WYOMING STATE GEOLOGICAL SURVEY
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CONSTRUCTION AGGREGATE IN WYOMING

by

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Construction Aggregate in Wyoming

Introduction

Natural construction aggregate is one of the most abundant natural resources and one of the most widely used. Construction aggregate is the sized, or crushed and sized, rock material used in a variety of construction products. If the aggregate is selected because of its color or appearance, it is decorative aggregate. Construction aggregates are used in concrete and asphalt which compose most of our streets and highways, bridges, houses and other buildings, wallboard, roofing, and other structural components. Aggregates range in size from large boulders (rip rap) used as fill in large construction projects to finely ground flour-sized particles used in paint, glass, plastic, medicine, agricultural feed and soil conditioners, and many other industrial and household products. Construction aggregates are also used in water purification, emissions control, soil erosion control, and other environmental improvement products.

More than 90% of asphalt pavement and 80% of concrete are composed of construction aggregate (**Figure 1**). The remainder is a binder such as asphalt or cement. About 60% of all construction aggregate is sand and gravel, while most of the remaining is crushed stone (Tepordei, 2000).

Aggregates consist of crushed and sized rock (either quarried stone or crushed gravel) (**Figure 2**) or natural sand and gravel, which are not crushed, but sized (**Figure 3**). Sand and gravel aggregate is less expensive than crushed stone aggregate, but crushed stone has the advantage of consistency. A few projects use other aggregate materials such as expanded shale or factory by-products such as mill slag.

Construction aggregate comprises more than half the volume of all mining in the United States. In 1999, 2.64 billion tons of aggregates were mined in the U.S. (Bolen, 2000, Tepordei, 2000).

Construction aggregates are the lowest priced of all mined products. Since they are so low priced, transportation costs from the mine to the point of use can become the major part of their cost to the consumer. In Wyoming, material produced for $2.00 per short ton is subject to transportation costs averaging $1.10 per ton-mile. At transportation distances of even less than two miles the transportation cost exceeds the cost of the product at the mine mouth. Therefore, it is imperative that aggregate sources be located as close to the point of use as possible. This fact usually creates conflicts between aggregate producers and people who live in proximity to aggregate sources, since economically, aggregate sources must be located close to population.

The transportation costs for construction aggregate are so important to its cost at the point of use that large-scale low-cost water transportation makes aggregate sources near navigable water more feasible. Crushed granite from Newfoundland, Nova Scotia, Scotland, and the Yucatan Peninsula of Mexico is used for construction on U. S. Atlantic coastal areas from Maine to Texas (Holmes, 2000). This material is less costly than aggregate quarried in coastal states and transported to the job site by truck. A granite quarry is being developed on an Alaskan island; this source will supply construction aggregate to Pacific coastal areas as far south as San Diego, California (Manydeeds, 2000). Other sources near navigable water in British Columbia and the U. S. Pacific Northwest are supplying increasing amounts of aggregate to Los Angeles and San Diego (Holmes, 2000)

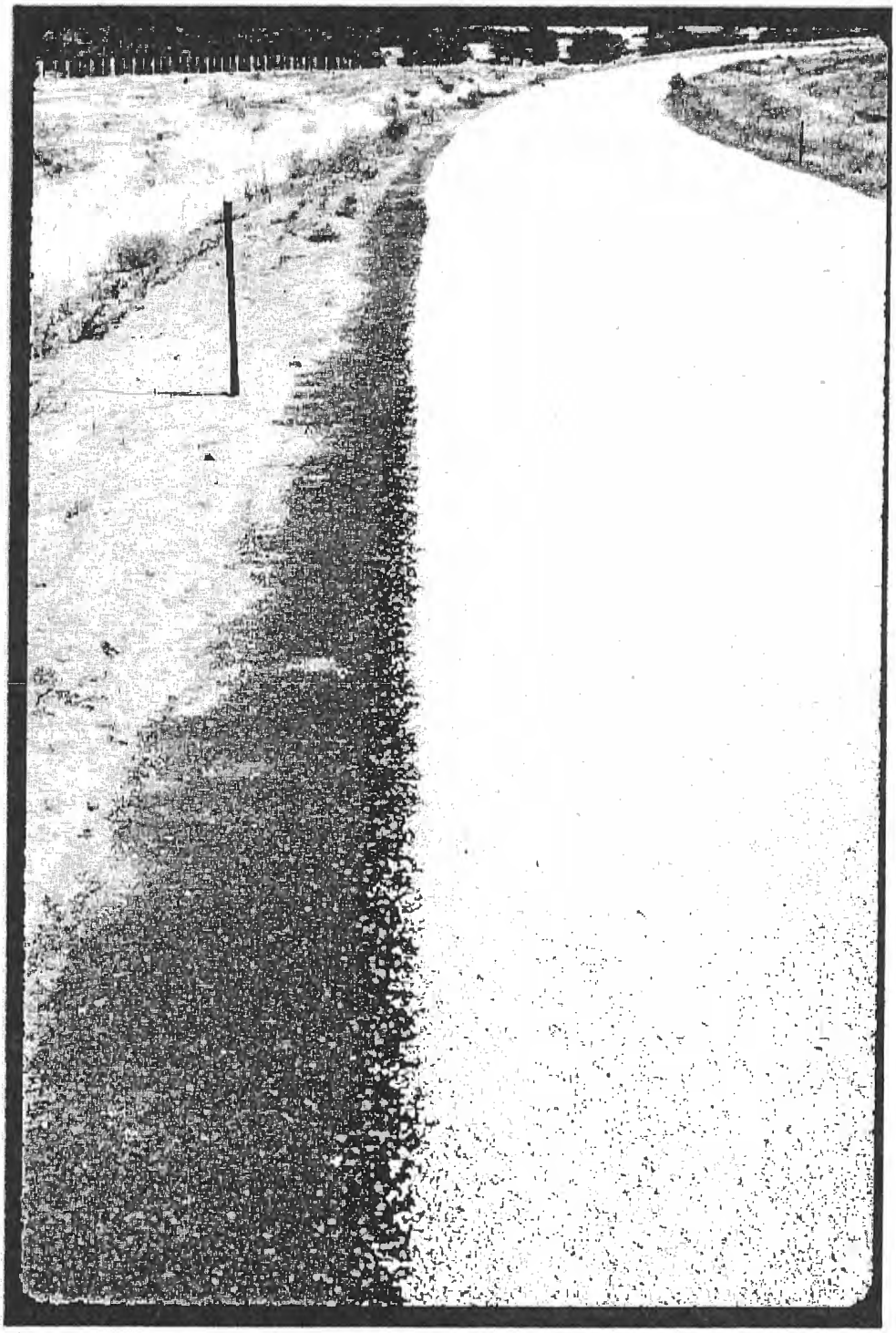

Figure 1. Crushed rock used for road surfacing (chip seal), Converse County, Wyoming. The binder is the oil sprayed on the road prior to spreading the crushed aggregate on the surface.

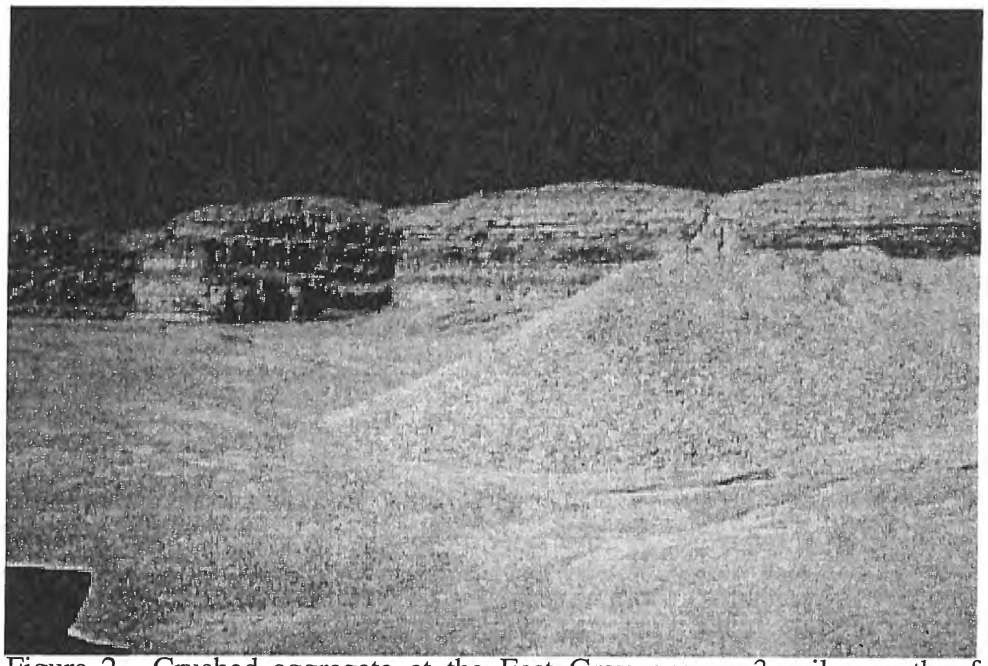

Figure 2. Crushed aggregate at the East Gray quarry, 3 miles north of Glendo, Platte County, Wyoming. The rock in the quarry face is limestone of the Permian-Pennsylvanian Hartville Formation. Limestone is blasted from the face of rock in the background, and crushed and sized into the desired specifications. The stockpile at right center is crushed and sized limestone.

Figure 3. Natural gravel deposit at an unnamed quarry site one mile north of Guernsey, Platte County. The deposit is a Pleistocene fluvial gravel with interbedded sand lenses (above bed of pickup).

Construction aggregate was produced in all of the 50 states in 1999. The most populous states usually mine most of this product. California, Texas, Michigan, Ohio, and Arizona were the leading states in the production of construction sand and gravel (Bolen, 2000) and Texas, Pennsylvania, Florida, Georgia, and Illinois were the leaders in Crushed Stone production (Tepordei, 2000).

Only four states, Delaware, Hawaii, North Dakota, and Rhode Island produce less construction aggregate than Wyoming. However, Construction aggregate is the fourth most important mineral product produced in Wyoming (in value) after oil and gas, coal, and trona. The value of construction aggregate produced in Wyoming exceeds the value of materials such as bentonite, uranium and gypsum, when all uses of aggregate including limestone produced for cement production are included. In 1999, 15,206,461 short tons of construction aggregate were produced in Wyoming according to the State Inspector of Mines of Wyoming (1996 - 2000). This included railroad ballast, power plant emissions rock, sand and gravel, and crushed stone. Limestone was the primary crushed stone produced in Wyoming, followed by various types of granite, clinker (baked and fused shale), and shale. For the location of construction aggregate deposits in Wyoming see Harris (1996).

Origin of construction aggregate deposits in Wyoming

Crushed stone

Crushed stone resources occur where suitable material is located close to transportation and end users. A few large quarries are located on suitable rock next to rail transportation, such as the Martin-Marietta Materials quarry west of Cheyenne (**Figure 4**). The rock type quarried can be any material that exhibits sufficient strength, resistance to wear, high rate of production potential, and low amount of waste. Limestone is the preferred rock for highway construction (**Figure 5**). Limestone is located throughout Wyoming, especially on the flanks of the mountain uplifts (Harris, 1996). Granite, gneiss, basalt, sandstone, quartzite, scoria (clinker, baked and fused shale), and other rock types have been used for construction aggregate in Wyoming. The rock at the Martin Marietta Materials quarry is a quartzofeldspathic gneiss. This quarry was originally developed by the Union Pacific Railroad as a ballast quarry; ballast is currently one of the quarry's main products. The foliation in the gneiss causes the rock to break into pieces with the dimensional ratio of 2:4:6, which is a specification for certain types of railroad ballast.

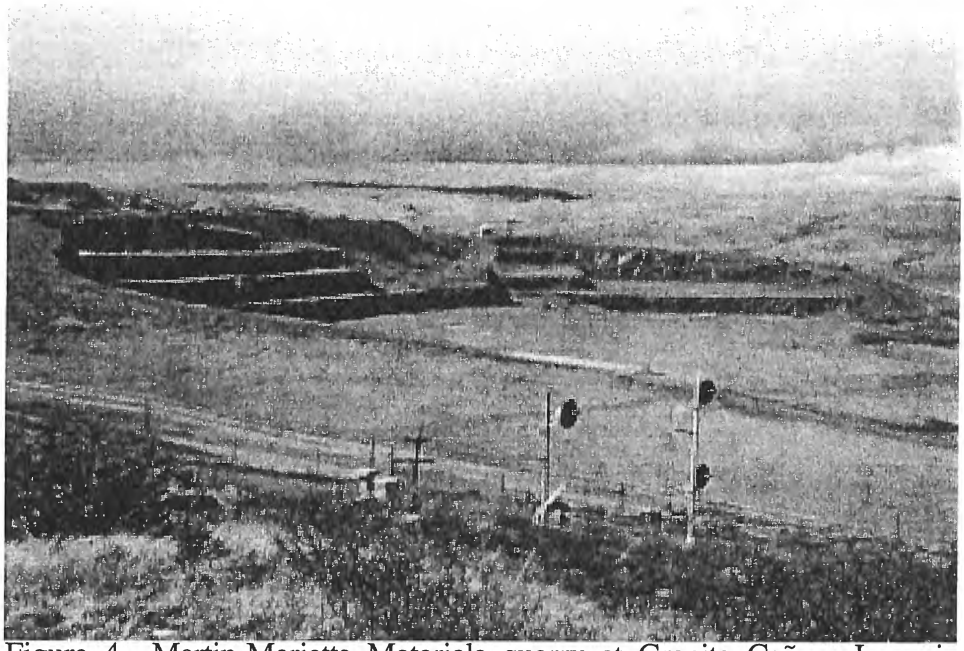

Figure 4 Martin-Marietta Materials quarry at Granite Cañon, Laramie County, Wyoming. Railroad cars, upper left center above benches for scale.

Figure 5. Crusher and screens (left of belt) produce aggregate for a highway construction project. Crushed limestone aggregate operation, Albany County, Wyoming.

Natural gravel sources

Natural gravel sources are found in a variety of different geologic environments. They consist of unconsolidated gravel, or loosely or partially cemented gravel that can be dug out of a pit without blasting or cutting. For the location of these types of construction aggregate in Wyoming, see Harris (1996).

Alluvial sand and gravel deposits

Stream channel and flood plain deposits are found along Wyoming's larger streams and rivers. The largest natural gravel production in Wyoming for a long time was a source in gravels of the Bear River at Evanston. Many permanent gravel sources are located in stream channel deposits, including those along the Snake River at Jackson; the Green River at Cora and Green River; the North Platte at Saratoga, Fort Steele, and downstream from Casper; The Tongue River at Sheridan; the Wind-Bighorn Rivers at Dubois, Riverton, Worland, Greybull, and Lovell; the Shoshone River at Cody; the Laramie River at Laramie; and Lodgepole and Crow Creeks at Cheyenne; as well as other streams at other locations.

Terrace sand and gravel deposits

Terrace deposits in Wyoming were mostly formed during the Pleistocene in basin areas near the present mountain ranges . Braided streams and sheet floods from the mountains provided material derived from various sources. The changing climate of the Pleistocene (glacial and non-glacial intervals in the higher mountains, dry and wetter cycles in the lower parts of Wyoming) resulted in terrace gravel deposition in certain areas (see Harris, 1996). They are located on the tops of benches and terraces and frequently form a surface layer more resistant to erosion than the surrounding deposits. Their quality is highly variable. Terraces may contain areas of caliche, a calcium carbonate particle coating that can be detrimental. Caliche coated gravels will not bind adequately with asphalt or cement. Terrace gravel sources are used for construction aggregate in the Bighorn Basin, near Casper, near Lander, near Cheyenne, near Wheatland (**Figure 6**), and near Laramie.

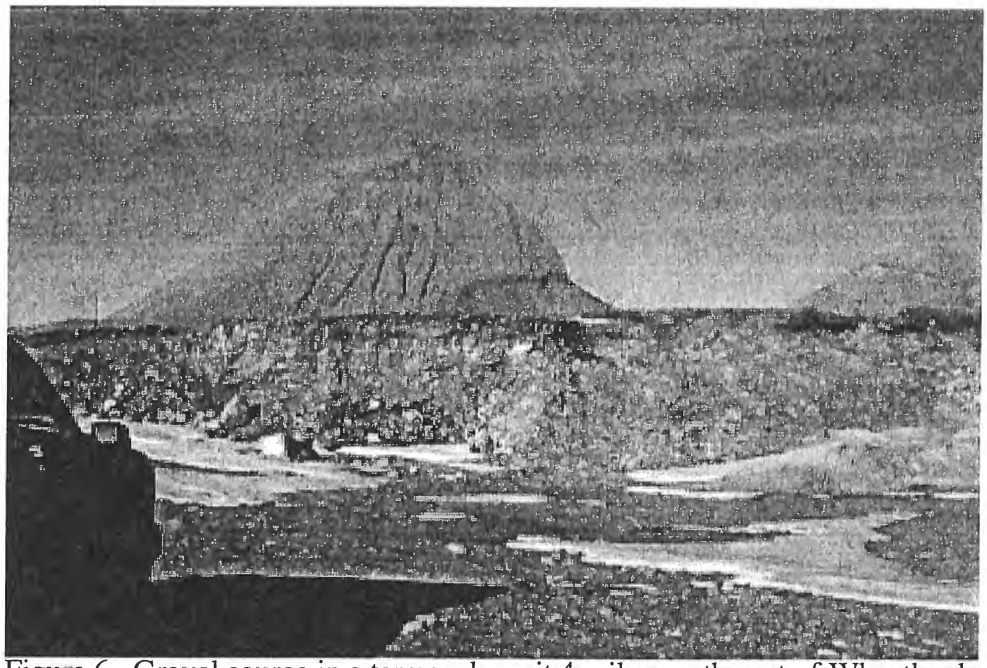

Figure 6. Gravel source in a terrace deposit 4 miles southwest of Wheatland.

Pleistocene gravels of uncertain origin

In east central Wyoming, in particular, localized thick gravel deposits are found in areas related to Pleistocene faulting. They may be formed from the ancestral Platte River alluvium in locations related to vertical faulting (Harris, 1997, 1998). Typically these deposits are very thick, often interbedded with sand lenses (**Figure 3**), and contain a great variety of rock types. Some of the rocks in the gravel can be traced to the Granite Mountains west of

Casper. Other rocks in the gravel are of local (less than a half mile) origin. These gravels have been used extensively in this region for construction projects.

Glacial gravels

Some glacial deposits contain large deposits of unsorted gravel. These are found in Wyoming in and adjacent to the higher mountain ranges in northern and western Wyoming and in the higher parts of the Medicine Bow Mountains and Sierra Madre in south-central Wyoming (Harris, 1996). In Wyoming, glacial sources for aggregate are not extensively used. They are used locally for construction projects, such as roads and highways in the National Forests. However, many of these deposits are in areas with restrictions or prohibitions on their production, such as in National Parks and regions of National Forests.

Older gravel deposits

In parts of Wyoming, rock units from Late Cretaceous to Pleistocene in age contain unconsolidated or poorly consolidated conglomerate that may be suitable for the production of natural gravel (Harris, 1996). These are usable if they can be quarried without additional disaggregation processes. These have been used especially in the eastern Green River Basin, western Wyoming, and south of Sheridan along the east front of the Bighorn Mountains.

Windblown and other sand deposits

Sand-sized material is used as aggregate in certain types of construction projects such as sidewalk concrete, some concrete finishes, railroad traction sand, highway sand, and others. Wyoming contains extensive deposits of windblown sand. Areas of active and stabilized dunes extend from the western Green River Basin across central and east-central Wyoming and into western Nebraska (Harris, 1996). However, most sand used in Wyoming is a by-product or co-product of gravel operations. Sand-sized material is sorted from the gravel and processed separately (**Figure 7**).

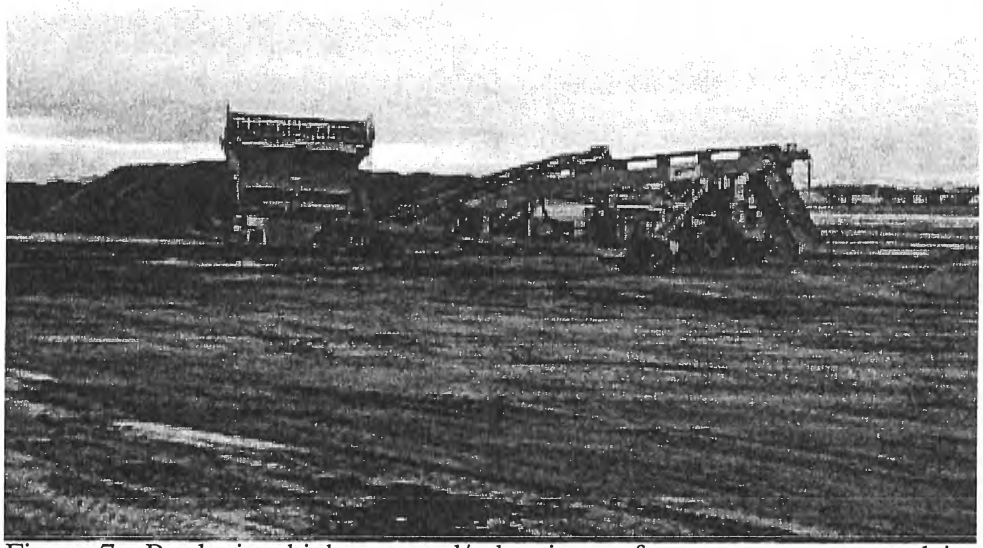

Figure 7. Producing highway sand/salt mixture for use on snowy and icy highways in the winter. Wyoming Highway Department pit, 2 miles south of Wheatland.

Production of construction aggregate in Wyoming.

Since 1995, the production of construction aggregate in Wyoming has increased each year except for a slight decline from 1996 to 1997 (**Table 1**). Construction aggregate reflects the general economic picture in Wyoming. When the amount of construction aggregate produced increases, the economy is growing.

Year	Construction Aggregate Production (short tons per year)
1995	8,793,098
1996	11,071,998
1997	10,419,971
1998	11,246,477
1999	15,206,461

Table 1. Annual production of construction aggregate in Wyoming. Construction aggregate includes products reported to the State Inspector of Mines of Wyoming as sand & gravel, industrial sand, crushed stone reported as limestone and others, railroad ballast reported as granite, and scoria. Data from State Inspector of Mines of Wyoming (1996-2000).

It is becoming more difficult to locate new sources of construction aggregate. New sources are needed as Wyoming's demand for construction products continues, the locations of this demand change, and older sources are depleted. Typically a construction aggregate source is less than five acres in size. Wyoming has a ten acre permit exemption (this exempts a producer from some costly permit application requirements, but not reclamation requirements) designed primarily for aggregate production. However, recent interpretations of the permit requirements include the acreage of roads, stockpiles, and plant facilities in the ten acres allowed, which often limits quarry size to near or below the minimum size for economical operation of aggregate production.

Wyoming has adequate deposits of construction aggregate raw materials in most areas of growth, with the notable exception of the Powder River Basin. Continued production is necessary for a sustained economy as well as economic growth.

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