February 2020

City of Circleville WWTP

Industrial Pretreatment Program

Local Limits Report

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List of Acronyms

AHL	Allowable Headworks Loading
BOD	5-Day Biochemical Oxygen Demand
BMP	Best Management Practices
CBOD	5-Day Carbonaceous Biochemical Oxygen Demand
I/I	Infiltration/Inflow
IU	Industrial User
MAHL	Maximum Allowable Headworks Loading
MAIL	Maximum Allowable Industrial Loading
MDL	Method Detection Limit
MRE	Mean Removal Efficiency
NPDES	National Pollutant Discharge Elimination System
OEPA	Ohio Environmental Protection Agency
POC	Pollutant of Concern
POTW	Publicly Operated Treatment Works
SUO	Sewer Use Ordinance
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
WWTP	Wastewater Treatment Plant

Scope

The purpose of this local limits study is to develop local limits for the City of Circleville in accordance with their OEPA Authorization to Discharge Under the NPDES permit 4PD00003*RD and USEPA Local Limits Development Guidance (EPA 833-R-04-002A July 2004). The report includes identification of pollutants of concern (POC), flow and load analysis, maximum allowable headworks loading (MAHL), and local limits development.

Wastewater treatment plants are typically designed for treating compatible pollutants (Biological Oxygen Demand, Total Suspended Solids). A local limits evaluation focuses on pollutants of concern that the wastewater treatment plant is not specifically designed to remove (primarily heavy metals like Arsenic, Cadmium, Copper, etc.) Determining allowable headworks loadings provides assurance that the wastewater treatment facility is prepared to accept industrial discharges without adversely impacting the treatment processes or effluent quality.

Introduction

The City of Circleville currently has no industrial users (IUs) online. In anticipation of new IUs coming online, significant research, testing, and data analysis was performed. The following describes the procedures and data used to calculate MAHL, maximum allowable industrial loading (MAIL), and local limits for the City of Circleville WWTP. The primary references for conducting this analysis was the USEPA Local Limits Development Guidance (EPA 833-R-04-002A July 2004). The determination of pollutants of concern is based on NPDES limits, USEPA Local Limits Development Guidance recommendations, water quality criteria, and current industrial contributory flow. Using the MAHL, data analysis, and a common sense approach, MAIL can be determined and local limits calculated if an IU comes online.

Flow Domestic and Industrial

The City of Circleville owns and operates an activated sludge wastewater treatment plant designed to treat domestic, commercial, and industrial wastewater from the city. The WWTP has a nominal capacity of 4.0 MGD and a maximum capacity of 12.0 MGD. Actual influent flows to the plant averaged 2.11 MGD in 2019. As previously stated, the City of Circleville currently has no IUs on line. One hundred percent of the WWTP influent comes from domestic, commercial, and infiltration/inflow (I/I).

Pollutants of Concern

A POC is any pollutant that might be expected to be discharged into the sewer system in amounts significant enough to pass through or cause interference. The *OEPA* Authorization to Discharge Under the NPDES permit 4PD00003*RD and the USEPA Local Limits Development

Guidance (EPA 833-R-04-002A July 2004) requirements were used for the screening methods and determination of POCs.

As identified in the City of Circleville's *NPDES permit Part1, C-Schedule of Compliance, subsection A - Municipal Pretreatment Schedule*; technical justifications are required for the following POCs: Arsenic, Cadmium, Total Chromium, Dissolved Hexavalent Chromium, Copper, Free Cyanide, Lead, Mercury, Molybdenum, Nickel, Silver and Zinc.

As identified in the *USEPA Local Limits Development Guidance Chapter 3 Determining POC*; technical justifications are recommended for the following conventional POC: Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS) and Ammonia. Though BOD is recommended, the City of Circleville has determined that Carbonaceous Biochemical Oxygen Demand (CBOD) is a more valuable parameter to develop and will be used in substitution of BOD.

Local limits shall be developed around these 16 POC. Further POC will be determined as IUs come online using the following criteria:

- IUs are required to submit an industrial waste discharge permit to the Director of Public Service as required in *The City of Circleville Sewer Use Ordinance section 925.21.*
- The National Categorical Pretreatment Standards developed by the USEPA.
- IUs are required to submit a Priority Pollutants Scan (PPS) within the first quarter of coming online and a subsequent annual PPS submission thereafter.

Domestic/Background Testing

Sampling must be performed to determine pollutants contributed by domestic, commercial, and other uncontrollable sources. As previously stated, the City of Circleville currently has no IUs. All influent flow to the WWTP is from domestic, commercial, other uncontrollable sources, and I/I. Logically, there is no need to sample additional locations throughout the collection system. Per a direct conversation on Wednesday, February 5, 2020 with EPA Environmental Specialist II, Greg Sanders, raw influent MAHL results shall be used as domestic/background concentrations.

Sampling Methods

Positioned above the primary treatment tank influent channel, a refrigerated auto sampler collected raw influent composite samples. The sampler is set to collect 80mls of sample every 20 minutes for a 24 hour period. Raw influent composite samples were collected for seven consecutive days, from February 4, 2020 to February 10, 2020, to test for the following POC: Arsenic, Cadmium, Total Chromium, Copper, Lead, Mercury, Molybdenum, Nickel, Selenium, Silver, Zinc, CBOD, TSS, and Ammonia.

Located in the de-chlorination building, a refrigerated auto sampler collected final effluent composite samples from the Parshall flume. The sampler is programmed to a flow-proportional setting which collects 70mls of sample for every 20,000 gallons of effluent. Final effluent composite samples were collected for seven consecutive days, from February 4, 2020 to February 10, 2020, to test for the following POC: Arsenic, Cadmium, Total Chromium, Copper, Lead, Mercury, Molybdenum, Nickel, Selenium, Silver, Zinc, CBOD, TSS, and Ammonia.

Grab samples were collected from two locations for seven consecutive days. From February 5, 2020 to February 11, 2020, raw influent and final effluent grab samples were collected to test for free cyanide.

- Raw influent samples were collected from the primary treatment tank influent channel prior to the manual coarse bar screens.
- Final effluent samples were collected from the final effluent Parshall flume.

Final effluent samples were collected one detention time cycle (approximately 8 hours) after the collection of the raw influent sample.

Though a POC, due to the following reasons an analysis on Hexavalent Chromium was not performed.

- Difficulty and cost of sampling and testing.
- Several years of past screenings in the raw influent and final effluent have indicated this POC is not present in significant amounts.

The presence of Hexavalent Chromium will be re-evaluated when a new IU applies for discharge to the City's collection system (presently there are no IUs discharging to the collection system).

Data Collection

As described earlier, except for Free Cyanide, all POTW wastewater analyses utilized 24-hour composite samples. The pollutants of concern, and the analytical methods employed for these reporting/detection limits, are presented in Table 1.

The NPDES permit issued to the City of Circleville has no daily final effluent limitation for any of the 16 POC analyzed. For the purpose of evaluating local limits, the following criteria was utilized to establish reporting limits for mathematical calculations and MAHL.

- *Part 2, section Z-Pretreatment Program Requirements, subsection 5 Local Limits* of the City of Circleville's NPDES permit, lists waste load allocation values to be used when evaluating local limits for the following POC: Arsenic, Cadmium, Dissolved Hexavalent Chromium, Total Chromium, Copper, Free Cyanide, Lead, Mercury, Molybdenum, Nickel, Selenium, Silver, and Zinc.

- Given no daily final effluent limitations in the City of Circleville's NPDES permit for CBOD and TSS, the monthly discharge limitations given will be substituted, as they are more stringent than the weekly limits.

- In the absence of a daily, weekly, or monthly final effluent Ammonia Nitrogen limitation, nor an assigned waste load allocation value in City of Circleville's NPDES permit, a maximum daily discharge limit of 1.0 mg/l for Ammonia Nitrogen was chosen based on the most restrictive Ammonia discharge limitation we have reviewed.
- In cases where analytical results were reported as 'below detection limits', the detection limits (MDL) were used in the calculation of average influent and effluent pollutant concentrations in accordance with methods referenced in *USEPA Local Limits Development Guidance Appendix R and V.*

Analysis performed by the City of Circleville WWTP Laboratory

- 5 day CBOD
- TSS
- Ammonia Nitrogen
- Dissolved Hexavalent Chromium

Analysis performed by the City of Circleville WWTP Laboratory was conducted with strict adherence to the quality control practices required by the 23rd Edition of Standard Methods.

Analysis performed by Alloway Laboratories

- Arsenic
- Cadmium
- Total Chromium
- Copper
- Free Cyanide
- Lead
- Mercury
- Molybdenum
- Nickel
- Selenium
- Silver
- Zinc

Table 1. Analytical Methods, Reporting Limits, and Detection Limits for Wastewater

Analyte	Analytical Method	Reporting Limit (mg/l)	MDL (mg/l)	Average Influent Data (mg/l)	Average Effluent Data (mg/l)
Arsenic	EPA 200.8 Rev. 5.4	.68	.003	.003	.003
Cadmium	EPA 200.8 Rev. 5.4	.03	.0005	.0005	.0005
Total Chromium	EPA 200.8 Rev. 5.4	3.943	.01	.01	.01
Dissolved Hexavalent Chromium	SM 3500-Cr B	.031	.00244	.00244	.00244

Copper	EPA 200.8 Rev. 5.4	.076	.01	.0742857	.01357143
Free Cyanide	ASTM-D7237-10	.092	.003	.003	.003
Lead	EPA 200.8 Rev. 5.4	.667	.002	.0025	.002
Mercury	EPA 245.1 Rev. 3.0	.000012	.0002	.0002	.0002
Molybdenum	EPA 200.8 Rev. 5.4	370	.01	.010142857	.01571428*
Nickel	EPA 200.8 Rev. 5.4	2.3	.01	.01	.01428571
Selenium	EPA 200.8 Rev. 5.4	.134	.003	.003	.003
Silver	EPA 200.7 Rev. 4.4	.02	.005	.005	.005
Zinc	EPA 200.7 Rev. 4.4	.59	.01	.06157143	.02714286
Ammonia Nitrogen	SM 4500-NH3 D	1.0	.023	15.7	.20571
5 day CBOD	SM 5210-B	25	2.0	125	5.39429
TSS	SM 2540 D-1997	30	2.0	120.85714	5.91429

* During testing, we found the average effluent concentration of Molybdenum to be slightly higher than the influent concentration. We intend to investigate these results at a later time to determine if internal processes are adding Molybdenum to the effluent stream.

Sludge to Disposal

Grab samples were collected from the sludge dewatering belt press discharge conveyor prior to outfall. For the month of February 2020, sludge dewatering was performed two times per week. During each run, small representative grab samples were collected (3-5 per run). Analysis for percent solids of sludge to disposal was performed. The average of the analysis results, and the average of the sludge volume were used in the local limits determination based on sludge regulations.

- Average sludge flow to disposal February 2020: 0.022755625 MG
- Average percent solids of sludge to disposal February 2020: 20.500%

Analytical Results

Removal Efficiencies

Calculation of removal efficiencies, in cases where a large proportion of the values are non-detects, can result in removal efficiencies that are unreliable. Substitution of the detection

limit, in such cases, can distort the calculations to an unknown extent (since it is unknown how much the substituted values deviate from the true value of the pollutant concentration). In order to minimize the effects, the following approach was taken:

- For those POC that were detected less than half of the time, surrogate data was used from removal efficiencies reported by other POTWs similar to ours, as discussed in *The USEPA Local Limits Development Guidance, Chapter 5.1.4 Applying Removal Efficiencies Reported By Others*. The Median removal efficiencies found in *Appendix R* of *The USEPA Local Limits Development Guidance* were used in cases where surrogate data was substituted. Surrogate data was substituted for Arsenic, Cadmium, Total Chromium, Free Cyanide, Lead, Nickel, Selenium, and Silver.
- The Mean Removal Efficiency (MRE) method found in *The USEPA Local Limits Development Guidance, Chapter 5 Calculation of Maximum Allowable Headworks Loadings*; was used to calculate the removal efficiency for Copper, Mercury*, Molybdenum*, Zinc, CBOD, TSS, and Ammonia Nitrogen. For the purpose of deriving removal efficiencies, analysis results reported below MDL were set equal to the MDL, The *USEPA Local Limits Development Guidance Appendix R and V*.
    - * During the time of this testing, Mercury analysis results came back as all non-detects for both the influent and effluent. In the past, the City of Circleville had an IU that discharged Mercury into the wastewater stream. During this time low level Mercury test (method EPA 1631E) were performed monthly. In order to generate a more accurate and site specific removal efficiency of Mercury, we determined that by using the monthly sampling results from the most recent seven months the industry was online (January of 2017 through July of 2017), such a result could be achieved.
    - * During the time of this testing, we found the average effluent concentration of Molybdenum to be slightly higher than the influent concentration. As previously noted, we intend to investigate these results at a later time to determine if internal processes are adding Molybdenum to the effluent stream. Six of the seven influent results were non-detects while, conversely, only one effluent result was non-detect. Though six out of the seven effluent samples were able to be determined, the average result was minimal (.01571428 mg/l). Similar to Mercury, in the past the City of Circleville had an IU that discharged Molybdenum into the wastewater stream. In order to generate a more accurate and site specific removal efficiency for Molybdenum, we determined that by using quarterly sampling results from the most recent seven quarters the IU was online (March of 2016 through August of 2017) such a result could be achieved.
- In the case of Dissolved Hexavalent Chromium (which years of past screenings in the raw influent and final effluent have indicated is not present in significant amounts), surrogate data was used to determine removal efficiency as discussed in *The USEPA Local Limits Development Guidance, Chapter 5.1.4 Applying Removal Efficiencies Reported By Others*. Unlike the other POC in which surrogate data was used, removal efficiency for Dissolved Hexavalent Chromium is not found in *Appendix R of The USEPA Local Limits Development Guidance*. Per emails with EPA Environmental Specialist II, Greg Sanders, a removal efficiency of 50.0% shall be used for Dissolved Hexavalent Chromium.

Maximum Allowable Headworks Loadings

EPA guidelines state: "a MAHL is an estimate of the upper limit of pollutant loading to a POTW intended to prevent pass through or interference. MAHL are the basis for local limits." Equation used for the MAHL calculation:

MAHL lbs/day = (NPDES limit mg/l * Flow MGD * 8.34 (conversion factor)) / (1-Removal Efficiency as a decimal)

Maximum Allowable Industrial Loadings

Table 2 shows the data for the MAIL, which represent the amount of pollutant loadings the City of Circleville can receive from controlled sources such as industrial sources and, if necessary, commercial sources. Equation used for MAIL calculation:

MAIL lbs/day = MAHL (1-Safety Factor as a decimal) - Loadings from uncontrolled sources lbs/day

The City of Circleville currently does not accept hauled waste at its treatment plant, so this was not used in the MAIL calculation. In addition, no growth allowance was used at this time. The uncontrolled source loadings were calculated by averaging the domestic/commercial background concentration for a particular POC in mg/l, multiplied by flow in MGD, multiplied by 8.34 (conversion factor).

Safety Factor

EPA guidelines state: "determining safety factors is an imprecise process, which has the potential to affect significantly the final local limits. A safety factor is site specific and depends on local conditions. The main purpose of a safety factor is to address data uncertainties". The EPA recommends a minimum 10% safety factor. The City of Circleville will be utilizing a 20% safety factor. A 20% safety factor was determined as to insure no threat of potential pass through of the WWTP by a POC as IUs come online.

Local Limits

Local limits development is a continual process for POTW. Equation used for local limits calculation:

Local Limits mg/l = MAIL lbs/day / (IUs Flow MGD * 8.34 (conversion factor))

At this time the City of Circleville has no IUs and thus the calculation of local limits in mg/l is unable to be determined. This report recommends the City of Circleville issue prospective IUs local limits in lbs/day instead of mg/L for the following reasons:

- Concentration-based local limits do not take flow into account

- Concentration-based limits penalize IUs with high concentrations regardless of whether their flow is low

Table 2 lists the most critical MAIL and which local limit determination it is based on. Local limits determination are based on the following:

- Water Quality NPDES Permit, pass-thru
- Activated Sludge Inhibition Level
- Nitrification Inhibition Level
- 503 Sludge Regulations
- Anaerobic Digester Inhibition Level (The City of Circleville does not digest sludge anaerobically, thus local limits determination based on anaerobic digestion inhibition level is not applicable. Sludge is pumped to a gravity thickener for storage prior to dewatering by a Klein belt press then taken to another NPDES permitted facility.)

Table 2. Maximum Allowable Industrial Loadings (MAIL) "Local Limits"

Pollutant of Concern	Removal Efficiencies (%)	MAHL (lbs/day)	Domestic / Commercial (lbs/day)	MAIL (lbs/day)	Safety Factor (%)	Most Critical Limit
Arsenic	45.0	22.77316761	0.055258421	1.418299483	20	Activated Sludge Inhibition
Cadmium	67.0	1.674497618	0.009209737	1.330388358	20	Water Quality Pass-Thru
Total Chromium	82.0	403.4888066	0.184194738	20.00152997	20	Activated Sludge Inhibition
Dissolved Hexavalent Chromium	50.0	1.142007376	0.044943516	0.868662384	20	Water Quality Pass-Thru
Copper	81.76583	7.677234603	1.368303505	2.672346286	20	Nitrification Inhibition
Free Cyanide	69.0	5.622009066	0.056831179	2.01919361	20	Activated Sludge Inhibition
Lead	61.0	31.50202314	0.046048685	15.26095147	20	503 Sludge Regulation
Mercury	96.14322	0.005731042	0.003683895	0.000900939	20	Water Quality Pass-Thru

Molybdenum	7.51633	7369.090463	0.186826089	30.86978696	20	503 Sludge Regulation
Nickel	42.0	73.04274093	0.184194738	6.167347952	20	Nitrification Inhibition
Selenium	50.0	4.936418978	0.055258421	3.893876761	20	Water Quality Pass-Thru
Silver	75.0	1.473557904	0.092097369	1.086748954	20	Water Quality Pass-Thru
Zinc	55.91647	24.65204021	1.134113342	1.540006274	20	Nitrification Inhibition
Ammonia Nitrogen	98.68971	1405.755505	289.1857387	835.4186649	20	Water Quality Pass-Thru
5 day CBOD	95.68457	10670.70593	2302.434225	6234.130521	20	Water Quality Pass-Thru
TSS	95.10638	11291.93141	2226.124924	6807.420206	20	Water Quality Pass-Thru

Operational Conditions Noted During Sampling.

- Secondary tanks thoroughly cleaned on February 5, 2020.
- Belt press malfunction caused a significant amount of thickener tank sludge solids to return to our secondary treatment process on February 6, 2020.
- Inflow and Infiltration events occurring during sampling period. Significant I&I occurred on February 6, 7, and 10.

It is also important to note that, during the period of this study, there were no automated bar screens or grit removal processes in use. Additionally, no hauled waste (septage, leachate, etc.) was received for treatment.

Allocation of MAILs

As previously stated, the City of Circleville currently has no IUs. As new IUs come online, pollutant allocations will be determined and calculated on a case-by-case basis. Discharge loading lbs/day and/or concentration mg/L will be evaluated based on their Industrial User Waste Permit Application and Priority Pollutant Scan. In general, this is a straight forward approach that is easiest to administer. The Sewer Use Ordinance will have to be updated to reflect the changes in the limits. In the future, pollutant allocations will be reevaluated if need arises using

methods found in *The USEPA Local Limits Development Guidance, Chapter 6 Designation and Implementing Local Limits, Table 6-2.*

Best Management Practices

As stated in The City of Circleville Sewer Use Ordinance, section 925.191, the Superintendent is authorized and may develop BMP, in individual, general, or temporary wastewater discharge permits. BMP may be used when there is an insufficient flow from a permitted or category of permitted users to obtain a representative sample, or when the BMP is clearly the most feasible method for regulating the pollutant of concern.

Conclusion and Recommendations

Sixteen pollutants were identified in developing local limits for the City of Circleville. Local limits for oil, grease, PH, temperature, and collection system concerns were not evaluated at this time, as they are addressed in the *City of Circleville's Sewer Use Ordinance 925.18 (b)*. As new IUs come online further POC will be determined.

At this time, pollutant allocations will be determined and calculated on a case-by-case basis. Discharge loading lbs/day and/or concentration mg/L will be evaluated based on the IUs Industrial User Waste Permit Application and Priority Pollutant Scan. In general, this is a straight forward approach that is easiest to administer. In the future, pollutant allocations will be reevaluated if need arises using methods found in *The USEPA Local Limits Development Guidance, Chapter 6 Designation and Implementing Local Limits, Table 6-2.*

Table 3. Proposed Local Limits

Pollutant of Concern	Current Limit (mg/L)	Current Limit (lbs/day)	Proposed Limit (lbs/day)
Arsenic	0.62	0.19	1.41
Cadmium	0.29	0.09	1.33
Total Chromium	51.0	16.01	20.00
Dissolved Hexavalent Chromium	0.94	0.29	0.86
Copper	7.00	2.17	2.67
Free Cyanide	5.10	1.58	2.01
Lead	2.5	0.78	15.26
Mercury	0.004	0.004	0.0009
Molybdenum	2.00	0.63	30.86
Nickel	5.00	1.54	6.16
Selenium	0.97	0.30	3.89
Silver	3.20	0.99	1.08

Zinc	12.50	3.87	1.54
Ammonia Nitrogen	n/a	n/a	835.0
5 day CBOD	n/a	n/a	6234.0
TSS	n/a	n/a	6807.0

It is recommended to require all IUs to submit a Priority Pollutants Scan (PPS) within the first quarter of coming online and a subsequent annual PPS submission thereafter.

With the advice of Phoebe Low from the Ohio EPA it is recommended that the City of Circleville remove 'allowable discharge concentration (mg/l)' from the *Sewer Use Ordinance 925.19 (e).* In its place iterate: "The City of Circleville will enforce the local limits most recently approved by the Ohio EPA;" then reference a new additional document (City of Circleville's Local Industrial User Limits). This new additional document separate from the City of Circleville's Sewer Use Ordinance should iterate: "The City of Circleville has the authority to develop, implement, and enforce local limits in the industrial users' Industrial Wastewater Permit to ensure that the total pollutant loading from industrial sources do not exceed the following: (Insert MAIL Table Here). This total industrial loading limit was approved by the Ohio EPA on (Date)." It is tedious to update the SUO every time a change to the local limits for a pollutant is needed requiring multiple City Council readings and other legal documents. Since a SUO does not have to explicitly state the numerical limits, it can reference another document instead. By listing local limits outside of the SUO this new additional document (The City of Circleville's Local Industrial User Limits) could be updated by the POTW without obtaining approval from the City Council.

For the following reasons it is recommended that the City of Circleville issues Industrial User Waste Permit local limits in "lbs/day" instead of "mg/L" while keeping the ability to set concentration limits "mg/L" if issues arise with routine batch discharges, non-routine batch discharges, or slug load discharges that has a reasonable potential to cause interference or pass through, or in any other way violate the POTW's regulations, local limits, or permit.

- Concentration-based local limits do not take flow into account
- Concentration-based limits penalize IUs with high concentrations regardless of whether their flow is low

Finally it is recommended that the City of Circleville's website be updated and the following documents be available for prospective new IUs:

- City of Circleville's Sewer Use Ordinance
- City of Circleville's Local Industrial User Limits Document
- City of Circleville's Industrial User Waste Permit Application

References

Authorization to Discharge Under the National Pollutant Discharge Elimination System. Ohio Environmental Protection Agency, Permit Number 4PD00003*RD, Issued Date: July 31, 2019

City of Circleville Sewer Use Ordinance. City of Circleville

Local Limits Development Guidance. U.S. Environmental Protection Agency, Office of Wastewater Management, 2004.

Low, Phoebe. "Environmental Protection Agency Environmental Specialist II."

Sanders, Greg. "Environmental Protection Agency Environmental Specialist II Pretreatment Division of Services Water Central District Office."

TABLE 1

Local Limits Determination Based on Water Quality (NPDES Permit)

Pollutant	ENVIRONMENTAL CRITERIA AND PROCESS DATA BASE						MAXIMUM LOADING		INDUSTRIAL		
	IU Pollut. Flow (MGD) (Qind)	POTW Flow (MGD) (Qpotw)	Removal Efficiency (%) (Rpotw)	NPDES Limits (mg/l) (Ccrit)	Domestic and Commercial Conc. (mg/l) (Cdom)	Domestic and Commercial Flow (MGD) (Qdom)	Allowable Headworks (lbs/day) (Lhw)	Domestic/ Commercial (lbs/day) (Ldom)	Allowable Loading (lbs/day) (Lind)	Local Limit (mg/l) (Cind)	Safety Factor (%) (SF)
Arsenic	0	2.20857	45	0.68	0.003	2.20857	22.77316761	0.055258421	18.16327566	#DIV/0!	20
Cadmium	0	2.20857	67	0.03	0.0005	2.20857	1.674497618	0.009209737	1.330388358	#DIV/0!	20
Chromium (total)	0	2.20857	82	3.943	0.01	2.20857	403.4888066	0.184194738	322.6068506	#DIV/0!	20
Chromium (hex)	0	2.20857	50	0.031	0.00244	2.20857	1.142007376	0.044943516	0.868662384	#DIV/0!	20
Copper	0	2.20857	81.76583	0.076	0.0742857	2.20857	7.677234603	1.368303505	4.773484177	#DIV/0!	20
Cyanide	0	2.27143	69	0.092	0.003	2.27143	5.622009066	0.056831179	4.440776074	#DIV/0!	20
Lead	0	2.20857	61	0.667	0.0025	2.20857	31.50202314	0.046048685	25.15556983	#DIV/0!	20
Mercury	0	2.20857	96.14322	0.000012	0.0002	2.20857	0.005731042	0.003683895	0.000900939	#DIV/0!	20
Molybdenum	0	2.20857	7.51633	370	0.010142857	2.20857	7369.090463	0.186826089	5895.085544	#DIV/0!	20
Nickel	0	2.20857	42	2.3	0.01	2.20857	73.04274093	0.184194738	58.24999801	#DIV/0!	20
Selenium	0	2.20857	50	0.134	0.003	2.20857	4.936418978	0.055258421	3.893876761	#DIV/0!	20
Silver	0	2.20857	75	0.02	0.005	2.20857	1.473557904	0.092097369	1.086748954	#DIV/0!	20
Zinc	0	2.20857	55.91647	0.59	0.06157143	2.20857	24.65204021	1.134113342	18.58751883	#DIV/0!	20
Ammonia	0	2.20857	98.68971	1	15.7	2.20857	1405.755505	289.1857387	835.4186649	#DIV/0!	20
CBOD	0	2.20857	95.68457	25	125	2.20857	10670.70593	2302.434225	6234.130521	#DIV/0!	20
TSS	0	2.20857	95.10638	30	120.85714	2.20857	11291.93141	2226.124924	6807.420206	#DIV/0!	20

(Qind) Industrial User total plant discharge flow in Million Gallons per Day (MGD) that contains a particular pollutant.

(Qpotw) POTW's average influent flow in MGD.

(Rpotw) Removal efficiency across POTW as percent.

(Ccrit) NPDES daily maximum permit limit for a particular pollutant in mg/l.

(Qdom) Domestic/commercial background flow in MGD.

(Cdom) Domestic/commercial background concentration for a particular pollutant in mg/l.

(Lhw) Maximum allowable headworks pollutant loading to the POTW in pounds per day (lbs/day).

(Ldom) Domestic/commercial background loading to the POTW for a particular pollutant in pounds per day (lbs/day).

(Lind) Maximum allowable industrial loading to the POTW in pounds per day.

(Cind) Industrial allowable local limit for a given pollutant in mg/l.

(SF) Safety factor as a percent.

8.34 Unit conversion factor

$$Lhw = \frac{8.34 * Ccrit * Qpotw}{1 - Rpotw}$$

TABLE 2

Local Limits Determination Based on Activated Sludge Inhibition Level

Pollutant	ENVIRONMENTAL CRITERIA AND PROCESS DATA BASE						MAXIMUM LOADING		INDUSTRIAL		
	IU Pollut. Flow (MGD) (Qind)	POTW Flow (MGD) (Qpotw)	Removal Efficiency (%) (Rprim)	Activated Sludge Inhibition Level (mg/l) (Ccrit)	Domestic and Commercial Conc. (mg/l) (Cdom)	Domestic and Commercial Flow (MGD) (Qdom)	Allowable Headworks (lbs/day) (Lhw)	Domestic/ Commercial (lbs/day) (Ldom)	Allowable Loading (lbs/day) (Lind)	Local Limit (mg/l) (Cind)	Safety Factor (%) (SF)
Arsenic	0	2.20857	0	0.1	0.003	2.20857	1.84194738	0.055258421	1.418299483	#DIV/0!	20
Cadmium	0	2.20857	15	1	0.0005	2.20857	21.66996918	0.009209737	17.3267656	#DIV/0!	20
Chromium (total)	0	2.20857	27	1	0.01	2.20857	25.23215589	0.184194738	20.00152997	#DIV/0!	20
Chromium (hex)	0	2.20857	27	1	0.00244	2.20857	25.23215589	0.044943516	20.1407812	#DIV/0!	20
Copper	0	2.20857	22	1	0.0742857	2.20857	23.61471	1.368303505	17.5234645	#DIV/0!	20
Cyanide	0	2.27143	27	0.1	0.003	2.27143	2.595030986	0.056831179	2.01919361	#DIV/0!	20
Lead	0	2.20857	57	1	0.0025	2.20857	42.83598558	0.046048685	34.22273978	#DIV/0!	20
Mercury	0	2.20857	10	0.1	0.0002	2.20857	2.0466082	0.003683895	1.633602665	#DIV/0!	20
Molybdenum	0	2.20857	0		0.010142857	2.20857	-	0.186826089	-	-	20
Nickel	0	2.20857	14	1	0.01	2.20857	21.41799279	0.184194738	16.95019949	#DIV/0!	20
Selenium	0	2.20857	0		0.003	2.20857	-	0.055258421	-	-	20
Silver	0	2.20857	20		0.005	2.20857	-	0.092097369	-	-	20
Zinc	0	2.20857	27	0.3	0.06157143	2.20857	7.569646767	1.134113342	4.921604072	#DIV/0!	20

(Qind) Industrial User total plant discharge flow in Million Gallons per Day (MGD) that contains a particular pollutant.

(Qpotw) POTW's average influent flow in MGD.

(Rprim) Removal efficiency across primary treatment as percent.

(Ccrit) Activated sludge threshold inhibition level, mg/l.

(Qdom) Domestic/commercial background flow in MGD.

(Cdom) Domestic/commercial background concentration for a particular pollutant in mg/l.

(Lhw) Maximum allowable headworks pollutant loading to the POTW in pounds per day (lbs/day).

(Ldom) Domestic/commercial background loading to the POTW for a particular pollutant in pounds per day (lbs/day).

(Lind) Maximum allowable industrial loading to the POTW in pounds per day.

(Cind) Industrial allowable local limit for a given pollutant in mg/l.

(SF) Safety factor as a percent.

8.34 Unit conversion factor

$$Lhw = \frac{8.34 * Ccrit * Qpotw}{1 - Rprim}$$

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TABLE 3

Local Limits Determination Based on Nitrification Inhibition Level

Pollutant	ENVIRONMENTAL CRITERIA AND PROCESS DATA BASE						MAXIMUM LOADING		INDUSTRIAL		
	IU Pollut. Flow (MGD) (Qind)	POTW Flow (MGD) (Qpotw)	Removal Efficiency (%) (Rsec)	Nitrification Inhibition Level (mg/l) (Ccrit)	Domestic and Commercial Conc. (mg/l) (Cdom)	Domestic and Commercial Flow (MGD) (Qdom)	Allowable Headworks (lbs/day) (Lhw)	Domestic/ Commercial (lbs/day) (Ldom)	Allowable Loading (lbs/day) (Lind)	Local Limit (mg/l) (Cind)	Safety Factor (%) (SF)
Arsenic	0	2.20857	45	1.5	0.003	2.20857	50.23492855	0.055258421	40.13268441	#DIV/0!	20
Cadmium	0	2.20857	67	5.2	0.0005	2.20857	290.2462538	0.009209737	232.1877933	#DIV/0!	20
Chromium (total)	0	2.20857	82	0.25	0.01	2.20857	25.5826025	0.184194738	20.28188726	#DIV/0!	20
Chromium (hex)	0	2.20857	50	1	0.00244	2.20857	36.8389476	0.044943516	29.42621456	#DIV/0!	20
Copper	0	2.20857	81.76583	0.05	0.0742857	2.20857	5.050812239	1.368303505	2.672346286	#DIV/0!	20
Cyanide	0	2.27143	69	0.34	0.003	2.27143	20.77699003	0.056831179	16.56476084	#DIV/0!	20
Lead	0	2.20857	61	0.5	0.0025	2.20857	23.61471	0.046048685	18.84571932	#DIV/0!	20
Mercury	0	2.20857	96.14322		0.0002	2.20857	-	0.003683895	-	-	20
Molybdenum	0	2.20857	7.51633		0.010142857	2.20857	-	0.186826089	-	-	20
Nickel	0	2.20857	42	0.25	0.01	2.20857	7.939428362	0.184194738	6.167347952	#DIV/0!	20
Selenium	0	2.20857	50		0.003	2.20857	-	0.055258421	-	-	20
Silver	0	2.20857	75		0.005	2.20857	-	0.092097369	-	-	20
Zinc	0	2.20857	55.91647	0.08	0.06157143	2.20857	3.34264952	1.134113342	1.540006274	#DIV/0!	20

(Qind) Industrial User total plant discharge flow in Million Gallons per Day (MGD) that contains a particular pollutant.

(Qpotw) POTW's average influent flow in MGD.

(Rsec) Removal efficiency across primary treatment and secodary treatment as percent.

(Ccrit) Nitrification threshold inhibition level, mg/l.

(Qdom) Domestic/commercial background flow in MGD.

(Cdom) Domestic/commercial background concentration for a particular pollutant in mg/l.

(Lhw) Maximum allowable headworks pollutant loading to the POTW in pounds per day (lbs/day).

(Ldom) Domestic/commercial background loading to the POTW for a particular pollutant in pounds per day (lbs/day).

(Lind) Maximum allowable industrial loading to the POTW in pounds per day.

(Cind) Industrial allowable local limit for a given pollutant in mg/l.

(SF) Safety factor as a percent.

8.34 Unit conversion factor

$$Lhw = \frac{8.34 * Ccrit * Qpotw}{1 - Rsec}$$

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TABLE 4

Local Limits Determination Based on Sludge Regulations

Pollutant	ENVIRONMENTAL CRITERIA AND PROCESS DATA BASE								MAXIMUM LOADING		INDUSTRIAL		
	IU Pollut. Flow (MGD) (Qind)	POTW Flow (MGD) (Qpotw)	Sludge Flow (MGD) (Qsldg)	Percent Solids (%) (PS)	Removal Efficiency (%) (Rpotw)	503 Sludge Criteria (mg/kg) (Cslcrit)	Domestic and Conc. (mg/l) (Cdom)	Commercial Flow (MGD) (Qdom)	Allowable Headworks (lbs/day) (Lhw)	Domestic/ Commercial (lbs/day) (Ldom)	Allowable Loading (lbs/day) (Lind)	Local Limit (mg/l) (Cind)	Safety Factor (%) (SF)
Arsenic	0	2.20857	0.022755625	20.5	45	41	0.003	2.20857	3.544704388	0.055258421	2.780505089	#DIV/0!	20
Cadmium	0	2.20857	0.022755625	20.5	67	39	0.0005	2.20857	2.264636404	0.009209737	1.802499386	#DIV/0!	20
Chromium (total)	0	2.20857	0.022755625	20.5	82		0.01	2.20857	-	0.184194738	-	-	20
Chromium (hex)	0	2.20857	0.022755625	20.5	50		0.00244	2.20857	-	0.044943516	-	-	20
Copper	0	2.20857	0.022755625	20.5	81.76583	1500	0.0742857	2.20857	71.37203658	1.368303505	55.72932576	#DIV/0!	20
Cyanide	0	2.27143	0.022755625	20.5	69		0.003	2.27143	-	0.056831179	-	-	20
Lead	0	2.20857	0.022755625	20.5	61	300	0.0025	2.20857	19.13375019	0.046048685	15.26095147	#DIV/0!	20
Mercury	0	2.20857	0.022755625	20.5	96.14322	17	0.0002	2.20857	0.687921587	0.003683895	0.546653375	#DIV/0!	20
Molybdenum	0	2.20857	0.022755625	20.5	7.51633	75	0.010142857	2.20857	38.82076631	0.186826089	30.86978696	#DIV/0!	20
Nickel	0	2.20857	0.022755625	20.5	42	420	0.01	2.20857	38.90529206	0.184194738	30.94003891	#DIV/0!	20
Selenium	0	2.20857	0.022755625	20.5	50	100	0.003	2.20857	7.781058413	0.055258421	6.169588309	#DIV/0!	20
Silver	0	2.20857	0.022755625	20.5	75		0.005	2.20857	-	0.092097369	-	-	20
Zinc	0	2.20857	0.022755625	20.5	55.91647	2800	0.06157143	2.20857	194.8170508	1.134113342	154.7195273	#DIV/0!	20

(Qind) Industrial User total plant discharge flow in Million Gallons per Day (MGD) that contains a particular pollutant.

(Qpotw) POTW's average influent flow in MGD.

(Qsldg) Sludge flow to disposal in MGD.

(PS) Percent solids of sludge to disposal.

(Rpotw) Removal efficiency across POTW as a percent.

(Cslcrit) 503 sludge criteria in mg/kg dry sludge.

(Qdom) Domestic/commercial background flow in MGD.

(Cdom) Domestic/commercial background concentration for a particular pollutant in mg/l.

(Lhw) Maximum allowable headworks pollutant loading to the POTW in pounds per day (lbs/day).

(Ldom) Domestic/commercial background loading to the POTW for a particular pollutant in pounds per day (lbs/day).

(Lind) Maximum allowable industrial loading to the POTW in pounds per day.

(Cind) Industrial allowable local limit for a given pollutant in mg/l.

(SF) Safety factor as a percent.

8.34 Unit conversion factor

$$Lhw = \frac{8.34 * Cslcrit * (PS/100) * Qsldg}{Rpotw}$$

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TABLE 5

Local Limits Determination Based on Anaerobic Digester Inhibition Level

Pollutant	ENVIRONMENTAL CRITERIA AND PROCESS DATA BASE							MAXIMUM LOADING		INDUSTRIAL		
	IU Pollut. Flow (MGD) (Qind)	POTW Flow (MGD) (Qpotw)	Sludge Flow to Digester (MGD) (Qdig)	Removal Efficiency (%) (Rpotw)	Anaerobic Digeste Inhibition Level (mg/l) (Ccrit)	Domestic and Conc. (mg/l) (Cdom)	Commercial Flow (MGD) (Qdom)	Allowable Headworks (lbs/day) (Lhw)	Domestic/ Commercial (lbs/day) (Ldom)	Allowable Loading (lbs/day) (Lind)	Local Limit (mg/l) (Cind)	Safety Factor (%) (SF)
Arsenic	0	2.20857		45	1.6	0.003	2.20857	0	0.055258421	-0.055258421	#DIV/0!	20
Cadmium	0	2.20857		67	20	0.0005	2.20857	0	0.009209737	-0.009209737	#DIV/0!	20
Chromium	0	2.20857		82	130	0.01	2.20857	0	0.184194738	-0.184194738	#DIV/0!	20
Chromium, Hex	0	2.20857		50	110	0.00244	2.20857	0	0.044943516	-0.044943516	#DIV/0!	20
Copper	0	2.20857		81.76583	40	0.0742857	2.20857	0	1.368303505	-1.368303505	#DIV/0!	20
Cyanide	0	2.27143		69	1	0.003	2.27143	0	0.056831179	-0.056831179	#DIV/0!	20
Lead	0	2.20857		61	340	0.0025	2.20857	0	0.046048685	-0.046048685	#DIV/0!	20
Mercury	0	2.20857		96.14322		0.0002	2.20857	-	0.003683895	-	-	20
Molybdenum	0	2.20857		7.51633		0.010142857	2.20857	-	0.186826089	-	-	20
Nickel	0	2.20857		42	10	0.01	2.20857	0	0.184194738	-0.184194738	#DIV/0!	20
Selenium	0	2.20857		50		0.003	2.20857	-	0.055258421	-	-	20
Silver	0	2.20857		75	13	0.005	2.20857	0	0.092097369	-0.092097369	#DIV/0!	20
Zinc	0	2.20857		55.91647	400	0.06157143	2.20857	0	1.134113342	-1.134113342	#DIV/0!	20

(Qind) Industrial User total plant discharge flow in Million Gallons per Day (MGD) that contains a particular pollutant.

(Qpotw) POTW's average influent flow in MGD.

(Qdig) Sludge flow to digester in MGD.

(Rpotw) Removal efficiency across POTW as percent.

(Ccrit) Anaerobic digester threshold inhibition level in mg/l.

(Qdom) Domestic/commercial background flow in MGD.

(Cdom) Domestic/commercial background concentration for a particular pollutant in mg/l.

(Lhw) Maximum allowable headworks pollutant loading to the POTW in pounds per day (lbs/day).

(Ldom) Domestic/commercial background loading to the POTW for a particular pollutant in pounds per day (lbs/day).

(Lind) Maximum allowable industrial loading to the POTW in pounds per day.

(Cind) Industrial allowable local limit for a given pollutant in mg/l.

(SF) Safety factor as a percent.

8.34 Unit conversion factor

$$Lhw = \frac{8.34 * Ccrit * Qdig}{Rpotw}$$

TABLE 6

Local Limits Comparison

Pollutant	ENVIRONMENTAL CRITERIA AND PROCESS DATA BASE						Concentration Based Limits						Proposed Limits mg/L
	Table 1 Pass-Thru	Table 2 Act. Sludge Inhibition	Table 3 Nitrification Inhibition	Table 4 503 Sludge	Table 5 Anaerobic Digestion Inhibition	MINIMUM	Table 1 Pass-Thru	Table 2 Act. Sludge Inhibition	Table 3 Nitrification Inhibition	Table 4 503 Sludge	Table 5 Anaerobic Digestion Inhibition	MINIMUM	
Arsenic	18.1632757	1.41829948	40.13268441	2.780505089	-0.055258421	1.418299483	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
Cadmium	1.33038836	17.3267656	232.1877933	1.802499386	-0.009209737	1.330388358	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
Chromium	322.606851	20.00153	20.28188726	-	-0.184194738	20.00152997	#DIV/0!	#DIV/0!	#DIV/0!	-	#DIV/0!	#DIV/0!	
Chromium, Hex	0.86866238	20.1407812	29.42621456	-	-0.044943516	0.868662384	#DIV/0!	#DIV/0!	#DIV/0!	-	#DIV/0!	#DIV/0!	
Copper	4.77348418	17.5234645	2.672346286	55.72932576	-1.368303505	2.672346286	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
Cyanide	4.44077607	2.01919361	16.56476084	-	-0.056831179	2.01919361	#DIV/0!	#DIV/0!	#DIV/0!	-	#DIV/0!	#DIV/0!	
Lead	25.1555698	34.2227398	18.84571932	15.26095147	-0.046048685	15.26095147	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
Mercury	0.00090094	1.63360267	-	0.546653375	-	0.000900939	#DIV/0!	#DIV/0!	-	#DIV/0!	-	#DIV/0!	
Molybdenum	5895.08554	-	-	30.86978696	-	30.86978696	#DIV/0!	-	-	#DIV/0!	-	#DIV/0!	
Nickel	58.249998	16.9501995	6.167347952	30.94003891	-0.184194738	6.167347952	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
Selenium	3.89387676	-	-	6.169588309	-	3.893876761	#DIV/0!	-	-	#DIV/0!	-	#DIV/0!	
Silver	1.08674895	-	-	-	-0.092097369	1.086748954	#DIV/0!	-	-	-	#DIV/0!	#DIV/0!	
Zinc	18.5875188	4.92160407	1.540006274	154.7195273	-1.134113342	1.540006274	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
Ammonia	835.418665	#REF!	#REF!	#REF!	#REF!	835.4186649	#DIV/0!	#REF!	#REF!	#REF!	#REF!	#DIV/0!	
CBOD	6234.13052	#REF!	#REF!	#REF!	#REF!	6234.130521	#DIV/0!	#REF!	#REF!	#REF!	#REF!	#DIV/0!	
TSS	6807.42021	#REF!	#REF!	#REF!	#REF!	6807.420206	#DIV/0!	#REF!	#REF!	#REF!	#REF!	#DIV/0!	

The City of Circleville does not digest sludge anaerobically, thus local limits determination based on anaerobic digestion inhibition level is not applicable (Table 5). Sludge is pumped to a gravity thickener for storage prior to dewatering by a Klein belt press then taken to another NPDES permitted facility.