

Title	NAKE'MUU: VILLAGE ON THE EDGE
Prepared by	Bradley J. Vierra Los Alamos National Laboratory Larry V. Nordby National Park Service Gerald S. Martinez Los Alamos National Laboratory
Edited by	Paul Reed
Date	May 2001

NAKE'MUU: VILLAGE ON THE EDGE

Bradley J. Vierra
Los Alamos National Laboratory

Larry V. Nordby
National Park Service

Gerald S. Martinez
Los Alamos National Laboratory

In Collected Papers for the Sixth Occasional Anasazi Symposium
Edited by Paul Reed

INTRODUCTION

Pursuant to federal requirements under the National Environmental Policy Act, in 1996 the Department of Energy (DOE) completed an environmental impact statement, record of decision, and mitigation action plan (MAP) for the Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility. DARHT is a new explosives testing facility located at TA-15, Los Alamos National Laboratory (LANL). As part of the implementation of the MAP, the ESH-20 Cultural Resources Team at LANL is conducting a long-term monitoring program at the ancestral pueblo site of Nake'muu (LA 12655). DOE considers the monitoring program to be an appropriate and necessary mitigation for the potential operational impacts associated with the DARHT Facility. This chapter presents the preliminary findings of the monitoring program from 1997 through 2000.

Nake'muu is situated about 350 m (1155 ft) southwest of the facility on an adjacent mesa. The name Nake'muu means “village on the edge” or “village on the point” in Tewa, the language spoken by six of the northern Rio Grande Pueblos. This name refers to the site's location high above the confluence of two deeply entrenched canyons at the end of a narrow finger of the mesa at an elevation of 2200 m (7220 ft). The site represents the only ancestral pueblo at LANL that still retains its original standing walls. It has been mapped and photographed and detailed drawings have been made of all the standing walled masonry architecture. This baseline database is updated on an annual basis, and continual assessments are made of site condition, deterioration rate, and possible sources of impact.

The Nake'muu site monitoring program was initiated by ESH-20 and the Mesa Verde Architectural Team, National Park Service (NPS) in 1997. Archaeologists from LANL and NPS have completed the detailed recording of all the walls at Nake'muu and the final site evaluation plan was finished in 1998 (Nordby et al. 1998). The plan describes the methods used for site monitoring, continued site revisits, and updates on wall condition by LANL archaeologists.

The primary objective of the monitoring program is to identify and evaluate the long-term effects of the ambient environment and DARHT Facility operations on the architecture at Nake'muu. Is the dynamic-testing program affecting the site, and if so, to what degree? What are the short-term and long-term implications of facility operations?

PREVIOUS RESEARCH AT NAKE'MUU

Edgar Lee Hewett was the first archaeologist to visit and describe the ruins of Nake'muu, referring to it as Site No. 18 (Hewett 1906:25–26). He sketched a ground plan of the site, stating that it was “the best preserved ruin in this region” and that it had “walls standing in places eight feet above the debris” (ibid:25). The site is illustrated in plates VIII and IX.

Charlie Steen visited the site in 1975 (Steen 1977:36–38). He provides a brief site description and several photographs of the standing walls and also drew a site sketch map. Steen noted the presence of Santa Fe Black-on-white, Wiyo Black-on-white, and Biscuit A and Biscuit B ceramics. He also described a room in the northeast section of the site that contained preserved wall plaster. Steen attempted to preserve the plaster by applying a “patching plaster” around its edges. It is unclear how old the original plaster actually is, however, an elderly resident of San Ildefonso Pueblo considered it to be recent in age during a 1998 site visit.

David Snow of Cross-Cultural Systems made a collection of surface artifacts at the site in 1985, recovering 27 Santa Fe Black-on-white, one possible biscuitware, and 120 smeared-indentured corrugated sherds (Vierra et al. 1999). There are very few artifacts present on the surface of the site today. Beverly Larson (1995) suggested that the lack of artifacts at the site could be attributed to the fact that the occupants threw their trash over the mesa edge. However, no evidence of a trash midden was identified during an archaeological survey around the base of the mesa.

NAKE’MUU SITE CONDITION ASSESSMENT STUDY

The DARHT MAP stipulated that several mitigation measures would be taken to evaluate the long-term effects of the explosive-testing program on Nake’muu. One of these was the implementation of a monitoring program that involved an initial site condition assessment, followed by annual site revisits. As national experts in the field, the Mesa Verde Architectural Team, National Park (NPS) was hired to conduct the initial site condition assessment. The NPS Team is responsible for monitoring the condition of prehistoric ruins at the various national parks throughout the American Southwest. They had therefore developed a set of procedures for monitoring long-term changes in these sites and mitigation measures that could be undertaken to reduce the effect of tourism and natural deterioration. The Team was subsequently accessed through an interagency agreement to carry out the following tasks:

- 1) Improve the existing maps of the site.
- 2) Create a descriptive baseline for standing architecture.
- 3) Record the condition of exposed site architecture.
- 4) Create a computerized database that ordered site data.
- 5) Develop monitoring procedures, a plan, and a monitoring schedule.

Field Methods

Larry Nordby was the principal investigator for the NPS Team. Their work began in July, 1997. The specific methods and architectural terminology used by the team is provided in the ArkDoc, Version 1.0 manual (Nordby and Windes 1997). To accomplish the field work, a 15-cm contour map was made of the site that denoted wall outlines and specific room numbers (Figure 1). Fifty-five rooms and 13 open areas were defined. In addition,

individual maps were drawn of each room. These consist of plan maps and standing wall profiles. The plan maps illustrate wall outline, abutments or bonding between wall segments, the presence of wall fall (i.e., rubble), internal drainage patterns, and vegetation (Figure 2).

The wall profiles consist of detailed drawings of individual wall elements, including masonry blocks, chinking stones, and plaster that were derived from 1:50 scaled photographs (Figure 2). Each profile is colored coded to denote the level of wall deterioration and adobe mortar loss. No coloring reflects that the mortar is intact and roughly flush with the building stones and the wall fabric is generally stable. Yellow indicates moderate mortar loss and that chinking stones are missing or that there is severe erosion around the chinks. Red indicates severe to total mortar loss. If chinks are present, they are lying directly on the underlying masonry stones. Black refers to holes or voids through the wall. Green represents wall or floor features (e.g., closed entryways, tie stone, and hearths). Blue indicates that an architectural element that was present during a previous monitoring session has since fallen out of the wall and is missing. Tan represents wall plaster. Blue/white targets represent the location where adobe mortar depth measurements were taken. These measurements are defined as the maximum distance in mm between the outside face of the masonry block and the adobe mortar. In addition to the detailed wall drawings, other specific information was also monitored for each wall, including data on wall integrity and deterioration.

Site Construction History

Nake'muu is organized around a central plaza; however, a closer inspection of the wall construction sequence indicates that two separate linear roomblocks were initially built. These consist of the Southeast Block (including Rooms 2 to 12 and 53 to 54) and the Northwest Block (including Rooms 28 to 45). The roomblocks are oriented northeast-southwest and contain two rows of rooms that are about seven rooms long. The western set of rooms was constructed first, followed by the attachment of the eastern set of rooms. The original doorways opened towards the southeast where outside activity areas were located. Later a series of lateral northern and southern roomblocks was added, enclosing a central plaza. The outside doorways were subsequently sealed and the focus of the pueblo became the central plaza area.

A cursory review of the site map indicates that room size differs across the site. That is, small rooms that are from 4 to 7 m² in size, medium rooms that contain 7 to 8.5 m², and large rooms that are greater than 8.5 m² in size. The roomblocks are generally two rooms

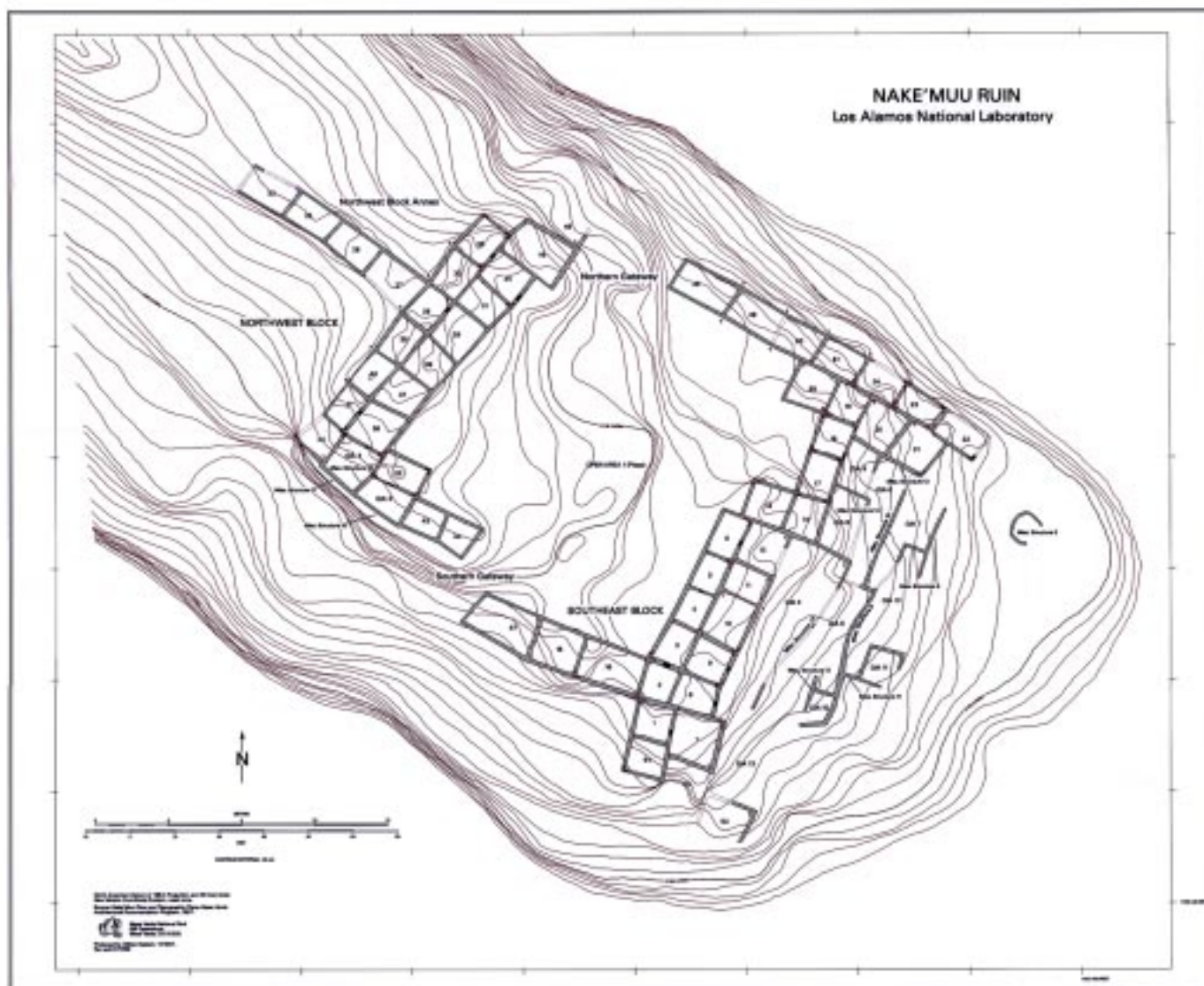


Figure 1. Nake'muu site plan.

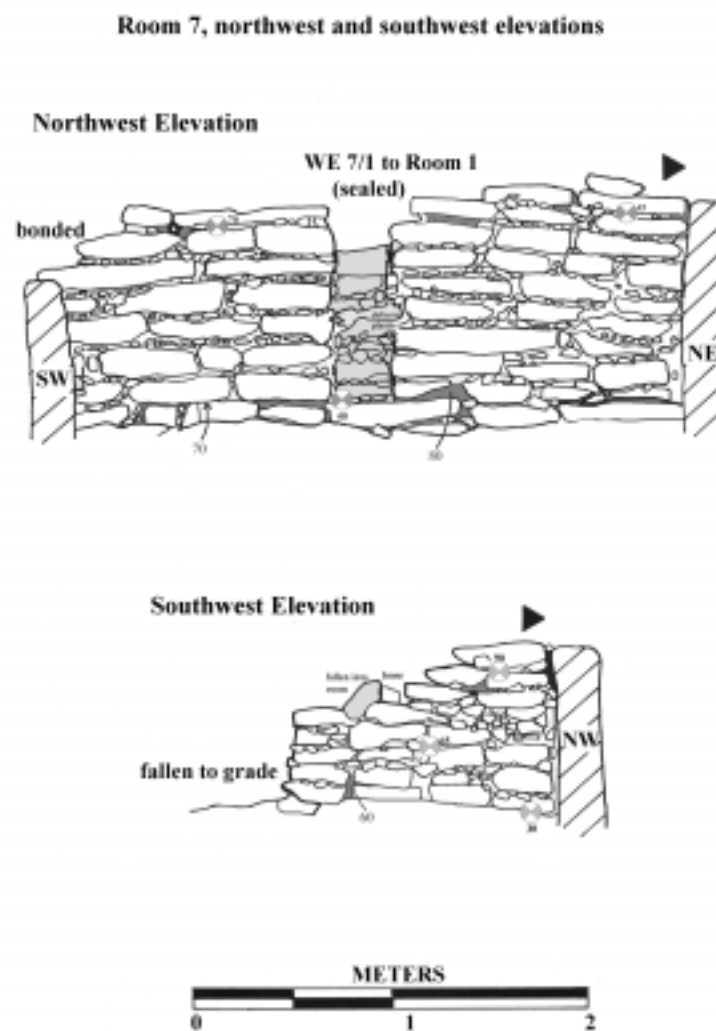
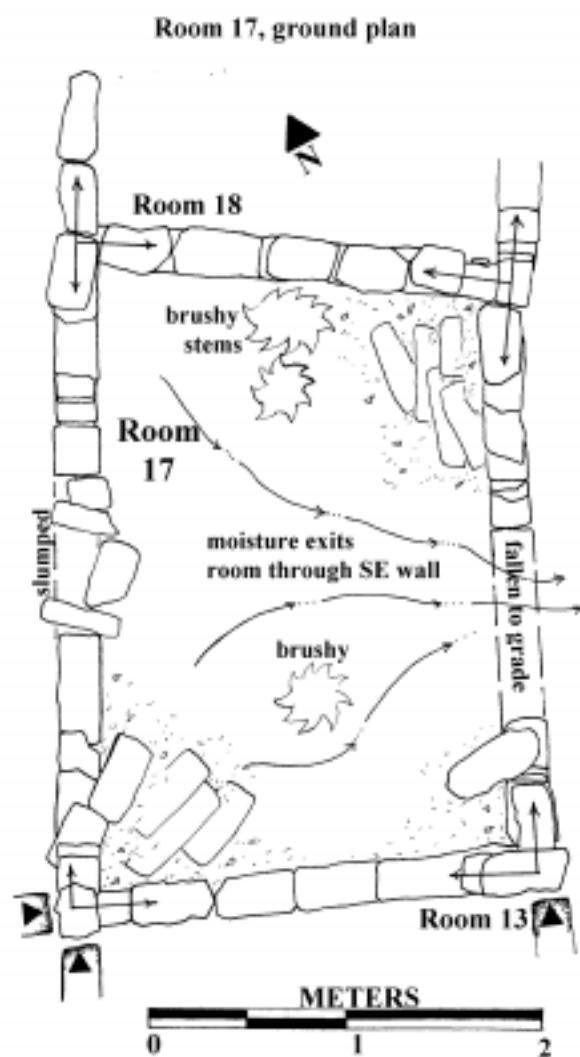


Figure 2. Room plan map and wall profile.

deep, with medium-sized living rooms in the front and smaller storage rooms located at the rear. Large rooms were probably used for communal social activities. For example, several large rooms are located at the entry ways to the central plaza (Rooms 45, 47, and 48).

There are very few artifacts present at the site; however, previous surface collections identified the presence of mostly Santa Fe Black-on-white and smeared-indented corrugated ceramics that reflect a Coalition period occupation (ca. AD 1200 to 1325). This time period corresponds with the identification of several Santa Fe Black-on-white sherds that were used as wall chinking stones. Nonetheless, the masonry at Nake'muu is characterized by shaped tuff blocks and chinking stones that are typical of the later Classic period. This characterization contrasts with the Coalition period masonry style that is characterized by the use of unshaped blocks without any chinking stones.

A lack of a trash midden, shallow interior room fill (ca. 10 cm), and limited evidence of remodeling would seem to reflect that the site was occupied for a brief period of time. Regional architectural studies indicate that the typical pueblo room had a use-life of about 20 years before some remodeling was necessary (Ahlstrom 1985; Crown 1991). If so, we could conjecture that Nake'muu was occupied for about this length of time.

Like many of the ruins on the Pajarito Plateau, Nake'muu was constructed of stone, mud, and wood. That is, the stone is shaped tuff from local bedrock, the mud is adobe mortar used to hold the walls together, and the wood is the timbers used to build the roofs. Why the walls at Nake'muu have survived to the present is not known; however, it may be attributed to several factors: 1) the roofs may have been periodically repaired during site revisits (e.g., during the Pueblo Revolt). If so, the roofs would have continued to protect the walls from the weather; 2) its isolated location, whereby fewer people visited the site; 3) roofing materials might not have been scavenged until the turn of the century when homesteaders moved into the area; and 4) the site has been located in a controlled access area, where visitation was limited.

Site Condition Assessment

The condition of each wall at Nake'muu was evaluated and classified as to Category 1, 2, 3, or 4. Category 1 walls are the most fragile and probably have the largest areas of severe damage. Category 2 walls are slightly more stable, and Category 3 walls are the most stable standing walls. Category 4 walls are those that are not currently standing above grade. Table 1 provides the information on wall category for north- vs. south-facing walls. A chi-square test of this contingency table indicates that there is no significant difference in the wall condition by direction ($\chi^2 = 4.5$, $df = 3$, $p = 0.21$); however, the cell for north-facing Category 1 walls does contain a significant adjusted residual value of 2.0. Adjusted residuals greater than 1.96 or -1.96 are significant at the .05 level. Therefore, there does appear to be relatively more Category 1 walls on the north-facing sides. It is along these north-facing façades that the winter snows tend to build up, with snow melting during the day and then freezing at night. This freeze/thaw

and contraction/expansion process has a detrimental effect on the wall construction elements.

Table 1. Wall Condition by Direction

Condition	North-facing	South-facing
Category 1	10 2.0	3 -2.0
Category 2	29 -0.3	27 0.3
Category 3	13 -0.8	18 0.8
Category 4	83 -0.6	87 0.6
Total	135	135

Chi-sq = 4.5, *df* = 3, *p* = 0.21

Figure 3 graphically illustrates the distribution of Category 4 walls across the site. As can be seen, most of the collapsed walls are situated around the periphery of the site in areas affected by sheetwash and a steep break in the slope. This condition includes the northern side of the pueblo and parts of the southern and eastern sections of the site. Total wall failure in these areas is presumably attributed to the erosion of mortar from the lower portions of the wall that eventually led to the weakening and subsequent collapse of the wall. This weakening would especially be a problem during the summer monsoonal rainy season. On the other hand, Rooms 25 to 28 and 33 are located on a high spot along a ridge in the western section of the site. This area would not have been greatly affected by seasonal runoff. It is, however, a natural corridor used by elk and people to enter the site. This traffic could have led to the destruction of this roomblock.

Besides rainfall and snow melt, there are several other factors that could have contributed towards the long-term deterioration of the architecture at Nake'muu. The site is covered with scrub oak and isolated pine and juniper trees. The root systems of these plants can undermine and dislodge the basal sections of wall, rendering them unstable and likely to collapse. This is especially a problem in the area of Rooms 5 to 6, 11 to 16, and 47 that are completely filled with oak. Most of the brush was cut at the site during the 1997 monitoring visit, but it is slowly growing back. Large trees have pushed against the walls in Rooms 48 and 53, and fallen trees have partially destroyed sections of the walls in Rooms 3, 5, and 16.

Because of the shallow surface deposits, burrowing animals do not appear to pose a problem to the site; however, there are elk trails that pass through the ruins. Biggs' et al. (1999: 22) study of elk movement identified a primary elk travel route from the mesa top down to Water Canyon near Nake'muu. There is evidence of elk at Nake'muu, including trails and scat present on the ground.

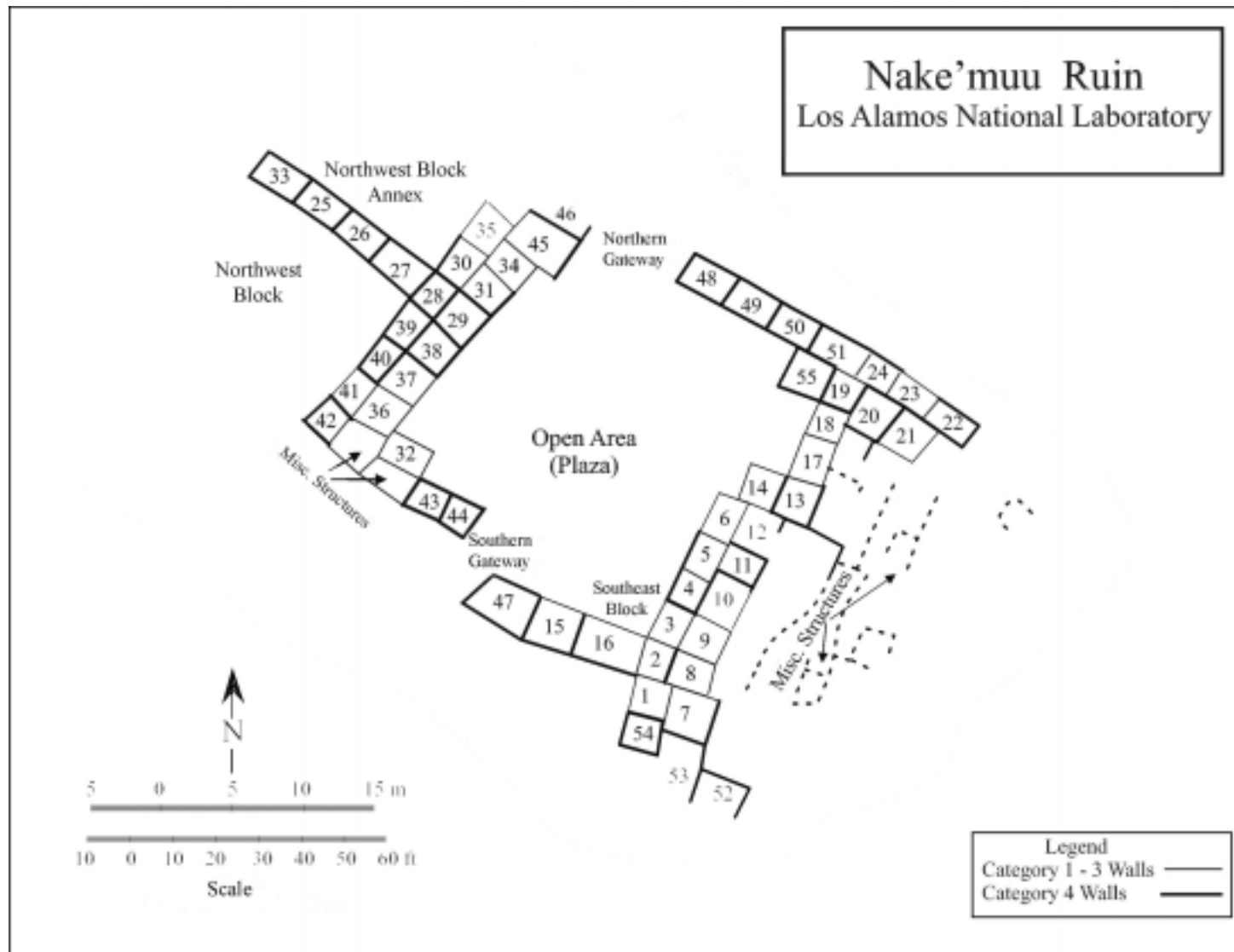


Figure 3. Nake'muu wall condition map.

Earthquakes also pose a potential threat to the architecture at Nake'muu. LANL is situated in the Pajarito fault system that includes the Pajarito Mountain, Guaje Mountain, and Rendija Canyon faults. Earthquakes along the Rio Grande Rift system have been recorded during historic times, including magnitude 4 to 6 earthquakes. Magnitude 3 and 4 earthquakes have occurred at LANL in 1952 and 1971. Otherwise, recent geologic studies have documented a faulting event between approximately 1500 to 2500 years ago (Gardner et al. 1999).

Nake'muu is located on a narrow finger between two major canyons, so it is extremely exposed to the elements. This could include other sources of potential impact like lightning, thunder, and heavy winds.

PHOTOGRAPHIC STUDIES

The Los Alamos Historical Society Archives contain a series of photographs that were taken of Nake'muu in 1915. This series includes a site overview looking east, Rooms 4 to 6, Rooms 8 to 10, the area between Rooms 14 and 55, and a section of the pueblo with Rooms 32, 36, and 43. What we see is that some portions of the pueblo have not changed at all since 1915, whereas, other portions have witnessed the total collapse of wall segments. Photographs show that the roomblock containing Rooms 25 to 28 and 33 had already collapsed down to the ground. The northeast standing walls of Rooms 30 and 31 are the same as today, whereas, the southeast walls of Rooms 29 and 38 and the northwest wall of 42 have fallen to grade. Along the south side of the pueblo, Rooms 15, 16, and 47 seem to have partially collapsed, but Room 43 or 44 may still have standing walls. In the eastern roomblock, Rooms 4 and 5 may also have standing walls. The standing ponderosa pine in a photograph has fallen, destroying the walls in Room 16.

A comparison of photographs for Rooms 4 to 6 reveals that the walls have not changed over this 85-year period. Photographs of Rooms 8 to 10 indicate that a set of top wall stones has fallen in Room 9, and a wall segment between the east doorway of Room 8 and the adjacent abutted wall to Room 9 has separated and collapsed. Otherwise, the walls are quite similar today. The eastern roomblock is much the same as today, with Rooms 4 to 6, 8 to 10, and 14 exhibiting few or no changes. It looks like Rooms 48 to 50 had already collapsed, but there were still some standing walls in the area of Room 55 along the northern side of the pueblo. Lastly, photographs in the area of Rooms 32, 36, and 43 show that the south wall of Room 32 is still standing, with only a single building stone having fallen from the top of the wall. On the other hand, the south-facing sealed doorway of Room 36 is still intact. These stones have since fallen, leaving the doorway open today. The picture foreground shows that the lower portion of the south wall of Room 43 is also still intact, with these stones having since fallen to grade.

Overall, the photographs seem to indicate an increased rate of deterioration along the northern and southern sides of the pueblo in the areas with an increased slope and greater runoff. In addition, it appears that the western roomblock extension had already collapsed by this time.

SITE MONITORING VISITS

The first follow up monitoring visit to the site was conducted in August 1998. Of the 110 standing wall façades, 47, or 43%, had some degree of deterioration in the 13 months since the original baseline study. Almost all of these were limited to a single chinking stone falling from a wall façade. Overall, there were a total of 90 chinking stones and 23 masonry blocks displaced during this period; however, four masonry blocks were accidentally displaced during the field work. If we consider that there are a total of 6578 chinking stones and 3994 masonry blocks forming the standing walled architecture at Nake'muu, then we have witnessed a 1.3% displacement of site chinks and 0.5% displacement of masonry blocks during this monitoring period.

The second monitoring visit was conducted in April 1999. An additional 64 chinking stones and 6 masonry blocks were displaced during this 8-month period. This displacement represents an increase from 6.9 to 8.0 chinks per month, but a decrease in the loss of building stones during the first two monitoring periods. Overall, a total of 154 chinking stones and 29 masonry blocks were displaced during these 21 months. We have therefore witnessed a 2.3% displacement of chinking stones and 0.5% displacement of blocks during this period. Stated another way, this represents a projected annual loss rate of 1.3% of the chinking stones and 0.4% of the masonry blocks.

A third monitoring visit was conducted in April 2000. A total of 70 chinking stones and 17 masonry blocks were displaced from the standing walls during this 12-month period. This represents an overall loss of 224 (3.4%) chinks and 46 (1.1%) masonry stones for the 33-month monitoring period. The projected loss rate on an annual basis for this roughly three-year period can therefore be calculated at 1.2% of the chinking stones and 0.4% of the masonry blocks. This is a similar figure to the one based on the 21-month period.

Although it is impossible to predict short-term or local environmental conditions and project their impact to the standing architecture at Nake'muu, it is probably reasonable to suggest that the entropy curve for the site will increase as the next century progresses. Simply using the average figures for the past three years of monitoring over a ten year period indicates that the next decade will see at minimum a 4% loss in individual masonry blocks, a 12% loss in chinking stones, and an unknown number of wall collapses or failures. At this same rate, in 25 years individual masonry block loss will approximate 10% and chinking stone loss will approximate 30%, at minimum.

Since the monitoring program has not yet encountered a complete standing wall failure, it is impossible to predict overall when one might occur. Because the style of construction at Nake'muu relies on the interface between mortar and chinking stones to stabilize the masonry blocks that comprise the primary construction elements and because chinking stones fall out as the mortar erodes, total wall collapse rates are more likely to be approximated by chinking stone loss than they are by the displacement of individual masonry blocks. The distribution of chinking stone displacements (i.e., the intensity of displacements in localized areas of the wall), a pattern that cannot yet be predicted from

three year's worth of monitoring, is probably what will become the best measure of predicted wall failure.

PUEBLO CONSULTATION

Nake'muu is an ancestral home of the people from San Ildefonso Pueblo. Information on the site has been passed down from generation to generation through oral history and traditional songs. For example, although some of the inhabitants of San Ildefonso sought refuge at Black Mesa during the Pueblo Revolt, many of the women and children hid at Nake'muu. The Pueblo elders speak of traveling the canyons from Navawi to Nake'muu to the Valle Grande. This trek included sleeping in cavates at Navawi and then hiking towards Nake'muu where they experience the winds coming down the canyon. They collected herbs at the base of the mesa near the site and visited Nake'muu. Finally, they headed on to higher elevations where they collected obsidian. Agricultural fields were also located on the mesa near DARHT. However, Nake'muu has not been visited for traditional purposes since the 1950s.

Representatives from San Ildefonso Pueblo currently visit the site on an annual basis to personally evaluate the changing condition of the architecture. They are also involved in the site monitoring program.

CERRO GRANDE WILDFIRE

Portions of Nake'muu were burned by the Cerro Grande wildfire. Much of this was, however, limited to the northern edge of the site where ground cover like scrub oak was burned. The rooms in this area have mostly fallen to grade, so that ground-level rubble was primarily exposed and burned. Nonetheless, two large trees were also burned and these posed a threat to the standing walls situated in the northeastern section of the site. Consultation with San Ildefonso was initiated and they agreed that the two trees should be cut.

Besides cutting the trees, a series of wattles was placed along the northern side of the site to reduce erosion. Some straw was also placed on the ground in the area of the burned rubble to enhance plant growth.

SUMMARY AND CONCLUSIONS

Nake'muu is one of only a few standing-walled ancestral pueblos remaining in the Jemez Mountains. Perched on a narrow finger between two adjacent canyons, it is both isolated and exposed to the natural and human-modified environment. Nonetheless, it has mostly survived the effects of the natural elements for over 700 years. Under the DARHT MAP, the ESH-20 Cultural Resources Team is monitoring the effects of DARHT operations on the standing walled masonry at Nake'muu.

In a 1997 baseline assessment, the Mesa Verde Architectural Team suggested that the ambient environment posed the greatest threat to the pueblo. This suggestion is primarily based on the condition assessment and the observation that rainfall and snowmelt have eroded adobe mortar, thereby rendering many of the walls unstable. In addition, several other natural factors may also be contributing to the deterioration of Nake'muu, including vegetation, elk, deer, human visitors, earthquakes, lightning, thunder, and heavy wind. It is, however, difficult to quantify all of these events.

The three-year monitoring program indicates that on the average about 1.2% of the chinking stones and 0.4% of the masonry blocks are falling out of the walls on an annual basis. Simply using the average figures for the past three years of monitoring over a ten-year period indicates that the next decade will see at minimum a 4% loss in individual masonry blocks, a 12% loss in chinking stones, and an unknown number of wall collapses or failures. At this same rate, in 25 years individual masonry block loss will approximate 10% and chinking stone loss will approximate 30%, at minimum.

The photographic studies indicate that sections of some walls have not changed since 1915; whereas, other walls have totally failed and fallen to grade. The latter appears to be the result of slope runoff and the undercutting of walls located along the northern and southern periphery of the site.

In summary, the preliminary results of this three-year monitoring program indicate that there have been some minor changes in the standing walled masonry at Nake'muu, however, a long-term data base must be established in order to provide the basis for a more meaningful interpretation of monitoring program results. As the monitoring program progresses, additional data will provide the basis for addressing the following fundamental questions:

- 1) What is the quantifiable relationship between affects from ambient environmental conditions and DARHT operations and which of the two factors have the greater impact on the site?
- 2) What is the quantifiable significance of changes that are observed with respect to the condition, long-term protection, and on-going monitoring of the Nake'muu site?

Future studies will involve the use of accelerometers to record the amount of vibration being transmitted from DARHT facility operations. The DARHT MAP will be used to modify the monitoring program, as needed, to address modifications in DARHT Facility operations as well as changing environmental and site conditions.

ACKNOWLEDGEMENTS

The continued success of the Nake'muu monitoring program would not be possible without the dedicated and professional support of many individuals from throughout DOE and several LANL organizations. As part of the DARHT MAP, the Nake'muu

monitoring program is supervised by the ESH-20 Group Leader, Diana Webb. Elizabeth Withers of the DOE Los Alamos Area Office provides DOE leadership and oversight of the program. Funding for the program is provided by DOE through the LANL's Associated Directorate for Nuclear Weapons, specifically Tom Alexander (DX-DO, FMU-67), under the DARHT MAP project. Facility management unit access and program site coordination is provided by Tom Alexander and Bob Grace (ESA- DO, FMU-80). DARHT project guidance and support is provided by Bob Deupree (DX-7). Project management and coordination guidance is provided by the DARHT MAP project leader, Todd Haagenstad. In addition, we wish to thank the Pueblo of San Ildefonso for their help and co-cooperation with this project. Mrs. Angelita Martinez, a tribal member, visited the site and provided us with information on the traditional use of Nake'muu. We especially want to thank Mrs. Martinez for her help and assistance. This is LANL report LA-UR-01-0762.

REFERENCES CITED

- Ahlstrom, R.V.N.
1985 The Interpretation of Archaeological Tree-Ring Dates. Ph.D. dissertation, University of Arizona, Tucson.
- Biggs, J. R., K.D. Bennett, and P.R. Fresquez
1999 Resource Use, Activity Patterns, and Disease Analysis of Rocky Mountain Elk (*Cervus elaphus nelsoni*) at the Los Alamos National Laboratory. LA-13536-MS, Los Alamos National Laboratory.
- Crown, P.L.
1991 Evaluating the Construction Sequence and Population of Pot Creek Pueblo, Northern New Mexico. *American Antiquity* 56(2):291–314.
- Gardner, J.N., A. Levine, G. Wolde Gabriel, D. Krier, D. Vaniman, F. Caporuscio, C. Lewis, P. Reneau, E. Kluk, and M.J. Snow
1999 Structural Geology of the Northwestern Portion of Los Alamos National Laboratory, Rio Grande Rift, New Mexico: Implications for Seismic Surface Rupture Potential from TA-3 to TA-55. LA-13589-MS, Los Alamos National Laboratory.
- Hewett, E.L.
1906 Antiquities of the Jemez Plateau, New Mexico. *Bureau of American Ethnology, Bulletin* No. 32. Smithsonian Institution, Washington DC.
- Larson, B.M.
1995 DARHT II: Preliminary Report of Expanded Area and Alternatives. Cultural Resource Survey Report No. 94. ESH-20, Los Alamos National Laboratory.
- Nordby, L.V. and T. Windes
1997 Mesa Verde National Park: Level 1 Architectural Documentation Database. Ark Doc, Version 1. Contributions to Ancestral Puebloan Architectural Studies No. 1. Mesa Verde National Park.
- Nordby, L.V., J. Mayberry and J. Brisbin
1998 Nak'e'muu: Village on the Edge. Description and Condition of a Prehistoric New Mexican Pueblo. Cultural Resource Survey Report No. 163. ESH-20, Los Alamos National Laboratory.
- Steen, C. R.
1977 Pajarito Plateau: Archaeological Survey and Excavations. LASL-77-4, Los Alamos Scientific Laboratory.
- Vierra, B.J., S.R. Hoagland, B.M. Larson, and K.L. Manz
1999 Dual Axis Radiographic Hydrodynamic Test Facility (DARHT) III: Expanded Area of Potential Effects. Cultural Resource Survey Report No. 110. LA-CP-99-36, Los Alamos National Laboratory.