ARKANSAS RESOURCES FOR CRUSHED-STONE CONSTRUCTION AGGREGATE

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ABSTRACT

This report is to convey the results of a project to evaluate the various bedrock units of Arkansas as to their suitability for producing crushed stone construction aggregate. To accomplish this goal, records of engineering tests run on stone from throughout the State were obtained from the U.S. Army Corps of Engineers and the Arkansas State Highway and Transportation Department. From these records, and from other sources, information has been obtained regarding 423 quarries, test pits, and other sites that have been either utilized for crushed stone aggregate or tested for the same. Of these, there are 274 sites from which 1775 samples have been taken and tested for one or both of two major parameters used in identifying stone quality: the LA abrasion test and the sodium sulfate soundness test. There are also data on absorption and specific gravity for a number of sites, as well as some information on alkali-silica reactivity. Based on site locations, the geologic bedrock map unit for each site was determined. The test data were then compiled according to rock unit, in order to compare how products from these units have performed in the past. Based on these comparisons, the various bedrock units of Arkansas are evaluated in this report as to their relative quality for use as crushed stone aggregate, and particular advantages and problems peculiar to the different units are presented.

In the northern Arkansas Ozarks region, limestones have consistently outperformed dolostones, because of a tendency for about one third of the dolostone samples to have unacceptable soundness results. This is true for all three of the dolostone-rich units for which test results are available: the Cotter and Powell Dolomites and the Everton Formation (Ordovician). The Pitkin Limestone (Mississippian) has been an important sedimentary unit for siting of aggregate quarries. There are many successful quarries in the Boone Formation (Mississippian) also, but some problems have occurred because of porous chert in the Boone in places. In general, the Plattin and Kimmswick Limestones (Ordovician) have obtained good results, but there are some tendencies for soundness problems with the Plattin similar to, but not as severe as, the dolostones. The Fernvale Limestone (Ordovician) tends to degrade excessively under the LA abrasion test.

For the most part, sandstones in the main part of the Ozark region are either too friable or they are stratigraphically too thin for production of durable aggregate. However, in the southern Ozarks and in the Arkansas River Valley, some sandstones in the Bloyd, Atoka, Hartshorne, and Savanna Formations (Pennsylvanian) have silica cement and produce durable, high-quality aggregate. Of these, some sandstones in the Bloyd have marginal results in the LA abrasion test.

In the Ouachitas region, durable sandstones in the Jackfork Sandstone (Pennsylvanian) have been extensively utilized, though in some facies of the Jackfork there are slight tendencies to a more friable stone. The Arkansas Novaculite (Devonian/Mississippian) has consistently produced durable aggregate, though higher operating expenses are common because of wear on equipment. The Bigfork Chert (Ordovician) has very durable stone, but soft tripolitic chert and shale interlayers are commonly too abundant for producing first class aggregates; on the other hand it is easily extracted and very suitable for dressing unpaved secondary roads. In the Stanley Shale (Mississippian) a thick and somewhat extensive tuff bed, the Hatton Tuff Lentil, makes a high quality source for aggregate in the southwest part of the Ouachita Mountain region. Also in the basal Stanley, the Hot Springs Sandstone Member has produced high quality stone in the Hot Springs area. Plutons of nepheline-bearing syenite (Cretaceous) in the Little Rock area have long produced outstanding aggregate, and much reserves remain. Very little of the alkaline igneous rock of the famous Magnet Cove intrusive complex has been utilized for aggregate, but of late, hornfels (baked rocks of the Stanley Shale) from the contact metamorphic aureole has been used with acceptable results.

Arkansas is geographically well situated for export markets to the south, where resources for crushed stone aggregates are nonexistent, and reserves in the State are abundant for long-term supply for both local and out-of-state needs.

INTRODUCTION

The crushed stone industry is important in the economy of Arkansas. In spite of a comparatively low population, Arkansas ranked 19th in the nation in production of crushed stone in 1996 (U.S. Geological Survey, 1997a). In the same year, crushed stone accounted for nearly 40% of Arkansas' non-fuel mineral production value, with a total raw material production value of about $176 million (U.S. Geological Survey, 1997b). Demand for this commodity has increased in recent years. Between the years of 1971 and 1990 the total annual output fluctuated between 12 and 19 million metric tons (Tepordei, 1997), but in both 1995 and 1996 the annual total exceeded 25 million metric tons (U.S. Geological Survey, 1997b).

The demand for construction materials in the future should continue to increase. Numerous federal reports on the condition of the nation's infrastructure indicate long term need for infrastructure renewal (Sidder and Sims, 1993). Population increase also will provide a steady market pressure for construction materials. Population forecasts (Swanson and McGehee, 1993) predict continued growth in the area surrounding Little Rock, and the northwest region of Arkansas may have increases as much as 40% over the 1990 census by the year 2010.

Increasing demand for crushed stone as a construction material will not only come from economic factors, but also as a result of constraints from technological advances. The Strategic Highway Research Program (SHRP) was initiated to find ways to improve highway construction in the United States. A number of the recommendations that resulted from those studies make crushed stone the aggregate of choice over natural river gravels for many applications because of the angularity of crushed rock (Cominsky et al., 1994). Arkansas and other states are gradually implementing these recommendations as required by the federal government. However, southern and eastern Arkansas and the neighboring states to the south do not have outcroppings of rock suitable for producing crushed aggregate. Therefore, the stone producers of the hard-rock-bearing region of Arkansas (the Ozarks, Arkansas River Valley, and Ouachitas) have been increasingly involved in exporting crushed stone.

The geology of resources for crushed stone aggregate in Arkansas was previously described by various workers and summarized by Stroud and others (1969). The present report can be considered as an update on that report, although the scopes of the two reports are not equivalent. The purpose of the present study is to discuss characteristics of the various bedrock types throughout Arkansas as they relate to suitability for producing crushed stone aggregate. The distribution of bedrock types has been mapped throughout the State by various workers with differing degrees of detail and compiled on geologic maps available through such agencies as the Arkansas Geological Commission (AGC) and the United States Geological Survey (USGS). The data presented in this report will be used to evaluate the relative quality of stone produced from the various bedrock units shown on these maps, and to identify problems and/or special benefits peculiar to specific bedrock units. By using the available geologic maps and the information about bedrock units presented in this report, producers seeking to establish new quarries for crushed stone can better target areas for exploration.

Aggregates are used in a variety of construction applications, and each application has its particular requirements as to the aggregate's properties. The focus of this report is on aggregates that generally are used in applications that require durable stone, that is, stone that is resistant to mechanical breakdown through such things as freeze and thaw action and stone-to-stone grinding caused by loads on the aggregate. Stone of this nature, such as is used for aggregate in large concrete structures and highways for heavy traffic, generally commands higher prices and is more difficult to obtain. On the other hand, there are numerous pits and quarries that have been opened to obtain materials for less-rigorous applications, such as laying highway subbase, dressing unpaved secondary roads, and paving driveways. Although such enterprises are important, materials acceptable for these applications are not subject to stringent requirements and are generally easier to locate and of lower value. Only a few comments are made in the report on materials for these applications.

METHODS OF STUDY

Stone Quality Data

For construction applications, stone used in aggregates must be sufficiently durable to meet the rigors placed on the aggregate by its intended use. A number of techniques have been devised by research engineers to test stone for its suitability in construction applications (Marek, 1991). For purposes of comparison, these physical tests have been standardized as to procedure, and these standard procedures are authorized and published by organizations such as the American Society for Testing and Materials (ASTM) and the American Association of State Highway and Transportation Officials (AASHTO). It is performance on these standard tests that determines a particular stone's durability, not just how "hard" it seems to be when striking it with a hammer.

An approach one could take for comparing the suitability of various bedrock types in Arkansas for construction aggregate would be to take a suite of samples from outcrops representative of the various geologic map units in the State and then to run a battery of definitive tests on each sample. Use of such an approach, however, would be an expensive proposition. The method for comparison chosen for this study was instead to use records from past tests. The Arkansas State Highway and Transportation Department (AHTD) and the U.S. Army Corps of Engineers have both used much Arkansas crushed stone in various construction projects in the State, and both have testing regimens required for acceptance of stone before it is used. Since the many projects of both organizations are in the realm of public works, the records of engineering tests on the stone submitted for those projects are also public-domain information.

Test data sheets from Corps of Engineers projects dating back to the 1940's have been compiled by the Waterways Experiment Station, Vicksburg, Mississippi, in a document entitled, "Test Data: Concrete Aggregates and Riprap Stone in Continental United States and Alaska". The compilation updated as of July 1990 for the area including Arkansas was obtained for this study. The AHTD Division of Materials and Research has records of tests performed by their Materials Testing Lab dating back to 1970. These records were acquired in various forms including photocopies of original hand-written data logs, typed data sheets, and some in-house compilations.

The Corps of Engineers data sheets present data from a wide range of analyses, as well as data regarding the location from which samples were obtained. The types of analyses reported vary considerably among the data sheets, varying from a narrow to a wide range of tests having been performed on any one sample. The more common tests performed include bulk specific gravity, absorption, Los Angeles abrasion, magnesium sulfate soundness, sodium sulfate soundness, Deval abrasion, reactivity with NaOH, percent flat and elongate particles, mortar-bar expansion, linear thermal expansion, freeze and thaw, and petrographic analysis.

The data that was obtained from the AHTD came from tests run on stone submitted yearly by companies that intend to bid on AHTD jobs. Occasionally drill core or stone from a test blast site might be submitted, but usually samples are from quarries, either from the quarry ledge, unprocessed “shot rock”, or from a stockpile. A number of tests are performed, the specific ones depending on the intended use of the stone. Of all the tests performed, records of results from the Los Angeles abrasion test and the sodium sulfate soundness test are the most consistently available data in their archives (dating back to 1970). Data records from 1987 forward generally include specific gravity and absorption as well.

The engineering tests used in the present study to evaluate the various bedrock types of Arkansas are the ones most consistently reported in both the AHTD records and the Corps of Engineers data sheets. Because the AHTD test battery is generally more restricted than that of the Corps of Engineers, the analysis is done primarily with those tests listed in the preceding paragraph. These are also the most consistently run tests by the Corps of Engineers. Reference is also made to petrographic analyses reported on the Corps of Engineers data sheets. A brief description of the significance of each of these tests follows.

The Los Angeles abrasion test (AASHTO T-96; ASTM C 131) is designed to measure an aggregate’s resistance to degradation by abrasion and impact. The test is intended to indicate whether an aggregate will hold up under action of mixer blades, compacting equipment, and heavy wheel loads (Marek, 1991). The test involves placing a sample of crushed stone with a prescribed grading in a drum with steel balls and rotating the drum for a prescribed time period. The more durable a stone, the less it will be degraded during this process. Analyzing the amount of material passing a prescribed sieve at the end of the trial shows a percent loss as a result of degradation. A low percent loss indicates a superior stone.

The sodium sulfate (or magnesium sulfate) soundness test (AASHTO T-104; ASTM C 88) is a test that simulates freeze-thaw action in weathering. A graded sample is placed in a container of sodium sulfate (or magnesium sulfate) solution and allowed to soak for a prescribed period of time. If the sample has any degree of permeability, the solution will work its way into the pores.

The sample is then removed and dried under a low heat, causing the sodium sulfate (or magnesium sulfate) to crystallize. This constitutes one cycle of the test. The complete test consists of five such cycles of soaking and drying. The process of repeated crystallization and then rehydration produces repeated expansive forces in the pore spaces of the rock, simulating the force of ice crystallizing from water under freezing conditions. Thus material that would be susceptible to freeze-thaw degradation is broken up during the test. An analysis of the size grading at the end of the test indicates a percent loss due to the process. Again, a low percent loss indicates a favorable material for construction.

There is a problem with including the Corps of Engineers test data for soundness in with the AHTD data, because most of the Corps tests were with magnesium sulfate, while all of the AHTD tests were done with sodium sulfate. On the average, if the same stone is tested with both of the solutions, the test using magnesium sulfate will be more severe by a factor of 1.5, so the recommended acceptance “loss” is 12% or less for the sodium sulfate soundness test and 18% or less for the magnesium sulfate soundness test (ASTM C 88). Based on this, the data for the magnesium sulfate soundness test from the Corps of Engineers was converted by a factor of 1.5 to a sodium sulfate soundness equivalence and included in the data sets.

In all the data, there are 28 quarries for which there are records of tests done by both the Corps of Engineers and the AHTD. After the conversion for soundness values discussed above was made and the data were compiled, these 28 quarries were singled out, and comparison was made between values recorded by the two agencies for both the soundness test and the LA abrasion test. There are no single quarries for which both agencies reported many tests so that a statistical comparison might be made; in most cases where there are records of multiple tests from one quarry, there are many more AHTD tests than Corps of Engineers tests. However, in most of the cases, the Corps of Engineers values for both the soundness test and the LA abrasion test are within the range of values reported by the AHTD. In cases where the Corps of Engineers values are outside the AHTD range, some are higher and some lower than the range. There is no recognizable pattern of values reported by one agency being consistently higher or lower than the other. Because both agencies designed their testing procedures according to ASTM standards, it is considered that the data from both agencies can be compiled together, including the soundness values after the modification discussed above.

Specific gravity and absorption (AASHTO T-84 & T-85; ASTM C 128 & C 127) are tests that relate primarily to stone destined for use as riprap and asphalt pavement, respectively. Specific gravity is a number related directly to density, which in turn indicates the weight per volume ratio. A material with a low specific gravity (or density) is lightweight material that could more easily be moved around by wave action or currents and thus is unsuitable for use as riprap. Absorption, measured as increase in weight from water absorbed after submersion of a sample, is related to the permeability of the sample. A sample with a high absorption value will absorb greater amounts of the bituminous binder into the aggregate in an asphalt pavement application and thus increase costs.

Petrographic analysis (ASTM C 295) is performed chiefly in order to ascertain if there are potentially reactive minerals contained in the stone that will be used as aggregate in portland cement concrete (PCC). Several types of reactions are possible between certain natural minerals and the ingredients of portland cement, the most common being alkali-silica reaction (ASR). Petrographic analysis involves inspection of thin sections of the prospective stone using a petrographic microscope, a special instrument equipped with light polarizers and generally operated by a trained mineralogist, to search for the presence and abundance of potentially reactive ingredients.

Sample Site Locations

In their descriptions of the locations from which samples were obtained, individual data sheets from the Corps of Engineers have differing degrees of both precision and accuracy. Site descriptions were compared with USGS 7.5 minute topographic quadrangles. When site descriptions matched or very nearly matched quarry symbols on the quadrangles, those sites were considered as accurately located, and the location of the quarry symbol was used to determine the latitude and longitude of the site. In some instances the symbol on the quadrangle map shows a gravel pit where a data sheet specifies a quarry. Field checking indicated that many “gravel pits” shown on the topographic quadrangles are actually hard-rock quarries.

In instances where a data sheet’s location description does not have a corresponding symbol on a topographic quadrangle, a field search was implemented to find the site. In some cases, county road maps published by AHTD were helpful because they show approximate locations of many of the quarries and gravel pits (again with some of the sites shown as gravel pits actually being hard-rock quarries). When a site was found in the field, its location was determined using a Magellan ProMARK V GPS Receiver coupled with inspection of local topography. In all, there are a total of 72 different Corps of Engineers localities for which the site-location information is adequate, including quarries, test pits, diamond drill holes, and rock outcrops. The data sheets contain records of tests performed on 106 samples from these sites. However, there are other data sheets obtained from the Corps of Engineers that were unusable because locations could not be determined with certainty.

Regarding AHTD materials test data, the locations given with the data are very general at best; in some cases locations are totally absent. Most often, a town or community near the sample site is given along with a quarry name. The most useful document that was used for determining locations of the sample sites is a report (AHTD, 1984) entitled Materials Availability Study (MAS). This study compiled the locations of all aggregate sources known by AHTD personnel in 1984. In the MAS, on a county by county basis, quarries are listed, giving a quarry name, a site location, the land owner, and the quarry’s status (active or inactive). The quarry name given in the MAS is usually a designation based on the property owner’s name, such as “Smith Quarry”, but in some cases the quarry is designated by the quarry superintendent’s name, or the name of the company that operated the quarry. Regarding location, usually both a verbal description and U.S. General Land Office

Grid System coordinates are given. By comparing the test data records with the MAS document, information leading to site locations for many quarries and test pits was acquired.

Regarding quarry names and locations, much internal confusion exists in the AHTD stone test records, and there is also confusion in correspondence between test records and the MAS. The main factors for this confusion are (1) for some sites, property ownership and/or the company extracting stone have changed through the years, thus changing the "quarry name" in entries for the same site in different years, and (2) personnel entering data often changed through the years, and different persons called the same quarry by different names and/or associated the quarry site with a different nearby community. Although much of this confusion was resolved by site visits and discussion with various individuals, many data entries had to be discarded because their relation to known sites could not be determined.

For locations of quarries opened more recently than 1984, much information was gained from discussions with AHTD personnel, primarily W.J. Pay of the Division of Materials and Research. William Ritchie of the Federal Mine Safety and Health Administration (MSHA) also rendered assistance.

As with the Corps of Engineers data, if a location that was obtained, either from the MAS or through personal communication, matched or nearly matched a site designated as a quarry or gravel pit on a USGS quadrangle, it was accepted as a valid location. For all others, site visits (combined with discussions with involved people) were used to determine location, as outlined above. The reader should be cautioned here that through this exercise it was found that the majority of locations given in the MAS are inaccurate. Most locations are off by a quarter mile to two miles, some by more. A number of sites simply were not found.

Locations were obtained for 230 of the AHTD sites, from which 1,669 samples of stone had been taken and tested by the AHTD. Of these, 28 are sites that were also tested by the Corps of Engineers. A total of 274 sites are represented in the data set formed by combination of the two sources. There were, however, 178 data entries in the AHTD records, from about 120 other sites that could not be located.

Bedrock Sources of Tested Samples

To determine the bedrock source for each sample that was tested, either by the Corps of Engineers or the AHTD, the location of each sample site was plotted on the appropriate USGS 7.5 minute quadrangle and then also on the corresponding Arkansas Geological Commission geologic worksheet. The geologic worksheets are 7.5 minute quadrangles on which lines have been drawn that divide up each quadrangle into areas underlain by the various bedrock mapping units. Thus, based on the sample location, the bedrock unit was determined. In cases where the location was very close to a borderline between two map units, field checking was done to verify the assignment of the sample test to a rock unit. Only on rare occasion was a quarry that plotted in one unit on a geologic worksheet found to be actually in the adjacent unit.

The mapping units used on the geologic worksheets are, for the most part, those that are also designated on the Geologic Map of Arkansas (Haley et al., 1993). Most of the mapping units have a dominant rock type, but also may have some other interlayered rock types. For example, the Atoka Formation is a map unit that is widespread. The most abundant rock type in this formation is shale, but there are many sandstone intervals in it, some of which are thick enough to support quarry operations. Figure 1 gives a brief description of each of the map units and includes which rock type in each unit is used for crushed stone aggregate. More detailed stratigraphic descriptions are given in various published geologic reports. Croneis (1930) provides a useful detailed summary of the Paleozoic stratigraphy. However, since then a number of revisions have been made regarding formation boundaries, especially in the area of the Arkansas River Valley. Clarification of some stratigraphic problems can be obtained from Hendricks and Read (1934), Hendricks and Parks (1950), Haley (1961), Stone (1968), and several papers in Stone and others (1977).

Appendix I lists the quarries (and test-hole sites, etc.) that were located in this study, a total of 423 in all. This list does not include all quarries in the State; it represents those in the sources listed above, plus some quarries found in the field while searching for other quarries, plus some referenced by other professionals. Some sites listed in Appendix I (149 in all) are quarries for which there are no test data. Each site has been given a number, the beginning of which includes two letters designating the county in which it is located. For each site, the USGS topographic quadrangle on which it is located is given, as well as the bedrock map unit it is in, and its location in terms of both latitude and longitude and General Land Office Grid System coordinates. Appendix II gives some of the names by which the various quarries have been known.

Methods of Analysis

To evaluate the relative durability of stone from the various bedrock units, LA abrasion and sodium sulfate soundness data were grouped according to the bedrock units of the sample sites and compared statistically. The statistical analysis employed here is not a rigorous one. The data were simply compiled in the form of histograms and compared by visual inspection. Some irregularities with the data set make the value of a rigorous statistical analysis questionable. One potential problem is that most of the samples that were tested came from quarries operated by different individuals, no doubt with variable competency. Also some quarries had many samples submitted over a number of years, while others were short-term operations with only one sample having been taken during its lifetime. In spite of these problems, some consistent trends do appear in the histograms, and it is thought that fundamental meaning can be derived from them. Regarding the problem of different quarry operators, this may not be a serious drawback because most of the formations being compared had a large number of quarries represented, and it is likely that a similar range in competency could be found among operators working in each of the formations. Concerning the uneven number of samples being drawn from each site, there was an attempt to look at the overall data from a particular formation both with and without the data from the large contributors.

In most cases, data from single large contributors in a particular formation tend to mimic the data from the rest of the set. Where there seems to be some difference, comments are made about it in the discussion.

Absorption and specific gravity data are also treated with a simple statistical approach. The petrographic analyses done by the Corps of Engineers were also studied to see if any deleterious substances were noted in samples from particular formations. In addition to these analyses of the raw data, some matters related to the suitability of stone from the various formations are addressed based on discussions with AHTD personnel in the Division of Materials and Research, quarry operators, and other professionals, and from personal observations. Following a brief discussion of the geology of Arkansas as it relates to aggregate resources, the comparison of the various bedrock units, shown by analysis of the data obtained for this study, will be presented.

GENERAL GEOLOGY OF ARKANSAS

The distribution of bedrock types and the variation in structural style of the rocks have influenced development of topography in the State. As a result, a map of the physiography of Arkansas (Fig. 2) is useful in describing the occurrence of bedrock in Arkansas. The areas shown on Figure 2 as the West Gulf Coastal Plain and Mississippi Alluvial Plain are composed mostly of unconsolidated sediments ranging in age from Cretaceous through Quaternary. There is no bedrock suitable for crushed stone aggregate in these areas, though coarse gravels have been crushed to supply angular aggregate. Gravels coarse enough to crush and still make size requirements for most construction applications are becoming scarce, though some gravel production continues (W.J. Pay, personal communication, 1995). Recent SHRP guidelines for highway construction recommend that a high percentage of the coarse aggregate's particles should have at least two fractured surfaces (Cominsky et al., 1994). To meet this specification, crushed river gravels would require two rounds of crushing. This requirement raises even further the necessary initial size of the gravel. For these reasons, the West Gulf Coastal Plain and Mississippi Alluvial Plain are not considered significant long-term sources for crushed stone aggregate.

The remaining central, western, and northern parts of the State (the Interior Highlands, comprised of the Ozark Plateaus, the Arkansas River Valley, and the Ouachita Mountains) contain bedrock suitable for producing crushed stone. The Ozark Plateaus region typically consists of nearly horizontal, bedded sedimentary rocks of Paleozoic age (the rock sequence there spans much of the 570-245 Ma range of the Paleozoic Era). The stratigraphy of the Ozarks is presented in Figure 1A. This stratigraphy includes many disconformities, especially below the Boone Formation, so many rock units are not continuous across the entire Ozark region. Also, many formations have facies changes from east to west, so the lithologic character of a single unit can vary across the region. The rock types in the northern two-thirds of the Ozarks are dominantly limestone and dolostone, with some shale and carbonate-cemented sandstone. The southern third is dominated by shale with some sandstone that is cemented by silica and/or iron oxide.

Figure 1A. Stratigraphy of the Ozarks Region.

Atoka Formation Age: Pennsylvanian	Interbedded shales, siltstones, and sandstones commonly in deltaically deposited coarsening-upward sequences. Much of the formation is dominated by shale. In most places where sandstones occur, they are interlayered with shales and siltstones, but some thick sandstone sections occur, commonly at the top of deltaic sequences, that support major quarries. The Atoka may be as much as 25,000 ft thick in the southern Arkansas River Valley, but thins to less than 3,500 ft in the Ozarks.
Bloyd Shale Age: Early Pennsylvanian	In the western portion of the region, the Bloyd consists of marine shale with some interbedded limestone. Towards the east, the limestone units thin and disappear and there are more abundant fluvial/deltaic sandstones. Noteworthy is a thick bluff-forming sandstone called the Middle Bloyd Sandstone. Other sandstone layers thick enough to support quarries occur in the east. The Bloyd ranges from 175 to 350 ft in thickness. A number of quarries occur in sandstones of the Bloyd Shale.
Hale Formation Age: Early Pennsylvanian	The Hale Formation consists of two members. The lower member, the Cane Hill, is composed of silty shale with interbedded siltstone and thin-bedded, fine-grained sandstone. Some isolated thickly-bedded sandstones occur. Sections with sandstone thick enough and free enough of shale to support quarry operations are not common. The upper member, the Prairie Grove, consists of limey sandstone, or sandy limestone with lenses of relatively pure fossiliferous limestone. The thickness of the Hale Formation ranges from very thin to over 300 ft. The upper member is included with the Bloyd Shale on the State geologic map (Haley et al, 1993).
Pitkin Limestone Age: Late Mississippian	In most places the Pitkin is a coarse-grained oolitic fossiliferous limestone. In some places, especially in the east, some black shale is interbedded with the limestone. Also, shale is more common towards southern exposures. The average thickness ranges from around 50 ft in the west to about 200 ft in the east, but it can be over 400 ft in places. The Pitkin supports many quarries.
Fayetteville Shale Age: Late Mississippian	Predominately black fissile shale. In north-central Arkansas some thin limestones are interbedded with shales. In western Arkansas the Wedington Sandstone member ranges from 0 to 55 ft in thickness. It is noted as being calcareous in places. Other than possibly the Wedington Sandstone, the Fayetteville Shale is unsuitable for aggregate quarries. The Wedington Sandstone reaches a maximum thickness of around 150 ft in the Wedington Mountains northwest of Prairie Grove. Thickness the entire Fayetteville Shale ranges from 10 to 400 ft.
Batesville Sandstone Age: Late Mississippian	Fine- to coarse-grained sandstone with thin shale interbeds. The sandstone is noted as being calcareous in places. In the west, much of the lower part or, in places, all the formation is replaced with the Hindsville Limestone Member. The Batesville Sandstone is noted by Croneis (1930) as being generally softer and thinner-bedded in its lower part, and harder and more massive upwards. The Batesville Sandstone thickness varies from very thin to over 200 ft. The Hindsville Limestone Member can reach up to 50 ft in thickness, but averages no more than about 10 ft. Recently active quarries are rare in the Batesville Sandstone, and there are no data on stone from those operated in the past, such as those mentioned by Croneis (1930).
Ruddell Shale Age: Late Mississippian	This unit is dominantly gray fissile clay shale with some limestone concretions. This unit is considered by many to be the upper member of the Moorefield Formation. This unit does not contain rock suitable for aggregate.
Moorefield Formation Age: Late Mississippian	Black calcareous shale and siliceous limestone. Many geologists consider the Ruddle shale to be an upper member, but units are mapped separately on the State geologic map (Haley et al, 1993). The total thickness of Moorefield and Ruddle units is from very thin to about 300 ft. No quarries have been located in the Moorefield.

Boone Formation Age: Early & Middle Mississippian	Gray fossiliferous limestone with interbedded and nodular chert. Abundance of chert is highly variable, some areas may be almost 100 percent chert. Other areas may be 100 percent limestone. Chert beds are normally very discontinuous. Chert is more commonly dark in color and hard in the lower part of the formation, and white in the upper part of the formation. In places the chert is highly porous and soft. The lower 0 to 100 ft thick part of the Boone Formation is called the St. Joe Limestone Member, which is generally chert-free. This limestone is commonly shades of reds and browns and can also be gray. The Boone Formation is generally 300 to 350 ft thick. The Boone Formation supports numerous quarries for aggregate.
Chattanooga Shale Age: Late Devonian/Early Mississippian	Dominantly a black fissile clay shale. The Sylamore Sandstone Member occurs in the lower part of the interval in some places and can dominate the entire formation. The occurrence of the Chattanooga Shale is quite discontinuous in Arkansas ranging from 0 up to 85 ft, but normally no more than about 30 ft. The Sylamore Sandstone is reported by Croneis as being generally less than about 5 ft thick and has extensive distribution in Arkansas. It ranges up to a maximum of 75 ft on a bluff on the south bank of the White River just east of Hickory Creek near Springdale. It is described as being porous and quite friable in ways similar to the St. Peter Sandstone. No quarries occur within the Sylamore Sandstone.
Clifty Limestone Age:	This unit consists of sandy limestone or sandstone of similar nature to the Sylamore Sandstone. This unit is only a maximum of 4 ft thick, and is therefore too thin to support a quarry.
Penters Chert Age: Early Devonian	Dense, massive, mottled gray chert overlying dolomitic limestone with some chert, chert breccia occurring at some places at the top of the formation. This unit occurs sporadically in Arkansas. Croneis (1930) says that the maximum thickness is 90 ft, however, some reports indicate a maximum of 25 ft No quarries were found in this formation.
Lafferty Limestone Age: Middle/Late Silurian	This is an earthy red micritic limestone that is gray-green in its upper part. The formation is also more clayey in its upper horizons. The formation has a limited aerial extent, averaging 5-20 ft thick with a maximum thickness of over 95 ft in the area west of West Lafferty Creek in Izard County. No quarries are known within this formation.
St. Clair Limestone Age: Early/Middle Silurian	This is a thick-bedded to massively-bedded limestone that is coarse-grained and highly fossiliferous, closely resembling the Fernvale Limestone. This formation is discontinuous and limited to small areas of Independence, Izard, and Stone Counties. The maximum thickness is about 100 ft. No quarries in this unit were located by this study.
Brassfield Limestone Age: Early Silurian	Light gray to red biosparite and biomicrite limestones. Stratigraphic thicknesses range from 0 to 38 ft, and this formation has rather limited distribution in Arkansas. No quarries in the Brassfield Limestone are known.
Cason Shale Age: Late Ordovician	This unit includes phosphatic sandstone and shale, and oolitic limestone and calcareous shale. This unit is discontinuous in Arkansas, ranging to a maximum of 23 ft thick. No aggregate quarries are known in the Cason.
Fernvale Limestone Age: Late Ordovician	A coarse-grained massively-bedded echinodermal biosparite limestone. The formation ranges from 0 to over 100 ft thick. Although it is thick enough to support a quarry, its use as coarse aggregate is problematic (see text).
Kimmswick Limestone Age: Middle Ordovician	Thin- to massively-bedded, fine- to coarse-grained biosparite limestone with a characteristic sugary texture. This formation has discontinuous occurrence ranging from 0 to 55 ft in thickness. Some aggregate quarries have been supported by the Kimmswick.
Plattin Limestone Age: Middle Ordovician	Thinly bedded to laminated, gray micritic limestone. Small scattered blebs of sparry calcite are a characteristic. The formation does not extend west of Searcy County, but in the eastern part of the Ozarks ranges up to 250 ft in thickness. Several aggregate quarries occur in the Plattin.

Joachim Dolomite Age: Middle Ordovician	This formation contains fine-grained dolomite and dolomitic limestone with thin beds of shale. Laminated horizons are common. The formation occurs from Newton County thickening eastward to a maximum of 100 ft. No quarries are known in the Joachim.
St. Peter Sandstone Age: Middle Ordovician	Massive bedded, medium- to fine-grained well-rounded calcite-cemented sandstone. The formation ranges from very thin to 175 ft in thickness. The rock is generally too friable to be suitable for an aggregate quarry.
Everton Formation Age: Middle Ordovician	A highly variable formation consisting of dolomite, sandstone, and dolomitic limestone. Sandstones in the Everton are composed of carbonate-cemented well-rounded quartz sand similar to the St. Peter. The formation ranges from 300 to 650 ft in thickness. A number of aggregate quarries are located in the Everton Formation, primarily in the carbonates.
Powell Dolomite Age: Early Ordovician	The Powell is a light gray argillaceous dolomicrite with occasional thin beds of shale. In many places the dolomite is thinly laminated with clay partings. This formation is about 200 ft thick and is widespread in northern Arkansas. There are occasional beds of chert in the Powell. Many quarries have been located in the Powell Dolomite.
Cotter Dolomite Age: Early Ordovician	Fine- to medium-grained dolomite with occasional minor shale beds. The Cotter ranges from 340 to 500 ft thick, and is widespread in northern Arkansas. The formation commonly contains chert nodules. There are numerous quarries in the Cotter.
Jefferson City Dolomite Age: Early Ordovician	Fine-grained dolomite with considerable chert. As to rock type, the Jefferson City Dolomite is indistinguishable from the Cotter. It is distinguished only by fossils present. Its exact distribution in Arkansas is not known, and it is included with the Cotter on the Geologic Map of Arkansas (Haley et al., 1993). It is not known which quarries, if any, are in this specific unit.

Figure 1B. Stratigraphy in the Ouachitas and Arkansas River Valley Regions.

Boggy Formation Age: Pennsylvanian (Desmoinesian Series)	In Arkansas, only the basal portion of the Boggy crops out, and in very limited aerial extent. Basal Boggy consists of sandstone with minor siltstone and shale. No quarries are reported in the Boggy Formation
Savanna Formation Age: Pennsylvanian (Desmoinesian Series)	This formation consists mostly of shale and siltstone with some fine-grained sandstone beds. Sandstones are thickest near the base of the formation in Arkansas, being about 100 ft thick near Paris and 300 ft thick atop Magazine Mountain. The formation also contains some coal beds. The formation is estimated to have 1600 ft total thickness, but only the lower 500 ft or so occur in Arkansas. A few quarries in Arkansas have been located in Savanna sandstones.
McAlester Formation Age: Pennsylvanian (Desmoinesian Series)	This formation consists predominantly of shale with thin sandstones. Some prominent coal beds occur. The unit ranges from 500 to 2,300 ft in thickness. No major quarries are known in this formation, though a couple of small quarries have operated in the past, with no record of stone quality.
Hartshorne Sandstone Age: Pennsylvanian (Desmoinesian Series)	Predominately medium-grained, thick-bedded fluvial sandstones with minor discontinuous shale layers. Stratigraphic thickness ranges from 10 to 300 ft, and in most places in Arkansas it is over 100 ft. Many rock quarries are supported by Hartshorne Sandstone.

Atoka Formation Age: Pennsylvanian (Atokan Series)	See description in Ozark stratigraphy. As in the Ozarks, the Atoka Formation in the Arkansas River Valley and in the Ouachita Mountains consists of shales and standstones, but in the more southerly parts of its distribution, the Atoka was deposited by deeper marine processes, such as turbidity flows, rather than by deltaic processes as in the north. Despite this difference, there are thick sandstones that support numerous rock quarries in this area as well. The unit attains about 25,000 ft maximum thickness.
Johns Valley Shale Age: Pennsylvanian (Morrowan Series)	Dominantly black clay shale with intervals of silty, thin-bedded to massive sandstone (possibly reaching 100 ft thick). In places large amounts of exotic cobbles and boulders of limestone, dolomite, and chert occur. The formation's total thickness is difficult to discern because of structural complications, but may exceed 1,500 ft. Some small quarries in large carbonate exotic blocks have been opened in the vicinity of Boles (C.G. Stone, personal communication, 1998).
Jackfork Sandstone Age: Pennsylvanian (Morrowan Series)	This formation is dominated by thin- to massive-bedded, fine- to coarse-grained quartz-cemented sandstones with smaller amounts of shale. Some intervals are dominated by thin sandstone and shale, especially in the north, where sandstone intervals in the Jackfork are generally lenticular within shale. The formation is reported to range from 5,000 to 7,000 ft in thickness. Numerous quarries occur in sandstones of the Jackfork.
Stanley Shale Age: Mississippian	The Stanley Shale is dominated by dark gray shale, but is almost ubiquitously interbedded with fine-grained sandstone layers. Sandstones are rarely very thick, except for the Hot Springs Sandstone, which occurs near the base of the formation in the vicinity of Hot Springs, where it reaches its maximum thickness of about 200 ft. Another rock unit, the Hatton Tuff, occurs also in the lower part of the Stanley Shale, predominantly in the western part of the Ouachitas. The thickness of the Hatton Tuff ranges from about 30 ft to a little over 100 ft. A few other tuff layers that are thinner occur in the lower part of the Stanley. The Stanley Shale has a total thickness of 7,000 to 11,000 ft. Other than the Hot Springs Sandstone, sandstones in the Stanley generally are not sufficiently thick to support quarries for high-quality, shale-free aggregate. One quarry occurs in the Hatton Tuff, and a few have been located in the Hot Springs Sandstone.
Arkansas Novaculite Age: Devonian and Early Mississippian	The Lower Division consists predominantly of white, massive-bedded novaculite. In the Middle Division is an interbedded sequence of dark gray shales and dark chert. The Upper Division is a white, thick-bedded, in places calcareous, novaculite. The maximum thickness of the entire formation is about 900 ft in its southern exposures, but thins to as little as 60 ft in the north. Numerous rock quarries have been located primarily in the Lower Division of the Arkansas Novaculite.
Missouri Mountain Shale Age: Silurian	This formation is predominantly shale with various amounts of thin-bedded conglomerate, chert, and sandstones. The maximum thickness of this formation reaches 300 ft. No quarries are known in this formation.
Blaylock Sandstone Age: Silurian	This formation is dominated by fine- to medium-grained sandstones interbedded with dark-colored shale. Sandstones are normally thin bedded, and although some fairly thick-bedded intervals occur, shale-free intervals thick enough to support stone quarries are not known. Total thickness of the formation is as much as 1,200 ft in the southwestern part of this outcrop area, but thins rapidly to the north.
Polk Creek Shale Age: Late Ordovician	This formation is dominated by black fissile shale with minor dark chert. Its thickness ranges from 50 to 225 ft. Rock in this formation is unsuitable for aggregate and no quarries are known to be located in it.
Bigfork Chert Age: Middle to Late Ordovician	Thinly bedded dark-gray chert interbedded with black siliceous shale and occasional thin limestone layers. The formation ranges from 450 ft thick in the northern Ouachitas to 750 ft in the southern Ouachitas. Numerous pits in the Bigfork have been opened for aggregate for gravel roads and other applications. Its use in premium-quality aggregate applications is problematic.

Womble Shale Age: Middle Ordovician	Black shale with thin layers of limestone, silty sandstone, and some chert. Limestones occur predominantly toward the top of the formation, generally in thin to medium beds. At least three locations in the Womble have limestone intervals that have supported small aggregate quarries. The thickness of the Womble ranges from 500 to 1,200 ft thick.
Blakely Sandstone Age: Middle Ordovician	This formation consists predominantly of shale, but with very hard, gray sandstone interlayers. In many locations, the prominence of blocks of sandstone at the surface give the false impression that it is a massive sandstone interval. The sandstone is normally medium bedded with interlayered shales, but a sandstone interval that attains 80 ft of thickness is reported by Croneis (1930) on Little Glazypeau Creek near Hot Springs. No quarries in the Blakely Sandstone were found during this study. The formation's thickness ranges from a few feet to about 700 ft.
Mazarn Shale Age: Early Ordovician	Predominantly shale with small amounts of siltstone, sandstone, limestone, and chert. The thickness of this unit ranges from 1,000 to over 2,500 ft. No quarries are known in this unit.
Crystal Mountain Sandstone Age: Early Ordovician	Predominantly massive, coarse-grained, well-rounded sandstone with lesser amounts of interbedded shale, chert, and limestone. The sandstone is usually strongly quartz veined. The sandstone in the lower part of the unit is the most massive and stout within the formation. The maximum thickness ranges from 500 to 850 ft thick. No active quarries in this formation were located during the present study. However, minor activity has occurred in the past, and some potential exists for aggregate quarries in this formation.
Collier Shale Age: Late Cambrian to Early Ordovician	Gray to black shale with occasional thin beds of black chert and an interval of thin-bedded limestone. Total thickness of the formation exceeds 1,000 ft. One quarry has been located in limestone of the Collier Shale.

Figure 1. Descriptions of the rock types in stratigraphic units of the Paleozoic terrane of Arkansas, with emphasis on matters pertinent to stone for construction aggregate. The descriptions are simplified from references mentioned in the text and are not intended to be complete definitions of stratigraphic units. Information is also drawn from Lumbert and Stone (1992), from unpublished data of the Arkansas Geological Commission (J.D. McFarland, personal communication, 1997; C.G. Stone, personal communication, 1998), and from personal observations of the author of this report. **A.** Stratigraphy in the Ozarks region. **B.** Stratigraphy in the Arkansas River Valley and Ouachitas regions.

The limestones, dolostones, and silica-cemented sandstones are the components that have been quarried for crushed stone aggregate. The horizontal bedding is warped in some places by broad gentle folds, but bedrock rarely is inclined more than about 5 degrees. Also, some normal faults occur, but they generally are widely spaced and rarely are a problem to quarrying.

The topography in the Ozark Plateaus region is mountainous in the southern part, much of that area being in steep slopes, requiring tortuous roads. Population density in that area is low, much of it being National Forest. The northern part of the area also has some mountains, but more of it is rolling topography. It is mostly an agricultural region, but some urbanization is occurring, especially in the northwest.

The rock types present in the Arkansas River Valley are typically similar to those in the southern part of the Ozark Plateaus, mostly shales and silica-cemented sandstones of Paleozoic age. The stratigraphy of the Arkansas River Valley is shown in Figure 1B (bedrock units of the Arkansas River Valley and the Ouachita

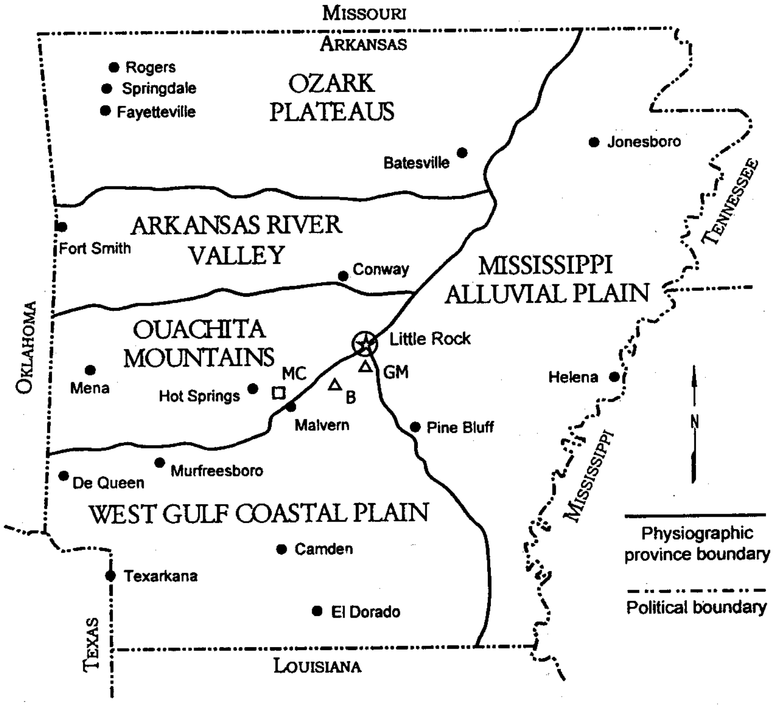


Figure 2. Map of Arkansas showing general physiographic divisions. Well-lithified sedimentary rocks of Paleozoic age occur in the Ozark Plateaus, Arkansas River Valley, and Ouachita Mountains. Generally poorly lithified sediments of Cretaceous and younger age occur in the West Gulf Coastal Plain and Mississippi Alluvial Plain. Two prominent nepheline-bearing syenite plutons are designated with triangles (GM = "Granite Mountain", B = the pluton near Benton). The Magnet Cove alkaline intrusive complex is shown with a square designated MC.

Mountains are grouped together in the figure, following Haley and others [1993], because of regional differences based on structure, not solely on aerial distribution of mapped bedrock units). Bedding in the Arkansas River Valley is, for the most part, horizontal to gently dipping; however, there are places where compression from the Ouachita orogeny generated large-scale folds and/or thrust faults, and bedding can be steeply inclined or even vertical. This kind of structural disturbance increases southward in the region. In comparison to the Ozarks, the Arkansas River Valley has a higher density of normal faults, but still they are widely spaced and rarely pose problems in quarry operations.

Most of the Arkansas River Valley is of low rolling hills, but there are also some isolated flat-topped mountains, including the highest point in the State, Magazine Mountain (839 m [2753 ft]). An important surficial feature in this area relevant to the stone industry is the Arkansas River, which trends east and west and connects with the Mississippi River and, because of a system of locks and dams, is suitable for shipping stone by barge to the states to the south.

The Ouachita Mountains region is a system of long ridges and valleys that trend generally east and west, though with some variation, especially in an area of northeast-trending ridges in the vicinity of Hot Springs. North-south transportation routes (crossing the topographic grain) in this region are generally fewer than those trending east west, so haul distances can be longer in the north-south direction. The topography is structurally controlled by a complex system of folds and thrust faults. Because of this deformation, the Paleozoic sedimentary rocks which form the bedrock of this region are rarely found in horizontal orientation; moderately dipping to vertical bedding orientations prevail, and overturned sections are present. It is not uncommon to find major changes in bedding orientation due to folding, and/or bedding offset by faulting, within the dimensions of a moderate-sized quarry, though many sites also occur with more-or-less constant bedding orientation.

The stratigraphy of the Ouachita Mountains is given in Figure 1B. The most common rock type in this region is shale, in places metamorphosed sufficiently to be considered slate or slaty shale. The most widespread rock types suitable for crushed stone aggregate include silica-cemented sandstone and thick beds of microcrystalline silica, called “novaculite” (similar to chert). Other resources that are more restricted in their range of occurrence within the Ouachita Mountains include Paleozoic-age volcanic tuff, several nepheline-bearing syenite and other alkalic igneous plutons of Cretaceous age, a baked “hornfels” zone around a major igneous intrusive complex east of Hot Springs, and minor quantities of limestone. The Cretaceous igneous bodies are in the area between Little Rock and Hot Springs, and some lie physically in the West Gulf Coastal Plain, marginal to the Ouachita Mountains (Fig. 2).

RESULTS

The comparison of bedrock units as to their suitability for crushed stone aggregate is presented below, beginning with rock units of the Ozark Plateaus, then the Arkansas River Valley, and finishing with the Ouachita Mountains.

Carbonate Rocks of the Ozark Plateaus

Limestones

Data from quarries that used limestone bedrock from various formations were grouped by formation. Histograms for both LA abrasion and sodium sulfate soundness test results were constructed to show how stone from the individual formations performed on these tests. These histograms are presented as Figure 3. The pass/fail line indicated on each diagram is given as a reference. The values of LA abrasion loss of 40% and sodium sulfate soundness loss of 12% were chosen because most AHTD requirements for pavements, whether PCC rigid pavement (AHTD, 1993, p. 275) or asphalt binder and surface course (AHTD, 1993, p. 220), have these values as upper limits of acceptability; the same limits apply to structures made of PCC (AHTD, 1993, p. 563). The LA abrasion and soundness restrictions of 40% and 12% loss are also commonly employed pass/fail values for first class aggregate used in asphalt surfacing and PCC pavements in many other parts of the United States (Nichols, 1991, p. 15-10, 12, 13; White, 1991, p. 13-40, 41). Some applications, however, have other requirements. For example, in Arkansas, for crushed stone for road base, AHTD requires an LA abrasion loss of <45% and does not require the soundness test (AHTD, 1993, p. 303), whereas for aggregate used in asphalt surface treatments the <12% soundness loss applies, and the LA abrasion requirement drops to <35% loss (AHTD, 1993, p. 195).

The majority of quarries in limestone units are in the Boone and Pitkin Formations. This is not because of a previously known superiority of stone from these as compared to other limestones, but because of a much more widespread surface distribution, due in part to thickness and in part to favorable position with respect to topographic development. What is meant by "surface distribution" here is the bedrock formation first encountered below any soil or regolith that has developed. The Boone Formation is especially widespread in northwestern and north-central Arkansas because it occupies an extensive plateau. The Pitkin Formation's average thickness is greater in the east than in the west, and there are more shale interlayers in it toward the east and south (J.D. McFarland, personal communication, 1997). Fortuitously, the Pitkin tends to occur in more mountainous terrane than the Boone, and as a result its outcrop belt is narrower. The same is true for the Plattin, Kimmswick, and Fernvale Limestones, the other limestones historically used for crushed stone aggregate, but these thin drastically toward the west and are not present west of central Newton County.

The Boone and Pitkin limestones fare very well on both the LA abrasion and the sodium sulfate soundness tests (Fig. 3A, B), though the Pitkin does a little better. Both are durable limestones. Some problems, however, peculiar to the Boone Formation are not indicated by the tests.

These problems are related to the presence of variable, often unpredictable, abundance of chert in the Boone. Chert typically is non-porous and hard, but in some parts of the Boone Formation chert may be unusually porous and friable. The porosity of the chert tends to give the Boone samples high absorption values and low density. On the other hand, where the chert is not friable, the presence of chert may cause difficulties during crushing, because chert behaves differently in the crusher than

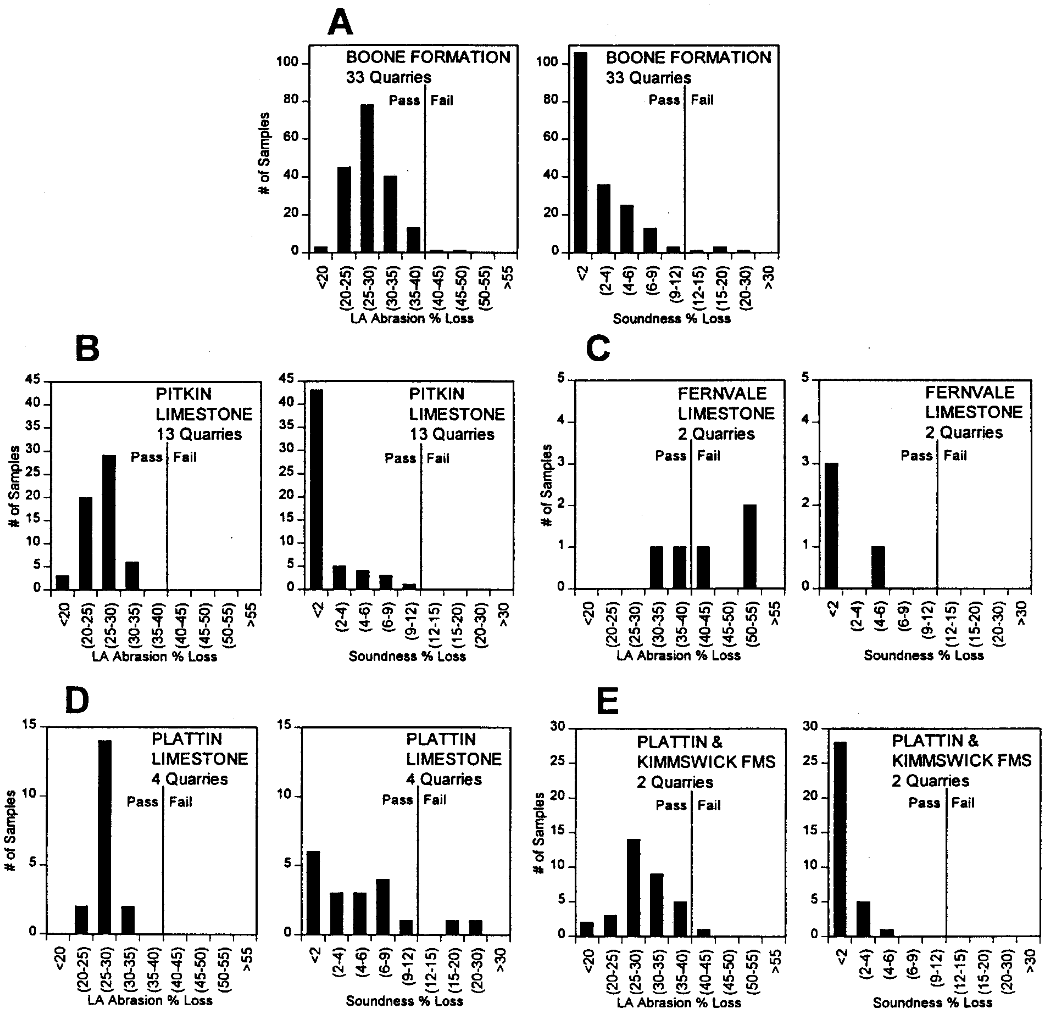
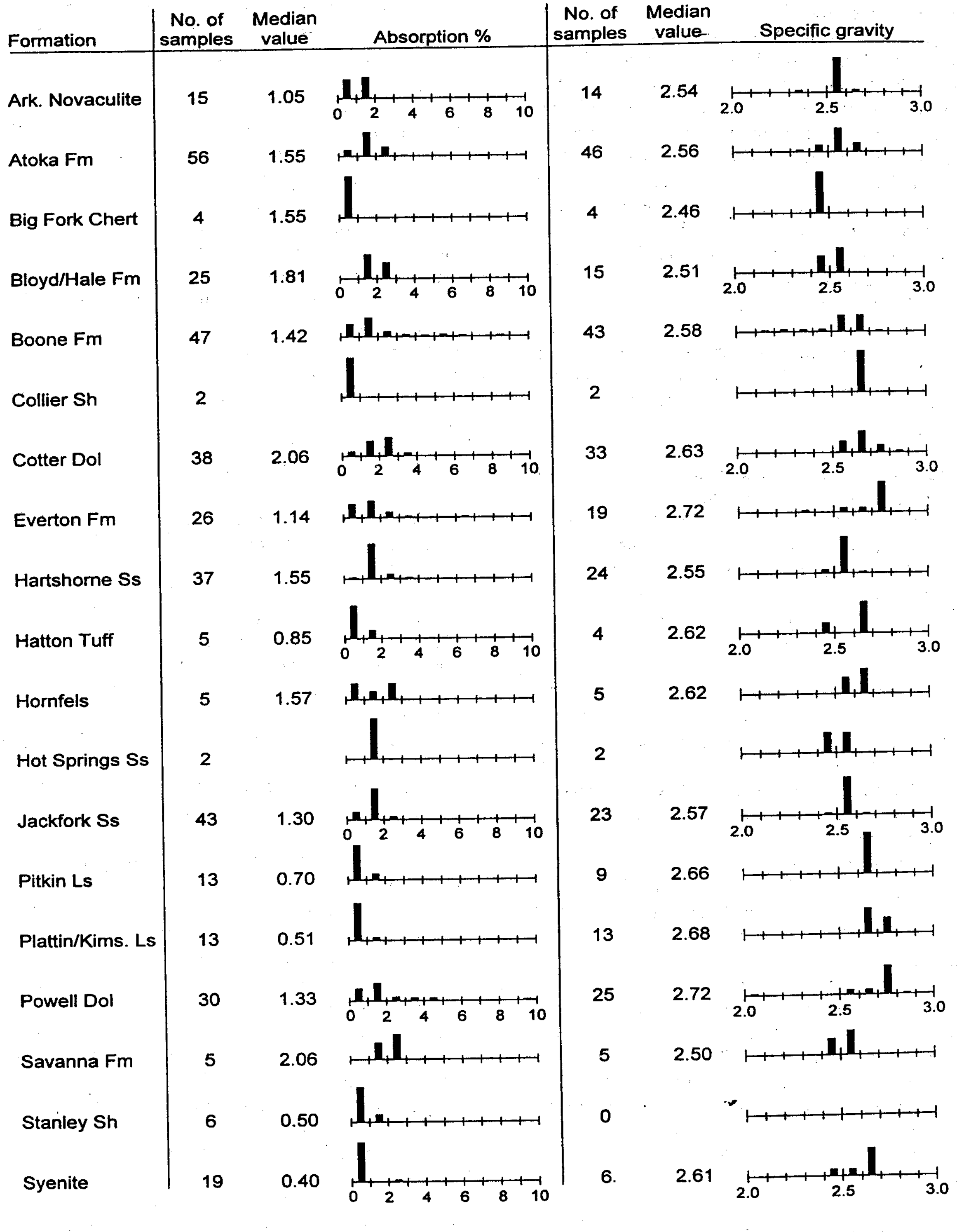


Figure 3. Histograms showing combined AHTD and Corps of Engineers test results on crushed stone, by bedrock map unit: limestone-dominated formations of the Ozark region. For each formation two histograms are given, one for results of the LA abrasion test, one for the sodium sulfate soundness test. A commonly employed pass/fail limit for each test is given (see text for discussion of pass/fail restrictions).



Formation	No. of samples	Median value	No. of samples	Median value
Ark. Novaculite	15	1.05	14	2.54
Atoka Fm	56	1.55	46	2.56
Big Fork Chert	4	1.55	4	2.46
Bloyd/Hale Fm	25	1.81	15	2.51
Boone Fm	47	1.42	43	2.58
Collier Sh	2		2	
Cotter Dol	38	2.06	33	2.63
Everton Fm	26	1.14	19	2.72
Hartshorne Ss	37	1.55	24	2.55
Hatton Tuff	5	0.85	4	2.62
Hornfels	5	1.57	5	2.62
Hot Springs Ss	2		2	
Jackfork Ss	43	1.30	23	2.57
Pitkin Ls	13	0.70	9	2.66
Plattin/Kims. Ls	13	0.51	13	2.68
Powell Dol	30	1.33	25	2.72
Savanna Fm	5	2.06	5	2.50
Stanley Sh	6	0.50	0	
Syenite	19	0.40	6.	2.61

Figure 4. Histograms showing combined AHTD and Corps of Engineers absorption and specific gravity test results on crushed stone, by bedrock map unit. Relative heights of bars are proportional to the percentages of values that fall in each indicated range.

the admixed limestone.

Although the presence of chert may result in some problems in aggregate production for construction of surfaced roads, it gives the Boone Formation an advantage in production of low-cost gravel for less rigorous applications, such as unpaved secondary roads. The typical Boone regolith above bedrock is a mixture of red clay residuum from dissolution of the limestone plus abundant fragments of chert. This regolith can be easily dug with loaders and placed as surface dressing on gravel roads with little treatment.

Figure 4 gives some statistics on data from absorption and specific gravity tests for each formation. Regarding the Boone Formation, it can be seen by the median of 1.42% absorption and the high incidence of values below 2% that this unit usually has fairly good results, but some samples register much higher absorption than the median. Absorption in 9% of Boone aggregate samples was unacceptable (between 5.5% and 8.27% absorption). In contrast, the Pitkin limestone samples show consistently low absorption. The occurrences of poor absorption results in Boone samples is always from inclusion of porous chert. Boone limestone with high amounts of the porous chert should be avoided in asphalt applications.

Boone Formation samples that tested high in absorption also had low specific gravity (SG), because of the low density of the porous chert. Specific gravity of the Boone samples ranged from 2.72 to 2.12. In contrast, the Pitkin samples all were between 2.62 and 2.68. Large amounts of low-SG chert in a parcel of rock could make it undesirable for use as riprap. Additional problems can arise due to the presence of low-SG chert in aggregate used in PCC applications. If a quarry in the Boone Formation has a significant portion being low-SG chert, there will be a bi-modal distribution in particle density. Variation in particle SG in a PCC batch can lead to segregation of aggregate during handling and mixing (White, 1991).

For aggregate in asphalt applications, a consistent bulk specific gravity is important for asphalt mix design (Marek, 1991). The bulk SG of the aggregate, obtained by testing a representative sample, is used in calculations of void content in compacted asphalt, which influences the amount of asphalt used in the mix. If the bulk SG of the aggregate varies from the SG used in the calculation, batches with too much or too little asphalt will be produced. If a quarried rock unit has low-SG chert, care must be taken to insure that the entire lot of aggregate intended for a specific asphalt job be uniform in its chert content.

The variation in abundance of low-SG chert in the Boone can also be a problem in base-course applications. The material used for base must be consistent throughout a single job (Nichols, 1991, p. 15-30). Base-course aggregate must be compacted to an optimum compaction, with a target density of compaction determined by laboratory tests such as AASHTO T-180. This test determines the maximum dry density and an optimum moisture content for the tested material. If the material has significant changes on the job from that used in the laboratory test, target densities may be impossible to achieve in the field. Such problems have occurred in material from Boone Formation quarries that have widely varying abundances of low-SG chert (W.J.

Pay, personal communication, 1997). Not all sites in the Boone have major lateral or vertical changes in percentage of chert on the scale of a single quarry, but where there are changes, operators must be careful to select areas of uniform chert content for single job applications.

The data are fewer for quarries in the Plattin, Kimmswick, and Fernvale Limestones (Fig. 3C, D, E). Four quarries appear to be entirely within the Plattin and two quarries are composites of more than one formation. Although the data are too few to be conclusive, there does seem to be some differences in the performance of these limestones as compared to the Boone and Pitkin. A few comments are made below regarding these apparent differences.

Considering the four quarries that lie within the Plattin Limestone (Fig. 3D) and comparing them to the Pitkin and Boone Formation limestones (Fig. 3A, B), the LA abrasion values have a similar distribution, but the soundness values for the Plattin do not have the strong mode at the lower end of the range, as do the Pitkin and the Boone. Instead, the soundness values have a flatter distribution over a wide range, including some in the failing range. It is not known what causes the poorer performance on the soundness test, but there are certain lithologic similarities between the Plattin Limestone and Arkansas dolostones that have also shown problems with soundness (discussed below). The Plattin Limestone is mostly a very fine-grained limestone called micrite. The dolostones are mostly dolomicrites. A significant portion of the Plattin micrites are finely laminated (Craig and Deliz, 1988), as are major sections of the dolostones. Laminae in the Plattin micrites examined by the author have somewhat of a stylolitic character. Stylolites in general have been characterized as having buildups of clay and/or other insoluble residues on them (Boggs, 1992, p. 122), and clay is suspected to be involved in the dolostone soundness problem discussed below. It may be that laminated horizons in the Plattin are related to poorer soundness results. Detailed study is needed to test this hypothesis. The uncertainty of this idea must be stressed; it is included here to show where further research is needed.

The majority of the Plattin data (Fig. 3D), 16 out of 19 samples, come from quarry IN06. When this quarry was visited by the author, it was half filled with water and largely inaccessible for study. It is uncertain how much of the quarry includes laminated micrites. It is also possible that the quarry's lower part (now submerged) includes the underlying Joachim Dolomite, and that could be the source of poorer soundness results. The three other samples in the Plattin histogram come from three quarries; two are in the <2% loss range, and the third has a value of 10%. This spread being recognizable in more than one quarry lends credence to the idea that the Plattin has a tendency to have a wide range of soundness values. On the other hand, there are two quarries that include both Plattin and Kimmswick Limestone, and soundness tests on stone from these composite quarries do not show the tendency for higher values (Fig. 3E). These quarries were not studied in detail, and the abundance of the thinly laminated facies of the Plattin Limestone of these quarries is not known.

One of the two quarries that use a combination of Plattin and Kimmswick Limestone, IN01, also includes the overlying Fernvale Limestone. In constructing the histogram in Figure 3E, an attempt was made to choose samples that appear to have come from levels that did not have the Fernvale or where friable portions of the Fernvale (discussed below) had been removed by processing. Samples from the quarry that were exclusively from the Fernvale are included in Figure 3C. One other quarry, IN03, is reported by the Corps of Engineers to be in the Fernvale Limestone. Of the five analyses shown for the Fernvale in Figure 3C, four are from the upper levels of quarry IN01, and one (at 51.6% loss) is from quarry IN03.

Though sparse, the data suggest problems with LA abrasion tests for the Fernvale Limestone, especially since failing tests are not restricted to one quarry. In outcrop the Fernvale seems to be stout, but during crushing a substantial amount crumbles to sand-sized particles (W.J. Pay, personal communication). Perhaps it is the very coarse-grained nature of the Fernvale that leads to this behavior. Most of this formation is made up of an accumulation of various echinoderm plates, some of which are still together as recognizable fossils. Echinoderm plates are all single crystals of calcite, and they were cemented together by overgrowths of calcite, which enlarged the individual crystals. The resulting rock is like an intergrowth of coarse calcite crystals. It may be that the very strong mineral cleavage of calcite starts to become a breakage factor in the whole rock when the calcite grain size is very coarse. Whatever the cause, any quarries that might be located solely within the Fernvale Limestone might be expected to encounter problems with the LA abrasion test.

All the data for absorption and SG of samples from the Plattin and Kimmswick Limestones are combined in Figure 4; there were no data available solely from the Fernvale. Consistently, results indicating high quality rock are obtained in both tests.

Dolostones

Histograms showing performance of dolostones on LA abrasion and sodium sulfate soundness tests are shown in Figure 5. Available data for the three dolostone formations tested indicate that there are no significant problems regarding the LA abrasion. However, all three formations have consistent problems with the soundness test. Of the samples submitted from the Everton Formation, 20% have failing soundness values. Of samples from the Cotter Dolomite, 41% failed, and of those from the Powell, 39% failed. Among the quarries in the Cotter Dolomite from which stone was submitted for testing, there was one quarry that had many more samples than the others. The same is true of the Powell. However, if the data from these quarries are eliminated, there is not an apparent change in the distributions of soundness values. So the soundness problem is widespread and not an artifact from a few large quarries.

The cause of the consistent soundness problems with Arkansas dolostones is not known with certainty. The problem may be associated with high clay contents in the dolostones. According to D.W. Lumbert of AHTD (personal communication, 1995), a quarry in the Missouri Ozarks submitted dolostone samples to AHTD for approval, many of which failed the soundness test. Some experimentation was done, and it was found that significant quantities of clay occur in the dolostone. A quarry in Arkansas, LR03, has a 1949 entry in the Corps of Engineers test records showing a fairly poor magnesium sulfate soundness result (17.9% loss, which would correspond to about a 12% loss on the sodium sulfate soundness test). The data sheet notes clay-rich stylolites were present in the sample and reported 12% insoluble residue (chert + quartz + clay). In quarry site visits for the present study, finely laminated dolomicrites were commonly observed in each of the dolostone formations, and broken surfaces along the bedding planes in the laminated portions of the rocks were observed to have clay on them. Of the quarries that were visited, the quarry that has had the most severe soundness problems also has a high percentage of the rock being laminated dolomicrite with clay-rich parting surfaces.

Further support to the idea that high soundness loss is related to clay-content in dolomite comes from R.L. Neman, Professor of Chemistry at East Central University in Oklahoma and consultant to the aggregate industry, who states (personal communication, 1998) that he has seen a positive correlation between soundness values and insoluble residue in data he obtained from testing stone from many dolostone quarries, including some from Arkansas. However, Rowland (1972) collected samples from 26 quarries in carbonate rocks in Oklahoma and analyzed, among other things, insoluble residue and Na-sulfate soundness. Scatter plots of Rowland's (1972) data were made by J. Bliss of the U.S. Geological Survey (personal communication, 1998), and these show no correlation between the two parameters.

These conflicting observations indicate the uncertainty of the cause of the dolostone soundness problems in Arkansas. Future research should involve an examination of the cause of this problem. When the cause is correctly determined, it would then be useful to identify any textural features (such as the lamination discussed above) by which problem dolostones and better dolostones can be distinguished in the field or in core samples. If there are stratigraphic intervals that can be identified that have fewer soundness problems, perhaps areas with these stratigraphic intervals could be mapped out. A study focused on the dolostone soundness problem could be valuable to industry, because it is the only rock type available for aggregate in a large section of the northeastern portion of the Ozarks.

Other than the Boone Formation, the dolostones have the greatest tendency for variability in absorption and SG (Fig. 4). Even so, good results were obtained from most of the samples that were tested. For example, the 30 samples tested from the Powell Dolomite came from 9 quarries. All of the samples with absorption greater than 3% came from two quarries, representing 6 out of the 30 total samples. The same samples that had higher absorption values were the ones with lower SG. From the Everton Formation, one sample had 6.05% absorption (with a SG of 2.38), but of the remaining 25 samples from 10 quarries, only 5 samples had greater than 2% absorption, with the high being only 3.1%. Good results are usually the case in the dolostone formations, but caution must be exercised because variability exists.

Other problems common to the carbonate rock area of Arkansas

Unlike most rock types, limestone

and dolostone are relatively soluble in water. This is why caves are present most often in regions where such carbonate rocks constitute the bedrock. Solution features in Arkansas' carbonate terrane can be problems for producers of crushed stone aggregate, because they can occur near the surface and may extend down into the subsurface for 10 m (30 ft) or more. Solution cavities most commonly form along large joints and especially at joint intersections. As space is created in the bedrock by dissolution, clay may be washed in from the soil horizon above the bedrock, filling the open cavity that is created. Such solution features may be only a few inches wide, or may be cavities 3 m (10 ft) or more across. The distribution of solution cavities can be unpredictable, though in some places the regularity of joint spacing and orientation can produce a regularity to the occurrence of solution cavities. When such features are encountered during quarrying, contamination of aggregate with large amounts of clay can ruin a batch of rock intended for applications that require clay-free aggregate. Solution cavities can also negatively impact quarry operations by causing unexpected results during blasting. Solution features are most widely known in

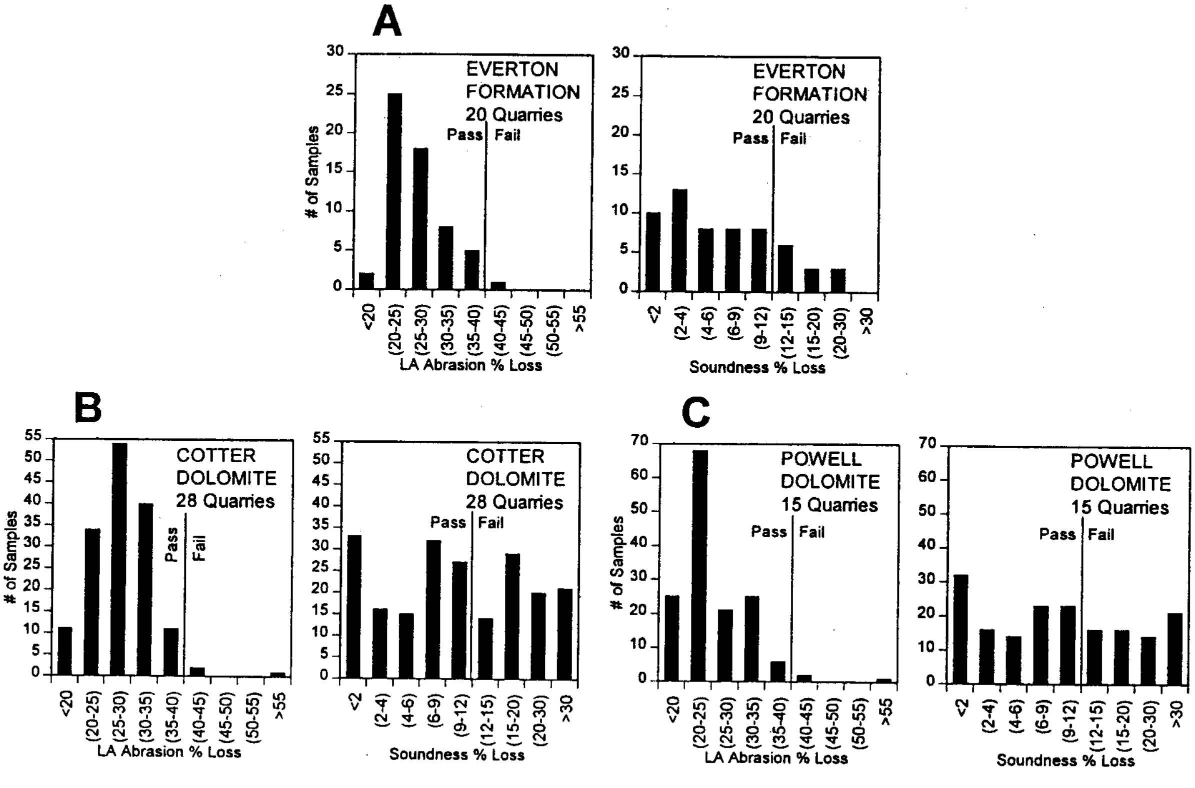


Figure 5. Histograms showing combined AHTD and Corps of Engineers LA abrasion and sodium sulfate soundness test results on crushed stone, by bedrock map unit: dolomite-dominated formations of the Ozark region.

the Boone Formation, but any of the carbonate formations may have them. Limestones are generally more susceptible to solutioning than dolostones.

Another problem that is fairly common among quarries in the carbonate rocks of Arkansas concerns fines in the aggregate created during crushing. AHTD requires that for base-course aggregate, a parameter informally called "dust ratio" must be measured (AHTD, 1993, p. 303). The dust ratio is an indication of how much of the fine material in the aggregate is of dust-sized particles. The requirement is that of all the material that passes the #40 sieve, no more than 2/3 of it can be material that also passes the #200 sieve. Apparently, because of the very fine grain size of many of the dolostones and of some of the limestones, an excessive amount is reduced to dust size when they are crushed. At many quarry sites, sand must be brought in from external sources to mix with the aggregate to lower the dust ratio. The quarry which has the Fernvale Limestone in its upper levels uses to its advantage the tendency for the coarse limestone of the Fernvale to crumble to sand-sized grains during crushing. By mixing an amount of Fernvale with finer limestone of the Plattin and Kimmswick Limestones from the lower part of the quarry, a greater proportion of the resultant fine aggregate ends up in the sand size range, thus meeting the dust ratio specifications. Yet another quarry mixes in sand crushed from a nearby occurrence of the friable St. Peter Sandstone to overcome its dust ratio problems.

In Arkansas, formations having chert in them have traditionally had problems with "stripping", that is, the loss of adhesion between aggregate and the bituminous binder in asphalt applications (W.J. Pay, personal communication, 1995). Of the formations generally used for aggregate in the Ozarks region, primarily the Boone Formation and the Cotter Dolomite have chert as a component. The same problem is produced when chert, either as local river gravel or as crushed stone imported from elsewhere, is used as an additive to the carbonate aggregate to meet AHTD specifications for surface-course asphalt pavement (discussed below). However, the stripping problem is easily overcome by addition of anti-strip agents to the asphalt mixture.

Another problem common to the entire carbonate terrane across the northern tier of Arkansas involves AHTD requirements for the upper layer of an asphalt road pavement. The specifications allow no more than 60% of the coarse aggregate to be of limestone or dolostone; at least 40% must be "siliceous" aggregate (AHTD, 1993, p. 220). Siliceous aggregates include such materials as sandstone, syenite, novaculite, or chert. The reason for this requirement is that carbonate rocks have low resistance to wear. They are soft by comparison to siliceous materials, and after a period of road use they become smooth, even polished, making the road surface slick. The more resistant siliceous aggregate is mixed in with carbonate aggregate to reduce this tendency for surface wear.

In the northern part of the Ozark area of Arkansas the bedrock is almost exclusively limestone and/or dolostone. There are sandstones in the Everton Formation that in some areas are thick, and there is the St. Peter Sandstone that has a wide range of occurrence. However, the St. Peter is quite friable in most places. There may be some areas in which the St. Peter is cemented more completely and might pass LA abrasion and soundness criteria, but even if such areas can be found, neither the St. Peter Sandstone nor the Everton Formation sandstones can be classified as siliceous materials by the AHTD method of designation. The reason for this is that to be classified as siliceous material by AHTD, 85% of the stone must be insoluble when subjected to a 1:1 solution of hydrochloric acid and water (AHTD, 1993, p. 220). The St. Peter Sandstone and the sandstones in the Everton Formation are quartz sandstones, but they are cemented by soluble carbonate cement, which normally constitutes more than 15% of the rock.

One short-lived quarry (CR12), from which there were five samples tested by AHTD in 1982, included both limestone from the Pitkin (the rock at the surface) and sandstone (from below the surface) from the Fayetteville Formation (probably the Wedington Sandstone Member). From the available records, it is impossible to tell what rock type was being tested in each sample, but all passed the LA abrasion test, and all but one passed the soundness test. A thin section of sandstone from a large block lying beside the abandoned pit shows only a minor portion being calcite cement. This quarry is in the Green Forest area of Carroll County, which is in the general area of the thickest development of the Wedington Sandstone according to Croneis (1930). This area is one of the northernmost parts of the Wedington's range of near-surface occurrence. Perhaps there is potential somewhere in that area for a quarry utilizing the Wedington Sandstone to supply siliceous aggregate.

The Batesville Sandstone underlies the Fayetteville Formation and might be a source of siliceous aggregate. From the data sources used in this study, only one quarry has been noted in the Batesville Sandstone (BE16) that was evidently used for aggregate, and no test data are available for it. Croneis (1930) notes that parts of the Batesville are very calcareous, but no study exists that describes the cementation of the Batesville Sandstone in detail. He also mentions the existence of a number of quarries in the Batesville area, but does not mention the use of the stone that was produced. According to C.G. Stone (personal communication, 1998) a number of old quarries in that area were used for aggregate and/or building stone. There is no data on the quality of the aggregate from any of these quarries.

Another source of siliceous aggregate might be cherts that occur in with certain of the carbonate formations of northern Arkansas, but this idea is problematical. In the past, siliceous aggregate for mixing with carbonates in surface-course asphalt was obtained from river gravels, where the natural action of tumbling along stream beds, coupled with weathering, concentrated the more durable cherts of the area. However, the trend in recent years has been to reduce or even eliminate the practice of stream-bed mining of river gravel, in order to preserve the natural qualities of the rivers in this scenic part of the State. Looking to direct bedrock extraction of chert for siliceous aggregate presents other problems. Other than in the Boone Formation, the chert abundance is too low, being in most places only a few percent of the total bedrock. In the Boone, most of the chert is too soft and porous to be viable. However, in places there are occurrences of durable chert in the Boone Formation. At one quarry in northwest Arkansas, where a stratigraphic interval in the Boone has close to 40% durable chert, the possibility of using that interval as a source of aggregate for surface-course asphalt is being explored. It is possible that similar sites in the Boone may be located containing durable chert in sufficient abundance to qualify for surface-coat asphalt.

Sandstones of the Ozark Plateaus and the Arkansas River Valley

The principal bedrock units of the Ozarks that contain sandstones that are quarried for construction aggregate are the Hale, Bloyd, and Atoka Formations. The Atoka Formation's distribution includes both the southern part of the Ozark Plateaus and the entire Arkansas River Valley region (Fig. 2). For this reason, aggregate sources in the southern part of the Ozarks are discussed along with the Arkansas River Valley. In the Arkansas River Valley, besides the Atoka, the Hartshorne Sandstone is extensively used for aggregate, and there are a few sites in the less-extensive Savanna Formation that have been exploited for sandstone construction aggregate. The LA abrasion and sodium sulfate soundness data from these formations are summarized in Figure 6.

The stratigraphy of the Hale and

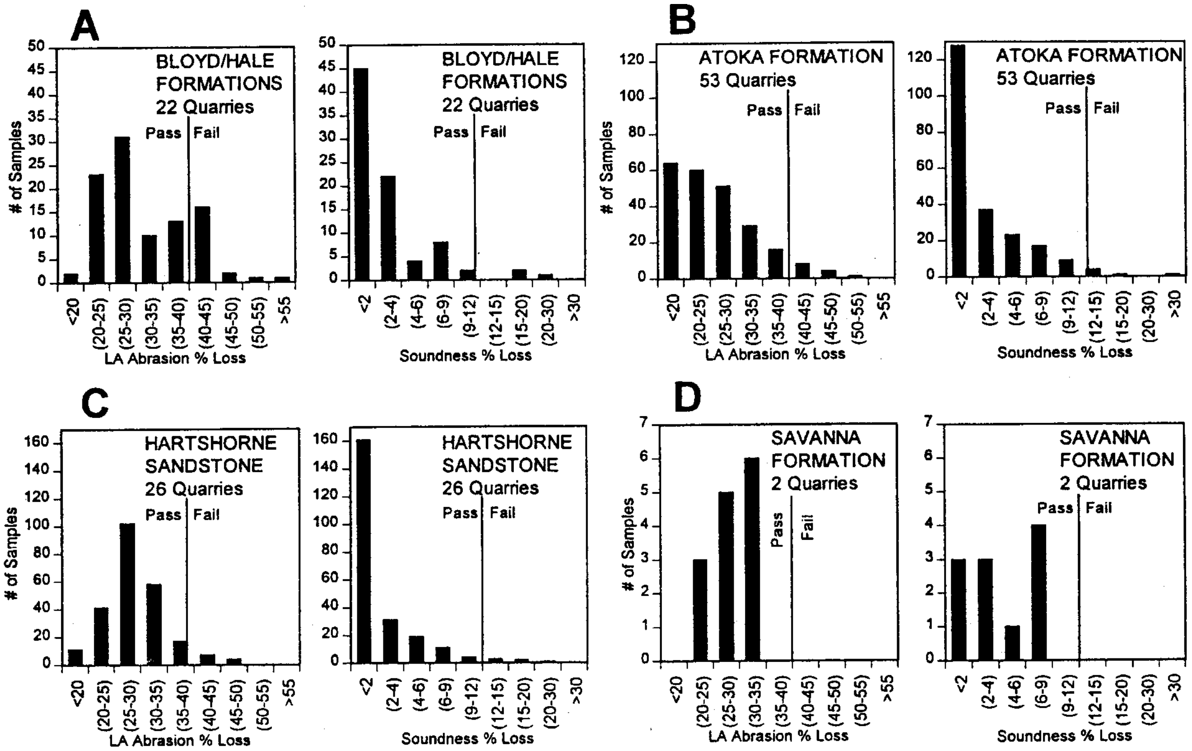


Figure 6. Histograms showing combined AHTD and Corps of Engineers LA abrasion and sodium sulfate soundness test results on crushed stone, by bedrock map unit: sandstones of the southern part of the Ozarks plus the Arkansas River Valley region.

Bloyd Formations (Fig. 1A) is complicated by the fact that there are facies changes in these formations laterally toward the east from the areas in northwest Arkansas where the formations were originally defined. On the geologic map of the State (Haley et al., 1993) and on most of the pertinent geologic worksheets, the lower part of the Hale Formation, the Cane Hill Member, is mapped separately from the rest of the Hale, and the upper part of the Hale Formation is included with the Bloyd Shale. On some geologic worksheets these are grouped together as "Morrowan", referring to the geologic series to which these rocks belong. In Appendix I, the quarries are indicated as to formation simply by the map unit they fall in ("Cane Hill" or "Bloyd/Hale"); no attempt was made to distinguish quarries in the upper part of the Hale Formation from those in the Bloyd.

There are only two quarries in sandstone of the Cane Hill Member of the Hale Formation, CB20 and ST04, for which there are data; a third quarry, WA02, is partly in the Pitkin and partly in the overlying Cane Hill, but there are no records of sample tests for it. From CB20 and ST04 a total of four LA abrasion tests were performed, and all were in the 24-30% loss range; three soundness tests were performed, and all fell in the <2% range. Histograms were not produced for these data.

Of the data presented in Figure 6, the most problematical are the LA abrasion scores for the combined Bloyd/Hale unit. About 20% of the tests were above the "failing" limit of 40% loss, and a significant number that passed were close to that limit. Some of the poor results may come from instances where quarry operators included too much material from the upper parts of quarries, where the rock is excessively weathered. However, most of the poor values recorded for the Bloyd/Hale unit come from two quarries that commonly obtained poor results even from samples well below the surface. In the sandstone units of the Ozarks and Arkansas Valley, the fresher rock is usually gray in color, and the weathered rock is light brown. According to W.J. Pay (personal communication, 1997), the rock in these two problematic quarries tends to be brown and weathered in appearance to greater depths than is typical of most sandstone units in Arkansas. He considers unusually deep weathering to be a general tendency for rocks of the Bloyd/Hale bedrock unit.

As a possible explanation for zones of deep weathering, Pay (personal communication, 1997) has suggested that perhaps the original character of cementation in sandstones of this unit is, at least in places, such that cementation was incomplete, so that groundwater is able to soak into the rock more readily and thus weather it to greater depths. Or perhaps, if some of the sandstones were cemented by calcite cement, the rock would be more readily weathered than silica-cemented sandstones. These ideas are reasonable, especially in light of the common occurrence of undercut bluffs formed in the thick "Middle Bloyd Sandstone", where the undercut part of the sandstone seems unusually crumbly, evidently having a different degree of cementation or different type of cement than the more resistant part of the sandstone. The fresh-rock samples of the Bloyd/Hale unit that the author has examined in thin section are cemented by silica cement, making a very durable material. In one quarry, however, there are concretion-like nodules where the sand grains are cemented by calcite instead of silica. If there are large portions in sandstones of the Bloyd and Hale Formations that have calcite cement, these would be more susceptible to weathering than portions with silica cement and might account for the less durable sandstones that have the poorer LA abrasion numbers. Probably there is more occurrence of calcite-cemented sandstones in the western part of the outcrop belt for these formations, because the western part has more occurrence of limestone in the formation, indicating an abundance of carbonate in the original depositional system, while the eastern part is almost entirely clastic. In spite of the above discussion, it should be noted that there are many very good quarries in this map unit that have not encountered significant problems with LA abrasion or soundness.

There is a problem in using the geologic worksheets for exploration for potential quarry sites in the Bloyd/Hale or Cane Hill units, and this problem also applies to using them for sites in the Atoka Formation. These bedrock units are generally dominated by shale and siltstone rather than sandstone, but they have sandstone layers that are thick enough to support aggregate quarries. The geologic worksheets only indicate areas underlain by bedrock of the unit as a whole and do not distinguish the areas with sandstone from areas dominated by shale. Each of these units occupy widespread areas of the State. To single out areas of sandstone within an area shown on a geologic worksheet as occupied by Cane Hill or Bloyd/Hale or Atoka Formation, one must apply some knowledge of geomorphology. For example, "hog-back ridges" are the topographic expression of inclined layers of durable rock such as sandstone, which "hold up" the ridge.

There are, however, some specific reports that have maps with variable-lithology bedrock units divided according to lithologic character, such as Merewether (1967) and Merewether and Haley (1969). A listing of such reports is beyond the scope of this paper, but help with locating such reports is generally available through the Arkansas Geological Commission. A resourceful way to determine the location of one prominent sandstone layer in the Bloyd Formation, the "Middle Bloyd Sandstone", was suggested by J.D. McFarland (personal communication, 1996). He says that what is now designated as the "Middle Bloyd Sandstone" is what was once mapped as the base of the Atoka Formation. Thus the trace of the base of the Atoka on the 1929 Geologic Map of Arkansas (Miser and Stose, 1929) shows the distribution of the "Middle Bloyd Sandstone".

The Atoka Formation in Arkansas is an extremely thick sequence of shales, siltstones, and sandstones. The unit is informally subdivided into the "Lower", "Middle", and "Upper" Atoka. In part of its aerial extent, these three subunits are distinguished on the geologic worksheets and on the State geologic map (Haley and others, 1993), whereas in other places it is just mapped as a whole, without subdivision. The sandstone layers in this unit are cemented by silica cement, and there are a number of thick beds that have been quarried. Of all the bedrock units of the State, there are more quarries in the Atoka Formation than in any other single unit. This is, in part, due to the fact that the Atoka is the most widespread (Croneis, 1930; Haley and others, 1993).

The histograms for LA abrasion and soundness tests of sandstone from the Atoka (Fig. 6B) show very good results. The most frequent values on the LA abrasion test occur in the range of <20% loss. However, almost half of the tests that fall in that range come from two longstanding quarries, PY01 and LN01/PU05. Nevertheless, even if these two quarries are eliminated from the data set, the results are still quite good. Speculating as to why these two quarries turn out such good abrasion values, it is notable that they contain some of the finer-grained sandstones as compared to many other quarries (W.J. Pay, personal communication, 1997). Of the quarries in the Hartshorne Sandstone, which is also a silica-cemented sandstone and in a similar structural setting, the quarry producing rock with the best results on the LA abrasion test also has sandstones with relatively fine grain sizes. Coarser-grain-sized rock from other quarries in the Hartshorne does not fare as well. It may be that for some reason the finer grain sizes in the sandstones were advantageous to better original cementation, or perhaps they are less susceptible to weathering. The notion that better LA abrasion values are associated with finer sandstones, however, has not been rigorously tested. It should also be noted that even if this idea is true, in many cases the depositional systems that deposited finer average grain sizes of sand also tended to deposit more clays, which become shales. Sandstone deposits with abundant shale interlayers are more difficult to deal with in a quarrying operation, because excessive shale is not allowed in high-dollar aggregate applications. On the other hand, for adherence purposes, small quantities of shale are often preferred, and a few quarry sites may be “too sandy” without some shale additions, and thus be lacking in material that will produce enough fines upon crushing. Lateral changes in shale content through sedimentary facies changes is a concern in essentially the entire sedimentary rock terrane of Arkansas.

The few cases of poorer LA abrasion and soundness values in the Atoka are probably attributable to cases where too much weathered rock got into the batch that was tested. This was confirmed in a few site visits where entire quarries were small, shallow pits mostly in weathered rock. Even in large quarries that tap down into fresh rock, operators can, on occasion, get too much weathered rock from the top of the quarry included in a batch.

The Hartshorne Sandstone shows consistent good results on the abrasion and soundness tests (Fig. 6C), the few “failing” tests being negligible as far as evaluating the formation as a whole. The formation is dominated by thick, fluvial, quartz-cemented sandstones. However, there are shale interlayers in places, so it is not everywhere suitable for quarry sites for high-quality crushed stone. There are a number of places where thick sandstones of the Hartshorne occur in close proximity to the navigable Arkansas River. This is also true of the Atoka Formation. Such locations are advantageous for using the river for transportation of stone to neighboring states.

Two quarries in the Savanna Formation have had samples tested, all the tests having good results (Fig. 6D). Sandstones are only a minor part of the Savanna, which is dominated by shale and siltstone, and the formation as a whole does not have an extensive outcrop area in Arkansas. This formation should not be considered a major resource for aggregate in the State. Nevertheless, it has some potential in the western and southwestern part of the Arkansas River Valley region.

Similarly, the McAlester Formation is also dominated by shale, but with some sandstone intervals. AHTD's Materials Availability Study (AHTD, 1984) mentions two quarries in the McAlester (FR07 and SB06), but no data are available from these. One of these, SB06, was operated by Sebastian County for some years, ending in 1972. The former Superintendent of the quarry, C. Gasaway, said (personal communication, 1998) that there was a 3-5 m (10-15 ft) thick sandstone that was crushed for aggregate for a period of time, and that beneath it was shale that was ripped by dozers for many years after that, for use as dressing for unpaved secondary roads. Based on descriptions of the McAlester (Croneis, 1930; Hendricks and Parks, 1950; Haley, 1961), it is unlikely that there are many places with significantly thicker sandstones in this formation.

Absorption values (Fig. 4) for the sandstones discussed above (other than sandstone in the McAlester) are fairly consistent, rarely having values over 3%. Specific gravity values also are fairly consistent. In sandstones, SG tends to be a little lower than SG in carbonate rocks, because the constituent minerals of limestones and dolostones are denser minerals than quartz, the main constituent of sandstones. The slight variations in both absorption and SG in these sandstones may be due to some porosity differences resulting from cement dissolution due to weathering.

Rocks of the Ouachita Mountains Region

Figure 7 shows the histograms of available results from engineering tests run on various rocks of the Ouachita Mountains region. Below is a discussion of the various rock types of this region that have been utilized for aggregate.

Sandstones

The sandstones of the Jackfork Sandstone show generally good results on the two tests (Fig. 7A), especially on the soundness test. Although most of the LA abrasion tests are in the "passing" range of less than 40% loss, these sandstones do not seem to have as strong a showing as the sandstones of the Hartshorne or Atoka on this test. Some of the cases of poorer results may be from zones of deep weathering. According to C.G. Stone (personal communication, 1998), the Jackfork can in some places be weathered as deep as 30 m (100 ft) and yet in a short lateral distance be very hard to within a few feet of the surface. This especially deep weathering occurs primarily in the southern part of the Ouachitas near the border of the area of Cretaceous and Tertiary sediments. The rocks of this area were near the earth's surface both in the Cretaceous and early Tertiary as well as today, so this area has been exposed for a significant period of time to weathering processes (C.G. Stone, personal communication, 1998).

It is noteworthy that of the "failing" tests, not all are associated with parcels of weathered rock near the surface. In some quarries, rocks from well below the surface may be very durable in one place, while laterally the same interval of rock at the same depth may be softer (W.J. Pay,

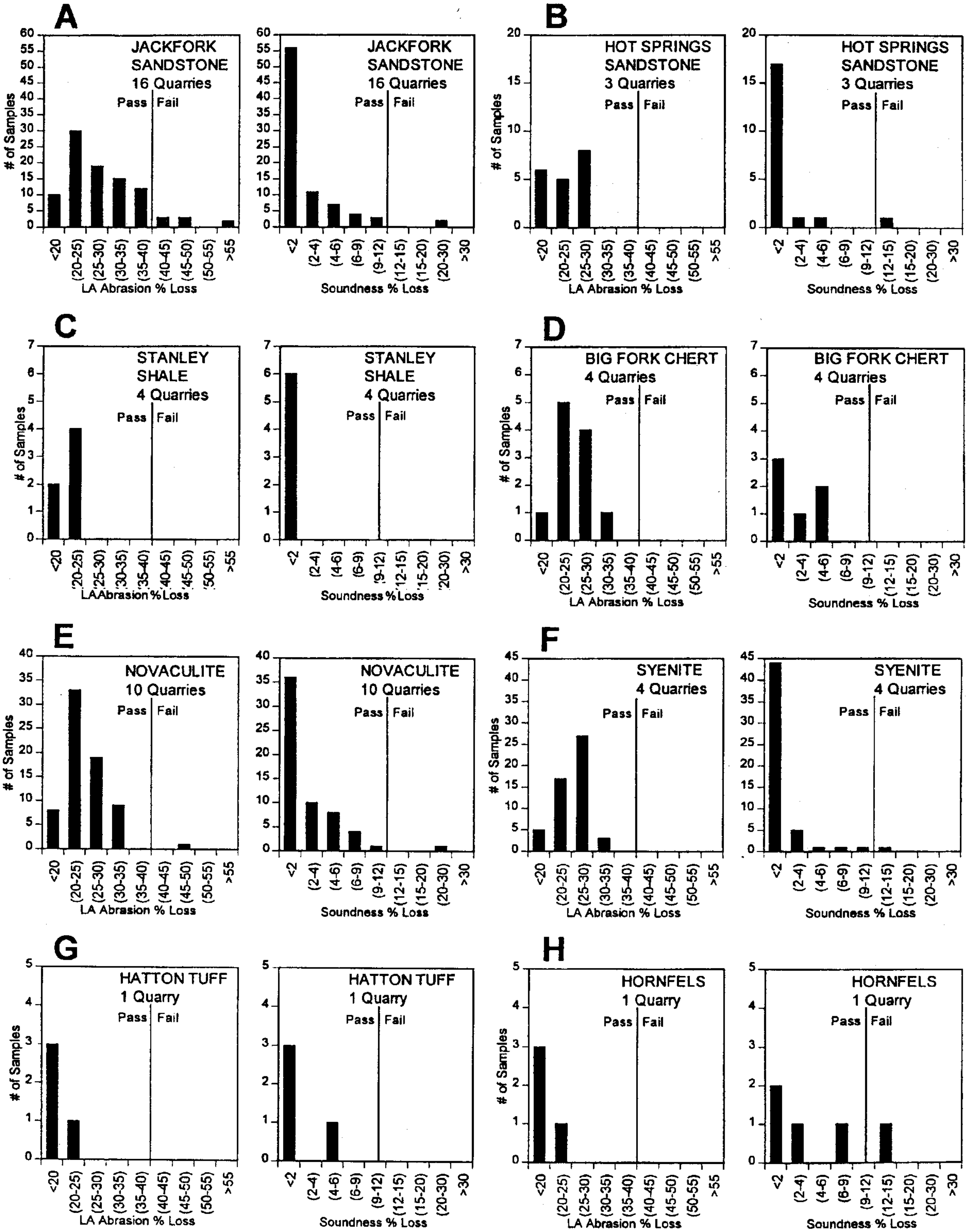


Figure 7. Histograms showing combined AHTD and Corps of Engineers LA abrasion and sodium sulfate soundness test results on crushed stone, by bedrock map unit: rocks of the Ouachita Mountains region.

personal communication, 1998). This kind of variability may be due to original cementation properties of the Jackfork sandstones that lead to zones of friable sandstone.

Pauli (1994) discusses cementation factors that may have contributed to areas of friable sandstone in the Jackfork in the Lynn Mountain syncline area of Le Flore County, Oklahoma. The cementation factors appear to be related to depositional facies of the Jackfork sands, which are interpreted to have been deposited as turbidites in submarine fans. One factor appears to be the presence of detrital clay in interstices between original sand grains. The clay hindered cementation by overgrowth silica cement. This condition is found, primarily in medium- to coarse-grained, poorly sorted channel facies of the Jackfork. In channel sandstones there are also indications that calcite cement may have been present in some of the rock, and dissolution of the calcite has left the sandstone poorly cemented. The nonchannel sandstones from fan lobes or channel levees are finer grained and are normally hard, well-cemented sandstones.

Although cementation properties are suspected to be behind the tendency for a few Jackfork samples to have marginally satisfactory LA abrasion results, they are not evident in the absorption and SG data (Fig. 4). If any samples having poor cementation were submitted for absorption and SG tests, they should show high absorption and low SG, but there is no significant variation seen in these data for the Jackfork. However, only two of the samples that had “failing” LA abrasion values were also tested for absorption and SG, so the data are too few to determine if there is a correlation.

The original depositional environment of the Jackfork also has influenced lateral continuity of bedding in the formation. Lateral variation from a sandstone-dominated sequence into a more shale-rich sequence along strike is undesirable from a rock quality consideration. Some areas in the Jackfork have sandstone that was originally deposited in a fan lobe setting. Sandstones of this facies have good lateral continuity, while other areas, more closely associated with channels, have greater lateral discontinuity (C.G. Stone, personal communication, 1998). In general, lateral continuity is better where the trend of the formation in outcrop follows the trend of original deposition. Greater rock-type variations commonly occur where the present trend of outcrop is transverse to the trend of the original depositional system. These kinds of relationships are not easy to determine, even by experienced geologists, especially in undeveloped sites where exposure is limited. Development of quarry sites for aggregate in the Jackfork Sandstone can sometimes present difficulties, but a number of successful quarries have been brought into production over the years.

Another sandstone resource in the Ouachitas is the Hot Springs Sandstone. The Hot Springs Sandstone is locally a thick sandstone unit near the base of the Stanley Shale. The unit is best developed in the eastern part of the Ouachitas, in the vicinity of Hot Springs. The Hot Springs Sandstone is not shown on the geologic worksheets; it is simply part of what is mapped as Stanley Shale. However, there are geologic maps for part of the region that subdivide the Stanley and show specifically where the Hot Springs Sandstone crops out. These maps include the Hot Springs folio (Purdue and Miser, 1923) and the Malvern 15-minute quadrangle (Danilchik and Haley, 1964).

Nearly 20 samples tested from three quarries in the Hot Springs Sandstone (Fig. 7B) indicate a durable stone. Only two absorption and SG test records are available from this unit (Fig. 4), and they indicate good results.

The majority of the samples tested for LA abrasion and soundness, as well as the two tested for absorption and SG, were from one long-standing quarry, GA03. Some confusion exists regarding this quarry in that, according to W.J. Willis (personal communication, 1997), many people in the Hot Springs area have thought the quarry was in the Arkansas Novaculite. However, the author visited the site and spoke with a long-term employee, C. Porter, who operated the asphalt plant there under several changes in ownership. He was thoroughly familiar with the two rock types because of the difference in the way they behave in the asphalt plant. He showed where the workings were at different times in the quarry's history. There is a pit on the property that is in novaculite that was a source for a short time, but some 80-90% of the time the workings were in the Hot Springs Sandstone (C. Porter, personal communication, 1997). The apparent volumes taken from the areas of the two rock types, as viewed by the author, seem to corroborate his statements.

The four quarries in the Stanley Shale indicated in Figure 7C are all sites that have been used by the Corps of Engineers to obtain riprap. The stone that was tested and used from these quarries is sandstone. A very durable stone is indicated by the tests, and probably many occurrences of sandstone in the Stanley are similarly durable. Two of the sites (HO02 and PK04) were field checked by G.D. Hunt, an assistant in this project. One of them (HO02) was accessible for examination, and a photograph was taken. The sandstones there are significantly thicker than in most places in the Stanley Shale, but shale interlayers, so typical in the Stanley, are ubiquitous throughout the highwall exposure. C.G. Stone states (personal communication, 1998) that during operation of that quarry, thicker sections of sandstone without shale occurred. He also comments that there are other places in the Stanley where thick intervals of sandstone exist without significant shale interlayers. Such thick sandstone intervals in this formation are generally the result of "amalgamation" during deposition of sands from turbidity flows. Individual turbidity flow deposits normally have sand at the bottom and clay at the top, and there are variable thicknesses of clay possible between successive sand layers. In cases of amalgamation, during the deposition process, each successive flow can erode some or all of the clay from the underlying layer, so that sand is deposited on sand. In cases where this process happened often, thick sandstones result. Although isolated occurrences of significant amalgamation exist in the Stanley, and thus other locations may exist in the Stanley where aggregate quarries can be successfully opened, most of the Stanley has insufficient amalgamation of sand units to support a quarry for stone that must pass stringent requirements on exclusion of soft particles such as shale.

The Crystal Mountain Sandstone (Fig. 1B) is a unit in the Ouachitas for which there are no records of aggregate mining activity in the data sources used for this study, but for which there may be potential for future use. According to C.G. Stone (personal communication, 1998), at least one quartz crystal mine in this formation has intermittently supplied riprap and decorative architectural materials. Parts of this sandstone unit were cemented with calcareous cement and have been deeply weathered, but other parts are cemented with silica and are very hard, even at the surface. There may be areas in which there is sufficient volume of durable sandstone to support an aggregate quarry.

No records exist of quarries in sandstones of the Johns Valley Shale, but according to C.G. Stone (personal communication, 1998), places where turbiditic sandstones in the sequence have been sufficiently amalgamated, sandstone thicknesses can exceed 30 m (100 ft), and significant ridges are held up by such sandstone intervals in the Johns Valley Shale. It may be that there are resources for sandstone construction aggregate in this formation in some areas. C.G. Stone has also indicated that there are portions of the Johns Valley Shale in the Boles area where exotic blocks of carbonate rock are sufficiently large to support small aggregate quarries.

Novaculite and Chert

The Arkansas Novaculite is discussed along with the Bigfork Chert, because novaculite may be considered a special form of chert. Of these two formations only the Arkansas Novaculite is truly suitable for high-quality aggregate applications. The Bigfork Chert has been used in some AHTD applications and some good results have been returned on engineering tests run on samples that have been submitted (Fig. 7D and Fig. 4). However, those good samples were obtained only with very careful and selective quarrying, because most of the Bigfork has excessive tripolitic chert and/or shale. For this reason, its use in applications with rigorous restrictions on soft particles is problematic. On the other hand, the material from this formation is easily quarried with earth-moving equipment (not requiring blasting), and it packs well and sets up very hard, so it is widely used for dressing unpaved secondary roads. However, sharp edges are common on the chert aggregate particles, and high rates of tire puncture are common on roads dressed with stone from the Bigfork (C.G. Stone, personal communication, 1998).

The Arkansas Novaculite consistently scores well on both the LA abrasion and sodium sulfate soundness tests (Fig. 7E), and a number of long-standing quarries have been established in this aggregate source. The Arkansas Novaculite also has excellent absorption values (Fig. 4), making it quite suitable for asphalt concrete. This material has had problems with stripping in asphalt in the past, but anti-strip agents added to the asphalt eliminate this problem.

The part of the formation that normally is quarried is the Lower Division. The Middle Division has too much shale, and the Upper Division is usually thin, and rock in it is commonly not as durable as in the Lower Division. In many places in the eastern part of the Ouachitas, the Upper Division is described as being “tripolitic”, in that it readily disintegrates to a silica powder. This tripolitic character is especially common in places where the beds are structurally overturned (C.T. Steuart, personal communication, 1997). Toward the west, the upper member is commonly less tripolitic, but it still is generally not as durable or as thick as the lower member. Along the northern limb of the Benton uplift, facies changes in the Arkansas Novaculite reduce the thickness of the formation on the whole and essentially eliminate the rock-types most suitable for high-quality construction aggregate.

Although the Arkansas Novaculite makes an excellent aggregate, this material also is the most abrasive to mining and processing equipment. The novaculite breaks with a semi-conchoidal fracture that very often produces jagged, knife-sharp edges that take heavy tolls on rubber-tired equipment in the quarry. It is very abrasive in contact with steel, producing rapid wear on crushing and handling equipment. It produces more wear to components of an asphalt plant than even the most indurated of the silica-cemented sandstones.

Igneous Rocks

Igneous rocks are not widespread in Arkansas, but several significant occurrences constitute important resources for crushed stone aggregate. In the area between Little Rock and Benton, several Cretaceous-age plutons of nepheline-bearing syenite occur, and east of Hot Springs, at the community of Magnet Cove, an alkaline intrusive complex occurs with a wide range of rock types. Most of the utilization has been from several quarries situated in Pulaski County on Granite Mountain, in the pluton that is in closest proximity to Little Rock. The name “Granite Mountain” is a misnomer, because the rock is nepheline-bearing syenite rather than true granite. The stone from Granite Mountain makes a high quality aggregate (Figs. 4 and 7F), and the location provides several transportation advantages, being near the largest populated area of the State, near rail lines, and near the Arkansas River. Although the area exposed at the surface is not extensive, amounting to less than ten square miles, a significant volume of material probably continues laterally at depth, based on a large gravity anomaly (Kruger and Keller, 1986).

Another igneous rock type that is used for aggregate is the Hatton Tuff. This bedrock unit has only recently been brought into production, so the number of data are few (Figs. 4 and 7G), but the available data are very encouraging. The Texas Department of Highways and Public Transportation obtains similar good results on their tests of the material (C. Fu, personal communication, 1996). The rock type “tuff” is generally a “red flag” when considering a material for aggregate, because if used in portland cement concrete the glassy component (i.e. volcanic glass) of typical tuffs can enter into alkali-silica reactions with the cement and degrade the concrete (Smith and Collis, 1993, p. 210). However, tuffs with reactive volcanic glass are universally of Tertiary age, while the Hatton tuff is of Mississippian age, and its volcanic glass has devitrified to crystalline substances, primarily feldspar (Niem, 1977; Kline, 1996), eliminating the potential for alkali-silica reactions.

The Hatton Tuff Lentil occurs in the lower part of the Stanley Shale (Fig. 1B). This unit is not shown on the Geologic Map of Arkansas (Haley et al., 1993), nor is it shown on most of the Arkansas Geological Commission geologic worksheets. The distribution of the Hatton Tuff in the southwest portion of the Ouachitas in Arkansas is shown, however, on the maps of Miser and Purdue (1929) and Miser and

Stose (1929). Although the Hatton Tuff is reported to thin to the north and also to the east (Niem, 1977), Danilchik and Haley (1964) have mapped a tuff in the lower Stanley up to 15 m (50 ft) thick in the Malvern quadrangle that they tentatively called the Hatton Tuff.

Other Rock Types

One quarry has been opened in a hornfels zone within the Stanley Shale adjacent to the Magnet Cove intrusive complex, east of Hot Springs. The few test results available show reasonably good results (Fig. 7H, Fig. 4), though one of five soundness tests failed. Prior to metamorphism, the rocks were interbedded shales and sandstones which normally would not pass engineering tests, but heat from the plutonic complex baked them into durable hornfels. The contact metamorphic zone in which these rocks occur averages about 550 m (1800 ft) wide around the plutonic complex, as mapped by Erickson and Blade (1963).

Limestones are rather rare in the Ouachitas, but two quarries for which engineering test results are available are situated in limestones. One is in limestone of the Collier Shale (quarry MG01); the other is in a limestone layer in the Womble Shale (GA02). Two samples from MG01 were tested, with LA abrasion values of 26% and 26.5% loss and soundness values of 1% and 1.7% loss. The one sample from GAO2 had a loss of 25.4% in the LA abrasion test and 0.1% loss in the soundness test. Despite these excellent results, these formations are not considered major resources, because limestones of sufficient thickness to support a quarry are not extensive in the Collier, the Womble, or other Lower Paleozoic strata, all of which are generally dominated by shale. However, based on observations during a site visit, the author thinks significant reserves may remain in the limestone body at site GA02. Formerly two other limestone intervals in the Womble were quarried on a limited scale for aggregate and/or riprap (C.G. Stone, personal communication, 1998), and there could be other limestone bodies like these elsewhere in the Womble. The limestone in the Collier Shale in which site MG01 is located is approximately 30 m (100 ft) thick and may contain as much as a million short tons of limestone (C.G. Stone, personal communication, 1998).

POTENTIAL FOR ALKALI-SILICA REACTIVITY

From the available information, there are no apparent problems from alkali-silica reactivity (ASR) in the various bedrock units that have been utilized for construction aggregate in Arkansas. Of the Corps of Engineers data sheets, there are 106 samples for which various forms of analysis were done, most of which included information about petrographic constituents of the samples. Of the bedrock units covered in this report, only the following are not represented in data sheets from the Corps: the Cane Hill Member of the Hale Formation, limestone in the Collier Shale, the hornfels zone in the Stanley Shale, the Hot Springs Sandstone, the Plattin and Kimmswick Limestones, and the Savanna Formation. None of the reports mentioned any constituents that have been identified as common producers of ASR (Smith and Collis, 1993, p. 209-211), and 10 data sheets specifically stated that there were no constituents vulnerable to ASR, including samples from the following units: the Atoka

Formation, the Bloyd Formation, the Cotter and Powell Dolomites, the Everton Formation, the Hartshorne Sandstone, the Stanley Shale, and nepheline-bearing syenite of “Granite Mountain”. This is not an extensive sampling, but the apparent paucity of reactive substances in aggregate-supplying formations in Arkansas is corroborated by the Research Division of AHTD, for D.W. Lumbert of that organization has stated (personal communication, 1995) that ASR is not a problem in Arkansas. Furthermore, a recent SHRP document (Whiting, et al., 1993, p. 47) indicates that Arkansas is a state without any reported ASR incidences.

CONCLUSIONS

Overall, Arkansas has abundant resources for crushed stone aggregate in the Interior Highlands, including the areas associated with the Cretaceous intrusive igneous complexes. These resources are presently adequate to supply the needs of Arkansas, as well as neighboring states that lack such resources. The bedrock units that have been extensively used in the past have wide distribution in the State and thus have ample reserves for the foreseeable future, and there are reserves in some units that have not been significantly utilized. Within the region of the Interior Highlands there will be places where transportation distances are greater than others, but virtually every part of this terrane has some units suitable for aggregate. The most favorable areas for location of large long-term quarries for construction aggregate will be (1) near major population centers within the Paleozoic region, (2) within the Paleozoic region along its southern and eastern border (Fig. 2), for advantages in shipping to areas in southern and eastern Arkansas that lack adequate resources, and (3) along the Arkansas River for use of this transportation option in exporting stone.

Although every part of the Interior Highlands region has some bedrock units that have proven suitable for a wide variety of construction applications, some units that are generally acceptable are nonetheless more problematic than others. Geologic maps can be used, along with the information in this report, to locate the best stratigraphic units available in a particular area. However, there are some aspects of the bedrock in these units that are of importance to the stone industry that are not conveyed by most existing geologic maps. Some matters that would be of benefit to the stone industry have been identified herein that could be addressed by future research. These include (1) locating areas in the northeastern Ozarks with dolostone that would more consistently pass soundness test requirements, (2) locating zones of abundant durable chert in the Boone Formation to use as a local source of siliceous aggregate for surface-course asphalt concrete in northern Arkansas, (3) producing geologic maps that delineate the surface distribution of thick sandstones within shale-dominated bedrock units like the Atoka and Bloyd Formations, and (4) determining and mapping the aerial distribution of the better-cemented portions of thick sandstones of the Jackfork Sandstone in the Ouachitas. Information of this nature would facilitate exploration for suitable quarry locations for crushed stone aggregate.

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APPENDIX I

Quarry Location and Bedrock Source Information

This table gives information regarding the location of quarries used in some way for producing crushed-stone aggregate. Also the geologic bedrock mapping unit is given for each quarry if it could be determined, and something about the source of the information about the quarry. A description of the various abbreviations used in the table is given here.

Quarry No. The first column gives a quarry identification number assigned to the quarry in this study. Each designation begins with two letters that indicate the county in which the quarry is located. The abbreviations are as follows:

BE = Benton, BN = Boone, BX = Baxter, CB = Cleburne, CF = Crawford, CR = Carroll, CW = Conway, FA = Faulkner, FR = Franklin, FU = Fulton, GA = Garland, HS = Hot Spring, HO = Howard, IN = Independence, IZ = Izard, JO = Johnson, LG = Logan, LR = Lawrence, MD = Madison, MG = Montgomery, MR = Marion, NT = Newton, PI = Pike, PK = Polk, PP = Pope, PU = Pulaski, PY = Perry, RD = Randolph, SA = Saline, SB = Sebastian, SC = Scott, SE = Searcy, SH = Sharp, ST = Stone, SV = Sevier, VB = Van Buren, WA = Washington, WH = White, YE = Yell.

Some quarries have an A & B designation. Each is a single operation with either more than one pit, or a pit with upper and lower parts in different formations. FA03A is an older pit on the east side of Black Fork; FA03B is a newer pit on the west side. HS01A is the original novaculite pit at the site, while HS01B is excavations in the hornfelsic Stanley Shale. IN01A is the lower part of the quarry in the Plattin and Kimmswick Limestones; IN01B is the upper part of the same quarry in the Fernvale Limestone. IZ01 is split into IZ01A, the lower part in the Powell Dolomite, and IZ01B, the upper part in the Everton Formation. IZ02 is split into IZ02A, the upper part in the Powell, and IZ02B, the lower part in the mineralized Powell/Cotter contact zone. LG10A is the western of two pits in close proximity and LG10B the eastern, AQuarry #1 & #2" respectively, as designated by the owners. LR01A is the eastern and older of two pits, LR01B the western and newer. PK01A is in novaculite, and PK01B is a pit in the Hatton Tuff.

A few numbers are listed with "-CCG". These were operations that crushed creek rock, to produce crushed-stone aggregate. These operations were included only if it seemed that large creek rocks were used and that they would have come only from one bedrock unit, so that engineering tests on the crushed rock would be representative of that formation.

One quarry overlaps the boundary of two counties and is thus designated with a number indicating each county. It is listed twice, as LN01/PU05 and as PU05/LN01.

Quadrangle. This column indicates which USGS 7.5 minute topographic quadrangle the site can be found. There is for most a corresponding Arkansas Geological Commission geologic worksheet; in a few areas the worksheet is a 15 minute quadrangle map.

Township/Range. The quarry's location is given in this column according to the US Federal Rectangular Survey (General Land Office Grid System). This designation, as given here, is based on the position of the quarry with respect to the grid system as shown on the USGS quadrangle maps, not based on any legal description. A designation such as "W2, NE3, SW3, Sec 11, T9N, R25W" means Athe western half of the northeast quarter of the southwest quarter of Section 11, in the land block designated T9N, R25W. If a site seems to lie on a border between two parcels of land, it is designated with a "/". For example, "SE3 Sec 11/SW3 Sec 12" means the site is on the border between the southeast quarter of Section 11 and the southwest quarter of Section 12. Similarly, if a quarry is large and occupies significant parts of two adjacent parcels of land, a "-" is put between the designations of the two parcels.

Latitude and Longitude. These columns are used to give the quarry location as precisely as possible in terms of latitude and longitude. Some quarries were not field checked and did not have corroborating quadrangle map symbols, but their location is given in AHTD=s Materials Availability Study (MAS) or another source. For these, what is listed is the latitude and longitude (with a designation "ca") at the center of the quarter section that was indicated, or a likely spot for it to be in that indicated area. However, in some of these situations, a topographic feature on the quadrangle map was seen that is suggestive of a quarry, more-or-less corresponding with the given location. In these cases, the topographic feature's coordinates are given and accepted as accurate.

Cor. If a quarry symbol on the USGS quadrangle corroborates the location given, a Q is placed in this column. If a symbol on the county map corroborates the location, a C is indicated. If the location was field checked, an F is indicated. If the location was given by a reputable professional and considered to be reasonably accurate, the letter P is indicated. If the location given corresponds to a topographic feature that can be recognized as being derived from quarry activities, a T is indicated. Where none of these forms of corroborating information supports the location, an N is listed, and the latitude and longitude column has "ca".

Rock Unit. This column indicates the geologic bedrock map unit in which the quarry is located, as indicated by plotting the quarry's position on a geologic worksheet. In some parts of the State, the Atoka Formation is divided into Upper, Middle, and Lower Division; in such cases, this is indicated in the table. The symbol H is used to indicate sites that according to the geologic worksheet are in a different unit than what was observed to be in the quarry. The reason for the discrepancy is either incorrect mapping or the stripping off of the surface layer (which is what was mapped) to get at the underlying formation which was actually utilized; the rock unit that was apparently utilized is what is designated in this appendix.

Activ. This indicates activity as of summer 1997: AC = active; IN = inactive; UN = undeveloped (samples in such cases being either cores or samples taken from an exposed ledge).

Corps Map No. & Corps No. These columns indicate quarries for which Corps of Engineers data sheets are available. The pair of numbers under "Corps Map No." designates which 11 X 11 locator map the quarry is on, the numbers representing respectively the latitude and longitude of the southern and eastern margins of the map. The number in the next column is the number on that map used to designate the particular quarry. In some cases, investigation revealed that the same site was designated with a different number in different years, so more than one number may appear in this column.

AHTD Suppl. This column indicates whether or not the quarry was or is used for bidding on AHTD contracts, that is, whether or not there is some record of this quarry with the AHTD. An asterisk with Y means that the quarry is mentioned in the MAS. In some cases there was a question as to whether or not a particular quarry was the one that was indicated in the MAS; for these a "?" was included with an educated guess. In other cases, a quarry might have been located by other means, and persons interviewed may have been uncertain as to whether or not the stone was used in AHTD jobs.

QUARRY NO.	QUADRANGLE	TOWNSHIP/RANGE	LATITUDE	LONGITUDE	COR.	ROCK UNIT	ACTIV.	CORPS MAP NO.	CORPS NO.	AHTD SUPPL.
BE01	Springdale	NW¼, NE¼,Sec 21, T 18 N, R 30 W	36°13'32"	94°10'54"	F	Boone Fm	AC			Y
BE02	Pea Ridge	E½,NE¼, Sec 21, T 20 N, R 29 W	36°23'39"	94°03'26"	QF	Boone Fm	AC	36-94	3	Y
BE03	Sonora	SW¼, SE¼, Sec 16, T 18 N, R 29 W	36°13'34"	94°04'26"	Q	Boone Fm	AC			Y
BE04	Gravette	NE¼, Sec 36, T 21 N, R 33 W	36°27'32"	94°26'24"	F	Boone Fm	AC			Y
BE05	Bentonville North	NW¼, Sec 18, T 20 N, R 30 W	36°24'49"	94°12'51"	F	Boone Fm	IN			Y
BE06	Siloam Springs	NW¼, NE¼, Sec, 36, T 18 N R 34 W	36°12'04"	94°33'28"	F	Boone Fm	IN			Y
BE07	Siloam Springs	SW¼, Sec 11, T 18 N, R 34 W	36°14'54"	94°34'36"	F	Boone Fm	IN			Y
BE08	Pea Ridge	SW¼, Sec 31, T 21 N, R 28 W	36°26'42" ca	94°00'12" ca	N	Boone Fm	IN			Y*
BE09	Centerton	SW¼, Sec 35, T 20 N, R 31 W (?)	36°21'38" ca	94°15'12" ca	N	Boone Fm (?)	IN			Y*
BE10	Cherokee City	NE¼, SW¼, Sec 14, T 19 N, R 34 W	36°19'32"	94°34'27"	QC	Boone Fm	IN			Y*
BE11	Cherokee City	SW¼, SW¼, Sec 20, T 19 N, R 33 W	36°18'20"	94°31'37"	Q	Boone Fm	IN			Y*
BE12	Rogers	NW¼, Sec 30, T 19 N, R 29 W	36°17'37" ca	94°06'51" ca	N	Boone Fm	IN			Y*
BE13	Spring Valley	SE¼, Sec 12, T 18 N, R 28 W	36°14'30" ca	93°54'35" ca	N	Boone Fm	IN			Y*
BE14	Garfield	SW¼, Sec 22, T 21 N, R 28 W	36°28'17" ca	93°57'00" ca	N	Boone Fm (?)	IN			Y*
BE15	Gravette	SE¼, SW¼, Sec 36, T 21 N, R 33 W	36°26'57"	94°26'46"	Q	Boone Fm	IN			Y
BE16	Centerton	SE¼, NW¼, Sec 34, T 20 N, R 31 W	36°22'04"	94°16'06"	Q	Batesville Ss	IN			?
BN01	Harrison	SW¼, SE¼, Sec 33, T 18 N, R 19 W	36°09'42"	93°00'17"	Q	Boone Fm	AC	36-93	5?	Y
BN02	Omaha	NE¼/SE¼, SW¼, Sec 8, T 20 N, R 21 W	36°24'07"	93°13'55"	F	Boone Fm	AC			Y
BN03	Gaither	SE¼, 'NE¼, SE¼, Sec 13, T 18 N, R 21 W	36°12'36"	93°09'24"	QC	Boone Fm	IN			Y*
BN04	Omaha NE	SW¼, SE¼, Sec 16, T 21 N, R 20 W	36°28'02"	93°06'30"	Q	Cotter Dolomite	IN			Y*
BN05	Zinc	SE¼, NW¼, SE¼, Sec 23, T 20 N, R 19 W	36°21'59"	92°57'57"	QCF	Boone Fm	IN			Y*
BN06	Diamond City	SW¼, SE¼, Sec 6, T 20 N, R 18 W	36°24'30"	92°55'43"	CF	Cotter Dolomite	IN			Y*
BN07	Everton	NW¼, NE¼, Sec 4, T 19 N, R 18 W	36°09'20"	93°53'44"	F	St. Peter Ss	AC			Y
BN08	Batavia	N½, NW¼, SW¼, Sec 23, T 19 N, R 21 W	36°17'14"	93°11'16"	F	Boone Fm	AC			Y
BX01	Mountain Home West	NW¼, SW¼, Sec 8, T 19 N, R 13 W	36°19'52"	92°24'22"	QC	Cotter Dolomite	IN			Y
BX02	Mountain Home West	Central part of Sec 25, T 20 N, R 14 W	36°22'28"	92°26'10"	QC	Cotter Dolomite	AC			Y
BX03	Mountain Home East	NE¼, SE¼, Sec 25, T 19 N, R 13 W	36°17'11"	92°19'17"	QC	Powell Dolomite	AC			Y
BX04	Norfork	NE¼, NE¼, Sec 12, T 17 N, R 13 W	36°07'55"	92°18'18"	F	Everton Fm	AC			Y
BX05	Norfork SE	SW¼, Sec 7, T 17 N, R 12 W	36°07'17"	92°17'55"	CF	Everton Fm	IN			Y
BX06	Clarkridge	NW¼, NE¼, Sec 10, T 20 N, R 13 W	36°25'27"	92°21'21"	Q	Cotter Dolomite	IN			Y*
BX07	Norfork Dam South	SE¼, SE¼, Sec 35, T 18 N, R 12 W	36°10'43"	92°14'09"	QCF	Everton Fm	IN			Y*
BX08	Norfork	NE¼, NW¼, Sec 28, T 18 N, R 12 W	36°12'12"	92°16'43"	F	Cotter/Powell Dolomites	IN			Y*
BX09	Norfork	SE¼, SE¼, NW¼, Sec 34, T 18 N, R 13 W	36°09'23"	92°20'51"	CF	Everton Fm	IN			Y
BX10	Mountain Home West	SW¼, SE¼, Sec 25, T 19 N, R 14 W	36°16'59"	92°26'02"	CF	Cotter Dolomite	AC			Y
CB01	Brownsville	NE¼, NE¼, Sec 13/SE¼, SE ¼, Sec 12, T 10 N, R 10 W	35°30'15"	92°00'20"	QC	Bloyd/'Hale	AC	35-92	14	Y
CB02	West Pangburn	SE¼, NW¼, Sec 34, T 10 N, R 9 W	35°27'19"	91°56'56"	QC	Atoka (Lower)	IN	35-91	4	Y*
CB03	Greers Ferry Dam	NW¼, SW¼, Sec 9, T 10 N, R 9 W	35°30'38" ca	91°58'11" ca	N	Bloyd/Hale	UN	35-91	3	N
CB04	Greers Ferry Dam	SE¼, Sec 30, T 11 N, R 9 W	35°33'10" ca	91°59'36" ca	N	Bloyd/Hale	UN	35-91	2	N
CB05	West Pangburn	W½, Sec 17, T 10 N, R 9 W	35°29'52" ca	91°59'19" ca	N	Bloyd/Hale	UN	35-91	5	N
CB06	Greers Ferry	NE¼, SE¼, Sec 19, T 11 N, R 11 W (under lake)	35°34'19"	92°11'49"	F	Bloyd/Hale	IN	35-92	1	N
CB07	Quitman	NE¼, SW¼/NW¼, SE¼, Sec 11, T 9 N, R 11 W	35°25'32"	92°08'12"	F	Atoka Fm	IN			Y?
CB08	Brownsville	NE¼, SW¼, Sec 36, T 11 N, R 10 W	35°32'25"	92°00'56"	Q	Bloyd/Hale	IN	35-92	4	Y
CB09	Greers Ferry	SE¼, SW¼, Sec 12, T 10 N, R 12 W	35°30'36"	92°13'27"	QCF	Atkoa Fm	IN			Y*
CB10	Greers Ferry	SW¼, NE¼, SW¼, Sec 12, T 10 N, R 12 W	35°30'48"	92°13'28"	QCF	Atkoa Fm	IN			Y*
CB11	Brownsville	NE¼, SW¼, Sec 12, T 11 N, R 11 W	35°35'55"	92°06'59"	QC	Bloyd/Hale	IN			Y*
CB12	Greers Ferry Dam	NW¼, SW¼, Sec 12, T 11 N, R 9 W	35°33'17"	91°56'57"	QC	Bloyd/Hale	IN			Y*
CB13	Heber Springs	SW¼, NW¼, Sec 5, T 9 N, R 10 W	35°26'40"	92°05'43"	QCF	Atkoa Fm	IN	35-92	2	Y*
CB14	Quitman	NE¼, NE¼, Sec 15, T 9 N, R 11 W	35°25'10"	92°08'53"	F	Atkoa Fm	IN			Y*
CB15	Heber Springs	NE¼, SE¼, Sec 31, T 10 N, R 10 W	35°27'19"	92°05'48"	F	Atkoa Fm	IN			Y*
CB16	Brownsville	SE'¼, SW¼, Sec 12, T 11 N, R 11 W	35°35'45"	92°06'59"	CF	Bloyd/Hale	IN			Y*
CB17	Brownsville	NW¼, SE¼, Sec 12, T 11 N, R 11 W	35°35'57"	96°06'49"	QCF	Bloyd/Hale	IN			Y*
CB18	Greers Ferry Dam	SW¼, SW¼, SE¼, Sec 6, T 11 N, R 9 W	35°36'48"	91°59'48"	QC	Bloyd/Hale	IN			Y*
CB19	Drasco	NE¼, SW¼, NE¼, Sec 27, T 12 N, R 9 W	35°39'03"	91°56'20"	QCF	Bloyd/Hale	IN			Y*
CB20	Concord	SE¼, Sec 11, T 12 N, R 8 W	35°41'13"	91°48'48"	F	Cane Hill	IN			Y*
CB21	Quitman	SE¼, NE¼, Sec 3, T 9 N, R 11 W	35°26'34"	92°08'49"	CF	Atkoa Fm	IN			Y*
CF01	Van Buren	SW¼, SE¼, Sec 10, T 9 N, R 31 W	35°27'57"	94°16'59"	CF	Hartshorne Ss	AC			Y

CF02	Mountainburg SW	NE¼, NW¼, Sec 19, T 10 N, R 30 W	35°31'58"	94°13'52"	F	Atkoa Fm	IN			Y
CF03	Van Buren	SW¼, Sec 9 - SE¼, Sec 8 - NE¼, Sec 17, T 9 N, R 31 W	35°27'55"	94°18'46"	QC	Hartshorne Ss	IN	35-94	6	Y*
CF05	Mountainburg	NW¼, SE¼, SE¼, Sec 34, T 12 N, R 30 W	35°40'01"	94°09'56"	F	Atkoa Fm	IN			Y
CF06-CCG	Mountainburg SW	NE¼/SE¼, Sec 31, T 11 N, R 30 W	35°35'11"	94°13'26"	F	Atoka-CCG	IN			Y
CK01	Caddo Valley	Sec 35, T 6 S., R 20 W	34°10'23" ca	93°06'31" ca	N	Atoka (Lower)	IN	34-93	12	N
CK02	Caddo Valley	S½, SE¼, Sec 13, T 6 S., R 20 W	34°12'40"	93°05'03"	QC	Jackfork Ss	IN	34-93	20	N
CK03	Caddo Valley	SW¼, Sec 14, T 6 S., R 20 W (at DeGray dam site)	34°12'47" ca	93°06'42" ca	N	Jackfork Ss	UN?	34-93	14	N
CK04	Caddo Valley	SE¼, NW¼, Sec 9, T 6 S., R 19 W	34°13'56"	93°02'23"	CP	Jackfork Ss	IN	34-93	23, 26	Y
CK05	Chalybeate Mtn. East	NE¼,SE¼, Sec 8, T 7 S., R 21 W	34°08'43"	93°15'30"	QC	Jackfork Ss	AC	34-93	19	Y
CK06	Antoine	NW¼, SE¼, Sec 27, T 7 S., R 23 W	34°06'21"	93°26'28"	QC	Jackfork Ss	IN	34-93	7	N
CR01	Berryville	NW¼, SW¼, Sec 34, T 20 N, R 24 W	36°20'58"	93°31'40"	Q	Cotter Dolomite	AC			Y
CR02	Blue Eye	SE¼, Sec 20, T 20 N, R 23 W	36°22'30" ca	93°26'38" ca	N	Boone Fm	UN	36-93	4	N
CR03	Beaver	SW¼, NW¼, Sec 10, T 20 N, R 27 W	36°25'02"	93°50'46"	Q	Boone Fm	IN	36-93	7	N
CR04		Location uncertain			N			36-93	8	
CR05	Beaver	NE¼, NW¼, Sec 35, T 21 N, R 27 W	36°27'06" ca	93°49'26" ca	N	Cotter Dolomite	UN?	36-93	9	N
CR06	Denver	NE'¼, NW¼, NE¼, Sec 21, T 21 N, R 22 W	36°28'15"	93°19'08"	F	Boone Fm	IN			Y*
CR07	Osage	NE¼, SE ¼, NE ¼, Sec 24, T 18 N, R 24 W	36°12'30"	93°28'47"	F	Boone Fm	IN			Y*
CR08	Green Forest	S½, NE¼, SE¼, Sec 19, T 19 N, R 23 W	36°17'24"	93°27'43"	Q	Boone Fm	IN			Y*
CR09	Grandview	E½, SE¼, SE¼, Sec 32, T 21 N, R 24 W	36°26'04"	93°32'51"	F	Cotter Dolomite	IN			Y*
CR10	Blue Eye	NW¼, 'SW¼, Sec 13, T 20 N, R 23 W	36°23'23	93°23'02"	C	Boone Fm	IN			Y*
CR11	Blue Eye	SE¼, SW¼, Sec 13, T 20 N, R 23 W	36°23'15"	93°22'49"	CF	Boone Fm p	IN			Y*
CR12	Green Forest	NW¼, SE¼, NW¼, Sec 14, T 19 N, R 23 W	36°18'28"	93°23'58"	F	Weddington Ss / Pitkin Ls	IN			*Y
CR13	Green Forest	W½, NW¼, SW¼, SE¼, Sec 36, T 20 N, R 24 W	36°20'48"	93°29'07"	F	Boone Fm	IN			?
CW01	Morrilton West	SE¼, SE¼, Sec 25, T 6 N, R 18 W	35°07'58"	92°51'30"	QC	Hartshorne Ss	IN	35-92	8	Y*
CW02	Morrilton West	SE¼/SW¼, SE¼, Sec 24, T 6 N, R 17 W	35°08'39"	92°45'29"	Q	Atoka (Upper)	IN	35-92	15	N
CW03	Menifee	NE¼, Sec 30,T. 6 N, R 14 W	35°07'56"	92°31'47"	Q	Atoka (Middle)	IN			Y*
CW04	Adona	SE¼, Sec 36, T 6 N, R 19 W	35°07'17"	92°57'57"	Q	Atoka (Upper)	IN			Y*
CW05	Springfield	SE¼, SE¼, Sec 31, T 9 N, R 15 W	35°22'21"	92°37'25"	F	Atkoa Fm	IN			Y*
CW06	Formosa	N½, NE¼, SE¼, Sec 36, T 9 N, R 15 W	35°22'35"	92°32'13"	F	Atkoa Fm	IN			Y*
CW07	Hattieville	NE¼, NW¼, Sec 1,T. 7 N, R 17 W	35°17'08"	92°45'41"	QC	Atkoa Fm	IN			Y*
CW08	Springfield	NE¼, SW¼, SE¼, Sec 2, T 7 N, R 15 W	35°16'16"	92°33'38"	F	Atkoa Fm	IN			Y*
CW09	Springfield	NE¼, NE¼, Sec 16, T 17 N,R. 15 W	35°15'11"	92°35'37"	QF	Atkoa Fm	IN			Y*
CW10	Morrilton East	SE¼, SW¼, Sec 13, T 7 N, R 16 W	35°14'35"	92°39'15"	QC	Atoka (Upper)	IN			Y*
CW12	Menifee	SE¼, Sec 12, T 6 N, R 15 W	35°10'14"	92°32'39"	CF	Atoka (Middle)	IN			Y*
CW13	Morrilton East	SE¼, SW¼, Sec 7, T 6 N, R 15 W	35°10'14"	92°38'18"	CF	Atoka (Middle)	IN			Y*
CW14	Morrilton West	N½, SW¼, Sec 11, T 6 N, R 17 W	35°10'40"	92°47'00"	QC	Atoka (Upper)	IN			Y*
CW15	Morrilton East	SE¼, NE¼, NW¼, Sec 16, T 6 N, R 16 W	35°10'02"	92°42'36"	QCF	Atoka (Upper)	IN			Y*
CW16	Morrilton East	NE¼, SE¼, Sec 21, T 6 N, R 16 W	35°08'50"	92°42'07"	CF	Atoka (Upper)	IN			Y*
CW17	Springfield	SE¼, Sec 31, T 8 N, R 14 W	35°17'06"	92°31'32"	F	Atkoa Fm	IN			Y*
CW18	Menifee	NW¼, SW¼, Sec 30, T 6 N, R 14 W	35°07'44"	92°32'20"	QC	Atoka (Middle)	IN			N
CW19	Morrilton West	SW¼, Sec 24, T 6 N, R 17 W	35°08'44"	92°45'58"	QC	Atoka (Upper)	IN			N?
CW20	Morrilton West	NE¼, NE¼, Sec 22/NW¼, NW¼, Sec 23, T 6 N, R 17 W	35°09'20"	92°47'19"	Q	Atoka (Upper)	IN			N?
CW21	Formosa	NW¼, SE¼, SE¼, Sec 1, T 9 N, R 15 W	35°26'41"	92°32'09"	QF	Atkoa Fm	IN			?
CW22	Cleveland	SW¼, NW¼, Sec 23, T 9 N, R 16 W	35°24'36"	92°40'20"	CF	Atkoa Fm	IN			Y
CW23	Cleveland	SW¼, SE¼, Sec 8, T 9 N, R 16 W	35°26'04"	92°42'54"	QC	Atkoa Fm	IN			?
FA01	Guy	SE¼, NE¼, Sec 11, T 8 N, R 13 W	35°20'41"	92°20'36"	QF	Atkoa Fm	IN	35-92	3	N?
FA02	Damascus	NW¼/SW¼, SE¼, Sec 29, T 8 N, R 13 W	35°17'49"	92°24'05"	CF	Atkoa Fm	AC	35-92	5, 12	Y
FA03A	Holland	NE¼, Sec 24, T 7 N, R 13 W	35°13'58"	92°19'38"	CF	Atoka (Upper)	IN	35-92	9	Y*
FA03B	Holland	NE¼, Sec 24, T 7 N, R 13 W	35°13'51"	92°19'48"	CF	Atoka (Upper)	IN			Y*
FA04	Fourche	NW¼/SW¼, SW¼, Sec 13, T 4 N, R 15 W	34°58'54"	92°33'38"	Q	Atoka (Middle)	IN			Y*
FA06	Fourche	NE¼/SE¼, Sec 19, T 4 N, R 14 W	34°58'10"	92°31'48"	QC	Atoka (Lower)	IN	34-92	16	Y
FA07	Hamlet	SW¼, Sec 11 - NW¼, Sec 14, T 5 N, R 12 W	35°04'21"	92°15'17"	QCF	Atoka (Upper)	AC			Y
FA08	Vilonia	S½, SE¼, SE¼, Sec 15, T 5 N, R 11 W	35°03'28"	92°09'28"	F	Atoka (Upper)	IN			N
FA09	Rose Bud	SE¼, SW¼, Sec 24, T 8 N, R 11 W	35°18'18"	92°07'20"	Q	Atoka (Middle)	IN			Y*
FA10	Holland	S½, NW¼, NE¼, Sec 10, T 6 N, R 12 W	35°10'18'	92°15'53"	Q	Atoka (Upper)	IN			Y*
FA11	Mayflower	N½, NW¼, SW¼, Sec 6, T 3 N, R 13 W	34°55'24"	92°26'21"	QC	Atoka (Upper)	IN			Y*
FA12	Mayflower	NE¼, Sec 28, T 4 N, R 14 W	34°57'32"	92°29'59"	QC	Atoka (Upper)	IN			Y*
FA13	Greenbrier	NE¼, NE¼, Sec 16, T 7 N, R 13 W	35°14'51"	92°22'46"	QF	Atoka (Upper)	IN			Y*

FA14	Gleason	SW¼, Sec 18, T 5 N, R 14 W	35°03'57"	92°32'22"	QC	Atoka (Middle)	IN			N?
FA15	Guy	SW¼, SE¼, Sec 11, T 8 N, R 13 W	35°20'16"	92°20'51"	QF	Atkoa Fm	IN			N?
FR01	Hunt	SE¼, SW¼ - SW¼, SE¼, Sec 23, T 10 N, R 26 W	35°30'32"	93°43'57"	CF	Hartshorne Ss	AC			Y
FR02	Ozark	NE¼, Sec 19, T 9 N, R 26 W	35°26'03"	93°48'00"	Q	Hartshorne Ss	IN			N
FR03	Ozark	S½, SW¼, SW¼, Sec 16, T 9 N, R 26 W	35°26'16"	93°46'35"	QC	Hartshorne Ss	IN	35-93	7	Y*
FR04	Ozark	NE¼, NE¼, Sec 1, T 8 N, R 27 W	35°23'57"	93°48'36"	QF	Hartshorne Ss	IN			Y*
FR05	Cravens	SW¼, SW¼, Sec 2, T 10 N, R 28 W	35°33'33"	93°56'56"	Q	Atoka Fm	IN			Y*
FR06	Mulberry	SW¼, SW¼, Sec 1, T 8 N, R 29 W	35°23'41"	94°02'15"	QCF	Hartshorne Ss	IN			Y*
FR07	Branch	SW¼, NW¼, NW¼, Sec 13, T 7 N, R 28 W	35°17'07"	93°56'07"	T	McAlester Fm	IN			Y*
FR08	Mountainburg SE	NE¼, SE¼, Sec 35, T 11 N, R 29 W	35°34'50"	94°02'30"	QF	Atoka Fm	IN			Y
FR09	Mountainburg SE	S½, NE¼, SW¼,Sec 25, T 11 N, R 29 W	35°35'33"	94°01'58"	QCF	Atoka Fm	IN			Y
FR10	Yale	NW¼/SW¼, Sec 22, T 12 N, R 26 W	35°41'24"	93°44'52"	F	Atkoa Fm	AC			Y
FU01	Gepp	NW¼, SE¼, Sec 13, T 20 N, R 11 W	36°23'48"	92°06'17"	CF	Cotter Dolomite	IN			Y*
FU02	Gepp	SW¼, SE¼, Sec 23, T 21 N, R 11 W	36°27'53"	92°07'20"	F	Cotter Dolomite	IN			Y*
FU03	Salem	SW¼, SE¼, Sec 31, T 20 N, R 7 W	36°20'30"	91°46'15"	Q	Cotter Dolomite	IN			Y*
FU04	Salem	NW¼, SW¼, Sec 34, T 20 N, R 8 W	36°20'50"	91°50'05"	QC	Cotter Dolomite	IN			Y*
FU05	Wirth	NE¼, SE¼, Sec 15/NW¼, SW¼, Sec 14, T 20 N, R 5 W	36°23'12"	91°29'20"	QF	Cotter Dolomite	IN			Y*
FU06	Mammoth Spring	NE¼, Sec 21, T 20 N, R 6 W	36°22'40"	91°37'26"	F	Cotter Dolomite	IN			Y*
FU07	Agnos	N½, SW¼, NE¼, Sec 31, T 19 N, R 6 W	36°15'49"	91°39'42"	Q	Cotter Dolomite	IN			Y*
FU08	Viola	SW¼, SE¼, Sec 19, T 21 N, R 9 W	36°27'47"	91°58'46"	Q	Cotter Dolomite	IN			Y*
FU09	Mammoth Spring	NW¼/SW¼, NE¼, Sec 15, T 21 N, R 6 W	36°28'53"	91°36'28"	F	Cotter Dolomite	IN			Y*
FU10	Agnos	NW¼, SE¼, Sec 8, T 19 N, R 6 W	36°18'57"	91°38'42"	CF	Cotter Dolomite	IN			Y*
FU11	Salem Knob	NW¼, NW¼, Sec 26, T 21 N, R 8 W	36°27'26"	91°49'04"	Q	Cotter Dolomite	IN			Y*
FU12	Stuart	SW¼, SE¼, Sec 12, T 19 N, R 6 W	36°18'33"	91°34'17"	QF	Cotter Dolomite	IN			Y
FU13	Camp	NW¼, NW¼, Sec 31, T 21 N, R 6 W	36°26'28"	91°40'11"	QF	Cotter Dolomite	IN			?
GA01		Probably under Lake Ouachita now; location uncertain			N			34-93	1	
GA02	Mountain Pine	SW¼, NW¼, Sec 34, T 1 S., R 20 W	34°36'20"	93°08'17"	QF	Womble Shale (Ls)	IN	34-93	2	Y
GA03	Lake Catherine	NW¼, Sec 18, T 3 S., R 18 W	34°28'29"	92°58'51"	QF	Hot Springs Ss	IN			Y
GA05	Fountain Lake	N½, NW¼, Sec 21, T 2 S., R 18 W	34°32'53"	92°56'37"	QCF	Arkansas Novaculite	IN			Y
GA06	Fountain Lake	SW¼, Sec 26, T 2 S., R 18 W	34°31'27"	92°54'28"	Q	Arkansas Novaculite	IN			Y
GA07	Mountain Pine	SE¼, SW¼/SW¼, SE¼, Sec 9, T 2 S., R 20 W	34°34'06"	93°08'49"	QF	Hot Springs Ss	IN			Y
HO01	Gillham Dam	NW¼, Sec 32, T 6 S., R 30 W	34°12'16" ca	94°13'30" ca	N	Stanley Fm	UN?	34-94	8	N
HO02	Gillham Dam	NW¼, NE¼, Sec 29, T 6 S., R 30 W	34°13'05"	94°12'56"	F	Stanley Fm	IN	34-94	19	N
HS01-A	Malvern North	S½, NE¼, SE¼, Sec 29, T 3 S., R 17 W	34°26'01"	92°50'59"	CF	Arkansas Novaculite	IN			Y
HS01-B	Malvern North	NW¼, SE¼, Sec 29, T 3 S., R 17 W	34°26'12"	92°51'15"	F	Stanley Fm - hornfels	AC			Y
HS02	Caddo Valley	SW¼, NW¼, Sec 14, T 6 S., R 19 W	34°12'58"	93°00'36"	Q	Jackfork Ss	IN	34-93	22	N
HS03	Malvern North	N½, SE¼, NW¼, Sec 34, T 3 S., R 17 W	34°25'31"	92°49'17"	QC	Arkansas Novaculite	AC			Y*
HS04	Malvern North	SW¼, NW¼, Sec 29, T 3 S. R 17 W	34°26'17"	92°51'48"	F	Syenite	IN			N
HS05	Malvern North	S½, SE¼, NW¼,Sec 9, T 4 S., R 17 W	34°23'42"	92°50'23"	Q	Arkansas Novaculite	IN			Y*
HS06	Hempwallace	SE¼, Sec 15, T 4 S., R 20 W	34°22'50"	93°07'33"	F	Arkansas Novaculite	IN			Y*
HS07	Malvern North	SW¼, Sec 8, T 3 S. R 16 W	34°28'43"	92°45'05"	QP	Arkansas Novaculite	AC			Y
IN01A	Batesville/Sulphur Roc	SW¼, Sec 34, T 14 N, R 6 W	35°48'33"	91°37'30"	QC	Plattin/Kimmswick	AC			Y
IN01B	Batesville/Sulphur Roc	SW¼, Sec 34, T 14 N, R 6 W	35°48'33"	91°37'30"	QC	Fernvale	AC			Y
IN02	Batesville/Bethesda	N½, Sec 9, T 13 N, R 7 W	35°47'30"	91°45'00"	QC	Boone Fm	AC			Y
IN03	Salado	W½, SW¼, SE¼, Sec 14, T 12 N, R 6 W	35°39'46"	91°36'18"	QC	Pitkin Ls	AC	35-91	13	Y
IN04	Cord	SW¼, SW¼, Sec 17, T 14 N, R 3 W	35°50'52"	91°20'15"	F	Plattin Ls	IN			Y
IN05	Olyphant	SW¼, SE¼, Sec 2, T 11 N, R 5 W	35°36'09"	91°29'54"	CF	Pitkin Ls	IN	35-91	11	Y*
IN06	Cord	SW¼/SE¼, Sec 8, T 14 N, R 3 W	35°51'40"	91°20'02"	QCF	Plattin Ls	AC			Y
IN07	Cord	NE¼, Sec 17, T 14 N, R 3 W	35°51'22"	91°20'02"	F	Plattin Ls	IN			Y
IN08	Cord	SW¼, SE¼, Sec 17, T 14 N, R 3 W	35°50'57"	91°19'42"	F	Plattin Ls	IN			Y*
IN09	Concord	NW¼, Sec 30, T 13 N, R 7 W	35°43'46"	91°46'41"	QC	Pitkin Ls	IN			Y*
IN10	Salado	SE¼, Sec 21, T 12 N, R 5 W	35°38'45"	91°31'42"	F	Pitkin Ls	IN			Y*
IN11	Charlotte	NE¼, SE¼, Sec 23, T 14 N, R 4 W	35°50'14"	91°22'38"	QF	Plattin Ls	IN			Y*
IN12	Huff	NE¼, NE¼, Sec 34, T 11 N, R 6 W	35°32'37"	91°37'08"	F	Bloyd/Hale	UN			Y
IZ01A	Franklin	NW¼, SW¼, Sec 4, T 17 N, R 8 W	36°09'13"	91°51'12"	QCF	Powell Dolomite	AC			Y

IZ01B	Franklin	NW¼, SW¼, Sec 4, T 17 N, R 8 W	36°09'13"	91°51'12"	QCF	Everton Fm	AC			Y
IZ02A	Myron	SW¼, NW¼, Sec 25, T 18 N, R 7 W	36°11'17"	91°41'27"	CF	Powell Dolomite	AC			Y
IZ02B	Myron	SW¼, NW¼, Sec 25, T 18 N, R 7 W	36°11'17"	91°41'27"	CF	Cotter/Powell contact	AC			Y
IZ03	Mt. Pleasant	SE¼, Sec 4, T 14 N, R 8 W	35°53'10"	91°51'16"	QC	Fernvale Ls	IN	35-91	1	N
IZ04	Mt. Pleasant/Guion	Center, Sec 5, T 14 N, R 8 W	35°53'27"	91°52'30"	QC	Plattin Ls	IN	35-91	6	N
IZ05	Zion	SE¼, SE¼, Sec 15, T 16 N, R 8 W	36°01'57"	91°49'41"	F	Everton Fm	AC			Y
IZ06	Zion	NW¼, NE¼, Sec 20, T 16 N, R 7 W	36°01'41"	91°45'35"	F	Plattin Ls	IN			Y
IZ07	Myron	NE¼, SE¼, Sec 26, T 18 N, R 7 W	36°11'05"	91°41'40"	QCF	Powell Dolomite	IN			Y*
IZ08	Norfork Dam South	NW¼/SW¼, SW¼, Sec 22, T 18 N, R 11 W	36°12'25"	92°09'25"	Q	Everton Fm	IN			Y*
IZ09	Mount Pleasant	SE¼, Sec 9, T 15 N, R 8 W	35°57'34"	91°50'53"	Q	Everton Fm	IN			Y*
IZ10	Sylamore	NW¼/SW¼, SE¼, Sec 35, T 16 N, R 10 W	35°59'34"	92°01'40"	F	Everton Fm	IN			Y*
IZ12	Oxford	NE¼, NE¼, Sec 10, T 18 N, R 9 W	36°14'30"	91°55'41"	F	Powell Dolomite	IN			Y*
IZ13	Pineville	NE¼, SW¼, Sec 9, T 18 N, R 10 W	36°14'06"	92°03'48"	F	Everton Fm	IN			Y*
IZ14	Melbourne	SE¼, Sec 18, T 16 N, R 8 W	36°02'03"	91°52'54"	F	Everton Fm	IN			Y*
IZ15	Zion	SW¼, SE¼, Sec 32, T 17 N, R 27 W	36°04'29"	91°45'41"	F	Powell Dolomite	IN			Y
JO01	Clarksville	N½, NW¼, SE¼, Sec 27, T 10 N, R 23 W	35°29'34"	93°25'39"	F	Hartshorne Ss	AC			?
JO02	Clarksville	NE¼, SW¼, Sec 27, T 10 N, R 23 W	35°29'33"	93°25'51"	F	Hartshorne Ss	IN			Y
JO03	Clarksville	NW¼/SW¼, SE¼, Sec 27, T 10 N, R 23 W	35°29'24"	93°25'36"	F	Hartshorne Ss	IN			Y*
JO04	Clarksville	NE¼, Sec 23, T 9 N, R 23 W	35°25'24"	93°24'22"	F	Savannah Fm	IN			Y*
JO05	Hartman	NE¼, NW¼, Sec 36, T 10 N, R 25 W	35°29'23"	93°36'36"	F	Hartshorne Ss	IN			Y*
JO06	Hartman	SW¼, SE¼, Sec 8, T 9 N, R 24 W	35°26'54"	93°34'17"	F	Hartshorne Ss	IN			Y*
JO07	Hartman	NW¼, Sec 17, T 9 N, R 24 W	35°26'32"	93°34'41"	F	Hartshorne Ss	IN			Y*
JO08	Harmony	SW¼, Sec 6, T 10 N, R 24 W	35°32'54"	93°35'41"	Q	Hartshorne Ss	IN			Y*
JO09	Ozone	SW¼, SW¼, Sec 28, T 12 N, R 23 W	35°39'41"	93°27'03"	F	Atkoa Fm	IN			Y*
JO10	Knoxville	SW¼, NW¼, Sec 32, T 9 N, R 22 W	35°23'32"	93°22'02"	F	Savannah Fm	IN			Y*
JO11	Hagarville	NW¼, SW¼, NW¼, Sec 1, T 10 N, R 22 W	35°33'10"	93°17'31"	F	Atkoa Fm	IN			Y
JO12	Coal Hill	NW¼, NW¼, SW¼, Sec 30, T 9 N, R 25 W	35°24'43"	93°42'28"	QC	Hartshorne Ss	IN			Y
LG01	Hartman	NW¼ - NE¼, Sec 12, T 8 N, R 25 W	35°22'44"	93°36'20"	CF	Savannah Fm	IN			Y
LG02	Delaware	NE¼, SE¼, Sec 20, T 8 N, R 22 W	35°19'55"	93°21'02"	CF	Hartshorne Ss	AC	35-93	9	Y
LG03	Scranton	SE¼, Sec 34 - SW¼, Sec 35, T 8 N, R 24 W	35°18'32"	93°31'30"	QC	Hartshorne Ss	AC			Y
LG04	Delaware	NE¼, Sec 26, T 8 N, R 22 W ?	35°19'22" ca	93°17'59" ca		Hartshorne Ss	UN	35-93	3	N
LG05	Ozark	SW¼, NW¼, Sec 8, T 8 N, R 26 W	35°22'45"	93°47'11"	QCF	Hartshorne Ss	IN			Y*
LG06	Ozark	NW¼/NE¼, NW¼, Sec 8, T 8 N, R 26 W	35°23'02"	93°47'08"	QF	Hartshorne Ss	IN			Y*
LG07	Ozark	NE¼, NW¼, SE¼, Sec 6, T 8 N,R. 26 W	35°23'32"	93°47'40"	QC	Hartshorne Ss	IN	35-93	6	N?
LG08	Magazine Mtn. NE	N½, NE¼, Sec 24, T 6 N, R 25 W	35°10'32"	93°36'13"	CF	Savannah Fm	IN			Y*
LG09	Caulksville	NW¼, NE¼, Sec 4, T 7 N, R 27 W	35°18'52"	93°52'14"	QF	Savannah Fm	AC			Y*
LG10A	Ozark	NE¼, SE¼, NW¼, Sec 6, T 8 N, R 26 W	35°23'44"	93°47'56"	QCF	Hartshorne Ss	IN			Y
LG10B	Ozark	NW¼, SW¼, NE¼, Sec 6, T 8 N, R 26 W	35°23'41"	93°47'46"	F	Hartshorne Ss	IN			Y
LN01/PU05	Cabot	See PU05/LN01. Quarry straddles 2 counties.	34°57'52"	92°04'10"	Q	Atoka (Middle)	AC			Y
LN02	Beebe	NW¼, NW¼, Sec 27, T 5 N, R 9 W	35°02'19"	91°57'34"	QF	Atoka (Middle)	IN			Y
LN03	Beebe	SE¼, SW¼, Sec 32, T 5 N, R 9 W	35°00'40"	91°59'36"	P	Atoka (Middle)	IN			Y
LR01A	Imboden	SE¼, SW¼, Sec 31, T 18 N, R 1 W	36°09'13"	91°07'42"	QC	Powell Dolomite	IN			Y
LR01B	Imboden	SW¼/SE¼, Sec 36, T 18 N, R 2 W	36°09'21"	91°08'38"	QC	Powell Dolomite	AC	36-91	9	Y
LR02	Imboden	NW¼, SE¼, Sec 2, T 17 N, R 2 W	36°08'36"	91°09'34"	QC	Powell Dolomite	AC	36-91	7, 8	Y
LR03	Imboden	SE¼, SW¼, Sec 25, T 18 N, R 2 W	36°10'05"	91°08'45"	Q	Powell Dolomite	AC	36-91	3	Y
LR04	Black Rock	SE¼, SE¼, SE¼, Sec 18, T 17 N, R 1 W	36°06'33"	91°07'07"	Q	Everton Fm	IN	36-91	5	N
LR05	Black Rock	NE¼, NW¼, Sec 29, T 17 N, R 1 W	36°05'27"	91°06'38"	QC	Everton Fm	IN	36-91	6	N
LR06	Strawberry	NE¼, Sec 31, T 16 N, R 3 W	35°59'33"	91°20'27"	F	Everton Fm	IN			Y
LR07	Imboden	SW¼, SW¼, Sec 12, T 17 N, R 2 W	36°07'37"	91°09'02"	F	Powell Dolomite	UN			Y
MD01	Huntsville	NE ¼, SW¼, Sec 19, T 17 N, R 25 W	36°07'12"	93°41'14"	QCF	Boone Fm	IN			Y*
MD02	Kingston	S½, SW¼, SE¼, Sec 28, T 17 N, R 24 W	36°05'53"	93°32'24"	Q	Boone Fm	IN			Y*
MD03	Marble	SE¼, SW¼, Sec 17, T 17 N, R 24 W	36°08'35"	93°34'42"	F	Boone Fm	IN			Y*
MD04	Hartwell	SW¼, SE¼, Sec 21, T 16 N, R 27 W	36°02'12"	93°50'44"	QF	Pitkin Ls	IN			Y*
MD05	Hindsville	SE¼, Sec 28, T 18 N, R 27 W	36°11'35" ca	93°51'25" ca	N	Boone Fm	IN			Y*
MD06	Forum	SW¼, NW¼, Sec 11, T 18 N, R 26 W	36°14'22"	93°43'31"	QF	Boone Fm	IN			Y*
MD07	Forum	NW¼, SW¼, Sec 16, T 17 N, R 25 W	36°08'05"	93°39'16"	F	Boone Fm	IN			Y*
MD08	Forum	NE¼, Sec 22, T 17 N, R 26 W	36°07'48"	93°44'03"	QF	Boone Fm	IN			Y*

MG01	Mt. Ida	NE¼, NW¼, Sec 33, T 2 S., R 25 W	34°32'04"	93°40'52"	F	Collier Shale (Ls)	IN			Y
MG02	Caddo Gap	S½, SE¼, SW¼, Sec 7, T 4 S., R 24 W	34°24'09"	93°36'44"	F	Big Fork Chert	AC			Y
MG03	Mount Ida	NW¼, SE¼, SE¼, Sec 3, T 2 S., R 25 W	34°35'47"	93°39'12	QCF	Big Fork Chert	IN			Y*
MG04	Caddo Gap	NE¼, NW¼, Sec 6, T 4 S., R 24 W	34°25'48"	93°36'36"	P	Womble Shale (Ls)	IN			?
MR01	Cotter SW	SW¼, 'NW¼, SW¼, Sec 26, T 19 N, R 16 W	36°15'34"	92°39'14	CF	Powell Dolomite	IN	36-92	3	N
MR02	Cotter SW	SW¼, SW¼, Sec 30, T 19 N, R 16 W	36°15'36"	92°43'26"	F	Powell Dolomite	IN			Y
MR03	Cotter SW	SE¼,SE¼, Sec 25, T 19 N, R 17 W	36°15'33"	92°43'37"	F	Powell Dolomite	AC			Y
MR04	Cotter SW/Cotter	W½, SE¼, Sec 13, T 19 N, R 16 W	36°17'08"	92°37'35"	QC	Everton Fm	IN	36-92	1	N
MR05	Yellville	SW¼, Sec 15, T 18 N, R 16 W	36°12'02"	92°40'09"	CF	Powell Dolomite	AC			Y
MR06	Peel	SW¼, SW¼, Sec 4, T 20 N, R 17 W	36°24'26"	92°47'34"	F	Cotter Dolomite	IN			Y*
MR07	Cotter	SE¼, Sec 27/NE¼, Sec 34, T 19 N, R 15 W	36°15'12"	92°33'09"	QC	Cotter Dolomite	IN			Y*
MR08	Bruno	NW¼, SW¼, Sec 25, T 18 N, R 18 W	36°10'38"	92°51'07"	QF	Boone Fm	IN			Y*
MR09	Pyatt	SW¼, NE¼, Sec 19, T 20 N, R 17 W	36°22'10"	92°49'09"	Q	Powell Dolomite	IN			Y*
MR10	Peel	SW¼, SW¼, Sec 10, T 20 N, R 17 W	36°23'29"	92°46'28"	QCF	Boone Fm	IN			Y*
NT01	Murray	SE ¼, NE¼, Sec 23, T 15 N, R 22 W	35°56'37"	93°16'36"	F	Boone Fm	AC			Y
NT02	Parthenon	NW¼, NE¼, NE¼, Sec 2, T 15 N, R 21 W	35°59'27"	93°10'16"	F	Boone Fm	IN			Y*
NT03	Fallsville	NE¼/SE¼, Sec 18, T 13 N, R 23 W	35°47'03"	93°28'00"	Q	Atkoa Fm	IN			Y*
NT04	Murray	SE¼, SW¼, SW¼, Sec 34, T 16 N, R 22 W	35°59'34"	93°18'17"	F	Boone Fm	IN			Y*
NT05	Jasper	SW¼, NW¼, Sec 34, T 16 N, R 21 W	36°00'05"	93°12'00"	F	Boone Fm	IN			Y*
NT06	Mt. Judea	SW¼/SE¼, SW¼, Sec 6, T 15 N, R 19 W	35°58'30"	93°02'29"	Q	Powell Dolomite	IN			Y*
NT07	Mt. Judea	NW¼, SE¼, SW¼, Sec 17, T 15 N, R 19 W	35°56'45"	93°01'30"	F	Pitkin Ls	IN			Y*
NT09	Parthenon	SW¼, SW¼, SW¼, Sec 36, T 16 N, R 21 W	35°59'31"	93°09'56"	F	Boone Fm	IN			Y?
NT10	Jasper	SW¼, NW¼, Sec 27, T 16 N, R 21 W	36°00'55"	93°12'01"	QF	Boone Fm	IN			?
NT11	Mt. Judea	NW¼, SE¼, Sec 21, T 15 N, R 20 W	35°56'07"	93°06'24"	F	Boone Fm	IN			Y
NT12	Lurton	NW¼, Sec 14, T 13 N, R 20 W	35°46'56"	93°05'20"	F	Atkoa Fm	AC			Y
PI01	Antoine	SE¼, NW¼, Sec 3, T 8 S., R 23 W	34°04'53"	93°26'42"	Q	Atoka (Lower)	IN	34-93	6	N
PI02	Narrows Dam	NW¼, Sec 23, T 6 S., R 25 W	34°13'10"	93°38'12"	P	Jackfork Ss	AC			Y
PI03	Murfreesboro	SW¼, SE¼, Sec 2, T 8 S., R 26 W	34°04'52"	93°44'29"	QC	Jackfork Ss	AC	34-93	15	Y
PI04	Murfreesboro	NE¼, Sec 6, T 8 S., R 25 W	34°05'20"	93°41'53"	F	Jackfork Ss	IN	34-93	21	N
PI05	Delight	NE¼, Sec 26, T 7 S., R 24 W	34°06'48"	93°31'40"	F	Jackfork Ss	IN	34-93	27, 28	?
PK01A	Wickes	NW¼, NW¼, Sec 6, T 5 S., R 31 W	34°21'21"	94°21'29"	QF	Arkansas Novaculite	AC	34-94	23	Y
PK01B	Wickes	SW¼, NW¼, Sec 6, T 5 S., R 31 W	34°21'14"	94°21'31"	F	Hatton Tuff	AC	34-94	23	Y
PK02		Cannot locate			N			34-94	1	
PK03	Potter	SW¼, SW¼, Sec 20/NW¼, NW¼, Sec 29, T 2 S., R 31	34°33'40"	94°20'06"	Q	Stanley Fm	IN	34-94	2	Y
PK04	Gillham Dam	SE¼, NE¼, Sec 36, T 6 S., R 31 W	34°12'06"	94°14'43"	QCF	Stanley Fm	IN	34-94	10	N
PK05	Wickes	NE¼, NE¼, Sec 1, T 5 S., R 32 W	34°21'23"	94°21'45"	Q	Arkansas Novaculite	IN			Y
PP01	Holla Bend	NE¼, Sec 27 - SE¼, Sec 22, T 7 N, R 20 W	35°13'54"	93°06'30"	QC	Hartshorne Ss	AC			Y
PP02	Dover	SW¼, SE¼, Sec 34, T 9 N, R 20 W	35°22'58"	93°06'27"	F	Atoka Fm	AC			N
PP03	Russellville West	SW¼, NE¼, Sec 18, T 7 N, R 20 W	35°15'32"	93°09'50"	Q	Hartshorne Ss	IN	35-93	1	N
PP04	Russellville East	NE¼, NW¼, Sec 21, T 8 N, R 19 W	35°20'00"	93°01'25"	F	Atoka (Upper)	AC			Y
PP05	Russellville West	W½, SE¼, Sec 18, T 7 N, R 20 W	35°15'14"	93°09'53"	Q	Hartshorne Ss	IN			Y*
PP06	Russellville East	N½, NE¼, SE¼, Sec 27, T 8 N, R 20 W	35°18'49"	93°06'11"	Q	Hartshorne Ss	IN			Y*
PP07	Russellville East	NW¼, SE¼, Sec 26, T 8 N, R 20 W	35°18'45"	93°05'32"	Q	Hartshorne Ss	IN			Y*
PP08	Russellville West	SW¼, NE¼, Sec 28, T 8 N, R 20 W	35°19'01"	93°07'39"	F	Hartshorne Ss	IN			Y*
PP09	Russellville West	N½, NW¼, NW¼, Sec 30, T 8 N, R 20 W	35°19'20"	93°10'19"	QC	Hartshorne Ss	IN			Y*
PP10	Delaware	SW¼, SE¼, Sec 18, T 8 N, R 21 W	35°20'23"	93°16'08"	QC	Hartshorne Ss	IN			Y*
PP11	Delaware	NE¼, Sec 24, T 8 N, R 22 W	35°20'13" ca	93°17'01" ca	N	Hartshorne Ss	IN			Y*
PP12	Dover	SW¼, SE¼, NE¼, Sec 34, T 9 N, R 20 W	35°23'14"	93°06'12"	F	Atkoa Fm	IN			Y*
PP13	Dover	SW¼/SE¼, SW¼, Sec 26, T 9 N, R 20 W	35°23'41"	93°05'44"	F	Atkoa Fm	IN			Y*
PP14	Atkins	SE¼, NW¼, - NW¼, SE¼, Sec 25, T 7 N, R 19 W	35°13'31"	92°58'14"	QC	Atoka (Upper)	IN			Y*
PP15	Moreland	NE¼, Sec 12, T 8 N, R 19 W	35°21'27"	92°57'42"	F	Atkoa Fm	IN			Y*
PP16	Solo	SE¼, SE¼, Sec 3, T 11 N, R 18 W	35°37'24"	92°53'04"	QC	Bloyd/Hale	IN			Y*
PP17	Sand Gap	NE¼, Sec 2, T 12 N, R 20 W	35°43'19"	93°04'57"	F	Atoka (Lower)	IN			Y*
PP18	Treat SW	NE¼, NW¼, Sec 24, T 10 N, R 21 W	35°30'37"	93°10'56"	F	Atoka Fm	IN			Y
PP19	Russellville West	SE¼, Sec 2, T 8 N, R 21 W	35°22'13"	93°11'29"	F	Hartshorne Ss	IN			N
PP20	Moreland	NE¼, Sec 12, T 8 N, R 19 W	35°21'29"	92°57'54"	CF	Atoka Fm	IN			Y

PU01	Little Rock	E½, SW¼ - W½, SE¼ - SW¼, NE¼, Sec 26, T 1 N, R 12	34°41'08"	92°15'49"	QC	Syenite	AC	34-92	9, 12	Y
PU02	Little Rock	NE¼, Sec 34/NW¼, Sec 35, T 1 N, R 12 W	34°40'37"	92°16'24"	QC	Syenite	AC	34-92	14, 17, 5	Y
PU03	Little Rock	E½, E½, Sec 28 - NW¼, Sec 27, T 1 N, R 12 W	34°41'34"	92°17'21"	QC	Syenite	AC			Y
PU04	Sweet Home	NW¼, SW¼, Sec 17, T 1 N, R 11 W	34°42'52"	92°13'04"	Q	Syenite	AC	34-92	15	Y
PU05/LN01	Cabot	Parts of Sec 21, 22, & 23, T 4 N, R 10 W	34°57'59"	92°04'31"	QC	Atoka (Middle)	AC			Y
PU06	North Little Rock	SW¼, Sec 2, T 2 N, R 13 W	34°49'48"	92°22'16"	Q	Jackfork Ss	AC	34-92	11	Y
PU07	Alexander	SE¼, NE¼, Sec 24, T 1 N, R 14 W	34°42'39"	92°26'57"	QF	Arkansas Novaculite	AC			N
PU08	Cannot locate	Cannot locate						34-92	1	
PU09	North Little Rock	NE¼, NE¼, Sec 28, T 2 N, R 12 W	34°46'51"	92°18'15"	Q	Jackfork Ss	IN	34-92	3	Y?
PU10	North Little Rock	N½, Sec 8, T 2 N, R 12 W	34°49'15"	92°18'23"	T	Jackfork Ss	IN	34-92	6	N
PU11	Sweet Home	E½, NE¼, Sec 36, T 1 N, R 12 W	34°40'22"	92°14'21"	Q	Syenite	IN	34-92	10	N
PU12	Alexander	NW¼, SW¼, Sec 19, T 1 N, R 13 W	34°42'26"	92°26'39"	QF	Arkansas Novaculite	IN			Y
PY01	Gleason	NE¼, SW¼, Sec 2, T 5 N, R 15 W	35°06'09"	92°34'01"	CF	Atoka (Middle)	AC			Y
PY02	Gleason	NW¼, SE¼, Sec 16, T 5 N, R 15 W	35°04'26"	92°35'53"	CF	Atoka (Lower)	AC	35-92	7?	N
PY03	Houston	SW¼, SE¼, Sec 35, T 5 N, R 16 W	35°01'46"	92°40'13"	QC	Atoka (Middle)	IN			Y*
PY04	Houston	N½, NW¼, Sec 21, T 5 N, R 16 W	35°04'08"	92°42'34"	QC	Atoka (Lower)	IN			Y*
PY05	Nimrod Dam	SE¼, Sec 33, T 4 N, R 20 W	34°57'01"	93°07'56"	F	Atoka (Lower)	UN			Y
PY06	Martindale	SW¼, NE¼, Sec 18, T 4 N, R 15 W	34°59'31"	92°38'13"	QF	Atoka (Upper)	IN			Y
PY07	Casa	NE¼, SE¼, Sec 30, T 5 N, R 19 W	35°03'12"	93°03'17"	CF	Hartshorne Ss	IN			Y*
PY08	Gleason	NW¼, NE¼, SE¼, Sec 15, T 5 N, R 15 W	35°04'24"	92°34'47"	CF	Atoka (Lower)	IN			Y*
PY09	Fourche	NE¼/SE¼, Sec 16, T 4 N, R 15 W	34°59'22"	92°36'03"	QC	Atoka (Middle)	IN			N
RD01	Ravenden Springs SE	SE¼, Sec 21, T 19 N, R 1 W	36°16'09" ca	91°04'44" ca	N	Cotter Dolomite	UN	36-91	2	N
RD02	Pocahontas	NW¼, SE¼, Sec 15, T 19 N, R 1 E.	36°17'13"	90°57'28"	F	Cotter Dolomite	IN			Y*
RD03	Maynard	NW¼, NE¼, Sec10, T 20 N, R 1 E.	36°23'56"	90°57'17"	F	Cotter Dolomite	IN			Y*
RD04	Supply	SW¼, Sec 28, T 21 N, R 2 E.	36°25'58"	90°52'14"	F	Cotter Dolomite	IN			Y*
RD05	Warm Springs	SE¼, SW¼, Sec 8, T 20 N, R 1 W	36°23'29"	91°06'13"	QC	Cotter Dolomite	IN			Y*
RD06	Pocahontas	NE¼, NW¼, Sec 16, T 19 N, R 1 E.	36°17'48"	90°58'53"	QF	Cotter Dolomite	IN			Y
RD07	Pocahontas	NE¼, SW¼/NW¼, SE¼, Sec 22, T 19 N, R 1 E.	36°16'27"	90°57'40"	Q	Cotter Dolomite	IN			?
RD08	Pocahontas	NE¼, NE¼, Sec 14, T 19 N, R 1 E.	36°17'46"	90°56'09"	F	Cotter Dolomite	IN			N
RD09	Pocahontas	SW¼, SE¼, Sec 11, T 19 N, R 1 E.	36°17'52"	90°56'22"	F	Cotter Dolomite	IN			?
RD10	Ravenden Springs SE	NE¼, SE¼, Sec 28, T 20 N, R 1 W	36°21'11"	91°04'43"	QCF	Cotter Dolomite	IN			?
SA01	Goosepond Mountain	SE¼, SE¼, Sec 3, T 1 S., R 18 W	34°39'56"	92°54'35"	F	Big Fork Chert	AC			Y
SA02	Paron	SE¼, NW¼, Sec 2, T 1 N, R 17 W	34°45'40"	92°47'09"	F	Big Fork Chert	IN			Y
SA03	Traskwood	NW¼, SW¼, Sec 9, T 3 S., R 16 W	34°28'49"	92°44'08"	CP	Arkansas Novaculite	IN			y
SB01	Greenwood	SE¼, Sec 32 - SW¼, Sec 33, T 7 N, R 31 W	35°14'28"	94°18'55"	F	Hartshorne Ss	AC	35-94	11	Y
SB02		Uncertain location			N		IN?	35-94	20	
SB03		Uncertain location			N		IN?	35-94	12	
SB04	Burnville	SW¼/SE¼, Sec 36, T 6 N, R 30 W	35°08'44"	94°08'57"	CF	Atoka (Middle)	IN			Y*
SB06	South Fort Smith	SE¼, NW¼, Sec 23, T 8 N, R 32 W	35°21'50"	94°22'41"	Q	McAlester Fm	IN			Y*
SB07	Mulberry	NW¼, Sec 5/NE¼, Sec 6, T 8 N, R 29 W	35°24'21"	94°06'48"	QCF	Hartshorne Ss	IN			?
SB08	Alma	NW¼, SW¼, Sec 31, T 9 N, R 29 W	35°25'08"	94°07'40"	CF	Hartshorne Ss	IN			Y*
SB09	Mulberry	NW¼, Sec 4, T 8 N, R 29 W	35°24'21"	94°05'38"	QF	Hartshorne Ss	IN			Y*
SC01	Hon	SE¼, NE¼, Sec 15/SW¼, NW¼, Sec 14, T 3 N, R 30 W	34°55'15"	94°09'47"	QCF	Atoka (Middle)	IN			Y*
SC02-CCG	Boles	SW¼, SW¼, Sec 11, T 1 N, R 29 W	34°45'12"	94°03'40"	F	Jackfork Ss-CCG	IN			Y*
SC03-CCG	Hon	SW¼, NE¼, Sec 21, T 3 N, R 30 W	34°54'25"	94°11'16"	F	Atoka (Middle)-CCG	IN			Y*
SC04-CCG	Waldron	NW¼, Sec 20, T 4 N, R 29 W	34°59'44"	94°06'09"	F	McAlester/Savannah-CCG	IN			Y*
SC05-CCG	Y-City	NE¼, NE¼, Sec 23, T 1 N, R 29 W	34°44'05"	94°02'55"	F	Jackfork Ss-CCG	IN			Y*
SC06-CCG	Freedom Mountain	SE¼, NW¼, Sec 22, T 3 N, R 27 W	34°54'03"	93°51'36"	QF	Atoka (Lower)-CCG	IN			Y*
SE01	Coazhome/Harriet	Ctr. Sec 30, T 16 N, R 14 W	36°00'00"	92°30'41"	F	Plattin Ls	IN			Y*
SE02	Witt Springs	SW¼, NW¼, Sec 3, T 13 N, R 17 W	35°48'13"	92°47'06"	QCF	Pitkin Ls	IN			Y*
SE03	Leslie	NE¼, SW¼, NE¼, Sec 20, T 14 N, R 15 W	36°50'36"	92°35'57"	F	Pitkin Ls/Fayetteville Fm p	IN			Y*
SE04	Snowball	NW¼, SW¼, SW¼, Sec 20, T 15 N, R 17 W	35°55'39"	92°49'18"	F	Boone Fm	IN			Y*
SE05	St. Joe	SW¼, SE¼, NE¼, Sec 20, T 16 N, R 17 W	36°01'10"	92°48'21"	F	Boone Fm p	IN			Y*
SE06	Snowball	SE¼, SE¼, NE¼, Sec 28, T 15 N, R 17 W	35°55'02"	92°47'18"	F	Boone Fm	IN			Y
SE07	Alread	NE¼, NE¼, Sec 28, T 13 N, R 16 W	35°44'47"	92°41'04"	CF	Bloyd/Hale	AC			Y

SH01	Ravenden	SW¼, Sec 36, T 19 N, R 4 W	36°14'53"	91°21'57"	Q	Cotter Dolomite	IN	36-91	1	Y
SH02	Ash Flat	SE¼, SW¼/SW¼, SE¼, Sec 1, T 18 N, R 6 W	36°14'10"	91°34'32"	F	Cotter Dolomite	AC			Y
SH03	Hardy	SW¼, Sec 5, T 19 N, R 4 W	36°20'00"	91°26'22"	QF	Cotter Dolomite	IN			Y
SH04	Poughkeepsie	SW¼, Sec 11, T 16 N, R 5 W	36°02'32"	91°29'01"	QF	Everton Fm	IN			Y*
SH05	Sitka	NE¼, SW¼, Sec 15, T 18 N, R 4 W	36°12'26"	91°23'55"	F	Cotter Dolomite	IN			Y*
SH06	Evening Shade	NE¼, SE¼, Sec 6, T 16 N, R 5 W	36°03'37"	91°33'08"	F	Everton Fm	IN			Y*
SH07	Ash Flat	SW¼,NW¼, Sec 14/SE¼, NE¼, Sec 15, T 18 N, R 6 W	36°12'58"	91°36'08"	Q	Cotter Dolomite	IN			Y*
SH08	Poughkeepsie	SE¼, SE¼, Sec 19, T 16 N, R 4 W	36°00'45"	91°26'41"	QF	Everton Fm	IN			Y*
SH09	Smithville	SE¼, NW¼, Sec 25, T 16 N, R 4 W	36°00'17"	91°21'50"	F	Everton Fm	IN			Y*
SH10	Sidney	SW¼/SE¼, Sec 30, T 16 N, R 6 W	36°00'10"	91°40'16"	F	Everton Fm	IN			Y*
SH11	Ash Flat	SE¼, NE¼, Sec 4, T 17 N, R 5 W	36°09'21"	91°30'39"	F	Cotter Dolomite	IN			Y*
SH12	Ash Flat	SW¼, 'SW¼, Sec 32, T 18 N, R 5 W	36°09'53"	91°32'44"	F	Cotter Dolomite	IN			Y*
SH13	Evening Shade	SE¼, SE¼, Sec 23, T 16 N, R 6 W	36°00'52"	91°35'24"	QF	Everton Fm	IN			Y*
SH14	Ash Flat	NE¼/SE¼, Sec 22, T 18 N, R 6 W	36°11'59"	91°36'24"	F	Cotter Dolomite	UN			Y
ST01	Sylamore	NW¼, Sec 31, T 16 N, R 10 W	35°58'56"	92°05'26"	F	Everton Fm	IN			Y
ST02	Drasco	NW¼, NW¼, Sec 19, T 13 N, R 9 W	35°44'51"	91°53'12"	F	Pitkin Ls	IN			Y*
ST03	Mountain View SW	SE¼, NW¼, Sec 22, T 14 N, R 11 W	35°50'03"	92°08'50"	Q	Pitkin Ls	IN			Y*
ST04	Mountain View SW	NE¼, NW ¼, Sec 23, T 13 N, R 12 W	35°45'17"	92°14'04"	CF	Cane Hill	IN			Y*
ST05	Mountain View	SE¼, NW¼, Sec 35, T 14 N, R 10 W	35°48'15"	92°01'23"	F	Pitkin Ls	IN			Y*
ST06	Onia	S½, NE¼, NW¼, Sec 36, T 15 N, R 13 W	35°53'57"	92°19'10"	Q	Boone Fm	IN			Y*
ST07	Sylamore	SE¼, NE¼, Sec 36, T 16 N, R 11 W	35°58'52"	92°05'58"	CF	Everton Fm	IN			Y*
ST08	Sylamore	NW¼, Sec 6, T 15 N, R 10 W	35°58'09"	92°05'26"	F	Everton Fm	IN			Y*
ST09	Fiftysix	SE¼, Sec 8, T 15 N, R 11 W	35°56'50" ca	92°10'33" ca	N	Boone Fm	IN			Y*
ST10	Boswell	SW¼, SE¼, Sec 2, T 16 N, R 11 W	36°02'51"	92°07'15"	F	Everton Fm	IN			Y*
ST11	Guion	NW¼/SW¼, NW¼, Sec 33, T 15 N, R 9 W	35°53'24"	91°57'21"	F	Plattin/Kimswick	IN			Y
ST12	Sylamore	SE¼, SE¼, NW¼, Sec 1, T 15 N, R 11 W	35°57'50"	92°06'24"	F	Everton Fm	IN			Y
SV01		Location uncertain			N			34-94	3	
SV02		Location uncertain			N		UN	34-94	4	
SV03	Gillham	SE¼,SW¼, NW¼, Sec 8, T 7 S., R 31 W	34°10'12" ca	94°19'43" ca	N	Stanley Fm	UN?	34-94	5	N
SV04	Gillham	NW¼, NE¼, Sec 16, T 7 S., R 31 W (?)	34°09'34" ?	94°18'12" ?	N	Stanley Fm	UN	34-94	6	N
SV06	Chapel Hill	Sec 34, T 7 S., R 32 W	34°06'29" ca	94°23'17" ca	N	Stanley Fm	IN	34-94	21	N
SV07	Geneva	NW¼, Sec 11, T 8 S., R 30 W	34°05'17"	94°09'40"	QC	Jackfork Ss	AC	34-94	9	Y
VB01	Bee Branch	SW¼, SE¼, Sec 24, T 10 N, R 14 W	35°29'09"	92°25'44"	CF	Atoka Fm	AC			Y
VB02	Clinton	NE¼, SE¼, Sec 13, T 10 N, R 14 W	35°30'08"	92°25'26"	QC	Atoka Fm	IN			Y
VB03	Bee Branch	SE¼, NE¼, Sec 36, T 10 N, R 14 W	35°27'53"	92°25'38"	Q	Atkoa Fm	IN			Y*
VB04	Bee Branch	SE¼, NW¼, Sec 24, T 10 N, R 14 W	35°29'34"	92°26'00"	Q	Atkoa Fm	IN			Y*
VB05	Clinton	NW¼, NE¼, Sec 10, T 10 N, R 14 W	35°31'33"	92°27'48"	QCF	Bloyd/Hale	IN			Y*
VB06	Leslie	SE¼, NW¼, NW¼, Sec 12, T 13 N, R 15 W	35°47'14"	92°32'11"	Q	Pitkin Ls	IN			Y*
VB07	Botkinburg	NW¼/SW¼, NW¼, Sec 29, T 13 N, R 14 W	35°44'32"	92°30'22"	Q	Bloyd/Hale	IN			Y*
VB08	Fairfield Bay	SE¼, NW¼, Sec 9, T 10 N, R 12 W	35°31'04"	92°16'37"	QC	Bloyd/Hale	IN			Y*
VB09	Fairfield Bay	NE¼, NW¼, Sec 6, T 11 N, R 12 W	35°37'25"	92°18'33"	F	Bloyd/Hale	IN			Y*
VB11	Morganton	SE¼, SW¼, Sec 30, T 9 N, R 12 W	35°22'54"	92°18'50"	QC	Atkoa Fm	IN			Y*
VB12	Morganton	SE¼, Sec 25, T 9 N, R 13 W	35°22'52"	92°18'55"	F	Atkoa Fm	IN			Y*
VB13	Scotland	NW¼, SW¼, Sec 11, T 11 N, R 15 W	35°36'25"	92°33'34"	QC	Bloyd/Hale	IN			Y*
VB14	Old Lexington	SW¼, NE¼, Sec 27, T 12 N, R 14 W	35°39'09"	92°27'41"	QC	Bloyd/Hale	IN			Y*
VB15	Shirley	SW¼, Sec 34, T 12 N, R 12 W	35°37'44"	92°15'25"	Q	Bloyd/Hale	IN			Y*
VB16	Tilly	NW¼, Sec 26, T 12 N, R 17 W	35°39'36"	92°46'17"	F	Bloyd/Hale	IN			Y*
VB17	Tilly	SE¼, Sec 9, T 12 N, R 17 W	35°41'41"	92°47'56"	Q	Bloyd/Hale	IN			Y*
VB18	Formosa	NW¼, SW¼, Sec 30, T 10 N, R 14 W	35°28'38"	92°31'40"	QF	Atoka Fm	IN			Y
VB19	Clinton	SE¼,Sec 3, T 10 N, R 14 W	35°31'42"	92°27'44"	F	Bloyd/Hale	AC			N
VB20	Old Lexington	NE¼, Sec 3, T 11 N, R 14 W	35°37'35"	92°27'48"	F	Bloyd/Hale	UN			Y
WA01	West Fork	SW¼, Sec 30 - SW¼, Sec 29, T 15 N, R 30 W	35°56'38"	94°12'05"	Q	Pitkin Ls	AC	35-94	7	Y
WA02	Sulphur City	NW¼, NW¼, Sec 20, T 15 N, R 29 W	35°57'57"	94°05'18"	F	Pitkin/Cane Hill	AC			Y*
WA03	Springdale	S½, SW¼, Sec 22 - E½, SE¼, Sec 21, T 17 N, R 30 W	36°07'39"	94°10'07"	Q	Boone Fm	IN			Y*
WA04	West Fork	NW¼, SW¼, Sec 4, T 14 N, R 30 W	35°54'58"	94°10'44"	F	Pitkin Ls	IN			Y*
WA05	Durham	SW¼, NE¼, Sec 19, T 15 N, R 28 W	35°57'29"	93°59'24"	F	Pitkin Ls	IN			Y*
WA06	Lincoln	NE¼, SW¼, Sec 1, T 14 N, R 33 W	35°55'13"	94°26'26"	F	Pitkin Ls	IN			Y*

WA07	Wheeler	NE¼, NW¼, Sec 31, T 16 N, R 31 W	36°01'37"	94°18'58"	F	Boone Fm	IN			Y
WA08	Strickler	SE¼, SE¼,Sec 27, T 13 N, R 31 W	35°46'17"	94°15'59"	F	Pitkin Ls	R			Y
WA09	Strickler	SE¼, NW¼, Sec 23, T 13 N, R 31 W	35°47'30"	94°15'18"	F	Atkoa Fm	UN			Y
WA10	Sulphur City	SW¼, NE¼, SE¼, Sec 25, T 15 N, R 29 W	35°56'24"	94°00'18"	F	Pitkin Ls	IN			Y
WA11	Sulphur City	SW¼, SW¼, Sec 30, T 15 N, R 28 W	35°56'17"	94°00'02"	F	Pitkin Ls	IN			Y
WA12	Evansville	NE¼, NW¼, Sec 30, T 14 N, R 32 W	35°52'12"	94°25'38"	F	Boone Fm	AC			N
WH01	Judsonia	NE¼, Sec 31, T 8 N, R 6 W	35°16'52"	91°41'03"	QC	Bloyd/Hale	AC			Y
WH02	Bradford	NE¼, SW¼, Sec 12, T 9 N,R. 5 W	35°25'01"	91°29'18"	F	Bloyd/Hale	IN			Y
WH03	Judsonia	NW¼, SE¼, NW¼, Sec 26, T 8 N, R 7 W	35°17'36"	91°43'29"	F	Bloyd/Hale	IN			Y
WH04	Bald Knob	NW¼, Sec 25, T 8 N, R 6 W	35°17'30"	91°36'06"	QC	Bloyd/Hale	IN	35-91	7, 8	Y?*
WH05	Bald Knob	SW¼, Sec 24, T 8 N, R 6 W	35°17'52"	91°36'18"	QC	Bloyd/Hale	IN			Y*
WH06	Velvet Ridge	SE¼, NE¼, Sec 6, T 9 N, R 5 W	35°26'13"	91°34'12"	F	Bloyd/Hale	IN			Y
WH07	Steprock	NE¼, SW¼, Sec 27, T 10 N, R 6 W	35°27'46"	91°37'49"	F	Bloyd/Hale	AC			Y
WH08	Floyd	NE¼, NW¼, Sec 23, T 7 N, R 9 W	35°13'37"	91°56'01"	F	Atoka (Middle)	AC			Y
WH09	Bald Knob	NE¼, NW¼,Sec 24, T 8 N, R 6 W	35°18'39"	91°35'50"	QC	Bloyd/Hale	IN			Y*
WH10	Pleasant Plains	SE¼,Sec 7, T 10 N, R 6 W	35°30'17"	91°40'35"	QCF	Bloyd/Hale	IN			Y*
WH11	Floyd	NE¼, Sec 18, T 6 N, R 8 W	35°09'02"	91°53'37"	QCF	Atoka (Middle)	IN			Y*
WH12	Bald Knob	SE¼, SW¼/SW¼, SE¼, Sec 34, T 9 N, R 5 W	35°21'20"	91°31'27"	QC	Bloyd/Hale	IN			Y*
WH13	Floyd	SW¼, SE¼, Sec 15, T 7 N, R 9 W	35°13'41"	91°56'57"	F	Atoka (Middle)	IN			Y*
YE01	Bluffton	NW¼, NW¼, Sec15, T 3 N, R 24 W	34°55'02"	93°33'01"	F	Atoka (Middle)	IN			Y*
YE02-CCG	Bluffton	SW¼, Sec 24, T 3 N, R 24 W	34°53'46"	93°30'37"	F	Atoka (Lower & Mid.)-CC	IN			Y*
YE03-CCG	Danville	SW¼, NE¼, Sec 17, T 4 N, R 23 W	35°00'06"	93°28'10"	F	Atoka (Lower & Mid.)-CC	IN			Y*
YE05	Dardanelle	SW¼, Sec 19, T 7 N, R 20 W	35°14'31"	93°10'16"	Q	Hartshorne Ss	IN			Y*
YE06	Ola	SE¼, NW¼, Sec 4, T 5 N,R. 20 W	35°07'00"	93°07'57"	QC	Atoka (Upper)	IN			Y*
YE07	Chickalah Mountain E.	NE¼, NE¼, Sec 33, T 6 N, R 22 W	35°08'19"	93°20'09"	QC	Atoka (Upper)	IN			Y*
YE08	Nimrod Dam	NE¼, NW¼, Sec 28, T 4 N, R 21 W	34°58'30"	93°14'41"	F	Atoka (Lower)	IN			Y*
YE09-CCG	Plainview	SE¼, Sec 27/SW¼, Sec 26, T 3 N, R 22 W	34°52'50"	93°19'23"	F	Atoka (Lower)-CCG	IN			Y*
YE11	Danville Mtn.	NW¼, Sec 17, T 5 N, R 22 W	35°05'43" ca	93°22'00" ca	N	Atoka (Lower)	IN			Y*
YE12	Ola	SE¼, Sec 8/SW¼, Sec 9, T 5 N, R 20 W	35°05'55"	93°08'20"	F	Atoka (Middle)	IN			Y*

APPENDIX II

Correspondence between Quarry Identification Number and Quarry Name

No systematic manner of identifying quarries has been used in Arkansas. The name some people use for a quarry might come from the name of the property owner, for example “the Jones Quarry”. Someone else might refer to the same quarry by the name of the main person who operates the quarry or by the company name operating it, such as the “McGraw Construction Company Quarry”. Property owners may also change, and/or the operator of the quarry may change. Still other persons might refer to a quarry by the name of a nearby community, for example the “Cooperton Quarry” or the “McGraw Cooperton Quarry”. If a quarry lies in a rural area between two communities, some people might refer to the quarry by identifying it with one community while others the other community. All these forms of confusion occur with regard to naming of quarries in Arkansas.

An attempt to avoid such confusion is made in this report by assigning arbitrary quarry identification numbers to each site. The beginning of the quarry identification number is two letters as an abbreviation of the county in which the quarry exists. Throughout the report this number is what is used in making reference to any quarry.

This appendix is given to reference the quarry identification numbers to names that have been used for the various quarries. For each quarry number a listing of the various names that have appeared in various documents is given. These source documents include AHTD records of tests used to qualify stone for AHTD jobs; names used in the data books of these tests are designated “AHTD” in the column under “Source”. Quarries mentioned in the AHTD Materials Availability Study are listed with “MAS”. Quarry names listed with the Mine Safety and Health Administration are indicated with “MSHA”. Names in the Corps of Engineers data sheets are designated with “CORPS”. Some quarries that are shown on USGS quadrangles but of unknown “name” are included with the designation “QUAD”. Some quarry names were those used by other sources, for example by word of mouth from professionals related to the stone industry or from residents in the area of a particular quarry; these are indicated with “Other”. In each of these cases, if a locality is referenced in the document, that locality is listed in the column under “Given town”.

Correspondence between Quarry Identification Number and Quarry Name

Quarry #	***Name/designation***	***Given town***	***Source***
BE01	APAC-AR, Sharps Quarry	Lowell	MSHA, AHTD
BE01	McClinton-Anchor, Sharp Quarry	Lowell	AHTD
BE01	Sharp Quarry	Lowell	MAS
BE02	APAC-AR, Avoca Quarry	Avoca	MSHA
BE02	McClinton-Anchor, Avoca Quarry	Avoca	AHTD, MAS, CORPS
BE02	Avoca Quarry	Avoca	AHTD
BE03	Reb Enterprises Inc, Reb Quarry	Springdale	MSHA, AHTD
BE04	Benton County Stone	Gravette	AHTD, MSHA
BE05	APAC/McClinton-Anchor	Bentonville	AHTD
BE05	McClinton-Anchor	Bentonville	AHTD
BE06	Jewell Quarry	Siloam Springs	AHTD
BE07	Rutherford Quarry	Siloam Springs	AHTD
BE07	Two State Materials	Siloam Springs	AHTD
BE08	Sey Quarry	Garfield	MAS
BE09	Quarry	Centerton	MAS
BE10	Cherokee City Quarry	Cherokee City	MAS
BE10	Inman Quarry	Cherokee City	MAS, AHTD
BE10	McClinton Bros, Cherokee Quarry	Cherokee City	AHTD
BE11	Baridige Quarry		MAS
BE12	Biggs Quarry	Cross Holler	MAS
BE13	Quarry	Best	MAS
BE14	Quarry	Gateway	MAS
BE15	Quarry	Gravette	QUAD
BE16	Quarry	Centerton	QUAD
BN01	APAC-AR, Harrison Quarry & Plant		MSHA
BN01	McClinton-Anchor, Valley Springs Quarry	Valley Springs	AHTD, MAS
BN01	Boone County Lime Products		CORPS
BN02	Journagan Quarry	Omaha	AHTD
BN02	Finley Quarry	Omaha	MAS, AHTD
BN02	Omaha Quarry	Omaha	AHTD
BN03	Crouse Quarry	Harrison	MAS, AHTD
BN04	Quarry		MAS
BN05	Price Quarry		MAS
BN06	Seeley Quarry	Lead Hill	AHTD
BN06	Journagan, Seeley Quarry	Lead Hill	AHTD
BN07	McClinton-Anchor Everton Quarry	Everton	AHTD
BN08	Journagan, Bear Creek Quarry	Francis	AHTD
BN08	Bear Creek Quarry	Francis	AHTD
BX01	Twin Lakes Quarries, Quarry #2	Mountain Home	MSHA, AHTD, MAS
BX01	McClinton Rentals	Mountain Home	AHTD
BX02	Twin Lakes Quarry #1	Mountain Home	MAS, AHTD
BX02	McGuire Quarry	Mountain Home	MSHA, AHTD
BX02	King Sand & Gravel	Mountain Home	AHTD
BX02	Twin Lakes Quarry	Mountain Home	AHTD
BX03	Baxter County Quarry	Mountain Home	MAS, AHTD, MSHA
BX04	Twin Lakes Quarries, Foster Quarry	Norfork	AHTD
BX04	Foster Quarry	Norfork	AHTD
BX05	Rock Products Acklin Quarry	Big Flat	AHTD
BX05	Acklin Quarry	Big Flat	AHTD
BX06	Wilkerson Quarry		MAS, AHTD
BX07	Pickens Quarry	Old Joe	MAS, AHTD
BX08	Norfork Quarry	Norfork	MAS
BX09	Stone County Materials, Woods Quarry	Norfork	AHTD
BX09	Woods Quarry	Norfork	AHTD
BX09	Rock Products, Woods Quarry	Norfork	AHTD
BX10	Mountain Home Materials	Buford	AHTD
BX10	Mountain Home Quarry	Mountain Home	AHTD
BX10	Mountain Home Quarry	Buford	AHTD
BX10	Journagan Quarry	Buford	AHTD
CB01	Rock Products, Heber Springs Quarry	Heber Springs	AHTD, MSHA, CORPS, MAS
CB01	Heber Springs Quarry, Rock Products	Heber Springs	AHTD

CB02	Quarry	Heber Springs	MAS
CB02	Red River Stone Company	Heber Springs	CORPS
CB03	Undeveloped site		CORPS
CB04	Undeveloped site		CORPS
CB05	Undeveloped site		CORPS
CB06	Old WPA Quarry near Higdon	Higdon	CORPS
CB07	Goff Quarry	Pearson	Other
CB08	Corps of Engineers Quarry	Tumbling Shoals	MAS
CB08	Tumbling Shoals Quarry	Tumblins Shoals	CORPS
CB09	Fairfield Bay Quarry	Pryor Mountain	MAS, AHTD
CB09	Hellcat Heights Quarry	Pryor Mountain	AHTD
CB09	Pryor Mountain Quarry, Rock Products	Pryor Mountain	AHTD
CB09	Rock Products, Pryor Mountain Quarry	Pryor Mountain	AHTD
CB10	Pryor Mountain Quarry, Southeast Construction Co.	Pryor Mountain	MAS, AHTD
CB10	Southeast Construction Co., Pryor Mountain Quarry	Pryor Mountian	MAS, AHTD
CB11	Cabot Quarries, Inc.		MAS
CB11	Freshour Quarry	Greers Ferry	AHTD
CB12	Vance Quarry	Tumbling Shoals	MAS
CB13	Gray Quarry		MAS
CB13	New WPA Quarry near Pearson	Pearson	CORPS
CB14	Todd Quarry		MAS
CB15	Crider Quarry		MAS, Other
CB16	Dewey Stone Quarry		MAS
CB16	Stone Quarry		AHTD
CB17	Murphy Quarry		MAS
CB18	Quarry	Drasco	MAS
CB19	Fullerton Quarry		MAS
CB20	Cooper Quarry	Concord	MAS, AHTD
CB21	S & S Quarry	Pearson	MAS, AHTD
CF01	Arkhola, Preston Quarry	Van Buren	MAS, AHTD, MSHA
CF01	Preston Quarry, Arkhola/APAC	Van Buren	AHTD
CF01	APAC/Arkhola, Preston Quarry	Van Buren	AHTD
CF01	Arkhola	Alma	AHTD
CF02	Rock Producers, Brock Quarry	Deans Market	AHTD
CF02	Brock Quarry, Rock Producers	Deans Market	AHTD
CF03	Old Alma Quarry, Arkhola	Alma	MAS
CF03	Arkhola, Alma Plant	Alma	CORPS
CF05	Roadcut on Hwy. 540	Mountainburg	Other, AHTD
CF06-CCG	France Pit	Frog Bayou	MAS, AHTD
CK01	USAE Vicksburg District		CORPS
CK02	Murray Limestone Quarry	Arkadelphia	MAS, CORPS, AHTD
CK03	USAE Vicksburg District		CORPS
CK04	Little Rock Quarry Company	Arkadelphia	CORPS
CK04	Little Rock Quarry Company	Friendship	AHTD, CORPS
CK04	DeRoach Quarry, Carter Construction	Benton	CORPS
CK04	Carter Construction, DeRoach Quarry	Benton	CORPS
CK04	DeRoach Quarry, Little Rock Quarries, Inc	Friendship	AHTD
CK04	Little Rock Stone & Materials	Friendship	AHTD
CK05	Little Rock Quarry	Hollywood	AHTD
CK05	Hollywood Quarry, Pine Bluff Sand & Gravel	Hollywood	AHTD
CK05	Hollywood Quarry, L & R	Hollywood	AHTD
CK05	L & R Quarry	Hollywood	AHTD
CK05	Pine Bluff Sand & Gravel	Hollywood	AHTD
CK05	Sweet Home Stone Company		CORPS
CK06	Pennington-Winter Construction		CORPS
CR01	Carrol County Stone Co., R & R Quarry	Berryville	AHTD, MSHA
CR01	R & R Quarry	Berryville	MAS
CR01	Pyron Quarry, Freshour	Berryville	Other
CR02	Undeveloped site		CORPS
CR03	Kirk Mountain Core		CORPS
CR04	Sugar Mountain		CORPS
CR05	Quarry		CORPS
CR06	Gilbert Quarry	Blue Eye	MAS, AHTD
CR07	Smith Quarry	Rudd	MAS, AHTD
CR08	Chaney Quarry	Rule	MAS

CR09	Summers Quarry		MAS
CR10	R & R Quarry	Green Forest	MAS, AHTD
CR10	Kilbourne Quarry	Farewell	Other
CR10	Berryville Quarry	Berryville	AHTD
CR11	Robinson Quarry	Farewell	AHTD
CR11	Robertson Property	Farewell	Other
CR12	R & R Quarry (New quarry)	Green Forest	AHTD, Other
CR13	Powell Quarry		Other
CR13	R & R Quarries	Green Forest	AHTD, Other
CR14	Underwood Quarry	Eureka Springs	AHTD
CW01	Anderson-Oxandale Company		CORPS
CW01	Rockerfeller Quarry		MAS
CW02	Souter Quarry		AHTD
CW03	Gleason Quarry		MAS
CW03	Geeslin Quarry	Menifee	AHTD
CW03	M & M, Gleason Quarry	Menifee	Other
CW04	Robinson Quarry		MAS
CW05	Quarry	Center Ridge	MAS
CW05	Flowers Quarry	Center Ridge	AHTD
CW05	Payne Property	Center Ridge	AHTD
CW06	Quarry	Center Ridge	MAS
CW06	Oats Quarry	Center Ridge	Other
CW07	Koffman Quarry		MAS
CW08	Stell Quarry		MAS
CW08	Stell Quarry #1	Springfield	Other
CW09	Scroggins Quarry #1		MAS
CW09	Stell Quarry (#2)	Springfield	AHTD, Other
CW10	Quarry	Solgohachia	MAS
CW10	Souter Construction	Solgohachia	AHTD
CW10	Parks Quarry	Morrilton	AHTD
CW10	Parks Quarry	Solgohachia	AHTD
CW10	Souter, Parks Quarry	Solgohachia	AHTD
CW10	Souter, Morrilton Quarry	Morrilton	AHTD, Other
CW12	Pace Quarry	Menifee	MAS
CW12	Martin Quarry	Menifee	Other
CW12	Hogan Quarry	Menifee	Other
CW13	Quarry	Plumerville	MAS
CW13	Chatman, Carl Quarry	Plumerville	Other
CW14	Dixon Quarry	Morrilton	MAS
CW14	Freshour, Dixon Quarry	Morrilton	Other
CW15	Quarry		MAS
CW15	Croom Quarry	Morrilton	Other
CW16	Greene Quarry	Sardis	MAS
CW16	Green, Lloyd Quarry	Morrilton	AHTD
CW16	Greer Quarry	Plumerville	AHTD
CW16	M & M, Greene Quarry	Morrilton	AHTD
CW17	Scroggins Quarry #2	Springfield	MAS
CW18	Souter Quarry	Menifee	Other
CW19	Souter Quarry	Point Remove Creek	Other
CW19	Freshour Quarry	Point Remove Creek	Other
CW19	Markham & Brown Quarry	Point Remove Creek	Other
CW20	Burns & Swilley Quarry	Morrilton	Other
CW20			
CW21	Bond, Ferris Quarry	Austin	Other
CW21	Winningham, Opie Quarry	Austin	Other
CW22	Arkansas Kraft Quarry		AHTD
CW22	Wells Quarry	Cleveland	Other
CW23	Hammond Quarry	Cleveland	Other
FA01	Guy Quarry		CORPS
FA02	North Cadron Creek Quarry		CORPS
FA02	M & M Rock, Reynolds Quarry	Greenbrier	AHTD
FA02	M & M Rock Company	Conway	CORPS
FA02	Reynolds Quarry, M & M Rock	Greenbrier	AHTD, MAS
FA03A	Greenbrier Quarry	Greenbrier	CORPS
FA03A	McClung Quarry (Old Quarry)	Greenbrier	Other
FA03B	McClung Quarry (New Quarry)	Greenbrier	AHTD

FA03B	McClung Quarry	Green Forest (typo)	AHTD
FA03B	Quarry	Greenbrier	MAS
FA04	Quarry		MAS
FA04	Mississippi Valley Construction Engineers		Other
FA06	Harrell Quarry		CORPS
FA06	Quarry	Mayflower	MAS
FA06	Markham & Brown	Mayflower	Other
FA06	Souter Construction, Harrell Quarry	Mayflower	Other
FA07	Rowlett Quarry	Beryl	MAS
FA07	M & M Rock Company, Beryl Quarry	Beryl	AHTD
FA07	Rogers Group, Beryl Quarry	Beryl	AHTD
FA07	Beryl Quarry, Rowlett, M & M, Rogers Group	Beryl	AHTD, MAS
FA08	Old WPA Quarry		Other
FA09	Quarry		MAS
FA10	Quarry	Holland	MAS
FA11	Atkinson Quarry, Freshour		MAS, Other
FA12	Quarry (Hogan)	Mayflower	MAS, Other
FA13	Quarry	Greenbrier	MAS
FA13	McCrae Quarry	Greenbrier	Other
FA13	McGray Quarry	Greenbrier	AHTD
FA13	McRae Quarry	Greenbrier	AHTD
FA14	Burns & Swilley		Other
FA15	Sims Quarry	Guy	Other
FR01	Chrisman, Altus Quarry	Altus	AHTD
FR01	Chrisman Quarry	Altus	MAS, MSHA
FR01	Altus Quarry, Chrisman	Altus	AHTD
FR02	Opper Quarry	Altus	Other
FR03	Altus Quarry, J.J. Alston	Altus	MAS
FR03	Alston Quarry	Altus	CORPS
FR04	Hillard Quarry, Garland Cotton Company		MAS, Other
FR04	Cotton Quarry	Ozark	AHTD
FR04	Cotton Quarry #1	Roseville	AHTD
FR04	Cotton Quarry	Web Park	AHTD
FR04	Mid-South, Hillard Quarry		AHTD
FR05	Lonelm Quarry		MAS
FR05	Johnson Quarry	Lone Elm	AHTD
FR06	Vesta Quarry	Vesta	MAS
FR07	Branch Quarry	Branch	MAS
FR08	McCollum Quarry	Mulberry	Other
FR09	Isaacs Quarry	Mulberry	Other
FR10	Carder Construction, Byrd Quarry	Cass	AHTD
FR10	Byrd Quarry, Carder Construction	Cass	AHTD
FU01	Freshour, Campbell Quarry	Gepp	AHTD, MAS
FU01	Campbell Quarry, Freshour Construction	Gepp	AHTD, MAS
FU02	Hall Quarry	Vidette	MAS, AHTD
FU03	Freshour, Moody Quarry	Salem	MAS
FU03	Moody Quarry	Salem	AHTD
FU04	Joyce Quarry	Salem	MAS, AHTD
FU05	Taylor Quarry		MAS, AHTD
FU06	Watson Quarry	Saddle	MAS
FU06	Stephens Quarry	Saddle	Other
FU07	Quarry	Agnos	MAS
FU08	Brown Quarry	Viola	MAS
FU09	Freeman Quarry		MAS
FU10	Nichols Quarry		MAS, AHTD
FU11	Ray Quarry	Moko	MAS, Other, AHTD
FU12	Warwick Quarry	Cherokee Village	Other
FU12	Cherokee Village Quarry	Cherokee Village	AHTD
FU13	Marler Quarry	Myatt Creek	Other
GA01	Undeveloped site	Lake Ouachita	CORPS
GA02	Proposed site	Glazy Pau Creek	CORPS
GA03	Mid-State Quarry #3	Hot Springs	MAS
GA03	Mid-State, Westinghouse Drive Quarry	Hot Springs	AHTD
GA03	Westinghouse Drive Quarry, Mid-State	Hot Springs	AHTD
GA03	Highway 270 Quarry, Mid-State	Hot Springs	AHTD

GA03	Rip Evans Quarry	Hot Springs	AHTD
GA03	Hogan Quarry	Hot Springs	AHTD
GA05	Malvern Minerals Quarry	Hot Springs	AHTD
GA06	Quarry		Other
GA07	Mountain Pine Quarry	Mountain Pine	AHTD
GA07	Weyerhauser Quarry	Mountain Pine	Other
HO01	Test blast		CORPS
HO02	Quarry		CORPS
HS01	Mid-State, Jones Mill Quarry	Jones Mill	AHTD, MAS, MSHA
HS01	Mid-State, Highway 51 Quarry		AHTD
HS02	Caddo Quarries, Souter Construction	Friendship	CORPS
HS02	Souter Construction, Caddo Quarry	Friendship	CORPS
HS03	Tidwell Quarry	Butterfield	MAS, AHTD
HS03	Coleman Quarry	Butterfield	AHTD
HS04	Diamond Joe Quarry	Jones Mill	Other
HS05	Mid-State, Highway 270 Quarry	Malvern	MAS, AHTD
HS05	Malvern Quarry, Mid-State	Malvern	AHTD
HS06	Mid-State, Highway 7 South Quarry	Hot Springs	AHTD, MAS
HS06	Mid-State Quarry	Hot Springs	AHTD
HS06	MId-State Quarry #4	Highway 7	MAS
HS07	Tidwell, I-30 Quarry	Glen Rose	AHTD
HS07	Tidwell Quarry	Benton	AHTD
IN01	Midwest Lime Quarry	Batesville	AHTD, MSHA, MAS
IN02	Arkansas Lime Company Quarry	Batesville	AHTD
IN02	Limedale Quarry, Arkansas Lime Company		MSHA
IN03	Rocky Point Quarry, Tommy Gipson Construction	Southside	MSHA, CORPS, MAS, AHTD
IN03	Rocky Point Quarry	Huff	AHTD
IN03	Rocky Point Quarry	Batesville	AHTD
IN03	Southside Materials, Rocky Point Quarry	Batesville	AHTD
IN03	Southside Materials, Rocky Point Quarry	Southside	AHTD
IN03	Bryant, John E., Rocky Point Quarry	Southside	AHTD
IN04	Baughn Construction, Oakridge Quarry	Cord	MAS, MSHA
IN04	Oakridge Quarry, Baughn Construction	Cord	AHTD
IN05	Duffield Quarry	Oil Trough	AHTD, MAS, CORPS
IN05	Souter Construction Quarry	Oil Trough	MAS
IN06	Rock Products, Bradley Quarry	Cord	MAS, AHTD
IN06	Bradley Quarry	Cord	AHTD
IN06	Bradley Quarry	Dowdy	AHTD
IN06	Rock Products	Cord	AHTD
IN07	Ace Partnership, Coleman Quarry	Cord	AHTD
IN07	Coleman Quarry, Ace Partnership	Cord	AHTD
IN08	Quarry		QUAD
IN09	Quarry	Locust Grove	MAS
IN10	Wyatt Quarry	Rosie	MAS
IN11	Quarry	Walnut Grove	MAS
IN11	Crabtree Quarry	Walnut Grove	Other
IN12	Rock Products, Martin "Quarry" (Test Core)	Pleasant Plains	AHTD, Other
IZ01	Edwards Brothers Quarry	Violet Hill	AHTD, MSHA
IZ02	Ace Partnership Myron Quarry	Myron	AHTD, MSHA
IZ02	Atlas Asphalt, Myron Quarry	Myron	AHTD
IZ02	Myron Quarry	Myron	AHTD
IZ02	Horseshoe Bend Quarry, Hogan	Myron	AHTD, Other
IZ02	Hogan, Horseshoe Bend Quarry	Myron	AHTD, Other
IZ03	Reynolds Aluminum Co.	Guion	CORPS
IZ04	Quarry		CORPS
IZ05	Edwards Brothers, Wortham Quarry	Sage	AHTD
IZ05	Wortham Quarry, Edwards Brothers	Sage	AHTD
IZ06	Rock Products, Womack Quarry	Sage East	AHTD
IZ06	Womack Quarry, Rock Products	Sage East	AHTD
IZ07	Freshour Quarry	Myron	Other
IZ07	Ferguson Quarry	Myron	MAS
IZ08	Kerr Quarry	Pineville	MAS, AHTD
IZ09	Rout Quarry	Gid	MAS
IZ10	Twin Creek Quarry	Melbourne	MAS

IZ12	Helems, Arlin Quarry	Oxford	MAS
IZ12	Alum Helm Quarry, Hogan Company		AHTD
IZ13	Engels Quarry	Pineville	MAS
IZ14	Tate Quarry	Melbourne	AHTD
IZ15	Lake, Kenneth Quarry	Zion	AHTD
JO01	Chrisman Quarry, Chrisman Ready Mix	Clarksville	AHTD, MSHA
JO02	Roward Quarry		AHTD
JO02	Johnson County Quarry		AHTD, MAS
JO03	Hurley Quarry	Clarksville	MAS, AHTD
JO04	Goff Quarry		MAS
JO05	Phillips Quarry		MAS
JO06	Brotherton Quarry		MAS
JO07	Freshour Quarry	Clarksville	AHTD, MAS
JO07	Skaggs Quarry, Freshour		MAS
JO08	Baskin Quarry		MAS
JO09	Lewis Quarry	Ozone	MAS
JO10	MeLinard Quarry	Knoxville	MAS
JO11	Kraus Quarry, Patton Construction	Hagarville	AHTD
JO11	Patton Construction, Kraus Quarry	Hagarville	AHTD
JO12	Southeast Construction Company	Alix	Other
LG01	Pine Bluff Sand & Gravel, Morrison Bluff Quarry	Morrison Bluff	AHTD, MSHA
LG01	Arkansas Rock Company	Scranton	AHTD
LG01	Arkansas Sandstone, Jackson Quarry	Scranton	AHTD
LG01	Mid-South Construction, Jackson Quarry	Scranton	AHTD
LG02	Pine Bluff Sand & Gravel, River Mountain Quarry	Delaware	AHTD, MSHA
LG02	River Mountain Quarry, Pine Bluff Sand & Gravel	Delaware	AHTD, MSHA
LG02	Western Arkansas Sandstone Company		CORPS
LG03	Schwartz Quarry		MAS
LG03	Logan County Building Stone, Schwartz Quarry	Midway	AHTD, MSHA
LG04	Undeveloped Site		CORPS
LG05	S & W Rock Quarry	Roseville	MAS, AHTD
LG05	Robberson, Slick Quarry, S & W Rock	Roseville	MAS
LG06	Robertson Quarry (Robberson)	Roseville	MAS, Other
LG07	Robertson Quarry, Roseville Hole #4	Roseville	CORPS
LG08	Magazine Mountain Quarry	Mount Magazine	MAS
LG09	Parrott Quarry	Caulksville	MAS, Other
LG09	Meyers Quarry		AHTD, Other
LG09	Chrisman, Ratcliff Quarry	Ratcliff	AHTD
LG10	B & D Sand & Gravel	Roseville	MAS, AHTD
LG10	B & G Sand & Gravel	Roseville	AHTD
LG10	F & G Sand & Gravel	Roseville	AHTD
LN01/PU05	Freshour, Cabot Quarry	Cabot	MSHA, AHTD, MAS
LN02	Baludwin Quarry	Ward	AHTD
LN02	Balding, Tolbert Quarry	Ward	Other
LN03	Utley Quarry	Austin	AHTD, Other
LR01A	Hogan Quarry	Black Rock	AHTD
LR01A	Black Rock Limestone Products	Black Rock	AHTD
LR01B	Hogan Quarry	Black Rock	AHTD
LR01B	Boorhem Fields Quarry	Black Rock	AHTD, MSHA
LR01B	Meridian Quarry	Black Rock	AHTD, MSHA
LR01B	Valley Stone Quarry, St. Francis Materials	Black Rock	CORPS
LR01B	Valley Stone Quarry, Boorhem Fields		CORPS
LR01B	St. Francis Materials Company	Black Rock	MAS, AHTD
LR02	Black Rock Sand & Gravel	Black Rock	AHTD, MAS
LR02	Verkler Quarry, Black Rock Sand & Gravel	Black Rock	MSHA, AHTD
LR02	Black Rock Quarries	Black Rock	AHTD
LR02	W.W. Smith Quarry	Black Rock	AHTD, CORPS, MAS
LR02	Vulcan Quarry	Black Rock	Other
LR03	Tate Quarry		CORPS
LR03	Tate Quarry, Hogan, Meridian	Black Rock	Other
LR03	Sloan Quarry	Black Rock	Other
LR03	Meridian, North Quarry (Atlas)	Black Rock	AHTD
LR04	Quarry	Black Rock	CORPS
LR05	Toles, Perry Quarry		AHTD

LR05	Rowand Materials	Black Rock	CORPS
LR06	Walker Quarry	Strawberry	Other
LR07	Delta Asphalt Quarry (Test Hole)	Black Rock	AHTD, Other
MD01	McClinton Anchor Quarry	Huntsville	MAS, AHTD
MD01	War Eagle Quarry	Huntsville	AHTD
MD02	Parker Quarry	Kingston	MAS, AHTD
MD03	Elsey Quarry	Marble	MAS
MD04	Neal Quarry	Huntsville	MAS
MD05	Carr Quarry	Hindsville	MAS
MD06	Smith Quarry	Forum	MAS, AHTD
MD07	Quarry	Old Alabam	MAS
MD08	Quarry	Huntsville	MAS
MG01	Tigue Brothers, Alexander Pit	Mt. Ida	AHTD
MG01	Woods, Jack, Alexander Pit	Mt. Ida	AHTD
MG01	Alexander Pit	Mt. Ida	AHTD
MG02	Tigue Brothers, Davis Pit	Caddo Gap	AHTD
MG03	Mauldin Pit	Mt. Ida	AHTD, MAS
MG03	Montgomery County Quarry	Mt. Ida	Other
MG04	Buttermilk Springs Quarry	Caddo Gap	Other
MR01	Eblen, Alexander Quarry	Summitt	Other
MR01	Alexander & Eblen Pit	Summitt	AHTD
MR01	T.J.'s Materials and Construction	Yellville	AHTD, CORPS
MR02	Burl King Quarry, Freshour	Yellville	AHTD
MR02	Freshour Construction, Portable Crusher #1		MSHA
MR03	Marion County Road Department	Yellville	MSHA, AHTD
MR03	Marion County Quarry, Burl King #2		AHTD
MR04	Flippin Materials Company		CORPS
MR04	Lee Mountain Quarry	Lee Mountain	CORPS
MR04	Twin Lake Quarry	Flippin	AHTD, Other
MR04	Carter Quarry	Summit	AHTD, Other
MR05	Twin Lakes, Jefferson Quarry	Yellville	AHTD
MR05	Jefferson Quarry, Twin Lakes	Yellville	AHTD
MR05	Jefferson Quarry, Guy King & Sons	Yellville	MAS
MR06	Evans Quarry	Peel	MAS
MR07	Luck, Ted Quarry	Flippin	MAS
MR08	Lowery Quarry	Eros	MAS, AHTD
MR08	Gray Quarry	Eros	AHTD, Other
MR09	Burleson Quarry	Monarch	MAS
MR10	Riseley Quarry	Peel	QUAD, Other
NT01	Hardy Construction, Turney-Hughes Quarry	Parthenon	AHTD
NT01	Turney-Hughes Quarry, Hardy Construction	Parthenon	AHTD
NT02	Harrison Quarry	Jasper	AHTD, MAS
NT03	U.S. Forest Service Quarry	Fallsville	MAS
NT04	McElhaney Quarry	Low Gap	MAS, AHTD
NT04	Clark Quarry	Low Gap	AHTD
NT05	Hudson Quarry	Jasper	MAS, AHTD
NT06	Holt Quarry	Carver	MAS
NT06	Holt Quarry	Hasty	AHTD
NT07	Johnson Quarry	Mt. Judea	MAS, AHTD
NT09	Harrison Quarry	Jasper	Other
NT10	Hudson Quarry	Jasper	Other
NT11	Smith, Edward Quarry, Rock Products	Highway 374	AHTD
NT11	Rock Products, Smith Quarry	Mt. Judea	AHTD
NT12	Freshour Quarry	Lurton	AHTD
PI01	Pennington-Winter Construction		CORPS
PI02	Plant, R.D. Quarry	Kirby	AHTD
PI03	Beavert Quarry, Souter Construction, R.D. Plant	Murfreesboro	AHTD, CORPS
PI03	Plant, R.D., Beavert Quarry	Murfreesboro	AHTD
PI03	Souter Construction, Beavert Quarry	Murfreesboro	AHTD
PI04	M & P Power Equipment		CORPS
PI04	D & E Construction Company		CORPS
PI05	Delight Quarry, Carter Construction Co.	Delight	CORPS
PI05	Little Rock Quarry	Delight	CORPS

PK01	Herzog Stone Products Hatton Quarry	Hatton	AHTD, CORPS, MSHA
PK01	Meridian, Hatton Quarry	Hatton	AHTD, MSHA
PK02	Quarry	KCS Railroad	CORPS
PK03	Quarry	Potter	MAS
PK03	Markham & Brown Quarry		CORPS
PK04	Quarry		CORPS
PK05	Walker Stone Company	Hatton	AHTD, MAS
PK05	Hatton Rock Company	Hatton	AHTD
PP01	Duffield New Hope Quarry	Russellville	AHTD
PP01	New Hope Quarry, Duffield	Russellville	AHTD
PP02	Pope County Quarry	Dover	MSHA
PP02	Duffield Quarry	Dover	Other
PP03	Mobley Construction		CORPS
PP03	Hogan Quarry	Russellville	AHTD
PP04	Duffield Gumlog Quarry	Gumlog	AHTD
PP05	Ferguson Quarry		MAS
PP06	Witherspoon Quarry	Russellville	MAS
PP07	Barton Quarry	Russellville	MAS, AHTD
PP07	Hogan, Barton Quarry	Russellville	AHTD
PP08	Young Quarry		MAS
PP09	Carpenter Quarry	Russellville	MAS, AHTD
PP10	Price Quarry #1		MAS
PP11	Price Quarry #2		MAS
PP12	Abernathy Quarry	Dover	MAS, AHTD
PP13	Cravens Quarry	Dover	MAS
PP14	Quarry	Atkins	MAS
PP15	Smith Quarry	Oak Grove	MAS
PP16	Fountain Quarry	Nogo	MAS, AHTD
PP17	Hefley Quarry	Pelsor	MAS, AHTD
PP17	Souter, Hefley Quarry	Pelsor	Other
PP17	Duffield, Hefley Quarry	Pelsor	AHTD
PP17	Rock Products, Hefley Quarry	Pelsor	Other
PP18	Ragsdale Pit	Bullfrog Valley	AHTD
PP19	Huckleberry Creek Dam Quarry	Dover	Other
PP19	McGeorge Construction, Huckleberry Creek Dam	Dover	Other
PP20	Duvall Quarry	Oak Grove	Other
PU01	Granite Mountain Quarry #1, McGeorge Construction		MSHA
PU01	Granite Mountain Quarries	Sweet Home	AHTD, CORPS
PU02	Mid-State Construction Company (3M Site)	65th St., Little Rock	MAS
PU02	Mid-State Materials, Big Rock Quarry	Little Rock	AHTD
PU02	Big Rock Quarry	Little Rock	AHTD
PU02	Arch Street Quarry, Mid-State	Little Rock	AHTD
PU02	Big Rock Stone & Materials Company		CORPS
PU02	3M Corporation, Big Rock Quarry		CORPS
PU03	McGeorge Contractors, Granite Mountain Quarry #2		MSHA
PU03	Granite Mountain Quarries (#2)	Sweet Home	AHTD
PU04	Little Rock Quarry, Carter Construction	College Station	CORPS, MSHA
PU05	Freshour Construction	Cabot	MSHA, AHTD
PU05	Freshour Construction, Wingate Quarry		MAS, AHTD
PU06	Rowlett, Crystal Hill Quarry	Maumelle	MAS, AHTD
PU06	Crystal Hill Quarry, Rowlett	Maumelle	
PU07	Mid-State Lawson Road Quarry	Little Rock	MAS, AHTD
PU07	Mid-State Materials, Taylor Quarry	Little Rock	MAS, MSHA, AHTD
PU07	McGeorge Quarry, Lawson Road	Little Rock	AHTD
PU07	Taylor Quarry, McGeorge	Little Rock	AHTD
PU07	Taylor Quarry, Mid State	Little Rock	AHTD
PU08	Pinnacle Mountain Talus	Little Rock	CORPS
PU09	Big Rock Stone & Materials Company	North Little Rock	CORPS
PU10	Jeffery Stone Company		CORPS
PU11	Sweet Home Stone Company		CORPS
PU12	Pulaski County Quarry		AHTD
PY01	Chapman Quarry	Toadsuck	AHTD, MAS
PY01	M & M Rock, Chapman Quarry	Toadsuck	AHTD, MSHA
PY01	Rogers Group, Chapman Quarry		AHTD

PY02	Quarry	Stony Point	MAS
PY02	Freeman Quarry, L & R	Stony Point	Other
PY02	Souter Construction, Freeman Quarry	Stony Point	Other, MSHA
PY02	Stane Reach Quarry		CORPS
PY03	Quarry	Houston	MAS
PY03	Van Dalsen Quarry	Houston	AHTD
PY04	Quarry	Houston	MAS
PY04	International Paper Company, Souter Construction	Houston	Other
PY05	English Quarry (Test Blast)	Nimrod	AHTD
PY06	McGlother Quarry	Bigelow	AHTD
PY07	Jones Quarry	Casa	MAS, AHTD
PY07	Hogan, Test Holes	Casa	AHTD
PY08	Strassle Quarry		Other
PY08	Quarry		MAS
PY09	Nutt Quarry, Souter Construction	Bigelow Park	Other
PY09	Souter Construction, Nutt Quarry	Bigelow Park	Other
RD01	Undeveloped Site		CORPS
RD02	Baltz Quarry	Pocahontas	AHTD, MAS
RD03	Jarrett Quarry	Maynard	MAS, AHTD
RD03	Freshour Quarry	Maynard	AHTD
RD04	Melton, Curtis Quarry		MAS
RD04	Quarry	Supply	AHTD
RD05	Botard Quarry		MAS
RD06	Melton, Curtis Quarry (#2)	Pocahontas	Other, AHTD
RD07	Baltz Quarry (Old Quarry)	Pocahontas	Other
RD08	Thielemier Quarry (#1)	Pocahontas	Other
RD09	Thielemier Quarry (#2)	Pocahontas	Other, AHTD
RD10	Harrington Quarry	Pocahontas	Other
SA01	Hot Springs Village Quarry	Hot Springs Village	AHTD
SA01	Cooper Communities Quarry	Hot Springs Village	MSHA
SA02	Teague Brothers Pit	Paron	AHTD
SA02	Weyerhauser Pit	Paron	AHTD
SA03	West, Ira; I-30 Quarry	Haskell	AHTD
SB01	Jenny Lind Quarry, Arkhola	Old Jenny Lind	MAS, AHTD, MSHA
SB01	Arkhola, Jenny Lind Quarry	Old Jenny Lind	AHTD
SB01	Tygart Quarry		AHTD, CORPS
SB01	Arkhola Sand & Gravel	Greenwood	AHTD
SB02	Arkhola Sand & Gravel	Fort Smith	CORPS
SB03	Fort Chaffee Quarry	Fort Chaffee	CORPS
SB04	Hayes Quarry	Mill Town	MAS
SB06	Sebastian County Quarry	Fort Smith	MAS
SB07	Martin, Bobby Quarry		Other, QUAD
SB08	Court House Slough Quarry		MAS
SB09	Floyd Quarry		MAS
SC01	Quarry	Waldron	MAS
SC02-CCG	Mill Creek Mountain Quarry		MAS
SC03-CCG	Nelson Quarry		MAS
SC04-CCG	Quarry	Waldron	MAS
SC05-CCG	McConnell Pit	Y-City	MAS, AHTD
SC06-CCG	Morgan & Hall Pit	Rocky Branch	MAS
SC06-CCG	Morgan, Billie Quarry		AHTD
SE01	Sutterfield Quarry	Harriet	MAS
SE02	Harris Quarry		MAS, AHTD
SE03	Ashley Quarry	Leslie	MAS, AHTD
SE03	Freshour Quarry	Leslie	AHTD
SE03	McClinton Anchor (APAC)	Leslie	AHTD
SE04	Evans, Melvin Quarry	Snowball	MAS, AHTD
SE05	Hudspeth Quarry	St. Joe	MAS, AHTD
SE05	L & R Quarries, Hudspeth Quarry	St. Joe	AHTD
SE06	Cooper Quarry	Snowball	AHTD
SE07	Myrick Quarry, Rock Products		AHTD
SE07	Rock Products, Myrick Quarry		AHTD

SH01	Abandoned Quarry		CORPS
SH02	Williams Quarry, Harold Carroll	Ash Flat	AHTD
SH02	Arkansas Quality Stone, Rick Parrott	Hardy	Other
SH03	Evershire Quarry		MAS
SH03	Veshire Quarry		AHTD
SH03	Harper, Ron Quarry	Sharp County	AHTD
SH04	Freshour Quarry	Poughkeepsie	MAS
SH05	Morgan Quarry	Williford	MAS
SH06	Cushman Quarry	Evening Shade	MAS, AHTD
SH07	Quarry	Ash Flat	MAS
SH07	Farris, Walter Quarry	Ash Flat	AHTD
SH07	Freshour Quarry	Ash Flat	Other
SH08	Quarry	Calamine	MAS
SH09	Mize Quarry		MAS
SH09	Polston Quarry	Cave City	
SH10	Moser Quarry	Sidney	MAS
SH11	Murphy Quarry	Center	MAS, AHTD
SH12	Runsick Quarry		MAS, AHTD
SH13	Alexander Quarry		AHTD
SH14	Ace Partnership, Himschoot Quarry (Test Pit)	Ash Flat	AHTD, Other
ST01	Stone County Materials, Ace Partnership	Sylamore	AHTD, MSHA
ST01	Stone County Materials	Allison	AHTD
ST02	Ivy Quarry		MAS, AHTD
ST03	Purdom Quarry	Mountain View	MAS, AHTD
ST04	Green, Oram Quarry	Turkey Creek	MAS, AHTD
ST05	Freeze Quarry	Mountain View	MAS
ST06	Powell, Otis Quarry	Timbo	MAS, AHTD
ST07	U.S. Forest Service Quarry	Allison	MAS
ST07	Middleton Quarry	Allison	AHTD
ST08	Wade Quarry	Allison	MAS, AHTD
ST09	U.S. Forest Service Quarry #2	Fifty-Six	MAS
ST10	Quarry	Optimus	MAS
ST10	Cartwright Quarry		AHTD
ST11	Cruse Quarry, Edwards Brothers	Guion	AHTD
ST11	Edwards Brothers, Cruse Quarry	Guion	AHTD
ST12	Haydin Quarry	Allison	AHTD
ST12	Rock Products, Haydin Quarry	Allison	Other
SV01	Railroad Cut?	KCS Railroad	CORPS
SV02	Railroad Cut	KCS Railroad	CORPS
SV03	Undeveloped Site	Gillham	CORPS
SV04	Jester, Ollie	Gillham	CORPS
SV06	Outcrop?	Rolling Fork River	CORPS
SV07	HMB Quarry	DeQueen	AHTD, CORPS
SV07	Weyerhauser Quarry, HMB Construction		CORPS
SV07	Provo Covenant Quarry	DeQueen	AHTD
VB01	Treece Quarry, Clinton Ready Mix		MSHA
VB01	Treece Quarry, Clinton		AHTD
VB01	T & T Materials, Treece Quarry	Bee Branch	AHTD
VB02	Freshour Quarry		MAS
VB03	Crownover Quarry	Bee Branch	MAS
VB04	Hatchett Quarry		MAS
VB05	Jones Quarry		MAS
VB06	Quarry		MAS
VB06	Payton Creek Phosphate Mine Location	Payton Creek	Other
VB07	Ormond Quarry	Denard	MAS
VB08	Quarry		MAS
VB09	Kline Quarry		MAS, Other
VB11	Edwards Quarry		MAS
VB12	Quarry		MAS
VB12	Walls Quarry	Gravesville	AHTD
VB13	Coffman Quarry	Crabtree	MAS
VB14	Moody Quarry	Clinton	MAS
VB15	Shull Quarry		MAS
VB16	Jones Quarry		MAS, AHTD
VB17	Freeman Quarry, T & T Materials	Tilly	AHTD

VB18	Chason Quarry	Formosa	AHTD
VB19	Van Buren County Quarry	Choctaw	Other
VB20	Hall Quarry (Test Pit)	Clinton	AHTD, Other
WA01	McClinton Anchor/APAC	West Fork	MAS, AHTD, MSHA, CORPS
WA01	APAC/McClinton Anchor	West Fork	MSHA, AHTD
WA02	Washington County Quarry	Black Rock	MSHA
WA02	Sulphur City Quarry	Sulphur City	MAS
WA02	Washington County Quarry	Sulphur City	AHTD
WA03	McClinton Anchor	Johnson	MAS, AHTD
WA04	McClinton Quarry	West Fork	MAS, Other
WA05	Combs, Chester Quarry	Durham	MAS
WA06	Bush, Bill Quarry	Lincoln	MAS
WA07	Moore, Bill Quarry	Farmington	AHTD
WA08	Twehous Construction, Pit #1, "Pitkin Strip"	Devils Den State Park	AHTD, Other
WA09	Twehous Construction, Pit #2 (Test)	Devils Den State Park	AHTD
WA10	Mitchner Construction, Howard Quarry	Durham	AHTD
WA10	Howard Quarry, Mitchner Construction	Durham	AHTD
WA11	Hardy Construction, Brooks Quarry	Durham	AHTD
WA11	Brooks Quarry, Hardy Construction	Durham	AHTD
WA12	Washington County Quarry	Morrow	Other
WH01	Searcy Asphalt Materials	Judsonia	AHTD, MSHA
WH01	St. Francis Materials	Judsonia	MAS
WH01	Hogan Quarry	Judsonia	AHTD
WH01	Adler Creek Quarry, Hogan		AHTD
WH02	L & R Quarries, Bradford Quarry	Bradford	AHTD
WH02	Smith Quarry	Bradford	AHTD
WH02	D & S Construction, Smith Quarry	Bradford	AHTD
WH03	L & R Quarries, Searcy Quarry	Searcy	AHTD
WH04	Hogan, Bald Knob	Bald Knob	CORPS
WH04	Acme Materials	Bald Knob	CORPS
WH05	Acme Materials Company	Bald Knob	AHTD, MAS
WH05	Hogan Quarry	Bald Knob	AHTD
WH06	Jackson Quarry, Rock Products	Velvet Ridge	AHTD
WH06	Rock Products, Jackson Quarry	Velvet Ridge	AHTD
WH07	Rock Products, Peacock Road Quarry	Denmark	AHTD
WH07	Peacock Road Quarry, Rock Products	Denmark	AHTD
WH08	L & R Quarries	Floyd	AHTD
WH08	Vulcan Quarry	Floyd	Other
WH08	D & S Quarry	Floyd	AHTD
WH08	Dugout Mountain Quarry, D & S	Floyd	AHTD
WH09	McKee Quarry	Bald Knob	MAS
WH10	Shook, Kitty Quarry	Pleasant Plains	MAS
WH11	Blue Hole Quarry, Freshour Construction		MAS
WH11	Freshour Construction, Blue Hole Quarry		MAS
WH11	Blue Hole Wallow	Antioch	AHTD
WH12	Roetzel Quarry	Russell	MAS, AHTD
WH13	Neal Quarry	Floyd	AHTD
YE01	James Quarry	Fourche Valley	MAS
YE02-CCG	Hunt Quarry	Briggsville	MAS
YE03-CCG	Thomas Quarry	Danville	MAS, AHTD
YE05	Quarry		MAS
YE06	Miller Quarry	Centerville	MAS
YE07	Vestal Quarry	Chickalah	MAS
YE08	Quarry	Plainview	MAS
YE08	Deltic Timber Company Quarry	Plainview	AHTD
YE09-CCG	Cossage Quarry		MAS
YE11	U.S. Government Quarry	Danville	MAS
YE12	Tillman Quarry	Centerville	MAS