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4300 Cherry Creek Dr. S.
Denver, Colorado 80246-1530
Phone (303) 692-2000
Located in Glendale, Colorado

http://www.cdphe.state.co.us

Laboratory Services Division
8100 Lowry Blvd.
Denver, Colorado 80230-6928
(303) 692-3090

Colorado Department
of Public Health
and Environment

June 9, 2011

Ms. Alisha Reis, Town Administrator
Town of Nederland
P.O. Box 396
Nederland, CO 80466

RE: Clean Water State Revolving Fund - Green Project Reserve Qualification Review
WWTF Improvements; Town of Nederland
CDPS CO-0020222; Boulder County; Financial Solutions Unit Project No. 030195W

Dear Ms. Reis:

The Water Quality Control Division (the Division) has reviewed the State Revolving Fund (SRF) Green Project Reserve qualification for the Town of Nederland Phase 1 Wastewater Treatment Facility (WWTF) Improvements clean water project which is eligible for SRF funding. The project was evaluated in accordance with the *State of Colorado 2011 Water Pollution Control Revolving Fund and State Domestic Wastewater Treatment Grant Intended Use Plan* and the USEPA April 21, 2010 *Attachment 2: 2010 Clean Water and Drinking Water State Revolving Fund 20% Green Project Reserve: Guidance for Determining Project Eligibility*. This letter shall serve as documentation of the Green Project Reserve evaluation upon which the above mentioned project was reviewed for qualification toward meeting the 20% Green Project Reserve capitalization grant requirements.

Green Reserve Project – Categorical Project:

As stated in the USEPA April 21, 2010 Attachment 2, there are some types of projects that clearly will qualify towards the 20% Green Project Reserve (GPR), being entirely and explicitly framed as a green infrastructure or a water or energy efficiency project. Such projects are considered to be "categorically" green projects. This project is considered to be a categorically green project as defined by the USEPA guidance documentation.

List of Eligible Green Project Reserve Components:

1. Proposed Sequencing Batch Reactor (SBR) system for the Town of Nederland Wastewater Treatment Facility Improvements
2. Total Project Cost = \$4.77 million
3. Total SRF Loan/Grant Request = \$4.77 million
4. Total Project Cost Eligible for Green Project Reserve = \$4.77 million (100 % of total project cost)

The *State of Colorado 2011 Water Pollution Control Revolving Fund and State Domestic Wastewater Treatment Grant Intended Use Plan,* Part 4 states "projects that have implemented eligible green costs that are equal to or greater than 20% of the total project cost may be eligible for additional subsidy in the form of a reduced interest rate to the total executed loan amount. Specific terms of the interest rate will be set by the Authority's Board". The eligible green costs for this project are greater than 20% of the total project costs and therefore, the Division recommends the Authority Board consider the project as "green".

<u>Green Project Reserve Type:</u>

Energy Efficiency (Part 3.0) "the use of improved technologies and practices to reduce the energy consumption of water quality projects, use energy in a more efficient way, and/or produce/utilize renewable energy."

Energy Efficiency (Part 3.2-2) "Projects that achieve a 20% reduction in energy consumption are categorically eligible for GPR. Retrofit projects should compare energy used by the existing system or unit process to the proposed project."

The reduction in energy consumption was determined to exceed 20% based on the following information:

- The proposed innovative SBR system for the Town of Nederland will replace the existing lagoon facility. The existing lagoon facility has two-10 HP surface aerators and five-7 HP downdraft aerators that run 24-hours per day, which is an inefficient technology from an energy conservation standpoint.
- The estimated energy consumption of the proposed Nederland Phase 1 WWTF (new SBR facility) was calculated to be 181,920 kW-hr/yr compared to the existing WWTF actual energy consumption which is 312,335 kW-hr/yr. The proposed system is estimated to be 41.8 percent more energy efficient than the existing lagoon system, and the estimated annual energy cost savings for the project is $8,868.22 per year (130,415 kW-hr/yr estimated cost savings times current electric rate for Nederland equals $8,868.22 per year). This equates to approximately $177,364 over a 20 year period.

<u>Documents Submitted and Reviewed:</u>

1. Preliminary Engineering Report dated May 2011 entitled: *"Town of Nederland Phase 1 Wastewater Treatment Facility Improvements"* prepared by Frachetti Engineering, Inc. on behalf of the Town of Nederland.
2. Preliminary Engineering Report supplement dated June 6, 2011 entitled: *"Town of Nederland Phase 1 Wastewater Treatment Facility Improvements"* prepared by Frachetti Engineering, Inc. on behalf of the Town of Nederland.

<u>Green Reserve Project – Evaluation Conclusion:</u>

The Division has determined that the categorical 'Green' project submitted for the Town of Nederland by Frachetti Engineering, for the above noted project, is consistent with the requirements of the green project reserve and identifies clear and substantial technical and financial benefits in accordance with USEPA guidance. The Division considers the identified green portion of the project totaling $4.77 million (100%) of the total project cost to be eligible to count toward the Green Project Reserve. As stated in the *State of Colorado 2011 Water Pollution Control Revolving Fund and State Domestic Wastewater Treatment Grant Intended Use Plan,* Part 4 states "projects that have implemented eligible green costs that are equal to or greater than 20% of the total project cost may be eligible for additional subsidy in the form of a reduced interest rate to the total executed loan amount. Specific terms of the interest rate will be set by the Authority's Board". The eligible green costs for this project are greater than 20% of the total project costs and therefore, the Division recommends the Authority Board consider the project as "green".

Thank you for your efforts and cooperation in this matter. Please feel free to contact me at 303-692-3566 or Heather Drissel at 303-692-3419 of our Engineering Section if you have any questions or concerns regarding our review.

Sincerely,

Dennis W. Pontius, P.E., District Engineer
Engineering Section/Water Quality Control Division

cc: Nate Brown, P.E., Frachetti Engineering
Bob Frachetti, P.E., Frachetti Engineering
Brian Friel, USEPA Region 8

ec: Dave Akers, Water Pollution Control Program Manager/WQCD
Donna Davis, Operations Program Manager/WQCD
Jennifer Miller, P.E., Engineering Section Manager/ WQCD
Michael Beck, Financial Solutions Unit Manager/WQCD
Lisa Pine, Project Manager, Financial Solutions Unit/WQCD
Heather Drissel, P.E., Denver Field Unit II Manager/Engineering Section/WQCD
Louanna Cruz, Project Manager, Financial Solutions Unit/ WQCD

MEMORANDUM

Date: June 14, 2011

To: Michael Beck, Financial Solutions Unit Manager

From: Dennis Pontius, District Engineer, ES/WQCD

Re: WPC PRELIMINARY ENGINEERING REPORT AMENDMENT REVIEW
Town of Nederland; CO-0020222; Boulder County

The Engineering Section received and reviewed the Preliminary Engineering Report (PER) Amendment for the above referenced project. The document entitled is as follows:

WPC PER Amendment dated May 2011 and received May 18, 2011entitled:
"Amendment to the Preliminary Engineering Report for Phase 1Wastewater Treatment Facilities Improvements " prepared by Frachetti Engineering, Inc. for the Town of Nederland

The PER Amendment documents received for this review were stamped and signed by a P.E. registered in Colorado (Bob Frachetti, Frachetti Engineering, Inc.).

The PER Amendment Guidance and Review Checklist Form is attached for information. See the review comments below.

1. A transmittal entitled, 'Preliminary Engineering Report & Site Location Approval Amendment Clarifications' prepared by Frachetti Engineering, Inc. (FEI) and dated June 7, 2011 (received by the WQCD on June 9, 2011) was also reviewed as part of this document.
2. The public meeting requirement is to notice it in the local newspaper at least 30 days prior to the Power Authority meeting. The PER Amendment to be used for the meeting should be the FEI document dated May 2011 and submitted to us for review. The PER Amendment Clarifications document dated June 7, 2011 should also be available during the public meeting. After the notice has been run in the paper, the Town must get an "Affidavit of Publication" from the legal department of the newspaper. This document along with the meeting agenda, meeting roster, and meeting minutes that reflect any issues or questions that may have come up about the project from the community and the responses they received will need to sent to the FSU/WQCD.
3. While the Fluidyne ISAM/SBR process is the basis of design for the project, other manufacturers that offer similar SBR equipment will be considered "or equal" as a supplier by the Town and the engineer. In the event an SBR process other than Fluidyne ISAM/SBR is used in the design for the facility, the Town and the engineer will consider including dedicated vortexing grit removal, pumping, and solids separation/clarifiers in the project.
4. A letter dated June 9, 2011entitled, 'Clean Water State Revolving Fund – Green Project reserve Qualification Review WWTF Improvements; Town of Nederland', was mailed to the Town (and the Financial Solutions Unit) on June 10, 2011. The letter states "the project cost of $4.77 million is 100 percent eligible for Green Project Reserve funding."
5. A tertiary filter (upflow sand filter) w/ chemical addition is required by the City of Boulder to meet phosphorus limits established by the City. This filter will replace the disk filter that was included in the previous design that required a new technology review and approval by the WQCD/Engineering Section.

Attachment: As Stated

Pontius, Dennis W.

From:	Nate Brown [nate@frachetti.com]
Sent:	Monday, June 06, 2011 5:04 PM
To:	Pontius, Dennis W.
Cc:	Bob Frachetti; Bob Orsatti
Subject:	Nederland, CO -- Responses to Questions RE: 2011 Amendment to PER
Attachments:	NEDL - Amendment to PER - Pages 25 - 28.pdf; NEDL - O&M Costs at Startup with Biosolids Pond (Alternative Approach).pdf; NEDL - O&M Costs at Startup with ISAM Only (Primary Approach).pdf

Dennis:

Bob Frachetti informed me of questions you have relative to our May 2011 Amendment to the PER for the Town of Nederland, CO Phase 1 WWTF Improvements Project. This email seeks to clarify those questions you and Bob discussed.

1. Alkalinity adjustment – Chemical dosing of supplemental alkalinity will be provided with the Project. The Town is amendable to using caustic soda (50% solution) and this will be the basis for our design. FEI will provide supplemental information (MSDS, secondary containment, pumps, etc. with the upcoming PDR) as we do not believe it is required for the PER.

2. Grit Removal – Grit removal will not be included in this Project. However, provisions will be made for future inclusion of dedicated grit removal systems. The provisions we're providing include added fall for the additional headloss and a couple of stop plates locations to redirect flow if needed.

3. Electrical consumption discrepancy between Page 25, Table 7.3, Table 7.4, and Table 7.5 – The discrepancy in the PER is that two different startup load values are presented: 134,774 and 144,000 kW-hr/yr. The 144,000 kW-hr/yr value is correct and accounts for 48% of the expected build-out load. The error in the document occurred because I became mixed up and started using 45% of the build-out load instead of 48% for the second two tables. The build-out energy estimate totaled 299,498 kW-hr/yr; 45% x 299,498 = 134,774; 48% x 299,498 = 143,892. The attached pages will replace the erroneous pages in the original submittal. FEI will put hard copies of the modified pages in the mail tomorrow (6/7) along with a stamped cover letter. Let me know if this approach is not acceptable and I'll address the stamped modifications as you like.

4. Electrical usage in long-term biosolids storage – The proposed Nederland WWTF will include the ISAM™ tanks as the primary biosolids storage/ partial stabilization reactors (i.e., no other biosolids storage/ stabilization required). The Kersey WWTF, also an ISAM SBR, runs well in the same fashion. For the energy analysis presented in the PER, I assumed the facility would operate with only the ISAM for biosolids storage, similar to Kersey, as this provides them the lowest energy usage. I have attached a complete electricity O&M estimate for the ISAM™ only option.

   For Nederland, the existing Lagoon No. 2 will be left in service to provide long-term biosolids storage/ emergency storage if the Town elects to operate it as such. This option increases their energy usage and, correspondingly, lowers the sludge hauling costs. To allow long-term biosolids storage, FEI recommends two 7.5 HP aerators be used with an on/off control strategy to maintain a mixed, mostly aerobic environment, which will reduce odor generation. At build-out, aerating the biosolids storage lagoons for 75% of each day (18 hr on/day) with two aerators running at 7.0 BHP adds about 80,000 kW-hr/yr of energy use, which is a 27% increase in energy use vs. running the ISAMs only (379,000 vs. 299,498 kW-hr). I have attached a complete electricity O&M estimate for the biosolids lagoon storage option.

   At this time, it is unknown if the ISAM only biosolids storage or the ISAM + lagoon option would provide the lowest overall O&M cost to the Town. This is unknown because FEI has not contacted sludge haulers to inquire about pricing for dredging and disposal on an annual or bi-annual basis.

   Adding the two lagoon aerators represents a worst-case energy consumption for build-out flows/load at 379,000 kW-hr. Derating this value by 48% put the annual energy demand at start up at about 182,000 kW-hr/yr of consumption. If this value were used in the PER, Tables 7.4, 7.5, and 7.6 would look as follows. As can be seen in the Edited Tables 7.5 and 7.6, the reduction in energy consumption still easily exceeds the 20% threshold compared to the existing and compared to the as-bid SBR by TEC in 2011, and thus the Project remains categorically green.

Edited Table 7.4 Energy Demand Comparison with Lagoon No. 2 Biosolids Storage

Parameter	Kersey Operating Values[1]		Estimated Nederland Values at Start up [2]	
Ann. Avg. Daily BOD Load	294	ppd	234	ppd
Yearly BOD Load	107,310	ppyr	85,498	ppyr
Estimated Ann. Elec. Use	206,044	kW-hr/yr	181,920	kW-hr/yr
Energy Use per lb BOD treated	1.9	kW-hr/lb BOD	2.1	kW-hr/lb BOD

Edited Table 7.5 Comparison of Existing WWTF to Proposed SBR with Lagoon No. 2 Biosolids Storage

Parameter	Nederland Existing WWTF Values[1]		Estimated Nederland Values at Start up [2]	
Ann. Avg. Daily BOD Load	202	ppd	234	ppd
Yearly BOD Load	73,730	ppyr	85,498	ppyr
Estimated Ann. Elec. Use	312,335	kW-hr/yr	181,920	kW-hr/yr
Energy Use per lb BOD treated	4.2	kW-hr/lb BOD	2.1	kW-hr/lb BOD
Percent Reduction in Electricity Demand	**n/a**		**41.8%**	

Edited Table 7.6 Comparison of Previously Bid SBR to Proposed ISAM™ SBR with Lagoon No. 2 Biosolids Storage

Description	Electricity Demand (kW-hr/yr)	
	Previously Bid SBR	**Proposed ISAM™ SBR**
Fine Screen	758	758
SBR Blowers	250,536	131,400
Motive Pumps	0 (not required)	101,215
Digester Blowers at 80% Capacity	371,205	76,446
Effluent Equalization Pumps	12,013	12,013
Upflow Sand Filter Air Compressor	25,482	25,482
UV Disinfection	12,264	12,264
NPW Pump	2,290	2,290
Ferric Dosing Pumps	964	964
Alkalinity Dosing Pumps	964	964
4% Misc. Electrical	24,807	14,577
TOTAL	**585,982**	**379,002**
Percent Reduction compared to Previous Bid SBR	**n/a**	**35.3%**

Please let me know how you would like the discussion in Item #4 included in PER, if at all.

Thanks.
Nate

Nate Brown, P.E.

Frachetti Engineering, Inc.
5325 S. Valentia Way
Greenwood Village, CO 80111
Phone: (303) 928-1388
Cell: (720) 663-7494
www.frachetti.com

section.

Table 7.3 Comparison between Fluidyne and FEI Estimated Electrical Demands

Parameter	Fluidyne Estimated Elec. Values		FEI Estimated Elec. Values	
Elec. Demand at Start up	250	kW-hr/day	393	kW-hr/day
Elec. Demand at Build out	526	kW-hr/day	820	kW-hr/day

The Nederland energy consumption estimated by FEI is much lower than previous estimates provided to the Town for the previously bid SBR (TEC, February 2011). In order to supplement FEI's analysis and validate our estimate, the expected start up energy demand was converted into energy demand per lb BOD_5 treated, and this value was compared to actual operating data from a similarly designed and constructed Fluidyne ISAM SBR operated by the Town of Kersey, Colorado. The Town of Kersey provided FEI with annual O&M costs, including electricity. The Kersey Operator in Responsible Charge (Ramey Environmental Compliance) provided FEI with DMR reports, which FEI used to determine the annual BOD_5 load. From this data, FEI determined the energy usage per lb of BOD_5 treated for the Kersey WWTF.

Table 7.4 compares the operating energy consumption data to the estimated start up energy consumption at Nederland. As can be seen, the two energy consumption (kW-hr) per lb BOD5 values are within about 10 percent of each other. Thus, the startup energy demand estimate generated by FEI is reasonable and can be used to provide an energy use estimate for the proposed Project. FEI's estimate of 1.7 kW-hr per lb BOD treated for the proposed ISAM™ SBR improvements easily exceed the 20 percent energy efficiency reduction requirement.

Table 7.4 Energy Demand Comparison

Parameter	Kersey Operating Values(1)		Estimated Nederland Values at Start up (2)	
Ann. Avg. Daily BOD Load	294	ppd	234	ppd
Yearly BOD Load	107,310	ppyr	85,498	ppyr
Estimated Ann. Elec. Use	206,044	kW-hr/yr	143,892	kW-hr/yr
Energy Use per lb BOD treated	1.9	kW-hr/lb BOD	1.7	kW-hr/lb BOD

(1) Estimated based on data provided by the Town Clerk and WWTF Operator in Charge (Ramey Environmental Compliance)
(2) Estimated per methodology described in Section 7.5.2. Refer to Appendix E.03 for detailed electricity demand calculations for the proposed SBR.

7.5.3 Justifications & Confirmations – 20 Percent Energy Use Reduction Compared to Existing Facility

The existing Nederland WWTF is a lagoon treatment system using two lagoons in series followed by a polishing pond and chlorine disinfection. To maintain adequate treatment, the two lagoons use a total of seven aerators/ mixers, each of which runs 24 hours a day. The lagoon process is inefficient and is expected to use more energy than the proposed SBR upgrade. FEI estimated the annual energy demand for the existing facility and compared that to the start up demand estimate for the proposed SBR. Refer to Table 7.5 for the comparison. As can be seen, the proposed WWTF improvements are clearly more than 20 percent more efficient than the existing facility and will provide Nederland with reduced electricity costs once in operation.

The ISAM™ reactors also provide for a very large reduction in energy demand due to the inclusion of WAS storage and partial stabilization in an anaerobic ISAM™ environment. As stated by the Water Environment Federation "*... early attempts to use aerobic digestion as a solution to solids disposal and handling regulations led to relatively long solids retention time (SRT) values, which made both the capital and operating costs [due to high energy requirements for aeration equipment] very unappealing*" (pg. 31-4; WEF, 2008). Per the previously bid plans and specifications, the Digester Blower's design point would have utilized 56.5 kW at 100 percent capacity (TEC, February 2011). Assuming 18 hours of operation per day and 6 hours of downtime to facilitate anoxic conditions, the aerobic digester blower operating at 80 percent capacity would consume up to 257,544 kW-hr per year, which is worth about $17,513 in electricity costs at the Town's current rate of $0.068 per kW-hr. At 100 percent capacity, the digester blowers would use 44 percent more power.

<u>Influent Equalization/ Anoxic Tanks (SAM™ Reactors)</u> – The SAM™ reactors serve as partial influent equalization reactors and provide anoxic conditions for denitrification (*i.e.*, conversion of nitrate to nitrogen gas). Denitrification allows for reduced AOR demand to downstream aerobic reactors and "theoretically, 2.86 kg oxygen demand is satisfied per kilogram (2.86 lb/lb) of nitrate-nitrogen reduced to nitrogen gas (pg. 20-11; WEF, 2008). Including the SAM™ reactors for denitrification reduces the AOR for the SBR by about 29 percent (from 904 to 649 lb O_2 per day)

7.5.2 Proposed SBR O&M Cost Validation and Comparison

FEI developed O&M estimates for the Project by selecting preliminary equipment and operating points at <u>design flow/ load</u>. Then equipment run times were determined at design flow/ load for all equipment. Motor loads counted in the analysis include: fine screen, jet motive pumps, process aeration blowers, effluent equalization pumps, sand filter compressors, UV disinfection, non-potable water (NPW) pumps, and chemical dosing pumps (for alkalinity and ferric addition). 4 percent of additional miscellaneous electrical loads were added for electrical equipment such as lighting and programmable logic controllers (PLCs). Refer to Appendix B.01 for detailed O&M assumptions, calculations, and estimates.

The electrical loads were summed and about 300,000 kW-hrs of electricity consumption per year was estimated at design flow and load. Then, to simulate start up conditions, FEI compared 2007 – 2011 average influent BOD5 data (204 ppd) to the design influent BOD5 load (488 ppd). Current influent loading is about 42 percent of the design load. For conservatism, FEI applied a 48 percent de-rate to the design load power estimate and estimated the proposed SBR will use 144,000 kW-hr per year at startup (year 2013). FEI used the expected annual loading and electricity usage to estimate an energy demand per lb of BOD_5 treated (See Table 7.3)

Note that for the 20-year cash flow analysis budgeting purposes *only*; a 1.5 times safety factor was applied to this demand estimate to provide a more conservative electricity budget (refer to Appendix B.01 and B.02 for O&M estimates).

Fluidyne's process calculations at initial (*i.e.*, start up) flow and loads and build out flow and loads are included in Appendices E.01 and E.02, respectively. FEI's estimated electricity demands include a more conservative approach to blowers and includes minor loads not included in the Fluidyne estimates. Table 7.3 contains a comparison between the two electricity demand estimates. FEI's electrical demand estimates are used for both justifications presented later in this

Table 7.5 Comparison of Existing WWTF to Proposed SBR

Parameter	Nederland Existing WWTF Values(1)		Estimated Nederland Values at Start up (2)	
Ann. Avg. Daily BOD Load	202	ppd	234	ppd
Yearly BOD Load	73,730	ppyr	85,498	ppyr
Estimated Ann. Elec. Use	312,335	kW-hr/yr	143,892	kW-hr/yr
Energy Use per lb BOD treated	4.2	kW-hr/lb BOD	1.7	kW-hr/lb BOD
Percent Reduction in Electricity Demand	**n/a**		**59.5%**	

(1) Estimated based on data provided by the Town, refer to the electricity demand spreadsheet in Appendix E.05

(2) Estimated per methodology described in Section 7.5.2. Refer to Appendix E.03 for detailed calculations of the electrical demand for the proposed SBR.

7.5.4 Justifications & Confirmations – 20 Percent Reduction Compared to Previous Improvements Design

SBR improvements for the Town of Nederland were designed and bid out to General Contractor in February of 2011. The previous Project bids came in high and were above the Town's affordability. Thus, FEI was hired to value engineer the previously bid design, and, ultimately, concluded that an ISAM™ SBR would provide the Town a more affordable and energy efficient design. Major differences for the previously bid SBR compared to the proposed ISAM™ design include fine pore aeration, no motive feed pumps, and aerobic digesters. Minor differences include a different method for tertiary filtration (disk filters vs. upflow sand filters), and a different number of chemical dosing pumps.

For the purposes of providing an apples-to-apples comparison between the previously bid SBR against FEI's proposed SBR design, FEI assumed all of the equipment for the two projects was the same except for the aeration/ mixing systems. The previously bid SBR included only process aeration to aerate and mix both the SBR and an aerobic digester. FEI's ISAM™ SBR design includes jet aeration and mixing, with motive pumps to provide the liquid component. For the purposes of the comparison, the Digester Blower in the previously bid SBR system was assumed to operate 18 hours on and 6 hours off each day, which is a typical operating regime for an aerobic digester. Also, the Digester Blower was assumed to run at 80 percent of design capacity for the 18 hours a day, not at 100 percent capacity. Refer to Appendices E.03 and E.04 for electricity demand estimates for the proposed ISAM™ SBR and the previously bid SBR (TEC, February 2011)

A comparison of electricity usage for the two SBR designs for Nederland is included in Table 7.6 for review. As can be seen, the proposed ISAM™ SBR system is expected to be more than 50 percent more efficient than the previously bid SBR project. The main differences between the two approaches that accounts for this large energy savings are as follows:

1. The proposed ISAM™ SBR design utilizes an influent conditioning (ISAM™) reactor to provide primary sedimentation and a 30 percent BOD_5 reduction.
2. The proposed ISAM™ SBR design provides for significant denitrification while the previously bid SBR does not include denitrification
3. The previously bid SBR includes an aerobic digester, which is notoriously a very large

consumer of electricity. FEI utilized the 80 percent capacity value for the digester blower, whereas the digester blower operating at 100 capacity would use about 44 percent more power.

Table 7.6 Comparison of Previously Bid SBR to Proposed ISAM™ SBR

Description	Electricity Demand (kW-hr/yr)	
	Previously Bid SBR	Proposed ISAM™ SBR
Fine Screen	758	758
SBR Blowers	250,536	131,400
Motive Pumps	0 (not required)	101,215
Digester Blowers at 80% Capacity	371,205	0 (not required)
Effluent Equalization Pumps	12,013	12,013
Upflow Sand Filter Air Compressor	25,482	25,482
UV Disinfection	12,264	12,264
NPW Pump	2,290	2,290
Ferric Dosing Pumps	964	964
Alkalinity Dosing Pumps	964	964
4% Misc. Electrical	24,807	11,519
TOTAL	**585,982**	**299,498**
Percent Reduction compared to Previous Bid SBR	**n/a**	**48.9%**

7.5.5 Summary of GPR Justification

As discussed in the previous sections, the proposed ISAM™ SBR WWTF improvements utilize numerous energy efficiency components. The energy estimate developed by FEI is conservative, when compared to Fluidyne's design calculations; and the projected electricity demand per lb of BOD_5 treated is similar (within 10%) to the operating ISAM™ SBR WWTF in Kersey, Colorado. Based on this treatment efficiency, the proposed Project, provides for a significant reduction in electricity usage compared to both the existing lagoon WWTF and the previously bid SBR (TEC, February 2011).

Energy efficiency improvements with the proposed ISAM™ SBR is greater than 50 percent more efficient than the existing WWTF and more than 40 percent more efficient than the previously bid SBR. Therefore, the proposed ISAM™ SBR design meets the requirements of example 3.2-2 and the entire project is categorically eligible for the GPR. The energy efficiency reduction in example 3.2-2 requires at least 20 percent reduction in energy demands. FEI will be happy to provide additional supporting documentation upon request.

7.6 COSTS

7.6.1 Capital Costs

The Engineer's Opinion of Probable Construction Cost (OPCC) for the proposed project,

OBJECTIVE: Calculate the annual Operations and Maintenance (O&M) costs for a Fluidyne ISAM SBR System @ Nederland, CO

GIVEN: The brake horsepower (or motor HP) values were pulled from representative manufacturer's equipment quotations.

ASSUMPTIONS:
1. 90% Motor Efficiency when not provided by manufacturer. If motor HP provided, no motor efficiency included.
2. Inflation (30-year average) 3.65%
3. Interest Rate @ 6.55% (30-year average for Federal Overnight Fund)
4. Real Cost Increase Rate @ 2.90% (Interest Rate - Inflation)
5. 20-Year Present Value to Annual Cost Factor (P/A) @ 15.016
6. Annual Average Month Flows and Loads used to pick duty point of each piece of equipment

REFERENCES: N/A

CALCULATIONS:

A. ELECTRICITY O&M ESTIMATE

(1) *Cost of Electricity*

Energy Inflation Rate 3.40% *Source: EIA average industrial power cost (2000 - 2009)*
\# Years to 2032 20

Year	Cost of Electricity ($/kWhr)
2011	$0.068
2013	$0.073
2031	$0.133
20-yr Average	**$0.091**

1st year of SBR operation

(2) *Estimate of Operating Electrity Demand*

(a) Major Electrical Loads for Headworks, Secondary, and Tertiary Treatment

Description	Quantity: Installed	Quantity: Operating	Motor Size: Motor Size (HP)	Motor Size: Total Installed (HP)	Operating Load (per Motor): (BHP)	Operating Load (per Motor): Motor Eff.	Operating Load (per Motor): (kW)	Run Time (hrs/motor) (hr/day)	Daily Energy Use (kWh/day)	Annual Energy Use at (kWh/yr)
Fine Screen	1	1	2	2	1.25	90%	1.0	2.0	2	758
Motive Pumps	2	2	10	20	9.80	90%	8.1	17.0	277	101,215
Blowers	3	2	25	75	--	--	15.0	12.0	360	131,400
Effluent Equalization Pumps	2	1	5	10	1.65	90%	1.4	24.0	33	12,013
Upflow Sand Filter Air Compressor	1	1	15	15	7.00	90%	5.8	12.0	70	25,482
UV Disinfection	2	1	--	--	--	--	1.4	24.0	34	12,264
NPW Pump	1	1	3	3	2.00	90%	1.7	4.8	8	2,920
Lagoon Aerators	2	2	8	15	7.00	90%	5.8	18.0	209	76,446
Ferric Dosing Pumps	2	2	0	0.5	--	--	0.22	6.0	3	964
Alkalinity Dosing Pumps	2	2	0	0.5	--	--	0.22	6.0	3	964

Installed HP **141**

Annual kW-hr	**364,425**
4% for Misc. Electrical Loads	**14,577**
TOTAL ANNUAL USE (kW-hr)	**379,002**

(3) Estimate of Electricity Demand at Startup

Buildout Organic Capacity	488 ppd BOD5
Actual 2007 - 2011 Avg Organic Load	202 ppd BOD5
Startup % of Buildout	**41%**
Buildout Avg. Hydraulic Capacity	250,000 gpd
Actual 2007 - 2011 Avg Hydraulic Capacity	115000 ppd BOD5
Startup % of Buildout	**46%**

Therefore, for purposes of estimating startup electrical demand, it is assumed the WWTF will use 45% of the buildout flow/ load energy demand in 2011.

Assuming 3% growth in population per year (and 3% growth in flow/load), the WWTF will reach buildout capacity in ~18 years

A 1.5 times safety factor has been used to provide a more conservative estimate of the annual electrical demand.

	Number	Year	Plant Capacity	Est. Ann. Elec. Demand (kW-hr/yr)	Est. Ann. Elec. Demand w/ 1.5 SF (kW-hr/yr)	Est. Elec. Cost ($/kW-hr)	Annual Cost of Electricity ($/yr)
Estimated for existing WWTF	0	2012	45%	--		$0.07	$25,000.00
	1	2013	48%	181,921	272,881	$0.07	$19,839
	2	2013	51%	193,291	289,936	$0.08	$21,796
	3	2014	54%	204,661	306,992	$0.08	$23,863
	4	2015	57%	216,031	324,047	$0.08	$26,045
	5	2016	60%	227,401	341,102	$0.08	$28,348
	6	2017	63%	238,771	358,157	$0.09	$30,777
	7	2018	66%	250,141	375,212	$0.09	$33,339
	8	2019	69%	261,511	392,267	$0.09	$36,039
	9	2020	72%	272,881	409,322	$0.09	$38,885
	10	2021	75%	284,251	426,377	$0.10	$41,882
	11	2022	78%	295,621	443,432	$0.10	$45,038
	12	2023	81%	306,992	460,487	$0.11	$48,361
	13	2024	84%	318,362	477,542	$0.11	$51,857
	14	2025	87%	329,732	494,597	$0.11	$55,535
	15	2026	90%	341,102	511,653	$0.12	$59,404
	16	2027	93%	352,472	528,708	$0.12	$63,471
	17	2028	96%	363,842	545,763	$0.12	$67,746
	18	2029	99%	375,212	562,818	$0.13	$72,238
	19	2030	102%	386,582	579,873	$0.13	$76,958
	20	2031	105%	397,952	596,928	$0.14	$81,915

Date: May 9, 2011
Calculations by: NRB
Checked by: --

OBJECTIVE: Calculate the annual Operations and Maintenance (O&M) costs for a Fluidyne ISAM SBR System @ Nederland, CO

GIVEN: The brake horsepower (or motor HP) values were pulled from representative manufacturer's equipment quotations.

ASSUMPTIONS:
1. 90% Motor Efficiency when not provided by manufacturer. If motor HP provided, no motor efficiency included.
2. Inflation (30-year average) 3.65%
3. Interest Rate @ 6.55% (30-year average for Federal Overnight Fund)
4. Real Cost Increase Rate @ 2.90% (Interest Rate - Inflation)
5. 20-Year Present Value to Annual Cost Factor (P/A) @ 15.016
6. Annual Average Month Flows and Loads used to pick duty point of each piece of equipment

REFERENCES: N/A

CALCULATIONS:

A. ELECTRICITY O&M ESTIMATE

(1) Cost of Electricity

Energy Inflation Rate 3.40% *Source: EIA average industrial power cost (2000 - 2009)*
\# Years to 2032 20

Year	Cost of Electricity ($/kWhr)	
2011	$0.068	
2013	$0.073	*1st year of SBR operation*
2031	$0.133	
20-yr Average	**$0.091**	

(2) Estimate of Operating Electrity Demand

(a) Major Electrical Loads for Headworks, Secondary, and Tertiary Treatment

Description	Quantity		Motor Size		Operating Load (per Motor)			Run Time (hrs/motor)	Daily Energy Use	Annual Energy Use at
	Installed	Operating	Motor Size (HP)	Total Installed (HP)	(BHP)	Motor Eff.	(kW)	(hr/day)	(kWh/day)	(kWh/yr)
Fine Screen	1	1	2	2	1.25	90%	1.0	2.0	2	758
Motive Pumps	2	2	10	20	9.80	90%	8.1	17.0	277	101,215
Blowers	3	2	25	75	--	--	15.0	12.0	360	131,400
Effluent Equalization Pumps	2	1	5	10	1.65	90%	1.4	24.0	33	12,013
Upflow Sand Filter Air Compressor	1	1	15	15	7.00	90%	5.8	12.0	70	25,482
UV Disinfection	2	1	--	--	--	--	1.4	24.0	34	12,264
NPW Pump	1	1	3	3	2.00	90%	1.7	4.8	8	2,920
Ferric Dosing Pumps	2	2	0	0.5	--	--	0.22	6.0	3	964
Alkalinity Dosing Pumps	2	2	0	0.5	--	--	0.22	6.0	3	964
		Installed HP		**126**				**Annual kW-hr**		**287,979**
								4% for Misc. Electrical Loads		**11,519**
								TOTAL ANNUAL USE (kW-hr)		**299,498**

(3) ***Estimate of Electricity Demand at Startup***

Buildout Organic Capacity	488 ppd BOD5
Actual 2007 - 2011 Avg Organic Load	202 ppd BOD5
Startup % of Buildout	**41%**
Buildout Avg. Hydraulic Capacity	250,000 gpd
Actual 2007 - 2011 Avg Hydraulic Capacity	115000 ppd BOD5
Startup % of Buildout	**46%**

Therefore, for purposes of estimating startup electrical demand, it is assumed the WWTF will use 45% of the buildout flow/ load energy demand in 2011.

Assuming 3% growth in population per year (and 3% growth in flow/load), the WWTF will reach buildout capacity in ~18 years

A 1.5 times safety factor has been used to provide a more conservative estimate of the annual electrical demand.

	Number	Year	Plant Capacity	Est. Ann. Elec. Demand (kW-hr/yr)	Est. Ann. Elec. Demand w/ 1.5 SF (kW-hr/yr)	Est. Elec. Cost ($/kW-hr)	Annual Cost of Electricity ($/yr)
Estimated for existing WWTF	0	2012	45%	--		$0.07	$25,000.00
	1	2013	48%	143,759	215,639	$0.07	$15,678
	2	2013	51%	152,744	229,116	$0.08	$17,224
	3	2014	54%	161,729	242,594	$0.08	$18,857
	4	2015	57%	170,714	256,071	$0.08	$20,581
	5	2016	60%	179,699	269,549	$0.08	$22,401
	6	2017	63%	188,684	283,026	$0.09	$24,321
	7	2018	66%	197,669	296,503	$0.09	$26,345
	8	2019	69%	206,654	309,981	$0.09	$28,479
	9	2020	72%	215,639	323,458	$0.09	$30,728
	10	2021	75%	224,624	336,936	$0.10	$33,096
	11	2022	78%	233,609	350,413	$0.10	$35,591
	12	2023	81%	242,594	363,891	$0.11	$38,216
	13	2024	84%	251,579	377,368	$0.11	$40,979
	14	2025	87%	260,564	390,845	$0.11	$43,886
	15	2026	90%	269,549	404,323	$0.12	$46,942
	16	2027	93%	278,534	417,800	$0.12	$50,156
	17	2028	96%	287,518	431,278	$0.12	$53,535
	18	2029	99%	296,503	444,755	$0.13	$57,085
	19	2030	102%	305,488	458,233	$0.13	$60,814
	20	2031	105%	314,473	471,710	$0.14	$64,731

Pontius, Dennis W.

From: Pontius, Dennis W.
Sent: Tuesday, June 07, 2011 12:02 PM
To: 'Nate Brown'
Subject: RE: Nederland, CO -- Responses to Questions RE: 2011 Amendment to PER

Nate,

1. (discussion regarding Item #4 included in PER?) Yes. The PER text will need to be revised per the revised numbers in the tables.
2. (more questions - sorry) The TEC SBR design included an aerobic digester. FEI deleted the aerobic digester from the ISAM SBR design, and replaced the aerobic digester with the lagoon #2 for biosolids storage. Will the ISAM SBR produce a stable sludge? What class? What are the pros/cons of eliminating the aerobic digester from the design/replacing with lagoon #2 for storage? Is lagoon #2 intended to stabilize sludge, or only store sludge with surface aerators to keep odors down and reduce the volume? How will the sludge from Lagoon #2 be removed? Please describe. Is the lagoon lined? If so, describe liner. Does your energy calculation need to reflect energy needed to remove/manage the sludge? How will sludge disposal be accomplished?

I appreciate your efforts on this. Please let me know if there is anything I need to clarify. Dennis Pontius, WQCD

From: Nate Brown [mailto:nate@frachetti.com]
Sent: Monday, June 06, 2011 5:04 PM
To: Pontius, Dennis W.
Cc: Bob Frachetti; Bob Orsatti
Subject: Nederland, CO -- Responses to Questions RE: 2011 Amendment to PER

Dennis:

Bob Frachetti informed me of questions you have relative to our May 2011 Amendment to the PER for the Town of Nederland, CO Phase 1 WWTF Improvements Project. This email seeks to clarify those questions you and Bob discussed.

1. Alkalinity adjustment – Chemical dosing of supplemental alkalinity will be provided with the Project. The Town is amendable to using caustic soda (50% solution) and this will be the basis for our design. FEI will provide supplemental information (MSDS, secondary containment, pumps, etc. with the upcoming PDR) as we do not believe it is required for the PER.

2. Grit Removal – Grit removal will not be included in this Project. However, provisions will be made for future inclusion of dedicated grit removal systems. The provisions we're providing include added fall for the additional headloss and a couple of stop plates locations to redirect flow if needed.

3. Electrical consumption discrepancy between Page 25, Table 7.3, Table 7.4, and Table 7.5 – The discrepancy in the PER is that two different startup load values are presented: 134,774 and 144,000 kW-hr/yr. The 144,000 kW-hr/yr value is correct and accounts for 48% of the expected build-out load. The error in the document occurred because I became mixed up and started using 45% of the build-out load instead of 48% for the second two tables. The build-out energy estimate totaled 299,498 kW-hr/yr; 45% x 299,498 = 134,774; 48% x 299,498 = 143,892. The attached pages will replace the erroneous pages in the original submittal. FEI will put hard copies of the modified pages in the mail tomorrow (6/7) along with a stamped cover letter. Let me know if this approach is not acceptable and I'll address the stamped modifications as you like.

4. Electrical usage in long-term biosolids storage – The proposed Nederland WWTF will include the ISAM™ tanks as the primary biosolids storage/ partial stabilization reactors (i.e., no other biosolids storage/ stabilization required). The Kersey WWTF, also an ISAM SBR, runs well in the same fashion. For the energy analysis

presented in the PER, I assumed the facility would operate with only the ISAM for biosolids storage, similar to Kersey, as this provides them the lowest energy usage. I have attached a complete electricity O&M estimate for the ISAM™ only option.

For Nederland, the existing Lagoon No. 2 will be left in service to provide long-term biosolids storage/ emergency storage if the Town elects to operate it as such. This option increases their energy usage and, correspondingly, lowers the sludge hauling costs. To allow long-term biosolids storage, FEI recommends two 7.5 HP aerators be used with an on/off control strategy to maintain a mixed, mostly aerobic environment, which will reduce odor generation. At build-out, aerating the biosolids storage lagoons for 75% of each day (18 hr on/day) with two aerators running at 7.0 BHP adds about 80,000 kW-hr/yr of energy use, which is a 27% increase in energy use vs. running the ISAMs only (379,000 vs. 299,498 kW-hr). I have attached a complete electricity O&M estimate for the biosolids lagoon storage option.

At this time, it is unknown if the ISAM only biosolids storage or the ISAM + lagoon option would provide the lowest overall O&M cost to the Town. This is unknown because FEI has not contacted sludge haulers to inquire about pricing for dredging and disposal on an annual or bi-annual basis.

Adding the two lagoon aerators represents a worst-case energy consumption for build-out flows/load at 379,000 kW-hr. Derating this value by 48% put the annual energy demand at start up at about 182,000 kW-hr/yr of consumption. If this value were used in the PER, Tables 7.4, 7.5, and 7.6 would look as follows. As can be seen in the Edited Tables 7.5 and 7.6, the reduction in energy consumption still easily exceeds the 20% threshold compared to the existing and compared to the as-bid SBR by TEC in 2011, and thus the Project remains categorically green.

Edited Table 7.4 Energy Demand Comparison with Lagoon No. 2 Biosolids Storage

Parameter	Kersey Operating Values(1)		Estimated Nederland Values at Start up (2)	
Ann. Avg. Daily BOD Load	294	ppd	234	ppd
Yearly BOD Load	107,310	ppyr	85,498	ppyr
Estimated Ann. Elec. Use	206,044	kW-hr/yr	181,920	kW-hr/yr
Energy Use per lb BOD treated	1.9	kW-hr/lb BOD	2.1	kW-hr/lb BOD

Edited Table 7.5 Comparison of Existing WWTF to Proposed SBR with Lagoon No. 2 Biosolids Storage

Parameter	Nederland Existing WWTF Values(1)		Estimated Nederland Values at Start up (2)	
Ann. Avg. Daily BOD Load	202	ppd	234	ppd
Yearly BOD Load	73,730	ppyr	85,498	ppyr
Estimated Ann. Elec. Use	312,335	kW-hr/yr	181,920	kW-hr/yr
Energy Use per lb BOD treated	4.2	kW-hr/lb BOD	2.1	kW-hr/lb BOD
Percent Reduction in Electricity Demand	**n/a**		**41.8%**	

Edited Table 7.6 Comparison of Previously Bid SBR to Proposed ISAM™ SBR with Lagoon No. 2 Biosolids Storage

Description	Electricity Demand (kW-hr/yr)	
	Previously Bid SBR	Proposed ISAM™ SBR
Fine Screen	758	758
SBR Blowers	250,536	131,400

Motive Pumps	0 (not required)	101,215
Digester Blowers at 80% Capacity	371,205	76,446
Effluent Equalization Pumps	12,013	12,013
Upflow Sand Filter Air Compressor	25,482	25,482
UV Disinfection	12,264	12,264
NPW Pump	2,290	2,290
Ferric Dosing Pumps	964	964
Alkalinity Dosing Pumps	964	964
4% Misc. Electrical	24,807	14,577
TOTAL	**585,982**	**379,002**
Percent Reduction compared to Previous Bid SBR	**n/a**	**35.3%**

Please let me know how you would like the discussion in Item #4 included in PER, if at all.

Thanks.
Nate

Nate Brown, P.E.

Frachetti Engineering, Inc.
5325 S. Valentia Way
Greenwood Village, CO 80111
Phone: (303) 928-1388
Cell: (720) 663-7494
www.frachetti.com

Dennis –
where did the
$8,868/yr come from?

6-7-11

note - Nederland WWTP
email 6-7 12N

sludge class B - Yes??

lagoon 2 - storage & stabile

lagoon 2 - dry land

lagoon 2 - dredge ≈1/3 yrs

Pontius, Dennis W.

From: Bob Frachetti [bob@frachetti.com]
Sent: Monday, June 06, 2011 2:26 PM
To: Pontius, Dennis W.; Nate Brown
Subject: RE: Nederland WWTP PER and SA document

Hi Dennis,

It is my understanding of the funding regulations for Green Project reserve that the entire project is eligible. However, the maximum monetary amount available at the Green Project interest rate of 0% interest is $2,000,00.

Perhaps Louanna can clarify.

Bob Frachetti, P.E.
President
Frachetti Engineering, Inc.
5325 S Valentia Way
Greenwood Village, CO 80111
Phone: (303) 300-3464
Fax: (303) 300-3451
www.frachetti.com

From: Pontius, Dennis W. [mailto:Dennis.Pontius@dphe.state.co.us]
Sent: Monday, June 06, 2011 2:13 PM
To: Nate Brown; Bob Frachetti
Subject: Nederland WWTP PER and SA document

Bob/Nate, Hope you had a good weekend.

Question – Will the total project cost ($4.77 million) be 100 percent eligible for Green Project Reserved funding? I am asking that question in light of the fact that the energy savings is a result of the SBR system components, not all the components of the facility (e.g. UV disinfection and flow EQ system). Thx Dennis Pontius, WQCD

5325 S. Valentia Way
Greenwood Village, Colorado 80111

ph 303.300.3464
fx 303.300.3451

www.frachetti.com

Frachetti Engineering INC

LETTER OF TRANSMITTAL

TO: Dennis Pontius, P.E.
Colorado Department of Public Health & Environment, WQCD-TS-B2
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

FROM: Bob Frachetti, P.E.

DATE: June 7, 2011

CC: Alisha Reis, Town of Nederland
Louanna Cruz, CDPHE WQCD

PN/ FILE NO.: NEDL-11-0033

RE: Preliminary Engineering Report & Site Location Approval Amendment, May 2011
Town of Nederland, Colorado Phase 1 Wastewater Treatment Facility Improvements

We are sending you the Following Items:

☑ Attached ☐ Under Separate Cover ☐ Best Way ☐ Other _____
☐ Shop Drawings ☐ Submittal(s) ☐ Plans ☐ O & M Manuals
☐ Copy of Letter ☑ Report ☐ Specifications ☐ Other:

Copies	Spec #	Rev	Description
1	--	--	Preliminary Engineering Report (5/2011) & Site Location Approval Amendment (5/2011) Clarifications

These are transmitted as checked below:

☑ For Your Use ☐ Approved as Submitted ☐ Resubmit ☐ Copies for Approval
☐ As Requested ☐ Approved as Noted ☐ Submit ☐ Copies for Distribution
☐ For Approval ☐ Returned for Corrections ☐ Return ☐ Corrected Prints
☐ For Review & Comment ☐ For Signature ☐ Other: ____________________

Remarks:

5325 S. Valentia Way
Greenwood Village, Colorado 80111
ph 303.300.3464
fx 303.300.3451
www.frachetti.com
Frachetti Engineering INC

Mr. Dennis Pontius, P.E.
Colorado Department of Public Health and Environment
Water Quality Control Division
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

June 6, 2011

RE: Phase 1 WWTF Improvements
Town of Nederland, CO
Supplemental Information – Amendment to the Preliminary Engineering Report

Dear Mr. Pontius,

This letter presents our supplemental information to the recently submitted Amendment to the Preliminary Engineering Report for the Town of Nederland, CO Phase 1 Wastewater Treatment Facility (WWTF) Improvements Project. The energy demand analysis originally presented in the PER included no mixing/ aeration energy for the biosolids storage lagoon (to be retrofitted from existing Lagoon No. 2). This assumption was made because the ISAM™ reactors within the sequencing batch reactor (SBR) process can solely serve as sludge storage and partial stabilization tanks. Several similar facilities in Colorado, including an installation for the Town of Kersey, use the same approach for biosolids partial stabilization and storage with good success. However, the Town of Nederland would like the *option* to store/ stabilize biosolids in Lagoon No. 2 in addition to the ISAM™ reactors. If biosolids are stored in Lagoon No. 2, then aeration/ mixing energy will be required to reduce odor generation.

Frachetti Engineering is submitting four revised PER pages and energy calculations to include the added loads from mixing/ aerated Lagoon No. 2, which is the worst-case energy demand scenario for the Project. The revised energy demands still exceed the 20 percent energy efficiency requirement to meet the Green Project Reserve.

Please feel contact me with further questions and/or comments.

Sincerely,
FRACHETTI ENGINEERING, INC.

Bob Frachetti

Bob Frachetti, P.E.

COLORADO REGISTERED PROFESSIONAL ENGINEER
ROBERT WALTER FRACHETTI
30233
6-6-11

cc: Mr. Alisha Reis, Town of Nederland

Attachments:

1. Revised four pages of the PER
2. Revised electricity demand calculations

OBJECTIVE: Calculate the annual Operations and Maintenance (O&M) costs for a Fluidyne ISAM SBR System @ Nederland, CO

GIVEN: The brake horsepower (or motor HP) values were pulled from representative manufacturer's equipment quotations.

ASSUMPTIONS:
1. 90% Motor Efficiency when not provided by manufacturer. If motor HP provided, no motor efficiency included.
2. Inflation (30-year average) 3.65%
3. Interest Rate @ 6.55% (30-year average for Federal Overnight Fund)
4. Real Cost Increase Rate @ 2.90% (Interest Rate - Inflation)
5. 20-Year Present Value to Annual Cost Factor (P/A) @ 15.016
6. Annual Average Month Flows and Loads used to pick duty point of each piece of equipment

REFERENCES: N/A

CALCULATIONS:

A. ELECTRICITY O&M ESTIMATE

(1) Cost of Electricity

Energy Inflation Rate 3.40% *Source: EIA average industrial power cost (2000 - 2009)*
\# Years to 2032 20

Year	Cost of Electricity ($/kWhr)
2011	$0.068
2013	$0.073
2031	$0.133
20-yr Average	**$0.091**

1st year of SBR operation (2013)

(2) Estimate of Operating Electrity Demand

(a) Major Electrical Loads for Headworks, Secondary, and Tertiary Treatment

Description	Quantity		Motor Size		Operating Load (per Motor)			Run Time (hrs/motor)	Daily Energy Use	Annual Energy Use at
	Installed	Operating	Motor Size (HP)	Total Installed (HP)	(BHP)	Motor Eff.	(kW)	(hr/day)	(kWh/day)	(kWh/yr)
Fine Screen	1	1	2	2	1.25	90%	1.0	2.0	2	758
Motive Pumps	2	2	10	20	9.80	90%	8.1	17.0	277	101,215
Blowers	3	2	25	75	--	--	15.0	12.0	360	131,400
Effluent Equalization Pumps	2	1	5	10	1.65	90%	1.4	24.0	33	12,013
Upflow Sand Filter Air Compressor	1	1	15	15	7.00	90%	5.8	12.0	70	25,482
UV Disinfection	2	1	--	--	--	--	1.4	24.0	34	12,264
NPW Pump	1	1	3	3	2.00	90%	1.7	4.8	8	2,920
Lagoon Aerators	2	2	8	15	7.00	90%	5.8	18.0	209	76,446
Ferric Dosing Pumps	2	2	0	0.5	--	--	0.22	6.0	3	964
Alkalinity Dosing Pumps	2	2	0	0.5	--	--	0.22	6.0	3	964
		Installed HP		**141**				**Annual kW-hr**		**364,425**
								4% for Misc. Electrical Loads		**14,577**
								TOTAL ANNUAL USE (kW-hr)		**379,002**

(3) *Estimate of Electricity Demand at Startup*

Buildout Organic Capacity	488 ppd BOD5
Actual 2007 - 2011 Avg Organic Load	202 ppd BOD5
Startup % of Buildout	**41%**

Buildout Avg. Hydraulic Capacity	250,000 gpd
Actual 2007 - 2011 Avg Hydraulic Capacity	115000 ppd BOD5
Startup % of Buildout	**46%**

Therefore, for purposes of estimating startup electrical demand, it is assumed the WWTF will use 45% of the buildout flow/ load energy demand in 2012.

Assuming 3% growth in population per year (and 3% growth in flow/load), the WWTF will reach buildout capacity in ~18 years

A 1.5 times safety factor has been used to provide a more conservative estimate of the annual electrical demand.

Estimated for existing WWTF

Number	Year	Plant Capacity	Est. Ann. Elec. Demand (kW-hr/yr)	Est. Ann. Elec. Demand w/ 1.5 SF (kW-hr/yr)	Est. Elec. Cost ($/kW-hr)	Annual Cost of Electricity ($/yr)
0	2012	45%	--		$0.07	$25,000.00
1	2013	48%	181,921	272,881	$0.07	$19,839
2	2013	51%	193,291	289,936	$0.08	$21,796
3	2014	54%	204,661	306,992	$0.08	$23,863
4	2015	57%	216,031	324,047	$0.08	$26,045
5	2016	60%	227,401	341,102	$0.08	$28,348
6	2017	63%	238,771	358,157	$0.09	$30,777
7	2018	66%	250,141	375,212	$0.09	$33,339
8	2019	69%	261,511	392,267	$0.09	$36,039
9	2020	72%	272,881	409,322	$0.09	$38,885
10	2021	75%	284,251	426,377	$0.10	$41,882
11	2022	78%	295,621	443,432	$0.10	$45,038
12	2023	81%	306,992	460,487	$0.11	$48,361
13	2024	84%	318,362	477,542	$0.11	$51,857
14	2025	87%	329,732	494,597	$0.11	$55,535
15	2026	90%	341,102	511,653	$0.12	$59,404
16	2027	93%	352,472	528,708	$0.12	$63,471
17	2028	96%	363,842	545,763	$0.12	$67,746
18	2029	99%	375,212	562,818	$0.13	$72,238
19	2030	102%	386,582	579,873	$0.13	$76,958
20	2031	105%	397,952	596,928	$0.14	$81,915

The ISAM™ reactors also provide for a very large reduction in energy demand due to the inclusion of WAS storage and partial stabilization in an anaerobic ISAM™ environment. As stated by the Water Environment Federation *"... early attempts to use aerobic digestion as a solution to solids disposal and handling regulations led to relatively long solids retention time (SRT) values, which made both the capital and operating costs [due to high energy requirements for aeration equipment] very unappealing"* (pg. 31-4; WEF, 2008). Per the previously bid plans and specifications, the Digester Blower's design point would have utilized 56.5 kW at 100 percent capacity (TEC, February 2011). Assuming 18 hours of operation per day and 6 hours of downtime to facilitate anoxic conditions, the aerobic digester blower operating at 80 percent capacity would consume up to 257,544 kW-hr per year, which is worth about $17,513 in electricity costs at the Town's current rate of $0.068 per kW-hr. At 100 percent capacity, the digester blowers would use 44 percent more power.

Influent Equalization/ Anoxic Tanks (SAM™ Reactors) – The SAM™ reactors serve as partial influent equalization reactors and provide anoxic conditions for denitrification (*i.e.*, conversion of nitrate to nitrogen gas). Denitrification allows for reduced AOR demand to downstream aerobic reactors and "theoretically, 2.86 kg oxygen demand is satisfied per kilogram (2.86 lb/lb) of nitrate-nitrogen reduced to nitrogen gas (pg. 20-11; WEF, 2008). Including the SAM™ reactors for denitrification reduces the AOR for the SBR by about 29 percent (from 904 to 649 lb O_2 per day)

7.5.2 Proposed SBR O&M Cost Validation and Comparison

FEI developed O&M estimates for the Project by selecting preliminary equipment and operating points at design flow/ load. Then equipment run times were determined at design flow/ load for all equipment. Motor loads counted in the analysis include: fine screen, jet motive pumps, process aeration blowers, effluent equalization pumps, sand filter compressors, UV disinfection, non-potable water (NPW) pumps, and chemical dosing pumps (for alkalinity and ferric addition). 4 percent of additional miscellaneous electrical loads were added for electrical equipment such as lighting and programmable logic controllers (PLCs). Refer to Appendix B.01 for detailed O&M assumptions, calculations, and estimates.

The electrical loads were summed and about 379,000 kW-hrs of electricity consumption per year was estimated at design flow and load. Then, to simulate start up conditions, FEI compared 2007 – 2011 average influent BOD5 data (204 ppd) to the design influent BOD_5 load (488 ppd). Current influent loading is about 42 percent of the design load. For conservatism, FEI applied a 48 percent de-rate to the design load power estimate and estimated the proposed SBR will use about 182,000 kW-hr per year at startup (year 2013). FEI used the expected annual loading and electricity usage to estimate an energy demand per lb of BOD_5 treated (See Table 7.3)

Note that for the 20-year cash flow analysis budgeting purposes *only*; a 1.5 times safety factor was applied to this demand estimate to provide a more conservative electricity budget (refer to Appendix B.01 and B.02 for O&M estimates).

Fluidyne's process calculations at initial (*i.e.,* start up) flow and loads and build out flow and loads are included in Appendices E.01 and E.02, respectively. FEI's estimated electricity demands include a more conservative approach to blowers and includes minor loads not included in the Fluidyne estimates. Table 7.3 contains a comparison between the two electricity demand estimates. FEI's electrical demand estimates are used for both justifications presented later in this section.

Table 7.3 Comparison between Fluidyne and FEI Estimated Electrical Demands

Parameter	Fluidyne Estimated Elec. Values		FEI Estimated Elec. Values	
Elec. Demand at Start up	250	kW-hr/day	393	kW-hr/day
Elec. Demand at Build out	526	kW-hr/day	1038	kW-hr/day

The Nederland energy consumption estimated by FEI is much lower than previous estimates provided to the Town for the previously bid SBR (TEC, February 2011). In order to supplement FEI's analysis and validate our estimate, the expected start up energy demand was converted into energy demand per lb BOD_5 treated, and this value was compared to actual operating data from a similarly designed and constructed Fluidyne ISAM SBR operated by the Town of Kersey, Colorado. The Town of Kersey provided FEI with annual O&M costs, including electricity. The Kersey Operator in Responsible Charge (Ramey Environmental Compliance) provided FEI with DMR reports, which FEI used to determine the annual BOD_5 load. From this data, FEI determined the energy usage per lb of BOD_5 treated for the Kersey WWTF.

Table 7.4 compares the operating energy consumption data to the estimated start up energy consumption at Nederland. As can be seen, the two energy consumption (kW-hr) per lb BOD5 values are within about 10 percent of each other. Thus, the startup energy demand estimate generated by FEI is reasonable and can be used to provide an energy use estimate for the proposed Project. FEI's estimate of 2.1 kW-hr per lb BOD treated for the proposed ISAM™ SBR improvements easily exceed the 20 percent energy efficiency reduction requirement.

Table 7.4 Energy Demand Comparison

Parameter	Kersey Operating Values(1)		Estimated Nederland Values at Start up (2)	
Ann. Avg. Daily BOD Load	294	ppd	234	ppd
Yearly BOD Load	107,310	ppyr	85,498	ppyr
Estimated Ann. Elec. Use	206,044	kW-hr/yr	181,920	kW-hr/yr
Energy Use per lb BOD treated	1.9	kW-hr/lb BOD	2.1	kW-hr/lb BOD

(1) Estimated based on data provided by the Town Clerk and WWTF Operator in Charge (Ramey Environmental Compliance)

(2) Estimated per methodology described in Section 7.5.2. Refer to Appendix E.03 for detailed electricity demand calculations for the proposed SBR.

7.5.3 Justifications & Confirmations – 20 Percent Energy Use Reduction Compared to Existing Facility

The existing Nederland WWTF is a lagoon treatment system using two lagoons in series followed by a polishing pond and chlorine disinfection. To maintain adequate treatment, the two lagoons use a total of seven aerators/ mixers, each of which runs 24 hours a day. The lagoon process is inefficient and is expected to use more energy than the proposed SBR upgrade. FEI estimated the annual energy demand for the existing facility and compared that to the start up demand estimate for the proposed SBR. Refer to Table 7.5 for the comparison. As can be seen, the proposed WWTF improvements are clearly more than 20 percent more efficient than the existing facility and will provide Nederland with reduced electricity costs once in operation.

Table 7.5 Comparison of Existing WWTF to Proposed SBR

Parameter	Nederland Existing WWTF Values(1)		Estimated Nederland Values at Start up (2)	
Ann. Avg. Daily BOD Load	202	ppd	234	ppd
Yearly BOD Load	73,730	ppyr	85,498	ppyr
Estimated Ann. Elec. Use	312,335	kW-hr/yr	181,920	kW-hr/yr
Energy Use per lb BOD treated	4.2	kW-hr/lb BOD	2.1	kW-hr/lb BOD
Percent Reduction in Electricity Demand	**n/a**		**41.8%%**	

(1) Estimated based on data provided by the Town, refer to the electricity demand spreadsheet in Appendix E.05

(2) Estimated per methodology described in Section 7.5.2. Refer to Appendix E.03 for detailed calculations of the electrical demand for the proposed SBR.

7.5.4 Justifications & Confirmations – 20 Percent Reduction Compared to Previous Improvements Design

SBR improvements for the Town of Nederland were designed and bid out to General Contractor in February of 2011. The previous Project bids came in high and were above the Town's affordability. Thus, FEI was hired to value engineer the previously bid design, and, ultimately, concluded that an ISAM™ SBR would provide the Town a more affordable and energy efficient design. Major differences for the previously bid SBR compared to the proposed ISAM™ design include fine pore aeration, no motive feed pumps, and aerobic digesters. Minor differences include a different method for tertiary filtration (disk filters vs. upflow sand filters), and a different number of chemical dosing pumps.

For the purposes of providing an apples-to-apples comparison between the previously bid SBR against FEI's proposed SBR design, FEI assumed all of the equipment for the two projects was the same except for the aeration/ mixing systems. The previously bid SBR included only process aeration to aerate and mix both the SBR and an aerobic digester. FEI's ISAM™ SBR design includes jet aeration and mixing, with motive pumps to provide the liquid component. For the purposes of the comparison, the Digester Blower in the previously bid SBR system was assumed to operate 18 hours on and 6 hours off each day, which is a typical operating regime for an aerobic digester. Also, the Digester Blower was assumed to run at 80 percent of design capacity for the 18 hours a day, not at 100 percent capacity. Refer to Appendices E.03 and E.04 for electricity demand estimates for the proposed ISAM™ SBR and the previously bid SBR (TEC, February 2011)

A comparison of electricity usage for the two SBR designs for Nederland is included in Table 7.6 for review. As can be seen, the proposed ISAM™ SBR system is expected to be more than 50 percent more efficient than the previously bid SBR project. The main differences between the two approaches that accounts for this large energy savings are as follows:

1. The proposed ISAM™ SBR design utilizes an influent conditioning (ISAM™) reactor to provide primary sedimentation and a 30 percent BOD_5 reduction.
2. The proposed ISAM™ SBR design provides for significant denitrification while the previously bid SBR does not include denitrification
3. The previously bid SBR includes an aerobic digester, which is notoriously a very large

consumer of electricity. FEI utilized the 80 percent capacity value for the digester blower, whereas the digester blower operating at 100 capacity would use about 44 percent more power.

Table 7.6 Comparison of Previously Bid SBR to Proposed ISAM™ SBR

Description	Electricity Demand (kW-hr/yr)	
	Previously Bid SBR	Proposed ISAM™ SBR
Fine Screen	758	758
SBR Blowers	250,536	131,400
Motive Pumps	0 (not required)	101,215
Digester Blowers at 80% Capacity	371,205	0 (not required)
Lagoon Aerator/ Mixers	0 (not required)	76,446
Effluent Equalization Pumps	12,013	12,013
Upflow Sand Filter Air Compressor	25,482	25,482
UV Disinfection	12,264	12,264
NPW Pump	2,290	2,290
Ferric Dosing Pumps	964	964
Alkalinity Dosing Pumps	964	964
4% Misc. Electrical	24,807	14,577
TOTAL	**585,982**	**379,002**
Percent Reduction compared to Previous Bid SBR	**n/a**	**35.3%**

7.5.5 Summary of GPR Justification

As discussed in the previous sections, the proposed ISAM™ SBR WWTF improvements utilize numerous energy efficiency components. The energy estimate developed by FEI is conservative, when compared to Fluidyne's design calculations; and the projected electricity demand per lb of BOD_5 treated is similar (within 10%) to the operating ISAM™ SBR WWTF in Kersey, Colorado. Based on this treatment efficiency, the proposed Project, provides for a significant reduction in electricity usage compared to both the existing lagoon WWTF and the previously bid SBR (TEC, February 2011).

Energy efficiency improvements with the proposed ISAM™ SBR is greater than 50 percent more efficient than the existing WWTF and more than 40 percent more efficient than the previously bid SBR. Therefore, the proposed ISAM™ SBR design meets the requirements of example 3.2-2 and the entire project is categorically eligible for the GPR. The energy efficiency reduction in example 3.2-2 requires at least 20 percent reduction in energy demands. FEI will be happy to provide additional supporting documentation upon request.