Narrative Water Quality Objective

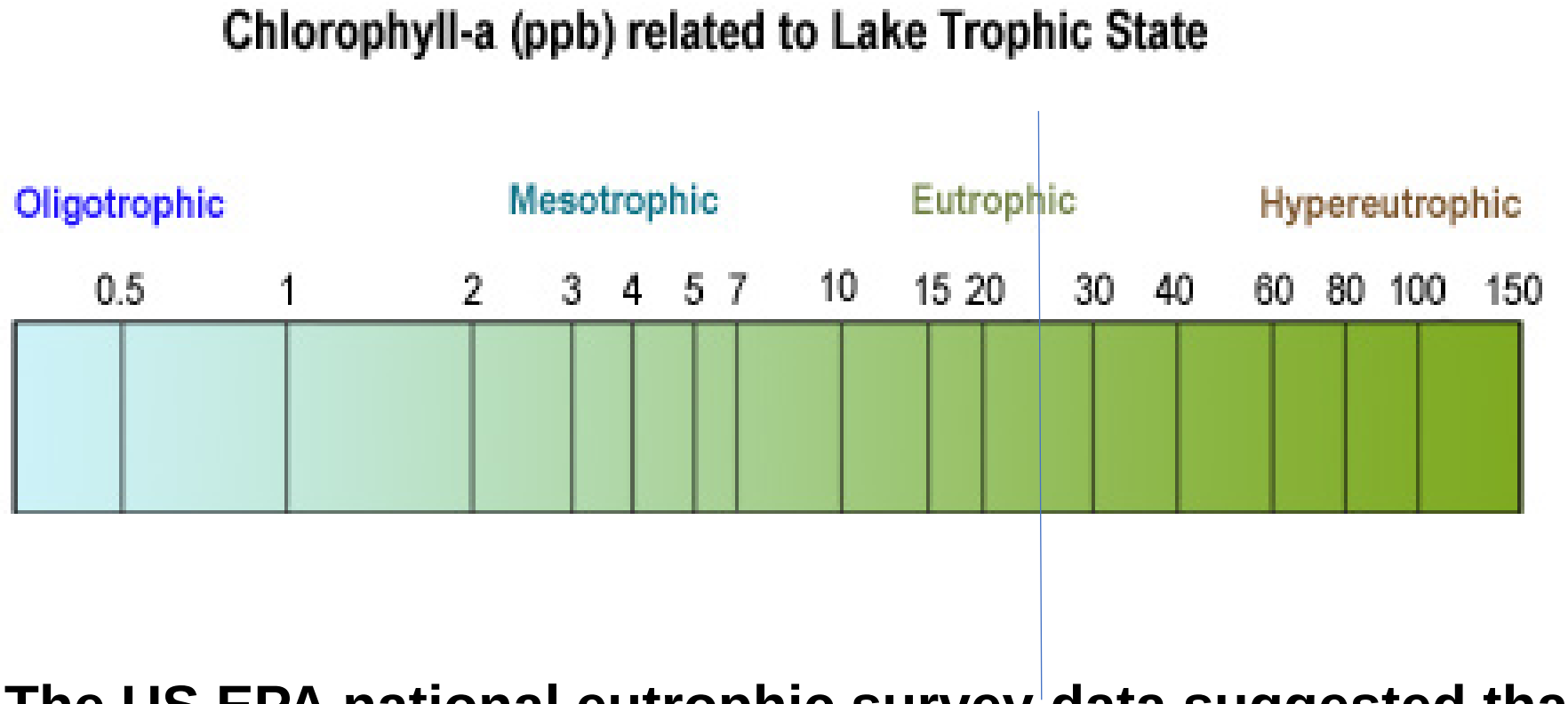
"Waste discharges shall not contribute to excessive algal growth in inland surface receiving waters."

(Basin Plan, 1995, pg. 4-5)

- "Excessive" is not defined
- No numeric standard for Chlorophyll-a

“Due to completely natural processes, Lake Elsinore has been at the eutrophic stage since the early 20th century, before the Clean Water Act was enacted. Therefore a reference state for Lake Elsinore based on historical water quality data seemed appropriate as the basis for selecting numeric targets. Using the same values for Canyon Lake provides consistency because the two lakes are nested in the same watershed, within five miles of each other.” *(Staff Report, 2004, pg. 15)*

TMDL Final Chlorphyll-a Target = 25 ug/L



"The US EPA national eutrophic survey data suggested that a chlorophyll *a* concentration of 10-25 ug/L corresponds to eutrophic conditions." *(Staff Report, 2004, pg. 21)*

Phosphorus Target = 0.1 mg/L

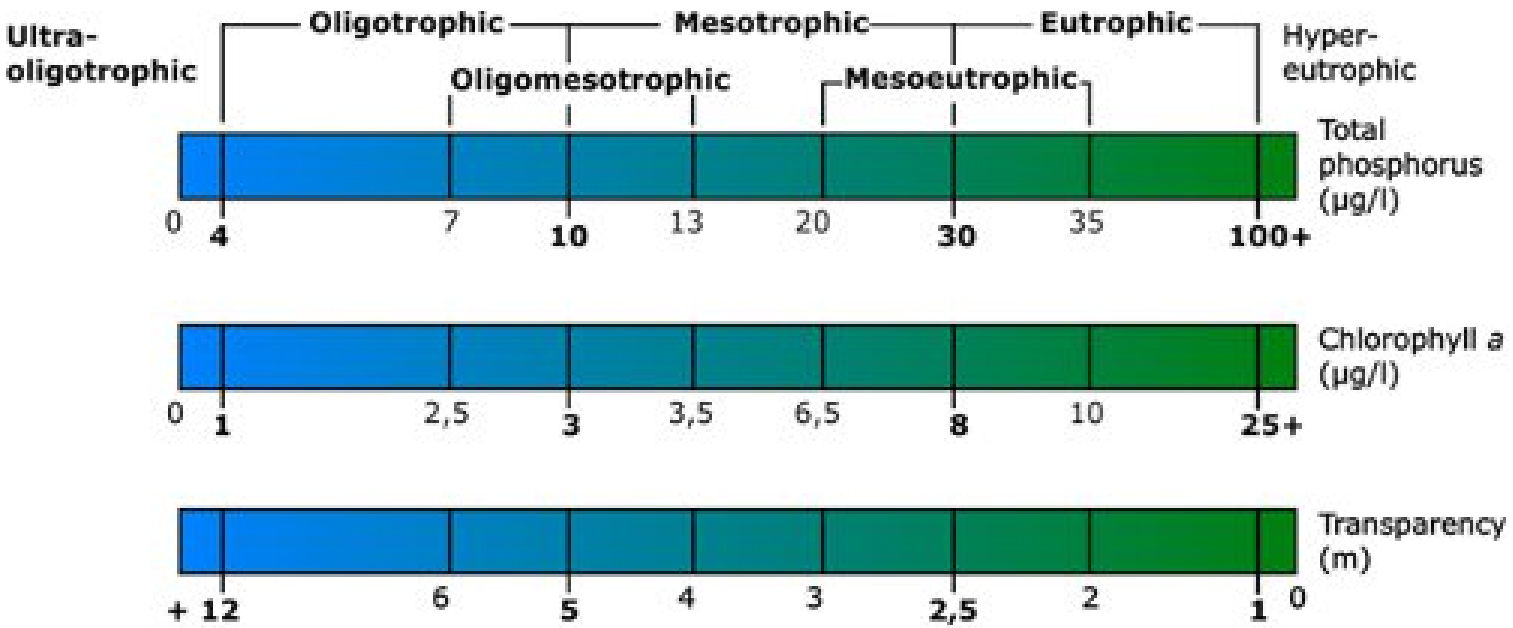
"The proposed interim target for total phosphorus is 0.1 mg/L as the annual average concentration in the water column. This number represents the 25th percentile of the total phosphorus concentration during the year 2000-2001 monitoring period. This time period is identified as the reference state since the lake did not experience severe algal blooms or fish kills, and the average lake elevation was 1240 feet above sea level, the acceptable operational level for Lake Elsinore." *(Staff Report, 2004, pg. 17)*

Nitrogen Targets

"To maintain the balance of nutrients for beneficial algal growth, a ratio of total nitrogen to total phosphorus of 10 is used to derive the 1.0 mg/L interim target for total nitrogen (US EPA, 1990)."
(Staff Report, 2004, pg. 17)

- Proposed Interim Target = 1.0 mg/L
- Proposed Final Target = 0.05 mg/L
- EPA Recommended = 0.02 mg/L
- **Adopted Final Target = 0.75 mg/L**

Trophic classification based on chlorophyll a, water clarity measurements, and total phosphorous values			
Trophic class	**Total phosphorous (µg/L)**	**Chlorophyl a (µg/L)**	**Clarity (m)**
Oligotrophic	**0 - 12**	**0 – 2.6**	**>8 - 4**
Mesotrophic	**12 - 24**	**2.6 - 20**	**4 - 2**
Eutrophic	**24 - 96**	**20 - 56**	**2 – 0.5**
Hypereutrophic	**96 – 384+**	**56 – 155+**	**0.5 - <0.25**



Predicted Chlorophyll-a Concentration

"Using the nutrient data developed for 2000-2001 (Anderson, 2001), one estimates an internal loading rate constant, *k* of 0.0156 m/yr, a resuspension velocity of 0.0021 m/yr, a volumetric sediment TP concentration of 247,000 mg/m3 and a settling rate, *vs*, of 37.4 m/yr. Substituting these values into eq 9, one estimates a steady-state TP concentration of 0.117 mg/L. This value is in excellent agreement with the annual average TP concentration of 0.119 mg/L reported by the RWQCB for the 2000-2001 period. The water quality associated with this TP concentration in the lake was predicted using empirical relationships. The relationship of Dillon and Rigler (1974) was used to predict lake chlorophyll levels, where:

$$log\ chl\ (\mu g/L) = 1.449\ log\ TP\ (ug/L) - 1.136$$

The predicted chlorophyll level for the lake at a stable 1242 ft elevation (without external loads) is 73 µg/L…"

(Anderson, 2003, pg. 9)

Predicted Water Quality in Lake Elsinore after adding 15,000 af/yr of Recycled Water

(assumes zero load from other external sources)

Influent P Concentration	Lake TP Concentration	Chlorophyll-a	Secchi Depth
0 mg/L	0.100 - 0.123 mg/L	58 – 78 ug/L	0.50 – 0.59 m
0.05 mg/L	0.113 – 0.131 mg/L	69 – 85 ug/L	0.48 – 0.54 m
0.1 mg/L	0.127 – 0.140 mg/L	82 – 94 ug/L	0.45 – 0.49 m
0.5 mg/L	0.208 – 0.236 mg/L	167 – 202 ug/L	0.26 – 0.30 m
1.0 mg/L	0.293 – 0.374 mg/L	274 - 391 ug/L	0.15 - 0.20 m

Anderson, 2003, pg. 9

Predicted Water Quality in Lake Elsinore after adding 15,000 af/yr of Recycled Water

(assumes 30% reduction in internal loading rate from LEAMS)

Influent P Concentration	Lake TP Concentration	Chlorophyll-a	Secchi Depth
0 mg/L	0.036 - 0.076 mg/L	12.8 – 38.9 ug/L	0.71 – 0.98 m
0.05 mg/L	0.040 – 0.079 mg/L	15.4 – 41.1 ug/L	0.69 – 0.94 m
0.1 mg/L	0.045 – 0.082 mg/L	18.2 – 43.5 ug/L	0.68 – 0.90 m
0.5 mg/L	0.084 – 0.108 mg/L	45.2 – 65.9 ug/L	0.56 – 0.67 m
1.0 mg/L	0.133 – 0.152 mg/L	87.1 – 105.6 ug/L	0.42 - 0.47 m

Anderson, 2003, pg. 10

Predicted Water Quality in Lake Elsinore adding Recycled Water to maintain 1240' level

(assumes TP in runoff = 0.22 mg/L)

Lake Management Scenario	Lake TP Concentration	Chlorophyll-a	Secchi Depth
Baseline	**0.377 mg/L**	**395 ug/L**	**0.15 m**
Aeration Only (30%↓)	**0.148 mg/L**	**102 ug/L**	**0.42 m**
Carp Removal Only (50%↓)	**0.331 mg/L**	**327 ug/L**	**0.18 m**
Aeration + Carp Combined	**0.121 mg/L**	**76 ug/L**	**0.51 m**

Anderson, 2006, pg. 25

Predicted Chlorophyll-a in Canyon Lake

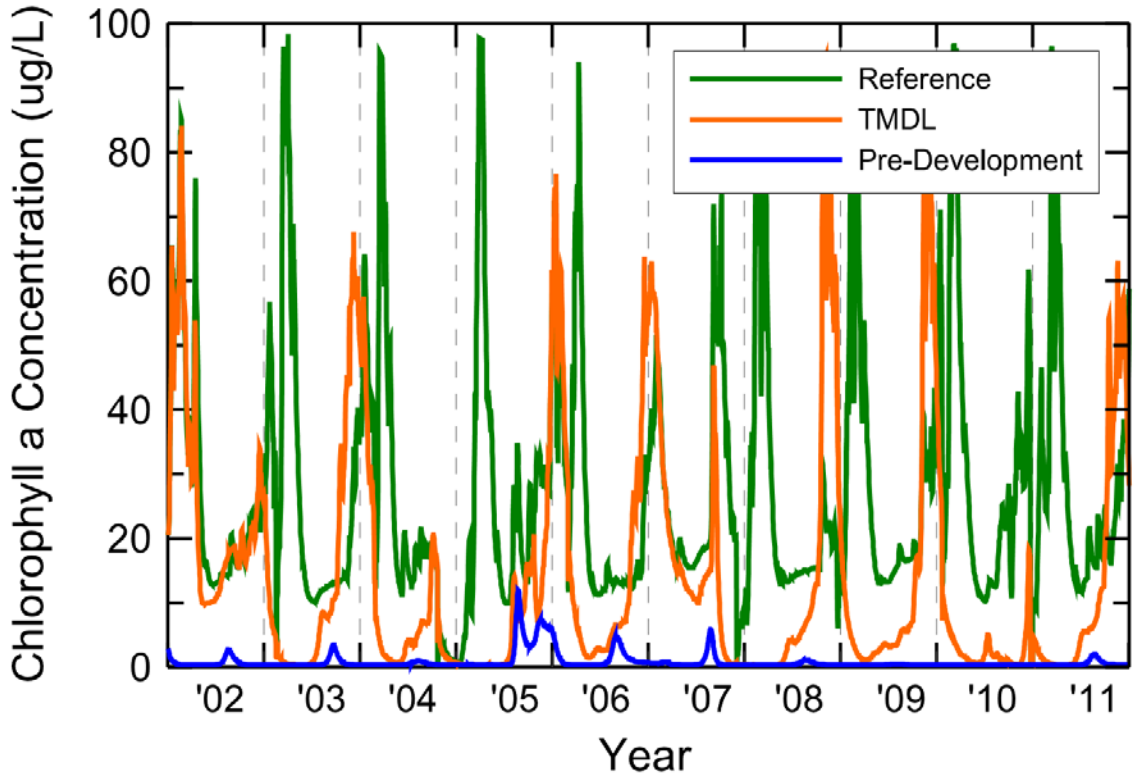


Fig. 5. Volume-weighted daily chlorophyll a concentrations under the reference (existing) condition, TMDL-prescribed reductions in external loading, and the pre-development scenario.

Anderson, June-2012, pg. 5