Environmental Impacts of Aggregate and Stone Mining

New Mexico Case Study

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1. Introduction

The primary environmental impacts from aggregate, stone, and industrial mineral mines in New Mexico are degraded air quality from stack emissions and disturbed areas on the mine and groundwater usage. Surface and groundwater quality impacts from such mines are relatively benign in New Mexico due to the semi-arid climate and lack of perennial streams. Other environmental impacts include increased traffic on new or improved or existing roads; cumulative impacts as construction materials are hauled, stockpiled, and spread on highway and building construction projects; and aesthetic degradation caused by both active and abandoned aggregate, stone, and industrial mineral mines in major viewsheds.

Aggregate and stone mining produces materials that are used in road construction (aggregate, base course, crushed rock, sand and gravel); building construction and landscaping (topsoil, fill dirt, rip rap, scoria, travertine, dimension stone); and other general construction uses. Because the economics of construction materials depend heavily on the proximity of the mine to the point of use, aggregate and stone mines are found in the highest concentrations in urban areas where most home and office construction and general highway construction occurs. However, these mines are located in every county of the state and many of the largest of the mines producing road construction materials are situated immediately adjacent to highways in order to reduce haul costs. Because haul costs (i.e., fuel, labor, and maintenance) are the single largest variable in determining the cost of material in road construction, sand and gravel mines are often opened near to a specific road project and then abandoned once the project is completed. Consequently, the majority of both active and inactive sand and gravel mines are located along interstate highways or major state and county roads.

New Mexico had more than 200 permitted aggregate, stone, and industrial mineral mines in 2001. Total employment for all industrial mineral and aggregate mines was 1710 in 2001; total combined revenues for industrial mineral and aggregate production was $2,025,426, with 48% of that total coming from aggregate and stone mines (MMD and others, 2001, Table 1). No data are available for the areas disturbed by each of these mines but most operations range in size from one to 20 acres. Several hundred abandoned or inactive sand and gravel, aggregate, and other mines that produced construction materials are scattered across the state. Few of these mines have been formally reclaimed, although some have been naturally re-vegetated to some extent.

2. Environmental Impacts

Documenting the environmental impacts produced by aggregate, stone, and selected industrial mineral mines in New Mexico is difficult because of several complicating factors:

- Lack of regulatory data collection for most mines due to exemptions under NM Mining Act (aggregate and stone mining);
- Complications in urban areas caused by numerous sources of air pollution;
- Lack of "baseline" data that would allow comparisons of pre-mining and active mining conditions for air and water quality;
- Naturally arid climatic and soil conditions that create conditions favorable for wind and water erosion.

However, it is possible to perform qualitative analyses of the environmental impacts of aggregate, stone, and industrial mineral mining for relatively small areas.

The most recognized health hazards from these mines involve airborne particulate emissions. Total Suspended Particulates (TSPs) is a measure of all particulates emitted by a mine, while PM-10 particles represent some of the smallest particles (<10 μ in diameter) that can stay suspended in the air for long periods and pose the greatest respiratory health hazards. Some industrial minerals, like perlite and silica flux, create extremely fine particles of silica that can cause silicosis on prolonged exposure. Gypsum mines can also produce very fine gypsum [$Ca(SO)_4 \cdot 2H_2O$] dust that can irritate the lungs and mucus membranes. All other types of aggregate and sand mining involve the excavation, crushing, and screening of rocks that are predominantly Al-Mg-Fe-silicates, except for limestone and caliche, which are calcium carbonate. None of the minerals contained in these types of rocks is known to cause heavy-metals poisoning or cancer, and the potential health risks posed by TSPs from these minerals involve respiratory problems caused by chronic irritation of the lungs and mucus membranes.

Many air quality permits require that sampling be done only once every 7 days for one 24-hour period, which means that the air quality at a given mine or mill is sampled only 14% of the time. Thus, the mine is allowed to choose when these samples will be collected, which means that sampling can be avoided on extremely windy days and can usually be done under calm conditions. This selective sampling allows the permittee (the mine and/or mill) to remain in compliance with the air quality permit even though its operation may be violating terms of the permit the majority of the time. Although the mine must meet TSP standards for 24-hour, 7-day, and 30-day averages, these measurements are taken from a stack and do not include TSPs from pits, haul roads, and disturbed areas on the property.

One environmental impact that is often a problem in more temperate climates is the sediment load produced to surface water by aggregate, stone, and industrial mineral mines. In wetter areas of the United States, the sediment loading from these mines to streams, bays, lakes, and wetlands has been identified as a source of significant degradation to water supplies. Mines are required to capture surface water runoff and treat it on site, generally in settling ponds where the sediments drop out of the ponded water. However, because of the semi-arid climate in New Mexico, where annual precipitation in lower (less than 6000 feet msl) elevations ranges from 4 to

12 inches, very few perennial streams exist. Consequently, excess sedimentation in surface runoff from mines is generally not a problem except in those instances where a sand and gravel (or industrial mineral) mine is located immediately adjacent to a perennial stream. Most mines comply with water quality standards by installing silt fences or sediment basins to capture sediments on the permitted property.

Generally, aggregate and stone mines do not produce materials containing heavy metals or radionuclides. Because no current or historical aggregate or stone mines are known to have produced ARD (Acid Rock Drainage), acidic runoff containing heavy metals is not considered to be an environmental problem at these mines.

Another major environmental impact from aggregate and stone mines is groundwater use. Because mines are required to wash some materials on site and also control dust, some mines use millions of gallons of scarce groundwater to perform these tasks. Although dust control is necessary at these mines, the use of scarce potable water for dust suppression must be weighed against the increasing demands of domestic water use.

Cumulative and Associated Environmental Impacts

The most obvious environmental impact from aggregate, stone, and industrial mineral mines is degraded air quality, and associated health effects, resulting from airborne emissions from both the stack and the disturbed areas at these mines. In an arid landscape like New Mexico, the impacts of such mines on surface and groundwater quality is not likely to be significant. However, these mines should be viewed as a first step in development, whether it is highway, residential, or general construction. When one tracks a truck load of sand and gravel from its excavation, through loading and hauling, and to its ultimate use as either fill dirt, base course, cement, or some other construction use, it becomes clear that the environmental impacts of sand and gravel mining are widespread and cumulative. Below is a partial list of the potential cumulative impacts from the development of a typical sand and gravel mine:

- Dust and diesel fumes generated on the haul road to and from the mine.
- Fugitive dust blowing from the uncovered or partially covered dump trucks.
- Fugitive dust from poorly monitored crushers and out-of-compliance operations.
- Fugitive dust from piles of sand and gravel at the construction sites.
- Fugitive dust from the spreading of sand and gravel at the construction site, whether highway or building construction.
- Increased traffic (highways) or population (building construction), with a concomitant increase in air pollution from more vehicles (highways and rural roads) and more disturbed land (building construction).
- Increased air pollution from some sand and gravel mines after they are abandoned and until natural re-vegetation stabilizes the surface soil.

Each of the impacts listed above produces real-world effects that are difficult to measure. In the past, smaller populations and lower levels of development made these impacts less noticeable. But with larger populations and development that consistently outstrips the government's ability to regulate its impacts, the cumulative effects of aggregate and stone mining, especially in urban areas, contribute to the overall degradation of the environment. In rural areas these impacts are also serious for affected local communities.

A related impact from aggregate and stone mining is increased traffic congestion and safety hazards in both small rural communities and urban areas. Unlike metals or coal mines where most of the truck traffic occurs on private mine property, aggregate, stone, and industrial mineral mines create traffic on public highways. Wherever such mines are located, it is common to note traffic hazards as trucks enter and leave public highways dozens of times each day.

Another important impact of aggregate and stone mining is aesthetic degradation. The major transportation corridors of New Mexico (I-40 East-West; I-25 North-South) were built with local materials, as are all highways. Drivers on I-40 and I-25 crossing New Mexico can see hundreds of abandoned pits and dozens of active aggregate and stone mines from the highway. Sprawling urban areas like Albuquerque and Santa Fe-Española are pock-marked with huge sand and gravel pits. Although these mines made highway construction less expensive, their impacts on the scenic viewsheds across New Mexico are significant.

One final impact created by these mines could be called the "public nuisance" effect. Some operations can emit dust that disturbs neighbors. Nearby homes can be covered with a fine layer of perlite or mica dust from the mill. Mills sometimes operate at night and make enough noise to disturb neighbors as far as a mile away. The combination of bright lights to aid night operations, loud noises from crushers and screen plants, and chronic dust emissions creates a public nuisance for those people unfortunate enough to live near such operations.

3. Conclusions and Recommendations

The primary environmental impact from aggregate, stone, and industrial mineral mines in New Mexico is degraded air quality from stack emissions and disturbed areas on the mine. Surface and groundwater quality impacts from such mine are relatively benign in New Mexico due to the semi-arid climate and lack of perennial streams. Other environmental impacts include increased traffic on new or improved roads; cumulative impacts as construction materials are hauled, stockpiled, and spread on highway and building construction projects; and aesthetic degradation caused by aggregate, stone, and industrial mineral mines in major viewsheds.

Mitigating the environmental impacts of aggregate, stone, and industrial mineral mines could be improved by making some changes to existing regulations and, most importantly, by controlling development and sprawl in both urban and rural areas. The following recommendations are made to better manage environmental problems and mitigate the effects of aggregate, stone, and industrial mineral mines.

1. Deny operating permits to new operations if inactive or abandoned mines could be re-opened to provide the same resource. New operations should be permitted <u>only</u> if no other suitable materials are available in a given area. This would make better use of existing resources in areas where disturbance has already occurred and prevent the random and incoherent development of aggregate and stone mines.
2. Enforce existing mine and mill air quality permits strongly and consistently. This would require state inspectors and making certain "problem" mines and mills come into compliance to set an example for all operations.
3. Deny permits to mines that propose locating in areas unsuited for mining. Mines should not be allowed to operate near Native American "sacred sites," residential neighborhoods, historic rural communities, or in areas where the resulting "scar" will ruin a scenic viewshed.
4. Encourage the use of re-cycled materials like "glassphalt," "plasphalt," and used tires to replace aggregate, crushed rock, base course, sand, and gravel in highway construction. This would reduce the need to open new mines and help with the problem of overloaded landfills. Because re-cycled materials are not currently competitive with many highway construction materials, the state and federal government will likely have to subsidize the use of re-cycled materials. However, over time it is likely that re-cycled materials will become more widely used and the cost differential between road construction materials and re-cycled materials will narrow.

4. References

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