FACILITY PLAN

FOR

WASTEWATER TREATMENT FACILITY

CRESTON, IOWA

OCTOBER, 2016

VEENSTRA & KIMM, INC.

FACILITY PLAN

FOR

WASTEWATER TREATMENT FACILITY

CRESTON, IOWA

OCTOBER, 2016

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

Signed: Date:

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My license renewal date is December 31, 2017

Parts covered by this seal:

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CRESTON, IOWA

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CHAPTER 1 - INTRODUCTION

SCOPE

This report sets forth the results of the facility planning for the wastewater treatment facility in the City of Creston. The report projects the future conditions and effluent requirements for the design period of 20 years. The report evaluates various treatment improvements necessary to meet future requirements.

FACILITY OVERVIEW

The current Wastewater Treatment Facility was originally constructed in the 1930s as a trickling filter wastewater treatment facility with one primary and one final clarifier and a sludge storage tank. The 1967 added a second primary clarifier, a second final clarifier, and a sludge digester. In 1987, an intermediate pump station was constructed, along with a screenings building. The original final clarifier was abandoned and a new redundant final clarifier was constructed. In 1995, an additional sludge storage tank was constructed.

The last improvement project on the facility was constructed in 1997. This project converted the two final clarifiers into intermediate clarifiers. Two new final clarifiers were constructed. The original primary clarifier from the 1930s construction was abandoned and a new redundant primary clarifier was constructed. Two nitrification towers, or "trickling towers", were also constructed. A laboratory was added to the control building at the digester, and a maintenance building was constructed.

The typical life span for mechanical process equipment is considered to be in the range of 20 years. Almost all of the equipment and processes at the Wastewater Treatment Facility are between 20 to 40 years old.

The Wastewater Treatment Facility was designed with the following design parameters:

Average Dry Weather Flow (ADW)	1.10 mgd
Average Wet Weather Flow (AWW)	3.60 mgd
Maximum Wet Weather Flow (MWW)	7.50 mgd
Biological Loading - BOD_5	3,000 lbs./day
TKN Loading	270 lbs./day

Flow in excess of the MWW Flow of 3.60 mgd is sent to the equalization pond until it can be pumped back through the treatment facility.

The average daily flow at the Wastewater Treatment Facility is in the original design range of 1.10 mgd to 3.60 mgd.

The biological loading to the Wastewater Treatment Facility is normally in the range of 1,000 to 3,000 pounds per day of BOD_5. The biological loading to the Wastewater Treatment Facility is normally lower than the biological loading projected during the construction of the original Wastewater Treatment Facility occurred. Although some increases in biological loading are anticipated, the future biological loading to the Wastewater Treatment Facility is expected to remain below the existing design levels.

The total Kjeldahl nitrogen (TKN) loading to the Wastewater Treatment Facility is in the range of 300 to 400 pounds per day of TKN. The TKN loading to the Wastewater Treatment Facility is higher than the loading projected during the original construction of the Wastewater Treatment Facility. The future TKN loading at the Wastewater Treatment Facility is expected to be higher than the design levels from the original construction.

The key objectives of the facility planning included:

1) **evaluation of the physical condition of the existing facilities,**
2) **projection of what the future effluent limitations would be, and**
3) **evaluation of the potential for the existing facilities to meet those limitations.**

Some of the physical facilities do not provide the operational flexibility essential for optimizing the Wastewater Treatment Facility performance. The facility planning can also be fairly characterized as focusing on the preservation and optimization of existing facilities, including analysis of the available industrial and domestic growth that could be treated using the existing facilities.

COST ESTIMATES

The facility planning includes preliminary estimates of cost for proposed improvements. The preliminary estimates of cost are based on a facility planning level of analysis.

The Facility Plan cost estimates include the estimated construction cost. The cost estimates include a 15% contingency allowance and a 15% allowance for engineering, legal and administrative.

The facility planning cost estimates are approximate. Generally, facility planning cost estimates are considered accurate to within a range of plus or minus approximately 15%. The estimated cost of improvements by each major process is set forth. The cost estimate presented with each recommended improvement is the total cost that includes the construction cost, contingency and allowance for engineering, legal and administrative costs.

Within the financing analysis, the estimated construction cost, contingency and allowance for engineering, legal and administrative costs are separately identified.

CHAPTER 2 - EFFLUENT LIMITATIONS

GENERAL

This chapter discusses the water quality standards and effluent limitations which impact the proposed improvements to the Creston, Iowa Wastewater Treatment Plant. Point discharges of pollution in Iowa are normally regulated by permits issued by IDNR. Because the permits limit the quantity of certain parameters and pollutants in the effluent from point sources, the limitations which apply to a given effluent are essential for proper planning and design of wastewater treatment facilities. These effluent limitations are also, in turn, directly related to the water quality standards which apply to the river or stream receiving the discharge and must be appropriately modified to suit local conditions.

RECEIVING STREAMS

The City of Creston currently discharges its treated wastewater into an Unnamed Creek which is a tributary to the Platte River. Both the Unnamed Creek and the Platte River are classified as secondary contact recreation use (Class A2) and a warm water fisheries - Type 2(Class B(WW-2) waterways.

WATER QUALITY STANDARDS

Water quality standards for the State of Iowa are regulated by IDNR and presented in Section 567 - Environmental Protection Commission of the Iowa Administrative Code under Chapter 61 - Water Quality Standards. IDNR has developed a classification system for all surface waters in the State of Iowa to define water quality according to use and for the protection of beneficial uses. This classification system establishes general use and designated use river and stream segments.

General use segments are watercourses with intermittent flow or typically flow only for short periods of time following precipitation or as a result of discharges from wastewater treatment facilities. These waters do not support a viable aquatic community of significance during low flow, and do not maintain pooled conditions during periods of no flow. However, during elevated flow periods when sufficient flow exists in the intermittent watercourses to support various uses, the general use segments are to be protected in accordance with the "General Water Quality Criteria" which are discussed later in this chapter. Also, aquatic life existing within these watercourses during elevated flows are to be protected from acutely toxic conditions.

Designated use segments are bodies of water which maintain flow throughout the year, or contain sufficient pooled areas during intermittent flow periods to maintain a viable aquatic community of significance. Designated use waters are to be protected for all uses of general use segments in addition to the specific uses assigned.

Designated use segments include:

Class A1 - Primary Contact Recreation Use: Waters in which recreational or other uses may result in prolonged and direct contact with the water, involving considerable risk of ingesting water in quantities sufficient to pose a health hazard. Such activities would include, but not be limited to, swimming, diving, water skiing, and water contact recreational canoeing.

Class A2 - Secondary Contact Recreational Use: Waters in which recreational or other uses may result in contact with the water that is either incidental or accidental. During the recreational use, the probability of ingesting appreciable quantities of water is minimal. Class A2 uses include fishing, commercial and recreational boating, any limited contact incidental to shoreline activities and activities in which users do not swim or float in the water body while on a boating activity.

Class A3 - Children's Recreational Use: Waters in which recreational uses by children are common. Class A3 waters are water bodies having definite banks and bed with visible evidence of the flow or occurrence of water. This type of use would primarily occur in urban or residential areas.

Class B(WW-1) Warm Water - Type 1: Waters in which temperature, flow and other habitat characteristics are suitable to maintain warm water game fish populations along with a resident aquatic community that includes a variety of native nongame fish and invertebrate species. These waters generally include border rivers, large interior rivers, and the lower segments of medium-size tributary streams.

Class B(WW-2) Warm Water - Type 2: Waters in which flow or other physical characteristics are capable of supporting a resident aquatic community that includes a variety of native nongame fish and invertebrate species. The flow and other physical characteristics limit the maintenance of warm water game fish populations. These waters generally consist of small perennially flowing streams.

IDNR has also established "General Water Quality Criteria" which are applicable to all surface waters including those which are designated use segments. As stated in Chapter 61, the "General Water Quality Criteria" are applicable at all places and at all times to protect livestock and wildlife watering, aquatic life, non-contact recreation, crop irrigation, and industrial, domestic, agricultural and other incidental water withdrawal uses not protected by specific numerical criteria. The "General Water Quality Criteria" are as follows:

1. Such waters shall be free from substances attributable to point source waste discharges that will settle to form sludge deposits.

2. Such waters shall be free from floating debris, oil , grease, scum, and other floating materials attributable to wastewater discharges or agricultural practices in amounts sufficient to create a nuisance.

3. Such waters shall be free from materials attributable to wastewater discharges or agricultural practices producing objectionable color, odor, or other aesthetically objectionable conditions.

4. Such waters shall be free from substances attributable to wastewater discharges or agricultural practices in concentrations or combinations which or toxic to human, animal, or plant life.

5. Such waters shall be free from substances attributable to wastewater discharges or agricultural practices, in quantities which would produce undesirable or nuisance aquatic life.

6. The turbidity of the receiving water shall not be increased by more than 25 Nephelometric turbidity units by any point source discharge.

7. Cations and anions guideline values to protect livestock watering may be found in the "Supporting Document for Iowa Water Quality Management Plans," Chapter IV, July 1976, as revised on November 11, 2009.

8. The Escherichia coli (E. coli) content of water which enters a sinkhole or losing stream segment, regardless of the water body's designated use, shall not exceed a Geometric Mean value of 126 organisms/100 ml or a sample maximum value of 235 organisms/100 ml. No new wastewater discharges will be allowed on watercourses which directly or indirectly enter sinkholes or losing stream segments.

EFFLUENT LIMITATIONS

The Federal Wastewater treatment Act Amendment of 1972 (PL92-500) increased the role each state plays in control of the discharge of pollutants into its waterways. Under this amendment, the National Pollutant Discharge Elimination System (NPDES) permit program was established which is administered by the Environmental Protection Agency (EPA). Monitoring and surveillance of water quality is conducted by IDNR through its operation permit program. IDNR has assumed the responsibility of the NPDES program for the State and the program is now operated through the state operating permit system. The NPDES permit establishes effluent limitations for all wastewater treatment systems discharging or planning to discharge effluent to rivers and streams within the State of Iowa.

REGULATORY REQUIREMENTS

The City of Creston's wastewater treatment facility operates under Iowa NPDES Permit No. 8816001 issued by the IDNR. The current permit was issued on July 1, 2015 and expires on June 30, 2020. A copy of this permit is included in Appendix A. A summary of the major effluent parameters of the operating permit are:

Parameter	Permit Limit
Average 30 Day $CBOD_5$, mg/l	25
Average 30 Day $CBOD_5$, ppd	1,201
Maximum 7 Day Average $CBOD_5$, mg/l	40
Maximum 7 Day Average $CBOD_5$, ppd	751
Average 30 Day TSS, mg/l	30
Average 30 Day TSS, ppd	1,351
Maximum 7 Day Average TSS, mg/l	45
Maximum 7 Day Average TSS, ppd	901
30 Day Geometric Mean E. coli, #/100 ML	630
Average 30 Day Total Silver, mg/l	0.00380
Average 30 Day Total Copper, mg/l	0.01687
7 DayAverage pH	6.5
Daily Maximum pH	9.0

The current permit also includes new ammonia limits and disinfection requirements and a schedule to meet those requirements.

The new disinfection limits do not become effective until July 1, 2018. The disinfection requirements are such that the geometric mean is less than 630 colonies of E. coli per 100 ml. The E. coli effluent limitations are only required to be met from March 15 through November 15 of each year.

The new ammonia limits became effective July 1, 2015. Based on current effluent monitoring reports, the existing treatment facility will be able to meet the new ammonia effluent limits. Figures 2-1 through 2-4 show the new ammonia effluent limits vs. the highest reported effluent concentration and loading from the last 5-years of MOR data. **The figures show that there have not been any months in the last 5-years of monitoring that would exceed the new ammonia limits in the draft permit.**

(Insert Ammonia Graphs)

The new metal limits do not become effective until June 1, 2020. The allowable metal contributions from the significant industrial users have not changed from the current NPDES permit. A separate compliance schedule and strategy are dedicated to the silver and copper limits. They are not further addressed in this report.

NUTRIENT REDUCTION REQUIREMENTS

The current permit includes a requirement to evaluate reducing the amount of nitrogen and phosphorous discharged into surface water. For the City of Creston treating typical domestic strength sewage, the effluent limits will be 10 mg/l for total nitrogen and 1.0 mg/l for total phosphorous.

Nutrients, such as nitrogen and phosphorus, are essential for healthy marine and freshwater environments. However, an overabundance of nutrients can literally be too much of a good thing. An overabundance of nutrients can trigger excessive algal growth (or eutrophication) which results in reduced sunlight, loss of aquatic habitat, and a decrease in oxygen dissolved in the water.

In addition to the effects on the receiving waters, excessive nutrient discharges in the Mississippi River basin have resulted in a "dead zone" in the Gulf of Mexico's Texas-Louisiana Shelf. An area of hypoxia (low dissolved oxygen levels) forms during the summer months covering 6,000 to 7,000 square miles, an area that has doubled in size since 1993. This condition is believed to be caused by a complicated interaction of excessive nutrients transported to the Gulf of Mexico by the Mississippi River; physical changes to the river, such as channelization and loss of natural wetlands and vegetation along the banks; and the interaction of freshwater from the river with the saltwater of the Gulf.

A significant portion of the nutrients entering the Gulf from the Mississippi River comes from a variety of human activities, including discharges from sewage treatment plants, stormwater runoff from city streets, and nonpoint source pollution from farms. In addition, some nutrients from automobile exhaust and fossil fueled power plants may enter the waterways and the Gulf directly through air deposition. It has been estimated that 9% of the nitrogen and 11% of the phosphorus entering the Gulf of Mexico from the Mississippi River Basin are municipal and industrial point sources.

Based on current effluent monitoring reports, the existing treatment facility will not be able to meet the new effluent limits for total nitrogen and total phosphorous. Figure 2-7 shows the new total nitrogen effluent limits vs. the reported effluent concentrations for total nitrogen from the treatment facility. Figure 2-8 shows the total phosphorous effluent limits vs. the reported effluent concentrations for total phosphorous for the treatment facility.

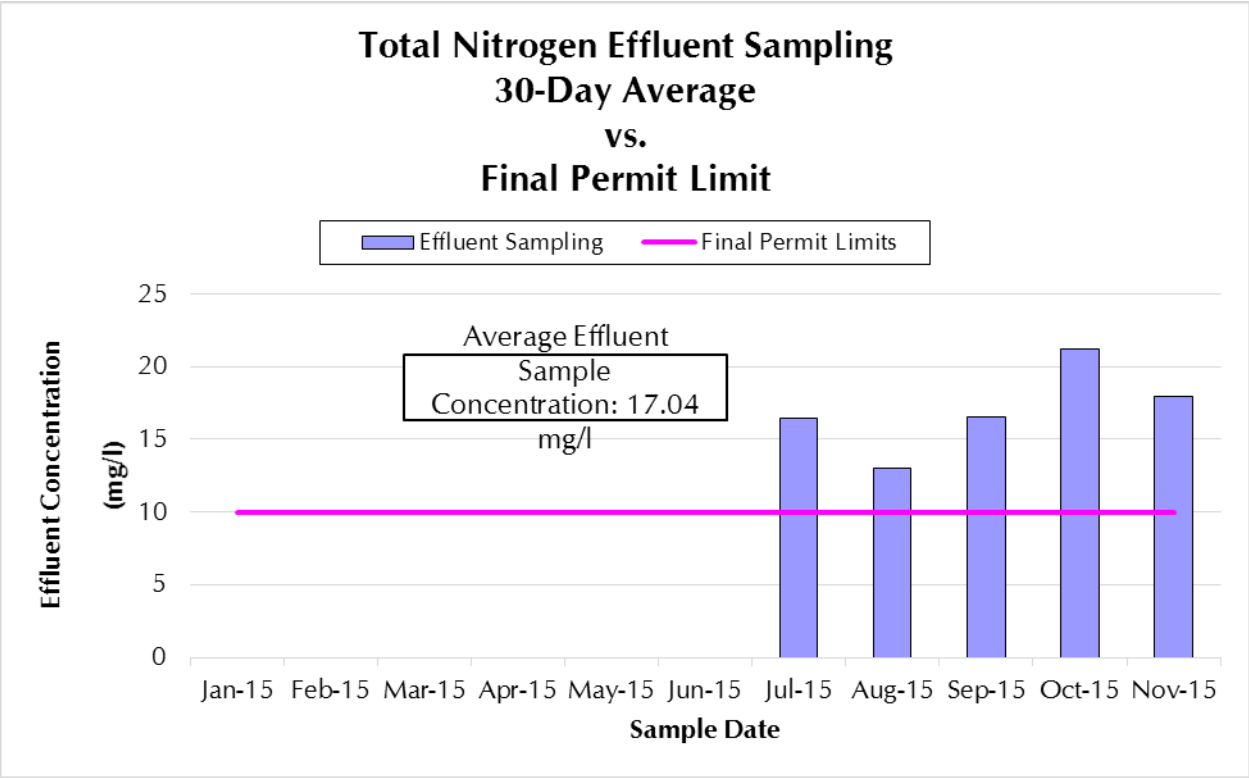

Figure 2-7

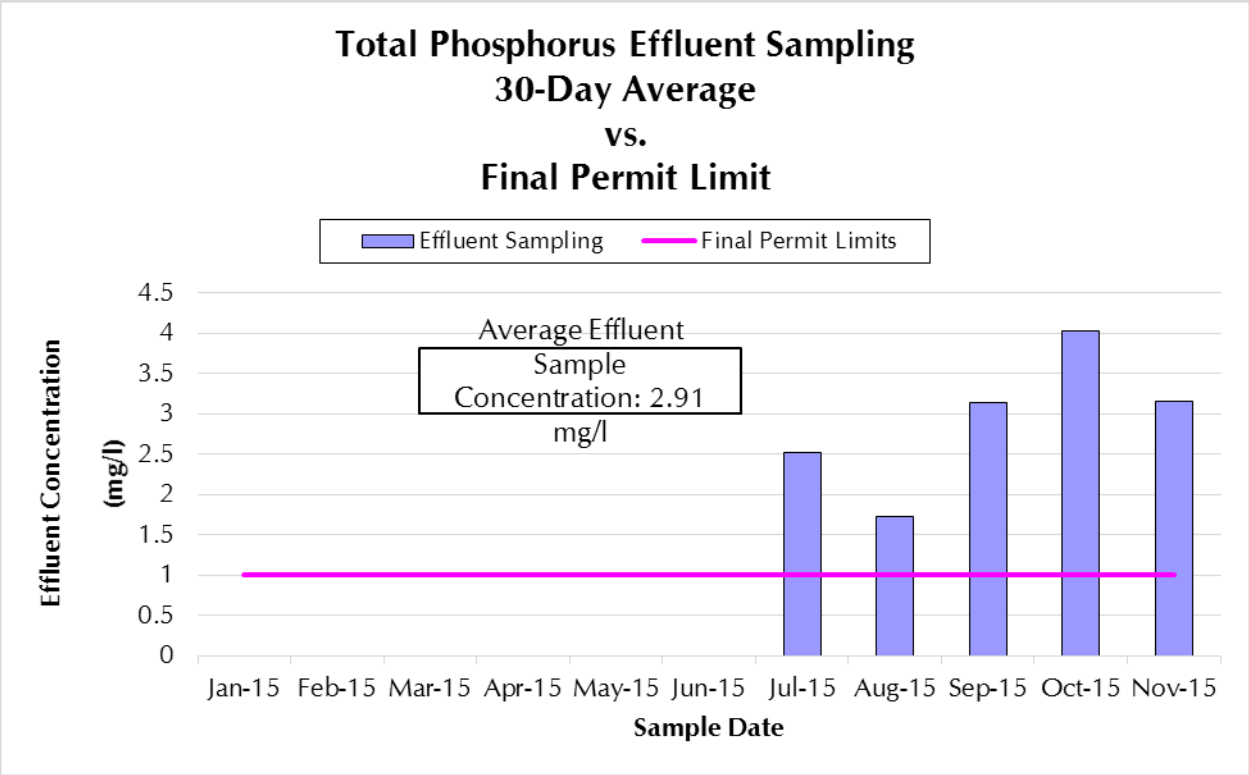
Total Phosphorus Effluent Sampling
30-Day Average
vs.
Final Permit Limit
Effluent Sampling
Final Permit Limits
Average Effluent Sample Concentration: 2.91 mg/l
Effluent Concentration (mg/l)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-15
Feb-15
Mar-15
Apr-15
May-15
Jun-15
Jul-15
Aug-15
Sep-15
Oct-15
Nov-15
Sample Date

Figure 2-8

CHAPTER 3 - POPULATION AND FLOWS

POPULATION

The City of Creston has experienced some historical population decline, with a more recent subtle increase over the past 45 years. The historical population data for the City is presented in Table 3-1.

TABLE 3-1
Population

Year	Population
1970	8,234
1980	8,429
1990	7,911
2000	7,597
2010	7,834
2014	7,839
2015	7,854
2038*	8,050*

*Estimate

The future projection in Table 3-1 assumes a moderate annual population growth to reach a population of 8,050 by the year 2038. Although Creston's annual decline rate from 1980-1990 was approximately 6.2%, the population experienced a slight increase between 2000 and 2010 and has remained within + / - 1% of the 2010 population. The average decline rate over the 45 years of U.S. Census Bureau data was 4.62%. However, because of the population trends within the past five years, a moderate population growth of 0.1% was assumed for the future projection.

STUDENTS

The City of Creston is part of the Creston Community School District. The school district serves the community of Creston and surrounding rural areas. The elementary, middle and high schools are located in Creston, Iowa.

INDUSTRIES

The city of Creston is home to a few industries. Several are considered significant industrial users. These industries are required to have an NPDES permit or treatment agreement with the city.

WASTEWATER FLOWS

Existing wastewater flows and loadings were determined by analyzing Monthly Operating Reports (MOR) from five years of historical data, January 2011 to July 2016. Table 3-2 presents a summary of the average monthly wastewater flows and daily peak flows for the period.

The Iowa Department of Natural Resources requires wastewater flows during specific conditions be determined to establish the design parameters for improvements to wastewater treatment facilities. These conditions include the following:

Average Dry Weather (ADW) Flow – The daily average flow when the groundwater is at or near normal and runoff is not occurring.

Average Wet Weather (AWW 180) Flow – The daily average flow for the wettest 180 consecutive days.

Average Wet Weather Flow (AWW 30) – The daily average flow for the wettest 30 consecutive days.

Maximum Wet Weather (MWW) Flow – The total maximum flow received during any 24-hour period when the groundwater is high and runoff is occurring.

Peak Hourly Wet Weather (PHWW) Flow – The total maximum flow received during one hour when the groundwater is high, runoff is occurring, and the domestic, commercial and industrial flows are at their peak.

Table 3-2 - WASTEWATER FLOWS
CRESTON, IOWA

Year	Month	30-Day Average gpd	Maximum gpd	Year	Month	30-Day Average gpd	Maximum gpd
2011	January	764,194	870,000	2012	January	778,065	860,000
	February	1,324,286	2,370,000		February	1,392,414	2,380,000
	March	1,460,000	2,180,000		March	1,532,903	2,390,000
	April	1,879,333	2,440,000		April	1,544,667	2,380,000
	May	2,064,194	2,430,000		May	1,079,677	1,870,000
	June	1,898,333	2,380,000		June	868,000	1,270,000
	July	1,076,452	2,160,000		July	666,452	890,000
	August	1,050,968	2,360,000		August	759,355	1,610,000
	September	775,000	1,040,000		September	768,667	1,190,000
	October	595,161	680,000		October	933,226	1,910,000
	November	978,333	1,860,000		November	865,667	1,620,000
	December	1,180,645	2,410,000		December	876,774	1,740,000
	Average	**1,253,908**			**Average**	**1,005,489**	
	Maximum	**2,064,194**	**2,440,000**		**Maximum**	**1,544,667**	**2,390,000**
2013	January	920,968	1,840,000	2014	January	712,581	830,000
	February	947,857	1,930,000		February	840,000	1,300,000
	March	1,332,258	2,430,000		March	787,742	1,140,000
	April	1,711,000	2,530,000		April	986,333	2,370,000
	May	1,825,806	2,410,000		May	1,134,516	2,340,000
	June	1,660,667	2,530,000		June	1,487,000	2,370,000
	July	835,161	1,030,000		July	890,645	1,760,000
	August	751,613	1,190,000		August	1,530,000	2,390,000
	September	787,333	1,270,000		September	1,634,000	2,460,000
	October	752,258	1,140,000		October	1,295,484	2,160,000
	November	742,667	1,310,000		November	876,667	1,030,000
	December	670,968	750,000		December	951,935	1,430,000
	Average	**1,078,213**			**Average**	**1,093,909**	
	Maximum	**1,825,806**	**2,530,000**		**Maximum**	**1,634,000**	**2,460,000**
2015	January	894,000	1,050,000	2016	January	1,675,484	2,340,000
	February	1,077,000	1,640,000		February	1,697,931	2,560,000
	March	1,065,000	1,860,000		March	1,389,032	2,010,000
	April	1,520,000	1,520,000		April	1,506,333	2,400,000
	May	1,748,000	2,410,000		May	1,861,935	2,390,000
	June	1,936,000	2,380,000		June	1,000,000	1,780,000
	July	1,958,000	2,450,000		July	1,252,581	2,390,000
	August	2,080,000	2,460,000		August	---	---
	September	2,020,000	2,400,000		September	---	---
	October	1,153,000	1,870,000		October	---	---
	November	1,611,000	2,440,000		November	---	---
	December	2,239,000	2,460,000		December	---	---
	Average	**1,608,417**			**Average**	**1,483,328**	
	Maximum	**2,239,000**	**2,460,000**		**Maximum**	**1,861,935**	**2,560,000**

Average Dry Weather (ADW) Flow
To determine the ADW flow based on historical data, the three lowest monthly flows during that period were averaged. The three lowest monthly flows were from November 2013 to January 2014, with and average flow of 0.709 mgd. This flow corresponds to 90 gallons per day per capita. The Iowa Department of Natural Resources standards recommends 100 gallons per capita per day. This historical value is only slightly lower than the Department of Natural Resources recommendation, and it is an accurate representation of dry weather flow. **Therefore, the current ADW flow for Creston is 709,000 gpd or 0.709 mgd.**

Average Wet Weather (AWW) Flow
The AWW 180 flow is the daily average flow for the wettest 180 consecutive days. This flow is generally used for sizing controlled discharge lagoons. A review of Table 3-2 shows the maximum AWW 180 flow occurred during the months of April 2015 through September of 2015. **The AWW 180 flow rate is 1,877,000 gpd or 1.877 mgd.**

The AWW 30 flow is the daily average flow for the wettest 30 consecutive days. This flow is generally used for sizing aerated lagoons and mechanical treatment facilities. A review of Table 3-2 shows the highest daily average flow of 2.239 mgd occurred during the month of December of 2015. **The AWW 30 flow rate is 2,239,000 gpd or 2.239 mgd.**

Maximum Wet Weather (MWW) Flow
The currently permitted MWW flow is 7.50 mgd. In the past six years of MORs there are no months with recorded days where the flow was in excess of the permitted 7.50 mgd. The highest maximum flow was 2.56 mgd and was recorded in February of 2016. **Therefore, the MWW flow rate is estimated to be 2,560,000 gpd or 2.56 mgd.**

Peak Hour Wet Weather (PHWW) Flow
Peak Hour Wet Weather Flow is a flow condition that occurs when the groundwater is high, runoff is occurring, and the domestic, commercial and industrial flows are at their peak. Because there is currently no way to record hourly flow at the facility, a historical PHWW flowrate could not be determined.

LOADINGS

Wastewater influent is sampled one time each week for biochemical oxygen demand (BOD) and twice each month for total suspended solids (TSS). Total Kjeldahl Nitrogen (TKN) is not monitored. Tables 3-3 and 3-5 present a summary of the BOD and TSS loadings for the six years of MORs.

Biochemical Oxygen Demand (BOD)
The historical 30-day average BOD loading is 1,144 lbs/day. On a per capita basis, the BOD loading equates to 0.146 lbs/capita/day. The Iowa Department of Natural Resources design standard for BOD is 0.17 lbs/capita/day.

There is a difference between the IDNR standards' per capita loading recommendations and the recorded loading rates at Creston. Because the BOD sampling occurs each week, the confidence in its accuracy is enough to utilize the historical flow. The consistency of the BOD loading being in the low 1,000s range throughout the five years of historical data, as opposed to varying greatly and averaging in this range, provided further confidence in its accuracy. Therefore, the decision was made to base the design of the BOD loading off of the historical data. **Therefore, the current BOD loading is estimated at 1,144 lbs/day.**

Total Suspended Solids (TSS)
The historical 30 day average TSS loading is 1,646 lbs/day. On a per capita basis, the TSS loading equates to 0.21 lbs/capita/day. The Iowa Department of Natural Resources design standard for TSS is 0.20 lbs/capita/day.

There is a slight difference between the IDNR standards' per capita loading recommendations and the recorded loading rates at Creston. However, the historical 30-day average results in a more conservative figure than the DNR recommendation. Therefore, the decision was made to base the design of the TSS loading off of the historical data. **Therefore, the current TSS loading is estimated at 1,646 lbs/day.**

Total Kjeldah Nitrogen (TKN)
The historical 30 day average TKN loading is 344 lbs/day. On a per capita basis, the TKN loading equates to .044 lbs/capita/day. The Iowa Department of Natural Resources design standard for TSS is 0.036 lbs/capita/day.

There is a difference between the IDNR standards' per capita loading recommendations and the recorded loading rates at Creston. However, the historical 30-day average results in a more conservative figure than the DNR recommendation. Therefore, the decision was made to base the design of the TKN loading off of the historical data. **Therefore, the current TKN loading is estimated at 344 lbs/day.**

TABLE 3-3 – BOD LOADINGS
CRESTON, IOWA

Year	Month	Average ppd	Maximum ppd	Year	Month	Average gpd	Maximum gpd
2011	January	1,167	1,473	2012	January	969	1,260
	February	1,063	1,327		February	1,041	1,285
	March	1,307	1,747		March	933	1,297
	April	1,267	1,717		April	1,279	2,081
	May	1,142	1,641		May	981	1,871
	June	856	1,200		June	895	1,090
	July	782	931		July	913	1,490
	August	733	1,233		August	869	1,213
	September	728	1,021		September	1,238	1,608
	October	866	1,118		October	1,231	1,585
	November	914	1,155		November	1,236	1,500
	December	821	1,458		December	1,287	2,133
	Average	**971**			**Average**	**1,073**	
	Maximum	**1,307**	**1,747**		**Maximum**	**1,287**	**2,133**
2013	January	979	1,208	2014	January	881	1,086
	February	1,353	1,924		February	995	1,291
	March	1,490	2,061		March	1,041	1,490
	April	1,651	3,025		April	1,211	1,536
	May	1,298	1,945		May	1,075	1,563
	June	979	1,046		June	860	1,171
	July	912	1,243		July	1,029	1,627
	August	1,226	1,777		August	1,240	2,234
	September	1,353	2,807		September	830	1,259
	October	1,249	2,168		October	1,206	1,875
	November	1,291	1,600		November	915	1,053
	December	860	1,138		December	1,043	1,481
	Average	**1,220**			**Average**	**1,027**	
	Maximum	**1,651**	**3,025**		**Maximum**	**1,240**	**2,234**
2015	January	1,132	1,606	2016	January	1,718	2,387
	February	1,157	1,409		February	1,718	2,115
	March	1,386	2,425		March	1,591	2,158
	April	1,417	1,417		April	1,689	2,325
	May	1,346	2,385		May	1,825	2,795
	June	983	1,848		June	1,195	1,462
	July	883	1,228		July	1,369	2,262
	August	1,101	1,559		August	---	---
	September	1,369	1,982		September	---	---
	October	1,053	1,513		October	---	---
	November	1,000	1,629		November	---	---
	December	1,256	2,214		December	---	---
	Average	**1,174**			**Average**	**1,587**	
	Maximum	**1,417**	**2,425**		**Maximum**	**1,825**	**2,795**

Table 3-4 – TSS LOADINGS
CRESTON, IOWA

Year	Month	Average ppd	Maximum ppd	Year	Month	Average gpd	Maximum gpd
2011	January	1,859	2,175	2012	January	1,158	1,351
	February	1,648	2,372		February	1,995	3,103
	March	1,956	2,620		March	1,522	2,223
	April	2,288	3,097		April	1,596	2,562
	May	1,992	4,504		May	1,316	2,178
	June	1,642	2,816		June	1,417	2,059
	July	1,234	1,495		July	1,252	1,857
	August	1,047	1,666		August	1,422	2,612
	September	987	1,270		September	1,686	2,580
	October	1,187	1,594		October	1,621	2,338
	November	1,202	1,981		November	1,484	1,765
	December	1,657	5,064		December	1,816	2,205
	Average	**1,558**			**Average**	**1,524**	
	Maximum	**2,288**	**5,064**		**Maximum**	**1,995**	**3,103**
2013	January	1,416	1,878	2014	January	1,284	1,522
	February	1,982	4,217		February	1,627	2,452
	March	2,419	3,900		March	1,579	2,049
	April	2,467	5,757		April	1,418	2,035
	May	1,708	2,838		May	1,603	2,059
	June	1,478	1,901		June	1,569	3,163
	July	1,401	1,869		July	1,008	1,468
	August	1,460	2,660		August	1,526	3,360
	September	1,318	2,404		September	1,211	2,141
	October	1,438	2,415		October	2,311	3,882
	November	1,550	2,894		November	1,466	1,930
	December	1,258	1,749		December	1,738	3,395
	Average	**1,658**			**Average**	**1,528**	
	Maximum	**2,467**	**5,757**		**Maximum**	**2,311**	**3,882**
2015	January	1,571	2,124	2016	January	2,165	3,586
	February	1,304	1,419		February	2,054	2,649
	March	1,663	2,417		March	2,109	2,919
	April	2,127	2,127		April	2,643	3,976
	May	1,843	3,276		May	2,393	3,296
	June	1,378	2,472		June	1,556	2,628
	July	1,436	2,433		July	1,327	2,362
	August	1,287	1,765		August	---	---
	September	2,639	5,589		September	---	---
	October	1,822	2,773		October	---	---
	November	2,055	3,051		November	---	---
	December	1,661	2,623		December	---	---
	Average	**1,732**			**Average**	**2,035**	
	Maximum	**2,639**	**5,589**		**Maximum**	**2,643**	**3,976**

Table 3-5 – TKN LOADINGS
CRESTON, IOWA

Year	Month	Average ppd	Maximum ppd	Year	Month	Average gpd	Maximum gpd
2015	January	-	-	2016	January	321	401
	February	-	-		February	310	337
	March	-	-		March	342	381
	April	-	-		April	459	631
	May	-	-		May	468	836
	June	-	-		June	356	503
	July	429	429		July	443	652
	August	257	330		August	-	-
	September	255	524		September	-	-
	October	306	402		October	-	-
	November	273	370		November	-	-
	December	251	367		December	-	-
	Average	**295**			**Average**	**385**	
	Maximum	**429**	**524**		**Maximum**	**468**	**836**

FUTURE WASTEWATER HYDRAULIC AND ORGANIC LOADINGS

The future wastewater hydraulic and organic loadings for the design year 2038 are determined based on the future population projection and the average per capita contribution for the flows and loadings. For the City of Creston, the moderate population growth results in the design year 2038 having greater wastewater hydraulic and organic loadings currently experience at the existing facility. The existing NPDES Permit for the City of Creston contains a design capacity as show in Table 3-6.

TABLE 3-6
EXISTING PERMITTED DESIGN CAPACITY
CRESTON, IOWA

Flow/Loading	Existing Permitted Design Capacity
Flow, mgd	
ADW	1.100
AWW 30	3.600
AWW 180	---
MWW	7.500
PHWW	---
Organic Loadings, lbs./day	
BOD	3,000
TKN	270

However, because the City of Creston is projected to have and increasing population, the design year 2038 needs to be designed for greater hydraulic and organic loadings than the current historical flows and loadings experienced. To determine the future design flows and loadings, the needed extra capacity for potential domestic growth was calculated based on the projected population increase presented in Table 3-1. Because ADW flow is defined as the average daily flow when the groundwater is at or near normal and runoff is not occurring, it is the closest representation of the domestic contribution, in that it is not affected by runoff or storm events. Therefore, the per capita flow contribution as determined in the historical ADW flow analysis could be used in the domestic growth projection. Using the previously calculated 90 gal/cap/day ADW flow multiplied by the increase in population from 7,854 to 8,050, an additional domestic flow contribution of 0.0419 mgd would need to be added to all design flows.

For the future BOD, TSS and TKN loadings, the per capita loading rates discussed in the paragraphs analyzing historical data above were multiplied by the increase in population as well. Table 3-7 presents the proposed wastewater treatment facility design criteria for the Creston Wastewater Treatment Facility in the design year 2038 with an estimated population of 8,050, based on the moderate population growth presented earlier in the report.

TABLE 3-7
PROPOSED FUTURE DESIGN CAPACITY
CRESTON, IOWA

	Historical Data	Domestic Growth	Potential Future Design
Population	7,854*		**8,050***
Flows, mgd			
ADW	0.709	0.0419	**0.751**
AWW30	2.239	0.0419	**2.281**
AWW180	1.877	0.0419	**1.919**
MWW	2.560	0.0419	**2.602**
Organic Loadings, lbs/day			
BOD	1,144	68	**1,212**
TSS	1,646	98	**1,744**
TKN	344	21	**365**

Table 3-8 shows a comparison of the potential future design capacity from Table 3-7 with the existing design capacity of the wastewater treatment facility. It illustrates that in all areas besides TKN, the projected future flows and loadings are not higher than what the existing facility is designed to handle. The final column of Table 3-8 shows the future flows and loadings the upgraded facility should be designed for based on this comparison.

TABLE 3-8 – POTENTIAL FUTURE DESIGN CAPACITY vs. EXISTING DESIGN CAPACITY vs. FINAL FUTURE DESIGN CRESTON, IOWA

	Potential Future Design	Existing Design Capacity	Final Future Design Capacity
Population	8,050*		**8,050***
Flows, mgd			
ADW	0.751	1.100	**1.100**
AWW30	2.281	3.600	**3.600**
AWW180	1.919	---	**---**
MWW	2.602	7.500	**7.500**
Organic Loadings, lbs/day			
BOD	1,212	3,000	**3,000**
TSS	1,744	----	**1,744**
TKN	365	270	**365**

CHAPTER 4 – EXISTING FACILITY EVALUATION – EFFECTIVENESS TO MEET IDNR DESIGN STANDARDS

GENERAL

The IDNR adopted design standards for certain treatment processes at a wastewater treatment plant. The design standards determine the maximum hydraulic capacity and maximum biological capacity of a treatment facility.

The IDNR design standards are used to establish the capacity of an existing facility. New facilities must be designed in accordance with the IDNR design standards.

The existing wastewater treatment facility equipment utilizes the following processes in its current operation:

- Grit Removal
- Primary Clarifiers
- Intermediate Clarifiers
- Trickling Filters & Towers
- Final Clarifiers
- Sludge Handling

All of the above processes were evaluated to determine their effectiveness/ability to meet the requirements of the current IDNR design standards.

Because the City of Creston's wastewater treatment plant discharges into a Class B – warm water body of water that is not designated for primary contact water use, it falls under the Facility Reliability Class II. All units are sized for redundancy based off of the reliability class.

GRIT REMOVAL

Grit removal is discussed in Chapter 15 of the IDNR design standards. Grit removal units should be sized for the MWW flow. Redundancy requirements are such that with the largest grit removal unit out of service, the remaining units shall have the design capacity to handle 100% of the MWW flow.

Because the MWW flow experienced at the plant is within the design MWW flow limits, the existing grit removal equipment is adequately sized.

PRIMARY CLARIFIERS

Primary clarification is discussed in Chapter 16 of the IDNR design standards. The sizing of primary clarifiers is based off of surface overflow rates. The applicable surface overflow rates are as follows:

Flow Condition	Surface Overflow Rate (gpd/SF)
Average Wet Weather (AWW)	1,000
Peak Hour Wet Weather (PHWW)	1,500

There are two primary clarifiers at the wastewater treatment facility, each with a different diameter. The first is approximately ___ ft in diameter, the second is approximately ___ ft in diameter.

The total effective surface area of the two clarifiers is _____ square feet. Based on the Iowa Department of Natural Resources standards, the maximum capacity of the primary clarifiers is:

Flow Condition	Rated Capacity (mgd)	Design Flow (mgd)
Average Wet Weather (AWW)	----	3.600
Peak Hour Wet Weather (PHWW)	----	7.500

A review of records indicates the maximum 30 day flow at the wastewater treatment facility in the past five years was 2.239 mgd. This flow would be considered the AWW flow. The treatment facility is designed to treat an AWW flow of 3.600 mgd. **The existing primary clarifiers are adequate to meet AWW conditions.**

The IDNR design standards indicate the influent BOD_5 removal for primary clarifiers designed within the rating capacity is between 30% and 35%. The weirs on the primary clarifiers are a total length of ___ feet. The 10-State Standard's design limit for weirs is 30,000 gpd/linear foot. The weirs are rated at ___ mgd.

Redundancy requirements are such that with the largest unit out of service, the remaining units shall have the design capacity to handle 50% of the design loading. **With the larger clarifier out of commission, the smaller clarifier can still handle 50% of the AWW and PHWW flows. Therefore, the current primary clarifiers have the capacity to meet the design loading, and this redundancy requirement is met.**

INTERMEDIATE CLARIFIERS

Intermediate clarification is discussed in Chapter 16 of the IDNR design standards. The sizing of intermediate clarifiers is based off of surface overflow rates. The applicable surface overflow rates are as follows:

Flow Condition	Surface Overflow Rate (gpd/SF)
Average Wet Weather (AWW)	900
Peak Hour Wet Weather (PHWW)	1,200

There are two intermediate clarifiers at the wastewater treatment facility, each with a different diameter. The first is approximately ___ ft in diameter, the second is approximately ___ ft in diameter.

The total effective surface area of the two intermediate clarifiers is ____ square feet. Based on the Iowa Department of Natural Resources standards, the maximum capacity of the intermediate clarifiers is:

Flow Condition	Rated Capacity (mgd)	Design Flow (mgd)
Average Wet Weather (AWW)	----	3.600
Peak Hour Wet Weather (PHWW)	----	7.500

Redundancy requirements are such that with the largest unit out of service, the remaining units shall have the design capacity to handle 50% of the design loading. **With the larger clarifier out of commission, the smaller clarifier can still handle 50% of the AWW and PHWW flows. Therefore, the current intermediate clarifiers have the capacity to meet the design loading, and this redundancy requirement is met.**

TRICKLING FILTERS

Fixed film reactors are discussed in Chapter 18a of the IDNR design standards. The sizing of trickling filters is based off of both hydraulic and organic loading at AWW flow. The applicable loading rates are as follows:

Operating Characteristics	Classification of Filter	
	Roughing	Intermediate Rate
	(gpd/SF)	(gpd/SF)
Hydraulic Loading	700-4,200	90-230
	(BOD ppd/1000 CF)	(BOD ppd/1000 CF)
Organic Loading	100-500	15-30

There are two trickling filters and two final trickling towers at the wastewater treatment facility. The trickling filters are approximately __ feet in diameter with a sidewall height of approximately __ feet and the two trickling towers are approximately ___ feet in diameter with a sidewall height of approximately __ feet.

The total effective surface area of the trickling filters is ____ square feet and the total effective volume is ____ cubic feet. The total effective surface area of the two trickling towers is _____ square feet and the total effective volume is _____ cubic feet. Based on the Iowa Department of Natural Resources standards, the maximum capacity of the trickling filters and trickling towers are:

	Rated Capacities	
Operating Characteristics	Trickling Filters	Trickling Towers
Hydraulic Capacity	____ – ____ mgd	____ – ____ mgd
Organic Loading, BOD Capacity	____ – ____ ppd	____ – ____ ppd

The treatment facility is designed to treat an AWW flow of 3.600 mgd. Redundancy requirements are such that with the largest unit out of service, the remaining units must be sized to handle 50% of the total design loading. **With one filter out of service, the remaining three filters are adequately sized to meet AWW conditions.**

The wastewater treatment facility is designed to treat 3,000 ppd of BOD. The combination of the trickling filters and towers allows for this loading rate.

FINAL CLARIFIERS

The IDNR Standards and 10-State Standards have established several design standards for final clarifiers. The controlling design standard for trickling filter final clarifiers is the hydraulic loading, or surface overflow rate. The surface overflow rate for final clarifiers following trickling filters is 1,200 gallons per day per square foot at Peak Hour Wet Weather flow.

The wastewater treatment plant includes two final clarifiers each with a diameter of ___ feet. The total effective area of the two final clarifiers combined is approximately ____ square feet. Based on the IDNR and the 10-State Standards, the rating of the final clarifiers is:

Flow Condition	Rated Capacity (mgd)	Design Flow (mgd)
Peak Hour Wet Weather (PHWW)	____	7.500

The maximum rated capacity of the final clarifiers is approximately ____ mgd.

With the largest unit out of service, the remaining unit has the design capacity to handle ____% of the design loading. **This exceeds the redundancy requirement set in place by the IDNR Standards.**

SLUDGE THICKENERS/SLUDGE HOLDING TANKS

Sludge handling and disposal is discussed in Chapter 17 of the IDNR design standards. The IDNR design standards recommend that sludge should be thickened to at least 5% solids prior to transmission to digesters.

The IDNR design standards give sludge holding tanks mixing and air requirements. For diffused air systems, the mixing requirements are such that an aeration rate of 20 cfm per 1,000 cubic feet of tank volume is achieved. For mechanical aeration systems, the mixing requirements are such that a minimum of 1.0 horsepower per 1,000 cubic feet of tank volume is provided.

The existing facility has one sludge digester that is approximately ____ feet in diameter with a ___ foot sidewall height. The existing facility has two sludge storage tanks that combined hold approximately ____ gallons in storage volume.

CHAPTER 5 – EXISTING FACILITY EVALUATION – PHYSICAL CONDITION

GENERAL

The facility planning included an evaluation of the major facilities and processes of the wastewater treatment plant. The analysis evaluated the operational and physical condition of the process components of the wastewater treatment plant. Figure 5-1 shows the existing wastewater treatment plant layout. Figure 5-2 shows an aerial view.

SCREENING AND GRIT REMOVAL

The wastewater flow arriving at the wastewater treatment facility enters through the Screening Building. The Screening Building contains a mechanical screen and a manual bar screen for back up. The mechanical screen was installed in 1987, making it nearly 30 years old. There is no screenings wash press, and the building itself has issues with moisture. A view of the screening waste is shown below in Picture 1.

Picture 1

After the Screening Building, there is bypass to the storm equalization basin for flows in excess of the MWW 7.50 mgd. For flow within the MWW 7.50 mgd, flow continues from the Screening Building to the Grit Building. Here, grit is removed in in a grit chamber. Like the mechanical screen, the grit removal equipment is also from 1987 and nearly 30 years old. The Grit Building is not insulated, and has issues with moisture similar to the Screening Building. Below, Picture 2 shows an exterior view of the Grit Building.

Picture 2

A summary of the major issues with the Screening Building and Grit Building is as follows:

- **Replacement of unit heater in Screening Building**
- **Replacement of vent fans in Screening Building**
- **Replacement of electric panel in Screening Building**
- **Replacement of electrical conduit through floor in Screening Building**
- **Addition of Screen Wash Press to Screening Building**
- **Replacement of grit classifier**
- **Replacement of under-water components of grit removal equipment**

PRIMARY CLARIFIERS

Flow from the Grit Building travels through a splitter box and is divided between the two primary clarifiers. There are two primary clarifiers at the wastewater treatment facility, each of a different diameter.

The smaller primary clarifier was constructed in 1967, the larger was constructed in 1997.

While primary clarifier 1 is well over 50 years in age, the concrete structure is still in working order. The equipment on both clarifiers, however, is in need of servicing. The equipment in primary clarifier 1 is the age of the concrete, and in need of replacement. The equipment in primary clarifier 2 is nearing 20 years in age and is in need of rehabilitation of the mechanisms. The scum pit is in need of a new electrical box for the sludge pumps. An image of the primary clarifier wiers is show below in Picture 3.

Picture 3

A summary of the major issues with the primary clarifiers is:

- **Age and condition of equipment in both clarifiers**
- **Need for new electrical box in scum pit**

TRICKLING FILTERS

From the primary clarifiers, the wastewater flow combine and are split again into the two trickling filters. While the trickling filters structurally are more than 50 years old, they do contain geodesic dome covers and are still in working order. The roof vent fans, however, are in need of replacement. Below, Picture 4 shows an exterior view of one of the trickling filters.

Picture 4

A summary of the major issues with the trickling filters is:

- **Roof vent fans in need of replacement**

INTERMEDIATE CLARIFIERS

From the trickling filters, the wastewater is again combined and then split between the two intermediate clarifiers. Like the primary clarifiers, the two intermediate clarifiers were constructed at different times and are different sizes.

The smaller intermediate clarifier was constructed in 1967, the larger was constructed in 1997.

Like the primary clarifiers, the concrete structure of both intermediate clarifiers are in working order, and the equipment is in need of rehabilitation or replacement. Additionally, the skimmers on intermediate clarifier 1 need to be replaced. Below, Picture 5 shows a view of intermediate clarifier 1.

Picture 5

A summary of the major issues with the intermediate clarifiers is:

- **Age and condition of equipment in both clarifiers**
- **Condition of skimmers in intermediate clarifier 1**

Flow from the intermediate clarifiers is pumped at the intermediate lift station. The intermediate lift station has equipment from the 1980s and 1990s. Many of the valves and motors are inoperable. The electrical equipment is all outdated.

A picture of the electrical/control equipment is shown below in Picture 6.

Picture 6

A summary of the major issues with the intermediate lift station is:

- **Age and condition of equipment**
- **Age and condition of electrical equipment**

TRICKLING TOWERS

From the intermediate clarifiers, the wastewater travels to the two trickling towers (nitrification towers). The trickling towers were constructed in 1997 and are in working order. Although, because the equipment is nearly 20 years in age, the distributer bearings are in need of replacement. Like the trickling filters, the roof vent fans are in need of replacement. The electrical disconnects at the tower base are also in need of replacement.

Below, Picture 7 shows the electrical disconnects in need of replacement.

Picture 7

A summary of the major issues with the final trickling towers is:

- **Distributer bearings in need of replacement**
- **Roof vent fans in need of replacement**
- **Electrical disconnects in need of replacement**

FINAL CLARIFIERS

From the trickling towers, wastewater is combined and split again into the two final clarifiers. The wastewater treatment facility includes two final clarifiers, both built during the 1997 construction project. While the concrete structures of the final clarifiers are nearing 20 years in age, they are appear to be in good working order. The equipment, however, is in need of repair. The gate actuators are inoperable, the mechanisms and skimmer arms are in need of rehabilitation and replacement, and algae growth is frequently occurring in the troughs.

A picture of the inoperable gate actuator is shown below in Picture 8.

Picture 8

A summary of the major issues with the final clarifiers is:

- **Age and condition of equipment in both clarifiers**
- **Condition of skimmers in both clarifiers**
- **Algae growth in clarifier troughs**

SLUDGE HANDLING

Sludge from the primary, intermediate, and final clarifiers is pumped to the anaerobic sludge digester. The digested sludge is then stored in two separate sludge storage tanks, one of which was constructed in 1987. The anaerobic digester contains equipment from 1987. The decanters in the sludge storage tank are inoperable, along with many of the valves and the sludge transfer pump in the anaerobic digester. A picture of the sludge transfer pump is shown below in Picture 9.

Picture 9

A summary of the major issues with the sludge handling facility is:

- **Age of equipment**
- **Inoperable sludge tank decanters**
- **Inoperable valves**
- **Inoperable sludge transfer pump**

DISINFECTION

The current wastewater treatment plant does not include disinfection. **While not currently required, the new permit the City received from IDNR includes a schedule that begins enforcement E. coli effluent limitations beginning in July of 2018. Disinfection will be required to meet these E. coli effluent limitations**

INSTRUMENTATION AND CONTROL AND LABORATORY

The wastewater treatment facility does not currently have adequate SCADA (supervisory control and data acquisition) capabilities. There are no data or alarm signals. The objective of the process control system is to allow for responsive process control. Responsive process control allows for preset parameters to initiate and terminate the operation of major process equipment. Responsive process control allows for manual operation of equipment from any terminal within the process control system.

The laboratory in the Control Building has worn out lab countertops and cabinets, rusted doors, worn flooring, and no hot water in the shower.

An image of the laboratory is shown below in Picture 10.

Picture 10

A summary of the major issues with respect to the instrumentation and process control include:

- **Lack of centrally located controls and data acquisition**
- **Age and condition of laboratory**

CHAPTER 6 - PROCESS ALTERNATIVES

GENERAL

The facility planning process evaluated the processes used in the current operations of the wastewater treatment plant in Chapters 4 and 5.

The existing treatment facility is capable of meeting the treatment requirements in the current NPDES discharge permit, with the exception of the new E.coli effluent limit. The new E. coli limits require the installation of a disinfection system.

The facility planning evaluated alternative processes, operational changes, and changes to equipment to improve the efficiency and effectiveness of the wastewater treatment facility meeting the existing and future NPDES discharge permits and developed recommended improvements. The improvements to existing structures and processes are discussed in Chapter 7. The evaluation of process alternatives and recommended improvements for the issue of E.coli disinfection is discussed below.

The process alternatives evaluated for the disinfection were as follows areas:

- Ultraviolet Light Disinfection in Open Channel
- Ultraviolet Light Disinfection – Non-Contact
- Wetland Disinfection

DISINFECTION

The existing treatment plant does not include disinfection. However, the newly received NPDES operating permit includes E. coli effluent limitations that require the addition of disinfection. Disinfection will need to occur downstream of the final clarifiers. UV disinfection in two different applications, open channel and non-contact, and wetland disinfection were all evaluated.

Ultraviolet Light Disinfection

Ultraviolet (UV) light disinfection is by irradiation of the effluent with the UV wavelength light that has a germicidal effect at 250 – 270 nanometers (nm). UV light is effective on bacteria, most viruses, and protozoa by causing photochemical damage to their DNA and RNA rendering them unable to reproduce.

There are options on the type of UV lamps and systems as follows:

- Low Pressure Low Intensity Lamps (LP/LI) – used for smaller systems, manual controls, manual cleaning, requires more lamp bulbs.

- Low Pressure High Intensity Lamps (LP/HI) – has higher power level but fewer lamps. Power can be modulated to demand. Automatic cleaning systems are provided. Longer lamp life is expected of 0.5 to 1.5 years.
- Medium Pressure High Intensity Lamps (MP/HI) – These lamps have a high power demand but require fewer lamps, have a shorter lamp life, and require automatic cleaning due to scaling. This type of system is used in very large installations and is proprietary to a couple of manufacturers.

There are also two types of UV application:

- Open Channel
- Non- Contact

Open Channel UV applications have a long history in the State of Iowa. There are installations across the state in a variety of sizes. Non-Contact UV applications are in general newer in the State of Iowa. The first municipal installation was only completed within the last few years.

The City of Creston is more comfortable with the Open Channel installations because of the both the quantity of installations around the State and the length of time these installations have been in operation. The amount of performance data available for Open Channel UV applications is significantly greater than the amount of performance data available for the Non-Contact applications.

Wetlands Disinfection

Wetland disinfection is evidenced through fecal coliform data from the influent to the effluent of fully vegetated wetland systems. While data has shown just over 2 logs of removal from the influent to the effluent, there are no obvious relationships between the influent and effluent concentrations of fecal coliform. This has been studied and reported on by the EPA in the *Constructed Wetlands Treatment of Municipal Wastewaters* manual in Chapter 4.

Furthermore, while there has been data to show a significant drop in E.coli through a fully vegetated wetland system, the data does not show effluent results consistently at a low level. There have been random spot outliers in effluent data in long term wetland systems. Accordingly, wetland disinfection was discounted as a consistently reliable source of disinfection for the City of Creston.

Recommendation

It is recommended that the City install a UV Disinfection system in the Open Channel style at their existing facility to meet the new E.coli effluent limits.

CHAPTER 7 - RECOMMENDED IMPROVEMENTS

GENERAL

The evaluation of the wastewater treatment facility identified several physical deficiencies and process deficiencies with grit removal, primary, intermediate, and final clarification, trickling and nitrification filtration, sludge handling, and disinfection. The facilities planning evaluated each of the operational and physical condition issues. The facility planning evaluated the existing treatment processes and alternative treatment processes. The facility planning developed recommendations for continuation of the existing treatment process or development of new facilities.

The proposed improvements are summarized in this part of the Facility Plan. The recommended improvements are set forth in conceptual detail.

Preliminary cost estimates were developed for each of the recommended improvements. Based on the level of analysis, the cost estimates should be anticipated to be in the range of plus or minus approximately 15%.

The details regarding each recommended improvement will be developed during detail design. Revised cost estimates prepared during design will refine the estimated cost of the improvements.

SCREENING AND GRIT REMOVAL

The proposed improvements to the screening and grit removal include:

- Replace unit heater in Screening Building
- Replace vent fans in Screening Building
- Replace electrical panel in Screening Building
- Replace electrical conduit through floor in Screening Building
- Add Screen Wash Press to Screening Building
- Replace Grit Classifier
- Replace under-water components of grit removal equipment

The estimated cost for the improvements at the Screening and Grit Removal is $290,000.

PRIMARY CLARIFIERS

The proposed improvements to the primary clarifier include:

- Replace mechanism in primary clarifier 1
- Rehabilitate mechanism in primary clarifier 2
- Install new electrical box for sludge pump in scum pit

The estimated cost for the improvements to the primary clarifiers is $200,000.

TRICKLING FILTERS

The trickling filters are generally in good working order, and only need to have their vent fans replaced and rewired.

The estimated cost for the improvements to the trickling filters is $25,000.

INTERMEDIATE CLARIFIERS

The proposed improvements to the intermediate clarifiers include:

- Rehabilitate mechanisms in both clarifiers
- Replace skimmers in intermediate clarifier 1

The estimated cost for the improvements to the intermediate clarifiers is $70,000.

INTERMEDIATE LIFT STATION

The proposed improvements to the intermediate lift station include:

- Replace pinch valve with V-notch gate and actuator
- Replace flow meters to trickling towers
- Replace flow meters to flume effluent
- Replace (2) east starts with VFDs
- Replace sump pump with larger capacity sump pump
- Add GFI outlets to basement of lift station
- Add dehumidifier to basement of lift station
- Add air conditioning to building
- Repaint all piping

The estimated cost for the improvements to the intermediate lift station is $185,000.

TRICKLING TOWERS

The trickling towers are generally in good working order, but are in need of repairs. A summary of the proposed improvements to the trickling towers is as follows:

- Replace vent fan motors (must be outdoor rated)
- Replace disconnects at tower bases
- Replace distributor bearings

The estimated cost for the improvements to the trickling towers is $40,000.

FINAL CLARIFIERS

The proposed improvements to the final clarifiers include:

- Rehabilitate mechanisms in both clarifiers
- Replace skimmers in both clarifiers
- Replace manual gate actuators
- Add Nefco Trough Covers to minimize algae growth

The estimated cost for the improvements to the final clarifiers is $95,000.

SLUDGE HANDLING

The existing facility has one anaerobic digester and two separate sludge storage tanks. The equipment in both the digester and storage tanks is old and in need of repairs

The summary of the necessary improvements to the sludge handling include:

- Replace sludge transfer pump
- Replace all valves in anaerobic digester
- Replace sample piping in digester
- Replace decanters in sludge storage tank with decant pumps

The estimated cost for the improvements to the sludge handling is $50,000.

Future improvements to the sludge handling at the facility could be made with the addition of sludge thickening. This could be accomplished through the addition of a Rotary Drum Thickener and a building for the RTD to be housed in.

The estimated cost for these future improvements to the sludge handling is $260,000.

DISINFECTION

The current wastewater treatment plant does not include disinfection. The new permit the City received from IDNR includes a schedule that begins enforcement E. coli effluent limitations beginning in July of 2018. Disinfection will be required to meet these E. coli effluent limitations

The recommended addition of disinfection is UV disinfection. **The estimated cost to add UV disinfection to the current facility is $450,000.**

INSTRUMENTATION AND CONTROL AND LABORATORY

The wastewater treatment facility does not currently have adequate SCADA (supervisory control and data acquisition) capabilities. There are no data or alarm signals. The laboratory on side has worn out and rusted fixtures.

The necessary improvements to the instrumentation and process control and existing laboratory is as follows:

- Addition of SCADA
- Addition of air conditioning
- Replacement of counter tops
- Addition of chemical cabinet
- Replacement of existing lab cabinetry
- Replacement of doors in laboratory
- Replacement of office window
- Repair of hot water to shower
- Repainting of inside of building
- Installation of new flooring

The estimated cost for the improvements to the instrumentation and control and laboratory is $525,000.

MISCELLANEOUS SITE ITEMS

In addition to the structure specific items listed above, the bypass flow meter is in need of replacement.

The estimated cost for the new bypass flow meter is $15,000.

SUMMARY OF IMPROVEMENTS

The Facility Plan recommends a comprehensive set of improvements to the wastewater treatment plant. The improvements fall into two general categories. **The first category of improvements are those that should be undertaken within the next 2 years improve the function of the existing facility and to remain in compliance with the newly received NPDES permit.**

The second category of improvements are those that can be deferred. They are larger scale improvements to the function of the facility that do not need to be immediately addressed.

A summary of the two categories of improvements is:

Category	Description
Category 1	Improvements to be completed within 2 years
Category 2	Improvements to be completed within 5 to 10 years

A summary of the proposed recommended improvements to the wastewater treatment facility by category are:

Category 1 Improvements

Screening and Grit Removal	$	290,000
Screening Building:		
Replace Unit Heater & Vent Fans		
Replace Electric Panel & Electrical Conduit		
Add Screen Wash Press		
Replace Grit Classifier		
Grit Building:		
Replace Under Water Components of Grit Channel		
Primary Clarifiers	$	200,000
Replace Mechanism in Clarifier 1		
Rehab Mechanism in Clarifier 2		
Install new Electrical Box for Sludge Pump		
Trickling Filters	$	25,000
Rewire & Replace Vent Fans		
Intermediate Clarifiers	$	70,000
Rehabilitate Mechanisms		
Replace Skimmers in Clarifier 1		
Intermediate Lift Station	$	185,000
Replace Pinch Valve w/ Mellen V-Notch Gate and Actuator		
Replace Flow Meters to Trickling Towers & Flume		
Replace (2) Easy Starts w/ VFDs		
Replace Sump Pump w/ Larger Capacity Sump		
Add A/C, Dehumidifier & GFI Outlets		
Repaint Piping		
Trickling Towers	$	40,000
Replace Vent Fan Motors - Must be Outdoor Rated		
Replace Diconnects at Tower Base		
Replace Distributor Bearings		
Final Clarifiers	$	95,000
Rehabilitate Mechanisms and Replace Skimmer Arms		
Replace Manual Gate Actuators		
Add Nefco Trough Covers		
Sludge Handling		
Sludge Tank:	$	50,000
Replace decanters w/ decant pumps		
Digester:		
Replace Sample Piping & all Valves		
Replace Transfer Pump		

Category 1 Improvements Continued:

Disinfection	$	450,000
Install UV Disinfection System		
Construct Building Over UV Disinfection Equipment		
Replace Parshall Flume		
Instrumentation and Control and Laboratory	$	525,000
Add SCADA for Instrumentation and Controls		
Add A/C to Lab		
Replace Cabinetry and Countertops		
Replace Doors and Windows where needed		
Repair Hot Water to Shower		
Repaint Inside of Building		
Install New Flooring		
Miscellaneous Site Items	$	15,000
Replace bypass flow meter		
Subtotal	$	1,945,000
Contingencies	$	305,000
Construction Cost	$	2,250,000
Engineering, Legal & Administrative	$	350,000
Total Category 1 Project Cost	**$**	**2,600,000**

Category 2 Improvements

Sludge Handling	$	260,000
Install Rotary Drum Thickener		
Construct Building for RDT		
Subtotal	$	260,000
Contingencies	$	40,000
Construction Cost	$	300,000
Engineering, Legal & Administrative	$	50,000
Total Category 2 Project Cost	**$**	**350,000**

CHAPTER 8 - ENVIRONMENTAL IMPACT

GENERAL

This chapter will describe more specific impacts, both positive and negative, which will result from the implementation of the water pollution control plant improvements. It is divided into four parts: Natural Environment, Socio-Economic Factors, Sensitive Areas, and Irretrievable and Irreversible Commitment of Resources.

NATURAL ENVIRONMENT

Water Quality

The primary goal of the recommended water pollution control plant improvements is to improve the water quality in the area. The improvements to the existing treatment facility will provide the necessary treatment facility to handle the community's wastewater treatment needs and to comply with state and federal water quality standards.

Construction of the recommended water pollution control plant improvements may impact the area's surface water supplies temporarily. Excavated materials may be introduced into streams during periods of heavy rains or winds or during construction of the water pollution control plant improvements. Measures to prevent construction runoff include excavating the smallest areas of land for the shortest amount of time or applying mulch to exposed areas. Also, the existing water pollution control plant will be in operation at all times during construction of the recommended improvements to protect the water quality of the receiving stream.

Air Quality

Air quality in Creston will be temporarily impacted by fugitive dust produced during construction depending on weather or soil conditions. Some precautions will be necessary to avoid serious impact on air quality. Spraying earth mounds with water or other dust retardants and excavating the minimum amounts of land are two solutions.

Population growth and development will impact air quality through increased sources of pollution. Automobile ownership and use will increase, thus increasing emissions. Continued advancements by the auto industry to reduce emissions and continued regulation of emissions by EPA will also promote air quality goals. Industrial development may create additional point sources of pollution; however, those emissions will be regulated by the Iowa Department of Natural Resources to help achieve and ultimately maintain ambient air quality in Creston.

Noise

Noise impacts will be short term and associated with construction. Depending on when construction occurs, residences and businesses near the existing treatment facilities may be affected by heavy equipment noise. No long term impacts are anticipated, however, since noise producing equipment or facilities will be located away from residential development or contained within structures.

Energy

An increase in energy consumption is anticipated as a result of the implementation of the recommended improvements. The operation of the upgraded treatment facilities will increase the demand for electricity.

Future development will also place increased demands on energy. Measures to reduce energy consumption include building more energy efficient homes and landscaping. Advanced developments in alternative forms of energy, such as wind or solar, may make those sources more economically feasible in the future.

SOCIO-ECONOMICAL FACTORS

Population

Implementation of the recommended improvements will indirectly affect population growth. The improvements to the treatment facilities may promote new residential, commercial and industrial growth. The creation of new jobs or housing opportunities will help attract people to the community.

Economy

The recommended improvements will result in a positive impact on the community's economy. Creston will be able to market itself as having complied with water quality management objectives in order to seek new investment in the area. New firms attracted to the area will create new jobs as well as increase the tax base. The community will also benefit from employment opportunities directly associated with construction of the treatment facilities.

Negative impacts associated with the recommended improvements will be the costs to the users for construction, and operation and maintenance of the expanded facilities. Sewer fees per household will increase; however, by maximizing the use of the existing treatment facilities, the costs will be reduced.

Land Use

The recommended improvements will result in both short term and long term impacts on land use. The improvements will temporarily affect land adjacent to the treatment facility and along the sewer routes.

Long term impacts on land use will result from future growth in the community. Development will expand into agricultural areas and the productivity of the land will be lost. The conversion of farmland, however, will not significantly impact the amount of land available in the area for agricultural purposes.

SENSITIVE AREAS

Wildlife Habitats

A direct benefit of the recommended improvements will be an improved environment for aquatic and terrestrial wildlife due to the improved water quality. Construction of the facilities may temporarily affect wildlife habitats, but long term impacts should be minor.

Any future development anticipated in the community may have a greater impact on wildlife. Future development may encroach on wildlife habitats existing in undeveloped areas. Buildings and paved surfaces may adversely affect stream habitats by removing bank cover, resulting in increased runoff, siltation, or bank erosion. Some species may become more vulnerable to predators by removing burrowing or nesting areas. New roads may present barriers to seasonal movements of some species or separate them from food sources. Urbanization can also impact common "urban" wildlife where more intensive human activity on the ground may affect nesting areas.

Means of minimizing impacts to wildlife habitats include cutting the minimum swath of vegetation for trenching and pipe placement; aligning piping which minimize the taking of young and mature trees; filling and regrading backfill material as soon as possible after trenching; using cover material that is equal in quality to the topsoil removed during excavation; replanting excavated areas with materials native to the disturbed areas or otherwise well suited to it; and inspecting replantings and erosion control measures to ensure successful regeneration to plant materials.

Rare and Endangered Species

Little impact is foreseen on rare or endangered species due to the implementation of the recommended improvements. Since construction of the treatment facilities improvements will occur in developed or cultivated areas, no impact is anticipated on endangered species.

Cultural Resources
No archaeological sites in or around the Creston Wastewater Treatment Facility are expected. A copy of this report will be submitted to the State Historical Preservation Office for approval prior to the construction of any facilities.

Recreational and Open Space
No impact on recreation areas are anticipated from construction of the proposed improvements.

IRRETRIEVABLE AND IRREVERSIBLE COMMITMENT OF RESOURCES

Land, energy and materials are the greatest areas of resource commitment. The Creston Wastewater Treatment Facility improvements should not require any additional land.

Energy in various forms will be utilized during construction, operation and maintenance of the facilities. The commitment of resources must be weighed in light of the anticipated water quality and socio-economic benefits resulting from the upgrading of the existing wastewater collection and treatment facilities.

CHAPTER 9 - FINANCING

GENERAL

This section of the report discusses financing options for the proposed improvements that have been recommended in this Facility Plan. The intention of discussing these financing options is to serve only as a rough guide and not to take place of the detailed program which will be developed by the City's bonding attorney and financial counsel.

A financing plan is necessary so that the wastewater utility can carry out its primary responsibility which is to produce a high quality effluent to meet its projected NPDES permit requirements. The wastewater utility must also function as a business in that revenues generated from water sales and other miscellaneous items must cover all operating and maintenance costs, equipment replacement, capital improvement projects, all outstanding debt, and maintain a reasonable surplus in case of emergencies. In the following paragraphs we will review methods of financing, past utility transactions, projected capital improvement projects, the costs of the proposed improvement program and the impact on existing wastewater rates.

METHODS OF FINANCING

In general, most wastewater improvement projects are financed through one of the following methods or a combination of the following methods: general obligation bonds, revenue bonds, special assessment bonds, general obligation bonds abated through revenues, State Revolving Fund (SRF) and utility fund reserves. In addition to these methods, the potential for financing a portion of the project with a Community Development Block Grant exists.

General Obligation Bonds are supported by ad valorem tax on real properties within the corporate limits of the city. As the name indicates, after the issuance of the bonds their repayment becomes a general obligation of the entire city's taxpayers. This method of financing is used for projects that are viewed as being beneficial to the entire population. The Code of Iowa states that the city may bond up to 5% of its actual value of taxable property. Because GO bonds are secured by the general tax base, they receive more favorable treatment in terms of interest rate when compared with other financial instruments. In general, general obligation bonds require an approving vote of 60% of the total votes cast. However, since wastewater improvements come under the category of essential corporate purpose, a public referendum is not needed if the Council follows procedures detailed in Iowa Code Section 384.25 entitled "General Obligation Bonds for Essential Purposes."

Revenue Bonds are paid through surpluses in the particular utility fund and are usually funded through increases in rates. These bonds are not supported by general taxation and, therefore, are viewed as more risky in the financial market. This increased riskiness causes these bonds to typically sell for ½% above similar GO issues. In addition, reserve funds of approximately 25% of the annual principal and interest are required in order to provide the bond buyers an additional level of protection. Also, other reserve funds for equipment replacement and capital improvements are typically required. Revenue bonds do create a force savings plan in that additional reserve accounts do contain monies which can be used once the revenue issue is paid off. However, revenue bonds, because of the additional required reserve, do demand higher wastewater rates than a comparable GO issue. Finally, unlike general obligation bonds, no election is required for revenue bonds.

Special Assessment Bonds are paid through the collection of periodic payments from benefitted property owners. Special assessment bonding has been utilized to finance the construction of public utilities and streets in the past. The method simply assigns a proportional share of the cost against the benefitted properties, usually according to a front foot or area formula. The bond issue is sold by the municipality and it is paid off when the benefitted property owners pay their assessment on an annual basis. The assessment against a property resides with the property title in the form of a lien (financial obligation) against the property. The rates for special assessment bonds are usually somewhere between the revenue bond issue and general obligation bonds. It is not expected that the City of Creston will utilize special assessment financing for the proposed wastewater improvement projects.

General Obligation Bonds/Abated With Utility Revenues. This form of bonds combines the attributes of general obligation and revenue bond financing. A general obligation bond is financed by pledging a portion of the tax base. Utility rates are increased to pay for the new debt. Surplus revenues are utilized to pay the principal and interest on the general obligation bond and the pledged increase in property taxes is abated through the use of this source of funds. Because this type of financing pledges part of the taxation base of the city, the reserve funds that are required under revenue bonds are not needed. On the surface to the bond holder, this type of financing appears to be a straightforward general obligation bond. It is recommended that the City of Creston explore this type of financing with its bond counsel and financial adviser.

Community Development Block Grant (CDBG). Grants of up to $600,000 are available for cities with populations between 2,500 and 15,000 people through the Iowa Department of Economic Development for the development of "viable" urban communities. One of the objectives of the program is to assist communities in the preservation and development of infrastructure. Applicants for CDBG funds must demonstrate that the project primarily benefits low- and moderate-income persons and addresses a problem that has particular community urgency. The City's application would be ranked by the State along with all other applications.

State Revolving Fund (SRF). This fund is operated by the Iowa Department of Natural Resources and the Iowa Finance Authority and provides low interest loans for financing improvements to wastewater treatment facilities. The loan takes the form of a revenue bond or a general obligation bond issued by the City and purchased by the Iowa Finance Authority. The interest rate is dependent upon the rate which the State can sell bonds. The annual rate has been running at 2% to 3% depending on the term of the loan. For a sewer revenue issue the coverage requirement is 10%. This means that the net revenues of the system cannot be less than 110% of the operating, maintenance and debt service expenses of the system. This compares to a typical coverage of 25% for a conventional sewer revenue bond issue. There is a 1% loan initiation fee and a 0.25% annual loan servicing fee. In addition, the City must have an approved user charge system to ensure "fairness" and to ensure that adequate revenues are generated. There are also some additional requirements with respect to the construction contract documents.

USDA Rural Development Grants and Loans. The Rural Development program of the United States Department of Agriculture administers programs to provide grants and loans to Iowa communities. USDA grants are available based on a need basis. In determining grant availability, USDA Rural Development will take into account average or median household income and the sewer user charge rates which would be required to finance the project. Most communities will either not qualify for a USDA Rural Development Grant or will qualify for a portion of the project cost as a USDA Rural Development Grant. As the financing plan is developed, consideration of USDA Rural Development Grant funding will be a component of the evaluation.

The USDA Rural Development also administers a loan program. The loan is available to Iowa communities for a 40 year period. The interest varies based on established program criteria. The interest rate will either be the market interest rate loan or a subsidized interest rate loan based on household income of the community. USDA Rural Development Loan financing requires a coverage factor and reserve fund requirements. The USDA Rural Development loan reserve and coverage requirements are less stringent than the requirements for commercial revenue loans.