Town of Stevensville

Wastewater Treatment Plant Improvements

Preliminary Engineering Report

Phase 2 Improvements

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Section I. Executive Summary

This Preliminary Engineering Report (PER) serves as an update to the 2008 PER prepared for the Phase 1 Improvements Project. The Phase 1 Improvements Project included the following process improvements to the Stevensville WWTP.

- UV Disinfection
- Sludge Drying Beds
- Decommissioning polishing pond
- Outfall modification
- Instrumentation and controls improvements
- Alum metering pumps.

Due to changing regulations, funding opportunities and work already completed, it was necessary to update the PER and provide recommendations for the current most pressing needs for the Town of Stevensville.

The Town of Stevensville will be issued their new Montana Pollution Discharge Elimination System (MPDES) permit in early 2012, and the draft version indicates that a maximum daily nitrate limit of 10 mg/L will be required to meet the human health standard for nitrate. The daily limit is derived because the side channel of the Bitterroot River to which they discharge has a 7Q10 flow of zero. The current and draft permits are included in Appendix D. The nitrate requirements are summarized in Table I-1.

Table I-1. MPDES Discharge Limits

Parameter	Units	Average Monthly Limit	Average Weekly Limit	Maximum Daily Limit
Nitrate plus Nitrite, as N	mg/L	NA	NA	10

The draft permit also includes the following special conditions:

- To meet the nitrate-nitrite limit, the Town must have a plan in place by January 2013 and construction complete to meet the limit by March 17, 2017.
- The Town of Stevensville is required to monitor the groundwater wells around the abandoned polishing pond quarterly from 2012 through 2014 to determine if it is contaminating the groundwater. The Town must provide annual reports to DEQ and a final report by June 30, 2015.

Work is underway to develop the Bitterroot River Total Maximum Daily Load (TMDL) for nutrients and numeric water quality standards for the Bitterroot River. It is estimated that numeric water quality standards for the Bitterroot River will be similar to the Upper Clark Fork River, 20 ug/L of total phosphorus and 300 ug/L of total nitrogen. In-stream data shows that the Bitterroot River is nearing or already at these levels. Initial implications of the Bitterroot River TMDL would require stream dischargers to perform some level of nutrient removal. According to the October 2011 draft edition of Montana Department of Environmental Quality (DEQ) Circular 12, the requirements for discharges less than 1 MGD, would be 15 mg/L total nitrogen and 2 mg/L total phosphorus. This would be granted to the Town through the EPA approved variance process. The limit could continue to be ratcheted down to the in-stream numeric nutrient standards under future permit renewals. It is anticipated that the Town could be expected to perform to the 10 mg/L total nitrogen and 1 mg/L total phosphorus currently expected of dischargers great than 1 MGD and eventually to the Limits of Technology as defined in the draft Circular DEQ 12 to be 4 mg/L TN and 0.07 mg/L TP. Implementation of the TMDL's has yet to be solidified, but it is in the best interest of the Town to prepare themselves for what will likely happen based on the most current information and decision making history.

In addition to the permit and water quality required improvements, parts of the Stevensville WWTP need upgrades. The Stevensville WWTP headworks and oxidation ditch were placed into operation in 1979. These facilities are reaching the end of their useful life. The Headworks screen consists of a manual bar rack that must be cleaned by hand. Grit removal does not exist at the facility and, as a result, plant staff spends a significant amount of resources maintaining the many submersible pumps installed as part of the 1998 Wastewater Treatment Plant Expansion project. The oxidation ditch is shallow, experiences infiltration when groundwater is high and is not capable of performing biological nutrient removal.

This preliminary engineering report evaluates alternatives and costs associated with making phased improvements to the Stevensville WWTP to:

- Meet the requirements of the MPDES permit
- Meet the requirements of the future Bitterroot River TMDL
- Meet the requirements of future in-stream water quality standards
- Provide for renewal, replacement, and upgrade to the existing headworks and oxidation ditch.
- Meet the requirements for DEQ Circular 2.

Alternatives were evaluated for the following WWTP elements:

- Secondary biological treatment
- Screening
- Grit removal

Alternatives considered for each of the WWTP elements are summarized below.

Secondary Biological Treatment

- No action
- Upgrade existing oxidation ditch

- Construct new biological nutrient removal basin
- Convert existing aerobic digester to conventional biological nutrient removal

Screening

- No action
- Rotary Drum screen
- Perforated Plate screen
- Traveling Rake screen

Grit Removal

- No action
- Vortex grit tank
- Aerated grit tank
- Inclined plate

Recommended Plan

The recommended plan includes converting the existing aerobic digester to conventional biological nutrient removal; construction of a new headworks facility consisting of a perforated plate screen, screenings washer/compactor, vortex grit removal tank and grit washer.

The overall cost of the recommended plan in 2014 dollars, the assumed midpoint of construction, is summarized in Table I-2.

Table I-2. Project Cost Summary

Project Element	Estimated Implementation Cost
Secondary Biological Treatment	$2,150,000
Headworks Improvements	$1,264,000
Total Estimated Project Cost	$3,414,000

Net Cost per User

The funding plan will only consider Phase 2 since that is the project that is being considered in grant applications for the 2012 funding cycle. The Town of Stevensville has been preparing for their future upgrade needs in recent years including scheduling five rate increases beginning in 2010. The Town's current sewer user rates are $44.59 per month for, not including water rates. After the final adopted rate increase in 2014, the rates will be $47.54 per month. By comparison, the Department of Commerce target rates for this community are $20.96 per month. The Town will be above their target rate by a factor of 2.27 in 2014, without additional raises due to this project. Additionally, Stevensville's Median Household Income (MHI) is $27,951, making their sewer bill over 2 percent of their median household income. This borders on financial hardship for the community and shows the Town has been proactive in preparing for their upcoming needs at the WWTP. However, the new nitrate limit is ahead of the anticipated schedule for the Town, and has required them to need to make improvements sooner.

The funding plan includes cash reserves from the Town, a $100,000 RRGL grant, a $750,000 TSEP grant, a $450,000 CDBG grant, a $676,900 RD grant, and a $1,579,000 RD loan at 3.5% over 40-years. The annual loan payment will be approximately $74,000 per year, plus an additional 10% required replacement reserve costs. This does not include additional operations and maintenance costs. An analysis of the Town's finances determined that if the funding is provided, they will be able to undertake these costs without raising the rates beyond the currently planned rate increases. However, if the funding isn't provided, the annual loan payment and replacement reserve would be $126,000 per year. A similar analysis of Town finances indicates that rates would have to increase by an additional $4/month for the average user to complete a project of the same magnitude placing their average residential sewer rate at nearly 250% of their target rate.

Section II. Problem Definition

A. Identify Planning Area and Existing/Potential Service Area

1. Location

The Town of Stevensville is located in the Bitterroot Valley, in the northern portion of Ravalli County, approximately 25 miles south of the City of Missoula in western Montana. The Town is situated on a valley plain bounded on the west by the Bitterroot Mountains and on the east by the Sapphire Mountains. After Hamilton, it is the second largest of 10 communities within Ravalli County. The Town is situated on the east side of the Bitterroot River and east of US Highway 93. The Town is located at 46 degrees 30.57 minutes north latitude and 114 degrees 5.77 minutes west longitude (Figure II-1).

The specific planning area for this study encompasses the present Town Limits and unincorporated county areas to the northeast, east and south. The planning area includes those areas east and south of the existing Town Limits where growth is occurring now and is expected to continue during the planning period and where there is sufficient land to support that growth. The planning area includes the extended zoning district as adopted by ordinance of June 24, 1996, as well as other areas of logical extension of municipal services. The Stevensville Planning Area is about 1,438 acres (2.25 square miles) in size. Further expansion to the west beyond the Town Limits is constrained by the Bitterroot River and its associated floodplain.

A map of the planning area is included herein as Appendix A.

Figure II-1: Location of Stevensville, MT

2. Physical Characteristics of the Area

Geology

According to "*Roadside Geology of Montana*" by David Alt and Donald W. Hyndman, the principal geologic units deeply underlying the Stevensville area are granite rocks of the Idaho Batholith. Overlying the basement rock are valley fill sediments of the Renova formation, eroded off the Bitterroot Mountains to the west. Atop this are more geologically recent sediments from successive washout from Glacial Lake Missoula during several cycles of the heavy glaciation followed by periods of melting of ice jams and catastrophic flooding. These sediments have been reworked and redistributed by the Bitterroot River during more recent geological history.

Stevensville sits on a low terrace adjacent to the relict flood plain of the Bitterroot River, which meandered widely during recent geological history. Surface deposits underlying the area consist of alluvium of modern channels and flood plains (quaternary) consisting of well-rounded gravel and sand with lesser amounts of silt and clay.

Topography

The surface topography of Stevensville and environs is relatively flat with a falloff in elevation from east to west towards the Bitterroot River at about one to two percent. The average surface elevation of the Town and its immediate environs is 3,370 feet MSL. A topographic map of the planning area is included in Appendix A.

Soil Types

The majority of the land surrounding the Town of Stevensville WWTP is situated on a soil classified as Holloron loam (Map symbol 120B) on slopes less than 4.0%. This soil type is described as well drained, non-saline soil with moderate available water capacity that rarely experiences flooding.

There are three main soil types found within the WWTP boundary, designated by map symbols 16E, 147A, & 904. The soils are classified as Riverside Tiechute Curlew, Histic Endoaquolls Curlew, and Dumps/Landfill respectively.

A soils map, legend, and soils description of the area is included with the Environmental Checklist in Appendix B.

Groundwater

Groundwater depths in the area around Stevensville are relatively shallow. Thus, dewatering pipeline trenches and structure foundations will likely be required during the construction of system improvements.

A review of well logs in the area indicates that typical depths to groundwater are in the range of 3 to 20 feet below land surface. The depth to groundwater also varies with the irrigation of the surrounding land with high groundwater being reported during months of more intense irrigation of nearby farmlands in June, July and August. The general direction of groundwater flow underlying the area is to the west towards the Bitterroot River. The river surface generally represents the governing “link sink” relative to groundwater levels and localized hydrogeology.

Surface Water

The Bitterroot River is the primary surface water body in the area and is located at the western edge of the Stevensville planning area. Waters in this river are classified by MDEQ as “B-1” and are considered suitable for drinking after conventional treatment. Other suitable uses under this classification include bathing, swimming and aquatic recreation, growth and propagation of salmonid fishes and aquatic life, waterfowl and furbearer habitat, and agricultural and industrial water supply. Flows in the river vary primarily in response to rainfall and snowmelt on the surrounding mountains. In addition, flows in the river are regulated to a considerable extent by the Painted Rocks Reservoir, located on the West Fork of the Bitterroot River upstream of Conner, MT. In addition to this base flow, four other major tributary streams (Sleeping Child Creek, Skalkaho Creek, Blodgett Creek and Bear Creek) contribute substantial flows upstream of Stevensville.

Flows from the river and some of the tributary streams are diverted into irrigation ditches to support agricultural activities in the valley. The Supply Ditch is the primary irrigation ditch within the Planning Area and runs from south to north in the eastern segment of the Planning Area.

Within the planning area, there are two other smaller, but still significant, tributaries of the Bitterroot River: Mill Creek and North Swamp Creek. The Town of Stevensville obtains a substantial portion of its raw water supply indirectly from these two streams by means of a subsurface infiltration system of tile pipe laid parallel to the creeks in fields between the creekbeds. A direct discharge from North Swamp Creek is available in winter months. MDEQ considers the water from this source to be “under the direct influence of surface water" and therefore subject to Surface Water Treatment Requirements (SWTR).

Climatological Information

Climatological information for the Town of Stevensville is summarized in Table II-1. The information below was obtained from the National Climatic Data Center (NCDC), and it covers the period from 1911 to 2004. Average annual precipitation is 12.56 inches, which places Stevensville in the "semiarid" category. The average annual maximum and minimum temperature is 58.5 °F and 31 °F, respectively.

Table II-1. Local Climatological Summary

Average	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Avg
Max. Temp. (F)	33.1	39.7	48.8	59.5	68.0	75.2	84.8	83.4	72.1	59.1	43.3	34.6	58.5
Min. Temp (F)	14.9	19.0	24.5	30.6	37.4	44.0	47.1	45.3	38.1	30.5	23.1	17.0	31.0
Total Precip. (in.)	1.07	0.85	0.78	0.83	1.49	1.65	0.87	0.90	1.07	0.88	1.06	1.09	12.56
Total Snowfall (in.)	7.7	5.8	4.1	0.4	0.1	0.0	0.0	0.0	0.0	0.2	3.0	5.9	27.3
Snow Depth (in.)	3	2	1	0	0	0	0	0	0	0	1	2	1
*Period of Record: 8/23/1911 to 6/30/2004 **Percent of possible observations for period of record: Max. Temp 98.4%, Min Temp 98.3%, Precip 98.7%, Snowfall 47.2%, Snow Depth 48.3%													

Floodplain

Appendix A includes the FEMA floodplain map for the planning area. The planning area and the proposed improvements are located outside of the 100-year floodplain of the Bitterroot River.

Vegetation and Wetlands

Since Stevensville is the oldest permanent settlement in Montana, dating from 1841, most if not all of the original native vegetation within the existing town limits had been replaced with cultivated varieties of trees, shrubs and grasses. Outside of the existing town limits and within the eastern extent of the planning area, homesteads and small farms with irrigated hay fields or grassy rangelands spread out beyond the Town. For the most part, native grasses and other indigenous herbaceous plants have been replaced with hay and alfalfa fields. With the exception of scattered groupings of pine and fir trees, there are no real stands of native timber left within the planning area. Trees mainly consist of cottonwoods and scattered fruit bearing trees (mainly apple, pear and plum trees) which are generally found along the edges of the creeks and man-made irrigation ditches where there is sufficient year-round moisture to sustain vibrant growth.

Wetlands within the planning area are generally found within the floodplain of the Bitterroot River just west of the planning area and immediately adjacent to the run of area creeks. These are generally confined to the edges of these streams or in isolated pockets were groundwater levels are at or near the surface. Substantial wetland areas along with highly valued waterfowl habitat are found mainly within the confines of the Lee Metcalf National Wildlife Refuge, located just north of the planning area. This refuge contains a diverse combination of wetland types and forested river bottom habitat and is highly protected from any disturbance or perturbations by man.

3. Environmental Resources Present

As part of a previous study by Professional Consultants Incorporated (PCI), information on the environmental resources present in the planning area were collected, and anticipated impacts to the resources from the previous projects were summarized in their *Uniform Environmental Checklist* (UEC). This information was taken into account for the WWTP Phase 2 Improvement Project’s UEC. In addition, a narrative summary of the proposed project was submitted to local, regional, state and federal agencies for comments on the project. This information was used to determine if any environmental resources will be impacted by the project. Potential impacts, along with any mitigation measures where pertinent, are discussed in the following subsections. A copy of the updated, project-specific UEC, accompanying narrative and agency comments received are included in Appendix B.

Historical and Archeological Resources

Saint Mary’s Mission, located at the end of 4th Street in the Town of Stevensville, was the first Catholic mission in the northwest and the first permanent white settlement in Montana. The mission was established in 1841 by Father Pierre DeSmet, who came to the Bitterroot Valley in response to requests for “Black Robes” by various Native American tribes of present-day Montana and Idaho. The mission complex includes the chapel/residence, Father Anthony Ravalli’s log house and pharmacy, Chief Victor’s cabin and the Native American burial plot. All buildings have been restored to the 1880 era and are furnished with items built by Father Ravalli, Montana’s first medical doctor. Chief Victor’s cabin is restored as an Indian museum. Nearby DeSmet Park was dedicated in 1991 to commemorate the 150th anniversary of the establishment of St. Mary’s Mission.

Also included in the complex is the Stevensville Museum. This facility features the early growth and development of the Bitterroot Valley with displays of artifacts, pictures and information panels regarding the history of the American Indian population (the Salish Indians), the Lewis and Clark Corps of Discovery expedition through the valley in 1805-1806, the arrival of Father DeSmet in 1841, the establishment of the earliest mission in what is now Montana, the development of Fort Owen as one of the earliest trading posts and the history of Stevensville itself.

The historic Catholic mission complex and Fort Owen will not be impacted by the activities associated with the subject project. The response from the State's Historic Preservation Officer (SHPO) to the Environmental Checklist regarding this PER is included in Appendix B. It indicates a low likelihood of significant impact to both archaeological and historical resources for the proposed project since virtually all actions will be conducted in previously disturbed areas.

Fish, Wildlife and Endangered Species

During the preparation of the UEC, the database of the *Montana Natural Heritage Program* was researched for the presence of sensitive animal, fish or plant species within the planning area. No conflicts relative to the proposed project were noted.

The response received from the US Fish and Wildlife Service, USDI indicated that there are three (3) threatened species that may occur in the Planning Area, namely, the Canada Lynx, the Bull Trout and the Bald Eagle. In addition, the Gray Wolf, considered to be a nonessential experimental species introduced into the area, and the Yellow-billed Cuckoo, a candidate threatened species, may also occur in the area. The response indicated that, considering the nature, scope and location of the project, this agency does not anticipate adverse impacts to any federally listed threatened, endangered, candidate or proposed species or critical habitat.

Agricultural Land

The planning area includes many agricultural parcels. The principal agriculture activities conducted within the planning area are the raising and pasturing of livestock, primarily cattle and horses, and hay cropping on irrigated lands. The upcoming upgrade and expansion of the Town of Stevensville's water system will permit nearby agricultural lands to be developed as residential or commercial use. Overall, higher density development on lands provided with municipal level facilities will require less of the available land area and will ultimately serve to reduce impacts on agricultural lands throughout the general area.

The improvements proposed by this PER are replacements or upgrades to existing facilities and do not directly impact agricultural lands or uses.

Surface Waters, Floodplains and Wetlands

The improvements proposed by this PER do not impact any surface waters, floodplains or wetlands. All work will be conducted away from surface waters, outside of the 100-year flood zone and away from area wetlands. All work will take place within the boundaries of the existing wastewater treatment plant site which is not located in a wetlands, surface water site, or 100 year floodplain.

Groundwater

Groundwater under the Planning Area is known to be plentiful and generally of good quality. The near surface waters are seasonal and supported by summer irrigation of integral and surrounding pasture lands and hayfields.

Water quality testing of Stevensville's municipal drinking water supply both from the infiltration gallery and from the wells had not indicated any persistent or recurring water quality issues.

4. Growth Areas and Population Trends

According to the year 2010 census, the Town of Stevensville had a population of 1,809 persons. The year 2000 census population was 1,553 and the year 1990 census population was 1,221. There was a 27.2 percent increase in population over the decade from 1990 to 2000 and an 11.8% increase from 2000 to 2010. Towns in Ravalli County posted a 27% growth rate over the decade from 1990 to 2000, and 20% for 2000 to 2010. Similar to the Town, Ravalli County as a whole showed an increase from 2000 to 2010 of 11.5% growth.

The Stevensville 2012 population is based on data from the 2010 census, with no new users being added in the last two years. The current population used in this report will mirror the 2010 census data. After this year, the expected growth rate is anticipated to continue at the historic rate of 1.1% per year.

Projected population growth is estimated using the current population of 1,809 and an assumed 1.1% annual growth rate (Table II-3). Growth trends indicate future growth of the Town is expected to be primarily towards the east and south where there is available suitable land for development.

Table II-2. Projected Population Growth

	Current (Year 2012)	Year 2015	Year 2025	Year 2035
Population	1809	1869	2085	2326

B. Evaluate Condition of Existing Facilities

1. Schematic Layout

The schematic presented in Appendix C provides the layout of the Town of Stevensville WWTP. As the figure shows, the WWTP has an influent manual bar screen, influent sampling, 9" Parshall flume flow measurement, 34,758 cubic foot oxidation ditch for biological treatment, two 30 foot diameter covered secondary clarification units, UV disinfection and flow measurement. Effluent from the WWTP is discharged to a 3,000 foot drainage ditch that runs directly to the Bitterroot River.

Solids collected in the secondary clarifier are wasted to a 718,125 gallon aerobic digestion complex. Following digestion, waste solids are stored in three sludge drying beds until they can be transported to Eko-Compost in Missoula. Decant from the sludge drying beds is routed to the oxidation ditch for biological treatment.

The WWTP has an abandoned 37,000 gallon final clarifier which was once considered for modification to a primary clarifier. There is also an abandoned 55,000 gallon aerobic digestion tank which sits almost entirely above grade.

2. History

This facility was originally operated as a controlled discharge lagoon. In 1979, the facility began operation as a mechanical treatment plant. Upgrades at that time included flow measurement, biological treatment in the oxidation ditch, final sedimentation, aerobic solids digestion, and solids storage in sludge drying beds.

In 1998 major improvements to the facility were constructed, including the new secondary clarification units, new aerobic digestion facility and blower building complex, and additional sludge drying beds.

In 2011, the Phase 1 Improvements project was completed which added UV disinfection, an additional sludge drying bed, and bypass and decommissioning of the polishing pond.

3. Analysis of Existing Facilities

3.1 Existing Flows: The monthly influent flow to the Stevensville wastewater treatment plant over the past five years is shown in Table II-3. The annual average daily flow (220,000 gpd) is approaching the plant design capacity of 300,000 gpd. However, it should be noted that the 2011 construction project uncovered additional issues with the influent flow meter, and the data is considered suspect and inaccurate. It is recommended to use an average of the four previous years and not consider the flows in 2011. This would provide an average flow of 206,300 gpd.

Table II-3. Monthly Influent Daily Flows [MGD] to Stevensville WWTP

Month	2007	2008	2009	2010	2011	Average
January	0.194	0.204	0.277	0.181	0.249	0.221
February	0.221	0.242	0.236	0.188	0.244	0.226
March	0.219	0.264	0.241	0.186	0.249	0.232
April	0.196	0.219	0.207	0.200	0.288	0.222
May	0.203	0.240	0.191	0.212	0.313	0.232
June	0.191	0.231	0.190	0.216	0.306	0.227
July	0.159	0.217	0.176	0.188	0.276	0.203
August	0.174	0.192	0.206	0.190	0.253	0.203
September	0.183	0.202	0.192	0.196	0.272	0.209
October	0.210	0.196	0.205	0.193	0.312	0.223
November	0.203	0.238	0.192	0.187	0.317	0.227
December	0.236	0.206	0.192	0.212	0.208	0.211
Average	0.199	0.221	0.209	0.196	0.274	0.220

With an estimated population of 1,809 in 2012, the average per capita flow corresponds to about 122 gallons per capita per day (gpcpd) as compared to a typical national average of 100 gpcpd.

A review of the plant's daily flow records for the years 2007 to 2010 indicates a maximum daily flow of 397,000 gpd which corresponds to a 1.9 peaking factor for maximum daily flow. Looking at historical monthly flows, a conservative maximum monthly peaking factor of 1.33 is used to determine the maximum month flows. The minimum daily flow recorded was 145,000 gpd which corresponds to a 0.73 peaking factor for minimum to average daily flow. Current peak hour flow is estimated at 742,000 gpd based on a peaking factor of 3.6 calculated from Circular DEQ 2, Design Standards for Wastewater Treatment Facilities. Design flows are depicted in Table II-4.

Table II-4. Design Flow Points

Year	Average Day (MGD)	Max Month (MGD)	Peak Hour (MGD)
Current 2012	0.21	0.29	0.74
2035	0.30	0.40	1.08

3.2 Treatment Standards: A summary of permit violations from the past 12 years is below (violation letters, in addition to MDEQ MPDES Compliance Inspection Reports, are included in Appendix E):

- The Town of Stevensville has received 21 violation letters for reported discharge values of E. coli exceeding the permit limit.
- The Town of Stevensville has received 7 violation letters for reported discharge values of phosphorus exceeding the permit limit.
- The Town of Stevensville received 2 violation letters for not reporting nitrogen (Total Kjeldahl Nitrogen) values.
- The Town of Stevensville received 1 violation letter for not reporting a phosphorus value.
- In 2003, the Town of Stevensville alerted MDEQ of a permit violation in a letter for a reported clarifier effluent BOD exceeding permit limitation. This violation may have been a result of faulty RAS/WAS pumping equipment.
- The Town of Stevensville received 3 violation letters for reported discharge of BOD5 exceeding the permit limit
- The Town of Stevensville received 6 violation letters for reported discharge of TSS exceeding the permit limit.
- The Town of Stevensville received 1 violation letter for reported discharge of value of pH exceeding the permit limit.
- The Town of Stevensville received 8 violation letters for failure to submit DMRs.

3.3 Existing Facilities/Capacities: Currently sludge is tested by plant staff for heavy metals, nitrogen, phosphorus, moisture content, pH and other constituents before it is picked up by Eko-Compost. Eko-Compost then produces a Class A sludge.

The estimated capacities of liquid stream unit processes are summarized in Table II-5. The capacities are compared to MDEQ requirements and/or design guidelines.

Table II-5. Estimated Capacities of Liquid Stream Treatment Processes

Component	Units or Parameter	Initial Design or Current Conditions	Current or Proposed Design Standards	Design Year of Maximum Capacity	Comment
Manual Bar Screen	Spacing in inches	1	1	Outdated	Needs replacement
9” Parshall Flume	MGD	5.73	Measurement required	>2035	Good Condition
Oxidation Ditch	Detention time in hrs @ ADF	21	18 to 24 hours	2027	Ditch is too shallow, Significant infiltration into the unit Unable to meet nitrate limits
	Loading rate in lbs BOD/1000cf	11	15	2023	
Final Clarifier	SOR gal/day/sq ft	637	1,000	2029	Good Condition

The estimated capacities of solids stream unit processes are summarized in Table II-6. The capacities are compared to MDEQ requirements and/or design guidelines.

Table II-6. Estimated Capacities of Solid Stream Treatment Processes

Component	Units or Parameter	Initial Design or Current Conditions	Current or Proposed Design Standards	Design Year of Maximum Capacity	Comment
RAS/WAS Pumps	Capacity, gpm	200	50-150% Q	2035	Problems with Grit
Aerobic Digester	cu ft/P.E.	12	4.5	>2035	Oversized
	SRT days	220	27	>2035	
Sludge Storage	Sq.ft/P.E.	1	4	2020	

Accurate management of the microorganism population within the system is critical to proper operation of the oxidation ditch. The RAS pumping facilities include six 3.8 HP submersible RAS pumps (two duty and one spare per clarifier), two 3.8 HP submersible WAS pumps, and two 3.8 HP submersible chopper type scum pumps. These pumps experience more than normal wear due to the grit and screenings that make it through the plant headworks.

The WWTP includes four covered aerobic sludge digestion tanks with a total capacity equaling 718,000 gallons. There are four 40 HP blowers dedicated to the aerobic digester and all are in good working condition. Solids are pumped from the final clarifier wetwell to the digesters at an average solids concentration of 10,000 mg/L (1.0 percent). Based upon the projected wastewater raw sludge loadings, the existing digesters have capacity far beyond year 2035.

The existing sludge storage basin provides storage capacity for the winter months but due to freezing, it usually cannot be emptied until the spring, when solids are hauled to Eko-Compost. Decant water from the storage basins is routed to the oxidation ditch.

3.4 <u>Lift Stations</u>: The Stevensville collection system contains one lift station on the west side of town. Two pumps, each with a design condition of 180 gpm at 35 feet of total dynamic head, currently serve approximately 30 dwellings. The maximum capacity of this lift station is 270 homes, based on an October 21, 2003 memorandum from PCI to the Town of Stevensville.

3.5 Collection System: Existing collection system mapping was used to develop a spreadsheet-based model in order to evaluate existing sewer collection facilities. The minimum and maximum slopes in the system are 0.0001 and 0.057 ft/ft, corresponding to minimum and maximum full depth capacities of 0.088 and 3.38 MGD. Two subdivisions in development on the eastern edge of town will increase the future load on the existing sewer system. Available capacity will be exceeded in the three segments of mains approaching the WWTP and in the main entering manhole 11. A peaking factor of 3.6 was used to estimate peak hour flows in accordance with Circular DEQ 2. It is recommended that more precise flow data be recorded at the wastewater treatment plant to verify the peak hour value. If plant data reveals a peaking factor smaller than 3.6, then exceeding capacity in the existing collection system may not be a concern. Verification of peak hour flow should be accomplished prior to making expensive improvements to the collection system.

3.6 Impact of Infiltration or Inflow on System Performance: As noted previously there is significant infiltration occurring at the WWTP. It is suspected that the majority of this infiltration occurs at the oxidation ditch. The increased flows into the plant may be contributing to the permit limits violation. Infiltration is also suspected in the collection system in the area east of Church Street (PCI 1996 Water and Sewer Facilities Plan) but it is not significant considering that the average monthly flow into the WWTP varies little throughout the year as shown in Table II-3. Even so, the Town of Stevensville has a program in place to perform closed circuit television inspection in areas suspected of infiltration to identify and repair leaks.

3.7 Operational and Management Practices and Capabilities: Operation of the WWTP is overseen by the Town's water/wastewater superintendent. Normal maintenance, operation, and testing duties for the WWTP are shared by two other town employees. These three individuals take care of not only the wastewater treatment plant but also the wastewater collection system, the water treatment plant, wells, water distribution system, streets, swimming pools, parks, and cemetery. The employee time is spread very thin among their duties. It is estimated that the average time spent at the treatment plant is somewhere between 3 to 6 manhours per day (depending on the time of year and the demands of their other tasks).

The existing headworks consists of a manual bar screen with 1" bar spacing which has been modified to allow influent to flow over the top and into the channel during times when operator attention is not available. This was necessary since the screen must be raked by hand and if someone isn't there to rake it when an item blinds the screen, influent can back-up and overflow the channel. The influent screen does not function as required and should be replaced with a mechanically operated fine screen. Figure II-1 shows the concrete, stained with screenings from a previous upset. This screen configuration poses health risks for employees of the Town, and overflows provide a vector attraction. The existing influent measurement system is a 9" Parshall flume with adequate capacity for future growth (Figure II-1).

There is no grit removal system in place at the WWTP. Grit removal facilities are required by Circular DEQ 2, Design Standards for Wastewater Treatment Facilities. The accumulation of grit in the plant pumping wetwells is evident and indicates an overall grit problem throughout the plant. The problems associated with grit distribution in this plant are widespread and significant. Any improvements to the existing WWTP should include addition of a headworks facility that includes a grit removal process. Due to the numerous submersible pumps located in later processes within the WWTP grit removal upgrades are essential. Grit currently entering the plant is continuously damaging pumps, particularly waste activated and return activated sludge pumps, and could lead to a system upset.

Figure II-1 Photograph of influent screen and Parshall flume showing the modifications to the screen on the left.

Following the Parshall flume, flow is routed directly to the oxidation ditch with a bypass capable of sending the flow to an abandoned primary clarifier. The primary clarifier could be made to function with upgrades. However, it may be more beneficial if converted to an equalization tank.

The existing oxidation ditch is around 38,770 cubic feet with sloped sidewalls and a 5 foot operating depth. Current design standards for an oxidation ditch are to use a 15-25 foot operating depth to enhance biological nutrient removal efficiency. Plant flow data shows that significant infiltration from the groundwater is entering the system at the oxidation ditch. Due to the design of the oxidation ditch and the probability of a compromised seal, the existing oxidation ditch should be decommissioned and alternative treatment processes should be investigated.

The effluent from the oxidation ditch is routed to a clarifier influent splitter structure which divides the flow evenly to the two final clarifiers. The covered final clarifiers are 30 foot diameter and have adequate hydraulic capacity to design year 2029 with one clarifier out of service. The final clarifiers are currently in good working order. Effluent from the final clarifiers is metered before discharge into an onsite polishing pond.

4. Financial Status of Facilities

The Town of Stevensville has been preparing for their future upgrade needs in recent years including scheduling five annual rate increases adopted in 2010 and completing wastewater and water capital improvement plans. Current user rates are $44.59 per month for a single family residential unit (sewer only). After the final adopted rate increase in 2014, the rates will be $47.54 per month. The Department of Commerce target sewer rate for this community is $20.96 per month. The Town will be above the target rate by a factor of 2.27. Additionally, Stevensville's Median Household Income (MHI) is $27,951, making their sewer bill over 2 percent of their median household income. This is a financial hardship for the community as demonstrated by a recent income survey performed for a CDBG application on a water project which resulted in a LMI percentage of 53%. Adoption of an aggressive rate increase program shows the Town has been proactive in preparing for their upcoming needs at the WWTP.

The rate increases have allowed the Town of Stevensville to operate with a healthy cash balance despite significant bond principal and interest assessments for wastewater upgrades completed in 2000 and 2011. There was approximately $376,000 cash on hand, at the end of fiscal year 2010/2011. Financial analysis of the sewer utility determined that if funding is acquired as described above, the entire Phase 2 Wastewater Treatment Plant Improvements Project could be completed and a healthy cash balance could be maintained without further rate increases. In addition, the Town could complete the other wastewater improvement projects scheduled in the Town's capital improvement plan.

If TSEP, RRGL, and CDBG funding is not acquired, an additional rate increase would be required. It is estimated that an additional $4.09 rate increase would be required in fiscal year 2014/2015. This rate increase would bring the Town's total monthly single family residential sewer rate to $51.63. This rate would be $30.67 over the target rate set by the Department of Commerce (250% of the target rate) and 2.2% of the Town's median household income.

Figure II-1. The Stevensville WWTP is located directly adjacent to Lewis & Clark Park and the Town's public swimming pool.

C. Describe and document the need for the project and the problems to be solved

1. Health and Safety

Protection of public and internal staff health is the primary factor in determining the need for system upgrades. The excessive handling of raw wastewater sewage by Town staff should be accounted for when existing facility upgrades are considered. The operations staff must handle screenings several times each day at high moisture and organic content, which is a worker health and safety problem. It is recommended to

Figure II-2. Fly fisherman just below where the WWTP discharges to the Bitterroot River.

replace the equipment with a more modern screenings system that includes the capability to mechanically wash and compact screenings prior to disposal. Additionally, the manual bar screen overflows lead to vector attraction. Rodents and birds spread the exposed screened materials, furthering the contamination and risk of disease. The WWTP is located directly adjacent to Lewis and Clark Park and the Town's public swimming pool.

Potential for contamination of groundwater in the vicinity of the wastewater treatment plant due to leaking process units may dictate the need for additional upgrades. The WWTP discharges to the Bitterroot River which is classified as B-1 suitable for bathing, swimming and aquatic recreation, growth and propagation of salmonid fishes and aquatic life, waterfowl and furbearer habitat, and agricultural and industrial water supply, however; the plant does not treat for nitrate removal. A nitrate limit of 10 mg/L will be a MPDES permit requirement as a means to protect public health.

The Bitterroot River is highly prized for its recreational activities. On any given summer afternoon bathers can be seen swimming at the Stevensville bridge access, just downstream of the discharge from the WWTP. Figure II-2 shows fly fishing anglers in the fall at the same location.

Figure II-3 shows a graph of the WWTP's effluent data for nitrate-nitrite in recent years. The graph demonstrates that the level required by the permit in unattainable with the Town's current treatment process. In fact, the effluent data indicates that the Town hasn't even come to close to meeting the proposed permit limit for many years.

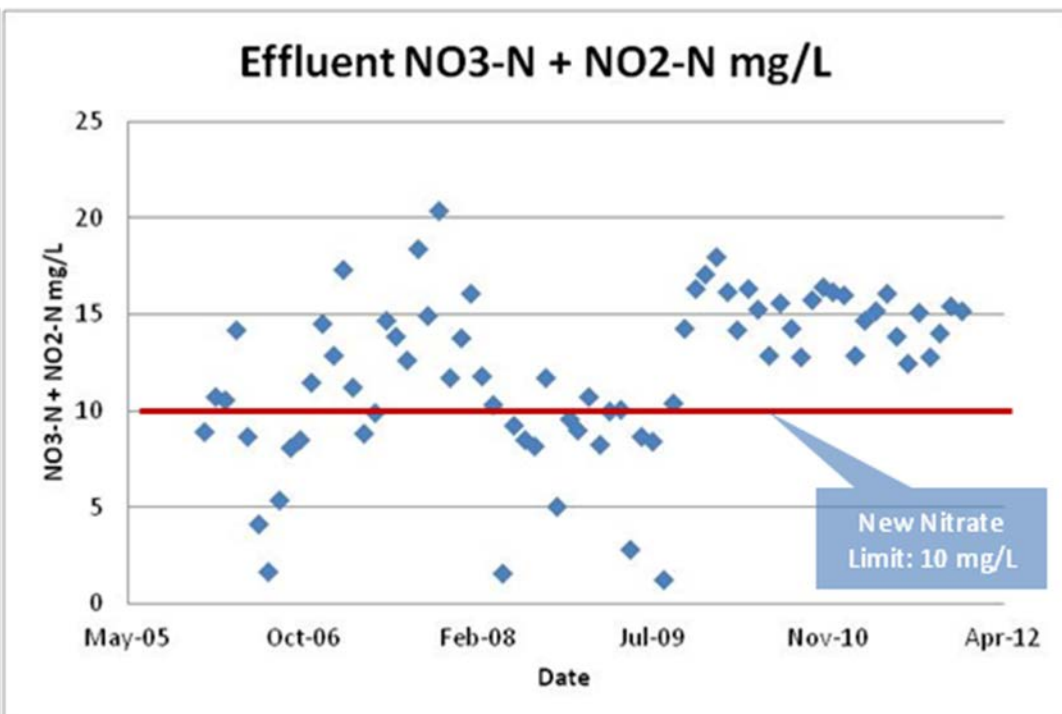

Figure II-3. Nitrate Effluent Data for the WWTP

The Bitterroot Valley Aquifer has been designated a Sole Source Aquifer (SSA) for many public water supplies in the Bitterroot Valley, including Stevensville. The overall goal of the designation is:

> "…to ensure that projects receiving Federal financial assistance in an SSA project review area is designed and constructed in a manner that will prevent the introduction of contaminants into the SSA in quantities that would create a significant hazard to public health."

The Bitterroot Valley aquifer is identified as vulnerable to contamination. Public health problems could potentially worsen within the Town's current planning area and adjacent to the wastewater treatment plant. Failure to implement the recommended improvements in a timely manner would have significant adverse impacts on the Town of Stevensville, including:

- Non-compliance with discharge permit requirements;
- Raw sewage spills, and associated public health impacts;
- Water quality impairment of the Bitterroot River; and
- Inability to handle wastewater generated by the community.

The consequences would likely lead to regulatory enforcement actions and fines.

2. System O&M

A primary operations concern at the influent screen is the operator attention required. The screen must be cleaned by hand multiple times each day and irregularities in plant influent that occur when no operator is present could blind the screen and cause an overflow. The screen has been modified to allow unscreened overflow to re-enter the channel on the downstream side of the screen. The operations concern for the screen is the handling of raw sewage by operations staff.

The most intensive maintenance items within the WWTP are the submersible pumps. Due to grit accumulation within the system, the pumps are wearing out more often than should be expected and require frequent replacement.

The other major operations and maintenance concern is the infiltration and exfiltration occurring within the WWTP. The main source of leakage is the oxidation ditch. The leakage results in decreased treatment capacity as well as adjacent groundwater contamination.

3. Growth

Future development in the eastern part of town would increase load and exceed the current collection system capacity. An estimated 2,326 users will be served by this project by 2035, as shown in Table II-2, an increase of 517 users and the includes the future flows from within the planning area. Proposed WWTP facilities are designed and planned to meet the needs of the Town into year 2035 and beyond, providing long-term solutions for the Town.

4. Unresolved Problems

All the problems identified above are unresolved and should be addressed by making improvements to the Stevensville WWTP. Portions of the WWTP are nearing the end of their useful life including the influent bar screen and oxidation ditch. The MPDES permit requires nitrate removal. In addition, grit removal is required by MDEQ Circular DEQ 2. The proposed upgrades take the most economic approach to extend the life of the WWTP, meet the requirements of the MPDES permit and MDEQ regulations and poise the Town to meet future nutrient discharge requirements for the Bitterroot River.

D. General Design Requirements for Improvements

General design criteria are based on the following elements:

- Process Sizing. These criteria specify design loading rates and operating parameters for critical unit treatment processes. Examples include clarifier overflow rates, aeration basin mixed liquor concentrations, and hydraulic head loss requirements.
- Reliability/Redundancy. These criteria define reliability and redundancy requirements for unit processes and critical equipment.
- Water Quality Parameters. Until a TMDL waste load allocation is established for the Bitterroot River, the currently permitted effluent quality targets will be used for planning, with the best possible anticipation of preparing the Town for upcoming TMDL and numeric nutrient requirements, when practical.
- Hydraulic and organic load are based on current plant influent data and the historical growth rate of the Town. For design year 2035 the average daily flow is projected to 0.30 MGD and the average BOD_5 load is projected to 550 ppd.

Design requirements for a new headworks with mechanical screen, screenings washer/compactor, and grit removal equipment would most likely include a building to house the influent screen and the grit removal equipment. Due to site limitations it would have to be a narrow building situated to the south of the existing Parshall flume. Reliability is achieved by including a bypass channel with manual bar screen for use when the mechanical screen is in need of repair. In the future, the bypass channel could be fitted with a second mechanical screen.

Grit removal facilities are required by Circular DEQ 2, Design Standards for Wastewater Treatment Facilities. Any improvements to the existing WWTP should include addition of a headworks facility that includes a grit removal process. Grit removal units are typically oversized and have a longer lifespan than other equipment commonly found in a wastewater plant. Sizing for this process equipment should be based on a 30-40 year population projection for the Town. Reliability for this type of system is usually achieved by including a bypass channel.

Since the oxidation ditch is beyond its useful life, a new secondary treatment system will need to be investigated. The design requirements for a new system would be to provide capacity for at least a 20-year design life. Nutrient limitations are becoming stricter and any new biological process will need to be designed to perform nitrogen and phosphorus removal. It is possible, in the Stevensville climate, to meet effluent total nitrogen limits of 10 mg/l and effluent total phosphorus limits of 1 mg/l. Further reductions in nutrient discharge may be achieved with chemical addition and filtration.

Section III. Alternative Screening Process

Influent Screen

Alternative IS 1 – No Action Alternative

Due to the health and safety concern, as well as the overall impacts on the WWTP, this alternative is not suitable for further consideration.

Figure III-1 Rotary Screen

Alternative IS 2 – Rotary Screen

A rotary screen contains a basket screen and spiral screw auger that lifts the debris from the semi circular screen and conveys it from the influent channel to a cylinder into a washing section. Organic material is washed from the screenings and returned to the flow stream. The debris continues up the cylinder via the continuous auger into a compaction zone where it is dewatered. Following dewatering, the compacted screenings are discharged into a receiving dumpster cart. This alternative would not require building a structure and will be considered in a later section.

Figure III-2 Perforated Plate Screen

Alternative IS 3 – Perforated Plate Screen

The perforated plate screen is a continuous filter element driven by two conveyor chains. The filter panels are shaped as circular segments cleaned by a rotary brush. Lifting tines allow larger objects, such as stones or wood, to be removed, preventing a build–up of larger solids in the bottom of the channel. The screenings are carried upwards by the filter elements and are continuously removed and discharged by the rotary brush as the screen element moves past the brush. This alternative will be considered further in a later section.

Alternative IS 4 – Traveling Rake Screen

A traveling rake screen consists of a vertical bar screen with multiple rake assemblies that travel along the bar screen via a chain and sprocket drive periodically clearing debris from the leading edge of the bar rack. Debris is dumped onto a chute and into a container for disposal. The screen is capable of removing large items. The mechanism is low profile and has a high hydraulic capacity even with small bar spacing. This alternative will be considered further in a later section.

Grit Removal

Alternative GR 1 – No Action Alternative

Due to the damage the grit is causing to the WWTP's existing submersible pumping system and the fact the Circular DEQ 2 is not met, this alternative is not suitable for further consideration.

Alternative GR 2 – Vortex Grit Removal

Flow enters and exits these grit chambers tangentially and a rotating turbine maintains constant velocity. The propeller creates a toroidal flow path causing particles to settle to the bottom where they are pumped to a dewatering system. This alternative will be considered further in a later section.

Alternative GR 3 – Aerated Grit Removal

In aerated grit chambers, air is introduced at the bottom of a tank on one side to create a spiral flow pattern. Heavy particles settle to the bottom and are pumped to a dewatering system. Air flow adjustment determines the size of particles collected. This alternative will be considered further in a later section.

Alternative GR 4 – Inclined Plate Grit Removal

A flow distribution header distributes influent onto multiple trays. Tangential feed establishes a vortex flow pattern where solids settle into a boundary layer on each tray and are swept down to the center underflow collection chamber. These settled solids are continuously pumped to a dewatering system. This alternative will be considered further in a later section.

Secondary Biological Treatment

Alternative SBT 1 – No Action Alternative

This alternative does not address the issue of infiltration to the WWTP, replacement of process tankage and equipment at the end of their useful life, or current nutrient removal requirements. This alternative is not suitable for further consideration.

Alternative SBT 2 – Upgrade the Existing Oxidation Ditch

The existing oxidation ditch infrastructure is nearing the end of its useful life. The system leaks and because it is constructed with sloped side walls of concrete poured against the earth it is difficult to perform long term repairs. In addition, the depth of the existing tank limits its ability to perform nutrient removal. This alternative is not suitable for further consideration.

Alternative SBT 3 – Convert a Portion of the Existing Aerobic Digester to a Conventional Biological Nutrient Removal System

This alternative investigates the possibility of converting some of the excess aerobic digester space into a new conventional biological nutrient removal treatment system. This alternative would be relatively easy to build, would use existing tank capacity, and would provide both nitrogen and phosphorus removal. The specific design and layout of the biological nutrient removal facility would be determined during final design. This will be considered further in a later section.

Alternative SBT 4 – Construct a New Biological Nutrient Removal System in Place of the Existing Oxidation Ditch

This alternative investigates the possibility of building a new biological nutrient removal facility within the boundaries of the existing WWTP. This alternative presents the greatest design flexibility and will be considered further.

Section IV. Alternative Analysis

Headworks Improvements

A. Description

A screen is a device with small openings placed in the path of wastewater flow to retain solids found in the influent and provide for their removal. Screens are classified based on their opening size and methods for solids disposal. Screens are generally the first treatment process at a WWTP and typically the most unhygienic process encountered at a WWTP. Mechanical grit removal is most commonly located following the screening step. Grit removal chambers are designed to remove grit, consisting of sand, gravel, and other heavy non-organics with high specific gravities from influent wastewater streams. This process is intended to deter buildup of solids within the WWTP and to protect equipment which could be damaged by these constituents.

B. Schematic Layout

As shown in Figure 3 in Appendix C, in order to maintain use of the existing Parshall flume the arrangement of the proposed headworks must be to the south of the flume. Additionally, the oxidation ditch and the property boundary confine the dimensions of the proposed headworks to be long and narrow in form. The proposed layout is typical for a WWTP headworks (Figure 4).

C. Operational Requirements

Operational requirements for the proposed headworks improvements are mainly of a maintenance nature. Although the screen will require less operator attention, the kind of attention that it will require is more technical. For all the equipment considered, maintenance will include mechanical replacement of wear parts and responding to failure alarms. The current operations staff at the Stevensville WWTP has the skills required for these types of maintenance issues. Operator health benefits will be observed by removal of the manual bar screen that is currently cleaned by hand.

D. Energy Requirements

All viable alternatives will require more energy. All of the equipment would run on electric motors. The new screen, screenings washer/compactor, grit pumps, and grit washer would all require approximately 2 HP each, regardless of the chosen technology.

E. Regulatory Compliance and Permits

The existing manually cleaned bar screens satisfy current regulatory requirements. Circular DEQ 2, Design Standards for Wastewater Treatment Facilities states that all mechanical plants must have grit removal facilities. A single grit chamber with bypass is acceptable for small wastewater treatment plants serving separate sanitary sewer systems.

F. Land Requirements

There is ample space available within the current boundaries of the Stevensville WWTP to implement this improvement. The headworks facility would be located on the eastern edge of the property (see Figure 6).

G. Environmental Considerations

The improvements to the headworks will not have significant impacts on the environment outside of the WWTP. The headworks will eliminate the potential for vector attraction and the illicit transportation of screened material off site. This is of a particular benefit because the WWTP borders the public park and public swimming pool.

H. Construction Problems

Construction problems for implementation of the preferred alternative would occur due to limited space in the desired location. The new building would be located between existing utility lines and the current oxidation ditch. Additionally there would be the concern with tying in the new system to the existing. There would need to be a short period of time in which no influent could reach the plant through the Parshall flume. Influent would either need to back up in the collection system or be pumped directly to the oxidation ditch from an upstream manhole. Other concerns are high groundwater and the adequacy of on site soils for constructing the required structures

I. Cost Estimates

Table IV-1 describes the engineer's estimate of probable construction costs for each alternative.

Table IV-1. Engineer's Probable Construction Cost for Headworks

Alternative	Estimated Construction Cost	Estimated Annual O&M Cost	20 Yr Present Worth
Influent Screening System			
IS 2	$292,000	$2,024	$317,000
IS 3	$853,000	$5,098	$917,000
IS 4	$970,000	$5,098	$1,034,000
Grit Removal System			
GR 2	$838,000	$7,122	$927,000
GR 3	$875,000	$7,122	$964,000
GR 4	$958,000	$7,122	$1,047,000

Project Costs

All grit alternatives and screen alternatives, with the exception of IS 2, would require construction of a headworks building. This requirement is reflected in the higher constructions costs of these alternatives. For those alternatives requiring a building, the cost for a building is included in both the grit and the screenings option. If an alternative requiring a building is chosen for both, the cost can be reduced as only one building is needed.

2. Annual O&M Costs

Annual operation and maintenance costs for the rotary screen (IS 2 alternative) would be lower than either the perforated plate or traveling rake screen (IS 3 or IS 4). However, the perforated plate or traveling rake would provide the most dependable, long-term solution to the pre-treatment problem at this WWTP. Also, the perforated plate or traveling rake would provide better removal of debris and result in cleaner, drier screenings.

The annual operations and maintenance cost for headworks alternatives are based on the power to operate the screens, wash water and grit removal equipment and pumps. Power costs are based on $0.07 KW-Hr usage, plus a $9.18/KW demand charge, with all systems operating 24 hours a day 365 days a year at 80% efficiency. The actual impact to the Town will gradually increase to the design demand as flows increase. The total O&M cost of the selected alternative would be $9,800.

3. Present Worth Analysis

The 20-year present worth was calculated based on a 5% annual interest rate.

J. Selection of Preferred Alternative

Table IV-2 provides a comparative analysis of all the alternatives for influent screening discussed above. The criteria rankings range from 1 to 5 with 1 being poor, 5 being best. The preferred alternative is the perforated plate screen based on a majority of the criteria utilized for comparison. Although this type of screen cost more than the traveling rake or the rotary screen, it has far superior screening capability and is at the forefront of screening technology.

Table IV-2. Influent Screening Selection Logic Matrix

Evaluation Criteria	Rotary Screen (IS 2)	Perforated Plate (IS 3)	Traveling Rake (IS 4)
Regulatory Coordination	4	4	4
Operations/ Technology	3	5	3
Compatibility with Site	4	3	3
Implementation	3	3	3
Public Health/Safety	3	3	3
Community/ Environmental	4	4	4
Risk	4	4	4

Evaluation Criteria	Rotary Screen (IS 2)	Perforated Plate (IS 3)	Traveling Rake (IS 4)
Cost	3	4	4
TOTAL	**28**	**30**	**28**

Table IV-3 provides a comparative analysis of all the alternatives for grit removal discussed above. The criteria rankings range from 1 to 5 with 1 being poor, 5 being best. The preferred alternative is vortex grit removal based on a majority of the criteria utilized for comparison. The ease of operation, limited space constraint, and overall cost of the units are the driving forces for selection of this technology.

Table IV-3. Grit Removal Selection Logic Matrix

Evaluation Criteria	Vortex Grit (GR 2)	Aerated Grit (GR 3)	Inclined Plate (GR 4)
Regulatory Coordination	4	4	4
Operations/ Technology	4	3	4
Compatibility with Site	4	3	3
Implementation	3	3	3
Public Health/Safety	3	3	3
Community/ Environmental	4	3	3
Risk	4	3	3
Cost	3	2	2
TOTAL	**29**	**24**	**25**

Secondary Biological Treatment

A. Description

Biological treatment is accomplished by using a fluidized culture of microorganisms under aerobic conditions to use organic materials in wastewater as substrates for growth, thereby removing contaminants through respiration and growth. The activated sludge wastewater mixture, termed mixed liquor, moves through a biological reactor with the wastewater absorbing organics and nutrients as it moves. After the mixture leaves the reactor it is separated from the water through the clarification process. Solids removed from the clarification process are termed activated sludge which are pumped back to the head of the reactor and mixed with raw wastewater to begin the process again. This type of process has many variations that have been optimized to perform under varying conditions. The primary constituents removed from a secondary biological wastewater treatment system are organics (BOD), nitrogen and phosphorus. The specific layout and type of BNR process would be determined during the final design stage of the project. A BNR process schematic is shown in Figure IV-1.

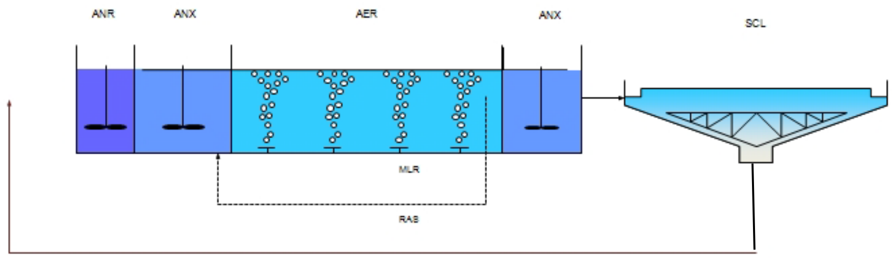

Figure IV-1. Example Schematic of a BNR Process for Nitrogen and Phosphorus Removal

The proposed alternatives would result in a secondary treatment system capable of meeting a max month flow rate of 0.4 MGD producing an effluent with a maximum concentration of 10 mg/l nitrogen and 1 mg/l phosphorus. Chemical addition to the secondary clarifiers could provide for additional phosphorus removal capabilities. Chemical metering was added in the Phase 1 Improvements project to help aid in meeting the phosphorus permit. The move to a BNR facility would reduce the chemical costs necessary to remove that phosphorus. As the population in the Town of Stevensville increases, the actual flow realized by the WWTP may result in the need for sludge thickening under Alternatives SBT 3 and SBT 4 in order to provide additional capacity in the aerobic digester.

B. Schematic Layout

The proposed biological process would be located in the existing aerobic digester complex (see Figure 2, Appendix C). The north two digestion tanks would be converted to biological treatment trains and the south two tanks would remain aerobic digestion. Due to the elevation of the digester complex, an influent pump station would be required to convey influent to the new biological treatment process. The influent piping is valved so it could go to the abandoned final clarifier. A simple way to configure the proposed influent pump station would be to use the abandoned clarifier as the new pump station wet well. The added benefit to this arrangement is the influent flow equalization inherent to this type of setup.

C. Operational Requirements

The number of aeration basins in service will change depending upon the time of year, maintenance activities and plant influent flow. At plant startup, normally one aeration basin will provide adequate capacity to treat the wastewater flow during the dry season and both basins will be needed during the wet season. On a seasonal basis, staff should cycle one of the basins out of service during the dry summer months. The idle basin should be alternated annually. While the basin is empty, the fine bubble diffused aeration system, sluice gates and slide gates should be inspected and cleaned as necessary.

The dissolved oxygen concentration in the main aeration basin mixed liquor should be maintained at approximately 2 to 3 mg/L. Actual operating experience will determine specific operating dissolved oxygen levels to maintain an adequate BOD reduction and nitrification without excessive energy consumption. Dissolved oxygen meters will measure the DO levels in the aeration basins. Under automatic control, the programmable logic controller (PLC) will modulate the valve position to control the air flow as needed to achieve the desired mixed liquor dissolved oxygen concentration.

Controlling the return activated sludge (RAS) flow balances the distribution of activated sludge between the aeration basin and the secondary clarifier. The proper distribution of activated sludge helps to maintain the aeration basin biomass population necessary to stabilize the wastewater pollutants by keeping the bulk of the biomass in the aeration basin where the treatment occurs. The biomass concentration is determined by the mixed liquor volatile suspended solids (MLVSS) test. Wasting activated sludge from the system controls the biomass.

In addition, the RAS flow rate helps determine the RAS concentration and thus the waste activated sludge (WAS) concentration. The process strategy should be to optimize RAS flow to achieve both a minimum sludge detention time in the clarifier and a maximum RAS concentration. Because these are contradictory goals, compromises are necessary. A minimum sludge detention time in the clarifier is important to prevent denitrification and subsequent floating sludge. A maximum RAS concentration is desirable to minimize the RAS flow rate. In addition, maximum RAS concentration (and thus WAS concentration) is desirable to reduce the WAS volumes in subsequent solids handling processes.

The objective of wasting activated sludge is to maintain a balance between the microorganisms in the activated sludge system (system solids inventory) and the amount of food (BOD) applied to the system.

As microorganisms remove organic material and nutrients from wastewater and as suspended solids are adsorbed by the activated sludge floc, the amount of activated sludge increases (microorganisms grow and multiply). The rate at which these microorganisms grow is called the growth rate and is defined as the increase in the amount of activated sludge taking place in one day. Sludge wasting serves to remove only the amount of increase. When this is done, the amount of activated sludge produced by the microorganism growth is balanced by what is removed from the process. This allows the total amount of activated sludge in the process to remain relatively constant. This condition is called steady state and is the desirable condition for operation. However, steady-state conditions can only be approximated because of the variations in the nature and quantity of the food supply and of the microorganism population.

Sludge age or mean cell residence time (MCRT) is a measure of the average number of days the activated sludge remains in the system. The goal of a sludge-wasting program should be to maintain the activated sludge system at a sludge age that, based on operating experience, will meet the operating objectives of the plant. These objectives might include parameters such as secondary effluent total suspended solids (TSS) and BOD, sludge volume index (SVI) and extent of nitrification required.

D. Energy Requirements

The energy requirements associated with upgrading the secondary biological treatment process to a biological nutrient removal process include influent pumping, mixed liquor recirculation pumping, basin mixing, and aeration requirements. The existing plant currently employees RAS/WAS pumping so the upgrade would not add energy for that obligation. The mixed liquor pumps would likely consist of three, 2 HP MLR pumps operating continuously. The existing blowers in the blower room are sized adequately for the upgrade and would need to be run more frequently. Variable frequency drives will be added to minimize unnecessary blower operation. The added air requirements would result in an additional 50 to100 HP operating daily.

E. Regulatory Compliance and Permits

Circular DEQ 2, Design Standards for Wastewater Treatment Facilities states that the activated sludge processes "may be employed to accomplish varied degrees of removal of suspended solids and reduction of carbonaceous and/or nitrogenous oxygen demand. All designs must provide flexibility in operation and should provide for operation in various modes. Where primary settling tanks are not provided, effective removal or exclusion of grit, debris, and screening of solids must be accomplished prior to the activated sludge process." There are many other requirements that deal with arrangement, inlets and outlets, freeboard, aeration equipment, return activated sludge (RAS), waste activated sludge (WAS), etc, that will need to be considered during design of a new treatment train.

F. Land Requirements

There is ample space available within the current boundaries of the Stevensville WWTP to implement this improvement. The secondary biological treatment process would be located in the existing digester building (Figure 6, Appendix C).

G. Environmental Considerations

The proposed improvements to the secondary biological treatment process will have impacts on the environment including a more uniform and healthy point source discharge to the Bitterroot River. The improvements to the biological treatment process will bring the Town's discharge to within the limits proposed for nitrate in the new discharge permit. Additionally, the upgrade will reduce the need to chemical addition to the meet the phosphorus limits that are so frequently violated, because the phosphorus will be removed biologically in conjunction with the nitrogen.

H. Construction Problems

There are no construction problems anticipated for this other than construction sequencing. Alternative SBT 4 would require greater coordination for construction sequencing and bypassing treatment during construction, as well as dealing with utility conflicts. Alternative SBT 3 is more easily able to be constructed.

I. Cost Estimates

Table IV-4 describes the engineer's estimate of probable construction costs for each alternative.

Table IV-4. Engineer's Probable Construction Cost for Secondary Biological Treatment

Alternative	Estimated Construction Cost	Estimated Annual O&M Cost	20 Yr Present Worth
SBT-3:	$ 2,023,000	$ 74,199	$ 2,948,000
SBT-4:	$ 4,629,000	$ 60,708	$ 5,386,000

1. Project Costs

Project cost for implementation of a new secondary biological treatment system for the Town of Stevensville as presented in Table IV-4. The estimated construction cost includes engineering, modifications to existing structures, influent pumping modification, all required pumps, mixers, piping, analyzers, modifications to aeration piping and equipment, and flow control gates, valves, and weirs.

2. Annual O&M Costs

The annual operations and maintenance cost for the secondary biological treatment upgrade alternatives are based on the power to operate the blowers, MLR pumps, and mixers only for SBT 4. In addition to those costs, SBT 3 includes the influent pumps. Power costs are based on $0.07 KW-Hr usage, plus a $9.18/ KW demand charge, with all systems operating 24 hours a day 365 days a year at 80% efficiency. The actual impact to the Town will gradually increase to the design demand as flows increase. Also, for budgeting assumptions, the current operating costs for the oxidation ditch mechanical aerators can be subtracted from the operating costs for a total cumulative initial O&M cost of $8,400.

3. Present Worth Analysis

The 20-year present worth was calculated based on a 5% annual interest rate.

J. Selection of Preferred Alternative

Table IV-5 provides a comparative analysis of all the alternatives for secondary biological treatment discussed above. The criteria rankings range from 1 to 5 with 1 being poor, 5 being best. The preferred alternative is converting a portion of the existing aerobic digester to a conventional biological nutrient removal process based on a majority of the criteria utilized for comparison. This alternative provides treatment capacity for the Town of Stevensville WWTP to design year 2035, represents a reasonable cost, and is equally easy to implement.

Table IV-5. Secondary Biological Treatment Selection Logic Matrix

Evaluation Criteria	Convert portion of digester to conventional BNR System (SBT 4)	New process in place of existing (SBT 5)
Regulatory Coordination	4	4
Operations/ Technology	3	4
Compatibility with Site	3	4
Implementation	4	2
Public Health/Safety	3	3
Community/ Environmental	3	3
Risk	4	3
Cost	4	1
TOTAL	**28**	**24**

Section V. Detailed Description of the Preferred Alternative

A summary of the preferred alternative for WWTP upgrades at the Town of Stevensville is as follows:

- Perforated plate influent screen with washer compactor
- Vortex grit removal
- Convert existing aerobic digester to conventional biological nutrient removal

A. Site Location and Characteristics

Site location of the facility and characteristics of the site have already been discussed in previous sections. The improvements will require no acquisition of new property and are confined entirely to the existing plant site. Drawings and schematics of the proposed improvements have been provided in Appendix C, Figures 1 through 6.

B. Operational Requirements

The current operators of the Stevensville WWTP have the expertise required to operate the facility following all recommended upgrades. Construction of a grit removal system will result in less maintenance for the various submersible pumps throughout the WWTP. Installation of a mechanically cleaned influent screen and washer/compactor will eliminate the need for handling of solids by plant staff. The proposed biological treatment process will require additional sampling to document nutrient removal efficiency. Performing biological nutrient removal will likely require additional on-line analyzers.

C. Impact on Existing Facilities

The phased improvements to the WWTP are not expected to impact other facilities operated by the Town of Stevensville. Construction traffic in the vicinity of the WWTP will increase during construction of the proposed improvements. This will also impact the public park adjacent to the WWTP as the access road to the WWTP passes through the park. At no time is public access expected to be blocked. Adding nutrient removal capability at the WWTP should allow the Town to continue to use phosphate based corrosion inhibitors in the water system.

D. Design Criteria

Headworks:

Hydraulic Capacity – 3.0 MGD

Influent Screen:

- 1.0 MGD with single screen
- 3.0 MGD with manual bypass screen
- 6.0 mm perforated plate

Screenings Washer/Compactor:

- Volume Reduction: 80%
- Organic Removal: 90%
- Minimum Solids Concentration: 50%

Grit Removal Capacity:

- 95% removal of grit greater than 50 mesh
- 85% removal of grit greater than 70 mesh
- 65% removal of grit greater than 100 mesh

Biological Treatment Process

10 mg/L total Nitrogen

1 mg/L total Phosphorus

0.40 MGD max month flow

E. Cost Summary of the Preferred Alternative

Project Cost Estimate

The overall cost of the recommended plan in 2014 dollars, escalated to the midpoint of construction, is summarized in Table V-1.

Table V-1. Project Cost Summary

Project Element	Estimated Implementation Cost
Secondary Biological Treatment	$2,150,000
Headworks Improvements	$1,264,000
Total Estimated Project Cost	$3,414,000

A detailed cost breakdown for the Phase 2 project in 2014 dollars. The total estimated project cost is shown in Table V-2. This cost includes the implementation cost shown in Table V-1, in addition to preliminary engineering, contingency, and administrative costs.

Table V-2 Phase 2 Detailed Project Cost Summary

Project Element	Estimated Implementation Cost
Preliminary Engineering	$35,000
Final Design Engineering	$311,776
Construction Engineering Services	$93,099
Inspection/Resident Project Representative	$175,000
Construction	$2,834,323
Contingency	$283,432
Activity Cost Subtotal	**$3,732,630**
Personnel Costs	$0.00
Office Costs	$1,000.00
Professional Services	$0.00
Legal Costs	$1,000.00
Audit Fees	$6,000.00
Interim Interest	$10,000.00
Bond Council and Related Costs	$20,000.00
Administrative Cost Subtotal	**$38,000**
Total Estimated Project Cost	**$3,770,630**

Annual Operating Budget

The funding plan includes cash reserves from the Town, a $100,000 RRGL grant, a $750,000 TSEP grant, a $450,000 CDBG grant, a $676,700 RD grant, and a $1,579,000 RD loan at 3.5% over 40-years. The annual loan payment will be approximately $74,000 per year.

Income

The vast majority of the Town of Stevensville sewer utility operating budget is from residential user fees. Monthly user fees currently average $44.59 per month for a single family residence. These fees will increase to $47.54 per month once the 2013 and 2014 rate increases are in place. Table V-3 provides existing meter data for FY 2011/2012 which was utilized to determine the Town's annual sewer utility income. The table assumes 3% of bills will be unpaid.

Table V-3 Phase 2 Detailed Project Cost Summary

FY 2011/2012					
Meter Size	**No.**	**Base Rate (FY 11/12)**	**Debt Service Charge**	**Quarterly Income (FY 11/12)**	**Annual Income (FY 11/12)**
3/4"	757	$72.87	$60.90	$101,263.89	$405,055.56
1"	43	$130.44	$109.00	$10,295.92	$41,183.68
1.5"	15	$291.48	$243.60	$8,026.20	$32,104.80
2"	4	$520.29	$434.83	$3,820.48	$15,281.92
				Total Projected Annual Income	**$493,625.96**
				Total Collected Annual Income	**$481,213.28**

O&M Costs

Increased operation and maintenance costs associated with the Phase 2 project are expected to be due primarily to power consumption and pump maintenance. The total increase in annual operation and maintenance for the Phase 2 project is estimated to be $18,200 and includes headworks, influent pumping, MLR pumping, mixers and additional aeration capacity from running the existing blowers.

Capital Improvements

The Town of Stevensville completed comprehensive capital improvement planning for the wastewater and water utilities in 2011. The capital improvement plan was adopted by the Town Council on September 13, 2011 by Council Resolution No. 259. A copy of the adopted Capital Improvement Plan is attached to this Preliminary Engineering Report as Appendix G.

Debt Repayment and Coverage Requirements

The town currently has outstanding loans in the amount of $1,796,286 for improvements made to the WWTP in 2000 and outstanding loans in the amount of $776,573 for the

Phase 1 Improvements project. The annual average payment for these loans is $144,972. Debt coverage on these loans is equivalent to a single annual payment or approximately $144,972.

Reserves

Reserve requirements will increase by approximately $7,400 due to proposed funding associated with the Phase 2 project bringing the total coverage requirements to $152,372. If TSEP, RRGL, and CDBG funds are not acquired, the debt coverage associated with the Phase 2 project will increase by approximately $11,500 bringing the total coverage requirements to $156,472. The majority of the equipment at the WWTP is expected to have a life longer than 20-years.

Section VI. Recommendations and Implementation

Funding Strategy

The Town of Stevensville intends to utilize a combination of RRGL Grant, TSEP Grant, CDBG Grant, Rural Development (RD) Grant, RD Loan, and Town funds to finance the Phase 2 project. The RD and RRGL programs do not have match requirements. RRGL provides grants in a maximum amount of $100,000. TSEP and CDBG have match requirements and provide grants in the maximum amounts of $750,000 and $450,000 respectively. The required match will be met through the use of Town funds and loans. The RD program typically provides grant/loan packages with a 30%/70% split respectively. RD loans are currently provided at approximately 3.5% interest over 40-years.

It will be necessary to utilize RRGL, TSEP, CDBG and RD grant and loan funds to design and construct the proposed Phase 2 project. The work associated with the Phase 2 project is planned to be complete and operational by July 31, 2015. The Town intends to utilize RD loan, RRGL grant and its own cash reserves to proceed with design of the proposed improvements project. RD grant and loan, TSEP grant, and CDBG grant funds will be utilized for construction and engineering service during construction. The proposed amounts to be contributed by each source of funding are as follows:

RRGL Grant - $100,000

TSEP Grant - $765,000 ($15,000 TSEP Planning Grant Included)

CDBG Grant - $450,000

RD Grant – $676,700

RD Loan – $1,579,000

Town Funds - $200,000

The annual debt service for the RD loan will be approximately $74,000 and the Town’s current rates can handle the increased payment. As stated previously, the Town has been proactive in raising rates in recent years and now has a rate over twice the target rate. If the funding is not provided for this project, financial analysis indicates that rates may have be raised on the order of $4/month for each household.

Implementation

Implementation of the recommended plan will require a coordinated effort on the part of the Town of Stevensville, their selected engineer, and the citizens of Stevensville. The Town should complete and submit their loan application as soon as possible to meet the funding sources timeline. The final design, bid, and construction of Phase 2 should be implemented as soon as possible to protect the health and safety of the public. Additionally, construction cost is escalating and any delay will result in increased cost for the required improvements. An approximate schedule for the project is described below:

- Obtaining Phase 2 project funding: July 2013
- Engineering design of Phase 2 improvements: March - December 2013
- Construction of Phase 2: January – December 2014

To assure successful implementation of the above schedule, it is recommended the Town of Stevensville undertake the following:

- Continue to maintain contact with government leaders, stakeholders, and citizens to further develop a support base for the recommended changes at the WWTP.
- Continue to stay abreast of the Bitterroot River TMDL program progress and other regional water quality studies.

Public Participation

A public hearing was held on March 22, 2012 and April 26, 2012. In March, a presentation describing in detail the preliminary engineering report was delivered by the project manager Craig Caprara and project engineer Coralynn Revis of HDR Engineering, Inc. In April, the environmental review of the project was presented. Both of the meetings were open to the public and advertised in the local newspaper. Announcements, minutes, public hearing documentation, and relevant newspaper articles are included in Appendix F - Public Involvement.

Appendix A – Planning Area Reference Maps

Appendix B – Environmental Checklist

Appendix C – WWTP Maps

Appendix D – MPDES Permit

Appendix E – MDEQ Letters/Reports

Appendix F – Public Involvement

Appendix G – Water and Wastewater Systems Capital Improvement Plan

Appendix H – Cost Estimates