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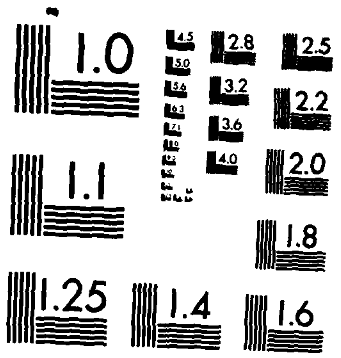

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UNIVERSITY OF WASHINGTON, OFFICE OF PUBLIC ARCHAEOLOGY
for U.S. ARMY CORPS OF ENGINEERS, SEATTLE DISTRICT

RESEARCH DESIGN FOR THE CHIEF JOSEPH DAM CULTURAL RESOURCES PROJECT

S.K. Campbell, editor

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This document summarizes the research goals and strategy of intensive data recovery performed by the University of Washington Office of Public Archaeology at the Chief Joseph Dam Project in north-central Washington state, 1978-1985. During the seven-year span of the project, the overall goals changed in response to changes in the theoretical interests of the discipline and in cultural resources management practices and concerns. The introductory chapter discusses the scientific and humanistic concerns which guide cultural resource management for the project and the specific objectives of this phase of data recovery. Background information on the environment, Native American inhabitants and previous archaeological work in the area is provided in three separate chapters. The remainder of the report emphasizes strategic and tactical decisions made in data collection and analysis. The method of site selection, the sampling designs used at individual sites, and the excavation techniques used are reported. The rationale and procedures for dividing sites into analytic cultural zones based on stratigraphic analysis and other chronological information is described. A brief description of the data management system is given. Separate chapters summarize the goals, special data collection techniques, and analytic methods used in analysis of artifacts, faunal remains, botanical remains, and features.

RESEARCH DESIGN FOR THE CHIEF JOSEPH DAM CULTURAL RESOURCES PROJECT

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Office of Public Archaeology
Institute for Environmental Studies
University of Washington

1984

ABSTRACT

This document summarizes the research goals and strategy of intensive data recovery performed by the University of Washington Office of Public Archaeology at the Chief Joseph Dam Project in north-central Washington state, 1978-1985. During the seven-year span of the project, the overall goals changed in response to changes in the theoretical interests of the discipline and in cultural resources management practices and concerns. The introductory chapter discusses the scientific and humanistic concerns which guide cultural resource management for the project and the specific objectives of this phase of data recovery. Background information on the environment, Native American inhabitants and previous archaeological work in the area is provided in three separate chapters. The remainder of the report emphasizes strategic and tactical decisions made in data collection and analysis. The method of site selection, the sampling designs used at individual sites, and the excavati techniques used are reported. The rationale and procedures for dividing sites into analytic cultural zones based on stratigraphic analysis and other chronological information is described. A brief description of the data management system is given. Separate chapters summarize the goals, special data collection techniques, and analytic methods used in analysis of artifacts, faunal remains, botanical remains, and features.

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PREFACE

The Chief Joseph Dam Cultural Resources Project (CJDCRP) has been sponsored by the Seattle District, U.S. Army Corps of Engineers (the Corps) in order to salvage and preserve the cultural resources imperiled by a 10 foot pool raise resulting from modifications to Chief Joseph Dam. Intensive data recovery took place between 31 July 1978 and 31 December 1984 under Contract DACW67-78-0106, which provided for excavation, analysis, and reporting of 18 prehistoric habitation sites.

The Project's investigations are documented in four report series. Reports describing archaeological reconnaissance and testing include (1) a management plan for cultural resources in the project area (Jermann et al. 1978), (2) a report of testing at 79 prehistoric habitation sites (Leeds et al. 1981), and (3) an inventory of data derived from testing. Series I of the mitigation reports includes (1) the project's research design (Campbell 1984d) and (2) a preliminary report (Jaehnig 1983b). Series II consists of descriptive reports on prehistoric habitation sites excavated as part of the project (Campbell 1984b; Jaehnig 1983a, 1984a,b; Lohse 1984a-f; Miss 1984a-d), prehistoric nonhabitation sites and burial relocation sites (Campbell 1984c), and a report on the survey and excavation of historic sites (Thomas et al. 1984). A summary of project results is presented in Jaehnig and Campbell (1984).

Like management of cultural resources in general, the design of data recovery for this project was never static, but changed considerably throughout the history of the project. Until 1978, when the initial reconnaissance had been completed and the salvage of the first six sites begun, the Corps policy was that it did not fund research but only studies, and the word "research" was not connected with the project. Explicit study goals, data recovery decisions, and plans for analysis systems were presented in a Plan of Action for testing (Jermann, Dancey, and Whittlesey 1978) and a Plan of Action for salvage (Jermann and Whittlesey 1978) and a Management Plan (Jermann, Dancey, Dunnell and Thomas 1978). A Research Design was added to the list of reports required by the contract when the Corps policy changed. A draft research design (Jermann et al. 1980) presented to the Corps in 1980 was not accepted as fulfillment of the contractual requirement for a research design but is nonetheless an important project document outlining research goals and relating these to many specific data recovery strategies and tactics.

The draft research design was written as a regional study, not restricted in geographic scope to the project area, nor restricted in scope of work to minimum mitigation. Although there were many practical problems with the research design, it was an integrated design aimed at investigating activity areas at sites and testing a subsistence system model based on reconstruction of Sanpoil/Nespelem ethnographic subsistence and settlement pattern. One of the weaknesses of the draft research design was a lack of emphasis on temporal control and on measuring cultural change through time. However, more important were its shortcomings as an actual guide for project data analyses (field data recovery already having been completed at that point). The draft research design did not adequately relate the model to be tested to the archaeological data recovered. Some aspects of data recovery and analysis were well described and their relevance to project research goals adequately justified, particularly site sampling, faunal analysis, and artifact analysis. However, specific expectations were not derived from the model to be tested in the archaeological record. Further, certain critical aspects of the data collected, such as features, were not dealt with at all.

While the draft research design is an exciting and important document because of the elaborate effort at modelling which it comprises, it is not an accurate summary of what was actually done in analysis, and it does not reflect the goals which evolved during the analysis and writing of the descriptive site reports. The project did not immediately revise the research design but turned to the higher priority of writing the descriptive site reports. The present research design was written at the same time as the summary report, the last project report to be written. It is not a revision of the first draft, but a document with a rather different goal. I did not attempt to construct post hoc a research design that accounts for all the strategic and tactical decisions made. My goal is rather to describe those decisions, how they affected the data, and the reasons behind them, regardless of whether they relate to the same integrated research design or not.

This document refers primarily to investigatons of prehistoric habitation sites. The research objectives for investigation of historic sites and prehistoric nonhabitation sites, including details of site selection and analysis not discussed here, are in the historic and nonhabitation site reports. (Thomas et al. 1984; Campbell 1984c).

ACKNOWLEDGEMENTS

This report is the result of the collaboration of many individuals and agencies. During the excavation and early reporting stages, Coprincipal Investigators were Drs. Robert C. Dunnell and Donald K. Grayson, both of the Department of Anthropology, University of Washington, and Dr. Jerry V. Jermann, Director of the Office of Public Archaeology, University of Washington. Dr. Manfred E.W. Jaehnig served as Project Supervisor during this stage of the work. Since the autumn of 1981, Dr. Jaehnig has served as Coprincipal Investigator with Dr. Dunnell.

Three Corps of Engineers staff members have made major contributions to the project. They are Dr. Steven F. Dice, Contracting Officer's Representative, and Corps archaeologists Lawr V. Salo and David A. Munsell. Both Mr. Munsell and Mr. Salo have worked to assure the success of the project from its initial organization through site selection, sampling, analysis, and report writing. Mr. Munsell provided guidance in the initial stages of the project and developed the strong ties with the Colville Confederated Tribes essential for the undertaking. Mr. Salo gave generously of his time to guide the project through data collection and analysis. In his review of each report, he exercises that rare skill, an ability to criticize constructively.

We have been fortunate in having the generous support and cooperation of the Colville Confederated Tribes throughout the entire length of project. The Tribes' Business Council and its History and Archaeology Office have been invaluable. We owe special thanks to Andy Joseph, representative from the Nespelem District on the Business Council, and to Adeline Fredin, Tribal Historian and Director of the History and Archaeology Office. Mr. Joseph and the Business Council, and Mrs. Fredin, who acted as liaison between the Tribe and the project, did much to convince appropriate federal and state agencies of the necessity of the investigation. They helped secure land and services for the project's field facilities and to establish a program which trained local people (including many tribal members) as field excavators and laboratory technicians. Beyond this, their hospitality has made our stay in the project area a most pleasant one. In return, conscious of how much gratitude we wish to convey in a few brief words, we extend our sincere thanks to all the members of the Colville Confederated Tribes who have supported our efforts, and to Mrs. Fredin and Mr. Joseph, in particular.

My role as editor was to meld various project documents to outline the large goals, the intentions behind our analyses, the finer details of biases and changes in analytic procedures, and even the failures of some attempts. Data collection methods used throughout the course of the project are well documented in project files. However, there are gaps both between the overall research goals and the detailed tactical decisions which were made, and between plans of action and what was actually done later. These are gaps which I have attempted to fill. I have not emphasized intentions, except as they explain the context within which some decisions were made. Otherwise my purpose is primarily to describe what was actually done.

As indicated above, I compiled this manuscript from a variety of project documents. So many people have contributed to each section by writing, commenting, or editing, that I have not indicated individual authorship. Here I would like to express my appreciation for all individual contributions.

One of the major sources I used in compiling these chapters was the draft research design. It was an invaluable document for explaining the research goals which dictated many of the analytic decisions. It also contained sections on sampling, field techniques, lithic analysis, faunal analysis, botanical analysis, and records management. The only parts that I used **verbatim** are in Chapter 8, the artifact analysis chapter. The flow charts of various analyses were taken from that report as well.

Another major source of information was the introductory sections written originally for the descriptive site reports, and then excised to be included in the research design. Introductory materials for the faunal chapter were contributed by Lee Lyman and Stephanie Livingston and those for the botanical chapter by Nancy Stenholm. Both Nancy Stenholm and Dorothy Sammons-Lohse contributed to the introduction for the feature chapter. All of these sections were updated considerably for this report as they were initially written for the first few site reports, 45-OK-287, 45-OK-288, and 45-OK-18, after which there were many changes in practices. Nancy Stenholm wrote a methods section for her summary report section that was used here to update the methods section. Dorothy Sammons-Lohse also contributed some discussion of method in her summary report of features.

I took the bulk of the Chapters 2, 3, and 4, the environmental, cultural and archaeological background chapters, from the preliminary report (Jaehnig 1983b) written by Manfred Jaehnig with the assistance of Linda Leeds, Marilyn Hawkes, and Helen Mundy-Hudson. They had adapted the environmental and cultural context sections for the preliminary report from comparable chapters in the testing report (Leeds et al. 1981) and abridged versions thereof originally developed for inclusion in the site reports. To Chapter 3 I added a summary of the historic period which I had originally written for the 45-OK-2 site report. Lawr Salo of the Corps edited and expanded Chapter 4.

For the description of site sampling designs I used two sources. The draft research design provided an overview of the goals of the sampling program and explanation of some aspects of the sampling strategies. Details of the actual practices, considerably more complex and variable than anticipated, were taken from write-ups made for each site by Dr. Jermann.

The description of stratigraphic data collection and analysis incorporates a description of the sediment analysis program written by S.N. Crozier. I wrote the original version of the section on site zoning, which benefited considerably from editorial work and comments made by other project researchers.

Karen Whittlesey, in charge of the laboratory throughout most of the project kept excellent records of procedures and changes in procedures, and circulated these to participating researchers. Her records have been invaluable for summarizing processing and artifact analysis practices, and changes therein.

Lawr Salo provided editorial comments on the first draft of this version of the research design. Although there was no editor to review the second draft, all of the sections benefited from editing done previously by Linda Leeds, Marc Hudson, and Helen Mundy-Hudson.

1. INTRODUCTION

This report describes the data recovery design of a program of intensive excavation of cultural resources sites along the upper Columbia River area in north central Washington State (Figure 1-1). This cultural resources project, conducted by the University of Washington, Office of Public Archaeology (OPA) between September 1978 and December 1984 under contract (Contract DACW 67-78-C-0106) with the U.S. Army Corps of Engineers, Seattle District (the Corps) was undertaken because of an imminent ten-foot pool raise behind Chief Joseph Dam near Bridgeport, Washington.

CHIEF JOSEPH DAM PROJECT

The dam project authorized as "Foster Creek Dam and Powerhouse" by the River and Harbor Act of 24 July 1946 was renamed "Chief Joseph Dam" in 1948. In 1978, it consisted of the dam and powerhouse, storage and construction facilities, switchyards, recreational facilities, Resident Engineer offices, several miles of access roads and 9,872 acres (3,995 ha) of land. These facilities and properties are in north-central Washington along the Columbia River, beginning 545 miles upstream from its mouth and extending a distance of 45 river miles upstream. To the north, the project is bordered by the Colville Reservation, belonging to the Colville Confederated Tribes.

In March 1976 the U. S. Army Corps of Engineers, Seattle District, began modification of the Chief Joseph Dam by adding 11 power generation units to the 16 units already in operation. These additions would be accompanied by a ten foot (3 m) raise in the level of the impounded reservoir (Rufus Woods Lake) to 956 feet (291 m) above mean sea level (m.s.l.). The pool raise would inundate approximately 700 acres along the 106 miles of shoreline of Rufus Woods Lake, causing total or partial flooding of cultural resource sites. The construction of the additional power units and the raise in pool level required (1) adding approximately 3,700 acres to the project lands, for a total of 13,642 acres; (2) structurally modifying the dam and power house; (3) constructing haul roads and storage and staging areas; (4) relocating 1.4 miles of Douglas County Road No. 321; and (5) excavating borrow pits and developing recreation areas.

The project area for cultural resources mitigation extends from Chief Joseph Dam at River Mile (RM) 545 upstream 45 miles to RM 590, just short of Grand Coulee Dam, and includes 2,015 ha (4979 acres) on both banks of the reservoir within the guide-taking lines for the pool raise (Figure 1). The pool raise took place in February 1981, flooding or partially flooding the cultural resources sites investigated by the project.

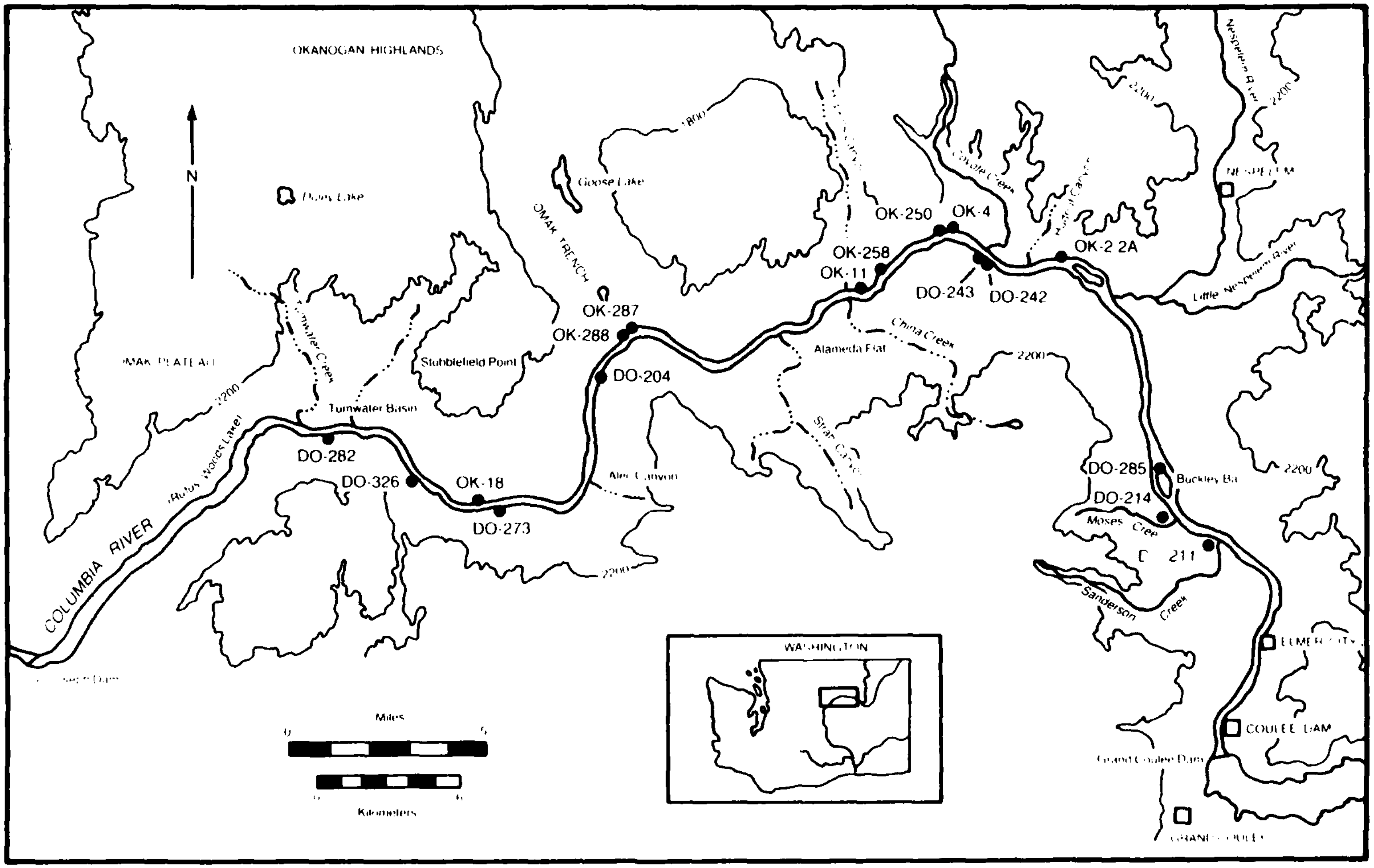

Figure 1-1. Map of project area showing locations of prehistoric habitation sites excavated.

CULTURAL RESOURCES MANAGEMENT, RUFUS WOODS LAKE

The current project is but one of a series of cultural resources projects related to construction or modification of Chief Joseph Dam. In fact, all archaeological investigations in the project area have been federally funded projects aimed at complying with legal requirements of protecting cultural resources. The first was a reconnaissance by the Smithsonian Institution River Basin Survey in 1949 before construction of the dam. This and the other projects are described in Chapter 4. Since 1975, the cultural resources in the Chief Joseph Dam project area have been managed by the U.S. Army Corps of Engineers, Seattle District.

Through time, the goals and specific objectives of cultural resources management in the project area have become increasingly sophisticated, explicit, and specific. Partly, this reflects changes in the practice of cultural resources management in general, but it is largely due to increases in the amount of information available about the cultural resources of the project area and the amount of time available to assimilate and utilize the information gathered by various projects.

Cultural resources investigations in and around this area during the past 20 years have identified over 240 prehistoric sites (Osborne 1949; Osborne et al. 1952; Leonhardy 1970b; Lyman 1976; Munsell and Salo 1977; Leeds et al. 1981). The conclusions of the first testing project were that there was minimal cultural variability represented by the archaeological remains in the Rufus Woods reservoir and that cultural occupation was very recent (Osborne et al. 1952). In 1970, Leonhardy had noted that the archaeological history of north-central Washington differs markedly from better known areas to the south, and that the north-central region could not be adequately understood on the basis of studies conducted along the Columbia River in the southern part of the state. The 1975 WSU study confirmed this conclusion when tests of the known prehistoric sites in the project area disclosed an even greater range of site types and materials than had been predicted. Both researchers concluded that cultural resources in the project area would provide a critical link in the understanding of the Columbia River prehistory (Leonhardy 1970b; Lyman 1976). Test excavations by the University of Washington in 1977 and 1978 at 79 of the prehistoric habitation sites increased our knowledge of the resource base many fold, particularly with respect to the length of occupation and the richness of individual sites. This information was used to develop a mitigation program to bring the Chief Joseph Dam Project into compliance with Section 106 of the National Historic Preservation Act of 1966 (16USC470) (Jermann, Dancey, Dunnell, and Thomas 1978; Salo and Munsell 1979). A number of documents written since then by the Corps and by the project (Jermann, Dancey, Dunnell and Thomas 1978; Salo and Munsell 1979; Jermann et al. 1980; Salo 1983) summarize the research potential of the prehistoric record in the project area and suggest directions for research.

At the most general level, cultural resources management has been guided by two fundamental concerns beyond the need for compliance with federal regulations: (1) to address humanistic concerns and (2) to meet scientific needs. The former are the feelings expressed by a local community of interest about cultural resources important to them; the latter are the research issues raised by a concerned scientific community with respect to a set of cultural resources in a project. The following discussion of these concerns is adapted from the Corps management plan (Salo and Munsell 1979) and subsequent Corps documentation connected with a testing project in the River Mile 590 vicinity (Salo 1983).

HUMANISTIC CONCERNS

Many members of the Colville Confederated Tribes currently live within a few miles of the project. The impact of the Chief Joseph Dam Project on current and former Indian lands are of particular concern to the Sanpoil and Nespelem members of the Tribes because many material resources relating to their cultural heritage had already been lost. All known Sanpoil winter villages were inundated by the reservoir behind Grand Coulee Dam before they could be properly salvaged. Likewise, many Nespelem villages and occupation sites were flooded and presumably destroyed when Chief Joseph Dam was built. The Tribal Council had expressed a desire to see their local history preserved through scientifically balanced preservation programs. They also wanted to see evidence of carefully planned consideration of their cultural resources by the Federal and other governments. By and large, recent cultural resource management programs in the area have successfully addressed Tribal humanistic concerns through their scientific investigation programs.

SCIENTIFIC CONCERNS

The project is in the Columbia Plateau culture area (Kroeber 1939). The chief long-range scientific reason for research into the prehistory of the area is to shed light on the process of how human beings arriving there were able to develop a stable pattern of village life while supporting themselves exclusively by fishing, hunting and gathering. In few other parts of North America, primarily the Northwest Coast and Coastal California areas, were such economic ways of life known in the mid-19th century when scientific interest in human economic systems arose and ethnographers began systematically recording details of native cultures. Many areas prehistorically appear to have supported stable hunting and gathering villages, but this way of life nearly always was replaced in the remote past by systems that relied on food producing, such as farming or herding, long before they could be studied as living systems. In only a few places has the hunting and gathering village pattern persisted until recorded history, mainly in coastal areas. The Columbia Plateau area is the only inland region where the pattern is documented well enough to develop archaeologically testable models.

Because human beings have spent nearly all of their two million year history as hunters and gatherers, study of that form of economic adaptation should be of interest intrinsically, inasmuch as hunting and gathering ways of life had a major influence on the process of becoming human. Understanding the strengths and weaknesses of the hunting and gathering adaptation and the processes of its development can add great depth to scientific knowledge of the flexibility and viability of other ways of life. The Columbia Plateau is one of the few places where an economic way of life that many cultures passed through earlier in their development can be studied with both historic and archaeological data to help us attain this understanding.

How hunters and gatherers adapted to glaciated and near-glacial environments, such as the project area, is a topic of special interest to scholars world‥'de. European prehistory shows a time lag in pioneering of deglaciated areas by human populations at any given level of economic adaptation, whether they are hunters, herders or farmers. The closer to the center of a glaciation, the longer it takes for stable human populations to establish themselves (Nelson; personal communication 1983). Why this is the case is not readily apparent, as glaciated areas support vegetation almost immediately after ice is no longer present. There is even evidence that thin continental glaciers were overgrown by vegetation colonizing the soil and rubble on top of the ice mass at its advancing or stagnant fronts. Where there is vegetation, there will also be animal life that could be used to sustain human lives.

The lag before most deglaciated areas were populated seems to be many hundreds or thousands of years. In areas of the northern part of the Plateau locally covered by glaciers, the earliest occupations are dated about 9,000 years ago, or over 3,000 years after the glacier departed. In areas further from the glaciers, occupations about 10,000 years old are found. Even further to the south, in Oregon and Idaho, occupations in excess of 12,000 years old occur. Occupations of the glaciated areas of the Plateau, such as the project area, did not become frequent until after about 7,000 years ago, and even then it was not until about 5,000 years ago the the population finally began to stabilize and expand. How the expansion was achieved has been the major focus of Plateau archaeology since the 1960s but it is not well understood. There is the corollary problem of **where** specific adaptations arose and how they came to predominate in an area.

To approach the major question of how hunting and gathering adaptations evolve in different situations many subordinate problems must be overcome. The temporal sequence of different levels and kinds of adaptation in an area has to be identified and described, a task that has occupied Plateau prehistorians for many decades with very limited success until recently. Hunters and gatherers, particularly the more mobile ones, typically leave behind little debris at their dwelling and worksites, so finding and identifying the age of these sites itself is a difficult task. To learn how these peoples used their territory and how and why those uses may have changed, scholars must have evidence from the many different kinds of activities the inhabitants engaged in at those locations. There also must be evidence from the sites to disclose their ages, if changes in the systems that left them are to be recognized. There is much information, albeit incomplete, from sites on riverbanks but little from the highlands which also were used, limiting the spatial scope of knowledge. Many of the observed differences in the record of cultural occupation in different localities on the Columbia Plateau might be accounted for by vagaries of sampling. Previous archaeological studies for exigent reasons simply had to ignore common caution and propose outlines of cultural sequences based on their samples in hand, even though these were small and with uncertain biases. Notable biases in Plateau archaeology include the lack of early assemblages representing houses, the areas within habitation sites in between houses but outside middens, and sites other than winter residences.

The chief assumptions of the mitigation program are as follows. The form and evolution of hunting/fishing and gathering adaptations are worthy of further scientific study using archaeological methods. Previous work in the Plateau was inadequate to understand how the local adaptation arose, or when, where and by whom it was introduced or created. The evolutionary history of the particular adaptation known from the Sanpoil-Nespelem area is of special interest to studies of adaption to wholly glaciated environments and of general interest because of the Plateau-wide use of Sanpoil-Nespellem ethnographic information to interpret archaeology and materials. As the last relatively major body of unspoiled riverine cultural resources from the homeland of the Sanpoil-Nespelem people, the Chief Joseph Dam Projects' archaeological sites offered the best hope for substantial and strong advances in knowledge of cultural chronology, economic patterns, settlement patterns, demography, and social organization for this area. Another chief assumption of the project therefore was that a significant effort was worthwhile to understand how sample systematics and size could bias regional reconstructions.

OBJECTIVES OF THE CHIEF JOSEPH DAM CULTURAL RESOURCES PROJECT

As discussed above, the driving force behind the project was the outstanding potential of the Chief Joseph Dam Project's archaeology as a natural laboratory for the study of evolution of land use and settlement patterns of semi-sedentary, hunting/fishing and gathering adaptive systems. In practice, our approach to these kinds of studies was constrained by contract requirements that we recover data only from sites in immediate danger of destruction by the pool raise. We also would be unable to carry out crucial auxiliary environmental background research. Because we know that prehistoric and ethnographic occupants of the area used the uplands as well we would not be able to identify all key economic elements of any prehistoric culture, nor could we carry out, therefore, a definitive study of change in any prehistoric system. With this constraint clearly in mind, we aimed our work at providing a useful sample of crucial information from the riverine setting, so that future scholars might be able to characterize whole systems and investigate their dynamics. In particular, we were interested in obtaining information from the very late prehistoric or protohistoric intervals that could be used to model and archaeologically test the adaptive system represented in the ethnography of the Sanpoil-Nespelem.

Developing and testing such a model has a high priority as a regional research topic, because the description of the Sanpoil/Nespelem seasonal round has been widely used as an informal model for interpreting the archaeological record of prehistoric cultural systems. This point has been made recently by other researchers.

> "Archaeologists have typically used Ray's ethnographic model for Sanpoil and Nespelem settlement for interpreting the past 2-4,000 years of the archaeological record in the southern Plateau. The rationale behind the heavy dependence upon this particular model is .... that these people were among those least affected by influences from the Plains and that, therefore, their adaptations were more "traditional". (Schalk 1982:208).

> "In order to interpret Plateau prehistory, archaeologists have placed heavy reliance on aboriginal culture as reconstructed by Verne Ray (1933) for the Sanpoil and Nespelem. The problem with strict adherence to this view is that it ignores some fundamental yet unexamined questions regarding ethnographic reconstruction of Plateau culture: (1) what was the nature of the early acculturation process on various Plateau groups? (2) what were the various elements that characterized the Euro-American/Indian contact process (missionaries, fur trade economy, disease, intermarriage)? (3) what was the significance of these elements among various groups or areas of the Plateau? and finally (4) how did these elements alter pre-contact cultural patterns such as seasonal movements, religious and political organization, ecological ties, and settlement patterns? (Mierendorf et al. 1981:76-77).

The assumption was made by the project that ethnographic modeling offers a reasonable path to understanding the relationship between archaeological data and local prehistoric land use/settlement patterns and an understanding of how local cultures evolved. The draft research design (Jermann et al. 1980) was a preliminary attempt to develop such a model and describe the data recovery program needed to test it. There are three major aspects of the draft research design, a model of the ethnohistoric Sanpoil-Nespelem subsistence and settlement patterns, a model of environmental productivity, and a research design for carrying out data acquisition, analysis, and synthesis to properly test the model. It is written as a regional study, not constrained to the contract specifications.

The ethnohistoric model was developed by identifying the most important economic activities described in the ethnohistoric record that would be likely to have archaeological consequences; and listing the location, timing/duration, energy sources, and material consequences of each activity. This was done in the framework of behavioral chain analysis. A thorough and explicit archeologically-oriented description of the Sanpoil-Nespelem subsistence and settlement patterns, this model is a major contribution to Plateau archaeology. We have included it in the project summary report (Jaehnig and Campbell 1984).

The environmental model comprises definition of topographic surrogate environmental zones and determining resource potential and productivity cycles within them. An important attempt at modelling environmental productivity, it nonetheless has major shortcomings. Although there is a significant body of evidence for past environmental changes, the model is static rather than dynamic. As the authors point out, the available environmental studies do not address all the important aspects of the environment, particularly change through time; supplemental data would have to be collected. Because of our interest in environmental modelling we encouraged independent researchers to do research on environments and paleoenvironments in the project area. A geomorphological study was carried out to investigate the history of landforms in the project area (Hibbert 1984). Dalan (1984a, 1984b) and Nickmann and Leopold (1984) did palynological studies on lake sediments. Stenholm surveyed the project area to determine relative seasonal plant productivity (Stenholm 1984).

The final step of the modelling, using the two environmental and cultural models as input for "economic simulation modelling" to assess the potential for different kinds of economic strategies in the study area, was never taken. Also, linkages between the model and the archaeological data were not adequately established. Comparability of such a model and archaeological data would be attained by expressing the model's consequences in the analytic units used by the archeological data recovery program. In this case, the model outputs were not stated explicitly in terms of the archaeological analytic units, and furthermore, required analyses which were too ambitious to be carried out by the project (particularly spatial analyses to define activity areas). However, some of the mechanics for carrying out data acquisition, analysis, and synthesis to properly test the model were well developed. Sampling at the regional and site level to insure appropriateness of the data and data recovery operations were specified in detail. Paradigms for classifying lithic artifacts were well developed, as were analyses of faunal and botanical remains. Systems of analysis for features and activity areas were vague, as were other synthetic types of tasks such as defining components.

Further development of this ambitious model would require data from a large number of sources and would be a major undertaking. Testing it would require specialized pedological, botanical and zoological studies beyond the scope of our work, to say nothing of archaeological studies in environments far outside the Chief Joseph Dam Project's boundaries. Because the model was never refined and completed, it did not serve as our interpretive guide when writing the descriptive site reports. However, the draft research design did guide the selection of types of analyses to be performed and the specific content of some.

Because testing the ethnographic model requires almost exactly the same general kinds of information as many other kinds of studies, the basic descriptive data generated by the analytic program developed in Jermann et al. (1980) was consistent with many types of research. When we began writing the descriptive reports, we wrote several objectives as a guide to a more limited and descriptive approach to summarizing the prehistory of the area. The four operating objectives which guided data recovery at the Chief Joseph Dam Cultural Resources Project were:

(1) to recover selected archaeological data pertinent to regional prehistory from within U.S. Army Corps of Engineers guide-taking lines;
(2) to organize these materials into a data base offering potential for future regional research;
(3) to describe geographic and chronological variability in the prehistoric record;
(4) to interpret this record and discuss its implications for Plateau prehistory.

The first objective, designed to guide field recovery of data, incorporated the following goals:

(a) using data from test excavations, to select sites for data recovery on the basis of kinds of sites present in the project area, structural/functional variability, geographic distribution, environmental variability, and the temporal variability of their assemblages;
(b) to recover assemblages representative of time periods and site functions existing prehistorically in the project area.

The second objective, designed to guide laboratory work, includes the following goals:

(a) to process and classify all recovered lithic, faunal, floral, sedimentary, and feature data;
(b) to computerize all data from field data recovery, lab processing, and classification and organize them into a manageable data base.

The third objective, developed to guide descriptive site reports, includes the following goals:

(a) to identify the history of natural deposition at each site and to specify its effect on questions about chronology and site use;
(b) to define discrete, vertical units of cultural deposition, termed analytic zones, that can be used for intrasite and intersite comparisons;
(c) to place zone assemblages in relative chronological order on the basis of stratigraphic information, radiocarbon dates, and artifact types and styles;
(d) to describe each temporally discrete assemblage in terms of standardized classes or data that will inform on the content and structure of functional activities within each analytic zone;

(e) to group the chronologically ordered assemblages into cultural periods.

2. ENVIRONMENTAL CONTEXT

The project area includes the floodplain and lower terraces in the Big Bend region of the upper Columbia River. This area once was occupied by hunter-gatherers who ranged from the banks and escarpments of the Columbia River Canyon to the Columbia Plateau and Okanogan Highlands, at least 100 kilometers to the south and north of the valley proper (Ray 1932; Spier 1938). The following sections summarize physical and biological aspects of the environment which probably influenced the lives of the area's prehistoric peoples.

PHYSIOGRAPHY

The Big Bend region is physiographically varied. In order to describe its main features, the area has been subdivided into four biophysiographic zones (B-P Zones): the floodplain (I), the canyon of the Columbia River (II), the basaltic Columbia Plateau (III), and the granitic Okanogan Highlands (IV). Figure 2-1 shows the elevational patterning of these zones at three locations within the project area. Each region probably was utilized by prehistoric peoples as all may be reached easily from the riverside sites and all offer sources of food.

BIOPHYSIOGRAPHIC ZONE I

The floodplain of the Columbia River (B-P Zone I) includes the river, its beaches and bars, and those lower terraces eroded by river action or built up by overbank deposits during postglacial times. In general, the pre-dam floodplain zone was dominated by a rather narrow, rapid river of high volume, flowing on bedrock between sedimentary bluffs of varying elevation. Where the valley is broadest--in the downstream portion of the project area--sparsely vegetated beaches of annually flooded sand and gravel bordered the river. In the upstream half of the area, low-lying terraces of glaciolacustrine sediments were inundated only during infrequent peak floods. Pre-dam aerial photographs show that deltas, bars, and cut-off meanders were rare. Rufus Woods Lake now covers most of this part of the floodplain.

Although close to the river, terraces standing above the sand and gravel banks are arid. Their sediments consist of well-drained silts and sands with little soil development. Few of the draws and valleys dissecting the floodplain are perennial watercourses although the bottoms of draws remain moist throughout much of the year. Away from the river, the lower terraces

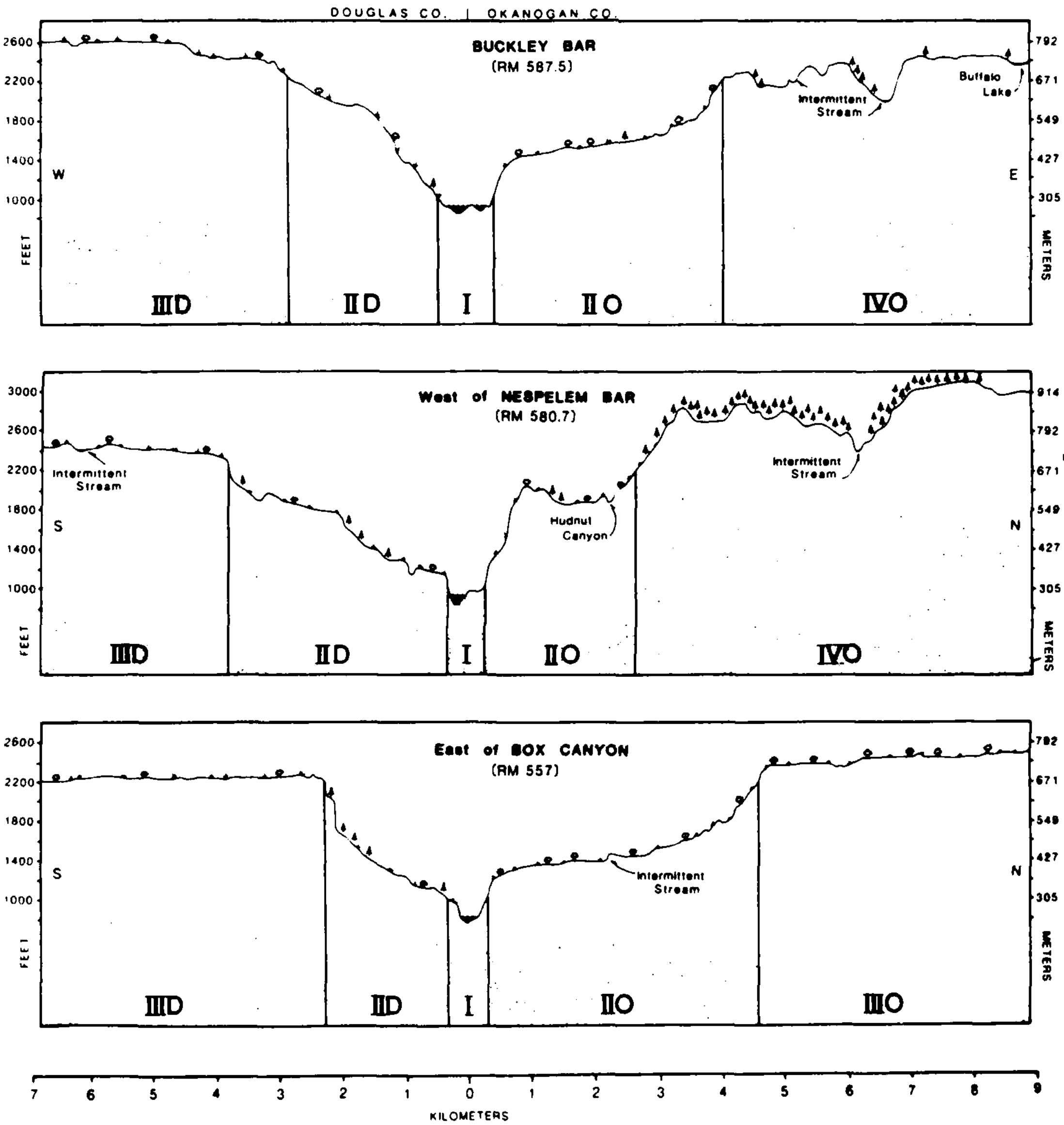

Figure 2-1. Three transects of the project area showing biophysiographic zones (D and O indicate Douglas and Okanogan Counties).

are overlaid by alluvial fans, colluvium, and rock slides from the canyon walls.

BIOPHYSIOGRAPHIC ZONE II

The physiographic features and geological deposits in B-P Zone II, the canyon of the Columbia, are the most varied in the project area. At lower elevations along some sections of the river, broad, flat terraces occur along both sides of the canyon. Depending on elevation and orientation to the river, the flat land and deep sediments provide surfaces ideal for constructing residences as well as for preserving evidence of occupation. The terraces are dissected by a multitude of draws: some deep and straight, others more shallow and meandering. While few of these contain perennial watercourses, their shallow, moist soils support a variety of vegetation which attracts animal life.

Where the original canyon was narrow, terraces have been washed away and towering bedrock bluffs rise from the river's edge. Stepped basalt escarpments rim the canyon's south side and basalt escarpments thinly cap the older highlands along the eastern margin of the Nespelem Valley (B-P Zone IIR). They also form the north side of the canyon west of the Omak Trench. High along these rims, just above and below 610 m (2000 ft) basalt vesicles and contact zones contain common opal, jasper and chalcedony, all commonly found in the project sites. Massive basalt lag blocks and glacial erratics are common along some stretches of the river.

The late Pleistocene glaciofluvial events that formed B-P Zone II are complex and not yet understood in detail. A geologic study carried out as part of the Chief Joseph Dam Project, however, does suggest that the canyon had essentially achieved its present form by at least 7000 B.P. and probably much earlier (Hibbert 1984). Soils and matrices examined in floodplain and fan deposits also imply no radical change of depositional environments during the last 6000 years (Crozier, personal communication). Since the Columbia terraces are believed to have been cut in quick succession before human occupation of the area, they are not useful for constructing a chronology of area occupations.

BIOPHYSIOGRAPHIC ZONE III

Zone III, the Columbia Plateau, includes all the area south of the Columbia River escarpment and the Omak Plateau, the area on the Okanogan bank west of the Omak Trench to the Okanogan River Valley. Beyond the Columbia River canyon rim, the land surface is shallowly dissected and gently undulant, with occasional low basalt bedrock mesas aproned with talus. The average elevation is 670 m (2,200 ft). Soils are characteristically thin and rocky, although the shallow heads of deeper valleys cutting the escarpment have thicker alluvial deposits and some soil development. Near the project area, glacial origin. On the Omak Plateau to the west of the Omak Trench, many of these lakes are saline.

The Grand Coulee and Moses Coulee, vast canyons cut deeply into basalt and granite, are the two major and highly dramatic landforms on the Columbia Plateau. They generally run north and south, perpendicular to the Columbia River. Both are located south and west of the project area. They were formed during the late Pleistocene when vast floods swept down the Spokane and Columbia Rivers beyond the nose of the resident glacier (the Okanogan Lobe) into the lower Columbia region. Moses Coulee is believed to have been formed sometime before Grand Coulee. This cataclysmic series of floods gave modern eastern Washington its characteristic channeled scablands. Both Grand and Moses Coulees were well within the range of project area peoples. According to Ray (1932), the Sanpoil and Nespelem hunted antelope in the Grand Coulee country. In addition to providing varied food sources, the coulees were convenient north-south travel routes.

The massive shield of bedrock north of the Columbia River in the project area is Cretaceous granitic rock known as the Colville Batholith. It was formed by underground crystallization of large volumes of molten rock probably during the early part of Late Cretaceous (McKee 1972). The Colville Batholith extends beyond the north and west parts of the project area and includes the Tonasket gneisses. Several acidic deposits from the Cretaceous and early Tertiary Ages intrude the batholith. The Columbia River runs on a bed entirely within these crystalline basement rocks. Outside the river canyon, the basalt-granitic contact generally lies above 1,800 m (5,095 ft) above sea level. The south rim of the Columbia River Canyon is basalt of Miocene age as is the north rim upstream from the Omak Trench. A later interbed from the Middle Miocene Age (Swanson and Wright 1978) consists of flat-lying, well-bedded fine sandstone and siltstones.

BIOPHYSIOGRAPHIC ZONE IV

The Highlands of Zone IV are a deeply dissected tableland with an average elevation between 600-900 m (2,000-3,000 ft). The peaks become progressively higher to the north. For example, Moses Mountain with a 1970 m (6,000 ft) elevation is less than a day's walk from the river up Coyote Creek. These are relatively ancient mountains, broad and well-rounded, representing a fairly mature stage of erosion.

Except for the Columbia River itself, there is little surface water in the project area although Foster, China, Sanderson, Stahl and Tumwater Creeks are perennial water sources. With its heavy snowfall, the Highlands is the area's major watershed. The Buffalo Lake aquifer where the Nespelem River, Little Nespelem River, and Coyote Creek originate is another dependable water source.

Although bedrock in B-P Zone IV is composed mainly of acidic intrusives (quartz monzonite-quartz diorite) of the granitic Colville Batholith (Pardee 1918:30), quartzite, greenstone, shale, limestone, marbles, and cherts sometimes are found in glacial outwash and tills in the uplands as well as in flood deposits on the floodplain. All of these minerals were used in lithic manufacture by the area's prehistoric peoples.

CLIMATE

The climate of the Columbia Plateau is semiarid (Daubenmire 1970:6). During the summer, moderate winds blow from the north and clear skies prevail: days are warm, and nights cool. During winter and early spring, storm fronts from the north Pacific bring overcast skies and southerly winds. The marine air masses lose most of their moisture crossing the Olympic and Cascade mountains, so overall precipitation is slight. The mean July temperature in Nespelem is 21° C. Winter temperatures, moderated by the marine air flow, are relatively mild. The mean January temperature in Nespelem is -4° C.

Elevation in the area has a major effect on both temperature and precipitation. Statistics gathered at Grand Coulee Dam and at Nespelem between 1964-1973 (NOAA 1974) indicate that precipitation increased as much as two inches per 1,000 ft (300 m) of elevation. Observers during the five-year span of the project note that the first killing frost in the Highlands occurs up to three weeks earlier than on the floodplain. Snows are heavier and accumulate more in the Highlands. Spring warming there may be as much as a month later than near the river.

The semiarid, steppe nature of the project area is expressed by the seasonal pattern of precipitation and the great variability from year to year. Most of the precipitation in the area falls from November to January; at lower elevations snow and rain evaporate quickly. Data gathered at Nespelem between 1915 and 1980 indicate that dry and wet years tend to alternate. Since vegetation in semiarid regions is sensitive to small changes in precipitation, the amounts of flora and fauna in the project area may vary considerably from year to year. However, these short-term and moderate variations are not necessarily indicative of long-term change. The significance of vegetation and climate changes over the last several thousand years, indicated by pollen analyses carried out at Goose Lake (Dalan 1984a; Nickmann and Leopold 1984) for hunter and gatherer groups is not known.

VEGETATION

Description of the vegetation in the project area's four bio-physiographic zones is based on studies conducted by Erickson et al. (1977), Daubenmire (1970), Daubenmire and Daubenmire (1968), and field studies made by Dr. Stenholm between 1981 and 1983. Sufficient information exists to present a general view of vegetation communities (Table 2-1). Figure 2-2 shows the biophysiographic zones and plant communities along an 8 km transect near RM 582. The transect runs northwest-southeast bisecting Mount Iams south of Panama Canyon in Okanogan County and crossing Bissell Flat along a line toward Black Lake in Douglas County.

Table 2-1. Location and dominant vegetation of habitat types in the project area (adapted from Erickson 1970).

	Habitat Type	Dominant Vegetation	Zone	Physiography
Steppe	Shrub-steppe	Sage (*Artemisia tridentata*) Bunchgrass (*Agropyron spicatum*) Bitterbrush (*Purshia tridentata*)	Zones I and II	Open terraces and hillsides
	Grass-steppe	Bunchgrass (*Festuca idahoensis*, *Poa sandbergii*) Sage (*A. tripartita*, *A. rigida*)	Primarily Zone III and upper parts of Zone IIL	High terraces and Plateau
	Rock	Bunchgrass (*A. spicatum*) Western virgin's bower (*Clematis ligusticifolia*) Mock-orange (*Philadelphus lewisii*)	Mosaics in all zones	Steep slopes (north-facing in Zone I)
	Rockland	Balsamroot (*Balsamorhiza sagittata*) Nine-leaf lomatium (*Lomatium triternatum*) Sage (*A. tripartita*, *A. tridentata*)	Mozaics in Zones I, II, and III	Open terraces and hillsides
	Macrophyllous vine and Shrub	Serviceberry (*Amelanchier alnifolia*) Mock-orange (*P. lewisii*) Western virgin's bower (*C. ligusticifolia*)	Mosaics in Zones I, II, and III	Seasonally moist draws
Broadleaf	Broadleafed tree Over Shrub	Hawthorn (*Crataegus columbiana*) Cottonwood (*Populus trichocarpa*) Water birch (*Betula occidentalis*) Ryegrass (*Elymus glaucus*)	Mosaics in all zones	Draws with perennial flowing springs
	Coniferous Tree Over Shrub	Pine (*Pinus ponderosa*) Serviceberry (*A. alnifolia*) Mockorange (*P. lewisii*) Bitterbrush (*P. tridentata*)	Mosaics in Zones I and II	Steep, north-facing slopes
	Coniferous and Broadleafed Tree Over Shrub	Pine (*P. ponderosa*) Water birch (*B. occidentalis*) Mockorange (*P. lewisii*) Snowberry (*Symphoricarpos albus*)	Mosaics in Zones I, II, and IV	Draws with perennial flowing springs
Coniferous	Coniferous Forest	Douglas fir (*Pseudotsuga menziesii*) Pine (*P. ponderosa*) Bitterbrush (*P. tridentata*) Squaw current (*Ribes cereum*)	Zones I, II, and IV	Widespread in Zone IV; steep, north-facing slopes in Zones I and II
Riparian	Riparian	Horsetail (*Equisetum arvense*) Dutch rush (*E. hyemale*) Tule (*Scirpus acutus*) Sedges (*Carex spp.*)	Patches in all zones	Surface water

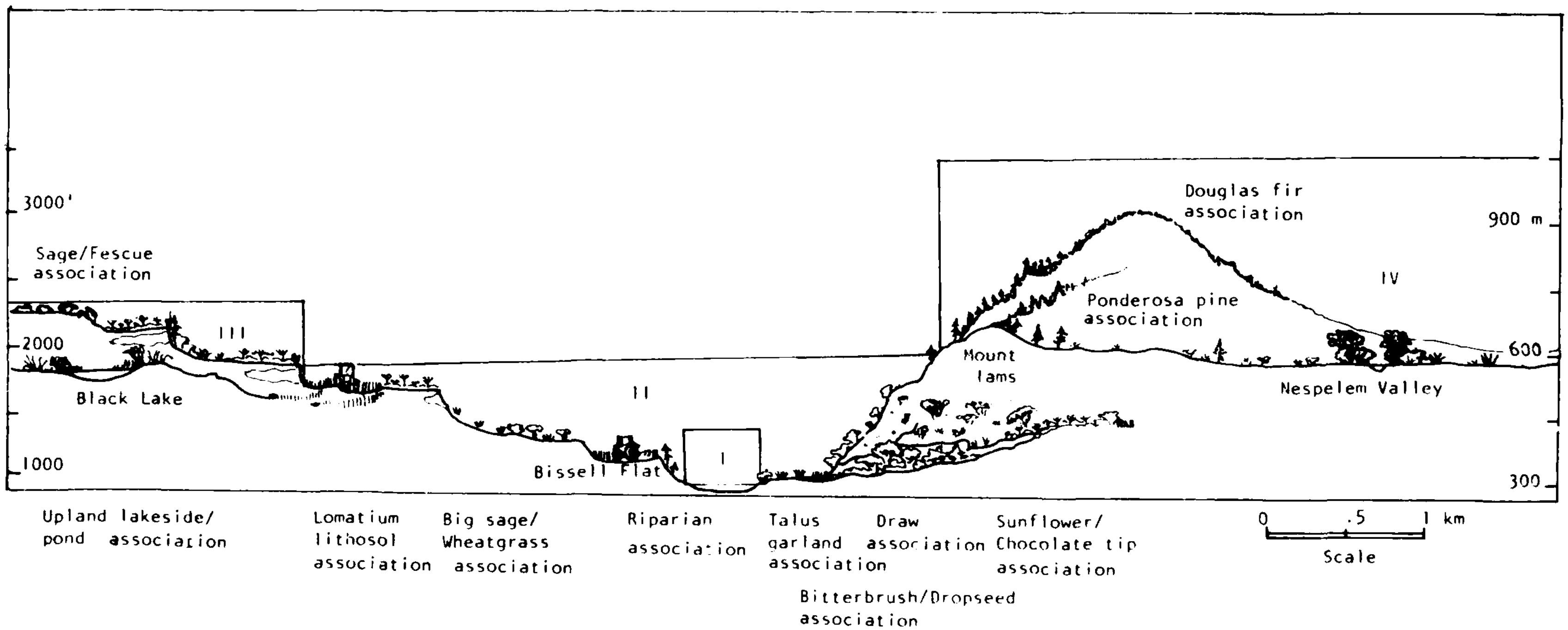

Figure 2-2. Transect near RM 582 showing plant communities.

Since long-term climatic changes probably affected the relative abundance and distribution of plants rather than their presence and absence, and since all sites in the project area have yielded tools useful for preparing plant foods, it is likely that the economic flora used in recent times also were used in prehistoric times. Area vegetation is of particular interest to the Chief Joseph Cultural Resources Project because botanic remains from several sites were analyzed. The project botanist has made a detailed study of area plants by biophysigraphic zone which stresses descriptions of economic plants utilized by Native Americans during the ethnographic period. This more extensive and detailed description will be incorporated into the summary report (Jaehnig and Campbell 1984d).

In general, the project area region produces a varied supply of roots, berries, nuts, seeds, reeds, and mosses. Timber, in the form of driftwood, probably was salvaged from the river. B-P Zone II is the richest zone for collecting edible plants and other materials. The bases of rockfalls and talus slopes support a variety of shrubs valued for their berries. Serviceberries, rose hips, cherries, currants, hawthorn fruits and hackberries are found here along with important woods (mockorange and hackberry, among others) and cordage materials. Near the lakes in B-P Zones II and III, reeds and other construction materials abound.

Sandy soils support the important lomatium community. Today the former dietary staples of camas, onion and bitterroot still may be found in relative abundance around Rebecca Lake and in stony ground on Goose Lake flats (see Figure 1-1). Many roots and nearly all stored berries collected by people in ethnographic times are from B-P Zone II. Roots grow in greatest abundance in B-P Zone III.

The upland region of B-P Zone IV probably was always more important as a hunting rather than a gathering area. Edible black "moss" (actually a food) grows there, mainly on larch trees, as well as several berries (foam berries, mountain huckleberries, thimbleberries and others) that are not found at lower altitudes. Wild strawberries and several kinds of mushrooms also have been gathered from the moist upland forest in recent times. In general, the forest was a repository of late-ripening fruits and arborescent raw materials such as bark, nuts, boughs, sap, resin and cambium.

FAUNA

The modern occurrence, relative frequencies, habitats, distribution, and behavior of faunal species in the project area has been documented by Payne et al. (1975), Bureau of Reclamation (1976), Chaney and Perry (1976), Fielder (1976, 1977), Erickson et al. (1977), Erickson (1980), and Chambers (1980). Modern abundance and seasonality are summarized in Table 2-2. The structure and distribution of prehistoric faunal populations was greatly disturbed by Euroamerican influences, including fur trading, horses and guns. Certain species, whose remains commonly are found in archaeological sites, including elk, bighorn sheep, pronghorn antelope, bison, and fur-bearing mammals, are either severely reduced or locally extirpated. Deer is the chief exception.

Table 2-2. Relative abundance and seasonality of mammal species in the project area, July 1974-July 1975 (from Erickson et al. 1977:Table 8-2).

Resident Species		Relative abundance[1]	Seasonality[2]
Common Name	Scientific Name		
Yellow-bellied marmot	(*Marmota flaviventrii*)	Common	Resident
Least chipmunk	(*Eutamias minimus*)	Rare	Resident
Yellow pine chipmunk	(*Eutamias amoenus*)	Rare	Resident
Northern pocket gopher	(*Thomomys talpoides*)	Common	Resident
Great Basin pocket mouse	(*Perognathus parvus*)	Abundant	Resident
Western harvest mouse	(*Reithrodontomys megalotis*)	Rare	Resident
Bushy-tailed wood rat	(*Neotoma cinerea*)	Common	Resident
Deer mouse	(*Peromyscus maniculatus*)	Abundant	Resident
Sagebrush meadow mouse	(*Lagurus curtatus*)	Common	Resident
Muskrat	(*Ondatra zibethica*)	Rare	Resident
House mouse	(*Mus musculus*)	Rare	Resident
Montane meadow mouse	(*Microtus montanus*)	Common	Resident
Beaver	(*Castor canadensis*)	Rare	Resident
Porcupine	(*Erethizon dorsatum*)	Common	Resident
White-tailed hare	(*Lepus townsendii*	Rare	Resident
Nuttall cottontail	(*Sylvilagus nuttallii*)	Common	Resident
Shrew	(*Sorex* sp.)	Rare	Resident
Coyote	(*Canis latrans*)	Abundant	Resident
Black bear	(*Ursus americanus*)	Rare	Visitor
Raccoon	(*Procvon lotor*)	Common	Resident
Wolverine	(*Gulo luscus*)	Rare	Visitor
Badger	(*Taxidea taxus*)	Rare	Resident
Striped skunk	(*Mephitis mephitis*)	Rare	Resident
Bobcat	(*Lynx rufus*)	Common	Resident
Mule deer	(*Odocoileus hemionus*)	Abundant	Resident & Local migrant
White-tailed deer	(*Odocoileus virginianus*)	Rare	Local migrant
Moose	(*Alces alces*)	Rare	Visitor
Bat	(*Myotis* sp.)	Common	Resident

[1] Abundance rating: Abundant = frequently recorded; Common = regularly recorded in low abundance; Rare = infrequent records.

[2] Seasonality: Resident = year-long presence in study area; Local Migrant = seasonal in-migrant; Visitor = occasional occurrence.

Archaeological evidence suggests that relatively few resident animal species were hunted regularly by prehistoric peoples although pronghorn antelope and bison appear to have been used widely during some phases of the area's prehistory.

Ethnographic literature indicates that artiodactyls were the most frequently hunted mammals; deer bone (mule and white-tailed deer) is the most common mammal bone found in archaeological sites. Although data on the population size and structure of present deer herds cannot be applied to prehistoric herd sizes and structures, certain behavior patterns may be long lasting. Erickson (Erickson et al. 1977) found that during the winter (January to March), mule deer form large herds and forage nearer the Columbia River while in the summer (May through August), they form smaller herds and forage in the uplands away from the river (Erickson et al. 1977).

Among the other mammals, the omnivores (wolf, coyote, bear, cougar) in particular, roam throughout the project area. Chipmunks, pocket gophers, marmot, cottontails, ground squirrels, and badgers commonly dwell near the river. Archaeologists expect the bones of the smaller animals to occur naturally in archaeological sites on the floodplain. For example, mice remains are very common in project area sites, probably because the animals burrowed there. On the other hand, larger animals--badgers and cottontails, for instance--probably were hunted and brought to the sites for food.

A larger group of project area mammals live away from the river. The largest populations of fur-bearers are found in B-P Zones II and IV although muskrat and beaver are found along the Nespelem River. Other project area species, including martin, fisher, ermine, weasel, mink, porcupine and wolverine, inhabit uplands with tree cover or the coniferous forest itself. When bones of these mammals are found in archaeological sites, it is presumed that people brought them.

Although migratory waterfowl, upland game birds and other birds once inhabited the project area in large numbers, the hunting of birds, other than the occasional taking of eagles for feathers, rarely is mentioned in ethnographies; the ceremonial use of feathers may be a late practice. Occasionally, carved, decorated or polished bird bones are found in project sites.

Other major food sources of prehistoric peoples were anadromous fish, fresh water molluscs, and reptiles. Dam construction eliminated the mussel and turtle populations from the project area and destroyed the salmon runs. Some historical data on runs in the pre-dam Columbia River system may help reconstruct an average annual fish population available to earlier residents. Chaney and Perry (1976) estimate that 5,000,000 pounds (2,268,000 kg) of chinook salmon were taken from the river above the present site of Grand Coulee Dam each year. Table 2-3 provides data on fish species once prevalent in the Columbia River.

Table 2-3. Seasonality and availability of Columbia River fish in the study area.

Group	Species	Run Time	Average Weight (lbs)
Trout	*Salmo* spp.	Resident	---
Sucker	*Catostomus* spp.	Resident	---
Whitefish	*Prosopium williamsoni*	Resident	---
Steelhead	*Salmo gairdneri*	Mar.-July	9 3/
Sturgeon	*Acipenser transmontanus*	August ?	---
Chinook	*O.tschawytscha*	L.May-Jul. 1/	25 1/ 3/
Silver (coho)	*O.kisutch*	L.Aug.-L.Nov. 1/	10 3/
Chum (dog)	*O.keta*	L.Aug.-L.Nov. 1/	11 3/
Sockeye	*O.nerka*	June-Sept.	31/2-8 2/

1/ Ray 1932; 2/ Carl, Clemens, and Lindsey 1977; 3/ Bureau of Reclamation 1976.

3. CULTURAL CONTEXT

The primary ethnographic sources for the project area are Ray's (1932) study of the Sanpoil and Nespelem--the people occupying the area north and south of the Columbia River from above the Spokane River west to the Omak Trench--and Spier's (1938) study of the Sinkaietk, or Southern Okanogan--the people occupying the area around the Columbia and Okanogan River west of the Omak Trench. Regional summaries, ethnohistories, and ethnogeographies (Teit 1930; Spier 1936; Ray 1936, 1939, 1945, 1975; Lee 1967; Chance 1973; Chalfant 1974; Kennedy and Bouchard 1975; Bouchard and Kennedy 1979) provide useful supplementary information. Recent ethnobotanies of the area contain botanical identifications of plants used for food and technological purposes, as well as additional information on cultural activities associated with their colection and preparation (Turner et al. 1980; Turner 1978, 1979).

ETHNOGRAPHIC STUDIES

In 1928, Verne F. Ray began a study of the Salishan peoples of Northeastern Washington. Written as a masters thesis (UW 1933), this study of the Nespelem and the Sanpoil tribes, who lived in and around the present project area, has become the major ethnographic source of the region. Although the first contacts with Euroamerican culture had already taken place when Ray's informants were youths, the old life was as yet little disturbed. Like other Indians of the north-central Plateau, the Sanpoil and Nespelem were never party to treaties with the United States. They remained in their traditional habitats and lived according to their native culture, despite the presence of whites, until 1872. At that time, a reservation was set aside and they were concentrated on it gradually. The original reservation boundaries were the Columbia River on the south and the east, the international boundary on the north, and the Okanogan River on the west. Subsequently, the northern half of the area was subtracted (Ray 1932:3).

A second important source of information about northern Plateau life is Spier's (1938) study of the Sinkaietk or Southern Okanogan, the people occupying the area around the Columbia and Okanogan Rivers west of the Omak Trench. These various groups lived quite similar lives and the subsequent information is drawn from both Ray and Spier as well as other studies of Plateau peoples.

Present tribal residents, some of whom are descendants of the area's prehistoric peoples, occupy the original southern half of the reservation. The ten tribes, first gathered onto the reservation in 1872, are officially known as the Colville Confederated Tribes. The occupation area of the Sanpoil and Nespelem, north and south of the Columbia River from above the Spokane River west to the Omak Trench, is partly within the bounds of the present reservation. Both tribes spoke a dialect of Interior Salish as did the bands surrounding them.

While it was difficult, even forty or fifty years ago, to disentangle the original lives of the native peoples from cultural changes which began with the arrival of white settlers, the ethnographic summaries (and more recent ethnobotanies) are considered relatively reliable because the Plateau tribes remained more isolated and independent than tribes whose lands were more thickly settled by Euroamericans. Furthermore, some living members of the Plateau tribes (mainly older people now) know tribal customs and do some hunting and gathering. Although aided by rifles, pick-up trucks and freezers, they nevertheless follow certain seasonal work patterns of their immediate ancestors, some of which may have been passed down from more remote ancestors.

THE SEASONAL ROUND

Major activities of the yearly cycle are summarized in Table 3-1 and diagrammed in Figure 3-1. The central base of the settlement network was the winter village occupied from mid-October or November until the spring thaw. Foods (primarily roots, fish, and meat) and other materials destined for winter consumption were stored in or around the village. Before the protohistoric period, all winter dwellings were reported to be semi-subterranean (Ray 1932:31). The people devoted winter months to hunting, to maintaining their stores, clothing and tools; they visited between villages, held ceremonies, played music, told stories and amused themselves in other ways. During some winters, short hunting trips along the river supplied enough meat. In leaner years, groups of men and women went into the Okanogan Highlands in search of game (Ray 1932:28,77-94; Spier 1938:11,19-25). If the hunt lasted several days and produced a large kill, the party set up a base camp in the Highlands and butchered the meat there.

All the villages that Ray described were located along the Columbia River, although occupation sites have been found elsewhere in the project area. The Colville Tribal Archaeologist recently found a housepit village site in the Omak Trench north of the Goose Lake Substation (Jaehnig, personal communication). In general, however, parts of the territory away from the river were visited for hunting and gathering.

Ray states that after early spring thaws, families abandoned underground housing and established camps nearby (1932:27). During this season, a variety of local resources, such as freshwater mussels, fish, early greens, and small game supplemented the last stored foods.

Approximately 300 species of plants were known by area peoples in the recent past (Ray 1932, Spier 1938, Turner 1978, 1979, Turner et al. 1980). Fully 50% of the aboriginal diet consisted of plant foods (Post 1938:12) gathered by women in the spring and summer months. Little in the floral universe was neglected. If a plant was not selected as food, it found use as

Table 3-1. Subsistence/settlement system of the Sanpoil/Nespelem.

Season	Site Type	Location	Group	Subsistence Activities and Critical Resources
Feb - Mar	Spring camp	Floodplain	Most of community	Domestic activities. Day-long foraging trips: shellfish, small game, fish, prickly-pear, pine cambium, black tree lichen, early greens. Stored foods.
Mar - May	Root camp	Plateau, coulee	Several families	Day-long root digging trips: bitter-root, white camas (biscuit root), other roots. Consolidation and processing of roots. Occasional domestic activities. Base for hunting parties. Base for lithics procurement parties (?).
	Way camp	Plateau, coulee	Men	Hunting: antelope, deer, small game. Primary butchering (?). Quarrying (?): cryptocrystalline (?).
	Way camp	Plateau, coulee	Women	Root digging: bitter-root, white camas (biscuit root), other roots.
May - Aug	Fish camp	Floodplain	Large groups, mixed communities	Preparation of weirs and channels. Construction of summer dwellings and fish drying racks. Fishing: steelhead, chinook salmon. Day-long foraging trips: serviceberries, other early berries. Domestic activities.
Sep - Nov	Fish camp	Floodplain	Small groups	Fishing: silver (coho) and chum (dog) salmon, whitefish, suckers, trout. Day-long foraging trips: seeds, nuts.
	Way camp	Forest	Family groups	Long foraging/hunting trips: berries, nuts, black tree lichen, forest products, tules (?), deer.
	Way camp	Plateau	Family groups	Long foraging/quarrying (?) trips: tules, fall roots, cryptocrystalline (?).
Nov - Feb	Winter village	Floodplain	Winter community	Construction and maintenance of winter dwellings. Domestic activities: crafts, tool construction. Day-long foraging trips: fuel, pine cambium, black tree lichen. Opportunistic hunting: deer/elk.
	Hunt camp	Forest	Men, some women	Trapping: fur-bearing mammals. Hunting: deer/elk. Primary butchering and meat processing.

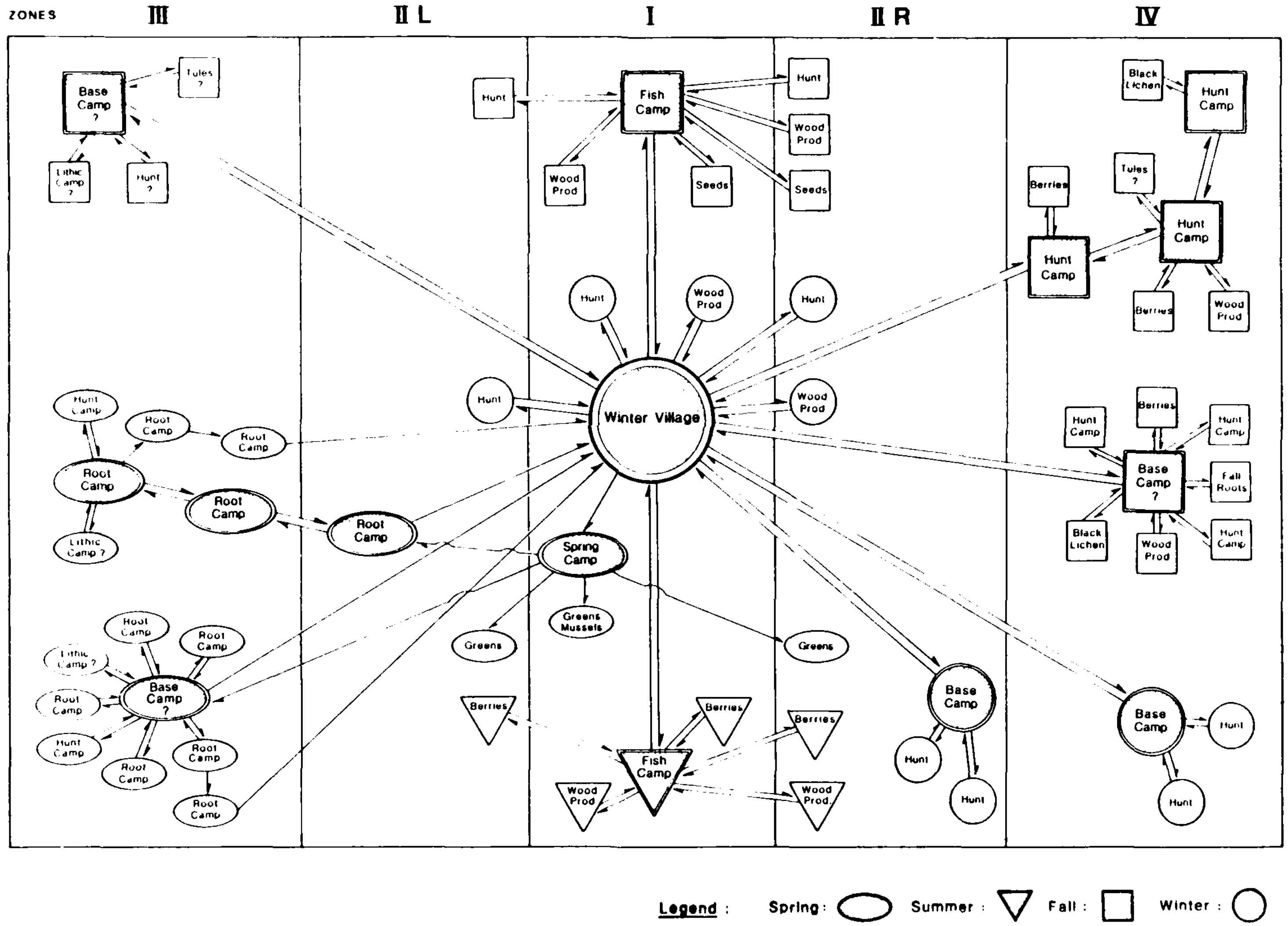

Figure 3-1. Diagram of ethnohistoric seasonal round.

a medicine, fuel, tool or raw material to make mats, textiles or cordage. The range of floral edibles was large and included bulbs, roots, nuts, seeds, fruits, lichen, mushrooms, tree sap and conifer cambium.

The yearly subsistence round began with the gathering of the first green shoots of spring, progressed to intensive collection of roots after April, continued with the serviceberry harvest in June and ended with harvests of chokecherries and other fruits in July, August, and September. Serial ripening of the major foodstuffs allowed time for processing and storing each crop, and time for travel between harvest areas. Impressions gained from ethnographic accounts suggest that the vegetal food supply was adequate in most years, and that surpluses were common enough to form the basis of trade (Post 1938:26; Turner et al. 1980:65,116).

Vegetable collection began in earnest when spring shoots appeared on the south-facing slopes near winter villages. Small groups of women guided by a leader with extensive knowledge of past conditions moved over the fields with digging sticks and collection baskets. A single collector might cover half an acre a day and harvest up to a bushel of fresh roots (Ray 1932:98). Roots were dried on the spot and transported back to the winter village site for storage. Roots which were particularly sought and gathered in large numbers included "white camas" or biscuit root (lomatium) and bitterroot. Desert parsley, Indian celery, wild onion, and desert lily also were prized. This early harvesting was accompanied by a First Fruits Ceremony to insure a good harvest. Similar ceremonies were held for each important food as it ripened. During the spring season, some families living on the north side of the river moved to traditionally rich gathering grounds in B-P Zones II and III. Others went to fishing areas.

About the first of May, sturgeon, small suckers and trout began to appear in the rivers, followed shortly by steelhead and chinook salmon (Ray 1932:28). As the first fish arrived, the people began setting up temporary fishing camps. The mouth of the Nespelem River is the only spot in the project area suitable for construction of a fish trap, and the spawning area below the falls in this stream is quite small. Accordingly, most fishing in the project area probably was done from canoes or by spearing and dip netting at rapids where weirs and artifical channels could be constructed (Ray 1932:58). Women were in charge of processing and drying fish on the temporary racks set up at the fishing sites. During this same season, women also were busy harvesting serviceberries along the lower stream courses and canyon bottoms. Wild currants and spring sunflower seeds were added to the food cache during midsummer. Chokecherries were harvested in August and either dried whole or made into cakes. Dogwood fruits, Oregon grape and wild gooseberries were picked in canyons and draws.

Summer fishing continued into August when the runs of chinook salmon ended. Around the first of September, there was a general disbanding (Ray 1932:28). While some people ventured up or down river in search of salmon which became scarcer in the fall, others went "into the mountains," either the Okanogan Highlands or possibly, after horses were introduced, into the Cascades to hunt and to collect berries, black tree lichen, and autumn roots.

The gathering season was mostly finished by the end of September. The last lower elevation fruits--blue elderberry and hawthorns--ripen then as do pine and hazelnuts in the mountains. Winter villages apparently were reoccupied around the middle of October. Ray (1932:28) reports that all dried foods were stored at this time and the houses cleaned and repaired. With the coming of the first frosts, a final phase of gathering took place around marshes and lakesides. Fiber-producing plants (nettle and Indian hemp), mat-making materials (bulrush) and other flexible materials such as bunchgrass, were taken in after they matured.

By mid-October the seasonal vegetal round was at an end. Berries, salmon, and raw materials were stored in underground pits and in above ground holds. In years of short supply, a few floral edibles--cactus pads, rosehips, and black moss--were collected throughout the winter to prevent starvation.

THE HISTORIC PERIOD

Historic period Native American occupations were investigated at 45-OK-2 and 45-OK-258. The fact that they were suspected, on the basis of survey and testing data, to be historic period village sites was a primary factor in selecting these two sites for excavation. The sites provide a research base for studying contact, and for evaluating the archaeological applicability of the ethnographically derived model of Sanpoil-Nespelem subsistence. Historic data thus provide an important context for interpreting the archaeological remains of the latest period of occupation in the project area. The following section provides a brief summary of nonIndian activities in the region between 1811 and 1950.

Three periods, distinguished by the nature of nonIndian activities in the region, can be distinguished. The period from 1811-1850 saw the establishment, operation, and eventual decline of the fur-trading system. Apart from the personnel of the fur companies, the only other nonIndians entering the area were missionaries and explorers. During the following period, 1850-1900, the primary economic activity was mining, and little settlement took place. However, the road to settlement was forcibly opened with military action against the Indians and the creation of reservations. In the period between 1900 and 1950, the reservation was open for settlement and settlement by nonIndians established a new economic system. Meinig (1968) has provided a detailed account of these periods on which the following discussion relies heavily.

The historic era in the region commences in 1811 with the records of a trip down the main trunk of the Columbia River from the Colville River to Astoria made by David Thompson of the North West Fur Company. Later that same year, a party representing the Pacific Fur Company established Fort Okanogan at the mouth of the Okanogan River, but did not travel further upriver. During the first season of operation, the lone man at the post, Alexander Ross, received 1550 pelts in return for a small amount of trade goods. The second season was less productive. In 1813, the North West Fur Company purchased all of the Pacific Fur Company holdings, and began operating Fort

Okanogan. The post was used primarily as a route junction, repair station, and supply depot, as the take of furs fell below the profitable level. In 1821, the North West Company merged with the Hudson's Bay Company, and the fort once again changed hands. The basic nature of the operations remained unaltered, however. In 1848, shortly after the 1846 treaty between the United States and Great Britain which established the International boundary at the 49th parallel, the Hudson's Bay Company abandoned Fort Okanogan, and began to withdraw from south of the new border.

During this same period, several church groups sent missions to the Columbia Plateau. Although the Methodist missionaries performed their work largely to the south, Francis Parker visited Fort Okanogan in 1836 as part of his larger tour of observation. Two Roman Catholic priests began making rounds of the Hudson's Bay Company posts in 1838, and regular services were established at Fort Colville in 1844.

During the British dominated fur trade era, a number of official and unofficial American expeditions explored the Columbia region. Although the travels of Bonneville in 1833-34 and Fremont in 1843 were further to the south, the Wilkes expedition of 1841 did pass through the project area. These explorations had little immediate impact on the native inhabitants, although the geographical information gained was an essential first step towards settlement in the area.

Thus, in the period 1811-1850 very few non-Indians ventured into the area, and they offered the native inhabitants little competition for land or resources. No archaeological evidence of Euroamerican activity dating from this period was found during the CJDCRP historic sites survey of the project area (Thomas et al. 1984). The Native Americans of the project area were probably less affected by direct contacts than by the indirect effects of contacts in other regions. The horse was introduced into the Plateau around 1730 (Haines 1938) and epidemic diseases for which the native had little immunity at least by 1780. Although the timing of their spread into the project area is not known, it was certainly before the beginning of historic records in 1811.

There was no rush to settle the Columbia Plateau after the signing of the international treaty: the westward stream of American settlers had been deflected southward by the discovery of gold in California. But in 1855 gold was discovered near Kettle Falls, and American and Chinese miners followed the gold rush north from California to the Plateau. The closest major mining area to the project area was the Okanogan district. Five placer mining sites found during the CJDCRP historic sites survey (Thomas et al. 1984) indicate some mining was done in the project area. The area was also affected by the new transportation routes which were developed to move supplies from Portland and Walla Walla north to the mining districts. The two ferry crossing sites found in the project area (Thomas et al. 1984) may date from this time period.

The Colville Reservation was created in 1872 and later diminished in favor of miners who said they had prior claims to the land. Along the Okanogan River, where there were many mining claims, Indian resentment over the loss of their land resulted in hostilities between the Indians and the miners. Competition with miners was probably less in the project area than to the north where mining was more productive. The north half of the Colville Reservation was opened for settlement in 1891, and the south half in 1916.

Although the fur trading period lasted for nearly 40 years, it seems to have had little impact on the native cultures of the Big Bend region. Although the Southern Okanogan were initially anxious to have the post established among them, they never had much interest in trapping. Relationships between the Indians and the post continued to be friendly, and Indians camped frequently outside the stockade walls, the volume of trading was probably slight. Although the Indians gained a few new items of material culture, there is no evidence of a shift to a cash economy, or adaptation to new food resources. The traders and trappers received most of their food supplies from the company and did not make so much use of the local food resources as to constitute a threat to the Indians. The impact on more distant groups, such as the Nespelem, would have been even less. None of the activities involved in the fur trade were oriented towards this stretch of the river; even transportation routes avoided the Big Bend region as much as possible to save time.

4. REGIONAL ARCHAEOLOGICAL HISTORY

Previous archaeological studies on the Columbia Plateau were consequential for working out cultural frameworks, chronologies, and classification systems at the Chief Joseph Dam Cultural Resources Project. Archaeological studies of the Plateau, nearly all undertaken in conjunction with the dam network along the Columbia River, are relatively recent when compared to similar work in other parts of the country. Most archaeological reports specific to the Columbia Plateau have been written within the past fifteen years. Before then, the Plateau's prehistoric life had been described only in broad terms as a part of general regional hypotheses about migrations and cultural habits. We will refer to these pioneering cultural synopses in the course of summarizing several projects which bear most directly on the Chief Joseph Project.

Other relatively recent investigations have also been influential in establishing a framework for the present project. Between 1958 and 1977, series of surveys, tests, and excavations were conducted at Kettle Falls, upriver from the Chief Joseph Dam Project; near the confluence of the Okanogan and Columbia Rivers, downstream from Chief Joseph Dam at Wells Reservoir; at Sunset Creek near Vantage, downstream from Wells Reservoir; and along the Lower Snake River (Figure 4-1).

FRASER RIVER

In the late 1960's, David Sanger summarized a series of archeological projects that had been carried out in the previous 15 years in southern British Columbia along the Fraser and Thompson Rivers, approximately 200 miles northwest of the Chief Joseph Dam Project (Sanger 1967). Based on excavated assemblages from about 20 components, Sanger (1963, 1966, 1968a, 1968b, 1969) saw a rough tripartite chronology comprising Early (four components dated from 7,600 to 5,000 years ago), Middle (5 components from 5,000 to 2,000 years ago)and Late Periods (11 components dating within the last 2,000 years). Five of these components were radiocarbon aged by 12 different determinations. Two sites near the mouth of the Fraser Canyon excavated by Borden provided comparative data. A projectile point typology/chronology was not developed.

Early Period assemblages show a microblade/microcore technology, not associated with housepit sites. Projectile points are large lanceolate forms, triangular and leaf-shaped, including some side and basal notched forms. These tend to resemble northern Plains more than Plateau sequences (Plano versus Windust/Cascade), although Cascade-like assemblages certainly are present. Antler wedges and rodent incisor woodworking tools are found. Fish

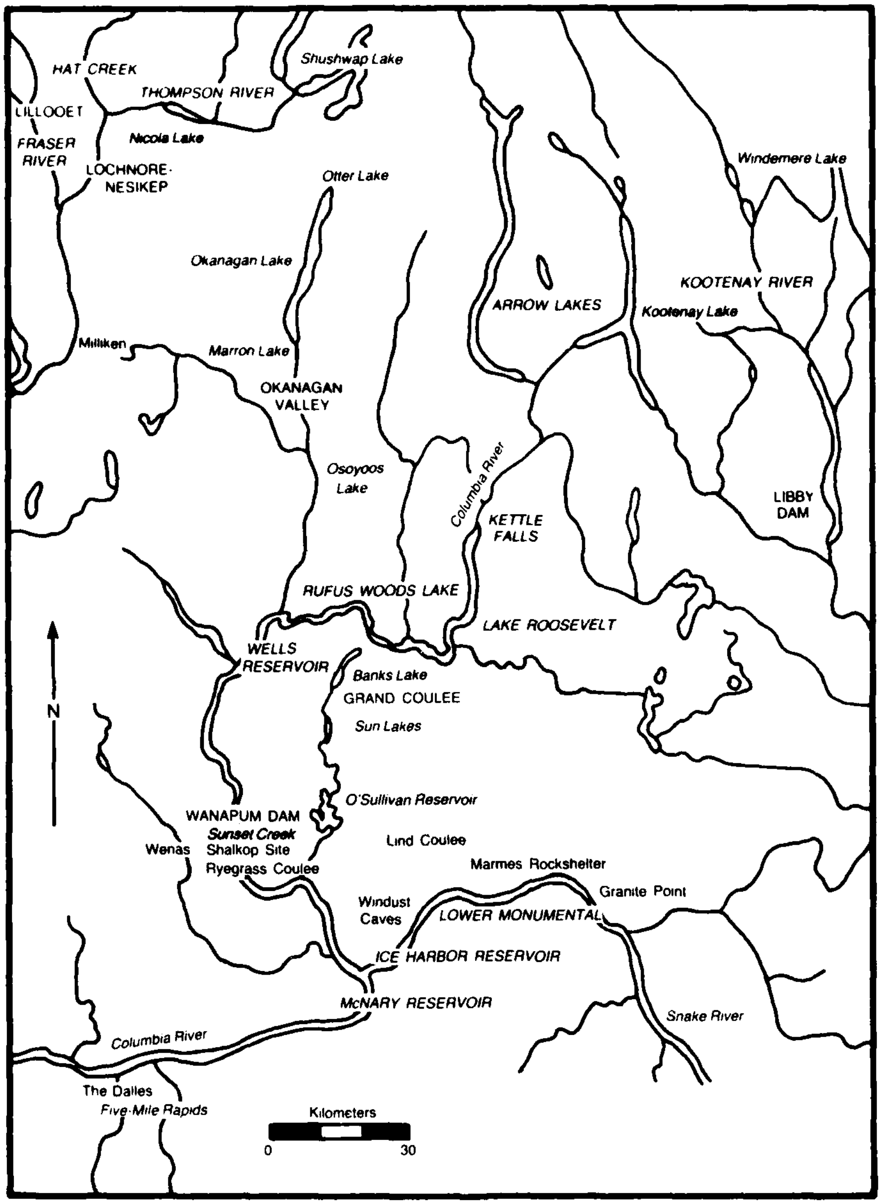

Figure 4-1. Map of Columbia Plateau showing locations of archaeological projects mentioned in text.

remains, presumed to be salmonid, are found at the Milliken site (8,000-9,000 years ago) and with at least one component about 7,600 years ago. No house forms were identified.

Middle Period assemblages continue the microblade/core technology, especially strongly expressed in the early part of the period from 5,000 to 3,500 years ago. This technology does not seem to be unequivocally associated with house sites although excavation samples often were small and may have failed to reveal buried houses. Projectile points mainly are expanding-stem and lanceolate forms with indented and notched bases that resemble northern Plains forms (Hanna-Duncan-McKean-Pelican Lake) more closely than southern Columbia Plateau forms, especially in the earlier part of the period. Later Middle Period (post 3,500 B.P.) basal notched and corner notched forms bear much stronger resemblance to southern Plateau forms. The later Middle Period also has a woodworking kit of wedges, nephrite adzes, beaver incisor chisels, and pecked mauls. Fish remains occur throughout the period. Houses (two meter deep subterranean) appear in the Later Middle period.

Late Period assemblages have no microblade technology. Small side-notched projectile points (arrow points presumably) are the characteristic forms, and the woodworking kit of the late Middle Period is continued. Fish remains continue. Housepits are more circular and shallower.

Many of Sanger's interpretations have been overshadowed by data from massive cultural resource projects since the mid-1960's but several observations still bear mention: the decline of the microblade technology by about 2,500 years ago, the apparent northern/eastern (Plains) cultural affinities of the Fraser River region until the later Middle Period, and the "northwesternization" of the area in the last 2,000 years.

ARROW LAKES

A series of salvage excavations at five of approximately 80 recorded sites in the Arrow Lakes region of the Columbia River in southern British Columbia was summarized in 1971 by Turnbull. Approximately 150 miles northwest of the Chief Joseph Project along the Columbia, Slocan and Kootenay Rivers, the investigations disclosed occupations corresponding in age to Sanger's Late Middle Period (about 3,300 to 2,300 years B.P.) bracketed by five radiocarbon dates. These "Deer Park Phase" assemblages have stemmed, corner-notched, and leaf-shaped projectile points resembling both northwestern Montana and Columbia Plateau types. There is a woodworking assemblage with nephrite adzes, and a stone tool industry in tabular-fracturing quartzite schist. There are circuloid, semisubteranean houses and what appear to be mat lodges. Faunal assemblages were not discussed in the 1971 summary.

A Later Plateau phase dated from about 2,000 to 500 years ago by radiocarbon dates is known at one site. Projectile points are small side- and corner-notched forms. House form is not specified in the 1971 summary report, no, is faunal usage discussed.

UPPER COLUMBIA PROJECT

Near the project area one major investigation was carried out before completion of Grand Coulee Dam. During this study, conducted in 1939 and 1940, the entire length of the Columbia from Grand Coulee Dam to the Canadian border was surveyed along both banks, including the lower portions of the Spokane and Kettle Rivers (Collier et al. 1942). This study, done in haste as the waters were rising behind the dam, did locate a large number of sites, 35 of which were clearly identified and test excavated. Most of them are now inundated.

Project archaeologists recorded three types of sites which they named habitation sites, shell middens and cemeteries. They reported that "about half of all artifacts (of stone, bone, and shell) recovered, and nearly all the more elaborate artifacts were found associated with burials" (Collier, et al. 1942:14). Although the study failed to produce descriptive evidence for differentiating house types, the authors concluded that the area surveyed was culturally homogeneous throughout and did not suggest to investigators "any significant cultural changes through time" (Collier et al. 1942:10). The only major chronological distinction was drawn when artifacts of European origin were found.

Collier and team believed that the prehistoric culture of the Upper Columbia was most like that of the Fraser and Thompson river regions though, in fact, at the time few other studies existed for comparison. Similarities were noted in artifact types, in materials and in specific forms. The authors point out striking similarities in certain bone implements, particularly in harpoon points (see Collier et al. 1942:Plate IX), tubular pipe forms (see Collier et al. 1942:Plate XIV), and a class of quartzite scrapers (see Collier et al. 1942:Plate VI). The "northward affiliation" was further confirmed when certain obvious contrasts with Lower Columbia sites became apparent. For example, the north-central region assemblages have no elaborate bone and stone carvings like those recovered at Wahluke, in the Yakima Valley, and in the Dalles-Deschutes region (see Krieger 1928; Smith 1910; and Strong 1930). Furthermore, the characteristic circle and dot design, usually found incised on bone or in rock art in the Upper Columbia and Fraser drainages is found only sporadically or not at all on the Lower Columbia (Collier et al. 1942:12).

Collier believed that Plateau culture on the Upper Columbia had been minimally altered by influences from either Plains or Coast. He was also convinced that the area had been sparsely populated and that the culture was a simple one when contrasted with the prehistoric populations and cultural development of the Lower Columbia, particularly the Dalles-Deschutes region. He cited ethnological data compiled by Kroeber (1939) in support of the lower population density along the Upper Columbia.

Archaeological excavation procedures on the Upper Columbia Project were quite different than those employed today. Our modern bias is to collect as much data as possible and make extensive records of both artifacts and features. In contrast, the Upper Columbia excavators, according to contract, particularly sought out burial grounds. When large cemeteries were found, the

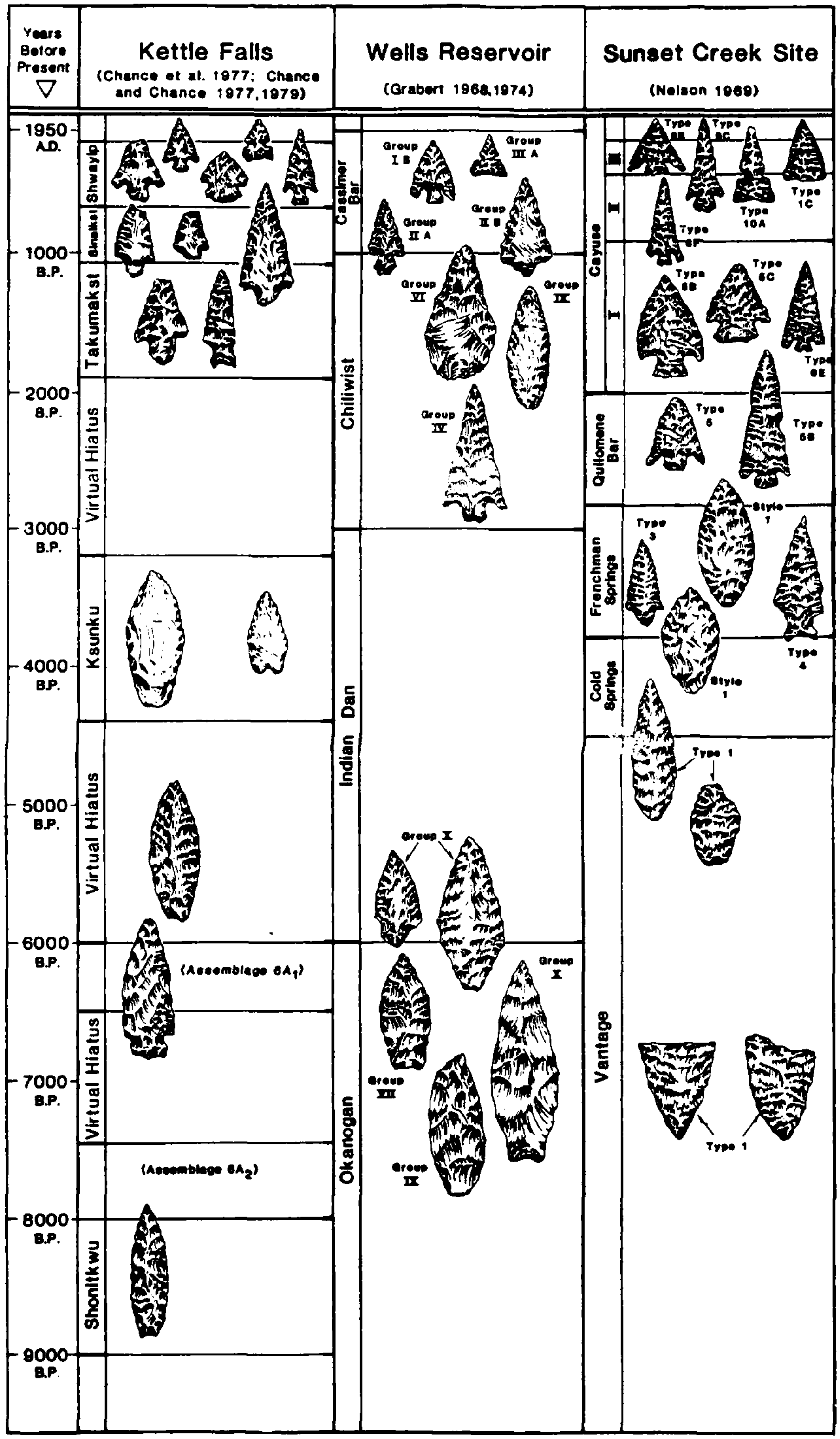

Figure 4-2. Columbia Plateau cultural chronologies.

work was contracted out to commercial undertakers. The excavation team itself paid little heed to bone artifacts, nor did they take botanical samples or collect lithic cores, flakes, and other manufacture detritus. The primary interest was in perfectly formed projectile points, other recognizable tools, and decorative objects. Collier and his fellow writers believed that their oldest artifacts were no more than 2000 years old. Because of carbon assays and stylistical analyses, we know today that some Upper Columbia artifacts may be up to 9000 years old (Chance and Chance 1982). Yet, if the contemporary reader overlooks Collier's lack of time distinctions, the Upper Columbia collection appears to be similar to the Chief Joseph Project assemblage in both age and morphological type indicating that the cultural groups in the two project areas were similar.

KETTLE FALLS PROJECT

The several studies conducted by David Chance and others (Chance 1967, 1970, 1972; Chance and Chance 1977, 1979) express the point of view that the most durable archaeological remnants, namely stone tools and projectile points, are not the most sensitive to cultural change nor the most representative objects of a cultural site. Lithics, Chance says, represent a small and "relatively unelaborated segment of the material culture inventory" (Chance et al. 1977:150). Chance's strong emphasis on cultural reconstruction points up his admittedly historical bias, a bias explained in part by the unusual quantity of ethnohistoric data available to him. For nearly 15 years, Chance has intermittently investigated sites at the major fishery at Kettle Falls. Unlike other areas of the Plateau, the fishery was documented in photographs and paintings during the nineteenth century. These sources and others have given a more vivid and detailed picture of protohistoric life than available for most areas.

In 1971 and 1972, crews found evidence of a long sequence of prehistoric occupations at sites near Kettle Falls as well as abundant cultural materials and definitive associated stratigraphy. Chance's major chronological divisions (Figure 4-2) are five in number: Shonitkwu (9000 B.P. - 6000 B.P.), Ksunku (4000-3200 B.P.), Takumakst (2800-1700 B.P.), Sinaikst (1700-600 B.P.), and Shwayip (600 B.P.-Euroamerican settlement).

Chance believes that the Shonitkwu occupation of Kettle Falls was relatively large. The peoples possessed a microblade industry and fished for salmonids, likely with weighted nets and other gear. These earliest people probably consumed wild fowl, bears, other large mammals, and a species of turtle now believed to be extinct.

The density of the material near the end of the Ksunku Period indicates a dramatic increase in human activity near Kettle Falls. Small tools are predominantly of black argillite. Obsidian (a non-local material) appears in the deposits. Overall, the lithic assemblage is utilitarian. An abundance of salmon as well as big game and turtles probably were eaten by these peoples and large numbers of wild hyacinth bulbs (Brodiaea) are characteristic. In the Ksunku level at the Ksunku site, 45-FE-45, medium sized side-notched points with shallow notches, stemmed points, and medium sized "hawk-tail" side-notched points were uncovered. These suggest northern or simply local affiliation. Late barbed points, typical of the Middle Columbia River, also are scarce at Kettle Falls, and only appear around 2000 B.P.

The third period, the Takumakst, is a division based on comparative stratigraphic data from four fisheries excavations. Chance currently suspects a Pre-Takumakst Period dating from around 3000 B.P. and lasting until 2600 B.P. or later. Occupations in the Pre-Takumakst show a lower population density along the shores of the river in the Kettle Falls region. Sites dating to this period contained a relatively high frequency of cryptocrystalline artifacts, a few cobble cutting tools and some contracting- and square-stemmed projectile points. The Takumakst period itself is characterized by a relatively rough quartzite technology. The most characteristic tool from this period is the small, chunky "Takumakst chopper." Takumakst sites seem to be somewhat specialized in character even though they show the lowest level of skill in stone technology of any period.

The Sinaikst Period is the most stylistically complicated and least uniform of the periods. Projectile points are widely varied and the sequence of styles is not clear. During this period, Chance believes that trade from outside the region became significant as witnessed by the number of exotic lithics associated with this period at Kettle Falls. The proliferation of styles suggests to Chance that several contemporary traditions existed side by side at the Fishery. Deep pit houses were occupied on Hayes Island during this period.

During the Shwayip Period, the population density seems to have declined. The era shows the first evidence of economic stratification, based possibly on access to the best fishing places, a pattern that may have continued into the last century. The period is marked by a tool that Chance calls a "miniature quartzite knife."

Certainly Chance offers the best source of ethnographic data allied with an archaeological collection available to Chief Joseph Project studies. The time depth of the archaeological record in the Kettle Falls area coincides closely with that in the Rufus Woods reservoir area. However, Chance's caution regarding the reliability of lithics as indicators of cultural change makes him reluctant to categorize projectile points according to a definitive system. Consequently, although his chronological distinctions provide important comparative data for this project, his system remains typologically rudimentary. Since other regional assemblages (Nelson's, Grabert's, Leonhardy's and Rice's) are organized according to projectile point classifications, it is difficult to draw parallels between Kettle Falls and other regional collections. The data itself, of course, will be useful.

WELLS HYDROELECTRIC PROJECT

Another relatively recent series of investigations undertaken near the Chief Joseph Dam Project area is Garland F. Grabert's studies conducted downriver from Chief Joseph Dam. During the 1960's Grabert directed a salvage project in the Wells Hydroelectric project area of the lower Okanogan Valley and adjacent portions of the Columbia River (Grabert 1968). He later extended his work northward to the watershed between the Thompson and Okanogan River systems of south-central British Columbia (Grabert 1970). Many of his reported sites also are in Okanogan and Douglas Counties.

Grabert's perspective is strongly prehistoric. He is particularly interested in how living patterns in the region were influenced by the retreat of the glacier, and hypothesizes that the slower drying and warming in the nothern area may have prolonged more mobile hunting and gathering (as opposed to fishing) patterns. Grabert also views his assemblages as part of Paleowestern cultural tradition at large. The presence of a microblade industry and certain woodworking techniques, for example, are shared circumboreal traits. Grabert's primary goal was to establish a regional chronology for the Okanogan Valley area, and then correlate it with the previously established cultural sequences from the Southern Plateau and Middle Fraser regions.

Grabert carried out his most intense investigations at sites in the Wells Reservoir region. Like the Chief Joseph Project sites, these are close to the Columbia River. The Wells investigations form the basis for both his projectile point classification system and his cultural period assignments. Grabert's subsequent work, mainly to the north of these sites in British Columbia, often depended on the willingness of local landowners to allow archaeological investigation. Nevertheless, he was able to collect certain diagnostic artifacts for comparison data.

Grabert's northward explorations confirmed his earlier findings that most materials were datable to the last two or three thousand years and no house structures were observable for components more than 3000 years in age. The dwellings he found appeared to be generally uniform throughout the project area: all were semisubterranean dwellings. Houses in British Columbia did tend to be in sheltered areas while those in the Middle Columbia were more often on the floodplain. Large villages were more common in the middle and southern parts of the Okanogan Valley but did exist in the north too.

Dating sequences established for Wells Reservoir held for the northern region. Projectile point types were similar, although side-notched triangular points were more numerous in the north while small stemmed and corner-notched varieties predominated in the south (Grabert 1970:230).

In comparing the region he studied to other areas of the Plateau, Grabert suggests that the upper reaches of his region probably supported the most conservative way of life. In the Upper Okanogan and Thompson regions, larger, deeper semisubterranean houses persisted well into the nineteenth century. In contrast, the Southern Okanogan and adjacent Columbia peoples probably abandoned such dwellings by the first quarter of the nineteenth century. Another observed difference between the upper and lower reaches was the greater use of shellfish south of the international boundary. This may, however, be attributable to the differing locations of the lower (more riverine) and upper (lake and upland) sites.

On the basis of his in-depth study of six sites around Wells Reservoir near the confluence of the Columbia and the Okanogan Rivers and six comparative sites to the north Grabert suggested four general cultural phases for the project area (Figure 4-2). These are: Okanogan (?-c. 6000 B.P.), Indian Dan (c. 6000-c. 3000 B.P.), Chiliwist (c. 3000 B.P.-c. 900 B.P.) and Cassimer Bar (c. 900-c. 150 B.P.).

Many distinguishing features are shared by the Okanogan and Indian Dan phases, although the older Okanogan is marked by large ridge-backed scrapers or knives, abundant larger flake tools, larger leaf-shaped points and some stemmed points. Basalt is the most common material of the Okanogan phase.

In the Indian Dan Phase, large basal-notched and stemmed points appear along with smaller lozenge and leaf-shaped points. There are possibly some milling stones although hand milling stones were not found and no certain identification of pestles was made. Pit ovens were found during the Indian Dan Phase but no housepits. Simple flaked tools were numerous as were shellfish and fish remains.

The Chiliwist Phase is marked by deep, steep-walled housepits. Larger projectile points of leaf-shaped, corner-notched, basal-notched and stemmed varieties are associated with this phase. The stone adze appears and bone implements are relatively common. Settlements were smaller but the houses are larger than those of the subsequent phases. Fish remains were abundant in some components. Various sorts of lithic raw materials, including obsidian, were used for implements. Deer, elk, mountain sheep and goat remains were common along with evidence of extra-regional trade.

The most recent phase, Cassimer Bar, had shallow saucer-shaped and rectangular houses. Projectile points were small corner-removed, corner-notched, and side-notched. A stone basket mortar base, some zoomorphic stone carvings and a limited group of steatite carvings are associated with this phase. Geometric designs are found on bone and stone objects. Composite harpoons were recovered. The Cassimer Bar Phase settlements are large, and abundant fish and shellfish remains are found in them (Grabert 1970:Table 10).

Grabert's chronology is based largely on diagnostic tools and projectile points, and substantiated in several instances by carbon assay results. Although volcanic ash is an important stratigraphic marker in several sites, it was not analyzed.

SUNSET CREEK

Nearly contemporaneous with Grabert's report on the Okanogan Highlands region was Nelson's (1969) report on 45-KT-28, a site at Sunset Creek near Vantage, Washington (see Figure 3-A). Although it mainly reports on a single site, the carefully drawn conclusions and exhaustive artifact summaries establish this report as a baseline against which other Plateau studies test their own chronological divisions, artifact types and distributions. As the subsequent synopsis reveals, Nelson does not report on features, nor on botanic remains.

In order to establish a framework for his study, Nelson posits five phases: Vantage (?-4500 B.P.), Cold Springs (c. 4500-3700 B.P.), Frenchman Springs (c. 3700-2800 B.P.), Quilomene Bar (2800-2100 B.P.) and Cayuse (2100 B.P.-European settlement). These are illustrated in Figure 4-2. Nearly all distinctions between these phases are based on changes in projectile points. The properties of the phases may be summarized as follows:

1. During the Vantage Phase projectile points were very large and based on a leaf-shaped outline which was sometimes modified by shouldering. During the Cold Springs and Frenchman Springs phases, leaf-shaped points declined in importance. During this period there was a great reduction in size, flaking became finer, and a greater number of body outlines are in use. Throughout the Quilomene Bar and Cayuse phases leaf-shaped points are rare, representing items of trade or aberrant forms.

2. Both notched and unnotched triangular projectile points were first introduced during the Cold Springs Phase at which time a dramatic shift occurs from leaf-shaped to triangular point forms. This shift is completed by the beginning of the Quilomene Bar Phase. Thereafter, virtually all projectile points are based on a triangular outline, notched points being manufactured from triangular blanks (Nelson 1969:102).

In order to suggest cultural features allied with these phases, Nelson reviews Daugherty's (1962) idea of the Intermontane Western Tradition. This model proposes general developmental ties between the Southwest, the Great Basin and the Plateau, and specifies a sequence of periods visible in the archaeology of each. In general, Daugherty's model hypothesizes that in the Early Period (11,000-8000 B.P.) all regions were characterized by diverse hunting and gathering economies. Although intense use of locally available food would have been expected, regional traditions probably had not developed. Archaeological information about this earliest phase is very scarce.

During Daugherty's Transitional Period (8000-4500 B.P.), the Plateau peoples began to concentrate along existing waterways and became increasingly reliant on freshwater mussels and salmon. The following Developmental Period (4500-2000 B.P.) saw an increase in regional specialization that eventually culminated in practices recorded in ethnographies. During this period, the Northwest developed more advanced fishing techniques while the Southwest developed and refined agricultural habits. The Late Period (2000 B.P.-Historic Period) saw fully developed area traditions. Near the end of it, the Plains groups exerted influence on the Plateau.

From this comprehensive model, Nelson evolves a series of seven periods describing features exhibited solely on the Plateau as they may be conjectured from archaeological evidence from Plateau assemblages. In summary, he concludes that Period I, dated from 11,000 B.P.-9000 B.P. is only represented by four well known sites: Lind Coulee (Daugherty 1956), 35-WS-4 (Cressman et al. 1960), Windust Cave (H. Rice 1965; Daugherty 1962) and Marmes Rockshelter (Daugherty, personal communication 1964). This period is characterized by stemmed lanceolate projectile points. Lack of uniformity in associated faunal assemblages makes it difficult to assess particular adaptations. The economy is presumed to be mixed hunting and gathering.

Period II, dated from 8000 B.P. to 6500 B.P., is associated with general desiccation of the region which reduced big game populations on the Columbia Plateau. Gustafson (1972) argued that although populations of some game species shrank during this period, others grew, leaving the overall amount of game relatively unchanged. Cressman et al. had noted somewhat earlier (1960) that fishing at the Dalles also diminished during Period II. Such changes in food supplies may have led to formation of highly generalized hunting-gathering patterns in which food gathering and hunting small animals was emphasized. This period includes the Vantage Phase assemblages. Influences from outside the Columbia Plateau are not evident in the tool assemblage.

Period III, dated from 6500 B.P. to 4500 B.P., is represented by Cold Springs Phase points and tools. This era saw the introduction of a food grinding tool complex into the Plateau and was marked by a major shift from hunting to food gathering. The appearance of notched points and manos suggests that this basic adaptation may have been introduced from the Great Basin. The first appearance of large quantities of obsidian further points toward a close link between the northern Great Basin and the Columbia Plateau.

Period IV is dated from 4500 B.P. to 2000 B.P. Nelson believes no significant economic changes took place on the Plateau during this time although trade with the Great Basin continued. As the generalized patterns established in Periods II and III endured, regional variations on the Plateau became more distinct. This is particularly evident in assemblages of projectile points and cobble implements from the Middle Columbia, the Lower Snake and the Upper Columbia (Nelson 1969:105). This period holds the first definitive evidence of connection with coastal groups. Although there are no suggestions of strong coastal influences, there is duplication of projectile points in the two areas (see Nelson Appendix A, Stemmed Projectile Points Type 3 and 5) and a few trade items from Rabbit Island I.

Period V, which Nelson calls "Coastal Ties," begins about 2000 B.P. Others have surmised that this era, the early Cayuse Phase, marks the migration of Salishan speakers into the Plateau. Nelson neither supports nor denies this theory, but agrees that there are strong ties with the Washington coastal peoples dating from this period. <u>Dentalia</u>, shell pendants, mussel shell adzes, ground stone adzes and other coastal implements appear. Probably there is diffusion in art motifs as well (Nelson 1969:105). Most impressive, however, is the appearance on the Plateau of some basic fishing tools known much earlier from the West Coast. Prominent examples are the three-pronged salmon spears and composite harpoon toggles both in use along the British Columbia coast and along the coasts of Washington by 3000 B.P. This suggests to Nelson that the strong riverine characteristics known from Plateau ethnographies may have been developed in Western Washington and later were introduced to the Plateau peoples near the beginning of Period V. Specifically regional artifact styles occur during this period as well, and, while trade with the Great Basin continues, it seems to wane, particularly in the north. (This observation coincides with both Ray and Grabert's belief that the northern Plateau peoples were the more independent and conservative).

Period VI, from about 350 B.P. to 190 B.P., involves the protohistoric movements of population and culture. A Cayuse subphase, this period represents the indirect effects of the expanding American frontier. Trade between the Plateau and the Northwest Coast, the Great Basin and the Plains is regular, resulting in much diffusion of stylistic elements. There is an efflorescence in material culture and a tendency away from regional variation toward homogeneity in artifact assemblages.

Period VII, from 190 B.P.-present, represents expanded contact between Plateau peoples and the American frontier. Cultural efflorescence continues briefly and then withers rapidly.

As Nelson himself points out, his periods emphasize diffusion, acculturation and migration rather than internal development. He cautions that, since any differentiations are based on the magnitude of the assemblages, the differences simply may appear more distinct during the later periods for which we have more material (Nelson 1969:104-108).

Nelson's artifact catalog, organized by general category and defined by number, material, measurement and description, and technique of manufacture, proves to be a vital resource for any Plateau archaeology project interested in integrating new findings into a comprehensive classification system.

LOWER SNAKE RIVER

In 1970, Frank C. Leonhardy and David G. Rice produced a report proposing a cultural typology for the Lower Snake Region, the territory north and east of the confluence of the Snake and the Columbia Rivers below the Snake's confluence with the Clearwater River in Lewiston, Idaho. This report is of particular value to Chief Joseph work and supplemental to other regional studies because the Lower Snake is rich in very early occupations.

Although earlier excavations at Windust Caves (H.S. Rice 1965) and Marmes Rockshelter (Fryxell and Daugherty 1962; D.G. Rice 1969) first established relative and absolute chronologies for regional prehistories, it is primarily work on the Marmes Rockshelter (D.G. Rice 1969) and the Granite Point Locality 1 (Leonhardy 1970a) which provide the basis for Leonhardy and Rice's synthesis of Lower Snake River prehistory (Leonhardy and Rice 1970).

The authors propose six phases as a basis for ordering archaeological manifestations in the Lower Snake River region of southeastern Washington. They are: Windust (10,000-9000 B.P.), Cascade (8000-5000 B.P.), Tucannon, (5000-2500 B.P.), Harder (2500-700 B.P.), Piqunin 9700 B.P.-300 B.P.), and the ethnographic Numipu (300-100 B.P.).

The Windust Phase, described from artifacts at Windust Caves (H.S. Rice 1965), Marmes Rockshelter (D.G. Rice 1969) and Granite Point Locality 1 (Leonhardy 1970a), is recognized by a group of projectile point forms with relatively short blades, shoulders of varying prominence, principally straight or contracting stems, and straight or slightly concave bases (Leonhardy and Rice 1970:Figure 2). Lanceolate points are present but rare. The knives are relatively crude large lanceolate or oval forms. Utilized flakes are the most numerous and varied of the artifacts. Bone materials are few. Lithic technology was well developed. Blades were most often made from cryptocrystalline silicates, although fine-textured basalt was used in small quantities.

The Windust Phase sites contain remains of elk (Cervus canadensis), deer, pronghorn antelope, rabbits, beaver and river mussel, all believed to have been economic fauna. To date, no artifacts associated with processing plant foods have been found.

The Cascade Phase is defined on the basis of components from ten sites. It is subdivided into chronological subphases on the basis of a style marker, the Cold Spring side-notched projectile point (Butler 1961). Only the latest subphase has the distinguishing point. Except for it, the assemblages are essentially identical. Large, generally well made lanceolate and triangular knives are characteristic and tabular and keeled end scrapers are common. Cobble implements include pounding and grinding stones and an edge ground cobble, a hallmark artifact. Bone is more abundant than in Windust while lithic technology relies more on fine-textured basalt; cryptocrystalline silicates continue to be abundant in early phases.

Elk, deer, and pronghorn antelope continue to be used for food. Remains of two species of river mussels (Gonidea angulata and Margaritifera falcata) appear as do various large salmonids. While hunting patterns seem to continue on from Windust, the increased presence of fish remains indicates a new economic resource. Manos for grinding food appear first in the Cascade Phase.

The Tucannon Phase is distinctly separate from the Cascade: the two, in fact, are not considered to be related historically (Leonhardy and Rice 1970:11). Yet a hiatus in knowledge of regional prehistory about 5000 B.P. prevents speculation about this cultural shift.

Two kinds of projectile points are prominent in Tucannon assemblages. In both, the blade is short, with shoulders of varying prominence and a contracting stem. The second variety is notched low on the side or at the corner to produce an expanding stem and short barbs (see Leonhardy and Rice 1970:Figure 7). Various scrapers and pounding stones are present along with hopper mortar bases, pestles and sinkers; well-formed knives are virtually absent. Bone and antler implements include awls and a wedge, while a bone shuttle indicates net making (Leonhardy and Rice 1970:11). Compared to earlier and later phases, the lithic technology appears crude. Basalt is the predominant material.

Economic fauna remain by and large the same although the increased quantity of mussels seems to indicate they became an economically important resource.

The Harder Phase is known from five sites. Two subphases are distinguished principally on the basis of settlement types and stratigraphy. In an early subphase, all components appear to be camps; in the latter, substantial pit villages appear. The early subphase is characterized by large, basal-notched projectile points and corner-notched projectile points called "Snake River Corner-Notched" (Leonhardy and Rice 1970:Figure 9). In the later subphase these are relatively rare and are replaced by small, finely made corner- and basal-notched forms associated with the Snake River Corner-Notched type. Several varieties of scrapers with distinctive shouldered forms appear in both subphases and lanceolate and pentagonal knives are characteristic of both. Cobble implements (sinkers, utilized spalls, pestles and hopper mortar bases) and bone objects (awls, needles, beads, and gaming pieces) are common.

Bison (Bison bison) appear among the economic fauna as do mountain sheep; deer, elk and antelope persist. Remains of smaller mammals, including dog (Canis familiaris) are abundant. Efficient fishing techniques (weirs and traps) are believed to be in use by this time.

Unlike other regions of the Plateau, knowledge of Lower Snake River Region prehistory is more complete for earlier phases than later. The Piqunin Phase, following the Harder, is known by only one site which was being excavated at the time Leonhardy and Rice were writing their report. Wexpusnime (45-GA-61) is a village of circular housepits. The authors believe that the houses were split pole frameworks covered with grass thatch. Small delicately made projectile points (Leonhardy and Rice 1970:Figure 11) also characterize the Piqunin and small utilized flakes are "amazingly abundant" (Leonhardy and Rice 1970:20). Many cobble implements (pounding stones, decorated pestles, hopper mortar stones and sinkers) are found along with bone implements (matting needles and composite harpoon elements). Twined basketry also has been recovered.

At the time of writing, the economic fauna recovered were primarily elk, deer and salmon. This phase ends as the ethnographic period begins.

The Numipu Phase is a putative phase intended to represent the archaeological manifestations of ethnographic Indian culture from the time the horse was introduced (shortly after 1700 A.D.) to the time Indians were relegated to reservations. This phase is proposed totally on the basis of burials. In the Lower Snake River Region, no historical habitation sites have been excavated; one had been tested at the time this report was written. The authors believe the era will be characterized by trade goods.

Leonhardy and Rice do believe that certain historic or evolutionary relationships exist between their seven proposed phases, but until detailed comparative studies are made, they cannot be described accurately. There is, however, sufficient evidence to hypothesize that two distinct cultural traditions are visible in the Lower Snake regional sequence. Apparently, the Windust and Cascade are related, and Leonhardy and Rice suggest that they represent a single evolutionary continuum in the region. They posit the Lind Coulee assemblage as a likely ancestor for the tradition (Leonardy and Rice 1970:25). A second evolutionary phase appears during the Tucannon and extends through the Numipu. The authors are original in this suggestion; most previous discussions (except for Caldwell and Mallory 1967) presume a single continuum.

Leonhardy's and Rice's report has a thoroughness comparable to Nelson's. It is of particular interest to other studies of the Middle Columbia because of the two separate traditions the authors posit. The split between the Cascade and the Tucannon Phases remains unexplained on the basis of Snake River information alone. Further evidence may appear in other findings along the Middle Columbia since artifacts from this region resemble those from the Lower Snake River Phases.

SUN LAKES/GRAND COULEE PROJECT

In connection with development of a state park system in the lower Grand Coulee in the late 1950's, archaeological salvage of threatened sites was carried out by Washington State College (Osborne 1959,1967; Mallory 1962, Sprague 1960). One rockshelter in the upper Grand Coulee also was salvaged by the University of Washington in 1950, in connection with construction of Banks Lake (Mills and Osborne 1952). Data from these series of excavations at rockshelters and open sites still comprise the major upland archaeological assemblage for the area. These show an early use of the upland area in the mid-Holocene, correlating in time with Late Cascade and Frenchman Springs Phases, followed by an increased use in the past 2,000 years in the Cayuse phase. A housepit site at Blue Lake yielded data on saucer-shaped pits analogous to ethnographically described mat lodges and dated about 800 years ago.

MESA (GRAND COULEE) PROJECT

In the mid-1970's, upland sites in the Lower Grand Coulee were surveyed by Central Washington University. Rock alignments and other rock features were classified and test excavation was conducted at sites with indication of midden accumulation (Smith 1977). Radiocarbon dates and projectile point forms suggest occupation occurred in the Cayuse Phase from about 2000 years ago to roughly 150 years ago. Interestly, none of the tested sites was in a situation where significant sedimentation could be expected.

CHIEF JOSEPH DAM PROJECT

A number of reconnaissance and survey projects have been undertaken in the Rufus Woods Lake vicinity in connection with construction or modification of Chief Joseph Dam: the Smithsonian Institution River Basin Survey (Osborne 1949); University of Washington (Osborne et al. 1952); Washington State University (Leonhardy 1970b; Lyman 1976); Corps of Engineers, Seattle District (Munsell and Salo 1977); and University of Washington, Office of Public Archaeology (Leeds et al. 1981). During this same period, several burials were recovered and reinterred on Colville Tribal lands by the University of Washington (1956) and University of Idaho (1973) under separate contracts with the Corps of Engineers, Seattle District. Additional survey level investigations undertaken by the University of Idaho have identified and/or confirmed several burial areas within project lands (Sprague and Miller 1978). Taken together, the above listed studies indicate that the prehistory of this reach of the Columbia differs distinctly from that of the better documented Sahaptian areas lying to the south. Most importantly, these studies strongly suggest that project area prehistory cannot be understood on the basis of currently available local information or by extrapolation from adjacent areas.

RIVER BASIN SURVEY (1945-1950)

During the late 1940's, the Smithsonian Institution sponsored a reconnaissance program to locate archaeological, paleontological, or historical resources in the area to be inundated by the initial pool raise behind Chief Joseph Dam. Information and inventory developed by these investigations subsequently was used to recommend a program of cultural resources salvage. The reconnaissance located 20 archaeological sites within the projected pool area and recommended 11 of these for partial salvage excavation. Only the right bank of the river was included in the survey; the investigators concluded that the south bank was much less suitable for habitation.

UNIVERSITY OF WASHINGTON (1950)

Based upon previous reconnaissance results, a small scale recovery program was initiated by the University of Washington during the summer of 1950. Limited test excavations were conducted at ten prehistoric and historic winter village, open camp and burial sites. Osborne and his coworkers concluded that the reservoir area manifested only minimal cultural variability and that occupation/use of the area was a comparatively late phenomenon (Osborne et al. 1952). While these conclusions were not to be substantiated by later investigations, two factors were of key importance in their formulation. First, testing efforts were concentrated at sites with surface-evident structural remains (housepits). This no doubt resulted in inadequate sampling of other kinds of sites present in the area. Additionally, the bias toward housepit sites may have excluded older sites from investigation; older occupational components typically are obscured under sediments deposited by fluvial or aeolian processes. Finally, these investigations were conducted at a time when knowledge of Northwest prehistory was in its earliest stages and radiocarbon dating techniques were not yet readily available. It is not surprising then that these researchers felt the project area had been occupied only relatively recently.

WASHINGTON STATE UNIVERSITY (1969-1970)

Renewed reconnaisance of the reservoir margins by Washington State University, under contract to the National Park Service, was undertaken in 1969 and 1970 in anticipation of proposed modifications to the dam and powerhouse. Reconnaissance concetrated along the reservoir's northern shoreline, although spot checks were make along the south bank. Two prehistoric sites were identified within the project and a total of 17 sites was examined and assigned excavation priorities. Leonhardy (1970b) concluded that the prehistory of north-central Washington exhibited marked differences from better known areas to the south and more importantly, he observed that the project area could not be understood on the basis of available information. As a consequence of his findings, Leonhardy went on to recommend a program for salvage of cultural resources.

WASHINGTON STATE UNIVERSITY (1975)

Additional cultural resource investigations were carried out by Washington State University during summer 1975. The studies were limited to a reappraisal of previously recorded sites and additional reconnaisssance along selected portions of the reservoir (Lyman 1976). Reconnaissance added 15 prehistoric and nine historic sites to the project inventory, and described a total of 59 prehistoric and historic sites, including several not within project boundaries. Thirty of these were assessed as "significant" in terms of criteria established by the Advisory Council on Historic Preservation under provisions of the National Historic Preservation Act of 1966 (Public Law 89-665), and therefore determined worthy of inclusion on the National Register of Historic Places. Test excavations of several prehistoric sites revealed a broader range of site types and artifacts than had been described previously. This suggested that the project area manifests more complex cultural patterns than envisioned by earlier investigatiors. Lyman (1976) concluded that the project area was a critical link for understanding and interpreting Columbia Plateau prehistory and recommended that a major effort be undertaken to preserve significant data.

U.S. ARMY CORPS OF ENGINEERS, SEATTLE DISTRICT (1976)

In October 1975, Seattle District staff archaeologist David A. Munsell made a brief reconnaissance of the project area to verify previous survey reports and evaluate the proposed mitigation program of the National Park Service. Although his activities were restricted to a two-day field evaluation, Mr. Munsell located and identified several previously unrecorded sites. Based on the apparent limitations of previous cultural resource investigations within the project area and revised authorities established under amendment (Public Law 93-291) to the Reservoir Salvage Act of 1960, the Corps initiated an in-house reconnaissance program to inventory the sites within project guide-taking lines and assess potential effects on them. Subsequently, Corps personnel completed reconnaissance of approximately 57.4 % (54 of 94 miles) of shoreline within its jurisdiction during winter and spring 1976. An additional 192 previously unrecorded sites were identified within the project representing nearly a four-fold increase in site inventory (previous investigators had identified 45 sites actually within the project area). Because reconnaisance had not been completed on all project lands, Munsell and Salo (1977) estimated that approximately 400 sites could be expected at the project and recommended futher investigations to complete the inventory of project lands and to evaluate all potentially significant sites as a necessary first step toward future impact mitigation.

UNIVERSITY OF IDAHO (1977-1978)

As part of a burial relocation program, the Corps contracted with the University of Idaho for a survey of the project to identify burial sites in previously unexamined areas, to confirm reported burial sites, and to estimate numbers of graves at each confirmed site. Interviews with Tribal elders also were conducted to locate burial sites that could be affected by the project. A total of nine sites at the project was confirmed; several places that could be prehistoric cemeteries also were identified during the interviews (Sprague and Miller 1978).

UNIVERSITY OF WASHINGTON (1977-1978)

Based on recommendations by Munsell and Salo (1977), the Corps awarded a contract to the University of Washington's Ofice of Public Archaeology for a cultural resources survey of the project. Initiated in the fall of 1977 and renewed in the spring of 1978, field work and subsequent data analysis sought to: (1) complete reconnaissance inventory of all project lands, (2) test/evaluate selected prehistoric habitation and historic sites to permit temporal and functional characterizations of past human occupation and use of the project areas, (3) assess individual and collective resource significance, and (4) develop and recommend a plan for a comprehensive mitigation program and future resource management. The results of survey and testing of prehistoric habitation sites are reported in Leeds et al. (1981). The historic sites survey is reported in Thomas et al. (1984).

Reconnaissance located 37 previously unrecorded sites, bringing the site inventory at the project to 274. Most of the newly found sites were either historic structures attributable to Euro-American presence in the area during the past 100 years or small concentrations of lithic debris situated atop higher, older terraces along the lower half of the reservoir. On cursory inspection, projections of the number of prehistoric sites within the project area (Munsell and Salo 1977) appear to have been too high. However, in large measure, the discrepancy is attributed both to the fact that the estimate included sites on lower terraces long inundated by the original pool raise and to the marked differences in resource potential between reconnoitered areas. The 1976 Corps reconnaissance concentrated on the reservoir's immediate margins and adjacent lower terrace formations, areas more likely to contain evidence of cultural resources because of their proximity to a perennial water supply. More recent reconnaissance was restricted largely to the higher terraces, and a significantly lower site density was found. Thus, while fewer new sites were located during 1977-1978 survey level investigations than anticipated, the resultant site inventory probably accurately reflects the number and kinds of cultural resources now present in the project area.

Test excavations were conducted at 79 prehistoric habitation sites. Sites chosen for test evaluation were selected according to their condition and potential for improving current understanding of resource variability and significance; a concerted effort was made to include all potentially significant prehistoric sites. Excavations sought to determine horizontal and vertical site limits, minimum number of distinct occupations, age of each occupation component, and the general nature of functional variability at each site. A 0.2% minimum areal sample was recovered at each site within 1 x 2-m excavation units. Units were purposively placed and surface depressions were avoided to obtain relatively complete and uncomplicated depositional sequences, and to minimize disturbance to house structures.

In addition to testing prehistoric sites, the survey also evaluated historic cultural resources in the field. Because historic sites almost always could be seen entirely on the present surface and included numerous structures and features, test excavations were not warranted. Instead, assessment consisted of mapping and photographing all cultural remains, noting architectural features of construction, and conducting archival search and informant interviews. The latter was a particularly valuable technique for determining site function and history; many local inhabitants are long-time residents of the area or are descendents of early settlers and have direct knowledge of a majority of recorded historic sites.

While the sampling intensity used to assess prehistoric sites did not permit detailed descriptions of internal site structure, the data were used to characterize site age, type and general structure. Radiocarbon age determinations of charcoal samples taken from cultural contexts showed that human occupation of the project area spans the last 5,000 years. Based on comparison of projectile point styles from firmly dated contexts elsewhere in the Plateau, it is likely that occupation began considerably earlier. Several specimens from deeply buried site components appear to be "Cascade Points," a highly distinctive point style that dates to the period between 6,000-8,000 years ago. While testing detected occupations within the entire timespan between the most recent Euro-American presence and earliest occupation, the intensity of representation for all periods is not uniform. Cultural remains of certain timespans were sparse while others were relatively abundant. For example, no occupation components could be attributed unequivocally to the late prehistoric/protohistoric period (i.e. A.D. 1500-1800). At the same time, components dating between 2,500-4,000 years ago were abundant. Two explanations were advanced: (1) the observed temporal distribution of site components reflects the actual cultural situation and thus there was differential use of the project area through time or (2) the observed temporal distribution results from sampling error that arises as a consequence of differential destruction of occupation components because of past changes in the river regime and/or present reservoir impoundment. Futher investigations to test the veracity of either explanation or to develop more plausible hypotheses were recommended.

RIVER MILE 590

The lands administered by the Corps in connection with the Chief Joseph Dam Project extend from Chief Joseph Dam upriver to River Mile (RM) 590; lands upstream are under the jurisdiction of the Bureau of Reclamation. A number of cultural resources sites located in the Corps reconnaissance in 1976 (Munsell and Salo 1979) were excluded from testing or salvage in our project because agreements had not been reached with the landowner and the Bureau of Reclamation. In 1982 negotiations were completed and a new series of sites at RM 590 were available for investigation. A testing program was conducted by the Central Washington Archaeological Survey for the Corps and the Bureau of Reclamation (Chatters 1984b) followed by intensive excavations at two sites (Chatters 1984a).

SUMMARY OF REGIONAL PREHISTORY

Review of the foregoing projects together with findings of the 1977-1978 test program at the project and a recently completed testing program in the upper part of the project (Chatters 1984b) suggests the following broad, tentative outline of cultural intervals in the prehistory of the northern Columbia Plateau.

EARLY (PLEISTOCENE/HOLOCENE TRANSITION)

The Columbia Plateau apparently was first occupied about 12,000 years ago by small, highly mobile groups of hunters oriented toward pursuit of larger game, beginning the Windust phase of Plateau prehistory. Apparently the first populations arrived from a south or southeast direction along the Snake River Plain. Many of their implements bear strong resemblance to implements characteristic of Great Basin variants of High Plains Paleoindian cultures. During the interval from 12,000 to about 8,000 years ago, the climate was somewhat cooler and moister than at present.

FIRST INTERMEDIATE PERIOD (EARLY HOLOCENE)

A pronounced warming and drying trend from about 8,000 to 4,700 years ago accompanied the development of the Cascade phase. During this interval people moved their residences frequently from place to place. Populations seem to have lived mainly along the larger rivers. The animal remains from their dwelling and campsites suggest they ate whatever they could obtain, whenever they could obtain it. The records of the environment for the time suggest that the climate was drier and warmer than present, and animal and plant populations probably were smaller than now. In several places, fishing seems to have been an important pursuit.

SECOND INTERMEDIATE PERIOD (MIDDLE HOLOCENE)

From about 4,700 years to 2,500 years ago, populations became more settled, but still moved winter base camp locations frequently. Use of uplands increased. Sites became more diverse in kind and animal and plant remains in them suggest specialized hunting and a greater reliance on food storage, which permitted a more settled existence. Fishing seems to have become a focus of economic interest. Populations actually may have increased during this time and seem to have concentrated in the northern part of the

Plateau. Late in the period, population pressure along rivers may have led to greater use of the uplands and intensification of fishing. Also, during this time, the climate moistened, then grew cooler, probably increasing the overall amount of animal and plant life in each local population's territory.

LATE PERIOD (LATE HOLOCENE)

The Cayuse phase of Columbia Plateau prehistory (roughly 2,500 years ago to the historic era about 150 years ago) witnessed several changes in environment and culture. The beginning of the phase (sometimes called Quilomene Bar) from about 2,500 to 2,000 years ago saw a climatic shift from Neoglacial (about 4,000 to 2,000 years ago) cooler, moister conditions compared to today to a warmer, dryer and more modern environment. Forests retreated upslope and desert increased. Around 1,000 years ago, slightly cooler, moister conditions prevailed. A pronounced mountain glaciation, the Little Ice Age from about 300 to 150 years ago, seems to have been characterized by colder, but not moister, conditions.

During this period (2,500 years ago to present) the number of archaeological occupations found in the region's sites show distinct shifts. The early part of the period (Quilomene Bar, 2,500 to 2,000 years ago) has very few occupations and is poorly represented, but seems to be the beginning of the time in which the local people established the cultural system that was typical of the area when Euroamericans first arrived in the early 1800's. This system depended upon a highly specialized fishing technology that emphasized efficient trap and weir rather than net harvesting methods. It was characterized by a seasonal round in which work parties dispersed from winter villages in the spring, summer and fall to obtain foods and raw materials, process them, and return them to the winter village to sustain the population through the dark of the year.

Around 2,500 to 2,000 years ago, there was a distinct cultural change. Larger villages appear and seem to have been occupied for a long time. There seems to be a decrease in the number of sites, but this may be a result of population concentration rather than a decline in population. Fishing technology is elaborated, probably explaining the appearance of villages. The environment became warmer and drier, a change that may have decreased the local upland food supply and provided impetus to adopting an improved fishing technology.

About 2,000 years ago, more archaeological occupations begin to appear. This time also saw the introduction of bow and arrow hunting, which further increased the efficiency of the economic system and represents a major change in artifact inventories. There seems to have been some change in the way upland areas were used in this period; fewer rock shelters show use as habitation sites, but rather seem to have been storage caches. There are proportionately more open-air campsites with evidence of constructed shelters. Overall, upland use is poorly understood for this time period, as for all others.

PROTOHISTORIC PERIOD

When Plateau peoples acquired the horse in the late 18th century A.D., major changes to their ways of life ensued. Even greater use of long-favored fishing sites such as the Dalles and Kettle Falls resulted, upland resource use seems to have been intensified, and easier travel seems to have promoted greater contact of all kinds between distant groups. Diseases also swept the area, wiping out entire villages and severely disrupting lifeways.

In the 1920's and 1930's, ethnographers interviewed elders from the Sanpoil-Nespelem and Sinkaietk (Southern Okanogan) tribes to gather accounts of tribal ways of life before the arrival of the whites and, if possible, before the horse. The description that resulted, while far from perfect, is the only information detailed enough to build an archaeologically testable model that suggests what various kinds and distributions of archaeological remains attest to where, when, and how prehistoric Plateau peoples used the natural abundance of their lands and waters. Well-dated sites and occupations from the protohistoric and late Cayuse phases in the known territory of the Sanpoil-Nespelem are critical to test this model for (1) its accuracy in describing local conditions, and hence (2) its applicability to other times and adjacent areas.

5. SAMPLING AND DATA RECOVERY

Our broad goal for data recovery was to recover selected archaeological data which would sufficiently characterize the chronological and geographic variability in the prehistoric record to support regional research into the development of prehistoric subsistence and settlement systems. This chapter reviews data recovery operations, particularly those aspects that affect the reliability of our statements about prehistoric cultural activities. Description of the strategies and tactics that influence the content of an excavated assemblage is necessary to identify potential limitations on analytic and interpretive schemes. Only selected data could be recovered, and the means of selection has an important bearing on the representativeness of the final data base. First we discuss selection of mitigation sites, then sampling within sites. This is followed by a description of the excavation techniques.

SITE SELECTION

Prehistoric habitation sites were selected for full-scale excavation to represent the widest possible range of evidence about prehistoric use of the project area, at least insofar as temporal and environmental dimensions were concerned. The 18 sites chosen were not selected through probabilistic sampling. The commitment of time, resources, and personnel for excavation is so great and the cultural diversity in the study area so uncertain that purposive selection was chosen as the best route to maximum sample efficiency. We relied on the results of testing to characterize sites along the river and to assess their relative research significance.

Due to exigencies of the contract process, sites were selected in two stages. The first sites were chosen late in 1977 by an informal process on the basis of field assessments made during 1977 testing. Following survey field work, only a short time was available for testing and mitigation before the planned pool raise. Therefore, in mid-December 1977, the Corps aked OPA to identify a set of prehistoric habitation sites that would be judged significant and in need of further investigation within virtually any regional archaeological research context. Accordingly we drew up a priority list of six sites: 45-DO-204, 45-DO-214, 45-OK-11, 45-OK-18, 45-OK-258, and 45-OK-292. The Corps, in consultation with the Washington State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation (ACHP), established an interim Memorandum of Agreement (MOA) under which data recovery at those six sites could proceed. Site 45-OK-292 was later dropped because of limited funding and because the years' field work showed it to be redundant. In August 1978, data recovery began at five of these six sites.

Concurrently, data from the 1977 and 1978 testing, and those from previous testing efforts (Osborne et al. 1952; Lyman 1976), were synthesized into a management plan recommending measures to minimize loss of significant resources. A draft version of this document, filed with the Corps in December 1978, called for excavations at 31 prehistoric habitation sites throughout the reservoir area, including the six already selected (Jermann et al. 1978). The final MOA included 20 of these. This second stage of site selection was a more formal process which made use of a "resource variability matrix" to summarize known site variability. The variability matrix provided a ready means of assessing knowledge of the resource and pointed out gaps that further research might be expected to fill. Even more important for planning purposes, the matrix provided a framework within which a representative cross-section of the resource could be identified.

RESOURCE VARIABILITY MATRIX

We selected four dimensions for characterizing occupations in the resource variability matrix (Table 5-1): (1) probable age, (2) kind of occupation, (3) general site topography, and (4) geographic location along the river. Because test sampling at any given site was so limited, test data could be used to address only certain site characteristics. The variables time interval and kind of occupation were kept at a simple level because of the limitations of the testing data. Nonetheless, it was still not possible to classify all components. Geographic cluster and topographic association simply required locational information.

Time Interval. The minimum number of occupational episodes at each site was determined by correlating the stratigraphic profiles of each unit with frequencies of various artifact categories by unit level. Temporally significant artifact classes (e.g., projectile points) were dated by comparison to similar points in regional chronologies and used, along with radiocarbon age determinations, to assign site assemblages to a particular time interval directly or to temporally bracket them.

Kind of Occupation. Each component also was classified by kind of occupation, on the basis of differences in stone reduction debris and fire modified rock densities. Components with housepits were classified in a separate system based on the number and size of dwelling units. Although these discriminations are far from fine-grained, they do nonetheless appear to carry functional significance (see Jermann, Dancey, Dunnell and Thomas 1978, Chapter 2 for a more detailed treatment of these component classifications).

Geographic Cluster. Sites also were classified according to their location in different reaches of the river. Nelson and Rice (1969) have noted a tendency for Plateau sites along the major river course to cluster in space and to include a variety of different activity clusters. Termed site complexes, these clusters are believed to be products of cultural activities performed by a single community of people. The dispersion of sites along the river in the study region suggests a tendency toward spatial clustering.

Table 5-1. Resource variability matrix for prehistoric habitation and nonhabitation sites.

Site	Component	Time Interval						Non-Habitation Site				Habitation Site[1]												Geographic Cluster[2]						Topographic Association[3]					
												Non-Housepit				Housepit																			
		I (12000-6500 BP)	II (6500-3500 BP)	III (3500-2800 BP)	IV (2800-1600 BP)	V (1600-500 BP)	VI (500-200 BP)	Cairn	Cache	Blind	Pictograph	11	12	21	22	1A	1B	1C	2A	3A	4A	4C	4D	a	b	c	d	e	f/g	aa	ab	ac	ba	bb	ca
45-DO-102								x																					x	x					
45-DO 197								x																		x									
45-DO-204	1			x											x											x						x			
45 DO-204	2					x									x											x						x			
45-DO-208											x													x											
45-DO-211	1												x																x	x					
45-DO-211	2												x																x	x					
45-DO-211	3												x																x	x					
45-DO-214	1			x											x														x		x				
45-DO-214	2				x										x														x		x				
45-DO-216							x																						x		x				
45-DO-217							x																						x		x				
45-DO-221							x																						x	x					
45-DO-222							x																						x	x					
45-DO-223							x																						x				x		
45-DO-224							x																						x			x			
45-DO-228							x																						x			x			
45-DO-229							x																						x			x			
45-DO-232							x																						x				x		
45-DO-239							x																					x					x		
45-DO-240							x																					x							x
45-DO-242	1										x																	x				x			
45-DO-242	2													x														x				x			
45 DO-242	3												x															x				x			
45-DO-243	1			x								x																x				x			
45-DO-243	2													x														x				x			
45-DO-244							x																					x							
45-DO-248												x															x			x					
45-DO-249	1												x														x			x					
45 DO-249	2				x									x													x			x					

Table 5-1. Cont'd.

Site	Component	Time Interval						Non Habitation Site				Habitation Site[1]												Geographic Cluster[2]						Topographic Association[3]					
												Non-Housepit				Housepit																			
		I (12000-6500 BP)	II (6500-3500 BP)	III (3500-2600 BP)	IV (2600-1600 BP)	V (1600-500 BP)	VI (500-200 BP)	Cairn	Cache	Blind	Pictograph	11	12	21	22	1A	1B	1C	2A	3A	4A	4C	4D	a	b	c	d	e	f/g	aa	ab	ac	ba	bb	ca
45-DO-249	3												x														x			x					
45-DO-264								x																			x						x		
45-DO-267								x																			x			x					
45-DO-268								x																			x			x					
45-DO-273	1	x										x													x								x		
45-DO-273	2											x													x								x		
45-DO-273	3														x										x								x		
45-DO-276	1													x											x								x		
45-DO-276	2													x											x								x		
45-DO-276	3													x											x								x		
45-DO-277								x																	x								x		
45-DO-278								x																	x								x		
45-DO-280								x																	x										x
45-DO-281								x																x											x
45-DO-282	1												x											x									x		
45-DO-282	2												x											x									x		
45-DO-282	3		x										x											x									x		
45-DO-285	1														x														x	x					
45-DO-285	2														x														x	x					
45-DO-304								x																x									x		
45-DO-315								x																		x							x		
45-DO-318								x																			x								x
45-DO-326																										x							x		
45-OK-2	1						x											x										x		x					
45-OK-2	2					x								x														x		x					
45-OK-2	3																			x								x		x					
45-OK-4																			x								x			x					
45-OK-11	1				x									x													x			x					
45-OK-11	2					x																	x				x			x					

Table 5-1. Cont'd.

Site	Component	Time Interval						Non-Habitation Site				Habitation Site[1]												Geographic Cluster[2]						Topographic Association[3]					
												Non-Housepit				Housepit																			
		I (12000-6500 BP)	II (6500-3500 BP)	III (3500-2800 BP)	IV (2800-1600 BP)	V (1600-500 BP)	VI (500-200 BP)	Cairn	Cache	Blind	Pictograph	11	12	21	22	1A	1B	1C	2A	3A	4A	4C	4D	a	b	c	d	e	f/g	aa	ab	ac	ba	bb	ca
45-OK-18	1													x											x								x		
45-OK-18	2					x									x										x								x		
45-OK-28							x										x											x			x				
45-OK-158						x															x							x			x				
45-OK-170											x																x				x				
45-OK-175								x																				x		x					
45-OK-179								x																		x				x					
45-OK-181											x															x				x					
45-OK-202								x																					x				x		
45-OK-203								x																					x				x		
45-OK-213								x																					x				x		
45-OK-214								x																					x				x		
45-OK-216								x																				x			x				
45-OK-223									x																			x		x					
45-OK-239	1				x																		x					x		x					
45-OK-239	2					x																	x					x		x					
45-OK-240											x																	x		x					
45-OK-242								x																				x		x					
45-OK-245	1						x								x													x		x					
45-OK-245	2																x											x		x					
45-OK-250	1											x															x			x					
45-OK-250	2			x											x												x			x					
45-OK-250	3						x						x														x			x					
45 OK 258	1		x									x															x			x					
45-OK-258	2			x										x													x			x					
45-OK-258	3						x															x					x			x					
45-OK-262								x																			x			x					
45-OK-263								x																			x			x					
45-OK-264								x																			x			x					

Table 5-1. Cont'd.

Site	Component	Time Interval: I (12000-6500 BP)	II (6500-3500 BP)	III (3500-2800 BP)	IV (2800-1600 BP)	V (1600-500 BP)	VI (500-200 BP)	Non-Habitation Site: Cairn	Cache	Blind	Pictograph	Habitation Site[1] Non-Housepit: 11	12	21	22	Habitation Site[1] Housepit: 1A	1B	1C	2A	3A	4A	4C	4D	Geographic Cluster[2]: a	b	c	d	e	f/g	Topographic Association[3]: aa	ab	ac	ba	bb	ca
45-OK-272										x																	x			x					
45-OK-273								x																			x			x					
45-OK-276								x																			x			x					
45-OK-278								x																		x				x					
45-OK-281								x																		x				x					
45-OK-282								x																		x								x	
45-OK-283								x																		x								x	
45-OK-285								x																		x								x	
45-OK-286								x																		x								x	
45-OK-287							x							x												x					x				
45-OK-288	1			x										x												x					x				
45-OK-288	2													x												x					x				
45-OK-288	3											x														x					x				
45-OK-291								x																		x						x			
45-OK-295								x																		x				x					
45-OK-300								x																		x				x					
45-OK-302								x																		x				x					
45-OK-305								x																		x							x		
45-OK-306								x																		x									x
45-OK-307								x																		x									x
45-OK-335								x																x								x			
45-OK-339								x																											x

1

Non-Housepit Class	Lithic Debitage	Fire-Cracked Rock
11	<8.0/m^3	<600gm/m^3
12	<8.0/m^3	>600gm/m^3
21	>8.0/m^3	<600gm/m^3
22	>8.0/m^3	>600gm/m^3

Housepit Class	Housepit Size (m)	Housepit Number
1A	3-7 m	1-3
1B	3-7	4-5
1C	3-7	6-10
2A	8-10	1-3
3A	11-15	1-3
4A	3-7/8-10	1-3
4B	3-7/8-10	4-5
4C	3-7/8-10	6-10
4D	3-7/8-10	11-13
5A	8-10/11-15	1-3
5C	8-10/11-15	6-10

2 Cluster Name

a = Box Canyon
b = Gaviota Bend
c = Parsons Rapids
d = Mah-kin Rapids/ Lee Weber Canyon
e = Coyote-Hudnut-Deep Canyon
f/g = Buckley Bar/ Sanderson Creek

See Figure 5-1 for location.

3

Topographic Association Class	Relative Elevation (1931 River Level)	Topography
aa	0-99 feet	Broad terrace
ab	0-99	Narrow terrace
ac	0-99	Alluvial fan
ba	100-174	Broad terrace
bb	100-174	Narrow terrace
ca	>175	Broad terrace

Whether or not these clusters indicate site complexes, the mere existence of a nonrandom distribution suggests a cultural pattern. Munsell and Salo (1977:Figure 1) defined seven geographic clusters. Eleven clusters were later defined (see Jaehnig et al. 1984:Table 1-B). Here we use the original seven clusters (Figure 5-1), but combine Clusters F and G in Table 5-1.

Topographic Association. Two dimensions of topographic variability were used to classify the components. The first of these was based on a combination of local site topography and elevation above pre-dam river level. Topographic variation was categorized into three alternatives: (1) broad terraces flanking the main river channel, (2) narrow terraces constrained by bedrock or by higher terrace margins, and (3) alluvial fans located at the mouths of the small canyons which drain the uplands. Height above pre-dam river levels (low water level January 1931 was used as a base elevation) was likewise divided into three categories: (1) 0-100 feet (0-30 m), (2) 100-175 feet (30-55 m), (3) greater than 175 feet (55 m). Each site was assigned to one of the nine potential combinations of topography and elevation.

SELECTED SITES

Although sites were selected in two stages, the initial selections were incorporated into the second stage and we can conveniently discuss the process as if all sites were selected at once.

The guiding principle of the selection process was that proposed site selections should maximize coverage of temporal, cultural, and environmental differences while minimizing the number of sites to be excavated. The latter requirement was satisfied by selecting multicomponent sites whose constituent components occupied differing cells in the variability matrix. Components were chosen as follows: first, occupation areas were chosen to represent all known combinations of occupation age and type. Once a full set of such occupations had been represented, a few components were chosen to fill in geographic clusters, and then topographic associations not already covered by the first priority choices.

Initially, 31 sites were selected to represent the range of cultural variability manifest in the floodplain zone of the Chief Joseph Dam Project area (Jermann, Dancey, Dunnell and Thomas 1978:Chapter 5). These 31 sites include 70 cultural components divided among 38 matrix classes--only 41 of the 70 recognized components are fully classified in the variability matrix. However, potential project cost, effects and available time then entered the selection process. The 31 sites included several that would not be immediately affected by the project. These were included in a program for monitored, passive preservation (45-DO-222, 45-DO-248, 45-DO-254, 45-DO-276, 45-DO-284, 45-DO-312, 45-OK-28, 45-OK-158, 45-OK-168, 45-OK-239, 45-OK-245, 45-OK-292, 45-OK-309, 45-OK-311, and 45-OK-313). Prehistoric habitation sites 45-DO-204, 45-DO-211, 45-DO-214, 45-DO-242, 45-DO-243, 45-DO-249, 45-DO-273, 45-DO-282, 45-DO-285, 45-OK-2, 45-OK-2A, 45-OK-4, 45-OK-11, 45-OK-18, 45-OK-250, 45-OK-258, 45-OK-287, and 45-OK-288 were retained.

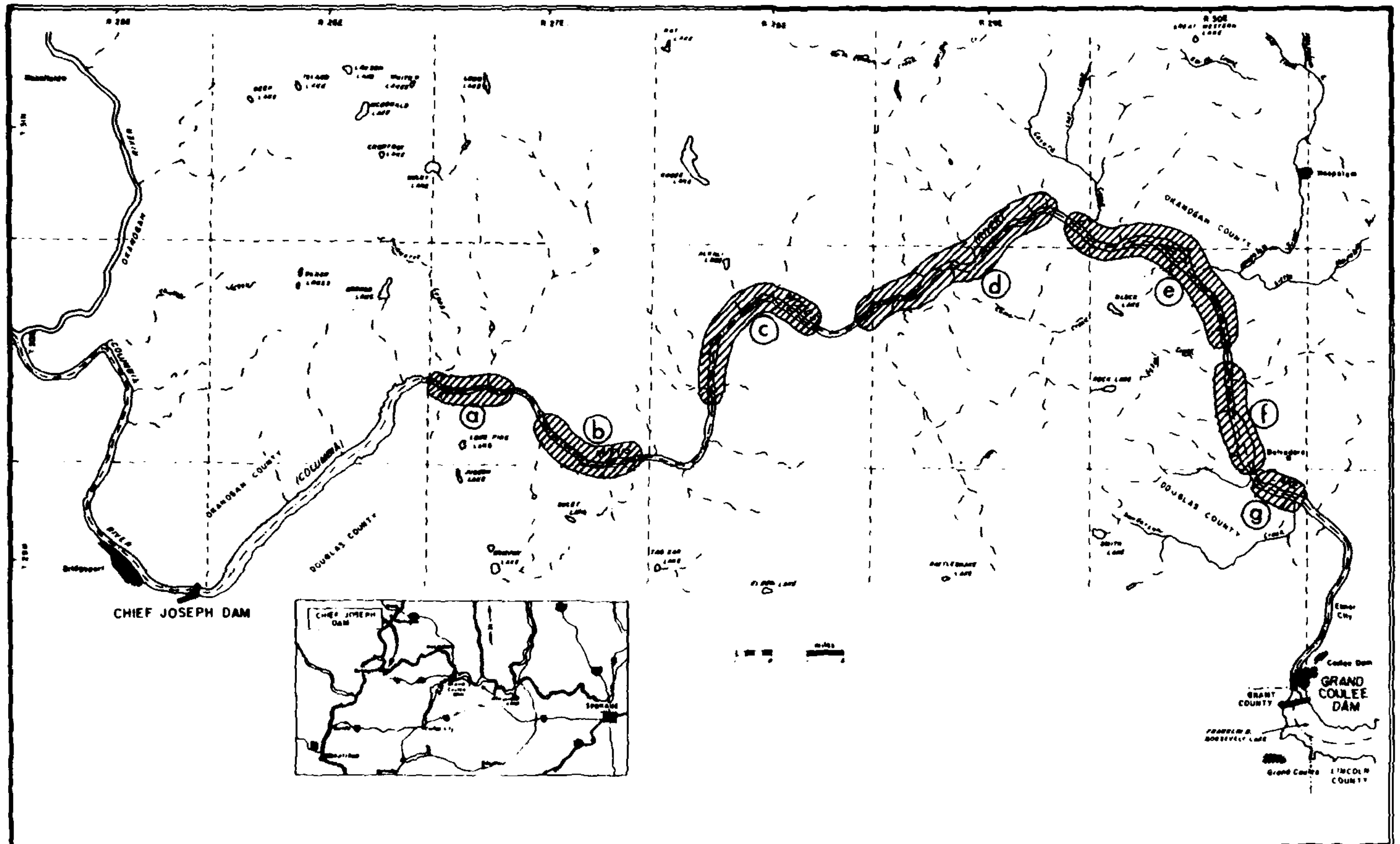

Figure 5-1. Distribution of geographic site clusters.

Some changes in site selection were made after data recovery began at the second set of sites in May 1979. One of the excavated sites, 45-DO-326 was not among those originally chosen. It was found and tested in summer 1979. Full-scale excavation followed immediately, since this site, a rockshelter, filled a previously unrepresented category in the variability matrix. Work was begun at 45-DO-249, but was soon discontinued when we found that the entire site had been redeposited by an historic placer mining operation. Between 31 July 1978 and 21 August 1980, excavations were completed at 18 sites (Figure 1-1). The characteristics of these sites as determined from testing results are summarized in Table 5-2.

In addition, all nonhabitation sites were to be examined to determine the accuracy of their classification. Potential burial sites were to be tested to determine if they contained burials and to assess the need to relocate them, All rock art sites were to be recorded to scale photographically and by tracing.

SITE SAMPLING

We required a site sampling design that would allow recovery of sufficient information to (1) adequately characterize the content of the archaeological record and (2) characterize the spatial structure of the site, i.e. internal patterning of activities. Recent investigations into sampling strategy (Jermann 1981) indicate that samples adequate for estimating a population's size do not provide adequate information about its spatial patterning. These investigations also suggest that simply adding probabilistically selected units does not increase the chances of predicting spatial patterns. Therefore we used a two-stage sampling program at all sites. The first stage consisted of probabilistic sampling to recover representative data on site content and general structure. In the second stage a purposive (chosen on the basis of judgement) sample was designated to provide additional information about site structure in specific areas.

PROBABILISTIC SAMPLING

An unbiased, representative, reliable sample of the content of the archaeological record requires excavations within a framework which guarantees that all potential excavation units have an equal, or known, chance of selection. The only means of satisfying this requirement is through some form of probabilistic sampling. At the same time, the explicit spatial focus of our research demanded that we try to use sampling schemes which included provisions for maximum sample dispersal. Although we recognized that probabilistic designs might not be the most efficient means of characterizing spatial pattern, some designs are more useful for this purpose than others, while still providing unbiased estimates of population parameters. These designs were to be used for content-based investigations.

Several sampling schemes were used, depending upon site size, site shape, and available information on site structure (Table 5-3). A simple random sample design was used at 45-DO-273, the smallest site excavated. All other

Table 5-2. Attributes of sites selected for excavation.

Site	Component	Area (m2)	Geographic Cluster [1]	Component Type [2]	Topographic Type [3]	Cultural Period [4]	Destruction Probability Class [5]
45-DO-204	(1)	1,000	c	N 2-2	ac	III	1
	(2)			N 2-2		V	
45-DO-211	(1)	2,975	g	N 1-2	aa	-	2
	(2)			N 1-2		V	
	(3)			N 1-2		-	
45-DO-214	(1)	1,200	f	N 2-2	ab	III	2
	(2)			N 2-2		V	
45-DO-242	(1)	990	e	N 1-1	ac	-	1
	(2)			N 2-2		-	
	(3)			N 2-1		-	
45-DO-243	(1)	1,596	e	N 1-2	ac	III	1
	(2)			N 1-2		-	
45-DO-273	(1)	336	b	N 1-1	ba	-	1
	(2)			N 1-1		-	
	(3)			N 2-2		I	
45-DO-282	(1)	93,700	a	N 1-2	ba	-	1
and	(2)			N 1-2		IV	
45-DO-188	(3)			N 1-2		II	
45-DO-285	(1)	1,125	f	N 2-2	aa	V	1
	(2)			N 2-2		IV	
45-DO-326	(1)	600	b	R 2-2	ba	VI	1
	(2)			R 2-2		IV	
45-OK-2	(1)	12,000	e	H 1-C	aa	V	1
45-OK-2A	(1)	23,400	e	N 2-1	aa	III	1
	(2)			H 3-A		-	
45-OK-4	(1)	3,700	d	H 2-A	aa	-	1
45-OK-11	(1)	6,600	d	N 2-1	aa	II	1
	(2)			N 2-2		III	
45-OK-18	(1)	2,000	b	N 2-1	ba		2
	(2)			N 2-2		III	
45-OK-250	(1)	3,450	d	N 1-1	aa	-	1
	(2)			N 2-2		IV	
	(3)			N 1-2		III	
45-OK-258	(1)	4,200	d	N 1-1	aa	II	1
	(2)			N 2-1		III	
	(3)			H 4-C		VI	
45-OK-287	(1)	1,200	b	N 2-1	ab	VI	1
45-OK-288	(1)	1,312	b	N 2-1	ab	III	1
	(2)			N 2-1		-	
	(3)			N 1-1		-	

1 See Figure 5-1 for location of geographic clusters.

2 Component types

Nonhousepit (N) and Rockshelter (R)
- Debitage objects per m^3:
  - 1 = <8.0
  - 2 = >8.0
- FMR grams per m^3:
  - 1 = <600
  - 2 = >600

Housepit (H)
- Number of housepits:
  - A = 1-3
  - B = 4-5
  - C = 6-10
  - D = 11-13
- Length of housepits:
  - 1 = 3-7 m (10-23 ft)
  - 2 = 8-10 m (26-33 ft)
  - 3 = 11-15 m (36-49 ft)
  - 4 = 3-10 m (ie., combinations of 1 and 2)

3 Topographic types

Meters above original river level:
- a = 0-32 (0-99 ft)
- b = 33-57 (100-175 ft)
- c = more than 57 (175 ft)

Topographic location:
- a = broad terrace
- b = narrow, confined terrace
- c = alluvial fan

4 Jermann, Dancey, Dunnell, and Thomas (1978) proposed six chronological divisions for prehistorical cultural periods within the project area.

Period I = 12,000-6500 B.P.
Period II = 6500-3500 B.P.
Period III = 3500-2600 B.P.
Period IV = 2600-1600 B.P.
Period V = 1600-500 B.P.
Period VI = 500 B.P.-Historic

5 Site destruction probability classes:

1 = now eroding or with high probability of eroding after pool raise
2 = subject to increased sloughing from pool fluctuations
3 = not subject to immediate destruction by sloughing, but within guide-taking lines.

Table 5-3. Sampling designs employed, by site.

Site	Probabilistic Sampling Design		Total Site Area (m^2)	Area Excavated (m^2)	Total Volume Excavated (m^3)	Purposive Sample Volume[a] (m^3)	Probabilistic Sample Volume (m^3)
	Nonhousepit	Housepit					
45-DO-204	Stratified random	-	1,000	104	153.8	11.1	142.7
45-DO-211	Stratified unaligned systematic random	-	2,875	88	157.2	53.7	103.5
45-DO-214	Stratified random	-	1,200	120	192.6	64.3	128.3
45-DO-242	Stratified unaligned systematic random	-	990	80	153.5	41.2	112.3
45-DO-243	Stratified unaligned systematic random	-	1,596	50	84.9	-	84.9
45-DO-273	Simple random	-	336	98	158.6	91.8	66.8
45-DO-282	Aligned systematic	-	93,700	126	186.1	-	186.1
45-DO-285	Stratified unaligned systematic random	-	1,125	74	142.5	70.7	71.8
45-DO-326	Aligned systematic	-	600	73	92.8	75.2	17.6
45-OK-2	Stratified random cluster	Stratified random	19,200	428	473.0	280.6	192.4
45-OK-2A	Stratified random cluster	Stratified random	23,400	58	90.6	-	90.6
45-OK-4	Stratified unaligned systematic random	Stratified random	3,750	152	253.8	71.4	182.4
45-OK-11	Stratified random	-	6,600	558	960.9	486.2	474.7
45-OK-18	Stratified random	-	2,000	226	166.1	7.2	158.9
45-OK-250	Stratified unaligned systematic random	-	3,450	184	373.5	174.4	199.1
45-OK-258	Stratified random	Purposive	4,200	353	488.3	129.8	358.5
45-OK-287	Stratified random	-	1,200	57	55.1	5.3	49.8
45-OK-288	Stratified unaligned systematic random	-	1,312	100	175.0	100.0	75.0

sites were stratified by some means. Except for housepit strata encompassing surface depressions at some sites, the sampling strata were arbitrary divisions intended to insure sample dispersion. Two different means of stratification were used. For the first sites excavated, 45-DO-204, 45-DO-214, 45-OK-11, 45-OK-18, and 45-OK-258, the site was first divided into 2 x 2-m squares which were serially numbered from the NW corner. These were then divided into sampling strata of roughly equal size. Sites excavated later (except 45-DO-273) were first broken into 10 x 10-m blocks subdivided into 2 x 2-m sampling units. It was not possible to approximate the site boundary as closely using this latter method. However, use of small strata of regular geometric shape rather than large irregular strata made it feasible to employ an unaligned systematic sample.

Sampling intensity was not specified in the sampling strategy outlined in the draft research design (Jermann et al. 1980). It is noted there that the absolute number of observation points is more important than simple sampling fraction. An arbitrary minimum limit of 25 units was suggested to balance cost and sample reliability requirements. It was expected that sampling intensities would vary according to the density and complexity of site deposits.

Simple Random

Site 45-DO-273 was excavated with a simple random sampling design. The site, the smallest excavated, consisted of 42 2 x 2-m units. Stratification was not considered necessary to achieve adequate spatial dispersion.

Systematic Aligned

Two sites, 45-DO-282 and 45-DO-326, were sampled with an aligned systematic sampling design. The decision to use this type of design at 45-DO-326 was prompted by the absence of adequate testing data with which to determine the horizontal limits of cultural deposits outside the shelter proper. The area outside the shelter was divided into 5 x 5-m blocks and a 1 x 1-m unit in the center of each block was selected for excavation. The resulting data were used to plot the site boundaries. A systematic aligned sampling design was chosen for 45-DO-282 because of the large size of the site (over 40 hectares). The goal was to achieve extensive spatial coverage and the assumption was made that any spatial cultural patterning would not be coincident with the pattern of the sampling units over the entire site.

Stratified Random

A stratified random sampling design was used for 45-DO-204, 45-DO-214, 45-OK-11, 45-OK-18, 45-OK-258 nonhousepit strata, and 45-OK-287. The site was divided into 2 x 2-m squares, which were numbered serially, starting from the NW corner of the site and proceeding west to east and north to south. The strata were then divided into roughly equal-sized strata. The size of the strata varied from site to site. For example, at 45-OK-18, there were 260 units, divided into strata containing 52 units. Stratum I consisted of units 1-52, Stratum II of units 53-104, etc. At 45-DO-204 the strata consisted of 21 2 x 2-m units, except in the last stratum, which included 23. The strata at 45-OK-11 included 100 sampling units except for the last, which contained 111. This produced irregularly shaped strata which were long, thin and parallel to the length of the site at 45-OK-18, and somewhat less elongated and perpendicular to the length of the site at the other sites (see Figure 5-2 for an example). At 45-OK-258, variable size strata were used, varying between 70 and 90 2 x 2-m units.

A table of random numbers was used to select sample units within each stratum. The specific procedure used to make such selections is quite straightforward and can be illustrated best by a brief example. Suppose the following sequence of random numbers is drawn from a table:

013, 321, 162, 045, 847, 208, 524, 115, 683, 077, 259

Those numbers lying outside the bounds of the viable range of available unit designators, i.e. >260, are ignored (in this case #'s 321, 847, 524, and 683). The remaining numbers are allocated to their appropriate stratum, taking care to note the order in which a particular unit was chosen within a particular stratum (Table 5-4). The order corresponds to a sequence in which units within a given stratum would be excavated to realize an interval, staged sample. Using the example given above, the following sample unit assignments and orders result. Additional numbers would be drawn until the requisite number of units are selected for each stratum. As soon as a requisite number of units had been chosen for a particular stratum, random numbers in that stratum's range were ignored, so that an equal number of sample units were selected for each stratum.

Table 5-4. Example of sample unit selection, stratified random design.

	Sample Unit Distribution				
Sampling Stage	Stratum I (1-52)	Stratum II (53-104)	Stratum III (105-156)	Stratum IV (157-208)	Stratum V (209-260)
1	13	77	115	162	259
2	45			208	
3					
4					
.					
.					
.					
n					

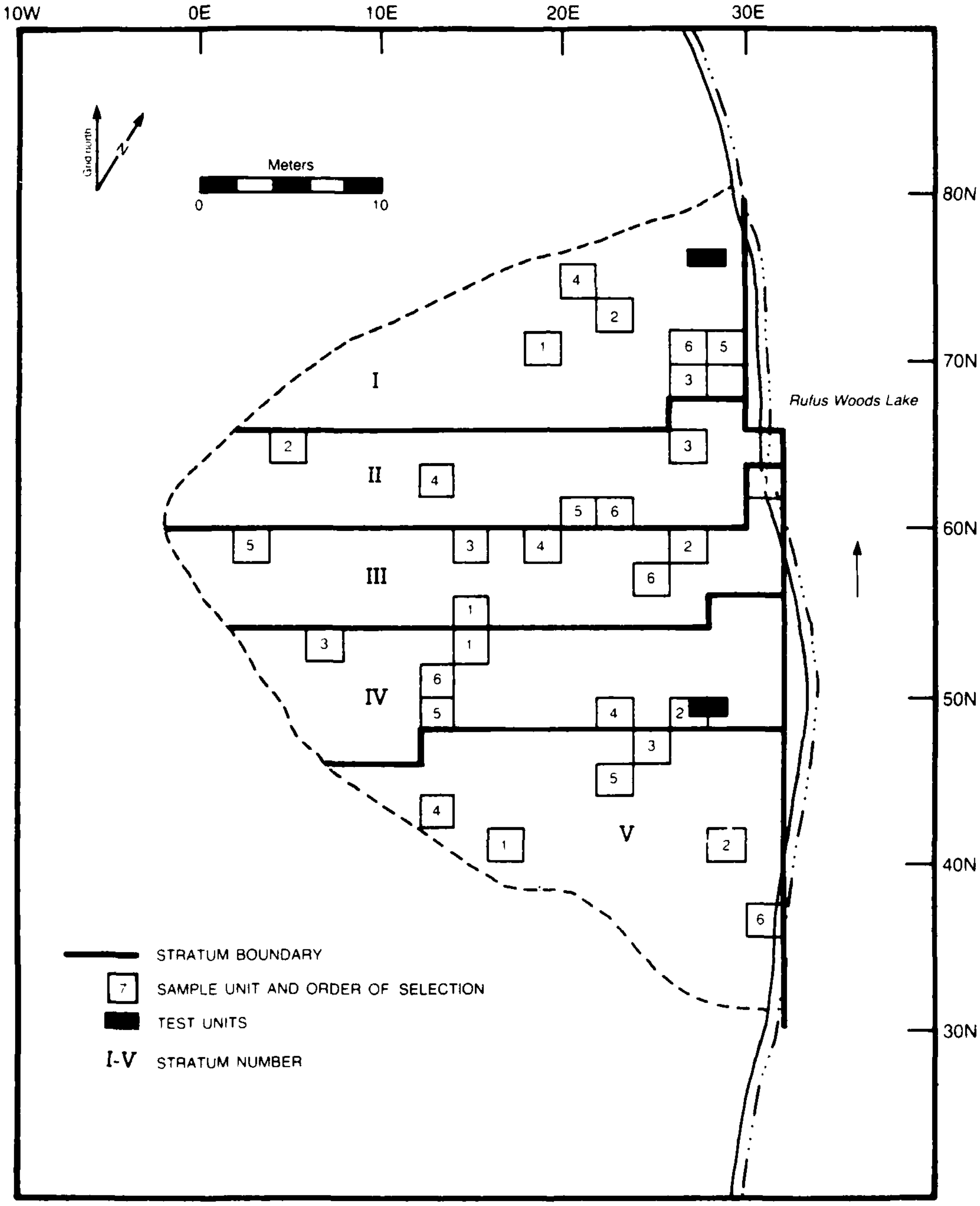

Figure 5-2. Example of stratified random sampling design, 45-DO-214.

Stratified Unaligned Systematic Random

Probabilistic sampling at 45-DO-211, 45-DO-242, 45-DO-243, 45-DO-285, 45-OK-4 nonhousepit strata, 45-OK-250 nonhousepit strata, and 45-OK-288 was conducted within a stratified unaligned systematic random sampling design (Table 5-3). This particular sampling design was chosen because it is a hybrid of systematic and stratified random schemes that offers both random (probabilistic) unit selection and systematic spatial separation. The random unit selection offers unbiased estimators for underlying population parameters, useful in predicting site content, and the systematic element guarantees some measure of spatial separation between units, necessary for explorations of site structure. Since both concerns are relevant to our research goals, this design provides an optimal compromise within a probabilistic sampling framework.

First we subdivided the site area, as identified during testing operations, into 10 x 10-m sampling strata. These were internally divided into 25 primary sampling units 2 x 2 m in size (see Figure 5-3 for an example).

Individual sampling units within each stratum were selected for excavation in the following manner. Each of the 25 primary sampling units was identified by a pair of coordinates; the coordinate axes in the **x** (N-S) direction were labelled 1 through 5, and the coordinate axes in the **y** (E-W) direction also were labelled 1 through 5. Each primary sampling unit was then identified by its **x** and **y** intersections. The same internal coordinate system was applied to each of the sampling strata.

The following description of the unit selection procedure uses 45-DO-211 (Figure 5-3) as an example. Beginning with Stratum 1, two random numbers between 1 and 5 were selected as "seeds" for sample design generation. In this case, the unit with coordinates (1,4) was selected initially for Stratum 1, Unit 1. From these seed coordinates, coordinates were determined for first-level sample units in the vertical tier of strata that included Strata 1, 2, and 3; the other three first-stage sample units were found by holding the **x** coordinate of the seed constant and randomly selecting three new **y** coordinates in the 1-5 range. The resulting values were 5 and 1. The resulting first-stage units are located at (1,5) in Stratum 2, and (1,1) in Stratum 3. An identical procedure was followed in the horizontal tier of sample strata, except here the **y** coordinates of the seed were held constant and the **x** values randomly varied, resulting in first-stage units at (1,4) in Stratum 4 and at (3,4) in Stratum 3. Once these units had been selected, a new random seed coordinate pair (1,5) was selected for Stratum 5. This was used to generate sample units for its constituent horizontal and vertical strata tiers. This procedure could be extended to accomodate any number of additional tiers of strata. The same procedure was applied to select units for additional sampling stages.

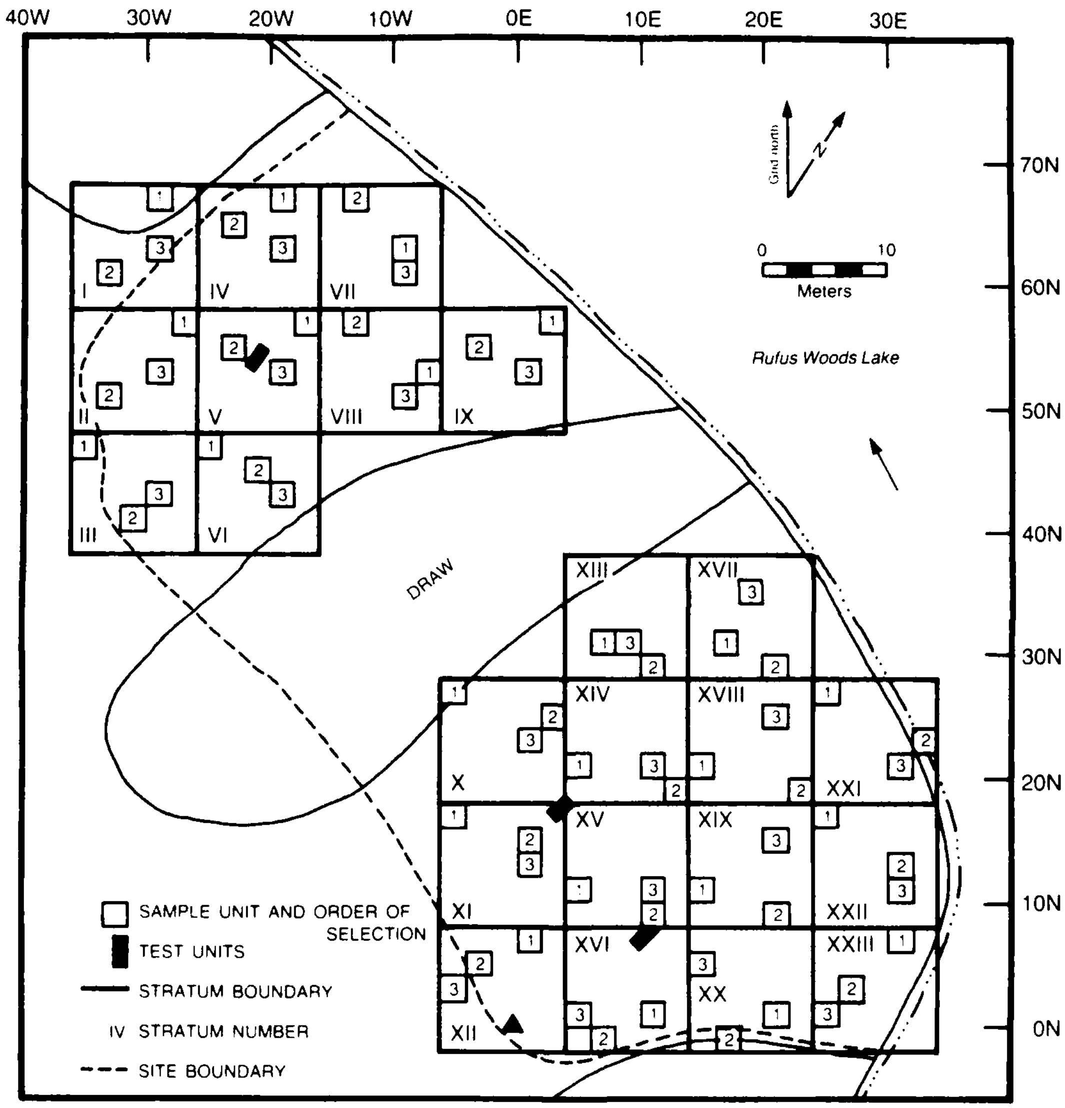

Figure 5-3. Example of stratified systematic unaligned random sampling design, 45-DO-211.

Stratified Random Cluster Sampling

This sampling design was used only at 45-OK-2 and 45-OK-2A. As in the stratified systematic unaligned random sampling design described above, the site was first divided into 10 x 10-m sampling blocks, subdivided into 2 x 2-m primary sampling units. The housepit strata were delineated and the remaining 10 x 10-m blocks were grouped into roughly equal sized strata with irregular shapes. A random sample of 10 x 10-m blocks was drawn from each nonhousepit sampling stratum and then a random sample of 2 x 2-m units was chosen within the selected clusters.

Housepit Strata

Where the location and size of housepits at a site were known from surface depressions, the housepit areas were treated as separate sampling strata for purposive sampling. In most instances, housepit strata selected for investigation were sampled at a higher intensity than nonhousepit strata, sometimes even being excavated entirely. Preferential treatment was accorded to intact structures.

Housepit sampling strata were designated at 45-OK-2, 45-OK-2A, 45-OK-4, and 45-OK-258 (Table 5-3). At 45-OK-258, the site was first divided into 2 x 2-m squares as described above under the stratified random design. Square or rectangular boundaries were drawn to encompass the housepits and an additional 2-4 meters outside the rim. It was expected that domestic activities related to the house would occur in this buffer zone. The housepit strata at 45-OK-258 were not probabilistically sampled: the plan was to excavate two of the housepit strata entirely. As complete excavation was not achieved, it is best to consider it purposive sampling. The other sites were first divided into 10 x 10-m sampling blocks as described above, and the minimum number of blocks encompassing each housepit were designated housepit sampling strata (see Figure 5-4 for an example). A random sample was selected from each 10 x 10-m block in each housepit stratum to be investigated. Time did not allow investigation of each housepit stratum; those which appeared to contain intact houses were selected. The size of the strata varied, depending on the size of the housepits or the number which were adjacent to one another and encompassed in the same sampling stratum.

APPLICATION OF PROBABILISTIC SAMPLING DESIGNS

Within all the sampling designs described above, flexibility and economy were obtained in several ways. First, in the stratified designs, it was possible to investigate different sampling strata with differing intensities, or omit some entirely, without invalidating the probabilistic nature of the sample obtained from each one. This applies particularly to housepit and nonhousepit strata. At 45-OK-2, the housepit strata were sampled with a different sampling design and at a higher intensity than the nonhousepit strata. However, the flexibility is also apparent at sites with only housepit strata, as at 45-OK-11. Probabilistic sample units in several sampling strata

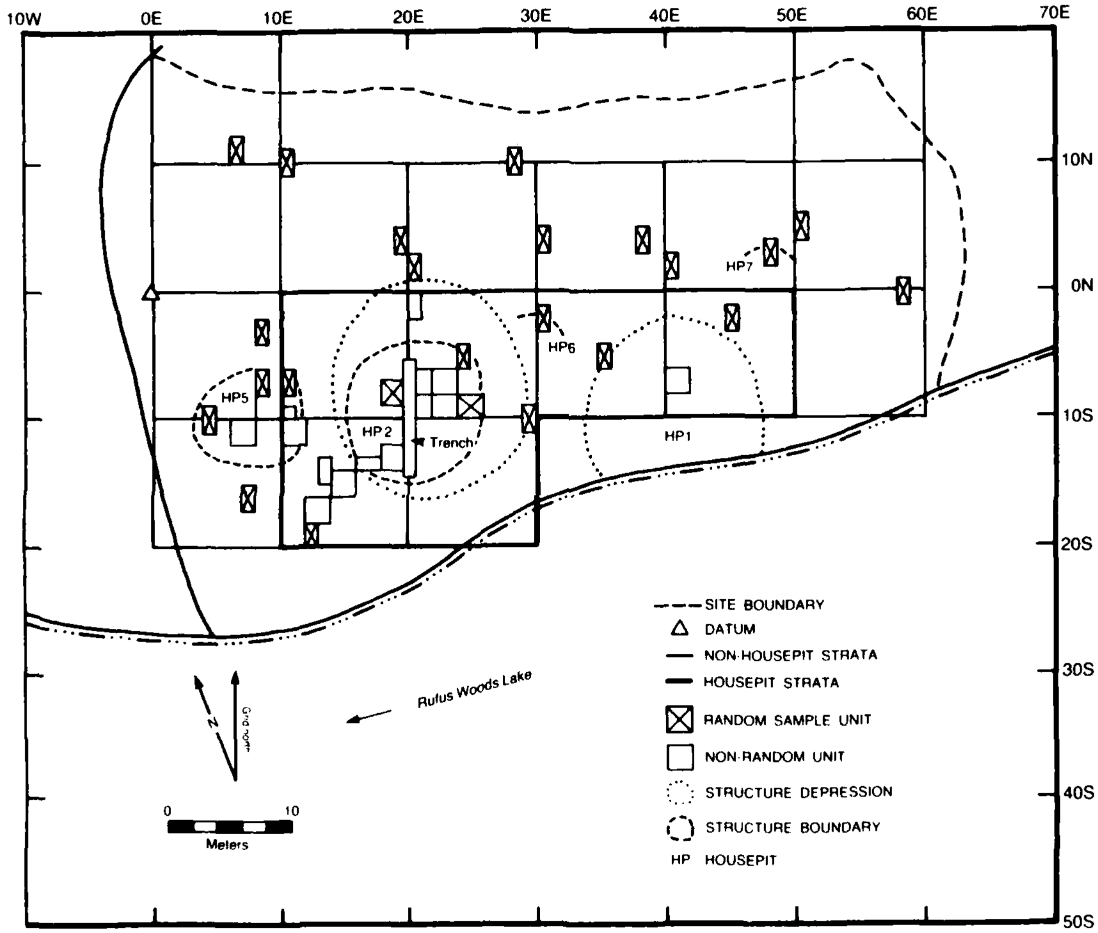

Figure 5-4. Example of housepit strata definition, 45-OK-4.

at the northern margin of the site were never excavated. Given the low densities of cultural material at this end of the site, time and money were better spent on collecting a large purposive sample of the early housepits encountered elsewhere on the site.

Because a staged interval sample was drawn in the stratified random and stratified unaligned systematic random designs, sample intensity could be varied within one or more sampling strata by terminating the sampling at a different stage, without violating the probabilistic nature of the sample. When the sample was drawn, the order of selection was noted for each unit. To assure equal areal representation and interstratum comparability, the sample units selected first for each stratum were excavated first, followed by all units selected second, and so on. Units farther down the list (after the second selection) were excavated only if the number of artifacts and the complexity of the deposits warranted further investigation. In a few cases, only the first units were excavated.

Also, the size of the recovery unit could be altered for greater efficiency. The sampling unit, a 2 x 2-m square, could be excavated entirely or a smaller portion could be excavated when field circumstances warranted. Where cultural deposits were relatively shallow and characterized by low artifact density, 1 x 1-m recovery units were excavated. In moderate density areas, 1 x 2-m units often were used. This strategy saved time without sacrificing sample integrity. Regardless of the size of the recovery unit the northwest quadrat of the 2 x 2-m sampling unit always was included, ensuring that data from all probabilistic sampling units was internally consistent and comparable for at least one scale of locational analysis.

It was not possible, given the time and funding constraints for completing the descriptive site reports, to make use of the probabilistic sample as such. For our analyses, the entire assemblages have been considered. It should be kept in mind that the samples recovered from different sites vary considerably in the proportionate amount of probabilistic sampling of dense occupation areas and houses.

PURPOSIVE SAMPLING

The second stage of excavations was conducted within a purposive sampling framework. Excavation units were selected almost entirely upon the results of probabilistic sampling. A few purposive units might be used to complete excavation of a feature or a block excavation might be opened up to investigate a structure or occupation surface. If probabilistic sampling encountered deposits critical to overall site interpretation, we expanded excavations to include the data of interest. Obviously, planning for such purposive excavations relies heavily on concurrent evaluation of findings. Therefore, processing and analysis of excavated materials were initiated during fieldwork, and the results were used along with field observations to plan placement of purposive units.

Excavation, collection, and data recording procedures were the same for excavation units selected through purposive sampling as through probability sampling. However, the probabilistic units were almost always isolated units, that is they were not contiguous with any other units when excavated, while the purposive units generally were part of block excavations. In block areas, excavation was scheduled so that a given recovery unit was excavated, profiled, and described in its entirety before any units sharing a common edge were excavated. This system provided a preview of depositional structure that was used to guide recovery efforts in adjoining units. It also enabled us to collect profiles from most internal walls in a block excavation, important because of our reliance on profiles and mapping to reconstruct the horizontal and vertical relationships in these areas of complex cultural and natural stratigraphy.

Although our general strategy for all sites was a two stage sampling program, the purposive sampling stage was of varying importance at different sites (Table 5-3). Purposive sampling was not employed at all at some sites, such as 45-OK-2A and 45-DO-282 where nothing was found during probabilistic sampling which justified further excavation. At 45-DO-204, only a single purposive unit was excavated. At other project sites, eg. 45-OK-2, the purposive sample is larger than the probabilistic sample.

EXCAVATION TECHNIQUES

In the field, each excavation unit was designated by its northwest corner grid point. All 1 x 2-m units were subdivided into two 1-m squares, and all 2 m squares were subdivided into 1-m quadrats (quads). Excavation procedures and recovery techniques were designed to keep 1-m^2 subunits separate.

Excavations proceeded in arbitrary 10-cm units (unit levels) for vertical control within each sampling unit. Excavators switched to 5-cm levels for finer control when identifying and excavating housepit floors or other important features. Excavation levels were measured from the surface of the northwest corner of each 1 x 2-m or 2-m^2 sampling unit. Designations for individual levels were referenced by the vertical distance of unit level floor above or below this local elevational datum (unit datum). For example, Unit Level (UL) 10 refers to the floor of the level that encompasses materials lying between 0 and 10 cm below surface at the northwest corner stake of the sampling unit. Negative (below ground) values are implied. Matrix above unit datum was designated in plus levels; for example, all levels excavated between 20 and 10 cm above unit datum were designated +10.

When excavators encountered a matrix different from that being excavated, it was given a feature number, and unit level and feature level materials were collected separately (Figure 5-5). When further excavation indicated that matrix differentiation was due to natural processes, the different matrix was called a geological feature, but it was handled essentially the same as a cultural feature (see below). If matrix characteristics reverted back to those found above the feature within a unit level, the matrix below the feature was termed "Feature 888" (Figure 5-5) to differentiate materials from above and below the feature.

Features were handled in the following manner. Once a feature had been defined and outlined during excavation, a plan view was prepared. One half of the feature was excavated in arbitrary 10-cm levels but separately from the

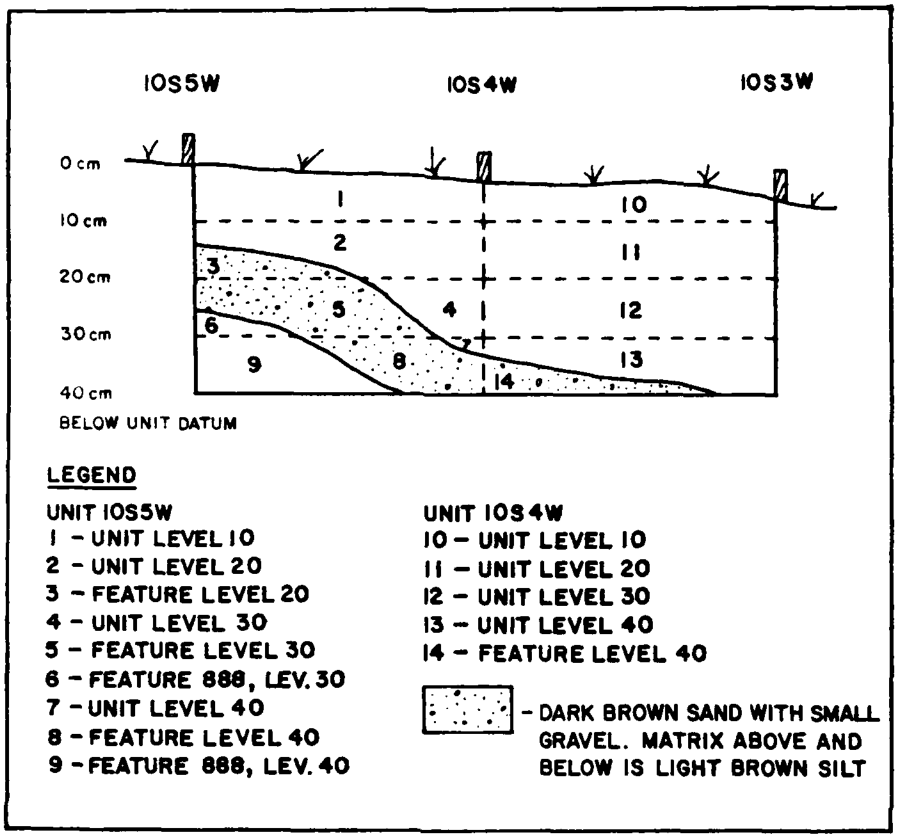

Figure 5-5. Schematic representaton of arbitrary level and feature designations in excavation.

surrounding matrix. A profile map was then drawn of the bisected feature, and the second half was excavated in arbitrary levels that could be subdivided by stratigraphic levels as warranted.

Units were excavated by skimming with flat shovels. When we encountered artifacts, matrix staining or features, small masonry trowels replaced shovels. All matrix was screened through handheld, two-legged, 1/8-inch mesh screens. In most cases, we employed dry screening methods, but wet cold conditions during November 1979 dictated a change to wet screening techniques. Three wet screening methods were used. At several sites, including 45-OK-287 and 45-OK-288, lower levels of sampling units near the river were screened by placing screens in the river and agitating. At several other sites, including 45-DO-273, 45-OK-2, 45-OK-4, and 45-OK-258, water was pumped to screens set up on the beach, but only a limited number of units were water screened. The only large scale water screening operation was at 45-DO-273, set up to handle large volumes efficiently because of the limited time during the reservoir drawdown.

We also varied conventional field methods somewhat at sites 45-DO-326, 45-OK-2, and 45-OK-4. The matrix of site 45-DO-326 consisted mainly of boulder-sized to very small talus detritus interspersed with relatively large quantities of lithics and bone fragments, making screening laborious. Toward the end of the excavation season, several units were screened in the field but sorted later at the project's field laboratory. The matrix at the other two sites was tractable enough in the summer but not in the winter when 45-OK-2 and 45-OK-4 were partly excavated. From November 1979 until February 1980, the ground at the sites was sometimes frozen. Chunks of frozen matrix were taken to the lab, thawed, screened, and then sorted. Most of the laboratory sorting was done by excavation crews during bad weather. This kept the bias introduced by laboratory-versus-field sorting at a minimum.

Soil samples, radiocarbon samples, samples of organic material, and any artifacts of particular significance found _in situ_ were collected as field catalogued items (FIELDCAT). Field catalogued items were measured in reference to a 5-cm grid superimposed on each 1-m quad. The northwest corner of each 5-cm square was used as a reference point. Depths for field catalogued items were taken directly from unit datum. Any item might be field catalogued, i.e. a formed tool, identifiable bone, fire-modified rock, charcoal, bone, or lithic detritus. The number and type of items recorded as field specimens varied depending on what was interesting at that site and the decisions of the site supervisor. More field specimens and samples were collected from features and housepit floors than in other situations.

Extensive field records were kept during excavation. Before excavation began a unit summary form was started for each sampling unit; this form was finished after excavation. Level records for each level of each sampling unit included provenience information; maps of field catalogued items and level floors; the field catalogue; separate estimates of amounts of lithics, formed tools, bone fragments, shell, charcoal, and miscellaneous items per 1-m quad for unit and feature levels; and a written record of the excavator's observations.

Power equipment was used in excavation at only two sites, 45-OK-288 and 45-OK-258. At 45-OK-288, a test unit and five random sample units in the northeastern site area indicated sparse cultural materials in the upper 1-2 m of matrix overlying dense early occupational remains. Furthermore, the matrix in this area consisted largely of loose, loamy sand, making wall collapse likely in deep excavations. A bulldozer was used to remove approximately 1 m to 1.5 m of soil. At 45-OK-258, a backhoe was used to excavate trenches.

All cultural materials were taken into the project's field laboratory except FMR, which was classified in the field by material type (basalt, granite, quartzite, and other) counted and weighed by type, recorded in two places, and discarded. At the end of each excavation day, all other materials were taken into the field laboratory, and the site supervisors and two laboratory technicians checked through all bags and records, making sure that information recorded on bags and records matched. In the laboratory, materials were cleaned and sorted into groups of lithics, bone, and shell. Each category was counted and weighed and entered onto a laboratory catalogue (LABCAT), together with field-recorded FMR information, to be entered into the computerized data base. Detailed information about field and lab techniques may be found in other project reports (Jermann and Whittlesey 1978; Jermann et al. 1980).

6. STRATIGRAPHIC ANALYSIS AND DEFINITION OF CULTURAL ZONES

Interpretation of the prehistoric record of the project area requires that one understand the depositional history of each site in the context of the depositional history of the entire area. To do this, each site must be divided into units which can be compared to those at other sites and be used to delimit episodes of cultural deposition. Stratigraphy provides temporal control within each site as well as a means of correlating cultural deposits with regional geomorphology. Strata mapped during excavation are grouped into site-wide depositional units, which provide the basis for determining how deposition occurred and for correlating cultural materials among units. Cultural strata, or analytic zones, are defined within this framework.

GOALS OF STRATIGRAPHIC AND SEDIMENT ANALYSIS

Detailed analysis of sediments is now widely recognized as an important component of archaeological research. Archaeologists working within an environmental and ecological construct concern themselves with changes in landscape and site environment that may have occurred as recently as the past few thousand years. Soil or sediment analysis can provide an understanding of the processes involved in the transportation, depositional history, and alteration of these deposits. It can help us to understand how stratigraphic sequences were produced and to interpret strata containing cultural material.

Unfortunately, there are no soil or sediment survey reports that cover the immediate project region, and little sediment data is available from previously investigated archaeological sites in this locale. Several reports, however, involve survey and analysis of Plateau riverine environments (Kelley and Sprout 1956; Taylor 1969; Whitlam 1976; Crozier 1978; Bussey 1981). These reports contain valuable comparative information, but each locality must be considered unique because of microenvironmental diversification. In addition, riverine environments and stream morphology have been covered extensively in geological and geomorphogical papers (e.g. Leopold and Maddock 1953; Leopold and Wolman 1957; Wolman and Leopold 1957; Schumm 1969).

Soil has been defined as that earth material which has been so modified and acted upon by physical, chemical, and biological agents that it will support rooted plants (American Geological Institute 1974:459). Sediments, on the other hand, consist of solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water, or ice, and has come to rest on the earth's surface either above or below sea level (American Geological Institute 1974:442). Sediments throughout the Chief Joseph Dam project area consist of alluvial fan material, river-deposited fine to coarse gravels, overbank and channel bank sand, silt, and clay and fine particles deposited by wind. In areas to the south, such deposits have been classified as wind-modified glacial fluvial sediments (Gilkeson 1958:Soil Map).

STRATIGRAPHIC DATA COLLECTION AND ANALYSIS

During field investigations at the Chief Joseph Dam Cultural Resources Project, stratigraphic recording was handled by a special crew. Dr. Ula Moody was in charge of the program in 1978. Sites 45-DO-204, 45-DO-214, and 45-OK-18 were completely profiled during this time and some units were profiled at other sites where excavation was ongoing, e.g. 45-OK-11, and 45-OK-258. In 1979, S. Neal Crozier took over the stratigraphy program and directed a full-time crew of four to six members. In late April, 1979, the archaeological sediment analysis laboratory was established in conjunction with the stratigraphic profile program. From 1979 through 1980, the stratigraphy crew handled all stratigraphic profile recording, sediment column sampling, and sediment analysis. Laboratory analyses were performed in the field laboratory until 1981, when the laboratory was moved to OPA in Seattle. The flow chart shown in Figure 6-1 depicts the sequence of field and laboratory analyses.

To achieve consistency of methods, profile data from 1978 was not used. At 45-DO-204, 45-DO-214, and 45-OK-18, selected units were re-opened and re-profiled by the stratigraphy crew. For these sites our interpretation of the depositional history is based on excavator's notes as well as on the profiles drawn by the stratigraphy crew. Although the latter provide the most detailed and accurate information about site sediments, their horizontal coverage is limited. Excavator's notes are our only source of information for some areas of the site. In addition, the notes frequently contain sediment descriptions which can be related to the profile strata and provide us with additional horizontal information about the extent, topography, and variation in certain depositional units. At other sites, we relied on stratigraphic data collected in 1979 and 1980; the 1978 profiles generally comprise only a few isolated probabilistic units.

PROFILE DESCRIPTION AND SAMPLE COLLECTION

Field description and mapping of excavation unit stratigraphic profiles followed a standard set of procedures. After significant findings which might affect matrix interpretation were reviewed with the field supervisor and relevant excavation personnel, unit walls were troweled back 1-3 cm to provide a smooth surface for inspection. Profiling consisted of outlining major and minor matrix discontinuities identified on the basis of characteristics such as color, texture, staining, consistency, and compaction. During field mapping, which followed, stratigraphic distinctions made during profiling were measured with reference to arbitrary vertical and horizontal planes and transferred to gridded paper. Measurements were usually taken 10 cm apart horizontally, but the interval varied depending on the number of stratigraphic distinctions being mapped and the complexity of strata boundaries. Finally,

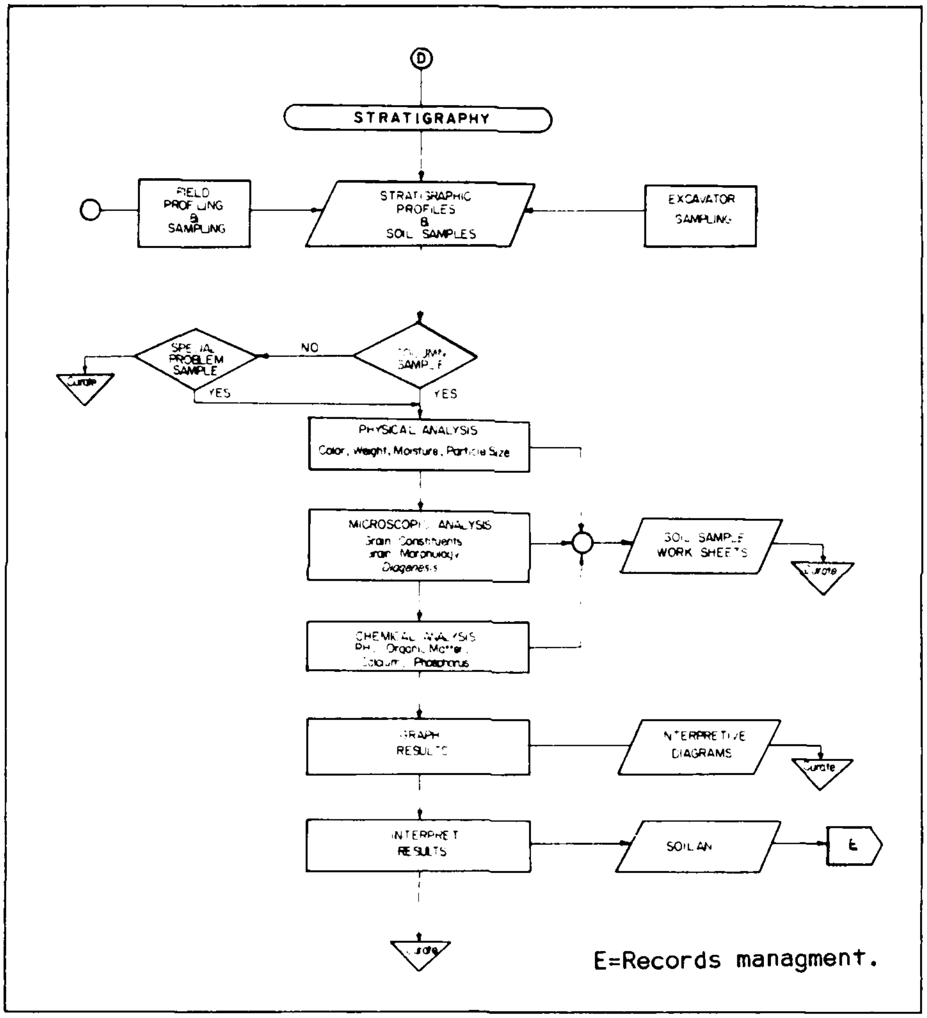

Figure 6-1. Flow chart of stratigraphic and sediment analysis.

each unit was described. Any of the following characteristics may be included: Munsell color, structure, consistency, sorting, boundary distinctness, topography, grain size, orientation, shape and surface textures, cementation, sedimentary structures, salts, roots and pores, pH, porosity and permeability, mineralogy, mode of deposition, and relation to cultural features.

Approximately 20% of the soil samples were ones taken by excavators from unit levels and features. The remainder were column samples collected by the the stratigraphy crew from selected representative on-site and off-site locations. Each column consisted of a 10 x 10 cm block which extends from ground surface to at least the base of excavation. All sediments in a given column were collected, vertically separated in the field by natural stratigraphic units and by arbitrary 10 cm levels within very thick strata. Samples were collected off-column when there were distinct natural or cultural deposits which could not be sampled by a single column location.

Each column was sampled from top to bottom rather than as a monolith to avoid contamination which might result from slumping or collapse--a problem inherent in dry, coarse, sandy sediments. Rectangular trowels were used to remove the sample from the profile wall and each sample was bagged separately. Field soil sample sheets were completed for each sediment sample and accompanied the sample through laboratory analyses.

Since the sites were to be destroyed, more samples were collected than would be immediately analyzed. Approximately 5.000 samples were collected between May 1, 1979 and August 30, 1980. These were inventoried and stored by column in the soil laboratory.

SEDIMENT ANALYSES

Samples of volcanic tephra wre sent to Dr. P.T. Davis, Mt. Holyoke College, for identification. Other physical and chemical analyses were conducted at the field sediment laboratory. Physical analyses include particle-size determination, matrix color, and microscopic examination and quantification of the cultural and mineral constituents. Chemical analyses performed include pH determination and measurement of exchangeable calcium, soluble phosphate, and organic material. Measurements of pH were taken with an electronic pH meter and a Spectronic 20 single-beam Colorimeter was used to measure organic percent, exchangeable calcium, and soluble phosphate.

At least one column from every site was completely analyzed and most sites received more extensive coverage. Not all samples underwent microscopic or organic matter analysis. Decisions as to which samples to run through these analyses were based on the known constituents and properties of samples from nearby units as well as the established nature of the sediments along the Columbia River (eg. Gilkeson 1958).

Samples selected for analysis were oven dried at 100° C or less for a period of up to 10 hours. This method is recommended by the Pacific Forest Research Laboratory in Victoria, B.C. Temperatures above 100° C can destroy nitrogen in the sample as well as micro-organisms (McMullan, personal communication 1976). Moisture holding capacity or saturation capacity were

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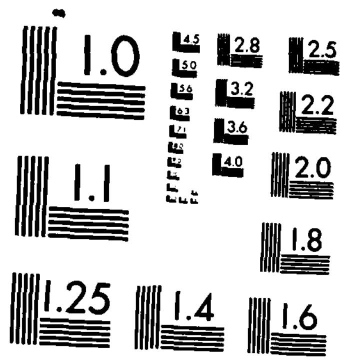

MICROCOPY RESOLUTION TEST CHART
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not calculated since the samples were collected under extreme climatic conditions--from over 100 degrees F in the summer to heavy rains in the spring and sub-zero temperatures in the winter.

Matrix Color

Moist, or field collected colors were recorded with Munsell Color Charts when circumstances warranted. Dry color was always recorded.

It is often difficult to determine the precise hue, value, and chroma for all deposits since many exhibit a salt-pepper pattern. The Munsell color coding presented for each layer or level represents that of the dominant color unless otherwise stated.

The color of a soil or sediment is essentially a physical characteristic and can be useful in determining its organic content, iron, and gleying features. In cases where the depositional characteristics are assumed to represent those of the parent material, several generalizations can be made. Dark colors of underlying horizons indicate a high humus content, grassland, or a high amount of organic carbon, high manganese, or a geological deposit of soil material formed higher up in the watershed; mottled colors with shades of grey (low chroma) indicate reducing conditions or seasonally saturated deposits; light colors in top soil (gray to white) suggest forest vegetation; and red and yellow suggest forest vegetation or tropical climates (Lavkulich 1969:36).

The sediments encountered in the project region generally do not represent the underlying bedrock material but rather alluvium from distant provenances. The color range (10YR4/3 to 10YR8/1) is indicative of regional sediments in a fluvial environment. The browns and pale browns with low chroma give evidence of the absence of humic material and manganese. Color determination was used primarily as one means of separating the numerous natural depositional layers and to isolate layers containing cultural debris.

Particle Size

Particle-size analysis, or grain sorting analysis, measures the thoroughness with which the soil's mineral constituents have been worked by transporting agents and can be a valuable indicator of the rate at which a soil was deposited as well as the conditions under which it was laid down. Approximately 95 percent of all analyzed samples fall into the coarse grain category on the textural classification triangle, which include the sands, loamy sands, and sandy loams. The thin overbank bands generally designated as silt deposits by the excavators are actually loam in texture.

The Bouyoucos hydrometer suspension method was used to determine particle-size composition. Generally, samples containing a high amount of organic material are first subjected to removal of the organics but this was not necessary for our sediments, which are low in organic material.

Particle-size percentages are often used to characterize the mode of deposition, especially in a riverine environment. However, erroneous conclusion could be reached if particle size distribution alone is relied on:

therefore, it should be stressed that "although considerable effort has gone into studying the use of particle-size distribution in differentiating depositional environments, its use in this is still only qualitative and empirical" (Catt and Weir 1976:77).

The various size components of clay, silt, sand and gravel are seldom present in equal proportions in any region. Shifts in the distributions of the sizes of particles, such as an increase in fine sand and silt in upper layers, are commonly interpreted as overlays of wind-blown material (Cady 1973:23). Strong winds will sweep up both sand and silt, depositing the coarser grades first and closer to the source of deflation. The finer particles are carried farther (Butzer 1971:16).

Microscopic Examination

Microscopic analysis provides quantitative and qualitative data about the minute constituents that form the deposits. Mineral grains are the dominant constituent in most of our samples, with cultural debris such as bone, shell, and charcoal being limited in occurrence. Organic material and aggregates in the process of breaking down into loamy and clayey debris are also at a premium in our samples. Thus, emphasis was placed on mineral grain identification and morphology.

A portion of each sample was put through standard mm dry sieves. The medium sand fraction was set aside for microscopic analysis including the identification and determination of constituent percentages and an estimation of mineral abundance and suite composition. For this stage, a Nikon 102 low power binocular microscope was used, or a Vickers monocular petrographic model when higher power was needed.

Examination of mineral grains is an important aspect of sediment microscopy, since there can be differences in the lithology, morphology, and chemical properties of the different depositional episodes represented in the profile. Colluvium, channel bank deposits, aeolian material and alluvium generally display unique morphologies. Grain surface finish, roundness, and particle-size distribution are major categories in the interpretation of the depositional history of sediments.

Mineral composition also may indicate provenance of sediments. The major suite of rocks and rock forming minerals found in our samples is listed below. Quartz, a mineral very resistant to weathering, is dominant and ranges from 40% to 75% of the grain total. The last eight rocks and minerals listed above (4-11) together seldom comprise more than five percent of the total. With the exception of epidote and soapstone, all of the grains identified under the microscope are indigenous to the region. Grains of soapstone and epidote probably were transported into the region during the Wisconsin glaciation or by Columbia River floods from sources to the north and northeast. Channel bank deposits contain considerable amounts of magnetite, plagioclase feldspar, and miscellaneous ferromagnesian minerals. Alluvial fan and colluvial accretions are higher in granitics and contain orthoclase feldspar and quartz.

1. Quartz
   a)crystal
   b)milky
   c)rose
2. Feldspar
   a)orthoclase
   b)plagioclase
3. Mica
   a)biotite
   b)muscovite
4. Hornblende
5. Basalt
6. Diorite
7. Olivine/Serpentine
8. Jasper
9. Epidote
10. Calcite
11. Soapstone

Soil Reaction (pH)

Soil reaction is a measure of the concentration of the active hydrogen ion (H+) in the soil solution. It is expressed as a percentage of hydrogen (pH) which is computed as a negative logarithm of the concentration of the active H+ ion; pH= -log (H+). Because the pH scale is logarithmic, a unit change in pH corresponds to a tenfold change in the concentration of the H+ ion.

Although the pH scale ranges from 1 to 14, with pH 7 being neutral, the pH of soils generally falls between 4 (very strongly acid) and 10 (very strong alkaline). Soil reports for the Columbia River Basin note a pH range between 6.8 and 9.6 (Gilkeson 1958:6-7). Samples from the project range between 6.8 (neutral) to 10.1 (very strongly alkaline). When tested in 1979, the pH of Columbia River water in the project area was moderately alkaline. Off-site non-cultural samples also exhibit an alkaline reaction. Interpretation of cultural episodes thus is tentative and pH was used primarily as a variable for the determination of depositional layer separation rather than the isolation of cultural activity areas.

Organic Matter

Although organic matter makes up a distinctly small portion of a soil, sediment, or even a cultural deposit, either by weight or volume, it nevertheless can exercise a very important influence on the physical and chemical properties. It also plays an important role in determining such characteristics as moisture holding capacity, color, structure, and granular consistence.

Sediments from project sites are generally very low in organic material and organic matter. With the exception of the surface litter mat and cultural features, organic matter seldom registered more than a trace. But even these slight changes were significant enough to aid in the isolation of cultural layers when the stratigraphic profile gave no indication of human occupation.

The high alkalinity of the sediments is a contributing factor in the low amount of organic matter. Hearth or earth oven samples may not always register organic content as the amount can drop substantially as heat from fires often destroys organic building micro-organisms.

Soluble Phosphate

As a result of the low solubility and limited movement of phosphorus in soils, loss of phosphorus by leaching is generally negligible (Black 1965:250). With the stability of phosphorus through time, significant changes in content are generally good indicators of cultural episodes or periods of abandonment. The deposition of shell, bone, animal tissues and fluids, and feces considerably affect the phosphate property of a soil or sediment. Together with calcium, phosphate is an excellent interpretive tool for the detection of anthrosols and is widely used by archaeological chemists (e.g. Dietz 1957, Eidt 1977).

The relatively high phosphate content recorded in the non-cultural lower deposits of many project sites is attributed to small amounts of river deposited shell and to phosphorus bearing minerals and phosphate rocks in the basal sands and gravel.

Exchangeable Calcium

We were unable to locate any soil survey reports of the Columbia River Basin that recorded chemical results other than pH. There is, however, general agreement concerning the substantial variation in the calcium cation exchange capacity, both vertically and horizontally, between sediment levels of the same profile. This variability is, in part, due to high leaching rates for calcium.

Increases in calcium content, in an archaeological site, is often attributed to debris such as shell, bone, animal tissue, and decomposing flesh. Off-site alluvial deposits often contain shell fragments which are naturally deposited, so minor changes in parts-per-million must be viewed with interpretive caution. A distinctive increase in calcium and phosphate at given levels is, however, significant and can often be viewed as evidence of human occupation, even if such evidence is not visible on the profile walls.

In addition to being an aid for cultural interpretation, calcium, together with phosphate, may be useful in determining overbank deposits. The 1948 flood deposits tested show considerable consistency in chemical properties, suggesting that it may be possible to chemically fingerprint the thin, fine grained overbank layers which represent earlier floods.

INTERPRETING DEPOSITIONAL HISTORY

Stratigraphic profiles throughout the project area generally were complex, especially those that incorporated archaeological or geological features, thin lenses, and rodent burrows. Depending on the depth of the deposit, it was not unusual for the stratigraphers to identify 30 or more strata within one excavated unit. Based on data from laboratory analyses and field analyses, the stratigraphic analyst grouped these into strata which could be correlated between units. These were in turn grouped into depositional units, or series of deposits with a similar depositional history and separated by stratigraphic unconformities. At 45-OK-2, and 45-OK-2A the field strata were grouped directly into depositional units without the intervening step of grouped strata. The separation between stratigraphic units at most sites is reasonably straightforward and the sequence of depositional events is generally sitewide, despite areal anomalies. Interpretation of the depositional agencies responsible for the site sediments and past landforms was based on laboratory analyses discussed above, such as mineral composition and grain texture, but also on profile information such as extent, shape, and bedding structure of depositional units.

GOALS OF ANALYTIC ZONE DEFINITION

Archaeological sites are limited geographical areas where cultural materials are found. Although sites are useful units for administration and management, as well as important tactical units in data collection, cultural materials associated by virtue of having been recovered from the same site may in fact owe their occurrence to several distinct and independent cultural and natural depositional events. For research purposes, sites excavated as part of the Chief Joseph Dam Cultural Resources Project are subdivided into smaller spatial units called **analytic zones,** each of which is a bounded set of associated cultural deposits. The **analytic assemblages**--cultural materials recovered from different zones--represent briefer events than does the site assemblage as a whole and are more amenable to interpretation. These subassemblages allow intrasite comparisons and also are appropriate units for intersite comparisons.

Two important concepts are embodied in the term **analytic zone.** The word **zone** indicates that the unit is spatially defined. The word **analytic** was chosen to emphasize that the significance of cultural materials from the zone is the subject of the research and is unknown at the outset. This is why **occupation** and **component** were rejected as labels. Such terms, although commonly applied to units similar in scale to our analytic zones, imply certain interpretive conclusions or assumptions about the nature of cultural activity, its intensity and duration, and its relationship to other archaeological phenomena in the region. In this analysis, such interpretations are to be demonstrated, not assumed. Analytic zone assemblages may represent radically different kinds of cultural use. In fact, some may consist entirely of secondary, rather than primary cultural deposits. The term **analytic** is doubly appropriate. It conveys the role of the concept in the research procedure, and it is neutral with respect to the ultimate interpretation, as it implies nothing about function, duration, intensity, or relationship to units of regional scale.

One other important aspect of analytic zones, as we have used them, is that they are exhaustive. We defined cultural aggregates by spatial boundaries which approximate temporal boundaries. We have included all site materials (except obviously unusable data such as slumped areas or trenches dug by previous excavators) as by definition all cultural materials in the site must belong to some time period. We have not excluded low density areas. To do otherwise would be to bias the sample by including only those things thought **a priori** to be associated.

STRATEGY OF ANALYTIC ZONE DEFINITION

The natural depositional sequence is the appropriate framework for organizing the cultural depositional sequence. Sedimentary strata themselves are temporally significant units; sedimentary deposits are assumed to be time-parallel events over these small horizontal distances. Furthermore, sedimentary strata provide the only means of correlating units between units confidently. The slope and relief of the surface topography, and the variable topography of buried surfaces at all sites in the reservoir preclude simple correlation by depth.

The stratigraphic boundaries were used as temporal markers to aid in subdividing the cultural deposits for analysis. For profiled units, the horizontal and vertical distribution of artifacts by quad and level was compared with the natural depositional sequence and feature boundaries. Those stratigraphic units containing a discrete cultural deposit were defined as analytic zones. At sites with unprofiled units, the zones were extrapolated to adjacent units with the aid of field notes and other chronological information such as radiocarbon dates and projectile points.

While each stratum is a distinct temporal unit, there is no necessary one-to-one correspondence between the discontinuities in natural deposition that we recognize as stratigraphic boundaries and breaks in cultural deposition. A single peak in a histogram of cultural materials may be found to span a number of short-term natural deposits. On the other hand, more than one concentration of cultural materials, vertically separated, may be apparent within a single, massive stratum. An analytic zone corresponds to a single, recognizable cultural deposit that can be defined in terms of stratigraphic boundaries. It is either a single natural stratum, a unit comprised of multiple adjacent strata, or a conformable subdivision of a single stratum. Strata may be split and aggregated, as long as depositional principles and stratigraphic boundaries are not violated.

The data base allowed assignment of an analytic zone and an area designation to each provenience. For most sites, analytic areas were not designated because the cultural depositional sequence was relatively uniform across the site. At some sites, such as 45-DO-211 and 45-OK-11 an extensively excavated housepit was designated as an analytic area. Because the houses were excavated with a number of different feature designations, and some areas were not featured, this was the simplest way to allow computer retrieval of the entire house assemblage. Because the house was a limited part of a site wide zone, the area designation functioned as a subzone designator. At 45-OK-11, block excavations were given separate area designations because it was possible to define a number of zones within the block which could not be correlated one-to-one with those in other areas.

Analytic zone assignments, and area assignments if applicable, generally were made for all units excavated during salvage operations. Slumped or disturbed units were not zoned. Unzonable units were coded as Zone 0 or Zone 9 in the computerized data base. At some sites testing units were also zoned so that radiocarbon dates and diagnostic projectile point styles could be integrated into the analysis for better temporal control. Because the stratigraphic information from testing units was less detailed, test units in close proximity to salvage units were zoned.

The analytic zone structure defined for each site in the descriptive site reports may differ from that defined in the preliminary summary report (Jaehnig 1983a). The latter report was completed before stratigraphic information was available, and zone definitions were based upon the observations of the excavation crew and on cultural material densities in a few selected units.

PROCEDURES FOR ANALYTIC ZONE DEFINITION

Definition of analytic zones and assignment of every provenience unit to a zone involved four steps. The first step was delimitation of vertical discontinuities in the density of cultural materials in each excavated 1 x 1-m quad. In the second step, these discontinuties were compared to stratigraphic boundaries to determine how many cultural deposits could be recognized and correlated across the site. The third step was assignment of every provenience unit to a single zone. The fourth step was evaluating the temporal integrity of the zones by examining the distribution of temporally sensitive artifact types and radiocarbon dates.

Defining Cultural Discontinuities

Because all 10-cm excavation levels are equivalent in volume, we could compare the absolute frequency of culturally deposited materials directly between 1-m^2 quads. Counts of artifacts recovered from arbitrary levels constitute a systematic vertical sample of the density of cultural materials. We assumed that changes in cultural material density indicated boundaries of cultural deposits at a resolution of 10 cm. In units where 5-cm levels were used extensively, they are retained, and we take the volume difference into account in comparing 5-cm with 10-cm levels.

The initial analytic step used a computer printout summarizing amounts of cultural materials by level for each quad (for an example, see Figure 6-2). Arbitrary excavation levels are listed in the first column; the columns to the right show the total number of artifacts per level, with a breakdown into lithic materials, bone, shell, and fire-modified rock. Modes and breaks

UNIT LEVEL	TOTAL COUNT	LITHIC COUNT	BONE COUNT	SHELL COUNT	FCR COUNT	FEAT	STRUCTURAL FEAT	FEAT	FEAT	STRATA BY % OF UL STRT	STRT	STRT	STRT	STRT	STRT	PERCENT OF UL
10	1	1	0	0	0					0						100
20	0	0	0	0	0					0	300					68 31
[illegible]	1	1	0	0	0					300						100
10	[illegible]	1	7	0	0					400	300					54 45
[illegible]	13	4	[illegible]	0	0					400	420					65 34
30	2	1	1	0	0					420	500	650				51 36 11
20	7	3	4	0	0					650	500					57 42
[illegible]	1	1	0	0	0					615	500	650	600			38 34 25
[illegible]	0	0	0	0	0					600	615	740	500			78 16 2

Zone 1
Zone 2
Zone 3
D.U.4
D.U.3
D.U.2

Figure 6-2. Sample printout of cultural material frequencies with modes and breaks marked.

between unimodal curves are marked on the printout for each material category. These are generally consistent with each other, although each of the material categories may show a slightly different distribution.

Recognition of Site-wide Cultural Deposits

To identify site-wide cultural deposits we compared the cultural material discontinuity data with stratigraphic information. Stratigraphic data were summarized by unit level on the same printout as the cultural material counts.

As stratigraphic data were related only indirectly to arbitrary levels, a separate procedure is required to assign stratigraphic information to provenience units. For some sites, analyzed stratigraphic profiles were digitized, and a computer program used to interpolate the stratigraphic boundaries across each unit and estimate the total volume of each stratum per arbitrary unit level (see Appendix G for a summary of this procedure). This information was listed on the printout with the cultural materials (see Figure 6-2). Strata are listed in order of volume in the right hand columns, followed by the percentages in the same order (percentages are shown for a maximum of five strata). For sites that were not digitized, the stratigraphic information was transferred to the computer printout by hand from the analyzed profiles.

On a separate sheet of paper, stratigraphic information and cultural discontinuities in each excavation unit were summarized in column form by arbitrary level. The excavation units were arranged in transects and adjusted vertically by absolute elevation. This allowed visual comparison across the site so that regularly and consistently occurring peaks could be identified. The strata with which these were associated were selected as analytic zones. If a single peak regularly corresponded to the same two or more strata, these strata were grouped as one analytic zone. If a stratum consistently had two peaks, these were designated as two separate analytic zones.

Assignment of Unit Levels to Analytic Zones

Once the final set of analytic zones is selected, each provenience unit (unit level or feature level) was assigned to a zone. In this step, the computer printout referred to above was used in conjunction with information about cultural and depositional features. Since stratigraphic boundaries and arbitrary level floors do not necessarily coincide and cultural materials may be vertically translocated across stratigraphic boundaries, the actual location of the boundary was drawn with respect to artifact distribution within excavation levels. In cases where a stratigraphic boundary bisected an arbitrary level and each stratigraphic unit was assigned to a separate analytic zone, the zonal assignment of the level was decided on the basis of information in field notes, the relative abundance of materials in the two zones, and the kind of matrix in the zones. In other cases, stratigraphic boundaries coincided with excavation level floors but not with breaks in frequencies of cultural materials. When this situation occurred, the break in cultural materials took precedence to minimize mixing of cultural materials from different deposits. Since many strata are characterized by gradual, diffuse boundaries, breaks in cultural material distributions are an alternative indication of where a somewhat arbitrary boundary should be placed.

Features also play a role in the determination of analytic zone boundaries. All features originate on buried surfaces, and their vertical location and distribution may help in tracing such surfaces, which are used as analytic zone boundaries. Boundaries always were drawn to preserve the integrity of features.

Evaluation of Zones

After a preliminary definition of zones based on stratigraphic correlation, the zones were evaluated for chronological significance. Radiocarbon dates, diagnostic artifact distributions, and feature associations were checked to see that the zone assignments did not violate the expected distributions of these factors. The horizontal distribution of zones was also checked to verify that zones were continuous or that interruptions had valid explanations such as different excavation procedures, or natural or cultural disturbance, or a real boundary.

7. RECORDS AND DATA MANAGEMENT

The research program outlined in this report entailed a network of interrelated recording and classificatory schemes. To be useful for integrative analysis and synthesis, information recorded at all stages of recovery and descriptive analysis had to be accurate and accessible. The records and data management aspects of the research program provided a critical link between project operations and research results (Figure 8-1).

RECORDS MANAGEMENT

The records management section of the project was responsible for the accuracy and completeness of field and laboratory forms and records. Since archaeological data recovery procedures are necessarily destructive of the resource, all reasonable measures were taken to minimize significant information loss.

Permanent field and laboratory records associated with research activities--temporary records used as internal checks in the system do not require further discussion--were designed to provide a standard, consistent level of reporting within each task element of the project. Field forms, designed with the understanding that they would provide the only record of contextual conditions at the time of data collection, focus on narrative descriptions of these conditions. Laboratory forms, on the other hand, were designed to be directly entered, via keypunching, into a computer data base. The results of laboratory analyses were recorded as alphanumeric codes on 80 column forms. Both record types were subject to review procedures and amendment before physical and/or electronic curation.

We reviewed all records, particularly field forms, as soon as possible after their completion so that observations were still fresh in the recorder's memory. Field forms were first checked by field supervisors and then reviewed by laboratory and administrative personnel. In the lab, the crew supervisors and laboratory staff assigned to each field crew checked bags and compared the information recorded on them with field catalogues and notes. After a unit was processed, notes were transferred to the laboratory director, who checked the work. Notes and corrections then were returned to the laboratory for use in data interpretation and site reporting. All field records were photocopied and the copies and originals stored separately.

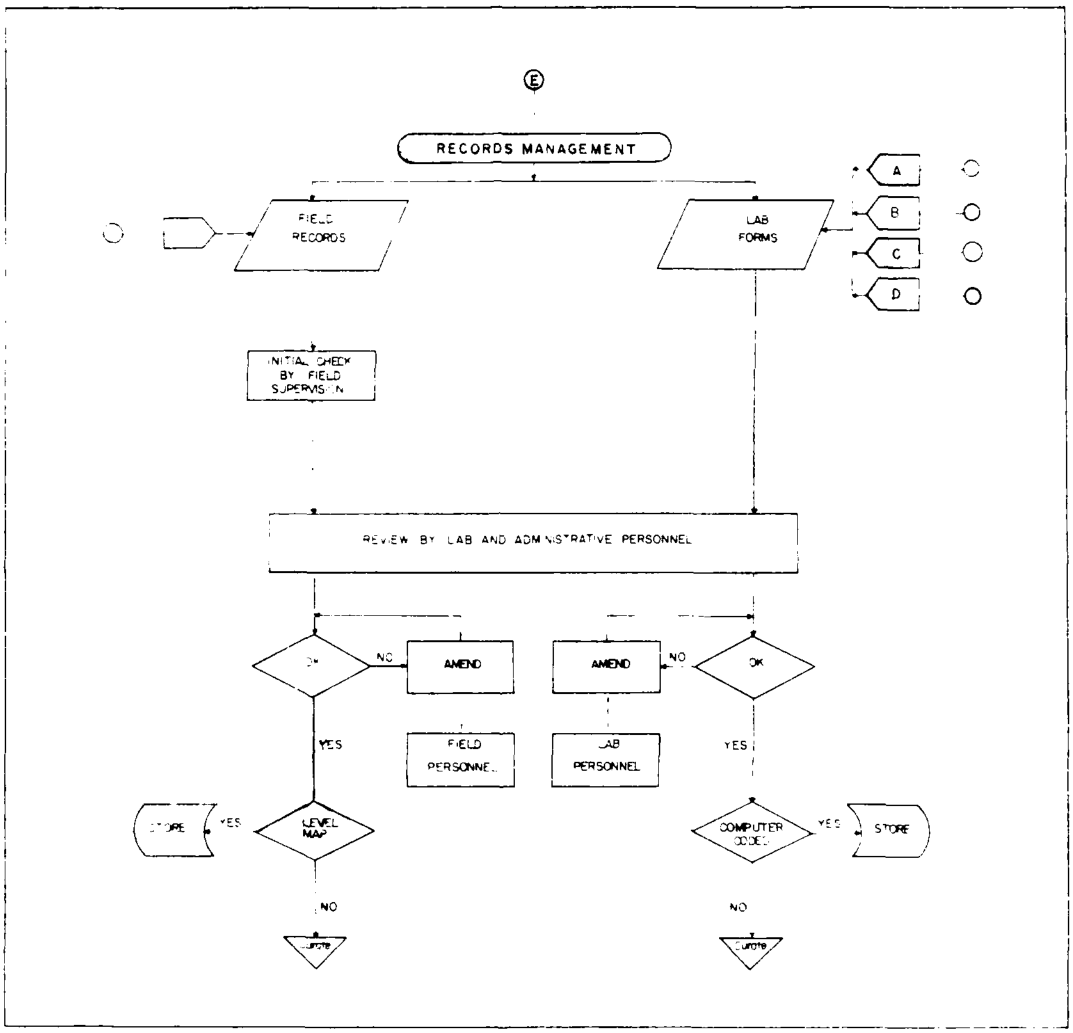


Figure 7-1. Flow chart of records management.

A=Lithic analysis
B=Faunal analysis
C=Botanical analysis
D=Stratigraphic analysis

COMPUTER DATA ENTRY

Because of the large size of the project and the amount of data collected, we planned from the start to use computers for storing and managing the data. We primarily used the CDC 6400 at the University of Washington for data storage and manipulation. Two microcomputers were obtained for use in data entry, digitizing, and word processing.

Coding forms were initially keypunched directly into files on the CDC via a remote terminal located at the field station. Later, data was entered on floppy disks using a microcomputer and then transferred to the CDC. All forms were punched twice and compared to verify their correctness.

A digitizer and plotter connected to a microcomputer were used to electronically record and edit information in spatial form. Three kinds of data were digitized: stratigraphic profiles, site maps, and projectile point outlines. The data was digitized, plotted, and compared to the original for verification. It was more efficient, because of our location, to use the microcomputer, plotter and digitizer, than to digitize information on the main-frame in Seattle. The data was later transferred to files on the CDC.

Once verified, the data was transmitted and stored on the CDC 6400. Keypunched files were small, containing only a part of a complete site file. These smaller segments were combined into data files on the CDC system.

Not all data was converted to electronic form; for example, the results of sediment and botanical analyses were not keypunched.

ORGANIZATION OF THE DATA FILES

We initially intended to use a commercially available data base management system (DBMS) for organizing our data. Data base systems offer several general advantages. They allow individuals who are unfamiliar with a computer to access data and manipulate it without recourse to high level languages. Also, they facilitate editing. If an error is discovered, such as a mistake in provenience, the error needs to be corrected in only one location, rather than in multiple data files. The draft research design (Jermann et al. 1980) proposed that the project use Scientific Information Retrieval (SIR) system and SYSTEM 2000. Both link files in a hierarchical structure based on spatial referential scales, an important capability given the intention of isolating spatial patterning. For example, it would be an easy retrieval task to request all occurrences of a particular tool class from all unit levels excavated in the range 34-40 cm below site surface at all purposive sampling units.

Of the two DBMS's we chose SYSTEM 2000 because it is compatible with Fortran and would be cheaper to use than SIR which is compatible with SPSS. However, as we planned the kinds of operations we would perform on our data files, we realized that it would not be efficient, after all, to use a DBMS. A data base management system is designed to facilitate access to subpopulations of the data, while our analyses would generally utilize the entire data file. It would have been more costly to access the entire file with System 2000 than with Fortran programs written for the purpose.

Although we decided to manage our files with our own programs, we retained the hierarchical file structure we had developed for use in SYSTEM 2000. Also, because SYSTEM 2000 requires that every entry have a unique spatial referent, we eliminated all proveniences which could not be assigned to a unique 10 or 5-cm level, e.g., slump material which derived from two or more 10-cm levels. Table 7-1 summarizes the basic data files used in our analyses and shows their hierarchical relationship.

The first level in the hierarchical structure is the LABCAT file, which contains a complete list of all valid provenience units at the site and summarizes the broad material categories in each (see the LABCAT form in Appendix A). The N/S coordinate, E/W coordinate, level, code, feature and associated feature information together uniquely specify each separately excavated volume. There is a line for every arbitrary level in every quad, and separate lines for every feature or combination of features in that arbitrary level. The descriptive data recorded for each line includes the total counts and weights of bone, shell, and fire-modified rock by material type, and a count of lithic and nonlithic artifacts. The proveniences in the LABCAT file were checked by hand against the master unit level records to insure that every valid provenience was included and no invalid ones included. The LABCAT file was used as the master file for checking proveniences, with a computer program, in other files. The strata file is at a comparable level, although it contains data for each arbitrary level as a whole, regardless of whether it was excavated as a number of different feature and nonfeature proveniences.

The FIELDCAT, BONAN, and LITHAN files constitute the second level of files. Their relationship to the LABCAT file is tree-like. For example, the LITHAN file contains one or more lines representing the analyzed lithics from each unique provenience in the LABCAT file. Each of these lines duplicates the unique provenience identifier in the "parent" LABCAT line, followed by further information which uniquely identifies the line within the LITHAN file. For objects individually analyzed, the unique identifier is the specimen number, for grouped objects it is the object category. Point provenience is also included in the LITHAN file for those field catalogued items which received individual analysis. The BONAN file is parallel to the LITHAN file; one or more lines recording the identified elements from a single provenience unit duplicate the provenience identifier of a single line in the LABCAT line. They are uniquely identified within the BONAN file by a specimen number or a unique category. The FIELDCAT file contains the provenience information and specimen number for all field catalogued items except those that went through the LITHAN procedure. It was not used in our analyses, but is available for future research.

The third level of files include the FUNCAN, cobble tool, and projectile point files. Each line in the FUNCAN file summarizes the functional data recorded for an individual object. Each line matches a line in the LITHAN file, and has the same unique identifier, the provenience and specimen number.

Table 7-1. Summary of project data files.

File	Form	Level of Inclusiveness	Level of Record	Linkages to Other Files
LABCAT Counts and weights of bone, shell (by material type) and lithic artifacts.	LABCAT	Site	Provenience unit	Provenience (N/S, E/W, Level, Code, Fea, Assocfea1, Assocfea2)
FIELDCAT Point provenience of field catalogued data	LABCAT	Site	Field catalogued sample or item	LABCAT provenience
STRATA Percent by volume of each stratum in arbitrary level	Digitized stratigraphic profiles	Site[1]	Entire 10 or 5 cm level (including feature levels)	Provenience (N/S, E/W, Level)
LITHAN Technological artifact data	LITHAN	Site	Individual object or group of objects	LABCAT provenience, specimen #
BONAN Faunal data, identified elements	BONAN	Site	Individual element or groups of elements	LABCAT provenience, specimen #
FUNCAN Functional artifact data	FUNCAN	Site	Individual object	LABCAT provenience, specimen #
Special cobble tool analysis	Cobble tool form	Site[2]	Individual object	LABCAT provenience, specimen #
Projectile point data	Projectile point form and digitized measurements	All sites	Individual object	LABCAT provenience, specimen #

[1]Strata were not digitized for 45-DO-326, 45-DO-4, 45-OK-11, 45-OK-250, or 45-OK-258.
[2]Special cobble tool analysis performed at 45-OK-2, 45-OK-2A, 45-OK-4, 45-OK-11, 45-OK-250, and 45-OK-258 only.

Multiple tools may be recorded for each object. Up to six tools fit on one line; additional tools require a second line. The FUNCAN lines do not duplicate the descriptive information in the LITHAN file, however, so these two files must be linked by their unique identifiers to collate all descriptive information collected for each object. The projectile point file is organized somewhat differently, as it duplicated all the LITHAN and FUNCAN information for each projectile point, as well as including additional information collected in the stylistic analysis. Projectile points from slump, surface, and testing, which were not including in LITHAN and FUNCAN were also added into this file. The cobble tool file is also a complete analysis which is independent of the other analyses, but it can be cross-referenced to the cobble tool data in the LITHAN and FUNCAN files by using the provenience and specimen number as a unique identifier. The master catalogue numbers were not included in the original design of the files but were added later. Unlike the specimen numbers, which are unique only within a single provenience, the master numbers were given sequentially for the entire site and thus provide the simplest means of matching the computerized data with the actual artifact.

Except for the projectile point file, all files were at the level of the site. It was most efficient to group the data at this scale, as the principal analyses took place at the site level. The largest data sets, particularly the LITHAN data, would have been awkward to handle if combined for all sites.

DATA EDITING AND AMENDMENT

Common to all the files is an arbitrary locational reference (unit level provenience and possibly feature provenience). A zone assignment was added later to the provenience information. The hierarchical relationship of the files facilitated adding this information as it could be added to the LABCAT file and then transferred to files at the next lower level, and then transferred from the LITHAN file to the next set of files.

While keypunching errors were minimized by verification, errors made in coding the data had to be eliminated in other ways. We wrote computer programs to make a number of systematic checks for data errors. For example, cross checks were made in the LABCAT file to determine whether units which had recorded weights of a variable, e.g. basalt FMR, also had a count for this variable. Extreme values of metric variables in the LITHAN file were sorted out and checked for accuracy against the original hand coded forms. We determined a list of codes which were invalid in the lithic analysis and checked for these. These and many other kinds of systematic checks were helpful in developing an accurate data base. These checks, however, did not find errors which did not stand out as nonsensical or extreme.

8. ARTIFACT ANALYSIS

Artifacts were subjected to three kinds of analyses. Technological analysis describes elements of prehistoric tool manufacture, detailing processes of lithic reduction. Functional analysis describes attributes of wear on tools and develops inferences concerning the use of tools at the site. Stylistic analysis descibes morphological elements that have demonstrated temporal and spatial significance and compares recovered artifacts with types defined outside the project area. Analyses were focused on lithic artifacts with the asssumption that these artifact classes would be of most value in comparisons with other researcher's work and in developing reconstructions of site activities.

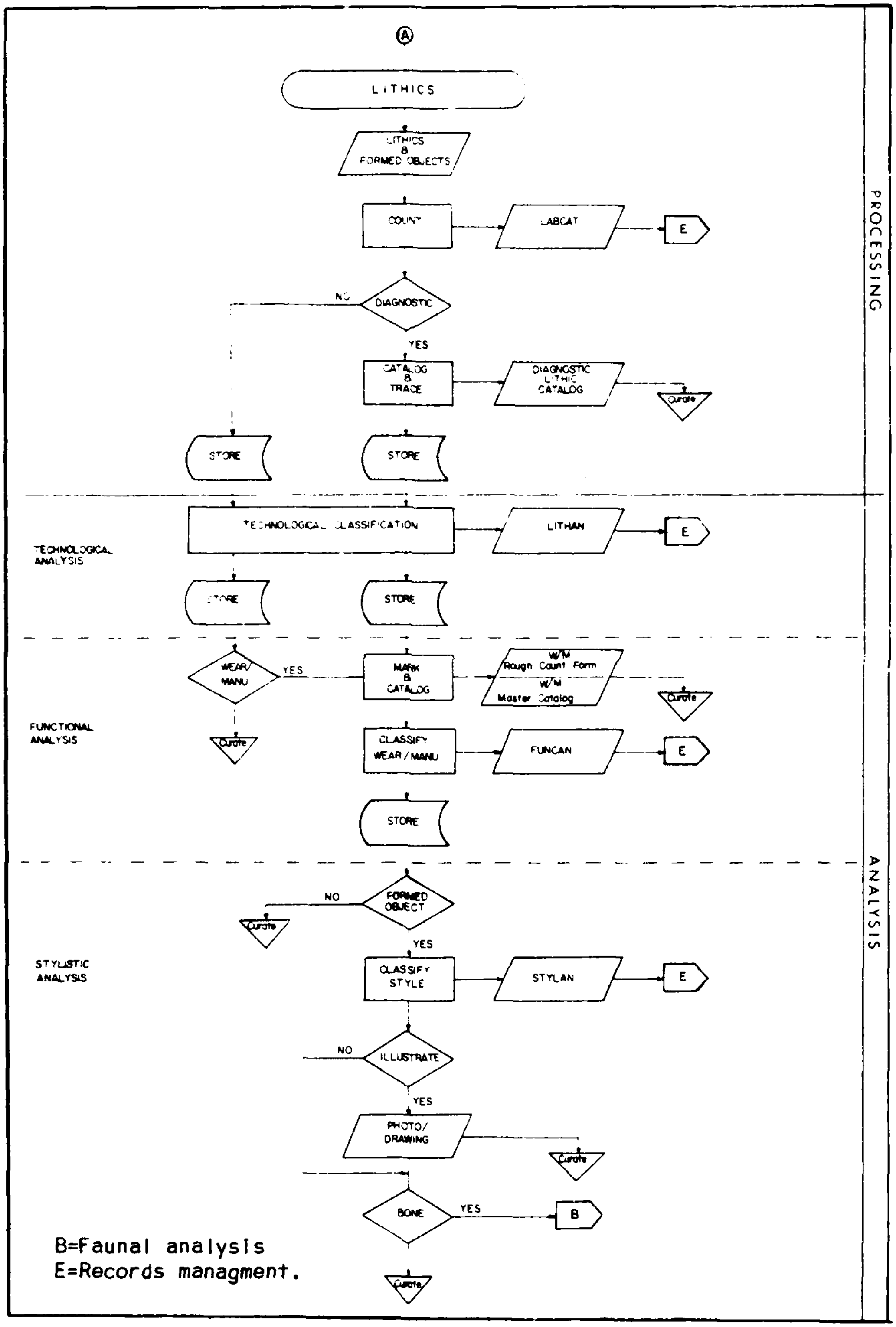
The major artifact analyses make use of paradigmatic classification as defined by Dunnell (1971, 1979). In this type of classification, classes are defined by the intersection of exhaustive, mutually exclusive dimensions, which are logical sets of modes at nominal, interval, ordinal, or ratio scales. The dimensions of variability may be grouped into three broad categories: (1) technological dimensions, which describe attributes of manufacture; (2) functional dimensions, which describe attributes of wear; and (3) stylistic dimensions, which describe attributes of form (Dunnell 1971, 1978, 1979).

The sequence of operations outlined in Figure 8-1 consisted of four stages: processing, technological analysis, functional analysis, and stylistic analysis. During processing, all objects were washed and sorted. Bone and shell were counted and the information was coded onto the Laboratory Catalog form (LABCAT--see Appendix A for a copy of the form). Counts and weight of fire-modified rock by material type were coded onto the LABCAT form from the field records. The count of lithics made in the field for the bag list was also recorded. These rough counts were adequate for tabulating cultural material densities for site zoning but were replaced later in the computer data base with the count of lithics derived from lithic analysis.

TECHNOLOGICAL ANALYSIS

Following initial processing steps (Figure 8-1), all lithic materials and worn or formed bone and shell objects were categorized, where applicable, according to classificatory dimensions described below, and the appropiate codes entered onto the LITHAN form, along with applicable provenience data, for later keypunching. The following section, taken from the draft research

Figure 8-1. Flow chart of lithic analysis.



B=Faunal analysis
E=Records managment.

design (Jermann et al. 1980) indicates the research interests and assumptions which guided the choice of data to be recorded in analysis.

BACKGROUND

Technological analysis attempts to categorize an assemblage into various component parts which have significant correlates in the manufacturing stages used to fashion the multitude of implements required for domestic and non-domestic cultural activities. Although technological analysis need not be restricted to a particular field of phenomena (e.g. stone, bone, shell, wood, etc.), lithic manufacturing is by far the most common focus of such analyses. This fact no doubt stems from two major factors: (1) lithic manufacture is a subtractive technology which generates large numbers of intermediate (waste) products in the process of producing desired outcomes, and (2) lithic materials are highly resistent to degradation from natural environmental processes and therefore can generally be expected to occur in the archaeological record. While the latter factor has obvious importance for our ability to conduct technological analyses at all, the fact that lithic manufacture is necessarily a subtractive technology is of singular importance to our ability to identify and categorize elements of the reduction sequence involved in tool production.

During the past several decades a considerable amount of experimental research has been devoted to lithic technology and to identification of stages in the manufacture of stone tools (e.g., Pond 1930; Ellis 1965; Crabtree 1967b, 1972; Sharrock 1966; Muto 1971; Newcomer 1971; Speth 1972; Knudson 1973; Swanson 1975; Smith and Goodyear 1976; Stafford 1979). Although specific details of lithic reduction sequences vary from one researcher to the next, most workers in the field are in general agreement about the processual staging of stone tool manufacture. Experimental findings (particularly Pond 1930; Muto 1971; Knudson 1973; and Stafford 1979) can be used to generate a series of physical expectations which have identifiable realizations in the archaeological record. For example, researchers agree that it is possible to distinguish between pressure flaking and hard-hammer (e.g.,stone) and soft-hammer (e.g., wood or antler) percussion flaking (Ellis 1965; Crabtree 1967b, 1972; Muto 1971; Newcomer 1971; Smith and Goodyear 1976; Stafford 1979), and there is evidence to suggest that debitage from hard- and soft-hammer percussion may be diagnostic of specific manufacturing stages (Crabtree 1967b; Muto 1971). Muto (1971:56) summarizes the relationship as follows:

> It would seem apparent that different qualities in the fabricator are suitable to different operations in the manufacturing process. Bold general shaping flakes are more readily produced by a hard hammer; thinning flakes are more readily produced by a softer hammer.

If the source material is in cobble or nodule form, information is available which may indicate a specific manufacturing stage. Several researchers distinguish primary, secondary, and even tertiary flakes. Their descriptions of these flakes, however, do not entirely agree. Muto (1971:57) describes the preliminary stages of stone tool manufacture as follows:

> The first blow is usually struck on a bulge or corner which affords purchase for the hammerstone. The resultant flake has a cortex covered platform and dorsal face, and is termed a primary decortication flake. There can be several primary decortiation flakes struck from a nodule with no way of telling which one was removed first. The decortication continues around the periphery of the objective piece removing adjacent overlapping flakes. These flakes exhibit cortex on part of their dorsal face and also the scars of a previously removed flake or flakes. They may or may not have cortex covered platforms and are termed secondary decortication flakes.

Sharrock (1966:51) suggests "a threefold division into primary, secondary, and tertiary flakes, with the criteria being based on length, width, and overall size and size-striking platforms." He describes tertiary flakes as "quite small" and says they "may have been pressure flaked from [his] Stage 5 blanks, projectile points, knives, etc." (Sharrock 1966:50). Stafford (1979) divides assemblages of percussion flakes into primary, secondary, and tertiary, although the characteristics which distinguish one from the other are not entirely clear. The major difference among them appears to be the degree of cortex: (1) primary flakes exhibit cortex over 93.1% (mean value) of their dorsal surface; (2) secondary flakes exhibit 43.2% cortex; and (3) tertiary flakes exhibit 0.3% cortex. Additionally, tertiary flakes are "noticeably smaller in regard to platform and size dimensions" (Stafford 1979:110-111). For the purposes of analyses proposed here, we will follow Muto's definitions of primary and secondary decortication flakes. Tertiary flakes will be defined as all percussion flakes exhibiting no cortex on either dorsal surface or platform. Additionally, distinctions will be made between those flakes resulting from percussion on an anvil (bipolar flakes), pressure flakes, and non-diagnostic shatter fragments consisting of chunks and detritus (Crabtree 1972).

In addition to variability in morphological characteristics, which can be used to identify particular manufacturing processes, certain chemical properties can be of considerable importance for technological characterizations. Obviously, the type of materials used in various manufacturing sequences is dependent upon such factors as availability, workability, and desirability for ultimate use in specific activities (Crabtree 1967a). Because attributes of the outputs of the various reduction stages will vary with varying material types, this dimension of variability should be included in the classificatory scheme. Material type is also vitally important in analyzing resource procurement patterns.

In a similar vein, heat treatment is known to improve the elasticity of siliceous materials, allowing the artisan greater control of flake removal (Crabtree and Butler 1964; Flenniken and Garrison 1975; Purdy 1974). Ray (1932:90) mentions that projectile points sometimes were buried beneath a hearth before a hunt. Experience with lithic materials from the study region has shown, however, that it is difficult to determine whether a particular object has been thermally altered. While Crabtree and Butler (1964) state that heat treatment results in a "greasy lustre" rarely seen in naturally occurring rock, a significant amount of stone occurring in our assemblages is highly hydrated opal, which naturally exhibits a "waxy" lustre (Gilluly et al. 1975). Heat treatment should also produce a color change in the parent stone (Crabtree and Butler 1964), but in the absence of comparative treated and untreated specimens it is impossible to specify a priori just what the resultant color transformations will be. However, once raw material sources for the study area have been identified, we would be able to experimentally determine necessary and sufficent identifying characteristics. In any case, if heat treatment was practiced in this region, we could expect to find a variety of heat spalled and crazed materials. Although the appearance of such evidence does not <u>necessarily</u> indicate heat treatment, its absence would provide a strong argument against it.

TECHNOLOGICAL CLASSIFICATION AND MODIFICATIONS

The technological analysis system used at the Chief Joseph Dam Cultural Resources Project was designed to provide rudimentary data useful to the distinctions noted above. Five basic classificatory dimensions were employed: (1) type of object, (2) raw material, (3) condition of object, (4) amount of cortex, and (5) treatment of material. In addition, several quantitative attribute states were also measured, including length, width, thickness, and weight. Table 8-1 summarizes the dimensions and their recognized attributes. The number next to a particular attribute is the code value entered onto the LITHAN computer form. In Appendix B the working definitions and criteria for measurements are described in detail.

Lithic analysis took place over a five year period and was performed by 22 different analysts. Consistency checks were made periodically to keep the analysis as uniform as possible. The content of the analysis itself was changed several times during the course of the project. Table B-2, Appendix B, summarizes the procedures used at each site. Records stored with the collections include more detailed information on the specific procedures in effect when each site, or individual units within the site, was analyzed.

The initial procedure, which we call LITHAN, was in effect until January 1981. Even LITHAN procedures underwent some changes before being finally standardized. Initially, all analysis was object-specific; that is, information was coded on the forms for each individual object. A decision was made to group <1/4-inch flakes by material and record as a group count after only a few units had been analyzed. This was done in the interest of economy; lithic objects almost universally are tertiary flakes. Platform attributes

Table 8-1. Technological dimensions.

DIMENSION I: OBJECT TYPE

1. Conchoidal (non-tabular) flake
2. Chunk
3. Core
4. Linear (blade-like) flake
5. Unmodified
6. Tabular flake
7. Formed object
8. Weathered (antique)
9. Indeterminate

DIMENSION II: RAW MATERIAL

1. Jasper (chert)
2. Chalcedony
3. Coarse-grained quartzite
4. Fine-grained quartzite
5. Basalt
6. Granite
7. Fine-grained basalt
8. Petrified wood
9. Obsidian
10. Bone/antler
11. Ochre
12. Shell
13. Textiles
14. Sandstone
15. Nephrite
16. Siltstone/mudstone
17. Pumice/volcanic material
18. Steatite
19. Mica
20. Silicized mudstone
21. Schist
22. Calcite
23. Shale
24. Porphyritic volcanic
25. Porphyritic microdiorite
26. Fossilized bark
27. Wood
28. Quartz
29. Felsite
30. Argillite
31. Gneiss
32. Diorite
33. Feldspar
34. Dentalium (shell)
35. Graphite/molybdenite
36. Olivella (shell)
37. Glass
38. Scoria
39. Very fine-grained red sandstone
40. Opal
41. Rhyolite
99. Indeterminate

DIMENSION III: CONDITION

1. Complete
2. Proximal fragment
3. Proximal flake-squared distal end
6. Less than 1/4 inch
8. Broken
9. Indeterminate

DIMENSION IV: DORSAL TOPOGRAPHY

1. None
2. Partial cortex
3. Complete cortex
9. Indeterminate/not applicable

DIMENSION V: TREATMENT

2. Definitely burned
4. Dehydrated (possibly heat treated)

ATTRIBUTE I: WEIGHT

Recorded weight in grams

ATTRIBUTE II: LENGTH

Flakes: length is measured between the point of impact and the distal end along the bulbar axis

Other: length is taken as the longest dimension

ATTRIBUTE III: WIDTH

Flakes: width is measured at the widest point perpendicular to the bulbar axis

Other: width is taken as the maximum measurement along an axis perpendicular to the axis of length

ATTRIBUTE IV: THICKNESS

Flakes: thickness is taken at the thickest point on the object, excluding the bulb of percussion and the striking platform

Other: thickness is taken as the measurement perpendicular to the width measurement along an axis perpendicular to the axis of length were dropped when a few units had been analyzed. The treatment category was not used until a few units had been analyzed. For all the above changes, however, it was possible to re-analyze or re-record the previously analyzed material to make it consistent with later procedures. When later changes were made, it was not feasible to re-analyze materials. The decision to add Object codes 7, 8, and 9 was made after sites 45-DO-204, 45-DO-214, and 45-OK-18 had been completely analyzed. It was also at this point that the decision was made to add to the initial list of material types. Most of the additional material types are rare, and this bias presents only minor problems in comparing between sites. However, opal was one of the last material types to be added. Prior to this point, opal had been recorded as chert. This bias should be kept in mind in making comparisons between sites with regard to type of CCS materials used. Initially Object type 4 was "slab". This distinction was later dropped and the code "4" re-used for blade-like (or linear) flake. For units analyzed when object type 4=slab, code 4 was recoded as unmodified. Blade-like flakes are rare in our assemblages, however, it is important to bear in mind that their absence or rarity in some sites is due strictly to the fact that they were not coded as a separate object type.

Later changes made primarily to speed up the analysis because it was falling behind schedule involved reducing the amount of information recorded, rather than adding new categories. Through time, more and more categories of artifacts were treated in grouped fashion, rather than receiving individual analysis. These changes were formalized as new procedures, LITHAN AB, LITHAN X, and LITHAN AB-R (Table B-1, Appendix B).

LITHAN AB and LITHAN X were implemented on 12 January 1981. In LITHAN AB, chunks and conchoidal flakes with no cortex, wear, or manufacture present, and which were not field catalogued, received abbreviated analysis. The conchoidal flakes (including blade-like flakes) were grouped by object type (1 or 4) and material, and whether they were complete. Complete examples were grouped by 5 mm length increments. No other measurements were taken. A count was recorded for each of these groupings. For chunks, a count was recorded for each material type. No measurements were taken. In LITHAN X, only objects which were field catalogued, worn or manufactured, or were classified as a formed object (Object type 7) received full analysis. All other objects were grouped by object type and material and a group count recorded. This form of analysis was used only at 45-DO-282, where it was applied to quads other than the NW quad. The NW quad received fuel analysis so that a systematic sample of the complete data was collected. Lithan AB-R was implemented on July 23, 1982. The focus of Lithan AB-R was on individual descriptions of worn and/or manufactured items. Only those objects pulled for functional analysis were given full technological analysis. Objects with cortex (given full analysis in Lithan AB) were grouped by object type and material. All of the codes are the same as in Lithan AB--the same code sheet is used. Details of these different procedures are provided in Appendix B.

FUNCTIONAL ANALYSIS

Initially there were two major steps in classifying worn objects (Figure 8-1). First, all lithics exhibiting evidence of wear and/or manufacture (here, purposeful shaping) were separated from unworn objects, catalogued along with worn/manufactured shell and bone identified in other analytic sequences, and set aside for further analysis. Following this initial sorting stage, each area of use (tool) on an object was categorized according to our classificatory scheme, and the relevant attributes were entered onto FUNCAN forms. Later, the sorting step was combined with the LITHAN analysis to save time.

The following section taken from the draft research design (Jermann et al. 1980) discusses the research interests which guided the choice of data to be recorded in functional analysis.

BACKGROUND

During the past two decades an impressive body of literature has developed concerning the analysis of edge damage/attrition on lithic artifacts (Sonnenfeld 1962; Frison 1968; White 1968; Wilmsen 1968, 1970; Ahler 1971, 1979; Wylie 1975; Odell 1977; Stafford 1979). Recognizing the interpretive potential of attributing specific attrition patterns to tool motion (e.g. cutting, scraping, etc.) and to use on particular media (e.g., bone, flesh, wood, etc.), a considerable number of experimental studies have been directed toward inferring exact tool function solely on the basis of wear characteristics (Sonnenfeld 1962; Semenov 1964; Keller 1966; Witthoft 1967; Faulkner 1972; Crabtree 1973; Keeley 1974, 1978; Tringham et al. 1974; Wylie 1975; Keeley and Newcomer 1977; Odell 1977; Hayden 1979; Lawrence 1979; Newcomer and Keeley 1979; Stafford 1979). Much of this experimental data strongly supports a wear pattern-tool function correlation.

Of considerable interest are the studies on microwear, particularly polishes, carried out by Keeley (1978), Keeley and Newcomer (1977), and Newcomer and Keeley (1979). This experimental work suggests tht it is possible to correctly identify varying modes of tool use, as well as to specify the medium on which a tool was used. Specifically, they found that diagnostic polishes appear on a tool edge or surface as a result of use on such materials as bone, wood, and gristle. These wear landmarks were identified microscopically at 200X. However, the examination of all tools at such a high magnification is not feasible with large lithic assemblages and may not even be necessary. Stafford and Stafford (1979) and Holley (1979) have both reported on experiments in which macroscopic and microscopic wear identifications were conducted on identical assemblages. They report that no appreciable information gain resulted from higher microscopic magnification. This suggests that for many kinds of tool identifications, macroscopic wear characterizations will be adequate for inferring cultural activity. The first draft of the research design suggested that it would be useful to examine the correlations between macro- and microwear patterns for tools in the study area in order to verify inferred relationships between tool function and edge/surface attrition but time did not allow this to be done. Because the wear classification system currently in use is based on macroscopic identification, proposed additional studies would entail microscopic examination of a relatively small subset of artifacts, perhaps 1000 specimens. The results of microscopic studies would be compared with macroscopic identifications on the same objects to determine whether significant differences occcur.

A different but related avenue of approach to the problem of tool function attribution has recently emerged in which residues on and in the working edges and surfaces of tools have been used to identify the materials on which tools have been used (Briuer 1976; Shafer and Holloway 1979). While these techniques have proved successful, they require special field and laboratory handling of tool objects and may not be efficacious in many circumstances. Because such residues are organic, their presence in identifiable amounts is dependent upon their contextual surroundings. Highly alkaline and abrasive sediments such as those found on the floodplain are particularly detrimental to residue preservation. A preliminary examination of approximately 200 tool specimens from an assemblage dated at 4500-5000 B.P. found virtually no evidence of organic residues. However, a similar examination of a set of tools from a relatively recent assemblage (100-500 B.P.) yielded much more fruitful results. Artifacts suspected to have residues (these were commonly milling stones and hopper mortar bases) were not washed in processing and were stored sealed in aluminum foil and plastic bags. It was not possible to complete a residue analysis, given constraints of time and money, but these artifacts are available for such an analysis in the future.

FUNCTIONAL CLASSIFICATION

Nine classificatory dimensions were employed in functional analysis (Table 8-2). Three describe the tool object: (1) utilization/modification, (2) type of manufacture, and (3) manufacture disposition. Six describe each tool: (1) condition of wear, (2) wear/manufacture relationship, (3) kind of wear, (4) location of wear, (5) shape of worn area, and (6) orientation of wear. A tenth, metric dimension, angle of worn edge or surface, is measured for each tool. This dimension can be converted to attribute data for convenience or if significant clustering is found at identifiable nodes on the continuum. The dimensions employed in the functional paradigm are intended to be exhaustive; that is, for each tool that is identified, an attribute state exists in each dimension that can be used to describe that tool.

Documents in Appendix C provide detailed definitions and working criteria for the above dimensions. The functional analyses was performed by only two different analysts throughout the course of the project, and efforts were made to keep analysis consistent.

Tab.e 8-2. Functional dimensions.

OBJECT SPECIFIC DIMENSIONS

DIMENSION I: UTILIZATION/MODIFICATION

0. None
1. Wear only
2. Manufacture only
3. Manufacture and wear
4. Modified/indeterminate
9. Indeterminate

DIMENSION II: TYPE OF MANUFACTURE

0. None
1. Chipping
2. Pecking
3. Grinding
4. Chipping and pecking
5. Chipping and grinding
6. Pecking and grinding
7. Chipping, pecking, grinding
9. Indeterminate/not applicable

DIMENSION III: MANUFACTURE DISPOSITION

0. None
1. Partial
2. Total
9. Indeterminate/not applicable

TOOL SPECIFIC DIMENSIONS

DIMENSION IV: WEAR CONDITION

0. None
1. Complete
2. Fragment

DIMENSION V: WEAR/MANUFACTURE RELATIONSHIP

0. None
1. Independent
2. Overlapping - total
3. Overlapping - partial
4. Independent - opposite
9. Indeterminate/not applicable

THE WEAR CLASSIFICATION

DIMENSION VI: KIND OF WEAR

A. Abrasion/grinding
B. Smoothing
C. Crushing/pecking
D. Polishing

DIMENSION VI: Continued

F. Feathered chipping
G. Feathered chipping/abrasion
H. Feathered chipping/smoothing
I. Feathered chipping/crushing
J. Feathered chipping/polishing
M. Hinged chipping
N. Hinged chipping/abrasion
O. Hinged chipping/smoothing
P. Hinged chipping/crushing
Q. Hinged chipping/polishing
Z. None

DIMENSION VII: LOCATION OF WEAR

1. Edge only
2. Unifacial edge
3. Bifacial edge
4. Point only
5. Point and unifacial edge
6. Point and bifacial edge
7. Point and any combination
8. Surface
9. Terminal surface
0. None

DIMENSION VIII: SHAPE OF WORN AREA

0. Not applicable
1. Convex
2. Concave
3. Straight
4. Point
5. Notch
6. Slightly convex
7. Slightly concave
8. Irregular

DIMENSION IX: ORIENTATION OF WEAR

0. Not applicable
1. Parallel
2. Oblique
3. Perpendicular
4. Diffuse
9. Indeterminate

DIMENSION X: OBJECT EDGE ANGLE

Actual edge angle
00. None
99. Not applicable

TRADITIONAL DESCRIPTOR

A tenth dimension, traditional descriptor or formal type, was added to the functional analysis to facilitate comparison with previously reported assemblages from other Plateau sites. The formal type names are based on traditionally accepted terms, not on functional analysis of manufacture or wear patterns. This information was recorded in the FUNCAN procedure but in the reports has been used in technological analysis as well to tie both analyses together. Appendix D contains a list of the traditional descriptor categories used, their computer codes, and criteria for inclusion.

ADDITIONAL COBBLE TOOL ANALYSIS

An independent analysis of cobble tools was designed for application at 45-OK-11 because the standard functional analysis did not adequately express the morphological variability in this large and complex assemblage. The analysis was also applied at 45-OK-2, 45-OK-2A, 45-OK-4, 45-OK-250, and 45-OK-258 so that assemblages of different ages could be compared. The 45-OK-11 cobble tool assemblage, the largest in the project area, comprised diverse morphological forms and wear patterns rare in other assemblages. Because these forms were potentially temporally diagnostic, we wished a thorough morphological description of the assemblage.

The traditional descriptor categories seemed inadequate for the complexly worn cobble tools at 45-OK-11. Many of the cobbles were used for several purposes; we found flaked, rounded, and bevelled edges co-occurring on individual cobbles, with varying combinations of grinding and crushing wear. The additional classification emphasized separate recording of each different types of use. The classification also incorporated information on the spatial relationship between wear and manufacture on the cobble. Nonetheless, like the standard project functional analysis the classification calls for a single object type name for each object. It was no easier with this classification to separate the multi-purpose hand cobble tools into uniform categories. In fact, the 45-OK-11 report (Lohse 1984f) uses the traditional descriptor from the regular analysis with the descriptive information on wear and manufacture from the special analysis.

The dimensions of the classification and comments on their application are provided in Appendix E. The classification was applied to those objects which had been previously classified as tabular knives, hammerstones, mauls, pestles, edge-ground cobbles, choppers, peripherally flaked cobbles, milling stones, hopper mortar bases, anvils, or indeterminate. The data file was designed to be cross-referenced to the original analysis, so that the information could be combined.

STYLISTIC ANALYSIS

The final analytic stage for lithic artifacts consisted of stylistic analysis of selected shaped artifact classes to establish historical, or temporally sensitive, types. Chronological ordering of occupational episodes was a key component of the proposed research program. While radiocarbon age determinations on organic samples taken from cultural contexts would provide absolute dates for analytic zones, historical artifact types would extend our ability to assign analytic zones to a relative chronological order.

Projectile point styles in particular, have been shown to be relatively sensitive temporal indicators elsewhere along the Columbia and Snake Rivers (Nelson 1969; Leonhardy and Rice 1970; Pettigrew 1974, 1975, 1976, 1977; Dunnell et al. 1976; Dunnell, Lewarch, and Campbell 1976; Dunnell and Whitlam 1977; Dunnell and Campbell 1977). Preliminary examinations of projectile points recovered from sites in the project area indicated definite similarities with styles reported by researchers in nearby reservoirs. Figure 4-2 presents a diagrammatic and pictoral summary of the evolution of projectile point styles at three localities that may be related culturally to the Chief Joseph Dam area; Kettle Falls, the Wells Reservoir, and the Sunset Creek site. When examined along with similar constructs proposed for more distant localities, such as Leonhardy and Rice's (1970) lower Snake River chronology, several major themes emerge in the development of point styles throughout the Plateau.

(1) . Points tend to get smaller through time; this change may parallel the change in the type of implement to which the projectile was attached--from spear to atlatl to arrow.

(2) The basic outline of the blade tends to change from lanceolate to ovate to triangular.

(3) Separate haft elements (stems) tend to appear through time; the sequence apparently runs from no separate haft element to shouldering to distinctly separate haft element.

(4) The shape of the stem tends to change through time from contracting to straight and/or expanding.

(5) Notching tends to appear through time; more specifically, notching tends to change from corner- to side-notching late in the sequence.

Although existing regional projectile point classifications provided considerable insight into historical morphological trends of regional significance, we found several problems with these classifications. The classifications lack comparability with each other; each applied to only a limited geographic area. They lacked unambiguous definitions which would allow other researchers to arrive at the same units. Also, their historic significance had not been well tested.

Our goal in investigating stylistic variability in projectile points recovered at the project was to develop a classificatory scheme that yielded objective, unambiguous classes or types of demonstrable historical significance. We had several considerations in selecting methods for stylistic analysis of projectile points. First and foremost was our requirement that a method yield classes to which unambiguous definitions could be applied. We also wanted a system that was as objective as possible; different researchers should be able to apply the classification to identical assemblages and get identical, or nearly identical, results. Because we viewed classifications as dynamic, rather than static constructs, we wanted a system that would permit inclusion of assemblages from other areas of the Plateau without altering basic class constructs. Finally, the classificatory system should yield classes of demonstrable historical significance.

We felt that numerical taxonomy and paradigmatic classification met the above criteria, particularly when used with metric data. Because we planned to perform the numerical taxonomy with metric variables, and derive metric descriptions for the paradigmatic classes defined on the basis of qualitative attributes, we needed a means of rendering significant morphological variability into metrical attributes amenable to further manipulation. Further, we required, not just any set of metrics, but a set that would bear identifiable, unambiguous relationship to the kinds of historical trends in point styles noted previously. Fortunately, several investigators in other parts of the country have been interested in morphometric transcription of projectile points (e.g., Gunn and Prewitt 1975; Thomas and Bettinger 1976; Benfer and Benfer 1981), and we built upon their experience to define a number of landmarks on the projectile points, and measurements and indices which could be derived from these.

We tried both methods on the resultant sample of 549 points which was available when points from 12 of the 18 salvage sites had been processed.

Our attempt at numerical taxonomy, using cluster analysis, was unsuccessful. Several trials were made using various combinations of nine metric variables selected for their apparent historical significance. None of the runs yielded groups that on the basis of prior archaeological experience we considered historically significant. Two main reasons account for the failure of this method to yield useful results. Most important is that numerical taxonomic methods cannot be expected to yield unambiguous results when the underlying dimensions upon which partitions are desired do not exhibit marked modalities. The distributions of the metric variables used lacked the kinds of multiple modes that would cause numerical techniques like cluster analysis to identify "natural" data groupings. Consequently, the program partitions the assemblage on purely statistical grounds that bear no necessary relationship to splits we might make on morphological grounds. Also, because cluster analysis attempts to minimize intragroup and intergroup variances as measured by a summary distance metric, situations can easily arise in which groups are identified that exhibit very low variability for a majority of the variables being used in a particular run but are permitted to vary freely on other variables. If these freely varying dimensions happen to be the ones that we know have historic importance, then the resulting groups are likely to be morphologically unsatisfactory, despite their desirable statistical properties. This can sometimes be overcome by stepwise clustering, but this would not help in our situation where natural modes are lacking in the data.

Although attempts to develop a numerical taxonomic partitioning based on a variety of quantitative variables known to be temporally significant elsewhere on the Columbia Plateau proved futile, results of these investigations clarified many of the problems confronting any potential classificatory scheme and provided a much better appreciation of the assemblage's morphological variability.

The paradigmatic classification we used was modified from one developed by W. Dancey in 1978 for projectile points from the project. The paradigmatic classification included five dimensions; blade-stem juncture, outline, stem edge orientation, and stem edge curvature, with a relatively large number of modes for each dimension. A total of 171 classes were identified among the sample of 549. On the basis of these initial results it was decided that the number of distinctions in each dimension should be decreased, and that size should be added as a dimension. These dimensions were retained in the final morphological classification used in the report series. Only the first three were used in defining classes, in combination with size.

Although we did derive, after several approximations, a satisfactory paradigmatic classification of projectile points with demonstrated historic significance, we had not accomplished our other goals. We performed one further analysis which emphasized comparison with other areas and metric definition of points. Using typed specimens from collections throughout the Plateau, we used numerical techniques to derive metric definitions for the types, and then to assign our points to types. Because the development of the paradigmatic classification and the metric version of the historical type classification are actually results of the project rather than a priori analytic systems, we include the full details in the project summary report (Jaehnig and Campbell 1984) rather than here.

9. FAUNAL ANALYSIS

The faunal analysis was designed to provide information from which to infer prehistoric environments, biogeographic changes, and subsistence systems. Faunal data from which such inferences can be made consist of taxon, skeletal elements, condition of those elements, age and sex of individuals, and marks of food preparation and consumption.

The presence of skeletal elements may provide information about primary and secondary butchering, preparation, consumption, tool or other manufacturing, ritual disposal, and scavenging. The number of identified specimens (NISP) and the analytic unit of quantification, MNI (the minimum number of individuals), provide an estimate of abundance. Depending upon the species and state of preservation, the sex of an individual can be determined by diagnostic features present on a few skeletal elements, and age can be determined by tooth eruption, fusion of epiphyses, and other maturation characteristics. Sex and age are potential indicators of preferences in predation methods, in diet, and in intended use of animal products. Also, age and sex seasonal characteristics can be used to determine, in some instances, the season of occupation. The relevance of burning and butchering marks to activities such as food preparation, preservation, and consumption is obvious. In combination the dimensions of the analysis provide information for identifying and controlling for the effects of taphonomic processes. Bone deposited by cultural activities can be distinguished from naturally deposited bone by presence and absence of burning, butchering marks, kind of breakage, stratigraphic context, ethnographic analogy, and ethology of the animal (Thomas 1971; Binford 1981). Changes in taxa or relative abundance of taxa may indicate shifts in subsistence systems, or in regional or local environmental conditions.

In addition to its relevance to questions about regional prehistory, the faunal assemblage offers considerable potential for evaluating methodological problems in quantification, sampling, and taphonomy that are of current interest to the field (Grayson 1979; Lyman 1982). A considerable literature has developed in the last decade concerning: (1) the relation of economic theory to descriptive methods (Smith 1976; Begler and Keatinge 1979); (2) the inadequacy of existing methodology (e.g., Grayson 1973, 1979; Casteel 1977, 1978; Lyman 1982; Klein and Cruz-Uribe 1984); (3) the development of new methods of quantification (e.g., Binford 1978; Grayson 1979, 1984; Fieller and Turner 1982); (4) sampling (e.g, Payne 1972; Grayson 1978); and (5) taphonomic processes, (Behrensmeyer 1978; Hill 1979; Lyman 1982). A regional research context and large assemblages from multiple sites analyzed in a standardized fashion make this project ideal for the refinement of analytic strategy.

PROCESSING

In the processing stage, which took place in the field laboratory, faunal remains were separated from other materials collected during excavation (Figure 9-1). Elements showing evidence of wear and/or manufacture were sorted from the remaining faunal materials and put through artifact analysis (Sequence A). The remaining unmodified faunal remains were separated into bone and shell, and each category was quantified.

This initial sorting and quantification was not performed or designed by the faunal analysts. Some tactical decisions in the processing stage were based on criteria other than the goals of the faunal analysis. For example, changes made in shell processing to save time resulted in noncomparable quantification at different sites.

QUANTIFICATION OF BONE

Unmodified bone was separated from shell and modified bone, and counted and weighed (all together, not separated into bird, fish, and mammal). Soon after processing began, it was noted that bone disintegrated considerably between the field and the laboratory, resulting in many very small pieces. Thus, after several sites had been processed, a procedure was instituted in which the bone was put through a 1/8" screen (see Table 9-1 for a summary of which technique was used at each site). Only the bone remaining in the 1/8" screen was counted and weighed. Potentially identifiable pieces which went through the screen were saved and kept with the rest of the bone, but were not weighed and counted.

Also, after some sites had been completely processed, a decision was made to separate **economic bone,** i.e. subsistence remains, from **noneconomic bone,** i.e. probable intrusive rodent bone, and to count and weigh only the former (see Table 9-1 for a list of which method was used at each site). Noneconomic bone was excluded because the LABCAT counts would be used in defining cultural components, and should not be biased by inclusion of noncultural bone. This distinction was ignored in the later taxonomic analysis: all bone was looked at by the faunal analysts. The weights taken during processing, therefore, do not necessarily correspond to the weight of the bone assemblage examined by the analysts. However, this difference should not be a major problem, as the rodent bone contributed a minor amount by weight in most assemblages. It is only at site 45-DO-282 (Lohse 1984d) where a discrepancy is apparent. The majority of identified elements are of rodents not included in the bone weights; further, the majority of the bones weighed were unidentifiable fragments of bone. The bone counts and weights in the LABCAT data, reported by zone in Table 2-2 (Lohse 1984d) and the counts of identified specimens reported in Table 4-1 (Lohse 1984d) measure two nearly mutually exclusive assemblages.

The justification given for this procedure is logical: the bone counts on the LABCAT forms were intended as a measure of culturally deposited material. However, there are several unforseen problems that arose from this

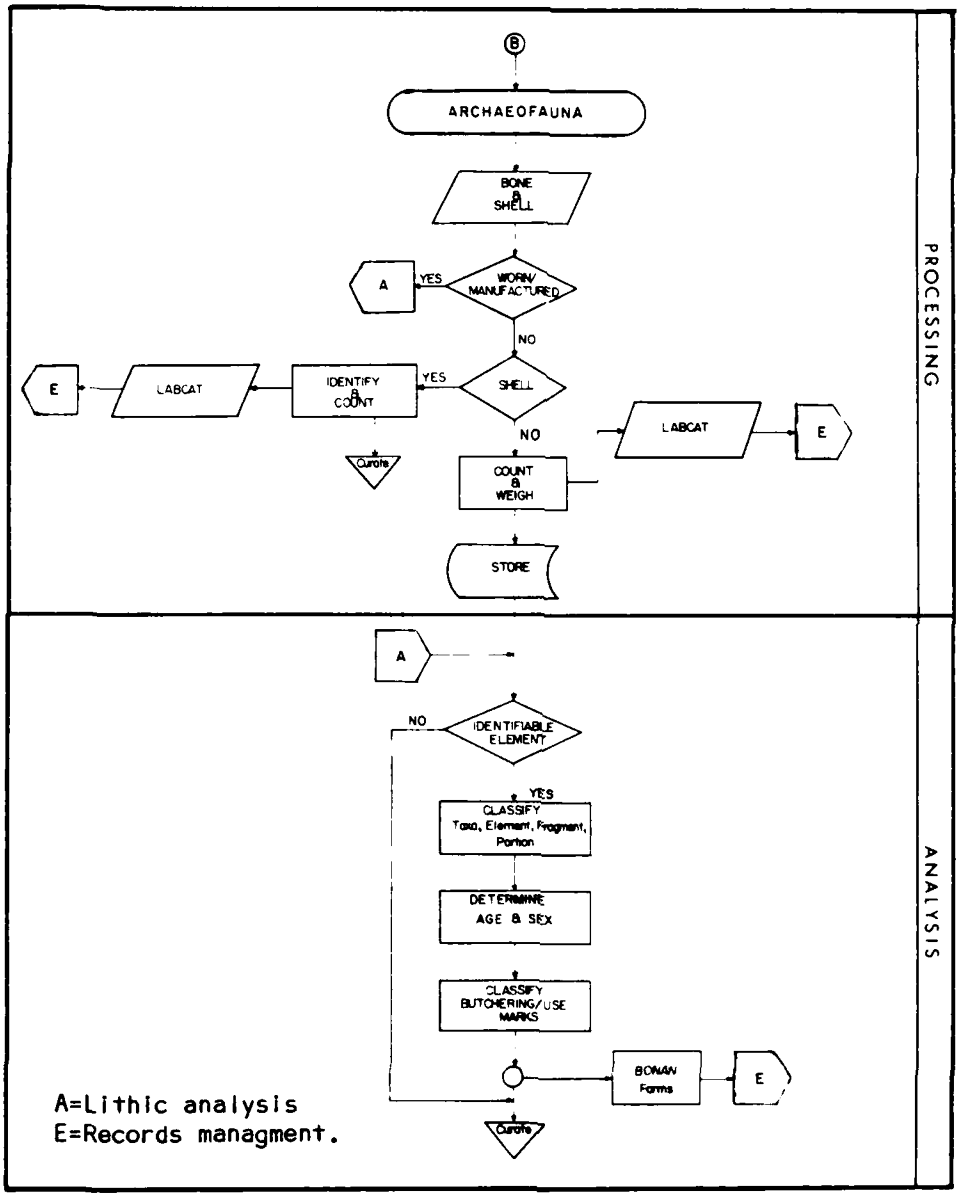


Figure 9-1. Flow chart of faunal analysis.

Table 9-1. Summary of bone and shell processing techniques by site.

Site	Shell Processing[1]			Bone Processing			
	Original Standard	New Standard	Other	Not Screened in Lab	Screened in Lab	Non-economic Bone Counted and Weighed	Non-economic Bone Not Counted or Weighed
45-DO-204	X				Non-identifiable bone only	X	
45-DO-211	X	8 Units[2]			X		X
45-DO-214	X			8 Units	X	X	
45-DO-242	X				X		X
45-DO-243	X				X		X
45-DO-273	X		1 Unit not weighed		X		X
45-DO-282	X				X		X
45-DO-285	X				X		X
45-DO-326	X	11 Units			X		X
45-OK-2	9 Units	X					X
45-OK-2A		X					X
45-OK-4			No weights				X
45-OK-11	X	25 Units		21 Units	X		X
45-OK-18	X			20 Units	X	X	
45-OK-250	X	21 Units		15 Units	X		X
45-OK-258	X				X		X
45-OK-287	X				X		X
45-OK-288	11 Units	X			X		X

[1] Original standard = hinges separated and counted; remaining shell screened through 1/2-inch screen; hinges and shell >1/2 inch weighed together and saved. New standard = hinges separated and counted; remaining shell passed through 1/2-inch screen; hinges and shell >1/2 inch saved; shell >1/2 inch weighed if no hinges in unit.

[2] Includes 1 x 2-m units.

procedure. The primary logical problem is that it requires an explicit and practical definition of noneconomic bone, stated in terms of species, bone condition, or skeletal completeness. No such definition was developed. Also, application of such a definition would require technical expertise not found among the individuals employed to do the processing. A second logical problem is that the definition of what species were deposited by noncultural agents should be a result of analysis, not an a priori assumption of it. Apart from whether this should have been done, and whether it was done consistently, a third drawback is that it resulted in quantification of bone in measures that cannot be related to those from the faunal analysis. The counts of identified specimens include some, but not all, noneconomic bones. The counts of all bone do not include noneconomic bone. We cannot specify the relationship between these two counts, and we cannot obtain the count of unidentifiable bone by subtraction.

The fact that rodent bone was excluded from total bone weights and counts from some sites should not present difficulties for most analyses. These small bones make only a minor contribution to the total weights and counts: variations in their recording does not invalidate comparisons among sites, zones, or features.

QUANTIFICATION OF SHELL

The initial procedure for quantifying shell was to count all hinges, put all hingeless fragments through a 1/2-inch screen, and then weigh the hinges plus the pieces remaining in the screen. After processing had been under way for several months, we reconsidered the utility of obtaining weights, as this process was extremely time-consuming (partially because dirt had to be removed from concavities before weighing). Linear regression analysis of weight and count data available in 1979 showed that hinge number was a very accurate predictor of total shell weight (Table 9-2). After October 30, 1979, hinges were counted and not weighed, and weights were taken on pieces over 1/2 inch, for only those units which had some shell but no hinges. The decision to quantify shell in this way was basically an economic one; it saved time while sacrificing very little data.

Table 9-2. Results of linear regression analysis of shell counts and weights.

Site*	R	R^2	Significance of Alpha	Significance of Beta	Intercept	Slope	N**	Significance of R
45-DO-204	-	-	-	-	-	-	4	-
45-DO-211	.98772	.97560	.22278	.00001	-1.06077	2.42819	533	.00001
45-DO-214	.94840	.89946	.01004	.00001	-4.98655	3.23016	619	.00001
45-DO-242	.95626	.91444	.00837	.00001	-8.33118	5.92622	250	.00001
45-DO-243	.99518	.99037	.29223	.00001	-0.95183	3.61744	123	.00001
45-DO-273	-	-	-	-	-	-	6	-
45-DO-285	-	-	-	-	-	-	1	-
45-OK-11	.95975	.92111	.34082	.00001	-2.02000	6.35120	1,614	.00001
45-OK-18	-	-	-	-	-	-	16	-
45-OK-250	.91167	.83114	.00795	.00001	-5.76862	4.61265	1,585	.00001
45-OK-258	.97825	.95698	.33444	.00001	-0.88379	2.84555	767	.00001
45-OK-287	.78982	.62382	.06726	.00001	-1.63793	4.39655	37	.00001

* No shell from 45-DO-282, 45-DO-326, 45-OK-288, or 45-OK-2 had been processed at this time. Shell weights not taken at 45-OK-2A.
** N is the number of labcat lines with shell present.

The regression analysis is interesting not only because a very high correlation was found between shell counts and weights, but also because the slope of the line and the intercept were different at each site. Because the relationship was different at each site, some units at all sites (except 45-OK-4) were processed by the original method to obtain data for calculating the correlation. Table 9-1 summarizes the variations in processing at different sites. Comparisons of shell abundance among zones and sites should be done using shell counts, which were always recorded in the same manner. Shell weights should be used with caution.

DESCRIPTIVE STUDIES

Further analysis of the vertebrate remains, conducted by Stephanie Livingston and R. Lee Lyman at the University of Washington in Seattle, included taxonomic identification and identification of skeletal element, and recording of other descriptive attributes such as side, portion, presence or absence of butchering marks, burning, age, and sex. Information on taxonomic identification and other specimen attributes were entered on the BONAN coding form for entry to the computerized data base (Figure 9-1). The coding form and coding keys for faunal data are included in Appendix F. Additional detail on treatment of some of these variables is given below.

ELEMENT AND TAXON IDENTIFICATION

Identifiable elements were assigned to the finest taxonomic level possible, depending on size, condition, and extant diagnostic features. Identifications were based on comparisons with reference collections held by the analysts; the Burke Memorial Washington State Museum, University of Washington; and the Museum of Comparative Zoology, University of Puget Sound. More detailed discussions of the level of identification possible for different taxa and elements can be found, taxon by taxon, in the summary report.

Taxonomic identity was recorded with a mnemonic key similar to that developed by Gifford and Crader (1977). The nine-column field allows three letter codes for family, genus, and species. Class and order level distinctions were not made, with the following exceptions. Fragments which could not be assigned to a taxon but were recognizable as artiodactyl remains, were recorded as "deer size"--a category which includes deer, pronghorn, and sheep--or as "elk size"--which includes elk, horse, bison, and cow (Lyman 1979). The bone element was recorded with a four-letter mnemonic code, followed by letter codes for fragment, portion and side.

Invertebrate remains, consisting entirely of freshwater mussel shell, were not identified to taxon. Analysis of shells from testing excavations showed that shell in the project area consists primarily of only two species, _Margaritifera falcata_ and _Gonidea angulata_, the latter in very small quantities. While we decided that it was not economically feasible to separate species of shellfish, analysis of shells during testing indicated species composition is a potential indicator of changes in riverine environments or exploitation preferences. This topic might practically be pursued in further research, using available data on shell quantities to select appropriate sample units.

Element identification is rudimentary for shellfish, consisting of hinge versus not hinge, and right versus left. Minimum number of individuals is determined by counting only right or left valves. Frequencies of left and right valves were computed, and they were found to be represented equally. Consequently minimum number of individuals (MNI) can be calculated by dividing the number of valves by two.

AGE AND SEX

Data on age and sex of individual animals may be used in determining MNI and also in interpreting cultural practices such as what kinds and ages of animals were hunted. Most important, age of individuals of taxa of a known season of birth can be used to interpret seasonality of assemblage.

A category for sex was included; however, the only elements for which sex could practically be determined were artiodactyls with antlers or horn cores.

Age of individuals can theoretically be determined from several types of data, principally epiphyseal union, tooth eruption, and tooth wear. Epiphyseal union was recorded for all elements on which it could be observed. On a complete element with two unfused epiphyses, the epiphysis with the earliest fusion date was recorded as unfused. On a complete element with one fused and one unfused epiphysis, the unfused epiphysis was recorded. Information on tooth eruption and wear was recorded only for deer, bighorn sheep, and antelope, species for which data relating tooth eruption and wear to age is available. The ages of individual deer at death were estimated using criteria from Robinette et al. (1957), and Severinghaus (1949). Bighorn sheep mandibles were aged with reference to the criteria described by Cowan (1940) and pronghorn mandibles using criteria described by Dow and Wright (1962). An estimate of the age of the individual in months was entered on the coding form. Later, in presenting this data for purposes of interpreting seasonality of site assemblages, the age was indicated as a range of several months because individual variation in wear pattern from which age is assessed increases with age and varies depending on location and forage type.

BUTCHERING AND BURNING

Evidence of cultural modification in the form of butchering or burning was recorded if present on an element. This information is relevant to questions about cultural practices--how particular animals were used and prepared. Also, it is our most reliable means of distinguishing culturally and naturally deposited bone. The difficulties inherent in making this distinction have been discussed, but not resolved, in the literature (Thomas 1971; Brain 1981; Binford 1981, and references therein). For the purposes of this analysis, cultural bones are distinguished through indications of skinning and butchering marks on the bones, evidence of burning, and patterns of fragmentation.

Evidence of human butchering activities can take one of two forms: bone fragmentation (Noe-Nygaard 1977) and butchering marks (Potts and Shipman 1981). Because fragmentation of bones may result from any number of natural processes (Bonnichsen and Will, in Gilbert 1980), only butchering marks are considered here. **Butchering marks** are artificial features which occur on specimen after specimen in the same location; the reason for the occurrence of a particular kind of mark at a given location most likely is anatomically dictated (Guilday et al. 1962). The classification of butchering marks used in this analysis is based on the kinds of marks expected to occur if the force creating the mark resulted from human activity. These are described below:

Striae. Striae are cutmarks produced by drawing the edge of a sharp tool across a bone surface in a direction continuous with the long axis of the tool edge. Striae produced in this manner are elongate grooves which occur in groups of relatively parallel marks and are V-shaped in cross section (Potts and Shipman 1981). Striae may be expected to occur when the process of skinning brings the butcher's tool in contact with bone (e.g., at the head and lower legs), in the process of filleting meat from bones, in dismembering the carcass at points of articulation, and in stripping periosteum from bones in preparing elements for marrow extraction (Binford 1981).

Flaking. When green bones are struck a direct blow with a blunt instrument, the resultant fracture leaves crescentic, conchoidal flake scars, which may be ringed with small, incompletely fractured impact chips (Binford 1981). Flake scars may be expected to occur when bone is fractured after the surrounding muscle tissue has been removed, for instance in the process of marrow extraction.

Chopping. Marks produced by striking the bone surface at a roughly perpendicular angle with a heavy sharpened implement (e.g., hand axe or cleaver) have V-shaped cross sections and small fragments of bone crushed inward at the bottom of the main groove (Potts and Shipman 1981). Chopping marks may be expected to occur when disarticulation of a carcass is accomplished by chopping blows concentrated at joint articulations or insertions of major muscle masses or tendons, or by cleaving through a bone rather than between bones at their articulations (Binford 1981).

Saw cuts. The use of historic metal tools to cut through bone leaves a relatively smooth surface that displays numerous parallel striae. Saw marks are expected to occur only in a context where metal tools were available.

Artifact. This category was created for individual elements that exhibit extensive, patterned modifications. A series of aligned flake scars, deep grooving, or extensive polish concentrated on a particular area are examples of the kinds of phenomena that would be assigned to this category. These kinds of modifications can be expected to occur if the element was being altered in order to be used as a tool and/or had been used as a tool.

In addition to the kinds of marks described, whether or not a bone had been burned was recorded. Burning may result if a bone is used as fuel or disposed of in a fire or it can occur as a by-product of roasting (Wing and Brown 1979:109). Burned bones do not necessarily mean that the taxon was being exploited as a food resource, but they can be interpreted as evidence of some kind of human activity involving the taxon if other independent lines of evidence indicate the bones were handled by people. Bones may be burned as a result of natural factors (Balme 1980), but if bones of a taxon are burned and also display butchering marks, then the argument can be made that the bones and the taxon are present in the site as a result of human activity.

Analysis of butchering marks and burning must be viewed as an asymmetrical study. The frequency of butchering marks on, or burning of, various elements may indicate either those elements most commonly butchered or burned or those elements that most commonly preserve traces of human activity (Binford 1981). However, an animal may be butchered, and few if any bones may be artificially altered in the process (Guilday et al. 1962). Consequently, the absence of butchering marks and/or burning should not be interpreted as indicating that a given taxon or portion of an individual was not utilized. A bias in this particular study of butchering is that only identifiable bones were examined for presence of butchering marks and burning; unidentifiable burned and butchered bone was not recorded.

QUANTIFICATION

The faunal analysts received computer listings of all faunal identifications from a particular site, by zone, after the zones had been assigned. The faunal data was then tabulated by zone for that site, for use in interpreting the site assemblage. Both NISP (number of identified specimens) and MNI (minimum number of individuals) values were reported for each site assemblage. MNI values were derived for the entire assemblage and for each analytic zone. For 45-OK-4, 45-OK-11, 45-OK-250, and 45-OK-258, MNI values were derived only for combined zones or components.

10. BOTANICAL ANALYSIS

The study of vegetable materials found in archaeological matrices, termed archaeobotany or paleoethnobotany, (Dennell 1967; Dimbleby 1967; Ford 1979; Renfrew 1973) provides valuable information about the resource base of people who inhabited a site. With lithic and faunal materials, they give us the means for making inferences about the peoples' patterns of subsistence, as well as interpreting site features. The presence and condition of specific kinds of fruit seeds and flower parts, for instance, can suggest seasonality of site use.

The importance of archaeobotanical analysis to study of hunter-gatherer subsistence economies in the project area cannot be overstated. While the proportion of plant to animal products in the subsistence economy cannot be estimated reliably, relative proportions of various species and parts of plants in components of different ages can be compared. When conjoined with faunal classes and with technological or functional classes, rough proportions and simple presence and absence of species in pits, hearths, and dwellings, can help us to interpret the activities that created these features.

Problems of sampling and taphonomy discussed for faunal analysis are equally relevant to archaeobotanical analysis. As a science, archaeobotany is in its infancy, and many of these problems have not yet been investigated systematically. Questions of contamination and survival rate are seldom discussed, and only one recent study deals with flotation recovery rates (Wagner 1982).

DEVELOPMENT OF THE BOTANICAL ANALYSIS PROGRAM

Because botanical analysis had not previously been done for open sites in the Columbia Plateau, the preservation of plant remains other than wood charcoal was uncertain. Dr. Nancy Stenholm joined the project in the summer of 1980 and performed preliminary analyses to determine the potential for botanical remains in these sites. Eleven flotation samples were collected from 45-OK-2 and examined for botanical remains. They yielded six kinds of wood charcoal, fruit, seed, and root specimens, and other types of tissue including bark, epithelium, and leaf. Given this demonstration of the wide range of plant materials which could be preserved under local depositional conditions, it was clear that botanical analyses could make a major contribution to the project. Dr. Stenholm re-joined the staff in 1981 and between then and 1983 supervised the processing of flotation samples and identified botanical remains in the field laboratory.

Originally we planned to analyze 200 samples from 45-OK-2 only, but in the summer of 1981 we expanded the scope of the analysis to include 450 samples from a number of project sites. When samples from sites 45-OK-287, 45-OK-288, 45-OK-18, 45-DO-204, and 45-DO-214 had been analyzed, it became apparent that it was not possible to analyze materials from each site within the time frame of the project. We then chose sites 45-OK-2, 45-OK-2A, 45-OK-11, 45-OK-250, and 45-OK-258 for analysis. Each site had one or more housepit component, all dating to different time periods; thus they would provide interesting comparisons. We hoped as well to analyze materials from 45-DO-326, the sole rockshelter excavated, but time did not allow. Nor was it generally possible to analyze all samples from a given site. The samples to be analyzed were chosen by the botanical analyst and senior author responsible for the particular site report. The decisions were generally made well in advance of component and feature analyses and thus depended on preliminary interpretations of site structure.

PROCEDURES

Evidence of plant gathering, preparation, and use often is preserved as charred, microscopically identifiable tissues in soil samples. Because these materials seldom are recovered in situ or during routine screening, general processing procedures are different from those used for faunal material and lithics. The following discussion describes methods used to collect and analyze flotation samples and other botanical samples from 1978 to 1981. It focuses particularly on biases introduced by field and laboratory methods, and the steps taken to correct them. A flow chart of prcedures is shown in Figure 10-1.

COLLECTION OF SAMPLES

The possibility of recovering and analyzing botanical remains was not overlooked in the initial development of project excavation strategy. However, the samples earmarked for botanical analysis had other purposes as well and their size, method of collection and treatment were not designed specifically with botanical analysis in mind. Soil samples were collected for use in both soil analyses and flotation if desired. Likewise, charcoal samples were collected primarily for radiocarbon dating, but were available for taxonomic identification if not sent for dating. Because most excavation had been completed by the time the botanical analyst joined the staff, it was necessary to use existing soil samples for flotation, rather than collecting samples specifically for botanical analysis. Only at 45-OK-2, during the 1980 summer season, were flotation samples collected specifically for botanical analysis.

Before the spring of 1980, approximately 650 soil samples had been collected in the field for possible botanical analysis. In the testing phase, soil samples were removed from each 10 cm unit level for a column sample. Samples also were taken from selected feature matrices during testing and full-scale excavation. Soil samples from unit levels tended to be very small,

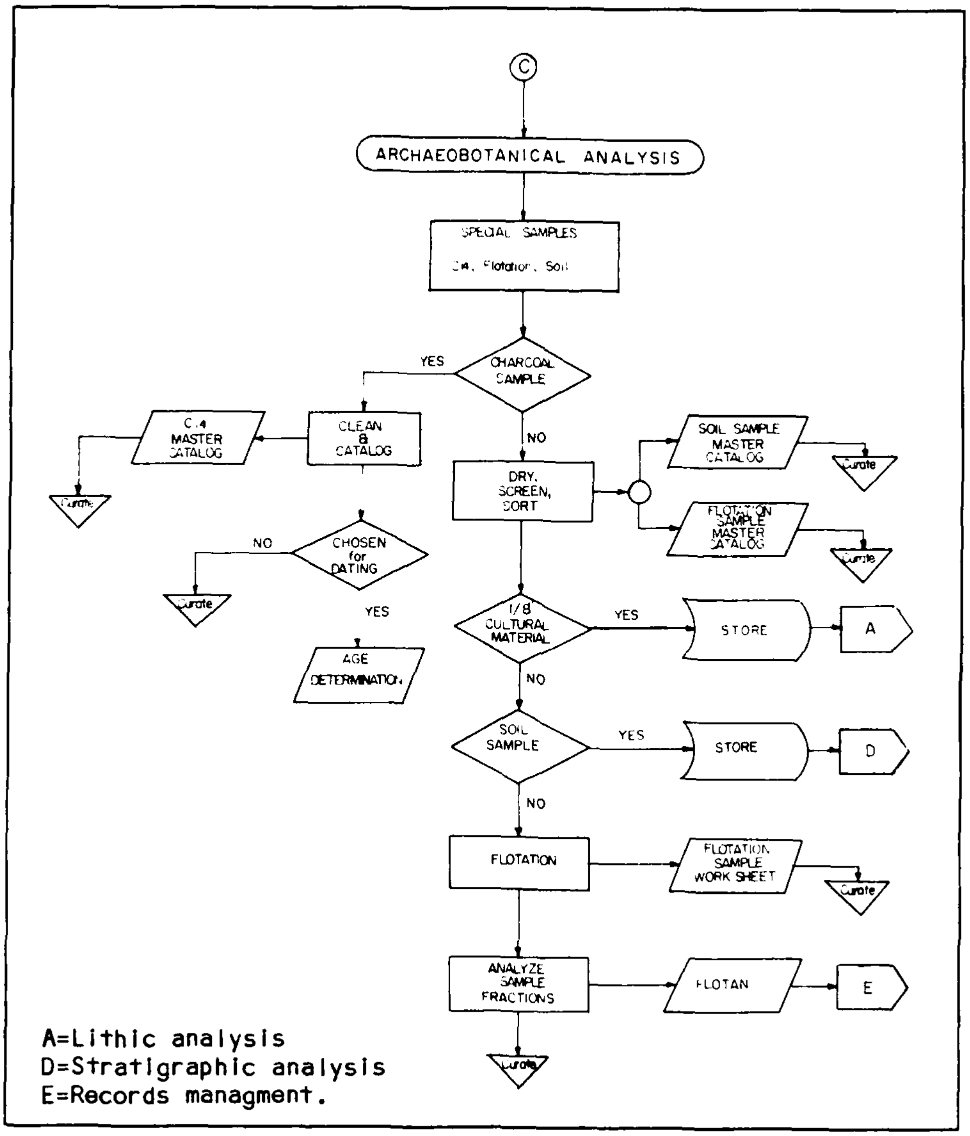


Figure 10-1. Flow chart of botanical analysis.

approximately one-tenth the size of the samples from features. These samples were catalogued and passed through a 1/8-inch (3.2 mm) mesh screen in the field, or sometimes in the laboratory. Lithics and faunal material greater than 1/8 inch were removed by hand for separate analysis. After coarse screening, a mineral matrix mixed with lithics, faunal and floral material less than 1/8 inch remained in the soil sample. Sample weight was recorded after air- or oven-drying. Soil samples were sometimes extracted by passing the matrix through a screen with mesh a size of 0.5 mm. Material smaller than 0.5 mm was weighed and sent to the soils laboratory for analysis. The remainder became a botanical flotation (bot flot) sample stored for possible analysis.

Flotation samples collected before the summer of 1980 varied greatly in weight and laboratory treatment. Most of the testing phase samples weighed less than 100 g and the majority of the samples from salvage exceeded 1000 g per sample. The samples had been screened at least once, sometimes twice, before flotation.

When the author joined the project in the summer of 1980, she instituted new flotation sample collection procedures. These were used only at 45-OK-2, the last site to be excavated. Soil from a block 20 cm x 10 cm x 5 cm was bagged entire. At the end of summer 550 samples were air-dried, weighed, and subjected to water separation (flotation) in the field. The samples varied in weight from 2.4 kg to 5.5 kg, and averaged approximately 3.0 to 3.5 kg.

FLOTATION METHODS

While a variety of techniques have been developed for floating lighter vegetable materials from heavier organics and lithics (Jarman et al. 1972; Limp 1974; Watson 1976; Minnis and LeBlanc 1976), simple water separation (Struever 1968) was used for all but special sampling. Water separation involved submerging a container with a fine screen (0.05 mm) bottom in the river and gently agitating the matrix until silts, sands, and clays washed out and lighter materials floated to the surface. The floating material (the water light fraction) was taken off the surface of the water, dried, and further processed.

Some charcoal and some semi-charred floral material will not float in water without additives to increase density, and thus remain in the residue at the bottom of the container (water heavy fraction). Manual extraction of floral material from the heavy fraction was time-consuming and inefficient so the water heavy fraction was refloated in a sugar solution with a specific gravity of 1.15. The floating material (sugar light fraction) was removed, washed, dried, weighed, and set aside for analysis. The sugar heavy fraction was weighed and added to the water light fraction for analysis.

The sugar flotation process is fast, safe, and inexpensive. The sugar solution, made by mixing 0.65 g of white sugar to each 1.0 g of water at room temperature, is inexpensive, non-toxic, biodegradable, and can be reused after filtration. A small amount of formaldehyde solution (10-50 ml per liter) was added to inhibit bacterial growth. The flotation process itself is gentle on floral material and efficiently separates vegetable material from heavier organic and lithics. An average sample takes about 12 minutes to float, collect, and set aside for drying. Examination of the first 33 samples, most of which were approximately 1200 years old, indicated that the recovery rate was good. The light fractions from these 33 samples weighed 5.5 g on the average (range 0.2-29.1 g) and 66% weighed 1.5 g or more.

The flotation procedures were developed over a period of time, thus there are some variations in how individual sites were processed. For example, flotation samples from 45-OK-287 and 45-OK-288 were subjected only to water flotation and not sugar flotation, and testing soil samples from 45-OK-18 were subjected to sugar flotation without first being floated in water. The chapters on botanical analysis in individual site reports mention variations from standard processing.

SUBSAMPLING OF FLOATED MATERIALS

By the end of July 1981, all 45-OK-2 samples had been processed, and most of the remaining 890 flotation samples from other sites had passed the water separation stage. At this time the decision was made to enlarge the scope of botanical analysis to include sites other than 45-OK-2, originally the only site considered for analysis. The sample size was increased from 200 to more than 450 flotation samples and bulk carbon samples (i.e., radiocarbon and miscellaneous charcoal samples). The sample universe now contained small and large soil samples; screened and unscreened samples; and samples which had not been subjected to the entire flotation sequence.

In the interval before November 1981 when the first report was due, we attempted to find a way to make the diversity of flotation samples comparable. The small, light-weight testing phase column samples were a problem. While most other samples could be reduced to a standard weight (e.g., 1-2 kg), or standard volume (1-2 liters) for analysis, the column samples were already smaller than optimum size. It was necessary to use them, however, as they comprised the only samples from housepits at sites other than 45-OK-2.

Although the samples could not be made more uniform by reducing the sample weight or sample volume to a common denominator, we could standardize subsample size. Floated materials were sieved to produce a subsample of materials. Determining an optimum subsample size involved a trade-off between optimum item size and optimum total weight.

Experimentation with the first assemblage analyzed, that from 45-OK-287, indicated that the optimum size range for analysis was between 4.75 mm and 2.0 mm in diameter (U.S.A. Standard Sieve sizes 4 and 110, respectively). Items of this size were large enough to handle and to split to obtain fresh faces for identification. At sizes above 4.75 mm, identification was easier, but the pieces were not representative of the sample as a whole. Experimentation showed that a subsample consisting of pieces larger than 4.75 mm generally included a higher proportion of wood carbon to other materials than the flotation sample from which it came. Furthermore, not all flotation samples included items of this size. At sizes below 2.0 mm in diameter, the items were increasingly representative, but identification was difficult and time consuming. Therefore, our assessment was that the optimum subsample would be

1.0 g of material ranging in size from 4.75 to 2.0 mm. However, when the preservation was poor, the density of botanical remains was low, or the sample was small, there were not enough items of optimum size to make 1 g. In this case, the next smaller category (2.0-1.0 mm) was used to fill out the subsample. In such cases, only 0.1 g was analyzed, since more than that amount adds too many pieces to handle efficiently (0.1 g of materials of this size includes 80-150 items). In extreme cases, when it was necessary to use materials smaller than 1.0 mm in diameter, a 0.01-g sample was scanned, and the items counted.

After analyzing several sites, we realized that many flotation samples would not yield a 1.0 g sample between 4.75 and 2.00 mm, and we selected 0.1 g of light fraction material ranging in size from 2.0 mm to 1.0 mm as our standard subsample. If a flotation sample had archeobotanical material, some of it was in this range. In a test run of 45 subsamples ranging in age from 5000 years to the present, 41% contained 49 or fewer items and 37% contained from 50 to 149 archeobotanical items. A feature 2700 years old, consisting of 95% carbon by weight, yielded a subsample with 215 botanical artifacts, the highest number. The average number of botanical items was 47 per test subsample, a manageable number of identifications given time limitations. A subsample with this number of items was thought to be representative. Fragile items such as grass stems, leaf fragments, conifer pitch, herbaceous tissue, and seed parts as well as more durable woody tissue were present in many subsamples. The number of taxa varied. The subsample with 215 items yielded but ten taxa, while a smaller sample of similar age, yielded 18 taxa, the greatest number from any sample. Numerous subsamples contained four or more taxa. As far as could be determined, there was little in the <1.0 mm fraction and nothing in the >4.0 mm fraction not found in our selected subsamples.

In sum, our choice of a subsample standard was in response to bias noted in sample collection and pre-flotation processing. It was not our preferred subsample category. The small size of items made it difficult to identify them and determine their weight accurately. In attempting to remedy the initial biases, we created others. We believe, however, that these new biases do not significantly alter the general conclusions of our study.

As the subsampling procedures were developed over a period of time, and the types of flotation samples available for particular sites varied, there are variations in processing of individual sites. For example, flotation materials from 45-OK-18 and 45-DO-204 were so sparse that they generally were analyzed entirely rather than subsampled. See individual site reports for information on specific procedures used.

RADIOCARBON SAMPLES AND MISCELLANEOUS CHARCOAL SAMPLES

Radiocarbon samples were analyzed as well as flotation samples. We had not originally planned to include radiocarbon samples because of the obvious problems in comparing different kinds of samples. However, at 45-OK-287, the first site analyzed, we picked five radiocarbon samples to analyze as a check against flotation sample woods. Three of these turned out to be western red cedar (Thuja plicata), and one was a sample of western white pine (Pinus monticola), neither of which were represented in the flotation assemblage. These species were of particular interest as they are not indigenous to the areas. The closest live trees of either species are 120 km (75 miles) east over mountainous terrain near Inchelium.

Because bulk charcoal samples generally include the largest pieces of charcoal from the site, they are easier to identify taxonomically, and more likely to be identifiable as artifacts through traces of wear or manufacture. Thus they contribute qualitative data not available from flotation samples. The analyst examined radiocarbon samples and miscellaneous charcoal samples as time permitted after analysis of flotation material from a particular site had been completed. Samples chosen for analysis generally were associated with interesting features or unusual flotation samples. Most were samples which had not been selected for dating, although subsamples of some dated charcoal samples also were examined.

IDENTIFICATION AND QUANTIFICATION

In the identification process, the floral material was divided into wood, seeds, surface and subsurface stem tissues, and disassociated tissue types. The coding form is shown in Figure 10-2. For the most part, species, genus, family, or general category identifications could be made only for wood and seeds. Wood was identified by examination of cell patterning (Phillips 1963; Panshin and de Zeeuw 1970; Brazier and Franklin 1971; Friedman 1978), and seeds were identified by reference to seed manuals (Schopmeyer 1974; Gunn 1977; Montgomery 1977) and general floral identification keys (e.g., Hitchcock et al. 1969). Some seeds and most surface and subsurface stem tissues could not be identified on the basis of standard identification keys. These elements were compared microscopically with carbonized samples of local plants represented in a comparative collection compiled at the project.

As discussed above, the small size of the individual items in the subsamples made identification difficult. Many pieces were necessarily assigned to residual categories, such as Other Conifer or Other Hardwood. Examination of radiocarbon samples closely associated with the flotation samples, as well as items over 2.0 mm in diameter, provided some help. Our microscope (Bausch & Lomb StereoZoom 7), which had good resolving power of 140, was adequate, although we often wished for higher power when working with conifer and some hardwood species.

The total weight of each identified taxon or material category was recorded for each sample. Our balance, a Mettler PC400, reads weights to 0.01 g with a reproducibility of ±0.005 g. The last digit is rounded off by the 5/4 principle. That is, if a specimen weighs between 0.005 and 0.009 g, the balance indicates 0.01 g. Weights smaller than 0.005 g are rendered as <0.01 g, or trace. Traces are not taken into account in row and column totals on botanical tables. These totals, then are approximations of actual weight. Quantification by weight often was made difficult by the small size of the identified items and the small total size of the subsample, especially for taxonomically rich samples. Our laboratory balance, with its sensitivity to 0.01 g, was not accurate enough to weigh minor groups in a subsample. Some

BOTANICAL SCAN SHEET

Site: 45- ______ Master # ______

Unit Datum ______ Quad ______

Fe. # ______ Field Cat. # ______

Loc. ______ Depth ______ Bag # ______

Exc. Date ______ 2 x 2m ______ 1 x 1m ______

1. WOOD CHARCOAL: ______ gm.
   Conifer: ______ gm.
   ______
   ______
   Diffuse porous: ______ gm.
   ______
   ______
   Ring Porous ______ gm.
   ______
   ______
   ______
   Other ______ gm.
   ______

2. CARBONIZED SEEDS: ______
   ______ / ______
   ______ / ______
   ______ / ______
   ______ / ______
   ______ / ______

3. STEM TISSUE: ______ gm.
   Grass ______
   Rush ______
   Leaf ______
   Other ______

4. UNDERGROUND STEM: ______ gm.
   Root ______
   Bulb ______
   Rhizome ______

Flot. Volume ______ cc.

Wet Weight ______ gm.

Uncleaned Light Fraction ______ gm.

Uncleaned Heavy Fraction ______ gm.

Separation Medium ______

Subsample: ______ mm. Cleaned?
______ gm. ______
______

5. TISSUE TYPES: ______ gm.
   Bark ______
   Fiber ______
   Testa ______
   Paryenchmoid ______
   Epitheloid ______
   Other ______

6. UNIDENTIFIED: ______ gm.

7. UNCHARRED MATERIAL:
   Seeds ______
   Lithic ______
   Bone ______
   Insect ______
   Rodent ______
   Shell ______
   Other ______

8. DRAWINGS/PHOTOS:

COMMENTS: ______
______
______

Array Type ______ Date ______

Figure 10-2. Botanical scan sheet.

botanical materials naturally weigh very little. Furthermore, in soil samples of small initial weight, many of the materials recovered also weigh very little. A more sensitive balance would have been useful, but such instruments are not suited for semipermanent field stations.

The subsamples also contained other items such as rootlets, insect parts, non-floral cultural material, and modern floral contaminants. We considered several criteria in deciding whether botanical material in the samples was culturally or naturally deposited: (1) evidence of manufacture or wear; (2) presence of charring; (3) association with non-botanical artifacts; and (4) relative absence of bioturbation.

Except for signs of manufacture, none of the other factors is sufficient in itself for judging whether floral material is artifactual. Association with other kinds of artifacts usually is a good indication that floral material is artifactual provided there is little or no bioturbation. Wear is another good sign, but not an invariable one. Wear can be natural as in the case of water-worn driftwood; decay also may be mistaken for wear. If we allowed only manufactured items in our study, we would have only about a dozen objects from several hundred samples to discuss. Most of them are wood objects less than 1/8 inch long (see discussion of procedures below) and a few are cut and split cedar and birch bark, as well as one or two examples of prepared (retted) fibers.

The presence of charring is another criterion by which botanical items are identified as culturally introduced. Carbonized material resists decay for considerable periods of time, while noncharred material is more likely to be recent introductions incorporated into the sample matrix through bioturbation. However charring is neither a necessary nor sufficient indication of cultural introduction, and determinations must be made on a case by case basis.

Some charred organic items in our samples evidently were burned naturally. Charred rodent pellets, for example, are found occasionally in our flotation samples. In a region such as ours, prone to summer lightning fires and heavy thunderstorms, and pocked with animal burrows, naturally charred materials can be introduced into buried strata at considerable depth. Fortunately, flotation samples are sensitive indicators of modern biological contamination. They can be checked for mammal hair, fecal material, insect parts, small bones, fresh floral material and the like. We tallied biological contaminants, and we did not hesitate to disregard, or comment on, an array which seemed suspect.

Likewise, we found noncarbonized and semi-carbonized materials which appeared to be contemporaneous with culturally deposited carbonized remains. Although most floral items recovered were completely carbonized, a few (four) uncharred wood and bark artifacts survived for 1200 years, for example, a tool of western red cedar at 45-DO-214 (Miss 1984a). Partially charred botanical materials are common in our assemblages, dating as far back as 3300 years. Ancient contamination in very old sites, however, is difficult to detect, and this problem will need further study.

For presentation in the site reports and summary report, the botanical remains were divided into three basic categories: woods, edibles, and other nonwoody tissue. Both weight (g) and number of appearances (#) is given. By edible plants we mean those stated in ethnographic and ethnohistoric reports from the Plateau and other areas to be such. Nonwoody tissue includes such items as seeds not believed to be edible (eg. *Purshia tridentata* seeds), grass or tule parts, and a final catch-all groups consisting of stem, pith, and leaf parts of herbaceous plants that cannot be identified to family. Although tissues rarely can be identified taxonomically, the distinction of general tissue types is important since bark and fiber are outputs from processing and technological uses of plants, testa are outputs from seed grinding, and other tissues are outputs from processing of soft tissues, usually for foods and medicines.

Two measures determined during the course of analysis are of general use in site interpretation. First, we calculated the carbon purity, that is the proportion of archaeological carbon relative to contaminants and nonfloral cultural remains--insect parts, rootlets, shell, lithics, bone, etc.--in the floated subsamples. The total weight of carbon in the air-dried subsample was divided by the total subsample weight and expressed as a percent. This measure is useful in judging the reliability of radiocarbon age determinations on carbon samples from the same location. A purity rating of less than 30% for instance, indicates considerable contamination, and the reliability of an associated radiocarbon date might be questionable depending on the type of contaminant.

Secondly, we devised a method to measure the amount of archeobotanical material or carbon in the soil sample by expressing the carbon ratio as a percentage of soil weight. This ratio is found by multiplying the carbon purity percentage times the weight (measured after air drying) of the light fraction from the sample and dividing the resulting figure by the pre-flotation soil weight (taken on an oven-dried sample). For example, a flotation sample with a pre-flotation weight of 100 g, a light flotation fraction weight of 10.0 g and a subsample purity rating of 50%, has a carbon ratio of 5%. Carbon ratios proved useful in charting the waxing and waning of archeological material in column samples, as well as in determining particularly rich samples. A rating over 1% is high, and usually indicates carbon rich features such as hearths, midden deposits and occupation floors.

It should be noted that there is bias in using one subsample as the basis for deriving sample-wide carbon content. The bias has been tested experimentally, with actual flotation samples, by dividing into various size categories, separating carbon from noncarbon, weighing the fractions, and determining the differences. The results indicate that the contamination ratio in the 4.75-2.0 mm and the 2.0-1.0 mm size categories is about the same. In the fraction above (.4.75 mm) the purity rating is about 4-5% higher, and in the fraction below (1.0 MM) it is about 8% lower.

11. FEATURE ANALYSIS

Analysis of finer temporal units and spatial distributions of artifacts and features within the zone is an important adjunct to the broad comparisons of zonal content. The analytic zones necessarily span relatively long periods because finer temporal distinctions cannot reliably be correlated across the site. The zones combine the material products of numerous short-term activities, thus obscuring much small scale temporal and spatial variability in cultural activities. Knowledge of the structure and content of features increases our understanding of the prehistoric activities that took place at the site. Consequently, features were excavated separately, and their contents recorded separately from unit level materials. Methods and procedures used in excavation and analysis of features and their contents are described below.

EXCAVATION AND RECORDING OF FEATURES

Because excavation destroys the association of objects in a feature and because methods of data gathering may bias later analysis and interpretation, this chapter begins with a brief discussion of how cultural features were recognized in the field, excavated, and recorded.

Features were numbered consecutively at each site. They were excavated as separate proveniences from the surrounding unit level matrix. Features were generally bisected by excavating one half in arbitrary 10 cm levels. After a profile of the bisected feature was drawn, the other half was removed in either arbitrary 10 cm levels or in natural strata. When features had diffuse bondaries with unit level matrices or with other features, the boundary areas were excavated as "mixed feature and unit level", or "mixed feature level".

FEATURE RECOGNITION

While feature excavation was relatively straightforward, feature recognition was a more subjective matter. One of the project's research goals was the acquisition of useful information about structural remains and artifact patterns reflecting prehistoric activity areas at a number of different scales. In pursuit of this goal, we expanded the usual field definition of a "feature" to include anything that appeared different from the surrounding matrix, such as soil anomalies, distinctive artifact groupings, and other artifact associations of note, even if they did not necessarily exhibit clear boundaries.

However, this loose definition--essentially, anything that looked different--did not solve all the problems of feature recognition because of the role of the individual site supervisors. Some supervisors took sterile substrata as their norm and assigned feature numbers to any thing deviant from that, including cultural strata, natural strata of contrasting composition, light soil stains, artifact clusters. Other site supervisors designated only striking anomalies as features; thick strata, material-bearing or not, were considered status quo and not treated as features. However, the latter was true in only a few instances, generally cases where artifacts were sparse and evidence of occupation meager. Features were also short-changed in the field when time and rising water forced a rapid excavation schedule with little tolerance for the extra work, notes, and photographs which feature reporting demanded.

These biases left by the excavation of features are partly negated by the laboratory analysis. The detailed notes on each unit, level by level, as well as the site notes kept by the supervisors clued the feature analysts to anything which should have been considered with other features, but which was not designated separately in the field. Some features were defined in the lab in the course of analysis, although time did not allow us to do this systematically for each site.

RECORDING

Reconstruction of features after excavation was made possible by the detailed records made in the field. Information about individual excavation units was transcribed into unit level notes and maps and in the supervisors' daily logs. These provided the basic information--size, shape, and contents--for any post facto feature designations. For field-assigned features, other forms were added to the record: separate feature excavation notes and maps, and a feature summary form on which the salient descriptive information was to be condensed. In addition, photographs, carbon and soil sample records, and field specimen lists were kept.

A Summary Feature Record was made for each feature. The recorded information included a description of the feature, the reason it was defined as a feature, a plan view drawing of the defined surface, the profile drawing, top and bottom elevations, matrix description, collection procedures, and a list of soil, botanical, and other samples taken. Excavators' level records, site supervisors' notebooks, and Daily Site Summary forms often included additional information. Excavated materials from features were kept separate by feature and level and treated in the same manner as artifacts from unit levels (see Chapter 3). Data recorded in the field, along with the results of laboratory analyses of feature contents, including soil samples, botanical and faunal remains, and artifacts, are used in the classification, description, and analyses presented below.

Therefore, there was a large body of detailed description for each unit and each feature upon which to draw during analysis. However, there was one basic problem with this system which should be avoided in other projects: it was too cumbersome. Feature records were often redundant with the unit level record; two identical sets of maps were not uncommon. Feature level notes merely paraphrased information in unit level notes, and the feature summary forms re-stated the same information, but not concisely, and all of these were, of course, subject to the strengths and weaknesses of individual excavators and supervisors. The extra, but essentially redundant, forms and maps for features put a heavy time burden on excavators and supervisors and two solutions evolved. Either a supervisor might not assign a feature number, but note the presence of an important anomaly with which the laboratory analyst should deal, or <u>all</u> phenomena were treated as features. The last strategy proved the most useful for lab analysis, which was also under time constraints. It allowed us to gain a clearer picture of the site as a whole more quickly, and also to gain access to information on the computer (which was encoded by feature) without making a series of time-consuming amendments.

The cumbersome record system placed a smaller burden on the lab analyst than on the field excavators, but a very real one nonetheless. There were too many places to look for information: field notes and maps (for unit and feature levels) were stored together, but the supervisors' notes, feature summary forms, photo catalogs, artifact catalogs, the results of artifact analysis, including faunal and botanical assemblages, stratigraphic profiles, and radiocarbon redults each had their own notebook and were stored in different buildings at the project. A more streamlined approach to note-taking and record-storage is strongly recommended.

In general, however, despite the logistical problems, the descriptive record of cultural features on the project is very reliable. Having mastered the system, we next turned to the problem of sorting the features recorded into a logical, comparable classification.

ANALYSIS

In the laboratory, field-defined features were discarded, combined, or redefined as data were synthesized. The analytic definition of the term "feature" was critical in this process. For purposes of analysis, we defined feature as a quantitively isolated unit composed of one or more associated artifact classes and/or one or more types of nonrecoverable matrices (adapted from Binford 1972:145).

We did not include a boundary as a necessary element of this definition for several reasons. First, not all features identified at project sites include matrix distinct from the surrounding sediments. Some are simply associations of artifacts that stand out from the general artifact scatter at the site. Second, it is not always possible to identify the boundary of a given feature. While some boundaries involve distinct matrix discontinuities or close association of artifacts, as in a pile of rocks that touch each other, others are more diffuse, and any boundary we draw must be considered arbitrary. Furthermore, not all feature were excavated completely. When a feature extends into an adjoining, unexcavated unit, extrapolation of the boundary also must be considered arbitrary. In short, while features probably should be considered bounded units, we cannot always find or demonstrate their boundaries.

Our analysis went through several stages as different approaches were discussed, tried, modified, or jettisoned. At first, a purely paradigmatic classification was attempted which sought to sort objectively all features recorded in the field into comparable classes.

INITIAL PARADIGMATIC CLASSIFICATION

Attributes of features may include the shape, size, and boundary characteristics of the overall associations, as well as the nature of the contents and their spatial patterning. The feature classification presented below addresses these attributes.

Initial feature analysis involved a two-stage classification system; (1) a classification of features by structural attributes and (2) a classification of the material contents of features. The first classification was applied to all cultural features. The second classification was applied to the contents of those features that yielded sufficient amounts of materials to warrant additional treatment.

Structural Classification

The structural feature classification is shown in Table 11-1. The dimensions include the placement of the feature with respect to an occupation surface, the shape of the feature perimeter or boundary, the nature of the feature perimeter, and the gross internal characteristics of the feature contents.

Content Classification

For some purposes, the structured distinctions may be sufficient to characterize features. Further discrimination may be warranted, however, for features with content diversity. For example, Class 1111 (structured, subsurface features with structured contents and periphery) combines such functional types as human burials, housepits, ovens, and postmolds. Artifacts within each feature can be classified to allow finer distinctions. Intially, feature contents are broken down into material types. Each material type is classified according to abundance, condition with respect to burning, and dispersal or spread of the category within the feature (Table 11-2).

Dimension B, ABUNDANCE OF CONTENT, requires some discussion. Although it was relatively easy to determine when a material type was present, it was more difficult to define whether it was abundant. Some objective measurement had to be used if the classification were to be applied consistently. We propose the following density distinctions for 45-OK-288. For our purposes, abundant meant (1) 50 or more bone fragments per unit level (500/m^3); (2) 10 or more pieces of lithic debitage >1/4 in (64 mm) per unit level (100/m^3); (3) five or more fire-modified rocks per unit level (50/m^3); (4) one or more worn or manufactured objects per unit level (10/m^3).

We derived these figures from analysis of the contents of 375 1-m x 1-m x 10-cm unit levels at 45-OK-288. The unit levels ranged in depth from 0 to 240

Table 11-1. Dimensions of structural feature classification.

DIMENSION A: VERTICAL PLACEMENT OF FEATURE

1. **Subsurface**: the upper boundary originates from a real or extrapolated occupation surface, and the lower boundary lies below that surface (e.g., pits, depressions). Subsurface features may be as small as a postmold or as large as the depression of a "house" pit, which, itself, holds other features.

2. **Surface**: the upper and lower boundaries are essentially parallel to the plane of the occupation surface (e.g., planar, as in a scatter or sheet debris).

3. **Suprasurface**: the lower boundary is parallel with the occupation surface, while the upper boundary lies above it (e.g., pile, mound).

DIMENSION B: PERIMETER SHAPE

1. **Regular**: the perimeter has an orderly or symmetrical shape in one or more cross-sections (e.g., it is circular, ellipsoid, rectangular, U-shaped).

2. **Irregular**: the perimeter has no regular shape, is not uniform, orderly, or symmetrical in outline (e.g., the irregularly convoluted outline of a scatter).

3. **Unknown**: the perimeter shape cannot be discerned or so little is present that it cannot be characterized.

4. **Arbitrary**

DIMENSION C: PERIMETER BOUNDARY

1. **Structure**: the perimeter edge is bounded or marked by a matrix discontinuity or by an alignment of items in a class (e.g., a stack of rocks, a line of fired rock, an edge of a pit).

2. **Unstructured**: the edge is unbounded and appears unmarked by purposeful construction or action, unplanned (e.g., a scatter which gives out).

3. **Arbitrary**

DIMENSION D: CONTENT CHARACTERISTICS

1. **Structured**: the feature contents are unmixed, unordered; the spatial segregation of at least one constituent class can be seen (e.g., a layer of bone in a pit whose other contents are otherwise unstructured).

2. **Unstructured**: the contents are mixed in random fashion; there is no spatial or patterned segregation of any constituent class.

Table 11-2. Dimensions of feature content classification.

DIMENSION A: MATERIAL TYPE

1. **Lithic detritus**: >1/4-in lithic material that has not been analyzed functionally.
2. **Lithic artifact**: objects that exhibit evidence of wear and/or manufacture in functional analysis.
3. **Fire-modified rock**: any rock type altered by fire staining or cracking.
4. **Modified soil**: soil modified by heat or other artifical processes.
5. **Aquatic bone**: identified fish bone; bone of aquatic animals such as turtles.
6. **Terrestrial bone**: all bone that cannot be identified as aquatic bone.
7. **Bone object**: bone that exhibits evidence of wear and/or manufacture.
8. **Botanical**: charred and uncharred botanical materials.
9. **Shell**: Margaritifera falcata, Gonidea.
10. **Other**: includes historic items (e.g., glass, coins).

DIMENSION B: ABUNDANCE OF CONTENT

1. **Abundant**: the category occurs in quantity relative to amounts in unit levels at the site.
2. **Present**
3. **Absent**
4. **No Data**

DIMENSION C: CONDITION OF THE CONTENT

1. **Burned**: shows definite signs of burning.
2. **Unburned**: shows no evidence of burning.
3. **Mixed**: burned and unburned material present.
4. **Unknown**: not enough information for determination.

DIMENSION D: CONTENT DISPERSAL

1. **Patterned**: the category distribution indicates design or pattern (e.g., an alignment of rock, a cluster of bone, a layer of ash).
2. **Dispersed**: no pattern or design discernable (e.g., objects which appear scattered, dropped, blown, or otherwise casually accumulated).

cm below unit datum (b.u.d.) and included feature levels as well as nonfeature levels. In general, an item was abundant when it exceeded 2/3 to 3/4 of the cases. For instance, four or fewer fire-modified rocks occurred in 72% of the unit levels; therefore, we considered five abundant. Similarly, since 75% of the units had between one and 49 pieces of bone, 50 became the measure of abundance for bone.

We could not derive density measures for all material types. Soil, for instance, remained a difficult category to work with. In the following classification, modified soil was judged abundant if the excavator commented on major areas of staining, evidence of burning, and so on.

Discussion

The above classifications were used for roughly one-half of the analysis. We found this system awkward and unsatisfactory for reporting the project features, largely because it overdivided the features. This happened because the classification was applied to each individually numbered feature. This assumes that each feature number represents a single cultural entity, clearly an unwarranted assumption. Unless field-assigned features are combined into cultural features first (which is a subjective process) there is the distinct possibility that separate parts of a single feature (e.g., the edge and the center of a bone scatter, excavated in separate units) will be placed in different classes. Also strict interpretation of the boundary criteria resulted in many features being recorded as indeterminate, and thus not in functionally interpretable classes. Boundary information was not always available, either because it was not consistently recorded on the forms or because the feature extended beyond the excavation unit. Thus similarities between features of like function were masked, since variables of preservation or quality of excavation influenced the classes into which they were placed. Therefore, guided by our experience in applying the paradigmatic classification, we developed a more traditional functional classification of features.

It should be pointed out that the problems mentioned above are not inherent in the paradigmatic classification itself; rather, they arose from overly mechanistic application. To result in objective, functionally distinct classes of discrete cultural features, the classification must be applied to discrete cultural features, that is, it assumes that field-assigned features have already been reviewed and combined to form discrete cultural features. This general problem is encountered in any classification of features. Likewise, in any feature classification, the analyst must take into account the degree of preservation, particularly the effects of postdepositional disturbance to boundaries and internal patterning.

TRADITIONAL FUNCTIONAL CLASSIFICATION

Table 11-3 shows the functional classification which we devised after working with the Chief Joseph Dam Project material for many months. The list

Table 11-3. Traditional functional feature types.

Type	Structural Characteristics			Content Characteristics	
	Relationship to Surface of Origin	Boundary Shape	Boundary Abruptness	Contents	Internal Structure of Contents
Housepit					
Floor	Surface	Regular	Abrupt	Dense, diverse	Structured
Wall/rim	Subsurface	Regular	Abrupt	Sparse	Unstructured
Fill	Surface	Irregular	Abrupt to diffuse	Variable	Unstructured
Firepit					
Interior	Surface/subsurface	Regular	Abrupt	Predominantly FMR charcoal, ash	Structured
Exterior	Surface/subsurface	Regular	Abrupt	Predominantly FMR charcoal, ash	Structured
Pit					
Interior	Subsurface	Regular	Abrupt	Variable	May be structured
Exterior	Subsurface	Regular	Abrupt	Variable	May be structured
Posthole	Subsurface	Regular	Abrupt	Trash or remains of post	Unstructured
Exterior Occupation Surface	Surface	Irregular	Diffuse	Dense, diverse	Structured
Debris Concentration					
Bone Concentration	Surface	Irregular	Diffuse	Predominantly bone	Unstructured
Shell Concentration	Surface	Irregular	Diffuse	Predominantly shell	Unstructured
FMR Scatter	Surface	Irregular	Diffuse	Predominantly FMR	Unstructured
Mixed Debris Concentration	Surface	Irregular	Diffuse	Diverse	Unstructured
Stain	Surface	Irregular	Diffuse	Variable	Unstructured
Other					
Cultural Strata	Surface	Irregular	Diffuse	Dense, diverse	Unstructured
Artifact Cluster	Surface	Regular	Abrupt	Variable	Structured

reflects the variety of features recorded during the Project, and should allow easy comparison with other work on the Columbia Plateau.

Table 11-3 indicates general structural and content characteristics of each feature type (not necessarily definitive). Subsurface features, because they are necessarily constructed, have regular, abrupt boundaries. Firepits are listed as surface/subsurface because this category includes both surface features (hearths) and subsurface features (ovens). Housepits, considered as an entire feature, are subsurface, and the walls have been so designated. Housepit floors, however, we considered surfaces. Although they may have been below ground level, they were large enough to have been used as surfaces by people. At any rate, the housepit category includes surface houses as well. Surface houses, although not excavated, were also constructed and have abrupt, regular boundaries. Housepit fill is generally a geologic stratum filling in the housepit depression, but may be characterized by a specific type of cultural use. Housepit depressions at the project tended to be used for trash disposal or for shelter. However, if there was an occupation within housepit fill, it was classified as an occupation surface or the appropriate type of feature. Exterior occupation surfaces share most characteristics with house floors, except for the lack of abrupt and regular boundaries. Of course, this is a somewhat circular definition, as we generally interpret a living surface with a regularly shaped boundary as a house floor because we assume the spatial constraints are provided by a wall.

Debris concentrations are irregularly shaped surface features with diffuse boundaries and unstructured contents, differentiated by the nature of the contents. Some comment should be made here about the use of the terms concentration and scatter. We tended to use the words concentration and scatter interchangeably. This may seem contradictory at first glance, but it is not. **Concentration** signifies that some type of material is found in higher density within the feature than in the surrounding matrix, while **scatter** indicates that the contents are randomly distributed within the feature. Thus both words can be applied to the same feature, as long as the scale is specified. The contents of stains is indicated as variable, but commonly they have no contents, as the feature consists of the stained matrix itself.

Various problems were encountered in applying the functional classification. Occasionally features were so poorly preserved that they were classified on a "best-guess" basis. Eroded surface hearths may be seen as "FMR (fire-modified rock) scatters", while intact examples would be grouped with "Firepits." Or, a cultural feature may exhibit two distinct functions: For example, at 45-OK-250, evidence of in situ activity ("Exterior Living Surface") was often found within thick shell middens ("Shell Concentrations") or trash dumps ("Debris Concentrations") and could not be separated during analysis. In these grey areas, we sorted features to the class supported by the majority of evidence recovered under that feature number. The greatest weakness of this functional classification is that it is too broad: too many types of features have been grouped together. For example, the category "Firepits" includes prepared firepits, surface hearths or fires, and rock-lined earth ovens. We have gouped them into a single category because there are so few examples of each kind. In order to make phase-to-phase or regional comparisons, it is important to have group memberships as large as possible. The same caveat applies to "housepit," which includes deep and shallow pit structures, as well as surface structures, and to "concentrations" (bone, rock, or shell) which range from small and sparse to thick, extensive middens.

However, despite some weaknesses, this functional classification has strengths of comparability, comprehensibility, and flexibility. Features from sites previously analyzed were re-analyzed in this system.

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APPENDIX A:
LABCAT FORM

CHIEF JOSEPH DAM CULTURAL RESOURCES PROJECT / Laboratory Catalog

Site ______ Unit Datum ______ Page ____ / ____

[illegible]	UNIT N-S	UNIT E-W	LEVEL	FEATURE	COUNT	BONE #	BONE WT	SHELL #	SHELL WT	QUARTZITE CCR #	QUARTZITE CCR WT	BASALT CCR #	BASALT CCR WT	GRANITE CCR #	GRANITE CCR WT	OTHER CCR #	OTHER CCR WT	FIELD CATALOG NUMBER	LOCATION	DEPTH	ASSOC. FEATURE 1	ASSOC. FEATURE 2

Recorder ______ Date ______ Checked by ______ Date ______ Keypunched by ______ Date ______

KEY TO PROVENIENCE COLUMNS ON LABORATORY CATALOG FORM

Unit Code (Column 1)

Blank = Random
A = Arbitrary
S = Systematic

Volume (Column 2)

Blank = Regular 1.0 x 1.0 x 10 cm level or 1.0 x 1.0 x 5 cm level
N = Not excavated
X = Partially excavated
T = Entire level not screened (bulldozed levels coded this way)
S = Partial level not screened
I = Quad too large (whole Unit Level entries only)
H = Quad too large (partial Unit Level or Feature Level)
L = Lag deposit (no matrix)

Level Code (Column 3)
(A column was borrowed from the N/S coordinate when this code was added.)

Blank = UL* or FL* (10 cm)
R = UL or FL (5 cm)
Y = UL + FL (5 cm)
Z = UL + FL (10 cm)
W = FL + FL (5 cm)
X = FL + FL (10 cm)
E = FL + FL + UL (5 cm)
F = FL + FL + UL (10 cm)
V = FL + FL + FL (5 cm)
G = FL + FL + FL (10 cm)
K = FL + FL + FL + UL (5 cm)
J = FL + FL + FL + UL (10 cm)

*UL = Unit Level
FL = Feature Level

N/S (Column 4-6)

North/South coordinate of NW corner of 1.0 x 1.0 m quad

E/W (Column 7-10

East/West coordinate of NW corner of 1.0 x 1.0 m quad

Unit Level (Column 11-13)

Lower boundary of 10 or 5 cm level

998 = mixed levels; slumps and wall scrapings
1 = surface

APPENDIX B:
TECHNOLOGICAL ANALYSIS FORM AND KEYS

CHIEF JOSEPH DAM CULTURAL RESOURCE
PROJECT / Lithics Analysis

CODE	VOL.	UNIT N/S	UNIT E/W	UNIT LEVEL	FEATURE NUMBER	SPECIMEN NUMBER	OBJECT TYPE	MATERIAL	CONDITION	DORSAL TOPO	TREATMENT	NUMBER ≤1/4" FLAKES	WEIGHT	MAXIMUM LENGTH	MAXIMUM THICKNESS	MAXIMUM WIDTH	LOC.	DEPTH	
		5	10		15		20				25		30	35	40	45		50	55 60 65 70 75 80

Checked by________ Keypunched________ Analyst________ Date________

CLASSIFYING

Dimension I: Type of Object

First, look at ALL sides of the object for a ventral surface. If one ventral surface exists, then the object is a *non-tabular flake* regardless of its shape, size, or general morphology.
If the ventral side exists, find the direction of impact and follow to point of impact, indicating a proximal end is present. See next page for defining criteria of a proximal end.

1. Non-tabular flake: A chip of rock exhibiting more than one of the following characteristics: platform or proximal end, dorsal flake scars, bulb of percussion, conchoidal fracture, concentric rings.

2. Chunk: Defined as having at least two planes that are not flake scars and not of parent, weathered surface. Includes fire spalls and mudstone/siltstone objects. Most chunks are considered as complete under Condition.

3. Core: No one ventral surface; has at least two negative bulbs and platform preparation.

4. Blake-like: A non-tabular flake at least twice as long as it is wide and exhibiting fairly parallel sides and one or more parallel dorsal ridges. Take all possible measurements. Be liberal: this is a "flag" category.

5. Unmodified: Any object that was potentially used, but not deliberately manufactured. For example, cobbles, unshaped pestles, hammerstones, milling stones.

6. Tabular Flake: A flake split along a tabular bedding plane, exhibiting no conchoidal fracturing characteristics, and whose dorsal and ventral sides are then roughly parallel and indistinguishable one from the other. These are usually broken. Take a thickness measurement on all tabular flakes and any other possible complete measurement. Does not include bedded, probably non-cultural materials such as schists, flat chunks of mudstone, etc.

7. Formed Object: Any object whose original shape has been radically altered through manufacture, such as a projectile point, steep-ended scraper, bone awl,cobble chopper, etc. This is often a matter of judgement, so ask if in doubt. Quartzite knives are rarely formed objects. Utilized flakes (exhibiting no manufacture) are not formed objects. List description of all formed objects in the right-hand margin of the Lithan form. Take a weight and enter either "broken" or "complete" under condition. Take no measurements on formed objects. (Condition in formed objects refers to whether the object is broken or not, not the parent flake.) Also includes all groundstone objects, such as beads, formed pestles, etc.

8. Antique: An object that exhibits the characteristics of one of the above object types except that its edges are smoothed by weathering and/or transporting. Antiques will be weighed and the material type entered. Condition, dorsal cortex, and measurements are not applicable.

9. Indeterminate: Any object that cannot be resolved into another object type. All bone and shell that aren't formed objects are indeterminate. Don't take measurements except with Dentalium, for which a length is taken, along with the larger diameter for width and the smaller diameter for thickness.

Dimension II: Material type (definitions are given for inorganic materials)

1. Jasper: bedded, massive, opaque chalcedony with a pronounced conchoidal fracture giving sharp edges; wide range of color variation; texture can vary from very fine-grained to coarse-grained; differentiated here from chalcedony by opaqueness and from fine-grained quartzite by relative quartz crystal size.

2. Chalcedony: compact varieties of silica which comprise minute quartz crystals with submicroscopic pores; transparent to subtranslucent; colorless to red, yellow, brown, grey, green, and black; pronounced conchoidal fracture; defined here as a better grade raw material than chert; criteria demands at least some portion be translucent.

3. Coarse-grained quartzite: metamorphosed sandstone consisting of tightly interlocking grains of quartz; here, crystals must be visible macroscopically and fracture only very slightly conchoidal, if at all; often occurs in tabular form which may be quartzo-feldspathic schist; color white, grey, reddish; visible bedding.

4. Fine-grained quartzite: differentiated here from coarse-grained quartzite by microscopic crystal size and greater tendency toward conchoidal fracture, although not nearly so pronounced as chert; wide range of color.

5. Basalt: a fine-grained volcanic rock usually consisting mainly of plagioclase, pyroxene, olivine, and magnetite; phenocrysts of olivine, plagioclase, and pyroxene are common; recognized here as having macroscopically visible crystals; irregular to sub-conchoidal fracture.

6. Granite: a coarse- to very coarse-grained volcanic rock consisting mainly of feldspar plus at least 10% quartz; biotite and/or muscovite are usually present and hornblende may occur; very wide range of associated minerals; non-homogeneous structure; irregular fracture.

7. Fine-grained basalt: very fine-grained basalt in which minerals are visible microscopically; sub-conchoidal; one of the distinguishing characteristics is its potential for fine, controlled flaking; grey, dark blue-grey, black, green.

8. Petrified wood: plant fiber which has been impregnated with minerals, such as silica and calcite, and has recrystallized; original plant characteristics readily visible; fracture varies from laminar (parallel to annular rings) to conchoidal, depending on the degree of petrification.

9. Obsidian: siliceous glass with very rare phenocrysts of quartz and feldspar; very pronounced conchoidal fracture; color varies from green to grey to red to black; often banded.

10. Bone/antler.

11. Ocher: Iron oxide, dull and earthy, reddish color, soft and friable, red streak.

12. Shell.

13. Textiles.

14. Sandstone: medium-grained, usually well-sorted quartz grains cemented by silica, calcite, or iron oxides; may include olivine, rutile, magnetite, and other minerals; color highly variable.

15. Nephrite: an actinolitic or tremolitic amphibole; vitreous luster; hardness 5-6; massive to fibrous habit; specific gravity 3.0-3.4; light green to dark green in color.

16. Siltstone/mudstone: compacted silts (0.06-0.004 mm) and clays (<0.004 mm) with massive or laminated structure; easily scratched; color varies greatly, although tans and greys commonly occur at the project.

17. Pumice: highly vesicular variety of rhyolite; fine-grained with occasional inclusions of larger grains; low specific gravity; frothy appearance; highly abrasive; usually light-colored.

18. Steatite: a massive variety of talc also known as soapstone; extremely soft; color varies from white to pale/dark green; soapy feel.

19. Mica: potassium alumino-silicate characteristic of alkali granite; perfect basal cleavage; cleavage flakes flexible and elastic; colorless to pale grey, green, or brown; translucent to transparent.

20. Silicized mudstone: an apparent variety of mudstone/siltstone that is much harder and displays a subconcholdal fracture; coarser-grained than chert, chalcedony, or argillite; tan to grey in color.

21. Schist: a coarse-grained metamorphic rock with marked layering defined by platy or elongate mineral layering, often finely interleaved with quartz and feldspar.

22. Calcite: crystalline calcium carbonate; perfect rhombohedral cleavage; transparent to translucent; usually colorless or white, although many other colors occur.

23. Shale: finely bedded, laminated mudstone; black to dark grey in color.

24. Porphyritic volcanic: medium-grained volcanic rock of granitic composition containing embedded phenocrysts; better flaking properties than coarser-grained granites and diorites.

25. Porphyritic microdiorite: a medium-grained, intrusive igneous rock of dioritic composition; the greenish-hued groundmass is embedded with larger crystals of hornblende and feldspar phenocrysts that are visible to the unaided eye.

26. Fossilized bark: petrified wood with a visible bark structure.

27. Wood.

28. Quartz: crystalline silica; transparent to translucent; vitreous luster; conchoidal fracture; no cleavage; commonly colorless or white, but the range of color is very wide.

29. Felsite: a textural variety of the granite-granodiorite family composed entirely of apahanitic rock (a uniform, fine-grained texture in which individual crystals are not visible to the unaided eye); composed of quartz and potash feldspar, with or without sodic plagioclase as a separate phase.

30. Argillite: very fine-grained metamorphosed mudstone with laminar fracture; color ranges from grey to brown to black, waxy luster.

31. Gneiss: a coarse-grained rock composed largely of quartz and feldspar, but with a marked, although often irregular, layered structure.

32. Diorite: a coarse-grained rock composed of plagioclase (oligoclase or andesine) and hornblende, although other minerals may also be present; equigranular or porphyritic texture; commonly speckled black and white.

33. Feldspar: coarse-grained sodium, potassium, calcium, or barium alumino-silicate minerals; common constituent of granite and metamorphosed rocks.

34. Dentalium (shell).

35. Graphite/molybdenite: graphite is one of several structural forms of carbon; hardness 1-2; perfect basal cleavage; dull metallic luster; black streak. Molybdenite is also black and soft, with a metallic luster.

36. Olivella (shell).

37. Glass.

38. Scoria: a medium-grained variety of basalt with readily visible vesicles.

39. Very fine-grained red sandstone: a distinctive variety of sandstone found in project assemblages, characterized by fine texture and red color.

40. Opal: hydrous silica, amorphous structure, greasy luster, light color, conchoidal fracture.

41. Rhyolite: fine-grained silicic volcanic rock, light colored.

99. Indeterminate.

Dimension III: Condition (Technological)

1. Not broken. Three measurements (length, width, thickness) are available which reflect the original dimensions of the object.

2. Proximal Fragment. Any non-tabular flake that retains all or most of its proximal (point of impact/pressure) end, but has all or a portion of its distal end broken off. See 3 below. Take all available measurements.
3. Proximal flake- distal step fracture. Any proximal flake which exhibits a step (squared) or snap break on the distal end which could be attributed to either breakage or to technology; take all three measurements.

6. Less than 1/4" flakes (but greater than 1/8")

7. Less than 1/8" flakes Count and record on lab comment forms. Do not record onto computer form.

8. Broken. No proximal end present, broken formed tools, etc.

9. Indeterminate

Dimension IV: Dorsal Topography

Cortex is defined as the surface of the parent rock. Caution should be exerted (to a certain extent) when defining cortex as many times an inclusive band of coarser grained material can be found in cherts and chalcedonies.

1. No cortex.
2. Partial cortex.
3. Complete cortex.

9. Indeterminate or Not Applicable. (includes bone and shell)

Dimension V: Material Condition (Treatment)

2. Definitely burned.

4. Possibly heat-treated (dehydrated opal only at this time)

METRICAL ATTRIBUTES

Weight:

Each specimen is weighed on an electronic balance to the nearest .1 gram (tenth of a gram). If an object is too light to register, record as 1. Less than 1/4" flakes are weighed as a group.

If the weight of an object exceeds the number of available columns on the computer form, divide the weight by 10 (or 100 or whatever) and enter that new number onto the form in the weight column. Place a "D" (deviant) code in column 80 on the computer form and write a note in the margin to multiply the weight by whatever your divisor was. Underscore the "D" code with red ink.

Measurements:

With the exception of formed tools, for which no measurements are taken at this time, record every complete measurement that is possible to take.

Complete objects should have all three (length, width, thickness) taken. Proximal and broken flakes are case by base although usually at least a thickness measurement is available.

Chunks and cores: take the longest measurable dimension as length, the longest planar perpendicular to that is the width, and the perpendicular to that (on the same plane) in the thickness. Same applies for unmodified objects.

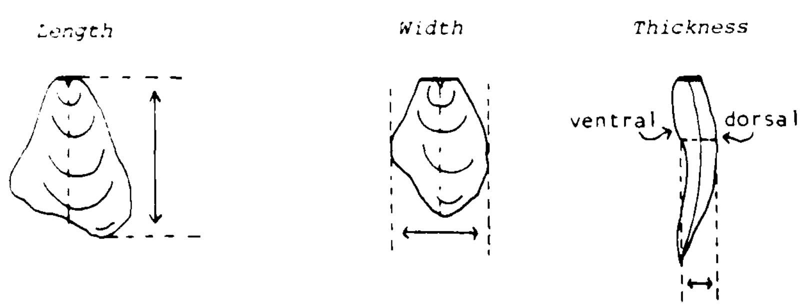
Tabular objects should always have a thickness taken at the very least.

Length: Round to the nearest millimeter. On a flake measure from the point of impact through the distal end, paralleling the bulbar axis.

Width: Round to the nearest millimeter. On a flake, measure the widest point perpendicular to the length measurement.

Thickness: Measure to the nearest tenth of a millimeter. Thickness on a flake is measured just below the bulb, or at the thickest point on the flake, excluding the bulb and the striking platform.

Measurements are meaningless on objects which are coded "Indeterminate" in either Object Type or Condition category. Don't take any on these.



Defining characteristics: proximal flake

One or more of the following must be present:

1) Striking platform with preparation.

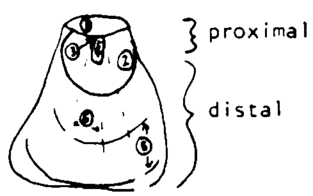
2) Striking platform without preparation, but with at least one of the following:
   a. bulb of percussion
   b. point of impact or pressure
   c. eraillure scar

3) Complete bulb and supporting concentric rings.

4) Any combination of two or more below:
   a. dorsal preparation*
   b. point of impact or pressure
   c. eraillure scar
   d. complete or almost-complete bulb of percussion

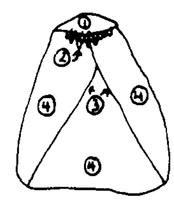
*- preparation on dorsal surface can include "chewing" of the platform area, which does not technically extend to the dorsal surface

VENTRAL SURFACE OF NON-TABULAR FLAKE



1. striking platform remnant
2. bulb of percussion
3. point of impact/pressure
4. eraillure scar
5. conchoidal rings (undulations)
6. stress lines (lances)

DORSAL SURFACE OF NON-TABULAR FLAKE



1. striking platform remnant
2. platform preparation
3. dorsal ridges
4. dorsal flake scars

COMPARISON OF LITHAN PROCEDURES

Table B-1. Selection criteria for full analysis of individual objects in different LITHAN procedures.

Object Type	LITHAN	LITHAN AB	LITHAN X	LITHAN AB-R
1 Conchoidal flake	A	C	F	W
2 Chunk	A	C	F	W
3 Core	A	A	F	A
4 Blade-like flake	A	C	F	A
5 Unmodified	A	A	F	W
6 Tabular flake	A	A	F	W
7 Formed object	A	A	A	A
8 Antique	A	A	F	N
9 Indeterminate	A	A	F	W

A = All objects of this type received full analysis.
W = Objects of this type analyzed if worn or manufactured.
C = Objects of this type analyzed if cortex, wear, or manufacture present, or if field catalogued.
N = No objects of this type analyzed.
F = Objects of this type analyzed if worn, manufactured or if field catalogued.

ADDITIONAL INFORMATION ON LITHAN AB

Chunks: Chunks without cortex were divided by material. A count was recorded for each material group. The object type, material, and dorsal topography columns were recorded as usual, treatment = blank, and condition = X. No measurements were taken.

Flakes: Flakes with cortex, wear, or manufacture, or which were field catalogued, received full analysis. All other flakes were divided by material types. For broken flakes, a count was recorded for each material group. The object type, material, and dorsal topography were recorded as usual, treatment = blank, and condition = B. Measurable flakes were grouped into 5 mm increments (0-5, 6-10, 11-15, etc.). A count was entered for each material and length group. The object type, material, and dorsal topography were recorded as usual, treatment = blank, and condition = A. The upper end of the length increment (0-5=5, 6-10=10, etc.) was entered into the length column.

ADDITIONAL INFORMATION ON LITHAN X

All objects which did not receive individual analysis were grouped by object type and material. For each group, the object type and material were recorded as usual, condition = X, dorsal topography = blank, and treatment = blank, and the total count and total weight were recorded.

If unmodified objects were definitely unworn, they were not recorded on the LITHAN form, but discarded or left in the bag unanalyzed.

ADDITIONAL INFORMATION ON LITHAN AB-R

Chunks: Chunks without cortex were divided by material and dorsal topography. A count was recorded for each material group. The object type, material, and dorsal topography columns were recorded as usual, treatment = blank, and condition = X. No measurements were taken.

Concholdal flakes: treated as in LITHAN AB except that field catalogued items did not receive full analysis unless also worn or manufactured.

Unmodified: Unmodified objects which were not worn were not analyzed (under the assumption that objects both unworn and unmodified were non-cultural). Most of these objects were kept in the bags; some were discarded.

Tabular Flakes: Retouched or worn tabular flakes received full analysis. The non W/M tabular flakes were grouped by material and cortex. Condition was recorded as X.

Antiques: Antiques were not pulled for functional analysis and were not technologically analyzed. They were left in the bag unanalyzed.

Indeterminates: If the object was worn or manufactured it received full analysis as an indeterminate object type. If the object was not worn or manufactured it was left in the bag unanalyzed.

Blades: Object type 4 (linear flake) was not coded during technological analysis. Blades and microblades were pulled for functional analysis, and given full technological analysis, but were coded as concholdal flakes (object type = 1). Later, if the object was functionally classified as a blade or microblade, the object type was changed to a 4 in the LITHAN file.

Field Catalogued Items: These were given full analysis only if worn or manufactured; location and depth were recorded. If the item was not worn or manufactured it was put into its appropriate technological grouping, and its point provenience was not recorded on the LITHAN form. Unworn F.N.'s remained in their bags.

Siltstone: Siltstone objects which appeared to be modified received full analysis as chunks. Unmodified siltstone was not recorded in the technological analysis; the objects remained in the "unworn lithics" bags.

Millingstones: Worn or manufactured millingstones received full technological analysis; unmodified ones were not recorded in technological analysis.

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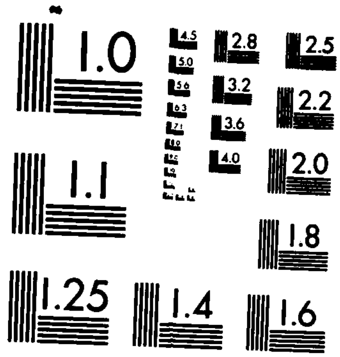


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Table B-2. LITHAN procedure used by site.

Site	LITHAN		LITHAN AB	LITHAN X	LITHAN AB-R
	# Units	Variant			
45-DO-204	All	No formed object code	-	-	-
45-DO-211	All	Material types 1-38	-	-	-
45-DO-214	All	No formed object code material types 1-12	-	-	-
45-DO-242	21	Object type 4 changed from slab to blade-like flake during analysis, material types 33-41 added during analysis	7 units	-	-
45-DO-243	All	Material types 38-41 added during analysis	-	-	-
45-DO-273	All	Material types 38-40 added during analysis	-	-	-
45-DO-282	All NW quads	-	-	All other quads	-
45-DO-285	All	Object type 4 changed from slab to blade-like flake during analysis, material types 33-38 added during analysis	-	-	-
45-DO-326	20	Material types 1-37	-	-	15 units
	1	Material types 1-38	-	-	-
45-OK-2	3	-	149 units	-	-
45-OK-2A	-	-	All	-	-
45-OK-4	-	-	-	-	All
45-OK-11	35	Before standard full analysis	20 units	-	53 units
	33	Standard full analysis	-	-	-
45-OK-18	All	Object type 4 = slab material types 1-15	-	-	-
45-OK-250	13	-	52 units	-	-
45-OK-258	38	Object type 4 = slab material types 1-19	16 units	-	-
	67	Material types 19-41 added during analysis, object type 4 changed from slab to blade-like during analysis	-	-	-
45-OK-287	All	-	-	-	-
45-OK-288	All	-	-	-	-

APPENDIX C:
FUNCTIONAL ANALYSIS FORM AND KEYS

CHIEF JOSEPH DAM CULTURAL RESOURCES PROJECT: Functional Analysis

Site ________ Unit ________ Page ________

CODE	UNIT N-S	UNIT E-W	LEVEL	FEA #	FIELD NUMBER	WEAR/MANU	MANU TYPE	MANU DISPO.	TOOL 1	TOOL 2	TOOL 3	TOOL 4	TOOL 5	TOOL 6	COMM.	ASSOCIATED FEA.	
									C R	C R	C R	C R	C R	C R			
	5			15			20		25	30 35	40 45	50	55 60	65	70	75	80

Keypunched by ________ Date ________ Checked by ________ Analyst ________ Date ________

CHIEF JOSEPH DAM CULTURAL RESOURCES PROJECT

Functional Classification

Following is an explanation of the object specific and the tool specific dimensions utilized in the functional classification of worn and/or manufactured objects on the Chief Joseph Dam Cultural Resources Project.

THE OBJECT SPECIFIC DIMENSIONS

DIMENSION I: Utilization/Modification

This dimension is used to describe the overall disposition of all bone, stone, and shell objects pulled as worn and/or manufactured during the functional sorting. For the purposes of this classification, *manufacture* is defined as the deliberate modification of an object such that the original shape or size is altered. No differentiation is made in the dimension between retouch and more extensive manufacture. Wear (*utilization*) is defined here as the non-deliberate manifestation of a reductive activity on the edge or surface of an object.

Empirically, there is no distinction between wear and manufacure, as both manifest themselves similarly on objects (chipping, abrasion, etc.). Generally, however, manufacture is expected to result in more extensive reduction, and analysts are required to make consistent judgments when differentiating between the two.

0. None.
1. Wear only. Utilization is present with no evidence of manufacture (e.g., polishing on the end of a long bone shaft; chipping along the edge of a flake).
2. Manufacture only. Obvious modification is present, but there are no visible signs of utilization. These objects are not described in the tool specific dimensions.
3. Manufacture + wear.
4. Modified/Indeterminate. Obvious modification is visible, but wear cannot be discerned from manufacture. The area in question is classified in the tool specific dimensions (e.g., shaft abrader).
9. Indeterminate. Reserved for specimens which have been sorted out from the unworn objects, but which are not resolvable into definite wear or manufacture.

DIMENSION II: Type of Manufacture

This dimension is used to describe the process(es) by which an object was purposefully modified.

0. None.
1. Chipping. Removal of a portion of an edge by percussion or pressure resulting in a negative scar on the parent object and a flake.
2. Pecking. Reduction of a surface by percussion resulting in a pitted surface. [same process as crushing wear]
3. Grinding. Reduction of a surface by abrasion resulting in a smooth or striated surface.

4. 1 + 2.
5. 1 + 3.
6. 2 + 3.
7. 1 + 2 + 3.
9. Not Applicable/Indeterminate.

DIMENSION III: Manufacture Disposition.

This dimension relates information concerning the degree of manufacture on the object.

0. None.
1. Partial. Manufacture does not totally cover all surfaces.
2. Total. Manufacture covers all surfaces such that the original shape is indeterminate.
9. Not Applicable/Indeterminate.

THE TOOL SPECIFIC DIMENSIONS

CONDITION OF WEAR (C)

This dimension describes the completeness of each tool on each object without regard to the condition of the parent tool object. Complete tools do occur on broken objects. Broken tools cannot occur on complete objects.

1. Complete.
2. Partial.

WEAR/MANUFACTURE RELATIONSHIP (R)

This dimension desc-ibes the position of a tool on an object in relation to the position of manufacturing. The drawings help to illustrate. Tool area is shaded. Manufactured area is clear.

1. Independent. The tool appears to have no apparent relationship to any area of manufacture.

2. Overlapping - Total. The tool area is completely contained within a manufactured area.

3. Overlapping - Partial. The tool area is partially contained within a manufactured area, but a portion of the tool extends to an area of the object which displays no manufacture.

4. Independent - Opposite. The tool area is directly opposite an area of manufacturing.

9. Not Applicable/Indeterminate.

The Functional Paradigm

DIMENSION I: Kind of Wear

This dimension describes the physical manifestation of utilization. Definitions for the basic types (chipping, etc.) can be found in Dimension II in the Object Specific Dimensions.

Allomorphic variation due to variability in material and duration of use (e.g., extensive use of an edge may result in chipping and smoothing rather than just chipping) is accounted for. Chipping wear is subdivided into two categories, feathered and hinged, because this information is potentially useful for distinguishing cutting from scraping and/or use on a hard from use on a soft surface. If feathering and hinging co-occur, "hinging" will be coded after its percentage of occurrence reaches 20%. "Feathered" will be coded if hinging is less than 20%.

Because "wear" can be caused by phenomena other than human utilization (weathering, breakage), minimum criteria have been set for each mode within this dimension for the purpose of consistency.

A. Abrasion/Grinding. Striations must be visible. Minimum criteria: at least three striations in close proximity.

B. Smoothing. Reduction which results in an edge being smooth to the touch, but on which there are no visible striations or gloss. Occurs with chipping wear and alone on hard materials (basalt). Minimum criteria: one "non-smoothed" edge must appear on object which is not a fresh break.

C. Crushing/Pecking. Minimum criteria: at least three pits on surface in close proximity; on edge, crushed crystals must be visible and crushing should be in association with chipping.

D. Polishing. Reduction which results in an area of high gloss, but no visible striations. Minimum criteria: object must exhibit similar edges or surfaces which are not polished.

[Minimum criteria for chipping wear: at least three overlapping flake scars; wear near striking platform on dorsal surface must extend to a lateral edge.]

F. Feathered Chipping.

G. Feathered Chipping + Abrasion.

H. Feathered Chipping + Smoothing.

I. Feathered Chipping + Crushing.

J. Feathered Chipping + Polishing.

M. Hinged Chipping.

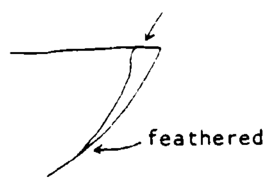
N. Hinged Chipping + Abrasion.

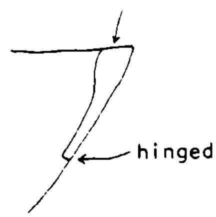
Ø. Hinged Chipping + Smoothing.

P. Hinged Chipping + Crushing.

Q. Hinged Chipping + Polishing.

Z. None.





DIMENSION II: Location of Wear

This dimension describes the location of the tool on the object.

1. Edge only. Wear occurs only on a single edge formed by the intersection of two planes.

2. Unifacial edge. Wear extends from an edge onto the surface of one of the two intersecting planes.

3. Bifacial edge. Wear extends from an edge onto the surfaces of both intersecting planes.

4. Point only. Wear occurs only at the juncture of three or more planes; planes must intersect to form an angle of less than 90°.

5. 4 + 2.

6. 4 + 3.

7. 4 + (2 or 3) + (2 or 3) [+(2 or 3)].

8. Non-terminal surface. Wear occurs on an area which does not intersect an edge and which cannot be defined as a terminal surface.

9. Terminal surface. Wear occurs on an area which does not intersect an edge and which forms a termination for the object.

DIMENSION III: Shape of Worn Area

This dimension describes the shape of the tool in relation to the object. The plan configuration of the wear, not the object, is described. Consistent judgments must be made concerning the degrees of convexity and concavity.

0. Not applicable.

1. Abruptly convex.

2. Abruptly concave.

3. Straight.

4. Point.

5. Notch.

6. Slightly convex.

7. Slightly concave.

8. Irregular. The overall shape of the worn area cannot be resolved into either conves, straight, or concave.

DIMENSION IV: Orientation of Wear

This dimension describes the relationship of the direction of the wear manifestation to the object edge or surface, and should be a direct reflection of the direction of use.

0. None.

1. Parallel. This mode is specific to abrasion. Striae must be roughly parallel (less than 30° angles) to each other if on a surface, and to each other *and* the edge if on an edge.

2. Oblique. On an edge, chipping and/or abrasion intersect the edge at an angle of greater that 30° and less than 60°.

3. Perpendicular. On an edge, chipping and/or abrasion intersect the edge at an angle of greater that 60° but not greater than 90° Crushing wear on a surface is considered to be perpendicularly oriented.

4. Diffuse. Multi-directional.

9. Indeterminate.

DIMENSION V: Object Edge Angle

This dimension relates the actual angle of the edge taken perpendicular to the plane view. This dimension should characterize the pre-worn edge angle (the angle of intended use) as opposed to the local edge arising from wear. The actual angle of the edge is measured.

00. None/ Not Applicable. This mode should be used to code wear on surface.

99. Indeterminate.

In all cases, in all dimensions within the functional paradigm, the "Indeterminate" mode is used when an area of wear is too fragmentary to classify.

APPENDIX D:
TRADITIONAL DESCRIPTORS

CHIEF JOSEPH DAM CULTURAL RESOURCES PROJECT
TRADITIONAL DESCRIPTORS

An * indicates codes added later and used only at 45-OK-4, 45-OK-11, 45-OK-250, 45-DO-214, and 45-DO-326.

CATEGORY	CODE
Utilized Flake/Chunk	UTL
Unifacially Retouched Flake	URT
Bifacially Retouched Flake	BRT
Resharpening Flake	RES
Amorphously Flaked Object	AMØ
Burin Spall	BSP
Biface	BIF
Projectile Point, Whole	PPT
Projectile Point, Base	BAS
Projectile Point, Tip	TIP
Blade	BLA
Microblade	MIC
Flake Off of Blade Core	FBC
Blade Core	MIB*
Drill	DRI
Graver	GRA
Burin	BUR
Scraper	SCR
Spokeshave	SPØ
Core	CØR
Tabular Knife	TKN
Hammerstone	HAM
Maul	MAU
Pestle	PES
Edge Ground Cobble	EDG
Netsinker/Net weight	NES
Chopper	CHØ
Peripherally Flaked Cobble	PFC
Amorphously Flaked Cobble	AFC
Milling Stone	MIL
Hopper Mortar	HØP
Anvil Stone	ANV
Shaft Abrader	SHA
Paint Stone	PAI
Adze	ADZ
Pipe	PIP
Bead	BEA
Shaped/Incised Siltstone	SIL*
Dentalium	DEN

Olivella	ØLI
Marginella	MAR
Mussel	MUS
Rolled Copper	RCØ
Copper Needle/Pin	CØN
Other Copper	CØP
Indeterminate	IND
Composite Harpoon, Valve	TØG
Composite Harpoon Head (Alternate code for above)	CHV*
Composite Harpoon, Valved Point	CHP*
Barbed Harpoon Point	BHP
Harpoon Point	PØI
Unbarbed Harpoon Unipoint (Alternate code for above)	UUP*
Hook/Leister Barb Unipoint	LUB*
Round Cross-section Bipoint	RSB*
Flat Cross-section Bipoint	FSP*
Needle	NEE
Shuttle	SHU
Awl	AWL
Chisel/Adze	CHI*
Wedge	WED
Antler Flaker/Billet	BLT
Handle	HAN
Bone Bead/Bead Blank	BED*
Pendant, Bone	PEN
Other Formed Bone Object	UFØ
Articular End, Metapodial or Longbone Shaft	PRX*
Articular End, Other Element	PRØ*
Pointed Bone Fragment	PBF
Edged End	EDE*
Squared/Rounded End	SRE*
Blunted End	BES*
Formed Shaft Fragment, No Formed Ends	SHB*
Flaked Long Bone Shaft	FLB
Other Formed Bone Fragment	BTR*
Bone, Technologically Modified Only	TMØ*
Bone, Utilized Fragment	UTB*

OBJECT DEFINITIONS

CATEGORY CODE	OBJECT TYPE	DESCRIPTION
FLAKES		
UTL	Utilized Flake	Flake, chunk, or flake fragment that shows utilization (wear) along the edges, but is otherwise unmodified.
URT	Unifacially Retouched Flake	Flake or chunk that shows retouch along the edge of one surface. Retouch is defined as scars of purposefully removed flakes, larger than scars left by utilization but smaller than flakes removed to thin the center of the object. An object thinned a significant amount should have been called a Uniface if such a category existed. Therefore some objects in URT might be more appropriately classified as Unifaces.
BRT	Bifacially Retouched Flake	Flake or chunk that shows retouch along both sides of an edge. Retouch is defined as above under URT. *When the piece is very small (i.e.,* only the very edge of something bifacially worked), it may be called BRT. When a piece is very small, it is difficult to determine whether it is a BRT or a BIF (Biface). If we can see a remnant of the original flake surface, then we label it BRT. If the flake scars are large, and are believed to have thinned the object, then we label it BIF.
RES	Resharpening Flake	A flake taken off the edge of a biface, BRT, URT, or UTL. The platform of a resharpening flake is a small section of the edge of the original object. Resharpening flakes are pulled for functional analysis if they are worn or if they are a large section of a biface. This judgement was not made consistently.
AMØ	Amorphously Flaked Objects	Objects with scattered flake scars. They don't fit into a definite category but are definitely modified.
BSP	Burin Spall	A nonutilized burin. The category may also include "possible" burins, if wear in the right spot confirms that the object is a burin. The long axis of the "flake/spall" is parallel to

		the edge of the flake from which it has been removed. Spalls from bifaces have two worked planes on the dorsal surface and one smooth plane on the ventral surface; together they form a triangular cross section. Burin spalls could also be removed from unifaces, URT, BRT, or UTL. Those from bifaces or BRT are most common. See also Burin.
POINTS		
BIF	Bifaces	All or a section of a bifacially worked object. A biface is distinguished from a bifacially retouched flake by the size and extent of the flake scars. A biface has large flakes that thin the surface. It might also have several "layers" of working unlike the BRT which has only a single "layer." Some objects coded as bifaces may be sections of projectile points, but if we're uncertain we mark Biface. A biface is distinguished from a projectile point by shape: it is broader and does not have shaped stems. Again, when uncertain, we use the Biface category rather than Point.
PPT	Projectile Point	A whole or almost whole point.
BAS	Projectile Point Base	All or most of a base.
TIP	Projectile Point Tip	Tip of a projectile point, as opposed to that of a biface. Broadness of tip is used to distinguish between the two -- projectile points are thinner, bifaces broader. The tip of a biface = BIF.
BLADES		
BLA	Blade	Parallel-sided flake with one or two parallel arrises down the center. The flake is approximately twice as long as it is wide and is more than 1 cm wide.
MIC	Microblade	Parallel-sided flake with one or two parallel arrises down the center. The flake is approximately twice as long as it is wide and is less than 1 cm wide. If only the proximal end is available, the length criterion is not used. The dorsal side should show that the flakes removed in order to form the arrises were taken from the same platform as the microblade.

FBC	Flake from a Blade Core	Flakes with the platform and arrises that indicate preparation for the removal of a microblade.

DRILLS

DRI	Drill	Objects in the drill category include shaped (worked) drills and objects utilized in a drilling fashion. Shaped drills range from totally manufactured objects to those with only the drill bit shaped. The manufacture that produces the tip is usually bifacial. Utilized drills have three planes that converge at a point, and they have wear (utilization) on at least two of the three edges. The wear is either unifacial or bifacial. Unifacial wear often shows the direction of use--clockwise or counterclockwise.

GRAVERS

GRA	Graver	Objects in the Graver category include shaped (worked) gravers and objects utilized in a graving fashion. Shaped gravers range from totally manufactured objects to those with only the graver bit shaped. The manufacture which produces the tip is usually unifacial, leaving a flat plane on one side, with unifacial working originating at the flat plane. Utilized gravers have two to three planes that converge at a point or chisel shaped edge. The utilization on a graver is usually unifacial on two edges, both with the wear "up." Often there is an impact scar on the tip.
BUR	Burin	A burin is triangular in cross section. The long axis of the flake is parallel with the edge of the biface, uniface, BRT, URT, or UTL from which it has been removed. Burins from bifaces have two worked planes and one flaked ventral surface. To be classified as a burin, the object must be utilized at one end (wear on the edge from which it was removed does not count). If not worn, it is called a burin spall and bagged with flakes. See also Burin Spall (BSP).

SCRAPERS

SCR	Scraper	Flake with steep edged, unifacial working that forms a convex edge. The manufacture must significantly alter the shape of the original flake, with most of the edge of one surface

being worked. (i.e., it is not just a retouched flake).

SPØ	Spokeshave	Object with deeply concave, entirely retouched edge. Utilization results in an abundance of hinged wear flakes.

CORES

CØR	Core	What remains of a cobble after a lithic reduction sequence. Ideally, a core should have a prepared platform with at least two flake scars removed from it. Cores without prepared platforms occur, but all must show two or more flake scars. The scars should also be large enough that the flakes removed could actually be used for something (this criterion is often used to distinguish between a core and an object with unifacial retouch on a steep angled edge). There are some instances, however, when core-like objects are not pulled; as when an object shows random or sporadic flaking but no two flakes come off the same platform (sometimes opal does this--thus imitating a core).

KNIVES

TKN	Tabular Knife	A thin plane, usually of quartzite, but sometimes of other tabular or laminar material. The edges are retouched. We take retouch as the minimum criterion for pulling tabular knives. Wear on tabular knives is classified as smoothing only because quartzite doesn't produce flaking. An edge that is smooth but shows no retouch must be very smooth for the object to be pulled for functional analysis. Tabular knives showing extensive retouch may be pulled for manufacture only.

HAMMERSTONES

HAM	Hammerstone	Most hammerstones are hand-size cobbles that are unmodified, but utilized. Utilization takes the form of crushing/pecking wear, usually on a terminal surface (the end, the edge). Some hammerstones have some modification; some have flaking on the end opposite the wear for a hand hold. On others, the utilized end has been shaped but is still blunt (vs. a chopper, which has a sharper edge). Not all objects called hammerstones are hand-size. Some of the larger cobbles have pecking/crushing wear on a terminal surface with no manufacture and must be gripped and by

two hands and require strong arms. These are also called hammerstones.

MAULS/PESTLES

MAU	Maul	Both are large heavy stones used for grinding or crushing. These two categories are sometimes hard to distinguish. In general, mauls have "rougher" working--mostly large flakes; pestles have the rough edges pecked and ground down. The working end of a maul is larger than that of a pestle. Overall, a maul is cone- or pear-shaped, and a pestle generally cylindrical, but tapering toward both ends with a bulge in the center. It is sometimes easier to classify wear on a maul because there is a distinct difference between the rough edges and the extremely battered end. Wear on a pestle is sometimes difficult to classify--the grinding use is almost impossible to distinguish from grinding manufacture.
PES	Pestle	

EDGE-GROUND COBBLES

EDG	Edge-Ground Cobble	Flat, round cobbles with continuous grinding around the perimeter. These differ from hammerstones in that they often have bevelled edges, while hammerstones have distinct flat areas of wear. Their use is unknown.

FLAKED COBBLES

CHØ	Chopper	Cobble, usually made of quartzite or basalt but also sometimes of chert, with flakes removed to form a large, fairly steep angled edge. Ideally the edge is sharp enough to "cut," unlike the blunt end or edge of a hammerstone, which would only crush the material being worked on. Wear on the edge of a chopper usually manifests itself in crushing, hinged fractures, and sometimes with prolonged use, a pecked effect.
PFC	Peripherally Flaked Cobble	Large cobble with the edges removed. It must have parallel flakes taken off its edges. Box-like.
AFC	Amorphously Flaked Cobble	Cobble with flakes removed that doesn't fit into the Chopper category. Some AFCs have only one flake removed; some have flakes removed that seem randomly struck. Many do not exhibit wear, as the type of wear present often helps to put an object into a more specific class.

MILLING STONES

MIL	Milling Stone	Large cobble or rock with wear and/or manufacture present. MIL is used for those with manufacture only or those which are worn on a flat or indeterminate shaped surface.
HØP	Hopper Mortar	Used when the area of wear is concave.
ANV	Anvil Stone	Used when the area of wear is convex.

SHAFT ABRADERS

SHA	Shaft Abrader	Object usually made of a coarse, abrasive material (pumice, sandstone). It has a groove down the long axis surface. Whether the groove results from wear or from manufacture is hard to determine. Shaft abraders sometimes occur in pairs (to be used on top and bottom of object being abraded).

PAINT STONES

PAI	Paint Stone	Thin, flat rock with a smooth area in center of one surface. Rare.

ADZES

ADZ	Adze	Large piece of stone that has been worked over its entire surface until it is wedge shaped in cross section and the surface is ground and smooth. (All recorded have been nephrite.)

PIPES

PIP	Pipe	Stone pipe or pipe fragment.

BEADS

BEA	Bead	Small round/roundish disc of stone, shell, or bone with a hole in the center for stringing. Long tubular sections of bone that may also be considered "beads" have been bagged with bone (classified as IND). Because wear vs. manufacture is usually difficult to determine, beads have been systematically coded as "modified/indeterminate."

NET SINKERS

NES	Net Sinker or Net Weight	Cobble with opposing indentations caused by any combination, of the following: flaking, crushing, pecking, battering, and smoothing.

BONE: Old Categories (These were used at all sites. Sites 45-OK-4, 45-OK-11, 45-OK-250, 45-DO-214, and 45-DO-326 have additional categories).

AWL	Awl	Sharply pointed bone tip with handle (one piece). The handle is blunt, often the joint end of a mammal long bone.
TØG (CHV)	Toggle (Composite Harpoon Head)	Actually the valve section of the harpoon. At 45-DO-214, the designation CHV was used.
NEE	Needle	Small, thin object, round in cross section. It is pointed at one end and has a hole in the other -- essentially like a modern needle.
SHU	Shuttle	Flat, long object, with a rounded point at one end and a hole in the other.
WED	Wedge	Object, usually of antler, with the "tip" end bevelled down to a wedge shape. The contact end may be crushed from being struck.
HAN	Handle	This category was created, we believe, for the 45-DO-214 "digging stick handle." It may be the only example.
PØI (UUP)	Point (Unbarbed Unipoint)	The bi-pointed section, which fits into the grooves of the valve of the harpoon tip. At DO-214 the designation UUP was used.
PEN	Pendant	Usually rectangular, flat, worked bone with hole in center of one end.
FLB	Flaked Long Bone	Portions of long bone shafts, usually split longitudinally, with the split edges flaked. Sometimes only one or two flakes have been removed. Sometimes the whole length of the bone is flaked.
BLT	Billet	Antler (or bone?) tool pointed and/or blunt end, used to flake stone tools. The object would be unmodified (no manufacture), and the tip or end would be somewhat crushed.
PBF	Fointed Bone	Category created for all of the pointed bone objects, whole or broken, which do not fit into awl, shuttle needle, etc., either because they are broken and the diagnostic section is missing, or because their use is unknown.

BONE: New Categories (These were used at 45-OK-4, 45-OK-11, 45-OK-250, 45-DO-214, and 45-DO-326 in addition to the Old Bone Categories. For CHV and UUP see under TØG and PØI respectively in the Old Categories.)

CHP	Composite Harpoon Valved Point	A valved point or a two part, composite harpoon head.
BHP	Barbed Harpoon Point	Pointed object with barbs.
LUB	Hook/Leister Barbed Unipoint	Small pointed object with either a round or flat cross section. One end flattened or thinned for lashing purposes.
RSB	Round Cross-Section Bipoint	Object meeting that criteria.
FSP	Flat Cross-Section Point	A point that may either be single or double pointed but definitely has a flat cross-section.
CHI	Chisel/Adze	Object usually made of antler that is wedge shaped in cross section and has an almost bevelled end. This object would resemble a modern tool.
BED	Bone Bead/ Bead Blanks	Modified bone pierced so that it could be strung as a bead.
UFØ	Other Formed Bone Object	Any other complete, formed bone object that does not fit into our categories.
PRX	Proximal or Articular End, Metapodial or Long Bone Shaft	Any object exhibiting that criteria and missing its tip.
PRØ	Proximal End, Other Element	Essentially the same as PRX but this category is for non-long bones or metapodials.
EDE	Edge End	Bone fragment that has a chisel-like edge.
SRE	Square/Rounded End	A shaft fragment that has a somewhat square but rounded end.
BES	Blunted End	Class of bone objects that has a point formed by at least three converging planes. The resulting tip has a wide angle.
SHB	Formed Shaft Fragment, No Formed End	Objects with complete cross sections made from bone shafts lacking their articulating ends.

BTR	Other Formed Bone Fragments	Miscellaneous, non-identifiable fragments of assorted bone objects.
TMØ	Bone, Technologically Modified Only	Category made for bones that do not actually show definite wear and/or manufacture, but rather have incising or splitting lines or grooves.
UTB	Bone, Utilized Fragment	A bone that has been utilized only but not manufactured.

SHELL

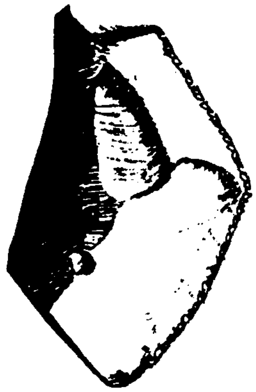
DEN	Dentalium	Whole dentalium shell or sections thereof. It is usually difficult to tell whether these shells have been modified or not. All are classified as "modified/indeterminate."
OLI	Olivella	Whole Olivella shell or sections thereof. It is usually difficult to tell whether these shell have been modified or not. All are classified as "modified/indeterminate".
MAR	Marginella	Rare. Used with the classification "modified/indeterminate.
MUS	Mussel	Rare. Used with the classification "modified/indeterminate".

INDETERMINATE

IND	Indeterminate	This category is used for stone and bone (and indeterminate) materials. Siltstone under the old system, was all classified IND. Most indeterminates are classified as "Modified-indeterminate."
SIL	Shaped/Incised	This category was used only at some sites. Pieces of siltstone that indicate some type of deliberate modification are put in this category. Items that we are not sure of are still classified as "IND."

COPPER

CØN	Copper Needle/Pin	One only, from 45-OK-2. Formed, worked copper pin or needle.
RCØ	Rolled Copper	Rolled copper bead. From 45-OK-2 only.
CØP	Other Copper Pieces	



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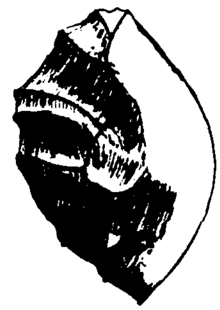

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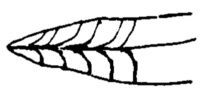

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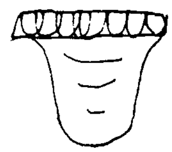

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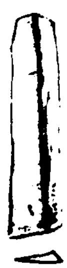

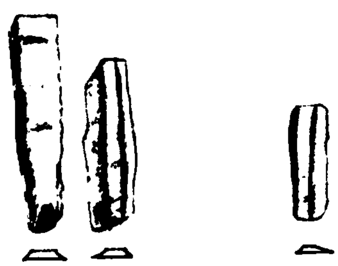

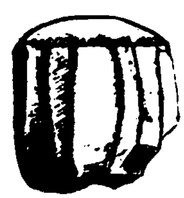

MIB

BLA

MIC

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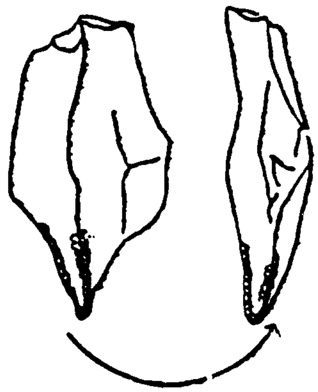
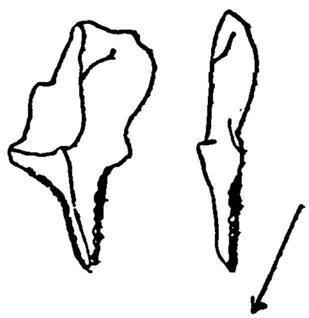
DRI



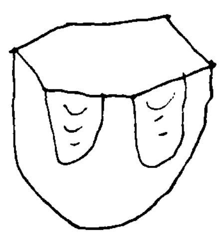
DRI

GRA



GRA

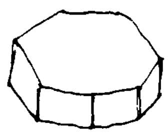
SCR

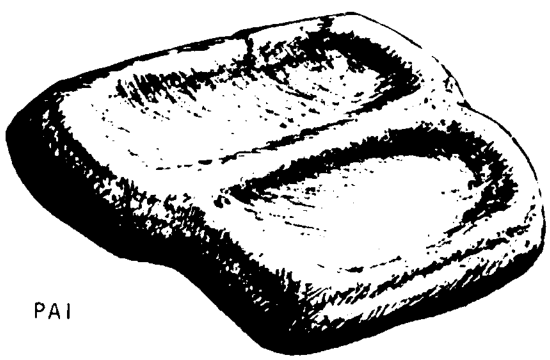


COR

HAM

PFC





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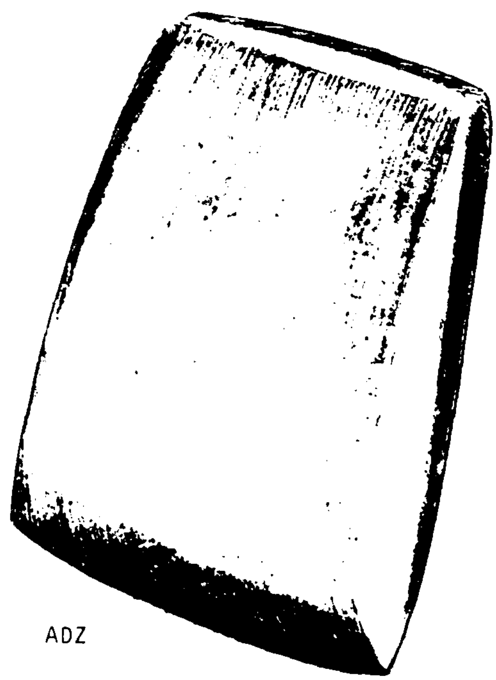

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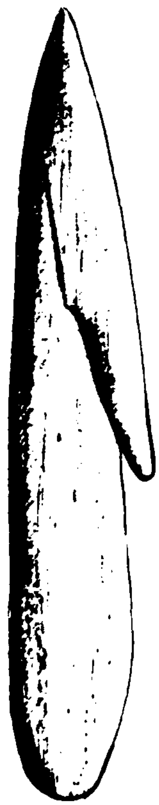

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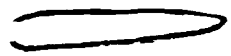

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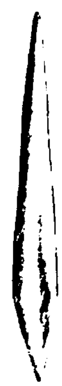
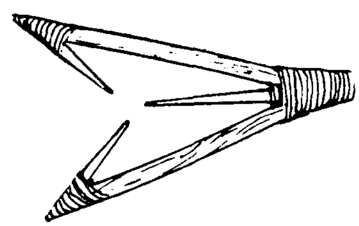
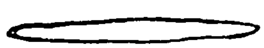
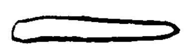




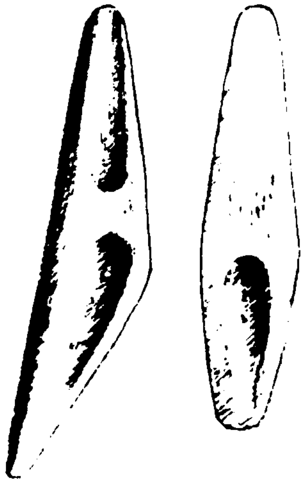
LUB



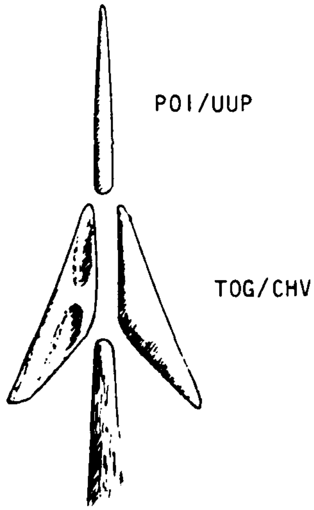
RSB



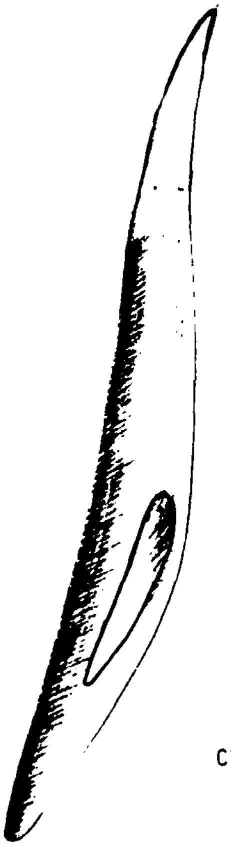
FSP



TOG/CHV



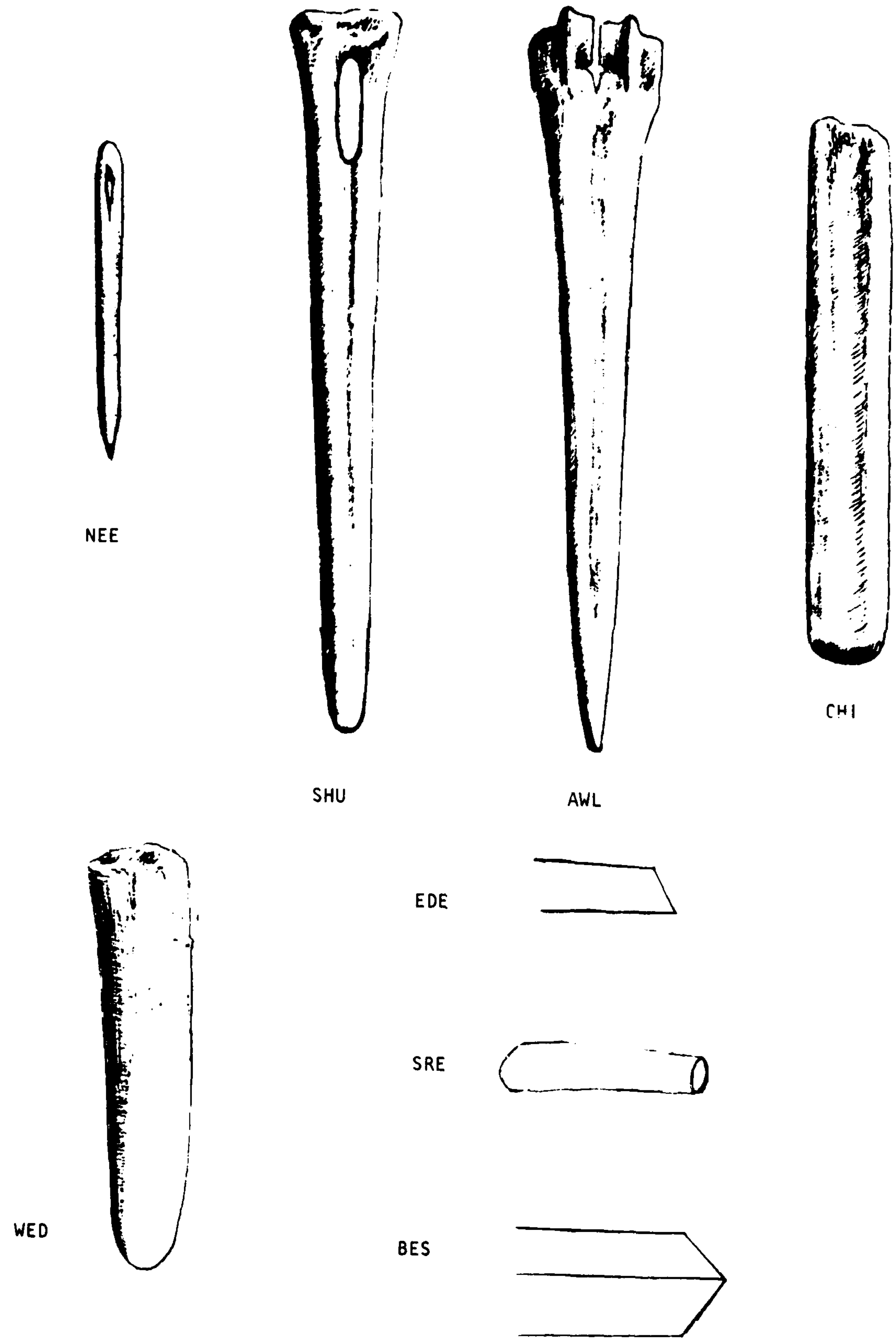
Toggling harpoon put together



CHP

CHP

Composite harpoon valved point put together


NEE
SHU
AWL
CHI
EDE
SRE
WED
BES

APPENDIX E:

ADDITIONAL COBBLE TOOL ANALYSIS

CHIEF JOSEPH DAM CULTURAL RESOURCES PROJECT:Cobble Classification

Page ___/___

Site ______

Master No.		OBJECT					Area		Manufacture		Wear			
				III SIZE					VI MANUFACTURE	VII DIAG. MANUF.	VIII WEAR LOC	IX WEAR	X WEAR LOC.-MAN	XI LOC.-COBBLE
site	specimen	obj type I	mat II	length	width	thick.	tool IV	wear V	fs t e t d p s p e p d g s p e f a d n o	u e b e f b k c s f s v s p n t g w n o	s e ed m n	p s b c a g f n	p d l a s w f n	c l f n
1	3	4	5	13	17	21	22	23	24 28 31	35 38 42 46	48	53 56 59	62 65 68	70

Keypunched by______ Date_____ Checked______ Date_____ Analyst______ Date_____

COBBLE TOOL CLASSIFICATION

Categories:

I. OBJECT TYPE

1.	Abrader	Rough tool used to rub or wear away some material by friction. Type defined by wear consisting of pronounced striae that do not reduce the original surface of the object.
2.	Adze	Cutting tool that has a thin arched blade set at right angles to the handle. Type defined by a unifacial cutting edge and thin tool cross-section. Adze preforms also included.
3.	Axe	Heavy, edged cutting tool that has a straight blade set with the edge parallel to the handle. Type defined by a bifacial cutting edge and a thick, tapered tool cross-section.
4.	Anvil	A heavy, thick stone on which some material is worked by pounding. Type defined by semi-diffuse to sparadic pecking/crushing wear and a lack of surface manufacture.
5.	Chopper	Edged, unhafted tool used to deliver a short, forceful, downward blow to cut or sever some hard material. Type defined by a crudely flaked edge, either unifacial or bifacial, and the presence of heavy crushing wear. Some with manufactured edges but no wear were included.
6.	Cleaver	Edged, unhafted tool used to slice or sever soft material. Type defined by a carefully flaked, thin edge, either unifacial or bifacial, and the presence of smoothing wear.

7. Core	A stone that exhibits some consistent pattern of flake removal across surfaces or margins. Type defined by an absence of wear on any flaked edge.
8. Flake spall	A lamellar stone product, often exhibiting a striking platform, percussive stress lines, and other evidence of conchoidal fracture. Type defined as any thin, lamellar form detached from a core, and without manufacture.
9. Flesher	Tool used to remove hide from meat. Type defined by creation of an edge by manufacture that has an oblique angle and exhibits smoothing or polishing wear.
10. Hammerstone	A tool used to batter or smash some material. Type defined by heavy battering/crushing wear on any surface, margin, or end.
11. Hammer	A tool used to detach flakes or blades from a core. Type defined by a regular facet or bevelled facet along one or more margins.
12. Hand millingstone	A hand tool used to grind seeds or other plant parts on a flat, rough stone surface. Type defined by grinding wear on a flat, planar surface or edge. The shape of the tool may be natural or manufactured.
13. Pestle	An elongate, club-shaped tool used to pound or grind substances in a mortar. Type defined by elongate form with a broad working end with battering, crushing and grinding wear. Lateral and end surfaces may or may not be manufactured.
14. Maul	A heavy , elongate hammerstone used to drive or pound. Type defined by its elongate, cylindrical shape, and heavy battering or crushing wear at one or both ends.
15. Millingstone	Large stone used as a base for grinding seeds or other plant parts. Type defined by heavy grinding wear on a flat-planar to flat-concave

	surface. The surface may be shaped or resharpened by pecking, and the margins may or may not be modified.
16. Mortar	A stone with a marked concavity where substances are pounded and ground; manufacture may extend past this concavity on one surface to include the lateral margins. Type defined by presence of a well on one surface, and grinding wear confined to the interior of that concavity.
17. Hopper mortar base	A stone used with a basketry hopper to pound and grind a variety of substances; manufacture may be totally absent. Type defined by the presence of intense crushing-grinding wear or organic residue restricted to a circular area on one surface.
18. Net weight	A notched or girdled stone used to anchor fishing nets or fish lines. Type defined by one or more lateral notches or a complete girdle, and the lack of any sort of wear.
19. Indeterminate	Any object that does not fit into one of the above categories.
20. Biface	A cobble flaked so that it resembles a biface or biface preform.
21. Peripherally flaked cobble	Cobble shaped by lateral flaking.

II. MATERIAL

1. Basalt	Any fine-grained, dark-colored igneous rock. Specifically,rock composed primarily of calcic plagioclase (bytownite to labradorite) and pyroxene (augite, pigeonite, hypersthene, or bronzite), with or without olivine.
2. Quarzite	Granulose metamorphic rock consisting largely of quartz or sandstone cemented by silica.
3. Granitic	Plutonic rock consisting principally of alkali feldspar and quartz. Can be any light-colored, coarse-grained igneous rock.

4. Porphyritic	Igneous rock in which larger crystals are set in a finer groundmass that may be crystalline or glassy or both.
5. Other	Category includes any metamorphic, sedimentary or igneous rock not described above. Includes indeterminate specimens.

III. SIZE

Length	Measurement in millimeters taken along the long axis of a cobble. (Flakes were measured as in technological analysis.)
Width	Measurement in millimeters taken along the widest axis perpendicular to the long axis of a cobble.
Thickness	Measurement in millimeters taken on an axis placed through the thickest part of the rock and perpendicular to the length and width axes.

IV. TOOL AREAS — Each distinct tool area is recorded as a separate line, sequentially numbered.

V. WEAR AREAS — Each distinct wear area is recorded as a separate line, sequentially numbered.

VI. MANUFACTURE (for each tool)

FS Flaked surface
FE Flaked edge*
FD Flaked end
PS Pecked surface
PE Pecked edge*
PD Pecked end
GS Ground surface
GE Ground edge*
GD Ground end

These categories will be filled in as Presence/Absence designations, and will be ranked in the following order: Grinding, Pecking, Flaking (e.g., a flaked edge that is also ground will be coded as Ground edge-1, Flaked edge-2).

N None

*or margin in rocks without edges (for each tool)

VII. DIAGNOSTIC MANUFACTURE

UE	Unifacial edge	Categories are Presence/Absence designations and will be ranked relative to the order established for MANUFACTURE (e.g., a flaked bifacial edge that is also ground unifacially, will be coded as unifacial-1, bifacial-2).
BE	Bifacial edge	
F	Facet	
BV	Beveled facet	
CS	Convex surface	
FS	Flat surface	
VS	Concave surface	
P	Point	
NT	Notch	
G	Girdle	
W	Well	
N	None	
O	Other	

VIII. WEAR LOCATION--NO MANUFACTURE

S Surface

E Edge--natural or manufactured edge

ED End

M Margin

N Not applicable

IX. WEAR (refers to tool/wear area)

P	Polishing	Wear evident as a sheen, not necessarily obliterating irregularities on the surface, and not altering the oringinal shape of the surface.
S	Smoothing	Wear that obliterates irregularities on the working surface but has not

		altered the orininal shape of that surface.
B	Battering	Heavy attrition but sporadic, not continuous over the working surface.
C	Crushing	Confined and intense wear.
A	Abrasion	Striae visible but wear has not created a flat plane or facet or totally reduced the working surface.
G	Grinding	Striae may or may not be visible but attrition has created a flat plane or facet on the working surface.
F	Flaking	Wear consists of regularly shaped flake scars.
N	None	
I	Indeterminate	

X. WEAR LOCATION WITH RESPECT TO MANUFACTURE

P	Proximal edge	Wear occurs on an edge opposite where manufacture flakes removed.
D	Distal edge	Wear occurs on edge where manufacture flakes were removed.
L	Lateral edge	Wear occur on an edge perpendicular to 1 + 2 (proximal and distal).
H	Adjacent edge	Wear and manufacture are on different planes.
S	Separate edge	Wear occurs opposite or independent of manufacture.
W	Whole facet	Complete
F	Partial facet	Broken
N	Not applicable/Indeterminate	

XI. WEAR LOCATION WITH RESPECT TO THE COBBLE

C	Cortex
I	Interior
IF	Interface of cortex and interior
N	Not applicable/Indeterminate

APPENDIX F:
FAUNAL ANALYSIS FORM AND KEYS

CHIEF JOSEPH DAM CULTURAL RESOURCES PROJECT
Faunal Analysis Form

Site ________ Unit ________ Page ______
Year Excavated ___

CODE	UNIT N-S	UNIT E-W	LEVEL	FEA #	FIELD NUMBER	SPECIMEN NUMBER	FAMILY	GENUS	SPECIE	SKELETAL ELEMENT	FRAG	PORTION	SIDE	SEX	BURN	BUTCH	QUANTITY	MIXED FEATURES #1	MIXED FEATURES #2	AGE			PA NUMB
	5		10	15		20	25		30	35		40				48		50	55			60 65 70 75	80

Keypunched by ________ Date ________ Checked by ________ Analyst ________ Date ____

Computer Key for Archaeofauna Taxa

Order	Computer Code: Family	Computer Code: Genus	Computer Code: Species	Family	Genus/Species	Common Name
Pelecypoda	MAR	MAR	FAL	Margaritiferidae	*Margaritifera falcata*	River mussel
	AMB	GØN	ANG	Amblemidae	*Gonidea angulata*	River mussel
	UNI	ANØ	KEN	Unionidae	*Anodonta kennerlyi*	River mussel
		ANØ	ØRE		*A. oregonensis*	
	SPH	SPH	PAT	Sphaeriidae	*Sphaerium patella*	Pill clam
		PIS	IDA		*Pisidium idahoense*	
		PIS	CØM		*P. compressum*	
		PIS	UAR		*P. variablile*	
Amphibia	AMB	AMB	MAC	Ambystomatidae	*Ambystoma macrodactylum*	Long-toed salamander
		AMB	TIG		*A. tigrinum*	Tiger salamander
	PEL	SCA	INT	Pelobatidae	*Scaphiopus intermontanus*	Great Basin spadefoot
	BUF	BUF	BØR	Bufonidae	*Bufo boreas*	Western Toad
	HYL	HYL	REG	Hylidae	*Hyla regilla*	Pacific treefrog
	RAN	RAN	PRE	Ranidae	*Rana pretiosa*	Spotted frog
		RAN	CAT		*R. catesbeiana*	Bullfrog
Reptilia	CHE	CHR	PIC	Chelydridae	*Chrysemys picta*	Painted turtle
	IGU	PHR	DØU	Iguanidae	*Phrynosoma douglassi*	Pigmy horned lizard
	SCI	EUM	SKI	Scincidae	*Eumeces skiltonianus*	Western skink
	ANG	GER	CØE	Anguidae	*Gerrhonotus coeruleus*	Northern alligator lizard

Computer Key for Archaeofauna Taxa

Order	Computer Code: Family	Genus	Species	Family	Genus/Species	Common Name
Reptilia	BØI	CHA	BØT	Boidae	*Charina bottae*	Rocky Mountain rubber boa
	CØL	CØL	CØN	Colubridae	*Coluber constrictor*	Western yellow-bellied racer
		PIT	MEL		*Pituophis melanoleucus*	Gopher snake
		THA	SIR		*Thamnophis sirtalis*	Valley garter snake
		THA	ELE		*T. elegans*	Wandering garter snake
	VIP	CRØ	UIR	Viperidae	*Crotalus viridis*	Northern Pacific rattlesnake
Pisces	PET	ENT	TRI	Petromyzontidae	*Entosphenus tridentatus*	Pacific lamprey
	ACI	ACI	TRA	Acipenseridae	*Acipenser transmontanus*	White sturgeon
	SAL	ØNC	KIS	Salmonidae	*Oncorhynchus kisutch*	Coho salmon
		ØNC	NER		*O. nerka*	Kokanee/sockeye salmon
		ØNC	TSH		*O. tschawytscha*	Chinook salmon
		SAL	CLA		*Salmo clarkii*	Cutthroat trout
		SAL	GAI		*S. gairdneri*	Steelhead/rainbow trout
		SLV	MAL		*Salvelinus malma*	Dolly varden
		PRØ	CØU		*Prosopium coulteri*	Pygmy whitefish
		PRØ	WIL		*P. williamsoni*	Mountain whitefish
	CYP	ACR	ALU	Cyprinidae	*Acrocheilus alutaceus*	Chisel mouth
		MYL	CAU		*Mylocheilus caurinus*	Peamouth
		PTY	ØRE		*Ptychocheilus oregonensis*	Northern squawfish
		RHI	CAT		*Rhinichthys cataractae*	Longnose dace

Computer Key for Archaeofauna Taxa

Order	Computer Code: Family	Genus	Species	Family	Genus/Species	Common Name
Pisces	CYP	RHI	FAL	Cyprinidae (cont.)	*R. falcatus*	Leopard dace
		RHI	ØSC		*R. osculus*	Speckled dace
		RIC	BAL		*Richardsonius balteatus*	Redside shiner
	CAT	CAT	CAT	Catostomidae	*Catostomus catostomus*	Longnose sucker
		CAT	CØL		*C. columbianus*	Bridgelip sucker
		CAT	MAC		*C. macrocheilus*	Largescale sucker
		CAT	PLA		*C. platyrhynchus*	Mountain sucker
	GAD	LØT	LØT	Gadidae	*Lota lota*	Burbot
	CØT	CØT	ASP	Cottidae	*Cottus asper*	Prickly sculpin
		CØT	BAI		*C. bairdi*	Mottled sculpin
		CØT	CØG		*C. cognatus*	Slimy sculpin
		CØT	CØN		*C. confuscus*	Shorthead sculpin
		CØT	RHØ		*C. rhotheus*	Torrent sculpin
Mammalia	SØR	SØR	ØBS	Soricidae	*Sorex obscurus*	Duskey shrew
		SØR	VAG		*S. vagrans*	Vagrant shrew
		SØR	CIN		*S. cinereus*	Masked shrew
		SØR	TRØ		*S. trowbridgii*	Trowbridge shrew
		SØR	MER		*S. merriami*	Merriam shrew
	TAL	SCA	TØW	Talpidae	*Scapanus townsendii*	Townsend mole

Computer Key for Archaeofauna Taxa

Order	Computer Code: Family	Computer Code: Genus	Computer Code: Species	Family	Genus/Species	Common Name
Mammalia	VES	MYØ	LUC	Vespertilionidae	*Myotis lucifugus*	Little brown myotis
		MYØ	CAL		*M. californicus*	California myotis
		MYØ	SUB		*M. subulatus*	Small-footed myotis
		MYØ	YUM		*M. yumaensis*	Yuma myotis
		LAS	NØC		*Lasionycteris noctivagans*	Silvery-haired bat
		EPT	FUS		*Eptesicus fuscus*	Big brown bat
		ANT	PAL		*Antrozous pallidus*	Pallid bat
		PLE	TØW		*Plecotus townsendii*	Lump-nosed bat
	LEP	LEP	CAL	Leporidae	*Lepus californicus*	Black-tailed jackrabbit
		LEP	TØW		*L. townsendii*	White-tailed jackrabbit
		SYL	NUT		*Sylvilagus nuttallii*	Nuttall cottontail
	SCI	MAR	FLA	Sciuridae	*Marmota flaviventris*	Yellow-bellied marmot
		CIT	CØL		*Citellus columbianus*	Columbian ground squirrel
		CIT	TØW		*C. townsendii*	Townsend ground squirrel
		CIT	WAS		*C. washingtoni*	Washington ground squirrel
		EUT	MIN		*Eutamias minimus*	Least chipmunk
		EUT	AMØ		*E. amoenus*	Yellow pine chipmunk
		TAM	HUD		*Tamiasciurus hudsonicus*	Red squirrel
		GLA	SAB		*Glaucomys sabrinus*	Northern flying squirrel
	GEØ	THØ	TAL	Geomyidae	*Thomomys talpoides*	Northern pocket gopher
	HET	PER	PAR	Heteromyidae	*Perognathus parvus*	Great Basin pocket mouse

Computer Key for Archaeofauna Taxa

Order	Computer Code: Family	Computer Code: Genus	Computer Code: Species	Family	Genus/Species	Common Name
Mammalia	CAS	CAS	CAN	Castoridae	*Castor canadensis*	Beaver
	CRI	REI	MEG	Cricetidae	*Reithrodontomys megalotis*	Western harvest mouse
		PER	MAN		*Peromyscus maniculatus*	Deer mouse
		ØNY	LEU		*Onychomys leucogaster*	Northern grasshopper mouse
		NEØ	CIN		*Neotoma cinerea*	Bushy-tailed woodrat
		LAG	CUR		*Lagurus curtatus*	Sagebrush vole
		MIC	PEN		*Microtus pennsylvanicus*	Meadow mouse
		MIC	LØN		*M. longicaudus*	Long-tailed meadow mouse
		MIC	MØN		*M. montanus*	Montane meadow mouse
		ØND	ZIB		*Ondatra zibethica*	Muskrat
	ERE	ERE	DØR	Erethizontidae	*Erethizon dorsatum*	Porcupine
	CAN	CAN	LAT	Canidae	*Canis latrans*	Coyote
		CAN	LUP		*C. lupus*	Wolf
		CAN	FAM		*C. familiaris*	Dog
		VUL	FUL		*Vulpes fulva*	Red fox
	URS	URS	AME	Ursidae	*Ursus americanus*	Black bear
		URS	HØR		*U. horriblis*	Grizzly bear
	PRØ	PRØ	LØT	Procyonidae	*Procyon lotor*	Racoon
	MUS	MAR	AME	Mustelidae	*Martes americana*	Martin
		MAR	PME		*Martes pennanti*	Fisher
		MUS	VIS		*Mustela vison*	Mink
		MUS	FRE		*M. frenata*	Long-tailed weasel

Computer Key for Archaeofauna Taxa

Order	Computer Code: Family	Genus	Species	Family	Genus/Species	Common Name
Mammalia	MUS	MUS	ERM	Mustelidae (cont.)	*M. erminea*	Ermine
		TAX	TAX		*Taxidea taxus*	Badger
		MEP	MEP		*Mephitis mephitis*	Striped skunk
		LUT	CAN		*Lutra canadensis*	River otter
	FEL	FEL	CØN	Felidae	*Felis concolor*	Mountain lion
		LYN	RUF		*Lynx rufus*	Bobcat
		LYN	CAN		*L. canadensis*	Lynx
	CER	ØDØ	HEM	Cervidae	*Odocoileus hemionus*	Mule deer
		ØDØ	VIR		*O. virginianus*	White-tailed deer
		CER	CAN		*Cervus canadensis*	Elk
		ALC	ALC		*Alces alces*	Moose
		RAG	TAR		*Rangifer tarandus*	Caribou
	BØV	ØRE	AME	Bovidae	*Oreamnos americanus*	Mountain goat
		ØVI	CAN		*Ovis canadensis*	Mountain/bighorn sheep
		ØVI	ARI		*O. aries*	Domestic sheep
		BIS	BIS		*Bison bison*	Bison
		BØS			*Bos*	Cow
	ANT	ANT	AME	Antilocapridae	*Antilocapra americana*	Pronghorn antelope
	EQU	EQU	CAB	Equidae	*Equus caballus*	Horse
	SUI	SUS	SCR	Suidae	*Sus scrofa*	Pig
	HØM	HØM	SAP	Hominidae	*Homo sapiens*	Human

Computer Key for Archaeofauna Taxa

	Computer Code					
Order	Family	Genus	Species	Family	Genus/Species	Common Name
		DER	SZE	Deer size (incl. deer, pronghorn, sheep)		
		ELK	SZE	Elk size (incl. elk, horse, bison, cow, moose)		
		SHE	ANT	Sheep/antelope		

If a bone is only identifiable to Family, leave Genus and Species fields blank.

If a bone is only identifiable to Genus, leave the Species field blank.

For DER SZE and ELK SZE, leave the Family field blank.

Computer Key for Condition States of Archaeofaunal Material.

Columns	Heading	Key Code	Key Name
1 - 31	Provenience		
32 - 35	Skeletal Element Key	SKEL	Complete skeleton
		SKUL	Skull
		BCSE	Braincase
		PMXI	Premaxilla
		PMXT	Premaxilla with teeth
		MAXI	Maxilla
		MAXT	Maxilla with teeth
		PALA	Palatine
		VØMR	Vomer
		NASL	Nasal
		SPHE	Sphenoid
		ETHM	Ethmoid
		LACR	Lacrimal
		FRØN	Frontal
		HCØR	Horn Core
		HSHT	Horn Sheath
		JUGL	Jugal
		ZYGA	Zygomatic Arch
		ØRBR	Orbital Region
		TEMP	Temporal
		SQAM	Squamosal
		PART	Parietal
		ØCCP	Occipital
		BØCP	Basioccipital
		ØCCN	Occipital Condyle
		MAST	Mastoid Process or Region
		PETR	Petrosal
		BULL	Bulla
		MAND	Mandible complete without teeth
		MANT	Mandible with teeth
		SYMP	Symphysis
		SYMT	Symphysis with teeth
		DENC	Dentary or Corpus (Horizontal Ramus) No teeth
		DENT	Dentary with teeth
		ANGU	Angular Process
		RAMA	Ramus, Ascending
		CØRN	Coronoid Process
		ARTC	Articular Condyle or Articular
		TØTH	Tooth Indet
		INCI	Incisor Indet Upper of Lower Indet
		DINI	Deciduous Incisor Indet Upper of Lower Indet
		CANI	Canine Upper or Lower Indet
		DCNI	Deciduous Canine Upper or Lower Indet
		PREM	Premolar Indet Upper or Lower Indet
		DPRI	Deciduous Premolar Indet Upper of Lower Indet
		MØLI	Molar Indet Upper or Lower Indet

Columns	Heading	Key Code	Key Name
32 - 35	Skeletal Element Key (continued)	CTHI	Cheektooth Indet Upper or Lower Indet (Molariform)
		THRI	Toothrow Upper or Lower Indet
		DTHR	Deciduous Toothrow Upper or Lower Indet
		UPIØ	Upper Incisor Indet
		UPI1	Upper Incisor 1
		UPI2	Upper Incisor 2
		UPI3	Upper Incisor 3
		UPI4	Upper Incisor 4
		DUIØ	Deciduous Upper Incisor Indet
		DUI1	Deciduous Upper Incisor 1
		DUI2	Deciduous Upper Incisor 2
		DUI3	Deciduous Upper Incisor 3
		DUI4	Deciduous Upper Incisor 4
		UCAN	Upper Canine
		DUCN	Deciduous Upper Canine
		UPPØ	Upper Premolar Indet
		UPP1	Upper Premolar 1
		UPP2	Upper Premolar 2
		UPP3	Upper Premolar 3
		UPP4	Upper Premolar 4
		DUPØ	Deciduous Upper Premolar Indet
		DUP1	Deciduous Upper Premolar 1
		DUP2	Deciduous Upper Premolar 2
		DUP3	Deciduous Upper Premolar 3
		DUP4	Deciduous Upper Premolar 4
		URMØ	Upper Molar Indet
		URM1	Upper Molar 1
		URM2	Upper Molar 2
		URM3	Upper Molar 3
		UCH	Upper Cheekteeth Indet
		UTHR	Upper Toothrow
		DUTR	Deciduous Upper Toothrow
		LINØ	Lower Incisor Indet
		LIN1	Lower Incisor 1
		LIN2	Lower Incisor 2
		LIN3	Lower Incisor 3
		LIN4	Lower Incisor 4
		DLIØ	Deciduous Lower Incisor Indet
		DLI1	Deciduous Lower Incisor 1
		DLI2	Deciduous Lower Incisor 2
		DLI3	Deciduous Lower Incisor 3
		DLI4	Deciduous Lower Incisor 4
		LØCN	Lower Canine
		DELC	Deciduous Lower Canine
		LØPØ	Lower Premolar Indet
		LØP1	Lower Premolar 1
		LØP2	Lower Premolar 2
		LØP3	Lower Premolar 3
		LØP4	Lower Premolar 4

Columns	Heading	Key Code	Key Name
32 - 35	Skeletal Element Key (continued)	LP34	Lower Premolar 3 or 4
		DLPØ	Deciduous Lower Premolar Indet
		DLP1	Deciduous Lower Premolar 1
		DLP2	Deciduous Lower Premolar 2
		DLP3	Deciduous Lower Premolar 3
		DLP4	Deciduous Lower Premolar 4
		LØMØ	Lower Molar Indet
		LØM1	Lower Molar 1
		LØM2	Lower Molar 2
		LØM3	Lower Molar 3
		LM12	Lower Molar 1 or 2
		LM23	Lower Molar 2 or 3
		LØCH	Lower Cheektooth Indet
		LTHR	Lower Toothrow
		DLTR	Deciduous Lower Toothrow
		HYØD	Hyoid Axial/Vertebra Indet
		VERT	Vertebra Indet
		CENT	Centrum Indet
		CENE	Centrum Epiphysis Indet
		CERV	Cervical Vertebra Indet
		ATLS	Atlas Cervical Vertebra 1
		AXIS	Axis Cervical Vertebra 2
		CER3	Cervical Vertebra 3
		CER4	Cervical Vertebra 4
		CER5	Cervical Vertebra 5
		CER6	Cervical Vertebra 6
		CER7	Cervical Vertebra 7
		CERC	Cervical Centrum
		CERE	Cervical Zygapophysis
		THØI	Thoracic Vertebra Indet
		THØ1	Thoracic Vertebra 1
		THØ2	Thoracic Vertebra 2
		THØ3	Thoracic Vertebra 3
		THØ4	Thoracic Vertebra 4
		THØ5	Thoracic Vertebra 5
		THØ6	Thoracic Vertebra 6
		THØ7	Thoracic Vertebra 7
		THØ8	Thoracic Vertebra 8
		THØ9	Thoracic Vertebra 9
		TH10	Thoracic Vertebra 10
		TH11	Thoracic Vertebra 11
		TH12	Thoracic Vertebra 12
		TH13	Thoracic Vertebra 13
		TH14	Thoracic Vertebra 14
		TH15	Thoracic Vertebra 15
		TH16	Thoracic Vertebra 16
		TH17	Thoracic Vertebra 17
		TH18	Thoracic Vertebra 18
		THØL	Last Thoracic Vertebra
		THØR	Thoracic Dorsal Spine

Columns	Heading	Key Code	Key Name
32 - 35	Skeletal Element Key (continued)	THØC	Thoracic Centrum
		THEC	Thoracic Zygapophsis
		LUMB	Lumbar Vertebra Indet
		LUM1	Lumbar Vertebra 1
		LUM2	Lumbar Vertebra 2
		LUM3	Lumbar Vertebra 3
		LUM4	Lumbar Vertebra 4
		LUM5	Lumbar Vertebra 5
		LUM6	Lumbar Vertebra 6
		LUM7	Lumbar Vertebra 7
		LUML	Last Lumbar Vertebra
		LUMZ	Lumbar Zygapophysis
		LUMD	Dorsal Spine
		LUMC	Lumbar Centrum
		LUME	Lumbar Transverse Process
		SACC	Sacrum Complete
		SACV	Sacral Vertebra Fragment
		CAUD	Caudal Vertebra
		RIBB	Rib
		CØSC	Costal Cartilage
		STER	Sternum or Sternabrae
		SCPI	Scapula Indet
		SCPC	Scapula Complete
		SCPG	Glenoid of Scapula
		SCPA	Acromion of Scapula
		SCPS	Spine of Scapula
		SCPB	Blade of Scapula
		CLVC	Clavicle
		CØRC	Coracoid
		ACRM	Acromion Bone
		ACØR	Coracoid-Acromion
		PELV	Pelvis Indet or Complete
		INØM	Innominate
		ILIU	Ilium
		ISCH	Ischium
		PUBS	Pubis
		ILIS	Ilium Plus Ischium
		ILPB	Ilium Plus Pubis
		ISPB	Ischium Plus Pubis
		ACET	Acetabulum
		AILI	Acetabulum Ilium only
		AISC	Acetabulum Ischium only
		APUB	Acetabulum Pubis only
		AISI	Acetabulum Ischium and Ilium only
		APIL	Acetabulum Pubis and Ilium only
		APIS	Acetabulum Pubis and Ischium only
		LBNI	Longbone Indet
		HUMR	Humerus
		RADS	Radius
		ULNA	Ulna

Columns	Heading	Key Code	Key Name
32 - 36	Skeletal Element Key (continued)	ULCS	Ulna Olecranon with Sigmoid Notch
		ULSN	Ulna Sigmoid Notch only
		RULN	Radio Ulna
		METP	Metapodial Indet
		MTCP	Metacarpal Digit Indet
		MCP1	Metacarpal First Digit
		MCP2	Metacarpal Second Digit
		MCP3	Metacarpal Third Digit
		MCP4	Metacarpal Fourth Digit
		MCP5	Metacarpal Fifth Digit
		MCPM	Main Metacarpal
		MCPA	Accessory Metacarpal
		CMCP	Carponetacarpus
		FEMR	Femur
		TIBF	Tibio-Fibula
		TIBI	Tibia
		FIBU	Fibula
		TBTR	Tibiotarsus
		MTTR	Metatarsal Digit Indet
		MTT1	Metatarsal First Digit
		MTT2	Metatarsal Second Digit
		MTT3	Metatarsal Third Digit
		MTT4	Metatarsal Fourth Digit
		MTT5	Metatarsal Fifth Digit
		MTTM	Main Metatarsal Cannon Bone
		MTTA	Accessory Metatarsal
		TMTT	Tarsometatarsus
		PATL	Patella
		CARP	Carpal or Manus Bone Indet
		SCAF	Scaphoid
		LUNA	Lunate
		CUNF	Cuneiform
		UNCF	Unciform
		PISI	Pisiform
		TZDM	Trapezoid Magnum
		TARS	Tarsal or Pes Bone Indet
		ASTR	Astragalus
		CALC	Calcaneum
		NVCB	Naviculocuboid
		MCUN	Medial Cuneiform (Tarsal)
		SESA	Sesamoid Indet
		PHAI	Indeter Phalanx
		PHA1	First Phalanx
		PHA2	Second Phalanx
		PHA3	Third Phalanx
		CARP	Carapace
		PLAS	Plastron
		ØTØL	Otolith

Columns	Heading	Key Code	Key Name
36 - 38	Fragment Field	COM	Complete
		PEN	Prox. End
		PEP	Prox. Epiphysis
		PAS	Prox. and Shaft
		PSH	Prox. Shaft
		SHF	Shaft
		DSH	Distal Shaft
		DAS	Distal and Shaft
		DEP	Distal Epiphysis
		DEN	Distal End
		FRG	Fragment
39 - 41	Portion Field	DRS	Dorsal
		DOL	Dorsal/Lat
		DOM	Dorsal/Med
		DLG	Dorsal/Lin
		DOB	Dorsal/Buc
		VNT	Ventral
		VEL	Ventral/Lat
		VEM	Ventral/Med
		VLG	Ventral/Lin
		VEB	Ventral/Buc
		ANT	Anterior
		ANL	Anterior/Lat
		ANM	Anterior/Med
		ALG	Anterior/Lin
		ANB	Anterior/Buc
		PST	Posterior
		POL	Posterior/Lat
		POM	Posterior/Med
		PLG	Posterior/Lin
		POB	Posterior/Buc
		MID	Mid
		MIL	Mid/Lat
		MIM	Mid/Med
		MLG	Mid/Lin
		MIB	Mid/Buc
		DMD	Dorsal and Mid
		DML	Dorsal and Mid/Lat
		DMM	Dorsal and Mid/Med
		DMG	Dorsal and Mid/Lin
		DMB	Dorsal and Mid/Buc
		VMD	Ventral and Mid
		VML	Ventral and Mid/Lat
		VMM	Ventral and Mid/Med
		VMG	Ventral and Mid/Lin
		VMB	Ventral and Mid/Buc
42	Side	L	Left
		R	Right
		C	Center
		I	Indeterminant

Key

Columns	Heading	Code	Name
43	Sex	9	Indeterminant
		1	Male
		2	Female
44	Burning	1	Unburned
		2	Burned
		9	Indeterminant
45	Butchering Marks	8	Absent
		1	Striae
		2	Flake Scar
		3	Chopping Scar
		4	Saw Cut
		9	Indeterminant
		5	Artifact
46-49	Quantity		
50-55	Additional Provenience Information		
56-58	Age	PEU	Proximal Epiphysis Unfused
		PEF	Proximal Epiphysis Fused
		DEF	Distal Epiphysis Fused
		DEU	Distal Epiphysis Unfused
		FTL	Foetal
		#	Age in Months

APPENDIX G:
STRATIGRAPHIC ASSIGNMENT OF UNIT LEVELS

As units were excavated in arbitrary unit levels, and stratigraphic information was obtained from wall profiles following excavation, we assigned unit levels to stratigraphic units in the laboratory. Because the information on arbitrary levels was already being put in a computerized data base, we felt that the most efficient means of accomplishing the task would be to enter the stratigraphic data on the computer and link the two data sets via a mathematical model.

We needed a model that would identify the strata occurring in a unit level, estimate the volume of each stratum, and assign point proveniences to particular strata as well.

Information about the strata was limited to that provided by the profiles which included information only from the boundaries of the unit. The number of walls which were profiled varied from all four to one. Some strata were discontinuous, i.e., the stratum did not exist at all points on the wall profiles. The units varied in size from 1 x 1 meter to 2 x 2 meters. The elevation at the base of each arbitrary unit level was recorded at the four corners of each 1 x 1 meter quad. The model would have to determine the surfaces of both the strata and the arbitrary levels of a unit. Calculating a suface involves both determining its extent and determining the elevation of the surface at various points. Once the surfaces are known, the volume is determined by evaluating the distance between the different surfaces. Several alternative methods exist for estimating both the extent and the elevation.

THE MODELS

Four models for predicting the strata surfaces were tested. The first two models use simple linear methods to estimate elevations while using an identical method for determining the extent of a stratum surface. The third model utilized a trend surface equation for predicting the surface elevations and extent. The degree of the trend surface was varied to determine the preferred trend surface equation. Finally, a gravity model was evaluated. Here too, the power of the model was varied to find the optimal power.

Linear Model 1. The existence of the stratum surface is determined in the following way. Any nonprofiled point is determined to exist if its closest profiled wall point exists. Where the point is equidistant from two or more profiled points, the point is determined to exist if any one of the profiled points exist. While the tests used only the 2 x 2-m analog with four profiled walls, the above conditions can be applied to any shaped unit with any set of profiled walls. Figure G-1 illustrates how the extent of the stratum is reconstructed from the wall points given the above conditions.

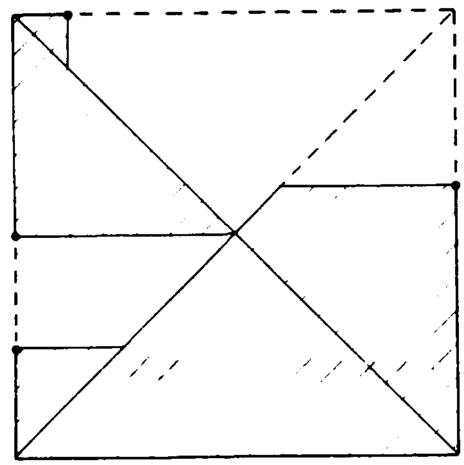


Figure G-1. Example of estimated stratum extent in linear model.

The elevations of the surface are determined by the nearest profiled wall point elevation. Where the surface location is equidistant from two or more profiled wall points, the average elevation is used.

Linear Model 2. The existence of the surface is determined in the same manner as in Linear Model 1. Elevations are calculated in the following way. If profiled points exist on opposing walls, a line is passed between them and the elevation of this line is used for predicting the surface elevation. Where both a vertical and horizontal line exist, the elevations of the two lines are averaged. Where one line exists and a wall point exists, then the line elevation and the wall point elevation are averaged. Where no lines exist, only the wall point elevation is used, as in Linear Model 1.

Trend Surface Model. The trend surface model uses information from the profiled walls to estimate the coefficients of an equation. Once the equation coefficients are estimated, then the surface elevations are calculated. The coefficients are calculated by minimizing the residuals squared error. Alternative trend surface equations of varying power can be estimated:

1st Order $\quad \text{Elevation} = b_0 + b_1X + b_2Y$

2nd Order $\quad \text{Elevation} = b_0 + b_1X + b_2Y + b_3X^2 + b_4XY + b_5Y^2$

3rd Order $\quad \text{Elevation} = b_0 + b_1X + b_2Y + b_3X^2 + b_4XY + b_5Y^2 + b_6X^3 + b_7X^2Y + b_8XY^2 + b_9Y^3$

4th Order $\quad \text{Elevation} = \text{the above} + b_{10}X^4 + b_{11}X^3Y + b_{12}X^2Y^2 + b_{13}XY^3 + b_{14}Y^4$

To estimate the model, the number of profiled data points must be equal to or greater than the number of coefficients to be estimated. Variation must exist in the values of "x" and "y", which will not occur if a stratum exists only in a single wall. In that case, the above equations can not be calculated. The trend surface model lacks generality and numerous situations must be treated as special cases.

The existence of a stratum surface is determined by calculating the bottom surface of the stratum as well as the top surface. The stratum exists so long as the bottom surface lies below the top surface.

The trend surface model will predict best when the surface to be predicted is close to the points used in calculating the equation. Like a regression analysis, the error of prediction increases as one moves to combinations of "x" and "y" that are not in the realm of the data. This problem will be most severe where the stratigraphic profiles are not available for all walls.

For the 2 x 2-m unit, the information collected to estimate the surface is all on the boundary. The consequence of this is that the prediction error will increases as one approaches the center of the unit. If the strata are regular in shape and continuous, this problem will be minimized but talks with Neal Crozier of the pedology crew convinced us that this is not the case and that considerable change can occur at one meter intervals. This had the further implication that information about strata from other units would not be useful for predictive purposes.

Gravity Model. In the gravity model, the elevation of all points on the walls are used to estimate the internal elevations. Each elevation is weighted by its distance from the point to be estimated, so that closer elevations receive more emphasis. The form of the gravity equation is:

$$E_i = \frac{\sum_{j=1}^{n} \frac{E_j}{D_{ij}^P}}{\sum_{j=1}^{n} \frac{1}{D_{ij}^P}}$$

where

E = elevation at point i or j
D = distance from point i to j
n = number of existing elevations
P = distance exponent

During testing, the distance exponent, P, was tested wth values of 1, 2, 3, 4, 5, 6, and 7. The higher the power, the greater the influence of the nearest existing wall point. A higher power implies that the information from other points is less useful for prediction. This is consistent with the observations of the stratigraphy crew as noted earlier.

The extent of a surface was determined in a separate process. If all wall points existed, then all internal surface points existed. If a discontinuity existed, the endpoints of the discontinuity were connected either by a straight line, if the points were on different walls, or by a semi-circle if the points were on the same wall. These line or lines formed the boundary of the surface. This is explained in greater detail later.

THE TEST

To test the performance of the different models, it was necessary to create a data base where volume and surface locations were known. This was accomplished by building a glass box with an interior surface of 20 x 20 cm as an analog of the 2 x 2-m pit. Known volumes of colored sands were measured out and poured into the box. The strata were allowed to vary so that discontinuities occurred; however, the strata created in this manner were probably simpler and more continuous than many field situations. After each stratum was created, a surface elevation was taken at nine interior locations. If the stratum did not exist at one of the nine locations, this information was noted. Finally, after all the strata were created, the stratigraphic profiles were traced through the glass walls. The wall profiles were then digitized to provide the location and elevation data for use by the different predictive models. Points were digitized at 1 cm intervals, so that a total of 80 points were collected when all four walls were complete.

In order to facilitate testing, unit levels were not developed for the glass box data. Thus, testing is only aimed at the models ability to predict the strata. The glass box was used to create two separate data sets. In Set 1, 10 strata were created and in Set 2, 17 strata were created. The four models were only tested using the data from all four wall profiles. Thus, the cases where only one, two, or three profiles exist were not evaluated.

SURFACE ELEVATIONS AND EXTENT

None of the models predicted actual surface elevations with accuracy. Even the best models had average errors for surfaces of six to eight centimeters. With this amount of error, it was apparent that locating point provenience data within a stratum would be risky at best. As might be expected, the models were also subject to failure when determining the extent of a stratum. The trend surface did not do any better than other models in determining the surface extent. In terms of the difference between actual and predicted surface, the trend surface had the smallest average error but it also had the largest individual errors, some of which were over 30 cm. Unlike the linear models or gravity models that cannot have elevations greater than the maxumum or smaller than the minimum measured elevations, the trend surface can have regions that are beyond the range of the wall elevations. The consequence of this is that large individual errors can result even though the average error is small. The consequences of these large errors would be to assign strata to arbitrary levels far above or below their location indicated by stratigraphic profiles. As no model did an adequate job of estimating the actual surfaces, it was decided that no in situ data could be assigned a stratum.

VOLUME ERRORS

This left only the volume estimates to be evaluated. The results of the different models for Test 1 and Test 2 are shown in Table G-1. The number reported is the average error of prediction; that is, the average difference between predicted and actual volumes. The table shows that the third order trend surface model and the fifth power gravity model minimize the average volume error. Because the gravity model is more general in that it handles all cases and because it did not have excessive surface errors like the trend surface model, it was chosen for use in the final program.

Table G-1. Error in volume estimates made by different models.

MODEL	TEST 1	TEST 2
Linear 1	137	101
Linear 2	101	215
Gravity		
Power 1	130	123
Power 2	130	129
Power 3	120	123
Power 4	111	115
Power 5	111	113
Power 6	113	112
Power 7	117	112
Trend Surface		
3rd Order	167	102

Even the "best" model results in average errors that are equal to 1/4 the volume of an arbitrary unit level. Our recommendation is that if one needs to estimate strata volumes for determining densities or other reasons, this model is better than an **ad hoc** method because it has a consistency that can be duplicated and its problems are known. One limit of the model is that the more complex the situation, the worse job it will do. If the strata are thin, then volume errors will probably be a greater problem. Volume errors are the consequence of mis-specifying a surface and therefore the errors occur on the borders of the stratum. When strata volumes are split between unit levels, unit levels with more than one stratum will have larger errors than unit levels with fewer strata. Hence, there will be a greater probability of error in work where a unit level has many strata.

ADDITIONAL DETAILS ON THE STRATIGRAPHIC EXTRAPOLATION PROGRAM

Besides the information on specific strata and unit levels, the strata program requires information concerning the dimensions of the unit and the existence of profiled walls. The dimension of the unit is required for determining the size of the surface to be estimated. A change in the internal dimensions does not alter the general running of the program. However, when walls have not been profiled, a part of the program must be devoted to determining whether a stratum would or would not have existed on the missing wall. This determination requires a set of assumptions about how the missing data should be handled. There are many alternative approaches that could be taken. However, without outside information as to the shape of the stratum, it is not possible to evaluate the ability of one set of assumptions over another in determining the existence of the stratum.

The determination of a stratum's existence when one or more profiles were missing was undertaken in the following manner. Four possible cases exist: three walls are missing; two adjacent walls are missing; one wall is missing; or two non-adjacent walls are missing.

If three walls are missing, then the entire case was deemed special and the evaluation of volumes was done in a different fashion. If a point exists on the wall, it is assumed that all interior points closest to that point exist and have the same elevation.

If two adjacent walls are missing then the rules of a stratum's existence are the following:

1. If the stratum exists at the two end points of the existing profiles, then the stratum is assumed to exist at all points on the missing walls.
2. If the stratum does not exist at either of the end points then the stratum is assumed not to exist at any point on the missing walls.
3. If only one of the end points exists then the stratum's existence is evaluated on a point by point basis. Starting with the point adjacent to the nonexistent end point, if that point exists then the stratum exists on the missing walls. So long as contiguous points fail to exist then the stratum of the missing walls is assumed not to exist.

If a single wall is missing or two nonadjacent walls are missing, then the following assumptions were made:

1. If the two end points exist then the stratum exists all along the missing walls.
2. If the two end points do not exist then the stratum does not exist along the wall.
3. If a single end point exists, as many points that exist and are contiguous to that end point are assumed to exist on the missing wall. No more than half of the possible points on the missing wall can be assumed to exist in this manner. If the maximum number of points are determined to

exist, then the rest of the points are determined by counting the number of nonexisting points that are contiguous to the missing endpoint. The second half of the missing wall is then determined by the number of missing points.

Once the existence of a stratum on a missing wall is determined, the program proceeds to determine what part of the surface exists.

In determining the extent of a stratum, the surface is broken into 10 x 10-cm sections, where actual elevations from the stratigraphic profiles are located at the center of the 10 x 10-cm square. As elevations were taken at 10 cm intervals along the walls, this corresponds to the unit being divided up as Figure G-2. Each section is then evaluated for whether it would be a part of the stratum surface.

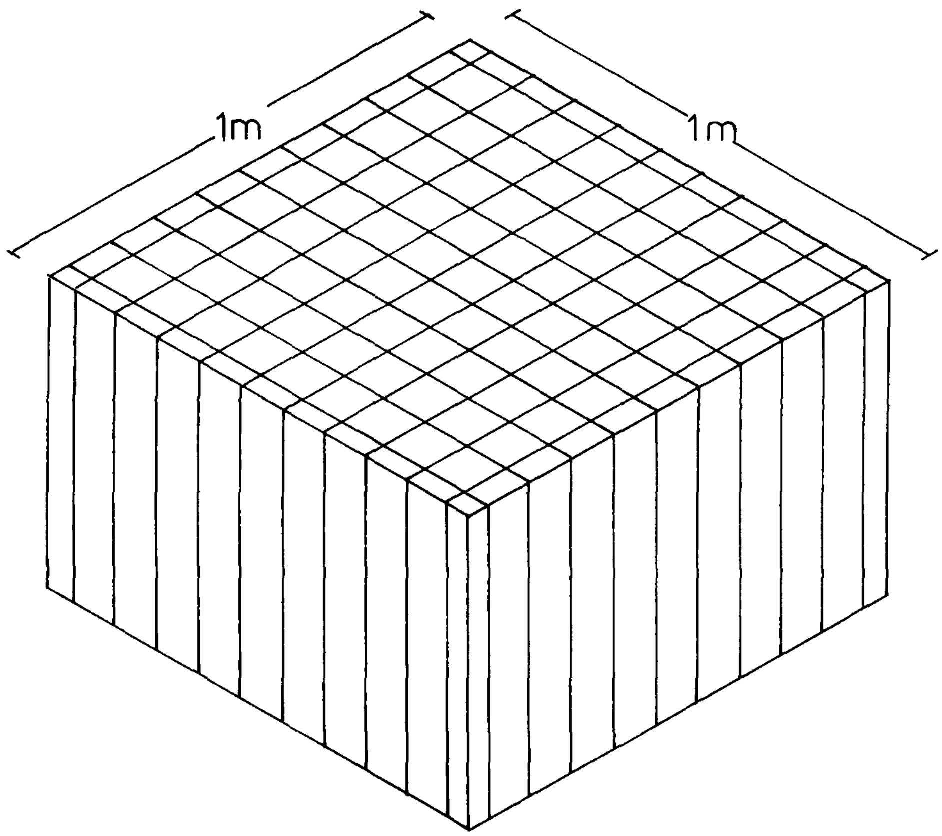


Figure G-2. Division of excavation quad into 10 x 10 m sections and columns for purposes of estimating stratum extent and volume.

The determination of whether a section is part of the stratum surface is based solely on the existence of nonexistence of strata at the perimeter of the unit. The importance of the prior section becomes apparent in that the existence or nonexistence of a stratum on missing walls is used in this section to determine the extent of the stratum. It was assumed that the section of surface to reject would always be determined by the two end points of a nonexistent boundary section. Two potential cases exist, one where the two end points are on the same wall and a second where the two end points are on separate walls. In the first case, a semicircle was inscribed and then the inner or outer section was determined to be the nonexisting part. For two points on different walls, a straight line was drawn between the two points and it was then determined which side of the line did not exist. Of course it was also possible to have situations where combinations of the above could occurred. Figure G-3 illustrates two simple cases and Figure G-4 illustrates two complex cases.

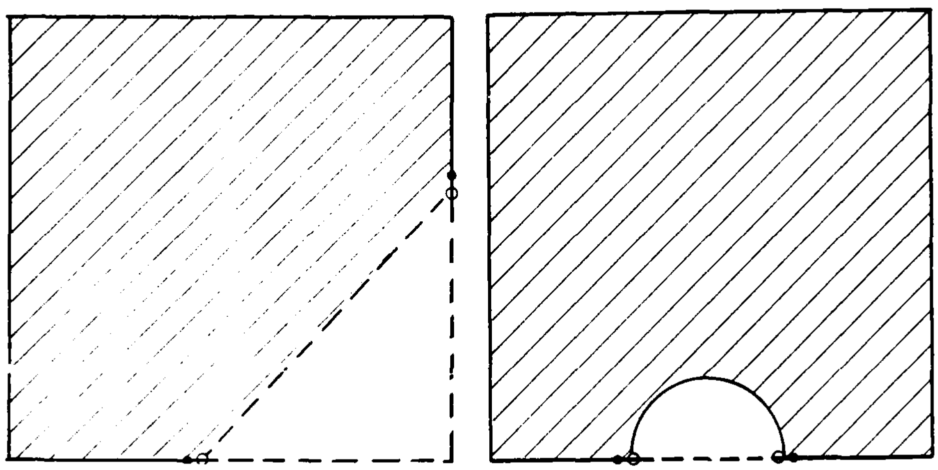


Figure G-3. Two simple cases of reconstructing stratum extent.

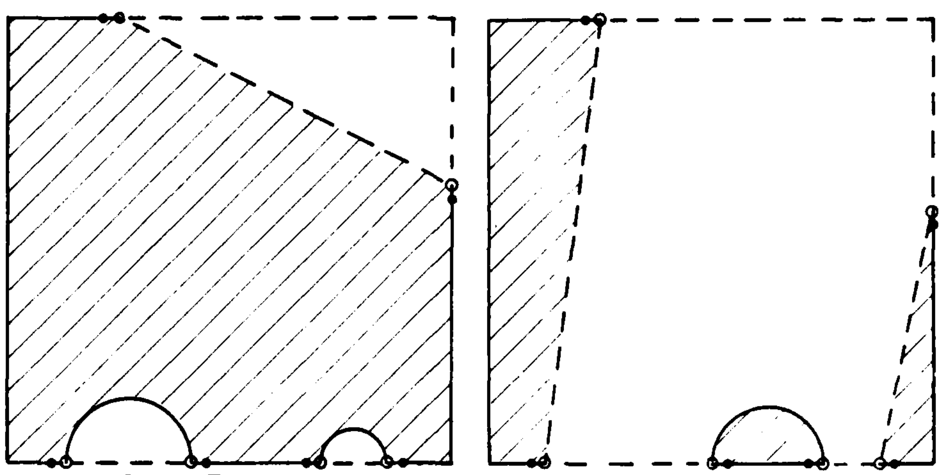


Figure G-4. Two complex cases of reconstructing stratum extent.

Note that an alternative to linking the end points of a discontinuity would be to link the end points of a continuity. This would have the same results in the simple cases but in very different results in the complex cases.

While either assumption might be used, there is no way of determining which is best. In different circumstances, each will be preferred to the other. Thus there does not appear to be an _a priori_ method for deciding which method to use. Hence, one must simply be chosen.

Finally, having ascertained the location of the surface, the elevation of the surface is predicted. The central elevation is predicted for each 10 x 10-cm section of the surface. A gravity model is used to evaluate the actual elevations.

Each elevation that is predicted uses all elevations from existing wall points. However, the different elevations are weighted inversely to their distance from the location to be predicted. The choice was made to use the distance taken to the fifth power. The result of using this high power is that the nearest elevation will have the greatest weight. This weighting is supported by the fact that strata surfaces are highly variable over the distances being measured. After the surface elevations have been predicted, this information is stored until all the strata have been evaluated. The surface of the arbitrary unit levels are dealt with in a similar fashion, but of course they only need to have elevations calculated for all internal points.

Once the extent and elevation of both the upper and lower boundaries of a stratum have been determined, the volume of that stratum can be calculated. The volume of the stratum in each 10x10 cm column calculated from the elevational difference between the upper and lower boundaries of the stratum. Summing this information for each stratum over all the columns that comprise the unit gives the total volume of the different strata. By interposing the arbitrary unit level elevations, the volumes of the 10x10 cm columns can be assigned to the appropriate strata. By locating the actual digitized data at the center of the 10 x 10-cm columns, the area of the column at the edge and corner is only partially in the unit. The corners are only 1/4 in the unit while the remaining edge column are 1/2 in the unit as shown in Figure G-2. These column volumes are weighted appropriated to give the corrected volume.

END

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