BMPs FOR SEWAGE BIOSOLIDS

THIS CHAPTER SETS OUT BMPs FOR:

- **storage at treatment plants and in-field**
- **hauling and handling**
- **contingency planning**
- **application methods and equipment**
- **site criteria, including slope, soil characteristics, drainage, and distance to water bodies.**

For land-applied sewage biosolids, best management practices begin with storage and end in the field.

STORAGE

WASTEWATER TREATMENT PLANTS

Storage facilities are required to hold biosolids during periods of inclement weather, equipment breakdown, frozen or snow-covered ground, and when land is unavailable during the growing season.

Liquid biosolids can be stored in digesters, tanks, lagoons, or drying beds. Dewatered biosolids can be stockpiled. It is a BMP to have enough storage capacity to store the amount of sewage biosolids that would be produced over a 240-day period.

Sewage biosolids can only be stored in specially designed, permitted, and approved storage facilities.

Wastewater treatment plants have designated storages for biosolids destined for land application.

BIOSOLIDS ODOUR CATEGORIES

Ontario Regulation 267/03 and the associated Odour Guide set out an odour categorization system for all NASM. The odour categories are OC1, OC2 and OC3. Sewage biosolids are categorized as:

- OC1 – liquid, anaerobically digested sewage biosolids from a municipal sewage treatment plant or its off-site storage facility
- OC2 – liquid, aerobically digested sewage biosolids from a municipal sewage treatment plant or its off-site storage, and sewage biosolids that have been dewatered by means other than a centrifuge operated at less than 2,000 revolutions per minute (rpm) and stored less than 30 days after dewatering is completed
- OC3 – sewage biosolids that have been dewatered by a centrifuge operated at less than 2,000 rpm, or sewage biosolids that have been dewatered and stored less than 30 days after the dewatering process is completed.

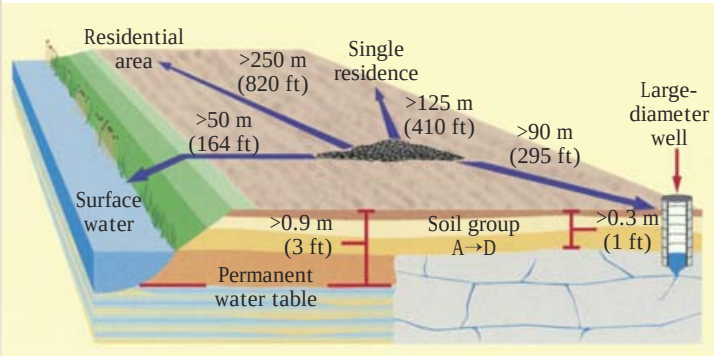
TEMPORARY IN-FIELD STORAGE

Temporary in-field storage sites may be used for dewatered municipal sewage biosolids. The amount of dewatered municipal sewage biosolids stored at the temporary site should not exceed the quantity needed for crop production on that farm unit, as outlined in the NASM plan. The maximum length of time that dewatered municipal sewage biosolids that are OC2 can be kept in a temporary in-field storage is 10 days from the time that the first load is delivered. If the biosolids are categorized as OC3, then they must be land-applied and incorporated the same day they are received at the application site.

When determining the location of a temporary site for dewatered municipal sewage biosolids, the site should have the following features:

- slope less than 3% unless the soil depth is at least 0.9 metre (3 ft) to bedrock
- Hydrological Soil Group A–D – Group A soils must have a depth of soil that is at least 0.9 metres to bedrock
- not located in a regional or 1 in 100-year flood plain
- at least 0.3 metre (1 ft) of soil above the bedrock and at least 0.9 metre (3 ft) of unsaturated soil above the permanent water table
- a flow path that is at least 50 metres (164 ft) from the nearest surface water and is located at least 0.3 metre (1 ft) above bedrock
- at least 45 metres (148 ft) from a drilled well having a depth of at least 15 metres (49 ft) and a watertight casing extending to a depth of at least 6 metres below ground level, 90 metres (295 ft) from any other well except a municipal well, and at least 100 metres (330 ft) from a municipal well
- at least 125 metres (410 ft) from a single residence and 250 metres (820 ft) from a residential area if the biosolids are OC1
- at least 200 metres (656 ft) from a single residence and 450 metres (1,476 ft) from a residential area if the biosolids are OC2.

Keep records of the location and dates of pile establishment, turning and removal.



Temporary storage sites for dewatered biosolids must be selected carefully to reduce the risk of contaminating groundwater and surface water.

HAULING AND HANDLING

Successful hauling and handling is:

- ► practical
- ► conducted with public safety and acceptability in mind
- ► in adherence with all provincial regulations and local bylaws
- ► environmentally sound.

The method of transport and subsequent application depends on many factors. Considerations include:

- ► the characteristics and quantity of sewage biosolids to be transported
- ► distance to the application site
- ► costs of transport and application method.

The final plan for hauling for land application is a mutual decision made by the municipality and the broker. It is usually outlined in a written agreement.

While a municipality may operate its own land application program, most municipalities hire experienced contractors to handle their sewage biosolids land application program.

Critical components of a hauling and handling program include:

- ► transport method – type and quantity of materials to handle
- ► contractor and staff education on the safe handling of biosolids
- ► timing of transportation to coincide with periods of low traffic volume, if possible
- ► proper signage and safety practices
- ► distances and routes
- ► number and capacity of vehicles
- ► vehicle maintenance and sanitation
- ► suitable transfer sites
- ► contingency plans including:
  - ▷ contingency measures for spills
  - ▷ alternative delivery locations.

Most municipalities use highway transports to haul biosolids to the application site.

TRANSPORT METHOD

Liquid Transport: <18% solids

- ► sealed tanks used only for transport
- ► tankers should be equipped with baffles to reduce internal movement of liquids
- ► dedicated pumps and hoses are used to load and unload materials
- ► nurse tanks may be used at the application site as interim holding tanks between hauling equipment and the land application operation

Biosolids are often transferred from highway transports to nurse tanks prior to land application.

Bladders are used for temporary storage at the staging area for application operations.

Specialized application equipment is used to handle dewatered biosolids.

Solid Transport: >18% solids

- ► usually transported by truck and covered trailer
- ► loaded and handled by front-end loaders, conveyors and other industrial equipment

BIOSOLIDS HANDLING

Biosolids handling includes the transfer of liquid biosolids from tanker to the application system at the field site. Nurse tanks and storage bladders are temporary containment devices used in the field to store liquid materials in the interim between hauling and land application. Material cannot be left in these devices overnight.

With all biosolids handling systems, human safety and environmental protection are priority concerns during these activities.

BMPs for Nurse Tanks and Storage Bladders

If you're using a nurse tank, it should be:

- ► leak-proof
- ► equipped with emergency shut-off valves, and
- ► equipped with safety grills to prevent human entry.

Location-wise, there are minimum regulated separation distances that must be adhered to. As a BMP, a nurse tank or bladder should be located on level ground as far away from sensitive features such as wells and surface water as is practical, while still accessible to delivery equipment. The objective is to ensure minimal environmental damage in case of a spill, and minimal impact on neighbours from odours and activities associated with a land application operation.

Vacuum-loading arms work well for unloading tankers. Where appropriate, farmers should include them in contingency plans, as they're also useful in case of a spill.

CONTINGENCY PLANNING

The best way to prevent emergencies is to set out and follow the BMPs and guidelines for application.

Generators and haulers/land applicators are required to draw up a contingency plan and take the necessary precautions, in case an emergency arises. Being prepared is the best defence.

SPILL PREVENTION

- ✔ Train staff. Instruct staff about road and load safety, suitable routes, and driving practices.
- ✔ Develop and review a spill protocol that includes instructions on containment, contacts, and reporting procedures.
- ✔ Inspect all safety features prior to haulage: hatches, seals, tires and running gear.

Contingency plans are not worth the paper they're written on *unless* they're followed up by adequate staff training and spill cleanup materials.

IN CASE OF A SPILL

- ✔ Stop the source: stop the leak at the source.
- ✔ Contain the spill: use bales or other absorbent materials to contain spill.
- ✔ Clean up: use loaders or vacuum equipment as appropriate to clean up the mess.
- ✔ Report the spill: have contact numbers prominently placed on hauling equipment
  - ► call MOE Spills Action Centre, 1-800-268-6060.

APPLICATION SITE CRITERIA

Sewage biosolids can only be applied to agricultural land that's suitable to receive them and where location and site conditions don't restrict or prohibit application.

SURFACE SLOPE

The steepness, length and shape of the surface slope can influence the potential movement of liquid or solid sewage biosolids through runoff or soil erosion.

SURFACE SLOPE AND POTENTIAL MOVEMENT OF BIOSOLIDS

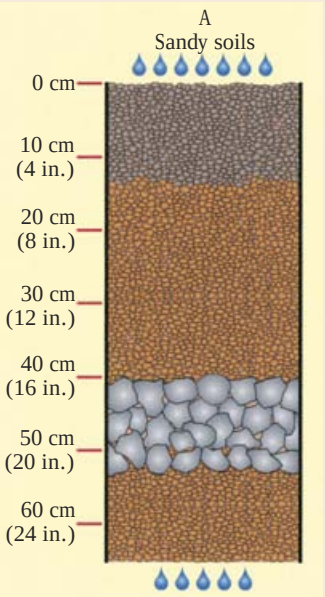
SURFACE SLOPE	IMPLICATIONS
0–<3%	• considered best for maximizing soil infiltration and absorption, while minimizing potential for lateral surface flow in the form of runoff or erosion
3–<6%	• is highly suitable with careful management (e.g., conservative application rates)
6–<12%	• poses an increased risk of runoff if liquid sewage biosolids are to be applied • usually requires incorporation or reduced application rates
≥12	• cannot be applied if the slope is within 150 metres (492 ft) of the top of bank of surface water • if distance is greater than 150 metres (492 ft) from the top of bank of surface water, as a BMP, applications are not recommended on slopes of 12% and greater, due to risks of liquid biosolids movement downslope and pooling in low areas

Slope is measured as a percentage of elevation difference over a specified length. For example, a 6-metre (20 ft) incline over a 100-metre (328 ft) distance is a 6% slope.

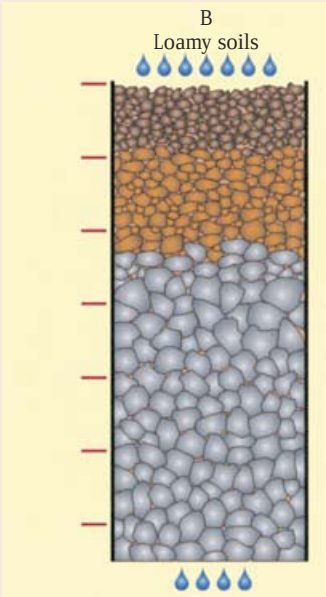
SOIL PERMEABILITY

The rate at which a liquid will infiltrate and move down through a soil depends on the permeability of the soil.

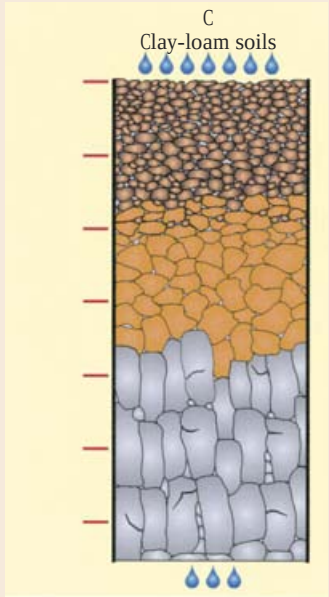
HYDROLOGIC SOIL GROUP	IMPLICATIONS
A, B SANDY SOILS, LOAMY SOILS	• A and B soils have a high infiltration and conductivity rate • liquid sewage biosolids may move quickly into and downward through these soils • applying too much liquid sewage biosolids to these soils may result in the leaching (seepage) of nutrients below the rooting zone and down into groundwater before they can be taken up by the plant roots
C, D CLAY LOAMS, CLAYS	• C and D soils are less permeable and have a lower infiltration and conductivity rate • sewage biosolids applied to these soils are more likely to be retained within the rooting zone and taken up by crops – this reduces the risk of nutrients leaching to groundwater, but care must be taken to avoid pooling



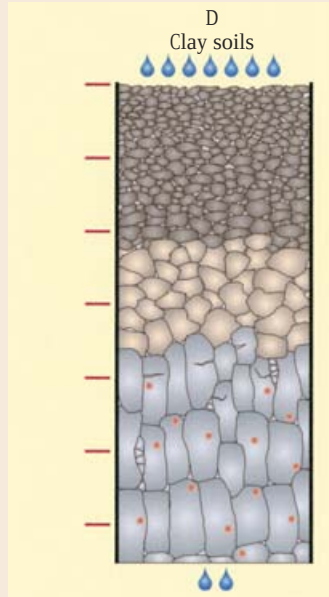
Group A is sand, loamy sand or sandy loam types of soils. They have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels, and have a high rate of water infiltration.



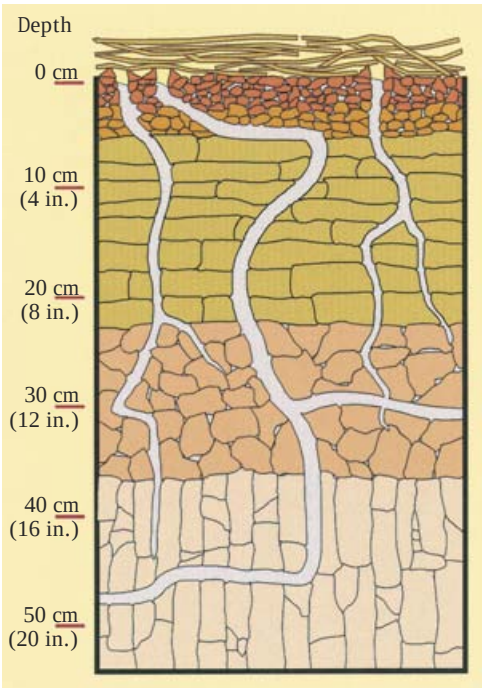
Group B is silt loam or loam. It has a moderate infiltration rate when thoroughly wetted and consists chiefly of moderately deep to deep, moderately well to well-drained soils.



Group C soils are sandy clay loam, clay loams, and silty clay loams. They have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water, and soils with moderately fine to fine structure.



Group D soils are sandy clay, silty clay or clay. This HSG has the highest runoff potential. These soils have very low infiltration rates when thoroughly wetted and consist of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material.



Following application, liquid sewage biosolids can travel in soils through cracks, worm channels, and large continuous pores. In advance of applying liquid sewage biosolids, pre-tilling soils that are prone to cracking can reduce risk.

SOIL DRAINAGE

The rate at which excess water will naturally be discharged or will move through and out of a soil can influence the rate and timing of sewage biosolids application.

Poorly drained soils, shown in this profile and scanned soil map (map unit symbol Pal for Parkhill loam), may be unsuitable for biosolids applications.

SOIL/SITE FACTOR	CONSIDERATIONS
POORLY DRAINED SOILS	• these soils discharge water slowly and tend to stay wet for longer periods in early spring and late fall as compared to well or imperfectly drained soils • they may wet up quickly after substantial rainfalls – when soils stay wet longer, there can be a risk of compaction, runoff and/or erosion • poorly drained soil series (or types) are identified on soil maps
IMPERFECTLY OR WELL-DRAINED SOILS	• these offer greater flexibility than poorly drained soils in terms of biosolids application
WELL-STRUCTURED SOILS WITH MACROPORES	• macropores may act as direct conduits to tiles or groundwater • minimize risk with lower application rates and/or tillage prior to application
PRESENCE OF SUBSURFACE TILE DRAINAGE	• used to improve imperfect and poorly drained soils ○ improved in-field drainage allows field operations earlier in the spring and later in the fall, and sooner after rain events as compared to a non-tiled field • take care during application to avoid movement down through the soil to the drainage pipe (tile) and subsequent discharge to a watercourse or drainage ditch • delay application or take extra caution when applying liquid sewage biosolids to a field with subsurface drainage if water is flowing from the outlets • monitor outlet water (outfall) frequently • pre-till prior to application to disrupt potential pathways (e.g., cracks or macropores) down to the drainpipes (tiles) to further reduce the risk of biosolids reaching the outlets (outfall) • don't apply sewage biosolids within 20 m (65 ft) of a surface inlet (e.g., Hickenbottom drain) that outlets to surface water
DEPTH TO WATER TABLE	• need to ensure regulatory compliance • ensure adequate depth to groundwater to minimize the risk of leaching of nutrients out of the root zone and down into groundwater • use management practices such as pre tillage or lower application rates of liquid biosolids to minimize risk
SOIL TYPE	• sandy (coarse) soils ○ have large pores, drain quickly, with minimal retention of applied liquids ○ higher rates could pass through rooting zone • loamy (medium) soils ○ diverse pore size, drain at a moderate rate, and retain a moderate amount of liquid materials ○ loamy soils in good condition have higher loading capacity • clay (fine) soils ○ have small pores, drain slowly, and retain applied liquids in small pores ○ higher rates could lead to runoff

SOIL/SITE FACTOR	CONSIDERATIONS
SLOPE	• with higher application rates, the risk of runoff increases with steepness of slope • slopes steeper than 12% significantly increase the risk of runoff and application is not recommended
DEPTH TO WATER TABLE	• soils with high water tables have less storage capacity for applied liquid materials, thus posing a higher risk for groundwater contamination
DEPTH TO BEDROCK	• soils shallow to bedrock are closer to the point of application or injection – posing a higher risk for groundwater contamination
SETBACK DISTANCE TO SURFACE WATER	• a regulatory requirement • reduce the risk of surface water contamination
SETBACK DISTANCE TO WELLS	• necessary for fields and sites adjacent to wells to reduce the potential risk of well contamination from surface runoff, or the remote risk of subsurface movement of contaminated groundwater

APPLICATION METHODS AND EQUIPMENT

Sewage biosolids can be applied as a liquid or a solid. The most appropriate application method for agricultural land depends on the physical characteristics of the biosolids and the soil, as well as the types of crops grown.

Biosolids are commonly injected or incorporated into the soil by ploughing or disking after the biosolids have been applied unless minimum or no-till systems are being used. Biosolids application methods such as incorporation and injection are implemented to retain nutrients and reduce runoff, odours, and vector attraction.

LIQUID BIOSOLIDS

Liquid application is attractive because of its simplicity and flexibility in application options. Liquid sewage biosolids can be pumped from the storage facility to transportation vehicles, and then transported to field sites to be pumped directly from the vehicle to the field application equipment.

Liquids can be surface-applied to pastures – provided the proper waiting times (at least two months) are followed.

Liquids can be surface-applied and incorporated, or injected directly into the soil.

SURFACE APPLICATION

Equipment used for surface application includes tractor-drawn tank wagons, special applicator vehicles, and tank trucks with flotation tires to minimize compaction on moist soils. Historically, high-trajectory guns were sometimes used for surface application of biosolids. Due to a number of issues such as inaccurate application, this practice is no longer allowed in Ontario.

INJECTION

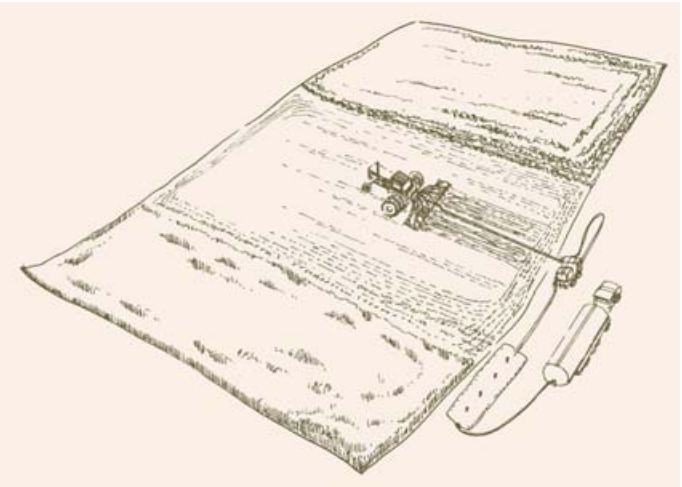
Liquid biosolids can also be injected below the soil surface using:

- tractor-drawn tank wagons with injection shanks
- tank trucks fitted with flotation tires and injection shanks
- tractor-mounted injection and drag hose systems.

This equipment minimizes odour problems and reduces ammonia volatilization by the immediate mixing of soil and biosolids. Injection can be used before planting, between the rows of crops like corn while the crop is growing, or after harvesting.

Subsurface injection can also help minimize runoff. Injection should be made perpendicular to slopes to avoid having liquid biosolids run downhill along injection slits and pond at the bottom of the slopes.

Injection isn't recommended for forages and sod production. Injection shanks can damage the sod or forage stand and leave deep injection furrows in the field.



Injection across slope – or in concert with cross-slope contour cropping designs – will drastically limit the risk of runoff.

DEWATERED BIOSOLIDS

Dewatered sewage biosolids may be less costly to transport, but usually require post-application incorporation. Typically, solid or dewatered sewage biosolids are applied to cropland using equipment similar to that used for applying lime, animal manures, or commercial fertilizer. Because of the low water content, these sewage biosolids can be ploughed or disked into the soil immediately after application. New technology has been developed to inject some types of dewatered sewage biosolids.

Dewatered biosolids are applied using specialized injection equipment or modified livestock manure application equipment.