Meeting Minutes

Engineering/Minerals
Tonto National Forest
Phoenix, AZ

To: Project Record

From: Tyler Loomis, SWCA

Re: Resolution All Things Water Work Group Meeting 3/26/2020

Attendees:

USFS: Mary Rasmussen, Judd Sampson, Eddie Gazzetti
SWCA & subcontractors: Chris Garret, Donna Morey, Tyler Loomis, Mark Williamson, Nick Enos, Mike Henderson, Gabi Walser, Derek Hrubes
EPA: Hugo Hoffman
AGFD: Jim Ruff
ADEQ: Wayne Harrison
ADWR: Brett Esslin
San Carlos Apache Tribe: Jim Wells
Resolution & their subcontractors: Greg Ghidotti, Vicky Peacey, Jim Butler, Cameo Flood, Matt Wickham, Ted Eary, Tim Bayley, Chris Pantano, Gustavo Meza-Cuadra, Kate Patterson, Alex Racosky, Mark Logsdon, Janeen Duarte

Handouts:

Agenda
Ted Eary and Matt Wickham PowerPoint on geochemistry (5pg)
Tim Bayley's PowerPoint on current projects (9pg)

Discussion:

Introductions and logistics

Recap of Action Items

Maest technical report

- Resolution has some slide presentations that can be shared. They have taken a similar approach to sort by buckets, not comment by comment.
- Mark Williamson – thematic approach not item by item.
    - Initial thoughts: most overarching comment – the project has not resolved the high degree of uncertainty. Does not think resolved is fair term as detail is there, and thoroughness is there, not lacking resolution. All of us would agree that we have not removed all uncertainty.
    - Tailings characterization/ management as a topic.
    - Engineered controls as it relates to water quality.
    - The topic of least concern is the block cave water quality.
- Review of comments and thoughts from Mark Williamson
    - Block cave water quality/loading – not ready yet

  - Mark Williamson – finds that it specifically falls into 2 camps. 1. How that modeling impacts chemical loadings impacts the TSF. The model relies upon the Hatch 2018 analysis and clearly produces a greater chemical load. We need to improve our presentation of it, and it is fair to say that the approach takes a conservative approach to estimating the highest impacts. Flooding of the mine and how that might relate to a subsidence lake. Whatever happens in the mine void stays in the void? There aren't any actual connections or locations of daylighting, impacts are coming up short. There are bounds on how far one will choose to asses impact. There is uncertainty, but it is appropriate that the model forecasts the worst possible TSF impact. It is appropriate for the long term mine void and the consequences of it. Maest speaks to 2. What about long-term water quality?
  - Chris Garrett– the DEIS presents 2 different reports that estimated the sump water, Eary Report and the Hatch Report. The differences between the two is that the Hatch estimates are much higher than the Eary report. 1. Eary values were used to feed the TSF water quality models?
  - Mark Williamson – concentrations, total mass loading, includes sump water, chemical mass entrained in the ore itself. Would prefer to stop using term concentration and instead use chemical loads.
- Ted Eary Presentation Slides
  - Why two models? Not really two models, the model for Eary 2018 is really an update of the Hatch 2016 model. The models are not that much different. Primary difference – In Hatch 2016 we didn't know much about the hydrology at that time so the oxidation of ore made assumption that runoff would go over ore and create sump water. We gasot hydrology modeling later that didn't prove water would runoff Apache leap tuff. Sump water was represented by all the types of water and kept the oxidation separate. Created two loads from oxidation, one from ore and one from sump water with different loads. CAP water makes a very small difference. Updated model supersedes preliminary model, 2018 has much better info. Oxidation in both models and primary source for chemical loads, selenium is the most problematic.
  - The DEIS table only noted sump water results, Resolution request to add additional columns for ore moisture which contains the bad elements. Thinks moisture water data would help clarify potential effects. Not just sump water that leaves the block cave, but also the ore and moisture water.
- Chris Garrett – During operations, Mark mentioned it appears the updated model from 2018 predicted higher loading than the 2016 model. Is there a way we can demonstrate that the updated 2018 model loading is more conservative to show the amount of chemicals entering the TSF is higher?
    - Ted has not done the comparison. No reason to use a preliminary (2016) model when we have a final (2018) model available. It is not just sump water coming out of the mine as ore moisture contains a lot of different chemical components. The way it was presented in the draft EIS caused confusion. Ore moisture was obscured, made it look like the concentrations were much higher when really, they were the same.

- Would the long-term water quality in block cave area be somewhere between these two types of water?
  - Ted Eary – yes
- Jim Wells – Why would you assume all oxidation goes from the pit into tailings? Wouldn't the Apache leap water will get some of that load?
    - Ted Eary – The model was developed for during operation and loads are averaged over the mine life, where the DEIS shows only 1 year. The mine is done panel by panel and each panel will be closed off individually. Gives reasonable prediction of when the mine ends. It is a fair prediction of what will be there at the end of mining.
    - Jim Wells still does not feel it is a fair representation of sump water and not accounting for oxidation in the apache leap tuff.
    - Ted Eary – There won't be any further oxidation in the process once the panel is closed.
- Hugo Hoffman– ore moisture concentrations or mass load is an intermediate, we should look at the final endpoint which is tailings. Would final water quality in the area post mining looks different and have a different flow diagram.?
    - Chris Garrett – Why would we look at ore moisture in isolation, why would the public be interested in that?
    - Mark Williamson – This is just an operational model that we are discussing.
    - Ted Eary – Ore moisture is the biggest load going into tailings and is important. It is something that has to be part of the discussion with tailings.
      - Ted has not done modeling post closure.
    - Greg Ghidotti– The load into the tailings is calculated in the model, it is not a proxy for tailings load.
    - Mike Henderson – At the end of mining a panel, you would end up with a zone of high permeability and would have access to oxygen and would contribute to sump water?
      - Vicky Peacey– The panels are not "backfilled" but are closed off from oxygen as they will continue to cave with 7,000' of rock above it that will compact over time.
      - Ted Eary – There would not be a continuous source of oxygen, a little oxygen would be in the system, but it would be consumed.
      - Vicky Peacey – The ventilation would be shut off for areas no longer mined.
      - Mike Henderson – I think that's fair to say, you can't block off groundwater, but you can for the outside oxygen to the cave.
      - Ted Eary – Water carrying oxygen would have to go down 7,000' to oxidize, most oxygen is removed by the rock within the first hundred feet.
  - Chris Garrett – in the FEIS, long-term water quality in reflooded block cave zone, setting aside any outlet for that water, what is the most appropriate way to show to the public our predictions on long-term water quality?

    - Hugo Hoffman – The EIS needs to explain the differences between Hatch and Eary models described.
    - Ted Eary – The only water at the end of mining would be in the pore spaces of the rock after compaction.
    - Chris Garrett – Is it appropriate to show long term water quality for the length of the mine?
        - Mark Williamson - The intention in the EIS was to contrast the perspectives of both models. If a person takes the 2018 model as fully representing of the operations, maybe the contribution for peripheral rock eroding – per Ted's description and the hydrologic SMEs suggest that it does not come from the apache leap. The Endpoints as described are reasonable. It's probably closer to the ore moisture in the most aggressive weathering environment possible. You cannot model long-term water quality from that.
    - Chris Garrett – Is there any chance the deep groundwater water would have worse quality than the ore moisture?
        - Jim Wells – I don't think it's fair to say the sump water prediction is a proper lower bound.
        - Chris Garrett – The wish is to disclose worse, not better.
        - Ted Eary – sump water contains blowdown water; I think sump water is a reasonable way to do that.
        - Hugo Hoffman – there is an important distinction between worst case scenarios. Ore moisture vs sump water
    - Mark Williamson – sump water as reported right now is worse than natural groundwater that will report to the mine in time. Forget about blowdown water. Groundwater will oxidize down there and lower in quality, the ore moisture is the high bound of low quality.
    - Hugo Hoffman – How sensitive is the 2018 model to oxidation?
        - Ted Eary – The model is sensitive to oxidation.
        - Hugo Hoffman– how much confidence do you have on oxidation based on mine process? There may be variations in work schedule?
        - Ted Eary – Durations for the project is well researched, I believe they are reasonable projections. This was an improvement of the 2016 model, hence the 2018 model.
- Wayne Harrison – Did the groundwater model at the block cave site predict that the block cave water quality would be contained in perpetuity after closure by passive hydraulic capture and containment? Or will it migrate away from the site at some time after closure as water levels reach an equilibrium?
    - Greg Ghidotti – The model at 1,000 years shows there is still a sink and no migration.
    - Jim Wells – I believe that even if the system hasn't reached equilibrium there will still be losses through the walls, it's not an entirely closed system. Water will be gradually flowing out with deep groundwater.

- Gustavo Meza-Cuadra – The lowest outlets are the old Magma mine workings and one long decline tunnel. In the future the cave zone is still a hydraulic sink and below these features' daylighting.
- Chris Garrett – Long-term will the deep groundwater and Apache Leap behave seperately?
  - Gustavo Meza-Cuadra– at depth there might be a small amount of flow through a panel and there is a gradient towards the cave hydraulically
- Jim Wells – Once the water reaches the top of the deep groundwater, the Apache Leap would still be feeding the pit.
- Chris Garrett – Where is the top of the whitetail in elevation? We could tell approximate timing before the water rebounded to that level, when the deep system would be operating differently from the overall system.
- Jim Wells – it's not accurate to say the cave zone is blocked off from the environment
- Gustavo Meza-Cuadra – we have a figure comparing the gradients that can be shared.
- Chris Garrett – New Action Item to the list to obtain the gradient levels. We need to be sure we can say that the bad groundwater will not leave the cave.
- Jim Wells - How long could the stockpiles be sitting there and oxidizing?
  - Vicky Peacey– The covered stockpiles and residence time expected during operations are included in the model. The site does not have space for large stockpiles anywhere else.

PAG/NPAG definitions

- Mark Williamson – There were two components to the tailings management.
  - 1. How much of the tailings meets the criteria of being PAG versus NPAG for management? There are tests that have been done to oxygen consumption rate of tailings that are not typical of humidity. Results show that for PAG materials there is a dramatic lowering of the oxidation rate, not quite to zero but there is sufficient data to show that if you put the stuff under water it becomes a non-concern for chemical load. PAG tailings that require specific and aggressive storage.
  - 2. Wish to change the nomenclature to something other than PAG/NPAG. The label is problematic when you are correlating with lab samples and allows many NPAG "labeled" samples to qualify as PAG.
- Vicky Peacey– We agree the terminology can be confusing and is open to changing terms; consider Pyrite/Scavenger over "cleaner" term.
- Mark Logsdon – Presentation slide showing requested revisions to the table 3.7.2-6 in the EIS. These numbers come from the 2018 Duke Hydrochem report and have much better detail than the one that is in the draft EIS. We've arranged this table in terms of scavenger and pyrite tailings. Need to describe the system and how the tailings will be handled and how they will be stored.
- Chris Garrett – Mark you referenced that we have tests for submerged PAG, are those generic?
  - Mark Williamson – I was referring to test on this specific project
  - Matt Wickham – in the draft EIS, there is a section including mine rock analysis. There isn't a section for tailings analysis, with the number of tests and type of tests.

- Mark Logsdon – re: table 3.7.2-6 – Pyrite and scavenger tailings. What will be the impacts associated with the scavenger tailings, they have lower engineering controls over them? What would the geochemical impacts be on the scavenger tailings?
    - Most people in mining industry would use the factor of safety approach. If it is high enough, then it will not be acid generating as there is not enough neutralizing capacity. These are mathematical comparison of two tests that have very strong assumptions.
- Tailings solute model – field barrel test only applies to Alt 4 – Silver King
- No results from SPLP tests were used in the predictive models
    - Mark Williamson – doesn't change our trajectory at all
    - Chris Garrett – the table may change entirely base on a future stormwater discussion
    - Hugo Hoffman– If SPLP is appropriate, what was used?
        - We used 2 different kinds of info. Water to rock ratio is not appropriate for SPLP. People tend to use SPLP results to compare them to groundwater results. We didn't use them that way. Scavenger tailings that have been weathered. Pyrite tailings was used in barrel tests, not humidity cell. Resolution used both in the results for the water quality predictions.
- Chris Garrett – 1. Clarify what assumption is used in oxidation of pyrite tailings 2. Are there analog sites with subaqueous solutions? 3. What if you have more PAG tailings than we expect. What if during operations, we have 20% PAG as opposed to 16% PAG?
    - Kate Patterson – The design was created to allow for some percentage changes and ample contingency of storage space in pyrite.
    - Vicky Peacey – Some analog examples had already been provided, but additional analogs in arid environments will be researched.
    - Chris Garrett – What is the assumption in the tailings water quality modeling for the pyrite tailings?
        - Ted- no oxidation going on
    - Chris Garrett – how does that compare to the oxidation rate tests, did they go to zero?
        - Resolution did oxidation tests and you can calculate pyrite oxidation rate. The testing was on two separate kinds of pyrite tailings with 3 different moisture contents. They did not do subaqueous testing, at 40% content the value drops.
        - Vicky Peacey – We can find literature and examples that show subaqueous disposal works.
    - Jim Wells – This still does not address Maest's points that the scavenger tailings, some fraction of that would be potentially acid generating and it wouldn't be managed by being submerged. What is the possibility that in 20 years there are acid generating potential material ending up in the tailings as not submerged?
    - Hugo Hoffman– What criteria is used to classify the management of the tailings?
    - Vicky Peacey - The system is going to produce two streams of tailings. Scavenger – sulfide depleted, pyrite tails. We are constantly checking tailings for acid generating materials during operations. Towards the end of the mine they can move tailings around and sort them to make sure correct materials remain in tailings. Can do spot treatments as necessary. There might have small occurrences in the uncertain category, but the amount is small when looking at it holistically and it gets buried.

  - During operations there are thousands of draw points and blending of the ore can minimize changes for the mill as mills don't like fluctuating grades. That helps to mitigate what might be considered aberrations in sulfide content in the scavenger tailings. We are required to wet the beach every 4 days, so the tailings are spread out over a very large area and they are subsequently buried. So, there is a lot of blending in the process to keep the extremes from causing problems.
  - Chris Garrett summary of Mark William's noted issues:
    - 1. Uncertainty in our water quality estimates in block cave. – we missed the boat in properly describing what has been done and the differences between the Hatch and Eary reports. Will revise in the EIS. We all agree it was upgrade and not a different hypothesis. The ultimate water quality for the TSF does receive the entire load and the later report includes the load from the ore moisture and sump water.
    - 2. Tailings management – how do you classify NPAG vs PAG and have you demonstrated that the storage of PAG is adequate to handle fluctuations and need to better describe PAG/NPAG and the term/language used in document.
  - Hugo Hoffman – What is the balance of nitrates introduced into the block cave zone, need clarification of the ultimate fate of that nitrate. What percent goes where?
    - Ted Eary – Nitrate loading is based on a powder factor provided by Resolution. It contained ammonia and nitrate. The assumption was that the ammonia would be converted to nitrate and the nitrate would stay in the water and go with the ore. Assumed that it all ends up in the tailings and when it's in the tailings it should all stay as nitrate.

Tim Bayley presentation

- Field program:
  - QAL/DC Wells are comparison wells.
    - These wells will be monitoring wells into the future
  - Pumping test at Irrigation well – Bedrock well on the other side of the fault
  - Will do pumping tests at all the wells
- Queen Valley:
  - Winter precipitation is what fills the water behind the dam, not necessarily the summer rain.
  - The well in Apache Leap Tuff is a municipal well.
  - Do we need to do water quality stream assessment further downstream of Whitlow Ranch Dam to see if there is an increase in sulfate in base flow behind whitlow ranch dam?

Resolution discharge under existing AZPDES permit

- Vicky Peacey: There is an existing permit, the renewal is in litigation.
- Chris Garrett – Would there be discharges under that permit during operations, possibly into Queen Creek? What is the source of the water being discharged now?
  - Vicky Peacey– No discharge is occurring now, if discharge did occur it would be RO water.

- Chris Garrett – Do we need to analyze a potential discharge into Queen Creek?
    - Mary Rasmussen – Yes, if it goes forward as a mitigation for the project.
    - Chris Garrett – What other conversations are occurring with Resolution that feed into the conversation on discharges to Queen Creek?
    - Vicky Peacey– Were talking with a number of stakeholders including the Town of Superior – it is currently uncertain if it would occur. There are a variety of options being discussed, but none of them have much water being discharged and if it occurred it would be RO water.

Impaired reaches

- Hugo Hoffman – Where would the RO water be coming from during mitigation? The concern seems to be the impacts of where you are drawing the water from.
- Vicky Peacey- Could be deep-water, could be stored water for future use, not decided at this time. It is a very small amount of water being asked by Town of Superior to replace into Queen Creek.

Round Robin:

- Mary Rasmussen– Interested in hearing a little more from the participants today. Covered a lot of material today. Hope to organize the April meeting for it to be the most effective.
- Hugo Hoffman– Appreciated the explanation on the difference between Hatch and Eary models.
- Jim Ruff – Would like to see more data from Skunk Camp and have a discussion next meeting on the data.
- Wayne Harrison – Need to better resolve the issue of containment in the block cave area post-closure in the EIS. It will come up again later in permitting.
- Cameo Flood– It appears there might be a significant re-write of the EIS text for this section, I was wondering if you were thinking of re-routing the EIS text revisions?
    - Chris Garrett – in favor of more reviews than less
    - Mary Rasmussen– yes, we need geo-chem expertise review by the appropriate folk.

Next steps in April:

- Tim Bayley – Is the BGC memo on the ADWM memo available on SharePoint?
    - Donna will find and send Tim the link. (completed on 3/26)
- Chris Garrett – Does Resolution have the Skunk Camp water quality modeling on track for April meeting to focus on this?
    - Yes, the seepage modeling should be prepared by April.
- Chris Garrett - Would it be more useful to talk more about the items that Tim will be submitting (Skunk Camp data and updated water level information) or circle back to water modeling responses?
    - Tim Bayle would like to first discuss the conceptual model first.
    - The ESRV information wouldn’t take too long to discuss
- Update April meeting to be from 8am – 12noon on April 23rd.

Action Items:

1. Standing items, ongoing
2. Standing items, ongoing
3. Standing items, ongoing. Meeting notes were posted
4. Standing, keep lines of communication open. Let people know it exists
5. Keep SharePoint folder accessible.
6. Updated info on water quality or other data after 2016
    a. Greg Ghidotti – document and data ready to go out, M&A will be getting that to them ASAP.
    b. Tim Bayley – approved yesterday for submission, can get it to you later today or tomorrow. Will have presentation about submittals. Applies to WR-7 and WR-9 as well.
7. Should see tomorrow
8. Greg Ghidotti – Ready in April
9. Tim Bayley – ready to go
10. Kate Patterson - in progress, owe you the lab testing memo. Will get that to you in the next week or so. Document will be ready for April meeting.
11. Already completed.
    a. Greg Ghidotti – not planning on presenting on this today
12. Tim Bayley – have a memo to submit next week and a presentation on memo to over today
13. Received responses and were circulated.
14. Ongoing
15. Tim Bayley – we will talk about that in April
16. Greg Ghidotti – Will update in April
17. Need to draft a letter for ADWR
18. Gabi Walser– in process in BGC's court, will be ready in April
19. Received
20. Greg Ghidotti – underway, if they have time April, they will do it
21. Matt Wickham – ready in April

Recap: most will be ready in the next couple of weeks and ready for discussion in April. May need to prioritize some of these. Skunk camp should probably be a priority. April's meeting will not be an all-day meeting, hoping to cap online meetings to about 4 hours in length.

Engineering/Minerals
Tonto National Forest
Phoenix, AZ

Agenda

To: Attendees, Project File
From: Donna Morey, SWCA
CC:
Date: 3/26/2020

Re: Resolution Copper Mine – Water Resources Workgroup – 3/26/2020

1. Welcome and introductions; Logistics

2. Recap of action items

3. Discussion of Maest technical report
    a. Review of comments; initial thoughts from M. Williamson
        i. Specific issue: block cave water quality/loading
        ii. Specific issue: PAG/NPAG definitions
        iii. Specific issue: PAG cell deposition technique

4. Discussion of appropriate bounds of water quality analysis
    a. Review of comments
        i. Specific issue: RCM discharge under existing AZPDES permit
        ii. Specific issue: Impaired reaches
        iii. Specific issue: Median vs. low flow for surface waters

5. Further discussion of previous topics
    a. Additional stormwater quality discussion
        i. Recap on approach from February meeting:
            1. DEIS approach of assuming no discharge of stormwater would occur is not realistic; failures and planned releases can occur
            2. Disclose the potential impacts from a reasonable release scenario (large storm, spillway release) or an unanticipated release
            3. Distinguish between short, infrequent release versus long-term persistent releases (like seepage)
    b. Further responses to Prucha comments
    c. Queen Valley hydrologic framework

6. Update on available sampling data since 2016

7. Update on seeps and springs inventory

8. Open discussion

9. Next Steps – Plans for April meeting

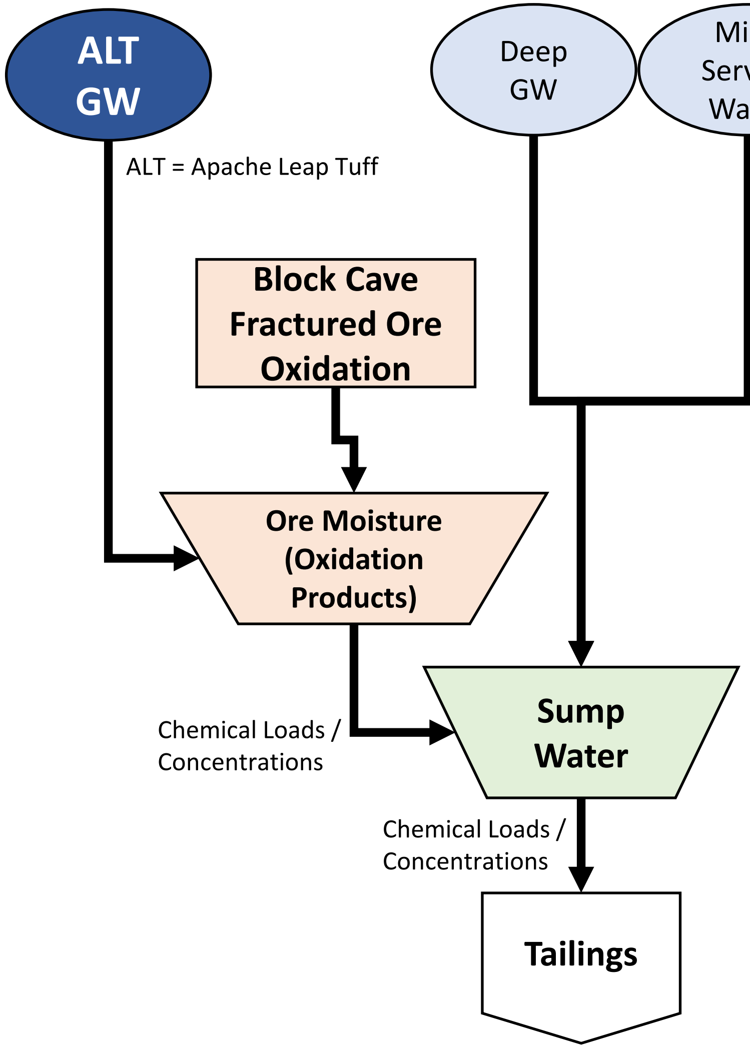
Supporting Materials for Discussions about the Block-Cave Geochemical Model

Resolution Copper Mine
All Things Water - Water Resources Workgroup
3/26/2020

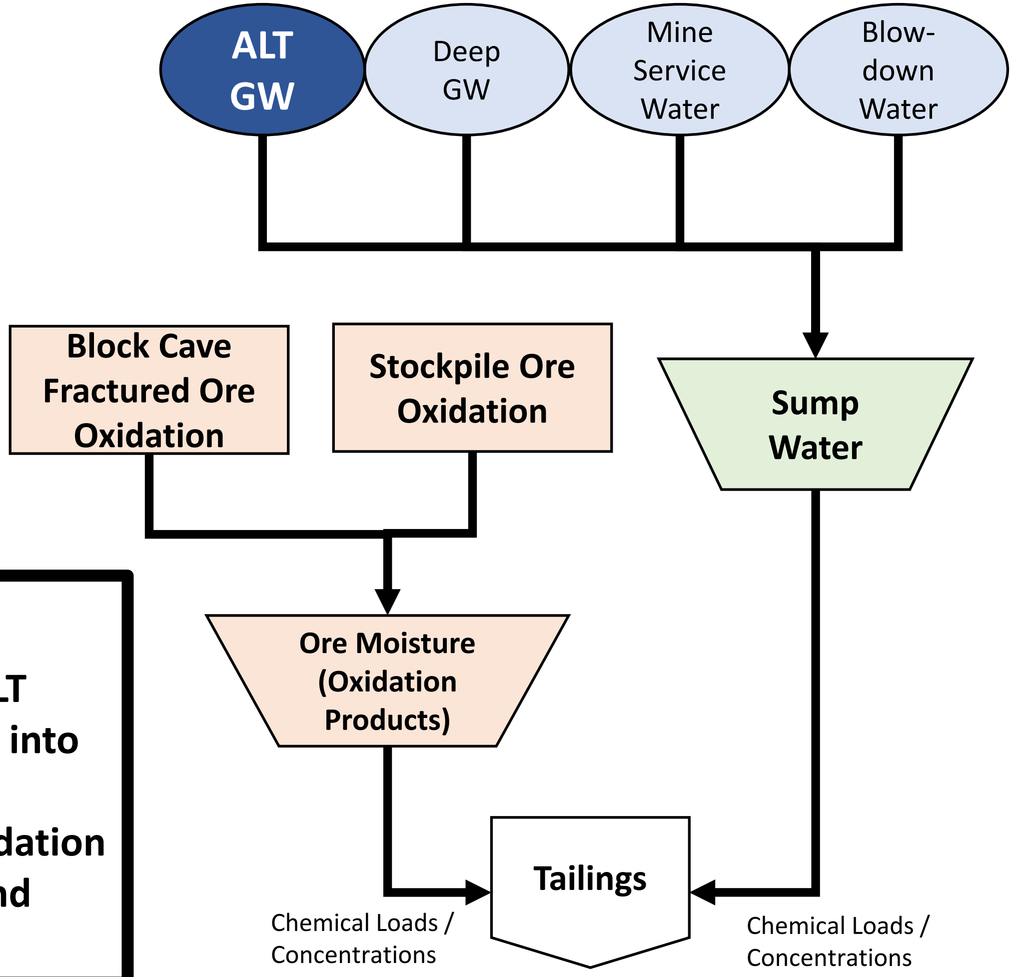
Ted Eary
Enchemica LLC
Loveland, Colorado

Block Cave Geochemical Model Versions – Structure and Concepts

Hatch (2016) Preliminary Model



Eary (2018) Final Model



Differences

- **Hatch (2016) model assumed ALT water rinses oxidation products into Sump Water**
- **Eary (2018) model assumed oxidation products from the block cave and stockpile stay with the ore**

Updates of the Hatch (2016) model made in the Eary (2018) model

New Information available after the Hatch (2016) model	Model Updates for the Eary (2018) model
New geologic block model (2016 MPO)	Oxidation: same approach as in Hatch (2016) but with the following updates: ▪ Re-aggregation of experimental kinetic data for the new geologic block model ▪ Improved representation of the mass of fractured ore exposed to oxygen per time and per panel ▪ New calculations of oxygen penetration depth based on temperature and re-aggregated kinetic data ▪ Addition of sulfide mineral oxidation in surface stockpiles
Panel mining sequence (2016 MPO)	
Schedule for active draw-bells (2016 MPO)	
Schedules for ore movement and production (2016 MPO, Labrecque, 2017)	
Draw-bell geometry (RCM)	
Temperature profiles for ore in draw-points (Moreby, 2018)	
Analysis of CAP water from March 2018 (RCM)	▪ Re-calculation of sump water chemistry
Estimates for rate of explosives use (RCM)	▪ Addition of nitrogen loading
Final groundwater hydrology model (WSP)	▪ Underground water balance ▪ 100% of chemical loads in ore moisture and sump water delivered to tailings

The updated Eary (2018) model supersedes the preliminary Hatch (2016) model in all aspects of the expected mining operation

Comparison of Predicted Concentration Ranges for Ore Moisture from Sulfide Oxidation

Parameter	Hatch (2016)	Eary (2018)
pH	4.5 to 5.0	2.2 to 3.6
SO_4 (mg/L)	1900 to 3800	500 to 3200
Fe (mg/L)	0.1 to 0.3	30 to 100
Cu (mg/L)	5 to 670	180 to 650
Zn (mg/L)	3 to 35	2 to 15

Oxidation represented by similar methods in both models:

- **Mass of rock exposed to O_2**
- **Elevated temperatures**
- **Sulfide oxidation rates**
- **Rates of solute release**
- **Oxidation products contained in ore moisture**

Table 3.7.2-1. Modeled block-cave Sump Water and Ore Moisture chemistries (clarifications)

Constituent	Eary Block-Cave Geochemistry Model Predicted Average Concentrations for Sump Water (mg/L)	Eary Block-Cave Geochemistry Model Predicted Average Concentrations for Ore Moisture (mg/L)	Arizona Aquifer Water Quality Standard (mg/L)
Ca	~~237~~ 246	~~434~~ 545	–
Mg	~~63~~ 66	~~147~~ 19	–
Na	~~130~~ 134	~~181~~ 13	–
K	~~28~~ 29	~~85~~ 38	–
Cl	~~46~~ 47	~~85~~ 30	–
HCO3	~~114~~ 112	~~19.9~~ 0	–
SO4	~~934~~ 976	~~2247~~ 2805	–
SiO2	~~22~~ 22	~~17~~ 20	–
F	~~2.3~~ 2.7	~~Not reported~~ **24.2**	4
N	~~0.8~~ 0.7	~~Not reported~~ 12.1	–
Al	~~0.0857~~ 0.0828	~~9.3~~ 26.8	–
Sb	~~0.0047~~ 0.0042	**~~0.035~~ 0.015**	0.006
As	~~0.0227~~ 0.0228	~~0.013~~ 0.035	0.05
Ba	~~0.0199~~ 0.0197	~~0.02~~ 0.02	2
Be	~~0.0003~~ 0.0003	**~~0.036~~ 0.058**	0.004
B	~~0.342~~ 0.351	~~0.48~~ 0.293	–
Cd	~~0.0008~~ 0.0007	**~~0.19~~ 0.050**	0.005
Cr	~~0.0027~~ 0.0026	**~~0.241~~ 0.391**	0.1
Co	~~0.0063~~ 0.0058	~~2.72~~ 0.608	–
Cu	~~0.0158~~ 0.0158	~~141~~ 458	–
Fe	~~0.0025~~ 0.0025	~~0.1~~ 63	–
Pb	~~0.005~~ 0.005	**~~0.088~~ 0.092**	0.05
Mn	~~0~~ 0	~~14.2~~ 6.0	–
Hg	Not reported	Not reported	0.002
Mo	~~0.0135~~ 0.0134	~~0.000012~~ 0.385	–
Ni	~~0.0076~~ 0.0072	**~~2.5~~ 0.614**	0.01
Se	~~0.0051~~ 0.0046	**~~0.5~~ 0.849**	0.05
Ag	~~0.0039~~ 0.004	~~0.165~~ 0.244	–
Tl	~~0.0043~~ 0.0038	~~0.009~~ 0.004	0.002
Zn	~~0.221~~ 0.23	~~8.2~~ 12.6	–
pH s.u.	~~8.58~~ 8.56	~~5.05~~ 2.41	–

SUPPORTING MATERIALS FOR GEOCHEMISTRY DISCUSSIONS

All Things Water – Tailings Geochemistry
26 March 2020

In response to:

Dr. Maest Comment No. 1
Regarding use of static acid base accounting for NPAG and PAG classifications

Proposed action:

Additional narrative sub-sections in Section 3.7.2:

- TAILINGS ANALYSIS
  - Amount of geochemistry tests conducted
  - Types of geochemistry tests conducted
  - Suggested additional table (draft)

Rationale:

Intended to highlight the large body of geochemistry testwork that forms the basis for understanding weathering behavior of the tailings and predicting water chemistry

Table 3.7.2-6. Number of tailings samples submitted for geochemical evaluation 2014-2016

Metallurgical Testing Program	Type of Test	Scavenger Tailings	Pyrite Tailings
Individual Ore Composites	Static ABA	63	
	NAG	63	
	NAG Effluents	63	
Master Ore Composites LCT	Static ABA	39	
	NAG	39	
	NAG Effluents	39	
2014 Pilot Plant	Static ABA	7	6
	NAG and Effluents	7	6
	SPLP	7	6
	TCLP	7	6
	Process Waters	17	
HCT Program for Master Composites	Static ABA	12	
	NAG	12	
	NAG Effluents	12	
	SPLP	12	
	XRD	12	
	QEMSCAN	12	
	XRF-WRA	12	
	Elemental – ICP/OES-MS	12	
	PSD	12	
	Particle Class. / Specific Gravity	12	
	HCT	6	
HCT Program for 2014 Pilot Plant	Static ABA	6	
	NAG	6	
	NAG Effluents	6	
	SPLP	6	
	XRD	6	
	QEMSCAN	6	
	XRF-WRA	6	
	Elemental – ICP/OES-MS	6	
	PSD	6	
	Particle Class. / Specific Gravity	6	
	HCT	6	
Pyrite Oxidation Rate for 2014 Pilot Plant HCT samples	Oxygen Consumption Tests as Function of Moisture Content	6	6

Notes: Summary derived from Duke HydroChem 2016.

In response to:
Dr. Maest Comment No. 1
Regarding use of static acid base accounting for NPAG and PAG classifications

Proposed action:
- Global reference to Scavenger tailings and Pyrite tailings opposed to NPAG tailings and PAG tailings
- Update to Table 3.7.2-6 (and others)

Rationale:
Clarification of tailings types vs. ARD classification based on static ABA testing

Original

Table 3.7.2-6. Acid-generation classification of tailings samples

Tailings Type	Acid Generating	Non-acid Generating	Potentially Acid Generating
NPAG tailings (84% of total amount)	15%	41%	44%
PAG tailings (16% of total amount)	100%	0%	0%

Proposed modifications

Table 3.7.2-6. Acid-generation classification by Tier 1 static screening tests of tailings samples

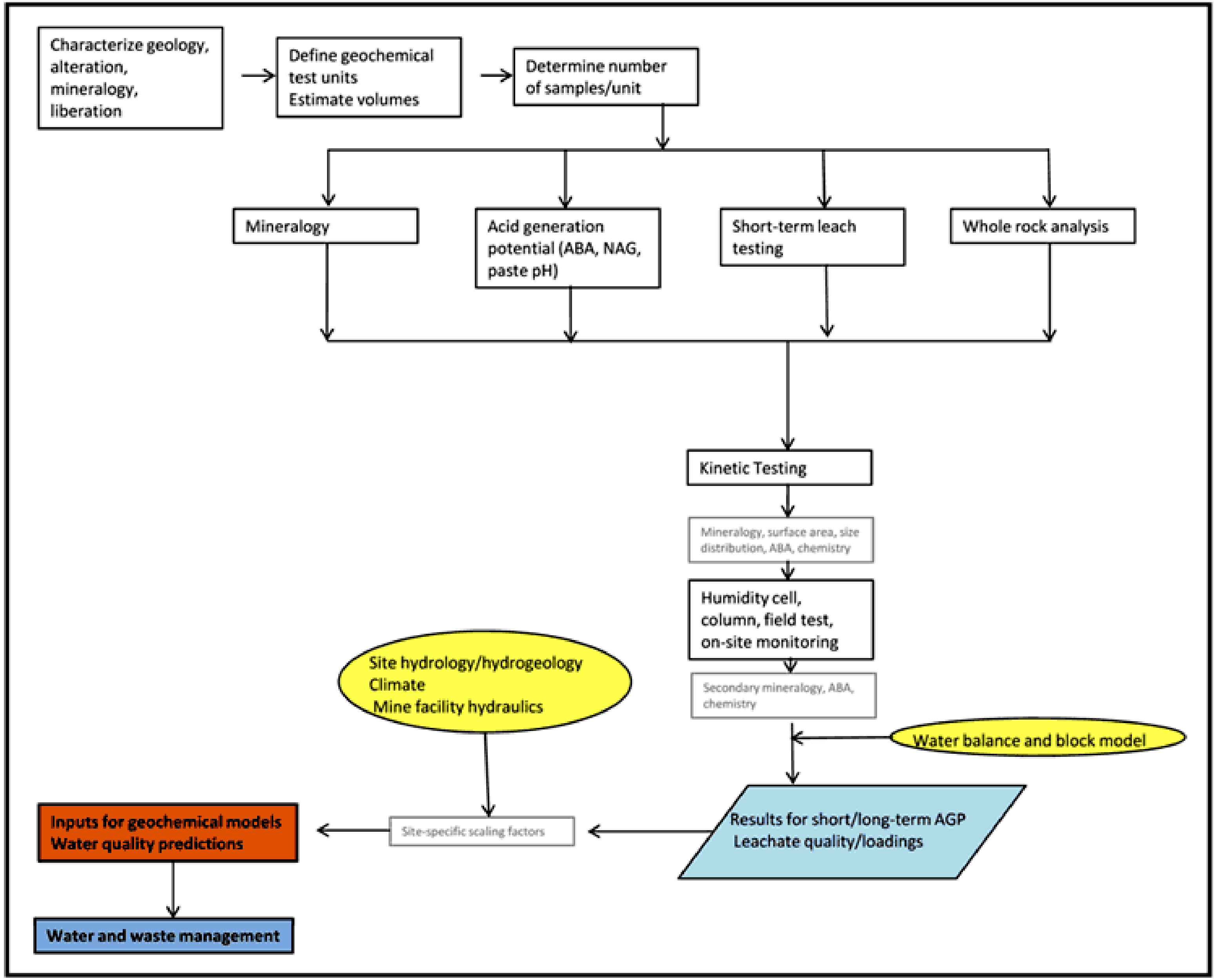
Tailings Type	Potentially Acid Generating	Not Potentially Acid Generating	Uncertain
Scavenger tailings (84% of total amount)	15%	41%	44%
Pyrite tailings (16% of total amount)	100%	0%	0%

In response to (continued):
Dr. Maest Comment No. 1
Regarding use of static acid base accounting for NPAG and PAG classifications

Proposed action:
None

Rationale:
Explanatory

Illustration of Geochemical Characterization Program
(GARD Guide, 2020; Maest and Kuipers, 2005)



In response to (continued):
Dr. Maest Comment No. 1
Regarding use of static acid base accounting for NPAG and PAG classifications

Proposed action:
None

Rationale:
Explanatory

Static Acid-Base Accounting [Conceptual Model: Always Open to Atmosphere]

Sample Preparation

ACID GENERATING POTENTIAL – Split 1	ACID NEUTRALIZING POTENTIAL – Split 2
1. Leco Furnace a) Pyrolysis at 1,300 ^{o}C b) IR Spec: SO_2 c) Calculate as Total S d) Calculate as FeS_2 equiv. 2. HCl Extraction on split: SO_4 a) Acid soluble sulfides (pyrite) b) Calculate <u>Sulfidic S</u> as $S_{tot} – S_{SO4}$ 3. HNO_3 Extraction on split: S^{2-} a) Calculate <u>Sulfidic S</u> 1 mol $CaCO_3$ neutralizes 1 mol H_2SO_4 Convert FeS2 eq (Total or Sulfidic) to units of CaCO3 eq as g $CaCO_3$/kg rock	1. Treat with excess HNO_3 a) Original Sobek: Warm Acid (accelerate test) b) Modified Sobek: Room-T Acid 2. Back Titrate with NaOH 3. Compute Amount of Acid Consumed by Sample Matrix Convert to stoichiometry of CaCO3 eq to units of g CaCO3/kg Rock (parts per 1000)

In response to (continued):
Dr. Maest Comment No. 1
Regarding use of static acid base accounting for NPAG and PAG classifications

Proposed action:
None

Rationale:
Explanatory

<u>"Factor of Safety": ANP/AGP</u>

- **NPAG : NPR ≥ 3†**
- **PAG : < 1**
- **"Uncertain" : 1 ≥ NPR < 3†**

<u>Alternative: Net Acid Generation (NAG) Test‡</u>

- **React with Excess H_2O_2 (strong oxidant)**
- **Leave 24 hours**
- **Measure pH (NAG pH)**
- **NPAG : Final pH ≥ 4.5**
- **PAG : Final pH < 4.5**

† Arizona Department of Environmental Quality's (ADEQ's) Best Available Demonstrated Control Technology (BADCT) guidance document

‡ MEND. 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. Report 1.20.1, Version 0.0, Prepared by W.A. Price of CANMET – Mining and Mineral Sciences Laboratories for MEND, December 2009.

Stewart, W.A., S.D. Miller, R. Smart, 2006. Advances in Acid Rock Drainage (ARD) Characterization of Mine Wastes, Paper presented at the 7th International Conference on Acid Rock Drainage (ICARD), March 26-30, 2006, St. Louis MO. R.I. Barnhisel (ed.), Published by the American Society of Mining and Reclamation (ASMR), Lexington, Kentucky.

In response to:
Dr. Maest Comment No. 1 Regarding use of acid base accounting results

Proposed action:
None

Rationale:
Explanatory. Intended to highlight the large body of geochemistry testwork used to predict water quality

Block Cave Geochemical Model

Sulfide-sulfur content for ore-bearing lithologies
- Leco determination with sulfur speciation

Intrinsic oxidation rate for ore-bearing lithologies
- Humidity cell tests conducted with core samples of sulfidic ore from the block-cave zone

Solute release rates for ore-bearing lithologies
- Effluent analyses from humidity cell tests conducted on core samples of sulfidic ore from the block-cave zone

Sump water chemistry
- Measured water chemistry for mine service water
- Measured water chemistry for groundwater sources

Tailings Solute Models

Surface runoff chemistry for Scavenger tailings
- Humidity cell tests conducted with master composite samples of scavenger tailings

Surface runoff for Pyrite tailings
- Field barrel test with pyrite tailings

Solute release rates during ore processing
- Lock-cycle hydrometallurgical tests on core samples of ore

Embankment Sulfide Oxidation Modeling (Scavenger tailings)

Sulfide-sulfur content for Scavenger tailings
- Leco determination with sulfur speciation

Intrinsic oxidation rate for Scavenger tailings
- Humidity cell tests conducted with master composite samples
- Measured mineral surface area determined by BET measurements on Pyrite tailings

Solute release rates for Scavenger tailings
- Effluent analysis from humidity cell tests conducted

Mineralogy for Scavenger tailings
- Carbonate content – Calcite content from QEMSCAN
- Silicate content – X-Ray Diffraction

Initial / entrained porewater chemistry
- Predicted chemistry from tailings solute models

Guidance for mobile-immobile flow domain transfer coefficients
- Measured porewater chemistry from RTK tailings suction lysimeters

In response to:

Dr. Maest Comment No. 2 Regarding use of Synthetic Precipitation Leaching Procedure (SPLP) test results for stormwater water quality

Proposed action:

Update table with full SPLP dataset
Identify non-detects
Header clarification
Correct citation

Rationale:

SPLP tests reflect fresh, unweathered tailings, therefore SPLP results were not used in the water quality predictions

	Estimated Runoff Water Quality from Weathered Scavenger Tailings (Alternatives 2, 3, 5, 6)*	Estimated Runoff Water Quality from Weathered Pyrite Tailings (Alternatives 4)*	Water Quality Measured in Natural Runoff†	SPLP Results for Unweathered Scavenger Tailings‡	SPLP Results for Unweathered Pyrite Tailings‡	Surface Water Standard for Most Restrictive Use (Gila River or Queen Creek)	Surface Water Standard for Most Restrictive Use (Ephemeral Tributaries)
Regulated Constituents							
Antimony	0.00073	0.00062	0.00027	< 0.0002 - 0.0004	< 0.0002 - 0.0002	0.03	747
Arsenic	0.00016	0.576	0.0052	< 0.0002 - 0.0014	< 0.0002 - 0.001	0.03	0.28
Barium	0.0128	0.208	0.0128	0.00459 - 0.0366	0.0124 - 0.0275	98	98
Beryllium	0.002	0.192	0.0005	< 0.000007 - 0.00245	< 0.000007	0.0053	1.867
Boron	0.0028	0.0104	0.03	0.029 - 0.0768	0.0306 - 0.037	1	186.667
Cadmium	0.00097	0.106	0.000019	0.000003 - 0.00063	0.000011 - 0.000061	0.0043	0.2175
Chromium, Total	0.00036	9.107	0.00095	0.00017 - 0.00119	0.00009 - 0.00079	1	-
Copper	9.81	3294	0.012	0.00051 - 14.5	0.00284 - 0.0202	0.0191	0.0669
Fluoride	0	424.6	0.013	0.26 - 5.46	0.61 - 0.92	140	140
Iron	0.177	5353.8	0.0225	< 0.002 - 0.299	0.004 - 0.012	1	-
Lead	0.00026	0.0095	0.0001	< 0.00001 - 0.0115	0.00002 - 0.00029	0.0065	0.015
Manganese	0.693	43	0.017	0.00099 - 0.619	0.0273 - 0.141	10	130.667
Mercury				< 0.00001 - 0.00001	< 0.00001 - 0.00007	0.00001	0.005
Nickel	0.112	26.39	0.0013	< 0.0001 - 0.0802	0.0002 - 0.0035	0.1098	10.7379
Nitrate	0	0	3.1	-	-	3733.333	3733.333
Nitrite	-	-	-	-	-	233.333	233.333
Selenium	0.0088	0.322	0.00027	< 0.001 - 0.003	0.002 - 0.0043	0.002	0.033
Silver	0.000006	1.78	0.000018	0.000002 - 0.000029	0.000006 - 0.000193	0.0147	0.0221
Thallium	0.00008	0.0177	0.00015	< 0.000005 - 0.000076	< 0.00007 - 0.000017	0.0072	0.075
Uranium				0.000003 - 0.00278	0.000006 - 0.000062	2.8	2.8
Zinc	0.171	17.29	0.0015	< 0.001 - 0.126	< 0.001 - 0.002	0.2477	2.8759
pH	5.48	2.13	7.59	6.1 - 9.82	6.72 - 8.92	6.5-9.0	6.5-9.0
Constituents without Numeric Standards							
Sulfate	264	28452	6.8	229	115	-	-
Total Dissolved Solids				294	186	-	-

Notes:

See appendix N, table N-5, for details regarding the water quality standards used in this table.

All values shown in milligrams per liter, except pH. Shaded cell and bolded text indicate concentrations above at least one water quality standard.

Some water quality standards for metals are specific to total recoverable metals or dissolved metals. Predicted results are compared with standards regardless of whether the standard specifies total or dissolved.

* From Enchemica, Common Inputs Memorandum, 7/18/18, table 3-4 (Eary 2018g).

† From Enchemica, Common Inputs Memorandum, 7/18/18, table 3-2; from stormwater samples collected at Near West location (Eary 2018g).

‡ Duke HydroChem 2016 and Golder Associates Inc., 2007

Resolution Copper
USFS – All Things Water Working Group

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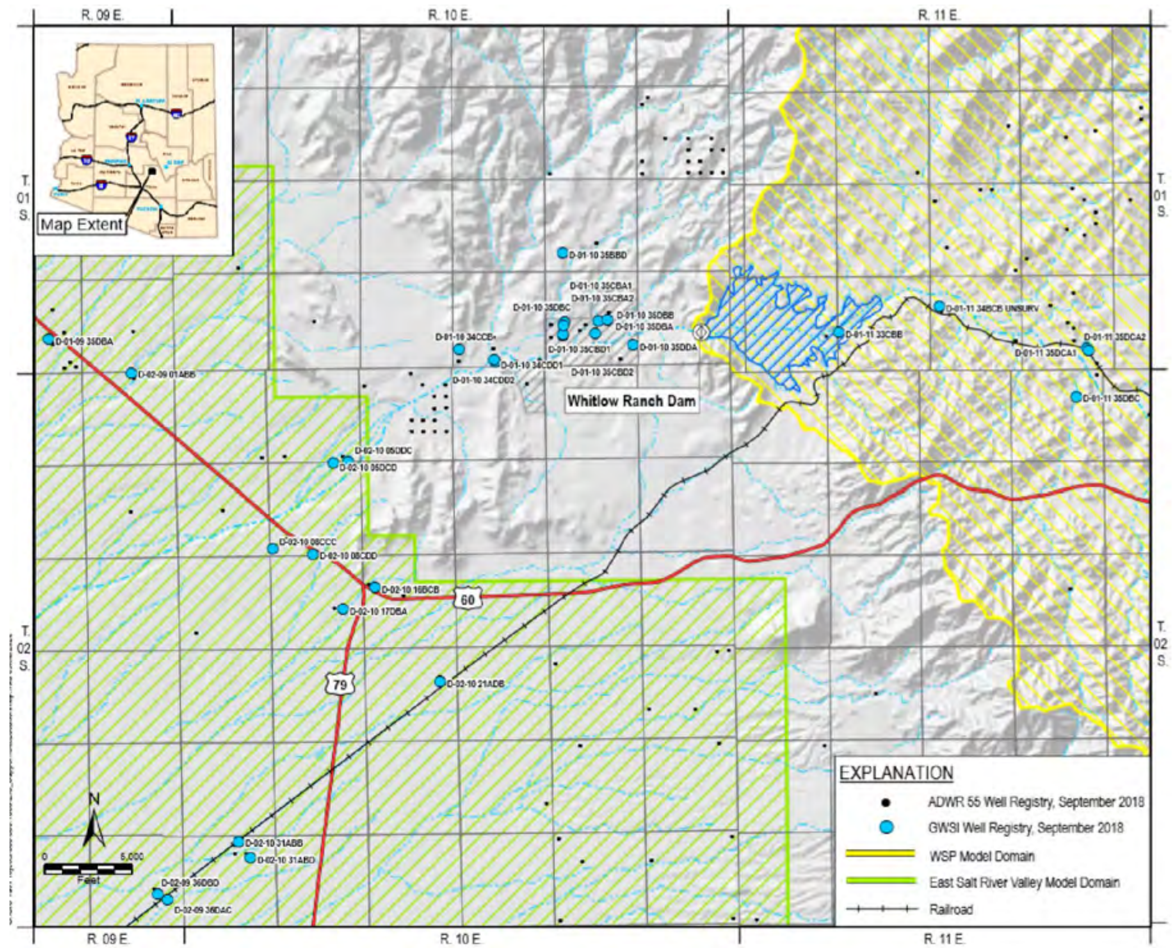
March 26, 2020

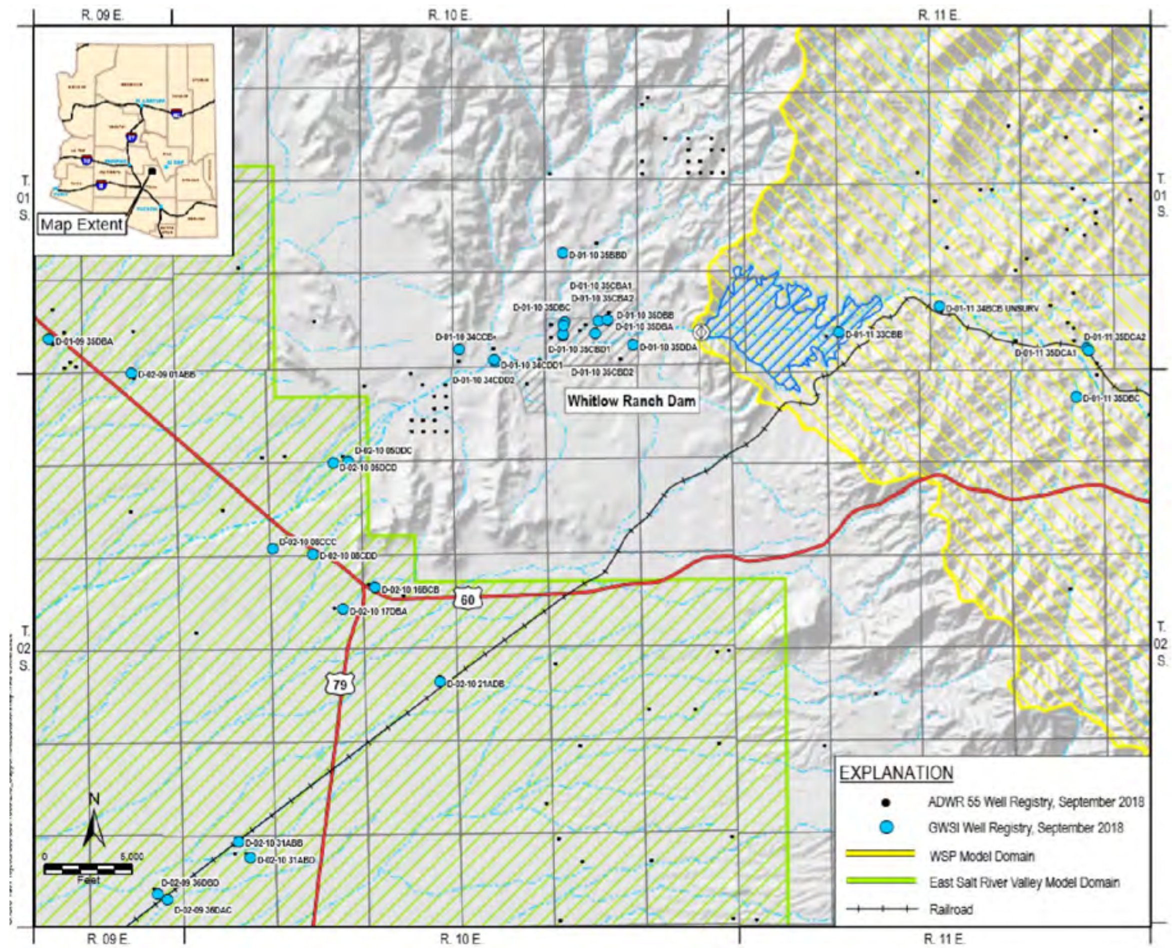
Queen Valley

- Small community between ESRV and WSP model domain
- DEIS received comments
  - Should either model domain be changed to include Queen Valley?
  - Will there be impacts to water resources at Queen Valley?



Queen Valley

- Memo submitted next week
  - Review hydrogeologic setting
  - Review Queen Valley water resources portfolio
  - Describes expected impacts



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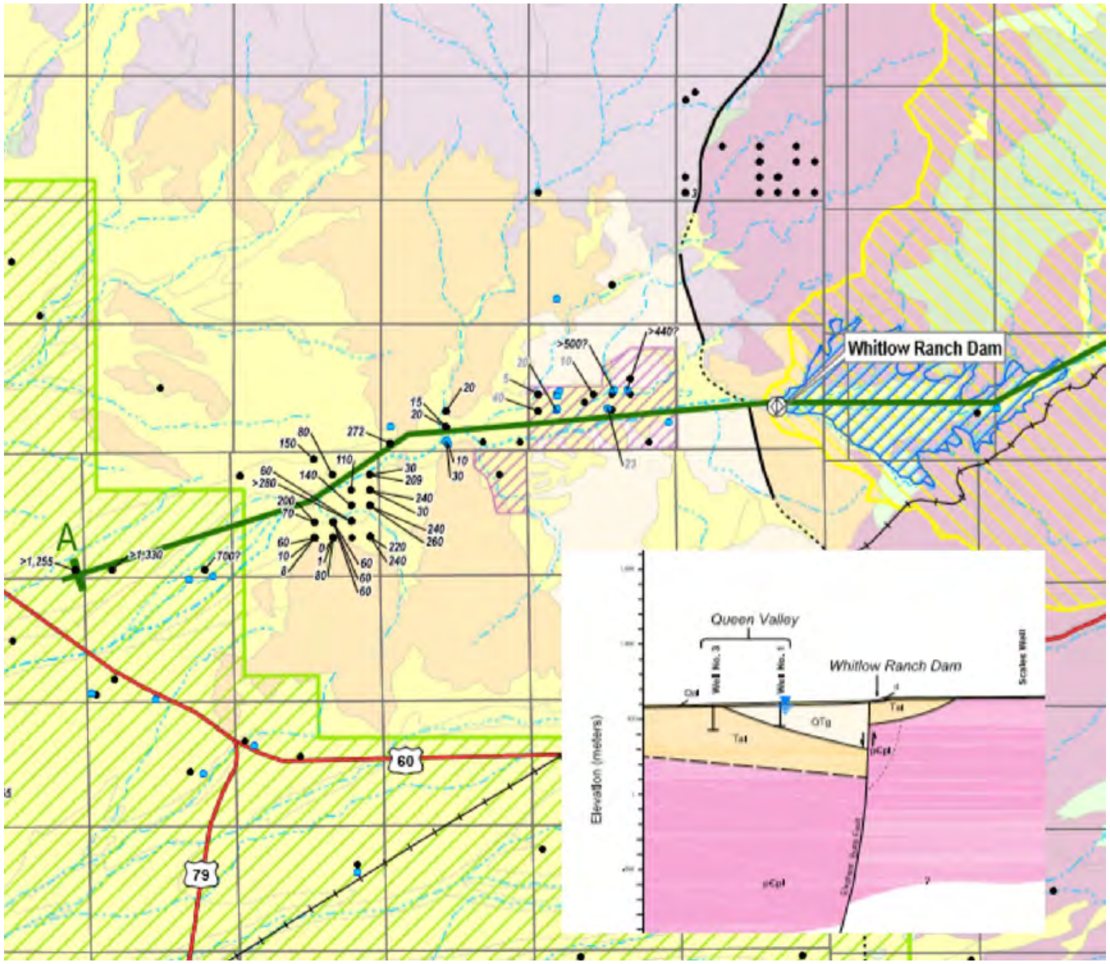
Queen Valley

- Whitlow Ranch Dam built into notch in Tal
- Queen Valley sit on wedge of Qal and QTg
    - Hydraulic conductivity of QTg is on the order of 1e-3 to 1e-2 cm/s
- Tal outcrops again on western edge of Queen Valley
    - Hydraulic conductivity of Tal is on the order of 1e-5 cm/s
- Transmissivity contrast is even greater



Queen Valley Water Uses

- Golf course
- Several ponds
- Municipal demand
  - 820 people as of 2000 census
  - 575 connections

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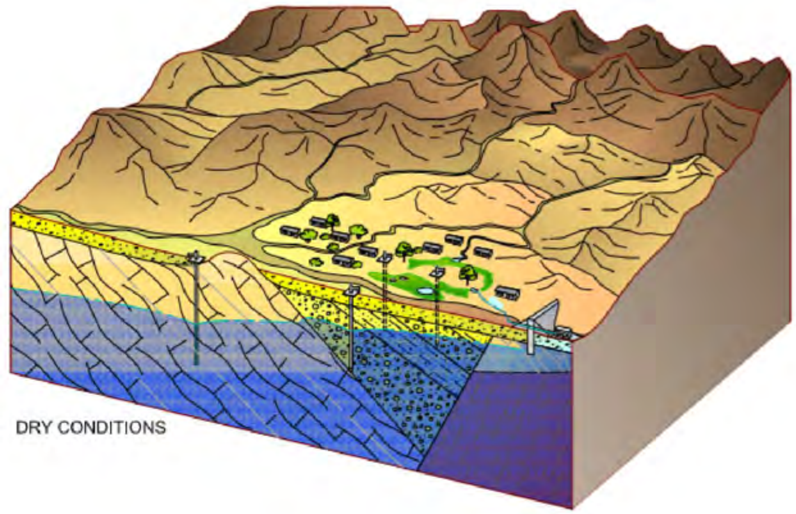
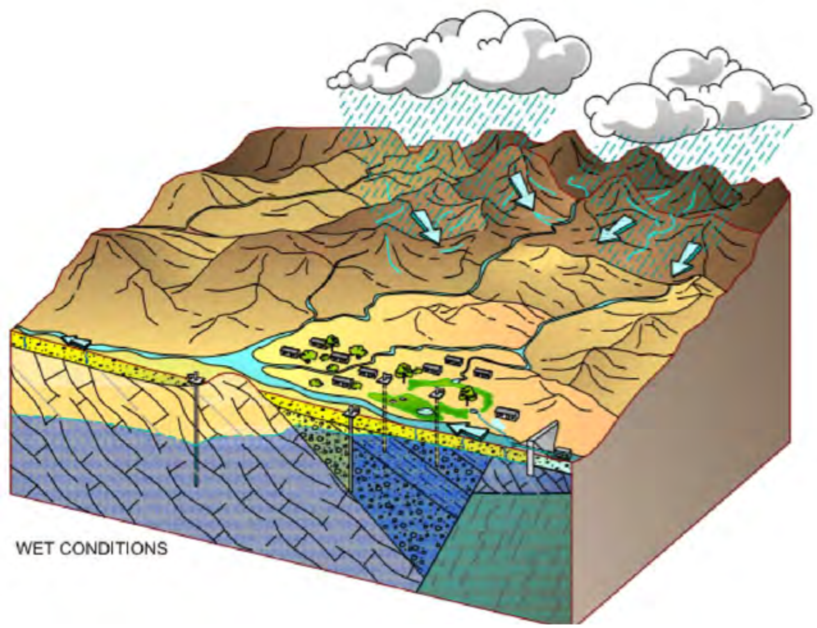
Queen Valley Water Supply

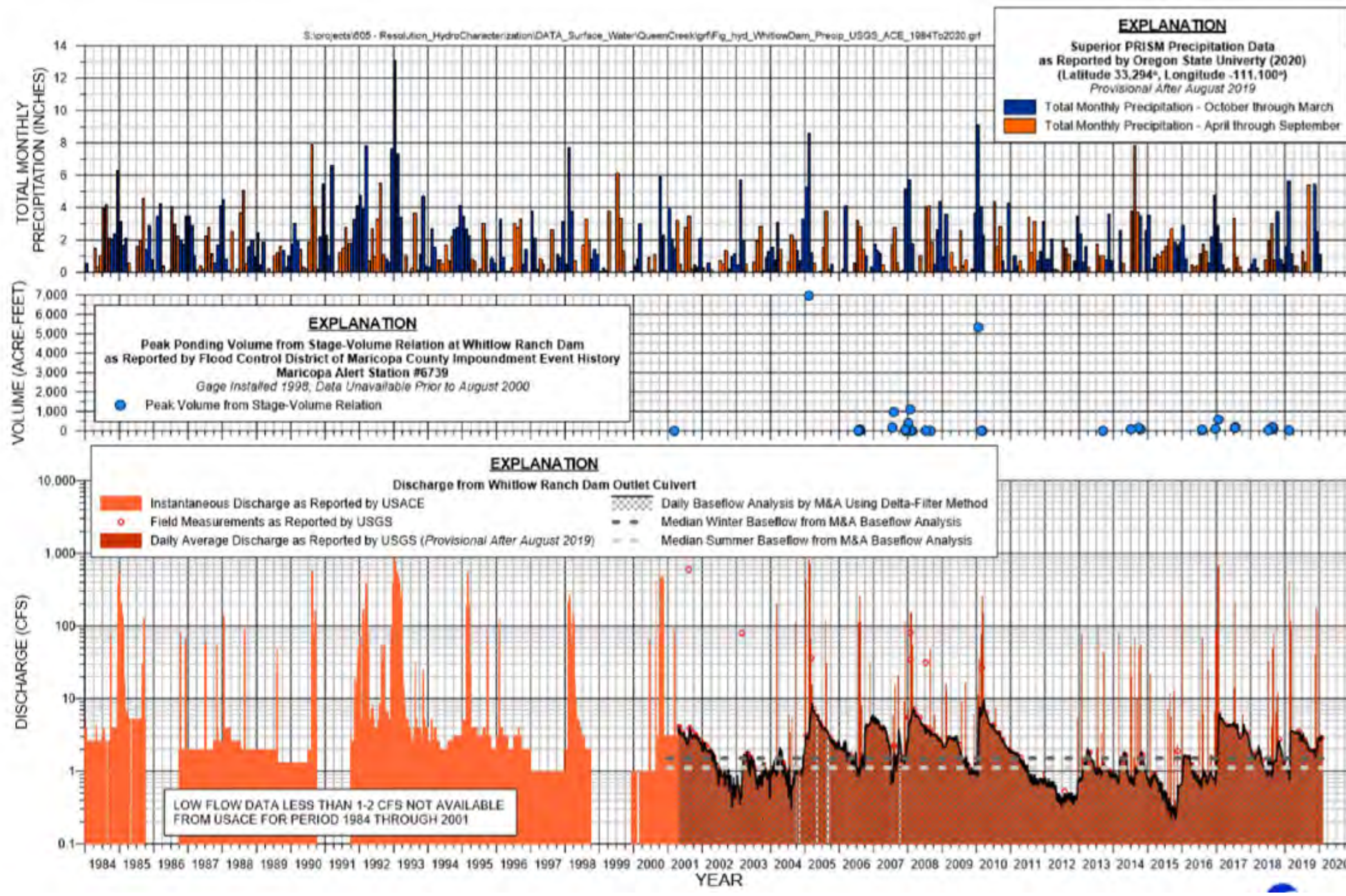
- Surface water supplies golf course, irrigation, and recreational ponds
- Groundwater supplies domestic demand





Whitlow Ranch Dam Flows

- Varies year to year
- Winter precip events fill reservoir (2005, 2010)
- Comparable summer precip events do not fill reservoir



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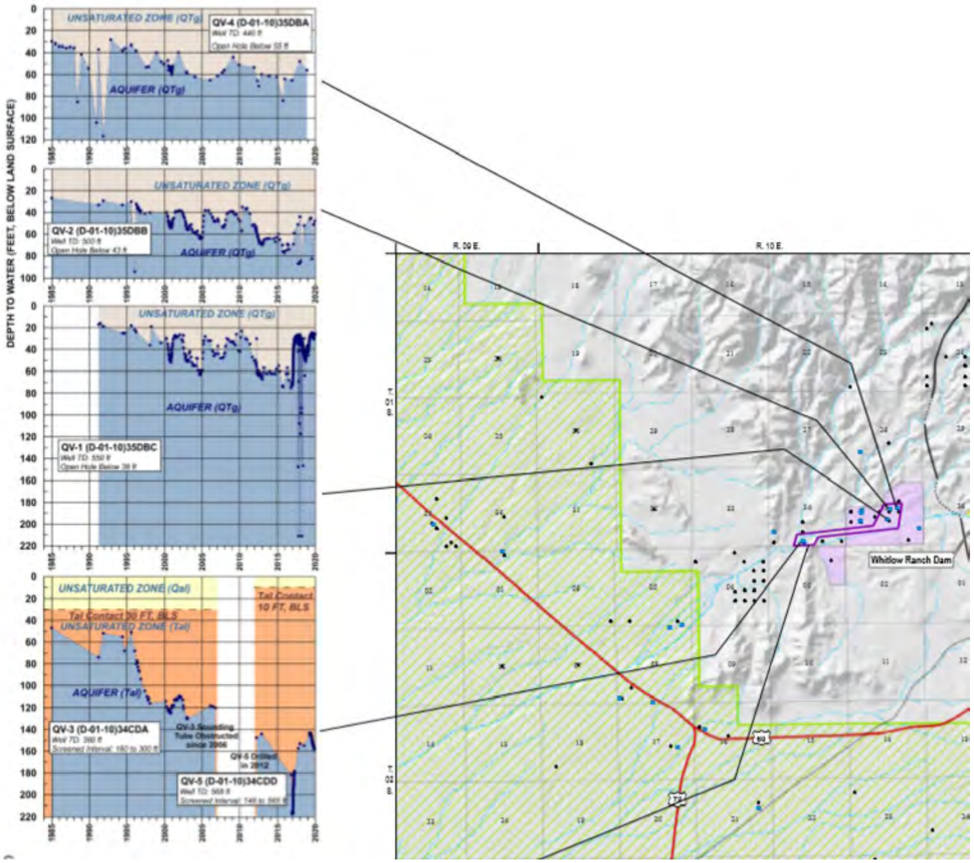
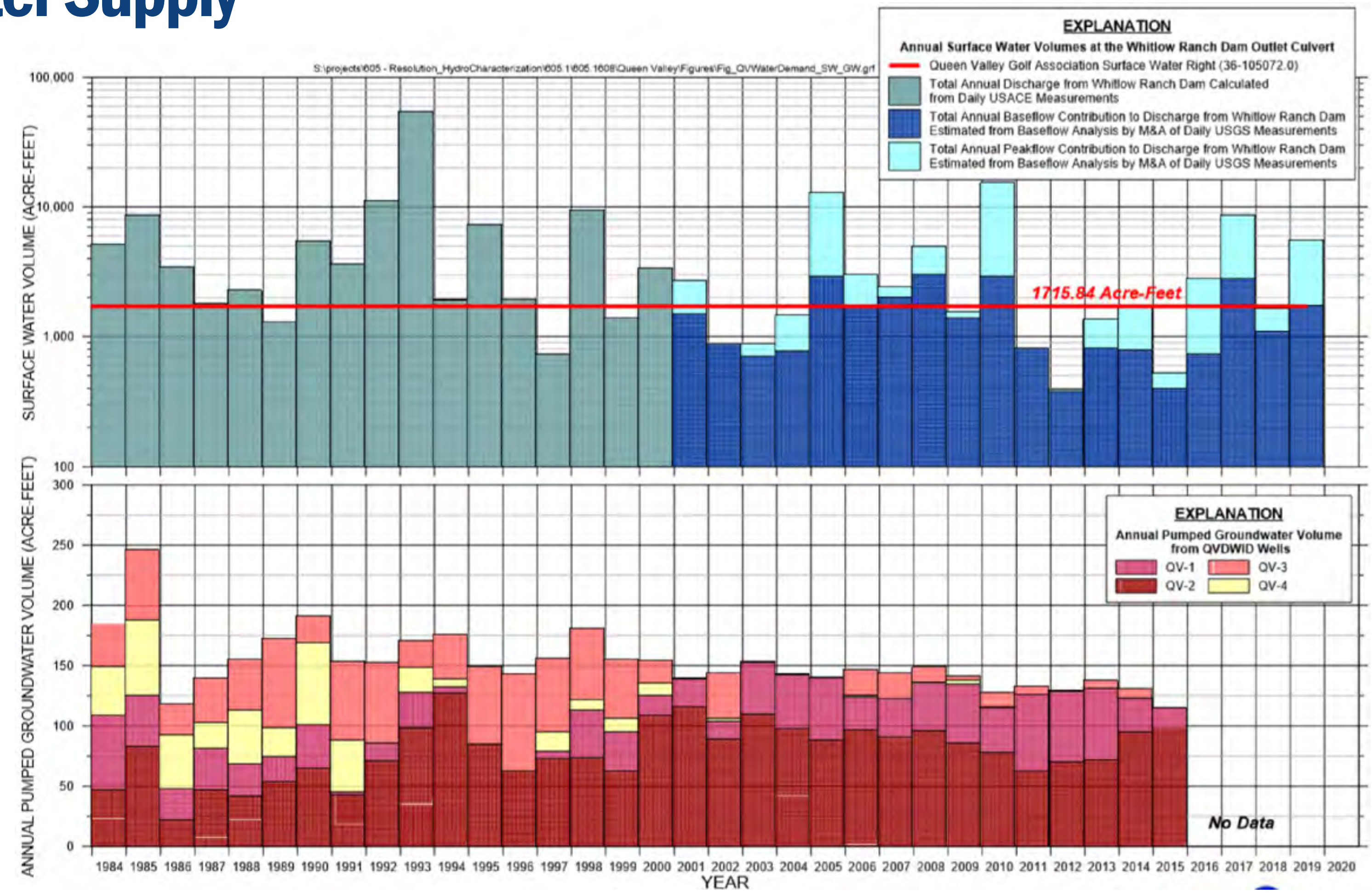
Queen Valley Water Levels



- Water levels in Tcg wells are dynamic and refill in response to winter precipitation
  - Respond to atmospheric river events (2005, 2010)
  - Groundwater supply is dependent on surface water flows
- Water levels in Tcg wells have shown long term decline

Queen Valley Water Supply

- Surface Water right of 1715.84 AF/yr
- Received full surface water allocation 67% of years since 1984



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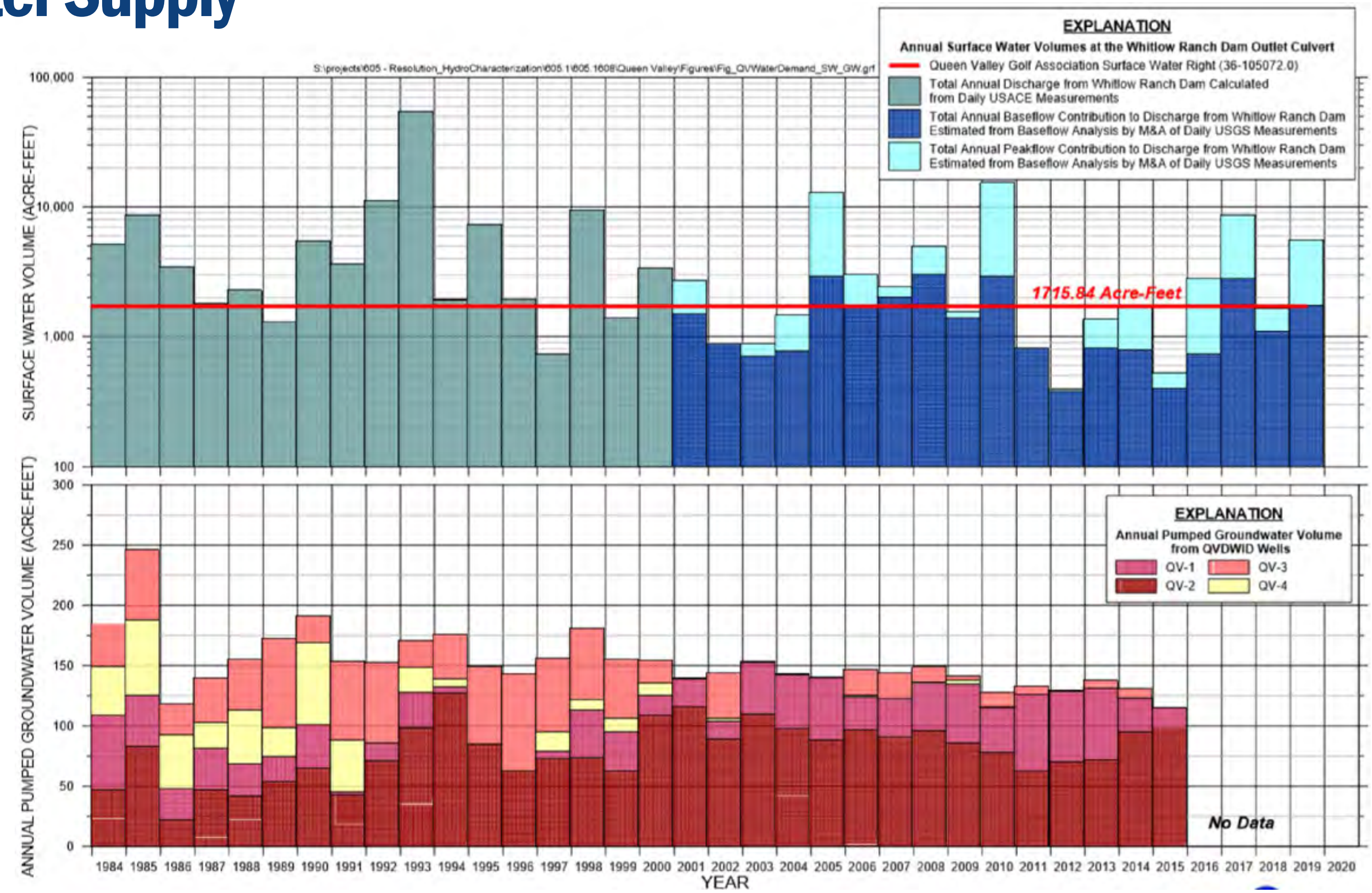
Queen Valley Water Supply

- Groundwater demand has averaged 139 AF/yr over last 15 years
- Decreasing demand trend consistent with regional municipal trends
- Decreasing use of Tal wells



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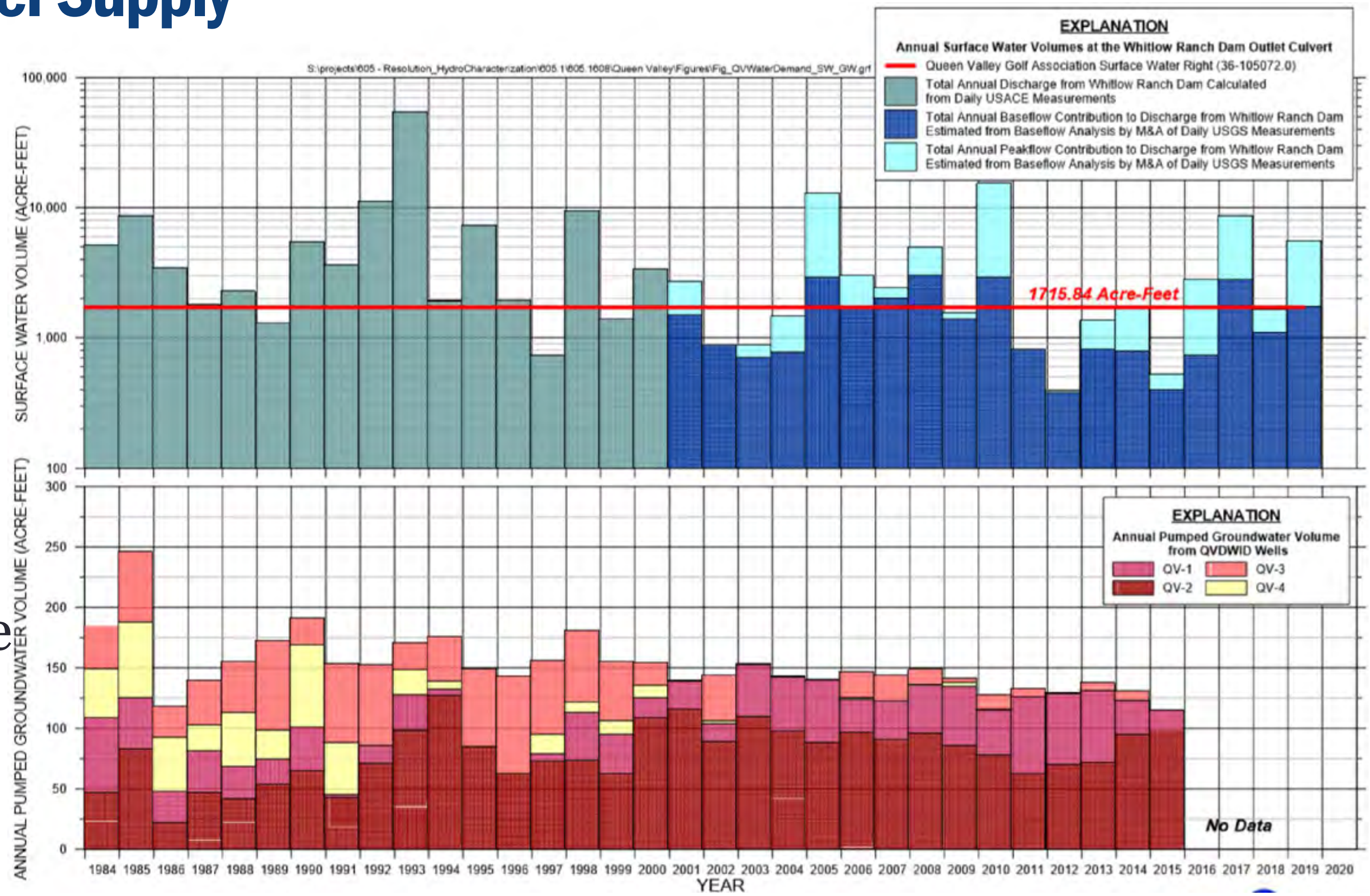
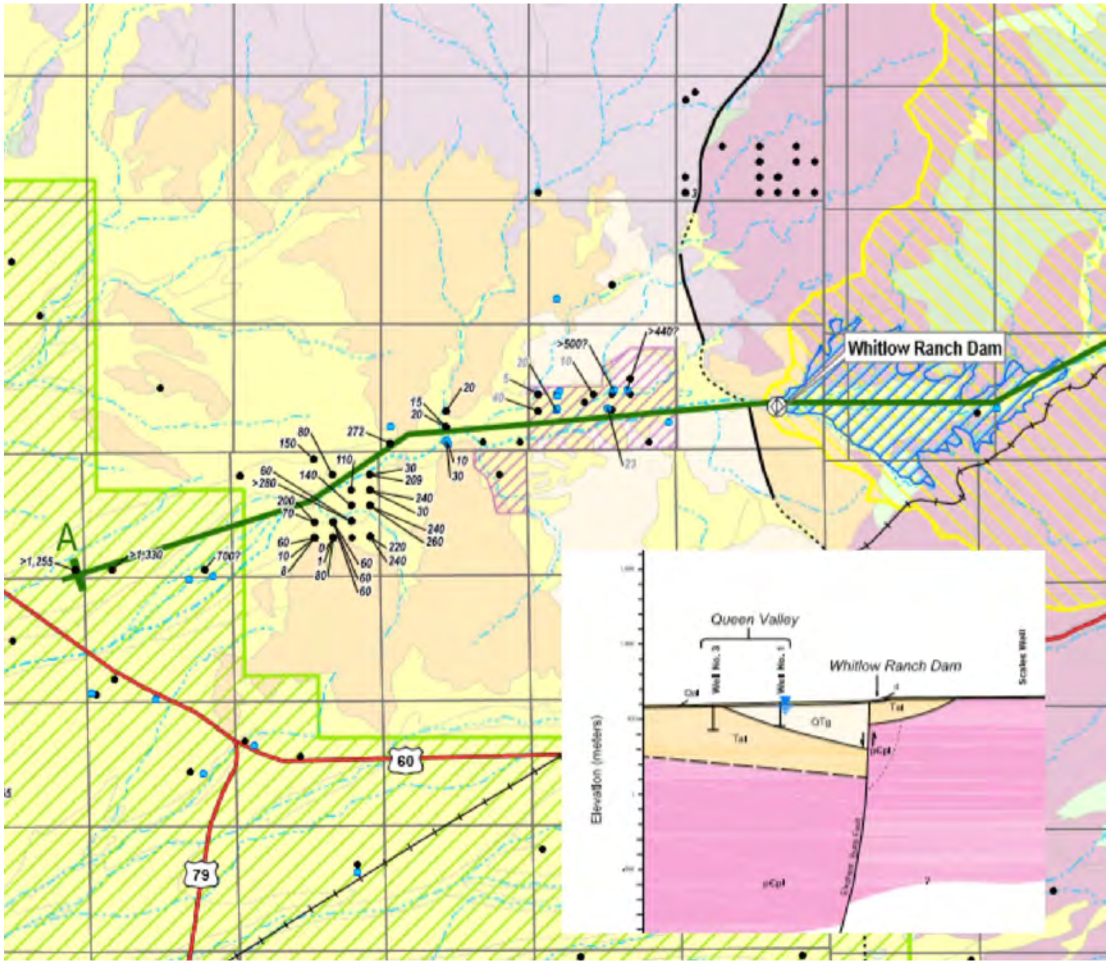
Queen Valley Water Supply

- Total water demand portfolio is about 90% surface water
- Both groundwater and surface water portion are dependent on surface flows



Queen Valley – Potential Impacts

- Queen Valley is almost entirely dependent on surface flows
- WSP model does not show drawdown at model boundary near WRD



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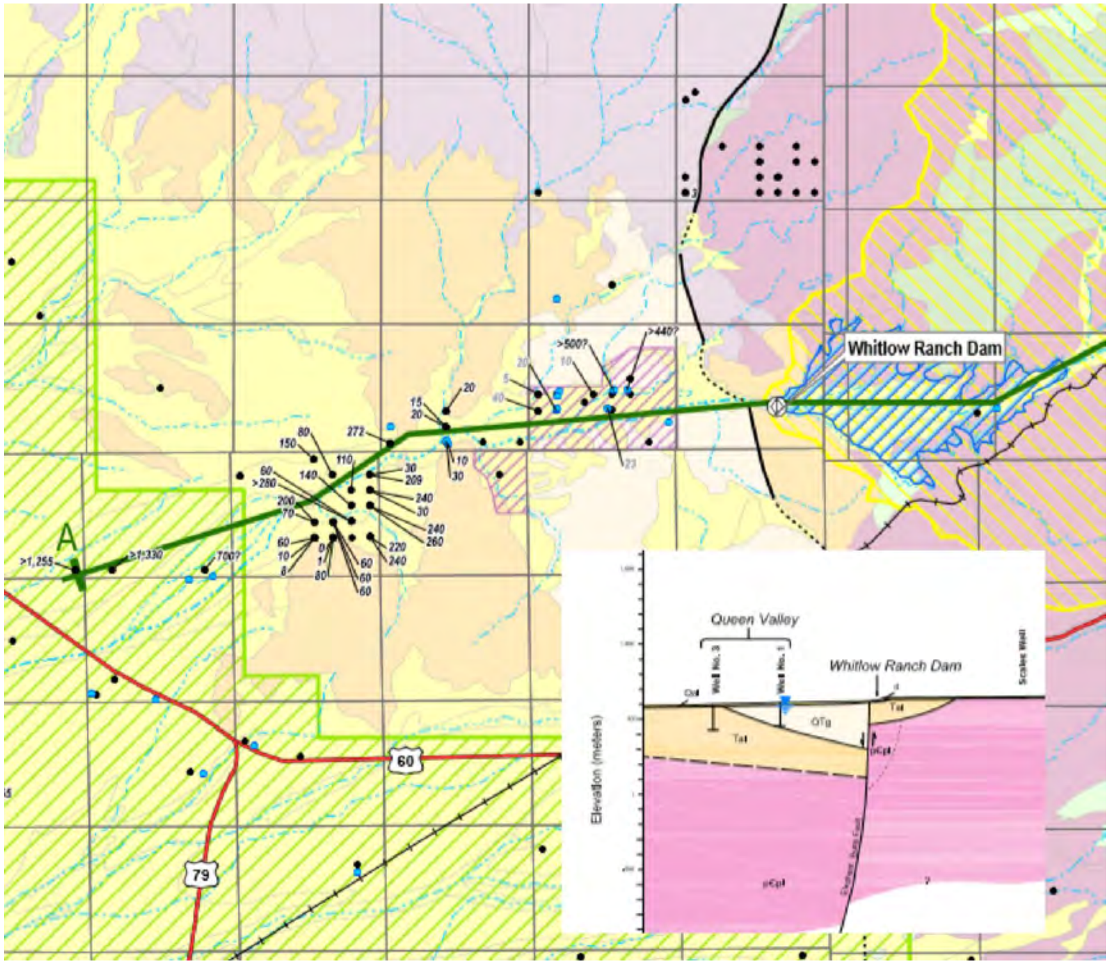
Queen Valley – Potential Impacts

- Queen Valley wells in Tal show long term drawdown from pumping does not recover quickly
- Hydraulic conductivity of Tal is on the order of 1e-5 cm/s
- Hydraulic conductivity of QTg is on the order of 1e-3 to 1e-2 cm/s
- Transmissivity contrast is even greater



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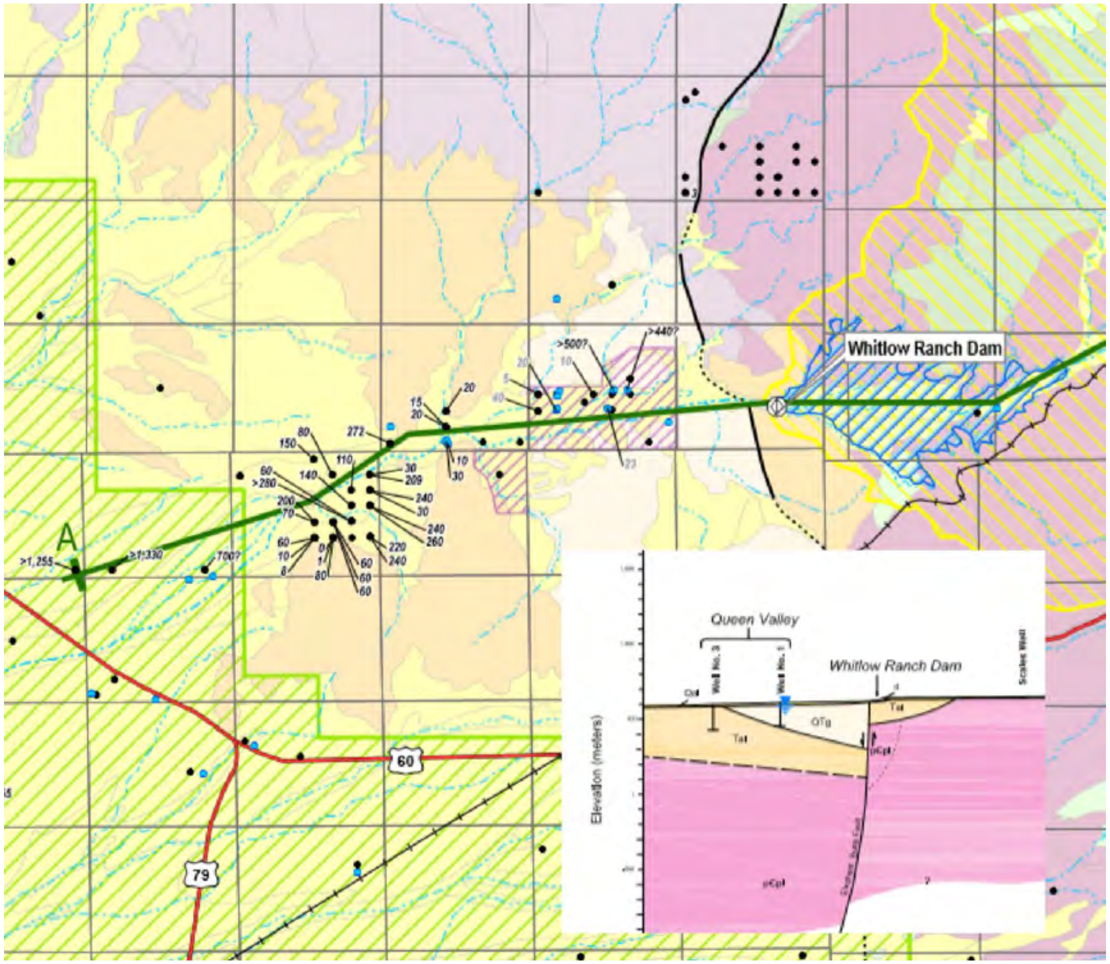
Potential Impacts – Reduction to Surface Flows

- Peak-flow frequency could potentially be reduced between 1.0 % to 1.1%
- Volume-duration frequency could be potentially reduced between 1.0% to 2.2%
- JE Fuller, 2020



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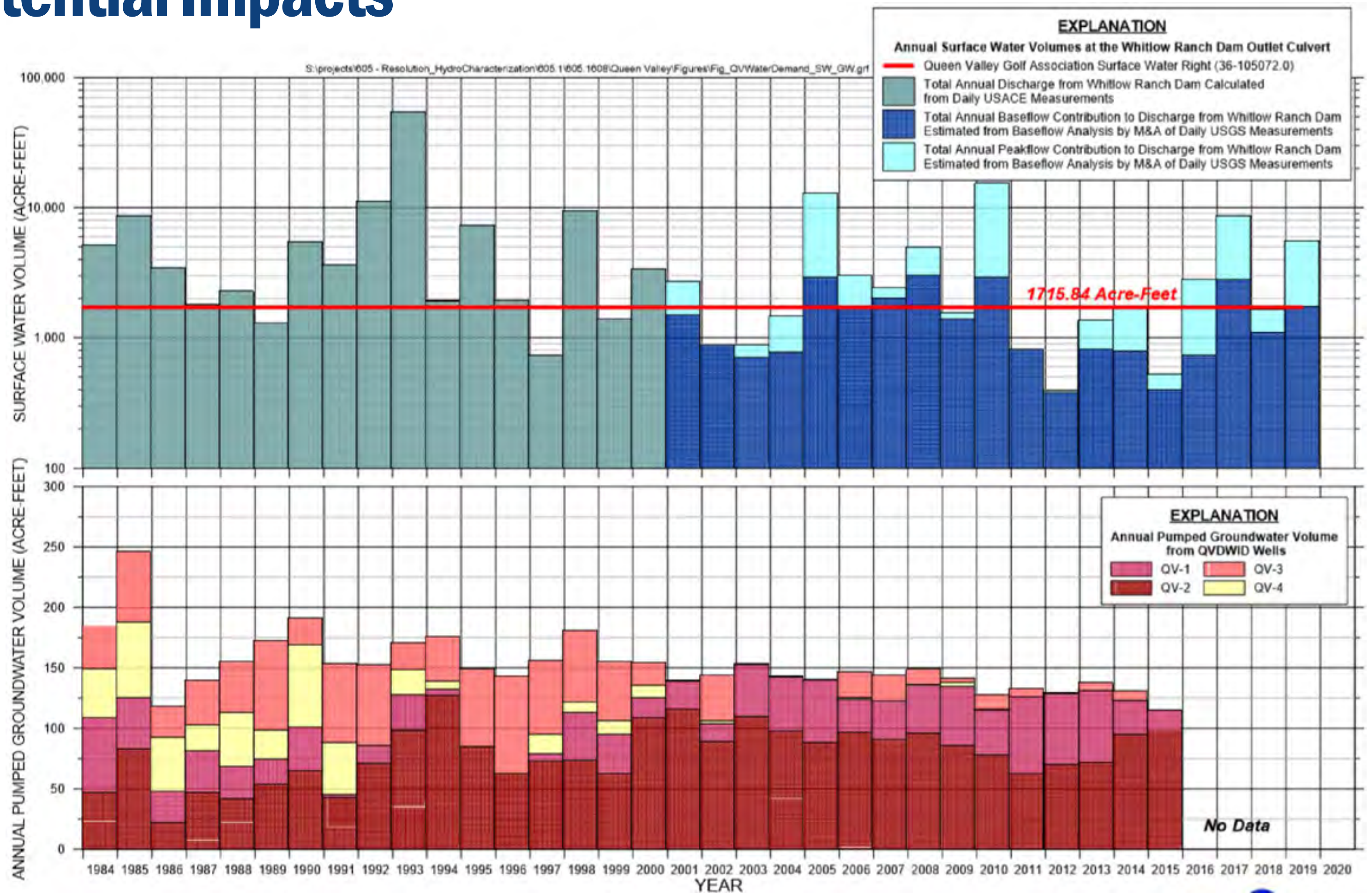
Queen Valley – Potential Impacts

- Only the year 2014 would have not met surface water rights if history were rerun after block cave
- For years that did not meet the surface water right, the potential reduction in flow would be 4 to 36 acre-feet.
- For years that did meet the surface water right, the potential reduction of flow would be 17 to 341 acre-feet



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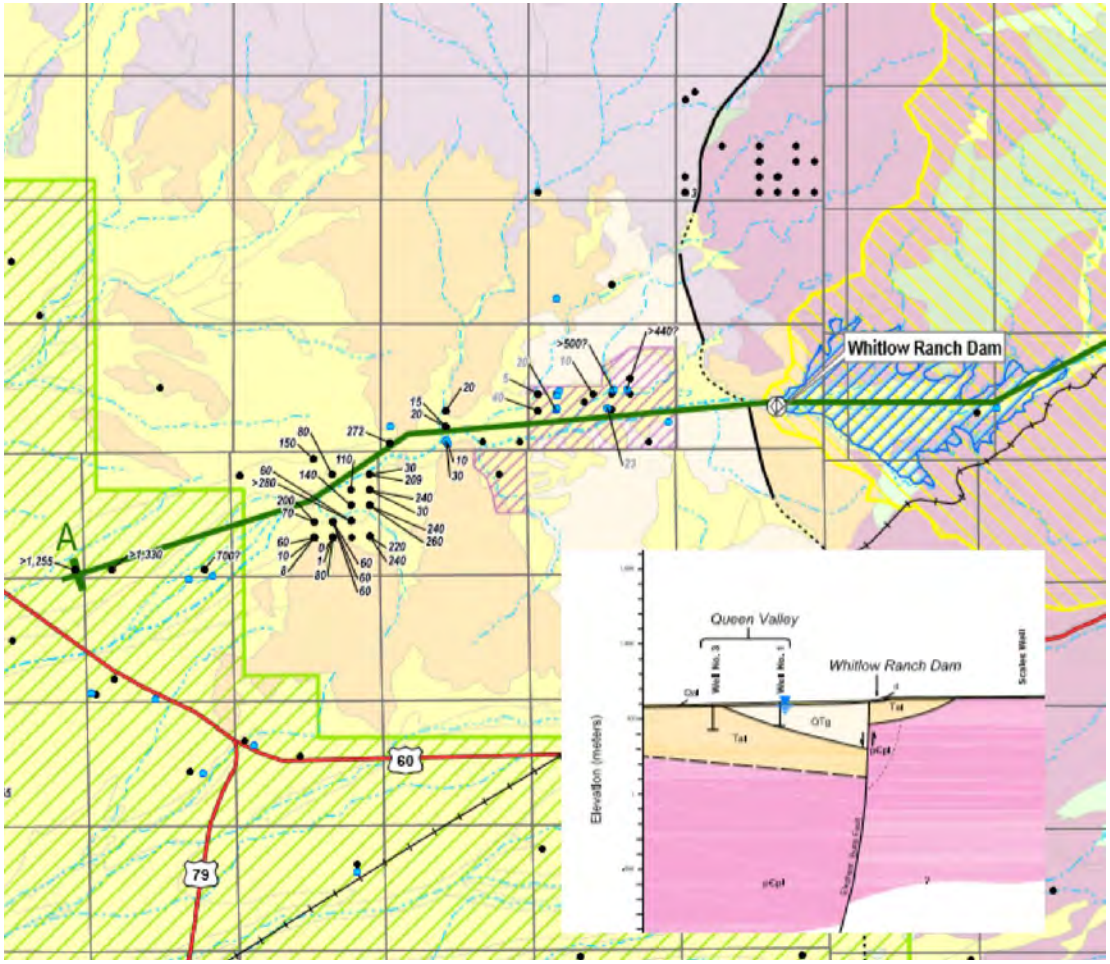
Queen Valley – Conclusions

- Queen Valley is almost completely dependent on surface water flows
- Impacts should not be estimated with a groundwater model
- Reductions in surface water may have some impacts
- Queen Valley should be monitored



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Overview of Data Submittals

- **Mine Area**
  - Water Levels
  - Hydrochemistry
  - Streamflow Monitoring Stations
  - Occurrence Surveys
  - Springs and Seeps
- Submitted by tomorrow

- Skunk Camp
  - Water Levels
  - Springs and Seeps
  - Sampling and Analysis Plan
  - Hydrochemistry

Mine Area Water Levels/Pressures Update

- Updated since 2016 in all mine area monitoring sites
  - HRES wells
  - DHRES wells
  - Local wells
- Submitted as hydrographs and Excel files with data
- Total of 50 plots

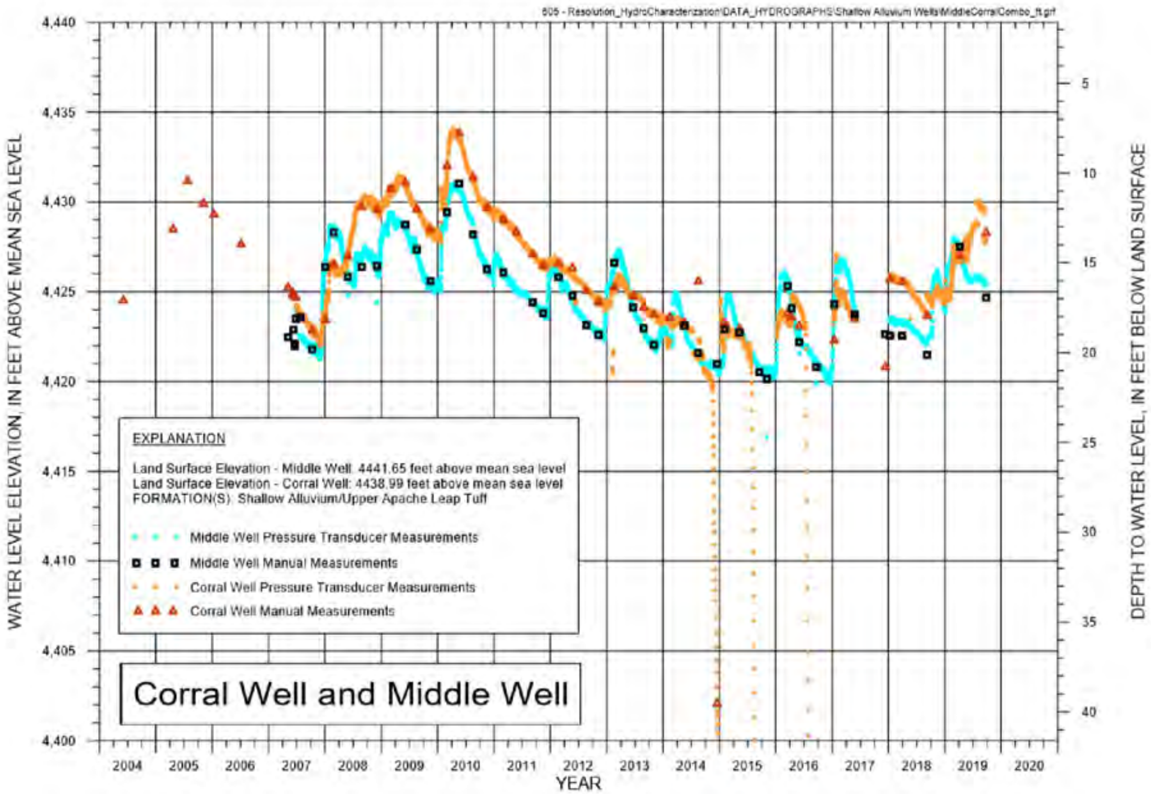
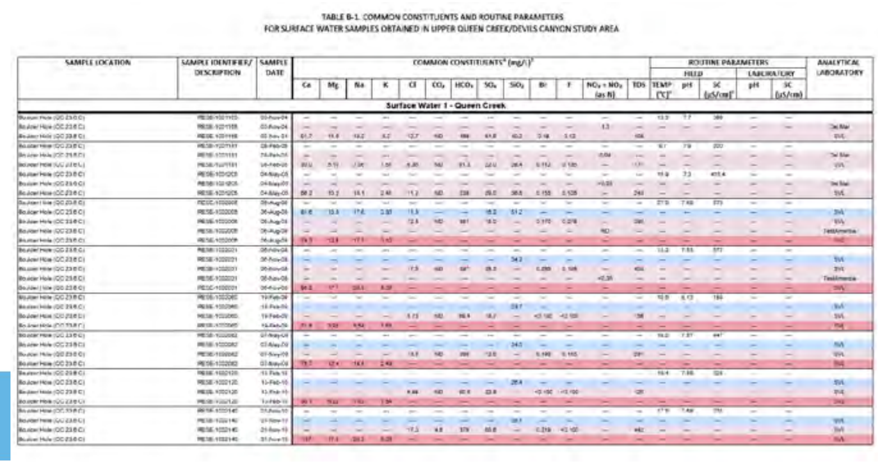


FIGURE B-1. WATER LEVEL HYDROGRAPH FOR CORRAL WELL AND MIDDLE WELL

Mine Area Hydrochemistry Update

- 40 spring and surface water sites
  - Queen Creek, Devils Canyon, and Mineral Creek watersheds
- 26 wells
  - Mostly Near West area
- Includes full suite of parameters
  - Common/trace
  - Radiologicals
  - Radiogenic Isotopes
  - Stable Isotopes

- Total of ~11,500 new data points
  - (site, analyte, date, filter fraction)
- Submitted as
  - Formatted PDF tables
  - Excel spreadsheets



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Surface Water Station Streamflow Update

- Updated at all Resolution streamflow stations with new data since 2016
- Graphs show head converted to flow
- Graphs and spreadsheets with raw data

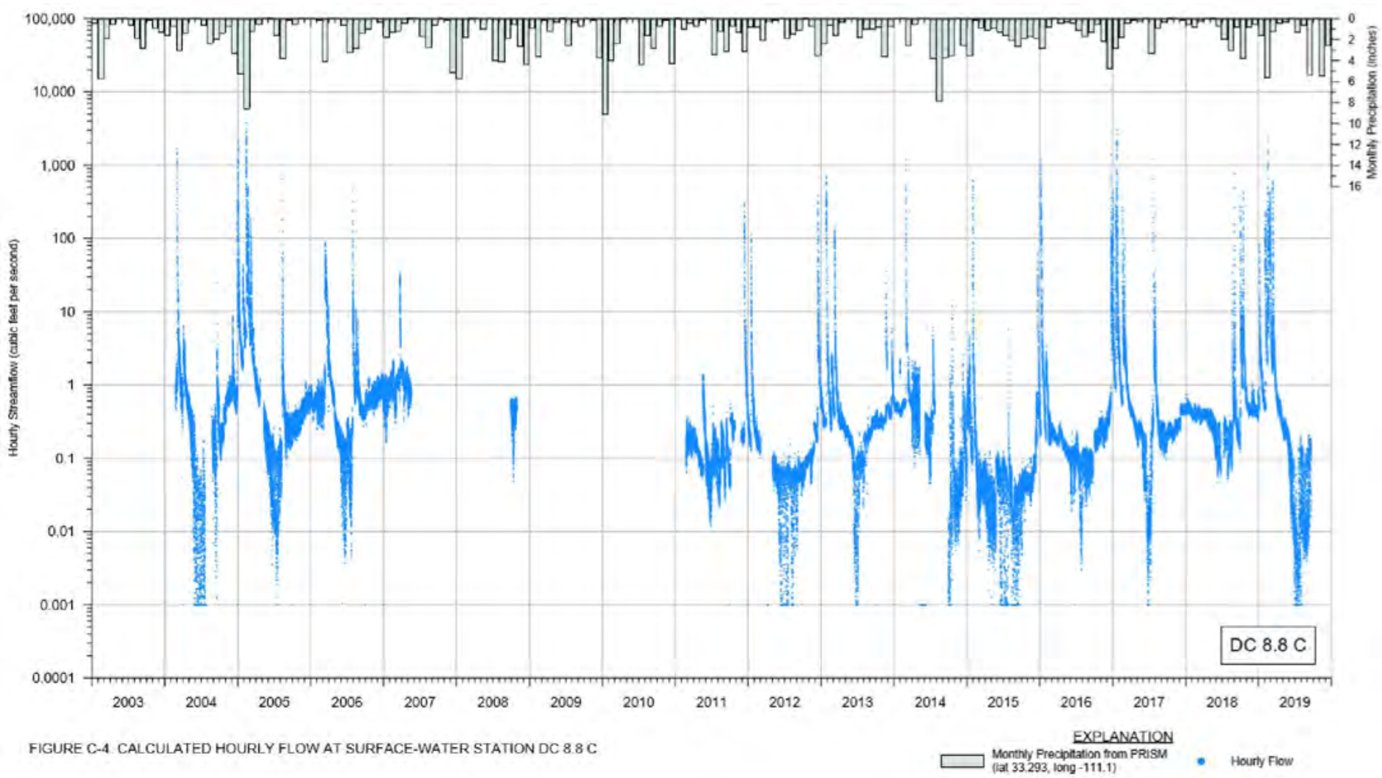

FIGURE C-4 CALCULATED HOURLY FLOW AT SURFACE-WATER STATION DC 8.8 C

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Occurrence Survey Update

- Q4 2019 occurrence surveys conducted
  - Arnett Creek
  - Devils Canyon
  - Mineral Creek
  - Queen Creek
  - Telegraph Canyon
- Consistent with previous findings

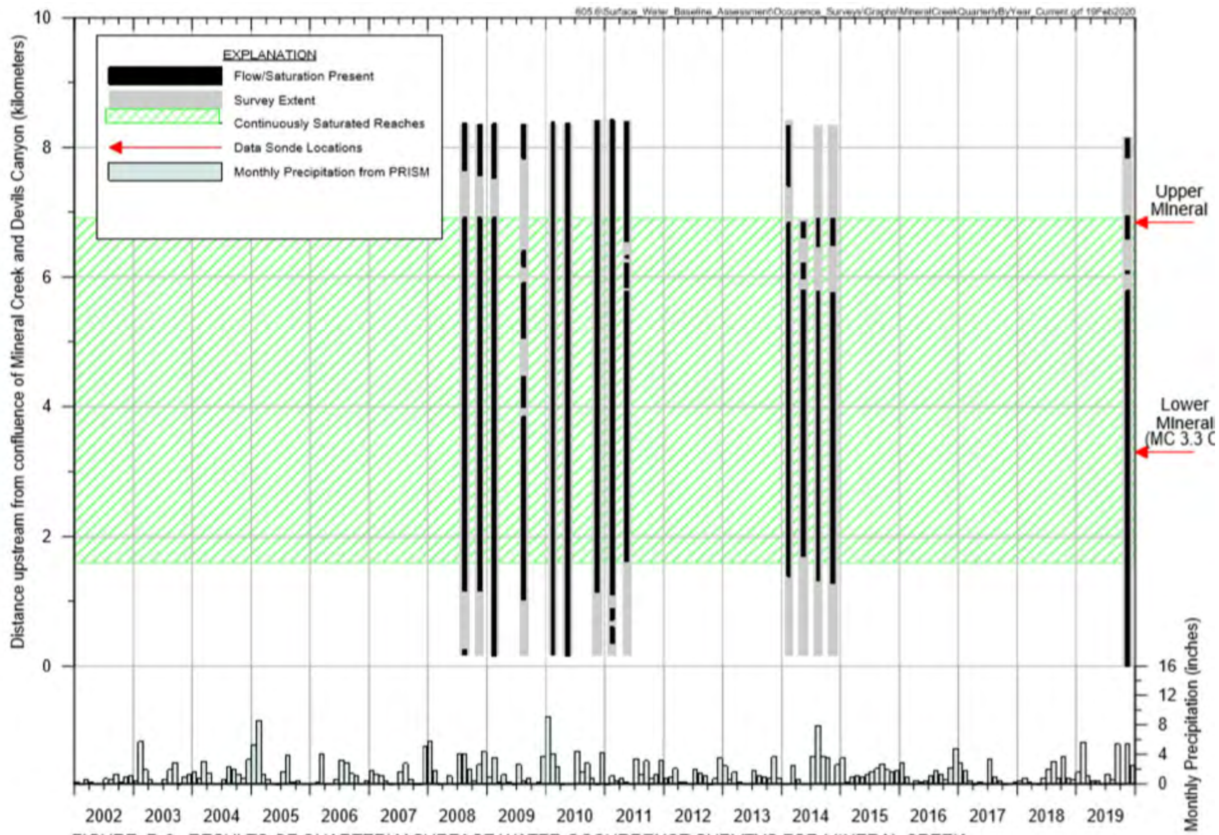

FIGURE D-3. RESULTS OF QUARTERLY SURFACE WATER OCCURRENCE SURVEYS FOR MINERAL CREEK

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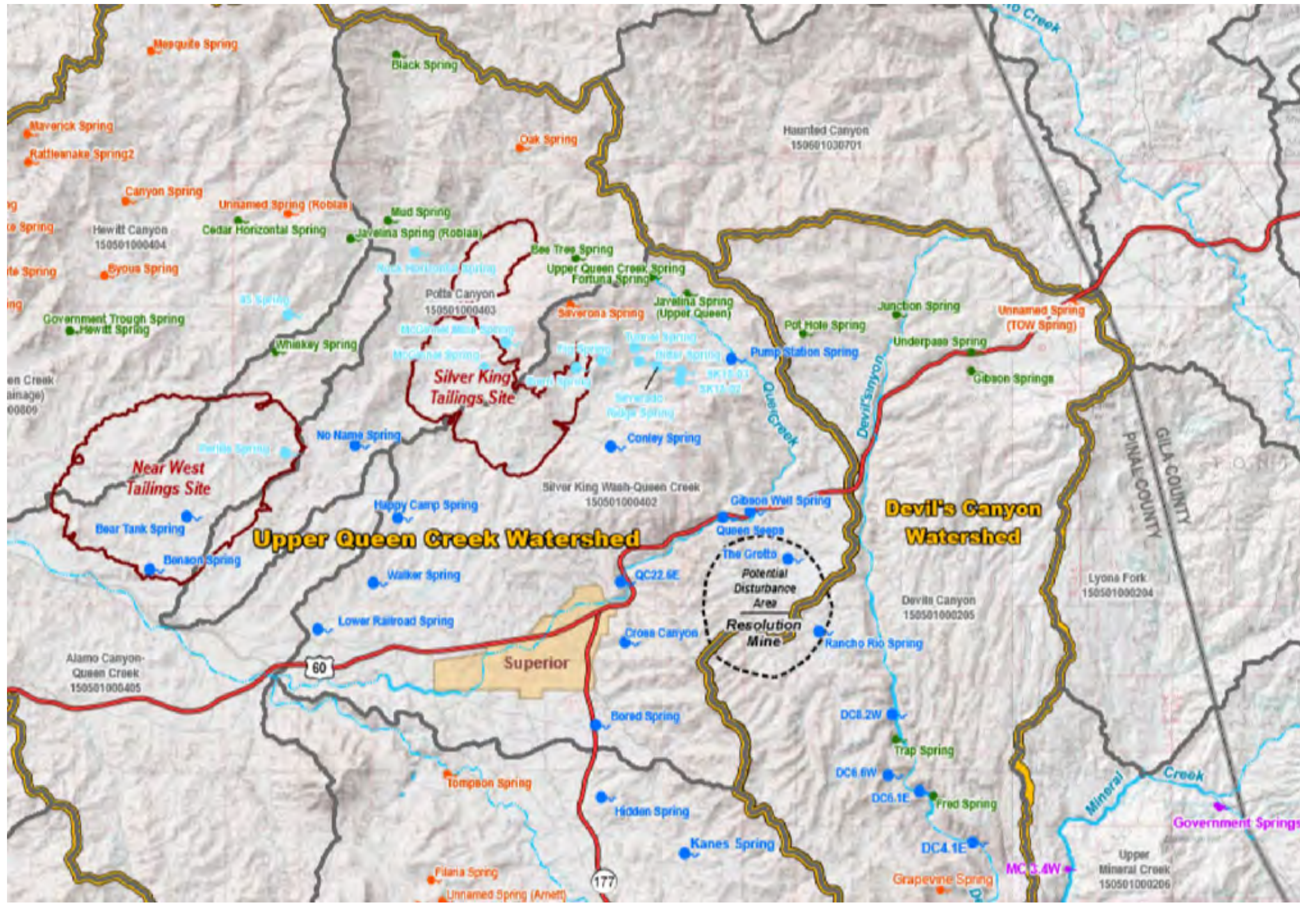
Mine Area Seep and Spring Update

Spring Catalog 3.0

- Includes all previously submitted surveys
- Includes additional quarterly hydro and bio surveys at all DEIS identified GDEs
- Added MC 3.4W and Government Springs
- Consistent with previous findings



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Government Spring - Added

- Main water source is from bunker built into Apache Leap Tuff
- Second emergence point identified 80 feet north of bunker
  - Emerges out of spring box
  - Arizona Sycamore, Freemont Cottonwood, watercress, cattail, water speedwell

Photo 1. Government Springs, view of entrance to bunker that houses the spring box, September 2019

Photo 3. Government Springs. Hillside seep with adjacent spring box. Water fills small sandy bottom pool. March 2020.

Photo 2. Government Springs, uncovered spring box in the back of the bunker. The box is plumbed into the nearby ranch house. September 2019

Photo 4. Government Springs. October 2019. Bermuda grass (*Cynodon dactylon*) lines the perimeter of the pool.

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MC 3.4W - Added

- Hillslope spring
- Ecology survey added
  - Arizona Sycamore, Velvet Ash, Willow, Arizona Walnut

Photo 3. MC 3.4W Spring. Saturated organic substrate. Water discharging from several seeps along hillslope. April 2019.

Photo 4. MC 3.4W Spring. Seepage along the tributary below the hillslope. Velvet ash (*Fraxinus velutina*) is pictured. October 2019.

Photo 5. MC 3.4W Spring. Canopy cover at the site includes velvet ash (*Fraxinus velutina*) and Arizona sycamore (*Platanus wrightii*). October 2019.

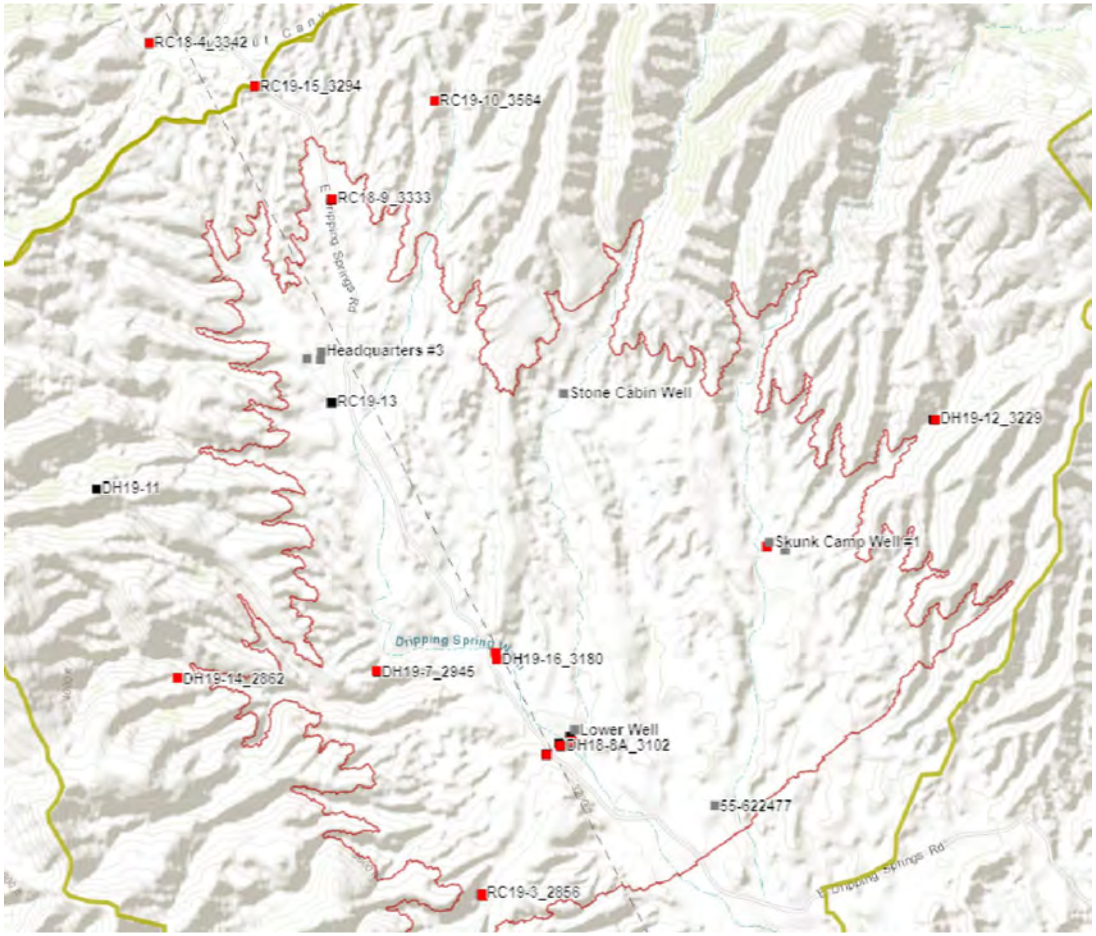
Photo 6. MC 3.4W Spring. Saturated soil and an accumulation of leaf litter and woody debris on the hillslope. December 2019.

Overview of Data Submittals

- Mine Area
  - Water Levels
  - Hydrochemistry
  - Streamflow Monitoring Stations
  - Occurrence Surveys
  - Springs and Seeps
- **Skunk Camp**
  - Water Levels
  - Sampling and Analysis Plan
  - Hydrochemistry
  - Springs and Seeps
  - Current Field Program

Wells and Water Level Monitoring

- Resolution has drilled:
  - 9 diamond drill holes
  - 12 RC wells
  - Additional wells in progress



Skunk Camp Area Water Levels/Pressures

- Total of 47 wells and piezometers being monitored
  - 9 Local/GWSI wells
  - 12 Resolution Wells
  - 25 Resolution Vibrating Wire Piezometers
- Submitted as hydrographs and Excel files with data

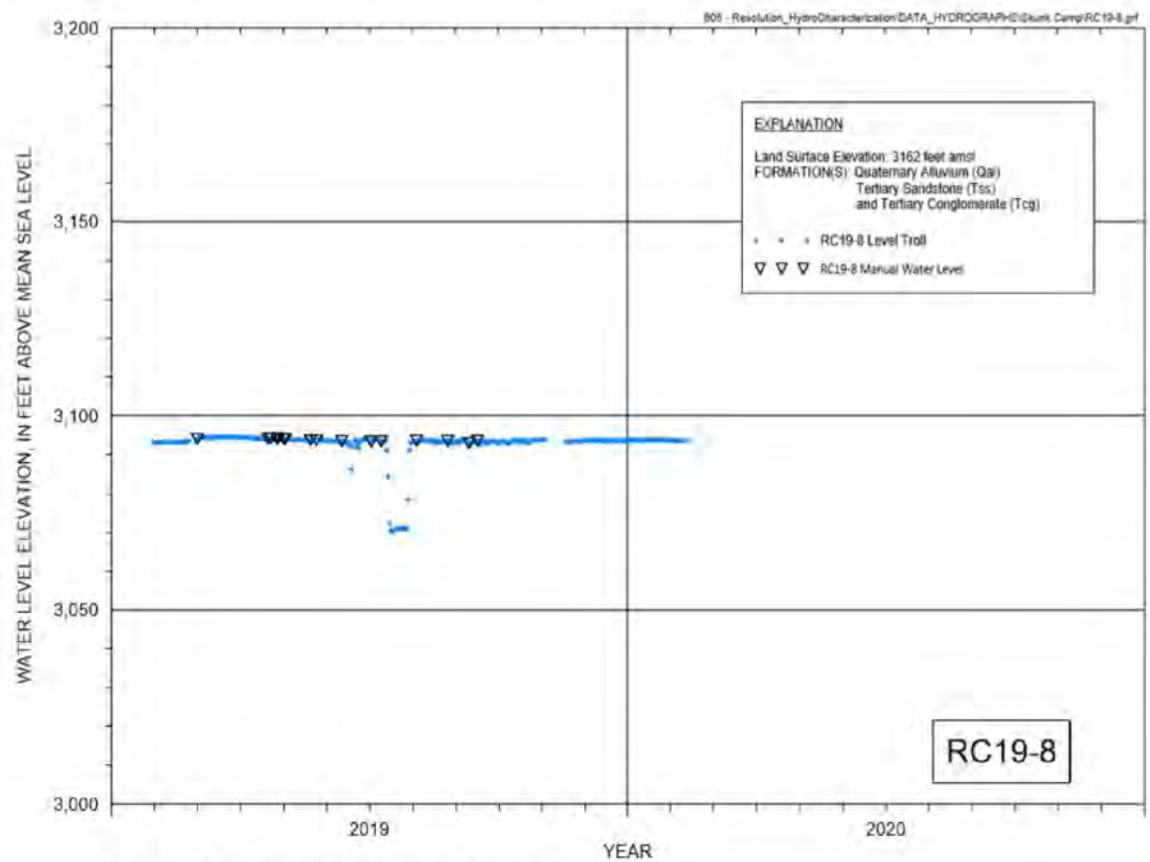


FIGURE B-10. HYDROGRAPH OF WATER LEVEL
AT HYDROLOGIC TEST WELL RC19-8

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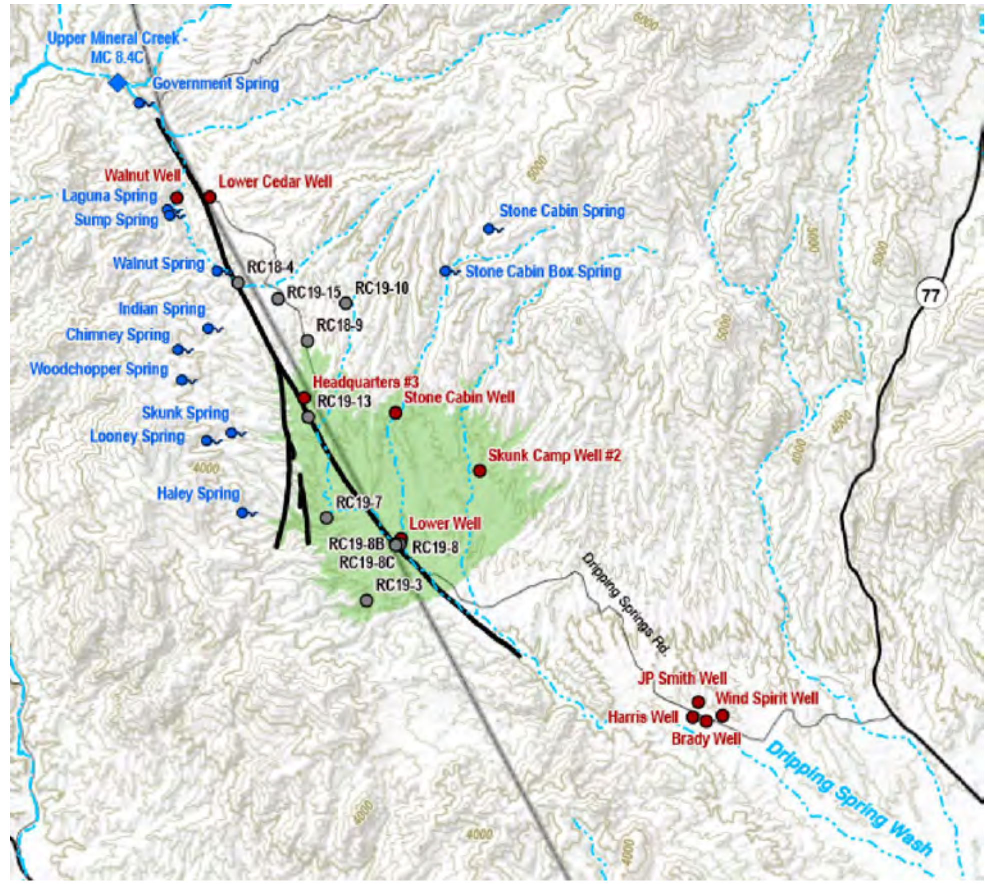
Sampling and Analysis Plan

- 10 Resolution wells
- 10 local wells
- 15 springs in program currently
- Additional springs and wells will be added if suitable



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Sampling and Analysis Plan

- 10 quarterly samples for wells
- Biannual samples for springs that are not subject to impacts from seepage
- Quarterly samples for Gila River

	Year	2018								2019										2020				2021				22	Sample Count	Land Ownership	Objectives
	Quarter/Month	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1			
RC WELLS	RC19-3												D				*		*	X	*	X	X	*	X		X	X	10	Hebbard & Webb	APP background of western TSF
RC WELLS	RC18-4								D										*	X	*	X	X	*	X	*	X	X	10	Hebbard & Webb	Background Mineral Creek watershed
RC WELLS	RC19-7														D	*			*	X	*	X	X	*	X		X	X	10	Hebbard & Webb	APP background, understand fault chemistry
RC WELLS	RC19-8									D	T	T							*	X	*	X	X		X	*	X	X	10	Hebbard & Webb	upper 250 feet of Tg (just below RC19-8B)
RC WELLS	RC19-8B													D			*		*	X	*	X	X	*	X		X	X	10	Hebbard & Webb	Critical upper 50 ft of Tg
RC WELLS	RC19-8C																		*	X	*	X	X	*	X	*	X	X	10	Hebbard & Webb	Only Qal location
RC WELLS	RC18-9								D	2T									*	X	*	X	X		X	*	X	X	10	Hebbard & Webb	APP background upgradient well
RC WELLS	RC19-10													D					*									*	2	Hebbard & Webb	APP background upgradient well (low K => low sampling frequency)
RC WELLS	RC19-13										D				*				*	X	*	X	X	*		*	X	X	10	Hebbard & Webb	APP background northern TSF
RC WELLS	RC19-15															D	*		*	X	*	X	X	*	X		X	X	10	Hebbard & Webb	APP background upgradient well
REGIONAL WELLS	Brady Well																*		*	X	*	X	X	*	X		X	X	10	Dideminicus	Background downgradient
REGIONAL WELLS	Harris Well																*		*	X	*	X	X	*	X		X	X	10	Harris	Background downgradient
REGIONAL WELLS	Headquarters Well #3									*									*	X	*	X	X		X	*	X	X	10	Hebbard & Webb	Background northern TSF (fault?)
REGIONAL WELLS	JP Smith Well																*		*	X	*	X	X	*	X		X	X	10	Smith	Background downgradient
REGIONAL WELLS	Lower Cedar Well									*									*	X	*	X	X		X	*	X	X	10	Hebbard & Webb	Background Mineral Creek watershed
REGIONAL WELLS	Lower Well																		*	X	*	X	X	*	X	*	X	X	10	Hebbard & Webb	Possible contamination from livestock; sample once and re-evaluate
REGIONAL WELLS	Skunk Camp Well #2							X											*	X	*	X	X	*	X	*		X	10	Hebbard & Webb	Background northern TSF (fault?)
REGIONAL WELLS	Stone Cabin Well												*						*	X	*	X	X	*		*	X	X	10	Hebbard & Webb	Background northern TSF
REGIONAL WELLS	Walnut Well																*		*	X	*	X	X	*	X		X	X	10	AZ State Land Dept	Upgradient Mineral Creek
REGIONAL WELLS	Wind Spirit Well															*			*	X	*	X	X	*	X		X	X	10	Wind Spirit Comm	Background downgradient
SPRINGS AND SURFACE WATER	Chimney Spring		*												*				*					*		*			5	Hebbard & Webb	Upgradient western TSF
SPRINGS AND SURFACE WATER	Government Springs																*		*		*			*					4	Gvt. Spr. Ranch	APP downgradient stream
SPRINGS AND SURFACE WATER	Haley Spring																		*		*			*		*			4	Hebbard & Webb	Upgradient western TSF
SPRINGS AND SURFACE WATER	Indian Spring														*				*					*		*			4	Hebbard & Webb	Upgradient western TSF
SPRINGS AND SURFACE WATER	Laguna Spring																		*		*			*		*			4	AZ State Land Dept.	Downgradient Mineral Ck
SPRINGS AND SURFACE WATER	Looney Spring	*																	*					*		*			4	Hebbard & Webb	Upgradient western TSF
SPRINGS AND SURFACE WATER	Skunk Spring																		*		*			*		*			4	AZ State Land Dept	Upgradient western TSF
SPRINGS AND SURFACE WATER	Stone Cabin Box Spring		*																*					*		*			4	Hebbard & Webb	Upgradient eastern TSF
SPRINGS AND SURFACE WATER	Stone Cabin Spring										*								*		*					*			4	Hebbard & Webb	Upgradient eastern TSF
SPRINGS AND SURFACE WATER	Sump Spring																*		*		*			*					4	AZ State Land Dept	Downgradient Mineral Ck
SPRINGS AND SURFACE WATER	Upper Mineral Creek - MC 8.4C																		*		*			*		*			4	Gvt. Spr. Ranch/AZ State	APP downgradient stream
SPRINGS AND SURFACE WATER	Walnut Spring									*									*		*					*			4	Hebbard & Webb	Upgradient Mineral Ck
SPRINGS AND SURFACE WATER	Woodchopper Spring									*									*		*					*			4	Hebbard & Webb	Upgradient western TSF
SPRINGS AND SURFACE WATER	Gila River downstream of DSW							X					*					*	X	*	X	X	*	X	X	X	X	X	12	BLM or private	APP downgradient stream

NOTES:

X COM/TR; RL (common, trace, and radiologicals)

* COM/TR; RL; ST; RG (all of the above + radiogenic isotopes)

D Development. COM/TR; RL (no low-level Hg; total U; total isotopic U)

T/T Test sample (analyte suite indicated by letter color)

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Skunk Camp Hydrochemistry Update

- 14 spring and surface water sites
- 21 wells
  - One local well that is not currently part of long-term program
- Includes full suite of parameters
  - Common/trace
  - Radiologicals
  - Radiogenic Isotopes
  - Stable Isotopes

- Total of ~6,000 new data points
  - (site, analyte, date, filter fraction)
- Submitted as
  - Formatted PDF tables
  - Excel spreadsheets

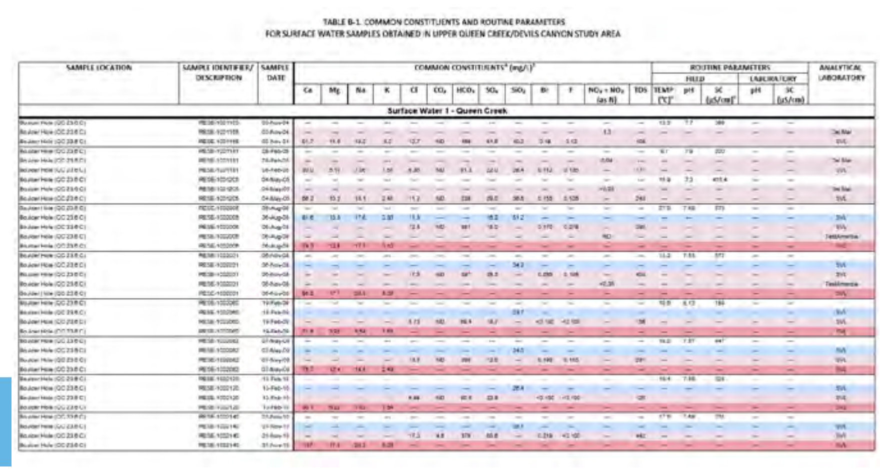
TABLE B-1. COMMON CONSTITUENTS AND ROUTINE PARAMETERS
FOR SURFACE WATER SAMPLES OBTAINED IN UPPER QUEEN CREEK/DEVILS CANYON STUDY AREA

MONTGOMERY & ASSOCIATES
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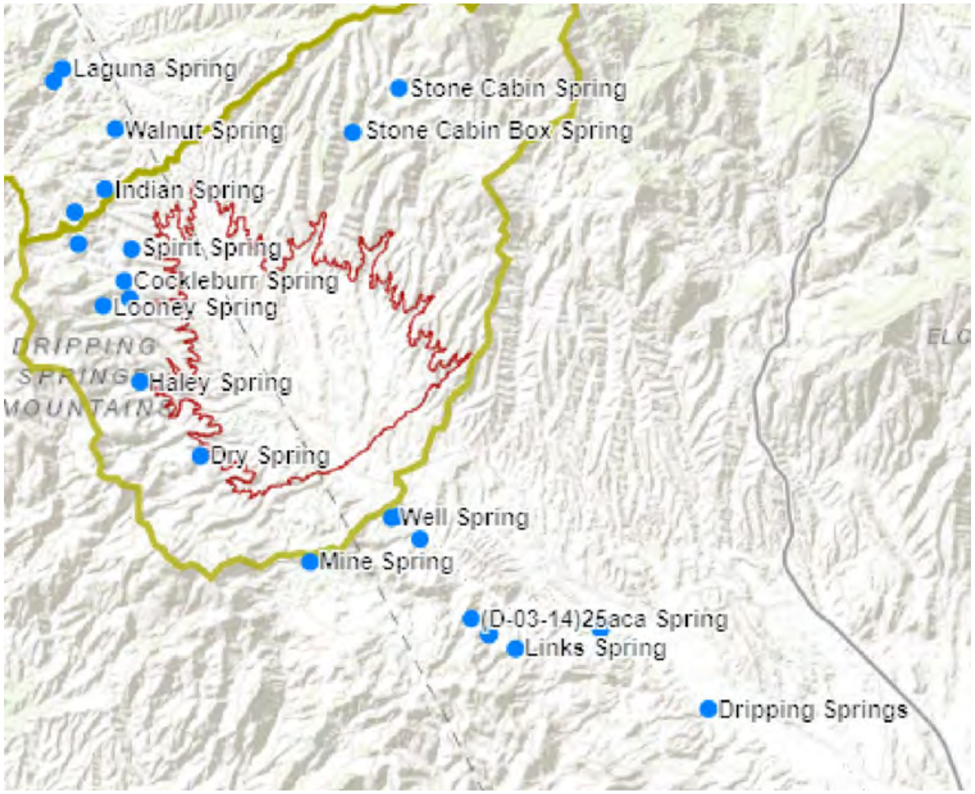
Skunk Camp Seeps and Springs

- 23 springs in TSF area
  - 18 in Dripping Springs Watershed
  - 5 in Mineral Creek Watershed
  - Visited by hydrologist/ biologist teams this week
- Spring Catalog 4.0 being submitted before next meeting



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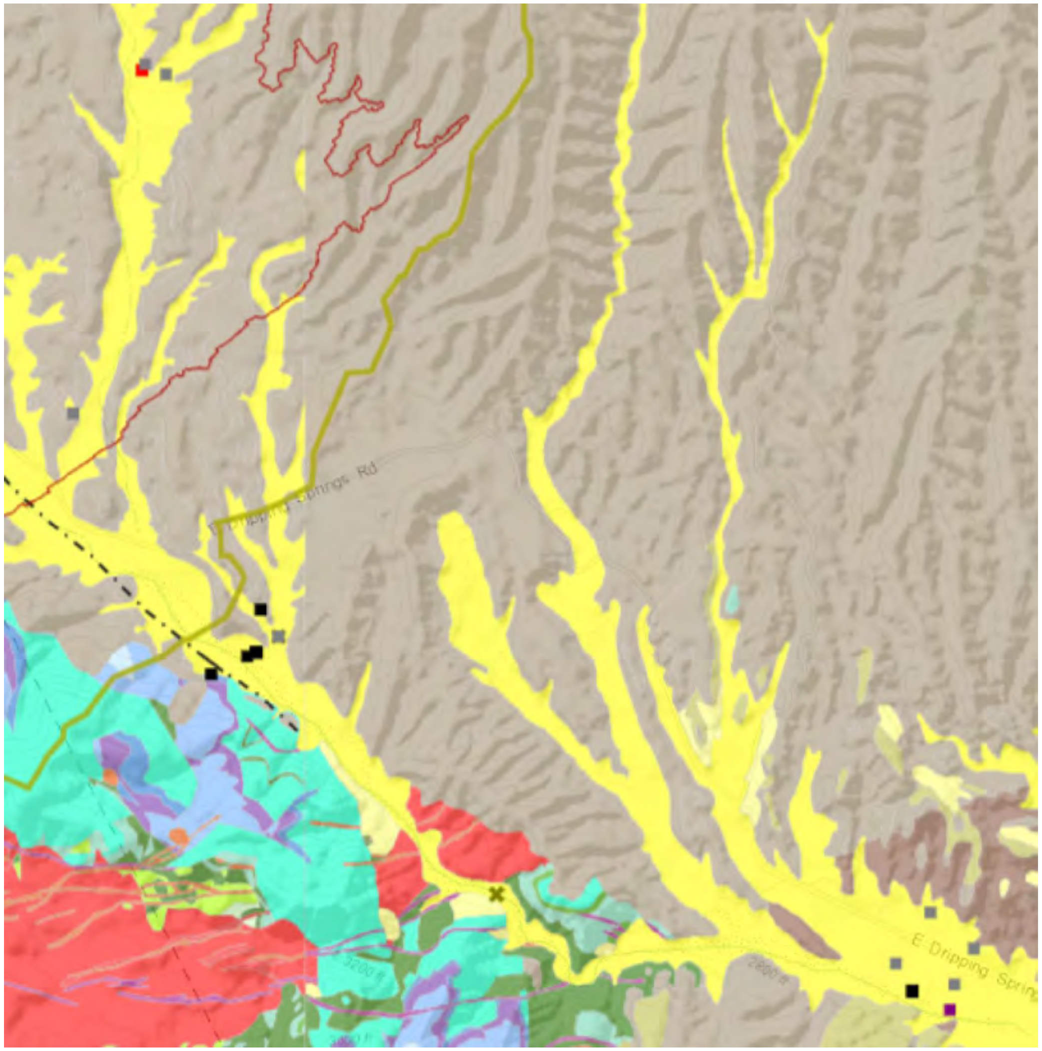
Current Field Program

- 9 additional wells
  - 3 in Qal
  - 3 dual completion (Tcg/Qal)
  - 2 in Tcg
  - 1 in Bedrock
- Pumping test at irrigation well
- Pumping test at Skunk Camp Well #2



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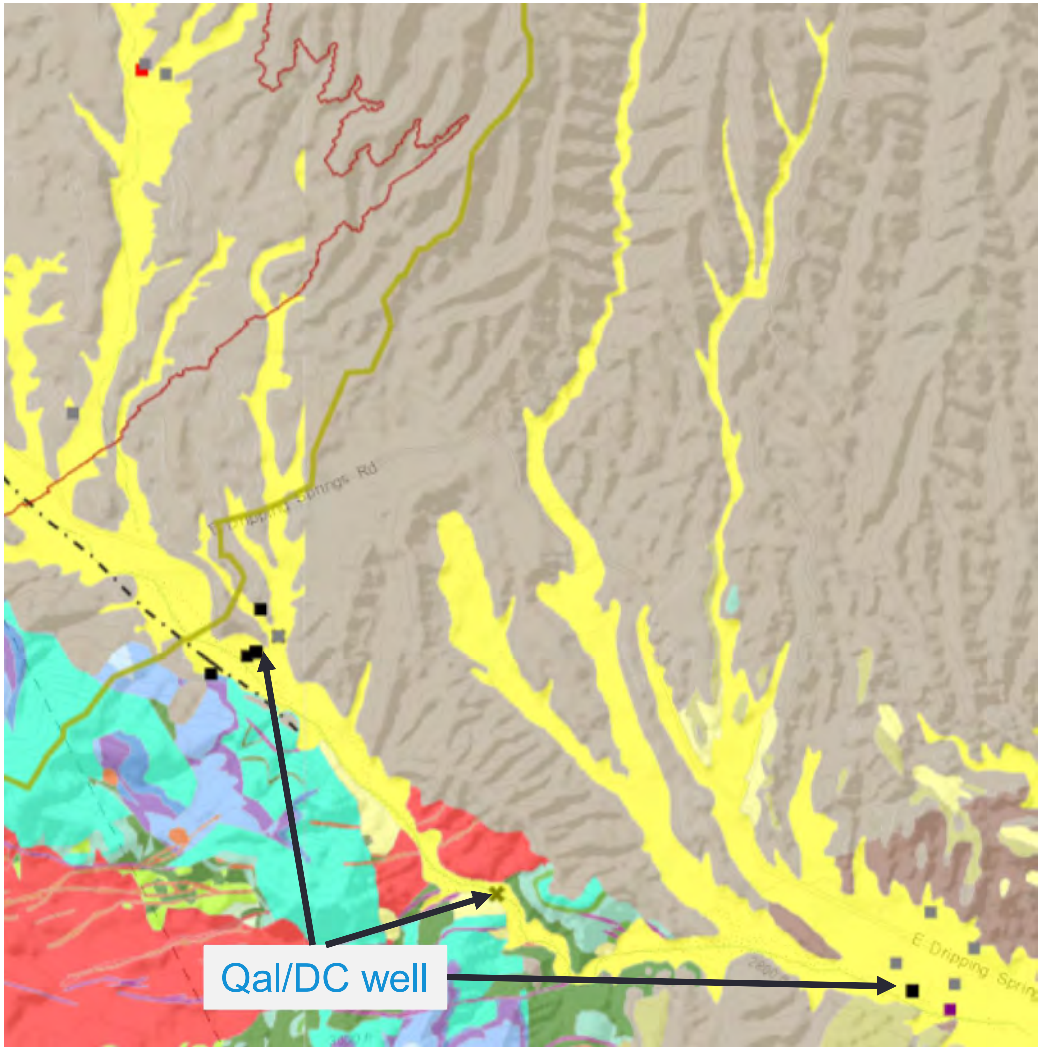
Current Field Program

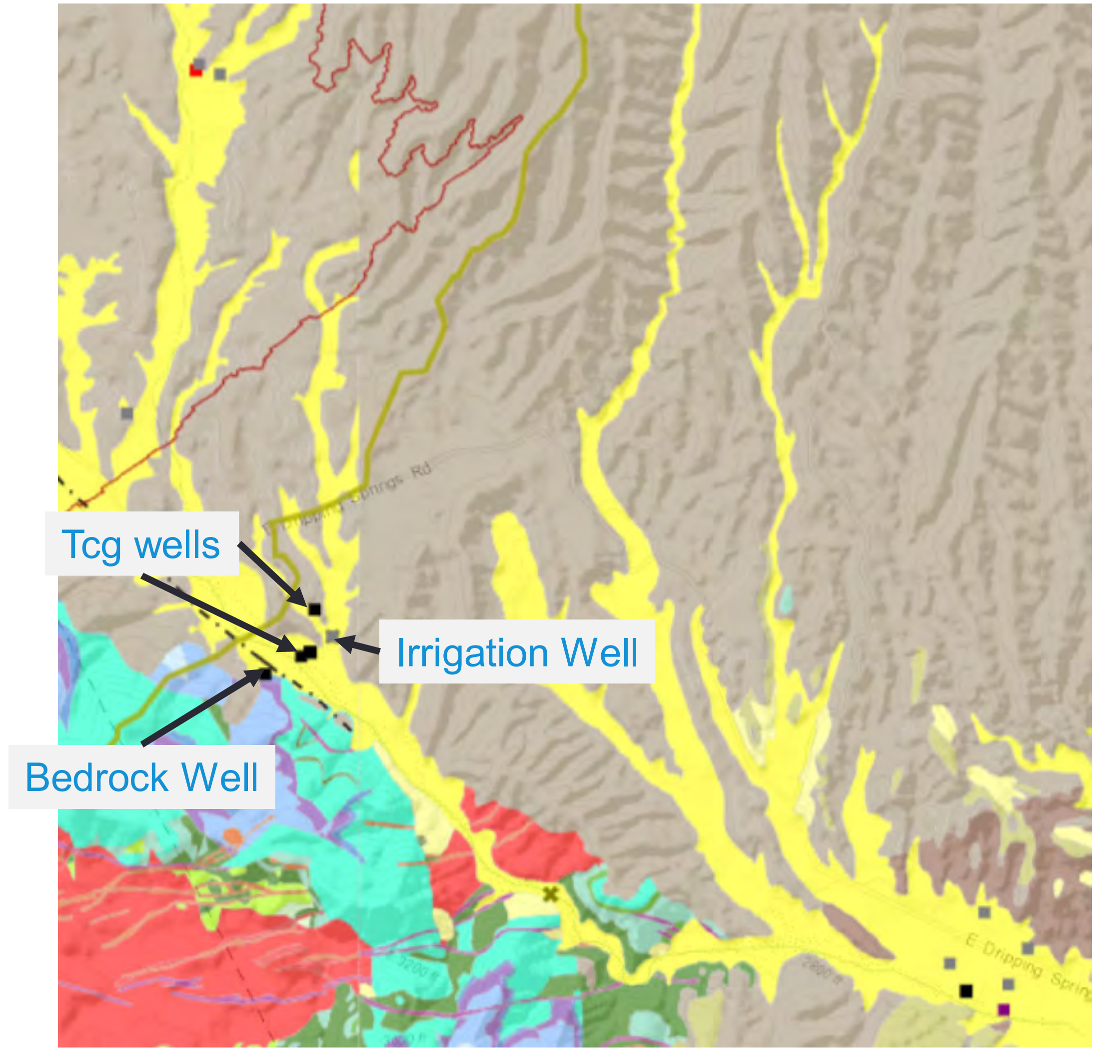
- 9 additional wells
  - 3 in Qal
  - 3 dual completion (Tcg/Qal)
  - 2 in Tcg
  - 1 in Bedrock
- Pumping test at irrigation well
- Pumping test at Skunk Camp Well #2



MONTGOMERY & ASSOCIATES Water Resource Consultants

Current Field Program

- 9 additional wells
  - 3 in Qal
  - 3 dual completion (Tcg/Qal)
  - 2 in Tcg
  - 1 in Bedrock (Bolsa Quartzite)
- Pumping test at irrigation well
- Pumping test at Skunk Camp Well #2



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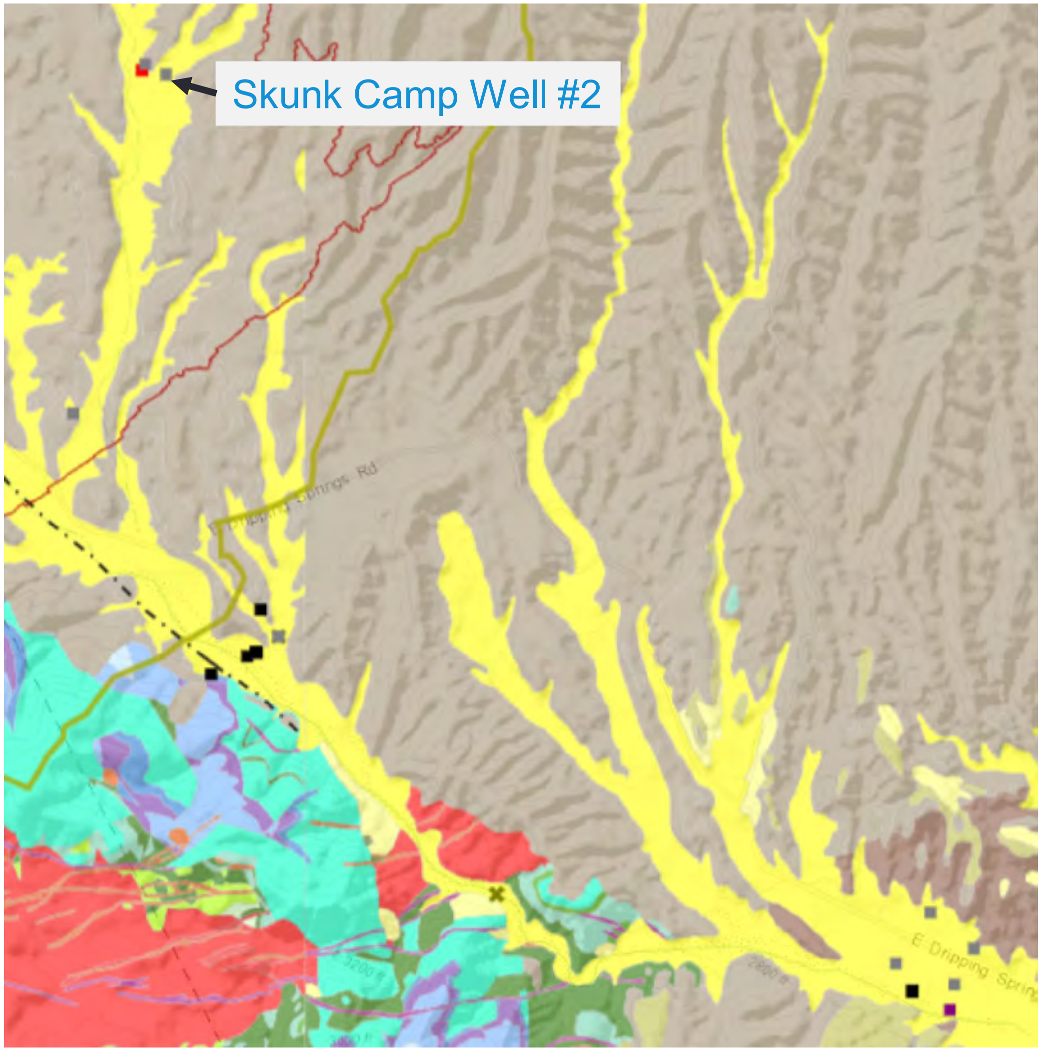
Current Field Program

- 9 additional wells
  - 3 in Qal
  - 3 dual completion (Tcg/Qal)
  - 2 in Tcg
  - 1 in Bedrock
- Pumping test at irrigation well
- Pumping test at Skunk Camp Well #2



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& ASSOCIATES
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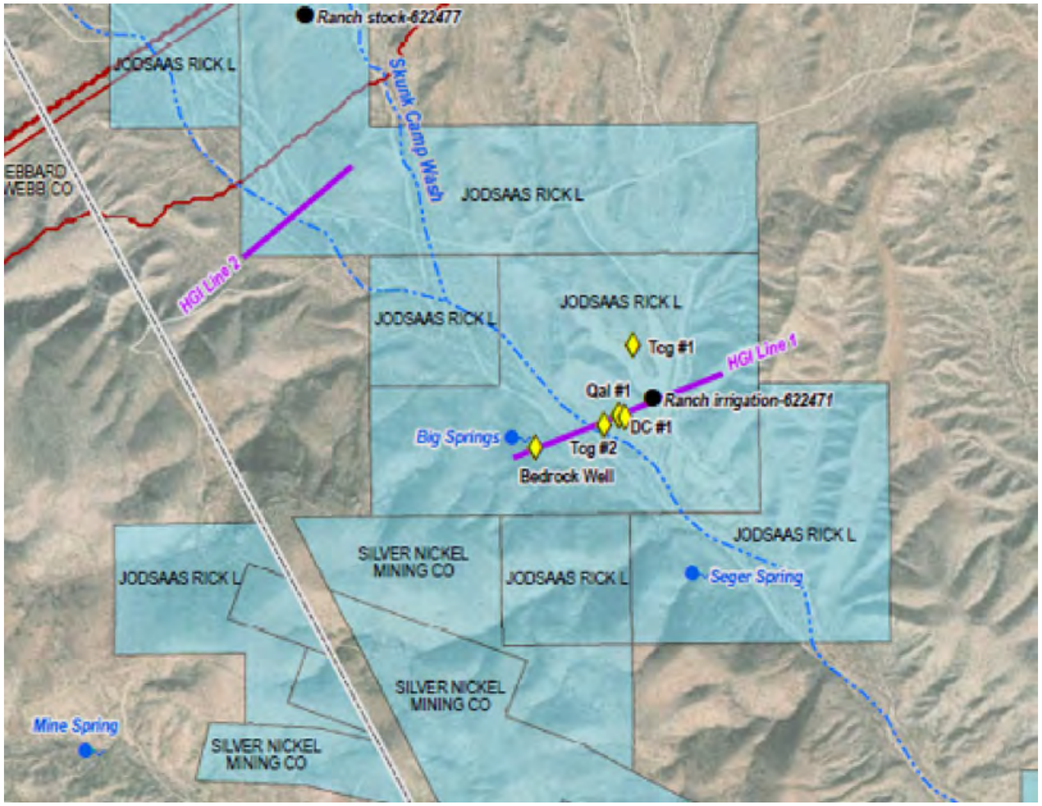
Current Field Program

- 2 geophysical transects
  - Seismic
  - Resistivity
  - Multichannel analysis of surface waves (MASW)



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DRAFT ACTION ITEMS

Date Assigned	Action Item	Resolved
1/23/2020	WR-1 (ALL): Provide resumes and quals for project record	Ongoing
1/23/2020	WR-2 (SWCA): Produce "Proceedings" process memo to document all data requests, data submittals, and workgroup actions (pre-DEIS and post-DEIS)	Ongoing
1/23/2020	WR-3 (SWCA): commit to sending the meeting notes prior to the next meeting	Continual
1/23/2020	WR-4 (SWCA): notify the group of substantial updates to documents (i.e. process memo living docs)	Continual
1/23/2020	WR-5 (SWCA): provide access to a SharePoint site to members of the workgroup and provide the technical reports and BGC report	Continual
1/23/2020	WR-6 (RCM): Updated water qual, water data for long term around mine site/springs, water level, stream length (approx. 2016 – 2019) likely raw database not a report, (early March)	In process and should see before April meeting
1/23/2020	WR-7 (RCM): Summary & data for water quality, water level database for Skunk Camp & Gila River – report or database (early March) includes wells downgradient & other springs	In process and should see before April meeting
1/23/2020	WR-8 (RCM): Skunk Camp modeling presentation – March 26 Water working group	April
1/23/2020	WR-9 (RCM): Springs Inventory 3.0 (April)	In process and should see before April meeting
1/23/2020	WR-10 (RCM): Closure and reclamation information, cover design – not ready yet/optional for this working group, but will be included for Closure working group	In progress – lab testing memo in next 2 weeks & closure study by April meeting
1/23/2020	WR-11 (RCM): ESRV cumulative effects modeling (early February) include presentation in February	Report submitted by RCM 1/24/2020; circulated to workgroup 1/27/2020
1/23/2020	WR-12 (RCM): pull well records and other information for QV and think of ways to model the impacts	In process and should see in next 2 weeks

Date Assigned	Action Item	Resolved
1/23/2020	WR-13 (RCM): RCM to get written responses to Prucha comments/criticisms from Resolution modeling team. Those would be distributed to the Water working group so we can better discuss in the next meeting.	Received (3/23)
1/23/2020	WR-14 (SWCA/BGC): Screen thru Prucha report/comments and respond with previous background information from the BGC draft model review document	Continual
2/20/2020	WR-15 (M&A): Will investigate possible analytical tools or an approach to evaluate the local subsidence issue in or near the desert wellfield.	Will discuss in April
2/20/2020	WR–16 (RCM): Provide usage numbers for ESRV for comparison to RCM pumping	Will discuss in April
2/20/2020	WR-17 (TNF): Follow up with ADWR on ESRV model update approval.	In process
2/20/2020	WR-18 (BGC): Review SRV model and purpose memo on M&A extension and appropriateness of model	In process ** consider with AWBM 3.5% reduction at WRD in addition to JE Fuller 1-2%**
2/20/2020	WR-19 (RCM): Resend September 2019 powerpoint	Received (3/17)
2/20/2020	WR-20 (RCM): Provide input on potential for stormwater release and estimate of quality. Focus on operations. Follow up on in Mar/Apr.	In process and can discuss as early as April
2/20/2020	WR-21 (M&A): Estimate remaining water in aquifer at several snapshots in time.	In process and can discuss as early as April
3/26/2020	WR-22 (RCM): Information on modeled gradients near block cave over time; verify hydraulic containment will occur	New
3/26/2020	WR-23 (RCM): Kate send contingency information for Design of Facility able to handle varying percentage split between pyrite/scavenger tailings.	New
3/26/2020	WR-25 (RCM): • provide previous water submittal that should provide examples of analog design features • possibly add additional water closure projects that could also be analogs in arid environments, if any • provide discussion on how tailings are managed/tested during operations based on Kennecott	New
3/26/2020	WR-26 (M&A): provide GIS layer of springs and wells	

Date Assigned	Action Item	Resolved

Emily Newell

From: Emily Newell
Sent: Tuesday, November 17, 2020 3:32 PM
To: Emily Newell
Subject: Resolution - All things Water working group
Attachments: 20200220_Water Workgroup_ACTION ITEMS-dm.docx; 20200326_WaterWorkgrp_notes_pkg.pdf

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From: Donna Morey
Sent: Monday, April 13, 2020 5:09 PM
To: Rasmussen, Mary C -FS <mary.rasmussen@usda.gov>; 'Victoria.Peacey@riotinto.com' <Victoria.Peacey@riotinto.com>; Chris Garrett (cgarrett@swca.com) <cgarrett@swca.com>; Gabi Walser <GWalser@bgcengineering.ca>; 'Mark Williamson Geochemical Solutions' <mark@geochemical-solutions.com>; Donna Morey (dmorey@swca.com) <dmorey@swca.com>; Nick Enos - DOWL <nenos@bgcengineering.ca>; Derek Hrubes BGC <dhrubes@bgcengineering.ca>; Hamish Weatherly <hweatherly@bgcengineering.ca>; Sampson, Judd - FS <judd.sampson@usda.gov>; Atkinson, Lee Ann -FS <leeann.atkinson@usda.gov>; edward.gazzetti@usda.gov; Gazzetti, Edward - FS <egazzetti@fs.fed.us>; cameo.flood@tetratech.com; 'Jim Butler' <jbutler@parsonsbehle.com>; Ghidotti, Greg (G&I) <Gregory.Ghidotti@riotinto.com>; 'Todd Keay' <tkeay@elmontgomery.com>; Timothy Bayley <tbayley@elmontgomery.com>; 'gustavo.meza-cuadra@wsp.com' <gustavo.meza-cuadra@wsp.com>; Hale Barter <hbarter@elmontgomery.com>; Christopher Gregory <cgregory@elmontgomery.com>; Patterson, Kate <KPatterson@klohn.com>; Derek Groenendyk <dgroenendyk@elmontgomery.com>; Hoffman, Hugo <Hoffman.Hugo@epa.gov>; Bret C. Esslin <bcesslin@azwater.gov>; wh2@azdeq.gov; christopher.pantano@wsp.com; James Wells <JWells@everettassociates.net>; 'ted.eary@enchemica.com' <ted.eary@enchemica.com>; 'James Ruff' <jruff@azgfd.gov>
Cc: Dailey.Hannah@epa.gov; Langley, Michael SPL (Michael.W.Langley@usace.army.mil) <Michael.W.Langley@usace.army.mil>; mark.logsdon@sbcglobal.net; Michael Henderson <MHenderson@bgcengineering.ca>
Subject: RE: Resolution - All things Water working group

Greetings everyone –

I have two nifty items for you in this email.

1st the meeting notes and action item list are attached and 2nd is an updated link to the SharePoint folder with all the Water working group files where the data requests go to live.
https://swcacorp.sharepoint.com/:f:/s/EXT_SWCAFileShare/Eirbyu-OjuVHkNs9BRxX9xUBFP3KB_E-OoSoYo-CwH5Htw

The link that Chris had provided last week was just updated today to extend the deadline for how long the folder would be available for you to access, and sadly – a new link is required.

Please let me know if you run into any issues with this information or SharePoint – we will all talk again on 4/23 at 8am.

Best,
Donna Morey

-----Original Appointment-----
From: Donna Morey
Sent: Thursday, December 5, 2019 9:12 AM

To: Donna Morey; Rasmussen, Mary C -FS; Victoria.Peacey@riotinto.com; Chris Garrett (cgarrett@swca.com); Gabi Walser; Mark Williamson Geochemical Solutions; Donna Morey (dmorey@swca.com); Robert "Nick" Enos; Derek Hrubes BGC; Hamish Weatherly; Sampson, Judd - FS; Atkinson, Lee Ann -FS; edward.gazzetti@usda.gov; Gazzetti, Edward - FS; cameo.flood@tetratech.com; Jim Butler; Ghidotti, Greg (G&I); Todd Keay; Timothy Bayley; gustavo.meza-cuadra@wsp.com; Hale Barter; Christopher Gregory; Patterson, Kate; Derek Groenendyk; Hoffman, Hugo; Bret C. Esslin; Wayne Harrison; christopher.pantano@wsp.com; James Wells; ted.eary@enchemica.com; James Ruff
Cc: Dailey.Hannah@epa.gov; Langley, Michael SPL (Michael.W.Langley@usace.army.mil); mark.logsdon@sbcglobal.net; Michael Henderson; Tyler Loomis
Subject: Resolution - All things Water working group
When: Thursday, March 26, 2020 9:00 AM-4:00 PM (UTC-07:00) Arizona.
Where: webinar or in person

Who: TNF, RCM & Contractors, NEPA Team (CGarrett, DMorey, GWalser, MWilliamson)
What: 3rd 2020 meeting to reconvene the Resolution Water Resources team
Where: Webinar or in person (see below)
When: Thursday, March 26th 2020 from 9am – 4pm Arizona/MST
Why: To combine mine site modeling, desert wellfield modeling, new Skunk Camp modeling, and water quality for the project. Will discuss new data received, comments received on Draft EIS, and discussion on how to move forward

How to join?
In Person: SWCA Phoenix office – 20 East Thomas Rd, Suite 1700
Webinar:
1. Call-in Number: +1 (669) 900 6833 or (888) 475-4499
2. Meeting ID: 667 369 6060
3. Meeting URL: https://swca.zoom.us/j/6673696060