Antidegradation Alternatives Analysis

[redacted]

[redacted]

[redacted]

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[redacted]

Executive Summary

The [redacted] an affiliate of [redacted] operates a [redacted] is discharges to the [redacted] is instituting a pretreatment program to assist the [redacted] by reducing both the flows and loads to the WPCF.

The reduction of pollutant loads will allow the City to more efficiently meet it's NPDES permit. The reductions in flow and loading will provide additional treatment and hydraulic capacity at the WPCF; allowing for economic development and growth at no additional capital investment to the City.

Wastewater at [redacted] consists of two components. The first is a stream of high strength process wastewater from the operation of the plant, filling [redacted] sanitation and cooling water. The average process wastewater flow is 168,680 gallons per day (gpd) with an average Biochemical Oxygen Demand (BOD) load of 6,033 pounds per day (lbs/day) of BOD (4500 milligrams per liter (mg/l)). The second wastewater stream consists of Reverse Osmosis (RO) Reject water. RO Reject water is the residual produced by stripping City of [redacted] potable water when making either [redacted] The RO Reject flow is up to 290,000 gpd. The RO Reject meets drinking water criteria and is of better quality than the most stringent of Iowa's water quality-based effluent limitations (WQBELs).

The process wastewater will be pretreated to reduce the BOD load by 75%, to 1508 lbs/day. This allows the WPCF to comfortably meet the criteria of their NPDES permit. Additionally, this would increase treatment capacity at the WPCF to a degree equivalent either to 6,198 additional households (250 gpd at a loading of 350 mg/l per household (1 Emission Reduction Unit (ERU))). Alternatively, the capacity increase could accommodate one or more additional large industrial users. This would be the equivalent of a capital expansion of $20,918,250 (6198 users at 250 gpd – 1,549,500 gpd at $13.50 per gallon; current cost being $12 to $15 per gallon). The pretreatment of this waste is not a subject of this alternatives analysis but is included as descriptive of the entirety of the project. To achieve this level of pretreatment it is necessary to separate the clean RO Reject stream allowing for the efficient pretreatment of the high contaminant load in the industrial wastewater in a reasonable footprint.

We request an NPDES permit to discharge the RO Reject water to [redacted] via the existing storm water sewer currently serving the area. The discharge of this water will increase the hydraulic capacity of the WPCF by the equivalent of 1160 households (250 gpd per ERU). The equivalent hydraulic capacity increase to the WPCF would have a capital cost of $3,915,000 (290,000 gpd at a current cost of $12 to $15 per gallon)

A total of six alternatives were evaluated including the current treatment by the WPCF, 3 non-degrading alternatives and 3 less-degrading alternatives. The alternatives were evaluated based on their practicability, economic efficiency, affordability and degradation on a pollutant-by-pollutant basis. One of the non-degrading alternatives (recycle/reuse) was determined to be non-practicable. The remaining non-degrading alternatives (anaerobic digestion, evaporation and land application) were found to be economically inefficient. Of the two less-degrading alternatives, treatment by the WPCF was economically taxing, fiscally imprudent and detrimental to the operation of the facility. Alternative No. 6 – Segregation and Diversion of RO Reject to [redacted] via storm sewer was found to be the least degrading reasonable alternative (i.e. the preferred alternative).

Although the preferred alternative is considered less degrading and expected to improve overall water quality in the receiving stream network for a number of pollutants; degradation for some pollutants of concern will occur. Therefore, a description of the project social and economic importance is included at the end of the analysis.

Existing Conditions and Design Parameters

Tables 1 and 2 describe the current and proposed wastewater flows and loads for the ABC facility.

Table 1: Existing Combined Wastewater Flow and Loading

Water	Maximum Daily Flow (Mgd)	Contaminant	Maximum Daily Load (lbs/day)
Combined Flow	0.49	BOD_5	7200

Table 2: Split Wastewater Flow and Loading

Water	Maximum Daily Flow (Mgd)	Contaminant	Maximum Daily Load (lbs/day)
Industrial Wastewater	0.20	BOD_5	7193
RO Reject	0.29	BOD_5	7

The pretreatment proposed for the highly contaminated industrial waste stream is a series of biological reactors, the [redacted], that will provide series treatment via trickling filtration, anoxic reaction and aerobic/anaerobic digestion. The treated effluent will be sent to the WPCF.

The RO Reject water would be positively physically segregated from all other flows and sent though an open channel Parshall flume for metering. The flume also allows access for water quality sampling prior to discharge to the existing storm sewer network en route to its' outfall at [redacted] 1.3 Miles (6864 feet) from the plant.

Receiving Stream Network

The existing storm sewer discharge receiving stream network consists of discharge to Little Cedar Creek tributary to the Des Moines River to the Mississippi River.

The current receiving stream network designations, Use Attainability Analysis (UAA) and impairment status are summarized in Tables 3, 4 and 5:

Table 3: Current Stream Designations

Stream	Current Designation	Source
[redacted]	A1, B(WW-2)	2/17/10 Surface Water Classification Document
[redacted]	A1, B(WW-2)	2/17/10 Surface Water Classification Document
Skunk River	A1, B(WW-1), C, HH	2/17/10 Surface Water Classification Document
Mississippi R.	A1, B(WW-1), C,HH, C	2/17/10 Surface Water Classification Document

Table 4: UAA Status

Stream	UAA Type(s)	Fieldwork Complete?	Recommended Designation(s)	Status
[redacted]	Recreational and Aquatic	Yes	A2, B(WW-2)	DRAFT

Table 5: Impairment Status[1]

Stream	Impairment(s)	TMDL Status	Notes
[redacted]	None	N/A	Fully Supported
[redacted]	E.Coli		TMDL Needed
Skunk River	E.Coli		Nutrients
	Nitrate	Fully Supported	No causes or sources listed
Mississippi R.	Bacteria	Not scheduled	Multiple downstream segments impaired
	Arsenic	Not scheduled	Multiple downstream segments impaired
	Aluminum	Not scheduled	Multiple downstream segments impaired

1. Source: Final 2008 Impaired Waters List (submitted to EPA)

Effluent Limitations to Surface Water

Carbonaceous biochemical oxygen demand (5 day) — $CBOD_5$.

1. The 30-day average shall not exceed 25 mg/l.
2. The 7-day average shall not exceed 40 mg/l.

Suspended solids — SS.

1. The 30-day average shall not exceed 30 mg/l.
2. The 7-day average shall not exceed 45 mg/l.
3. The 30-day average percent removal shall not be less than 85 percent.

pH

The effluent values for pH shall be maintained within the limits of 6.0 to 9.0

Chloride

Acute and chronic criteria listed in main table are based on a hardness of 200 mg/l (as CaCO 3 (mg/l)) and a sulfate concentration of 63 mg/l. Numerical criteria (µg/l) for chloride are a function of hardness (CaCO 3 (mg/l)) and sulfate (mg/l) using the equation for each use according to the following table:

B(CW1), B(CW2), B(WW -1), B(WW -2), B(WW -3), B(L W)

Acute $287.8(\text{Hardness})^{0.205797}(\text{Sulfate})^{-0.07452}$

Chronic $177.87(\text{Hardness})^{0.205797}(\text{Sulfate})^{-0.07452}$

Sulfate

Table 6: Aquatic Life Criteria for Sulfate for Class B Waters

(all values expressed in milligrams per liter)

	Chloride		
Hardness mg/l as $CaCO_3$	Cl - <5 mg/l	5< = Cl- < 25	25 < = Cl- < = 500
H < = H < = 500	500	500	500
100 < = H < = 500	500	[-57.478 + 5.79 (hardness) + 54.163 Chloride)] X 0.65	[1276.7 + 5.508 (hardness) –1.457 (chloride)] × 0.65
H > 500	500	2,000	2,000

Effluent Characteristics of RO Reject Water

Table 7: Effluent Characteristics of RO Reject Water

Pollutant	Maximum Daily Value		Average Daily Value (last year)	
	Mass	Concentration	Mass	Concentration
Biochemical Oxygen Demand (BOD)	7.26 lbs	3 mg/l	2.05 lbs	3 mg/l
Total Suspended Solids	0	<0.002	0	<0.002
Escherichia coli (E.coli)	0	<DL	0	<DL
Ammonia (as N)	0	<DL	0	<DL
Oil and Grease	0	<DL	0	<DL
Chemical Oxygen Demand	9.68 lbs	4 mg/l	2.74 lbs	4 mg/l
Total Organic Carbon	0	<DL	0	<DL
Total Residual Chlorine	0.93 lbs	0.38 mg/l	0.29 lbs	0.38 mg/l
Discharge Flow	Million Gallons per Day (MGD) 0.290 MGD		Million Gallons per Day (MGD) 0.082 MGD	
pH	7.5 Minimum		7.7 Maximum	

Table 8: Sulfate and Chloride Data

Pollutant	Maximum Daily Value		Average Daily Value (last year)	
	Mass	Concentration	Mass	Concentration
Sulfate	711 lbs	294 mg/l	162 lbs	236 mg/l
Chloride	346 lbs	143 mg/l	79 lbs	121 mg/l

RO Unit Cleaning Compounds

Chemicals used to clean the membranes are chemicals of concern but will not be discharged via the storm sewer. During the pilot testing of the industrial wastewater pretreatment technology the RO Units were bypassed to the sanitary sewer upstream of the pilot unit so that the wastewater could be pilot tested independent of the RO Reject flow. When the pilot test ended the valves connecting the RO Units to the by pass were closed and the RO Reject Flow was redirected to the sanitary sewer. When an NPDES permit allowing discharge of the RO Flow to the storm sewer is granted the pilot program bypass will be connected to a Parshall flume and sampling pit that in turn will be connected to the storm sewer. Position switches will be installed on the valves connecting the RO Units to the bypass. The position switches will go to the closed position when the valves are closed and the units discharge reject flow to the sanitary sewer and will be in the open position when the valves open and the discharge flow is directed to the storm sewer. These switches will be connected to the controls of the RO Unit. The units will be hard programmed so that they will only go into a cleaning cycle if the discharge valves to the storm sewer are closed and the position switch closes allow for the signal to commence the cleaning cycle to pass the completed circuit. Since the RO can only enter a cleaning cycle with the bypass valves closed, no chemicals of concern will be discharged to the storm sewer.

Pollutants of Concern Identification and Tier Protection Level

Table 9 identifies the pollutants of concern (POC) for the proposed discharge.

Table 9: Pollutants of Concern

POC	Secondary or WQBEL?	Beneficial Use Affected	Tier	Notes
Organic Matter ($CBOD_5$)	Yes	Aquatic life	2	Better than WQS[1]
Suspended Solids (TSS)	Yes	General uses	2	Better than WQS
Ammonia-Nitrogen	Yes	Aquatic life	2	Better than WQS
Bacteria (E. coli)	Yes	Contact recreation	2	[redacted] not currently listed as impaired. Tier 2 review level assumed.
TRC	Yes	Aquatic life	2	Elimination of TRC per calculation
Chloride	Yes	Aquatic life	2	Better than WQS
Sulfate	Yes	Aquatic life	2	Better than WQS
Total Nitrogen	No	Human health (drinking water), aquatic life (indirect), general uses (nuisance aquatic life)	2	No WQS numeric criteria.
Total Residual Chlorine (TRC)	Yes	Aquatic life	2	Distance to [redacted] at flow rate of <0.5 foot per second (228 minutes) is sufficient to destroy TRC
Priority Pollutants	No		2	See note below

[1] Water Quality Standard

567 IAC 61 lists a total of 88 priority pollutants, some of which may reasonably be expected to be present in a treated municipal effluent absent significant industrial contributors. For example, lead and copper may be present in the treated effluent (and the drinking water supply) due to plumbing corrosion. To date the existing treatment facility has not been required to test for any priority pollutants due to lack of significant contributing industries that discharge any of the constituents to the sanitary sewer system and associated lack of reasonable potential to violate water quality standards criteria for these constituents. The concentrations of priority pollutants are not expected to increase as the result of additional wastewater flows and loadings. However, in as much as these constituents may be present in the effluent and the proposed treatment system is not designed to remove them, the total mass discharged to the receiving stream may increase.

Identification & Discussion of Alternatives

The quality of the RO Reject Water meets or exceeds all posted criteria for discharge to surface water. However an analysis of antidegradation alternatives is required by Iowa statute.

Alternate. No. 1: Recycle/Reuse

To be considered a Non Degrading Alternative (NDA), this option must include recycle or reuse of the entire proposed increase in treated wastewater volume. This alternative was determined to be not practicable due to the following factors:

- Seasonal constraints and lack of consumptive demand for agricultural irrigation, landscape irrigation, recreational area irrigation or industrial water use applications.
- Aquifer augmentation through well disposal is prohibited by 567 IAC 62.9.

Alternate No. 2: Land Application

Land application of the proposed increase in design loading in addition to any treatment modifications necessary to meet the new WQBELs was evaluated and determined to be economically inefficient.

The Iowa Wastewater Facilities Design Standards Chapter 21 governs design requirements for land application of wastewater. The minimum storage required for land application is 200 days based on climatic restraints per Figure 3 of Chapter 21. The storage requirement associated with storage of the RO Reject Flow for 200 days was calculated as 29 million gallons using the half of the daily maximum flow as a conservative estimate of the maximum 200-day wet weather flow. The associated land area required for a 29 million gallon storage lagoon would be approximately 11 1/2 acres. The land application area required for slow rate application assuming a maximum percolation of 10 inches per month would be approximately 24 acres neglecting any buffer area. As the [redacted] facility adjoins the [redacted] Airport a storage lagoon would be forbidden by FAA regulations as an avian attraction

Assuming that the land application site could be located adjacent to the treatment and storage site (no transmission costs) the addition of a slow rate land application system to land apply this proportion of the flow would add approximately $2.6 million dollars (present worth) to the BPCA project cost, including storage lagoons, a pumping station, chlorine disinfection prior to land application, land purchase, sprinkling system and associated operation and maintenance costs. This cost differential includes design of the BPCA for existing flows and loadings rather than projected flows and loadings for the 20-year design life.

Alternate No. 3: City Water Pollution Control Facility Treatment

Regional treatment is considered an LDA in this analysis. The City of [redacted] WPCF cannot remove the TDS constituents of Sulfate and Chloride, as these components are present in the water as sourced from the Des Moines River by the City of [redacted] Water Department. Alternative 6, Segregation and Diversion of the RO Reject Water relocates the return of these materials upstream in the watershed from where they are currently discharged.

The City of [redacted] WCPF currently receives the RO Reject flow and this clean water flow consumes a great deal of the WPCF's hydraulic capacity. The segregation and diversion of this water via storm sewer to [redacted] Alternative 6, will increase the hydraulic capacity of the WPCF by the equivalent of 1160 households. (250 gpd per ERU). The equivalent hydraulic capacity increase to the WPCF would have a capital cost of $3,915,000 (290,000 gpd at a current cost of $12 to $15 per gallon). Similarly, the flow of this water through the proposed industrial pretreatment system would increase the hydraulic capacity by this same volume and add the same $3,915,000 worth of capital costs to that system.

The primary purpose of the segregation and direct discharge of this RO Reject Flow of essentially clean water is to reduce the hydraulic load on the City of [redacted] WPCF as well as making the pretreatment of the industrial wastewater generated by ABC more efficient and capital cost efficient.

Alternate No. 4: Anaerobic Digestion of Sulfate and Chlorides

While there are Anaerobes that will consume both Sulfates and Chlorides the concentrations of these POC's in the RO Reject water are too low to support a colony of such bacteria unless there was an anaerobic solution in coordination with Alternate 5: Vacuum Evaporation. As discussion of Alternate 5 follows the extreme cost of such a solution even if reduced by thirty percent precludes it's consideration as totally impractical.

Alternate No. 5 Vacuum Evaporation

Technology exists to evaporate the RO Reject water resulting in a distilled quality water and a solid residue of the sulfates and chlorides. Unfortunately a unit capable of evaporating a flow of this magnitude, over 200 gpm, would have a capital cost of $7,500,000 and an annual operation expense for energy alone of $1,950,000. Additionally, the distilled product would need a re-aeration facility to get the DO of the water to a level capable of discharge to a facility of any sort and it would have a pH so low that the required buffering agent would lift the chloride content back to or beyond that which one sought to resolve originally.

Evaporation is dismissed as an impractical solution.

Alternate No. 6: Segregation and Discharge of the RO Reject to Storm Sewer

The primary purpose of the segregation and direct discharge of this RO Reject Flow of essentially clean water reduces the hydraulic load on the City of [redacted] WPCF. Segregation and diversion of the RO Reject water via storm sewer to [redacted] will increase the hydraulic capacity of the WPCF by the equivalent of 1160 households. (250 gpd per ERU). The equivalent hydraulic capacity increase to the WPCF would have a capital cost of $3,915,000 (290,000 gpd at a current cost of $12 to $15 per gallon)

The Diversion of the Flow to the existing Storm Sewer System serving the [redacted] Airport industrial park including a Parshall flume metering and sampling structure is $20,000.

Table 10: Alternatives and Present Worth Costs

Alt. No.	Description	Present Worth Cost[1]
1.	Recycle/reuse	N/A
2.	Land Application	$5,734,000
3.	WPCF Treatment	$3,915,000
4.	Anaerobic Digestion of Sulfate and Chlorides	$5,250,000
5.	Vacuum Evaporation	$7,500,000
6.	Segregation and Direct Discharge via Storm Sewer	$20,000

Table 11: Alternative Classification and Evaluation

Alt No	BPCA NDA or LDA	Is the Alternative Reasonable?					
		Practicable	Economic Efficiency	% of BPCA	Affordable	% of MHI	Reasonable
1.	NDA	No	N/A	N/A	N/A	N/A	No
2.	NDA	Yes	No	286	N/A	N/A	No
3.	NDA	Yes	No	196	N/A	250	No
4.	NDA	No	No	263	No	1500	No
5.	NDA	No	No	375	No	2000	No
6.	LDA[1]	Yes	Yes	1	Yes	1	Yes

Alternative No. 6, Segregation and Direct Discharge via Storm Sewer, is the preferred reasonable treatment alternative based on anticipated treatment performance.

Preferred Alternative

Alternative No. 6, Segregation and Direct Discharge via Storm Sewer, is the preferred reasonable treatment alternative based on anticipated treatment performance. Table 12 summarizes evaluation of the reasonable alternatives on a pollutant-by-pollutant basis.

Table 12: Reasonable Alternatives Degradation Comparison

Pollutant of Concern	Potential Degradation? Alt. No. 3	4	5	6	Comments
$CBOD_5$	No	No	No	No	BOD load of RO Reject is ½ that of [redacted]
TSS	No	No	No	No	TSS of RO Reject is <0.002
Ammonia-Nitrogen	No	No	No	No	Ammonia (as N) of RO Reject is <DL
E. coli	No	No	No	No	E. coli of RO Reject is <DL
Chloride	Yes	No	No	Yes	Neither the existing treatment system nor the alternative treatment systems are designed to remove chloride or sulfate. The mass of these pollutants discharged to the stream will increase in the absence of other mechanisms of control. See discussion of chloride, sulfate & priority pollutants in the Justification of Degradation section.
Sulfate	No	No	No	Yes	See Chloride above.
Total Nitrogen	Yes	No	No	No	N in RO Reject is <0.002
TRC	No	No	No	No	Distance to [redacted] at flow rate of <0.5 foot per second (228 minutes) is sufficient to destroy TRC
Priority Pollutants	Yes	No	No	Yes	See note below.

567 IAC 61 lists a total of 88 priority pollutants, some of which may reasonably be expected to be present in a treated municipal effluent absent significant industrial contributors. For example, lead and copper may be present in the treated effluent (and the drinking water supply) due to plumbing corrosion. To date the existing treatment facility has not been required to test for any priority pollutants due to lack of significant contributing industries that discharge any of the constituents to the sanitary sewer system and associated lack of reasonable potential to violate water quality standards criteria for these constituents. The concentrations of priority pollutants are not expected to increase as the result of additional wastewater flows and loadings. However, in as much as these constituents may be present in the effluent and the proposed treatment system is not designed to remove them, the total mass discharged to the receiving stream may increase.

Justification of Degradation

The preferred treatment alternative will result in attainment of all secondary standards and WQBEL's. It will also result in improved water quality with respect to BOD. The RO Reject water has a BOD concentration of 3 mg/l; [redacted] has a BOD concentration of 6 mg/l. The BOD concentration of [redacted] will decrease.

In addition, the mass of micro constituents (i.e. priority pollutants) as well as chloride and sulfate will increase, but by considerably less than the strictest discharge criteria. It should be noted that currently the levels of these pollutants in the [redacted] WPCF influent and effluent are unknown, or based on limited monitoring have been deemed to meet applicable water quality standards. Note also that treatment to remove these pollutants is, as a general rule, not feasible where they are part of a combined municipal wastewater stream. Such pollutants are best addressed through source reduction efforts. Reduction in chloride concentrations will be achieved at the WPCF by this diversion from the sanitary sewer system and will result in a reduction of sulfates and chlorides at the discharge point of the WPCF and thereby allowing better dispersion across a wider portion of the Des Moines River watershed. However, selective treatment for removal of chloride at the sewage treatment plant would require the use of an advanced membrane filtration process, which in turn would generate a highly concentrated waste stream that is difficult to dispose of. In as much as these POC's are the product of a state of the art membrane system the capital and operating costs of a nanofiltration system more efficient than the [redacted] RO would be prohibitively expensive.

As described above, it has been determined that degradation for some POCs will result from the implementation of the preferred treatment alternative. Since Iowa's Antidegradation Implementation Procedures apply to net mass pollutant increases irrespective of effluent or receiving stream pollutant concentrations, and because they do not exempt POCs that are not feasible to remove absent source reduction efforts, the Social and Economic Importance (SEI) of the project must be demonstrated.

Project Social and Economic Importance

Affected Stakeholders:

The affected stakeholders are the City of [redacted], IA, [redacted] County, IA and their citizens and the [redacted] an affiliate of [redacted] and its' 210 employees at this facility. The entire project is an industrial pretreatment process of two parts, pretreatment of the highly loaded industrial wastewater and segregation and diversion of the clean RO Reject. The entire population of the community will benefit from the project the primary costs of which will be borne by the [redacted].

Relevant Social and Economic Factors:

The segregation and diversion of the clean RO Reject presents no known potential public health, safety or environmental problems.

Associated Social and Economic Development:

The proposed project is undertaken to meet a request by the City of [redacted] to [redacted] to reduce the high BOD loading and flows from their facility so that the WPCF can stay within its' effluent permit limits and maintain adequate sewage treatment for the City. The high BOD loads and hydraulic demands of [redacted] flows limit both residential and commercial/industrial growth as well as the WPCF's ability to meet more stringent effluent limits. This project provides the community expansion of both treatment capacity and improvement of treatment efficiency without the expense of the capital or operating costs of expanding the current facility.

The project may well directly affect community employment rates, income levels, population trends or housing starts by allowing a large employer maintain the current economics of production in [redacted] despite the disadvantages the location presents in logistics required to serve its' primary market. The project will have indirect impacts on some of these factors. The City will not be required to increase in employment at the WPCF while gaining increased efficiencies and capacity that will be realized as the result of this project increasing the treatment and hydraulic capacity of the existing treatment facilities. The existing and proposed infrastructure is funded through municipal sewer revenues and will have a number of economic and non-economic impacts including:

(a) Restriction of the hydraulic and treatment capacity of the WPCF will slow or prevent community growth rates if future potential industries or residents are prevented from locating in [redacted] because there is not sufficient capacity at the WPCF.

(b) The segregation and diversion of the RO Reject is an economically efficient and affordable treatment alternative. The project will provide the citizens of [redacted] additional capacity at the WPCF worth almost $4,000,000 at no capital cost.

(c) By increasing the treatment capacity and degree of treatment provided, the project will benefit the receiving stream as well as the aquatic and recreational beneficial uses associated with it.

(d) By increasing the treatment capacity, the project will allow for continued growth of the community.