7.1 INTRODUCTION

A wide range of solids processing alternatives were considered in the *2002 Wastewater Facilities Plan* and the *2003 Wastewater Facilities Plan Amendment.* A detailed discussion of the solids processing alternatives and biosolids management is presented in Chapter 7 of the *2002 Wastewater Facilities Plan*.

This chapter reviews the biosolids management concepts considered in the original facilities planning effort. Some revisions are needed as a result of the increased solids that will be generated to meet the requirements of the Washington Department of Ecology's Dissolved Oxygen Total Maximum Daily Load (TMDL) and the June 30, 2006 *Foundational Concepts for the Spokane River TMDL Managed Implementation Plan.* The discussion is organized to first update solids quantities, and then provide an overview of current biosolids management issues. The conclusion of the chapter summarizes the recommended solids process and biosolids management plan.

7.2 PROJECTED SLUDGE QUANTITY AND CHARACTERISTICS

During wastewater treatment, several streams of residual materials may be produced, depending on the specific liquid treatment technologies selected for use:

- Grit and screenings removed during pretreatment
- Organic sludge produced by initial settling of the wastewater (primary sludge)
- Biological waste sludge resulting from biological treatment processes to remove nutrients and oxygen-consuming organics (secondary sludge)
- Chemical sludge produced by the chemical precipitation of phosphorus

Typically, the grit and screenings are dewatered to an acceptable moisture content and sent to a landfill or incinerator for disposal. The other sludge streams are normally blended and passed through treatment processes to prepare the material for its designated end use—either beneficial reuse or disposal. This processed material is termed "biosolids."

In developing the biosolids management alternatives, projections of sludge quantities and characteristics were made. These projections were based on: (1) the projected raw wastewater characteristics presented in Chapter 2 (Basis of Planning Summary); and (2) a representative liquid treatment process with advanced levels of phosphorus removal shown in Figure 7-1 (described in Chapter 6 – Treatment Systems).

Projected primary, secondary (biological) and chemical sludge production are shown in Table 7-1 (Solids Process Loadings) associated with average design flow rates of 8 mgd and 12 mgd.

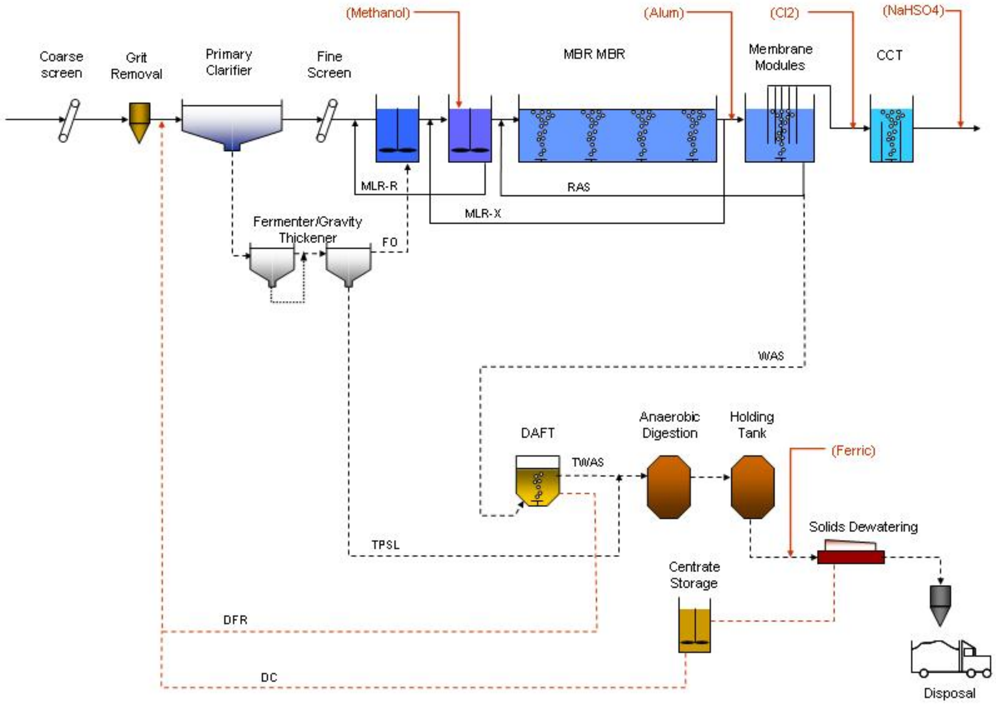

Figure 7-1. Representative Liquid Treatment Process Used in Developing Sludge Quantities

In developing the sludge generation projections, the following assumptions were made:

- Year-round primary sludge production is based on: (1) an average suspended solids removal efficiency of 65 percent in primary treatment; and (2) a volatile fraction of 75 percent.
- Year-round secondary sludge production is based on: (1) an average BOD_5[1] removal of 30 percent in primary treatment; and (2) a volatile solids fraction of 75 percent.
- Secondary sludge production during the phosphorus removal permit season (anticipated to be April through October) is based on: (1) operating the activated sludge system to provide nitrification; (2) partial denitrification; and (3) biological phosphorus removal.
- Secondary sludge production during the (anticipated to be November through March) permit season without phosphorus removal is based on: (1) operating the activated sludge system to provide nitrification; and (2) carbonaceous BOD removal only. (Nitrification/denitrification may be operated year-round for alkalinity and pH control.)

[1] BOD_5 = 5-day biochemical oxygen demand.

- Chemical sludge production occurs only during the phosphorus removal permit season and is based on an alum dose of 20 mg/L and removal of an additional 10 mg/L of suspended solids across the tertiary treatment process.

Table 7-1. Solids Process Loadings from Preferred Liquid Stream Alternative (Alternative 2)

Solids Stream	8 mgd	12 mgd
Primary Sludge		
Total Solids, 1,000 lb/d	10.3	15.45
Solids Concentration, %	0.5	0.5
Flow rate, MGD	0.27	0.405
Secondary Sludge		
Total Solids, 1,000 lb/d	8.1	12.15
Solids Concentration, %	1.2	1.2
Flow rate, gpd	78,150	117,225
Digested Sludge		
Total Solids, 1,000 lb/d[1]	10.8	16.2
Solids Concentration, %	2.9	2.9
Flow rate, gpd	42,350	63,525
Dewatered Sludge		
Total Solids, 1,000 lb/d	10.3	15.45
Solids Concentration, %	25	25
Flow rate, gpd	4,940	7,410

[1] Includes chemical sludge from ferric addition upstream of dewatering

[2] Solids for 8 mgd are based upon maximum monthly flow of 8.5 mgd. Solids for 12 mgd are scaled by 1.5 times the 8.5 mgd maximum monthly flow.

7.3 SUMMARY OF REGULATIONS

Chapter 7 of the *2002 Wastewater Facilities Plan* presented a summary of state and federal regulations pertaining to biosolids management. As noted in Chapter 2, the Washington State Department of Ecology (Ecology) recently updated the state biosolids rule. This update became effective June 24, 2007. The updated biosolids rule changes septage requirements and fee structure, as well as requirements for Class A biosolids, eliminating some options that require only sampling and testing (EPA Class A Alternatives 3 and 4). The rule now includes a requirement for “significant removal of manufactured inerts," from biosolids before land application. The rule specifies that solids must be screened “through a bar screen with a maximum aperture of 3/8-inch,” or inerts must be removed using another method approved by Ecology.

7.4 ADVANCES IN SOLIDS PROCESSING EQUIPMENT AND TECHNOLOGY

The biosolids management industry has been changing rapidly in recent years and technology has been dramatically improving to respond to these changes. Improvements in dewatering process operations and maintenance have been made with new technology and equipment now available in the marketplace. Centrifuge manufacturers have made improvements such as variable pond depths to provide better operational control and increased solids dryness. Preliminary experience with some of the new dewatering technologies, particularly the screw press, shows that they provide advantages over traditional dewatering equipment in operations and maintenance.

The confluence of geopolitical pressures on petroleum prices and public perception of biosolids land application is increasing interest in fuel production from biosolids. A first of its kind proprietary biosolids-to-fuel facility will be constructed soon in southern California. This facility will accept biosolids from several municipalities in the region. Also, research and demonstration projects are underway to investigate the use of biosolids to fertilize canola and other oil-producing crops.

7.5 RECOMMENDED BIOSOLIDS ALTERNATIVE

A wide range of biosolids management alternatives was identified in Chapter 7 of the *2002 Wastewater Facilities Plan* as summarized in Chapter 3 of this *2006 Wastewater Facilities Plan Amendment*. The recommended biosolids management program is presented in Chapter 9 of the *2002 Wastewater Facilities Plan* and recommends that all biosolids produced at the Spokane County Regional Water Reclamation Facility (SCRWRF) will be stabilized through anaerobic digestion and dewatered to produce a Class B biosolids. The material will be applied to agricultural land or to reclaimed mining sites. This will beneficially recycle nutrients and organic material to the land. At the SCRWRF, a biosolids management program must be developed and implemented.

The County has elected to implement the Spokane County Regional Water Reclamation Facility (SCRWRF) as a design-build-operate (DBO) contract. In parallel, Spokane County has initiated preparation of a Biosolids Management Plan that will be submitted to Ecology in 2008. Once a preferred biosolids management plan is identified, the County will apply for coverage under the Statewide General Permit for Biosolids Management.

7.5.1 Alternative B-1: Class B Biosolids and Land Application

In the preferred alternative, biosolids management at the Spokane County Regional Water Reclamation Facility (SCRWRF) would be similar to the practice at the City of Spokane’s RPWRF. In this approach, the various sludge streams would be thickened, anaerobically digested using mesophilic reactors, dewatered and applied to agricultural land or used for reclamation of historic mining sites. Sludge storage would be provided in liquid form at the treatment plant and in dewatered form at the application site. Figure 7-1 illustrates the Alternative B-1 Class B Treatment and Land Application solids process schematic diagram.

7.5.1.1 Applicability to Spokane County

Land application of Class B biosolids is the most common biosolids management practice in Washington State and in the Spokane region. Based on discussions with City of Spokane personnel, there appears to be ample demand for this product within a reasonable proximity of the Spokane County service area. Although detailed demand surveys have not been conducted, it appears that agricultural application sites would most likely be located within a

30-mile haul distance (one-way) from a new treatment plant site. To gain sufficient acreage for a long-term biosolids management program, it will probably be necessary to also locate some land application sites in neighboring counties.

For mining area reclamation, dewatered biosolids most likely would be applied to hillsides at the Kellogg mine site for slope revegetation. This facility is located in Idaho, about 50 miles (one way) east of Spokane. The State of Idaho Department of Environmental Quality (IDEQ) and the Environmental Protection Agency (EPA) currently manage the Kellogg mine site. Based on discussions with IDEQ personnel, individual contracts would be needed to take biosolids for each application area where this material is used for revegetation. Although the amount of land needing revegetation has not been delineated by IDEQ, it appears that as many as 3,000 acres may be available. Mine site reclamation may not be able to use all of the biosolids generated by an 8 mgd plant; consequently, this program may serve as a supplement to an agricultural reuse program.

Most biosolids application programs in Washington State have used dewatered biosolids. The primary reasons for this are reduced hauling costs, ability to store the biosolids at the application site during the winter, and ease of application. Facility requirements are based on the process schematic diagram shown in Figure 7-1. These facilities are presented as representative unit processes for production of Class B biosolids. If this concept were eventually selected for implementation, a more detailed evaluation and selection process would be conducted for the individual unit processes. The number and size of the unit process elements, listed in Figure 7-1 (Alternative B-1 Facility Requirements) are based on the sludge generation rates associated with an 8 mgd plant flow.

The following comments outline key assumptions associated with the facility requirements.

- Grit and screenings would be disposed of off-site at the landfill and Waste-to-Energy Facility, respectively.
- A fermenter/gravity thickener would thicken primary sludge (shown as in Figure 7-1). This facility could run unattended during weekend and nighttime periods and could be used to generate organic substrate to augment the performance of biological phosphorus removal in the liquid treatment system.
- Secondary sludge and seasonally-generated chemical sludge would be thickened in a dissolved air flotation thickener, which could run unattended during weekend and nighttime periods.
- The two thickened sludge streams would be combined for digestion in mesophilic digesters (operated at 95^{o}F). Digester sizing is based on a 20-day detention time at maximum-month sludge generation rates.
- Digested sludge storage would be provided in a mixed holding tank equipped with biogas safety equipment. This tank would serve as a “wide spot” between digestion and dewatering, allowing shut down of the dewatering process over the weekend or for prolonged maintenance measures. The holding tank would also be used when icy roads or other conditions prevented haul of dewatered sludge to the application sites. For initial evaluation, a detention time of 7 days was used.

Table 7-2. Alternative B-1 Facility Requirements

Description		Design Criteria[1]
Maximum Month Sludge Loading	Primary sludge, lbs/day[2]	10,300
	Biological sludge, lbs/day	7,000
	Chemical sludge, lbs/day	1,100
Gravity Thickening	Number	1
	Diameter, each, feet	25
	Solids loading, lbs/day/sq ft	24
	Overflow rate, gal/day/sq ft	700
	Solids concentration, percent	6
	Thickened sludge flow, gpd	20,600
Fermentor	Number	1
	Diameter, each, feet	40
	Solids concentration, percent	4
	Solids residence time, days	3
	Blanket depth, ft	8.8
	Thickened sludge flow, gpd	30,900
Dissolved Air Flotation Thickening	Number	2
	Diameter, each, feet	20
	Solids loading, lbs/day/sq ft	26
	Solids concentration, percent	4
	Thickened sludge flow, gpd	24,300
Anaerobic Digesters	Number	2
	Volume, each, MG	0.75
	Solids residence time, days	15
	Percent volatile reduction	40
	Digested sludge, lbs/day	11,500
Liquid Sludge Storage	Number	1
	Volume, each, MG	0.75
	Detention time, days	15
Centrifuges	Number of units	2
	Capacity, each, gpm	80
	Capacity, each, lbs/hour[3]	2,000
Dewatered Sludge Storage (on-site)	Number	1
	Cake Solids, lbs/day	10,300
	Volume, each, cu yd	45
	Detention time, days	1
Centrate Storage	Number	2
	Volume, each, MG	0.11
	Detention time, days	1

[1] Design criteria based on maximum month loading conditions.

[2] Chemical sludge is from secondary process only. Primary sludge may increase if chemical precipitation is used in the primary system on an emergency basis.

[3] 50 lbs/hr is from the ferric feed upstream of dewatering for struvite control.

Dewatering would be provided by centrifuge, operating 8 hours per day, 5 days per week. It is estimated that a cake solids concentration of 25 percent would be produced.

- Centrate from the dewatering operation would be collected in a storage tank for equalization. The centrate would then be metered back to the liquid treatment process to equalize the ammonia loading to the process. This is needed to improve permit compliance and prevent process upset.

- One day of dewatered sludge storage would be provided on-site in the form of "live-bottom" hoppers used to load the haul trucks. Additional biosolids storage is provided with the anaerobic digesters upstream of the dewatering process.
- All solids handling facilities would be covered, with exhaust air routed to odor control systems.

Biogas produced in the digestion process would be recovered for use in heating the digesters. Excess gas could be used for other purposes such as power generation or building heat.

Facility Requirements for Hauling Biosolids. It is assumed that sludge haul to the application sites would be provided by 12 cubic yard trucks. Based on the biosolids production associated with an 8 mgd plant flow, the estimated number of trips per week is shown in Table 7-3.

Table 7-3. Biosolids Haul Truck Trips for 8 mgd Plant (assuming 12 cubic yard trucks)

Season	Trips per Week at Average Loading	Trips per Week at Maximum Month Loading
Summer	15	18
Winter	14	17

Agriculture Reuse Requirements. For agricultural reuse, dewatered biosolids would be land applied through cooperative arrangements with local farmers. Typically, a multi-year contract is negotiated between the utility and the farmer for this purpose. The land application program must be developed subject to approval by the Department of Ecology (DOE). This program would include locating, investigating, and permitting sites to receive Class B biosolids, as well as developing an operational plan and a monitoring/reporting program. The application sites would need to meet regulatory requirements governing crop growth, harvesting, and public access.

Biosolids application rates are governed by nutrient and trace element loading rates. Typically, nitrogen loading is the controlling factor. Based on the City of Spokane's experience, an average annual loading rate of 3 dry tons/acre has been assumed. For an 8 mgd plant, this equates to approximately 900 acres. As a general rule-of-thumb, an additional 50 percent of the total required acreage as useable land is recommended to be under contract in a given year. Consequently, a total of 1,350 useable acres under contract is recommended.

In addition to hauling the dewatered biosolids to the application site, it is assumed that the County would be responsible for loading the material into spreading equipment and applying the biosolids to the land. The local farmer would be responsible for disking or plowing in the biosolids following application. Consequently, County-supplied on-site equipment would include a front-end loader and a spreader truck.

Since dewatered biosolids cannot be land-applied year-round, storage for dewatered solids during the winter months must be provided. Again, it is assumed that this practice would be modeled after the City of Spokane's RPWRF operation. That is, dewatered biosolids would be stored in bermed areas at the land application sites. This on-site stockpiling occurs after the ground has frozen. The biosolids are then piled in the bermed area. Since the biosolids act as an insulator, the ground remains frozen until the solids can be applied to the land in the spring.

Mining Site Reuse Requirements. For mine site reclamation, the County would likely be responsible for hauling biosolids to the mine site. IDEQ would be responsible for loading and spreading the biosolids on the hillsides. Due to the steepness of the application sites, application would only take place during the spring and summer months when revegetation would occur quickly. However, biosolids may be stored at the mine site during the winter months if sites have been identified for revegetation during the following spring or summer months.

Estimated Biosolids Management Operations Costs. Costs estimates for annual truck hauling of biosolids and land application for an 8 mgd treatment plant are summarized in Table 7-4.

Table 7-4. Estimated Annual Costs for Biosolids Hauling and Land Application[1]

Biosolids Management Activity	Estimated Annual Cost
Biosolids Truck Hauling[2]	$110,000
Biosolids Land Application[3]	$180,000
Total	$290,000

[1] Based on an average plant flow of 8 mgd

[2] Truck hauling costs 10 to 15 $/wet ton for nearby sites (<50 miles) and 25 to 35 $/wet ton for distant sites (>50 miles)

[3] Estimated agricultural land application costs approximately 15 to 25 $/wet ton.