Task 5a: Simulations Using Refined Model Parameter Set Under Steady-State Conditions for Lake Elsinore

- A refinement of earlier model predictions made based upon information available at that time and prior to alum treatment for P removal at EVMWD and carp removal program
- Approach same as that used in Anderson (2006) that calculated a steady-state condition in Lake Elsinore under different management actions
- The average recycled H_2O flow from EVMWD (5660 af yr^{-1}) assumed to be added to lake at TP concentrations of 0.5, 0.4, 0.3, and 0.2 mg L^{-1}
- 75% reduction in carp populations also assumed

$$C = \frac{\frac{H(\sum_i Q_i C_i + PRA_w C_w)}{V} + iOC + fP_f M_f B + w_r A_r B}{\nu}$$

where:

- C – predicted steady state conc of TP
- H – mean depth
- Q_i – flow from source i
- P – precipitation rate
- R – runoff coefficient
- A_w – local watershed area
- C_w – conc in local runoff
- V – volume of lake
- i – slope of internal loading function
- O – scalar for aeration effects
- f – carp resuspension rate
- P – carp population
- M – average mass of carp
- B – bioavailable P in sediment
- W_r – wind resuspension rate
- A_r – fraction of sediments resuspended
- ν – settling velocity

Table 1. Hydrologic submodel results.

Scenario	Area (acres)	Elevation (ft)	Volume (af)	Mean Depth (m)
No EVMWD Flow	1190	1222.7	3752	0.96
5660 af Flow	2652	1238.1	33,224	3.80

- Assuming the geometric mean annual San Jacinto R. flow to lake (558 af yr^{-1}) persisted for a number of years, a very low lake level and very shallow depth are predicted
- Delivery of 5660 af yr^{-1} from EVMWD results in much higher lake level, 4x greater depth and a 9x greater volume

Table 2. Predicted median water quality and phosphorus loading assuming 0 af yr^{-1} (reference) and 5660 af yr^{-1} EVMWD recycled water input with TP 0.2-0.5 mg L^{-1}, geometric mean San Jacinto River flow to Lake Elsinore (558 af yr^{-1}) at 0.22 mg L^{-1} total P, and 75% reduction in carp population (226 carp ha^{-1}).

Scenario	**Water Quality Variables**			**Phosphorus Loading (mg m^{-2} d^{-1})**				
Influent P Conc	TP mg L^{-1}	Chl a ug L^{-1}	Z_{sd} m	Ext	Internal	Wind	Carp	Total
No flow	0.812	1201	0.05	0.7	67.7	11.0	0.7	80.1
0.5 mg L^{-1}	0.189	145	0.33	1.2	16.0	1.0	0.7	18.9
0.4 mg L^{-1}	0.181	137	0.35	1.1	15.3	1.0	0.7	18.1
0.3 mg L^{-1}	0.165	119	0.38	0.9	14.0	1.0	0.7	16.6
0.2 mg L^{-1}	0.152	107	0.41	0.7	12.9	1.0	0.7	15.3

- Delivery of recycled water predicted to have dramatic effect on water quality as well

• Relatively modest subsequent improvements predicted when total P concentrations further reduced in recycled water

• This results in part because of inputs from other external sources (e.g., local runoff and San Jacinto River), and from wind and carp resuspension

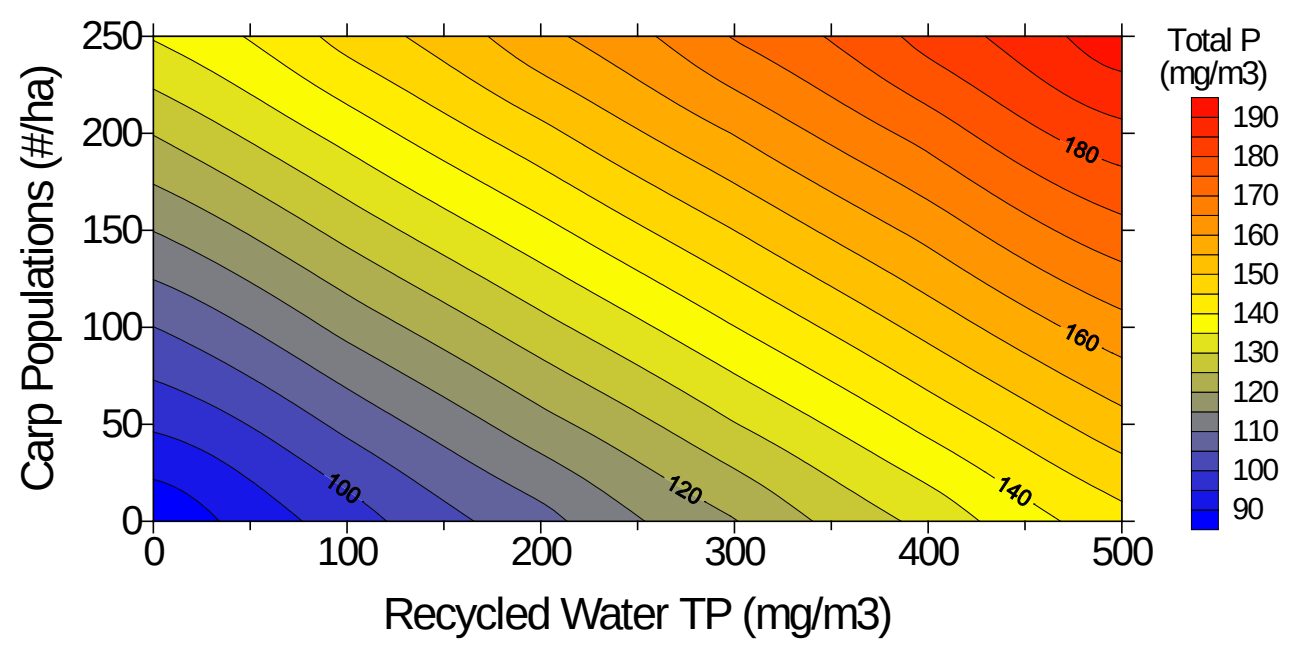

Table 3. Predicted median water quality and phosphorus loading assuming supplementation with 5560 af/yr EVMWD flow with TP concentration of 0.5 mg L^{-1}, geometric mean San Jacinto River flow to Lake Elsinore (558 af yr^{-1}) at 0.22 mg L^{-1} total P, 75% reduction in carp population (226 carp ha^{-1}), and aeration (as % reduction in internal loading)

Scenario	Water Quality Variables			Phosphorus Loading (mg m^{-2} d^{-1})				
Aeration Reduction	TP mg L^{-1}	Chl a μg L^{-1}	Z_{sd} m	External	Internal	Wind	Carp	Total
0%	0.189	145	0.33	1.2	16.0	1.0	0.7	18.9
+10%	0.121	77	0.51	1.2	9.2	1.0	0.7	12.1
+20%	0.090	50	0.64	1.2	6.1	1.0	0.7	9.0
+35%	0.064	30	0.78	1.2	3.5	1.0	0.7	6.4

- Effective aeration predicted to more significantly improve water quality than reductions in TP in recycled H_2O
- Characterization of sediment Fe speciation, color, etc. suggest limited effectiveness of system

Table 4. Predicted median water quality and phosphorus loading assuming 5660 af/yr EVMWD recycled water input of 0.5 mg L^{-1} total P, geometric mean San Jacinto River flow to Lake Elsinore (558 af yr^{-1}) at 0.22 mg L^{-1} total P, 75% reduction in carp population (226 carp ha^{-1}), and 0-2000 af yr^{-1} groundwater inputs at 0.12 mg L^{-1} total P.

Scenario	Water Quality Variables			Phosphorus Loading ($mg/m^2/d$)				
Island Well	TP (mg/L)	Chl a (ug/L)	Z_{sd} (m)	External	Internal	Wind	Carp	Total
0 af y^{-1}	0.189	145	0.33	1.2	16.0	1.0	0.7	18.9
+500 af y^{-1}	0.170	124	0.37	1.2	14.4	0.7	0.7	17.0
+1000 af y^{-1}	0.154	109	0.41	1.2	13.1	0.5	0.7	15.5
+2000 af y^{-1}	0.134	88	0.47	1.1	11.4	0.3	0.7	13.5

- Addition of groundwater predicted to raise lake level and further improve water quality through dilution and reduced wind resuspension

- The steady-state approach provides a useful theoretical basis for comparing hydrologic and water quality conditions, although such static conditions will not realistically be met
- Dynamic conditions and hydraulic linkages between watershed, Canyon Lake and Lake Elsinore will be undertaken in tasks 2-4 and 5b
- The model simulations will serve as a more comprehensive assessment and include P, N, DO, and related physical, chemical and ecological conditions in both Lake Elsinore and Canyon Lake