RECLAMATION OF GRAVEL PITS

Paper presented
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INTRODUCTION

Unlike other types of mining, gravel pits develop around populated areas. In the Lower Mainland alone there are about 320 gravel pits. Just five miles from downtown Victoria, is the largest aggregate producer in Western Canada, Construction Aggregates (Producers Pit), which barges in excess of 2 million tonnes of product to Vancouver annually, and depending on market conditions, is capable of producing 4 million tonnes annually. In this paper I'll discuss some of the legislative requirements, operational and reclamation conditions, and potential future land uses which typify gravel pits.

LEGISLATION

The Ministry of Energy, Mines and Petroleum Resources has a legislative responsibility for administering reclamation on all gravel pits in the province, however, the present practice is to exempt Ministry of Transportation and Highways pits, Ministry of Forests pits and gravel pits within Municipalities that have a soil removal by-law which is acceptable to the Chief Inspector of Mines. Within these Municipalities, if the Chief Inspector of Mines is not satisfied with the way the operator is performing he may require the operator to obtain a Reclamation Permit.

Prior to commencement of work an operator is required to obtain a Reclamation Permit. To do this he must submit a mining plan and a reclamation program to the district office. The Inspector of Mines then reviews this with reclamation staff and submits it to affected agencies for comment. After receiving the comments he sends the package to Victoria with recommendations on the level of bonding, and the specific terms and conditions for the permit (the Mining Regulation Act also allows for the representation of any public concerns). The permitting process usually takes 30 to 60 days.

Basic requirements of a Reclamation Permit are:

1) stockpiling of topsoil
2) protection of watercourses
3) upon completion of mining,
   (a) recontouring -two horizontal to one vertical -cosmetics
   (b) distribution of topsoil or suitable growth medium
   (c) removal of buildings, covering concrete foundations
(d) revegetation
Details of these requirements are enclosed in Appendix A.

The Ministry of Energy, Mines and Petroleum Resources is not the only government agency which has a legislative responsibility to exercise. Some of the other agencies whose jurisdiction affects gravel pits are: Ministry of Lands, Parks and Housing, Ministry of Environment, Ministry of Health, Ministry of Transportation and Highways, Ministry of Forests, Federal Fisheries, Ministry of Agriculture and Food (Agricultural Land Commission).

Because operations develop around the urban centers, Regional Districts and Municipalities through their zoning and planning function can significantly effect the viability of some operations. Although existing operations can be permitted as nonconforming, new operations must be consistent with particular zoning.

OPERATION AND RECLAMATION

A mine which integrates mine planning and reclamation planning is usually very successful in completing their reclamation obligations. There are some cases, however, where poor mine planning has led to situations where reclamation becomes difficult and in fact because of topographical or budget constraints reclamation is impossible.

There are four main categories of materials mined in a sand and gravel operation: boulders; gravel; fine sands, silts and clay; and topsoil (Table 1).
<table>
<thead>
<tr>
<th>Material</th>
<th>Particle Size</th>
<th>Typical Uses Commercial</th>
<th>Problems Associated</th>
<th>Potential Uses for Reclamation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boulders (oversize)</td>
<td>18&quot;</td>
<td>Rip Rap Clean fill French drains</td>
<td>Hard to handle depending on size, may have to drill and blast</td>
<td>- Fill low spots - Stream protection - Often used as barriers for safety reasons</td>
</tr>
<tr>
<td>Gravel Products</td>
<td>+100 mesh 18&quot;</td>
<td>Road construction and maintenance Concrete Asphalt Railway ballast Clean fill</td>
<td>Storage may be problem for some products (sands) Crushing, washing</td>
<td></td>
</tr>
<tr>
<td>Fine Sands, Silts and Clays</td>
<td>100 mesh</td>
<td>Fill, some local farmers may buy it to mix with topsoil Binders</td>
<td>Has to be washed from gravels Storage</td>
<td>Surface growth medium Fill low spots</td>
</tr>
<tr>
<td>Topsoil</td>
<td></td>
<td>In site specific cases an abundance of top-soil can be sold</td>
<td>- Contaminant - Has to be stripped</td>
<td>Growth medium</td>
</tr>
</tbody>
</table>
When developing the mine plan, geomorphology is of utmost importance. Thickness of deposit, for instance, can vary from 5 meters in the Chilliwack area, to 150 meters in some coastal deposits, and allowing high pit faces to develop has led to unsafe conditions and reclamation problems.

Another important factor is the consolidation of the gravels. If the gravels are unconsolidated the abandoned pit faces tend to quickly slough to their natural angle of repose. Conversely, highly consolidated faces can stand vertical for years, not only remaining unreclaimed but also increasing public safety problems. Variables which influence the angles of repose include degree of consolidation, particle size, particle geometry, clay content, and moisture content. The common angle of repose for unconsolidated mixed sand and gravel is between 28 and 32 degrees but records have indicated up to 42 degrees for very coarse angular gravels. When planning extraction, if the deposit is unconsolidated, materials can be loaded out directly, whereas highly consolidated deposits may require a cat to feed the loaders. A point to stress when in mine planning and reclamation planning is utilization of equipment when it's available. Specifically when an operator has a cat on site he should be planning to landscape during idle time.

Seasonal fluctuations in water tables may necessitate pumping, and often operators are required to construct peripheral ditches for control of runoff. The construction of settling ponds or treatment systems is another common requirement when the operator washes gravel. On occasion the addition of coagulants is required. The silts and clays from these systems is often valuable for reclamation.

Although mine and reclamation planning are very dependent on the preceding, other items which influence them are location, operational control, and whether the operation is continuous or non-continuous.

The location dictates access and method of shipping product (potential problems - road restrictions, weather, etc.). Often along highways or beside residential areas there is a potential for establishing greenbelt areas. This can significantly reduce the volume of mineable gravel. Topsoil stockpiling is one of the first operations an operator must deal with. Delineating the deposit so topsoil won't be moved again before final application is usually cost effective. A windrow next to the property boundary tends to be a common method of stockpiling topsoil. Often specifications require blending of
materials from different parts of the pit. This can lead to various faces being active or inactive over time. Normally continuing operations crush, screen and wash gravels to produce a variety of products, whereas the non-continuous operations may sell pit run only and have crushing or screening plants brought in as the market dictates. The latter is more difficult to plan for as markets likely will be tied to local trends.

Some specific regulations in the Mining Regulation Act which can lead toward easier reclamation are:

(a) working faces shall not exceed 5 ft. above maximum reach of loader,
(b) operator must stay the same distance from property boundaries as bank height,
(c) public must be safeguarded.

POTENTIAL FUTURE LAND USES

The following land uses have been used for former gravel pits:

1) Industrial Developments:
   cement plants, storage compounds, commercial garbage burners, sawmills and dryland log sorts.
2) Residential Developments.
3) Recreational Areas:
   motor-cross (dirt bikes), rifle ranges (target shooting), camping and picnic sites, and fishing (man-made lakes).
4) Agricultural Use:
   It is possible for the agricultural land to be enhanced by removing the gravel. This, however, requires very careful operational control. Specifically, the ground can be recontoured giving a more acceptable working surface and in some cases, more significantly, changing a previously well drained or quite pervious area into an area capable of retaining moisture.
5) Reforestation:
   This is common in more isolated areas. In some of the older abandoned pits natural reforestation has occurred, alders being the quickest to "pioneer", although conifers have succeeded in some areas.
6) Wildlife Habitat:
   Given that most operators have developed a protective attitude for wildlife, some ungulate and migratory species take up residence.
NOTES PERTAINING TO SAND AND GRAVEL OPERATIONS
AND FORM 10-11

Note 1. OWNERSHIP
When the operator of the gravel pit is not the registered owner of the property (surface of the land under the Land Act), then the name and postal address of the registered owner is to be shown. In this situation, a letter is required from such registered owner acknowledging that he is aware of and approves the content of the Form 10-11.

Note 2. TOPSOIL
Topsoil is defined as extending to maximum root penetration. Topsoil must not be taken from the property; it is to be conserved for use in the reclamation program. Topsoil is to be removed from operational areas prior to any disturbance of the land, and stockpiled separately on the property.

Note 3. WATERCOURSES AND WATERTABLE
If watercourses are to be disturbed in any manner by the operations, prior application must be made to the Water Rights Branch, for a licence under the Water Act. If washwater is to be used the Pollution Control Branch should be contacted for a permit under the Pollution Control Act.

When a gravel pit has been extracted to below the watertable, thereby forming a residual pond, the Chief Inspector may require that backfilling, drainage, and/or bank contouring measures can be carried out, to complement reclamation.

Note 4. CONDITION OF THE LAND. AND FUTURE USE AFTER RECLAMATION
A wide variety of usage may be made of gravel pits, after the gravel has been extracted, such as picnic sites, parks, recreation areas, Christmas tree farms, farm lands, residential or industrial development, etc. The reclamation program shall be carried out as soon as the usage of the land, or any substantial part of it, for mining purposes has been terminated. Pit banks, berms, benches, and hummocks shall be graded to a gently undulating surface, using waste and overburden as required to achieve this condition. The stockpiled topsoil shall be evenly distributed over the disturbed and regraded areas. All areas shall then be re-vegetated to the most suitable type of vegetation, relevant to the nature of and the location of the land. The maximum permissible slope of the reclaimed land shall be one vertical in two horizontal, unless the Inspector has otherwise approved.

Plants and buildings are to be completely removed, and the foundations backfilled or covered, at the termination of operations, except with the written approval of the Inspector of Mines.

The land shall be left in a neat, clean, and safe condition.

Note 5. AESTHETICS AND PUBLIC SAFEGUARDING
The Mines Regulation Act provides for the safeguarding of the public [see section 7(1)]. It also regulates the distance from the property boundary within which excavation operations shall not be carried out [see section 23, Rule 253(a)]. The Inspector may require that a suitable screen of trees, shrubs, etc., be left or be established between the operations and the property boundary, when such boundary abuts on a playground, park, residential development, main highway, or other area open to the public at large.