Permit No. CP001997

STATE OF MISSOURI

DEPARTMENT OF NATURAL RESOURCES

MISSOURI CLEAN WATER COMMISSION

CONSTRUCTION PERMIT

The Missouri Department of Natural Resources hereby issues a permit to:

PCRSD, Red Rock WWTP
Red Rock Subdivision
Platte City, MO 64079

for the construction of (described facilities):

See attached.

Permit Conditions:

See attached.

Construction of such proposed facilities shall be in accordance with the provisions of the Missouri Clean Water Law, Chapter 644, RSMo, and regulation promulgated thereunder, or this permit may be revoked by the Department of Natural Resources (Department).

As the Department does not examine structural features of design or the efficiency of mechanical equipment, the issuance of this permit does not include approval of these features.

A representative of the Department may inspect the work covered by this permit during construction. Issuance of a permit to operate by the Department will be contingent on the work substantially adhering to the approved plans and specifications.

This permit applies only to the construction of water pollution control components; it does not apply to other environmentally regulated areas.

December 17, 2018
Effective Date

Edward B. Galbraith, Director, Division of Environmental Quality

December 16, 2020
Expiration Date

Chris Wieberg, Director, Water Protection Program

CONSTRUCTION PERMIT

I. CONSTRUCTION DESCRIPTION

This is a **DEMONSTRATION** project and additional monitoring requirements are included in the operating permit in accordance with the Approval Process for Innovative Technology Factsheet. The facility is constructing an additional Advantex AX100 pod to go along with the existing 5 Advantex AX1000 pods, along with two moving bed bioreactors, settling basin, and an ultraviolet disinfection system. The design average flow remains 15,000 gallons per day.

This project will also include general site work appropriate to the scope and purpose of the project and all necessary appurtenances to make a complete and usable wastewater treatment facility.

II. COST ANALYSIS FOR COMPLIANCE

Pursuant to Section 644.145, RSMo, when issuing permits under this chapter that incorporate a new requirement for discharges from publicly owned combined or separate sanitary or storm sewer systems or publicly owned treatment works, or when enforcing provisions of this chapter or the Federal Water Pollution Control Act, 33 U.S.C. 1251 et seq., pertaining to any portion of a publicly owned combined or separate sanitary or storm sewer system or [publicly owned] treatment works, the Department of Natural Resources shall make a "finding of affordability" on the costs to be incurred and the impact of any rate changes on ratepayers upon which to base such permits and decisions, to the extent allowable under this chapter and the Federal Water Pollution Control Act. This process is completed through a cost analysis for compliance. Permits that do not include new requirements may be deemed affordable.

The Department is required to determine "findings of affordability" because the permit applies to a **combined or separate sanitary sewer system for a publically-owned treatment works.**

Cost Analysis for Compliance - The Department has made a reasonable search for empirical data indicating the permit is affordable. The search consisted of a review of Department records that might contain economic data on the community, a review of information provided by the applicant as part of the application, and public comments received in response to public notices of this draft permit. If the empirical cost data was used by the permit writer, this data may consist of median household income, any other ongoing projects that the Department has knowledge, and other demographic financial information that the community provided as contemplated by Section 644. 145.3. See the draft permit **ADDENDUM APPENDIX B – COST ANALYSIS FOR COMPLIANCE**.

III. CONSTRUCTION PERMIT CONDITIONS

The permittee is authorized to construct subject to the following conditions:

1. This construction permit does not authorize discharge.

2. All construction shall be in accordance with the plans and specifications submitted by North Hills Engineering on June 7, 2018.

3. The Department must be contacted in writing prior to making any changes to the approved plans and specifications that would directly or indirectly have an impact on the capacity, flow, system layout, or reliability of the proposed wastewater treatment facilities or any design parameter that is addressed by 10 CSR 20-8, in accordance with 10 CSR 20-8.110(8).

4. State and federal law does not permit bypassing of raw wastewater, therefore steps must be taken to ensure that raw wastewater does not discharge during construction. If a sanitary sewer overflow or bypass occurs, report the appropriate information to the Department's Kansas City Regional Office per 10 CSR 20-7.015(9)(E)2.

5. The wastewater treatment facility shall be located at least fifty feet (50') from any dwelling or establishment.

6. The wastewater treatment facility shall be located above the twenty-five (25)-year flood level.

7. Wastewater treatment facility shall not be located within one hundred feet (100'), and preferably three hundred feet (300') of any water well or water supply structure.

8. In addition to the requirements for a construction permit, 10 CSR 20-6.200 requires land disturbance activities of 1 acre or more to obtain a Missouri state operating permit to discharge stormwater. The permit requires best management practices sufficient to control runoff and sedimentation to protect waters of the state. Land disturbance permits will only be obtained by means of the Department's ePermitting system available online at dnr.mo.gov/env/wpp/epermit/help.htm. See dnr.mo.gov/env/wpp/stormwater/sw-land-disturb-permits.htm for more information.

9. A United States (U.S.) Army Corps of Engineers (COE) permit (404) and a Water Quality Certification (401) issued by the Department or permit waiver may be required for the activities described in this permit. This permit is not valid until these requirements are satisfied. If construction activity will disturb any land below the ordinary high water mark of jurisdictional waters of the U.S. then a 404/401 will be required. Since the COE makes determinations on what is jurisdictional, you must contact the COE to determine permitting requirements. You may call the Department's Water Protection Program at 573-751-1300 for more information. See dnr.mo.gov/env/wpp/401/ for more information.

10. Upon completion of construction:

A. Platte County Regional Sewer District will become the continuing authority for operation, maintenance, and modernization of these facilities;

B. Submit an electronic copy of the as builts if the project was not constructed in accordance with previously submitted plans and specifications; and

C. Submit the enclosed form Statement of Work Completed to the Department in accordance with 10 CSR 20-6.010(5)(D) and request the operating permit modification be issued.

IV. REVIEW SUMMARY

1. CONSTRUCTION PURPOSE

The proposed construction is to meet final effluent limits for ammonia and *E. Coli* established in the May 1, 2015 permit renewal and revised December 1, 2017 with the time of travel study for ammonia.

2. FACILITY DESCRIPTION

The Red Rock WWTF is located in Red Rock Subdivision, Platte City, in Platte County, Missouri. The existing treatment plant is a STEP system with a recirculating media filter with sludge disposal completed by a contract hauler. The existing sludge storage provides approximately 348 days of storage at 3.0% solids. In 2017 the operating permit was modified to include a time of travel study for the ammonia limits, which modified the effective limits that the facility had to meet as part of the schedule of compliance.

In the table below is a summary of the last 5 years of discharge monitoring reports. Construction will add an additional filter bed, two MBBR units for ammonia treatment, and UV disinfection system. The facility discharges to Tributary to Clear Branch (8-20-13 MUDD V1.0 (C) (3960)). The facility has a design average flow of 15,000 gpd and serves a hydraulic population equivalent of approximately 150 people.

Parameter	Unit	Monthly Average Limit	Average from DMRs 2013-2018
Flow	MGD	*	0.009089
BOD5	mg/L	30	11.50
TSS	mg/L	30	9.78
Ammonia-summer	mg/L	*	13.8
Ammonia-winter	mg/L	*	11.12
pH	SU	6.5-9.0	7.13

*monitoring only

3. COMPLIANCE PARAMETERS

The final effluent limits the project is required to meet are established in the operating permit renewal issued on May 1, 2015 and modified December 1, 2017. The schedule of compliance expires on April 30, 2020 for final ammonia and *E. Coli* effluent limits. The table below is a summary of the monthly average effluent limits that become effective when construction is complete.

Parameter	Units	Monthly Average Effluent Limit
Flow	MGD	*
BOD	mg/L	30
TSS	mg/L	30
Ammonia-summer	mg/L	4.2
Ammonia-winter	mg/L	4.9
E. Coli	#/100mL	206
pH	SU	6.5-9.0

*monitoring only

4. REVIEW of MAJOR TREATMENT DESIGN CRITERIA

The current design guides, 10 CSR 20-8, do not contain design parameters for the innovative MBBR technology for ammonia removal. As a **DEMONSTRATION** project, the data gathered with the operating permit will be used to help develop design criteria for future projects.

Existing major components which will remain in use include the following:

- The facility has an existing STEP system with a septic tank at each residence. Settled solids in the septic tank shall be removed by a contract hauler.
- The existing recirculation tank is 15,000 gallons per day.
- The existing recirculating media filter system is five Advantex AX100 pods, each with 100 square feet of media, with flow is broadcast across the top of each filter pod using rotary distributor heads. The design recirculation ratio is 4:1.

Construction will cover the following items:

- Recirculating Media filter-A sixth Adavantex AX100 pod will be installed with 100 square feet of media, with flow broadcast across the top of each filter pod using rotary distributor heads.
    - From the sixth pod, it will flow to the existing 15,000 gpd recirculation tank where there is a design recirculation ratio is 4:1.
    - The drain rate from the filters to the recirculation tank is 50 gpm at peak hourly flow.

  - Alkalinity chemical feed system with a 50-gallon tank with a metering pump with a turndown ratio of 100:1 to feed the existing RMF recirculation tank.
  - Two dosing pumps will be installed that have the capabilities to dose at 150 gallons per minute.
  - From the recirculation tank, flows are either recycled back or flow on to the new MBBR system.
- Moving Bed Biofilm Reactor (MBBR) – Installation of two MBBR tanks capable of treating a design average flow of 15,000 gpd and a peak flow of 43,200 gpd.
  - The MBBR is approximately 6 ft diameter and 10 ft deep with a sidewater depth of 7 ft for a volume of approximately 1480 gallons.
  - The hydraulic retention time at design flow is 2 hours.
  - The fill material will be Bio-pack "Kontakt 500" or approved equivalent with a total surface area of 152 ft2 per cubic ft.
  - Aeration by means of two positive displacement type blowers each capable of supplying 24 scfm with 1.5 HP motors to the coarse bubble aeration diffusers.
  - Two submersible pumps with the capacity of 40 gpm at 26 ft of head.
- The effluent from the MBBR will flow by gravity to the disinfection system.
- Disinfection – Disinfection is the process of removal, deactivation, or killing or pathogenic microorganisms. An open channel, gravity flow, low pressure high intensity UV disinfection system capable of treating a peak flow of 57,600 gpd while delivering a minimum UV intensity of 30 mJ/cm^2 with an expected ultraviolet transmissivity of 50% or greater.
  - The single open channel UV system consists of one bank with 4 modules and 2 lamps per module, for a total of 8 UV lamps.
  - The disinfected effluent will flow by gravity through flow measurement equipment and to Outfall No. 001.
- Flow meter- A magnetic flowmeter will be installed between the UV disinfection system and the effluent discharge.
- Emergency Power – The project will install a new standby generator to provide operational power to the treatment facility in event of power failure.

5. <u>OPERATING PERMIT</u>

Operating permit MO-0122432 will require a modification to reflect the construction activities. The modified Red Rock WWTF, MO-0122432, was successfully public noticed from October 5, 2018 to November 5, 2018 with no comments received. Submit the Statement of Work Completed to the Department in accordance with 10 CSR 20-6.010(5)(D) and request the operating permit modification be issued.

Leasue Meyers, EI
Engineering Section
leasue.meyers@dnr.mo.gov

AP 30054
CP 0001997

RECEIVED
JUN 07 2018
Water Protection Program

MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM

APPLICATION FOR CONSTRUCTION PERMIT – WASTEWATER FACILITY

FOR DEPARTMENT USE ONLY	
APP NO.	CP NO.
FEE RECEIVED $1000.00	CHECK NO. 21701
DATE RECEIVED 6-7-18	

APPLICATION OVERVIEW

The Application for Construction Permit – Wastewater Facility form is for construction pertaining to domestic wastewater treatment facilities, agrichemical facilities, and components thereof. This form has been developed in a modular format and consists of Part A and B. **All applicants must complete Part A.** Part B should be completed for applicants who currently land-apply wastewater or propose land application for wastewater treatment. **Please read the accompanying instructions before completing this form. Submittal of an incomplete application may result in the application being returned.**

PART A – BASIC INFORMATION

1.0 APPLICATION INFORMATION (Note – If any of the questions in this section are answered NO, this application may be considered incomplete and returned.)

1.1 Is this a Federal/State funded project? ☐ YES ☑ N/A Funding Agency: _____ Project #: _____

1.2 Is this an application for an agrichemical? ☐ YES (See instructions.) ☒ N/A

1.3 Has the Missouri Department of Natural Resources approved the proposed project's antidegradation review?
☐ YES Date of Approval: n/a - not expanding flows.

1.4 Has the department approved the proposed project's facility plan*?
☑ YES Date of Approval: 04/26/2018 ☐ NO ☐ N/A (If Not Applicable, complete No. 1.5.)

1.5 [Complete only if answered Not Applicable on No. 1.4] Is a copy of the engineering report* for wastewater treatment facilities with a design flow less than 22,500 gpd included with this application?
☐ YES ☑ NO

1.6 Is a copy of the appropriate plans* and specifications* included with this application?
☑ YES Denote which form is submitted: ☑ Hard copy ☐ Electronic copy (See instructions.) ☐ NO

1.7 Is a summary of design* included with this application? ☑ YES ☐ NO

1.8 Is a general operating permit applicable?
☐ YES Submit the appropriate operating permit application to the Regional Office at least 60 days prior to operation.
☑ NO Enclose the appropriate operating permit application and fee submittal. Denote which form: ☑ B ☐ B2

1.9 Is the facility currently under enforcement with the department or the Environmental Protection Agency? ☐ YES ☑ NO

1.10 Is the appropriate fee included with this application? ☑ YES ☐ NO (See instructions for appropriate fee.)

* Must be affixed with a Missouri registered professional engineer's seal, signature and date.

2.0 PROJECT INFORMATION

2.1 NAME OF PROJECT
Platte Co. Regional Sewer District - Small WWTF Upgrade - 2018

2.2 PROJECT DESCRIPTION
Upgrade the Existing Red Rock WWTF. Add one RMF pod (to make 6 total), replace four dosing pumps, add back-up generator set for emergency power, add UV Disinfection and effluent flow-meter, add MBBR (moving bed biofilm reactor) located after (downstream) of the RMF system, toaccomplish further treatment of ammonia. MBBR is being proposed as "demonstration technology".

2.3 SLUDGE HANDLING, USE AND DISPOSAL DESCRIPTION
No change to existing facility. Sludge is hauled in liquid form by a contract hauler, and disposed of at a large regional WWTF.

2.4 DESIGN INFORMATION
A. Current population: 104 ; Design population: 150

B. Actual Flow: 8,100 gpd; Design Average Flow: 15,000 gpd;
Actual Peak Daily Flow: 15,000 gpd; Design Maximum Daily Flow: 15,000 gpd;
Design Wet Weather Event: n/a - S.T.E.P.

2.5 ADDITIONAL INFORMATION
A. Is a topographic map attached? ☑ YES ☐ NO

B. Is a process flow diagram attached? ☑ YES ☐ NO

2.6 ESTIMATED PROJECT CONSTRUCTION COST
$ 330,000.00

3.0 WASTEWATER TREATMENT FACILITY

NAME	TELEPHONE NUMBER WITH AREA CODE	EMAIL ADDRESS
PCRSD, Red Rock Wastewater Treatment Facility	(816) 858-2052	dkoch@pcrsd.com

ADDRESS (PHYSICAL)	CITY	STATE	ZIP CODE	COUNTY
Red Rock Subdivision	Platte City	MO	64079	Platte

Wastewater Treatment Facility: Mo- 0122432 (Outfall Of)

3.1 Legal Description: ¼, NE ¼, SE ¼, Sec. 33 , T 53N , R 34W
(Use additional pages if construction of more than one outfall is proposed.)

3.2 UTM Coordinates Easting (X): 352273 Northing (Y): 4358295
For Universal Transverse Mercator (UTM), Zone 15 North referenced to North American Datum 1983 (NAD83)

3.3 Name of receiving streams: Tributary to Clear Branch, 8-20-13 MUDD V1.0 (C) (3960)

4.0 PROJECT OWNER

NAME	TELEPHONE NUMBER WITH AREA CODE	EMAIL ADDRESS
Platte County Regional Sewer District	(816) 858-2052	dkoch@pcrsd.com

ADDRESS	CITY	STATE	ZIP CODE
11724 NW Plaza Circle, Suite 800	Kansas City	MO	64153

5.0 CONTINUING AUTHORITY: Permanent organization that will serve as the continuing authority for the operation, maintenance and modernization of the wastewater collection system.

NAME	TELEPHONE NUMBER WITH AREA CODE	EMAIL ADDRESS
Platte County Regional Sewer District	(816) 858-2052	dkoch@pcrsd.com

ADDRESS	CITY	STATE	ZIP CODE
11724 NW Plaza Circle, Suite 800	Kansas City	MO	64153

5.1 A letter from the continuing authority, if different than the owner, is included with this application. ☐ YES ☐ NO ☑ N/A

5.2 COMPLETE THE FOLLOWING IF THE CONTINUING AUTHORITY IS A MISSOURI PUBLIC SERVICE COMMISSION REGULATED ENTITY.

A. Is a copy of the certificate of convenience and necessity included with this application? ☐ YES ☐ NO

5.3 COMPLETE THE FOLLOWING IF THE CONTINUING AUTHORITY IS A PROPERTY OWNERS ASSOCIATION.

A. Is a copy of the as-filed restrictions and covenants included with this application? ☐ YES ☐ NO

B. Is a copy of the as-filed warranty deed, quitclaim deed or other legal instrument which transfers ownership of the land for the wastewater treatment facility to the association included with this application? ☐ YES ☐ NO

C. Is a copy of the as-filed legal instrument (typically the plat) that provides the association with valid easements for all sewers included with this application? ☐ YES ☐ NO

D. Is a copy of the Missouri Secretary of State's nonprofit corporation certificate included with this application? ☐ YES ☐ NO

6.0 ENGINEER

ENGINEER NAME / COMPANY NAME	TELEPHONE NUMBER WITH AREA CODE	EMAIL ADDRESS
Jay E. Norco, P.E. / North Hills Engineering, Inc.	(816) 935-2777	northhillseng@gmail.com

ADDRESS	CITY	STATE	ZIP CODE
1825 Sunrise Dr.	Smithville	MO	64089

7.0 PROJECT OWNER: I hereby certify that I am familiar with the information contained in this application and to the best of my knowledge and belief such information is true, complete, and accurate, and if granted this permit, I agree to abide by the Missouri Clean Water Law and all rules, regulations, orders, and decisions, subject to any legitimate appeal available to applicant under Missouri Clean Water Law. I also understand the issuance of the construction permit does not guarantee the proposed wastewater treatment will meet the required effluent limitations of the issued Missouri State Operating Permit for this facility.

PROJECT OWNER SIGNATURE

PRINTED NAME	DATE
Dan Koch	5/30/18

TITLE OR CORPORATE POSITION	TELEPHONE NUMBER WITH AREA CODE	EMAIL ADDRESS
Executive Director	(816) 858-2052	dkoch@pcrsd.com

Mail completed copy to: MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM
P.O. BOX 176
JEFFERSON CITY, MO 65102-0176

END OF PART A.
REFER TO THE APPLICATION OVERVIEW TO DETERMINE WHETHER PART B NEEDS TO BE COMPLETE.

APPENDIX F1

SUMMARY OF DESIGN

RED ROCK WWTF UPGRADE
DESIGN CRITERIA AND CALCULATIONS

JEN
12/6/2017
REV 4-23-18

Purpose:

These calculations are prepared to address the upgrade of the existing Red Rock WWTF.
The exsting recirculating media filter (RMF) is not capable of meeting the proposed ammonia limits in the draft NPDES permit.
This report will set for the the design criteria, and the basis of design for several options, some of which use the existing RMF.
Note that the rated design flow of the facility (15,000 gallons per day) is NOT being increased and will be maintained.

Existing Flows:

Number of existing homes connected: 47 units (SFR)
Metered Historical Water use of :
Avg. water usage = 4,629 gal/mo = 154.3 gpd/unit.
Note that this equates to an per-capita flow: 154.3 gpd/unit / 2.5 cap = 62 gal/cap-d
(Based on water use billling records, winter averaging neglects consumptive use - See **Appendix F1**)
(This average value considers only homes that are occupied - vacant homes are not used.)
Note: This errs on the conservative side, because vacant homes are a statistical reality.
Note: Across entire PCRSD service base, average monthly water usage is about 4,500 gal/mo, based on water meter readings.

Estimate actual ADF (not used in calcs) 4,629 gal/mo-unit x 47 units = 7,252 gpd avg.
Note: This rate equates to: = 5.04 gpm

Note that these flows above are presented for information only. See below, that more conservative, higher flow values will be used for design.
Note that the design flow of the existing facility is much higher than the existing connected flows.

Design Flows:

Use a higher-than-historical unit flow factor, and apply peak factor to be conservative.
The current design population of 150 will be retained.

Derive number of units: 60 units SFR, compared to existing units this is: 28% growth.
Design population : 60 lots x 2.5 cap/lot = 150 capita
Compare existing design popl.: 150 design PE / 128% = 118 capita
Design avg flow per lot = 2.5 cap/lot x **80** gal/cap-d= 200 gpd/lot
(Note this is higher than the 62.4 gal/cap-d documented by water use records.)
Average flow (ADF) 60 units x **200** gpd/lot = 12,000 gpd
= 500 gal/hr = 8.3 gpm

Peak Daily Flow = 15000 gpd, same as current Operating Permit.
(This correponds to the permitted design flow of the WWTF, 15,000 gpd.)

Estimated peak hourly (PHF): 15,000 gpd = 10.4 gpm x **4.0** PF = 42 gpm
Note: Peak hourly flows are attenuated by the recirc tank - does not directly affect downstream hydraulics.

Estimated range of flows for proposed effluent flowmeter: **4** gpm to **50** gpm
(Effluent flows will have inflow peaks attenuated by tank volume.)

Notes:
1 This subdivision contains newer homes on a pressurized system. Wet weather flow (I/I) is a non-factor.
2 The design flow of facility, (15,000 gpd monthly average flow) will be maintained.
3 The existing collection system is STEP, and peaks are dampended by septic/dosing tank volume.
The exising OSI effluent pumps run about 9 gpm.

Existing System Info:

Type of Collection System: STEP
Septic Tank Vol. (each SFR unit) : 1,000 gal
Septic Tank Vol / ADF (each unit): 500%
RecirTank Existing:
Type: HDPE horiz cylinder
Total Vol: 15,000 gal
Work Vol: 12,000 gal
HRT at ADF: 1.00 days
Work vol % of ADF: 100%
Filter Beds Exist:
Model Orenco AX-100, single stage system, 5 pods.
Media: Vertical porous cloth sheets, arranged in racks.
Bed area: 100 sf / pod
Media Depth 2.5 feet approx.

Design Wastewater Char's

Based on sampling and testing peformed from 2014 to 2014 - ***See Appendix F2: Red Rock WWTF Sampling Data.***
BOD5 150 mg/L
TSS 80 mg/L

TKN 73 mg/L (Kjeldahl N is the sum of organically bound nitrogen and ammonia-ammonium N.)
NH3 65 mg/L

Otther supplemental influent data:
FOG 14 mg/L
Alkalinity 479 mg/L as CaCO3

Design Wastewater Loads

Based on average sampled characteristic, and rounded to whole numbers.

BOD5	150 mg/L	x	0.0120 mgd	x	8.34 lb/mgal =	15.0 lb/day
TSS	80 mg/L	x	0.0120 mgd	x	8.34 lb/mgal =	8.0 lb/day
TKN	73 mg/L	x	0.0120 mgd	x	8.34 lb/mgal =	7.3 lb/day

Alkalinity: Measured alkalinity averages : 479 mg/L as CaCO3.
Assuming some denitrification recovery (which can be up to 3.5 ppm of 7.14 ppm for complete denite),
The system should have enough alkalinity for complete nitrification.
Provisions will be made for future addition of alkalinity feed system, using granular feeder.
Net alk demand = (assuming partial denite)
65 ppm NH3 oxidized x 5 ppm alk demand/ppm NH3 oxid = 325 ppm
Thus remaining alk = 154 mg/L as CaCO3

Alkalinity Feed System:

Needed for supplementing alkalinity.
Assume partial supplementation:
50 mg/L x 0.0120 mgd x 8.34 lb/mgal = 5.0 lb/d as CaCO3

Use sodium bicarbonate (NaHCO3) to adjust pH:
Standard dose: $\frac{\text{1.5 lb bicarb}}{\text{10000 gal) per (}}$ x 50 ppm alk x 12,000 gpd = 9 lb/d
10 ppm alk incr)

(Note same alkalinity adjustment using Na2CO3 would take about 0.9 lbs per 10kgal per 10 ppm alk., at a slightly reduced cost.)
But we proposed using Bi-Carb for safety and ease of use.

Estimated cost = $ 13.00 / 50 lbs = $ 0.26 / lb x 9 lb/d = $ 2.34 / day

Solubility of Bicarb= 8.00 lbs per 100 lbs water ,or 8.00% solution, S.G. = 1.05
Density of solution= 65.52 lb/gal

Metering pump avergage feed rate =	9 lb/d /	8.00% =	112.5 lb/d =	1.72 gpd
Metering pump range of pump rates =	1.72 gpd x	20% =	0.34 gpd =	0.01 gal/hr
	1.72 gpd x	300% =	5.15 gpd =	0.21 gal/hr

Thus, the minimum size mixing / solution tank for feeding solution is: 1.72 gpd x 20 days = 34.34 gal

Use a minimum feed tank of : 50 gallons

Option 1A: Expand Existing RMF System (Add 1 pod), and Construct MBBR as Second Stage (RECOMMENDED OPTION):

The existing system has 5 AX-100 pods, as a single stage.
Expand the first stage to six (6) AX-100 pods. (Add one pod and upsize one filter vault.)
Add a second vent fan to improve venting of the pods.

This would be a single-stage system designed to produce an effluent 10/10/3 (BOD/TSS/NH3).
The existing recirc tank and dosing pumps & controls are re-used.

Proposed 1st stage has: 6 Advantex modules (add one module to 5 existing) x 100 sf/pod = 600 sf surface

Proposed HLR = 12,000 gpd / 600 sf = 20.0 gpd/sf (at avg flow and loadings)

Proposed BOD Loading =	15.0 lb/d /	600 sf =	0.025 lb/sf-d
Proposed TKN Loading =	7.3 lb/d /	600 sf =	0.012 lb/sf-d

Adequate performance for BOD removal at the above loadings is documented by existing installations, and by this installation.
Note: Typical Orenco loadings for AX100 system with nitrification are HLR=25 gpd/sf, BOD 0.30 lb/sf-d

Note: Alkalinity supplementation will be made to the existing recirculation tank.

Dosing Hydraulics:
Assume recirculation ratio = 4 : 1

ADF =	12,000 gpd,	Total daily dose flow =	60,000 gpd, =	41.7 gpm =	2,500 gal/hr
PDF =	15,000 gpd,	Total daily dose flow =	75,000 gpd, =	52.1 gpm =	3,125 gal/hr

For Normal Dosing Cycle:

Assume Normal Total Dose Cycle = 4.5 min Dosing rate = 150 gpm
Thus number of dosing events per day = 320
Run time per dose event:
ADF: 60,000 gpd / 320 evnt = 187.50 gal/dose, / 150 gpm = 1.25 min

Peak effluent rate = 20% of the peak delivery (dosing rate) x 150 gpm = 30.0 gpm
(Compare the peak run time as a percentage of the total cycle time: 28%
This is because the dose volume takes time to work through the pods, across the media sheets.

For High Rate Dosing Cycle:
Assume Normal Total Dose Cycle = 3.5 min Dosing rate = 150 gpm
Thus number of dosing events per day = 411.4
Run time per dose event:
ADF: 60,000 gpd / 411.4 evnt = 145.83 gal/dose, / 150 gpm = 0.97 min
PDF: 75,000 gpd / 411.4 evnt = 182.29 gal/dose, / 150 gpm = 1.22 min

Peak effluent rate = 20% of the peak delivery (dosing rate) x 150 gpm = 30.0 gpm
(Compare the peak run time as a percentage of the total cycle time: 35%
This is because the dose volume takes time to work through the pods, across the media sheets.

(SEE SUPPLEMENTAL MBBR CALCULATIONS, PRESENTED AFTER THESE CALCULATIONS)

APPENDIX F1 - SUPPLEMENTAL

JEN
4/23/2018

SUMMARY OF DESIGN - NITRIFICATION MBBR

RED ROCK WWTF UPGRADE
DESIGN CRITERIA AND CALCULATIONS

Purpose:

Summarize the sizing and design of the MBBR to be used to polish ammonia nitrogen.
The exsting recirculating media filter (RMF) system by itself is not consistent at ammonia removal.
However, the existing RMF is very effective at removing carbonaeous BOD, achieving a consistent effluent BOD avg = 10.5 mg/L.
Note that the rated design flow of the facility (15,000 gallons per day) is NOT being increased and will be maintained.

MBBR SYSTEM CALCULATIONS

Influent stream to MBBR from RMF system:

ADF = 12,000 gpd
PDF = 15,000 gpd ***(Note this larger flow is being used to size the MBBR system.)***
BOD5 = 12 mg/L
TSS = 10 mg/L
TKN = 10 mg/L as N (can assume all is NH4+ - N, same equiv wt. as NH3-N)

Note: Studies have shown that as long as BOD5 loading is low (< 2 g/M^2-day), then nitrifiers will predominate.

Supplemental: Converion of media surface area loading rate:
1.0 gram / m^2 -day = 0.00229568 lb / 10.7639 sf-day
= 0.00021328 lb / sf-d
= 0.2133 lb / 1,000 sf-d

Calculate minimum surface area of media required:
Base on the surface area removal rate (SARR) = **0.20** gram NH4-N / m^2 of media -day
equates to: 0.043 lb NH4-N / 1,000 sf-d

Notes: This removal rate accounts for D-O2 = 3 ppm, winter conditions, max organic load.
Resarch and operating facilities have shown that once BOD is reduced a realistic SARR = 0.5 g NH4-N / m^2-d

Use MBBR media with surface area = **131** sf/cf (= 605.6 m2/m3)
Daily load of ammonia-N = 10 mg/L as N x 8.34 conv x 0.0150 MGD = 1.25 lb/day NH4
Minimum surface areas of media =
1.25 lb/day NH4-N x 1000 sf / 0.043 lb NH4 / 1,000 sf-d = 29,328 sf
Minimum bulk volume of media = 29,328.16 sf media / 131 sf/cf = 223.9 cf =
8.29 CY

Design volume of MBBR tank = **0.20** Q x 15,000 gpd peak daily = 3000 gallons
(4.8 hrs HRT) = 401.0 cf
Resultant fill factor of media = 223.9 CF / 401.0 CF = 56%
(For small, high surface area media, a common fill rate is 30% - 70%).

Check BOD surface loading (to make sure it is low enough):
Design BOD loading = 12 mg/L x 8.34 conv x 0.02 MGD = 1.5012 lb/day
Surface area loading = 1.5012 lb/day / 29,328 sf media = 0.0511863 lb/ 1,000 sf-day
= 0.240 gram / m^2 -day of BOD5

Design as two reactors in series: 1st will likely be oxygen limited, and 2nd will be reaction rate limited.
In summer conditions it is likely that only one tank will be required.

For MBBR tanks, use vertical manhole sections: **2** manhole tanks in series:

Volume each = 200.5 cf

Size each = **6.0** foot dia x 7.1 feet fluid depth. + 2.5 ft freebrd = 9.6 feet

Height of media per tank = 223.9 cf media / 401.0 tank V x 7.1 ft depth = 4.0 feet

Air Rate Total, for Both Tanks:

MBBR is mixing limited, so use rate of: **50** CFM/1000 CF x 401.0 cf = 20.1 scfm

(See supplemental calcs below, peak process air rate = 16 scfm)

Note; Although this air rate seems excessive (twice the rate of activated sludge), research has found that a higher D.O. drives the ammonia consumption in low loadings, improving transfer through the biofilm.

Design pressure of blowers:

Static:	7.1 feet -	0.3333 ft off floor =	6.8 feet =	2.929 psig
Pipe losses:				0.3 psig
Orifice Loss:				0.2 psig
				3.4 psig
			=	94.9 in H2O

Correction to site conditions: SCFM to ACFM

Site Barometric pressure: Pb =		**14.2**	psia
Inlet losses (filter, silencer), Li=		**0.2**	psi
Suction pressure = Pb - Li =		14.0	psi
Suction temperature (summer) Ta =		**100**	deg. F
Site vapor pressure Vpa =		**0.9503**	psia for 100 F
Relative humidity Rha =		**0.85**	
Discharge pressure Pd =	3.43 psi +	14.2 =	17.63 psia

$$ACFM\ corr = \left(\frac{14.7 - (0.36 \times 0.3391)}{14.2 - (0.85 \times 0.9503)}\right) \times \frac{560}{528} \times \frac{14.2}{14.0}$$

= 1.1710

Actual air at PEAK: Use ACFM= 20.1 scfm x 1.171 inlet correction = 23.48 acfm

Blower approximate horsepower:

W	lb/sec =	flow of air=	23 scfm peak **0.075** lb/cf at STP = 1.761 lb/min = 0.029349 lb/sec
R	**53.3**	ft-lb/ (lb air) - deg R	Engineering gas constant
T1	560	deg R =	absolute inlet temperature = 100 deg F maximum + 460 deg F = 560 deg R
P1	14.0	psia	Absolute inlet atmospheric pressure
P2	17.6	psia	Absolute outlet pressure = 14.2 psi + 3.43 psi = 17.63 psi
n	**0.283**		Constant for air.
e	**0.50**		Assumed mechanical efficiency for blower

$$Hp = \frac{0.029349\ lb/sec \times 53.3\ ft\text{-}lb/(lb\ air)\text{-}deg\ R * 560\ deg\ R \times \left(\left(\frac{17.6\ psi}{14.0\ psi}\right)^{0.283} - 1\right)}{550\ ft\text{-}lb/s\text{-}hp \times 0.5\ eff \times 0.283}$$

= 0.8 hp

Use min blower motor size = 1.5 Hp

Estimate air header pipe size:

Discharge pipe size:

Dia, in.	A, sf	Flow, cfm	Avg air flow Vel, ft/min	Target velocity range	
1	0.005	20	3676	1200-1800	
1.5	0.012	20	1634	1200-1800	Use 1.5-inch discharge piping
2	0.022	20	919	1200-1800	
2.5	0.034	20	588	1200-1800	
3	0.049	20	408	1200-1800	

SETTLING TANK:

Provide a third tank for settling of effluent solids, and for possible future recycling of nitrified effluent to first stage RMF system.
Note: Due to very long SRT and low organic load, anticipated sludge production should be very low.
Most second stage Nitrification reactors do not use or require any clarification tanks.

Tank dia = **6.0** feet
Overflow rate at peak daily flow: 15,000 gpd / 28.27 sf = 530.52 gpd/SF OK

DESIGN PROVISIONS:

Design process piping so that 2nd stage can be bypassed and dewatered in summer months, to allow maintenance, sludge removal, or use only 1 stage.
Use sieves for transfer and effluent draw-off, with max 3/8" openings.
Provide portable electric submersible dewatering pump, to be inserted (say monthly) to remove accumulated sloughed biofilm.
Aeration to be coarse bubblle diffused air, using retrievable stainless steel grid mounted on the floor.
Long air hose will be provided to connect to diffuser grid when inserting into tank with media in place - to fluidize as grid is lowered.
Provide blowers with AFD's to allow adjustment of air rate for seasonal variations in D.O2, and to periodically increase turbulence for sloughing.

SUPPLEMENTAL: COMPARE PROCESS AIR RATE REQUIRED:

Mass rate based on process demands,:

Neglect oxygen credit for cells in waste sludge.
In estimating oxygen for nitrif: Assume that nitrogen demand exerted = 10.0 mg/L x 0.015 mgd x 8.34 conv = 1.25 ppd
To estimate denitrification credit:
Full credit = (10.00 mg/L-N nitrate formed - 5.00 mg/L - N nitrate in effluent) = 5.00 mg/L nitrate oxidized
Credit used = 5.00 mg/L O2 full credit x **0%** denit credit used = 0.0 mg/L NO3-N
0.0 mg/L NO3-N x 8.34 conv x 0.015 mgd = 0.0 ppd

Design Average Conditions

Oxygen consumption ratio for carbonaceaous O2 demand = **1.10** lb O2/ lb BOD5 removed. (Common value 1.2 for endogenous respiration at long SRT.)

O2 for BOD:	1.5012 ppd BOD5 applied /	1 units x	80% trtmt eff x	**1.10** lbs O2 / lbs BOD5 =	1.32 ppd
O2 for Nitrogen:	1.251 ppd ammonia demand exerted x			**4.57** lbs O2 / lbsTKN =	5.72 ppd
O2 credit taken for denitrification:	0.0 ppd nitrate-N formed x			**-2.86** lbs O2 / lbsNO3-N =	- ppd
Total oxygen required:					7.04 ppd

Peak Oxygen Demand Conditions

Assume that the peaking factor for peak **hourly** BOD and Nitrogen = **1.20** (peaking factor) x 7.04 ppd = 8.45 ppd

Estimate AOTR/SOTR (Wastewater transfer efficiency)

Assume: Submergence = 7.1 foot depth - 0.333 foot diffusers off floor = 6.76 feet subm

Assume:	B =	**0.95**	Salinity-surface tension correction factor (beta)
	A =	**0.75**	Oxygen transfer correction factor, ratio of Kla for wastewater to cleanwater (alpha) (typical value = 0.6 for fine bubble aeration, 0.75 for coarse bubble aeration)
	T =	**15.00** deg C	Operating temperature (avg winter)
	Pa =	**14.2** psia	atmospheric pressure at jobsite = 734.15 mm Hg
	d =	6.76 ft	depth of air release = 2.93 psig
	Pd =	17.1 psia	Pressure at depth of air release = 14.2 pai atm + 2.93 psig = 17.1 psia
	Ot =	**19** percent	Oxygen concentration of gas leaving tank
	C =	**4.0** mg/L	Dissolved oxygen level in reactor
	Cs20 =	**9.07** mg/L	DO concentration at saturation in clean water at 20 deg C and 1.0 atm.
	F =	**0.95**	Fouling factor(Typ. 0.9 - 0.95 for diffusers)
	Cs'th =	**(calc)** mg/L	Average DO saturation conc. In clean water in aeration tank at temperature T and jobsite altitude.
	Csth =	**10.1** mg/L	Oxygen saturation concentration in clean water in temperature T and jobsite altitude.

Cs'th = 10.1 mg/L x 0.5 x ((17.1 psia / 14.2 psia) + (19 percent / 21 percent))= 10.66 mg/L

AOTR/SOTR =
(((0.95 (Beta) x 10.66 mg/L) - 4.0 mg/L) / 9.07 mg/L) x
(1.024 ^ (15.00 C - 20 C)) x 0.75 A x 0.95 = 0.428

Volumetric rate based on process demands, considering transfer efficiency:

Theoretical air required = 7.04 ppd O2 / (**0.075** pcf air x **0.232** frac O2) = 404 scf/day = 0.281 scfm O2 per basin

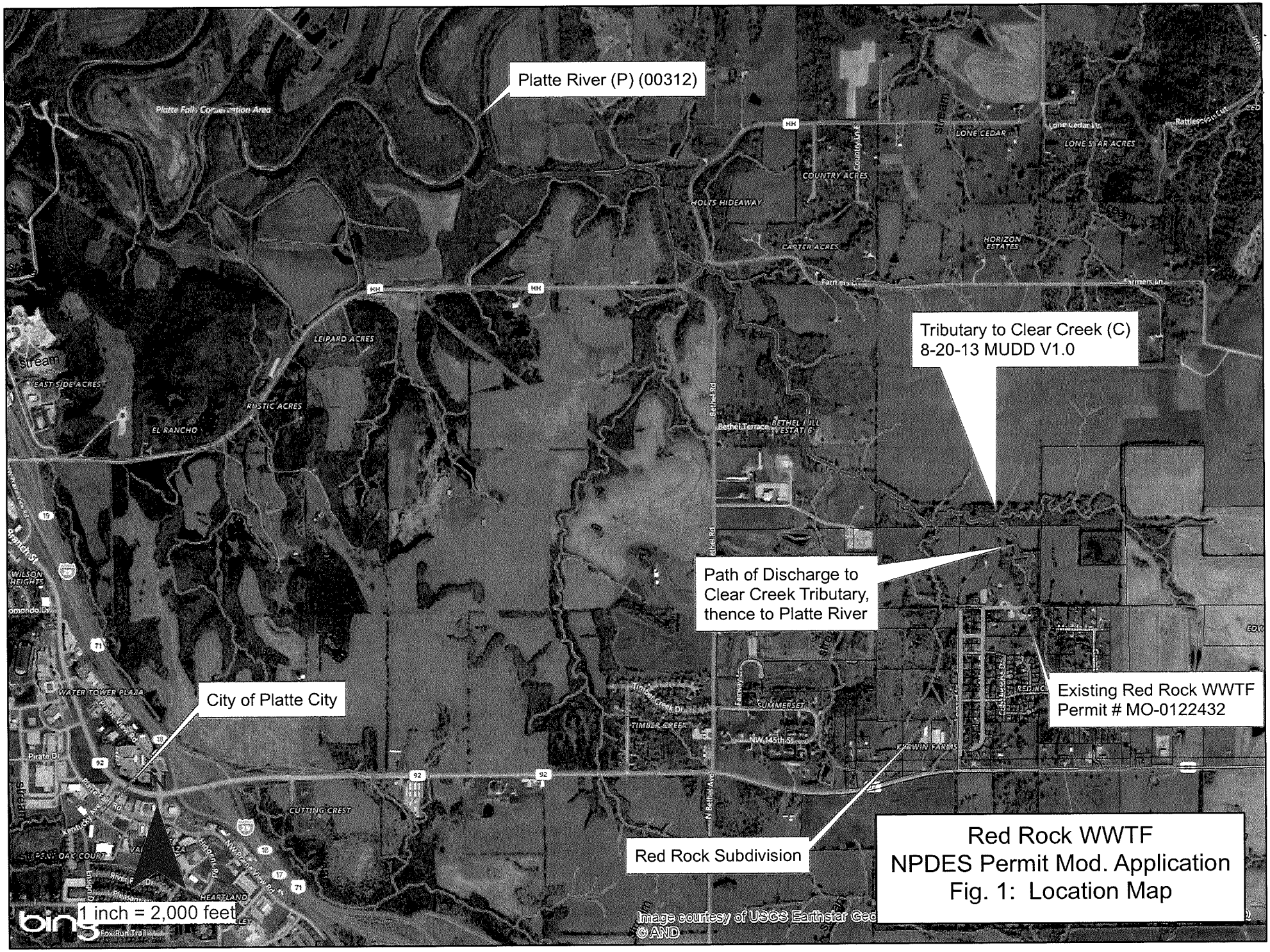
Clean water SOTE% = **0.75%** per ft x 6.8 ft subm = 5.1% applies to coarse bubble diffusers

Wastewater transfer efficiency = 42.8% of clean water efficiency (as calc'd above)

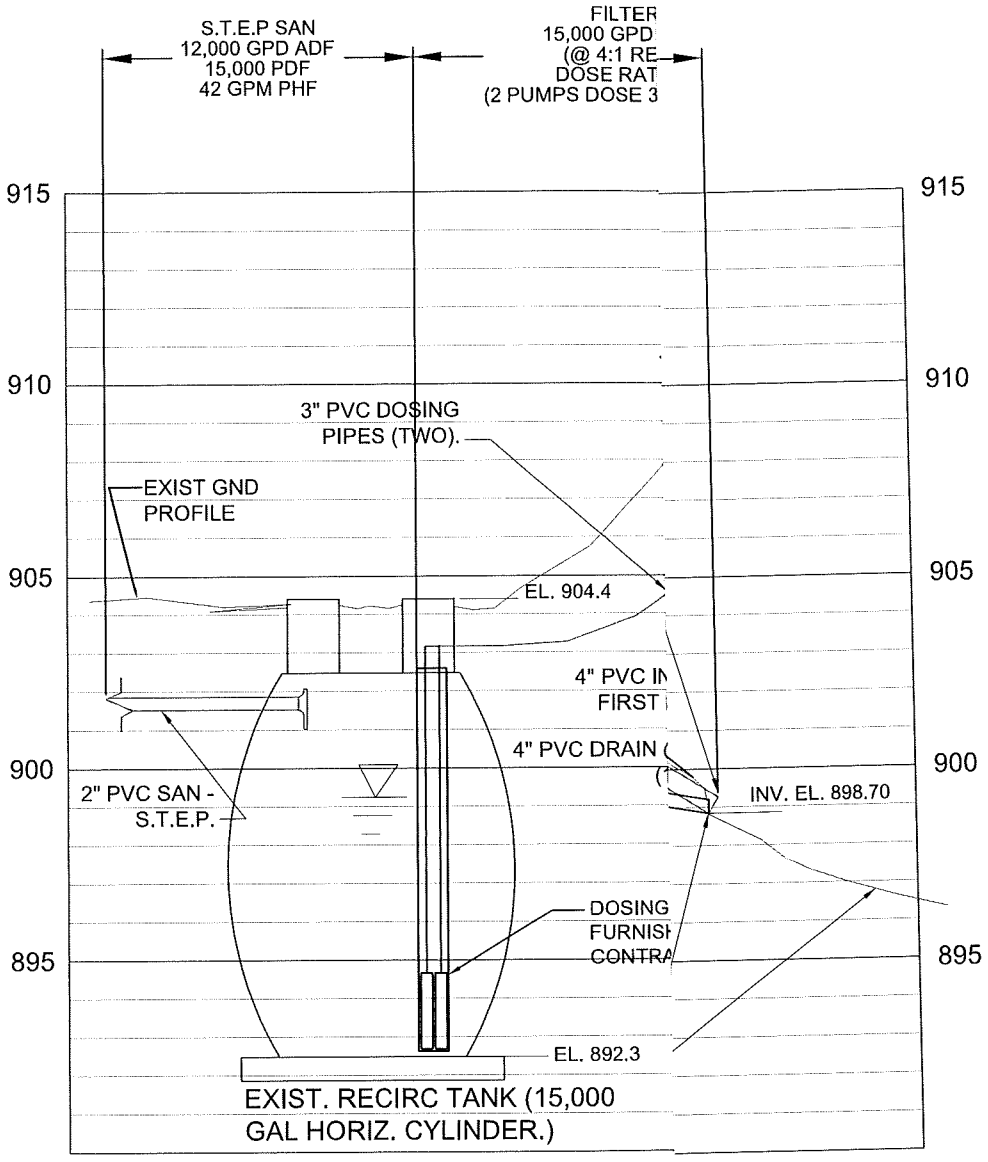
Design average airflow = 0.2809 scfm / (5.1% SOTE x 43% transfer) = 13 scfm Avg for system

Peak airflow (with safety factor added above) = 13 cfm x 1.20 factor = 16 scfm PEAK for system

Minimum airflow for blower= 13 scfm avg x **75%** min air = 10 scfm


Platte River (P) (00312)
Tributary to Clear Creek (C)
8-20-13 MUDD V1.0
Path of Discharge to
Clear Creek Tributary,
thence to Platte River
City of Platte City
Existing Red Rock WWTF
Permit # MO-0122432
Red Rock Subdivision
Red Rock WWTF
NPDES Permit Mod. Application
Fig. 1: Location Map
1 inch = 2,000 feet
Image courtesy of USGS Earthstar Geo
© AND

DESIGN FLOW RATES:
ADF = AVERAGE DAILY FLOW
PDF = PEAK DAILY FLOW
PHF = PEAK HOURLY FLOW



FLOW

SCALE:
SCALE:

Revisions		
No.	Date	Description

Jay E. Norco E-29748

ENGINEERING
REPORT DWG.

CL#2012038740

PLATTE CO. RGIONAL SEWER DISTRICT
11724 NW PLAZA CRC., SUITE 800, KCMO 64153

RED ROCK WWTF
HYDRAULIC PROFILE / DIAGRAM

Design:	Drawn:
JEN	JEN

Date: 5-01-18

Sheet: 1 OF 1

NORTH HILLS ENGINEERING, INC.
1825 Sunrise Dr., Smithville, MO 64089,
northhillseng@gmail.com, 816-935-2777

Missouri Department of NATURAL RESOURCES
dnr.mo.gov
Eric R. Greitens, Governor
Carol S. Comer, Director

APR 2 6 2018

Mr. Don Koch, Executive Director
Platte County Regional Sewer District
11724 NW Plaza Circle, Suite 800
Kansas City, MO 64153

RE: Red Rock WWTF Upgrade – Red Rock Wastewater Treatment Facility, MO-0122432, Platte County, Amended Facility Plan Approval

Dear Mr Koch:

The Missouri Department of Natural Resources' Water Protection Program has reviewed the amended facility plan regarding the Red Rock WWTF Upgrade submitted by North Hills Engineering, Inc. on behalf of the Platte County Regional Sewer District on April 23, 2018.

This amended engineering report recommends Alternative No. 1A. This alternative adds one pod to the existing treatment system, four 75 gpm pumps to replace the existing three, a new recirculation splitter valve with a fixed 4:1 ratio, two stage moving bed biofilm reactor (MBBR) as a second stage, an ultraviolet disinfection system, and magnetic flowmeter would also be added to the system. The proposed project is intended to achieve 3 mg/L of NH3. No additional flow is anticipated at this subdivision and was, therefore, not addressed in evaluating alternatives.

The current design guides, 10 CSR 20-8 do not contain design parameters for this configuration of technology or for moving bed bioreactors and therefore this is considered a demonstration project. As this is a demonstration project, for the first year of operation following construction, additional monitoring will be required before and after the MBBR. A final engineering evaluation report will be a condition of the operating permit also. The data gathered with the operating permit will be used to help develop design criteria for future projects.

The amended facility plan proposed six alternatives to meet effluent limits both for nitrogen ammonia and *e coli.*

Alternative No. 1A is to expand the RMF system and add a MBBR and is a viable proposal to meet water quality standards. It is the least-cost option and is expected to provide a more consistent level of treatment than the existing system.

Alternative No. 1B is to expand the RMF system with the addition of two Advantex pods.

Alternative No. 2 is to construct a two-stage, integrated fixed-film activated sludge system. Though feasible, the recommended alternative is more cost-effective in meeting water quality standards.

Alternative No. 3 is to construct an activated sludge system. Though feasible, the recommended alternative is more cost-effective in meeting water quality standards.

Alternative No. 4 is to pump to a regional wastewater treatment facility. This alternative is not feasible due to the long distance involved, high friction losses, and the need for an electrical upgrade with the increased pump sizes and generator being needed.

Alternative No. 5 is to combine with another wastewater treatment facility. The nearby plant was recently constructed and this community neither has the need or desire to combine therefore this alternative is not feasible.

Alternative No. 6 is to construct a drip irrigation system. Limits are not applicable and disinfection is not needed for this alternative, however the costs of implementing this alternative far exceeded the costs of the recommended alternative.

Any changes to the scope of work as shown in this facility plan will require submittal of a complete facility plan as outlined in the Facility Plan Guidance for Wastewater Treatment Facilities, Fact Sheet--PUB2416.

The Department recommends you continue to consider land application as an alternative. The treatment method would benefit both the land owner and the city as the irrigation would provide some nutrients to the fields and could be a cost effective solution for the city. The city would be exempt from the upcoming U.S. Environmental Protection Agency (EPA) ammonia limits as well as any other lower limits that may be adopted in the future. Land application would also remove the facility's disinfection requirements provided that the facility was not applying on public land.

The Department's review of engineer's cost estimate associated with this project is not rigorous. It serves only as a basis for project scope and general comparison of alternatives. Since the estimate is preliminary, costs to help the owner or community decide which option to pursue, the Department does not independently verify costs nor does it determine whether selected alternatives represent financially prudent decisions. It is important to understand that it is the community's or owner's responsibility to make sure that all planned expenditures are reasonable. For comparison purposes the Department recommends using a 20-year present worth analysis to provide a reasonable basis for lifetime cost comparisons.

Please proceed with securing financial support for the proposed project. This determination is valid for projects that are not utilizing funding from Department of Natural Resources. Projects seeking funding through the Department must be reviewed and approved by the Financial Assistance Center, due to additional conditions in 10 CSR 20-4, "Grants and Loans".

Following the Department's public notice of draft Missouri State Operating Permit, the Department will review any public notice comments received. Significant comments have the potential to require a facility plan amendment submittal for Department approval and an additional public notice.

After receipt of this letter, please submit one set of the construction plans and specifications, one copy of the summary of design, and, if possible, one electronic version of each, along with a construction permit application Application for Construction Permit - Wastewater Treatment Facility, Form--MO 780-2189 and an application fee of $1,000 for < 500,000 gpd and Form B - Application for Operating Permit for Domestic Wastewater (≤ 100,000 gallons per day), Form--MO 780-1512 and an application fee of $200.

For questions related to technical issues such as the preliminary engineering report, construction permit, or plans and specifications, please contact Ms. Diane Reinhardt, review engineer, by phone at 573-751-6568 or by mail at Department of Natural Resources, P.O. Box 176, Jefferson City MO 65102. Thank you.

Sincerely,

WATER PROTECTION PROGRAM

Refaat Mefrakis

Refaat Mefrakis, P.E., Chief
Engineering Section

RM:drn

c: Mr. Jay Norco, North Hills Engineering, Inc.
Kansas City Regional Office