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August 7, 2018

VIA EMAIL

Kristi Minahan
Wisconsin Department of Natural Resources
P.O. Box 7921
Madison, WI 53707

RE: Municipal Environmental Group – Wastewater Division Comments on the Economic Impact Analysis for Bacteria Standards

Dear Ms. Minahan:

We are submitting these comments to the Wisconsin Department of Natural Resources (DNR) on behalf of the Municipal Environmental Group–Wastewater Division (MEG) with respect to the Economic Impact Analysis (EIA) for proposed revisions to bacteria standards. MEG is an organization of approximately 100 municipalities statewide who own and operate wastewater treatment plants. We greatly appreciate the opportunity to submit comments on the EIA.

The proposed rule revising bacteria standards will impose a change in monitoring requirements from fecal coliform to *E. coli* for many municipal wastewater treatment facilities across the state. For those facilities, the EIA states that the impact will be an increase in cost of $599 annually.

However, MEG members have estimated the cost for compliance with the proposed rule revisions significantly higher. A number of facilities have projected increased costs at approximately $4,800-$6,000 for the first year of compliance, which includes costs of additional equipment in the range of $500-$1,000. These members estimate approximately $4,100 in increased costs each year after that. These yearly increased costs include approximately $3,000 per year in chemical costs. This is a significant expense for smaller communities in particular. For communities that need to invest in additional monitoring equipment, the cost would be even higher.

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Furthermore, the Racine Wastewater Utility has completed a study attached to these comments as Exhibit A that concludes costs associated with the proposed changes to the bacteria standard could be significantly higher for facilities using UV disinfection. This facility estimates an annual cost increase of $64,000 due to electric expenses for higher intensity UV treatment to comply with the proposed *E. coli* limits. This cost would further increase if more restrictive phosphorus limits are imposed, as those limits would require the addition of extra chemical that contains iron compounds and would necessitate increased cleaning, maintenance, and replacement of UV bulbs.

MEG requests that DNR consider these costs in evaluating the impact of this proposed rule.

Best Regards,

Stafford Rosenbaum LLP

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Paul G. Kent

VDW/PGK:mai

Racine Wastewater Utility

Comments Regarding Proposed Bacteria Standard Rule Change

Summary of Proposed Rule Change

The Wisconsin Dept of Natural Resources (DNR) is proposing to proceed with a change in the state bacteria standard by replacing the indicator parameter fecal coliform with *Escherichia coli* (E. coli). The change is based on EPA recommendations released in 2012 as guidance for state regulators to develop water quality standards for recreational use waters. Recommendation 1 sets the E. coli numeric concentration threshold at a colony forming unit (CFU) geometric mean of 126 per 100 mL (likely based on EPA beach standards). Recommendation 2 sets the E. coli numeric concentration threshold at a CFU geometric mean of 100 per 100 mL. It was assumed that the Recommendation 1 limit value for E. coli is comparable to the current CFU limit for fecal coliform of 400 per 100 mL.

Background

The Racine Wastewater Utility (RWWU) is a conventional activated sludge plant with chemical phosphorus precipitation, anaerobic sludge digestion for primary and thickened secondary sludge, belt filter press dewatering, and ultraviolet disinfection of effluent. The design average flow is 36 mgd, with peak flow capacity of 300 mgd. Wet weather flows above 108 mgd are diverted to equalization basins for settling and hypochlorite disinfection prior to blending with plant effluent.

As a Lake Michigan discharger, the RWWU has been required to monitor bacteria standards daily for both fecal coliform and E. coli since April 2003. Racine's WPDES permit requires an effluent monthly geometric mean limit of 400 CFU/100 mL, with E. coli only being tested without a discharge limitation. Although, E. coli has not previously been regulated by a discharge limit, the RWWU strives to maintain a monthly geometric mean discharge below the 235 CFU/100 mL EPA single sample maximum beach standards.

The RWWU has consistently used the same DNR-approved fecal coliform and E. coli test methods, as follows:
Fecal coliform: SM 9222D-1997 membrane filtration with m-FC broth.
Escherichia coli: Idexx Colilert enzyme substrate coliform test.

Data Review

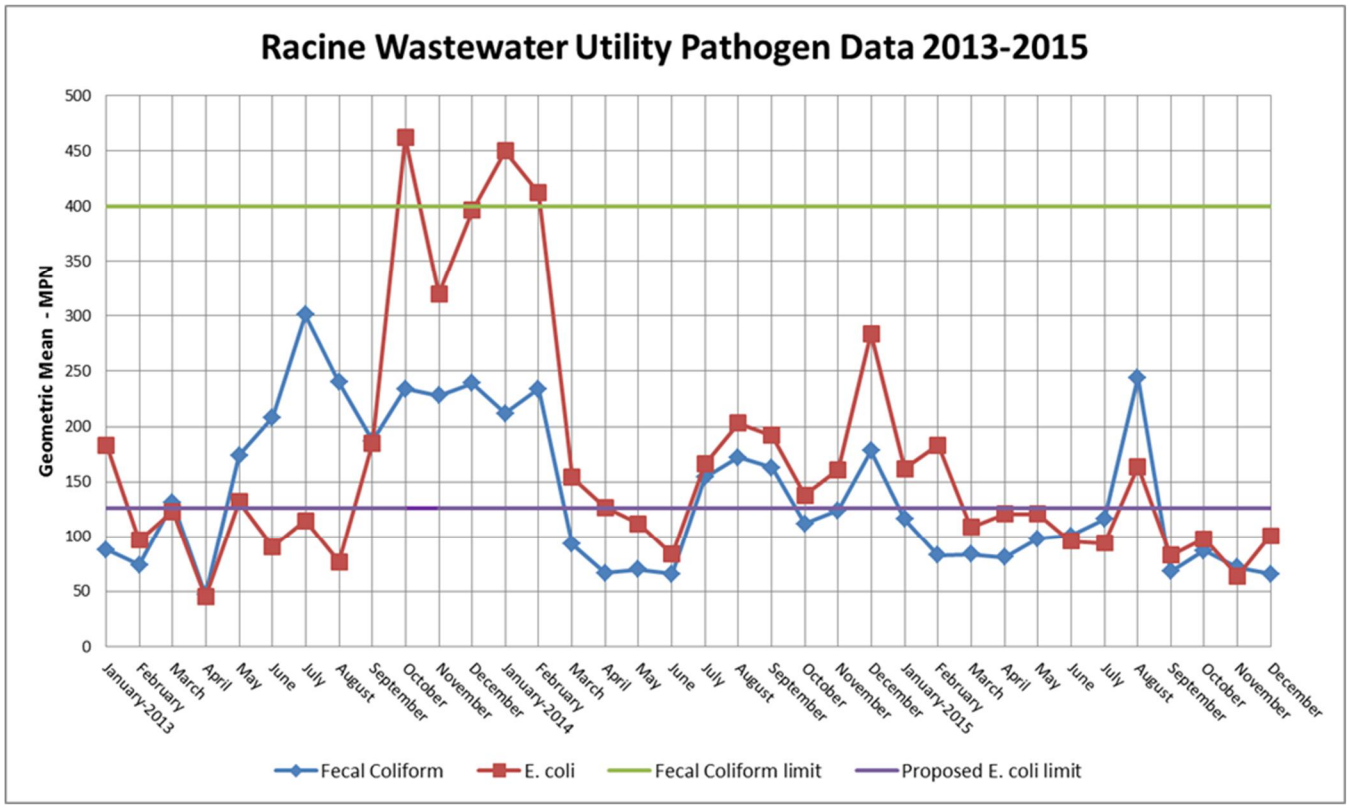
Table 1 provides RWWU state-certified lab test data for fecal coliform and E. coli monthly geometric mean from 2013 through 2015. This data is also graphically presented in Graph 1. As seen, the E. coli values exceed the fecal coliform values with an average of 170 CFU/100 mL to 139 CFU/100 mL for fecal coliform over this 3-year period using the test methods above. Thus, while the RWWU has maintained compliance with the fecal coliform 400 CFU/100 mL permit limit, the RWWU would not have met the proposed E. coli limit of 126 CFU/100 mL under the same operational characteristics over this time span. As E. coli is a subset of the fecal coliform group, intuitively it is not possible for E. coli to outnumber fecal coliform in the same sample.

EXHIBIT A

Table 1: Racine Wastewater Utility Bacteria Test Data 2013-2015

Geometric Mean	#/100 mL					
	Fecal Coliform	E. coli	Fecal Coliform limit	Proposed E. coli limit	Flow (MGD)	TSS (mg/l)
January-2013	88	183	400	126	17.28	6
February	74	97	400	126	20.44	5
March	131	123	400	126	28.94	7
April	47	45	400	126	47.40	7
May	174	132	400	126	21.06	5
June	208	91	400	126	31.28	6
July	301	115	400	126	20.52	6
August	240	77	400	126	13.91	4
September	187	185	400	126	12.24	9
October	234	462	400	126	12.73	5
November	228	320	400	126	14.15	6
December	239	396	400	126	12.41	7
January-2014	212	450	400	126	13.99	11
February	234	412	400	126	14.96	11
March	93	154	400	126	24.29	9
April	67	127	400	126	25.46	7
May	70	112	400	126	29.45	6
June	66	84	400	126	23.57	4
July	154	166	400	126	19.80	4
August	172	203	400	126	15.28	4
September	163	192	400	126	15.52	6
October	112	138	400	126	18.45	5
November	124	161	400	126	14.55	7
December	178	284	400	126	16.64	6
January-2015	116	162	400	126	14.57	5
February	83	183	400	126	12.79	6
March	84	109	400	126	21.66	5
April	81	121	400	126	26.63	6
May	98	121	400	126	22.63	5
June	101	96	400	126	19.05	4
July	116	94	400	126	14.95	4
August	244	164	400	126	13.82	8
September	68	83	400	126	14.86	8
October	87	98	400	126	12.67	5
November	72	64	400	126	19.28	5
December	66	101	400	126	28.18	4
AVERAGE	139	170				

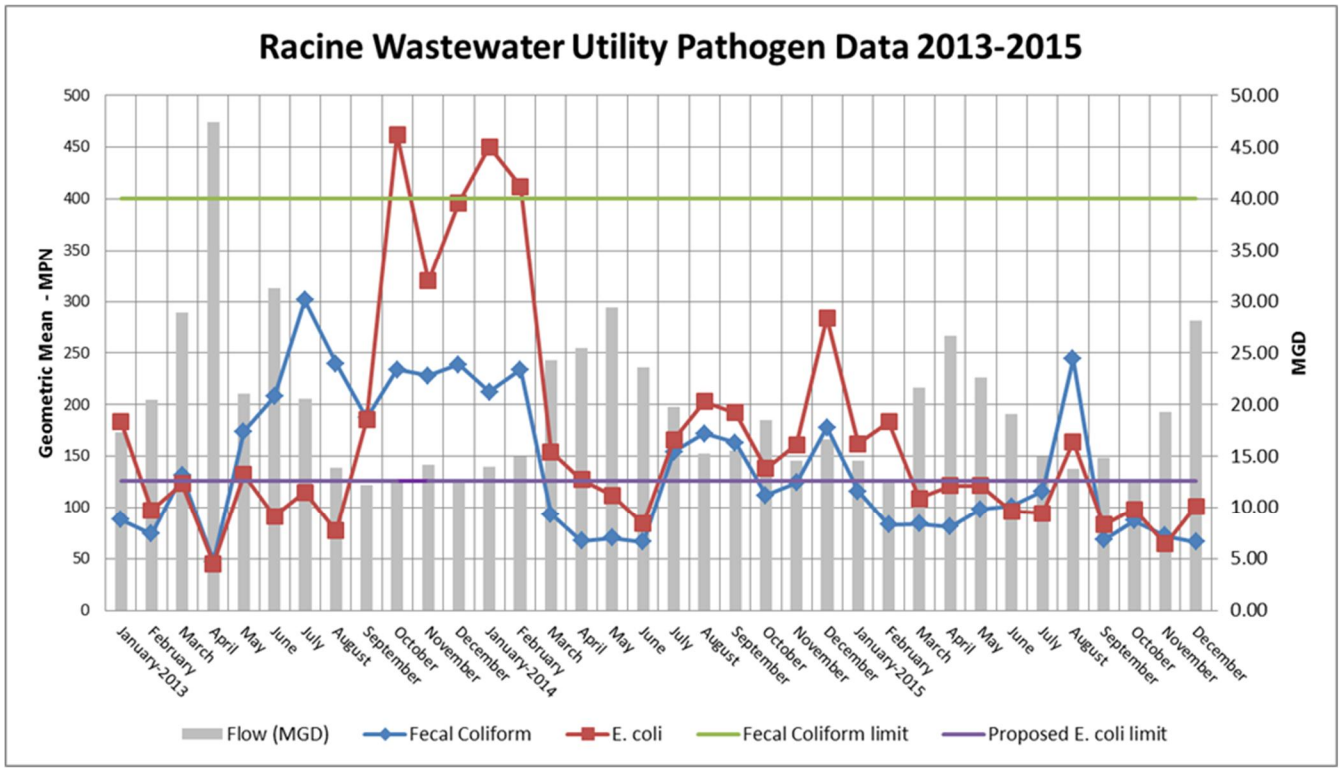
Graph 1: Racine Wastewater Utility Bacteria Test Data 2013-2015



The RWWU then reviewed operational and physical characteristics occurring during the same time span. Graph 2 shows the fecal coliform and E. coli test data plotted with monthly average flows from 2013 through 2015. As expected, both bacterial standards increased during periods of low flow and decreased during periods of high flow. Graph 3 adds the RWWU plant effluent monthly average TSS data to the fecal coliform and E. coli test data from 2013 to 2015. Solids can be a good indicator as bacteria can be shielded from disinfection treatment and remain viable. This is especially important for UV disinfection where UV transmittance efficiency may be decreased. The data shows this to be true, as both bacterial standards increased when TSS was highest, and decreased when TSS was lowest. Again, both bacterial standards responded similarly.

This review points to the E. coli test method used by RWWU (i.e. Idexx Colilert) as needing further review. Although, Colilert is a NR 219 DNR-approved test method for E. coli, the high results in comparison to fecal coliform are not possible. Thus, the RWWU implemented a different E. coli test method to compare to fecal coliform analysis and to the Colilert test method. This side-by-side test comparison began in April 2016, as seen in Table 2. This data is also presented in Graph 4. The new E. coli test method is a 2-step membrane filtration (MF) technique, specifically:
SM 9222D-1997 (fecal coliform) colonies/100 mL, followed by
SM 9222G-1997 using NA-MUG agar for E. coli verification and quantitation of colonies/100 mL (like FC).

Graph 2: Racine Wastewater Utility Bacteria Test Data 2013-2015 with Plant Flows



Graph 3: Racine Wastewater Utility Bacteria Test Data 2013-2015 with Plant Effluent TSS

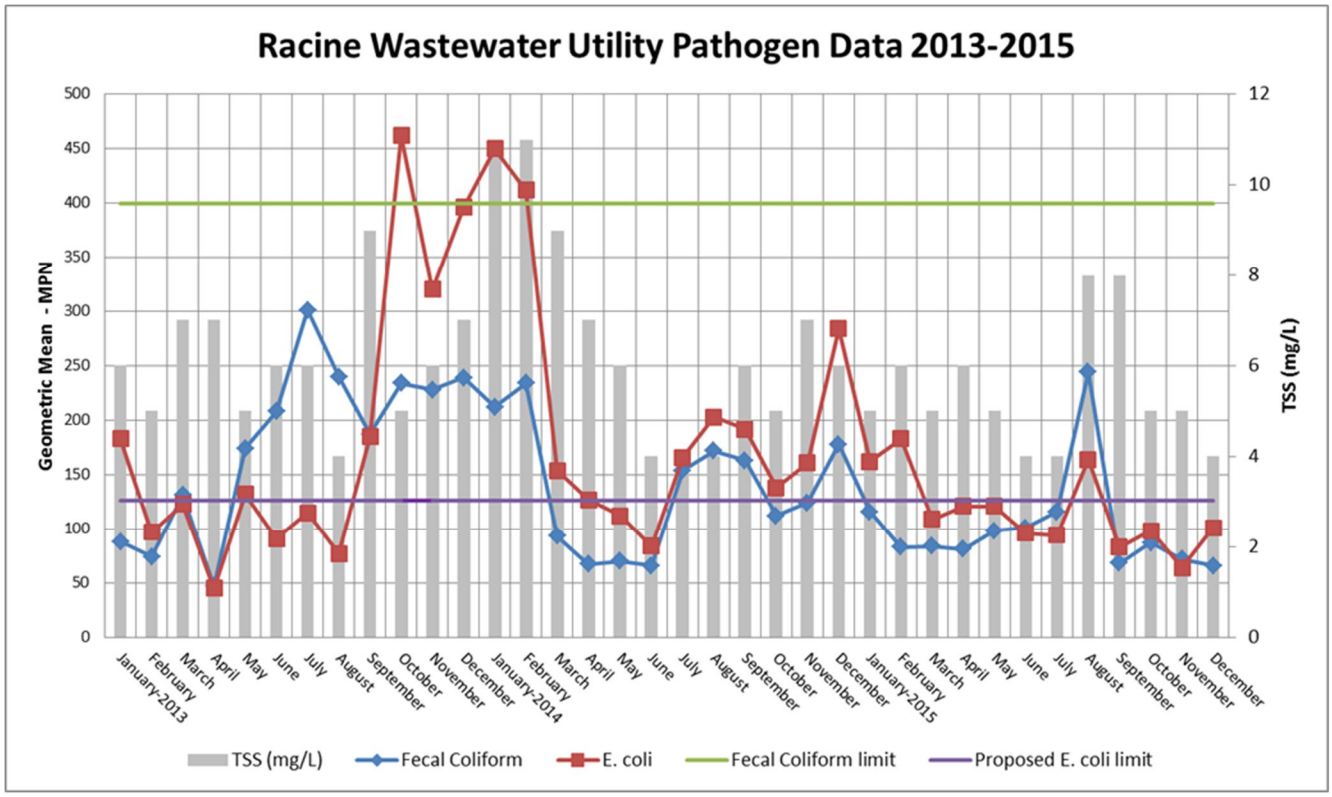
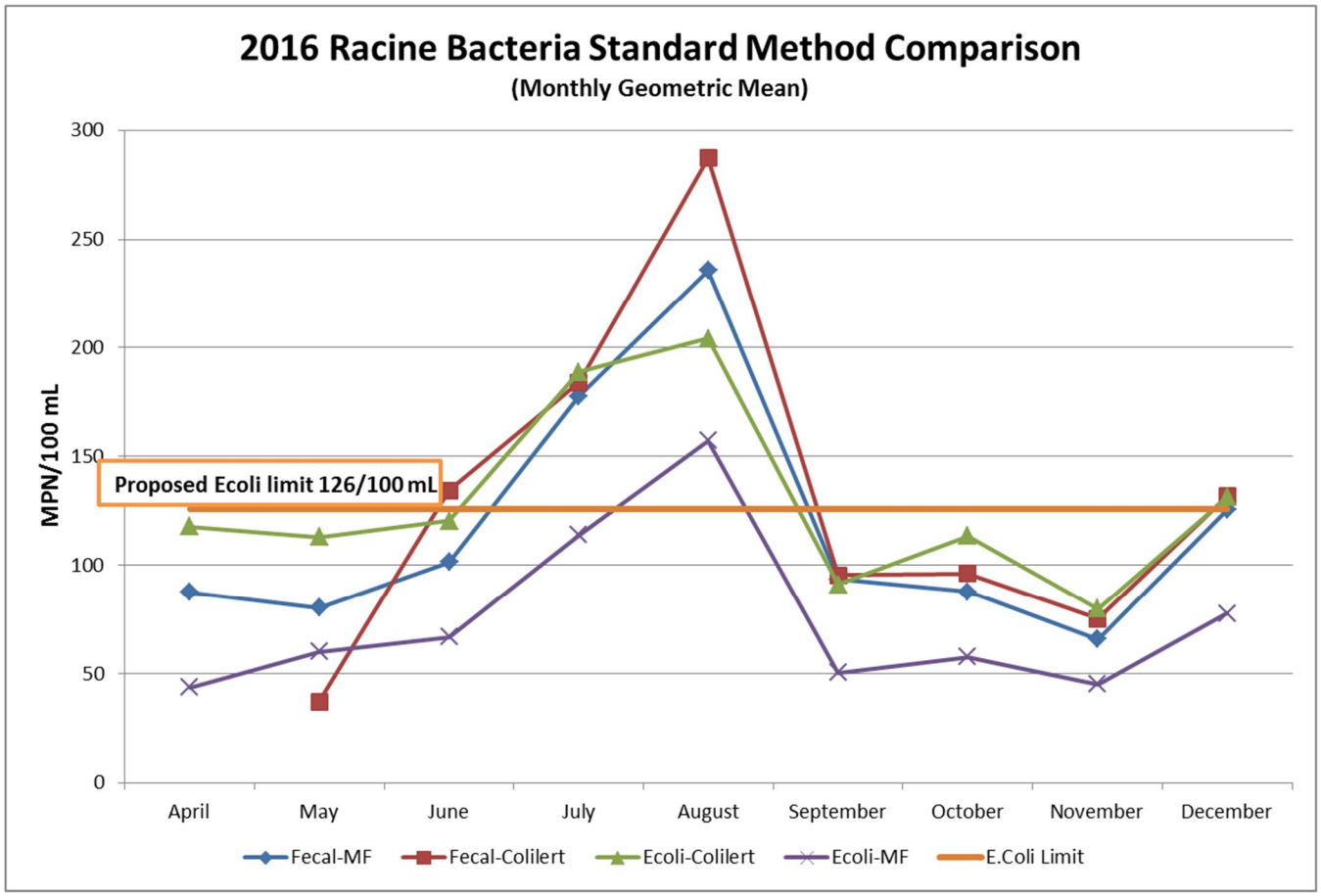


Table 2: Racine Wastewater Utility Bacteria Test Data Method Comparison

	Fecal Coliform (MF method)	Fecal Coliform (Colilert-18 Method)	E. Coli by Collilert (enzyme substrate) MPN	E. Coli by Partition Method (MUG Plate Media)	Fecal Coliform	E. Coli	Plant
		(not approved)	without sodium thiosulfate		Limit	Limit	Avg Flow
2016	Geometric Mean						MGD
January	54		79		400	126	21.850
February	123		186		400	126	20.630
March	116		179		400	126	26.410
April	88		118	44	400	126	28.440
May	80	37	113	60	400	126	23.930
June	101	134	120	67	400	126	16.860
July	178	184	189	114	400	126	14.460
August	236	287	204	157	400	126	16.770
September	94	95	91	50	400	126	16.180
October	88	96	113	58	400	126	18.690
November	66	75	80	45	400	126	18.860
December	125	132	131	78	400	126	19.800
AVG	**112**	**130**	**134**	**75**	**400**	**126**	**20.240**
Test Freq	Daily	4 Days/Wk	Daily	5 Days/Wk			

Graph 4: Racine Wastewater Utility Bacteria Test Data Method Comparison



The 2016 RWWU bacterial parameter data shows discrepancy for M-F fecal coliform results when compared to the Idexx Colilert E. coli test method. However, the alternative E. coli MF method indicates that E. coli to be less than the M-F fecal coliform colony forming units (CFU) per 100 mL. This relationship is as expected based on theoretical principle. This would infer that the MF method provides smaller test values than comparable Idexx Colilert test values. There is some study evidence indicating that the rosolic acid used in the MFC media for the membrane filtration (M-F) test may serve to suppress E. coli. RWWU makes no judgement on which method may be more accurate.

Conclusion

In reference to the proposed DNR bacteria standard change from fecal coliform (400 colonies/100 mL) to E. coli (126 colonies/100 mL), the test method implemented by the wastewater plant would appear to be crucial to meeting an E. coli geometric mean concentration threshold of 126 CFU/100 mL. Further, the proposed E. coli standard would appear to be a lowering of the bacteria standard from current fecal coliform limits. Generally, this assumption is based on a review of the ratio of fecal coliform (FC) to E. coli. The proposed standard change would result in a change from a limit of 400 CFU/100 mL for FC to a

limit of 126 CFU/100 mL for E. coli. This is a FC/E. coli ratio of 3.2. Preliminary data detected by Racine would determine this FC/E. coli ratio to be about 1.6 for M-F methods and 1.0 for Colilert methods. Thus, the new E. coli standard would seem to be a lowering of the existing bacteria standard limit. The RWWU would have failed to meet the 126 E.coli limit for five months in 2016, and failed to meet the 100 E.coli limit for nine months in 2016 (per Colilert method data). On a side note, the DNR is also proposing a weekly fecal coliform limit of 656 MPN/100 mL in lieu of the current monthly geometric mean limit of 400 MPN/100 mL. RWWU data shows that this limit can be achieved per current disinfection operation without any modification.

Still, if it were true that the proposed E. coli limit of 126 CFU/100 mL were a limit reduction, then wastewater plants in Wisconsin may have to operationally modify their disinfection process to meet this lower standard. The RWWU has made effort to estimate this cost to maintain compliance with the proposed E. coli limit.

Cost Analysis

As the RWWU utilizes UV disinfection, a lower standard would mean more electrical power would be required to increase UV transmittance for more efficient disinfection. An increase in electrical power would translate into additional O&M cost in terms of additional daily kWh and likely higher demand charges. Plants that utilize chemical methods, such as chlorine, for disinfection, will likewise see increased O&M cost for additional chemical. It is unknown if additional capital upgrades would be required for some wastewater plants to meet an increased bacteria standard. This would be a site specific issue.

The Racine Wastewater Utility uses a Trojan UV 4000 Plus for disinfection of secondary effluent. On the basis of the original design data (108 MGD, 65% UVT, TSS 30mg/l or less on a 30 day average, 400 FC per 100 ml on a 30-day geometric mean permit requirement) the dose specified was 24,000 uWs/cm^2. The Trojan unit, as set-up for our plant, can provide a dose of 26,314 uWs/cm^2 at worst case conditions and the required dose to meet the permit fecal coliform requirement based on plant data as used by Trojan in proprietary design is 22,400 uWs/cm^2. The UV Dose=Intensity*Time. Fortunately, the plant runs much better than the specified worst case scenario and based on plant experience and lab data, RWWU is able to easily meet the monthly geometric mean fecal coliform limit specified by permit.

Common wastewater parameters that impact UV intensity are UV transmittance (UVT, resulting from the presence of UV absorbing organic and inorganic compounds such as nitrate and iron) and TSS, or perhaps better said, the characteristics of the particles that make up the TSS such as the particle size and distribution, the number of particles in each size range and the optical properties of the particles. It should also be noted that industrial process wastes also impact the UVT. The presence of UV absorbing particles and dissolved organics and inorganics in this waste can shield the bacteria and limit the effect of treatment.

Iron in water absorbs UV directly, fouls sleeves and provides a protective shield by adsorption onto suspended solids and bacterial clumps. Note that RWWU uses an iron compound (ferric chloride) to

reduce phosphorus. Increased resistance to UV has especially been experienced when there is an increased amount of iron associated with the solids. RWWU has found that, even at lower dose levels, fouling of the sleeves requires weekly cleaning to avoid a reduction in UV capabilities. This may become more of a concern if RWWU receives a lower phosphorus limit. Dependent on the limit, RWWU may be able to reach the required phosphorus concentration by feeding additional ferric chloride after aeration. This increase in iron may be problematic, especially if the UV has to be run at a higher dose in order to meet the proposed E.coli limits. If this is the case, a chemical change, such as alum addition as a replacement for ferric chloride, may be needed. If this change were to happen, the use of both ferric chloride and alum, there would need to at least be piping changes with the possibility of additional chemical storage tanks and chemical feed pumps. This suggested chemical change may be beneficial to meet both lower phosphorus limits and the proposed E.coli limits. Flocculated solids containing aluminum do not show an increased resistance to UV disinfection relative to similar particles without aluminum. This change comes with a cost, which is not estimated here.

Each UV building contains a unit with two banks of lamps. Each bank is powered by a separate Power Distribution Center (PDC) which is mounted on the top of the channel insert. The PDC also contains the Communication Control Board and control equipment for its bank of lamps. The unit also has a Hydraulic Systems Center (HSC) between the two PDCs. The HSC contains the pumps, valves and reservoirs for the cooling and cleaning system. The cooling system is used to cool the electronic ballasts located in the module enclosures. The hydraulic system is used to extend and retract the wiper collars used in the cleaning system. The RWWU units also contain both low and high water sensors and an online UVT analyzer. All of this equipment would be used more in order to meet higher quality effluent limits. Any increased cost due to additional maintenance requirements should be considered in the total investment required to meet the proposed E.coli limit. It is expected that this maintenance increase for the Racine Wastewater Utility will be minimal. The UV system is one of the most energy intensive users in the treatment plant. The system operates in the “auto mode” by continuously reading the flow and %UVT and adjusting the power level and number of lamps in operation based on the entered dose. In order to meet a more stringent limit, the dose will be increased and because of the increased power consumption, the electrical cost will increase.

In order for the plant to meet the proposed E.coli limit of 126/100 or 100/100, the Trojan UV 4000 Plus would require a higher dose which would result in a higher power usage. When the plant is running at a steady operation, it is expected that the kW use for the UV systems will be 70% higher than what is currently used. If there are times when it is difficult to meet a daily goal and therefore, risk not meeting a weekly or monthly limit, both UVs may be needed. This decision will be based on the E.coli or fecal coliform data or the solids loading. There is the potential that the kW usage could be as much as eight times what is currently used. This eight-fold increase is based on doubling the power use of each of the 4 banks (both buildings) and running all 4 banks, rather than the typical operation which requires only one bank.

The RWWU established plant pilot testing in an effort to quantify the additional power requirement from the current fecal coliform limit to the proposed E.coli limit. Pilot testing was conducted over a 10-day period in August 2016 and again in October 2016 by operating both UV disinfection banks at

increased transmittance to achieve proposed E.coli limit discharge. This change in UV system kWh power draw is shown in Table 3. Note that costs are estimated based on 2016 RWWU plant electricity charges. As shown, RWWU estimates a daily increase of about $176 (from $249 to $425 per day) to comply with the proposed E.coli limit.

Table 3: Racine Wastewater Utility UV Disinfection Test Power Change

Dose	Daily kW Usage	E.Coli	Fecal Coliform
24.0	2427	290.9	190
24.0	2673	290.9	210
24.0	2402	117.8	180
24.0	2639	139.6	170
24.0	2709	146.7	160
24.0	2560	159.7	260
24.0	2483	182.7	270
24.0	2531	235.9	110
24.0	2707	151.5	220
24.0	2852	248.1	250
24.0	2818	547.5	440
Avg	2,618	228	224
Max	2,852	548	440
Min	2,402	118	110
Avg Cost	**$248.74**		
Geometric Mean		**206**	**211**
50.0	4655	81.3	85
50.0	3974	111.9	39
50.0	3867	83.6	49
50.0	3587	135.4	43
50.0	4010	47.2	44
50.0	4373	59.4	56
50.0	4416	69.7	60
50.0	4033	41.3	58
50.0	6338	307.6	160
50.0	5479	98.7	100
Avg	4,473	104	69
Max	6,338	308	160
Min	3,587	41	39
Avg Cost	**$424.95**		
Geometric Mean		**87**	**63**

Overall cost impact to the Racine Wastewater Utility is summarized in Table 4.

Table 4: Racine Wastewater Utility Cost Impact of Proposed Bacterial Standard Change

Daily cost increase	**$176**	**$/Day**
Annual cost increase	**$64,320**	**$/Year**
2016 Flow	20.24	MGD
Annual cost increase	**$3,178**	**$/MGD**
2017 O&M Budget	$9,005,000	
Annual cost increase	**0.7%**	% of O&M

A cost increase of about 1% to the RWWU O&M budget to achieve compliance with a revised bacteria standard would appear to be insignificant on its own merit. However, when added to cost burdens for other regulatory changes, such as reduced phosphorus limits, air emission permit compliance, or sewer overflow prevention projects, any cost increase will have an impact.

Respectfully Submitted,
Racine Wastewater Utility
January 9, 2017

Nora Erlandson	Mary-Frances Klimek	Mike Gitter
Lab Director	Plant Superintendent	Chief of Operations