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WASTE PRODUCTS IN MISSOURI WITH POTENTIAL HIGHWAY APPLICATION

MISSOURI HIGHWAY AND TRANSPORTATION DEPARTMENT

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A statewide survey to locate solid waste products having potential for highway applications was conducted during 1981. The survey inventory includes 305 separate entries representing some 80 million tons of waste material currently accumulating at an annual rate of about 5 million tons.

Due to the State being a prime source of metal ore mining and smeltering, vast tonnages of mine tailings have accumulated. Also, considerable tonnages of electric utility waste products continue to accumulate in the form of fly ash, dry bottom boiler ash, and wet bottom boiler slag.

Possible uses for each waste material product are cited. From the summarized inventory, certain waste products were selected that appear to warrant further evaluation.

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WASTE PRODUCTS IN MISSOURI WITH POTENTIAL HIGHWAY APPLICATION

FINAL REPORT

STUDY NO. 81-2

Prepared By

MISSOURI HIGHWAY AND TRANSPORTATION DEPARTMENT

DIVISION OF MATERIALS AND RESEARCH

APRIL, 1982

In Cooperation With

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

The opinions, findings, and conclusions expressed in this publication are not necessarily those of the Federal Highway Administration.

ABSTRACT

A statewide survey to locate solid waste products having potential for highway applications was conducted during 1981. The survey inventory includes 305 separate entries representing some 80 million tons of waste material currently accumulating at an annual rate of about 5 million tons.

Due to the State being a prime source of metal ore mining and smeltering, vast tonnages of mine tailings have accumulated. Also, considerable tonnages of electric utility waste products continue to accumulate in the form of fly ash, dry bottom boiler ash, and wet bottom boiler slag.

Possible uses for each waste material product are cited. From the summarized inventory, certain waste products were selected that appear to warrant further evaluation.

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INTRODUCTION

An inventory to locate solid waste product materials having potential highway application was conducted during the spring and early summer of 1981 within each of the State's ten districts.

Special emphasis was placed on quantities of materials that had accumulated up to the present time as well as determining the ongoing annual rate of accumulation. Other items of concern were accessibility to the waste material sites (i.e., good haul road), method of stockpiling, a need for crushing, sizing or washing the waste material and who owned or controlled it for any required future contact purpose.

The various materials reported were listed within one of ten categories for more orderly summarization and control purposes. A thorough review of this completed listing and subsequent inventory summary was then conducted by a committee of various disciplines. After the waste product inventory had been scrutinized, a determination was made as to which of these waste products offered the greatest potential for future highway construction and/or maintenance applications. Those waste products which would appear to offer satisfactory performance and which further would have favorable benefit/cost ratio will be considered for future laboratory testing. It is contemplated that this testing and evaluation will be accomplished in a follow-up research study.

CONCLUSIONS

This study has produced a statewide inventory of solid waste products with assessments of their potential for highway applications. A listing of 305 material entries representing some 80 million tons of material, are categorized in Table I.

Seven waste product types, which appear to offer the most potential or have vast quantities of, are proposed for consideration for future laboratory study. These are: Kiln Dust, Fly Ash, Graded Chat Piles (Joplin Area), Lead Mine Chat (Flat River Area), Gypsum, Lead Blast Furnace Slag, and Limestone Screenings (Table XIII).

A new study is recommended to follow this inventory effort. The new study should include the waste product sampling and laboratory testing phases. Based on the test results, further evaluation should be made of the potential for highway usage of these waste products.

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SCOPE

The purpose of this study was to conduct a statewide survey of limited scope to determine availability of waste products which may have a potential highway construction or maintenance application. The only limitations placed on the survey was that it be limited to solid wastes and that no sampling or testing be done at this time.

Actual plant or quarry contacts and inventorying of available waste products were made by district personnel. These reports were collected, categorized, and summarized. A thorough review of the survey data was then performed by a committee of various disciplines. As a result, a series of waste product items were selected which appear to offer the greatest potential for satisfactory performance and favorable benefit/cost ratio.

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DISCUSSION

This study began April 15, 1981, when personnel in each of the State's ten districts began canvassing their respective areas for those solid waste products having potential highway application. This would include but not necessarily be limited to, construction of highway embankment fills, bases, subbases, and surfaces. In acquiring certain background waste product data, special emphasis was placed on determining quantities of materials that had accumulated up to the present time as well as determining the present annual rate of accumulation. Other items of concern were accessibility to the various waste material sites (i.e., good all weather haul roads), methods of stockpiling or storing, a need for crushing, sizing, or washing the waste material and who owned and/or controlled it for any possible future contact or sampling purposes. The form utilized to gather the desired information may be seen as Appendix 1. The terms "wet and/or dry" are used in Table I to indicate how the material is stored. For clarification, the term "wet" indicates a settlement pond or basin type deposit where water borne material had been placed. The term "dry" indicates material is exposed to the elements in an open air drainable type of deposit. The first phase of this study was completed when the respective districts concluded their canvassing and submitted their field inventory survey sheets to the headquarters central office.

The second phase of this study effort included tabulation of some 305 submitted separate waste product material entries,

including those covered by footnotes (See Table I), covering a wide range of waste product solids. Table I lists the complete inventory of individual inventoried material items classified within one of ten categories with associated sub-headings of waste products. There are listed in Table I two different sources of stockpiled material that at present have been declared to be hazardous waste. The methods employed in extracting the desired minerals from the mined metal-bearing-ore body determine whether the waste material is hazardous or not. Tables II thru XI inclusive tabulate presently available quantities and annual rates of accumulation of each category per each sub-heading. Table XII tabulates presently available quantities and annual rates of accumulation for each category. All quantities are approximate.

A State, District and County outline map exhibiting the various locations is shown as Figure I.

Having determined what categories and quantities of waste products were available within the boundaries of the State, copies of the summary were submitted to personnel of various disciplines for their thorough review and input. To arrive at a method of rating the various waste products, a form was devised that took a series of factors into consideration. These factors were: Overall Potential, Use History, Environmental Safety, Processing Requirements, Quantity for Proposed Use and Evaluation Required. No attempt was made to weigh the individual merits of the foregoing factors but each factor was considered before

placing each waste product into a given rating class. This rating form may be seen as Figure II.

Each sub-headed waste product item under each of the ten broad categories was rated and placed in either Class I, II, or III. Seven sub-headed waste product items, which appeared to offer the greatest potential for use, were selected to be considered for possible future laboratory study. These products were Kiln Dust, Fly Ash, Graded Chat Piles (Joplin Area), Lead Mine Chat (Flat River Area), Gypsum, Lead Blast Furnace Slag and Limestone Screenings. See Table XIII. Further work in the laboratory is needed to determine methods to upgrade and to make these waste products usable in either highway construction or maintenance operations.

A series of brief descriptive passages follow covering each sub-headed waste product item under the ten broad categories as listed in Table I. A possible use/s is indicated for each waste product item. In general, broad descriptions are given when material inventories originated from multiple sources as well as coming from several districts. When material sources were more limited, more specific descriptions could be given. The sequence of these product descriptions is as treated in Table I.

Category I - Collected Mineral Dusts

I. Bag House Dust - This waste in the form of dry bag-house collected dust particles is a by-product from an electric arc melting furnace. Physical characteristics include a material that is a dark dirty brown color and a gradation

with 100% passing a No. 100 sieve consisting of essentially metallic oxides. It would not normally be considered chemically reactive in an aqueous solution. This material presently is available at only one site on an ongoing basis which would therefore limit it to local usage. A possible use of this product would be as embankment fill material.

II. Hydrator Tailings - This waste is a by-product of a lime slaking operation. Physical characteristics include a material that is white in color in its dry form, though, it would be a grayish white when wet. It would surface crust when stored in open stockpiles. Other characteristics include approximately 100% passing a 1/4 inch sieve with about 10% passing the No. 200 sieve. It consists essentially of calcium carbonates ($CaCO_3$), calcium oxides (CaO), and calcium hydroxides ($Ca(OH)_2$). This product would be chemically active in an aqueous solution. Possible uses of this waste product would be as aggregate for base material and as agricultural limestone.

III. Kiln Dust - This waste is generally a by-product of cement production. Some exceptions would be from lime production or lightweight aggregate production which entails a calcining shale process. Physical characteristics include a material that is grayish buff colored and a gradation having 100% passing the No. 80 sieve with about 90 to 99% passing the No. 200 sieve. It would generally be considered chemically inert. Kiln dust is typically collected in bag houses and then moved to waste dust silos. This material

would be more usable as it comes from the waste dust silos because is surface crusts when exposed to moisture on open stockpiles. There is some variation from plant to plant depending on the dust collective system utilized and the ledge rock formation being processed. Possible uses of this waste product would be as a mineral filler for bituminous mixes, in a mud jacking slurry, as a soil stabilizer, or soil neutralization process.

IV. Kiln Dust and Clinkers - This waste is a by-product of cement production. Though this material is collected separately, it is presently being hauled and dumped into a common waste area. This material is available at only one site which would limit it to localized usage. A possible use of this waste product would be as embankment fill material.

Category II - Electric Utility Waste Products

I. Dry Bottom Boiler Ash (Clinkers) - This waste is a by-product of a coal fired electric generating plant. Bottom ash is sometimes referred to as dry bottom boiler slag and is a by-product of a balance or forced draft boiler at a power plant. The balance or forced draft boiler requires that coal be thoroughly pulverized to a very fine powder size prior to being forced into the boiler system. As the residue of this system leaves the bottom of the boiler, it has solidified into various sized clinkers which are mechanically crushed into cinders and enter the water which carries the material to a collection site. This by-product is being used as snow and ice abrasive material. Possible uses of this waste product would be as embankment fill or as subbase material.

II. Fly Ash - This waste is a by-product of coal fired electric generating plants. Physical characteristics include a material that is a dirty gray color and predominantly silt sized particles. This ash residue is electrostatically precipitated from the burning of powdered coal. Fly ash may exhibit considerable variation in chemical composition, pozzolanic reactivity, and economic potential. These factors are influenced by the coal source, completeness of combustion of the coal, and the form of ash storage, (i.e., whether wet or dry). Possible uses of this waste product would be as embankment fill material, as a soil or base stabilizer, as partial replacement for Portland cement, and in a mud jacking slurry.

III. Fly Ash and Bottom Ash Mixed - This waste is a by-product of a coal fired electric generating plant. Bottom ash is sometimes referred to as dry bottom boiler slag. Dry bottom boiler slag is a by-product of a balance or forced draft boiler at a power plant. The balance or forced draft boiler requires coal be thoroughly pulverized to a very fine powder size prior to being forced into the boiler system. As the residue of this system leaves the bottom of the boiler, it has solidified into various sized clinkers which are mechanically crushed into cinders and enter the water which carries the material to a collection site. A common occurrence to this type of boiler is the emission of fly ash discharged in the hot gas leaving the stack. In a dry bottom system, there will be 80 to 90% fly ash with 10 to 20% cinders. A common practice is to

combine collected fly ash with the cinders for disposal. This mixture is not generally suitable for use in bituminous mixtures due to the high content of minus No. 200 sieve material. A possible use of this waste product would be as embankment fill material.

IV. Sulfate Scrubber Sludge - This waste is a by-product from spraying stack gasses of coal burning power plants with waste and finely ground limestone to remove sulfurous emissions. The result is a mixture principally composed of water, hydrous calcium sulfates, fly ash, and calcium carbonates in sludge form. A possible use of this waste product would be as embankment fill material.

V. Fly Ash and Scrubber Sludge Mixed - This waste is a by-product resulting from dumping both water transported scrubber sludge and fly ash into a common wet storage facility. A possible use of this waste product would be as embankment fill material.

VI. Wet Bottom Boiler Slag - This waste is a by-product of a coal fired electric generating plant. Physical characteristics include a material that is black in color with individual particles ranging from medium to fine in size. Other characteristics show the slag to be glassy in appearance, to have conchoidal fracture, and to be very hard. It is sometimes referred to as "Black Beauty". Wet bottom boiler slag is a result of a cyclone boiler system which receives coal crushed down to a minus 3/8 inch particle size in contrast to the fine pulverized coal used in a balance draft boiler. The coal and air enter the boiler in a spiral motion. The residue of the cyclone

boiler leaves the bottom of the boiler in a molten state at about 2600°F. When this molten mass enters a water bath it instantly solidifies and shatters itself into essentially various particle sizes due to the sharp temperature differential in quenching. Emission of fly ash discharged with the wet bottom system is only 10 to 20% fly ash with 80 to 90% slag. This material is currently being used as aggregate in bituminous mixtures, as snow and ice abrasive material, and with processing is being used as abrasives for blast cleaning bridge steel.

VII. Washed Fines From Coal Crushing Operation - This waste is a by-product from a final coal washing process. Physical characteristics include a material that is a dull black color and individual particles that are angular in shape. Generally, 100% would pass the No. 4 sieve and about 3% passing the No. 200 sieve. It is generally considered chemically inert although a low percentage of sulfur may be present. This product has only limited appeal due to the low tonnages involved. A possible use of this waste product would be as embankment fill material.

Category III - Reclaimed Paving Material

I. Bituminous Pavement Piles (Cold Milled) - This waste is a by-product of roto-milling or removal of an existing bituminous surface. The top size will vary depending on how it was removed. This material is a bituminous mixture (aggregates coated with asphalt) and can be combined with virgin aggregates and asphalt cement to produce a recycled bituminous mixture. It can also be used as an aggregate

for base or subbase without the addition of any new asphalt or aggregate.

Category IV - Low Quality Crushed Stone

I. Marginal Quality Crushed Stone - This waste is a by-product of crushed aggregate produced in excess. Many non-operating quarries throughout the state have stockpiles of crushed aggregate in quantities ranging from approximately 500 to 20,000 tons. This material is largely the remnants of former stockpile bases and other remnants of former crushing operations produced in excess of a given project requirement to meet a specific gradation. As some of these various quarry sites have long since been abandoned, the material has been exposed to varying degrees of weathering due to the elements which lowers the quality of the material. Possible uses of this product would be as aggregate for various types of bases and surfacing material.

Category V - Metallurgical Slags

I. Foundry Grain Sand - This waste is a by-product of a foundry molding operation. Physical characteristics include a material that is black in color after the firing process and a gradation showing 100% passing the No. 10 sieve with about 10% passing the No. 200 sieve. Prior to firing, this molding sand is generally mixed with 2% bentonite which gives it an affinity for water and also serves as a bonding agent for the sand particles. Possible uses of this waste product would be as embankment fill material and as a soil stabilizer.

II. Electric Arc Furnace Steel Slag - This waste is a by-product of producing steel from metal scrap. Steel slag, principally a fused mixture of oxides and silicates, is a synthetic aggregate produced as a by-product of basic oxygen, electric, or open hearth steel making furnaces. It may be used as a coarse aggregate in bituminous mixtures. It is not recommended as a base unless and until it has aged to a point where all free lime, which might cause objectionable swelling, has been eliminated.

III. Lead Blast Furnace Slag - This waste is a by-product of an extraction process which recovers lead from a mined metal-bearing-ore body. While the terms "Lead Blast Furnace Slag" and "Lead Smelter Slag" are oftentimes confused, a common practice is to use these terms interchangeably. A smelter entails the entire plant operation, whereas, a blast furnace is an integral part of that operation. Physical characteristics include a material that is a bright, black glassy color in the wet state and a dull black color when dry. Other characteristics of the lead slag are a gradation having 100% passing the 1/4 inch sieve with about 3% passing the No. 100 sieve. As this molten slag leaves the bottom of the furnace, it is granulated with water and solidifies. It breaks in a conchoidal fracture and is hard and durable. This material is high in metallic oxides and is considered chemically inert based on tests run on drainage water taken from under the piles. However, the process employed in the handling and cooling of the molten slag itself determines how the remaining metal oxides are encased in the hardened slag. There is one company in Iron County

whose process is such that its slag, at present, is considered a hazardous waste. With this exception, lead blast furnace slag is being used as aggregate in bituminous mixtures and possible uses as a snow and ice abrasive material or as porous fill material.

Category VI - Various Mine Tailings

I. Graded Chat Piles (Joplin Area) - This waste is a by-product of former metal mining operations. Physical characteristics include material that is grayish white in color and angular particles shapes. It is moderately well graded with 100% passing a 1/2 inch sieve with only minor amounts passing the No. 200 sieve. This material consists of chert fragments, residual from the mining and processing of lead and zinc ores, primarily from the Reeds Spring and Grand Falls formations. This material is currently being used as aggregate in bituminous mixtures and with processing is being used as abrasives for blast cleaning bridge steel. Possible uses of this waste product are as embankment fill material or as subbase material.

II. Remains of Graded Chat Piles (Joplin Area) - This waste is a by-product of former metal mining operations. This is essentially the same material as above and consists of remnants (stockpile bases) remaining on the ground where large chat piles have been depleted as well as any oversized material (typically as plus 1/2 inch sieve) remnant from past screening or scalping operations. Possible uses of this waste product would be as embankment fill material and as subbase material.

III. Lead Mine Chat Tailings (Flat River Area) - This waste is a by-product of generally former metal mining operations

though some lesser production still occurs. Mill tailings in this area are composed of Bonneterre Dolomite waste, the result of being reduced to small size ranges by rock crusher and some recrushed and milled two or more times for recovery of some of the remaining lead-zinc. The material was the host rock for lead and zinc. Early mill practice used jigs and tables for recovery methods, so some fairly coarse sizes were produced in the waste piles. "Tiff" chats, produced in Washington County by washing, crushing, and jigging residual barite ores, consists mostly of chert with lesser quartz druse and limonite. As a result of the method employed in the mineral dressing operation of one company in Reynolds County, their lead mine tailings, at present, have been declared to be hazardous waste. This results from their adding chemical agents in extracting lead from the crushed mined metal-bearing-ore body. With this exception, tailings are being used as snow and ice abrasive material and possible uses as embankment fill material or in bituminous mixtures.

IV. Iron Mine Tailings (Igneous Material) - This waste is a by-product of the mining and processing of iron ore. Iron mine tailings (trap rock) is either a felsite or rhyolite porphyry in nature which was the host rock of iron ore deposits and is the remaining by-product of that operation. The size varies from boulders to sand depending on the operation it came from. Material, requiring no processing or crushing, washing, and screening, has been extensively used in portland cement and asphaltic concrete. Only location and availability

limit its use. It is very desirable for use in special asphalt mixes to provide improved frictional properties.

V. Rhyolite Porphyry Sand (Igneous Material) - This waste is a by-product of mine operations as described above. This by-product is being used as aggregate in bituminous mixtures and also as snow and ice abrasive material.

Category VII - Organic Waste Materials

I. Sawdust Piles - This waste is a by-product of various sawing operations such as the production of railroad ties, dimension lumber, posts, flooring, and palletting materials. Though this waste product can generally be found throughout the State, by far the greatest amount is found in the southern region of the State commonly referred to as the Ozarks. Sawdust is derived from the cutting of both hardwood (oak) and softwood (pine) timber of a variety of species. It is usually placed in open air drainable stockpiles which are exposed to the elements. Some of these piles have been in existence for great periods of time and have accumulated in total to some 6 million tons. The leaching of tannic acid from sawdust derived from hardwood (various species of oak) would limit the use of this waste material as a mulch carrier for grass seed. This acid would kill most forms of vegetation in the mulched areas. Sawdust is now being used as a blotter material for surface bituminous crack sealing operations. It has limited usage in a blend of snow and ice abrasive materials.

II, III, and IV. Bark and Pole Peelings, Woodchips, and Shavings (Oak and Pine) - These wastes are a by-product of

post, palletting, and flooring operations. Though the reported sources are presently limited to District 9, there is a moderate amount of material available with an ongoing accumulation continuing. These waste products would have limited usage based on availability. Possible use of these waste products, derived from various species of pine, would be as a mulching material. The tannic acid leached from oak waste products would limit its usage as a mulching material.

Category VIII - Inorganic Waste Materials

I. Asphalt Shingles and Tabs - This waste is largely a by-product of culling out from production those items failing to meet desired quality standards. Present disposition of this waste is generally to city landfills or other waste sites. Quantities are relatively small, though it is accumulating on an ongoing basis. It may, therefore, have localized appeal when availability becomes more generally known. Possible use of this waste product would be as asphalt recycling material.

II. Refractory Materials (Fire Brick, Etc.) - These waste materials are a by-product of both brick and tile companies and of various refractories damaged fire brick taken from their rotating kilns. This is generally broken pieces of durable hard heat treated minus eight inch material and presently limited to sources in Districts 1, 2, and 3. Present disposition of most of this material is commonly placed in landfills where it is contaminated with other refuse. Possible use would be as embankment fill material.

III. Battery Cases (Bakelite and Plastic) - This waste is a by-product following the stripping of all salvageable metals from the cases. Capability exists at the source to shred the cases if needed. There is only a very limited supply available which would restrict it to localized usage. Possible use of this waste product would be as a ditch block.

IV. Rubber Tires - This waste is a by-product resulting from discarded worn tires collected at satellite locations around the state which are often then sent to central stockpiles outside the State. As this waste is generally weather resistant, it could successfully be used in retaining walls, as ditch blocks, and as ground scrap rubber blended with sand and asphalt emulsion to form a thin viscoelastic interface between a crack-prone base and a bituminous concrete overlay.

Category IX - Oversized and/or Undersized Gravel and Sand

I. Hill Sand (Glacial) - This waste is a by-product of fine sand size sorting and concentration of particles by water action of glacial material. Physical characteristics include a material that is a dirty brown color, sub-angular particle shapes and a gradation having 100% passing the No. 10 sieve with about 8% passing the No. 200 sieve. It has a group index of 0. This is generally a glacial outwash material and is located as sporadic irregular hill type deposits in the northwest and north central part of the State. Processing of this material would require washing. Possible uses of this product would be as a

subbase material, to lower plastic index for stone bases, as a soil cement mixture, and as a blending sand for asphaltic concrete. This by-product has had limited use as snow and ice abrasive material.

II. Fill and Waste Sand - This waste is a by-product of a washing and screening operation that produces blasting sand out of flint chat piles which are common to the southwest region of the State. Physical characteristics include a material that is grayish white in color, individual particles are angular in shape, and a gradation generally having 100% passing the No. 40 sieve. These chat piles are remnants of former lead and zinc mining operations which now dot the country side on the surface. Possible use of this product would be as an aggregate for bituminous mixes.

III. Low Quality Hill or Creek Gravel - This material is essentially an outwash of gravelly soils from hill deposits and is common to stream beds in several counties in the southwest part of the State. Physical characteristics include a material that is light tan colored and individual particles are generally rounded due to stream action. Other physical characteristics show the specific gravity ranges from 2.1 to 2.5 with an absorption ranging from 4 to 7 percent. Production of this material is accomplished by a washing and screening process, and commonly graded into four sizes with no crushing involved. Possible uses of this product would be as embankment fill and as base material. This material is currently being used as aggregate in bituminous mixes assuming satisfactory range of quality control.

IV. Oversized Gravel - This waste is a by-product of a

scalping operation of gravel taken from both pits and streams. Physical characteristics include a material that is tan to brown in color, individual particles are generally rounded due to stream action, and is generally a clean hard durable material ranging in size from a plus 2 inch to a minus 8 inch. These waste oversized gravel piles were reported by Districts 6 and 8. Several of these stockpile sites are now abandoned after former active highway projects were completed. Due to its hardness, it has not been economically feasible to crush this chert gravel with the present technology and methods available. Possible uses of this waste product would be as embankment fill material and in gabions as is, and as aggregate for bituminous surface courses with crushing and sizing.

V. Railroad Ballast Rock - This waste product is presently represented by an abandoned railroad bed extending some 62 miles and is located in the east central section of the State comprising some 230,000 cubic yards of material. It is generally made up of durable rock particles placed in layers of minus 2 1/2 inch material made up from both igneous and sedimentary rock types. Possible uses of this waste product would be as an aggregate for base, embankment fill, and shoulder material.

Category X - Miscellaneous

I. Boulders and Chat Piles Mixed (Joplin Area) - This waste is a by-product of former metal mining operations. Boulders of the Joplin area are also chert remnants wasted from lead and zinc mining. While most are approximately

12 inches in top size there is considerable variation in the degree of size uniformity from pile to pile. In most cases, graded chat has been wasted with these boulders in a common stockpile. These Joplin "flint" chats are mostly jasperoid and chert, both forms of silica. Possible uses of this waste product would be as base, embankment fill, shoulder material, and in gabions.

II. Digested Sludge - This waste is a by-product of a municipal sewage treatment plant. Digested sludge is a black, thin, mud-like, pumpable liquid which may contain 5 to 6 percent of organic solids and is fairly odor-free. It has been used in small quantities as a liquid fertilizer.

III. Gypsum - This waste is a by-product in the manufacture of phosphate fertilizer. Physical characteristics include a material that is a dull white to light gray in color and is silty textured. It is chemically similar to natural gypsum. It is stored in drained stockpiles in loose to poorly cemented form. At the present time, there are no known highway uses for this particular waste product.

IV. Limestone Screenings - This waste is a by-product from the production of crushed aggregate and is a remnant of a screening operation following a secondary crusher. Physical characteristics include a material that is generally grayish in color and a gradation having 100% passing the 3/8 inch sieve with about 8% passing the No. 200 sieve. This waste would be considered chemically inert. These screenings are commonly found at most quarry sites whether active or abandoned. A lime

producer in the east central section of the State has accumulated some three million tons of this material with about a quarter million tons a year still accumulating. This by-product is being used as snow and ice abrasive material. Possible use of this waste product would be as embankment fill material.

V. Mixture of Grit, Sand, Gravel, Organic Material, and Metal - These wastes are the by-products as a result of a screening process by removing solids at a municipal sewage treatment plant. Physical characteristics include a material that is dark blackish colored and a gradation that is generally all minus 1/4 inch. This material is presenting being disposed of in a trash dump. Though it continues to accumulate on an ongoing basis, its limited quantity and high organic content would not make it suitable for any known highway usage at this time.

VI. Quarry Overburden as Soil, Shale, and Limestone Boulders or Rip Rap Material - This waste is a by-product and occurs as a result of stripping the overburden material to get to desired ledges of stone or ore bodies. This procedure is common practice to the producers of crushed aggregate, cement, coal, and to some of the metal ore mines. There is extensive amounts of this material available as most quarries throughout Missouri have stockpiles of overburden ranging from 500 tons to in excess of 1,000,000 tons. A general characteristic would be the great variation in sizing. Possible use of this waste product would be as embankment fill material.

VIII. Waste Shale Associated With Inactive Coal Mine Operations - This waste is a by-product of former shallow

shaft (100' depths) coal mining operations which are no longer active. Physical characteristics include a material that is generally gray in color and a gradation having a top size of about six inches with about 10% minus No. 200 sieve material. Some 720,000 cubic yards of material are stockpiled at six different sites in the north central area of the State. This material commonly referred to as "gob" by the miners was in the form of shale layers encountered immediately above the coal seams. This shale would be brought up out of the mines and placed in large waste piles. In time, these piles would ignite by spontaneous combustion brought about by heat generated from within. This gave the shale waste a burnt or case hardened appearance. The outer exposed areas of these waste piles are now slaking down due to weathering by being exposed to the elements. This material become slick when wet and tends to have a cementing action. Possible use of this waste product would be as embankment fill material.

VIII. Waste Fire Clay (Plastic Clays) - This waste is a by-product of various clay refractory processes. Physical characteristics include a material that is generally grayish colored and of variable gradations with an approximate top size of three inches. This waste is composed of non-fired plastic clays that either (a) was not chemically suitable or (b) had been contaminated in moving or handling and therefore could not be utilized for its intended end product. Accumulation of this material is in outdoor waste piles with sources presently limited

to four sites, all of which, are in District 3. Possible use of this material would be as embankment fill material.

IX. Broken Concrete of Industrial Products - This waste is a by-product resulting from the manufacture of various precast concrete products such as manholes, pads, pipe, cubes, blocks, culverts, beams, etc. This material is made up of durable hard variable sized pieces and is considered to be chemically inert. Possible uses of this waste product would be as ditch checks and slide repair.

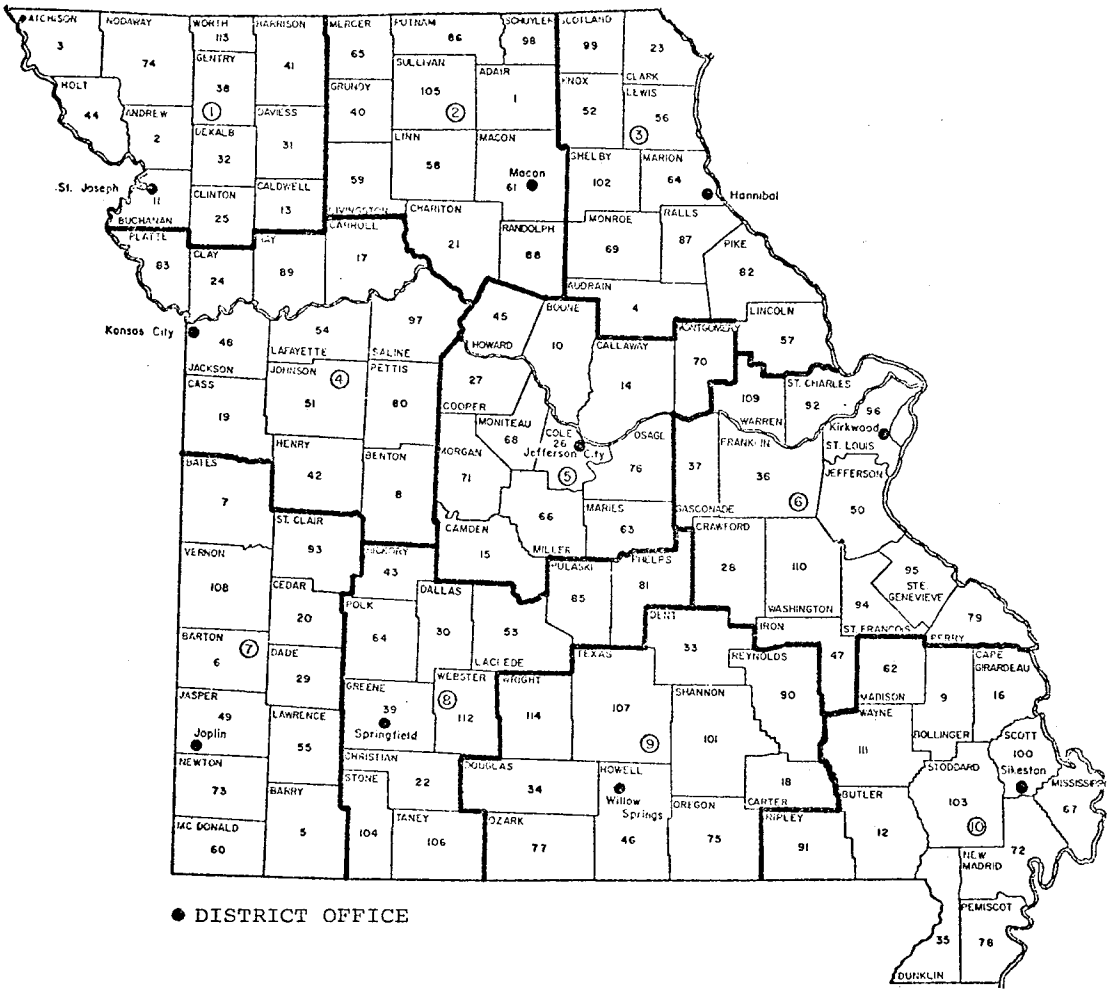
X. Crushed Limestone (Various Sized Fractions) - This quality material was essentially crushed to meet a specific gradation requirement though produced in excess of the given projects need. This excess material now remains in isolated stockpiles at various abandoned quarry sites. Possible uses of this material would be as various types of base and surface material.

XI. Porcelain (Broken Molds) and Broken Pottery - This waste is a by-product of rejects and damaged porcelain stools, flush boxes and lids, and also various casting molds and broken pottery pieces. This waste product is considered chemically inert and due to the firing process is made up of durable hard pieces of various sizes. Due to the limited quantities available it would only have localized appeal and usage. Possible uses of these waste products would be as embankment fill material as is, and as base material with crushing and sizing.

FIGURE I

STATE OUTLINE MAP

DISTRICTS AND COUNTIES



● DISTRICT OFFICE

INDEX

COUNTY	MAP NO.	DIST.	COUNTY	MAP NO.	DIST.	COUNTY	MAP NO.	DIST.	COUNTY	MAP NO.	DIST.
ADAIR	1	2	DADE	29	7	LINCOLN	57	3	PUTNAM	86	2
ANDREW	2	1	DALLAS	30	8	LINN	58	2	RALLS	87	3
ATCHISON	3	1	DAVIESS	31	1	LIVINGSTON	59	2	RANDOLPH	88	2
AUDRAIN	4	3	DEKALB	32	1	MCDONALD	60	7	RAY	89	4
BARRY	5	7	DENT	33	9	MACON	61	2	REYNOLDS	90	9
BARTON	6	7	DOUGLAS	34	9	MADISON	62	10	RIPLEY	91	10
BATES	7	7	DUNKLIN	35	10	MARIES	63	5	ST. CHARLES	92	6
BENTON	8	4	FRANKLIN	36	6	MARION	64	3	ST. CLAIR	93	7
BOLLINGER	9	10	GASCONADE	37	6	MERCER	65	2	ST. FRANCOIS	94	6
BOONE	10	5	GENTRY	38	1	MILLER	66	5	STE. GENEVIEVE	95	6
BUCHANAN	11	1	GREENE	39	8	MISSISSIPPI	67	10	ST. LOUIS	96	6
BUTLER	12	10	GRUNDY	40	2	MONITEAU	68	5	SALINE	97	4
CALDWELL	13	1	HARRISON	41	1	MONROE	69	3	SCHUYLER	98	2
CALLAWAY	14	5	HENRY	42	4	MONTGOMERY	70	5	SCOTLAND	99	3
CAMDEN	15	5	HICKORY	43	8	MORGAN	71	5	SCOTT	100	10
CAPE GIRARDEAU	16	10	HOLT	44	1	NEW MADRID	72	10	SHANNON	101	9
CARROLL	17	4	HOWARD	45	5	NEWTON	73	7	SHELBY	102	3
CARTER	18	9	HOWELL	46	9	NODAWAY	74	1	STODDARD	103	10
CASS	19	4	IRON	47	6	OREGON	75	9	STONE	104	8
CEDAR	20	7	JACKSON	48	4	OSAGE	76	5	SULLIVAN	105	2
CHARITON	21	2	JASPER	49	7	OZARK	77	9	TANEY	106	8
CHRISTIAN	22	8	JEFFERSON	50	6	PEMISCOT	78	10	TEXAS	107	9
CLARK	23	3	JOHNSON	51	4	PERRY	79	6	VERNON	108	7
CLAY	24	4	KNOX	52	3	PETTIS	80	4	WARREN	109	6
CLINTON	25	1	LACLEDE	53	8	PHELPS	81	8	WASHINGTON	110	6
COLE	26	5	LAFAYETTE	54	4	PIKE	82	3	WAYNE	111	10
COOPER	27	5	LAWRENCE	55	7	PLATTE	83	4	WEBSTER	112	8
CRAWFORD	28	6	LEWIS	56	3	POLK	84	8	WORTH	113	1
						PULASKI	85	8	WRIGHT	114	9

FIGURE II

PRODUCT TYPE RATINGS

	Class	I	II	III
Rating	Overall Potential	Highest	Limited	Lowest
Rating Factors*	Use History	Fairly Common	Limited	Little or None
	Environmental Safety	Generally Considered		
		Safe	Questionable or Unsafe	
	Processing Requirements	Little or None	Some	Extensive
	Quantity for Proposed Use	Large	Limited	Minor to Extensive
	Evaluation Required	Confirm properties and known		
		Applications	Research Possible Uses	

*Not all rating factors apply to all classes but all factors are considered in rating determination. For example, a hazardous substance would receive a III rating even if, in all other respects, it would fall under Class I.

Table I

Waste Product Material Inventory

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
Category I - Collected Mineral Dusts						
I. Bag House Dust						
Armco, Inc.	Kansas City [48]	Wet & Dry	Yes	Wasted	20,000 Tons	III
II. Hydrator Tailings						
Ash Grove Lime Company	Springfield [39]	Dry	Yes	Past accumulation is in a dump contaminated with trash (useless)	3,000 Tons	III
III. Kiln Dust						
Dundee Cement Company	1.5 Miles North of Clarksville [82]	Dry	Yes	2,000,000 Tons	138,000 Tons	I
Lehigh Portland Cement Company	2 Miles South of Hannibal [87]	Dry	Yes	750,000 Tons	50,000 Tons	I
Carter-Waters Corporation	New Market [83]	Wet	Yes	100,000 Tons	20,000 Tons	I
Alpha Portland Cement Company	Lemay [96]	Dry	Yes	30,000 Tons	60,000 Tons	I
Missouri Portland Cement Company	St. Louis [96]	Dry	Yes	50,000 Tons	30,000 Tons	I
River Cement Company	3 Miles Southeast of Festus (Selma Plant) [50]	Dry	Yes	Past accumulation is in a dump contaminated with trash (useless)	177,000 Tons	I
Mississippi Lime Company	St. Genevieve [95]	Dry	Yes	350,000 Tons	73,000 Tons	I
Ash Grove Lime Company	Springfield [39]	Dry	Yes	Stockpiled with other waste material	2,500 Tons	I

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
Category I - Collected Mineral Dusts (Continued)						
IV. Kiln Dust and Clinkers						
Missouri Portland Cement Company	Sugar Creek [48]	Dry	Yes	None	1,000 Tons	III
Category II - Electric Utility Waste Products						
I. Dry Bottom Boiler Ash (Clinkers)						
Kansas City Power and Light Company (Hawthorn Plant)	Kansas City [48]	Wet	Yes	40,000 Tons	15,000 Tons	II
Kansas City Power and Light Company (Montrose Plant)	Clinton [42]	Wet	Yes	None	90,000 Tons	II
Kansas City Power and Light Company (Iatan Plant)	Weston [83]	Wet	Yes	20,000 Tons	14,000 Tons	II
Kansas City Power and Light Company (Grand Avenue)	Kansas City [48]	Dry	Yes	None	2,000 Tons	II
Marshall Public Utility Company	Marshall [97]	Wet	Yes	None	1,500 Tons	II
University of Missouri Columbia	University Power Plant [10]	Dry	Yes	100 Tons	15,000 Tons	II
Union Electric Company (Rush Island Plant)	1 Mile Southeast of Rush Tower [50]	Wet	Yes	50,000 Tons	130,000 Tons	II
Union Electric Company (Meramec Plant)	St. Louis County [96]	Dry	Yes	20,000 Tons	100,000 Tons	II
Union Electric Company (Labadie Plant)	2 Miles North East of Labadie [36]	Dry	Yes	1,000,000 Tons	600,000 Tons	II
Springfield City Utilities (Southwest Power Station)	2 Miles West of Springfield [39]	Wet	Yes	5,000 Tons	15,000 Tons	II

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
	Category II - Electric Utility Waste Products (Continued)					
II. Fly Ash						
St. Joseph Light and Power Company	Southwest St. Joseph [11]	Dry	Yes	None	22,500 Tons	I
Kansas City Power and Light Company (Hawthorn Plant)	Kansas City [48]	Wet	Yes	320,000 Tons	50,000 Tons	I
Kansas City Power and Light Company (Montrose Plant)	Clinton [42]	Wet	Yes	None	340,000 Tons	I
Kansas City Power and Light Company (Iatan Plant)	Weston [83]	Wet	Yes	110,000 Tons	78,000 Tons	I
Kansas City Power and Light Company (Grand Avenue Plant)	Kansas City [48]	Wet	Yes	None	5,000 Tons	I
Kansas City Pollution Control	Kansas City [48]	Wet	Yes	200,000 Tons	20,000 Tons	I
Missouri Public Service Company (Sibley Plant)	Sibley [48]	Wet	Yes	100,000 Tons	1,500 Tons	I
Marshall Public Utility Company	Marshall [97]	Dry	Yes	None	5,500 Tons	I
Union Electric Company (Labadie Plant)	2 Miles Northeast of Labadie [36]	Wet	Yes	2,500,000 Tons	400,000 Tons	I
Union Electric Company (Meramec Plant)	St. Louis County [96]	Wet	Yes	1,000,000 Tons	50,000 Tons	I
Empire District Electric Company	1.5 Miles East of Asbury, [49]	Wet	Yes	400,000 Tons	43,000 Tons	I
Associated Electric Corporation	2 Miles East of Marston [72]	Dry	Yes	None	52,000 Tons	I

Table I (Continued)

Company	Where Stored (In Missouri)(1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
Category II - Electric Utility Waste Products (Continued)						
Sikeston Power Company	Sikeston [100]	Wet	Yes	None	73,000 Tons	I
III. Fly Ash and Bottom Ash Mixed						
American Cyanamid Company	6 Miles Northeast of Palmyra [64]	Dry	Yes	100 Tons	5,000 Tons	II
Springfield City Utilities (James River Plant)	1 Mile South of Springfield [39]	Wet	Yes	100,000 Yds.^{3}	35,000 Yds.^{3}	II
IV. Sulfate Scrubber Sludge						
Kansas City Power and Light Company (Hawthorn Plant)	Kansas City [48]	Dry & Wet	Yes	40,000 Tons	10,000 Tons	III
V. Fly Ash and Sulfate Scrubber Sludge Mixed						
Springfield City Utilities (Southwest Power Station)	2 Miles West of Springfield [39]	Dry	Yes	500,000 Tons	150,000 Tons	III
VI. Wet Bottom Boiler Slag						
St. Joseph Light and Power Company	Southwest St. Joseph [11]	Wet	Yes	None	25,000 Tons	I
Associated Electric Company (Thomas Hill Plant)	3.4 Miles North of Thomas Hill [88]	Wet	Yes	1,250,000 Yds.^{3}	164,000 Tons	I
Missouri Public Service Company (Sibley Plant)	Sibley [48]	Dry	Yes	400,000 Tons	64,000 Tons	I
Central Electric Power Coop.	0.5 Mile East of Chamois [76]	Dry	Yes	1,000 Yds.^{3}	15,000 Yds.^{3}	I
Union Electric Company (Sioux Plant)	2 Miles East of Portage Des Sioux [92]	Dry	Yes	1,000,000 Tons	150,000 Tons	I

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
Category II - Electric Utility Waste Products (Continued)						
Empire District Electric Company	1.5 Miles East of Asbury [49]	Wet	Yes	1,000,000 Tons	220,000 Tons	I
Associated Electric Corporation	2 Miles East of Marston [72]	Dry	Yes	500,000 Tons	250,000 Tons	I
VII. Washed Fines From Coal Crushing Operation						
Fred Alexander	8.5 Miles Northeast of Fayette [45]	Dry	Yes	200 Tons	(2)	III
Category III - Reclaimed Paving Material						
I. Bituminous Pavement Piles (Cold Milled)						
Weber Quarry	Vigus [96]	Dry	Yes	22,500 Tons	(3)	I
Weber Quarry	Oakville [96]	Dry	Yes	10,000 Tons	(3)	I
Weber Quarry	O'Fallon [92]	Dry	Yes	3,000 Tons	(3)	I
Missouri Highway and Transportation Department	0.7 Mile Southwest of Lebanon [53]	Dry	Yes	2,000 Tons	None	I
Category IV - Low Quality Crushed Stone						
I. Crushed Stone (4)						
Category V - Metallurgical Slags						
I. Foundry Grain Sand						
Missouri Steel Castings Company	Joplin [49]	Dry	Yes	100 Tons	3,600 Tons	II
II. Electric Furnace Steel Slag						
Armco, Inc.	Kansas City [48]	Wet & Dry	Yes	Wasted	30,000 Tons	I
Missouri Steel Castings Company	Joplin [49]	Dry	Yes	500 Tons	30,000 Tons	I

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
Category V - Metallurgical Slags (Continued)						
III. Lead Blast Furnace Slag						
St. Joe Lead Company	Herculaneum [50]	Dry	Yes	2,000,000 Tons	75,000 Tons	III
Asarco Mining Company	Glover [47]	Dry	Yes	1,000,000 Tons (5)	None	III
Category VI - Various Mine Tailings						
I. Graded Chat Piles (Joplin Area)						
Independent Gravel Company	2 Miles West of Wentworth [73]	Dry	Yes	70,000 Tons	None	I
Vance Bros., Inc.	2 Miles South of Carterville [49]	Dry	Yes	1,050,000 Tons	None	I
C. E. Simon	1/2 Mile West of Duenweg [49]	Dry	Yes	32,000 Tons	None	I
Ray Sharp	2 Miles South of Carterville [49]	Dry	Yes	152,000 Tons	None	I
Keith Nolan	1/2 Mile West of Prosperity [49]	Dry	Yes	1,700,000 Tons	None	I
Allan McReynolds	1 Mile Northwest of Duenweg [49]	Dry	Yes	75,000 Tons	None	I
II. Remains of Graded Chat Piles (Joplin Area)						
Independent Gravel Company	2 Miles North of Webb City [49]	Dry	Yes	19,000 Tons	None	II
Independent Gravel Company	1 Mile North of Webb City [49]	Dry	Yes	340,000 Tons	None	II
Independent Gravel Company	At North Edge of Webb City [49]	Dry	Yes	46,000 Tons	None	II
Independent Gravel Company	At Northeast Edge of Webb City [49]	Dry	Yes	33,000 Tons	None	II

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
	Category VI - Various Mine Tailings (Continued)					
Independent Gravel Company	1/2 Mile East of Webb City [49]	Dry	Yes	402,000 Tons	None	II
Independent Gravel Company	1/2 Mile East of Webb City [49]	Dry	Yes	349,000 Tons	None	II
Independent Gravel Company	1 Mile North of Webb City [49]	Dry	Yes	50,000 Tons	None	II
West 7th Street Salvage, Inc.	1 Mile West of Joplin [49]	Dry	Yes	30,000 Tons	None	II
Vance Bros., Inc.	2 Miles South of Carterville [49]	Dry	Yes	50,000 Tons	None	II
J. G. Mitchell	1 Mile East of Spring City [73]	Dry	Yes	85,000 Tons	None	II
Vance Bros., Inc.	2 Miles South of Carterville [49]	Dry	Yes	150,000 Tons	None	II
Vance Bros., Inc.	2 Miles South of Carterville [49]	Dry	Yes	5,000 Tons	None	II
Allan McReynolds	1 Mile Northwest of Duenweg [49]	Dry	Yes	100,000 Tons	None	II
Bell Egg Farm	2 Miles Northwest of Duenweg [49]	Dry	Yes	60,000 Tons	None	II
C. E. Simon	1/2 Mile West of Duenweg [49]	Dry	Yes	4,000 Tons	None	II
Keith Nolan	1/2 Mile West of Prosperity [49]	Dry	Yes	150,000 Tons	None	II
Keith Nolan	1/2 Mile West of Prosperity [49]	Dry	Yes	300,000 Tons	None	II
Keith Nolan	1 Mile West of Prosperity [49]	Dry	Yes	8,000 Tons	None	II
Keith Nolan	1 Mile West of Prosperity [49]	Dry	Yes	100,000 Tons	None	II

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
			Category VI - Various Mine Tailings (Continued)			
Carl McDonald	1/2 Mile South of Carterville [49]	Dry	Yes	1,100,000 Tons	None	II
Paul Fitzer	4 Miles West of Joplin [49]	Dry	Yes	2,500 Tons	None	II
Allan McReynolds	1 Mile Northwest of Duenweg [49]	Dry	Yes	175,000 Tons	None	II
Keith Nolan	1 Mile West of Prosperity [49]	Dry	Yes	61,000 Tons	None	II
Carl McDonald	1/2 Mile South of Carterville [49]	Dry	Yes	660,500 Tons	None	II
Brown and Root, Inc.	1/2 Mile South of Carterville [49]	Dry	Yes	36,000 Tons	None	II
Louis McDonald	Oronogo [49]	Dry	Yes	500,000 Tons	None	II
Steve Smith	3 Miles Southwest of Carl Junction [49]	Dry	Yes	12,000 Tons	None	II
Not Available at this Time	3 Miles West of Joplin [49]	Dry	Yes	15,000 Tons	None	II
Keith Nolan	1/2 Mile West of Prosperity [49]	Dry	Yes	190,000 Tons	None	II
C. E. Simon	1/2 Mile West of Duenweg [49]	Dry	Yes	72,000 Tons	None	II
III. Lead Mine Chat Tailings (Flat River Area)						
James Allen Materials, Inc.	1/4 Mile North of Desloge [94]	Dry	Yes	3,000,000 Tons	None	I
St. Joe Minerals Corporation	North City Limits of Bonne Terre [94]	Dry	Yes	3,000,000 Tons	None	I
St. Joe Minerals Corporation	Flat River [94]	Dry	Yes	6,000,000 Tons	None	I

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
Category VI - Various Mine Tailings (Continued)						
Lead Belt Materials Company	Flat River [94]	Dry	Yes	4,000,000 Tons	None	I
Jim C. Strange	1/4 Mile South of Doe Run [94]	Dry	Yes	1,500,000 Tons	None	I
David Rogers (Lessee)	South Side of Leadwood [94]	Dry	Yes	2,000,000 Tons	None	I
St. Joe Lead Mine Co. (Brushy Creek Div.)	3.5 Miles Northwest of West Fork [90]	Wet	Yes	None	(6)	I
St. Joe Lead Mine Co. (Fletcher Div.)	1.5 Miles South of West Fork [90]	Wet	Yes	200,000 Tons	(6)	I
Ozark Lead Mine Co.	0.5 Mile North of Sweetwater [90]	Wet	Yes	200,000 Tons (5)	(6)	I
Delta Asphalt, Inc.	3 Miles Northwest of Fredericktown [62]	Dry	Yes	17,500 Tons	None	I
IV. Iron Mine Tailings						
Pea Ridge Iron Ore Company	13 Miles from Sullivan [110]	Dry	No	300,000 Tons	150,000 Tons	I
Iron Mountain Trap Rock Company	Pilot Knob [47]	Dry	Yes	1,000,000 Tons	None	I
V. Rhyolite Porphyry Sand (Igneous Material)						
GAF Corporation	1/4 Mile Southwest of Annapolis [47]	Dry	Yes	2,000,000 Tons	200,000 Tons	II
Category VII - Organic Waste Materials						
I. Sawdust Piles (7)						
Willie Hibner Sawmill	2.5 Miles Southeast of Chillicothe [59]	Dry	Yes	2,000 Yds.^{3}	(8)	III
Carman's Sawmill	1.2 Miles East of Hartford [86]	Dry	Yes	2,000 Yds.^{3}	(8)	III

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
	Category VII - Organic Waste Materials (Continued)					
Robert Sommers	At South Edge of Luray [23]	Dry	Yes	100 Tons	(8)	III
Stewart Lumber Company	At South Edge of Luray [23]	Dry	Some Difficulty	100 to 200 Tons	(8)	III
Burr and Sons, Inc.	2 Miles East of Kahoka on Route 136 [23]	Dry	Yes	None	(8)	III
Midwest Veneer Company	5.5 Miles West of Louisiana [82]	Dry	Yes	25 Tons	1,000 Tons	III
R. W. Snow & Sons	1 Mile North of Palmyra [64]	Dry	Yes	20 Tons	(8)	III
Charlton & Sons Pallet and Lumber Company	4.5 Miles Northeast of New London [87]	Dry	Yes	50 Tons	(8)	III
Hardcastle Stave Company	1 Mile South of Center [87]	Dry	Yes	100+Tons	(8)	III
Drury Sawmill	Bosworth [17]	Dry	Yes	40 Tons	>40 Tons	III
Mid-Missouri Log and Lumber Company	1 Mile South of Carrollton [17]	Dry	Yes	25 Tons	30 Tons	III
Osage Products	0.5 Mile South of City Limits Eldon [66]	Dry	Yes	None	(8)	III
Gastineau Lumber Company	4 Miles South of New Bloomfield [14]	Dry	Yes	None	(8)	III
Native Lumber Company	5 Miles West of Jefferson City [26]	Dry	Yes	None	(8)	III
Rehagen Sawmill	3 Miles West of I-55 on Route 51 [79]	Dry	Yes	None	(8)	III
Schwartz Sawmill	At Jct. of Route 32 and O, Ste. Genevieve [95]	Dry	Yes	100 Tons	(8)	III

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
	Category VII - Organic Waste Materials (Continued)					
Bothin Lumber, Inc.	8 Miles East of Farmington on Route 32 [95]	Dry	Yes	300 Yds.^{3}	(8)	III
Lewis and Clark Sawmill	2 Miles North of Missouri River on Route 67 [92]	Dry	Yes	100 Yds.^{3}	(8)	III
Oliver Kenny	2.5 Miles South of Olympia [20]	Dry	Yes	20 Tons	(8)	III
Tom Mitchell	3 Miles North of Wheaton [5]	Dry	Yes	6,000 Yds.^{3}	3,000 Yds.^{3}	III
Harry Sumner	5 Miles Northeast of Eldorado Springs [20]	Dry	Yes	250+Tons	100+Tons	III
Howard Woodward	3.5 Miles Southeast of Seneca [73]	Dry	Yes	8,000 Yds.^{3}	2,000 Yds.^{3}	III
Darrell Fisher	4 Miles Southeast of Seneca [73]	Dry	Yes	1,200 Yds.^{3}	3,000 Yds.^{3}	III
Bill Hopkins	3 Miles Southeast of Vista [93]	Dry	Yes	10,000 Yds.^{3}	(8)	III
Lawrence & Sons Lumber Company	In Deerfield [108]	Dry	Yes	100 Yds.^{3}	(8)	III
Not Shown	Chadwick [22]	Dry	Yes	4,000 Yds.^{3}	(8)	III
Not Shown	2.5 Miles South of Edgar Springs [81]	Dry	Yes	7,000 Yds.^{3}	(8)	III
Not Shown	0.5 Mile South of Arlington [81]	Dry	Yes	10,000 Yds.^{3}	(8)	III
Alley Lumber Company	3 Miles Northeast of Van Buren [18]	Dry	Yes	3,000 Yds.^{3}	5,000 Yds.^{3}	III
Arnall Lumber Company	At Hartville [114]	Dry	Yes	300 Yds.^{3}	1,250 Yds.^{3}	III
Everett Bales	2.5 Miles Northwest of West Plains [46]	Dry	Yes	20,000 Yds.^{3}	(8)	III

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
	Category VII - Organic Waste Materials (Continued)					
Don Bay	At Mountain View [46]	Dry	Yes	10,000 Yds.^{3}	1,000 Yds.^{3}	III
Blue Ridge Lumber and Pallet Company	2 Miles Northwest of Eastwood [18]	Dry	Yes	50,000 Yds.^{3}	2,500 Yds.^{3}	III
Brown Sawmill	1 Mile West of Reynolds [90]	Dry	Yes	50,000 Yds.^{3}	2,000 Yds.^{3}	III
Cooley Lumber Company	4 Miles East of Summersville [101]	Dry	Yes	5,000 Yds.^{3}	2,000 Yds.^{3}	III
Eugene Davis	2 Miles Southwest of Hartville [114]	Dry	Yes	100,000 Yds.^{3}	2,000 Yds.^{3}	III
Pete Davis	5 Miles Southeast of Topaz [34]	Dry	Yes	200,000 Yds.^{3}	None	III
Pete Davis	2.5 Miles Northeast of Topaz [34]	Dry	Yes	50,000 Yds.^{3}	None	III
Dora Post Company	0.5 Mile North of Dora [77]	Dry	Yes	5,000 Yds.^{3}	(8)	III
Evans and Lee	At Boyer on Route 5 [114]	Dry	Yes	25,000 Yds.^{3}	1,000 Yds.^{3}	III
Leon Floyd (Fordell Development)	At North Edge of Salem [33]	Dry	Yes	1,000 Yds.^{3}	1,000 Yds.^{3}	III
Freeze Sawmill and Lumber Company	At Ellsinore [18]	Dry	Yes	50,000 Yds.^{3}	1,500 Yds.^{3}	III
Joe Graves	6 Miles Southwest of Van Buren [18]	Dry	Yes	50,000 Yds.^{3}	None	III
Grogan Lumber Company	At Summersville [107]	Dry	Yes	5,000 Yds.^{3}	(8)	III
Harris Lumber Company	3 Miles West of Mountain Grove [114]	Dry	Yes	100,000 Yds.^{3}	10,000 Yds.^{3}	III
Grogan Wood Products Company	5 Miles West of Ellington [90]	Dry	Yes	50,000 Yds.^{3}	2,000 Yds.^{3}	III
Howell Stone Company	At Dunn [107]	Dry	Yes	100,000 Yds.^{3}	1,250 Yds.^{3}	III

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
	Category VII - Organic Waste Materials (Continued)					
Royce Hutchinson	2 Miles Northwest of Hartville [114]	Dry	Yes	10,000 Yds.^{3}	2,000 Yds.^{3}	III
Independent Stave Company	2 Miles Southeast of Bunker [90]	Dry	Yes	50,000 Yds.^{3}	3,500 Yds.^{3}	III
Jones Sawmill	5 Miles Northeast of Van Buren [18]	Dry	Yes	50,000 Yds.^{3}	5,000 Yds.^{3}	III
Clifton Luna	3 Miles South of Dora [77]	Dry	Yes	50,000 Yds.^{3}	(8)	III
Will McVickers	At Pine Crest [107]	Dry	Yes	40,000 Yds.^{3}	(8)	III
Medley Lumber Company	At South Edge of Bunker [90]	Dry	Yes	500,000 Yds.^{3}	10,000 Yds.^{3}	III
Clinton Pallet	At Mountain View [46]	Dry	Yes	100,000 Yds.^{3}	(8)	III
Patterson Wood Products	2 Miles East of Teresita [101]	Dry	Yes	10,000 Yds.^{3}	1,000 Yds.^{3}	III
Ra Max Wood Products, Inc.	1 Mile Northeast of Teresita [101]	Dry	Yes	30,000 Yds.^{3}	3,000 Yds.^{3}	III
Martin Reese, Inc.	1.5 Miles Northwest of Topaz [34]	Dry	Yes	100,000 Yds.^{3}	(8)	III
Risby Pallet Company	At Bunker [90]	Dry	Yes	100,000 Yds.^{3}	2,000 Yds.^{3}	III
Risby Pallet and Lumber Company	1 Mile West of Ellsinore [18]	Dry	Yes	100,000 Yds.^{3}	2,000 Yds.^{3}	III
Ross and Greear Lumber Company	4 Miles East of Summersville [101]	Dry	Yes	10,000 Yds.^{3}	3,000 Yds.^{3}	III
St. Louis Wood Products	1 Mile North of Reynolds [90]	Dry	Yes	2,000 Yds.^{3}	1,000 Yds.^{3}	III
Sellers Lumber Mill	5 Miles East of Salem [33]	Dry	Yes	1,000 Yds.^{3}	1,000 Yds.^{3}	III
V. Smith Flooring, Inc.	0.2 Mile West of Mountain View [46]	Dry	Yes	100,000 Yds.^{3}	3,000 Yds.^{3}	III

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
	Category VII - Organic Waste Materials (Continued)					
Smith's Flooring, Company	3 Miles Southeast of Cabool [107]	Dry	Yes	10,000 Yds.^{3}	5,000 Yds.^{3}	III
Milton Spacek	2 Miles North of Pine Crest [107]	Dry	Yes	10,000 Yds.^{3}	(8)	III
Byron Stout	At Gentryville [34]	Dry	Yes	100,000 Yds.^{3}	(8)	III
Trask Lumber Company	At Trask [46]	Dry	Yes	20,000 Yds.^{3}	(8)	III
Don Tryon	5 Miles Northeast of Topaz [34]	Dry	Yes	50,000 Yds.^{3}	None	III
Arlin Wake	6 1/2 Miles Northeast of Topaz [34]	Dry	Yes	500,000 Yds.^{3}	(8)	III
Wilders Sawmill Company	1 Mile Southwest of Ellsinore [18]	Dry	Yes	50,000 Yds.^{3}	1,500 Yds.^{3}	III
Barks and Holiday Pallet and Lumber	10 Miles Northeast of Greenville on Route 34 [111]	Dry	Yes	1,000,000 Tons	600 Tons	III
Libla Industries	4.5 Miles North of Greenville [111]	Dry	Yes	1,000,000 Tons	20,000 Tons	III
Mitchell Pallet-Associated Grocers	2 Miles West of Lutesville on Route 34 [9]	Dry	Yes	5,000 Tons	500 Tons	III
Lester Filer Truman Lewis Wilson Lewis	2 Miles South of Lutesville on Route 51 [9]	Dry	Yes	1,000,000 Tons	300 Tons	III
Mike Webb	9 Miles Northeast of Greenville [111]	Dry	Yes	10,000 Tons	250 Tons	III
Virginia Wright	2 Miles East of Marble Hill on Route 34 [9]	Dry	Yes	5,000 Tons	300 Tons	III
II. Bark and Pole Peelings						
Smith Flooring, Inc.	1.5 Miles West of Mountain View [46]	Dry	Yes	5,000 Yds.^{3}	(8)	II

Table I (Continued)

Company	Where Stored (In Missouri)(1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
Category VII - Organic Waste Materials (Continued)						
III. Woodchips (Oak and Pine)						
Smith Flooring, Inc.	3 Miles Southeast of Cabool [107]	Dry	Yes	None	10,000 Yds.^{3}	II
IV. Shavings						
Clinton Pallet	At Mountain View [46]	Dry	Yes	20,000 Yds.^{3}	(8)	II
Bunker Post Company	At South Edge of Bunker [90]	Dry	Yes	100,000 Yds.^{3}	5,000 Yds.^{3}	II
Category VIII - Inorganic Waste Materials						
I. Asphalt Shingles and Tabs						
Certain-Teed Products Company	Kansas City [48]	Dry	Yes	None	7,200 Tons	III
Tamko Asphalt Products Inc.	Joplin [49]	Dry	Yes	5,000 Tons	9,100 Tons	III
II. Refractory Material (Fire Brick, Etc.)						
Neil Fanning	At St. Joseph [11]	Dry	Yes	10,000 Tons	None	III
Midland Brick and Tile Company	0.8 Mile Northwest of Utica [59]	Dry	Yes	70,000 Yds.^{3}	1,350 Tons	III
A. P. Green Company	Mexico [4]	Dry	Yes	6,000 Tons	500 Tons	III
Kaiser Refractories	1 Mile North of Mexico [4]	Dry	Yes	5,000 Tons	700 Tons	III
Harbison-Walker	At Vandalia [4]	Dry	Yes	10,000 Tons	11,500 Tons	III
Armco, Inc.	Kansas City [48]	Wet & Dry	Yes	Wasted	3,000 Tons	III
Missouri Portland Cement Company	Sugar Creek [48]	Dry	Yes	None	75 Tons	III
III. Battery Cases (Bakelite and Plastic)						
Kavanaugh Salvage	At East Edge of Hamilton [13]	Dry	Yes	50 Tons	25-50 Tons/ Year	III

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
Category VIII - Inorganic Waste Materials (Continued)						
IV. Rubber Tires (9)						
Kavanaugh Salvage	At East Edge of Hamilton [13]	Dry	Yes	50 Tons	25-50 Tons/Year	III
Jim Robbins Tire Company	0.75 Mile Northeast of Main City [19]	Wet	Yes	60,500 Yds.^{3}	12,100 Yds.^{3}	III
Burggraf Tire Company	At Joplin [49]	Dry	Yes	5,000 Units	12,000 Units	III
Evans Tire Company	At Joplin [49]	Dry	Yes	10,000-15,000 Units	10,000 Units	III
V. Incinerator Residue						
None Reported						
VI. Reclaimed Glass						
None Reported						
VII. Reclaimed Plastic						
None Reported						
Category IX - Oversized and/or Undersized Gravel and Sand						
I. Hill Sand (Glacial)						
E. I. Sargents Quarries, Inc.	6 Miles North of Allendale [113]	Dry	Yes	2,000 Tons	None	II
Earl Voltmer	6 Miles South of Craig [44]	Dry	Yes	4,000 Tons	None	II
Herman Fountain	3.5 Miles Northeast of Novinger [1]	Dry	Yes	100,000 Yds.^{3}	None	II
Forrest Eitel	7.5 Miles West of Queen City [98]	Dry	No	40,000 Yds.^{3}	None	II
C. G. Fremon	5 Miles West of Glenwood [98]	Dry	No (3/4 Mile unimproved haul road)	40,000 Yds.^{3}	None	II

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
	Category IX - Oversized and/or Undersized Gravel and Sand (Continued)					
Stewart Horejsis	7.5 Miles West of Glenwood [98]	Dry	Yes	250,000 Yds.^{3}	None	II
Mike Dixon	0.8 Mile North of Chariton [86]	Dry	Yes	56,000 Yds.^{3}	None	II
John O. Filkins	2.5 Miles North of Fegley [1]	Dry	Yes	40,000 Yds.^{3}	None	II
Gordon Collett	2.5 Miles Southeast of Novinger [1]	Dry	Yes	120,000 Yds.^{3}	None	II
Donald Wayman	3.3 Miles Northeast of Novinger [1]	Dry	Yes	100,000 Yds.^{3}	None	II
Mrs. Ben McKenzie Mrs. Kenneth McKenzie Mrs. Joyce Serfass	4.3 Miles Northwest of Purdin [58]	Dry	No (Bad Bridge)	70,000 Yds.^{3}	None	II
II. Fill and Waste Sand						
Mikkelsen Construction Company	2 Miles East of Brownville, Nebraska (Missouri Side) [3]	Dry	Yes	6,455,000 Yds.^{3}	None	II
Independent Gravel Company	Webb City [49]	Dry	Yes	30,000 Tons	15,000 Tons	III
Independent Gravel Company	1 1/2 Miles South of Prosperity [49]	Dry	Yes	10,000 Tons	5,000 Tons	III
III. Low Quality Hill or Creek Gravel (10)						
George Quinn	0.7 Mile North of Sampsel [59]	Dry	Yes	20,000 Tons	None	III
B & B Gravel Plant	4.5 Miles Southeast of Pineville [60]	Dry	Yes	25,000 Tons	80,000 Tons	III
Claude Lawrence	3.5 Miles Northwest of West Plains [46]	Dry	Yes	325,000 Yds.^{3}	None	III

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
Category IX - Oversized and/or Undersized Gravel and Sand (Continued)						
IV. Oversized Gravel (10)						
Meramec Materials Company	1/2 Mile East of Pacific [96]	Dry	Yes	4,000 Tons	1,000 Tons	III
Monroe Mount	2 Miles West of Leadwood [110]	Dry	Yes	102,000 Yds.^{3}	None	III
Andy Andersen	3 Miles South of Devils Elbow [85]	Dry	Yes	90,000 Yds.^{3}	None	III
Bill May	4 Miles Southwest of Bradleyville [106]	Dry	Yes	40,000 Tons	None	III
Howard Ready-Mix Concrete Company	4 Miles North of St. Roberts [85]	Dry	Yes	15,000 Tons	8,000 Tons	III
V. Railroad Ballast Rock						
Burlington Northern Railroad	Mexico to Old Monroe (Abandoned) [4,70,57] (Appr. 62 Miles)	Dry	Yes	230,000 Yds.^{3}	None	II
Category X - Miscellaneous Material						
I. Boulders and Chat Piles Mixed (Joplin Area)						
Independent Gravel Company	1 Mile North of Webb City [49]	Dry	Yes	11,000 Tons	None	II
Independent Gravel Company	1 Mile North of Webb City [49]	Dry	Yes	75,000 Tons	None	II
Independent Gravel Company	At the North Edge of Webb City [49]	Dry	Yes	97,000 Tons	None	II
Independent Gravel Company	At Northeast Edge of Webb City [49]	Dry	Yes	130,000 Tons	None	II
Independent Gravel Company	1/2 Mile East of Webb City [49]	Dry	Yes	592,000 Tons	None	II

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
			Category X - Miscellaneous Material (Continued)			
Independent Gravel Company	1/2 Mile East of Webb City [49]	Dry	Yes	324,000 Tons	None	II
Independent Gravel Company	2 Miles Northwest of Duenweg [49]	Dry	Yes	95,000 Tons	None	II
Independent Gravel Company	2 Miles North of Webb City [49]	Dry	Yes	7,000 Tons	None	II
Barton County Truckers Association	2 Miles Northwest of Purcell [49]	Dry	Yes	20,000 Tons	None	II
Barton County Truckers Association	2 Miles Northwest of Purcell [49]	Dry	Yes	45,000 Tons	None	II
Brown and Root, Inc.	1/2 Mile South of Carterville [49]	Dry	Yes	95,000 Tons	None	II
Charles Smith	2 Miles West of Joplin [49]	Dry	Yes	3,500 Tons	None	II
Steve Smith	3 Miles Southwest of Carl Junction [49]	Dry	Yes	4,000 Tons	None	II
B. E. Phillips	4 Miles Northwest of Joplin [49]	Dry	Yes	4,500 Tons	None	II
Bank of Jasper	1 Mile South of Carl Junction [49]	Dry	Yes	38,000 Tons	None	II
Not Available At This Time	3 Miles West of Joplin [49]	Dry	Yes	10,000 Tons	None	II
II. Digested Sludge						
Kansas City Pollution Control	Platte Woods [83]	Wet	Yes	None	832,000 Gal.	III
III. Gypsum						
Farmers Chemical Company	3 Miles West of Joplin [49]	Dry	Yes	2,000,000 Tons	None	III

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
			Category X - Miscellaneous Material (Continued)			
W. R. Grace and Company	1/2 Mile Northeast of Duenweg [49]	Dry	Yes	2,800,000 Tons	None	III
IV. Limestone Screenings (11)						
Francis Blair	3 Miles Northwest of Barnard [74]	Dry	Yes	2,000 Tons	None	II
Ed Froman	4 Miles Northwest of Gallatin [31]	Dry	Yes	10,000 Tons	None	II
Hardrock Quarries	2.5 Miles East of Ridgeway [41]	Dry	Yes	2,000 Tons	None	II
Lloyd Manville	3 Miles Northeast of Blue Ridge [41]	Dry	Yes (In Dry Weather)	2,000 Tons	None	II
Sam Parker	5 Miles South of Cameron [25]	Dry	Yes	650 Tons	None	II
E. I. Sargents Quarries, Inc.	6 Miles North of Allendale [113]	Dry	Yes	2,500 Tons	None	II
Darrell Wilson	3.5 Miles Southeast of Agency [11]	Dry	Yes	12,500 Tons	None	II
Maynard Vaughn	2.25 Miles Southeast of Maysville [32]	Dry	Yes	1,500 Tons	None	II
Mississippi Lime Company	Ste. Genevieve [95]	Dry	Yes	3,000,000 Tons	250,000 Tons	II
V. Mixture of Grit, Sand, Gravel, Organic Material and Metal						
Kansas City Pollution Control	Kansas City [48]	Dry	Yes	None	2,000 Yds.^{3}	III
VI. Quarry Overburden as Soil, Shale and Limestone Boulders or Rip Rap Material (12)						

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
Category X - Miscellaneous Material (Continued)						
VII. Waste Shale Associated with Inactive Coal Mine Operations						
Oral Francis	2.8 Miles North of Yarrow [1]	Dry	Yes	60,000 Yds.^{3}	None	III
J. B. Johnson	0.6 Mile Southeast of Higbee [88]	Dry	Yes	150,000 Yds.^{3}	None	III
John DeJonge	0.7 Mile Northeast of Higbee [88]	Dry	Yes	100,000 Yds.^{3}	None	III
John Trenago	3 Miles Northeast of Higbee [88]	Dry	Yes	250,000 Yds.^{3}	None	III
Ora Truitt	1.3 Miles West of Midland [1]	Dry	Yes	100,000 Yds.^{3}	None	III
C. L. Walters	3.1 Miles South of Novinger [1]	Dry	Yes	60,000 Yds.^{3}	None	III
VIII. Waste Fire Clays (Plastic Clays)						
A. P. Green Company	Mexico [4]	Dry	Yes	10,000 to 15,000 Tons	500 Tons	III
Harbison-Walker Refractories	Vandalia [4]	Dry	Yes	387,200 Yds.^{3} (Contaminated)	10,000 Tons	III
C-E Refractories (Div. of Combustion Engineering)	2 Miles East of Farber on Route 54 [4]	Dry	Yes	6,000 Tons	200 Tons	III
Kaiser Refractories	1 Mile North of Mexico on Route J [4]	Dry	Yes	10,000 Tons	11,500 Tons	III
IX. Broken Concrete of Industrial Products						
Neil Fanning	St. Joseph [11]	Dry	Yes	5,000 Tons	None	III
Gordon Quarries, Inc.	3 Miles South of Savannah [2]	Dry	Yes	239 Tons	None	III
Barbour Concrete Company	Independence [48]	Dry	Yes	50 Tons	50+Tons	III

Table I (Continued)

Company	Where Stored (In Missouri) (1)	How Stored	Access Road Yes/No	Estimated Present Quantity Available	Estimated Annual Rate of Accumulation	Product Type Rating
			Category X - Miscellaneous Material (Continued)			
Quinn Concrete Company, Inc.	Marshall [97]	Dry	Yes	100 Tons	100 Tons	III
X. Crushed Limestone (Various Sized Fractions)						
Francis Blair	3 Miles Northwest of Barnard [74]	Dry	Yes	4,000 Tons	None	II
Everett Quarries, Inc.	3.75 Miles Northwest of New York [13]	Dry	Yes	4,000 Tons	None	II
Hardrock Quarries	2.5 Miles East of Ridgeway [41]	Dry	Yes	18,000 Tons	None	II
E. I. Sargents Quarries, Inc.	6 Miles North of Allendale [113]	Dry	Yes	4,000 Tons	None	II
XI. Porcelain (Broken Molds) and Broken Pottery						
Crane Manufacturing Company	At Northeast Edge of Nevada [108]	Dry	Yes	20,000 Tons	5,000 Tons	III
Cerama Company, Inc.	Jackson, Jct. of Routes 34 and 25 [16]	Dry	Yes	40 Tons	300 Tons	III

FOOTNOTES

(1) County Number see Figure I for County reference location.
(2) Varies-depends on coal mining production.
(3) Dependent on projects requiring cold milling and a particular contractor obtaining owner right to product.
(4) Many non-operating quarries throughout the State have stockpiles of crushed aggregate with quantities ranging from approximately 500 to 20,000 tons.
(5) Presently is considered a hazardous waste.
(6) Approximately 500 ton/day when operating.
(7) Partial listing only of sawdust piles.
(8) Annual rate of accumulation varies due to intermittent production.
(9) Partial listing; generally satellite locations for pickup to control stockpile (often outside the State).
(10) Partial listing; numerous gravel operations with intermittent production with some accumulation (generally less than 100 tons.
(11) Partial listing; most quarries have limestone screening stockpiles. Rate of accumulation and quantity available varies.
(12) Most quarries throughout Missouri have stockpiles of overburden ranging from 500 tons to in excess of 1,000,000 tons.

Table II

Category I - Collected Mineral Dusts (Summary)

Item	Present Quantity Available		Annual Rate Of Accumulation	
	Tons	Yds.^{3}	Tons	Yds.^{3}
I. Bag House Dust			20,000	
II. Hydrator Tailings			3,000	
III. Kiln Dust	3,280,000		550,500	
IV. Kiln Dust and Clinkers			1,000	
TOTALS	3,280,000		574,500	

Table III

Category II - Electric Utility Waste Products (Summary)

Item		Present Quantity Available		Annual Rate Of Accumulation	
		Tons	Yds.^{3}	Tons	Yds.^{3}
I.	Dry Bottom Boiler Ash (Clinkers)	1,135,100		982,500	
II.	Fly Ash	4,630,000		1,140,500	
III.	Fly Ash and Bottom Ash Mixed	100	100,000	5,000	35,000
IV.	Sulfate Scrubber Sludge	40,000		10,000	
V.	Fly Ash and Sulfate Scrubber Sludge Mixed	500,000		150,000	
VI.	Wet Bottom Boiler Slag	2,900,000	1,251,000	873,000	15,000
VII.	Washed Fines From Coal Crushing Operation	200		*	
TOTALS		9,205,400	1,351,000	>3,161,000	50,000

* Varies - depends on coal mining production.

Table IV

Category III - Reclaimed Paving Material (Summary)

Item	Present Quantity Available		Annual Rate Of Accumulation	
	Tons	Yds.^{3}	Tons	Yds.^{3}
I. Bituminous Pavement Piles (Cold Milled)	37,500		*	
TOTALS	37,500		*	

* Dependent on projects requiring cold milling and a particular contractor obtaining owner rights to product.

Table V

Category IV - Low Quality Crushed Stone (Summary)

Item	Present Quantity Available		Annual Rate Of Accumulation	
	Tons	Yds.^{3}	Tons	Yds.^{3}
I. Crushed Stone (Various Sized Fractions-Abandoned Quarries)	71,100		None	
TOTALS	71,100*		None	

*Many non-operating quarries throughout the state have stockpiles of crushed aggregate with quantities ranging from approximately 500 to 20,000 tons.

Table VI

Category V - Metallurgical Slags (Summary)

Item	Present Quantity Available		Annual Rate Of Accumulation	
	Tons	Yds.^{3}	Tons	Yds.^{3}
I. Foundry Grain Sand	100		3,600	
II. Electric Furnace Steel Slag	500		60,000	
III. Lead Blast Furnace Slag	*3,000,000		75,000	
TOTALS	*3,000,600		138,600	

*1,000,000 tons of this total has at present been declared to be hazardous waste.

Table VII

Category VI - Various Mine Tailings (Summary)

	Item	Present Quantity Available		Annual Rate Of Accumulation	
		Tons	Yds.^{3}	Tons	Yds.^{3}
I.	Graded Chat Piles (Joplin Area)	3,079,000		None	
II.	Remains of Graded Chat Piles Non-Graded (Joplin Area)	5,105,000		None	
III.	Lead Mine Chat Tailings (Flat River Area)	*19,917,500		**	
IV.	Iron Mine Tailings	1,300,000		150,000	
V.	Rhyolite Porphyry Sand (Igneous Material)	2,000,000		200,000	
	TOTALS	*31,401,500		>350,000	

*200,000 tons of this total nas at present been declared to be hazardous waste.

**500 tons/day at each of three plants when operating.

Table VIII

Category VII - Organic Waste Materials (Summary)

Item	Present Quantity Available		Annual Rate Of Accumulation	
	Tons	Yds.^{3}	Tons	Yds.^{3}
I. Sawdust Piles	3,020,900	2,918,000	*23,100	**106,100
II. Bark and Pole Peelings		5,000		***100
III. Woodchips (Oak and Pine)	None			10,000
IV. Shavings		120,000	***3	5,000
TOTALS	3,020,900	3,043,000	>23,100	>121,200

*Sixty one tons of this total accumulate per plant working day.
**Eighty eight yds.^{3} of this total accumulate per plant working day.
***Accumulates per plant work day.

Table IX

Category VIII - Inorganic Waste Materials (Summary)

Item	Present Quantity Available		Annual Rate Of Accumulation	
	Tons	Yds.^{3}	Tons	Yds.^{3}
I. Asphalt Shingles and Tabs	5,000		16,300	
II. Refractory Materials (Fire Brick, Etc.)	31,000	70,000	17,150	
III. Battery Cases (Bakelite and Plastic)	100		25-50	
IV. Rubber Tires	>100	60,500	>50	12,100
V. Incinerator Residue		None Reported		
VI. Reclaimed Glass		None Reported		
VII. Reclaimed Plastic		None Reported		
TOTALS	>36,200	130,500	>33,550	12,100

Table X

Category IX - Oversized and/or Undersized Gravel and Sand (Summary)

Item	Present Quantity Available		Annual Rate Of Accumulation	
	Tons	Yds.^{3}	Tons	Yds.^{3}
I. Hill Sand (Glacial)	6,000	816,000	None	
II. Fill and Waste Sand	40,000	6,455,000	20,000	
III. Low Quality Hill or Creek Gravel	45,000	325,000	80,000	
IV. Oversized Gravel	59,000	192,000	9,000	
V. Railroad Ballast Rock		230,000	None	
TOTALS	150,000	8,018,000	109,000	

Table XI

Category X - Miscellaneous (Summary)

	Item	Present Quantity Available		Annual Rate Of Accumulation	
		Tons	Yds.^{3}	Tons	Yds.^{3}
I.	Boulders and Chat Piles Mixed (Joplin Area)	1,551,000		None	
II.	Digested Sludge	None		*832,000 Gallons	
III.	Gypsum	4,800,000		None	
IV.	Limestone Screenings	3,033,200		250,000	
V.	Mixture of Grit, Sand, Gravel, Organic Material and Metal	None			2,000
**VI.	Quarry Overburden as Soil, Shale, Limestone Boulders or Rip Rap Material	847,900	5,700,000	***12,500	100,000
VII.	Waste Shale Associated With Inactive Coal Mine Operations		720,000	None	
VIII.	Waste Fire Clay (Plastic Clays)	31,000	387,200	22,200	
IX.	Broken Concrete of Industrial Products	5,400		>150	

Table XI (Continued)

Category X - Miscellaneous (Summary)

Item	Present Quantity Available		Annual Rate Of Accumulation	
	Tons	Yds.^{3}	Tons	Yds.^{3}
X. Crushed Limestone (Various Sized Fractions)	30,000		None	
XI. Porcelain as Broken Molds and Pottery	20,000		5,300	
TOTALS	10,318,500	6,807,200	>*290,150	102,000

*Also 832,000 gallons of Item II is currently accruing.
**Most quarries throughout Missouri have stockpiles of overburden ranging from 500 tons to in excess of 1,000,000 tons.
***Accumulates per plant working day.

Table XII

Summary of Categories I thru X

Category		Present Quantity Available		Annual Rate Of Accumulation	
		Tons	Yds.^{3}	Tons	Yds.^{3}
I.	Collected Mineral Dusts	3,280,000		574,500	
II.	Electric Utility Waste Products	9,205,400	1,351,000	>3,161,000	50,000
III.	Reclaimed Paving Material	37,500		(1)	
IV.	Low Quality Ledge or Crushed Stone	71,100(2)		None	
V.	Metallurgical Slags	3,000,600(3)		138,600	
VI.	Various Mine Tailings	31,401,500(3)		>350,000	
VII.	Organic Waste Materials	3,020,900	3,043,000	>23,100	>121,200
VIII.	Inorganic Waste Materials	>36,200	130,500	>33,500	12,100
IX.	Oversized and/or Undersized Gravel and Sand	150,000	8,018,000	109,000	
X.	Miscellaneous	10,318,500	6,807,200	290,150	102,000
TOTALS		>60,521,700	19,349,700	>4,679,850	>285,300

General: The above quantities covers a total of some 305 separate inventoried material entries, including those covered by footnotes.

FOOTNOTES FOR TABLE XII, PAGE 61

(1) Dependent on projects requiring cold milling and a particular contractor obtaining owner right to product.
(2) Many non-operating quarries throughout the State have stockpiles of crushed aggregate with quantities ranging from approximately 500 to 20,000 tons.
(3) Indicates 1,000,000 tons of Category V and 200,000 tons of Category VI totals has at present been declared to be hazardous waste.

Table XIII

Potential Waste Products To Be Considered for Laboratory Study

Product Category	Type of Product	Product Type Rating
Collected Mineral Dusts	Kiln Dust	I
Electric Utility Waste	Fly Ash	I
Mine Tailings	Graded Chat Piles (Joplin Area)	I
Mine Tailings	Lead Mine Chat (Flat River Area)	I
Miscellaneous	Gypsum	III
Metallurgical Slag	Lead Blast Furnace Slag	III
Miscellaneous	Limestone Screenings	II

APPENDIX 1

WASTE PRODUCTS WITH POTENTIAL HIGHWAY APPLICATION

District _____ Date of Survey _____

Name of Waste Product: (Examples: Ash, Tailings, Oversize Gravel, Slag, Broken PCC Pavement Piles, Old Bit Mat Piles, Waste or Hill Sand, etc.) _____

Possible Potential Use of Product _____

Plant or Owner's Name _____

Mailing Address _____

Material Location: County _____ Sec. ___ Twp. ___ R___

Direction and Distance From Nearest Town _____

_____

Is Item Available For Our Use: Yes _____ No _____

If Yes, Material Controlled or Owned By _____

Telephone No. (Include area code) _____

What is Cost (per ton, cubic yd., etc.) _____

Present Quantity Estimate (tons, cubic yards) _____

Is Product Still Accumulating: Yes _____ No _____

Annual Rate of Accumulation _____

Is Product Presently in a (Check One) Dry Stock Pile _____;

Settlement Pit _____; Other (Describe) _____

Can Product Be Readily Sized: Yes _____ No _____ N/A _____

Does Material Need to Be Crushed From Present Condition:

Yes _____ No _____

Is This Material Currently Being Used: Yes _____ No _____

If Yes, For What _____

Is This Product or Material Readily Accessible, i.e,, good haul road: Yes _____ No _____

Highway Personnel Making the Contact _____

Remarks: _____

_____