APPENDIX
C. CHIPPED STONE FLAKING DEBRIS AND STONE TOOL ANALYTIC METHODS

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In the present section that deals specifically with methodology, we draw directly and in some cases verbatim on discussions of methodology written by Ahler for those projects (Ahler et al. 1997:261-268; Ahler and Smail 2000:117-127). A number of minor changes in methods were made specifically for study of Scattered Village samples, and such changes and adjustments are noted where appropriate.

Following basic artifact sorting, and prior to intensive analyses, the first step in this study was separation of the category "modified stone" into the classes stone tool and flaking debris. This was done using definitions widely applied by the senior author in previous studies in North Dakota (see Ahler et al. 1994a:26). A *stone tool* is defined as any lithic item which exhibits evidence of having been intentionally used (bears use-wear or use-modification) or which exhibits evidence of having been intentionally shaped or modified (bears negative flake scars or other modification damage which originates on the margin or surface of that particular item). In some cases where flake removals are very diminutive in size, as in flakes exhibiting small but regular flake removals, it may be difficult to know if flake removals are due to intentional flaking (purposeful retouch) or are result from use alone (utilization damage). This level of distinction is not relevant here, as modification from either source is sufficient to classify the artifact as a stone tool. *Chipped stone flaking debris*, on the other hand, consists of stone pieces which exhibit evidence of intentional or forceful fracture (most often some form of conchoidal fracture) which separated the item in question from a larger mass of stone, but which do not exhibit any evidence of use-modification or further intentional shaping through flaking or other processes after separation from the parent piece of stone. Therefore, tools consist of the object which was either used or intentionally shaped by flaking or other processes (pecking, grinding, etc.), and flaking debris consists of wastage resulting from some type of force-related intentional modification process. The morphology of flaking debris can vary greatly, ranging from whole flakes with classic conchoidal fracture features (platform, bulb, dorsal and ventral surface, etc.) to pieces of shatter or chunks which lack orientable fracture propagation features. Fire-cracked rock is excluded from both of these classes because it lacks evidence of force-related alteration. If a thermally broken rock piece does exhibit evidence of use or shaping subsequent to thermal fracture, it would be classified as a stone tool.

Flake Analysis Methods

Analysis methods applied to flaking debris fall largely under the domain of *mass analysis* procedures previously discussed in Ahler (1989a, 1989b) and as applied to several Plains Village age flaking debris samples (e.g., early studies in Big Hidatsa Village, reported in Ahler and Swenson 1985b; and Lower Hidatsa Village reported in Ahler and Weston 1981 and Goulding 1980; more recent studies in Ahler et al. 1997:268-297 and Ahler and Smail 2000:130-159). Data recording is simple and straightforward. For any given catalog number, flakes from each size grade are first sorted by raw material type, then by presence/absence of burning, then by presence/absence of cortex, then by flake type (usually size grade G1 and G2 flakes only), and finally by patination intensity. Then, the count and collective weight of flakes in each sorting group are recorded along with code values for sorting group criteria. For flakes in size grade G4, a decision is made before analysis began regarding whether the aggregate under a given catalog number will be sampled or not. If it is sampled, relevant G4 sample weight and total weight are recorded. The recorded variables and attribute states for flaking debris are listed in Table 1.

Table 1. Summary of variables and attribute codes applied to chipped stone flaking debris, Scattered Village (32MO31), 1998 excavated collection.

CATNO	catalog number
SIZE	size grade (1, 2, 3, or 4)
G4SAM	weight of the G4 flake sample, if the batch was sampled
G4TOT	total weight of G4 flakes, if the batch was sampled
RM	raw material type -- same as for stone tools -- see Table 2 herein
1-smooth gray Tongue River silicified sediment	24-catlinite 25-hematite (red ochre)
2-coarse (no longer exclusively yellow) Tongue River silicified sediment or silcrete (previous classes 2, 3, and 55)	26-limonite (yellow ochre) 27-gypsum 28-unburned Knife River flint 29-Rainy Buttes silicified wood
3-coarse red Tongue River silicified sediment (coded as type 2)	30-tough gray-green chert
4-solid quartzite (fine-grained orthoquartzite)	31-blonde French flint 32-Thames River (Dover) flint
5-Swan River chert (porous quartzite)	33-light yellow pigment stone 34-historic period glass
6.0-miscellaneous jasper/chert	35-metaquartzite (not class 4) 36-scoria
6.5-dendritic yellow	37-siltstone/limestone/mudstone 38-steatite
6.6-dendritic red	39-burned Knife River flint (use is optional)
6.7-dendritic other (green, etc.)	40-non-volcanic natural glass
7-White River Group silicates	41-opal 42-felspar 43-
8-clear/gray chalcedony (not obvious silicified wood)	50-Charlie Creek chert
9-yellow/light brown chalcedony (not obvious silicified wood)	51-Miocene flint (Sentinel Butte flint) (not used w/ Slant)
10-dark brown chalcedony (non-KRF, non-silicified wood)	52-obvious silicified wood 53-moss agate
11-plate chalcedony	54-antelope chert
12-burned chalcedony (not further identifiable)	55-gray silcrete (non-Tongue River types)(coded as type 2)
13-basaltic material 14-other unclassifiable	56-Scenic chalcedony
15-Bijou Hills silicified sediment	57-Hartville Uplift chert (not used w/ Slant)
16-milk or vein quartz 17-porcellanite	58-Yellowstone agate (not used w/Slant)
18-obsidian (any source) 19-granitic material	59-Turtle Valley orthoquartzite (not used w/ Slant)
20-coarse porous sandstone 21-compact sandstone	60-68- KRF quality and heat treatment codes (not used w/Slant)
22-fossil or concretion 23-clinker	69-Schmidtt chert (not used w/Slant)
	70-shist
BURN	burning or heat treatment
0-no heat application detectable	2-flake was removed before heat application (burned)
1-flake was removed after heat application (heat treatment)	
CORT	cortex 0-absent 1-present
TYPE	flake technological type, G1 and G2 only except for G3 flakes in special study
blank - size G3 or G4 flake	4-polyhedral blade
1-shatter/chunk	5-other simple flake
2-bipolar flake	6-other complex flake
3-biface thinning flake	
PATI	patination intensity
0-absent	2-moderate
1-light	3-pronounced
	9-not applicable (all raw materials except 8-10,28,52,53)
COUNT	count of flakes having a common code on all preceding variables
WEIGHT	combined weight of flakes for this data case

We can elaborate on sampling. In the Scattered Village Project, certain contexts produced quite large amounts and frequencies of small-sized artifacts, and analysis in those situations often involved sampling. For flaking debris, sampling only occurred for size grade G4, and it could occur in two ways. (1) The waterscreened residue that had been size-graded into size G4 might be sampled for purposes of sorting, and flakes would only be sorted from the sample fraction. The weight of the residue sample fraction would be recorded and divided into the weight of the total G4 residue batch to compute a multiplier that could be used to estimate the total count or weight of flakes or other materials physically sorted only from the sample fraction. (2) Even after applying such sampling procedures during sorting, very large counts of G4 flakes might be available for study from a given catalog number. In such instances, we might study only a sample of the total available G4 flakes. We sampled the total batch of G4 flakes by using a steel spatula tool to segregate and remove only part of a pile of G4 flakes on a sorting tray. We experimented with the shape of the tool until its form allowed consistent removal of about 150 flakes per scoop. All flakes were placed in a pile on a sorting tray, the spatula tool was inserted under the pile and lifted, thus extracting flake sample from the whole. When sampling in this fashion, we recorded the total weight of G4 flakes and the weight of G4 flakes in the flake sample. The ratio of total G4 flake weight to sampled G4 flake weight was used as a second multiplier to estimate the total count of flakes of any kind within the total G4 flake aggregate.

We analyzed each subset of G4 flakes in detail and then applied the first multiplier (from sample sorting of residue) and the second multiplier (from flake sampling) to the total count and weight of flakes in any line of data in order to compute an estimated count and weight of flakes of any particular type in any sampled context. During flake analysis, we applied G4 flake sampling in 103 instances. The sampled flake fraction generally ranged in count from 120 to 200 flakes, with a mean sample count of 156 flakes. Flakes in size grades G1, G2, and G3 were not sampled, and a total of 28,166 flakes were studied in those size classes. An additional 95,380 flakes in size G4 were also fully studied, yielding a total of 124,046 fully studied flakes in Priority 1 contexts. When appropriate multipliers are applied to the counts of sampled G4 flakes, the estimated count of total G4 flakes in studied contexts rises to 214,528, and the total estimated flake count in all size grades is 243,1194 specimens.

Codes for *raw material class* are the same as those applied to stone tools (see Table 2). Flaking quality distinctions were not made for Knife River flint (KRF) (as is commonly done for KRF flakes and tools in sites in the KRF Primary Source Area; Ahler et al. 1994a:97-98). A few changes in raw materials codes and classification were made specifically for the Scattered Village study, slightly altering procedures used at Slant Village and in the 1806 By-Pass Project. Raw material types 2, 3, and 55 -- all fairly coarse forms of silcrete -- were not distinguished from one another in the flake and tool classification and coding processes, but were coded together under a single raw material code (2) (Table 1). This procedure was based on the results of work with the Slant Village collection (Ahler et al. 1997:268-272) that demonstrated that these material types are quite difficult to consistently distinguish from each other, with the distinction probably have little analytic significance. Type 57, Hartville uplift chert, and type 68, Schmidt chert, were not distinguished from the more general class, type 6, (jasper/chert) in the present study. Even so, we did recognize some recurring variants of fine-grained, exotic chert in the collections that we considered to be worth tracking in greater detail. High quality chert containing small, black dendritic color splotches was recognized in three color variants, (yellow, code 6.5; red, code 6.6; and other [mostly greenish], code 6.7), and these were distinguished from all other jasper/cherts lacking black dendritic inclusions (code 6.0). We did separate porcellanite into subtypes based on color, as we chose to do in the 1806 By-Pass project (Ahler and Smail 2000). Shist (code 70.0) was added as a lithic raw material type, largely because it occurs in abundance at Menoken Village and served some special purpose at that site; shist is absent in Scattered Village flaking debris but is present in the tool collection.

Definite silicified wood, type 52, was abundant in the samples and was relatively easy to distinguish from other chalcedony-like stones of similar color (types 8, 9, and 10) when it occurred in the form of larger flakes or tools. Small pieces of this material, however, had a greater chance of lacking the distinguishing silicified wood attributes and could not always be consistently separated from types 8, 9, and 10. This difficulty in classification was reflected in the size grade distribution for type 52 flaking debris which is clearly biased toward flakes in larger size grades (so much so that the distribution is technologically improbable). Since most type 52 material was predominantly clear or gray in color, this classification problem could be resolved, when it might be important to do so, by recoding type 52 into type 8 (clear/gray chalcedony) for analytic purposes. A similar but perhaps less drastic size bias may also occur in moss agate (type 53), and all moss agate can, as necessary, be recoded as type 8, clear/gray chalcedony, for analytic purposes. The effects of these collapsing processes will be noted, as they are applied, in the discussion of flake and tool analysis. Type 51, Miocene or Sentinel Butte flint, and type

58, Yellowstone agate, were not distinguished from the more general group, type 8 (clear/gray chalcedony) in the present study.

Intentional *heat treatment* was relatively widely used in the production of stone tools at Scattered Village. Its presence is clear from differences in luster and rippling on pre- and post-heating flake scars on single artifacts, and these features are particularly easy to detect on tools made of fine-grained chalcedonies and silicified woods. The presence of heat treatment, as an intentional process, is much more difficult to determine in flaking debris, particularly in very small flakes. For this reason, we chose not to record heat treatment in flaking debris. We only recorded the presence of burning in flakes, if any degree of heat alteration could be detected in the specimen. Physical features and characteristics indicative of heat alteration in KRF follow the discussion in Ahler (1983). We can note that while burning was relatively easy to detect in fine-grained, translucent stones, heat alteration of any kind was very difficult to detect in smooth gray TRSS (type 1), a common stone type in the collection. Apparently, smooth gray TRSS shows little color, grain size, or luster change upon heating.

Flakes in size grades G1 and G2 were broken into six *flake technological types* as defined in Ahler et al. (1994b:125-129) (types are listed in Table 1). Flake type had not been previously recorded for Plains Village collections studied by the senior author in North Dakota prior to the study of Slant Village. Highly specialized (e.g., channel flake) and pressure flake types were not isolated in the present study because these types are rare to absent are confined to smaller size classes. We had reason to conduct a flake typology study for a sample of size grade G3 flakes from selected contexts (discussed below). The typology is the same, just applied to G3 as well as larger flakes.

A small number of patinated pieces of flaking debris were noted in the flake collections; these were presumed to derive from contexts predating the Plains Village period. Consequently, *intensity of patination* in patinable raw materials (generally, all translucent stones including Knife River flint, woods, and chalcedonies) was recorded on a four-part ordinal scale as discussed in Ahler et al. (1994a:109-113). Patination intensity was recorded as "not applicable" (code 9) for all coarser, opaque raw materials less subject to patination. For extremely small numbers of size grade G4 flakes in a given data batch, *weight* occasionally failed to register on the electronic balance that has a precision of 0.1 gram. In such cases, a weight of <0.1 gram was recorded on the data sheet and a value of 0.03 gram was entered in the database for cases where flake n=1, and a weight value of 0.05 gram was entered for cases where n=2 or greater.

Raw Material Classification Bias in Chipped Stone Flaking Debris

As this collection was being sorted, classified, and coded, it was felt that some raw material classification bias was present due to a *size effect*, in which certain raw material classes were more readily identifiable in larger pieces of flaking debris but were less confidently identifiable in the smallest, G4 size pieces of flaking debris. Because much of the technological study of flaking debris is based on size grade information and is linked to accurate raw material classification, it is important to explore such bias in raw material classification due to size before proceeding with technological assessment of mass analysis data. This same issue was explored with the Slant Village (Ahler, Minor, and Smail 1997:268-271) and 1806 Project flake samples (Ahler and Smail 2000:130-133), resulting in the collapsing of several raw material types which were not consistently identified across all size classes.

We explored bias in raw material classification in two ways, using procedures comparable to those used with the Slant Village flake sample (Ahler, Minor, and Smail 1997:Table 86). First, we examined the size grade distribution (percentages by count across size classes) for each raw material type to determine if the distribution for each material type was generally consistent with that expected from experimental replication. Based on data from several experimental replication studies involving several technologies (Kalin 1981; Stahle and Dunn 1984; Ahler 1989b), we expect G4 flakes to be at least twice as abundant as G1-G3 flakes. Second, we examined the relative frequency of each raw material as expressed in flaking debris (generally small items) and as expressed in stone tools (generally larger items). Inconsistencies in raw material proportions according to tool vs. debris may pinpoint areas where raw material classification in flaking debris is biased by size.

In Table 3 we present size grade distribution data (percentage by count) for each raw material type for all unburned flaking debris and total count and percentage data across raw material type for unburned flaking debris and unburned chipped stone tools. About 81% of the flake sample is classified as unburned, and about 78% of the chipped stone tool sample is classified as unburned. We limit the data set to unburned materials because the burning process introduces error in raw material classification due to altered appearance of the stone and also because the burning process induces thermal fractures which in turn alter the size distribution resulting from conchoidal fracture processes. We further limit the data on tools to those modified by flake reduction technologies (excluding pecked and ground stone tools).

Regarding size grade distribution in Table 3, we focus specifically on raw material types in which there are unusually low or unusually high percentages of flakes in the smallest size class, G4. Experimental knapping studies cited above sample (cf. Kalin 1981; Stahle and Dunn 1984; Ahler 1989b) indicate that regardless of reduction technology we can generally expect G4 debris to make up about two-thirds or more of any flake sample. G4 percentages above 90% can be expected only where pressure flaking technology accounts for the majority of technological operations in the site. In Table 3 we have highlighted several raw material types in which less than two-thirds (67%) of the flakes occur in G4, and several cells in which G4% is great then 90%.

Several raw material types with especially low G4 flake percentages are either extremely coarse materials not usually flaked, and not particularly subject to normal size breakdown (basaltic, coarse porous sandstone, compact sandstone, and scoria) and/or are materials that occur in extremely low frequency and are therefore subject to sampling error (Swan River chert, the sandstones, Rainy Butte silicified wood, and Turtle Valley quartzite). Most of these stones are quite distinctive, and there is no reason to suspect misclassification or size sample bias in these materials.

Several materials types exhibit especial *high* G4 percentages in flaking debris. Two of these are highly distinctive (obsidian and porcellanite) and there is no reason to expect size sampling bias or misclassification in these materials. The data simply indicate that pressure flaking probably played a large role in the on-site modification of these stones. Another type, yellow dendritic chert, was also probably heavily involved in pressure flaking, but the high G4 percentage is also part of a larger pattern that will be discussed in a moment.

Two types have exceptionally high percentages of G4 flakes (clear/gray and yellow/light brown chalcedonies – 8 and 9), and these are stones that fall into a group easily subject to misclassification when in the form of small artifacts. To better understand this, we need to examine comparative data material type classification of flakes versus tools in Table 3.

In the domain of translucent stones that include flints, chalcedonies and woods, three types have a much higher representation in flakes than in tools (the chalcedonies in types 8, 9, and 10) and two others have high representations in tools (silicified wood and Knife River flint). The percentage disparities are striking and clearly indicate classification bias. It is logical that small translucent pieces of KRF could readily be classified mistakenly as chalcedony types 9 and 10, and it is equally probable that similarly small pieces of true silicified wood could readily be classified as, particularly, types 8 and 9. Thus, if we accept the classification of tools to be the more accurate because of overall larger size (only 9% of tools whereas 89% of flakes are G4 in size). If we combine the yellow/light brown (type 9) and dark brown chalcedonies (type 9) with KRF (type 28) for flaking debris, and do the same for tools, this brings the percentage of these combined classes into very close congruence (50.8% for flakes, 52.1% for tools). Similarly, if we combine clear/gray chalcedony (type 8) and obvious silicified wood (type 52) for flakes, and do the same for tools, this brings their combined percentages into close congruence (14.8% for flakes, 15.6% for tools). Moss agate (type 53) is rare in both flakes and tools; because it is likely related to woods and chalcedonies in terms of geologic source, it will not be harmful to combine type 53 with types 8 and 52 for analytic purposes.

Table 3. Comparative data on raw material classification for stone tools versus flaking debris (the latter by size grade), restricted to unburned artifacts and tools of chipped technology, Scattered Village site (32MO31), 1998 excavations. Shading indicates possible problem areas; boxed indicates especially high values.

		Size Grade			N	%	%	N
Raw Material Type	G1	G2	G3	G4	CSFD	CSFD	Tool	Tool
1.0 smooth gray TRSS	.0	1.1	14.0	84.8	43416	22.1	18.7	631
2.0 coarse silcrete	.2	4.3	25.0	70.6	2988	1.5	1.4	48
4.0 orthoquartzite		.5	10.7	88.9	8350	4.3	2.9	99
5.0 Swan R. chert		33.1		66.9	3	.0	.0	0
6.0 misc. jasper/chert		.3	9.5	90.3	1046	.5	1.2	41
6.5 yell. dendritic chert		.3	7.5	92.2	2412	1.2	.5	17
6.6 red dendritic chert		.3	9.0	90.7	1901	1.0	.9	30
6.7 oth. dendritic chert		.6	10.2	89.2	1388	.7	2.1	69
7.0 White R. Group		.5	12.6	86.9	594	.3	.7	22
8.0 clear/gray chalcedony		.1	4.3	95.6	25166	12.8	2.1	70
9.0 yell/lt. brown chalced		.1	4.9	94.9	28787	14.7	5.7	192
10.0 dk. brown chalced		.4	9.2	90.4	6424	3.3	1.3	45
11.0 plate chalcedony		.5	19.2	80.3	380	.2	.2	6
13.0 basaltic		10.7	40.9	48.5	56	.0	.1	2
14.0 other/unidentifiable		11.7	11.7	76.6	9	.0	.0	0
16.0 quartz			16.8	83.2	12	.0	.0	1
17.0 porcellanite		.3	7.8	91.9	3146	1.6	2.1	70
18.0 obsidian			1.0	99.0	97	.0	.1	3
19.0 granitic	1.4	1.4	11.3	85.8	71	.0	.0	1
20.0 coarse por. sandst.			100.0	0.0	1	.0	.0	0
21.0 compact sandstone			46.1	53.9	7	.0	.1	2
22.0 fossil/concretion					0	.0	.0	1
28.0 Knife R. flint	.0	.4	10.5	89.1	64471	32.8	45.1	1519
29.0 Rainy Buttes SW		14.3	71.4	14.3	7	.0	.1	3
35.0 metaquartzite		1.7	11.2	87.1	403	.2	.1	5
36.0 scoria		8.8	49.9	41.2	34	.0	.1	2
37.0 silt/lime/mud stone	.5	.5	18.0	81.0	211	.1	.1	3
40.0 non-volcanic glass		.3	14.1	85.6	326	.2	.3	10
52.0 obvious silic. wood	.0	1.3	22.0	76.7	3859	2.0	13.5	453
53.0 moss agate		.3	12.7	87.0	771	.4	.6	21
54.0 antelope chert					0	.0	.0	1
59.0 Turtle V. quartzite			100.0	0.0	1	.0	.0	1
Flaking Debris Total n	22	1081	19716	175518	196337	100.0		
%	.0	.6	10.0	89.4	100.0			
Stone Tool Total n	135	1466	1450	317			3368	100.0
%	4.0	43.5	43.0	9.4			100.0	

Disparities are apparent for flakes vs. tools in the separation of dendritic cherts into three color classes. Yellow cherts are much more common in flakes, while other (mostly, green) is much more common in tools. This is probably due to shifts in color expression in very thin, semi-translucent pieces of flaking debris, versus larger pieces of tools. A solution would be to combine types 6.5 and 6.7 into a category of yellow/green/other dendritic cherts for flaking debris.

To summarize, for purposes of mass analysis and most other studies of flaking debris, we will recode type 8 and type 53 as type 52 (the dominant class, according to tool data) and designate it as silicified wood/chalcedonies; we will recode type 9 and type 10 as type 28 (the dominant type) and designate it as Knife River flint/brown chalcedonies; and we will type 6.5 as type 6.7 (the dominant type) and designate it as green/yell/other dendritic cherts. When carrying out comparative studies of flaking debris and tools, we will collapse tool data into the same collapsed categories; for other purposes, such as intersite comparisons, we will raw material classification in stone tools in unclasped form, as it is assumed to be a classification relatively free of size bias. It is worth noting that in the Slant Village project (Ahler et al. 1997:270-272) and the 1806 Project (Ahler and Smail 2000:132-133) precisely the same patters occurred regarding chalcedonies, woods, and KRF. In those projects types 8, 52, and 53 were also combined for flaking debris; problems related with KRF and brown chalcedonies were not as severe, and no combination occurred with those types.

In the two sections that follow directly, dealing with raw material variation and reduction technology in flaking debris, the focus is on description of the character and makeup of the entire site sample. In later sections in this chapter, we shift the focus to studying variation in stone sources and technology among analytic units identified for the site and relevant comparative samples, and towards addressing the specific research questions for the project.

Stone Tool Analysis Methods

Stone tool analysis methods are either compatible with or are more comprehensive than methods previously applied to several Plains Village collections in North and South Dakota (e.g., Ahler 1977b:62ff; Lovick 1980:236ff; Ahler and Weston 1981:108ff). Prior to the Slant Village study, the most recent and comprehensive explication of this system as applied to a specific North Dakota village collection occurs in Ahler and Swenson (1985b:79-84 and Appendices A-17,B-3,B-4,B-5). During the 1980s this analytic system was adapted for study of tool collections from sites within the Knife River flint primary source area (e.g., Kay et al. 1984; Ahler 1986), and recently, a comprehensive statement which involves an updated description of the system as applied to both Plains Village and KRF-rich collections has been printed. This latter document (Ahler, ed. 1994), and particularly, the section on stone tool analysis (Ahler et al. 1994a), forms the explanatory guide for the tool classification and analysis performed for the Scattered Village tool sample. The system used here is virtually identical to that recently applied to stone tools from nearby Slant Village (Ahler, Minor, and Smail 1997) as well as sites in the 1806 By-Pass Project (Ahler and Smail 2000). Herein, we need only discuss minor deviations from the system presented in the 1994 analytic guide as well as any added classification or analytic features applied to the Scattered Village collection that, with the exception of Slant Village and Highway 1806, were not previously applied to other Plains Villages collections in North Dakota.

Table 2 provides a list of 30 variables and attribute code states applied to the Scattered Village stone tool sample. This list reflects a somewhat scaled down version of all the possible variables discussed in Ahler et al. (1994a), dropping several technological variables which are pertinent to core reduction technologies at sites in the KRF quarry area. At the same time, it reflects a somewhat expanded analytic system compared to the system most recently applied to Knife region samples (Ahler and Swenson 1985b). The third variable in Table 2, sequence number, is new for the Scattered Village project and requires some explanation. Previously, we assigned a unique "computer number" to each artifact within a collection in order to track it in the data base and distinguish it from all other artifacts. The computer number was created by first sorting specimens into descriptive categories, and then assigning sequential four-digit numbers to specimens in each category, then linking the descriptive category number to the four digit sequence number to create a unique six-digit number for each specimen. Use of this "computer number" required that every artifact be physically segregated into descriptive category groupings, then individually bagged and labeled by computer number. Wishing to avoid this complex artifact handling process with the large Scattered Village collection, we devised a simpler means of handling, tracking, and retrieving (if necessary) individual specimens. Rather than apply sequence numbers within a descriptive category, we simply assigned them within each size grade for specimens in each catalog number. Because tools were already sorted and bagged by catalog number and size grade, we could simply lay the artifacts in a given size grade out in and order and code them, giving them sequential numbers as we went, then rebag them by size grade (without physical labeling) when coding was finished. An artifact could be retrieved by noting its recorded catalog number and size grade as well as weight, which was generally unique for each specimen within each size grade. If needed, the catalog number and sequence number could be conjoined with the sequence number to create a truly unique number for each specimen useful for photography and other purposes (e.g., for the 9th specimen in G2 within Cat No. 1275, this unique number would be 1275-2009, or 1275.2009). This revised procedure for specimen designation saved a large amount of time and simplified specimen handling.

The variable *general tool class* was used in the Scattered Village tool analysis as a simple organizational aid for data management; it has little analytic value. The variable *revised morphological class* reflects a substantial revamping of the system previously used to record artifact morphology. Included are code values which distinguish retouched from utilized flake tools, various forms of retouched or utilized flakes (depending on number and configuration of modified margins), and an abbreviated list of projectile point types applicable to Plains Village age collections. For Scattered Village, we added one new code value for the grooved ax form (code 80). Relatively new additions to the variable *technological class* are code states for radial break tools and retouched tabular tools.

The variable *original input blank form* is a recent, useful addition for study of Plains Village collections. We use this variable to characterize the technological form of the item or piece that is used as a blank for a tool. With this we record the technological nature of the original piece used as a tool, noting whether it is a flake, cobble of certain shape, or other more finished artifact type, and, if a flake, what type of flake. When we are interested in how the products of specialized core reduction find their way into the tool assemblage, this variable will allow us to track such information. For example, it will allow us to track how bipolar flakes or flakes from prepared cores are used in the broader lithic technological and functional system. This allows an important link to be made between production sites (such as at the KRF quarries and workshops) and tool-use sites (villages proper). When we began the Scattered Village tool study we overlooked the fact that simple and complex flakes were already in the code system (codes 17, 18) and we added codes 24 and 25 to accommodate these blank forms. Code sheets and the original Access database contain some combination of these four code values; they have been collapsed into only two in the SPSS analytic data set.

Functional classification, a critical step in the analysis, was performed with the aid of a low-power stereoscopic microscope involving procedures and use-wear attributes discussed in Ahler (1979). The *functional class* list used here is much the same as that explicated in Ahler and Swenson (1985b) but includes categories 67 through 71 that were added through studies in the KRF primary source area. These are specialized or expedient flake tool classes that in most cases involve working elements that consist of ridges on flakes or margins and points on radially broken flakes or other artifacts.

Table 2. Summary of variables and attribute codes applied to stone tools, Scattered Village (32MO31), 1998 excavated collection.

Variable	Description
CATNO	catalog number as assigned
SIZE	size grade 1-grade 1; 2-grade 2; 3-grade 3; 4-grade 4
SEQNo	sequence number A 4-digit number incorporating size grade and a sequential number within the size grade for all artifacts in a catalog number; numbering restarts with each catalog number. E.g., 2001, 2002, 2003, etc. are sequence numbers for first, second, third, etc. artifacts in size grade G2 under a catalog number.

DesCat descriptive category

01-triangular biface, complete and incomplete
03-notched or stemmed biface, complete and incomplete
08-pointed or ovoid biface, complete
09-other patterned biface fragment
14-unpatterned biface, nonbipolar core or core-tool, complete or incomplete
15-end scraper form, complete or incomplete
19-marginally retouched plate or tabular piece
23-polyhedral blades or flake blanks
24-acutely pointed flake tool
29-other retouched or utilized flake
30-bipolar core or core-tool
34-unpatterned pecked/ground stone tool
35-celt or celt blank, complete or incomplete
37-linearly grooved tool, complete or incomplete
38-grooved maul form, complete or incomplete
39-patterned complex ground stone tool
40-grooved ax form, complete or incomplete

CLAS general tool class

1-TRM, tested raw material
2-core with significant flake removal
3-irregular biface or crude tool
4-patterned biface
5-end scraper form
6-flake and tabular tools
7-non-chipped tool

MCII revised morphological class

1-bipointed biface
2-triangular, symmetrical biface
3-triangular, asymmetrical biface
4-ovoid biface
5-ovoid, pointed biface
6-rectangular biface
7-crescent-shaped biface
8-notched crescent
9-asymmetrical biface with notched haft element
10-hafted drill form
11-ovoid biface fragment
12-triangular or rectangular biface fragment
13-pointed biface fragment
14-drill tip fragment
15-indeterminate biface fragment
16-
21-generalized end scraper form (unspurred)
21.1-unspurred end scraper, lacking dorsal flaking from lateral margins
21.2-unspurred end scraper, with partial dorsal flaking from lateral margins
21.3-unspurred end scraper, with complete dorsal flaking from lateral margins
22-spurred or angled end scraper
22.1-spurred end scraper, lacking dorsal flaking from lateral margins
22.2-spurred end scraper, with partial dorsal flaking from lateral margins
22.3-spurred end scraper, with complete dorsal flaking from lateral margins
23-double ended end scraper form
24-bilaterally symmetrical, side-notched end scraper form
25-hafted beak form
26-
31-unpatterned retouched flake with one working edge
32-unpatterned retouched flake with two isolated working edges
33-unpatterned retouched flake with three isolated working edges
34-unpatterned retouched flake with two connecting working edges
35-unpatterned retouched flake with three connecting working edges
36-
41--unpatterned utilized flake with one working edge
42-unpatterned utilized flake with two isolated working edges
43-unpatterned utilized flake with three isolated working edges
44-unpatterned utilized flake with two connecting working edges
45-unpatterned utilized flake with three connecting working edges
46-
51-transverse snap break without crack
52-transverse snap break with crack
53-obtuse snap break without crack
54-obtuse snap break with crack
55-acute snap break without crack
56-acute snap break with crack
57-transverse hinge
58-transverse lip
59--
61-irregular
62-
71-complex patterned ground stone tool
72-complex core-tool form
73-bead
74-grooved maul form
75-celt form
76-sphere
77-paired grooved abrader form; shaft smoother
78-unpaired grooved abrader form
79-pipe
80-grooved ax form
101-159-various Paleoindian and Archaic point forms
144-misc. Late Plains Archaic
161-small, tanged, eared side-notched point
162-small, shallow side-notched point
163-Avonlea point
164-
171-Prairie Side-Notched arrow point
172-Plains Side-Notched arrow point
173-isosceles triangular arrow point
174-tri-notched arrow point
175-other miscellaneous arrow point forms
176-oversized Plains side-notched arrowpoint form
179-arrow point fragments

Table 2. Summary of variables and attribute codes applied to stone tools, Scattered Village (32MO31), 1998 excavated collection (continued).

COMP	completeness
1-complete	6-indeterminate end
2-nearly complete, primary part of core or tested raw material	7-margin fragment
3-distal end	8-channel flake or channel flake fragment
4-proximal end	9-other fragment
5-medial fragment or segment	
TECH	**technological class**
1-patterned small thin biface	7-nonbipolar core and core-tool
2-patterned large thin biface	8-bipolar core and core-tool
3-unpatterned small to medium biface	9-unpatterned pecked or ground tool
4-patterned steeply beveled flake tool	10-patterned pecked or ground tool
5-unpatterned other flake tool, retouched or use-modified	11-radial break tool
6-large, thick bifacial core-tool	12-retouched tabular piece or plate
BLANk	**original input blank form**
1-tabular cobble/pebble (>10 mm thick; w/th ratio >2.5)	12-other nonbipolar flake from prepared core; platform ground and/or dorsally reduced
2-thin plate (thickness < 10 mm)	13-finished patterned biface used as blank
3-subrounded, rounded, spherical cobble or pebble	14-unfinished patterned biface used as blank
4-blocky/angular cobble or pebble (thickness >10 mm; w/th ratio < 2.5)	15-unpatterned flake tool or ret. tabular piece used as blank
5-split cobble	16-patterned flake tool used as blank
6-other nonbipolar flake, with no platform present or with unprepared platform present	17-simple flake (code 24 used with Scattered Village)
7-bifacial thinning flake	18-complex flake (code 25 used with Scattered Village)
8-bipolar flake	19-non-bipolar core or core fragment
9-blade or bladelet	20-bipolar core
10-shatter	21-fire-cracked rock
11-indeterminate	22-unpatterned biface
	23-complex/patterned ground stone tool
FUNC	**functional class**
0-unknown function; also radial tools which show no wear	37-simple burnishing tool
1-projectile point 2-perforator, drill	38-unaltered fossil or concretion
3-light duty bilateral cutting tool	39-altered or modified fossil or concretion
4-transverse-edged cutting tool	40-unmodified manuport
5-basal scraper/grinder	41-pounding/grinding tool
6-light duty transverse scraper used on soft material	42-edge ground saw (not used on stone)
7-bilateral, heavy duty 1 bifacial cutting tool	43-gunflint
8-expedient, general purpose cutting tool	44-bifacial tools of generalized or unknown specific function
9-heavy duty 3 ripping, sawing, tearing tool	45-spokeshave
10-heavy duty 1 asymmetrical or unilateral bifacial cutting tool	46-large core-tool of uncertain function
11-stone saw	47-nonutilitarian item of uncertain specific function
12-bifacial cutting tool used on hard material	48-complex grooved abrasive grinding tool (shaft smoother)
13-lateral scraper used on soft material	49-reamer 50-smoking pipe
14-heavy duty chopping, pounding tool	51-pendant or bead 52-pigment source
15-generalized patterned bifacial cutting tool	53-edge or corner ground tool
16-transverse scraper used on abrasive material	54-generalized flake tool
17-transverse scraper used on hard material	55-digging tool
18-denticulated flake or edge modified tool	56-practice pieces and miscellaneous chipped stone tool
19-slotting or grooving tool	57-striker flake 58-notched flake
20-generalized transverse scraping tool	59-edge ground flake 60-patterned disc or tablet
21-core	61-rolled flake
22-utilized flake used to saw or slice hard material	62-ochre-stained flake or stone
23-retouched or utilized flake used on variable material	63-perforated stone hammer
24-whetstone 25-core/punch/wedge/chisel	64-clinker cylinder or cone
26-punch/wedge/chisel	65-donut-shaped stone
27-steep-edged heavy duty scraping/adzing tool	66-flake ridge plane used on resistant material
28-bipolar anvil or hammer 29-hammerstone or pounder	67-snap break plane used on resistant material
30-graving or incising tool 31-tested raw material	68-point-concentrated wear on radial break or pie-shaped tool
32-woodworking ax	69-hinge edge tool
33-simple hand-held abrading tool	70-isolated polish tool
34-simple hand-held grooved abrading tool	71-wood working adz
35-complex hand-held grinding/crushing tool	72-lance tip or symbolic weapon tip
36-complex anvil used in grinding/crushing (metate, mortar, etc.)	73-net weight 74-chipped marble-like object
	99-unknown due to fracture

Table 2. Summary of variables and attribute codes applied to stone tools, Scattered Village (32MO31), 1998 excavated collection (concluded).

Variable	Description and codes	
UsePh	use-phase class	
	1-unfinished, usable (unbroken) 2-unfinished, unusable (broken or rejected)	3-finished, usable (unbroken; includes usable cores) 4-finished, unusable (broken, burnt, exhausted, rejected; includes exhausted cores)
REJEct	reason for rejection, failure, disuse	
	1-has potential for further work or use 2-bending fracture or end shock 3-perverse fracture 4-material flaw or poor quality stone 5-outré-passé fracture 6-compound hinge/step occurrence 7-impact fracture 8-small size or exhaustion 9-indeterminate	10-heat or thermal fracture 11-lateral break 12-broken by radial fracture 13-crescentic chunk from tool margin 14-channel flake or fragment 15-recycled into another form or use, by bipolar process 16-burination spall 17-resharpening flake coded as a tool; no further use possible 18-recycled into another form or use, by non-bipolar process
CASE	case number, for single and mutiple records for a single artifact	
	1-first record and case for the artifact 2-second record and case for the artifact (implies different function)	3-third record or case for the artifact (implies different function) 4- fourth record or case for the artifact (implies different function)
COUNT	count of identical function and use-phase class occurrences under a data case	
	1-single occurrence 2-two identical occurrences (e.g., ret. Fl. W/ 2 edges coded FC23).	3-three identical occurrences, etc.
RESH	resharpened 0-absent 1-present	
RECY	recycling	
	0-absent 1-present, uses are apparently the same age (code only for the second, later function)	2-present, uses are apparently of different age (code only for the second, later function)
RAWM	raw material type -- same as recorded for flaking debris -- see Table 1.	
CORT	cortex 0-absent 1-present	
PCTU	percent unflaked (unmodified) surface; minimum of 200% both faces	
PATI	patination intensity 0-absent 1-light 2-moderate 3-pronounced 4-pronounced and eroded 9-indeterminate (burned, poor quality KRF, unpatinable raw material)	
CARB	carbonate adhering 0-absent 1-minor crust, <0.5 mm thick 2-major crust, ca. 0.5+ mm thick	
BURN	burning 0-absent 1-present 9-indeterminate	
HEAT	heat treatment 0-absent 1-possibly present 2-definitely present 9-not applic. due to raw mat. or indeterminate	
RESID	residues adhering	
	0-none observed 1-hematite 2-limonite, yellow ochre 3-catlinite 4-unidentified black mineral-like substance 5-bone or antler 6-bone or antler plus hematite 7-brown/black pitch or haft residue 8-hematite plus catlinite 9-yellow powder (not limonite) 10-unidentified white substance 11-baked shale or scoria 12-dark brown mineral-like substance 13-hematite plus black mineral	14-hematite plus limonite 15-black/brown pitch plus limonite 16-hematite plus yellow powder 17-unidentified red residue, may be soil stain or organic residue 18-black or brown organic residue 19-bone/antler plus limonite 20-black mineral plus limonite 21-hematite, limonite, and unidentified black mineral-like substance 22-bone/antler plus limonite plus unknown white substance 23-hematite, limonite, and unknown white substance 24-limonite and unknown white substance 25-rusted iron metal 26-hematite, limonite, and bone/antler 27-hematite, limonite, and black/brown organic residue 28-earthy pink substance (scoria?) 29-copper oxide
LENG	maximum length - to nearest 0.1 mm	
WIDT	maximum width -- to nearest 0.1 mm	
THIC	maximum thickness -- to nearest 0.1 mm	
WEIG	weight -- to 0.1 gram	
ILLus	potential for illustration blank-none 1-has potential	
UNCL	unclear classification (questionable) due to severe fragmentation	

New functional classes and codes are added as they are recognized through continuing study. A lance tip or symbolic weapon tip (code 72) was added in the Slant Village study (Ahler, Minor and Smail 1997:268), and spherical grooved stone net weight (code 73) was added in the 1806 By-Pass Project

(Ahler and Smail 2000). During the Scattered Village study we added one new class and two new codes. Several very small, nearly spherical, thoroughly chipped objects about the size of a marble were studied. These artifacts (given code 74) are too small to have functioned as a core, and their purpose is unclear. We added a code value of 99 for tools of indeterminate function due to severe fragmentation. This is meant to be distinct from class 0 (unknown function), which generally applies to specimens with unique, recognizable form and shaping but for which no purpose can reasonably be determined.

The variable *reason for failure, rejection, disuse* is one only recently applied to Plains Village samples. It is designed to record the apparent technological feature or flaw which led to the tool having been moved from a state of usefulness (use-phase class 1 or 3) to a state of non-usefulness (into use-phase class 2 or 4). In this variable we recognize a variety of failure and fracture types, some of which occur most commonly during manufacturing processes, as well as other features such as thermal deterioration which render the artifact no longer useful. In the Scattered Village analysis, we refined our recording of recycling behavior by distinguishing recycling by bipolar processes (code 15) from recycling through non-bipolar processes (code 18).

In the Scattered Village study, as with all previous studies using this same general format, we create a separate data record or data case for each distinct functional class occurrence that can be recognized within a given artifact. In this manner, we account for multifunction artifacts (perhaps in the form of different edges on a single biface or retouched flake) as well as for artifacts recycled from one function to another (e.g., and end scraper recycled into an bipolar punch). For Scattered Village we have simplified recording and documenting multifunction items. We simply record a *case number* for each record for each artifact. If there is only one function and record, the case number is one. If two records and functions are recorded, we designate one case 1 and the other case 2, etc. If recycling is involved, we are careful to assign case numbers and data records in the order in which the change in functional behavior occurred.

We record another variable, *count*, that allows us to identify these instances among retouched and utilized flake tools where multiple margins with identical function/use-phase occur. If two such margins occur on an artifact, count is recorded as 2, and if three such margins occur, then count is recorded as 3, etc. This allows us to weight the functional classification according to the number of distinct flake tool margins in a manner which is fully compatible with the coding system applied to the Knife River village samples and other Plains Village collections. We do not apply this concept to bifaces or ground stone tool forms. Under the variable *residues adhering*, we added a single new code (29) for copper oxide. We marked specimens that were good candidates for *illustration* in the data base; most but not all of these specimens were photographed, and a smaller fraction of them are actually illustrated in the report. All side-notched projectile points suitable for detailed measurement were also earmarked for illustration. We added one new variable in the Scattered Village tool analysis, this being *unclear classification*. We used this as a marker for tools that were severely fragmented (usually due to burning) and for which recorded functional, technological, and other classification was likely subject to error. We could potentially use this marker variable to remove some of the “noise” in the analysis, if the need arose. All of other variables listed in Table 2 are ones typically recorded previously in Plains Village samples in the Knife region and elsewhere (as discussed in much greater detail in Ahler et al. 1994a), and require no added explanation here.