ISSN 1538-2834

JOURNAL OF NORTHWEST ANTHROPOLOGY

On The Road Again or Red Light, Green Light: Transportation-Related Cultural Resource Management in Washington and Oregon

Scott Williams and Carolyn McAleer, editors

Fall 2011 Vol. 45, No. 2

JOURNAL OF NORTHWEST ANTHROPOLOGY

FORMERLY NORTHWEST ANTHROPOLOGICAL RESEARCH NOTES

Composed by Northwest Anthropology LLC, Richland, Washington; Printed by Copy Court, Moscow; Bound by Arts & Crafts, Oakesdale. Missing issue claim limit 18 months. For back issues and catalogue of prices contact Coyote Press, P O Box 3377, Salinas, CA 93912. <http://www.californiaprehistory.com>.

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Journal of Northwest Anthropology, published semiannually by Northwest Anthropology LLC in Richland, Washington, is a refereed journal and welcomes contributions of professional quality dealing with anthropological research in northwestern North America. Regular issues are published semiannually with additional memoirs issued as funds are available. Theoretical and interpretive studies and bibliographic works are preferred, although highly descriptive studies will be considered if they are theoretically significant. The primary criterion guiding selection of papers will be how much new research they can be expected to stimulate or facilitate.

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JOURNAL OF NORTHWEST ANTHROPOLOGY

VOLUME 45

DARBY C. STAPP, DEWARD E. WALKER, JR., AND RODERICK SPRAGUE

EDITORS

Number 1 Spring 2011

Number 2 Fall 2011

On The Road Again or Red Light, Green Light: Transportation-Related Cultural Resources Management in Washington and Oregon

RICHLAND

2011

JOURNAL OF NORTHWEST ANTHROPOLOGY

VOLUME 45 | Fall 2011 | NUMBER 2

AN INTRODUCTION TO *ON THE ROAD AGAIN OR RED LIGHT, GREEN LIGHT: TRANSPORTATION-RELATED CULTURAL RESOURCES MANAGEMENT IN WASHINGTON AND OREGON*

Scott Williams and Carolyn McAleer

ABSTRACT

Delivering successful transportation projects while effectively managing cultural resources is always a challenge. Over the years, the Washington State Department of Transportation (WSDOT) and Oregon Department of Transportation (ODOT) have continued to move forward with complex projects, "threading the needle," in an effort to avoid or minimize resources impacts. The on-going challenges have necessitated that cultural resources professionals at both agencies come up with new methods to identify sites, broaden perspectives, and re-evaluate past recommendations. All of these changes have come in the midst of an economic downturn, with less money for projects and compressed timelines to deliver jobs. Eight papers describe the experiences of both WSDOT and ODOT as the two agencies navigate the bumpy and often rutted road of transportation-related cultural resources management.

Transportation-related cultural resources management (CRM) is one of the most challenging jobs in the historic preservation field. For much of the past three decades and until very recently, most of the cultural resources-related work in Oregon was funded through transportation projects; transportation CRM is still the largest portion of work done in Washington. The recent acceleration of energy-related projects in Oregon may have eclipsed transportation for the lion's share of CRM, but new pipelines and wind farms projects are short lived; transportation facilities will need constant maintenance and upgrading for years to come. Every day, new challenges present themselves to both agencies—whether it is brand new road alignments, bridges to be replaced, new intersections for improved traffic flow, or simply communicating to engineers and designers the need to "work around" sensitive locations. "Threading the needle" to protect cultural resources, requires creativity, diligence and a good sense of humor to survive working with engineers and NEPA specialists.

This volume of the *Journal of Northwest Anthropology* (*JONA*) presents articles that originated from joint ODOT-WSDOT symposia on transportation-related CRM at the 2009 and 2010 Northwest Anthropology Conferences. Why organize sessions on transportation-related cultural resources management? At the most basic level, the reason is that much CRM work is done directly for or in relation to transportation projects. The amount of work being conducted and the diversity of projects were reflected well in the response to our calls for papers for the Northwest conference; topics ranged from geoarchaeology, early Holocene archaeology, historical archaeology, deep testing, methodology, and the Cold War.

Washington State Department of Transportation

The Washington State Department of Transportation (WSDOT) maintains over 20,000 lane miles of roadway and nearly 3500 bridges across the state, and operates the largest ferry system in the county. The agency undertakes roughly 400 projects per year, and over the last several years has been undergoing planning and construction for several "mega projects" that total nearly $12 billion in combined costs. WSDOT has one of the largest cultural resources programs in the state, employing a staff of nine people in the agency cultural resources program, with work also done by nine consulting firms as on-call consultants for cultural resources work and additional firms doing such work as engineering or environmental consultants. Each year, literally millions of dollars are spent complying with various federal and state cultural resources regulations and policies.

The WSDOT Cultural Resource Program is involved in more than just regulatory compliance. In 2005 WSDOT sponsored publication of the book *Spanning Washington: Historic Highway Bridges of the Evergreen State* by WSU Press, co-authored by WSDOT Historian Craig Holstine. Twice a year, in conjunction with State Parks and DAHP, WSDOT sponsor a four-day cultural resources training session attended by various state, federal, local government, and tribal employees, with cultural resource program staff serving as instructors.

One trend seen over the last few years at the WSDOT Cultural Resources Program is that WSDOT as an agency is on the cusp between the "old way" of doing things, where there was very little oversight of cultural resources work, to a period of much increased oversight, not only by Tribes and the State Historic Preservation Office, but within the agency itself. Tribes in particular are better funded and better staffed to do compliance review, and in Washington, the Department of Archaeology and Historic Preservation (DAHP) has two dedicated transportation archaeologists on staff. Also, given the economy, the public now expects more from the agency, both positively and negatively: the public in general is still very much interested in historic preservation, although they may not know it by that name, and want to hear the results of our work; at the same time there are those who question why we spend so money on something for which they see no direct benefit. It is in our best interest to demonstrate to the public that there is indeed some kind of benefit from our work.

Another issue has been the need to maintain the best professional practices along with our responsibility to taxpayers to do the best job for the least amount of money and the most good for the public dollar. This is often harder than it looks, since much of the work we do is archaeology or evaluations of the integrity of historic properties, which are inherently subjective fields that rely more on opinion and art than on science. Because of this, disagreements arise over the "best course of action." But that is good: while it is often painful, the profession advances through such discussions.

Oregon Department of Transportation

The Oregon Department of Transportation (ODOT) maintains just over 19,000 lane miles across the state. Over 2800 archaeological sites have been identified within the right-of-way, a narrow corridor usually 25 to 35 ft. wide. That means an archaeological site estimated every 6.7 mi. on a DOT project. The agency undertakes between 250 and 425 projects a year and while we do not have as many "mega projects" as our northern neighbor, we have complex projects just the same.

The ODOT Archaeology Program dates back to the late 1970s and exists to ensure that ODOT complies with federal laws that require the consideration of effects from federally funded transportation projects on cultural places eligible for or listed on the National Register of Historic Places (NRHP). Three federal laws primarily shape the way we do business: the National Environmental Policy Act (NEPA), Section 106 of the National Historic Preservation Act (NHPA), and Section 4(f) of the Department of Transportation Act. In addition, the agency has responsibility under other federal acts and executive orders, and state laws such as Oregon Revised Statute (ORS) 358.653 and Oregon Administrative Rule 660–023–000, which require the evaluation of project effects to significant cultural/historic resources that have been designated by local jurisdictions or significant cultural/historic resources that are owned by state or local government. The ODOT Archaeology Program is also responsible for ensuring compliance with ORS 97.740 and ORS 390.235, which establish protections for cultural resources throughout the state. Moreover, the centralized Archaeology Program is responsible for providing direct project support to ODOT regions and establishing and maintaining positive Government-to-Government relationships with Tribal representatives. This regulatory framework sets the stage for our daily operations.

In 1973, ODOT began work on what would become one of the agency's most challenging projects involving cultural resources. Taking over 30 years to negotiate and construct, the Beatty Curve Correction Project stands out as a classic examples of tireless negotiation and commitment. The project area, situated in the heart of southern Oregon, was surrounded by cultural resources, wetlands, and springs. Minimizing impacts proved to be challenging. After several redesigns, multiple stakeholder coordination meetings, site visits, and surveys, all parties agreed to move forward with data recovery. In addition, the final agreement included several creative mitigation commitments: a video would be put together documenting the project lifecycle including excavations and analysis, and a field school would be put together for tribal members at the recovery site. The archaeology studies revealed a complex multi-component site, the details of which are still being discussed and analyzed. The project was conducted in the summer of 2010 and required additional archaeological work as the summer progressed.

Transportation projects can range from short half-mile upgrades or bridge rehabs, to complex 9 mi.-long realignments in central Oregon, home to hundreds if not thousands of stacked rock features. Construction work can vary and be shallow with simple, new culvert upgrades or turn outs, or very deep, requiring new bridge piers, cutting through 10 to 20 ft. of fill. Such projects require standard methods for identifying cultural resources, but many times new, innovative methods are needed. Shovel testing has zero benefit on projects with 20 ft. of fill, so geo-technical coring becomes the choice method for discovery. Changes in scoping, which now include reviewing old right-of-way maps and LiDAR data, have improved the likelihood of identifying sites early in project. And, as always, constant and close communication with tribal governments is fundamental to our programs success.

Resources management does not end during the project development phase. Construction continues to be a challenge for cultural resources managers on transportation projects. While we make every effort to identify resources up front in project delivery, you can never be 100% certain that you have captured everything. So you manage the risk and you do the best you can. We have expanded environmental education for our construction inspectors so that those on the ground during construction can make informed decisions if potential cultural resources are encountered and stop construction and notify ODOT Cultural Resources Specialists when necessary. The training for construction inspectors has included segments on archaeological site types and artifact recognition. Projects that may have higher potential for undiscovered resources often incorporate archaeological monitoring as part of the construction plan, for example in areas with deep fills or large areas of areal disturbance.

Along with the realities of building the job, timing, deadlines, cost, and increased public scrutiny have forced ODOT to develop a more streamlined process while still being responsible stewards. We have had to juggle increased workloads and tighter timelines. In Oregon, Section 18 of the new Jobs and Transportation Act (JTA) which passed in 2010, has required us to develop programmatic tools for completing environmental compliance for transportation projects. Section 18 also allows us to develop best management practices and performance standards for cultural resources and target the gaps in our program, like surveying the remaining 80% of our right-of-way which has never been examined. Practices and standards targeted at every stage of the project, from planning, development, and through construction increase the chances of protecting significant resources.

Complex projects, tighter budgets and shorter timelines, illustrates something said to Carolyn McAleer upon starting at ODOT: "This job is like juggling plates," it is all about how many you can juggle at one time and where you find the balance between the project, the resource and the laws. There will always be roads to build and maintain and cultural resources will continue to play a critical role in developing and maintaining the transportation infrastructure of both states, and the nation as a whole.

This Volume

Taken as a collection, the articles presented in this volume provide a good representation of the types of cultural resource activities taking place within ODOT and WSDOT. The articles illustrate the challenges faced by project needs, regulatory requirements, tribal concerns, and available methods. The articles also illustrate the contributions that this federally funded work is making to the protection of important resources and our understanding and education of the past.

The collection begins with three articles involving pre-contact archaeological resources affected by transportation projects. Thomas Connelly and David Jenkins use the findings from five pre-contact sites encountered at bridge and interchange construction projects in the Malhuer River Basin of east-central Oregon to place the Malheur River in pre-contact context. Brian O'Neil and Debra Barner then describe the 9,0000 to 10,000 year old deposits encountered at Williams Creek on the North Umpqua River, Southwestern Oregon, in response to a culvert replacement. Michele Punke, Terry Ozbun, and Jo Reese conclude this group with a detailed report on archaeological deposits found in Clark County, Washington, within the Portland Basin, prior to an interchange construction project.

The next two papers concern historic resources. Thomas J. Connolly, Richard L. Bland, and Ward Tonsfeldt report on the historical archaeological deposits associated with an early twentieth century logging railroad camp, encountered during a northwest Oregon bridge replacement project. Craig Holstine then describes a Cold War fallout shelter in Seattle, WA, that was a prototype for thousands of similar structures to be installed nationwide under interstate highways.

The final three articles concern approaches and methods. Kurt Roedel addresses the cultural challenges that arose when ODOT used the design-build approach to improve 6.5 mi. of U.S.-20 between the cities of Corvallis and Newport, Oregon. Kevin Bartoy then discusses the costs and benefits of deep testing methods, using recent experiences carried out by WSDOT on its Mega Projects in the urban setting of Seattle. Terry Ozbun closes the volume with his results from an experiment designed to compare the effectiveness of ¼-in screens and ⅛-in screens for evaluating the significance of a prehistoric site.

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Journal of Northwest Anthropology 45(2):135–147 2011

ARCHAEOLOGY OF THE MALHEUR RIVER CORRIDOR, EAST CENTRAL OREGON

Thomas J. Connolly and Dennis L. Jenkins

ABSTRACT

Archaeological work at five sites in the Malhuer River Basin of east-central Oregon was conducted in response to bridge and interchange construction projects. Chronologically diagnostic projectile points and obsidian hydration values suggest occupation histories spanning the Holocene, but geoarchaeological, radiocarbon, and obsidian hydration evidence indicate that the major archaeological components are middle and late Holocene in age (ca. 3700 BP to late pre-Contact). Faunal remains, fishing equipment, and positive test results for fish proteins on projectile points, flake tools, bifaces, and ground stone indicate fishing for trout or salmon was an important activity at the sites. Obsidian sourcing provides insights on changing land use ranges through time.

Introduction

The Malheur and Snake rivers have served for millennia as major arterial east-west and north-south travel routes connecting populations from central and northeast Oregon with central and eastern Idaho populations. The region traversed by the Snake and Malheur rivers is hydrologically part of the Columbia River Basin, but is often considered to have been culturally linked to the Great Basin region to the south and southwest. That anthropologists often include this region in the Great Basin cultural area reflects the reality that these rivers drain high desert regions adjacent to the internally draining sub-region, were connected to pluvial lakes in the currently internally drained systems during the Pleistocene, are separated from the main portion of the Columbia Basin by rugged mountains, and were historically occupied by Numic speaking groups. Nonetheless, the people of this area share many attributes and subsistence practices with Columbia Plateau groups to the northwest, including a substantial dependence on anadromous fish runs and geophytic roots (Couture et al. 1986; Fowler and Liljeblad 1986; Murphy and Murphy 1986).

Although the archaeological records for the Snake River region of southeast Washington and southwest Idaho, and for the northern Great Basin of Oregon, are reasonably well known, very little substantive excavation has been undertaken in the Malheur River region. This limits our ability to address issues of culture-history, settlement-subsistence, cultural development, and population demographics, particularly as they relate to cultural-ecological variations in adjoining regions. Highway construction work along U.S. Highway 20 in the Malheur River corridor, and construction of an I-84 freeway interchange near the Malheur-Snake confluence at Ontario, Oregon, prompted archaeological work that substantially enhances the area's cultural record

(Jenkins and Connolly 2010; Jenkins et al. 2010). Evidence from the investigated sites suggests at least ephemeral use throughout the Holocene. Early occupations appear to have centered on the Snake River corridor and ranged over the western Snake River Plain, but later groups were more restricted in their movements within the Malheur River Basin.

The Archaeological Sites

General site patterns are described below; we then focus on obsidian hydration and sourcing data to provide evidence for changes in human geography through time at the two sites in the North Ontario Interchange project, and at the Speery Bridge and Squaw Creek sites on the Central Oregon Bridges project (Fig. 1).

North Ontario Interchange Sites, 35-ML-1328 and 35-ML-1379

The North Ontario Interchange (NOI) project replaced the OR Highway 201/I-84 interchange and overpass bridge. Sites 35-ML-1328 and 35-ML-1379, located within the interchange footprint, are near the confluence of the Malheur and Snake rivers and nearly opposite from where the Payette River enters the Snake from the Idaho side. The sites were initially identified and tested by Bard and Sharpe (2005, 2006). Subsequent work was conducted by Jenkins et al. (2010).

Investigations at the NOI sites identified a number of oven features, consisting of clustered river cobbles, fire-modified rock, mussel shells, and associated concentrations of tools and debitage. Projectile points were primarily of the Elko series. The vertebrate faunal assemblage was dominated by fish bone (85%); identifiable fish remains were primarily salmon (96%), and all specimens identifiable to species were Chinook salmon (Butler 2010). A charred cake of processed serviceberries, along with thousands of charred cheno-am and atriplex seeds, attest to summer occupation of these sites as seasonal fishing/hunting/harvesting camps (Dexter 2010).

Another noteworthy outcome of the archaeological work at the Ontario sites is its contribution to a study by Waite Osterkamp of the USGS, and his colleagues, to calibrate a reservoir correction factor for radiocarbon ages on freshwater mussel shells for the section of the Snake River from Ontario downstream to Hell's Canyon. Working with paired charcoal and mussel shell radiocarbon ages from the Ontario sites and from a number of others, Osterkamp and his colleagues have calculated a regression function to calibrate mussel shell dates to calendar ages for this stretch of river. The evidence suggests that mussel shells are dating roughly 2500 years too old in this study area. Using the Osterkamp et al. calibration, most radiocarbon ages from the site form a tight cluster between about 3100 and 2600 years ago (Jenkins et al. 2010).

Central Oregon Bridges Project, Speery and Squaw Creek Sites

The Central Oregon Bridges (COB) project involved the replacement of four Malheur River bridges on U.S. Highway 20 between Juntura and Ontario. The sites on which we focus here are between 45 and 60 mi. west of Ontario. Archaeological sites at three localities were either avoided, or found not to be significant cultural resources. The present discussion includes

Fig. 1. Location of the North Ontario Interchange (NOI) and Central Oregon Bridges (COB) projects within the Malheur River corridor of east central Oregon.

two sites at Squaw Creek (35-ML-980 and 35-ML-1042), which were subject to small-scale testing but not data recovery, and the Speery Bridge site (35-ML-1041) where both testing and limited data recovery excavations were conducted.

Charcoal-based radiocarbon dates were only obtained at the Speery Bridge site, where two cultural features were dated to 4100 and 3300 cal. BP. Ground stone tools found at the sites indicate root and seed processing. Faunal remains were sparse, but fish proteins were identified on five stone tools at the Speery Bridge site, including one projectile point; a small pebble net weight and two pointed bone tool fragments that appear to be parts of fish gorges or composite fishing gear confirm the importance of fishing here. Artiodactyl bone dominates the remarkably small terrestrial faunal assemblage at both the Squaw Creek and Speery Bridge localities. Squirrel, rabbit, and bird also occur in minimal numbers. The tool assemblage is dominated by middle Holocene Elko, Humboldt, and Gatecliff type projectile points, but Rose Spring arrow points are common in undated late Holocene sediments at Speery Bridge. While stemmed, foliate, and Northern Side Notch point fragments are present at Speery Bridge, geoarchaeological investigations indicate that a substantial middle Holocene erosive event caused by flooding from Speery Canyon may have left these early Holocene artifacts exposed on the site surface where they were recovered by later site occupants and reincorporated into later cultural deposits. Large basalt flakes, cobble and pebble tools, cores, edge-modified flakes, ground stone, and bone tools all occur in smaller numbers. These sites, like the Ontario sites, appear to have been repeatedly occupied, serving primarily as summer season fishing, hunting, and harvesting camps. River cobbles and more irregular camp stones appear to have been brought into the sites to hold heat in hearths, around which intense activities such as fish processing took place (Davis 2010; Helzer et al. 2010; Jenkins and Connolly 2010).

Obsidian Hydration Chronology

Radiocarbon dating is a critical chronological tool, but is limited to direct dating of recognizable cultural features, and does not necessarily reflect the overall chronology of occupation at the sites. For this, we relied on obsidian hydration dating to provide a more robust chronological sampling for the sites, and a more complete view of site use histories.

We obtained geochemical source results for 279 specimens from the two NOI sites. From this set, 186 obsidian hydration readings were recorded. A rate of hydration appropriate to the NOI project locality was determined by calculating from an induced hydration rate developed by Michels (1981) and reported by Pavesic (1985) for Timber Butte obsidian. We derived a rate for Ontario by converting from reported values using the local effective hydration temperature calculated from climate data recorded from 1948 through 2007. This calculation provided a hydration rate for Timber Butte obsidian at Ontario of $2.6\mu^2/1000$ years; we applied this rate to all tested obsidian from the sites (Fig. 2). While we recognize that additional research is needed to fully evaluate the applicability of the rate to other geochemical types identified at the sites, we have no reason at present to suspect significant variation among sources.

The age distribution of obsidian from the NOI sites suggests human use of the area throughout the Holocene. Based on the hydration results, we identified four periods of site use:

Period 1: Before ca. 8000 years ago (4.5μ and larger rinds)
Period 2: ca. 8000-3800 years ago (3.1μ -4.4μ rinds)
Period 3: ca. 3800-1500 years ago (2.0μ-3.0μ rinds)
Period 4: After ca. 1500 years ago (<2.0μ rinds)

Hydration ages suggest repeated but low intensity visitations in the early Holocene, and possibly increasing in frequency and/or duration during the middle Holocene. The period of most intense use falls between ca. 3800 and 1500 years ago. It is during this interval that most obsidian tool stone was deposited at the sites, and with which the identifiable cultural features and obsidian radiocarbon ages are associated. An ephemeral human presence is detected during the last ca. 1500 years, but it appears that both sites were largely outside of routine use areas during the most recent millennium.

For the Central Oregon Bridges project, geochemical source results were obtained for 23 obsidian specimens from the East and West Squaw Creek sites, and 147 from the Speery Bridge site. Hydration rinds were measured on 22 pieces from the West Squaw Creek site, and 140 from the Speery Bridge site. As no weather recording stations are sufficiently close to generate a reliable effective hydration temperature for these sites, we calculated a rate by pairing hydration values to radiocarbon ages from the Speery Bridge site, which provided a rate of $3.8\mu^2/1000$ years. We applied this rate to all hydration values from the site, again aware of the issues regarding geochemical variation in tested specimens.

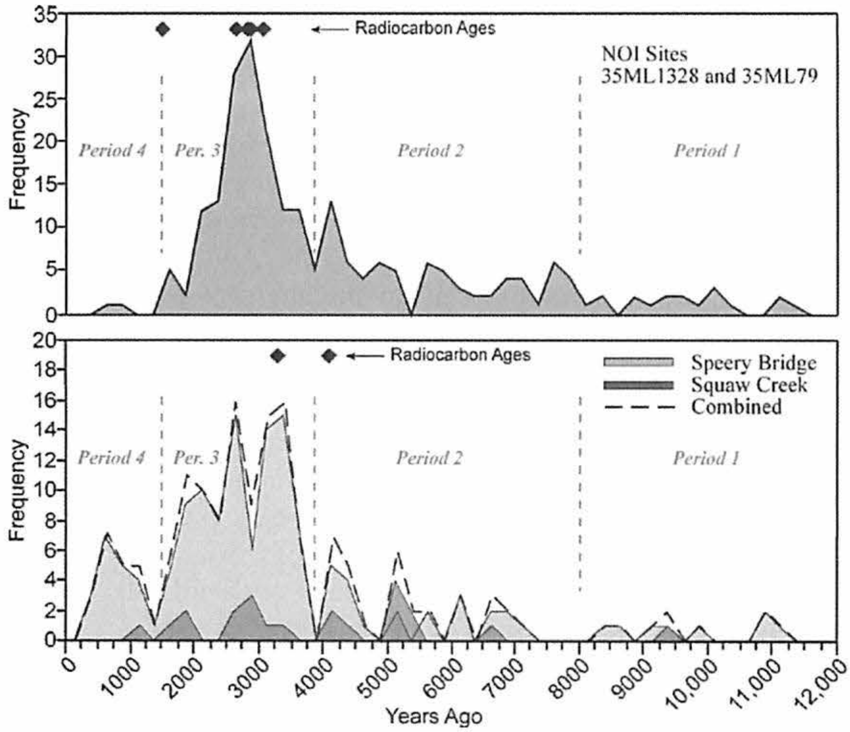

Fig. 2. Estimated occupation histories for the NOI and COB sites, based on obsidian hydration age calibrations.

Like the NOI sites, the Speery and Squaw Creek sites show evidence of use throughout the Holocene, including regular low-intensity site visits prior to ca. 3800 years ago (Fig. 2). The period of most intensive use appears to occur between ca. 3800 and 1500 years ago, closely matching the interval of greatest occupation intensity at the downriver NOI sites. Over 70% of tested specimens from the Speery Bridge site fall within this range. At the minimally sampled Squaw Creek localities, the proportion is smaller, about 45%. Also, as with the NOI sites, there is evidence of a relatively lower intensity site use within the last ca. 1500 years.

Social Geography of the Malheur Basin

Obsidian sources represented at the sites also exhibit important temporal differences in obsidian tool stone procurement ranges. Obsidian from the early and middle Holocene occupations at the NOI sites appears to be more diverse, originating from many sources in all directions from the sites, and distributed so that the sites are more-or-less at the central node with respect to source locations found surrounding the western Snake River Plain (Fig. 3a). The impression is for a western Snake River Plain center of gravity, with most obsidian deriving from sources in the Owyhee Mountains bordering to the southwest and the Boise Mountains to the northeast.

Between 3800 and 1500 years ago (Period 3) there is a dramatic increase in obsidian use, and, in contrast to the earlier pattern, the sourced obsidian reflects a distribution decidedly centered in the Malheur River Basin (Fig. 3b). Obsidian from Gregory Creek accounts for 90% of tool stone at this time, with only minor representation from other, primarily westerly, sources. Timber Butte, which is nearly equidistant to the east compared with Gregory Creek to the west, and the source of a majority of obsidian during earlier occupations, represents just 4% of the sample after ca. 3800 years ago. Other important changes that accompany the use intensity for the 3800–1500 BP time interval is a clear reduction in both the diversity of sources and the average source distance (Table 1). The obsidian sample from the earlier periods represent 13 different sources from 100 sampled specimens; for the 3800–1500 BP interval, just five different sources are represented in a larger sample of 134 specimens.

Chronological patterns with respect to obsidian procurement at the COB sites exhibit parallels with those observed at the downriver NOI sites. The earliest time periods, before ca. 3800 years ago, reflect relatively low rates of deposition of cultural material (Fig. 4a). Favored sources are located primarily to the southeast, in the Owyhee Mountain uplands, and source diversity is relatively high. Seven different geochemical sources are represented in the 31 sourced specimens from this time period. Source diversity and average distance to source are both significantly reduced during the period from 3800 to 1500 years ago; just five sources were identified among more than three times the sampled specimens from the pre-3800 BP sample (Fig. 4b). As with the NOI sites, the Gregory Creek source overwhelms all other sources. This reduced source diversity is also accompanied by a much higher rate of deposition of cultural materials, indicating more frequent and probably more sustained occupations.

Discussion

Intensity of site use was calculated for each defined time interval, measured as average number of hydration ages/century. We also calculated a diversity measure of obsidian sources for each defined period. Simpson's Diversity Index provides a statistic ranging from 0 (no diversity) to 1 (complete diversity). The values for samples pre-dating 3800 BP are high, and this diversity is reflected in both the tool and debitage assemblages. The diversity values for later occupations, including the time of most intensive site use, are low; the ephemeral post-1500 BP occupations score a zero on the diversity index, although this latter value is based on too small a sample to be considered seriously. The low Period 3 value reflects increasing domination of the Gregory Creek source, suggesting a reorientation from the Weiser/Payette Basin that characterized earlier times, to a westerly focus on the Malheur River corridor. This is most clearly reflected in the near abandonment of the Timber Butte source by later site occupants, in spite of its nearly equivalent distance to the east.

When we consider all sites (Fig. 5), we can see that before ca. 3800 years ago there is evidence that land use patterns were characterized by high residential mobility, as reflected in high source diversity and higher average source distance. There is an indication that mobile populations centered in the lowlands at the western end of the Snake River Plain made regular use of the mountainous uplands to the northeast and southwest.

Between about 3800 and 1500 years ago we see evidence of more sustained and frequent occupations at resource camps centered on the Malhuer River corridor. The former obsidian source diversity is replaced by an overwhelming reliance on the "local" Gregory Creek obsidian source, suggesting that people were focused on a more restricted procurement range during this time compared with earlier site visitors. Average distance to source decreases over time and, in contrast to earlier times, there is little indication of ranging beyond the Snake River to the east.

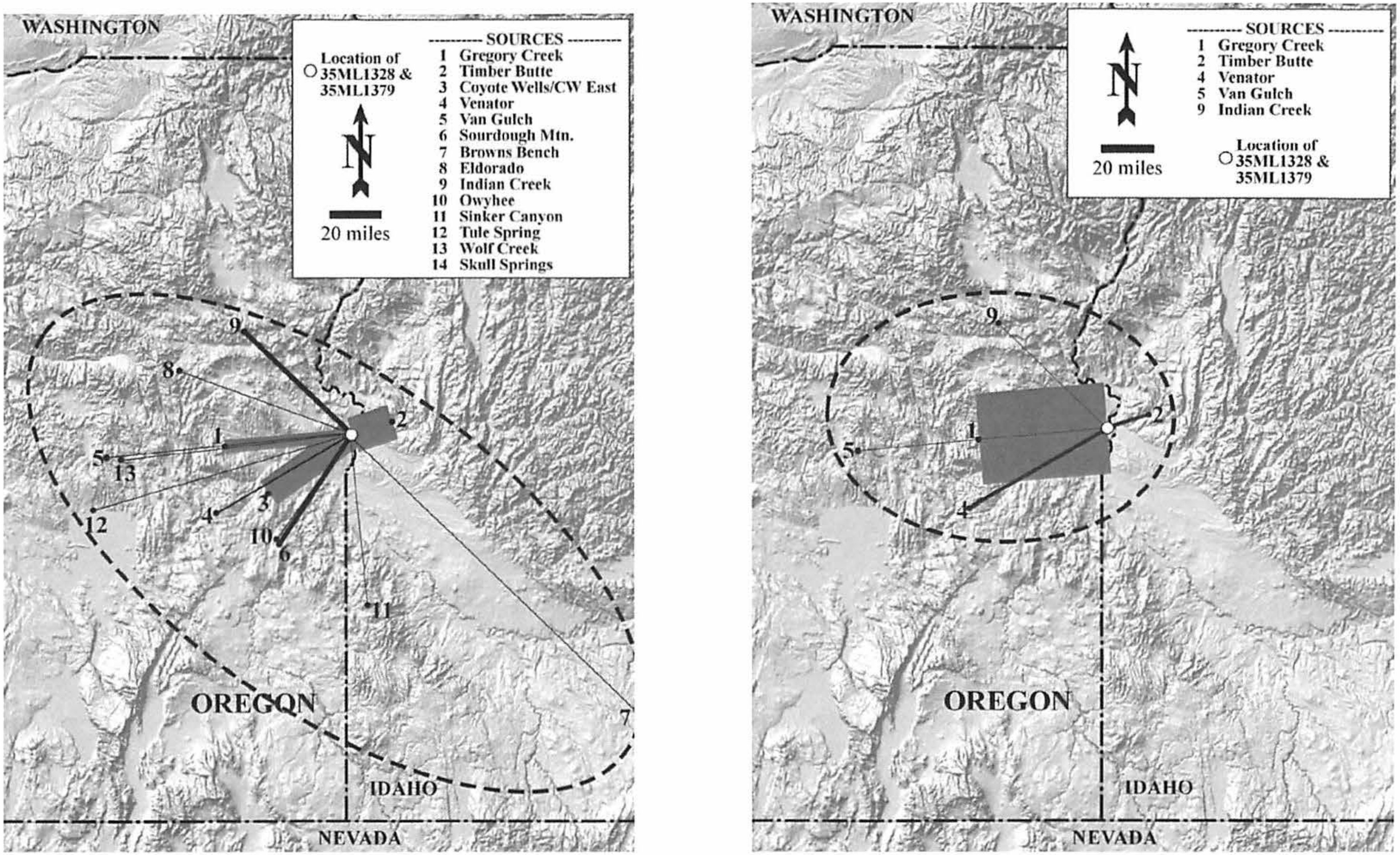

Fig. 3. Source locations for obsidian toolstone recovered from the NOI sites (35ML1328 and 35ML1379). Left: obsidian hydration specimens estimated to be older than 3800 years; Right: obsidian hydration specimens estimated to be younger than 3800 years.

TABLE 1. DISTRIBUTION OF TESTED OBSIDIAN BY SOURCE AND ASSIGNED AGE FOR THE NOI SITES (35ML1328 AND 35ML1329) AND THE SPEERY BRIDGE SITE; SQUAW CREEK SITE EXCLUDED DUE TO VERY SMALL SAMPLE SIZES.

Geochemical Source	ca. <1400 yrs		ca. 1400-3800 yrs		ca. 3800-8000 yrs		ca.>8000 yrs	
North Ontario Interchange Sites (35ML1328 and 35ML1379)								
Gregory Creek	2	100%	120	90%	12	15%	-	-
Timber Butte	-	-	6	4%	33	41%	3	16%
Coyote Wells/CW East	-	-	-	-	22	27%	7	37%
Venator	-	-	5	4%	1	1%	1	5%
Indian Creek	-	-	2	1%	6	7%	-	-
Sourdough Mtn.	-	-	-	-	3	4%	3	16%
Owyhee	-	-	-	-	1	1%	2	10%
Van Gulch	-	-	1	1%	1	1%	-	-
Browns Bench	-	-	-	-	-	-	1	5%
Eldorado	-	-	-	-	1	1%	-	-
Sinker Canyon	-	-	-	-	-	-	1	5%
Tule Spring	-	-	-	-	-	-	1	5%
Wolf Creek	-	-	-	-	1	1%	-	
Total	2		134		81		19	
Diversity Index	.00		.20		.74		.84	
Specimens/century	1.50		3.94		1.93		0.48	
Avg. Src. Distance (km)	70		71		70		91	
Speery Bridge (35ML 1041)								
Gregory Creek	17	81%	79	80%	4	13%	-	-
Venator	3	14%	12	12%	2	6%	-	-
Coyote Wells/CWE	1	5%	7	7%	21	66%	7	70%
Sourdough Mtn.	-	-	-	-	4	13%	-	-
Whitewater Ridge	-	-	1	1%	-	-	1	10%
Wolf Creek	-	-	-	-	1	3%	1	10%
Tule Spring?	-	-	-	-	-	-	1	10%
Total	21		99		32		10	
Diversity Index	.34		.35		.56		.52	
Specimens/century	1.50		4.13		0.76		0.25	
Avg. Src. Distance (km)	18		19		30		42	

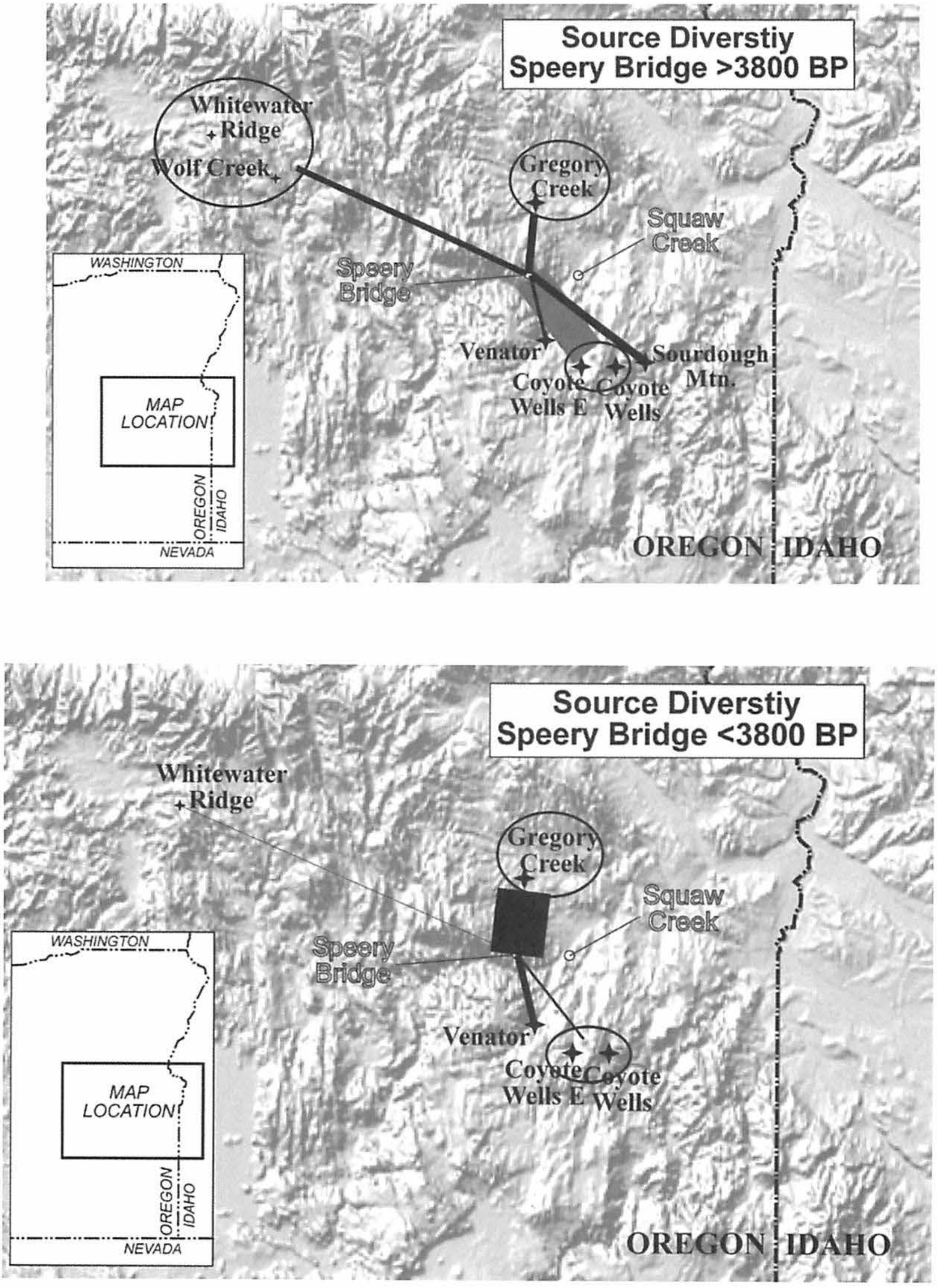

Fig. 4. Source locations for obsidian toolstone recovered from the COB Speery Bridge site (35ML1041). Top: obsidian hydration specimens estimated to be older than 3800 years. Bottom: obsidian hydration specimens estimated to be younger than 3800 years.

How do these patterns mesh with the broader context of Northern Great Basin and Columbia Plateau cultural history? Throughout this region, researchers have observed a pattern that has been characterized as a shift from generalist forager to logistical collector strategies, accompanied by increasing sedentism, increasing population density, and decreasing size of procurement ranges after about 3800 BP (Ames 1991; Chatters 1995; Andrefsky 2004; Jenkins 2004). The Malheur record appears to be largely consistent with these regional developments.

At all project sites we see a dramatic reduction in use within the last ca. 1500 years. The reasons for this change remains unknown, but, again considering the regional picture, there is evidence that small, dispersed, and isolated residential sites throughout the southern Plateau were abandoned during the last millennium in favor of larger residential centers, possibly as a measure of increased need for security (Ames 1991; Dumond and Minor 1983; Endzweig 1994; Hayden et al. 1985; Schulting 1995). While these questions go beyond the scope of this paper, we can note that the cultural record from the Malheur River corridor, which has been largely excluded from past discussions of regional archaeology, can now add a significant voice to the regional discussion, thanks to the Oregon Department of Transportation.

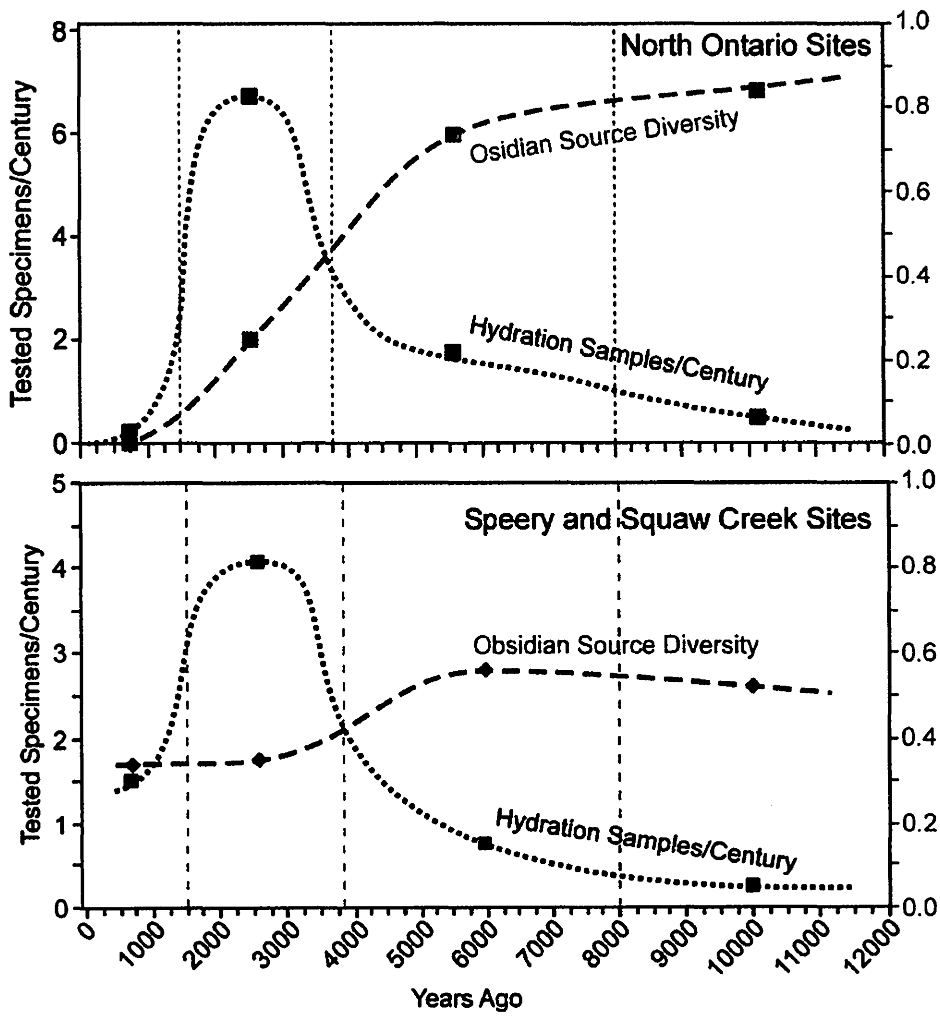

Fig. 5. Source diversity and occupation intensity (measured as samples/century) through time at the project sites.

ACKNOWLEDGEMENTS

This work was supported by the Oregon Department of Transportation, and facilitated by Carolyn McAleer. We would like to acknowledge the valuable input of the Confederated Umatilla Tribes, particularly Catherine Dickson, and the Burns Paiute Tribe on this project. Others who contributed to the research include Jim Bard, Virginia Butler, Jim Chatters, Loren Davis, Jaime Dexter, John Fagan, Pat O'Grady, Marge Helzer, Waite Osterkamp, Max Pavesic, and Saxon Sharpe.

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Journal of Northwest Anthropology 45(2):149–158 2011

A GOOD PLACE TO CAMP IS A GOOD PLACE TO CAMP: NINE THOUSAND YEARS AT THE WILLIAMS CREEK SITE ON THE NORTH UMPQUA RIVER

Brian O'Neill and Debra Barner

ABSTRACT

A pre-Mazama component was identified beneath approximately three meters of sterile ash and sand, and a post-Mazama component was confirmed at the top of a volcanic ash-covered terrace during investigations in 2008 for a proposed Oregon Department of Transportation box culvert replacement project at Williams Creek on the North Umpqua River. In 2009, a Forest Service-sponsored Passport In Time project examined eight square meters of this lower component of the Williams Creek site, recovering debitage, tools, and datable charcoal. Radiocarbon ages indicate that the site was occupied by at least 9000 years ago; obsidian hydration ages offer evidence it may have been occupied as early as 10,000 years ago. Ongoing analyses are addressing such issues as the site's focal economy and the source of the obsidian found in the site deposits.

Recent archaeological research in central Oregon has uncovered information indicating that the region was occupied by humans as long as 14,300 years ago (Gilbert et al. 2008). Mount Mazama erupted some 7600 years ago, or approximately midway between that ancient occupation and the present. In those areas blanketed by Mazama ash and pumice, there is the potential for a sealed record of nearly 7000 years of human prehistory to exist, one that encompasses the late Pleistocene and early Holocene.

The Williams Creek archaeological site (35-DO-848) is located in the North Umpqua River drainage on land administered by the Umpqua National Forest (UNF) some 20 mi. upstream from the small Douglas County community of Glide and 2 mi downstream from Steamboat Creek, a major North Umpqua tributary. The site is situated at the confluence of Williams Creek and the North Umpqua River. Williams Creek issues from a very steep and rugged gorge. At its mouth is a narrow remnant of a south-facing volcanic ash-covered terrace, which is protected from erosion by a cliff. Much of the terrace was removed in the past by construction of the highway and service roads. Volcanic ash is exposed in the road cuts and, in places, has sloughed, resulting in a talus below an undercut bank (Fig. 1).

The Williams Creek site was first recorded in 1999, and, in 2007, small-scale archaeological investigations were undertaken by the UNF, with the aid of a small backhoe, consisting of a 100-cm-deep profile column excavated along the exposed ash bank above the surface road. Intact cultural deposits were identified in the upper 80 cm of the pumiceous soil at the top of the remnant terrace, including debitage, an obsidian biface fragment, and pieces of animal bone (Barner 2007).

Fig. 1. Excavations in progress at the foot of the remnant volcanic ash-covered terrace at the Williams Creek site.

The 2008 Test Excavations

To facilitate fish passage up Williams Creek, the Oregon Department of Transportation (ODOT), the Oregon Department of Fish and Wildlife (ODFW), and UNF coordinated plans to replace a box culvert with a bridge at the mouth of the creek near the archaeological site. In 2008, the Museum of Natural and Cultural History at the University of Oregon conducted test excavations at the Williams Creek site (O'Neill 2008), focusing on an approximately 40 x 30 m area near the creek mouth where construction disturbances were anticipated. Investigations included the hand excavation of eight 50 x 50 cm shovel probes (several augmented by a 20 cm diameter bucket auger) and two test pits, including a 1 x 1 m pit and a 0.5 m x 2 m trench (Fig. 2). All of the soil, approximately 3.6 cubic m, was passed through 1/8-in. hardware cloth.

Five probes and one of the test pits were excavated at the top of the remnant terrace, north of the service road. One of these probes was placed at the face of the remnant terrace, near the profile column that the Forest Service had excavated, and was subsequently expanded into the .5 m x 2 m long trench. Three of the eight probes were place below and south of the ash-covered terrace. All of the probes yielded cultural material, consisting mainly of crypotocrystalline (CCS) and obsidian debitage.

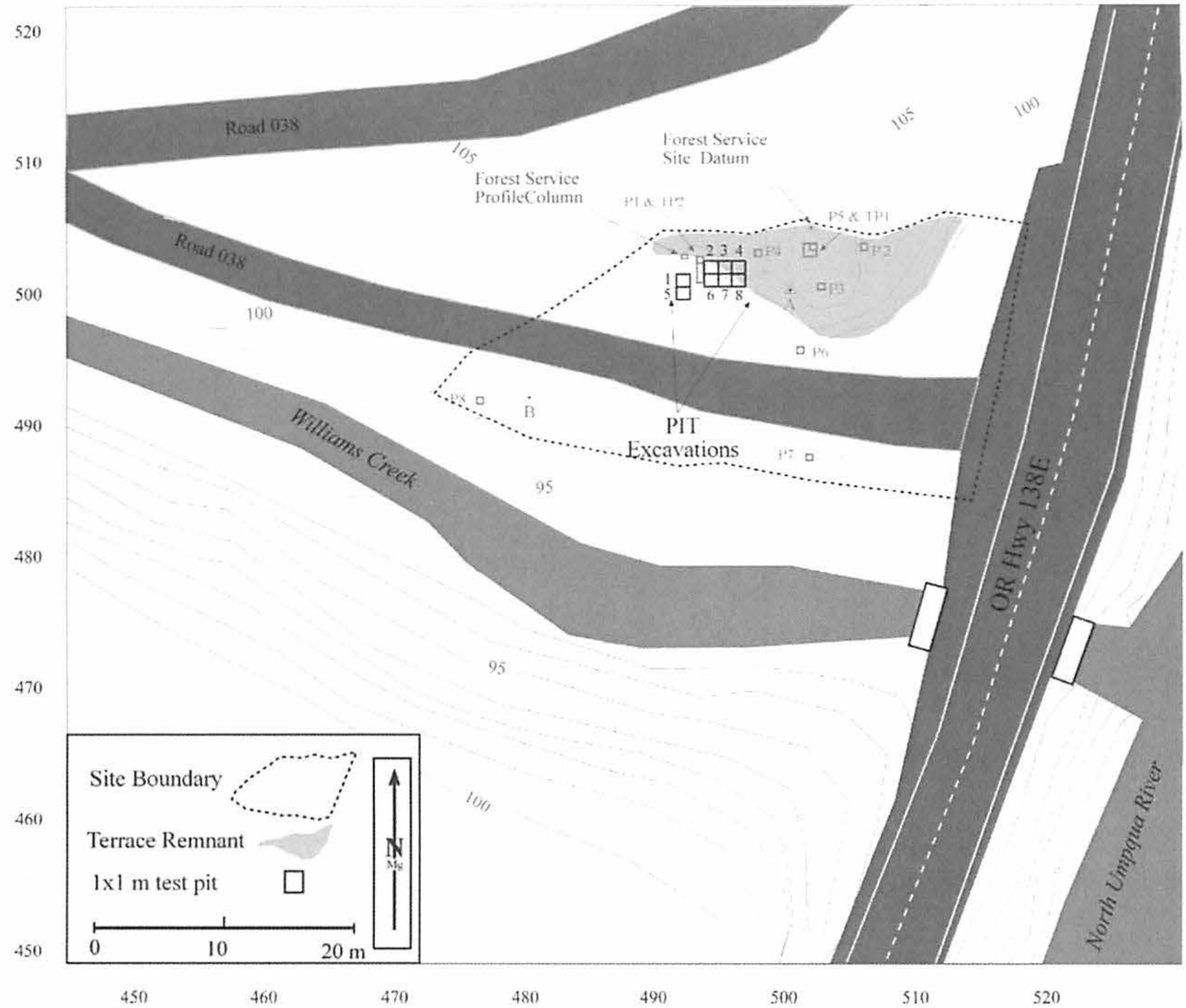

Fig. 2. Location of the 2008 and 2009 excavations at the Williams Creek site.

Excavations at the top of the terrace, away from its edge, generally reached 100 to 150 cm below the surface; the depth of one probe was extended with a bucket auger to 240 cm. The sediment in each of these units was redeposited volcanic ash. Cultural material was found in the upper 120 cm. At least two peaks in occupation intensity are suggested by the vertical distribution of cultural debris: a younger occupation in the upper 30 cm, and an older occupation between 30 and 110 cm below the surface in which a probable house pit depression was exposed (Fig. 3). The upper component artifact assemblage includes whole and fragmentary projectile points, bifaces, endscrapers, unifaces, utilized flakes, cores, hammerstones, battered cobbles, cobble unifaces, a ground stone fragment, and a piece of pointed bone. A peak density of 2160 waste flakes/m^3 was observed. Debitage was slightly dominated by obsidian (61%) with smaller proportions of CCS (34%) and basalt (5%). Small pieces of unidentifiable animal bone were collected. Projectile points recovered from the Upper Component include a small stemless specimen similar to those that have been associated with late Holocene assemblages and possibly used for fishing, and another fragmentary specimen similar to serated side-notched points recovered from the nearby Bogus Creek site (Winthrop 1989). Obsidian hydration estimates on specimens recovered from this component indicate a series of middle and late Holocene occupations.

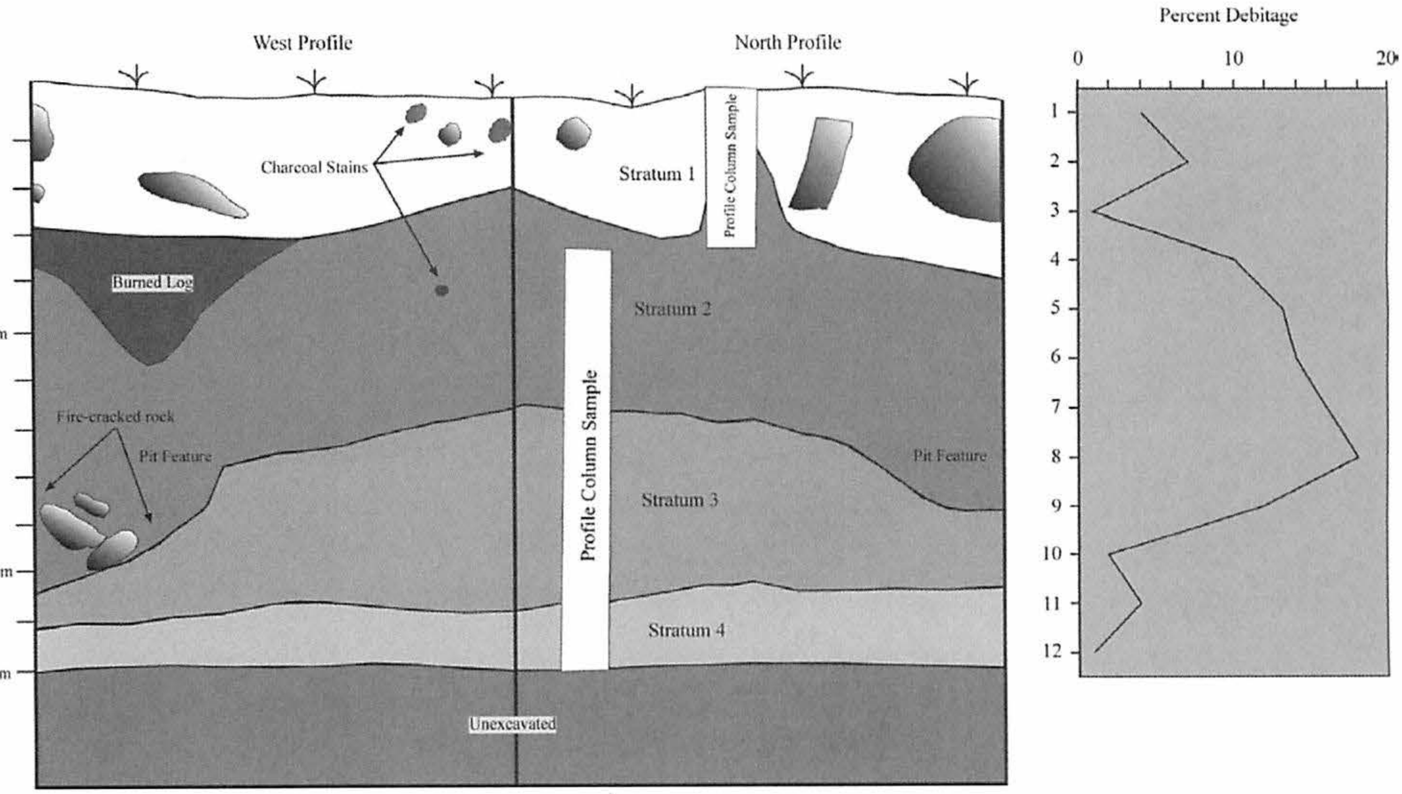

Fig. 3. West and north profiles of the test pit excavated at the top of the terrace, along with the vertical distribution of lithic debitage recovered from the test pit.

Excavations in the probe placed along the face of the terrace found cultural material in the upper 20 cm. Below this, a number of strata were exposed, representing fluvially-deposited volcanic ash, pumice, and sand; a depositional record of flood episodes that had backed up at the mouth of Williams Creek. These laminas are similar to those described in investigations at the Bogus Creek site (Winthrop 1989).

The museum crew excavated the shovel probe down the face of the cut bank through approximately 280 cm of sterile, re-deposited ash and sand, and eventually had to excavate a trench in the talus to continue to depth (Fig. 4). At approximately 300 cm below surface, the excavations encountered a fine, yellow-brown ash with small fragments of angular pumice—typical of airfall deposits from the cataclysmic eruption of Mount Mazama. Beneath this layer, from 300 cm to at least 380 cm below the surface of the terrace, the excavators encountered a buried soil consisting of a gravelly silt containing angular and subangular cobbles. Upon penetrating the pre-Mazama paleosol cultural material was immediately exposed.

In the 2 m x 0.5 m trench excavated perpendicular to the base of the remnant terrace, the cultural deposits were found to 60 cm below the ash/paleosol interface where the excavation was terminated due to safety concerns. The artifact assemblage of the pre-Mazama component included a projectile point, bifaces, an endscraper, uniface, utilized flakes, hammerstones, battered cobbles, an anvil stone, an edge faceted cobble, and a wedge. The peak density of debitage was 10,480 flakes/m^3, dominated by obsidian (86%) with lesser proportions of CCS (10%) and basalt (4%). A charcoal sample recovered from beneath a broken anvil stone approximately 10 cm

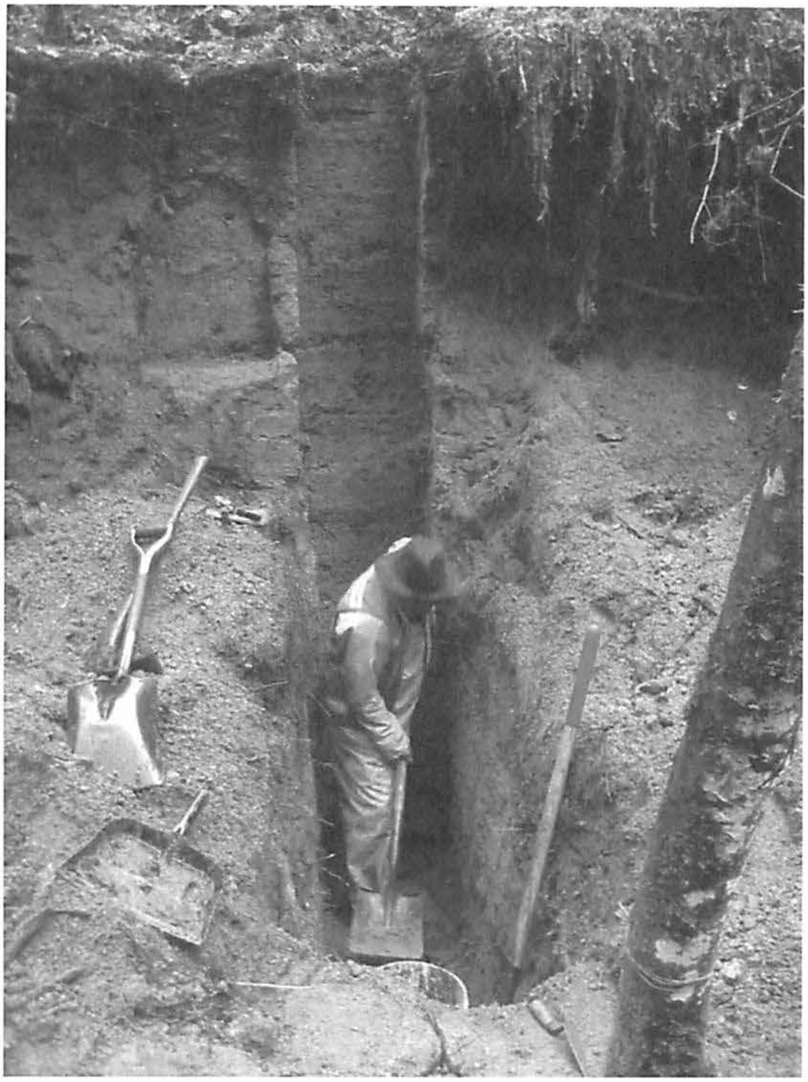

Fig. 4. Excavating the probe and 50 cm-wide trench at the face of the terrace.

below the ash/paleosol interface returned a calibrated age of 7690 BP (conventional radiocarbon age 6880±50 BP; Beta 243522; AMS, charcoal). The projectile point recovered from the pre-Mazama component is a Heavy Broad-necked contracting stem specimen. No faunal material was recovered during the 2008 test excavations.

A sample of 15 obsidian waste flakes from the pre-Mazama component was examined by non-destructive X-ray fluorescence to determine the geochemical source of the tool stone (Skinner and Thatcher 2008). Five of these were characterized to the Big/Buried Obsidian Flow and McKay Butte sources in the Newberry Crater vicinity—sources that are associated elsewhere with pre-Mazama occupations. The remaining 10 flakes were characterized to the Silver Lake/Sycan Marsh and Spodue Mountain sources.

Because the latter two sources hydrate at approximately the same rate, they were used to estimate when, before the eruption, the pre-Mazama occupation occurred. Obsidian hydration measurements of these specimens ranged from 4.1μ to 6.9μ, which yield computed hydration ages of 7680 BP to 10,280 BP. A cluster of six measurements (4.7 to 5.3) with an average measurement of 5.0μ yields a hydration age of 8100 BP.

Based on an analysis of macrobotanical remains recovered from a column sample collected from the pre-Mazama component, there may have been an open pine forest at this location during this time, as pine is the dominant species with less frequent occurrence of Douglas-fir and willow.

The 2009 Passport In Time Excavation

The original design for the culvert replacement called for an expanded parking area and reconfiguration of the intersection resulting in the elimination of the remnant terrace. Presented with the results of the test excavation and the prospect of conducting extensive data recovery excavations, plans to impact the terrace were scaled back. Both UNF and ODOT, however, were concerned with continued erosion of the significant upper component deposits where they were undermined by the road cut. To solve this problem, it was suggested that riprap cladding or a gabion wall be erected at the road cut and keyed into the base of the terrace. Excavating the key would also provide an opportunity to further examine the pre-Mazama component. With little available funding, however, a creative solution was needed.

The Passport In Time (PIT) program provided a mechanism for tapping into a pool of passionate volunteers, some of whom have years of excavation experience. The UNF sponsored the 2009 Williams Creek PIT Project, with the Museum a close partner and ODOT assisting. Plans called for a three-week summer field season with the goal of excavating eight square meters at the foot of the ash-covered terrace. By the end of the project, over 35 volunteers from the Pacific Northwest and across the U.S. had participated. In addition to the registered PIT volunteers, assistance also came from Forest Service and Bureau of Land Management archaeologists and soil scientists, and members of the Cow Creek Band of Umpqua Tribe of Indians. The project was interrupted in its third week; the 8500 acre Williams Creek Fire forced the evacuation of the volunteers and temporary abandonment of the site. A group of experienced volunteers returned in November to finish excavations under cold and rainy conditions.

The 2009 Williams Creek PIT Project began with the removal of a portion of the talus at the foot of the road cut and re-excavation of the 2008 season 2 m x .5 m trench. Two excavation blocks were established adjacent to the trench; a 1 x 2 m block perpendicular to the terrace and a 2 x 3 m block parallel to the terrace (Fig. 2). Careful excavation and screening confirmed that the volcanic ash was sterile. The paleosol was encountered approximately 3.7 m below the top of the terrace where an arbitrary datum of 100 m had been established. Four of the eight 1 x 1 m units were excavated to sterile.

The cultural deposits are approximately 1.3 m thick and end on an impenetrable layer of cobbles and boulders. The sediment grades from a silty clay loam to a very gravelly sandy silt. Angular and subangular cobbles and boulders were found throughout (Fig. 5). While no obvious cultural features were encountered during excavations, the volunteers did collect small pieces of charcoal. Also recovered were small, unidentifiable fragments of calcined animal bone.

Screening of some 6.5 m^3 of paleosol excavated during the PIT project resulted in the recovery of approximately 43,000 waste flakes with one 10 cm level yielding as many as 2255 flakes (for a density of 22,550 flakes/m^3). Obsidian comprises 83% of the assemblage with basalt (10%) and CCS (7%) contributing minor proportions.

The vertical distribution of debitage indicates that the bulk of the cultural deposits are found in the upper 60–70 cm of the paleosol and, within this, there may be distinguished two peaks. The cultural material—tools and debitage—continues to the base of the excavation.

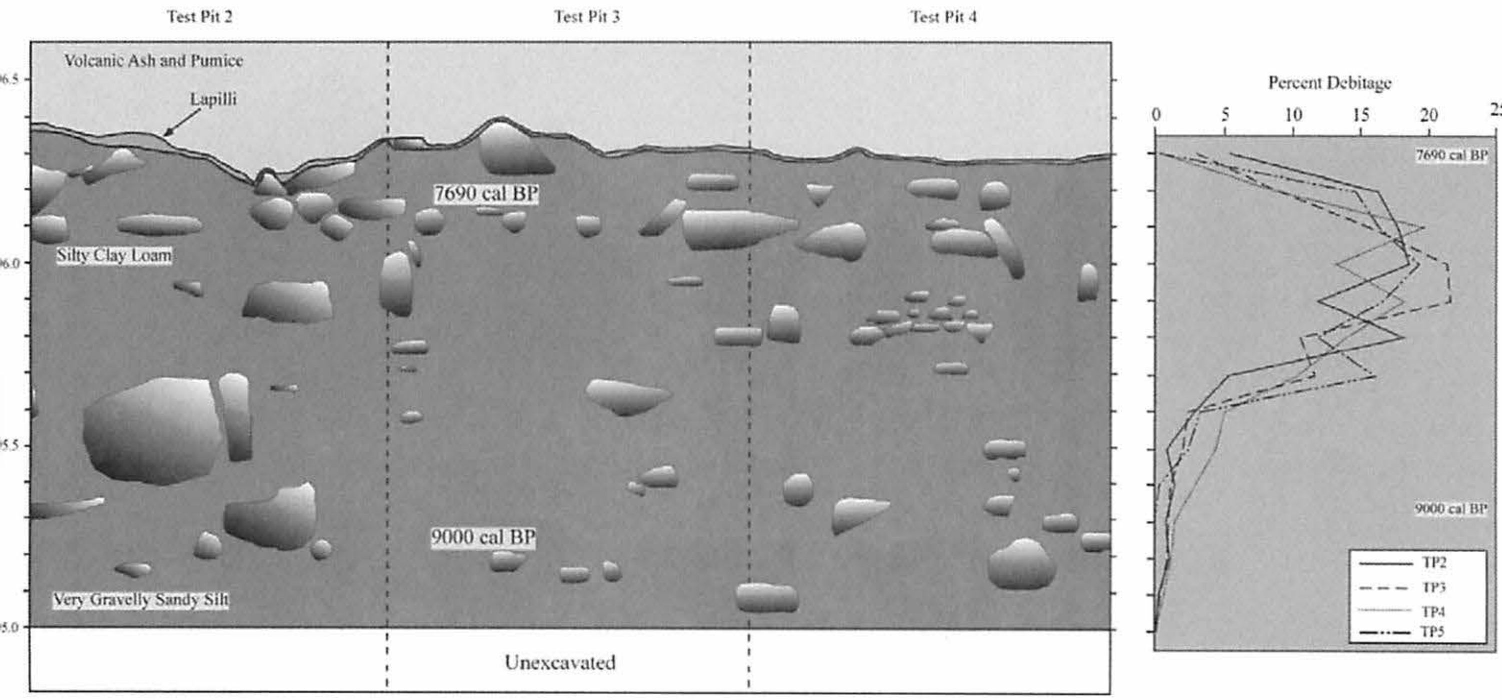

Fig. 5. North profiles of the 2009 PIT test pits excavated into the pre-Mazama paleosol at base of the terrace at the Williams Creek site. Also shown is the vertical distribution of debitage.

A charcoal sample recovered from next to a utilized obsidian flake nearer the base of the site deposits returned a calibrated age of 9000 BP (conventional radiocarbon age 8040 ± 50 BP; Beta 271072, AMS, charcoal).

Tools recovered from these excavations include 44 complete and fragmentary projectile points, 58 bifaces, 60 unifaces, 142 utilized flakes, 27 cobble unifaces, 69 hammerstones and battered cobbles, 27 cores (multidirectionally flaked pieces of CCS, obsidian, and basalt), five pieces of ground stone, four edge-faceted cobbles, a mano, a pestle, and an anvil.

The projectile point assemblage, consisting mostly of proximal fragments, is dominated by foliate-shaped specimens (Fig. 6). This assemblage is very similar to that described by Connolly and Jenkins (1999) for the upper pre-Mazama component at the Paulina Lake site at Newberry Crater, which is associated with an occupation between ca. 8500 and 7600 BP when environmental conditions were deteriorating and populations there and elsewhere in the northern Great Basin exhibited "increased mobility and decreased duration of residency at a given locality" (Connolly 1999:237).

Analysis of the recovered material is ongoing. Among the studies in progress are (1) radiocarbon dating of additional charcoal samples; (2) obsidian sourcing and hydration of tools and cortical flakes; (3) macrobotanical studies of collected column samples and charcoal specimens; (4) protein residue analysis of a broad array of chipped and ground stone tools; (5) mass analysis of the large debitage assemblage; (6) soil chemistry analysis; and (7) identification of a hair sample embedded in a clump of pre-Mazama sediment.

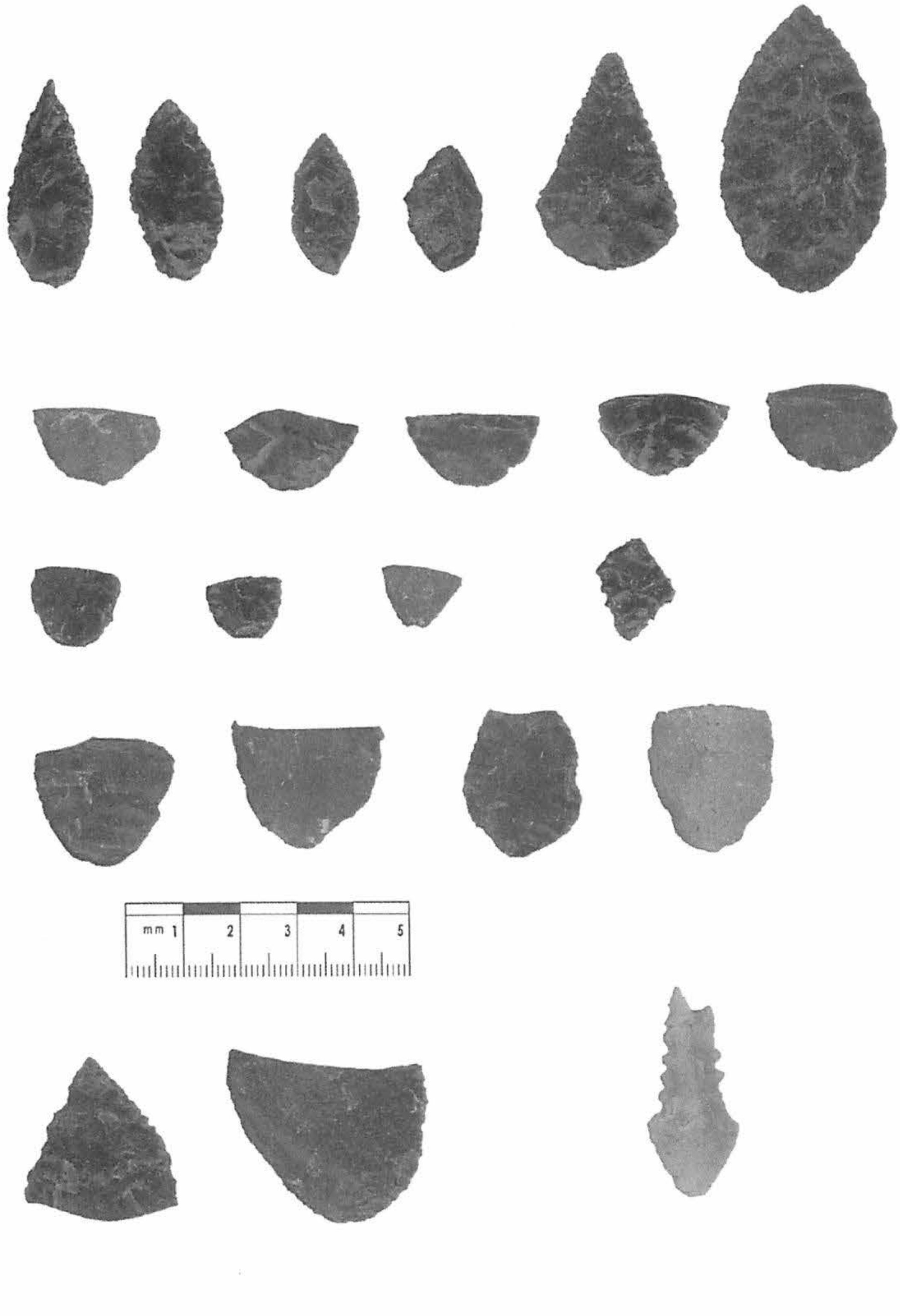

Fig. 6. A sample of the projectile points recovered from the pre-Mazama component at the Williams Creek site.

Conclusion

The Williams Creek site is one of ten sites in the North Umpqua drainage found to contain pre-Mazama components. Generally, these components do not have radiocarbon ages but, because they are found beneath Mazama ash, have a minimum age of 7600 BP. Only the Susan Creek (Musil 1994, 1997), Dry Creek (O'Neill et al. 1996), and Williams Creek (O'Neill 2008) pre-Mazama components have associated radiocarbon assays. Obsidian hydration studies at the Dry Creek (O'Neill et al.1996), Lough Terrace (O'Neill 2002), and Williams Creek sites indicate multiple episodes of occupation beginning perhaps as long as 10,280 years ago.

The cultural deposits of the Williams Creek site are extremely dense. They, along with the rather dense deposits at Medicine Creek (Snyder 1981) and Dry Creek, give us pause. Conventional wisdom generally states that early Holocene population density was low, and involved dispersed, highly mobile foragers in small groups focused on a broad spectrum of resources. These three sites suggest less mobility and increased duration of residency. Generally speaking, archaeologists have used the number of archaeological sites and attendant radiocarbon dates from particular periods as proxy data for population figures; that is, if you have a small number of sites, there is a correspondingly small population. In the ash-covered upper Umpqua drainage, absence of evidence is not evidence of absence. Archaeologists focused on finding these early Holocene cultural deposits are being successful. It is possible that because Mazama ash blankets the upper Umpqua and Rogue drainages, this region has the potential to contain evidence that could be used to address questions of late Pleistocene and early Holocene population density.

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Journal of Northwest Anthropology 45(2):159–197 2011

EARLY TO LATE HOLOCENE OCCUPATION AT THE GEE CREEK ARCHAEOLOGICAL SITES IN THE UPLANDS OF THE PORTLAND BASIN

Michele L. Punke, Terry L. Ozbun, and Jo Reese

ABSTRACT

Archaeological sites 45-CL-631 and 45-CL-632, collectively known as the Gee Creek sites, were archaeologically investigated prior to the construction of a new highway interchange in Clark Country, Washington. Together, the Gee Creek sites have produced one of the longest and most complete radiocarbon chronologies of prehistoric activity yet identified for an archaeological locality in western Washington or the Portland Basin. Archaeological materials dating up to 8000 years in age were encased in Holocene aeolian sediments that overlie Pleistocene alluvium. The archaeological record reveals a long tradition of upland occupation that involved extraction and processing of a variety of plant and animal resources. Earth ovens, fire pits, and hearths were used to process these resources and are scattered across a broad area containing the Gee Creek sites. Lithic technological traditions and resource procurement and processing activities represented at the Gee Creek sites appear to remain largely unchanged over several millennia.

Introduction

In preparation for the construction of a new highway interchange in Clark County, Washington, cultural resource studies were conducted by the Washington Department of Transportation (WSDOT). Inventory-phase work at the proposed interchange location resulted in the discovery of two archaeological resources, 45-CL-631 and 45-CL-632 (Smith et al. 2004). Testing and evaluation of the archaeological sites resulted in a recommendation for data recovery to occur at site 45-CL-631 (Smith et al. 2005). Archaeological construction monitoring was recommended for site 45-CL-632 (Wilson et al. 2005).

This article presents the results of archaeological data recovery work and monitoring at 45-CL-631, as well as the results of monitoring and subsequent investigations of archaeological deposits within site 45-CL-632. The article highlights some of the major discoveries associated with these investigations, including artifact assemblages, features, site chronology, and depositional setting. A full report of the archaeological investigations conducted in association with the Gee Creek sites is presented in Punke et al. (2009).

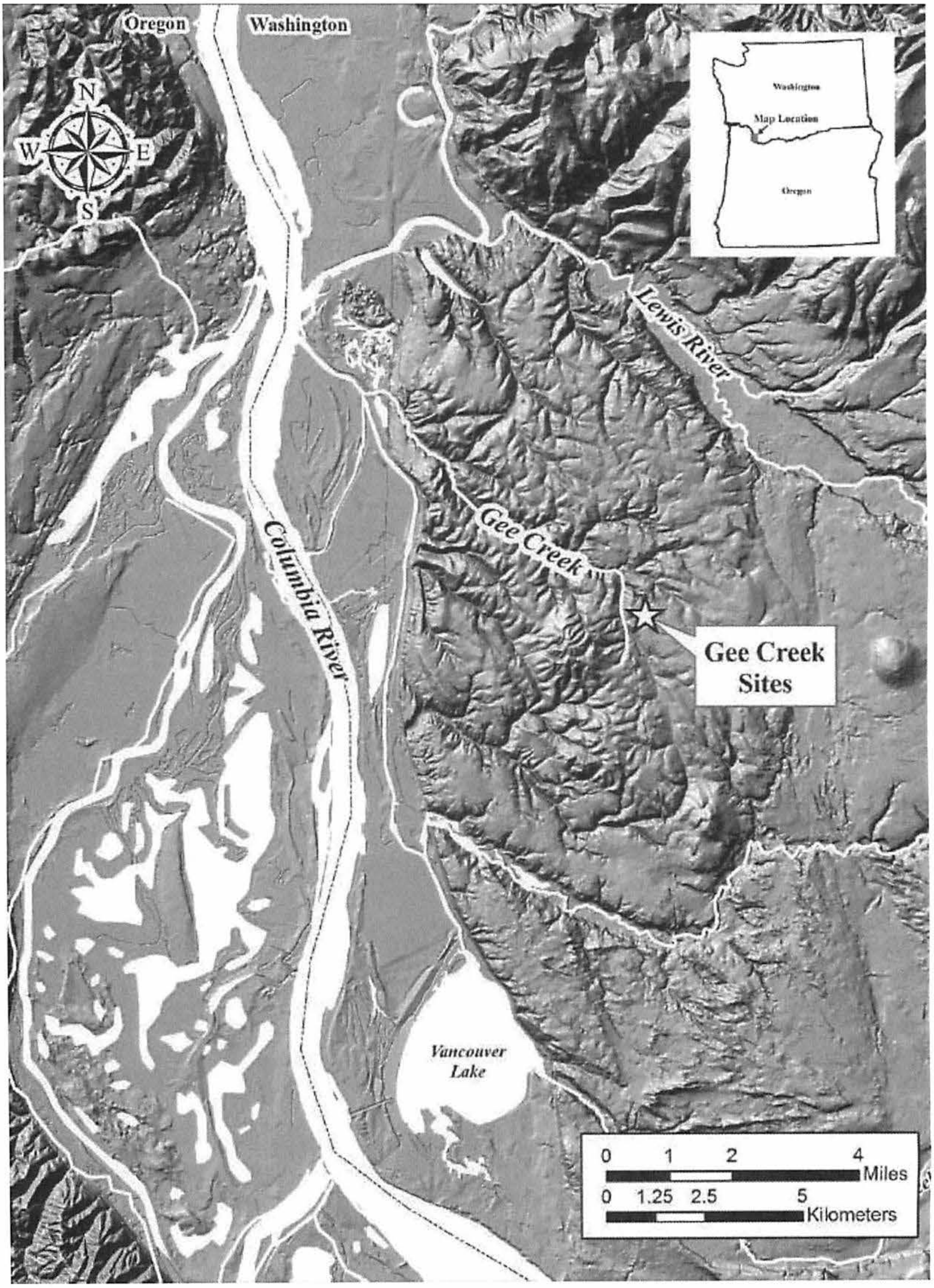


Fig. 1. Map showing general location of the Gee Creek sites.

Environmental Setting

The Gee Creek archaeological sites are located approximately 8 mi. north of Vancouver and 4 mi. southeast of Ridgefield in unincorporated Clark County, Washington (Fig. 1). The two sites are found within the uplands of the Portland Basin, gently rolling hills and meadows located above the Columbia River floodplain in the vicinity of Portland, Oregon. These uplands are deeply dissected by tributary streams of the Columbia River, which include Gee Creek. The Columbia River is approximately 4.5 mi. to the west of the sites location.

Archaeological site 45-CL-631 is located on a relatively level upland landform that is lined on its eastern edge by a low, seasonally-flooded swale (Fig. 2). Less than 100 m to the west is archaeological site 45-CL-632. The majority of site 45-CL-632 is positioned along the axis of a ridgeline that is bounded to the northeast by a small, intermittent drainage and to the southwest by Gee Creek (Fig. 2). At the time of the archaeological site discovery, the vegetation along the ridgeline was similar in character, but sparser, than at 45-CL-631. The elevations of the Gee Creek archaeological sites range from 220 to 270 ft. above mean sea level.

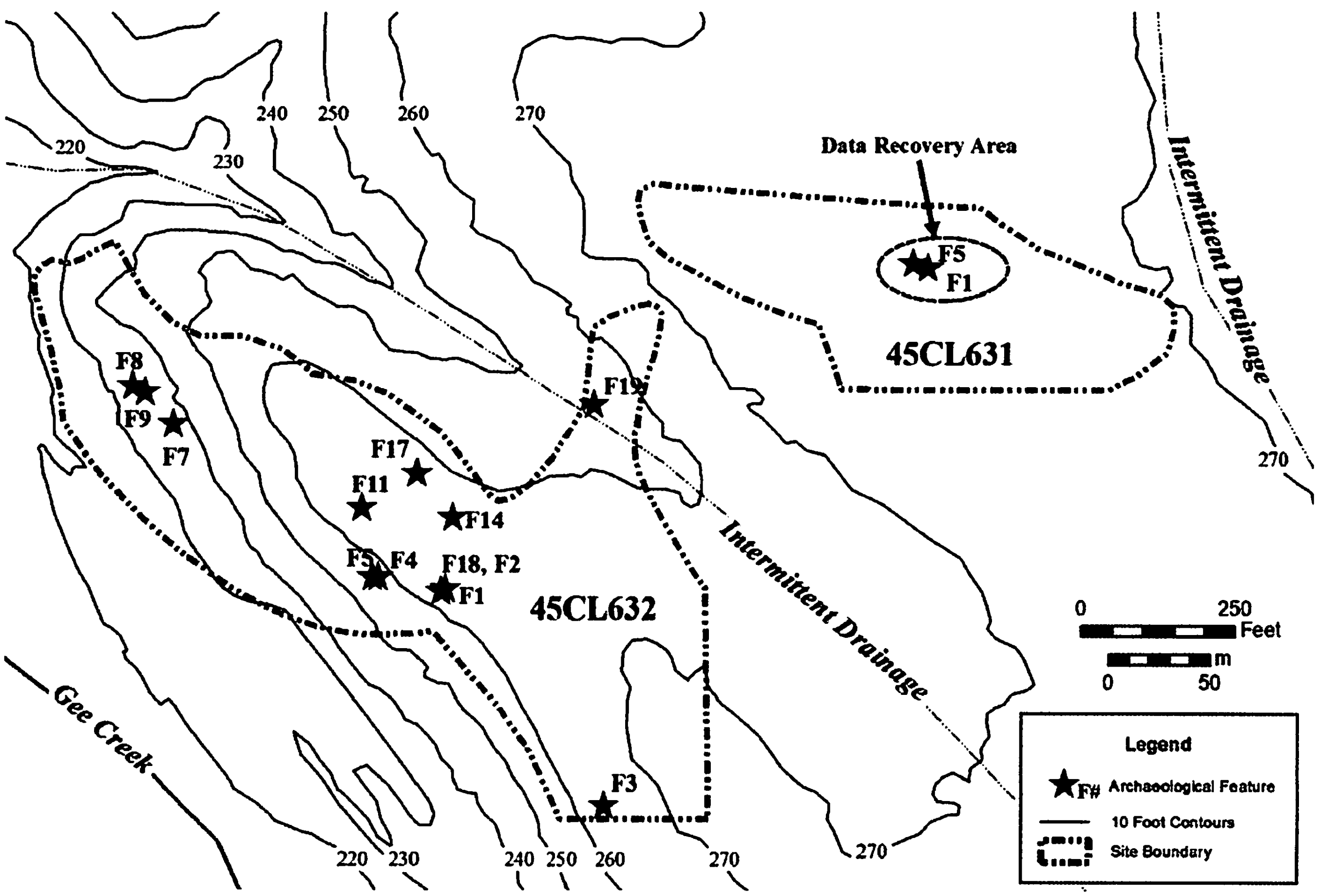


Fig. 2. Overview of archaeological sites 45-CL-631 and 45-CL-632, the Gee Creek sites. Contours are in feet above mean sea level.

The Gee Creek sites are located within the Portland Basin physiographic region, which is positioned between the Puget Lowlands to the north and the Willamette Valley to the south (Orr et al. 1992). The Portland Basin, Puget Lowlands, and Willamette Valley are physiological lowlands positioned between the Coast Mountain and Olympic Mountain ranges to the west and the Cascade Mountain Range to the east. These structural lows are filled with sedimentary and volcanic rock dating as early as the Eocene (Lasmanis 1991; Orr et al 1992).

Soils encountered within the vicinity of the archaeological sites were mapped as Gee Series soils (McGee 1972). These are described as deep, moderately well-drained silt loams to silty clay loams formed in old alluvium (Missoula Flood deposits) on dissected high terraces (McGee 1972). Surficial geologic mapping of the area also identifies the sites' surficial sediments as fine-grained Pleistocene-aged Missoula Flood deposits (Evarts 2004). These Missoula flood deposits are unconsolidated fluvial sediments emplaced during the catastrophic flood events that impacted the Columbia River Basin during the late Pleistocene (Trimble 1963). During the Pleistocene Epoch, the Clark Fork River in Montana was periodically blocked by glacial ice, resulting in the formation of glacial Lake Missoula. Episodic failure of these ice dams caused the release of catastrophic floodwaters into eastern Washington and the Columbia River Basin. These Missoula Floods, (also called the Bretz or Spokane floods) (Bretz 1969; Faroqui et al. 1981), scoured the landscape, removing topsoil and sediment. Left behind on the land were deposits of sediment ranging in size from boulders to silts and clays (Grondin et al. 1995). At least 25 late-glacial flood events occurred, the last having occurred before ca. 12,700 years BP (Mullineaux et al. 1978; Baker and Bunker 1985; Waitt 1985; Waitt and Atwater 1989; Benito and O'Connor 2003).

Temporary ponding occurred within the Portland Basin and its tributaries during many of the flood events due to a constriction in the Columbia River Valley near Kalama Gap (Glenn 1965; Allison 1978). The ponded water reached elevations of 120 to 150 m high in the Portland Basin (Minervini et al. 2003). Recession of the flood waters and drainage of the ponded basin left behind bedded, fine-grained lacustrine sediment, including fine sands, silts, and clays. These fine-grained materials are mapped in the area of the Gee Creek archaeological sites and are thought to represent the uppermost sediment deposit in much of the lowlands of the Portland Basin (Trimble 1963; Evarts 2004). Geoarchaeological data presented here suggests that flood sediments were reworked during the Holocene and accumulated at the Gee Creek sites where they encased stratified archaeological deposits.

Vegetation and climate conditions within the vicinity of the Gee Creek sites have fluctuated since the late Pleistocene (Barnosky 1985; Heusser 1985; Barnosky et al. 1987; Worona and Whitlock 1995; Grigg and Whitlock 1998, 2002; Long et al. 1998; Long and Whitlock 2002; Long 2003; Walsh et al. 2005, 2008; Whitlock and Brunelle 2007) (Fig. 3). Climate conditions at the end of the last glacial period in the study area were cooler and drier than at present, supporting Picea-Pinus parkland vegetation. Rising temperatures and increased moisture regimes accompanied an increase in more temperate vegetation through the late Pleistocene and early Holocene. After 11,000 years ago, temperatures continued to rise, but conditions became drier and vegetation shifted to dominantly nonarboreal species common to oak savannahs, including camas. Fire frequency during this time period, the mid-Holocene, was high relative to periods before and after. By around 4500 years ago, conditions became cooler and wetter with temperate forests becoming the dominant vegetation. Climate conditions resembled those of today by around 2000 years ago, which included cool, moist winters and warm, dry summers that supported temperate forest species.

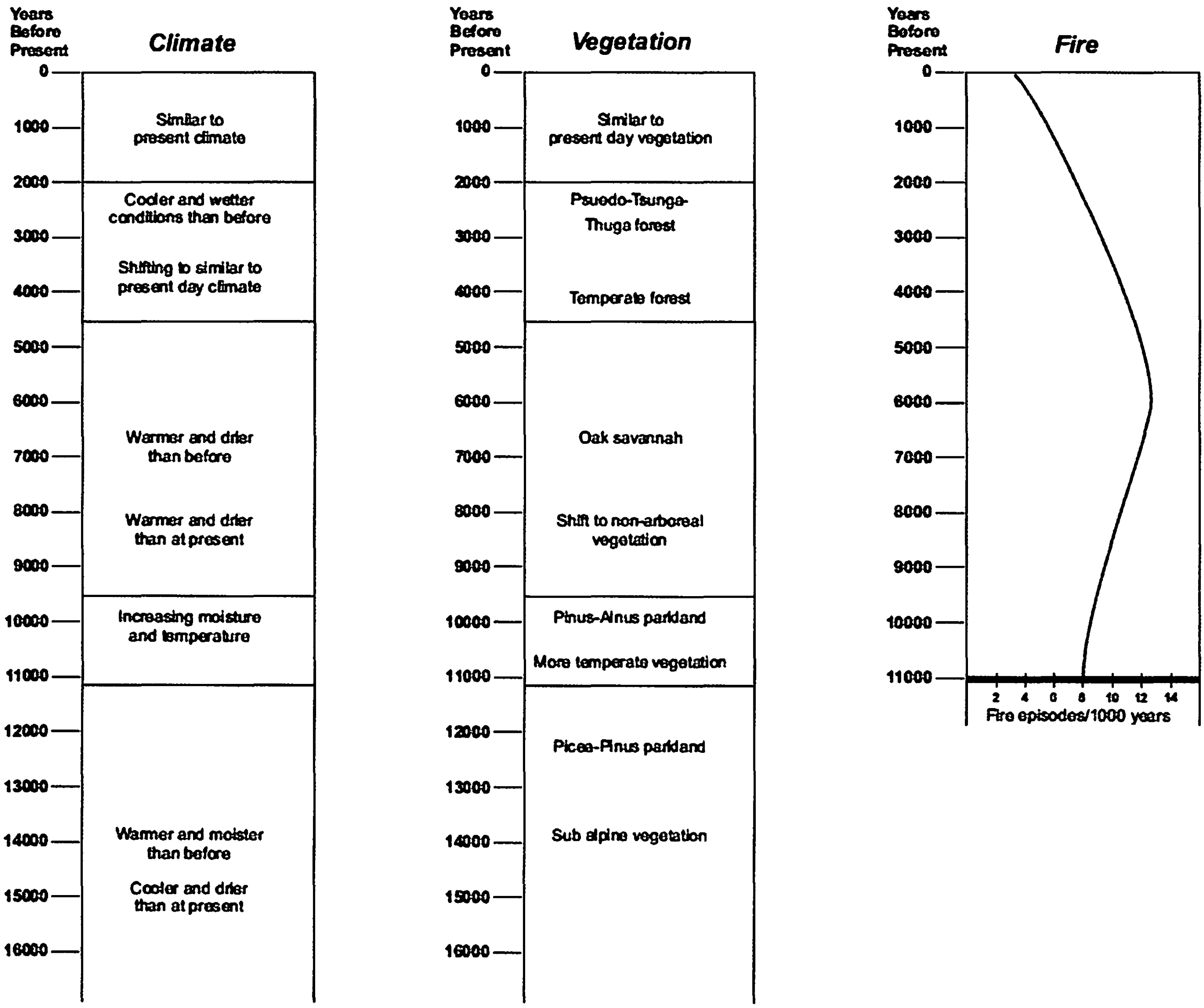


Fig. 3. General climate, vegetation, and fire histories for the Gee Creek project area. Histories are based on data collected from Battleground Lake, Washington (Barnosky 1985) and other regional locations (Heusser 1985; Barnosky et al. 1987; Worona and Whitlock 1995; Grigg and Whitlock 1998, 2002; Whitlock and Brunelle 2007; Long et al. 1998; Long and Whitlock 2002; Long 2003).

Methods

Archaeological excavation units were hand-dug in arbitrary 10-cm vertical increments (levels) unless obvious breaks in stratigraphy were noted, in which case a new level was initiated at the stratum break. The excavated sediment at both of the Gee Creek sites was screened through nested 6.4-mm and 3.2-mm mesh hardware cloth to sort materials for archaeological recovery. Bulk samples from some of the units were screened through 1-mm fine mesh cloth for microarchaeological recovery.

A detailed lithic analysis of all of the recovered tools and debitage was conducted and included examinations of technological information regarding production sequences; methods of resharpening, reworking, and recycling; use of heat treatment; and selection of raw materials. All identifications of faunal materials were made to the most precise taxonomic level possible. In cases where species identification beyond class was not possible due to the fragmentary condition of the specimens, the categories small, medium, and large mammal were used to provide some level of classification.

The occurrence of fire modified rock (FMR) (also called thermal rock, fire-cracked rock, or other similar terms) in an archaeological context is often indicative of fire hearths, cooking facilities, roasting ovens, or other such features. Following methods outlined in Schalk and Meatte (1988), Thoms (1989, 2008), Samuels (1993), Wilson and Roulette (1998), Petraglia (2002), and Pagoulatos (2005), analysis of the distribution of FMR across the sites, the morphology and characteristics of FMR as an assemblage, the appearance of individual pieces of FMR within the assemblage, and the types of materials found in association with the FMR feature provided clues as to the original functions of the features at these sites of prehistoric occupation. To analyze the FMR assemblages, all identified FMR from the Gee Creek sites were counted, measured, and weighed. The assemblage of FMR from each feature (or a sample of the FMR from larger features) was separated into cobbles versus spalls. The cobbles were identified as the original rock that was placed into the heating or cooking element, while the spalls were identified as the fragments of rock that broke or spalled off of the parent rock. The amount of cracking or spalling that each of the cobbles had incurred was determined by estimating how much of the outer surface of the cobble had been removed. The color change associated with the heating of the individual pieces of FMR was recorded using the Munsell color chart to determine the average chroma of an assemblage.

In order to determine what types of animal or vegetable products were processed at the sites, a sample of artifacts selected from feature contexts were submitted to Paleo Research Institute for Fourier Transform Infrared Spectroscopy (FTIR) analysis. FTIR uses infrared spectroscopy to identify absorbance signatures on compounds that adhere to artifacts or feature sediments, including organic residues from plants and animals. These signatures can then be compared to known signatures in order to identify what types of organic materials were processed with or in association with artifacts or feature fills.

Sediment samples from 45-CL-631 were submitted to the Central Analytical Laboratory in the Crop and Soil Science Department at Oregon State University for grain size measurements. Obsidian artifacts were submitted to Northwest Research Obsidian Studies Laboratory for geochemical sourcing by energy dispersive x-ray fluorescence (XRF) analysis and hydration rind measurement. Samples from 45-CL-631 and 45-CL-632 were submitted to Beta-Analytic, Inc., for Accelerator Mass Spectometry (AMS) radiocarbon-aging.

Results

A generalized stratigraphic profile was developed for 45-CL-631 and 45-CL-632 based on sedimentary characteristics observed during archaeological fieldwork within the two sites (Fig. 4). The depth below original ground surface shown in the figure represents average depths encountered throughout the area encompassing the two sites. An analysis of the sedimentary profile for soil characteristics revealed a deep, poorly-drained soil formed in a series of three similar but separate parent materials, or depositional units, underlain by a fourth, unaltered sandy parent material. Sediments were generally loams or silt loams, with varying amounts of sand, silt, and clay. Iron concretions were common throughout the profiles. Six stratigraphic units were identified within the four parent materials. The upper, surface stratigraphic units, Stratigraphic

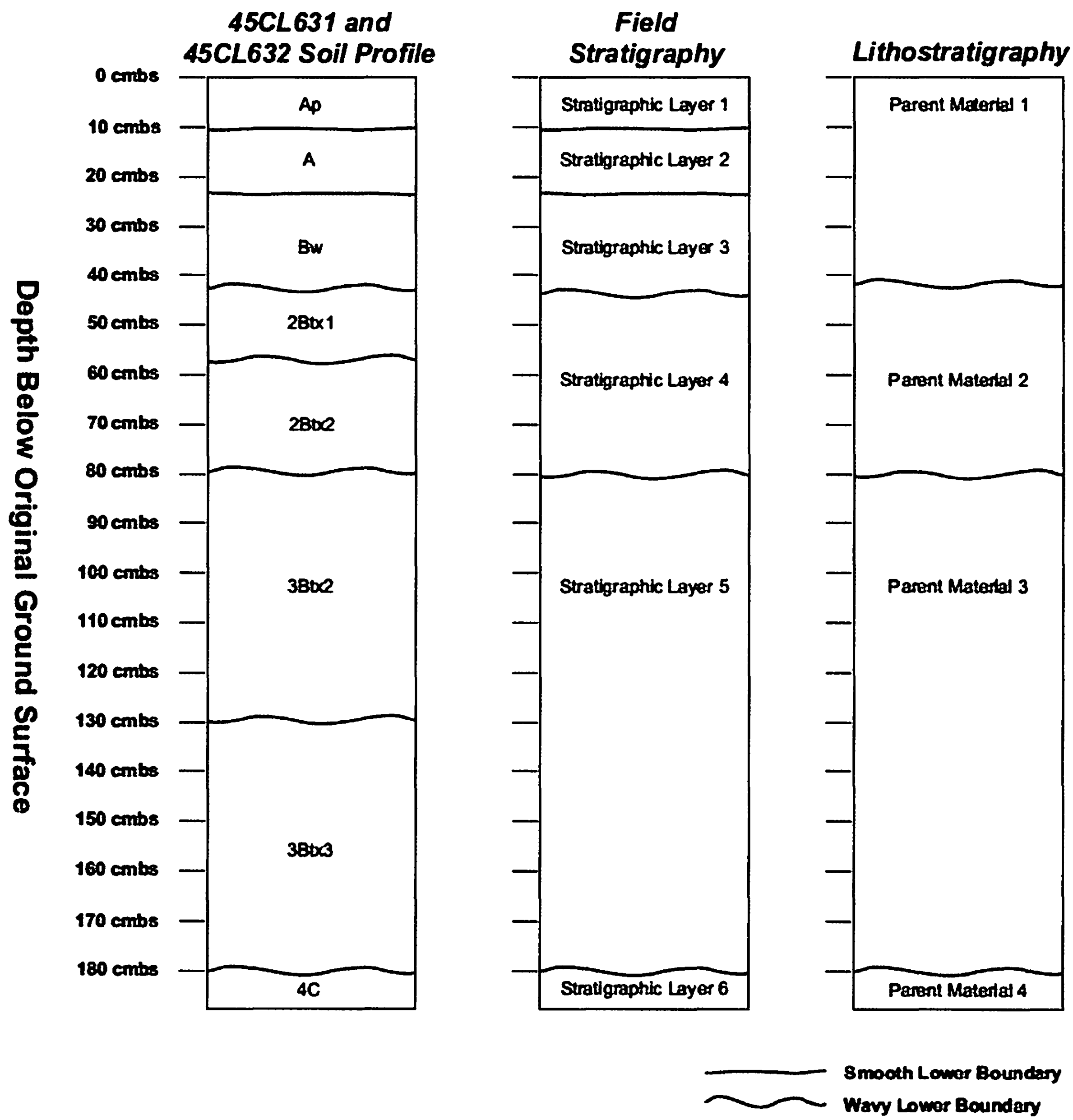


Fig. 4. Generalized profile, field-recorded stratigraphy, and interpreted lithologic parent material from 45-CL-631 and 45CL-632.

Layer 1 and Stratigraphic Layer 2, displayed characteristics typical of an A soil horizon, including positioning at the surface and the accumulation of humified organic matter (Soil Survey Division Staff 1993). Due to disturbance from farming and logging activity, Stratigraphic Layer 1 is considered an Ap soil horizon. Stratigraphic Layer 3, a Bw soil horizon, displays a more well-developed soil structure in relation to the stratigraphic horizons above it and incipient accumulation of iron, clay, and manganese was noted. Stratigraphic Layer 4, a Btx1 soil horizon, displayed characteristics of a fragipan, including a high bulk density, low water permeability, brittleness, a firm rupture class, and distinct concentrations of reduced or oxidized iron (redoximorphic features). Manganese nodules were common, and black staining appeared within peds and on ped faces (Soil Survey Staff 1998). Stratigraphic Layer 4 contained a higher clay content than above, with thin clay films coating peds and lining pores. Stratigraphic Layer 5 appeared similar to Stratigraphic Layer 4, with increases in structure, brittleness, density, redox features, and clay translocation noted. Both Stratigraphic Layers 4 and 5 displayed reduction and oxidation along the faces of peds, which highlighted the prismatic structure of the subsoil horizons.

Stratigraphic Layers 3, 4, and 5 contained notable differences in sand, silt, and clay content. The boundaries between each of these layers was very abrupt but wavy, and in some areas slightly irregular, suggesting possible erosional unconformities. The textural and bounding plane information suggest that Stratigraphic Layers 1 through 5, except 2 represent three different parent materials or depositional units. Stratigraphic Layer 6 appeared to be a relatively unmodified fourth parent material, a laminated, medium to fine-grained sand deposit. Distinct soil A horizons were not visible in the upper portions of each of the buried parent materials, suggesting that the former surfaces of these buried parent materials were truncated by erosion. Identifiable characteristics of buried soil subhorizons, if present, have been overprinted by subsequent pedogenesis associated with the overlying surface soil.

45-CL-631

Data recovery work at site 45-CL-631 included hand excavation of contiguous 1x1 m units divided into four blocks. The total volume of sediment excavated during the data recovery was 17 m^3. Artifacts recovered during the data recovery excavations at site 45-CL-631 suggest that it functioned, in part, as a stone tool production and maintenance workshop. Artifacts included 3,486 pieces of debitage and 139 flaked stone tools recovered from standard excavations and 213 pieces of debitage recovered from microarchaeological processing of bulk sediment samples. Table 1 presents a summary of lithic debitage and stone tool analysis data for 45-CL-631.

Although fragmentary, most of the projectile points exhibited attributes typical of dart-sized, willow leaf-shaped, Cascade points (Fig. 5). In addition to size and shape, other attributes associated with Cascade points include serrated margins, basal facets, and generally thick cross-sections (Ozbun and Fagan 2010). None of the artifacts found at 45-CL-631 display characteristics consistent with arrow point technologies. Other tools recovered during the excavations at 45-CL-631 included cores, bifacial blanks and performs, drills, flake tools, scrapers, cobble choppers, an anvil, hammerstones, and one pestle fragment (Table 1).

The types of lithic raw materials used for stone tools at 45-CL-631 are typical of most sites in the region in one respect: a heavy reliance on cryptocrystalline silicate (CCS) materials. Of the lithic artifacts, 70% are CCS and include chert, jasper, chalcedony, and petrified wood. A more unusual characteristic of the 45-CL-631 assemblage is a fairly substantial use of basalt to make bifacial tools. [The term basalt is used here to mean any dark gray, fine-grained lithic material and may include andesite, dacite, or other lithology with similar macroscopic characteristics]. Fourteen percent of the lithic debitage and stone tools are classified as basalt. Quartzite, quartz, and granite represent about 8% of the lithic assemblage; rhyolite represents 7%; and unidentified fine-grained and coarse-grained volcanic materials and other unidentified or unknown lithic materials comprise the balance of lithic assemblage. All of the lithic raw materials found at site 45-CL-631 are available in nearby alluvial gravel deposits (Trimble 1963; Evarts 2004).

A total of 20 bone fragments was recovered at site 45-CL-631, and the majority of these (61%) was found in the uppermost level of the unit. Most of the non-intrusive identified fragments were Mammalian. These were not identified beyond the general class Mammalia due to their high degree of deterioration and fragmentation. However, they did display extensive burning that suggests association with human activity (Stiner and Kuhn 1995), such as cooking or disposal of food waste.

Two cultural features were identified during excavations at 45-CL-631. Feature 1 was found between 65 to 115 cm below the ground surface (Fig. 6; Table 2). The feature displayed a trough-like morphology and a low FMR concentration that may signify it was once used as a drying facility, like those described by Mack and McClure (2002) for berries, nuts, or other resources. Analysis of the FMR revealed equal proportions of cobbles and spalls, which suggests the feature was not cleaned out after use. The size and discoloration of the rocks and the cobble to spall ratio suggest use of the feature multiple times. Burned mammal bones were recovered from the feature. FTIR analysis indicates that some of the artifacts associated with the feature may have been used to process fish, mammals, birds, nuts, seeds, and that camas or some other type of bulb in the lily family may have been cooked in Feature 1 (Table 3). Based on the feature's morphology and constituent artifacts and residues, Feature 1 appears to represent a shallow fire pit or series of pits within which were processed a variety of food products, including nuts, seeds, berries, and small to large mammals. Feature 1 likely served many functions through its lifespan, including drying, roasting, and cooking various resources.

Artifacts recovered in association with Feature 1 included 19 stone tools, 491 flakes, and 12 FMR fragments (Table 2). The tools were classified as 5 cores, 1 bifacial blank, 1 projectile point, 9 flake tools, 2 scrapers, and 1 hammerstone. The projectile point is the distal portion of a dart-sized point, probably a Cascade type considering the shape, thickness, and slightly serrated edges. The large number and variety of lithic artifacts found in association with Feature 1 suggests that it was a focus of residential camp activity, although their incorporation in the feature fill may be incidental to feature use.

Based on the depth of the feature when it was first encountered in the units and the characteristics of the surrounding matrix, it appears that Feature 1 originated in Stratigraphic Layer 4, which is assigned to Parent Material 2 (Fig. 4). A charcoal sample was extracted from the sediment matrix of Feature 1 from near a concentration of hardened, reddened earth at a depth of 87 cm below the ground surface. This sample returned a date of 3690±40 uncalibrated radiocarbon years BP (Beta-236477, calibrated 2-sigma date range of 3910 to 4150 calibrated radiocarbon years BP) (Table 4).

Feature 5 was found between 45 and 95 cm in depth below the ground surface and had a pit-like morphology in cross-section (Fig. 6; Table 2). FMR analysis indicated that the feature was used multiple times without smaller spalls being removed between uses. The multiple firings without clean-out of the feature or replenishment of the rock suggests repeated, but relatively short term, use of the feature such as might occur in association with a short-term resource procurement camp.

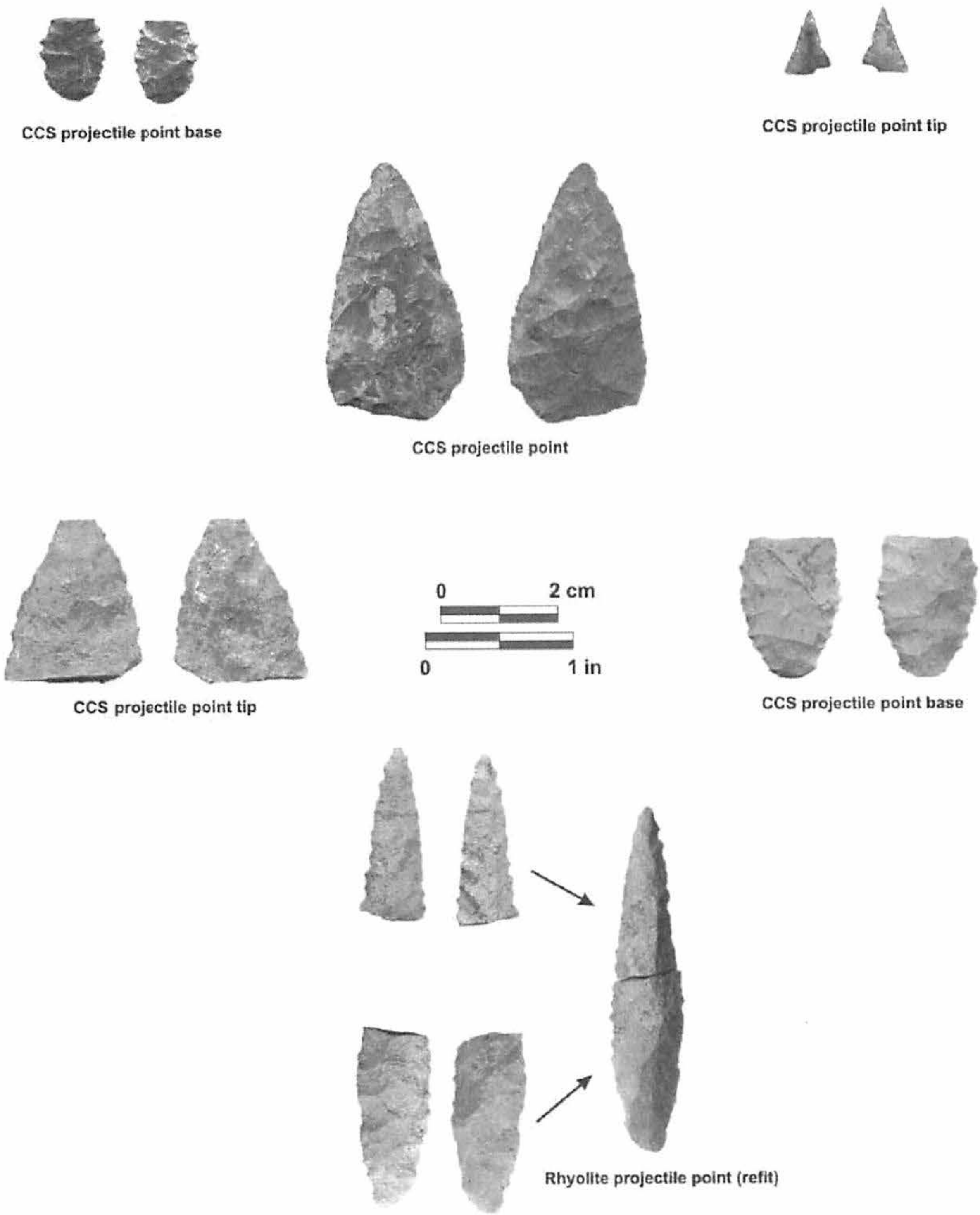


Fig. 5. Selected projectile points from 45-CL-631. Each artifact is shown from the front and back.

TABLE 1. SUMMARY OF LITHIC DEBITAGE AND STONE TOOL ANALYSIS DATA FOR 45-CL-631.

	QUARTZITE/ GRANITE		CCS/ PET. WOOD		BASALT		RHYOLITE GROUP*		SILTSTONE		QUARTZ		OBSIDIAN		*TOTAL*	
DIAGNOSTIC DEBITAGE	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Bipolar Core Reduction			1	0%											*1*	*0%*
Early-Stage Core Reduction	14	13%	102	10%	21	10%	11	9%	1	11%					*149*	*10%*
Late-Stage Core Reduction	86	77%	110	11%	128	61%	68	54%	3	33%					*395*	*27%*
Early-Stage Bifacial Thinning	12	11%	299	30%	34	16%	39	31%	4	44%					*388*	*27%*
Late-Stage Bifacial Thinning			79	8%	10	5%	5	4%							*94*	*6%*
Early-Stage Bifacial Pressure			181	18%	5	2%	1	1%	1	11%					*188*	*13%*
Late-Stage Bifacial Pressure			225	23%	11	5%	3	2%							*239*	*16%*
Subtotal	*112*	*100%*	*997*	*100%*	*209*	*100%*	*127*	*100%*	*9*	*100%*	*0*		*0*		*1454*	*100%*
UNDIAGNOSTIC DEBITAGE	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	
Percussion Flake Fragments	151		1270		289		103		22		6				*1841*	
Indeterminate Technology			148												*148*	
Thermal			43												*43*	
Undiagnostic Debitage Subtotal	151		1461		289		103		22		6		0		*2032*	
Debitage Total	*263*		*2458*		*498*		*230*		*31*		*6*		*0*		*3486*	
TOOLS	#		#		#		#		#		#		#		#	
Tested Raw Material			1												*1*	
Core	1		19		7		2								*29*	
Bifacial Blank	1		20		1		2								*24*	
Bifacial Preform			5												*5*	
Projectile Point			9				2								*11*	
Drill			2												*2*	
Flake Tool	1		33		5		1								*40*	
Scraper			10												*10*	
Chopper	3				3				1						*7*	
Anvil	1														*1*	
Hammerstone	5						3								*8*	
Pestle					1										*1*	
Tool Total	*12*		*99*		*17*		*10*		*1*		*0*		*0*		*139*	

* Rhyolite group includes coarse- and fine-grained volcanics and other unidentified raw materials.

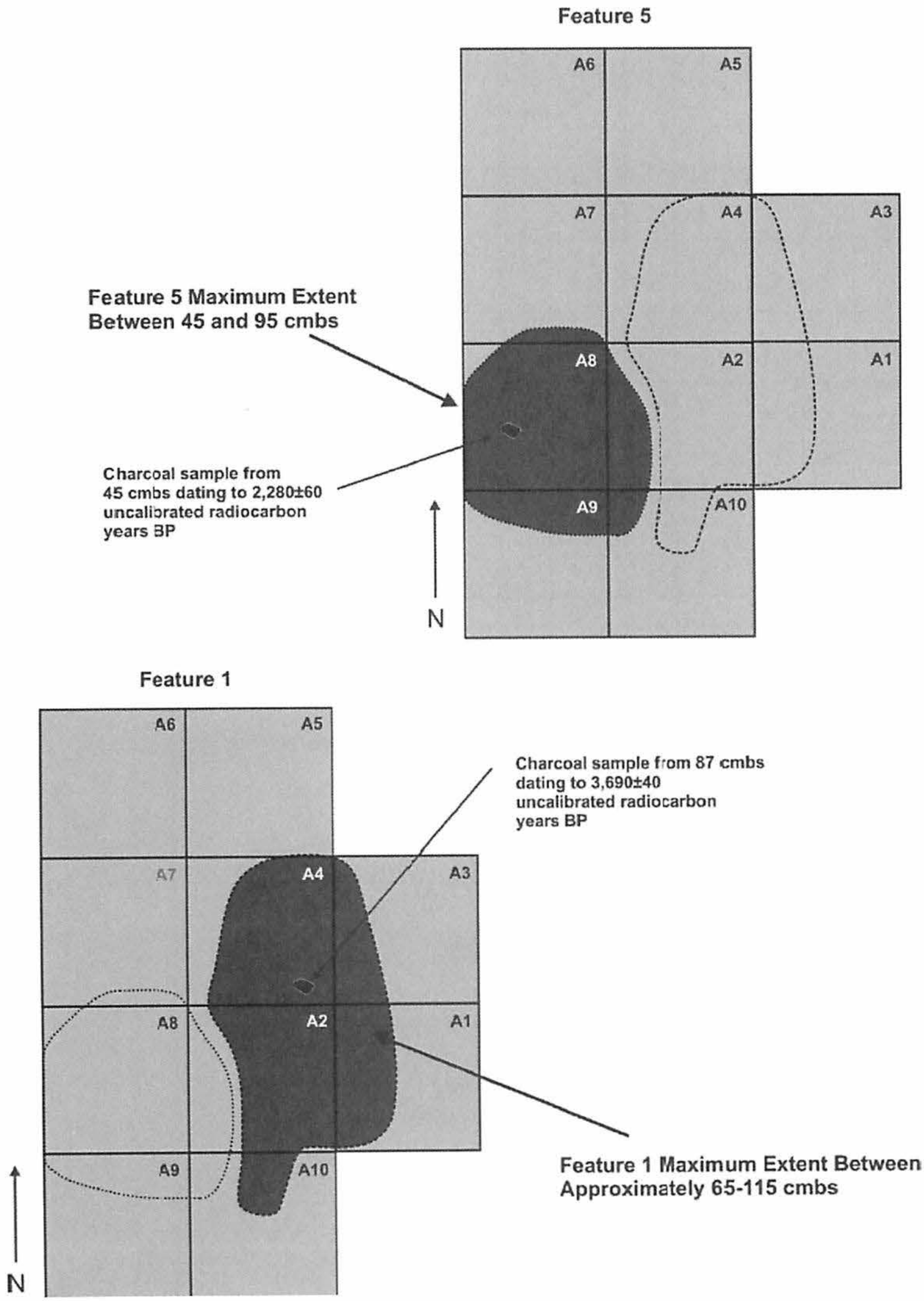


Fig. 6. Approximate maximum extents of Feature 1 and Feature 5 within 1 x 1 m excavation units (labeled A#) at 45-CL-631.

TABLE 2. FEATURE CHARACTERISTICS FROM ARCHAEOLOGICAL SITES 45-CL-631 AND 45-CL-632.

45CL631 Feature	Depth (cm below surface)	Maximum Diameter (cm)	Artifact Counts: Tools	Debitage	FMR	Total Artifacts	FTIR results	Uncalibrated Radiocarbon Years BP	Associated Stratigraphic Layer(s)	Associated Parent Material	Interpretation
1	65-115	220	19	491	12	522	nuts, seeds, berries, possible camas, small to large mammals, fish, bird	3690±40	4	1	fire pit or series of pits
5	45-95	150	14	373	45	432	nuts, small mammals, fish, turtle	2280±60	3	2	hearth or camp fire

45CL632 Feature	Depth (cm below surface)	Maximum Diameter	Artifact Counts: Tools	Debitage	FMR	Total Artifacts	FTIR results	Uncalibrated Radiocarbon Years BP	Associated Stratigraphic Layer(s)	Associated Parent Material	Interpretation
1	18-40	31	0	17	38	55	n/a	720±40	1,2,3	1	hearth or cooking feature
2	80-130	>100	0	7	23	30	nuts, seeds, berries, small animal, bird	7100±40	4	2	fire pit or roasting pit
3	75-120	>95	0	0	3	3	nuts	3760±40, 3820±40,	4	2	fire pit or roasting pit
4	35-45	65	1	0	19	20	n/a	not dated	3	1	hearth or cooking feature
5	35-42	34	0	0	10	10	n/a	not dated	3	1	component of Feature 4?
7	37-55	38	0	0	9	9	nuts, seeds, large and small animals	1640±40	2, 3	1	hearth or fire pit
8	95-132	124	1	0	43	44	nuts, seeds, large and small game, bird	3820±40	3,4	1,2	fire pit or oven
9	120-137	35	0	0	9	9	n/a	not dated	3	1	fire pit

TABLE 2. CONTINUED

45CL632 Feature	Depth (cm below surface)	Maximum Diameter	Artifact Counts: Tools	Artifact Counts: Debitage	Artifact Counts: FMR	Artifact Counts: Total Artifacts	FTIR results	Uncalibrated Radiocarbon Years BP	Associated Stratigraphic Layer(s)	Associated Parent Material	Interpretation
11	41-74	90	0	2	23	25	n/a	not dated	2,3	1	hearth or fire pit
14	80-120	90	1	1	61	63	lily (camas?), nuts, seeds, large to small mammals, birds, fish	7150±50	4	2	earth oven
17	0-67	120	3	3	179	185	nuts, seeds, berries, large to small animals, fish	1490±40	1,2,3	1	earth oven
18	10-60	100	5	143	97	245	nuts, seeds, large and small animals, turtle	1500±40	1,2,3	1	hearth or camp fire
19	65-100	75	0	1	0	1	n/a	not dated	3	1	fire pit

The artifact assemblage from Feature 5 indicates a variety of tasks took place at the location in association with the feature (Table 2). The artifacts found associated with Feature 5 included 14 stone tools, 373 flakes, and 45 fragments of FMR. The tools were classified as 2 cores, 5 bifacial blanks, 1 bifacial preform, 1 projectile point, 2 flake tools, 2 cobble choppers, and 1 hammerstone. The projectile point is the proximal portion of a lanceolate form that resembles the Cascade type in all respects, although it is relatively small and thin in cross-section. FTIR analysis suggests that large and small game, nuts, fish, and perhaps turtle were cooked in the feature (Table 3). Feature 5 originates in Stratigraphic Layer 3 and was created by the excavation of sediments that extended into both Stratigraphic Layers 4 and 5. It is therefore associated with Parent Material 1 (Fig. 4). A charcoal sample extracted from Feature 5 at a depth of 45 cm below the ground surface returned an age of 2280±60 uncalibrated radiocarbon years BP (Beta-236479, calibrated 2-sigma date range of 2150 to 2360 calibrated radiocarbon years BP) (Table 4).

In summary, nearly 4,000 artifacts were recovered during data recovery excavations at site 45-CL-631. The distribution of artifacts with depth at 45-CL-631 included at least two peaks in artifact numbers (Fig. 7). The first peak occurred in association with Stratigraphic Layers 1, 2, and 3, at a depth of approximately 35 cm below the ground surface. The second peak appeared in Stratigraphic Layer 4 materials, at a depth of approximately 65 cm below surface. A third peak in artifact densities occurred at a depth of approximately 95 cm below surface and may represent an even older component, associated with Stratigraphic Layer 5. The two pit features discovered at 45-CL-631 appeared to be associated with particular stratigraphic layers, as well, based on correlation of sediments at the upper rim of each feature. Feature 5 appears to be associated with Stratigraphic Layers 1, 2, and 3 (Parent Material 1) and Feature 1 appears to be associated with Stratigraphic Layer 4 (Parent Material 2).

Analysis of the lithic subassemblages from 45-CL-631 associated with the two fire pit features (Features 1 and 5) and three sedimentary parent materials that contained artifacts (Parent Materials 1, 2, and 3) revealed generally similar overall technological patterns (Table 5). In general, the same types and proportions of raw materials, debitage classes, and tool types are represented in all of the samples. This appears to reflect use of similar stone sources and performance of the same kinds of activities throughout the period of site occupations.

Identification of faunal remains from archaeological deposits at 45-CL-631 indicates that small and large mammals were processed at the site, although the role that these resources played in the subsistence system of the site occupants is not clear. FTIR analysis on archaeological artifacts and sediments from the site suggest that activities at the location included collection of vegetable foods, including nuts, seeds, berries, and possibly camas. Birds and fish also were procured at or near the site, as were small to large mammals.

Radiocarbon age ranges from charcoal samples extracted from the two cultural features at the site indicate a long history of use of the location by humans, beginning at least 3910 to 4150 cal yr BP. An additional radiocarbon date returned on charcoal found at a depth of 109 cm below the ground surface in association with more deeply buried artifacts in the excavations at 45-CL-631, from Stratigraphic Layer 5 (Parent Material 3), suggests occupation of the location by humans may have begun as early as 7590 to 7700 cal yr BP (Table 4).

TABLE 3. SUMMARY OF FTIR ANALYSIS FROM ARCHAEOLOGICAL SITES 45-CL-631 AND 45-CL-632.

Site	Feature	Date (uncalibrated yr BP)	Depth (cm below surface)	Artifact Type	Dominant Vegetation	Dominant Seeds/Nuts	Dominant Animal	Notes
45CL631	Feature 1	3690+-40	94	Flake tool		Seeds	Large game, bird	Sparse signature
			85-95	Dart-size projectile point			Bird, fish, turtle, possible small to large mammal	
			95-105	Scraper		Nuts	Large mammal, fish	Evidence for fruits, other plants limited
			105	Soil sample	Yucca-type (Camas), Opuntia (cactus)	Nuts, seeds, fruits (berries)	Large to medium mammal	
			112	Fire modified rock		Oily nuts and seeds	Turtle, possible small to large game	
			104	Cobble				Little evidence of matches
			125-135	Flake tool		Nuts and seeds	Possible processing of animals	Proteins present; may not be associated with feature
			130-148	Hammerstone		Nuts and seeds	Possible processing of animals	May not be associated with feature
45CL631	Feature 5	2280+-60	55	Chopper		Nuts, Seeds	Large to small mammals possible turtle	
			65	Cobble		Nuts, Seeds	Large to small mammal, possible turtle, possible fish	
			75	Fire modified rock			Small mammal, possible fish	
45CL632	Feature 2	7100+-40	110	Fire modified rock		Nuts, seeds, fruit	Possible medium mammal, bird, and turtle	
45CL632	Feature 3	3760+-40, 3820+-40	75-120	Fire modified rock		Nuts		
45CL632	Feature 7	1640+-40	37-55	Fire modified rock		Nuts, oily seeds		Many protein peaks, but few matches
45CL632	Feature 8	4680+-50	95-132			Nuts and oily seeds	Large to small mammal, bird	Blood matches suggest meat processing
45CL632	Feature 14	7150+-50	80-120	Soil sample	Carbohydrate-rich plants (camas?)	Nuts and oily seeds	Large game, birds, fish	
			106	Flake tool		Nuts and oily seeds	Medium to small mammal, fish, otter	Blood matches indicate general meat processing
			80-120	Fire modified rock		Nuts	Deer, fish	Protein matches rare
45CL632	Feature 17	1490+-40	23-33	Fire modified rock		Nuts and oily seeds, fruit	Variety	Many animal blood matches suggest cooking a variety of meats
			23-33	Fire modified rock		Nuts and oily seeds, fruit		Bison fat, fish oil matches may be part of general lipid signature
45CL632	Feature 18	1500+-40	10-50	Fire modified rock		Nuts and oily seeds	Large mammal, turtle	Blood matches suggest meat processing in feature

TABLE 4. RADIOCARBON DATING RESULTS FOR 45-CL-631 AND 45-CL-632.

ARCHAEOLOGICAL SITE 45CL631

Feature Number	Sample ID	Beta-Number	Material Dated	Uncalibrated age BP	Calibrated age BP	Depth (cmbs)*
5	45CL631-161-1	236479	Charred material	2280±60	2150 to 2360	45
1	45CL631-123-1	236477	Charred material	3690±40	3910 to 4150	87
	45CL631-67-1	236476	Charred material	5950±40	6670 to 6890	95
	45CL631-126-3	236478	Charred material	6820±40	7590 to 7700	109

ARCHAEOLOGICAL SITE 45CL632

Feature Number	Sample ID	Beta-Number	Material Dated	Uncalibrated age BP	Calibrated age BP	Depth (cmbs)*
1	45CL632-123-1	236481	Charred material	720±40	570 to 580 and 650 to 700	10-20
17	45CL632-88-1	23480	Charred material	1490±40	1500 to 1500 1470 to 1490 and 1300 to 1420	28-36
18	45CL632-141-2	23482	Charred material	1500±40	1310 to 1430 and 1460 to 1510	16-20
7	45CL632-237-1	236486	Charred material	1640±40	1420 to 1620	40-45
3	45CL632-210-1	236484	Charred material	3760±40	4060 to 4240 and 3990 to 4050	78-80
3	45CL632-212-1	236485	Charred material	3820±40	4090 to 4400	93
8	45CL632-88-1	236487	Charred material	4680±50	5510 to 5580 and 5310 to 5490	114-117
2	45CL632-141-2	236483	Charred material	7100±40	7850 to 7990	112-119
14	45CL632-270-2	236488	Charred material	7150±50	7930 to 8030 and 7870 to 7890	81-83

* cmbs = centimeters below the original ground surface level, prior to mechanical scraping.

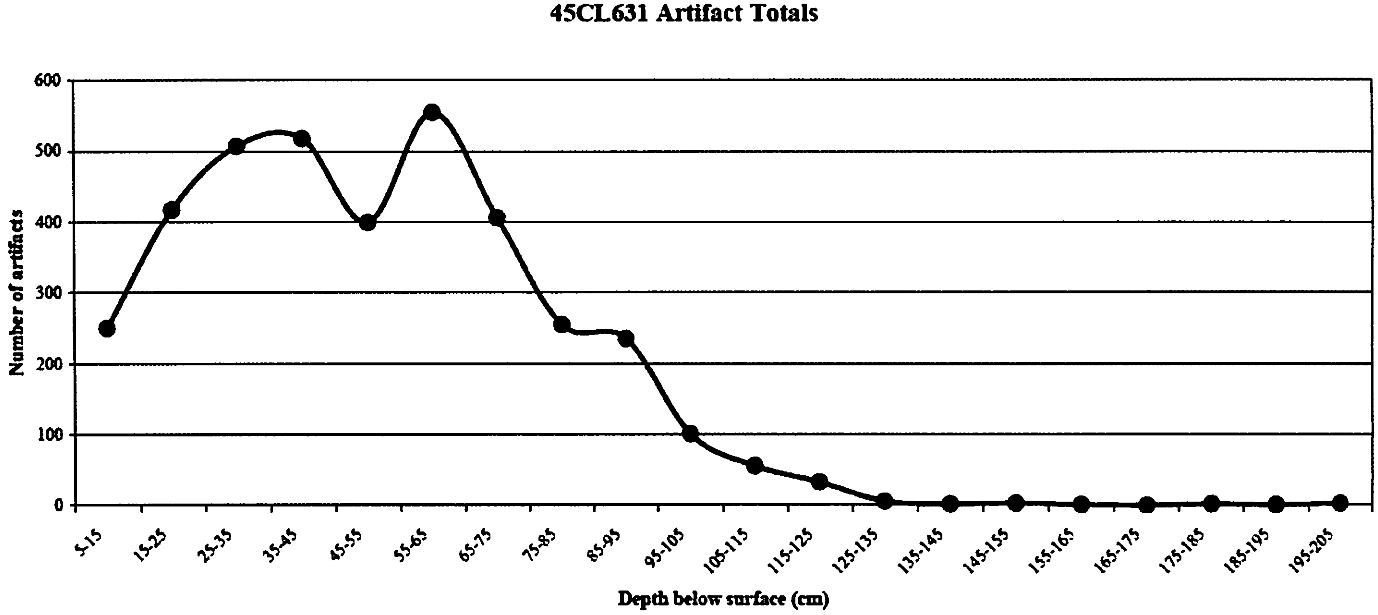


Fig. 7. Distribution of artifacts with depth at 45-CL-631.

TABLE 5. LITHIC TECHNOLOGICAL VARIABILITY BETWEEN LITHOSTRATIGRAPHIC LAYERS AND FEATURES AAT 45-CL-631.

	LITHOSTRATIGRAPHIC LAYERS			FEATURES	
	PM1	PM2	PM3	F1	F5
# Tools	54	28	4	19	14
# Flakes	1721	744	153	491	373
Ratio of Flakes to Tools	32:01:00	27:01:00	38:01:00	26:01:00	25:01:00
# Tools and Flakes	1775	772	157	510	387
% CCS	78%	71%	54%	63%	65%
% Basalt	11%	16%	20%	20%	16%
# Diagnostic Flakes	715	323	68	203	143
% Early-Stage Core Reduction	10%	12%	9%	9%	8%
% Late-Stage Core Reduction	26%	23%	34%	31%	33%
Ratio of Early to Late Core Reduction	1:03	1:02	1:04	1:03	1:04
% Early-Stage Bifacial Thinning	25%	26%	25%	33%	27%
% Late-Stage Bifacial Thinning	6%	8%	4%	6%	5%
Ratio of Early to Late Bifacial Thinning	4:01	3:01	6:01	6:01	5:01
% Early-Stage Pressure	13%	15%	16%	10%	10%
% Late-Stage Pressure	19%	16%	12%	10%	17%
Ratio of Early to Late Pressure	01:01.4	1:01	01:00.7	1:01	01:01.8

45-CL-632

Archaeological monitoring and excavations at site 45-CL-632 resulted in the recovery of over 500 lithic flakes and tools (Table 6). Additionally, a total of 13 archaeological features were identified and excavated during the construction monitoring and related archaeological investigations at 45-CL-632 (Fig. 2).

The features discovered during the archaeological work at site 45-CL-632 represent multiple types of fire-related facilities, including cooking pits, drying or roasting pits, and hearths or camp fires (Table 2). FTIR analysis on artifacts recovered from the features suggests a variety of resources were processed at the site (Table 3). The features were found at various depths beneath the surface and date to between 570 and 8030 cal yr BP (Table 4). The discussion below presents four of the most intact, representative features discovered at the site that help to illustrate this variety in feature form, function, and age.

Feature 14

Feature 14 consisted of tightly-clustered FMR associated with charcoal and burned earth revealed after the ground surface had been angle-cut with a mechanical scraper (Fig. 8; Table 2). The feature contained a total of 61 pieces of FMR mapped in place, some smaller FMR fragments recovered from the screen, a basalt flake, and a CCS flake tool. Charcoal and burned earth were found within and surrounding the feature. FMR associated with the feature displayed a roughly bowl-shaped distribution in profile, with some of the FMR pieces tipped at angles that suggested they had originally leaned against the perimeter wall of a basin or pit.

Two artifacts and a single bulk sediment sample were submitted for FTIR analysis (Table 3). Analysis using FTIR on the sediment sample from the feature indicated the presence of carbohydrate-rich foods in the cactus or lily families, probably camas. Matches with oily seeds and nuts were also abundant, as were proteins from large game animals, birds, and fish. FTIR results from a CCS flake tool and FMR suggested that the flake was used for processing meat, with matches including small mammals and fish, and that the FMR had come into contact with nuts and large mammals. These results suggest that the feature was used to process a variety of foods, including meat, seeds, nuts and possibly camas.

The FMR, flake, and tool were distributed from the top of the unit at an elevation of 80 cm below surface to a maximum depth of 120 cm below surface. Because the upper portion of Feature 14 had been truncated by construction activities, it is not clear within which stratigraphic layer the feature originated. However, the feature appeared to have been dug down into Stratigraphic Layer 5 and likely originated in the upper levels of this stratum. A charcoal fragment extracted from the feature was submitted for AMS radiocarbon dating and returned an age of 7,150±50 uncalibrated radiocarbon years BP (Beta-236488, calibrated 2-sigma date range of 7870 to 7890 or 7930 to 8030 calibrated radiocarbon years BP) (Table 4).

Based on the morphology of the feature and the characteristics of the constituent FMR, the feature appears to represent an earth oven or open fire pit. Charcoal and burned earth under and between the FMR fragments are consistent with the placement of feature rocks over a fuel source. The fuel and rocks appear to have been placed in a shallow pit and the rocks heated. The facility may have been capped by a layer of sediment to form an oven (Thoms 2008), but most of the overlying sediment was mechanically scraped from the area prior to the discovery of the feature.

However, the distribution of many smaller diameter FMR fragments and spalls at a slightly higher elevation and surrounding the feature may be evidence of the removal of the food resource from the oven and clean-out of rock.

Feature 3

Although part of Feature 3 was mechanically removed by construction scraping prior to archaeological excavation, enough of the feature remained in the cut bank to determine that originally it was basin-shaped (Fig. 9; Table 2). No linear extensions were apparent in the cross section of the feature and its basin shape was well-defined, suggesting the burning of tree roots was not responsible for the creation of the feature. The feature consisted primarily of highly reddened, burned earth and charcoal. Only three pieces of FMR and no flaked-stone artifacts were found in association with the feature. The highest concentration of burned earth and charcoal was found towards what appeared to be the center of the basin, at approximately 100 cm below the ground surface, where the largest piece of FMR also was found. This piece of FMR was submitted for FTIR analysis and returned a prominent signal of nuts (Table 3).

As with Feature 14, because the upper portion of Feature 3 had been mechanically removed prior to its discovery, it is difficult to determine the feature's stratigraphic association. However, most of the sediments encountered in the upper portion of the Feature 3 excavation were consistent with Stratigraphic Layer 4 and the feature appeared to have been dug down into Stratigraphic Layer 5 (Fig. 10). The feature extended from at least 75 cm below surface to a depth of approximately 120 cm below surface.

Charcoal was extracted from two sediment samples recovered from the feature at depths of 98–100 cm and 113 cm below surface. An AMS radiocarbon date returned on the charcoal from the upper sediment sample dated to 3760±40 uncalibrated radiocarbon years BP (Beta-236484, calibrated 2-sigma date range of 3990 to 4050 and 4060 to 4240 calibrated radiocarbon years BP). An AMS radiocarbon date returned on the charcoal from the lower sediment sample dated to 3820±40 uncalibrated radiocarbon years BP (Beta-236485, calibrated 2-sigma date range of 4090 to 4400 calibrated radiocarbon years BP) (Table 4).

This feature may have represented a fire pit or earth oven that was filled with fuel and burned with little use of rock for heat retention give the small amount of associated FMR. Such a feature may have been used for processing a resource that did not require an extended cook time. The presence of nut oils on the FMR recovered from the feature suggests it may have been used as a nut roasting pit. Alternatively, the fire may have been used to heat rocks that were then transferred to nearby features, such as described by Thoms (2008) for some earth ovens, steaming pits, or stone-boiling pits.

Features 18 and 2

A 1 x 1 m test unit was placed over a cluster of rocks identified as Feature 18. Because artifacts continued to be encountered in the test unit below the depth of Feature 18, excavation continued and a second feature, non-consecutively numbered Feature 2, was encountered at approximately 80 cm below surface (Fig. 10). Feature 18 consisted of a loose cluster of FMR, burned earth, charcoal, and lithic artifacts noted at the level of the scraped surface (Table 2). Artifacts associated with the feature included 97 pieces of FMR, 143 CCS flakes, and 5 tools. The

TABLE 6. SUMMARY OF LITHIC DEBITAGE AND STONE TOOL ANALYSIS DATA FOR 45-CL-632.

	QUARTZITE/ GRANITE		CCS/ PET. WOOD		BASALT		RHYOLITE GROUP*		SILTSTONE		QUARTZ		OBSIDIAN		*TOTAL*	
DIAGNOSTIC DEBITAGE	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Bipolar Core Reduction															*0*	*0%*
Early-Stage Core Reduction	3	20%	5	6%	5	17%									*13*	*10%*
Late-Stage Core Reduction	11	73%	7	9%	5	17%	3	43%							*26*	*19%*
Early-Stage Bifacial Thinning			23	28%	11	37%	2	29%					1	100%	*37*	*28%*
Late-Stage Bifacial Thinning	1	7%	16	20%	6	20%	2	29%							*25*	*19%*
Early-Stage Bifacial Pressure			8	10%	1	3%		0%							*9*	*7%*
Late-Stage Bifacial Pressure			22	27%	2	7%		0%							*24*	*18%*
Diagnostic Debitage Subtotal	*15*	*100%*	*81*	*100%*	*30*	*100%*	*7*	*100%*	*0*		*0*		*1*	*100%*	*134*	*100%*
UNDIAGNOSTIC DEBITAGE	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	
Percussion Flake Fragments	12		95		32		13				1				*153*	
Indeterminate Technology			15												*15*	
Thermal			11												*11*	
Undiagnostic Debitage Subtotal	12		120		32		13				1		0		*178*	
Debitage Total	*27*		*201*		*62*		*20*		*0*		*1*		*1*		*313*	
TOOLS	#		#		#		#		#		#		#		#	
Core			4												*4*	
Bifacial Blank			4		2		1								*7*	
Bifacial Preform			1												*1*	
Projectile Point			3		1										*4*	
Flake Tool	2		15		2		3								*22*	
Scraper			7												*7*	
Knife					1										*1*	
Chopper	13				11		6								*30*	
Flaked Cobble					2		1								*3*	
Anvil					1										*1*	
Hammerstone	7						1								*8*	
Pestle															*0*	
Tool Total	*22*		*34*		*20*		*12*		*0*		*0*		*0*		*88*	

* Rhyolite group includes coarse- and fine-grained volcanics and other unidentified raw materials.

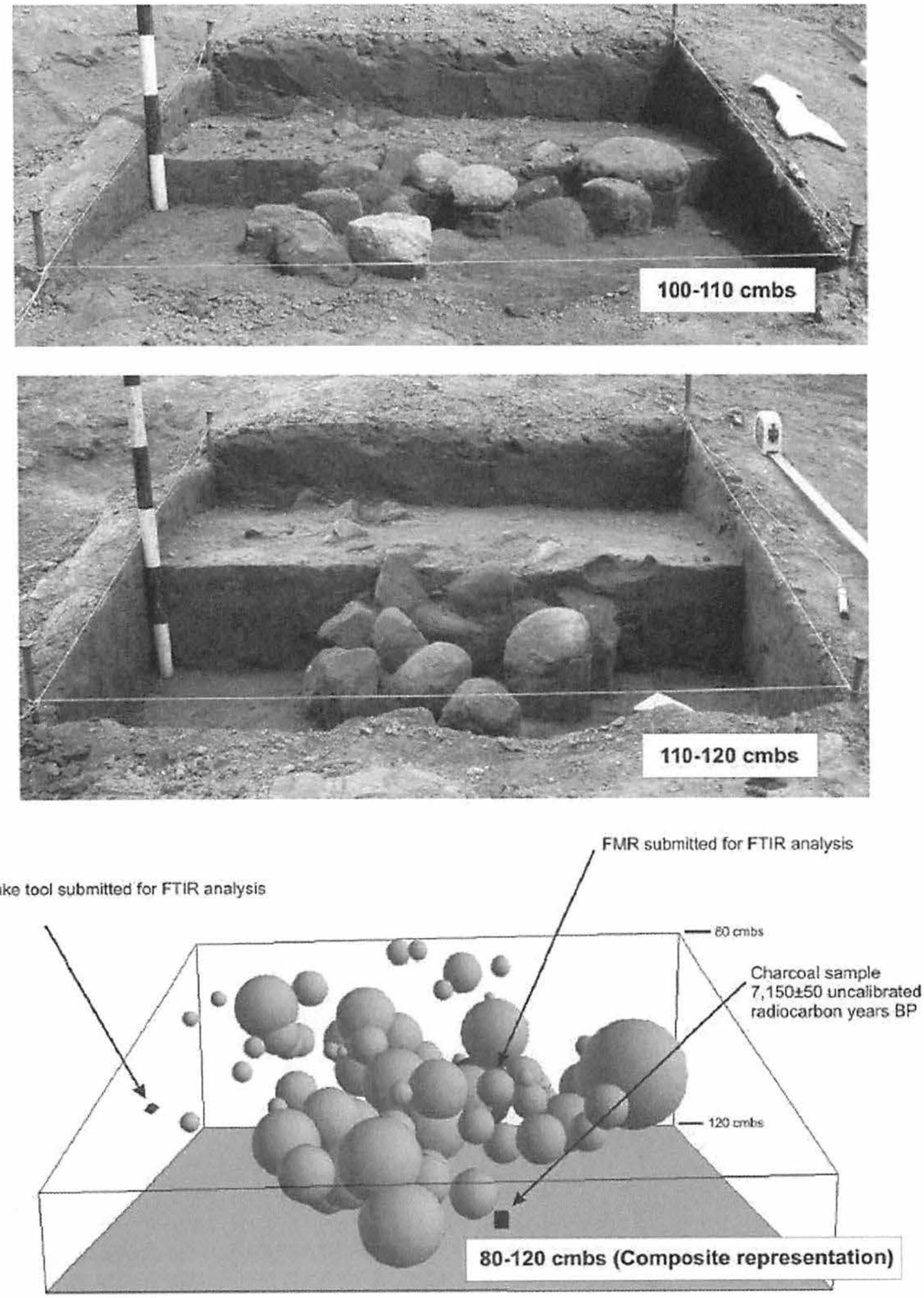


Fig. 8. Feature 14 within 1 x 1 m excavation unit viewed from outside the unit. The slope had been mechanically cut prior to discovery of the feature within 45-CL-632. In the composite representation, each piece of FMR is represented in the unit as a sphere with its average diameter assigned to the diameter of the sphere. Excavation unit and FMR sizes are proportional.

tools included a blank, a scraper, and three flake tools. The artifacts and burned materials extended from the scraped surface to a depth of approximately 60 cm below surface. Altogether, the flaked stone tools and debitage found in association with Feature 18 demonstrate a consistent technological pattern from top to bottom. This pattern appears to represent both production and resharpening of bifacial tools.

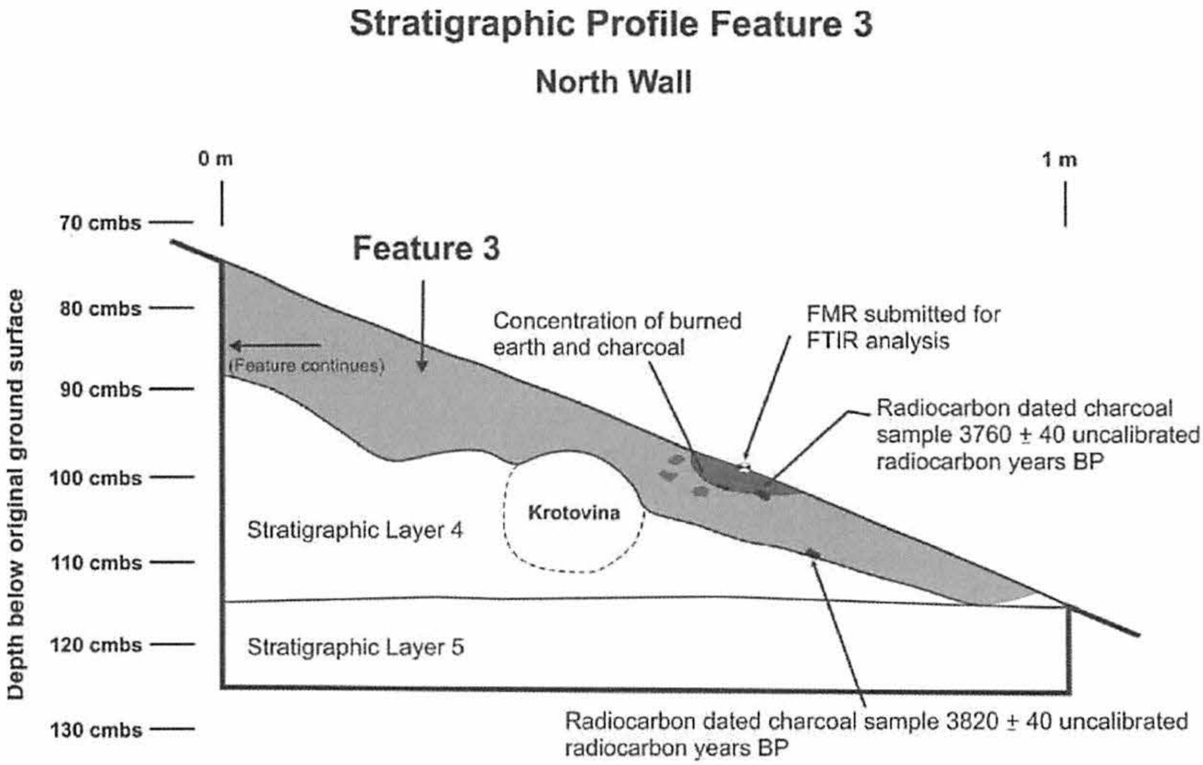
The FMR fragments associated with Feature 18 were highly fractured and small in size. These attributes suggest that the FMR associated with the feature had been re-used often. However, the percentage of spalls in the assemblage was low, suggesting that if the FMR was re-used in place, the feature had been well-maintained and frequently cleaned. A single artifact, an FMR fragment, was submitted for FTIR analysis (Table 3). Results indicate the processing of nuts and oily seeds in the feature, as well as large and small animals. The many organic residues detected on the FMR indicate that this feature was used to process a variety of food resources. The relatively small size of the feature and the number and types of associated flaked-stone artifacts suggest that this feature was used in a residential setting, probably as a cooking fire or hearth. Feature 18 is associated with Stratigraphic Layers 1, 2, and 3, which are thought to correspond to the uppermost parent material, Parent Material 1. A single AMS radiocarbon date returned on charcoal from the feature dated to 1500±40 uncalibrated radiocarbon years BP (Beta-236482, calibrated 2-sigma date range of 1310 to 1430 and 1460 to 1510 calibrated radiocarbon years BP) (Table 4).

Feature 2, discovered directly below Feature 18 approximately 80 to 90 cm below the ground surface, was first identified by an area of reddened sediment and high concentrations of charcoal in the southeastern portion of the 1x1m excavation unit (Fig. 10; Table 2). The feature had a roughly bowl—or pit—shaped morphology in profile and stratified sediment layers within the feature. The greatest number of flaked-stone artifacts was recovered in these upper layers, near to the rim of the pit feature. Lower in the feature, the sediment appeared lighter in color than the overlying and underlying sediment and likely represented a weathered, ash-rich deposit. Below this, the sediment was highly burned and oxidized and may have been directly below or within the hottest portion of the fire. FMR appeared most commonly in the lower and middle sediment layers.

The flaked-stone artifact assemblage associated with Feature 2 was small and therefore difficult to interpret (Table 2). In total, 28 pieces of debitage and no tools were recovered in association with Feature 2. Generally, the assemblage matched the character of the debitage from Feature 18 representing a variety of bifacial stone tool manufacturing and maintenance activities.

A total of 23 FMR fragments was recovered in sediments identified as Feature 2. All of the FMR was extremely small in size; the total weight of these fragments was 5 g and their average diameter was 1.25 cm. It is possible that most of the rock used in association with the feature was removed after use and re-used in another feature, leaving behind small fragments of FMR that had broken during firing. Alternatively, like Feature 3, the function of this feature may not have required extensive use of rock as part of the heating and cooking process. Residue analysis of a piece of FMR suggests that oily or fat-rich plant foods such as nuts or seeds were processed in the feature. Fruits may also have been present. Matches to blood residues included small animals and turtle (Table 3).

The Feature 2 pit was dug into Stratigraphic Layer 5 and appeared to originate in the upper portion of Stratigraphic Layer 5. A single AMS radiocarbon date returned on charcoal from the feature dated to 7100±40 uncalibrated radiocarbon years BP (Beta-236483, calibrated 2-sigma date range of 7850 to 7990 calibrated radiocarbon years BP) (Table 4).



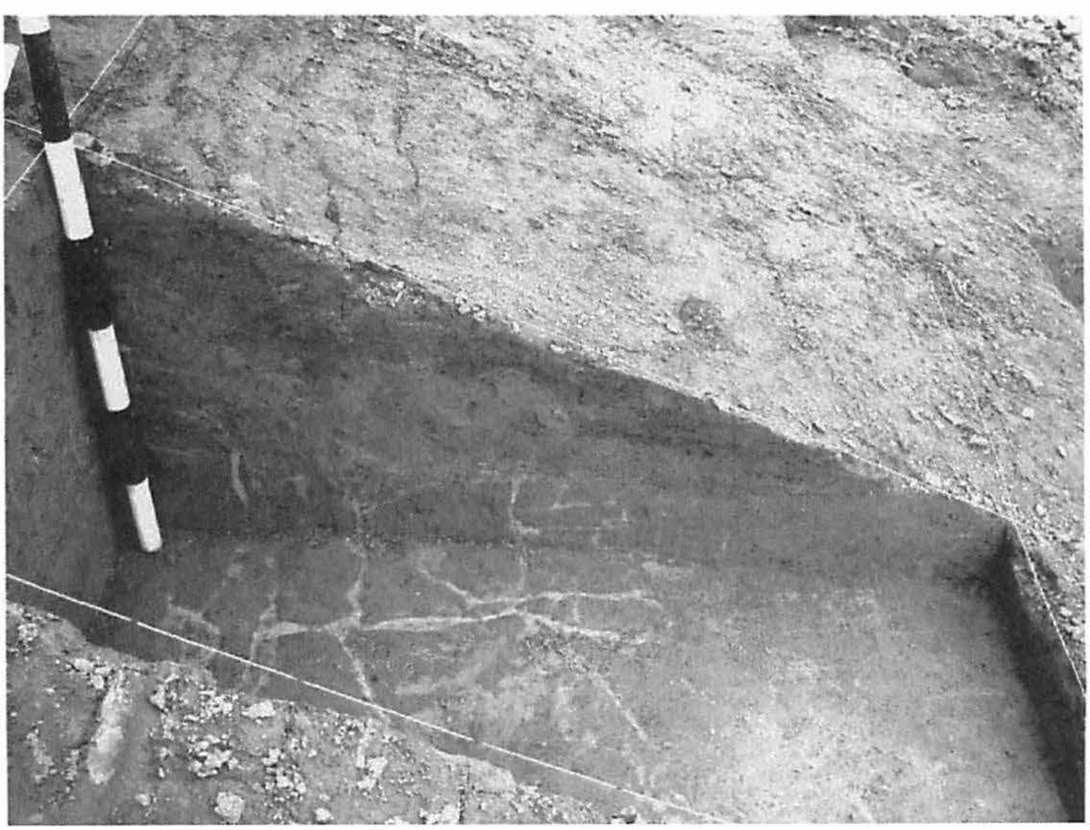
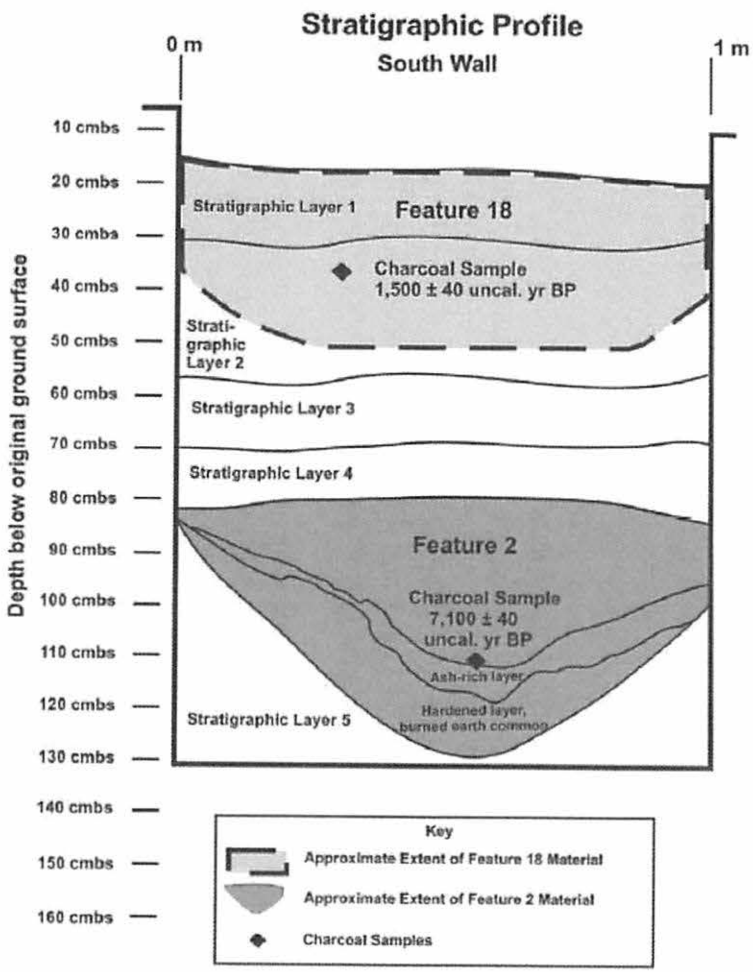
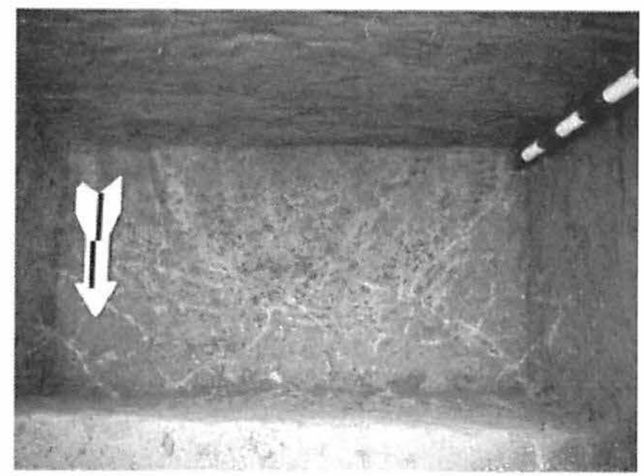


Fig. 9. Profile view of Feature 3 found within archaeological site 45-CL-632.



Feature 18 at 30 cm below surface.



Feature 2 at 100 cm below surface.

Fig. 10. Features 18 and 2 within 1 x 1 m excavation unit in archaeological site 45-CL-632. In the Feature 2 photograph, the lighter colored, linear streaks near the base of the excavation unit represent non-cultural, soil redoximorphic features (see discussion).

In summary, the artifact assemblages encountered at 45-CL-632 were very similar in character to those encountered at 45-CL-631. It is possible that the same groups of people were using these adjacent sites for similar or shared purposes. Thirteen cultural features were discovered during the archaeological investigations at site 45-CL-632. These features were morphologically diverse, were composed of varying amounts of flaked-stone artifacts and FMR, dated to between 570 and 8,030 years ago, and appeared to have been used to process a wide variety of resources. As with site 45-CL-631, archaeological deposits within site 45-CL-632 were associated with Stratigraphic Layers 1 through 5, which represent three different parent materials. At both sites, many of the archaeological features were buried beneath thick sedimentary deposits. Radiocarbon dates on charcoal associated with features found at the site suggest a long history of human use of the landscape.

Discussion

Stone Tool and Feature Technology

The debitage and flaked stone tools encountered at the Gee Creek sites reflect a manufacturing pattern that emphasizes use of durable, local toolstones and opportunistic core reduction techniques to produce a few linear flake blanks for bifacial reduction into lanceolate projectile points and, more commonly, flake blanks of various shapes and sizes for use as flake tools or reduction into other tools. Like most prehistoric archaeological sites in southwestern Washington, lithic raw materials used for flaked stone tools at the Gee Creek sites were predominantly of CCS composition (about 70% of the whole assemblage). However, the assemblage was more characteristic of early Holocene archaeological sites in that igneous stone, particularly basalt, rhyolite, and other unidentified volcanic materials, accounted for a substantial portion of the assemblage (nearly 20%). All of these materials are available from local stream gravel deposits. The common incipient cone cortex on artifacts and on the FMR indicates procurement from an alluvial context, probably the ancestral Columbia River gravels in the Troutdale formation or portions of the Pleistocene Missoula Flood gravel deposits, both of which are exposed in Gee Creek and its tributaries in the area of the Gee Creek sites.

Core reduction is represented by about one-third of the diagnostic lithic debitage at both sites and by 29 cores and 1 piece of tested raw material at 45-CL-631 and by 4 cores at 45-CL-632. Bifacial reduction of blanks, preforms, or tools is represented by 62% and 72% of the diagnostic debitage recovered from 45-CL-631 and 45-CL-632, respectively. This is a substantial proportion of the flaked stone artifacts and corroborates the inference that local materials were reduced at both sites.

The bifacial reduction debitage included relatively high proportions of early-stage percussion bifacial thinning flakes and low proportions of late-stage percussion bifacial thinning flakes indicating little systematic thinning of bifaces, especially at 45-CL-631. Since abundant late-stage percussion bifacial thinning debitage is characteristic of production for dart-sized (large) bifacial tools, its scarcity at 45-CL-631 is somewhat puzzling given that most of the bifacial blanks, preforms, and points were identified as dart-sized implements. The limited use of systematic bifacial thinning may reflect the nature of the generally thick Cascade points and their reduction from linear flakes. The relatively large proportion of late-stage pressure bifacial reduction flakes identified in the assemblages from both sites was indicative of repair and maintenance of projectile points and other bifacial tools. However, the overall small number of these flakes, coupled with the small number of discarded projectile points (n = 15 from both sites combined) reflects limited use of these sites as base camps for hunting forays.

Choppers are cobble tools that have been percussion flaked to form a sharp bit and are thought to be used in a variety of heavy processing tasks such as wood working (Wessen and Daugherty 1983; Roulette 1989). Although only 38 choppers were collected from the two sites (7 from 45-CL-631 and 31 from 45-CL-632), many additional choppers were discovered during construction monitoring but were not collected. Choppers appear to have been an important tool type at both sites and are probably related to processing of materials that are critical to site function. Given the number of fire-related features discovered at the sites, this abundance of wood-processing equipment may reflect gathering and preparation of fire wood or wood for other elements of food processing equipment, such as racks or stakes.

Ground stone tools are lithic artifacts manufactured by being pecked or ground, or are tools used for pounding or grinding other materials. Eight alluvial cobble hammerstones exhibiting battering wear from use in flintknapping and/or pounding other materials were recovered from the sites. One of the hammerstones from 45-CL-632 exhibits battering damage characteristic of use as a pecking tool for the manufacture of pestles or other ground stone tools. One anvil from each site was probably used during flintknapping or plant processing in conjunction with the hammerstones.

Stone tools found at the Gee Creek sites represent a generalized toolkit containing a variety of basic functional types (choppers, scrapers, drills, projectile points, flake tools, and hammerstones) common to many middle Holocene sites. The lithic assemblage also represents many stages of reduction from tested raw materials (early-stage cores) to refurbished and exhausted tools, along with intermediate-stage byproducts representing a variety of flaked stone and ground stone industries. This generalized toolkit meets expectations for foragers—hunter-gatherers who move their residence to the location of seasonally available resources and subsist primarily on fresh foods rather than stored foods. In theory, a generalized toolkit facilitates this type of settlement and mobility where camps house entire bands and many different group maintenance activities occur to provide shelter, clothing, food, socialization, and other common needs.

The range in feature morphologies and associated FMR and artifact assemblages noted at the two sites highlights not only the myriad resources processed at the site, but also the variety of functions the sites and their features may have served. It appears that cook-stone technologies representing both expedient processing of resources and resource-specific cooking, drying, or roasting are represented at 45-CL-631 and 45-CL-632. Many features represent hearths or campfires that were used in residential or short-term camp settings to expediently process resources acquired in the area. These features encountered at the two sites were found in association with flaked and ground-stone artifacts, contained artifacts covered with multiple types of organic residues, were small in size, and appeared to have been used and maintained through several firings. Other features were of a much larger size, appeared to have been used less frequently but for a longer duration, contained fewer types of organic residues, and were not associated with many flaked or ground-stone artifacts. These features represent resource-specific FMR feature technologies designed for bulk processing, perhaps for winter storage. The distribution of features within the general stratigraphic profile compiled for the site is shown on Fig. 11 in relation to their calibrated ages.

Later periods within the Portland Basin are generally characterized by increasing sedentism and an economic shift from foraging to collecting (Binford 1980; Hajda 1990; Ames 1994; Ames and Maschner 1999). In settlement models for later Holocene sites, upland areas are used for special tasks, for example bulk processing of abundant resources, or are used for summer camps as bases for such processing. From the perspective of the special task site or summer camp, the change from early period foraging to later period collecting should be seen in increasing use of bulk resource processing to create a surplus for winter storage. However, based on the stone tool assemblage and features discovered at the Gee Creek sites, the pattern of prehistoric activity does not appear to change significantly over time.

Observed as a whole, the Gee Creek sites do not conform to the expectation that early sites in the area should contain archaeological assemblages and features representing primarily foraging activities, while later sites should contain evidence for more resource-specific upland use. A similar variety of earth ovens and fire pits are represented throughout time, suggesting bulk processing of resources occurred during the early occupations as well as the late occupations. Additionally, the artifact assemblages recovered in association with materials dating to the time of the earliest occupations do not change appreciably from those dating to later periods, suggesting similar activities took place through time at the Gee Creek sites.

Subsistence

Due to the poor preservation conditions in the Pacific Northwest, it is often difficult to determine the types of resources utilized at prehistoric archaeological sites in the region. Only small and fragmentary pieces of prehistoric bone were identified at the Gee Creek archaeological sites, and none of these was sufficiently diagnostic for classification beyond mammal size class. The paucity of animal bone found at the site is predominantly due to the poor preservation conditions, but may also indicate that animal hunting and processing were not the primary activities at these sites.

The lithic artifact assemblages found at 45-CL-631 and 45-CL-632 also suggest that animal hunting and processing took place at the site, but may not have been the primary activity. Relatively few pieces of lithic debitage relating to the manufacture and maintenance of hunting toolkits were found at the sites. Projectile points were few. The presence of scrapers suggests some hide preparation, but scrapers were fewer in number than projectile points. Some scrapers may have been used to process other types of foodstuffs, including vegetable or herbaceous materials. Some of the hammerstones, anvils, and a pestle fragment may represent plant food processing.

Some evidence for bulk-processing of resources at the Gee Creek sites exists in the form of the more oven-like features that were found to contain residue evidence of predominantly nuts, seeds, berries, and root crops. This may suggest the processing of items specifically for storage and use at a later season. At the Gee Creek sites, such features date to as early as 8,030 years ago, far earlier than most such bulk-processing features found in the region.

Analysis of organic residues from artifacts and sediment recovered from 45-CL-631 and 45-CL-632 suggests that a variety of resources was processed at the site (Table 3). Residues from nuts and oily seeds were found associated with nearly every feature from both of the sites. This may represent a pattern of resource use at the site, or it may represent a background signal of general environmental conditions. Either way, this residue signifies the presence of nuts and seeds in the area at the time that the land was being occupied. Fruit residues, probably berries, appeared in many of the features, as well. This residue signature does not appear to be an environmental signal, as it was detected in some features but not others dating to the same time period. Evidence of a root crop in the lily family, perhaps camas, was also detected in the residue record for two of the features. Blood residue matches with animals ranging in size from large to small mammal were noted in association with many of the features. Some of the features contained matches to turtle, fish, and bird blood, as well.

Chronology

Several analytical approaches were used to estimate the ages of prehistoric occupations at the Gee Creek sites. Charcoal from 10 of the cultural features from 45-CL-631 and 45-CL-632 submitted for AMS radiocarbon dating returned dates ranging from 570 to 8030 years BP (Table 4). The distribution of the radiocarbon dated cultural features through time is depicted in Fig. 11.

The archaeological investigations reported here recovered a single obsidian flake found during construction monitoring on the surface. An obsidian hydration rind on this flake, identified as the Obsidian Cliffs geochemical type, measured 1.5-microns thick. Based on this rind thickness, the most appropriate hydration rate formula predicts an age of about 560 years old.

Previous archaeological work at 45-CL-631 resulted in the recovery of an obsidian flake of the Buck Springs geochemical type with a similar hydration rind thickness of 1.6 microns, along with a second more diffuse rind that was 5.8 microns thick (Smith et al. 2005). Using the same hydration rate as used on the Obsidian Cliffs artifact, the rind of 1.6 microns is estimated to be approximately 640 years old while the rind of 5.8 microns is estimated to be 8,410 years old. These age estimates are probably somewhat inflated since Buck Springs obsidian is thought to hydrate more rapidly than other obsidian, though a different rate has not been calculated for Buck Springs obsidian (Smith et al. 2005).

Although archaeological sites dating to the early Holocene have been found in the region, they are rare and often not well-dated. Within the Portland Basin, the most well-known early to middle Holocene sites include the Burnett site (35-CL-96) (Burnett 1991), the Morash Terrace site (45-CL-428) (Woodward and Associates 1996; Roulette et al. 2003), the Sunset Ridge site (45-CL-488) (Ozbun and Reese 2003), and archaeological site 45-CL-54 (Tuohy and Bryan 1958-1959; Pettigrew 1990). As with the Gee Creek sites, these sites contained a range of artifact types, but lanceolate-shaped, "Cascade-type" projectile points and cobble tools commonly were found in the assemblages.

Despite a number of features and associated deposits dating to later than the middle to late Holocene, there were no artifacts found at the Gee Creek sites characteristic of later periods. There were no side-notched points and no corner-notched points typical of the later periods, and no arrow points or characteristic debitage from the manufacture of arrow-points were found. In sum, the artifact assemblage seems to be distinctive of the middle Holocene, despite ages from the sites that date to as late as 570 years ago. This may indicate that activities producing artifacts that would be typical of post-early to middle Holocene-type assemblages did not occur at the Gee Creek sites. Activities such as camping in association with game hunting forays or long-term residential occupations may not have occurred at the site after the middle Holocene. Instead, activities associated with the acquisition of vegetable foods, fish, wood, or other raw materials may have taken place. Artifacts associated with these alternative activities were either not diagnostic of age (such as cobble choppers or cores) or were made from biodegradable materials (such as wooden digging sticks, woven fishing nets, or bone tools).

Depositional History

Geological studies of the Gee Creek sites vicinity identify surface deposits as fine-grained alluvial sediment that was emplaced during the catastrophic Missoula at the end of the Pleistocene (Evarts 2004). Soil mapping of the area corroborates this interpretation suggesting that all of the soils mapped for the location were formed in late Pleistocene alluvium (McGee 1972). However, the archaeological deposits found at the Gee Creek sites challenge this interpretation. Intact archaeological features of Holocene age found at 45-CL-631 and 45-CL-632 are buried as deep as one meter or more below the ground surface. This fact suggests that sediment accumulation did not end in the area after the Missoula Floods, but rather continued throughout the Holocene.

Most post-Missoula Flood deposition within the Portland Basin has been attributed to alluviation associated with the small and large rivers and streams that flow through the basin. However, although two small, intermittent streams are located in the vicinity of archaeological sites 45-CL-631 and 45-CL-632 and Gee Creek runs along their western border, none of these water courses are responsible for the thick, fine-grained sediments that overlie many of the archaeological deposits found at the sites.

This conclusion is based on multiple factors. No post-Missoula Flood alluvial deposits were noted in any of the sediments exposed at the sites during excavations or archaeological monitoring. None of the sedimentary deposits examined in association with the archaeological materials displayed characteristics of alluvial deposition, such as bedding planes, laminated sediments, or imbricated clasts (Miall 2006). Additionally, many of the archaeological features were found near the top of a ridge that runs through the central portion of 45-CL-632. This ridge is well above the elevation of the intermittent stream that borders the site to the north (Fig. 2). Neither the intermittent drainage nor Gee Creek are at a high enough elevation or provide sufficient power to deposit alluvium atop the ridge. Deposition associated with Gee Creek would have occurred much closer to the stream channel at a lower elevation. The features and deposits found at the archaeological sites are not within the floodplain of Gee Creek.

It appears that the sedimentary deposits encountered at the Gee Creek sites represent wind-deposited aeolian materials. Although not mapped in the immediate vicinity of the Gee Creek sites, thick aeolian deposits have been identified within the Portland Basin. The "Portland Hills Silt" (PHS) is a thick, upland silt deposit that blankets much of the Portland basin. The PHS was identified as loess deriving from the Columbia River floodplain by a number of early researchers (Darton 1909; Theisen 1958). Lentz (1981:6) described the PHS as displaying the following characteristics: yellowish brown colored (10YR6/4 to 6.5/4) when unweathered or darker, reddish- or brownish-colored (10YR6/6 to 8/5) when forming a B horizon; irregular, common mottled patches of yellowish brown and reddish- or rust-orange stained silt; interconnected grayish streaks that become vertically oriented at depth, indicating relict blocky or prismatic structure; high clay content; abundant concretionary "shot;" and organic carbon relatively abundant in zones where buried A horizons would be expected.

Lawes' (1997) geochemical studies determined that the origin of the PHS was similar to that of the Palouse loess deposits of southeastern Washington, namely continental glacial material. He argued that glacial "rock flour," or finely ground rock particles, are carried downstream in the Columbia River and its tributaries and deposited along these river systems as channel-side deposits or floodplain materials (Lawes 1997:174). After their deposition, they are available for re-entrainment as loess via aeolian forces. Based on information from regional geology, soil, and stratigraphic correlations, the PHS is thought to date between 960,000 and 10,000 years ago (Lentz 1977).

The description of the PHS closely matches the deposits found at the Gee Creek archaeological sites. Gee Creek materials are composed primarily of silt and display coloring, mottling (redoximorphic features), massive structure, and concretionary shot (iron concretions) similar to the PHS. Although the extent of the PHS has been mapped primarily in the mountainous areas surrounding the Portland Basin, it is likely that such aeolian deposits are widespread throughout the uplands of the region, including the area surrounding upper Gee Creek.

The origin of the thick aeolian deposits found at the sites is unknown. Reworking of some of the fine-grained Missoula Flood sediments during the period immediately following their deposition undoubtedly occurred. The landscape at that time would have been stripped of

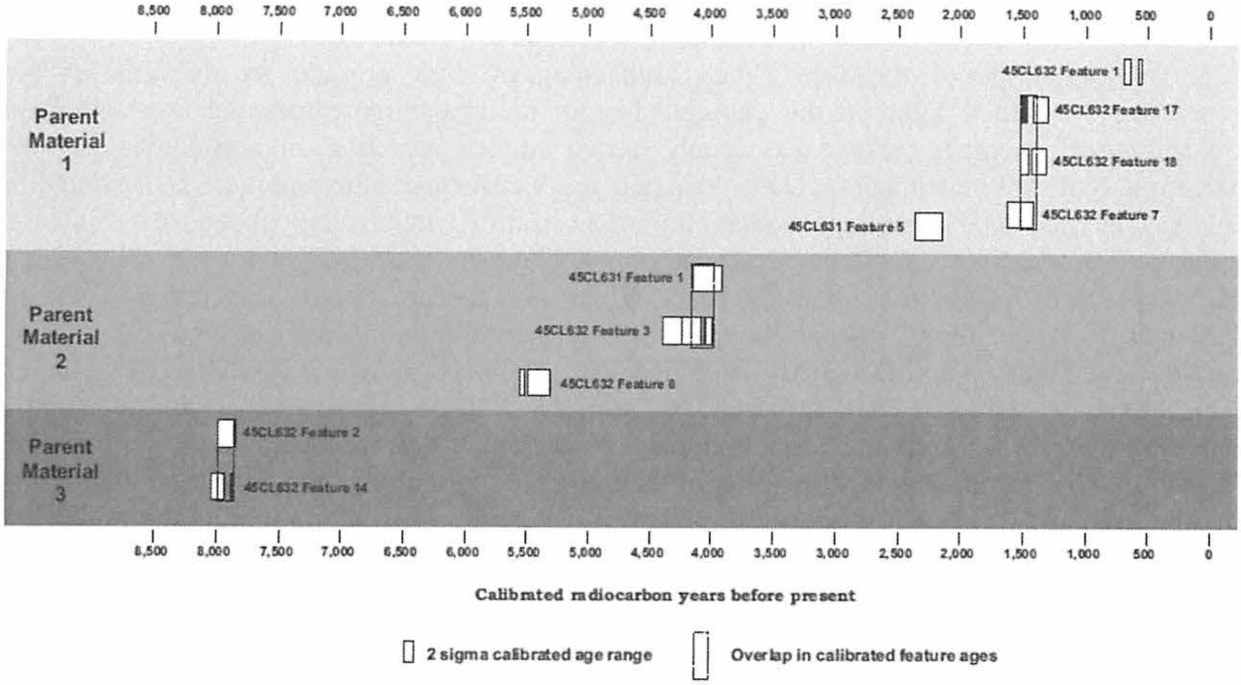


Fig. 11. Distribution of AMS radiocarbon dated features from 45-CL-631 and 45-CL-632 through time. See Table 4 for radiocarbon ages.

vegetation by the force of the floods, then buried in meters of alluvial sediment. Finer-grained sediment would have been deposited in areas further away from the Columbia River or at higher elevations. These finer-grained sediments would have been available for transport and redeposition by both water and wind. Even after vegetation was reestablished, subsequent episodes of sediment erosion and redeposition would have occurred during periods when vegetation cover was depleted such as after regional wildfires, after a flood, or during periods of extreme drought.

The timing of erosion and aeolian deposition of sediment on the landscape may be closely tied to regional wind and fire patterns. Wildfires in the vicinity of Gee Creek occurred most frequently during the early and middle Holocene and may have decimated the vegetation cover that helped to dampen active erosive forces (Fig. 3). This is the same time period during which strong westerly wind flow returned to the region (Sweeney et al. 2005). Researchers working in eastern Washington and Oregon have noted that aeolian dune deposition was heightened during the early to middle Holocene (Gaylord et al. 2001; Sweeney et al. 2005). A peak in wind strength during periods of increased sediment availability may have resulted in the deposition of thick sediments in the Gee Creek area. Later episodes of natural or human-induced burnings may have also encouraged surface erosion.

Although the archaeological record is by no means a comprehensive record of human occupation at the location, the distribution of archaeological features through time suggests periods of relative stability of the landscape when plant resources were most abundant in the area and the land was stable enough to be considered suitable for habitation or desirable for use (Fig. 11). Some archaeological deposits may have accumulated and been subsequently destroyed or disbursed during active erosive periods, as suggested by the truncated soils identified in the depositional sequence.

Conclusion

Investigations of the Gee Creek archaeological sites provide an example of how archaeology can shed light on the geologic history of deposition within the Portland Basin. Archaeological excavations revealed deeply buried cultural materials in non-alluvial settings, indicating that sediments geologically mapped as Pleistocene alluvium can be mantled by Holocene aeolian deposits and can contain important stratified archaeological deposits. Sites with low densities of artifacts, including scattered cobble choppers and FMR such as 45-CL-632, can yield a wealth of information about the past. While some researchers have interpreted sites with similar artifacts as simply "cobble chopper sites" representing woodworking or wood gathering and little else (Wessen and Daugherty 1983; Roulette 1989; Hamilton and Roulette 2002; Roulette et al. 2004), the scattered FMR at 45-CL-632 turned out to be indicative of features, including some that were well-preserved. Some materials of different ages were mixed on the surface of the site, while other areas contained deposits in their correct stratigraphic position. So, although the site appeared at first to be a shallow palimpsest of materials, construction monitoring and further archaeological investigation revealed more widespread exposures of the deposits containing patchy, but important, data.

Analyses of residues on artifacts are rarely employed in the region, despite its increasing use elsewhere. The current project shows the potential of FTIR analysis of residues on a variety of materials including stone tools, FMR, and feature-associated sediment samples. These data, in combination with other lines of evidence, can provide a more complete picture of feature and tool function and can elucidate past human activities within landscape settings where other evidence of their existence, such as perishable bone, wood, or vegetable remains, have long since vanished.

A variety of subsistence resources were processed at the sites, including large to small mammals, fish, birds, perhaps turtle, nuts, seeds, berries, and root crops. Flaked-stone artifacts represent stone tool making activities, processing of meat or fish, hide work, and minimal hunting. FMR feature technologies representing both expedient processing of resources and resource-specific cooking, drying, or roasting are present at 45-CL-631 and 45-CL-632. Cobble choppers appear to have been an important tool type at both sites, and are probably related to activities and materials that were critical to site function, including woodworking and food processing.

Two archaeological features at 45-CL-632 have been radiocarbon aged to 7850 to 7990 calibrated radiocarbon years BP (Feature 2, a fire pit) and 7870 to 8030 calibrated radiocarbon years BP (Feature 14, an earth oven). These are the oldest, well-dated archaeological features in the local area. The archaeological record of the Portland Basin is particularly lacking in well-dated early to middle Holocene sites, and these data represent a marked improvement in archaeological knowledge of this poorly known period. Other deposits at 45-CL-631 and 45-CL-632 have been radiocarbon aged as well and show that these sites provide a record of Holocene-age human activity dating to as recently as 570 to 700 calibrated radiocarbon years BP (45-CL-632, Feature 1, a hearth).

Despite the long duration of time represented by the archaeological deposits, artifacts and features are similar throughout. This suggests that the types of activities that occurred at the Gee Creek sites changed little over time and that these sites represent a long conservative tradition of upland use, although other aspects of settlement and social organization may have changed in nearby lowland settings.

Archaeological monitoring of mechanical ground scraping or grading during construction revealed deep, intact archaeological features and deposits that were not concentrated in one area of the landscape. These discoveries highlight the need for a better understanding of geological contexts and the nature of the cultural activities represented by archaeological deposits. Upland settings throughout the Portland Basin and southwestern Washington may have the potential to contain archaeological materials within thick aeolian deposits that blanket portions of the landscape. Archaeological sites found in these settings should be closely examined to determine if buried occupational horizons are present and alternative methods of exploring these deposits may be needed.

ACKNOWLEDGEMENTS

We are grateful for the dedicated efforts of the Cowlitz Indian Tribes' dAVe burlingame, Ed Arthur, and Nathan Reynolds who assisted in the field collection, interpretation, and presentation of archaeological data for this project. Ed Arthur was particularly diligent in construction monitoring at 45-CL-632 and should be credited with success in identification and data collection at many of the features uncovered during construction work there. The Washington State Department of Transportation (WSDOT) steadfastly supported every phase of the archaeological work even as it evolved into an ever more co-mplex undertaking. Many WSDOT employees contributed to archaeological preservation and mitigation of the Gee Creek sites, including Trent de Boer, Brad Clark, Susan Fell, Roger Kiers, Katie Mesich, Chris Tams, and Ben Vincent. We would also like to thank all of the crew members who worked very hard to make this project a success.

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Journal of Northwest Anthropology 45(2):199–208 2011

TRACKING THE KERRY LINE: EVIDENCE FROM A LOGGING RAILROAD CAMP IN THE NEHALEM VALLEY, OREGON

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ABSTRACT

A proposed bridge replacement over the Nehalem River between the communities of Birkenfeld and Mist in northwest Oregon identified the remains of an early twentieth century logging railroad camp. The railroad line was operated by the Kerry Timber and Logging Company sometime between ca. 1917 and 1925. As the camp bordered an elevated trestle, the entire camp was built on stilts above the ground. Due to this fact, and later highway and bridge construction, archaeological traces of the camp were relatively diffuse. Recovered artifacts were dominated by nails, and by robust white institutional ceramics ("hotel ware") that likely relate to a crew camp mess. Examination of artifacts associated with railroad grades east and west of the project area suggests that the rail line west of the camp was built as a branch-level grade, and the lines east as spur-level grades.

INTRODUCTION

The upper Nehalem River valley is a narrow plain that snakes through the rugged and heavily timbered Coast Range of northwestern Oregon (Fig. 1). Due to its remoteness from easily traveled routes, settlement by Euroamericans was slightly delayed compared to neighboring areas. The earliest land claims in the vicinity of the towns of Mist and Birkenfeld were made about 1870, and the first cadastral survey was done in 1872. Post offices were established at Mist in 1874, and at Vernonia in 1876 (McArthur and McArthur 2003).

During the first decades of the twentieth century, the dense forests of the region were penetrated by short line logging railroads. The most important of these for the Nehalem Valley was the Columbia & Nehalem River Railroad, most commonly known as the Kerry Line after company head Albert S. Kerry.

During 2008 and 2009, archaeological study was conducted for replacement of the Banzer Bridge on Oregon Highway 202 over the Nehalem River between the communities of Birkenfeld and Mist. During the course of cultural resource evaluation of the project, the remains of an early twentieth century logging railroad camp and associated grades were identified. The grades were part of the system operated by the Kerry Timber and Logging Company sometime between ca. 1917 and 1925 (Connolly 2008; Bland and Connolly 2008; Bland et al. 2009).

Fig. 1. Location of the Kerry main line and the Birkenfeld-Mist branch line.

The Kerry Line

Albert Kerry was involved with timber in Washington and Alaska[1] before acquiring timberlands in Oregon's Nehalem Valley. The Kerry Timber Company began its Oregon operations near Westport on the Columbia River, at a place that came to be known as Kerry. The Kerry community had its own post office from 1917 to 1938, when Nehalem Valley logging was at its peak. In 1913, the Kerry Timber Company incorporated the Columbia & Nehalem River Railroad Company, which began construction from Kerry, on the Columbia River, to the Nehalem Valley, where the company's timber holdings were located. The terrain was so rugged that only 25 mi. of track had been laid after two years, but the line was completed to Birkenfeld in the Nehalem Valley by 1916 (Adams 1961; Dougherty 2008; Industrial Service Co., 1928; Labbe and Goe 1961; McCamish 2008).

The Kerry Timber Company built branch lines and spurs from the Kerry main line to access its timber holdings, and permitted other logging outfits to do so as well. One of the Kerry branch lines ran east from Birkenfeld toward Mist. This branch is shown on a 1922 county map, and on a Metsker map with a publication date of 1956 that was clearly based on earlier mapping data, since the line was not extant in 1956 (Fig. 2). A local resident, Joseph Banzer, owned a photographic image of a Kerry Company camp strung along an elevated trestle grade on the west side of the Nehalem River within the current project area (Fig. 3). The photograph is a product of the Kinsey Studio of Seattle. Brothers Darius and Clark Kinsey were both noted Seattle-area

[1]Before establishing his company in Oregon, Kerry owned lumber mills and operated a boat service in Alaska during the Yukon Gold Rush era (ca. 1898–99). The boat, named the Olive May after his daughter, was featured in "The Ballad of Sam McGee," a poem by the Yukon Gold Rush poet, Robert Service. Kerry's boat was the setting for Sam McGee's cremation, though Service called it the "Alice May" in his poem.

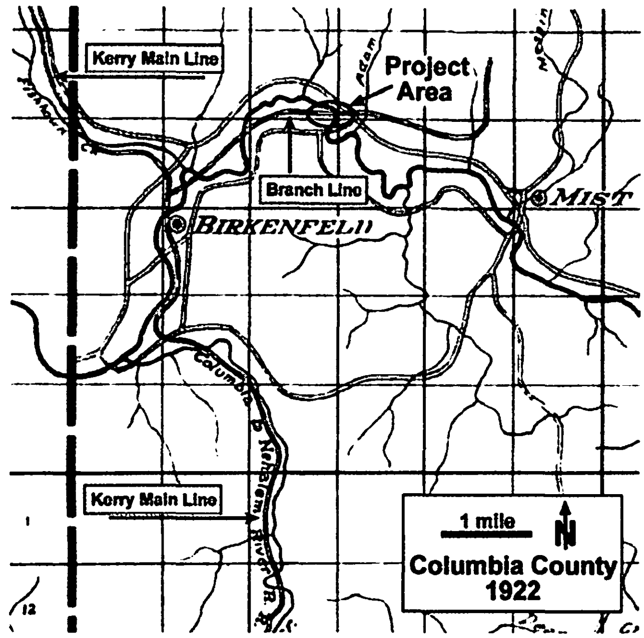

Fig. 2. Columbia County map from 1922 showing the Kerry main line (Columbia and Nehalem River Railroad) and branch line continuing east from Birkenfeld toward Mist, Oregon.

photographers, best known for their images of logging in the Pacific Northwest. Darius mainly focused on the area north of Seattle, while Clark operated mostly south of the Seattle area, including Oregon. Thus, this image is likely a Clark Kinsey photo. The caption identifies the camp as "Kerry Timber & Logging Co., Nehalem Valley, Ore." It is labeled No. 18, presumably one of a larger set. The Kinsey photo collection is housed at the University of Washington, but inquiries there failed to locate additional images from this series.

The photograph is undated, but must have been taken between 1917 and 1925; although partially obscured by trees, a locomotive in the image appears to be a 3-truck Climax, number 122. This particular locomotive was built in 1917 and operated by the Columbia and Nehalem River Railroad until it was sold to the K-P Timber Company in 1925 (Dougherty 2008).

Unlike most logging railroads, the Kerry Line was not associated with a mill. At its northern terminus, the Kerry Line joined with a subsidiary of the Northern Pacific Railroad, but logs were most commonly rafted on the Columbia River from the Kerry terminal to other ports (Labbe and Goe 1961).

The Kerry main line, like other major logging main lines, was built to high engineering and construction standards, designed to handle heavy log trains at the best speeds consistent with safety. It was built to last, with heavy rail and hardware. Branch and spur lines that radiated out into the woods from the main line were considered temporary; they were built to more modest standards, with lighter rails, steeper gradients, and less robust earthwork, all for roughly half the per-mile cost as the main line. Light rail was used on spurs so that it could be easily removed and re-laid, and engineering often employed tight curves and steep gradients. To cope with these conditions, spur lines often employed geared locomotives that could generate their maximum tractive effort at low speeds; geared locomotives could negotiate gradients up to 10%, but were too slow for main line use (Berry 1917). The Climax locomotive in the Kinsey photo is a geared machine.

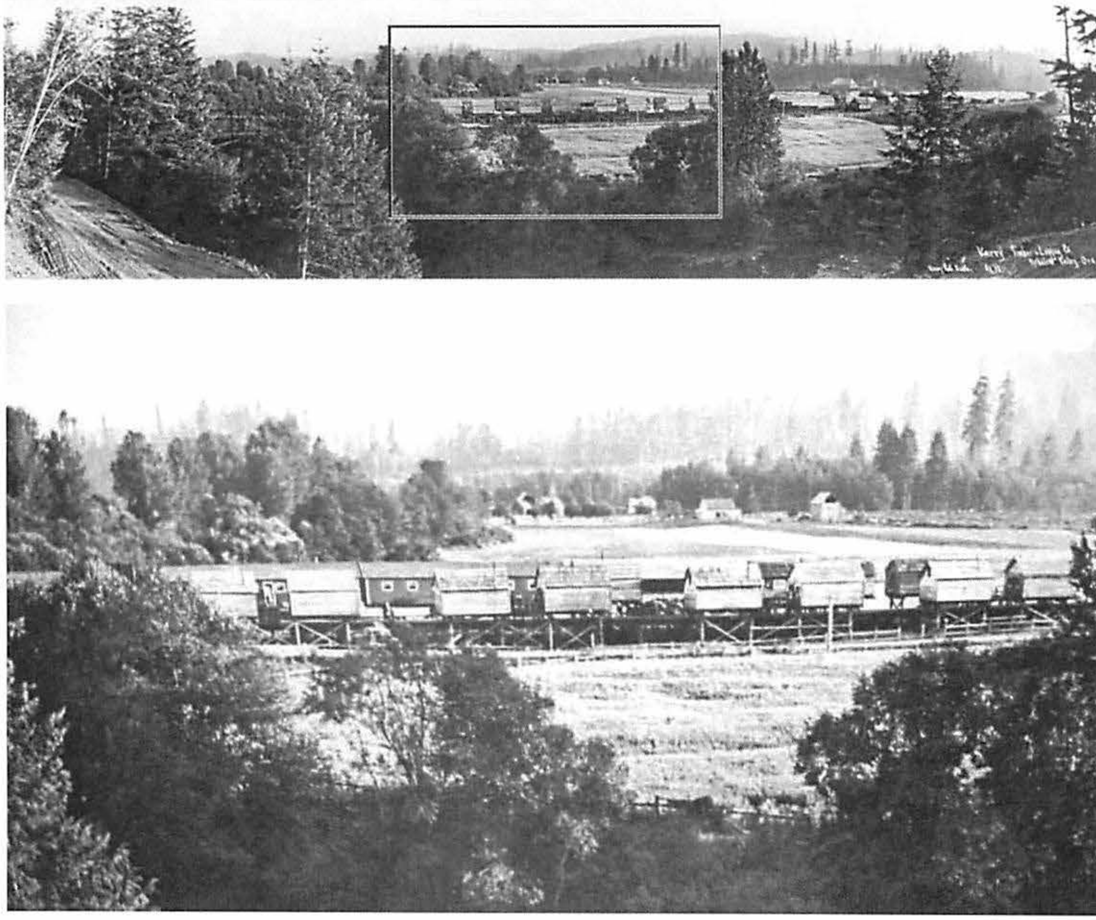

Fig. 3. Kinsey photograph of the Banzer Bridge project area taken between 1917 and 1925, showing an elevated camp bordering the trestle crossing to the left.

Archaeology of the Railroad Camp

Both the Kinsey photograph and a Rand McNally Auto Trails Map from 1925 confirm that an auto crossing of the Nehalem River was in place before 1925 (Cartography Associates 2003). This route was designated Oregon Highway 202 in 1935. Oregon Highway Department right-of-way maps from 1941 and 1942 show that the original roadway followed a sinuous course, looping north of the current right-of-way with a bridge north of the current highway structure. In 1941, the highway through the project area was straightened, and a bridge constructed on the current alignment, with bridge approaches elevated on fill that occupies the original railroad corridor and much of the Kerry Company railroad camp.

Plans to rebuild the Banzer Bridge prompted an archaeological study. Fieldwork in the bridge crossing area focused on visible railroad grade features and associated archaeological materials. Although it was discovered that most surviving grade elements were largely located outside the bridge area of potential effect, a cursory reconnaissance of grades to the east and west was conducted in order to help clarify the context of the camp within the larger rail system (Fig. 4). East of the river a grade had been cut into the hillside well above the highway (Fig. 5). The west end of the cut terminated abruptly on an alignment that approximated that of the modern highway bridge, at an elevation about six meters above the highway. This elevation is consistent with what would have been the east end of an elevated trestle structure. The grade continued easterly and divided into two grades as it turned northeasterly through dense forest. A lower grade followed the west side of Adams Creek for a distance before crossing (presumably across another trestle), and an upper grade followed a slightly higher course that continued along the west side. A third line continuing to the southeast is suggested by the historic mapping, but this grade was not confirmed because of access restrictions.

West of the river was a clear grade paralleling the south side of the highway beginning about 500 m west of the river, but there was no visible grade along the highway corridor for the 500 m between the grade and the river crossing. In this span, the Kinsey photograph shows a long trestle structure designed to gradually elevate the railroad to the level of the grade cut east of the river.

As shown in Fig. 3, a railroad camp bordered the elevated railroad on the west side of the river, built on supports to match the height of the railroad. Archaeological work in the camp area first involved 30 x 30 cm exploratory shovel probes to determine whether archaeological elements were present, followed by both a metal detector survey and systematic excavation of 50 x 50 cm probes in the camp area.

The vast majority of the site's cultural assemblage was dominated by three artifact classes: wire nails, industrial ceramic tableware, and glass. Relatively little of this material was highly diagnostic, and much of the collected material was roadside debris not associated with the rail camp. This was more of a problem with some classes than others; for example, there were hundreds of glass fragments, including modern bottle glass and automobile safety glass. A small number of glass fragments were likely early twentieth century in age. Among the possible historic glass were fragments of a lamp chimney, a square bottle base consistent with patent medicine bottles, and pane glass. One diagnostic fragment was a bottle base with the suction scar and "O" logo of an Owens automatic bottle machine; this technology came into use about 1905, and though lasting to the 1960s it began to disappear by the 1930s (Kipp 2008; Lindsey 2009).

By contrast, the ceramic assemblage likely derives entirely from the rail camp. Of the 153 ceramic fragments collected, all are consistent with institutional-style white tableware ("hotel-ware"). Only two fragments had identifiable, but identical, manufacturers' stamps (Fig. 6). These marks identify the ware as a product of the W. S. George Pottery Co., which produced wares under the W. S. George trade name from 1904 to the late 1950s (Lehner 1988). The fragments include pieces of plates, bowls, cups, and other tableware that likely represents debris from a crew mess facility.

The 188 wire nails ranged in size from 1¼ in. to 6 in., likely reflecting construction of both the camp's elevated structures and the scaffolding that supported them. Relatively few personal artifacts were found, but they included part of a glass marble (perhaps a child's toy) and a decorative button that could have come from a woman's coat. Though rare, these items suggest that the camp might have accommodated families, and not just male work crews.

Metal detector survey of the site was mostly unproductive, generally duplicating the array of nails and modern roadside debris recovered from the systematic excavations. However, there was one notable find, a double-bit axe head (Fig. 7). Most tree-falling axes had long, narrow bits; this broad-blade double-bit axe, commonly called a swamping axe, was used for clearing brush prior to felling timber, or for peeling bark from logs. It could also have served as a general purpose camp axe (Johnson 2007; Salaman 1975).

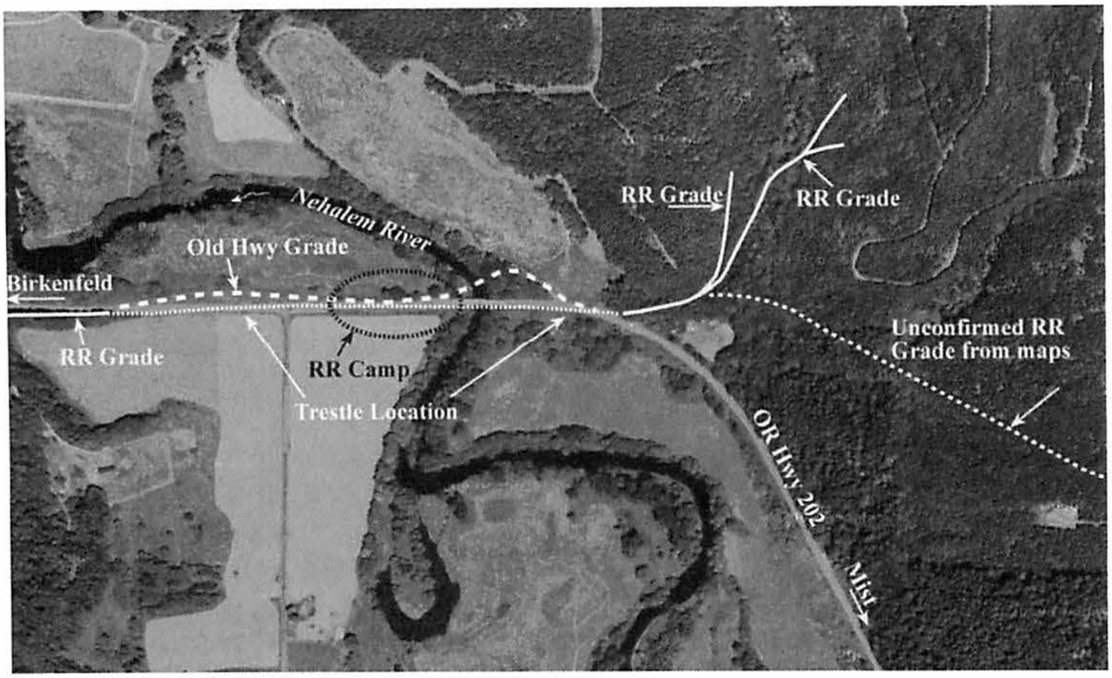

Fig. 4. Location of confirmed and speculative railroad grades in the Banzer Bridge vicinity.

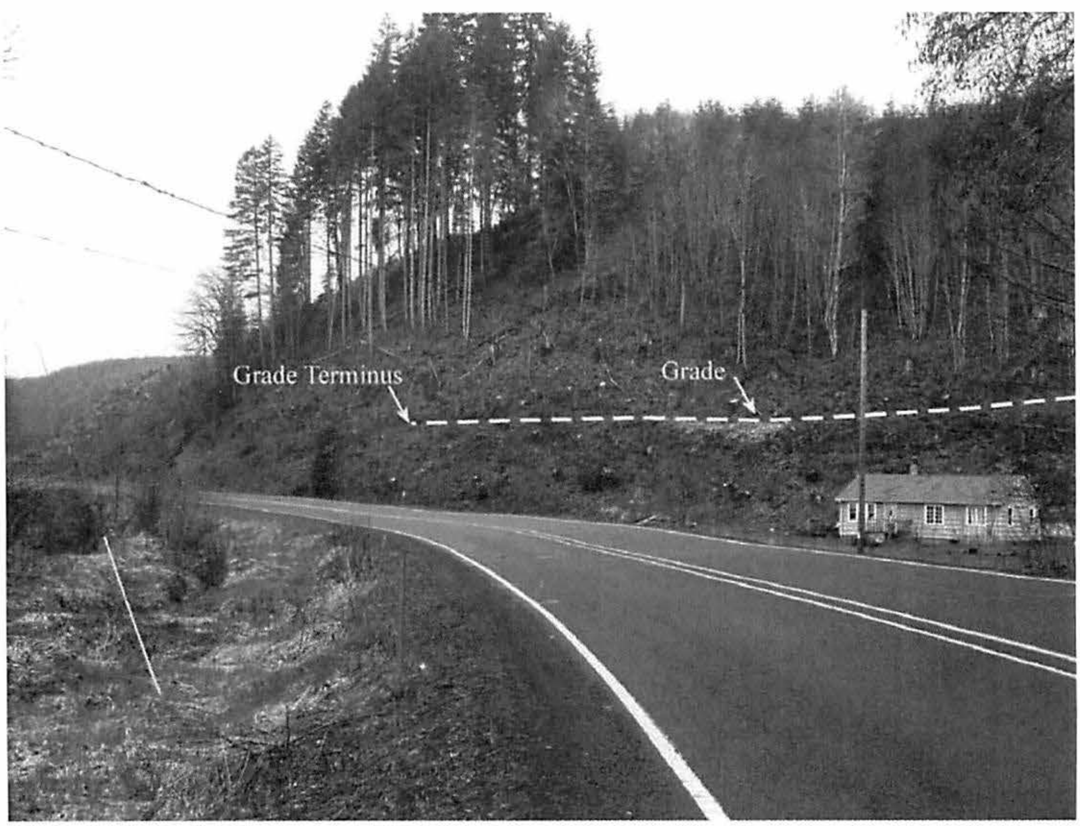

Fig. 5. View northwest showing the railroad grade east of the river; the grade terminus would have met the east end of the elevated trestle structure.

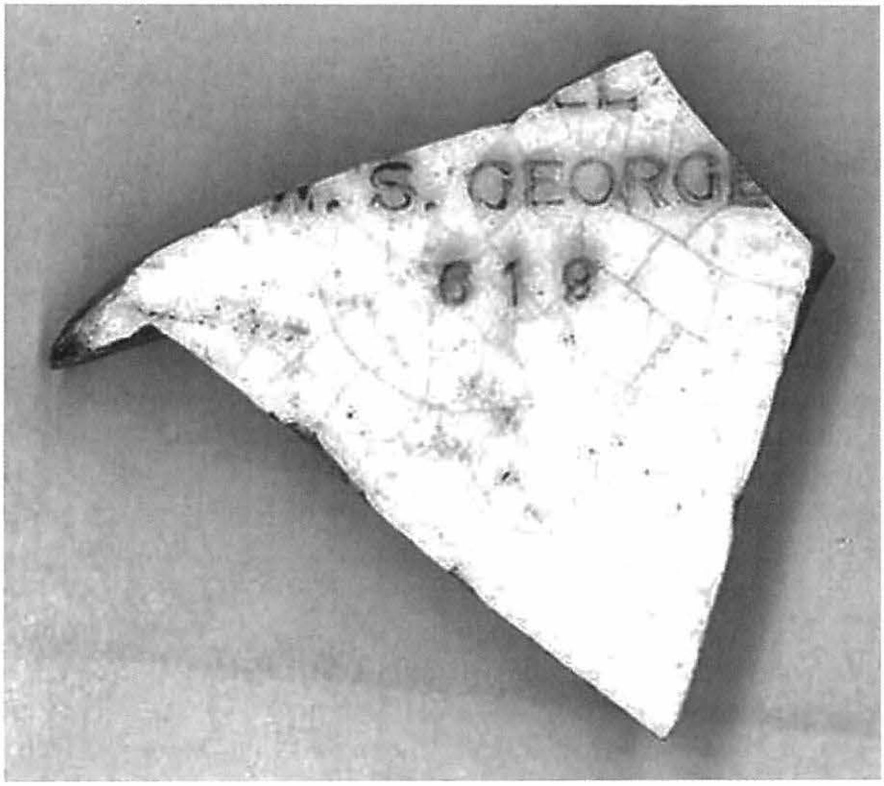

Fig. 6. Fragments of cups, bowls, and plates collected from probes west of the bridge were all heavy institutional ("hotel ware") ceramics; manufacturing stamps identify the W. S. George Pottery Co., which produced wares under W. S. George trade name from 1904 to the late 1950s.

Fig. 7. Double-bit axe head from the camp area (after treatment in an electrolysis bath).

Overall, testing appears to have sampled the southern edge of the camp area, the main part of which was likely centered in the area now occupied by the high fill that serves as the highway bridge approach, an area buried or destroyed by construction of the existing highway. The sampled area produced an assemblage with relatively limited diversity; it had apparently been deposited from an elevated camp with a very limited structural footprint. The archaeological value of the surviving camp elements was judged to be limited. At least as enlightening, however, was a consideration of artifacts associated with the surviving grades. A railroad brake shoe was observed on the surface of the grade east of the camp. Brake shoes broke off rail cars with some frequency, and they are a common artifact on old railroad grades. In general, there are two types: high-friction brakes with a composite asbestos lining, and low-friction cast iron brakes. The brake shoe on the Banzer grade was of cast iron construction, probably from a log car. The *Thomas Register of American Manufacturers* for 1905–1906 lists 19 manufacturers of railroad car and locomotive brakes. There is no reliable method of dating railroad brake shoes or identifying the manufacturer.

Drift bolts are steel fasteners driven into timbers to hold them together for trestle construction. A drift bolt was found near the grade terminus east of the camp.

Track hardware is important in the context of archaeological study because it reveals details of the different technology and the materials used (such as rail weight and spike dimensions) for main, branch, and spur lines. Rail spikes hold the rail to the ties. Smaller spikes were used on lighter rail, and larger spikes on heavier rail. Two spikes were found during the Banzer project; one was excavated from the camp area west of the river, and one was found on the grade continuing east from the Banzer camp. The one from the grade to the east was a 5 in. spike, a size consistent with use on 40–90 pound rail. The spike from the camp on the west side of the river was 6 in., among the largest made and suitable for use with 50–100 lb rail (Berry 1917; Brown 1934; Peele 1927).

Nuts and bolts were used to fasten rail splice plates, which joined 20 ft. rail sections together. The bolts had rounded heads with oval collars. In use, the oval collar fit into the splice plate and kept the bolt from turning as it was tightened. Three bolts were found; a small 1¾ in. bolt with an attached nut is too small to fasten a rail splice plate, and might have been hardware from a rail car or locomotive. The other two are probably splice-plate fasteners. One, excavated from the rail camp area west of the river, measured 4¼ in. long and 7/8 in. in diameter. According to Camp (1903:120), bolts of this size were primarily used for 75 lb and heaver rail. The bolt from the grade east of the camp had a narrower, ¾ in. diameter. Bolts of this size were used for all rail up to 85 lbs (Peele 1927).

Both the bolts and the rail spikes suggest that the line to the camp (i.e., the line to the west) was built with heavier rail than the line beyond the camp. In other words, it appears that the line to the camp, from the Kerry main line, was built to mid-range branch standards, while the multiple lines continuing east of the camp were built to a lower spur standard.

The research identified the Banzer rail camp as a nodal point between branch and spur lines of the Kerry Timber Company. It is possible that elements of the camp remain buried beneath the massive highway fill that now serves as the existing bridge approach, and monitoring during the bridge replacement construction is planned. Beyond the construction zone, the project has identified previously unmapped logging railroad grades.

ACKNOWLEDGEMENTS

The project was supported by the Oregon Department of Transportation, and facilitated by ODOT archaeologist Kurt Roedel. Fieldwork was conducted under archaeological permits AP-1198 and -1246 issued by the Oregon State Historic Preservation Office. Collected artifacts and associated field notes are located at the State Museum of Anthropology, University of Oregon, under accession 1813.

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Journal of Northwest Anthropology 45(2):209–220 2011

WAITING FOR THE END OF THE WORLD: A PROTOTYPE FALLOUT SHELTER UNDER INTERSTATE 5 IN NORTH SEATTLE

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ABSTRACT

The Weedin Place Fallout Shelter in Seattle, Washington, was built as a prototype in 1963 to be the model for countless similar shelters that would be installed nationwide under interstate highways. These and other types of shelters were part of the United States civil defense program designed to protect citizens from radioactive debris or fallout resulting from a nuclear attack. The Seattle structure was federally funded, announced as a more efficient use of public rights-of-way. Visitors to the fallout shelter on Weedin Place near Ravenna Boulevard today are struck less by the efficiency of design than by the utter dementia of fallout shelter mentality. Evaluation of such facilities for National Register eligibility must be made within a unique context, as Cold War esthetics are to architecture what Hamburger Helper® is to haute cuisine.

Introduction

Odd as it may seem, the Washington State Department of Transportation (WSDOT) Bridge and Structures Office (BSO) recently added a structure to the state's bridge inventory that is not really a bridge. The structure was built as a nuclear fallout shelter during the Cold War that developed between the United States and the Union of Soviet Socialist Republics (USSR) following the end of World War II (WWII). The shelter is technically a bridge since it has supported the south-bound lanes of Interstate 5 (I-5) since its completion in 1963. Despite the WSDOT Northwest Region's having used the shelter for records storage (and the Department of Licensing for issuing drivers licenses before that), the BSO was unaware that the shelter was holding up one the state's most important highways. Discovery of that fact prompted a request for WSDOT's Cultural Resources Program to evaluate the shelter's potential eligibility for inclusion in the National Register of Historic Places. That evaluation has included research to determine the shelter's origins and uses over the years. Attempts to discover other similar structures under highways in the U.S. have thus far been unsuccessful, suggesting that the so-called "prototype community" fallout shelter under I-5 is unique, perhaps the only one of its kind in the world.

Prosaic in its architecture, the shelter is virtually bereft of style, designed for survivability rather than elegance or comfort. Like most Cold War facilities, the shelter was designed by an engineering firm, rather than by architects, because the shelter was basically a functioning machine, not a building. Architects were involved in such undertakings only to the extent that the facilities were to house people. And, like most Cold War artifacts, the shelter is a victim of benign neglect (Vanderbilt 2004:49). Yet it is a vivid reminder of a fearful time in our history.

Unadorned, austere walls, floors and ceilings of cold concrete evoke images of huddled, terrified survivors escaping the horrors of unimaginable nuclear holocaust (Fig. 1). The shelter's appearance as a secure refuge from radioactive fallout is itself illusory and controversial, just as was the nation-wide program promoted as a way for the U.S. to survive, and thus "win," the Cold War. One visit to the shelter's inner sanctum inevitably brings one to question "What were they thinking?"

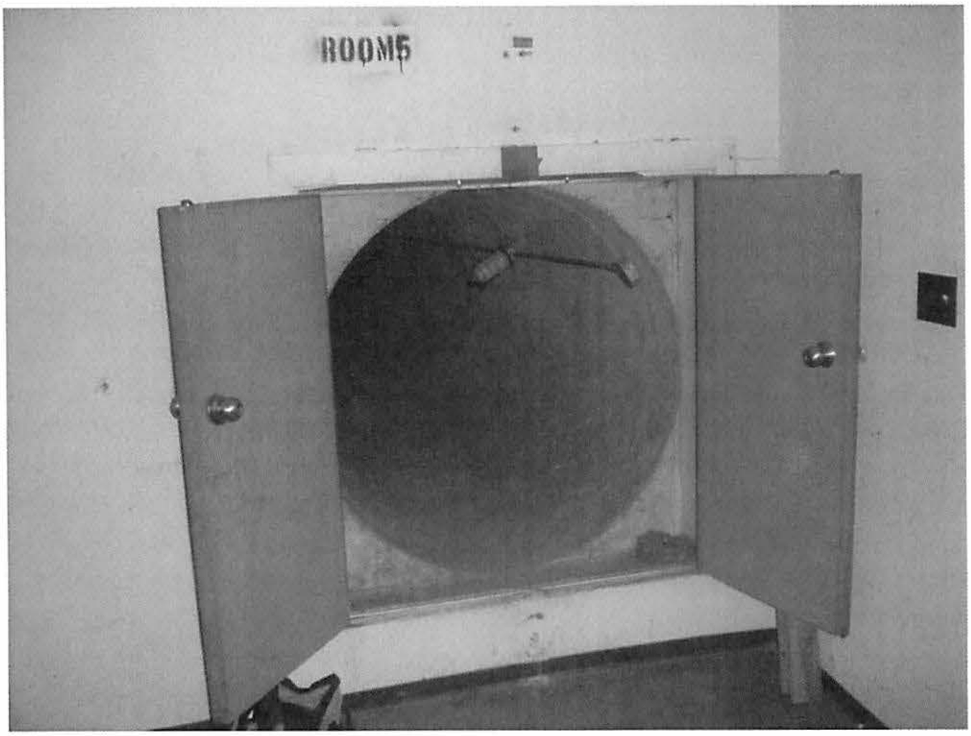

Fig. 1. Double doors close off entrance to the escape tunnel, adjacent to the food distribution window in the fallout shelter. (Photo by Craig Holstine, WSDOT, 2010).

Background

Visiting north Seattle in the mid-1950s, one would have seen modest, single-family houses lining the street called Weedin Place in a typical middle-class neighborhood. That serenity changed forever in the late 1950s with construction of Primary State Highway 1, now I-5. Under the north approach to the Ravenna Boulevard Overcrossing Bridge, excavation began in 1962 on what was to be the first of many fallout shelters under freeways and highways around the country. Unbeknownst to all involved, the facility on Weedin Place was to be the only highway fallout shelter ever built in the U.S. (Fig. 2).

Nowadays, "shelter" has entirely different connotations: battered women and children, the homeless and the hungry unfortunately populate too many of our shelters today. In the early 1960s, everyone knew when a "shelter" was to be used, and its yellow and black distinctive signs were universally recognized. The notion that shelters could preserve enough of the population and its will to fight derived largely from Britains' survival of "The Blitz" during WWII in "bomb" shelters, that is, underground bunkers designed to protect inhabitants from direct hits by

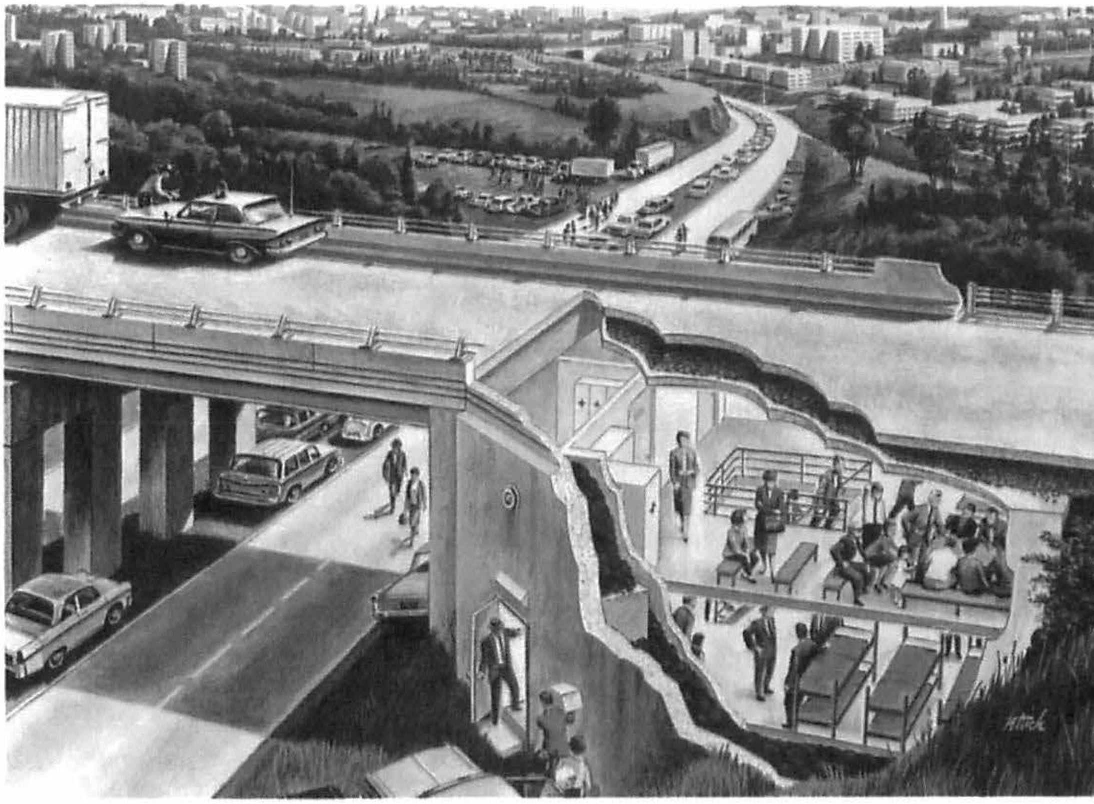

Fig. 2. A prototype highway shelter as envisioned by federal Civil Defense officials. (Photo # 311-M-23-9, Record Group 311, Still Pictures Branch, National Archives, College Park, MD. Courtesy David Monteyne, University of Calgary).

conventional explosives. Despite graphic evidence of the ineffectiveness of most shelters subjected to Allied firestorm bombings of German and Japanese cities, at least some Americans held fast to the notion that shelters were the answer to the question of nuclear holocaust survivability.

The fallout shelter on Weedin Place was a "prototype community" fallout shelter, meant to insulate occupants from the effects of radioactive fallout from a nuclear attack. The facility was federally financed and built on public property for emergency use by common citizens without access to private shelters. In hopes of encouraging families to install their own shelters, the federal government built four other "prototype" shelters in Washington, all "family" facilities on private properties in Everett, Seattle, Spokane, and Yakima (Barton 1960b; Civil Defense Scrapbook 1957–1962).

While thousands of home owners nationwide did install their own underground shelters, the Weedin Place facility was apparently the first, and only, fallout shelter ever constructed in the U.S. under a public roadway. It was built under what would become I-5 at the height of the Cold War in part as a way to demonstrate more effective uses of public rights-of-way. C. D. Curtiss, the Commissioner of Public Roads, head of the Bureau of Public Roads (BPR, predecessor agency to today's Federal Highway Administration), proposed putting shelters under the interstates as a way to: (1) save costs by combining needs of the national shelter and Federal-aid Highway programs; (2) recover some construction costs by charging parking fees; and (3) provide shelter for the traveling public. Commissioner Curtis emphasized that putting shelters under freeways was particularly advantageous in residential neighborhoods where costs of acquiring private property would be higher than in rural America, but where relatively denser populations would be served (Curtiss 1957).

At least one attempt to secure federal and state backing for a highway-type shelter ended unsuccessfully when the Washington State Department of Highways (DOH) rejected the idea of shelters under raised portions of Interstate 90 in Spokane, saying the freeway was too far along in design (Friend 1965; *Spokesman-Review* 1965). Its design was no further advanced than the Seattle freeway had been in 1959 when the Weedin Place shelter was approved, but by the mid 1960s the time had passed for building public shelters, under highways or anywhere else.

Charles Ralls, the Director of the Regional Office of Civil and Defense Mobilization, first discussed the idea for this shelter with William Bugge, the Washington DOH Director, on 21 December 1959. Bugge followed up his meeting with Ralls in a letter, stating his approval for the shelter under the future interstate. Only the month before, Bugge had rejected a suggestion by a Washington citizen that spaces under highways should be put to other uses. Bugge recited DOH and BPR policies forbidding facilities that could bring damage via fire or accident to public roadways (Bugge 1959a and b). To Bugge's letter was attached a sketch of the proposed shelter in its present location, shown as a 65 x 40 ft. rectangular shelter. Bjornstad, one of the designers, considered a two-story rectangular structure, but concluded that "the circular single story design appears to be the most economical for this project" (Chick 1961). Records reveal that costs would be a recurring source of dispute in shelter development.

In June 1960, the BPR approved the under-freeway shelter plan, but cautioned that additional costs would not be eligible for interstate funding (Bugge 1960). The federal Office of Civil and Defense Mobilization (OCDM) agreed to pick up costs involved with removing fill from under the Ravenna Boulevard Bridge approach. DOH's cost estimate of $1,300 was approved (Barton 1960a). Years later, when the DOH billed the Office of Civil Defense (OCD, successor to the OCDM) for $4,650, OCD refused to pay the invoice until DOH provided an explanation for the 358% increase over the initial estimate. Excess costs apparently resulted from items labeled "Furnish & Place Selected Backfill Material—$2,642," "Special Sand Bedding—$1,501," and "Construction Engineering, Prorated—$341.03." The total included sales tax (Washington State Department of Highways 1968; Office of Civil Defense 1969; Miller 1969).

On 10 October 1960, Washington Governor Albert Rosellini, Seattle Mayor Gordon Clinton, King County Board of Commissioners Chairman Howard Odell, and L. F. Kreiger of OCDM signed an agreement formalizing the project. Its authority was given as the Federal Civil Defense Act of 1950, and Executive Order 10773, authorizing the Director of OCDM to develop shelter designs and "publicly disseminate civil defense information by all appropriate means." Yet another justification was the National Policy on Shelter, in which the federal government "is conducting a program, for research and demonstration purposes," of various kinds of fallout shelters, "including construction and use of highway fill fallout shelters which also may serve a dual use . . ." To satisfy the federal requirement for facilities in public rights-of-way (ROWs) to serve other functions when not in use during emergencies, the state promised to permit the Washington State Patrol to use the shelter. (Until ca. 1977, the Department of Licensing (DOL) issued drivers licenses in the facility. A walled-in space remains in the shelter from the DOL and subsequent WSDOT use.) The City and County agreed to develop emergency occupancy plans and conduct tours of the facility, and to provide food, bedding, and unspecified "Recreational Supplies" sufficient to support 200 people for two weeks (Highway Fill Shelter Project Agreement 1960).

The agreement specified the location of the shelter, and its approximate size of 3,000 square feet (living space for shelterees was less). Per a subsequent "Utilization Plan," "assignment of specific segments of the population to this shelter is not possible and occupation of available shelter spaces will necessarily be transient. . . . Since no specific segment of the population has been assigned to this facility, entry will not be denied to anyone until such time as the maximum occupancy has been reached." Shelterees would be permitted to bring in only items that "would increase shelter habitability," as well as medicines and "special health foods." "General purpose items will be turned into general supply for possible later re-issue for the good of all. Animals and pets will not be permitted into the shelter for obvious health reasons." "When the maximum occupancy of the shelter has been reached, . . . the manager will cause the doors to be closed and locked. Any persons remaining outside the shelter will be directed to proceed to the next nearest public shelter." No other public shelter is known to have existed in the vicinity, however (Public Fallout Shelter Utilization Plan for the State Highway Fill Shelter Prototype 1963).

Design

Andersen Bjornstad Kane, Seattle consulting engineers, designed the shelter in early 1961 (Anonymous 1961; General Services Administration n.d. a). Built to the firm's specifications, the shelter is virtually invisible to all but the most observant visitors. A sidewalk runs from Weedin Place to a nearly unnoticeable concrete wall in the fill slope of I-5. The shelter's main entrance is a sliding, heavy metal grate accessing an underground "L"-shaped concrete hallway leading to the facility's inner sanctum. Along the hallway is a utility/maintenance room, containing a diesel-powered electricity generator; an air circulation system that includes electric heating and air conditioning units; a well, pump and pressure tank; and piping connecting the facility to the city water and sewer systems. (Although the design called for a 2,375 gallon emergency water supply tank, that was apparently never installed.) The shelter is equipped with decontamination showers and toilets (two for women, one for men plus a urinal), situated conveniently off the entrance hallway (Fig. 3). On the far end of the cramped rest rooms, a four-foot diameter, precast concrete culvert exits from a small hallway to its aluminum gate-covered portal off the sidewalk a few feet from the main entrance. Labeled "escape tunnel" on design plans, the burrow-like feature was standard in underground prototype shelters, meant to provide secondary egress in case the overhead structure (in this case, the I-5 freeway) collapsed.

Designed to accommodate 200 people for two weeks, the shelter's net (communal living) area provided roughly 9.13 sq. ft. of living space for each shelteree. (That's a little smaller than today's personal yoga mat.) At the center of the shelter's circular main interior, which measures approximately 60 ft. in diameter, a 2-ft. 6-in. thick concrete pier supports the 18-in.-thick concrete roof, nearly 5 ft. of roadway fill, and the I-5 south-bound lanes. (Stabilizing the pier and supporting that considerable weight is a concrete footing roughly 12 ft. wide and nearly 3 ft. thick lying beneath the shelter's concrete floor) (Fig. 4). A monotonous hum from the overhead traffic permeates the cavernous main activity area where shelterees were to sleep in triple-deck bunks, singles segregated by gender with families in between. Meetings, training and religious observances were also to occur in the central room, adhering to strict scheduling per shelter management plans. Behind a drywall originally to be painted "Flat White" to match the concrete walls of the main activity area (now an "institutional green"), an emergency medical center was equipped to provide no more than basic first aid. An office contains a black rotary telephone appearing ready for emergency calls. A second walled-off space across the main room is a later addition, dating to use of the facility for vehicle licensing and records storage. At the outer edge of the central area, a roll-away shutter covers a wide window above a long counter where canned and packaged food was to be distributed from the adjacent storage room. With no kitchen nor stove nor refrigerator, food preparation and preservation of perishables would have been

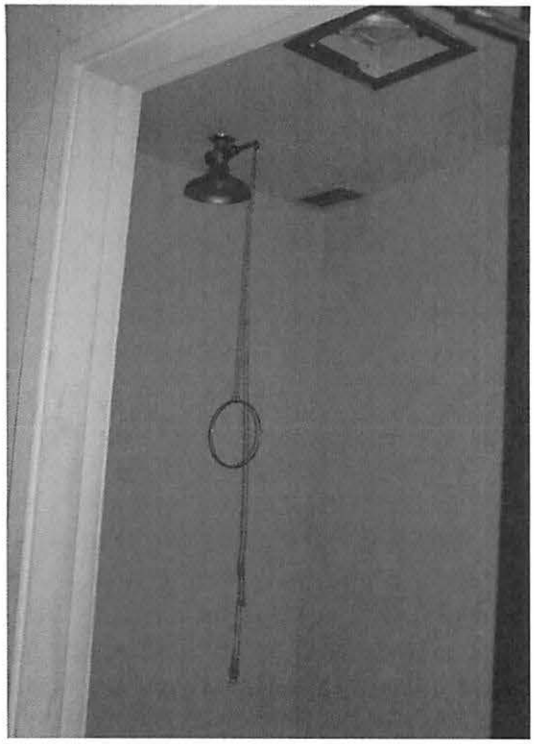

Fig. 3. Decontamination shower in the fallout shelter. (Photo by Craig Holstine, WSDOT, 2010).

impossible. Canned food could be warmed using body heat, suggested an operation manual. Similar Spartan living conditions were anticipated for shelterees' bathing opportunities, as reflected in the small (40-gallon) hot water heater mounted in the men's restroom ceiling. In fact, both "decontamination" and "emergency" labels are applied to the showers on the drawings, implying limited availability for shelter inhabitants. Not surprisingly, the facility's operating manual notes that "survival rather than comfort will be the primary objective" (Seattle-King County Civil Defense Organization 1963; Krier 2010) (Fig. 5).

Construction and Dedication

McDonald Construction of Seattle built what was then called the Seattle Freeway Prototype Community Shelter at a cost of $67,300. As with most Cold War facilities (such as NIKE missile silos, weapons research and manufacturing plants, communications centers, and the like), the shelter was installed with an urgency reflecting the mood of the nation's defense posture. The General Services Administration's construction contract specified that the shelter be completed within 120 calendar days from the notice to proceed (General Services Administration n.d. b). When dedicated, its capacity had grown: so it was reported to have been built and supplied for use by 300 people, rather than the 200 occupants anticipated by its designers.

Governor Rosellini was scheduled to have given the dedication address on 29 March 1963, but failed to join the Seattle mayor, chairman of the Board of County Commissioners, the State Patrol chief, and OCDM officials. Dignitaries approaching the shelter entrance were met by members of the Seattle Women Act for Peace organization, who offered handouts "attacking the shelter" (Dedication Program 1963; *Seattle Post-Intelligencer* 1963; *Seattle Times* 1963) (Fig. 6).

Although it is not known specifically what the handouts said, by then the country was engaged in a spirited debate about the effectiveness of shelters and the wisdom of President John F. Kennedy's "shelter program" launched in 1961. For the most part, the federal government had dumped shelter preparedness onto private citizens, with very few publicly financed shelters built

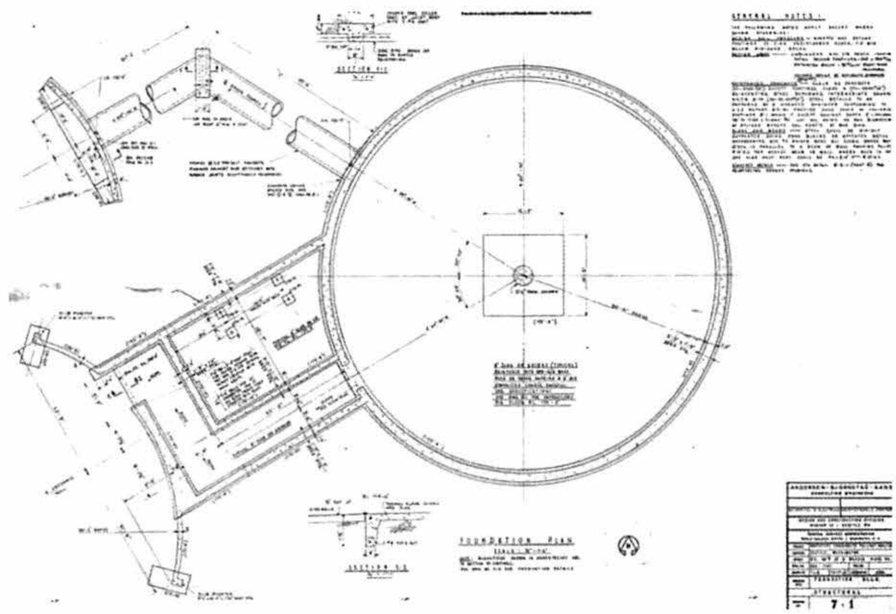

Fig. 4. Foundation plan drawing of the shelter as drawn by designers Andersen, Bjornstad and Kane, Seattle. Drawing 7.1, dated 17 October 1961. (Seattle Freeway Route Material, Record Group 30, Records of the Bureau of Public Roads, National Archives and Records Center, Seattle).

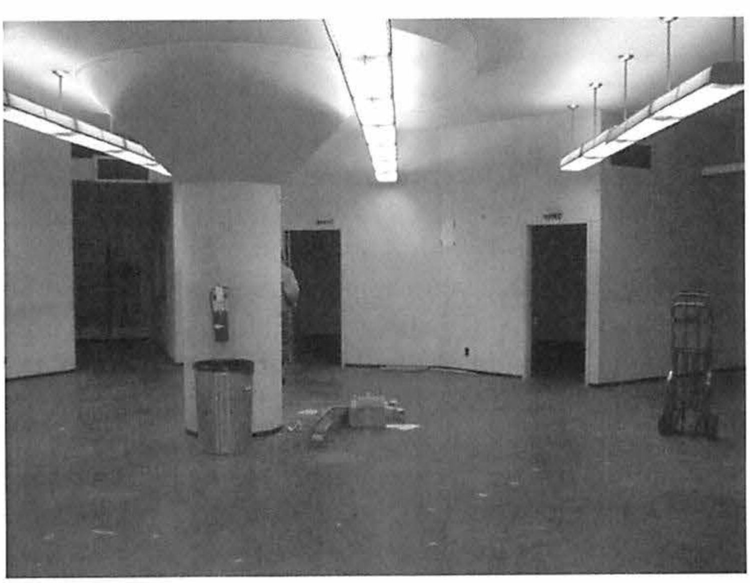

Fig. 5. Activity area surrounding the central pillar supporting 18-in. concrete roof, 5 ft. of highway fill, and the south-bound lanes of I-5. Behind the pillar (left to right) are the escape tunnel hallway, administrative office, and emergency medical room. (Photo by Craig Holstine, WSDOT, 2010).

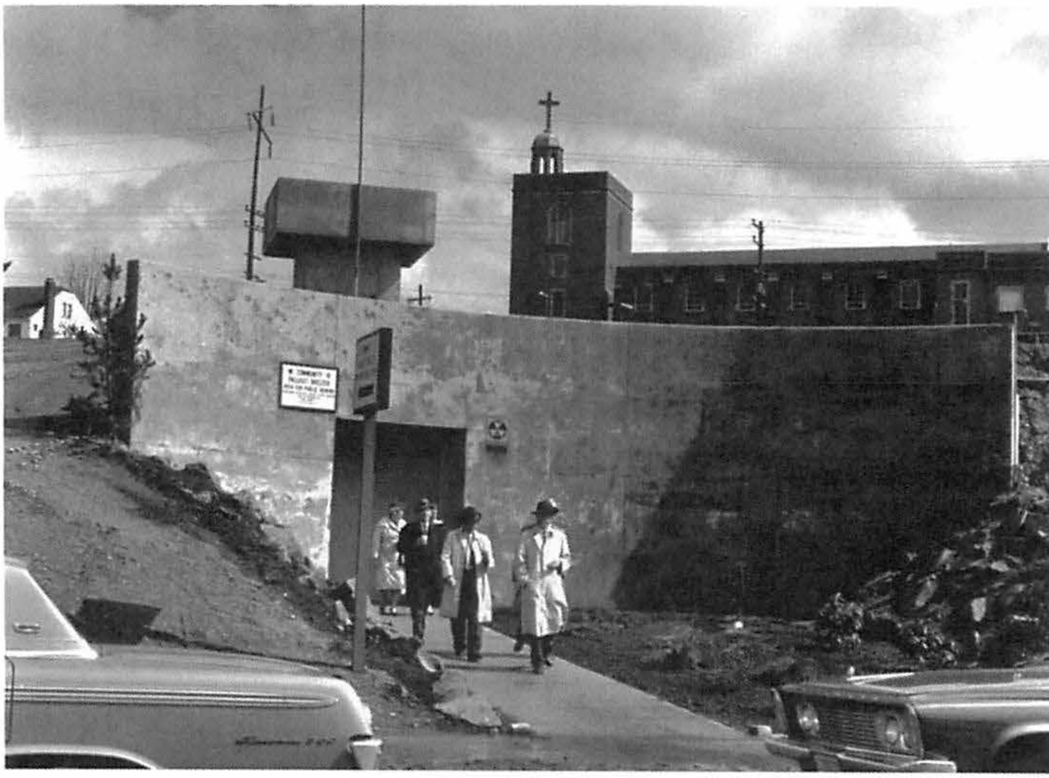

Fig. 6. The recently completed fallout shelter on Weedin Place was dedicated 29 March 1963. (Photo #3, Accession Group 86.5, Accession Item 2092, Museum of History and Industry, Seattle).

across the country. Shelters pitted the rich and well-to-do against the less fortunate, home owners against renters and apartment dwellers. Cost estimates for a bare-bones family shelter were in the neighborhood of $2,500, when median family income was only $5,315 in 1961 (Rose 2001:190).

Discussion

The Cuban Missile Crisis of October 1962 revealed the inadequacy of national shelter preparedness: the U.S. had few shelters, and those were largely unstocked; emergency supplies were languishing in warehouses. In 1961 only ca. 60,000 shelters were habitable; by 1965, as many as 200,000, or one shelter for every 900 people, or one for every 266 households, had been built, leaving the vast majority of Americans unsheltered (Rose 2001:202). By 1967, few shelters were under construction, and most shelter "spaces" were in urban downtowns in existing buildings not meeting shelter specifications. In 1969, the civil defense budget hit a record low, allowing very little for the shelter program (Rose 2001:206).

It seems counterintuitive, but the decline in shelter construction anticipated, rather than resulted from, the calming of Cold War hysteria. Businesses specializing in fallout shelter construction were already "faltering badly" in early 1962 (Rose 2001:191). According to a poll taken in 1959, nuclear war had been considered (by 64% of respondents) the nation's most urgent problem. By 1964, the figure had dropped to 16%. After that, the subject disappeared from the survey (Boyer 1985:355–356). Widespread fear of nuclear war ended abruptly after the Cuban Missile Crisis, as the "unthinkable" became less likely. The U.S., Britain and the USSR banned atmospheric nuclear tests, thus removing threatening images from view, giving the appearance that something was being done about avoiding nuclear war. Underground testing continued, however, propelling the nuclear arms race. In the period 1963–1980, U.S. nuclear warheads and bombs never numbered below 24,000, contributing to the seductive logic of deterrence theory: U.S. arsenals were seen as invulnerable assurance that the U.S. would not be attacked. In March 1964, our own Senator Henry M. Jackson, chairman of the Senate Armed Services Committee, shelved the Shelter Incentive Bill, effectively shifting funding to missile defense (Rose 2001:204). Contributing to diminishing shelter importance were nuclear missiles on Soviet submarines cruising relatively short distances off U.S. coastlines, rendering shelters virtually useless when attack preparation time would be mere minutes. As the likelihood of scampering underground became more remote, Americans' attention was diverted elsewhere.

Contributing to that happy development was the release in January 1964 of the movie *Dr. Strangelove or: How I Learned to Stop Worrying and Love the Bomb* (Boyer 1985:357–358). One of the film's many memorable scenes has a bombastic Air Force general lustily anticipating his role in re-populating the country after the approaching doomsday device detonation. Civil defense would never be quite the same, given satirical images of fallout shelters as virtual underground rabbit breeding hutches. One scholar credits the movie with popularizing skepticism of political and military leaders, and even beginning the anti-Vietnam War movement in the U.S. (Henrickson 1997). Construction of publicly funded fallout shelters waned as the climate for spending public money on civil defense passed, eclipsed by seemingly unending expenditures on the quagmire in Southeast Asia.

When theoretical physicist Edward Teller proposed building shelters as a way to survive and win a nuclear war, an array of distinguished scientists wrote a rebuttal in the *Saturday Evening Post*, saying "We regard Dr. Teller's plan for survival as not only an illusion but also a tragic dissipation of all hope for the future. We believe that most Americans will see that this plan is as preposterous as it is dangerous. Just as we reject the choice of being either "Red or dead," so we also reject the call for escape to an insane world" (*Saturday Evening Post* 1962).

In the late 1960s, long after the zenith of fallout shelter construction, the American Institute of Architecture (AIA) agreed to bestow shelter design awards on behalf of the OCD (Monteyne 2011). Although the AIA is no longer giving out such awards, the National Register of Historic Places recognizes properties over 50 years old that are worthy of preservation. Should the Weedin Place fallout shelter be one of those properties? Are we to enshrine it as a monument to civil defense and preparedness, or as a reminder of the ultimate "escape to an insane world"?

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Journal of Northwest Anthropology 45(2):221–227 2011

YOU SAY DESIGN/BUILD, I SAY OH NO! ODOT'S U.S. 20: PIONEER MOUNTAIN—EDDYVILLE PROJECT

Kurt Roedel

ABSTRACT

The Oregon Department of Transportation is replacing a 10-mi. segment of U.S. 20 between the cities of Corvallis and Newport with a shorter, faster, and safer route. The $215 million Pioneer Mountain-Eddyville Project will be complete in 2012, after decades of planning and several notable delays. The design/build nature of the project and the problems that emerged make the management of cultural resources during project planning, design, and construction worthy of discussion. Described are the project's history and significance, successful and ineffective attempts to address cultural resources and Tribal coordination concerns, and simple, but useful reminders to increase the success of future transportation projects.

Introduction

The Oregon Department of Transportation (ODOT) will complete the U.S. 20: Pioneer Mountain-Eddyville (PME) Project in 2012, seven years after the start of construction. This portion of U.S. 20 opened in 1918 and is one of the last unimproved sections of highway over the Coast Range between Corvallis in the Willamette Valley and the coastal community of Newport (Fig. 1). The highway does not meet current design standards, and exhibits narrow lanes, substandard curves, insufficient traffic capacity, and a high accident rate (Oregon Department of Transportation 2010).

At 6.5 mi. long and at a cost of $215 million, PME is one of the largest and most expensive design/build projects at ODOT. Design/build projects are fundamentally different in that historically, project planning and engineering/design is undertaken by ODOT staff, followed by the selection of a construction contractor through a competitive bidding process. The agency continues to provide oversight and inspection during construction. In contrast, design/build projects have less initial ODOT involvement and allow the contractor to design the project as it is being built. The construction industry touts design/build projects as a way to encourage innovation, reduce risk for the project owner (ODOT), shorten construction timelines by overlapping the design and construction phase, and promote environmental stewardship (Oregon Department of Transportation 2010).

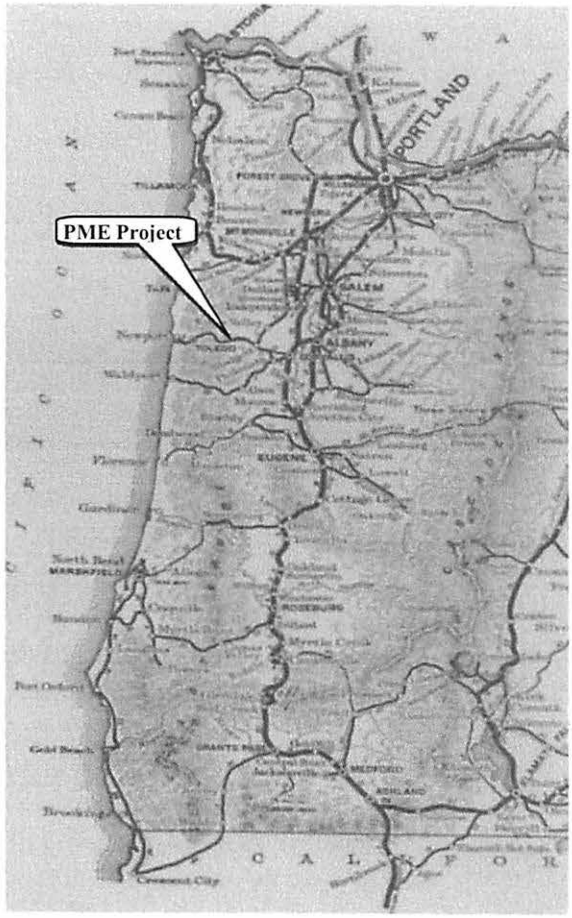

Fig. 1. View of the PME Project, about 80 miles southwest of Portland, Oregon (Oregon State Highway Department, 1919).

Environmental challenges are common for any transportation project, but PME is unique. The project involves 6.5 mi. of new roadway through mountainous terrain, requiring 10 new bridges, and massive cuts and fills in a region that receives about 90 in. of precipitation per year (Fig. 2). More than 3.1 million cubic yds of soil and rock were excavated between 2008 and 2009 (Oregon Department of Transportation 2010). In addition, the discovery of massive, ancient landslides in 2007 forced reexamination of a large portion of the project, though construction resumed in 2008, after a delay of nearly one year. ODOT continues to address residual landslide concerns in response to shifting vertical support columns on at least two bridges (Oregon Department of Transportation 2010).

The design-build nature of the project and the problems that emerged make the management of cultural resources during planning, design, and construction deserving of closer examination. The article begins with a description of the cultural resources encountered during construction, and the breakdowns identified as the causes. The events surrounding Tribal consultation are then described. The article concludes with several recommendations, which, if implemented, will increase the success of future design/build projects.

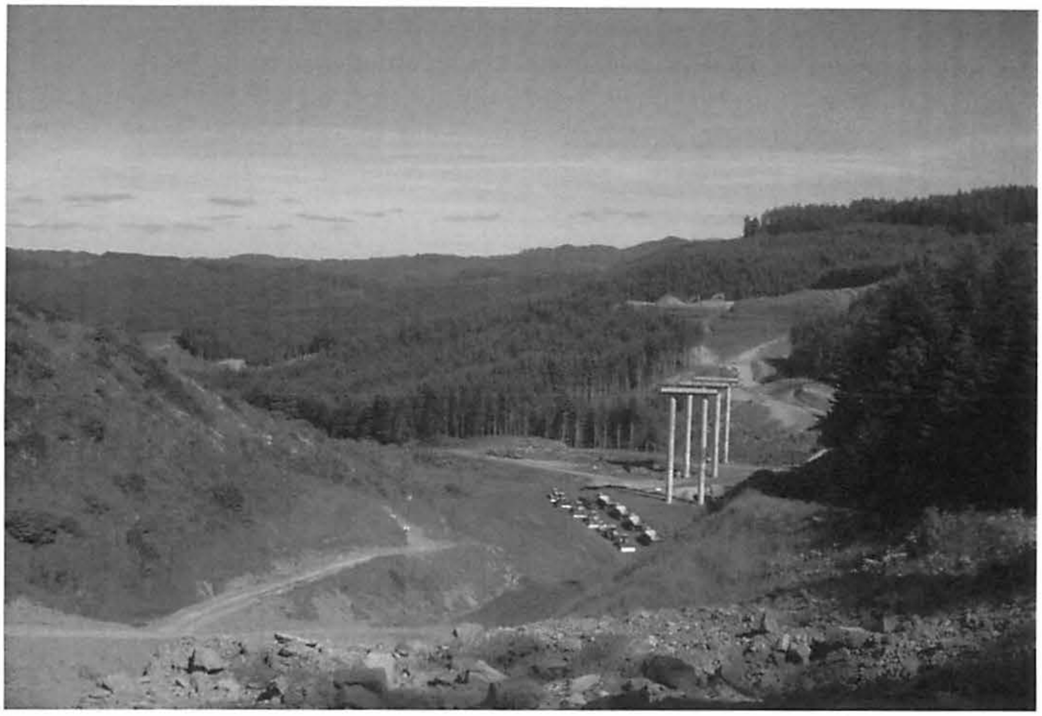

Fig. 2. View of road cut and bridge construction (Oregon Department of Transportation 2005).

Cultural Resources

Between 1992 and 2004, ODOT retained consultants to examine the proposed alignment for cultural resources. Initially, field reconnaissance was largely limited to pedestrian survey (CH2M Hill 2003; Scott 1992). Subsurface exploration occurred in 2004, when Connolly (2005) recorded and evaluated the Yaquina Meadows Site (35-LNC-98), a seasonal food processing camp adjacent to Yaquina Falls. The site dates to about AD 1000 and is eligible for listing in the National Register of Historic Places.

The proposed highway bisected the site; however, ODOT redesigned the alignment to avoid direct impacts. Additional site protection measures, developed in consultation with the Confederated Tribes of Siletz Indians (Siletz Tribes) and the Confederated Tribes of the Grand Ronde Community of Oregon (Grand Ronde Tribes), included establishing a no-work zone buffer around the site, redesigning embankment and fill areas, and archaeological monitoring during ground disturbing activities (Norman 2004).

Two years after PME broke ground in 2005, construction activities impacted Site 35-LNC-98 (Fig. 3). Site disturbance was not apparent until a newly appointed Project Manager requested an internal ODOT review to clarify differences between no work zone locations shown on construction plans and placed in the field. An archaeological damage assessment soon followed. ODOT realized that several causes led to disturbance of the Yaquina Meadows Site: 1) fieldwork was narrowly focused on the alignment and did not encompass secondary impacts, such as placement of embankment and fill, which led to inadequate recording of the site boundary; 2) the no-work zone established to prevent impacts to the site was not verified in the field and therefore, was incorrectly marked; 3) archaeological monitors were not retained for early identification of inadvertent discoveries; 4) the redesigned alignment was not fully examined for archaeological resources; 5) five different ODOT archaeologists managed the project; and 6) prior to 2007, ODOT contracted management of PME to a national engineering firm utilizing the design/build model. The construction contract retained responsibility for all Tribal coordination and archaeological review for ODOT. From a 2007 view point, it was readily apparent that the consulting engineer staff did not manage this portion of the contract in a manner consistent with ODOT or Tribal expectations.

Tribal Communication

ODOT worked most closely with the Siletz Tribes during project development, as the Grand Ronde Tribes deferred to the Siletz Tribes. Regardless, communication between ODOT and the Tribes was largely absent after the start of construction due to outsourcing of this responsibility to the national engineering firm. After impacts to Site 35-LNC-98 were fully understood, ODOT resumed control of archaeological review and Tribal coordination. In addition, ODOT expanded existing no work zones, developed strict project and Tribal communication protocol, revised the project's Section 106 Finding of Effect to address on-going issues and future efforts, and conducted additional archaeological fieldwork in areas previously unexamined and in areas of Tribal concern. Subsequent fieldwork resulted in the recording of four precontact and historic sites and several isolates, the designation of multiple new no work zones, and more than $200,000 in additional archaeological services. ODOT continues to conduct archaeological investigations that arise from the design/build process.

Fig. 3. View of road construction at Yaquina Meadows (Oregon Department of Transportation 2007).

Several project setbacks have occurred since 2007 even with the above changes and improvements in place. Construction impacts ranged from driving construction equipment in archaeologically sensitive areas to dumping fill and placing gravel in areas set aside for protection of the site. Construction activities in the vicinity of Site 35-LNC-98 that were not part of initial project planning have been difficult to address due to the 'design-as-you-build it' nature of PME. Once construction begins, many avoidance or protective options that could have been implemented are no longer viable or are difficult to implement. On-going construction mandates tight timelines for Tribal coordination and archaeological review and creates an uneasy sense of accommodation to ensure construction proceeds as scheduled. PME remains an ever-moving target to effectively manage cultural resources; however, ODOT and the Siletz Tribes have made strides to improve communication and identify and protect archaeological sites.

Positive Outcomes

Though ODOT and the Siletz Tribes have suffered several setbacks during PME, some beneficial gains are evident. These include improved project management based on increased project scrutiny, increased knowledge of precontact and historic use of the project vicinity based on identification of previous unrecorded resources, and a closer working relationship with the Siletz Tribes. PME Managers have established a rigid notification protocol with the Siletz Tribes, undertaken cultural awareness training for construction personnel, emphasized the importance of no work zones, and provided notification with as much advanced notice as feasible for project changes that may require archaeological review and Tribal coordination. Additional positive outcomes include the planting of culturally significant resources in wetlands and meadows, Tribal participation in report writing, and transfer of land encompassing Site 35-LNC-98 to the Siletz Tribes after construction is complete.

Summary

In reflecting on the national engineering firm's and ODOT's management of cultural resources within a design/build model for PME, several themes emerged. Keeping these themes in mind can help improve handling of future transportation projects, especially those that are design/build projects. The first involves fieldwork. Field efforts should equal the project's scope and project planners and developers should consider examination of a broader geographic area for cultural resources based upon the potential for design/build projects to extend beyond the planned project area. Understanding that a pedestrian survey may not be appropriate for a PME-sized project, a more comprehensive approach should involve conducting fieldwork beyond the proposed alignment in areas that have a high probability for cultural resources. This would help eliminate the need for archaeological review of project area expansions during construction. Other options could include the development of a region-wide, rather than a project-specific, probability model to guide fieldwork methodology during the design/build process, additional historical research and Tribal involvement to identify peripheral areas of concern, and creation of Section 106 Programmatic Agreements that outline project expectations and process. Upfront costs and time would be greater, but these efforts are likely to be more effective than examining the project in a piece-meal fashion during construction.

The second theme surrounds project management. Five different archaeologists have been responsible for management of cultural resources at PME. Each agency archaeologist currently manages about 150 projects, and important details may be lost in translation during a project handoff to a new archaeologist. It is imperative that the outgoing archaeologist convey the significance and minutiae of a project such as PME to ensure similar errors do not happen again.

The third theme is communication. There must be a persistent and straightforward exchange among Tribes, archaeologists, project teams, engineering firms, and the construction workforce that leads to an effective construction communication protocol with Tribes. ODOT maintains a good long-standing relationship with the Siletz Tribes, though ODOT's decision to contract responsibility for Tribal coordination to a national engineering firm tested that bond. Ultimately, ODOT is responsible for Tribal coordination, an issue too essential to outsource, especially on a project as complicated as PME. Examples to improve communication could include encouraging Tribal staff to attend planning, project development, and construction meetings in person or via videoconferencing; sending agency representatives to Tribal meetings to provide project updates; stressing face-to-face communication instead of e-mail correspondence; developing written expectations and understandings that project personnel can reference; and creating a dedicated agency position that focuses on design/build cultural resources/Tribal issues and concerns.

Conclusion

The ODOT and the Siletz Tribes have overcome significant obstacles during construction of PME. Identification and management of cultural resources and Tribal consultation will play a pivotal role in determining PME's ultimate success and how other's view ODOT's commitment to cultural resources and to its Tribal partners. As transportation agencies struggle to meet demands of increasing populations and decreasing revenues and staff, PME serves as an example on how to improve cultural resource management and Tribal consultation for future design/build projects.

ACKNOWLEDGEMENTS

Special thanks to Robert Kentta, Cultural Resources Director, Confederated Tribes of Siletz Indians; Tom Connolly, Director of Research, Oregon State Museum of Anthropology, Museum of Natural and Cultural History, University of Oregon; Carolyn McAleer, Cultural Resources Program Coordinator, and Joe Squire P.E., Project Manager, Oregon Department of Transportation.

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Journal of Northwest Anthropology 45(2):229–234 2011

URBAN ARCHAEOLOGY, GOOD FAITH EFFORTS, AND THE $12,000 SHOVEL TEST PIT: A COST-BENEFIT ANALYSIS OF DEEP TESTING METHODS FOR WSDOT MEGA PROJECTS

Kevin M. Bartoy

ABSTRACT

The issue of deep testing protocols has been a major concern for the Washington State Department of Transportation (WSDOT) since the discovery of *Tse-whit-zen* during construction of the Port Angeles Graving Dock. The complex geologic history of Washington State necessitates that archaeologists always keep in mind landform histories and site formation processes in their efforts to identify archaeological sites. In urban settings, complex natural histories become even more complicated due to the effects of humans upon the landscape. This article is a preliminary assessment of the cost-benefit of deep testing methods carried out by WSDOT on its Mega Projects in the urban setting of Seattle.

Introduction

In the urban core of Seattle, the Washington State Department of Transportation (WSDOT) has faced two primary challenges that have necessitated the development and use of deep testing methods: 1) the modern built environment; and, 2) the anthropogenic landforms of the city. More traditional methods, such as shovel test probes and exploratory trenching, are impractical given depths of deposits, the modern built environment, and the concerns with safety and logistics, particularly the need for shoring and dewatering. Given these challenging conditions, the use of deep testing methods, particularly sonicores and geoprobes, are especially beneficial for examining archaeological deposits. However, because these deep testing methods have been developed to address geologic and geotechnical research problems, their use cannot be expected to deliver answers to archaeological questions without a careful examination of the goals of the research and the limitations of the techniques.

As an interdisciplinary endeavor, archaeology by nature frequently borrows concepts and techniques from the natural sciences. Given the gross similarities and overlap in the principle object of study, archaeology, since its inception, has relied heavily on geology for inspiration. It is unfortunate that until relatively recently, archaeologists have seldom differentiated between the geologic concept of stratigraphy and the archaeological concept of stratigraphy. One of the first and most complete discussions of these differences was presented by Edward Harris in his seminal work, *The Principles of Archaeological Stratigraphy*. Harris argued that "when humans made their debut on the Earth, a revolution occurred in the process of stratification which had been carried out until then by natural agencies" (Harris, 1989:xii). It was this "revolution" that provided the basis for a separation in the geological (i.e., "natural") and the archaeological (i.e., "cultural") concepts of stratigraphy. Harris stated, "the stratigraphic records of many excavations, particularly those on complex urban sites, have thus been compiled with inadequate guidelines based on geological notions" (Harris, 1989:xiii).

As archaeological time is only a palimpsest of that of a geologic time, so too is archaeological space (i.e., archaeological stratification) but a palimpsest of that of its geologic cousin. It must be questioned whether the techniques to study these two distinct objects are interchangeable given the dramatic differences between the nature of the objects of study as well as the overall goals of the two disciplines. This is not to say that the methods of the two disciplines are mutually exclusive, but instead that we must fully understand the strengths and limitations of these methods given the divergent object of research and goals of each discipline. The focus of this article is to cast a critical eye at the use of primarily geological techniques in exploring the archaeological landscape of the complex urban environment of Seattle in the context of a transportation "mega project."

Parsing the Archaeological from the Geotechnical

The nature of most transportation projects of any scale requires that consideration be made of the geotechnical information related to the project area prior to or during the initial phases of design. These geotechnical data are critical for engineers as project design progresses beyond the conceptual, but the same data are also crucial in the development of a strategy to assess the potential project impacts to cultural resources. However, the scale of these data are such that the object of archaeological study is often subsumed under a generic heading of "modern fill" or some similar designation that equates to "uninteresting" in the minds of geotechnical engineers.

Although geotechnical coring efforts have the potential to identify archaeological sites, particularly if those sites manifest as dense accumulations of cultural materials, the geotechnical methods are much more suited to the discovery of landforms, ancient and modern, rather than cultural resources associated with those landforms. It is this landform information that is a key contribution of geotechnical testing. Each identified landform may not have associated cultural materials, but without a given landform in place, the presence of cultural materials is less likely. In this case, geotechnical methods can establish a baseline as to potential locations open to human activity even though these methods may be a poor indicator of the activity itself. It is this geomorphological baseline that is necessary to provide adequate data to assess a project area and develop an adequate archaeological testing strategy.

This point was proven in a very costly manner during excavations at *Tse-whit-zen*. One key finding of the inquiry into the Port Angeles Graving Dock was that inadequate geotechnical testing had been undertaken as part of the archaeological identification efforts in advance of construction.

> It is, in hindsight, a significant shortcoming of the site investigation that a historic landform analysis of the Area of Potential Effect was not conducted to support the design of field sampling. This work is referred to as "geomorphology." An important question emerging from the Section 106 experience at the graving dock site is what lessons in this regard should be taken for the future about the need to tie the field work to the knowledge of the original landform (MacDonald 2006:46).

It is likely that geotechnical testing in combination with the ethnographic and archaeological knowledge of prehistoric village structure would have been able to identify high probability areas within the construction site for further investigation. The initial survey report from this project stated that "cemeteries were typically near the beach, not a great distance from their dwellings" (Western Shores Heritage Services 2002:4). Geotechnical testing would have, and later did, provide information as to the location of the beach berm at the deeply buried site. It is no coincidence that the majority of burials uncovered at the site were clustered along this berm and it is unfortunate that the early testing efforts failed to adequately target this location since the buried landform had not been identified.

In dealing with dynamic landscapes that have been transformed both historically and prehistorically, geotechnical testing is an absolutely necessary first step in establishing the potential locations of human activity. At Port Angeles, this lesson was definitely learned the hard way. However, this geotechnical testing is only a first step in trying to identify deeply buried archaeological sites. This work is not unlike more conventional types of predictive modeling in which geologic mapping is used to identify areas once available for human occupation at a given time. In dealing with a project in the urban core of Seattle, the identification of these potential landforms only begins the difficult process of accessing these areas for further testing.

After potential landforms are identified, it is seldom the case that these areas can be tested through conventional archaeological methods. Given depths of deposits, the modern built environment, and the concerns with safety and logistics, there is seldom an opportunity to access deeply buried landforms in advance of construction. In relatively undeveloped locations within the urban core, testing has been conducted through the use of deep mechanical trenching. This trenching has allowed for gross observations as to presence or absence of cultural materials, but has not provided the finer detail necessary to evaluate resources for their eligibility for listing in the National Register of Historic Places (NRHP).

In dealing with deeply buried deposits, WSDOT has had to develop strategies in which evaluation and data recovery can be built into construction. This requires that WSDOT, the State Historic Preservation Officer (SHPO), the Department of Archaeology and Historic Preservation (DAHP), affected Tribes, and other consulting parties must work together in advance to create an agreement document that guides the archaeological work during construction. The safety measures put in place and deep excavation of fill allows for access to potential archaeological deposits, but construction scheduling only allows a brief window of time to complete the necessary cultural resources work. The integration of archeology into construction is not necessarily optimal, but WSDOT has been successful thus far in implementing such work.

Archaeology as Risk Management

In the world of transportation planning, archaeology is, in part, a practice of risk management. The use of geotechnical methods in concert with more traditional archaeological methods allows WSDOT to effectively manage risk for complex "mega projects" within the urban core of Seattle. Working outside of the traditional paradigm of survey, evaluation, and data recovery, it is possible to gain enough insight from geotechnical borings, historical and ethnographic background information, and limited archaeological testing to assess risk in terms of the interrelated concerns of time and cost. It is in the weighing of these concerns in relation to the agency's responsibilities within the Section 106 process as well as its commitments to the taxpayers and consulting parties that difficult decisions must be made.

In trying to identify landforms that have the potential for past human occupation, it is necessary to assess whether the efforts expended to identify this potential occupation justify the expense at the front end of the project when compared to the expense of an "unanticipated" discovery on the back end when a project is in construction. This question has both economic and regulatory aspects that must be taken into account in the decision making process.

The economic aspects of the situation described above are relatively easy to assess. However, this assessment leads us through a decision making process that appears to come right out of "Catch-22." WSDOT can create a testing program that uses innovative (read expensive) methods to handle the challenges posed by the urban environment and compare these costs against the costs of a potential unanticipated discovery during construction that would not only include costs for archaeology but also costs for work stoppages and project delays. Of course, the caveat to this exercise is the possibility that this innovative testing program identifies archaeological remains and WSDOT is somehow able to assess (to SHPO's satisfaction) that the site is eligible for listing in the NRHP. In this case, the site is likely only able to be mitigated during construction, which may allow for pre-planning, but does not necessarily avoid work stoppages and time delays similar to those of an unanticipated discovery. Alternatively, the innovative testing program may fail to identify archaeological remains, but unlikely to the satisfaction of SHPO, and thus require a monitoring program during construction that may lead to the unanticipated discovery that WSDOT was trying to avoid.

Ironically, it is the regulatory aspects of this decision making process that places WSDOT in this unenviable position. According to 36 CFR 800.4(b)(1), the agency shall make "a reasonable and good faith effort to carry out appropriate identification efforts." The definition of these efforts is not based on economic considerations, but instead upon the law, which requires federal agencies to not only assess but also to avoid or minimize their impacts on historic properties. Although deep testing methods, such as sonicores and geoprobes, appear to be best used to identify landforms with the potential for human activity, deep testing has often been approached as a substitute for "a reasonable and good faith effort to carry out appropriate identification efforts." When considering the use of deep testing methods, such as sonicores, essentially as an equivalent of a shovel probe, it must be considered whether an eight-inch diameter "shovel probe" costing in excess of $12,000 is "reasonable." As an aid to identify landforms, the utility and cost of these deep testing methods appears reasonable. But, as a method to identify and assess cultural resources, these geotechnical techniques lack the precision to address questions on an archaeological scale. In terms of risk management, the economic investment does not provide a subsequent return that would lessen the overall risk for the project.

When geotechnical methods are paired with more traditional archaeological methods, such as backhoe trenching, a cost effective solution can be developed to help identify buried archaeological sites. This combination has received a good deal of study in the Minnesota Department of Transportation's Deep Test Protocol Project (Commonwealth Cultural Resources Group, Inc. [CCRG] 2006). Although not explicitly calling for geotechnical work in advance of archaeology, the Deep Test Protocol Project concluded that "the discovery of buried archaeological sites is primarily a geoarchaeological process and should be undertaken as a multidisciplinary study by earth and archaeological scientists" (CCRG 2006). It is this same type of multidisciplinary approach that WSDOT is embracing as the agency seeks solutions that are effective in terms of both cost and archaeology.

A Working Model

Effectively managing risk for projects in the urban core of Seattle has required the creation of context-specific solutions that have been developed through consultation with a variety of individuals involved in the project as partners and as consulting parties. WSDOT has faced challenges not only from the complex urban environment in which the project lies, but also from the complex engineering techniques that are being proposed. At this point, an idealized protocol for deep testing on this project would involve the progressive use of the following:

1) Geotechnical boring to determine the landform characteristics within the project area and further identify potential locations for human activity. For the historical period, these data set can be combined with maps, photographs, and other documents to create a probability map. Given the urban location, Sanborn Fire Insurance Maps have proven especially useful and accurate in predicting the location of historic resources.
2) Deep trenching and large diameter augering in locations with potential for human activity to identify and assess cultural resources.
3) Conventional archaeological excavation integrated with construction as secant or sheet pile walls allow for safe access to archaeological deposits to mitigate for project effects.

This idealized protocol has been successfully implemented on one project. Given that the location was relatively shallow, at a maximum of four meters below surface, WSDOT has even been able to begin data recovery excavations in advance of construction. Other projects face unique challenges that do not allow for this idealized process to progress so easily. In some cases, the depth of deposit does not allow for trenching or augering. In other cases, project plans for ground improvement through jet grouting and other techniques do not allow for disturbance of soils in advance of construction. It should also be noted that WSDOT has yet to attempt a data recovery integrated with construction. Perhaps this idealized protocol is more akin to a working safety net at this point.

Conclusion

As WSDOT continues to meet the challenges created by deeply buried archaeological sites, the process of risk management is ongoing. Given the scale and location of many undertakings, WSDOT faces unique challenges that require innovative solutions that are formulated through consultation with engineers, geotechnical specialists, and archaeologists from WSDOT, DAHP, tribes and private consulting firms. The lessons learned from Port Angeles as well as new lessons from the urban core of Seattle eventually will be folded into a guidance document to help address cultural resources concerns for future development in other complex urban environments. This was one commitment among several in the Memorandum of Agreement for one of the projects within the Alaskan Way Viaduct Replacement Program.

If there is any take home lesson at this point, it is: "Be Conservative." WSDOT has taken a conservative approach when it comes to resources. In evaluation decisions, it is necessary to err on the side of eligibility even if there is limited data to assess a resource. In clearance decisions, it is necessary to err on the side of monitoring even if a resource has not been identified. At the same time, it is also important to be fiscally conservative. As a state agency in a challenging economic environment, WSDOT has a responsibility to the citizens of the State of Washington to wisely use tax dollars as the agency meets and exceeds its commitment to historical and cultural heritage. This is not to say that there may never be a time for a $12,000 shovel test pit. It is to say that the decision to pursue such a strategy must be based in a decision making process founded on solid archaeological practice as well as good risk management strategies.

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Journal of Northwest Anthropology 45(2):235–242 2011

THE INADEQUACY OF ¼ INCH MESH SCREEN IN ARCHAEOLOGY

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ABSTRACT

The vast majority of artifacts at most prehistoric archaeological sites are very small lithic flakes. Flakes two to three times as long as the widths of the openings in archaeological screens, often fall through those screens during archaeological sifting. Because of this, coarse-mesh (¼-in. or larger) screening typically fails to recover the majority of the artifacts at prehistoric archaeological sites and in some cases fails to recover any artifacts at all. Finer-mesh (⅛-in. or smaller) screening allows recovery of a more representative and informative sample of archaeological assemblages and provides more reliable results in site discovery and site boundary definition.

Introduction

> Don Crabtree in numerous conversations has repeatedly stressed that ¼-in. mesh screens do not allow the recovery of most pressure flakes and he continued to urge the use of finer mesh screens in order to recover this smaller detritus so necessary in determining the finishing stages of tool manufacture (Bucy 1974).

Lithic analysts have long advocated fine-mesh screening of archaeologically excavated sediments because some of the most technologically diagnostic stone artifacts, especially diagnostic flakes, are very small and usually not recovered without the use of fine-mesh screen. Fine-mesh hardware cloth (typically woven wire) with square openings that are ⅛-in. (3.2 mm)—wide or smaller is generally recommended. However, because fine-mesh screening takes more time and effort in sifting dirt for artifacts, some archaeologists consider coarse-mesh (¼-in. [6.4 mm] wide openings or larger) screening to be adequate and appropriate given cost/benefit considerations for some uses. Coarse-mesh screening is commonly considered sufficient for archaeological site discovery and boundary delineation when shovel testing during surveys. The logic of this argument is that larger artifacts generally accompany smaller artifacts at archaeological sites so it is not necessary to recover the small artifacts as identification of the larger artifacts will suffice for the purpose of site discovery and boundary delineation. A consideration of the mechanics of archaeological screening, a shovel testing case study, and some flintknapping experimentation show that this logic is flawed and demonstrate why the use of coarse-mesh screen is inadequate for most or all purposes in archaeology.

Long Flat Flakes through a Small Square Hole

The geometry of flakes is highly variable, but they tend to be relatively flat or thin in comparison to their widths and lengths. In many technologies, such as blade and pressure biface technologies, flake length is substantially greater than width and thickness. The two smallest dimensions of a flake, generally thickness and width, are the controlling factors in archaeological screening. That is, the three-dimensional artifact is likely to pass through the two-dimensional screen opening if the artifact's two smallest dimensions are less than the maximum dimensions (diagonals) of the square hole in the screen mesh. If a flake is long, narrow, and thin, the width and thickness of the flake must be less than the maximum dimensions of the holes in the screen mesh for it to pass through.

The largest dimension of the flake (often its length) is of little consequence since only the smallest dimensions of the flake are relevant to its passage through the mesh. Some observant archaeologists may note that artifacts sometimes "float" in the screen with their largest dimension across the openings so that they do not pass through. However, in a common "shaker" screen, the materials are intentionally vibrated so that each item intersects the mesh at multiple angles until it has the opportunity to pass through the screen with its smallest two dimensions aligned with the two largest dimensions of the screen mesh opening. Those who have seen long flakes hung-up in the screen can visualize the orientation of passage for flakes that get through.

In addition to size, the shape of a flake's cross-section is also a factor. Flakes are often lenticular to triangular or trapezoidal in cross section since the ventral surfaces are generally flat to slightly convex and the dorsal surfaces are generally facetted and convex. The passage of flakes through a square opening depends on alignment of flake width with one of the opening diagonals and flake thickness with the other diagonal. Because flake cross-sections are typically tapered in thickness at the lateral margins the smaller portions of the openings at the 90° corners of the square mesh holes generally accommodate this flake geometry. The maximum thickness of a flake is typically in the central portion of the cross section which aligns with one diagonal of the opening when the width of the flake is aligned with the other perpendicular diagonal (Fig. 1).

The maximum dimension of a square is its diagonal. A square that is ¼-in. (0.25 in. or 6.4 mm) on a side has a diagonal that is a little more than ⅓-in. (0.35 in. or 9.0 mm) long. The maximum dimensions of the openings in ¼-in. mesh screen are the two perpendicular diagonals of each square opening which, again, are a little more than ⅓-in. (9.0 mm) across. Therefore, a flake that is less than 9.0 mm in maximum width and less than 9.0 mm in maximum thickness can generally pass through the openings in ¼-in. coarse-mesh screen. Since flake thickness is generally much smaller than width and since the lateral margins of flakes are tapered, it is the width of a flake that most often controls its likelihood of passing through a square hole.

The diagonal of a square that is ⅛-in. (0.125 in. or 3.2 mm) on a side is 0.18 in. or 4.5 mm. Therefore, a flake that is less than 4.5 mm in maximum width and less than 4.5 mm in maximum thickness can pass through the openings in ⅛-in. fine-mesh screen.

If it is the width of the flake that most often determines the size of the mesh openings it will pass through, then the fact that many types of flakes are more than twice as long as they are wide, suggests that flakes 0.70 in. (18 mm) long or longer will not be captured in ¼-in. coarse mesh screen. Likewise, ⅛-in. mesh will allow flakes as long as 0.36 in. (9 mm) or longer to pass through. Basically, expect flakes and other types of artifacts that are two to three times larger in maximum dimension than the mesh sized used to pass through the screen.

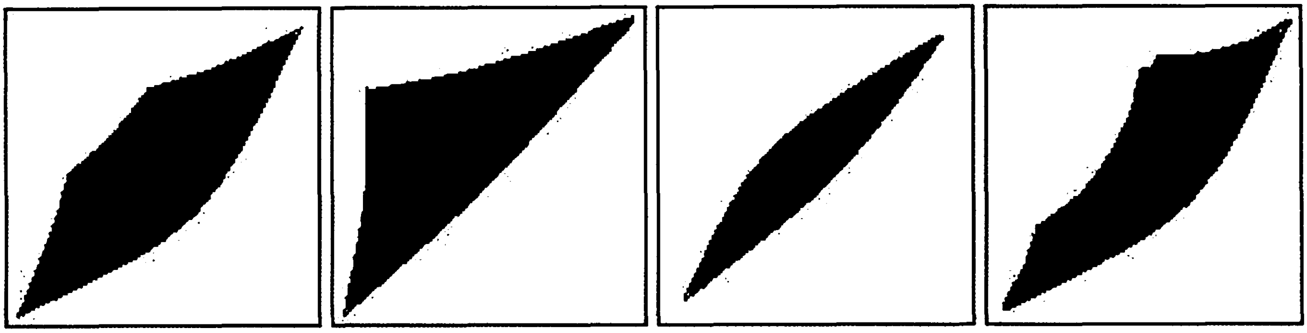

Fig. 1. Typical flake cross-sections and their orientations in passage through square openings as occurs in archaeological sifting or screening.

Also, since the openings in ¼-in. mesh are twice as large as those in ⅛-in. mesh one might assume that the finer mesh would capture twice as many artifacts. However, this assumption does not account for the variable frequency distribution between size classes for artifacts. As will be illustrated below in the flintknapping experimentation study, flakes, and possibly other types of artifacts, are much more abundant in the smaller size classes.

Archaeological Shovel Testing Case Study

Prehistoric archaeological site 45-LE-521 was discovered during a cultural resource survey for a natural gas pipeline project in a grassy prairie along a stream in western Washington (Hannum and Wilson 2002). Mineral ground surface visibility was poor and after extensive shovel testing using coarse-mesh (¼-in.) screening to delineate the archaeological site boundaries, the pipeline alignment was rerouted around the identified boundaries to avoid construction impacts to the archaeological site. Initially it appeared that the cultural resource management process was working to prevent inadvertent impacts to the archaeological deposits. However, after construction was completed local residents said that projectile points were unearthed during trenching for the pipeline in the rerouted alignment (Fig. 2). Subsequently, a local agency planning to extend a road across raw land in the same area commissioned a cultural resource survey according to Washington State Department of Transportation guidelines (Baker and Smits 2006; Sharma and Ozbun 2006). The road survey included a review of Department of Archaeology and Historic Preservation records which revealed that prehistoric archaeological site 45-LE-521 had been previously recorded in the area immediately adjacent to the proposed road alignment. The archaeological site boundary delineation conducted for the pipeline project indicated that the site did not extend into the road project area. Nonetheless, additional shovel testing was conducted in the road project area using fine-mesh (⅛-in.) screening to sift shovel test sediments for artifacts. The fine-mesh screened shovel tests identified artifacts in the same area where the coarse-mesh screened shovel tests excavated for the pipeline project had not. Based on the fine-mesh screened shovel tests, the boundaries of archaeological site 45-LE-521 were enlarged to more than three-times the previously recorded site size, extending across the proposed roadway and the already-constructed pipeline (Baker, Punke, and Ozbun 2006).

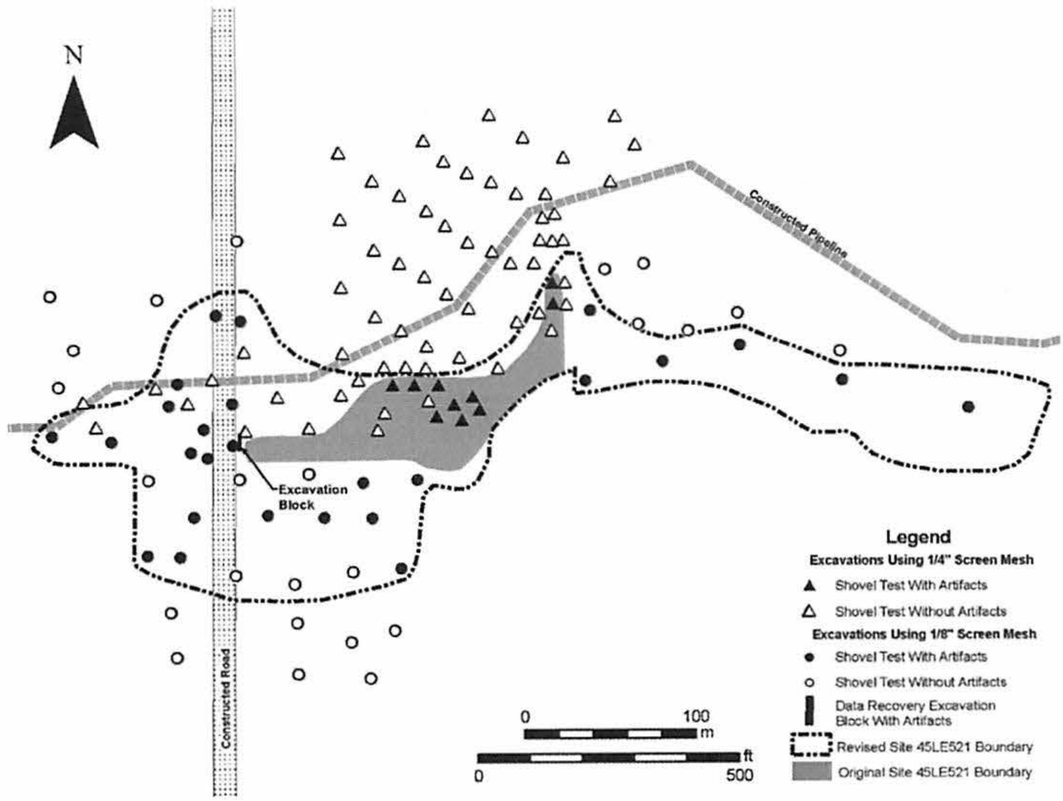

Fig. 2. Results of shovel test excavations using ¼-in. (triangle symbols on map) and ⅛-in. (circle symbols on map) screening to define site boundaries at 45-LE-521.

The now-larger size and configuration of 45-LE-521 precluded reasonable realignment of the proposed road project to avoid the archaeological site. A formal archaeological evaluation of the portion of site 45-LE-521 within the Area of Potential Effects of the road project was conducted resulting in identification of rich archaeological deposits determined eligible for listing in the National Register of Historic Places (Baker et al. 2006). As partial mitigation for impacts related to road construction, archaeological data recovery excavations were conducted and analyses of the data produced new information about the prehistory of the local area (Ozbun, Foutch, and Punke 2008). Over 25,000 artifacts were recovered in an area previously thought to be outside of the site boundary.

Why did the coarse-mesh-screened shovel tests fail to identify a highly significant archaeological deposit where fine-mesh screened shovel tests succeeded? The shovel tests dug for both projects were all about the same size and depth. The coarse-mesh screened shovel tests were more closely-spaced together than the fine-mesh screened shovel tests, a factor which should favor the coarse-mesh screened shovel tests. The coarse-mesh shovel tests were distributed in a more systematic pattern while the fine-mesh shovel tests were placed more opportunistically based on the judgment of the field archaeologists. While the merits of rigid systematics versus informed judgment are worthy of larger debate, the practical differences in this case are minor as both resulted in relatively even coverage of the respective project areas. It seems that the key factor was screen mesh size and that use of the finer mesh succeeded in identifying significant artifact deposits while the coarser mesh failed.

Flintknapping Experiment

In 1978 John L. Fagan conducted a series of seven flintknapping experiments. In each experiment he produced a basally-notched arrow point from a flake and captured all of the resulting debitage on a tarp. Many thousands of flakes and flake fragments were produced and all of them were passed through nested ¼-in. and ⅛-in. screen. Information for these experiments was obtained from tags located in the original bags containing the experimental materials and from recent (2009 through 2011) discussions about the experiments between the author and John Fagan (Fig. 3).

The results indicate that the vast majority of the debitage easily flowed through both screens and the screens captured a total of 316 pieces of debitage or flakes from all seven experiments combined. In the ¼-in. coarse-mesh screen a total of 6 flakes was recovered (2% of the screen-recovered assemblage) while 310 flakes (98% of the screen-recovered assemblage) were recovered in the ⅛-in. fine-mesh screen. In four of the seven individual experiments there were no flakes recovered in the coarse mesh at all (Table 1).

These flintknapping experimentation results show that ¼-in. or coarse-mesh screening allows recovery of only a tiny fraction of the abundant archaeological materials produced in the manufacture of arrow points. In fact, the recovery in coarse-mesh screen is so poor that it is easy to understand how the archaeological trace of such a flintknapping event could be missed altogether in a shovel test that would likely only sample a small portion of the debris from that event. Of course, arrow point production was probably not the only flintknapping activity to occur at most prehistoric residential sites and larger-sized debris might be expected to co-occur with the smaller artifacts. Nonetheless, my flintknapping experimentation in a broad variety of technologies indicates that very small flakes and flake fragments are almost always the most abundant.

Discussion and Conclusions

Lithic flakes or debitage from flintknapping are the most abundant artifacts recovered from prehistoric archaeological sites in the Pacific Northwest, and perhaps in most parts of the rest of the world as well. This is because they are produced in great quantities during flaked-stone tool manufacture and maintenance which were important technologies in prehistoric society. Lithic flakes are also remarkably durable, often preserved in good condition for tens of thousands of years or even hundreds of thousands of years or longer. Because of their durability, flakes survive in conditions where other potential archaeological materials do not. Conversely, perishable materials are rare except in extremely dry conditions such as in caves and in extremely wet conditions such as in water-logged sites.

Because lithic flakes are abundant in most prehistoric archaeological sites, they are excellent markers of activity areas in addition to being diagnostic of the flintknapping activities that created them. Though abundant, lithic flakes are often small and easy to overlook without close examination of the sediments that contain them at archaeological sites. Flintknapping experiments demonstrate that the tiniest flakes can exponentially outnumber larger flakes. Fine mesh screening is one technique that facilitates looking closely for these smaller flakes. Geometric logic, practical archaeological experience, and analyses of flintknapping experimentation dictate the abandonment of ¼-in. mesh in favor of ⅛-in. or finer mesh in most or all archaeological screening applications. In many cases it is probably better to dig less and capture more data from those excavations than it is to dig more and let the majority of the artifacts slip through our fingers.

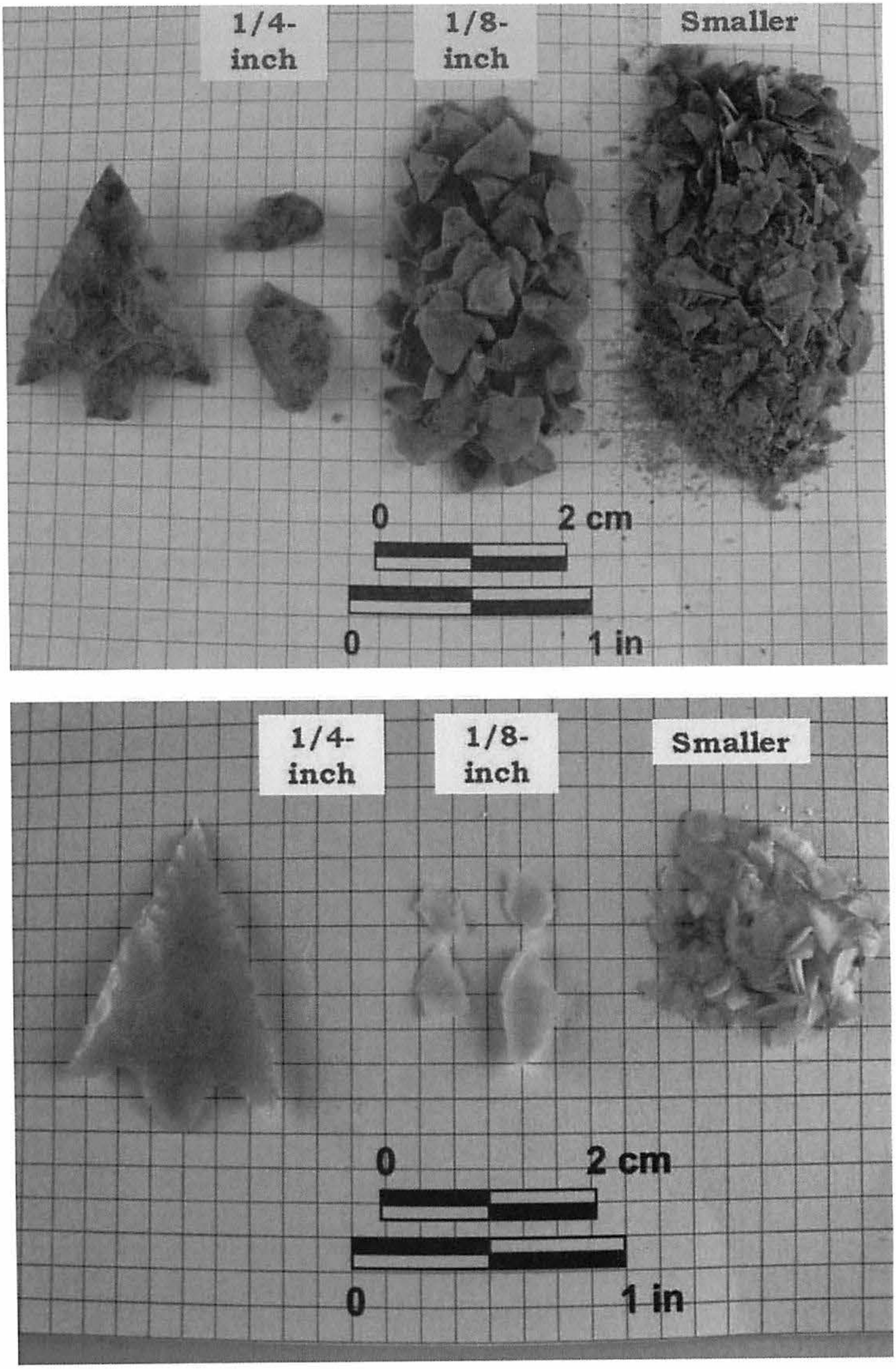

Fig. 3. Size distribution of flakes in two of John Fagan's arrow point manufacturing experiments. Experiment 1 (top) and Experiment 2 (bottom).

TABLE 1. SIZE DISTRIBUTION OF FLAKES IN JOHN FAGAN'S ARROW POINT MANUFACTURING EXPERIMENTS[a]

Experiment Number	Flakes in ¼–inch	Flakes in ⅛–inch
1	2	73
2	0	4
3	2	78
4	0	48
5	2	62
6	0	5
7	0	40
Total	6	310

[a]flake counts were obtained from tags placed inside each bag of flakes in 1978. These counts were verified through recounting of the flakes that were still separated in bags associated with the ¼-in. and ⅛-in. screen sizes. The many thousands of flakes that went through both screens were not counted.

ACKNOWLEDGEMENTS

I am indebted to Dr. John L. Fagan, President of Archaeological Investigations Northwest, Inc., for providing the experimental samples and data for his flintknapping experiments. John recognized the significance of small flakes and conducted these experiments in the year I graduated from high school, before I even knew what flakes or flintknapping were. His generosity in sharing knowledge and data is legendary. Carolyn McAleer (Oregon Department of Transportation) and Scott Williams (Washington Department of Transportation) graciously invited me to participate in their Northwest Anthropological Conference symposium and have been supportive and encouraging in the process of preparing this paper for publication.

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