SITE STRUCTURE AND CHRONOLOGY OF 36 LAKE MOJAVE AND PINTO ASSEMBLAGES FROM TWO LARGE MULTICOMPONENT SITES IN THE CENTRAL MOJAVE DESERT, SOUTHERN CALIFORNIA

by

DENNIS LEROY JENKINS

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Dr. C. Melvin Aikens

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Title: SITE STRUCTURE AND CHRONOLOGY OF 36 LAKE MOJAVE AND PINTO ASSEMBLAGES FROM TWO LARGE MULTICOMPONENT SITES IN THE CENTRAL MOJAVE DESERT, SOUTHERN CALIFORNIA

Approved: ______________________________
Dr. C. Melvin Aikens

The environmental context and chronology of the transition from Early Holocene Lake Mojave to Middle Holocene Pinto cultural complexes of the southern California deserts has long been debated. This dissertation re-examines that debate, based on excavations at two major sites, and a rethinking of our most basic assumptions concerning culture change, cultural ecology, site formation processes, and dating techniques.

Archaeological data recovered from two Lake Mojave/Pinto sites at Fort Irwin, in the Central Mojave Desert, were analyzed in order to track chronologically

sensitive shifts in Lake Mojave-Pinto artifact assemblages through time. The archaeological assemblages recovered from Rogers Ridge and the Henwood sites were carefully analyzed into 36 depositional/analytical components for this task. Defining and chronologically ordering these assemblages required systematic consideration of artifact distributions and the development and application of 3 obsidian hydration rates based on associations with twelve 14C dates.

The analysis shows that the Pinto Complex occurred in three phases. Phase I, ca. 8,200 to 7,500 BP, is marked by the addition of Pinto points to the Lake Mojave assemblage and a continuation of the basic Lake Mojave settlement-subsistence patterns. Phase II, 7,500 to 5,000 BP, is marked by the gradual disappearance of Lake Mojave points from the archaeological assemblages. Dramatic decreases in assemblage size and increases in assemblage diversity mark changing logistical strategies to infrequent and specialized site use. Phase III, 5,000 to 4,000 BP, is marked by a strong predominance of Pinto points and slightly larger assemblages. Patterns of variation among assemblages suggest that logistical strategies continued to emphasize infrequent and specialized site useage.

The link between environmental change and shifting settlement-subsistence strategies was apparently relatively direct during the Pinto period. Environmental changes during

the Early Holocene (11,000 to 8,000 BP) Mojave Desert led to subsistence stress among populations of the Pinto Complex. Cultural adjustments resulted in smaller human populations moving through larger home territories. It is suggested that critical thresholds in communication and mating networks were crossed which resulted in the collapse of social systems in the Mojave Desert about 7,000 BP.

VITA

NAME OF AUTHOR: Dennis LeRoy Jenkins

PLACE OF BIRTH: Eugene, Oregon

DATE OF BIRTH: November 16, 1952

GRADUATE AND UNDERGRADUATE SCHOOLS ATTENDED:

University of Oregon
University of Nevada, Las Vegas

DEGREES AWARDED:

Doctor of Philosophy, 1991, University of Oregon
Master of Arts, 1981, University of Nevada, Las Vegas
Bachelor of Arts, 1977, University of Nevada, Las Vegas

AREAS OF SPECIAL INTEREST:

Archaeology of the Great Basin
Analysis of Settlement-Subsistence Patterns in the Great Basin
Replicative Lithic Use-Wear Studies
Prehistoric Ceramics of the Great Basin and Adjoining Areas
Obsidian Hydration Dating

PROFESSIONAL EXPERIENCE:

Archaeological Field School Supervisor, Department of Anthropology, University of Oregon, Eugene, 1989-1991

Assistant Field Director, Oregon State Museum of Anthropology, University of Oregon, Eugene, 1987-1991

Graduate Teaching Fellow, Department of Anthropology, University of Oregon, Eugene, 1990

Graduate Teaching Fellow, Department of Anthropology, University of Oregon, Eugene, 1987-1988

Archaeological Consultant/Crew Chief, Dames and Moore, Inc., San Diego, California, 1988

Archaeologist, Infotec, Inc., Eugene, Oregon, 1986-1987

Archaeologist, Heritage Research Associates, Inc., Eugene, Oregon, 1986

Archaeological Consultant, Wirth Environmental Services, A Division of Dames and Moore, Inc., San Diego, 1985-1986

Field Director, Fort Irwin Archaeological Project, Wirth Environmental Services, A Division of Dames and Moore, Inc., 1981-1985

Archaeological Field Technician, U.S. Forest Service, Reno, Nevada, 1981

Archaeological Consultant, Centuries Research, Inc., Montrose, Colorado, 1981

Ceramic Analyst, Museum of Natural History, University of Nevada, Las Vegas, 1981

Archaeological Field Technician, U.S. Bureau of Land Management, St. George, Utah, 1978

Archaeologist, Museum of Natural History, University of Nevada, Las Vegas, 1975-1980

AWARDS AND HONORS:

A Grant, Shared with C. Melvin Aikens, for $16,494 from the State Historic Preservation Office, Salem, Oregon, 1990

A Grant for $1,000 from the Department of Anthropology, University of Oregon, Eugene, 1988

A Grant for $300 from the Graduate Student Association, University of Nevada, Las Vegas, 1981

PUBLICATIONS:

Sheilagh Brooks, Richard Brooks, and Dennis L. Jenkins
1985 Pathology or the Borings of Invertebrates: a Case Study from Nevada. In HEALTH AND DISEASE IN THE PREHISTORIC SOUTHWEST, Edited by Charles F. Merbs and Robert J. Miller. Arizona State University Anthropological Research Papers, No. 34, pp. 9-17.

Charles L. Douglas, Dennis L. Jenkins, and Claude N. Warren
1988 Analysis of Faunal Remains from Four Lake Mojave and Pinto Period Sites of the Mojave Desert. In EARLY HUMAN OCCUPATION IN FAR WESTERN NORTH AMERICA: THE CLOVIS-ARCHAIC INTERFACE, Edited by Judith A. Willig, C. Melvin Aikens, and John L. Fagan. Nevada State Museum Papers No. 21. Carson City.

Dennis L. Jenkins
1989 The Ceramics of Afton Canyon (CA-SBR-85). In THE ARCHAEOLOGY OF THE AFTON CANYON SITE (CA-SBR-85) MOJAVE DESERT SAN BERNARDINO COUNTY, CALIFORNIA by Joan S. Schneider. San Bernardino County Museum Association Quarterly 36(1):137-142.

1988 Testing and Evaluation of Mitchell Cave (35WH122), Wheeler County, Oregon. Report 88-5, Museum of Anthropology, University of Oregon and Department of Transportation, Salem, Oregon.

1987 DATING THE PINTO OCCUPATION AT ROGERS RIDGE (4-SBR-5250): A FOSSIL SPRING SITE IN THE MOJAVE DESERT OF SOUTHERN CALIFORNIA. Journal of California and Great Basin Anthropology Vol. 9, No. 2, pp.214-231.

1986 FLOOD, SWEAT, AND SPEARS IN THE VALLEY OF DEATH: SITE SURVEY AND EVALUATION IN TIEFORT BASIN, FORT IRWIN, CALIFORNIA. Fort Irwin Archaeological Project Research Report No. 17, Coyote Press, Salinas.

1986 Ceramic Analysis. In ARCHAEOLOGICAL TESTING AND DATA RECOVERY AT DRINKWATER BASIN, FORT IRWIN, SAN BERNARDINO COUNTY, CALIFORNIA, Edited by Jackson Underwood. Fort Irwin Archaeological Project Research Report No. 22, Coyote Press, Salinas.

1985 ROGERS RIDGE (4-SBr-5250): A FOSSIL SPRING SITE OF THE LAKE MOJAVE AND PINTO PERIODS--PHASE 2 TEST EXCAVATIONS AND SITE EVALUATION. Fort Irwin Archaeological Project Research Report No.18, Coyote Press, Salinas.

1984 Ceramic Analysis: the Test Implications. In ARCHAEOLOGICAL STUDIES IN NO NAME WEST BASIN, FORT IRWIN, SAN BERNARDINO COUNTY, CALIFORNIA by Michael S. Kelly and Claude N. Warren. Fort Irwin Archaeological Project Research Report No. 16, Coyote Press, Salinas.

1984 Bitter Spring (4-SBr-2659) Testing and Survey. In BITS AND PIECES OF PREHISTORY AT FORT IRWIN: TESTING OF KD-25, THE KNOLL SITE, CROSSROADS SITE, GARLIC SPRING AND BITTER SPRING; AND SURVEY OF AREAS 12A AND 12H, FORT IRWIN, SAN BERNARDINO COUNTY, CALIFORNIA by Elizabeth J. Skinner.Fort Irwin Archaeological Project Research Report No. 12, Coyote Press, Salinas.

1984 Ceramics from the Drinkwater Spring Site (4-SBr-3831). In AN INTENSIVE CULTURAL RESOURCE SURVEY AROUND DRINKWATER SPRING AND SOUTH OF LEACH LAKE, FORT IRWIN, SAN BERNARDINO COUNTY, CALIFORNIA by Richard Stockton. Fort Irwin Archaeological Project Research Report No. 5, Coyote Press, Salinas.

1982 TEST EXCAVATION AND SIGNIFICANCE ASSESSMENT OF ARCHAEOLOGICAL SITE 4-SBr-4448, A ROCKSHELTER IN THE DRINKWATER BASIN, SAN BERNARDINO COUNTY, CALIFORNIA. Fort Irwin Archaeological Project Research Report No. 2, Coyote Press, Salinas.

1981 CLIFF'S EDGE: A PUEBLO 1 SITE ON THE LOWER VIRGIN RIVER. Master's thesis on file at the Department of Anthropology, University of Nevada, Las Vegas.

Dennis L. Jenkins and Thomas J. Connolly
1990 ARCHAEOLOGY OF INDIAN GRADE SPRING: A SPECIAL FUNCTION CAMPSITE ON STINKINGWATER MOUNTAIN. University of Oregon Anthropological Papers No. 42, Eugene.

Dennis L. Jenkins and Claude N. Warren
1985 OBSIDIAN HYDRATION AND THE PINTO CHRONOLOGY IN THE MOJAVE DESERT. Journal of California and Great Basin Anthropology Vol.6, No.1, pp.44-60.

Dennis L. Jenkins, Claude N. Warren, and Thomas Wheeler
1986 TEST EXCAVATION AND DATA RECOVERY AT THE AWL SITE (4-SBr-4562), A PINTO SITE AT FORT IRWIN, SAN BERNARDINO COUNTY, CALIFORNIA. Fort Irwin Archaeological Project Research Report No. 13, Coyote Press, Salinas.

Mark Q. Sutton, Christopher B. Donnan, and Dennis L. Jenkins
1987 THE ARCHAEOLOGY OF SOUTHCOTT CAVE, PROVIDENCE MOUNTAINS, CALIFORNIA. Journal of California and Great Basin Anthropology Vol.9, No. 2, pp.232-250.

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CHAPTER I

RESEARCH PROBLEMS AND ANALYTICAL APPROACH

Introduction

The Mojave Desert is today, and has been for thousands of years, a region of severe climate and impoverished biota. When the first Paleoindians arrived, however, the Mojave Desert was a much more biotically productive mosaic of microenvironments, a patchwork of shrub-steppe and low elevation forests. The Owens, Mojave, and Amargosa rivers invaded the desert from three directions, north, west, and east, ultimately flowing together into Lake Manly in what is now Death Valley. In the process they filled Lake Mojave, China Lake, Searles Lake, and Panamint Lake forming a system of waterways that stretched from the slopes of the Sierras into what is now southern Nevada.

The streams, springs, and marshes along this system provided comparatively rich mesic environments which served to congregate plant and animal resources in the lowlands. These concentrations of subsistence resources effectively 'tethered' early human occupants to a relatively short foraging range around the water sources (Willig 1988:478). The mosaic of microenvironments typical of this time period (ca. 12,000 to 11,000 BP) probably supplied people a relatively broad diet, though artifact and faunal assemblages suggest a subsistence focus (the most culturally significant subsistence resource(s) within a particular cultural system [Warren 1986a]) based on the hunting of artiodactyls: deer, antelope, and mountain sheep (Douglas et al. 1988; Warren 1990).

Early Holocene (11,000 to 7,000 BP) human populations of the Mojave Desert region were forced to adapt to increasingly arid conditions as the cool/moist climatic regime of the late Pleistocene slowly gave way to the aridity and heat of the mid-Holocene. As plant productivity and diversity were reduced stress increased on the animals and the human populations dependent upon both. Occasional short term reversals of this drying trend may have temporarily stabilized these populations but the general trend toward aridity would have undoubtedly forced change in both animal and human populations.

Reductions in plant productivity probably led first to a general scattering of both animal and human populations, followed by a reduction in both. People and large mammals would have been most intensively affected. Cultural systems responding to this increasing stress probably shifted their emphasis among the various food items within their subsistence base. This period of changing subsistence techniques and cultural adjustment is termed the Early Archaic.

The resulting adjustments within the subsistence base do not necessarily mean that people changed their subsistence focus immediately. Whenever possible, they may have continued to emphasize their pre-existing subsistence focus, i.e. artiodactyl hunting, by making adjustments in social organization, population, and personnel movements. These adaptations may have temporarily prolonged the demise of their subsistence focus. The additional cost of maintaining the 'old system' however, and perhaps even the initial effectiveness of social readjustments, would have eventually made the artiodactyl subsistence focus maladaptive and caused its collapse (Warren 1990).

Whether or not humans managed to successfully adapt to the mid-Holocene (7,000 to 4,500 BP) environment of the Mojave Desert, which was apparently hotter, drier, and less biotically productive than that of today, is a major question. The objective of the present work is to systematically characterize a number of archaeological components which date from early through mid-Holocene times in the Mojave Desert, to determine whether or not there was temporal and cultural continuity between them. This question--usually posed in terms of whether or not an occupational and cultural break separated the Lake Mojave and Pinto complexes of the southern California deserts--has been much discussed.

The history of research on this problem is reviewed in detail below. In the following chapters, new data from Rogers Ridge and the Henwood site are analyzed in terms of site structure, chronometric controls, and assemblage variation as a means of shedding new light on this long-standing question.

The Rogers Ridge and Henwood sites are located on the Fort Irwin Military Reservation in the central Mojave Desert of southern California (Fig. 1). They were excavated by the Fort Irwin Archaeological Project which from 1981 to 1985 was headed by personnel of Wirth Environmental Services, Dames and Moore, Inc. under contractual agreement with the Interagency Archeological Services Branch Division of the National Park Service, Western Region who administered the contracts for the U.S. Army.

These sites were excavated because they were known to contain valuable deposits capable of addressing a series of questions posed in the <u>Fort Irwin Historic Preservation Plan, Vol. 2</u> (Warren 1986a) and because their destruction was considered unavoidable. I served as the Field Director during both excavations and acted as the Project Archaeologist, in charge of research and reporting, on the Rogers Ridge project. Sheila Vaughan was the Project Archaeologist in charge of the Henwood site project.

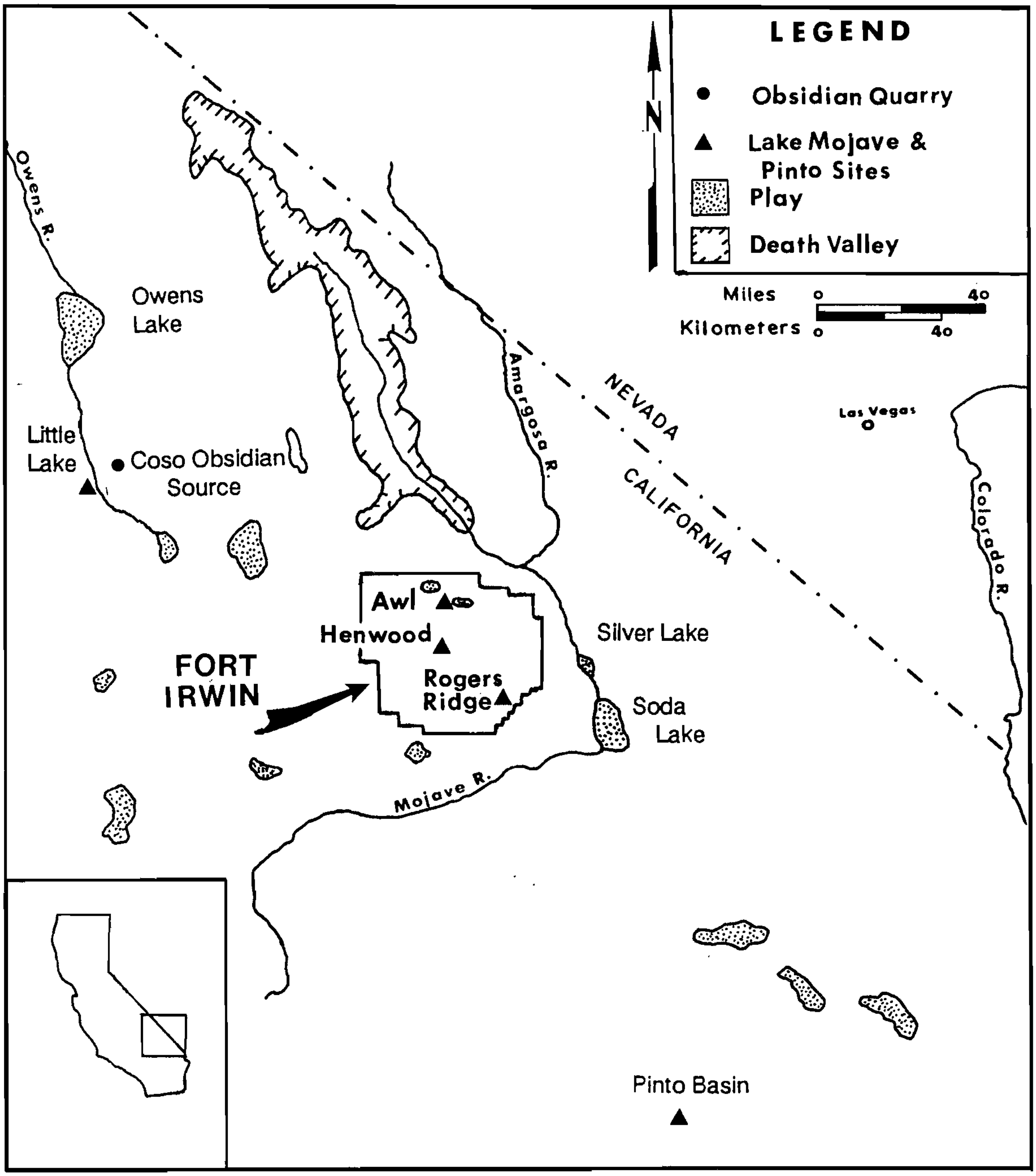

Figure 1. Fort Irwin in relation to some important features of the Mojave Desert. (After Jenkins 1987:Fig. 1).

In preview, data from these sites suggest that the transition from Lake Mojave to Pinto complexes occurred earlier than proposed by most researchers (Jenkins 1987; Warren 1990). They also lead to the suggestion that the current welter of conflicting opinions on what the Pinto complex represents culturally, and when it occurred in the Mojave Desert, can be resolved by discussing cultural developments there in terms of a three phase sequence spanning the time period from roughly 8,200 to 4,000 BP.

The key points of the interpretation developed in this study are enumerated below.

1) The Pinto period actually consists of three phases, each characterized by a distinctive subsistence-settlement pattern;

2) The Early Pinto Phase began with the end of the Lake Mojave period (ca. 8,200 BP) and ended with the desiccation of the Altithermal maxima (ca. 7,000 BP). The Early Pinto phase, with its many close similarities to Lake Mojave in technology and settlement-subsistence pattern, differs from Lake Mojave in the fading of long stemmed Lake Mojave type projectile points and crescents from, and the addition of Pinto points to, the Lake Mojave tool kit. As this period wore on people were more sparsely distributed throughout the Mojave Desert and the subsistence focus shifted from the hunting

of artiodactyls to the more intensive exploitation of rabbits and reptiles.

3) The Middle Pinto phase (7,000 to 5,000 BP) denotes the least well-represented of the three Pinto phases, a reflection of the reduced human carrying capacity of the Altithermal desert. Relatively few projectile points were made during this time of limited game resources; those that were used were a mixture of Pinto and Leaf shaped points. Sites of this phase were few and ephemeral because the few people then present in the Mojave were widely scattered and moving frequently. Site erosion in this arid period of unstable vegetation frequently followed occupation, and few radiocarbon-datable features survived. In short, site signatures from the Middle Pinto phase are weak, and such sites are seldom identified by archaeologists as important enough to be excavated.

4) The Late Pinto phase (5,000 to 4,000 BP) represents a time when the Mojave Desert once again received enough rainfall to support a richer biota, and human populations expanded and adjusted to the improved environmental conditions. Late Pinto sites may be small, but can give the impression of being relatively substantial because they have distinctive site signatures marked by large numbers of biface

fragments. Increased interaction with populations fringing the Mojave Desert ultimately led to the adoption of new artifact types, including Gypsum, Elko, and Humboldt points. The addition of these types to the Late Pinto assemblage marks the opening of the subsequent Gypsum Period.

Periods and Phases as Organizing Concepts

Warren (1980a) employs the concept of 'periods' to organize the prehistory of the Mojave Desert. In his view,

> "Period" is defined as a "unit of time" or "unit of contemporaneity," and as such is to be distinguished from cultural units or "units of similarity" (Rowe 1962). . . the period is . . . identified by the occurrence of a time sensitive artifact type termed period marker. The period marker identifies only the unit of time and not the cultural content. The cultural unit, as defined here, includes the taxonomic divisions and units traditionally used by the archaeologist. Complex, phase, stage, tradition, culture, etc. are all based on some degree of similarity of the cultural content of the archaeological components included. The concept used usually varies with the problem with which the archaeologist is coping or the bias of the archaeologist. However, the critical factor is that the basis for definition is similarity in cultural content (Warren 1980a:16-18).

Thus, the Lake Mojave period, as defined by Warren and Crabtree (1986:184), is a unit of time (12,000 BP to 7,000 BP) marked by the presence of Lake Mojave and Silver Lake projectile points. The Lake Mojave complex is the entire cultural assemblage dated to this period. Similarly, Warren and Crabtree (1986:184) define the Pinto period as a unit of time (7,000 BP to 4,000 BP) marked by the presence of Pinto points. The Pinto complex is the cultural assemblage of this time period. This conception is adopted in the present study, though the specific dates are modified, based on evidence to be presented.

The "Long" and "Short" Cultural Chronologies of the Mojave Desert

Though Warren and Crabtree (1986:184) argue for an unbroken cultural transition between the Lake Mojave and Pinto complexes, others have suggested that the two were separated by as much as 2,000 years of non-occupation in the Mojave Desert (Hunt 1960; Kowta 1969; Wallace 1958, 1962, 1977). The concept of an Altithermal hiatus between the Lake Mojave and Pinto complexes was proposed three decades ago by Wallace (1958). Opposition to the concept soon developed based primarily on the close similarity between the tool assemblages of both complexes (Simpson 1965:18,20,45; Susia 1964:31; Tuohy 1974:100-101; Warren and Crabtree 1986:184). Warren (1980a:36; 1980b:75) coined the reference to "long" and "short" chronologies to describe the different placements of the Pinto period in the chronological sequences proposed by various authors for the Mojave Desert. That terminology will be retained here for convenience in shorthand reference to the problem.

Proponents of the "long" chronology contend that similarities in the tool assemblages and site locations of the Lake Mojave and Pinto complexes are so strong they must indicate a gradual transition from Lake Mojave into Pinto. If a cultural hiatus on the order of two thousand years existed between Lake Mojave and Pinto, considerable change should have occurred in the tool assemblages. Significant changes did occur between each of the later cultural units of the region (i.e. the Gypsum, Saratoga Springs, and Shoshonean periods). The Gypsum complex contained higher quantities of ground stone, thin flake scrapers, and elaborate ceremonial and personal decorations than are present in Lake Mojave and Pinto assemblages. The Saratoga Springs and Shoshonean periods are marked by the added presence of distinctive ceramic and projectile point types. But, to reiterate, there is little disparity between the Lake Mojave and Pinto complexes and the differences that do exist between them suggest technological development amidst cultural continuity.

Proponents of the "short" chronology contend there is no acceptable evidence that the Pinto complex dates any earlier than 5,000 to 6,000 BP in the Mojave Desert. In the west-central Great Basin, a Pinto-like complex is assigned these dates (Layton and Thomas 1979; O'Connell 1975; Thomas 1981, 1983) and the Pinto complex is considered to be the result of adaptations to the refilling of shallow desert lakes during an early post-Altithermal wet phase (ca. 4,500 to 2,000 BP). In this interpretation, both the early postglacial and the later Mid-Holocene were wet periods, flowing and standing water in similar locations, and relatively high biotic productivity in the desert. This is thought to have resulted in close similarities (or identity) between the subsistence activities and settlement patterns of Lake Mojave (pre-Altithermal) and Pinto (post-Altithermal) complexes: the same sites that were occupied during the Lake Mojave period would have been re-occupied during the much later Pinto period. This line of argument then explains away the duplication of Lake Mojave tool types within Pinto assemblages, and the frequently found associations of Lake Mojave and Pinto artifacts, as due simply to chance mixing of assemblages originally separated by 2,000 years or more.

Background: The Lake Mojave Complex

The tools of the Lake Mojave complex include weakly shouldered, long stemmed Lake Mojave points and shorter stemmed Silver Lake points with more pronounced shoulders and shorter stems. These are the diagnostic markers of the Lake Mojave period. The rest of the cultural assemblage includes choppers, several varieties of domed and keeled scrapers, crescents, plano-convex knives, double convex knives, spoke shaves, and blades (Amsden 1937). Until recently ground stone was not considered a part of the Lake Mojave assemblage. However, Warren (1990) has recently shown that ground stone was present in small quantities, in the form of poorly developed slab metates and manos. This tool kit suggests a heavy dependence on big game hunting (Amsden 1937:90; Rogers 1939:27; Wallace 1958:11), in conjunction with generalized foraging that included small animal and seed production systems.

The Lake Mojave complex has generally been interpreted as a big game hunting tradition frequently associated with lacustrine settings. Amsden (1937:90) suggested the Lake Mojave lifeway was similar to that of the prehistoric bison hunters of the Great Plains. Rogers (1939:27) and Wallace (1958:11), noting the apparent lack of any form of ground stone for processing plant materials, believed the assemblage provided conclusive evidence that big game hunting was emphasized during the Lake Mojave period but did not believe the Lake Mojave people were specialized hunters. Warren (1967) interpreted the related San Dieguito complex as an extension of a <u>generalized</u> hunting pattern, implying no specialization in the hunting of particular animal species but rather an emphasis on large game generally, with small game, waterfowl, and fish supplementing the diet. He suggested this pattern was originally established in the Northwest, and spread down the east side of the Sierras and Peninsular ranges to the pluvial lakes of the Great Basin and California deserts. He noted that the surroundings of these now dry desert lakes would in early Holocene time have been similar to the forests and grasslands of the northwest.

In a similar vein Bedwell (1970; 1973) and Hester (1973) proposed the concept of a Western Pluvial Lakes Tradition, incorporating the late Pleistocene/early Holocene (11,000 to 8,000 BP) cultural complexes associated with pluvial lakes of the western Great Basin. This was seen as a generalized cultural and technological pattern. The concept emphasized adaptation, by an extremely successful and rapidly expanding human population, to a specialized lacustrine environment which was being enhanced by the slow desiccation of the late Pleistocene lakes. According to this concept, these lakes, while in the process of slowly drying up, actually increased in productivity as they became shallower. Marshes formed around lake fringes were visualized as extremely productive, providing plenty of water and plant growth to attract both animals and humans. The tool kit universally employed by the marsh oriented populations of this period included

> well-controlled percussion flaking, non-stemmed and non-notched lanceolate projectile points, stemmed (with round or indented bases), large lanceolate and ovate knives, and substantial numbers of large and moderate-sized scrapers, gravers, and use-worked flakes (Bedwell 1973:170).

Hester (1973:65), while endorsing the Western Pluvial Lakes Tradition concept, identified a wider range of contemporaneous projectile point types than had Bedwell. He added a few non-point tools to the cultural inventory as well. He stated that Western Pluvial Lakes Tradition

> Lithic traits consist of Lake Mohave, Haskett (and "Haskett-like"), Cougar Mountain, and related lanceolate points, lanceolate points with concave bases (cf. Black Rock Concave Base), probably also fluted points, long-stemmed points similar to Lind Coulee, crescents (Great Basin Transverse specimens), and possibly core-blade and burin technologies.

The evidence which led to the concept of the Western Pluvial Lakes Tradition is the widespread occurrence of sites with similar technologies around the fossil shores of early Holocene lakes of the Great Basin. The equation of such a site distribution with a specialized dependence on lacustrine resources has been rightfully questioned, however (Aikens 1983:244). Excluding the crescents, which have been interpreted as specialized projectile points designed for the taking of waterfowl (Clewlow 1968; Tadlock 1966), there is nothing in the Lake Mojave tool assemblage which suggests a specialized adaptation to lacustrine resources. Indeed, most of the tool assemblage comprises relatively large lanceolate and stemmed projectile points, heavy domed and keeled scrapers, gravers, choppers, and bifacial knives. These suggest that large game procurement and processing systems were an important part of the subsistence pattern.

The Lake Mojave complex has been traditionally cast against a late Pleistocene environmental background seen as much wetter and lusher than exists today in the Mojave Desert. The Campbells (1937) were the first to identify the Lake Mojave 'culture' which they attributed to a very early time period on the basis of its apparent association with high beach strands of late Pleistocene Lake Mojave. Rogers (1939) denied the great antiquity attributed to the Lake Mojave complex by the Campbells. He suggested that the association of Lake Mojave complex sites with ancient lake shores was a fortuitous occurence caused by people camping near later playa lakes which in wet periods temporarily refilled to the ancient levels.

Warren's (1967) analysis, description, and dating (9,030+/-350 BP and 8,490+/-400 BP) of the San Dieguito complex (in the coastal range of southern California), which has clear technological relationships to the Lake Mojave complex, bolstered the Campbell's argument for the great antiquity of the Lake Mojave complex. Later, Ore and Warren (1971; Warren and Ore 1978) radiocarbon dated (9,640+/-240 BP and 10,270+/-160 BP) fresh water mussel shells found among cultural materials which had been buried in lake beach deposits <u>prior to</u> the last high stand of Lake Mojave. This put to rest the argument against an association between the Lake Mojave cultural materials and the late Pleistocene-early Holocene lake itself.

Cultural materials of the Lake Mojave complex have been 14C dated in the Central Mojave Desert as early as 10,270 BP

(Warren and Ore 1978; Ore and Warren 1971) and as late as 8,470 BP (Warren 1990). Warren and Crabtree (1986:184) suggest the Lake Mojave period dates from 12,000 BP to 7,000 BP, roughly correlating with the Anathermal period proposed by Antevs (1948, 1955).

Background: The Pinto Complex

The Pinto complex, like the Lake Mojave complex, was first identified by the Campbells (1935). They discovered a series of campsites scattered for about 5 miles along the banks of the main wash that cuts across Pinto Basin. Working with professionals in geology, paleontology, and archaeology they described an ancient culture of hunters who camped along the banks of a wide, marshy Pinto River at the close of the Pleistocene period. The distinctive artifactual marker of this complex was the weakly shouldered, concave based Pinto point. Evidence for the collection and processing of small seeds was found in the presence of metates, manos, and pestles at the desert sites. The rest of the Pinto assemblage was characterized by keeled scrapers, choppers, worked flakes, leaf-shaped projectile points, and bifacial knives (Amsden 1935). These were artifacts suggesting a primary emphasis on the hunting and processing of large game.

Subsequent research has shown that Pinto assemblages are remarkably similar to Lake Mojave assemblages in the tool classes represented, except that they lack the crescents and domed scrapers of the Lake Mojave complex and may contain more groundstone artifacts. These few differences are not pronounced, since ground stone artifacts are found on some Lake Mojave sites and crescents are not found on all Lake Mojave sites.

The Campbells (1935) initially assigned the Pinto period a date of 12,000 BP, to coincide with the end of the Pleistocene. This was the latest period they thought would have been wet enough to maintain a running river in the Pinto Basin which could account for the many camps they had found along Pinto Wash. The subsequent 14C dating of the Lake Mojave-San Dieguito complex to this paleoclimatic period has, however, eliminated further serious consideration of placing Pinto in such an early time frame (Warren 1967; Warren and Ore 1978). As I have pointed out elsewhere,

> Currently, the most seriously considered dates for the advent of Pinto points are 5000 B.C. (Warren and Crabtree 1986), 4000 B.C. (Bettinger and Taylor 1974), and 3000 B.C. (Wallace 1962; Kowta 1969; Hester 1973). The proposed date of 2000 B.C. (Harrington 1957; Lanning 1963) is now generally considered too late and can be eliminated from further consideration. None of the proposed dates have been confirmed by radiocarbon dating of materials from sites in the Mojave Desert. Instead, authors have proposed dates by correlating the Pinto Period in the Mojave Desert with radiocarbon dates of various "Pinto" assemblages in other areas of the Great Basin (i.e. Monitor Valley [Thomas 1981] and Surprise Valley [O'Connell 1975], or relied on their own interpretations of human response to the

> desiccation of the desert after the Lake Mohave Period (Jenkins 1987:214).

Radiocarbon dates for Pinto components in the Mojave Desert are nearly non-existent and the validity of most of the few that do exist has been questioned on various grounds (Warren 1980a). Therefore, efforts to date the few Pinto components excavated within the Mojave Desert have generally involved typological cross-dating with 'Pinto' assemblages dated by 14C in the west-central Great Basin. The application to the Mojave of dates for 'Pinto' components in Great Basin sites has been severely criticized on the grounds that the points identified as 'Pinto' by most Great Basin specialists do not match the Pinto specimens found in the Mojave Desert (Warren 1980b). This is an extremely important consideration because the entire concept of cross-dating archaeological specimens rests on the assumption that the items compared are typologically the same. If they are not, the results are unreliable.

Thomas' (1981) work at Gatecliff rockshelter, in the Monitor Valley of central Nevada, has been extensively cited in relation to dating Pinto components in the Great Basin. Thomas (1983:183-186) proposed combining points with contracting and split stems, previously identified as Gypsum Cave, Pinto, Bare Creek Eared, and Little Lake types, into a new Gatecliff series. The Gatecliff series points are temporally diagnostic of the Devil's Gate phase at Gatecliff

Shelter. This phase has been dated by Thomas from 5,000 to 3,300 BP, based on 13 radiocarbon dates associated with 48 projectile points (Thomas 1983:174-177).

If the Gatecliff series points of central Nevada were in fact equivalent to the Pinto series points of the Mojave Desert, then grounds would exist for applying the dates associated with Gatecliff points to the Pinto series also. But Vaughan and Warren (1987:208), applying Thomas' (1981) analytical techniques to a series of Pinto points from the Awl site in the Mojave Desert, have concluded that these points are not the same as the Gatecliff points. They further note that the lithic raw material used in making the points of the two samples did not play a significant part in determining the morphological variation exhibited between them. They concluded therefore (Vaughan and Warren 1987:212) that Gatecliff and Pinto types cannot be equated, and should remain as separate series showing different morphological and technological attributes. Thus, the typological cross-dating of Pinto sites in the Mojave Desert to the time period described for Gatecliff series points in the Great Basin is probably invalid, and other methods of dating Pinto components must be applied.

<u>The Present Research: Chronology and Site Structure of Two Lake Mojave-Pinto Sites in the Mojave Desert</u>

A series of radiocarbon dates and obsidian hydration readings were acquired at three large, multicomponent Lake Mojave/Pinto sites at Fort Irwin, in the Central Mojave Desert (Basgall and Hall n.d.; Jenkins 1985, 1986, 1987; Jenkins and Warren 1985; Jenkins et al.1986; Warren 1990). Quite large assemblages of cultural materials were also collected from these sites, offering an opportunity to characterize datable cultural assemblages from both Lake Mojave and Pinto components. The data from two of these sites, Rogers Ridge and the Henwood site, are analyzed here to offer a fresh perspective on the foregoing problems.

This study is organized in terms of the considerations just outlined. The dominant theme of the research is to <u>track chronological shifts in Lake Mojave-Pinto artifact assemblages through time</u>. The paragraphs below outline the assumptions and structure of the analysis more specifically.

Extremely mobile hunter-gatherer groups (e.g. the Lake Mojave and Pinto people) exhibit subsistence strategies incorporating little or no food storage. Consequently, these groups operate within the limiting constraints of regional and local environmental regimes, having little insulation from their immediate influences. The choices they make are intended to maximize their chances of survival. These choices result in the distribution of artifacts at locations where cultural activities are conducted. Therefore, interpreting the cultural remains found at each location is at least partially dependent upon understanding the choices of environmental settings available to the occupants. Chapter II provides a description of the local environment and a brief paleoenvironmental reconstruction covering the time periods when the sites were occupied.

The articulation of cultural systems within natural and social environments results in the cultural assemblage found at each location. In Chapter III the artifacts recovered from the sites under study have been organized, for later comparative purposes, into a series of types sharing morphological and technological characteristics.

Chapter IV presents the methods and assumptions employed in the formation, dating, and analysis of the cultural assemblages studied here. This study of assemblages involves three primary phases of analysis. First, it was necessary to define what artifacts belonged together before beginning to identify changes in artifact assemblages through time. Definition of site structure was the first and most extensive effort of the study. The approach is outlined in Chapter IV and Chapters V and VI present fully the descriptions and analyses of the individual site components.

Second, it was necessary to date and chronologically order these assemblages. This required the careful consideration of the radiocarbon dates available for these sites and the development of a number of obsidian hydration rates. The third phase of the assemblage analysis was to investigate the amount of similarity and variation in the assemblages as it was expressed relative to time. Again, Chapter IV outlines the basic methods and asssumptions, and Chapter VII presents the results and summary of this stage of the analysis.

Finally, Chapter VIII presents an integration of the new data generated by these analyses within a regional perspective on the Lake Mojave-Pinto transition. The three phases of the Pinto period, sketched in preview earlier in this chapter, offer a resolution to the question of cultural change in the southern California deserts, and to the "Long" vs. "Short" chronology debate.

CHAPTER II

ENVIRONMENTAL BACKGROUND AND THE ARCHAEOLOGICAL SITES IN THEIR LOCAL SETTINGS

Introduction

Humans have developed cultural and technological systems to insure their survival in a variety of natural environments. Among mobile hunters and gatherers these systems are designed to facilitate the collection and processing of natural resources, while also ensuring the cohesion and survival of the cultural group. These systems are shaped by the choices of the participants in response to both physical and cultural needs and have both an evolutionary and historical perspective about them.

Variations in the environment require adaptive responses by mobile hunter-gatherer groups if they are to optimize their chances of survival. The archaeological remains presented in this study represent the refuse left behind as participants of the Lake Mojave-Pinto complexes attempted to adapt to the dynamic environments of the Early to Mid-Holocene. It is vital, therefore, that we understand the environmental and climatic settings these groups operated in if we want to understand the context of observed variation within these archaeological assemblages.

A comprehensive description of the central Mojave Desert environment surrounding Fort Irwin has recently been completed by Basgall et al. (1988). The purposes of this study will not be served by reiterating those data. Instead, a brief account of the regional environment and paleoenvironment will be given here followed by a description of the local landscapes which surround the sites under discussion--Tiefort Basin and Nelson/Bicycle Wash.

The Mojave Desert

The study area is located on Fort Irwin in the central Mojave Desert of southern California (Fig. 1). The northern border of the Mojave is generally set at about the 37th parallel, the latitude at which Mojave Desert floral patterns (most notably creosote and mesquite asssociations) change toward those of the Great Basin (i.e. shadscale and sagebrush associations). This vegetational change occurs along a somewhat irregular east to west boundary zone from southern Nevada through Death Valley and the Panamint, Saline, and Eureka valleys, and across the southern end of Owens Valley to the Sierra Nevada mountains. The western border of the Mojave is well defined by its extension south along the eastern Sierra Nevada front to the southeastern end of the Little San Bernardino Mountains. Here, at about the 34th parallel, the Mojave is conventionally separated from the Colorado Desert along a line running due east to the Colorado River drainage. From the Colorado, the boundary runs north back into southern Nevada, as far as the lower reaches of the Virgin and Muddy rivers (Basgall et al. 1988; Warren 1984; Warren and Crabtree 1986; Weide 1982; Wells 1979).

The Mojave is an extremely arid desert with temperatures that fluctuate from below freezing (18-22 degrees F) in winter to a recorded summer high in Death Valley of 134 degrees F (Warren 1984:342). Surface water is rare in the Mojave Desert, where annual precipitation does not generally exceed 100 mm, and average annual temperatures are generally 65-70 degrees F (Thompson 1929: 68-95). Precipitation is thus low and evaporation is high. Under these conditions water from light rainstorms seldom soaks into substrata to become ground water. Consequently, ground water is dependent on storms of greater magnitude for recharge. Such storms generally occur between November and March when as much as 85% of all annual precipitation occurs (Thompson 1929:92). Summer and early fall storms should not be entirely discounted, however, as 15-30% of the local water budget may fall within a very short period, causing heavy local flooding and considerable discharge into local playas. The plants of most subsistence value to humans benefit little from these rains since most of their seeds ripen and drop off in late spring and early summer. The effects of such events on the local water table are generally minimal since much of the water is lost to evaporation. Springs and seeps therefore generally occur only along fault lines where water bearing strata have been fractured near the surface. Water flowing through deep channels of permeable materials may also be forced to the surface by tectonic displacements such as occurs at Afton Canyon on the Mojave River south of Fort Irwin.

Flora

Vegetation in the Mojave Desert is sparse and typical of the Lower Sonoran life zone. This life zone has been subdivided by Bradley and Deacon (1967) into 6 plant communities, i.e. the Creosote Scrub, Saltbush Scrub, Shadscale Scrub, Blackbush Scrub, Desert Woodland, and Desert Springs and Marshes communities. Each is characterized by a number of dominant plant species which are partial to particular soil types, elevations, temperatures, and soil moisture regimes.

The predominant plant community at Fort Irwin is Creosote Scrub. The dominant plant species of the Creosote Scrub community are the hardy creosote (*Larrea tridentata*), bursage (*Ambrosia dumosa*), and saltbush (*Atriplex* spp.) plants. The creosote bush thrives in non-saline, well-drained alluvial deposits at elevations ranging from sea level to ca. 1200 m (Burk 1977:873-874; Vasek and Barbour 1977:837). It grows in large circular clusters, expanding outward from the center by a unique cloning process. This process results in circular bush clusters as the center of the plant dies off and the new plants continue to grow. In favorable locations with deep permeable alluvial deposits these plants may reach heights of 2 to 3 m and grow in relatively dense stands. They are, however, extremely brittle and do not stand up well to vehicular damage. Extensive military exercises at Fort Irwin have made this plant much less prevalent in the contemporary landscape than it would be under conditions of no disturbance.

Other plants common to the Creosote Scrub community are mormon-tea (Ephedra spp.), allscale (Atriplex polycarpa), wingscale (A. canescens), cacti (Opuntia spp.), and Yucca spp.. Other herbs and bushes, some of which were exploited as food items according to ethnographic accounts (Knack 1980), were desert thorn or Anderson wolfberry (Lycium andersonii), chia (Salvia columbariae), wild buckweat (Eriogonum spp.), desert mallow (Sphaeralcea ambigua), and little-leaf rattany (Krameria parvifolia).

Saltbush Scrub is the second most common plant community at Fort Irwin. It is generally found at lower elevations around the peripheries of playas. The plants of this community are characteristically more salt tolerant than the plants of the Creosote Scrub community. Varying salt tolerance levels of different plants have given rise to two phases of the Saltbush Scrub community, the xerophytic and halophytic phases. These phases tend to reflect the presence of highly mineralized ground water near the surface, or are formed on surfaces, such as playas, from which water evaporates after each storm.

The phases of the Saltbush Scrub community form concentric rings around playas and springs. Halophytic phase plants grow nearest the water source; beyond them grow xerophytic phase plants, which then intergrade at their outer margins with Creosote Scrub community plants growing in the non-saline soils above the basin floors. The halophytic phase of the Saltbush Scrub community is found in very salty and alkaline soils on and around playas, sinks, and springs (C. Hunt 1966). Plants included in this phase are pickleweed (<u>Allenrolfea occidentalis</u>), saltgrass (<u>Distichlis</u> spp.), glasswort (<u>Salicornia subterminalis</u>), sea-blite (<u>Suaeda</u> spp.), and greasewood (<u>Sarcobatus vermiculatus</u>).

Xerophytic phase plants of the Saltbush Scrub community, on the other hand, are somewhat less salt tolerant and tend to be found in coarser, better drained soils than the halophytic plants. Consequently, they usually occupy positions further from the playas, where they intergrade with surrounding plant communities. Plants common to the xerophytic phase are shadscale (<u>Atriplex</u>

confertifolia), allscale, and desert holly (A. hymenelytra).

The Shadscale Scrub community is not so widespread at Fort Irwin, being defined most accurately for the slightly higher, cooler elevations of the southern Great Basin. Elements of this community are relatively common, however, in rocky slope settings scattered throughout the southwestern portion of the Fort (Bouwkamp and Whiteside 1984). Shadscale and sagebrush (Artemisia spinescens) are the primary constituents of this community (Vasek and Barbour 1977:853) and may be found associated with ethnographically important subsistence plants such as Indian ricegrass (Oryzopsis hymenoides).

The Blackbush Scrub community is rare at Fort Irwin because it is usually found in higher elevations (1200-1800 m) and wetter settings than generally exist at the Fort. It is present, however, in a limited setting on the upper northward facing slopes of the Avawatz Mountains. This community is comprised of blackbush (Coleogyne ramosissima), sagebrush (Artemisia), hopsage (Grayia spinosa), turpentine-broom (Thamnosma montana), winter fat (Eurotia lanata), and succulents like yucca (Yucca bacata), and agave (Agave utahensis, and A. deserti). Other common plants include Ephedra, Atriplex, Eriogonum, and Lycium. The Blackbush Scrub community frequently co-occurs with the Joshua tree (Yucca brevifolia) and grades into the Desert Woodland community in settings that enhance the growth of the needle leafed, cactus-like Joshua trees.

The Desert Woodland community is limited to the crest of the Avawatz Mountains at Fort Irwin. It is defined by the presence of Joshua trees at lower elevations (1200 m) and juniper (*Juniperus californica*, and *J. osteosperma*) and pinyon pine (*Pinus monophylla*), at elevations up to 2200 m (Vasek and Barbour 1977). Low elevation Desert Woodland communities are comprised of relatively dense stands of Joshua trees with an understory of plants common to the Shadscale Scrub and Blackbush Scrub communities. Common associated plants include sagebrush, rabbit brush (*Chrysothamnus* spp.), *Ephedra*, cactus, (*Opuntia* spp.), Yucca, *Lycium*, and bitterbrush (*Purshia tridentata*). At upper elevations the Joshua trees grade into Desert Woodland communities associated with juniper, blackbush, sagebrush, turpentine-broom, and winter fat. Eventually, near the upper elevational range of this community, the pinyon pine appears, associated, in most situations, with plants of communities favoring higher elevations.

Finally, there is the specialized Desert Springs and Marshes plant community that is associated with seeps and springs in the Mojave Desert. This community varies considerably in composition, in response to local soil and hydrologic conditions. The presence of water establishes the nature of the community while the permanence, volume, and mineral content of the water source affects the breadth of the community (Bradley 1970). Most plants are salt tolerant (halophytic) species associated with aquatic and perennial herbs. Most notable are cattail (Typha angustifolia and T. latifolia), mesquite (Prosopsis glandulosa torreyana), screwbean (Prosopsis pubescens), rush (Juncus spp.), willow (Salix spp.), reeds (Phragmites spp.), and saltgrass (Distichlis spicata). A recent introduction is the salt cedar (Tamarix ramosissima) an Old World import which thrives in moist, highly mineralized environments of the American deserts.

The Desert Springs and Marshes community is well developed in only 2 locations at Fort Irwin: Bitter and Garlic springs. As the names imply, both water sources are highly mineralized. Neither flows more than a few meters during normal climatic episodes. Cattails are found only near the throats of the springs while the larger associates--with deeper root systems (mesquite, screwbean, willow, and reeds)--tend to spread out along the courses of their underground flow for a short distance. At no place on the Fort is this community extensive and only at Bitter Spring does it even cover a few acres. Still, this was a rich and important environmental niche to human and animal populations of the Mojave Desert. It provided a relative wealth of resources concentrated around water, the single most important necessity of life, particularly in the desert.

Fauna

Fauna typical of such Mojave Desert environments as those found at Fort Irwin include a broad variety of hardy reptiles, including the Mojave Green rattlesnake (Crotalus scutulatus), horned sidewinder (C. cerastes), gopher snake (Pituophis melanoleucus), and shovel-nosed snake (Chionactis occipitalis). Lizards include the desert banded gecko (Coleynyx variegatus), zebra-tailed lizard (Callisaurus draconoides), desert side-blotched lizard (Uta stansburiana), desert horned lizard (Phrynosoma platyrhinos), leopard lizard (Crotaphytus wislizenii), western bush lizard (Urosaurus graciosus), and collared lizard (Crotaphytus collaris). The ethnographically exploited (Steward 1938:40) chuckwalla (Sauromalus obesus) is the largest of the lizards; its charred bones are frequently found in archaeological sites of the region, along with the bones and plastron fragments of the desert tortoise (Gopherus agassizi) (Douglas 1982, 1986; Kent 1986).

Small rodents are the next most common fauna of the Mojave Desert and during the ethnographic period provided supplementary fare to the vegetable foods collected by women and children (Steward 1938). Commonly found throughout the desert are mice (Perognathus longimembris and P. formosus), kangaroo rats (Dipodomys deserti and D. merriami), whitetailed antelope ground squirrels (<u>Ammospermophilus leucurus</u>), and Mojave ground squirrels (<u>Spermophilus mohavensis</u>). Wood rats (<u>Neotoma</u> spp.) were frequently hunted, trapped, or snared by ethnographic peoples (Steward 1938) and their charred bones are fairly common among archaeological samples of the region (Douglas 1986; Kent 1986).

Jack rabbits (<u>Lepus californicus</u>) and cottontails (<u>Sylvilagus audubonii</u>) are fairly common in the Mojave Desert. They were, perhaps, the most important animal species hunted for food by humans because they grow quickly on the meager fare provided by the desert plants and they inhabit virtually all environmental settings of the desert. Though they were hunted with the bow and arrow and snared by individuals, their largest contribution to the human diet occurred when they were taken during communal drives. Relatively large numbers of people would congregate at a prearranged time and location to drive the rabbits into long nets where they could be clubbed to death (Steward 1938). This is the only cost effective method of capturing these small but valuable animals. They contain so little body fat that to chase them individually results in the capture of fewer calories than are expended in the chase. Thus, even the successful hunter could starve to death pursuing rabbits on an individual basis. But captured through communal efforts they offer a valuable source of protein and furs for the construction of coverings.

The largest and most valued animals of the Mojave are the bighorn sheep (Ovis canadensis nelsoni) and mule deer (Odocoileus hemionus), neither of which currently reside at Fort Irwin in significant numbers. The bighorn frequents rocky precipitous environments while the mule deer is commonly seen in more open terrain. Both were hunted by individuals and communally by groups of hunters, particularly around the water holes of the region where they were ambushed as they came to water. Though men of the ethnographic period spent an inordinate amount of time pursuing these animals, and the reward was great when they were taken, they did not comprise a large portion of the aboriginal diet (Laird 1976:112; Steward 1938:90). Their range was apparently limited by their need for potable surface water and good forage, and hunting pressure could quickly reduce their numbers.

Carnivorous animals of the Mojave include coyote (Canis latrans), desert kit fox (Vulpes macrotis), badger (Taxidea taxus), and ringtail cat (Bassariscus astutus). In most cases, carnivores did not form an appreciable portion of the ethnohistoric diet but were taken for their skins (Knack 1980:153; Driver 1937; Drucker 1937) and eaten when food was scarce. Birds were likewise of little subsistence value. The horned lark (Eremophila alpestris) and hawks (Buteo _jamaicensis_ [red-tailed] and _Falco sparverius_ [sparrow hawk]) were hunted for their feathers. The LeConte (_Toxostoma lecontei_) and sage (_Oreoscoptes montanus_) thrashers, raven (_Corvus corax_), and burrowing owl (_Speotyto cunicularis_) are present in the Mojave but were not generally eaten either. Waterfowl (_Anas_ spp.) are infrequently found on ephemeral bodies of water which occasionally stand for a period of time on the playas of the region. Not surprisingly, their remains are fairly rare among the archaeological remains of the region and Fort Irwin in particular.

Paleoclimatic and Paleoenvironmental Reconstructions

The interaction of human groups with their environment, and their response to environmental changes, are topics of intense interest to Great Basin archaeologists and anthropologists. Ethnographically, the inhabitants of the Mojave Desert region followed lifestyles based on the exploitation of sparse resources in this seemingly hostile desert environment (Knack 1980). However, the hot, dry modern climate results from the post-glacial drying trends of the Holocene. Palynological (Mehringer 1967; Mehringer and Warren 1976), macrofossil (Spaulding 1983, 1985; Spaulding and Graumlich 1986), geomorphological (Ore and Warren 1971), and archaeological (Jenkins 1987; Warren and Ore 1978) evidence indicates that prehistoric human populations in this area have witnessed substantial climatic and environmental change during the Holocene.

The environment of the Mojave Desert has been characterized by considerable change and continuity over the last 12,000 years since humans first inhabited the region. Continuity is evident in the paleoclimatic record of desert plants found in fossil rat middens spanning this long period (Spaulding 1983; 1985). On the other hand, changes have occurred due to fluctuating temperature and moisture regimes which affected the presence, quantity, and variability of water and plants in the region (Benson et al. 1990; Quade 1986; Quade and Pratt 1989). Thus, the data indicate that since the arrival of the first humans, the Mojave Desert has always been desert-like but during some periods was much more productive than others.

Recent paleoclimatic observations and computer aided simulations have begun to explain the mechanisms that cause weather change in the western United States (COHMAP Members 1988). During the Pleistocene, storm tracks shifted first to the south then northward in response to changing glacial conditions. Glacial conditions were themselves controlled by solar insolation variations caused by oscillations in the global tilt (Bartlein and Prentice 1989). This has resulted in oscillating increases and decreases in regional rainfall patterns throughout the American west (COHMAP Members 1988).

Thus, during the glacial maximum of 18,000 BP, when glacial ice was extremely massive, the storm track split into northern and southern branches. As the ice deteriorated (ca. 15,000 to 6,000 BP) the southern track moved north, generating increased monsoonal precipitation throughout most of the western United States by 12,000 BP. In the southern-most regions a summer dominant storm pattern prevailed around 9,000 BP and continued until roughly 8,000 BP, resulting in lowland desert forest conditions in the Sonoran and Chihuahan deserts (COHMAP Members 1988; Spaulding 1983).

It is clear that no simple unicausal model can fully describe the dramatic changes in climate documented for the Great Basin and Mojave Desert. One reason is that most methods employed in the study of paleoclimatology are coarse-grained rather than fine-grained in nature, generating data assignable only to large time units in excess of a thousand years. Another reason is the relative unreliability of radiocarbon dates accumulated over a long period of time.

Recent studies of radiocarbon samples associated with pluvial lakes in the Great Basin have demonstrated the magnitude of problems associated with dating carbonates of various forms from lake basins (Benson et al. 1990). Old and new carbon contamination has been shown to be extensive. Lake level reconstructions employing unscrutinized radiocarbon samples have been called into question and though the results of new studies are promising they have not been completed as yet for the pluvial lakes of the Mojave Desert (Benson et al. 1990).

Recent scientific consensus also recognizes the susceptibility of subregions within the Great Basin to variable, localized climatic conditions due to positions of latitude, elevation, and location in relation to the Sierra-Cascades rainshadow. This means that local, climatically controlled environmental conditions are not likely to have been precisely synchronized throughout such a vast area as the Great Basin.

Ernst Antevs (1948, 1952, 1953, 1955), on the basis of wide-spread geologic data, proposed a tripartite Holocene climatic sequence covering the last 11,000 years. This well known sequence began with the moist Anathermal period (11,000 to 7,500 BP), during which climatic conditions were controlled by post-glacial events. During this period the American west was somewhat moister than it is today and during at least a portion of this time pluvial lakes occupied some local basins within the Great Basin. The Anathermal was followed by the Altithermal period (7,500 to 4,500 BP) during which the west was hotter and dryer than it is currently. Lakes, streams, and marshes dried up. The following Medithermal period (4,500 BP to present) has been a time of increased moisture, generally wetter than the Altithermal and dryer than the Anathermal. During the

Medithermal there was a short, exceptionally wet `Neopluvial' period (Antevs 1953), dated sometime between 4,500 and 3,000 BP.

Broadly applied, Antev's model is still useful as an organizing structure for the paleoclimatic data of the Mojave Desert since it describes the basic sequence of climatic events. To be accurate, however, it must be adjusted to reflect the timing of these events within the Mojave Desert. More recent work by Spaulding (1983, 1985; Spaulding and Graumlich 1986) adds detail and a more precise chronology to the reconstruction.

Spaulding has studied a substantial number of fossil rat middens in the Mojave Desert. Wood rats (Neotoma sp.) collect botanical remains from a very limited perimeter (<50 m) around the caves and rock outcroppings which serve as the foundations for their nests. This makes their nests sensitive indicators of local environmental conditions. Twigs, leaves, needles, and other debris are mounded in the rear of the nest and slowly become embedded in an amber-colored compound of solidified urine and fecal matter. Spaulding has been working to reconstruct the sequence of climatological change in the Mojave Desert by dissecting these ancient storehouses of macrofossils, radiocarbon dating their stratified interiors, and analyzing the plants recovered from the strata.

Evidence of xerophytic desert plants, much the same as those found in the region today but in substantially different relative quantities, in rat middens 14,800 years old suggest that the cold-wet climate which characterized the late Pleistocene period gave way to warmer winters and wetter summers much earlier than previously supposed (Van Devender and Spaulding 1979; Spaulding 1983, 1985). Woodlands continued to grow at lower elevations of the Mojave Desert (at least in mesic locales) until roughly 8,000 BP. Xerophytic desert plants, however, were widely distributed throughout the Mojave Desert by 10,000 BP, indicating it was a desert environment albeit a much wetter one than at present.

Spaulding (1983, 1985) suggests that below 1,000 m amsl the Mojave was a mosaic of desert scrub and desert woodland after roughly 15,000 years BP. Between 12,000 and 8,000 BP, rainfall may have exceeded modern amounts by as much as 100% (Kutzbach 1981:59). These conditions prevailed, with expanding desert and retreating woodlands, until about 8,000 BP. After 8,000 BP climatic conditions apparently approximated those of the present.

It would seem then that Antev's Anathermal period is conceptually justified if the relativity of moister conditions is recognized. The Mojave Desert contained desert vegetation by 14,800 BP (Spaulding 1983). During the wet-warm period that followed, until at least 9,500 BP (Enzel et al. 1989), long-term, though fluctuating, lakes stood in interconnected basins of the Mojave, Owens, and Amargosa river systems. The continued trend toward increasing aridity after 12,000 BP was occasionally broken by short term reversals such as those which occurred between 9,500 and 8,000 BP. Pollen data indicate that the last major pre-Altithermal increase in moisture in the Mojave Desert occurred between 8,500 and 8,000 years BP (Mehringer 1967:193). Support for the existence of this wet period at Fort Irwin is found in the form of fossil spring deposits, dated between 8,400 and 8,000 BP, at the Rogers Ridge site (Jenkins 1987). There is considerable evidence that by 8,000 BP the Great Basin and Mojave Desert were subjected to increasing desiccation. This situation was perhaps accentuated, for human populations at least, by the unusually wet conditions of the 500 year period preceding it.

Two sets of observations, however, suggest that moister than modern conditions persisted for some time after 8,000 BP, and this evidence affects the positioning of the Altithermal period in the Mojave Desert. Paleo-spring activity, indicating locally greater moisture, may have continued until ca. 7,200 BP in the Las Vegas Valley (Haynes 1967; Quade 1986; Quade and Pratt 1989). Also, Lake Mojave may have experienced a shallow lake stand between 8,350 and 7,500 BP (Ore and Warren 1971:2561-2562). These late dates suggest that the Altithermal period in the Mojave Desert effectively began between about 7,000 and 7,500 BP, when regional moisture regimes approximated current conditions there.

The Altithermal maximum was attained sometime between 6,900 and 5,000 BP throughout most of the American west. Increased temperatures and reduced precipitation were apparently accompanied by a shift to ineffectual summer-dominant rain storms, resulting in the rapid loss of much of the yearly rainfall budget to evaporation (Davis 1982).

The Altithermal may or may not have been a `problem' to human populations in the Mojave Desert (Wallace 1962; Kowta 1969; Weide 1976:182). Opinions range from those suggesting the region was so arid that it was essentially unfit for human habitation (Wallace 1962), to the view that even under the severest conditions some hydrologic systems such as marshes, axial streams, and springs remained active and served as oases for local populations (Weide 1976:182). In general, it may be observed that, as in most of the Great Basin, there are relatively few culturally significant radiocarbon dates assignable to this time period (7,000 to 5,000 BP) in the Mojave Desert. Particularly difficult to find are culturally significant radiocarbon dates that fall between 6,900 and 6,000 years BP, suggesting that human populations were at comparatively low levels throughout the region during this period.

Mounting evidence suggests that the Medithermal began sometime between 5,000 and 4,500 years BP when the desert began to receive more rain than it had during the previous 1,500 to 2,000 years (Mehringer 1986). A few radiocarbon dates, associated with pluvial lake basins and marshes, suggest an unusually wet period about 3,600 BP (Enzel et al. 1989; Mehringer and Sheppard 1978:165; Stuiver 1964), which may indicate the beginning of the Neopluvial period in the Mojave Desert. This wet period apparently lasted until about 3,000 BP, as indicated by the retreat of Bristlecone Pine from the upper tree line in the nearby White Mountains of California (LaMarche 1973:655). Between 3,000 and 2,000 BP the climate slowly, but progressively, became drier.

Essentially modern climatic conditions, with short-term fluctuations in the amount of local precipitation, prevailed after 2,000 BP. Relatively brief phases of wetter-than-today and drier-than today conditions apparently occurred cyclically between longer periods of fairly normal climatic conditions characterized by roughly modern levels of precipitation. Significantly wetter conditions apparently prevailed from 1,200 to 1,100 BP (Basgall et al. 1988:50) and again from ca. 400 to 200 BP (Denton and Karlen 1973:193; Enzel et al. 1989; Mehringer and Warren 1976). Excessively dry periods occurred between 2,000 and 1,700 BP and again from 950 to 750 BP (Davis 1982:70).

Fort Irwin

Fort Irwin, the U.S. Army military installation that funded the research reported here, is located in the central Mojave Desert in San Bernardino County, California, approximately 56 km northeast of Barstow (Fig. 1). The Fort covers approximately 2,590 sq km (Basgall et al. 1988:14) and has been withdrawn from the public domain for the purpose of U.S. Army training exercises since 1940 (Fig. 2).

The basin systems, where most known Lake Mojave and Pinto sites at Fort Irwin are located, are divided from each other by mountains and ridges comprised primarily of granitic, volcanic, and alluvial deposits. Four mountain ranges dominate the geomorphology of Fort Irwin: the Avawatz, Granite, and Tiefort mountains, and Goldstone Ridge. The Granite and Tiefort Mountains will be described here because their geology and geomorphology has affected human occupation at the sites under study.

The Granite Mountains, comprised almost entirely of the granite for which they are named, rise to the considerable height of 1,616 m. Though they are unforested they give rise to 7 widely spaced springs. These springs are generally located in canyon and wash bottoms and to some small extent support increased plant growth, particularly during wet climatic cycles. The Granite Mountains are fully as large, though not as elevated, as the Avawatz. They trend toward

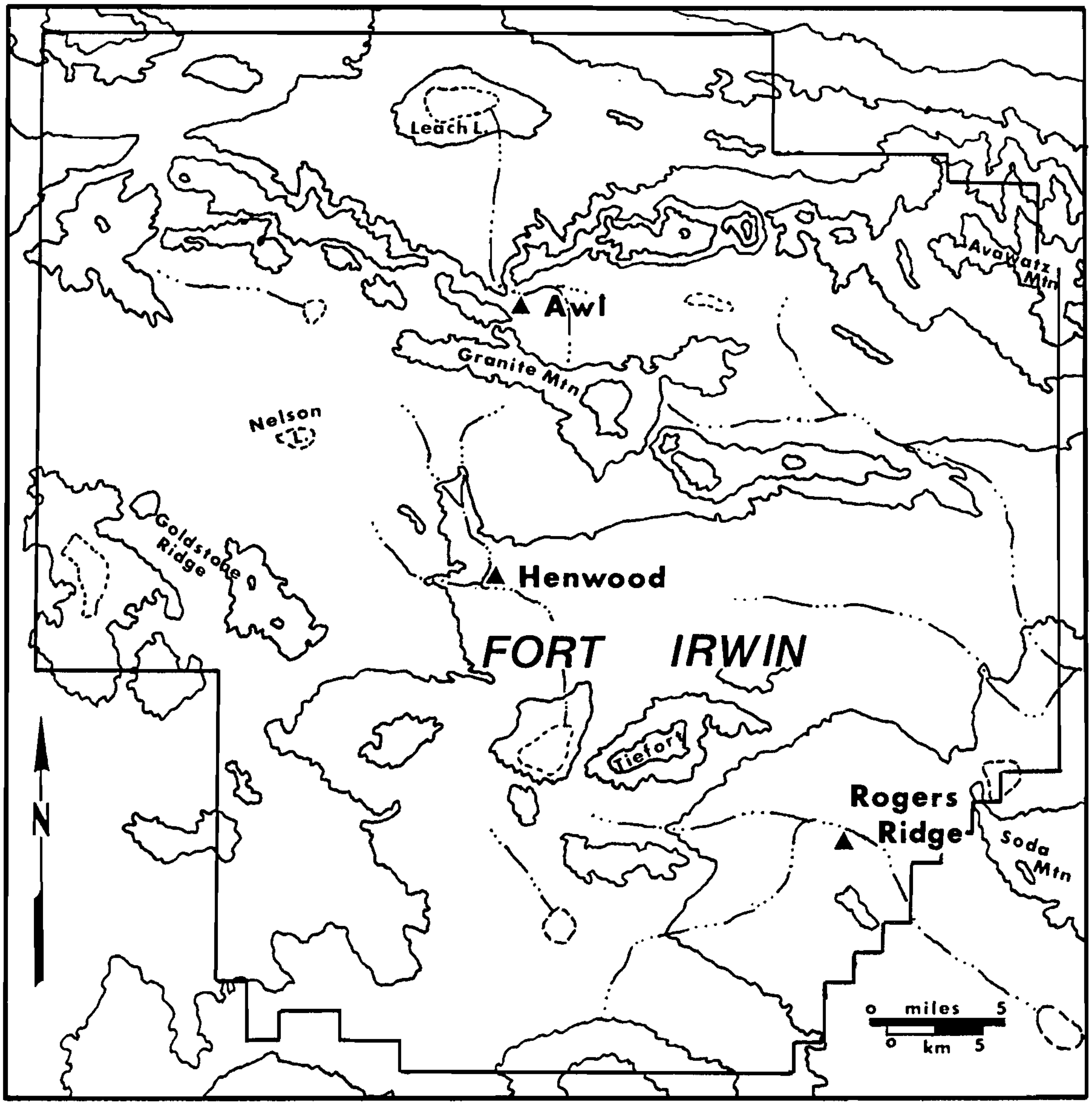

Figure 2. Topographic map of Fort Irwin at 1000 foot contours.

the southeast, splitting on the eastern end to form the C-shaped No Name Basin before joining an upthrust ridge of Plio-Pleistocene gravels at Bow Willow Wash. These gravels are most notable for their high content of excellent quality cryptocrystalline silicate stones. Aboriginal populations quarried the cobble to boulder sized nodules for thousands of years, generating a tremendous amount of lithic debris scattered over more than 15 sq. km (Bergin et al. 1985; Skinner 1984).

The Tiefort Mountains rise precipitously on the south shore of Bicycle Lake to a maximum elevation of 1,537 m. They are comprised primarily of Mesozoic granitic rocks, pre-Cretaceous metamorphic rocks, and Quaternary basalts (Jennings et al. 1962). They trend moderately toward the northeast. They begin in the southwest as a low series of hills cut by the Garlic Fault. This gives rise to Garlic Spring, which is the only spring known to exist on Tiefort Mountain. From the southwestern hills the Tieforts rise sharply to a peak and then drop sharply to a series of moderately elevated hills. On their east end the Tieforts slope gently into upthrust Plio-Pleistocene nonmarine deposits which contain cryptocrystalline stone nodules of an excellent quality for tool making. These deposits form the upper northern rim of Tiefort Basin and trend southeastward toward the west end of the Soda Mountains.

Lake Basins

Geomorphologically, Fort Irwin is divisible into 8 major lake basin systems and their associated drainages. The Leach Lake, McLean-Nelson Lakes, Drinkwater-No Name, Goldstone, Bicycle, Langford Well, Red Pass, and Tiefort basins comprise most of the land mass within the Fort's boundaries (Fig. 2). Only one basin, Tiefort, will be discussed here though a brief generic description of a typical basin is offered first.

Each basin is ringed by an apron of piedmonts, bajadas, and alluvial fans. These are arranged along the foot of the mountains and hills surrounding the basins and are composed of materials eroding from their flanks. Piedmonts and bajadas predominate throughout most of the Fort though alluvial fans are not uncommon.

Generally closed, non-overflowing playas occupy the lowest point of each basin. These playas are infrequently filled with flood waters collected from the surrounding terrain by inter-connecting washes.

Tiefort Basin is located in the southeastern quarter of Fort Irwin at the southern foot of the Tiefort Mountains. This basin does not currently have a true playa/lake system in it though one apparently formed in the basin, due to tectonic activity, at some unspecified period of the past (Ferraro 1986; Ore 1986). Water currently enters the basin from the Langford Well area at the northwest end of the Whale and flows north a short distance to a confluence with Tiefort Wash. Tiefort Wash originates near the southwest end of the Tiefort Mountains and flows east to the floor of the basin. There it turns south toward Bitter Spring and, ultimately, West Cronese Basin. A second wash, Langford Well Wash, enters Tiefort Basin in the southwest and flows northward over the Langford Aggradational Plain (Ferraro 1986) to join Tiefort Wash near mid-basin.

Axial Drainage Channels

The third major geomorphic feature on Fort Irwin is the large axial drainage system. There are 5 main drainages which emanate from or converge with the basin drainage systems. They are, from north to south, Bow Willow Wash, Nelson/Bicycle Wash, Red Pass/East Ranges Wash, Coyote Lake Wash, and Tiefort Wash. These large dry washes were surely important to prehistoric populations as major travel routes through the rugged terrain of the Mojave Desert. Also, water is, and apparently always has been, a major consideration of travellers in the Mojave Desert. It occasionally was available, during unusually wet seasons and climatic periods, along the course of these drainages in the form of seeps, springs, and ephemeral streams and ponds.

Consequently, archaeological sites, and those of the early to mid-Holocene in particular (i.e. the Lake Mojave and Pinto complexes) are often located along these currently dry water courses.

Two of the major wash systems will be discussed here, Nelson/Bicycle Wash and Tiefort Wash, because they flow past the archaeological sites and form major components of the local geomorphology. Nelson/Bicycle Wash originates in two small valleys of the Fort. The small basin that Nelson Wash begins in, named here East Nelson, covers an area of about 60 sq. km. Nelson Wash originates in Quaternary alluvial fans located at the base of the Granite Mountains east of Nelson Lake. Nelson Wash does not emanate from Nelson Lake and is separated from it by 'Crash Hill', a knoll formed by a granitic extrusion and tectonically uplifted Pleistocene nonmarine deposits. This knoll received its name from the wreckage of a troop transport plane, which lies scattered across its surface. Nelson Wash begins as two smaller washes which drain the north and western sectors of East Nelson basin. These smaller washes conjoin to form the main stream of Nelson Wash in the southeastern corner of the basin. Nelson Wash then flows southeast through a southern projection of the Granite Mountains (Nelson Ridge) to its confluence with Bicycle Wash at the northeastern edge of the Goldstone Ridge stone quarry.

Bicycle Wash is fairly well entrenched into the foot of the Goldstone Ridge piedmont, cutting through well developed desert pavements along most of its course to Nelson Wash. Bicycle Wash joins Nelson Wash at the Henwood site. The combined washes then flow in a southeasterly direction toward Bicycle Lake.

Finally, Tiefort Wash comprises two main stems draining a combined total of more than 400 sq. km. The first, Tiefort Wash proper, originates in the low range of hills near Garlic Spring on the west end of the Tiefort Mountains. It then flows east through a narrow valley, over and around the base of a Pliocene basaltic extrusion, and out over the alluvial fans and piedmont surrounding the base of the Tiefort Mountains. The second stem, Langford Well Wash, originates approximately 13 km west of Tiefort Basin on the slopes of the Alvord Mountains. It drains a large alluvial basin, ca. 150 sq. km, and like Coyote Lake Wash is prone to periodic flooding. Langford Well Wash enters Tiefort Basin at the northwestern end of a large Pleistocene basalt extrusion known locally as The Whale. It then flows northeast across the piedmont of Tiefort Basin to its confluence with Tiefort Wash. After joining Tiefort Wash the combined flow follows a gentle arc around the northeast floor of the basin and exits through Bitter Spring on its way to West Cronese Basin.

Local Environments of the Archaeological Study Areas

The archaeological sites addressed in this study are located in widely separated and environmentally distinctive areas. The Henwood site (4SBr4966) is located on the east bank of Nelson Wash on the south side of the Granite Mountains. Rogers Ridge (4SBr5250) is located in the bottom of Tiefort Basin, in the southeastern quarter of the Fort, approximately 25 km southeast of the Henwood site. A brief discussion of the local environmental settings of these locations will make clear the context of the cultural activities that took place there.

Nelson/Bicycle Wash and the Henwood Site

The Nelson/Bicycle Wash area lies between the Granite Mountains (on the north) and Goldstone Ridge (to the south). Nelson Ridge, a relatively low prominence which is an extension of the Granite Mountains, divides East Nelson basin from the Goldstone Ridge drainage area. This ridge rises roughly 200 to 300 m above the surrounding terrain to a maximum elevation of 1,195 m. Elevations at the base of the ridge range from 1,000 m in the west to 850 m in the east. Nelson Ridge lies on a northwest to southeast axis and covers an area 7 km long by 2.5 km wide.

Nelson Wash flows southeast across the piedmont of East Nelson basin to the base of Nelson Ridge where it becomes deeply entrenched. It has cut through Quaternary alluvial deposits that are thoroughly bound with calcium carbonates (caliche) and flows along the south side of a relatively small canyon cut through the southern projecting hills of the Granite Mountains. These hills rise from 20 to 100 m above the floor of East Nelson basin and the Granite Mountains piedmont. The wash averages 100 to 200 m in width at this point and is filled with at least 9 m of sand and gravels (Ferraro 1984:9). It flows approximately 4.5 km through the canyon and low hills to its confluence with Bicycle Wash.

Nelson Wash is flanked by granitic alluvial deposits washed down from the surrounding hills. These deposits are fairly coarse-grained sands and gravels incised by numerous shallow drainages. Sheet wash and the continual filling and movement of small meandering channels have caused these deposits to contain small pockets of sorted gravels.

The deposits have been sheared off where they contact the wash, forming terraces ranging from 2 to perhaps 7 m above the floor of the wash. In the lower (eastern) reaches of the wash these terraces are very old as evidenced by the presence of desert pavements covered with thick coatings of desert varnish. These terraces, situated on the west-southwest bank of Nelson/Bicycle Wash, are comprised of Pleistocene nonmarine sedimentary gravels (Jennings et al. 1962). The archaeological sites situated on them contain artifacts coated with desert varnish also, and well incorporated into the pavements capping the terraces.

Schist outcroppings comprise the predominant bedrock of some of the hills surrounding the wash. Two archaeological sites are situated, at least partially, on schist outcrops and these bedrock materials have contributed to the archaeological record by providing site inhabitants with thin tabular materials for the production of ground stone. Other archaeologically significant materials are the fine-grained basalts, rhyolites, and crypto-crystalline sillicate nodules available in the Pleistocene gravels of the terraces in the lower reaches of the wash. Quarrying and reducing these nodules for the production of bifacial artifacts was a predominant activity in the sites of Nelson/Bicycle Wash. In fact, the eastern most sites of Nelson Wash could be considered outliers of the behemoth Goldstone Ridge site located to the southwest.

Henwood Site (4SBR4966)

The Henwood site is located at the east end of Nelson Canyon. Nelson Wash turns south-southeast as it nears the end of the canyon and begins to open up toward the south. The wash is bordered by terraces rising 4-5 m above the floor of the wash. In the sidewalls of these terraces are extensive deposits of calcium carbonate-bound alluvium. Along the west central portion of the site these deposits have been exposed by erosion. The Henwood site parallels the east bank of Nelson Wash for roughly 1.1 km and extends east toward a large hill (Hill 910) for about 440 m. It is a huge site, comprised of many small loci (Fig. 3) and a thin inter-locus scatter of cultural materials covering an estimated area of 404,000 sq. m (Vaughan 1984:36).

Site elevations range from 840 to 860 m across this broad gently sloped area. Site deposits are comprised of poorly sorted granitic alluvium transported and deposited across the site by sheetwash and an extensive series of tiny (<2 m wide), shallow channels. Interspersed among these shallower channels are a few larger channels, cutting the site deposits to a maximum depth of 3 to 4 m; some of these drain as much as half a kilometer of site surface (Ferraro 1984:13). Bicycle Wash joins Nelson Wash at the southern end of the site and their combined flow turns east around the southern base of Hill 910.

> Locus A, referred to as Locus I in the testing and evaluation phase (Skinner 1985), represents the southernmost artifact concentration of the site. . . It occupies a low knoll of granitic bedrock. Near the center, a desert pavement has formed, and this area of the locus contained the most dense concentration of surface artifacts. . .Locus A,. . . encompasses 2,400 [sq.] m (Vaughan 1984:40).

Though artifacts were recovered to a maximum depth of 40 cm in selected areas of Locus A, they were more usually confined to the surface and first few cm of the deposit.

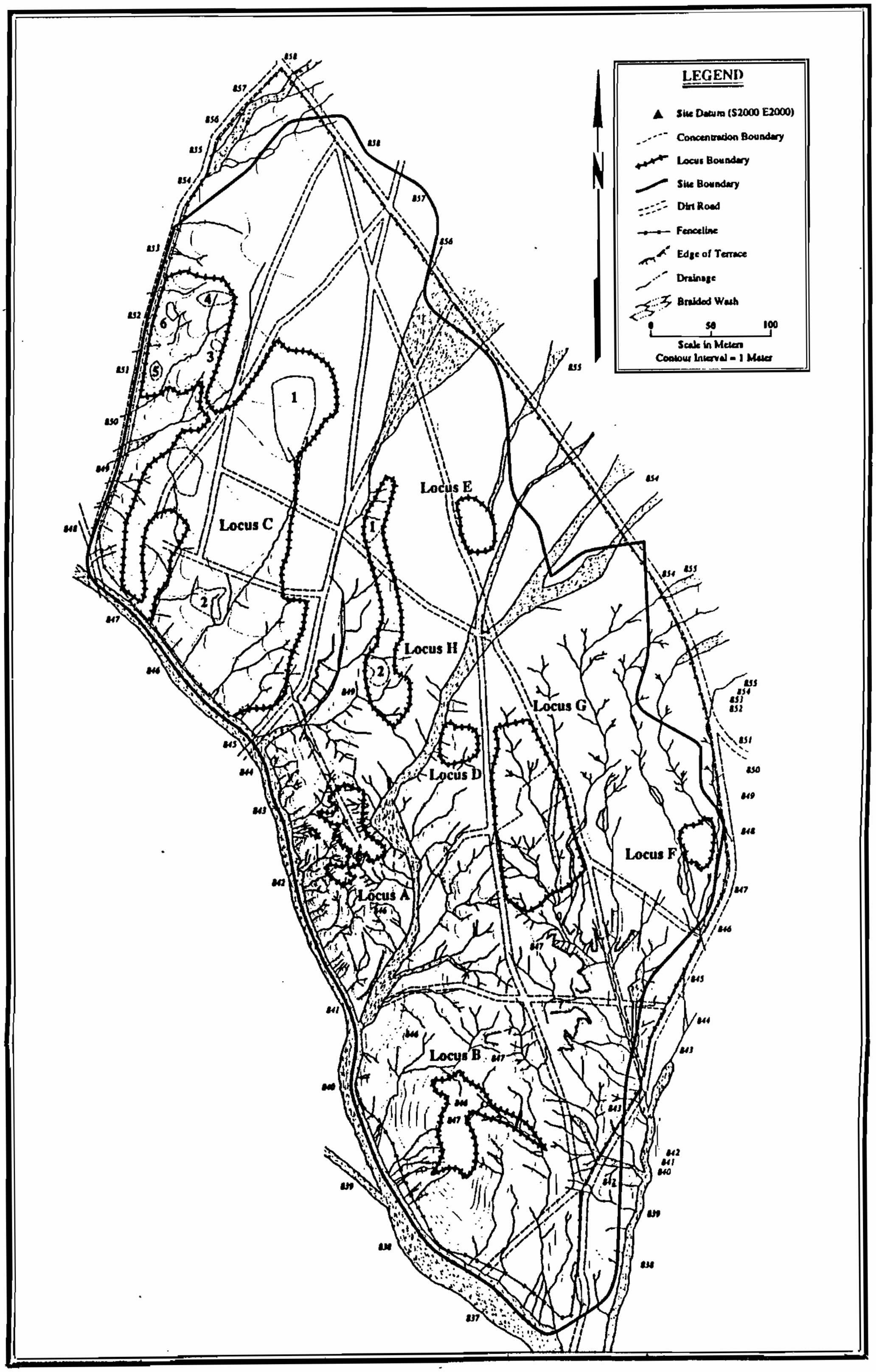

Figure 3. Contour map of the Henwood site.(After Warren 1990:Fig. 3.7).

> Locus B was previously referred to as Locus II in the testing and evaluation phase (Skinner 1985). . . Like Locus A, Locus B occupies a low knoll of granitic bedrock along the western margins of the site. Cultural material is found on the higher areas of the knoll in association with a desert pavement formation. Along the margins of the knoll, larger clasts are present, some free and others as embedded outcrop material. The southern and eastern margins of the knoll have been cut away and eroded by a major wash. . .The area covered [by Locus B] is approximately 1,875 [sq.] m (Vaughan 1984:41).

Artifacts were recovered to a maximum depth of 10 cm by excavations in Locus B. However, the vast majority of cultural materials recovered from this locus were found on the surface in the well developed pavement mentioned above.

> . . . Locus C involves a large area and includes Locus III and Locus VII, as designated during the testing and evaluation phase (Skinner 1985: Appendix H, Map 6). This 47,200 [sq.] m area is also the most severely impacted section of the site. It lies 80 m northwest of Locus B, and the western margin of the locus is coincident with the western site boundary, a large wash. The surface of the locus is flat but cut by many rills and small arroyos. . . Geologically, this section of the site is most exemplary of the juncture of the stream terrace deposits with the northeast-southwest trending alluvial fan deposts (Bachhuber 1984). In Locus C, the fan deposits are thin, as evidenced by the calcic soils which cap the stream deposit at the depth of 10-15 cm (Vaughan 1984:42).

Artifacts were recovered from a maximum depth of 40 cm in Locus C. Once again, however, most of the cultural materials were encountered on the surface and in the first 10-20 cm of the deposit.

> . . . Locus D is found near the center of the site, on a slight rise adjacent to a major wash. . . The area is covered with a thin veneer of alluvium; the whitish caliche cap of the stream terrace deposit is

> apparent immediately below the surface (Vaughan 1984:44).

Test excavations in Locus D recovered artifacts from a maximum depth of 40 cm. Very few artifacts or pieces of debitage were recovered from these excavations, however, and the majority of artifacts in the sample from this locus were surface collected.

> . . . Locus E, located north and east of Locus D, is situated on the Holocene-age alluvial fan deposit. Here the soils are sandy with gravel-sized clasts of granitic material. No desert pavement surface occurs at this locus (Vaughan 1984:55).

Cultural deposits reached a maximum depth of 80 cm in Locus E. Within these deposits were a relatively large number of cultural features (11) including 10 hearths (one with an associated metate) and a cache pit filled with basalt and cryptocrystaline silica (CCS) flakes (Vaughan 1984:58).

> Locus F is located to the south, along the eastern margins of the site. Alluvial deposits are present here, but are thin (Vaughan 1984:45).

Cultural materials were recovered from a maximum depth of 70 cm in Locus F. The majority of artifacts recovered, however, came from the upper levels, generally less than 30 cm deep.

Locus G was first identified when artifacts were found on the backdirt pile of a backhoe trench. Subsequent survey and artifact marking with surveyer's pin flags revealed the presence of the locus and identified its boundaries. It is situated in deep alluvial deposits, on relatively level ground, near the center of the site.

> The north and south boundaries of Locus G were determined by a light flake scatter, whereas a dense scatter is found in the central area of the locus. East and west boundaries were arbitrarily set using two dirt roads. Cultural material continued past the eastern road, but in lesser quantities (Vaughan 1984:46).

The excavations in Locus G were the most intensive and extensive subsurface investigations conducted at the Henwood site. Excavations continued to a maximum depth of 130 cm, with artifacts recovered from a maximum depth of 110 cm. A large block excavation within this locus uncovered three cultural features, two dark soil stains (hearths) and a scatter of rock.

> Locus H is located between Locus C and Locus E in the north-central area of 4-SBr-4966 [Henwood site]. . . This area is heavily dissected by rills and a small wash runs north-south through the southern section of the locus. Geologically, Locus H is similar to Locus C in that the area is covered by a thin alluvial fan deposit underlain by stream terrace deposits. From north to south, the fan deposit thins out. . . at the south end of the locus, the white calcic horizon appears on the surface. . . Locus H forms a linear configuration. Two areas of [artifact] concentration were identified within [Locus H]. . . Concentration 1, represents a moderate density scatter separated by a center strip which has suffered some military impacts. . . Concentration 1-south and Concentration 1-north. . . Concentration 2 was identified as a tight cluster of flakes within the larger Concentration 1-south area (Vaughan 1984:47-48).

Excavations in Locus H resulted in the recovery of artifacts to a depth of 90 cm. Unfortunately, very few artifacts were recovered during these excavations and the majority were encountered in the upper levels of the deposits.

> The northernmost locus, Locus I, is separated from the remainder of the site by approximately 80 m. The intervening area is heavily impacted and includes a large wash and a main military road. . . [Locus I] is similar to the main site area in types of raw material present, tool and debitage forms, and geomorphology. [C]ultural material is found on a series of small, low benches with well-developed desert pavement and along the lower, sandy gravel areas between the terraces. . . [F]our concentrations of cultural material were identified encompassing 1,875 [sq.] m of the 9,000 [sq.] m locus area (Vaughan 1984:49).

Artifacts were recovered from a maximum depth of 30 cm during the excavations of Locus I (Vaughan 1984:56). The very nature of the locus, situated on a low, rocky terrace between two major washes which effectively cut it off from any major source of alluvial sediments, dictates the shallow nature of cultural deposits in this area of the site. Thus, the majority of cultural materials recovered from this locus came from the desert pavement covering its surface.

Tiefort Basin and Rogers Ridge (4SBr5250)

Rogers Ridge is located in the bottom of Tiefort Basin in the southeastern quarter of Fort Irwin. The environment of Tiefort Basin and the archaeological site at Rogers Ridge have been thoroughly described (Ferraro 1986; Jenkins 1987; Waters 1988) and only a brief summary is provided here. Tiefort Basin lies between the base of Tiefort Mountain and the west end of the Soda Mountains. It is 22 km long (east-west) by 12 km wide (north-south) at its extremities. Its lowest elevational point (ca. 400 m) is located in Tiefort Wash near Bitter Spring, one of the few perennial water sources at Fort Irwin.

Tiefort Basin is bounded to the north and northwest by the Tiefort Mountains which rise to a maximum elevation of 1537 m. To the east and southeast are the Soda Mountains which are considerably lower in elevation (981 m) and are not as rugged as Tiefort Mountain. They separate the Tiefort Basin from Red Pass Lake. Both the Tiefort and Soda mountains are comprised of Mesozoic granitic rocks (e.g. granite, granodiorite, granotonolite, and diorite). Neither is sufficiently elevated to sustain trees or lusher flora of any kind.

Along the northeastern rim of Tiefort Basin, at an elevation of ca. 700 m, between the Tiefort and Soda mountains is a broad gently sloped piedmont (Tiefort Piedmont [Ferraro 1986:26]) of Pleistocene/Holocene alluviums. This piedmont is part of a continuous apron of piedmonts which cover the entire perimeter of the basin. Sediments of the Tiefort Piedmont are comprised of the decomposing bedrock materials of the Tiefort and Soda mountains in the northern and eastern sectors of the basin, respectively.

A second piedmont (the Whale Piedmont) has formed independent of the first along the southern margin of the basin at the foot of The Whale, a large Pleistocene basalt extrusion, which forms the southern border of the basin. The Whale Piedmont is predominantly comprised of eolian materials captured in the canyons of The Whale and transported to the Whale Piedmont by ephemeral run-off. This sand matrix is mixed with basalt boulders, cobbles, and gravels, decomposing from the Whale, during this process. Boulder trains form in wash bottoms and are sometimes buried as the aggradational process continues. These may later be exhumed, as has happened in the lower parts of the basin near Rogers Ridge (Ore 1985; 1986), leaving mounded alignments of boulders facing downslope.

The Whale Piedmont intergrades with a broad alluvial plain originating at the mouth of the Langford Well Wash. The Langford Aggradational Plain (Ferraro 1986) is comprised primarily of eolian and fluvial sands which originate in the broad valley southwest of Tiefort Basin, known as the Langford Well Impact Area. The Langford Aggradational Plain is a broad, sandy surface covered with shallow braided drainage channels. It covers an area of roughly 4 or 5 sq. km., terminating on the relatively flat barren surface comprising the floor of the basin. Its extent is easily discernible, for it is comprised of unusually light colored sediments which extend from the darker basalt laden alluvium of the Whale Piedmont north to Tiefort Wash. Here it terminates, contrasting with the darker alluvium of the Tiefort Piedmont.

Flood waters from the Langford Well drainage system enter the basin at the northwest end of the Whale. Near the entrance to the basin these waters diverge. Some continues northward to join Tiefort Wash and the remainder turns more eastward to flow across the Langford Aggradational Plain. Suspended alluvial materials are deposited as the flow broadens out into the smaller channels of the Plain. In the bottom of the basin, near Rogers Ridge, this myriad of small streams joins Tiefort Wash. The combined flow then procedes south past Bitter Spring and on to West Cronese Lake.

Tiefort Wash has carved a 600 m wide stream bed of sand and gravels and widely scattered rocks and boulders which passes between Rogers Ridge and the Tiefort Piedmont. The banks of the wash have been severely eroded by the intrusion of many small tributaries. Remnants of coarse sand deposits ring the playa-like bottom of the basin, some rising as much as 7 m. Many of them contain archaeological sites.

Rogers Ridge is a small upthrust ridge of sedimentary deposits located in the middle of a small playa-like flat on the floor of Tiefort Basin. The ridge is crested with large basalt boulders overlying thick deposits of clays and marl. It rises 17 m above the surrounding playa-like floor from 430 to 447 m above sea level (Fig. 4). The ridge is slightly

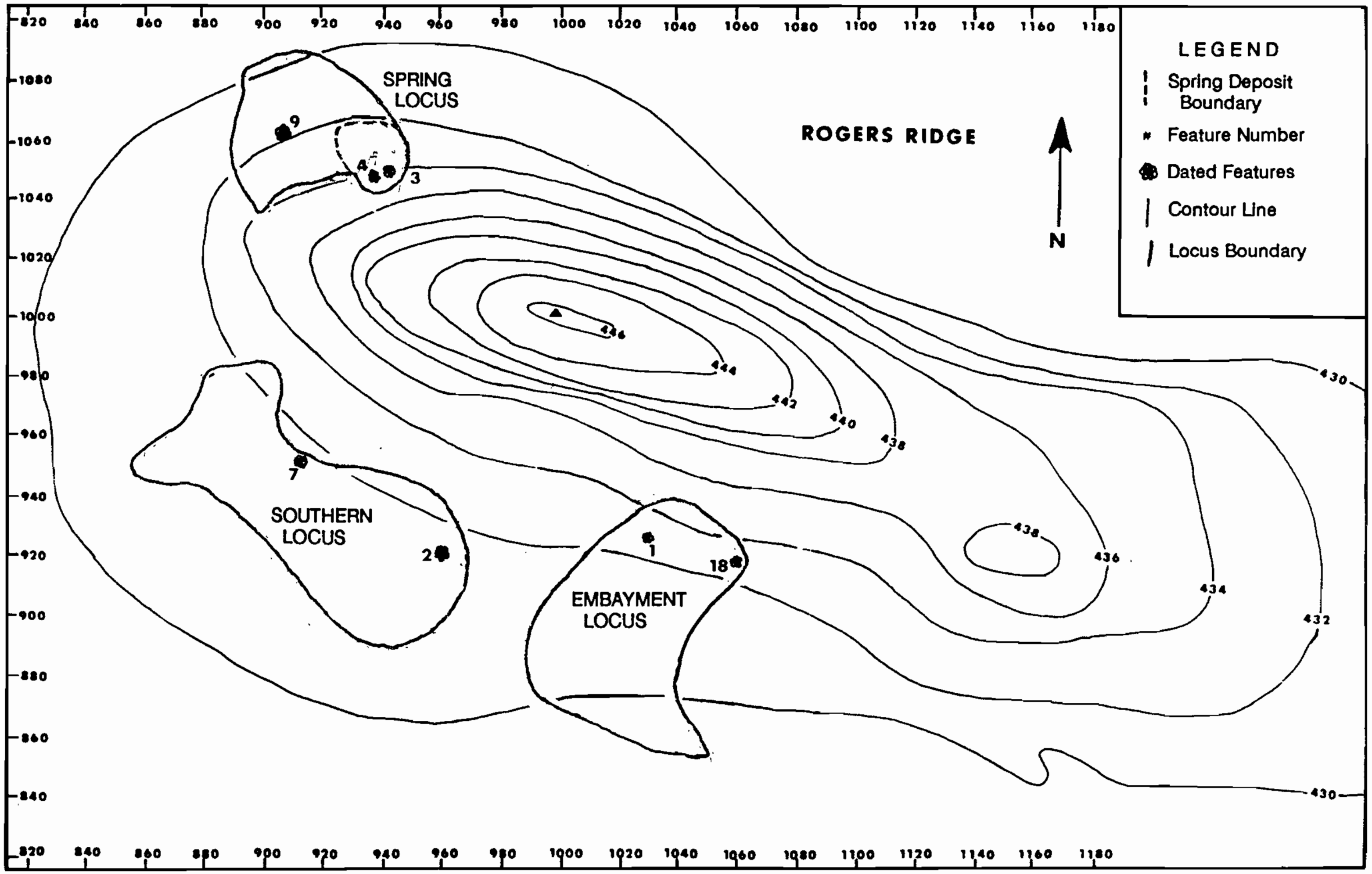

Figure 4. Contour map of Rogers Ridge.

crescent-shaped, covering an area of roughly 400 m (NW-SE) by 200 m (SW-NE), and artifacts are present in varying numbers across most of this area.

Rogers Ridge (4SBR5250)

The archaeological site, excavations, and stratigraphy of Rogers Ridge have already been described in detail (Jenkins 1985a, 1985b, 1986, 1987) so only a brief summating description need be presented here. There are three loci of cultural materials at Rogers Ridge each corresponds to a slightly different set of environmental parameters (Fig. 4).

> The Spring Locus, on the northwest point of the ridge in an area of spring deposited sediments, measures 60 m E-W by 40 m N-S and encompasses approximately 2,000 sq. m. Artifacts are abundant around the spring at the base of the ridge, dropping off dramatically with increasing distance from the spring deposit. . . Artifacts were recovered from a maximum depth of 130 cm. . . Most of the artifacts, however, were recovered from 10 to 70 cm below the surface. On the slope below the spring area, most of the primary deposits had been removed by erosion prior to excavation.
>
> The Southern and Embayment loci, both of which lie to the south, are considerably larger than the Spring locus. The Southern Locus covers an area of 4,800 sq. m of gently sloping surfaces between the 430 and 432 m contours of Rogers Ridge. Cultural deposits . . . are generally shallow, less than 50 cm deep. . .
>
> The Embayment Locus covers an area of 3,800 sq. m. It lies higher on the slope than the Southern Locus (up to the 435 m contour) and contains cultural deposits to a depth of 70 cm. Decomposing basalt cobbles and gravels are common on the surface but occur somewhat less frequently throughout the deposit, with the exception of a cobble layer

located 40 to 60 cm below the surface (Jenkins 1987:218).

Summary and Conclusions

The two sites discussed in this chapter overlap in time, but have very disparate environmental settings and internal characteristics. Variations within and between their cultural assemblages should be a result of the cultural activities conducted at these locations in response to their local environmental settings. The decisions made by the occupants of these sites were reached within the prevalent cultural, technological, and environmental parameters of the time. It is vital therefore to understand these parameters before attempting an interpretation of the archaeological record available to us. This chapter has attempted to describe the environmental and paleoclimatic parameters within which the Lake Mojave and Pinto people operated.

The environment of the Mojave Desert was extremely dynamic during the Early to Mid-Holocene. Prolonged and significant climatic changes occurred periodically between 12,000 and 2,000 years BP throughout the Desert West. Long-term, though fluctuating, lakes stood in the Mojave, Owens, and Amargosa river systems surrounding the study area from roughly 13,000 BP to possibly as late as 8,400 or 7,500 BP.

After a long period of dessiccation much shallower lake stands occurred again about 3,600 BP.

The relatively wet periods marked by these lake stands were undoubtedly 'good times' (Elston 1982) when human populations were relatively high in the Mojave Desert. The 'good times' were followed by 'hard times' however, and presumably the choices made by people during the 'good times' would have led to disaster during the 'hard times'.

Rogers Ridge is located in the basin of lowest elevation at Fort Irwin. At 430 m above mean sea level it provides a substantially warmer environment than is found at the Henwood site, which lies at approximately twice that elevation. Field crews working on the south facing slope of the ridge were frequently able to work in tee shirts in February of 1985. Crews working at higher elevations in Nelson, Drinkwater, and No Name basins during this time of year frequently encountered much colder weather than experienced at Rogers Ridge.

Increased temperatures in Tiefort Basin during the early Middle Holocene may have played a role in the seasonal round decisions of the site occupants and certainly must be considered as a major factor in the calculation of obsidian hydration rates today (discussed in Chapter IV). Plants and animals at this lower elevation may have been more available and/or in better condition during the early spring, a time of the year traditionally marked by resource scarcity among mobile hunters and gatherers, than those at higher elevations. This may have made Rogers Ridge a more attractive location during the spring and a less attractive location during the summer.

Certainly, the presence of the spring at Rogers Ridge, during at least part of the occupation, as well as that of Bitter Spring nearby, must have made this an attractive location. Populations exploiting the Tiefort Basin or traveling through toward the upper elevations in the west and the lower elevations to the east would have been magnetically drawn to these precious resources.

The Henwood site, on the other hand, is located at a more median elevation. It is situated on a major wash system which may have made water available in the form of seeps, springs, or shallow wells during at least some portions of the year. This wash may have formed an integral part of a major travel route through the region between the lower elevations of the Soda Lake basin and the uplands around Fort Irwin and what is now the China Lake Naval Weapons center.

The Henwood site was also located near a major source of stone tool quality cryptocrystalline silica and basalt nodules. Quarrying activities undoubtedly led to some decisions to occupy this site and resulted in variation between the artifact assemblages of this site and those of Rogers Ridge.

The excavations and surface collections conducted at both sites were designed to emphasize the recovery of archaeological data from definable site loci and components. Data recovery methods, therefore, varied from locus to locus but the same techniques were employed consistently throughout. The emphasis of the data recovery techniques changed, of course, in response to the character of each locus. For instance, 5X5 m surface collections were more important in deflated loci and less important in loci where deposits and excavations were more extensive. The varying application of these techniques thus reflected the variability of the individual site loci.

Variability in sampling techniques between sites and components, however, leads to certain potential problems in the comparability of artifact assemblages. Consequently, care was taken throughout this study to account for variability introduced into the record due to variations in data recovery techniques.

Chapter III below, explains the artifact classification system and how it has been designed to track the trajectory of artifacts through the cultural systems of the Lake Mojave and Pinto periods. If settlement-subsistence strategies changed during these time periods the associated tool assemblages should have varied in response to these changes.

CHAPTER III

ARTIFACT TYPOLOGIES

Tools are made, used, and discarded in response to the predicted and immediate needs of the user. Therefore, the various stages of artifact reduction, use, and discard found in an assemblage should be sensitive indicators of shifts in settlement-subsistence strategies through time.

The artifact typology presented in this chapter emphasizes both artifact morphology and the technological level of artifact reduction. It is meant to enhance assemblage variability caused by changes in the logistical strategies of archaeological site occupants through time. Tool production, use, and discard are viewed here as dynamic components of the technological systems basic to the maintenance of cultural systems. The tool assemblages, thus, reflect the support facilities employed in the collection, reduction, and processing of subsistence and material resources.

Development of the Artifact Typology

Preliminary field reports on the sites examined in this study were written by different archaeologists over a period of several years, and some of their typologies emphasized different characteristics. But projectile points and scrapers from all sites were subsequently reclassified by a single researcher (Claude N. Warren) and because this was done in a consistent manner well-suited to the analytical purposes of the present study, his categorizations are used here essentially unchanged (Jenkins et al. 1986:76-88, 90-101, 104-110; Warren 1985a, 1985b, 1986b, 1990).

The biface typology is completely new, created for the present study. It emphasizes the stage of lithic reduction and morphology each artifact attained prior to discard. In fact, the types themselves are intended to reflect a series of reduction choices. It is assumed that early reduction stages offered the tool maker a series of choices initially determined by the raw material type and form. As the tool was shaped it was concomitantly reduced in size. By keying the biface typology to the artifact length, width, and thickness, as well as morphology, I have attempted to encapsulate portions of the lithic reduction system into easily quantifiable segments.

For the present study, lithic debitage was simply tabulated according to raw material type--whether obsidian, cryptocrystalline silicate (CCS), or basalt for each component. The ground stone artifacts, following the original preliminary report categorizations, were divided into metates (grinding slabs) and manos (handstones) according to whether their abraded surfaces were concave or convex (Bergin 1986, 1990; Jenkins 1985). The projectile point, scraper, and ground stone types will here be discussed and summarized briefly from the cited literature. The new classification of biface artifact types is presented for the first time below. Table 1 lists the artifact types by categories and computer abbreviations.

Projectile Points

The majority of projectile points from the sites reported here have been identified with either the Lake Mojave or Pinto series (Warren 1985a, 1986b, 1990:63-78). The Lake Mojave series includes 3 types: Lake Mojave Long-stem (LMLS), Lake Mojave Short-stem (LMSS), and Silver Lake Rectangular-stem (SLR). The Pinto series includes 5 types: Pinto shoulderless; Pinto Sloping-shoulder expanding stem; Pinto Square-shoulder expanding stem; Pinto Sloping-shoulders straight-stem; and Pinto Square-shoulder straight-stem (Warren 1985a:104-116).

The following descriptions of Lake Mojave, Pinto, and Leaf- shaped projectile points represent Warren's extensive efforts to 'modernize' projectile point typologies for Lake

Table 1. Artifact types employed in the present analysis.

Types	Abbreviations
Projectile Points	
LAKE MOJAVE SERIES	
Lake Mojave Long Stem	LMLS
Lake Mojave Short Stem	LMSS
Silver Lake Rectangular Stem	SLR
LEAF SHAPED	LS
PINTO	P
OTHER PROJECTILE POINT TYPES	
Bipointed	BIP
Diamond Shape	DIAM
Clovis	CLOVIS
Elko	EL
Flake Point	FLAK
Great Basin Stemmed	GBS
Gypsum Cave	GYP
Large Side Notched	LSN
Large Stemmed Point	LSP
Straight Based Triangular	SBT
Thick, Parallel Edged	TPE
Weakly Shouldered Point	WSP
Point Fragment (Nondiagnostic)	PF
Point Fragment Concave Base	PFCB
Point Fragment Convex Base	PFCV
Point Fragment Leaf Shape	PFLS
Point Fragment Straight Base	PFSB
Bifaces	
Amorphous Biface Fragments	25
Complete Leaf Shaped Blanks	2
Contracting Base A	6
Contracting Base B	9
Convex/Rounded Base A	5
Convex/Rounded Base B	7
Convex/Rounded Base C	10
Discoids	19
Large Preform Fragments	14
Large Preforms	18

Table 1. (continued)

Perforator A	15
Perforator B	16
Perforator C	17
Rectangular Base A	3
Rectangular Base B	4
Rectangular Base C	8
Small-Mid-Sized Preforms	20
Stemmed Ovals	12
Tips	1
Weakly Shouldered	11
Ground and Battered Stone	
Hammerstone	HAMM
Mano (handstone)	MA
Metate (millingstone)	ME
Unground Tabular Fragment	UTF
Unifaces (Scrapers and Gravers)	
Domed Scrapers	DS
Miniature Domed Scrapers	MDS
Elongate Keeled Side Scrapers	EKSS
End Scrapers	ES
Large Keeled and End Scraper	LKES
Tear Drop Side/End Scrapers	TDSS
Concave Scrapers	CS
D Shaped Flake Scrapers	DSFS
Flake Knife	FK
Irregular Core Scrapers	ICS
Irregular Flake Scrapers	IFS
Miscellaneous Uniface Fragment	MUF
Ovoid Side Scrapers	OSS
Pointed Scrapers	PS
Thin Tabular Scrapers	TTS
Spiked Graver	SG
Split Cobble Graver	SCG
Standard Graver	STG
Triangular Engraver	TE
Cores	

Mojave and Pinto assemblages at Fort Irwin (Jenkins et al. 1986:76-88; Vaughan and Warren 1987; Warren 1985a, 1986b, 1990:63-78). Warren has applied a modified version of Thomas' (1981) Monitor Valley techniques of typology to the analysis of Lake Mojave and Pinto points. Some characteristics, stem length and the definition of shoulders, for instance, were added to distinguish between variants of the Lake Mojave and Pinto point series.

Lake Mojave Series (Fig. 1 a-k)

> . . . This series includes the traditional classes of Lake Mojave and Silver Lake points, and has been tentatively divided into three types or variants: (1) Lake Mojave Long-stem; (2) Lake Mojave Short-stem (formerly included in the Silver Lake type), and (3) Silver Lake Rectangular-stem (also formerly included in the Silver Lake type). All exhibit broad stems (WN 1.0 cm) and are generally large enough to be considered dart or spear points. Each of the variants is described below (Warren 1985a:114).

Lake Mojave Long-stem (LMLS)

> These points are either lanceolate or stemmed with long contracting stems and convex to pointed bases. Lanceolate forms lack shoulders; shoulder width on other forms vary considerably. On complete specimens the stem is usually equal to, or longer than the blade (Warren 1985a:114).

Lake Mojave Short-stem (LMSS)

> The Short-stem variant of the Lake Mojave series exhibits a slightly expanding to contracting stem and convex base. Here, the stem is shorter relative to the maximum width at the shoulders and shoulders

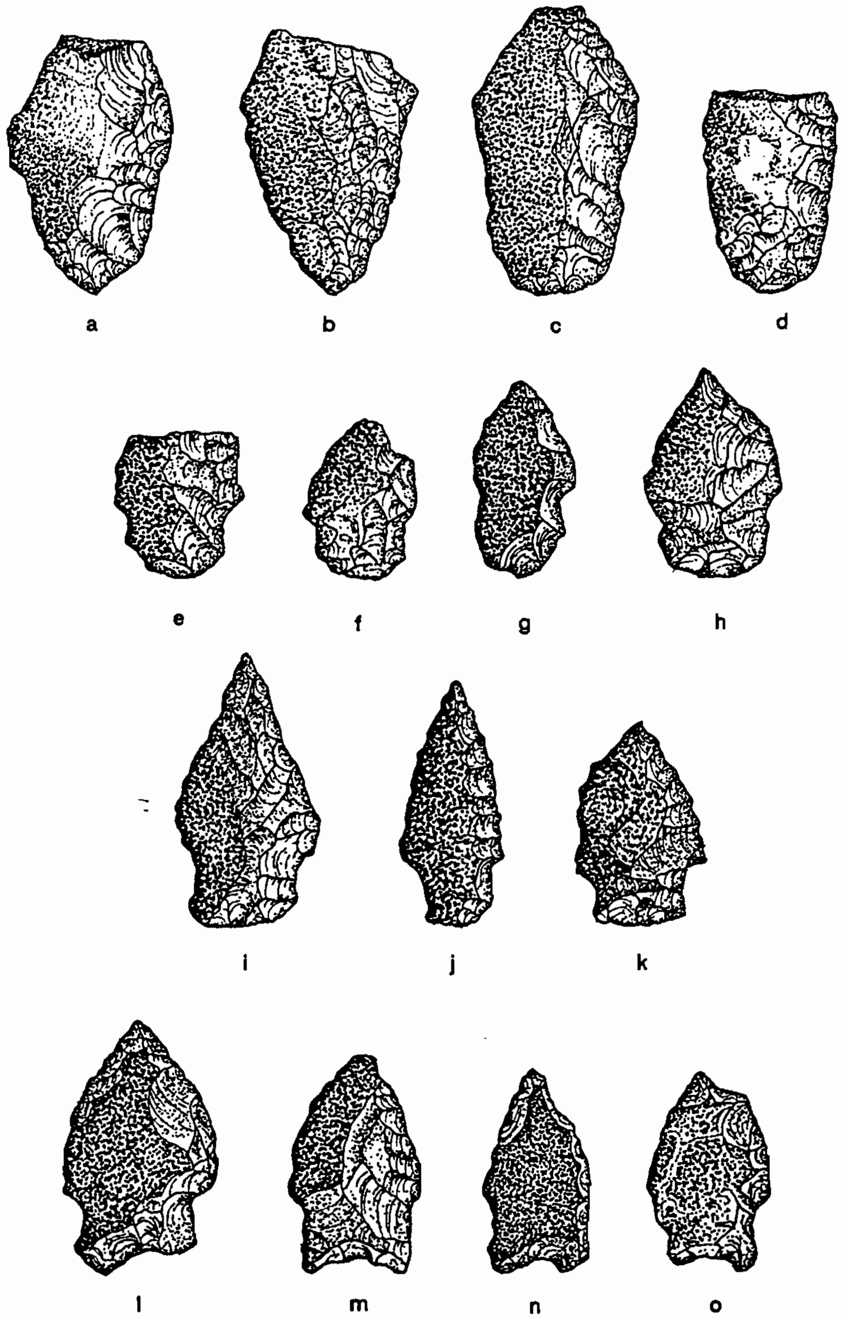

Figure 5. Projectile points. a-d, Lake Mojave Long-stemmed; e-h, Lake Mojave Short-stemmed; i-k Silver Lake Rectangular-stemmed; l-o Pinto points. Point c is 6.14 cm in length. (After Jenkins 1987:Fig. 2).

> are more prominent than on the Long-stem variant. . . In brief, the Short-stem variant is distinguished from the Long-stem variant by a parallel or slightly expanding stem (Warren 1985a:115).

<u>Silver Lake Rectangular-stem</u> (SLR)

> These points appear to be morphologically intermediate between the Lake Mojave Short-stem and the Pinto series. Silver Lake rectangular-stem points are shouldered with straight to slightly expanding stems with straight bases. Shoulders are essentially straight and may be slightly barbed (DSA < 90) or slightly sloping (DSA > 90), but the parameters of this variability have not been established (Warren 1985a:115-116).

Pinto Series (P)

Vaughan and Warren's (1987) analysis has proven that the Pinto points of the Mojave Desert are morphologically and technologically distinct from similarly shaped points in much of the Great Basin. Specifically, the Pinto points of the Mojave Desert are clearly distinguished from the Gatecliff Split-stem points of the Great Basin. That these points may date to a different time period or periods is a reasonable deduction from the fact that they are formally different.

> The taxonomy for the Pinto series is still in an experimental and "dynamic" state in which "clusters of attributes" have been identified that appear to characterize variants within the Pinto series as well as the Pinto series as a whole. However, these "clusters of attributes" may yet be modified by additions and/or deletions of attributes in an attempt to better identify the variants and to distinguish the Pinto series from other such morphological groupings.

> All points of the Pinto series, as defined here, exhibit relatively broad stems with both neck width and basal width greater than 10 mm and a concave or indented base creating a BIR equal to or less than .98. Pinto points also generally exhibit narrower shoulders and are thicker than other broad stemmed indented based points; parameters of these dimensions, however, have not been adequately defined. Given these descriptors, five variants have been identified within the Pinto series: (1) Pinto Shoulderless; (2) Pinto Sloping-shoulder, Expanding-stem; (3) Pinto Square-shoulder, Expanding-stem; (4) Pinto Sloping-shoulder, Straight-stem; and (5) Pinto Square-shoulder, Straight-stem (Warren 1985a:110).
>
> One characteristic found throughout the Pinto series is use of a percussion technique in the late stages of point production with pressure flaking restricted to final finishing of the edges. In most cases this is limited to fine flaking of blade edges and the stem margins. Occasionally, however, this fine flaking, on obsidian or cryptocrystalline quartz, extends further onto the blade. The most common material used in production of this series of Pinto points were coarser materials such as basalt and rhyolite . . . (Warren 1985a:111-113).

All Pinto points, regardless of type, have been combined for this analysis in order to facilitate quantitative analysis.

Leaf Shaped Series (LS)

> . . . The bases of these points are convex to pointed in form, cross sections vary from lenticular to plano convex, and edges are convex (Warren 1985a:118).
>
> Warren (1985a:118) has subdivided leaf shaped points into three subtypes on the basis of basal forms and position of greatest width relative to the base. All Leaf shaped points are considered a single type in this study, however, in order to facilitate quantitative analysis.

Other Point Types

Other point types recovered from the studied sites are Bipointed (BIP), Clovis, Elko (EL), Flake (FLAK), Gypsum Cave (GYP), Large Side-notched (LSN), Diamond shaped (DIAM), Straight Based Triangular (SBT), Thick Parallel Edged (TPE), Weakly Shouldered (WSP), Large Stemmed (LSP), and Great Basin Stemmed (GBS). The Great Basin Stemmed points are believed to be similar to the series known from the Northern Great Basin. They have been differentiated from Lake Mojave points on the basis of stem and shoulder morphologies but are probably comparable to Lake Mojave series points in age. Each type is briefly described below.

<u>Bipointed</u> (BIP)

> A slender artifact with a thick plano-convex cross section which, based on overall shape of the large fragment, appears to have been pointed on both ends (Warren 1985a:124).

<u>Clovis</u>

> [These] point[s] exhibit well-controlled fluting on both faces with secondary bifacial pressure flaking on the base and both edges (Warren 1986b:213).

<u>Diamond Shaped</u> (DIAM)

> These points are essentially diamond shaped with one end shortened by form of a convex . . . , straight . . ., or concave . . . base. Blade edges are straight and the edges of the stem contract from the widest

point of the artifact to the base. This contracting edge is straight to very slightly concave (Warren 1990:116).

Elko (EL)

The Elko series consists of large corner-notched projectile points with a basal width greater than 10 mm. and a proximal shoulder angle of 110 to 150 degrees (Vaughan and Warren 1987:206).

Elko points frequently have indented or bifurcated bases flaring outward to distinctive "ears" (Elko Eared) which give them a footed appearance. They are made on large flakes and have finely finished surfaces covered with long, shallow, predominantly pressure flaked scars. They are distinguished from Pinto points by their relative thinness, broad shoulders, and narrower distal shoulder angles (Vaughan and Warren 1987:206).

Flake (FLAK)

This point is made on a flake with a striking platform extending diagonally across the stem. One edge of the stem and adjacent shoulder is formed by minimal retouching of the flake edge. The opposite shoulder is more heavily bifacially worked, but the adjacent edge is an unmodified striking platform. The flake is curved, producing a curved point that is concavo-convex in section and roughly lenticular in cross section (Warren 1985a:118).

Great Basin Stemmed (GBS)

Large, leaf-shaped blade with convex edges, sloping shoulders, and long contracting stem with ground edges. Lenticular in cross section . . . remarkably similar to Cougar Mountain points and Parman points of the northern Great Basin (Bryan 1980:85) (Warren 1986a:86-87).

Gypsum Cave (GYP)

> . . . A contracting stem base with a small portion of the shoulders still remaining, has a relatively thick lenticular cross section which has been poorly thinned by percussion flaking (Warren 1985a:124).

Large Side-Notched (LSN)

> Large parallel edged triangular point with semicircular shaped side notches near the base (shoulder height 0.97 mm) and a slightly convex base. Cross section is lenticular and edges are irregular but not serrated (Warren 1985a:118).

Large stemmed (LSP)

This class of points comprises all large stemmed points which do not appear to be either Lake Mojave or Pinto. They have broad, straight or expanding stems, slightly convex, straight, or slightly concave bases and straight to sloping shoulders. Though Warren (1986b:209) divided this class of points into three subtypes they have been combined for this study in order to facilitate quantitative analysis.

Straight Based Triangular (SBT)

> Triangular with straight to slightly convex base and sharp basally convex edges are straight and even. All specimens are relatively thick in cross section and relatively long in relation to their width. . . (Warren 1986b:214)

<u>Thick Parallel-edged</u> (TPE)

> . . . This category is set off from the other parallel-edged type by a thicker cross section and straight or concave base (Warren 1986b:214).

<u>Weakly Shouldered Points</u> (WSP)

> . . . exhibit narrow-sloping shoulders and straight stems with slightly convex to slightly concave bases. Blade edges are straight to slightly convex and cross sections are lenticular (Warren 1985a:118).

<u>Bifaces</u>

Bifaces were classified by shape, size, probable portion of artifact represented, and probable function or level of reduction. In other words, the bifaces were identified by basal form, general outline, and the amount of reduction or 'completedness' evident. The types are sensitive to, and determined by, length, width, and thickness and include such considerations as whether or not the specimens are 'complete' tools, identifiable tool fragments--proximal or distal ends--, or preforms, cores, and amorphous fragments.

Each biface class was assigned a name and also a number, for convenience of computer manipulation. The stage of reduction was noted by appending its number, following a period, to the type number. For example, a minimally modified biface tip would be noted as 1.1. The first 1 indicates that the specimen was incomplete and had a point at one end. The second 1 indicates that it exhibited only percussion flaking, usually had some cortex material present, had sinuous edges, a thick cross-section, and flake scars that were large, deep, and only moderately overlapping. All of this information can be deduced from the two number system used here.

The stages of artifact reduction identified in this study are presented below. Appending the reduction stage number to any artifact type number in effect describes the form and attributes of lithic reduction present on that particular artifact.

Stages of Biface Reduction

Five relative stages of reduction are recognized within the biface typological system. These stages are defined by a decision making system designed to segment the continuum of biface reduction as it is represented in each sample collection. Thus, stage 1 bifaces are more similar to stage 2 bifaces than they are to stage 3 bifaces. In the same way, stage 2 bifaces are more similar to stage 1 and stage 3 bifaces than they are to stage 4 bifaces. The system is not one of absolute values defining stages of reduction, but rather establishes the general levels of reduction of artifacts within each site and component. When these data are combined with chronologically and/or technologically diagnostic artifact information, archaeological signatures are defined for individual components, which can be compared to other site and component signatures.

<u>Stage 1</u> is a barely modified form exclusively percussion flaked through the hard hammer technique. These artifacts have large, deep, unpatterned flake scars, sinuous edges, and a relatively thick cross-section. Some portions of the artifact may be completely unmodified, retaining cortex on the surface.

<u>Stage 2</u> bifaces have been thinned and reduced further through the removal of a series of contiguous, hard hammer percussion flakes. These flakes tend to be shallower than those of the previous stage and to overlap more. Their patterned removal adds significant definition to the artifact shape. Edges remain sinuous though somewhat straighter than those of the previous stage. Stage 2 artifacts are traditionally considered to be crude quarry blanks. They are, however, in many cases, fully useful as tools and some exhibit evidence of use-wear.

<u>Stage 3</u> bifaces tend to retain slightly sinuous edges, formed by the termini of relatively large to medium sized percussion flake scars. They generally exhibit little evidence of pressure flaking. Their entire surface has been modified to some degree by the removal of flakes that generally reach to the mid-line of the artifact. Major efforts are made to thin the artifact at this stage and many

are broken in the attempt. Consequently, stage 3 bifaces are common among all assemblages reported here.

Stage 4 bifaces have a relatively thin, finely finished appearance. This results from the carefully controlled removal of thin, shallow percussion and pressure flakes which commonly reach to the mid-line of the artifact. Large flake scar ridges and termini of the earlier reduction stages are obliterated and the artifact edges straightened through the careful removal of contiguous pressure flakes. Edges are strengthened through this process, which increases the edge angle. These artifacts are thin, finished or nearly finished tools which are fully useful for cutting and piercing.

Stage 5 artifacts are clearly finished tools with surfaces completely modified through the careful removal of soft hammer and pressure flakes. The edges have been completely straightened and strengthened by this process. Projectile points are most commonly either stage 4 or 5 bifaces. Any further reduction beyond this stage begins to reduce the usefulness and functional longevity of the artifact.

Biface Types

Each type is briefly described below in alphabetical order. The number designator employed in the analysis of each artifact class appears after the underlined name. Comments concerning the typology, e.g. about particular attributes, probable function of artifacts, or suggested evolutionary relationships of artifacts, are included in these descriptions.

'Complete' Leaf Shaped Blanks (2)

These tend to be pointed to slightly rounded at both ends and have a maximum width range from 21 to 38 mm. This width range places these artifacts, and all other artifact types with maximum width ranges of 38 mm or less in the category of potential projectile point preforms. 'Complete' Leaf Shaped Blanks show close morphological similarities to the Leaf shaped points but are not usually reduced as much as the Leaf Shaped points.

Contracting Base A (6)

These specimens have relatively more pointed bases than the Convex/rounded base A artifacts (below). However, they also frequently have a short straight (non-convex) butt located between fairly sharply contracting shoulders. The blade edges are generally convex but may also be parallel for some portion of the artifact. Their maximum width ranges from 19 to 38 mm. As a class, these artifacts share obvious similarities to the 'Complete' Leaf shaped blanks. The contracting shoulders are located in the lower third of the artifact in the Contracting Base A type, however, whereas the shoulders are located nearer the midsection of the 'Complete' Leaf shaped blank specimens.

Contracting Base B (9)

These artifacts have relatively pointed bases which frequently have a short straight (non-convex) butt located between strongly contracting shoulders. Blade edges are generally convex but may also be parallel for some portion of the artifact. Maximum width ranges from 39 mm to 70 mm.

Convex/Rounded Base A (5)

These artifacts have rounded to slightly subrectangular corners, slightly convex bases, parallel to slightly convex (i.e. expanding) blade edges, and have a maximum width ranging from 13 to 38 mm. These artifacts could be preforms for projectile points or relatively small cutting and scraping implements, perhaps hafted knives. They are, in general, similar to artifacts of the Rectangular Base A type (below). These two classes of artifacts have been distinguished from each other by a straight-forward method of dividing the morphological continuum in half so that the more or less rectangular based artifacts are grouped together and the more or less round based artifacts are grouped together. There is clearly a considerable amount of similarity between these classes near the 'center' of the continuum. However, it seemed most prudent to make this division because of the tendency for hafted knives of the following Gypsum period to have strongly rectangular basal forms. The current division of these two classes then, is an attempt to track the development of rectangular cornered, or triangular shaped, hafted bifaces from the end of the Pinto period into the early Gypsum period.

Convex/Rounded Base B (7)

These bifaces have rounded to slightly subrectangular corners, slightly convex bases, and parallel to slightly convex (i.e. expanding) blade edges. They differ from the Convex/Rounded Base A artifacts by ranging in maximum width from 39 mm to 55 mm. Though with further reduction in size they could serve as projectile points, they are uniformly larger than most projectile points and in general could easily serve as cutting and scraping tools without much further reduction.

Convex/Rounded Base C (10)

These specimens have rounded to slightly subrectangular corners, slightly convex bases, and parallel to slightly convex (i.e. expanding) blade edges. These artifacts differ from the Convex/Rounded Base A and B class artifacts by ranging from 56 to 84 mm in maximum width. Most of these artifacts clearly were discarded because they were broken early in the reduction sequence. With further reduction they probably would have become Convex/Rounded Base B artifacts.

<u>Rectangular Base A (3)</u>

These artifacts have rectangular to subrectangular corners. They range from 17 to 38 mm wide, and have parallel to slightly convex edges. These bifaces could have been reduced further to serve as either projectile points or relatively small cutting and scraping implements.

<u>Rectangular Base B (4)</u>

These specimens have rectangular to subrectangular corners, are between 38 and 44 mm wide, and have parallel to slightly convex edges. These artifacts are generally too large for projectile point blanks though they could be reduced further for such a use. These artifacts would appear most suitable, in the later stages of further reduction, for use as hafted cutting and scraping tools (i.e. 'knives').

<u>Rectangular Base C (8)</u>

These artifacts are morphologically similar to Rectangular Base types A (3) and B (4) but their maximum widths are equal to or exceed 45 mm. Their large size and tendency to be crudely reduced suggests they are rejected preforms or blanks.

Tips (1)

These are pointed to slightly rounded, worked on both faces, and are apparently proximal ends of fragmentary stone artifacts.

Amorphous Biface Fragments (25)

These are midsections, edge fragments, bifacial flakes, unformed bifaces, and bifacial fragments that could have originated from any number of artifact types.

Small-Mid-Sized Preforms (20)

These are percussion flaked, leaf shaped preforms with cortex occasionally remaining on one surface. They tend to have maximum widths less than 40 mm and relatively thick cross sections (15 mm or more).

Stemmed Ovals (12)

These artifacts have oval shaped blades and prominent, but broken, stems. Both are finely worked.

Weakly Shouldered (11)

These bifaces have maximum widths of 30 to 38 mm, incipient shoulders, and contract toward the base. They are almost always broken diagonally just above the indented sides of the blades.

Discoids (19)

These are oval to subrectangular or subtriangular preforms. Their relative length/width/thickness measurements suggest that these artifacts were discarded because they were too short and too thick for efficient reduction into the standard forms of bifaces. They tend to exhibit the same flaking characteristics as the other preforms.

Large Preforms (18)

These are relatively large elongated preforms characterized by broad, deep, flake scars, and relatively thick cross sections. These artifacts range from slightly ovate to lanceolate but seldom have a definite shape other than elongated.

Large Preform Fragments (14)

These fragmentary specimens are very crudely reduced and occasionally have cortex remaining on one of their surfaces. They generally have maximum widths exceeding 50 mm and the flake scars are large, deep, and irregular. The do not exhibit any regularity in form.

Perforator A (15)

These are drills or reamers with relatively broad, globular bases and generally short, narrow to medium width bits.

Perforator B (16)

These are narrow fragments of drill bits.

Perforator C (17)

These are relatively large, crudely shaped punches or reamers with short, relatively broad, blunt bits.

Unifaces

The unifacial artifacts (i.e. scrapers and gravers) were analyzed and described by Claude N. Warren (1985b, 1986b, 1990). His typology is compared, where appropriate, to the works of Amsden (1935, 1937) but varies considerably from it. Though the analysis of these artifacts occurred over the span of several years the major categories--Domed, Keeled, and End scrapers--are distinctive enough to be consistently identified, and it is upon these that the most emphasis has been placed in the present study.

The unifaces have been uniformly typed according to the Nelson Wash site typology. The following are descriptions of the scraper and graver types identified by Warren (1985b, 1990:109-122) in that typology. The descriptions are presented here as a series of citations from Warren

(1985b:142-160). For convenience sake, they have been arranged alphabetically by types.

2.0 Domed Scrapers (DS)

> Ovoid in outline and plano-convex to triangular in cross section, these tools are made on thick flakes and rarely on cores, by steep angle unifacial removal of flakes from about one-third of the edge to the entire periphery. . . The size range of the class is large, but represents a continuum and, as a result the class cannot be neatly subdivided on the basis of size. . . Some exhibit more even edges than others as a result of more intensive flaking and, in addition, tend to exhibit thinner cross sections, lacking a peak or keel. They do not appear to be any more circular in outline than other domed scrapers, however, and may exhibit flaking on as little as approximately one fourth of the periphery. On the basis of rather tenuous criteria Domed scrapers are divided into two variants:
>
> 2.1 Variant 1 (. . . equates more closely with Amsden's "round scrapers") exhibits even edges with intensive well controlled flaking and a relatively thin plano-convex cross section.
>
> 2.2 Variant 2 (. . . equates more closely with Amsden's "keeled round scrapers") exhibits more sinuous edges, with less well controlled flaking and a triangular or thick plano-convex cross section . . .

3.0 Miniature Domed Scrapers (MDS)

> Characteristic of this type are small thick flakes and cores which are unifacially flaked around one-fourth to the entire periphery producing an oval, circular or irregular outline and a thick triangular, plano-convex or irregular cross section. Flaked edges are most often convex, but may be a composite of convex and straight and/or concave forms. . . These Miniature Domed scrapers also exhibit the variants identified for the Domed scrapers:

3.1: exhibits even edges, well controlled flaking and a relatively thin plano-convex cross section.

3.2: exhibits more sinuous edges, less well controlled flaking, and triangular, thick plano-convex or irregular cross sections.

Elongate Keeled Side-Scrapers (EKSS)

Scrapers of this type are long and narrow with blunt sides and are triangular to plano-convex in cross section. One or both of the long lateral edges are steeply flaked unifacially. The ends are less frequently flaked and seldom to a point. . .

5.0 End Scrapers (ES)

Scrapers of this class are elongate oval, teardrop shaped, or triangular in outline and plano-convex to triangular in cross section. One end is steeply unifacially flaked to form a convex or straight edge.

Lateral edges are usually, but not always, unifacially flaked and occassionally exhibit limited bifacial flaking. There is considerable variation in this class, reflecting selection of original flake, and degree of modification. Six variants have been described for this class in the Nelson Wash assemblages (Warren 1990:113).

5.1: Made on an end struck flake with triangular cross sections and trapizoidal outline. Striking platform and/or bulb of percussion is located at one end. The opposite end is steeply unifacially worked forming a convex leading edge. Lateral edges are also modified by unifacial flaking.

5.3: Made on thick end struck flakes with broad tear drop outline and thick plano-convex cross section. Striking platform and/or bulb of percussion is located at narrow end. Broad end is unifacially percussion flaked and pressure retouched at a steep angle. One or both lateral edges are unifacially flaked. This variant is thickest at the broad leading edge and tapers gently to the trailing base.

5.5: Ovoid in outline and thick plano-convex to triangular in cross section. Most concentrated uniface flaking occurs on one end producing a steep, angled convex edge. One or both lateral edges are unifacially flaked. Variant 5 corresponds most closely to the small specimens included in Amsden's (1937:61) elongate keeled scrapers, and to his end and side scrapers (Amsden 1937:63-64). Flaking on lateral edges of Variant 5 extends from the edge to a medial line (the keel) on most specimens. . .

5.6: Triangular in outline, plano-convex in cross section. Unlike other end scrapers, the leading edge is straight rather than convex. The leading edge exhibits steep unifacial flaking. One or both lateral edges may be unifacially retouched.

1.0 Large Keeled End and Side Scrapers (LKES)

Ovoid to rectangular in outline, plano-convex to triangular in cross section, these scrapers are made on thick flakes by steep angle unifacial flaking along one or both long edges and usually on one or both ends.

The outline of these scrapers is modified by flake removal, although the gross form is largely determined by the shape of the original flake. . . This type is simlar to Amsden's (1937:61) elongate keeled scrapers, however, these large keeled scrapers correspond only to the large end of the size range described by Amsden.

6.0 Tear Drop Side/end Srapers (TDSS)

Artifacts of this category are tear drop shaped in outline and thin plano-convex in cross section. Typically, the outline is formed by extensive uniface flaking about the periphery. . . This class differs from end scrapers of similar form in exhibiting low angle of flaking on the broad convex end, steep heavy flaking on one lateral edge, and a thin cross section.

15.0 Concave Scrapers (CS)

Concave scrapers . . . are . . . elongate retangular or rhomboidal shaped in outline and plano-convex in cross section. One or more edges have a pronounced concave form similar to a spoke shave.

D Shaped Flake Scrapers (DSFS)

These artifacts are D-shaped in outline and triangular in cross section. The curved edge is sharp and unifacially retouched and the straight edge is a thick striking platform or cortex. The appear to be small backed knives or scrapers with a curved edge.

12.0 Flake Knives (FK)

Flake knives . . . were made on end struck (variant 12.1) or side struck (variant 12.2) flakes and exhibit low angle unifacial flaking on one or more edges. The unifacially flaked portions exhibit a smooth even, curved or straight edge. . .

20 Irregular Core Scraper (ICS)

Irregular cores and core fragments that have been modified by unifacial flaking on one or more edges comprise this category. The appear nothing more than exhausted or broken cores that were unifacially flaked and/or used as expedient tools.

13.0 Irregular Flake Scrapers (IFS)

These are flakes that have been either modified by use or have limited unifacial flaking exhibited on one or more edges. The are generally irregular in form with one or more retouched edges. Worked or used edges are convex, straight, or concave, and may occur in different combinations on a single flake. . . There are six variants recognized by this typology:

13.1: Basalt primary flake (cortex present) discoidal

13.2: Basalt primary flake (cortex present), elongate

13.3: Basalt secondary flake (cortex absent), discoidal

13.4: Basalt secondary flake (cortex absent), elongate

13.5: Cryptocrystalline quartz discoidal

13.6: Cryptocrystalline quartz elongate.

Elongate flakes may be either end struck or side struck and the worked edge may be either end or lateral edge. Discoidal flakes exhibit use wear or secondary flaking on one or more available edges. . .

14.0 Miscellaneous Uniface Fragments (MUF)

These are fragments of unifacially worked flakes that are too incomplete to identify as to category. They are divided into four variants on the basis of material (basalt and cryptocrystalline quartz) and the flake type (cortical and non-cortical) of the basalt specimens:

14.1: Primary basalt flake

14.2: Secondary basalt flakes

14.3: Cryptocrystalline flake

14.4: Obsidian flake

7.0 Ovoid Side Scrapers (OSS)

Elongate oval or rectangular in outline and plano-convex in cross section, these scrapers are unifacially flaked on one or both lateral edges. This class is variable, reflecting differences in edge angle, extent of flaking on edge (e.g. one or two lateral edges), and material. The variants listed below are based on size and extent of flaking along the edges.

7.1: Made on elongate flakes, either end or side struck, with unifacial flaking occurring on one or both lateral edges and at least one end. . . This variant is characterized by an elongate oval outline with rounded ends, and a relatively flat plano-convex cross section.

7.2: Made on elongate flakes, either side or end struck, with unifacial flaking limited to one or both lateral edges. Outlined is variable, ranging from ovoid to rectangular. Cross section varies from plano-convex to triangular. . .

7.3: Oval to elongate oval in outline, flat plano-convex in cross section. Made on side struck or end struck flakes. Unifacially flaked around one half to entire periphery with one lateral edge most heavily worked . . . The variant is small and thinner than other variants.

8.0 Pointed Scrapers (PS)

8.1: Scrapers of this class are elongate triangular in outline and plano-convex to triangular in cross section. The two long edges meet at an acute angle and are unifacially flaked to produce a relatively sharp point. The base is usually unworked and may exhibit a striking platform or an irregular edge. There is considerable variation in the thickness of these scrapers and this thickness is reflected in the angle of the flaked edges.

9.0 Thin Tabular Scrapers (TTS)

Irregular oval to subrectangular in outline and irregular to plano-convex in cross section, these scrapers are made on flakes by unifacial flaking of one or more edges to form straight or convex working edge. Flaking is limited to the margin, but extensive enough to have modified the shape of the flake.

16.0 Spiked Gravers (SG)

Spiked graver (scraper gravers of Amsden 1937) take a variety of forms, but all exhibit one or more small unifacially flaked "engraving" spikes. These small engraving spikes occur on the edges of worked flakes, flake scrapers, small domed scrapers and occasionally on reworked broken tools. The number of spikes on a single artifact may vary from one to five or six.

16.1: Single spiked gravers made on flakes and flake scrapers. Spikes occur on relatively straight edges where they are produced by unifacial pressure flaking, or on naturally sharp corners or projections where they are modified by unifacial pressure retouch.

16.2: Multiple spiked gravers made on flakes and flake scrapers. Spikes are produced by unifacial pressure flaking on naturally sharp corners or projections or by shaping on a curved edge.

16.3: The specimen . . . is a small dome scraper. . . exhibiting well flaked edges with flake scars nearly meeting at the midline of the dorsal face. A single small sharp spike has been formed by further unifacially reducing a portion of the edge.

Split Cobble Graver (SCG)

. . . This specimen is made on the end of a split cobble or pebble with the cortex present over nearly

> all of the dorsal surface. . . Size of the object and of the engraving spike suggests that this artifact belongs to a different category of tools from the spiked gravers described above.

Standard Gravers (STG)

> Standard gravers are "engraving" tools with considerably larger engraving spikes than on spiked gravers. The engraving spikes vary from 1 to 3 mm in length on spiked gravers, whereas on the three standard gravers here they are slightly greater than 1 cm in length. . .The spike or engraving tip is formed by reducing a portion of the end of the flake to an elongate triangular projection by unifacial pressure flaking.

Triangular Engraver (TE)

> This artifact is a triangular flake unifacially flaked at one corner with an acute angle, producing a possible engraving tip.

Cores

These are lumps of stone which have had at least one flake removed from them. This class includes both unifacial and bifacial cores.

Ground Stone

The millingstones (ME) of the Lake Mojave and Pinto period sites reported here are typically little more than flat slabs which have been ground smooth. They generally appear to have been discarded once their naturally rough surfaces were smoothed. They seldom exhibit evidence of having been pecked for resharpening. As a consequence, they characteristically do not have noticeably concave basins. Similar slabs have been reported from Pinto sites by Rogers (1939:52, 53), from the Pinto Basin site (Amsden 1935:33), and from Tule Springs, Nevada (Susia 1964:31), although they are usually thinner than those at the Awl Site (Jenkins et al. 1986:159).

A class of artifacts believed to be related to millingstones is identified in this study as Unground Tabular Fragments (UTF). These are generally schist, gneiss, sandstone, and granite platelets, which are probably fragments of millingstones. They are generally very thin (<1 cm), fragmentary, and badly deteriorated. Though they do not exhibit evidence of grinding there are two reasons to believe they should be included in the ground stone category. First,they are comprised of materials that do not occur naturally in the local geology (i.e. they are ecofacts) and second, similar fragments within these sites do exhibit grinding polish suggesting that these particular fragments either were unground portions of grinding slabs or raw materials intended for use as such. In either case, they are useful indicators of grinding activities though their exact use is unknown.

The handstones (MA) are typically (ca. 66%) unshaped cobbles of basalt, granite, quartzite, and sandstone. They tend to occur in relatively low ratios when compared to millingstones, a fact probably due to their high relative portability and the ephemeral nature of millingstone use which required frequent replacement (Jenkins et al. 1986:159).

The typology presented in this chapter is intended to emphasize morphological, functional, and technological differences between and within artifact classes. The guiding assumption, mentioned early in this chapter, is that people's logistical strategies as well as their technology changed through time. These changes should have resulted in variation in the composition of stone tool assemblages both within and between archaeological sites. Assuming an evolutionary trend toward greater adaptiveness through cultural responses to changing climatic, environmental, and social conditions--the artifact assemblages, which reflect the technological support systems of the Lake Mojave and Pinto complexes--should vary through time and space as logistical strategies varied.

Detected variability within and between the artifact assemblages under study must be proven to be diachronically sensitive. To accomplish this task required not only dating the deposits the artifacts were recovered from but also establishing the relationships of the artifacts to both those deposits and the other cultural materials within them. Chapter IV describes the methods and assumptions employed throughout the analyses as these concerns were addressed.

CHAPTER IV

ANALYTICAL METHODS

The artifacts present in the prehistoric tool kits of the people who visited Rogers Ridge and the Henwood localities were there because their use was anticipated, or they were made from local materials on the sites to meet the more or less immediate needs of the occupants. The artifact typologies described in the previous chapter were designed specifically to enhance and record variations in assemblage compositions which might exist because of changes in the settlement-subsistence systems of the Lake Mojave and Pinto complexes.

The artifacts recovered from these sites came, however, from a wide variety of settings and highly variable depositional contexts. They represent cultural remains that were left by prehistoric occupants many thousand years ago, which were then vertically and horizontally moved by natural and anthropic forces, and were finally sampled by the archaeologists. These depositional variables affected the composition of the artifact assemblages, and must be considered prior to any comparative analyses. The objective of this chapter, therefore, is to describe the distributional, quantitative, and chronological methods and assumptions that guided the definition and analysis of the Rogers Ridge and Henwood site components.

Distributional Analysis

Archaeological assemblages are generally the residue of multiple activities conducted during the course of multiple occupations. Few sites represent a single occupation, and even more seldom found is the site of a single occupation where only a single activity took place. Patterns of artifact association in normal sites are generally believed to result from repeated occupations during which predominant activities, performed in favored locations, resulted in the discard of particular classes of artifacts.

Recent studies have shown that large samples recovered from archaeological sites commonly yield a greater diversity of artifact types than do smaller samples (Grayson 1983; Jones et al. 1983). The cited studies ascribe this correlation of typological diversity with sample size to the increased statistical probability that, within any assemblage, rare artifact types will be more often observed as sample size increases. Carr (1984), on the other hand, believes this close correlation is due to many factors, but two in particular: 1) The over-division of artifacts into many morphological rather than few functional types, and/or

2) the mixing of tool sets into palimpsest assemblages (i.e., remains of earlier occupations overlain and mixed with the debris of later occupations). He suggests that appropriate methods of analysis entail the investigation of the effects of site formation processes on artifact assemblages, and the identification of monothetic (each activity and its tool kit represented identically at each locus of deposition investigated), polythetic (some acitivies and members of tool kits represented at each site but none have identical assemblages), and palimpsest assemblages. This is done through distributional analysis.

The purposes of artifact distributional analysis are 1) to discern patterns of artifact distribution as a means of identifying the activities and activity loci which produced specific discard patterns, and 2) to identify chronologically discrete artifact assemblages from within the broader context of the entire site assemblage. The goals of the distributional analysis to be pursued in this study are to identify activity loci, i.e. site components, and their associated artifact sets, and to provide a means of evaluating their vertical (chronological) integrity with respect to other cultural components within the same deposits.

Carr (1984:113-114) suggests that this type of analysis can best be addressed by identifying two types of artifact components: activity sets and activity areas. He observes that the term 'activity sets' has two meanings in the archaeological literature (Carr 1984:114):

(1) Those artifact types that repeatedly are used or produced together, and

(2) those artifact types that repeatedly aggregate in the archaeological record when it is excavated.

'Activity areas' have also been referred to in two quite different ways (Carr 1984:114):

(1) The location at which an activity was performed in a site, and

(2) the location where tools or debris indicating past activity aggregate within a site, at the time of excavation.

Carr's reason for juxtaposing these variant meanings of the two concepts is quite clear. Tools that are recovered together archaeologically were not necessarily used together as tool kits. They may have simply been discarded in the same location (e.g. in refuse dumps) or they may have been left at various times in a popular work area of the camp. In the present discussion, the identified activity areas are believed, due to the clustering and composition of cultural materials within them, to be <u>depositional sets</u> of artifacts, those artifacts that were deposited together. The term is not meant to imply, unless it is expressly stated, that the activities in which the artifacts were used occurred exactly in the locations where the artifacts were recovered. In this frame of reference, therefore, the clustering of artifacts within a refuse pit is just as valid an association as the clustering of artifacts around a hearth.

The work to follow will not emphasize the segregation of individual tool kits from within depositional sets; instead, it will deal primarily with activity areas (depositional sets), and only secondarily with activity sets. I imagine that many activities common to camp maintenance and immediate subsistence needs were performed at different times within the same archaeological activity areas. The identification of specific tool kits related to certain camp activities is not central to my purpose of tracking chronologically sensitive shifts in artifact assemblages through time. In my interpretation, such shifts are assumed to relate to temporal changes in site function, and thus serve to indicate changing subsistence-settlement patterns.

If chronological shifts in artifact assemblages have been accurately identified by this study they should exhibit patterned change through time and between site components. If artifact assemblages exhibit a random distribution through time and between site components then the assemblages are probably not chronologically or culturally significant. We can assume, then, that such assemblages are probably the result of post depositional factors such as erosion, artifact mixing, and artifact misidentification (i.e. emphasizing the wrong attributes in the formation of artifact types).

The key to discerning meaningful patterns of artifact distributions (activity areas) is to identify artifact components that are defined by " a behaviorally significant archaeological criterion (Carr 1984:110)". The primary characteristic of activity areas to be emphasized in my assessment is the presence of identifiable boundaries (a notable decrease in artifact frequency) around artifact clusters, either vertically or horizontally. Carr (1984:126) points out that activity areas may be areas of low artifact density rather than high artifact density. My analysis, because of the limitations placed on it by the type of excavations and surface collections conducted, was not designed to detect activity areas characterized by low artifact densities.

Methods of Analysis

The majority of artifacts recovered from the excavations treated in this study were found in the screens rather than *in situ*. Their proveniences are thus assignable only to the 1 m excavation square, stratum, and arbitrary 10 cm level they were recovered from. This limits the types of distributional analyses which can be applied to them. However, my goals are simple and compatible with the provenience data available. These goals are 1) to identify activity areas, 2) to compare artifact assemblages of the various site components, and 3) to understand the degree of artifact mixing between components.

In this context, a component is defined as a depositional or analytical unit of cultural materials which has a definable quality differentiating it from other cultural materials in the same location or site. Thus, artifacts which share the same location but different strata in an excavated deposit derive from different components. Likewise, artifacts recovered from a dense concentration of cultural materials within a locus derive from a different component than those recovered from the thin artifact scatter around them. Artifacts recovered from these thin scatters form analytical units which are directly comparable to the dense concentrations (components) but have lesser contextual reliability. For the sake of brevity, both types of data sets will be called components after their individual natures have been described.

Assemblages are the artifacts recovered from the individual components and analytical units of analysis. There is no implication here that the assemblages comprise tool kits. They are simply depositional or analytical sets.

The initial stage of the artifact distributional analysis consisted of manually producing maps of artifact recovery locations. Densities of lithic debitage by material types (i.e. obsidian, CCS, and basalt), were plotted on maps of the block excavations and surface collection units. Percentages of each material type were then calculated unit by unit to produce contour maps of relative debitage density (see Fig. 7 for example). The recovery locations of various tool types were plotted in the same way. Color and shape coding systems were then devised to facilitate identification of clustered artifact types; that is, stone material and tool types were assigned different colors or shapes for plotting purposes. These efforts clearly identified a number of dense artifact concentrations, with distinctive boundaries, in each cultural component of the sites under study.

In many cases, activity areas were centered in more or less the same location in more than one superimposed component. This suggests that downward (or upward) mixing of artifacts from different components may have occurred, perhaps due to erosion, rodent activity, and/or excavation techniques. Alternatively, it could be that some characteristic of the site could have caused its occupants to continuously use just a few favored work locations throughout various periods of occupation.

A computerized contour mapping program was employed to address this question of the vertical relationship of activity areas across cultural component boundaries. The program generates contour lines based on elevations at individual cartesian grid locations (see Fig. 7 for example). Each data entry constitutes a set of X, Y, and Z values corresponding to grid locations and elevations in the area being mapped. In this work the X coordinate is the east site grid line and the Y coordinate is the north site grid line. The Z value is the number of artifacts of a particular class recovered at that location. Coordinate positions entered correspond to the center of each unit (1X1 m excavation unit or 5X5 m surface collection unit).

Contour maps were produced showing the distribution within each component of lithic debitage, formed tools, and, where enough data were present, bone. Activity areas within each component were identified by relatively high concentrations of artifacts. The maps for each vertical component were over-lain to identify activity areas that co-occured in space across cultural component boundaries. If activity areas overlapped but were separated by a cultural or natural component that did not contain an artifact concentration, the two activity areas were considered separate components. If overlapping activity areas were not separable, they were considered to be mixed deposits.

Two opposing hypotheses about the site formation processes potentially responsible for producing overlapping activity areas have been suggested above. Wholly overlapping activity areas could be the result of vertical intercomponent mixing due to rodent activity, erosion, and/or excavation techniques. To put it another way, mixing could create the appearance of two superimposed activity areas where originally there had been only one. Or genuine activity areas might legitimately overlap because of some site characteristic which made certain areas of the site surface more attractive than others (the presence of level, firm ground in just a few places, for example).

To determine which of these potential causes was responsible in a given case, each overlapping activity area was assessed to see if its assemblage mirrored that of its overlapping mate. To do this, the assemblage from each activity area was entered into a computerized data file and a cluster procedure run on a SAS program to investigate the degree to which the compared assemblages resemble each other. A high correlation of artifact types between overlapping activity areas might reinforce an interpretation of intercomponent assemblage mixing. Low correlations, on the other hand, probably indicate that the overlapping assemblages were deposited in the same area of the site during chronologically distinct occupations.

Obviously, this method is not foolproof. Its biggest shortcoming is likely to be the elimination of small (thin), legitimately overlapping activity areas which overlie large (dense) activity areas. The large activity areas, by virtue of the sheer numbers of artifacts within their boundaries, are likely to contain a wider variety of artifact types and thus, to duplicate the artifact types of the smaller, overlapping activity areas. However, in such cases the presence and/or absence of functionally or chronologically diagnostic artifact types in the overlapping activity areas were given additional consideration (e.g. the presence/absence of particular projectile point types or ground stone). In these cases, the diagnostic artifacts were given greater importance than the more common artifacts present in the assemblages. Such a differential in the importance of artifact classes is not adequately considered by most statistical methods.

The weight of the artifacts included in the smaller assemblages was also considered as evidence for or against vertical mixing. Pettigrew (1982:23) has convincingly argued that larger, heavier artifacts are less likely to be displaced upward or downward by rodent activity (although the opposite has also been argued; see Baker 1978; Bocek 1986; Pierce 1988; Stockton 1973 for varying opinions). Pettigrew also argues that the more concentrated a cluster of artifacts was originally, the more likely it becomes that some of those artifacts will be displaced. Rodents excavating through dense concentrations of cultural materials have a higher probability of displacing a greater number of artifacts than rodents digging through light concentrations of cultural materials. Archaeologists, who generally assess the significance of activity areas by their densities, will tend to ascribe more importance to the artifacts recovered above and below dense concentrations than they will to the few artifacts recovered above and below light artifact concentrations. In terms of the situation described by Pettigrew, this is a mistake.

Chronometric data also play a role in the definition of activity areas. Routinely, the contents of each activity area were compared with those of the other activity areas within the same component to determine their similarity. If their assemblages were essentially identical, with only minor variations, and the chronometric data available suggested they represented occupations of a single time period, then they were joined for analysis. However, if the mapping procedures suggested that multiple occupations dating from disparate time periods existed within a single component, then efforts were made to sort out spatially discrete assemblages from the mass of artifacts.

Analysis of site structure was accomplished by studying both the physical context of the site components (i.e.

stratigraphic associations) and the distribution of cultural materials and artifact types within these components. Site components comprised of primarily surface collections were defined by a number of variables in a multi-stage process.

In most cases dense concentrations of artifacts were found to be embedded within larger, thinner distributions of artifacts. This type of situation is normal. As activity and depositional areas age, they become more scattered and less distinct. They also tend to become mixed with later assemblages laid down in the same general area. These 'later' assemblages, even though they may be from the same time period, should be on the whole less variable and more tightly clustered spatially than the 'older' site components (Ascher 1968), due to natural and culturally induced entropy. Therefore, for maximum separation, artifacts recovered from the denser concentrations have been assigned to separate units of analysis from those of the surrounding, more dispersed concentrations. Thus, within the sites I have identified loci (areas of cultural materials) and within these there are components comprised of activity areas which form the basic units of study. Broad, thin artifact scatters also form natural units of analysis, termed components here for ease of comparison, each with their own level of integrity.

Carr (1984) contends that either dense or thin artifact distributions may reflect activity areas. I am making no formal attempt at this stage of the analysis to distinguish between data set types since I am not trying to identify tool kits within particular site components *per se*. It is not essential to the analysis of site structure and chronology to identify tool kits within activity areas. It is only neccessary that those types which are chronologically diagnostic be identified with a larger series of cultural materials from an identifiable segment of the site assemblage. Broad patterns should exist within assemblages of the same time periods, though some variability is expected due to differences in site functions and locations.

As noted above, random mixing of artifacts from widely separated chronological units should result in nonpatterned, extremely variable assemblages of cultural materials. Short term, intensive occupations restricted to a single time period should result in more sharply patterned assemblages. In reality, these statements must be tempered with the knowledge that an increase in sample size generally brings an increase in variability of the tool types represented within it (Leonard and Jones 1989). It is necessary, therefore, to look beyond the distribution of any single class of artifacts or ecofacts to the more general pattern of cultural materials which form the signatures of site components.

Ultimately, it is impossible to separate the 'older' background artifacts randomly scattered among the mass of 'latest' artifacts. It is possible to reduce the amount of overlap and mixing of assemblages, however, by stringently identifying the artifacts to be included in each assemblage according to their spatial relationships to each other. Inclusion in an assemblage then hinges on the predominant characteristics of the individual artifact clusters. For instance, obsidian debitage may occur in high frequencies in a relatively small area where bifaces, unifaces, or projectile points also cluster, suggesting they were associated in some nonrandom manner in the past (see discussion of component Sol in the following chapter, for example).

Site formation processes, of course, must also be considered whenever cultural material distributions are being studied. For instance, erosion cutting across cultural deposits buried at varying depths has exposed an area of extremely dense lithic debitage and artifacts in the Embayment Locus at Rogers Ridge (cf. Chapter V). The resulting mass of highly localized cultural materials on the surface at this contact zone represents a data set with greater integrity than the randomly scattered artifacts surrounding it, but on the other hand, it does not have the contextual integrity of the assemblages still buried in the deposits nearby.

Site formation processes were, therefore, identified for the individual site components to provide a method whereby their degree of integrity could be determined. Some of these site formation processes were cycles of deposition and erosion, post-depositional movement and reuse by site occupants, rodent activity, and military impacts (Fort Irwin is, among other things, a tank and gunnery range). All of these forces may have caused stratigraphic movement and mixing of artifacts from different time periods. The intensity of these forces probably varied from site to site and from component to component. The effect is not directly quantifiable, but may be recognizable at levels which permit judgmental statements about the probable degree of integrity of each site component. This study uses such statements to categorize the site components by their degree of integrity. The groups of components are then analyzed for contents, to make statements about cultural processes which appear to have had an effect on their formation.

The rock type composition of lithic debitage was routinely computed during the identification of site components. Percentages of individual lithic material types were calculated for each data unit (5x5 surface collection, 10 cm excavation level, or stratum) and color coded on maps of similar units within site loci. Concentrations of contiguous or semi-contiguous data units with similar percentages of raw lithic material types were then joined together as the analytical basis of the site components.

The distribution, clusterings in particular, of lithic debitage, projectile points, bifaces, unifaces, ground stone, and in a few cases bone, were compared to learn more about each component and the processes which have affected its formation. This was accomplished by producing a series of computer generated contour maps representing densities of various artifact classes within each locus.

This process generated a large number of artifact density maps. For the sake of text brevity only the most pertinent figures are included in the body of the text. The remainder are placed in Appendix A. Figures placed within the text are numbered consecutively, those located in Appendix A are cited as Appendix A: #.

Sampling Procedures and Previous Analyses

The majority of artifacts recovered at Rogers Ridge come from randomly selected surface collection units or excavation units and therefore comprise a sample representative of the site. All projectile points encountered at the site were collected and thus also represent an unbiased sample. Other classes of artifacts (like bifaces and extensively modified scraper forms) were systematically collected only during the initial work at the site in 1984. All artifacts observed during the initial site testing were marked with surveyors pin-flags at that time (Jenkins 1986). They were then recovered and their proveniences recorded by the site mapping team. Thus, though this was a judgmental collection, the only requirement necessary for selection was that each artifact be macroscopically identifiable as a tool or tool fragment.

During the later phase of work at Rogers Ridge only projectile points were systematically recovered whenever they were encountered. The major emphasis at that time was on the collection of surface artifacts from a large series of randomly selected 5x5 m surface collection units and the excavations in each locus. However, some artifacts were judgmentally collected as they were encountered by the crew. Consequently, I have divided the various kinds of samples to avoid the possibility of sample skewing, which might occur if judgmentally recovered artifacts were included with the randomly selected samples. Accordingly, the artifacts included in the various component samples will be explained on an individual basis.

Analysis of the Henwood site components vary somewhat from that done at Rogers Ridge. For one thing, Warren and his associates (Warren 1990), have already discussed the Henwood site and its various assemblages quite extensively. Recognizing the complexity of both site formation and data recovery processes which have affected the archaeological record, they have systematically investigated the assemblages of both the surface and subsurface components of the site. Their investigations included both chronological and functional comparative analyses of the assemblages. As stated in chapters II and III, I have drawn substantially upon their findings during the formation and investigation of the assemblages presented here.

Another important difference between the Henwood site and Rogers Ridge is that at the Henwood site, all artifacts identified by crew members were point-provenienced and collected by the mappers after the site was pin-flagged. This collection process continued throughout the project, resulting in the recovery of more than 1,500 artifacts. This effort attempted to collect all identifiable artifacts regardless of condition. Thus, a biface, uniface, core, or ground stone fragment, regardless of how small it was, was collected whenever it was recognized as a tool (Vaughan 1984:37).

The Henwood site and the archaeological data base amassed from it during the various field phases conducted there are unusually large. For instance, there were 2,637 tools and 49,988 pieces of debitage collected from the site (Vaughan 1984: 60). This mass of information has made the investigation of every aspect of artifact distribution there virtually impossible. In particular, it was noted during the data recovery efforts that artifact clusters existed within the various loci. The massiveness of the project and the small size of some assemblages, however, militated against an effort to identify these internal clusters during the analysis conducted by Warren and his associates (Warren 1990).

My contribution to the analysis of the Henwood materials, therefore, will involve the investigation of artifact clusters within the loci and components previously identified by Warren (1990) and others (Skinner 1985; Vaughan 1984) and is intended to provide an independent test of the methods they employed in their analysis. The Henwood site analysis presented here divides the locus samples into smaller component assemblages in many cases. It should be noted that actual numbers of artifacts recorded for each locus by Warren (1990) may vary from those recorded here because of this subdivision.

For instance, the original boundaries of the loci were generally determined by mapping the distribution of contiguous cultural materials. Concentrations of artifacts within these loci were futher identified when their presence was easily detectable (i.e. in loci C, H, and I). In the analysis presented here, the specimens recovered from the areas of light artifact scatter around the major concentrations within the loci were not tabulated with those from the areas of dense artifact concentrations.

Though Warren has essentially followed the same method of assemblage grouping as I am employing here, our dividing lines are seldom comparable. It is not compatible to my purposes to include as he did, large areas of light artifact distribution within the areas of study, e.g. the locus boundaries. In general, I have reset locus boundaries to exclude small outlying artifact clusters that would require the inclusion of large areas of thin artifact density in the mapping procedure. In a similar vein, I have set concentration boundaries within 5 m of the peripheral data collection units whether they be 5x5 m surface collections or excavation units. This has the result of reducing the size of the study units (loci or concentrations) and sharpening the resolution of the computer-generated artifact contour maps.

These data manipulations have not, however, changed the overall assemblage characterization of each Henwood site locus, as outlined by Warren (1990). The identification of biface reduction activities within a locus, for instance, will, because of the presence of many small bifacial artifact fragments, be the same in my analysis as it is in Warren's. The only difference may be that if a center of more intense activity, or more recent activity, exists which contains a disproportionate variety of tool types, my analysis will separate that assemblage from the surrounding artifacts. The drawback to this procedure, of course, is in the resultant reduction in sample sizes. On the other hand, once the assemblages from each artifact cluster of a locus have been examined for variation they may be recombined for statistical purposes, providing that no significant difference exists between their assemblages.

Warren's (1990) analyses of the Henwood site involved separating the judgmentally collected artifacts from the artifacts collected in the randomly selected surface collection (5x5 m) units. This process led to the fragmentation of artifact concentrations within the loci. Though the samples have been shown to be statistically variable the only significant differences are in small flake tool categories such as gravers and flake scraper fragments, artifacts so small as to be missed by judgmental collection procedures. For all other tool categories there are no significant differences between judgmental and randomly collected assemblages. This is most likely due to the fact that <u>all</u> recognizable tool fragments were recovered by the mappers.

In accordance with this finding, and in order to avoid separating artifacts that clearly belong together within the artifact clusters, I have included both random and judgmental surface collection samples in my analysis of the Henwood site materials. Consequently, inter- and intra-loci assemblage variability had to be individually investigated to ascertain the affects of assemblage skewing due to the presence or absence of small flake tools. This problem is judged to be minimal, however, because randomly selected 5x5 m surface collection units, representing the method most likely to result in the recovery of small tools, were placed in all loci and identifiable artifact concentrations of cultural materials at the site. Any skewing effect the very small artifacts might have on the samples should remain constant across all loci thus sampled.

Dating Site Components

Radiocarbon dates, obsidian hydration measurements, and projectile point typology have been used to date the site components identified in this study. Radiocarbon dates are the most precise and widely employed method of dating archaeological deposits employed here. Many of the site components analytically identified are not dated by this method, however, and the use of more relative methods of dating was necessary to provide chronometric control for these.

Obsidian hydration measurements are widely used in dating archaeological assemblages. To be reliable the method must be applied only after the obsidian source has been identified for each specimen, and a significant number of specimens has been processed for each assemblage. The majority of obsidian at Fort Irwin, over 90%, comes from the Coso quarries located in the southern end of Owens Valley (Fig. 1) and only the results of analysis on Coso obsidian will be reported here.

At Rogers Ridge, in particular,

> Obsidian samples were selected for sourcing and hydration analyses based on adequate size of items for analytical manipulations, artifact form (all projectile points and intentionally modified tools of obsidian were analyzed, and proximity to radiocarbon-dated features. An effort was made to select at least 10 specimens close to each radiocarbon-dated feature of the site (Jenkins 1987:226).

In cases where features did not yield enough obsidian specimens to provide 10 samples for analysis, all available obsidian specimens of sufficient size were analyzed.

Warren (1990:233), noting the extreme variability of obsidian hydration readings in individual Coso specimens (as conveyed to him by Jackson [personal communication, 1984]), uses the mean of the sample for dating purposes. He suggests the use of standard deviations to define the acceptable spread of readings within any given sample. Aberrant readings, those outside two standard deviations for any particular sample, were excluded from consideration in the formation of the mean obsidian hydration measurement for that sample. Warren's (1990:233) suggested technique has been applied throughout this study and the results will be discussed in detail in Chapter VII.

Chronologically sensitive artifacts, projectile points in particular, have been used as time markers to provide a relative dating scheme for the cultural assemblages studied here. As previously discussed (Chapter I), the method of cross-correlation with dated artifacts in other locations is only accurate if the artifacts compared for dating purposes are indeed of the same types. This is particularly true among assemblages from widely separated regions. In this study all projectile points and potentially chronologically sensitive unifacial tools (i.e. scrapers and gravers, etc.) were analyzed by Warren, who is a leading expert in the identification of Lake Mojave and Pinto assemblages in the Mojave Desert (cf. Vaughan and Warren 1987; Warren 1980a, 1980b, 1985a, 1985b, 1986b, 1990).

Projectile point types, comprised primarily of the Lake Mojave and Pinto series, were employed throughout the study as the initial factor in the division of site component assemblages from each other. This does not mean that site assemblages were considered to be mixed if both Lake Mojave and Pinto types were present. The possibility that the two types were made simultaneously over some period of time was a major consideration throughout the study. Whenever both point types were present, however, extreme caution and care were taken to insure that these point types shared precisely the same vertical and horizontal distributional patterns. If they did not, then the assemblage was considered to be a palimpsest, an indication that an early Lake Mojave period assemblage had been overlain by a later Pinto assemblage. Further efforts were then made to sort the two assemblages.

Each cultural and analytical component of the sites under study, and the actual justification for the inclusion of the cultural materials comprising their tool assemblages will be described in Chapters V and VII. The tool assemblages and chronometric data collected from these components are included in these chapters, along with discussions of cultural features and their associations with the artifact assemblages. A summary integration of these two studies is then presented in Chapter VII.

CHAPTER V

DESCRIPTION AND ANALYSIS OF ARCHAEOLOGICAL COMPONENTS AT ROGERS RIDGE

The site at Rogers Ridge was briefly described in Chapter II but it is important to review a few key attributes of this extremely important site. Rogers Ridge is located in the relatively flat bottomland of Tiefort Basin. The site is surrounded by barren expanses enhanced by broad wash bottoms of braided channels. It comprises 3 loci of dense cultural materials located on the northwest point and along the southern base of the ridge. Cultural deposits are generally shallow but frequently retain some contextual integrity. In this chapter I shall describe how the site and analytical components were formulated with the concerns for site formation processes and possible sampling biases mentioned in previous chapters in mind.

The 3 loci of cultural materials at Rogers Ridge (Fig. 6) have been named the Spring Locus, Southern Locus, and Embayment Locus for ease of discussion (Jenkins 1987:218). The artifacts from each of these loci were identified with a particular site component dependant upon the circumstances

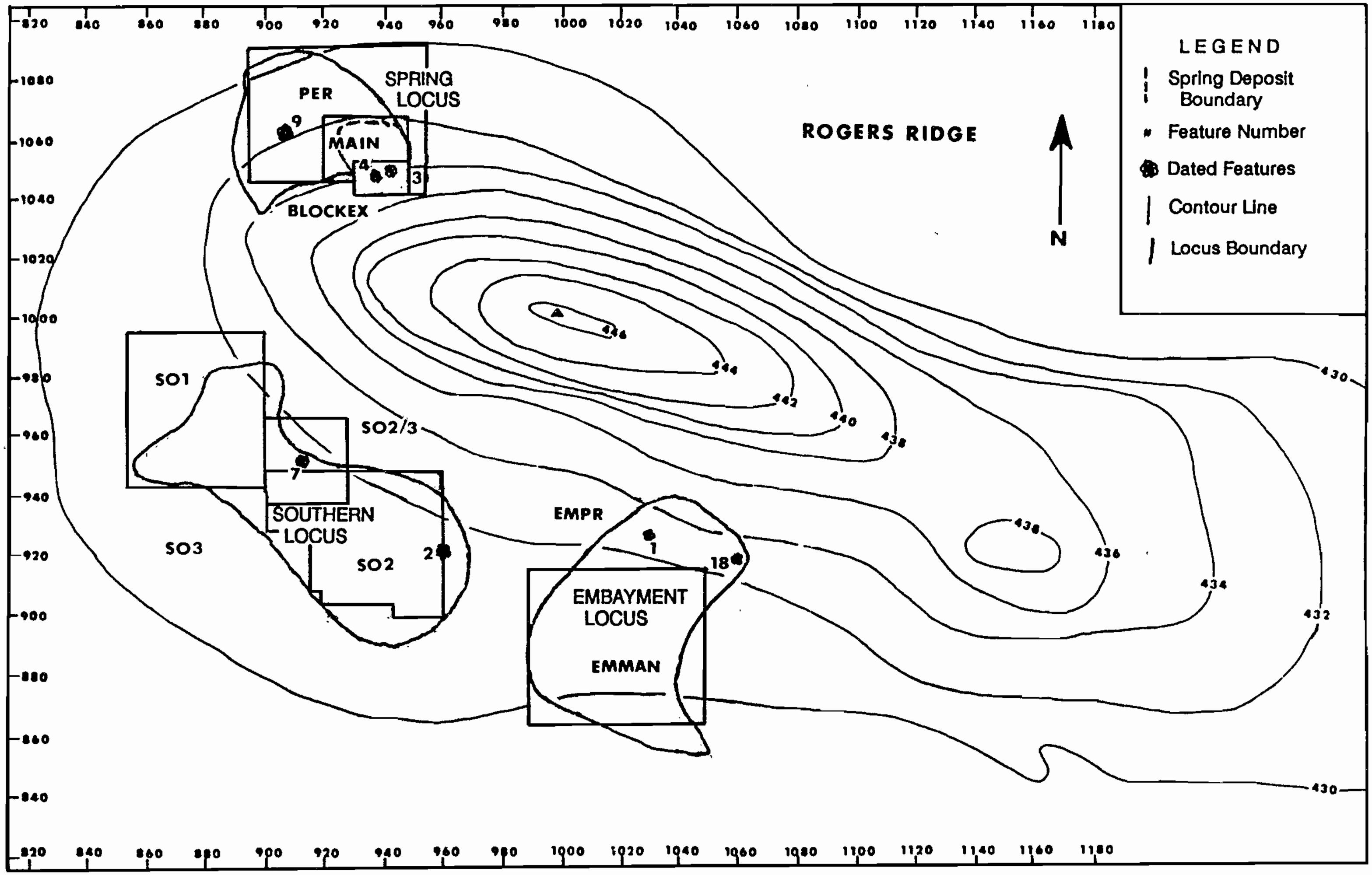

Figure 6. Locations of cultural components at Rogers Ridge.

of collection (surface or excavation), location within the locus (e.g. above or below elevations of severe erosion), and artifact density and distributions of lithic material types. Each component and the reasoning behind its deliniation is discussed below.

Spring Locus

The sample of artifacts recovered at the Spring Locus was horizontally and vertically subdivided into two main components. These components are: Surflo, artifacts collected on the surface and in shallow test excavations on the lower eroded slope north of the base of the ridge (Fig. 6), and Blockex, the block excavation in sandy spring deposits at the south end of Surflo at the base of the ridge. The excavated materials recovered in Surflo comprise a very small sample of tools and debitage generally recovered from the first few centimeters of deposit. These few artifacts were, therefore, included with the surface sample since their small number did not significantly affect the distribution of artifacts within the component.

Surflo

Figure 7 illustrates the distribution of lithic debitage in the Surflo sample. This contour map suggests there was a dense concentration of cultural materials lying directly down slope from the block excavation. Projectile

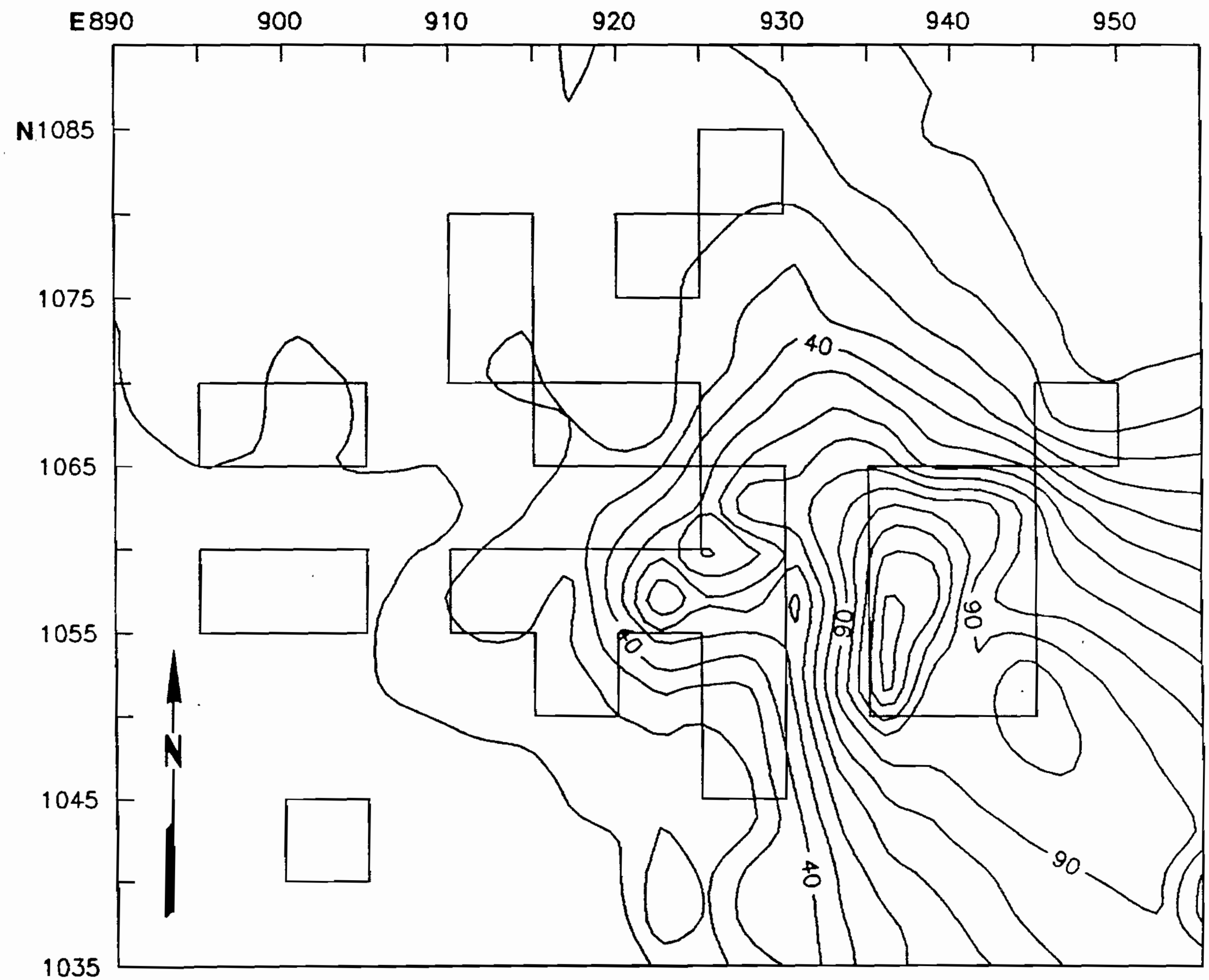

Figure 7. Distribution of lithic debitage in Component Surflo.

points, bifaces, and unifaces all cluster tightly in the same area of the locus (Fig. 8-9; Appendix A: 1). Ground stone, on the other hand, appears to be clustered in two separate localities of the locus (Appendix A: 2).

Ground stone in the larger central cluster is predominantly comprised of small thin, tabular fragments similar to the 'Pinto' slabs described by Rogers (1939:51). The small cluster of ground stone artifacts in the area of site grid lines E900-905 is comprised of larger, more metate-like artifacts. This western cluster is located next to a small, well-defined late period hearth, dated by radiocarbon at 1,280+/-50 BP (Beta-12839), and is probably associated with it. As is evident from Figure 7 there is little other cultural material in this area. The large size of the ground stone artifacts recovered probably prevented them from being eroded away with the smaller artifacts associated with this feature.

Figure 10 illustrates the distribution of all tools in the Surflo component of the Spring Locus. The peaks in artifact numbers near the center of the illustration are located directly down slope from Feature 4 in the Blockex component at the base of the ridge. This distribution suggests erosion has exposed cultural materials at the southern end of Surflo which originated with the buried deposits of the Blockex component (compare the concentration of artifacts at site grid line E934 in Fig. 11 with the

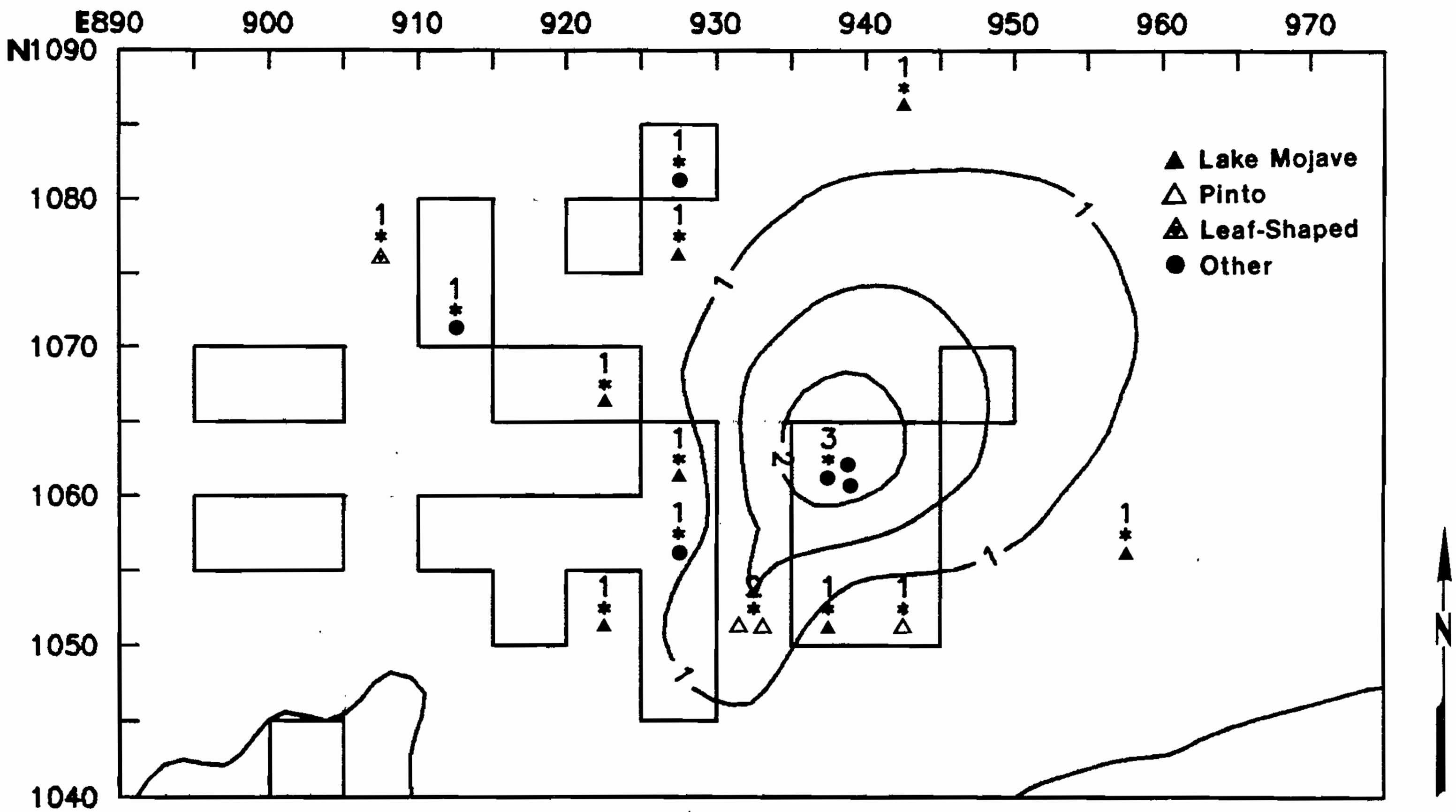

Figure 8. Distribution of projectile points in Component Surflo.

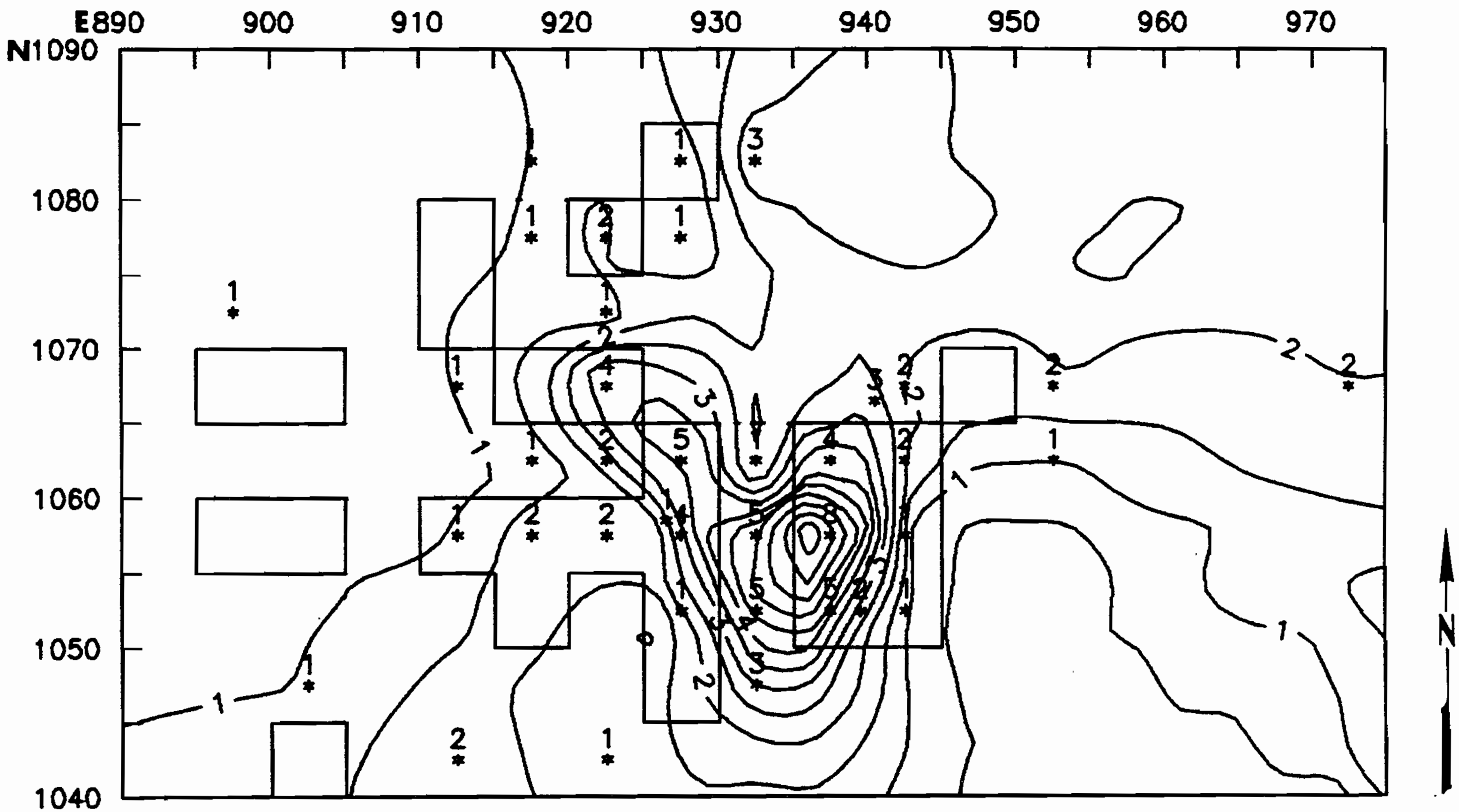

Figure 9. Distribution of bifaces in Component Surflo.

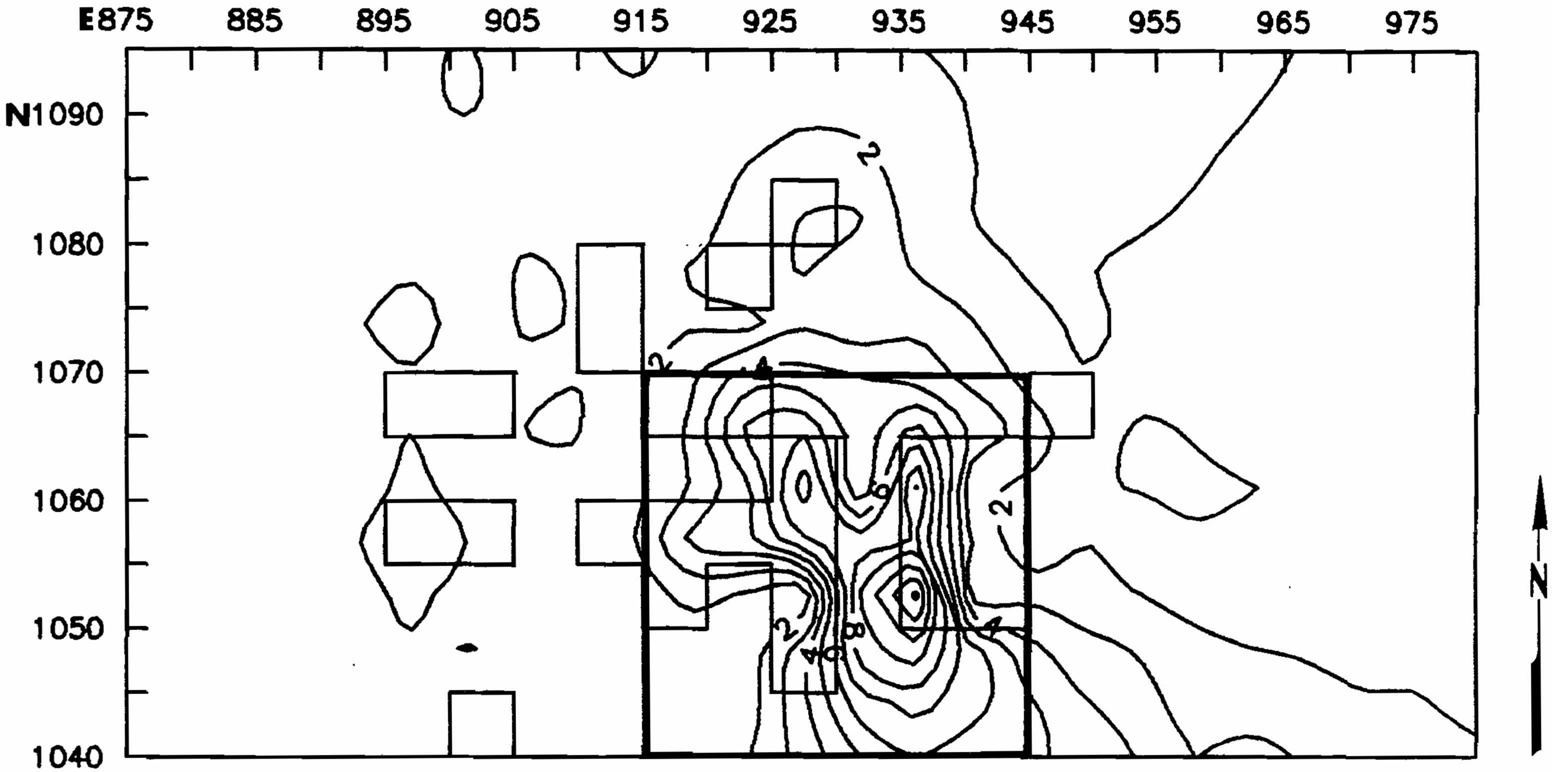

Figure 10. Distribution of all tools in Component Surflo.

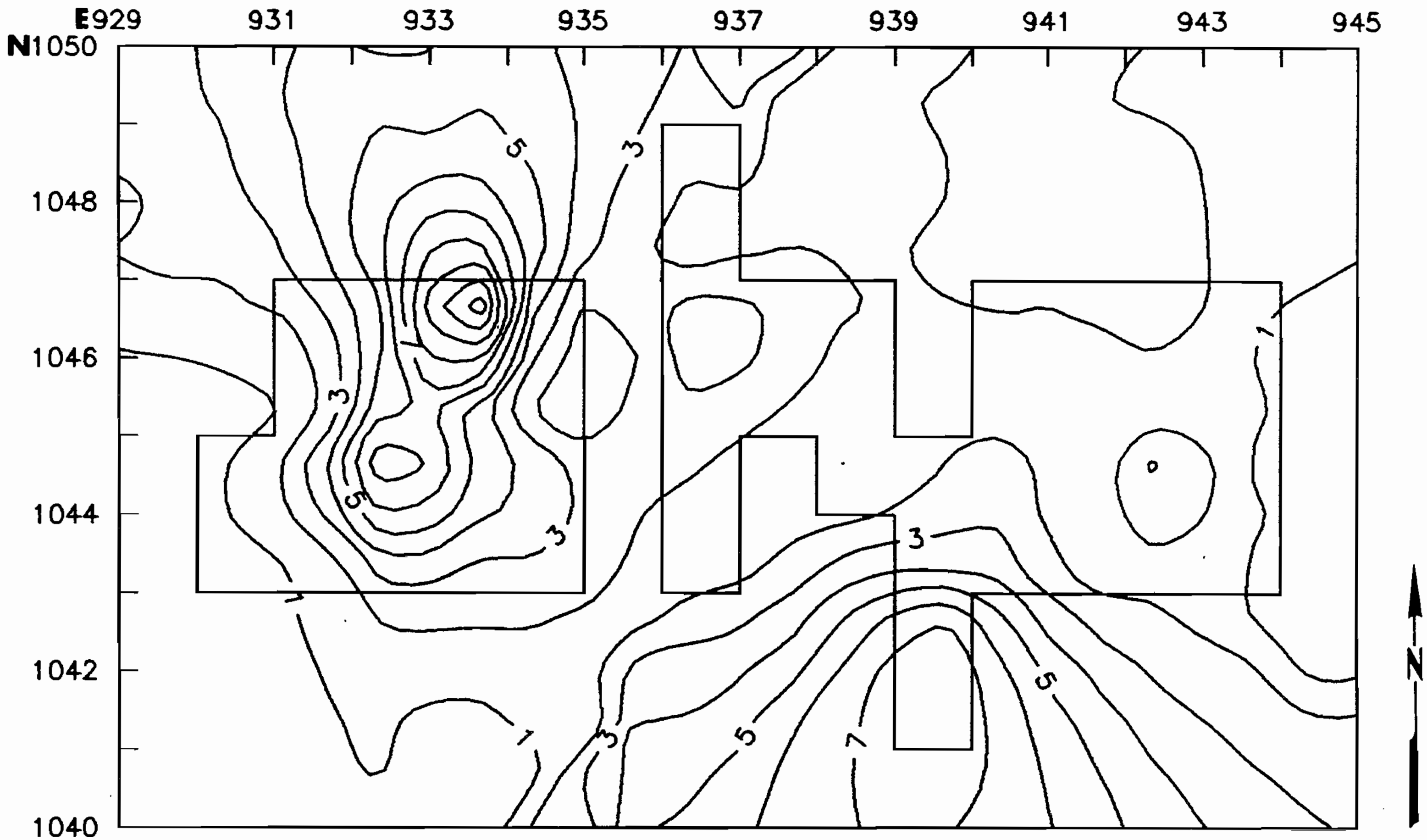

Figure 11. Distribution of all tools in Component Blockex.

clustered tools evident directly downslope at the same location in Fig. 10). Consequently, the artifacts recovered north of grid line 1070, west of grid line 910 and east of gridline 945 (the area outside the heavy black lines in Fig. 10) were separated from the artifacts recovered within the main cluster. The two samples were named Main, for main block, and Per., for periphery. The artifacts recovered from each of these subunits appear in separate columns of Table 2 below.

I have noted elsewhere (Jenkins 1987:218) that the distribution of artifacts in the Spring Locus closely follows the distribution of the grayish spring deposit soils (Stratum 4). This observation holds true in both the eroded Surflo component and the undisturbed Blockex component. The artifacts apparently were distributed on the surface of the spring deposit (Stratum 4) when the spring was active. Occupation was confined primarily to the area mantled by dense plant growth but probably also included lesser use of the surrounding area as evidenced by the presence of small quantities of artifacts. The possibility that erosion may have cut through the softer deposits on either side of the spring deposits and removed most of the artifacts which existed in these areas cannot be entirely discounted.

The artifact clusters of the Spring Locus represent the latest and most intense occupation in that area of the site.

It is important to note that Pinto points were recovered only from within the Main concentration of artifacts in the Surflo component, supporting the interpretation that this concentration is at least partially derived from the Pinto aged Stratum 2B deposits of the Blockex component. Most artifacts in the Main component date from an early Lake Mojave occupation (Lake Mojave Long-stemmed [LMLS] points and domed scrapers, in particular). A much smaller number of artifacts apparently originated with the Pinto deposits eroding out of Stratum 2B.

Blockex

The Blockex deposits are divided into 4 artifact bearing strata (1, 2a, 2b, and 4). Each will be briefly described and the distribution of artifacts within them discussed.

Stratum 1. Stratum 1 (1A in Jenkins 1987:218) is for all intents and purposes a culturally sterile deposit of eolian sand which mantles portions of the spring deposits at the base of the ridge. The distribution of the small amount of lithic debitage recovered from these recently deposited sands is illustrated in Appendix A: 3. The tiny size of the debitage sample and the total lack of tools in Stratum 1 indicates this stratum post-dates the site occupation and makes no interpetation of the artifact distribution necessary.

Table 2. Artifacts recovered from all components at Rogers Ridge.

Loci:	Surflo		Blockex			Southern			Embayment		
Component:	Main	Per.	2A	2B	4	So1	So2	So2/3	So3	Emman	Empr
Types:											
lmls	2					1	2		4		2
lmss	1	1		3			5	1	1		3
slr	1	1				3				1	1
ls		1		4		2	2		2	1	1
lsp		1				1	1				
wsp											1
sbt	1									1	
pfcv	1						1	1	1		
pfls								1		2	2
pfsb	1						1		1	1	
p	2		1	4	1			2	1	14	7
pfcb	1			1						2	
oth. pts.	2			1				1	2		1
ds	1	2	1	4	1	2	7		1	1	1
mds	1	1		1		1	4				
ekss	3			1		1				1	1
lkes	1					1					
es	1			2			3		1	1	
ifs			1			1		1		1	1
oss	4	2		4	1	3	2			3	
muf	10	3		5	1	4	1	4	4	11	
oth. scr.	2	1		5	1		6	2	3	2	1
grav.	4			5			3	1	1	2	
1	8	2		6		6	16		5	25	4
2	3	1		1		2	4	1		1	1
3	5	1					3			5	5
4				1			2			2	1
5	10	1	3	9	1	6	5	1	4	13	3
6	8		1	3		1	4	1	3	8	
7	2		1	2		2	2	1		1	2
9				4			2	1		2	
10	1			1			1			1	1
11						1					
14	4	2		3		2			2	3	1
15	2	1					1			1	
17						1					
18	1					1					
19	2	2						1			2
20	5			5		5	4				1
25	22	7	2	11		6	14	3	1	34	2
cores	11	5	6	8	1	3	10	3	2	10	3
gro. sto.	13	6		17						1	
	158	41	16	110	7	56	106	26	39	151	48

Stratum 2. Stratum 2, as defined by Jenkins (1987:218) "is a layer of tan, silty-sandy sediment . . . containing small basalt gravels and a rich concentration of cultural material." The densest concentrations of artifacts recovered from Stratum 2 were in the 10 cm of deposit directly above and including the loose gravels overlying the Stratum 4 deposits. This generally comprised a 20 to 30 cm deposit though some variation in thickness did occur along the north-south axis of excavations as a result of erosion in the more northerly units (Figs. 12-13). Consequently, the artifacts in Stratum 2 were separated into two groups.

Stratum 2A comprises the firmer sands with very tiny basalt chips, directly underlying the eolian sands of Stratum 1, where they exist. There are relatively few cultural materials in this deposit. Stratum 2B comprises the contact zone between strata 2 and 4. Gravels are common and fairly large, cultural materials are relatively dense. Stratum 2B is the only significant deposit of cultural materials in the sediments located at the base of the ridge.

Artifacts in Stratum 2A have similar distributions to the cultural materials in Stratum 2B (Appendix A: 4-11). The cluster of lithic debitage and tools at grid lines E936, N1046 (Appendix A: 5) corresponds with the unusually deep occurance of Stratum 2A soils in this unit (cf. Fig. 13). This suggests the excavations in this particular unit cut across the boundary between these strata incorporating

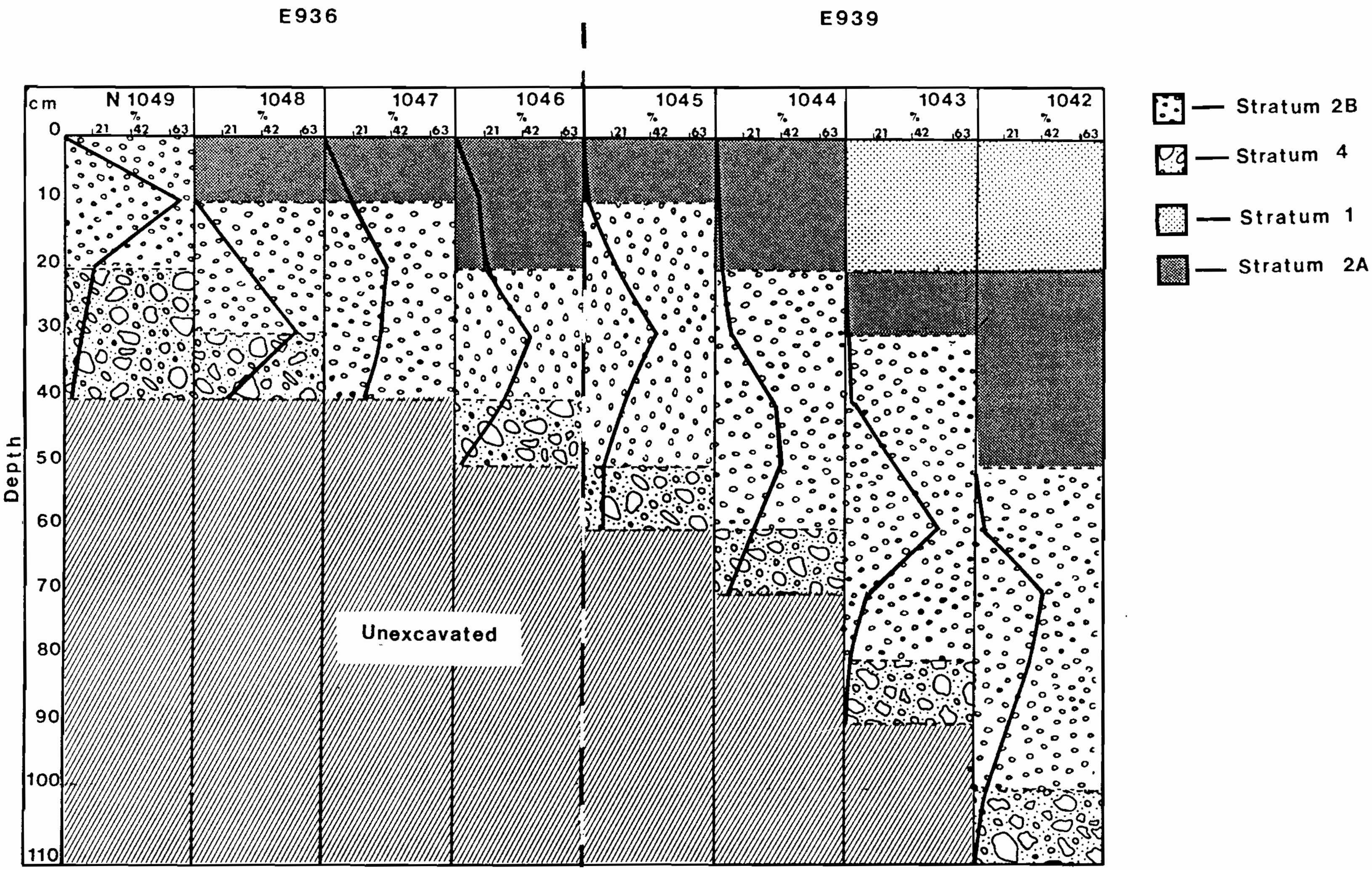

Figure 12. Profile of lithic debitage distributions in contiguous 1x1 m excavation units of Trenches E 936 and E 939.

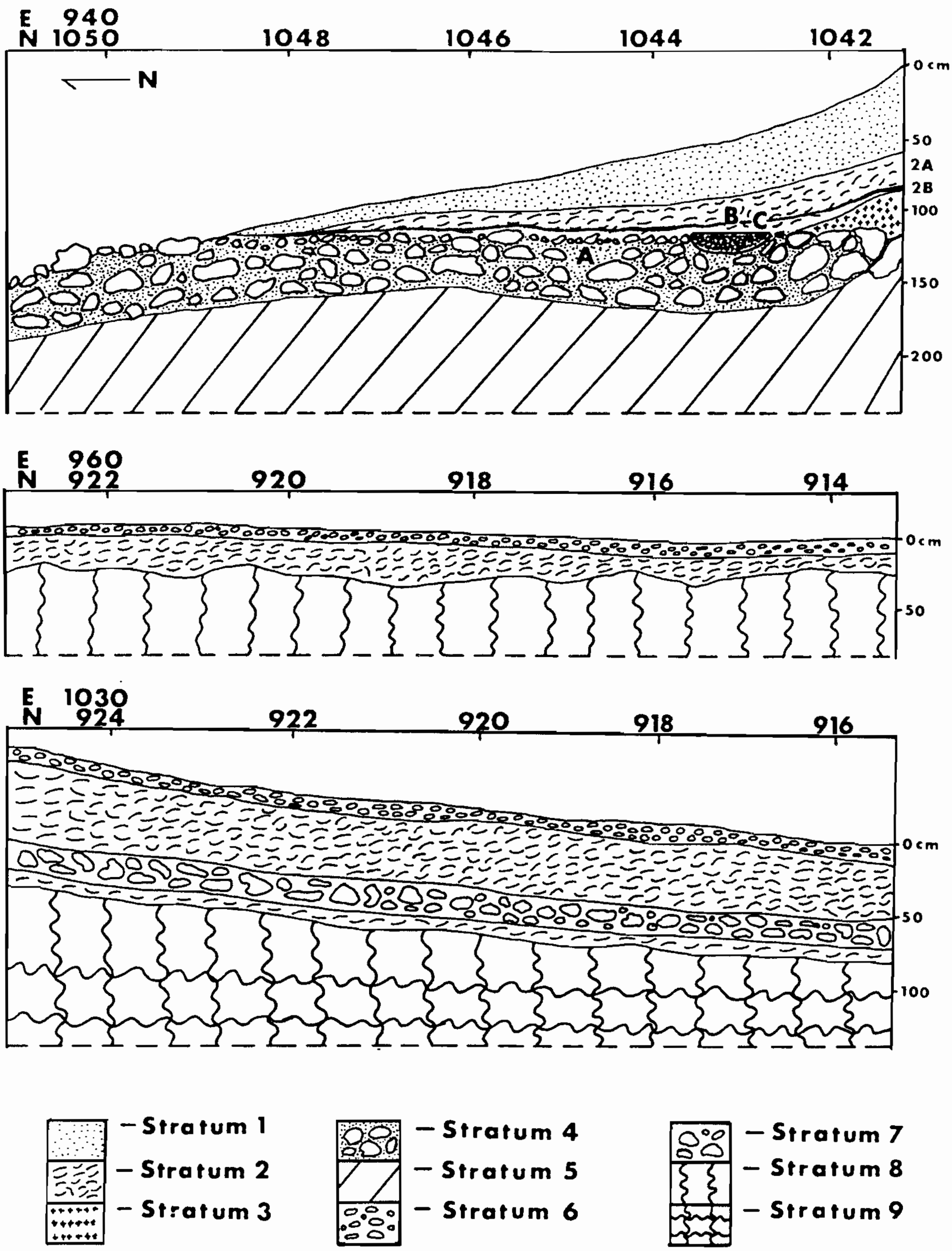

Figure 13. Stratigraphy. Upper, Spring Locus; center, Southern Locus; lower Embayment Locus. (After Jenkins 1987: Fig. 4).

Stratum 2B artifacts in with Stratum 2A artifacts.

Cultural materials in Stratum 2B are strongly associated with the two cultural features (numbers 3 and 4 in Fig. 14) exposed by the block excavations of the Blockex component (Appendix A: 6-11). Feature 3, located in the south central portion of the block, was an unlined hearth approximately 1 m wide by 1.5 m long and 15 cm deep. It was located at a depth of 50 to 65 cm and was radiocarbon dated at 8,410+/-140 B.P. (Beta-12840). Ten specimens of Coso obsidian, recovered from within a 2 m radius of Feature 3, produced obsidian hydration readings ranging from 13.9 to 22.1 microns (Table 3). When the specimen with the hydration reading of 22.1 microns is omitted from the mean calculation (Warren 1990:234) a mean of 15.7 microns is attained.

Figure 14 suggests projectile points (primarily Pinto) are clustered tightly around Feature 3. Bifaces (Appendix A: 9) cluster near Feature 3 and around Feature 4. Bone was recovered in relatively large amounts from these features also (Appendix A: 11).

Feature 4, located in the western end of the block excavation between grid lines E933 and 934 and N1044 and 1047 is comprised of two attached pits, a small ovoid pit attached to a larger elongated pit (Figs. 14-15). This feature, radiocarbon dated by the accelerator mass spectrometry method at 8,180+/-150 B.P. (Beta-13463), has been interpreted as a spring throat reservoir (Jenkins

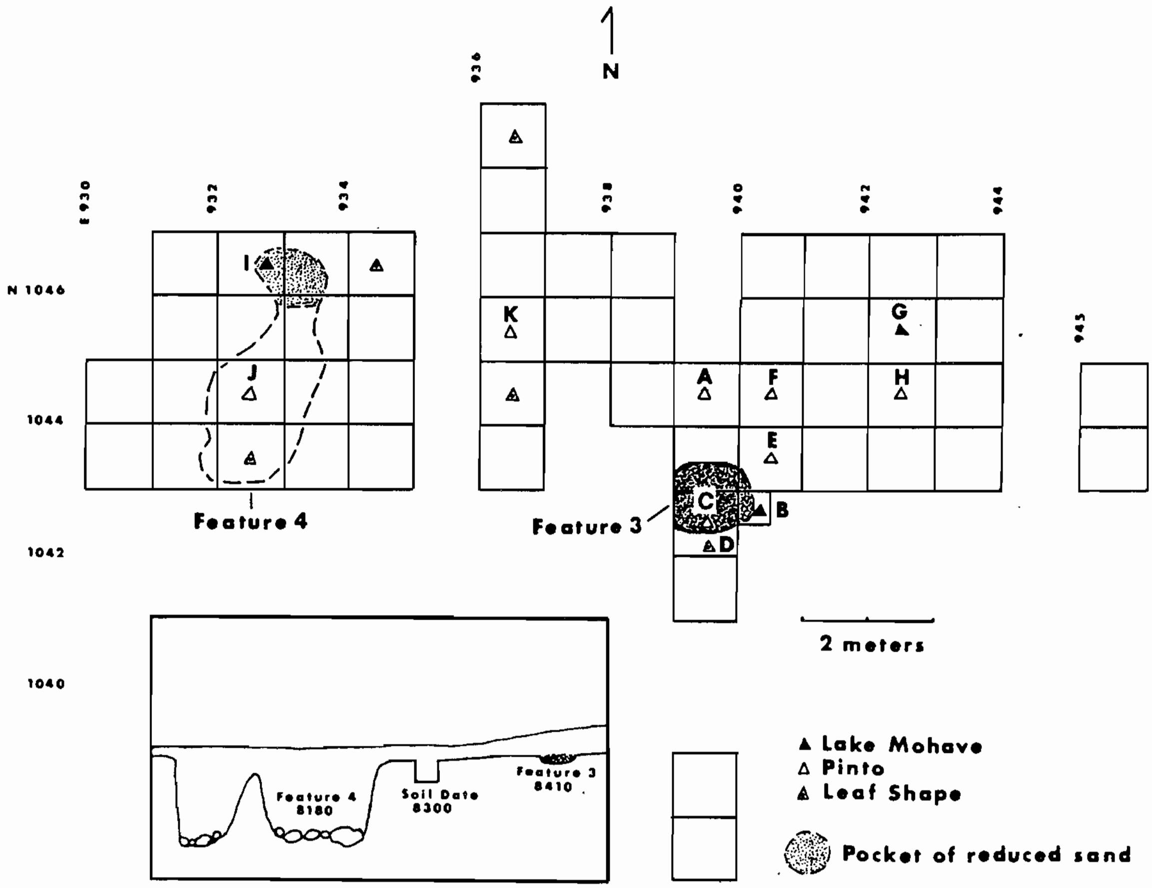

Figure 14. Location of projectile points in relation to radiocarbon-dated features of Component 2B. (After Jenkins 1987:Fig. 5).

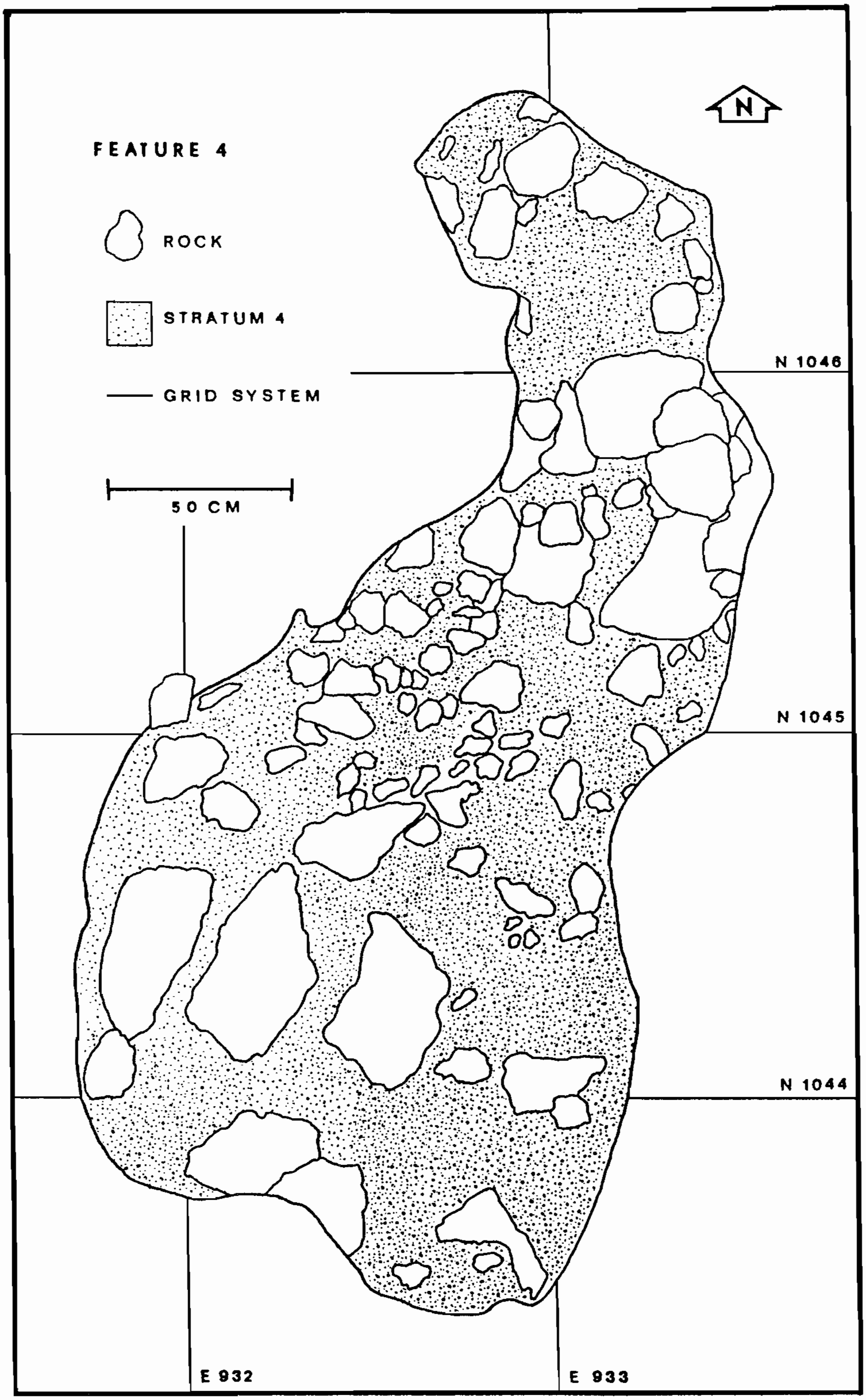

Figure 15. Spring reservoir (Feature 4) in the Spring Locus. (After Jenkins 1987:Fig. 6).

Table 3. Obsidian hydration readings from the Spring Locus.

Compon.	Stratum	Feature association	Spec. number	Hydra. band	Comments/ Results
Blockex	2B	Feature 3	498-2149-1	18.1	Initial
	2B		498-2218	16.3	results:
	2B		498-2891	15.7	
	2B		498-2163-4	13.9	N = 11
	2B		498-2906-1	16.2	Mean = 16.3
	2B		498-2184	15.4	SD = 2.3
	2B		498-2180-1	17.0	
	2B		498-2934-1	14.2	Adjusted
	2B		498-4553	15.3	results:
	2B		498-2943-1	22.1 **	
	4		498-2952	14.7	N = 10
					Mean = 15.7
					SD = 1.3
Blockex	1	Feature 4	498-4098	3.3 **	Initial
	2B		498-4111	15.1	results:
	2B		498-2265-1	14.1	
	2B		498-4000-1	17.7	N = 26
	2B		498-2285	14.7	Mean = 15.3
	2B		498-4008-1	14.0	SD = 3.3
	2B		498-3935-2	12.9	
	2B		498-4131	16.8	Adjusted
	2B		498-2294-2	17.1	results:
	2B		498-4019-3	15.3	
	2B		498-4151-5	14.1	N = 24
	2B		498-2316	16.3	Mean = 15.5
	2B		498-4031-2	14.9	SD = 1.5
	2B		498-2348-4	17.2	
	2B		498-2348-3	14.5	
	2B		498-4163-5	14.1	
	2B		498-4036-8	15.2	
	2B		498-2359-3	14.4	
	2B		498-2352-2	15.6	
	2B		498-4174-2	15.1	
	2B		498-4050	19.3	
	2B		498-4051-3	15.7	Adjusted
	2B		498-4181-1	23.8 **	results:
	2B		498-4063-9	16.4	
	2B		498-4076-3	16.5	N = 40
	2B		498-4086	14.5	Mean = 15.4
Blockex	2B	Nonfeature	498-2439	15.2	SD = 1.5
	2B		498-2158	15.9	
	2B		498-2446	11.4	
	2B		498-2456	13.9	
	2B		498-2463-5	15.4	
	4		498-2413	14.0	

** Specimen omitted from calculation of mean

1985:80, 1987:223). Whatever its actual function at the time of occupation, it was clearly utilized as a garbage dump during the final phase of occupation. It was literally full of camp debris including, a Lake Mojave Short-stemmed projectile point, a Pinto point, a Leaf-shaped point, a shell bead, bone, ground stone, core fragments, scrapers, biface fragments, and thousands of stone flakes. The small northern pit was filled with garbage and sand sometime before the larger southern pit was filled in. Water then saturated the fill of the smaller pit, giving it a light greenish color associated with reduction in water. It was then stained in a mottled fashion with humic materials leached from the surrounding soils. The larger southern pit was also filled with garbage but the sand filling it was not reduced by immersion in water. It was this later fill that provided the sample of charcoal that was radiocarbon dated (Jenkins 1985:83).

Obsidian was exceptionally common in and around Feature 4. Twenty-six specimens of Coso obsidian were selected for hydration studies, producing a range from 3.3 to 23.8 microns. Twenty-four of the specimens recovered from within 2 m of Feature 4, including a Lake Mojave Short-stemmed point (16.8 microns) from the interior of Feature 4, produced a mean hydration reading of 15.5 microns (Table 3). Two outlier readings of 3.3 and 23.8 microns exceed the two standard deviation limit and were not included in the calculation of the sample mean (Table 3).

Table 3 includes 6 obsidian hydration readings from specimens recovered in the Blockex component that were not associated with features. The mean of these specimens is 14.3 microns. This is somewhat lower than average for this component but the sample is small and the 11.4 micron reading reduces the mean significantly suggesting little importance should be placed on the mean of this sample. It is probably much more significant to consider the mean of all the acceptable readings from the Blockex component since 95% (38) of these were recovered from Stratum 2B.

Not considering the three outliers previously eliminated from the computaions of the hydration reading means of the features leaves 40 specimens to develop the mean of hydration measurements for the entire Blockex component. These specimens produced a mean of 15.4 microns. In other words, Blockex obsidian samples have means ranging between 15.3 and 15.7 microns, depending on how the samples are computed. There is no significant statistical difference between any of these samples. This suggests that they represent a single component, a component which has been dated by radiocarbon from roughly 8,000 to 8,400 years BP.

It is interesting to note that ground stone is strongly associated with Feature 4 but does not cluster around Feature 3 (Appendix A: 10). Bone, on the other hand, clusters strongly around the hearth of Feature 3 but also is found in relatively large amounts in Feature 4 (Appendix A: 11). These patterns most likely result from the use of Feature 4 as a catch-all for discarded items after its primary purpose was served.

Stratum 4. Stratum 4, as defined by Jenkins (1987:218), consists of hard, dark gray-brown, mineralized sandy soils containing roughly 0.1% decomposed plant material, basalt clasts ranging in sizes from sand to boulders, and sparse cultural materials. Underlying Stratum 4 are the culturally sterile reduced sands of Stratum 5 which apparently predate human occupation of the region.

The distributions of lithic debitage, artifacts, and bone in Stratum 4 are represented in three figures in Appendix A (12-14). Each of these classes of cultural materials are most strongly clustered in and around excavation units which were excavated deeper than normal into Stratum 4 soils. This suggests that the 'clustering' evident in the figures of Appendix A (12-14) is a result of increased soil volume and may not be culturally significant.

Table 2 presents the numbers of artifacts recovered from each of the 4 culturally significant strata identified in the area of the Blockex component. As already noted, there is little difference between the assemblages of the Surflo component and those recovered from the strata of the Blockex component. It is interesting to note, however, that no Lake Mojave Long-stemmed (LMLS) points or other weakly shouldered, long-stemmed points were recovered from the excavations of the Blockex component. Rectangular Base A (Type 3) bifaces also occur only on the surface. In both of these cases, however, it should be noted that where they do exist their numbers are small and their lack of representation in the Blockex sample may simply result from sampling error.

Type 9 bifaces (Contracting Base B with maximum widths of 39 mm to 55 mm) are included in the class Other bifaces in Table 2. They occur only in Stratum 2B in the Blockex component and 3 of the 4 specimens were recovered from the interior of Feature 4. The fourth specimen was recovered from E940, N1047. Three of the four are stage 2 artifacts and probably were intended to be reduced further before use.

Southern Locus

The Southern Locus was originally identified as a cluster of primarily Lake Mojave period artifacts located at the west end of a very large locus (Locus 2 [Jenkins 1985, 1986]). Between what is now the Southern Locus (renamed in Jenkins 1987) and the Embayment Locus is an area which contains a lower artifact density than is found within the boundaries of these loci. These loci have, therefore, been separated on the basis of this distinction.

The Southern Locus is characterized by relatively dense cultural materials lying on the surface where they have eroded out of a thin subsurface deposit (Fig. 13, center). This surface is practically flat, lies between the 930 and 932 m contour, and slopes gently toward the south away from Rogers Ridge. Surface collected materials comprise the vast majority of the artifacts recovered from the Southern Locus. In fact, so little cultural material was recovered from subsurface deposits that they have been added to the surface sample for the present analysis.

Manually produced, color coded maps of lithic debitage material types recovered from the surface collection units of this locus suggested there was a distinct clustering of obsidian in the northwestern third of the locus. The cultural materials in this area, identified here as component So1, were separated from those located southeast of them on this basis and on the fact that debitage, in general, is much more concentrated to the southeast in component So2 (Fig. 6). Finally, CCS also tends to be somewhat more common in So1 than in So2. Artifacts recovered from around these two components have been joined into a conglomeration of cultural materials identified as So3. These have not been mapped due to their extremely scattered distribution around the other components, however, artifacts from all three components appear for comparison in Table 2.

Sol

Figure 16 illustrates the distribution of lithic debitage in component Sol. The center of highest lithic debitage distribution is also the location where the majority of obsidian artifacts were located. Surface collection units both north and south of this center recovered unusually high percentages of obsidian also. Not surprisingly, the majority of artifacts recovered from Sol were also found in this area of the component (Appendix: 15).

Figure 17 illustrates the distribution of projectile points in Sol. Projectile points cluster in the east-central portion of the component. This location corresponds well with the distribution of obsidian, bifaces (Appendix A: 16), and unifaces (Appendix A: 17). Bifaces, however, are somewhat more widely distributed than the other artifact classes. This could be an example of scavenging of valued materials (i.e. obsidian, scrapers, and projectile points) from older, more widely distributed deposits; or could simply reflect the disproportionate size of the biface sample. If the patterns observed in these figures are not the result of random scattering then they most likely reflect the most recent intensive occupation in this area of the Southern Locus. They also suggest there were two

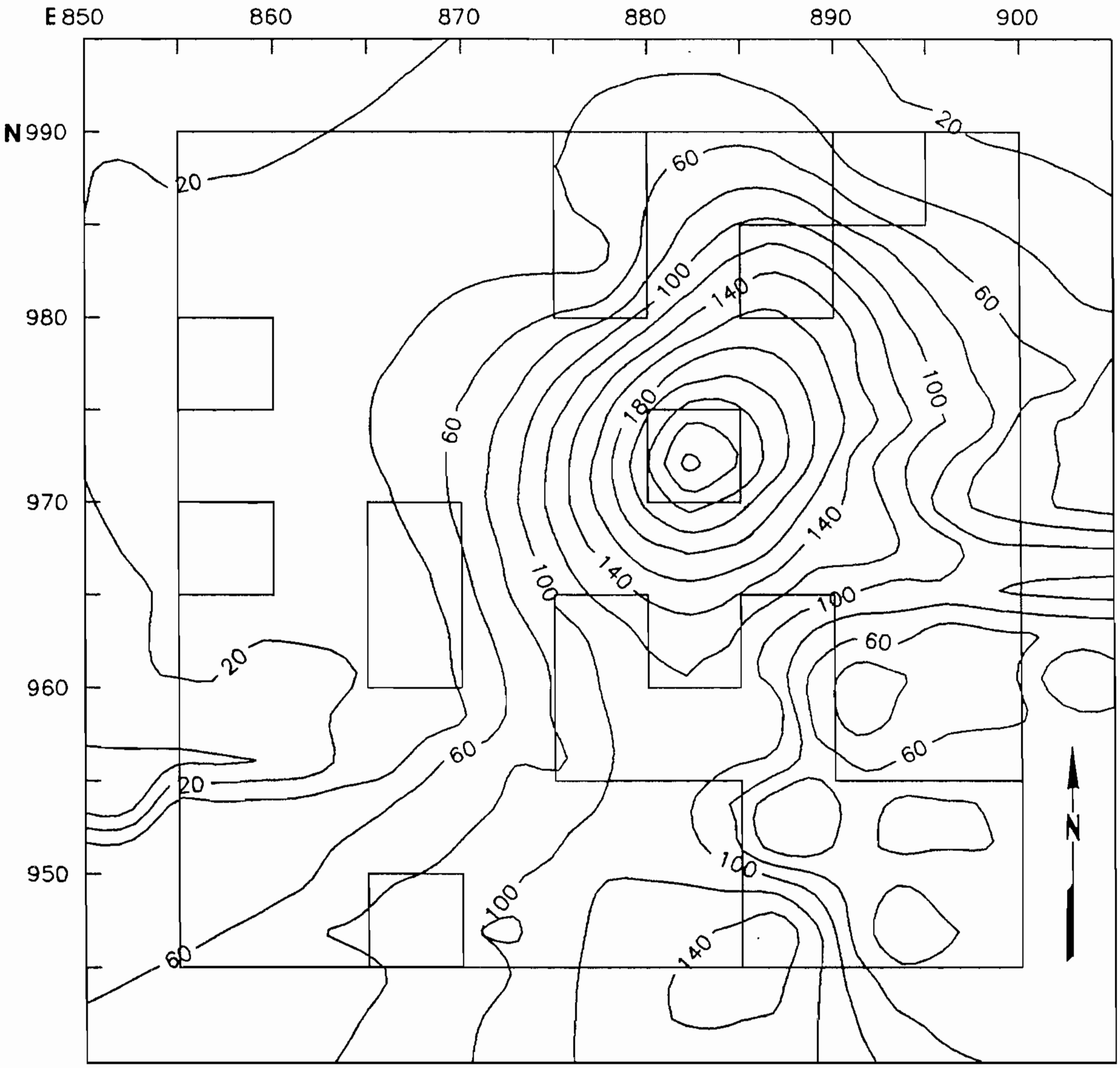

Figure 16. Distribution of lithic debitage in Component Sol.

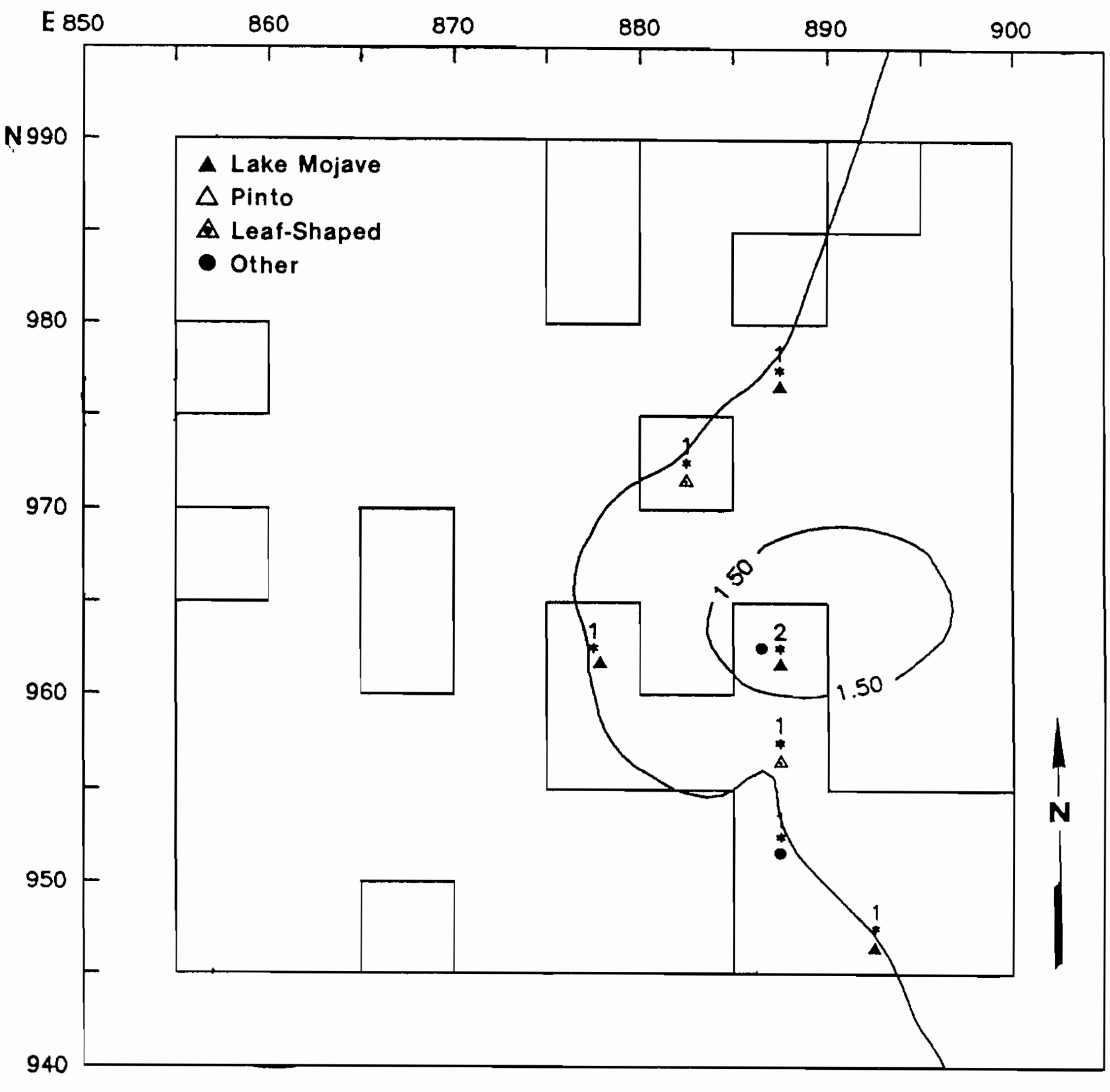

Figure 17. Distribution of projectile points in Component Sol.

activity areas located within the main concentation of artifacts in Sol.

The artifacts recovered from Sol are listed in Table 2. All projectile points recovered from this component are either Lake Mojave series or Leaf-shaped. One of these, a Lake Mojave Short-stemmed point (498-59), was made of Coso obsidian. This point produced two hydration readings, 11.8 and 12.3 microns (Table 4). These measurements seem exceptionally low when compared to the hydration readings of the Blockex sample. It must be remembered however, that all of the cultural materials recovered from Sol were recovered from the surface or from very shallow deposits whereas the Blockex sample was recovered exclusively from buried deposits. It is possible that these circumstances have in some way resulted in the apparent discrepancy between the samples of these two components, perhaps through artifact surface damage among artifacts exposed on the surface for some time.

Domed, keeled, and ovoid side scrapers comprise the majority of typeable unifaces in component Sol. Gravers, found predominently in Pinto assemblages at Nelson Wash (Warren et al. 1990:278) are conspicuously missing, as are ground stone artifacts. The artifact sample is small, however, and may thus be an incomplete assemblage resulting from seasonally scheduled occupations (i.e. late fall or winter?).

Table 4. Obsidian hydration readings from the Southern and Embayment loci.

Compon.	Stratum	Feature association	Spec. number	Hydra. band	Comments/ Results
Sol	surface	none	498-59	11.8	Lake Mojave
			498-59	12.3	Short-stem. pt.
So2/3	surface	none	498-82-1	11.4	
			498-82-1	12.8	
	2	7	498-3817-1	11.3	
			498-3822	12.6	
So2	2	2	498-3670-3	15.3	Group A
			498-3670-2	17.7	
			498-2675-3	13.9	Results:
			498-2675-3	15.8	N = 11
			498-2669-3	14.4	Mean = 16.2
			498-2669-3	17.3	SD = 1.3
			498-2665-2	16.2	
			498-2590-2	17.1	
			498-2590-3	17.1	
			498-2647	15.5	
	surface		498-487	17.6	
So2	2	2	498-489	23.8	Group B
			498-2609-3	20.3	
			498-2609-3	24.2	Results:
			498-2609-4	23.1	N = 6
			498-2609-5	24.5	Mean = 23.4
			498-2609-6	24.2	SD = 1.6
Emman	surface	none	498-148	8.5	Pinto pt.
Empr	2/7	none	498-3605	17.4	biface frag.
	surface	none	498-486	14.9	
	surface	none	498-274	15.4	
	2/7	18?	498-4712-2	9.0	
	2/7	18?	498-4715	14.9	

So2

The distribution of lithic debitage in component So2 (Appendix A: 18) suggests that lithic reduction was conducted in multiple events. Lithic debitage is widely scattered across So2 in a number of fairly dense clusters. This pattern probably results from lateral movement of camps across the surface of this locus when it functioned as a favorite camp spot.

The distribution of tools (Figs. 18-19; Appendix A: 19-20) suggests that at least two relatively discrete depositional sets exist in So2 as it was originally defined. In fact, the types of projectile points in the more northwesterly of the two artifact clusters (2 Pinto, 1 PFCV, and 1 Clovis [Fig. 19]) suggests it is a palimpsest component comprised of a late Pinto assemblage overlying one or more earlier assemblages. The artifacts recovered from this cluster have, therefore, been removed from the So2 sample as a whole and with the artifacts recovered from a 15 m radius around Feature 7 comprise a tiny Pinto/Lake Mojave component identified as So2/3 to reflect its low relative reliability. This process places some of the artifacts from earlier occupations in the So2/3 component sample (i.e. 1 LMSS point and 1 PFCV point were recovered from this area) but this is an unavoidable consequence of the attempt to segregate site components into logical assemblages. These

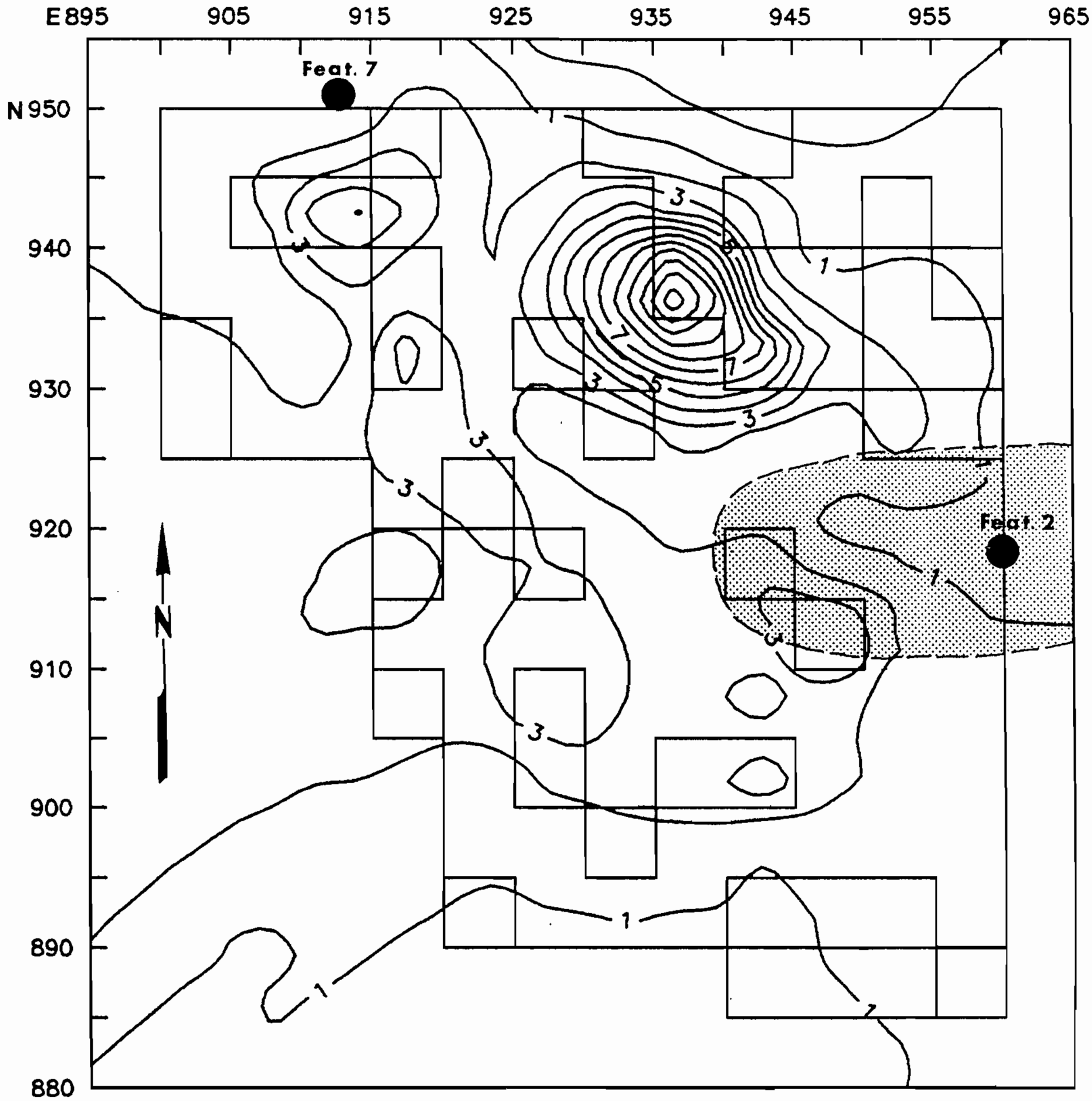

Figure 18. Distribution of all tools in Component So2.

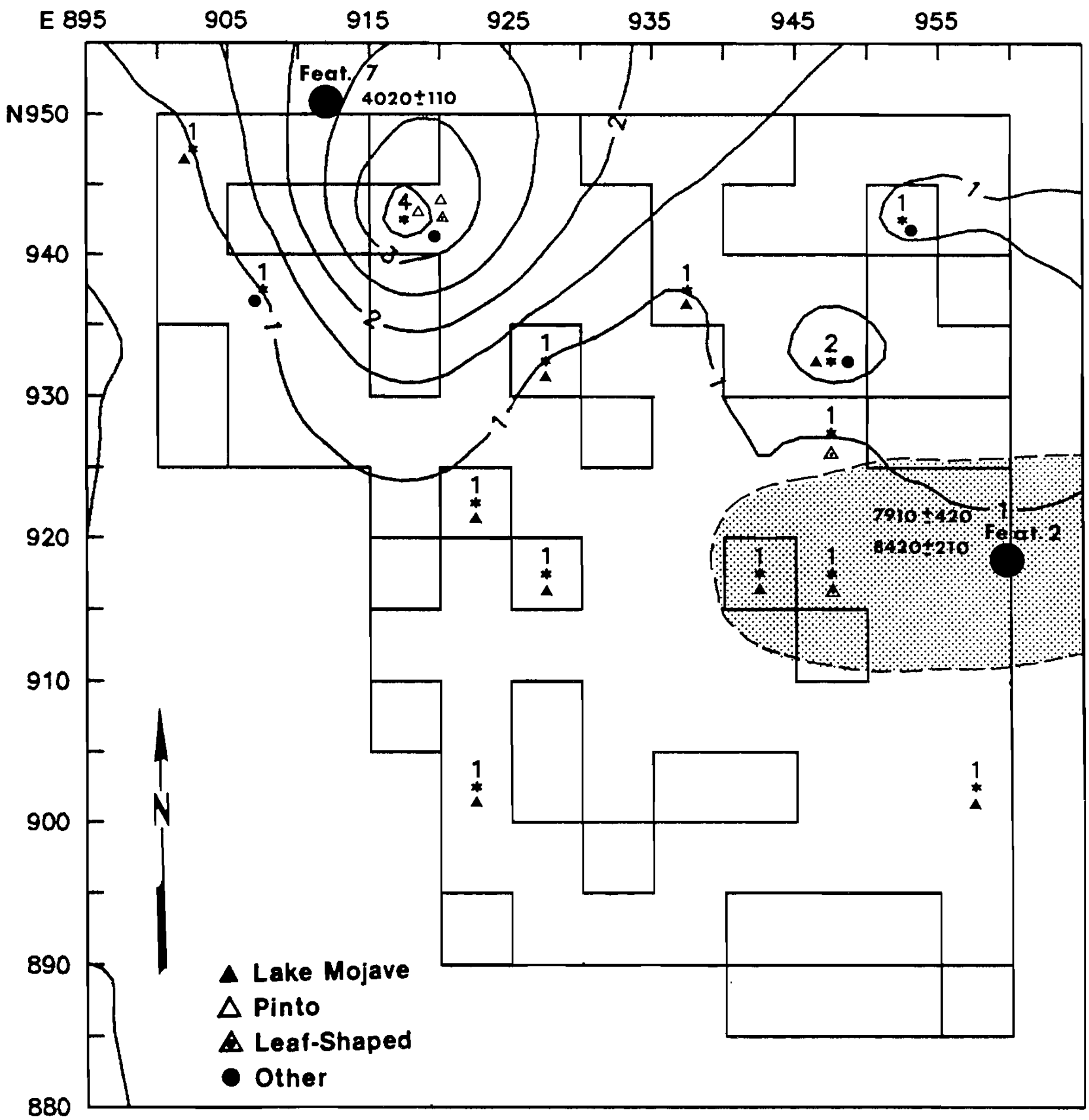

Figure 19. Distribution of projectile points in Component So2.

Pinto artifacts were clearly laid down over an old Lake Mojave component. Though the distribution of artifacts in component So2/3 is not illustrated the tools are listed separately in Table 2.

It may be significant that Feature 7, a hearth radiocarbon dated to 4,020+/-110 BP (Beta-12841 [Jenkins 1987:225]) was located within 10 m of the cluster of points found in component So2/3. This suggests some portion of the So2/3 assemblage may be a depositional set dating from the late Pinto period.

Three Coso obsidian specimens produced four hydration readings which are pertinent to the dating of component So2/3. Two readings, 11.4 and 12.8 microns, were taken from a biface fragment (specimen 498-82-1 in Table 3) which was recovered from the surface at N942 E920 during the mapping of the site in 1984 (Jackson 1986:D-3). The other two readings were taken on debitage recovered during the excavation of Feature 7. These measurements, 11.3 and 12.6 microns, are remarkably similar to those taken from specimen 498-82-1.

The hydration readings recovered from So2/3 are very similar to the two readings taken on artifact 498-59 (11.8 and 12.3 microns), the Lake Mojave Short-stemmed point recovered from component So1. This disconcerting situation suggests something has happened to these artifacts which has in effect 're-set' their hydration clocks. The only things they share in common are the facts that they were found on or near the surface in one portion of the site. Excessive heat, i.e. fire, has been suggested as a cause for the loss of hydration rinds in South American sites (Friedman and Trembour 1983:545). This seems a possible explanation for the close similarity of hydration rinds among these specimens which apparently date from widely divergent time periods.

The more easterly cluster in So2 contains only Lake Mojave series, Large Stemmed, and Leaf-shape projectile points (Fig. 19; Table 2). These are the types of points recovered from the rest of the surface of component So2 also. These artifact types suggest this component represents the latest Lake Mojave occupation in the southern portion of the site. The assemblage appears to be associated with Feature 2 which has produced radiocarbon dates of 7,910+/-420 BP (Beta-10790) and 8,410+/-210 BP (Beta-12844; Jenkins 1987:228). Feature 2 is a badly deflated midden which appeared in three separate geological test trenches, two in the Southern Locus and one on the west end of the Embayment Locus, as a dark charcoal stain in the side walls (Jenkins 1985:10).

Obsidian hydration studies resulted in 17 readings from 14 specimens. These specimens were recovered primarily from the shallow (20 to 30 cm) subsurface deposits of Feature 2, though one (498-487) was recovered from the surface of the feature in 1984 (Jackson 1986). They produced hydration readings ranging from 13.9 to 24.5 microns. The measurements form two distinct groups (Fig. 20). Group A is comprised of measurements taken on 11 individual specimens. These range from 13.9 to 17.6 microns and produced a mean of 16.2 microns (Table 4). Group B, comprised of 6 readings taken from 2 locations on each of three specimens, produced a range of 20.3 to 24.5 microns with a mean of 23.4 microns.

There is complete overlap in the range of readings from specimens recovered near features 3 and 4 in the Spring Locus and the readings taken from the specimens of Feature 2 known as Group A (Fig. 20). The mean of the 11 samples of Group A from Feature 2 and the mean of the samples taken from the specimens of the Spring Locus are also quite similar. Group B, however, is clearly much older than either of the two previously mentioned samples. These specimens could well be associated with the earliest occupation of the site suggested by the recovery of 2 fluted points, one in the Spring Locus and the other in So2/3.

Feature 2 probably retains most of its original shape though erosion may have spread and thinned the artifacts out over this area of the Southern Locus. Feature 2 lies downslope and downstream from the areas of densest artifact concentrations. It most likely contains artifacts from a number of occupations, all of which appear to date from pre-

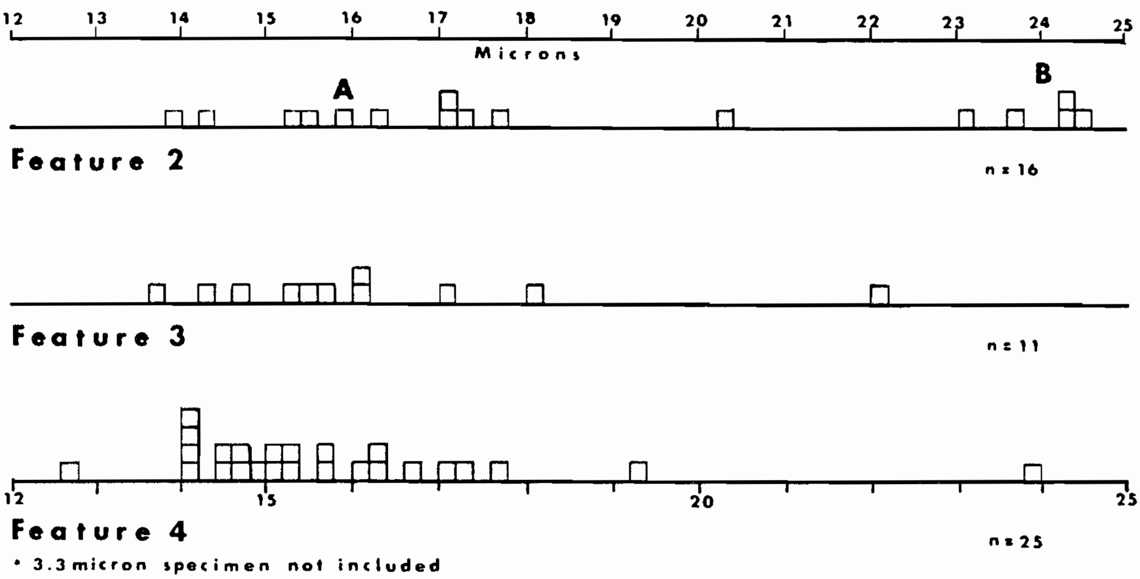

Figure 20. Obsidian hydration rind measurements on artifacts from features 2, 3, and 4. (After Jenkins 1987: Fig. 7).

Pinto times. There is no basis, therefore, for separating the few artifacts recovered from the feature from those recovered from the rest of the component.

So3

The So3 component sample is comprised primarily of artifacts collected from 31 5X5 m surface collection units scattered around the outside of components Sol and So2. Artifacts judgementally recovered from the surface of these peripheral areas comprise a significant portion of the So3 sample and the few artifacts recovered from test excavations in these areas have also been added to it.

It was expected that this component would exhibit relatively great internal diversity because it covers such a large area of the site. Its intended purpose therefore was to serve as a comparative sample. For instance, the sample of projectile points recovered from So3 (Table 2) includes four Lake Mojave Long-stem (LMLS), 2 Lake Mojave Short-stem (LMSS), 1 Pinto, and 1 Gypsum point. The LMLS points are believed to be the oldest points found at the site while the Pinto and Gypsum points represent the middle and younger end of the time scale. We would expect the oldest points to be the most widely distributed due to natural and culturally induced entropy. Interestingly, domed and keeled scrapers are fairly rare. This may be due to size sorting and scavenging. It should be remembered, however, that the nature of the So3 sample (i.e. partially judgmental) makes certain comparisons of artifact types and classes with the other components impossible.

<u>Embayment Locus</u>

The Embayment Locus is situated along the southern base of Rogers Ridge and up the slope a short distance toward a small saddle in the ridge. This saddle gives the impression of curvature to the locus and thus the name Embayment. Cultural deposits are primarily surficial or very shallow throughout most of this area of the site and are thus similar to those of the Southern Locus. They deepen to a maximum of about 70 cm as one proceeds upslope and then give out for all practical intents and purposes at the base of the ridge. Though the subsurface deposits were tested with 25 1X1 m excavation units very few classifiable artifacts were recovered. Consequently, this analysis will deal primarily with the large surface samples recovered from this locus and strive to establish the relationship between the surface materials and those in nearby subsurface deposits.

There are two components in the Embayment Locus. The first, and largest, is a sample of artifacts recovered from a large block of 5X5 m surface collection units named the Emman component. This component occupies the juncture between the base of the ridge slope and an extremely shallow, almost undetectable, drainage which flows southeast around the ridge. The second component has been named Empr and is comprised of artifacts recovered from the Embayment Locus around Emman. The few artifacts recovered from test excavations in these components have been tabulated with the much larger surface samples. Finally, the results of the excavations will be discussed.

Emman

The Emman component is 60 m long (east-west) by 55 m wide (north-south). A substantial cultural deposit is eroding out of the ridge slope in the northeastern end of the component, generating the strong patterns of artifact distributions in the upper right hand quadrant of Figures 21-23 and Appendix A: 21-22. This area of the site is characterized by a whitish deposit densely covered with basalt flaking debris and gravels derived from a prominent gravel lens present throughout much of the northern portion of the locus. It is clear that this single deposit is not the only one present, however.

Figures 21 and 22 suggest a second major concentration of artifacts exists near the south-central portion of Emman and smaller clusters of artifacts appear to be scattered throughout the component. These smaller clusters are difficult to evaluate because of the sparsely distributed nature of the surface collection units. It is likely that

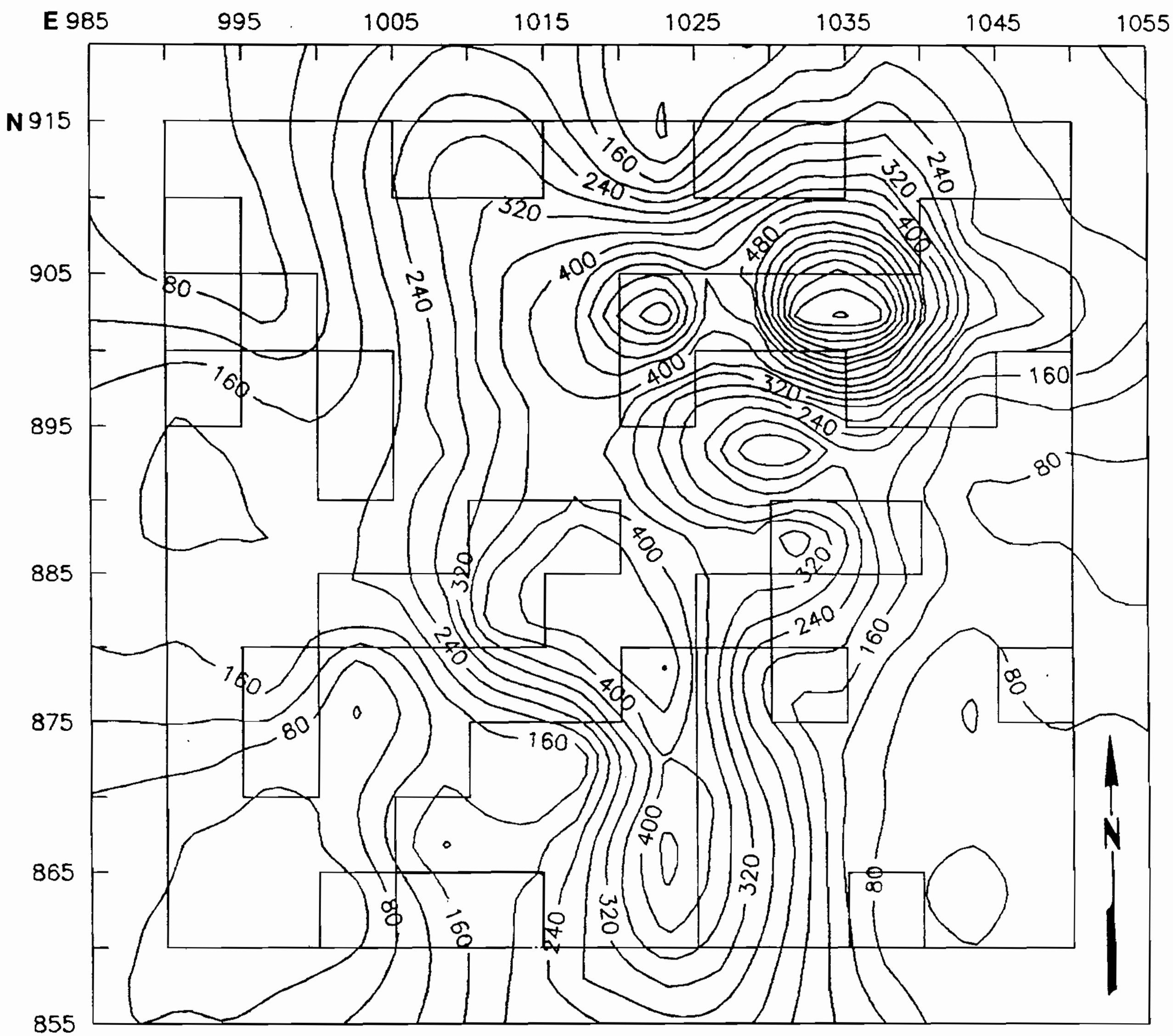

Figure 21. Distribution of lithic debitage in Component Emman.

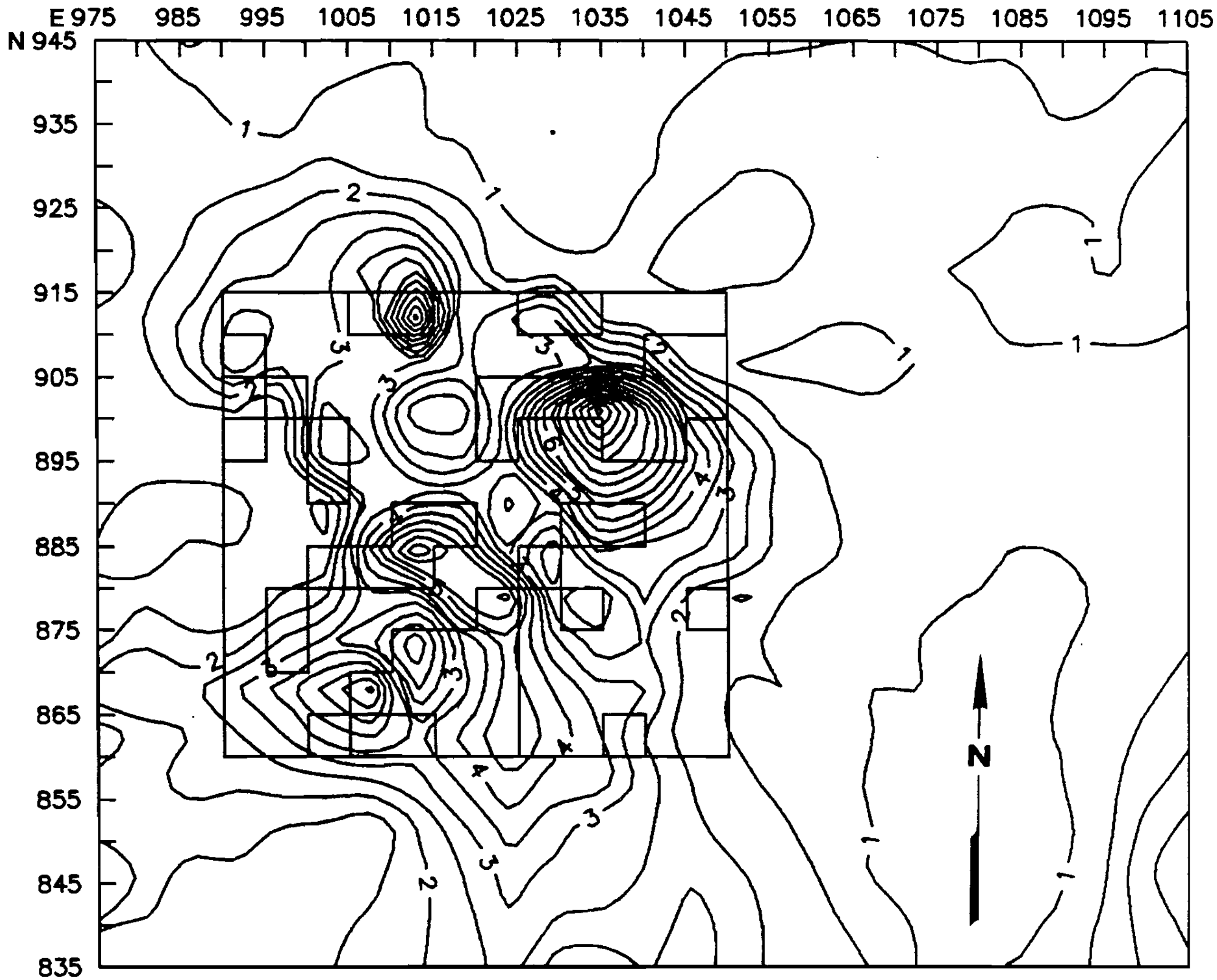

Figure 22. Distribution of all tools in Component Emman.

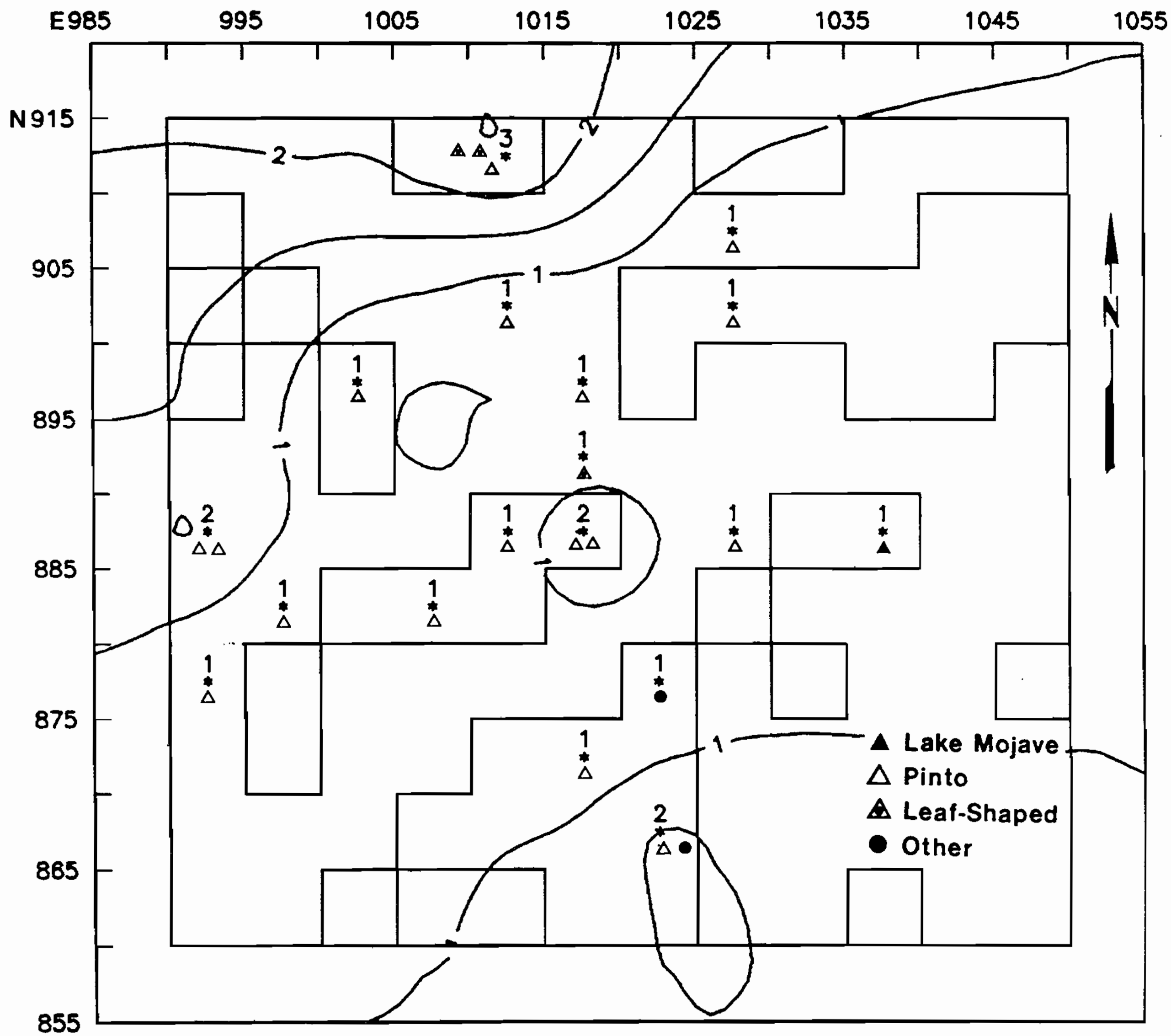

Figure 23. Distribution of projectile points in Component Emman.

the pattern of collection units has affected the distributional patterns in figures 21 and 22 to some degree. Therefore, not much importance is placed here on these smaller clusters.

Projectile points (Fig. 23) are distributed in an oval pattern around the center of the component. They occur only sparsely in the artifact/debitage cluster in the northeastern quadrant of the component though this area contains many bifaces (Appendix A: 21) which generally tend to cluster with points in most components. Projectile points cluster with bifaces in a more typical pattern of distribution in the south-central portion of Emman, however. Most of the points (65%) recovered from this component are Pinto or fragments of concave base points suggesting this area of the site was a favorite camping location during the Pinto period. It is interesting to note, therefore, that unifaces are unusually sparse in this component (Table 2) and that they occur most frequently in the northeastern cluster of artifacts where projectile points are sparsely distributed (compare Fig. 23 and Appendix A: 22).

There were no radiocarbon dates recovered from the deposits of the Emman component. Feature 1, located 15 m north of the Emman component in the upslope deposits of the Empr component, provides a date of 5,050+/-230 BP (Beta-12186) which may be related to the cultural assemblage recovered from the northeastern cluster of artifacts in the

Emman component. Only one obsidian hydration reading was taken from a specimen recovered in Emman (Table 4). This measurement was taken on a small Pinto point recovered from the surface of N905 E1025 and is one of only two points recovered from the northeastern cluster of artifacts. At 8.5 microns this point appears to date from the very end of the Pinto period.

Empr

The Empr component is the area of more diffuse artifact distributions around the Emman component. It covers the area of the site from roughly site grid line N825 to N955 and from E970 to E1120 (Fig. 6). This area encompasses the basin floor and eastward flowing drainage mentioned above, and the gently sloping portion of the ridge in the Embayment Locus. Erosion has clearly affected the distribution of artifacts in most of this component particularly in the area of the shallow drainage at its southern end where artifacts are most densely distributed.

The artifact sample from the Empr component comprises the artifacts recovered from 37 5X5 m surface collection units. Artifacts judgementally collected during both the survey and testing phases were included in the sample also. Predictably, this sample exhibits a greater variability than does the Emman sample (Table 2). Pinto points comprise the single largest class of chronologically diagnostic projectile points (7 [39%] of 18 specimens) although the combined members of the various types of the Lake Mojave series comprise a similar amount of the sample (7).

Excavations in the Embayment Locus

A row of 1X1 m test pits was excavated along the E1030 site grid line through the densest deposit of artifacts in the Emman component and on up into the gently sloping deposits of the Embayment Locus. The two test units located south of the densest cluster of artifacts were dug into shallow Stratum 4 deposits (fluvially reworked slope deposits with cultural materials) which quickly gave way to Stratum 7 (sandy, gravelly, precipitate laden, soils [Jenkins 1987:220]). Each recovered more cultural material in the upper 10 cm of deposit than in subsequent levels. Proceeding in the opposite direction up the slope, resulted in excavation units encountering primary deposits at progressively greater depths.

Figure 24 shows the location of each test pit in the Embayment Locus. Pits with two symbols exhibit bimodal distributions when the lithic debitage recovered from them is graphed by level and percentage of the recovered sample (Fig. 25). This pattern of distribution suggests there may be stratified deposits in this area of the site. Unfortunately, there were too few chronologically diagnostic

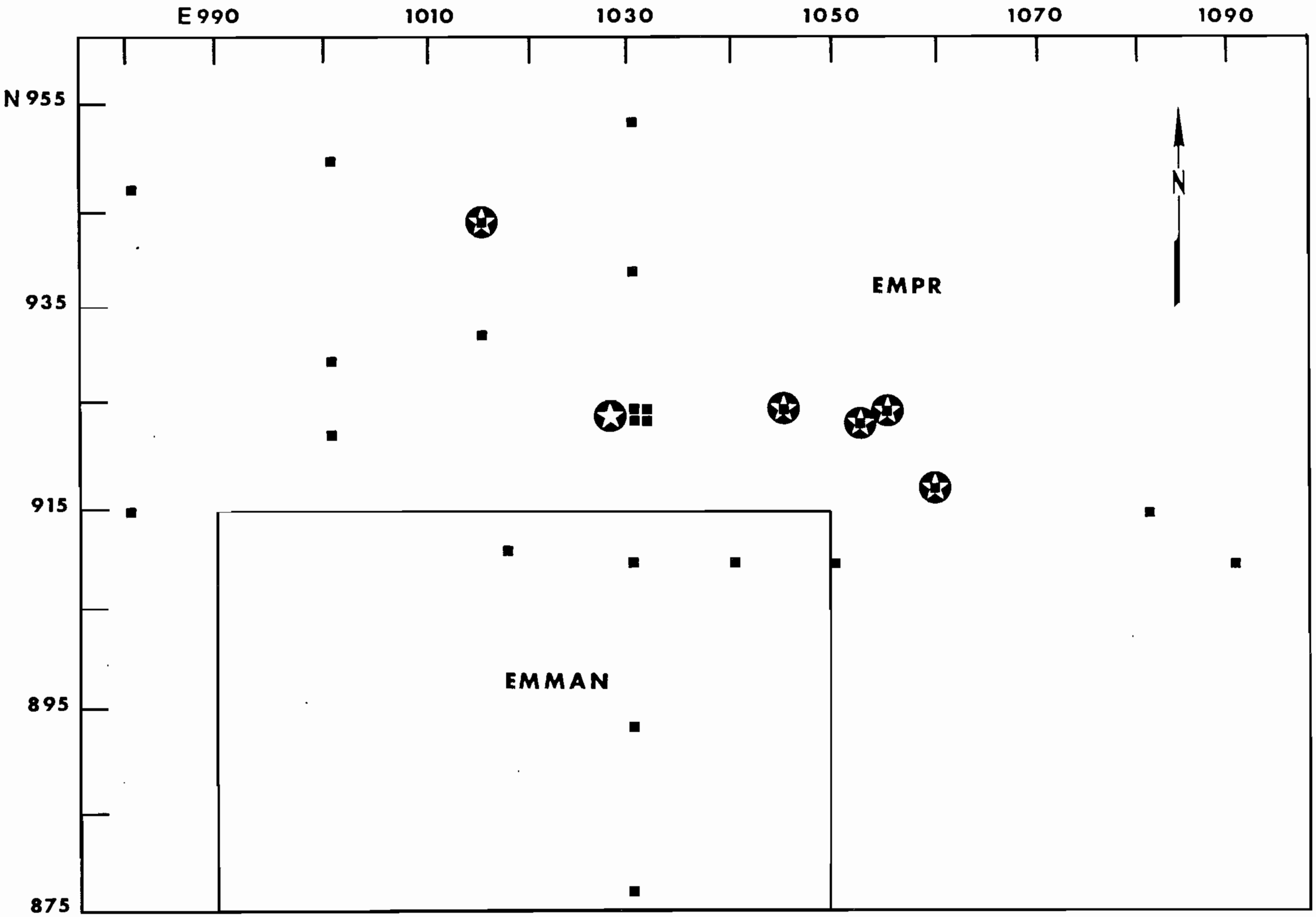

Figure 24. Distribution of excavated test pits in the Embayment Locus. Stars indicate dual peaks in lithic debitage distributions within the deposits.

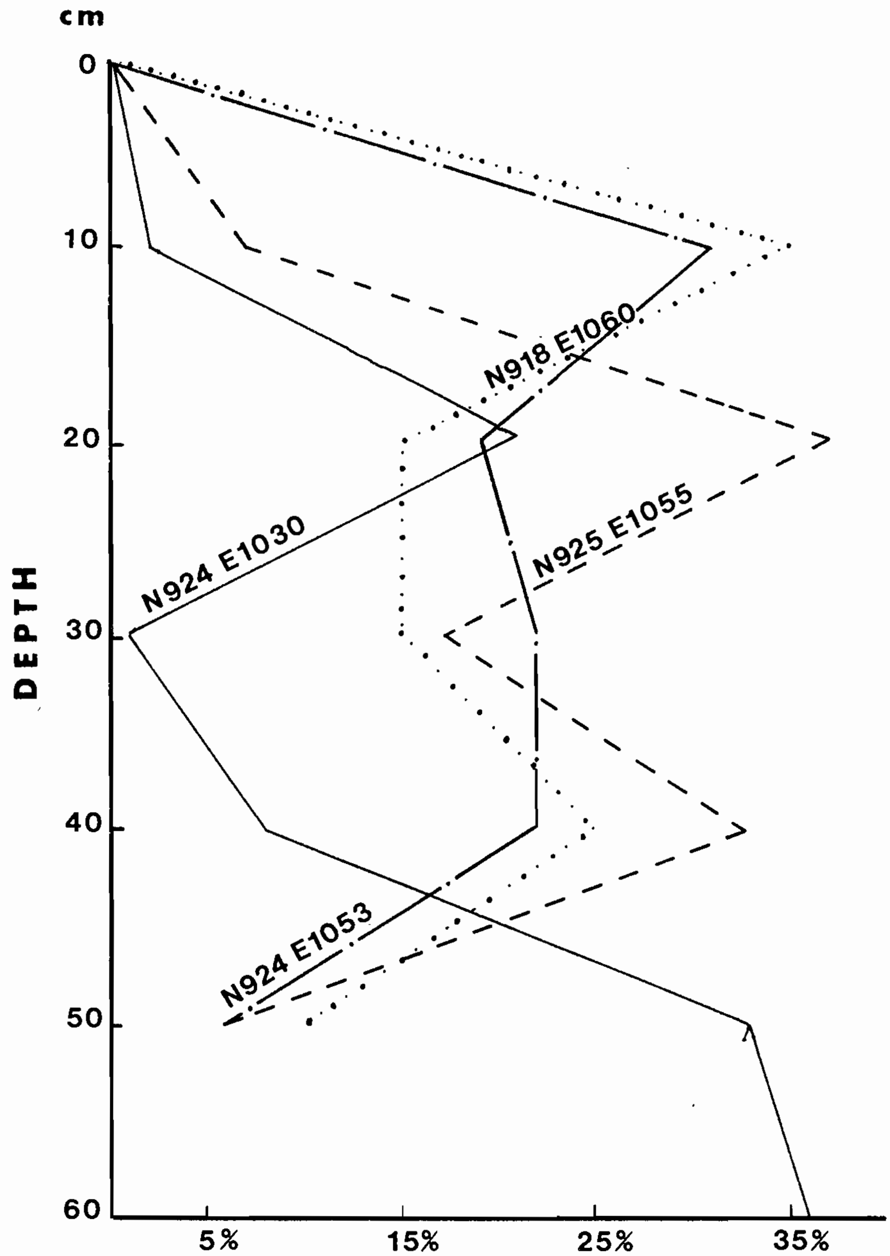

Figure 25. Vertical distribution of lithic debitage in selected excavation units of the Embayment Locus.

artifacts and radiocarbon samples recovered to confirm their respective ages.

As previously mentioned, Feature 1, a pair of carbon stains approximately 40 cm wide, 70 cm long, and 15 to 20 cm thick, was located in the subsurface deposits of the Empr component. Encountered at 50 cm these stains were situated slightly above and within a cobble lens underlying the Embayment Locus (Fig. 13, lower). Soil samples were recovered from both stains and material from the darker of the two was radiocarbon dated to 5,050+/-230 BP. Unfortunately, no obsidian specimens of sufficient size for analysis were recovered from the excavation of Feature 1. A Pinto point was recovered from above the feature at the 20 to 30 cm level. Graphing the distribution of lithic debitage from this excavation pit (N924 E1030; Fig. 25), however, suggests this point is more likely associated with a concentration of cultural materials generally located between 10 and 30 cm. It may not be associated with the feature which was located in the lower levels of the deposits associated with a second concentration of artifacts.

Feature 18, also located in the Empr component, was a hearth 70 to 80 cm in diameter and 15 cm deep. It was covered by 14 fairly large (10 to 25 cm) stones which were first encountered at a depth of about 35 cm. Carbon-stained soil, however, was first encountered above them in the 20 to

30 cm level. This dispersal of soil suggests rodent disturbance, which might explain the statistically modern date it produced (Beta-12842). Only two obsidian specimens recovered during the excavation of Feature 18 were large enough to provide hydration rind measurements. Both were recovered from above the hearth and they produced widely disparate measurements of 9.0 and 14.9 microns. No diagnostic projectile points were recovered during the excavation of Feature 18.

Summary

The archaeological site at Rogers Ridge comprises 3 main loci of cultural materials. These loci and the data collected from them form, and are formed of, 9 cultural and analytical components. These components have been found to have varying levels of contextual reliability. Some are spatially and temporally discrete (i.e. Sol, So2, Main, 2B, and Emman) while others are composites of many occupational phases (i.e. Per, Empr, So2/3, and So3). In Chapter VII, where the comparative analysis of both the Rogers Ridge and Henwood assemblages will be presented, each of these components will be shown to be more similar to components exhibiting the same levels of reliability than they are to components of other groups.

CHAPTER VI

DESCRIPTION AND ANALYSIS OF ARCHAEOLOGICAL COMPONENTS AT THE HENWOOD SITE

The environmental and site settings of the Henwood site were described briefly in Chapter II. It seems best, however, to briefly review the most pertinent information about these settings before going on to describe the manner in which the component assemblages were delineated.

The Henwood site is situated on the east bank of Nelson Wash at the southern base of the Granite Mountains. The site is located between this large wash and the base of a north-south trending hill. Alluvial deposits with cultural materials incorporated in them are generally shallow (30 to 50 cm) but occasionally reach depths of 1 m. These deposits are charactistically located near the center and eastern portions of the site. The western and southern portions of the site are characterized by shallow deposits and artifacts deposited on desert pavement and bedrock.

There are nine loci of cultural materials at the Henwood site, designated as A through I in previous reports (Skinner 1985; Vaughan 1984; Warren 1990) (Fig. 3). These designations will continue to be used here as the loci and their various components are discussed.

Locus A

Locus A is situated on a small knoll of granitic bedrock located at the southern end of the site. The crest of the knoll is at an elevation of 847 m. Figure 26, the topographic/ sampling map, indicates the knoll actually comprises two low crests separated by a small saddle. The smaller northern crest apparently was not occupied prehistorically. The larger southern crest is where the main occupation of the locus occurred and is the site from which approximately two-thirds of the cultural materials of Locus A were recovered. The other third of the sample was recovered from a smaller component of the locus occupying the saddle and gentle western slopes between the two knobs.

At the time of the data recovery (summer 1983) impact to the surface of Locus A was limited to a few sets of vehicle tracks which appeared to be the result of scouting vehicles using the knoll as a vantage point. Artifacts were relatively profuse on the surface, however, and there were no obvious indications of artifact collection by military personnel prior to our data recovery efforts.

The relatively level surfaces of the knob crests are covered with desert pavement, however, the slopes and small washes around them are unconsolidated deposits (Warren

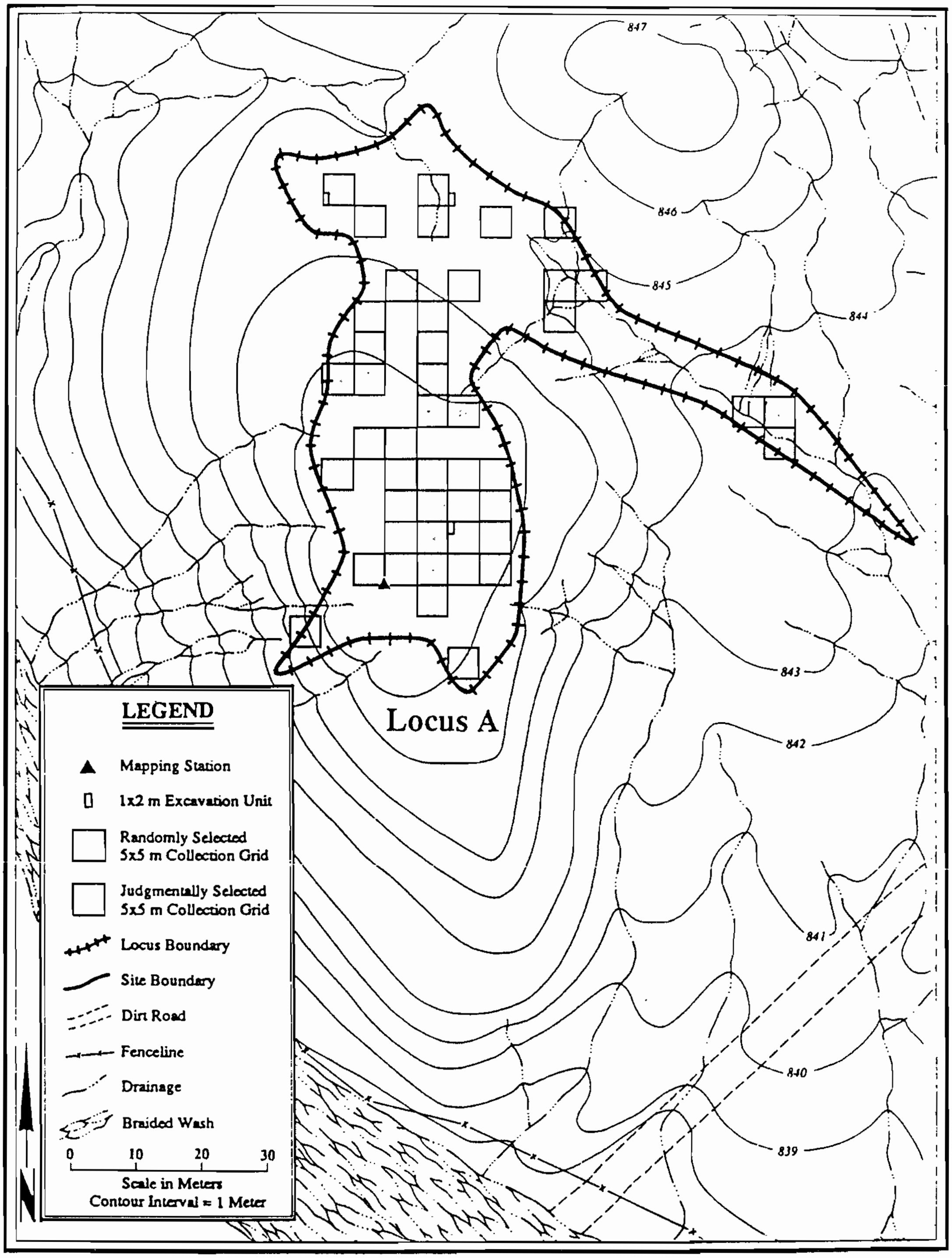

Figure 26. Map of Locus A. (After Warren 1990:Fig. 3-10).

1990:44). Though artifacts were recovered to a maximum depth of 40 cm, in one of these areas of deposits, the majority of cultural materials lie on or near bedrock in the south-central portion of the locus. The artifacts recovered in the limited excavations have been included with the surface sample from the locus because they comprise less than 1% of the sample.

The main concentration of artifacts at Locus A was known to be distributed in relatively discrete clusters at the time of the data recovery (Vaughan 1984:41). The distribution of lithic debitage (Fig. 27; Appendix A: 23-24), particularly basalt, suggests the locus contains two main concentrations of materials separated by an area of light artifact distribution. This area of lightly scattered cultural materials clearly corresponds with the slope of the knoll down to the saddle between the knobs. The heavy line drawn along the S1965 grid line in the contour maps repesents the division line between these groups of cultural materials. Those artifacts recovered between S1930 and S1965 are designated component Anorth and those south of S1965 are designated component Asouth for comparative purposes. Artifact types recovered in these subdivisions are presented in Table 5.

Figure 28, representing the distribution of all tools recovered, indicates there were four smaller concentrations of artifacts within the two larger components of Locus A.

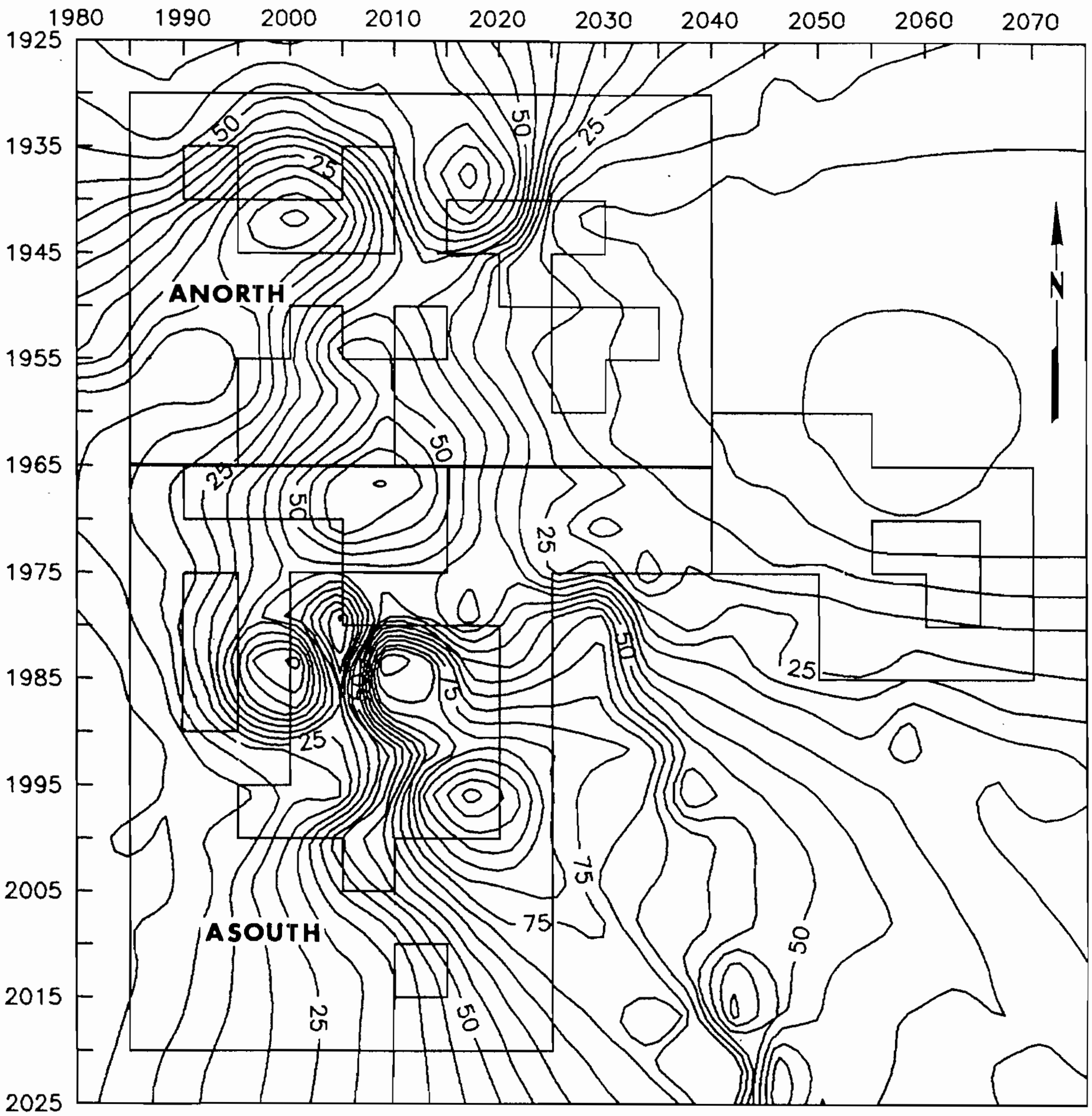

Figure 27. Distribution of lithic debitage in Locus A.

Table 5. Artifacts recovered from components of Loci A, B, and C at the Henwood site.

Loci:	A			B		C				
Component:	North	South	A-NL*	B	B-NL*	CA	CB	CC	CD	C-NL*
Types:										
lmls	2	1		2						
lmss	4	3		1						
lm	6			1		1		1		3
slr		1		3	1					2
lsp										1
ls	6	4	1	6		1	1		1	2
lsn							1			1
lan		1				1				
pinto	2	5	1						1	1
clovis							1			
oth. pts.		1		1						
ds	4	7	2	16	3		3	2		3
mds	3	1	1	1	1					1
fk		1		2						1
lkes	1			1						1
es	2			8	2		3			1
ifs	10	14		15		1		2	2	2
oss	5	5		4	1	2		1		1
tts	2	1		4			1	1		
thts	2	1			1			1		3
muf	19	40	2	33	2	6	5	5	2	7
oth. scr.	4	4	2	9	1		2	1		
grav.	3	3	1	1						1
1	55	58	12	72	12	17	1	30	18	33
2	11	21	2	16	5	7	2	13	5	8
3	4	11	1	9		4	1	1	4	5
4	2	1	1	9	1	2	1		1	5
5	5	27	1	25	2	6	3	11	4	8
6	6	16	1	12	5	3		3	7	11
7	25	31	8	53	9	14	7	28	3	32
8	1	1	2	10	1					7
9	16	10	2	16	5	2	1	13	4	7
10	4	7	2	7	1		4	4	1	9
11	3			1					1	1
12				1						
14	8	1	1	10	2			2	1	2
15			1					1	1	
17		1		1						
18	3	2	1	9				2		1
19	6	14	2	11		1		7		4
20	3	6		11	2	3	1	2		6
25	49	81	5	67	10	19	15	34	18	37
cores	8	15	1	28	7	3	3	5	1	6
gro. sto.	1			2	2					1
	285	396	53	478	76	93	56	170	75	214

* Non-Locus artifacts

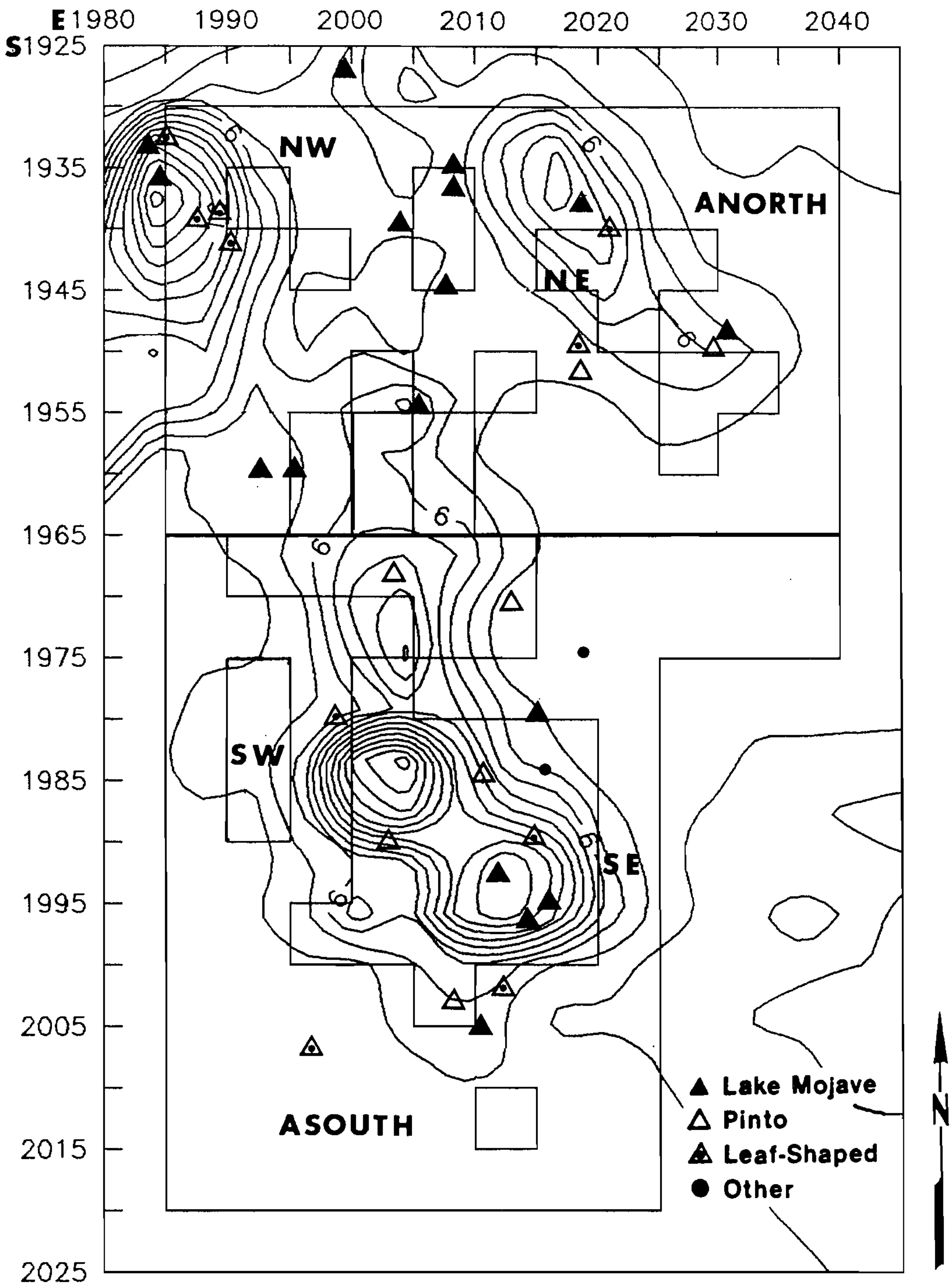

Figure 28. Distribution of all tools in Locus A.

Table 6 lists all the artifact types recovered from the four artifact clusters of Locus A (NW, NE, SW, and SE).

Warren (1990: 220) has shown there is a significant correlation between the distribution of small flake unifacial tools (gravers and scrapers) and the 5x5 m surface collection units. These small tools were found in significantly larger numbers when all cultural materials, including debitage, were recovered from the surface. This suggests that when the distributions of scrapers is contoured their distribution should follow closely to that of the 5x5 m surface collection units, which it apparently does (Fig. 29).

Bifaces, on the other hand, are generally easier to identify as tools and, thus, should have been recovered by the mappers, in their judgmental collection, at a rate more representative of their actual distributions. Their distributions, therefore, should not be so closely correlated with surface collection units except that significant differences exist between their distributions and those of the scrapers. Figure 30 indicates bifaces are generally distributed in similar patterns to those of scrapers (Fig. 29), there are some differences between the two, however. Scrapers are relatively weakly represented in the SE artifact cluster and are more tightly associated with surface collection units in the NW and NE clusters than bifaces. Bifaces, on the other hand exhibit a distribution

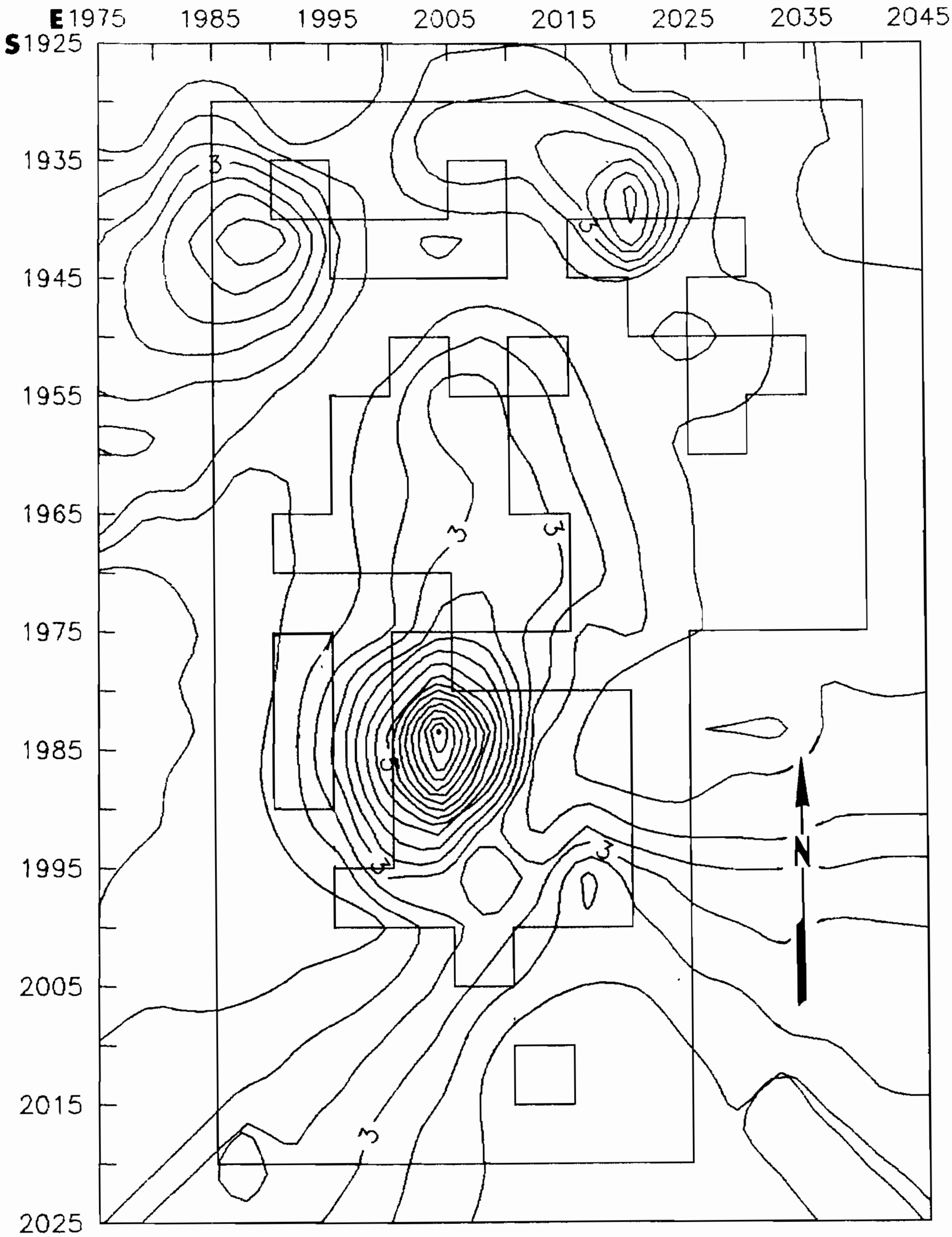

Figure 29. Distribution of scrapers in Locus A.

Table 6. Artifacts recovered from artifact concentrations of Locus A.

Types	Artifact Clusters NW	NE	SW	SE
LMSS	2	1		3
LS	4	1	1	2
PINTO		1	2	1
1	23	24	18	18
2	6	4	5	7
3	2	2	5	2
4	1	1	1	1
5	2	2	8	9
6	3	1	5	6
7	10	9	9	12
8		1	1	
9	6	6	3	2
10	3	1	2	3
11	1	2		
14	1	6		
17			1	1
19	3	1	6	4
20	2	1	2	1
25	11	13	24	18
CORE	2	4	6	3
DS	2	2	3	2
MDS	3		1	
IFS	1	3	3	4
MDS	3		1	
MUF	6	11	18	9
TTS	1	1		
THTS		2	1	
SG	1			
OSS7.3			2	3
CS		2		
LKES		1		
PS			2	
TDSS		1		
	99	104	130	111

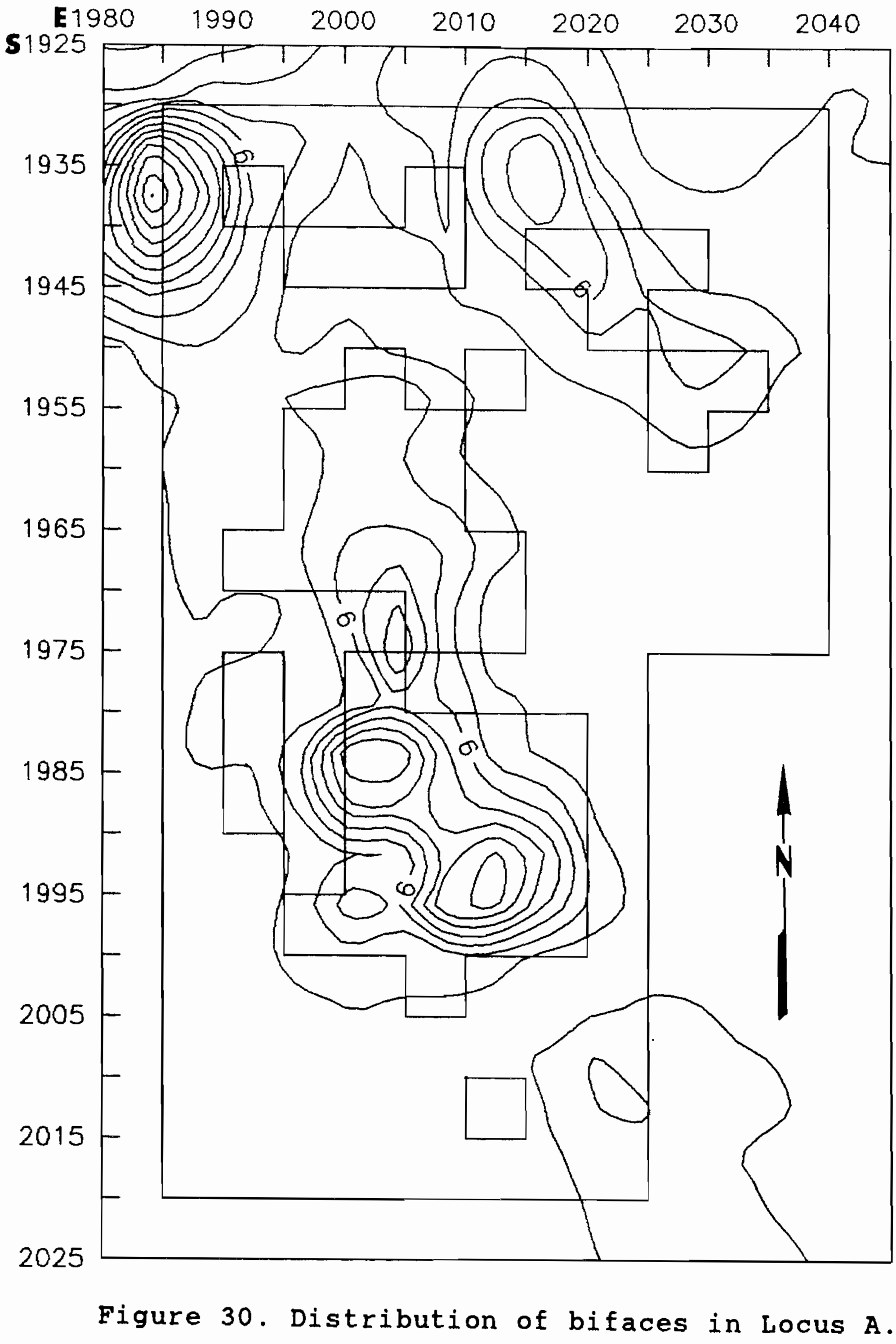

Figure 30. Distribution of bifaces in Locus A.

virtually identical to that of all tools in Figure 28, indicating they are strongly affecting the configuration of this illustration. Also, bifaces in the NW and NE clusters are not so closely associated with the surface collection units.

It would appear as if some skewing of the sample toward bifaces is evident in this case though there does not appear to be evidence of skewing in the southern clusters, probably because they were more intensively sampled by surface collection units. I believe this skewing of the sample reflects the difference in the recovery of small unifacial tools and fragments in the surface collection units as identified by Warren (1990:224) because all larger uniface fragments would have been collected with the bifacial tools in this area of the site. Consequently, the sample of artifacts for Locus A includes both the judgemental sample and the 5x5 m surface collection unit sample. Any differences in the number of unifaces and bifaces within the various cluster assemblages will be discussed on a component by component basis in the summary section below.

Lake Mojave and Leaf-shaped points comprise the majority of chronologically diagnostic projectile points throughout the locus. Though these types were broadly distributed across both the Anorth and Asouth components they tend to cluster around only three of their subcomponents, NW, NE, and SE. Pinto points, on the other hand, appear to be most commonly distributed in the Asouth component, particularly around the SW cluster.

Only two Pinto points were recovered from the Anorth component, both from near the head of a small drainage on the east side of the saddle. This drainage may have affected the distribution of artifacts to some degree in the NE artifact cluster. It is interesting, and perhaps important, to note that most, if not all projectile points associated with this cluster were recovered in or near the head of drainages. This could indicate that subsurface materials were being eroded from these deposits and that the Anorth component retains buried deposits which clearly do not exist in the Asouth component. The somewhat unusual elongation of the NE cluster (Fig. 28) may be a result of artifacts eroding from the deposits and then being scattered in a downslope, southeastward direction by erosive forces.

Artifacts were fairly common on the surface of the unconsolidated rocky deposits surrounding the Asouth component. These artifacts were collected by the mappers and catalogued with Locus A materials. They, along with the artifacts located outside site grid lines S1930 to S2020, and E1980 to E2040 (the area outlined in Fig. 28), have been combined to form a group of artifacts identified as A-NL in Table 5.

A small cluster of artifacts located in the drainage near the northeastern base of the knoll has also been included in the A-NL sample . This cluster of artifacts was included in the Locus A sample by Warren (1990; Fig. 26) and it appears in the artifact density contour maps of the lithic debitage (Fig. 27; Appendix A: 23-24). These artifacts are more closely associated with the Locus A materials than any other locus but they are not included with the main body of artifacts in this analysis because of the distance between them.

The very limited and shallow excavations in Locus A did not result in the recovery of materials suitable for radiocarbon dating. Consequently, there are only two relative dating methods available for chronologically placing the locus, projectile points and obsidian hydration. As previously mentioned, Lake Mojave and Leaf-shaped projectile points are the predominant types recovered from both the Anorth and Asouth components. This is not to say they are the same, however. Lake Mojave series points comprise 60% of all points recovered in the Anorth component. Leaf-shaped points and Pinto points comprise 30% and 10%, respectively. In the Asouth component, Lake Mojave series points comprise only 31% of the point sample while Leaf-shaped and Pinto points comprise 31% and 25%, respectively. Two other point styles were recovered from the Asouth component but are not considered chronologically diagnostic.

The projectile point distribution suggests the Anorth component is in general somewhat older than the Asouth component. It would be nice if the obsidian hydration data could be used to test this observation. Unfortunately, there are two reasons why this is not so. First, the sample of only 4 hydration rind measurements on Coso obsidian specimens is insufficient to develop a reliable mean for any one portion of Locus A, much less to account for the 4 separate artifact clusters which may span a considerable amount of time. Second, all 4 of these samples came from a relatively small area on the boundary line between components Anorth and Asouth and may well represent a single sample derived from a severely dispersed Lake Mojave component nearby. Two of the samples (178-1907 and 178-3541), in fact, are Lake Mojave series point fragments with widely disparate hydration rind thicknesses (14.7 and 12.2, respectively). Warren (1990:251) has computed a mean meaurement of 13.7 microns from the four readings listed in Table 7.

Locus B

Locus B is very similar to Locus A in many aspects. It is situated on the east bank of Nelson Wash on top of a low granitic bedrock knoll. This knoll, and the concentration of artifacts located on its crest, at about 848 m elevation,

Table 7. Obsidian hydration readings from components A, B, and C of the Henwood site.

Compon.	Stratum	Feature association	Spec. number	Hydra. band	Comments/ Results
Anorth	surface	none	178-1907	14.7 (LM)	Results:
Anorth			178-3541	12.2 (LM)	N = 4
Asouth			178-241	14.1	Mean = 13.7
Asouth			178-1903	13.7	SD = 1.07
B	surface	none	178-609	14.2	Results:
B			178-945	13.1	N = 3
B			178-1499	27.7**	Mean = 14.6
				16.6	SD = 1.79
C			178-5382	13.4	
				10.0	
CA			178-571	15.1	
CB			178-2128	12.3	
CB			178-2154	0.0**	
CC			178-2172	5.6**	
CD			178-2874	13.6	

** Specimen reading omitted from calculation of means

have been shaped to some degree by erosion (Fig. 31). A relatively large wash approaches the knoll from the east, cuts into the eastern slope, and then sweeps around it's southern end to join Nelson Wash. Small gullies have formed and crept up the sides of the knoll from this wash and from Nelson Wash to the west. A few artifacts were recovered from these rivulets but there was no evidence (i.e. no artifact clusters in the bottoms of these rivulets) that erosion has cut into any substantial subsurface deposit.

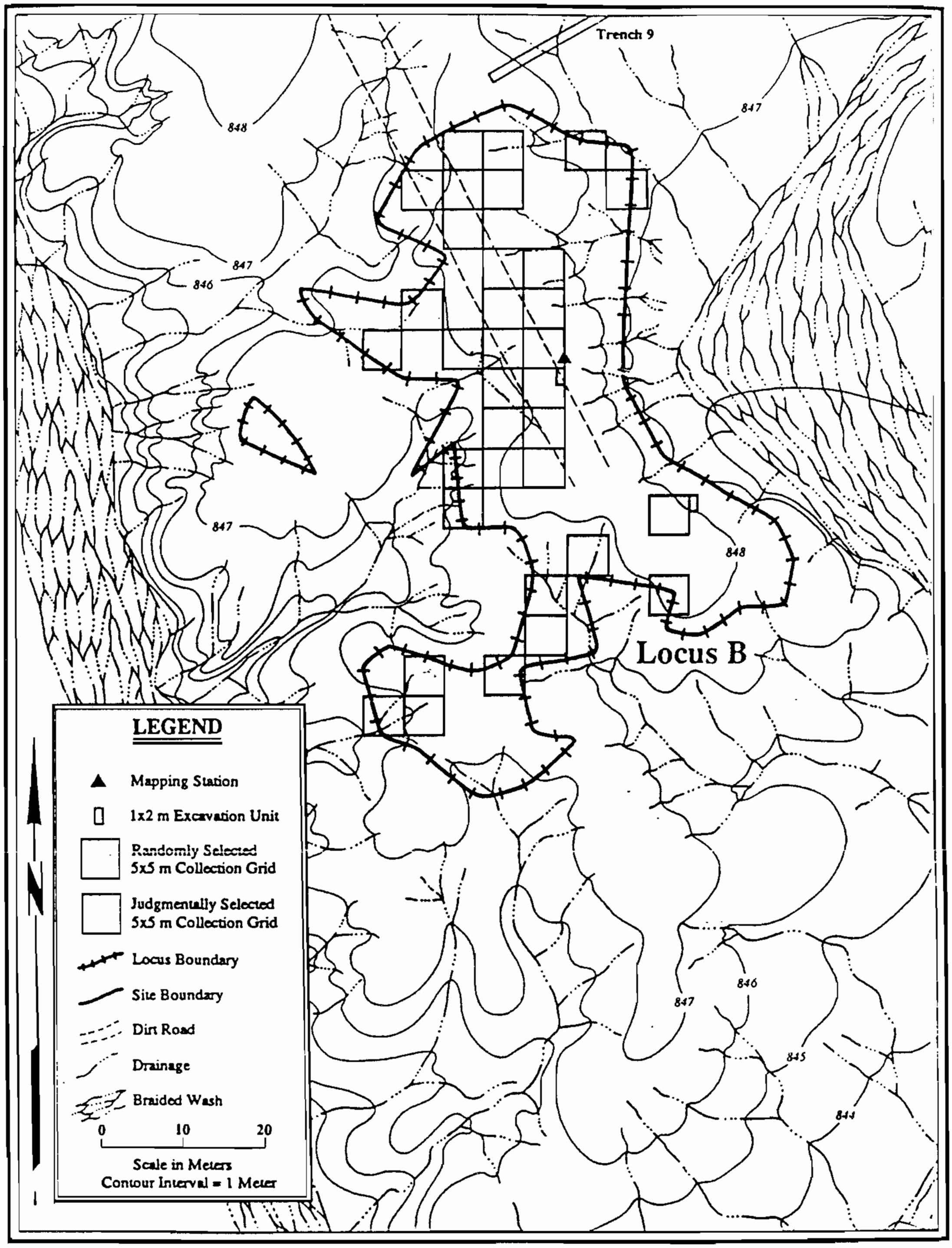

Figure 31. Map of Locus B. (After Warren 1990:Fig. 3-11).

At the time of data recovery the main impact to the site comprised a dirt track that crossed the locus from the northwest to the south. At the southern end of the site this track followed a small sloping spit southeastward into the wash. At the northern end of the locus the road continued along the top of the bench, roughly paralleling Nelson Wash.

There was no evidence of artifact collection by military personnel prior to our surface collection. Artifacts were densely distributed across the flat, desert pavement surface of the locus. Excavations recovered artifacts to a maximum depth of 10 cm. The few specimens recovered from the two 1x2 m test pits have been included with the sample of artifacts recovered from the surface because they clearly belong with this assemblage. Artifacts recovered from the washes surrounding the locus and from the alluvial fan bordering it to the northeast (near Trench 9 in Fig. 31) were originally catalogued with Locus B materials but have been formed into a separate group designated here B-NL (Table 5).

The distribution of lithic debitage (Appendix A: 25-26) suggested there were several artifact clusters within Locus B. Basalt was much more common than CCS and probably provides a more accurate example of debitage distribution since it was much easier to see, and thus recover, than the CCS which was often translucent. Also, the small size of the

CCS sample may be dramatically affecting the contour map since it seems likely that the recovery of tiny CCS flakes could well be affected by the flake recovery expertice of the individual field personnel.

The distribution of all tools in Locus B (Fig. 32), however, also suggests there were a number of small artifact clusters within the larger domain of the locus. Notably, there appear to be two or three clusters in the south, one or two in the center of the locus, and one or possibly two clusters in the north. The distribution of bifaces (Appendix A: 27) is virtually the same as that of all tools, clearly indicating that bifaces are predominant in this assemblage and their distribution has strongly affected the configuration of Figure 32. On the other hand, scrapers are widely scattered throughout the locus, only weakly clustering near the center (Appendix A: 28).

The projectile point assemblage from Locus B is remarkably limited in variation. All projectile points recovered in this locus were either Lake Mojave or Leaf-shaped series (Fig. 32) and the two types were present in roughly equal quantities. This suggests Locus B was most heavily, if not exclusively, occupied during the Lake Mojave period. Without evidence of later occupations there is no benefit to subdividing the sample of artifacts from this locus. Therefore, no division of the sample has been

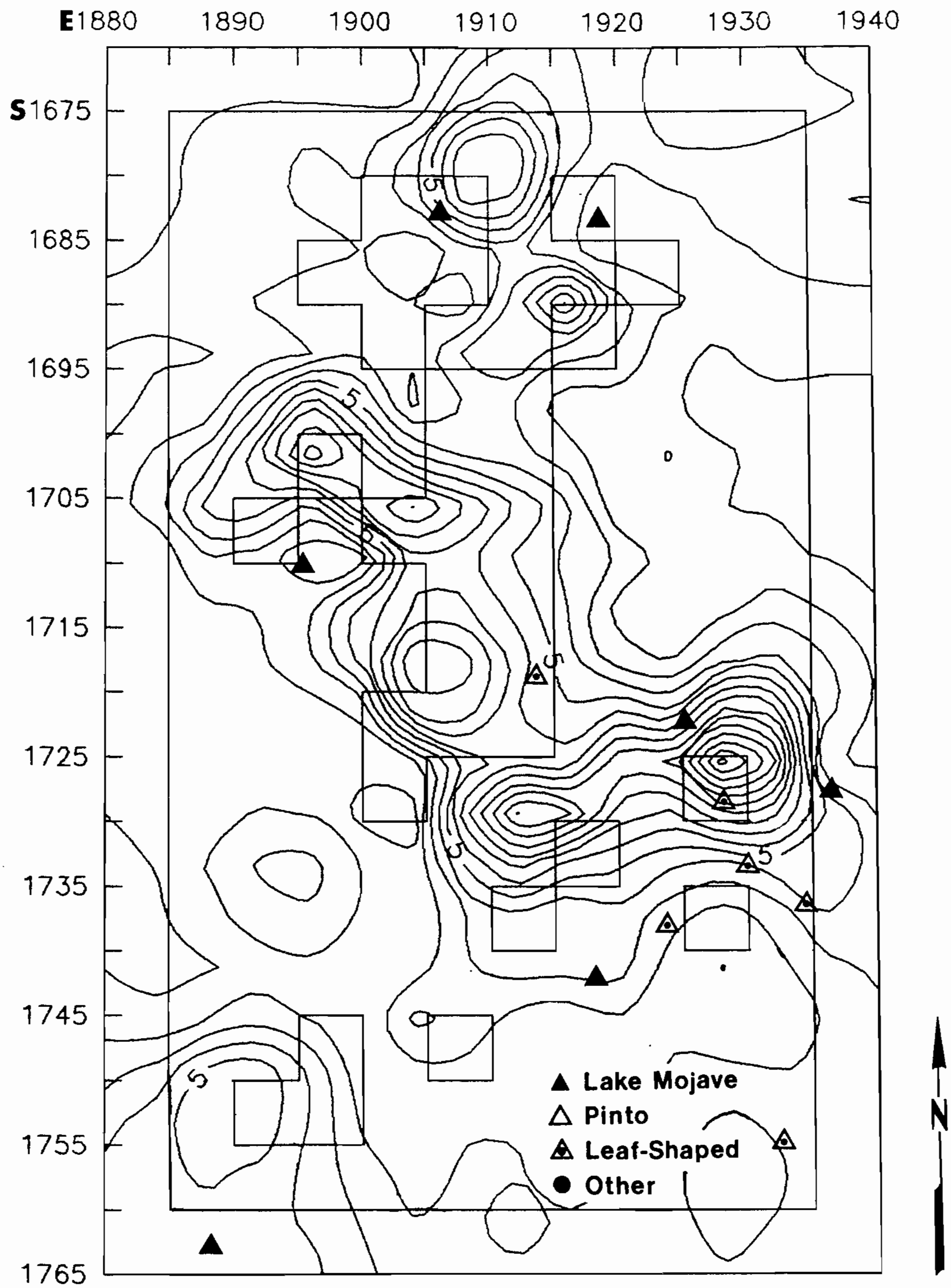

Figure 32. Distribution of all tools in Locus B.

attempted though it is clear that several artifact concentrations exist within it.

The shallow and generally unproductive excavations in Locus B did not recover carbon samples for radiocarbon dating. Obsidian was also relatively scarce in Locus B, as it was in Locus A. Only three samples of Coso obsidian, all recovered from the surface, were submitted for hydration analysis in an attempt to date the locus. All three of these specimens were recovered from the southern half of the locus. Specimen 178-945 was recovered from the southeastern artifact cluster so prominently displayed in Figure 32. Specimens 178-609 and 178-1499, a non-diagnostic point fragment, were not recovered from artifact clusters. These three samples produced a hydration mean of 14.6 microns (Table 7; cf. Warren 1990:251). This is a mean fairly consistent with that of Locus A (13.7) which it is so similar to in so many other aspects, as well.

Locus C

Locus C was an unusually large locus, covering 47,200 m sq, situated on the east bank of Nelson Wash approximately 80 m north of Locus B (Fig. 33). It is very irregularly shaped, and in it's original form was totally incompatible with the format of analysis employed here.

The complexity of Locus C was recognized during the earliest phases of fieldwork and 9 separate sampling strata

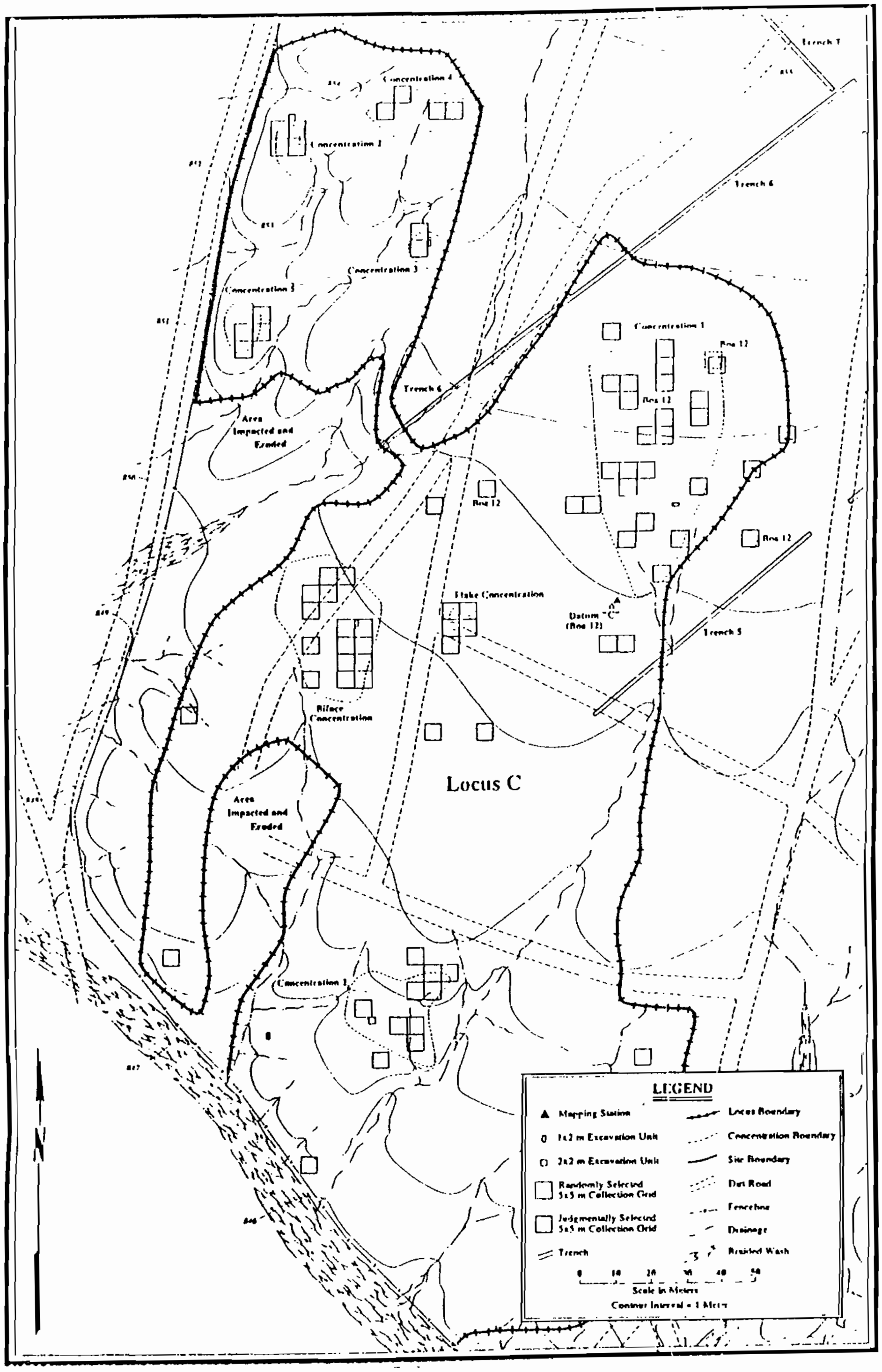

Figure 33. Map of Locus C.(After Warren 1990:Fig. 3-12).

were identified (Vaughan 1984:42). Six of these artifact concentrations have been numbered (1-6), two have been named the Biface and Flake concentrations, and the remaining artifact group comprises artifacts recovered from the much broader area of low to moderate artifact density surrounding these concentrations. This division of locus sample into artifact concentrations closely approximates my own technique. Once again, however, it must be remembered that the boundaries of our clusters are not precisely the same and this has undoubtedly affected the number of artifacts comprising each group.

Soil deposits in Locus C are generally a shallow alluvium which is underlain by a calcium carbonate (caliche) layer which in turn overlies ancient stream deposits. The thin to nonexistent nature of deposits throughout Locus C was evident in the very limited excavations conducted in the various artifact concentrations. The few artifacts recovered in these excavations have been included in the appropriate surface samples of these components.

The surface of Locus C is generally flat but is occasionally cut by shallow rills and washes. Desert pavement has formed on the tops of isolated segments of slightly raised site surface, particularly in the northern quadrant of the locus, and artifacts are incorporated into these pavements. In the Biface Concentration, near the center of the locus, artifacts are lying directly on the ancient caliche deposit.

Military impacts have been unusually severe in Locus C. Four major road systems cross and intersect in this area. In addition to impacts due to vehicular traffic, was the placement of several military vehicle targets (old Armored Personnel Carriers [APC's]) on the site which were then fired on during training exercises. The placement, destruction, and removal of these hulks caused severe damage to the surface in at least 3 separate areas of the locus. Artifacts lying on shallow, light colored caliche deposits in the Biface concentration, in particular, were broken and scattered to some degree by these activities.

In the analysis conducted by Warren and his associates (1990:177), artifact samples were grouped with other samples when the following conditions held:

> 1. The ratio of metavolcanic [basalt, rhyolite, and felsite] flakes to flakes of chert/chalcedony were similar.
>
> 2. The quantitative composition of the assemblage, in terms of the major categories of bifaces, projectile points, unifaces and cores, was similar, or, tools were present in such small quantities that the assemblage composition, even at this gross level, was obscure (Warren 1990:177).

Employing these principles, Warren (1990:48) identified and described the following artifact groups:

1. Concentration 1, a dispersed, moderate density lithic scatter with a few tools, located in the

northeastern portion of Locus C. Unlike other concentrations, materials are found on a thin deposit of recent alluvial deposits, but the concentration showed no subsurface cultural materials. . .

2. Concentration 2, a more limited moderate density lithic scatter located in the southernmost part of Locus C on a surface of eroded old alluvial soils (AS-37). . .

3. Concentrations 3, 4, 5, and 6, each small, low density lithic scatters, confined to remanant patches of desert pavement formed on fluvial gravels in the northwest section of the locus adjacent to Nelson Wash. . . [T]hey are combined for quantitative analysis below.

4. The Flake Concentration, probably a discrete chipping station with a small dense concentration of debitage in the central part of the locus. The flakes showed some local redistribution in the erosion channels that affect this portion of the site. The surface deposits are old soil.

5. The Biface Concentration, an area in which pinflagging revealed an unusual number of bifaces in a constricted area adjacent to the Flake Concentration (4). Materials were on the surface of old soil.

6. The remaining areas of Locus C were designated the Low-Moderate Density Area . . .

I have followed Warren's definitions of artifact samples closely, the only exception being the inclusion of the Flake Concentration with the Biface Concentration. The location of Warren's original concentrations are presented in Figure 33. The numbers and names of his concentrations have also been placed on the artifact contour maps produced for the four study areas I have identified. These areas have been named CA, CB, CC, and CD. Each is discussed in detail below. Artifacts recovered from non-concentration contexts within Locus C (Warren's Low-Moderate Density sample) and those artifacts recovered nearby which were catalogued under Locus C are listed in Table 5 as C-NL.

CA

Component CA corresponds to Concentrations 3, 4, 5, and 6 (Fig. 33). It is located in the northwestern corner of Locus C at an elevation of 851 and 854 m in elevation. It's surface is crossed by several small rivulets which have shallowly entrenched themselves between the slight rises covered with desert pavement. The small concentrations of artifacts comprising this component are generally perched atop these rises though one, Concentration 4, is bisected by a rivulet. Very shallow sandy deposits accumulate along these rivulets but barring this relatively minor form of deposition most of the component is covered with thin alluvium and underlain with very old, culturally sterile soils.

CA is an area of the site ill-suited to the type of analysis being conducted here. It covers an area roughly 90x90 m square which contained 4 small, widely spaced, concentrations of artifacts (Fig. 33). The boundaries of each of these concentrations were very distinct, suggesting that these small loci may have been areas of very limited occupation which have experienced relatively little post-depositional disturbance.

The concentrations of artifacts in CA were so small that most of the cultural materials in each one could be collected with either 2 or 4 of the 5x5 m surface collection units. The distribution of lithic debitage (Appendix A: 29) is not very informative, possibly because the collection units were so widely separated. This figure does indicate, however, that debitage is most dense in Concentration 4, as are all other artifact classes (Fig. 34). Figure 34 suggests that the boundaries of Concentration 3 were not well defined in the field and/or that some artifacts may have been carried westward by the small drainage which passes by Concentration 3 (compare Figs. 33 and 34).

Bifaces comprise a very large percentage of the artifacts recovered in CA (87% here, 89.5% in Warren 1990:186) and their distribution has strongly affected the configuration of Figure 34 (compare Figs. 34 and 35). Scrapers, on the other hand, comprise a very small portion of the sample (7%), nearly all of which were recovered from Concentration 4 (Appendix A: 30). It is clear that Concentration 4 produced not only the largest collection of artifacts but also the most diverse assemblage from component CA.

Only three projectile points were recovered in component CA (Table 5). A Lake Mojave series point fragment

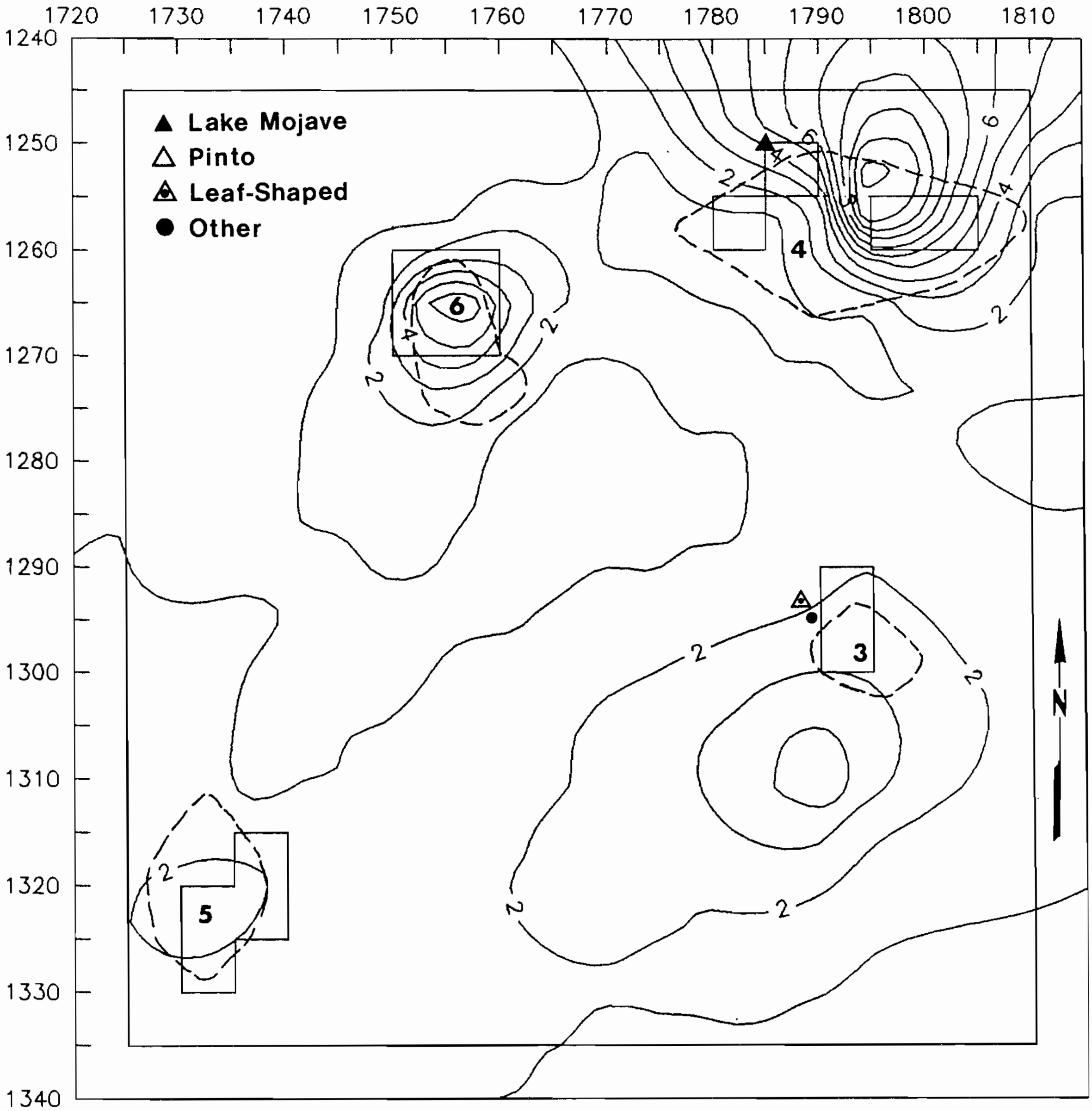

Figure 34. Distribution of all tools in Component CA.

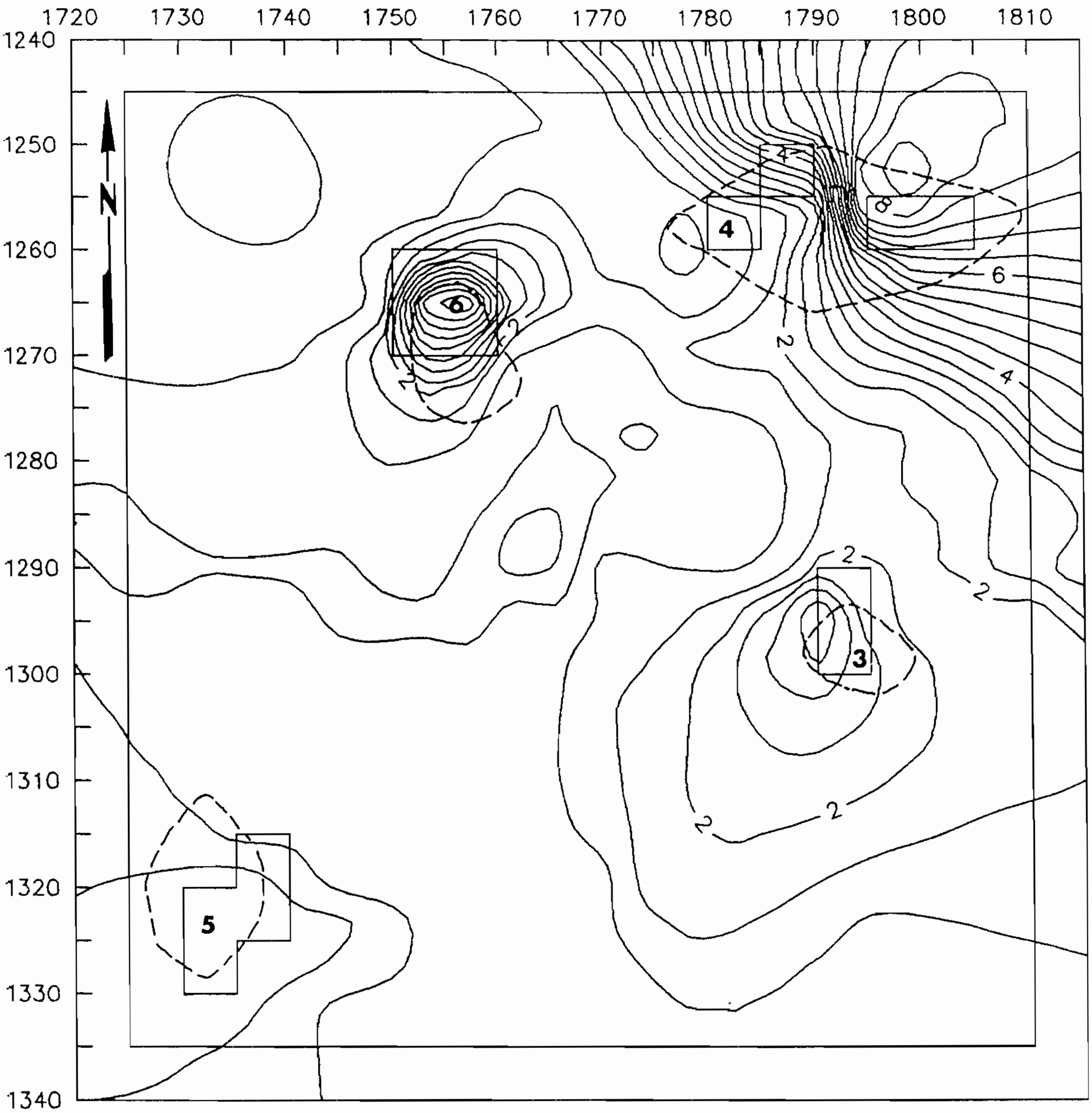

Figure 35. Distribution of bifaces in Component CA.

was recovered from Concentration 4 and a Leaf-shaped point was recovered from Concentration 3 where it was found with a Lanceolate point (Fig. 34). A single specimen of Coso obsidian provides the only hydration measurement available for the CA component. Specimen 178-571, recovered at site grid coordinates S1284 E1769 near the center of the component, produced a hydration rind measurement of 15.1 microns (Table 7). Thus, the obsidian hydration and the projectile point styles suggest that the occupation of CA dates from the Lake Mojave period.

CB

Component CB corresponds with Concentration 1 (Fig. 33) in Locus C. It is located in the northeast corner of the locus and lies between 852 and 854 m elevation on a relatively flat segment of thin alluvium. A single shallow drainage branches just south of this component and one of the two branches drains its southern tip.

Component CB, like component CA, is fairly large, 80x75 m, and characterized by a relatively thin scatter of lithic tools and debris. Lithic waste materials are most densely distributed in the northern end of the component (Appendix A: 31-32). The vast majority of flakes are basalt. CCS is thinly distributed across the surface of the component and the interpretation of it's distribution (Appendix A: 32) cannot be considered reliable. It is interesting to note, however, that scrapers, which are predominantly made of CCS, are distributed in a pattern similar to that of CCS debitage (compare Fig. 36 with Appendix A: 32). These figures suggest the component contains two clusters of artifacts, an interpretation strongly supported by Figures 37 and 38. The distribution of bifaces (Fig. 37), once again strongly affects the density contour map of all tools recovered in CB (Fig. 38). Table 5 lists the combined artifacts recovered from the component since there is no evidence that the two clusters vary significantly in age.

Only 3 projectile points were recovered from CB. A Clovis-like, fluted point was recovered from the periphery of the northern artifact cluster (Fig. 38) and two points were recovered from the southern artifact cluster, a Leaf-shaped and a Large Side-notched point. The depositional setting of CB suggests the deposits are not as old as the fluted point in the northern cluster. Therefore, I believe this point is the product of aboriginal curation practices and that there is no substantial evidence that the northern cluster is any older than the southern cluster. A single Coso obsidian flake (178-2128), recovered from the southern artifact cluster, produced a hydration rind measurement of 12.3 microns. A second specimen (178-2154), also recovered from the southern artifact cluster, exhibited no signs of a hydration rind at all (Table 7).

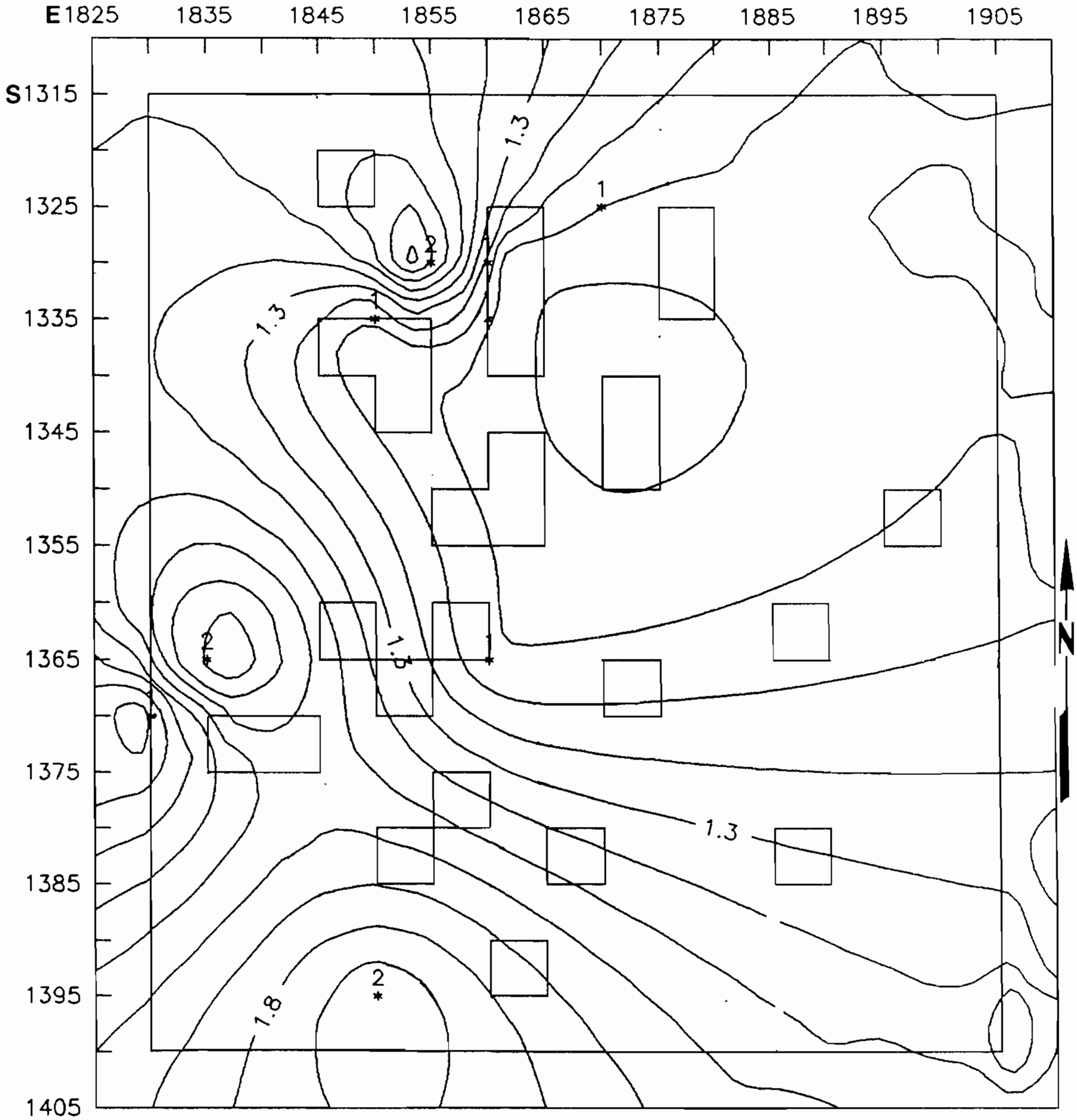

Figure 36. Distribution of scrapers in Component CB.

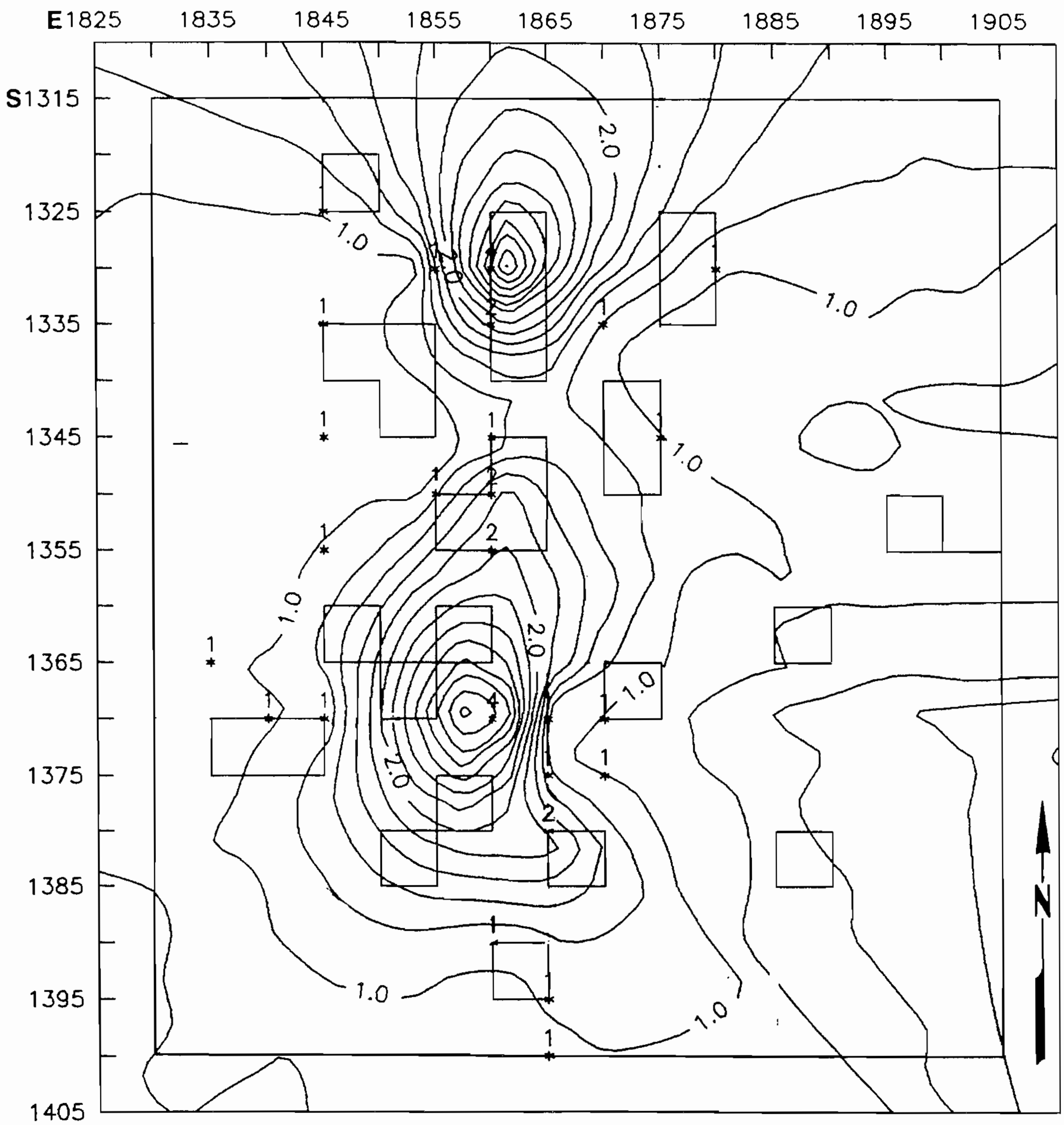

Figure 37. Distribution of bifaces in Component CB.

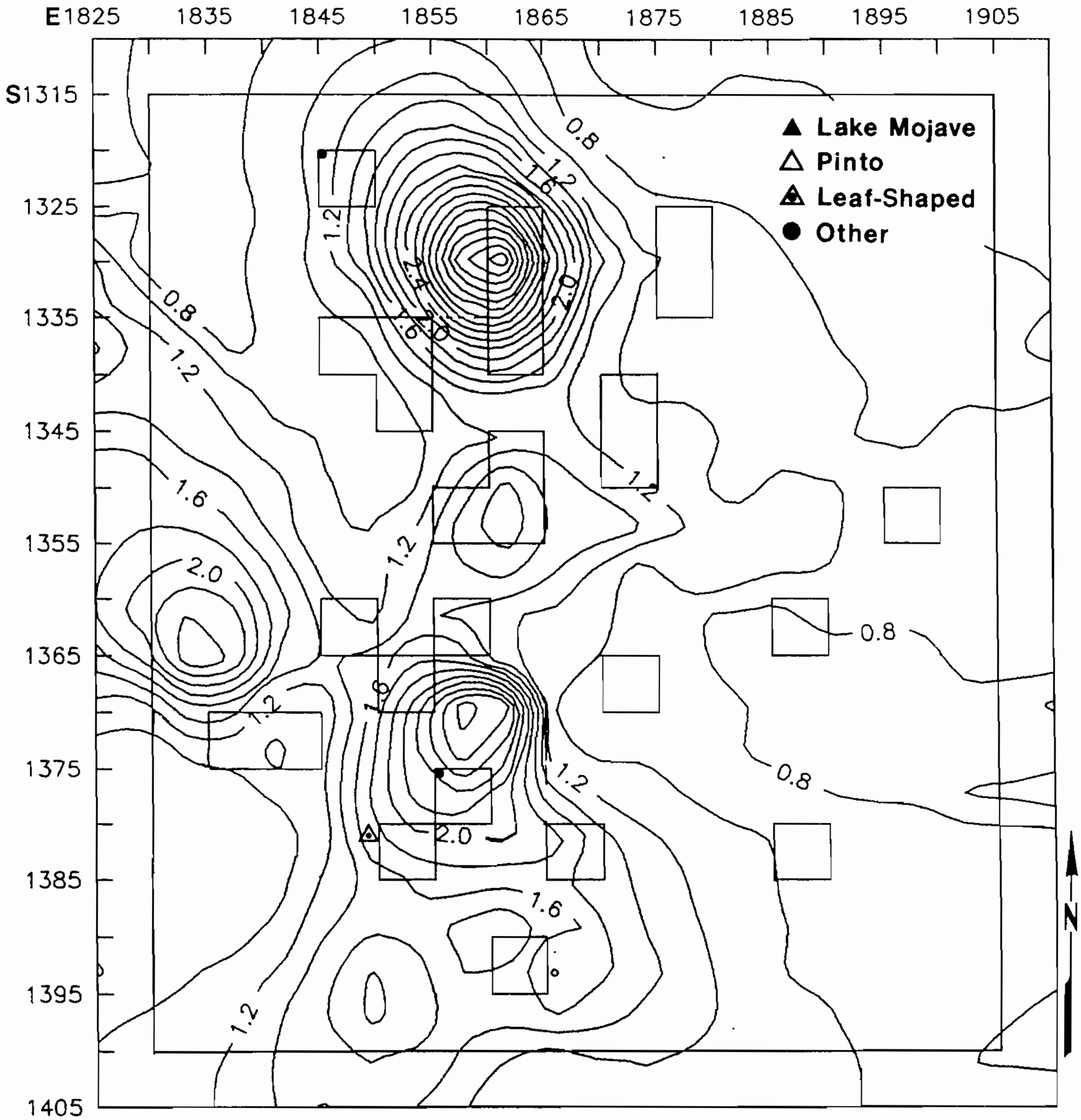

Figure 38. Distribution of all tools in Component CB.

CC

Component CC comprises the Biface and Flake concentrations of Vaughan (1984:43) and Warren (1990:48) (Fig. 33). Both concentrations were lying on ancient, culturally sterile soils, at an elevation of 851 m. The surface of both concentrations had been impacted by roads and target maintenance activities which may have affected the distribution of cultural materials to some degree. Some erosion was noted in the Flake concentration but the distribution of both flakes and tools suggests its affects on this tiny cluster of cultural materials were minimal. This may have been due to the relative flatness of the surface in this component.

The Flake concentration was so named because lithic debitage comprised the majority of cultural materials, suggesting this tiny component had been a distinct chipping station. In fact, very few tools were recovered from the Flake concentration (Fig. 39) and the majority of those present were biface fragments similar to the types recovered in the Biface concentration. Contouring the distribution of flakes clearly demonstrates the differences in densities of lithic debitage between the Flake and Biface concentrations (Appendix A: 33-34; Fig. 39). More than 90% of these flakes are basalt, the predominant material used in the production of bifaces. CCS is practically non-existent throughout the

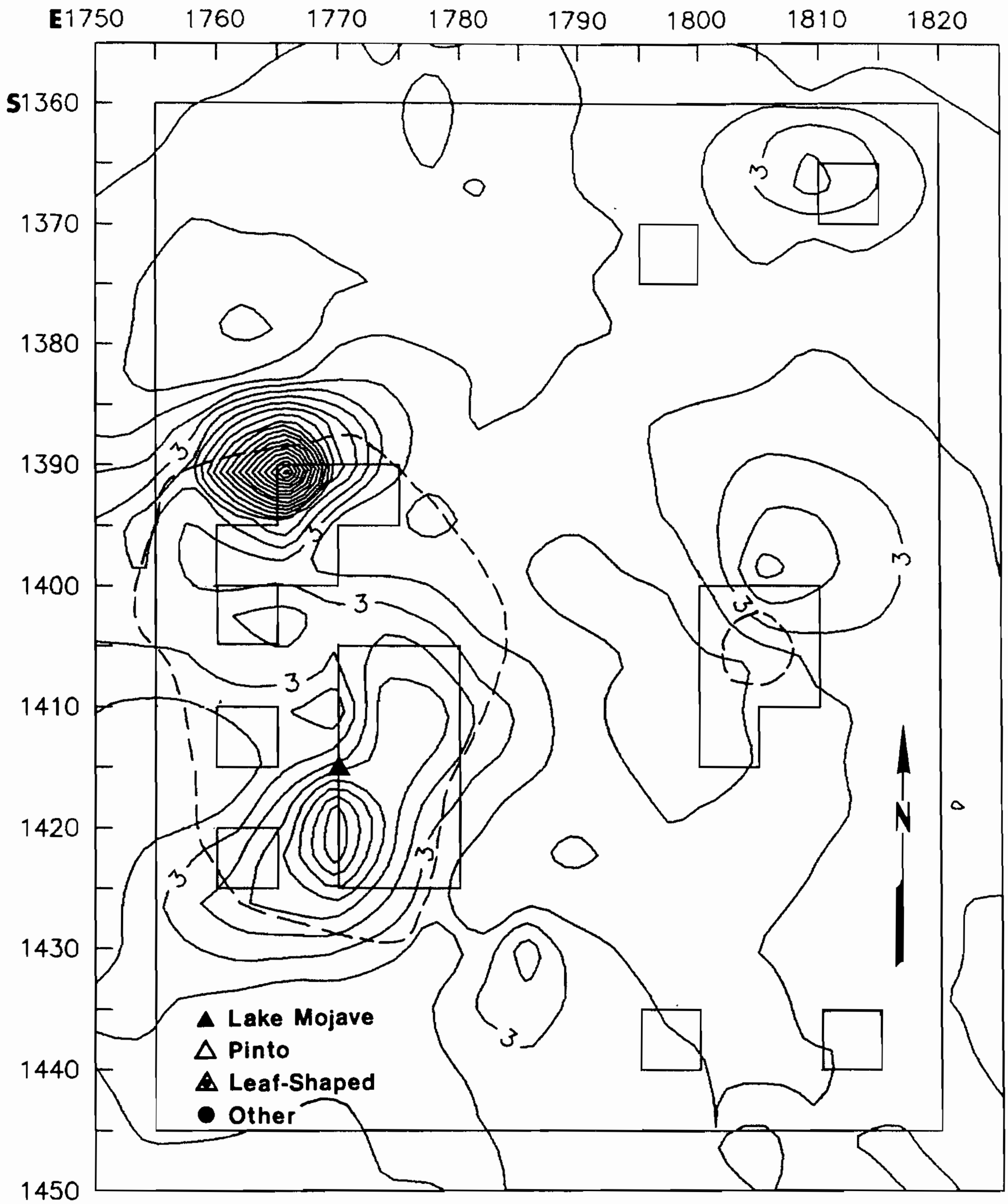

Figure 39. Distribution of all tools in Component CC.

component (Appendix A: 34), a characteristic which may be related to the relative scarcity of scrapers (Table 5 and Appendix A: 35), as mentioned above.

Table 8 lists the artifacts from the Biface concentration (artifacts recovered between site grid lines E1755-1780, S1380-1430) and Flake concentration (artifact recovered between grid lines E1785-1820, S1380-1430) separately. The Biface concentration, obviously named because of the large number of bifaces recovered there, contained remarkably little debitage (Appendix A: 33) compared to the number of artifacts (Fig. 39). It's assemblage comprises more than 97% bifaces, including only 2 cores and 2 scrapers (Table 8). Interestingly, the Flake concentration contains a disproportionate number of scrapers (4 MUF's) which may well reflect the large number of flakes, some of which may have been utilized, in this area of the component.

Figures 39 and 40 suggest there were two artifact clusters within the Biface concentration. It must be remembered, however, that the concentration was bisected by a major tank trail. The distribution of cultural materials in this area of the component may well have been seriously affected by this road and the two apparent artifact clusters could well be an artifact of this disturbance. Therefore, no effort has been made to subdivide the Biface concentration assemblage.

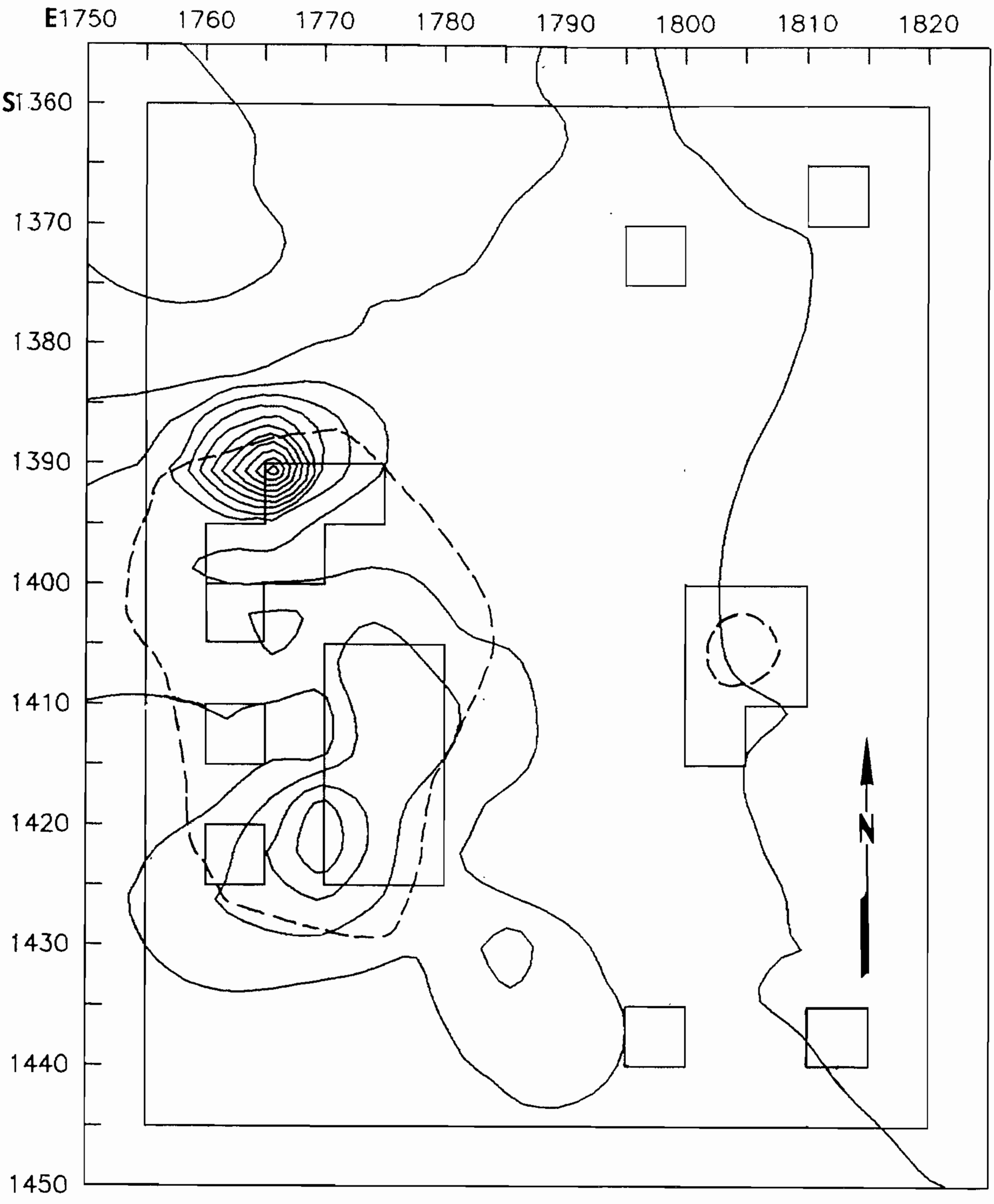

Figure 40. Distribution of bifaces in Component CC.

Table 8. Artifacts recovered from the Biface and Flake concentrations of Locus C, component CC.

Types	Biface	Flake
LM	1	
MUF		4
OSS7.1	1	
TTS	1	
1	21	1
2	13	
3	1	
5	9	1
6	3	
7	24	2
9	17	2
10	3	
15	1	
18	1	
19	1	1
20	1	1
25	24	7
cores	2	1
	123	20

The single shallow excavation conducted in the Biface concentration did not recover materials suitable for radiocarbon dating this component. A fragment of a Lake Mojave series projectile point, recovered in the southern half of the Biface concentration (Fig. 39), was the only chronologically diagnostic artifact recovered from component CC. Unfortunately, obsidian was also relatively scarce in this area of the site. The single Coso obsidian biface fragment measured for hydration rind thickness produced an unreliable rind measurement of 5.4 microns (Table 7). Consequently, the age of component CC is set in the Lake

Mojave period commensurate with the evidence provided by the projectile point.

CD

The CD component (Concentration 2 of Vaughan 1984:43 and Warren 1990:48) is located at the southern end of Locus C. This small component, roughly 45x40 m, is situated on the terrace-bank above Nelson Wash at an elevation of 848 to 849 m. The terrace soil is fairly old. Though flakes were recovered in some quantity (106) from a shallow (20 cm) excavation penetrating this soil they clearly post-date it and have apparently worked their way downward into it. These flakes have not been included in the surface sample, however, because their inclusion would distort the contour map of the lithic debitage distributions (Appendix A: 36).

Two small drainages border CD to the east and west and a third rivulet cuts into the eastern portion of Concentration 2. These drainages are shallow and probably have had minimal effect on the distribution of cultural materials in the component. There are no major trails through CD and if vehicular impacts to the surface were present they were relatively insignificant.

CD clearly represents a cluster of artifacts relatively isolated in space from other cultural materials. Bifaces predominate within the assemblage (Table 5; Appendix A: 37), exhibiting the same distribution as all other tools. Figure 41 suggests the assemblage comprises a single component with Pinto and Leaf-shaped points recovered from near it's center. A single flake of Coso obsidian, recovered from the first level of the test excavation, produced a hydration rind measurement of 13.6 microns. Component CD appears to represent an unusually discrete Pinto occupation.

Locus D

Locus D is a small concentration of artifacts located on the east bank of Halfway Wash between Locus H and G (Fig. 42). It occupies a slight rise at about 849 m elevation. A hard, whitish caliche cap of the stream terrace is covered by a thin veneer of more recent alluvium. Artifacts were incorporated in this thin deposit of alluvium and to a lesser degree were present on the surface of the caliche.

Though a major tank trail passes 5 m to the east of Locus D it does not appear to have been adversely impacted by it. Erosion may be the most significant cause of the distributional patterns observed at this locus, however.

Most lithic debitage was recovered at the contact between the more eroded western portion of the locus and the slightly deeper alluvium covering the eastern portion of the locus (Fig. 43). The 849 m contour line in Figure 42 roughly approximates this contact zone. These patterns suggest the

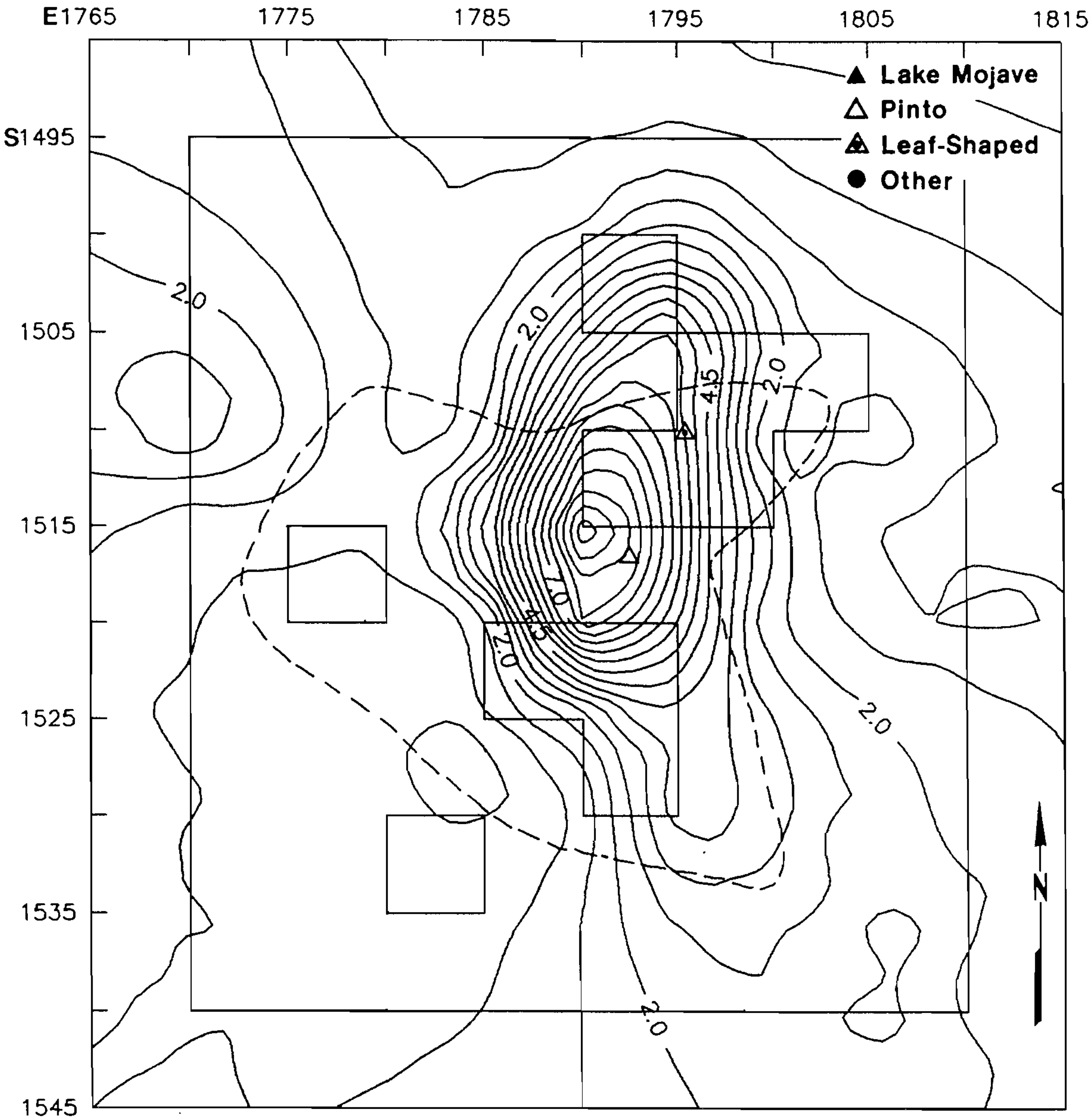

Figure 41. Distribution of all tools in Component CC.

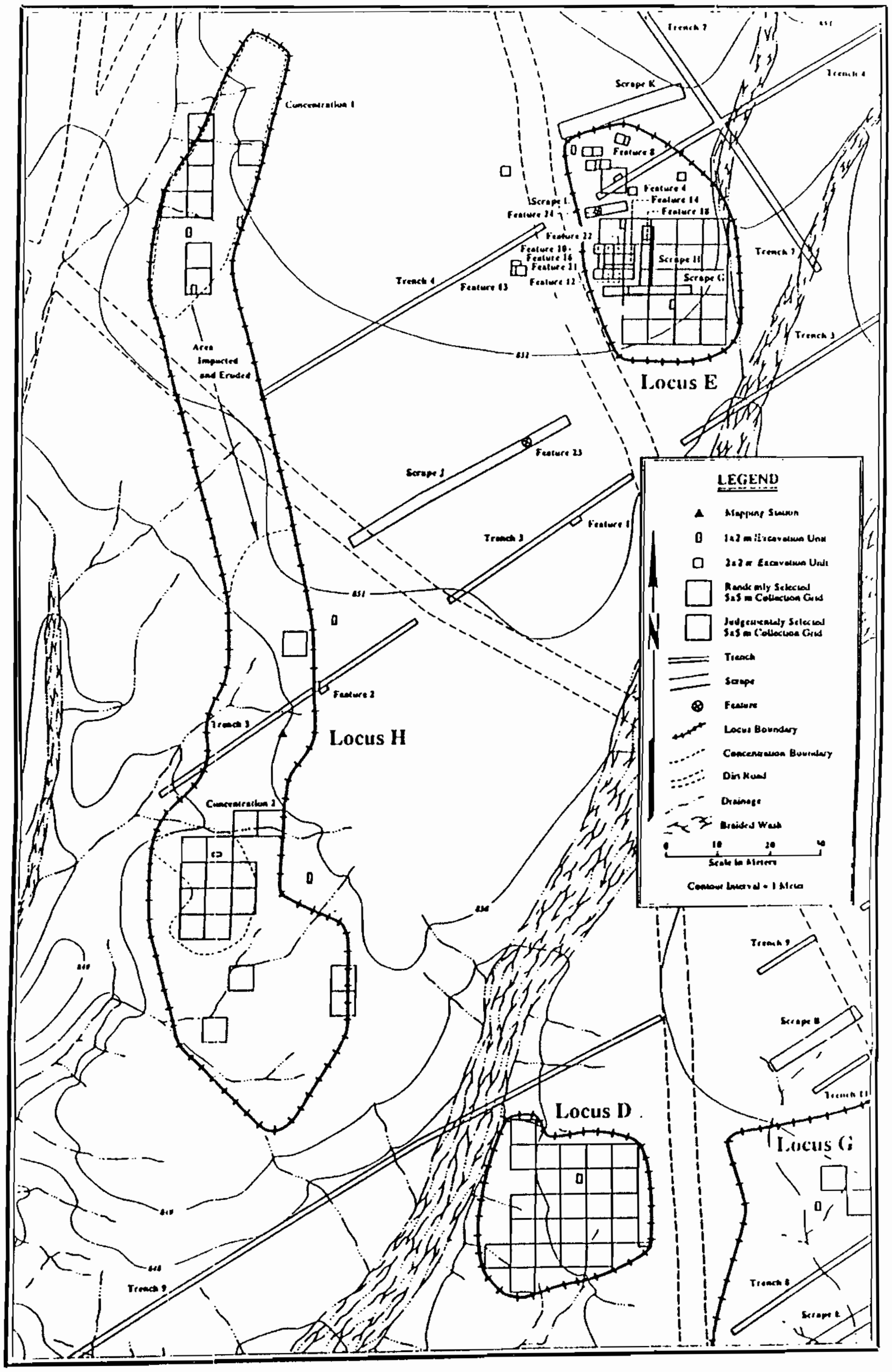

Figure 42. Map of Loci D, E, and H.(After Warren 1990: Fig. 3-13).

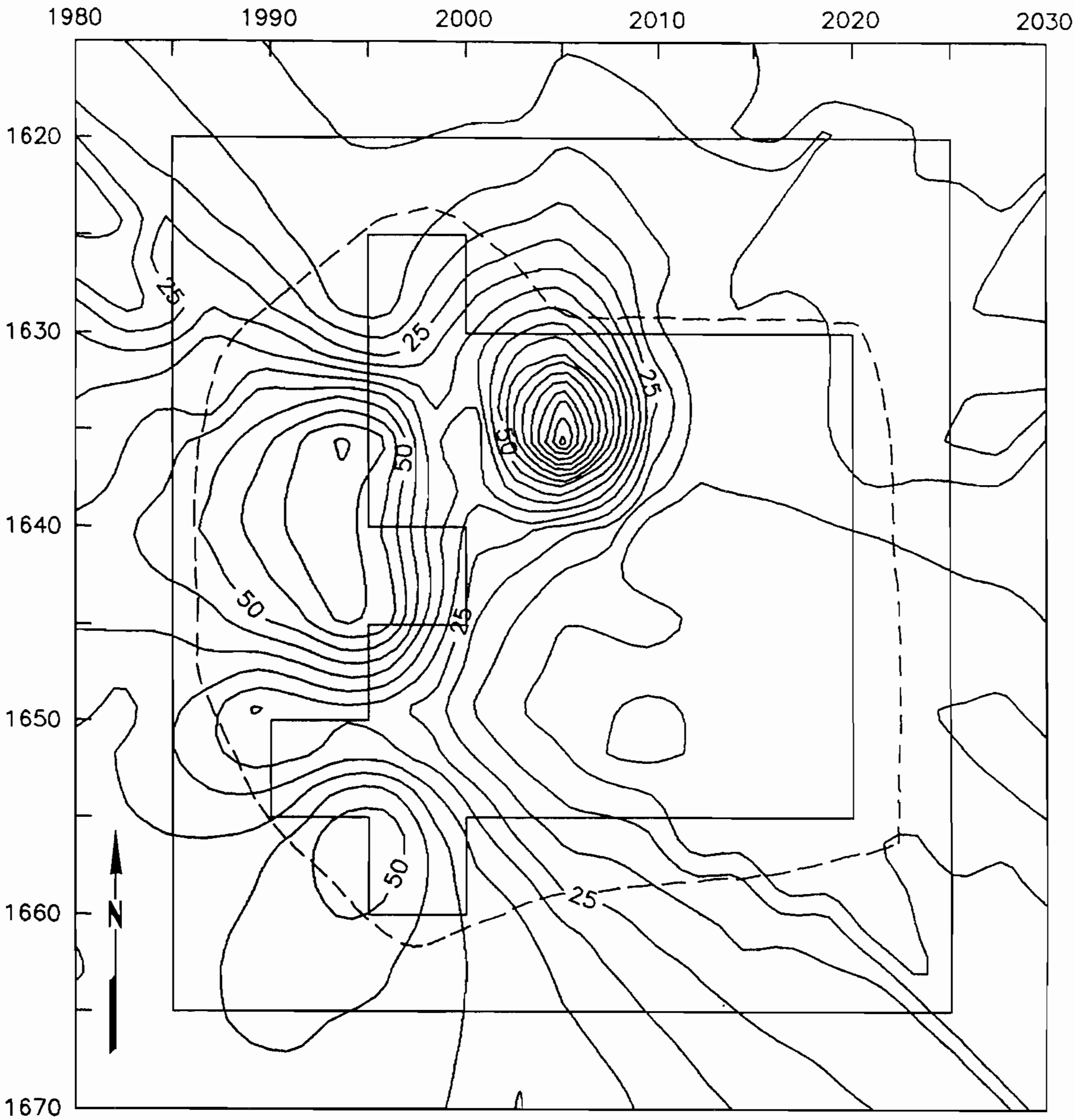

Figure 43. Distribution of lithic debitage in Locus D.

distribution of debitage is related to erosion, to some degree at least, in this portion of the site. Lithic debitage appears to be most densely scattered just below the crest of the rise. Perhaps sheet wash is removing much of the debitage once it becomes exposed on the relatively hard surface of the caliche or, alternatively, erosion could simply have begun only recently cutting eastward into the thin archaeological deposits of this locus.

It is interesting that when the distribution of all artifacts is plotted they appear to be distributed in two clusters (Fig. 44), one in the northwest corner and the other just outside the southeast corner of the locus. Most, roughly 72%, of these artifacts are bifaces (Appendix A: 38; Table 9) whose distributions have clearly affected the configuration of Figure 44. Scrapers comprise 23% of the assemblage and cores make up the remaining 5% of the sample.

Scrapers cluster well with the other artifacts (Appendix A: 39) and the entire distributional pattern may be a result of two primary factors. First, and perhaps foremost, erosion appears to be exposing artifacts along the western fringe of the locus, particularly in the northwestern quadrant where the largest concentration of artifacts was encountered. Second, artifacts also appear to be clustered outside the southwestern quadrant of the locus. Figure 42 shows the intrusion of a small drainage in this area. It is quite possible these artifacts were recovered

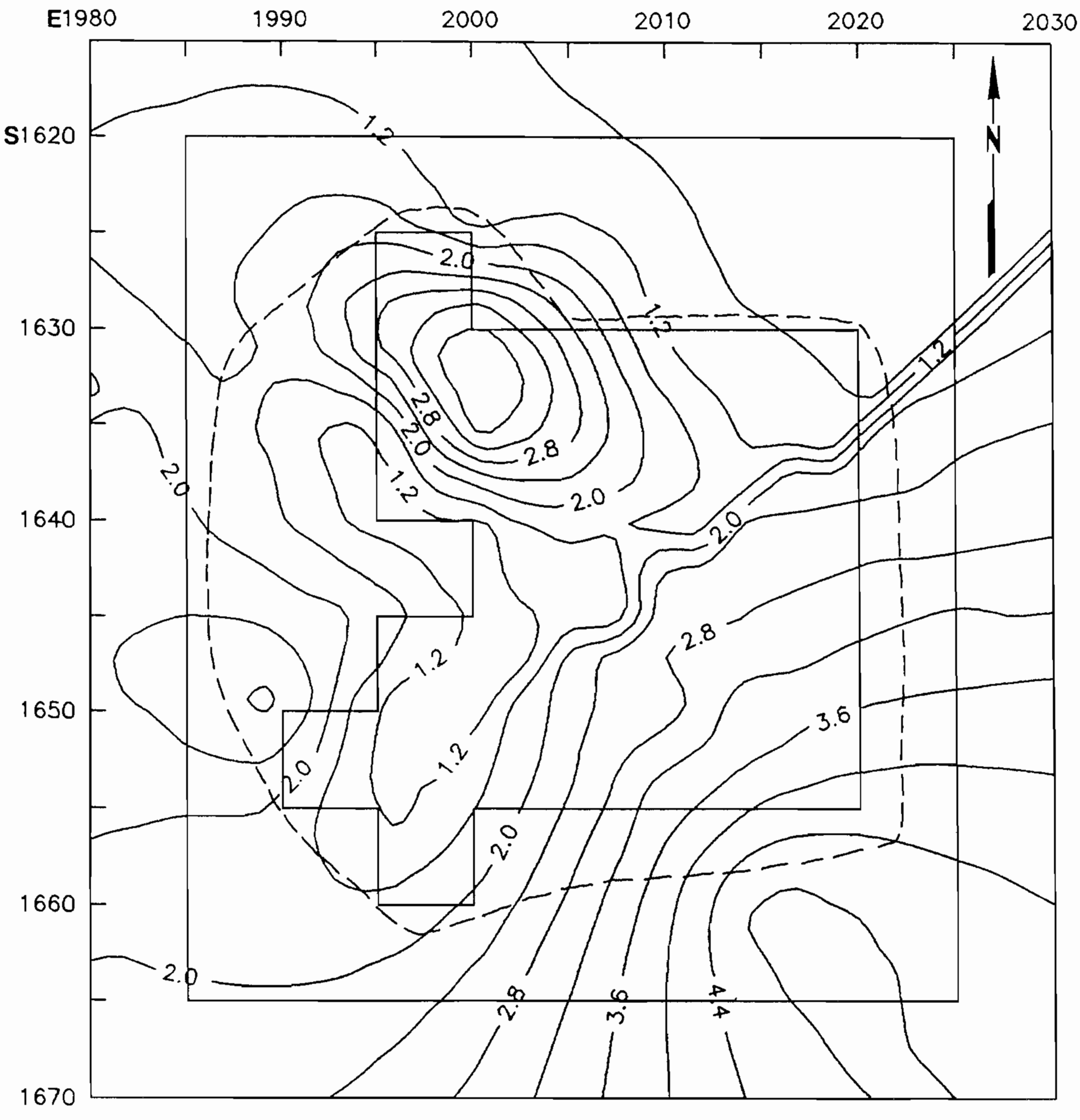

Figure 44. Distribution of all tools in Locus D.

Table 9. Artifacts recovered from components D, E, F, and G at the Henwood site.

Loci:	D	E		F	G			COMP.3
Component:		ESUR	2		G1SUR	G2SUR	COMP.1	
Types:								
lmls							2	
lm					1			1
ls					1		1	
lan					1			
pinto				1	3			
clovis							1	
ds	2				1		2	
mds					1			1
fk	1		3				2	
es				1	3	2		
ifs		1	3	1	2	2	2	
oss	1		1				2	
tts							1	
thts					1			
muf	5	2	7	8	5	4	11	5
oth. scr.	1				1		1	1
grav.				1			1	1
1	3	3	15	4	15	6	7	2
2	1		3		1	2		
3			2			1		
4	1	1			1	2	2	
5			3		6	1	1	
6		1	2			1		
7	9		3	1	9	9	3	
8			1			3		
9	1	1	3		3	1	2	
10	2				5	3		1
11			1					
14	2			4	1	1	2	1
18			1	3		1	1	
19			1		1	1	1	1
20		1	1			1		
25	13	4	34	18	18	6	14	2
cores	2	1	14		5	1	1	3
gro. sto.			6		1	1	4	1
	44	15	104	42	86	42	66	20

along the floor of this drainage where they were eroded from the deposits and exposed on the surface.

The two shallow excavations in Locus D did not recover materials suitable for radiocarbon dating and no projectile points were recovered from this locus, either. A single flake of Coso obsidian (specimen 178-2329; Table 10), recovered in the southwestern quadrant of the locus, produced two widely divergent hydration rind readings of

Table 10. Obsidian hydration readings from the surface components of loci D and E and subsurface Component 2 of Locus E.

Compon.	Stratum	Feature association	Spec. number	Hydra. band	Comments/ Results
D	surface	none	178-2172	9.1	Results:
				13.4	N = 2
					Mean = 11.3
Esur	surface	none	178-2412	11.0	
Esur			178-4905	0.0**	
Comp. 2	AS-7	21	178-7664	13.0	Results:
				11.5	N = 4
Comp. 2			178-7711	9.3	Mean = 10.4
Comp. 2			178-8002	7.6	SD = 2.07
G1sur	surface	none	178-839	17.7	Results:
G1sur			178-2968	13.4	N = 5
G1sur			178-3246	10.7	Mean = 13.5
				13.0	SD = 2.56
G1sur			178-3247	12.7	
G2sur	surface	none	178-716	12.9	Results:
G2sur			178-718	12.7	N = 6
G2sur			178-838	9.9	Mean = 10.7
G2sur			178-3100	9.1	SD = 1.93
G2sur			178-6098	11.4	
				8.2	

** reading not included in mean

9.1 and 13.4 microns. Warren (1990:247) accepts both of these readings and gives a mean for them of 11.3 microns.

Locus E

Locus E is a small locus (45x35 m) located near the center of the site approximately 150 m northeast of Locus D. It is situated on the west bank of Halfway Wash near the confluence of this major drainage with a minor drainage. The minor drainage cuts slightly into the eastern deposits of the locus. The surface is loose to moderately hard alluvium.

Locus E is one of two major loci at the site with substantial subsurface deposits of cultural materials in association with radio carbon datable features. Cultural deposits were found to reach a maximum depth of 80 cm by excavations in Locus E. Consequently, the analysis of Locus E artifact distributions involves a two stage process designed to address the questions of the relationship of surface materials to subsurface materials, and the number of cultural components which may be present in the subsurface context. The distribution of surface materials, identified here as Esur, will be dealt with first, followed by discussions of the subsurface cultural materials which have been named Component 2 (Warren 1990:52).

ESUR

The surface of Locus E appeared to be relatively undisturbed by military traffic though a major tank trail passes by and actually forms the western border of the locus. Surface artifacts were very thinly distributed west of this trail and excavations in this area recovered very little cultural material. The surface appeared to be fairly stable and erosion does not appear to be a major consideration in this area of the site.

It appears as if the majority of cultural materials were distributed within a relatively small area just west of the locus center. Excavations later encountered several features (Fig. 42) below the area of heaviest surface concentrations of cultural materials (Figs. 45-47; Appendix A: 40). This pattern strongly suggests the main source for cultural materials on the surface derives from the subsurface materials associated with these buried features. Rodent activity, in particular, is suspected as the primary cause in this instance. This is not overly surprising, nor does it mean that the subsurface component is abnormally disturbed, since features were encountered at minimal depths of 10 cm in some cases.

It is interesting to note that the distribution of CCS flakes (Fig. 48) differs to some degree from that of all materials (Fig. 45). Note in particular that CCS is most

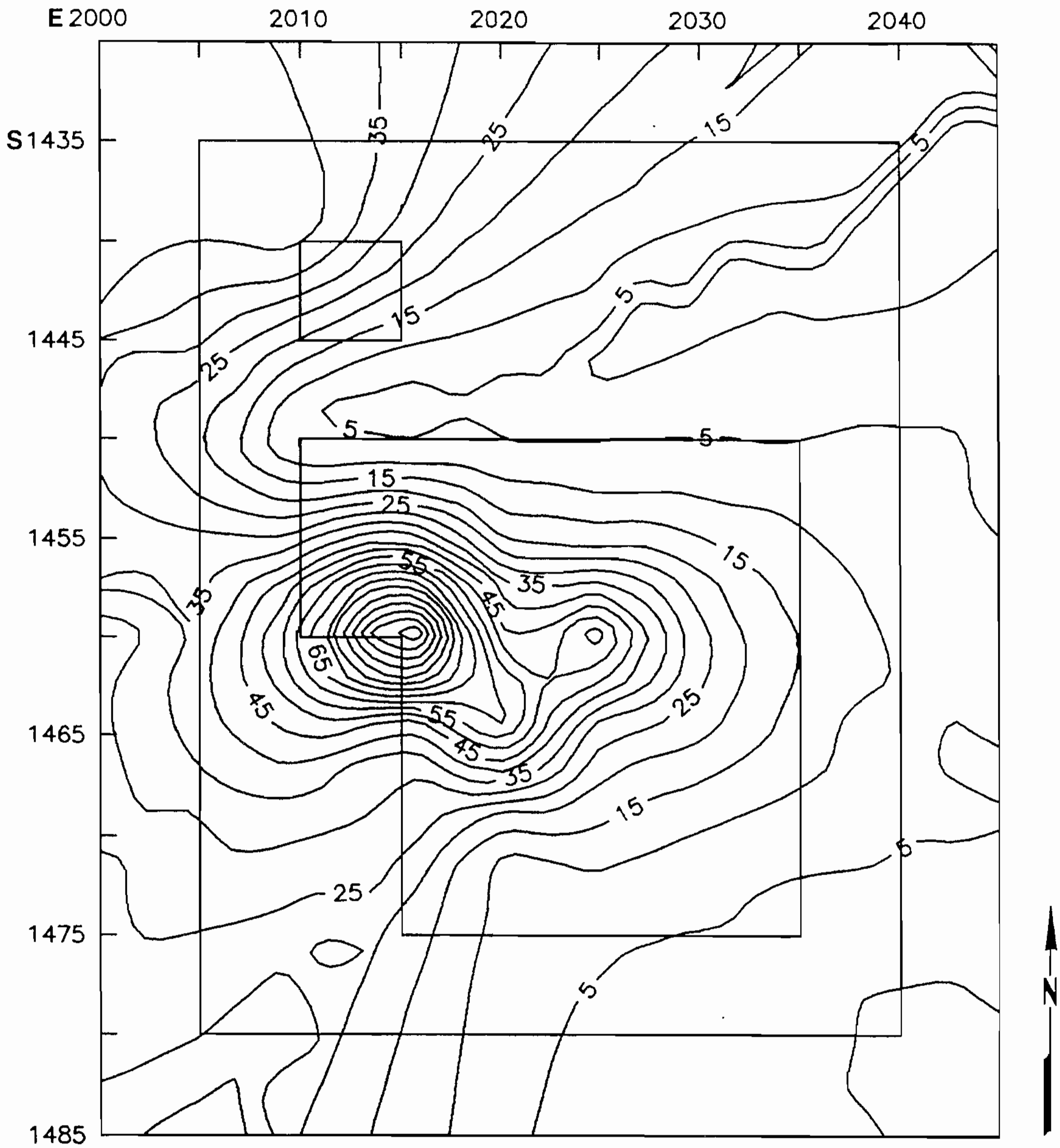

Figure 45. Distribution of lithic debitage in Component Esur.

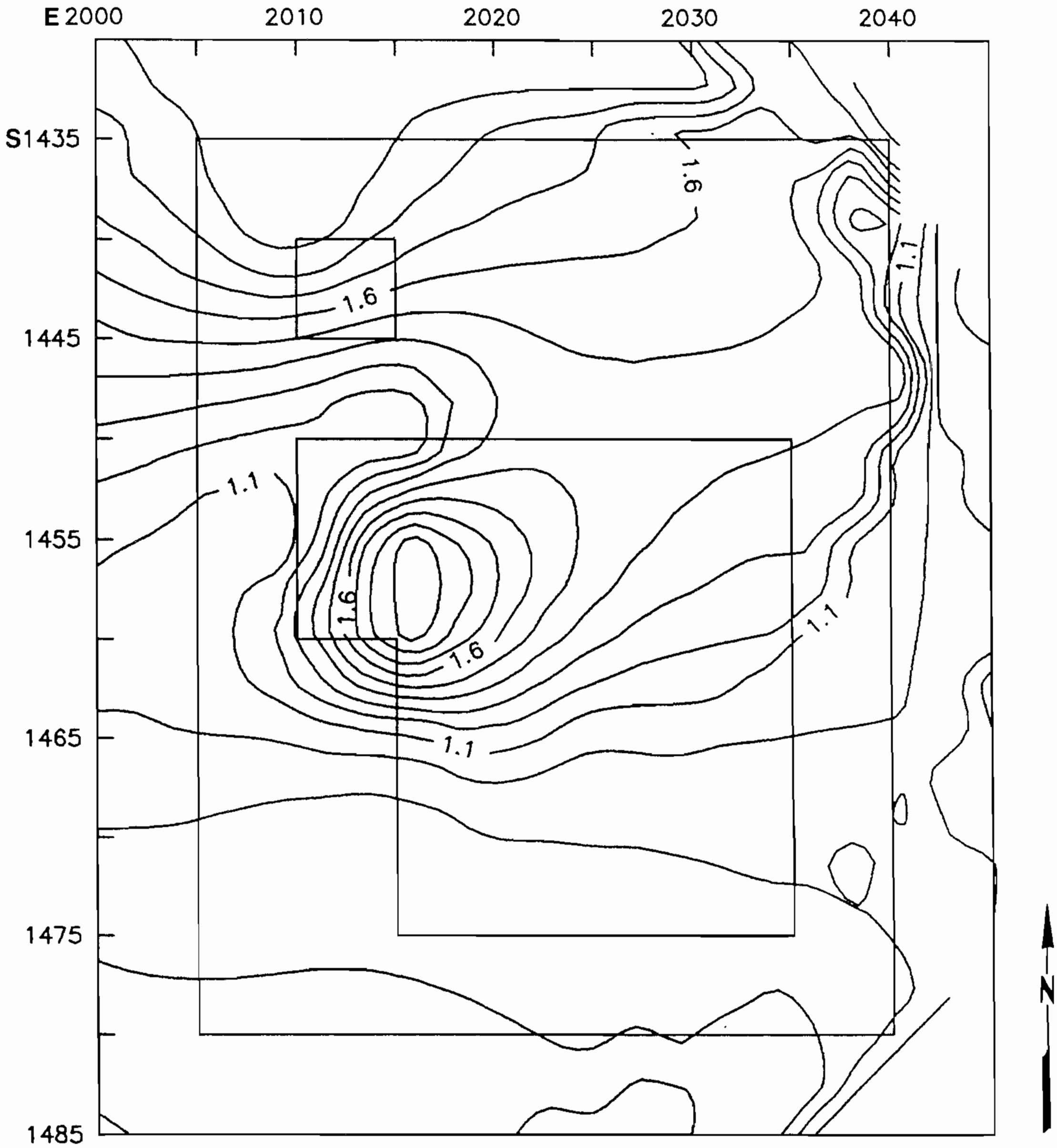

Figure 46. Distribution of all tools in Component Esur.

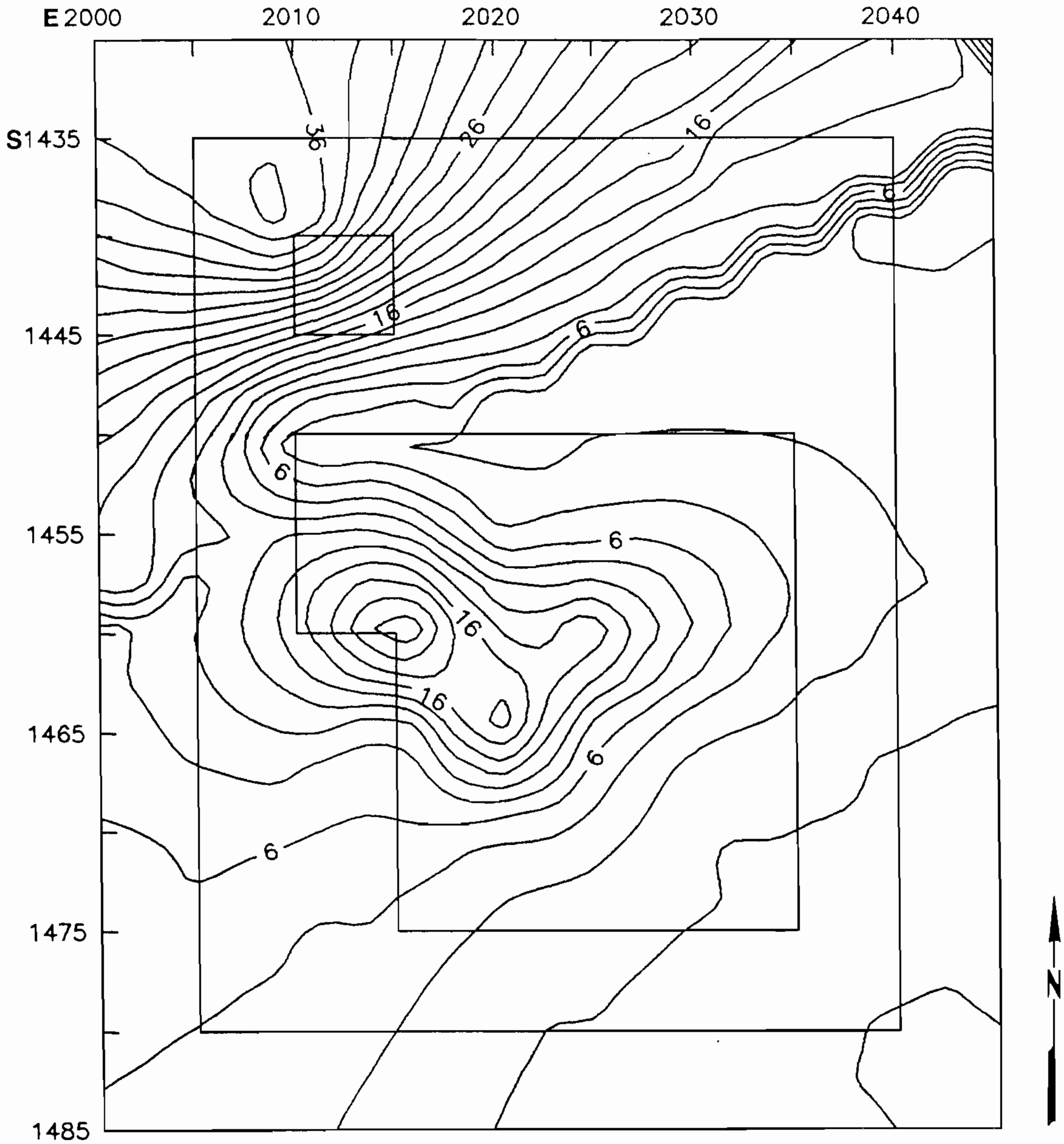

Figure 47. Distribution of CCS lithic debitage in Component Esur.

common in the northwestern corner of the locus while basalt, which is the predominant material throughout this locus, is clustered over the features in the west-central portion of the locus.

The surface collection unit in the northwestern corner of the locus was later trenched and a soil stain (Feature 4) was encountered below it. A second feature (Feature 8) was encountered within several meters of the northwest corner of this surface collection unit. Ground stone was recovered in a non-block excavation in this area also. CCS flakes were recovered twice as frequently on the surface in the area of these two features as they were above the more southern features and the coincidence of CCS distributions with these northern features may well be related.

Bifaces make up 73% of the tiny Esur assemblage. Scrapers comprise 20% and a core (7%) completes the surface sample (Table 9). These numbers are similar to the representations of the same tool classes in the Component 2 sample which will be discussed in more detail below.

Unfortunately, no projectile points were recovered in Locus E, either on the surface or in the buried deposits. Dating the surface component then relies solely on the results of hydration measurements taken on two Coso obsidian flakes. One of these specimens (178-4905) had no observable hydration rind, the other produced a measurement of 11.0

microns. Warren (1990:248) lists seven hydration readings from the surface of this locus but the specimens from his sample were not recovered from within the boundaries of Locus E as they are established here.

Component 2

Component 2 is the assemblage of cultural materials encountered in subsurface contexts, below 10 cm, at Locus E. The following is the description of this component provided by Warren (1990:205):

> The presence of numbers of subsurface materials in Locus E was indicated by discovery of features and groundstone in Trench 4 [Fig. 6.32]. A block excavation comprised of 14 excavation units was undertaken in this area, and the contents of these units below the depth of 10 cm is considered Component 2. They are bounded by grid lines S1455, S1462, E2009, E2017.
>
> Component 2 is a complex area. It included six features: four (Features 10, 14, 21, and 22) were localized concentrations of gray soil; Feature 16 was a cache of metabasalt and chalcedony flakes; and Feature 12 was a hearth associated with a gray stain. Ferraro (personal communication, 1986) suggests that the features occurred in two levels, judging from profiles. In four non-adjacent excavation units, S1455E2011, S1455E2015, S1457E2015, and S1459E2011, vertical flake distributions exhibit two highs per unit, one at -10 or -20 cm, and the second at -40 cm.
>
> Soil stratification or, more accurately, the lack of it, prevented excavation by depositional units within Component 2. The matrix of Component 2 is gravelly, sandy recent alluvial soils of the AS-7 unit. In the quantitative analysis the internal distributions of materials in the component will be examined before deciding whether it should be

> divided into two analytic units. The soils that include Component 2 are considered to be slightly younger than those in which Component 1 was encountered.

Lyneis (1990:202) discusses the cultural stratification, or rather the lack of it, in the alluvial soils of the site:

> The cultural concentrations are manifested only by their counts of flakes and bone. The gravelly granitic soils do not result in the preservation of organic staining that ordinarily accompanies occupation, so there was no way that components could be excavated following cultral depositional stratification. Within the Holocene alluvial soils, deposition was the accumulation of myriad small cuts and fills as the fan surface built, and natural strata could no more be followed than the invisible cultural strata.
>
> Within individual components, non-existent may be a better term than invisible for cultural strata. It is evident that the occupation occurred on the surface of the fan when it was actively building, in the sense of net deposition exceeding net removal, in the locations where cultural material is buried. The surface was unconsolidated, and cultural materials would be stirred into the upper few centimeters by human traffic. At least localized redistribution of smaller pieces of debitage must have happened when the downpours of heavy rain that characterized desert storms struck. In addition, the soils have been much affected by rodent burrows. . . The fact that the distinctive material composition of the flakes from the subsurface deposits of Locus E are reflected in the surface collection from that locality indicate the extent of mixing of the Holocene deposits.

The figures presented in the discussion of Esur above support Lyneis' assessment of Component 2. The surface materials in the area of the block excavation do reflect the distribution of cultural features and artifacts in the subsurface deposits. As previously mentioned, rodent activity is suspected as the primary source of movement for cultural materials from the buried component to the surface.

To investigate the nature of the deposits in Locus E further, in hopes of subdividing the buried materials of Component 2, I graphed the vertical distribution of lithic debitage in 41 excavation units of Locus E. In 21 (51%) of these cases there was evidence of more than one peak in lithic debitage and, consistent with Warren's (1990:205) findings, these peaks were usually at 10 to 20 cm and 30 to 40 cm. Consequently, the Component 2 artifacts were separated into cultural strata E1 and E2, in accordance with these findings, on a unit by unit basis. In other words, if only a single peak existed in a particular unit I divided the artifacts recovered from that unit along the lines of the more general distributional pattern of the component. Thus, stratum E1 comprises the artifacts recovered from the upper peak in cultural materials or the upper 30 cm of deposit, and stratum E2 comprises those recovered from the lower peak or those artifacts recovered below 30 cm to the bottom of the deposits.

Table 11 records the types and number of specimens from the cultural strata of Component 2. The interesting point that this table brings out is that strata E1 and E2 are very similar in content. Though the types of scrapers vary somewhat between strata they are found in equal numbers in each and the numbers are so small that any differences

Table 11. Artifacts recovered from cultural strata E1-E3 in Component 2, Locus E.

Types	Stratum E1	Stratum E2	Stratum E3
FK	-	3	-
IFS	1	2	-
MUF	6	1	-
OSS7.3	-	1	-
1	8	6	-
2	2	1	-
3	-	2	-
5	2	1	-
6	1	1	-
7	1	2	-
8	1	-	-
9	2	1	-
11	1	-	-
18	-	1	-
19	1	-	-
20	-	1	-
25	16	17	1
CORE	-	-	3
GRO.STO.	-	-	4
	42	40	8

between the two may be more apparent than real. The biface samples are also very similar, tips (1) and amorphous fragments (25) being the most common in each assemblage. Cores and ground stone are noticibly missing from both. The activities represented by these assemblages could well be identical and certainly the production of bifaces was a major portion of it in each.

It may also be instructive that the total numbers of artifacts in each stratum are practically the same in this case. The volume of soil removed from each stratum is very similar. One might expect that if a single cultural stratum is represented in this deposit and if that deposit has been evenly divided, then all things being equal, the same number of artifacts should be recovered from each sample. The recovery of equal numbers of very similar artifact types in each of these strata suggests they repesent a single sample. As Lyneis (1990:202) points out:

> Considering the natural processes that have affected the artifact-being processes and the distribution of cultural materials, we are left with little choice but to treat each of the concentrations of buried material as a discrete unit essentially lacking internal structure, either horizontally or vertically. When flake densities for each component are plotted in plan, they approximate a diminishing concentric distribution, each with a central high, and lower frequencies toward the margin. When the flake counts for the units within each component are examined vertically, they exhibit a unimodal distribution, generally approximating a normal distribution, skewed slightly toward the upper levels but peaking at 30 to 40 cm below the surface. That the components were spatially limited seems clear. That they are vertically mixed seems evident.

Another way to investigate the question of vertical mixing is to map the density of cultural materials within the cultural strata (E1 and E2) and examine them to see if they overlap in such a precise manner as to suggest that they actually stem from the same sample, having simply been moved up or down through the deposits. Figures 48 and 49 illustrate the distribution of basalt flakes in E1 and E2, respectively. Two clusters of flakes are evident in Fig. 48. Figure 49 exhibits a single cluster near the southern border of the excavation block but also shows a fairly large number

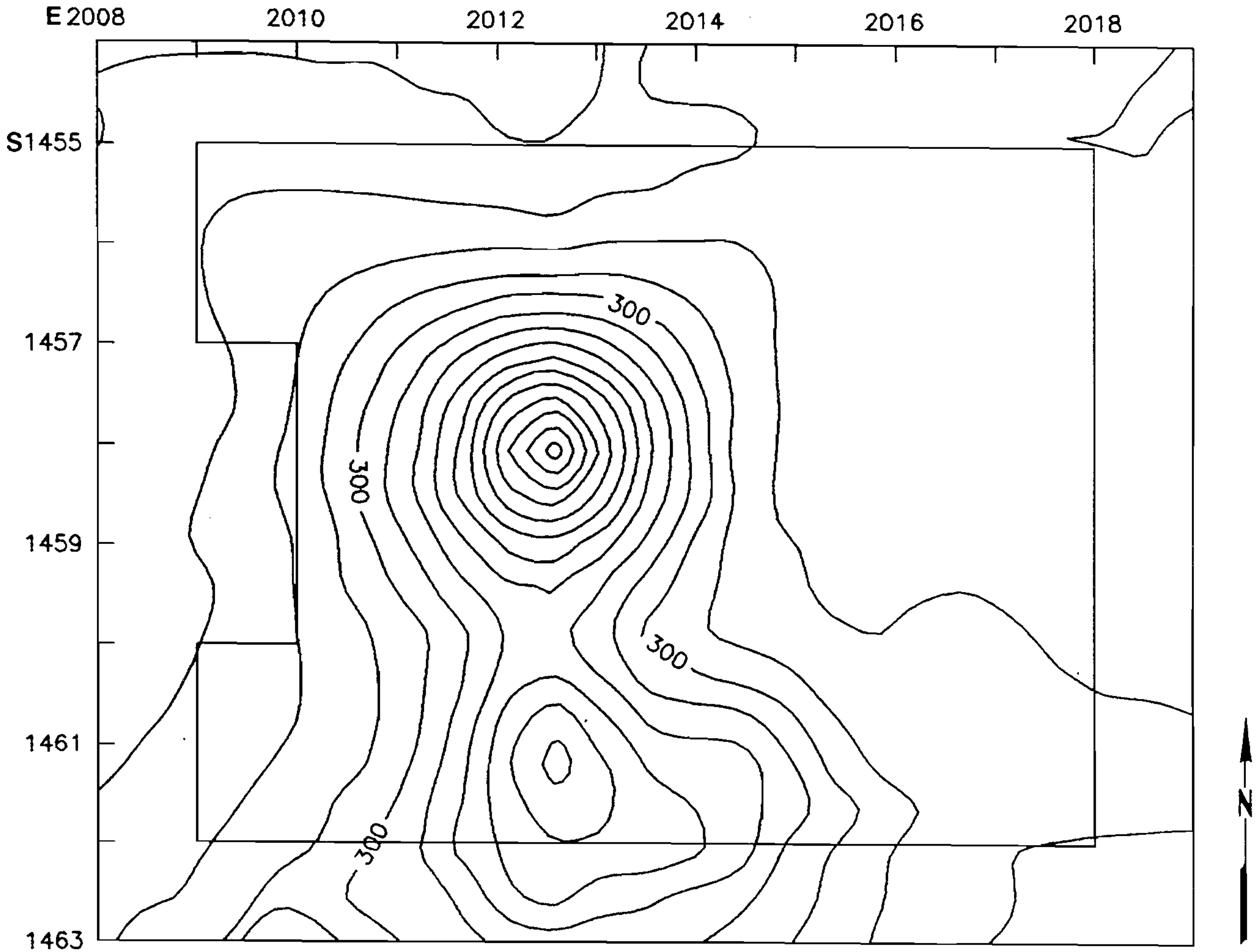

Figure 48. Distribution of basalt lithic debitage in Subcomponent E1 of Component 2.

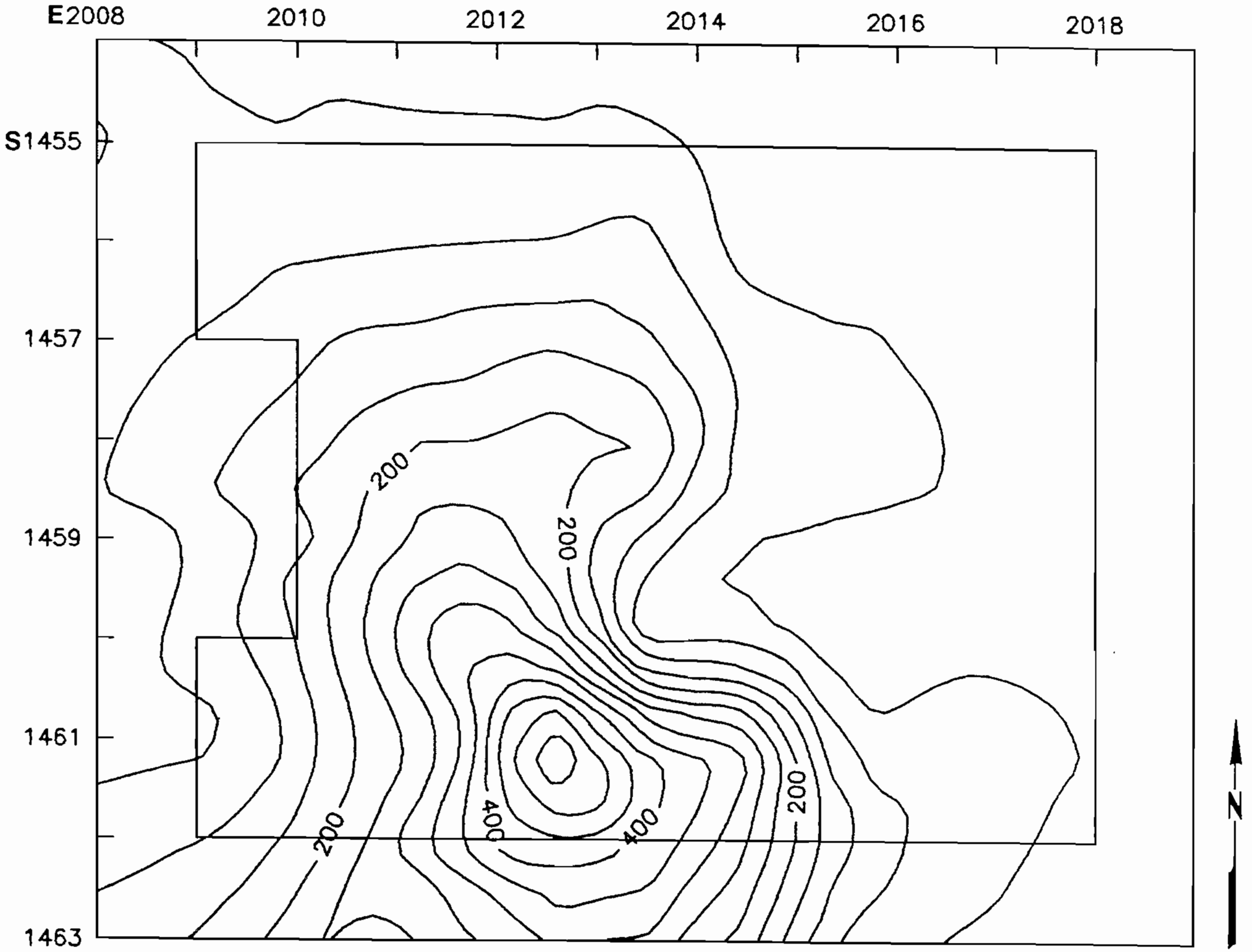

Figure 49. Distribution of basalt lithic debitage in Subcomponent E2 of Component 2.

of flakes in the area of the more northern cluster. The presence of Feature 16, the cache pit filled with metabasalt and CCS flakes explains the presence of the dense cluster of debitage in E1 (Fig. 48). Features 12 and 21, both apparent hearths, were located in the area of the southern cluster of flakes in E2. Considering the fact that Feature 21 was first encountered at a depth of 32 cm it is not surprising that cultural materials associated with it were found throughout both components E1 and E2.

The distributions of tools (Appendix A: 41-42) suggest that a single depositional component, comprised of at least two activity areas, has been disturbed and tools from the concentration of artifacts which generally is located 30 to 40 cm below the surface have been redistributed throughout the deposit, primarily upward. Consequently, only the Component 2 assemblage, combining the E1 and E2 assemblages, will be discussed throughout the rest of the analysis.

The distribution of faunal remains in strata E1 and E2 are displayed in figures 50-51. The influence of Feature 21 on the distribution of bone in both strata is clear from these figures. Feature 10, another gray soil stain found at approximately the same depth as Feature 21, does not appear as a cluster of bone in E1 but does appear in E2. The interpretation of the small cluster of bone near the center of the block excavation is less clear, however. There was no feature found in this excavation unit and the small sample

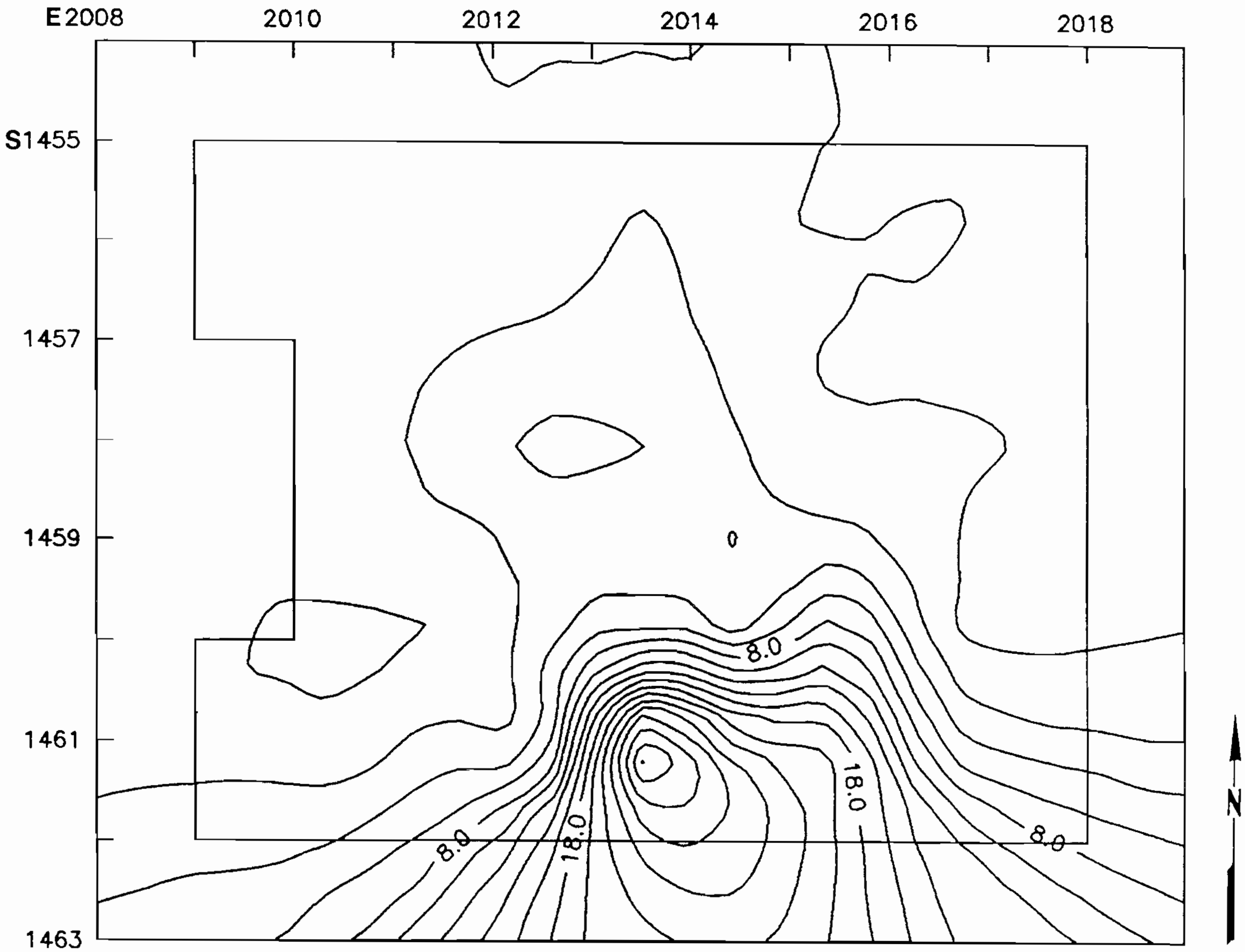

Figure 50. Distribution of bone in Subcomponent E1 of Component 2.

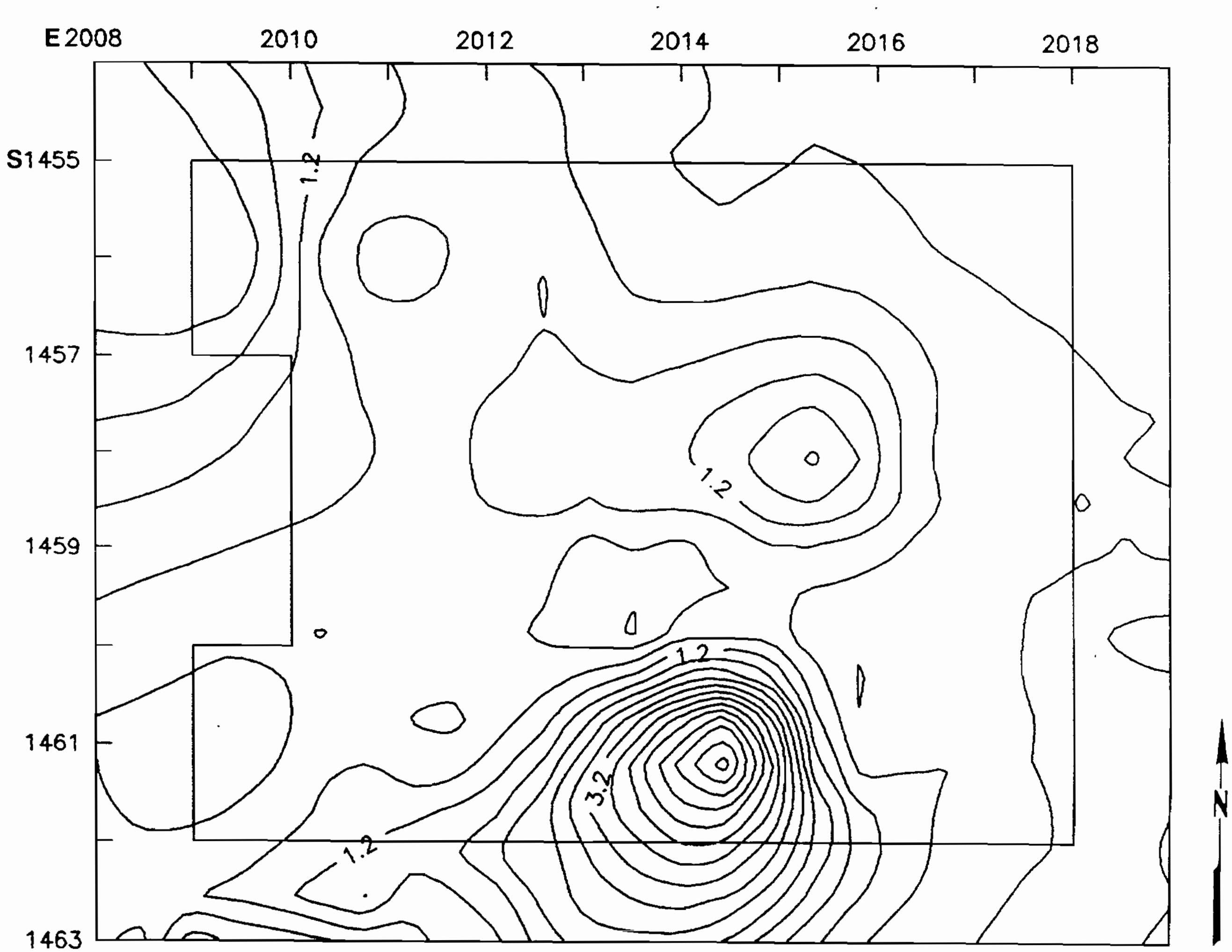

Figure 51. Distribution of bone in Subcomponent E2 of Component 2.

of bone recovered from it could be an isolated scrap which originated with one of the known features or it could represent a small natural deposit.

Figure 47 above suggested there was a difference in the amount of CCS recovered from the surface of the more northerly portion of Locus E compared to the sample recovered from the surface above the features in the block excavation. The distribution of flakes in the excavation units located north of the main block excavation (at the top of Locus E in Fig. 42) indicated a single shallow cultural deposit exists in the upper 10 cm of alluvium. The relationship of this isolated material to that of the block excavation is unknown. Consequently, artifacts recovered from isolated test units in this area, with lithic debitage distributions peaking in the upper 20 cm of deposit, were combined to form component E3 in Table 11. This component is comprised of a high percentage of CCS debitage, three cores, four ground stone artifacts, and a single amorphous biface fragment.

The patterns of both artifact distributions and types in cultural stratum E3 suggests a very limited occupation involving a different set of activities than those pursued in Component 2 in the area of the block excavation. The shallowness of the E3 deposit indicates this occupation probably occurred sometime after the Component 2 occupation represented by the more deeply buried features and cultural materials in the area of the block excavations. Clearly, some of these later E3 cultural materials may also be present in the area of Component 2. If so, then they represent a very small intrusive sample which is inseparably mixed in the upper 10 to 20 cm of deposit with the displaced artifacts of the much larger Component 2 deposits. The lack of cores and ground stone, the most strongly represented artifact types of E3, from the area of Component 2 suggests that no serious admixture of E3 artifacts with Component 2 artifacts has occurred, however.

Two accelerator mass spectrometry radiocarbon dates were obtained from cultural features exposed in Component 2. Feature 10 was a bowl-shaped area of gray-stained soil. First encountered at 33 cm below the surface, it had a roughly oval outline and extended to a depth of 78 cm. A 3.9 liter soil sample taken from the 60 to 70 cm level of the interior of this feature produced a carbon sample of 0.5 gm. This sample generated a radiocarbon date of 5,200+/-290 BC (AA-649). The second sample was taken from Feature 21, located 4 m south of Feature 10. Feature 21 was also a gray stained soil concentration. It was first encountered at a depth of 32 cm below the surface. Roughly oval in outline, Feature 10 was 85 cm long by 35 cm wide and 23 cm deep. It contained two fire-affected rocks but very little charcoal. Flotation of all the soil recovered from its interior (10 liters) resulted in the recovery of less than .01 gm of carbon. This sample was dated to 5,450+/-280 BC (AA-800). Thus, the two radiocarbon dates from this component were very similar suggesting the primary occupation of Component 2 occurred sometime around 5,300 B.C.

The lack of projectile points in Component 2 is disappointing as is the relatively small sample of obsidian recovered there. Only 3 pieces of Coso obsidian, an insufficient sample to produce a reliable mean, were large enough to be processed from this component. These 3 samples produced 4 hydration rind measurements with a mean of 10.4 microns (Table 10).

Locus F

Locus F is the eastern most locus at the Henwood site (Fig. 52). It is a small, discrete concentration of cultural materials roughly 45 m long (north-south) by 25 m wide (east-west). It is located relatively near the western base of Hill 910 in an area of Holocene alluvium deposits. A major tank trail passes approximately 15 m east of the eastern locus boundary, curving slightly southwestward around it. Though vehicular impacts to the soft alluvium surface must have occurred prior to our research, there was little evidence of substantial impacts and no evidence of artifact collection by military personnel.

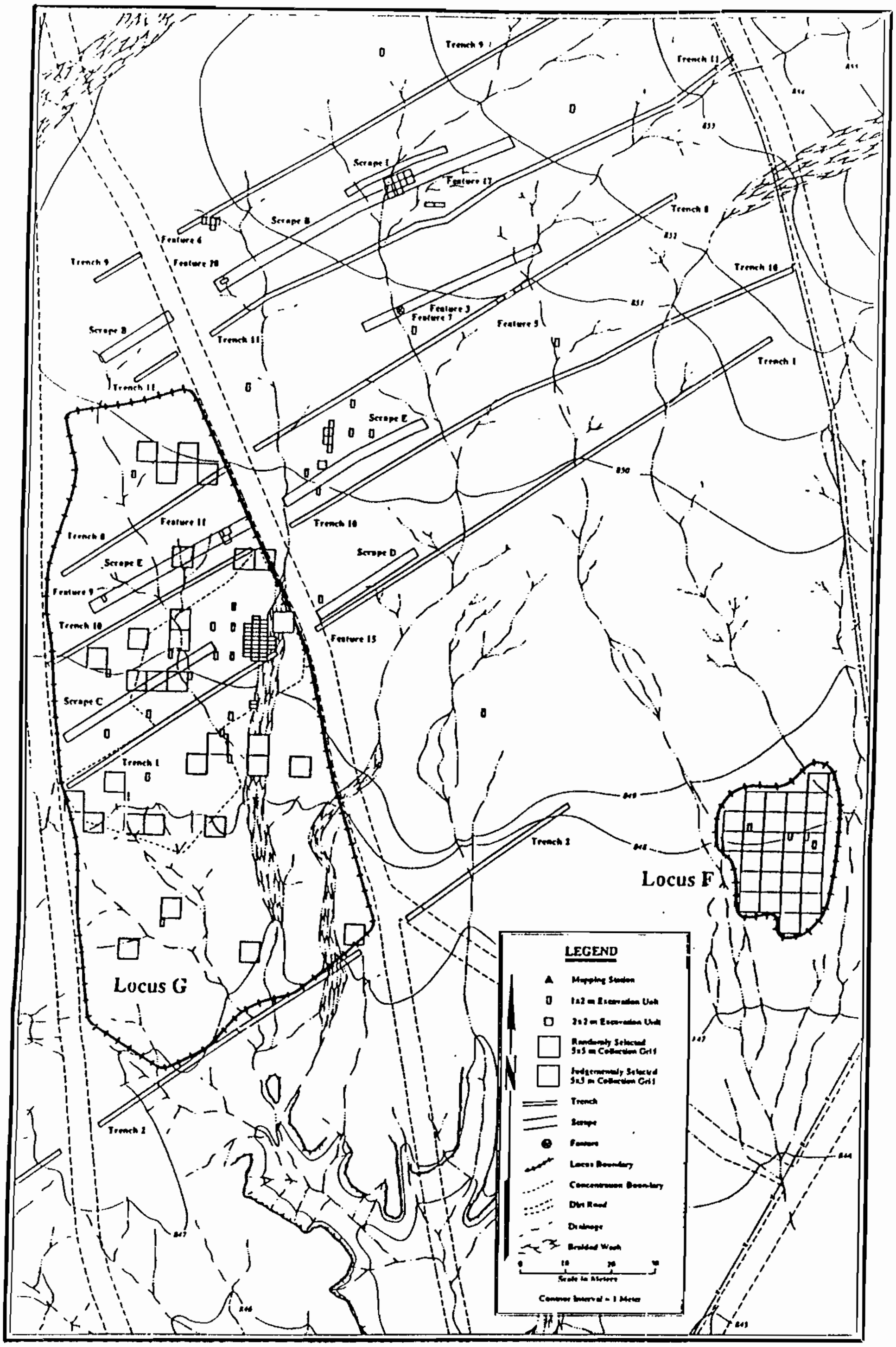

Figure 52. Map of loci F and G.(After Warren 1990:Fig. 3-14).

The surface of the locus is relatively level, sloping only slightly toward the south. Two small rivulets, flowing from north to south, form the east and west boundaries of the locus. Though these drainages probably have caused only minor erosive damage to the locus its elongated shape, in the direction they flow, is suggestive of some movement of artifacts.

The distribution of lithic debitage, predominantly basalt, in Figure 53 suggests Locus F was a very discrete component. The tiny sample of CCS flakes was recovered from the same area as the basalt but was apparently artificially subdivided by adjoining surface collection units (Appendix A: 43). The distribution of all tool types may reflect artificial subdivision as well (Fig. 54) though the possibility that more than one activity area is present cannot be discounted. Bifaces are clearly the predominant artifact type of the locus and exhibit the same distribution as when all tool types are mapped (Appendix A: 44). Scrapers were few in number and apparently most were collected from a single 5x5 m surface collection unit (Fig. 55). This distribution suggests these artifacts result from a very limited period and/or intensity of occupation.

In short, the cultural materials of Locus F were discretely clustered and there is no evidence for a complex depositional situation. A single Pinto point was recovered from the surface near the center of the artifact cluster

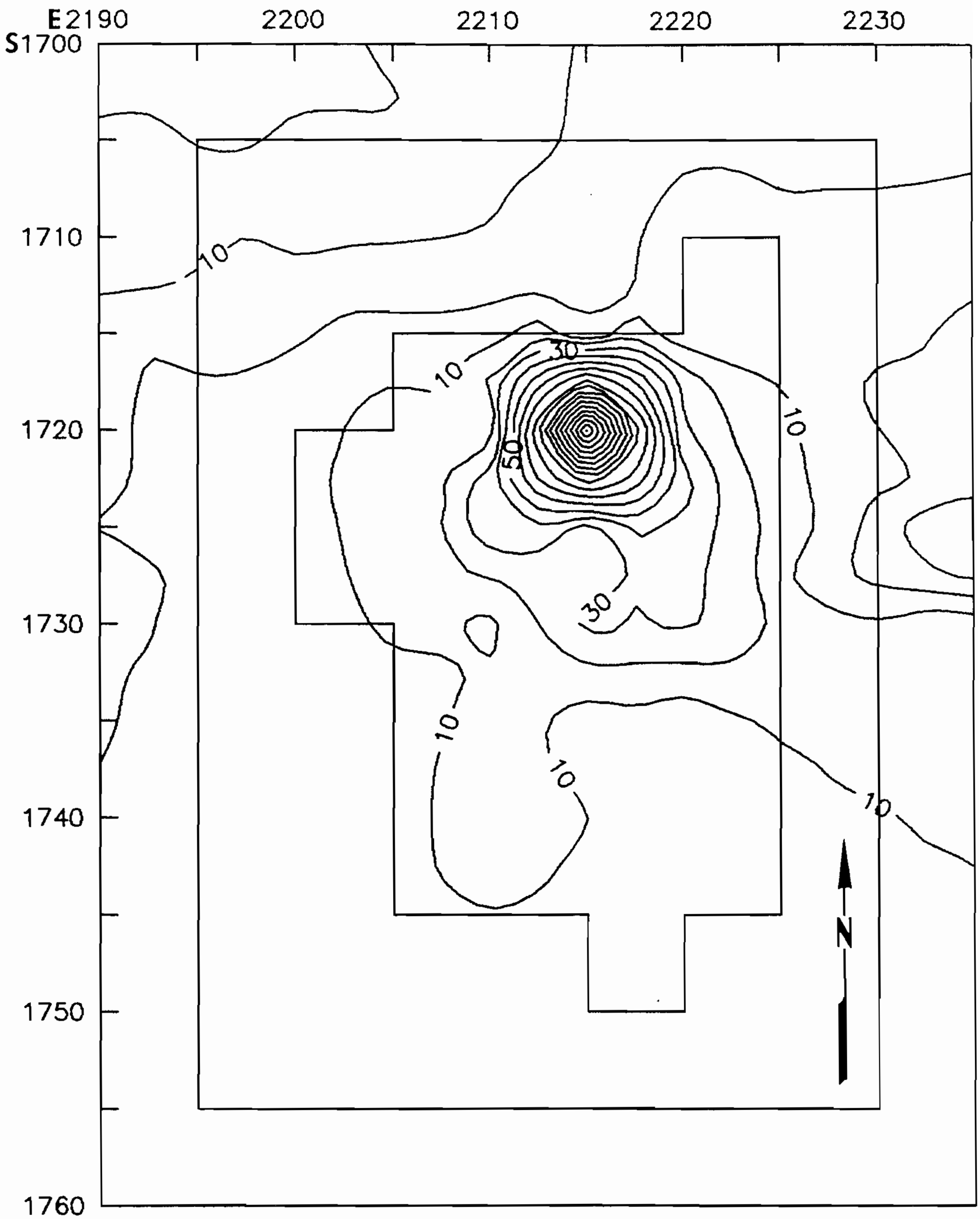

Figure 53. Distribution of lithic debitage in Locus F.

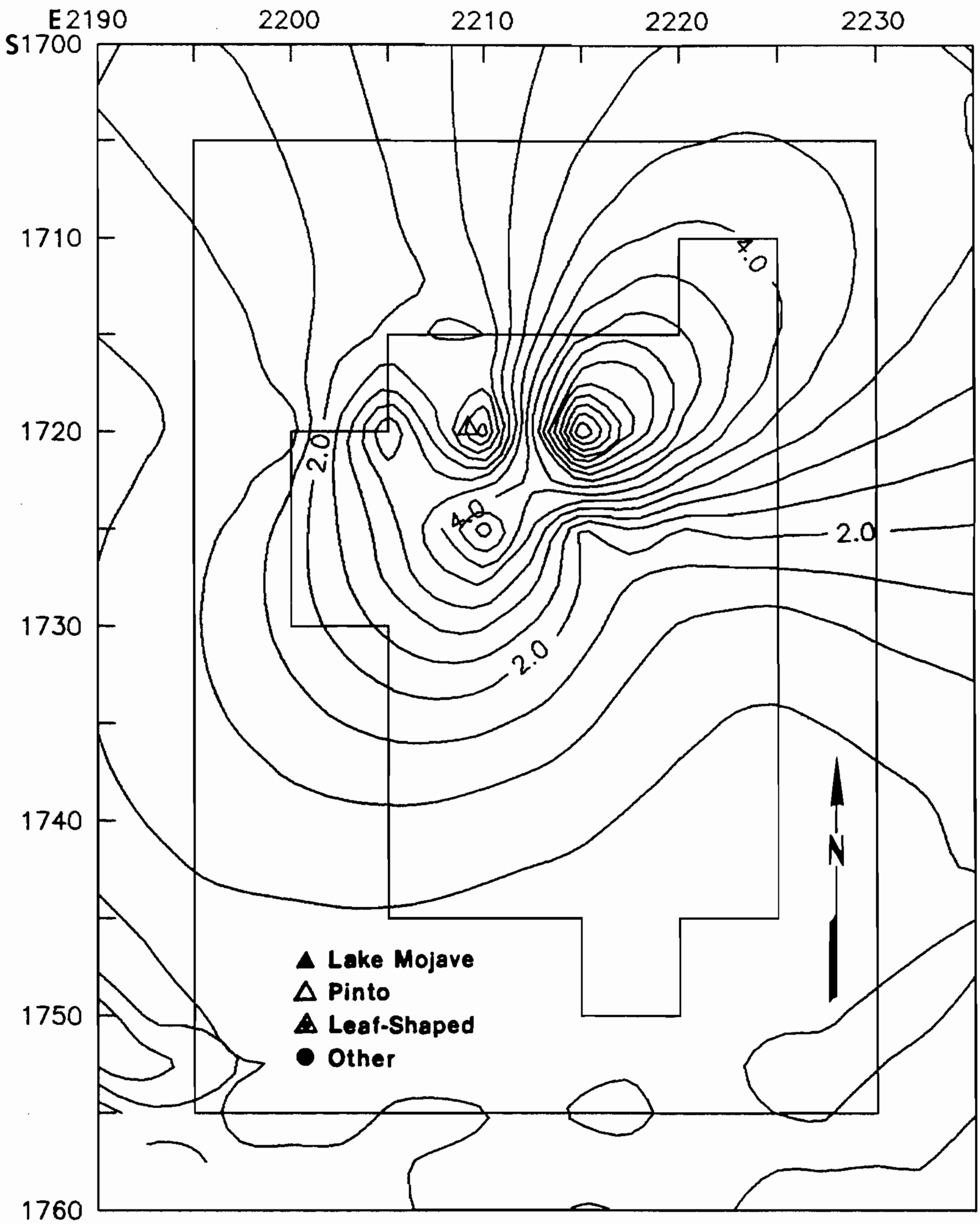

Figure 54. Distribution of all tools in Locus F.

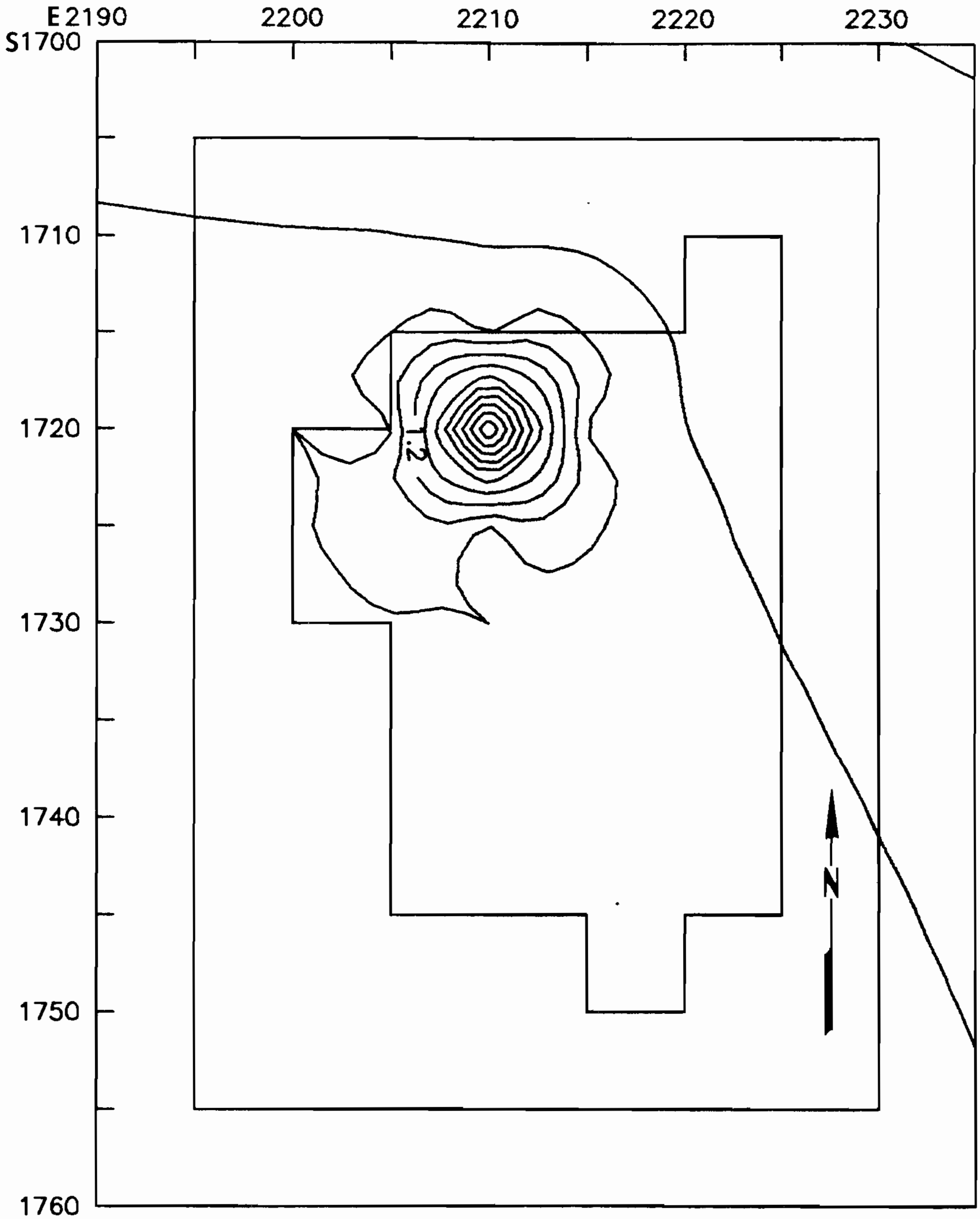

Figure 55. Distribution of scrapers in Locus F.

(Fig. 54). Though four relatively shallow excavation units produced some cultural materials to a depth of 70 cm they did not uncover substantial numbers of artifacts or other evidence which would indicate that further excavations would prove fruitful. No features were encountered and no radiocarbon samples were recovered from these excavations. Unfortunately, obsidian was also absent from the sample of cultural materials recovered from this locus and it must remain dated to the Pinto period on the basis of the presence of the single Pinto point.

Locus G

Locus G comprises a very light lithic scatter located in the central portion of the site. It was discovered during the data recovery in backhoe Trench 1 which uncovered a metate and several basalt flakes in an area of very light lithic scatter. A crew pin-flagged the locations of flakes and artifacts around the trench and eventually identified a large (150x60 m), elongated locus with a north-south long axis.

The central area of the locus, near Trench 1, contained a denser lithic scatter than the surrounding concentration of artifacts. Cultural materials continued to be lightly scattered beyond the eastern and western boundaries of the locus, which were arbitrarily set between two north-south tank trails (Fig. 52) because there were no discrete locus boundaries marked by the presence-absence of cultural materials. Flakes and isolated artifacts were found to be lightly distributed east, west, and north of Locus G. To the south, below Trench 2, the alluvium has been eroded away and a white caliche cap is exosed, providing a somewhat less arbitrary boundary to the locus in that direction.

Locus G was the site of the most intensive excavations conducted at the Henwood site during the data recovery. Warren (1990:204) defines Component 1 as the cultural materials and features encountered below 10 cm depth in the 31 contiguous units of the main block excavation. I have divided the Locus G materials into 3 groups. Component 1 is comprised of the excavated materials as defined by Warren above. G1sur is comprised of the cultural materials recovered from the surface of the central artifact concentration above and surrounding Component 1 and is bounded by site grid lines E2035-E2105 and S1655-S1735. G2sur is the sample of cultural materials recovered from Locus G outside the boundaries of G1sur. Only the distribution of G1sur and Component 1 artifacts will be discussed though tables including Locus G artifacts will also include the G2sur sample.

G1SUR

G1sur covers the center of Locus G where the majority of 5x5 m surface collection units were randomly distributed.

The surface of Locus G had undoubtedly been impacted by military vehicles but no signs of unusually heavy traffic were noted prior to our data recovery efforts. Probably much more significant to the question of displacement of cultural materials in this locus is the pattern of erosion in the south and the many small drainages which cross it on their way to Nelson Wash in the south. As stated by Lyneis (1990:202), above, the entire alluvial surface of the Henwood site has accumulated through the cutting and filling of small rivulets and drainages. This process has undoubtedly moved at least some of the smaller cultural remains from their original locations. This may account for at least a portion of the thinly scattered cultural remains so prevalent throughout Locus G and the surrounding alluvial surface. The presence and character of deposits in Component 1, however, suggests that any such damage to buried deposits was localized and probably limited to the lateral movement of the smaller and lighter materials.

The randomly distributed surface collection units were widely scattered and recovered relatively little cultural material. Still, a few comments can be made about the distribution of lithic debitage and tools in Glsur. Lithic debitage was most densely distributed in the area of Component 1 (outlined with heavy black lines) and throughout the northeast quadrant of the locus (Fig. 56). Three other possible concentrations of surface materials are suggested

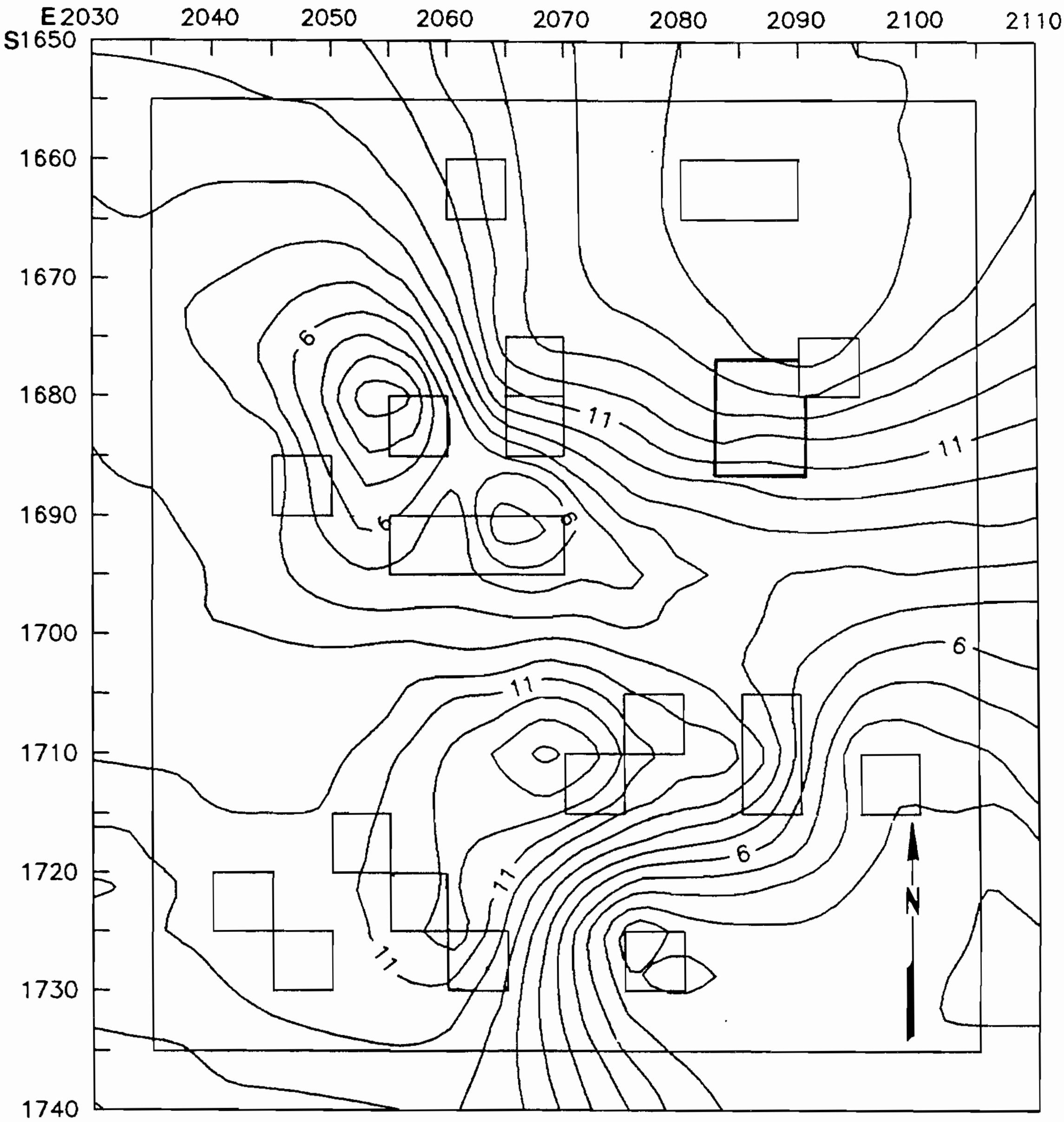

Figure 56. Distribution of lithic debitage in Component Glsur. Dark box marks location of Component 1.

by this figure, one located just west of Component 1 and two located south and west of it. Artifacts were distributed in tiny clusters, comprised primarily of bifaces, in each of these locations as well (Fig. 57; Appendix A: 45).

Two Pinto points were recovered from the surface of G1sur but neither was recovered particularly close to any of the other clusters of artifacts (Fig. 57). A 1x2 m test excavation pit, located at E2078 S1704, recovered another Pinto point and a Lake Mojave series point fragment from the 0 to 10 cm level. These points are included in Figure 57 with the surface materials since they were found near the surface in a depositional situation Warren (1990:204) specifically excludes from Component 1. Very little cultural material was recovered from this test unit and though it was excavated to 30 cm only 3 or 4 basalt flakes were recovered per 10 cm level. The other points recovered in G1sur were a Leaf-shaped point and a Lanceolate point, both recovered from the southwestern cluster of artifacts. The artifacts recovered from G1sur are presented in Table 9 with those of G2sur and Component 1.

Only four specimens of Coso obsidian were recovered from G1sur. Specimen 178-839 was recovered from the southwestern artifact cluster. Specimen 178-2968 was recovered from a shallow excavation between the two southern clusters and specimens 178-3246 and 178-3247 were recovered from the 0 to 10 cm and 10 to 20 cm levels, respectively, of

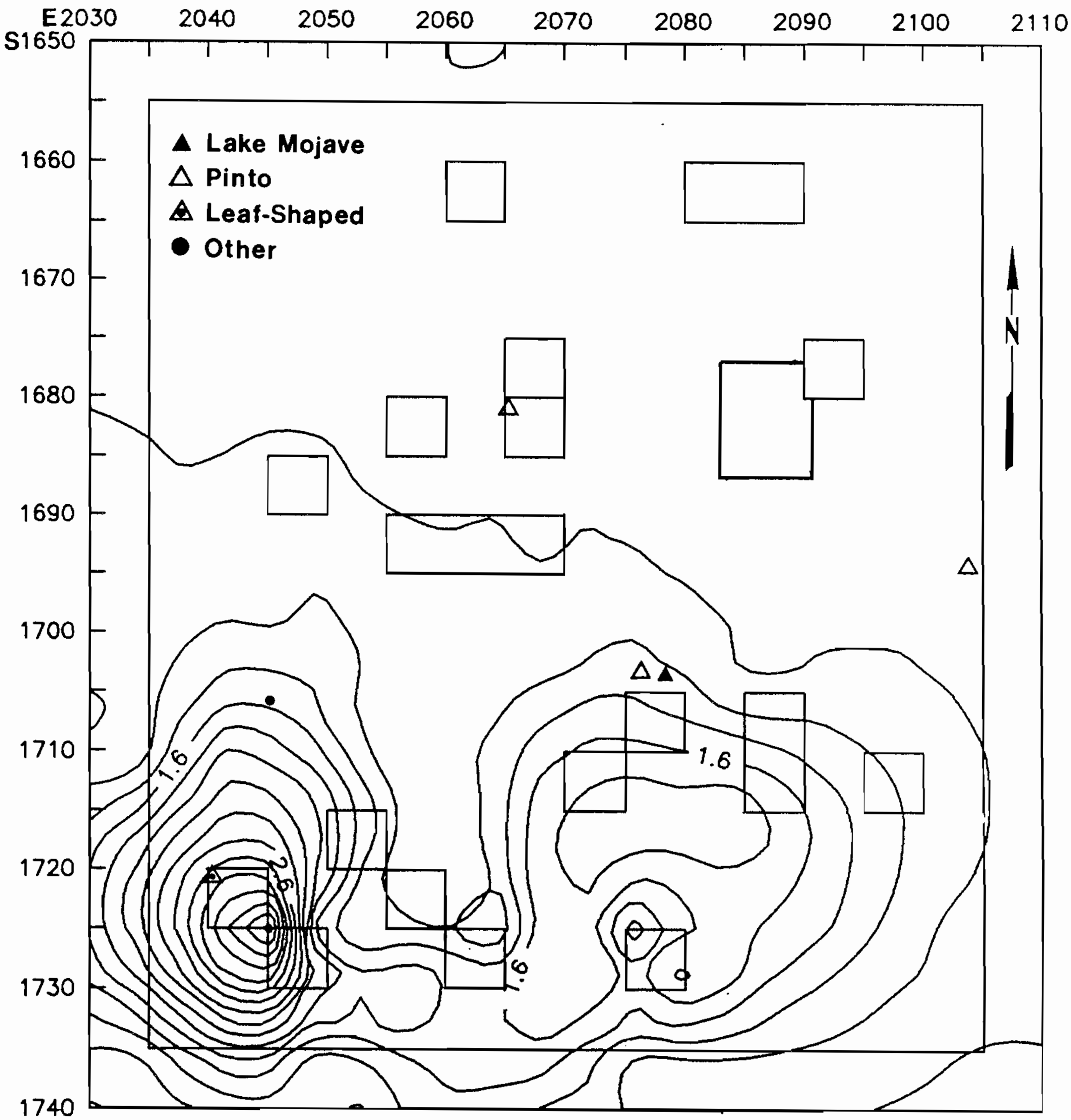

Figure 57. Distribution of all tools in Component Glsur. Dark box marks location of Component 1.

a test excavation located 12 m northeast of Component 1. These four specimens produced five hydration rind measurements with a mean thickness of 13.5 microns. Individual readings for these specimens, as well as those of G2sur, are presented in Table 10.

Component 1

Component 1 comprises the 31 contiguous excavation units of the main block in Locus G. The natural deposits of Component 1 (AS-1b and AS-2) are comprised of gravelly loamy, sandy soil which in Locus G, as is the case with all alluvial deposits at the site, is the result of sheetwash and small rivulet cut and fill sequences. Nearby trench exposures exhibit occasional gravel concentrations representing the remains of these cut and fill sequences. No large channels were noted in these trench exposures. The upper 30 cm of deposit (AS-1b) is usually harder and more finely grained than the underlying AS-2 deposit which has a higher gravel content. This is apparently due to the presence of increased quantities of calcium carbonates in the upper layers of the deposit.

Cultural materials were recovered from a maximum depth of 110 cm below the surface in Component 1, however, the vast majority (88%) of the tools were recovered above 40 cm. Roughly 40% of the sample was recovered from 0 to 20 cm, 48% from 20 to 40 cm, 10% from 40 to 60 cm, and the remaining 2%

from 60 to 70 cm. Though Warren (1990:204) excludes artifacts recovered from the 0 to 10 cm level in his definition of Component 1, I have chosen to include them here in an attempt to define more precisely their relationship to the artifacts recovered deeper in the deposit.

The analysis of Component 1 began with the mapping of lithic debitage densities. Basalt, which comprises 92% of the lithic debitage, is distributed in an elongated oval pattern paralleling the direction of wash flow across the surface of the alluvium (Fig. 58). This suggests that either this was the original shape of the locus or some movement of cultural materials along small rivulets had occurred in the area of the block excavation. The distribution of excavation units or their depths have clearly affected the patterns in Figure 58. The individual concentrations indicated in this figure are not considered significant since they correspond precisely with the northwest (unit datum) corners of the excavation units.

The distribution of CCS does not appear to have been as strongly affected by the data units as basalt was (Fig. 59) probably because it comprises a much smaller portion of the assemblage and has a stronger tendency to cluster. Figure 59 indicates a relatively large cluster of CCS in the southern portion of the block excavation with two smaller clusters, one near the middle and the other in the north end of the

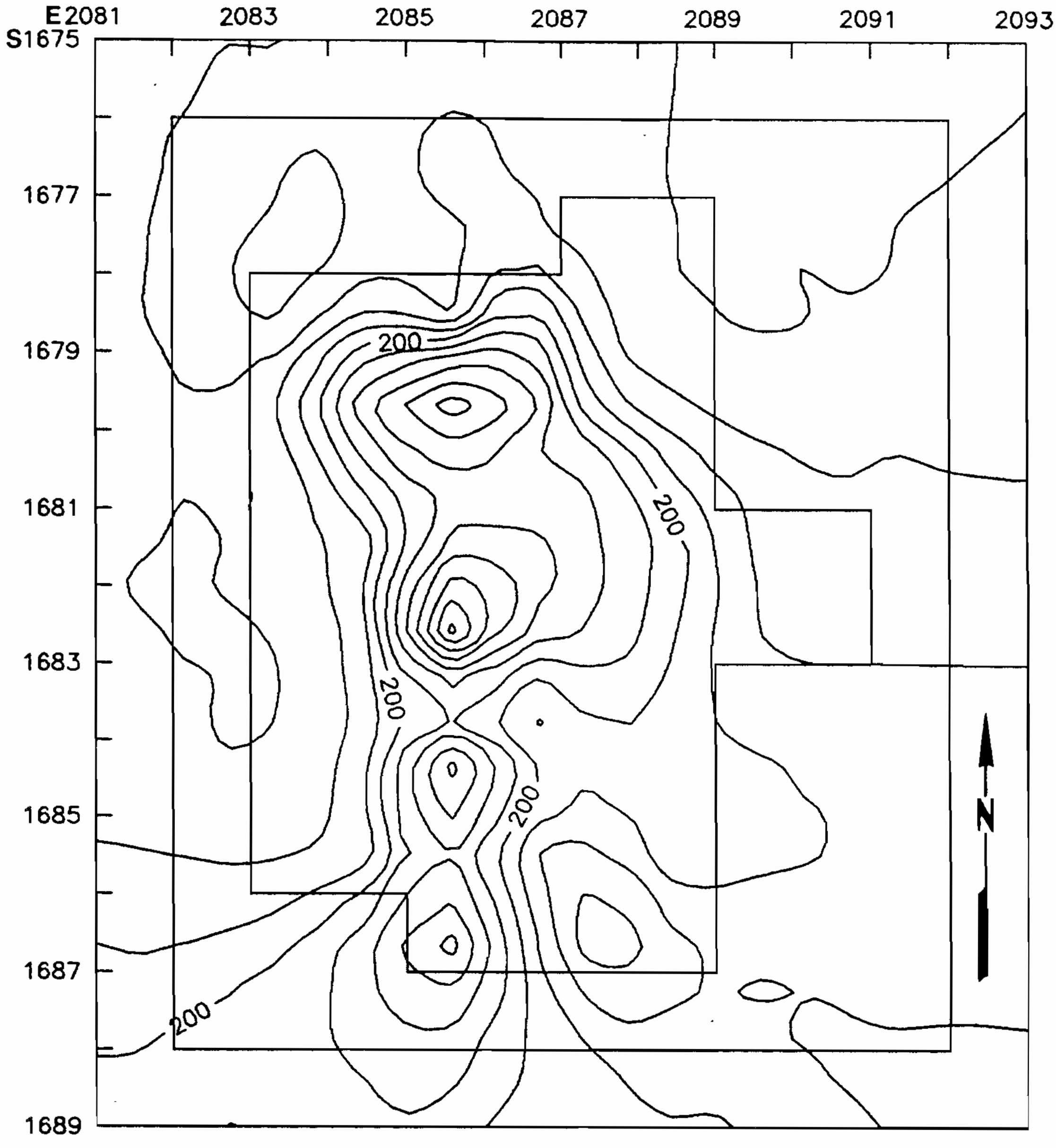

Figure 58. Distribution of basalt lithic debitage in Component 1.

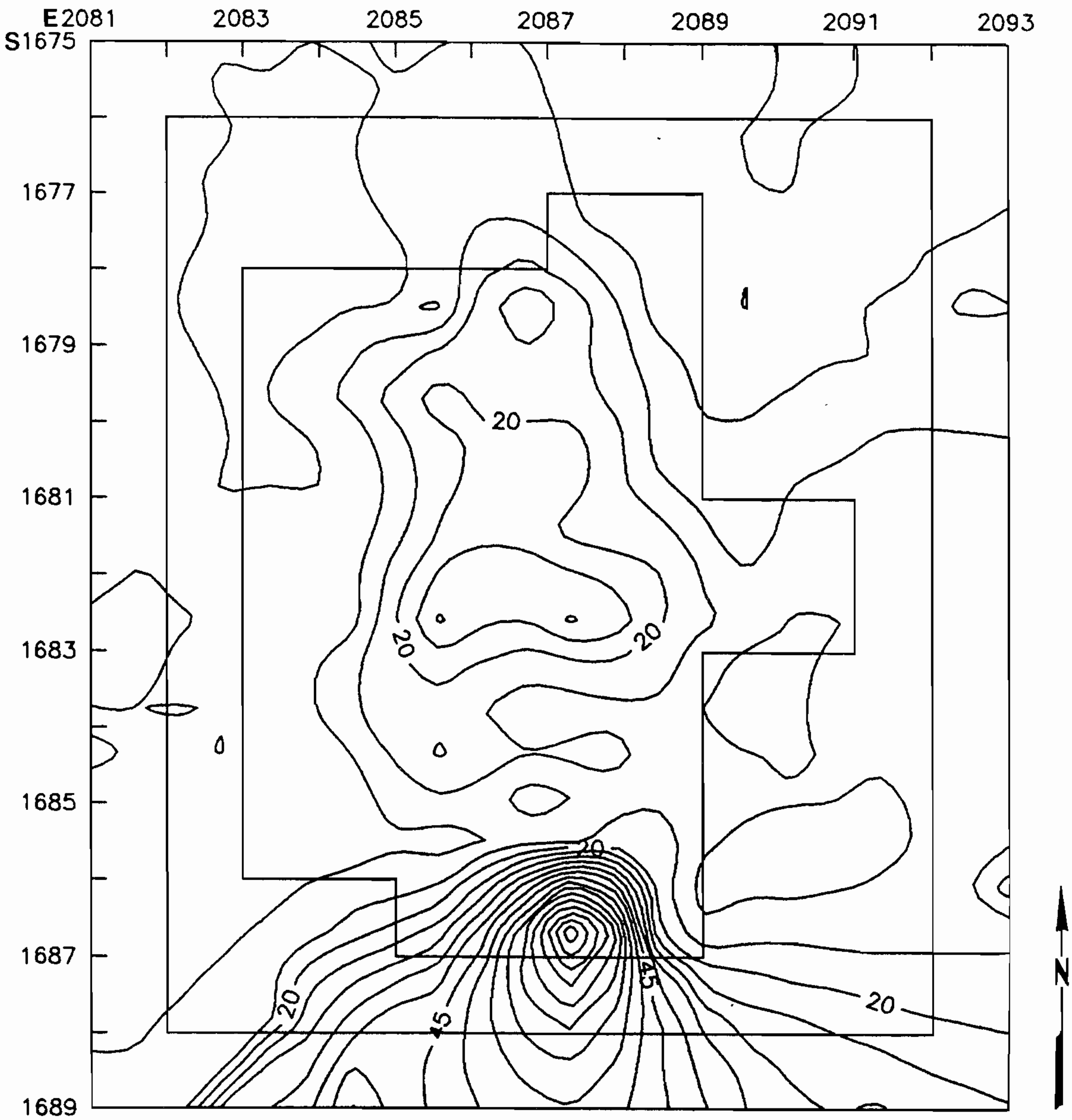

Figure 59. Distribution of CCS lithic debitage in Component 1.

block, occurring north of it. Obsidian distributions (Fig. 60) exhibit strong north-south patterns also, suggesting there were at least two activity areas if not two separate occupations of the locus. Bone was densely distributed in the southern most excavation units (Appendix A: 46) but these are believed to represent burrow deaths (Douglas et al. 1988:137) and when they are eliminated from consideration two small clusters of archaeological bone remain near the center of the component.

Considering the strong tendency of CCS and obsidian to cluster in a north-south pattern, I divided the units of the block excavation, for analytical purposes, into North and South subcomponents at the S1681 grid line. I began the analysis by graphing the distribution of lithic debitage in 54 of the 1x1 m excavation units. Only 19 (35%) of these units had lithic debitage distributions peaking in more than one excavation level, suggesting they may have cut through more than one concentration of cultural materials. The majority of these (68%) were located in the South end of the block excavation. This was the area which characteristically contained the deepest excavation units.

The possibility that depth of excavation may have something to do with multipeak distributions among these graphs cannot be ruled out. In particular, it may well be that small to tiny flakes have worked their way down through the deposits (i.e. size sorting) until the accumulated at

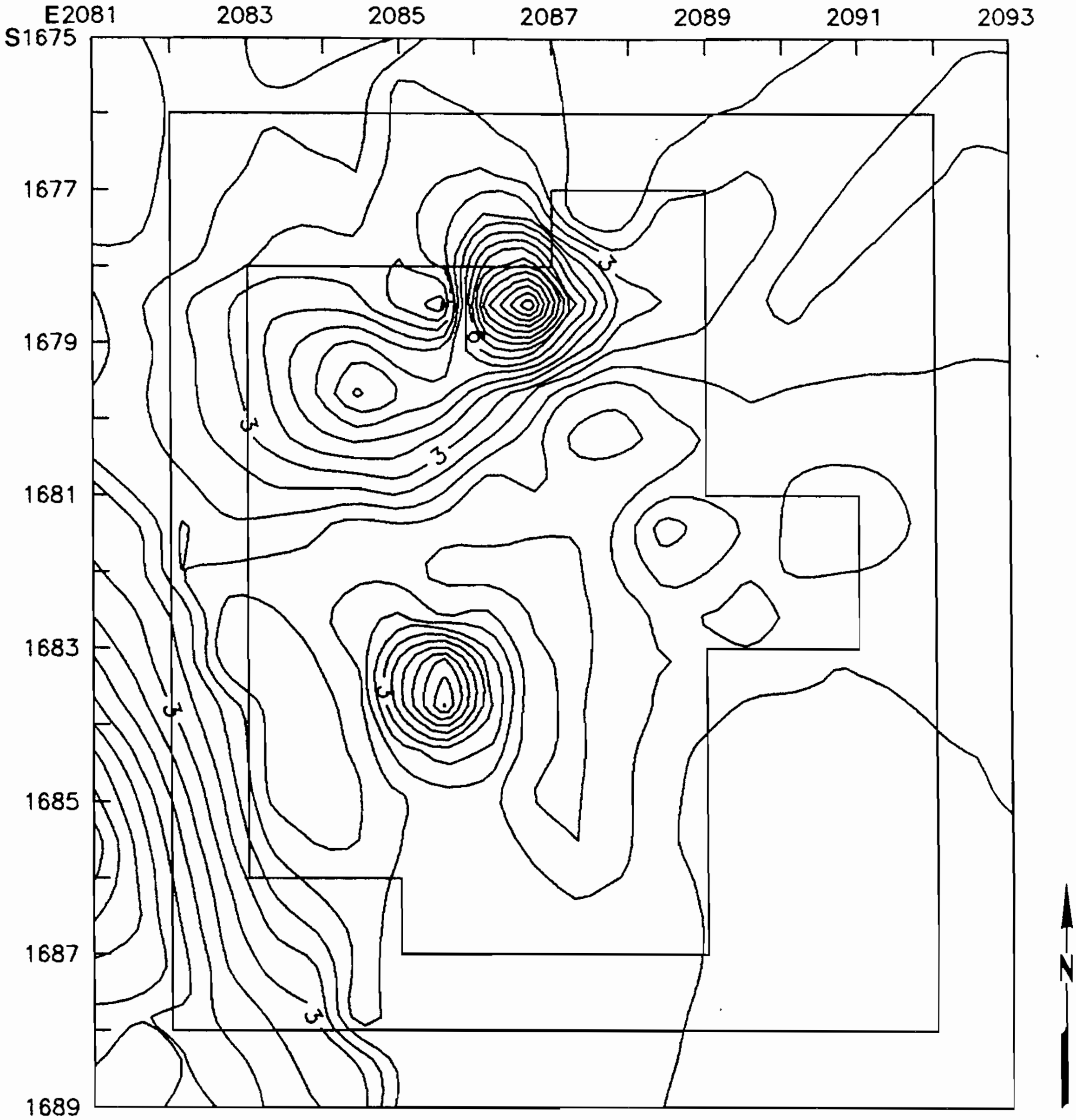

Figure 60. Distribution of obsidian lithic debitage in Component 1.

the top of a more compact soil horizon. Another scenario which may explain this lower accumulation of cultural materials is that rodents may have excavated downward until they encountered a more resistant soil and then stopped or turned to horizontal tunneling (evidence of burrowing was present in the very old deposits underlying AS-2). Artifacts may have filtered downward through collapsing tunnels to accumulate at the top of the underlying soil in this case. The deeper excavation units would be more likely to encounter accumulations of lithic debitage at the contact zone between the upper, softer deposits and the deeper, harder deposits thus exhibiting dual peaks in cultural materials.

Most major peaks in debitage occurred in the 20 to 30 and the 30 to 40 cm levels. Peaks in debitage at 0 to 10 cm occurred most frequently in the northern units and only occurred among units with multiple peaks. Among those units with multiple peaks, small increases in lithic debitage occurred at lower levels, e.g. 50 to 60 and 60 to 70 cm, particularly in the south. Only 8 tools were recovered below 40 cm, however, suggesting that these lower peaks in debitage could well be the result of size sorting and abnormally deep excavations.

When the 36 test units with single peaks are considered a definite pattern emerges. The northern units are most variable. The majority (57%) of these units have debitage peaks in the 20 to 30 cm level. Peaks also occur 19% of the time in the 10 to 20 and 30 to 40 cm levels, however, suggesting that either cultural materials have been deposited in an overlapping pattern or a concentration of cultural materials has been dispersed upward and downward through the deposits. In either event, there is evidence that the deposit has a complex depositional history in the northern units of Component 1.

In the southern units, single peaks in debitage occur in the 20 to 30 cm levels 31% of the time and single peaks occur 69% of the time in the 30 to 40 cm level. It would appear as if the southern units either represent a single occupation that is older than that of the northern units, because they exhibit peaks in lithic debitage at deeper levels, or the 30 to 40 cm peak in the south is equivalent to the 20 to 30 cm peak in the north. I favor the latter interpretation.

When the distributions of tools are graphed for the North and South units a strange pattern is presented (Fig. 61). Artifacts occur in highest percentages in the 20 to 30 cm levels in the South and in the 30 to 40 cm levels in the North, exactly the opposite tendencies of the lithic debitage distributions. It should be remembered, however, that more artifacts were recovered in the 0 to 10 cm level in the northern units, also. In other words, the cultural materials recovered from the North units exhibit relatively

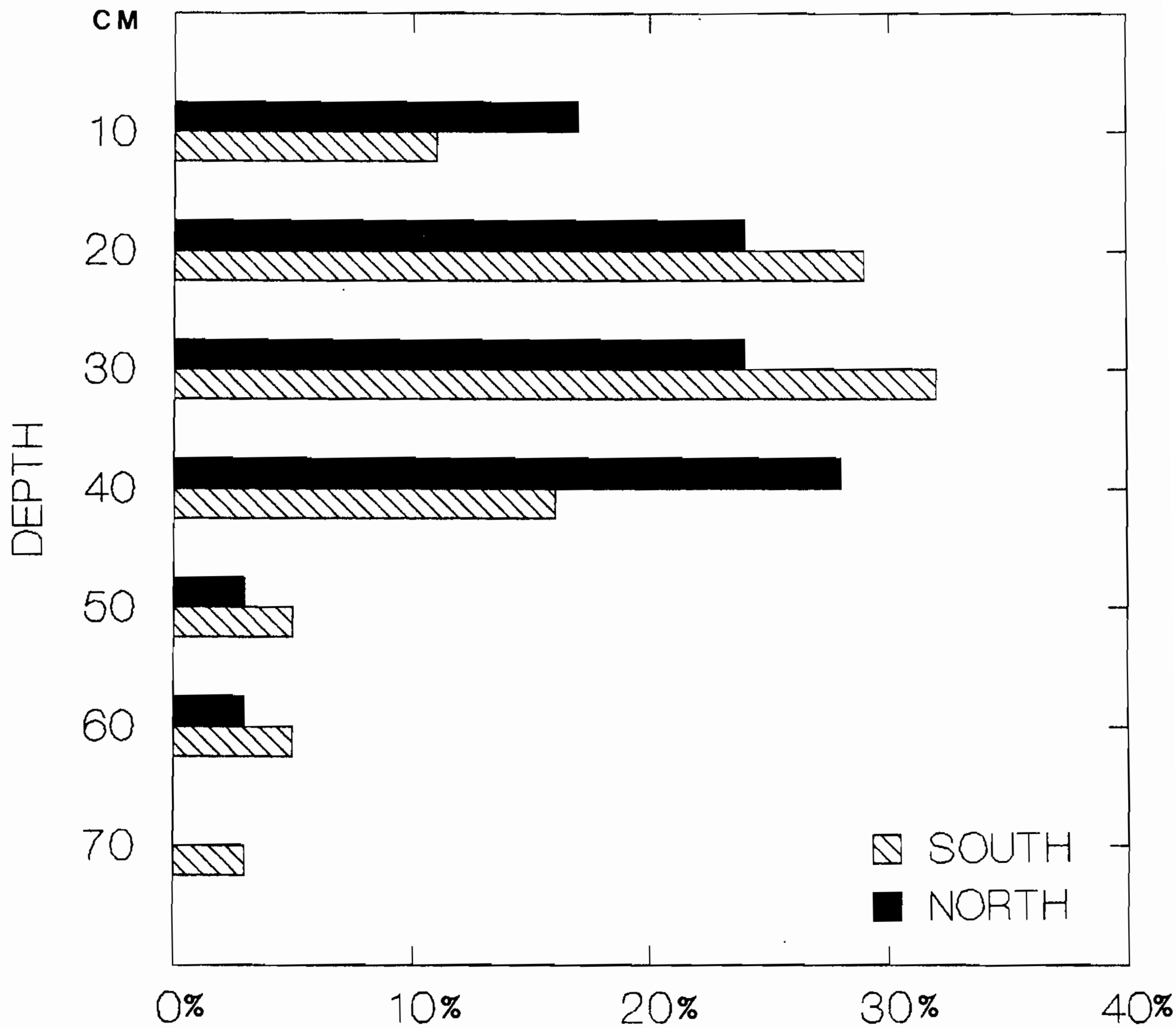

Figure 61. Percentage of artifacts by level in the South and North subcomponents of Component 1.

greater vertical displacement than those recovered in the South units. This pattern could be the result of increased disturbance in the North units or it could indicate the presence of a small deposit, comprised primarily of tools, lieing just below the primary occupation zone at 20 to 30 cm. The artifacts recovered from the North and South subdivisions are presented in Table 12.

Cultural Feature 15, a circular gray-stained area centrally located in the excavation block, was encountered at 28 cm and continued to a depth of 58 cm. Feature 15 appears to have been bowl-shaped and somewhat irregular in outline. At 40 cm below surface it measured roughly 60x75 cm in diameter. It narrowed to 50 cm in diameter with a more regular outline at 50 cm below the surface and was only 30 cm in diameter at the bottom.

Though there were no stones inside this feature there was a scatter of about 60 fire-affected stones distributed nearby at approximately the same elevation though slightly lower. Their somewhat scattered distribution suggests they were disturbed culturally and/or by hydraulic means. They tend to slope slightly toward the south, the direction of water flow, and become more dispersed away from the center of the block excavation. The areal extent of these stones closely approximates the area of densest cultural materials and the association is believed to be culturally significant (Warren 1990:56).

Table 12. Artifacts recovered from the North and South subdivisions of Component 1.

	NORTH						SOUTH						
TYPES	0-10	10-20	20-30	30-40	40-50	50-60	0-10	10-20	20-30	30-40	40-50	50-60	60-70
lmls				1								1	
clovis									1				
ls									1				
ds		1								1			
fk		1							1				
ifs									1		1		
oss			1						1				
tts		1											
muf		2	3	1			2	2	1				
oth. scr.				1									
grav.				1									
1	2		1				1	3					
4						1				1			
5	1												
7			1	1									1
9							1		1				
14								1			1		
18		1											
19								1					
25	2		1	1	1			4	4	2		1	
cores								1					
gro. sto.		1		2						1			
Total:			29							37			

Two accelerator mass spectrometry samples were recovered by soil flotation from Feature 15. Sample AA-798, recovered from 40 to 50 cm, weighed approximately 0.1 gram and produced a date of 2,410+/-280 BC. Sample AA-648, recovered from 28 to 50 cm, weighed approximately 0.5 gram and produced a date of 6,520+/-370 BC. These samples were recovered from the same feature, clearly they cannot both be correct. The recovery of a Clovis and two Lake Mojave projectile points in close proximity to this feature suggests the older date should be accepted and the younger date rejected (Warren 1990:230).

The artifact density map for all tools (Fig. 62) suggests artifacts were recovered in a pattern very similar to that of lithic debitage (Fig. 58). The distributions of scrapers and bifaces are generally quite similar though bifaces are present in larger numbers at the north end of the block while scrapers tend to be found more often in the west-central portion of the block (Appendix A: 47-48).

Warren (personal communication, 1991) thought there might be two occupational strata present in Component 1 because the stones scattered throughout the deposit occur slightly deeper (30 to 40 cm) than the top of Feature 15 (28 cm). Thus, one occupation may be represented by the radiocarbon date of 6,520 BC and the peak in cultural materials at approximately 30 cm. The other occupation may be undated and slightly deeper in the deposits.

Warren (1990:240) computed a mean hydration rind thickness of 11.89 microns for the Component 1 Coso obsidian sample after showing that it was not vertically separable. It is clear from the data presented above that no simple sorting of upper and lower cultural strata across the entire component is possible. Dividing the Coso obsidian samples which have been measured for hydration rind thickness

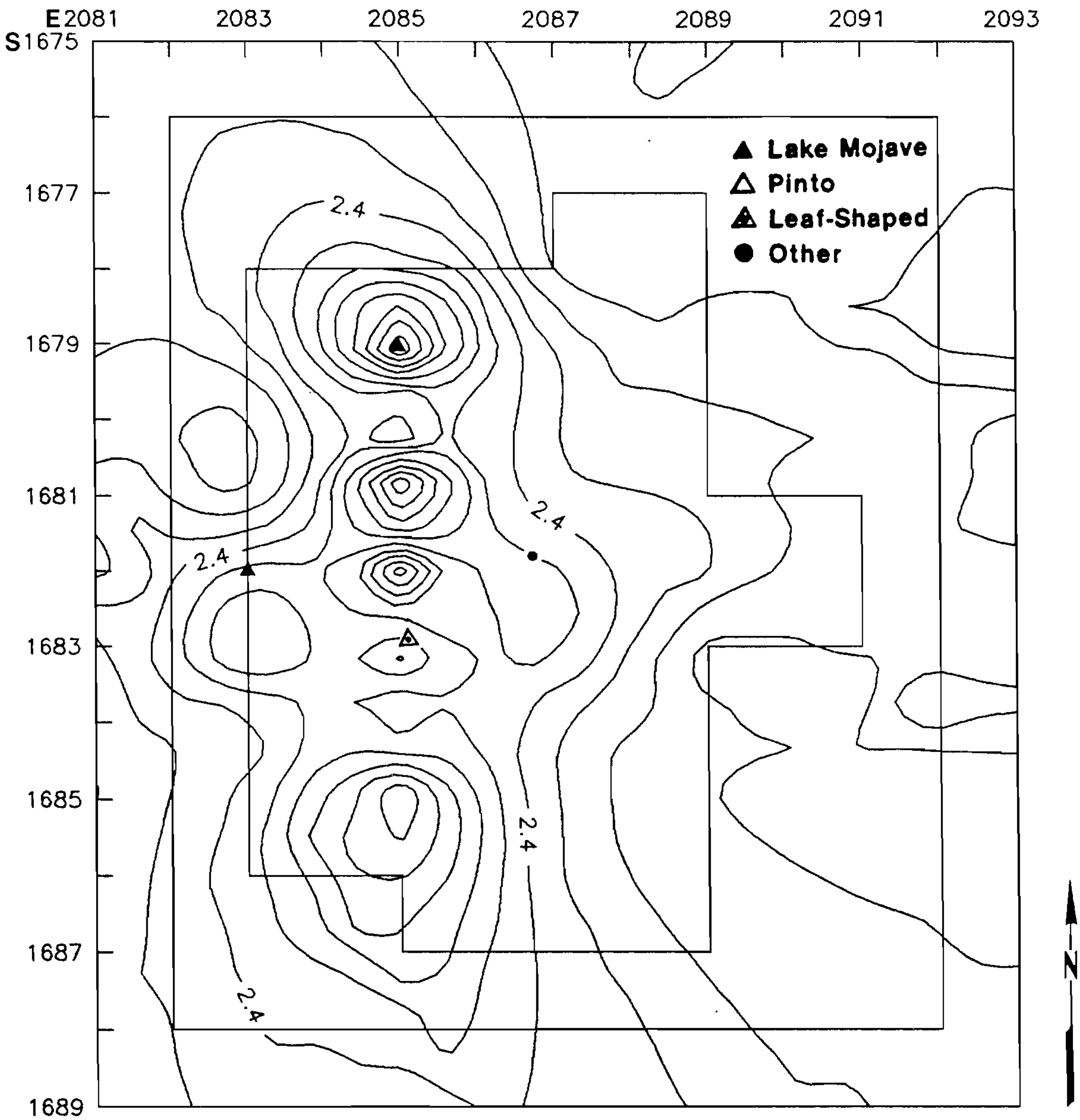

Figure 62. Distribution of all tools in Component 1.

between the suggested North and South subunits, however, produced somewhat different results than Warren's (Table 13).

The North obsidian sample comprised 11 readings from 10 specimens. The South sample comprised 13 readings from 11 specimens. The outliers, 0.0 and 20.3 microns, were eliminated from all computations because they fell more than two standard deviations outside the mean. The North sample produced a mean of 12.38 microns and the South sample produced a mean of 11.48 microns from the remaining specimens.

Though the computations of the mean suggested that a difference existed between the two samples their standard deviations overlapped. One of the specimens in the North sample and two specimens in the South sample had been measured twice. In each case the two readings were significantly variable. Consequently, I calculated a mean for these pairs and recomputed the subcomponent means. This procedure did not affect either the mean or the standard deviation of the North sample and only the original calculations appear in the results column of Table 13. The mean of the South sample was reduced to 10.99 microns by this procedure though the standard deviation was not reduced.

A Student's T test of the probability that these two samples were from separate groups gave a T value of 1.40

Table 13. Obsidian hydration readings from Component 1, Locus G.

Compon.	Stratum	Feature association	Spec. number	Hydra. band	Comments/ Results
North	AS-1b/AS-2	Feature 15	178-6309	12.2	Results:
North			178-6387	13.1	N = 10
North			178-6622	15.9	Mean = 12.38
North			178-6643	12.0	SD =2.24
North			178-6731	11.8	
North			178-6743	9.5	
North			178-6876	10.0	
North			178-6879	9.8	
				14.8	
North			178-6976	0.0**	
North			178-6984	14.7	
South	AS-1b/AS-2	Feature 15	178-3016	10.9	Results:
South			178-3019	9.4	N = 12
South			178-3205	11.0	Mean = 11.48
South			178-6305	9.8	SD = 2.2
South			178-6422	7.5	
South			178-6459	11.0	Adjusted:
South			178-6465	15.1	N = 10
				13.1	Mean = 10.99
South			178-6489	11.4	SD = 2.2
South			178-6561	20.3**	
South			178-6812	11.1	
South			178-6867-1	12.4	
South			178-6867-2	15.1	

** not included in calculation of mean

with 18 degrees of freedom. The two samples were not statisically separable at the .1 level but would be at the .2 level. This is a very weak indication that the two samples could be different even though the 1.39 micron difference between them would indicate a 990 year time span if Warren's (1990:245) hydration rate of 712 years per micron, for subsurface samples recovered from the Henwood site, were employed. In sum, though the difference in hydration means is suggestive of two samples, the broad variability in Coso hydration readings makes it impossible to statistically demonstrate any difference in mean hydration measurements between the North and South groups.

Component 1 is considered to be a single cultural component dating from the Lake Mojave period. The cultural deposits may have been the result of at least two occupations separated by a relatively long time span, though this has not been proven. Stratigraphic disturbance by rodent activity, human foot traffic, and possibly erosion, and the broad variablility inherent in the hydration process of Coso obsidian makes it impossible to separate the assemblages of these occupations, if they indeed do exist. The important point in this study is that if two occupations did occur they both apparently date from the Lake Mojave period and no mixing with cultural materials younger than the Lake Mojave period is indicated.

Component 3

Component 3 was located approximately 65 m northeast of Locus G in an area with so little cultural material on the surface that no locus boundaries could be defined for it. The component comprises the cultural materials recovered below 30 cm by a block of excavation units established around Feature 17, a cluster of large, tabular granitic stones exposed by Scrape B (Fig. 52). These stones were encountered at an average depth of 40 cm below the surface and were surrounded by a fairly dense concentration of cultural materials. The soil matrix is stratum AS-2, the gravelly granitic alluvium cultural components are typically buried in at the Henwood site. These deposits contained an exceptional amount of gravel near their contact zone with AS-1b. They may have been rapidly covered by stream action, at least in the northern portion of the excavation area, after the component was occupied and prior to the development of AS-1b which caps the component.

Graphing the vertical distribution of debitage in 19 of the excavation units around Feature 17 revealed a single peak in cultural materials generally occured between 40 and 50 cm below the surface. Figure 63 illustrates the density of lithic debitage in Component 3. Debitage densities are highest in excavation units adjacent to Feature 17 and thin dramatically in most directions as one gets further away from it. Debitage appears to be densest in the southern portion of the block excavation, however, this is the area where the most volume of soil was consistently removed and this may be affecting the density patterns of basalt and CCS (Appendix A: 49-50).

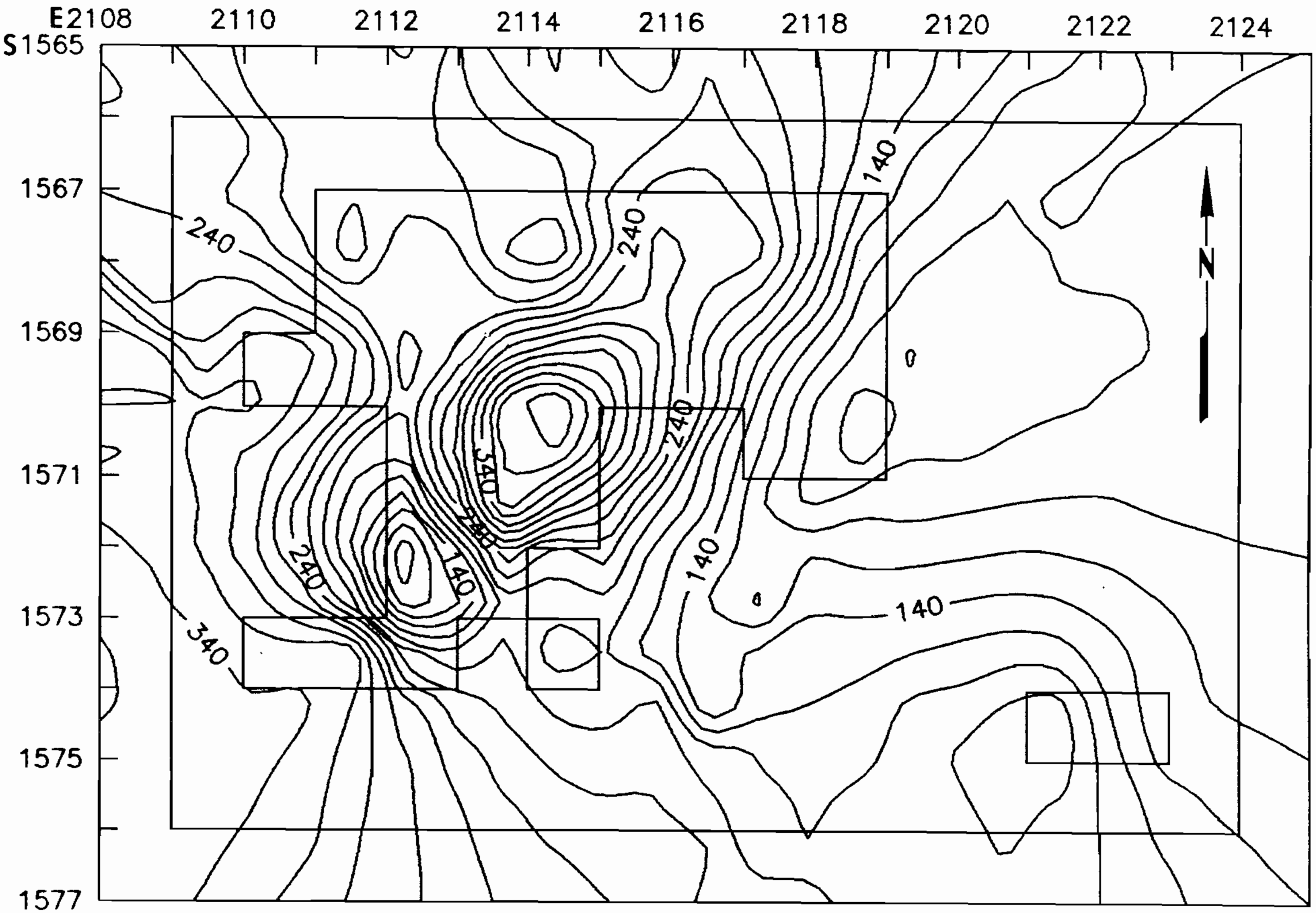

Figure 63. Distribution of lithic debitage in Component 3.

Basalt is the predominant material type in this component; exhibiting a distributional pattern similar to the pattern of all lithic debitage. Obsidian was recovered primarily from two areas of the block (Fig. 64), one in the southwest quadrant and the other near the center. Bone is distributed in a similar fashion to obsidian (Appendix A: 51).

Only 20 tools were recovered from Component 3 (Table 9). Tools exhibit a distribution which varies from that of the debitage (Fig. 65) by clustering most densely around the north side of Feature 17 which was centered in excavation unit E2113 S1569. A single Lake Mojave series projectile point fragment was recovered from this cluster suggesting this tiny component dates from the Lake Mojave period.

Hydration readings on 8 specimens from the Coso obsidian source provided the only form of absolute dating for this component since no materials for radio carbon dating were recovered. Seven of the eight specimens provided an adjusted mean measurement of 11.76 microns from 8 hydration rind measurements. Two outliers, 5.8 and 19.8 microns, were eliminated from the computations of the sample mean because they fell more than two standard deviations from the mean (Table 14). Two hydration readings on a single obsidian specimen recovered from an isolated test unit

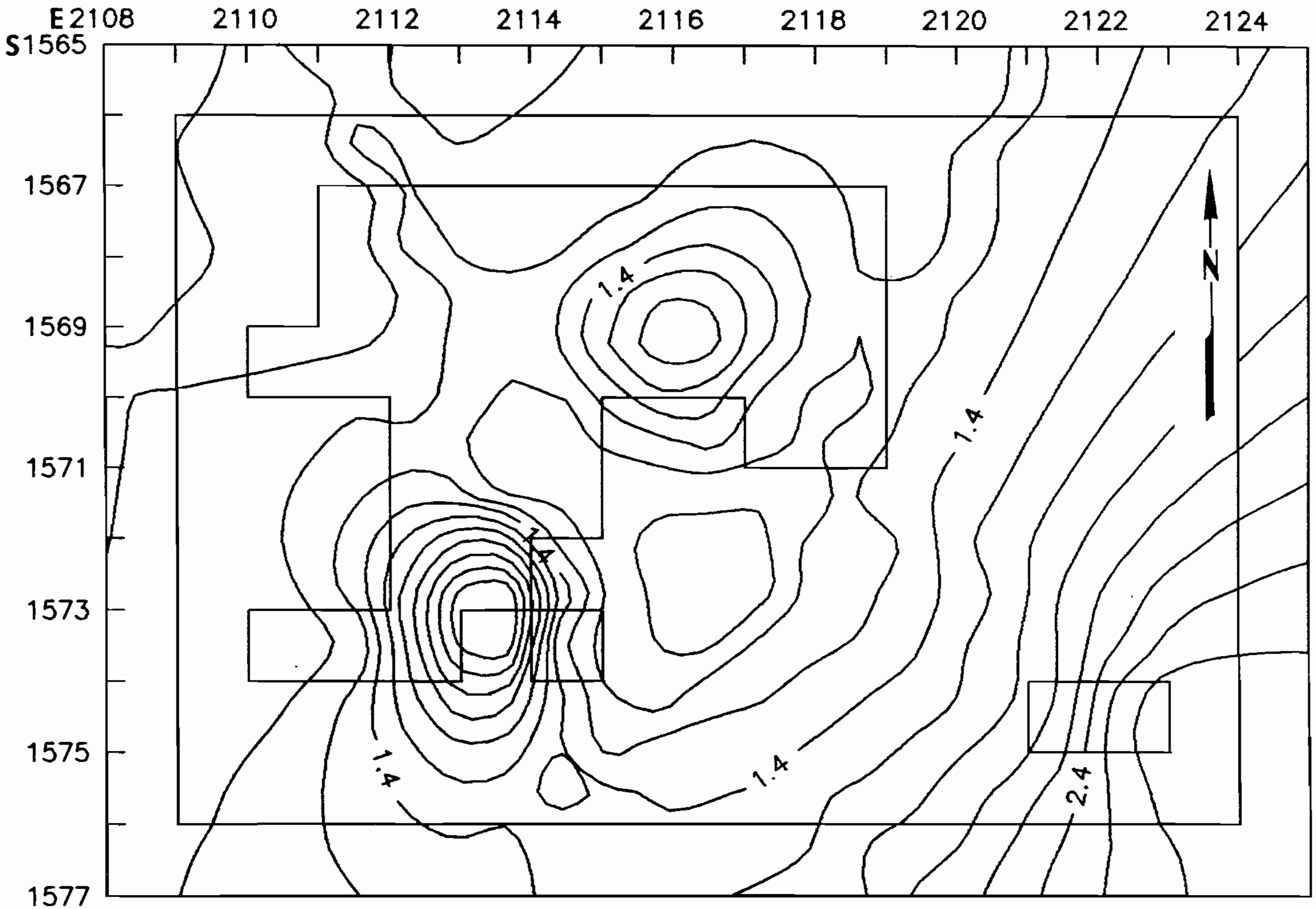

Figure 64. Distribution of obsidian lithic debitage in Component 3.

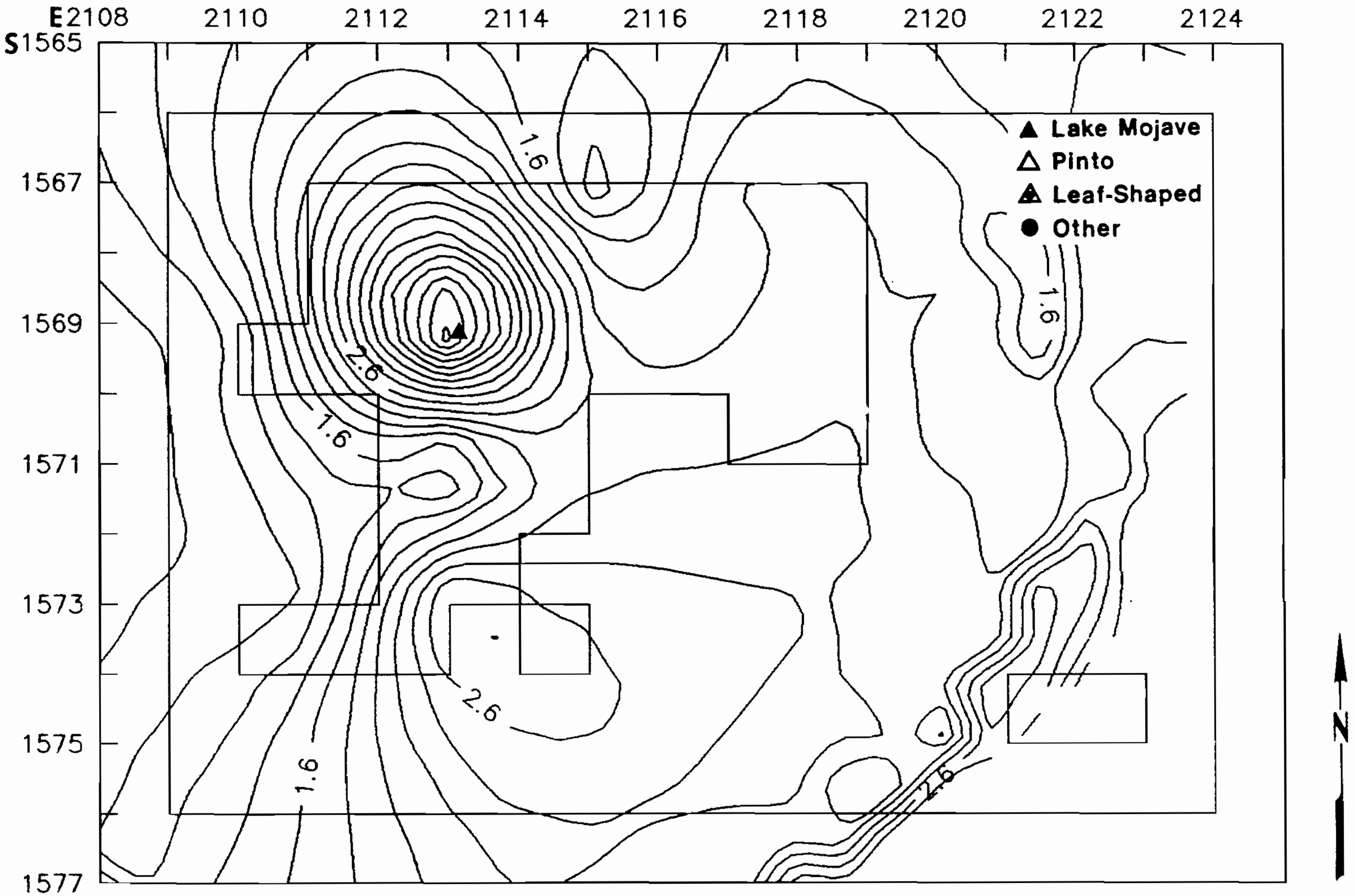

Figure 65. Distribution of all tools in Component 3.

Table 14. Obsidian hydration readings from components 3, 4, and Locus H at the Henwood site.

Compon.	Stratum	Feature association	Spec. number	Hydra. band	Comments/ Results
COMP.3	AS-2	Feature 17	178-7265	10.9	Results:
				12.4	
			178-7292	12.3	N = 10
			178-7381	19.8**	Mean = 11.97
			178-7391	9.0	SD = 3.51
			178-7405	12.0	
				5.8**	Adjusted
			178-7435	13.2	results:
			178-7451	12.2	
			178-7625	12.1	N = 8
					Mean = 11.76
					SD = 1.28
COMP.4	AS-2	none	178-836	14.0	Results:
			178-3310-1	8.9	
			178-3310-9	18.3	N = 12
			178-3315-7	14.9	Mean = 13.57
			178-3478-1	8.9	SD = 4.39
			178-3488-2	7.4**	
			178-3488-2	10.1	Adjusted
			178-3488-5	20.0	results:
			178-3492	18.5	
			178-3509	11.5	N = 11
			178-6156	17.4	Mean = 14.13
			178-8107	11.2	SD = 4.25
			178-8111-2	15.7	
HA	surface	none	178-2547	0.0**	
HA			178-3712	14.0	
				11.9	

** measurement not included in computation of mean

nearby (southeast corner of Fig. 65) are reported by Warren (1990:242) but are not shown here.

Component 3 is a single cultural component dating from the Lake Mojave period. It comprises the cultural materials surrounding what may have been a storage facility or materials processing location. The distribution of cultural materials, both vertically and horizontally, indicates occupation was probably limited in duration and intensity. It is a very discrete, albeit tiny, component, however.

Component 4

Component 4 is an exceptionally small component comprised of the cultural materials recovered from 6 contiguous 1x2 m excavation units located between site grid lines S1628, S1636, E2099, and E2101. This component was situated between Scrape E and Trench 8 about 20 m east of Locus G (Fig. 52). Too little cultural material was present on the surface to identify locus boundaries in this area and the component was discovered by the excavation of a judgmentally placed test unit. The soil matrix of this component was AS-2, the same gravelly alluvium the other components at the site are buried in.

Warren (1990:61) defines the component as the cultural materials recovered below 30 cm and considers the entire assemblage a single unit. Flake densities tend to be greatest at depths of 50 to 60 cm though artifacts generally continued to be recovered to depths of 70 to 80 cm. The entire tool assemblage comprises only 4 tools and is far too small for comparison to other components.

Component 4 is really only interesting because it produced such a relative abundance of obsidian. Warren

(1990:242-243) suggests this obsidian repesents two separate occupations, one located from 20 to 50 cm below the surface and the other from 50 to 70 cm. Figures 66 and 67 illustrate the distribution of obsidian from Component 4 and the test pits distributed around it. Figure 66 shows that obsidian was recovered in a light, regular pattern from the upper 30 cm of all excavation units in the immediate vicinity of Component 4. Component 4, however, contained a relatively large quantity of obsidian in excavation levels below 30 cm while the test units scattered around it recovered only 1 flake of obsidian on an average below 30 cm (Fig. 67).

This is not the general pattern of debitage among the other lithic materials, however. Basalt and CCS both occur in larger relative quantities in the upper 30 cm of deposit in a test unit located 3 m south of Component 4 (Appendix A: 52-53). This same test unit recovered the greatest amount of basalt debitage in deposits located below 30 cm (Appendix A: 54). CCS, on the other hand, is distributed more densely in Component 4 in levels below 30 cm, in a pattern similar to that of obsidian in the lower levels (Fig. 68). Bone occurs almost exclusively in Component 4, both above and below 30 cm (Appendix A: 55-56), but primarily in the lower deposits, also.

Excavations in Component 4 did not recover sufficient carbon samples to radio carbon date the component, nor did they recover projectile points. The only method for dating

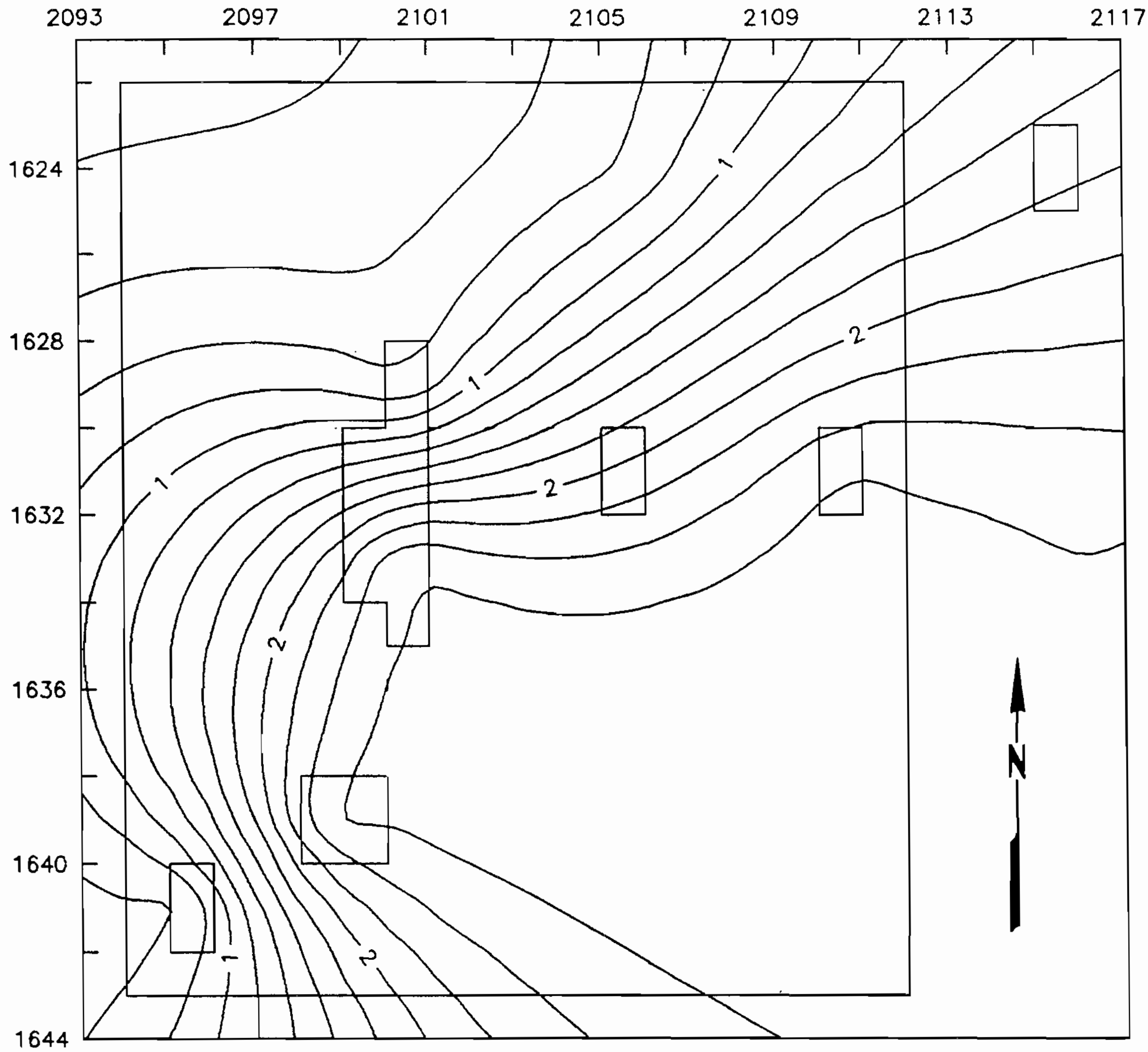

Figure 66. Distribution of obsidian in Component 4, 20 to 50 cm.

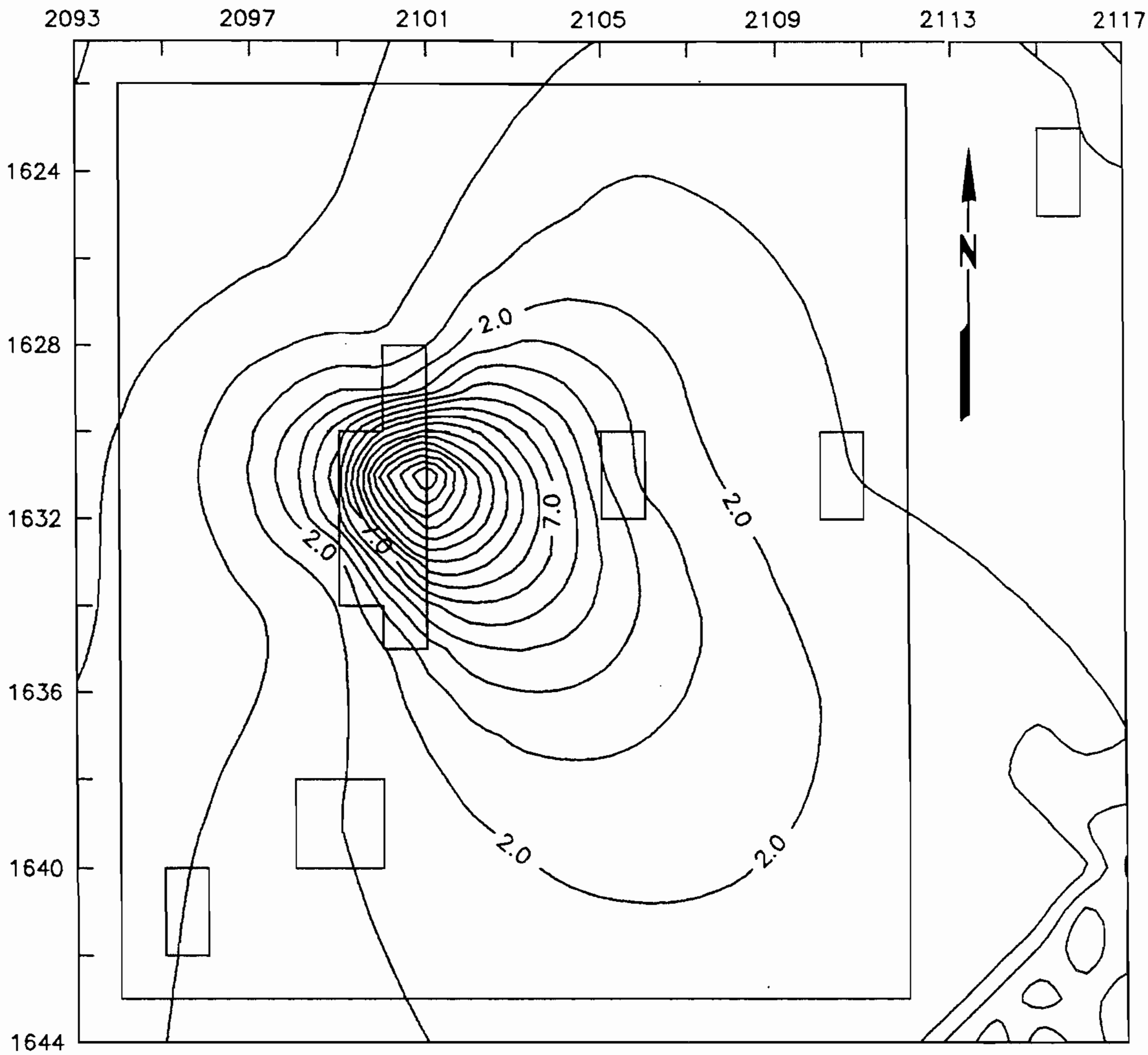

Figure 67. Distribution of obsidian in Component 4, 50 to 70 cm.

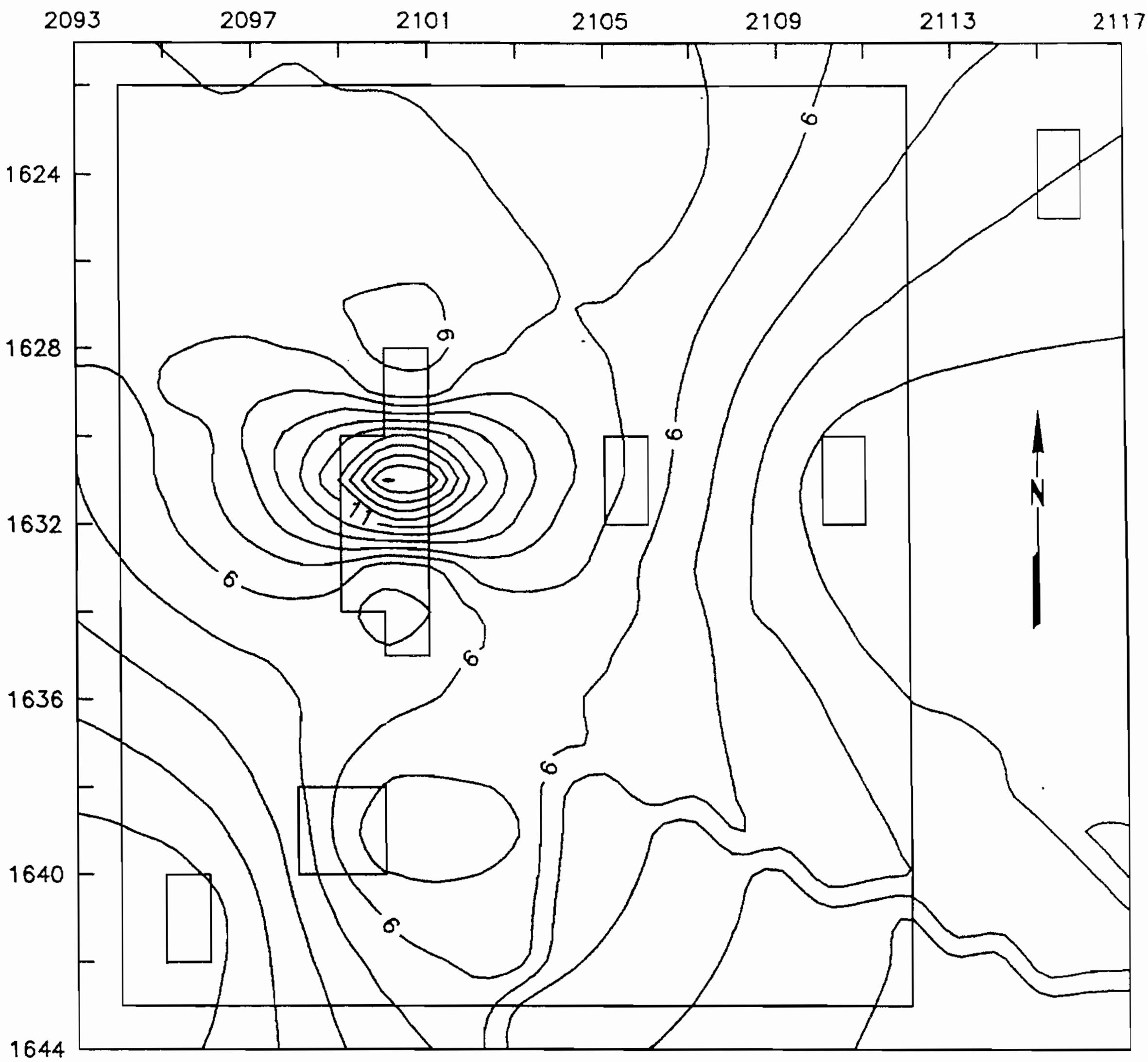

Figure 68. Distribution of CCS in Component 4, 50 to 70 cm.

Component 4 was through the 12 obsidian hydration measurements taken on 11 specimens. These specimens combined produced a mean of 14.13 microns. However, Warren (1990:244) suggests these specimens represent two separate samples, one comprised of specimens from 20 to 50 cm with a mean of 11.8 microns and the other comprising specimens recovered from 50 to 70 cm with a mean of 16.1 microns. Both samples would date from the Lake Mojave or earlier periods.

Locus H

Locus H is a large elongated locus (215x20 m) comprised of surface materials recovered from two concentrations, one located in the north-central part of the site near Locus E and the other located across Half-Way Wash from Locus D. Between these two concentrations, named HA (north) and HB (south) here, is a moderate lithic scatter which has experienced considerable military impact and erosion (Fig. 42). The area is dissected by many small rivulets and several small washes make their way through the southern half of the locus. Alluvial deposits are characteristically shallow throughout the locus. They thin from north to south, completely disappearing in the southern end where the white calcic horizon, capping the underlying stream terrace, is exposed on the surface.

The two concentrations of surface artifacts were sampled individually with randomly selected 5x5 m surface collection units and four 1x2 m test excavation units. In addition, all tools not recovered in the surface collection units were collected by the mapping crew as they were throughout the site. The few artifacts recovered in the test units have been included with the surface artifacts here and have not affected the artifact density maps of either HA or HB. Artifacts recovered from within the locus boundaries but outside HA and HB, as identified here, are recorded in Table 15 as H-NL.

HA

Component HA is located at the extreme northern end of Locus H at an elevation between 851 and 852 m. Tank trails pass through Locus H along the southern border of HA and also within 20 m of the western border. Military impacts were particularly noticable in the southern end of the component, suggesting substantial military activity in this area and the collection of artifacts by military personnel in this area cannot be ruled out.

The surface of HA is covered with a thin deposit of alluvium cut by three small rivulets. Artifacts recovered from these drainages suggested erosion was exposing subsurface cultural materials in the west-central portion of the component. This prompted investigators to excavate three 1x2 m test pits in the most promising deposits of the southern area. The results of these excavations indicated

Table 15. Artifacts recovered from loci H and I, and the Nonlocus area.

Loci:	H			I					NL
Component:	HA	HB	H-NL	I1	I2	I3	I4	I-NL	NL&NLX
Types:									
lmls									3
lmss									3
lm									2
ls	1		2						2
lsn									1
lan			1						1
slr			1			1			1
stb						1			
pinto		1	1						1
oth. pts.									1
ds	1		2						11
lkes								1	1
fk									2
es						1			5
ifs	2	5	2				1		6
oss		3	1		2			3	7
tts			2						
thts		2						1	2
muf	4	4	7	1		2			13
oth. scr.						1			2
gravers		2				1			1
1	1	3	13	2	2	10	3	4	38
2		3	2	2		2	2	1	10
3		1	3			1		1	4
4			3			1			15
5		3		2		2			7
6		1	1					2	5
7		10	7			5	7		50
8	1	1	1			1			7
9		1	1			1	1		17
10		3							6
11								1	
12		1							
14		1	2						12
15						1			
16		1							
18		2							3
19		4				1		1	12
20	1	1	1						3
25	7	17	3	3	3	5	5	4	48
cores		7	5			2			32
gro.sto.	1		2						20
	19	77	63	10	7	39	19	19	354

there was no appreciable deposit of buried artifacts and the remainder of the data recovery effort in HA was restricted to recovering thinly distributed surface materials.

Lithic debitage was most densely distributed around the southern most drainage in HA (Fig. 69) but even here was relatively sparse. More than 90% of the sample was basalt, which CCS appears to share a close distribution with (Fig. 70).

Only 19 artifacts were recovered in HA (Table 15). The majority of these were widely scattered throughout the area in a pattern of less than 1 tool per 25 m square, making the artifact density map relatively unreliable even when all classes of tools were combined (Fig. 71).

A single Leaf-shaped point was recovered from the center of the component but is not particularly diagnostic of either the Lake Mojave or Pinto periods since they seem to occur in both assemblages. Two samples of Coso obsidian from HA were measured for hydration rind thickness. One specimen (178-2547) contained no visible hydration rind, the other (178-3712) produced two readings of 14.0 and 11.9 microns with a mean of 12.95 microns. Warren (1990:248) lists a single obsidian hydration measurement of 12.4 microns from specimen 178-3910 but this artifact was recovered 20 m south of the HA boundaries. It is clearly comparable in age to the mean of the HA sample, however. If

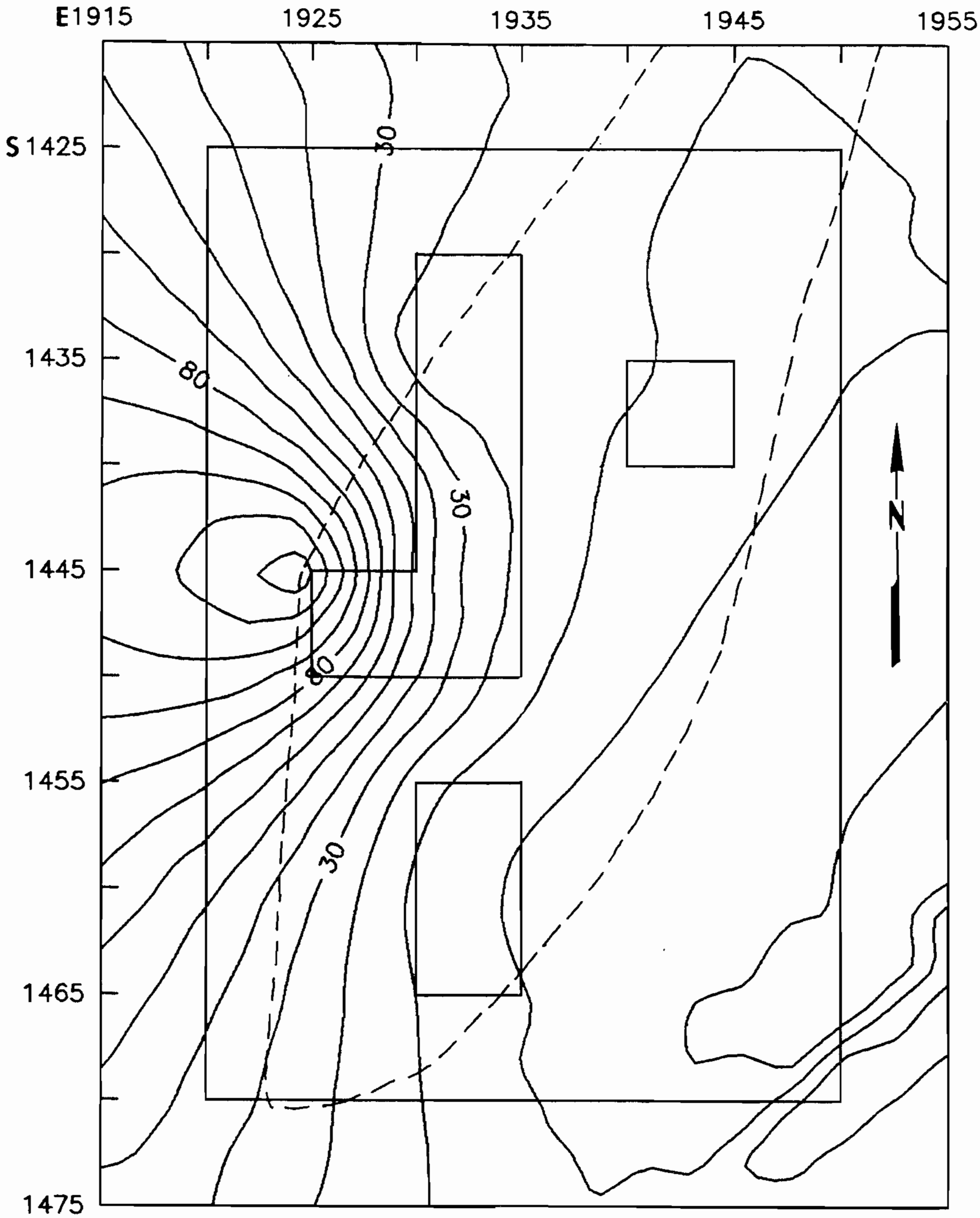

Figure 69. Distribution of lithic debitage in Component HA.

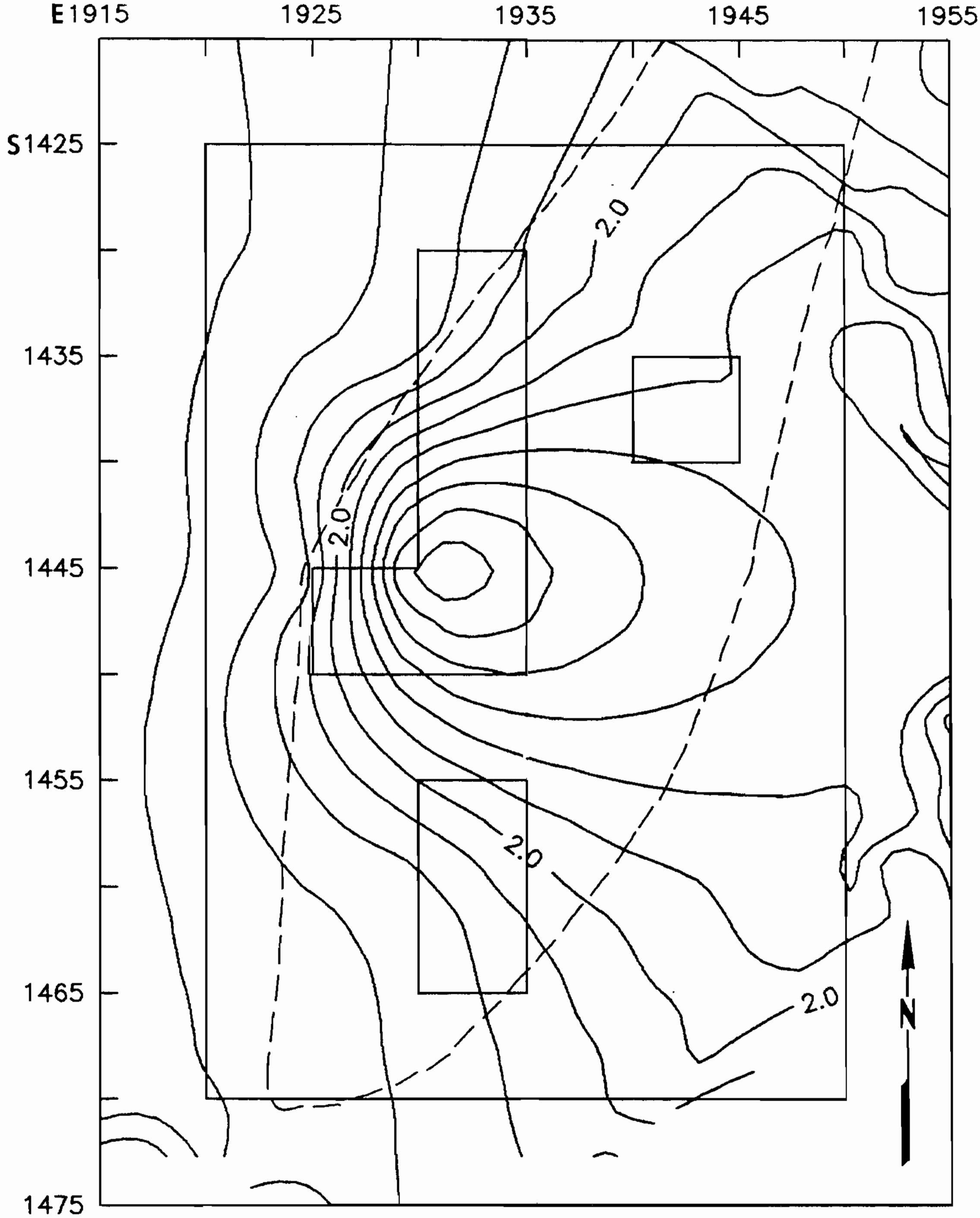

Figure 70. Distribution of CCS lithic debitage in Component HA.

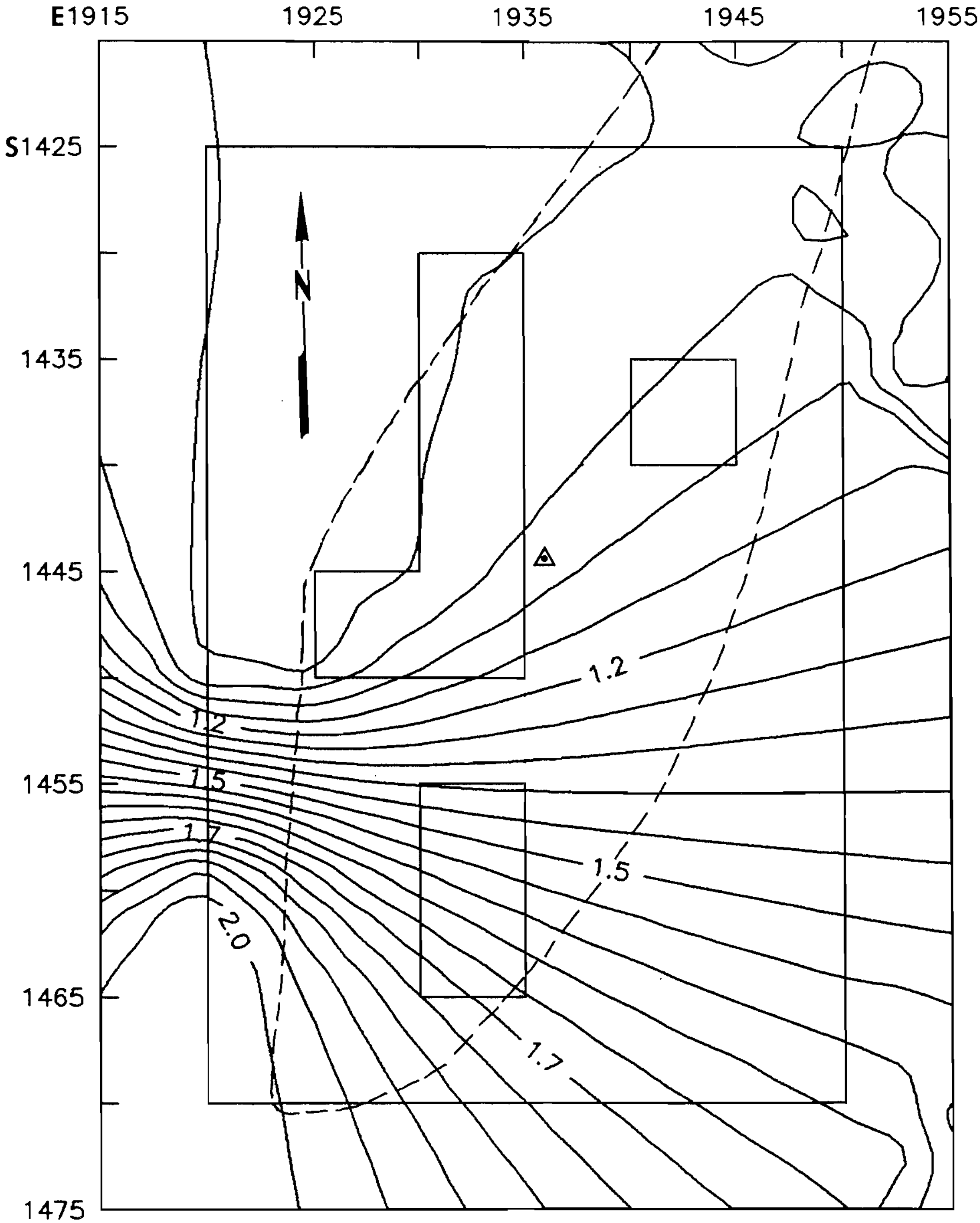

Figure 71. Distribution of all tools in Component HA.

this tiny sample accurately dates the occupation of HA it suggests the component dates from the Pinto period.

Little can be said about the sparse remains recovered from component HA. The artifact density maps suggest artifacts are sparsely distributed across the surface and are notable only because they do not appear to cluster. This pattern could be the result of repeated occupations of extremely limited duration by small numbers of people or, and this seems most likely, the surface materials have been severely disturbed and some artifacts may have been removed prior to the data recovery effort.

HB

Component HB is a small component (55x45 m) located at the southern end of Locus H at an elevation of 849 m. It is situated 50 m west of Halfway Wash and 25 m east of an unnamed wash. Small rivulets cut through the hard caliche surface of the component and erosion is certainly an important factor in understanding the pattern of artifact recovery within this component.

The surface of HB was a whitish caliche cap on which the artifacts were lying. The single 1x2 m excavation unit placed in HB demonstrated the lack of cultural materials within this ancient deposit. The artifacts were either deposited directly on the caliche surface or in a thin alluvial deposit which was then completely eroded away, leaving the artifacts exposed on top of the sterile caliche cap.

The surface collection units recovered the most debitage near the north end of the component (Fig. 72). The majority of this material (84%) was basalt, the distribution of which is dominating the density map for all debitage. CCS occurs in an unusually high number here, as it does in Component 2, comprising 16.4% of the sample (Warren 1990:197) and has a similar distribution to that of basalt (Fig. 73).

Tools and debitage are both most densely distributed in the northern portion of the surface collection block (compare Fig. 74 with Fig. 72) but tools appear to form a second major cluster about 15 m south of the first. A few bifaces were recovered near each other another 15 m south of the second cluster (Fig. 75) but scrapers do not occur in this area (Fig. 76). Bifaces comprise equal portions of the assemblages from the two northern clusters, as do scrapers.

At least two and possibly three activity areas are suggested by the distribution of artifacts in Component HB. Unfortunately, no projectile points were found in these activity areas. One Pinto and one Lanceolate point were recovered from the extreme southern end of the component. This somewhat tenuous data remains the strongest evidence available for dating this component since neither radiocarbon nor obsidian samples were recovered for dating

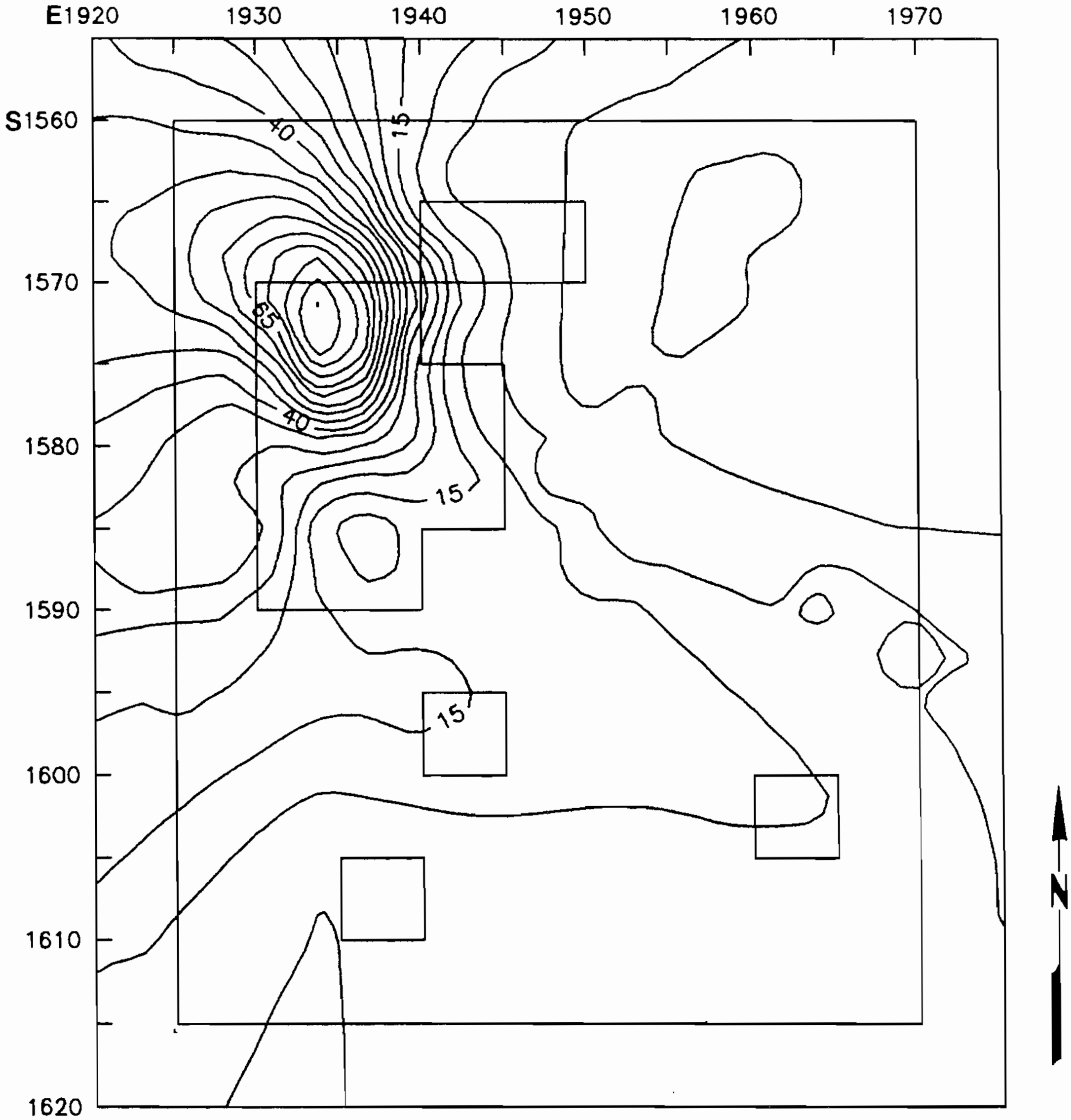

Figure 72. Distribution of lithic debitage in Component HB.

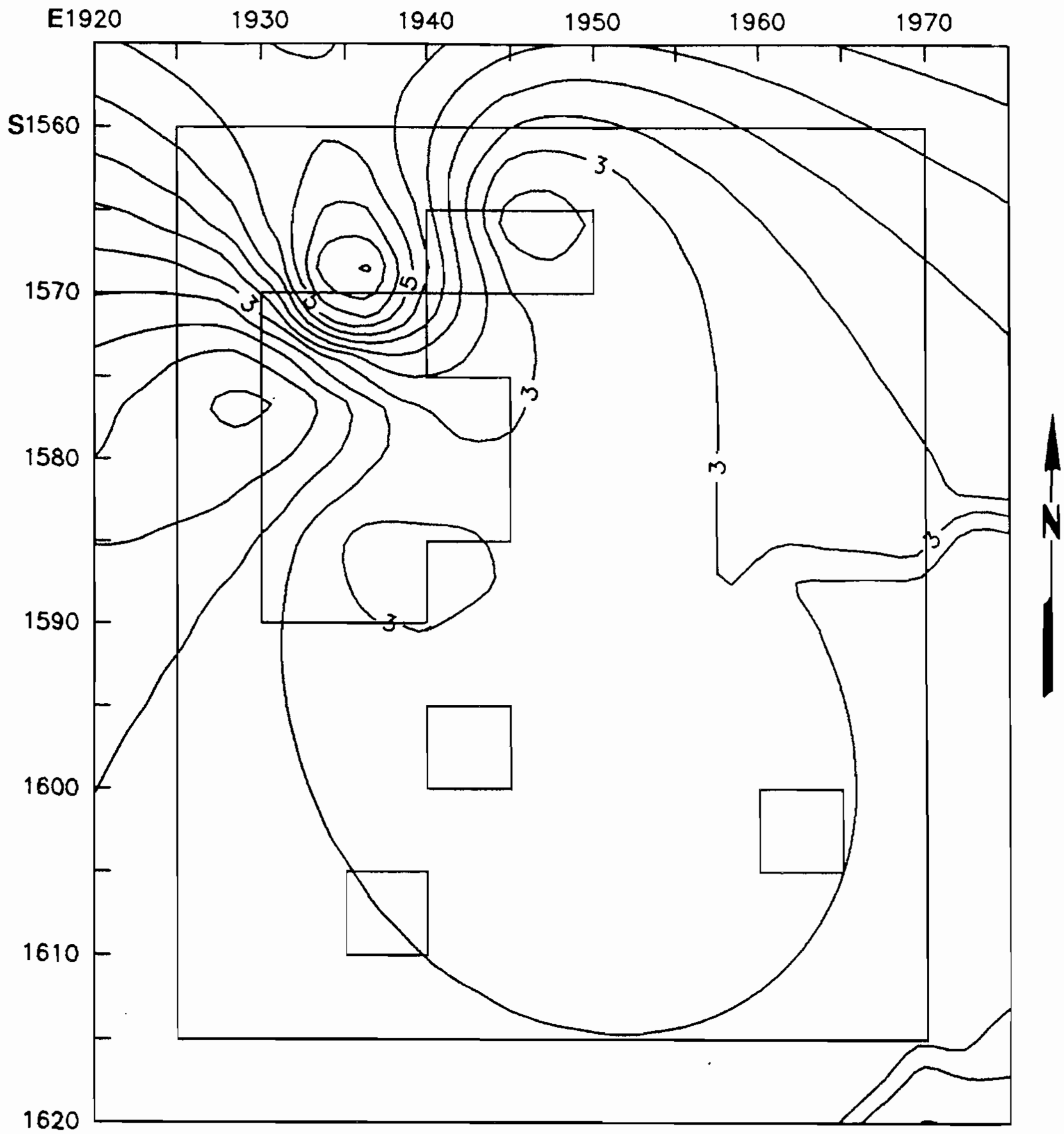

Figure 73. Distribution of CCS lithic debitage in Component HB.

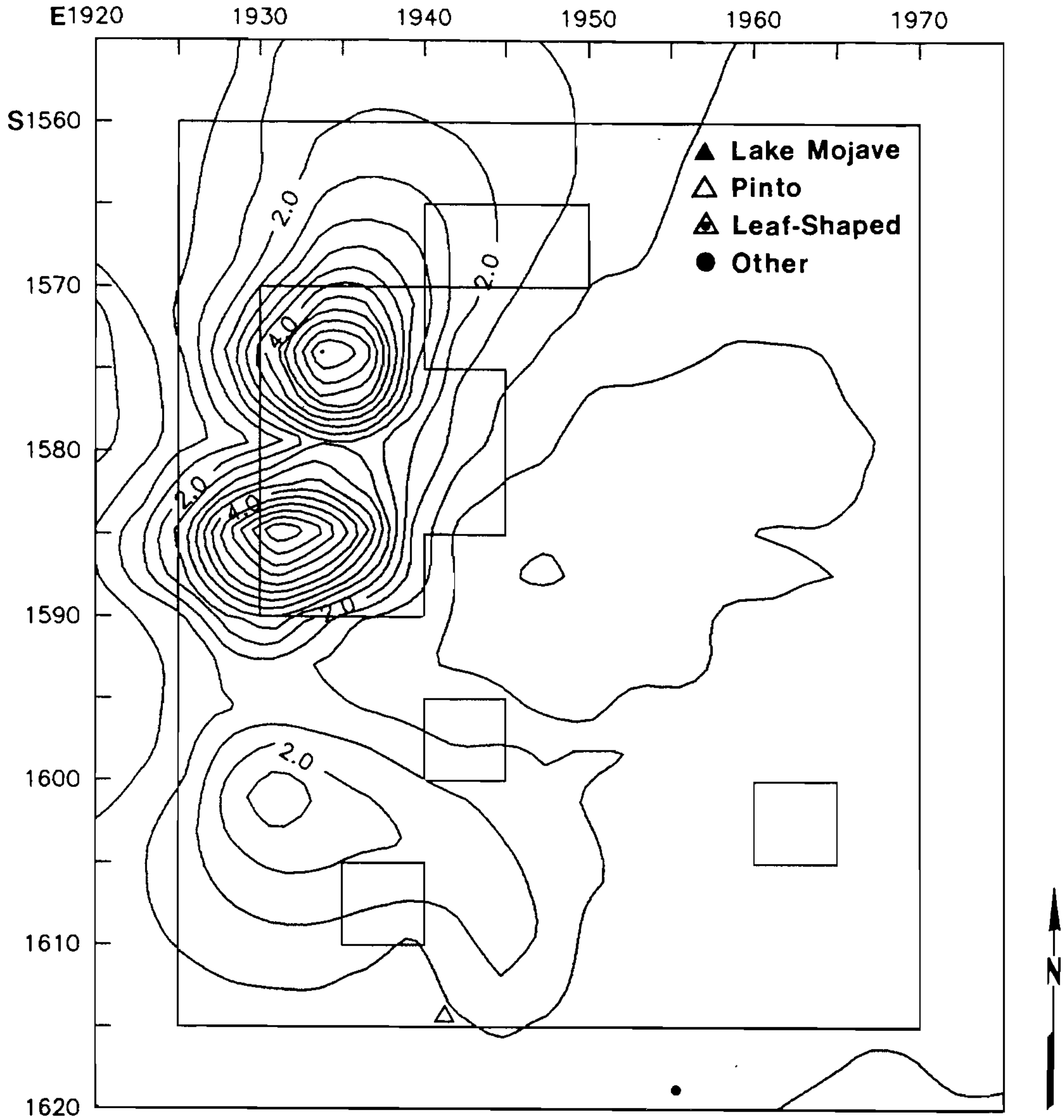

Figure 74. Distribution of all tools in Component HB.

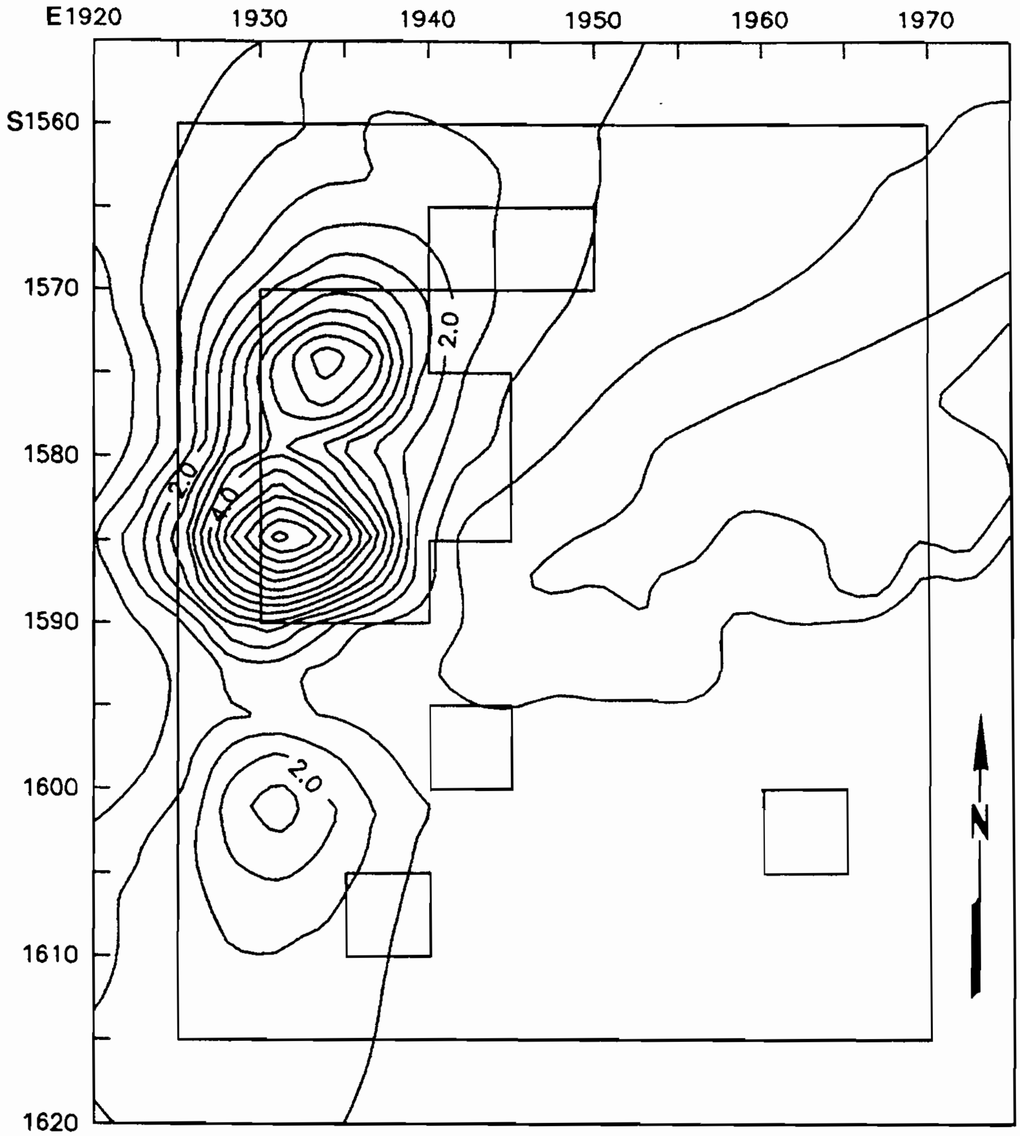

Figure 75. Distribution of bifaces in Component HB.

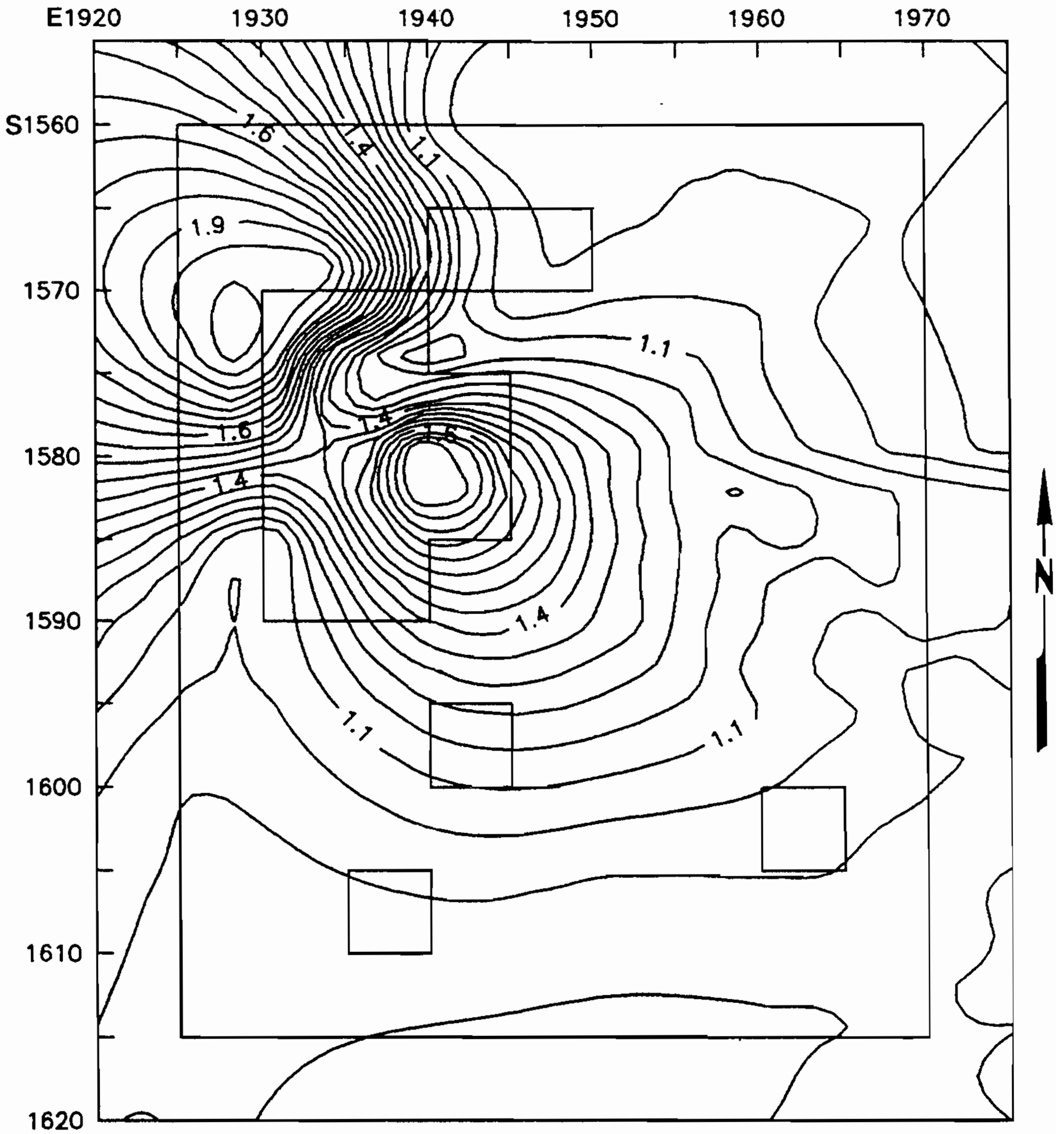

Figure 76. Distribution of scrapers in Component HB.

purposes (Fig. 74). The acceptance of a Pinto date for this component is made somewhat more acceptable by the facts that: 1) it is relatively isolated from all other components, 2) CCS comprises more and obsidian less of the assemblage than is found in most Lake Mojave components, and 3) the nearest dated feature (Feature 2), located approximately 30 m northeast of HB, has a radiocarbon date of 5,190+/-290 BC. Still, Component HB is only tenuously identified as a Pinto component.

Locus I

Locus I is located at the northwestern end of the site. It is situated on an interfluvial ridge in Nelson Wash and is separated from the main portion of the site by a branch of the wash which sweeps around the ridge before rejoining the main stem at the southern end of the ridge (Fig. 77). The locus is situated at elevations between 851 and 855 m on a series of narrow, low terraces at the southern (downstream) point of the ridge. The surface of the ridge was covered with desert pavement except in areas where the slope was broken by the terraces which were dominated by gravels.

A major tank trail passes up the wash branch east of the locus. Military impacts, including cratering, devegetation, and some bulldozing were noted (Vaughan 1984:49) within the boundaries of the locus but did not

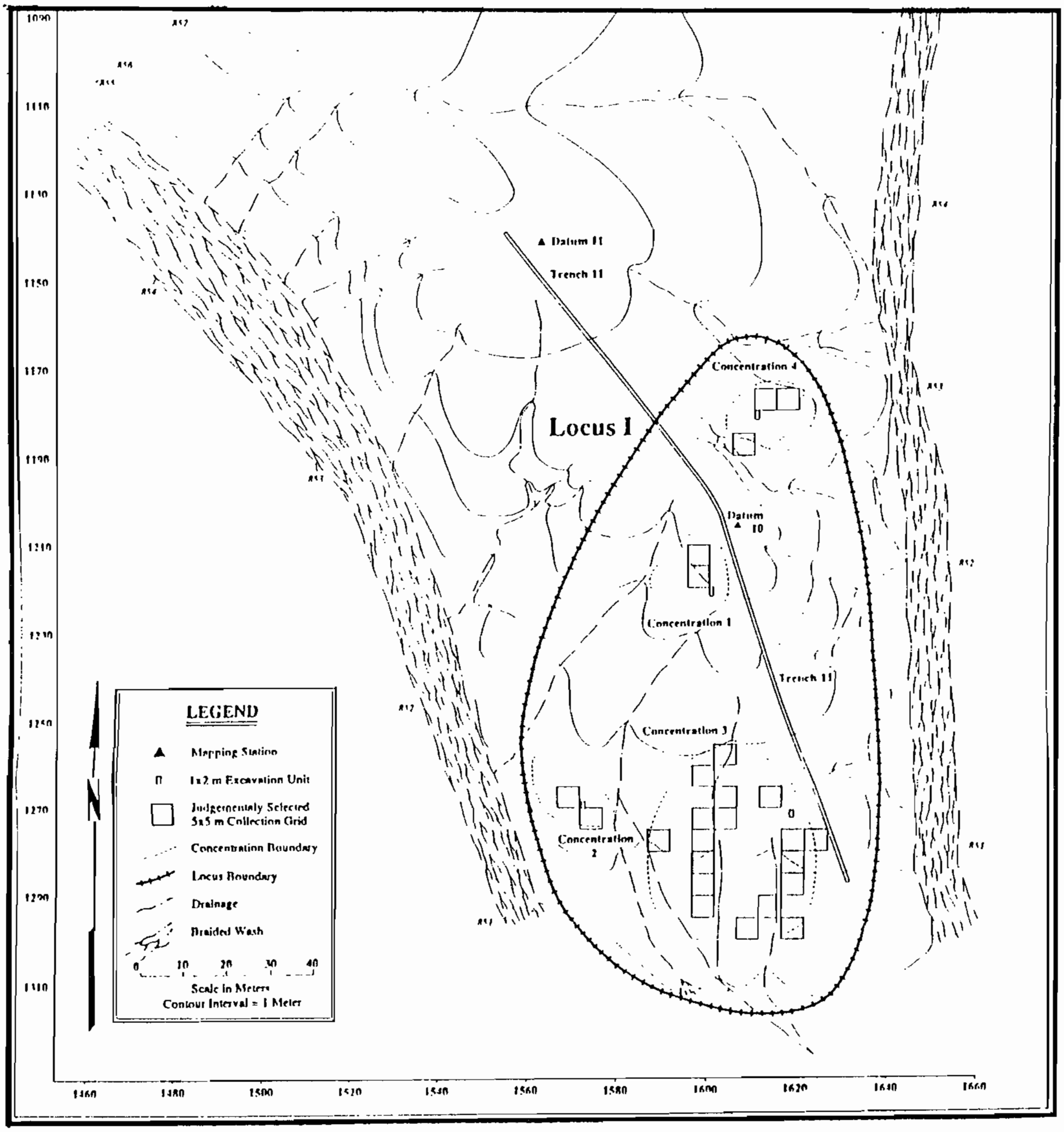

Figure 77. Map of Locus I.(After Warren 1990:Fig. 3-15).

cause significant damage to the four discrete concentrations of cultural materials, identified here as I1-I4.

Each concentration of cultural materials in Locus I was horizontally separated from the others. Three of the artifact concentrations were exceptionally small, the largest (I4) being only 25x25 m and containing only 19 tools. The fourth and largest concentration (I3) is twice as large (50x55 m) and produced twice as many (39) artifacts (Table 15). Test excavations in all four components indicated there were no substantial buried cultural deposit throughout the entire locus and no radiocarbon samples were recovered there. Obsidian was not recovered from this locus and only two projectile points, both in I3, were recovered there.

I1

Component I1 was an exceptionally small cluster of artifacts located on the ridge spin in the north-central portion of Locus I. It covered an area roughly 15x20 m in size and contained only 10 artifacts (Table 15). Artifacts were distributed lightly over the entire surface of this tiny area but do appear to cluster slightly more near it's center (Fig. 78).

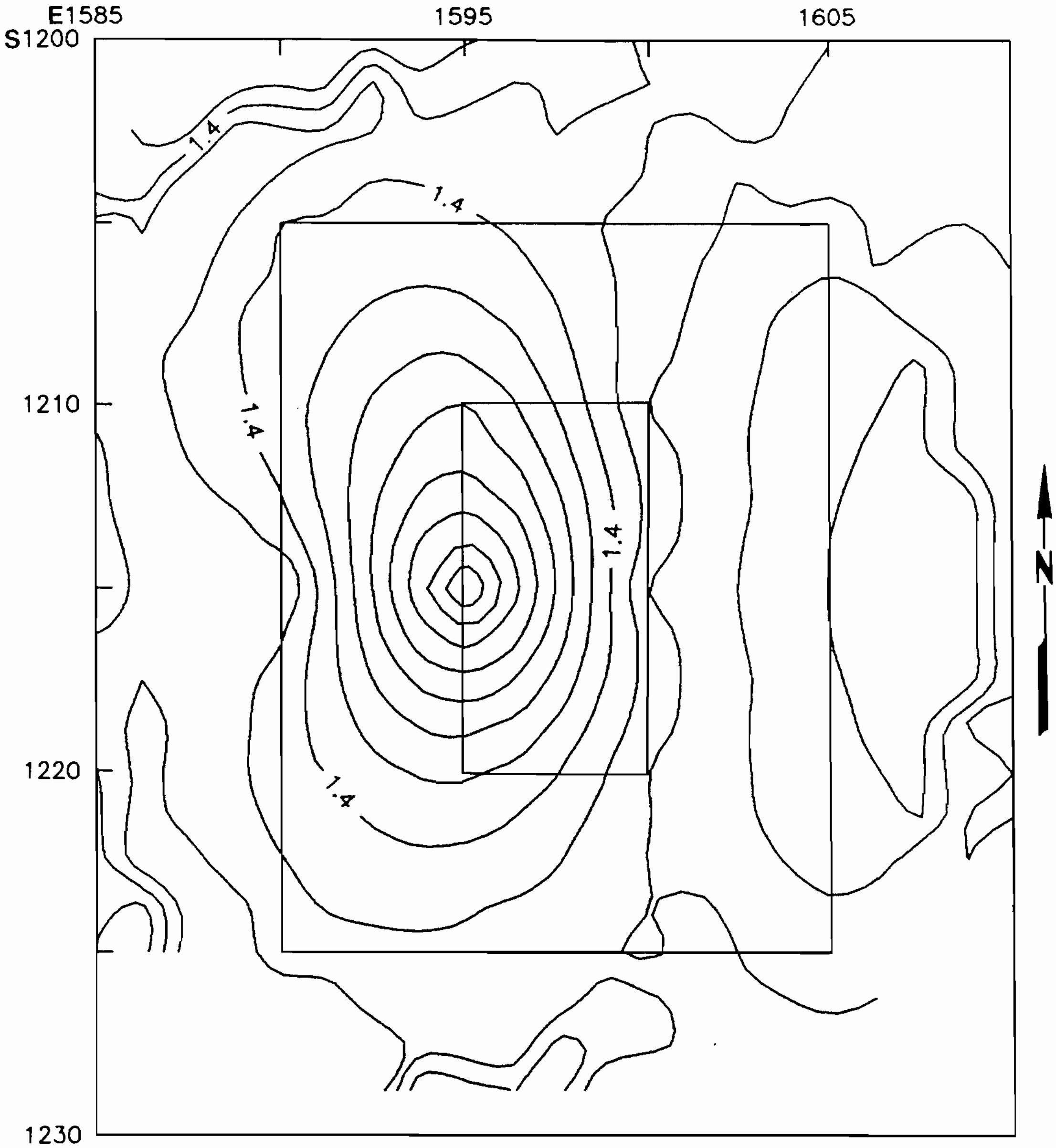

Figure 78. Distribution of all tools in Component I1.

I2

Component I2 is the smallest concentration of cultural materials at Locus I. It is located on the toe of the ridge 10 m west of I3. It is separated from that component by a tiny rivulet which flows off the end of the ridge into Nelson Wash. Only 7 tools and 35 pieces of lithic debitage were recovered from this component. The artifact types appear in Table 15 even though this component will not be compared to the other components because the sample is too small. The lithic debitage is predominantly basalt and only a few pieces of CCS were recovered in the 2 surface collection units which sampled this component (Figs. 79-80).

I3

Component I3 is located at the southern end of Locus I on the toe of the ridge. It produced a surprisingly small number of lithic flakes and a disproportionately high number of artifacts. Figure 79 indicates that I3 surface collection units recovered roughly half as much debitage as I2 units. CCS, however, is distributed in roughly similar amounts in each of these components. Tools were sparsely and broadly distributed across the component. Three small tool clusters are suggested for I3 by Figure 81. The two projectile points recovered in Locus I both came from the area of the southeastern cluster. One of these two points is a Silver

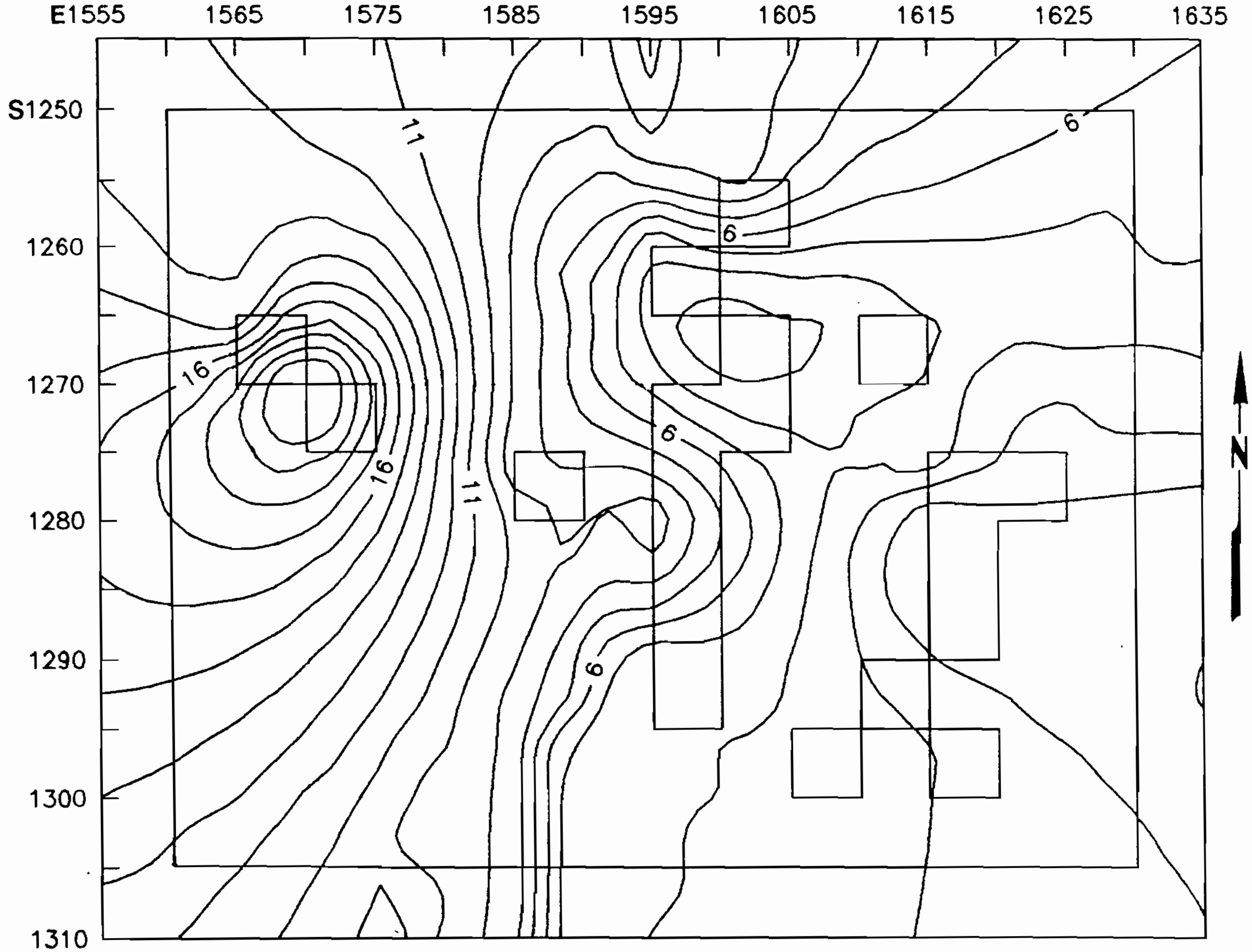

Figure 79. Distribution of lithic debitage in components I2 and I3.

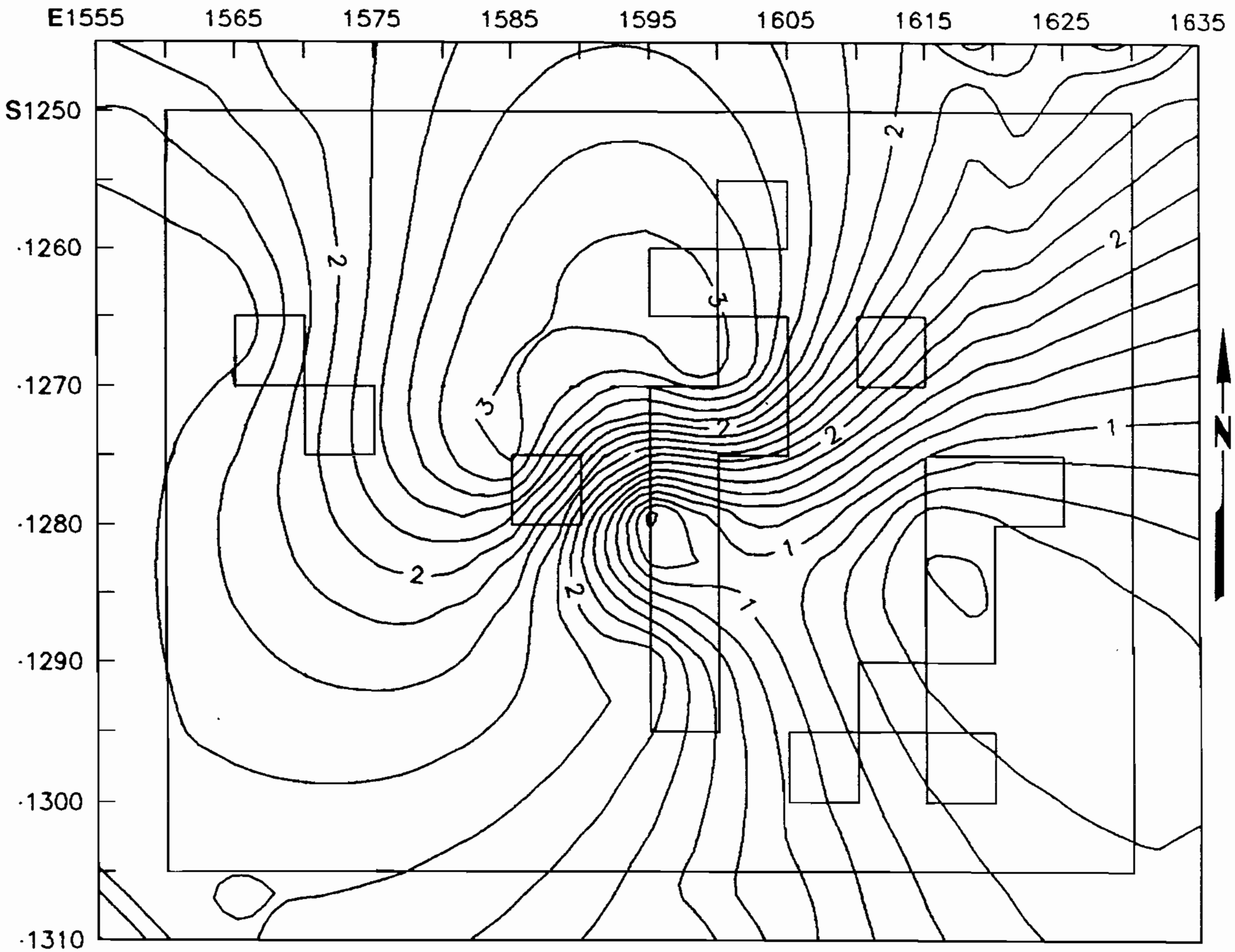

Figure 80. Distribution of CCS lithic debitage in components I2 and I3.

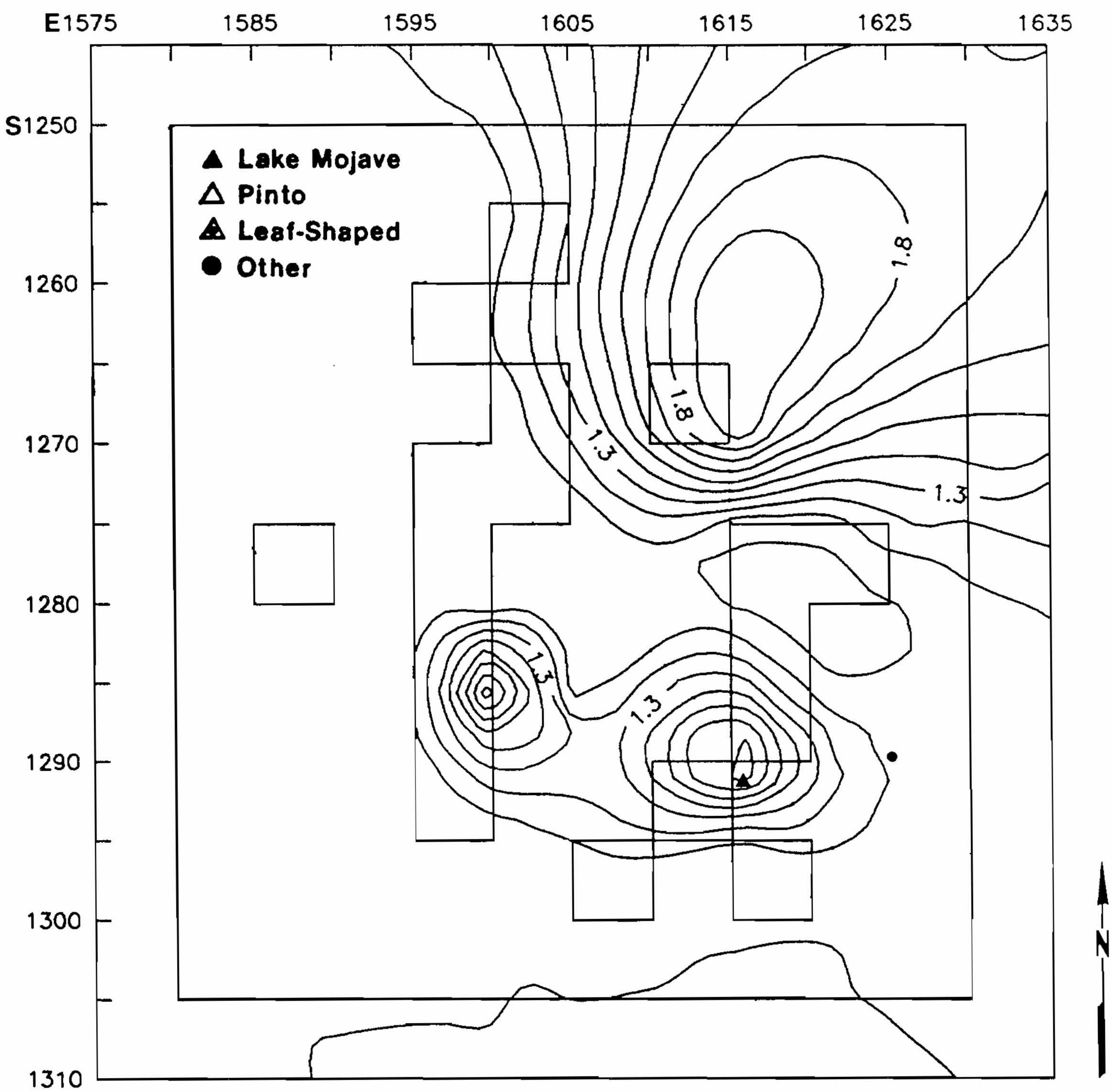

Figure 81. Distribution of all tools in Component I3.

Lake Rectangular point (Lake Mojave series) suggesting at least a portion of this component dates from the Lake Mojave period.

I4

Component I4 is another tiny component which is located in the northern end of the locus on a side terrace above the wash. It is bounded to the north and south by small rivulets. The surface collection recovered 58 flakes and 19 artifacts from this tiny component. The majority of the artifacts were clustered together near the southwestern corner of the component suggesting that erosion may have significantly affected the pattern of artifact distribution (Fig. 82).

Summary

The descriptions of 27 cultural and analytical components at the Henwood site have been presented in this chapter. These components are of unequal size, depth, and integrity and they are also both chronologically and functionally variable. Components A, B, CA, CB, CC, CD, D, F, HA, HB, I3, I4, 1, 2, and 3 comprise the assemblages of sufficient size for complete analysis and most reliable depositional contexts. Components Esur, I1, I2, and 4 comprised assemblages too small for some analysis, and components A-NL, B-NL, C-NL, G1sur, G2sur, H-NL, I-NL, and

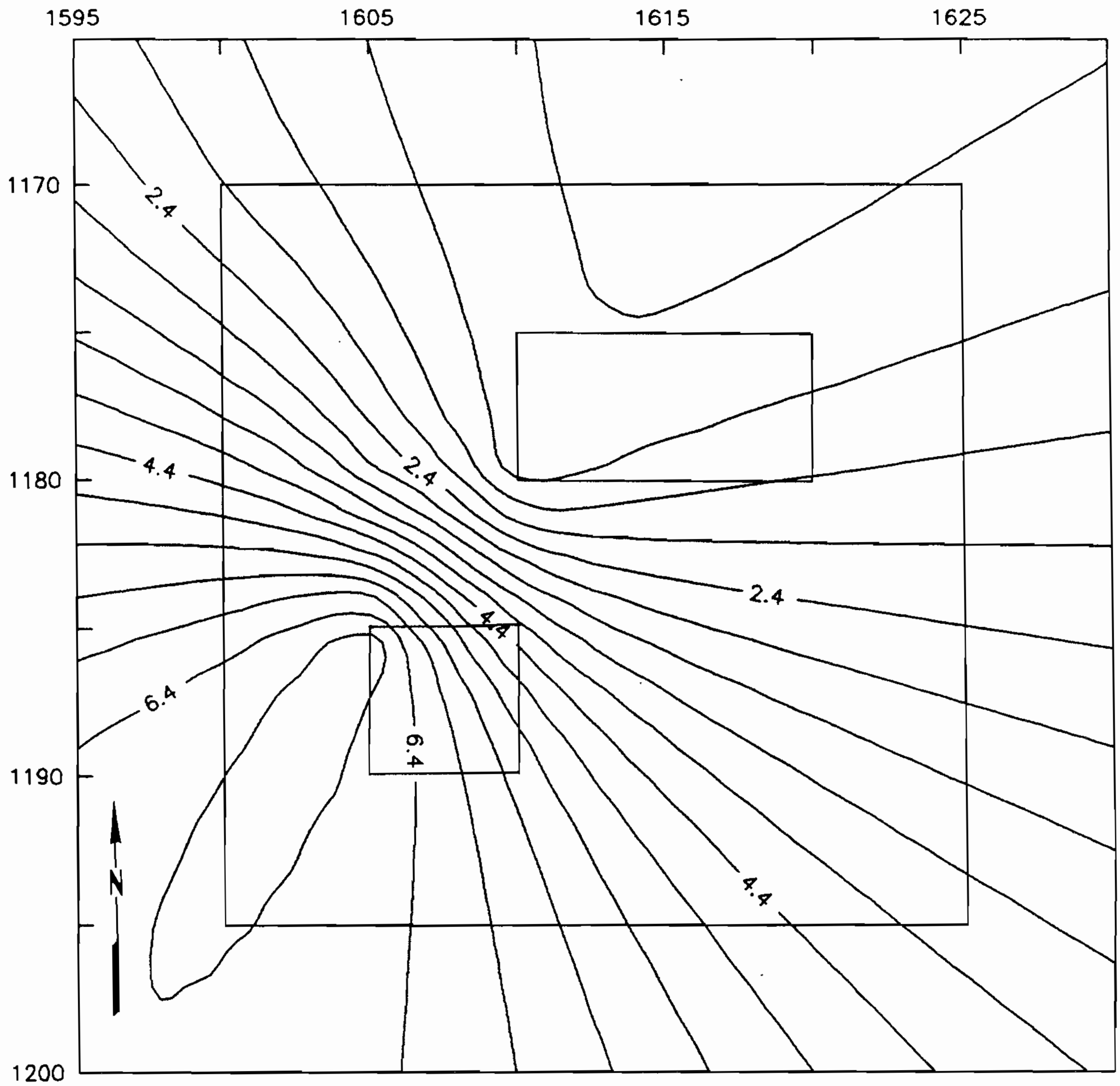

Figure 82. Distribution of all tools in Component I4.

NL&NLX are units of varying degrees of contextual reliability and analytical value. Each of these aspects will be considered in the inter-component analysis presented in Chapter VII.

CHAPTER VII

DEFINITION OF COMPONENT ASSEMBLAGES: INTER-COMPONENT ANALYSES OF CULTURAL MATERIALS

The investigation of artifact distributions presented in Chapters V and VI resulted in the delineation of 9 cultural and analytical components making up 3 loci at Rogers Ridge and 27 components in and around 9 loci at the Henwood site. Substantive efforts to sort out and date the cultural assemblages within these components have been presented. In this Chapter the components are chronologically ordered and their cultural assemblages compared. Three forms of chronological data--radiocarbon dates, projectile point distributions, and obsidian hydration measurements--will first be discussed, followed by a comparative analysis of the tool assemblages from the components. The 14C dating and projectile point assemblage methods and their intrinsic characteristics are well understood, requiring relatively little comment. Obsidian hydration, however, requires more control of local variables and will be discussed at greater length.

Radiocarbon Dating

Radiocarbon dating is the most accurate and informative kind of dating applicable at both Rogers Ridge and the Henwood sites. Though the number of datable cultural features encountered by the excavations was relatively small (10), the reliable radiocarbon dates presented in Chapters V and VI constitute a major addition to Lake Mojave-Pinto period archaeology in the Mojave Desert.

Projectile Points

The distribution of chronologically sensitive projectile points was employed as a relative means of dating the components. The artifact assemblages were chronologically seriated by the relative numbers of particular projectile point types found within them. Lake Mojave series, Leaf-Shaped, and Pinto points are the most prevalent types in the assemblages reported here.

Lake Mojave series points constitute the earliest common type of projectile points in the typology. Throughout the Intermontane West these points have repeatedly been shown to date primarily between 8,000 and 11,000 BP (Willig et al. 1988). Leaf-shaped points co-occur in varying percentages, in the assemblages studied here, with both Lake Mojave and Pinto series points. In the Columbia Plateau and Northern Great Basin similar point types have been dated from roughly 7,000 to 10,000 BP and are believed to interphase, at the younger end of this time period, with the Cascade series which continues well into the Mid-Holocene (Hanes 1988). Leaf-shaped, Pinto, and Lake Mojave series points co-occur at Rogers Ridge in deposits dated between 8,000 and 8,400 BP (Jenkins 1987:229). In this chapter we will see that they continue together until ca. 7,500 BP when Lake Mojave points are completely replaced by Leaf-Shaped and Pinto points which then continue together until at least 7,000 BP and possibly much later.

This method of dating must, of course, be cautiously used. As can be seen in the examples above, many of the point styles common in the Desert West were made over a period of several thousand years and are not particularly good time markers, in the sense that the best one can do with projectile point dating is to place the occupation within a relatively broad time span. Scavenging and curation of projectile points from earlier occupations must be carefully considered as a possible 'contaminant' in this type of dating, and the mixing of artifacts from occupations widely separated in time is another. Still, a high degree of success in the use of this technique is accomplished and reported in this chapter despite these potential problems.

Obsidian Hydration

Obsidian hydration dating proved to be widely applicable at Rogers Ridge and the Henwood site. Its application had to be approached carefully because of our current lack of full understanding and control of the variables which affect rates of hydration. The method can nevertheless be an effective tool when applied properly, even though it has not proven to be as straight-forward a method of dating as some researchers would like it to be (Ericson 1977; Meighan 1981).

Obsidian from different sources can hydrate at extremely variable rates in response to variation in its chemical composition. Variation is primarily controlled by the amount of rhyolite in the obsidian, which varies from source to source and even between flows of the same source (Friedman 1977). Hydration rates are also dependent on soil temperatures, which fluctuate greatly with site elevation, soil composition and color, and amount of vegetation, to name a few variables (Ridings 1991). It quickly becomes apparent that without careful control of sampling and interpretive procedures the results of obsidian hydration studies at archaeological sites can be misleading.

To achieve control of these variables I selected only obsidian from the Coso source for hydration studies, and processed a minimum of 10 samples or, alternatively, all available specimens, for each feature at Rogers Ridge. Similarly, Warren (1990) processed as many Coso obsidian samples as were available for each locus and/or component at the Henwood site.

Coso obsidian is distinctive among that from known sources in California, Nevada, and Oregon. Most of these obsidians tend to hydrate at a mean rate of ca. 1,000 years per micron (Tuohy 1980). That from the Coso source hydrates at an unusually fast rate, which has resulted in many hydration rinds exceeding 15 microns. Meighan (1981) has suggested a hydration rate of 220 years/micron for Coso obsidian and Ericson (1977) suggests a rate of 344 years/micron. These 'linear' rates, however, have proven unreliable in accurately dating cultural components of the Pinto and Lake Mojave periods (Jenkins and Warren 1985; Jenkins 1987). Part of the reason for this failure is probably inherent in the hydration process of the obsidian itself.

Jackson, who analyzed all the obsidian employed in this study, reported special problems with Coso hydration rind measurements and their interpretations to Warren (1990:232-233) in a personal communication:

> Hydration rinds of large size (and presumably great age) are often highly variable and exhibit poorly demarcated diffusion fronts. This is not always the case, but such problems are common. Variations in the thickness of individual measurements along single hydration bands can exceed one micron

> (variation is expressed as a standard deviation on the data sheet). The variable nature of measurements are inherent properties of the hydration itself, rather than phenomena produced by sample preparation or reading methods. It is entirely possible that these same phenomena occur with smaller hydration rinds, but they occur as a percentage of the total thickness and are, therefore, negligible with smaller bands. This is conjectural, but is a real problem that is not usually dealt with in hydration studies. This implies that hydration might be unable to provide precise chronometric dates.

Warren (1990:233) continues:

> If Coso obsidian is characterized by highly variable hydration measurements, then similar variability may be expected among hydration measurements of different items as well as among hydration measurments of a single specimen. Therefore, we assume that hydration measurements for a sample of Coso obsidian items from a short period of time will be highly variable. Consequently, it is stressed here that it is the mean of a group of measurements that is significant, not single or individual measurements. Standard deviation makes it possible to identify individual measurements that are aberrant.

Figure 83 illustrates the differences in hydration readings between Rogers Ridge and the Henwood site. The results of hydration measurements from the Awl site are also included in this figure because Warren (1990) has compared the hydration results from this site to those from the Henwood site.

We should remember while interpreting the graph in Figure 83 that the tremendous variability in the hydration rate of Coso obsidian makes it impossible in most instances to statistically prove any significant difference between samples of 1 micron thickness or less (cf. Jackson's

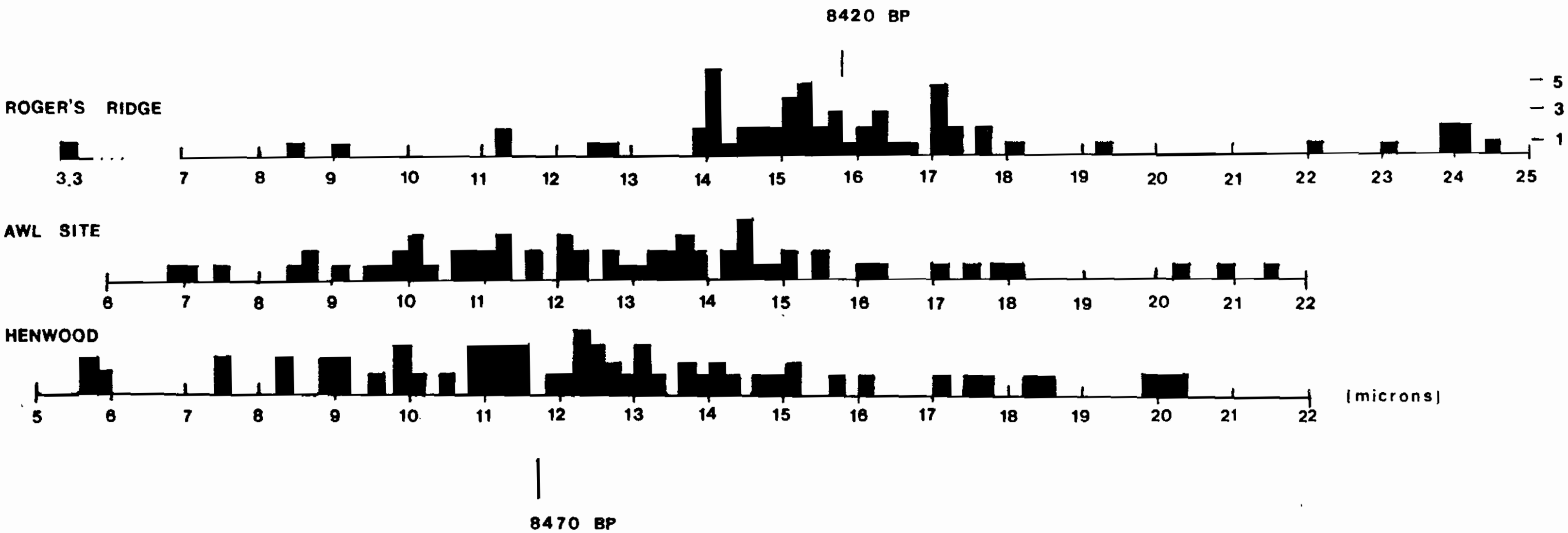

Figure 83. Obsidian hydration results from Rogers Ridge, Henwood, and Awl sites.

comments above and discussion of Component 1 at the Henwood site in Chapter IV, for example). To oversimplify the interpretation of this data, i.e. to simply imply that every occurrence of an aberrant reading among the samples is the result of mixing of deposits, would be to put us in the futile situation of attempting to explain every hydration reading individually. Mixing of deposits is one of many possible causes for unreliable readings among a sample of hydration measurements but it certainly is not the main cause of problems with the interpretation of individual Coso specimens here.

As stated above, the main problem with Coso hydration measurements is probably inherent in the obsidian itself, i.e. it hydrates rapidly and is normally quite variable. Some of the readings in Figure 83 are aberrant for the samples they were recovered with and simply must be rejected. What is important is for us to understand how the mean of each sample fits the overall pattern of hydration through the period(s) of occupation represented by the data.

Figure 83 indicates that obsidian hydration rates have varied significantly between these three sites but that the general patterns of hydration are duplicated in many ways throughout their samples. The two sites located at higher elevations in alluvial settings are most similar to each other, have smaller hydration means, and exhibit greater variability in their samples. All of the sites have a relatively broad range of hydration readings, but the Rogers Ridge sample is far less variable than those of the other sites.

At the upper end of the scale in Figure 83 there is a group of hydration readings at each site ranging from 20 microns upward. This group could represent Clovis occupations, as suggested by the recovery of fluted points at Rogers Ridge and the Henwood sites, or these readings may represent measurements taken on cortex or old surfaces of quarry material as suggested by Warren (1990:259). Next, there is a possible cluster of readings from 17.0 to 18.0 microns. This group, in most cases, cannot be shown to be statistically different from the main body of readings from each site. In most cases, these readings occur as somewhat aberrant samples falling within 1 or 2 standard deviations of the mean for the component they were recovered in.

The corpus of readings at Rogers Ridge falls between 16.5 and 14.0 microns. Those at the Henwood and Awl sites fall out between 9.0 and 15.0 microns (Fig. 83). Yet, Features 2 and 3 at Rogers Ridge and Component 1 at the Henwood site produced radiocarbon dates in the range of 8,400 to 8,500 years BP. A mean of 15.9 microns from these dated features is equivalent to 8,420 RCYBP (radiocarbon years before present) at Rogers Ridge while a mean of 11.9 microns from the dated features is equivalent to 8,470 RCYBP at the Henwood site.

Clearly, one hydration rate for both of these sites will not work. The proper interpretation of these extremely variable readings hinges on our understanding that they represent highly divergent temperature histories. This is true even when the samples come from the surface and subsurface of the same site (cf. Ridings 1991 for further discussion of this general topic).

Two variables which must be considered in the interpretation of obsidian hydration rates are temperature and soil. Temperature regimes are the single most important factor in the formation of hydration rinds since hydration is accelerated by increasing temperatures (Friedman and Long 1976,Friedman and Smith 1960, Friedman and Trembour 1983, Michels 1986, Ridings 1991). Temperatures can vary greatly between surface and subsurface settings. Temperatures at the surface of sites in the Mojave Desert range well above 100 degrees during the summer while deposits 30 cm below the surface are subjected to lower and more constant temperatures. This suggests that hydration rinds should be thicker among specimens recovered on or near the surface and that separate hydration rates should be calculated for surface and subsurface samples (cf. Friedman 1977:339, for example).

The effects of soil composition must also be a factor, since it affects the rate at which temperature changes. Compaction, grain size, and the depositonal sequence(s) of each deposit affect the temperatures to which the obsidian samples are subjected. Samples recovered in slowly accumulating, fine grained deposits may be exposed on and near the surface longer than obsidian samples deposited on more coarsely-grained and rapidly accumulating alluvial surfaces. Eolian deposits frequently accumulate and blow away rapidly, once again varying the amount of time artifacts remain on or near the surface in fairly loose deposits.

This suggests that measurements taken on surface artifacts will probably be most reliable when these artifacts have been consistently exposed on or near the surface, e.g. in areas of shallow or non-existent deposits like desert pavement and bedrock. The constant exposure to high temperatures in these settings should cause specimens recovered from them to have relatively constant hydration rates, producing smaller standard deviations in most cases. This assumption appears supported by the data from loci A and B at the Henwood site, which both have low standard deviations. This may also explain why hydration rims are more consistent in later period sites than in early sites. Later cultural materials are generally found in shallow deposits near the surface. All the obsidian has been exposed to consistent, near surface, temperatures. Hydration rates should have varied little in such settings and standard deviations should be relatively small. Conversely, components in depositional sites of extreme antiquity should have more variable hydration readings simply because the possible combinations of hydration rates experienced by each specimen which may relate to individual depositional histories, are dramatically increased with time and depth of deposit.

It is impossible to calculate all the forces which have affected the temperatures to which individual samples have been exposed. Simply stated, the best we can do is to employ a hydration rate for sites close in proximity, elevation, environmental settings, and depositional context. Even then, individual specimens and tiny sample groups will often produce incomprehensible hydration readings and means which do not date predictable cultural events.

Though obsidian was widely distributed at both Rogers Ridge and the Henwood site, it generally comprised less than 1% of any sample of flaked stone specimens and was frequently missing completely from component assemblages at the Henwood site. This is not surprising since it is approximately 75 miles to the Coso obsidian source from the Henwood site and roughly 90 miles from Rogers Ridge. The vast majority of obsidian debitage at both sites results from the reworking of complete artifacts rather than initial manufacture of artifacts from quarried material. Combine this fact with the laboratory specimen size requirement for each piece to be at least 1 cm in diameter and the result is many tiny (1 to 3) to small (4 to 6) obsidian hydration samples per archaeological component. The data presented here suggest that small samples may well produce reliable results but tiny samples are frequently unreliable.

Warren (1990:232-252) has proposed the use of two hydration rates for the Henwood site and I present one here for Rogers Ridge. These rates are based on associations with radiocarbon dates at both sites. The depositional environments and soil types of these sites, however, vary significantly. This has led to significant variations in the obsidian hydration measurements, the hydration rates, and the need for one or more rates at each site.

The Henwood site samples were deposited in alluvial sediments which have apparently accumulated over many thousands of years. Intra-component comparisons of depth to cultural features, concentrations of artifacts, radiocarbon dates, and obsidian hydration rind thicknesses all suggest that the alluvial deposits of the site accumulated very slowly. This is primarily due to the very gradual accretion of sheet-wash and sieve deposits over most of the site's relatively flat surface. Warren (1990:245) proposes a 'slow' rate of 712 years per micron for the subsurface samples recovered in these deposits.

Erosion along the western side of the Henwood site nearest Nelson Wash, and along the banks of Halfway Wash, has exposed some cultural materials and left them lying on very old soil horizons. Other assemblages, particularly those in loci adjacent to Nelson Wash, were deposited directly upon these ancient surfaces and probably never have been shielded from the effects of high surface temperatures. Warren (1990:232-252) proposes a 'fast' rate of 570 years per micron for these samples, which consistently have thicker hydration rinds than the subsurface samples above.

Samples from Rogers Ridge have been subjected to a much different environmental and depositional context. The site is located 420 m lower in elevation (430 m as compared to 850 m at the Henwood site) and is situated in a much more dynamic environment than prevails at the Henwood site. Deposition tends to have occurred within eolian or fluvial sands and overall deposit depth is generally shallow (ca. 50 to 70 cm at maximum depth).

These conditions have subjected the obsidian samples at Rogers Ridge to higher average temperatures than prevail at the Henwood site and this has caused them to have consistently thicker hydration rinds. It has also resulted in the reduction of variability among individual readings by reducing the variation in mean temperatures between surface and subsurface environments. This has apparently led to a more consistent and faster rate of hydration at Rogers Ridge than at the Henwood site. The result is evident in Figure 83 in the tight clustering of hydration measurements from Rogers Ridge.

Two other factors, however, must also be taken into consideration. First, at Rogers Ridge the preponderance of measurements come from a few radiocarbon dated components and thus, may date a narrow period of time when obsidian was deposited in and near these features. That is, the dated obsidian may represent a skewed sample. Second, intense occupation of the site may indeed have been limited to one or more relatively short time periods when water was available in the now-fossil spring at the northwest end of the site. In either case, the tightly clustered hydration readings would be the result of a short time period during which the most intense occupations of the site occurred. The results presented in Figure 83 are probably due to all of these factors.

The radiocarbon dates from cultural features at Rogers Ridge suggest that hydration rates vary from 497 (Feature 2) to 536 (Feature 3) years per micron. The mean of these rates, excluding the non-cultural 14C date on soil from near Feature 4, is 525 years per micron and this is the rate which will be employed here for Rogers Ridge.

Application of this rate does not fit well with the radiocarbon date of 4,020 BP from Feature 7 which also produced two hydration readings (11.3 and 12.6 microns) with a mean of 12.0 microns. Applying the proposed hydration rate of 525 years per micron would produce an equivalent date of 6,300 RCYBP when applied to the mean of these readings.

Applying Ericson's hydration rate of 344 years, as suggested by Meighan (1989:115) would produce an equivalent RCYBP date of 4,128.

But application of Ericson's rate would conflict with the radiocarbon dates on all other dated features at the site! As I have previously stated (Jenkins and Warren 1985, Jenkins 1987), Ericson's rate must be rejected because it places most Pinto material well into the succeeding Gypsum period. Also, to accept Meighan's suggestion that we do so would require us to also accept a hydration mean of 12.0 microns on a Coso obsidian Lake Mojave point recovered nearby. A 4,128 year date on a Lake Mojave point is far too late, and is clearly another indication that Ericson's rate cannot be applied to Lake Mojave and Pinto age assemblages.

It seems clear to me, from my own extensive attempts to account for individual hydration readings, that it is futile, and naive, to continue to believe that each hydration reading is significant of itself. Considering the great variability of hydration rinds within a single specimen and the skepticism reported by Jackson and Warren, it would be unjustified to reject, on the basis of a few individual exceptions, the considerable weight of evidence which favors a much slower hydration rate for Lake Mojave-Pinto age specimens than those proposed by Ericson (1977) and Meighan (1981). It is much better to be consistent in our methods, to recognize the current limitations of the data and the hydration dating method, and develop a 'best fit' rate for each site or site setting as proposed by Gehr (1988) for other Coso samples.

Warren (1990) has applied a 'best fit' approach at the Henwood site, and I have done it here for Rogers Ridge. The results are useful and suggest a possible resolution to some of the apparent discrepancies between projectile point assemblages and radiocarbon dates evident in my first review of these data (Jenkins 1987). These problems are addressed below.

Chronological Variation Among Tool Assemblages

As stated in Chapter I, this work has focused on the effort to construct meaningful archaeological assemblages for analysis and to identify chronologically sensitive shifts in artifact assemblages. Chapter IV presents the methods and assumptions employed, while Chapters V and VI outline the reasoning behind the delineation of the cultural and analytical components. These analyses resulted in the assemblages compared in this chapter.

If chronologically sensitive artifact assemblages have been accurately identified by this study, the assemblages should exhibit patterned changes through time between site components. For instance, Warren (1990:279) found that domed and keeled scrapers are most common in Lake Mojave assemblages (those assemblages which contain only Lake

Mojave points) and early Pinto assemblages (where Lake Mojave and Pinto points co-occur). Spiked gravers occur in all Lake Mojave and Pinto assemblages but are most frequently associated with early Pinto assemblages, decreasing steadily in number from that time on. Retouched flake unifaces follow a pattern of steady increase through time at the expense of thicker, edge modified scrapers (e.g. domed and keeled scrapers).

The component assemblages from Rogers Ridge and the Henwood site are first chronologically ordered, then compared to identify patterns of artifact variation which may be indicators of cultural change through time.

Chronological Ordering of Components at Rogers Ridge

Table 16 chronologically orders the archaeological components at Rogers Ridge, with reference to projectile point assemblages, radiocarbon dates, and obsidian hydration measurements. The Lake Mojave series (LM) includes Lake Mojave Long-stemmed, Lake Mojave Short-stemmed, Silver Lake Rectangular-stem, and point fragments with convex bases. The Pinto series (P) includes Pinto points and point fragments with concave bases. The Leaf Shaped series (LS) includes Leaf Shaped points and fragments of Leaf Shaped points.

Lake Mojave series points are the oldest points clearly associated with artifact assemblages in the site, barring the two fluted points which are isolated and possibly

Table 16. Chronometric data and ordering of the cultural components at Rogers Ridge.

Compon.	Radiocarbon Dates (BP)	Obsid. Hydra. Measur. N =	Mean	Range	Projectile Point (freq.)			RCYBP
Emman	none	1	8.5*	8.5	Pinto	(16)	73%	4463
					LM	(1)	5%	
					LS	(3)	14%	
So2/3	4020+/-110	4	12.0*	11.3-12.8	Pinto	(2)	33%	6326
					LM	(2)	33%	
Empr	5050+/-230 ?	5	14.3*	9.0-17.4	Pinto	(7)	39%	7508
					LM	(6)	33%	
	modern				LS	(3)	17%	
2B	8180+/-150	40	15.4	11.4-19.3	Pinto	(7)	47%	8033
	8300+/-110				LM	(3)	20%	8085
	8410+/-140				LS	(4)	27%	8243
Main	none	-	-	-	Pinto	(3)	25%	
					LM	(5)	42%	
So3	none	-	-	-	Pinto	(1)	8%	
					LM	(6)	50%	
					LS	(2)	17%	
So2	7910+/-420	11	16.2	13.9-17.7	LM	(8)	66%	8348
	8420+/-210	6	23.4	20.3-24.5	LS	(2)	17%	8505
								12,338
Per	none	-	-	-	LM	(2)	50%	
					LS	(1)	25%	
Sol	none	2	12.1*	11.8-12.3	LM	(4)	57%	6353
					LS	(2)	29%	(9188)

* sample too small to provide a reliable mean
RCYBP= obsidian hydration equivalent of radiocarbon years BP

curated occurrences. Lake Mojave series points co-occur in most assemblages with Leaf Shaped projectile points (Table 16). Pinto points co-occur with Lake Mojave and Leaf-Shaped points in 5 of the 9 Rogers Ridge components but are clearly predominant only in the Emman assemblage, suggesting that this area was the scene of the most intense and latest Pinto occupation at the site.

Emman is the latest component at Rogers Ridge, judging from both the projectile point assemblage (73% Pinto points) and the single obsidian hydration reading of 8.5 microns. The strong patterns of artifact distribution and predominance of Pinto points clearly indicate this component is different than the majority of components at either Rogers Ridge or the Henwood site.

The estimated age (Table 16) of this component (RCYBP) is tenuous because it depends on a single hydration reading. A very late time period is suggested by the large number of Pinto points and the 5,050 BP radiocarbon date recovered from Feature 1 in the deposits of Empr nearby; however, Emman itself remains only provisionally dated.

Components So2/3 and Empr are small data sets comprised of mixed assemblages, portions of which possibly date from 'Late' Pinto occupations. Neither of the radiocarbon dates recovered from these components (Table 16) are clearly associated with a cultural assemblage. Consequently, though So2/3 and Empr suggest possible Neopluvial occupations they are not clearly representative of the main Pinto occupation at this site.

Component 2B is the most important and interesting component at Rogers Ridge. Three radiocarbon dates from this well preserved component indicate it represents a relatively short period of occupation associated with a now-fossil spring. The earliest of the cultural dates (8,410 BP) was recovered from a hearth surrounded both vertically and horizontally by Pinto points. This date is virtually identical to the earliest date recovered from Feature 2 (8,420 BP), a deflated midden on the south side of the ridge. No projectile points were recovered in direct association with the Feature 2 radiocarbon samples, but 4 Lake Mojave series points and 5 Leaf-shaped points were recovered from the surface within 20 m. of the location of the samples from which the dates were obtained (Jenkins 1987:225). Though the radiocarbon dates from these features are virtually identical, their obsidian hydration means vary slightly.

The type composition of the projectile point assemblage indicates Feature 2 should be somewhat older than 2B. Feature 2 produced two hydration means of 15.9 microns and 23.4 microns on samples which have proven to be statistically separable (Jenkins 1987:226). The older of these samples may date from the Clovis period or, alternatively, could be recording ancient quarry surfaces. This sample produces an equivalent date of 12,338 radiocarbon years BP, about a thousand years too old for most Clovis occupations in the western United States. The smaller of the two means from Feature 2 produces an equivalent date of 8,348 RCYBP. The combined So2 sample, including the younger sample from Feature 2, for a mean of 16.2 microns, suggests a date equivalent to 8,505 RCYBP.

On the other hand, Feature 3, in Component 2B, and radiocarbon dated to the same time period, produced a mean of 15.7 microns which is equivalent to 8243 rcybp. Feature 4, radiocarbon dated at 8,180 BP, produced a mean of 15.3 microns equivalent to a date of 8,033 RCYBP. Though these obsidian hydration means are not statistically divisable from either each other or the mean of Feature 2, they do suggest that the difference in projectile point assemblages could be due to the addition of Pinto points to the Lake Mojave assemblage sometime after 8,200 and before 8,000 years ago. This would explain why Feature 2 in Component So2 contains only Lake Mojave and Leaf-shaped points while Component 2B contains Lake Mojave, Leaf-shaped, and Pinto points. Thus, it is possible the majority of occupation in Component 2B actually occurred a few hundred years after the occupation of Feature 2, which contains no Pinto points.

Comparison of Non-projectile Point Assemblages

The work at Rogers Ridge involved several phases of excavation, mapping, and surface collection. This resulted in the relatively large artifact assemblages presented in Table 2. Intercomponent projectile point assemblages can be legitimately compared without worry that the samples were judgementally skewed because all projectile points were collected as they were encountered. This was not the case with other biface forms and unifaces, however.

To render the non-projectile point assemblages comparable, only the artifacts recovered in the excavations and the randomly selected 5X5 m surface collection units will be compared. The elimination of a significant number of artifacts by this process makes it prudent to combine some classes for the analysis. Gravers are considered as a separate class. All relatively thick, plano-convex scraper forms (domed, miniature domed, keeled, end, side, concave, pointed, and ovoid side scrapers 7.2) are combined into the class Thick Scrapers. All thin scrapers (ovoid side scrapers 7.1 and 7.3, tear drop side scrapers, D-shaped flake scrapers, irregular flake scrapers, etc.) were combined into the class Flake Scrapers on the basis of their relative thinness. Miscellaneous uniface fragments form the class MUF.

Biface types 1 (tips) and 25 (amorphous fragments) were combined to form the class Biface Fragments. Biface type 2 remains a single class as do types 5, 6, and 7. Types 3 and 4 are combined to form the class 3&4. Types 8, 9, 10, 14, 19, and 20 are combined to form the class Blanks. All forms of cores are represented by the class Cores and the class Gro.sto. represents all ground stone forms, consistent with previous tables. Table 17 presents the representative tool assemblages of these components, which can be directly compared to each other.

Table 17. Selected artifacts recovered from all components at Rogers Ridge.

Component:	So2/3	Emman	Empr	2B	Main	Per.	So2	So3	Sol
Types:									
GRAVERS	1	2		5	1		3		
THICK SCR.	1	5		17	3		12	2	5
FLAKE SCR.	1	1	1	6	2		7	1	2
MUF	2	10		6	8		1	3	3
BIF. FRAG.	3	63	3	19	20	4	24	2	1
2	1	2		1	3		3		2
3&4		7		1	4	1	5		
5	1	14		13	6		3	2	6
6		9	1	4	4		4	2	1
7	1	3		3	1		1		2
BLANKS		6	3	13	5		5	1	8
cores	3	10	1	15	9	2	9	1	3
gro. sto.		2	2	17	8				
	14	134	11	120	74	7	77	14	33

Cluster Analysis

The data from Table 17 were entered into a computer program (Systat) and cluster analyses, employing Euclidean distances and the average linkage method, ordered the assemblages by degree of similarity. A series of 20 such analyses were conducted. Different combinations of tool types believed to be possibly sensitive to change through time were run through the cluster program to investigate what artifact classes were most affecting the arrangement of components. The first ten cluster analyses did not include projectile points or ground stone artifacts. Projectile points and ground stone were included in the second set of 10 cluster analyses.

Varying the artifact classes in the cluster analyses frequently caused significant rearrangement in the clustering order of the components. Therefore, the number of times individual components occurred as pairs with other components were calculated from the 20 cluster diagrams to investigate the broad patterns of similarity between all assemblages. Scores of similarity between paired assemblages, as well as the number of times an assemblage was dissimilar to all other assemblages, are expressed as percentages in Table 18. The site components are ordered from youngest to oldest beginning in the upper left hand corner and extending to the right and bottom of the page.

Most assemblages (78%) in Table 18 were at least occasionally dissimilar to all others, as indicated by the diagonal line of circled scores, indicating some degree of variability within their assemblages. Emman, the youngest assemblage, varies strongly from all other assemblages, occurring as a dissimilar assemblage 67% of the time. It is characterized by large numbers of Pinto points and biface fragments, which comprise 47% of the assemblage, and small numbers of gravers and scrapers.

Table 18. Percentage of times individual components cluster with the other components or do not cluster with any other component.

	Emman	So2/3	Empr	Per	So3	2B	Sol	Main	So2
Emman	67%	0	0	0	0	17%	3%	7%	0
So2/3	0	0	27%	50%	31%	0	15%	0	0
Empr	0	26%	6%	43%	27%	4%	12%	0	0
Per	0	35%	27%	0	27%	0	6%	0	0
So3	0	30%	31%	0	2%	0	12%	0	7%
2B	19%	0	2%	0	2%	22%	0	15%	32%
Sol	5%	9%	8%	7%	7%	0	21%	26%	11%
Main	10%	0	0	0	0	17%	21%	22%	29%
So2	0	0	0	0	4%	39%	9%	30%	21%

Components 2B, So2, Sol, and Main all occur as dissimilar assemblages in 21 to 22% of the cluster analyses. These are very high scores compared to those of the four small less reliable assemblages (discussed later in the text) which average about 2% in this category (Table 18). On the other hand, these four assemblages are also most similar to each other throughout most of the cluster analyses.

Components So2/3, So3, and Empr clustered tightly throughout the cluster analysis. These assemblages, as well as the tiny Per assemblage, are predominently palimpsest assemblages which include both Lake Mojave artifacts scattered by natural and cultural atrophy as well as thinly deposited Pinto and possibly later artifacts. These four assemblages clustered from 26% to 50% of the time with each other (Table 18), indicating a high degree of similarity.

Summary of Components and Assemblages at Rogers Ridge

The earliest distinct assemblage at Rogers Ridge was recovered from the So1 component of the Southern Locus. It is an unmixed Lake Mojave assemblage of unknown age. It is most similar to the Main subcomponent of the Spring Locus. The Main assemblage is not dated by either radiocarbon or obsidian hydration but is very similar in age, function, or both to the So1 and So2 components. It probably dates somewhere in between the two, and its occupation may have actually overlapped both.

Components So2 and 2B, located in the Southern Locus and Spring Locus respectively, exhibit remarkable similarities. They are 14C dated to virtually the same time period (8,000 to 8,400 BP) and are nearly indistiquishable typologically. Though 2B, an early Pinto component, is strongly similar to So2 it is far less similar to Main which lies directly downslope from it. This suggests that 2B is younger than both So2 and Main but that it is most similar to So2. Though 2B contains a substantial proportion of Pinto points (47%) it also contains Lake Mojave Short-stemmed and Leaf Shaped points which comprise the majority of point types in the So2 assemblage. In addition, the 2B and So2 assemblages contain nearly identical proportions of gravers and scrapers (ca. 30%). They do not share the characteristic of ground stone but this apparently has little effect on their clustering.

Emman, the main assemblage from the Embayment locus, is a unique assemblage at Rogers Ridge. It is most similar to 2B, though even that similarity is weak. A radiocarbon date recovered in the adjacent Empr component, from the deposits the Emman materials are eroding out of, suggests the Emman component could be 3,000 years younger than the 2B deposits. The single obsidian hydration reading from the Emman component (8.5 microns) supports the interpretation that it is a late Pinto component. The assemblage is most strongly characterized by large numbers of Pinto points and bifaces and relatively small numbers of gravers and unifaces. It shares small numbers of ground stone items with 2B, Main, and Empr, components which also contain quartz/quartzite debitage and hammerstones.

Components So2/3, So3, Empr, and Per are all tiny assemblages composed of Lake Mojave artifacts derived from artifact concentrations which have been scattered by natural and cultural forces. Mixed in with these assemblages are small numbers of Pinto artifacts. The combination of small size and artifact compositions are believed to be the main cause for the frequent clustering exhibited by these assemblages.

Very late radiocarbon dates of 4,020+/-110 and 5,050+/-230 BP were recovered in So2/3 and Empr, respectively. The few obsidian hydration readings from these two components also suggest the presence of relatively late Pinto materials but these samples are too small to be reliable. In contrast to these, the So3 and Per assemblages are completely undated but seem to be more similar to the earlier (Lake Mojave) components of the site rather than to the later assemblages.

Inter-component Analysis of the Henwood Site

The analysis of artifact distributions and division of components at the Henwood site closely followed the pattern established for the analysis of Rogers Ridge. The Henwood site components and cultural materials, however, have already been extensively analyzed (Warren 1990) and the analysis presented here makes no attempt to duplicate that effort.

Lyneis and Warren (1990:176-200) compared all the assemblages recovered from the Nelson Wash data recovery project (re. Vaughan 1984). They employed a series of comparative analyses and concluded that 1) the large sites were mere conglomerates of the small sites and 2) diversity (a term they used to imply numbers of tool types rather than percentages of tools in each type, as I have used the term here) is directly related to assemblage size, i.e. the larger the assemblage the more tool types will be present. Warren (1990:262-279), continuing the analysis, employed a series of Chi-square tests to investigate the chronologic sensitivity of artifact types throughout this extremely large collection. As I alluded in Chapter III, his analyses lead him to conclude that several of the artifact classes investigated were chronologically sensitive, being good indicators of the Lake Mojave, Early Pinto, and/or Late Pinto periods.

Considering the extensive analyses of Warren and Lyneis, I chose to investigate the internal distributions of cultural materials within the components of the Henwood site. The use of different morphological types and the subdivision of some of the loci identified by Warren (1990) provided an independent evaluation of the assemblages of this site.

The investigations reported here identified 27 cultural/analytical components at the Henwood site. Some 23 of these components contained some form of chronometric data (radiocarbon, obsidian hydration, or projectile points; Table 19). Six components, those with the post-script -NL, are simply analytical units which comprise artifacts recovered from around the artifact concentrations/activity

Table 19. Chronometric data and ordering of the component at the Henwood site by projectile point frequencies.

Comp.	Radiocarbon Dates (BP)	Obsid. Hydra. Measur. N =	Mean	Range	Projectile Point (freq.)	Obsid. RCYBP
G2sur	none	6	10.7*	8.2-12.9	none	6099
Esur	none	1	11.0*	11.0	none (6954*)	6270
HB	7140+/-290 ?		none		Pinto (1) 100%	
F	none		none		Pinto (1) 100%	
A-NL	none		none		Pinto (1) 50%	
					LS (1) 50%	
CB	none	1	12.3*	12.3	LS (1) 33%	7011
H-NL	none	1	12.4*	12.4	Pinto (1) 25%	7068
					LS (2) 50%	
HA	none	2	12.9*	11.9-14.0	LS (1) 100%	7353
Comp.2	7150+/-290	4	10.4*	7.6-13.0	none	7405
	7400+/-280					
CD	none	1	13.6*	13.6	Pinto (1) 50%	7752
					LS (1) 50%	
G1sur	none	5	13.5*	10.7-17.7	Pinto (3) 50%	7695
					LM (1) 17%	
					LS (1) 17%	
Asouth	none	2	13.7**	13.7-14.1	Pinto (5) 33%	7809
					LM (5) 33%	
					LS (4) 27%	
C-NL	none	1	16.0*	16.0	Pinto (1) 10%	9120
					LM (5) 50%	
					LS (2) 20%	
Anorth	none	2	13.7**	12.2-14.7	Pinto (2) 10%	7809
					LM (12) 60%	
					LS (6) 30%	
NL&NLX	none	16	12.9	5.7-19.3	Pinto (1) 7%	7353
					LM (9) 64%	
					LS (2) 14%	
B	none	3	14.6*	13.1-16.6	LM (7) 54%	8322
					LS (6) 46%	
Comp.3	none	8	11.76*	9.0-13.2	LM (1) 100%	8372
Comp.4 (20-50 cm)	none	5	11.8*	8.9-18.3	none	8402
Comp.1	8470+/-370	22	11.9	7.5-15.9	LM (2) 50%	8472
					LS (1) 25%	
CA	none	1	15.1*	15.1	LM (1) 33%	8607
					LS (1) 33%	
I3	none		none		LM (1) 100%	
B-NL	none		none		LM (1) 100%	
CC	none	1	5.6*	5.6	LM (1) 100%	3192
Comp.4 (50-70 cm)	none	6	16.1*	10.1-20.0	none	11463

* sample is too small to provide a reliable mean
** small sample mean which appears for both Anorth and Asouth

areas. They are generally dated by projectile point assemblages and an occasional obsidian hydration reading, but are useful for comparison with the spatially discrete, more cohesive samples.

Component 4 has been subdivided, on the basis of obsidian hydration results, into two subcomponents (Table 19) for dating purposes only. It will not be considered in the comparative analysis of tool assemblages because only 4 tools were recovered from it. Components Esur, I1, and I2 will not be dealt with for the same reasons. No projectile points were recovered from any of these components and obsidian is rare in all but Component 4. Further analyses of these tiny components would not add significantly to our understanding of the site, culture history, or the cultural processes of the Mojave Desert. The analysis of tiny components at Rogers Ridge revealed a tendency for them to be most similar to each other simply because of their sample size. Therefore, only Henwood site components containing 19 or more artifacts will be compared for similarity.

Chronological Ordering of the Components at the Henwood Site

Excavations at the Henwood site encountered 24 cultural features. Unfortunately, these features generally contained insufficient carbon for dating purposes. Consequently, only 5 radiocarbon dates were recovered from the site. Though extreme care was taken to avoid contamination of the samples during sample preparation, one sample (AA-798) produced an unreliable date of 4,360 BP which must be rejected because it came from Feature 15, a hearth also dated at 8,470 BP, in a component containing only artifacts of the Lake Mojave complex (Warren 1990:230). The obsidian hydration rate of 712 years per micron, which is applied to the Coso obsidian in subsurface components, has been calculated from this radiocarbon date (Warren 1990:245).

Another problem with dating at the Henwood site was the complete lack of projectile points in Component 2, where two radiocarbon dates from Features 10 and 21 were recovered. The lack of points is somewhat surprising since a large block excavation was conducted around these features involving more than 50 sq. m of area. The dates of these features are remarkably similar to each other and to Feature 2 which is located near component HB. Feature 10 is dated 7,150 BP, Feature 21 is dated 7,400 BP, and Feature 2 produced a date of 7,140 BP. Warren (1990:251) employs these dates in his deductive calculation of the hydration rate of 570 years per micron for nearby surface materials. As we shall see below, the proof of the efficacy of this rate is in the chronological ordering of the various components.

Table 19 provides a comparison of the chronometric data by locus at the Henwood site. It demonstrates that good correlations exist between associated radiocarbon dates, obsidian hydration measurements, and projectile point associations at the Henwood site. If the obsidian hydration rates proposed for the site are fairly accurate we should be able to track the development of the projectile point sequence by converting the hydration measurement means into an estimated equivalent number of radiocarbon years (Table 19).

The amazing thing about Table 19 is that, considering the tremendous number of variables involved in the hydration rates of Coso obsidian at this site, there is any ordering evident in it at all. Yet clearly, the percentage of Lake Mojave and Pinto projectile points present in most assemblages is roughly predicted by the hydration means and equivalent rcybp. This is not to say there are no problems with the data. These appear to be at least predictable now, however, and with compensations in the hydration rates for variation the method apparently can be made to work.

The single obsidian hydration measurement (11.0 microns) taken from obsidian in the Esur component (materials recovered on the surface above Component 2 in Locus E) falls well within the range of obsidian hydration measurements from Component 2 which underlies it (Table 19). Warren (1990:248), who divides his Locus E surface sample differently, calculates a mean of 12.2 microns and a small standard deviation, for this component. This mean, calculated from six specimen readings, would produce an equivalent age of 6,954 rcybp for this component. This date is within a standard deviation of the later of the two radiocarbon dates recovered in Component 2.

Components C-NL and CC also produced anomalous single readings which will not be given much credence here. The C-NL component is a palimpsest assemblage and the single reading for CC (5.6 microns) clearly does not date anything in particular. It seems best to regard these readings as archaeologically insignificant.

The final anomaly in Table 19 is the NL&NLX Component data. The date of 7,353 RCYBP is too late for the number of Lake Mojave points in this assemblage. This component, however, comprises all the artifacts from the site which were not recovered in one of the identified loci. It is beyond doubt a palimpsest assemblage and the sample of 16 obsidian hydration measurements comprising the sample includes both surface and subsurface materials. In other words, it does not comprise a reliable sample either.

The important point in Table 19 is that obsidian hydration measurements roughly predict the projectile point sequence for 78% of the components. This is a remarkable accuracy rate considering the tremendous variability present in Coso obsidian hydration measurements. The results suggest Lake Mojave and Leaf-shaped points occurred in assemblages lacking Pinto points until sometime after 8,300 years ago. Lake Mojave, Pinto, and Leaf-shaped points co-occur until about 7,700 years ago. Pinto and Leaf-shaped points probably continued together until at least 7,000 years ago.

Comparison of Non-projectile Point Assemblages

I have grouped the artifact types from the Henwood components in the same manner as described for Rogers Ridge. Table 20 presents the adjusted tool assemblages from the Henwood components with at least 19 artifacts in them. The data from this table were entered into the Systat computer program and the same cluster analyses performed on them as were conducted on the Rogers Ridge assemblages. Only 10 sets of cluster analyses were run for the Henwood materials, however, because of their large number. Also, the percentage of each type was entered instead of the actual artifact numbers, so as to reduce the effect of variablility in assemblage sizes upon the clustering process. This procedure reduced the tendency for small assemblages to cluster together, a problem noted with the Rogers Ridge analysis.

Table 21 presents the percentage scores of similarity between each of the components with 19 or more tools in their assemblages. The components appearing in this table were roughly placed in their chronological order, youngest to the left and oldest to the right, during the formation of

Table 20. Selected artifact types recovered from the Henwood site components.

Component:	F	Comp.2	HB	CD	A-NL	H-NL	HA	CB
Types:								
GRAVERS	1		2		1			
THICK SCR.	1		3		5	3	1	8
FLAKE SCR.	1	7	7	2		5	2	1
MUF	8	7	4	2	2	7	4	5
BIF. FRAG.	22	49	20	36	17	16	8	16
2		3	3	5	2	2		2
3&4		2	1	5	2	6		2
5		3	3	4	1			3
6		2	1	7	1	1		
7	1	3	10	3	8	7		7
BLANKS	7	8	13	7	10	5	2	6
CORES		14	7	1	1	5		3
GRO. STO.		6				2	1	
	41	104	74	72	50	59	18	53

Component:	Glsur	Asouth	C-NL	Anorth	NL&NLX	B	Comp.3
Types:							
GRAVERS		3	1	3	1	1	1
THICK SCR.	8	12	10	13	25	41	2
FLAKE SCR.	2	20	3	13	11	23	
MUF	5	40	7	19	13	33	5
BIF. FRAG.	33	139	70	104	86	139	4
2	1	21	8	11	10	16	
3&4	1	12	10	6	19	18	
5	6	27	8	5	7	25	
6		16	11	6	5	12	
7	9	31	32	25	50	53	
BLANKS	10	41	37	44	60	75	3
CORES	5	15	6	8	32	28	3
GRO. STO.	1		1	1	20	2	1
	81	376	203	258	339	466	19

Table 20. (continued)

Component:	Comp.1	CA	I3	I4	B-NL	CC	D	G2sur
Types:								
GRAVERS	1		1					
THICK SCR.	4		2		8	4	3	2
FLAKE SCR.	6	3		1	1	3	2	2
MUF	11	6	2		2	5	5	4
BIF. FRAG.	21	36	15	8	22	64	16	12
2		7	2	2	5	13	1	2
3&4	2	6	2		1	1	1	3
5	1	6	2		2	11		1
6		3			5	3		1
7	3	14	5	7	9	28	9	9
BLANKS	6	6	4	1	11	30	5	11
CORES	1	3	2		7	5	2	1
GRO. STO.	4				2			1
	60	90	37	19	75	167	44	49

the cross-matrix. Components apparently randomly clustered with each other 10 to 20% of the time at the Henwood site. Co-occurrances of 40% suggest close correspondence between assemblages. Co-clustering half of the time or more indicates strong relative similarity between assemblages. Components which cluster 50% or more of the time are surrounded with dark boxes in Table 21.

Ordering the assemblages in this way has made it apparent that early components are more similar to each other than later components are to either each other or the early assemblages. There are 24 boxes marking pairs of assemblages which clustered together 50% or more of the time. Only 6 of these (25%) occur among assemblages less

Table 21. Percentage of times individual components cluster with the other components or do not cluster with any other component.

	F	D	Comp.2	HB	CD	A-NL	H-NL	HA	CB	G1sur	Asouth
F	70%	0	20%	0	0	0	0	20%	0	0	10%
D	0	30%	0	0	0	30%	20%	0	20%	0	30%
Comp.2	20%	0	40%	0	20%	0	0	30%	10%	0	0
HB	0	0	0	20%	0	0	20%	0	30%	20%	10%
CD	0	0	20%	0	50%	0	0	0	0	0	0
A-NL	0	30%	0	0	0	0	0	0	20%	40%	10%
H-NL	0	20%	0	20%	0	0	40%	0	10%	0	30%
HA	20%	0	30%	0	0	0	0	0	0	10%	0
CB	0	20%	10%	30%	0	20%	10%	0	30%	20%	10%
G1sur	0	0	0	20%	0	40%	0	10%	20%	0	40%
Asouth	10%	30%	0	10%	0	10%	30%	0	10%	40%	0
C-NL	0	20%	0	10%	0	70%	0	0	30%	40%	10%
Anorth	0	10%	10%	10%	0	20%	20%	0	10%	40%	40%
NL&NLX	0	20%	0	30%	0	40%	20%	10%	30%	20%	0
B	0	10%	10%	50%	0	20%	30%	0	40%	20%	30%
Comp.3	20%	0	20%	0	0	0	0	20%	0	0	0
G2sur	0	30%	10%	20%	0	20%	40%	0	30%	0	10%
Comp.1	20%	10%	20%	0	0	0	0	80%	0	0	10%
CA	0	10%	10%	10%	40%	20%	0	0	20%	40%	20%
I3	0	10%	0	20%	0	30%	0	0	30%	70%	40%
B-NL	0	0	0	50%	10%	20%	20%	0	30%	20%	20%
CC	10%	10%	10%	10%	20%	30%	10%	0	20%	40%	30%
I4	0	0	10%	0	30%	0	0	0	0	0	0

Table 21. (continued)

	C-NL	Anorth	NL& NLX	B	COMP.3	G2sur	Comp.1	CA	I3	B-NL	CC	I4
F	0	0	0	0	20%	0	20%	0	0	0	10%	0
D	20%	10%	20%	10%	0	30%	10%	10%	10%	0	10%	0
Comp.2	0	10%	0	10%	20%	10%	20%	10%	0	0	10%	10%
HB	10%	10%	30%	50%	0	20%	0	10%	20%	50%	10%	0
CD	0	0	0	0	0	0	0	40%	0	10%	20%	30%
A-NL	70%	20%	40%	20%	0	20%	0	20%	30%	20%	30%	0
H-NL	0	20%	20%	30%	0	40%	0	0	0	20%	10%	0
HA	0	0	10%	0	20%	0	80%	0	0	0	0	0
CB	30%	10%	30%	40%	0	30%	0	20%	30%	30%	20%	0
G1sur	40%	40%	20%	20%	0	0	0	40%	70%	20%	40%	0
Asouth	10%	40%	0	30%	0	10%	10%	20%	40%	20%	30%	0
C-NL	0	30%	30%	10%	0	0	0	30%	50%	20%	40%	0
Anorth	30%	0	0	40%	0	20%	0	30%	30%	20%	50%	0
NL&NLX	30%	0	10%	20%	0	60%	10%	10%	30%	30%	10%	0
B	10%	40%	20%	0	0	40%	0	0	0	70%	0	0
Comp.3	0	0	0	0	80%	0	20%	0	0	0	0	0
G2sur	0	20%	60%	40%	0	10%	0	10%	10%	20%	10%	0
Comp.1	0	0	10%	0	20%	0	0	0	0	0	0	0
CA	30%	30%	10%	0	0	10%	0	10%	50%	10%	70%	30%
I3	50%	30%	30%	0	0	10%	0	50%	0	10%	50%	0
B-NL	20%	20%	30%	70%	0	20%	0	10%	10%	10%	10%	0
CC	40%	50%	10%	0	0	10%	0	70%	50%	10%	0	10%
I4	0	0	0	0	0	0	0	30%	0	0	10%	70%

than 8,000 years old. The remaining 18 (75%) cluster to the right side of Table 21 among components dating to 8,300 years and earlier.

In general, components clustering more than 50% of the time have relatively large assemblages with many types of artifact classes. This is a characterisitic of older surface assemblages. Bifaces, in particular, exhibit greater variation in older components though the production of bifaces apparently increases through time. Later components are generally smaller, contain fewer artifact types, but also exhibit greater inter-component diversity. Therefore, they fail to cluster with any other assemblage at a higher rate than the earlier assemblages.

Not every component will be discussed equally in this summary. Many seem to have quite simple depositional histories and apparently date from a single time period. Other components are obviously palimpsest assemblages which will be grouped together for discussion. Finally, as previously stated, components I2, I4, Esur, and Component 4 were so small that they have not been included in this analysis.

As stated in Chapter VI, Locus A contains four artifact clusters labeled NE, NW, SE, and SW. Though these clusters are relatively discrete spatially and contain densely clustered artifacts they have been grouped throughout the study into Anorth, comprised of artifact clusters NW and NE, and Asouth, comprising artifact clusters SW and SE. Asouth does not strongly cluster with any component but it also never fails to cluster with at least one other component. It clusters with Anorth 40% of the time and is most similar to that component.

The reason for joining NW and NE into Anorth was the tendency for Pinto points to cluster in Asouth while Lake Mojave points were found most frequently in Anorth. The tool assemblages of these artifact clusters were compared to further investigate the wisdom of this decision.

The SW artifact cluster is apparently younger than the SE cluster. Projectile points clustered around SW include 2 Pinto points and 1 Leaf-shaped point. It is also the only artifact concentration in Locus A that ever fails to cluster with at least one other assemblage (Table 21). SE is apparently older than SW, containing 4 Lake Mojave, 2 Leaf-shaped, and 1 Pinto point(s). The cluster analyses place these two assemblages together 30% of the time (Table 21). This is not a particularly strong pattern. They are more similar to each other than to any other component at the site, however. As noted above, dissimilarity is a trait common to Pinto assemblages.

SW also clusters with NE 30% of the time. It only clusters with NW 10% of the time, however. Thus, the three artifact clusters in Locus A which contain some percentage of Pinto points are also more similar to each other in tool types than they are to the components of other loci. NW and NE cluster together 60% (Table 21) of the time and are clearly very similar in most aspects, including a predominance of Lake Mojave series projectile points. NW appears to be an early, unmixed Lake Mojave component. NE either represents a somewhat later occupation or is overlain with a very thin deposit of Pinto period artifacts.

The data suggest that these four assemblages can be chronologically arranged both by projectile point compositions and relative similarities in the remainder of their tool assemblages. NW is the oldest assemblage, followed in age by NE. These two cluster together in 60% of all cluster analyses and have practically identical assemblages. SW contains only Pinto points and is probably somewhat younger than SE. It is more similar to SE and NE than to any other component(s) at the site. Pinto points were found in both SW and SE, however, and it seems most appropriate to combine them into Asouth because of their close physical proximity. Thus, though there are differences in the projectile point assemblages of these artifact clusters, the division of component Asouth from Anorth chronologically separates the assemblages quite satisfactorily.

Locus B is an unmixed Lake Mojave assemblage with no evidence of Pinto or later assemblages associated with it. It is a large assemblage which probably accumulated over a relatively long period of time. Spatially, it contains a number of relatively dense artifact clusters suggesting either intensive or extensive occupations during the Lake Mojave period. The assemblage is predominantly bifaces with scrapers occurring widely scattered throughout the locus. An obsidian hydration equivalent date of 8,322 RCYBP supports a pre-Pinto time period for this assemblage.

The components of Locus C (CA-CD) contained predominantly Lake Mojave series projectile points and obsidian with hydration rind thicknesses typical of Lake Mojave assemblages. CA clusters by itself in Table 21 only 10% of the time, a characteristic common to early assemblages at the Henwood site. CA clusters with I3 50% of the time and with CC 70% of the time, both are early Lake Mojave assemblages. Component CD is the only component in Locus C which contained Pinto points. It fails to cluster with other assemblages in Table 21 50% of the time and appears to indeed be a Pinto assemblage in this respect. The relatively early date of 7,752 RCYBP is determined from a single obsidian hydration reading but may be supported by the fact that CD clusters most frequently with CA, suggesting that it is most similar to this Lake Mojave assemblage even though it contains no Lake Mojave projectile points.

Finally, CB contained 1 Clovis, 1 Leaf-shaped, and 1 Large Side-notched point in two distinct artifact clusters.

The association of a Large Side-notched point with an obsidian hydration date of 7,011 RCYBP and a Leaf-shaped point seems appropriate. CB fails to cluster in Table 21 with other assemblages 30% of the time, a characterisitic consistent with a late date. On the other hand, it clusters with Component B, a discretely Lake Mojave assemblage, 40% of the time. This suggests that either chronologically or functionally CB exhibits similarity to both early and late assemblages. The answer may be that the artifact cluster containing the Clovis point may indeed be a Lake Mojave assemblage. If so, it should not have been combined with the assemblage from the cluster containing the Side-notched point. There simply is not enough data available to make this determination, however.

Locus D was a small cluster of artifacts eroding from the banks of Halfway Wash. It did not contain projectile points and is dated by two obsidian hydration readings with a mean of 11.3 microns. This is equivalent to 6,441 RCYBP. It does not cluster tightly with any other assemblage and apparently dates from a relatively late time period.

Locus E contained two or possibly three components. Esur represented the artifacts recovered from the surface of the locus. These materials are dated by Warren (1990:251) to about 5,000 BC through the application of his 'fast' hydration rate (570 years/micron) for surface obsidian. These artifacts have been demonstrated to originate with materials associated with several cultural features located roughly 30 cm below the surface. The assemblage is so small that no comparisons are feasible.

Excavations around the features in Locus E recovered a somewhat unique assemblage named Component 2 (Warren 1990). No projectile points were recovered with this assemblage. It is dated, however, by two radiocarbon dates of 7,100 and 7,400 BP. Lyneis (1990:213) suggests Component 2 is a processing locality for CCS bifaces and Warren (1990:324) interprets it as a specialized site more typical of the collector strategy along the continuum between Foragers and Collectors. Component 2 does not cluster strongly with any other component in Table 21 and fails to cluster with others 40% of the time, supporting Warren's interpretations that this component is unique.

Locus G comprised three components, two from the surface (G1sur and G2sur) and one from a large block excavation (Component 1). Lake Mojave and Pinto points were recovered from G1sur, the central portion of Locus G. Two obsidian hydration readings from this component produced a mean of 13.5 microns which is equivalent to 7,695 RCYBP. G2sur did not produce projectile points but did produce 6 readings from 5 obsidian specimens. These readings have a mean of 10.7 microns which is the equivalent of 6,099 RCYBP. Both of the surface samples from Locus G are primarily judgmental and it is not surprising that they frequently cluster with the -NL assemblages in Table 21. More will be said about this below.

Component 1, the cultural materials recovered from the block excavation in Locus G, contained a Lake Mojave assemblage including 2 Lake Mojave, 1 Leaf-shaped, and 1 Clovis point. Feature 15 was radiocarbon dated at 8,470 BP and 22 obsidian hydration readings provided a mean of 11.9 microns. It is from this component that the 'slow' obsidian hydration rate (712 years/micron) for subsurface materials was calculated.

Component 1 clusters 80% of the time with HA which is believed to be a late period component based on an obsidian hydration date of 7,353 BP from a sample of only two hydration readings. This date for HA may be wrong or the fact that it has such a small assemblage may mean that it is only coincidental that it is very similar to Component 1. Component 1 never fails to cluster with at least one other component. This is probably true because it is clustering so frequently with HA. It seldom clusters with any other component in any event (Table 21).

Component 3 is remarkably dissimilar to all other components, also. There are two reasons why this may be. First, the excavations centered around a large stone slab feature and recovered unusually high numbers of Thick scrapers, MUF's, and cores. This, combined with low numbers of bifaces, make this a very unusual assemblage. Second, the small size of the assemblage may simply mean that only a portion of the assemblage is represented in this component. This last observation is quite possible since Component 3 apparently represents a specialized form of assemblage associated with a processing station of some kind (Lyneis 1990:213). It is quite possible that expanded excavations around Component 3 would have recovered a more generalized Lake Mojave assemblage. A single Lake Mojave point fragment was recovered in this component. Eight obsidian hydration readings give a mean of 11.8 microns which is equivalent to 8,402 RCYBP.

Locus H comprised two artifact clusters widely separated in space by an eroded area of moderate artifact density. These two artifact clusters were named HA and HB. HA has been discussed above. HB is believed to be a late period component based on the 14C dating of Feature 2, located about 30 m northeast of HB, to 7,140 BP. Also, the only projectile point recovered from HB was a Pinto point. This point was not closely associated with the main artifact concentration, however, and no obsidian was recovered from this component. In fact, HB comprises at least two artifact clusters and may contain another. It is possible that one or more of these dates from the Lake Mojave period.

In Table 21 HB clusters with B and B-NL 50% of the time. This suggests it is very similar to a known Lake Mojave assemblage. Though all the chronometric data available suggest HB is a Pinto site, the assemblage is Lake Mojave-like. This could simply be due to functional variability among Pinto components but the chance that at least one Lake Mojave assemblage is present there cannot be discounted.

Locus I contained four components, I1-I4. As previously stated, components I1 and I2 have such small assemblages they cannot be compared to the other components. Component I3 is a Lake Mojave component which clusters well with other Lake Mojave components. It also clusters well with G1sur and C-NL probably because it contained an unusually high number of bifaces. Component I4 was placed with the older components in Table 21 because it was located near I3 and was completely undated. It contains relatively large numbers of bifaces and biface fragments, a predominently late period characteristic. I4 does not cluster with any other assemblages 70% of the time (Table 21), it probably belongs at the younger end of the scale rather than with the older components.

It is interesting that components A-NL, C-NL, H-NL, and NL&NLX, probable palimpsest assemblages recovered from around the edges and in the moderate artifact density areas of the various loci, frequently do not cluster with the cultural materials recovered from the artifact concentrations of those same loci. It is most likely that, as Warren has pointed out, these samples have been skewed by a failure to recover small flake scrapers and MUF's, inflating the apparent importance of bifaces and formed scrapers.

A-NL and C-NL cluster in 70% of the cluster diagrams. G2sur, the artifacts recovered around the outside of Locus G, clusters 60% of the time with NL&NLX the cultural materials recovered from all over the site. B-NL, however, clusters 70% of the time with B, suggesting that this sample has been virturally unaffected by the skewing. Table 20 suggests this is due to the large numbers of Blanks and small numbers of Biface Fragments, Flake scrapers and MUF's recovered in the surface collection units of Locus B. In other words, the representative sample in this case resembles a judgmental sample.

Summary of Comparative Analyses of the Henwood Site Components

This study has shown that tool assemblage variability increases through time. Lake Mojave assemblages are both larger and more similar to each other than Pinto assemblages. Late Pinto assemblages tend to be small and contain unusual numbers of particular artifact types. In this variability they reflect occupations of both very limited duration and specialized activities. The beginning date for this change from the earlier more generalized pattern to a relatively more specialized pattern appears to have occurred about 8,000 BP.

Integration of Rogers Ridge and Henwood Chronologies: Lake Mojave/Pinto Cultural Development

The datable components of Rogers Ridge and the Henwood sites have been chronologically ordered in Table 22. This table provides the dating sequence for 34 archaeological components spanning the cultural transition from the Lake Mojave to the Pinto complex. It provides the basic chronologic information that is neccessary to track changes in tool assemblage compositions through time and ultimately provide the basis for explaining how and why these cultural complexes vary in the Mojave Desert.

Each component has been ascribed a level of contextual integrity ranging from excellent to poor. The term excellent means one chronologic period is strongly indicated by at least one, and generally two, of the dating methods (14C, obsidian hydration, projectile point assemblage). There is no contradictory evidence in the tool assemblage that more than one technological complex is represented, and the component clusters most frequently with components of a similar age.

A very good contextual integrity is indicated by strong evidence for a single chronologic time period from at least two of the dating methods. Some evidence of an occupation

Table 22. Chronological ordering of all components at the Rogers Ridge and Henwood sites.

Site	Component	RCYBP	Integrity
Rogers Ridge	So2/3	4020 (6326?)	Fair
Rogers Ridge	Emman	4463-5050	Very good
Henwood	G2sur	6099	Poor/Fair
Henwood	D	6441	Good/Fair
Henwood	Esur	6954 (6270?)	Poor
Henwood	CB	7011	Good
Henwood	H-NL	7068	Poor
Henwood	F	-	Excellent?
Henwood	HB	7140?	Good
Henwood	HA	7353	Good
Henwood	Comp. 2	7150-7400	Excellent
Rogers Ridge	Empr	7508 (5050?)	Fair
Henwood	G1sur	7695	Fair
Henwood	CD	7752	Excellent
Henwood	A-NL	-	Poor
Henwood	Asouth	7809	Very Good
Henwood	Anorth	7809?	Very Good
Rogers Ridge	2B	8033-8410	Excellent
Rogers Ridge	So3	-	Poor
Henwood	NL&NLX	8269 (7353?)	Poor
Henwood	B-NL	-	?
Henwood	CC	-	Good
Henwood	B	8322	Excellent
Rogers Ridge	So2	8348-8505 (7910?) (12,338?)	Excellent
Rogers Ridge	Main	-	Very Good
Rogers Ridge	Per	-	Fair
Henwood	Comp. 3	8372	Excellent
Henwood	Comp. 4 (20-50)	8402	Excellent
Henwood	Comp. 1	8470	Excellent
Henwood	I3	-	Excellent
Henwood	CA	8607	Excellent
Henwood	C-NL	(9120?)	Poor
Rogers Ridge	So1	(9188?)	Excellent
Henwood	Comp. 4 (50-70)	11,463	Excellent?

* Components I1, I2, and I4 contain no chronologic data and have not been included here.
Dates in parentheses are tenuous and/or do not fit well with other data.

dating from another time period, (i.e. projectile points or disconcordant 14C or obsidian hydration data) is present, however. Quantities of discordant materials are so small as to have little effect on the strong characterization or 'signature' of the primary occupation. Little or no contradictory evidence in the tool asssemblage of more than one technological complex represented (i.e. same as excellent integrity in this characteristic).

Good integrity means the component boundaries and artifact clusters suggest distinctive patterns of artifact distributions. A single time period or occupation is suggested but the data are not so positive as to be unquestionable. That is, radiocarbon or obsidian hydration dates are limited and/or questionable on some reasonable grounds and the association of the projectile point assemblage with the rest of the tool assemblage is reasonably questionable or there are no projectile points.

Fair contextual integrity means the component boundaries have generally been set through arbitrary means. The assemblage is possibly comprised of artifacts distributed over a long period of time or more than one chronologic time period is represented. Some portion of the data, however, suggests it dates from predominantly one time period. These assemblages tend to have weak or non-existent signatures because of small number of tools or the judgmental nature of the sample.

Finally, a component with poor integrity is a palimpsest assemblage or there are no chronologic data and the tool assemblage is so small as to be of no use in the formulation of a signature.

Half (17) of the components listed in Table 22 are judged to have very good or excellent contextual reliability. The other components provide from good to poor examples of assemblages and help to characterize what mixed assemblages should look and 'act' like throughout the comparative analysis.

Obsidian samples recovered in association with radiocarbon dated features were used to establish 3 new site-specific hydration rates for Coso obsidian. These rates were then applied to 155 Coso samples recovered from 26 of the components. The results of this process indicate that obsidian hydration measurements roughly correspond to the predicted projectile point sequence for 78% of the components studied. In other words, if one assumes that new projectile point styles slowly rise to popularity, then by ordering the components by the relative numbers of each point style we should be able to predict the chronologic order of the components. Once we have ordered them this way the obsidian hydration means of these components should be roughly in order also, provided the assemblages are <u>not</u> the result of mixing of earlier and later materials. Tables 16 and 19 have demonstrated that, in general, this is the case.

Resolving the "Long" vs. "Short" Chronology Debate

The results of this study suggest that Lake Mojave and Leaf-shaped points occurred in assemblages lacking Pinto points until sometime after 8,300 years ago. Lake Mojave, Pinto, and Leaf-shaped points co-occur starting sometime between 8,000 and 8,200 BP. They apparently continued together until at least 7,500 years ago. Pinto and Leaf-shaped points continued to be made together until at least 7,000 BP and quite possibly for some time after that. Thus, the evidence supports the "long" chronology but it also supports the interpretation of a long (Altithermal) period of near abandonment of this region. The most important observation about this issue, however, is that Pinto points were in use both before and after this time of near abandonment.

Table 22 suggests that occupations, as reflected by the number of chronologically ordered components, were relatively frequent and intense between 8,000 and 8,600 BP. Thirteen of the 33 datable components originated in this narrow time period. It was near the end of this time that the Pinto point was introduced into the Lake Mojave assemblage in the Mojave Desert, heralding the beginning of the Pinto period. Occupations apparently decreased dramatically over the next 500 years (8,000 to 7,500 BP) as only 6 components may date from this time period.

Occupations apparently continued at a low level over the next 500 to 600 years (7,500 to 6,900 BP) and then dropped to practically nothing. The evidence suggests that sometime around 5,000 BP people of the Pinto Complex were once again occupying these sites frequently enough to leave strong assemblage signatures. By 4,000 BP the Pinto complex came to an end, being replaced by the Gypsum Complex.

Warren (1990:262-264) has characterized the Lake Mojave and Pinto complexes in this way:

> 1) A preference for macrocrystalline material, usually volcanics or metavolcanics (e.g. basalt, rhyolite, felsite) in the manufacture of bifacial tools. Unifacial tools are more often made of cryptocrystalline materials.
>
> 2) An abundance of leaf-shaped or ovate bifaces that vary in size, are most often broken, and represent various stages of manufacture from very rough preforms to finished leaf-shaped cutting tools.
>
> 3) Unifaces vary considerably in shape but a large portion of most assemblages are well-formed with edges being modified to the extent that the shape of the original flake is much modified . . .
>
> 4) Distinctive unifaces include relatively large elongate keeled and domed scrapers . . . . These scraper types very rarely occur in later assemblages.
>
> 5) Small flake engraving tools are also another distinctive artifact type for these early assemblages. This tool, however, is usually found in relatively small numbers and may be missing from small samples.

This study has shown that tool assemblage variability, meaning that particular artifact types comprise differing and often unusual amounts of the assemblage, increases through time. The beginning date for this change from the earlier more generalized pattern to a relatively more specialized pattern appears to have occurred about 8,000 BP. This shift is closely associated with a reduction in component area and assemblage size, according to the data presented here. The contention here is that this pattern reflects cultural changes, including a dramatic shift in logistical strategies, during the Pinto period.

In general, Pinto camps were smaller and less frequently reoccupied than Lake Mojave camps. Therefore, their assemblages have more distinctive signatures, which reflect the strong influence of the dominant activities conducted during the occupation(s). They are more frequently polythetic in nature, than the Lake Mojave camps. On the other hand, the Lake Mojave camps were reoccupied more frequently, resulting in larger assemblages which contain a broader range of tool types. Their assemblages are more monothetic than the Pinto assemblages but also more overlapping because of the increased size and number of rare tool types in their assemblages (Carr 1984:118-121).

These site signatures reflect the changing logistical strategies which affected site formation and characteristics. The fact that the Lake Mojave assemblages reflect a broader range of activities as a result of longer term occupations and reoccupations is important, not because it indicates they are palimpsest in nature (which many of them undoubtedly are) but rather that these characteristics are a direct result of scheduling and logistical planning. Likewise, the more frequent polythetic and non-palimpsest natures of Pinto camps are direct reflections of a more ephemeral occupance of sites, i.e. less frequent visits of shorter duration.

These observations suggest that logistical strategies of cultural groups in the central Mojave Desert changed about 8,000 BP. These groups, supported by the technological systems of the Pinto Complex, visited much the same localities as previously occupied during the Lake Mojave and Early Pinto periods, excluding only those locations no longer functional because of the drying of springs and seeps. People now remained for shorter periods of time and may have conducted more specialized activities at locations where generalized camping took place during earlier periods. Eventually these visits became so infrequent that the sites of the 7,000 to 5,000 BP time period are almost never encountered. When these sites are encountered they have such small assemblages that they are generally judged inappropriate for study.

By 5,000 BP visits had begun to increase again in number and possibly in duration. Environmental conditions appear to have begun to improve throughout much of the Great Basin by this time and may have peaked about 3,600 BP when the lakes of the Mojave Desert apparently contained low but relatively long term fillings (Enzel et al. 1989). By this time, however, several new forms of projectile points were being made, i.e. the Elko, Gypsum, and Humboldt series, and the Pinto period had come to a close. The implication of these observations to the interpretation of Lake Mojave and Pinto culture histories and settlement-subsistence patterns is presented, in a regional perspective, in the final chapter of this study.

CHAPTER VIII

MODELING POPULATION AND COMMUNICATION NETWORK DYNAMICS FOR LAKE MOJAVE-PINTO TIMES: A REGIONAL PERSPECTIVE APPLIED TO THE MOJAVE DESERT

The Mojave Desert has been a relatively dry environment since human populations first arrived there ca. 12,000 years ago. This region has not always had the same character, however, throughout that period. Nor did human populations exploit its resources in the same manner.

In this chapter I shall discuss the interaction of cultural groups with the dynamic environments of the Early to Mid-Holocene (ca. 8,400 to 4,000 BP). The discussion will consider population dynamics, culture history, and culture change. I shall discuss population size, movement, positioning, and cultural interactions as modelled by Wobst (1974, 1976) for Paleolithic European groups. Employing ethnohistoric population figures and distances travelled as provided by Steward (1938) will bring a regional perspective to the application of Wobsts' model in the Mojave Desert. The importance of communication and information networks, problems of maintaining them at extremely low population densities and the implications of this for human occupation in the Mojave Desert, will become clear from this discussion.

The implications of increasing mobility and decreasing population over long distances and periods of time will be discussed in terms of the parameters leading to adaptive success or failure. Finally, I shall conclude the argument by explaining how cultural adaptations to changing environments over a three phase cultural sequence, spanning the time period from 8,400 to 4,000 BP, resulted in the near abandonment and eventual reoccupation of the Mojave Desert during the Pinto Period.

Population Dynamics: the Bottom Line of Adaptive Success

Human populations of the Mojave Desert apparently adapted in several ways to the changing environments of the Early Holocene. The evidence presented in Chapter VII suggests, however, that they were not 'successful' in terms of maintaining or increasing their populations during the height of the Mid-Holocene Altithermal period. Why did they successfully adapt to environmental change during earlier time periods and fail to do likewise during the Altithermal?

Wobst (1974, 1976) discusses two vital systems of mobile hunter-gatherer societies, mating and communication networks. These provide insight into the question of abandonment of the Mojave Desert region. The core of Wobsts' argument is that hunter-gatherer populations are organized, even in the simplest societies, into minimum and maximum bands as these have been defined by Steward (1969). These bands are intimately related and dependent on one another for both mates and subsistence related information.

Minimum bands tend to have a nearly universal mode of 25 persons and range from roughly 15 to 75 individuals. These people frequently live part of the year together (e.g. winter villages in the Great Basin), occasionally share food and/or cooperate in food getting activites, and participate together in most cultural events. Most of the individuals within these bands are related and therefore generally do not provide suitable mates for persons within the group. The need to meet potential mates is filled by a more infrequent association known as the maximum band.

Though Steward did not recognize the presence of bands in the Great Basin (Steward 1970), he defines the maximum band as "little more than a group with which its members vaguely identify" (Steward 1969:290). This definition can easily be fitted to the food-named groups of the Great Basin Numic populations at the time of historic contact, for instance (Steward 1938). Therefore, I will continue to use the term band for the sake of continuity in presenting Wobst' model (1974, 1976).

Maximum bands comprise a mate exchange network composed of a number of minimum bands. The size of maximum bands is quite variable, but Wobst (1976:50) estimates they generally ranged between 175 and 475 individuals. Wobst cites these as minimal figures and advocates 475 as the usual size of mating networks within the maximum bands. The number of minimum bands comprising a maximum band depends on band sizes and density/distribution of these bands. Maximum bands, however, are generally comprised of 7 to 19 minimum bands with ca. 25 persons in each minimum band.

Maximum bands, as mating networks, are seldom closed and members frequently draw mates from more than one maximum band. Maximum bands in areas of continuous population distribution frequently overlap and personnel move freely within the structure of the kinship networks of both the minimum and maximum bands. Such movement is important in marginal environments like the Mojave Desert because it adjusts numbers of personnel to subsistence resource availability.

In a maximally efficient mating network, a synonym used here for maximum band, each minimum band would be surrounded by 6 other equally spaced minimum bands (Wobst 1974:154). This frequently is not the case, however, in environmentally marginal regions where resources are unevenly distributed and populations tend to cluster around a finite number of relatively productive patches. In such cases, competition may develop between minimum bands to attract mates for their members. If so, some repositioning or agglomeration of minimum bands may be required to resolve the conflict. The result would be an increase in the size of unoccupied hinterlands surrounding productive patches.

There is a preference to exchange mates between nearest and second nearest neighbors within maximum bands. Peripheral minimum bands (i.e. those which are not surrounded by other minimum bands) therefore, suffer the disadvantage imposed by longer than average distances in meeting and attracting mates within these networks (Wobst 1976:52). This causes mating networks to be fragile in regions where populations are not continuously and evenly distributed. They tend to collapse, through population agglomeration or emigration, when they are stressed. Such stresses might occur when populations are being reduced by extended periods of environmental desiccation.

Wobst (1976:50) estimates mobile hunter and gatherer population densities to have ranged from .05 to .005 individuals per square kilometer (indivs/km). At a population density of .05 indivs/km a maximum band of 475 individuals would occupy an area of 9,500 square kilometers with a diameter of 120 km (75 mi). At .005 indivs/km this same band would occupy an area of 95,000 square km with a diameter of 382 km (237 mi). Wobst estimates that regional populations below .005 indivs/km would face such extreme travel distances that their ability to peacefully acquire mates would be seriously impaired.

To get a regional perspective on what all this would mean in the Mojave Desert I figured the distances from the Rogers Ridge and Henwood sites to a variety of sites and landmarks in and around the Mojave Desert (Table 23). At .005 indivs/km population density, a single mating network centered between Rogers Ridge and the Henwood site would extend from the Colorado River and Salton Sea in the south to a point north of Owens Lake in the southern end of Owens Valley. At a population density of .01, however, a mating network would only be 214.8 km (133 mi) in diameter. It would include an area from the base of the San Bernardino Mountains to the vicinity of Victorville, most of the Mojave River Valley, all of the Soda Lake Basin and eastward into the mountains of southern Nevada, much of the Amargosa River Valley, the southern half of Death Valley, all of Panamint Valley and the Panamint Range, and the China Lake Basin (Fig. 84).

Needless to say, under the kind of conditions requiring such widely dispersed populations as those at .005 indivs/km, it is doubtful that communication networks and information flow could, or would, have been maintained at sufficient levels to insure efficient use of many of the resources located within much of this region.

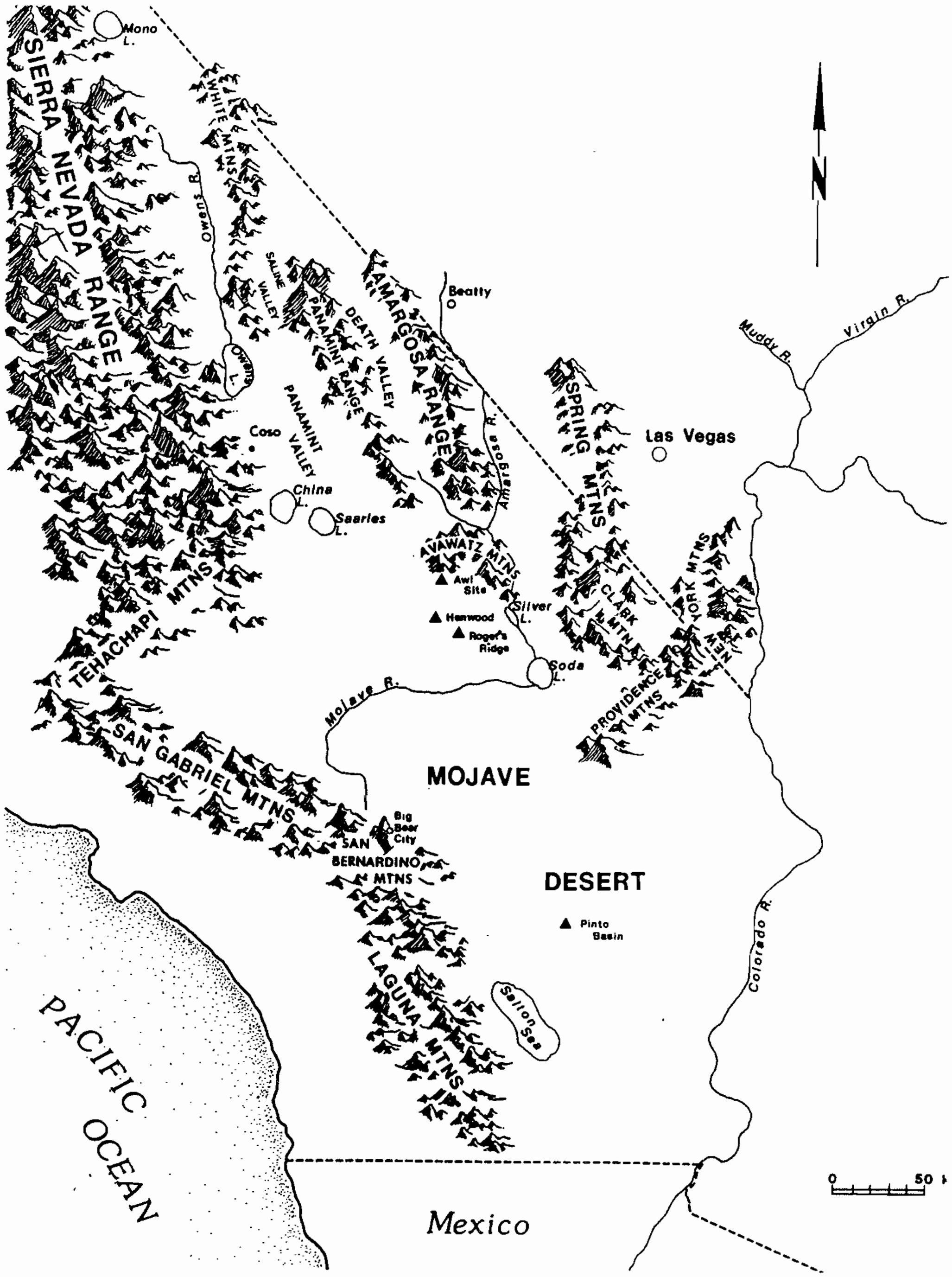

Figure 84. Mojave Desert and adjacent regions.

Table 23. Distances from Rogers Ridge and the Henwood sites to other sites and resource areas.

From	To	Km	Miles
Rogers Ridge	Pinto Basin Sites	160	100
	Big Bear*	115	72
	Victorville	110	68
	Furnace Cr.**	140	87
	Henwood Site	25	16
	Awl Site	35	22
	Silver Lake	30	19
	Colorado River	165	103
Henwood Site	Owens Lake	170	106
	Coso Obsid. Quarry	125	77
	Walker Pass***	130	81

* in the San Bernardino Mountains
** in Death Valley
*** in the Sierra Nevada Mountains

The resources of environmentally marginal areas can be effectively exploited if information is available concerning the location and quantity of subsistence items. The acquisition of such information apparently played a major role in ethnohistoric population dynamics in the Great Basin (Steward 1938; Thomas 1972). More will be said about this later, but suffice it to say for now that under primitive conditions of mobility--pedestrian movement being the only form of travel--the role of information transmittal is intimately related to population density and the distribution of abundant subsistence resources which allowed the seasonal or yearly gathering of large numbers of people for mate and information exchange.

During periods of exceptional subsistence stress, in an area of human populations as thin as .005 indivs/km, it is likely that populations in a region like the central Mojave Desert would have gravitated toward other populations located along the desert/montane ecotone, areas which would have had more diverse environments and relatively abundant subsistence resources. Places near or in the Sierra Nevada Mountains, foothills, and adjacent valleys, for instance, would have provided the seasonally abundant resources necessary to the gathering of relatively large numbers of people for the exchange of mates and information.

Ethnohistoric Population Densities and Distributions

The keys to the mating network concept are population density and distribution. To understand more fully how these may have affected the adaptive success of Pinto populations in the Mojave Desert, we can begin by investigating the manner in which people were distributed around the same landscape during the ethnohistoric period.

Steward (1938:48-49) provides information on Numic populations living in and around the Mojave Desert. Table 24 presents the population size and density data for 7 'regions'. Steward (1938:48) warns that these are not always band territories or subsistence areas, but simply convenient areas for study. If we view them as such and do not try to ascribe socio-political importance to them we can still use

Table 24. Population estimates and densities of historic Numic populations in and adjacent to the Mojave Desert.

Region	Pop.*	Area (Sq.Mi.)*	Area in Sq.Km	Pers./ Sq.Km**
Owens Valley	1000	2,100	5,439	.18
Fish Lake Valley	100	999	2,587	.04
Deep Spr. Valley	23	250	648	.04
Saline Valley	65	1,080	2,797	.02
Las Vegas	332	9,450	24,476	.01
Death Valley	42	1,260	3,263	.01
Beatty	29	1,300	3,367	.009

* Figures provided by Steward (1938:48).
** Figures comparable to Wobsts' (1974, 1976) calculations.

them as plausible examples of population distributions in this region at contact.

It seems clear from the information provided in Table 24 that populations were indeed generally high throughout the southern Great Basin and Mojave Desert during the Historic period. Even Beatty, the region of least population density at .009 indivs/km, contained nearly twice as many people per square kilometer as is required by Wobsts' minimum estimate of .005 indivs/km for a successful mating network.

The mean density derived from 5 of these groups, excluding Owens Valley--which appears to have had an unusually dense population uncharacteristic of the Mojave Desert--was .02 persons per square kilometer. At a mean density of .02 indivs/km Wobst (1976:51) estimates maximum band territory sizes to be 23,750 square kilometers with a diameter of 191 km (119 mi.) and a radius of 95.5 km (59 mi.).

According to Steward the longest combined trips of two different groups of this region, starting out at different places and converging on a midway point in an area of abundant resources, equalled roughly 160 km (100 mi.) (Steward 1938:58). The mean length of 15 separate trips, however, from winter villages and temporary campsites to meetings at specific resource collection localities, was only 61 km (38 mi.). These trips ranged from 32 km (20 mi.) to 99 km (61 mi.).

In other words, people were regularly visiting and attending social functions with both their nearest and second nearest minimum band neighbors. To understand how this pattern of socialization affected communication networks we must visualize groups as the 'bullseye' of concentric communication rings that surround them at any given point. In addition to visiting with first and second nearest neighbors, they would have known and frequently met (probably at least once a year) their third nearest neighbors. It would thus not have been unusual for a group to annually receive information on subsistence resources located as much as 112 km (70 mi.) away, and by extension--i.e. by connecting two third-nearest neighbor communication rings at the outer distances of each--to have some information about resources located as much as 224 km (140 mi.) away!

The communication networks of societies in marginal environments like those of the Mojave Desert have several components, but perhaps the most important is the gathering of large numbers of people, one or more times a year, at an unusually productive subsistence resource. The 'Fandangos' of the Western Shoshoni, for instance, may have served this purpose in the Great Basin (Thomas 1972). The resource around which these gatherings were most commonly organized was pine nuts. Antelope and rabbit drives may have served the same function in some locations, while unusually productive seed and root grounds served this function in others (cf. Couture et al. 1986 for an example). Wobst (1974) contends that these gatherings were very important because they provided the matrix within which both mates and information moved.

Mate Exchange and Communication Network Parameters

What does all this mean to our understanding of Mojave Desert archaeology? First, modelling mate and communication networks provides an organizational framework for conceptualizing population distributions and movements in the Mojave Desert. Second, it offers a systemic explanation for population collapses throughout the same area.

The primary point established above is that with the increased subsistence resources, due to long-term environmental improvement, came increased population resulting from both natural biologic increases and immigration. With population increases came increased density/efficiency in communication networks.

The human carrying capacity of the region may have thus, actually been further <u>increased</u>, to some degree, as populations increased and individuals were more efficiently moved to available subsistence resources during times of subsistence stress. In other words, when environmental conditions were good and human populations were moving out into the deserts and/or local populations were naturally increasing, their very numbers may have led to additional adaptive success. This would have been the condition in the Mojave Desert during the Lake Mojave/Early Pinto period (11,000 to 8,000 BP) when the archaeological record suggests flourishing human occupation (Fig. 85).

Conversely, reductions in human populations, generally related to limitation of the food supply because of environmental desiccation, caused stress in both the mating and communication networks. It increased the size of the territories necessary to sustain maximum bands, and the distances between minimum bands. This situation would cause reduced contacts between minimum bands and in severe cases may have resulted in the complete elimination of the annual

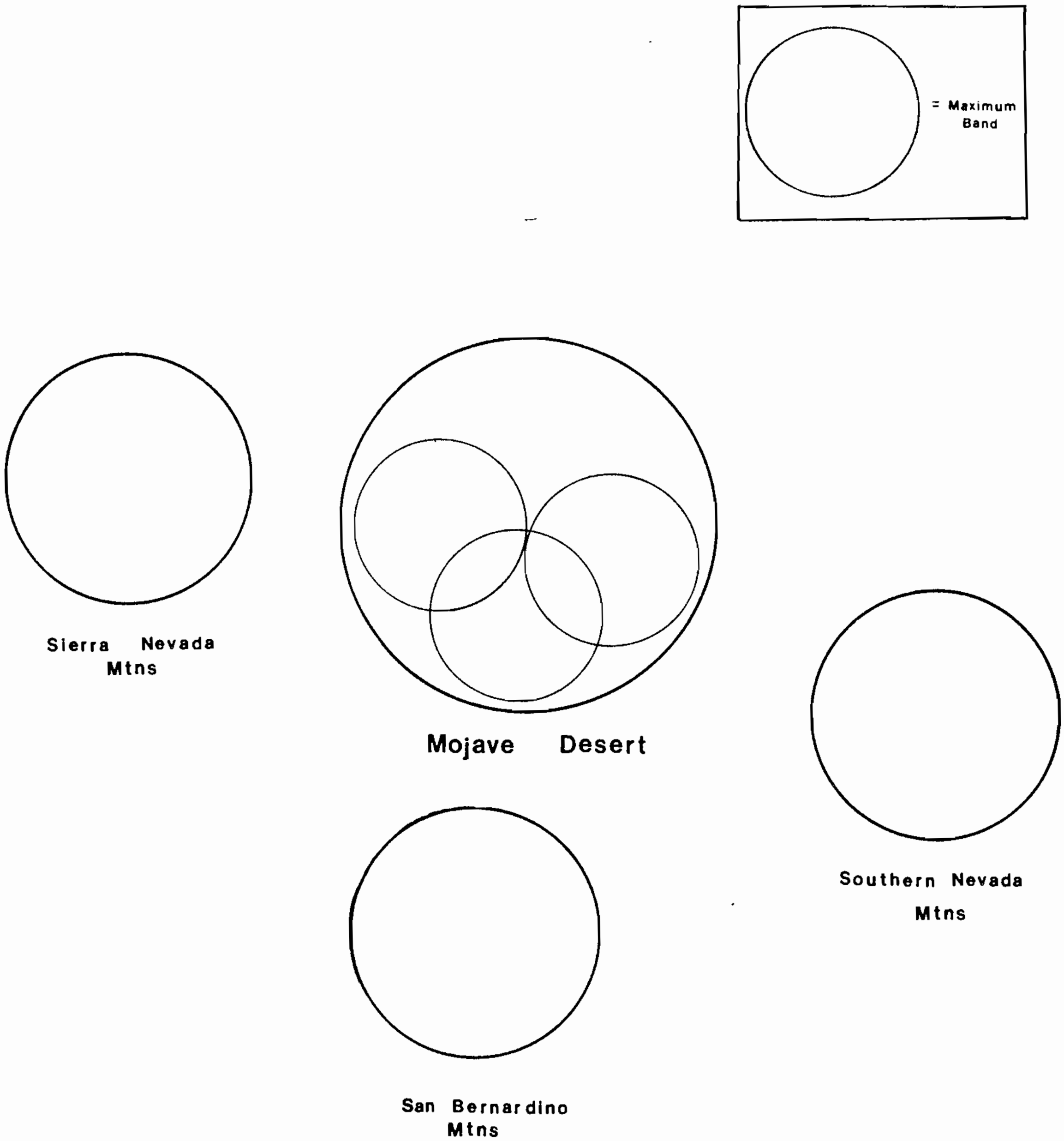

Figure 85. Mating/Communication networks in the Mojave Desert during Lake Mojave period.

fandangos. Mating and communication networks would be seriously disrupted when no unusually productive subsistence resource was any longer present within the area of the maximum band. This would have resulted in reduced information flow and less than optimum adaptability, especially for minimum bands in the more environmentally marginal regions of the maximum band. This would have been the condition in the Mojave Desert during the Middle Pinto period (7,000 to 5,000 BP) when the archaeological record suggests occupations were extremely limited.

As the human population spiralled downward, the information network would have been seriously weakened and human carrying capacity, already severely reduced, would actually be reduced further because of the decreasing efficiency of the communication network. Ultimately the minimum bands separated by the greatest distances may have found it impossible to maintain themselves. At that stage they probably would have moved closer to the 'center' of the maximum band. Due to geographic circumstances in the Mojave Desert, however, this 'center' was not 'centered' on the Mojave Desert (Fig. 86).

Areas of greatest potential for such a move toward population centers here are in the foothills and valleys of the Sierra Nevada, Little San Bernardino, and various mountain ranges of southern Nevada--i.e. Owens Valley, Las Vegas Valley, and the region of the Mojave River headwaters.

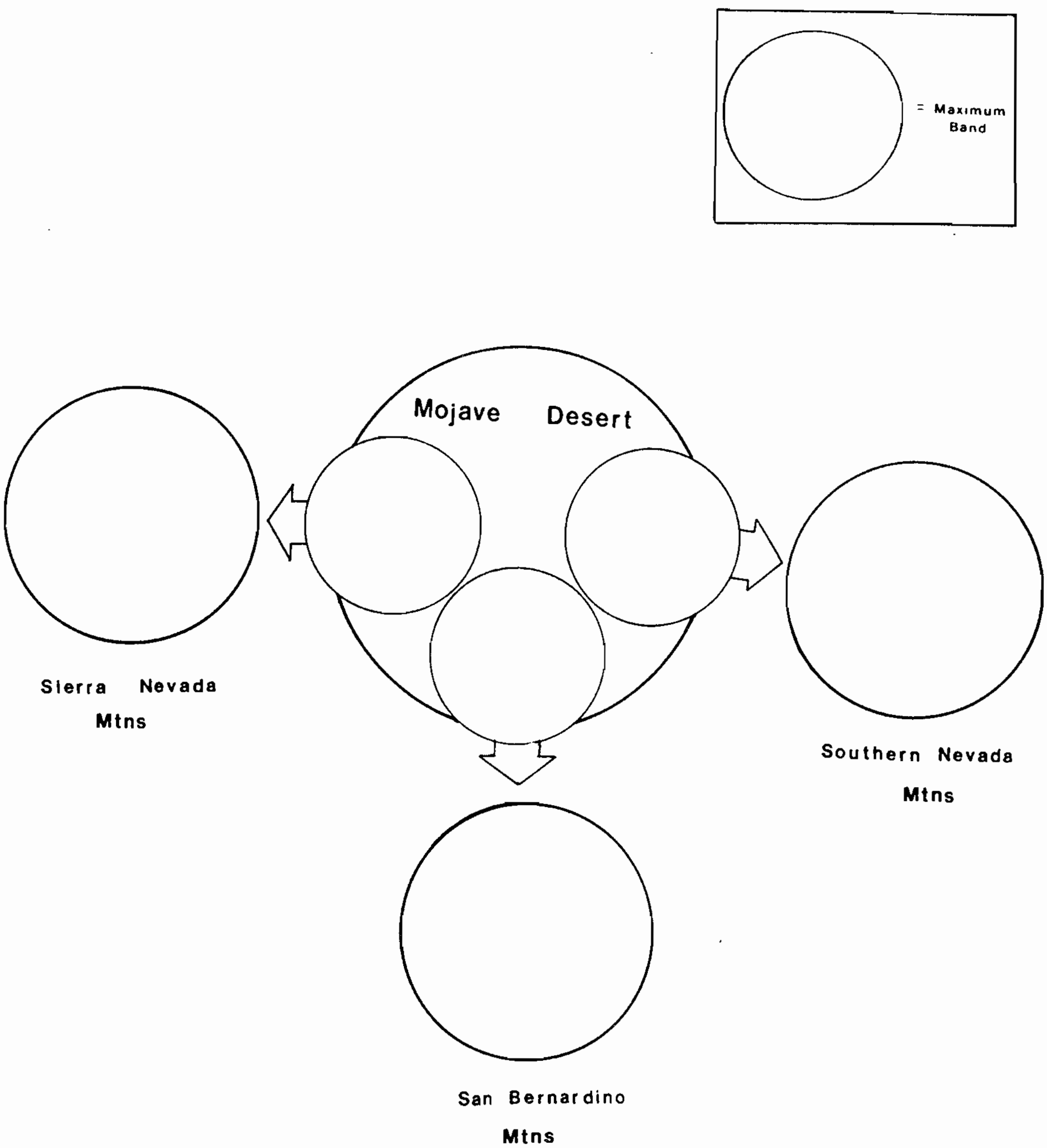

Figure 86. Mating/Communication networks in the Mojave Desert during the Middle Pinto period.

In these cases, corresponding again to the Middle Pinto period, people may have initially attempted to continue using their home territories as hinterlands, but continuation of this process over a long period of time would have ultimately resulted in the near or complete abandonment of the more environmentally marginal areas of the region.

Changing Human Ecology and Settlement-Subsistence Strategies of the Early to Mid-Holocene in the Mojave Desert

The evidence presented in Chapter II indicates that when the first emigrants arrived in the Mojave Desert they were adapted to a much more biotically productive patchwork of microenvironments than currently exists there (Spaulding 1983, 1985). This mosaic of microenvironments then provided a network of ecotones that was unparalleled in this area after 8,000 BP. By that time the environment was shifting towards more xeric conditions and less environmental diversity. The trends suggest that the carrying capacity of the Early Holocene desert was significantly higher before 8,000 BP than at any time period following it.

This does not mean, however, that human populations were higher during this period than during all subsequent time periods. Obviously, the manner in which this productive environment was exploited influenced the human carrying capacity of any portion of it. The environmental evidence does imply, however, that the settlement-subsistence patterns of post-8,000 BP human populations must have changed in response to climatic shifts that brought about a less diversified, more xeric environment.

Warren (1986) developed what he called a subsistence focus model to explain the interaction of cultural-technological subsystems with the environment. This systems theory suggests that the subsistence system of any cultural group is comprised of a series of production sets. Warren (1990:280-281) explains,

> This model holds that a subsistence system comprises a series of subsystems called production sets. A production set is defined as [the] procurement and processing activities carried out by individuals or organized groups of individuals through the use of systemically related tools, facilities, techniques, procedures, knowledge, and ideas about their use. . . Production sets differ from one another in tools, facilities, techniques, and/or procedures, as well as in personnel and organization. . . Production sets are not equal in productivity nor are they of equal concern to the population. There is a tendency for one production set to be the focus of activity in the sense that it is the one in which the greatest manipulation of ideas, technology, organization, procedures, techniques, and environment take place. That production set is designated the subsistence focus. . . Subsistence foci function within the context of cultural, demographic, and environmental forces. It is the relationship among these forces that results in changes in subsistence systems.

Warren (1990:294), concluding a review of the subsistence activities of Western Pluvial Lakes Tradition people, postulates that a large game production set (i.e. artiodactyl hunting and processing in the Mojave Desert) was the subsistence focus of the Lake Mojave complex. This implies that scheduling of cultural activities and population movements would have been most attuned to the distribution of artiodactyls, though other production sets, i.e. plant and small animal processing, would have continued to operate in conjunction with the dominant subsistence focus.

Warren (1990:297) postulates that the major water courses of the Mojave Desert region saw the greatest occupation during the pre-8,000 BP time period because they attracted the large game which formed the subsistence focus. If this was the case, the scheduling of people's visits and placement of field camps should have reflected attempts to maximize success in the procurement of artiodactyls. Most plant resources and small game, however, would have also been concentrated along these same water courses. Establishing field camps near them, particularly in areas near major game trails, would thus have also facilitated the more generalized pattern of foraging behavior assumed by most researchers for this time period (Ames 1988; Davis et al. 1969; Warren 1967).

The postulate that the Lake Mojave complex represents a culture with an artiodactyl subsistence focus implies it was a culture living relatively high on the food chain. This would require human populations to be relatively small even though the environment was considerably more biologically productive than it is today. The relatively large, and weak, mating and communication networks this system would result in were apparently buffered by the relatively high productivity of much of the environment. In other words, there was little risk attached to following a generalized foraging strategy because resources were more evenly distributed than they would be during later periods.

The evidence presented in Chapter VII indicates that the Pinto complex developed directly from the Lake Mojave complex. The transition is signaled by the addition of Pinto points to the Lake Mojave assemblage, with no apparent change in the settlement-subsistence system, between 8,200 and 8,000 BP. Pinto populations living from ca. 8,000 to 7,000 BP, however, had to adjust their culture and subsistence focus to a reduced carrying capacity resulting from the worsening environmental conditions in the region. To do this they necessarily increased their mobility and must have also increased their home territory sizes. Populations probably decreased due to migration out of the area, increased local mortality, and decreased fertility related to their increased mobility (Dumond 1965:302).

Dramatic technological advances, had they existed, (i.e. more effective collection, processing, and storage techniques) might have resulted in cultural adjustment to these changing environmental and social parameters without a concomitant loss in human populations. But there is no evidence of dramatic technological advances during this time period. In fact, people appear to have become even more conservative socially and technologically, a characteristic typical of populations under subsistence stress (Cowgill 1975:507). People were more careful in choosing when and where to go to ensure success after an investment of time and effort to get there. In short, they moved away from broad range foraging behavior and shifted more toward the collector end of the spectrum on the continuum between foragers and collectors (Binford 1980).

The evidence presented in Chapter VII shows that Pinto occupations were less numerous than Lake Mojave occupations and the sites left behind by them contain a greater diversity in tool assemblages. This evidence suggests human populations adjusted to the downward trend in carrying capacity by reducing the length of stay at particular processing locations, by more widely spacing their visits to these locations, and by conducting more specific activities while there. This implies that human populations thinned across broad areas of the region. The mating and communication networks just discussed would have been severely weakened by these tactics. Minimum bands occupying the most environmentally marginal areas of the region would have begun moving out toward areas of more diverse environments, such as the desert/foothills ecotone along the base of the Sierra Nevada Mountains, in an effort to re-establish their position in a viable mating and communication network.

Changes in archaeological faunal assemblages also give evidence that the subsistence focus was changing during this time period. Douglas et al. (1988) noted that the oldest sites excavated at Fort Irwin, the Awl site (9,400 BP) and Component 1 at the Henwood site (8,470 BP), had the highest artiodactyl bone content. Intermediate aged components (8,400 to 8,000 BP) contained more rabbit and rodent bones than were found in the earlier components. The later components (site SBR-4501 and the Embayment locus at Rogers Ridge) contained the highest percentages of rabbits and reptiles. This ordering of sites and faunal assemblages suggests the gradual weakening and eventual replacement of the artiodactyl subsistence focus during the Pinto period.

Though seed collection and processing were practiced, there is little evidence to suggest that they replaced artiodactyl hunting as the subsistence focus. In fact, at Fort Irwin, many Pinto components contain no evidence of seed gathering while Lake Mojave components frequently do. At present, the data suggest small animal collection may have replaced artiodactyls as the subsistence focus in the central Mojave Desert.

The evidence available suggests that by 7,000 BP visits to the Mojave Desert had either become so ephemeral that they resulted in sites which are virtually invisible to current archaeological techniques, or that the area was more or less abandoned. I believe both are true. The area probably continued to be used as a very marginal hinterland and the traces left by the Pinto peoples' infrequent visits were very sparse and therefore very difficult to successfully study.

Such evidence of Middle Pinto period occupation as there is from the Mojave Desert may well be due to the fact that even though the general trend during the Altithermal was toward extreme aridity over long periods of time, there were apparently short wet phases during this period when the desert greened up for a while (Mehringer 1977:149). Populations skirting the Mojave Desert could have profitably expanded out into it during these periods without risking too much. Any such reoccupations most likely would have followed a pattern of gradual reestablishment of minimum band networks rather than a headlong, linear movement of a maximal band into virtually unoccupied territory. The minimum bands in the most environmentally marginal situations would have again retreated, however, toward zones of greater environmental diversity and larger populations with the re-establishment of drought conditions.

Evidence presented by this study suggests that the period of reduced human occupation in the Mojave Desert lasted from about 7,000 until circa 5,000 BP, when a gradual reversal of hot and dry climatic trends once again made longer term and/or more frequent visits practical. Climatic trends apparently continued to improve regional environments until the Neopluvial maximum, which occurred about 3,600 BP in the Mojave Desert (Enzel et al. 1990).

By early in the Neopluvial populations had probably re-colonized most of the Mojave Desert, but were apparently most densely distributed in areas like the Mojave River Valley (Davis and Smith 1981), the Amargosa River Valley (Rogers 1939), and various parts of Death Valley (Hunt 1960). The Pinto period had come to an end before this maximum occurred, however, as shown by the introduction of Elko, Gypsum, and Humboldt projectile points at about 4,000 BP.

APPENDIX A

COMPUTER GENERATED ARTIFACT DENSITY CONTOUR MAPS

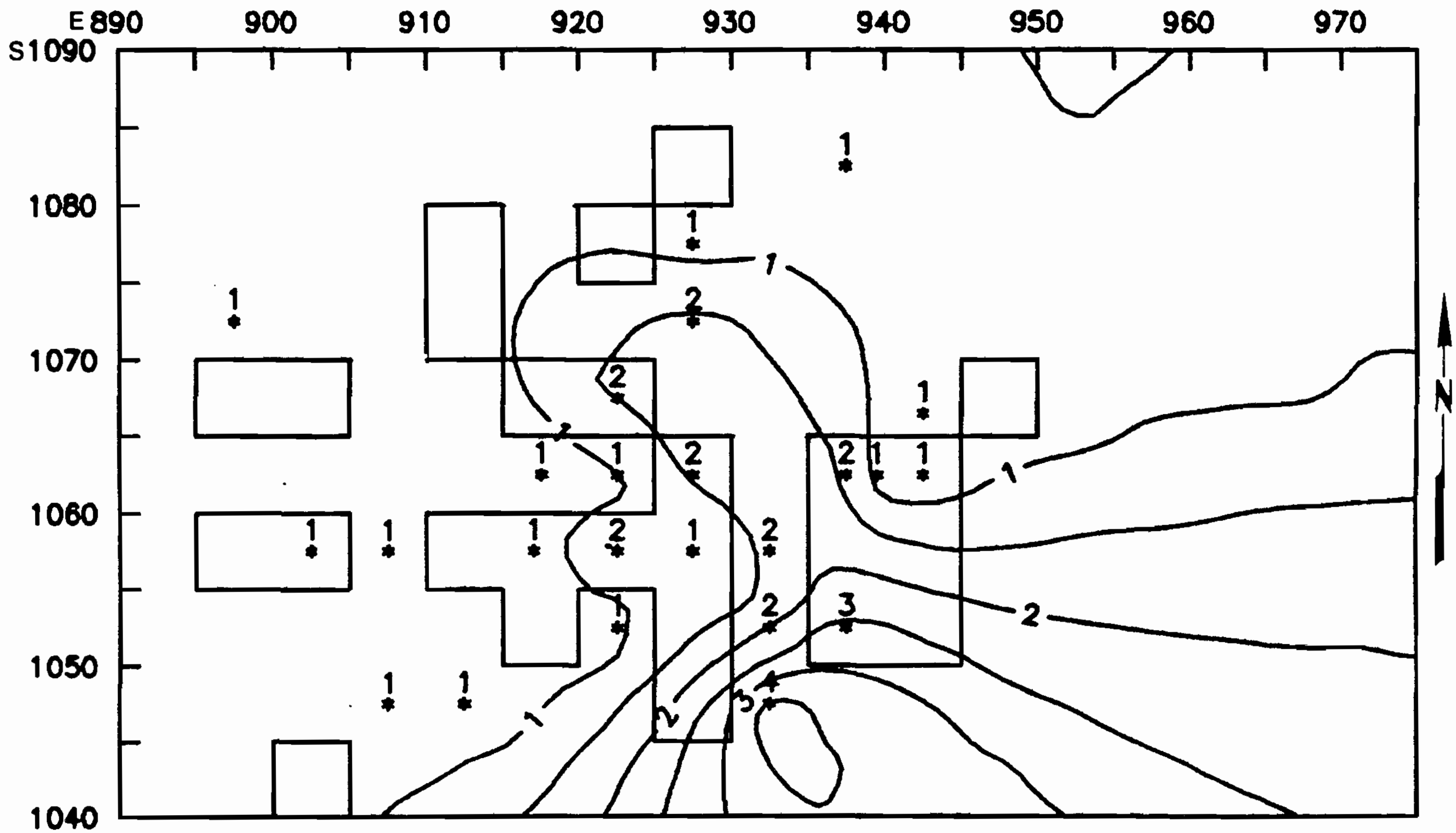

Figure 1. Distribution of scrapers in Component Surflo.

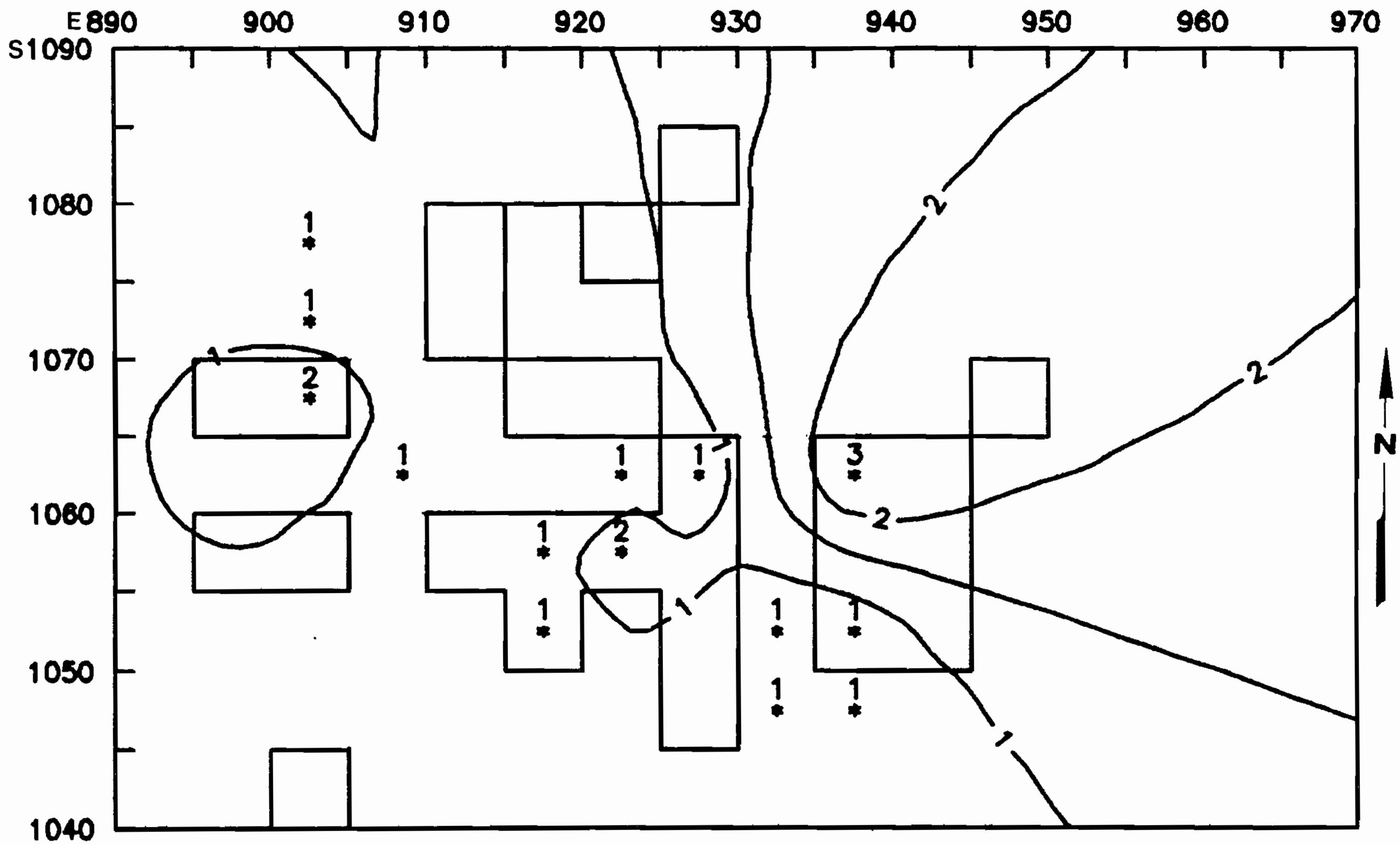

Figure 2. Distribution of ground stone in Component Surflo.

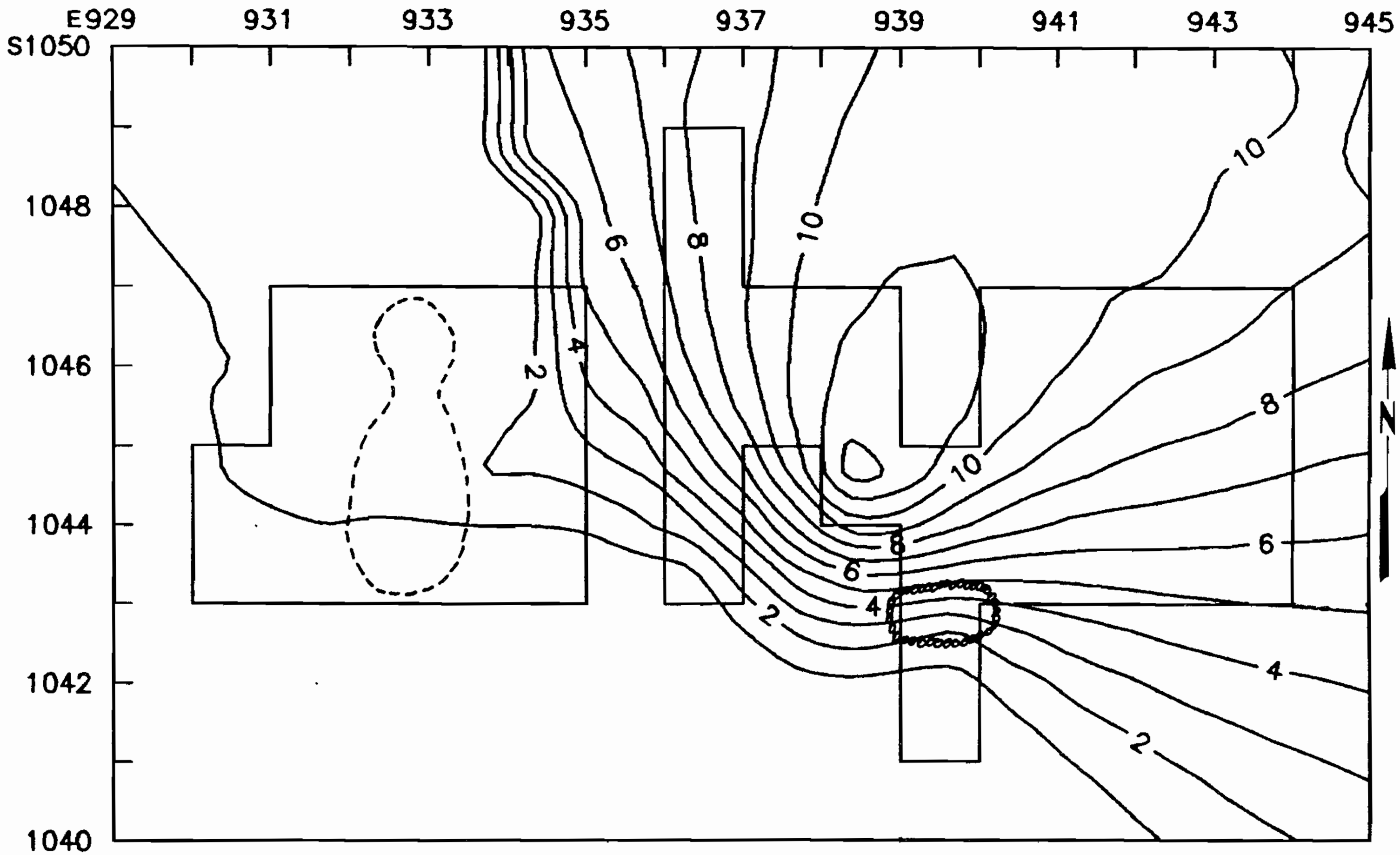

Figure 3. Distribution of lithic debitage in Stratum 1 of
Component Blockex.

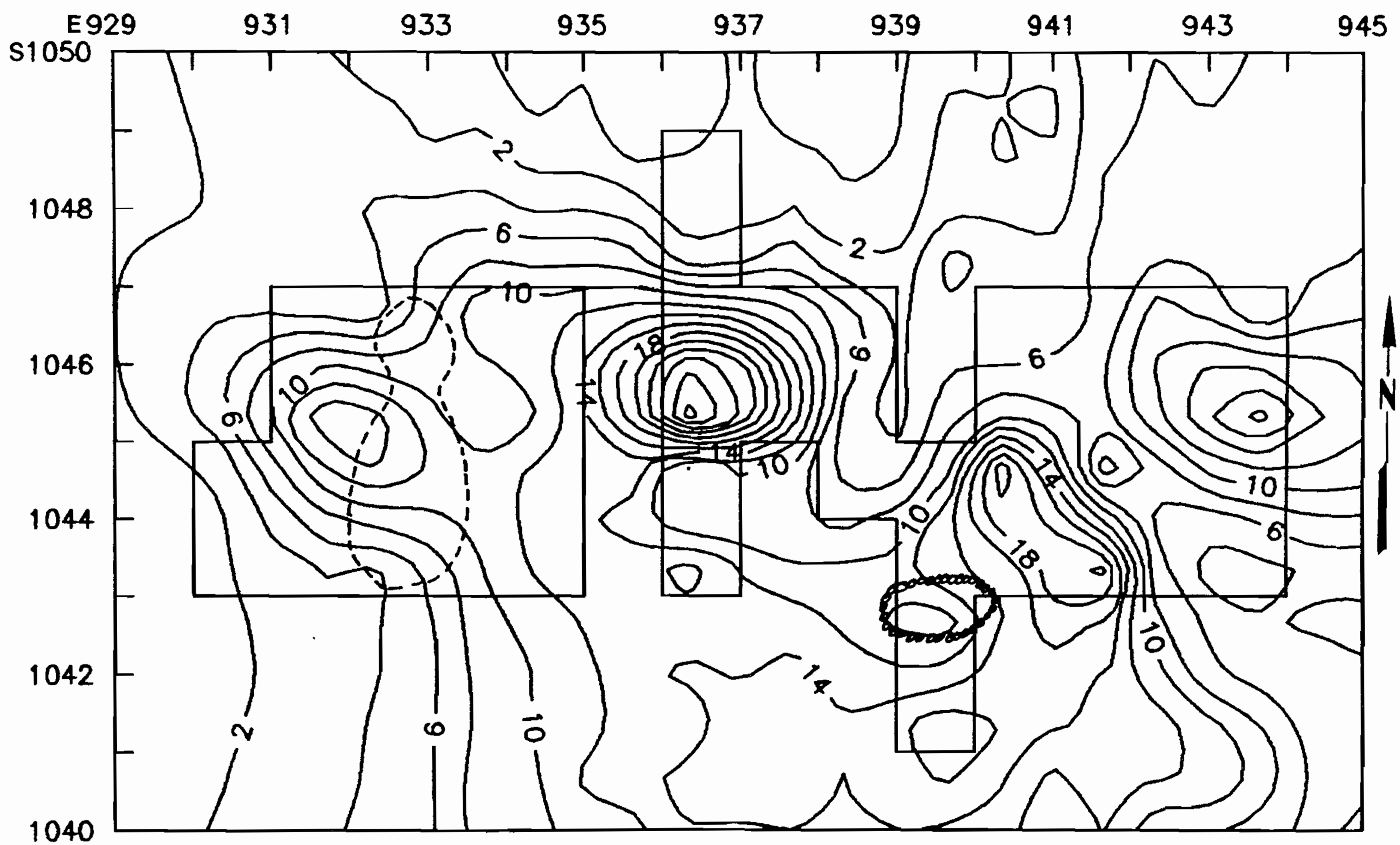

Figure 4. Distribution of lithic debitage in Stratum 2A of Component Blockex.

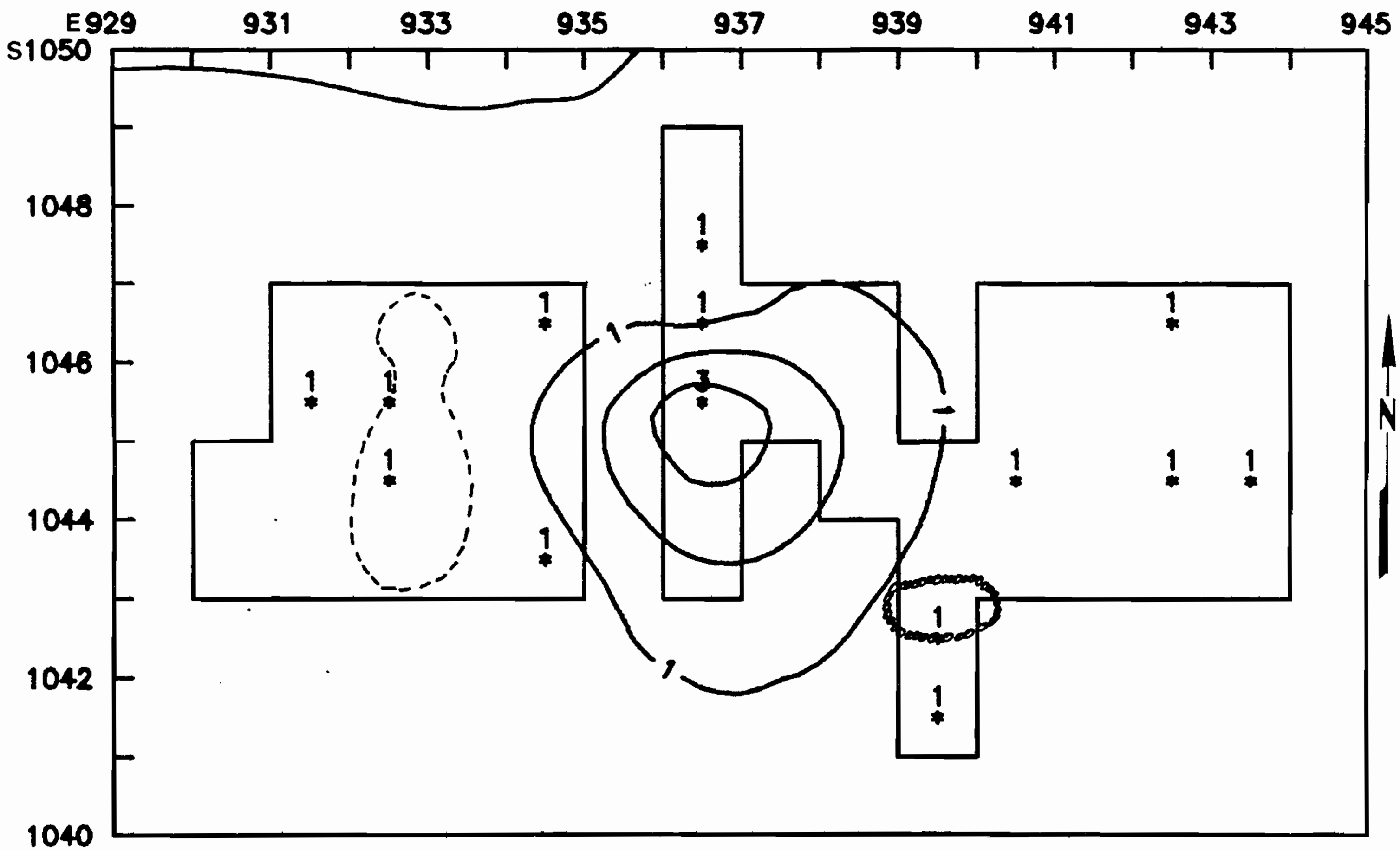

Figure 5. Distribution of all tools in Stratum 2A of Component Blockex.

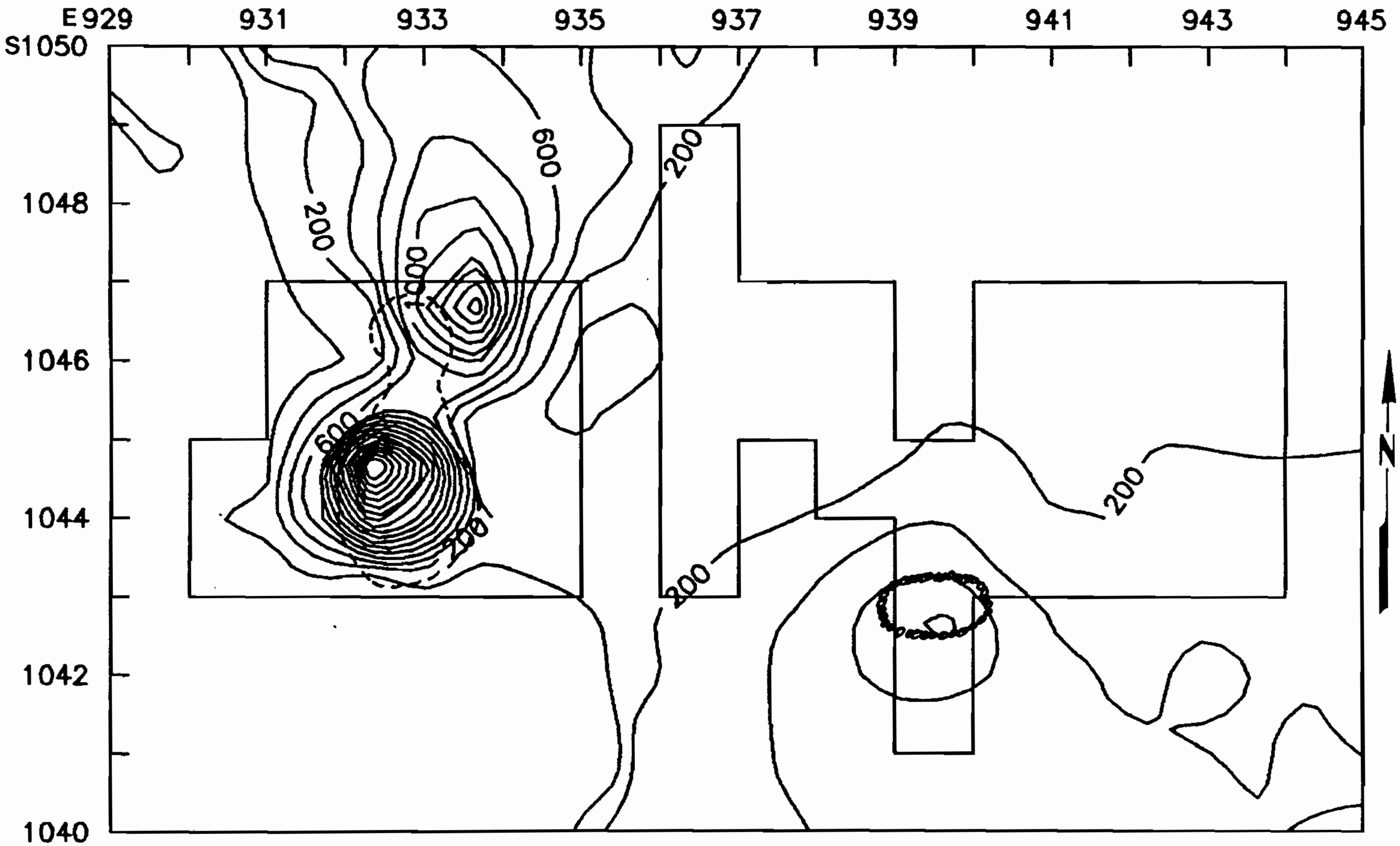

Figure 6. Distribution of lithic debitage in Component 2B.

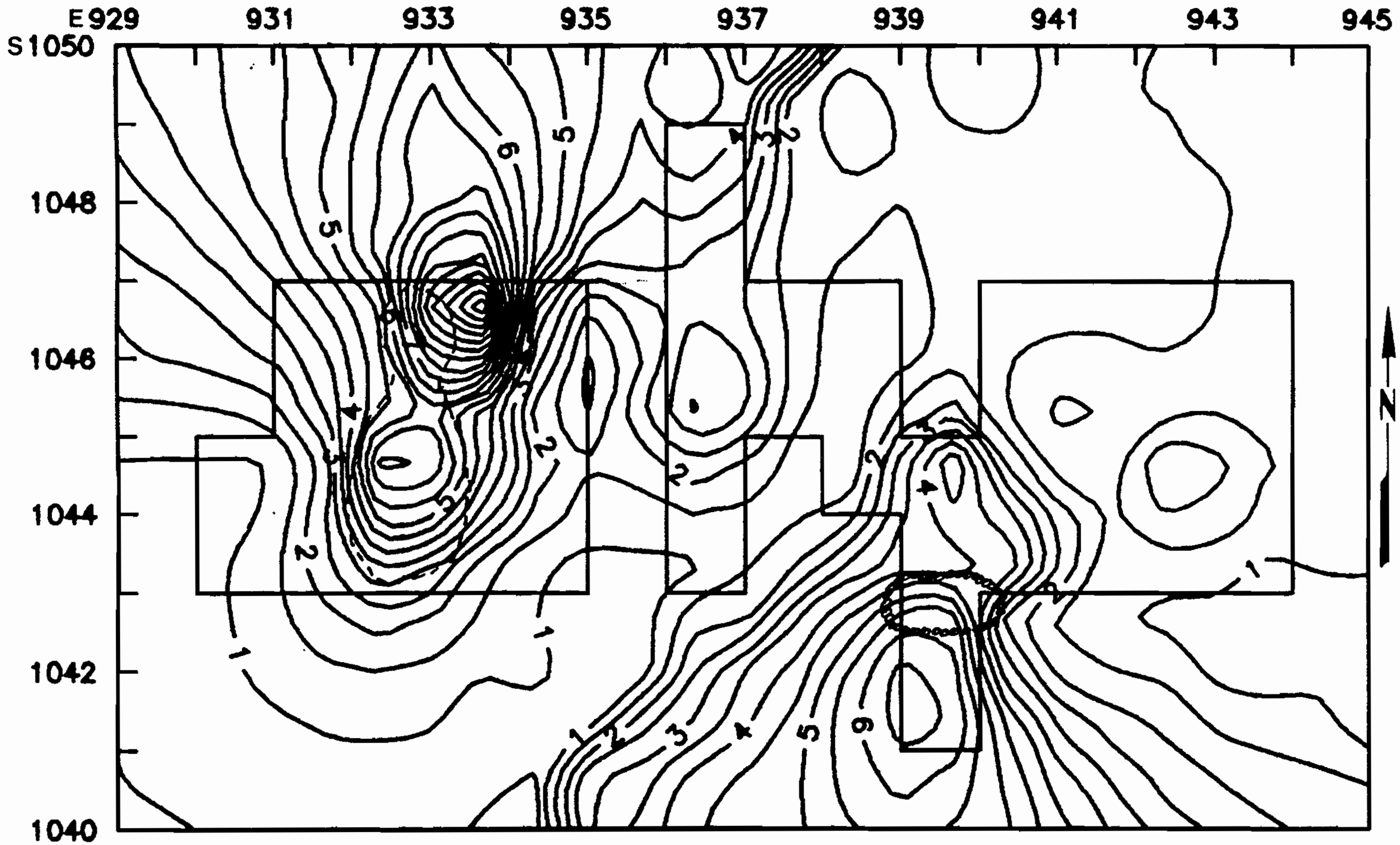

Figure 7. Distribution of all tools in Component 2B.

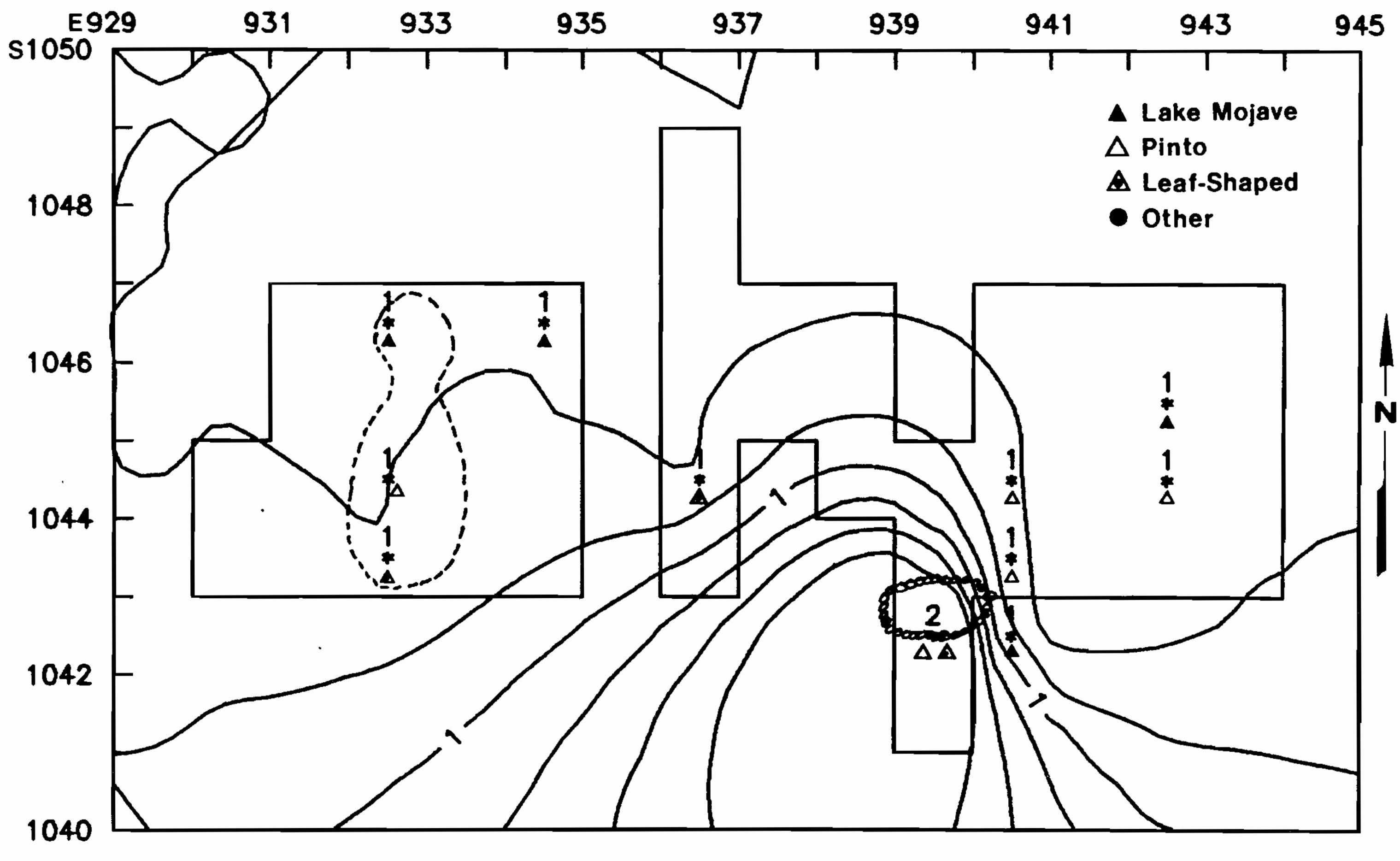

Figure 8. Distribution of projectile points in Component 2B.

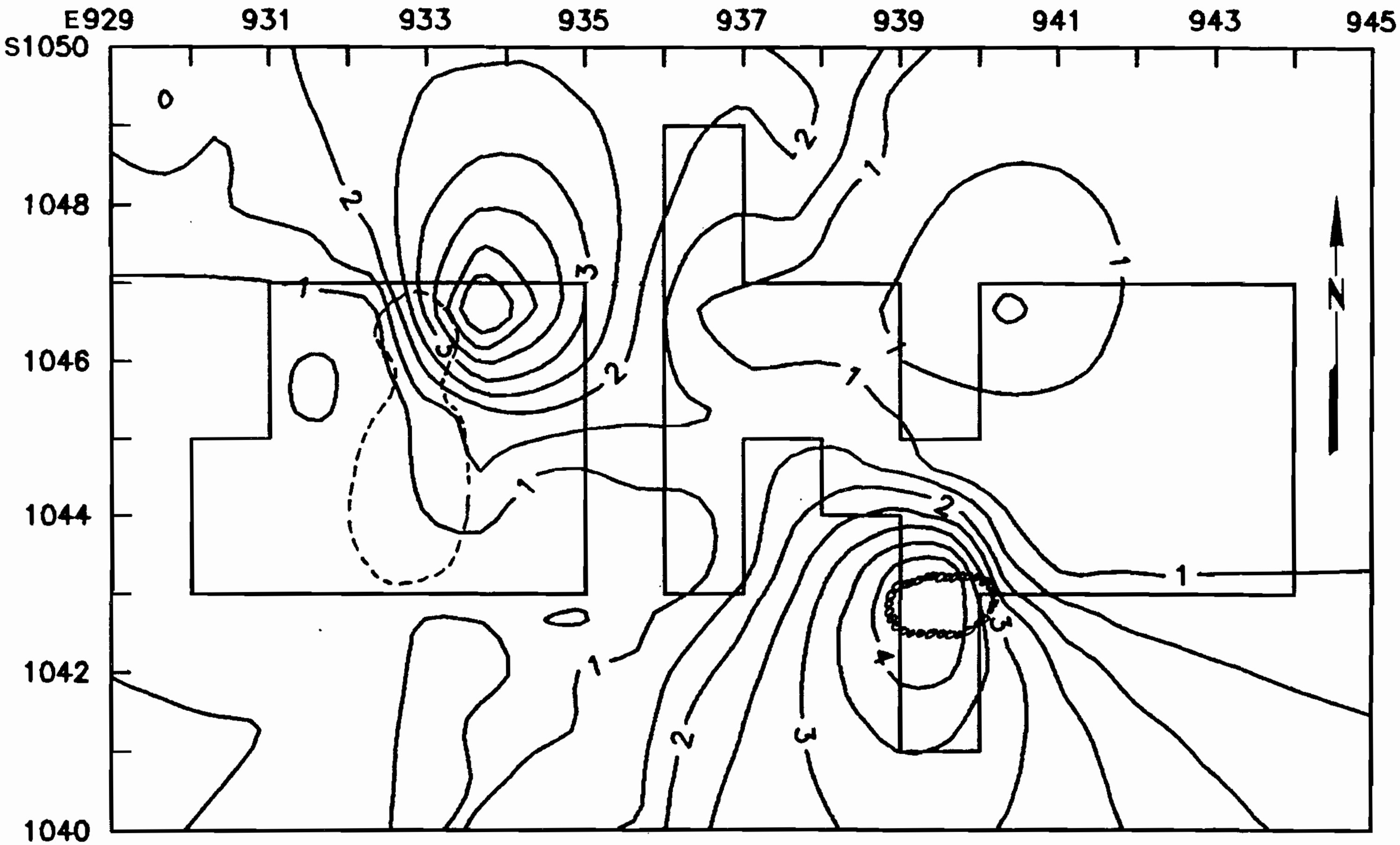

Figure 9. Distribution of bifaces in Component 2B.

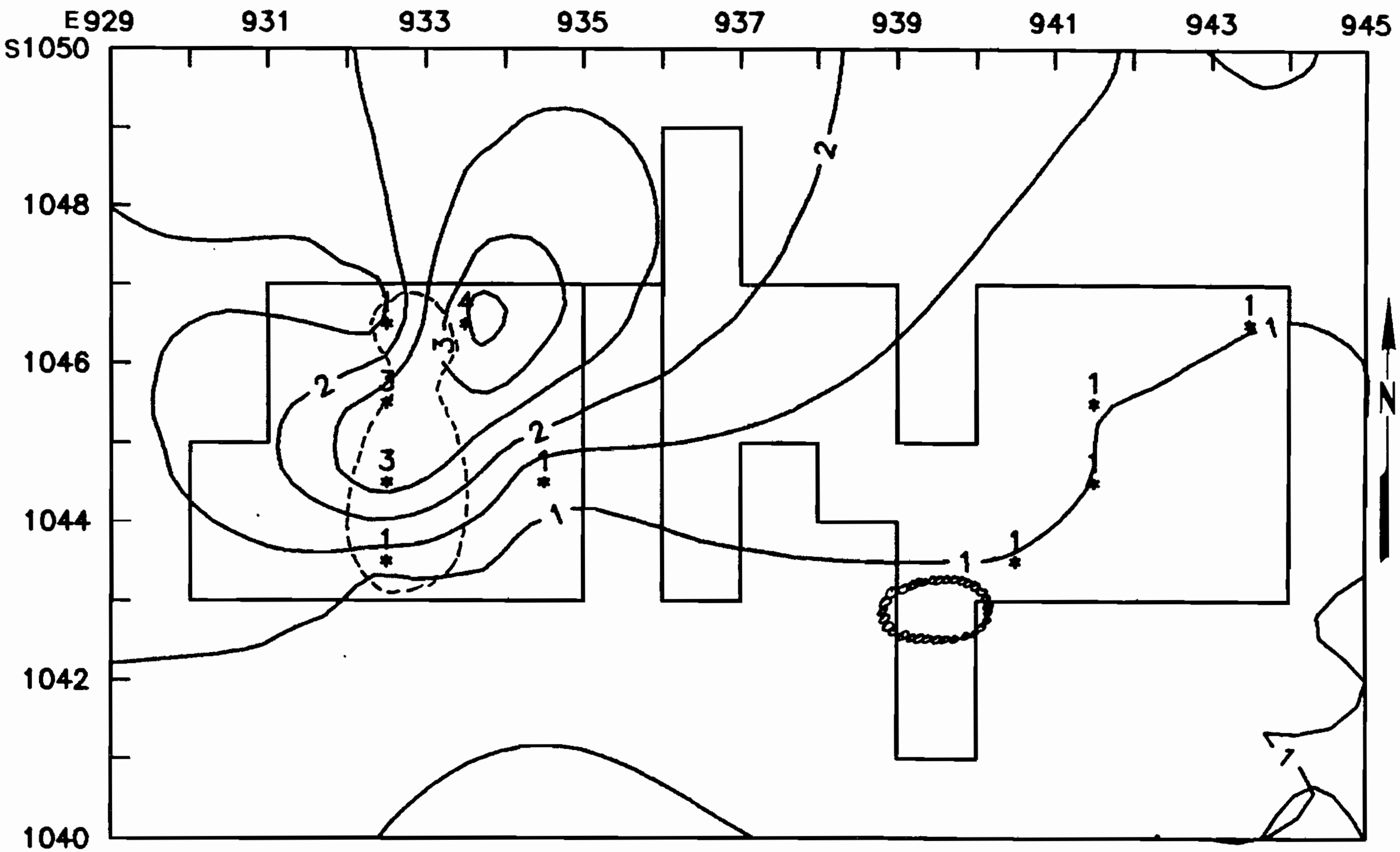

Figure 10. Distribution of ground stone in Component 2B.

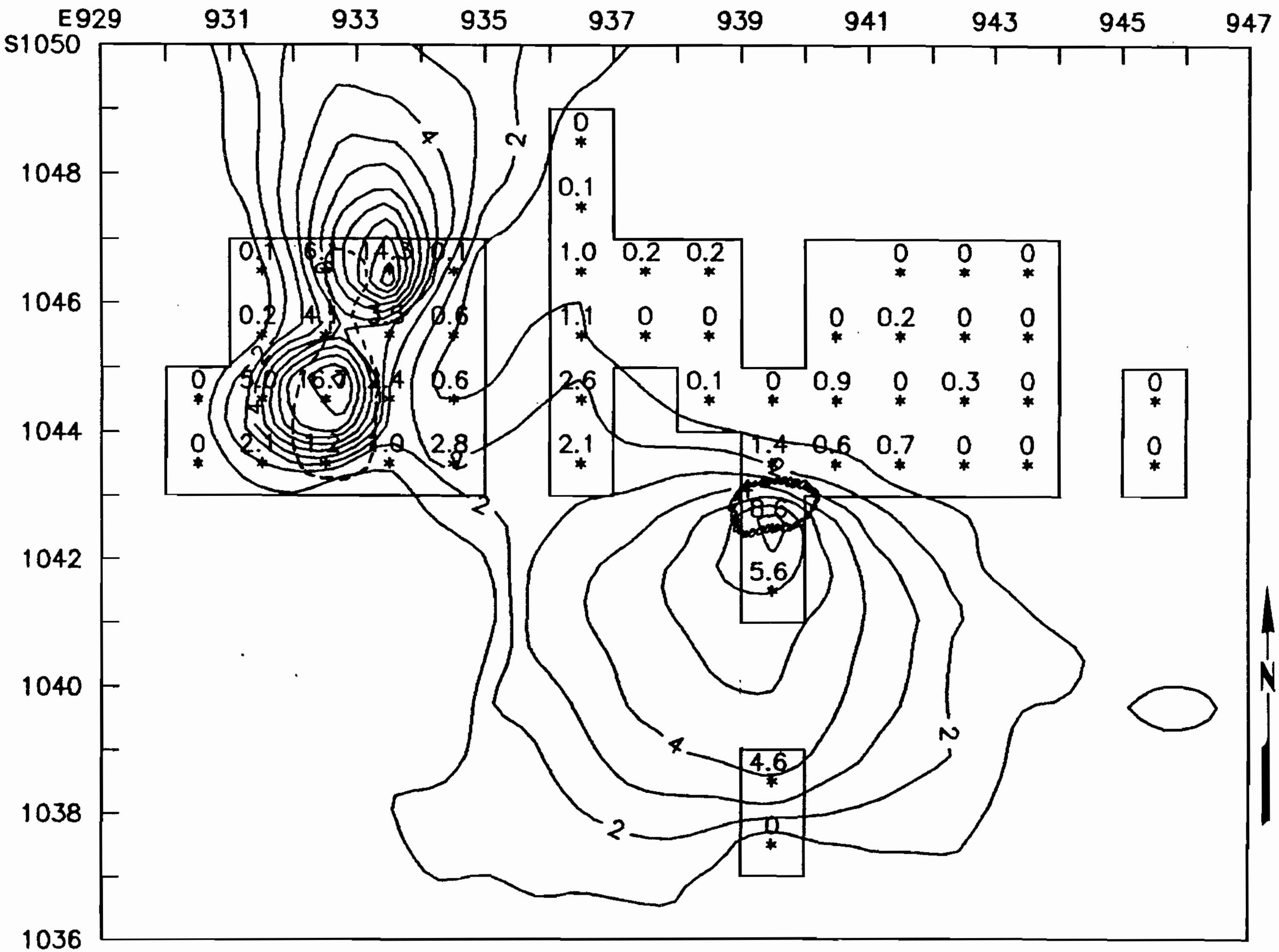

Figure 11. Distribution of bone in Component 2B.

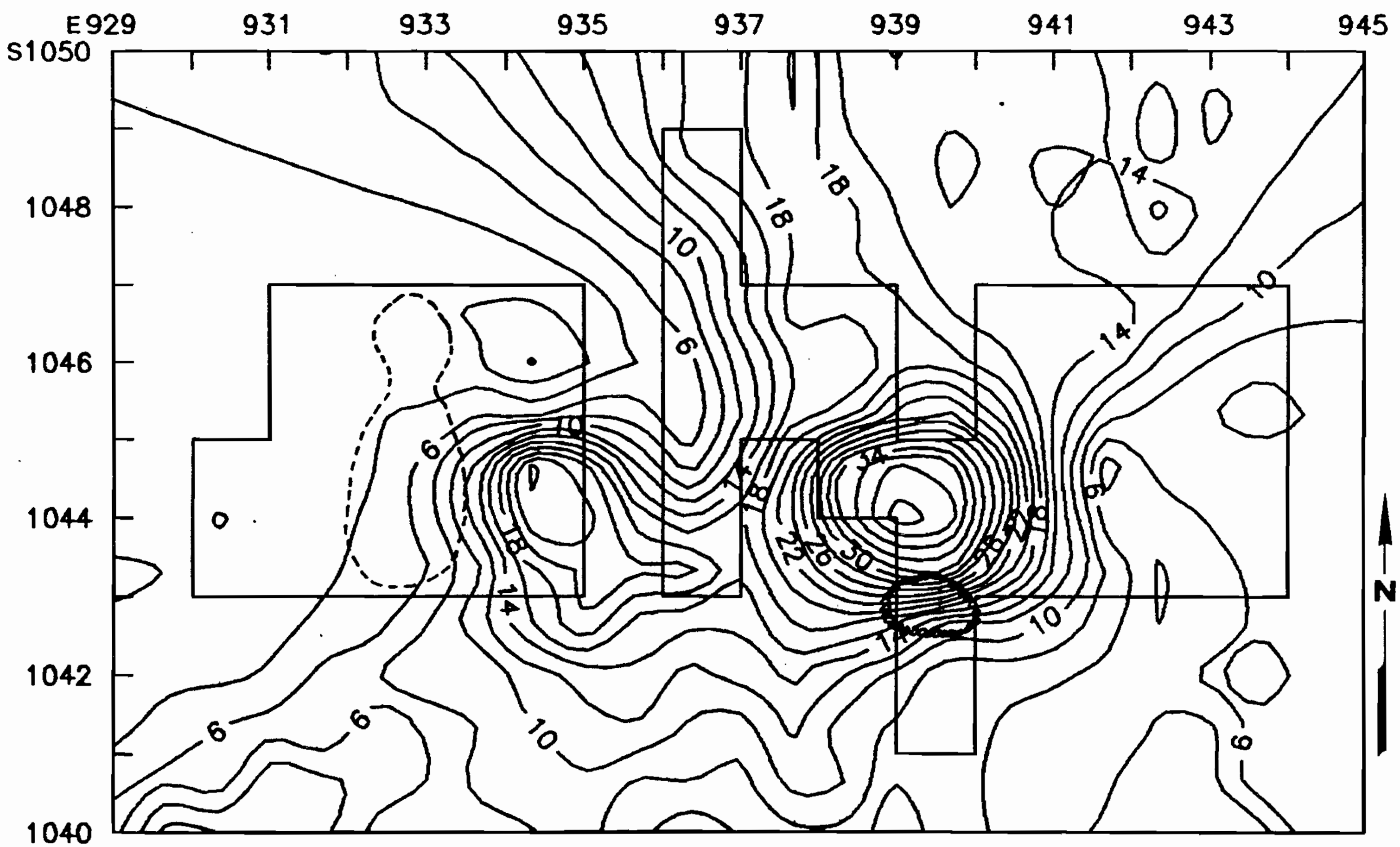

Figure 12. Distribution of lithic debitage in Stratum 4, Component Blockex.

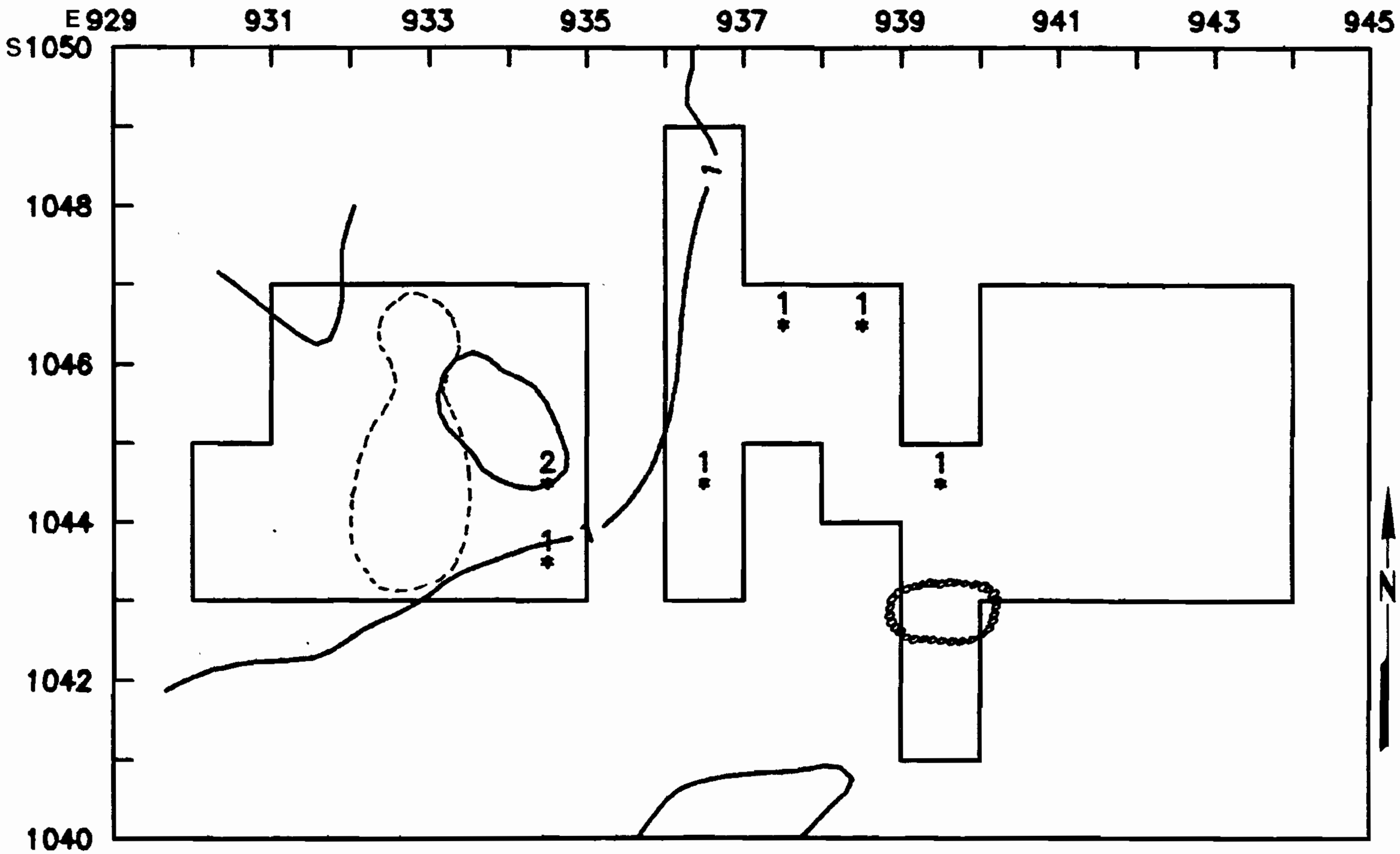

Figure 13. Distribution of all tools in Stratum 4, Component Blockex.

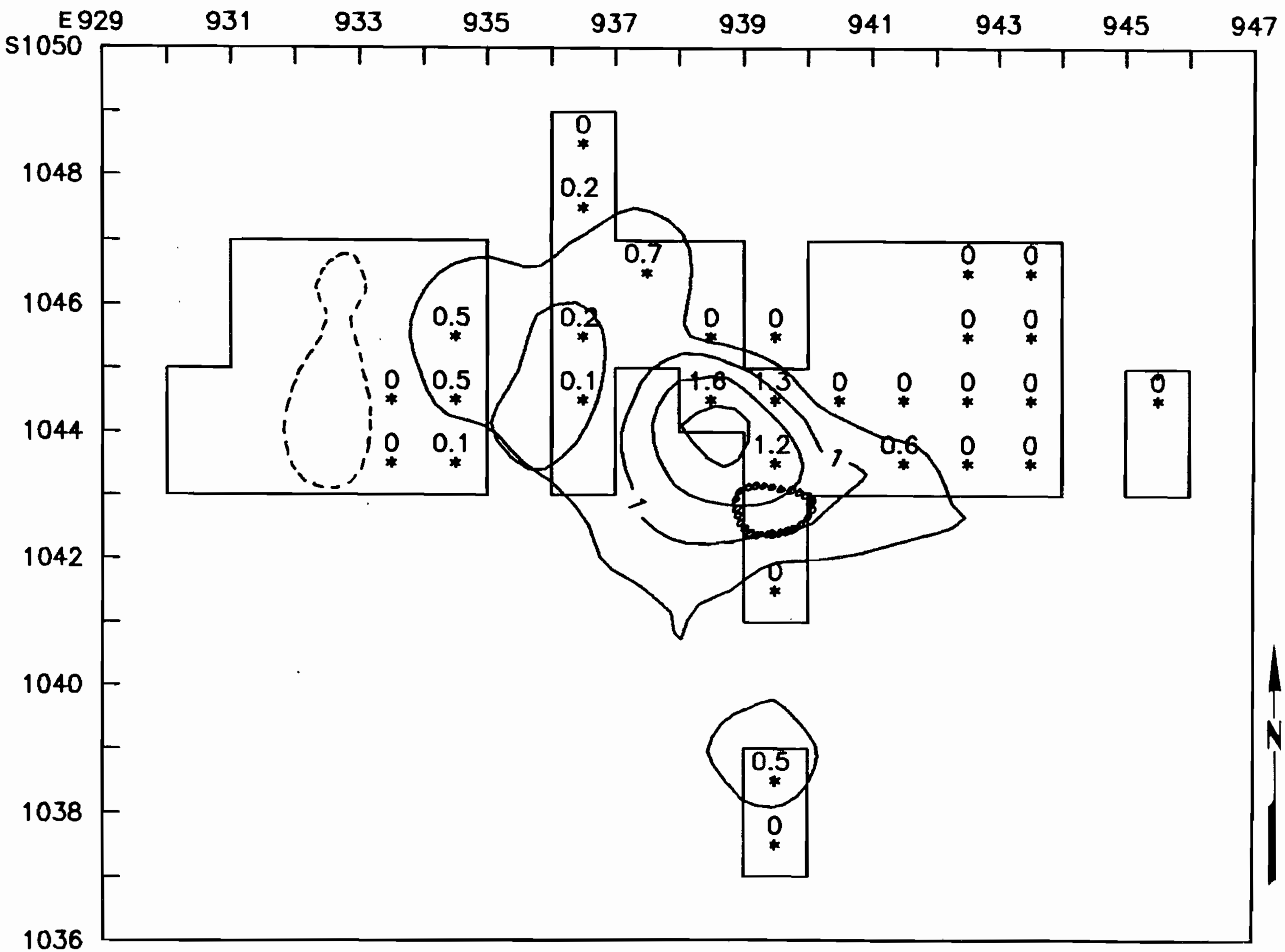

Figure 14. Distribution of bone in Stratum 4, Component Blockex.

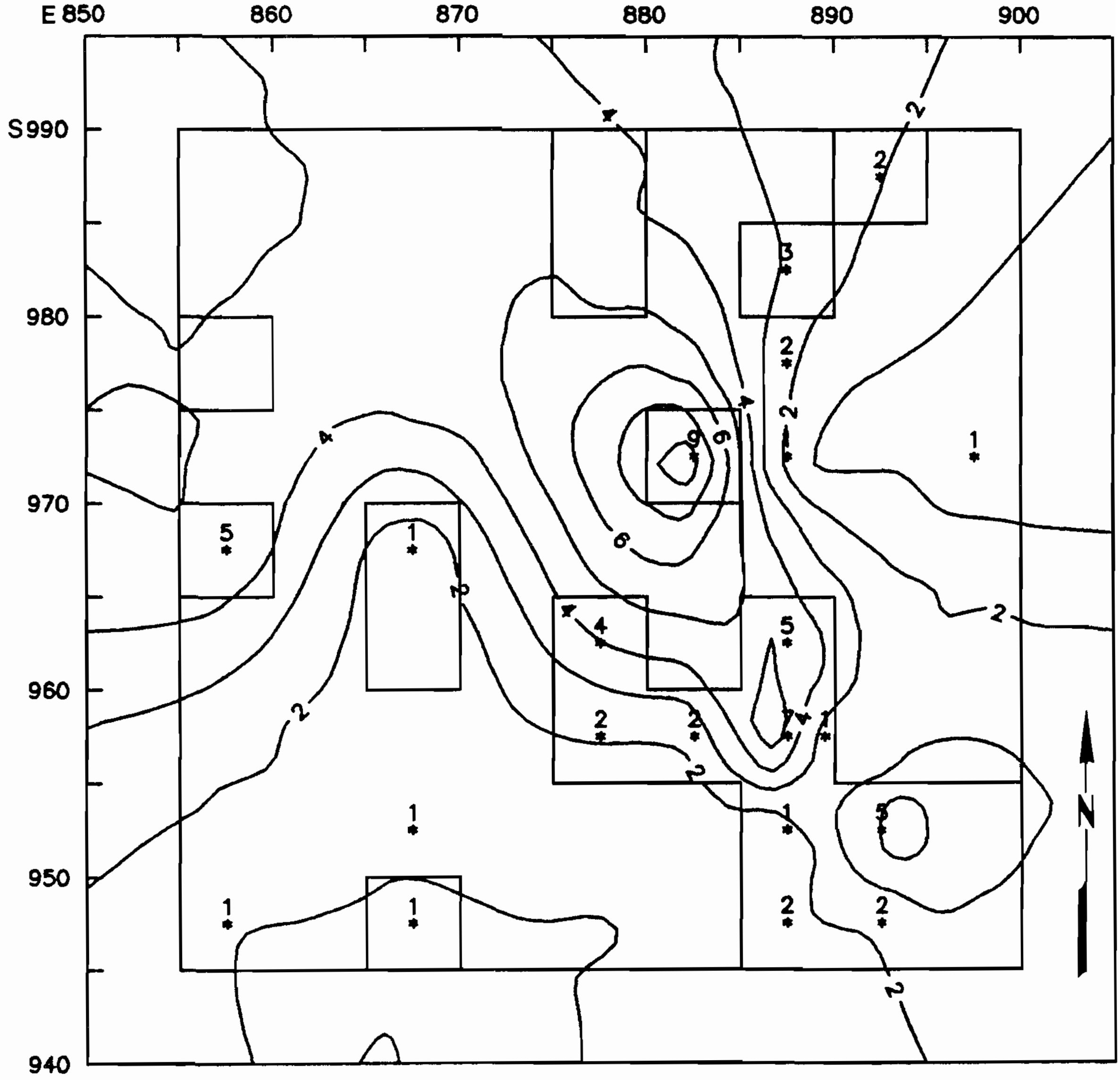

Figure 15. Distribution of all tools in Component Sol.

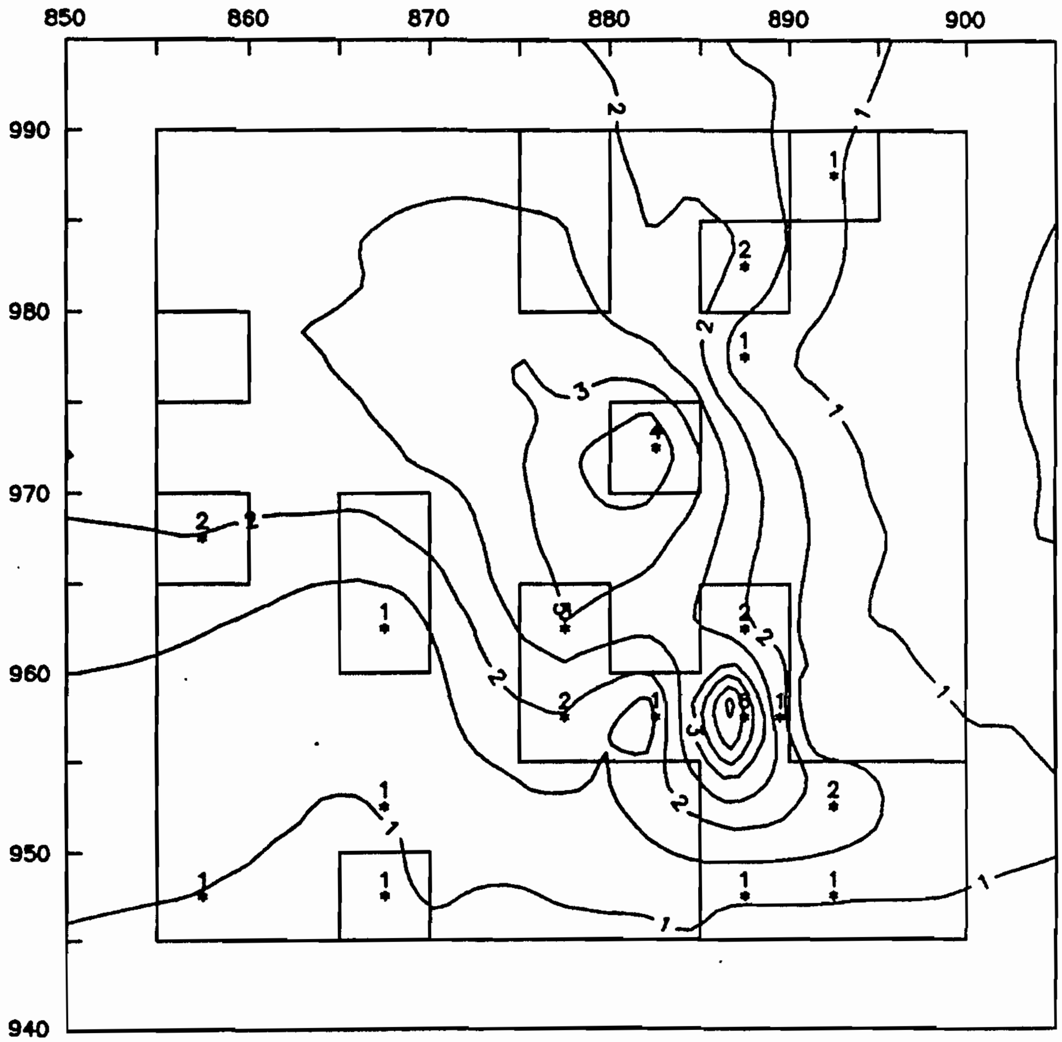

Figure 16. Distribution of bifaces in Component Sol.

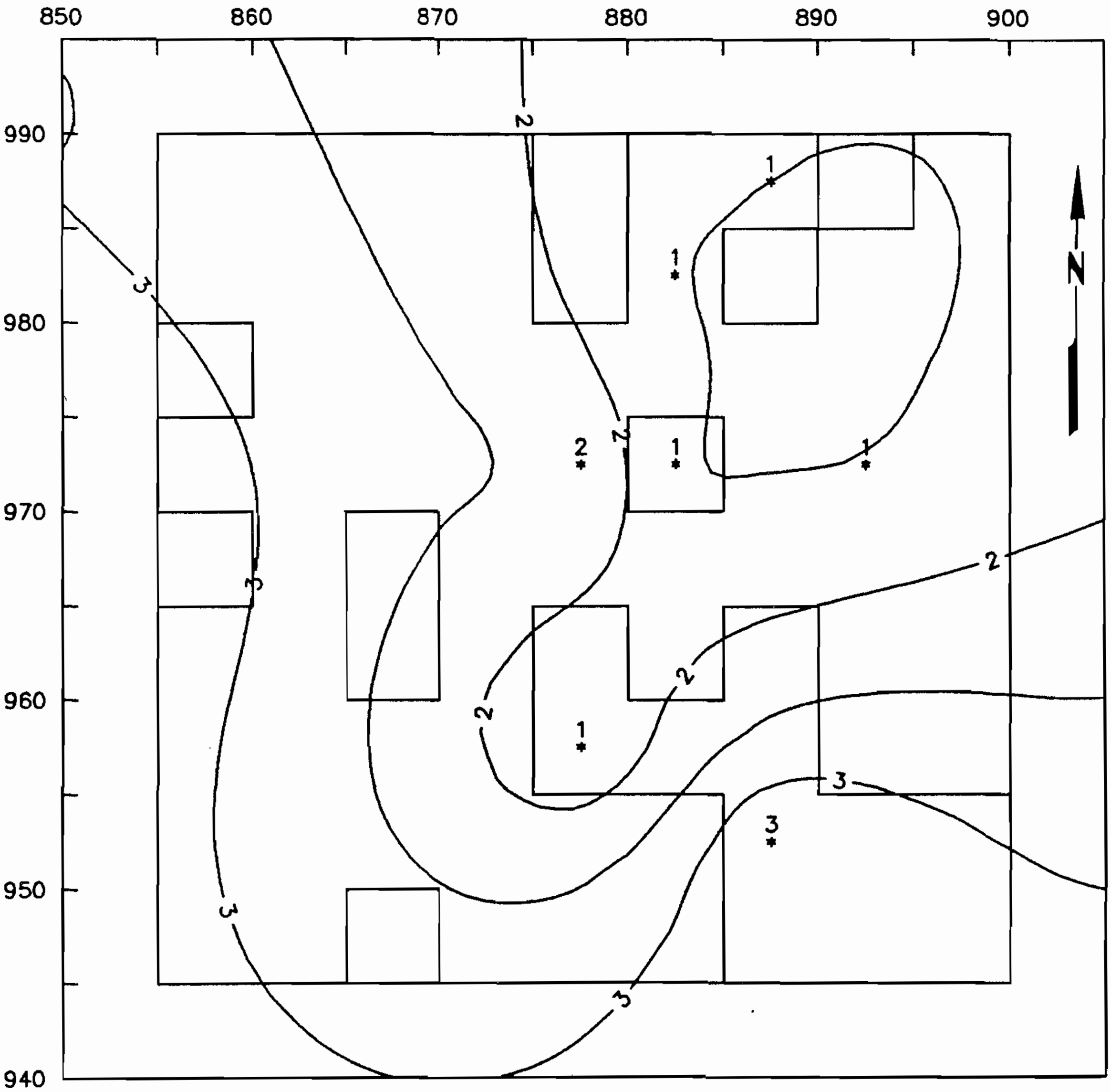

Figure 17. Distribution of scrapers in Component Sol.

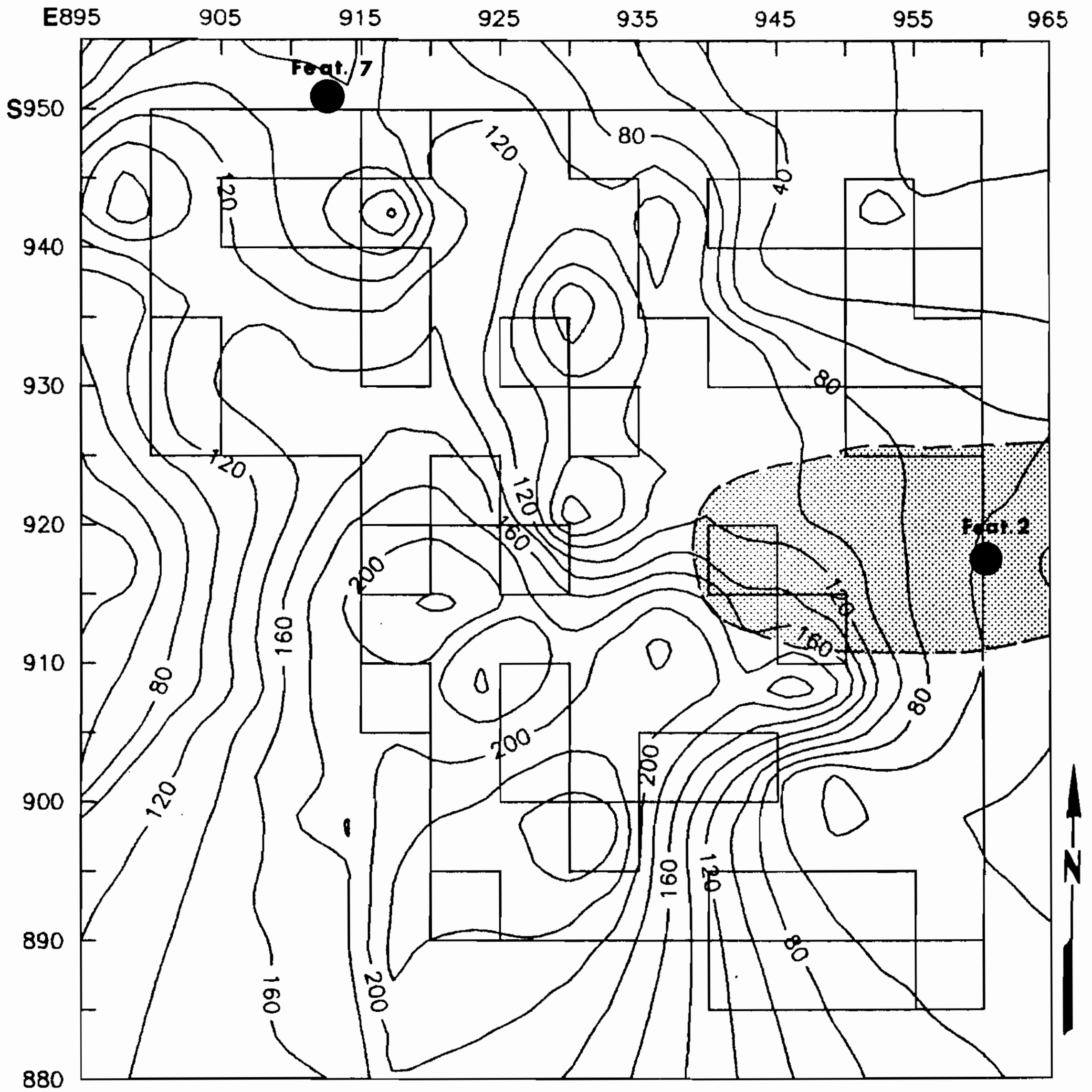

Figure 18. Distribution of lithic debitage in Component So2.

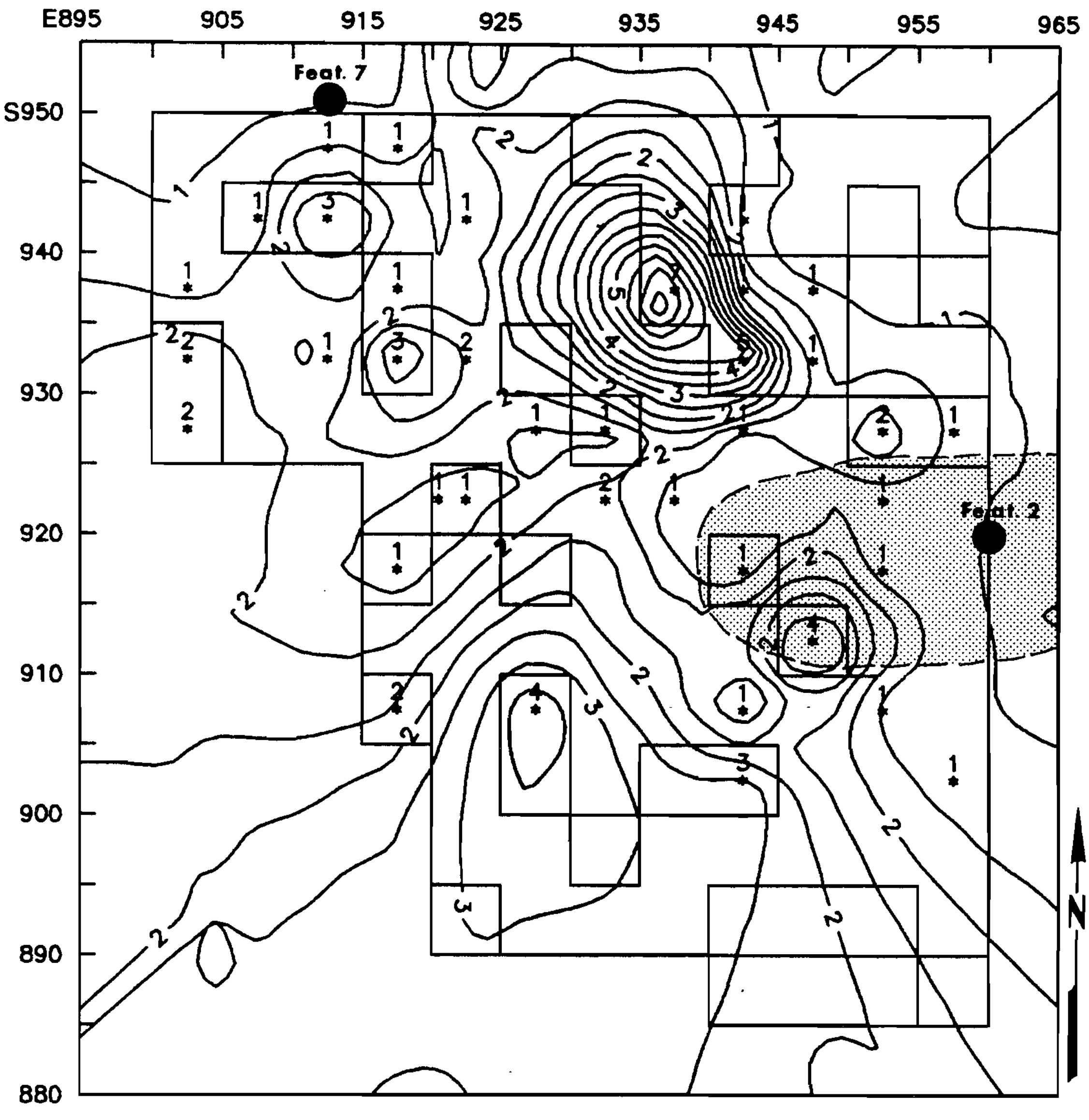

Figure 19. Distribution of bifaces in Component So2.

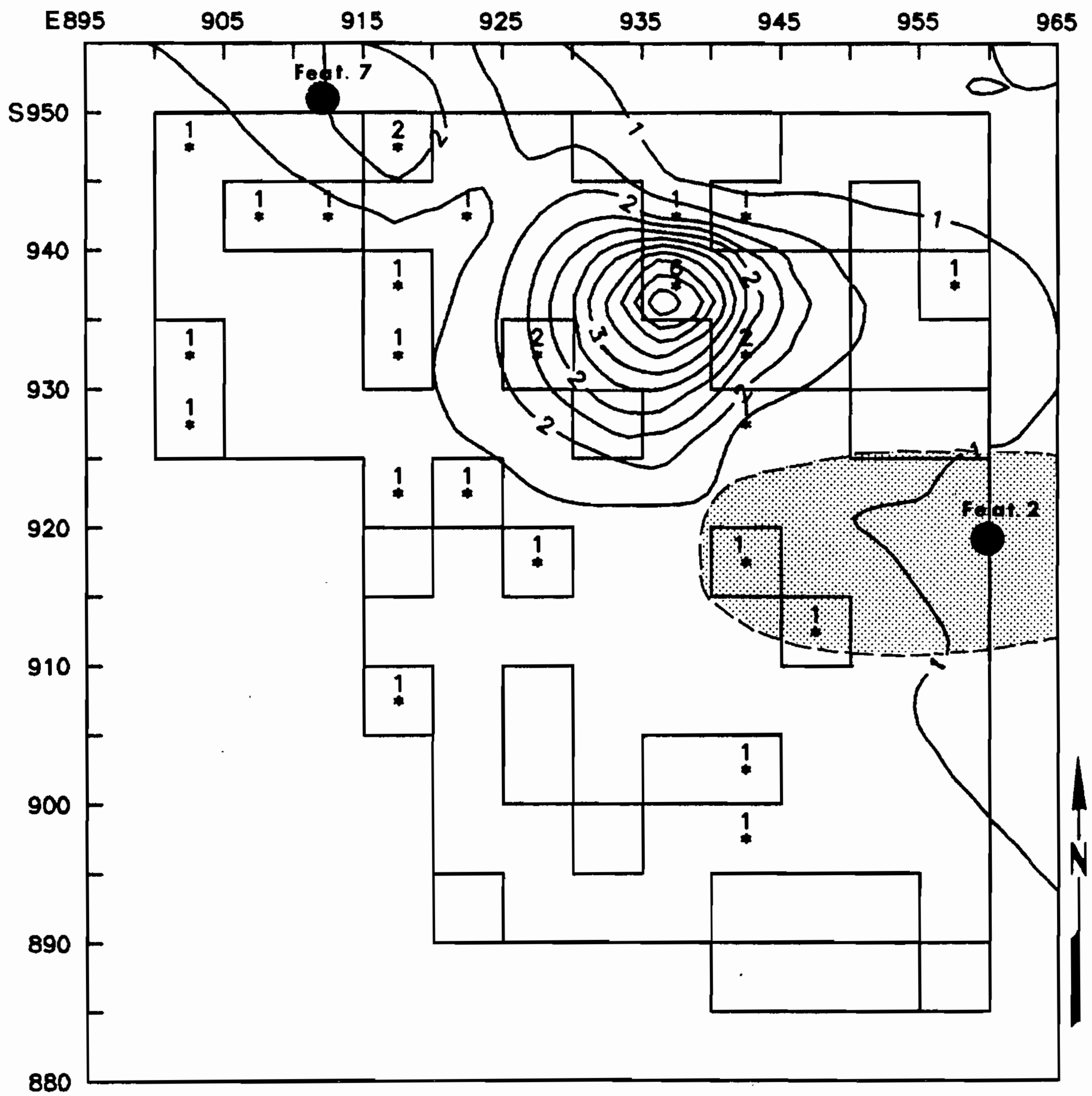

Figure 20. Distribution of scrapers in Component So2.

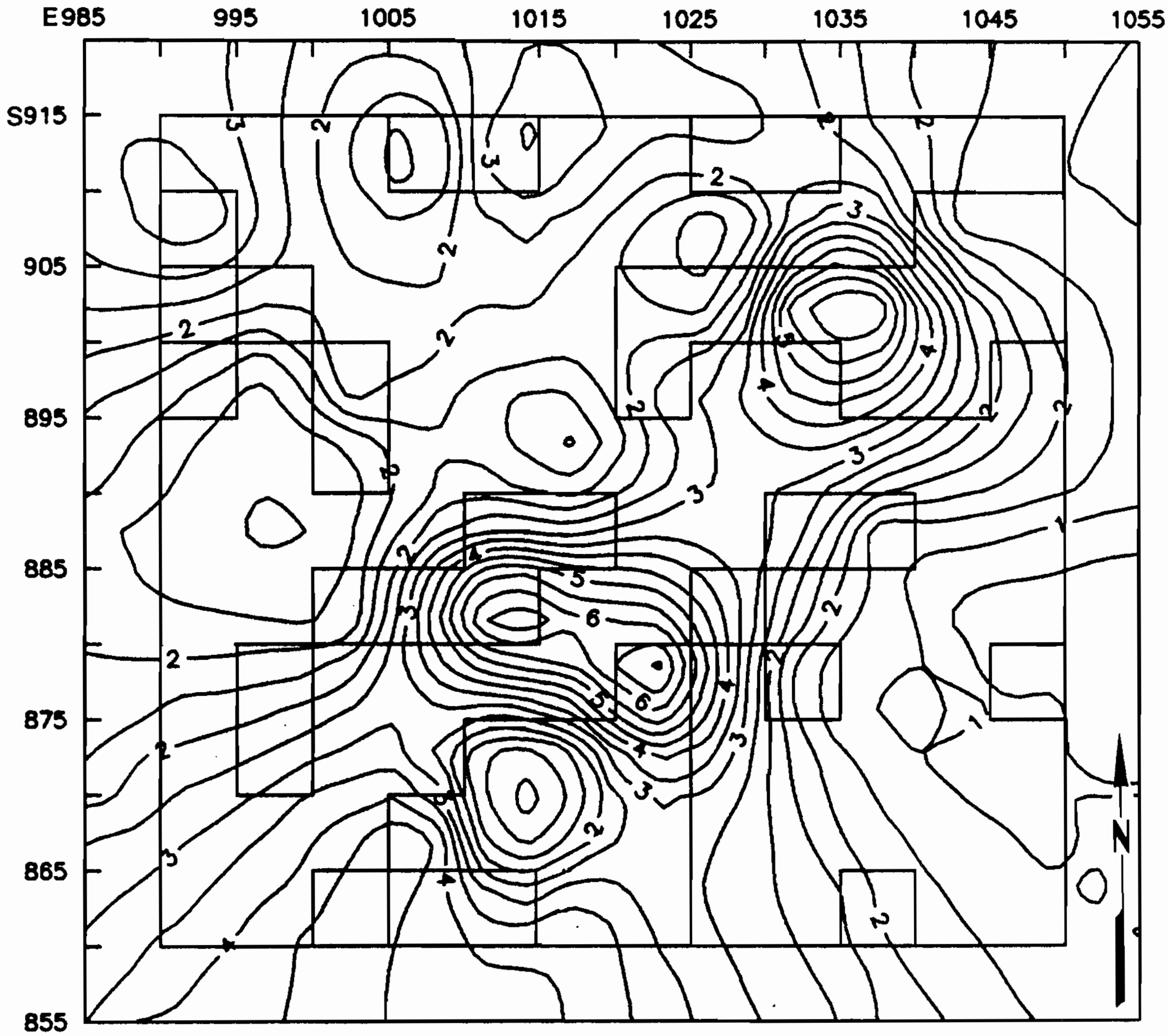

Figure 21. Distribution of bifaces in Component Emman.

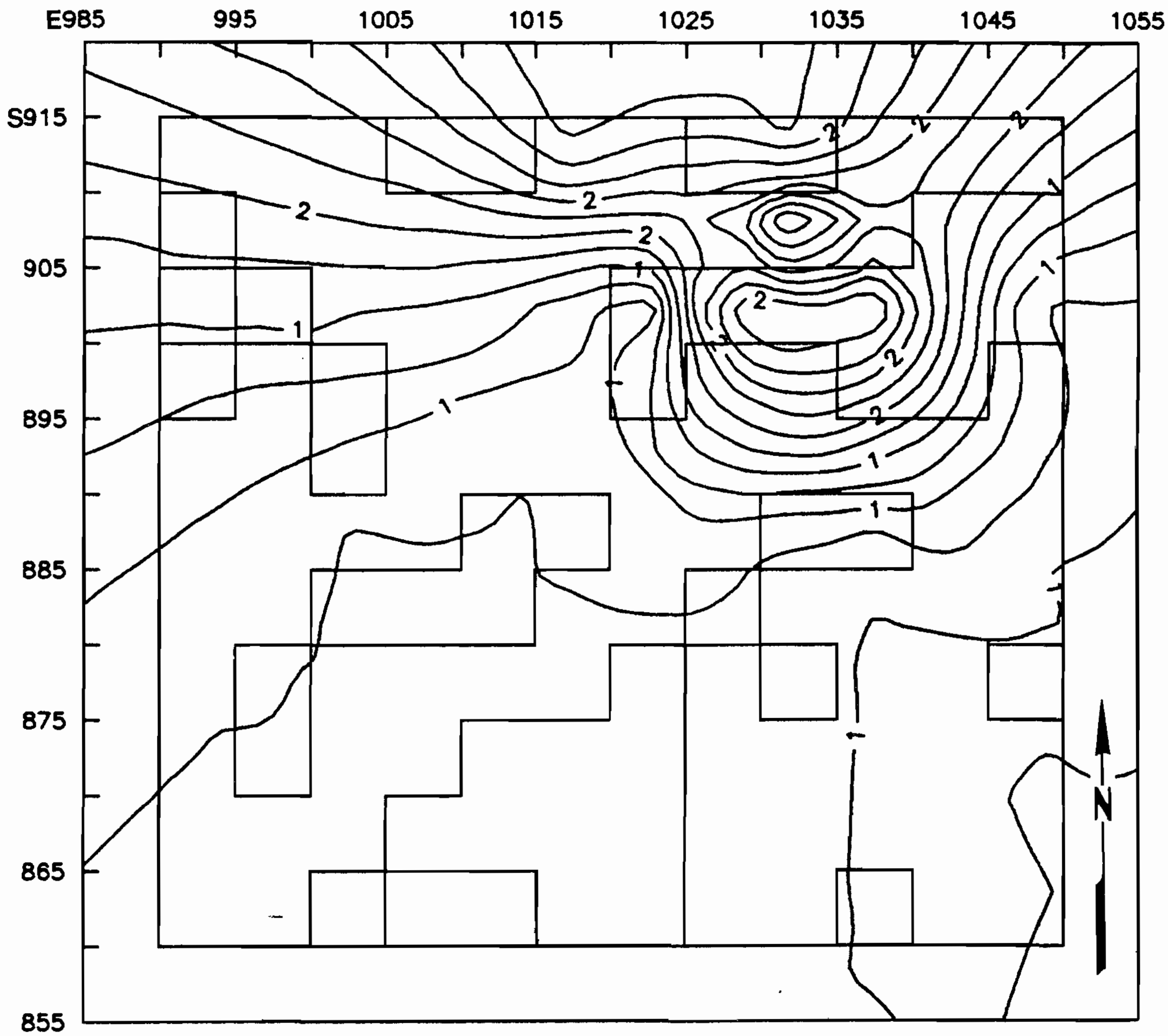

Figure 22. Distribution of scrapers in Component Emman.

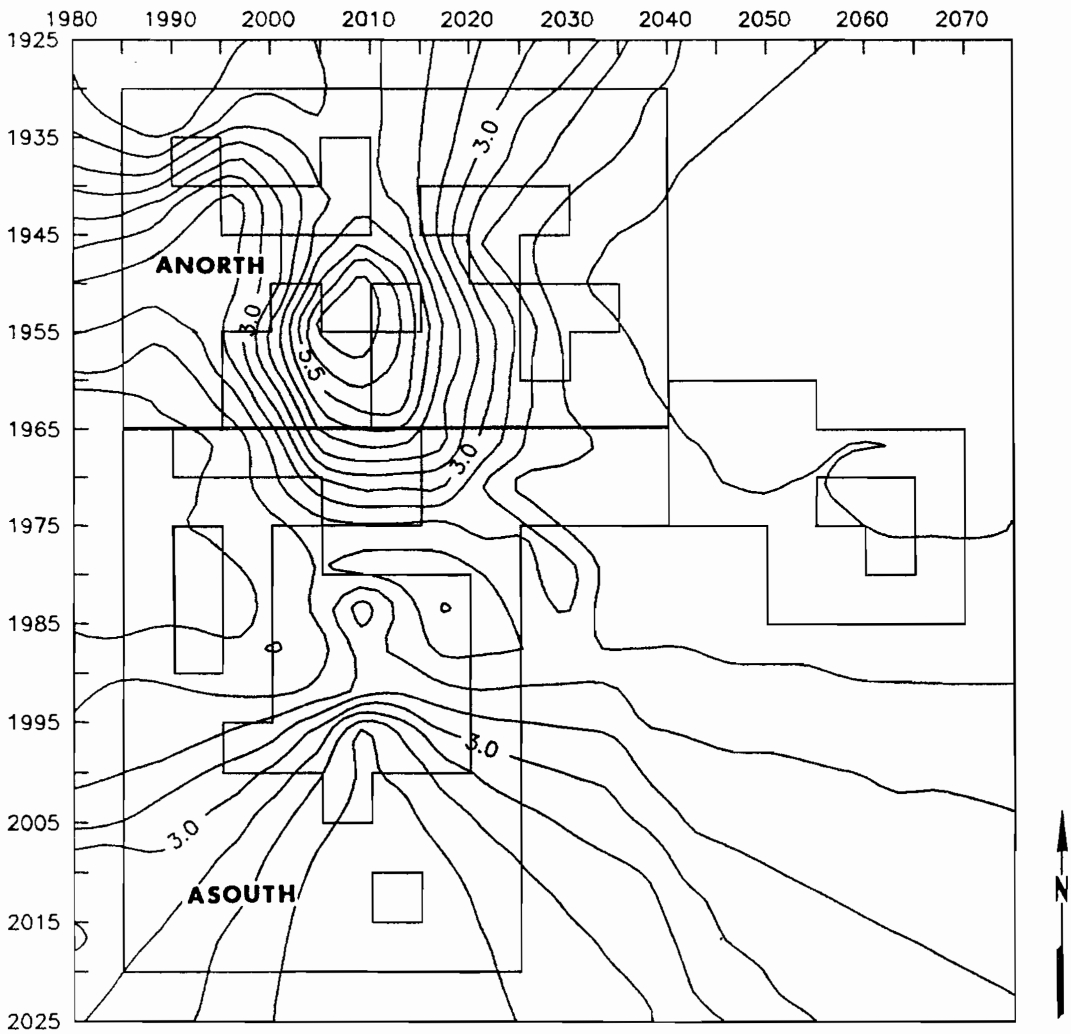

Figure 23. Distribution of CCS lithic debitage in Component Emman.

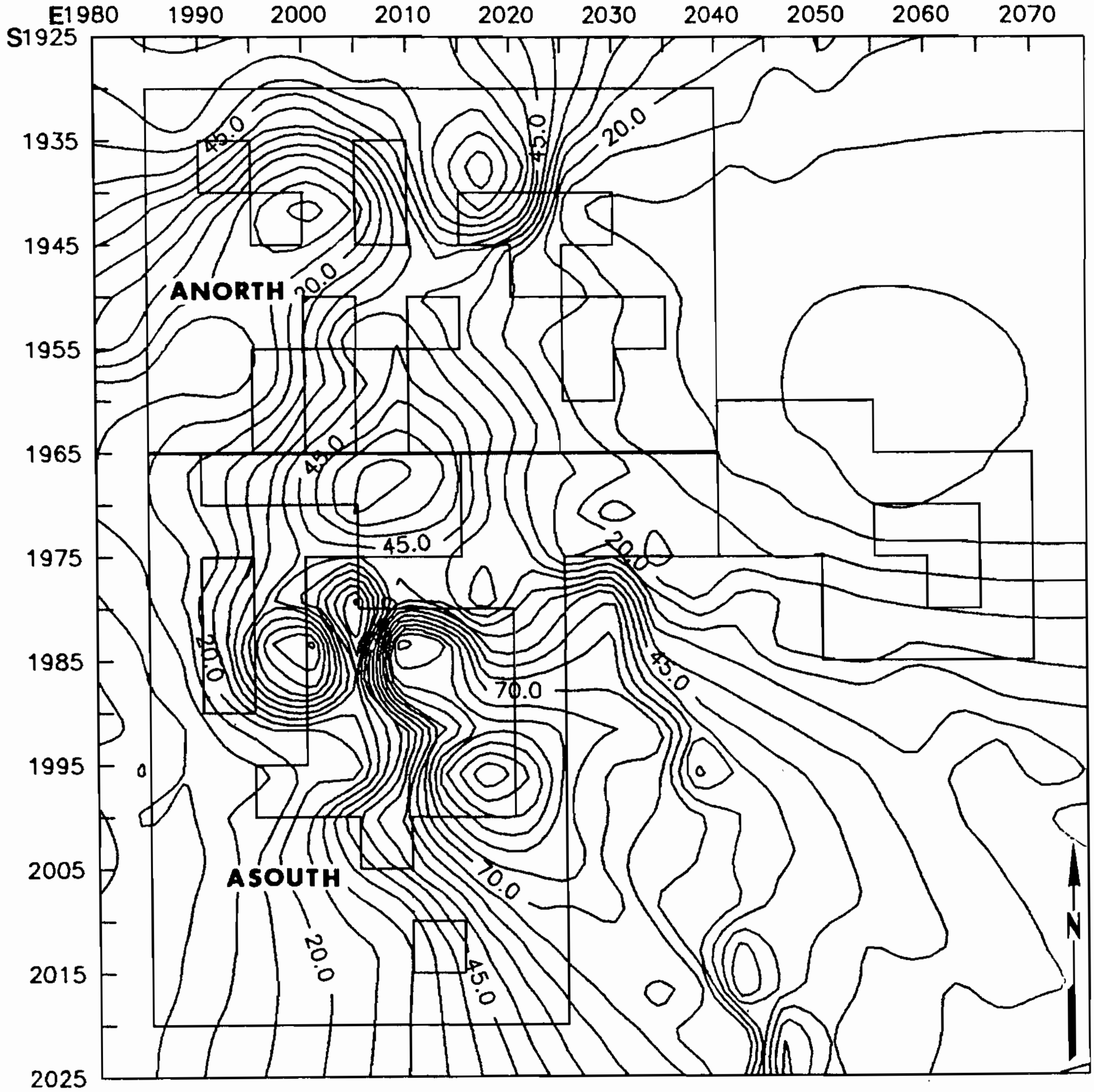

Figure 24. Distribution of basalt lithic debitage in Locus A.

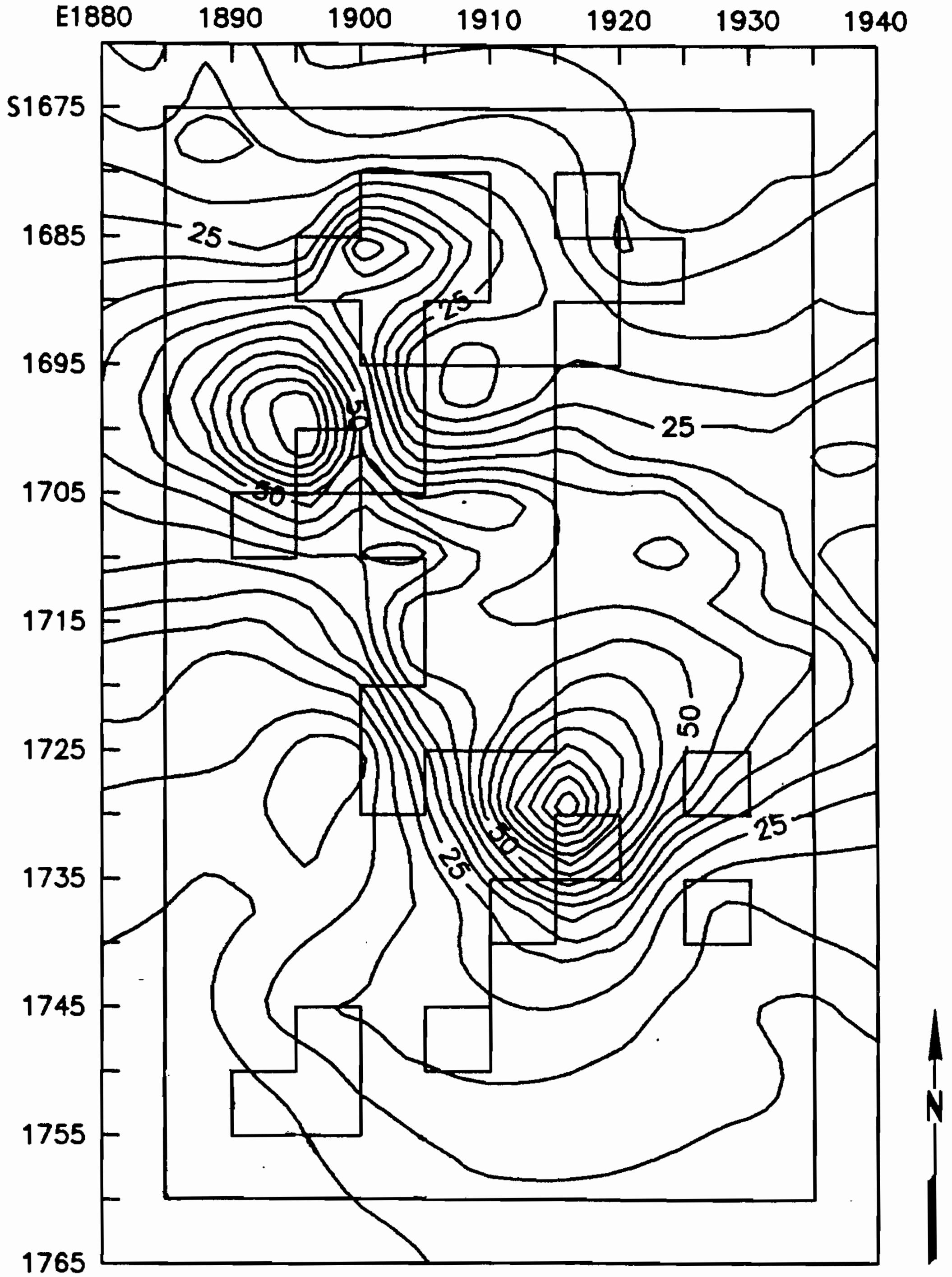

Figure 25. Distribution of basalt lithic debitage in Locus B.

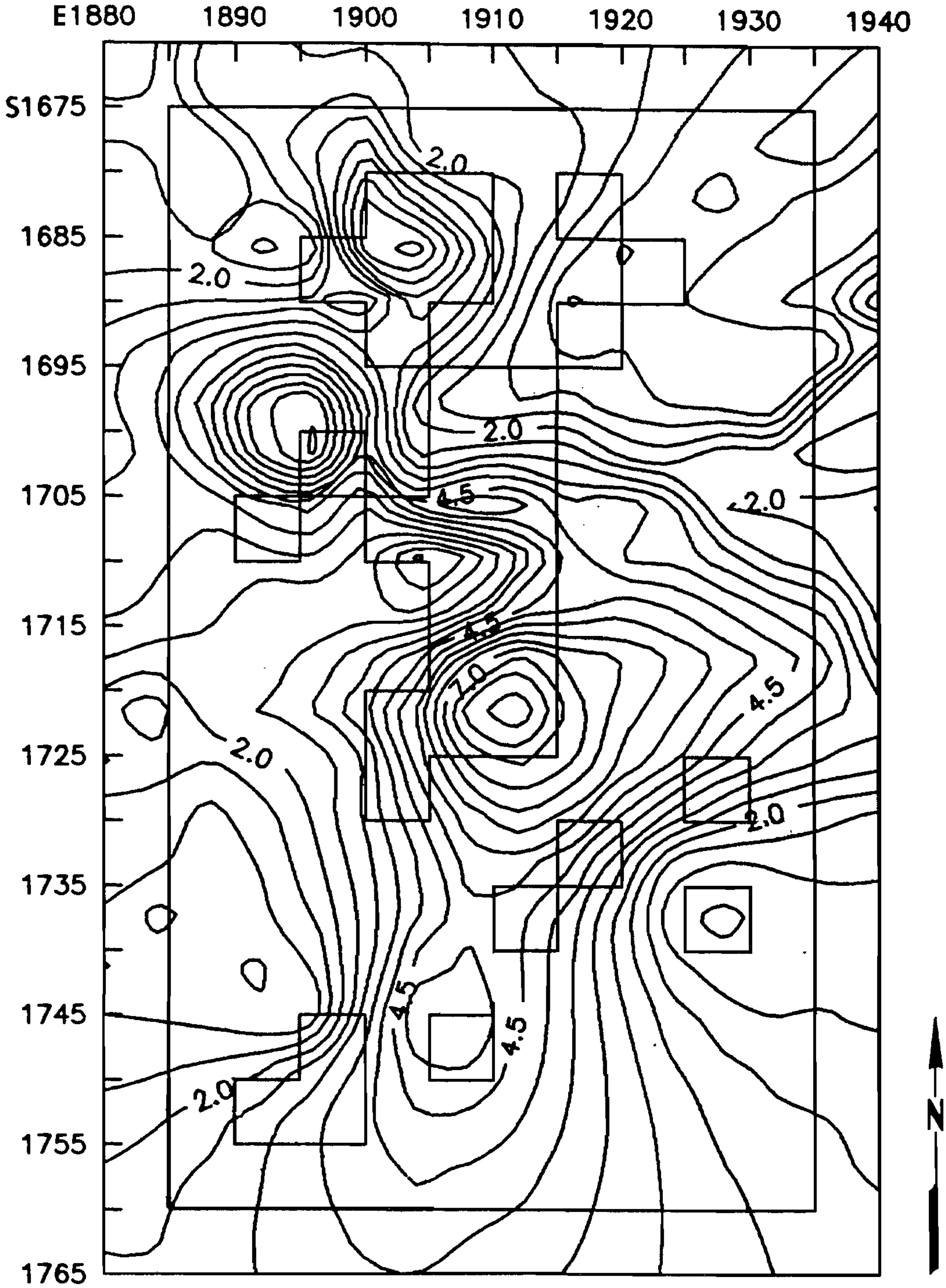

Figure 26. Distribution of CCS lithic debitage in Locus B.

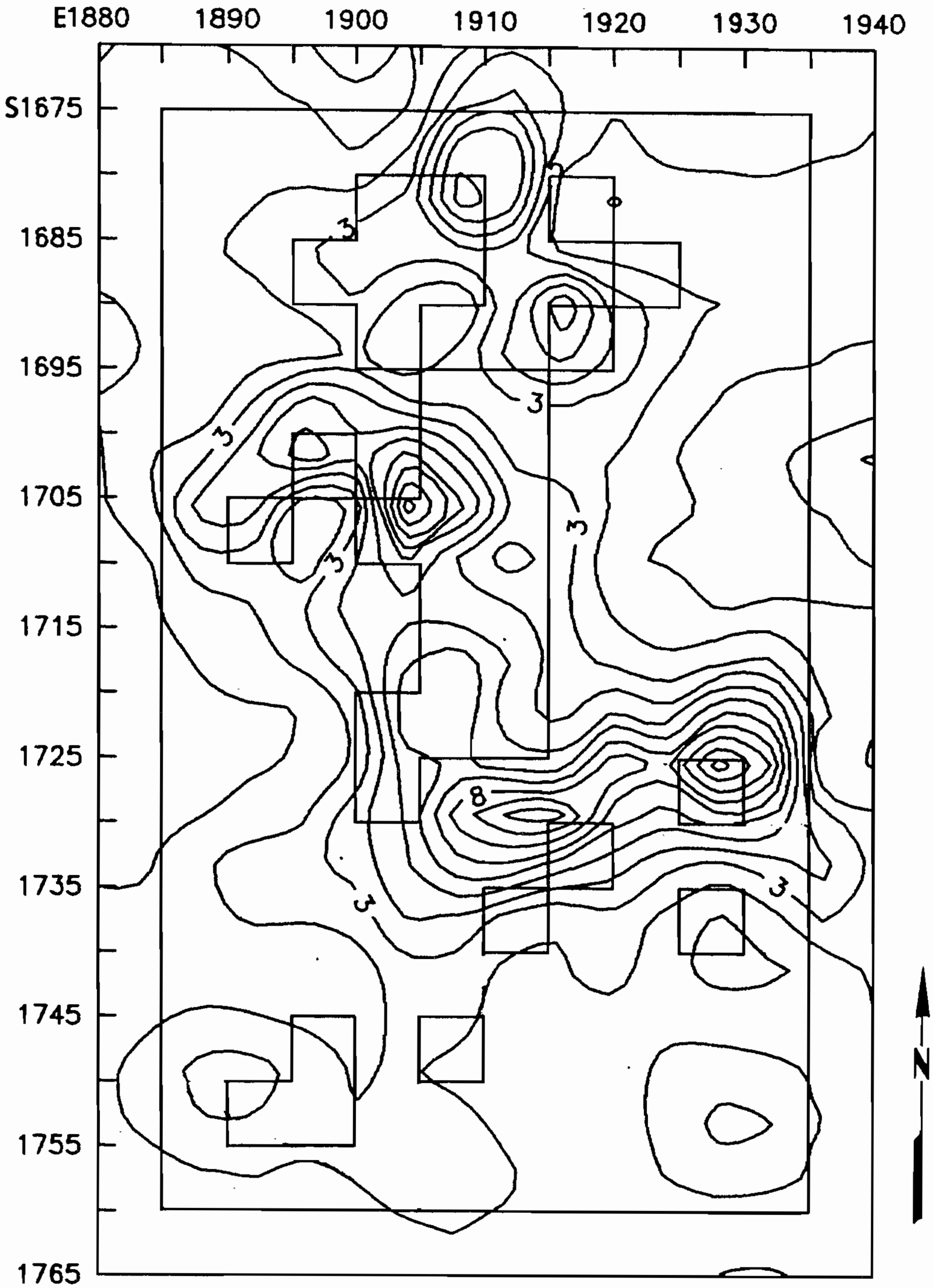

Figure 27. Distribution of bifaces in Locus B.

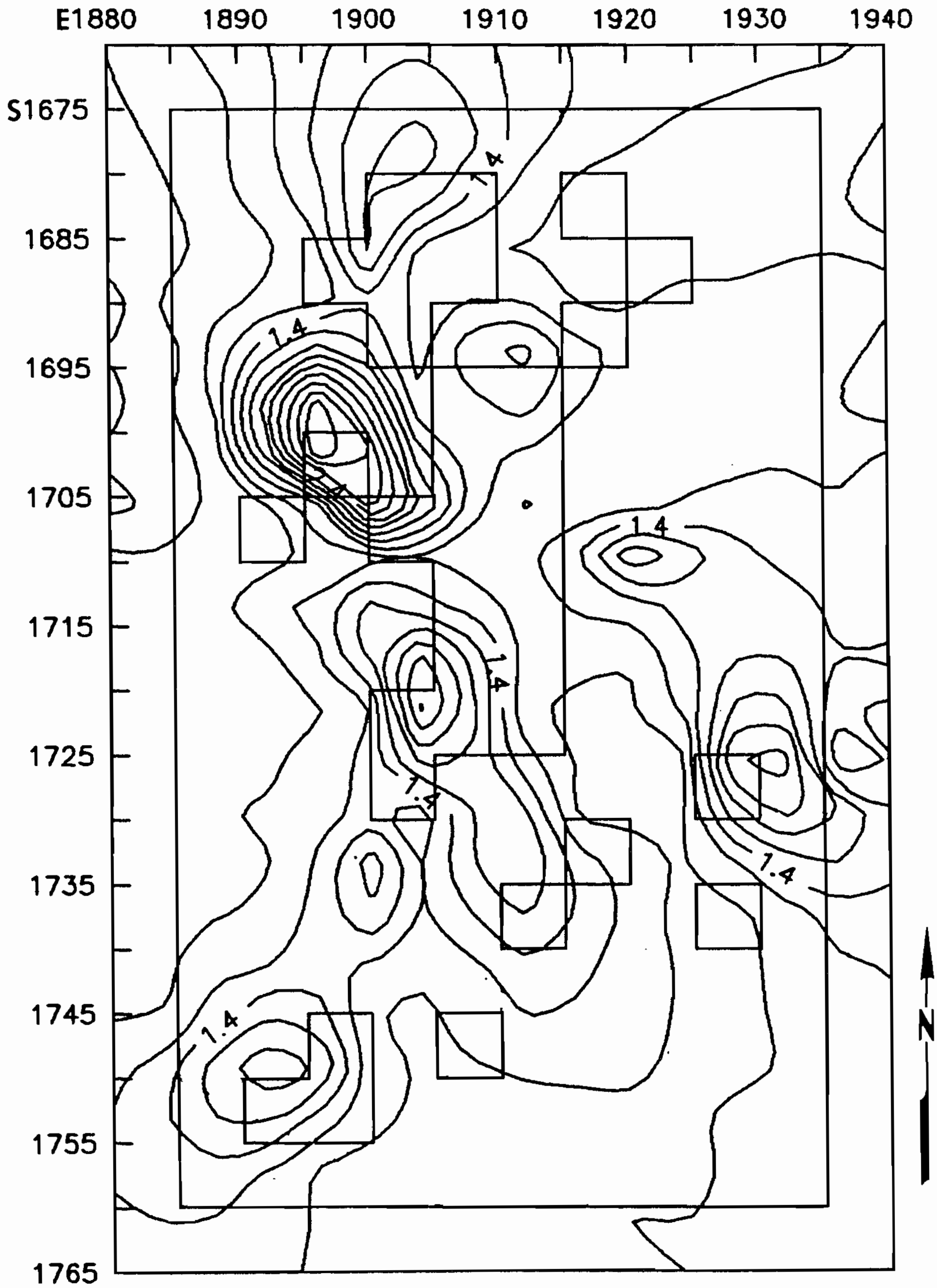

Figure 28. Distribution of scrapers in Locus B.

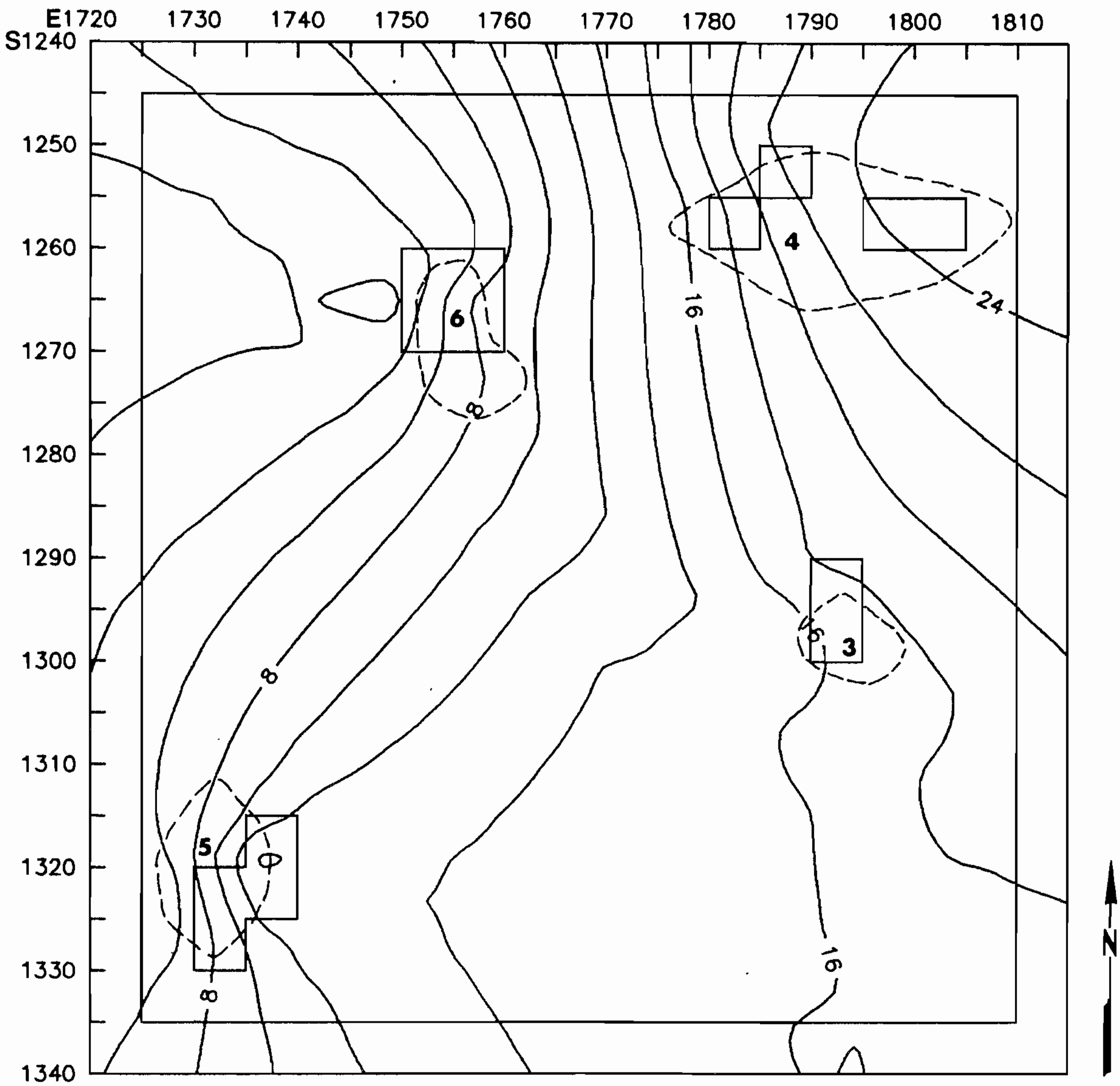

Figure 29. Distribution of lithic debitage in Component CA.

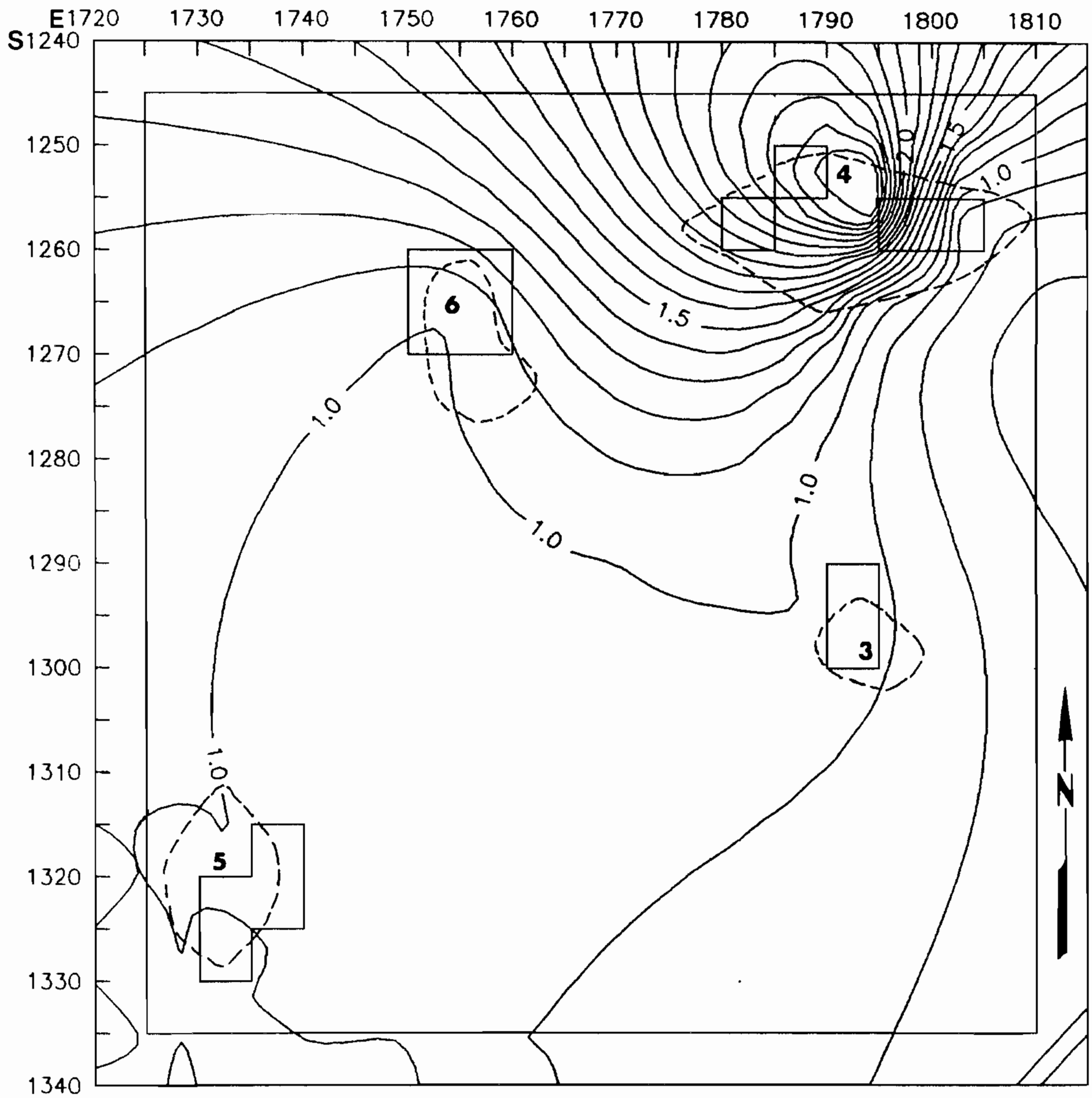

Figure 30. Distribution of scrapers in Component CA.

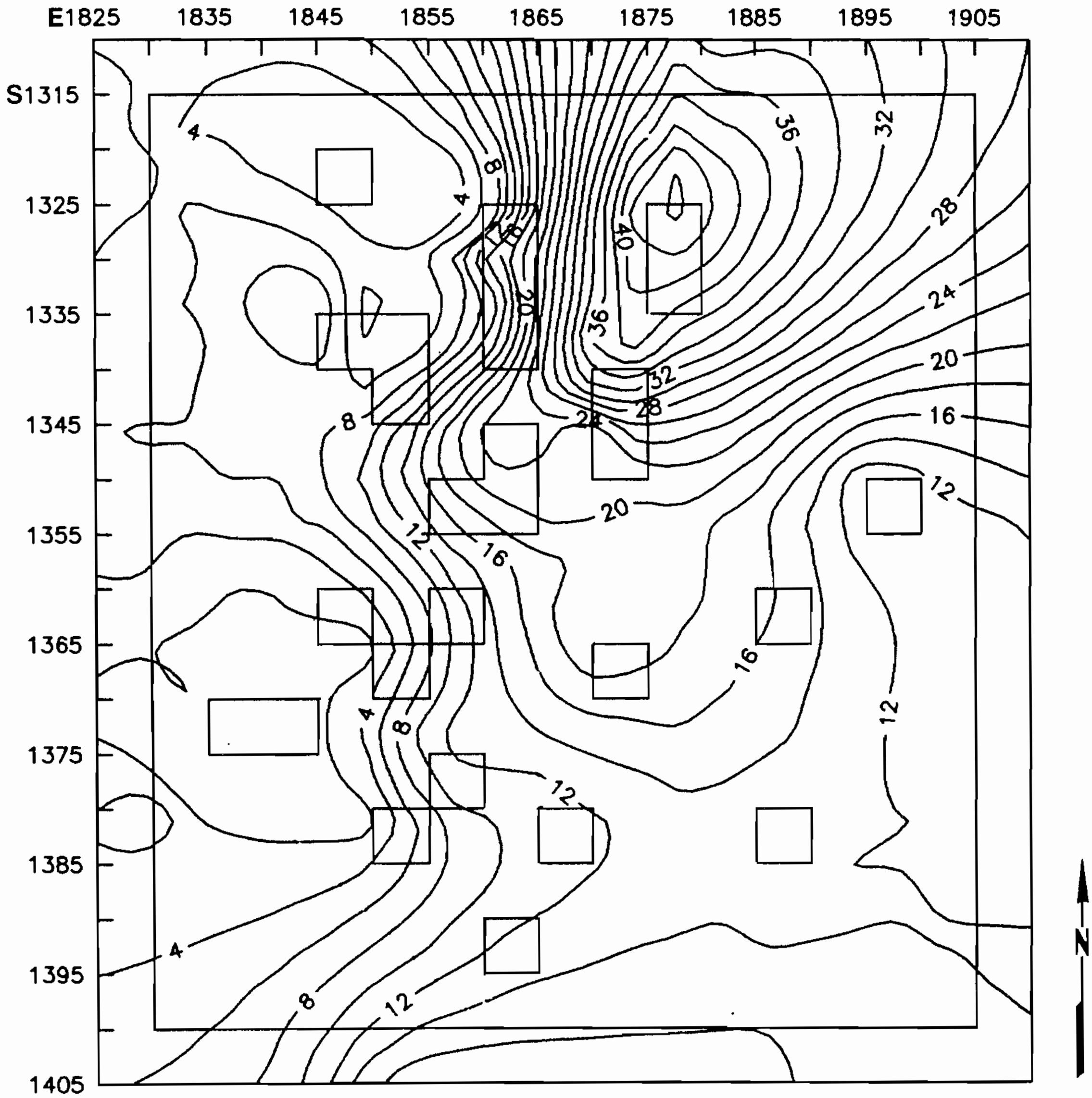

Figure 31. Distribution of lithic debitage in Component CB.

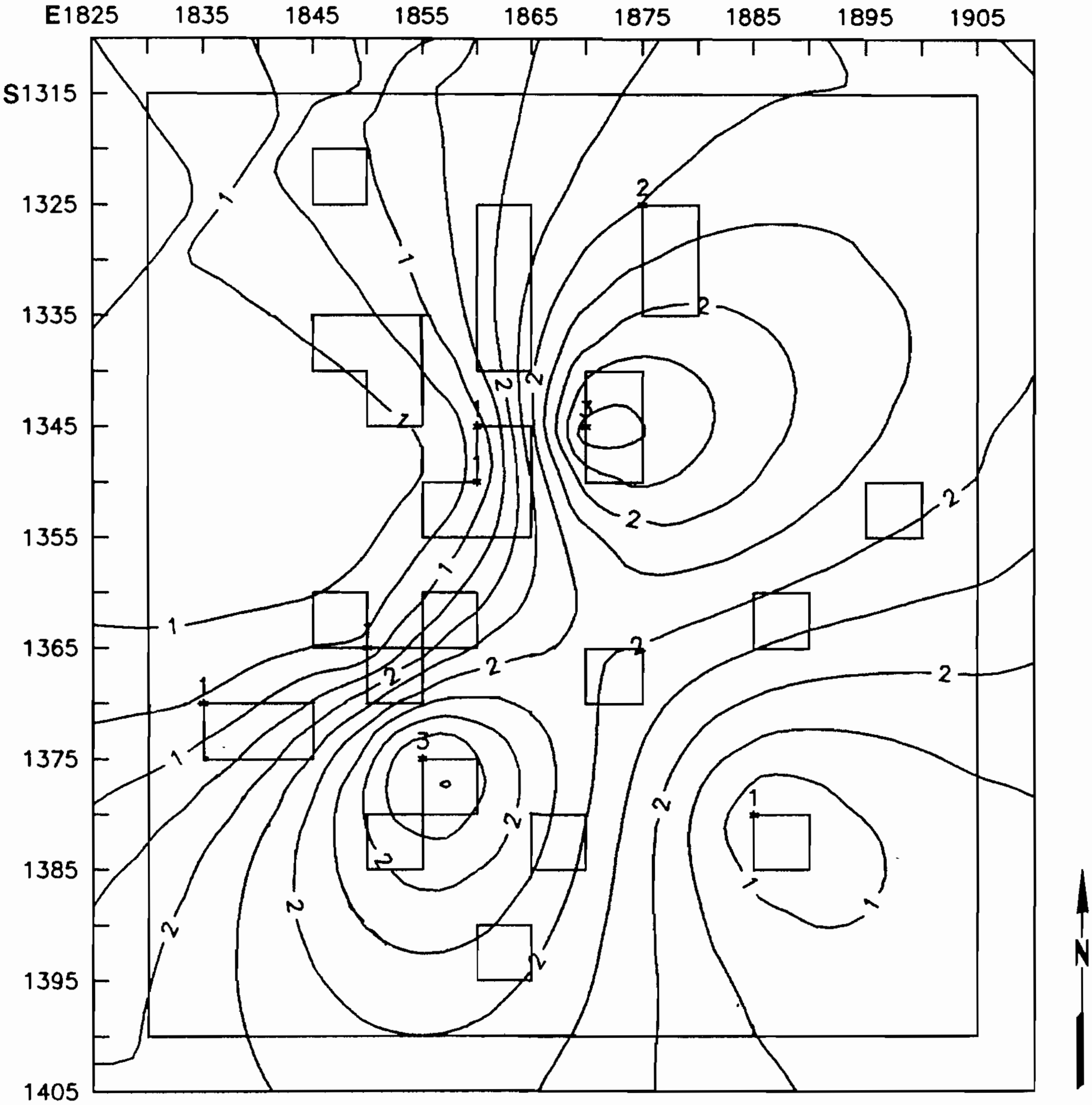

Figure 32. Distribution of CCS lithic debitage in Component CB.

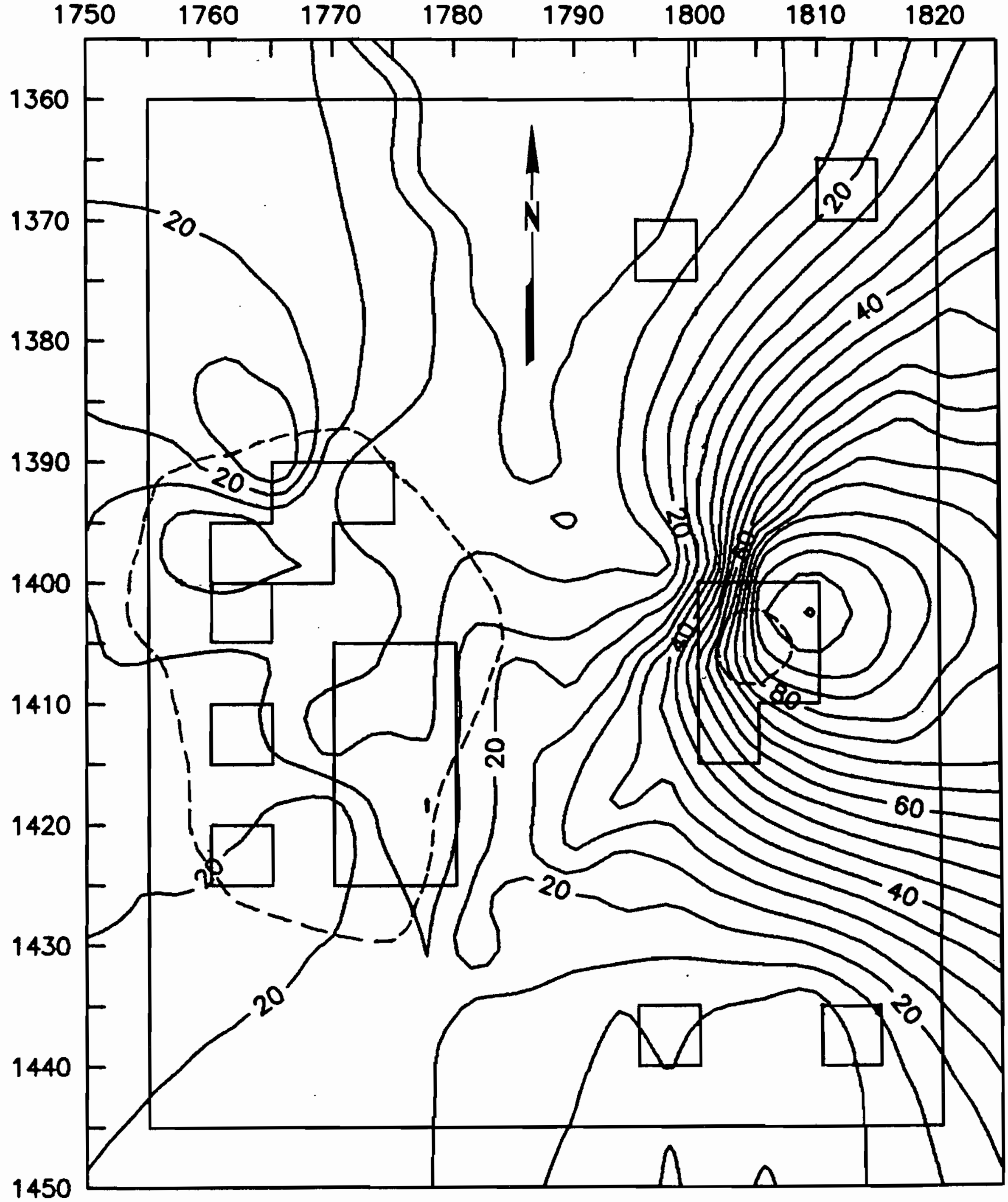

Figure 33. Distribution of basalt lithic debitage in Component CC.

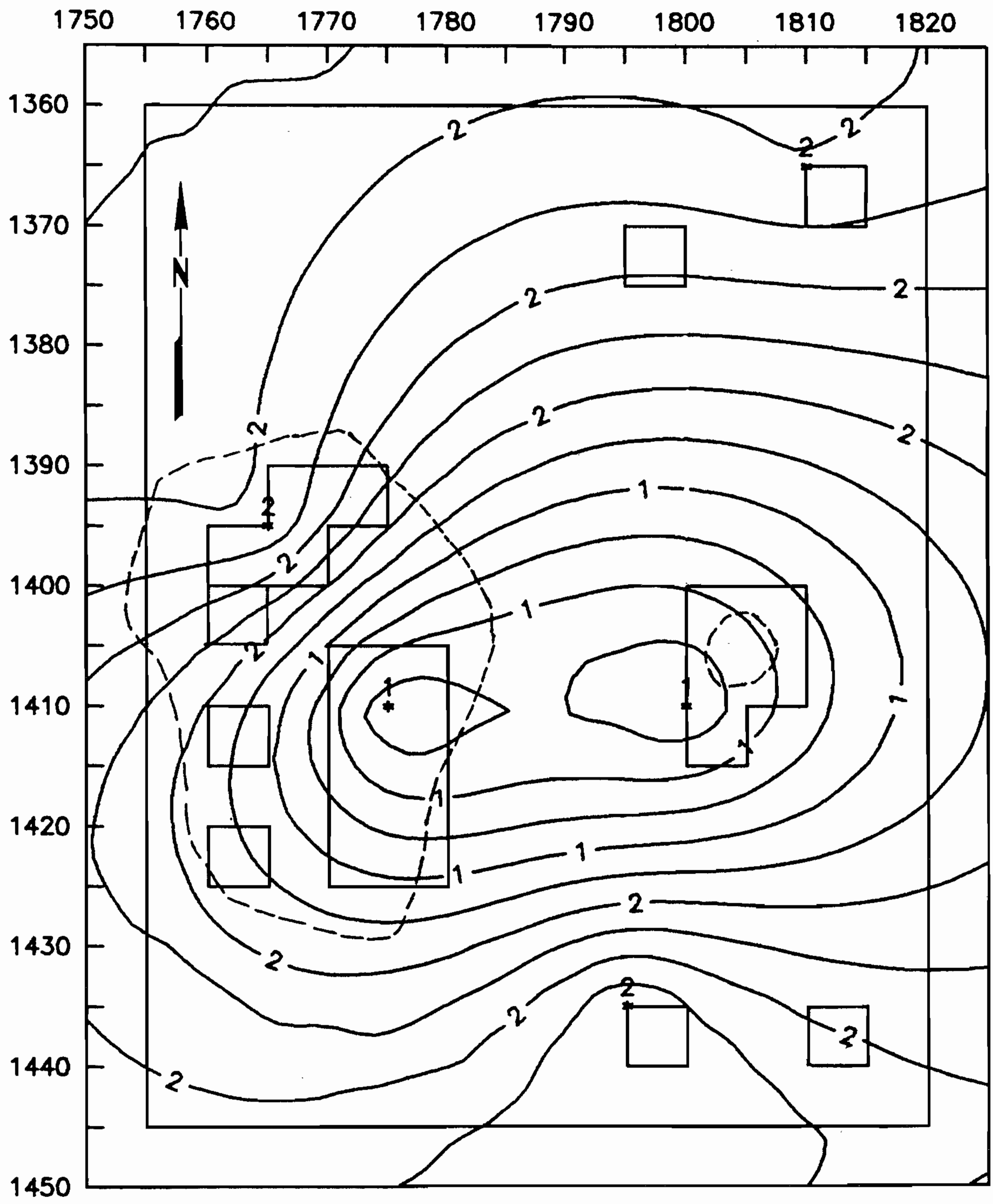

Figure 34. Distribution of CCS lithic debitage in Component CC.

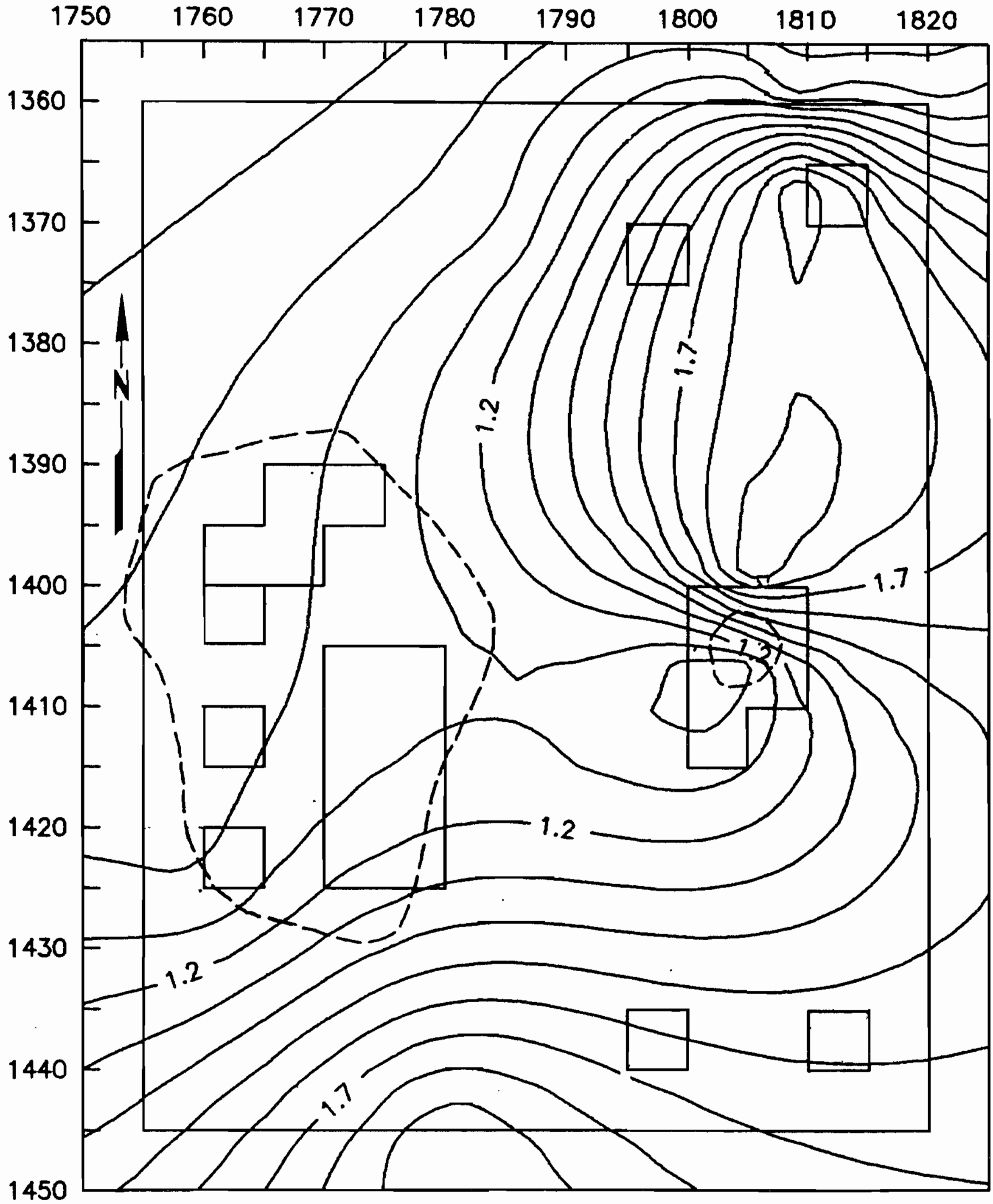

Figure 35. Distribution of scrapers in Component CC.

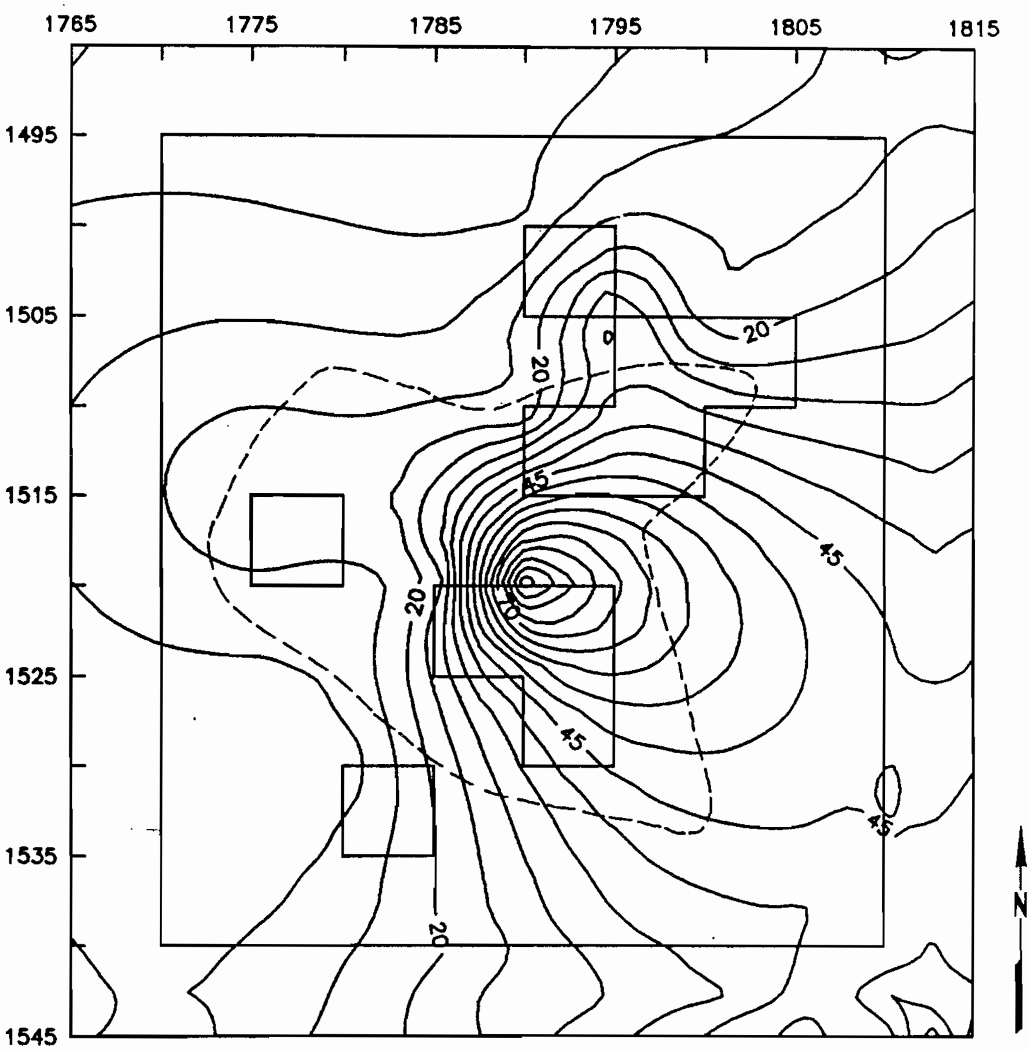

Figure 36. Distribution of basalt lithic debitage in Component CD.

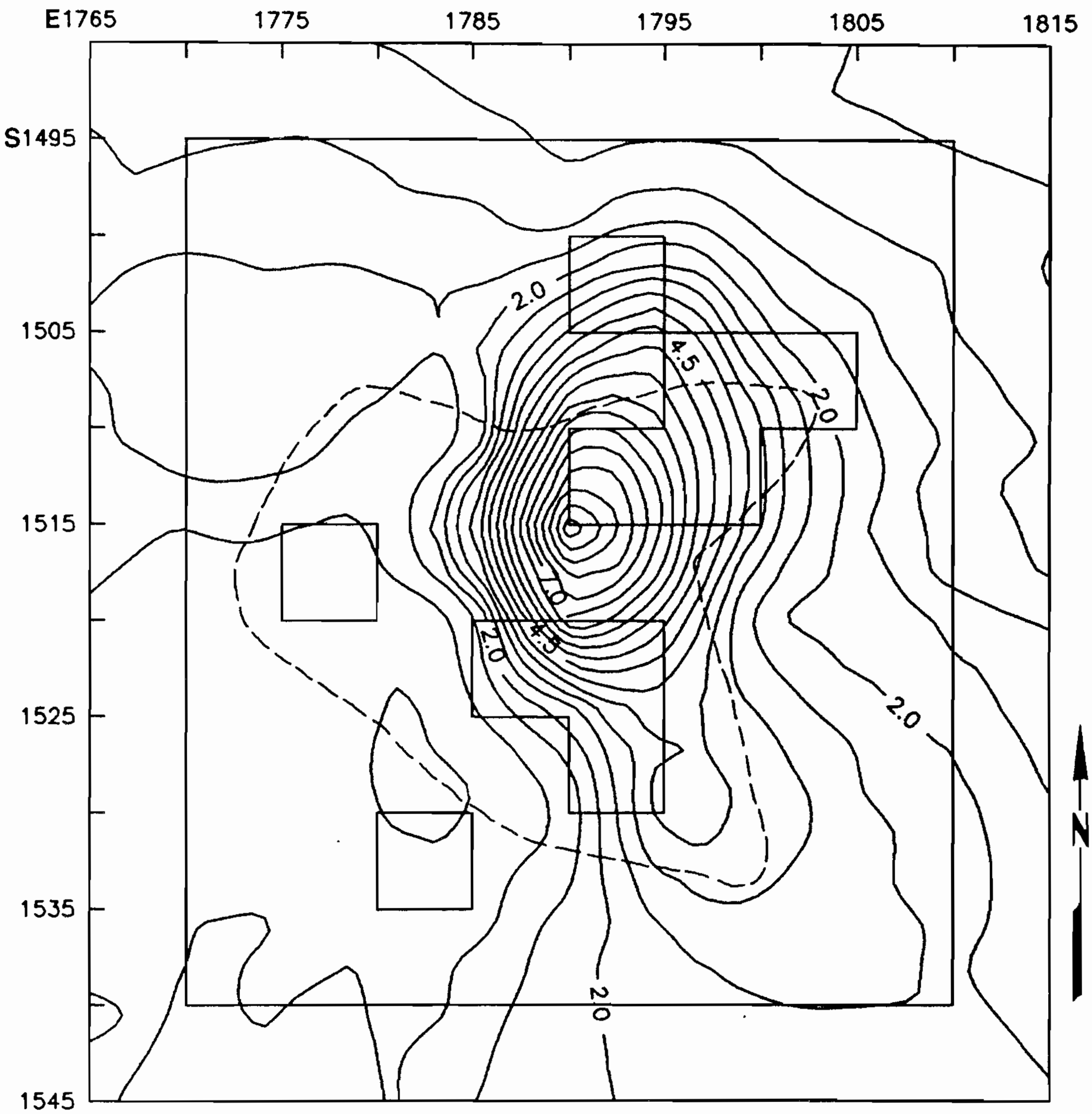

Figure 37. Distribution of bifaces in Component CD.

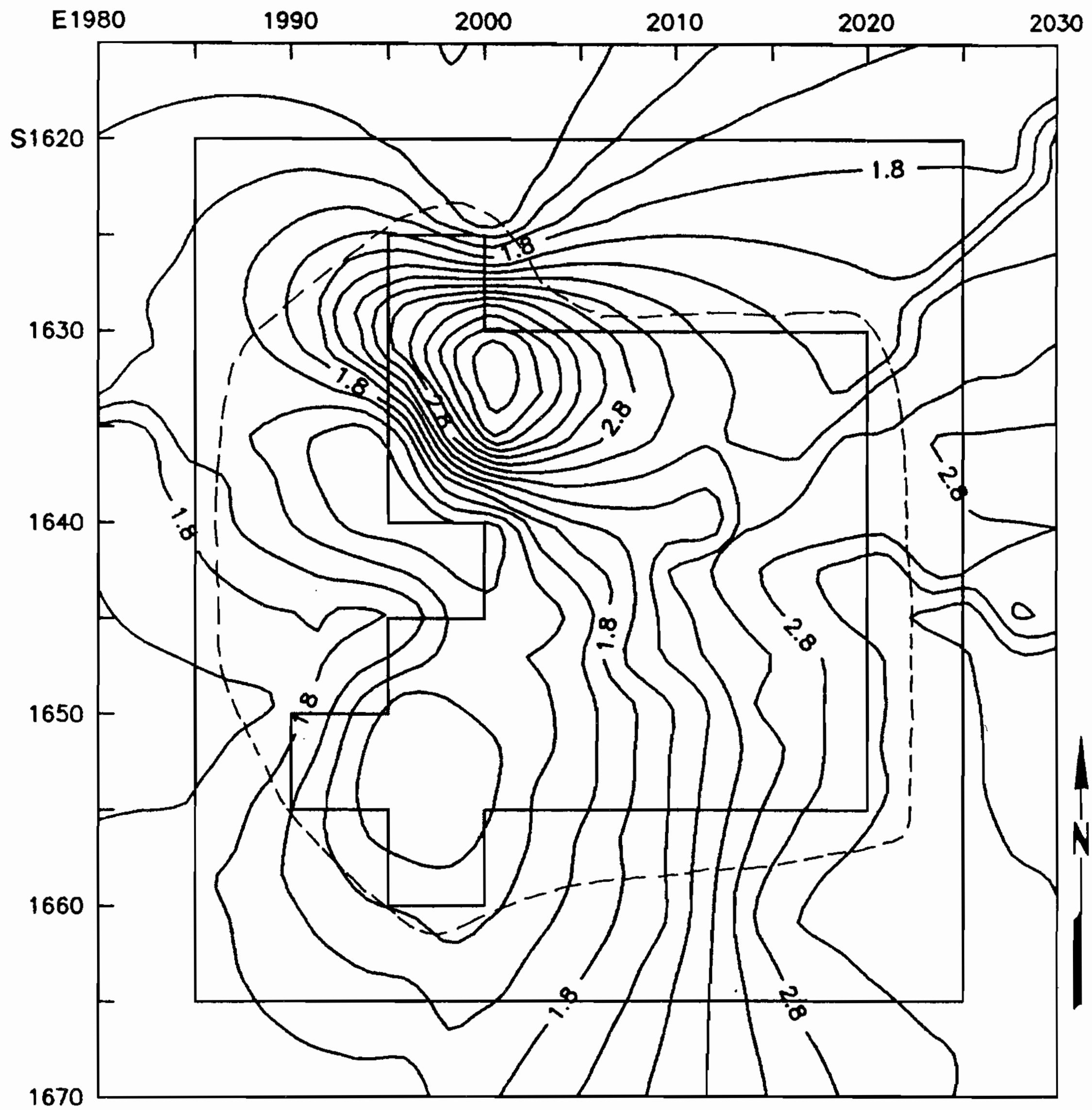

Figure 38. Distribution of bifaces in Locus D.

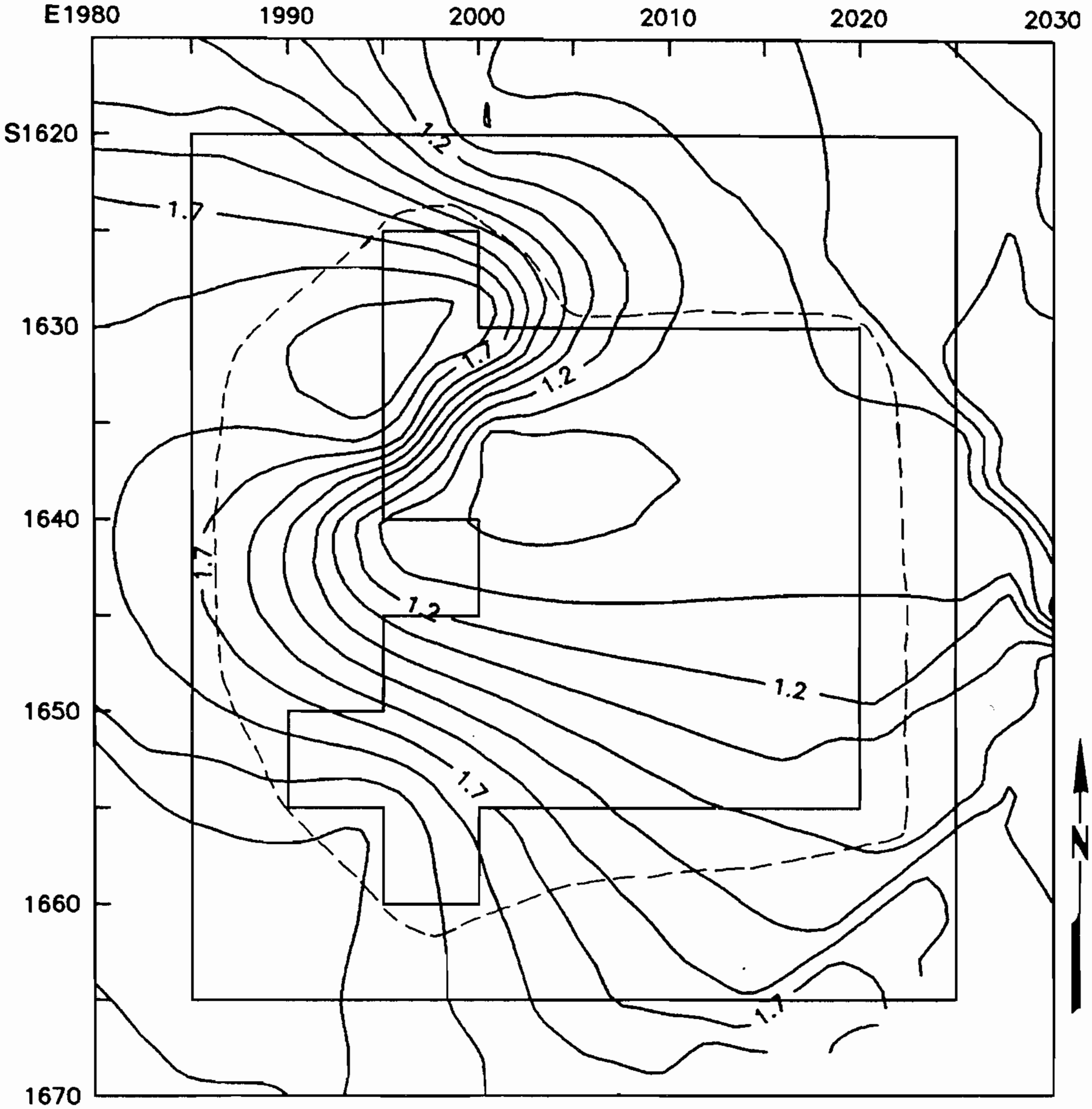

Figure 39. Distribution of scrapers in Locus D.

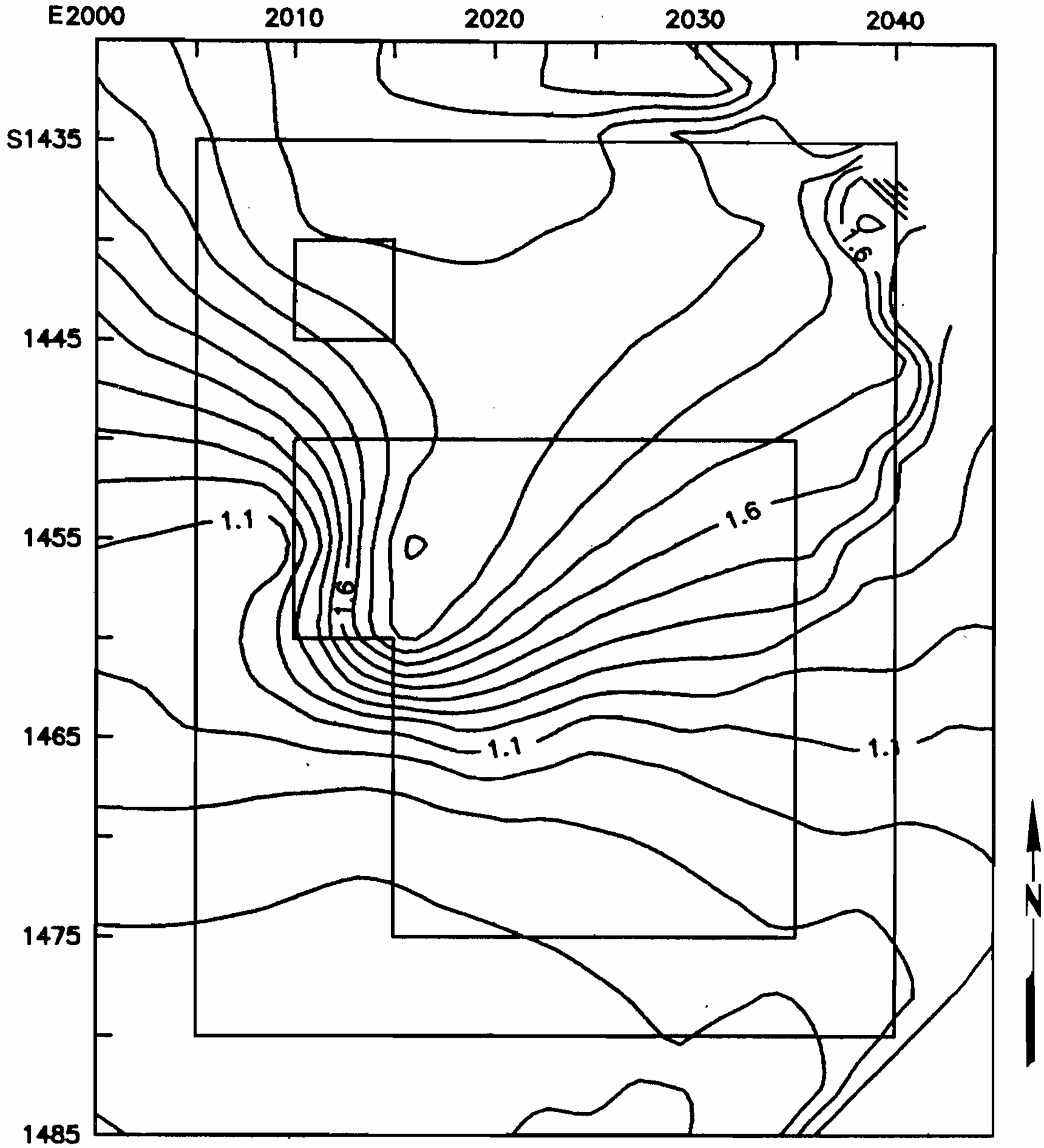

Figure 40. Distribution of bifaces in Component Esur.

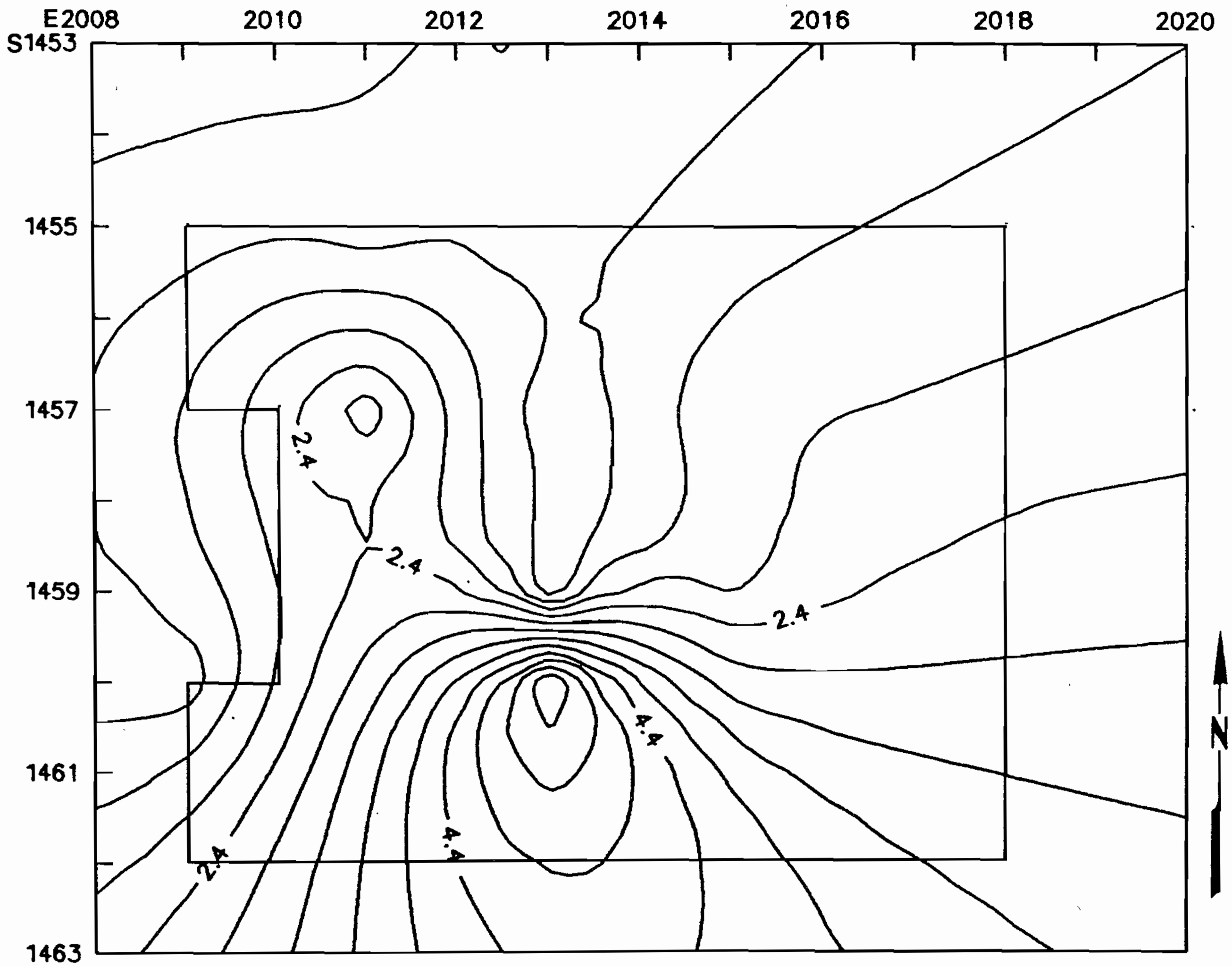

Figure 41. Distribution of all tools in Subcomponent E1 of Component 2.

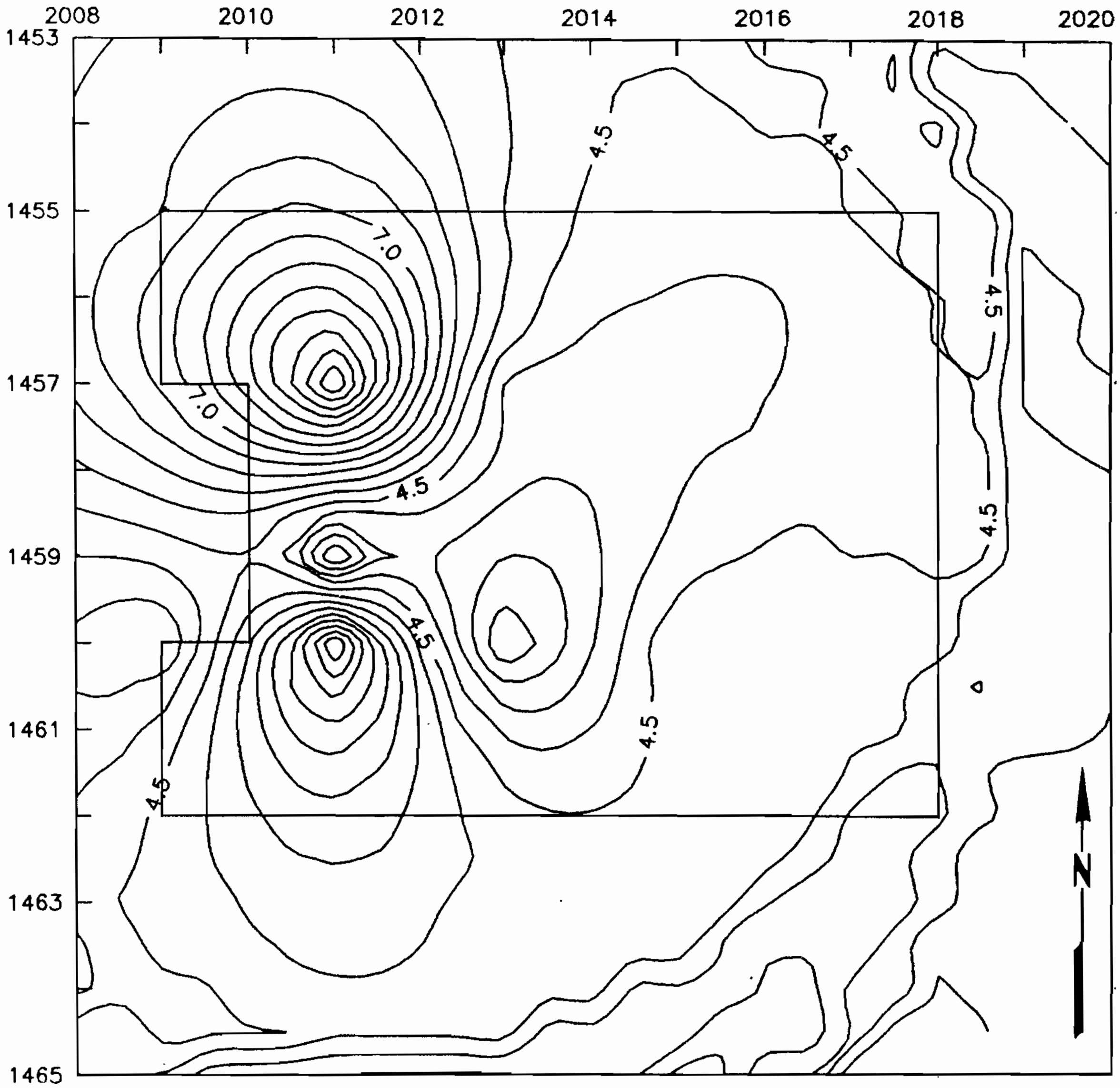

Figure 42. Distribution of all tools in Subcomponent E2 of Component 2.

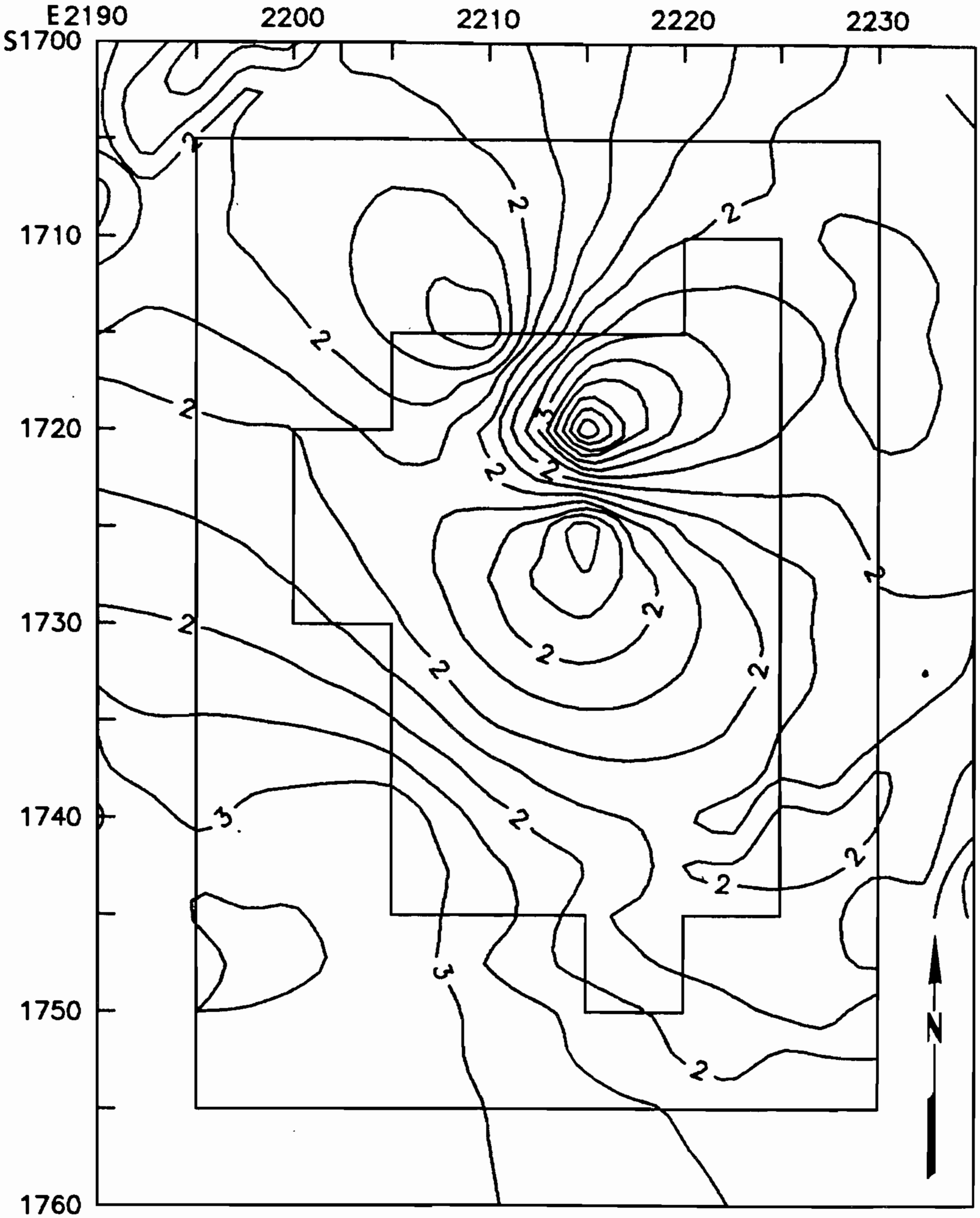

Figure 43. Distribution of CCS lithic debitage in Locus F.

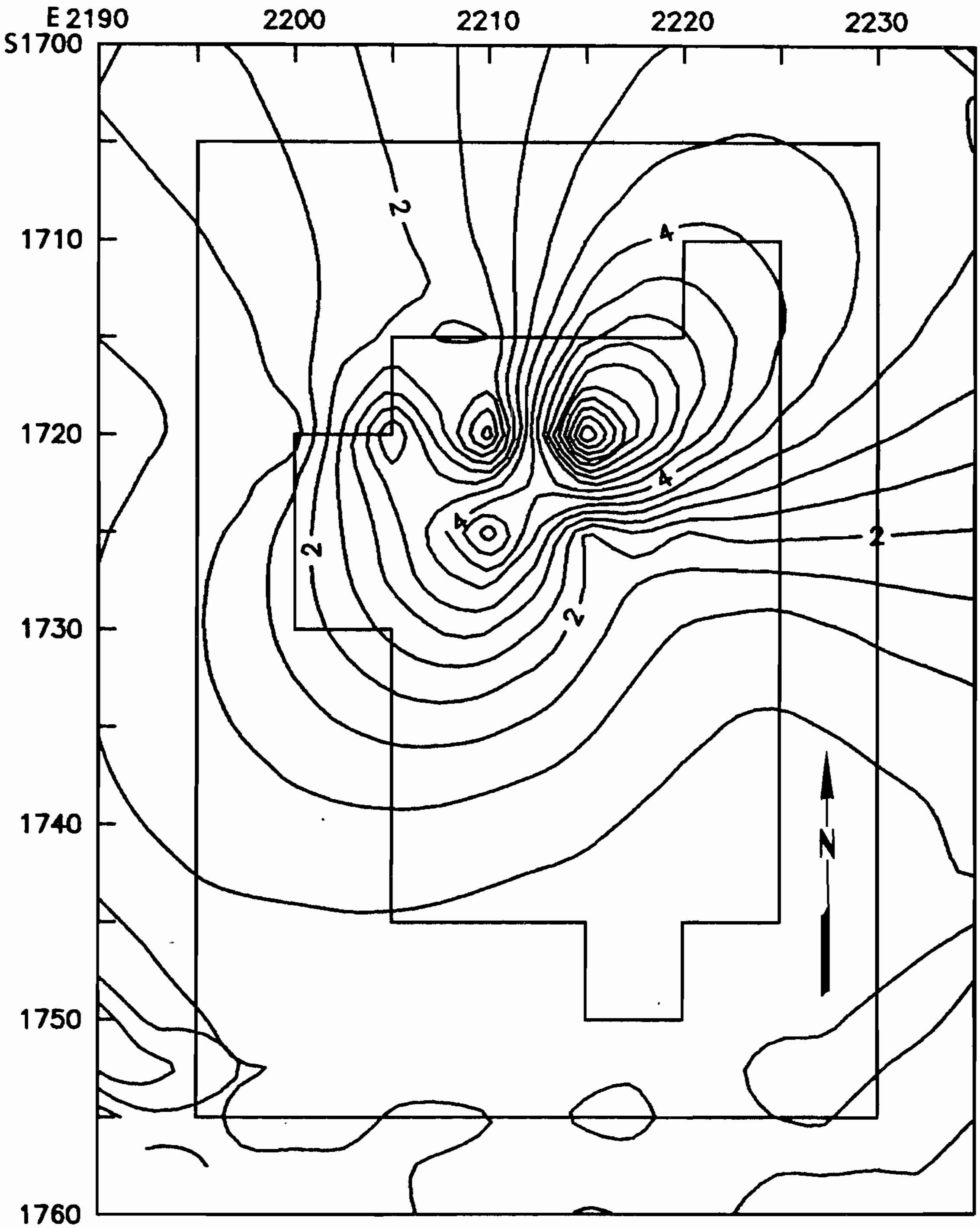

Figure 44. Distribution of bifaces in Locus F.

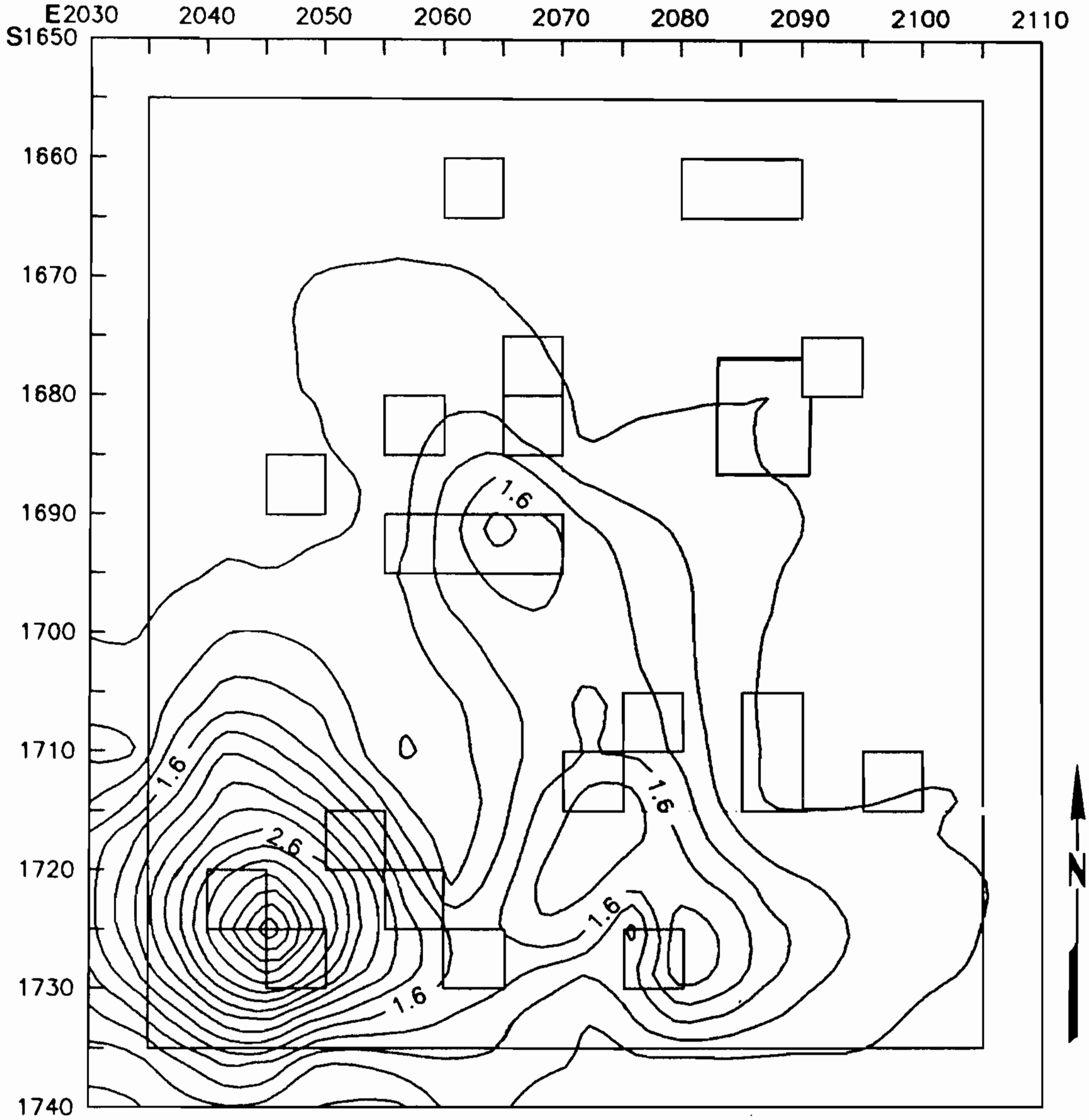

Figure 45. Distribution of bifaces in Glsur.

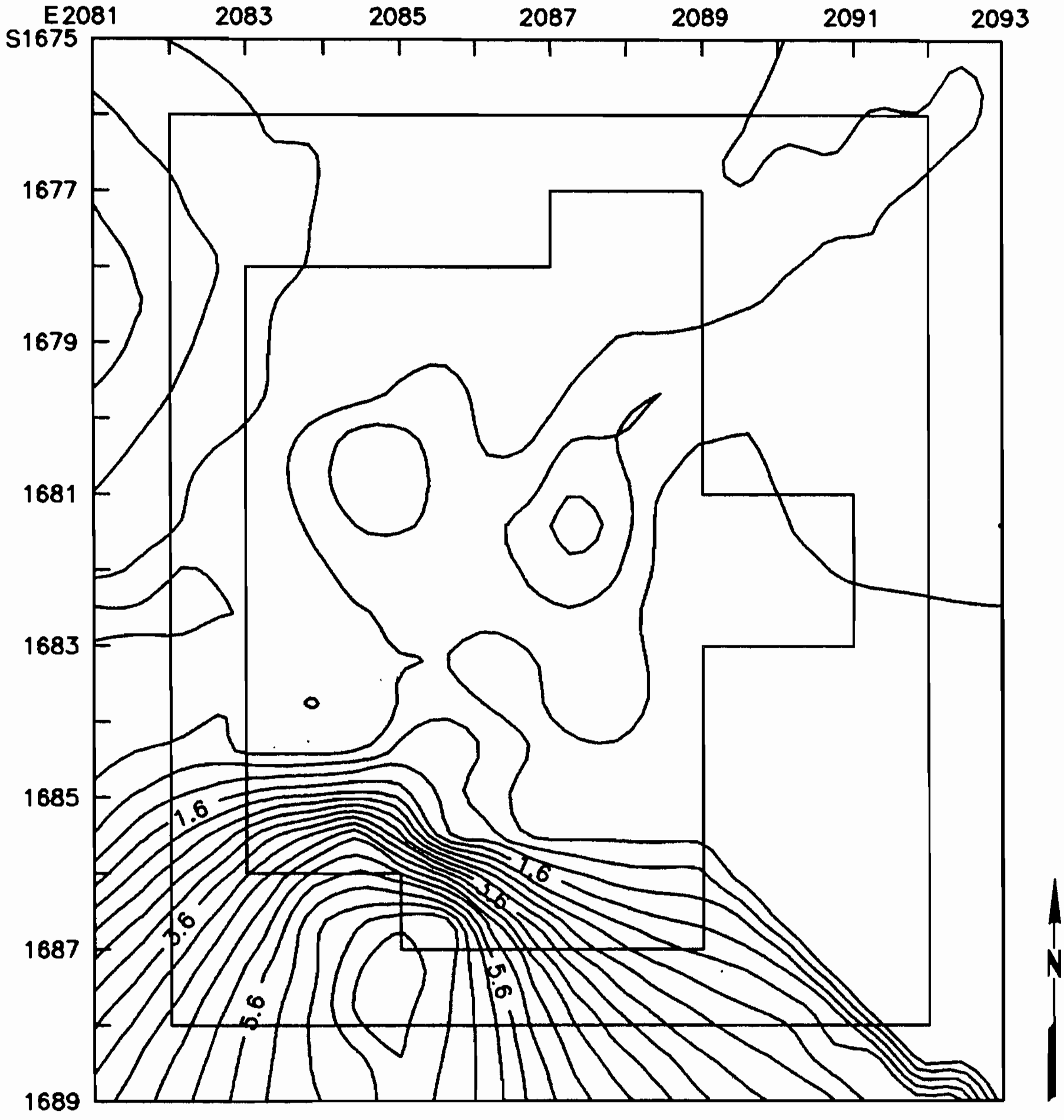

Figure 46. Distribution of bone in Component 1.

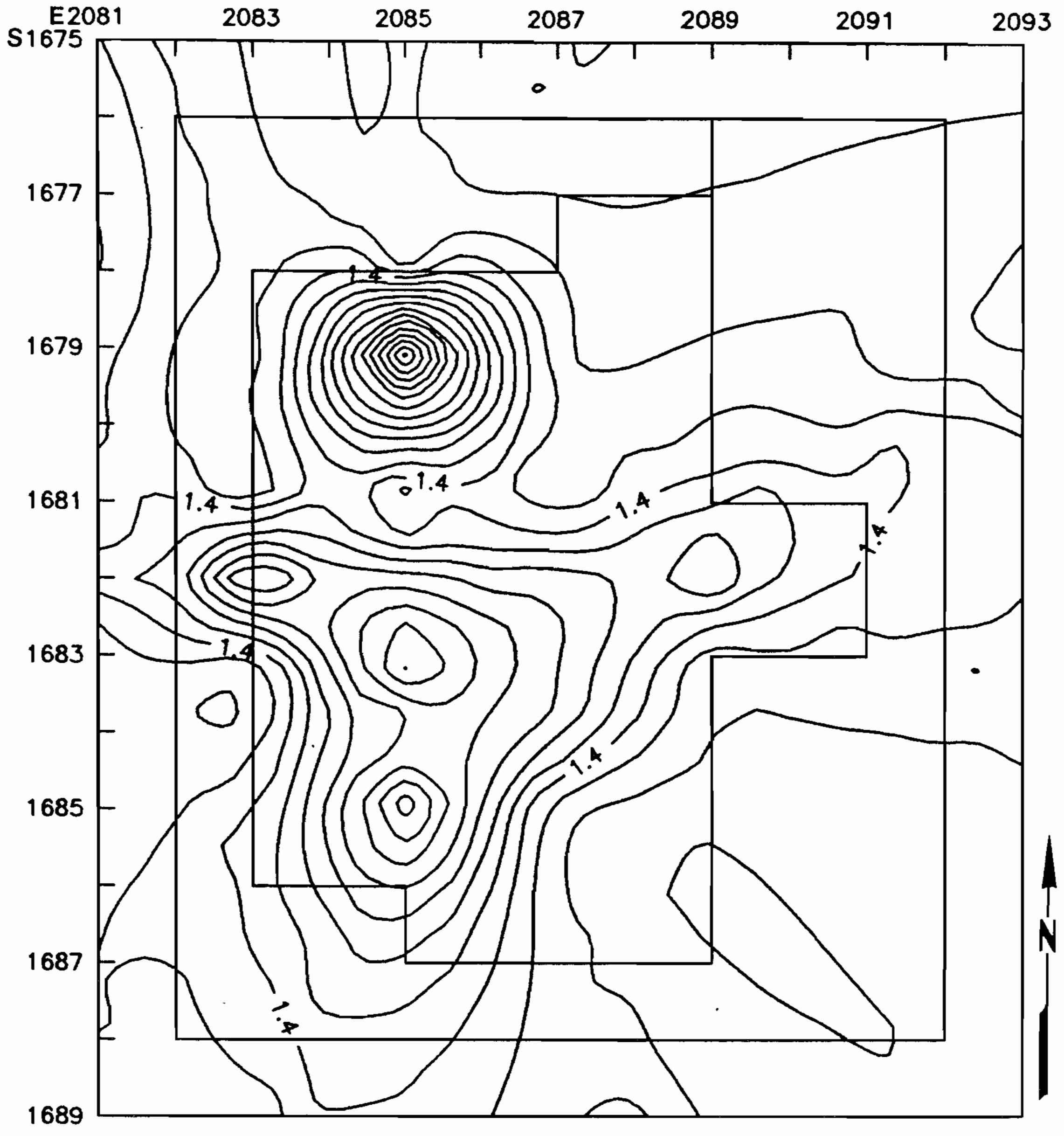

Figure 47. Distribution of bifaces in Component 1.

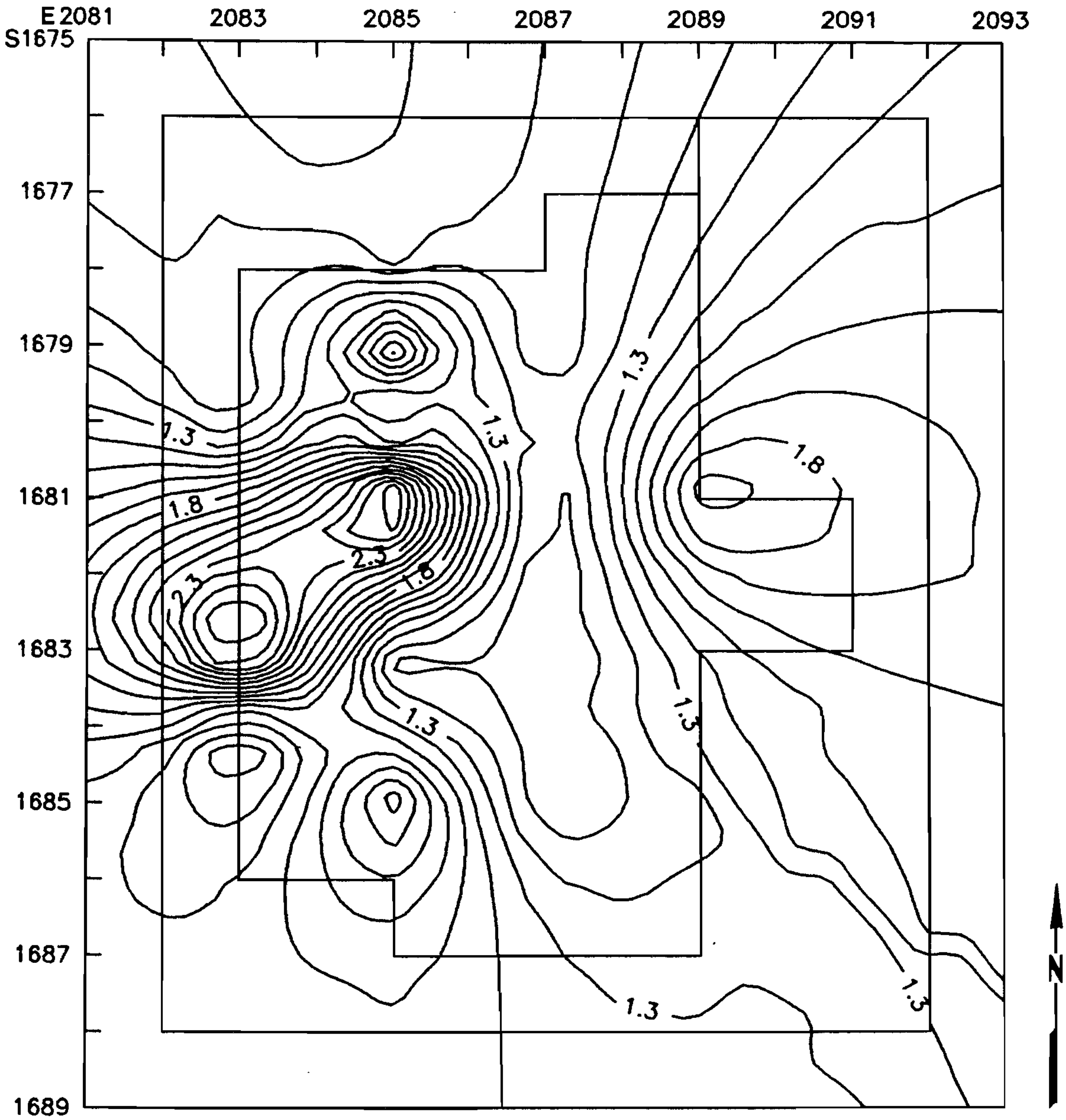

Figure 48. Distribution of scrapers in Component 1.

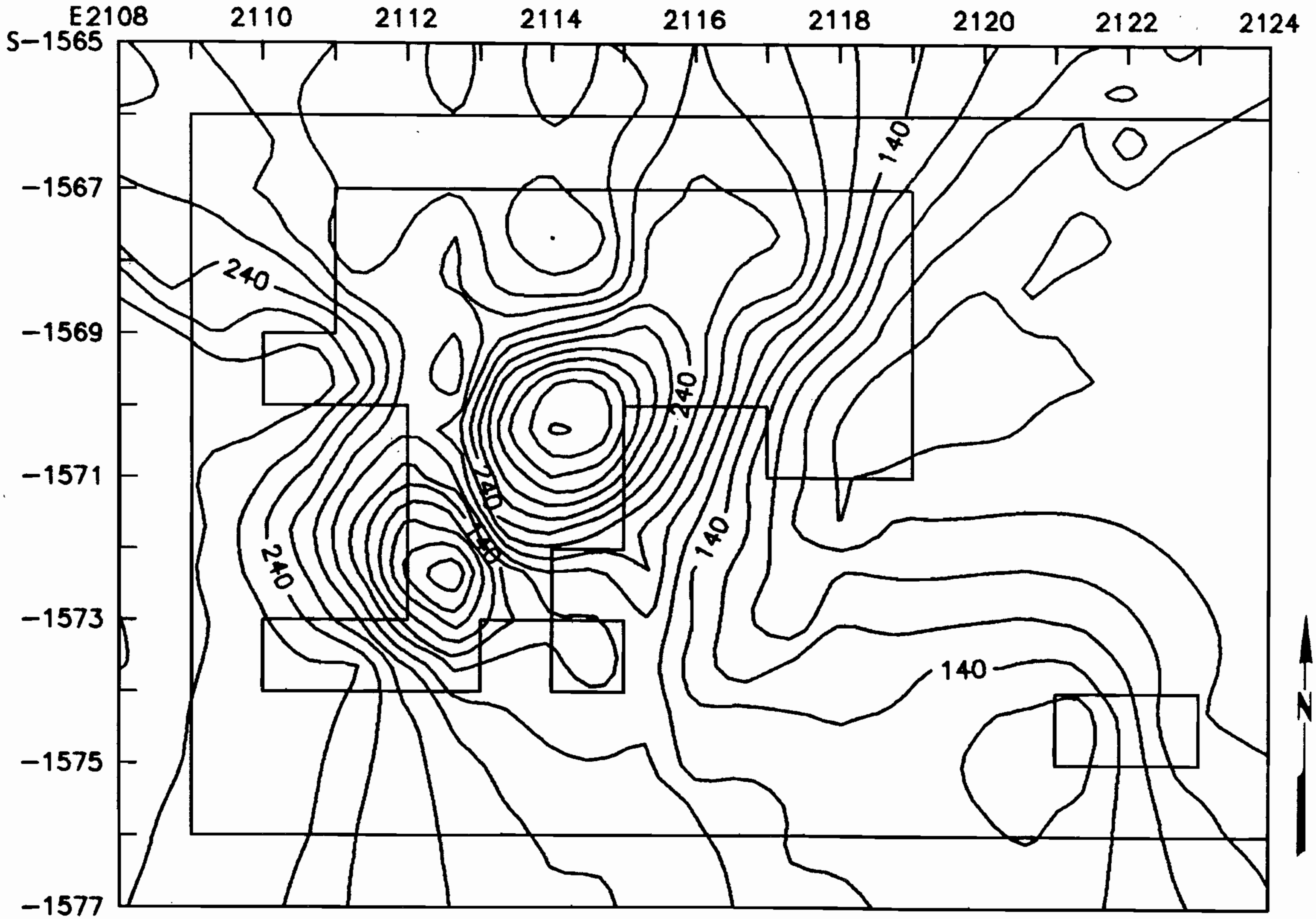

Figure 49. Distribution of basalt lithic debitage in Component 3.

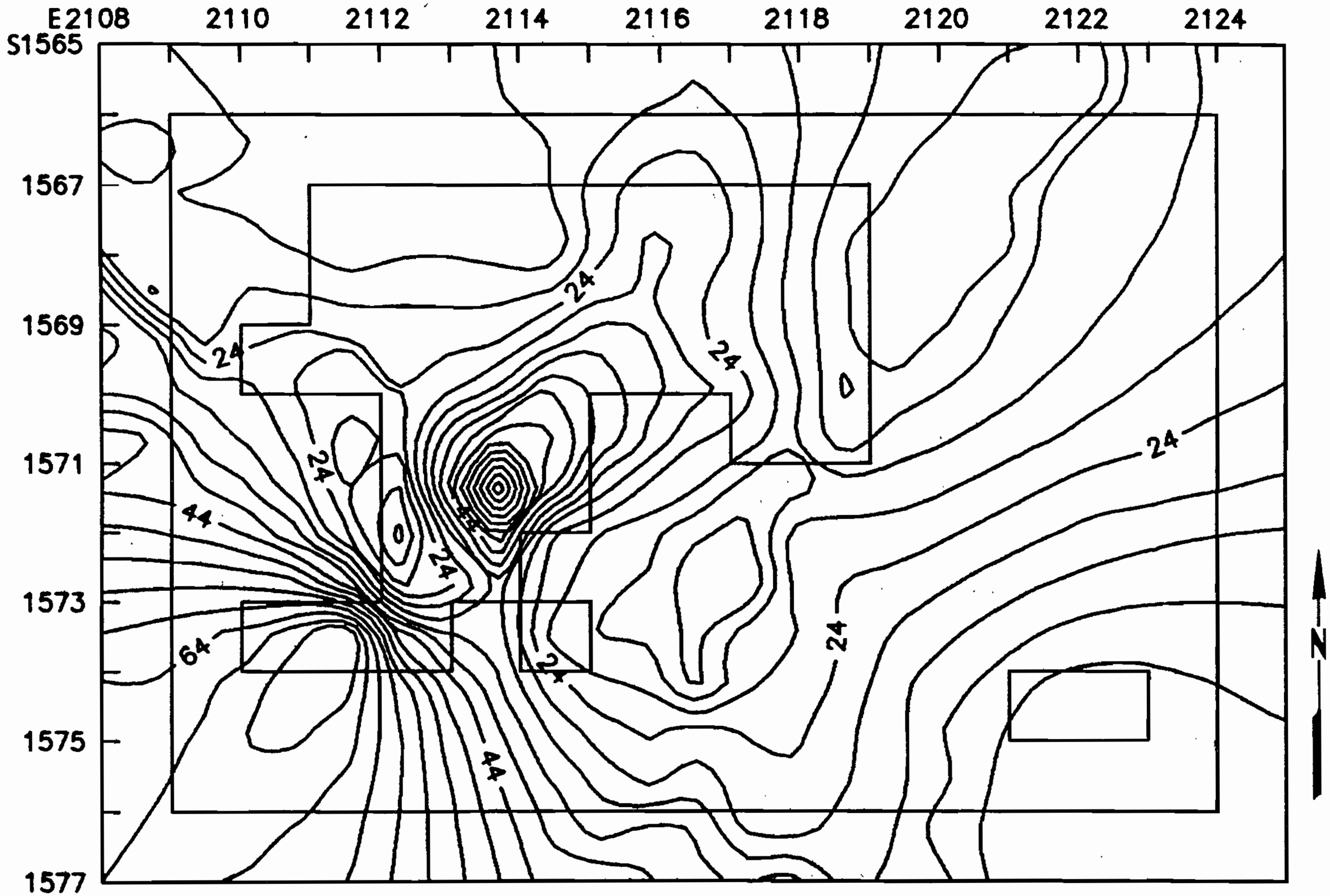

Figure 50. Distribution of CCS lithic debitage in Component 3.

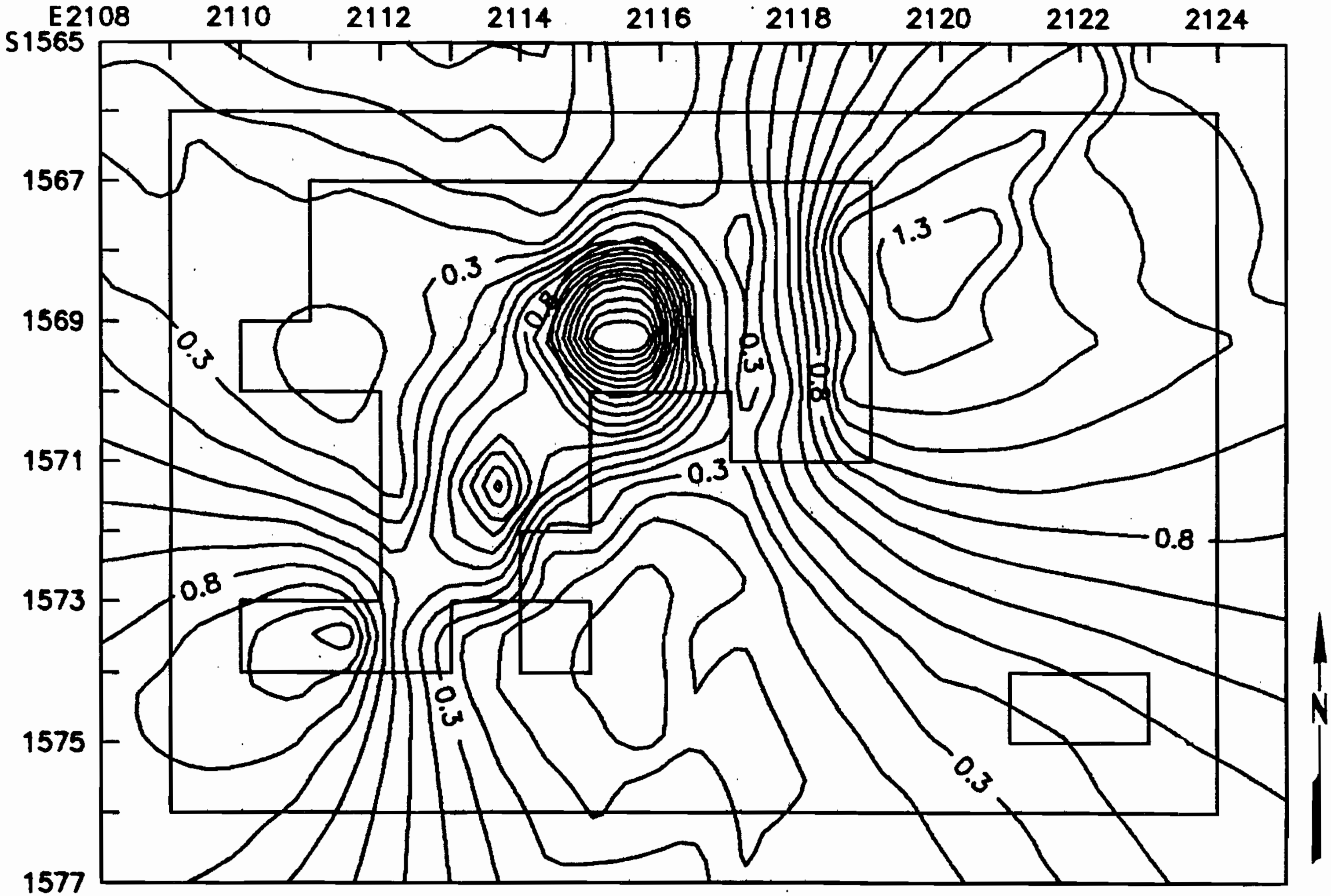

Figure 51. Distribution of bone in Component 3.

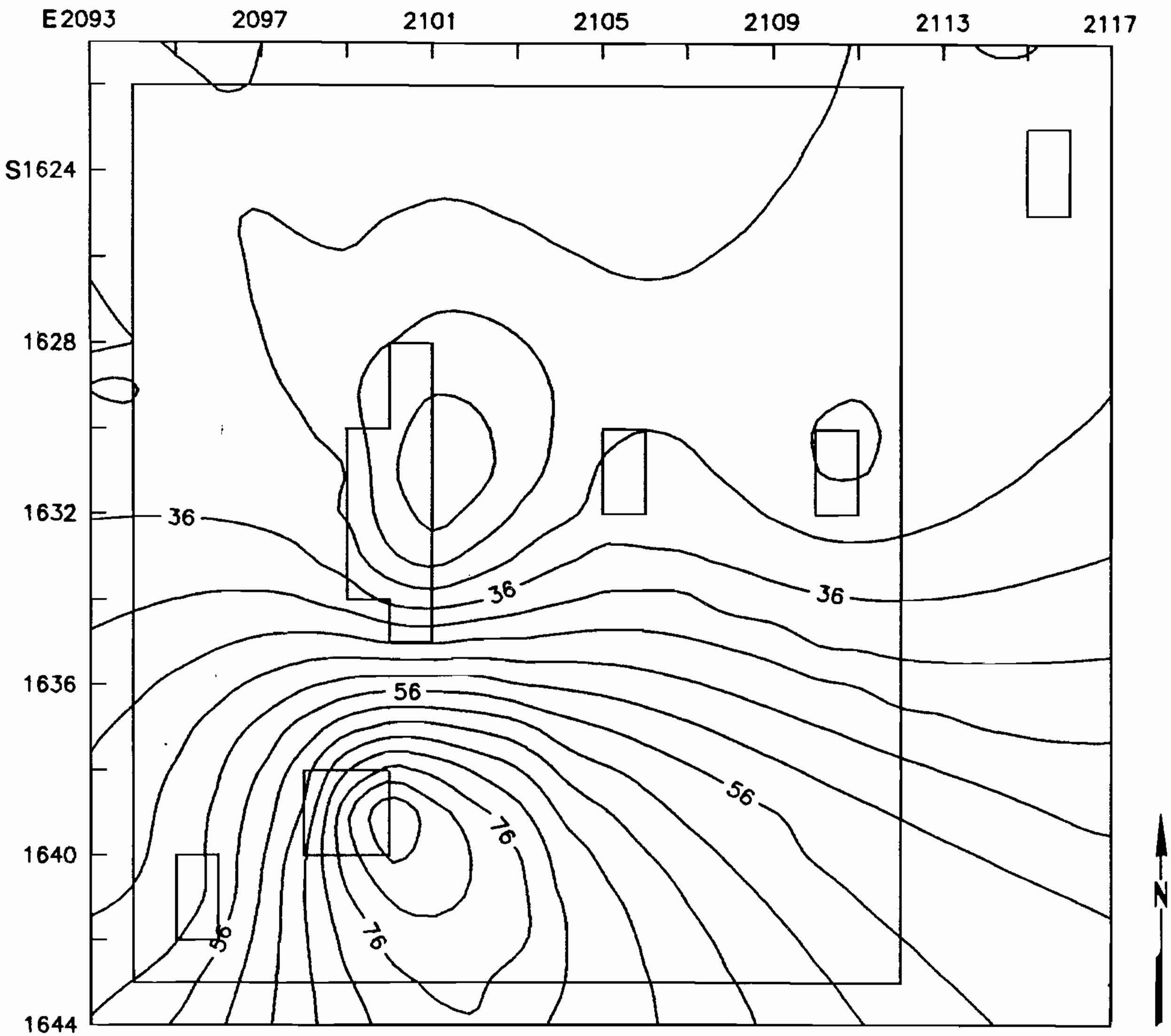

Figure 52. Distribution of lithic debitage in Component 4, 20 to 50 cm.

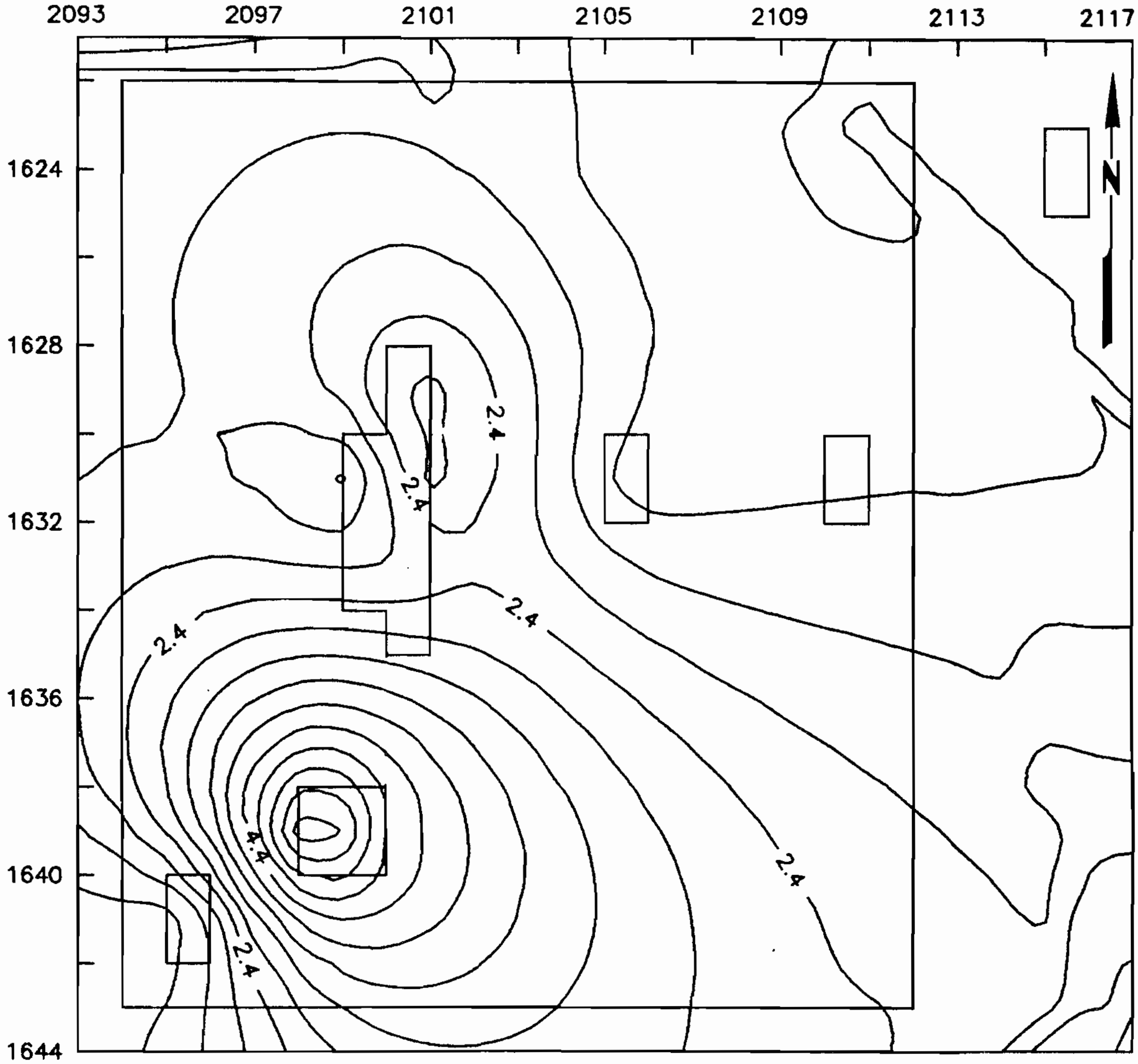

Figure 53. Distribution of CCS lithic debitage in Component 4, 20 to 50 cm.

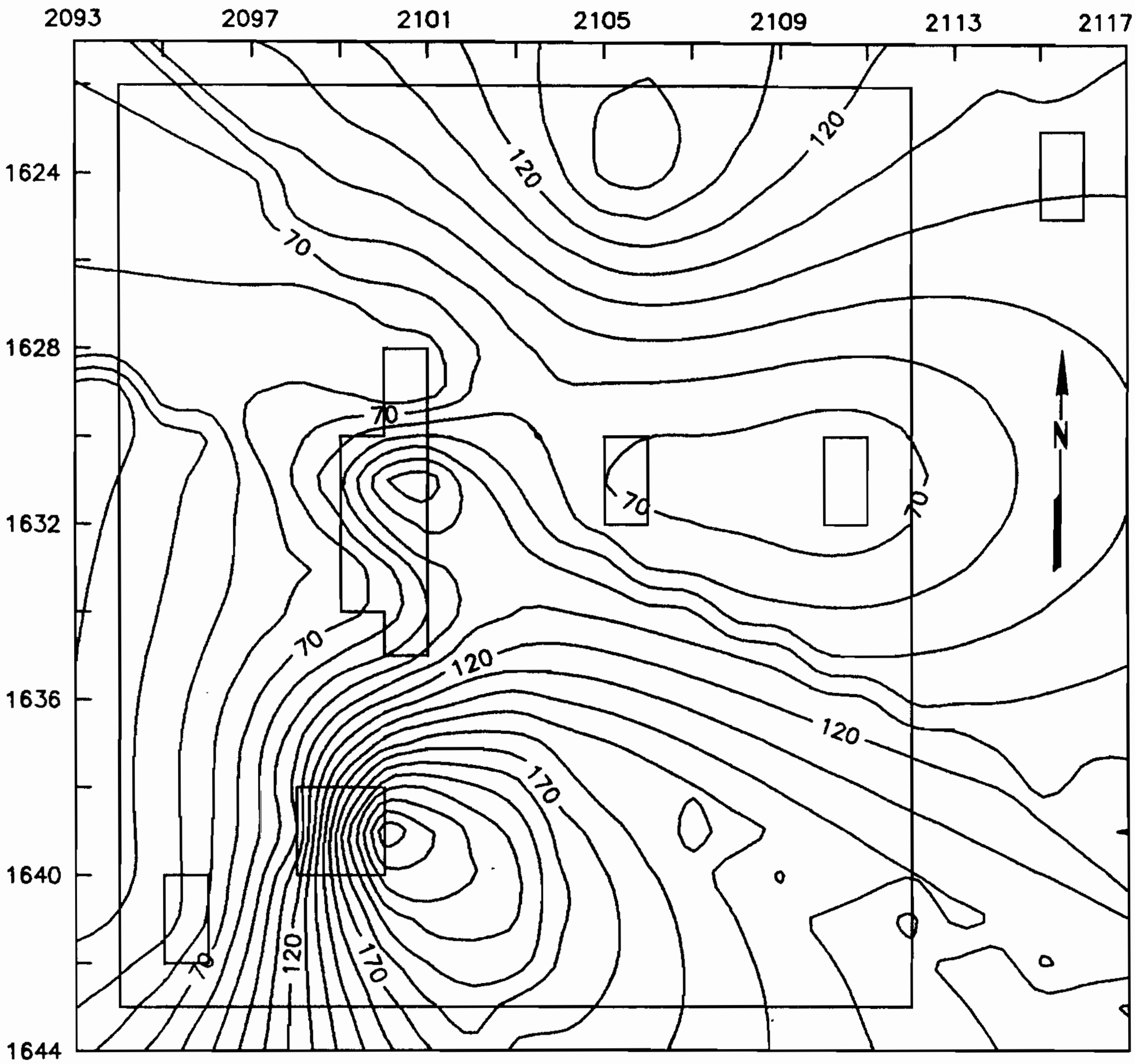

Figure 54. Distribution of lithic debitage in Component 4, 50 to 70 cm.

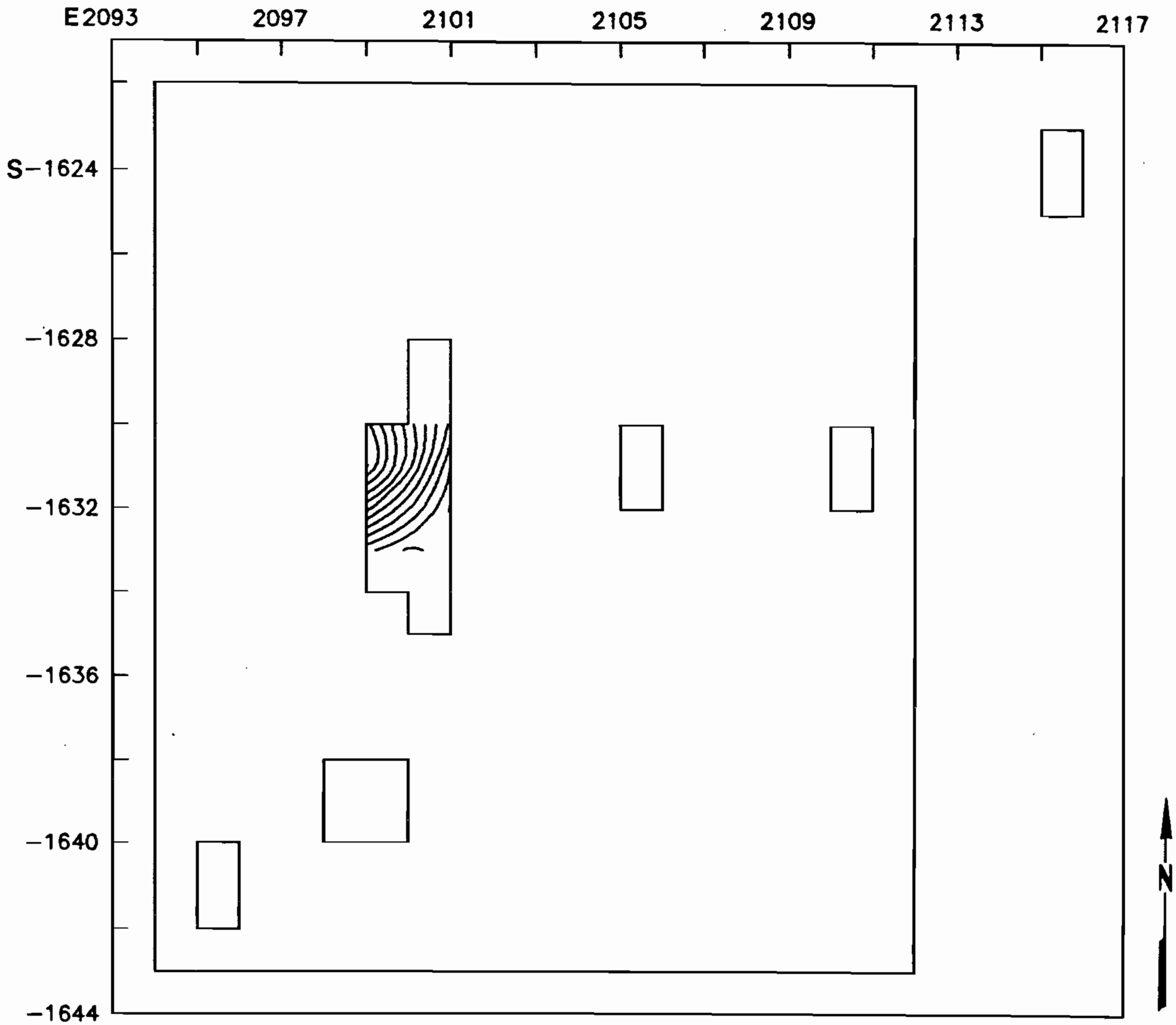

Figure 55. Distribution of bone in Component 4, 20 to 50 cm.

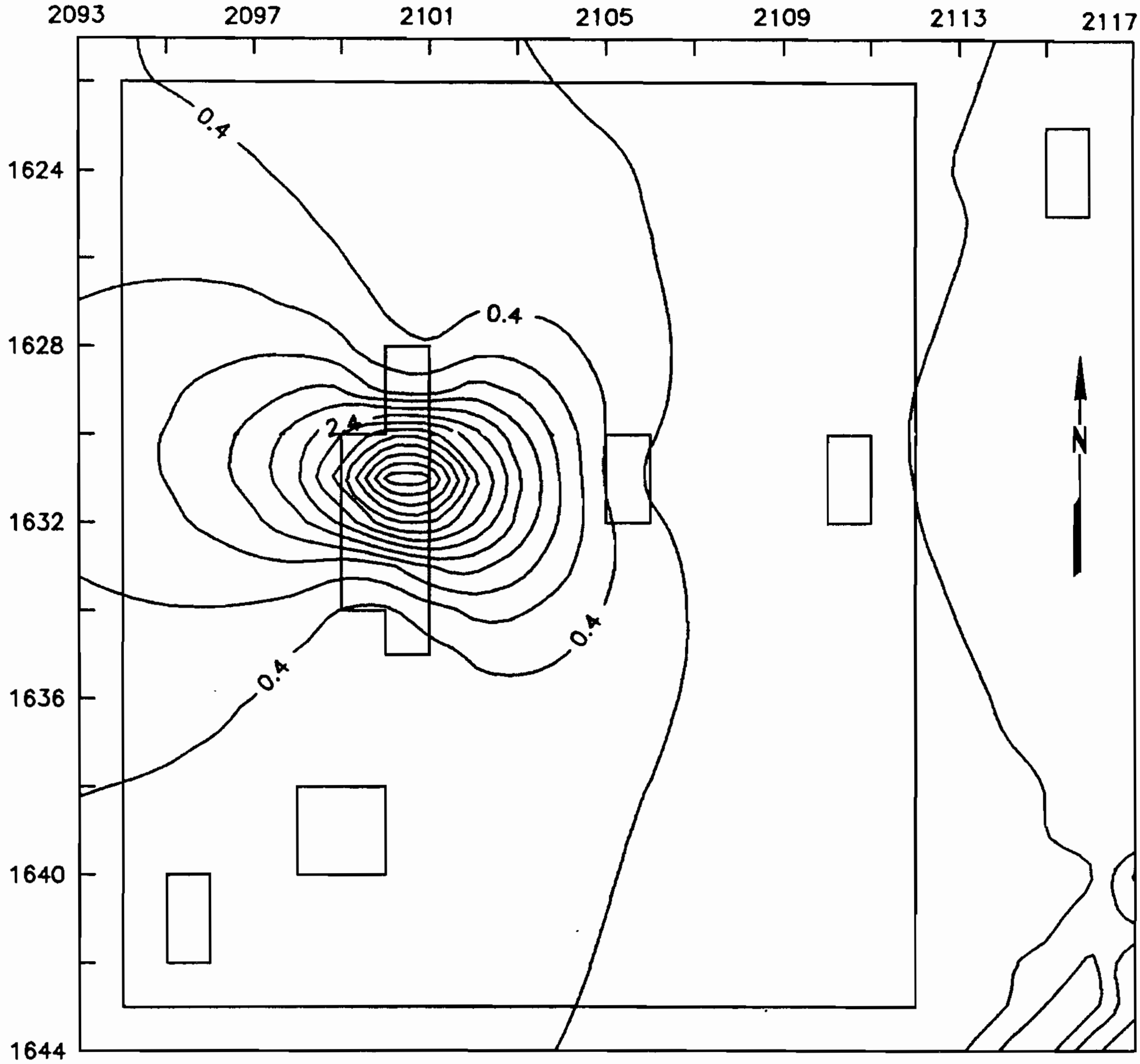

Figure 56. Distribution of bone in Component 4, 50 to 70 cm.

REFERENCES CITED

Aikens, C.M.
1983 The Far West. In Ancient North Americans, edited by J.D. Jennings, pp. 149-201. W.H. Freeman, San Francisco.

Ames, K.M.
1988 Early Holocene Forager Mobility Strategies on the Southern Columbia Plateau. In Early Human Occupation in Far Western North America: The Clovis-Archaic Interface, edited by J.A. Willig, C.M. Aikens, and J.L. Fagan, pp. 325-360. Nevada State Museum Anthropological Papers 21.

Amsden, C.A.
1935 The Pinto Basin Artifacts. In The Pinto Basin Site. Southwest Museum Papers 9:33-50. Los Angeles.

1937 The Lake Mohave Artifacts. In The Archaeology of Pleistocene Lake Mohave: A Symposium. Southwest Museum Papers 11:51-98. Los Angeles.

Antevs, E.
1948 Climatic Changes and Pre-White Man. In The Great Basin with Emphasis on Glacial and Postglacial Times. Biological Series 10(7), University of Utah Bulletin 38(20). Salt Lake City.

1952 Climatic History and the Antiquity of Man in California. University of California Archaeological Survey Reports 16:23-31. Berkeley.

1953 The Postpluvial or Neothermal. University of California Archaeological Survey Reports 22:9-23. Berkeley.

1955 Geologic-climatic Dating in the West. American Antiquity 20(4):317-335.

Bachhuber, F.
1984 Geologic Aspects of a Transect from Archaeological Site 4-SBr-4966(KD-25) to Nelson Lake and a Discussion of the Ridge Quarry Site (4-SBr-4977). In An Archaeological Survey of the 1982 Gallant Eagle Exercise Area, Fort Irwin, San Bernardino County, California, by C. Robarchek, W.H. Breece, K.A. Bergin, and C.N. Warren. Fort Irwin Archaeological Project Research Report 7, Appendix C. Coyote Press. Salinas, California.

Baker, C.M.
1978 The Size Effect: An Explanation of Variability in Surface Artifact Assemblage Content. American Antiquity 43(2):288-293.

Barlein, P.J. and I.C. Prentice
1989 Orbital Variations, Climate and Paleoecology. Trends in Ecology and Evolution 4(7):195-199.

Basgall, M.E. and M.C. Hall
n.d. Archaeological Investigations at the Awl Site (SBr-4562): an Early Holocene Settlement in the Mojave Desert, California. Report in preparation.

Basgall, M.E., M.C. Hall, and W.R. Hildebrandt
1988 The Late Holocene Archaeology of Drinkwater Basin, Fort Irwin, San Bernardino County, California. Report to Army Corps of Engineers, Los Angeles, Far Western Anthropological Research Group, Inc., Davis.

Bedwell, S.F.
1970 Prehistory and Environment of the Pluvial Rock Lake Area of Southcentral Oregon. Unpublished Ph.D dissertation, Department of Anthropology, University of Oregon.

1973 Fort Rock Basin: Prehistory and Environment. University of Oregon Books, Eugene.

Benson, L.V., D.R. Curry, R.I. Dorn, K.R. Lajoie, C.G. Oviatt, S.W. Robinson, G.I. Smith, and S. Stine
1990 Chronology of Expansion and Contraction of Four Great Basin Lake Systems During the Past 35,000 Years. Paleo Geography, Climatology, Ecology 79(90):241-286.

Bergin, K.A.
1990 Ground Stone and Other Items. *In* Archaeological Investigations at Nelson Wash, Fort Irwin, California. Edited by C.N. Warren, (draft) *Fort Irwin Archaeological Project Research Report* 23.

1986 Ground Stone Tools. *In* Flood, Sweat and Spears in the Valley of Death: Site Survey and Evaluation in Tiefort Basin, Fort Irwin, California, by D.L. Jenkins, pp. 294-326. *Fort Irwin Archaeological Project Research Report* 17. Coyote Press. Salinas, California.

Bergin, K.A., D.D. Ferraro, and C.N. Warren
1985 The Data Recovery of Three Sites in Bow Willow Wash South: The Fieldwork Phase, Fort Irwin, San Bernardino County, California. *Fort Irwin Archaeological Project Research Report* 14. Coyote Press. Salinas, California.

Bettinger, R. and R.E. Taylor
1974 Suggested Revisions in Archaeological Sequences of the Great Basin in Interior Southern California. *Nevada Archaeological Survey Research Papers* 5:1-26. Reno.

Binford, L.R.
1980 Willow Smoke and Dog's Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 45(1):4-20.

Bocek, B.
1986 Rodent Ecology and Burrowing Behavior: Predicted Effects on Archaeological Site Formation. *American Antiquity* 51(3):589-603.

Bouwkamp, C.A. and R.W. Whiteside
1984 Ecological Evaluation Fort Irwin, California, 12-26 March 1984. United States Army Environmental Hygiene Agency Water Quality Biological Study 32-24-0579-84.

Bradley, W.G.
1970 The Vegetation of Saratoga Springs, Death Valley National Monument. *Southwestern Naturalist* 15:111-129.

Bradley, W.G. and J.E. Deacon
1967 The Biotic Communities of Southern Nevada. *In* Pleistocene Studies in Southern Nevada, edited by H.M. Wormington and D. Ellis, pp. 201-295. *Nevada State Museum Anthropological Papers* 13.

Bryan, A.L.
1980 The Stemmed Point Tradition: an Early Technological Tradition in Western North America. In AnthropologicalPapers in Memory of Earl H. Swanson, Jr., edited by L.B. Harten, C.N. Warren, and D.R. Tuohy, pp. 77-104. Idaho Museum of Natural History. Pocatello.

Burk, J.H.
1977 Sonoron Desert. In Terrestrial Vegetation of California, edited by M.G. Barbour and J. Major, pp. 869-889. Wiley and Sons, New York.

Campbell, E.W.C. and W.H. Campbell
1935 The Pinto Basin Site. Southwest Museum Papers 9. Los Angeles.

1937 The Archaeology of Pleistocene Lake Mohave: a Symposium. Southwest Museum Papers 11.

Carr, C.
1984 The Nature of Organization of Intrasite Archaeological Records and Spatial Analytic Approaches to Their Investigation. In Advances in Archaeological Method and Theory, edited by Michael B. Schiffer, 7:103-222. Academic Press.

Clewlow, C.W., Jr.
1968 Surface Archaeology of the Black Rock Desert, Nevada. Reports of the University of California Archaeological Survey 73:1-93. Berkeley.

COHMAP Members
1988 Climatic Changes of the Last 18,000 Years: Observations and Model Simulations. Science 241:1043-1052.

Couture, M.D., M.F. Ricks, and L. Housley
1986 Foraging Behavior of a Contemporary Northern Great Basin Population. Journal of California and Great Basin Anthropology 8(2):150-160.

Cowgill, G.L.
1975 On Causes and Consequences of Ancient and Modern Population Changes. American Anthropologist 77(3):505-525.

Davis, C.A. and G.A. Smith
1981 Newberry Cave. San Bernardino County Museum Association. Redlands, California.

Davis, E.L., C.W. Brott, and D.L. Weide
1969 The Western Lithic Co-tradition. San Diego Museum Papers 6.

Davis, J.O.
1982 Bits and Pieces: The Last 35,000 Years in the Lahontan Area. In Man and Environment in the Great Basin, edited by D.B. Madsen and J.F. O'Connell, pp. 53-75. Society for American Archaeology Papers 2.

Denton, G.H. and W. Karlen
1973 Holocene Climatic Variations - Their Pattern and Possible Causes. Quaternary Research 3:155-205.

Douglas, C.L.
1982 Faunal Analysis. In Test Excavation and Significance Assessment of Archaeological Site SBr-4448, a Rockshelter in Drinkwater Basin, Fort Irwin, San Bernardino County, California, by D.L. Jenkins, pp. 53-57. Fort Irwin Archaeological Project Research Report 2. Coyote Press. Salinas, California.

1986 Faunal Analysis. In Test Excavation and Data Recovery at the Awl Site, 4-SBr-4562, a Pinto Site at Fort Irwin, San Bernardino County, California, by D.L. Jenkins, C.N. Warren, and T. Wheeler. Fort Irwin Archaeological Project Research Report 22, Appendix B. Coyote Press. Salinas, California.

Douglas, C.L., D.L. Jenkins, and C.N. Warren
1988 Spatial and Temporal Variability in Faunal Remains from Four Lake Mojave-Pinto Period Sites in the Mojave Desert. In Early Human Occupation in Far Western North America: The Clovis-Archaic Interface, edited by J.A. Willig, C.M. Aikens, and J.L. Fagan, pp. 131-144. Nevada State Museum Anthropological Papers 21. Carson City.

Driver, H.E.
1937 Culture Element Distributions, VI: Southern Sierra Nevada. University of California Anthropological Records 1(2):53-154.

Drucker, P.
1937 Culture Element Distributions, V: Southern California. University of California Anthropological Records 1(1)1-52.

Dumond, D.E.
1965 Population Growth and Cultural Change. Southwest Journal of Anthropology 21(4):302-324.

Eckhardt, W.T. and M.J. Hatley
1982 Preliminary Report of Survey, Testing, and Documentation, Assembly and Offense Areas, Live Fire Maneuver Range, Fort Irwin, San Bernardino County, California. Report on file, Interagency Archaeological Services, San Francisco.

Enzel, Y., D.R. Cayan, R.Y. Anderson, and S.G. Wells
1989 Atmospheric Circulation During Holocene Lake Stands in the Mojave Desert: Evidence of Regional Climate Change. Nature 341:44-47.

Ericson, J.E.
1977 Prehistoric Exchange Systems in California: the Results of Obsidian Dating and Tracing. An unpublished doctoral dissertation, University of California, Los Angeles.

Ferraro, D.D.
1984 Geomorphology of the Nelson Drainage Area and Data Recovery Sites. In The Field Phase of Data Recovery of Seven Sites Along Nelson Drainage, Fort Irwin, San Bernardino County, California, by S.J. Vaughan, pp. 9-14. Fort Irwin Archaeological Project Research Report 13. Coyote Press. Salinas, California.

1986 Stratigraphy and Environmental History of Tiefort Basin. In Flood, Sweat and Spears in the Valley of Death: Site Survey and Evaluation in Tiefort Basin, Fort Irwin, California by D.L. Jenkins, pp. 152-191. Fort Irwin Archaeological Project Research Report 17. Coyote Press. Salinas, California.

Friedman, I.
1977 Hydration Dating of Volcanism at Newberry Crater, Oregon. Journal of Research U.S. Geological Survey 5(3):337-342.

Friedman, I. and W. Long
1976 Hydration Rate of Obsidian. Science 191:347-352.

Friedman, I. and R.L. Smith
1960 A New Dating Method Using Obsidian: Part 1, The Development of the Method. American Antiquity 25:476-493.

Friedman, I. and F. Trembour
1983 Obsidian Hydration Dating Update. American Antiquity 48(3):544-547.

Gehr, E.A.
1988 Mean Temperature Scaling of Source-Specific Hydration Rates. In Obsidian Dates IV: A Compendium of the Obsidian Hydration Determinations Made at the UCLA Obsidian Hydration Laboratory, Monograph XXIX, edited by C.W. Meighan and J.L. Scalise, pp. 19-26. Institute of Archaeology, University of California, Los Angeles.

Grayson, D.K.
1983 The Paleontology of Gatecliff Shelter: Small Mammals. In The Archaeology of Monitor Valley 2. Gatecliff Shelter, by D.H. Thomas, pp. 99-126. Anthropological Papers of the American Museum of Natural History 59(1). New York.

Hanes, R.C.
1988 Early Cultural Traditions of the Owyhee Uplands as Seen from Dirty Shame Rockshelter. In Early Human Occupation in Far Western North America: The Clovis-Archaic Interface, edited by J.A. Willig, C.M. Aikens, and J.L. Fagan, pp. 361-372. Nevada State Museum Anthropological Papers 21.

Harrington, M.R.
1957 A Pinto Site at Little Lake, California. Southwestern Museum Papers 17. Los Angeles.

Haynes, C.V.
1967 Quaternary Geology of the Tule Springs Area, Clark County, Nevada. In Pleistocene Studies in Southern Nevada, edited by H.M. Wormington and D. Ellis, pp. 15-104. Nevada State Museum Anthropological Papers 13.

Hester, T.R.
1973 Chronological Ordering of Great Basin Prehistory. Contributions of the University of California Archaeological Research Facility 17. Berkley.

Hunt, A.P.
1960 Archaeology of the Death Valley Salt Pan, California. University of Utah Anthropological Papers 27. Salt Lake City.

Hunt, C.B.
1966 Plant Ecology of Death Valley, California. United States Geological Survey Professional Paper 509.

Jackson, R.J.
1985 Analysis of Obsidian Hydration on Archaeological Specimens From CA-SBr-5250. In Rogers Ridge (4-SBr-5250): a Fossil Spring Site of the Lake Mojave and Pinto Periods--Phase 2 Test Excavations and Site Evaluation by D.L. Jenkins. Fort Irwin Archaeological Project Research Report 18, Appendix D. Coyote Press. Salinas, California.

1986 Analysis of Obsidian Hydration on Archaeological Specimens From Fort Irwin. In Flood, Sweat, and Spears in the Valley of Death: Site Survey and Evaluation in Tiefort Basin, Fort Irwin, California by D.L. Jenkins. Fort Irwin Archaeological Project Research Report 17, Appendix D. Coyote Press. Salinas, California.

Jenkins, D.L.
1985a Rogers Ridge (4-SBr-5250): A Fossil Spring Site of the Lake Mojave and Pinto Periods--Phase 2 Test Excavations and Site Evaluation. Fort Irwin Archaeological Project Research Report 18. Coyote Press. Salinas, California.

1985b Area 12H. In Bits and Pieces of Prehistory at Fort Irwin: Testing of KD-25, The Knoll Site, The Crossroads Site, Garlic Spring and Bitter Spring; and Survey of Areas 12A and 12H, Fort Irwin, San Bernardino County, California, by E.J. Skinner, pp. 391-397. Fort Irwin Archaeological Project Research Report 12. Coyote Press. Salinas, California.

1986 Flood, Sweat, and Spears in the Valley of Death: Site Survey and Evaluation in Tiefort Basin, Fort Irwin, California. Fort Irwin Archaeological Project Research Report 17. Coyote Press. Salinas, California.

1987 Dating the Pinto Occupation at Rogers Ridge: A Fossil Spring Site in the Mojave Desert, California. Journal of California and Great Basin Anthropology 9(2):214-231.

Jenkins, D.L. and C.N. Warren
1985 Obsidian Hydration and the Pinto Chronology in the Mojave Desert. Journal of California and Great Basin Anthropology 6(1):44-60.

Jenkins, D.L., C.N. Warren, and T. Wheeler
1986 Test Excavation and Data Recovery at the Awl Site, 4-SBr-4562, a Pinto Site at Fort Irwin, California. Fort Irwin Archaeological Research Report 22. Coyote Press. Salinas, California.

Jennings, C.W., J.L. Burnett, and B.W. Troxel
1962 Geologic Map of California: Trona Sheet. California Division of Mines and Geology, Sacramento, California.

Jones, G., D. Grayson, and C. Beck
1983 Artifact Class Richness and Sample Size in Archaeological Surface Assemblages. In Lulu Linear Punctuated: Essays in Honor of George Irving Quimby, edited by R.C. Dunnell and D.K. Grayson, pp. 55-74. Anthropological Papers of the University of Michigan 72.

Kent, J.D.
1986 Faunal Remains from 10 Archaeological Sites in Tiefort Basin, Central Mojave Desert, California. In Flood, Sweat, and Spears in the Valley of Death: Site Survey and Evaluation in Tiefort Basin, Fort Irwin, California, by D.L. Jenkins. Fort Irwin Archaeological Project Research Report 17, Appendix E. Coyote Press. Salinas, California.

Knack, M.
1980 Ethnographic Overview of the Amargosa-Mojave Basin Planning Units. In A Cultural Resource Overview for the Amargosa-Mojave Basin Planning Units by C.N. Warren, M. Knack, and E. von Till-Warren, pp. 137-194. Cultural Resources Publications Anthropology-History, Bureau of Land Management, Riverside, California.

Kowta, M.
1969 The Sayles Complex: a Late Milling Stone Assemblage from Cajon Pass and the Ecological Implications of Its Scraper Planes. University of California Publications in Anthropology 6. Berkley.

Kutzbach, J.E.
1981 Monsoon Climate of the Early Holocene: Climatic Experiments with the Earth's Orbital Parameters for 9,000 Years Ago. Science 214:59-61.

Laird, C.
1976 The Chemehuevis. Malki Museum Press, Banning, California.

LaMarch, V.C., Jr.
1973 Holocene Climatic Variations Inferred from Treeline Fluctuations in the White Mountains of California. Quaternary Research 3:632-660.

Lanning, E.P.
1963 Archaeology of the Rose Spring Site INY-372. University of California Publications in American Archaeology and Ethnology 49(3):237-336. Berkley.

Layton, T.N. and D.H. Thomas
1979 The Archaeology of Silent Snake Springs, Humboldt County, Nevada. Anthropological Papers of the American Museum of Natural History 55(3):249-270.

Leonard, R.D. and G.T. Jones
1989 Diversity in Archaeology. Cambridge University Press, New York.

Lyneis, M.M.
1990 Subsurface Data Recovery at 4-SBR-4966. In Archaeological Investigations at Nelson Wash, Fort Irwin, California edited C.N. Warren (draft). Fort Irwin Archaeological Project Research Report 23.

Lyneis, M.M. and C.N. Warren
1990 Assemblage Composition Analysis. In Archaeological Investigations at Nelson Wash, Fort Irwin, California edited by C.N. Warren (draft). Fort Irwin Archaeological Project Research Report 23.

Mehringer, P.J., Jr.
1967 Pollen Analysis of the Tule Springs Site, Nevada. In Pleistocene Studies in Southern Nevada, edited by H.N. Wormington and D. Ellis. Nevada State Museum Anthropological Papers 13.

1977 Great Basin Late Quaterary Environments and Chronology. In Models and Great Basin Prehistory: A Symposium, edited by D.D. Fowler, pp. 113-167. University of Nevada, Desert Research Institute Publication in the Social Sciences 12. Reno.

1986 Prehistoric Environments. In Handbook of North American Indians, Vol. 11: Great Basin, pp. 31-50. Smithsonian Institution, Washington.

Mehringer, P.J., Jr. and J.C. Sheppard
1978 Holocene History of Little Lake, Mojave Desert, California. In The Ancient Californians: Rancholabrean Hunters of the Mojave Lakes Country, edited by E.L. Davis. Los Angeles County Museum of Natural History Science Series 29:153-166.

Mehringer, P.J., Jr. and C.N. Warren
1976 Marsh, Dune, and Archaeological Chronology, Ash Meadows, Amargosa Desert, Nevada. In Holocene Environmental Change in the Great Basin, edited by R. Elston. Nevada Archaeological Survey Research Papers 8:120-151. Reno.

Meighan, C.
1981 The Little Lake Site, Pinto Points and Obsidian Dating in the Great Basin. Journal of California and Great Basin Anthropology 3(2):200-214.

1989 Further Comments on Pinto Points and their Dating. Journal of California and Great Basin Anthropology 11(1):113-118.

Michels, J.W.
1986 Obsidian Hydration Dating. Endeavor 10:97-100.

O'Connell, J.F.
1975 The Prehistory of Surprise Valley. Ballena Press Anthropological Papers 4. Ramona, California.

Ore, H.T.
1985 Tiefort Basin Ft. Irwin Archaeological Project Geomorphic and Stratigraphic Comments. In Rogers Ridge (4-SBr-5250): A Fossil Spring Site of the Lake Mojave and Pinto Periods--Phase 2 Test Excavations and Site Evaluation. Fort Irwin Archaeological Project Research Report 18, by D.L. Jenkins, Appendix A. Coyote Press. Salinas, California.

1986 Geologic Comments on the Tiefort Basin. In Flood, Sweat, and Spears in the Valley of Death: Site Survey and Evaluation in Tiefort Basin, Fort Irwin, California, by D.L. Jenkins. Fort Irwin Archaeological Project Research Report 17, Appendix A. Coyote Press. Salinas, California.

Ore, H.T. and C.N. Warren
1971 Late Pleistocene Early Holocene Geomorphic History of Lake Mojave, California. Geological Society of America Bulletin 82:2553-2562.

Pettigrew, R.M.
1982 Archaeological Investigations in Mill Creek Valley, Crook County, Oregon. University of Oregon Anthropological Papers 26. Eugene.

Pierce, C.
1988 California's Millingstone Horizon: Of Mice or Men? Paper presented at the 53rd Annual Meeting of the Society for American Archaeology, Phoenix.

Quade, J.
1986 Late Quaternary Environmental Changes in the Upper Las Vegas Valley, Nevada. Quaternary Research 26:340-357.

Quade, J. and W.L. Pratt
1989 Late Wisconsin Groundwater Discharge Environments of the Southwestern Indian Springs Valley, Southern Nevada. Quaternary Research 31:351-370.

Ridings, R.
1991 Obsidian Hydration Dating: The Effects of Mean Exponential Ground Temperature and Depth of Artifact Recovery. Journal of Field Archaeology 18:77-85.

Robarchek, C., W.H. Breece, K.A. Bergin, and C.N. Warren
1984 An Archaeological Survey of the 1982 Gallant Eagle Exercise Area, Fort Irwin, San Bernardino County, California. Fort Irwin Archaeological Project Research Report 7. Coyote Press. Salinas, California.

Rogers, M.J.
1939 Early Lithic Industries of the Lower Basin of the Colorado River and Adjacent Desert Areas. San Diego Museum of Man Papers 3. San Diego.

Rowe, J.H.
1962 Stages and Periods in Archaeological Interpretation. Southwest Journal of Anthropology 18(1):40-54.

Simpson, R.D.
1965 An Archaeological Survey of Troy Lake, San Bernardino County: A Preliminary Report. San Bernardino County Museum Association Quarterly 12:3.

Skinner, E.J.
1984 Data Recovery of a Portion of Bow Willow Wash North Fort Irwin, San Bernardino County, California. Fort Irwin Archaeological Project Research Report 11. Coyote Press. Salinas, California.

1985 Bits and Pieces of Prehistory at Fort Irwin: Testing of KD-25, The Knoll Site, The Crossroads Site, Garlic Spring and Bitter Spring; and Survey of Areas 12A and 12H, Fort Irwin, San Bernardino County, California. Fort Irwin Archaeological Project Research Report 12. Coyote Press. Salinas, California.

Spaulding, W.G.
1983 Late Wisconsin Macrofossil Records of Desert Vegetation in the American Southwest. Quaternary Research 19:256-264.

1985 Vegetation and Climates of the Last 45,000 Years in the Vicinity of the Nevada Test Site, South-Central Nevada. United States Geological Survey Professional Paper 1329.

Spaulding, W.G. and L.J. Graumlich
1986 The Last Pluvial Climatic Episodes in the Deserts of North America. Nature 320:441-444.

Steward, J.H.
1938 Basin-Plateau Aboriginal Sociopolitical Groups. Bureau of American Ethnology Bulletin 120.

1969 Postscript to Bands: On Taxonomy, Processes, and Causes. In Contributions to Anthropology: Band Societies, edited by D. Damas, pp. 288-295. National Museums of Canada Bulletin 228.

1970 The Foundations of Basin-Plateau Shoshonean Society. In Languages and Cultures of Western North America: Essays in Honor of Sven S. Liljeblad, edited by Earl H. Swanson. Pocatello: Idaho State University Press.

Stockton, E.D.
1973 Shaw's Creek Shelter: Human Displacement of Artifacts and It's Significance. Mankind 9:112-117.

Stuiver, M.
1964 Carbon Isotopic Distribution and Correlated Chronology of Searles Lake Sediments. American Journal of Science 262:377-392.

Susia, M.L.
1964 Tule Springs Archaeological Surface Survey. Nevada State Museum Anthropological Papers 12. Carson City, Nevada.

Tadlock, W.L.
1966 Certain Crescentic Stone Objects as a Time Marker in the Western United States. American Antiquity 31(5):662-675.

Thomas, D.H.
1972 Western Shoshone Ecology: Settlement Patterns and Beyond. In Great Basin Cultural Ecology: A Symposium, edited by D.D. Fowler, pp. 135-153. University of Nevada , Desert Research Institute Social Sciences and Humanities Publications 8. Reno.

1981 How to Classify the Projectile Points from Monitor Valley, Nevada. Journal of California and Great Basin Anthropology 3(1):7-43.

1983 The Archaeology of Monitor Valley, 2: Gatecliff Shelter. Anthropological Papers of the American Museum of Natural History 59(1). New York.

Thompson, D.G.
1929 The Mohave Desert Region, California: A Geographic, Geologic and Hydrologic Reconnaisance. United States Geological Survey Water Supply Paper 578.

Tuohy, D.R.
1974 A Comparative Study of Late Paleo-Indian Manifestations in the Western Great Basin. Nevada Archaeological Survey Research Paper 5:91-116.

1980 Obsidian Hydration Dates for Western Great Basin Prehistory.
In Anthropological Papers in Memory of Earl H. Swanson, Jr. edited by L.B. Harten, C.N. Warren, and D.R. Tuohy, pp. 48-66. Idaho Museum of Natural History Pocatello, Idaho.

Van Devendar, T.R. and W.G. Spaulding
1979 Development of Vegetation and Climate in the Southwestern United States. Science 204:701-710.

Vasek, F.C. and M.G. Barbour
1977 Mojave Desert Scrub Vegetation. In Terrestrial Vegetation of California, edited by M.G. Barbour and J. Major, pp. 835-867. Wiley and Sons, New York.

Vaughan, S.J.
1984 The Field Phase of Data Recovery of Seven Sites Along Nelson Drainage, Fort Irwin, San Bernardino County, California. Fort Irwin Archaeological Project Research Report 13. Coyote Press. Salinas, California.

Vaughan, S.J. and C.N. Warren
1987 Toward a Definition of Pinto Points. Journal of California and Great Basin Anthropology 9(2):199-213.

Wallace, W.J.
1958 Archaeological Investigations in Death Valley National Monument 1952-1957. In Current Views on Great Basin Archaeology. University of California Archaeological Survey Reports 42:7-22. Berkeley.

1962 Prehistoric Cultural Developments in the Southern Californian Deserts. American Antiquity 28 (2):172-180.

1977 A Half Century of Death Valley Archaeology. Journal of California Anthropology 4 (2):249-258.

Warren, C.N.
1967 The San Dieguito Complex: A Review and Hypothesis. American Antiquity 32(2):168-185.

1980a The Archaeology and Archaeological Resources of the Amargosa-Mojave Basin Planning Units. In A Cultural Resource Overview for the Amargosa-Mojave Basin Planning Units by C.N. Warren, M. Knack, and E. von Till-Warren, Pp. 1-134. Cultural Resources Publications Anthropology-History, Bureau of Land Management, Riverside, California.

1980b Pinto Points and Problems in Mojave Desert Archaeology. In Anthropological Papers in Memory of Earl H. Swanson, Jr., edited by L.B. Harten, C.N. Warren, and D.R. Tuohy, Pp. 67-76. Pocatello, Idaho.

1984 Desert Region. In California Archaeology. by M.J. Morotto. Academic Press.

1985a Projectile Points. In Rogers Ridge (4-SBr-5250): a Fossil Spring Site of the Lake Mojave and Pinto Periods--Phase 2 Test Excavations and Site Evaluation by D.L. Jenkins, pp. 103-116. Fort Irwin Archaeological Project Research Report 18. Coyote Press. Salinas, California.

1985b Unifacially Flaked Stone Tools. In Rogers Ridge (4-SBr-5250): a Fossil Spring Site of the Lake Mojave and Pinto Periods--Phase 2 Test Excavations and Site Evaluation, by D.L. Jenkins, pp. 142-160. Fort Irwin Archaeological Project Research Report 18. Coyote Press. Salinas, California.

1986a The Research Overview. In Fort Irwin Historic Preservation Plan. Volume 2. Report on file, Interagency Archeological Services Branch Division of National Register Programs National Park Service, Western Region U.S. Department of the Interior, San Francisco.

1986b Projectile Points. In Flood, Sweat, and Spears in the Valley of Death: Site Survey and Evaluation in Tiefort Basin, Fort Irwin, California by D.L. Jenkins. Fort Irwin Archaeological Project Research Report 17:195-217. Coyote Press. Salinas, California.

1990 Archaeological Investigations at Nelson Wash, Fort Irwin, California, edited by C.N. Warren. Fort Irwin Archaeological Project Research Report 23 (draft). Dames and Moore, San Diego.

Warren, C.N. and R.H. Crabtree
1986 The Prehistory of the Southwestern Great Basin. In Handbook of North American Indians Vol. 11: Great Basin. Smithsonian Institution, Washington D.C.

Warren, C.N. and H.T. Ore
1978 Approach and Process of Dating Lake Mohave Artifacts. Journal of California Anthropology 5(2):179-187.

Waters, M.R.
1988 Geomorphology of Tiefort Basin. In The Archaeology of Tiefort Basin, Fort Irwin, San Bernardino County, California, by K.R. McQuire and M.C. Hall, pp. 20-37. Report on file, Army Corps of Engineers, Los Angeles.

Weide, D.L.

1976 The Altithermal as an Archaeological "Nonproblem" in the Great Basin. In Holocene Environmental Change in the Great Basin, edited by R. Elston. Nevada Archaeological Survey Research Reports 6:174-185.

1982 Paleoecological Models in the Southern Great Basin: Methods and Measurements. In Man and Environment in the Great Basin, edited by D.B. Madsen and J.F. O'Connell, pp. 8-26. Society for American Archaeology Papers 2.

Wells, P.V.

1979 An Equable Glaciopluvial in the West: Pleniglacial Evidence of Increased Precipitation on a Gradient from the Great Basin to the Sonoran and Chihuahuan Deserts. Quaternary Research 12:311-325.

Willig, J.A.

1988 Paleo-Archaic Adaptations and Lakeside Settlement Patterns in the Northern Alkali Basin. In Early Human Occupation in Far Western North America: The Clovis-Archaic Interface, edited by J.A. Willig, C.M. Aikens, and J.L. Fagan. Nevada State Museum Anthropological Papers 21:417-482.

Willig, J.A., C.M. Aikens, and J.L. Fagan

1988 Early Human Occupation in Far Western North America: The Clovis-Archaic Interface. Nevada State Museum Anthropological Papers 21. Carson City.

Wobst, H. M.

1974 Boundary Conditions for Paleolithic Social Systems: A Simulation Approach. American Antiquity 39:147-179.

1976 Locational Relationships in Paleolithic Society. Journal of Human Evolution 5(1):49-58.