Current Conditions and Potential Effect Thresholds for the Rosemont Project Supplemental BA (draft 08-14-2014)

Marc Stamer (USFS) and Mike Hatch (SWCA) and I discussed the possible thresholds for aquatic species during yesterday's tour of Cienega Creek, Empire Spring and Cieneguita ponds.

We visited the areas of accelerated erosion below the stream crossing near the Cienega Ranch (Ag fields) and those below Apache Canyon. We also looked at Cienega Creek above and below the creek ford on the power line service road near Fresno Canyon. The "Headwaters" segment above Gardner Canyon was also vised although very briefly. The purpose of the tour was to look at areas that would serve as key areas for analysis and any modeling of hydraulic changes in surface waters with incremental changes in ground water elevations.

<u>Baseline conditions that affect listed aquatic species:</u>

1) Lack of surface water in areas that are flowing during the wet-dry monitoring in mid-June but become dry by late June or early July;
2) Wetland desiccation from declining ground water elevations;
3) Soil moisture variation that affects plants to the point that they lose vigor and cannot reproduce, leading to accelerated erosion;
4) Accelerated erosion that poses a risk of lowering nearby aquifers due to channel incision (observed 5-8 feet in the field);
5) Negative feedback loop starting with inadequate soil moisture that reduces riparian plant vigor leading to loss of vegetation density and vigor allowing for rapid erosion (both vertical and lateral) of soils comprised largely of sand and silt, lowering of upstream aquifers that support riparian vegetation, thus spreading upstream until a geologic control (bedrock) is reached;
6) Excess sediment from bank and bed erosion contribute loss of habitat features (pools in Mattie Canyon) as a result of channel widening from past incision events;
7) Poor water quality conditions in areas with marginal surface flow but poor gas exchange (CO_2 and O_2);
8) Poor water quality conditions in areas with high loads of organic matter (depressed O_2 levels;
9) Fish and tadpoles confined to pools that decline rapidly in volume during June and July, leaving them vulnerable to high predation rates and poor water quality conditions (biological sink);
10) Fish, tadpoles, leopard frogs and gartersnakes transmitted downstream to distant perennial stream segments in years with exceptional summer precipitation through the

filling and extended longevity of pools (migration corridor and biological sink properties);

11) Documented long distance dispersal of leopard frogs (3-5 miles?) through Dispersal during summer rainy season;
12) Potential for long distance dispersal of Mexican gartersnakes (>5 miles?) through Dispersal during summer rainy season and, perhaps, at other times;
13) Conversion of marshland to willow dominated swamp habitat in the reach above Gardner Canyon;
14) Aggradation of sediment of 2 or more feet where monitored (increased aquifer capacity);
15) Decreased aquifer capacity with the failure of grade controls (gully plug failure in Mattie Canyon 2 miles above the confluence, 15-20 ft incision);
16) Periodic loss of pool and other surface water features through excess sediment discharge at Mattie Canyon, Wood Canyon, Spring Water Canyon, and Pump Canyon (surface waters features are smothered, cleared and re-smothered);
17) Loss of surface water features through encroachment of vegetation on open water
18) Some stream reaches are stable and functioning well with little or no disruption of riparian or aquatic habitat characteristics and function (e.g., reach from Cold Spring to Mattie Canyon, Empire Spring, lower ½ mile of Empire Gulch, Headwater reach upstream of Gardner Canyon – exception, some areas suffer from chronic low DO from heavy detrital load);
19) Bullfrog contamination threat from source populations on private lands
20) Climatic conditions that are changing precipitation timing and amounts;
21) Historic and recent ground water extraction on private lands south and west of Cienega Creek;
22) Low peak floods (indicating increased recharge volumes) from healthy watershed including intact semidesert grassland over large portions of the NCA and other areas;
23) Expanding gully erosion in some areas with reduced hydrologic function (e.g., Wood Canyon, Mattie Canyon, and Pump Canyon);
24) Slow incremental loss of the bedrock control above the gage station that threatens the function of the reach from Cold Spring to just upstream of Wood Canyon;
25) Eventual capture of Cienega Creek by Wood Canyon (>10ft elevation diff separated by ~100 ft of erodible soil) that would produce a head cut with the potential to dewater and erode about 1 mi of Cienega Creek, 1 mi of Mattie Canyon, ¼ mi of Cold Spring and >10 acres of wetland associated with Cold Spring;
26) The addition of beaver planned for 2015 or 2016 are anticipated to change hydrologic and hydraulic relationships in several important ways: 1) tree density will be reduced in some location, 2) structural diversity of the riparian area will change 2) erosion near beaver dams will be repaired by beaver, 3) recharge volumes are likely to increase greatly, 4) perennial reaches will extend further downstream, 5) riffle habitat on and below dam will greatly improve gas exchange, 6) water temperatures will increase, 7) tree canopy that

shades surface water will decrease, 8) the food web will be driven by autochthonous sources (algal production as the food base) as direct sunlight becomes available to more of the surface water, 9) Channel aggradation will increase at even faster rates thus increasing aquifer capacity, 10) beaver ponds will replace other aquatic habitat types (pools and runs) for long distances (100s of meters).

Thresholds by Species:

HWU – 1) Loss wetted perimeter and saturated soil, 2) loss of shallow channel features (<3" deep) on the edges of pools, 3) accelerated erosion created by loss of riparian plant vigor and density above geologic control (bedrock spine) 4) smothering of habitat by accelerated from upstream reaches due to loss of riparian function, and 5) loss of surface water in floodplain wetlands

Gila topminnow – 1) Loss of wetted perimeter in surface water greater than 0.1 foot in depth, 2) concentration of fish in pools where predators (wading birds, Gila chub, gartersnakes, skunks, raccoons, etc) can quickly consume or injure them, 3) declining water quality (DO < 2ppm), 4) increased distance from perennial portions of Cienega Creek on the NCA to perennial water in Lower Cienega Creek on the county preserve (loss of population connectivity), 5) accelerated erosion created by loss of riparian plant vigor and density above geologic control (bedrock spine) resulting in channelization and dewatering of habitat upstream (draining effect), and 6) smothering of habitat by accelerated from upstream reaches due to loss of riparian function and accelerated erosion 6) increase incidence of parasitism and disease from stress related to poor water quality and habitat conditions (e.g. yellow grub, black spot and a *Saprolignia* infection that spread throughout the chub population observed in Cienega Creek in 2000).

Gila chub - 1) Loss of pool habitats > 2 ft deep, 2) concentration of fish in pools where predators (wading birds, gartersnakes, skunks, raccoons, etc) can quickly consume or injure them, 3) declining water quality (DO < 2ppm), 4) increased distance from perennial portions of Cienega Creek on the NCA to perennial water in Lower Cienega Creek on the county preserve (loss of population connectivity), 5) accelerated erosion created by loss of riparian plant vigor and density above geologic control (bedrock spine) resulting in channelization and dewatering of habitat upstream (draining effect), 6) long-term smothering of habitat by accelerated from upstream reaches due to loss of riparian function and accelerated erosion and 6) increase incidence of parasitism and disease from stress related to poor water quality and habitat conditions (e.g. yellow grub, black spot and a *Saprolignia* infection that spread throughout the chub population observed in Cienega Creek in 2000).

Chiricahua leopard frog - 1) Loss of surface water greater than 0.5f ft in depth needed for spawning, 2) concentration of tadpoles and frogs in pools where predators (wading birds, Gila chub, gartersnakes, skunks, raccoons, and each other) can quickly consume or injure them, 3) increased distance from perennial portions of Cienega Creek on the NCA to perennial water in

Lower Cienega Creek on the county preserve (loss of population connectivity), 5) accelerated erosion created by loss of riparian plant vigor and density above geologic control (bedrock spine) resulting in channelization and dewatering of habitat upstream (draining effect), and 6) smothering of habitat by accelerated from upstream reaches due to loss of riparian function and accelerated erosion 6) increase incidence of parasitism and disease (*Bd*) from stress related to crowding and poor habitat conditions.

Mexican Gartersnake - 1) Loss of aquatic vertebrates that constitute this species prey base, 2) increased distance from perennial portions of Cienega Creek on the NCA to perennial water in Lower Cienega Creek on the county preserve (loss of population connectivity), 3) accelerated erosion created by loss of riparian plant vigor and density above geologic control (bedrock spine) resulting in channelization and dewatering of habitat upstream (draining effect), and 4) loss of open water, riparian plants and aquatic plants that provide cover from predators and shelter, 5) population decline from predation/competition by other snakes due to loss of aquatic habitat.

<u>Confounding factors in predicting effects of proposed mining project:</u>

1) Jesse Dickenson (USGS), suggested that the GW model boundary conditions used for the model exercises used for the EIS likely under estimate losses from Cienega Creek and other surface waters. The potential impacts of the mine project to ground water will be additive to GW removed from the system from private wells that have proliferated in the watershed over time; 2) ecologic conditions naturally change with time as do population distribution and abundance adding to the uncertainty of effects over time, 3) watershed management and the introduction of beaver may partially offset some of the cumulative impacts to groundwater and surface water resources.