Meeting Minutes

Engineering/Minerals
Tonto National Forest
Phoenix, AZ

To: Project Record

From: Donna Morey, SWCA

Re: Resolution Water Work Group Meeting 4/23/2020

Attendees:

USFS: Mary Rasmussen, Judd Sampson, Lee Ann Atkinson, Eddie Gazzetti
SWCA & subs: Chris Garrett, Donna Morey, Mike Henderson, Gabi Walser, Mark Williamson, Nick Enos, Derek Hrubes, Carl Mendoza, Hamish Weatherly
Resolution & subs: Vicky Peacey, Greg Ghidoitti, Cameo Flood, Hale Barter, Gustavo Mesa-, Kate Patterson, Janeen Duarte, Chris Pantano, Ted Eary, Mark Logsdon, Jason Nielson
ADWR: Brett Esslin
ADEQ: Wayne Harrison, Laurie "Rosi" Sherrill
AGFD: Jim Ruff,
EPA: Hugo Hoffman
San Carlos Tribe: Jim Wells
USACE: Mike Langley

Handouts:

Agenda (1pg)
Initial approaches for SW questions (13pg)
Action Item list (3pg)
WSP ISH Response (14pg)

Discussion:

Welcome and Roll Call

Topics we will be discussing today: Water quality seepage modeling is not ready yet, so will be discussing specific items listed on the agenda. It is ambitious and hope to finish in time.

- Jim Wells noted there is a edit needed on the bottom of Page 11. WSP will add a period to show the end of sentence, confirmed no text is missing and document is complete.
- Mary is open to scheduling another meeting if we find specific topics that might be a rabbit hole to discuss.
- Resolution does have some of the ESRV follow up topics that can be discussed.

Review of Action items

See Action item list – updates done in red text with yellow highlight

Presentation from Hale Barter on ESRV information

- Request by Chris Garret to receive the numbers and summary of information behind the graphics in presentation. Nothing large expected, suggest a couple of pages, 3 graphs and some context behind it to help describe action item 15 and 21; with references to bigger report for other information.

Suggest confirming in summary that Action 1 is the No Action alternative and be explicit that it does include the pumping of recovery credits by "someone." ADWR requires that all LTSC must be withdrawn for 100-year simulation – doesn't matter who withdraws them for simulation, but all LTSC are withdrawn. EPA suggests adding "No Action" to Alt 1 to help clarify that assumption.

Presentation from Tim Bayley on ESRV subsidence due to water drawdown

1983 was the start of the SRP model data and the 1980s is generally the lowest point of the aquifer for the area. This analysis shows the area within the yellow around the pumping wells as where subsidence may be seen from water withdrawal.

M&A warns this is a regional model and has many assumptions put into it.

Surface Water White Paper

These are not items that were missed in the DEIS, all had rationale for the decision made for each analysis. Today's discussion is to determine if there is a better way to do the analysis. The white paper shows what the NEPA team was thinking or leaning on but is not a final decision or a definitive path forward, open to discussion and other review points.

1. Other modeling technique

- Did not open or look at the other modeling package suggested but looked at the documentation of the modeling package. This model uses Lane's Balance equation for a relationship.
- Hamish noted the document they reference is a backup help document of information, the equation 1.4 is not a detailed analysis and is more of a gut check on sediment transport and then use ratio to show aggrading or degrading. Hamish does not feel the comment is asking us to use equation 1.4 or a change in modeling already used.
- With it being a sandy wash, there is an unlimited supply so does this equation really matter? Hamish has done the equations and seen that you might get a small aggregation, but you are cutting off watershed, so you are reducing sedimentation a bit, therefore a more nuanced final answer. Hamish thinks no new analysis is needed but could reframe the bullet points.
- Jim Wells thinks it is more of a scaling consideration to consider. If we know what the predicted reduction of volume or sediment; and if minor compared to natural flows, then it is a small issue.
- Jim Ruff thinks the reduction in peak flow (both loss from subsidence crater and from TSF), if 20%, then it would be a significant reduction in peak flow. 20% is correct for @ Magma bridge in Superior. Can we expect aggregation or degradation at the bridge? It is bedrock there, so hard to answer. Hamish thinks it will deposit further downstream regardless as it is bedrock there at the bridge.
- So, if we instead look at BTA and Hwy 60 bridge area, the reduction is 13 % in average flow as stated from information in DEIS. Hamish says you can go use the equation; his gut feeling is that it would be minor aggregation. Can do the equation as it is not much effort.
- Chris thinks we should do the technique as it is a valid technique that could be used for analysis. Should we limit this to infrastructure such as bridges (would limit it to half dozen points to look at)? Hamish states there are no fish, so looking at infrastructure could then be the focus.

- Other way to look at the mine – reduction of peak flow at the GDE on Queen Creek with various water sources (SW, GW, effluent, and IMRYS mine discharge). What concerns does the group have that we should look at? No answers from the group. Mary asked are we concerned there would be a different contribution of sediment to WRD?
- Points to analyze – WRD, Hwy 60 bridge @ BTA, Magma Ave Bridge, and 77 bridge where Dripping Springs wash crosses it.
- JE Fuller has done a sedimentation analysis at Dripping Springs and will be coming soon.

Summary – explore by NEPA team to consider if we should execute doing equation 1.4 on those areas. Put a pin in this topic before doing new analysis until we receive the Dripping Springs report

2. Analysis past first perennial water downstream of TSF?

- Sideboards, not worry about stormwater or wells that might access the GW impacted by seepages – just about GW surfacing and affects SW quality
- The DEIS did look at WRD for #1, Gila River @ Donnelly wash for Alt 5, and Gila River @Dripping springs wash for Alt 6.
- Jim W – notes that first, is water quality the appropriate level for disclosure? 2nd question is it appropriate to look at downstream.
    - o Jim Butler – the NEPA use of standards is appropriate and is how NEPA typically addresses if impacts are significant. You can disclose less than the standard. There are no requirements in regulations to look further.
    - o Jim W broadly agrees with Jim B, but states CWA says discharges that accrue to exceed are issues. Jim B also agrees if it is a cumulative issue it should be discussed.
    - o Jim W thinks qualitative downstream could be discussed and important to discuss for something that would occur for hundreds of miles downstream even if not over water quality standards.
    - o Chris G states there will be a whole new Cumulative Effects Analysis, with a new chapter in document and will include water quality and considerations of contributions to the Gila River will be discussed in that context.
- DEQ has a non-degradation clause and the point of issue here is Skunk Camp discharge to the Gila – GW impacted and discharges to SW past POC. It is a complicated legal /regulatory issue and this type of issue is currently relevant based on Maui vs Hawaii Wildlife fund currently in front of Supreme Court. In 2019, EPA issued guidance said such issues do not fall under CWA.
    - o Jim noted it came from Supreme court this morning, not a clear answer but have not had time to digest the opinion yet.
- Would the SW expression be covered under the TMDL study? Answer = only for impaired waters. The Gila River is impaired below for suspended sediment. It may be considered under a TMDL study below but would be very complicated as a regulated aspect under CWA.
    - o Chris says from runoff from the embankment to Gila river is disclosed in the EIS. The information disclosed was aquifer with standard, if any exist against the baseline quality at various distances. We are covered to the Gila River with numeric & narrative standards.
- Hugo agrees there are complicated permitting and we should look at NEPA to disclose what we can further downstream. He believes it can and should be done quantitatively.

- Do we understand the system enough between Dripping Spring wash and Florence to apply the tools?
    - For Skunk Camp we can answer that question – M&A has some spatial distribution of background chemistry for most of regulated constituents downstream. Part of the Gila river system is a dam-controlled system and is relatively consistent pulses of low and no flow. You would want to look at a range of mixed water based on those consistent changes. Tim thinks we can do this for Skunk Camp. There was a table in previous submittal with dilution and flows. Dilution will not give us a complete answer, but you would expect seepage entering the Gila River would be worst at entrance, not further downstream away from entering the Gila.
    - Chris showed DEIS Appendix M – Figure M-29 to show changes downstream in Skunk Camp. What is the magnitude of the problem? Sulfate does not have an obvious standard, could affect downstream. The EIS approach was that the Forest doesn't have permit/agency framework. It was informed by the regulation and asked if we are adding a load to the impaired waters and what type of load was being added. Also looked at assimilative capacity since it came up in the previous water work group. We looked at it in various directions without stating it was a regulatory answer.
        - Selenium is above baseline water quality but below standard. Figure M-31
        - Chris knows we need to look at this for cumulative effects and compare load we add to load added by others for cumulative downstream and can be done with some reasonable available information. Do we need to consider this a direct effect of the project? If so, what technique should we use? Is below standard but above baseline sufficient? Or do we not need to answer the question? No response from group members.
    - If we move from Gila River over to Queen Valley, there is a situation in which Whitlow Ranch Dam is between the water and the community - seepage daylights (not direct flow, but sub flow unless there is an overflow over dam. If we felt we need to ask if QV water supply would be affected, do we have a technique to use based on the complicated geology/dam? Tim says we have baseflow & chemistry of baseflow from the dam – they also have some flow volumes & chemistry that could be mixed. SW uses would be for irrigation purposes, could not be definitive to figure out difference of storm flow and baseline percentage – could assume full mixing.
    - Summary from # 4 – this is a disclosure issue, no regulatory issue if downstream sw would degrade for designated uses beyond the 1st perennial water. Other side- the way you get to that is by using standards which is what was already done. Tools would be mass balance mixing cells if we have all inputs for quantitative assessment. We will be looking at Cumulative effects as best we can as quantitatively as we can.
        - Should we do that? No responses – Chris says he is fine pausing on this – we are getting QV hydro report & other water information that may speak to this topic. Move on, no answers, no decisions, will review data and just wait by moving onto next question.

3. We have looked at first perennial water – do we need to go further downstream?

- Are we causing GW mounding that could cause SW expression where there is none now?

- This question was asked during ADEIS review – discussed internally and decided it did not need to be analyzed. We did not write down analysis documentation that someone else could follow.
    - Differs be alternative but doesn't appear to be a mechanism that would occur.
        - Alt 2/3/4 it is a small number and unlikely to change it to an intermittent stream.
        - Alt 5 is different approach – pumping to control aquifer for what it can take – designed to not reach ground surface.
        - Alt 6 – (calc done by Chris in 2019 and again in 2020). Chris does think Alt 6 has a higher seepage and could create a SW expression by using Darcy's law. Logic as 16 feet is what would be created and we have 70 feet to work for alluvial aquifer height, so not expected.
    - Tim thinks this is best to wait till we have gone thru conceptual and numerical models and this would help answer this – Resolution does not feel this is an issue and can answer directly for Skunk camp based on this new modeling. Tim will put more thought into it before next meeting when the new models are discussed.
    - Chris displayed map from the GDE memo – all drain below GDE

Questions 4 and 5 – the topics overlap so brought forth here together. Impaired waters and appropriate flow values

- First question – impaired water, did we point to right ones? Some comments said we missed some impaired segments. Chris believes most commenters were thinking about the proposed action being different than what we described. Our understanding is that there are a couple of outfalls that are permitted. This permit would allow Resolution to discharge treated dewatering-water. Resolution is NOT discharging right now but instead sending to NMIDD. When that does change to mine operations, there would still NOT be a discharge but would include water in the processing loop – not using discharge as permit would allow as part of the proposed action. Vicky says yes for current condition and current AZPDES permit.
    - Vicky would like to provide a written response to clarify the current condition versus the future condition.
    - There is possibility of mitigation of discharge of water based on Town of Superior mitigation idea.
    - Jim wells would like to note these hypothetical discharges should be disclosed and talked about in the DEIS. He thinks by Resolution asking for a renewal means that it is reasonably foreseeable to expect a discharge
    - Vicky says there is a transition period, but no plans exist to discharge as there is a water deficit for mine operations.
    - Jim thinks we should focus on the period of mine development and mine closure as the transition periods.
- Now considering discharge could occur – what are the boundaries? Resolution to provide likelihood during transitional periods and NEPA team will take it from there for NEPA disclosure
- 3rd question to look at low flow or other conditions
    - M&A able to do but want NEPA guidance for correct path forward. Resolution already has an Action Item to consider stormwater quality in event of a release – is this something similar? It is for overflow, not stormflow question.

        - Kate says the 7q10 flow is what Canada uses and where that standard derives from – used for impacts to salmon so not applicable here.
        - Rosi concern is for effects to Gila and what the downstream effects would occur with low flow.

Summary – we can do this with tools, half the time it will be below the medium and some small slice of that is very low. 7q10 is just one method to figure out that low flow. This is a 50-year project so yes it could occur, just in small portions of the time. Resolution says to do it as it seems easy to do to answer the question.

- Last question – we do not need to argue if Tier 1 is needed, but the other approach
    - The EIS has looked at changes in assimilative capacity based on seepage – yes, there are changes above the 20% threshold used under some regulatory conditions. We do not say if it can be permitted, just that the changes could occur.
    - Was our approach reasonable or should we dive further into the degradation standards? Resolution says you should disclose as 40CFR requires. A copper load could be added to Queen Creek with discharge which is an impaired water. It is an impaired reach and we agree, because of that being impaired we need to apply Tier 1 degradation – we say it is occurring and commenter wants us to say it is not acceptable or legal.
        - Jim Wells says it is not required to say.
        - Hugo says you should provide possible compatibility of getting a permit.
        - Vicky says we know uses Aquatic warm and disclose standards.
        - Should the Forest then require a mitigation. Vicky says there is nothing else that can be added for Alts 2 and 4.
        - Hugo says it does not need to be answered no, but with ADEQ is a CA and ADEQ should provide a preferred analysis type/methodology. You can make it clear you would not make a permitting determination, but show analysis is done & not making a permit decision.
        - ADEQ could weigh in with their approved approach. Chris not sure it is fair to ask that. This is a permitting question – what permit? As it is not a SW discharge, it is a GW that later enters SW further down stream and Wayne notes that type of question is in limbo and may never be able to get an answer. Hugo thinks it could be under 401 but not sure how or where it would apply. And if in Queen Creek then USACE has no decision so 401 not apply again. Jim Butler thinks we are getting further into the weeds than NEPA requires for Forest determining another agencies purview.
        - Mary suggests further clarify the DEIS (figure of impaired waters) and check if we have referenced the 303 waters list to make that link to the disclosure and continue with existing assessment of water quality aspects. Cameo says to leave disclosure to impaired waters and could add text that to be permitted the exceedance would need to be addressed to be permitted – one way could be with mitigations. IF ADEQ wanted to note that some are not permittable and the other agency approach would not consider the Alts 2 and 4 are not permittable per their thought. Chris notes on a previous project only the 401-

certification needed to be in hand before the Final ROD, and the other permits would be noted as needed prior to Final MPO.

- No one is saying you take this to the extreme that it can't be permitted but could try to better clarify what we have disclosed and will not say that this is or is not legal under DEQ regulations.
  - Jim says the process for ADEQ to analyses could be known (as we say unknown right night) Jim W thinks it could be a TMDL process. It is an action undertaken by the agency, not a permitting process to allow new discharges. We have a draft TMDL for Queen Creek we reference in DEIS, not sure that helps with Skunk Camp or Peg leg is for suspended sediment, not the metals we are talking about. Chris thinks the TMDL document could be good for CEA analysis. Vicky thinks we could add some more information on regulatory context about TMDL that ADEQ would evaluate a TSF proposal in the Queen Creek watershed.

Summary - No one has raised a new metric and our analysis was adequate. Add in 7q10 approach, better disclose regulatory context, will not take to will/will not be legal.

Open Mic for any new topics or concerns from those in attendance – no response from group

Other activities ongoing with the project: Chris estimated 472 responses to the 5,200 comments – of those about 100 are water related.

Review of Action Items –

Prucha comments generally fall into one of 3 categories

1. not valid for discussion – we can point into something in the record that we did look at that information
2. modeling choices – yes there is a different way to do it, we feel we did an appropriate way but there is a different way to do it
3. things that may have been flaws in approach or process.

- Chris would like to sort by buckets so we can focus our discussions. First got WSP response, BGC have done leg work to get the ones sorted into the 1st bucket, wish to circulate to this group the information and this group can then circle back to talk about the things that really need to be discussed.

Memo for slide slow briefing Hale Barter, but no additional information needed for Tim's slides.

Resolution should be able to submit a response to Hugo from M&A as well as a Sampling & Analysis plan

What will be covered in the May work group meeting –

- Chris hopes to discuss Skunk Camp to understand the new water quality modeling work that was done, understand the latest thinking on seepage control and what is being assumed in design, what the modeling shows (output) compared to SW thresholds & baseline water quality, stormwater release discussion – 200 year event front face of embankment.
- Resolution feels they will be able to present on that along with a review of the background data set for Skunk Camp (springs, hydraulic conductivity, and conceptual model) Chris asked that he also go over SW & GW new data set.

- Wayne wants to further discuss seepage control effectiveness as described during FMEA and what occurs after you shut off wells and breach the grout curtain. Chris G thinks May would be the start in what is assumed for operational period, but conversation may not be completed in May.
- Unlikely to get into Prucha comments in May. June meeting is supposed to be on mitigations and a few other things we have been pushing. June would be a good time to go over Prucha modeling stuff. Mary suggested we have more than 1 meeting in June (different week) to catch us up.

Mary is thankful for the focus given to the meeting design to assist while we all work remotely.

Action Items:

1. WSP to supply numbers and summary of information behind the graphics in the 4/23 presentation
2. Donna to send doodle poll – will schedule an extra 4 hour meeting in June for the water work group
3. Donna to update May calendar invite to 4 hours as it will be online
4. Chris to share newly submitted data responses
5. Resolution to provide May presentation information 1 week early to allow group to review

Engineering/Minerals
Tonto National Forest
Phoenix, AZ

Agenda

To: Attendees, Project File
From: Chris Garrett, SWCA
CC:
Date: 4/23/2020

Re: **Resolution Copper Mine – Water Resources Workgroup #4 – 4/23**
Call-in Number: +1 (669) 900 6833; Meeting ID: [redacted]
Meeting URL: https://swca.zoom.us[redacted]

1. Welcome and roll call

2. Topics for today, and looking forward to May and June
   a. May: Proposed main topic = Skunk Camp water quality modeling
   b. June: Proposed main topic = Monitoring and mitigation

3. Recap of action items

4. Surface Water Analysis Topics (see attachment)
   a. Specific issue: Is there a need to revise the geomorphology analysis?
   b. Specific issue: Do we need to analyze water quality past the first perennial water downstream of the TSF?
   c. Specific issue: Do we need to analyze surface water quality above the first perennial water downstream of the TSF?
   d. Specific issue: Which impaired waters are pertinent to the disclosure?
   e. Specific issue: What are the appropriate flow values to use when calculating surface water quality impacts in downstream perennial waters?

5. Groundwater Modeling Analysis Topics (response go Action Item WR-13)
   a. Specific issue: GW/SW Interaction
   b. Specific issue: Alternative Conceptual Models
   c. Specific issue: Predictive Uncertainty Analysis
   d. Question to group:
      i. Some Prucha concerns are demonstrably incorrect (i.e., data identified in comment can be readily pointed to in project record)
      ii. Some Prucha concerns represent a disagreement in the fundamental choices made in approach (baseline pumping conditions, 200 years)
      iii. Some Prucha concerns represent opinions of different modeling choices that could have been made
      iv. What Prucha comments, if any, represent potential flaws in the model (not just preferences), or potential flaws in the process?

6. Open discussion

7. Next Steps – Plans for May meeting (water quality modeling)

WHITEPAPER – FOR DISCUSSION PURPOSES

PERTININENT INFORMATION AND INITIAL APPROACHES FOR SELECTED SURFACE WATER COMMENTS

Surface Water – Specific Issue: Is there a need to revise geomorphology analysis?

Pertinent comments:

28449-55: "*Impacts to channel geomorphology (slope) from reductions in flood flows and changes in sediment loads can be estimated from Lane's Balance using equation 1.4 in USDA FS RMRS-GTR-226 (2009). This is a quantitative way to describe if you expect the channels to aggrade or degrade.*"

Pertinent information/submittals:

- USDA FS RMFS-FTR-226 (https://www.fs.fed.us/rm/pubs/rmrs_gtr226.pdf)
- Lane 1955a (https://semspub.epa.gov/work/01/554355.pdf)
- DEIS, p. 433-34

Initial screening of comment for discussion:

Understanding of basis of comment (fact check)

Comment is valid for consideration, in that the proposed analysis offers an alternative, quantitative method for assessing downstream geomorphological changes due to changes in sediment load, sediment size, flow, or slope. The fundamental concept is based on Lane's Balance (which is not a quantitative formula, but rather a statement of a relationship):

$$Qs\ d \propto Qw\ S$$

Where:

Qs = Sediment flow
d = Sediment particle size
Qw = Water flow
S = Channel Slope

Approach Taken in DEIS

The change induced by the mine is to cutoff part of the watershed (from TSF or subsidence crater), which will both reduce sediment moving downstream, reduce total water volume, and reduce peak storm flow.

There are two potential types of impacts from this change that are addressed in the DEIS (p. 433-34):

1. Aggradation/degradation (i.e., change in slope, S)
2. Downstream GDEs that might be impacted by sediment movement

With respect to #1, the DEIS disclosure is based on the understanding that the systems are ephemeral washes that are transport-limited, i.e., there is more sediment available than any given stormflow can carry.

To attempt to put this in the context of Lane's Balance, there is so much sediment available in the wide sandy beds of Dripping Spring Wash, Queen Creek, and Donnelly Wash, that Qs never becomes a limiting quantity. Qw can either increase or decrease, and Qs will always be able to respond in kind in order to balance the relationship; because sediment load always balances the equation, the change in Qw will not necessarily lead to any other major change in slope (S).

With respect to the GDEs, the DEIS identifies that those in Queen Creek are already adapted to this ephemeral system and unlikely to be impacted by any changes in sediment, and that no GDEs exist along Dripping Spring Wash, Donnelly Wash, or upstream tributaries. The DEIS disclosure also notes that these systems exhibit natural fluctuation much greater than the changes in peak flow wrought by the mine, and this natural variation hasn't changed the fundamental nature of the system or the GDEs.

Need to Change DEIS Approach – Initial Take

There is no need to change the DEIS approach, for the following reasons:

- First, the modeling described in USDA FS RMRS-GTR-226 requires substantial baseline data and even if that were collected, carries substantial uncertainty that may not improve the analysis
- Second, while the Lane's Balance relationship is just as valid for ephemeral flow as perennial flow, the unlimited availability of sediment in desert washes undercuts the relationship.
- This appears to be the only comment received that speaks to sedimentation or geomorphology impacts. Nothing in the comment actually criticizes the approach used, but rather offers an alternative approach. The effort needed to execute this alternative approach does not match the perceived importance of the issue.

Surface Water – Specific Issue: **Do we need to analyze water quality past the first perennial water downstream of the TSF?**

Pertinent comments:

524-12: *“Impact analyses for water quality in Queen Creek downstream from Whitlow Ranch Dam are also inappropriately limited because, according to the Draft-EIS, the first "perennial surface water locations are the point at which seepage would enter the surface water system and represent the location at which surface water quality is most at risk and any impacts on surface water or aquatic habitat would be greatest" (page 346). However, degradation to surface water quality and designated uses of surface water can persist far beyond where it is first affected. To comprehensively analyze and disclose potential surface water quality impacts related to tailings seepage, modelling should be performed as far downstream as water quality would be degraded from baseline conditions. Recommendations: Model surface water quality impacts as far as the project may detectably affect water quality. Include in the Final EIS, a summary and discussion of predictions for surface, water quality impacts wherever they are expected to be degraded from baseline.”*

Pertinent information/submittals:

- DEIS, p. 346

Initial screening of comment for discussion:

Understanding of basis of comment (fact-check)

Comment is valid for consideration. This represents a fundamental difference in the philosophy of disclosing downstream water quality impacts caused by seepage from the TSF.

Approach Taken in DEIS

For most constituents, the approach taken in the DEIS was to establish a practical threshold that defines a water quality “impact” that needs to be disclosed. The analysis thresholds chosen are the Arizona numeric surface water quality standards. The use of these thresholds is fundamental to the logic of only analyzing impacts at the first perennial water. As long as those standards are not exceeded at the first perennial water, they also won’t be exceeded anywhere downstream.

However, it’s important to note that the DEIS does not solely and blindly rely just on these thresholds for disclosure. For instance, the purpose of Table 3.7.2-11 (as an example for Alt 2), as well as Appendix M was to ensure that:

a) The public could see the anticipated water quality changes not just in the context of the numeric surface water quality standard, but also in comparison to baseline water quality (i.e., overall degradation, regardless of standards)
b) The public could see the changes in constituents (notably sulfate and TDS) that don’t have numeric water quality standards.

Need to Change DEIS Approach – Initial Take

The approach used in the DEIS is entirely reasonable and logical, but there is merit to discussing the alternative approach.

Note that in practice, the concept espoused in the comment "…wherever they are expected to be degraded from baseline…" does not allow for any practical limit to impacts. Water quality impacts are mass balance calculations. If the seepage contributes <u>any</u> additional mass of a contaminant (which it does), that would theoretically elevate water quality above baseline conditions for an infinite distance downstream, as long as there's flowing water (and assuming no reactions take place).

Practically speaking, undertaking this analysis would require:

- Estimating changes in water quality in the Gila River from Dripping Springs Wash (or Donnelly Wash) downstream past Winkelman and Kearny until the Gila River becomes ephemeral (diverted), with further consideration given to the water diverted past this point.
- Estimating changes in water quality from Whitlow Ranch Dam through Queen Valley, downstream until Queen Creek becomes ephemeral. However, note that the hydrologic connection from behind Whitlow Ranch Dam to Queen Valley is via seepage discharge under the dam and is not a straight forward downstream connection like in the Gila River.

Or:

- Alternatively, undertaking this analysis would require that a threshold other than the numeric surface water quality standards be selected and the analysis taken downstream until that limit is reached.

The current approach DOES:

- Use a practical, realistic threshold to define impacts.
- Disclose to the public how water quality will change compared to baseline
- Disclose to the public how other constituents without numeric standards will change, compared to baseline
- Does disclose that downstream users, communities, and environments will not experience water quality changes above numeric surface water quality standards (for the most strict use)

The current approach DOES NOT:

- Estimate water quality changes that might affect downstream communities (Queen Valley, Kearney, Winkelman) except that they should not exceed any surface water standards

Surface Water – Specific Issue: **Do we need to analyze surface water quality above the first perennial water downstream of the TSF?**

<u>Pertinent comments:</u>

524-11: "*The Draft EIS summarizes modelling of potential impacts to surface water quality in the Queen Creek watershed for Alternatives 2, 3, and 4 at one point location immediately upstream of Whitlow Ranch Dam. The basis for modelling surface water quality in Queen Creek at this initial point appears to be based on an assumption that flows above Whitlow Ranch Dam have no groundwater baseflow component; however, this appears to be inconsistent with other analyses presented in the Draft EIS and is counter to the conceptualization of the groundwater model that Queen Creek is a groundwater dependent ecosystem. Recommendations: In the Final EIS, include a summary of results from modelling surface water quality impacts in Queen Creek in reaches above Whitlow Ranch Dam potentially affected tailings seepage for Alternatives 2, 3, and 4*."

28449-49: *"…what's the likelihood that the groundwater mounding could intersect one of the ephemeral washes and discharge to the surface before reaching the Gila?"*

<u>Pertinent information/submittals:</u>

- DEIS, p. 313 (description of Queen Creek GDEs)
- GDE memo, esp. Attachment 5 (https://www.resolutionmineeis.us/sites/default/files/references/garrett-swca-groundwater-dependent-ecosystems-2018.pdf)

<u>Initial screening of comment for discussion:</u>

Understanding of basis of comment (fact-check)

Part of this concern is not valid for consideration, and part is valid for consideration:

- Not valid for consideration: With the exception of the GDE at Whitlow Ranch Dam, there are no existing GDEs in Queen Creek that would receive runoff or seepage from Alternatives 2, 3, or 4—at least for the boundaries as we have them drawn. For Alternative 4, Silver King Wash joins Queen Creek just downstream of the boundaries of the GDE below the wastewater treatment plant and seepage would therefore not affect that GDE (see GDE memo, Attachment 5 figure).
- Valid for consideration is whether groundwater mounding caused by tailings seepage would create a new GDE in either Queen Creek or Dripping Springs Wash.

Approach Taken in DEIS

The issue of mounding was raised by BLM in comments on the Administrative DEIS. A response was documented in the comment tracking spreadsheet, but not addressed directly in the DEIS or immediate reference documents. The response to the ADEIS comment contained none of the details discussed below, only the conclusion.

Need to Change DEIS Approach – Initial Take

The reason this was not analyzed in the DEIS is because the screening (in response to the BLM comment on the ADEIS) did not suggest it to be a substantial concern. This is based primarily on the magnitude of seepage involved. The specific rationale differs by alternative:

- The estimated subsurface flow in Queen Creek downstream of Alternatives 2, 3, and 4 is at least 575 acre-feet (see Montgomery, 9/14/18, Alternative 2 memo, Table 2a showing underflow between model cells QC3 and QC2). For Alternatives 2 (20.7 acre-feet of seepage), 3 (2.7 acre-feet of seepage), and 4 (9-17 acre-feet of seepage), the increase in the alluvial flow is about 0.5 to 3.5 percent, which did not seem sufficient to change the fundamental ephemeral nature of flow in the channel.

- For Alternative 5, the design of the pumpback system is designed specifically to the capacity of the aquifer to accept flow. By definition the pumpback system should ensure that water levels do not rise to the land surface and become surface flow.

- For Alternative 6, the estimated subsurface flow in Dripping Springs Wash is about 456 acre-feet (see Montgomery, 9/14/18, Alternative 6 memo, Table 2 showing underflow from model cell DS1 to DS2 with TSF seepage subtracted). Alternative 6 seepage of 70 to 180 acre-feet per year represents about 15 to 40 percent, which is substantial. However, the depth to water in the aquifer is about 70 feet, with an average width of about 2,000 feet, and a gradient of 0.021 to 0.024 feet/foot. KCB estimated K for alluvium of 27 feet/day. Solving Darcy's Law for the thickness of aquifer (d) needed to transmit 180 acre-feet of water:

  $$Q = K * (dh/dl) * (W * d)$$

  Where:

  Q = Flow (ft^3/day) = 180 acre-feet/year = 21,480 ft^3/day

  K = Hydraulic conductivity (ft/day) = 27 ft/day

  dh/dl = Hydraulic gradient = 0.024

  W = width of alluvium (feet) = 2,000 ft

  d = thickness of alluvium needed to transmit flow (feet)

  $$d = Q / (K * (dh/dl) * W) = 21{,}480 / (27 * 0.024 * 2{,}000) = 16.5 \text{ feet}$$

  This theoretical thickness of the aquifer (16.5 feet) is the additional aquifer capacity needed to move 180 acre-feet downgradient, and is substantially less than the 70 foot depth to water, suggesting that while groundwater mounding would occur, it would not be sufficient to create new GDEs.

At the very least, the above analysis is not clearly documented in the project record. Is further investigation warranted to assess whether groundwater mounding would cause expression of surface water (and potentially new GDEs) in either Queen Creek, Donnelly Wash, or Dripping Springs Wash?

Surface Water – Specific Issue: **Which impaired waters are pertinent to the disclosure?**

Surface Water – Specific Issue: What are the appropriate flow values to use when calculating surface water quality impacts in downstream perennial waters

<u>Pertinent comments:</u>

30075-42: *"…Queen Creek and Arnett Creek are already impaired for aquatic and wildlife use from copper during stormflow conditions. Action: Consider revising this discussion. For Queen Creek and Arnett Creek, since they're impaired for copper during stormflow conditions, AGFD believes that many of the constituents of concern would be elevated during stormflow conditions, not reduced via dilution.*"

30075-43: *"…Upper Queen Creek is currently listed as impaired for lead by ADEQ. Action: The text should be revised to include lead as a constituent of concern.*"

8031-60: "*The DEIS (p. 364) wrongly says that "Resolution Copper is not proposing any direct discharges to surface waters." A similar incorrect characterization can be found at p. 370. This is simply not correct. Resolution Copper has applied for and holds Arizona Pollutant Discharge Elimination System (AZPDES) Permit No. AZ0020389 issued by the Arizona Department of Environmental Quality (ADEQ). Resolution Copper has applied for this permit to discharge up to 3.6 MGD of water into Queen Creek, an impaired water body which is listed on the CWA 303(d) Impaired Waters List as required by the EPA."*

The DEIS (p. 364) incorrectly states that "assimilative capacity is the ability for a perennial water to receive additional pollutants without being degraded." This is not correct. Per the Arizona Administrative Code Section R18-11-107.01(A), Tier 1 antidegradation criteria applies to: "a. A surface water listed on the 303(d) list for the pollutant that resulted in the listing, b. An effluent dependent water, c. An ephemeral water, d. An intermittent water, and e. A canal listed in Appendix B." Regarding Tier 1 antidegradation protections, R-18-11-107 states: "The level of water quality necessary to support an existing use shall be maintained and protected. No degradation of existing water quality is permitted in a surface water where the existing water quality does not meet the applicable water quality standards." As an impaired water body on the 303(d) Impaired Waters List, Queen Creek is subject to the heightened Tier 1 antidegradation criteria but this analysis is absent from the DEIS. Meaningful, full, and fair discussion should have been included in the DEIS on the potential for this project to degrade water quality."

30075-32: "*Queen Creek Section 3.7.2, which identifies potential risks to water quality, including surface water, does not discuss or analyze the mine's permitted discharges to Queen Creek under ADEQ AZPDES Permit AZ0020389."*

8031-61: "*The DEIS fails to analyze the impacts of the project on impaired waters. Queen Creek Reach No. 15050100-014A, (headwaters to the Superior Wastewater Treatment Plant discharge), has been listed on Arizona's 303(d) list as impaired for dissolved copper since 2002. Reach No. 15050100-014B, (Superior Wastewater Treatment Plant discharge to Potts Canyon) has been listed as impaired for dissolved copper since 2004. Reach No. 15050100-014C (Potts Canyon confluence to the Whitlow Dam) has been listed as impaired for dissolved copper since*

2010…The DEIS (p. 370) claims that "only two reaches with the potential to receive additional pollutants caused by the Resolution Copper Project are Queen Creek below the Superior Wastewater Treatment Plant, due to runoff or seepage from Alternatives 2, 3, and 4, and the Gila River from the San Pedro River to Mineral Creek, due to runoff or seepage from Alternative 6." This is incorrect. Resolution Copper holds AZPDES permit No. AZ0020389 to discharge dewatered mine project water into Queen Creek, and has held this permit since 2010. Although the DEIS (p. 365) acknowledges that TNF is required to identify which waters have been determined to be impaired, identify specifically where contaminants from the project could enter those waters and further pollute waters, and estimate the loading from that impairment, this analysis was not done as required by law. Additionally, no discussion at all is provided in the DEIS about the exact location(s) where contaminants could enter those waters as seepage or runoff from these tailings alternatives, nor is there any discussion of attempts to avoid or mitigate such runoff or seepage, impacts, or the potential levels of loading into each water body resulting from each of those discharges. Instead, after simply stating that runoff "could be captured by the subsidence crater" (p. 370), discussion in the DEIS on impacts to impaired waters concludes and is never meaningfully revisited. This is entirely unacceptable and fails to comply with the requirements of NEPA at 40 C.F.R. § 1502.14 to "rigorously explore and objectively evaluate" all reasonable alternatives."

524-9: "*From a modeling perspective, the Draft EIS incorrectly evaluates flow conditions based on median flow volumes, thereby overlooking the most severe potential impacts to surface water quality as well as the importance of downstream ecological resources, specifically, the perennial flow of a stream located in southern Arizona. The continued existence of perennial flow in these stream reaches is based on critical (e.g., low flow) conditions, not median or peak flow conditions. While the EIS analysis cannot substitute for State permitting or water quality certifications which may also use low flow conditions, an evaluation of surface water quality impacts under low flow conditions is necessary in the EIS to capture the full range of significant impacts that could result from the project. Recommendations: Evaluate impacts to stream water quality based on low-flow, critical periods in addition to the evaluation of median annual. The evaluations should be informed by characterization of existing hydrologic flows regimes and expected flow regimes that would occur from the project.*

<u>Pertinent information/submittals:</u>

- DEIS, section 3.7.2
  - Impaired water descriptions: p. 359, 369-370
  - Use of median flows (in response to uncertainties): p. 361
  - ADEQ vs. FS regulatory frameworks: p. 363-365
  - Impacts to impaired waters and assimilative capacity: p. 392, 398, 404, 411, 417
- Newell and Garrett water process memo (https://www.resolutionmineeis.us/sites/default/files/references/newell-garrett-swca-water-analysis-2018.pdf)
  - Calculations of pollutant loading: p. 34
  - Assimilative capacity calculations: p. 19, Attachments 1 through 4

- ADEQ 2018a, 303(d) list (https://www.resolutionmineeis.us/sites/default/files/references/adeq-impaired-waters-list-2018.pdf)
- ADEQ 2017, Draft TMDL for dissolved copper, Queen Creek (https://www.resolutionmineeis.us/sites/default/files/references/adeq-queen-creek-dissolved-copper-2017.pdf)

Initial screening of comment for discussion:

Understanding of basis of comment (fact-check)

There are a lot of interrelated issues to unpack in these comments, broken out below into four different questions.

First question: Where are discharges from the mine occurring, and is there an AZPDES discharge unaccounted for in the DEIS analysis?

- The disclosure in the DEIS is about impacts caused by the proposed action or alternatives. It is our understanding that the AZPDES discharge permit held by Resolution is for the potential discharge of dewatering water after treatment, though at present all of that water is being sent to New Magma Irrigation and Drainage District. Based on the water balance, it is our understanding that once operations begin, no treated water would be discharged to Queen Creek but would be recycled into the process, regardless of whether there is an AZPDES permit on the books.
- Therefore, the discharges into Queen Creek are either related to stormwater or seepage from the TSFs.
- With respect to stormwater, no contact water would be discharged; no pollutants associated with mining are anticipated to enter Queen Creek (or any drainage). [It's fair to note that we have already separately discussed as a group the conditions under which TSF contact stormwater could actually be released, and we anticipate adding this scenario to the EIS disclosure]
- With respect to seepage, the entry points of that seepage into Queen Creek are clearly described in section 3.7.2, and the downstream impacts on groundwater quality and surface water quality (at closest perennial water) have been analyzed.
- If the above understanding is correct, then portions of these comments related to AZPDES discharge are not valid to be considered.

Second question: What impaired waters did we disclose in the DEIS, and were they appropriate?

- Impaired waters are shown in the DEIS on figure 3.7.2-3 (p. 359) and they are listed on p. 367-370.
- We relied on the 2018 303(d) list (ADEQ 2018a in the DEIS references).
    - Queen Creek, from headwaters to Superior Wastewater Treatment Plant discharge. Impaired for dissolved copper (since 2002), total lead (since 2010), and total selenium (since 2012).

- Two unnamed tributaries to this reach are also impaired for dissolved copper (since 2010).
- Queen Creek, from Superior Wastewater Treatment Plant discharge to Potts Canyon. Impaired for dissolved copper (since 2004).
- Queen Creek, from Potts Canyon to Whitlow Canyon. Impaired for dissolved copper (since 2010).
- Arnett Creek, from headwaters to Queen Creek. Impaired for dissolved copper (since 2010).
- Gila River, from San Pedro River to Mineral Creek. Impaired for suspended sediment (since 2006).

- "Of these, the only two reaches with the potential to receive additional pollutants caused by the Resolution Copper Project are Queen Creek below the Superior Wastewater Treatment Plant, due to runoff or seepage from Alternatives 2, 3, and 4, and the Gila River from the San Pedro River to Mineral Creek, due to runoff or seepage from Alternative 6."
- Considering the impairment to Queen Creek above the TSF discharges (copper, lead, selenium) is not valid, as nothing related to the mine is impacting these waters (Note: see question #3).
- Considering the impairment to Arnett Creek is not valid, as nothing related to the mine is impacting these waters.
- The appropriate impaired water reaches to analyze are for dissolved copper in Queen Creek, and suspended sediment in the Gila River, both of which were analyzed in the DEIS.

Third question: What are the appropriate flow volumes to use?

- The approach taken in the DEIS used median flow values, and a rationale was given for that choice. However, it is valid to at least discuss alternative approaches.

Fourth question: Was the analysis of impaired waters, assimilative capacity, and potential surface water degradation appropriate?

- Again, a rationale was given for the approach taken in the DEIS, but this is an important question, and it is valid to at least discuss alternative approaches.

Approach Taken in DEIS – Use of Median Flow Values

- "For comparisons against surface water standards, median flow values were used which is appropriate when replicating baseflow. Concentrations during runoff events would be expected to be lower due to dilution from stormflows. However, it should be noted that lower flow conditions can occur during the year that would not be reflected by median flow conditions, and for some constituents like copper, studies suggest that stormflows might increase in copper concentrations (Louis Berger Group Inc. 2013)." (p. 361)

- "The calculation of assimilative capacity also depends on specific "critical flow conditions." One technique (often called 7Q10) is to choose the lowest flow over 7 consecutive days that has a probability of occurring once every 10 years. By contrast, the seepage modeling in the EIS uses the median flow for surface waters, which is a common method of estimating baseflow conditions, because it tends to exclude large flood events. While assessing typical baseflow conditions (using the median flow) were determined to be the most appropriate method for the EIS disclosure, ADEQ could choose to apply different flow conditions during permitting." (p. 365, footnote 46)

We felt the disclosure needed to reflect baseflow conditions, not storm events, and median flow values are one widely accepted way to estimate baseflow conditions in ephemeral streams. We felt using median flow values was a conservative approach (i.e., tends to overestimate the impact of TSF seepage not underestimate it), because large storm events would dilute any impact from seepage.

We indeed could have used more extreme low flow values, as ADEQ might choose to do. However we felt our disclosure requirement was not the same as ADEQ's and median values were more appropriate to normal conditions.

Approach Taken in DEIS - Impaired waters/assimilative capacity/degradation

The difference between the ADEQ permitting framework and the Forest Service disclosure requirements is clearly spelled out (at length) in the DEIS (p. 363-364):

> " While the permitting process provides an assurance to the public that the project would not cause impacts on water quality, it does not relieve the Forest Service of several other responsibilities:
>
> - The Forest Service has a responsibility to analyze and disclose to the public any potential impacts on surface water and groundwater as part of the NEPA process, separate from the State permitting process.
> - The role of the Tonto National Forest under its primary authorities is to ensure that mining activities minimize adverse environmental effects on NFS lands and comply with all applicable laws and regulations. As such, the Forest Supervisor ultimately cannot select an alternative that is unable to meet applicable laws and regulations. However, it may be after the EIS is published when permits are issued by ADEQ that demonstrate that the project complies with state laws. In the meantime, it would be undesirable for the Forest Service to pursue and analyze alternatives that may not be able to comply. Therefore, a second goal of the analysis in this EIS is to inform the Forest Supervisor of alternatives that may prove difficult to permit.
>
> The analysis approaches used by the Forest Service in this EIS likely differ from those that ADEQ would use in assessing and issuing permits. ADEQ would use the assumptions, techniques, tools, and data deemed appropriate for those permits. The Forest Service has selected to use a series of simpler mixing-cell models to provide a reasonable assessment of potential water quality impacts that is consistent with the level of hydrologic and geological information currently available for the alternative tailings sites. This approach is sufficient to provide the necessary comparison between alternatives and assess the relative risk of violation of water quality standards. It is understood different analysis may be conducted later when ADEQ is reviewing permit applications for the preferred alternative.
>
> There are two specific additional aspects of the analysis in this section of the EIS that have a bearing on the ADEQ permitting process: assimilative capacity, and impaired waters."

The DEIS then goes on to discuss both the analysis of changes in assimilative capacity and impaired waters. In essence:

- For assimilative capacity there are many aspects of the ADEQ permitting process that are unanswered, including whether a discharge of seepage would even require analysis of assimilative capacity (keep in mind, it's an APP, not an AZPDES permit). The DEIS takes this approach: "In other words, neither the regulatory need to assess assimilative capacity, nor the consequences of exceeding the 20 percent threshold can be assessed outside of a specific permitting decision by ADEQ. Regardless, the Forest Service responsibility for the DEIS is to disclose possible water quality concerns. This includes the reduction assimilative capacity of a perennial water. For this purpose, a threshold of 20 percent loss in assimilative capacity is used."

- For impaired waters, we have a similar problem—how ADEQ would even consider seepage discharges in a permitting process is completely unknown. The DEIS takes this approach: "For the purposes of disclosure, the Forest Service approach in the EIS is to identify what surface waters have been determined to be impaired, where contaminants from the project could enter these surface waters and exacerbate an already impaired water, and the estimated loading for constituents associated with the impairment."

Need to Change DEIS Approach – Initial Take

- These questions should be approached as what is appropriate for disclosure under NEPA, not trying to replicate any kind of ADEQ permitting process.

- Because the concern is seepage at a steady rate, the choice to model baseflow conditions instead of stormflow conditions remains appropriate for NEPA disclosure, to avoid dilution effects. Notwithstanding that there are arguments that dissolved copper could increase during stormflow (because it is elevated in the watershed), as well as arguments that the subsidence crater in Oak Flat takes out a large portion of the watershed shown to be most elevated in copper.

- The use of median flow values appropriately models baseflow conditions. <u>The question is: is there a rationale for modeling more extreme low-flow conditions for a NEPA disclosure?</u>

- Aside from the appropriate flow values to use in the calculations, the overall analysis of impaired waters and assimilative capacity seems appropriate to address impacts of concern, but not tread into ADEQ's jurisdiction of permitting discharges.

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)	Received 4/7/2020; circulated to workgroup 4/9/2020
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
1/23/2020	WR-8 (RCM): Skunk Camp modeling presentation – March 26 Water working group	Now scheduled for May
1/23/2020	WR-9 (RCM): Springs Inventory 3.0 (April)	Received on 4/22 3:08pm – will send to work group on 4/23
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 process, likely to provide in May
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 - DONE

Date Assigned	Action Item	Resolved
1/23/2020	WR-12 (RCM): pull well records and other information for QV and think of ways to model the impacts	Received 4/22 9:41pm will be sent to work group on 4/23
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 3/23/2020; circulated to workgroup 3/25/2020 – DONE
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	Still in process – New Steps to be created on 4/23 for BGC review
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.	Resolution presented on 4/23 – will provide slides
2/20/2020	WR–16 (RCM): Provide usage numbers for ESRV for comparison to RCM pumping	Resolution presented on 4/23 – NEW Deliverable – Provide a 2-page tech memo memorializing the tables & summary of the information with references back to the larger report already submitted.
2/20/2020	WR-17 (TNF): Follow up with ADWR on ESRV model update approval.	Received 4/9/2020; additional follow-up possibly to be received from RCM
2/20/2020	WR-18 (BGC): Review SRV model and purpose memo on M&A extension and appropriateness of model	Still in process – in May ** 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 3/17/2020
2/20/2020	WR-20 (RCM): Provide input on potential for stormwater release and estimate of quality. Focus on operations.	In process – may present in May if time allows
2/20/2020	WR-21 (M&A): Estimate remaining water in aquifer at several snapshots in time.	Resolution presented on 4/23 – NEW Deliverable – Provide a 2-page tech memo memorializing the tables & summary of the information with references back to the larger report already submitted.

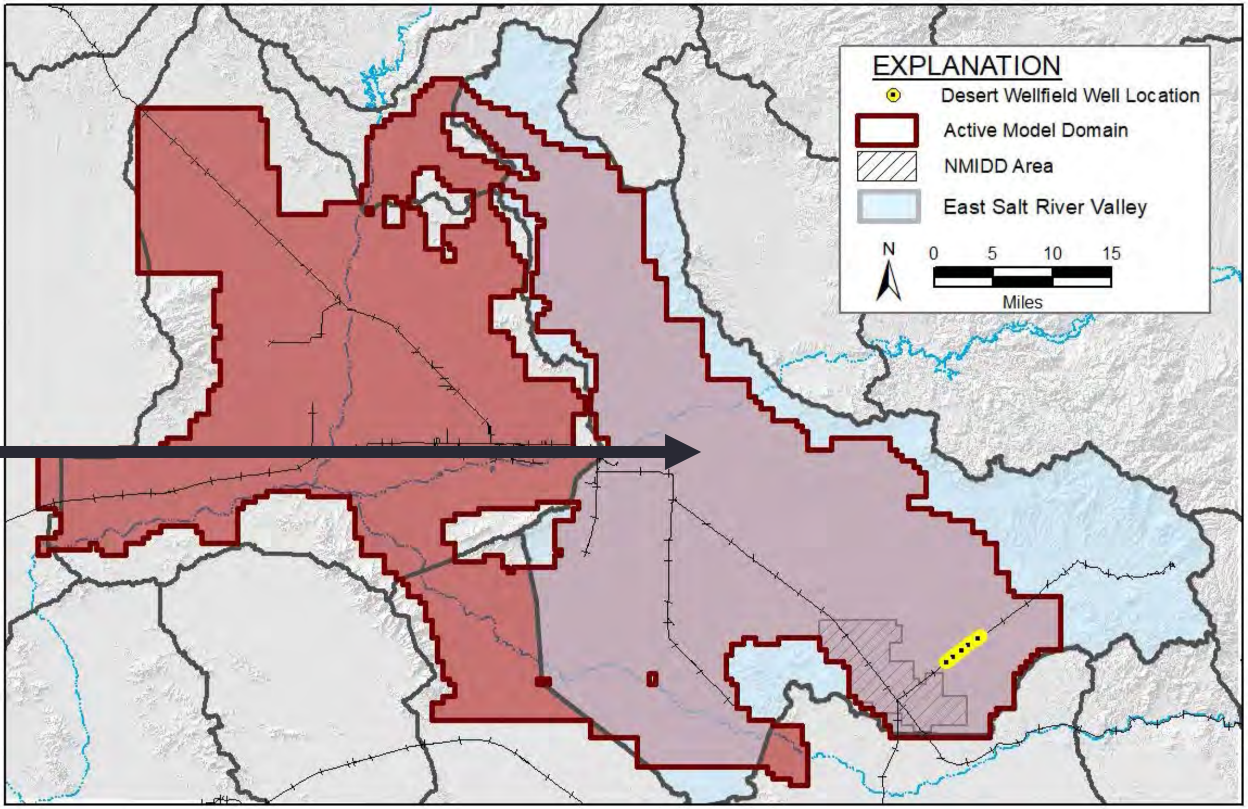
Date Assigned	Action Item	Resolved
3/26/2020	WR-22 (RCM): Information on modeled gradients near block cave over time; verify hydraulic containment will occur	Received on 4/22 – will send to work group
3/26/2020	WR-23 (RCM): Kate send contingency information for Design of Facility able to handle varying percentage split between pyrite/scavenger tailings.	In process – should see in May
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	Received Part 1 on 4/7/2020; circulated to workgroup 4/9/2020 Additional information on Part 1 received 4/17/2020; circulated to workgroup 4/21/2020 Check with Vicky if any other information exists
3/26/2020	WR-26 (M&A): provide GIS layer of springs and wells	In process – to be sent in April
4/23/2020	WR-27 (RCM): Document current conditions and expected conditions of discharge under AZPDES and exploration of discharges during transitional times of mine life.	
4/23/2020	WR-28 (M&A): Determine low flow from 7Q10 for low flow and how that would affect over median flows. Minimum for Alt 6, maybe for Alt 5.	
4/23/2020	WR-29 (SWCA): Distribute BGC Prucha responses for consideration with WSP Prucha responses; categorize comments for future discussion	

100-Year Drawdown Analysis for Desert Wellfield Pumping – Additional Data

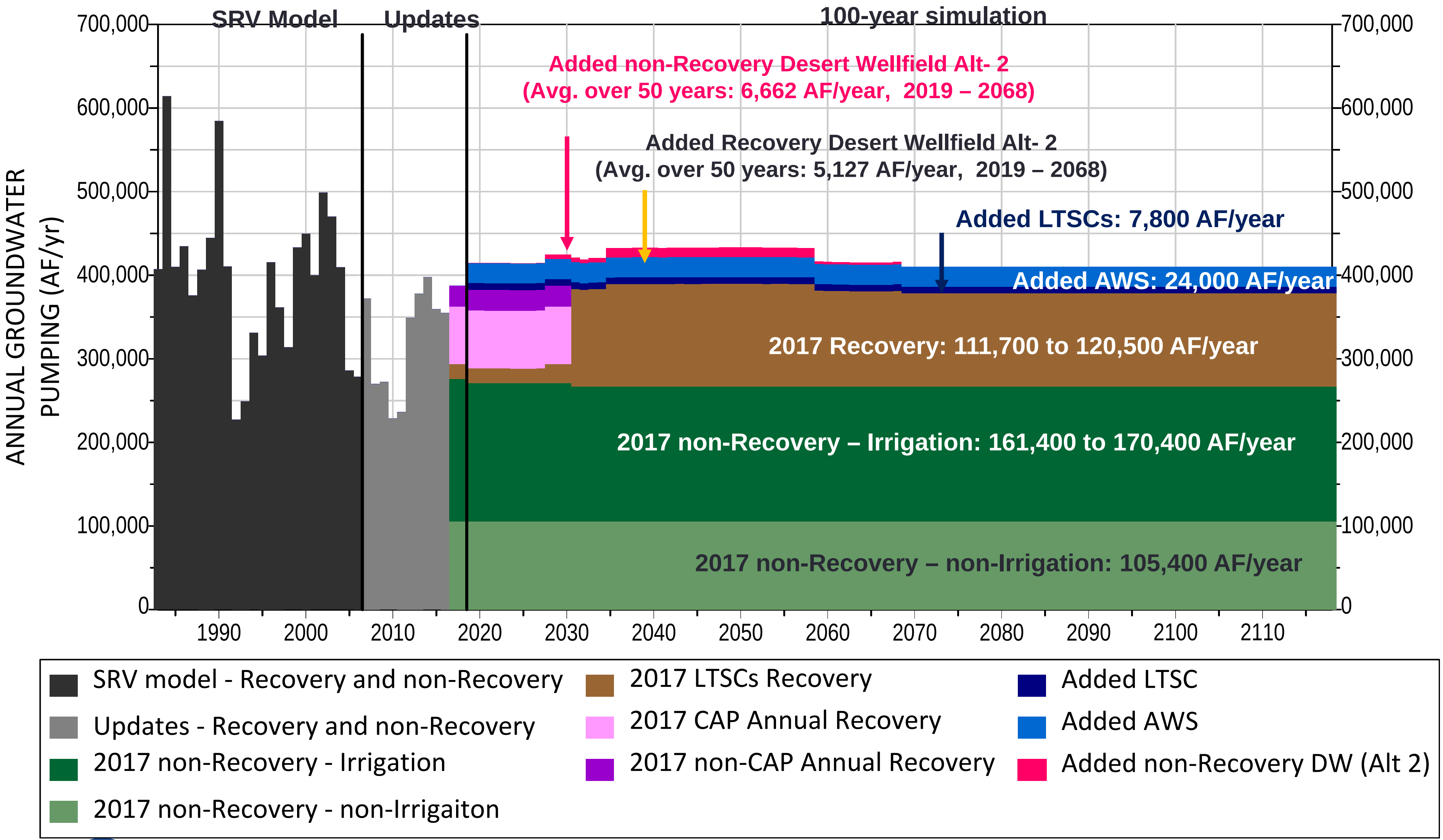
Resolution Copper | April 23, 2020

ESRV Sub Basin Map

Portion of East Salt River Valley Sub basin in SRV model



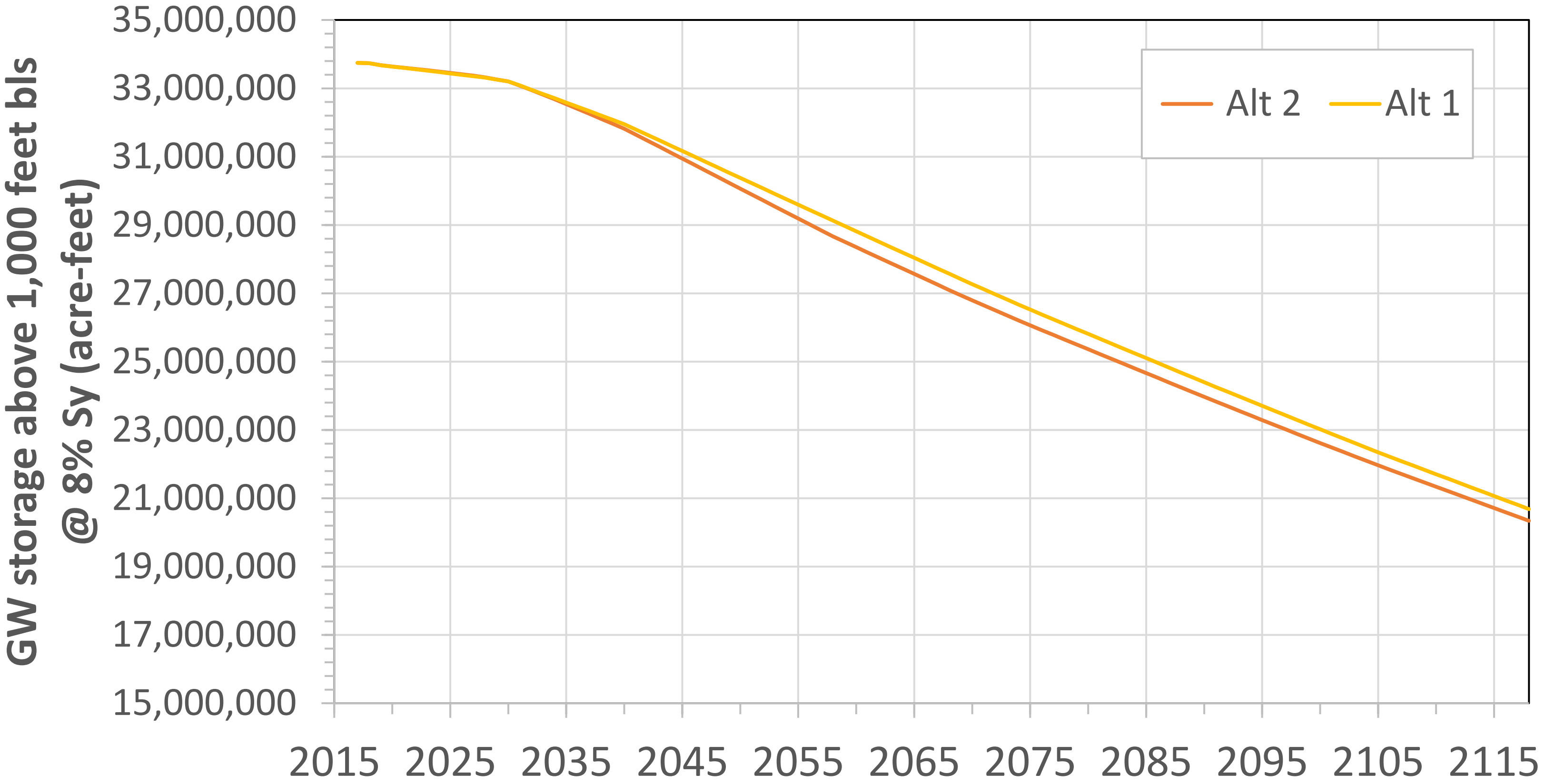
Simulated Pumping Summary for ESRV



Comparison of ESRV Pumping and DW pumping

Simulated Year Range	Total ESRV non-DW pumping		Alt-2 recovery		Alt-2 non-recovery	
	Volume (AF)	%	Volume (AF)	%	Volume (AF)	%
At maximum Drawdown 2019-2058 (40 years)	16,463,048	*96.8%*	236,437	*1.4%*	307,243	*1.8%*
End of DW Pumping 2019-2068 (50 years)	20,567,136	*97.2%*	256,338	*1.2%*	333,103	*1.6%*
End of 100-year Simulation 2019-2118 (100 years)	41,087,786	*98.6%*	256,338	*0.6%*	333,103	*0.8%*

Groundwater in storage above 1,000 feet bls in ESRV



Resolution Copper
Desert Wellfield and Potential Subsidence

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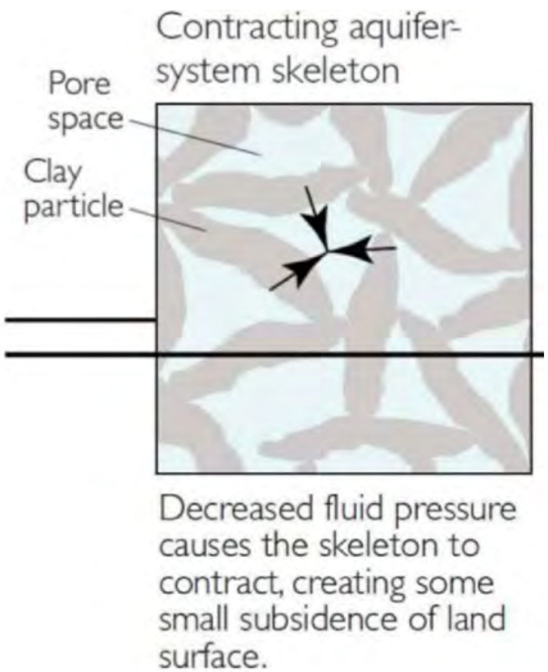
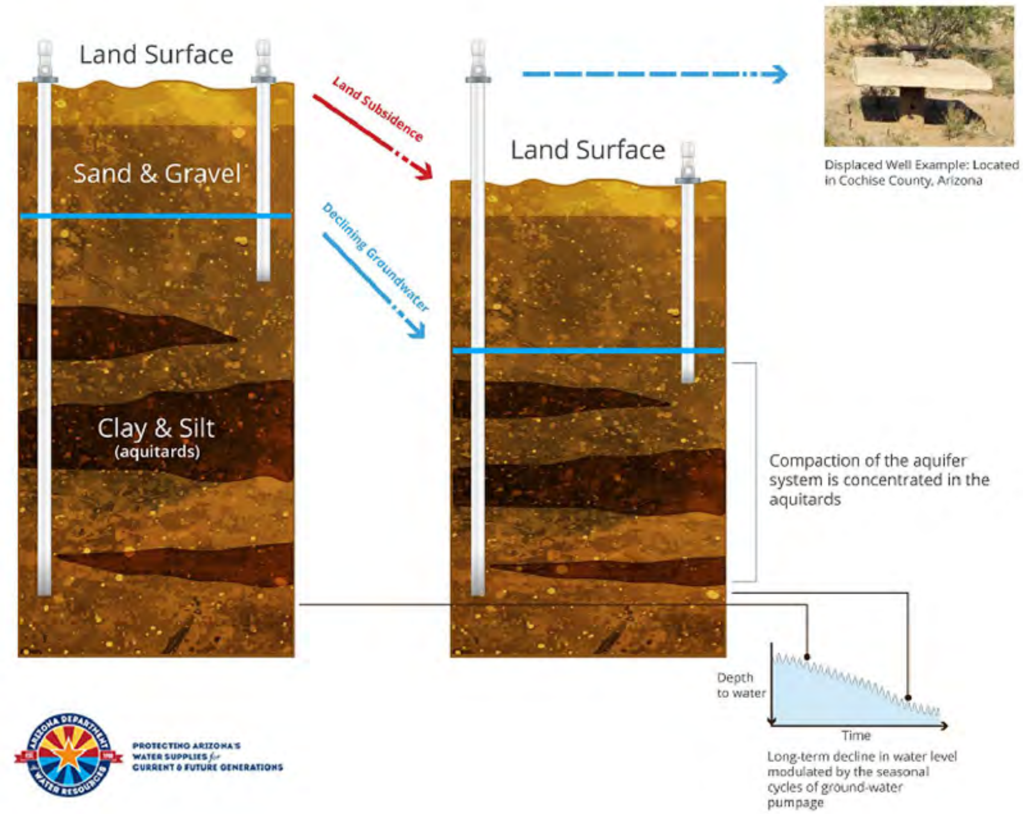
Resolution Copper | April 23, 2020

What Causes Subsidence?

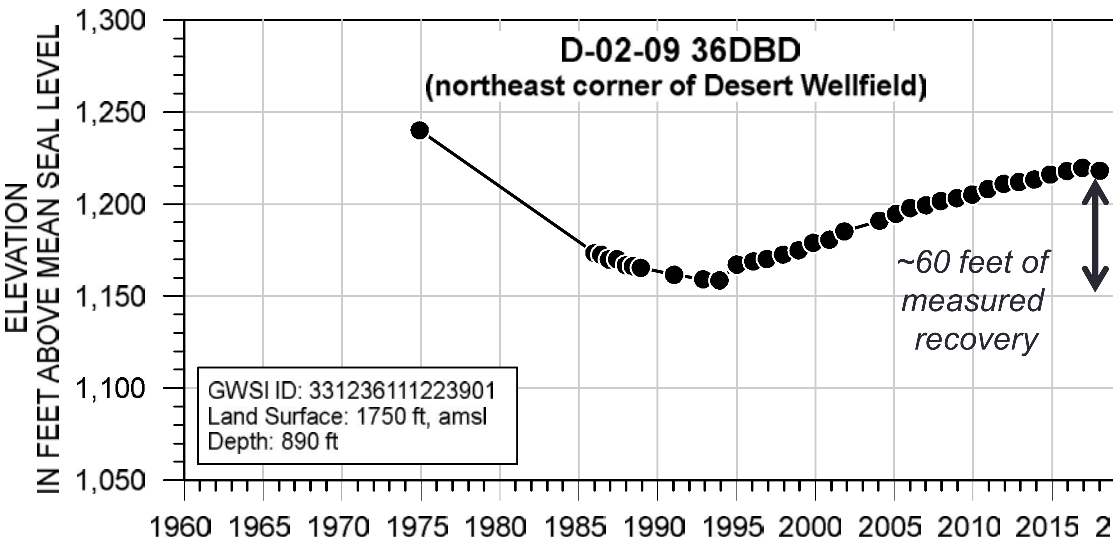
- Pumping reduces fluid pressure in pore spaces
- Results in reduction in support for “skeleton” of aquifer

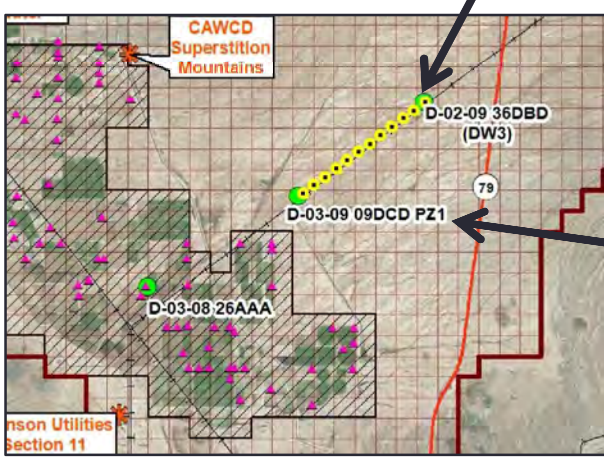


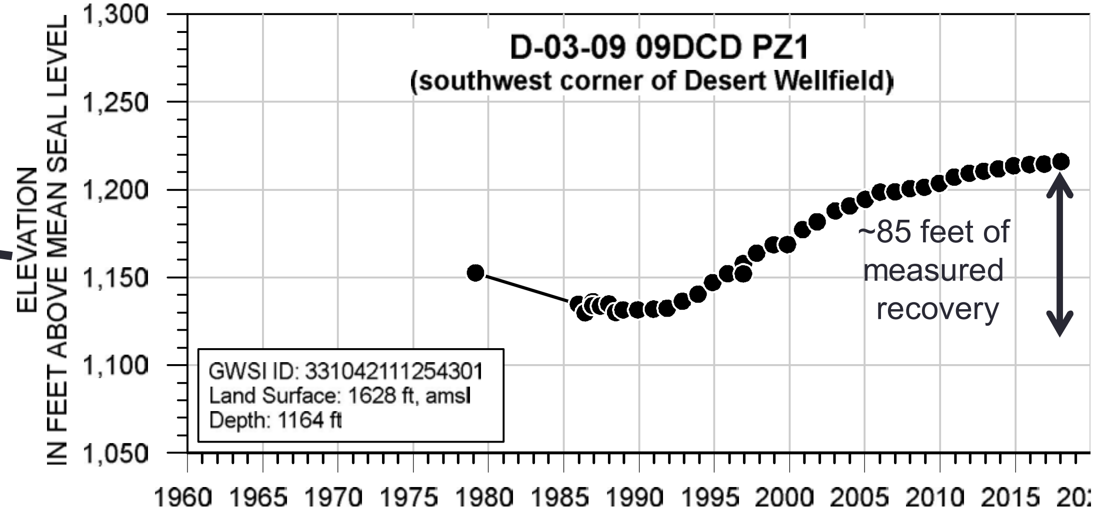


- Can range from 0.5% to 20% of head reduction

Historic Recovery in Desert Wellfield

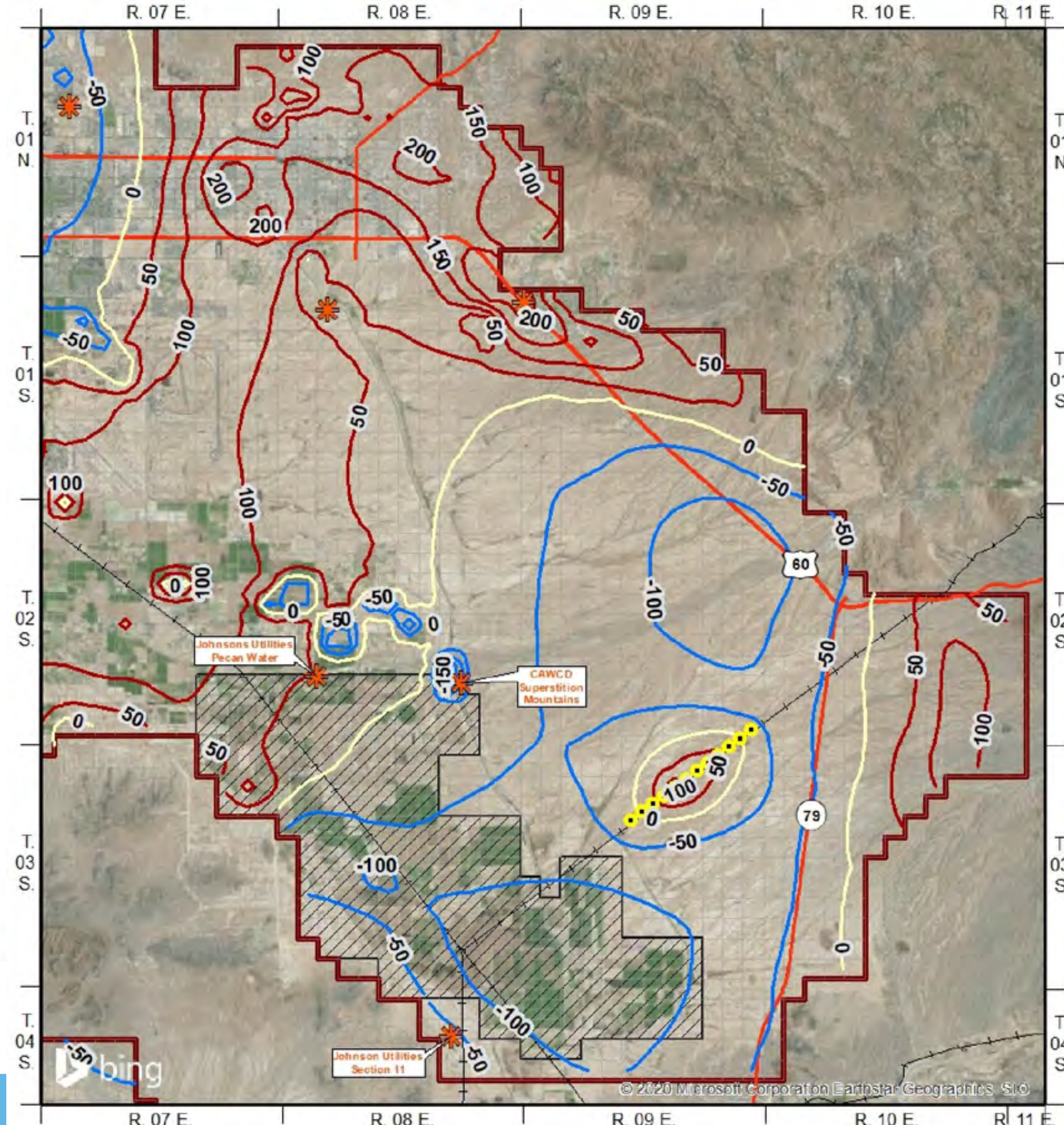






1983 & 2058 Alt 2 GW Levels Comparison

About 100 feet of additional (new) drawdown



EXPLANATION

- Desert Wellfield Well Location
- Underground Storage Facility
- Active Model Domain
- NMIDD Area

Simulated 1983 Water Level minus Alt-2 Projected 2058 Water Levels

- negative values indicate rise
- zero indicates no change
- positive values indicate drawdown

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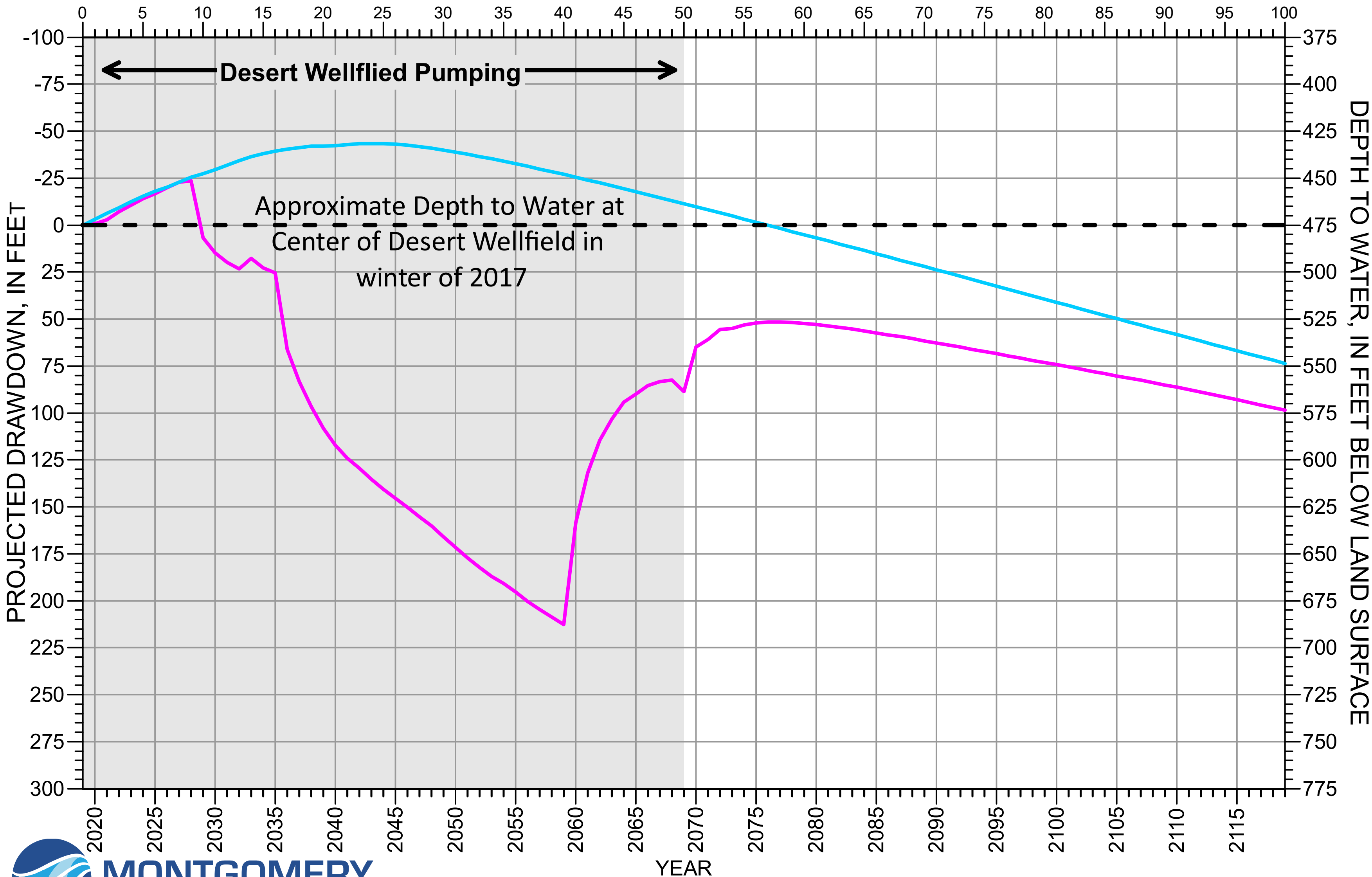
Aquifer storage



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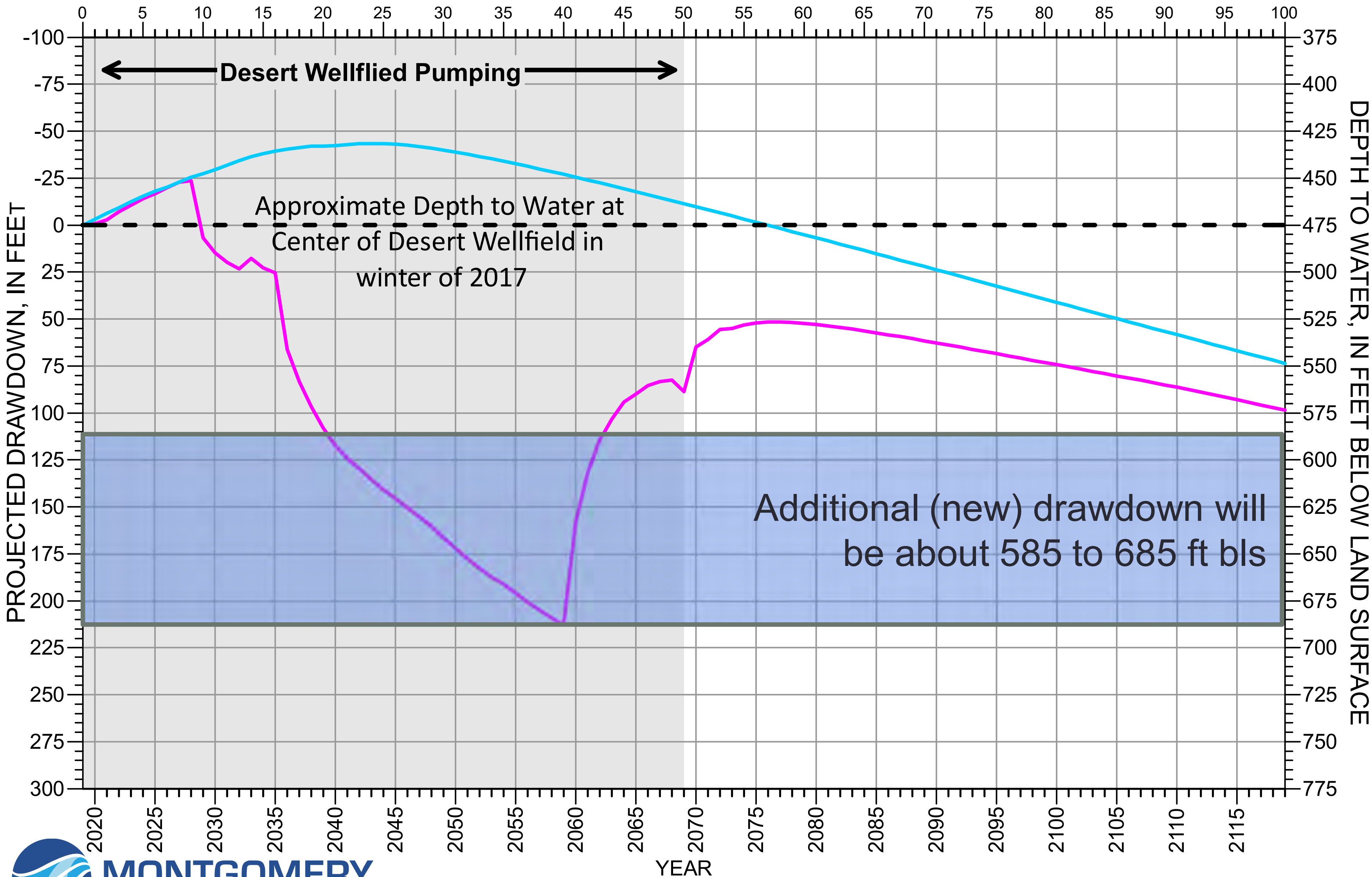
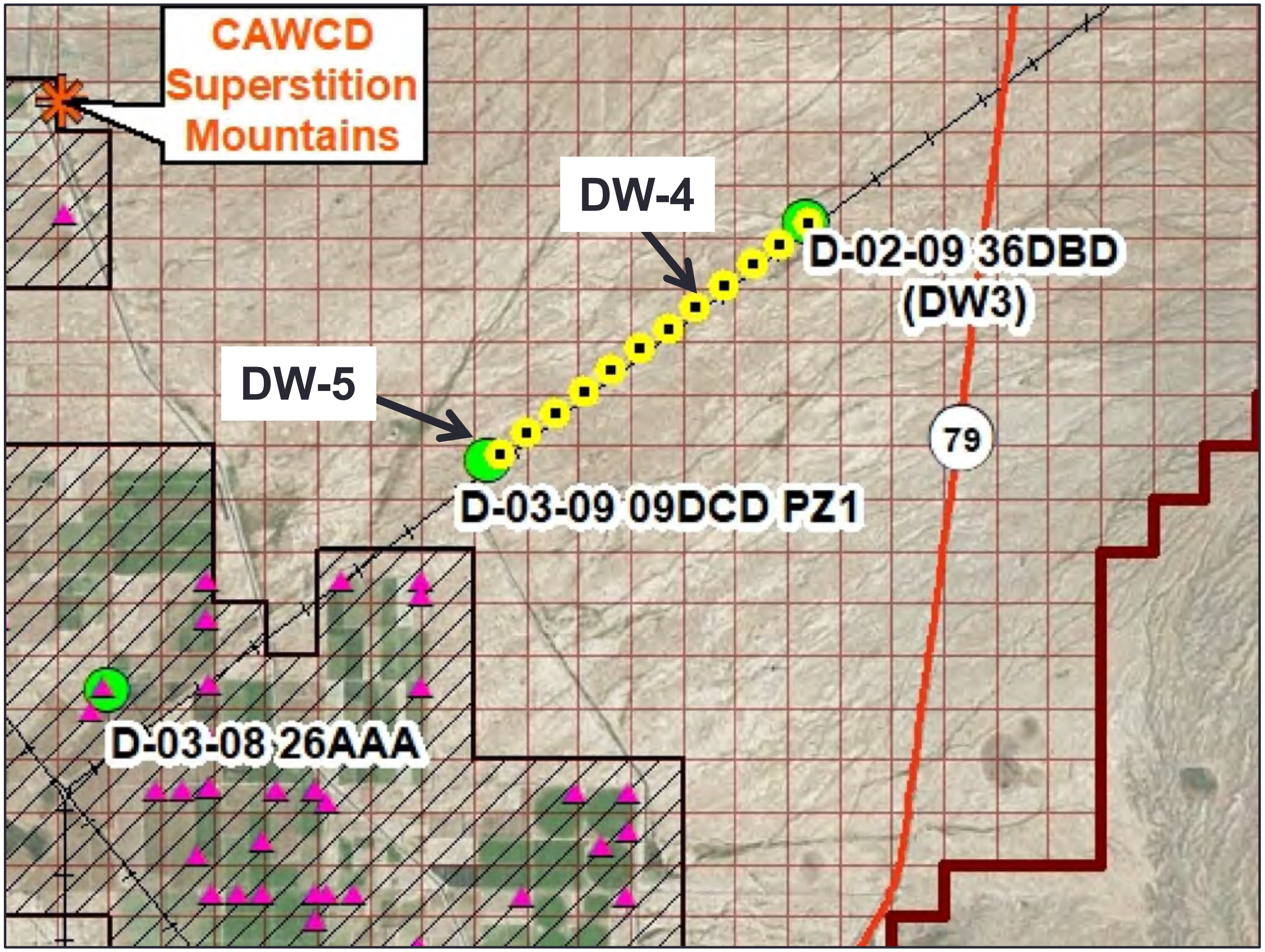
Aquifer storage



What is QTg like 585-685 ft bls?



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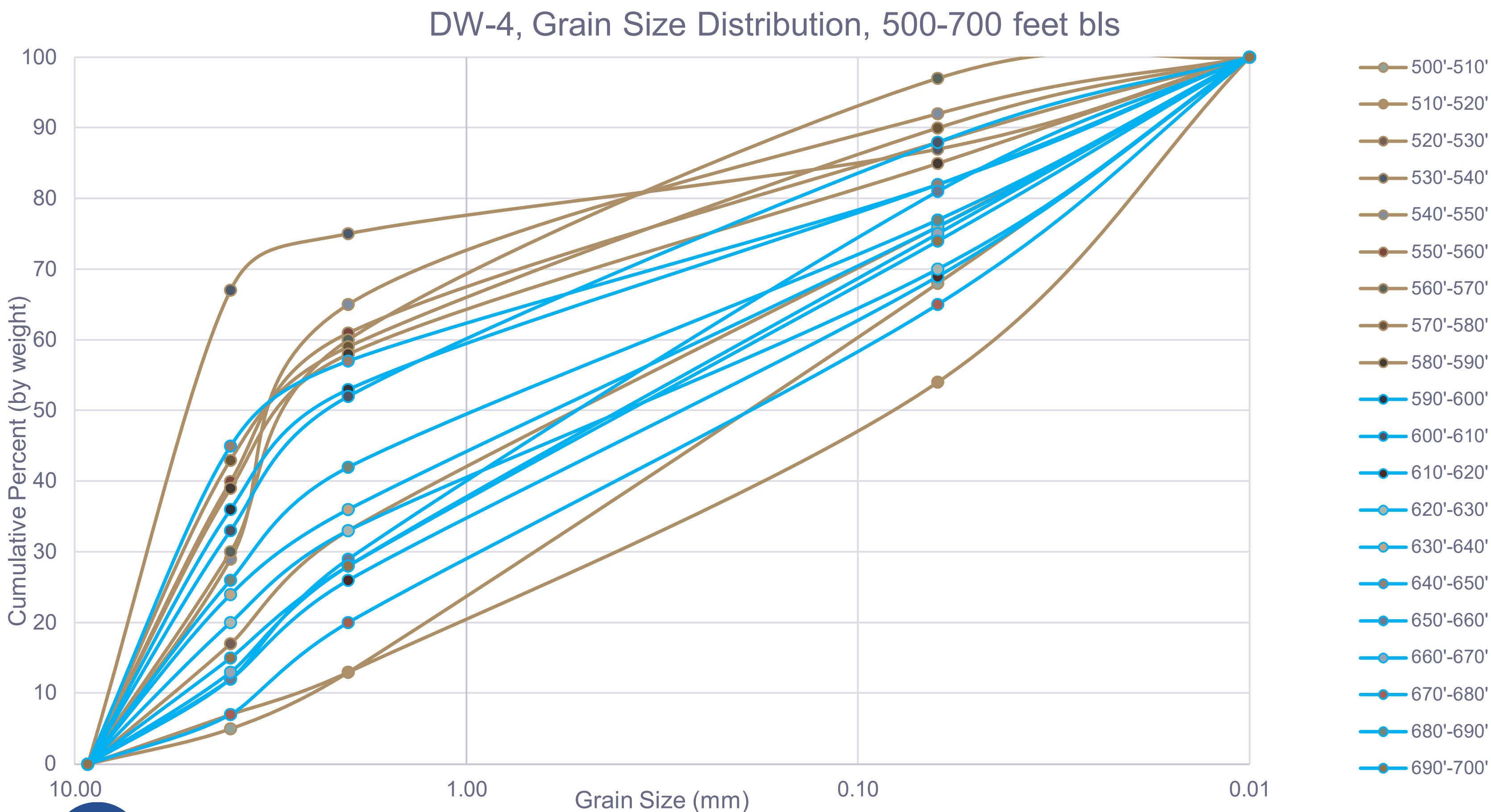
DW-4

- Lower fines content - less subsidence in northeast



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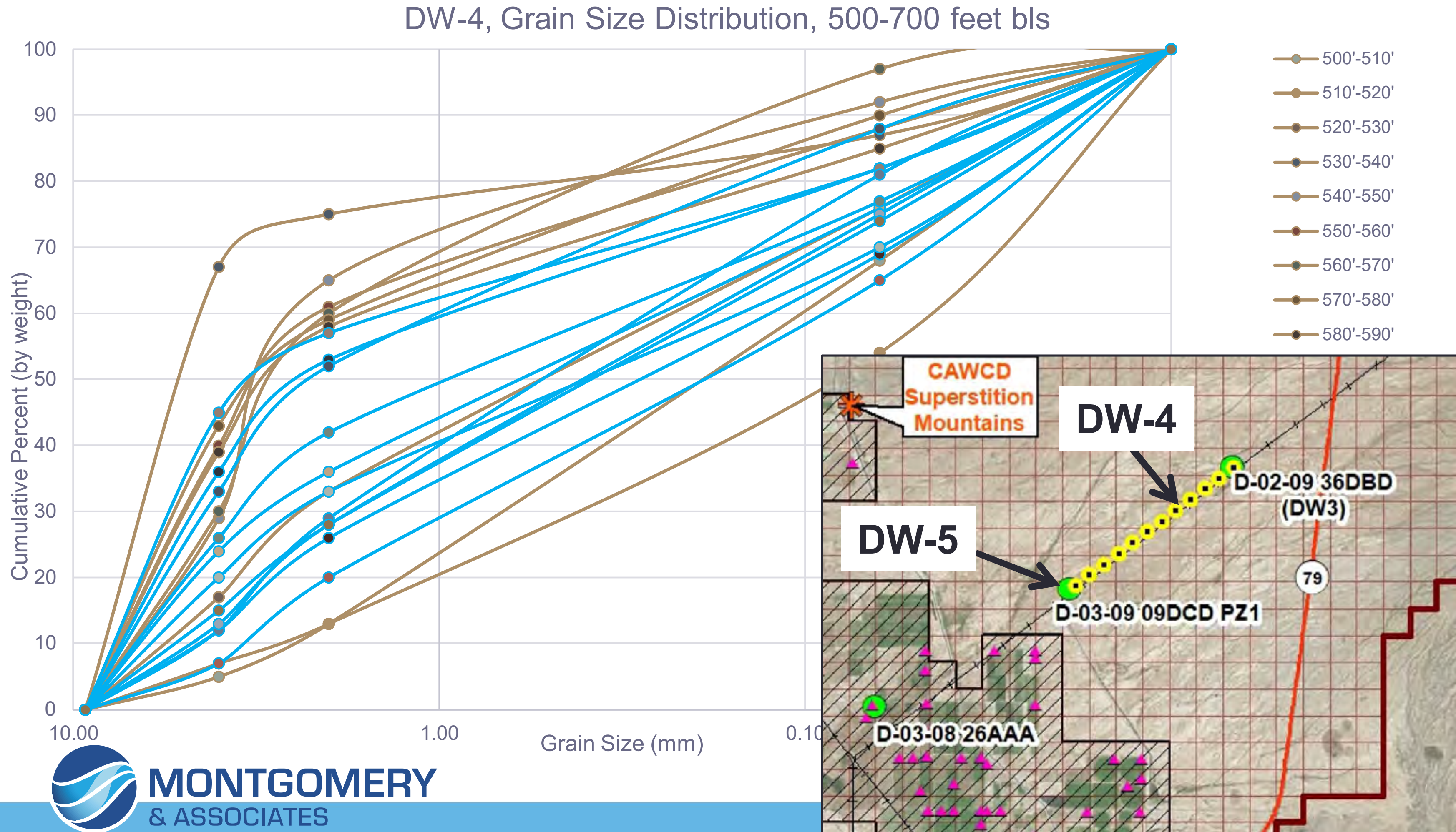
DW-4

- Lower fines content - less subsidence in northeast



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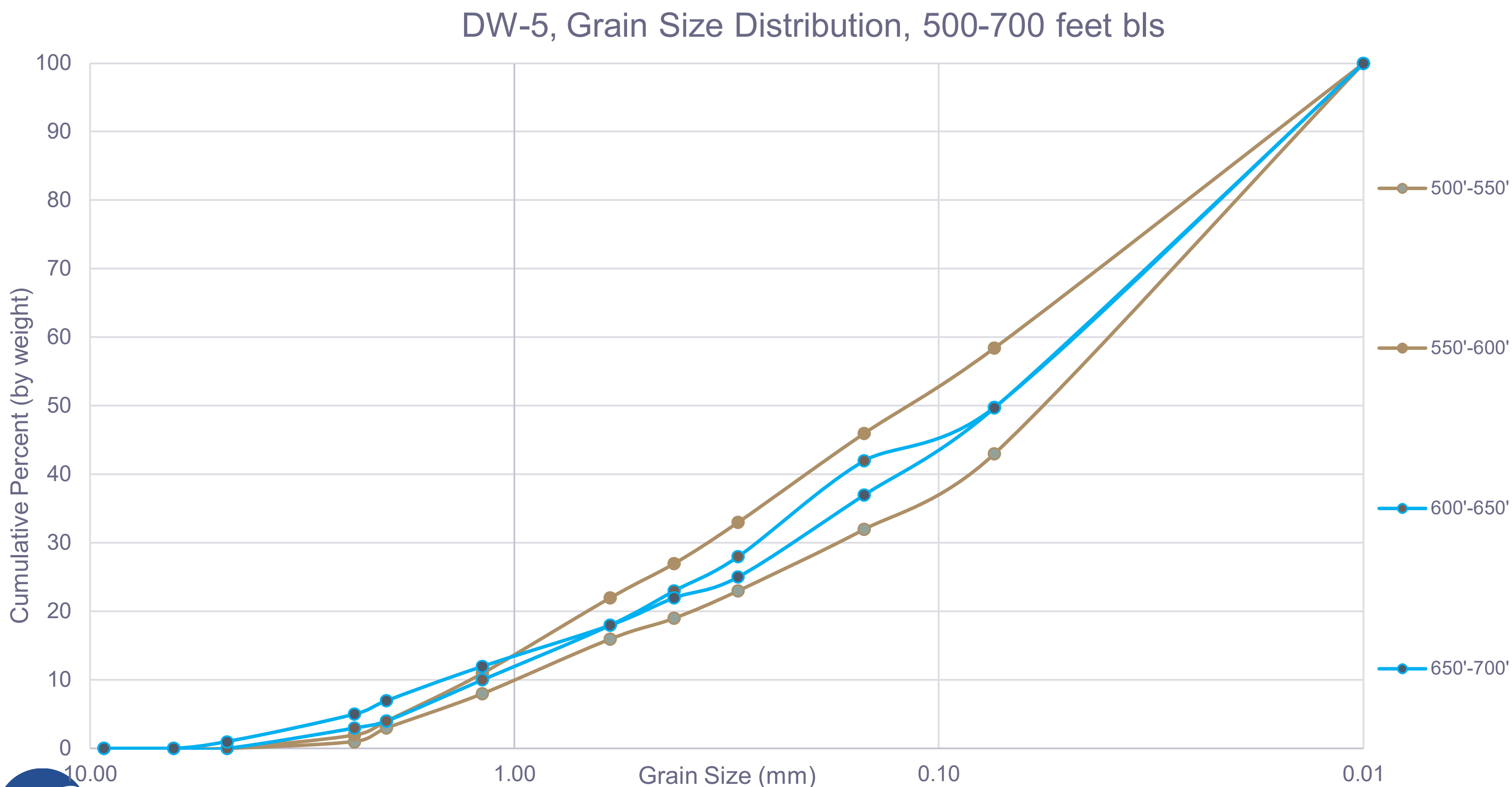
DW-5

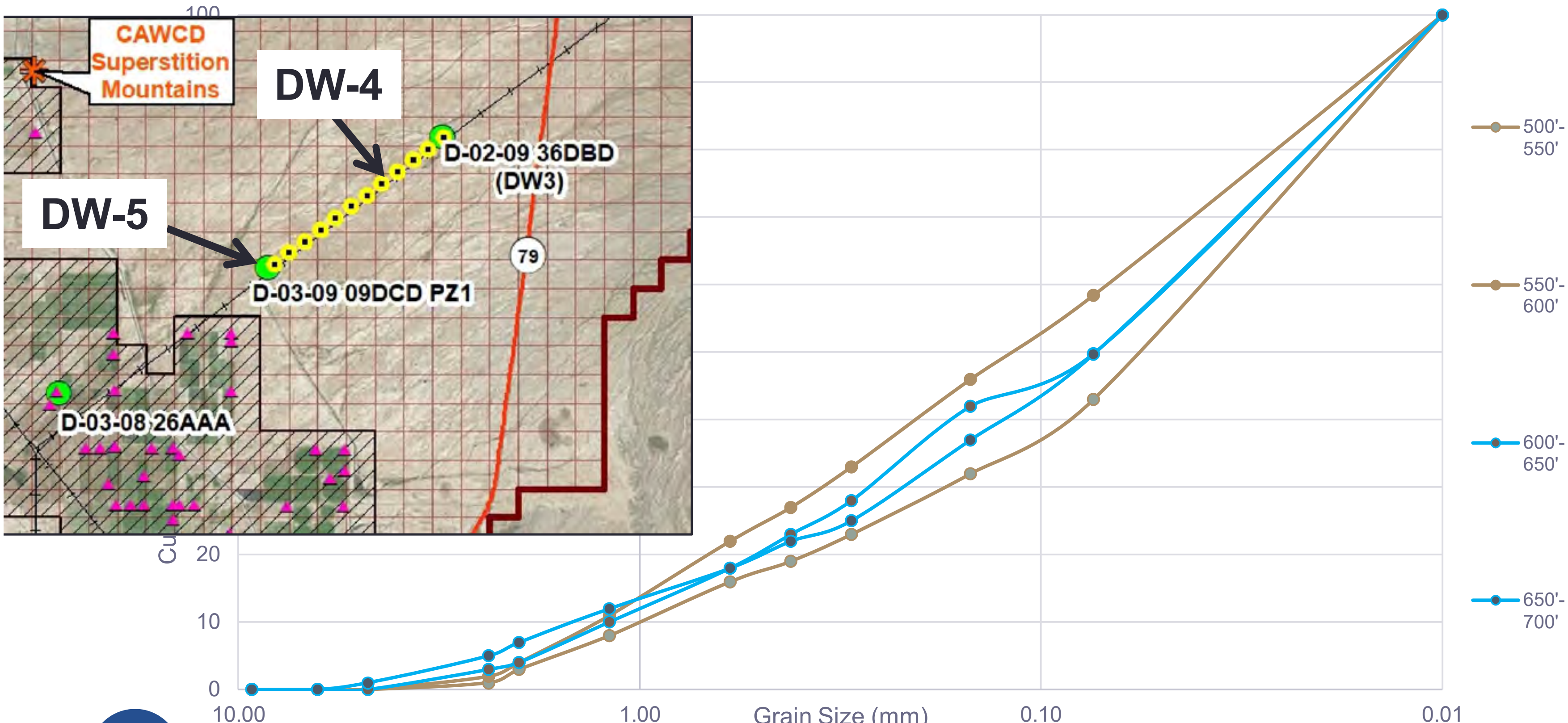
- Higher fines content - more subsidence in southwest



DW-5

- Higher fines content - more subsidence in southwest

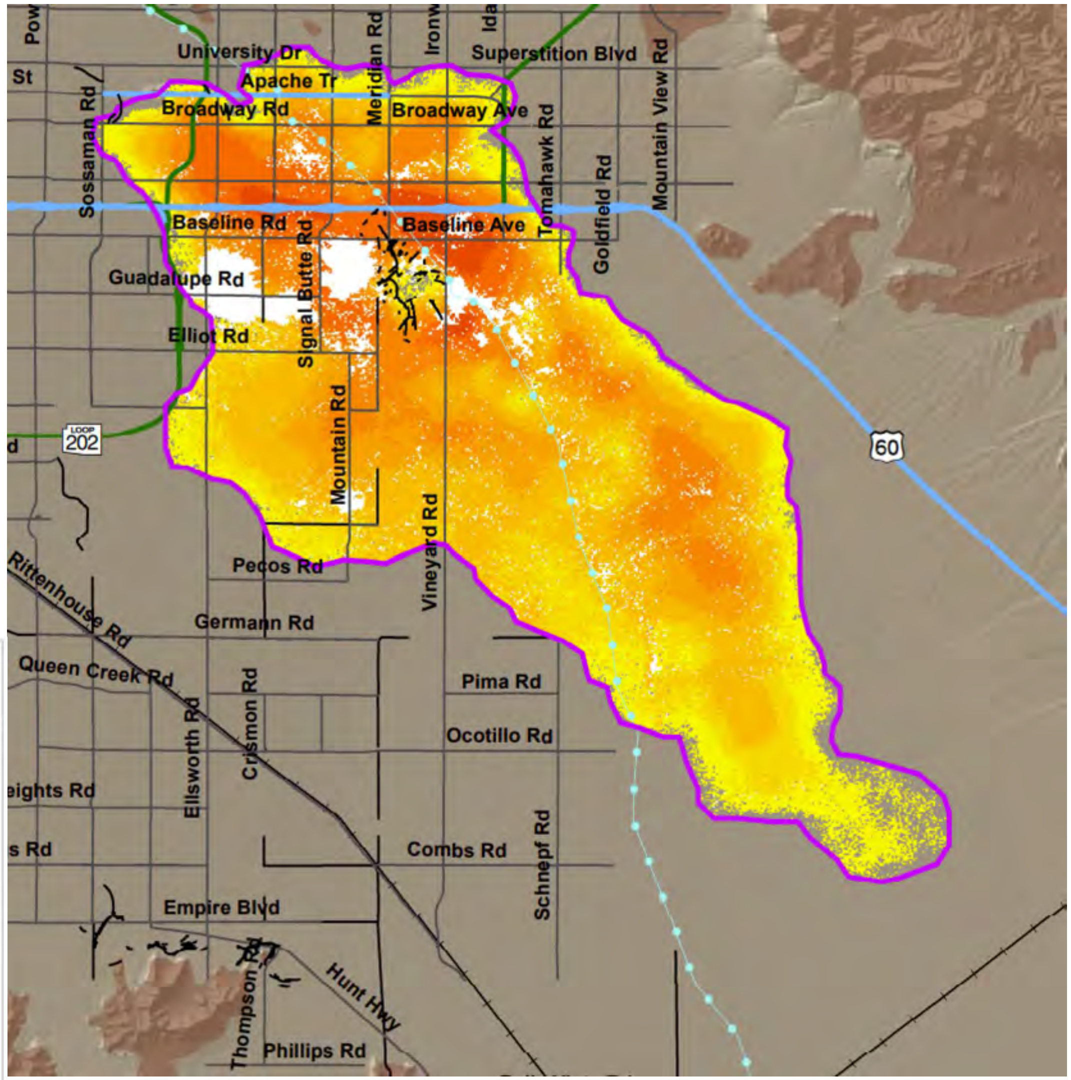
DW-5, Grain Size Distribution, 500-700 feet bls

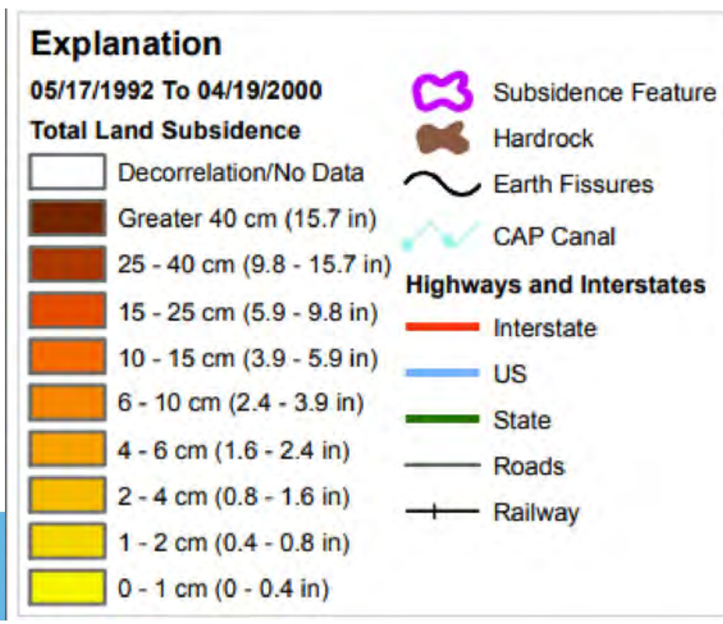


MONTGOMERY & ASSOCIATES
Water Resource Consultants

Hawk Rock Subsidence Area 1992-2000

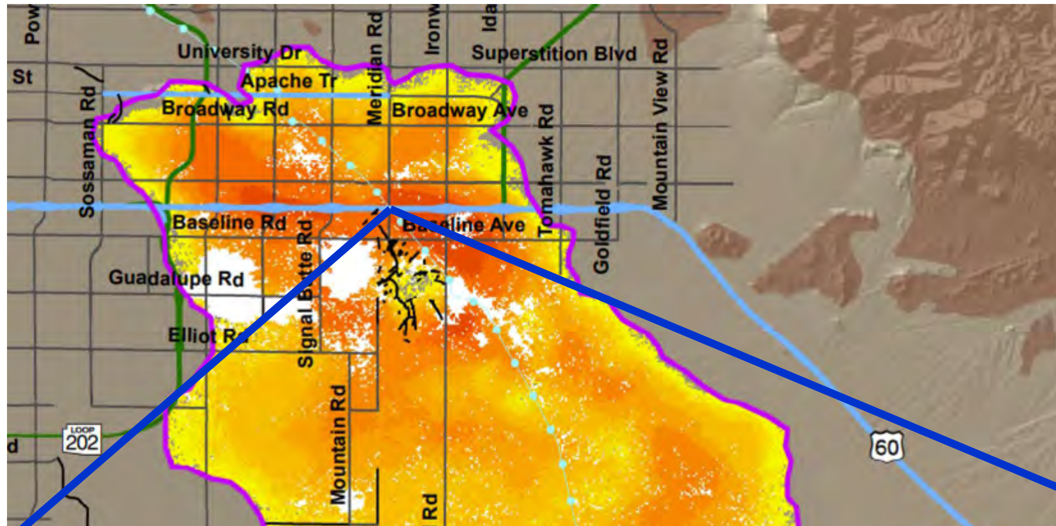
- Subsidence ranging from 0-9.8 inches

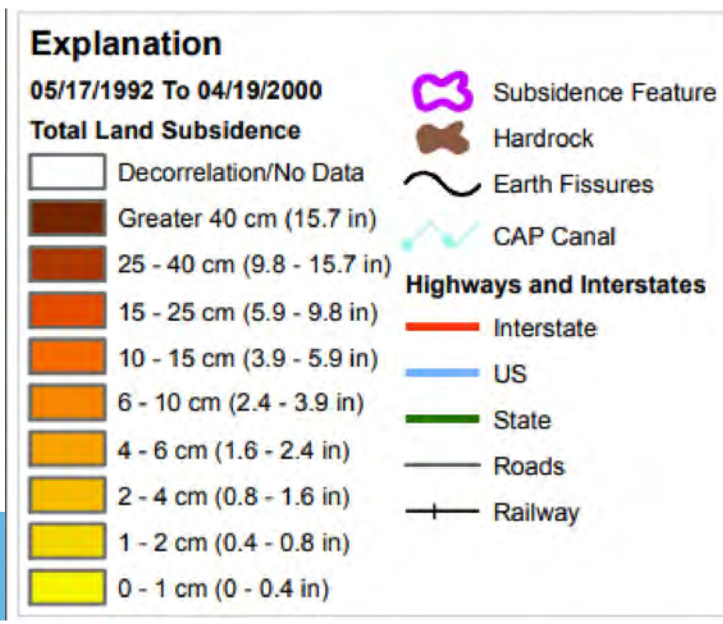




Hawk Rock Subsidence Area 1992-2000

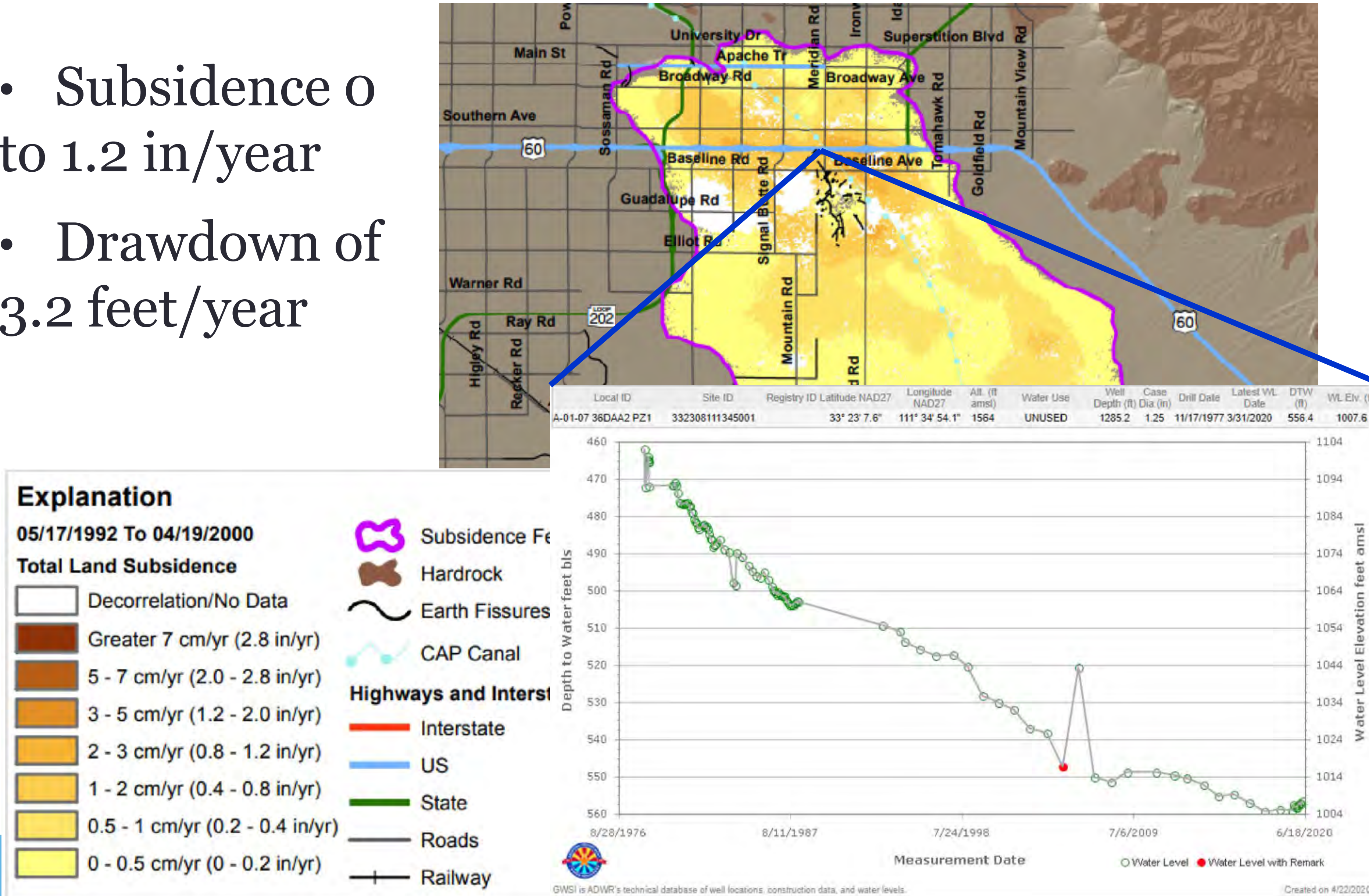
- Subsidence ranging from 0-9.8 inches
- Drawdown of 86 feet from 1977-2004





Hawk Rock Subsidence Rate 1992-2000

- Subsidence 0 to 1.2 in/year
- Drawdown of 3.2 feet/year



Subsidence Conclusions

- Desert Wellfield projected to cause about 100 feet of "new drawdown" in center of wellfield
- Magnitude of subsidence is highly variable depending on fines content, amount of drawdown, and overburden
  - Likely to be worse in SW than NE
- Hawk Rock area in same basin is reasonable analog
  - Subsidence rates ranged from 0 to 1.2 inches per year during period of significant drawdown

MEMO

TO: Greg Ghidotti, Resolution Copper

FROM: Gustavo Meza-Cuadra, Chris Pantano (WSP)

SUBJECT: Response to Integrated Hydro Systems Review

DATE: March 23, 2020

Integrated Hydro Systems, LLC (IHS) produced the document *Review of Hydrologic Impacts in the Draft Environmental Impact Statement Resolution Copper Project and Land Exchange August 2019 (IHS 2019)*, included as Appendix E of the Arizona Mining Reform Coalition (AMRC) document *Comments on Resolution Copper DEIS (AMRC 2019).* The Tonto National Forest has requested that Resolution Copper provide data and analysis which can be considered by the Forest Service in reviewing the IHS comments and Resolution has, in turn, requested assistance from WSP. In this document, WSP provides a summarized list of the primary comments with regards to the regional groundwater model, and then details responses to these.

For organizational purposes, WSP has structured the document to correspond with the primary components of the review and organized similar issues together. The sections are summarized as follows:

- Modeling Approach
- Code Selection
- Conceptual Model Development
- Model Setup
- Model Calibration
- Predictive Model Results

Throughout the following document, several references are made with respect to the United States Forest Service (USFS) Groundwater Working Group. The USFS Groundwater Working Group was assembled during the EIS process to collaboratively discuss numerous topics as related to groundwater and the development of the project, including the numerical flow modeling. The USFS Groundwater Working Group was led by the United States Forest Service and consisted of technical representatives of the Forest Service, including its NEPA contractor SWCA, EPA, other state and federal agencies, a representative from the San Carlos Apache Tribe and other associated consultants working on the Resolution Copper EIS.

Several topics raised by IHS were discussed in USFS Groundwater Working Group meetings prior to publication of the Draft EIS (DEIS). Decisions were made by the USFS after consideration of information provided and discussion by the Groundwater Working Group on the regional groundwater modeling efforts and associated disclosures with respect to groundwater impacts.

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Those decisions were described in process memo *Water Resource Analysis: Assumptions, Methodology Used, Relevant Regulations, Laws, Guidance, and Key Documents (Newell 2018d)* and *Draft EIS for Resolution Copper Project and Land Exchange (USFS 2019) [Section 3.7]*. Topics addressed by the USFS Groundwater Working Group will be mentioned in the appropriate sections that follow.

MODELING APPROACH

A general theme of the IHS review is a philosophical difference of approach with respect to model complexity. IHS makes repeated claims that simulating additional physical processes and incorporating more parameters is required for improving accuracy in the model and impact prediction. IHS recommends resolving this issue via use of other model code(s) and/or incorporation of additional model packages.

Although complexity may appear to provide a more accurate result in theory, increased complexity could produce more uncertainty through the requirement of estimating additional parameters where limited or no data is available to justify values. A model can be extremely precise in its output; however, its accuracy will only be determined by how well its parameters are estimated and how well the physical processes are represented. The USFS, informed by discussions within the Groundwater Working Group, determined that a practical modeling approach was ideal and most appropriate in the NEPA context where the agency has to explain and disclose its reasoning to the public.

The performance of the regional groundwater model demonstrates that the modeling approach utilized for the DEIS is appropriate and accomplishes the purpose of assessing impacts to groundwater dependent ecosystems (GDEs). The arguments provided by IHS single out specific topics and offer alternative methodologies without consideration for the way in which the model and representative processes were collectively handled. If considered holistically, it is apparent the groundwater system is well represented by the model as supported by agreement with multiple lines of evidence, including but not limited to, hydraulic conductivity values, estimates of recharge, head levels, streamflow rates, dewatering rates, and responses to transient stresses. The following sections address the specific topics raised by IHS with context and documentation regarding the model decisions and model performance.

CODE SELECTION

A concern brought up by IHS is that no formal code selection process was performed. This is not true as is evidenced by a discussion regarding code selection in report *Resolution Copper Groundwater Flow Model Report (WSP 2019) [Section 3.1.2]* as well as acknowledgment in the model review contained in the process memo performed by BGC Engineering Inc. (BGC) and reported in *Review of Numerical Groundwater Model Construction and Approach (Mining and Subsidence Area) (BGC 2018d) [Section 4.1]*. Additionally, the use of MODFLOW-SURFACT was discussed by the USFS Groundwater Working Group and the USFS made the decision to select this model as an appropriate tool to address the issues raised during scoping after considering discussions and recommendations by the working group.

MODFLOW is an open source code developed by the United States Geological Survey (USGS) and is the most widely used and accepted code in the United States. MODFLOW-SURFACT is a modified version of the USGS's MODFLOW code, which provided several features found desirable for modeling the proposed Resolution Copper project as further described below:

- Consideration that the code is accepted by the USFS and other regulatory agencies and has been used on other mining EIS projects. Large mining EIS reviews in the west and southwest using MODFLOW-SURFACT include recent projects at Rosemont [2017] and Cortez Hills [2019]. Conversely, other codes as recommended by IHS, have not been utilized as widely as the MODFLOW family of codes, especially in the United States.
- Use of the time-varying material properties (TMP) package within MODFLOW-SURFACT for simulation of the block cave progression over time. An accurate simulation of the block cave progression over time, utilizing the geotechnical subsidence model as reported in *Assessment of Surface and Subsidence Associated with Caving, Resolution Copper Mine Plan of Operations (Garza-Cruz 2017)*, was considered very important for simulating the hydraulic stress and estimating predictive impact.

Specific statements regarding code selection with respect to model complexity include:

1. Coupled GW/SW codes
2. Heat transport codes

COUPLED GW/SW CODES

IHS argues that GW/SW interactions were not simulated with a coupled modeling code and therefore calibration and predictions are less reliable. The use of integrated coupled GW/SW modeling codes is a topic that was discussed within the USFS Groundwater Working Group but the USFS determined that these tools are not appropriate in this context for the following reasons:

- Codes fully coupling GW/SW interactions (e.g. GSFLOW, Hydrogeosphere) are seldomly used in regulatory EIS analysis for mining projects. A fully vetted code, frequently utilized for mining EIS projects was an important consideration for code selection.
- Using the cited GW/SW coupled modeling codes would not allow for accurate representation of the block cave mining method (using TMP package to alter hydraulic conductivity and storage), which is critical to predicting the impacts.
- An integrated GW/SW model or use of the Streamflow-Routing (SFR) package would require fine-scale datasets for estimation of model parameters (e.g. stream bed conductance, stream widths) and absent those datasets could amount to further uncertainty. Additional rationale for the use of the drain package in lieu of the SFR package is addressed in more detail in the section on *Groundwater Discharge* later in this document.
- The scale of the regional groundwater model, encompassing three watersheds, makes the grid resolution required to represent point feature (i.e. spring discharges) unfeasible. The smallest model cells are 200-ft x 200-ft and further refinement would generate unwieldly runtimes and would not improve accuracy in the attempted physical representation of these features.

As such, MODFLOW-SURFACT and the packages simulated are an appropriate choice for the purposes of the analysis.

HEAT TRANSPORT CODES

IHS asserts that geothermal gradients were not considered in the groundwater flow modeling. This is false. Groundwater flow considerations associated with the geothermal temperature gradient, within the caved zone, is a topic that was discussed within the USFS Groundwater Working Group but the USFS determined it to have negligible (and likely immeasurable) effects for modeling impacts to GDEs. The Resolution Copper block cave produces a large-scale hydraulic sink within the groundwater system and the associated groundwater flow regime generated by this stress is the predominant driver of flow in the model.

Incorporation of geothermal driven flow would require selection of a different modeling code (e.g. TOUGH, FEFLOW) and for the stated reasons above and previous discussions regarding code selection, this was determined to be unnecessary.

CONCEPTUAL MODEL DEVELOPMENT

A concern brought up by IHS is that conceptual model development is lacking or incomplete. This is false as is evidenced by a discussion regarding the hydrogeologic conceptual model in report *Resolution Copper Groundwater Flow Model Report (WSP 2019) [Section 2.2]* as well as acknowledgment in the model review process memo performed by BGC Engineering Inc. *Review of Numerical Groundwater Model Construction and Approach (Mining and Subsidence Area) (BGC 2018d) [Section 3.0]*.

Specific statements made regarding conceptual model development, or lack thereof, include:

1. Perched groundwater zones
2. Alternative conceptual models
3. Future conceptual model

PERCHED GROUNDWATER ZONES

The purpose of the regional groundwater model was to assess impacts imposed on the regional groundwater system due to development of the proposed mine. It was discussed during the Groundwater Working Group and the decision was made by the USFS that the perched groundwater zones were not tied to the regional groundwater system (Apache Leap Tuff aquifer, Deep groundwater system) as was evident by multiple lines of analytical data as described below, and therefore were not to be considered by the model as these zones are hydraulically disconnected.

Extensive evaluation of GDEs was performed by WestLand Resources and Montgomery & Associates (M&A) in *Spring and Seep Catalog, Resolution Copper Project Area, Upper Queen Creek and Devils Canyon Watersheds (WestLand Resources and Montgomery & Associates 2018)* and by SWCA in *Summary and Analysis of Groundwater-Dependent Ecosystems (Garrett 2018d)* as part of the DEIS. The evaluations assessed all potential GDEs in the study area and specified GDEs that are considered part of the perched groundwater zone (product of shallow groundwater sources and not tied to the regional aquifers), therefore would not be impacted by drawdown associated with the mine or considered in the evaluation with the model.

ALTERNATIVE CONCEPTUAL MODELS

IHS asserts that alternative conceptual models were not evaluated. A conceptual model should be based on the data collected. The conceptual model presented in the DEIS is based upon approximately 15 years of extensive baseline field data including seeps and spring monitoring, stream monitoring, multiple shallow groundwater wells, deep groundwater wells, short term and long term pump testing, geologic information from deep and shallow core holes defining the geologic types and structure and most importantly – extensive and long term continual pump testing from mine dewatering from shafts 9 and 10. The conceptual model was then tested and verified further through the numerical model which calibrated to baseline data within accepted error in well referenced and accepted guidelines; scaled root mean square error (RMSE) of 3.0%, as reported in *Resolution Copper Groundwater Flow Model Report (WSP 2019).*

Additionally, in the predictive modeling, the simulation of 87 model runs with varied model parameters could be considered an assessment of alternative conceptual models. For example, one scenario increased hydraulic conductivity of all graben bounding faults providing an alternative conceptual model with respect to the control of groundwater flow across and along these key faults. *(Meza-Cuadra 2018b)*

BLOCK CAVE CONCEPTUAL MODEL

IHS expressed the need for cross sectional schematics outlining the conceptual hydrogeologic system and groundwater flow dynamics following block cave development. WSP provided a schematic representation of the extent of the fully developed cave along East-West cross section A-A' in *Resolution Copper Groundwater Flow Model – Predicted Flows to Block Cave (Meza-Cuadra 2018a).* WSP did not provide estimated graphical representation of groundwater levels and altered flow directions on this schematic as the predictive model output directly served this purpose. The assumptions associated with the predictive model setup and numerical implementation of the block cave development within the groundwater model utilized the work performed below and was detailed in report *Resolution Copper Groundwater Flow Model Report (WSP 2019) [Section 4]*.

MODEL SETUP

IHS cited numerous issues with respect to model setup and representation of boundary conditions within the regional groundwater model. Highlighted issues include:

1. Model domain
2. Groundwater discharge
3. Recharge
4. Evapotranspiration
5. Historic (1910-1998) dewatering
6. Faults

MODEL DOMAIN

Use of watershed boundaries is standard practice in groundwater modeling as they conceptually serve as groundwater divides and divergence in flow direction (*Anderson and Woessner 1992*). Ideally, boundary conditions will be set at a far enough distance from the main model stress (i.e. mine dewatering), that zero (or minimal) flow volume is provided. A domain was selected with the aim to minimize these effects, and be conscious of the further uncertainty created by including additional watersheds which are currently experiencing large stresses in the region (i.e. Pinto Valley and Ray Mine).

The question of boundary effects was discussed in the USFS Groundwater Working Group and an assessment of flow across the boundaries was reported as action item GW-77 and delivered in *Follow-up: July 17, 2018 Groundwater Modeling Workgroup – Response to Action Items GW-75, GW-76, GW-77, GW-80 and GW-81 (Resolution Copper 2018).* Predictive model flow across the entirety of the model domain boundaries (set as General Head Boundaries) was found to be a small percentage of the flow induced by the dewatering stress from mining; therefore, setup of boundary conditions is considered reasonable.

Additionally, as part of the model sensitivity analysis, a scenario was simulated where boundary conditions were changed from general head to a no-flow boundary condition. Results were reported in *Resolution Copper Groundwater Flow Model – Sensitivity Analysis (Meza-Cuadra 2018b).*

GROUNDWATER DISCHARGE

Use of a fully coupled GW/SW model code was previously addressed. However, additional issues were cited with respect to GW/SW interactions including the use of the drain package for simulating groundwater discharge at stream locations. IHS argues representation of groundwater discharge to streams via drains is inappropriate as it fails to provide a mechanism for water to be re-introduced into the groundwater system in losing stream reaches. Such mechanism could be simulated with the use of the Streamflow-Routing (SFR) package available in MODFLOW-SURFACT.

The methodology implemented is a simplified representation and only requires the assignment of streambed elevation to drain boundaries and estimation of a single parameter representing focused recharge. Alternatively, the SFR package includes several parameters with respect to stream and streambed characteristics, introducing additional uncertainty with such estimations.

Model performance with respect to groundwater discharge was presented in *Responses to Regional Model Queries (Meza-Cuadra 2018f)*, which showed the location and rates of modeled discharge compared well with stream baseflow. Additional assessment of model performance is demonstrated as action item GW-67 in *Comparison of Relative Vegetation Density to Regional Groundwater Model Predicted Discharge in the Floodplains and Stream Channels of Queen Creek, Mineral Creek, and Devils Canyon, Pinal County, Arizona (WestLand Resources 2018)* that shows modeled discharge with stream corridor vegetation density, showing good correlation. Hence, the methodology allows for baseflows to be reproduced and minimizes the number of uncertain parameters.

Two additional criticisms regarding the use of drains are made by IHS and include:

1 Inappropriate to set drain conductance sufficiently high and not estimate streambed conductance.

Drain conductance was set sufficiently high to allow the underlying hydrogeologic unit (HGU) and associated hydraulic parameters to dictate the discharge of groundwater. Given the scale of model cells and HGU assignments along stream reaches (i.e. alluvium vs bedrock), this assignment strategy is appropriate and prevents biasing an unconstrained parameter (drain conductance) values to match desired calibration targets.

2 Springs and seeps were not modeled as drains.

This statement is incorrect. Springs and seeps were simulated as drains and allow the discharge of groundwater within the cell in which they are located.

RECHARGE

IHS provides two issues with respect to assignment of recharge within the regional groundwater model summarized as follows:

1 Areal recharge specification is inappropriate.

IHS suggests use of the USGS Basin Characterization Method (BCM) to estimate recharge. While the BCM is a valid method, site specific, regional data, and research was considered and utilized for estimation of recharge rates applied within the model. Research was referenced in report *Resolution Copper Groundwater Flow Model Report (WSP 2019) [Section 3.1.6]*. Specific research cited includes:

- Recommendations for Representing Recharge in the Numerical Groundwater Flow Model, RCML (*Wickham GeoGroup, 2015b*)
- Perched Water in Fractured, Welded Tuff: Mechanism of Formation and Characteristics of Recharge (*Woodhouse 1997*)
- Implications of Projected Climate Change for Groundwater Recharge in the Western United States (*Meixner et al. 2016*)

Additionally, quantification of total recharge within each watershed was provided in *Resolution Copper Groundwater Flow Model – Watershed Water Balance (Meza-Cuadra 2018d).* Results were compared against an independent water balance developed by M&A, as reported in *System-wide Hydrologic Water Budget (M&A 2018),* and compared favorably.

2 Representation of focused recharge is incorrect.

IHS argues that the delineation of focused recharge along stream reaches is incorrect and unjustified. The conceptualization and implementation of focused recharge along stream reaches is appropriate and fits with the dual (diffuse and focused) recharge model as outlined in literature cited above *(Meixner et al. 2016).*

IHS expresses concern that the representation of focused recharge along stream reaches is exaggerated and represents an area larger than the physical dimension of streambeds. The use of a larger footprint is justified for purposes of representing stream bank storage which provides a mechanism for longer residence release of storm runoff event water to the groundwater system; particularly in areas with pronounced alluvium like that of Queen Creek. For a narrower stream reach like Devils Canyon, the delineated area is larger than physically present, but consideration should also be given to numerous higher order tributaries that are not accounted for. In total, a holistic view was taken with respect to groundwater recharge and the estimated spatial representation and rates, which reasonably aligned with a separate independently estimated water balance *(M&A 2018).*

Furthermore, as part of the model sensitivity analysis, additional model scenarios were simulated with recharge rates increased and decreased by 50%. Results were reported in *Resolution Copper Groundwater Flow Model – Sensitivity Analysis (WSP 2018b).*

EVAPOTRANSPIRATION

IHS suggests that ET is a necessary component and parameter required for inclusion in the groundwater model. IHS outlines in its document, the complexity of the physical and biological processes associated with ET. ET is a highly complex process, difficult to measure and therefore, difficult to accurately parameterize. While simplifications exist, as utilized in certain MODFLOW packages, the simplest parsimonious approach is to consider ET as a reduction in net recharge. As such, ET was implicitly included in the groundwater model.

FAULTS

IHS asserts faults should be represented as planar features during discussion of model code selection. Representation of faults as planar features does not constitute a valid reason for selection of another modeling code and is unwarranted as calibration of hydraulic responses across faults (discussed below) is more important that strict adherence to geometric representation. On the scale of a regional groundwater model, and in consideration of representing measured hydraulic parameters observed in the extensive baseline data collected, representation of faults in this manner is considered appropriate.

Faults are represented in the regional groundwater model as independent hydraulic property zones and delineated utilizing model grid cells, a representation that is subjected to the constraints of the rectilinear grid. Despite large widths being used, fault zones are conceptualized to include adjacent altered material, and are a numerical means for representing hydraulic resistance within the groundwater model framework and representing the actual hydraulic behavior measured in the field. Calibration of hydraulic properties for these features was focused on properly reproducing transient water levels and propagation of responses to dewatering stresses observed across faults (i.e. non-uniform drawdown inside and outside of graben).

Additional considerations for modeling fault properties utilized findings provided in *Fault Core Review and Guidance for Groundwater Flow Modeling, RCML (Wickham GeoGroup 2015a).*

MODEL CALIBRATION

IHS cited numerous criticisms with respect to model calibration of the regional groundwater model. Criticism regarding model calibration includes:

1. Non-unique solution
2. Location of target datasets
3. Pre-mining & historic conditions
4. Calibration residuals
5. Hydraulic testing

NON-UNIQUE NUMERICAL SOLUTION

IHS expresses the need to calibrate to both head and flow data to provide a unique numerical solution. Flow data was assessed and compared to stream data observed in the field. As previously discussed in section *Groundwater Discharge*, simulated groundwater discharge via drains was compared against observed baseflow estimations and was well matched to baseflow rates measured, particularly along Devil's Canyon. Additionally, the location of simulated groundwater discharge was shown to align well with observed continuously saturated stream reaches. The combination of these two qualitative assessments provided WSP confidence that the streams were relatively well represented and was provided in *Responses to Regional Model Queries (Meza-Cuadra 2018f).*

A supplemental assessment, showing modeled discharge occurring in areas of higher density vegetation, was provided by WestLand Resources as action item GW-67 in *Comparison of Relative Vegetation Density to Regional Groundwater Model Predicted Discharge in the Floodplains and Stream Channels of Queen Creek, Mineral Creek, and Devils Canyon, Pinal County, Arizona (WestLand Resources 2018).*

LOCATION OF TARGET DATASETS

IHS asserts that the location of datasets utilized as targets for calibration is denser in the area of the mine and lacking in areas further from the mine, specifically at GDE locations where impacts are considered important. The datasets near and around the mine are vital for characterization and calibration of the area in which the hydraulic stress will be imposed by the mine. Calibration to observed heads and dewatering responses both inside and outside of the fault graben is key to providing confidence in future predictions. Critically, Devils Canyon has a large network of monitoring points which were carefully considered during calibration efforts.

The monitoring and measuring network proposed in the DEIS was also developed considering certain limitations with regards to the drilling near various sensitive locations and property ownership. The monitoring network proposed in the DEIS covers dozens of GDE's in a far-reaching radius many miles away from the mine and will serve as key in the early detection of potential impacts during mine life as outlined in *Monitoring and Mitigation Plan for Groundwater Dependent Ecosystems and Water Wells* (*M&A 2019*). Additional monitoring locations may be incorporated into the final EIS and record of decision (ROD).

PRE-MINING & HISTORIC CONDITIONS

IHS highlighted the lack of model calibration from 1910-1998. Model calibration is primarily based on targets following Resolution field efforts undertaken after 2002 *(WSP 2019) [Section 3.2.1]* when Rio Tinto became involved in the project. However, available datasets from the 1910-1998 were incorporated, which includes the geometry of the Magma Mine development and associated dewatering rates *(WSP 2019) [Section 1.4 and Figures 1.3 & 1.4]*. The implementation of these hydraulic stresses and simulation of this historical period alongside calibrated parameters derived from more recent datasets, is considered the best approximation of historical conditions, given the available data.

CALIBRATION RESIDUALS

IHS asserts that calibration residuals were not provided for spatially assessing model error near GDEs and streams. This is incorrect. A spatial summary of residuals in the Apache Leap Tuff was provided in memo *Responses to Regional Model Queries (Meza-Cuadra 2018f).*

HYDRAULIC TESTING

IHS is critical of the use of two hydraulic aquifer tests used for model calibration, considering the tests as small scale and spatially biased. This assertion is not correct and contrary to accepted good practice in groundwater modeling as any informative and well-collected dataset should be utilized for verification of conceptual model and improving confidence in calibration. While these specific tests would be considered short term and small scale by comparison to the proposed stress imposed by the mine, aquifer testing is important for characterization and valuable information.

The ability to reproduce the results relatively well, as shown in *Resolution Copper Groundwater Flow Model Report (WSP 2019) [Section 3.2.4 and Figures 3.12 & 3.13]*, provides confidence that these areas of the model are performing and in alignment with the conceptual model. The location of both tests provides critical information and covers a broad area spatially distant from the mine; one test was conducted between the proposed mine and a key impact assessment area, Devils Canyon and the other east of Devils Canyon, and as such the notion that the test locations are spatially biased near the proposed mine is incorrect.

Furthermore, IHS does not recognize that a long-term aquifer test has been ongoing since 2009 as conducted via mine dewatering occurring within the deep groundwater system with continual measurements via the monitoring network. This long-term pumping and associated piezometric responses is a critical component of the model calibration. As previously stated, the calibration to observed water level trends and responses across key hydrogeologic features, including faults and the Whitetail Conglomerate aquitard, must be considered for providing confidence that a future hydraulic stress originating from the mine is accurately captured.

PREDICTIVE MODEL RESULTS

IHS provided several comments with respect to the predictive model and assessment of impacts. Issues include:

1. Definition of baseline conditions
2. Use of 10-ft drawdown contour
3. Impact assessment to 200 years
4. Groundwater flow to cave and subsidence lake
5. Predictive uncertainty analysis

DEFINITION OF BASELINE CONDITIONS

IHS states that pre-mining conditions (represented as 1910) should be utilized as baseline conditions for the impact assessment. Baseline conditions utilized for assessment of impacts associated with the Resolution Copper project was discussed, reviewed and validated the USFS and their third-party consultant as well as the Groundwater Working Group. Discussion and justification regarding this decision is provided in *Draft EIS for Resolution Copper Project and Land Exchange (USFS 2019) [Section 3.7.1.2]* and *Selection of Appropriate Baseline Conditions for NEPA Analysis (Garrett 2018c).* As detailed in these documents, the current dewatering related to the existing activities is legal, has been ongoing for approximately two decades and will continue legally in order to preserve the mining infrastructure investment made by Resolution Copper. These activities and the resulting conditions represent the baseline.

Current on-going dewatering, held steady through life of mine, was simulated within the No Action scenario (as described above) and compared against the Proposed Action scenario for calculating the impact (difference in drawdown). However, drawdown for both scenarios (No Action and Proposed Action) was also disclosed as part of the affected environment with respect to ongoing dewatering trends.

USE OF 10-FT DRAWDOWN CONTOUR

The use of a 10-ft impact contour was discussed by the USFS Groundwater Working Group and ultimately decided by the USFS as appropriate and reasonable for plan-view impact drawdown contour output. However, and most importantly, the EIS analysis was not limited to the 10-ft contour plan-view map for disclosure of potential impacts to GDE's, but the 10-ft contour was used as a tool for identification of GDE's exhibiting >10-ft of impact. The USFS determined that impacts at all GDE locations would be presented below the 10-ft threshold utilizing hydrographs detailing the range of potential impacts at each GDE location tied to the regional groundwater system, as shown in the DEIS [*Appendix L*].

Factors considered for utilizing the 10-ft contour for plan-view map assessment included model grid scale, seasonal water level variability, and mining EIS precedent. It is valid to say that groundwater models can output results with a high level of precision, however it is also true that accuracy of these results will be nowhere near these levels. The Resolution groundwater model encompasses an area of 190 square miles, with the smallest grid cells being 200-ft x 200-ft, and thus it is appropriate to expect that the accuracy of any output below 10-ft will be limited. This was a key discussion point within the USFS Groundwater Working Group and subsequently, the USFS deemed the 10-ft impact contour appropriate. Additionally, seasonal variations in water levels are observed to fluctuate; to estimate impacts at a threshold below seasonal variations in water levels could inadvertently attribute natural water level declines to mining. The use of the 10-ft impact contour is prevalent and was found to be sufficient for previous mining EIS assessments, including Cortez Hills [2017].

IMPACT ASSESSMENT TO 200 YEARS

The 200-year timeframe assessment was discussed within the USFS Groundwater Working Group and the USFS decided this was appropriate and reasonable for the purposes of the Draft EIS and that impacts beyond 200 years were remote and speculative. Discussion and justification regarding this decision is provided in *Draft EIS for Resolution Copper Project and Land Exchange (USFS 2019) [Section 3.7.1.2]*.

Fundamental limitations of models exist in predictions far into the future but results from the groundwater model could reasonably be assessed out to 200 years and therefore were restricted to this timeframe. Additionally, acknowledgement that groundwater levels and trends that continue past this point in time can be qualitatively explored and additional impacts disclosed even absent of quantitative predictions. It is unreasonable to assume that conditions today such as the climate and non-Resolution Copper activities would be the same at a time frame beyond 200 years. However, the predictive model was run to approximately 1000 years into the future to assess the potential for formation of a subsidence lake as further described below.

GROUNDWATER FLOW TO CAVE AND SUBSIDENCE LAKE

IHS comments on the representation and assumptions associated with cave simulation, future groundwater flow into the cave, and development of a subsidence lake.

1 IHS asserts that the predictive model was incapable of accurately modeling flows within the cave based on a comment regarding the upper limit of hydraulic conductivity applied to caved material.

Upper limits on the hydraulic conductivity were set at 100 ft/day as it was deemed that fractured rock would not on average present values larger than this. Clay content within the Whitetail Conglomerate is likely to fracture and compact, presenting much lower values likely limiting flow. A value of 100/ft per day assumes flow capabilities similar to a gravelly aquifer throughout and assigned to all rock types. The 100 ft/day value did not create any model instability, with cumulative mass balance errors less than 1%.

2 IHS expresses the need to model the change in ground surface elevation associated with the subsidence crater for the purpose of conducting a subsidence lake assessment

As described above, the USFS determined a post-closure assessment period of 200 years was reasonable and appropriate time frame after discussion with the Groundwater Working Group. However, for the purpose of assessing the potential development of a lake within the subsidence crater, a predictive model run was simulated to 1000 years into the future. The recovery associated with this model run was found to be below the lowest elevation of the subsidence crater, as well as other potential discharge points associated with the mine, hence the prediction of a surface water expression in the subsidence crater was determined to be remote and speculative by the Forest Service. The modeling detail, however, is included in the record.

IHS also asserts that groundwater recovery within the cave could be much quicker than predicted due to the use of a maximum hydraulic conductivity within the cave of 100 ft/day. The argument misses that flow into this dewatered block cave is largely dictated by the surrounding HGU hydraulic properties, which are far less than 100 ft/day. Therefore, the predicted recovery and associated timing is principally based on the hydraulic properties as determined from the calibrated model and collected hydraulic properties of data on undisturbed, in situ rock. As previously discussed, the calibration to the long-term dewatering currently ongoing at Resolution Copper was a key consideration and provides confidence that parameter estimation of the surrounding HGUs are favorable.

PREDICTIVE UNCERTAINTY ANALYSIS

IHS comments that the predictive uncertainty analysis provided by the DEIS is insufficient and should be conducted using alternative methodologies. However, the approach taken for the DEIS is commonly used. Uncertainty was discussed during the USFS Groundwater Working Group and the USFS determined that methodologies used in the existing mining EIS literature should be followed as it is accepted and common practice. As described in the response to comments in previous section *Alternative Conceptual Models*, a comprehensive sensitivity analysis was completed with modeled output from 87 sensitivity runs. Parameter values were varied in this predictive model based on their uncertainty, varying log parameters (e.g. hydraulic conductivity) by an order of magnitude and non-log parameters by 50% (e.g. recharge), and 87 forwards runs were carried out. This type of analysis is consistent with other EIS documents previously approved by regulators and provides a conservative approach to capturing uncertainty. A broad conservative impact is disclosed as the outer-most extent of all superimposed sensitivity contours, which was then used to inform the monitoring and mitigation plan for GDEs.

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