



RESTORING QUEEN CREEK

August 26, 2023

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INSPIRATION



SUPERIOR VISION

We are starting with a distressed creek, due the effects of climate change and historic mine impacts, but this is not the end of the story. We can restore the creek to its former glory!

Restoration projects have many positive effects.

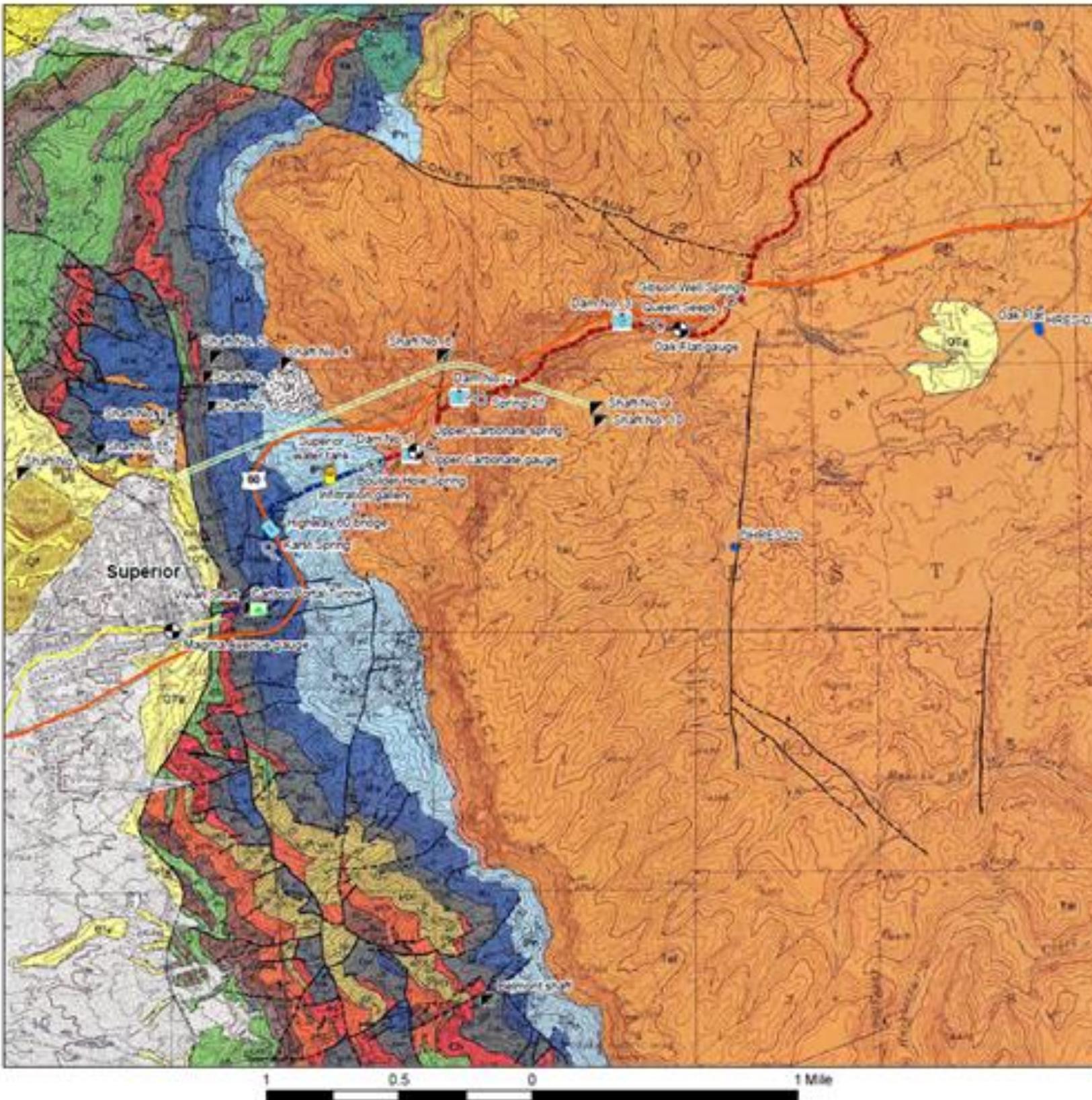
- Decreasing fire risk by reducing fire fuels in the wildland-urban interface,
- Mitigating flood risk by reducing obstructions and debris in the creek channel,
- Decreasing invasive species and allowing the native riparian species to recover,
- Lowering water usage by woody brush species and helping restore the shallow groundwater aquifer,
- Improving the appearance and recreation assets in the creek.
- Addressing water sustainability by conserving water in the local shallow groundwater system,
- Maximizing recharge of deeper groundwater systems,
- Improving the health of native riparian flora and fauna by decreasing competition increasing access to water resources,
- Decreasing the impacts of climate change by keeping the flora hydrated and more resistant to fire, and
- Passive cooling of the area adjacent to the creek through increased canopy and evaporative cooling.



RESTORATION GOALS

- Riparian Area Recovery
- Shallow Aquifer Recharge
- Restoration of Perennial Base Flow
 - Recreational Use

UNDERLYING GEOLOGY



Legend

- Springs and seeps (Spring 2 from Basset et al., 1994)
- Mine shafts
- Stream gages
- Dams
- Wells
- Queen Creek geology reaches
 - Apache Leap Tuff Reach
 - Paleozoic Limestone Reach
 - Alluvium/Gila Conglomerate Reach
 - Major roads
 - Never Sweat Tunnel

Surface geology map units

Qf Tailing and slag piles, sand and fill	Tt Apache Leap Tuff	Qd Quartz diorite UNCONFORMITY	Tq Troy Quartzite DISCONFORMITY
Ql Talus and landslide material	Tr Rhyolite	Pl Permian Limestone	Tb Basalt
Qal Alluvium UNCONFORMITY	Tw Whitetail Conglomerate UNCONFORMITY	Ma Marion Limestone	Tm Mural Limestone
Qbs Basalt	Em Martín Limestone DISCONFORMITY	Tds Dripping Spring Quartzite Data indicate Dripping Spring Conglomerate Member	Tf Florence Formation UNCONFORMITY
Qcg Gravel and conglomerate UNCONFORMITY	Qc Bolsa Quartzite UNCONFORMITY	Tf Florence Formation UNCONFORMITY	Tf Florence Formation UNCONFORMITY
			Tf Final Schist

Surface geology map data from: Peterson, Donald, 1969.
Geologic map of the Superior quadrangle, Pinal County, Arizona.
U.S. Geological Survey. Map GQ-818.

Figure 28. Surficial geology of the Queen Creek watershed focusing east of the Concentrator Fault

GEOLOGICAL TAKE-AWAYS



- The caliche below town does not absorb water easily, so water that reaches town is likely to flow on the surface or in shallow ground water systems.
- The rock higher in Queen Creek is more porous and fractured, absorbing more water and releasing it more readily through seeps and springs. This affect would naturally moderate stream flows.
- Interactions between surface and groundwater water is higher in upper Queen Creek than in the town itself.

PERENNIAL OR EPHEMERAL?



- Originally the Creek was Perennial, flowing for most or all of the year, providing municipal water and water for several different milling operations.
- The first impacts were felt between 1900 and 1920, due to the Lake Superior mining operation.
- Further impacts were seen after the Magma Mine extended the Neversweat Tunnel under the creek.
- Now the creek is ephemeral in most reaches.



HISTORIC MINE IMPACTS

Almost 150 years of active mining.

MINING HISTORY

1872 – A soldier named Sullivan at Camp Pinal discovers silver north of the current town site.

1875 – Mining starts at the Silver King Mine, shipping ore via 20 mule team wagons to the new town of Pinal, established near Queen Creek to provide water for steam generation.

1891 – The boomtown of Pinal fades.

1900 – The Town of Superior is established

1910 – Magma Copper Mine begins operation

1923 – Boyce Thompson Arboretum was established

MINING HISTORY

1971 - Magma Smelter closes

1982 – Magma Mine closes

1990 – BHP reopens the mine for a short period.

2000 – Resolution Copper, a joint venture of BHP and Rio Tinto, begins permitting on a new operation

2015 - Land exchange legislation passes congress.

2019 – A draft Environmental Impact Statement is released, laying out plans for the largest mine in the US.

DEFORESTATION

- Most trees in the area were cut to feed the steam generators of the mills in Pinal and Lake Superior and Arizona.



Ore wagons from the Silver King Mine at the Pinal mills, circa 1885

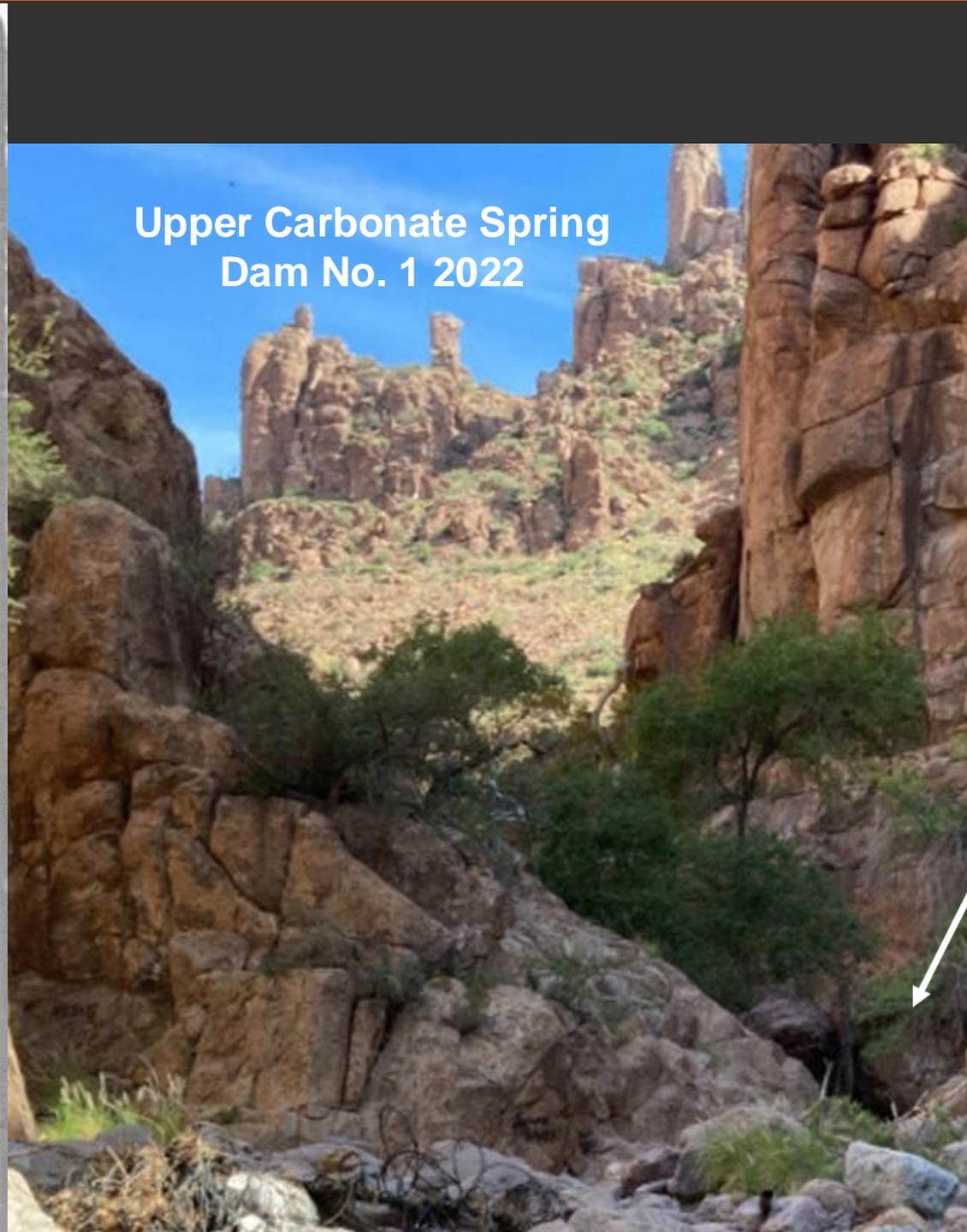


Lake Superior and Arizona Mill 1903

DAMS INSTALLED FOR MUNICIPAL WATER



Upper Carbonate Spring
1885

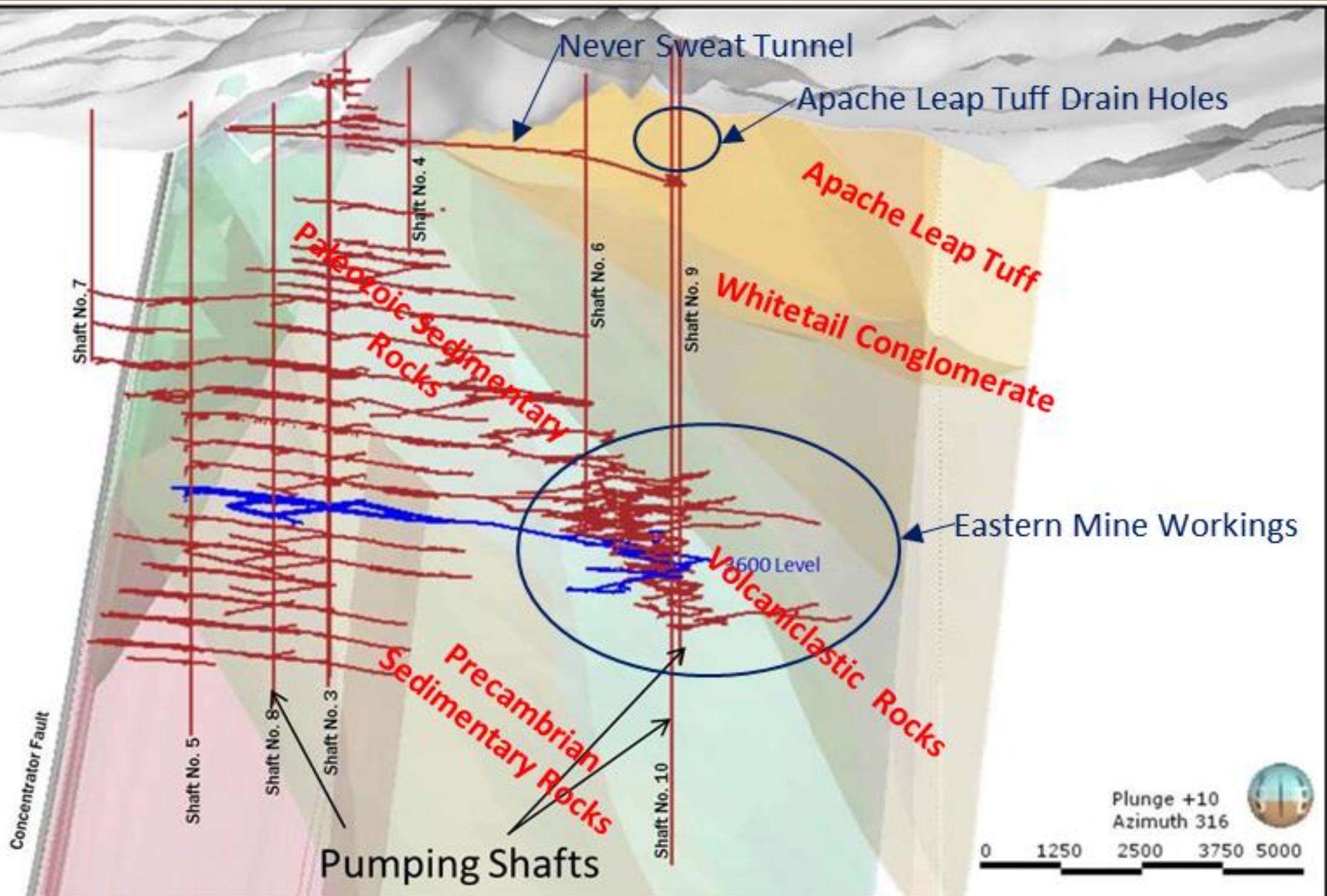


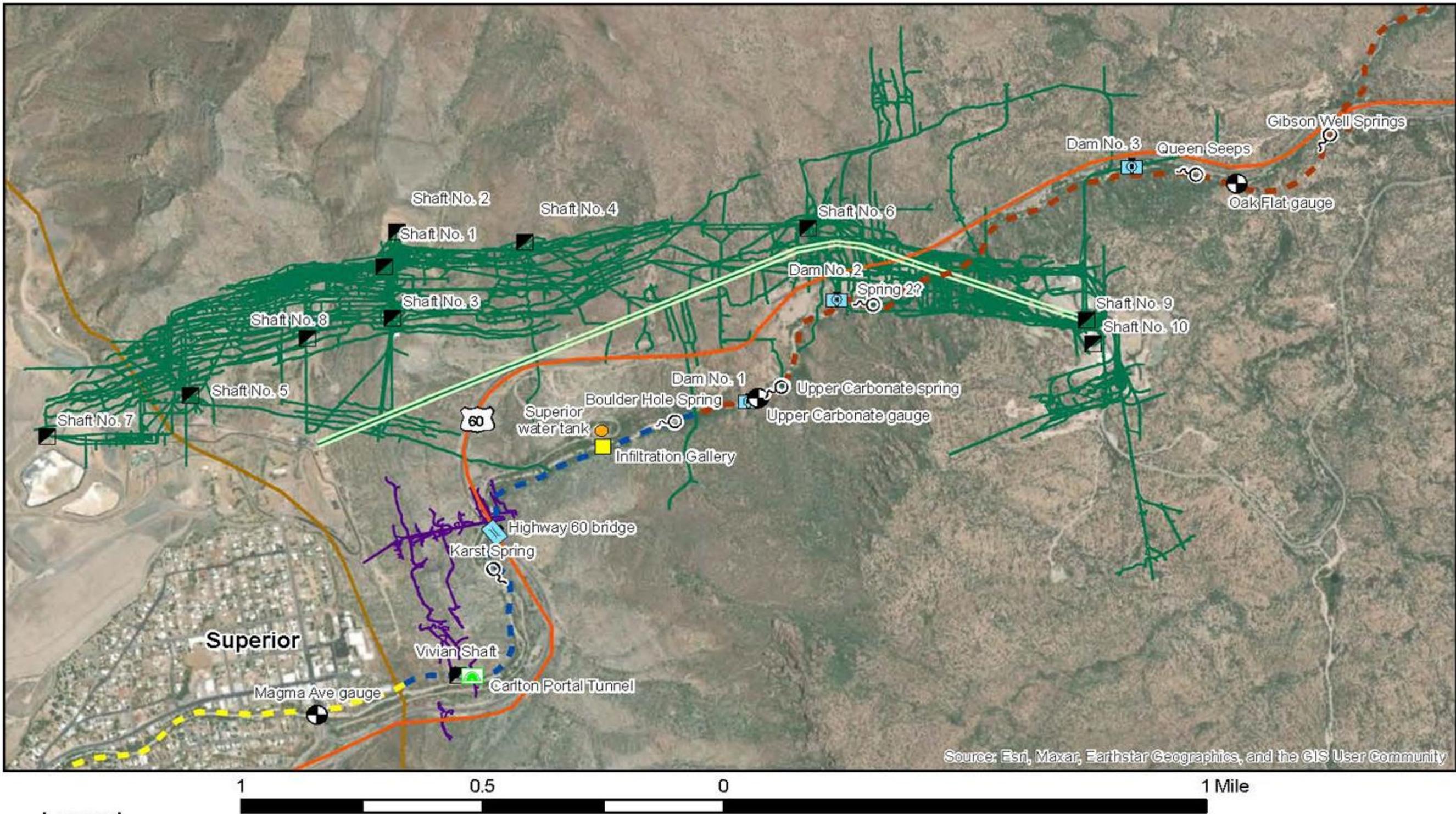
Upper Carbonate Spring
Dam No. 1 2022



Yuma Indians, Arizona, E. A. Bouine, Photo, Pasadena, Los Angeles Co., Cal.

MINE WORKINGS AND DEWATERING PUMPING





Legend

- | | | | | |
|---|-------------------|----------------------------------|---|--------------------------------------|
| ○ | Springs and seeps | Queen Creek geology reaches | — | Never Sweat Tunnel |
| ▣ | Shafts | Apache Leap Tuff Reach | — | Major roads |
| ⊙ | Stream gauges | Paleozoic Limestone Reach | — | Concentrator fault |
| 📷 | Dams | Alluvium/Gila Conglomerate Reach | — | Magma Mine underground workings |
| | | | — | L. S. & A. Mine underground workings |



Figure 6. Queen Creek canyon and Magma Mine and LS&A Mine workings

RESOLUTION COPPER ENVIRONMENTAL IMPACT STATEMENT

- Released in August of 2019, the Resolution Copper Environmental Impact Statement raised new issues about the impact of the proposed and historic mining activities on the Town of Superior and Queen Creek.
- The Town and Resolution Copper entered negotiations to address these impacts with appropriate mitigations.
- A final Mitigation Agreement was approved in January, 2021, and placed in the Final EIS as voluntary mitigations enforceable through the permit. It included: payment of direct costs for streets and public safety, dark skies, recreation projects, water mitigations, and other important issues.

IMPACTS TO GDEs

No ACTION

Continued Dewatering

- Bitter Spring
- Bored Spring
- Hidden Spring
- McGinnel Mine Spring
- McGinnel Spring
- Walker Spring



ALL ACTION ALTERNATIVES

Best-calibrated Model (Impacts are anticipated)

- DC-6.6W Spring
- Kane Spring

All Sensitivity Model Runs (Impacts are possible)

- No Additional GDEs

All Sensitivity Runs (Impacts are possible but unlikely)*

- Middle Devil's Canyon (DC-8.8C, DC-8.82W, DC-8.1C)
- Queen Creek (17.4-15.6)
- Iberri Spring

* Totals shown do not include GDEs with "possible but unlikely" impacts; while at least one model sensitivity run indicates impacts could happen to these GDEs, the great majority of model runs indicate otherwise.

ALTERNATIVES

	Subsidence Crater Alone	Alt 2/3 (Near West)	Alt 4 (Silver King)	Alt 5 (Peg Leg)	Alt 6 (Skunk Camp)
Direct Disturbance	<ul style="list-style-type: none"> • Grotto • Rancho Rio 	<ul style="list-style-type: none"> • Benson • Bear Canyon • Perlite 	<ul style="list-style-type: none"> • Iberri • McGinnel 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • None
Surface Water Reductions	<ul style="list-style-type: none"> • Queen Creek (17.4-15.6) • Queen Creek (Whitlow Ranch Dam) • Devil's Canyon 	<ul style="list-style-type: none"> • Queen Creek (Whitlow Ranch Dam) 	<ul style="list-style-type: none"> • Queen Creek (Whitlow Ranch Dam) 	<ul style="list-style-type: none"> • Gila River 	<ul style="list-style-type: none"> • Gila River
Total GDEs Impacted†	16	14	14	14	14

† Totals shown include both GDEs impacted by the subsidence crater and GDEs impacted by specific alternatives.

Aside from groundwater drawdown, this reach of Queen Creek also would see reductions in runoff due to the subsidence area, ranging from about 19 percent in Superior to 13 percent at Boyce Thompson Arboretum (see table 3.7.1-5). The anticipated 13 to 19 percent loss in flow during the dry season could contribute to a reduction in the extent and health of riparian vegetation and aquatic habitat. The complete drying of the downstream habitat, loss of dominant riparian vegetation, or loss of standing pools would be unlikely.

WATER

Data in the DEIS indicates that there will be a possible 18% drop in the amount of water flowing through Queen Creek, a drop of the water in wells in town limits by 10 to 30 feet, and impacts to a number of springs and seeps around the community over the next 56 years. All of these impacts have associated monitoring and mitigation plans.

ESTIMATED ANNUAL STREAMFLOW LOSSES



Queen Creek at Magma Avenue	
Runoff Coefficients (ac-ft/year)	
	439
	375
	407
Hydrologic Models (ac-ft/year)	
	704
	366
	535
	471

In-stream water loss between Upper Carbonate and Magma Ave (Courtesy Mila Besich)

In-stream void between Upper Carbonate and Magma Ave (Source: Greg Ghidotti)

WATER MITIGATIONS

- Return Freshwater Mine Inflow directly into Queen Creek above Magma Bridge, restoring 471 acre feet of the natural flow in Queen Creek by collecting streamflow that has seeped into the mine and discharging it back into the creek. This water will have to meet all water quality standards for a permitted discharge.
- Implement a Program to Remove Exotic Vegetation and Manage Floodway Vegetation in Queen Creek.
- The addition of enhance monitoring of Queen Creek stream and groundwater levels.
- Monitoring of groundwater wells within the area of impact.
- Establishment of a Conservation Easement for parts of Queen Creek.
- Restoration of lost stream flow due to subsidence impacts.

SUPERIOR WATERS AND TRAILS ACTION PLAN

SUPERIOR, ARIZONA - March 2020

The Superior Waters and Trails Action Plan identifies a practical road map for enhancing the recreational and natural values of the Town of Superior. The Action Plan will serve as a tool to identify tangible steps and projects that can be accomplished within the next five years. From completing the Legends of Superior Trail to enhancing native vegetation along Queen Creek, the projects included in the plan will help Superior make the most of its impressive natural setting and small town charm.

RECREATION ACTIONS

1. QUEEN CREEK GREENWAY - DOWNTOWN SUPERIOR

See Concept Plan

2. BESICH PARK IMPROVEMENTS

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3. IMPROVE WALKABILITY

Enhance pedestrian connection to and from downtown Superior, the new Multi-generational Center and other key destinations

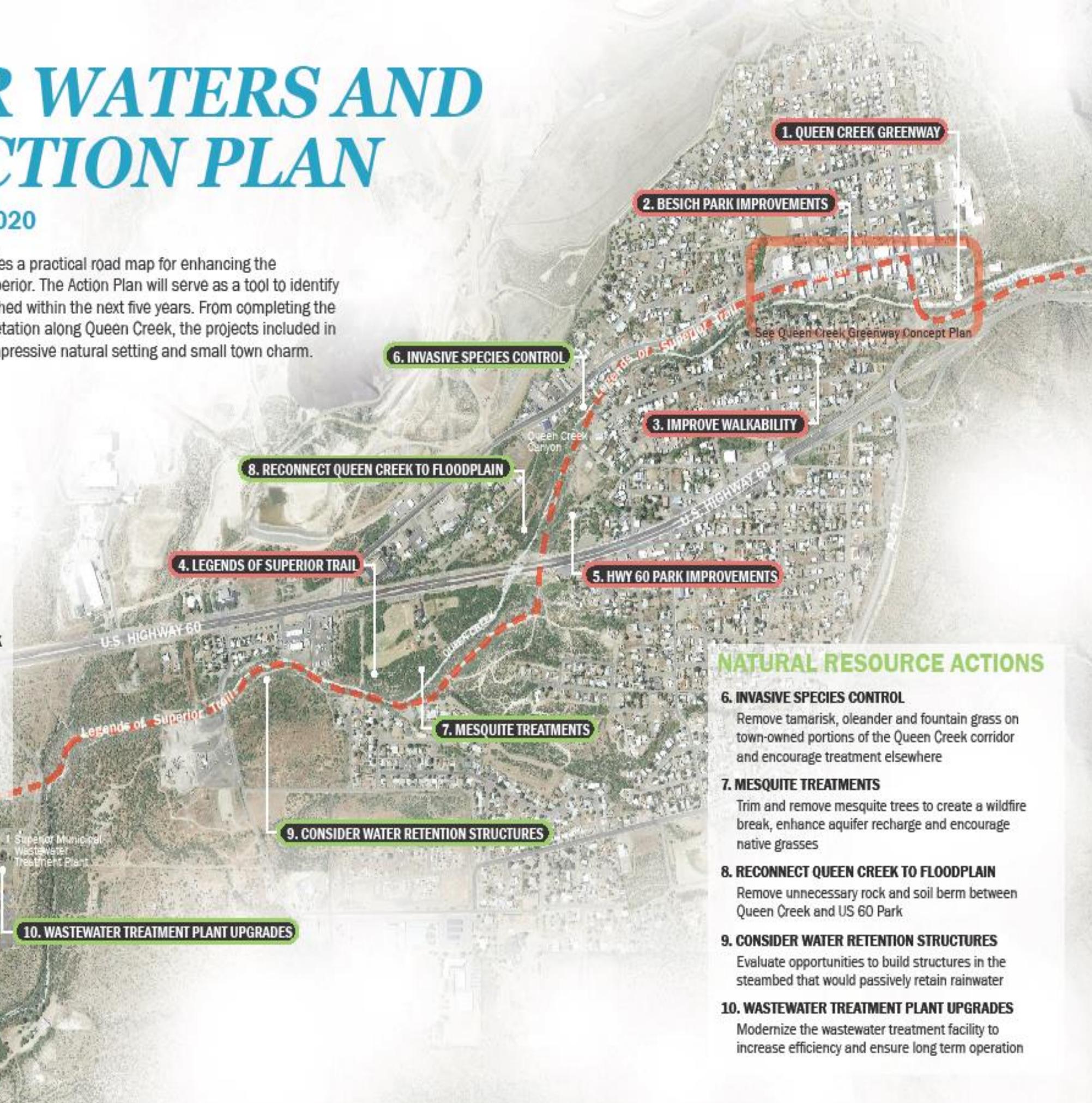
4. LEGENDS OF SUPERIOR TRAIL - AIRPORT TO US 60 PARK

Completion of the LOST Trail, creating a continuous connection from the Arizona Trail to Queen Creek Canyon

5. HIGHWAY 60 PARK IMPROVEMENTS

Complete park enhancements including new dog park, new playground, connection to LOST and improved Queen Creek access

Connection to Arnett Canyon & Arizona Trail



1. QUEEN CREEK GREENWAY

2. BESICH PARK IMPROVEMENTS

See Queen Creek Greenway Concept Plan

6. INVASIVE SPECIES CONTROL

3. IMPROVE WALKABILITY

8. RECONNECT QUEEN CREEK TO FLOODPLAIN

4. LEGENDS OF SUPERIOR TRAIL

5. HWY 60 PARK IMPROVEMENTS

7. MESQUITE TREATMENTS

9. CONSIDER WATER RETENTION STRUCTURES

10. WASTEWATER TREATMENT PLANT UPGRADES

NATURAL RESOURCE ACTIONS

6. INVASIVE SPECIES CONTROL

Remove tamarisk, oleander and fountain grass on town-owned portions of the Queen Creek corridor and encourage treatment elsewhere

7. MESQUITE TREATMENTS

Trim and remove mesquite trees to create a wildfire break, enhance aquifer recharge and encourage native grasses

8. RECONNECT QUEEN CREEK TO FLOODPLAIN

Remove unnecessary rock and soil berm between Queen Creek and US 60 Park

9. CONSIDER WATER RETENTION STRUCTURES

Evaluate opportunities to build structures in the steambed that would passively retain rainwater

10. WASTEWATER TREATMENT PLANT UPGRADES

Modernize the wastewater treatment facility to increase efficiency and ensure long term operation

ARMY CORP GRANT FOR RESTORATION PIPELINES



- An Earmark through Congressman Stanton with match funding provided by Resolution Copper.
- The first pipeline uses an old infiltration gallery that collected drinking water for the town, and pipes it past the fracture zone.
- Completes a reuse pipeline started in 2001 to bring recycled water from the wastewater treatment plant to the Caboose Park.
- The project will restore up to 110 acre feet per year, creating a small base flow in the creek.

QUEEN CREEK RIPARIAN AREA RESTORATION



- Three separate projects have been completed to restore the Queen Creek:
 - Treated 2 acres in 2022 to complete the lost trail and a 40 foot fuels reduction over two miles using an Americorp Crew (NCCC) and a \$35K grant from the Division of Forestry and Fire Management (DFFM)
 - In 2022 we treated 7.5 acres on a floodway lot donated by Dr. Glenn Wilt using another NCCC crew.
 - In 2023 we used a grant from DFFM to treat 7.5 of the creek through the center of town.

QUEEN CREEK RESTORATION





LEGENDS OF SUPERIOR TRAIL EXTENSION

INVASIVE SPECIES TARGETED

INVASIVE SPECIES



Tamarisk

(*Tamarix* spp.)

Tree/Shrub

Tamarisk (also known as Salt Cedar) are shrubs or shrub-like trees with numerous branches, reaching 13 to 26 feet (4-8 m) in height, but usually less than 20 feet (6 m). Leaves are scale-like, 1.5 to 3.5 mm long, with salt-secreting glands. Up close, the feathery branches resemble cedars or junipers, with tiny triangular, scale-like leaves on fine twigs. Many are deciduous in the winter.

Fountain Grass

(*Pennisetum setaceum*)

Grass

Fountain Grass is a tufted perennial bunchgrass with several upright stems growing from a densely clumped tussock; 2-4.5 feet tall. Leaves are bright green or purplish; these may turn reddish or tan with colder temperatures. Blades are long, slender, and arching (8-25 inches); sheath margin has stiff white hairs. Has a showy purplish, bottlebrush-like panicle (6-15 inches); spikelets have 1-inch long bristles.

Oleander

(*Nerium oleander* L.)

Shrub

Oleander is an upright, rounded evergreen subtropical to tropical shrub that flowers summer to fall. Purple, pink, or white five-petaled funnel-shaped flowers in clusters (terminal cymes). Narrow, willow-like, linear-lanceolate, glossy dark green leaves (to 5" long) have distinctive midribs.

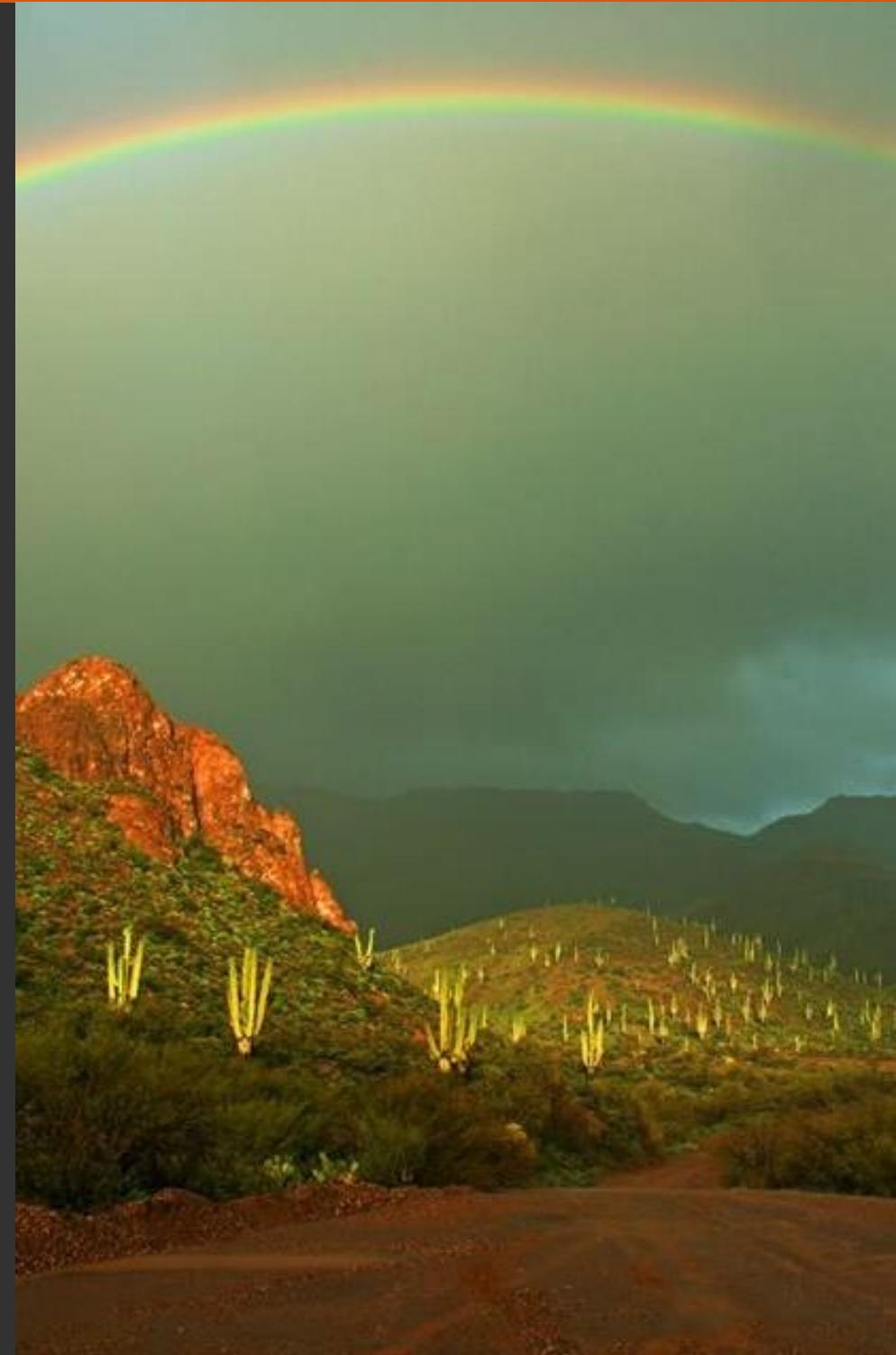
PLANS FOR THE FUTURE



- A project to restore flow by creating pipelines has been funded for \$3 million through the Army Corp of Engineers and advocacy by Congressman Greg Stanton. Resolution Copper providing matching funds.
- Invasive species and brush reduction has begun in the creek to maximize shallow groundwater recharge.
- Initial planning has begun to create a watershed strategy to maximize recovery and recharge.
- Several miles of new trail have been built along the creek, linking the trails to the downtown.

SUPERIOR STRATEGY

- Working from a strategy that guides how we build strong public-private partnerships based on integrity and shared values.
- Restoring of Queen Creek to guarantee the environmental health and water sustainability for the future.
- Maximizing the natural beauty and recreation assets of the community.





QUESTIONS?

TOWN OF SUPERIOR:
TOGETHER, WE ARE SUPERIOR!



Thank you!