✓ 9-14-06 14.4.9.2/18A.7. 14.4.9.3

VARIANCE REQUEST

Iowa Department of Natural Resources

1. Date:	June 16, 2003	13. **Decision:** Denied
2. Review Engineer:	Larry Bryant	Date: 6/23/03
3. Date Received:	May 16, 2003	
4. Facility Name:	City of Eagle Grove WWTP	14. **Appeal:**
5. County Number:	99 (Wright)	Date:
6. Program Area:	CP (Wastewater Construction)	
7. Facility Type :	C05 (Biological Treatment)	
8. Subject Area :	401 (Flow Splitting)	
9. Rule Reference:	567-64.2(9)a	
10. Design Stds Ref:	14.4.9.2; 14.4.9.3; 18A.7.4.5(a) (Flexibility; Flow Division Control; Flow Control)	
11. Consulting Engr:	Kuehl & Payer, Ltd.	
12. Variance Rule:	567-64.2(9)c	

15. Description of Variance Request:

The City of Eagle grove is in the process of upgrading their existing wastewater treatment plant. One of the improvements includes the addition of a new 3rd rotating biological contactor (RBC) to match the two existing units. The existing arrangement does not have positive flow splitting prior to the RBCs as required by the above referenced sections of the Iowa Wastewater Facilities Design Standards. Currently effluent from the plant's primary clarifiers is hard-piped to the RBC units from a common manifold. The RBC inlets are submerged and effluent weirs in the RBC basins provide level control. The City is proposing to connect the third unit by extending the existing manifold piping in lieu of providing a new splitter structure prior to the RBCs to meet the design standards.

16. Consulting Engineer's Justifications

A. The existing RBCs were constructed prior to current design standards.

B. Measurements were taken on 5/14/03, when flows were at the maximum that the mechanical plant currently handles (there is off-line equalization prior to the mechanical plant). The plant operator measured water levels (distance from the deck to the water level) in each stage of both trains and found identical levels, thus indicating that the flows through each of the two existing units are currently being split equally at the maximum flow.

C. Based on the above measurements, it appears the loss through the RBC units tend to level out the impact of the differences in pipe losses between the units.

D. At high flows (when the difference in flow between the units will be the largest) the influent characteristics are so low that a small difference in flows to each unit should not make a difference.

E. The size of the new manifold piping could be increased from 10" to 12" to minimize the additional piping head loss for the new unit.

17. Department's Justifications

Recommend variance denial:

Denial of the variance is recommended for the following reasons:

A. The degree of accuracy of the measurements taken by the operator and the calculated head differences are small enough such that the conclusion that can be drawn from the observed levels is questionable. The measurements indicate negative head loss (an impossibility) of ¼" between Stage 1 and Stage 2 (each of the two trains has 3 stages). The measurements were taken from decking in the RBC building that may not be completely level throughout and no measurements of head over the effluent weirs were provided. The theoretical difference in the head-over-weir (H.O.W.) for the existing units is not large assuming the effluent weirs are set at the same elevation and also assuming head loss across the RBC basins. A 6% to 8% difference in flow is expected at the existing maximum flow of 1.77 MGD corresponding to a H.O.W. elevation difference of approximately 0.4".

B. Addition of a 3rd unit will increase the maximum H.O.W. differential with an expected 16% to 18% difference (for 10" inlet piping) between flows through the 1st and 3rd units at the design AWW flow and an 11% to 16% difference for the design ADW flow. The lower percentages represent an assumed head loss across the RBC basins included in the calculations proportional to that measured by the operator as a function of the flow squared. Attached calculations show that this head loss through the RBC basins will decrease the percent flow differences between basins, but only slightly. An approximately equal flow split due to additional head loss across the RBC basins could only occur a) if the basin head loss between units was significantly different (e.g. the RBCs in the first train were much more "dirty" than the RBCs in the second train) or b) if the head loss across the basins was much more than the observed 7/8" (this would effectively "throttle" the flow through each basin).

C. Twelve-inch inlet piping for the 3rd RBC would achieve a more even flow split between the 2nd and 3rd units and would also decrease the flow difference between all of the units, but there would remain a significant difference with the 1st RBC receiving approximately 40% of the total influent loading at all flow rates.

D. A significant head loss differential through the RBC basins could occur due to excessive filter biomass buildup. This could in turn adversely affect the flow split regardless of the influent piping losses.

E. Flow through each unit is fairly sensitive to minor level fluctuations/head losses. For example, an 10% to 11% flow difference between the 1st and 3rd units corresponds to a basin level difference of less than ½" at the design ADW flow.

F. The existing and proposed effluent weirs are adjustable. In theory, they could be adjusted to provide an even flow split for a single total influent flow. However, at flows above or below the "target" flow, uneven division would occur. The current arrangement offers little operational flexibility in terms of measurement/adjustment of flows to each RBC unit.

G. The engineer's argument that the difference in flow splits would not make a difference in treatment at high flows due to the dilute nature of the wastewater may in part be valid. However, mass effluent limits for ammonia are controlling for this facility at the design wet weather flow and are quite stringent during some months. Also, significant maldistribution (close to 40% / 30% / 30% in all cases) will occur at the design average dry weather flow.

H. The cost for the splitting structure has been estimated at $16,000. The total project costs are approximately 1.7 million dollars. Although the additional cost is not insignificant, it is not a financial hardship in terms of the total project cost.

I. There appears to be adequate head available in the plant hydraulic profile for installation of a splitting structure.

18. Precedents Used

Des Moines RWF - Approved 3/6/87. This variance was for final clarifier splitting and a symmetrical piping arrangement (as opposed to the manifold arrangement proposed at Eagle Grove).

City of Ottumwa - Denied 8/27/97. This variance request was to retain an existing submerged influent control structure for two existing clarifiers.

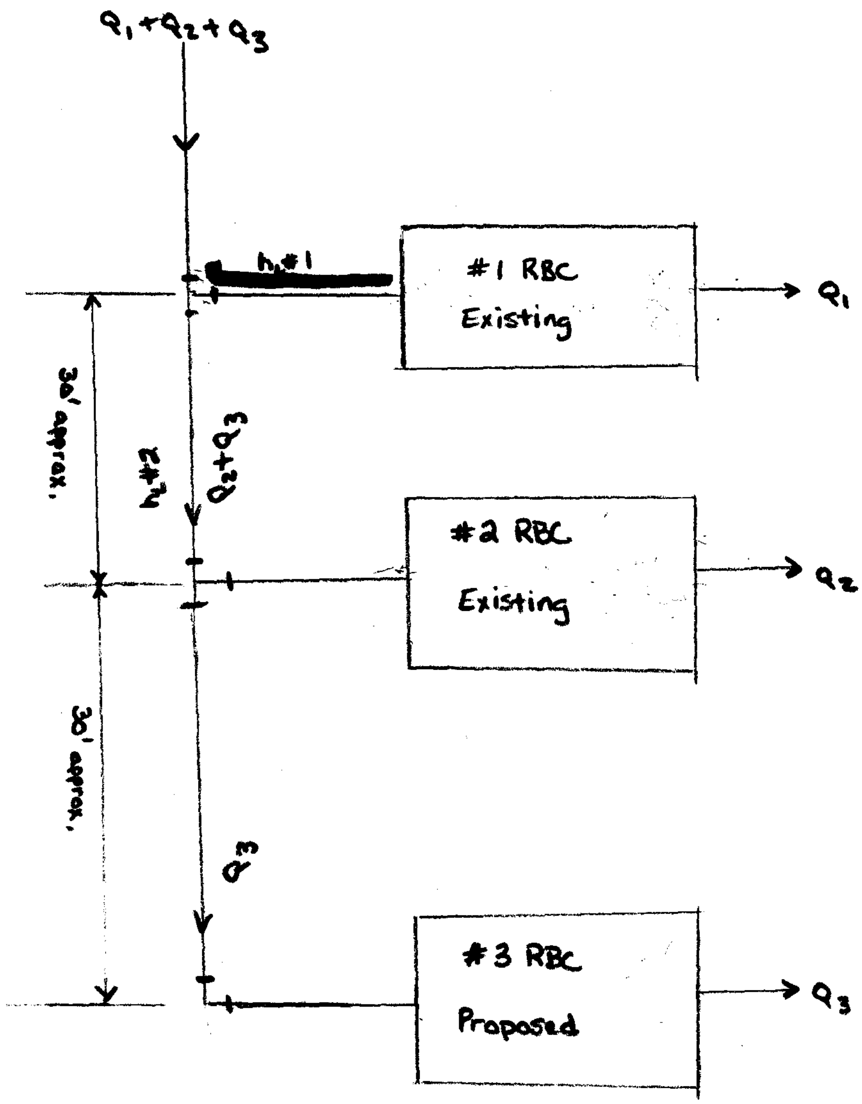
19. Staff Reviewer: [signature] Date: 6/16/03

20. Supervisor: [signature] Date: 6/16/03

21. Authorized by: J Riessen (denied) Date: 6/23/03

EAGLE GROVE FLOW SPLIT

1. General Arrangement (Existing / Proposed)



ADW = 0.84 MGD } proposed
AWW_{30} = 2.41 MGD }

ADW = 0.60 MGD est.
AWW_{30} (max. plant flow) = 1.77 MGD

Each RBC has a 2'-0" rectang weir on the effluent side

Assume:

(1) All effluent weirs are set at the same elevation

(2) No headloss through RBC themselves (for purpose of calculating split difference to piping only)

(3) For purpose of calculating initial friction loss, assu $Q_1 = Q_2$ (existing)

(4) C = 120

For flow split w/ all effluent weirs set at same elevation,

$(h_L\#1 + H.O.W.\#1) = (h_L\#2 + H.O.W.\#2) = (h_L\#3 + H.O.W.\#3)$, i.e. the hydraulic gradeline between all three units will be the same

Weir equation is $Q = 3.33(L-0.2h)h^{1.5}$ where L = 2 and Q is in cfs

See attached spreadsheet printouts (used Excel Solver to converge on solutions w/ [illegible]

Summary

Neglecting losses through the RBC basins themselves, the splits are:

Existing

Q (MGD)	0.6	1.77	0.6 (with assumed basin H_L)	1.77 (with assumed basin H_L)
RBC #1	52%	54%	52%	53%
RBC #2	48%	46%	48%	47%
H.O.W #1	0.176	0.375	0.175	0.372
H.O.W #2	0.166	0.338	0.166	0.341

Proposed 10-inch inlet piping

Q (MGD)	0.84	2.41	0.84	2.41
RBC #1	40%	44%	39.4%	43%
#2	31%	30%	31.4%	30%
#3	29%	26%	29.3%	27%
H.O.W. #1	0.184	0.405	0.183	0.396
#2	0.156	0.309	0.156	0.313
#3	0.148	0.282	0.149	0.289

Proposed 12-inch inlet piping

Q (MGD)	0.84	2.41	0.84	2.41
RBC #1	39%	43%	39%	41.7%
#2	30%	28%	30%	28.6%
#3	31%	29%	31%	29.6%
H.O.W #1	0.182	0.398	0.181	0.389
#2	0.152	0.295	0.153	0.301
#3	0.154	0.304		

CONCLUSIONS

- Difference in flow splits for existing units is not too great (4% @ ADW w/ ΔH = 0.12", 8% difference @ AWW w/ ΔH = 0.44"), and uniform H_L through the basins dampens the effect slightly.

- Addition of a 3rd unit will increase max differential between basins (11% @ ADW w/ $\Delta H.O.W._{1-3}$ = 0.43", 18% @ AWW w/ $\Delta H.O.W._{1-3}$ = 1.5"). Uniform H_L through the basins again dampens the effect, but not by much.

- 12" inlet piping for the 3rd (proposed) RBC achieves a more even flow split between the 2nd and 3rd units and also decreases ΔQ between 1-2 and 2-3 but there would remain a significant difference in split with the 1st unit recieving approx. 40% of the flow at all rates.

- Uniform H_L through the basins may not occur, depending on filter biomass growth, frequency of air scour cleaning, etc. Non-uniform loss through the basins could cause a much greater difference in the flow split.

- Flow through each unit is fairly sensitive to minor level fluctuations / head losses An 11% flow difference occurs w/ less than 1/2" W.L. difference for 3-units @ the ADW.

- The existing (and proposed) effluent weirs are adjustable. In theory, they could be adjusted to provide an even flow split for a single total influent flow. Howe at flows above or below the "target" flow, uneven division would occur. e.g. for the existing arrangement a 50/50 split would occur at 1.77 MGD if the 2nd unit weir was set 1.4" lower than the weir in the 1st unit. But this would cause a 36/64 split at 0.6 MGD. Conversely, if the 2nd unit weir was set for 50/50 at 0.6 MGD (−0.18"), a 53/47 split would still occur at 1.77 MGD.

[redacted]Losses

	V	K or L	Loss	
[redacted]	0.888471	0.18	Q1 45 Elbow	0.002206342
	0.888471	0.5	Q1 Wye	0.006128727
	0.888471	5	Q1 10" pipe	0.00213608
	0.888471	0.3	Q1 Gate Valve	0.003677236
	0.888471	1	Q1 Exit	0.012257454
	0.816652	0.3	Q2 thru Wye	0.003106771
	0.816652	35	Q2 10" pipe	0.012793642
	0.816652	0.5	Q2 Wye	0.005177951
	0.816652	0.18	Q2 45 Elbow	0.001864063
	0.816652	0.3	Q2 Gate Valve	0.003106771
	0.816652	1	Q2 Exit	0.010355903

C 120

Lookup Array

Q	H.O.W.
0.208502	0.1
0.211616	0.101
0.214744	0.102
0.217888	0.103
0.221047	0.104
0.22422	0.105
0.227408	0.106
0.23061	0.107
0.233827	0.108
0.237058	0.109
0.240303	0.11
0.243563	0.111
0.246837	0.112
0.250125	0.113

Sum Loss # 1	0.026405838
Sum Loss # 2	0.036405101
Delta H Sum Loss	0.009999262
[redacted]	
Sum Loss # 1 + H.O.W. 1	0.202405838
Sum Loss # 2 + H.O.W. 2	0.202405101
Delta H Total	[redacted]

[redacted]Losse[redacted]

	V	K or L	Loss	
[redacted]	[redacted].953662	0.5	Q1 Wye	0.007061106
[redacted]	[redacted].953662	0.18	Q1 45 Elbow	0.002541998
[redacted]	0.953662	0.3	Q1 Gate Valve	0.004236663
[redacted]	0.953662	5	Q1 10" pipe	0.002435047
	0.953662	1	Q1 Exit	0.014122211
	1.429843	0.3	Q2/Q3 thru Wye	0.009523838
	1.429843	30	Q2/Q3 10" pipe	0.0309074
	0.740637	0.5	Q2 Wye	0.004258875
	0.740637	0.18	Q2 45 Elbow	0.001533195
	0.740637	0.3	Q2 Gate Valve	0.002555325
	0.740637	5	Q2 10" pipe	0.00152545
	0.740637	1	Q2 Exit	0.008517751
	1.429843	0.3	Q2/Q3 thru Wye	0.009523838
	1.429843	30	Q2/Q3 10" pipe	0.0309074
	0.689206	0.3	Q3 thru Wye	0.002212755
	0.689206	35	Q3 10" pipe	0.009346984
	0.689206	0.5	Q3 Wye	0.003687925
	0.689206	0.18	Q3 45 Elbow	0.001327653
	0.689206	0.3	Q3 Gate Valve	0.002212755
	0.689206	1	Q3 Exit	0.00737585

Sum Loss # 1	0.030397025
Sum Loss # 2	0.058821834
Sum Loss # 3	0.066595159
[redacted]	
Sum Loss # 1 + H.O.W. 1	0.214397
Sum Loss # 2 + H.O.W. 2	0.214822
Sum Loss # 3 + H.O.W. 3	0.214595
Sum 1 - Sum 2	-0.000425
Sum 1 - Sum 3	-0.000198
Sum 2 - Sum 3	0.000227
Absolute Sum Differences	[redacted]

	Proposed (3-RBCs) Losses 10" Inlet Piping			
	V	k or L	Loss	
[redacted]	0.933146	0.5	Q1 Wye	0.00676057
[redacted]	0.933146	0.18	Q1 45 Elbow	0.002433805
[redacted]	0.933146	0.3	Q1 Gate Valve	0.004056342
[redacted]	0.933146	5	Q1 10" pipe	0.002339024
	0.933146	1	Q1 Exit	0.01352114
	1.450358	0.3	Q2/Q3 thru Wye	0.009799098
	1.450358	30	Q2/Q3 10" pipe	0.031732807
	0.719594	0.5	Q2 Wye	0.004020311
	0.719594	0.18	Q2 45 Elbow	0.001447312
	0.719594	0.3	Q2 Gate Valve	0.002412187
	0.719594	5	Q2 10" pipe	0.00144624
	0.719594	1	Q2 Exit	0.008040622
	1.450358	0.3	Q2/Q3 thru Wye	0.009799098
	1.450358	30	Q2/Q3 10" pipe	0.031732807
	0.730764	0.3	Q3 thru Wye	0.002487653
	0.730764	35	Q3 10" pipe	0.010416305
	0.730764	0.5	Q3 Wye	0.004146088
	0.730764	0.18	Q3 45 Elbow	0.001492592
	0.730764	0.3	Q3 Gate Valve	0.002487653
	0.730764	1	Q3 Exit	0.008292176

Sum Loss # 1	0.029110881
Sum Loss # 2	0.058898577
Sum Loss # 3	0.07085437
H.O.W. 1	0.182000
H.O.W. 2	0.152000
H.O.W. 3	0.154000
Sum Loss # 1 + H.O.W. 1	0.211111
Sum Loss # 2 + H.O.W. 2	0.210899
Sum Loss # 3 + H.O.W. 3	0.224854
Sum 1 - Sum 2	0.000212
Sum 1 - Sum 3	-0.013743
Sum 2 - Sum 3	-0.013956
Absolute Sum Differences	0.027912

[redacted] Losses [redacted]			
[redacted]		Loss	
0.933146	0.5	Q1 Wye	0.00676057
0.933146	0.18	Q1 45 Elbow	0.002433805
0.933146	0.3	Q1 Gate Valve	0.004056342
0.933146	5	Q1 10" pipe	0.002339024
0.933146	1	Q1 Exit	0.01352114
1.450358	0.3	Q2/Q3 thru Wye	0.009799098
1.450358	30	Q2/Q3 10" pipe	0.031732808
0.719594	0.5	Q2 Wye	0.004020311
0.719594	0.18	Q2 45 Elbow	0.001447312
0.719594	0.3	Q2 Gate Valve	0.002412187
0.719594	5	Q2 10" pipe	0.00144624
0.719594	1	Q2 Exit	0.008040622
1.450358	0.3	Q2/Q3 thru Wye	0.009799098
1.450358	30	Q2/Q3 10" pipe	0.031732808
0.730764	0.3	Q3 thru Wye	0.002487653
		Q3 10x12 Increaser	
0.730764		V1	0.001073312
0.507475		V2	
0.507475	35	Q3 12" pipe	0.00429
0.507475	0.5	Q3 12" Wye	0.001999464
0.507475	0.18	Q3 45 Elbow (12")	0.000719807
0.507475	0.3	Q3 Gate Valve (12")	0.001199678
0.507475	1	Q3 Exit	0.003998927

Sum Loss # 1	0.029110881
Sum Loss # 2	0.058898577
Sum Loss # 3	0.057300746
[redacted]	
Sum Loss # 1 + H.O.W. 1	0.211111
Sum Loss # 2 + H.O.W. 2	0.210899
Sum Loss # 3 + H.O.W. 3	0.211301
Sum 1 - Sum 2	0.000212
Sum 1 - Sum 3	-0.000190
Sum 2 - Sum 3	-0.000402
Absolute Sum Differences	[redacted]

[redacted] Losses

	V	K or L	Loss	
[redacted]	2.704551	0.18	Q1 45 Elbow	0.020444516
	2.704551	0.5	Q1 Wye	0.056790323
	2.704551	5	Q1 10" pipe	0.016749575
	2.704551	0.3	Q1 Gate Valve	0.034074194
	2.704551	1	Q1 Exit	0.113580645
	2.319143	0.3	Q2 thru Wye	0.02505478
	2.319143	35	Q2 10" pipe	0.088223029
	2.319143	0.5	Q2 Wye	0.041757967
	2.319143	0.18	Q2 45 Elbow	0.015032868
	2.319143	0.3	Q2 Gate Valve	0.02505478
	2.319143	1	Q2 Exit	0.083515935

C 120

Lookup Array

Q	H.O.W.
0.208502	0.1
0.211616	0.101
0.214744	0.102
0.217888	0.103
0.221047	0.104
0.22422	0.105
0.227408	0.106
0.23061	0.107
0.233827	0.108
0.237058	0.109
0.240303	0.11
0.243563	0.111
0.246837	0.112
0.250125	0.113

Sum Loss # 1	0.241639253
Sum Loss # 2	0.278639361
Delta H Sum Loss	0.037000108
[redacted]	
Sum Loss # 1 + H.O.W. 1	0.616639253
Sum Loss # 2 + H.O.W. 2	0.616639361
Delta H Total	[redacted]

[redacted] Losses [redacted]

	V	k or L	Loss	
[redacted]	3.019773	0.5	Q1 Wye	0.070799933
	3.019773	0.18	Q1 45 Elbow	0.025487976
	3.019773	0.3	Q1 Gate Valve	0.04247996
	3.019773	5	Q1 10" pipe	0.020539053
	3.019773	1	Q1 Exit	0.141599865
	3.819051	0.3	Q2/Q3 thru Wye	0.067943243
	3.819051	30	Q2/Q3 10" pipe	0.190281545
	2.04197	0.5	Q2 Wye	0.03237299
	2.04197	0.18	Q2 45 Elbow	0.011654276
	2.04197	0.3	Q2 Gate Valve	0.019423794
	2.04197	5	Q2 10" pipe	0.009959078
	2.04197	1	Q2 Exit	0.06474598
	3.819051	0.3	Q2/Q3 thru Wye	0.067943243
	3.819051	30	Q2/Q3 10" pipe	0.190281545
	1.777081	0.3	Q3 thru Wye	0.014711258
	1.777081	35	Q3 10" pipe	0.053911849
	1.777081	0.5	Q3 Wye	0.024518763
	1.777081	0.18	Q3 45 Elbow	0.008826755
	1.777081	0.3	Q3 Gate Valve	0.014711258
	1.777081	1	Q3 Exit	0.049037526

Sum Loss # 1	0.300906786
Sum Loss # 2	0.396380907
Sum Loss # 3	0.423942196
[redacted]	
Sum Loss # 1 + H.O.W. 1	0.705907
Sum Loss # 2 + H.O.W. 2	0.705381
Sum Loss # 3 + H.O.W. 3	0.705942
Sum 1 - Sum 2	0.000526
Sum 1 - Sum 3	-0.000035
Sum 2 - Sum 3	-0.000561
Absolute Sum Differences	[redacted]

Proposed (3-RBCs) Losses 10" Inlet Piping

[redacted]

V	k or L	Loss	
2.944086	0.5	Q1 Wye	0.067295368
2.944086	0.18	Q1 45 Elbow	0.024226332
2.944086	0.3	Q1 Gate Valve	0.040377221
2.944086	5	Q1 10" pipe	0.019596852
2.944086	1	Q1 Exit	0.134590735
3.894738	0.3	Q2/Q3 thru Wye	0.070662972
3.894738	30	Q2/Q3 10" pipe	0.197316716
1.908248	0.5	Q2 Wye	0.02827182
1.908248	0.18	Q2 45 Elbow	0.010177855
1.908248	0.3	Q2 Gate Valve	0.016963092
1.908248	5	Q2 10" pipe	0.008786224
1.908248	1	Q2 Exit	0.056543639
3.894738	0.3	Q2/Q3 thru Wye	0.070662972
3.894738	30	Q2/Q3 10" pipe	0.197316716
1.98649	0.3	Q3 thru Wye	0.018382653
1.98649	35	Q3 10" pipe	0.066249978
1.98649	0.5	Q3 Wye	0.030637755
1.98649	0.18	Q3 45 Elbow	0.011029592
1.98649	0.3	Q3 Gate Valve	0.018382653
1.98649	1	Q3 Exit	0.061275511
		Sum Loss # 1	0.286086507
		Sum Loss # 2	0.388722317
		Sum Loss # 3	0.473937831
		H.O.W. 1	0.398000
		H.O.W. 2	0.295000
		H.O.W. 3	0.304000
		Sum Loss # 1 + H.O.W. 1	0.684087
		Sum Loss # 2 + H.O.W. 2	0.683722
		Sum Loss # 3 + H.O.W. 3	0.777938
		Sum 1 - Sum 2	0.000364
		Sum 1 - Sum 3	-0.093851
		Sum 2 - Sum 3	-0.094216
		Absolute Sum Differences	0.188431

[redacted] Losses [redacted]

V	k or L	Loss	
2.944086	0.5	Q1 Wye	0.067295368
2.944086	0.18	Q1 45 Elbow	0.024226332
2.944086	0.3	Q1 Gate Valve	0.040377221
2.944086	5	Q1 10" pipe	0.019596852
2.944086	1	Q1 Exit	0.134590735
3.894738	0.3	Q2/Q3 thru Wye	0.070662972
3.894738	30	Q2/Q3 10" pipe	0.197316719
1.908248	0.5	Q2 Wye	0.02827182
1.908248	0.18	Q2 45 Elbow	0.010177855
1.908248	0.3	Q2 Gate Valve	0.016963092
1.908248	5	Q2 10" pipe	0.008786224
1.908248	1	Q2 Exit	0.056543639
3.894738	0.3	Q2/Q3 thru Wye	0.070662972
3.894738	30	Q2/Q3 10" pipe	0.197316719
1.98649	0.3	Q3 thru Wye	0.018382653
		Q3 10x12 Increaser	
1.98649		V1	0.007931302
1.379507		V2	
1.379507	35	Q3 12" pipe	0.027285341
1.379507	0.5	Q3 12" Wye	0.014775152
1.379507	0.18	Q3 45 Elbow (12")	0.005319055
1.379507	0.3	Q3 Gate Valve (12")	0.008865091
1.379507	1	Q3 Exit	0.029550304
		Sum Loss # 1	0.286086508
		Sum Loss # 2	0.388722321
		Sum Loss # 3	0.38008859
		[redacted]	
		Sum Loss # 1 + H.O.W. 1	0.684087
		Sum Loss # 2 + H.O.W. 2	0.683722
		Sum Loss # 3 + H.O.W. 3	0.684089
		Sum 1 - Sum 2	0.000364
		Sum 1 - Sum 3	-0.000002
		Sum 2 - Sum 3	-0.000366
		Absolute Sum Differences	[redacted]

Existing (2-RBCs) Losses

		V	k or L	Loss	
Q1	0.[illegible]94	0.885736	0.18	Q1 45 Elbow	0.00219278
Q2	0.446906	0.885736	0.5	Q1 Wye	0.006091055
Qt	0.93	0.885736	5	Q1 10" pipe	0.002123932
		0.885736	0.3	Q1 Gate Valve	0.003654633
		0.885736	1	Q1 Exit	0.01218211
		0.819387	0.3	Q2 thru Wye	0.003127614
		0.819387	35	Q2 10" pipe	0.012873016
		0.819387	0.5	Q2 Wye	0.00521269
		0.819387	0.18	Q2 45 Elbow	0.001876568
		0.819387	0.3	Q2 Gate Valve	0.003127614
		0.819387	1	Q2 Exit	0.010425379

Proposed (3-RBCs) Losses 10" Inlet Piping

		V	k or L	Loss
Q1	0.511894	0.93854	0.5	Q1 Wye
Q2	0.407803	0.93854	0.18	Q1 45 Elbow
Q3	0.380303	0.93854	0.3	Q1 Gate Valve
Qt	1.3	0.93854	5	Q1 10" pipe
		0.93854	1	Q1 Exit
		1.444965	0.3	Q2/Q3 thru Wye
		1.444965	30	Q2/Q3 10" pipe
		0.747692	0.5	Q2 Wye
		0.747692	0.18	Q2 45 Elbow
		0.747692	0.3	Q2 Gate Valve
		0.747692	5	Q2 10" pipe
		0.747692	1	Q2 Exit
		1.444965	0.3	Q2/Q3 thru Wye
		1.444965	30	Q2/Q3 10" pipe
		0.697272	0.3	Q3 thru Wye
		0.697272	35	Q3 10" pipe
		0.697272	0.5	Q3 Wye
		0.697272	0.18	Q3 45 Elbow
		0.697272	0.3	Q3 Gate Valve
		0.697272	1	Q3 Exit

C 120

Lookup Array

Q	H.O.W.
0.208502	0.1
0.211616	0.101
0.214744	0.102
0.217888	0.103
0.221047	0.104
0.22422	0.105
0.227408	0.106
0.23061	0.107
0.233827	0.108
0.237058	0.109
0.240303	0.11
0.243563	0.111
0.246837	0.112
0.250125	0.113

Additional Assumed Basin Loss
approximate 0.875" @ 1.37 cfs proportional to Q^2/2g

Sum Loss # 1	0.035304282	0.00906
Sum Loss # 2	0.044396182	0.007753
Delta H Sum Loss	0.009091901	
H.O.W. 1	0.175	
H.O.W.2	0.166	
Sum Loss # 1 + H.O.W. 1	0.210304282	
Sum Loss # 2 + H.O.W. 2	0.210396182	
Delta H Total	9.19007E-05	

Sum Loss # 1
Sum Loss # 2
Sum Loss # 3
H.O.W. 1
H.O.W. 2
H.O.W. 3
Sum Loss # 1 + H.O.W. 1
Sum Loss # 2 + H.O.W. 2

		Proposed (3-RBCs) Losses 10" Inlet Piping				Proposed (
		V	k or L	Loss		V
Q1	0.511894	0.93854	0.5	Q1 Wye	0.00683895	0.93854
Q2	0.407803	0.93854	0.18	Q1 45 Elbow	0.002462022	0.93854
Q3	0.380303	0.93854	0.3	Q1 Gate Valve	0.00410337	0.93854
Qt	1.3	0.93854	5	Q1 10" pipe	0.002364097	0.93854
		0.93854	1	Q1 Exit	0.013677899	0.93854
		1.444965	0.3	Q2/Q3 thru Wye	0.00972635	1.444965
		1.444965	30	Q2/Q3 10" pipe	0.031514834	1.444965
		0.747692	0.5	Q2 Wye	0.004340403	0.747692
		0.747692	0.18	Q2 45 Elbow	0.001562545	0.747692
		0.747692	0.3	Q2 Gate Valve	0.002604242	0.747692
		0.747692	5	Q2 10" pipe	0.001552442	0.747692
		0.747692	1	Q2 Exit	0.008680806	0.747692
		1.444965	0.3	Q2/Q3 thru Wye	0.00972635	1.444965
		1.444965	30	Q2/Q3 10" pipe	0.031514834	1.444965
		0.697272	0.3	Q3 thru Wye	0.002264854	0.697272
		0.697272	35	Q3 10" pipe	0.009550375	
		0.697272	0.5	Q3 Wye	0.003774757	0.697272
		0.697272	0.18	Q3 45 Elbow	0.001358913	0.484217
		0.697272	0.3	Q3 Gate Valve	0.002264854	0.484217
		0.697272	1	Q3 Exit	0.007549515	0.484217
						0.484217
						0.484217
Additional Assumed Basin Loss						0.484217
approximate 0.875" @ 1.37 cfs proportional to Q^2/2g						
0.00906				Sum Loss # 1	0.039618521	0.010172
0.007753				Sum Loss # 2	0.066437492	0.006456
				Sum Loss # 3	0.073618988	0.005615
				H.O.W. 1	0.183000	
				H.O.W. 2	0.156000	
				H.O.W. 3	0.149000	
				Sum Loss # 1 + H.O.W. 1	0.222619	
				Sum Loss # 2 + H.O.W. 2	0.222437	
				Sum Loss # 3 + H.O.W. 3	0.222619	
				Sum 1 - Sum 2	0.000181	
				Sum 1 - Sum 3	0.000000	
				Sum 2 - Sum 3	-0.000181	
				Absolute Sum Differences	0.000363	

Q1	0.50357
Q2	0.394916
Q3	0.401515
Qt	1.3

Proposed (3-RBCs) Losses 10" Inlet Piping

V	k or L	Loss		
0.923277	0.5	Q1 Wye	0.006618329	
0.923277	0.18	Q1 45 Elbow	0.002382598	
0.923277	0.3	Q1 Gate Valve	0.003970997	
0.923277	5	Q1 10" pipe	0.002293466	
0.923277	1	Q1 Exit	0.013236657	
1.460227	0.3	Q2/Q3 thru Wye	0.009932905	
1.460227	30	Q2/Q3 10" pipe	0.032133419	
0.724064	0.5	Q2 Wye	0.004070408	
0.724064	0.18	Q2 45 Elbow	0.001465347	
0.724064	0.3	Q2 Gate Valve	0.002442245	
0.724064	5	Q2 10" pipe	0.001462902	
0.724064	1	Q2 Exit	0.008140815	
1.460227	0.3	Q2/Q3 thru Wye	0.009932905	
1.460227	30	Q2/Q3 10" pipe	0.032133419	
0.736163	0.3	Q3 thru Wye	0.002524549	
0.736163	35	Q3 10" pipe	0.010559131	
0.736163	0.5	Q3 Wye	0.004207582	
0.736163	0.18	Q3 45 Elbow	0.001514729	
0.736163	0.3	Q3 Gate Valve	0.002524549	
0.736163	1	Q3 Exit	0.008415163	
		Sum Loss # 1	0.038346082	0.009844
		Sum Loss # 2	0.065702322	0.006054
		Sum Loss # 3	0.078070341	0.006258
		H.O.W. 1	0.181000	
		H.O.W. 2	0.153000	
		H.O.W. 3	0.155000	
		Sum Loss # 1 + H.O.W. 1	0.219346	
		Sum Loss # 2 + H.O.W. 2	0.218702	
		Sum Loss # 3 + H.O.W. 3	0.233070	
		Sum 1 - Sum 2	0.000644	
		Sum 1 - Sum 3	-0.013724	
		Sum 2 - Sum 3	-0.014368	
		Absolute Sum Differences	0.028736	

Additional Assumed Basin Loss
approximate 0.875" @ 1.37 cfs proportional to Q^2/2g

0.00906
0.007753

Proposed (3-RBCs) Losses 12" Inlet Piping

V	k or L	Loss		
0.923277	0.5	Q1 Wye	0.006618329	
0.923277	0.18	Q1 45 Elbow	0.002382598	
0.923277	0.3	Q1 Gate Valve	0.003970997	
0.923277	5	Q1 10" pipe	0.002293466	
0.923277	1	Q1 Exit	0.013236657	
1.460227	0.3	Q2/Q3 thru Wye	0.009932905	
1.460227	30	Q2/Q3 10" pipe	0.032133419	
0.724064	0.5	Q2 Wye	0.004070408	
0.724064	0.18	Q2 45 Elbow	0.001465347	
0.724064	0.3	Q2 Gate Valve	0.002442245	
0.724064	5	Q2 10" pipe	0.001462902	
0.724064	1	Q2 Exit	0.008140815	
1.460227	0.3	Q2/Q3 thru Wye	0.009932905	
1.460227	30	Q2/Q3 10" pipe	0.032133419	
0.736163	0.3	Q3 thru Wye	0.002524549	
		Q3 10x12 Increaser		
0.736163		V1	0.001089231	
0.511225		V2		
0.511225	35	Q3 12" pipe	0.004348824	
0.511225	0.5	Q3 12" Wye	0.002029119	
0.511225	0.18	Q3 45 Elbow (12")	0.000730483	
0.511225	0.3	Q3 Gate Valve (12")	0.001217472	
0.511225	1	Q3 Exit	0.004058238	
		Sum Loss # 1	0.038346082	0.009844
		Sum Loss # 2	0.065702323	0.006054
		Sum Loss # 3	0.064322555	0.006258
		H.O.W. 1	0.181000	
		H.O.W. 2	0.153000	
		H.O.W. 3	0.155000	
		Sum Loss # 1 + H.O.W. 1	0.219346	
		Sum Loss # 2 + H.O.W. 2	0.218702	
		Sum Loss # 3 + H.O.W. 3	0.219323	
		Sum 1 - Sum 2	0.000644	
		Sum 1 - Sum 3	0.000024	
		Sum 2 - Sum 3	-0.000620	
		Absolute Sum Differences	0.0012875178450736	

Existing (2-RBCs) Losses

		V	k or L	Loss	
Q1	1.458233	2.673618	0.18	Q1 45 Elbow	0.01997954
Q2	1.281767	2.673618	0.5	Q1 Wye	0.055498723
Qt	2.74	2.673618	5	Q1 10" pipe	0.016396902
		2.673618	0.3	Q1 Gate Valve	0.033299234
		2.673618	1	Q1 Exit	0.110997446
		2.350076	0.3	Q2 thru Wye	0.025727585
		2.350076	35	Q2 10" pipe	0.090412245
		2.350076	0.5	Q2 Wye	0.042879308
		2.350076	0.18	Q2 45 Elbow	0.015436551
		2.350076	0.3	Q2 Gate Valve	0.025727585
		2.350076	1	Q2 Exit	0.085758616

Proposed (3-RBCs) Losses 10" Inlet Piping

		V	k or L	Loss
Q1	1.593941	2.922435	0.5	Q1 Wye
Q2	1.131191	2.922435	0.18	Q1 45 Elbow
Q3	1.004868	2.922435	0.3	Q1 Gate Valve
Qt	3.73	2.922435	5	Q1 10" pipe
		2.922435	1	Q1 Exit
		3.916389	0.3	Q2/Q3 thru Wye
		3.916389	30	Q2/Q3 10" pipe
		2.073998	0.5	Q2 Wye
		2.073998	0.18	Q2 45 Elbow
		2.073998	0.3	Q2 Gate Valve
		2.073998	5	Q2 10" pipe
		2.073998	1	Q2 Exit
		3.916389	0.3	Q2/Q3 thru Wye
		3.916389	30	Q2/Q3 10" pipe
		1.842391	0.3	Q3 thru Wye
		1.842391	35	Q3 10" pipe
		1.842391	0.5	Q3 Wye
		1.842391	0.18	Q3 45 Elbow
		1.842391	0.3	Q3 Gate Valve
		1.842391	1	Q3 Exit

C 120

Lookup Array

Q	H.O.W.
0.208502	0.1
0.211616	0.101
0.214744	0.102
0.217888	0.103
0.221047	0.104
0.22422	0.105
0.227408	0.106
0.23061	0.107
0.233827	0.108
0.237058	0.109
0.240303	0.11
0.243563	0.111
0.246837	0.112
0.250125	0.113

Sum Loss # 1	0.318720077	0.082548
Sum Loss # 2	0.349720134	0.063778
Delta H Sum Loss	0.031000057	
H.O.W. 1	0.372	
H.O.W.2	0.341	
Sum Loss # 1 + H.O.W. 1	0.690720077	
Sum Loss # 2 + H.O.W. 2	0.690720134	
Delta H Total	5.67127E-08	

Additional Assumed Basin Loss
approximate 0.875" @ 1.37 cfs proportional to Q^2/2g

Sum Loss # 1
Sum Loss # 2
Sum Loss # 3
H.O.W. 1
H.O.W. 2
H.O.W. 3
Sum Loss # 1 + H.O.W. 1
Sum Loss # 2 + H.O.W. 2

		Proposed (3-RBCs) Losses 10" Inlet Piping				Proposed (
		V	k or L	Loss		V
Q1	1.593941	2.922435	0.5	Q1 Wye	0.066309207	2.922435
Q2	1.131191	2.922435	0.18	Q1 45 Elbow	0.023871314	2.922435
Q3	1.004868	2.922435	0.3	Q1 Gate Valve	0.039785524	2.922435
Qt	3.73	2.922435	5	Q1 10" pipe	0.019331067	2.922435
		2.922435	1	Q1 Exit	0.132618414	2.922435
		3.916389	0.3	Q2/Q3 thru Wye	0.071450801	3.916389
		3.916389	30	Q2/Q3 10" pipe	0.199350781	3.916389
		2.073998	0.5	Q2 Wye	0.033396497	2.073998
		2.073998	0.18	Q2 45 Elbow	0.012022739	2.073998
		2.073998	0.3	Q2 Gate Valve	0.020037898	2.073998
		2.073998	5	Q2 10" pipe	0.010249988	2.073998
		2.073998	1	Q2 Exit	0.066792994	2.073998
		3.916389	0.3	Q2/Q3 thru Wye	0.071450801	3.916389
		3.916389	30	Q2/Q3 10" pipe	0.199350781	3.916389
		1.842391	0.3	Q3 thru Wye	0.015812445	1.842391
		1.842391	35	Q3 10" pipe	0.057634464	
		1.842391	0.5	Q3 Wye	0.026354075	1.842391
		1.842391	0.18	Q3 45 Elbow	0.009487467	1.279438
		1.842391	0.3	Q3 Gate Valve	0.015812445	1.279438
		1.842391	1	Q3 Exit	0.05270815	1.279438
						1.279438
						1.279438
						1.279438

Additional Assumed Basin Loss

approximate 0.875" @ 1.37 cfs proportional to Q^2/2g

0.082548	Sum Loss # 1	0.38054316	0.098628
0.063778	Sum Loss # 2	0.462975305	0.049674
	Sum Loss # 3	0.487809408	0.039199
	H.O.W. 1	0.396000	
	H.O.W. 2	0.313000	
	H.O.W. 3	0.289000	
	Sum Loss # 1 + H.O.W. 1	0.776543	
	Sum Loss # 2 + H.O.W. 2	0.775975	
	Sum Loss # 3 + H.O.W. 3	0.776809	
	Sum 1 - Sum 2	0.000568	
	Sum 1 - Sum 3	-0.000266	
	Sum 2 - Sum 3	-0.000834	
	Absolute Sum Differences	0.001668	

		Proposed (3-RBCs) Losses 10" Inlet Piping				Proposed (3-RBCs) Losses 12" Inlet Piping				
		V	k or L	Loss		V	k or L	Loss		
Q1	1.55664	2.854044	0.5	Q1 Wye	0.063241995	2.854044	0.5	Q1 Wye	0.063241995	
Q2	1.067429	2.854044	0.18	Q1 45 Elbow	0.022767118	2.854044	0.18	Q1 45 Elbow	0.022767118	
Q3	1.105931	2.854044	0.3	Q1 Gate Valve	0.037945197	2.854044	0.3	Q1 Gate Valve	0.037945197	
Qt	3.73	2.854044	5	Q1 10" pipe	0.01850249	2.854044	5	Q1 10" pipe	0.01850249	
		2.854044	1	Q1 Exit	0.126483989	2.854044	1	Q1 Exit	0.126483989	
		3.98478	0.3	Q2/Q3 thru Wye	0.073968033	3.98478	0.3	Q2/Q3 thru Wye	0.073968033	
		3.98478	30	Q2/Q3 10" pipe	0.20583875	3.98478	30	Q2/Q3 10" pipe	0.205838754	
		1.957093	0.5	Q2 Wye	0.029737692	1.957093	0.5	Q2 Wye	0.029737692	
		1.957093	0.18	Q2 45 Elbow	0.010705569	1.957093	0.18	Q2 45 Elbow	0.010705569	
		1.957093	0.3	Q2 Gate Valve	0.017842615	1.957093	0.3	Q2 Gate Valve	0.017842615	
		1.957093	5	Q2 10" pipe	0.009206811	1.957093	5	Q2 10" pipe	0.009206812	
		1.957093	1	Q2 Exit	0.059475385	1.957093	1	Q2 Exit	0.059475385	
		3.98478	0.3	Q2/Q3 thru Wye	0.073968033	3.98478	0.3	Q2/Q3 thru Wye	0.073968033	
		3.98478	30	Q2/Q3 10" pipe	0.20583875	3.98478	30	Q2/Q3 10" pipe	0.205838754	
		2.027686	0.3	Q3 thru Wye	0.019153008	2.027686	0.3	Q3 thru Wye	0.019153008	
		2.027686	35	Q3 10" pipe	0.068814092			Q3 10x12 Increaser		
		2.027686	0.5	Q3 Wye	0.031921681	2.027686		V1	0.008263676	
		2.027686	0.18	Q3 45 Elbow	0.011491805	1.408116		V2		
		2.027686	0.3	Q3 Gate Valve	0.019153008	1.408116	35	Q3 12" pipe	0.028341382	
		2.027686	1	Q3 Exit	0.063843361	1.408116	0.5	Q3 12" Wye	0.015394329	
						1.408116	0.18	Q3 45 Elbow (12")	0.005541958	
						1.408116	0.3	Q3 Gate Valve (12")	0.009236597	
Additional Assumed Basin Loss						1.408116	1	Q3 Exit	0.030788658	
approximate 0.875" @ 1.37 cfs proportional to Q^2/2g										
0.00906				Sum Loss # 1	0.363006283	0.094065		Sum Loss # 1	0.363006283	0.094065
0.007753				Sum Loss # 2	0.451006395	0.044232		Sum Loss # 2	0.451006399	0.044232
				Sum Loss # 3	0.541663719	0.04748		Sum Loss # 3	0.444006377	0.04748
				H.O.W. 1	0.389000			H.O.W. 1	0.389000	
				H.O.W. 2	0.301000			H.O.W. 2	0.301000	
				H.O.W. 3	0.308000			H.O.W. 3	0.308000	
				Sum Loss # 1 + H.O.W. 1	0.752006			Sum Loss # 1 + H.O.W. 1	0.752006	
				Sum Loss # 2 + H.O.W. 2	0.752006			Sum Loss # 2 + H.O.W. 2	0.752006	
				Sum Loss # 3 + H.O.W. 3	0.849664			Sum Loss # 3 + H.O.W. 3	0.752006	
				Sum 1 - Sum 2	0.000000			Sum 1 - Sum 2	0.000000	
				Sum 1 - Sum 3	-0.097657			Sum 1 - Sum 3	0.000000	
				Sum 2 - Sum 3	-0.097657			Sum 2 - Sum 3	0.000000	
				Absolute Sum Differences	0.195315			Absolute Sum Differences	0.0000002321380574	

June 16, 2003

City of Eagle Grove
210 E. Broadway Street
P.O. Box 165
Eagle Grove, IA 50533-0165

Attn: Ryan Heiar, City Administrator

RE: Variance Requests - Wastewater Treatment Plant Improvements

Dear Mr. Heiar:

The Iowa Department of Natural Resources, in accordance with subrule 567 IAC 64.2(9), has denied the variances requested by the City and your consulting engineer in letters dated May 14, 2003. Variances from four sections of the Iowa Wastewater Facilities Design Standards were requested, three of which pertain to flow splitting and one that concerns scum removal.

<u>Flow Splitting</u>

Design Standards 14.4.9.2 and 14.4.9.3 require a central collection and distribution point with flow division control that is measurable and adjustable prior to duplicate unit processes. Design Standard 18A.7.4.5 requires even division of flow among all trains and provisions for measurement of flow to each train for Rotating Biological Contactors (RBCs).

The proposed means of flow splitting to the RBCs at the Eagle Grove treatment plant does not meet these requirements. The arrangement includes effluent weirs at the end of each RBC train for level control and submerged inlet piping connected to a common manifold. The actual flow split would depend on variable head losses that will fluctuate with the total flow rate. The flow split could also be affected by variable head loss that would occur through each RBC train due to differences in biomass accumulation on the RBCs themselves.

In evaluating these variance requests, the Department considered the justifications presented in the aforementioned letters, hydraulic calculations for predicted flow splits and previous correspondence regarding the issue. The following is a summary of our responses to items noted by the City and Kuehl & Payer:

(1) *The existing arrangement has been in use for over 20 years with no reported problems due to uneven flow splitting.*

We do not dispute this. However, any difference in effluent quality due to proportional flow splitting or lack thereof is impossible to quantify without individual monitoring of effluent characteristics from each RBC train. Also, the addition of a third unit at future design flows will increase maldistribution between the RBC trains.

(2) *Measurements taken at the existing maximum flow through each RBC train found identical water levels, thus indicating an even flow split with the current piping arrangement.*

It appears questionable whether or not the accuracy of the measurements obtained is sufficient to confirm or dispute calculated flow splits. The expected water level difference for the existing units at a total plant flow of 1.77 MGD is only 0.4", assuming that the effluent weirs are set at the same elevation. The observed levels show a negative head loss of ¼" between Stage 1 and Stage 2, which is not possible and indicates and error of at least ± ¼".

(3) *The above observation indicates that loss through the RBC units themselves dampens the effect of differential head loss between the RBC trains attributable to the manifold piping arrangement.*

We agree that head loss through the RBC units could cause a more proportional flow split by effectively throttling the flow. However, the head loss through the units would have to be much higher than the measured 7/8" loss to have a significant effect.

(4) *At high flows (when the difference in flow between the units will be the largest) the influent characteristics are so low that a small difference in flows to each unit should not make a difference.*

NPDES permit limitations for mass and minimum percent removals will still require significant treatment regardless of how dilute the influent concentrations are. Also, the proposed arrangement is expected to cause significant maldistribution even at average dry weather flows.

(5) As an alternative to a flow splitting structure, an increase in the size of the proposed inlet piping/valve to the third unit was previously suggested. While this modification would create a nearly even flow split between the second and third RBC trains, the first train would still receive approximately 10% more flow than the other units throughout the design flow range.

In view of these considerations, we will require positive flow splitting prior to the RBC units. The City's engineer should verify that sufficient hydraulic head is available for installation of a splitter box.

Scum Removal

Design Standard 16.4.1 requires that scum collection and removal facilities be provided for all primary and final settling tanks. The existing final clarifiers at this facility do not have scum collection and removal equipment. The proposed arrangement would not include scum removal equipment for the new final clarifier.

The primary justification presented for this variance request is that effluent TSS violations for the existing plant have been infrequent and will decrease with the additional clarifier area provided. From the data available, we found it impossible to discern what TSS violations or what percentage of historical effluent TSS may have been attributable to the lack of scum removal in the existing final clarifiers, if any. However, effluent data from January 1987 to the present was reviewed. During this time period the facility has experienced 23 months where 30-day average and/or 7-day average TSS violations occurred. Of the 23 months when violations occurred, over half corresponded to clarifier hydraulic loading rates below typical average design rates for settling following the RBC process. This indicates that a major portion of the facility's past TSS violations have been caused by factors other than excessive hydraulic loading on the final clarifiers.

We will require that scum collection and removal equipment be included for the new final clarifier. If TSS violations continue to occur following the improvements, it may be necessary to retrofit skimming equipment in the existing final clarifiers. We recommend that skimming equipment be retrofit in the existing final clarifiers regardless of effluent TSS performance. This provides a means of reliability if scum removal equipment in either of the primary clarifiers should fail to operate properly or need to be removed for maintenance/repair.

If there are any questions, please contact Larry Bryant at 515/281-8847.

Sincerely,

Jack Riessen, P.E., Chief
Water Quality Bureau

c: Neal Kuehl, P.E./Kuehl & Payer, Ltd.
Field Office 2

KUEHL AND PAYER, LTD.
CONSULTING ENGINEERS
AND LAND SURVEYORS
MANAGEMENT CONSULTANTS

Robert F. Payer, P.E.
Neal R. Kuehl, P.E.
Ivan D. Droessler, P.E.
J. Scott Shevel, P.L.S.
Donald D. Etler, P.E.
Curtis R. Wiseman, P.E.
Tom W. G. Edgerton, P.L.S.

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May 14, 2003

Larry Bryant
Project Manager, Wastewater Section,
Iowa Department of Natural Resources
Wallace State Office Building
Des Moines, IA 50319

Re: Request for Variance
City of Eagle Grove
Wastewater Treatment Plant Improvements

Dear Larry,

We understand that two (2) areas in the plans and specifications for the Eagle Grove wastewater treatment plant improvements do not meet the intent of rules and regulations governing wastewater treatment plant construction. This letter is a discussion of those two (2) items and a request that these two (2) items be considered for a variance to the rules and regulations.

1. RBC Flow Splitting

The existing RBC wastewater treatment plant was constructed in 1975 – 76 under rules and regulations that existing at that time. Flow splitting was certainly a consideration but not as the rules now require. The two (2) prints attached show the influent piping to the RBC units and the effluent weirs that exist on the effluent end of the RBC units. The influent piping is under the west end of the building which is the control portion of the building. Fittings and valves for the influent to each existing RBC unit are in a pits that are covered with grating. The effluent weir is an adjustable weir 24" wide weir at the end of each RBC train. The original designer apparently intended the effluent weir to control the flow through the RBC units. We believe that that occurs. Actual measurements bear this out.

Measurements were taken this morning (5/14/03) on the existing two (2) RBC trains. Because of recent rains, flows are at the maximum that the existing units can handle. The flow through the RBC units is at 1.773 MGD. The plant operator measured the

☑ 1725 N. Lake Ave., P.O. Box 458, Storm Lake, IA 50588 Phone 712.732.7745 or 866.732.7745
☐ 1609 US Hwy. 18 E., P.O. Box 715, Algona, IA 50511-0715 Phone 515.295.2980 or 866.295.2980
☐ 423 West Main, Sac City, IA 5058[illegible] Phone 712.662.7859 Fax 712.662.7038

level in each of the six RBC basins and found no detectable difference between the levels in the respective stages for either RBC train. There was a head loss as the flow passes through the units but the water level was equal in each stage for both trains. Actual measurements were:

ΔH basin = 7/8"

Stage 1 – 7 1/2" down from the deck – Both trains
Stage 2 – 7 1/4" down from the deck – Both trains
Stage 3 – 8 3/8" down from the deck – Both trains

Negative Headloss?

H.O.W.?

The measurements were affected by some surface turbulence caused by the turning of the RBC shafts and flow of water through the units but the measurements were taken as accurately as possible. The 1.773 MGD represents 0.89 MGD through each train. This is more that the 0.80 MGD (2.411 MGD/3) anticipated through each train from the AWWF accepted for the plant design with three (3) RBC trains.

As the flow enters the RBC building, headloss occurs in the main run of piping and in the influent piping to each unit. Assuming that the flow is split equally the head loss from the tee in the mainline piping to each RBC will be the same. With the 2.411 MGD AWWF the following flows, velocities and head losses will theoretically occur in the main line piping:

	Flow, MGD	Velocity, fps	Unit Head Loss	Total HL, in.
RBC Train #1 to Train #2	1.6073	4.54	8.7 '/1,000'	2.19
RBC Train #2 to Train #3	0.8037	2.27	2.41 '/1,000'	0.72
Total				2.91

Doing this same calculation for flows that are being experienced as we speak, the following would apply:

	Flow, MGD	Velocity, fps	Unit Head Loss	Total HL, in.
RBC Train #1 to Train #2	0.8865	2.50	2.95 '/1,000'	0.75
Total				0.75

Theoretically, therefore, we should be experiencing a difference in water level between RBC train #1 and RBC train #2 of ¾" with today's flows. We are not and I believe that is related to the headloss in the RBC basins as the water pushes through the units. This is shown by the difference in water level as the flow passes from stage to stage. This would be a very hard calculation to make and it would relate to how dirty the RBC units are and the headloss as the flow goes from one unit to the other. The calculations above show that there will be more of a theoretical headloss with the increased flows. However, I believe that, if there is a difference at all, it will be less than shown by theoretical calculations due to the headloss through the units themselves. In other words, the RBC units impact the influent flows and tend to level out the impact of the pipe friction loss. I would not say that there will be no difference but I believe the difference to be insignificant.

Finally, when the flows are at AWWF, the concentrations of influent characteristics is so low that a small difference in flows to each unit should not make a difference. With the high flows last week, the operator informs me that influent $CBOD_5$ was at 30 mg/l. That was before the water passed through the primary clarifiers. RBC influent was not measured.

If flow splitting is required a splitter box will need to be constructed west of the existing control building and piping brought into the box and directed to each RBC train individually. The floor will need to excavated in the former chlorine room as well as the existing control room to make the pipe connections. As the project is designed only the control room floor will need to be excavated. A sketch of the proposed splitter box and piping is attached.

In summary, flows are being split equally now even with flows above the AWWF design numbers for the RBC additions. We acknowledge that increased flows through the influent piping could increase influent pipe headloss but we believe that headloss through the RBC units themselves help to self regulate the flow. This is happening now and we believe it will continue with the new flows. Even with a slight variation in flow, we do not believe that a difference will be detectable in effluent characteristics from each RBC train under AWWF conditions. We request the existing effluent weir system be allowed to regulate flows through the RBC units.

2. Scum Skimmer

The Eagle Grove Wastewater Treatment Plant has two (2) existing final clarifiers neither of which have mechanical scum skimmers. The plans for construction of the plant shows that a scum skimmer was included in the plans for the one (1) clarifier that was built during the 1975 – 76 construction. Neither operator nor other City personnel know whether or not the scum skimmer was deleted from the construction contract during construction or removed later. The operator that was present during that construction is not available to ask. The older clarifier is believed to never have had a scum skimmer.

should be able to tell if there is an abandoned scum discharge line to the clarifier

The plant operates without scum skimmers on the existing final clarifiers with minimal effluent TSS violations. The RBC process yields well digested sludge that settles readily and is removed from the clarifiers routinely. Sludge discharge valves are normally left open slightly to affect a continuous return of water from the bottom of the clarifiers which effectively removes the accumulated sludge on a continuous basis. This is not separately measured at the present time but will be with the new plant improvements.

A chart is attached which shows effluent TSS for the years 2001 and 2002. The maximum permit amount was exceeded only once during this period and the average TSS was reported at 31 mg/l in March of 2001 – 1 mg/l above the average permit average. All other times, the TSS was well below the average and maximum permit levels and it is assumed that with a third clarifier this will continue and even get better. It is unknown what caused the two (2) values to be above permit allowances however, we do not believe that the lack of scum skimmers caused the problem. TSS values for the month previous and the month following each event were well below the permitted values. A more logical conclusion would be that an upset occurred that may or may not have been corrected with a scum skimmer.

Even with a scum skimmer on the new unit, the existing units will not have skimmers. In order to add skimmers to the existing units, the entire sludge removal mechanisms would have to be replaced. Those units are operating well now and replacement of those mechanisms would be cost prohibitive.

The value for the scum skimmer including the scum discharge piping is approximately $4,000 which the City could save if the a variance is allowed to delete the scum skimmer from the contract. The City respectfully requests that this be considered.

This request has been discussed with the City of Eagle Grove and they request that both variances be approved. If you have any questions about either of these issues, please let me know.

Sincerely,

Kuehl & Payer, Ltd.

Neal R. Kuehl, P.E.

nk

cc: City of Eagle Grove

CITY OF EAGLE GROVE
210 East Broadway
P.O. Box 165
Eagle Grove, Iowa 50533
Phone 448-4343

Eagle Grove
IOWA

MYRON AMDAHL
Mayor
RYAN HEIAR
City Administrator

May 14, 2003

Larry Bryant
Project Manager, Wastewater Section,
Iowa Department of Natural Resources
Wallace State Office Building
Des Moines, IA 50319

Re: Wastewater Treatment Plant Improvements
Eagle Grove, IA

Dear Larry,

Neal Kuehl of Kuehl & Payer, Ltd. has explained to our City Council two (2) concerns that you have regarding our treatment plant as they relate to rules and regulations set by IDNR with regard to the subject project. According to Mr. Kuehl, these areas are: 1) flow splitting to the RBC units and 2) scum skimming on the final clarifier. Both of these concerns are related to upgrades and improvements to a system that has been working for over 20 years. Our plant operator has not reported problems with the system as it now exists. In fact, even without the upgrades, very few violations have occurred at the wastewater treatment plant and we believe none have occurred because of the lack of influent flow splitting to the RBC's or scum skimming from the final clarifiers.

We understand that variances can be considered if they do not alter or diminish the treatment capabilities of the plant. The plant has been operating without influent RBC flow splitting and final clarifier scum skimming and we believe the new additions will enhance and not diminish the treatment capability of the plant. We respectfully request that you review and consider the request for variance proposal that Mr. Kuehl will be submitting on our behalf. In the end the City of Eagle Grove will respect your decision and is committed to following your requirements should the variance be denied.

According to Mr. Kuehl, the additional cost will be approximately $16,000 (to be added by Change Order if required) additional for the flow splitting and $4,000 (already included in the bid but can be saved if the skimmer is allowed to be removed) for the scum skimmer. We realize that this is not a lot of money on a $1.7 Million project but hope that the Department understands that it is a lot of money to the City.

If you desire further information or have other questions please do not hesitate to contact me. Thank you for your consideration.

Very truly yours,

Ryan C. Heiar
City Administrator

CC: Neal R. Kuehl, P.E., Kuehl & Payer, Ltd.

From: Neal Kuehl <kuehlnr@kpltd.com>
To: "'Larry Bryant'" <Larry.Bryant@dnr.state.ia.us>
Date: 5/2/03 10:48AM
Subject: RE: Eagle Grove Responses

Larry,

I do not believe that I can dispute your hydraulics for the RBC piping. It is a rather complicated set of calculations but I am sure that yours are as accurate as we can get.

I have provided a sketch and a take-off to Peterson Construction who will cost a splitter box set-up for me. I furnished the attached files for their use and they should have a price back to me today or early Monday. I will then contact you and we can see if it will be worthwhile presenting a change order for the City's consideration Monday night along with the construction contracts.

Kuehl & Payer, Ltd.
Phone: 712.732.7745
Fax: 712.732.6293
email: kuehlnr@kpltd.com
Web Site: www.kpltd.com

-----Original Message-----
From: Larry Bryant [mailto:Larry.Bryant@dnr.state.ia.us]
Sent: Thursday, May 01, 2003 4:57 PM
To: kuehlnr@kpltd.com
Subject: RE: Eagle Grove Responses

Neal,

5. Thanks.

7. This is a tough one. It's been awhile since I've performed this type of hydraulic calculation but I gave it a try. Assuming the piping layout as shown on the plans and that the RBC effluent weir elevations are set the same, I get the following splits at the 0.841 and 2.41 MGD design flows:

Incorrect - see revised calcs in variance requests

ADW	Head Above Effluent Weir (inches)
Unit # 1 = 0.55 cfs (42%)	2.30
Unit # 2 = 0.39 cfs (30%)	1.84
Unit # 3 = 0.36 cfs (28%)	1.73
AWW	
Unit # 1 = 2.00 cfs (54%)	5.55
Unit # 2 = 0.96 cfs (26%)	3.37
Unit # 3 = 0.77 cfs (21%)	2.89

I agree that the losses aren't that big, particularly between the 2nd and 3rd units, but at least in theory they have a pretty dramatic effect on the flow split. Although I haven't gone through the calculations for just the existing units, I would guess that they aren't getting even flow splits with the current arrangement.

A change to 12" piping/fitting/valves may help, but it becomes a tricky hydraulic balancing act to design the piping for a more even flow split and the lack of operational flexibility to adjust the flow split just in case the calcs prove wrong is a serious drawback. A revised piping arrangement could be considered in a variance request, but the hydraulic calculations would need to be submitted showing the estimated split at the ADW and AWW flows. The other considerations would be the estimated cost of installing an influent flow splitting box and whether or not headloss across the RBC basins themselves (due to buildup of biomass?) would be a factor.

Let me know if you do want to go ahead and request a variance in consideration of the above. Also, I can fax you my hydraulic calcs if you want. Like I said, it's been awhile and it's possible my calcs are wrong.

10. I agree that it doesn't make a whole lot of sense to have a baffle/skimmer on one out of three clarifiers. It's questionable whether or not the requirement can be waived simply because the originals were removed or not installed, though, even with only 2 TSS violations in the past couple of years. I'll process a variance request but would prefer to do it at the same time as the flow split request, if you do in fact decide to request variances on both issues.

Larry Bryant
IDNR Wastewater Section
Phone: 515/281-8847
Fax: 515/281-8895
larry.bryant@dnr.state.ia.us

>>> "Neal Kuehl" <kuehlnr@kpltd.com> 04/30/03 06:21AM >>>
Larry,

The following is a response the comments in you email shown below:

5. Copy of Schedule N attached as requested.

7. I understand your argument and would agree quickly if the existing piping were no so difficult to change. The existing RBC trains are fed by a header that goes under the Chlorine Room, lab, and control room. RBC train No. 1 tees off under the chlorine room and RBC train No. 2 tees off under the control room. A blind flange was left on the tee under the control room so we can connect to it and route it to RBC train No. 3. We will be removing some floor in the control room to connect to the blind flange. However, if we were to construct an influent splitter box, we would have to reconstruct the influent piping under both the chlorine room and the control room to the existing RBC

trains and relay it back a ways to the primary clarifier to get the head room for a splitter box. We also would have some clearance problems for existing pipes. This all could be done but would be quite expensive.

The head loss will be quite small to the 3rd RBC train at the ADW flow of 0.841 (0.280 to 3rd train). Velocity in the 10" pipe will be 0.8 fps, velocity head 0.01 feet, and head loss in the straight pipe of 0.35 feet/1,000 feet. At the AWWF of 2.411 (0.804 MGD to 3rd train), the values to the 3rd train will be velocity - 2.30 fps, velocity head - 0.08 feet and head loss in the straight pipe of 2.41 feet/1,000 feet. Since the two (2) existing trains also have bends and entrance losses to get the water into the units, the only additional head loss will be in the 30 feet of straight pipe or approximately 0.01 feet at ADW flow and 0.07 feet at AWWF.

I would offer the following solutions if you still believe this to be too much difference. 1st of all would be a variance that would recognize the difference. I believe the 0.01 head loss at ADW flows will be insignificant. Flows at the AWWF occur so infrequently and wastewater strength is so dilute that I also do not believe a noticeable difference will occur at these higher flows.

2nd solution would be to increase the size of the feed to the 3rd RBC train to 12". The velocity in the 30 feet would be reduced 1.58 fps and the head loss to 1.00 ft/1,000 feet or 0.03 feet total additional head loss in the straight pipe. We would need a reducer to get to the 12" size and 30 feet of 12" pipe, 12" wye, 12" 45°Bend, and 12" valve. We could make this change by Change Order if necessary.

I still believe that the difference is going to be so small that I on behalf of the City would request consideration of the variance if necessary.

10. Yes, the existing clarifier installed in 1975 did have a skimmer according to the plans. I don't know if it was removed or never installed in the first place. Neither of the two (2) existing clarifiers have skimmers. I went ahead and included a skimmer on the plans as they were bid so at the present time, there is a skimmer for the new clarifier. I don't know if it makes sense to have a skimmer on one (1) clarifier and not on the other two (2).

I reviewed the effluent records for the past two (2) years and have attached a spreadsheet with a graph that plots average and maximum TSS values against the permit average and maximums. There was only one (1) maximum violation and one (1)average violation during those 2 years.

As I indicated, there is a skimmer in the project at the present time. If a variance is appropriate, then we would remove it by Change Order. There would be time therefore to discuss this even after construction has started.

We have taken bids on the project and received what I believe to be excellent bids. Attached is a bid tabulation from that bid opening. We are planning to sign the construction contracts Monday night but will not issue the Notice to Proceed until you have issued the Construction Permit which I presume will come immediately after completion of the FONSI period. If there is any reason not to sign the construction contracts on Monday, please let me know.

Let me know if you have further questions or want to discuss these matter further.

Neal Kuehl

Kuehl & Payer, Ltd.
Phone: 712.732.7745
Fax: 712.732.6293
email: kuehlnr@kpltd.com
Web Site: www.kpltd.com

-----Original Message-----
From: Larry Bryant [mailto:Larry.Bryant@dnr.state.ia.us]
Sent: Tuesday, April 15, 2003 1:18 PM
To: kuehlnr@kpltd.com
Subject: Eagle Grove Responses

Neal,

I've looked over your April 8 letter. The only comments that remain issues to me are:

5. The Schedule N was missing. Could you please fax it or resend?

7. I agree that the flow could be split equally at a single flow point with the effluent weirs provided there is enough room for adjustment and that the elevations for the new/old RBCs are approximately the same. One could make the same argument for clarifier effluent weirs. However, I also think that when the influent flow is less than or greater than that weir set flow, the flow splits will become uneven. The reason is that the headloss between the primary clarifiers and each RBC will be different due to piping/fitting headloss (the new RBC will have the greatest headloss differential). If you set the effluent weirs to split equally to compensate for the different pipe/fitting headlosses (i.e. the weir elevation on the third unit slightly lower than the weir elevation on the 2nd unit and the elevation on the second unit slightly lower than the weir elevation on the 1st unit) at 2.41 MGD, the flow split won't be equal at 0.841 MGD or vice versa. I believe this is the reason why IA 14.4.9.2 requires that splitting be provided before each unit operation where duplicate units are provided.

10. The original design drawings we have (1975) show skimmers on the existing clarifiers. Perhaps the operator removed them because of freezing problems? To omit the skimmer on the new clarifier would require a variance. I can process it, but would probably need some more

information on the reasoning why it is not required besides the fact that the existing units are currently operating without. There are no precedents for this variance and scum going over the effluent weir and contributing to increased TSS in the effluent would be a DNR concern. A side question for variance consideration would be why and how well are the units operating without skimmers? A judgement on whether or not any TSS violations are attributable to the lack of scum removal would probably be a pretty tough call.

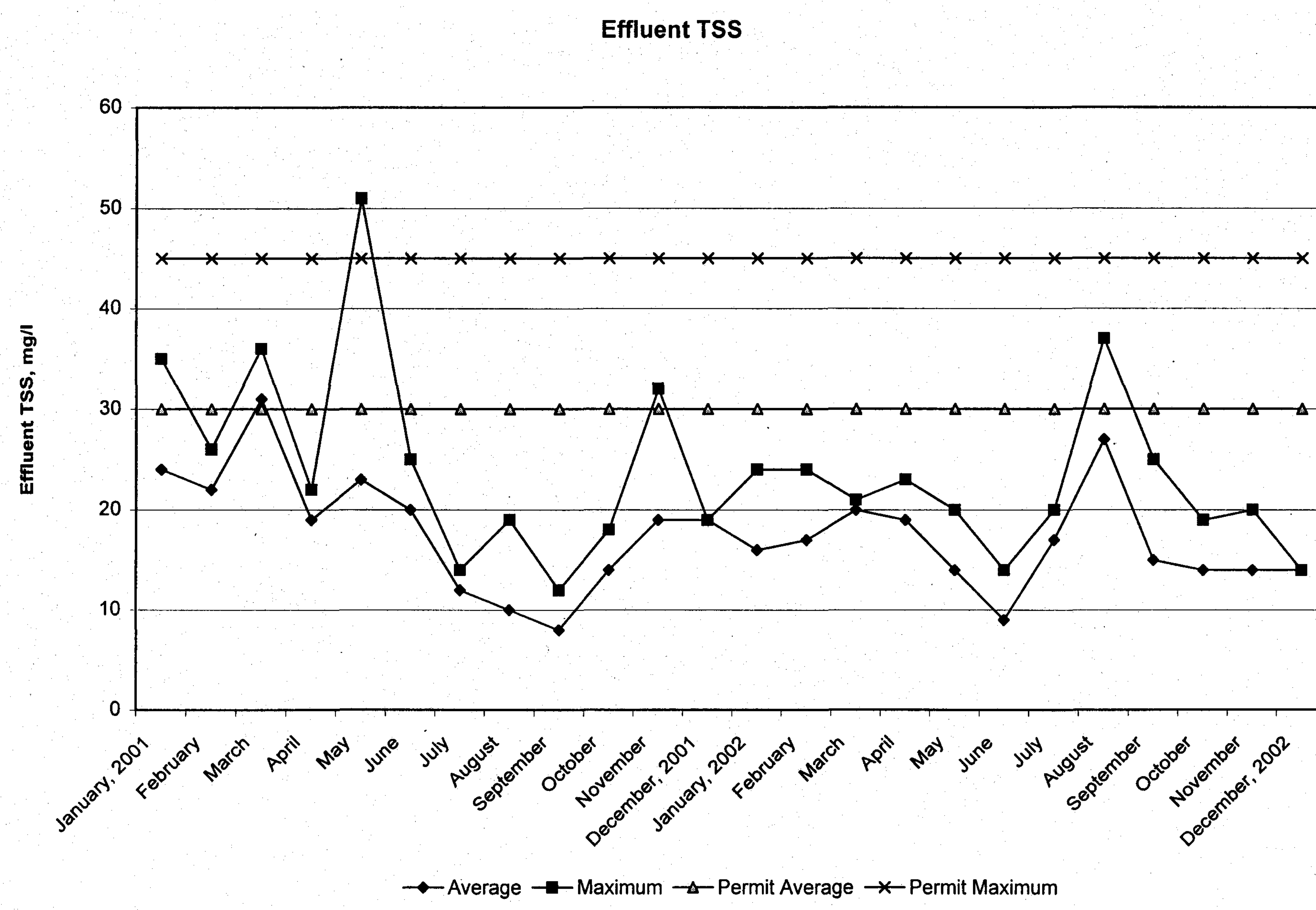
Give me a call or email back to discuss.

Larry Bryant
IDNR Wastewater Section
Phone: 515/281-8847
Fax: 515/281-8895
larry.bryant@dnr.state.ia.us

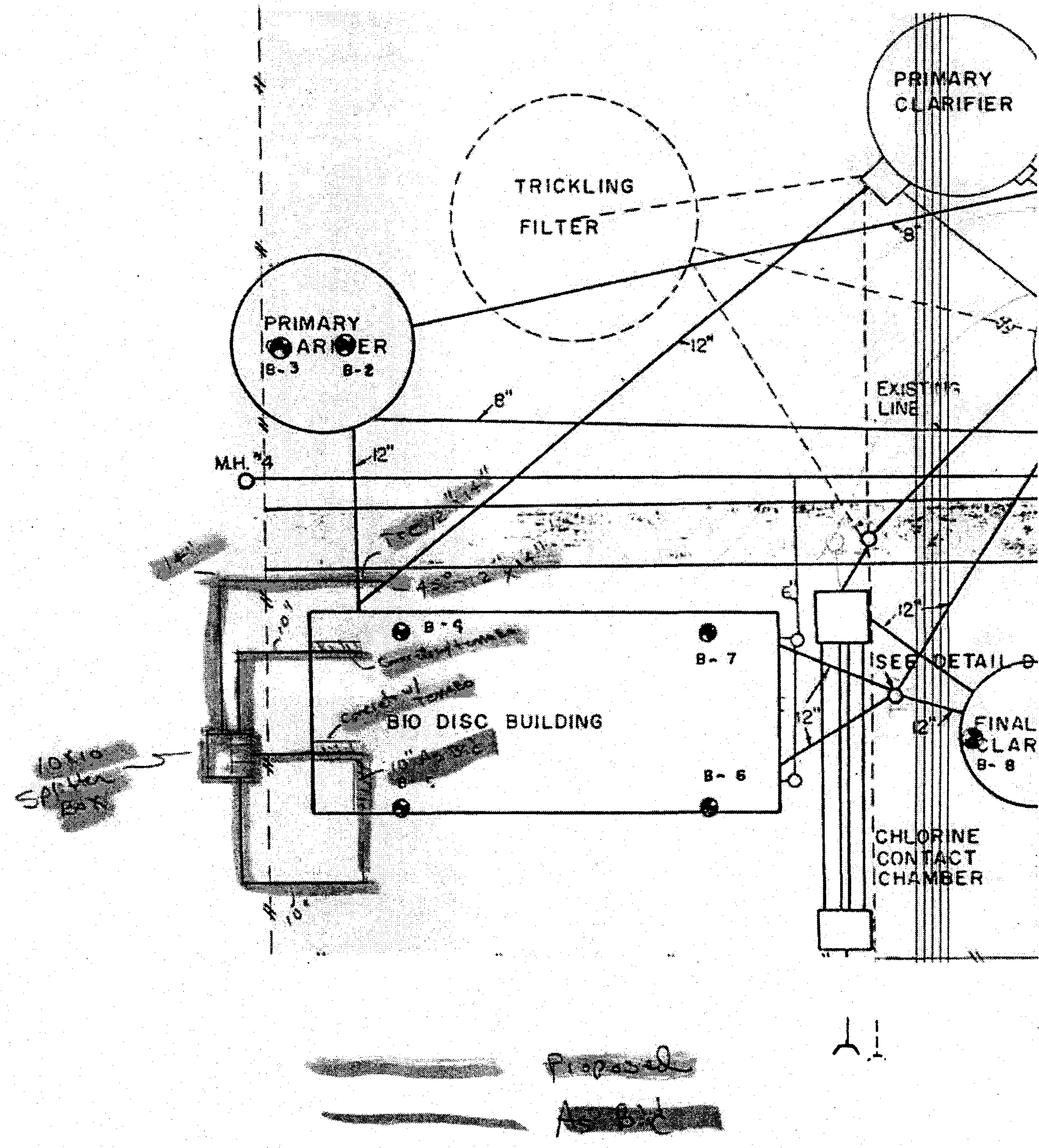
TSS, mg/l

EAGLE GROVE WWTP

	Average	Maximum	Permit Average	Permit Maximum
January, 2001	24	35	30	45
February	22	26	30	45
March	31	36	30	45
April	19	22	30	45
May	23	51	30	45
June	20	25	30	45
July	12	14	30	45
August	10	19	30	45
September	8	12	30	45
October	14	18	30	45
November	19	32	30	45
December, 2001	19	19	30	45
January, 2002	16	24	30	45
February	17	24	30	45
March	20	21	30	45
April	19	23	30	45
May	14	20	30	45
June	9	14	30	45
July	17	20	30	45
August	27	37	30	45
September	15	25	30	45
October	14	19	30	45
November	14	20	30	45
December, 2002	14	14	30	45



Effluent TSS
Effluent TSS, mg/l
60
50
40
30
20
10
0
January, 2001
February
March
April
May
June
July
August
September
October
November
December, 2001
January, 2002
February
March
April
May
June
July
August
September
October
November
December, 2002
Average
Maximum
Permit Average
Permit Maximum


PRIMARY CLARIFIER
TRICKLING FILTER
PRIMARY CLARIFIER
B-3
B-2
8"
12"
M.H. #4
EXISTING LINE
BIO DISC BUILDING
B-4
B-7
B-6
SEE DETAIL
FINAL
B-8
CHLORINE CONTACT CHAMBER
10x10 Splitter Box
Proposed
As-Built

KUEHL AND PAYER, LTD.
CONSULTING ENGINEERS
AND LAND SURVEYORS
MANAGEMENT CONSULTANTS

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April 8, 2003

Larry Bryant
Project Manager, Wastewater Section,
Iowa Department of Natural Resources
Wallace State Office Building
Des Moines, IA 50319

Re: Eagle Grove Wastewater Treatment Plant

Dear Larry,

The following are responses to your comments of March 27, 2003 concerning subject project.

1. We have added a direct connection to the pump station wet well and a parshall flow metering manhole as shown on the sketch attached to addendum No. 1. This will measure all return flows from the lagoon to the treatment plant and will keep those flows separate from the raw flows coming from the City until the pump station wet well. These return flows will not need to be screened and run through the screenings grinder since they are flows that have already passed through the equalization lagoon and will not contain solids.

2. The new solids grinder will be installed in the channel that currently contains a barminutor. The existing barminutor has a bypass channel containing a screen

3. There are two (2) existing screens located upstream of the existing barminutor which will be replaced with the screenings grinder. The first screen has 2" – 2 ½" openings and is in the open area upstream of the screenings building. The second screen has openings that are approximately 1" and is located in the screenings building.

4. The average daily and peak hourly flows were incorrectly stated in Section 11317 paragraph 2.02. The correct numbers are included in Addendum No. 1 attached hereto and include.
   a. Average Daily Flow 584 GPM
   b. Peak Hourly Flow 1,674 GPM

5. Schedule N has been completed and is attached hereto.
6. Ag Processing does not have an SBOD/BOD ratio significantly higher than residential. A physical/chemical pretreatment system at Ag Processing reduces the BOD significantly.

7. Each RBC has an effluent weir that controls the levels in the RBC units. They are therefore self leveling and will provide for equal splits.

8. Yes – dewatering is handled with bottom drains under each RBC unit.

9. Reverse rotation is available by reversing electrical leads.

10. Existing clarifiers do not include scum skimmers and we therefore did not include scum skimming capability for the new clarifier. We recognize that the scum baffles could accumulate scum that then would not be able to be removed. We therefore can either remove the scum baffles and leave the unit as the existing units are or we can add a scum removal skimmer. The City prefers that the new unit be operated as the existing units have been for 30 years or more. If a variance for operation as such is necessary, please accept this as a request for such variance. If this is not possible, then we will add a scum skimmer to the new clarifier. Please advise. We have proceeded to add a scum skimmer to the new unit by addendum but are hopeful that we can eliminate it later if a variance is approved.

11. Sludge is removed from the existing clarifiers by opening a valve and letting the sludge flow by gravity to the head end of the plant – no metering is in place. The City prefers to operate the new clarifier as the existing units have operated. Normally, the sludge valve is left open and recirculation takes place continuously. We understand the need for measuring this flow and have added a flow metering manhole for this purpose.

12. The 4,239 ft^3 is correct for what is called the primary digester on the plans. It will really operate as the secondary digester after the improvements are completed. This second digester will hold the same volume as the other digester, but it only has a variable volume of 4,239 ft^3 for sludge withdrawal to the sludge storage tank. For the sludge detention portion at the normal minimum water level, that which is normally not withdrawn, the volume available is approximately 9,000 ft^6 for a min. sludge detention time of 20 days with 10 additional days as the cover floats up.

13. It is anticipated that the new sludge storage tank will be constructed first and placed into operation. The "primary digester" with the floating cover is then installed and brought into operation. The contents of the "secondary digester" would then be transferred to the newly functional "primary digester". The "secondary digester" can then be removed from service and repaired. Other arrangements with the Contractor awarded the project may be considered if they provide continuous treatment or storage

for later treatment. The limitations and requirements for sludge storage and handling are being added by addendum prior to bidding.

In addition to the above comments and corrections, we have revised the specification document to include all of the requirements of the SRF program that you pointed out earlier. These were included in the bid documents that are being distributed to prospective bidders. A bid copy is included for your reference.

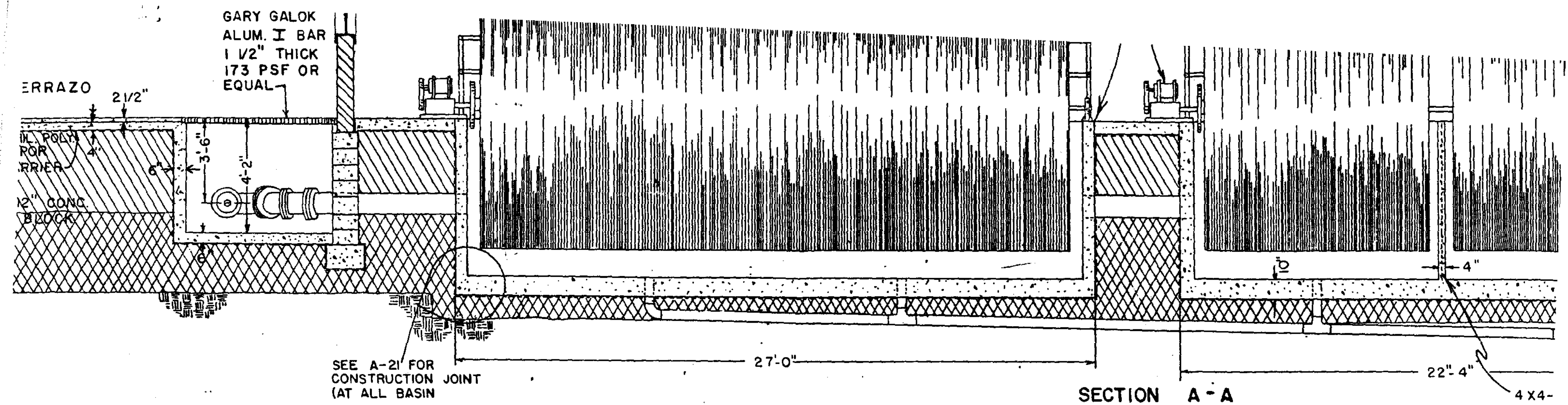
We hope that the above responds to your comments properly. Please let me know if you need anything else.

Sincerely,

Kuehl & Payer, Ltd.

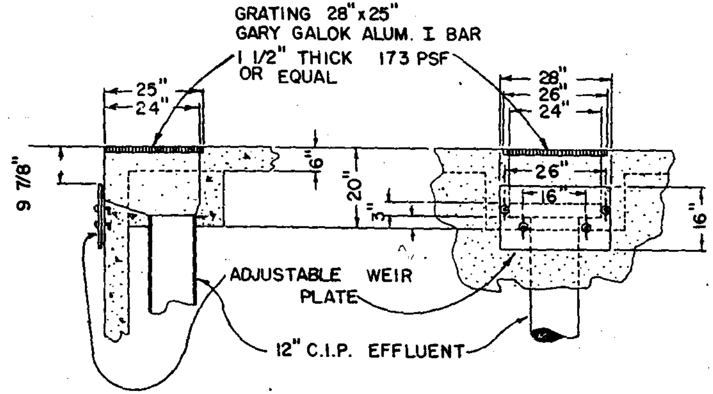
Neal R. Kuehl, P.E.

nk



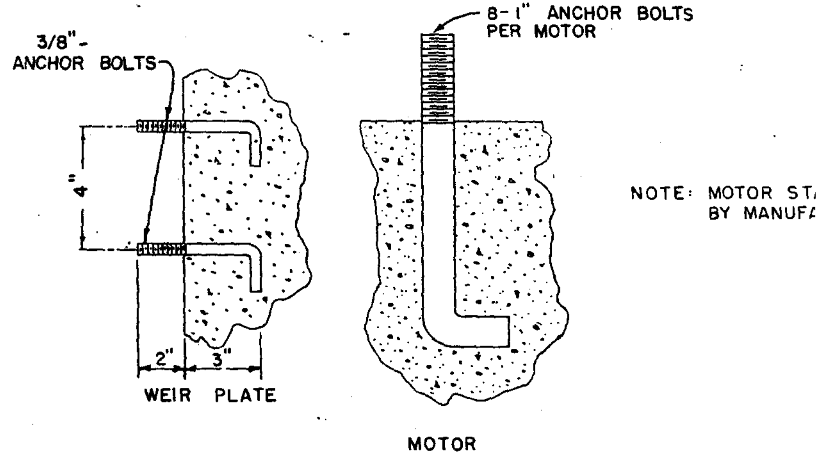
SECTION A-A

1/4" = 1'-0"



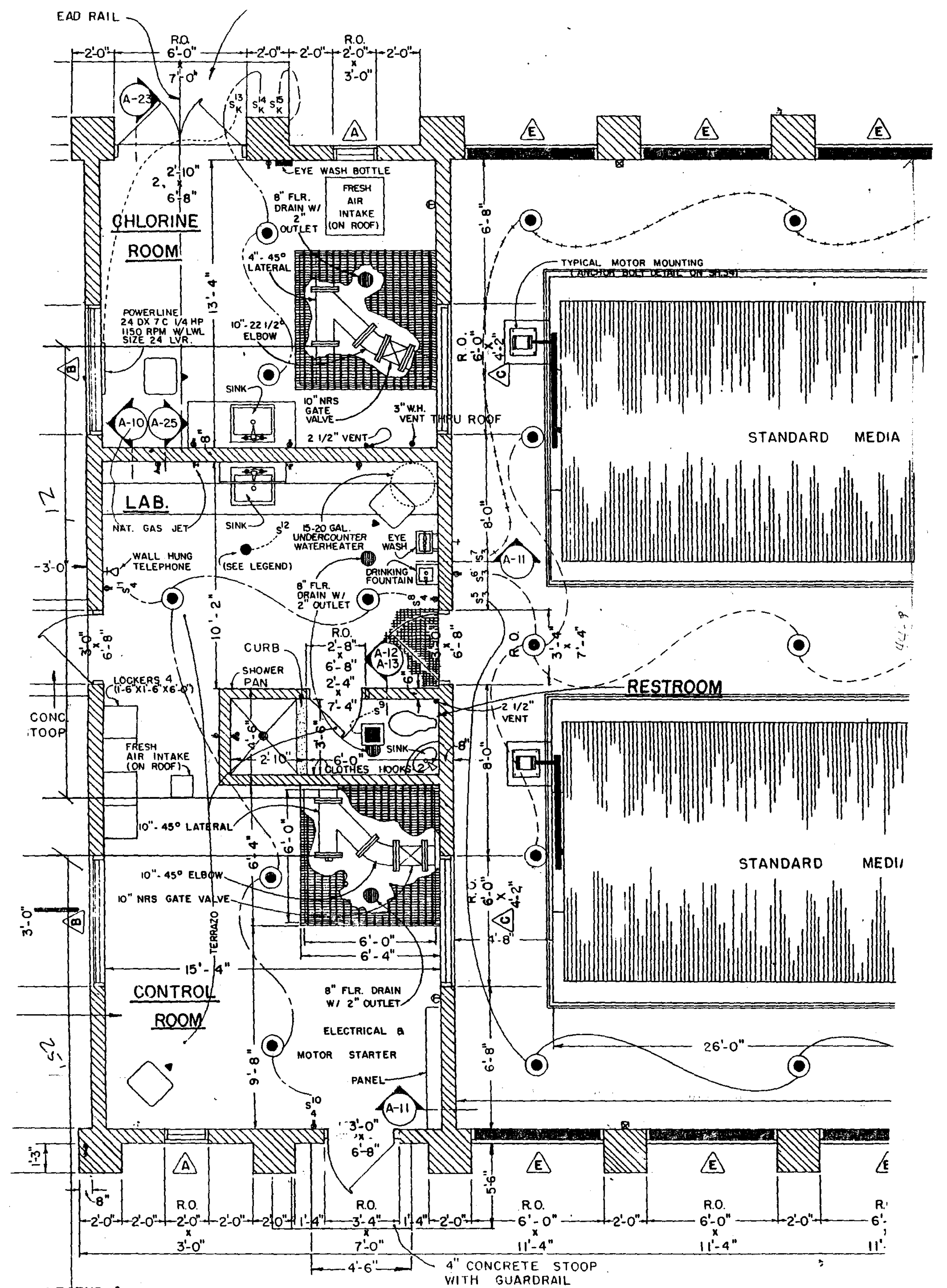
WEIR DETAILS

NO SCALE



ANCHOR BOLT DETAILS

NO SCALE



LEGEND :

- ● = 2 LAMP 40W FLOURESCENT FIXTURE (MOUNTED ABOVE SINK)
- ◉ = 400 W 277 V MERCURY VAPOR, G.E. FILTERGLOW C771G105 W/ LAMP H400A33-1
- ▬ = 250W 277V MERCURY VAPOR G.E. WL-250 WALLLIGHTER LUMINAIRE C730G010 W/ LAMP H250DX37-5
- ▣ = 100 W 120 V RESTROOM LIGHT/VENT FAN/HEATER COMBINATION NUTONE 9665, 5118 BTU.
- ... HEATER (10'-0" MOUNTING HEIGHT), CLG. HUNG

- S_K^{13} = 115 V KEYED
- S_K^{14}, S_K^{15} = 277V KEYED
- = HOSE
- Ⓣ = THERM
- Ⓐ = 2'-0" X FRAME