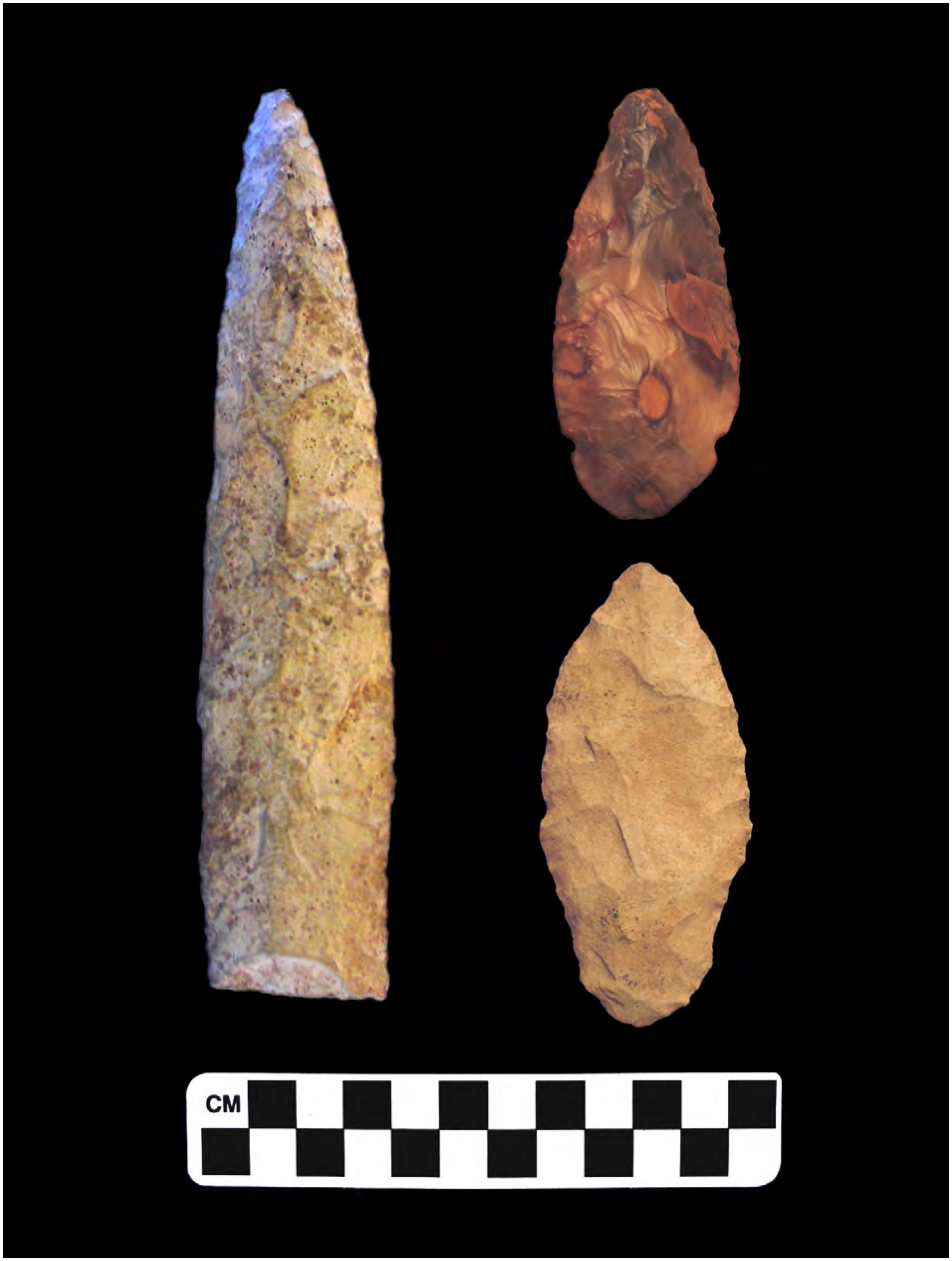

Figure 30. 02-08 Status bifaces, Kaech Family collection

Willapa River Valley
Prehistoric Artifact Classification

CHIPPED STONE SCRAPERS

03-01 Convex scrapers, “thumb-nail scrapers”
03-02 Convex scrapers, “thumb-nail scrapers”, small variety
03-03 Convex scrapers, minimally retouched/modified body
03-04 Large convex scrapers, minimally retouched body
03-05 Large flake and cobble spall “hand scrapers”
03-06 Steep domed scrapers, exaggerated convexity
03-07 Scrapers with 100% marginal retouch, discoidal
03-08 Scrapers with corners, squared and triangular
03-09 Angled bit scrapers
03-10 Angled bit scrapers, large variety
03-11 Bifacial scrapers
03-12 Rotated scrapers
03-13 Scrapers with concave bits
03-14 End-scrapers, special petrified wood type
03-15 Bifacial scrapers, recycled from projectile point base
03-16 Biface tip fragment scrapers
03-17 Beaked end-scrapers
03-18 Flake scrapers
03-19 Blade flake end-scrapers
03-20 Flake shatter scrapers

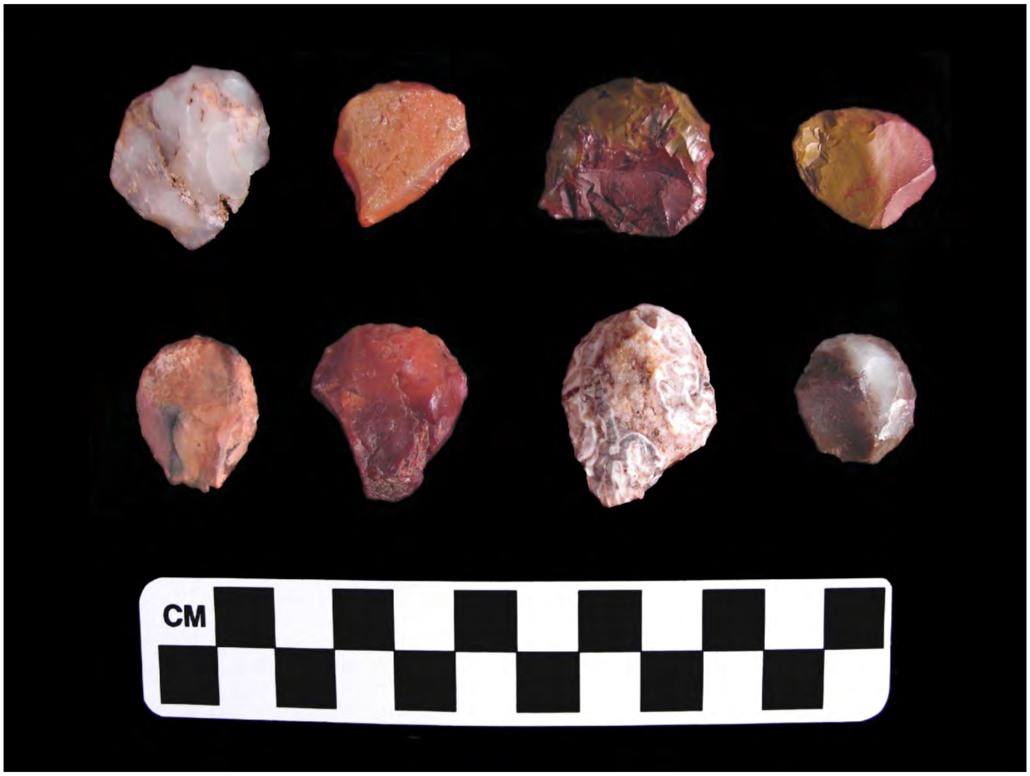

Figure 31. 03-01 Convex scrapers, “thumb-nail” scrapers

Figure 32. 03-02 Convex scrapers, “thumb-nail scrapers”, small variety

Figure 33. 03-03 Convex scrapers, minimally retouched/modified body

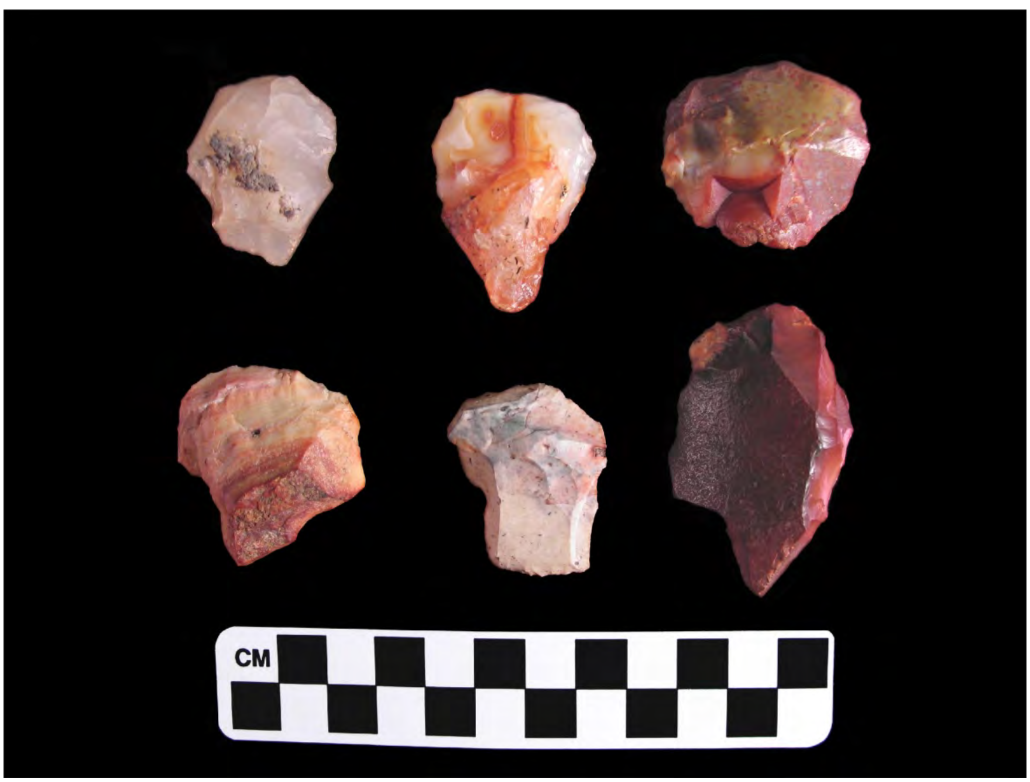

Figure 34. 03-04 Large convex scrapers, minimally retouched body

Figure 35. 03-05 Large flake and cobble spall "hand scrapers"

Figure 36. 03-06 Steep domed scrapers, exaggerated convexity

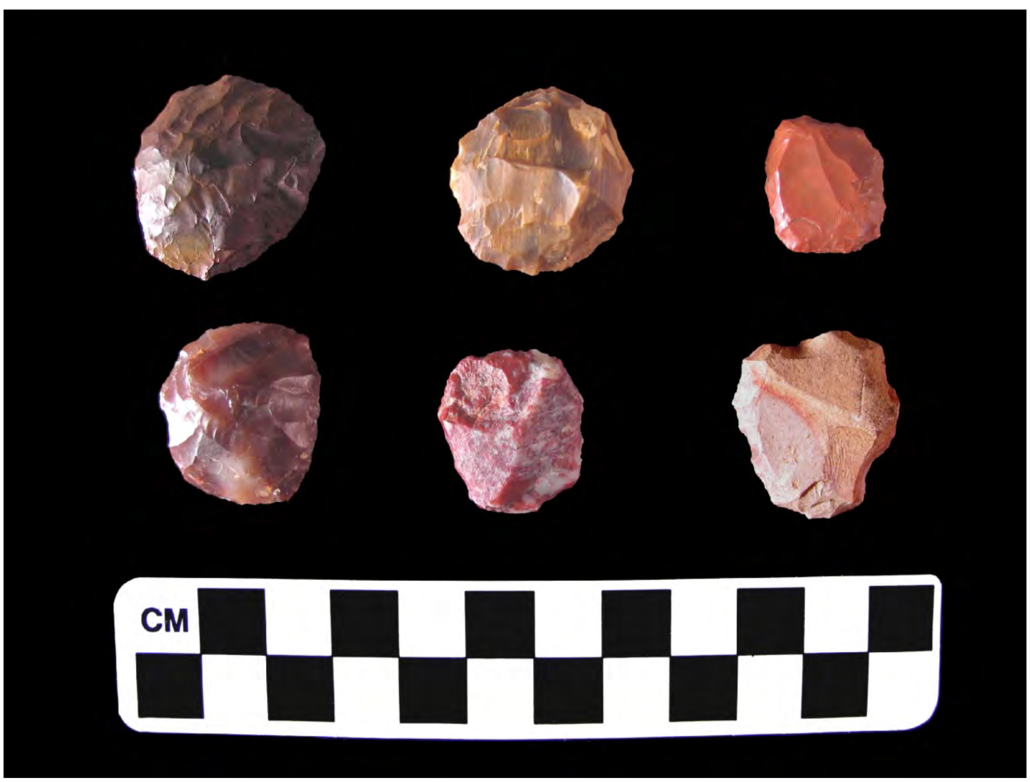

Figure 37. 03-07 Scrapers with 100% marginal retouch, discoidal scrapers

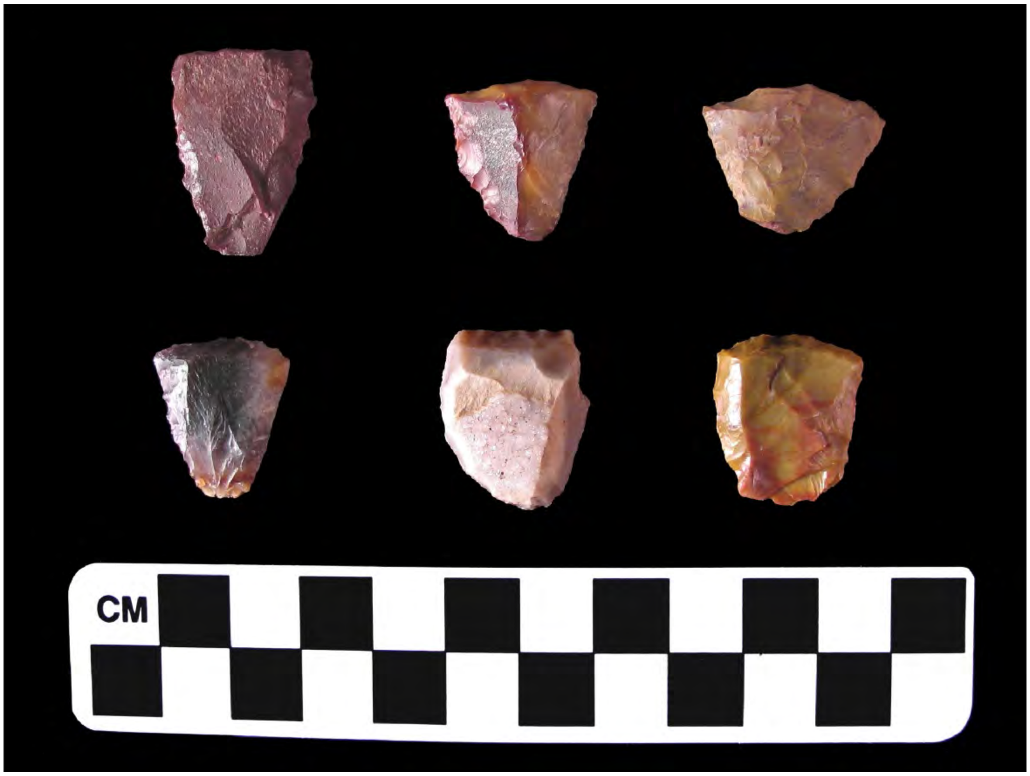

Figure 38. 03-08 Scrapers with corners, squared and triangular

Figure 39. 03-09 Angled bit scrapers

Figure 40. 03-10 Angled bit scrapers, large variety

Figure 41. 03-11 Bifacial scrapers

Figure 42. 03-12 Rotated scrapers

Figure 43. 03-12 Rotated scraper

Figure 44. 03-12 Rotated scraper

Figure 45. 03-13 Scrapers with concave bits

Figure 46. 03-14 End-scrapers, special petrified wood type

Figure 47. 03-15 Bifacial scrapers recycled from projectile point bases

Figure 48. 03-16 Biface tip fragment scrapers

Figure 49. 03-17 Beaked end-scrapers

Figure 50. 03-18 Flake scrapers

Figure 51. 03-19 Blade flake end-scrapers

Willapa River Valley
Prehistoric Artifact Classification

CHIPPED STONE GRAVERS and DRILLS

Figure 52. 04-01 and 04-02 Gravers

Figure 53. 05-01 Drills

Willapa River Valley
Prehistoric Artifact Classification

CHIPPED STONE CORES

06-01 Multidirectional cores
06-01 Sub-Type; Cores made from CCS Oligocene fossilized clams
06-02 Micro-cores, microblade cores
06-03 Blade cores
06-04 Cobble cores / choppers
.

Figure 54. 06-01 Multidirectional cores

Figure 55. 06-01 Sub-type: Multidirectional core of fossilized CCS Oligocene clam.

Figure 56. 06-02 Microblade core, rejuvenation flake dorsal face

Figure 57. 06-02 Microblade core, rejuvenation flake ventral face

Figure 58. 06-02 Microblade core, rejuvenation flake dorsal face, remnant blade flake

Figure 59. 06-02 Microblade core, rejuvenation flake platform

Figure 60. 06-02 Micro-cores, microblade cores

Figure 61. 06-03 Blade cores

Figure 62. 06-04 Cobble cores/choppers

Willapa River Valley
Prehistoric Artifact Classification

PECKED and GROUND STONE

08-01 Hammerstones
09-01 Edge ground cobbles
09-02 Edge ground “cobble mortars”
10-01a Pestles, unmodified body, end-wear
10-01b Pestles, unmodified tabular body, end-wear
10-02 Pestles, cylindrical body
10-03 Pestles, planar body
11-01 Hand mauls
11-02 Girdled mauls
12-01 Mortars
13-01 Adzes, nephrite
13-02 Cobble adzes
14-01 Clubs, lozenge style
14-02 Clubs, “hammer head” style
15-01 Bolas stones, girdled concretion
16-01 Stone pipes
17-01a Ornament, slate-like
17-01b Ornament, pendant
18-01 Net weights, notched cobbles
18-02 Net weight, girdled/grooved cobbles
20-01 Miscellaneous ground stone
20-03 Perforated cobble, digging stick handle

Figure 63. 08-01 Hammerstones

Figure 64. 09-01 Edge-ground cobbles

Figure 65. 09-02 Edge-ground “cobble mortars”

Figure 66. 10-01a Pestles, unmodified body with end-wear

Figure 67. 10-01b Pestles, unmodified tabular body with end-wear

Figure 68. 10-02 Pestles, cylindrical body

Figure 69. 10-03 Pestles, planar body

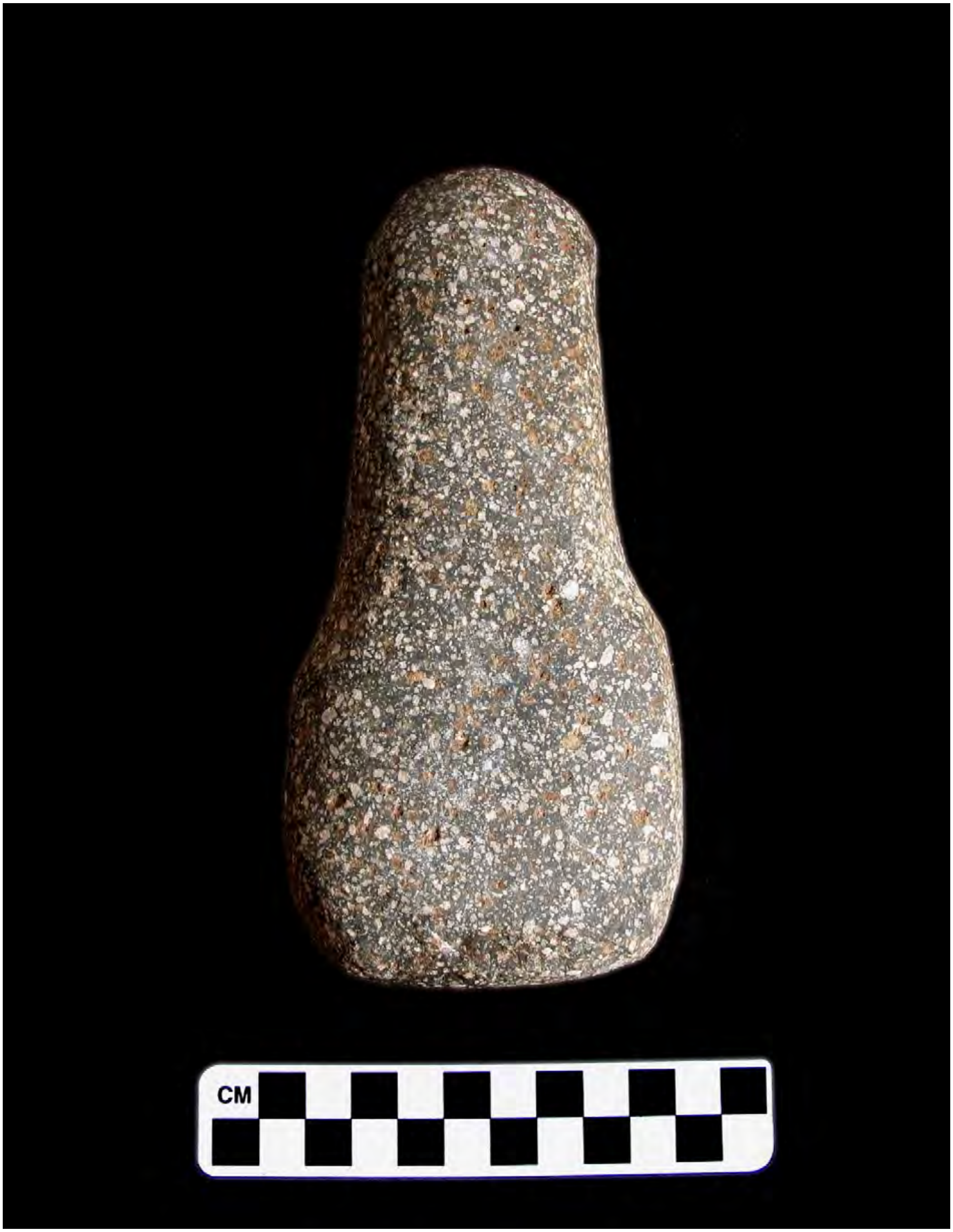

Figure 70. 11-01 Hand maul

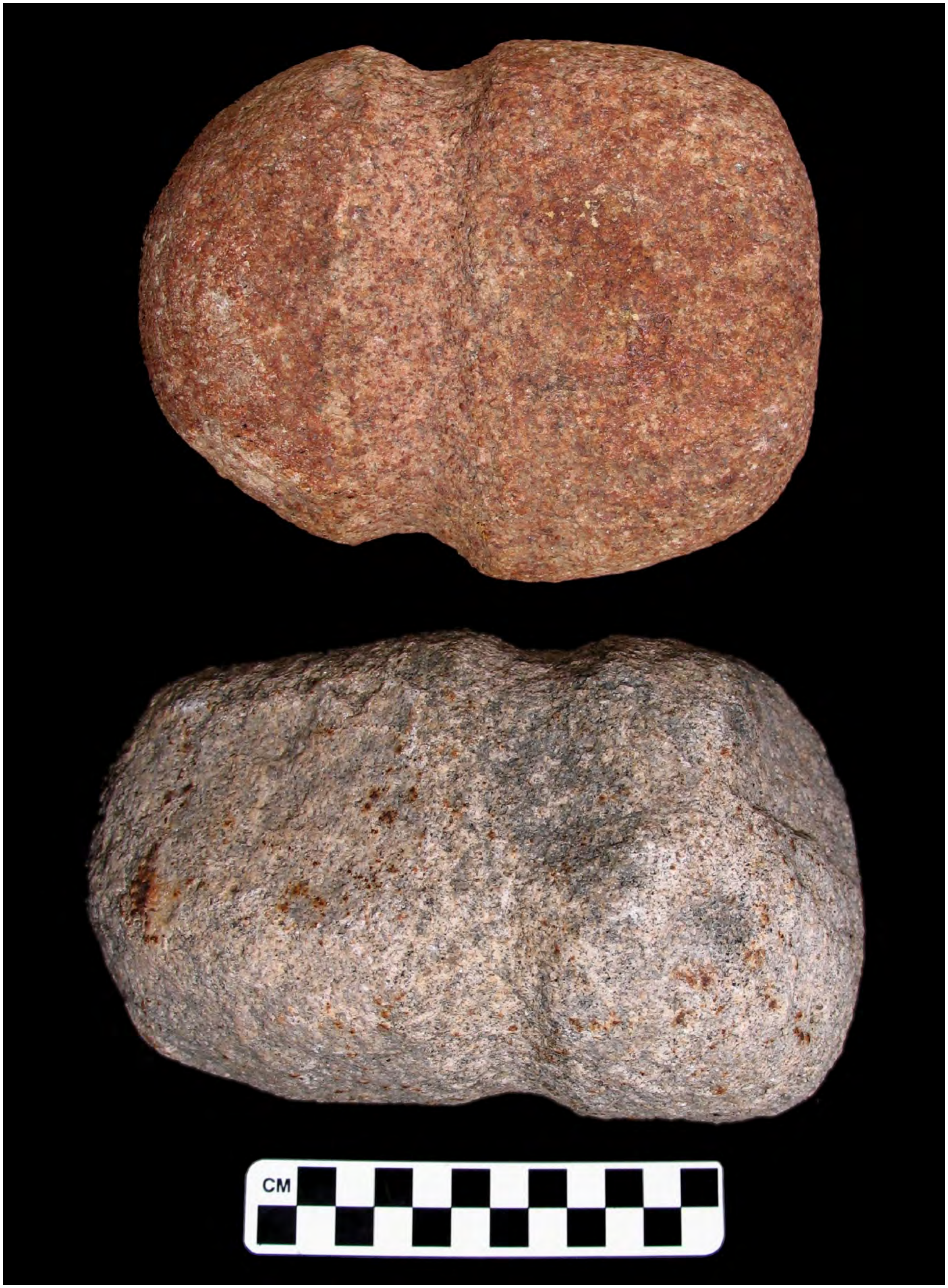

Figure 71. 11-02 Girdled mauls

Figure 72. 12-01 Mortars

Figure 73. 13-01 Adzes, nephrite

Figure 74. 13-02 Cobble adze

Figure 75. 14-01 Clubs, lozenge style

Figure 76. 14-01 Clubs, lozenge style, comparison of Willapa River Valley club tip fragments

Figure 77. 14-02 Club, “hammer head” style

Figure 78. 15-01 Bolas stones, girdled concretions

Figure 79. 16-01 Stone pipe

Figure 80. 17-01a Ornament, slate-like

Figure 81. 17-01b Ornament, pendant

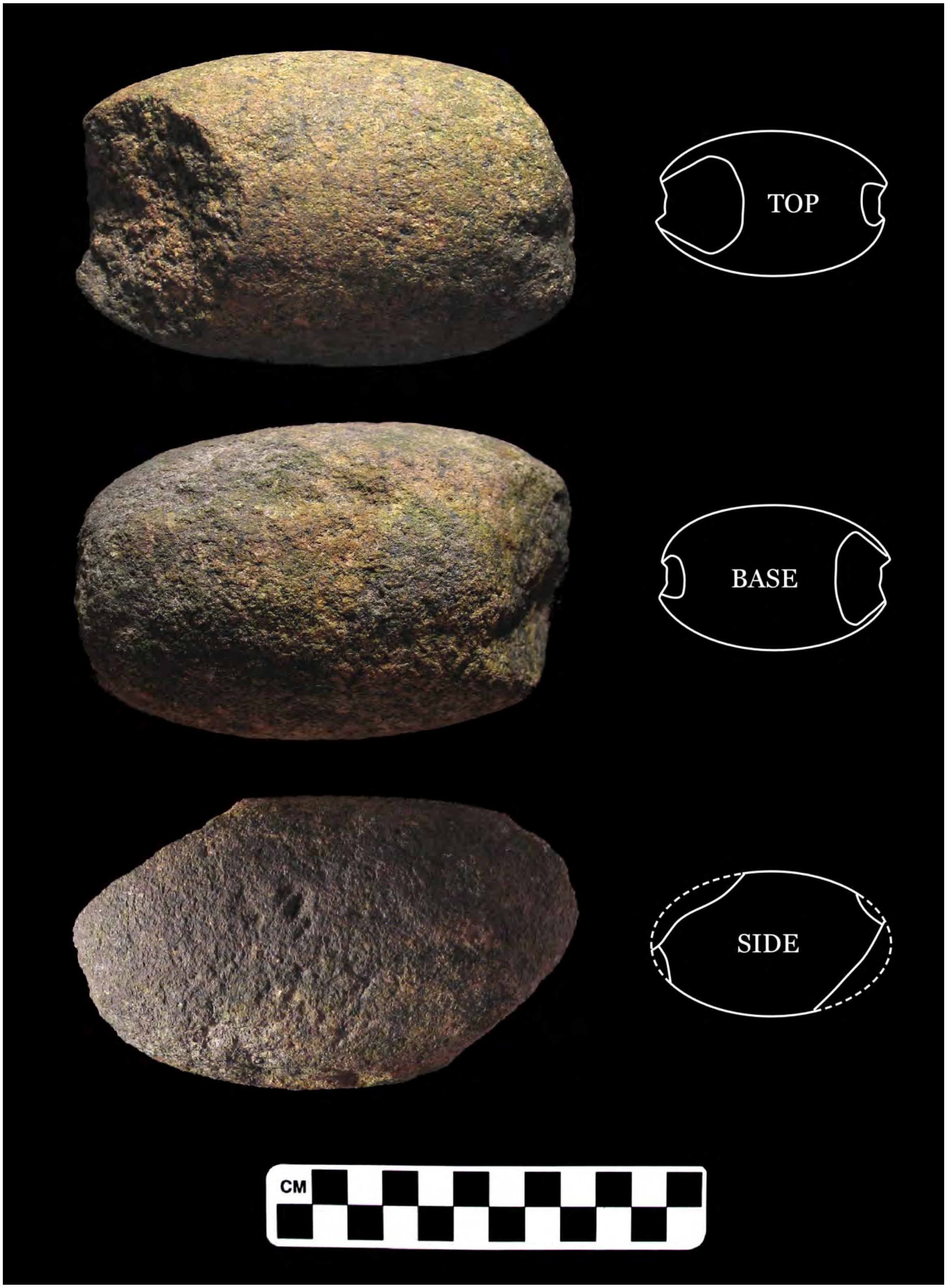

Figure 82. 18-01 Net weight, notched cobble

Figure 83. 18-02 Net weight, girdled/grooved cobble

Figure 84. 20-01 Miscellaneous ground stone

Figure 85. 20-03 Perforated cobble, digging stick handle?

Willapa River Valley
Prehistoric Artifact Classification

BONE ARTIFACTS

24-01 Bone points, no serration or barbs
25-01 Single piece serrated harpoons
26-01 Cylindrical harpoon foreshafts
27-01 Awls/Perforators
28-01 Tines
29-01 Matting needles
30-01 Wedges
31-01 Net gauges

Figure 86. 24-01 Bone points, no serration or barbs

Figure 87. 25-01 Single piece serrated harpoons

Figure 88. 26-01 Cylindrical harpoon foreshafts

Figure 89. 27-01 Awls/Perforators

Figure 90. 28-01a Tines, and 29-01 Matting needles

Figure 91. 30-01 Wedges

Figure 92. 30-01 Whale bone wedge

Figure 93. 31-01 Net gauges

Willapa River Valley
Proto-Historic & Historic
Artifact Classification

HISTORIC ARTIFACTS

50-01a Musket ball, lead
50-01b Musket ball mold spur
55-01 Metal tokens
56-01 Metal buttons
60-01a Glass bead A
60-01b Glass bead B
60-01c Glass bead C
60-01d Glass bead D
60-01e Glass bead E
60-01f Glass bead F
70-01 Chinese porcelain projectile point
75-01 Clay marbles
80-01 Bone corset rod
85-01 *Lahal* "*Slahal*" Bone game piece

Figure 94. 50-01a Musket balls, lead, 50-01b Musket ball mold spurs

Figure 95. 55-01 Metal tokens

Figure 96. 56-01 Metal buttons

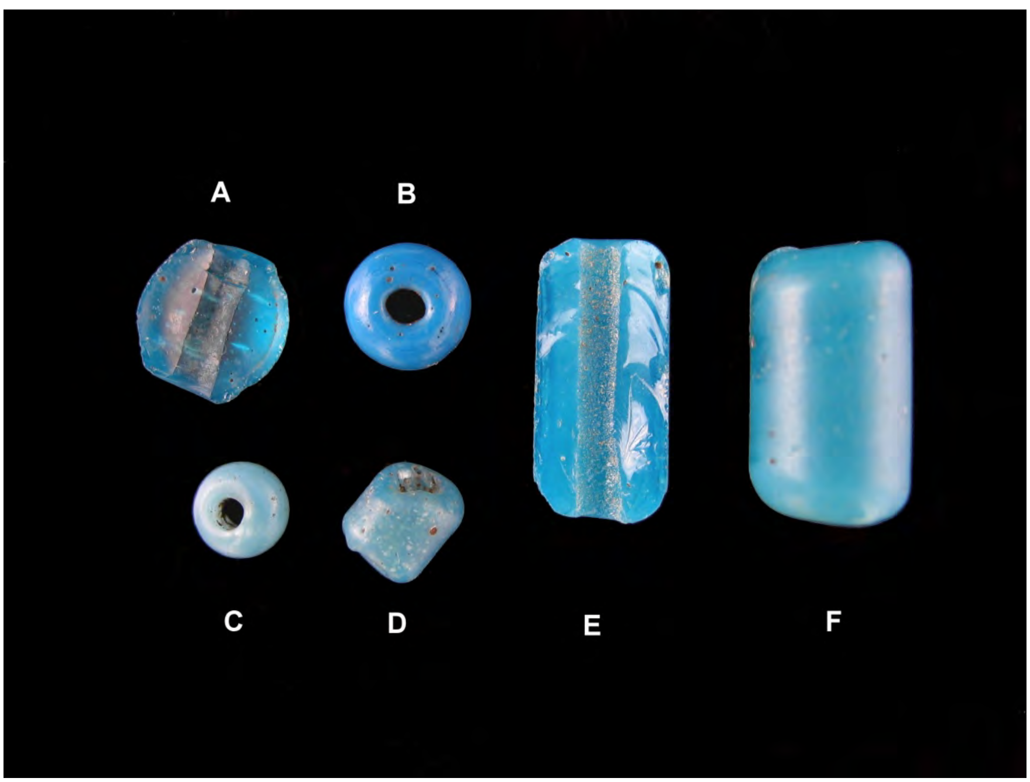

Figure 97. 60-01a-f Glass beads

Figure 98. 70-01 Chinese porcelain projectile point

Figure 99. 75-01 Clay marbles

Figure 100. 80-01 Bone corset rods

Figure 101. 85-01 *Lahal "Slahal"* bone game piece, "black" game piece

APPENDIX D

Willapa River Valley Project

Obsidian X-ray Fluorescence Results

Analyses and tables by

Craig Skinner

and

the Northwest Research Obsidian Studies Laboratory

Table D-1. Results of XRF Studies: Artifacts from Pacific County, Washington

Site	Specimen No.	Catalog No.	Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	$Fe_2O_3^T$	Fe:Mn	Fe:Ti	Geochemical Source
			Trace Element Concentrations											Ratios		
S. Niemcziek Collection	1	29	20	11	73	101	15	98	10	1021	273	840	0.85	26.9	28.5	Obsidian Cliffs
			± 17	5	4	9	4	7	2	100	32	24	0.14			
S. Niemcziek Collection	2	100	47	32	180	8	43	218	11	864	170	342	1.13	54.7	43.4	Napa Valley
			± 16	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	3	106	35	30	189	11	41	229	8	810	152	341	1.16	62.0	47.1	Napa Valley
			± 16	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	4	124	56	35	181	11	40	216	12	876	255	368	1.13	37.2	42.8	Napa Valley
			± 16	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	5	125	80	37	145	53	48	278	12	1342	375	541	2.06	44.7	49.3	Annadel
			± 15	5	4	9	4	7	2	100	33	24	0.14			
S. Niemcziek Collection	6	126	72	32	137	49	49	274	14	1293	353	552	1.96	45.0	48.6	Annadel
			± 15	4	4	9	4	7	2	100	32	24	0.14			
S. Niemcziek Collection	7	127	59	35	191	10	44	229	12	694	203	391	1.08	44.5	51.6	Napa Valley
			± 16	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	8	128	62	29	184	10	40	223	10	937	222	346	1.15	42.9	40.6	Napa Valley
			± 15	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	9	129	66	30	182	10	43	236	11	744	153	339	1.07	57.5	47.7	Napa Valley
			± 16	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	10	130	44	34	184	9	42	220	9	788	191	353	1.04	45.5	44.0	Napa Valley
			± 16	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	11	131	62	30	192	8	38	220	10	881	205	352	1.24	49.7	46.3	Napa Valley
			± 16	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	12	152	54	39	185	9	40	222	9	785	151	343	1.08	58.7	45.6	Napa Valley
			± 16	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	13	153	75	35	192	10	48	235	10	826	215	388	1.24	47.5	49.2	Napa Valley
			± 15	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	14	154	23	34	180	11	39	221	11	879	195	363	1.19	50.4	44.7	Napa Valley
			± 18	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	15	155	53	35	187	11	41	224	10	824	135	327	1.11	66.9	44.7	Napa Valley
			± 16	5	4	9	4	7	2	99	32	24	0.14			

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.
NA = Not available; ND = Not detected; NM = Not measured; * = Small sample; FGV = Fine-grained volcanic specimen.

Northwest Research Obsidian Studies Laboratory:REPORT 2010-110

Table D-1. Results of XRF Studies: Artifacts from Pacific County, Washington Table D-1 page 2

Site	Specimen No.	Catalog No.	Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	Fe^2O^{3T}	Fe:Mn	Fe:Ti	Geochemical Source
			Trace Element Concentrations											Ratios		
S. Niemcziek Collection	16	156	56	39	186	9	45	231	10	801	156	326	1.05	55.8	43.8	Napa Valley
			± 16	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	17	157	66	31	187	10	43	229	12	463	265	342	1.21	38.2	83.8	Napa Valley
			± 16	5	4	9	4	7	2	98	32	24	0.14			
S. Niemcziek Collection	18	166	45	12	118	85	24	128	10	1138	185	1399	0.73	34.5	22.6	Whitewater Ridge
			± 15	5	4	9	4	7	2	101	32	26	0.14			
S. Niemcziek Collection	19	180	58	18	81	146	18	107	10	NM	NM	NM	NM	27.1	89.1	Inman Creek A *
			± 16	5	4	9	4	7	2	NM	NM	NM	NM			
S. Niemcziek Collection	20	219	26	13	81	101	23	134	10	NM	NM	NM	NM	33.4	43.7	Glass Buttes 7? *
			± 17	6	4	9	4	7	2	NM	NM	NM	NM			
S. Niemcziek Collection	21	324	30	ND	0	7	5	20	ND	NM	NM	NM	NM	24.6	264.1	Not Obsidian
			± 16	ND	4	9	4	7	ND	NM	NM	NM	NM			
S. Niemcziek Collection	22	395	78	38	199	9	42	233	11	700	124	332	0.97	64.1	46.3	Napa Valley
			± 15	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	23	396	48	36	199	10	46	235	13	772	147	319	1.02	57.3	44.1	Napa Valley
			± 15	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	24	397	62	36	186	11	45	232	11	803	150	368	0.94	52.3	39.4	Napa Valley
			± 16	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	25	398	58	33	196	12	44	236	9	905	140	359	1.04	60.9	38.6	Napa Valley
			± 15	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	26	399	30	36	182	11	37	221	6	538	349	357	1.14	27.6	68.9	Napa Valley
			± 17	5	4	9	4	7	2	98	32	24	0.14			
S. Niemcziek Collection	27	400	72	31	178	10	40	211	10	1013	263	345	1.11	35.6	36.6	Napa Valley
			± 15	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	28	401	63	40	207	6	44	224	11	818	209	392	1.07	42.9	43.6	Napa Valley
			± 15	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	29	402	64	39	196	11	44	241	11	811	150	346	1.05	57.8	43.3	Napa Valley
			± 15	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	30	403	62	23	118	55	41	338	19	1489	427	834	1.98	37.9	42.8	Big Obsidian Flow
			± 16	5	4	9	4	7	2	101	33	24	0.14			

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.
NA = Not available; ND = Not detected; NM = Not measured; * = Small sample; FGV = Fine-grained volcanic specimen.

Table D-1. Results of XRF Studies: Artifacts from Pacific County, Washington Table D-1 page 3

Site	Specimen No.	Catalog No.		Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	$Fe_2O_3^T$	Fe:Mn	Fe:Ti	Geochemical Source
S. Niemcziek Collection	31	404		77	32	178	9	44	218	9	894	183	309	1.04	47.4	39.0	Napa Valley
			±	16	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	32	405		75	34	198	9	44	237	11	812	216	354	0.98	38.3	40.5	Napa Valley
			±	15	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	33	406		64	42	188	9	46	239	11	837	163	340	1.17	58.5	46.1	Napa Valley
			±	16	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	34	407		61	27	186	10	45	225	12	823	259	346	0.87	29.1	36.1	Napa Valley
			±	15	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	35	408		79	33	179	11	43	221	11	684	202	314	0.86	36.6	42.7	Napa Valley
			±	15	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	36	409		59	36	176	8	45	221	11	752	197	323	0.88	38.0	39.5	Napa Valley
			±	16	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	37	410		68	33	221	12	46	98	13	737	231	11	0.84	31.4	38.8	Borax Lake
			±	15	5	4	9	4	7	2	98	32	23	0.14			
S. Niemcziek Collection	38	411		59	28	183	7	43	231	11	813	241	384	1.11	38.5	45.1	Napa Valley
			±	16	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	39	412		68	37	209	12	45	238	13	757	180	348	1.15	52.8	50.2	Napa Valley
			±	16	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	40	413		78	35	186	10	42	229	8	851	245	381	1.11	38.0	43.3	Napa Valley
			±	15	5	4	9	4	7	2	99	32	24	0.14			
S. Niemcziek Collection	41	414		33	18	96	69	26	104	8	NM	NM	1176	NM	22.2	53.4	Glass Buttes 3 *
			±	16	5	4	9	4	7	2	NM	NM	26	NM			
S. Niemcziek Collection	42	415		37	13	132	60	41	269	17	1358	307	814	1.60	42.6	38.3	Newberry Volcano
			±	16	5	4	9	4	7	2	101	32	25	0.14			
S. Niemcziek Collection	43	416		60	15	96	147	24	94	16	749	586	874	1.01	14.9	44.8	Venator FGV
			±	16	5	4	9	4	7	2	99	33	25	0.14			
S. Niemcziek Collection	44	417		38	20	79	25	49	98	10	605	295	1057	0.55	17.2	32.5	Glass Buttes 1
			±	16	5	4	9	4	7	2	99	32	25	0.14			
S. Niemcziek Collection	45	418		26	11	103	82	26	123	8	975	173	1390	0.76	37.7	27.0	Whitewater Ridge
			±	17	6	4	9	4	7	2	100	32	25	0.14			

Zn through $Fe_2O_3^T$: Trace Element Concentrations; Fe:Mn and Fe:Ti: Ratios.

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.
NA = Not available; ND = Not detected; NM = Not measured; * = Small sample; FGV = Fine-grained volcanic specimen.

Table D-1. Results of XRF Studies: Artifacts from Pacific County, Washington Table D-1 page 4

	Specimen		Trace Element Concentrations											Ratios		
Site	No.	Catalog No.	Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	$Fe_2O_3^T$	Fe:Mn	Fe:Ti	Geochemical Source
S. Niemcziek Collection	46	419	82	49	100	92	77	378	13	1293	576	1099	2.35	33.1	57.7	Unknown
			± 17	6	4	9	4	7	2	101	33	25	0.14			
S. Niemcziek Collection	47	420	47	40	114	45	44	156	18	1019	491	NM	0.81	14.7	27.6	Tank Creek *
			± 16	5	4	9	4	7	2	100	33	NM	0.14			
S. Niemcziek Collection	48	421	176	26	28	68	72	408	34	11382	195	123	10.27	399.1	28.2	Unknown FGV
			± 18	7	4	9	4	7	2	121	33	25	0.14			
45-PC-195	49	1	50	12	91	120	21	106	7	NM	NM	NM	NM	30.2	59.1	Obsidian Cliffs *
			± 16	6	4	9	4	7	2	NM	NM	NM	NM			
NA	RGM-1	RGM-1	33	21	140	100	23	219	9	1652	416	763	1.86	36.7	36.5	RGM-1 Reference Standard
			± 17	5	4	9	4	7	2	101	33	25	0.14			

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.
NA = Not available; ND = Not detected; NM = Not measured; * = Small sample; FGV = Fine-grained volcanic specimen.

Table D-2. Results of XRF Studies: Artifacts from the Willapa Bay Area, Pacific and Lewis Counties, Washington

Site	Specimen No.	Catalog No.		Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	$Fe_2O_3^T$	Fe:Mn	Fe:Ti	Geochemical Source
				Trace Element Concentrations											Ratios		
Niemcziek B	1	1000		35	16	116	60	25	112	11	607	344	1410	0.85	21.5	47.1	Whitewater Ridge
			±	17	6	4	9	4	7	2	100	32	25	0.14			
Niemcziek B	2	1001		47	33	76	24	51	96	13	309	307	1054	0.73	21.0	77.7	Glass Buttes 1
			±	16	5	4	9	4	7	2	99	32	25	0.14			
Niemcziek B	3	1002		32	3	0	130	8	29	ND	265	192	27	0.22	13.3	35.9	Not Obsidian
			±	16	6	4	9	4	7	ND	97	32	33	0.14			
Niemcziek B	4	1003		25	30	106	15	21	110	7	NM	NM	164	NM	45.7	16.9	Unknown FGV 1 *
			±	16	5	4	9	4	7	2	NM	NM	24	NM			
Niemcziek B	5	1004		57	20	81	153	19	110	8	NM	NM	NM	NM	26.0	41.1	Inman Creek A *
			±	15	5	4	9	4	7	2	NM	NM	NM	NM			
Niemcziek B	6	1005		72	22	143	77	41	150	28	NM	NM	NM	NM	18.8	44.6	Clackamas River *
			±	15	5	4	9	4	7	2	NM	NM	NM	NM			
Niemcziek B	7	1006		60	20	101	157	26	98	10	NM	NM	NM	NM	18.0	60.3	Venator FGV *
			±	15	5	4	9	4	7	2	NM	NM	NM	NM			
Niemcziek B	8	1007		74	13	85	78	39	292	22	NM	NM	NM	NM	39.1	41.7	Unknown FGV 2 *
			±	16	5	4	9	4	7	2	NM	NM	NM	NM			
Niemcziek B	9	1008		50	19	78	108	14	100	8	611	468	803	1.05	19.2	56.4	Obsidian Cliffs
			±	16	5	4	9	4	7	2	99	33	25	0.14			
Niemcziek B	10	1009		ND	ND	0	6	ND	23	1	499	21	15	0.00	17.7	4.1	Not Obsidian
			±	ND	ND	4	9	ND	8	4	97	32	23	0.14			
Niemcziek B	11	1010		25	14	78	98	15	99	8	NM	NM	NM	NM	26.3	23.0	Obsidian Cliffs *
			±	17	5	4	9	4	7	2	NM	NM	NM	NM			
Niemcziek B	12	1011		95	19	115	12	49	317	21	NM	NM	NM	NM	16.7	34.9	Silver Lake/Sycan Marsh *
			±	16	5	4	9	4	7	2	NM	NM	NM	NM			
Niemcziek B	13	1012		12	ND	ND	6	3	20	ND	NM	NM	NM	NM	6.3	4.4	Not Obsidian
			±	26	ND	ND	9	5	14	ND	NM	NM	NM	NM			
45-PC-212	14	1		38	13	72	99	17	97	9	917	389	808	0.88	19.7	32.6	Obsidian Cliffs
			±	16	5	4	9	4	7	2	99	33	24	0.14			
45-PC-196	15	3		74	3	29	348	26	244	19	6517	607	299	5.40	70.6	26.1	Unknown FGV 3
			±	17	8	4	9	4	7	2	111	33	24	0.14			

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.
NA = Not available; ND = Not detected; NM = Not measured; * = Small sample; FGV = Fine-grained volcanic specimen.

Northwest Research Obsidian Studies Laboratory: REPORT 2012-39

Table D-2. Results of XRF Studies: Artifacts from the Willapa Bay Area, Pacific and Lewis Counties, Washington

Site	Specimen No.	Catalog No.		Trace Element Concentrations Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	$Fe_2O_3^T$	Ratios Fe:Mn	Fe:Ti	Geochemical Source
Jenkins Family	16	1		46	20	147	104	23	210	10	1621	247	802	1.48	49.0	30.0	Glass Mountain, Modern contaminant cobble
			±	16	5	4	9	4	7	2	101	32	24	0.14			
Penoyer Family	17	1		319	806	6	153	ND	72	11	904	29054	NM	6.76	1.9	228.3	Not Obsidian (Slag)
			±	198	369	6	10	ND	8	3	100	64	NM	0.14			
Kaech Family	18	1		30	39	76	103	15	95	10	1026	495	895	0.83	14.9	28.0	Obsidian Cliffs
			±	16	5	4	9	4	7	2	99	33	25	0.14			
Kaech Family	19	2		28	23	79	93	24	132	7	NM	NM	1088	NM	30.9	28.5	Glass Buttes 7 *
			±	17	5	4	9	4	7	2	NM	NM	26	NM			
Kaech Family	20	3		58	18	99	154	23	99	13	NM	NM	881	NM	15.0	30.9	Venator FGV *
			±	16	5	4	9	4	7	2	NM	NM	25	NM			
Kaech Family	21	4		23	ND	1	31	9	46	3	1304	153	NM	1.58	81.7	39.4	Not Obsidian
			±	17	ND	4	9	4	7	2	99	32	NM	0.14			
Kaech Family	22	5		11	6	0	ND	3	20	ND	1046	69	NM	0.32	44.2	12.8	Not Obsidian
			±	34	5	16	ND	6	12	ND	99	32	NM	0.14			
Kaech Family	23	6		ND	7	0	7	ND	28	6	909	65	NM	0.18	30.9	9.8	Not Obsidian
			±	ND	5	4	9	ND	7	2	98	32	NM	0.14			
Kaech Family	24	7		112	37	219	6	86	563	32	1372	804	0	1.91	19.6	44.8	Massacre Lake/Guano Valley
			±	16	5	5	9	4	7	2	100	33	23	0.14			
Kaech Family	25	8		48	21	73	140	21	80	15	698	464	2038	0.72	14.0	35.9	Gregory Creek
			±	16	5	4	9	4	7	2	100	33	27	0.14			
Kaech Family	26	9		53	27	108	56	28	99	9	479	444	999	0.72	14.6	51.1	Glass Buttes 6
			±	16	5	4	9	4	7	2	99	33	25	0.14			
NA	RGM-1	RGM-1		34	14	150	103	26	223	9	1506	277	711	1.79	52.5	38.5	RGM-1 Reference Standard
			±	17	6	4	9	4	7	2	101	32	25	0.14			

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.
NA = Not available; ND = Not detected; NM = Not measured; * = Small sample; FGV = Fine-grained volcanic specimen.

Northwest Research Obsidian Studies Laboratory: **REPORT 2010-161**

Table D-3. Results of XRF Studies: Artifacts from Several Sites in Pacific County, Washington Table D-3 page 1

Site	Specimen No.	Catalog No.	Trace Element Concentrations Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	$Fe_2O_3^T$	Ratios Fe:Mn	Fe:Ti	Geochemical Source
45-PC-180	1	1	42	24	77	120	18	115	11	960	447	815	0.98	19.0	34.4	Obsidian Cliffs
			± 16	5	4	9	4	7	2	100	33	25	0.14			
45-PC-183	2	1	75	26	227	49	64	443	45	1560	251	899	1.88	60.5	39.0	Browns Bench
			± 16	5	5	9	4	7	2	101	32	25	0.14			
45-PC-183	3	2	131	30	210	6	82	550	31	1392	848	0	2.05	19.9	47.1	Massacre Lake/Guano Valley
			± 16	5	4	9	4	7	2	100	33	23	0.14			
45-PC-183 or 186	4	1	43	10	77	103	15	98	8	569	318	858	1.07	28.7	61.9	Obsidian Cliffs
			± 16	5	4	9	4	7	2	99	32	24	0.14			
45-PC-183 or 186	5	2	53	20	79	104	13	100	8	579	540	853	1.01	16.1	57.4	Obsidian Cliffs
			± 16	5	4	9	4	7	2	99	33	25	0.14			
45-PC-183 or 186	6	3	51	9	80	103	17	100	8	610	305	811	1.00	27.9	54.2	Obsidian Cliffs
			± 16	5	4	9	4	7	2	99	32	25	0.14			
45-PC-183 or 186	7	4	37	24	109	69	17	104	11	637	605	606	0.73	10.9	39.5	Buck Mountain
			± 16	5	4	9	4	7	2	98	33	25	0.14			
45-PC-183 or 186	8	5	51	25	129	14	29	89	11	748	361	35	0.55	14.2	26.5	Drews Creek/Butcher Flat
			± 15	5	4	9	4	7	2	98	32	27	0.14			
45-PC-183 or 186	9	6	39	21	144	68	26	178	11	1225	499	612	0.90	15.8	25.1	GF/LIW/RS
			± 16	5	4	9	4	7	2	100	33	25	0.14			
45-PC-183 or 186	10	7	36	16	78	108	16	99	9	864	234	837	0.79	29.4	31.6	Obsidian Cliffs
			± 16	5	4	9	4	7	2	99	32	25	0.14			
45-PC-183 or 186	11	8	49	21	98	38	22	113	15	NM	NM	NM	NM	13.0	24.0	Spodue Mountain *
			± 16	5	4	9	4	7	2	NM	NM	NM	NM			
45-PC-183 or 186	12	9	41	16	123	8	28	87	17	NM	NM	NM	NM	9.0	112.9	Cowhead Lake *
			± 16	5	4	9	4	7	2	NM	NM	NM	NM			
45-PC-183 or 186	13	10	44	23	129	16	24	88	12	NM	NM	NM	NM	13.1	72.0	Drews Creek/Butcher Flat *
			± 16	5	4	9	4	7	2	NM	NM	NM	NM			
45-PC-183 or 186	14	11	59	20	113	62	19	96	12	NM	NM	NM	NM	21.1	42.6	Buck Mountain *
			± 16	5	4	9	4	7	2	NM	NM	NM	NM			
45-PC-183 or 186	15	12	40	25	153	74	34	190	14	NM	NM	NM	NM	37.3	35.0	GF/LIW/RS
			± 16	5	4	9	4	7	2	NM	NM	NM	NM			

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.
NA = Not available; ND = Not detected; NM = Not measured; * = Small sample; FGV = Fine-grained volcanic specimen.

Northwest Research Obsidian Studies Laboratory: REPORT 2010-161

Table D-3. Results of XRF Studies: Artifacts from Several Sites in Pacific County, Washington Table D-3 page 2

Site	Specimen No.	Catalog No.	Trace Element Concentrations											Ratios		Geochemical Source
			Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	$Fe_2O_3^T$	Fe:Mn	Fe:Ti	
45-PC-183 or 186	16	13	44	25	140	70	28	177	12	NM	NM	NM	NM	32.1	17.5	GF/LIW/RS *
			± 16	5	4	9	4	7	2	NM	NM	NM	NM			
45-PC-183 or 186	17	14	67	35	163	8	62	153	18	NM	NM	NM	NM	24.9	20.8	Cougar Butte *
			± 15	5	4	9	4	7	2	NM	NM	NM	NM			
45-PC-183 or 186	18	15	18	15	125	79	20	140	10	NM	NM	NM	NM	14.7	20.4	Alturas Unknown A FGV *
			± 18	5	4	9	4	7	2	NM	NM	NM	NM			
45-PC-196	19	1	78	32	290	11	53	146	47	NM	NM	NM	NM	25.4	41.5	Coso (West Sugarloaf) *
			± 16	5	5	9	4	7	2	NM	NM	23	NM			
45-PC-196	20	2	67	26	256	11	49	134	45	675	395	4	0.88	19.4	43.9	Coso (West Sugarloaf)
			± 15	5	5	9	4	7	2	NM	NM	23	NM			
Sandy Point, Rubey Family	21	1	62	10	119	57	46	346	24	1206	684	744	2.15	25.8	56.9	Big Obsidian Flow
			± 16	5	4	9	4	7	2	NM	NM	24	NM			
NA	RGM-1	RGM-1	39	23	156	103	26	218	5	1529	313	778	1.85	47.9	39.1	RGM-1 Reference Standard
			± 16	5	4	9	4	7	2	101	32	25	0.14			

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.
NA = Not available; ND = Not detected; NM = Not measured; * = Small sample; FGV = Fine-grained volcanic specimen.

***Northwest Research Obsidian Studies Laboratory*: REPORT 2011-11**

Table D-4. Results of XRF Studies: 45-PC-101, Pacific County, Washington Table D-4

	Specimen		Trace Element Concentrations											Ratios		
Site	No.	Catalog No.	Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	$Fe_2O_3^T$	Fe:Mn	Fe:Ti	Geochemical Source
45-PC-101	1	531	41	6	80	103	19	98	9	NM	NM	NM	NM	29.9	51.4	Obsidian Cliffs *
			± 15	5	4	9	4	7	2	NM	NM	NM	NM			
NA	RGM-1	RGM-1	31	26	150	106	25	214	9	NM	NM	NM	NM	25.2	34.9	RGM-1 Reference Standard
			± 16	5	4	9	4	7	2	NM	NM	NM	NM			

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.
NA = Not available; ND = Not detected; NM = Not measured; * = Small sample; FGV = Fine-grained volcanic specimen.

Northwest Research Obsidian Studies Laboratory: **REPORT 2011-12**

Table D-5. Results of XRF Studies: 45-GH-15, Grays Harbor County, Washington Table D-5

Site	Specimen No.	Catalog No.		Trace Element Concentrations											Ratios		Geochemical Source
				Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	Fe^2O^{3T}	Fe:Mn	Fe:Ti	
45-GH-15	1	4804		31	21	109	57	31	98	9	566	509	1020	0.77	13.6	46.4	Glass Buttes 6
			±	16	5	4	9	4	7	2	99	0.14	25	33			
NA	RGM-1	RGM-1		40	19	155	105	25	218	8	1614	575	740	1.72	24.9	34.7	RGM-1 Reference Standard
			±	16	5	4	9	4	7	2	101	0.14	25	33			

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.
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Northwest Research Obsidian Studies Laboratory REPORT FOR ISOLATE: 45PC222, Kudasik point

TableD-6 . Results of XRF Studies: Willapa Valley Area Artifacts, Washington

Site	Specimen No.	Catalog No.	Trace Element Concentrations									Ratios		Geochemical Source
			Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	$Fe_2O_3^T$	Fe:Mn	Fe:Ti	
Mill Creek	19	Kudasik01	72	103	15	91	6	NM	NM	815	NM	NM	NM	Obsidian Cliffs
			± 1	1	1	1	1	NM	NM	29	NM			

Table D-7. Results of XRF Studies: Willapa Valley Area Artifacts,Washington

Site	Specimen No.	Catalog No.		Trace Element Concentrations									Ratios		Geochemical Source
				Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	$Fe_2O_3^T$	Fe:Mn	Fe:Ti	
45-PC-175	3	294206-03		83	23	49	89	12	NM	NM	NM	NM	NM	NM	Glass Buttes 1 *
			±	2	1	2	2	2	NM	NM	NM	NM			
45-PC-175	4	294206-05		148	112	24	136	10	NM	NM	NM	NM	NM	NM	Whitewater Ridge *
			±	3	2	2	2	2	NM	NM	NM	NM			
45-PC-175	5	291208-04		129	100	24	127	7	NM	NM	NM	NM	NM	NM	Whitewater Ridge *
			±	2	2	2	2	2	NM	NM	NM	NM			
45-PC-175	6	291208-10A		98	125	14	95	7	NM	NM	NM	NM	NM	NM	Obsidian Cliffs *
			±	2	2	1	2	2	NM	NM	NM	NM			
45-PC-175	7	291208-10B		83	110	16	91	8	NM	NM	NM	NM	NM	NM	Obsidian Cliffs *
			±	2	2	1	2	2	NM	NM	NM	NM			
45-PC-175	8	291208-06		89	124	17	99	10	NM	NM	NM	NM	NM	NM	Obsidian Cliffs *
			±	2	2	1	2	1	NM	NM	NM	NM			
45-PC-175	9	291208-07		152	70	44	297	18	NM	NM	NM	NM	NM	NM	Newberry Volcano
			±	2	2	2	3	2	NM	NM	NM	NM			
45-PC-175	10	294207-01A		96	25	52	86	9	NM	NM	NM	NM	NM	NM	Glass Buttes 1 *
			±	2	1	2	2	2	NM	NM	NM	NM			
45-PC-175	11	294207-01B		90	25	50	93	11	NM	NM	NM	NM	NM	NM	Glass Buttes 1? *
			±	2	1	2	2	2	NM	NM	NM	NM			
45-PC-175	16	293208-03A		88	116	16	94	10	NM	NM	NM	NM	NM	NM	Obsidian Cliffs *
			±	2	2	1	2	1	NM	NM	NM	NM			
45-PC-175	17	293208-03B		120	28	51	85	11	NM	NM	NM	NM	NM	NM	Glass Buttes 1? *
			±	2	1	2	2	2	NM	NM	NM	NM			
Oysterville	18	Kemmer01		93	34	55	128	12	NM	NM	1181	NM	NM	NM	Cougar Mountain
			±	1	1	1	1	1	NM	NM	28	NM			
Mill Creek	19	Kudasik01		72	103	15	91	6	NM	NM	815	NM	NM	NM	Obsidian Cliffs
			±	1	1	1	1	1	NM	NM	29	NM			
45-PC-175	21	294207-05b		94	123	16	96	9	NM	NM	NM	NM	NM	NM	Obsidian Cliffs *
			±	2	2	1	2	1	NM	NM	NM	NM			

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.
NA = Not available; ND = Not detected; NM = Not measured; * = Small sample; FGV = Fine-grained volcanic specimen.

Table D-7. Results of XRF Studies: Willapa Valley Area Artifacts,Washington Table D-7 page 2

				Trace Element Concentrations									Ratios		
Site	Specimen No.	Catalog No.		Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	$Fe_2O_3^T$	Fe:Mn	Fe:Ti	Geochemical Source
45-PC-175	22	291207-12		231	20	48	75	38	NM	NM	NM	NM	NM	NM	Timber Butte *
			±	2	1	1	1	1	NM	NM	NM	NM			
45-PC-175	23	291210-01		98	27	57	94	9	NM	NM	NM	NM	NM	NM	Glass Buttes 1 *
			±	2	1	1	2	1	NM	NM	NM	NM			
45-PC-175	24	291208-13		135	70	45	302	17	NM	NM	NM	NM	NM	NM	Newberry Volcano
			±	2	1	1	2	1	NM	NM	NM	NM			
45-PC-175	25	291211-05		79	107	16	92	9	NM	NM	NM	NM	NM	NM	Obsidian Cliffs *
			±	2	2	1	2	1	NM	NM	NM	NM			
45-PC-175	27	291210-3b		137	70	42	275	15	NM	NM	NM	NM	NM	NM	Newberry Volcano
			±	3	2	2	3	2	NM	NM	NM	NM			
45-PC-175	28	291210-04		156	78	45	312	18	NM	NM	NM	NM	NM	NM	Newberry Volcano
			±	2	2	2	3	2	NM	NM	NM	NM			
NA	RGM-1	RGM-1		148	109	26	225	8	NM	NM	734	NM	NM	NM	RGM-1 Reference Standard
			±	2	1	1	2	1	NM	NM	30	NM			

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.
NA = Not available; ND = Not detected; NM = Not measured; * = Small sample; FGV = Fine-grained volcanic specimen.