South Carolina Department of Health and Environmental Control

TMDL Calculators Facilitate Allocation

Session #4 – Innovations in TMDL Development

2017 National Training Workshop for 303(d) Listing & TMDL Staff

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Outline

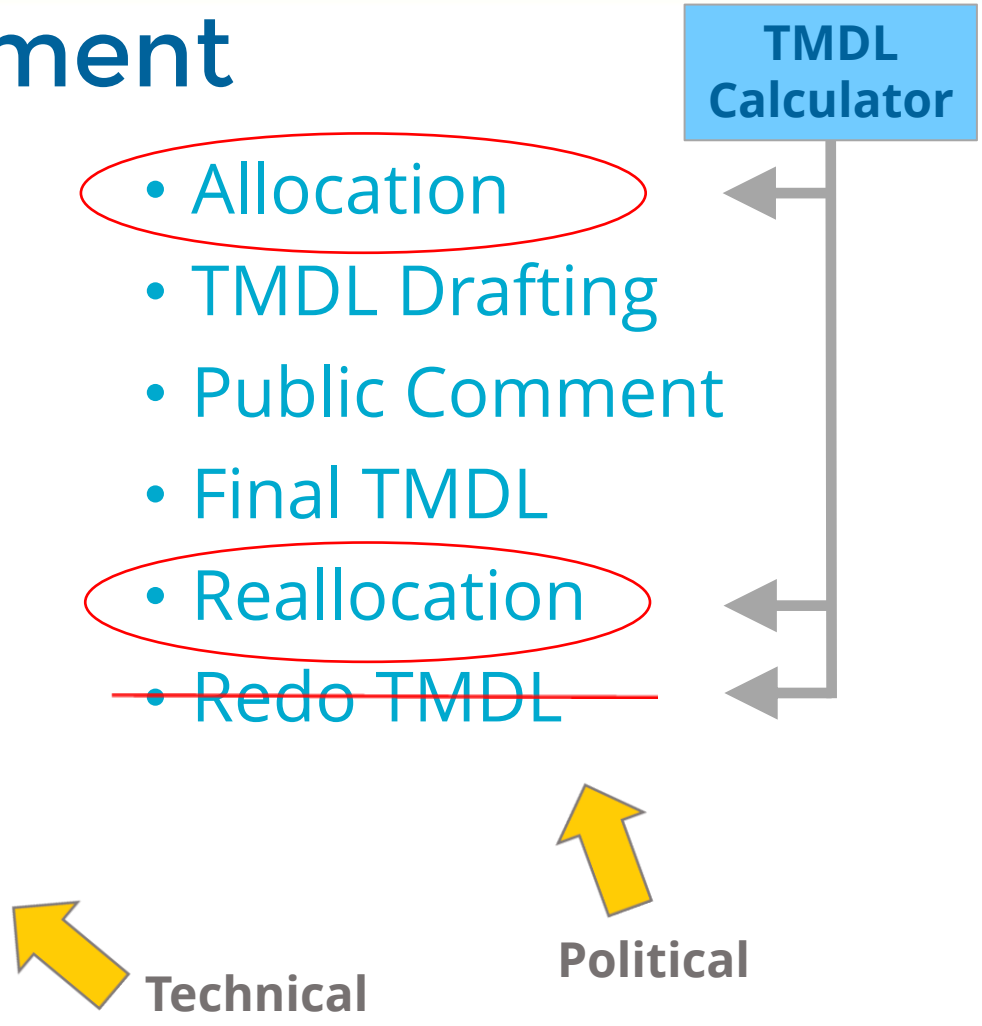
- Concepts
- Applications
- Demos
- Wrap Up

Concepts

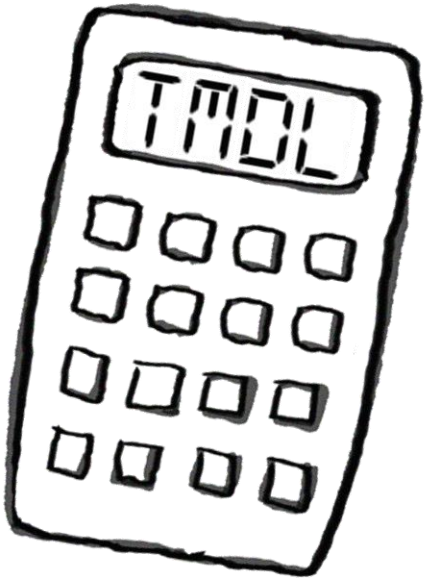
TMDL Development

- Impaired Water
- Source Assessment
- Model Development
  - Setup and Calibration
  - Critical Conditions
- Initial Scenarios
  - e.g. Equal percent below permit
  - e.g. Same treatment level
  - "Size of the Pie"

- Allocation
- TMDL Drafting
- Public Comment
- Final TMDL
- Reallocation
- ~~Redo TMDL~~



What is a TMDL Calculator?



- Basically, a "model of the model"
- Easy to use spreadsheet or program, inputs loads, outputs predicted WQ
- Load combinations are adjusted until the WQS is met
- Constructed after the baseline critical conditions WQ model is established
- Conceived by Jim Greenfield while at EPA R4 for the 2002 Charleston Harbor DO TMDL

TMDL Calculator Concepts

- Establish baseline WQ model first
- Then make a LOT of model runs
  - Individually, for each POC and for each source, determine unit response in critical segments
  - Often, the response is linear in the practical range
  - **y=mx+b** where **x**=POC load, **y**=WQ response, **m**=strength of the response, and **b**=WQ when load=0
  - Unique relation determined for each **POC**, each **source**, each **segment** and each **day** in the simulation
  - Keep track of all this in a spreadsheet, database, etc.

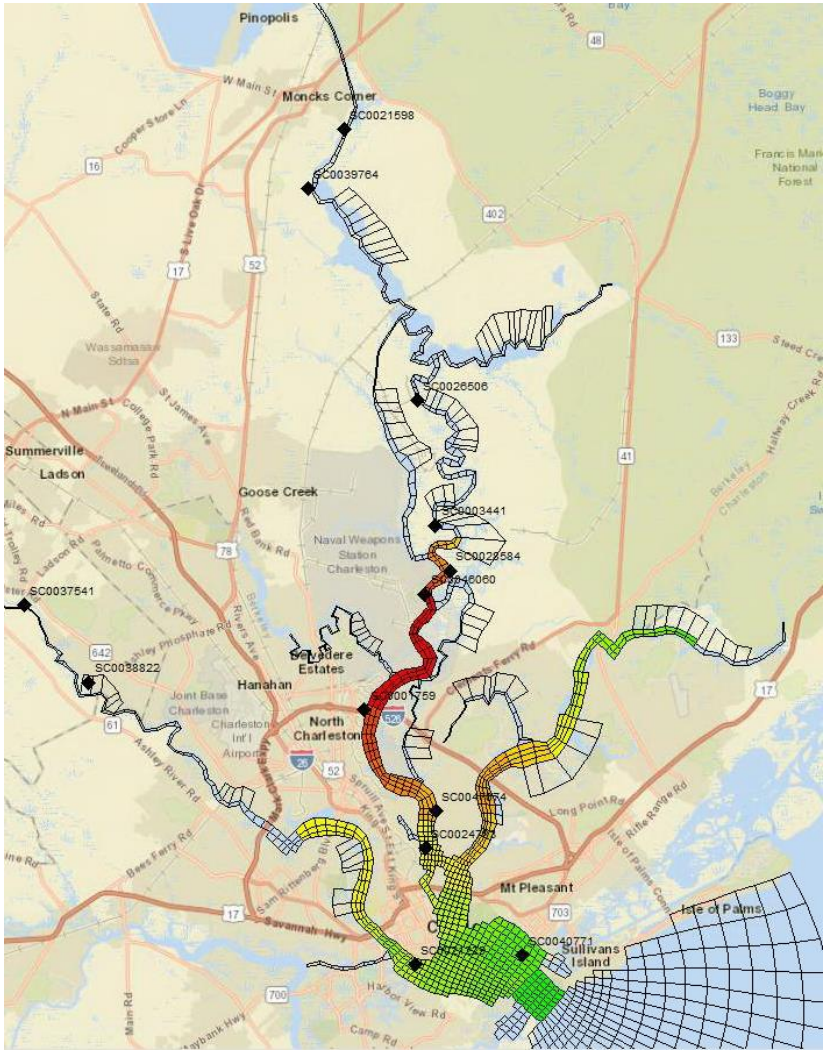
TMDL Calculator Concepts (cont.)

- Users adjust loads on the interface
- All of the individual daily responses are instantly recalculated and summed to get the total response in each segment
- Source-specific waste characteristics, assimilation rates, travel times, etc. are accounted for
- The TMDL Calculator is confirmed against the actual WQ model
- End result is a tool that replicates the WQ model without the work/time/cost of rerunning the full model

Applications

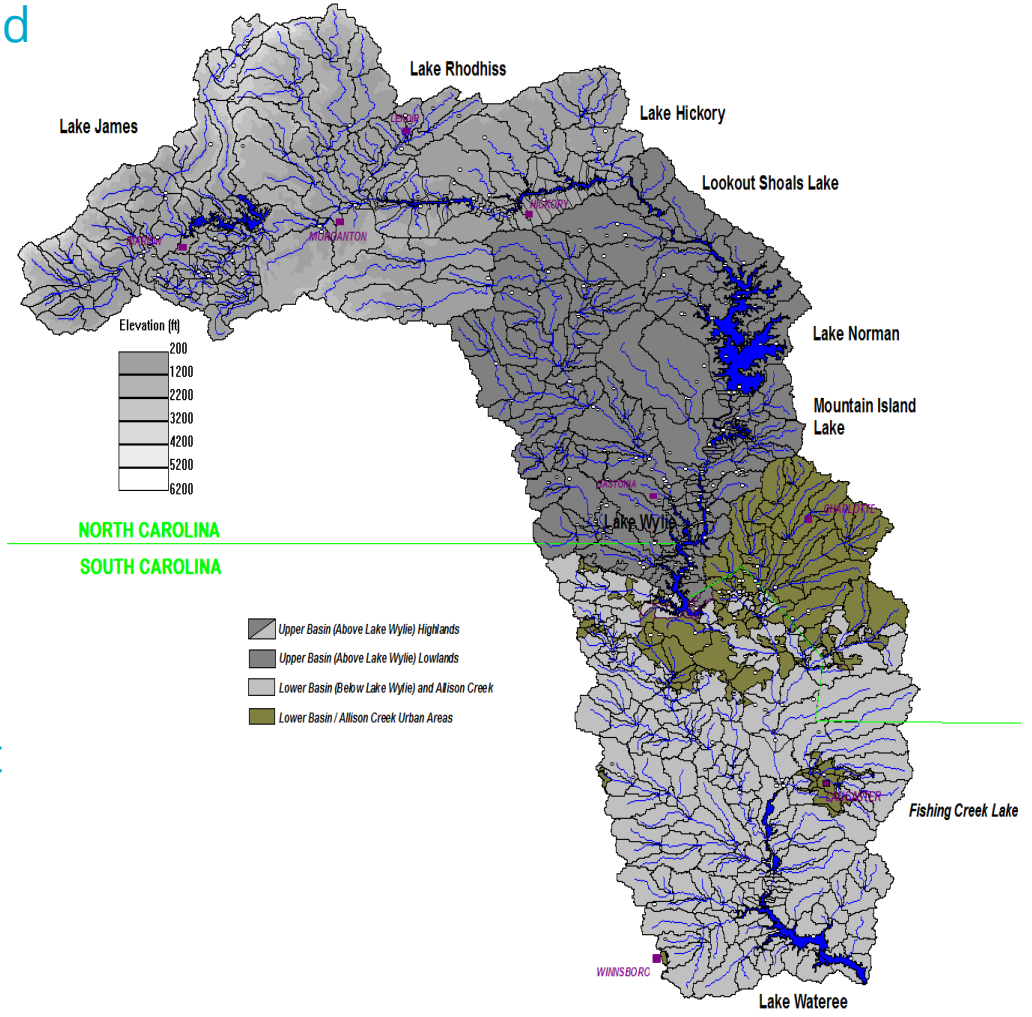
Charleston Harbor 2013 DO TMDL Model

- Model developed by Tetra Tech for BCDCOG
- 3-D EFDC Hydro & WQ
- POCs – fast and slow organic carbon, ammonia
- 13 NPDES facilities (domestic, industrial, paper)
- Target – 0.1 mg/L DO deficit (change from background)
- Total permit load cut ~60%



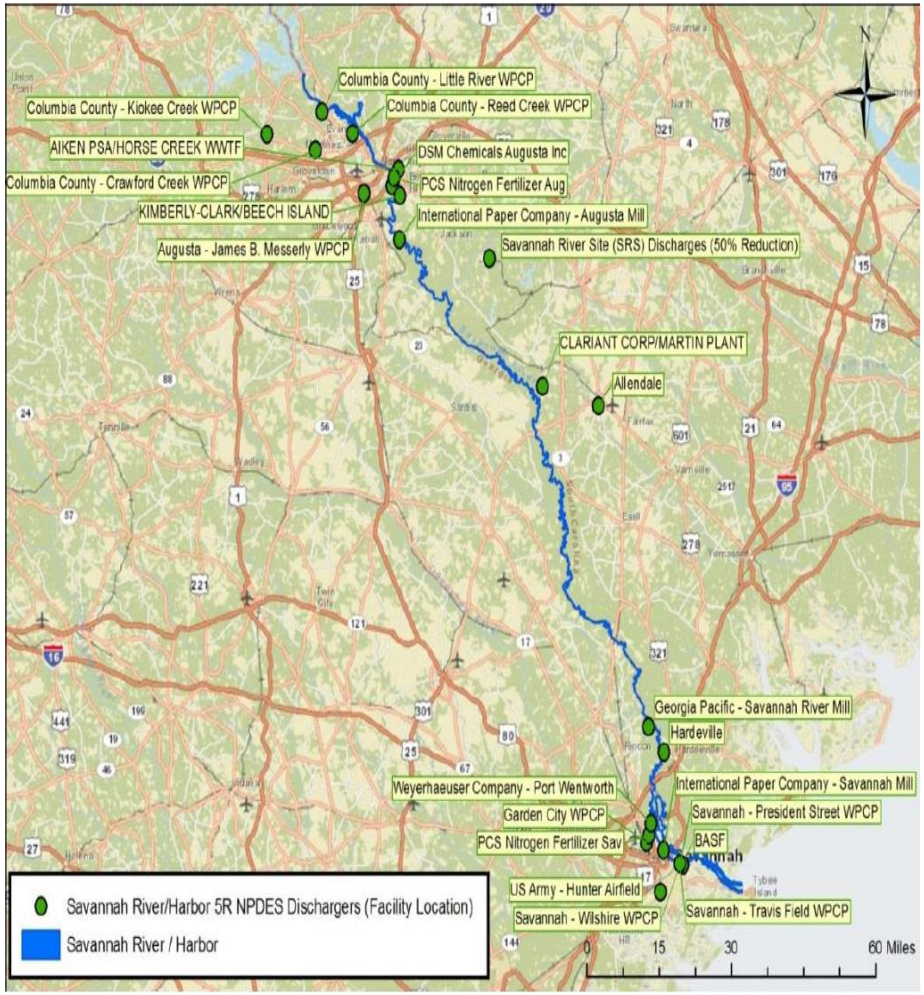
SC-NC Catawba Basin Nutrient Model

- WARMF model originally developed by Systech Water Resources for Duke Energy, NC and SC
- Lower basin updated by Systech for SCDHEC
- POCs – Phosphorus and Nitrogen
- 15 large NPDES facilities, 12 small NPDES facilities, MS4s, NPS
- 2 states, multiple municipalities
- Targets – 0.06 mg/L TP, 1.5 mg/L TN, 40 ug/L chla (SC WQS)
- Initial TP results - ~60% permit cut for facilities, ~40% cut in existing stormwater and NPS
- Additional work to refine model is underway



GA-SC Savannah Harbor 2016 5R Plan Model

- EPD-RIV1 river model developed by GA EPD linked to EFDC/WASP harbor model by Tetra Tech and EPA
- POCs – 2-component CBOD (river), 3-component CBOD (harbor), ammonia
- 24 NPDES facilities (domestic, industrial, paper)
- Time-varying load inputs
- 2 states, 2 metropolitan areas, multiple municipalities
- Target – 0.1 mg/L DO deficit (change from background)
- Total baseline load cut ~72%



Demos

Charleston DO TMDL Calculator DEMO

Charleston TMDL Calculator

Edit colored cells, copy/paste scenario table in gray frame, or click buttons in bottom right corner

011316 WLA Run

Discharge	NPDES	Location	Flow	CBOD5		F-ratio	CBODu		Ammonia		UOD	Percent	DO
Name	Permit No.	waterbody	MGD	mg/L	lbs/day		mg/L	lbs/day	mg/L	lbs/day	lbs/day	of total	mg/L
Summerville	SC0037541	Ashley	10	7.7	642	3.8	29	2,440	0.8	67	2,745	1.9%	7
DCPW/Lower Dorchester	SC0038822	Ashley	12	9	901	2.22	20	2,000	0.8	80	2,365	1.6%	5
Moncks Corner	SC0021598	WB Cooper	3.2	30	801	4.11	123	3,291	20	534	5,730	3.9%	5
BCWSA/Central Berkeley	SC0039764	WB Cooper	6	20	1,001	1.5	30	1,501	10	500	3,788	2.6%	5
DAK Americas Dupont	SC0026506 SC0048950	Cooper	1.32	31.3	345	6.99	219	2,409	1.15	13	2,466	1.7%	4
Sun Chemical+Evonik	SC0003441	Cooper	7.1	20.2958	1,202	4.03	82	4,843	11.5915	686	7,980	5.5%	4
BP Amoco	SC0028584	Cooper	4.19	20.5	716	6.5	133	4,656	0.5	17	4,736	3.3%	4
BCWSA/Lower Berkeley	SC0046060	Cooper	22.5	10	1,877	3.8	38	7,131	2	375	8,846	6.1%	5
KapStone	SC0001759	Cooper	25.6	21	4,484	8.7	183	39,007	2	427	40,959	28.2%	4
CPW/Daniel Island	SC0047074	Cooper	4	5	167	1.5	8	250	1	33	403	0.3%	5
NCSD/Felix Davis	SC0024783	Cooper	34	18	5,104	4.43	80	22,611	5	1,418	29,090	20.0%	4.5
CPW/Plum Island	SC0021229	Harbor	54	10	4,504	3.18	32	14,321	5	2,252	24,612	17.0%	4
Mount Pleasant/CS	SC0040771	Harbor	3.7	30	926	3.18	95	2,944	10	309	4,354	3.0%	1
Mount Pleasant/RR	SC0040771	Harbor	6	30	1,501	3.18	95	4,774	10	500	7,061	4.9%	1
										Total	145,136	100.0%	

Delta DO Results

Discharge	NPDES	Location	Ashley Seg A5		Ashley Seg A43		Cooper Seg C11		Wando Seg W4		Harbor Seg H6		Store
Name	Permit No.	mile*	Delta DO mg/L	Percent of total	Delta DO mg/L	Percent of total	Delta DO mg/L	Percent of total	Delta DO mg/L	Percent of total	Delta mg/L	Percent of total	
Summerville	SC0037541	28.1	-0.001	1%	-0.068	49%	0.000	0%	0.000	0%	0.000	0%	Retrieve
DCPW/Lower Dorchester	SC0038822	23.5	-0.003	3%	-0.069	49%	0.000	0%	0.000	0%	0.000	0%	
Moncks Corner	SC0021598	44.9	-0.002	2%	0.000	0%	-0.011	7%	-0.004	4%	-0.003	4%	WLA
BCWSA/Central Berkeley	SC0039764	42.5	-0.001	2%	0.000	0%	-0.010	7%	-0.003	3%	-0.002	3%	
DAK Americas	SC0026506	30.2	-0.001	1%	0.000	0%	-0.004	3%	-0.002	2%	-0.001	2%	
Sun Chemical	SC0003441	22.1	-0.004	5%	0.000	0%	-0.017	12%	-0.009	9%	-0.006	9%	
BP Amoco	SC0028584	19.2	-0.002	2%	0.000	0%	-0.006	4%	-0.004	4%	-0.003	4%	
BCWSA/Lower Berkeley	SC0046060	18.2	-0.005	5%	0.000	0%	-0.013	8%	-0.010	10%	-0.006	9%	
MeadWestvaco	SC0001759	12.9	-0.012	14%	0.000	0%	-0.041	28%	-0.026	25%	-0.016	23%	
CPW/Daniel Island	SC0047074	8.4	0.000	0%	0.000	0%	0.000	0%	0.000	0%	0.000	0%	
NCSD/Felix Davis	SC0024783	7.2	-0.016	18%	0.000	0%	-0.033	22%	-0.030	29%	-0.017	25%	
CPW/Plum Island	SC0021229	5.0	-0.037	42%	-0.001	1%	-0.007	4%	-0.008	7%	-0.007	11%	
Mount Pleasant/CS&RR	SC0040771	1.6	-0.004	5%	0.000	0%	-0.007	4%	-0.007	7%	-0.007	10%	
		Delta DO	-0.1	100%	-0.1	100%	-0.1	100%	-0.1	100%	-0.1	100%	

South Carolina Department of Health and Environmental Control

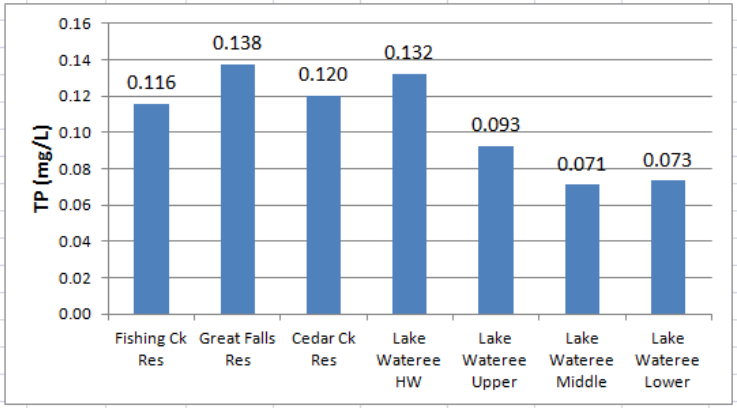
Lower Catawba Basin TP Calculator* DEMO

"Baseline" - 2014 Permit Limits and Existing MS4s and Human NPS							
NPDES	Name	Downstream Lake	Flow (MGD)	TP (mg/L)	TP (lbs/day)	TP (kg/day)	Fraction of Baseline
NC0024937	CMUD/Sugar Ck WWTP	Fishing Ck Res	20	1.00	166.9	75.7	1
NC0024945	CMUD/Irwin Ck WWTP	Fishing Ck Res	15	1.00	125.2	56.8	1
NC0024970	CMUD/McAlpine Ck WWTP	Fishing Ck Res	64	1.00	534.2	242.3	1
NC0085359	Union County/Twelvemile Ck WWTP	Fishing Ck Res	6	0.42	20.9	9.46	1
SC0001015	Resolute Forest Products	Fishing Ck Res	25	1.40	291.9	132.4	1
SC0020371	Fort Mill WWTP	Fishing Ck Res	3	0.50	12.5	5.67	1
SC0020443	Rock Hill WWTP	Fishing Ck Res	20	0.75	124.6	56.5	1
SC0027146	Foxwood SD/Blue Ribbon Utilities	Fishing Ck Res	0.12	1.00	1.0	0.454	1
SC0030112	Lamplighter Village SD/CWS	Fishing Ck Res	0.63	2.00	10.5	4.76	1
SC0046892	City of Lancaster WWTP	Fishing Ck Res	7.5	0.77	48.0	21.77	1
SC0047864	Lancaster County/Indianland WWTP	Fishing Ck Res	1.2	1.67	16.7	7.57	1
SC0038156	York/Fishing Ck WWTP	Great Falls Res	2	1.02	17.0	7.71	1
SC0001741	Chester/Lando-Manetta WWTP	Great Falls Res	0.8	0.62	4.1	1.88	1
SC0036056	Chester/Rocky Ck WWTP	Cedar Ck Res	1.36	1.00	11.3	5.13	1
SC0021211	Great Falls WWTP	Cedar Ck Res	1.4	1.03	12.0	5.44	1
FCR Subwatershed MS4s and Human NPS		Fishing Ck Res					1
GFR Subwatershed MS4s and Human NPS		Great Falls Res					1
CCR Subwatershed MS4s and Human NPS		Cedar Ck Res					1
LWAT Subwatershed MS4s and Human NPS		Lake Wateree					1

Results

	Fishing Ck Res	Great Falls Res	Cedar Ck Res	Wateree HW	Wateree Upper	Wateree Middle	Wateree Lower
Seg ID	L1562	L1563	L1567	R0624	L0579	L2310	L2292
TP mg/L	0.12	0.14	0.12	0.13	0.09	0.07	0.07

WQS = 0.06 mg/L TP



Input Effluent Flow Check	
Scenario Total Effluent Flow (MGD) =	168.01
Baseline Total Flow (MGD) =	168.01
Percent Change from Baseline =	0.0%
INPUT FLOWS OK	

*Initial version for information only, model is being refined

Wrapping Up…Why do this?

- With complex models, one scenario can take days and $$$ to set up, run, process and communicate results ***versus*** a few mouse clicks with the calculator
- Source weighting is clear and transparent which facilitates optimization and trading
- Empowers stakeholders to instantly evaluate unlimited alternatives in group settings
- Helps the conversation move from model minutiae to equitability, future growth, interstate allocations, etc.
- Allows future reallocations without redoing the TMDL…the calculator ***is*** the TMDL

CONTACT US

For additional information, contact

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