Chapter 2 – Federal and State Regulations

2.1 Federal Regulations

The major requirements of the 40 CFR Part 503 Rule (Part 503 Rule) are contained in the subheadings of this chapter. Biosolids managers should familiarize themselves with the information under each of these major requirements and develop their programs to address them.

This chapter lists the basic requirements; readers are referred to the appropriate use/disposal chapters of this Manual for more detailed methods and "rules of thumb" for meeting specific requirements.

2.1.1 History and Background

The USEPA has made recommendations for the use and disposal of biosolids for decades -- including two separate rulemakings in 1979 (USEPA 1979) and 1993 (USEPA 1993). The intervening years have seen further development and refinement of the approach currently in force. The Part 503 Rule is a complex, risk-based assessment of potential environmental effects of pollutants that may be present in biosolids (USEPA 1995), coupled with treatment and management practices designed to protect human health from illnesses that could potentially result from untreated and/or mismanaged use or disposal of biosolids. The basic provisions of the Part 503 Rule are presented in this chapter, with references for further details and discussion of these provisions.

The 1979 Interim Final Rule (40 CFR Part 257) governing biosolids was issued under the authority of the Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act (RCRA) of 1976 as well as Section 405(d) of the Clean Water Act (CWA). This 257 Rule was an interim final regulation that partially fulfilled the requirement of the CWA to provide guidelines for the disposal and utilization of biosolids. Because it was issued as a federal solid waste regulation, the 257 Rule resulted in many states regulating biosolids under their solid waste programs. In fact, this rulemaking stated that facilities that did not meet the criteria of the 257 Rule would be classified as “open dumps". As specified by the CWA, the criteria contained in the 1979 regulation were designed “to avoid a reasonable probability of adverse effects on health or the environment from disposal of sludge on land" (USEPA 1979). The criteria applied only to the placement of biosolids on land. All such practices were required to address environmentally sensitive areas and diseases (pathogen control) in addition to protecting food chain crops from the effects of cadmium and PCBs. The evaluation of lead, pesticides and persistent organics was deferred to future rulemaking because information available to the agency at the time was believed to be inadequate to support specific standards.

Many of the assumptions and the data used to develop the 1979 limits were unnecessarily conservative and/or based on an incomplete understanding of the mechanisms of metal uptake and accumulation in crops. Nevertheless, this rule (along with recommendations for cumulative loading limits developed by the U.S. Department of Agriculture) provided the federal regulatory basis for biosolids land application programs in the United States

for more than a decade. Even as it was published, USEPA and the scientific community identified gaps and limitations in the 257 rule and began efforts to develop a more comprehensive risk-based rule encompassing more of the pollutants of concern.

Under Section 405(d) of the CWA, USEPA identified, based on available information, pollutants that may be present in biosolids in concentrations that might affect public health and/or the environment. Then, for each identified use or disposal method, USEPA specified acceptable numerical limits and management practices for biosolids that contain these pollutants. Following more than 15 years of research and development, USEPA proposed the "Standards for the use or disposal of sewage sludge" (40 CFR Parts 257, 403 and Part 503 Rule) in 1989 and published the Final Rule on Feb. 19, 1993 (2), after extensive comments and detailed peer review (4, 5, 6).

2.1.2 Standards for the Use or Disposal of Biosolids

The 40 CFR Part 503 Rule sets standards for final use or disposal when biosolids are applied to agricultural and non-agricultural land (including products sold or given away), placed in or on surface disposal sites or incinerated. The Part 503 Rule does not specify operating methods or requirements for biosolids entering or leaving any particular treatment process. The Part 503 Rule does include a provision that requires a person disposing of biosolids in Municipal Solid Waste Landfills (MSWLF) or using biosolids as a cover material at MSWLF sites must ensure compliance with 40 CFR Part 258. Treatment works that use an MSWLF to dispose of their biosolids must insure that the material is non-hazardous (as determined by the Toxicity Characteristics Leachate Procedure, or TCLP) and passes the Paint Filter Liquid Test. They may also be subject to other state or local landfill requirements.

The standards contained in the final Part 503 Rule consist of general requirements, pollutant limits, management practices, operational standards and requirements for frequency of monitoring, record keeping and reporting.

The pollutant limits, management practices and other requirements developed for Part 503 Rule were specific to the use or disposal method employed. The use or disposal methods included in the proposed rule were:

- Application to agricultural or non-agricultural land
- Distribution and marketing (referred to in the final Part 503 Rule Regulations as sale or giveaway of biosolids)
- Disposal in on surface disposal sites
- Incineration

The Part 503 Rule Regulations contain five subparts:

Subpart A: General Provisions
Subpart B: Land Application
Subpart C: Surface Disposal
Subpart D: Pathogens and Vector Attraction Reduction
Subpart E: Incineration

General Provisions

The general provisions of the rule establish standards consisting of general requirements, pollutant limits, management practices, operational standards, and monitoring, record keeping and reporting for the final use or disposal of the solids generated by the treatment of domestic biosolids or of domestic septage. The regulations do not cover solids from an industrial biosolids treatment facility or those generated during water treatment.

Biosolids grit and screenings are not subject to the Part 503 Rule regulations as they have completely different characteristics than biosolids and must be disposed in accordance with appropriate requirements (e.g., 40 CFR Part 257 when disposed on the land).

Part 503 Rule is self-implementing, i.e., enforceable even before a specific federal permit is issued. Thus a responsible person must become aware of the Part 503 Rule regulations, comply with them, perform appropriate monitoring and record keeping and, if applicable, report information to the permitting authority even when a permit is not issued. These standards are also directly enforceable against any person who uses or disposes of biosolids through any of the practices addressed in the final regulations. An enforcement action can be taken against a person who does not meet those requirements, regardless of whether a permit has been issued.

Compliance with the regulatory standards has been required for all facilities since January 19, 1995. For detailed discussion of specific biosolids requirements, the reader is referred to Chapter 40 CFR Part 503 Rule (USEPA 1993) and the technical support documents (USEPA 1992) accompanying the final rule.

In the final regulation, USEPA uses the term “land application” in a restrictive sense to delineate clearly between different regulatory requirements. Since biosolids are not only disposed on land, but in many cases also used to condition the soil or provide nutrients, the Part 503 Rule uses the phrase “land application” only when referring to biosolids used for their beneficial properties. When biosolids are disposed of by placing them on the land, the Part 503 Rule refers to this practice as “surface disposal.”

Provisions under the Part 503 Rule also address the compliance period, permits and direct enforceability, relationship to other regulations, more stringent permitting requirements and exclusions.

Many requirements in the regulations apply to the “person who prepares” biosolids -- referring to the person or entity that effectively controls the quality of the biosolids or the material derived there-from that is ultimately either used or disposed. For example, in situations where a treatment works generates biosolids that are blended with other sources of biosolids, the person blending is the one who prepares the biosolids since s/he controls the quality of the material that is ultimately used or disposed. This preparer could be the person who oversees generation of biosolids during the treatment of domestic biosolids or a person who derives a material from biosolids.

2.2 General Requirements – 40CFR Part 503.12

Bulk biosolids subject to this section must include the:

- Transfer of sufficient information (Notice and Necessary Information) among the preparer, land applier, landowner and permitting authority
- Tracking of cumulative pollutant loading limits from biosolids that do not meet the concentrations contained in Table 3, § 503.13, (shown in Table 2.1, below)
- Movement of biosolids across state lines

2.2.1 Land Application

If the land applier is not the same person who prepared the biosolids, the preparer is responsible for providing documentation to the land applier on the quality of the biosolids before they may be applied to land. This information is provided on a Notice and Necessary Information (NANI) form.

Before land application, the land applier will need to obtain the following (either from the preparer or independently):

- Pollutant concentrations
- Nitrogen concentrations
- Class of pathogen reduction level achieved
- Vector attraction reduction option achieved, if any

The land applier also must provide the landowner/farmer with any information needed to comply with land application requirements (e.g., site restrictions). It is also advisable to provide the landowner/farmer with the biosolids quality information including nitrogen content and the amounts of other nutrients applied to the soil through the biosolids application.

As a practical matter, the permitting process for a land base will entail interaction with the landowner/farmer in obtaining information typically required by state regulatory agencies (e.g., maps, cropping information, soil test results).

Pollutant Limits

The Part 503 Rule provides two approaches to limiting trace metals: one specifies the amounts of trace metals that are allowed in biosolids; the other limits the cumulative amounts of these metals *added* to soils through biosolids application. Cumulative limits for metals are the amounts that can be added to the preexisting background amounts in soils. The cumulative pollutant loading rates (CPLRs) are based on a risk assessment performed by the USEPA, using data from decades of field research. The assessment evaluated 17 potential pathways and the risk to human, plant and animal life. Fourteen apply to land application on managed or unmanaged land.

The numerical standards for biosolids that are not subject to cumulative soil loading limits are directly related to the loading rates for trace metals through the various exposure assessment pathways. USEPA derived these "Pollutant Concentration" numbers from calculations using the risk -- based cumulative soil loading and applying certain

conservative assumptions. Such biosolids are known as Pollutant Concentration (PC) biosolids (Table 3 of § 503.13). Since Pollutant Concentrations are based on the cumulative loading rates established by the risk assessment calculations and include the same conservative safety factors, they provide the same degree of protection to human health and the environment as do the cumulative pollutant loading rates for soils. Table 2.1 (below) shows the maximum concentrations of metals in biosolids that, if not exceeded, allows the biosolids to be applied without maintaining records of cumulative applications. PC biosolids (with trace element concentrations less than or equal to those contained in Table 2.1) are a high quality material that will require minimal record keeping, depending upon the type of pathogen reduction treatment used.

Table 2.1 Pollutant Concentration (PC) Biosolids (Table 3 of § 503.13)

Pollutant	Allowable Concentration (mg/kg monthly average)
Arsenic (As)	41
Cadmium (Cd)	39
Copper (Cu)	1,500
Lead (Pb)	300
Mercury (Hg)	17
Nickel (Ni)	420
Molybdenum (Mo)	To be determined*
Selenium (Se)	100
Zinc (Zn)	2,800

*As of November, 2000

Table 2.2 shows the maximum allowable concentrations of these metals in any biosolids that are applied to land along with the corresponding cumulative pollutant loading rate (CPLR) for each metal. If any trace element contained within biosolids exceeds the amount shown in column 2 of Table 2.2, the material cannot be land applied. Biosolids with metal concentrations greater than those in Table 2.1 and less than or equal to those in column 2 of Table 2.2 may be applied to the land up to the amounts shown in column 3.

Table 2.2 Maximum Allowable Metal Concentrations and Loading Rates (Tables 1 & 2 of § 503.13)

Pollutant	Concentration Mg/kg dry wt.	CPLR Loading Kg/ha	lb/ac
Arsenic (As)	75	41	36.5
Cadmium (Cd)	85	39	35
Copper (Cu)	4,300	1,500	1,339

Pollutant	Concentration Mg/kg dry wt.	CPLR Loading Kg/ha	lb/ac
Lead (Pb)	840	300	267
Mercury (Hg)	57	17	15
Molybdenum (Mo)	75	N/A	
Nickel (Ni)	420	420	375
Selenium (Se)	100	100	89
Zinc (Zn)	7,500	2,800	2,500

As a result of several amendments to the Part 503 Rule, cumulative loading and PC limits for Molybdenum were deleted from the rule pending reevaluation of research data. Chromium was deleted because risk-based limits were extremely high and not relevant to existing biosolids quality. Ceiling limits for Selenium were raised to 100 based on new data, as shown in the tables above. In addition, USEPA clarified that ceiling concentration limits apply to all land -- applied biosolids.

For bulk biosolids subject to CPLRs, the land applier must notify the permitting authority in the state where the biosolids will be applied of his/her intent to apply to a particular site before the initial land application. Such notification must include the location of each land application site and the name, address, telephone number and a National Pollutant Discharge Elimination System (NPDES) permit number (if applicable) of the land applier. In addition, before beginning land application on a site, a land applier must consult the permitting authority to determine whether past applications of biosolids subject to CPLRs have been made after July 20, 1993. If no biosolids subject to CPLRs were applied after that date, the land applier must then begin keeping records of cumulative pollutant loadings for each of the ten regulated metals. Multiple land appliers on a single site must make their application data available to one another and coordinate the tracking of cumulative loadings to ensure that CPLRs are not exceeded. If biosolids subject to CPLRs were applied after July 20, 1993, the land applier is responsible for finding out the amount of each regulated metal that was applied and subtracting those loadings from the allowable limits.

When a land applier determines that bulk biosolids not meeting the Class A pathogen and PC metal concentrations are to be land applied in a state other than where they were generated, the land applier should notify the preparer, who is then responsible for notifying the permitting authority in the state where biosolids are to be applied before initial application to any site. In the case of interstate application of biosolids subject to CPLRs, the land applier as well as the preparer must send prior written notice to the permitting authority in the state where the application of biosolids will occur.

Pathogen and Vector Attraction Reduction

The land application subsection contains operational standards and methods for pathogen and vector attraction reduction. The operational standards set the pathogen requirements for various uses of biosolids. Class A pathogen requirements or Class B pathogen requirements with site restrictions must be met when biosolids are to be applied to agricultural land, forest, public contact sites or reclamation sites. Class A pathogen requirements must be met if the biosolids product is to be applied to lawns or home gardens, or if it will be sold or given away in bags or bulk. This portion of the subsection also specifies which vector attraction reduction requirement must be met for the various uses.

The Part 503 Rule establishes requirements for reducing pathogenic organisms or indicator organisms such as fecal coliforms in biosolids applied to the land. It also includes requirements for destroying or reducing the characteristics of biosolids that might attract birds, insects, rats and other animals (so-called “vectors”). Based on “vector” exposure to the pathogenic organisms potentially present in biosolids and potential spread of disease from these disease vectors to humans, the rule requires measures for reducing the attraction of vectors to biosolids. These vector attraction reduction measures include reduction or destruction of the odor-causing properties of biosolids that lure insects and animals by covering with soil, or injecting/incorporating the biosolids into the soil.

The pathogen reduction requirements (Class A and Class B) are operational standards. All biosolids intended for land application must meet at a minimum, the Class B pathogen reduction requirements.

To be a Class A biosolids, the material must meet one of the following criteria:

- Fecal coliform - a density less than 1,000 Most Probable Number (MPN) per dry gram of total solids; or
- Salmonellae - density of less than 3 MPN per 4 dry grams of total solids.

In addition, the material must meet one of the following requirements:

- Time/Temperature relationships
- Alkaline treatment and subsequent air drying
- Demonstration through testing of enteric virus and helminth ova prior to and after pathogen treatment with documentation that the process operating conditions convert non-class A levels to Class A levels. Ongoing testing for enteric virus and helminth ova is not required as long as the treatment process is then operated in accordance with the parameters that have achieved the Class A status
- Ongoing testing for enteric virus and helminth ova to demonstrate that levels meet Class A criteria
- Process to Further Reduce Pathogens (PFRP) or a PFRP-equivalent process

To be a Class B biosolids, the material must meet one of the following standards:

- Less than 2,000,000 MPN of fecal coliform per gram of total dry solids
- Less than 2,000,000 Colony Forming Units (CFU's) of fecal coliform per gram of

total dry solids.

- A Process to Significantly Reduce Pathogens (PSRP) or PSRP equivalent.

Any biosolids that meet the Class B pathogen reduction requirements and are intended for land application also must comply with the site restrictions included in the land application subsection.

In addition to the pathogen reduction requirements for land application, one of the vector attraction reduction (VAR) requirements shown below in Table 2.3 (below) must be met. Management practices also are required for Class A biosolids if they exceed any of the pollutant concentrations of Table 2.3 in the Part 503 Rule or do not meet one of VAR options 1-8.

Table 2.3 Vector Attraction Reduction Methods

1. Volatile Solids Reduction by a minimum of 38 percent
2. Volatile Solids Reduction additional testing for anaerobic digestion
3. Volatile Solids Reduction additional testing for aerobic digestion
4. Specific Oxygen Uptake Rate (SOUR) equal to or less than 1.5 milligrams of oxygen per hour per gram of dry solids at 20 degrees Celsius (°C)
5. Aerobic process for a minimum of 14 days at a temperature of greater than 40°C and an average temperature greater than 45°C
6. pH of 12 or higher by alkaline addition, and the maintenance of at least pH 12 for two hours without addition of more alkaline material; then pH 11.5 or higher for an additional 22 hours
7. A total solids concentration equal to or greater than 75 percent for a material that does not include unstabilized solids generated in a primary treatment process prior to mixing with other materials
8. A total solids concentration equal to or greater than 90 percent for a material that contains unstabilized solids generated in a primary treatment process prior to mixing with other materials
9. Injection of liquid biosolids below the land surface
10. Incorporation of biosolids that have been surface applied or placed on a surface disposal site within 6 hours after application to or placement on the land
11. Biosolids placed in an active disposal unit shall be covered with soil or other material at the end of each operating day
12. The pH of domestic septage shall be raised to 12 or higher by alkaline addition and, without further alkaline addition, remain at 12 or higher for 30 minutes.

The twelve VAR options specified in the Part 503 Rule are treatment options (1-8 and 12) and barrier options (9, 10, and 11). Treatment options are undertaken by the biosolids preparer, and in such a case, the land applier has no requirements relative to vector attraction reduction once he has been notified by the preparer that this requirement has been met. If such a treatment option is not performed by the preparer, the land applier must implement and certify compliance with one of the barrier options of injection below the soil surface or incorporation into the soil (Dominak, Robert P. 2000; USEPA 1989) within 6 hours following surface application.

The VAR alternatives a community uses depend on the method in which the biosolids are to be applied. Subsurface injection and incorporation apply only to biosolids that are applied to agricultural land, forest land, public contact or reclamation sites. Amendments to the Part 503 Rule specified that 1) pH readings must be reported at the standard temperature of 25 degrees Celsius to avoid errors; and 2) fecal coliform densities for Class B can be met at any time after achieving pathogen reduction.

Operational Standards
If biosolids are treated by a Class B process, site restrictions must be imposed to allow time for natural processes to further reduce pathogen levels. Site restrictions for Class B address: 1) public access to the site and 2) crop harvest and grazing of animals at the site.

Public access must be restricted for at least 30 days on all land application sites that receive Class B biosolids; this is usually accomplished by selecting sites on farmland in rural areas, remote lands or fenced areas. If the site is used frequently by the public or the potential for public contact is high, such access must be restricted for one year after Class B biosolids are applied. Such land would include parks, playgrounds and golf courses.

Besides public access, other site restrictions also may apply depending on the use of the site. If food crops are grown, certain waiting periods must be observed prior to harvest and waiting periods must be observed on sites where feed and fiber crops, as well as turf, are grown and where animals are grazed. Table 2.4 summarizes the site restrictions associated with application of Class B biosolids in order to achieve the same level of protection to public health and the environment as is provided by Class A biosolids treatment.

Table 2.4 Site Restrictions for Class B Biosolids Application

- Public access to land with a high potential for public exposure is restricted for one year after biosolids application
- Public access to land with a low potential for public exposure is restricted for 30 days after biosolids application
- Food crops, feed crops or fiber crops are not harvested for 30 days after biosolids application
- Food crops with harvested parts that touch the biosolids/soil mixture and are totally above the land surface (e.g., melons, cucumbers) are not harvested for 14 months after application of biosolids
- Food crops with harvested parts below the surface of the land (e.g., root crops such as potatoes, carrots, radishes) are not harvested for 20 months after application when the biosolids are not incorporated into the soil or remain on the soil surface for four or more months prior to incorporation into the soil
- Food crops with harvested parts below the surface of the land are not harvested for 38 months if the biosolids are incorporated into the soil less than four months after biosolids application
- Animals are not grazed on a site for 30 days after biosolids application*
- Turf shall not be harvested for one year after biosolids application if it is placed on land with high potential for public exposure or on a lawn unless otherwise specified by the permitting authority.

* In 1999, amendments to the Part 503 Rule clarified that the Class B grazing restriction applies to intentional grazing of domestic animals, not inadvertent grazing of wildlife.

The site restrictions to control public access or crop harvest and grazing animals must be implemented by either the land applier or the landowner/farmer. At a minimum, the land applier must provide the landowners/farmers with a list of these restrictions and inform them that they must be met for each site where Class B biosolids are applied. If the land applier intends to implement the restrictions, they must certify that they have been met and maintain this certification in their records for a five-year period. If it is agreed that the landowners/farmers will implement the appropriate restrictions, the land applier must provide them with a list of the restrictions and certify that they were appropriately informed.

Management Practices

The land application subsection also includes a number of management practices required for the land application of biosolids and the distribution of biosolids-derived products in bags or in bulk.

Biosolids may not be applied within 10 meters of waters of the U.S., and certain site restrictions may apply, depending on the level of treatment to reduce pathogens and the intended use of the land.

Management practices applicable to the land application of biosolids address the following:

- Threatened or endangered species
- Flooded, frozen or snow-covered land
- Distance to waters of the United States
- Agronomic rates

Threatened or Endangered Species: Bulk biosolids subject to the management practices of the Part 503 Rule may not be applied to the land if an adverse effect on threatened or endangered species or their designated critical habitat is likely to occur. An "adverse effect" includes any direct or indirect action that reduces the likelihood that a threatened or endangered species will survive or recover from an impact. The critical habitat is any location where a threatened or endangered species may live or grow during its life cycle. Threatened or endangered species are listed in 50 CFR 17.11 and 17.12, published by the U.S. Department of Interior, Fish and Wildlife Service (FWS).

The normal tillage, cropping and grazing practices, mining, forestry and other activities that involve turning the soil and impacting vegetation are not likely to cause any adverse impact on endangered species and may be beneficial because of the enhanced nutrient status and soil building which the application of biosolids imparts. Therefore, the application of biosolids to land would not normally be considered to have an adverse impact on threatened or endangered species or their habitat. If there is some specific reason to believe otherwise, a land applier should evaluate whether any threatened or endangered species or habitats at the site could potentially suffer a negative impact.

Flooded, Frozen or Snow-Covered Land: While bulk biosolids may be applied to flooded, frozen or snow-covered lands, this practice must not result in bulk biosolids entering wetlands or other waters of the United States unless specifically authorized by a permit under Sections 402 or 404 of the Clean Water Act. By insuring that proper runoff prevention and/or control measures exist to prevent biosolids from entering the waters of the U.S., the land applier is allowed to apply biosolids to flooded, frozen or snow-covered areas. Many state programs include such measures as slope restrictions, buffer zones, tillage requirements, crop residue or other means of insuring that biosolids will not migrate to wetlands or waters of the U.S. The land applier should be familiar with the details of such requirements and, in some cases, seasonal restrictions that relate to this requirement.

Distance to Waters of the United States: Bulk biosolids may not be applied to agricultural land, forest or reclamation sites within 10 meters (approximately 33 feet) of any waters of the U.S. unless otherwise specified by the permitting authority. The permitting authority (USEPA or a delegated state) may give approval for application within 10 meters of waters of the U.S. for site-specific conditions or to enhance the local environment.

Revegetating a stream bank suffering from severe erosion is an example of the situation where the permitting authority could reduce or eliminate this requirement. Additional management practices are sometimes required by states to minimize runoff and ponding

of biosolids. These management practices would be specific to a particular situation and land appliers should familiarize themselves with state and regional requirements that relate to this issue.

Agronomic Rate: Biosolids must be applied at a rate equal to or less than the agronomic rate unless otherwise specified by the permitting authority. The agronomic rate is the dry weight application designed to provide the amount of nitrogen needed by the crop or vegetation while minimizing the amount of nitrogen that passes below the root zone to groundwater. For reclamation sites, the permitting authority (USEPA region or a state that has been delegated authority to administer the Part 503 Rule) may specifically authorize application of biosolids above the agronomic rate. Such an application usually occurs only once to improve the soil physical properties and supply sufficient nitrogen, organic matter and other nutrients to establish vegetation. Land appliers should obtain approval for such an application rate from the permitting authority.

For non-PC (Table 3 -- Non-Pollutant Concentration) biosolids sold or given away in a bag or other container, the only management practice required is the provision of a label or information sheet indicating the appropriate annual application rate specified in Table 2.4 of 503.13. The applier is then required to read and correctly follow these instructions. *Monitoring, Record Keeping and Reporting* The record keeping and reporting requirements of the Part 503 Rule are mandated throughout the United States; other individual permitting requirements may vary from state to state. Federal and state regulations and guidance documents should be consulted to develop a system to comply fully with all applicable requirements. For land application under the Part 503 Rule, the number and stringency of requirements depends upon the quality of the biosolids and circumstances under which they are being applied. Land appliers are those who apply biosolids as a soil conditioner and/or to fertilize crops or vegetation grown in the soil.

Under the Part 503 Rule, this term includes those applying large quantities of bulk biosolids to agricultural land as well as those applying smaller quantities which may be distributed in bags for use on a lawn or home garden. The definition of “land applier” is therefore very broad and not all land appliers are required to comply with the same provisions of the Part 503 Rule.

The preparer of biosolids must monitor their quality and supply the land applier with biosolids quality information, It is the responsibility of the land applier to obtain information from the preparer. The land applier also could conduct independent verification by additional testing on the pollutant concentrations in bulk biosolids. USEPA -- approved procedures contained in the Part 503 Rule must be used to test biosolids. The following references provide detailed guidance on the collection and analysis of biosolids samples:

- *POTW Sewage Sludge Sampling and Analysis Guidance Document* (USEPA 1989, and updates)
- Standard Methods for the Examination of Water and Wastewater, 20th Edition (APHA, 1998)
- *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, USEPA

Publication SW-846 (USEPA, 1986)

- *Environmental Regulations and Technology: Control of Pathogens and Vector Attraction in Sewage Sludge*. USEPA Pub. No. 625/R-92/013, Center for Environmental Research Information, Cincinnati, OH 45268. Rev. 1999.

The preparer may, by contractual arrangement, designate the land applier as the party responsible for sampling and/or testing the preparer's biosolids. In that case, the land applier also will need to keep records documenting those results and provide them to the preparer.

All preparers must keep records on biosolids quality regardless of what that quality is. Land appliers are only required to keep records biosolids quality if they change its original quality and, therefore, meet USEPA's definition of a preparer.
The requirements for biosolids quality are usually the responsibility of the person who prepares the biosolids, not the land applier. However, such quality plays a significant role in determining land application requirements and is relevant to the discussion of the compliance requirements for land appliers. Biosolids meeting the most stringent limits for pollutant concentrations, pathogen and vector attraction reduction are considered comparable to commercial fertilizer products and therefore are not subject to any additional requirements for compliance under the Part 503 Rule. Additional requirements are imposed on biosolids that do not meet one or more of the preceding requirements to ensure the same level of protection for human health and the environment is met in all cases.

If the applier changes the quality of the biosolids prior to application, such a change may also influence the number of requirements with which they must comply. Monitoring data which establishes and certifies biosolids quality is provided by the person who prepares the biosolids (often the generator), who is then responsible for meeting the preparation requirements before the biosolids can be land applied. If the land applier then alters the quality in the biosolids received from the preparer, the land applier becomes a preparer and assumes responsibility for monitoring and certifying biosolids quality with respect to pollutant limits, level of pathogen reduction and level of vector attraction reduction.

If the biosolids have met the three criteria referred to above and are then mixed with other substances not subject to the Part 503 Rule (e.g., fertilizer materials, bulking agents), the person performing that mixing operation is not required to reevaluate the product's final quality. In other instances, however, where biosolids quality is considered to have been changed (for example when bulk biosolids from several sources that do not meet the above three criteria are mixed prior to land application or when a source that does meet these three requirements is mixed with a source that does not), the resulting quality of the mixtures must be determined in order to correctly land apply.

The frequency of monitoring, record keeping and reporting requirements in the Part 503 Rule depends on the quantity of biosolids used or disposed by a treatment facility. The pollutants for which a treatment facility must monitor their biosolids depend on the use or

disposal method employed; record keeping and reporting requirements also are specific to each use or disposal method.

The frequency of monitoring required in the land application subsection is presented in Table 2.5. Record keeping requirements for the various scenarios also are contained in this subsection. The level of record keeping varies depending upon the characteristics of the material and the degree of pathogen reduction.

Table 2.5: Monitoring Frequency Required

Amount of Biosolids Produced per 365 Day Period*		Frequency of Monitoring
Dry Metric tons	Dry English tons	
0 to 290	0 to 320	Once per year
290 to 1,500	320 to 1,654	Once per quarter (four times per year)
1,500 to 15,000	1,654 to 16, 540	Once per 60 days (six times per year)
greater than or equal to 15,000	greater than or equal to 16,540	Once per month (twelve times per year)

*Either the amount of bulk biosolids applied to the land or the amount of biosolids received by a person who prepares biosolids that are sold or given away in a bag or other container for application to the land.

More detailed information regarding monitoring requirements may be found in reference (2) of this section.

Amendments to the Part 503 Rule adopted in 1999 allow the permitting authority to reduce the monitoring frequency (to no less than annually) after at least two years of monitoring biosolids quality. The certification requirements for preparers and land appliers contained in the Part 503 Rule also were modified to require the record keeper to certify that the information verifying compliance has been collected properly.

Septage Management
Finally, the land application subpart addresses the application of domestic septage (8). Septage can be managed separately or as biosolids. If handled as septage, the material must be raised to a pH of 12 or greater for 30 minutes. It must be land applied at a hydraulic loading rate determined by crop nitrogen requirements and a conversion factor provided within the regulation. If the material is to be managed in another manner, it will be regulated as biosolids.

2.2.2 Surface Disposal

The surface disposal subpart applies to the placement of biosolids in a disposal unit.

These disposal units include biosolids -- only monofills, dedicated disposal surface application sites, on-site disposal at a biosolids treatment facility and impoundments or lagoons. This subpart does not regulate the storage of biosolids, including solids that accumulate in a biosolids treatment lagoon. Such a lagoon is considered a storage facility, not a disposal unit. The regulation allows biosolids to be stored for up to two years prior to having to meet the requirements of the surface disposal subpart.

The subpart for unlined disposal sites requires the following pollutant concentrations:

- Arsenic -- 73 mg/kg
- Chromium -- 600 mg/kg
- Nickel -- 420 mg/kg

These concentration limits vary depending upon the distance of the disposal site from the property line. In addition, the regulation requires that the site be monitored to ensure that the groundwater is not contaminated by nitrate breakthrough. Material placed in the surface disposal area must meet either Class A or Class B pathogen reduction requirements or be covered daily. One of the VAR requirements 1 through 11 also is required for surface disposal.

2.2.3 Incineration

Prior to promulgation of the Part 503 Rule, biosolids incinerators were subject to federal emission standards for particulate matter and mercury. The particulate standards differed based on whether the facilities were constructed or modified before or after June 11, 1973. Biosolids incinerator owners/operators were allowed one or two years from promulgation of the Part 503 Rule (February 1993) to achieve compliance.

The Part 503 Rule establishes current (October 2000) requirements for biosolids incinerators. It includes emission limits, operational standards, management practices, and monitoring and record keeping requirements for biosolids incinerators. The Part 503 Rule pertains to the feed system, the incinerator itself and the exhaust gases from the stack (USEPA 1992). It does not apply to hazardous waste incinerators or to incinerators that co-fire biosolids with other wastes. The USEPA does not consider up to 30 percent municipal solid waste “auxiliary fuel” as “other waste”.

The Part 503 Rule required site-specific emission limits for five metals: arsenic, cadmium, chromium, lead and nickel, facilities that incinerated biosolids had to conduct performance tests to determine the percentage of the five regulated metals contained in their feed solids that are emitted to the atmosphere. Using these data, along with air dispersion modeling and formulas established by USEPA, site-specific metal limits for each POTW that incinerates biosolids were developed.

The monitoring frequency for facilities that incinerate biosolids is based on the quantity processed annually.

Additional emission limits for incinerators under the Part 503 Rule are:

1. A beryllium limit of 10 grams per 24 hours (NESHAPS); and

2. A Total Hydrocarbon (THC) limit of 100 PPM, as propane, corrected to 7% oxygen and 0 % moisture, on the basis of a monthly average. (The THC measurement serves as a surrogate for potentially toxic organic compounds.)

Since 1994, USEPA has allowed owners/operators of biosolids incinerators the option of complying either with this THC limit or a more stringent carbon monoxide (CO) limit of 100 PPM with the same corrections applied.

To comply with the Part 503 Rule, owners/operators identified a need to find ways to reduce biosolids incinerator emissions. Testing established the following:

1. Lowering temperatures within an incinerator's burning zone reduced emissions of the regulated metals
2. Increasing incinerator exhaust gas temperatures decreased THC and particulate emissions
3. Installing internal or external afterburners also can decrease THC and particulate emissions
4. Lowering the levels of regulated metals in the feed solids will reduce emissions (this can be accomplished through the POTW's pretreatment program).

Current (2000) emissions from U.S. biosolids incinerators are typically well below federal regulatory limits (Dominak, Robert P. 2000).

2.3 Risk Assessment

In preparing the Part 503 Rule, USEPA used “reasonable worst-case assumptions.” Each of these has a margin of safety associated with it, depending on the accuracy of data and information supporting it. For example, if EPA had insufficient data from biosolids/field studies on metals uptake in crops (the most accurate data), they used data from biosolids/pot studies or salt/pot studies. Data from salt/pot studies are not representative of conditions in the field, and such studies drastically overestimated actual field results.

The risk assessment establishes concentrations and loading rates for 10 elements found within biosolids. The risk assessment was not restricted to these ten elements, however. In March 1984, USEPA developed a list of 200 pollutants to be considered. The pollutants were drawn from the Clean Water Act Toxic Pollutant List. By May 1984, the USEPA, working with a group of scientists, reduced the number to 50 pollutants for further study. In 1985, USEPA's Science Advisory Board approved the general risk assessment methodology, including the algorithms, exposure routes and functions. Between 1985 and 1992, additional review and data gathering resulted in the final list of organic and inorganic materials to be regulated by the Part 503 Rule.

For land application, 14 organic and 10 inorganic materials were evaluated. Following the risk assessment, the resulting concentrations for the organics evaluated were compared to those found in biosolids. The concentrations in biosolids were generally orders of magnitude below those determined allowable through the risk assessment. For this reason, organics were not included in the final Part 503 Rule. For surface disposal, 10 organics and six inorganics were evaluated, and for incineration, 78 organics are regulated under the total hydrocarbon, along with seven

inorganics.

In the final Part 503 Rule regulations (USEPA 1993; USEPA 1995), USEPA evaluated the risk to highly exposed individuals and populations from pollutants found in biosolids using different exposure assessment pathways. In evaluating the standards for the final Part 503 Rule, the Agency established criteria based not only on cancer risk but also on a series of other health and environmental effects. These included the overall incidence of other serious health effects within the exposed population as a whole (including average exposed and highly exposed individuals and within special subpopulations, such as children). USEPA also evaluated effects on plants and animals, estimated uncertainties and margins of safety, considered the scientific evidence for human health and environmental effects, and other quantified or unquantified health and environmental effects associated with use and disposal of biosolids before selecting the final standards.

The Part 503 Rule was unique not only with respect to the complexity of the task at hand, but the extensive review and input that was received by the Agency on the technical standards. Experts from both inside and outside USEPA reviewed the scientific literature and provided additional data and scientific and technical input which enabled the Agency to expand and refine the standards during the time following the comment period and before promulgation of the final standard. Reviewers included the USEPA Science Advisory Board, the Cooperative State Research Service, the Regional Research Technical Committee (the W-170 Committee), representatives of academia and other scientific/technical entities with specific experience in the areas covered by the Part 503 Rule (5,6,7,10).

Exposure Pathways

USEPA evaluated 14 pathways of potential exposure to pollutants in biosolids for the final Part 503 Rule. The Part 503 Rule distinguishes between biosolids applied to the land for a beneficial purpose and biosolids disposed of on the land. Table 2.6 summaries the pathways.

USEPA evaluated potential exposure when biosolids are used as a fertilizer or soil conditioner in one of two ways: agricultural and non-agricultural land application. Agricultural land application includes use to produce food or feed crops commercially by agricultural producers on pasture and rangeland and also by a home gardener. Non-agricultural land includes forest, reclamation and public contact sites. The descriptive term “surface disposal” in the final Part 503 Rule includes biosolids disposed on land either in piles or in biosolids-only landfills, which also are referred to as monofills. For surface disposal, USEPA evaluated two pathways of exposure. Incineration was evaluated by a single pathway of exposure -- inhalation.

Table 2.6 Pathways

Final exposure Assessment Pathways Evaluated

Land Application (Beneficial Use)
- Biosolids-soil-plant-human (Pathway 1)
- Biosolids-soil-plant-home gardener (Pathway 2)
- Biosolids-soil-child (Pathway 3)*
- Biosolids-soil-plant-animal-human (Pathway 4)
- Biosolids-soil-animal-human (Pathway 5)
- Biosolids-soil-plant-animal toxicity (Pathway 6)
- Biosolids-soil-animal toxicity (Pathway 7)
- Biosolids-soil-plant toxicity (Pathway 8)**
- Biosolids-soil-soil biota toxicity (Pathway 9)
- Biosolids-soil-soil biota-predator of soil biota toxicity (Pathway 10)
- Biosolids-soil-airborne dust-human (Pathway 11)
- Biosolids-soil-surface water-contaminated water-fish toxicity-human toxicity (Pathway 12)
- Biosolids-soil-air-human (Pathway 13)
- Biosolids-soil-groundwater-human (Pathway 14)

Surface Disposal
- Biosolids-soil-air-human (Pathway 13)
- Biosolids-soil-groundwater-human (Pathway 14)

Incineration
- Biosolids-incineration particulate-air-human (Pathway 13)

Footnotes:

*Most limiting pathway (regulatory limit) for arsenic, cadmium, lead, mercury and selenium.

** Most limiting pathway (regulatory limit) for copper, nickel and zinc.

All of the land application pathways, with the exception of Pathways 3, 5 and 7, anticipate incorporation of biosolids into the top 15 centimeters (6 inches) of soil. Pathways 3, 5 and 7 anticipate biosolids will remain on top of the soil. Because of this, the result of the risk assessment for all pathways other than 3, 5 and 7 are in the form of a loading rate in kilograms per hectare. The results for pathways 3, 5 and 7 are in the form of a concentration in milligrams per kilogram, dry weight.

A review of the pathways shows how they address the impact of biosolids on edible crops, the impact of direct ingestion by humans or grazing animals, phytotoxicity to plant life and the impact on aquatic life, soil biota and soil biota predators. They also address the safety of farmers and the public by evaluating airborne dust along with the impacts on surface and groundwater quality.

A more expanded description of the risk assessment pathways developed for the Part 503 Rule is contained in Appendix A; for more information about the development of the risk assessment in

easy-to-read format, reference 3 of this chapter is particularly recommended.

2.4 Biosolids Quality Information

Data on biosolids quality from reports provided to regional USEPA offices may be found at www.epa.gov/region08/water/wastewater/biohome/biohome.html; the Biosolids Data Management System.

2.5 Proposed Dioxin Standards

USEPA proposed revisions to the Part 503 Rule in December 1999, primarily to establish numerical limits for dioxins (chlorinated dibenzo-p-dioxins, or CDDs; chlorinated dibenzofurans or CDFs; and dioxin-like coplanar polychlorinated biphenyls, or PCBs) in biosolids that are land -- applied. The proposed standards were based on a risk assessment performed by USEPA with respect to land application, surface disposal and incineration. The risk to a highly exposed individual was found to be less than one in 1,000,000 for the latter two practices and the Agency decided not to impose numerical standards on either of them.

For land application, USEPA considered 15 exposure pathways (one more than the original Part 503 Rule's pathways), and performed a risk assessment on eight. The assessment yielded two pathways of concern: a rural family member consuming livestock that has incidentally consumed biosolids, and the nursing infant of a highly exposed mother. The limits proposed are established to protect against exposure via these two pathways. Details of the assessments and the proposed standards are contained in the December 23, 1999 Federal Register and comments were received until February 22, 2000. The revisions expected to be finalized in 2001.

The proposed standards vary with the levels of dioxins contained in the biosolids. Biosolids exhibiting a level of dioxins less than 30 PPT (parts per trillion or 0.00003 mg /kg) toxic equivalency units (teqs) -- calculated using relative toxicity factor currently in use in the U.S. would be required to be monitored every 5 years following an initial two-year cycle. Biosolids containing between 30 and 300 PPT (0.0003 mg/kg) TEQs would have to be monitored annually. Biosolids with TEQers over 300 PPT could not be land -- applied under the proposed revision to the Part 503 Rule.

USEPA also proposed monitoring, record keeping and reporting requirements for dioxins in land -- applied biosolids. Small POTWs (<1 mgd), preparers managing less than 290 dry metric tons (319 English tons) per year, and septage would be excluded from the proposed requirements. The standards discussed above are subject to change based on comments received and the outcome of USEPA's broad dioxin reassessment effort currently underway. Biosolids managers should have their material analyzed for dioxins and have the TEQ calculated. They also should keep abreast of the development of the USEPA standards for dioxin limits under the Part 503 Rule, as well as the results of the dioxin reassessment. It is very likely that changes will be made to the currently proposed biosolids regulations with respect to dioxins in biosolids.

2.6: State Regulations: Who's In Charge?

The self-implementation element of the Part 503 Rule establishes a regulatory baseline. States' standards, at a minimum, must follow the Part 503 Rule. They can, however, be more restrictive than the Part 503 Rule, e.g., have a lower pollutant limit for a particular metal. The majority of states follow the Part 503 Rule pollutant limits and pathogen and VAR requirements, but many have more detailed requirements regarding management practices.

When USEPA promulgated the Part 503 Rule, it was counting heavily on states to become delegated as the permitting authority. The permitting and enforcement of the technical standards in the Part 503 Rule can be accomplished by a state through a NPDES (National Pollutant Discharge Elimination System) permit and Part 123 state program requirements, or 40 CFR Part 501 State Sludge Management Program regulations. In the absence of delegation of the biosolids program to the states by USEPA, a dual system is common, with NPDES permits containing biosolids requirements, and state programs continuing to issue biosolids permits. Under such a dual approach, permittees have the obligation to monitor and report to both the USEPA Regional office and the state agency. Delegation of the federal program has proceeded slowly; as of this writing, only a handful of states have been delegated to administer some or all of the Part 503 Rule requirements. If the USEPA region is the permitting authority in a non-delegated state, it cannot impose more restrictive requirements than the Part 503 Rule (except on a case-by-case basis, which rarely occurs).

Once a state is delegated, it can run the program through its water quality, solid waste, natural resources or other program, depending on the state's law.

Most, if not all, states require specific management practices that are not contained in the Part 503 Rule, based on each state's regulatory history, and public demand for operational practices. Several states use the term "exceptional quality" biosolids. This term was coined to describe biosolids that do not exceed the pollutant concentration (Table 3) limits, meet Class A pathogen requirements by any of the alternative methods listed and achieve one of the first eight vector attraction reduction options listed in the Part 503 Rule. Biosolids managers should determine the current status of permitting in the state(s) where they intend to operate, and establish internal systems to obtain and conform to specific state and federal requirements.

Some states have developed regulations that allow the issuance of a General Permit or its equivalent for the state as a whole or for each facility. Each land application project must conform to the conditions of the General Permit.

Biosolids managers should examine both the Part 503 Rule and individual state technical requirements and include all such requirements in their internal management system to ensure complete regulatory compliance. Appendix B of this document provides federal and state contact information, including electronic mail addresses, for agencies responsible for regulating biosolids management. The states' web sites may contain their biosolids regulations; in some cases, permit applications also are available electronically.

2.7 Local Government Regulations

In terms of permitting, the majority of biosolids management programs are permitted through state agencies. However, local governments also may impose their own requirements. For example, a city or county health agency can put limitations on the quantity and types of materials processed at a site; a zoning board may restrict certain land use practices; an air quality district may set a limit on odor or dust emissions; and an overall governing body may restrict truck traffic, noise and other public nuisance factors. Biosolids managers will need to become familiar with any local ordinances or regulatory requirements that will apply to or affect their facility or biosolids management program.

More recently, a growing number of jurisdictions have adopted local ordinances or passed bans that primarily affect land application programs for biosolids. Several states report that their state laws override any local bans or ordinances.

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Suggested Reading:

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