CITY OF PHILOMATH
Wastewater System Facilities Plan,
Philomath, Oregon

Section 3

Regulatory Requirements & Basis of Planning

SECTION 3
REGULATORY REQUIREMENTS & BASIS OF PLANNING

3.1. Regulating Agencies

The U.S. Environmental Protection Agency (EPA) regulates disposal and/or reuse of sewage sludge and septage, as well as the discharge of wastewater effluent, whether to surface waters or subsurface disposal. The basis of the regulations imposed or overseen by the EPA is the Federal Water Pollution Control Act of 1972 (Public Law 92-500) often referred to as the Clean Water Act (CWA). The scope of the Clean Water Act has been revised and expanded over the subsequent years. The EPA promulgates regulations to implement the requirements of the CWA and subsequent legislation, and is required to coordinate its requirements with other federal agencies, such as the National Oceanic and Atmospheric Administration, the U.S. Army Corps of Engineers, and the U.S. Fish and Wildlife Service and with state agencies such as the Department of Environmental Quality (DEQ), the Department of Fisheries, and the Department of Health.

In Oregon, the lead agency in the regulation of sanitary sewerage systems is the Department of Environmental Quality (DEQ). Compliance with state water quality standards is a high priority to the DEQ in terms of how wastewater treatment facilities are regulated. For the sake of clarity, wastewater regulations are often broken into two major categories as follows:

- Wastewater Collection and Pumping
- Wastewater Treatment & Disposal

The following is a brief summary of the regulatory requirements and standards that form the basis of the facility planning effort. The requirements for the collection and pumping systems are summarized first, followed by a discussion of issues relating to the wastewater treatment.

In addition to the wastewater regulations outlined above, any work within the floodplain of the Marys River or wetlands is also under the jurisdiction of the Oregon Division of State Lands (DSL) and the U.S. Army Corps of Engineers.

3.2. Basis for Design of Wastewater Collection and Pumping Systems

3.2.1 Regulatory Requirements

For the sake of discussion and clarity, the requirements governing gravity wastewater collection and pumping systems are considered separately.

3.2.1.1 Collection Piping

The requirements and regulations covering the design and sizing of the collection piping portion of the wastewater conveyance system include both City design standards and DEQ guidelines. The City has Public Works Design Standards that apply to all public sewer improvements within existing and proposed public right-of-way and public utility easements, as well as to all improvements to be maintained by the City. This includes both gravity collection piping and pump stations.

The City design criteria dictates that the collection system piping must be designed to convey all flows projected at the ultimate development of land within the tributary area based on current land use designations. Although this may result in capacities greater than those needed during the 20-year planning period, sewage collection lines are, by their very nature, unsuited for incremental expansion without extensive capital outlays. Under DEQ guidelines, there is one allowable exception to this requirement as it relates to large diameter trunk sewers serving tributary areas that are not expected to develop for 30 or more years. However, none of the proposed new gravity sewers within the study area fall under this category.

The City Public Works Design Standards and associated details implement and clarify current DEQ standards as contained in OAR 340-52, Appendix A and DEQ design guidelines. **Table 3-1** summarizes the minimum allowable slope based on mainline pipe sizes.

TABLE 3-1
Minimum Mainline Pipe Slopes

Inside Pipe Diameter (inches)	% Slope (ft/100 ft)
8	0.40
10	0.28
12	0.22
15	0.15
18	0.12
21	0.10
24	0.09
27	0.08

3.2.1.2 Pump Stations and Force Mains

DEQ has extensive design guidelines for public pump stations. Under the authority granted by OAR 340-52, DEQ has established requirements and guidelines for the design of public sanitary sewer pump stations. These design guidelines include OAR 340-52 Appendix B and various design memoranda issued by DEQ. DEQ has established 20-years as being the proper planning period for pump stations.

In addition to DEQ standards, the City has established a policy that all new sewer pump stations and pump station upgrades are to be standardized to the extent possible. This standardization is based on submersible pump stations with auxiliary power, as well as remote communications and control system (telemetry) conforming to the City's current system. **Table 3-2** summarizes design criteria assumed for new pump stations or the upgrades of the existing pump stations.

TABLE 3-2 **Typical City Pump Station Minimum Design Criteria**	
Category	Minimum Design Criteria
Design Flows	• 20-year peak instantaneous flow (5 yr, 24 hour storm)
Pump Station Structure • Wetwell Type • Operational Storage • Valve Vault • Overflow	 • Precast concrete, hatches with integral hatches/fall protection • Based on pump starts or overflow storage as appropriate • Precast concrete vault adjacent to wetwell • Provide bypass in accordance with DEQ historical design requests.
Pumps • Pump Station Capacity • Type • Number • Motor Size • Min. Pump Cycle Time • Pump Retrieval	 • Convey design flow with largest single unit out of service • Submersible pumps • 2 minimum • HP as required, 480 volt, 3 phase power preferred • 6 minutes (10 starts per hour total) • Jib crane installed on or adjacent to wetwell
Force Mains • Minimum Size & Material • Min allowable F.M. Velocity • Max allowable F.M. Velocity	 • 4-inch, C-900 PVC, Class 52 Ductile Iron or fused HDPE • 3.5 fps • ±8 fps
Instrumentation & Control System • Location • Control Building • Pump Control • Pump Speed Control	 • Building adjacent to pump station • CMU block • Flygt Multitrode Probes, MPxPC Controller & MonitorPro as primary control, redundant pump control • Soft starters or VFDs if required by City or utility company
Auxiliary Power • Type • Location • Fuel Supply • Silencer	 • Permanent diesel generator w/ATS • Control building adjacent to P.S. • Sub-base tank, 24 hour minimum or as required by City • Critical grade, insulated
Telemetry • Type • Alarms	 • Match City system, programmed per City direction • Remote alarms as required by City
Hydrogen Sulfide Control *Continuously Ascending Force Main* • Type • Injection Rate • Control Strategy • Injection Point • Compressor Location • Air Piping *Ascending & Descending Force Main* • Type • Chemical Storage Volume • Chemical Feed Agent • Control Strategy • Injection Point • Storage Tank Location	 • Air Injection (compressor) • 2 scfm/inch diameter of force main • Continuous injection, air flow meter w/pressure gauge • Inside valve vault • Inside control building • Stainless steel • Chemical injection system • 4 months min. @ Avg Annual Flows • Bioxide by US Filter/Davis or equiv. • On/off control tied to pump motor starters • Inside valve vault • Inside control building

3.3. Basis for Design of Wastewater Treatment Systems

The following sections summarize current regulations used to evaluate and develop the treatment and disposal alternatives for wastewater from the City of Philomath. The manner in which the treatment and disposal of wastewater and its byproducts is regulated is by setting minimum standards that must be met by the end product (i.e., treated effluent and biosolids). The minimum treatment standards for effluent are outlined in either a National Pollutant Discharge Elimination System (NPDES) permit for surface water discharges, or a Water Pollutant Control Facility (WPCF) permit for systems that do not directly discharge to surface water, such as land application or subsurface disposal.

For the most part, DEQ does not specify the particular treatment processes that must be used by a municipality or service district, beyond the requirement that all discharges receive the "best conventional pollution control technology." Within the general limits imposed by this requirement, the permittee is required to determine the most cost effective treatment processes which will result in effluent and biosolids which comply with the "end of pipe" quality requirements.

The criteria discussed below include general requirements for a surface (i.e., Marys River) discharge, general reuse criteria for land application of effluent, general criteria for subsurface disposal of treated effluent, EPA criteria for reliability and redundancy, and a summary of the specific requirements under the City's existing NPDES permit.

3.3.1 Effluent Quality

3.3.1.1 Marys River Water Quality Standards (Surface Discharge)

The standards for river basins in the State of Oregon are established by the DEQ. These rules are reviewed every 3 years as a basis for setting new or modifying existing standards. Discharging treatment plant effluent to surface water (such as the Marys River) requires a National Pollutant Discharge Elimination System (NPDES) Permit from DEQ. The disposal of effluent to surface water is governed by OAR 340-41, *Water Quality Standards: Beneficial Uses, Policies, and Criteria for Oregon*.

For surface water discharge, the City of Philomath is required to comply with Sections 340, 344, and 345 of OAR 340-41, which pertain to the Willamette Basin. General water quality requirements for the receiving stream, the Marys River, are as follows.

3.3.1.2 Water Quality Limited Stream Standards

In addition to the general Willamette Basin Standards, the Marys River has been classified by DEQ as being "Water Quality Limited" (WQL) and is listed on the 303(d) list. Section 303(d) of the 1972 Clean Water Act requires each state to identify and list all streams, rivers, lakes and estuaries that do not meet current water quality standards. The State of Oregon is required to submit an updated list of these "water quality limited" streams to the EPA every two years.

The portion of the Marys River that includes the City of Philomath is from the mouth at the Willamette River (RM 0) upstream to river mile 13.8 west of the City. The existing treatment plant outfall is located at river mile 10.2. Parameters of concern include temperature during the low flow summer months, Fecal Coliform bacteria during the fall, winter and spring months, and Dissolved Oxygen (DO) from October 1 to May 31 (see **Appendix B**).

Since the recommended alternative does not include a summertime discharge, the temperature listing has no impact on Philomath's wastewater treatment facilities. Similarly, since all effluent is disinfected prior to discharge to the Marys River, the Fecal Coliform bacteria listing also has no impact on Philomath's treatment facilities. Conversely, all of the alternatives evaluated herein include discharge of treated wastewater containing some low levels of oxygen demanding wastes during the winter months. Therefore, the DO listing may impact the City's treatment and disposal facilities.

As part of the Clean Water Act, total maximum daily loads (TMDL's) must be established for water bodies included on the 303(d) list. TMDL's are mass load allocations that are set by the DEQ to ensure water quality standards are met. The Marys River is included in the Upper Willamette Sub Basin. The target date for setting TMDL's in the Upper Willamette Sub Basin is 2009. At that time, the DEQ will determine if the existing mass load allocations to the City's WWTP discharge should be reduced. If the City's mass load allocations are reduced, the reductions will go into effect when the City's NPDES permit is renewed in 2012 at the earliest. If the DEQ determines during the 2012 permit renewal that a reduction in mass load allocations is necessary, and treatment plant modifications are likely to be required, a Mutual Agreement Order (MAO) may be written as appropriate. The MAO would typically allow the City the duration of the NPDES permit cycle (from 2012 to 2017) to make the needed improvements to the facilities. Therefore, the 303(d) listing for DO in the Marys River, does not directly impact the current facilities planning effort.

Since the magnitude is unknown at this time, it would be premature to evaluate specific treatment options to address a decrease in the mass load allocation. Nonetheless, all of the treatment alternatives evaluated herein, are suitable for expansion or modification as required to meet a mass load allocation reduction. In short, it is the policy of the City to proceed with the facilities planning effort based on the current mass load allocations and address any reductions if and when they occur.

3.3.1.3 Temperature

As outlined in OAR 340-041-0028, the purpose of the temperature criteria is to protect designated temperature-sensitive, beneficial uses, including specific salmonid life cycle stages in waters of the State. The temperature standard is a function of the beneficial use designated for a particular receiving listed below. Several additional temperature criteria for Lahontan cutthroat and redband trout use, bull trout spawning and juvenile rearing use, Natural Lakes, Oceans and Bays, Cool Water Species, and specifically for the Borax Lake Chub are included in OAR 340-041-0028. However, discussions of these are not included below because they are not generally applicable to the City.

- For a stream designated as having salmon and steelhead spawning use, the seven-day-average maximum temperature may not exceed 13.0 degrees Celsius (55.4 degrees Fahrenheit) at the times indicated in the maps and tables set out in OAR 340-041-0101 to 340-041-0340.

- For a stream designated as having core cold water habitat use on the tables and maps set out in OAR 340-041-0101 to 340-041-0340, the seven-day-average maximum temperature may not exceed 16.0 degrees Celsius (60.8 degrees Fahrenheit).

- For a stream designated as having salmon and trout rearing and migration use, on the tables and maps set out in OAR 340-041-0101 to 340-041-0340, the seven-day-average maximum temperature may not exceed 18.0 degrees Celsius (64.4 degrees Fahrenheit).

- For a stream designated as having a migration corridor use on the tables and maps set out in OAR 340-041-0101 to 340-041-0340, the seven-day-average maximum temperature may not exceed 20.0 degrees Celsius (68.0 degrees Fahrenheit). In addition, these water bodies must have cold water refugia that is sufficiently distributed so as to allow salmon and steelhead migration without significant adverse effects from higher water temperatures elsewhere in the water body.

As set forth in OAR 340-0410-340, Figure 340A, the Marys River is designated as having salmon and trout rearing and migration use. As such, the temperature criteria requires that the seven-day-average maximum temperature may not exceed 18.0 degrees Celsius (64.4 degrees Fahrenheit). Based on DEQ data, the temperature in the Marys River exceeds this criteria during summertime low flow conditions. However, as previously mentioned, the recommended alternative does not include a summertime surface water discharge. Therefore, since the discharge period does not coincide with the period during which the stream is water quality limited, the 303(d) listing for temperature has no impact on the City's treatment facilities.

3.3.1.4 BOD/TSS

As outlined in OAR 340-41-345(3)(a)(A), during periods of low stream flows (approximately May 1 through October 31), current standards require that treatment result in monthly average effluent concentrations below 10/10 (mg/l BOD & mg/l TSS). During periods of high stream flows (approximately November through April), a minimum of secondary treatment, or equivalent treatment, must be provided.

The City's current NPDES permit allows discharge from the treatment plant from November 1 to April 30. Discharge to the Marys River during the months of May through October is not allowed. The permit limits allows a monthly average concentration of 30/50 (mg/l BOD & mg/l TSS) during the winter discharge period (November 1 through April 30).

3.3.1.5 Dissolved Oxygen

In accordance with OAR 340-41-0016, the DO standard requires that for water bodies identified as having a salmonid spawning use on the tables and maps set out in OAR 340-041-0101 to 340-041-0340 as well as any active spawning area used by resident trout species, the following criteria apply during the applicable spawning through fry emergence periods set forth in the tables and graphs.

- The dissolved oxygen may not be less than 11.0 mg/l. However, if the minimum intergravel dissolved oxygen, measured as a spatial median, is 8.0 mg/l or greater, then the DO criterion is 9.0 mg/l.
- Where conditions of barometric pressure, altitude, and temperature preclude attainment of the 11.0 mg/l or 9.0 mg/l criteria, dissolved oxygen levels must not be less than 95 percent of saturation.
- The spatial median intergravel dissolved oxygen concentration must not fall below 8.0 mg/l.

For water bodies identified by the Department as providing cold-water aquatic life, the dissolved oxygen my not be less than 8.0 mg/l as an absolute minimum. Where conditions of barometric pressure, altitude, and temperature preclude attainment of the 8.0 mg/l, dissolved oxygen may not be less than 90 percent of saturation.

For water bodies identified by the Department as providing cool-water aquatic life, the dissolved oxygen may not be less than 6.5 mg/l as an absolute minimum.

For water bodies identified by the Department as providing warm-water aquatic life, the dissolved oxygen may not be less than 5.5 mg/l as an absolute minimum.

3.3.1.6 Turbidity

Current DEQ standards require that discharge may not increase turbidity of the stream by more than 10 percent, as measured relative to a control point immediately upstream of the turbidity causing activity (OAR 340-41-0036). The DEQ is currently in the process of updating this turbidity standard. The updated standard may impact the City. These impacts could include additional treatment processes not included herein. It is premature to plan for improvements required to address the new turbidity standard before the standard is officially adopted.

3.3.1.7 pH

As outlined in OAR 340-41-345, the Willamette Basin Water Quality Standard specifies an allowed pH range of 6.5 to 8.5. The NPDES permit limits effluent pH to the range of 6.0 to 9.0. This limit is based on Federal wastewater treatment guidelines for sewage treatment facilities, and is applied to the majority of NPDES permittees in the State.

Within the mixing zone, the water quality standard for pH does not have to be met. It is the DEQ's position that mixing with ambient water within the mixing zone will ensure that the pH at the edge of the mixing zone meets the standard, and the Department considers the permit limits to be protective of the water quality standard. The DEQ standards therefore apply to the effluent discharge stream, which is easily monitored, rather than relying on in-stream criteria.

3.3.1.8 Bacteria

Based on OAR 340-41-0009, the current basin standards for bacteria are a 30-day log mean of 126 *E. coli* organisms per 100 ml (based on a minimum of 5 samples), with no single sample exceeding 406 *E. coli* organisms per 100 ml.

3.3.1.9 Toxic Substances

Discharge cannot raise the concentration of toxic substances outside of the regulatory mixing zone above the criteria listed in Table 20 of OAR Chapter 340, Division 41. Within the regulatory mixing zone, the chronic criteria set forth in Table 20 of OAR 340-041 must generally be met. The DEQ may further partition the regulatory mixing zone to define the zone of immediate dilution within which acute standards as set forth in Table 20 of OAR 340-041 must generally be met.

3.3.1.10 Mixing Zone

A mixing zone is a designated portion of receiving water that serves as a zone of dilution where wastewater and receiving waters mix thoroughly. The DEQ may suspend all or part of the water quality standards, or set less restrictive standards, within the defined mixing zone under the conditions outlined below.

DEQ typically describes the actual mixing zone limits and requirements in the NPDES discharge permit. The mixing zone is defined by DEQ on the basis of receiving water and effluent characteristics. The mixing zone limits or outfall location may be changed if DEQ determines that the water within the mixing zone adversely affects any existing beneficial uses in the receiving waters. For a particular discharge location the DEQ may establish a regulatory mixing zone (RMZ) within which chronic standards must be met. The DEQ may further partition the RMZ to define the zone of immediate dilution (ZID). The ZID represents the zone within which acute standards must be met.

a) The water within the mixing zone shall be free of:

- Materials in concentrations that will cause acute toxicity to aquatic life (bioassay testing required and approved by DEQ). Acute toxicity is lethality to aquatic life as measured by significant difference in lethal concentration between the control and 100 percent effluent in an acute bioassay test. Lethality in 100 percent effluent may be allowed due to ammonia, chlorine, and other parameters as approved by the Department only when it is demonstrated on a case-by-case basis that immediate dilution of the effluent within the mixing zone reduces toxicity below lethal concentrations.

- Materials that will settle to form objectionable deposits.

- Floating debris, oil, scum, or other materials that cause nuisance conditions.

- Substances in concentrations that produce deleterious amounts of fungal or bacterial growths.

b) The water outside the boundary of the mixing zone shall:

- Be free of materials in concentrations that will cause chronic (sub-lethal) toxicity. Chronic toxicity is measured as the concentration that causes long-term sub-lethal effects, such as significantly impaired growth or reproduction in aquatic organisms, during a testing period based on test species life cycle.

- Meet all other water quality standards under normal annual low flow conditions.

3.3.1.11 Other

OAR 340-41 also regulates the development of fungi or other growths, the creation of tastes or odors, the formation of appreciable bottom deposits, discoloration and floating solids, offensive aesthetic conditions, radioisotopes, total dissolved gas concentrations, and other extreme deleterious effects on the receiving water.

3.3.2 Effluent Disposal

3.3.2.1 Wastewater Effluent Reuse (Land Application)

During dry weather, an alternative to direct discharge to the Marys River is to apply the treated effluent to meet irrigation demands for agricultural lands, golf courses or parks. Effluent can also be reused as reclaimed water for specific nonagricultural industrial uses such as cooling water, although the lack of any appropriate industrial user in Philomath renders this option infeasible.

Land application of treatment plant effluent for a non-discharging facility requires a Water Pollution Control Facility (WPCF) permit from DEQ, with requirements based on state water quality regulations. Reuse of effluent by land application is governed by OAR 340-55, *Regulations Pertaining to the Use of Reclaimed Water (Treated Effluent) from Sewage Treatment Plants*, and groundwater quality is governed by OAR 340-40, *Groundwater Quality Protection*.

However, requirements for less than total effluent reuse can be included in a NPDES permit. Therefore, if the City desires to implement an effluent reuse plan in the future, a separate permit will not be required. The level of treatment required for land application of effluent depends on the type of land use, the access of the site to the public, and the available buffer areas around the site. Therefore, the site must be identified before the actual treatment requirements can be determined.

The DEQ will typically not approve of a surface water discharge unless it is demonstrated that there are no feasible non-discharging alternatives.

a) Application Rates

The goal of a wastewater reuse program for agricultural use (land application) is to apply the effluent at agronomic rates. This is defined as the rate necessary to meet the crop's gross irrigation and nutrient requirements. The gross irrigation requirement is the total crop water demand adjusted to compensate for precipitation, irrigation application efficiency, and soil moisture storage. The nutrient requirement is the amount of fertilizer, (i.e., available nitrogen, phosphorus, and potassium) that is required to obtain an optimum crop yield. In wastewater effluent, the available nitrogen includes organic nitrogen, ammonia nitrogen, and nitrate-nitrite nitrogen.

Furthermore, a draft guidance document issued by DEQ entitled *Guidance for Reclaimed Water Regulations OAR 340-55* states that " in the case of agricultural use of reclaimed water, the Department will be primarily concerned with assuring that the reclaimed water is applied at rates such that it is unlikely that water will runoff from the surface of the fields, that nitrogen and other parameters are not applied at excessive rates that would significantly impact groundwater, and that the reclaimed water is not incompatible with the type of crop proposed."

b) Seasonal Limitations

There are obvious seasonal limitations to a land application system because there are varying crop water requirements throughout the year. Most of the crops grown in the Willamette Valley typically have a growing season from April through October.

c) Treatment and Monitoring Requirements

As previously noted, DEQ has established treatment and monitoring requirements for potential agricultural and nonagricultural uses of the treated effluent in OAR 340-55. DEQ has classified reclaimed water into four categories and assigned a minimum degree of treatment required:

- Level I: Less than biological treatment or biological treatment without disinfection.
- Level II: Biological treatment plus disinfection.
- Level III: Biological treatment plus disinfection (stricter coliform limit).
- Level IV: Biological treatment, clarification, coagulation, and filtration treatment plus disinfection.

Limits for total coliform bacteria and turbidity have been established for the four treatment categories. These standards serve as a general guideline for defining the anticipated water quality required for the various uses. In addition to the water quality limits, DEQ has provided standards for the minimum monitoring required for total coliform and turbidity based on the four categories. **Table 3-3** summarizes the treatment and monitoring requirements for the four reuse categories listed above. DEQ may include additional effluent limitations or permit conditions if they have reason to suspect that the treated effluent may contain physical or chemical contaminants that would impose potential hazards to public health or the environment.

The amount of effluent that can be applied will vary depending on antecedent precipitation, temperature and crop maturity.

TABLE 3-3 Treatment & Monitoring Requirements for Agricultural Use of Reclaimed Water				
Reuse Category Level Minimum Degree of Treatment Required				
	I	II	III	IV
	Less than biological treatment or biological treatment without disinfection	Biological treatment plus disinfection	Biological treatment plus disinfection	Biological treatment, clarification, coagulation and filtration plus disinfection
Parameter - Total Coliform (number/100 ml)				
7 day median	No limit	23	2.2	2.2
2 consecutive samples	No limit	240	No limit	No limit
Maximum	No limit	No limit	23	23
Parameter - Turbidity (NTU)				
24 hour mean	No limit	No limit	No limit	2
5% of the time during any 24 hour period	No limit	No limit	No limit	5
Parameter - Minimum Monitoring Requirements				
Total Coliform	Not Required	1/week	3/week	Daily
Turbidity	Not Required	Not Required	Not Required	Hourly or continuous
From OAR 340-55				

d) Crop Limitations & Buffer Zone Requirements

DEQ rules based on OAR 340-55 also contain a number of general requirements addressing acceptable uses based on effluent water quality level, irrigation system, public access requirements, and buffer zones for irrigation. Although a detailed examination of these requirements is beyond the scope of this document, a brief summary is presented below.

Agricultural uses include general agricultural and specific agricultural uses. General agricultural uses include food crops, processed food crops, orchards and vineyards, fodder, fiber, and seed crops, as well as pasture for animals. Specific agricultural uses range from general produce (such as lettuce and carrots) to Christmas trees. Nonagricultural uses cover irrigation at parks, playgrounds, golf courses, cemeteries, and similar landscape irrigation. Based on the assumption that the existing and new treatment facilities are and will be capable of producing a Level II effluent, the potential uses are limited to irrigation of agricultural crops processed before human consumption or crops not for human consumption.

DEQ also provides guidelines on public access and buffer zones for reuse irrigation systems depending on the quality level of the effluent.

As discussed in OAR 340-55, public access requirements for the different effluent levels range from "prevented" (fences, gates, locks) to no direct public contact during the irrigation cycle. Based on a Level II effluent reuse program, public access must be "controlled." This means that this effluent can only be used to irrigate rural or non-public lands with limited potential for direct public contact. The site used would also require signs indicating the use of reclaimed water in the irrigation system. The level of public access control for Level III quality effluent would be similar.

Buffer zones for surface and spray irrigation systems are intended to protect public health and the environment. Assuming a Level II quality effluent, the minimum buffer zones for different irrigation systems are listed in **Table 3-4**.

TABLE 3-4
Irrigation System Buffer Zone Requirements

System Type	Boundary Buffer Zone (feet)
Center Pivot	75-300
Travelling Gun	300
Wheel Line	70
Hand Set	70
Solid Set – Aluminum	70
Solid Set – Micro Spray	35
Solid Set – Drip	10

3.3.2.2 Subsurface (On-Site) Disposal of Wastewater Effluent

Another alternative to direct discharge to the Marys River is subsurface disposal of treated effluent using a drainfield or disposal field. Under this alternative, the treated effluent is discharged to a system of buried pipes that distribute the effluent for final treatment and absorption by the soil in the unsaturated zone above any permanent or temporarily perched groundwater levels.

Subsurface disposal of sewage or effluent for a non-discharging facility also requires a Water Pollution Control Facility (WPCF) permit from DEQ, with requirements based on state water quality regulations. Subsurface disposal of effluent is governed by OAR 340-71, *On-Site Sewage Disposal.*

The specific requirements for community wide on-site system are summarized in OAR 340-71-500. Prior to the construction of an on-site system, a site evaluation must be performed to determine the physical qualities of the soil, how existing groundwater is distributed and moves in the soils, and other conditions that determine whether or not a soil based on-site treatment and/or disposal system is feasible.

Subsurface disposal is viable during the entire year, assuming that acceptable soil types are available and the drain field is above seasonal or perched groundwater tables. In addition, it does not have the same type of setback requirements as land application, as the effluent is not accessible to humans during the disposal process. Therefore, the treatment requirements are significantly less stringent than for land application or other reuse alternatives.

The existing treatment plant property and adjacent land are located on poorly drained alluvial soils with high groundwater tables. These types of soils are not suited for subsurface disposal. Therefore, any alternative that includes subsurface disposal would have to also include a pump station and force main to transport the effluent from the treatment plant to a suitable offsite drain field. The complexity and associated expense of such a system when compared to the alternatives evaluated herein renders subsurface disposal an infeasible disposal method in Philomath. As such, subsurface disposal will be removed from further consideration. The preceding discussion is provided for the sake of completeness.

3.3.3 Septage Management Regulations

DEQ mandates that if septic tanks are used to remove solids from the flow, the septage sludge must be disposed of at a facility with an approved point of discharge, such as a wastewater treatment plant which has been designed to accept septage. The 40 CFR 257 regulations outline the rules pertaining to the treatment and disposal of industrial, commercial or domestic septage. Treatment and land application of septage sludge must meet the same pathogen reduction standards as for sewage sludge.

Although the City does not appear to currently have an ordinance covering restrictions to the disposal of septage at the City's WWTP, there is a current City policy in effect to refuse to accept septage at the WWTP. We recommend that the City continue with this policy, and require that it be hauled to a larger community (i.e., Corvallis) with staffing and facilities which are better equipped to handle septage.

3.3.4 Biosolids Management

The term "sludge" refers to the solids that settle and are removed when a liquid with suspended solids passes through a settling basin or tank. Organic sludge may originate from several sources in a wastewater treatment plant, but can typically be classified as either raw or primary sludge (primary settling of untreated sewage) or secondary sludge (excess biological sludge from secondary treatment processes). All sludge must be stabilized prior to reuse or disposal. Stabilized sludge is a mixture of solids and liquids that is one of the end products of the wastewater treatment process.

Adequately processed sludge is classified in regulations as *biosolids*. It is commonly disposed of by applying it to agricultural or forest land after adequate processing.

3.3.4.1 Biosolids Quality

Wastewater biosolids are subject to differing regulations and restrictions based on quality. The Code of Federal Regulations (40 CFR 503) defines standards for three measures of biosolids quality:

- Pathogens.
- Vector attraction (the tendency of the sludge to attract rodents, insects and other organisms that can spread disease).
- Trace elements.

Biosolids that meet the higher of two standards for all three of these measures are designated exceptional quality (EQ) biosolids. EQ biosolids have fewer reporting and monitoring requirements and virtually no restrictions on use. Use is restricted for biosolids that do not meet the higher standard by any of these three measures. The following is a short discussion of each of these measurements of sludge quality.

a) Pathogen Requirements

Pathogen requirements define two classes of biosolids - Class A and Class B. Class A is the higher standard and requires complete destruction of pathogens before disposal. Class B requirements call for reducing pathogens before disposal and applying the biosolids to land in such a way that pathogens are further reduced.

To be classified as Class A, biosolids must be treated using one of the EPA's *Processes to Further Reduce Pathogens* (PFRP), or an equivalent process. These processes include composting, heat drying, heat treatment, thermophilic aerobic digestion, beta ray irradiation, gamma ray irradiation, and pasteurization. Regardless of the process used, Class A biosolids must not exceed maximum allowable fecal coliform density or Salmonella bacteria density.

Class B biosolids must be treated using one of the EPA's *Processes to Significantly Reduce Pathogens* (PSRP), or an equivalent process. These processes include aerobic digestion, air drying, anaerobic digestion, composting, and lime stabilization.

b) Vector Attraction Requirements

Biosolids must meet one of the following requirements for reducing vector attraction if they are to be applied to land without restrictions:

- Volatile solids in the sludge shall be reduced by a minimum of 38 percent.

- The specific oxygen uptake rate for sludge treated by aerobic digestion shall be less than or equal to 1.5 mg oxygen per hour per gram of total solids at a temperature of 20°C.

- Aerobic processes shall treat the sludge for a minimum of 14 days with an average temperature of at least 45°C and a minimum temperature of 40°C.

- Alkali addition shall raise the pH of the sludge to a minimum of 12 for two hours and maintain the pH at a minimum of 11.5 for an additional 22 hours without additional alkali.

The use of the land where the biosolids is applied is restricted if vector attraction reduction is achieved by measures, such as injecting the biosolids below the surface of the land or disposing of them on the surface and incorporating them into the soil within six hours.

c) Trace Elements

Ten elements typically found in biosolids have been identified as critical. Two limits have been set for each of these trace elements: Exceptional Quality (EQ) and a ceiling limit. If all the trace elements are below the EQ limit, then no restrictions are placed on loading rates. If any of the trace elements are over the ceiling limit, then the biosolids are not suitable for land application. If the trace elements fall between these two limits, restrictions are placed on loading rates.

3.3.4.2 Biosolids Use Restrictions Based on Quality

Table 3-5 outlines some of the general restrictions on the use of biosolids depending on the quality of the biosolids.

TABLE 3-5 **General Biosolids Use Restrictions Based on Quality Rating**			
Sludge Quality Rating by Category			
Pathogens	Vector Attraction	Trace Elements	Use Restrictions
EQ	EQ	EQ	No restrictions are imposed on application or use with regard to pathogens, vector attraction, or trace elements.
Class B	EQ	EQ	Application is subject to EPA defined waiting periods for crops, grazing, and public access. Biosolids cannot be distributed for home use, in bags, or in containers.
EQ	-	EQ	Biosolids must be injected or tilled into the soil. Biosolids cannot be distributed for home use, in bags, or in containers.
EQ	EQ	-	Bulk application must not exceed EPA defined cumulative loading rates. Biosolids distributed in bags or containers are subject to annual loading rate restrictions.
All Other Biosolids Qualities			Application is subject to trace loading requirements and pathogen waiting periods. Biosolids must be injected or tilled into the soil and cannot be distributed for home use, in bags, or in containers.
EQ – Exceptional Quality Biosolids			

a) Special Biosolids Management Considerations

As noted schedule C of the City's current NPDES permit, the City must prepare a sludge management plan and obtain DEQ approval prior to removal and/or reuse of sludge. New biosolids application sites or expansion of existing sites must be approved by DEQ prior to use. Site criteria for land applying biosolids includes geological formation, flood plain proximity, groundwater and surface water proximity, topography, and soils, as well as method of application. **Table 3-6** contains an overview of some of the general criteria contained in OAR 340-50.

TABLE 3-6 **General DEQ Site Criteria for Biosolids Application**	
Parameter	Criteria
Geology	Must have a stable formation
Within Flood Plain	Restricted period of application and incorporation of biosolids
Groundwater	At time of application; 4-foot minimum depth to permanent groundwater; 1-foot minimum depth to temporary groundwater
Topography Slope less than or equal to 12% Slope greater than 12% but less than 20%	Must have appropriate management to eliminate surface runoff • Surface application of liquid dewatered or dried biosolids • Direct incorporation of liquid biosolids into the soil, surface application of dewatered or dried biosolids
Soils	• Minimum rooting depth of 24 inches • No rapid leaching • Avoid saline or alkali soil • pH of 6.5 to 8.2 for heavy metal accumulator crops, or pH can be raised by adding lime to the soil.
Method of Application & Proximity to Water Bodies	Buffer strips may be required to protect water bodies. Size depends on method of application and proximity to sensitive area (determined at discretion of DEQ), generally as follows: • Direct injection: no limit required • Truck spreading: less than 50 foot buffer strip • Spray irrigation: 300 to 500 foot buffer strip • Near ditch, pond, channel, or waterway: greater than 50 foot buffer strip • Near domestic water source or well; greater than 200 foot buffer strip

Land application of biosolids at sites used for agricultural purposes requires special management considerations. These relate to access to the site, types of crops grown, plant nutrient rates, timing and duration of biosolids application (i.e., site life and seasonal constraints), and grazing restrictions. A brief discussion of each of these issues follows.

b) Access

Controlled access must be provided for municipal biosolids application sites for 12 months following surface application of biosolids. Controlled access is defined as public entry or traffic being unlikely. Privately owned rural land is typically assumed to have controlled access, while public lands such as parks may require fencing to ensure access control.

c) Crops

Biosolids or biosolids derived products are not to be used directly on fruits or vegetables which may be eaten raw. As a general rule, crops grown for human consumption should not be planted within 18 months of application of municipal biosolids. If the edible parts will not be in contact with the biosolid amended soil, or if the crop will be processed or treated prior to marketing in such a manner to ensure that pathogen contamination is not a concern, this requirement may be waived by DEQ. There are no restrictions on planting times for crops not grown for direct human consumption.

d) Nutrient Loading

Biosolids application to agricultural land should not exceed the annual nitrogen loading required for maximum crop yield. Biosolids are, therefore, typically managed according to their fertilizer value. Biosolids may be applied above agronomic rates on a onetime basis or less than once per year so long as runoff, nuisance conditions, and groundwater concerns are adequately addressed. In cases of higher than agronomic application rates, the acceptable loading rate and application frequency is typically based on nitrogen accumulation and annual nitrogen use.

e) Site Life

Sites generally have a limited application life, which may be determined by the chemistry of the soil and the metals loading from the biosolids. Site life is determined by dividing lifetime biosolids loading limits (based on the most limiting constituent) by the annual application rate.

f) Seasonal Constraints

The main consideration in land applying on sloping ground is to avoid surface runoff and soil erosion. Additionally, biosolids application should be restricted to the dry season to prevent soil damage that may occur from equipment traffic in during the wet season.

g) Grazing Restrictions

Grazing animals should not be allowed on pasture or forage for 30 days after application of stabilized biosolids, 180 days after application of non-stabilized biosolids, and 7 days after application of air-dried biosolids.

h) Site Monitoring and Reporting

As previously noted, site monitoring is typically not required where "EQ" biosolids are applied at or below agronomic rates based on crop nitrogen requirements. However, if the biosolids contain high concentrations of heavy metals or other toxic elements, or if crop nitrogen requirements are exceeded on a regular basis, soil monitoring and special management practices may be required. At the discretion of DEQ, monitoring wells and groundwater background characterization and/or monitoring may be required on any site on a case by case basis.

3.3.5 Reliability and Redundancy Criteria

The EPA has established minimum standards for mechanical, electrical, fluid systems, and component reliability for all new or expanding sewerage facilities, including treatment plants. These reliability standards establish minimum levels of reliability for three classes of sewerage facilities. Pump stations associated with, but physically removed from the actual treatment works may have a different classification than the treatment works itself.

The purpose of these reliability standards is to ensure that the treatment facilities will operate effectively on a day-to-day basis and that provisions are made for operation during power failures, flooding, peak loads, equipment failures, and maintenance shutdowns. These reliability and redundancy standards are designed to ensure that unacceptable degradation of the receiving water will not occur due to the interrupted operation of specific treatment process or unit operation.

The reliability classification will be based on the water quality and public health consequences of a component or system failure. Specific requirements pertaining to treatment plant unit processes for each reliability class are described in EPA's technical bulletin, *Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability*, EPA 430-99-74-001. EPA and DEQ guidelines for classifying sewerage works are summarized as follows:

- Reliability Class I. These are works whose discharge, or potential discharge, (1) is into public water supply, shellfish, or primary contact recreation waters, or (2) as a result of its volume and/or character, could permanently or unacceptably damage or affect the receiving waters or public health if normal operations were interrupted.

  Examples of Reliability Class I works are those with a discharge or potential discharge near drinking water intakes, into shellfish waters, near areas used for water contact sports, or in dense residential areas.

- Reliability Class II. These are works whose discharge, or potential discharge, as a result of its volume and/or character, would not permanently or unacceptably damage or affect the receiving waters or public health during periods of short-term operations interruptions, but could be damaging if continued interruption of normal operations were to occur (on the order of several days).

  Examples of a Reliability Class II works are works with a discharge or potential discharge moderately distant from shellfish areas, drinking water intakes, areas used for water contact sports, and residential areas.

- Reliability Class III. These are works not otherwise classified as Reliability Class I or Class II.

Table 3-7 contains the typical redundancy requirements for treatment plant and pump station components that are designed in accordance with the EPA Reliability Class I standards. In addition to the standards listed in the table, unit operations must be designed to pass the peak hydraulic flow with one unit out of service. Mechanical components in the facility must also be designed to enable repair or replacement without violating the effluent limitations or causing diversion of untreated sewage. The information in this table is not specific to the proposed alternative, and some of the plant components shown are not necessarily included in the existing or future facilities. Some of the items listed below apply regardless of the Reliability classification of the treatment facility.

The most significant difference between Class I and Class II reliability is that for Level II reliability, only 50 percent of secondary sedimentation design capacity is required with one unit out of service. Also, backup components are not mandatory for wastewater treatment systems used to provide treatment in excess of typical biological treatment and disinfection. Reliability Class I would require two grit basins and aeration basins, while Reliability Class II would only require a single aeration basin. More stringent requirements may be imposed by DEQ if an effluent reuse program is proposed. None of the proposed alternatives include the need for a biosolids program.

TABLE 3-7 Typical EPA Reliability Class I Requirements	
System Component	Capacity/Redundancy Requirements
Raw Sewage Pumps	Handle peak flow with largest unit out of service. As a minimum, the Peak flow is defined as the flow associated with a 5-year, 24-hour storm.
Mechanical Bar Screens	Provide one backup with either manual or mechanical cleaning (manual cleaning acceptable if only two screens)
Grit Removal	Provide a minimum of two units.
Primary Sedimentation	Handle 50% of design flow capacity with largest unit out of service. Design flow is defined as the flow used as the design basis of the component.
Activated Sludge Process	A minimum of two equal size basins. No backup basin required.
Aeration Blowers	Supply the design air capacity with the largest unit out of service. Provide a minimum of two units.
Air Diffusers	Allow for the isolation of largest section of diffusers (within a basin) without measurably impairing oxygen transfer.
Secondary Sedimentation	Handle 75% of design flow capacity with largest unit out of service. Design flow is defined as the flow used as the design basis of the component.
Disinfection Contact Basin	Handle 50% of the design flow with largest unit out of service. Design flow is defined as the flow used as the design basis of the component.
Effluent Pumps	Handle peak flow with largest unit out of service. Peak flow is defined as the maximum wastewater flow expected during the design period of the treatment works.
Electrical Power	Two separate and independent sources of electrical power shall be provided, either from two separate utility substations or from a single substation and a plant based generator. Designated backup source shall have sufficient capacity to operate all vital components, critical lighting, and ventilation during peak flow conditions, except that components used to support the secondary processes need not be included as long as treatment equivalent to sedimentation and disinfection is provided.

3.3.6 Design Considerations & Constraints

The design must take into account existing and projected flows and loadings, as well as the regulatory requirements as outlined previously. General design considerations incorporated in the alternatives are discussed below.

3.3.6.1 Design Period

The design period must be long enough to ensure the new facilities will be adequate for future needs, but short enough to ensure effective use within their economic and useful life span. The alternatives evaluated will be based on the effluent quality criteria discussed in the previous paragraphs. The design period will be twenty years for pump stations and treatment/disposal facilities, and buildout to City zoning for the gravity collection system components.

3.3.6.2 Treatment Efficacy

For alternatives involving wastewater treatment, a primary consideration will be the degree of treatment required to meet the discharge requirements and sufficient sizing of the facility to handle future projected peak hydraulic and organic loads.

3.3.6.3 Reliability

Although reliability can be enhanced by redundancy, conservative selection of the proper equipment helps ensure long life and minimize maintenance costs. Each unit process should be selected based on its ability to effectively treat the waste stream directed to it. Capabilities of the treatment plant operator and the community should also be considered. Processes that require a high degree of manual labor, special schooling, and unique instrumentation should generally be avoided.

3.3.6.4 Durability

Conveyance and treatment systems should consist of materials and equipment that are capable of satisfactory performance over the entire design life/period of the system components. The selection of wastewater system components is a matter of engineering judgement based on such factors as the type and intensity of use, type and quality of materials used in construction, the quality of workmanship during installation, manufacturer's reputation, and the expected maintenance that must be performed during life of the component.

3.3.6.5 Flexibility

The design of the conveyance and treatment system should allow for flexibility in operation and maintenance. For alternatives involving wastewater treatment, the operator should have the ability to route flows around the individual process units as required for repairs without significantly degrading effluent quality. This can be achieved by providing redundant units for critical processes and having multiple interconnections between units. In other cases, units can be oversized to assure flexibility. Such design flexibility will also help ensure that discharge requirements can be met under changing influent conditions, and should allow for the construction and connection of new process units as needed.

3.3.6.6 Operability

Operation of wastewater systems entails considerable responsibility and cost, especially since it directly impacts public health. The personnel assigned to operate and maintain a treatment facility must be appropriately trained. The more sophisticated the process or equipment, the greater the level of expertise required. Qualified individuals are usually more readily available in metropolitan areas, as is financial support for continued education and advanced training. However, small communities or service districts can have more difficulty in securing and retaining personnel with the required qualifications, as well as budgeting the money required to pay them. Consequently, the selection of a treatment process or equipment should reflect the regional and local training level of operations and maintenance personnel.

3.3.6.7 Miscellaneous

Consideration of site location, operational tasks, public perception, aesthetics, health and safety concerns, noise, odors, access to equipment, and hazards all must be considered when assessing treatment alternatives.

3.4. NPDES Permit - Specific Standards

OAR 340-41 outlines basin standards, as described above, while the NPDES permit issued by DEQ provides regulations for a specific wastewater collection & treatment system and its associated discharge(s). DEQ regulations require that non-discharging options be considered before discharge to surface water can be approved. An NPDES permit includes wastewater discharge limitations with regard to the concentrations of biochemical oxygen demand (BOD), total suspended solids (TSS), *E. coli* bacteria, as well as the mass loads of BOD and TSS and any other limitations required to maintain in-stream water quality.

The City has an NPDES Permit that was issued by DEQ on December 28, 2000 and is classified as a minor NPDES permit. The permit number is 102060 and the expiration date is 11/30/05 (see **Appendix B**).

The NPDES permit is divided into five sections as follows:

- Schedule A - Waste Discharge Limitations Not to be Exceeded
- Schedule B - Minimum Monitoring and Reporting Requirements
- Schedule C - Compliance Conditions and Schedules
- Schedule D - Special Conditions
- Schedule F - General Conditions

A short discussion of items of particular interest to this report follows.

3.4.1 Schedule A – Waste Discharge Limitations

There is one outfall identified in the current NPDES permit. Outfall 001 is the treated effluent discharge to the Marys River from the WWTP.

3.4.1.1 Outfall 001

A summary of the permit limitations for effluent discharge to the Marys River through Outfall 001 is presented in **Table 3-8**. BOD limitations are for 5-day BOD (BOD_5) testing.

TABLE 3-8
Current NPDES Permit Discharge Limitations
NPDES Permit Schedule A, Treated Effluent, Outfall 001
Discharge Permitted November 1 – April 30

Constituent	Max. Concentration (mg/L)		Max. Mass Load (lb/day)*		
	Avg. Monthly	Avg. Weekly	Avg. Monthly	Avg. Weekly	Daily
BOD_5	30	45	460	690	920
TSS	50	80	760	1100	1500
pH	Range		6.0 – 9.0		
E. coli Bacteria	Monthly Geometric Mean				126 cts/100 ml
	Maximum Single Sample				406 cts/100 ml
BOD_5 Removal	Min. Monthly Average Removal		65%		
TSS Removal	Min. Monthly Average Removal		55%		

* Based upon winter discharge rate of 1.82 MGD.

The mixing zone for the Outfall 001 is defined as a band extending out twenty (20) feet (not to exceed one-half the total stream width) from the south bank of the river and extending from a point ten (10) feet upstream of the outfall to a point one-hundred (100) feet downstream from the outfall. The zone of immediate dilution (ZID) is defined as that portion of the mixing zone within a ten (10) foot radius of the discharge point.

The permit also summarizes the conditions and restrictions relating to sewer system overflows.

- Sewer Overflows in Winter: Domestic waste collection and treatment facilities are prohibited from discharging raw sewage to waters of the State during the period of November 1 through May 21, except during a storm event greater than the one-in-five-year, 24-hour duration storm.

Based on NOAA Atlas 2, Volume X (Oregon), the 5 year 24 hour storm within the study area is 3.8 inches in 24 hours.

- Sewer Overflows in Summer: Domestic waste collection and treatment facilities are prohibited from discharging raw sewage to waters of the State during the period of May 22 through October 31, except during a storm event greater than the one-in-ten-year, 24-hour duration storm.

Based on NOAA Atlas 2, Volume X (Oregon), the 10 year 24 hour storm within the study area is 4.8 inches in 24 hours.

The permit clarifies that for overflows between May 22 and June 1, no violation will be triggered if the City demonstrates that the overflow was a result of a storm event greater than a one-in-five-year, 24-hour duration storm.

3.4.2 Schedule B – Minimum Monitoring & Reporting Requirements

Table 3-9 summarizes the minimum monitoring requirements imposed by the NPDES permit for influent and effluent flows.

TABLE 3-9
Minimum Monitoring And Reporting Requirements
NPDES Permit Schedule B

Item or Parameter	Min Frequency	Sample Type
Influent Flows		
Total Flow	Daily	Reading
Flow Meter Calibration	Annual	Verification
pH	2/week	Grab
BOD_5	1 per 2 weeks	Composite
TSS	1 per 2 weeks	Composite
Effluent Flows		
Total Flow (MGD)	Daily	Reading
Flow Meter Calibration	Annual	Verification
pH	2/week	Grab
Chlorine Used (lb)	Daily	Measurement
Chlorine Residual	Daily	Grab
BOD_5	1 per 2 weeks	24 hr Composite
TSS	1 per 2 weeks	24 hr Composite
Pounds discharged (BOD_5 & TSS)	1 per 2 weeks	Calculation
Avg. % Removal (BOD_5 & TSS)	Monthly	Calculation
Temperature	2/week	Reading
E. coli	1 per 2 weeks	Grab
Marys River		
Flow (Downstream)	2/week	Measurement

Schedule B also includes monitoring requirements for biosolids in the Cell #1 of the treatment lagoons. The permit requires that depth and extent of the sludge blanket be measured within twelve months of the issuance of the permit and at five year intervals thereafter unless sludge levels warrant more frequent measurements or removal of biosolids. Westech Engineering submitted a report to the DEQ on behalf of the City on November 20, 2001 demonstrating a relatively small volume of sludge accumulation. The DEQ concurred with the findings of the report and agreed that subsequent sludge measurements could be made at 5-year intervals. Therefore, the next sludge measurements must be submitted to the DEQ by November 20, 2006. The sludge survey prepared by Westech Engineering and the DEQ's approval letter are included in **Appendix C**.

There is one final annual report that must be submitted to DEQ. By February 1 of each year, an annual report must be submitted that details sewer collection maintenance activities during the past year that reduce inflow and infiltration, as well as those activities planned for the following year.

3.4.3 Schedule C – Compliance Conditions and Schedules

The following discussion is limited to those conditions that may impact the improvements recommended by this report, or which are addressed in conjunction with this report. Some of the compliance schedules referred to in Schedule C have already passed.

- Biosolids Management Plan (C3). Six months prior to the removal of accumulated solids from any of the lagoons, the City shall submit to the Department and updated biosolids management plan developed in accordance with OAR 340-50.

3.5. Basis of Cost Estimates

In order to compare between different alternatives, the comparative costs of the principal alternatives must be estimated. The cost estimates are based on numerous assumptions necessary due to the relative lack of detail available at the facilities planning stage. The basic assumptions are summarized below.

3.5.1 Accuracy of Cost Estimates

It is important to note that the cost estimates are estimates made without detailed engineering data or designs. The accuracy or precision of cost estimates is a function of the level to which alternatives are developed (i.e., detail and design) and the techniques used in preparing the actual estimate. Estimates are typically divided into three basic categories as follows:

a. Planning Level Estimates. These are order-of-magnitude estimates made without detailed engineering data. This type of estimate is normally accurate within +35% to –25% (i.e., final cost may be as much as 35% more or 25% less than the estimated amount). A relatively large contingency is typically included to reduce the risk of underestimating. This is particularly important since many times the project financing must be secured before the detailed design can proceed.

b. Budget Estimates. This type of estimate is prepared using process flow sheets, layouts, and equipment details during preliminary design. This type of estimate is typically accurate to within ±25%.

c. Engineer's Estimate. This estimate is prepared based on well-defined engineering data, typically when the construction plans and specifications are completed, and is sometimes called a definitive estimate. Since this type of estimate is based on comprehensive plans and elevations, piping and instrument diagrams, electrical diagrams, equipment data sheets, structural drawings, geotechnical data, and a complete set of specifications, The engineer's estimate is expected to be accurate within +15 percent to -5 percent (i.e., 15% more to 5% less than the estimate).

Since the alternatives (during the facilities planning process) are not developed in sufficient detail for a more precise estimate, the estimates presented in this document are order-of-magnitude estimates. Even though the final project cost may vary significantly from these estimates, the estimates are necessary to evaluate and compare the alternatives, and will be reasonably accurate relative to each other.

3.5.2 Adjustment of Cost Estimates over Time

As the costs of material, labor and equipment rise over time, comparable changes will occur in the costs presented in this study. However, since the relative costs of the alternatives compared to each other should remain reasonably constant, the recommendations based on the cost estimates should remain valid.

A commonly used indicator of these changes in construction costs is the Engineering News-Record (ENR) construction cost index. The index is computed from the prices for structural steel, Portland cement, lumber, and common labor, and is based on a value of 100 in the year 1913. The construction costs developed in this analysis are based on current ENR 20 cities index (for index number, see **Section 8**). The costs presented herein can be related to those at any time in the past or future by applying the ratio of the then-prevailing cost index to index number used at present.

3.5.3 Engineering & Administrative Costs & Contingencies

The cost of engineering services for major projects typically covers special investigations, pre-design reports, topographic surveying, geotechnical investigations, contract drawings and specifications, construction administration, inspection, project start-up, the preparation of O&M manual narratives, and performance certifications. Depending on the size and type of project, engineering costs may range from 16 to 25 percent of the contract cost when all of the above services are provided. The lower percentage applies to large projects without complex mechanical systems. The higher percentage applies to smaller, more complex projects, projects that involve remodeling of existing plants, or where full time inspection is required by the funding agencies or desired by the Owner.

The City will have administrative costs associated with any construction project. These include internal planning and budgeting/payments, administration of engineering and construction contracts, legal services, and coordination with regulatory and funding agencies. For a typical project of this size, the City's administrative, legal and permitting costs are expected to be about 10 percent of the contract cost. The total cost for engineering and administration is assumed to be 30 percent.

3.5.4 Construction Costs Estimates

Preliminary construction costs for collection system improvements recommended in this report are based on a number of assumptions as follows. The cost estimates reflect projects bid in late winter or early spring for summer construction. These estimates are based on construction costs for similar projects and manufacturer's information. The costs do not reflect a detailed investigation of existing utilities and soils. It is important to note that the cost estimates are planning level estimates, not engineering estimates, and are intended to be within the range of plus 35% to minus 25% of the actual project cost.

The elements which comprise these budget estimates for the piping portion of the collection system improvements include:

- 8 to 10 inch Pipeline Construction Cost (materials, installation & surface restoration, etc.) - $7.75 per inch-diameter per foot.
- 12 to 15 inch Pipeline Construction Cost (materials, installation & surface restoration, etc.) - $7.00 per inch-diameter per foot.
- 18 to 24 inch Pipeline Construction Cost (materials, installation & surface restoration, etc.) - $6.25 per inch-diameter per foot.
- Manholes - $3500 each
- Service Laterals - $2000 each
- Railroad & Highway Bores - $300/ft
- Manhole Rehabilitation - $1500 each
- Construction Contingencies - 10% of estimated construction cost
- Engineering Costs (surveying, engineering design, and construction administration) - 20% of estimated construction cost
- Legal, Permits & Administrative Costs (permitting, administration, legal, easement acquisition and financing) - 10% of estimated construction cost

Example: 300 lineal feet of new 12-inch pipe with 2 manholes & 3 laterals

Est. Construction Cost =	300 feet x 12 inches x $7.75 =	$27,900
	2 manholes x $3500 =	$7,000
	3 laterals x $2000 =	$6,000
Constr. Contingencies =	$27,900 x 10% =	$2,790
Engineering =	$27,900 x 20% =	$5,580
Legal, Permits & Admin =	$27,900 x 10% =	$2,790
Total Estimated Project Cost =		$52,100

The budget estimates for the pump stations and treatment plant work are based on construction costs for similar projects and manufacturer's information, and the assumption that the pump stations will be constructed in accordance with the pump station design criteria as previously outlined in **Table 3-2**. For the pump stations, construction contingencies of 20% of the estimated construction cost were assumed, as well as engineering costs (surveying, engineering design, and construction administration) of 20% of estimated construction cost, and legal, permits & administrative costs (permitting, administration, legal, land & easement acquisition and financing) of 10% of estimated construction cost.

The planning level estimates for the new wastewater treatment system are based on construction costs for similar projects and manufacturer's information, and the assumption that the treatment plant will be constructed in the recommended location. The estimates also include estimated costs for application for NPDES permit modification if required. For the WWTP improvements, construction contingencies of 15% of the estimated construction cost were assumed, as well as engineering costs (surveying, engineering design, and construction administration) of 20% of estimated construction cost, and legal, permits & administrative costs (permitting, administration, legal, easement acquisition and financing) of 10% of estimated construction cost.

These construction costs are planning level estimates, but they should help the City in the process of planning and allocating resources in the most cost effective manner. All costs are estimates of probable costs and do not reflect changes that could include increasing labor costs, material, and phased construction dates. Unit costs used for installation of sanitary sewers include excavation and export of material, bedding and backfill, cutting of asphalt, repaving of streets, pipe placement, bypass pumping and manholes.

Once the Facilities Plan is adopted by the City, the projects listed can be selected for completion through the City's budgeting process. The steps for completion are:

- Project identification and planning level cost estimate (completed by Facilities Plan)
- Project selection and secure project financing
- Retain consulting engineer for project
- Prepare pre-design report for review by regulatory agencies and to refine cost estimates
- Preparation of plans, specifications and final engineering cost estimates
- Bidding and contract award
- Construction