Total Dissolved Solids

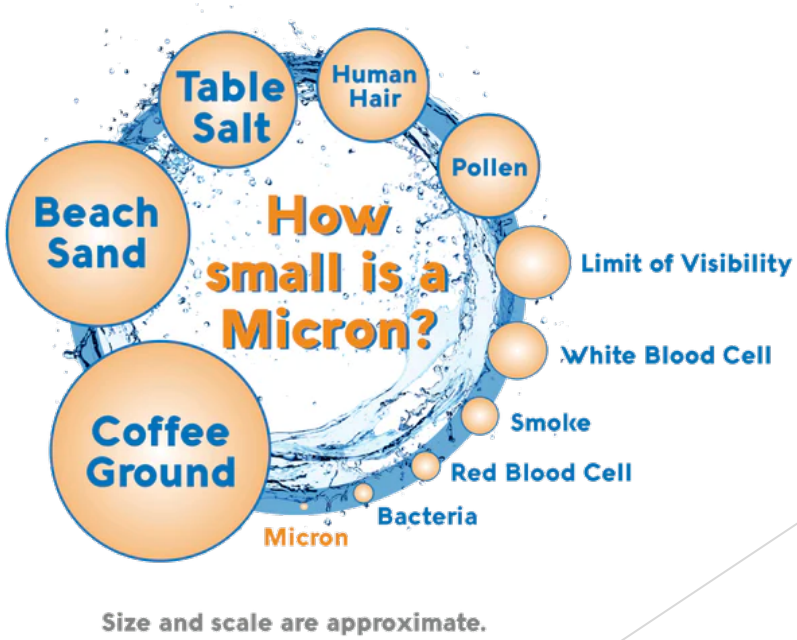
By Jeff Paull

Agenda

- What are Total Dissolved Solids (TDS)?
- What is the TCEQ's screening procedures and how do we conduct TDS/Chloride/Sulfate Screenings?
- Example of a TDS/Chloride/Sulfate Screening.
- How does the TCEQ calculate TDS/Chloride/Sulfate Limits?
- When are TDS/Chloride/Sulfate monitoring or limitations required?
- Example of TDS/Chloride/Sulfate monitoring/limitation screening.
- Questions.

Total dissolved solids (TDS)

- Comprise inorganic salts (chloride, calcium, magnesium, potassium, sodium, bicarbonates and sulfates) and organic matter dissolved in water
- Pollutants of concern to aquatic systems and water for human use
- Particles smaller than 2 microns



TCEQ screening procedures

When do we screen for TDS/Chloride/Sulfates?

- All domestic permits with a daily average permitted flow greater than or equal to 1 MGD
- All industrial permits (New, Major Amendment, Renewal)

Exceptions:

- No TDS screenings for stormwater discharges during wet weather events.
- No TDS screenings for Discharges to tidal water (salinity gradients must be maintained to support attainable estuarine dependent aquatic life uses.)

Steps for TDS/Chloride/Sulfate Screening

1. Select the appropriate screening procedure based on the type of receiving water. (e.g. Intermittent, intermittent with perennial pools, etc.)
2. Calculate the new mixture concentration (ambient + effluent TDS concentration).
3. If the new mixture concentration exceeds the Segment criteria, calculate the daily average effluent limitations for TDS/Chloride/Sulfate.
4. Compare the application TDS data to calculated effluent limitations for TDS/Chloride/Sulfate.
5. Implement monitoring requirements or limits in the draft permit as necessary.

Screening Scenarios

A. Perennial stream or river

B. Lake or reservoir

C. Intermittent stream

D. Intermittent stream with perennial pools (C+A)

E. Intermittent stream within three miles of a perennial stream/river (C+A)

F. Intermittent stream within three miles of a lake/reservoir (C+B)

Perennial Stream or River

- Screening is based on mass balance
- Resulting concentration in the stream after complete mixing should not exceed the criterion:

$$\frac{(Q_S \times C_A) + (Q_E \times C_E)}{(Q_S + Q_E)} \leq C_C$$

Where:

Q_S = harmonic mean flow of stream
C_A = ambient concentration in the stream
Q_E = average effluent flow
C_E = average effluent concentration
C_C = segment criterion

Sources of Information

Q_S = harmonic mean flow of stream

Critical Conditions Memo

Q_E = average effluent flow

Domestic – average permitted flow – **Permit Application**

Industrial – average of most recent two years of self-reported average flows – **ICIS** (If new application or amendment to increase flow, use requested permitted flow.)

C_A = ambient TDS, chloride, or sulfate concentration in the stream

Implementation Procedures, Appendix D

C_E = average TDS, chloride, or sulfate concentration of effluent

Permit Application

C_C = segment TDS, chloride, or sulfate criterion

Water Quality Standards, Appendix A

If New Mixture Concentration Exceeds Criterion:

- Calculate effluent concentration that would NOT cause criterion to be exceeded:

$$C_E = \frac{[C_C \times (Q_E + Q_S)] - (Q_S \times C_A)}{Q_E}$$

- This effluent concentration, C_E, is considered to be a waste load allocation (WLA); thus, the long term average (LTA), daily average, and daily maximum are:

$$LTA = 0.930 \times WLA$$

$$Daily\ Average = 1.47 \times LTA$$

$$Daily\ Maximum = 3.11 \times LTA$$

To the spreadsheet!

$$C_E = \frac{[C_C \times (Q_E + Q_S)] - (Q_S \times C_A)}{Q_E}$$

Screening Calculations for Total Dissolved Solids, Chloride, and Sulfate			
Menu 2 - Discharge to an Intermittent Stream within 3 Miles of a Perennial Stream			
Screen the Perennial Stream			
Applicant Name:			
Permit Number, Outfall:			
Segment Number:			
Enter values needed for screening:			Data Source (edit if different)
QE - Average effluent flow	1.2	MGD	
QS - Perennial stream harmonic mean flow	0.36	cfs	Critical conditions memo
QE - Average effluent flow	1.8567	cfs	Calculated
CA - TDS - ambient segment concentration	302	mg/L	2010 IP, Appendix D
CA - chloride - ambient segment concentrati	18	mg/L	2010 IP, Appendix D
CA - sulfate - ambient segment concentratio	27	mg/L	2010 IP, Appendix D
CC - TDS - segment criterion	600	mg/L	2018 TSWQS, Appendix A
CC - chloride - segment criterion	50	mg/L	2018 TSWQS, Appendix A
CC - sulfate - segment criterion	100	mg/L	2018 TSWQS, Appendix A
CE - TDS - average effluent concentration	615	mg/L	Permit application
CE - chloride - average effluent concentratio	122	mg/L	Permit application
CE - sulfate - average effluent concentration	54	mg/L	Permit application

Calculations

Screening Equation					
CC ≥ [(QS)(CA) + (QE)(CE)]/[QE + QS]					
Preliminary Calculations	**Load in River**	**Effluent Load**	**New Concentration**	**% Change in Ambient**	**% Change in Assim. Capacity**
Parameter	**QSCA**	**QECE**	**Equation 2**		
TDS	108.72	1141.86	564.17	86.8	88.0
Chloride	6.48	226.514	105.11	483.9	272.2
Sulfate	9.72	100.261	49.62	83.8	31.0
No further screening for TDS needed if:	**564.17**	**≤**	**600**		
No further screening for chloride needed if:	**105.11**	**≤**	**50**		
No further screening for sulfate needed if:	**49.62**	**≤**	**100**		

TDS Results

Permit Limit Calculations					
TDS					
Calculate the WLA	WLA= [CC(QE+QS) - (QS)(CA)]/QE			657.78	
Calculate the LTA	LTA = WLA * 0.93			611.74	
Calculate the daily average	Daily Avg. = LTA * 1.47			**899.25**	
Calculate the daily maximum	Daily Max. = LTA * 3.11			**1902.50**	
Calculate 70% of the daily average	70% of Daily Avg. =			629.48	
Calculate 85% of the daily average	85% of Daily Avg. =			764.36	
No permit limitations needed if:	**615**	**≤**	**629.48**		
Reporting needed if:	**615**	**>**	**629.48**	**but ≤**	**764.36**
Permit limits may be needed if:	**615**	**>**	**764.36**		
No permit limitations needed for TDS					

One of three statements will be shown in the yellow box:

1. "No permit limitations needed for TDS"
2. "Reporting needed for TDS"
3. "Permit limits may be needed for TDS"

Chloride and Sulfate Results

Chloride					
Calculate the WLA	WLA= [CC(QE+QS) - (QS)(CA)]/QE			56.20	
Calculate the LTA	LTA = WLA * 0.93			52.27	
Calculate the daily average	Daily Avg. = LTA * 1.47			**76.84**	
Calculate the daily maximum	Daily Max. = LTA * 3.11			**162.56**	
Calculate 70% of the daily average	70% of Daily Avg. =			53.79	
Calculate 85% of the daily average	85% of Daily Avg. =			65.31	
No permit limitations needed if:	**122**	**≤**	**53.79**		
Reporting needed if:	**122**	**>**	**53.79**	**but ≤**	**65.31**
Permit limits may be needed if:	**122**	**>**	**65.31**		
Permit limits may be needed for chloride					
Sulfate					
Calculate the WLA	WLA= [CC(QE+QS) - (QS)(CA)]/QE			114.15	
Calculate the LTA	LTA = WLA * 0.93			106.16	
Calculate the daily average	Daily Avg. = LTA * 1.47			**156.06**	
Calculate the daily maximum	Daily Max. = LTA * 3.11			**330.17**	
Calculate 70% of the daily average	70% of Daily Avg. =			109.24	
Calculate 85% of the daily average	85% of Daily Avg. =			132.65	
No permit limitations needed if:	**54**	**≤**	**109.24**		
Reporting needed if:	**54**	**>**	**109.24**	**but ≤**	**132.65**
Permit limits may be needed if:	**54**	**>**	**132.65**		
No permit limitations needed for sulfate					

Final Considerations

- Initial screening exceeds 70%, but not 85% = **effluent monitoring only**
- Initial screening exceeds 70% and 85%, but doesn't meet all the conditions listed on pg. 184 of the IPS = **limits**
- Initial screening exceeds 70% and 85%, meets all the conditions on page 184, secondary screening at segment indicates discharge will not result in exceedance in criteria in the segment –**no limits or monitoring**

Final Considerations Pt. 2

- Initial screening exceeds 70% and 85%, meets all the conditions on page 184, secondary screening at segment indicates discharge will result in exceedance in criteria in the segment (but not greater than typical TDS elevation) = **instream monitoring**
- Initial screening exceeds 70% and 85%, meets all the conditions on page 184, secondary screening at segment indicates discharge will result in exceedance in criteria in the segment (and greater than typical TDS elevation) = **source identification and reduction study**

Pg. 184 conditions part 1
(All conditions must be met)

- The effluent concentration of TDS is comparable to the water supply source; or, for domestic discharges, any elevations of salinity are small and typical of such discharges

- The water supply source is typical of TDS concentrations of surface waters in the area but does not include brine water that is produced during the extraction of oil and gas, or other sources of brine water that are substantially uncharacteristic of surface waters in the area of discharge

Pg. 184 conditions part 2

- For Industrial Discharges, there are no internal discharges of process water that result in a significant elevation of TDS in the external discharge compared to source water. For domestic discharges, there are no identifiable industrial discharges to the sewerage system that cause a significant elevation of TDS compared to source water

- The discharge will not result in significant increases in instream concentrations of chloride that would exceed EPA's aquatic life toxic criteria for chloride, which are 860 mg/L acute criteria and 230 mg/L chronic criteria.

If these conditions are met = instream monitoring if Segment criteria is exceeded, else no TDS requirements.

Process for addressing chloride and sulfate when screening indicates limits/monitoring is needed:

- "Screening for TDS is usually sufficient unless the ionic ratios of chloride or sulfate are out of balance. It has been demonstrated that ionic imbalances cause WET testing failures by overwhelming the osmotic capacities of the organisms being tested" (IPs pg. 174)

- 1. NO RP
- 2. Screen the Segment

- This ensures that we 1. Are protecting aquatic life in the receiving stream and; 2. Not causing an impairment for dissolved solids at the Segment.

Questions?