SAND AND GRAVEL MINING IN COLORADO RIPARIAN HABITATS

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Abstract.--The extent and general areas of sand and gravel mining in riparian habitats along Colorado streams and rivers is discussed. Emphasis is placed on the Colorado Front Range mines, but Western Colorado sand and gravel mining is also discussed. The similarities and differences between the areas are presented. A brief discussion of the primary problems with riparian sand and gravel mining is presented with particular emphasis on the impacts of mining on the loss of long-established terrestrial wildlife habitats and the prospects of loss mitigation by replacement with a combined terrestrial/aquatic habitat. A general discussion is also presented on related water problems in reclamation, and a request is made for an ecosystem based solution to the problems of phreatophyte and evaporative loss management, particularly as it relates to quality wildlife habitats.

INTRODUCTION

The Colorado Mined Land Reclamation Board (MLRB) administers the Colorado Mined Land Reclamation Act of 1976. This law requires that all mine operators obtain permits for mining and reclaim the land they affect. The law includes all types of mining including sand and gravel mining.

The Mined Land Reclamation Division (MLRD) is the staff for the MLRB. The MLRD processes applications for permits, inspects operations for compliance, and brings enforcement actions before the MLRB. In the process of reviewing an application, the MLRD critically examines all environmental aspects including wildlife, soil, revegetation, water impacts, and eventual land use of the affected areas.

No one knows exactly how many sand and gravel and other types of mines there are in Colorado and the number probably varies daily. Estimates of the total vary from less than 1,000 to more than 2,000. Generally, a 1,800 to 2,000 total is accepted. This figure includes not only the private operators but all the gravel sources used by the Colorado Division of Highways and the 63 counties in building and maintaining Colorado's many miles of dirt, gravel, and paved roads and highways.

It is apparent that the job before the MLRD, which has a technical staff of only 8 persons, is truly massive. Many other states have many more staff members to do an even smaller job than in Colorado. Obviously, if the agency is not enlarged the task of insuring all mined lands are properly reclaimed may suffer resulting in much unreclaimed, abandoned lands that will continue to present environmental hazards for decades to come.

COLORADO SAND AND GRAVEL MINING

Sand and gravel mining in our rapidly growing state is a big industry. It is necessary in order to build and maintain our many construction needs. In some areas gravel is actually in short supply and must be transported in by train. This is particularly true of the far eastern part of the state.

Some progress is being made in developing recycled aggregates, but at present the quality is not sufficient to meet the existing construction quality standards. More research and development in this technology may eventually take the demand off the new aggregate needs thereby possibly reducing the number of gravel pits required.

Gravel must be mined where it occurs. Being a fluvial deposit most gravel occurs in the floodplains of rivers and streams. In places, terraces left from old floodplains subsequently eroded can be mined, but often the gravel is not of a proper nature for certain uses. Usually it requires much washing and even then is adequate for only certain uses.

Large and small operations on the eastern slope are basically alike - they occur near rivers and produce lakes as a part of their reclamation. Furthermore, large operations on the western slope are essentially like the eastern slope operations. But, small western slope operations often are found mining right in the river during low water. These operations are called "gravel farms" by the MLRB.

Gravel farms occur in aggradational streams and generally cover only a few acres producing a few tens of thousands of tons per year. During high water they cannot operate. In this period the hole created the year before is filled with gravel originating upstream.

Generally, these operations do not widen the river or create lakes, but they may cause severe siltation downstream if the protective berms are not properly constructed. Also, the operation destroys whatever biological integrity the river bottom has at that location.

Generally, the Division of Highways attempts to avoid river bottom and riverside operations. Wherever possible, aggregates are derived from upland situations where impacts on water resources are minimal and reclamation is somewhat more simple.

RECLAMATION OF GRAVEL PITS

The location of sand and gravel mines, besides being where the gravel is, is primarily a problem of local government planning. The MLRB defers to local government the problem of deciding on the appropriateness of a gravel pit being located at a particular place. The local government entity is best suited to making such decisions in accordance with their zoning capabilities. Unfortunately, only about half the state is zoned and therefore much of the state has no control over siting of sand and gravel pits.

In some of the largest urban areas sand and gravel mining goes beyond the capabilities of zoning. In these areas regional planning and cooperation between adjacent counties is vital in controlling the proliferation of gravel pits in an uncontrolled, helter-skelter pattern that may seriously conflict with adjacent land uses.

Because of this lack of control over siting, be it good or bad, the MLRB and their staff concentrates their efforts on individual pits. There are many aspects the MLRB considers, but the primary ones include:

1. Pit slope grading
2. Revegetation
3. Impacts on wildlife

The MLRB is aware of, but has not taken an official position on one other matter - evaporative losses from lakes.

PIT SLOPE GRADING

In the expensive process of producing a suitable slope on the edge of the gravel pit the MLRB is primarily concerned with safety of such slopes, especially where recreational use of some degree is contemplated. It is not safe to assume that because a lake is on private land trespass will not occur. Children may enter the area to fish or swim. An unstable slope can collapse possibly resulting in drowning.

Grading is important to all aspects of reclamation. Safety, revegetation capability, and adequate shoreline habitat for wildlife are important considerations.

The MLRB prefers to have slopes that are at least 3 to 1 from 5 feet above to 10 feet below the average water line. Steeper slopes are acceptable if it can be shown that such a slope will be stable, but this is rarely the case.

The MLRB also prefers to see an irregular, more or less natural outline to the lake. This helps create the maximum shoreline relative to the area of water as well as being more attractive.

These standards can cause a loss of gravel resource. Such losses can be partially mitigated by restructuring the slopes where sufficient overburden exists. Of course, the MLRB recognizes that for industrial water storage the shape of the lake is not all that vital, but the slope standards must still be maintained. In the gravel pit reclamation plan the MLRB expects plans to produce the maximum multiple use possible and be adaptable to other uses that might be needed in the future.

REVEGETATION

In most cases the essence of reclamation is revegetation. The MLRB stresses the use of native species primarily because they are the most likely to survive during extremes of environmental factor change. However, this stress on revegetation is very much determined by the eventual land use selected.

In reclamation plans that strive for a more or less natural setting the MLRB looks for diversity of species and lifeforms, adaptability of the species, and appropriateness of the mixture for wildlife. Riparian vegetation is a complex and diverse mosaic of many species. Often, nature helps pattern the eventual vegetation through species selection in accordance with environmental gradients and natural invasion, but a good plan can do much in accelerating the process of establishing stable plant communities.

On the eastern slope revegetation is fairly simple due primarily to fair to good climatic and soil conditions. Often, well developed communities can be established within five years, (sometimes less), although the establishment of trees takes longer.

On the western slope revegetation of even the wettest pits is difficult. On these areas soils are often poor and rather saline particularly in the Grand Junction area. Poor soils combined with scanty precipitation combine to often create complete failure in revegetation.

In some areas of the western slope natural revegetation often works better mostly because of our ignorance in effectively dealing with desertic conditions. Unfortunately, such natural revegetation results, most commonly, in low diversity and highly competitive communities of tamarix, an introduced species that has locally out-competed native species. Such situations, although attractive, are certainly not advantageous for achieving the highest reclamation product.

In all areas of the state weeds and faulty grazing management act as a severe hindrance in reclamation. Annual weeds can usually out-compete perennials for moisture resulting in a loss of perhaps several years in

achieving the desired end use. Allowing cattle to graze an area before the vegetation is fully established can destroy, in a matter of days, hundreds of dollars worth and perhaps years of hard work. Both must be controlled through intelligent and well considered management programs. In most areas, the personnel of the U.S. Soil Conservation Service and the Soil Conservation Districts can aid operators and landowners greatly in developing these important management programs.

WILDLIFE

When a given number of acres of terrestrial habitat to which existing communities are fairly well adapted, are converted to aquatic habitat a loss to adapted ocmmunities occurs. The gain in aquatic habitat hardly offsets the loss of terrestrial habitat.

Locally, very severe displacements occur to terrestrial species. These displacements place stress on adjacent lands. It may be conceivable that the opening of new gravel pits should be done at a time when such displacements are at a minimum. If this were done when migratory species were not nesting the disruption might be somewhat mitigated. Still, however, when the migratory species return they may find less suitable habitat than the population needs.

The increase in aquatic habitat as a result of sand and gravel pits as well as the development of other aquatic habitats may cause disruptions in the winter ranges of migratory aquatic wildlife. Certainly, this is not as significant as the loss of terrestrial habitat, but it is a matter that, to the best of my knowledge, has not been investigated.

The MLRB relies heavily on the expertise of personnel from the Colorado Division of Wildlife in examining the impacts of mine development on wildlife resources. Often DOW reports indicate that most gravel mines have, at most, a moderate impact on wildlife, sometimes minor. The problem is that the DOW reports address only specific mines. As is true in other facets of this problem, it is not the specific mine that produces all the problems but the cumulative impacts of tens or even hundreds of mines occurring in a particular region, or unique and sensitive habitat which creates a serious and difficult problem.

EVAPORATIVE LOSSES

Because most gravel pits expose water that was once protected by several feet of earth evaporative loss of previous ground water can occur. Along the Front Range Corridor evaporative loss can reach three or more feet per year after deducting for precipitation. On the western slope the evaporation is not quite so intense, but still reaches 30 inches per year in Grand Junction. As a general rule, an acre-foot of water is lost to evaporation for every 15,000 $ft.^2$ of free water surface produced. At higher elevations it is not so severe, but still is no small amount.

The relationship between evaporative loss from a free water surface compared to losses resulting from evapo-transpiration by phreatophytes is still not well understood. It is reasonably certain that loss from a free water surface as compared to a dense cottonwood forest is less when

there is no or very little wind. The boundary layer established above a free water surface reduces the evaporative gradient resulting in less evaporation. A slight wind, however, destroys the layer and evaporative loss increases rapidly. The exact balances though are not well understood. Studies addressing this problem have mainly concentrated on certain phreatophytic species often studied outside of the natural community. Much more study must be done on the actual losses from natural riparian communities to determine the nature of this vital relationship under actual working conditions.

CONCLUSION

There are many who believe that sand and gravel mine reclamation is fairly simple. To be sure, the reclamation of sand and gravel mines is more simple than some other types of reclamation, but it should not be thought of as being simple. I hope I have shown there are many unsolved, large problems.

Each mine and mine type (sand and gravel, base metal, quarry, coal strip, etc.), has its own unique problems and there is probably as much if not more variation in reclamation problems within certain mine classes than there is between those classes. Reclamation, at present, is more of an art than a science.

Some companies are making concerted attempts to develop better and less expensive techniques to restore the land to a subsequent, highly useful condition. Most companies, though, tend to do only what is obvious to make it look nice with little thought to what it will be like fifty years from now. This approach of covering up the problems with green can be called landscape cosmetics. In the truest sense of the term this is not reclamation.

The fault should not be placed on these companies though, for excellent and innovative techniques for reclamation are expensive in both planning and implementation. Such expense is often beyond the means of small companies making it economically impractical for them to reclaim the land to such an extent. A technology that is both effective and economical simply does not exist. As a result, much land is reclaimed rather poorly.

One step that could be taken to aid in a rapid development of such a beneficial technology would be to have a symposium where miners, scientists, environmentalists, and government people discuss their respective problems and expectations. This could be followed by a workshop where groups seek solutions to the problems through objective, non-political discussion. We can all learn a lot from each other.

I perceive sand and gravel mining as a grand opportunity to add much diversity to man's and nature's world. It is an opportunity to produce areas for research, new habitats, education and recreation for our rapidly expanding urban areas. Not only can we all benefit from the aggregates produced but also from the result of the production of the aggregates. In some ways, the reclamation of coal strip mines, which seems to be at the forefront of reclamation politics today, is a fairly well studied and developed technology. That isn't to say that coal mine reclamation is without problems - it

most certainly isn't. Compared to taking full advantage of the reclamation and land use possibilities coal strip mine reclamation is approaching maturity while sand and gravel mine reclamation is in its infancy (a few states don't even recognize it as a form of mining).

Without a doubt, at least in Colorado, sand and gravel mining generally occurs in one of the most critical and sensitive habitats, the riparian habitat near urban areas. The wide dispersion of sand and gravel mining throughout the State presents an especially difficult administrative problem. The huge strip mines and sometimes even large metal mines are problems but they are concentrated with boundaries that can be watched, monitored and the effects often controlled with relative ease. Dispersion of literally hundreds of little disturbances, like sand and gravel mines, obscures the subtle, interaction effects that tend to suddenly explode into unmanageable problems.

It is ecological folly to think that dispersion produces a more easily handled problem. Time and the exponential relationship can quickly swamp any sense of well-being. It is essential that everybody insist on the management of the cumulative impact. I am sure we can have all the aggregate we really need and an excellent environment if we tackle the problem from two ends at once. First, develop very efficient construction designs that produce maximum space and strength with minimum material. Second, in deciding where aggregate mining occurs use a regional planning approach that restricts dispersion as much as possible and insists on reclamation to the highest quality using techniques that are quickly effective and economically usable by mines of all economic means. With this type of planning the problems can be overcome and all the people of Colorado can benefit.