

## What

- Using lifts of overburden or waste rock to restore a face or a mined out area to a specified reclamation slope.

## Purpose

- Reduces slope angles to specific or standard reclamation criteria.
- Can reduce the hazard of slope failure.
- Compaction may be required to achieve a specified minimum density.

## Where

**YES:** Where final face heights are higher and steeper than permit specifications or general reclamation standards.

## Materials, Equipment & Costs

- 🚛 Overburden, waste rock, construction or excavation materials.
- ✂ Haul truck, front-end loader, bulldozer, backhoe, sheep's foot roller and smooth vibrating drum roller.
- \$ Variable, depending upon height, moisture content and post-extraction land use.

## Specs

- A sand and gravel or quarry permit may specify reclamation slope angles and compaction specifications (dry densities of backfilling material, standard proctor, and compaction techniques). If slope angles are not specified in the permit, use general reclamation slope angles of 2 horizontal to 1 vertical.
- If in doubt regarding reclamation specifications, contact a regional office of the Ministry of Energy and Mines or the Mines Branch, Geotechnical Section, in Victoria.
- After all mineable aggregate is removed from an area, slopes can be re-contoured by:
  - concurrent backfilling using overburden mined elsewhere on the site,;
  - bringing in quality, clean fill material from construction projects or other sources offsite, and
  - retaining enough overburden or mine by-products for re-sloping.
- Backfilling is most efficient when stripped waste material is immediately placed into backfilling lifts. Using this approach, the material is handled only once, and its original moisture content may allow for the best compaction. The moisture content of stockpiled waste material may change during storage, making it difficult to achieve the required minimum density.
- Ensure that fill material is free of brush, rubbish, organics, logs, stumps, building debris and other materials inappropriate for constructing stable fills.
- Ensure that fills from unknown sources are free of contamination.
- Place fill in 6 centimeter layers, or other thickness specified in the design.
- Compact the layers to the required standard proctor dry density, as required, to ensure stability.
- Add water during compaction, as required to maintain optimum moisture content.

- Clay is best compacted with a sheep's foot roller, and granular material with a smooth vibrating drum roller.
- If overburden cannot be immediately placed into lifts, store the overburden where it can be readily and economically moved into position during reclamation.
- Plan stormwater drainage paths.

## Additional Considerations

- Stability and erosion control are primary concerns for backfilled slopes. Careful location of drains and water-control features will enhance slope stability and revegetation potential.
- If overburden or waste rock is strategically placed and there are no geotechnical concerns, backfilling may be done with a short push or haul.
- Back-slope benches should drain stormwater away from the crests.
- Backfilling areas proposed for buildings and roads may require increased density criteria and testing for control of compaction and grade.
- If permanent planting will be delayed, temporary protection of bare slopes against erosion with plastic sheeting, mulches, matting or seeding with grasses may be necessary.

## Options

- For sand and gravel pits, if no material is available for backfilling, simply knocking down the crest of the face can reduce the slope to the desired stable slope angle. Proper safety measures should be taken.

## Vegetation & Planting

- Vegetation can significantly reduce surface erosion, but cannot be relied upon to prevent movement of a soil that is unstable due to improper design and construction.
- Planning a phased succession for ground cover, grasses, shrubs and trees will establish good protection. Succession management involves the addition of naturally occurring types of plants, as the indigenous species create an environment in which further stages can flourish. For example, shade-loving species should not be planted in full sun, but would naturally begin to appear after the development of a canopy.

## Maintenance

- It is important to establish and maintain drainage to avoid flooding or erosion.
- Ensure that the vegetative cover is kept healthy, to avoid erosion.

## Sources

O'Brien, E. (2001): **Minimum Technical Requirements**; Stormwater Management Manual for Western Washington, Volume I. *Washington State Department of Ecology*, Publication 9911, URL <<http://www.ecy.wa.gov/biblio/9911.html>>, June 2001.

Norman, D.K., Wampler, P.J., Throop, A.H., Schnitzer, E.F. and Roloff, J.M. (1997): **Best Management Practices for Reclaiming Surface Mines in Washington and Oregon**; *Washington State Department of Natural Resources* Open File Report 96-2 and *Oregon Department of Geology and Mineral Industries* Open File Report O-96-2, page 5-5, URL <<http://www.wa.gov/dnr/htdocs/ger/pdf/bmp.pdf>> [PDF, 7.6 Mb] June 2001.