




Bacteria TMDLs for Eastern Bayous

November 12, 2008



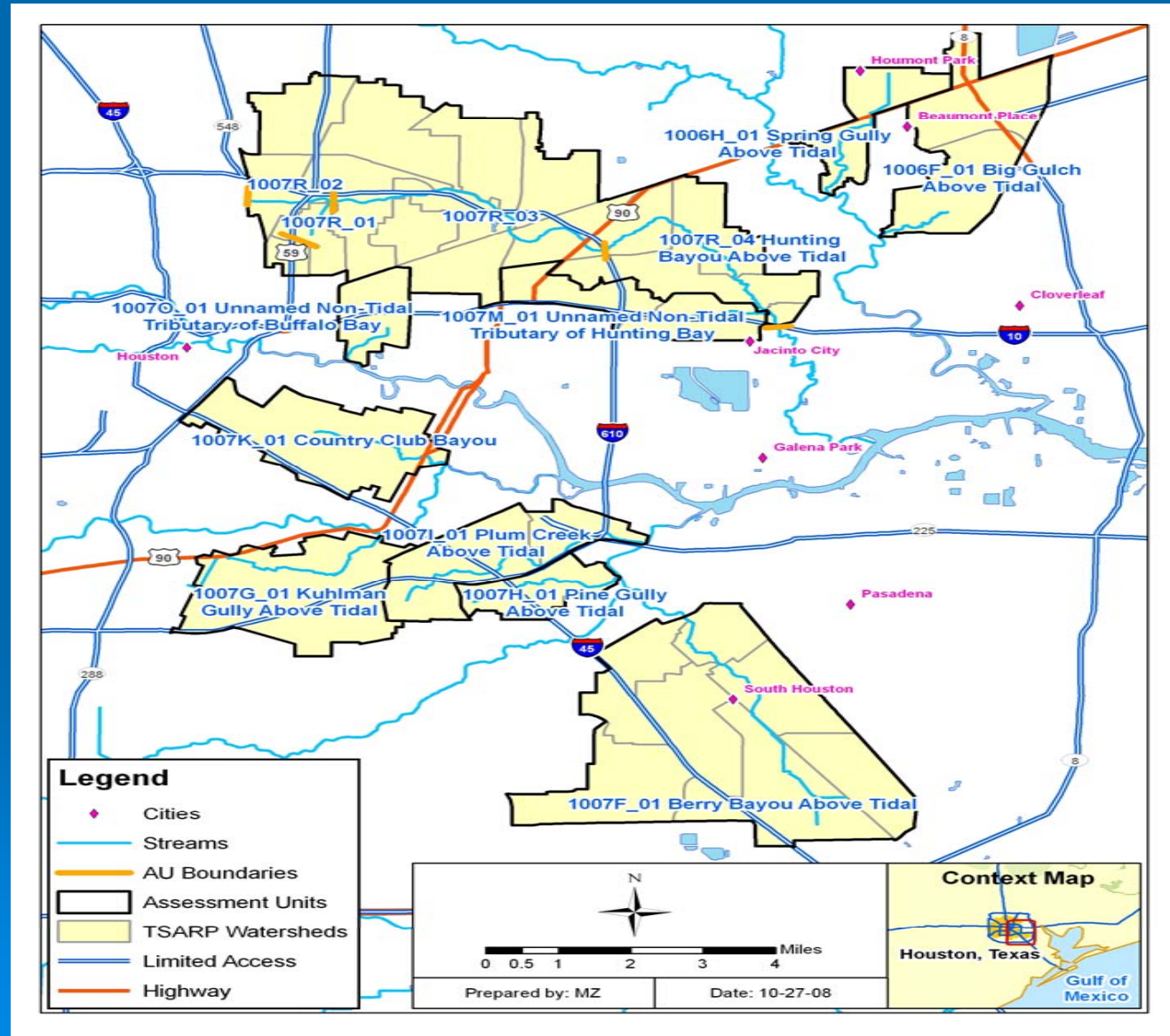
PARSONS

Outline

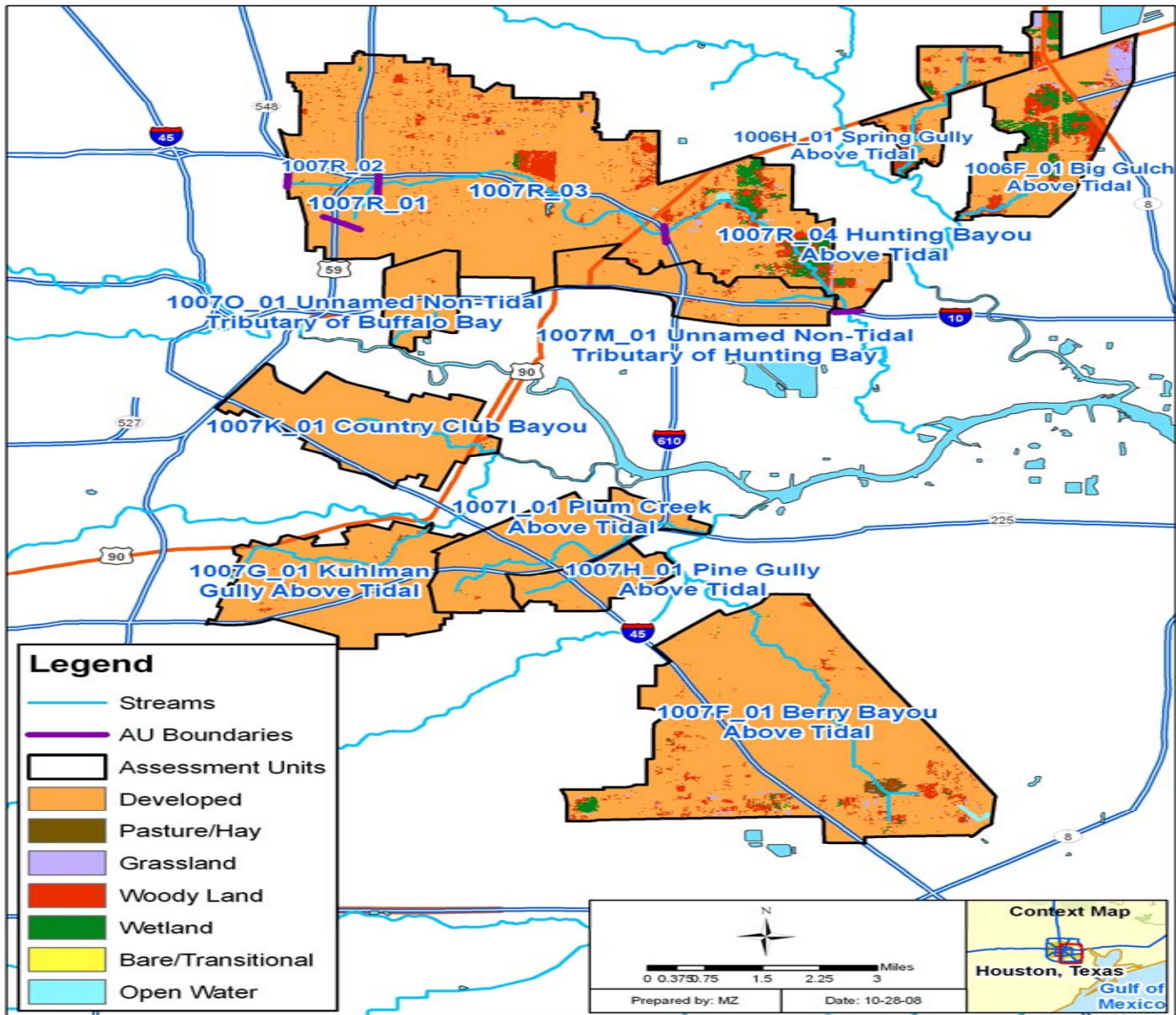
- **Watershed Overview**
 - **Pollutant Source Assessment**
 - **Technical Approach: Load Duration Curves**
 - **TMDL Calculations**
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Eastern Houston Bayou Watershed

- ▶ ~63 square miles
- ▶ Located within Harris County
- ▶ Average Annual Rainfall 49.8 inches (NOAA 2007)



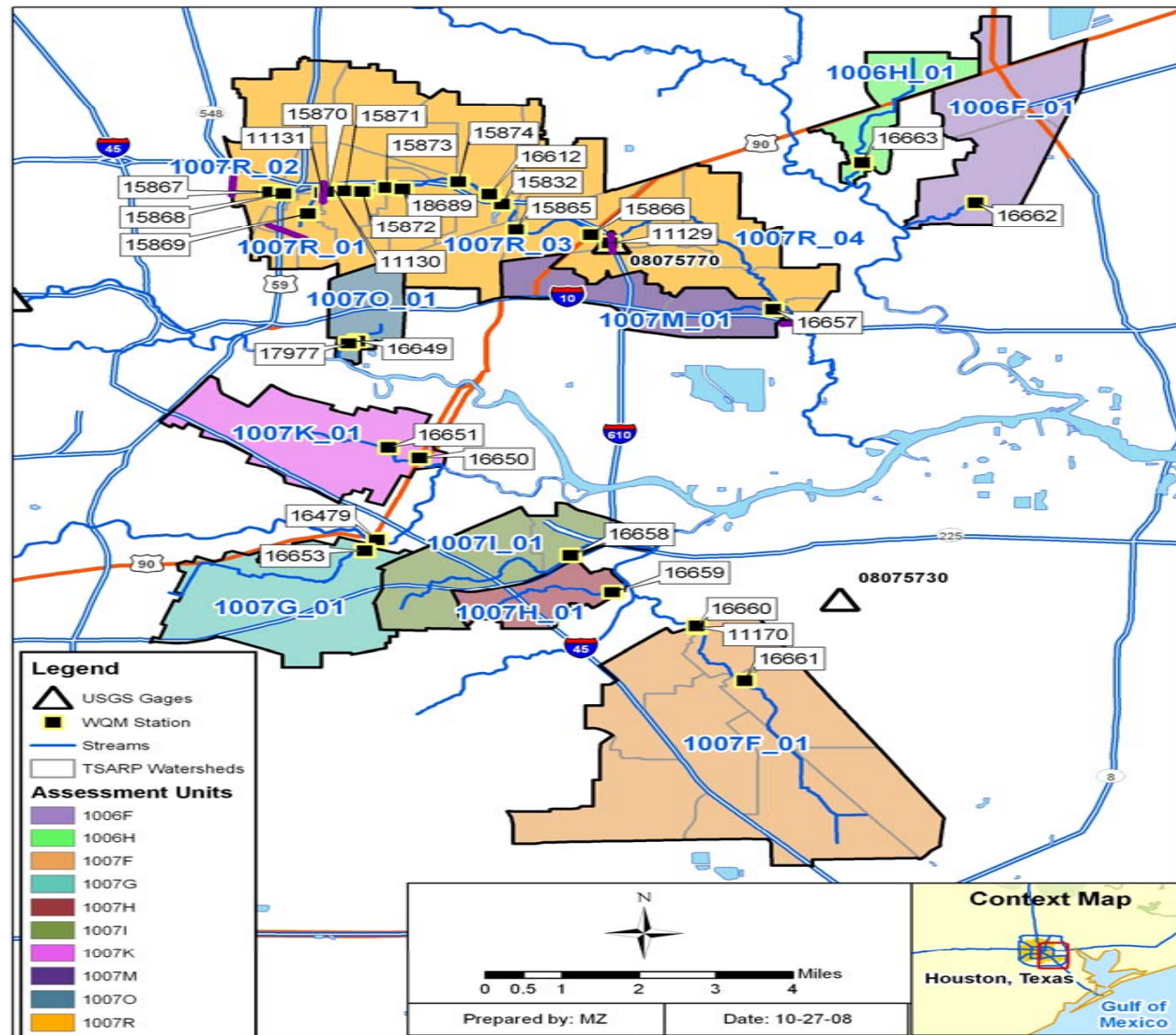
Land Use/Land Cover



303 (d) Listed Assessment Units (2008)

Assessment Unit	Water Body	Description of Assessment Unit Not Supporting Contact Recreation Use
1006F_01	Big Gulch above Tidal	Entire Segment
1006H_01	Spring Gully above Tidal	Entire Segment
1007F_01	Berry Bayou above Tidal	1.5 miles Upstream from Confluence with Sims Bayou to SH 3
1007G_01	Kuhlman Gully above Tidal	Entire Segment
1007H_01	Pine Gully above Tidal	Entire Segment
1007I_01	Plum Creek above Tidal	Entire Segment
1007K_01	Country Club Bayou above Tidal	Entire Segment
1007M_01	Unnamed Non-Tidal Tributary of Hunting Bayou	Entire Segment
1007 O_01	Unnamed Non-Tidal Tributary of Buffalo Bayou	Entire Segment
1007R_01	Hunting Bayou above Tidal	From Bain St. to Sayers St. (South Fork)
1007R_02		From just east of Elysian St. to Falls St. (N. Fork)
1007R_03		From Falls St. to Loop 610 (S. of US 90A)
1007R_03		From Loop 610 to IH 10

Water Quality Monitoring Stations

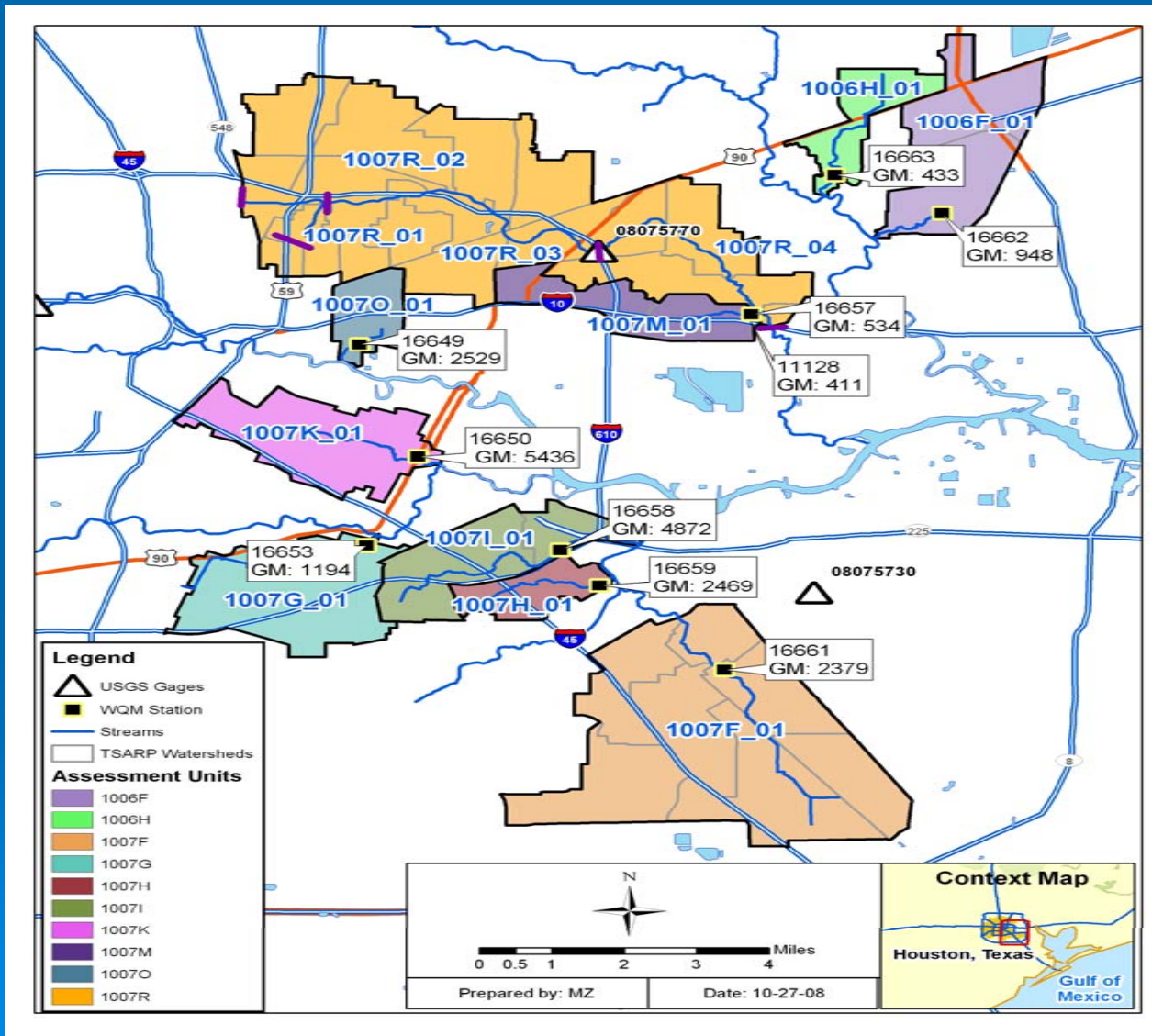


***E. coli* Data for TCEQ Stations from 1996 to 2006**

Assessment Unit	Station ID	Geometric Mean Concentration	Number of Samples	Number of Samples Exceeding Single Sample Criteria	% of Samples Exceeding
1006F_01	16662	948	83	56	67%
1006H_01	16663	433	80	43	54%
1007F_01	16661	2379	61	59	97%
1007G_01	16653	1194	80	48	60%
1007H_01	16659	2469	77	67	87%
1007I_01	16658	4872	71	65	92%
1007K_01	16650	5436	75	71	95%
1007M_01	16657	534	76	44	58%
1007O_01	16649	2529	77	63	82%
1007R_04	11128	411	77	46	60%

* Geometric Mean Criteria for *E. coli* is 126 MPN/100mL and Single Sample Criteria is 394 MPN/100mL

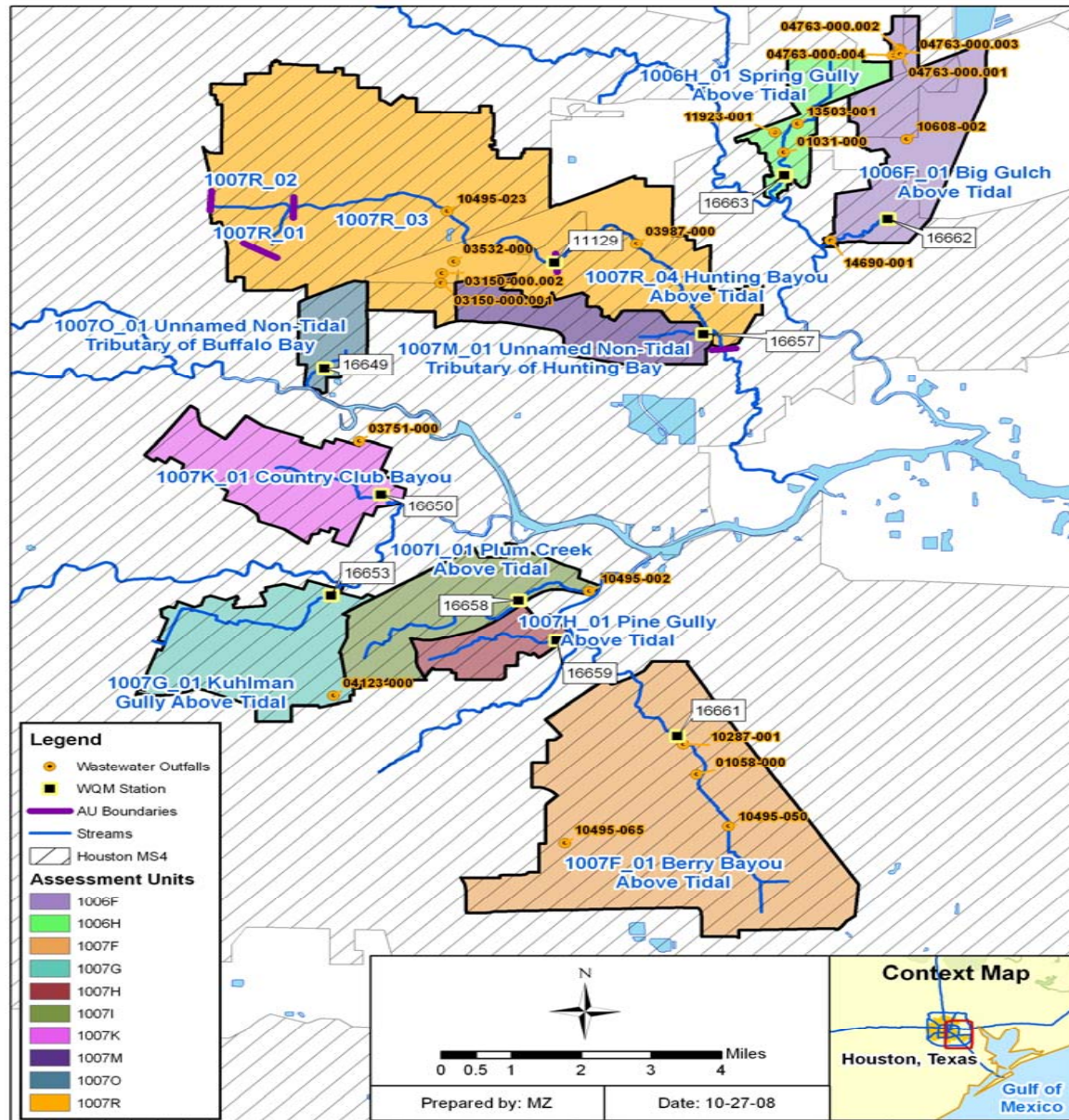
Eastern Houston Bayou *E. coli* Geomeans



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- Watershed Overview
- Pollutant Source Assessment
- Technical Approach: Load Duration Curves
- TMDL Calculations

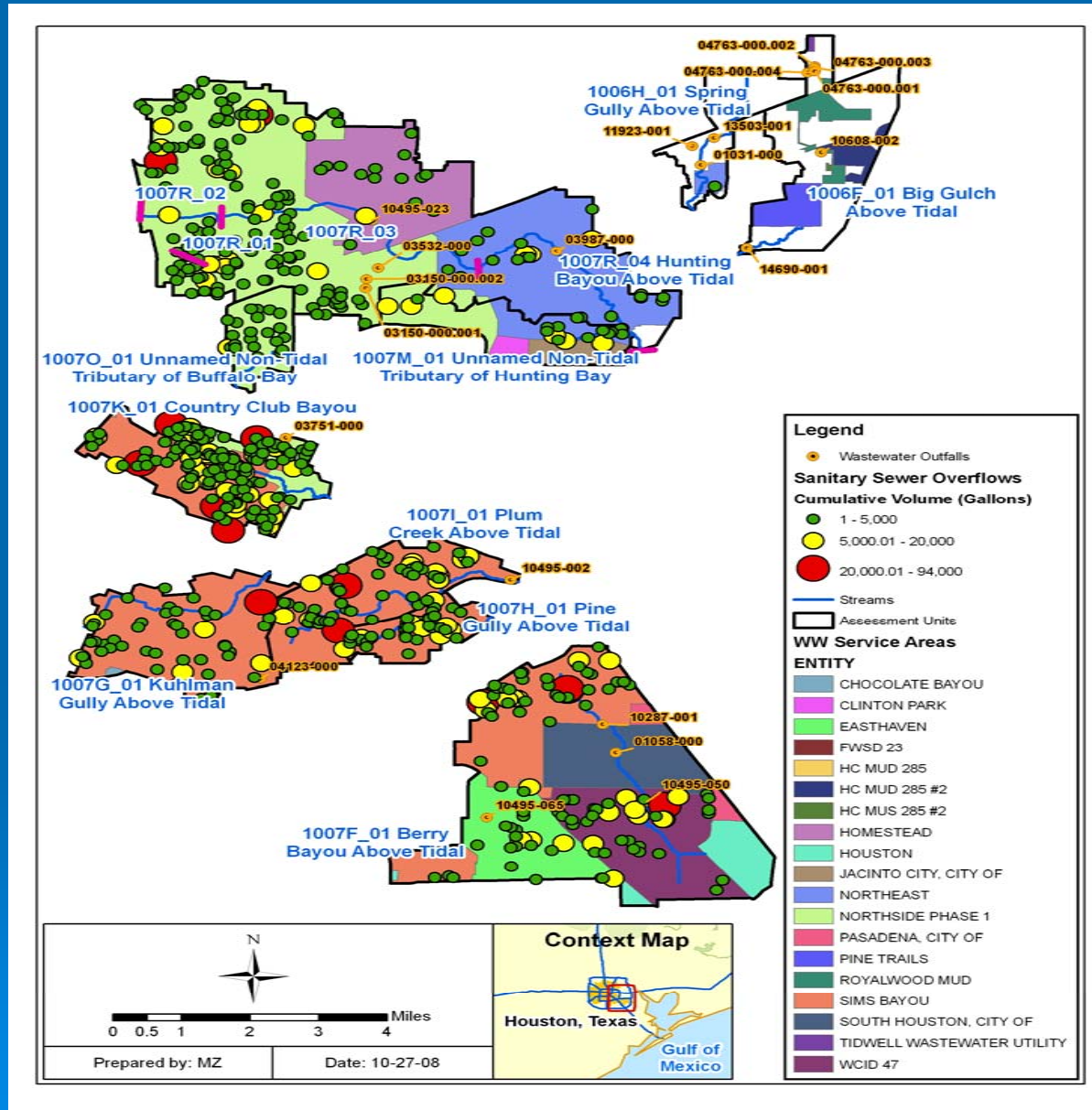
Wastewater Treatment Plants



Summary of TPDES-Permitted Facilities in the Study Area

Assessment Unit	Number of Facilities	Total Permitted Flow (MGD)	Total Average Monthly Flow (MGD)
1006F_01	2	0.35	0.124
1006H_01	2	0.025	0.006
1007F_01	3	12.76	6.7
1007R_03	1	4	1.8
1007R_04	1	0.2	0.001

Sanitary Sewer Overflows



Permitted Stormwater for WQ0004685000

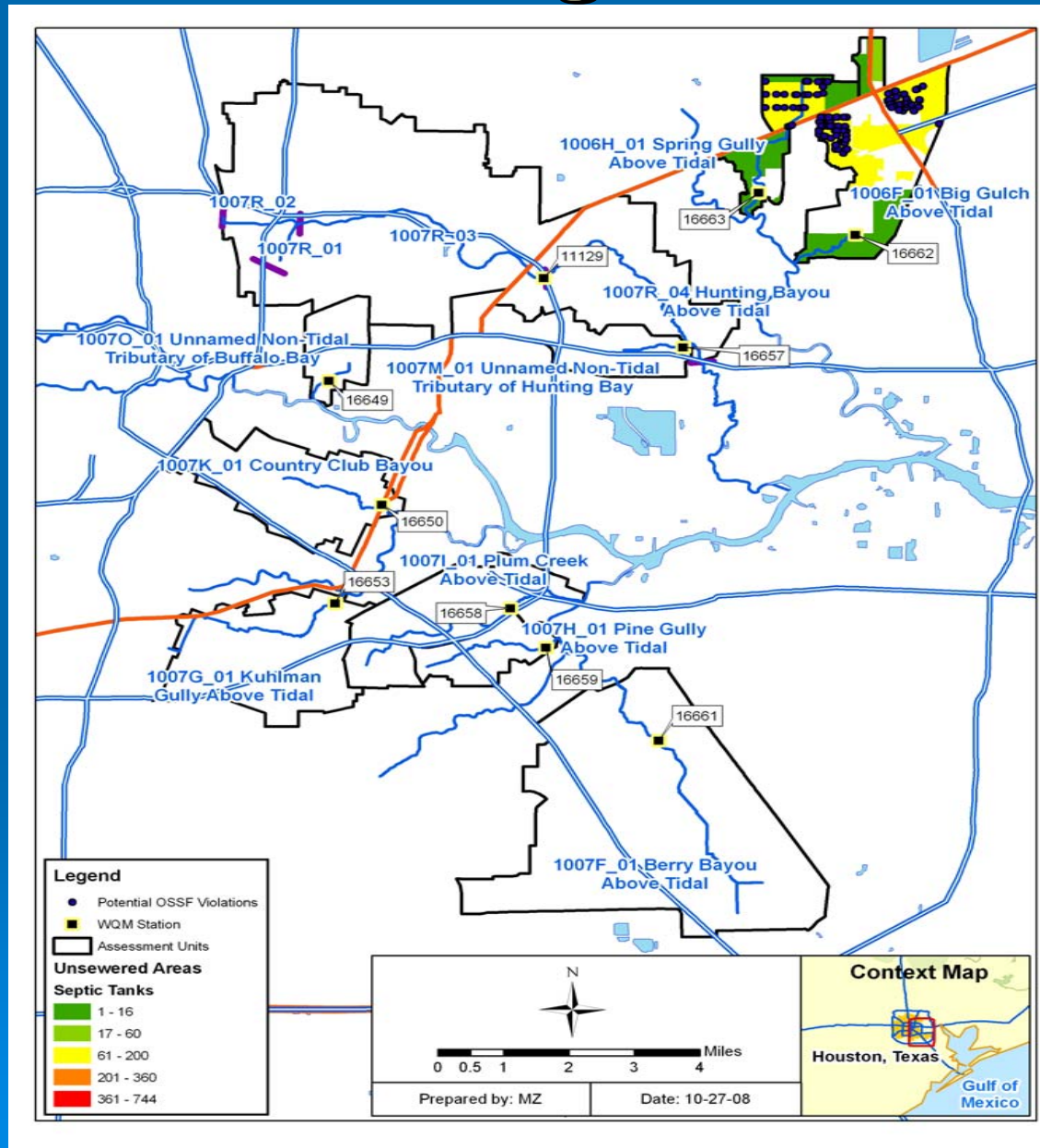
Assessment Unit	Stream Name	Total Area (acres)	Area under MS4 Permit (Acres)	Percent of Watershed under MS4 Jurisdiction
1006F_01	Big Gulch above Tidal	3,167	1,827	58%
1006H_01	Spring Gully above Tidal	1,265	1,123	89%
1007F_01	Berry Bayou above Tidal	9,916	9,916	100%
1007G_01	Kuhlman Gully above Tidal	3,356	3,356	100%
1007H_01	Pine Gully above Tidal	1,026	1,026	100%
1007I_01	Plum Creek above Tidal	2,548	2,548	100%
1007K_01	Country Club Bayou	2,894	2,894	100%
1007M_01	Unnamed Non-Tidal Tributary of Hunting Bay	1,771	1,771	100%
1007O_01	Unnamed Non-Tidal Tributary of Buffalo Bay	970	970	100%
1007R_01	Hunting Bayou above Tidal	788	788	100%
1007R_02		717	717	100%
1007R_03		9,111	7,939	87%
1007R_04		3,121	2,428	78%
1007R (total)		13,737	11,872	86%

Population Projections

Stream Name	Assessment Unit	2005	2035	Increase
Big Gulch Above Tidal	1006F_01	10,167	15,545	35%
Spring Gully Above Tidal	1006H_01	2,850	4,536	37%
Berry Bayou Above Tidal	1007F_01	68,390	89,140	23%
Kuhlman Gully Above Tidal	1007G_01	24,146	34,936	31%
Pine Gully Above Tidal	1007H_01	11,574	12,596	8%
Plum Creek Above Tidal	1007I_01	30,046	38,680	22%
Country Club Bayou	1007K_01	28,911	39,732	27%
Unnamed Non-Tidal Tributary of Hunting Bay	1007M_01	5,834	9,441	38%
Unnamed Non-Tidal Tributary of Buffalo Bay	1007O_01	5,864	7,350	20%
Hunting Bayou Above Tidal	1007R_01	5,134	5,468	6%
Hunting Bayou Above Tidal	1007R_02	4,061	5,541	27%
Hunting Bayou Above Tidal	1007R_03	45,918	62,092	26%
Hunting Bayou Above Tidal	1007R_04	8,673	13,773	37%

Source: HGAC 2007

On-Site Sewage Facilities




On-Site Sewage Facilities

Segment	Stream Name	OSSF Estimate using 1990 Census Method
1006F	Big Gulch Above Tidal	403
1006H	Spring Gully Above Tidal	197
1007F	Berry Bayou Above Tidal	0
1007G	Kuhlman Gully Above Tidal	0
1007H	Pine Gully Above Tidal	0
1007I	Plum Creek Above Tidal	0
1007K	Country Club Bayou	0
1007M	Unnamed Non-Tidal Tributary of Hunting Bay	0
1007O	Unnamed Non-Tidal Tributary of Buffalo Bay	0
1007R	Hunting Bayou Above Tidal	0

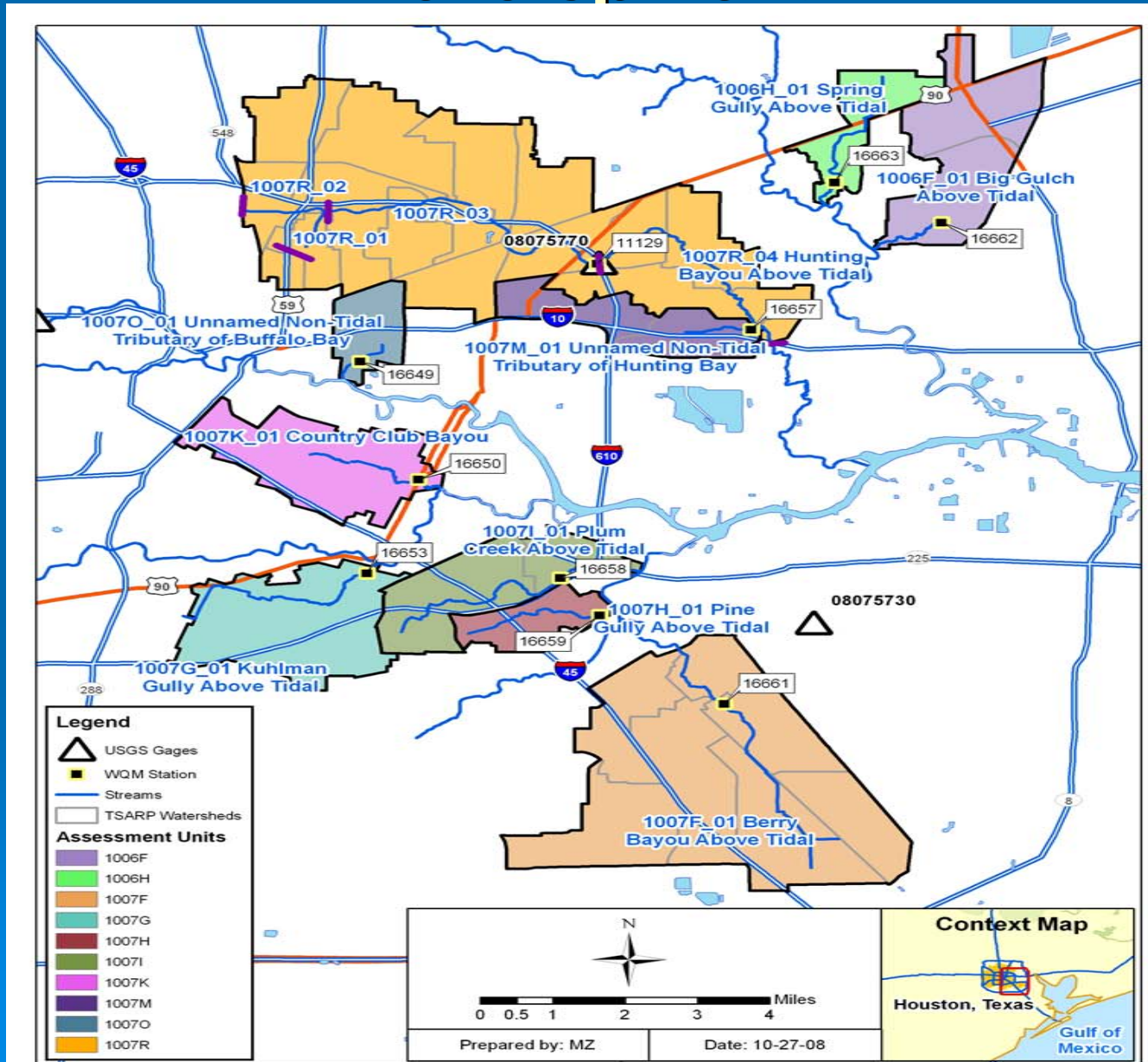
Estimated Number of Pets

Segment	Stream Name	Dogs	Cats
1006F	Big Gulch Above Tidal	2,096	2,385
1006H	Spring Gully Above Tidal	2,493	2,837
1007F	Berry Bayou Above Tidal	11,737	13,356
1007G	Kuhlman Gully Above Tidal	7,300	8,307
1007H	Pine Gully Above Tidal	4,177	4,753
1007I	Plum Creek Above Tidal	8,192	9,322
1007K	Country Club Bayou	8,348	9,499
1007M	Unnamed Non-Tidal Tributary of Hunting Bay	631	718
1007O	Unnamed Non-Tidal Tributary of Buffalo Bay	2,663	3,031
1007R	Hunting Bayou Above Tidal	10,495	11,942

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WQM Stations Targeted for TMDL Development



USGS Gages in the Eastern Houston Bayou Watershed

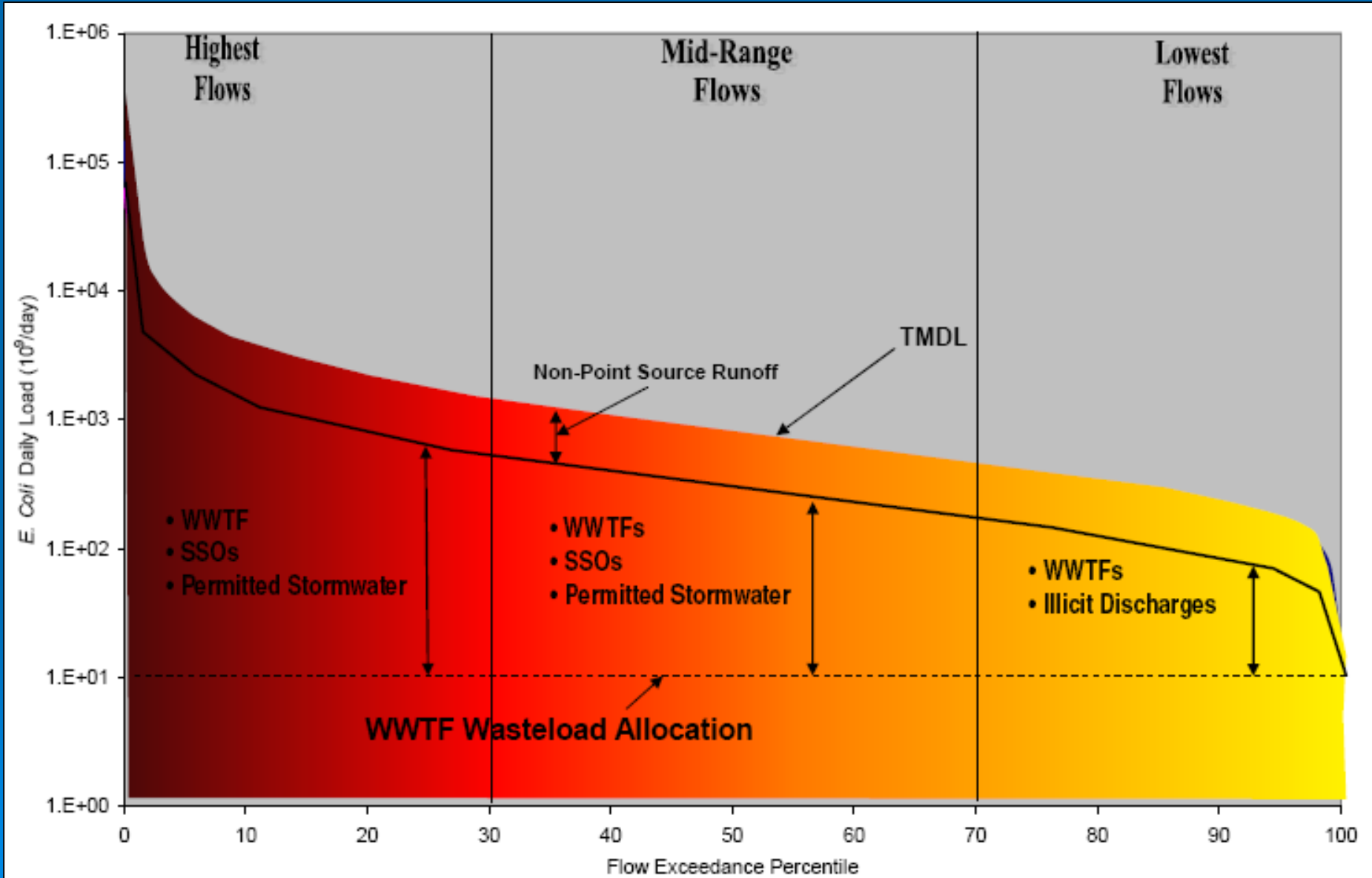
USGS Gage Number	Name	Period of Record	Data Type
8075770	Hunting Bayou at IH 610	5/1/1964 Present	Discharge (cfs)
		9/5/1996 - Present	Gage Height (ft)
8075650	Berry Bayou at Forrest Oaks St.	10/1/1997 - 10/3/2006	Gage Height (ft)

* Highlight - USGS gage station used to project flows.

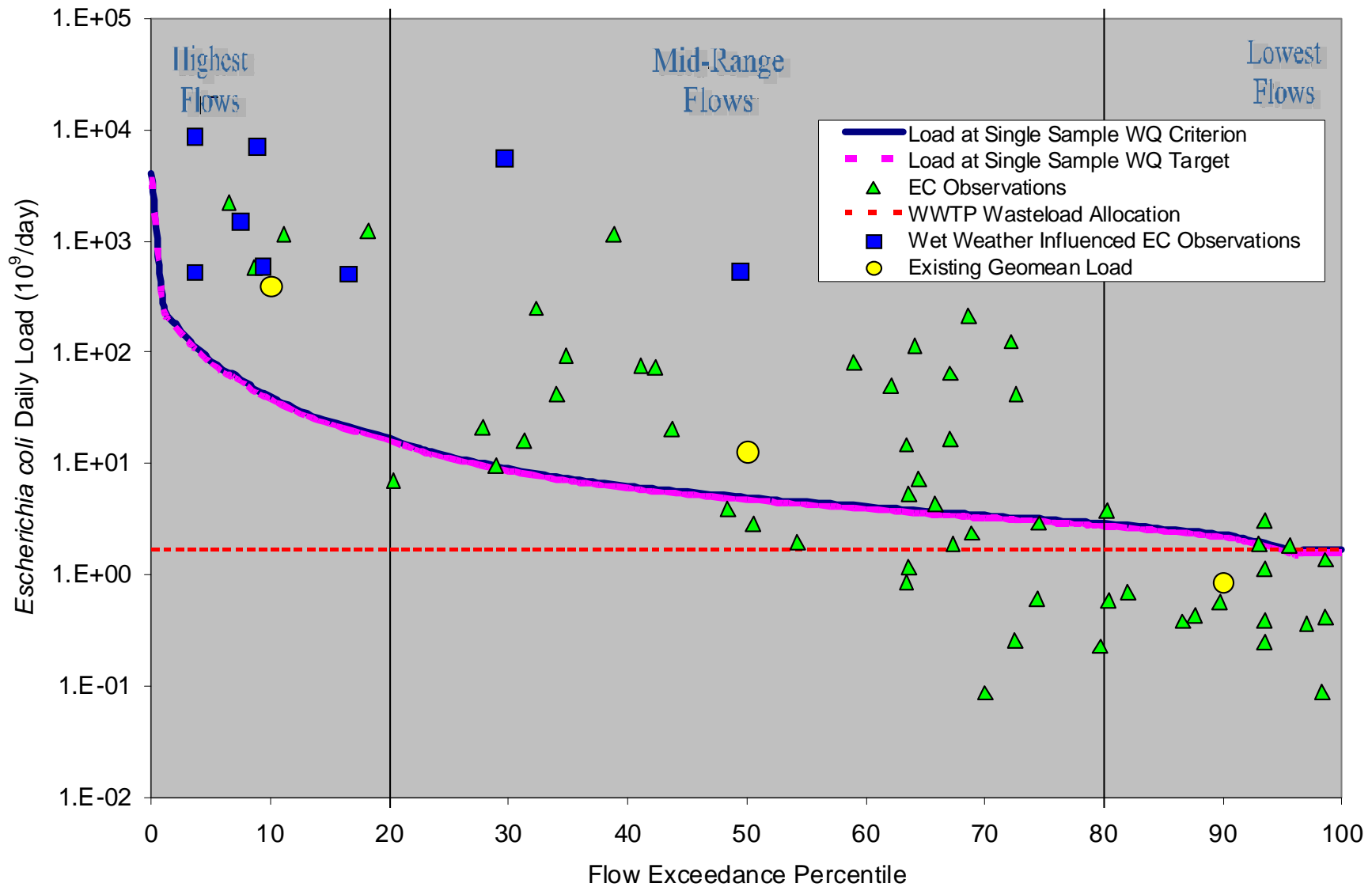
Flow Percentiles

Assessment Unit	1006F _01	1006H _01	1007F _01	1007G _01	1007H _01	1007I _01	1007K _01	1007M _01	1007O _01	1007R _04
Watershed Area (sq. mile)	4.4	1.8	9.5	5.2	1.6	3.3	4.5	2.8	1.4	24.1
Average Annual Rainfall (inch)	60.5	60.5	53.6	47.1	47.1	47.2	47.1	51.8	50.8	50.8
Percentile	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)
0	418	1,173	5,131	2,239	616	1,685	1,551	1,992	221	4,456
10	4.1	11	34	12	3.2	8.9	13	10	4.0	80
20	1.7	4.3	16	3.1	0.86	2.3	5.2	2.8	1.0	35
30	0.94	2.2	13	1.5	0.42	1.2	2.7	1.4	0.56	20
40	0.65	1.5	11	1.1	0.31	0.84	1.9	1.0	0.42	15
50	0.51	1.1	10	0.83	0.23	0.62	1.5	0.74	0.32	12
60	0.43	0.88	8.8	0.64	0.18	0.48	1.2	0.57	0.24	10.1
70	0.35	0.68	8.1	0.48	0.13	0.36	1.0	0.43	0.19	8.3
80	0.30	0.52	7.2	0.38	0.11	0.29	0.75	0.34	0.15	6.8
90	0.24	0.36	2.0	0.26	0.07	0.19	0.57	0.23	0.10	5.3
100	0	0.00	0.14	0.03	0.01	0.02	0	0.03	0.01	0

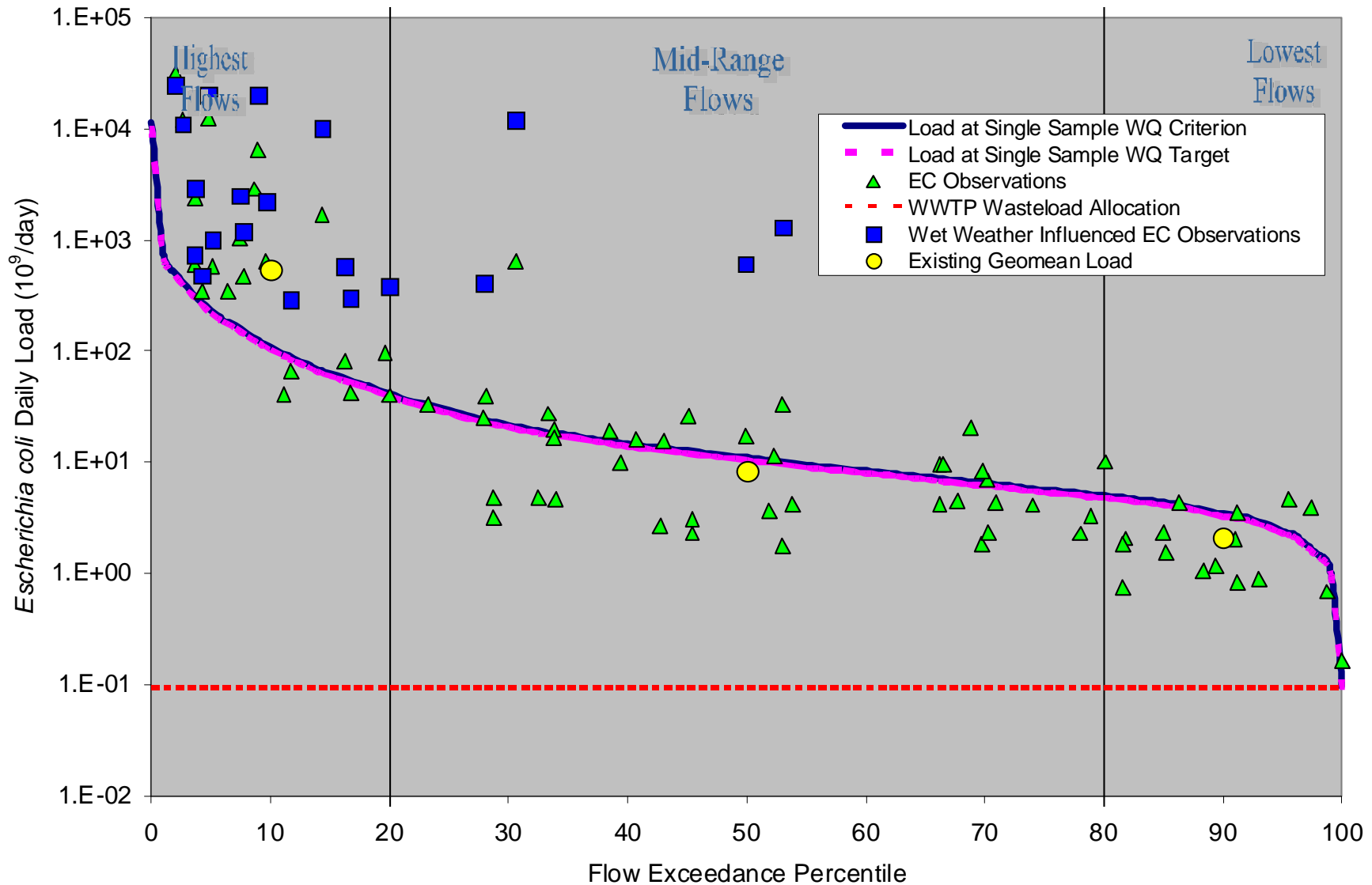
LDC Schematic



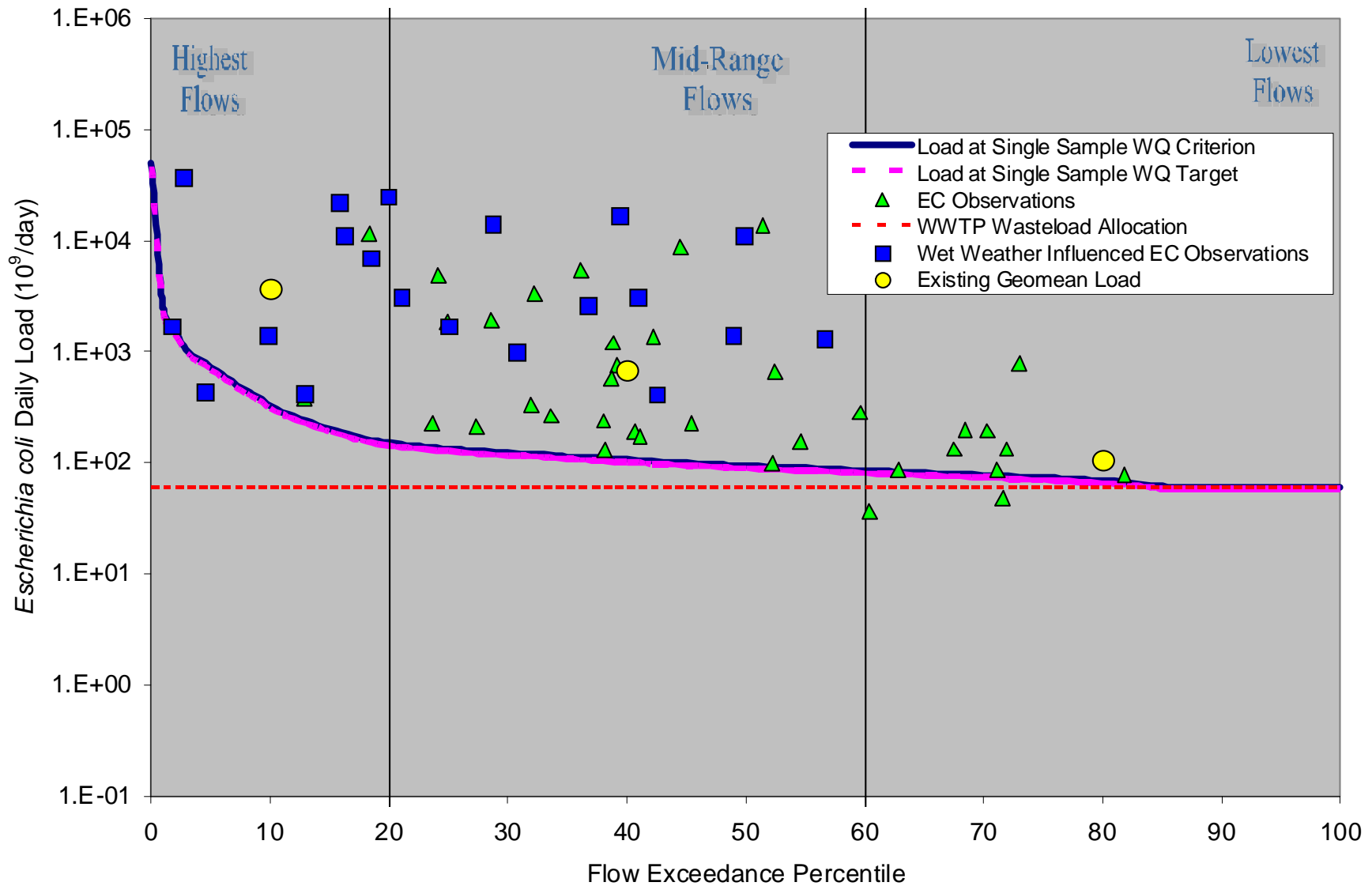
Load Duration Curve for Big Gulch Above Tidal (1006F_01)



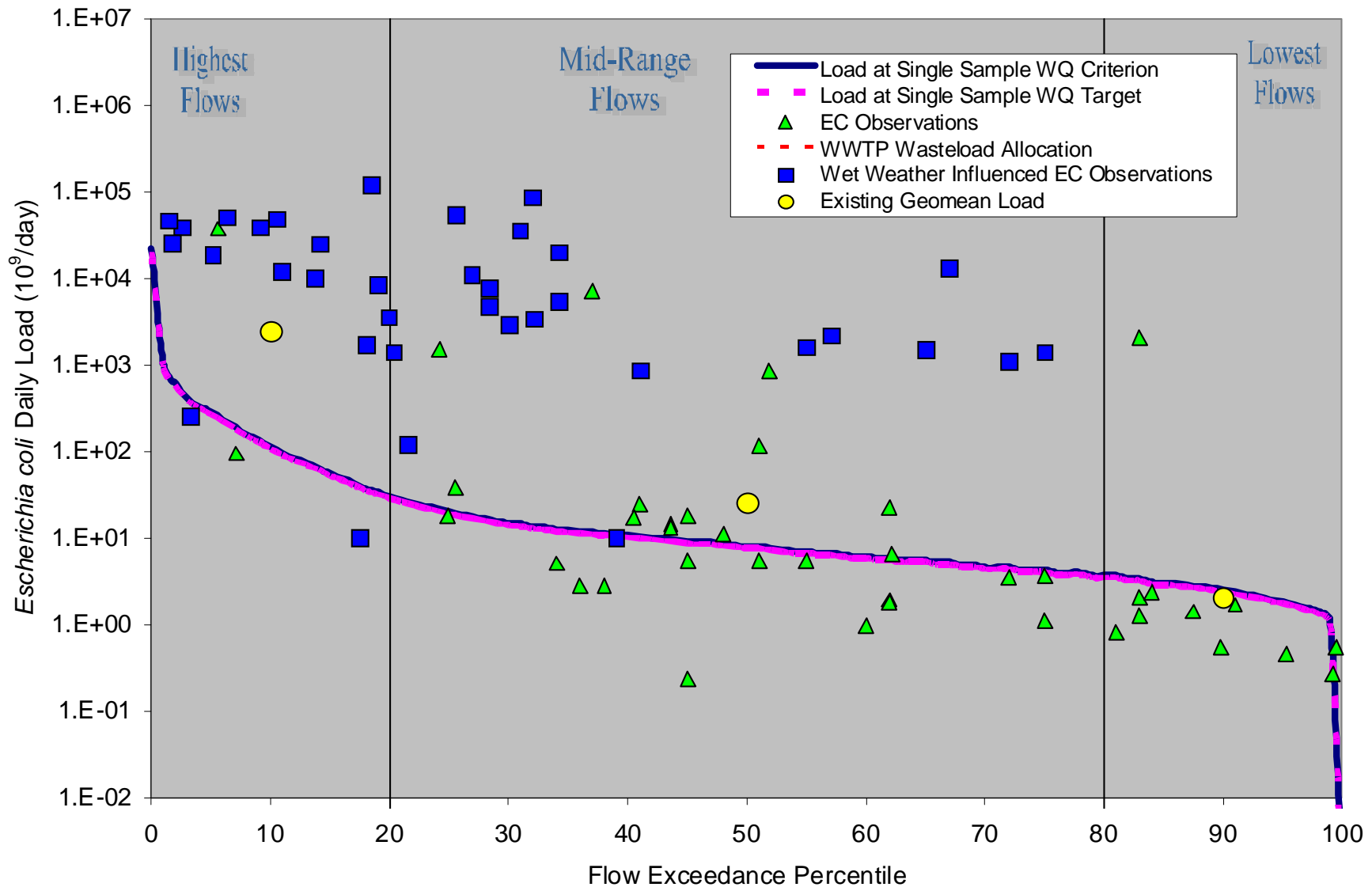
Load Duration Curve for Spring Gully Above Tidal (1006H_01)



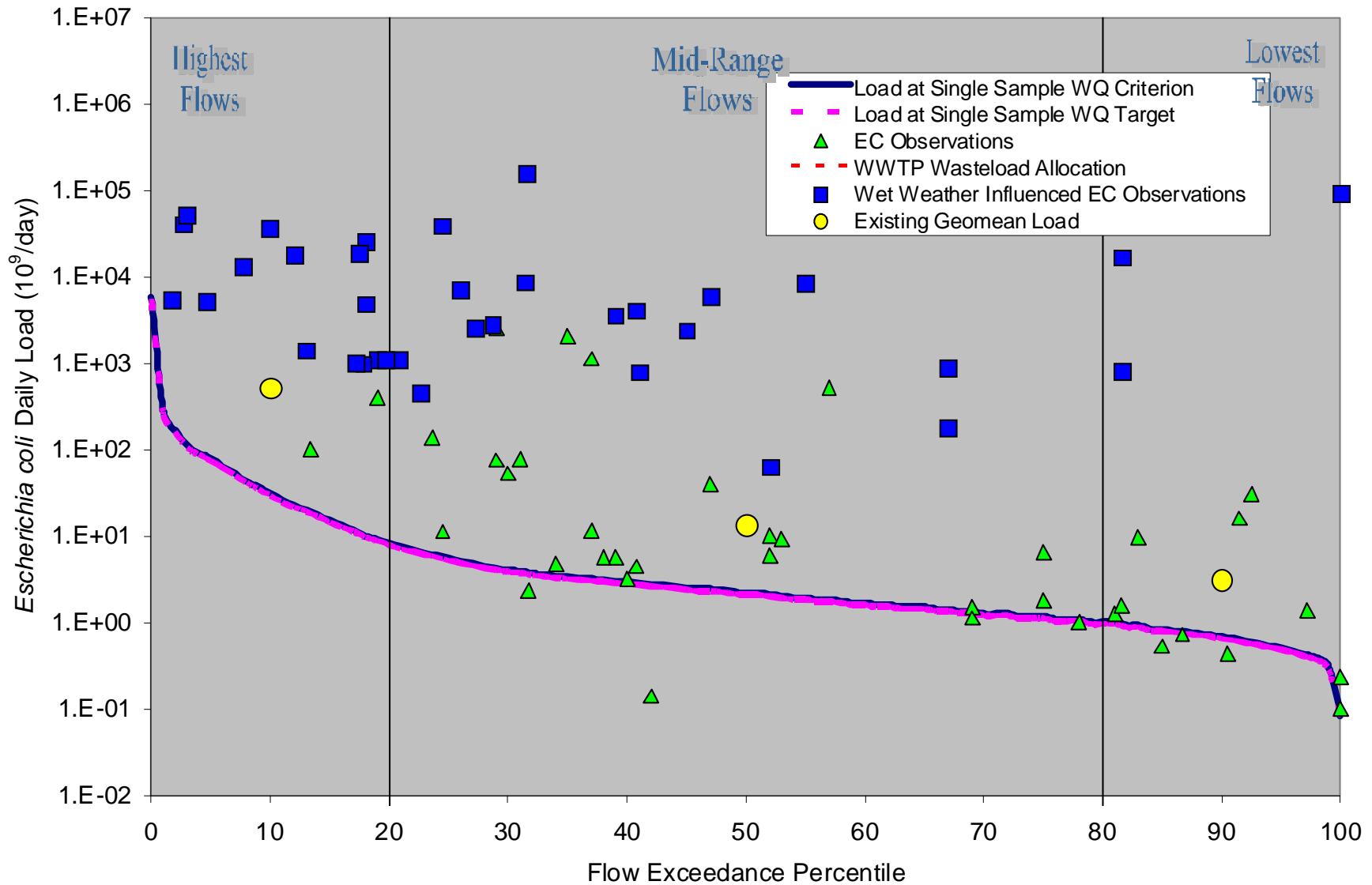
Load Duration Curve for Berry Bayou Above Tidal (1007F_01)



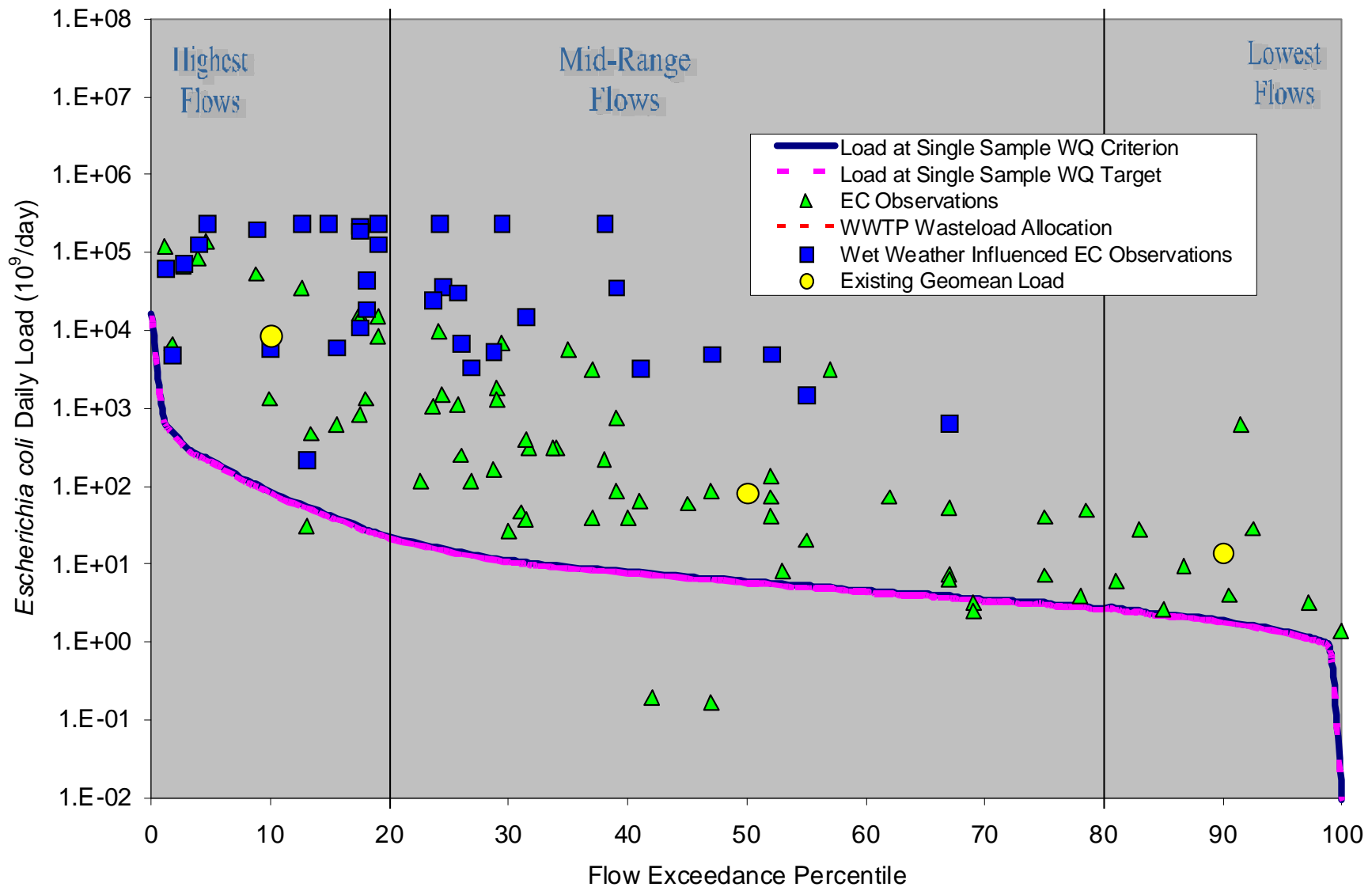
Load Duration Curve for Kuhlman Gully Above Tidal (1007G_01)



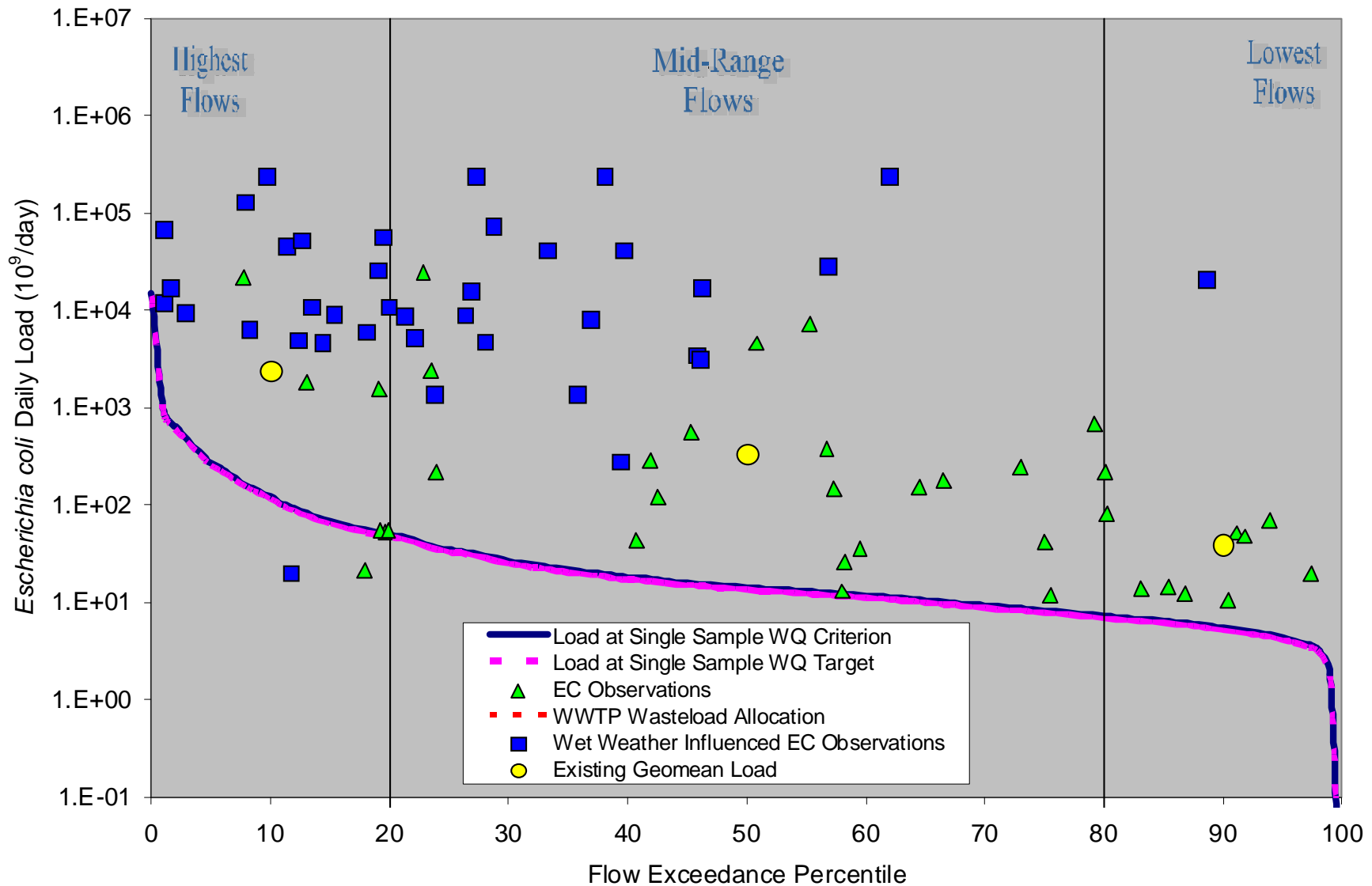
Load Duration Curve for Pine Gully Above Tidal (1007H_01)



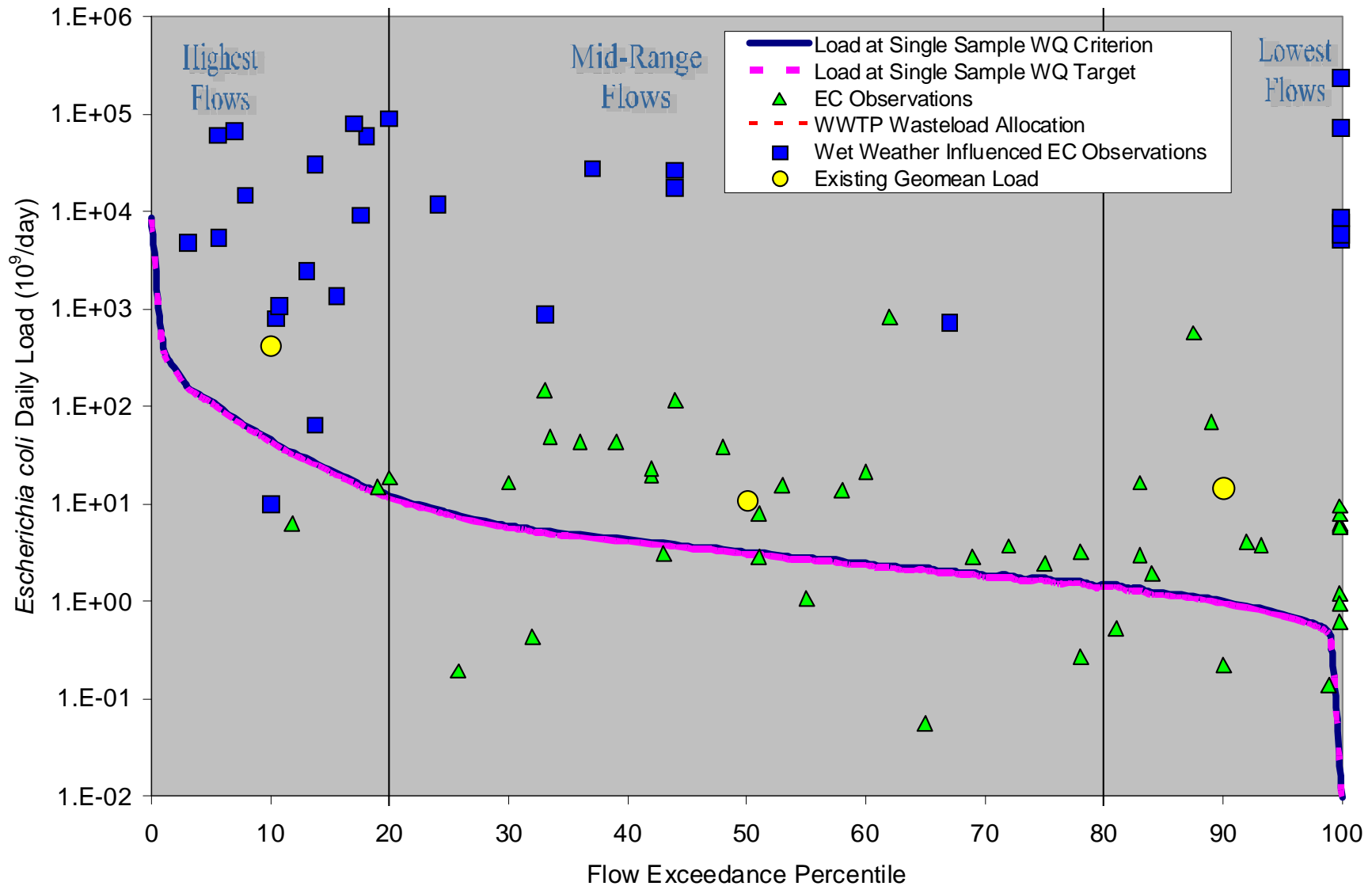
Load Duration Curve for Plum Creek Above Tidal (1007I_01)



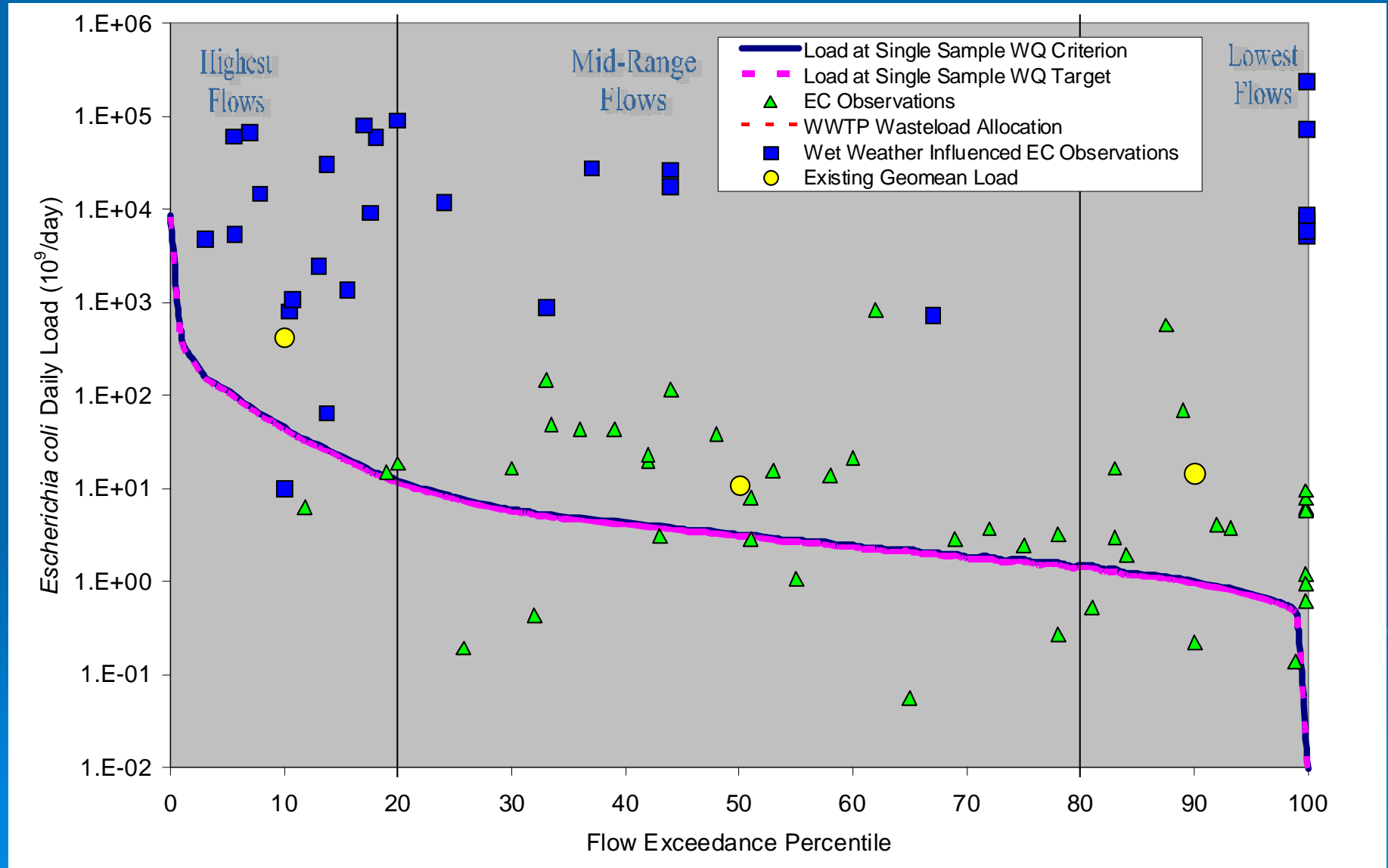
Load Duration Curve for Country Club Bayou (1007K_01)



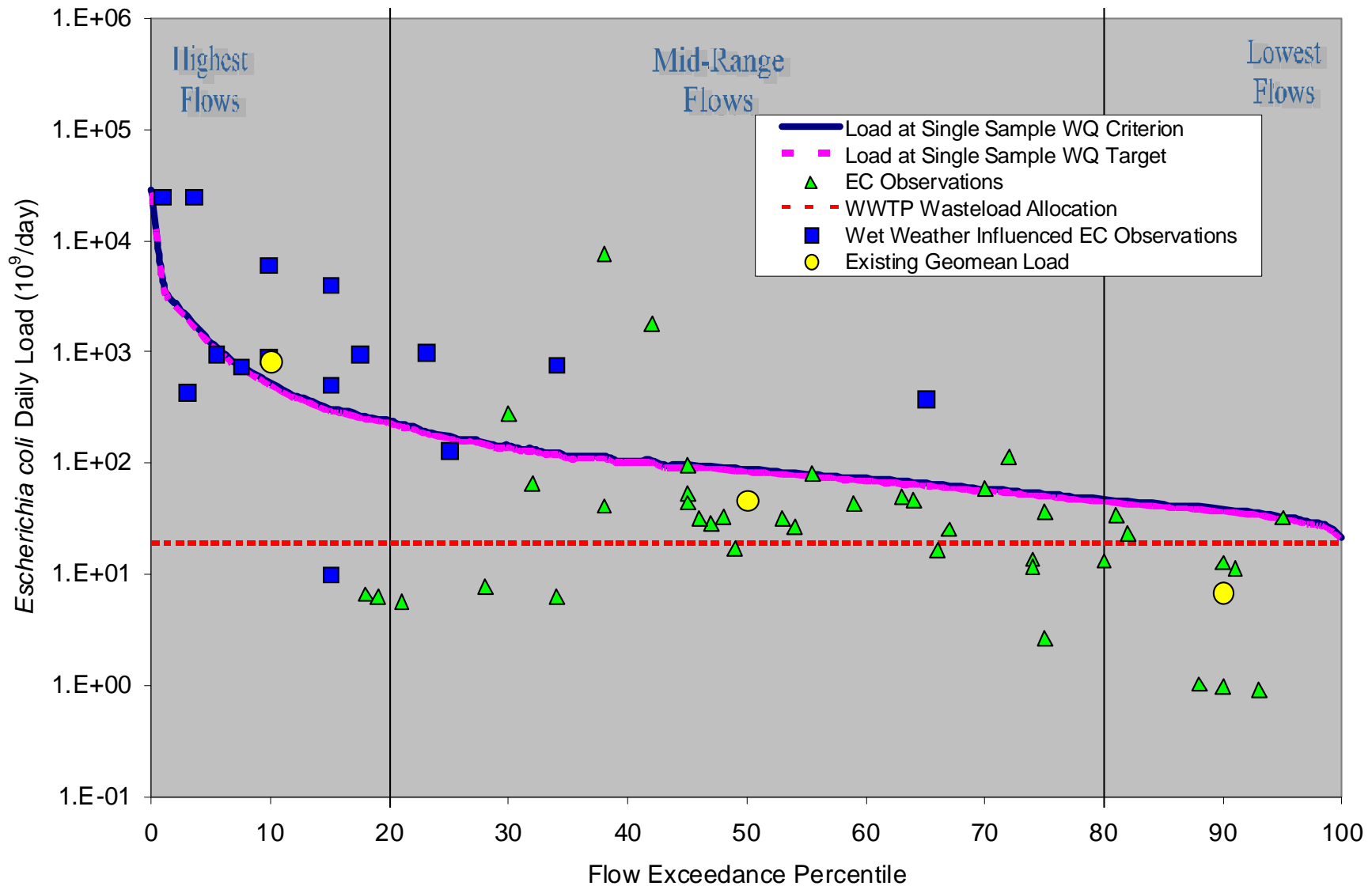
Load Duration Curve for Unnamed Non-Tidal Tributary of Hunting Bay (1007M_01)



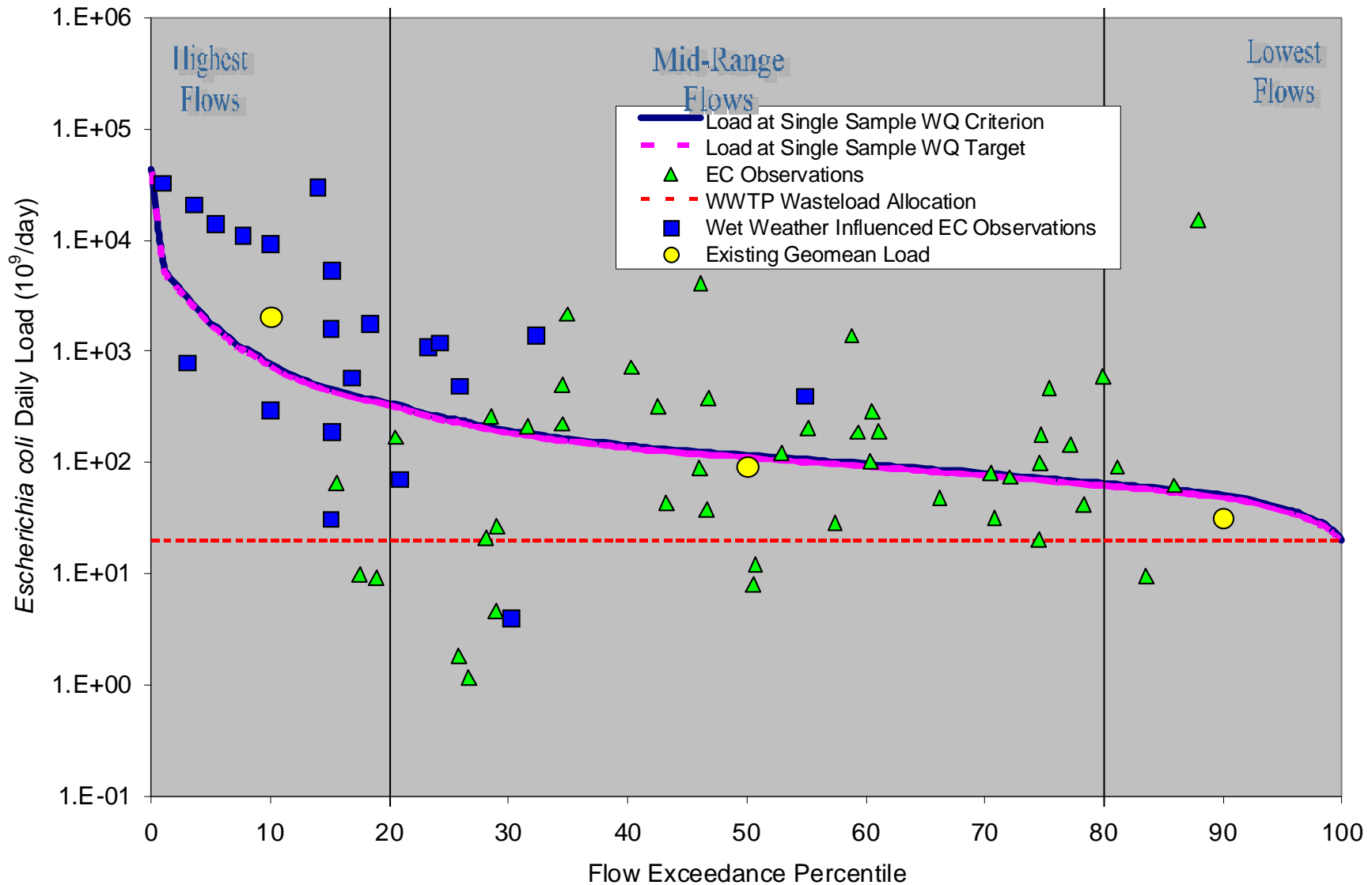
Load Duration Curve for Unnamed Non-Tidal Tributary of Buffalo Bay (10070_01)




Load Duration Curve Hunting Bayou Above Tidal (1007R_01 to 1007R_03)



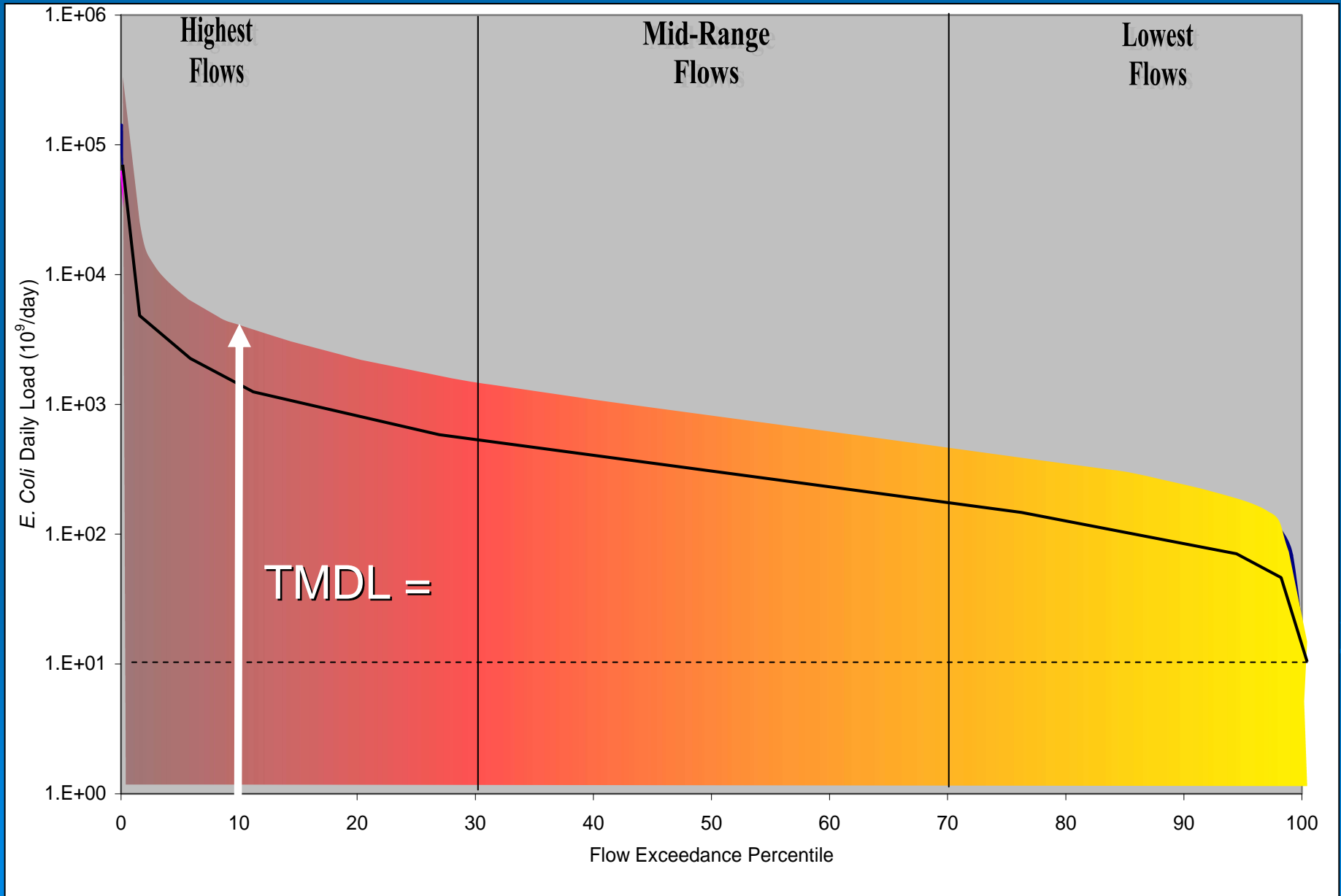
Load Duration Curve for Hunting Bayou Above Tidal (1007R_04)



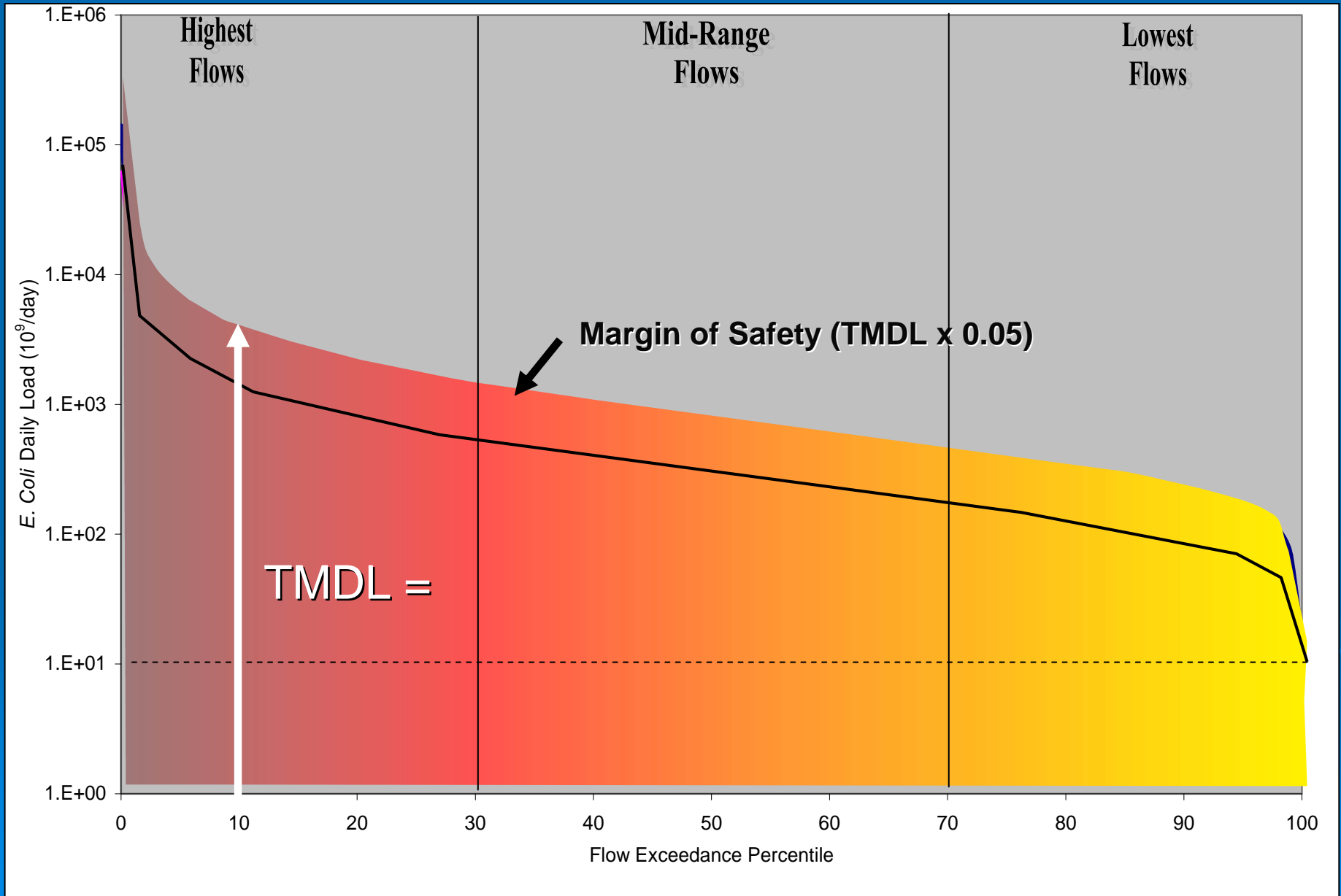
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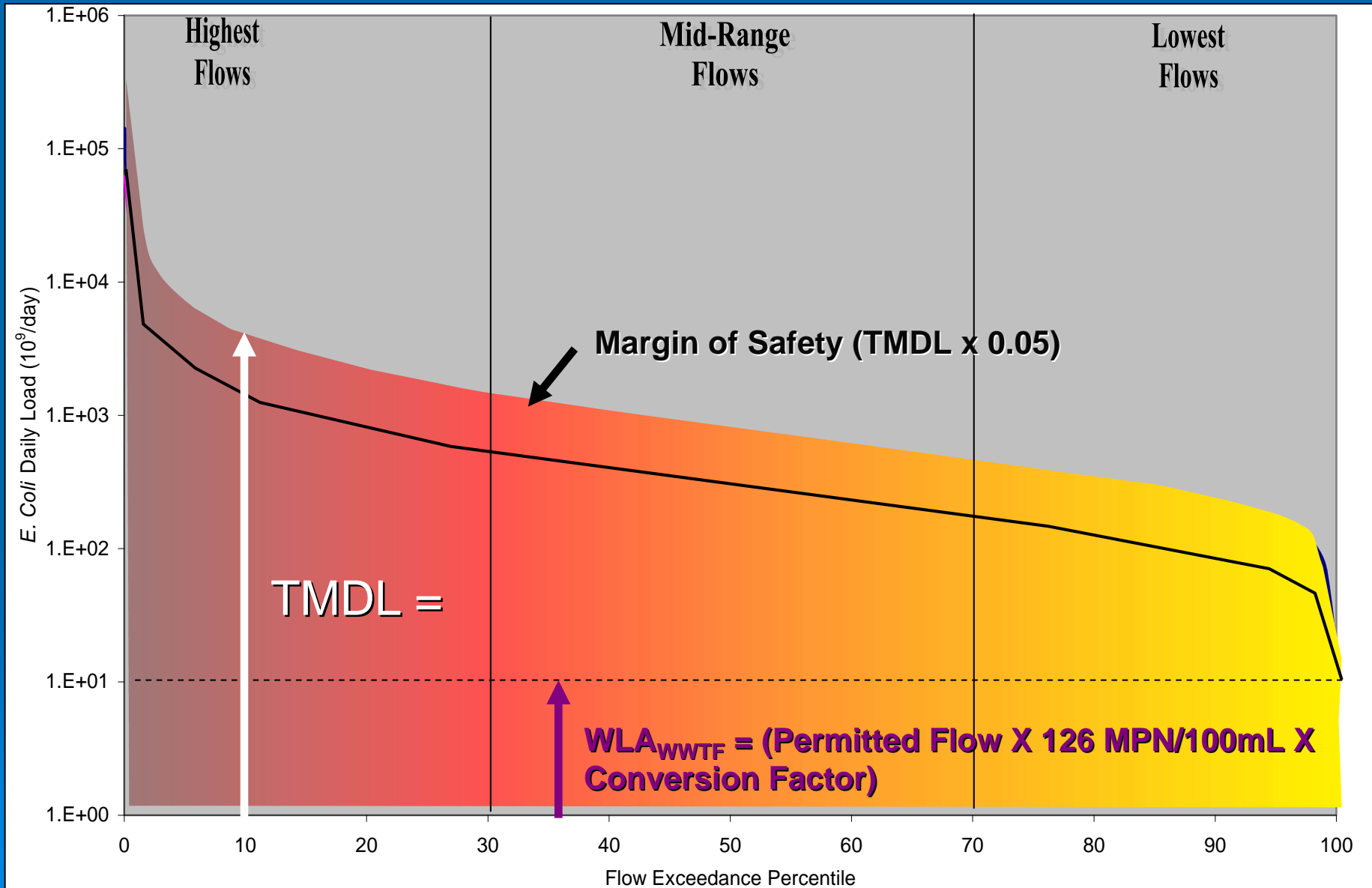
TMDL Calculations



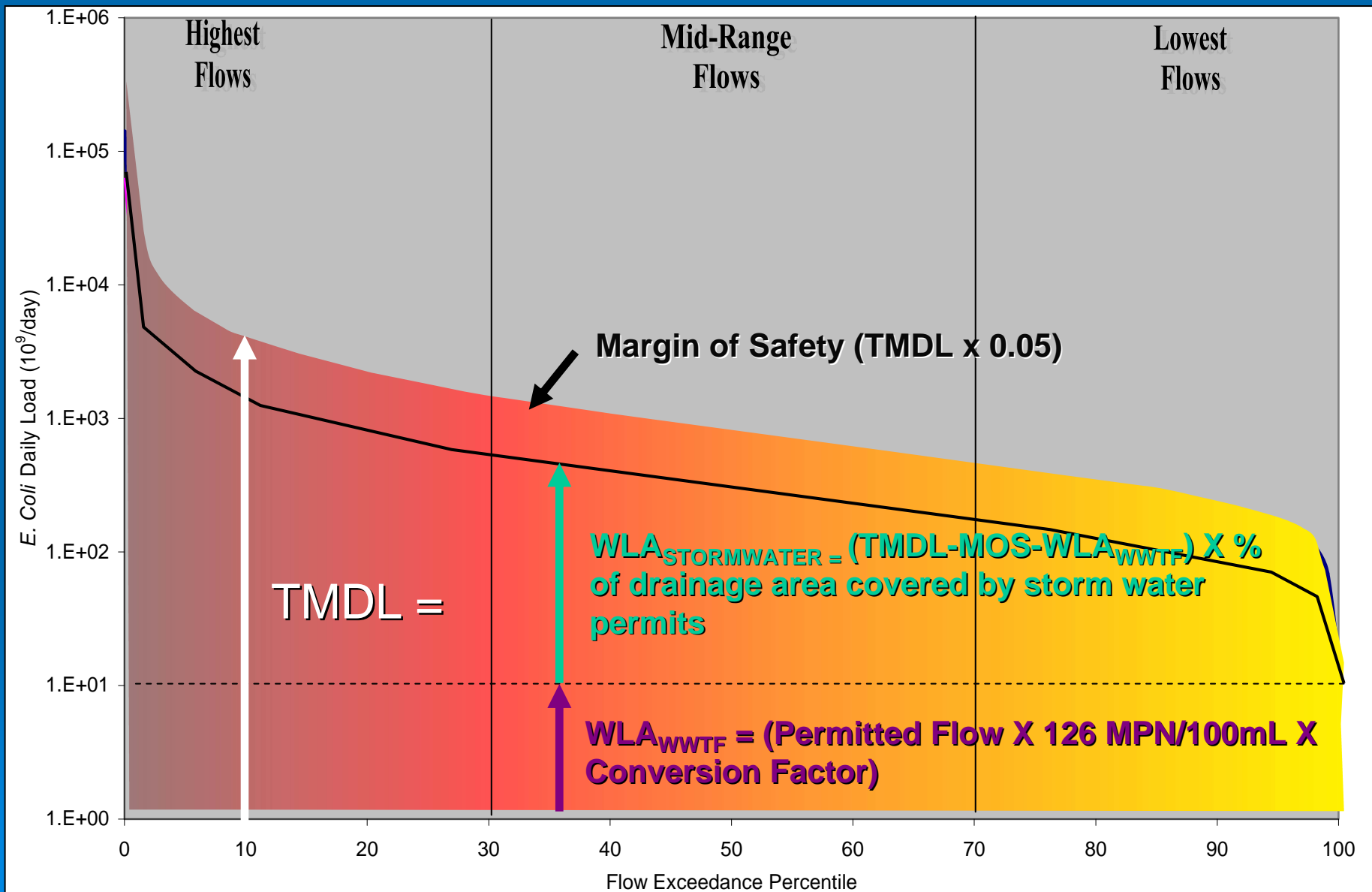
TMDL Calculations



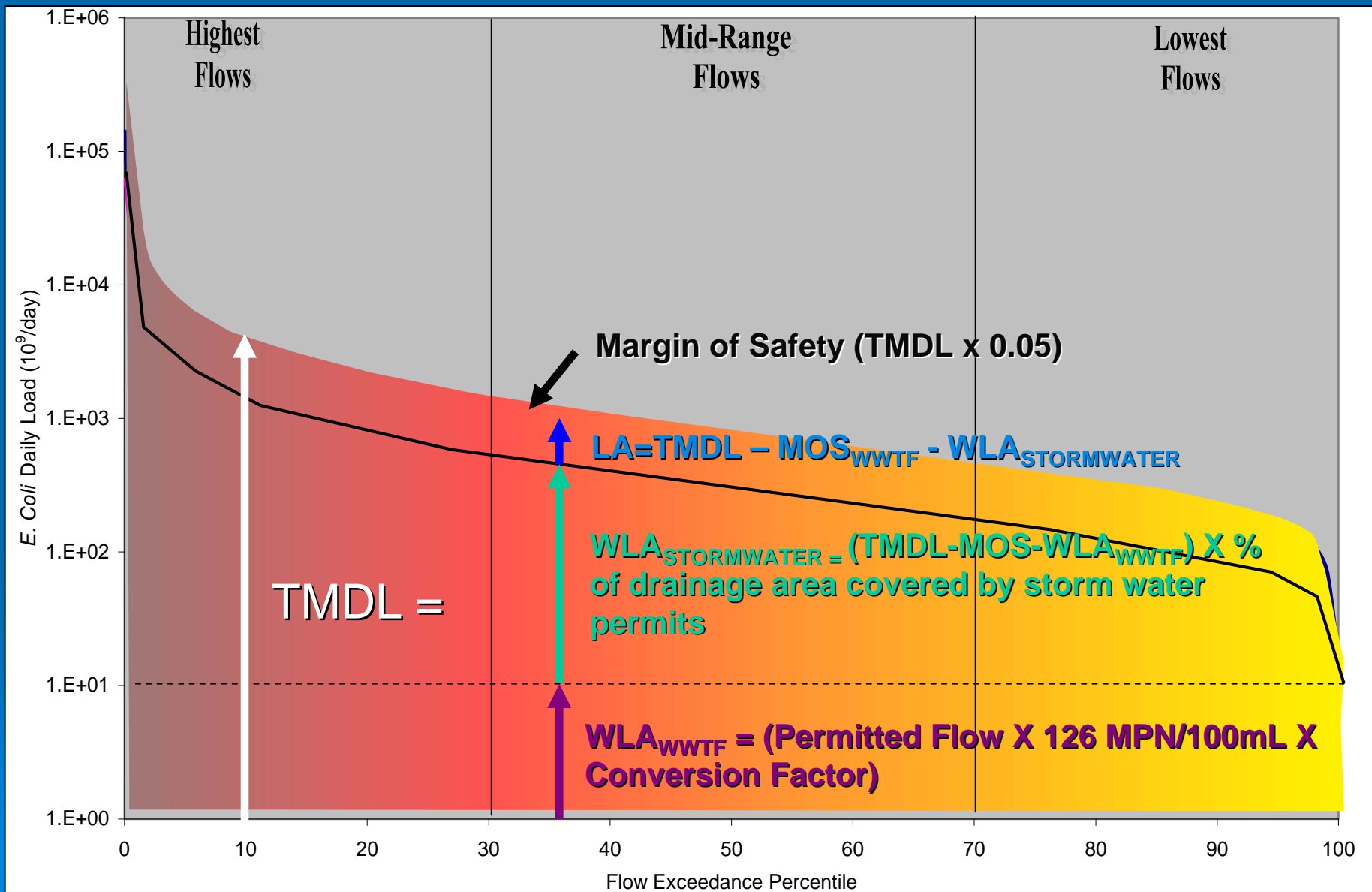
TMDL Calculations



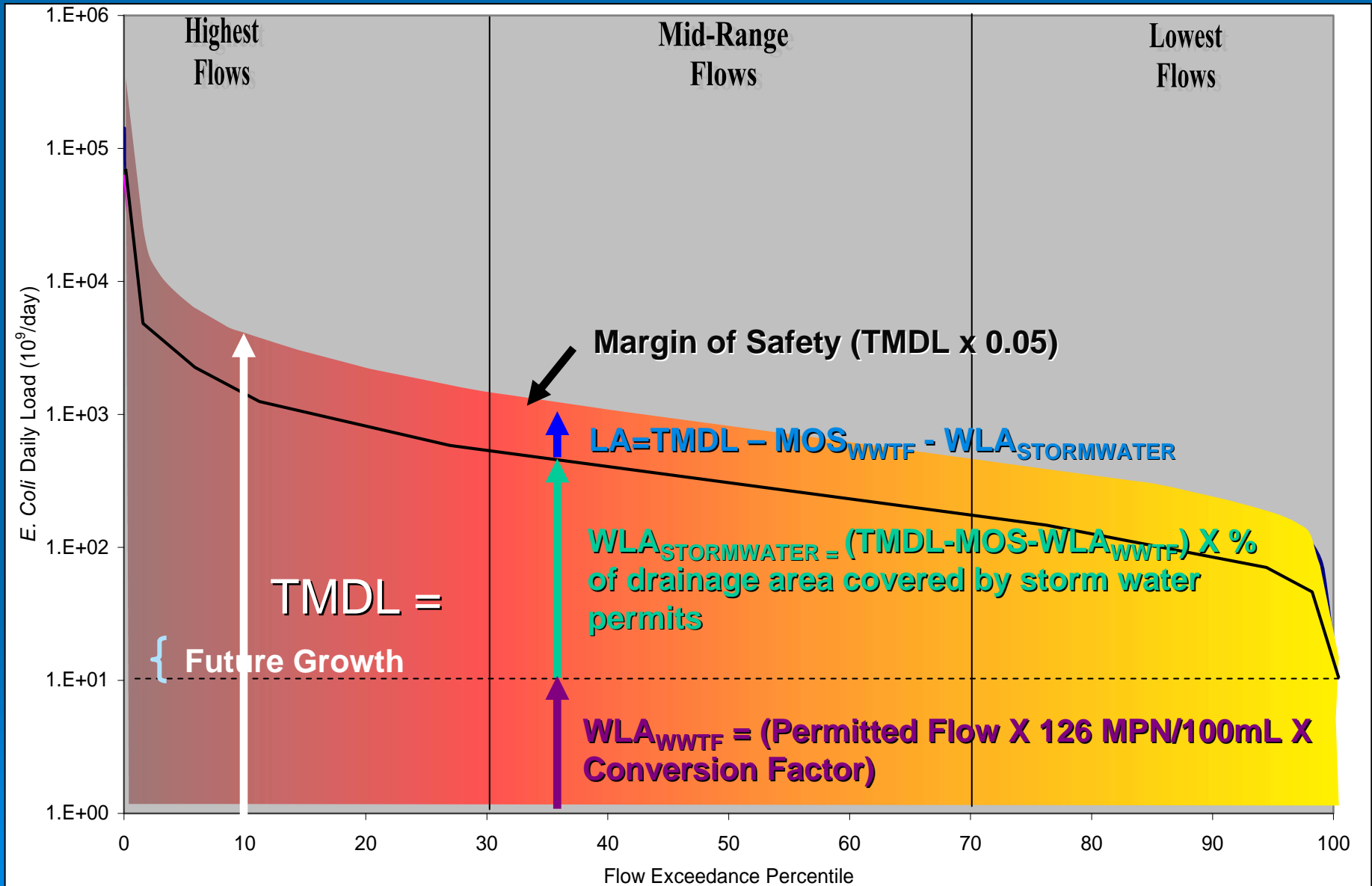
TMDL Calculations



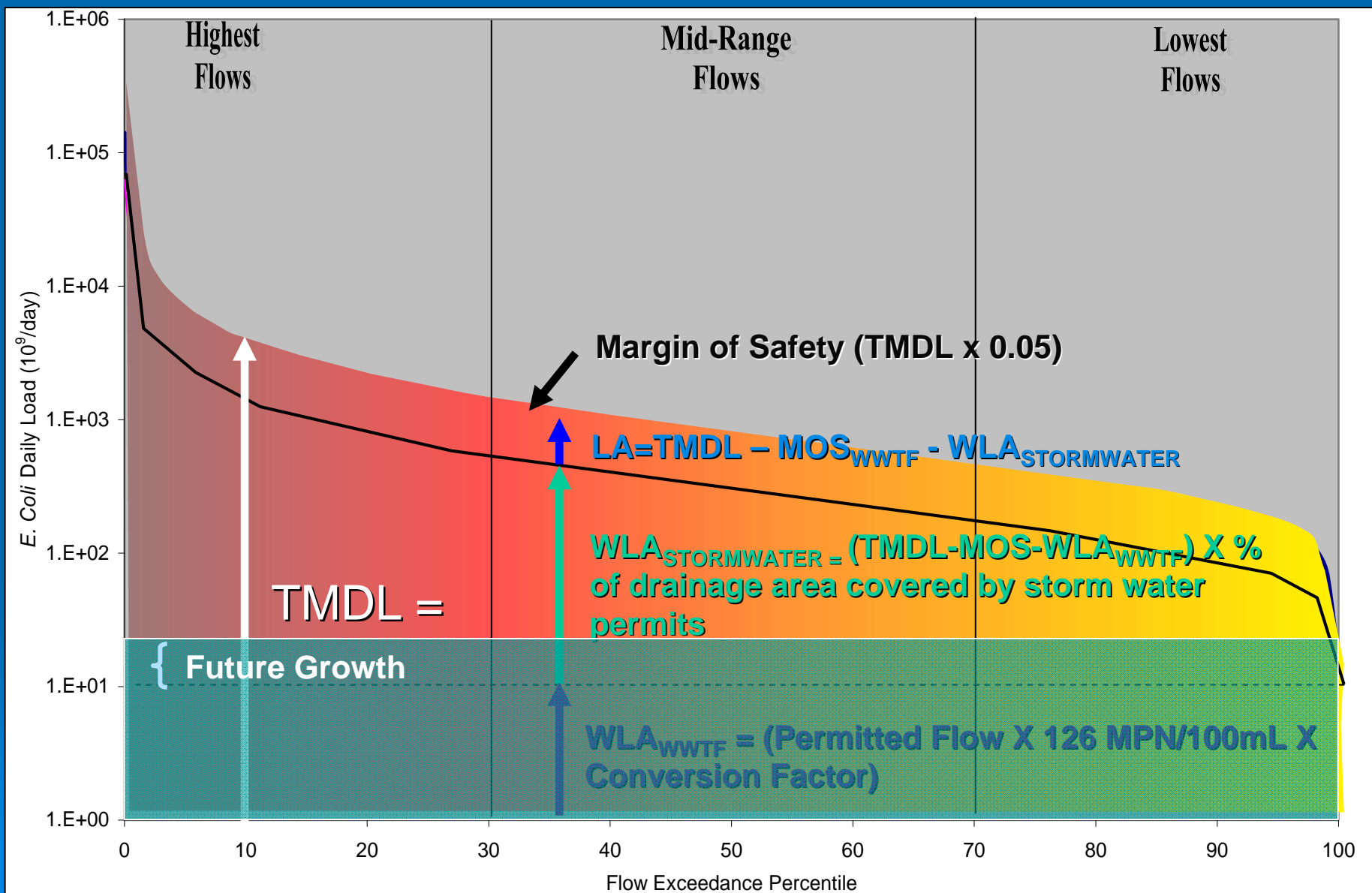
TMDL Calculations



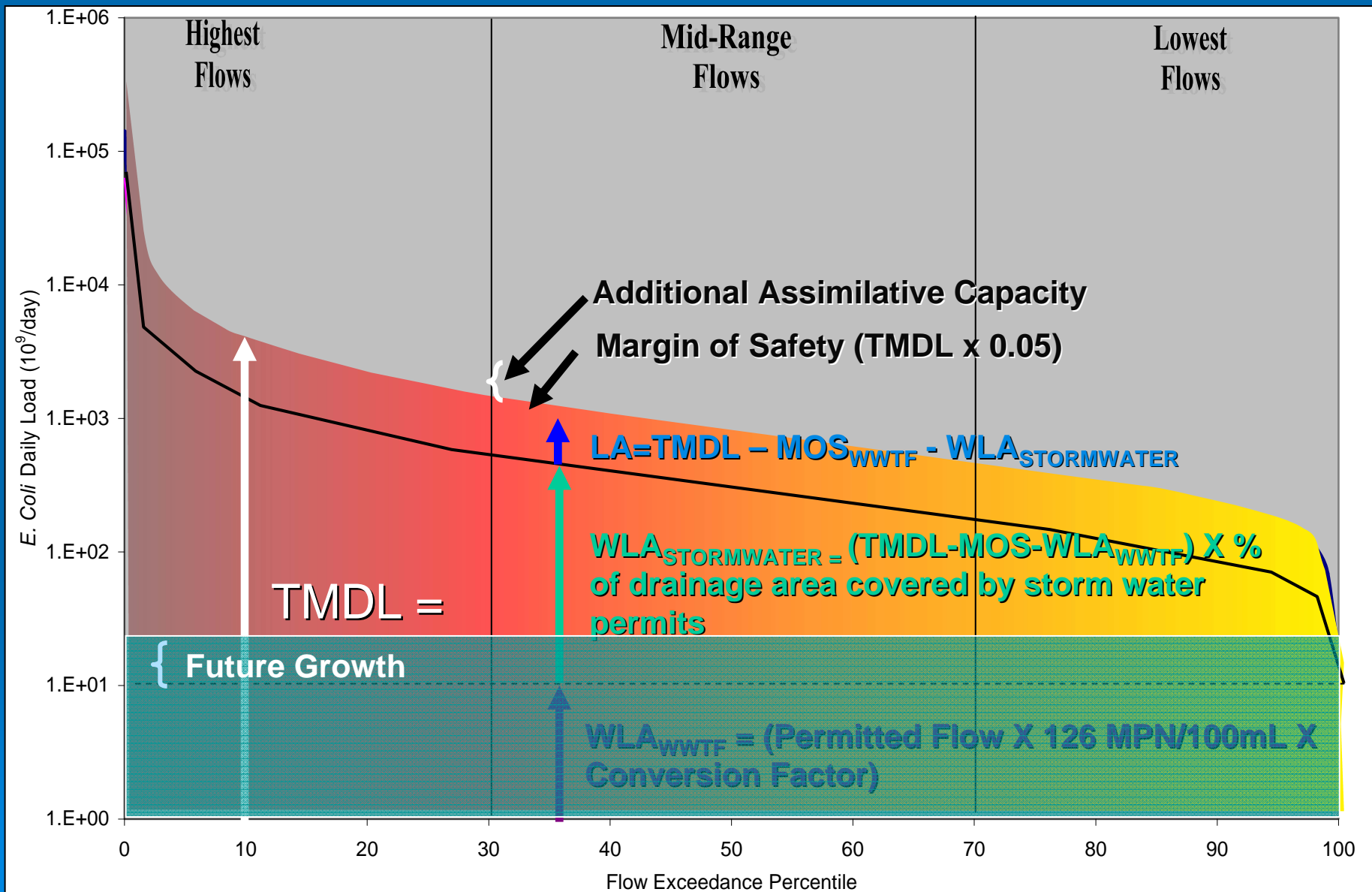
TMDL Calculations



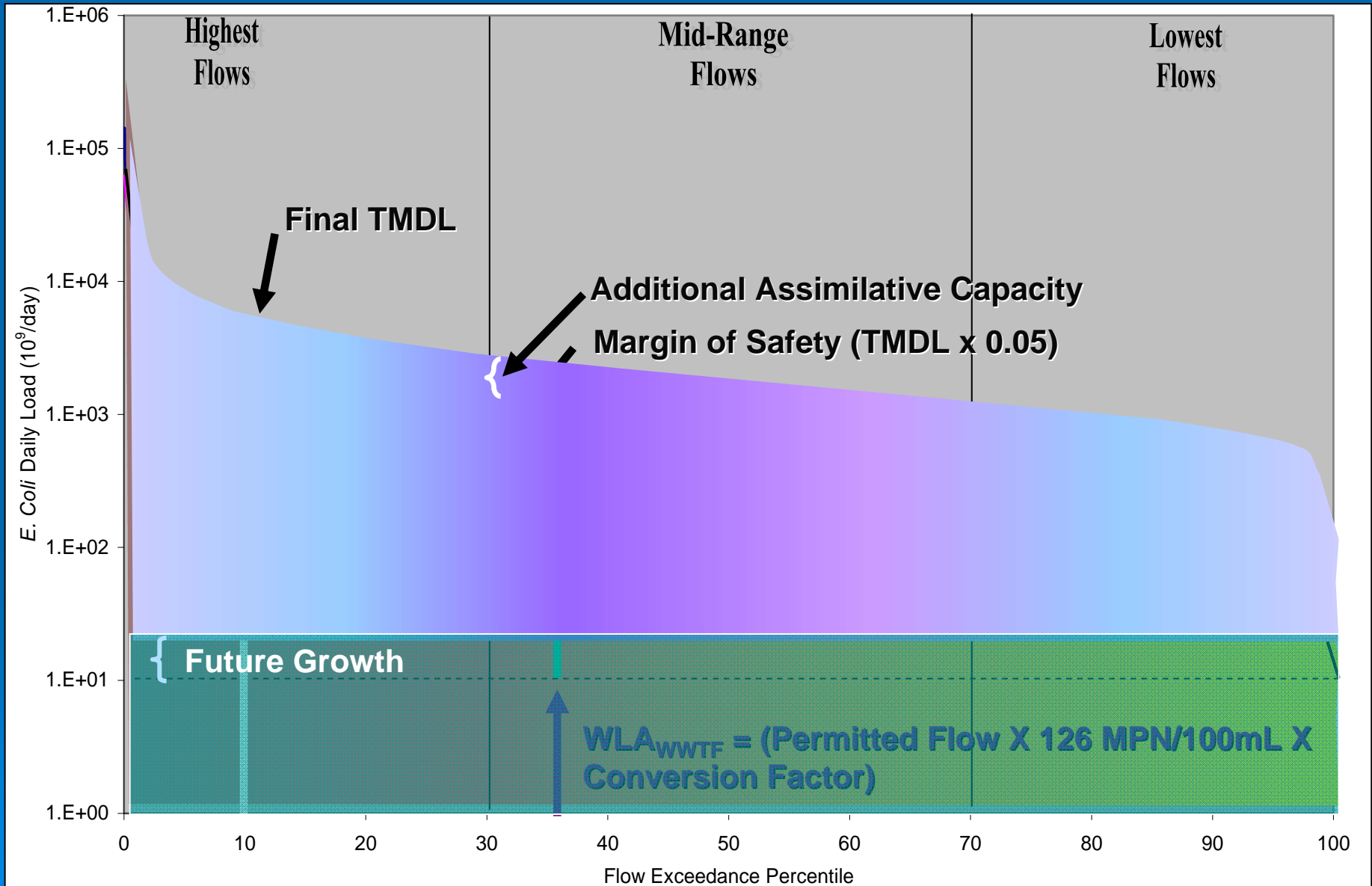
TMDL Calculations



TMDL Calculations



TMDL Calculations



Final TMDL Allocations

Assessment Unit	TMDL (MPN/day)	WLA _{WWTF} (MPN/day)	WLA _{STORM WATER} (MPN/day)	LA (MPN/day)	MOS (MPN/day)
1006F_01	1.46E+10	2.25E+09	6.61E+09	4.99E+09	7.28E+08
1006H_01	3.48E+10	1.31E+08	2.89E+10	3.95E+09	1.74E+09
1007F_01	1.58E+11	7.50E+10	7.51E+10	0	7.90E+09
1007G_01	3.63E+10	0	3.45E+10	0	1.82E+09
1007H_01	1.00E+10	0	9.50E+09	0	5.00E+08
1007I_01	2.73E+10	0	2.60E+10	0	1.37E+09
1007K_01	4.54E+09	0	4.32E+09	0	2.27E+08
1007M_01	3.23E+10	0	3.07E+10	0	1.62E+09
1007O_01	3.20E+08	0	3.04E+08	0	1.60E+07
1007R_01	2.15E+10	0	2.05E+10	0	1.08E+09
1007R_02	2.87E+10	0	2.73E+10	0	1.44E+09
1007R_03	1.91E+11	2.40E+10	1.35E+11	2.20E+10	9.53E+09
1007R_04	2.71E+11	2.54E+10	2.00E+11	3.25E+10	1.36E+10

a $WLA_{WWTF} = WLA_{WWTF} + \text{Future Growth}$

b LA includes upstream loads