Agenda

Santa Cruz County Advisory Panel
on the South32 Hermosa Project
September 20, 2023

Santa Cruz County Provisional Community College District
2021 N Grand Avenue, Nogales

Timing	Focus	Task/Action	Who
11:00 *2 hours*	**Dr. Ty Ferre**	Presentation, Question/Answer	All
1:00 *5 min*	**Panel Business - Welcome**		Catherine
1:05 *0 min*	**July Minutes –** Pending **August Minutes** - Pending	No action	Catherine
1:05 *25 min*	**Project Updates** • Mine Plan of Operation (MOP) – Overview • Ongoing Permitting and Site Activity • Workforce/Procurement • Traffic/Trac Out • Water/Dewatering Options • Fast-41 Dashboard • Additional timely updates	Share information, Q & A Note: The MOP will be the focus of the update for this meeting. [Generally, up to three of the topics listed will have an update. If there is no new information, there will be no update.]	South32
1:30 *15 min*	**Community/Panel** • PARA - Carolyn • Town of Patagonia Flood and Flow Committee - Carolyn • FOSCR – Ben • Other?	Share information, Q & A	Panel Members
1:45 *10 min*	**Standing Topics:** • CPBA (Community Protection and Benefit Agreement) • Q&A Document	Share information, Q & A	Catherine, Panel Members, South32
1:55 *5 min*	**Wrap Up** October Meeting: Patagonia	Final Comments	Catherine
2:00	**End**		All

Meeting Minutes for September 20, 2023

Santa Cruz County Advisory Panel on the South 32 Hermosa Project

Santa Cruz County Provisional Community College District, 2021 N Grand Avenue, Nogales

The meeting called to order at 12:00 by Catherine.

Attendance:

Meeting Facilitators (Interfuse Associates):
Catherine Tornbom, Joanne Lamb

South32 Hermosa:
Lina Bentacourt, Judy Brown, Jenny Fiore, Tomas Goode, Melanie Lawson, Sandra Moraga, Stephanie Moreno, Garrett Workman

Panel Members Present:
Maureen DeLaOssa, John Fanning, Gerry Issac, Ruth Ann LeFebvre, Ben Lomeli, Damian Rawoot, Fritz Sawyer, Carolyn Shafer, Linda Shore, Guillermo Valencia, Marcelino Varona, Michael Young

Panel Members Absent:
Olivia Ainza-Kramer, Elizabeth Collier, Christopher Young

Consultants/Guests/Visitors:
Kat Crockett, Mary Tolena, Baily Winston, Stephanie Smith

Presenter:
Dr. Ty Ferre

1. **Q&A Document Presentation – Dr. Ty Ferre:**

   The complete two hours of Dr. Ferre's discussion on the Q & A Document can be found in Attachment 1.

2. **Meeting Minutes – Catherine:**

   The July and August Meeting Minutes have been reviewed and approved by the Panel members via email.

3. **South32 Updates**

3.1 Ongoing Permitting & Site Activities (Slides in Attachment 3) - Melanie:

3.1.1. Flux Exploration Drilling Plan: The Plaintiff's motion for a preliminary injunction was denied. We are moving forward. It is one drill rig for 7 pads, on about 1.8 acres. The total duration of that program is less than a year, about 7 months. We have notified the residents in the Flux area. As a side note: South32 is not the only company in that area that will be doing exploration drilling. Barksdale Resources is in the area as well.

3.1.2. Small Tracts Act: There is no update. It is still being reviewed by the USFS.

3.1.3. AZPDES Permit: We are unable to provide an update due to the pending litigation.

3.1.4. APP Permit: There's no update.

3.1.5. Site Exploration: We are continuing shaft sinking activities. There were questions last month about the depth of the shaft. The depth is planned for 2900 feet.

Question:

Carolyn: *Will the ultimate depth of the shaft be more than 2900 feet?*

Melanie: I don't think so. In a typical mining operation from the shaft you are able to develop workings or tunnels to navigate underground.

3.1.6. Off-Site Projects: An update on off-site projects.

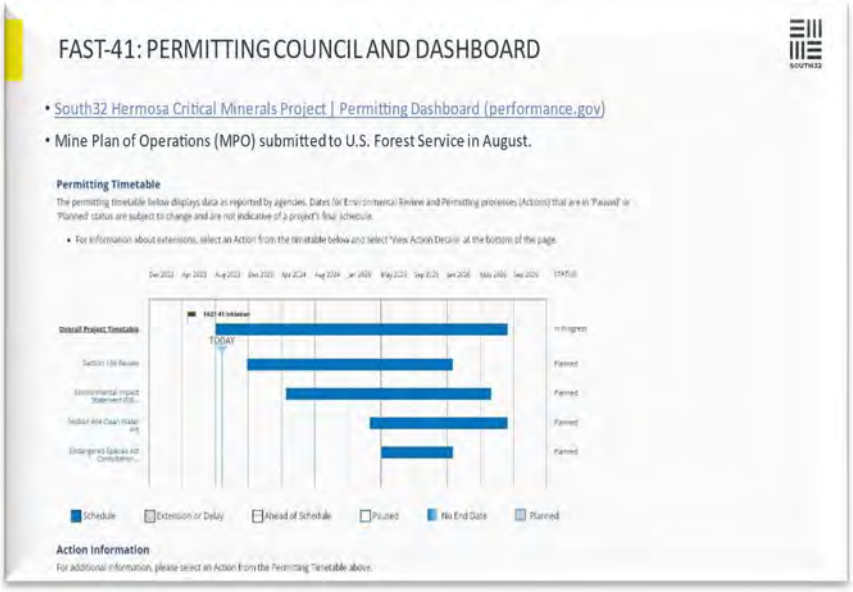
- **CCC Construction**: We are finalizing phase one grading. As discussed last time, phase two is the intersection at Harshaw and Cross Creek. Phase three is State Route 82. The target completion date is still June 2024.
- **The 9001 Bridge:** We are planning to resume construction on October 2. We had to pause construction because of breeding and nesting season for the Yellow Billed Cuckoo. We have

done a public notice because there will be a public detour. This project is anticipated to be completed in March 2024.

Comments:

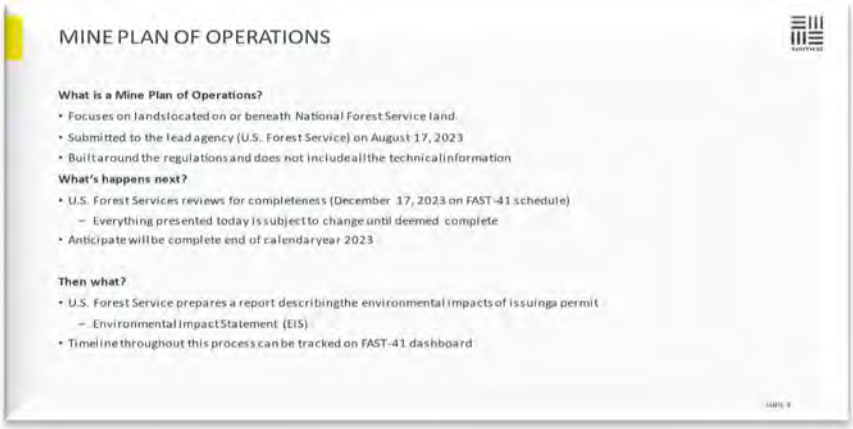
Carolyn: *On September 27 there's a meeting in the Town of Patagonia by the county with some of the county staff and supervisors to talk about the CCC construction in case anybody's interested. Are you discharging?*

Tomas: Here's some additional information. We have had periodic short-term discharges associated with our drilling program for the past several months.



3.2 FAST-41 Dashboard: I just did a new screenshot of the website that shows the current timelines. I encourage everyone to follow the dashboard for any updates.

3.3 Mine Plan of Operations (MPO) Overview: The MPO focuses on activities on or beneath the US Forest Service lands. We submitted it to the US Forest Service on August 17, 2023. The requirements for submittals are built around what's in the regulations and this does not include the technical information that was submitted. What happens next? The Forest Service reviews it for completeness. The date that's in the FAST-41 schedule is December 17th. So, everything that's presented today is subject to change. Then, the Forest Service prepares a report to describe the environmental impacts of issuing that permit. This is the Environmental Impact Statement (EIS).



Questions and Answers:

Linda: *What's the timeline between the end of the year when they say you did your work, it's complete and when they issue the EIS?*

Melanie: They have the EIS being released around April 2024.

Carolyn: *Typically, that is when the Forest Service would open the comment period and documents would become publicly available, but you are saying that you will release them. Now are you going to wait for the Forest Service to release it when they say in December that it's complete? And then we can see the entire Plan of Operation?*

Melanie: I will need to confirm if we can do that ahead of that April date.

Ben: *Normally there's a draft EIS and then the public comment and then a final draft.*

Judy: We submitted the Mine Plan of Operation. In December, the Forest Service will deem that application to be complete. And then between December and April they will prepare a Notice of Intent to prepare a draft EIS and then there will be a period where they will prepare a draft and that will be released. Then there'll be a comment period and after that comment period there will be the final EIS. You see on the dashboard that it goes through April 2026.

Melanie: I have information on the MPO by chapters.

- **Chapter 1**, **Introduction**: The introduction talks about the location and again focuses on the areas that are Forest Service land. The total anticipated disturbance on Forest Service land is less than 500 acres. That includes both temporary and permanent disturbance. The temporary disturbances are for construction activities and it's different from permanent disturbance. Compared to other mining operations in the state, this is significantly less impact. The introduction also describes some of the operations that are on private land and that provides a context for the project.

- **Chapter 2, Project Description:** We currently have about 150 acres of disturbance on our private land. What we've been saying publicly in our tours is that the total disturbance combining both private and US Forest Service is about 600 acres.

Questions:

Fritz: *How much is Forest Service?*

Melanie: There are about 225 acres that are Forest Service land, but that's not surface disturbance because we are doing long hole stoping method with the paste backfill so we're not anticipating surface subsidence. That also includes the dry stack tailings facility, the permanent access route, what we call the gas-line route, which is south of Flux Canyon. We included the exploration work, and the rapid infiltration basins which is illustrated here. This is something that the Panel has influenced. We did a presentation a little over a year ago, with the crowd-sourcing challenge and presented different options to the Panel other than discharge into Harshaw Creek. Some of the ideas included hydroponic farming, but what rose to the top of the list was aquifer recharge. And so, the rapid infiltration basins (RIBs) are included in the Mine Plan of Operations. There are six different locations that are proposed that the Forest Service will evaluate. And there could be a combination of two RIBs and also discharge into Harshaw Creek.

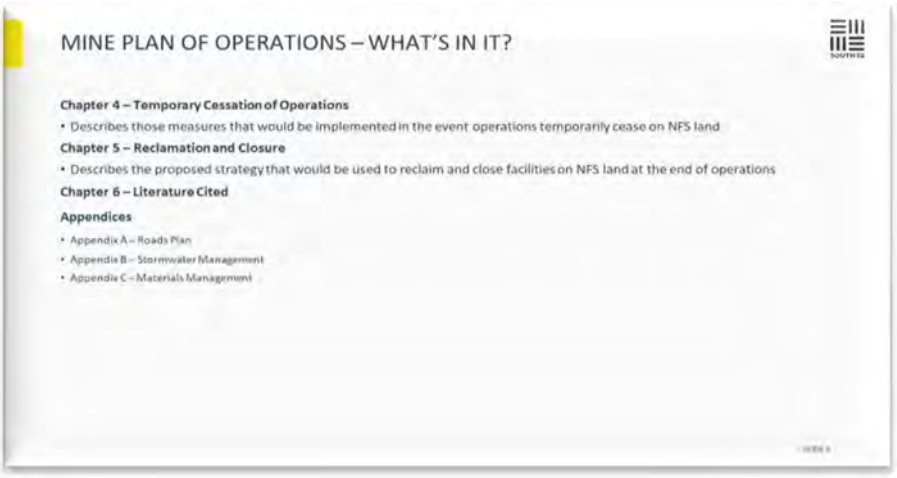
Carolyn: *Are any of the dry-stack tailings facility on public lands or are you talking about adding to what you have on your private property?*

Melanie: What's in the MPO is a dry-stack facility on Forest Service land.

- **Chapter 3, Environmental:** This goes into environmental protection measures and some examples include the criteria used to site facilities, our continued commitment to dry-stack tailings technology, the underground long-hole stoping mining method, and also our plan for electric vehicle transport.

  Ben: *I don't see historic cultural resources incorporated in the plan.*

- **Chapter 4, Temporary Cessation of Operations:** This describes those measures that would be implemented in the event operations temporarily cease on National Forest Service land. This can include care and maintenance activities as required to maintain the project in a safe condition.



- **Chapter 5, Reclamation and Closures:** We describe the strategy that's going to be used to reclaim and close the

facilities at the end of operations and plans for recontouring and re-grading to comply with US Forest Service regulations and other permit requirements. We also have industry best practices to comply with. There's a global industry standard on tailings management as an example. And then South32 also has internal standards for closure that we must comply with.

- **Chapter Six, Literature Cited:** This includes the literature that's cited, some appendices, and some of the maps. I think everyone has seen the gas line proposed route. There was a public survey on it. Stormwater management plans and materials management plans are included in there as well as how we handle explosives or concentrate transportation.

  Questions and Comments:

  Linda: *So, you'd be up to 500 acres of Forest Service land for the life of the mines?*

  Melanie: Yes.

  Michael: *What about the power line?*

  Judy: Tucson Electric Power has their own permit application. And what I think we're going to do through the EIS process is that we're talking about it with the Forest Service to combine it into the EIS.

  Carolyn: *I'm still pushing for an underground solution; you're paying for it and maintenance. The reason I'm doing that is not to cost more money, but because of biological diversity and those things create hazards. Look at how many municipalities are suing the electric companies because their power lines played a significant part in the huge fires in California.*

  Melanie: I also want to highlight how the Panel has shaped the MPO. The permanent access route was moved further to the south of Flux Canyon. We included feedback from the Tubac Hiking Club and a couple of other groups through a public survey that mentioned access to a waterfall and some of our hiking areas. And we've included areas along the road design to allow access. It's not in the MPO because it is not on Forest Service land, but the Panel and community's other feedback was to avoid State Route 83. We're looking at using route 90.

  Linda: *Is that the final word for now?*

  Melanie: The project team is looking at recent traffic and agrees that SR 83 is just not practical. From water management we are also including the rapid infiltration basins in the MPO because there was that preference for recharge over other alternatives that we have. Not in the Mine Plan of Operations, but through our social impact assessment, we've listened to some of the community feedback and one of the investment projects that was identified was Richardson Park. Town manager Ron Robinson has been fantastic to work with to make that happen. It opened last week, so we're very excited about that.

  Ben: *The dewatering upstream that Tomas and I talked about was under consideration. It looks like it's not anymore.*

  Melanie: The alternative discharge locations there would be a pipeline that could run to a rapid infiltration basin. It would be a combination of discharge and Harshaw Creek and rapid infiltration.

  Ben: *Not upstream in Sonoita Creek?*

  Melanie: No, we propose six different locations for the Forest Service to evaluate.

  Ben: *It wasn't under consideration. I'm not sure if it ever was.*

  Linda: *This is just related to the Forest Service land.*

  Ben: *We were talking about alternative dewatering points way upstream by the Sonoita Creek and then it comes back and does some recharging and not give you the full impact of dewatering just upstream of Patagonia. We were told numerous times that's it was under consideration.*

  Tomas: There're probably different things that we might be talking about there. In terms of alternative discharge points. That's what these recharge basins are.

  Ben: *What I am talking about is the dewatering upstream in the Sonoita Creek. And you said that was an excellent idea. People said it was under consideration. So now we're here.*

  Michael: *I believe that was a recommendation just by you because of the easement along the state highway. You've seen the recent fiber optic going through. I don't recall the Panel ever approving that be a*

consideration.

Linda: *We were just talking about that as an idea. Tomas did say that it was a good idea whether or not it went beyond that meeting.*

Ben: *Well, it could be rapid infiltration basin but what I am talking about is the location being upstream on Sonoita Creek so Patagonia would not receive the full brunt of the discharge in Harshaw Creek. The dewatering concerns could be mitigated by whether it's recharge basins or simply into the creek upstream. Excellent idea but I don't see it was considered at all.*

Tomas: It's not part of the Mine Plan of Operations.

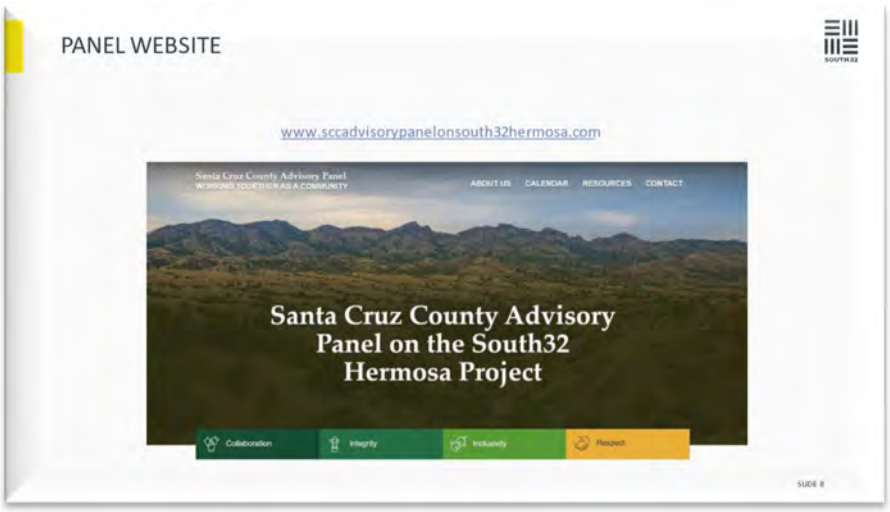
Carolyn: *Can you share the locations of the discharge locations?*

Tomas: No, because it's based on what the Forest Service determines is appropriate. They may say no, those aren't good locations, or they may propose alternative locations which we need to consider. There's still too much uncertainty.

Linda: *Is it 500 acres right around the mine of Forest Service land?*

Melanie: It's near the mine, but we can't share the exact location until it's deemed complete by the Forest Service.

3.4 **Panel Website:** The Panel website is now formatted but not live yet. It has the About Us tab, Calendar tab, Resources tab where the minutes and other documents will be posted, and a Contact tab which is currently turned off but can be turned on if there's a public input period. From now on, Catherine and Joanne will manage the site and work with the website developer to upload panel minutes and revise the site as needed. Linda has been very helpful with feedback.



4. Community/Panel Updates:

4.1. PARA – Carolyn:

- The Aquifer Protection Permit – a legal action by PARA against a state agency for failure to follow state statues that require a point of compliance. You can see in the report the actions taken by PARA. The Court has said during the week of September 18 it will issue a decision or a date for oral arguments.
- As I say in the report, we sent a letter to the EPA asking them to oversee what ADEQ is doing. The EPA copied us on a letter to ADEQ. We also know that the billing records of ADEQ are public information. We are watching communications between EPA and ADEQ in the hopes that the next version of this permit issued by ADEQ will be in compliance with the Clean Water Act.
- Correction: I mentioned in the report that the Board of Supervisors will discuss and vote on sending a letter to the EPA on September 19. Jesus Valdez, County Manager confirmed with me this morning, that they didn't vote on it. The recommendation to staff is to request a meeting with ADEQ's water quality director. And if water is discharged, they will send a letter to the governor. And I also want to say that they are meeting with ADEQ water quality director because they can't meet with the director of ADEQ because she has recused herself from all things related to South32 because she's married to a lawyer hired by South32 as outside counsel.
- The town of Patagonia has it on the agenda for the 27th and we will see what can happen on that.
- There is a hearing next week before the Water Quality Appeals Board on the Forest Service permitting exploratory drilling. As Melanie said earlier, this is both the Flux site, which is less than a year of activity and the Barksdale Resources Sunnyside project, which is substantially larger, seven years, and 24/7. That is the heart of biodiversity in the mountains. The judge denied the plaintiffs' request for a temporary injunction to stop it. The plaintiffs have now filed with the Ninth District Court of Appeals for that injunction. That's pending and we will see what happens with that.

4.2. Town Flood & Flow Committee – Carolyn:

- The Harshaw Creek watershed was listed by the Forest Service as the worst one in terms of its performance on several criteria, which is why the Flood & Flow committee chose to focus on that.
- There were also updates on the School Canyon failure of the original Civilian Conservation Corps structures. From the perspective of how many years ago that was done they did a credible job, but there's failure now with the berms, and unfortunately that is right above the fire department. Conversations are ongoing with the Forest Service and South32.
- Environmental Defense Fund two people gave a presentation on the Water Leadership Institute. There's a follow up planning session scheduled for next week and I want to let you know, they did the presentation to the Flood and Flow committee, and it was excellent, and they are going to be doing that presentation to the County Board of Supervisors on October 17. I highly recommend that you attend or look at the recording. The focus is what's going on with water conditions in the State of Arizona and for laws in the State of Arizona.

Comments:

Melanie: *I would like to point out that the governor appointed the ADEQ Director. It's a coincidence that she is married to a lawyer contracted by South32 as outside counsel.*

Linda: *Recusing yourself is impressive. Yes.*

4.3. FOSCR – Ben: I have a brief update. Tomorrow we'll be receiving the Volunteer Environmental Stewardship Award from ADEQ. Friends of Santa Cruz River (FOSCR) was awarded this for long term community leadership, monitoring efforts and cleanup efforts. This will happen tomorrow at 2:30 at Guy Tobin Trailhead in Rio Rico. We're not the only group receiving the award. There are two others: The Anza Trail Coalition is going to join us and so is Arizona Shine, a group recently formed to do cleanups. We've been working jointly with them. I also want to share that we've lost a treasurer and we're in desperate need. It's only a few transactions a month and you need to be a board member. We're hoping to get someone bilingual because we live in a community that is bilingual. One other thing I want to be sure everybody understands is that Friends of the Santa Cruz River is a nonprofit focused on being watchdogs for the environment but we're also pro-business. We are proud members of the Chamber of Commerce.

4.4. Nature Conservancy – Damian: I meant to introduce my colleague, Baily Winston, before she left. She is the Southern Arizona Water Programs Director. I invited her to listen to Dr. Ferre. She works alongside me and Dr. Jesse Pearl. Also with me today is my son Khalil, he's seven and school ended very early today. I'd like to mention that the State of Arizona through Arizona Game and Fish was awarded $2.3 million for a recovery and land acquisition grant. That's a project I've been working on and ideally that money will go directly for land acquisition or conservation easement acquisition, one of those places being the floodplain on the Rail X Ranch. The Nature Conservancy committed $850,000 to that as well. We have another grant proposal with the Department of Defense to match funding so we're trying to heavily invest and protect that area of Sonoita Creek north of Patagonia where the springs are located.

5. Standing Topics:

5.1. Community Protection and Benefits Agreement (CPBA) Working Group – Damian: First, the great news is that Mayor Andrea Wood joined us as a representative of the Town of Patagonia. We are still working on the Santa Cruz County representative. Looking at the slide on the report you can see the framework for the CBPA. There are four parts, the expected signatories, emphasis on resource protection that covers traffic, environmental impacts, community health and safety, and then that local hiring and procurement economic piece. We talked at length about monitoring, reporting, and feedback. There's a note here that says there is an element of redundancy that's being built into the agreement. The community will have the benefit of the permitting process and regulatory aspects, but this goes above and beyond. Acorn International has proposed that an additional fund be created based on the performance of the project. There are some details about this in the report, but they will need to be worked out.

Melanie: *We have the existing South32 Community Fund that would be separate from this. I propose CFSA because it's a third party that holds this type of funding for community benefit. Whether it's something to support economic development or local infrastructure education, the funds are set aside and then an advisory group can recommend how it should be used. It's typically tied to the business success of the company. That formula can be determined.*

Judy: *I think there are two issues. One is mitigation and how to fund that mitigation, whatever measures are agreed to with South32. I think the harder part is this other issue of funding in terms of how you set up a system where we are all joined together in success or failure in terms of what's required for the community investment. I think it's a way of trying to find ways that company funds can be independently run but are still*

somehow connected to the presence of the company in the community. That's what they've done at the Stibnite Mine in Idaho and Stillwater Mine in Montana. They have an agreement that's tied to the success of the business and the revenues of the business.

5.2. Q&A Document – Fritz: Since we had our two-hour meeting today with Dr. Ferre, and this was the topic of the meeting, we will skip this agenda item.

Marcelino: *I would like to say thank you for the good work that you have done so far. I didn't think it was going to be possible to get this done.*

6. Announcements:

6.1. Catherine: The Board of Supervisors would like an update about our Panel and what we're up to. I am not sure of the date at this point, the regular meetings are the first and third Tuesday of the month. I will represent the panel with a short presentation.

Linda: *And are you going to send us what you're going to say?*

Catherine: Yes. I am happy to have feedback from the Panel.

7. Upcoming Meetings

- October: Patagonia, 12:00 to 2:00 pm – ACORN International on the CPBA, & IROC Updates
- November: Patagonia, 12:00 to 2:00 pm – Manganese
- December: No meeting.

6. Wrap-Up: Meeting adjourned at 2:03 pm.

4 Attachments:

1 – Dr. Ferre's Responses to Q & A Questions

2 – South32 Briefing Slides

3 – PARA Update

4 – Town of Patagonia Flood & Flow Committee Update

5 – Working Group Meeting Summary

Attachment 1 – Dr Ty Ferre's Discussion and Responses to Q & A Questions

Ty: My goal today is to address the questions posed by the Panel and tell you what I know about where we stand on the modeling. I want to start off by reviewing what I see as my role here, so we make sure you guys see my role the same. I describe my role as a hydrologic intermediary. I stand between the Panel and the modelers. In that role, I gather all of the hydrologic and water related concerns that you have. Then as we go forward, I try to make sure that the way they're doing the modeling will produce models that can answer your questions. One of the problems is a model gets completely developed and calibrated and then it's in a report and then it's released. And at that point, it's a little bit too late to really do anything about it.

There will be some things in answering your questions that I won't be allowed to talk about, but I don't think that's a major limitation. In my view, the way I've seen this whole process, I feel like we're right on track. And we're right at the point where we get to have an impact on the way this works. I've seen a background report which talks about their hydrogeologic framework. More recently, I've seen a report that I would call a preliminary model. It's a model what shows their hydrogeologic framework can be calibrated. This will not be the last version of that model, but it's at least saying there aren't such big gaps that they can't get this thing to behave.

Linda: *Did you have any input in between the very first one and this preliminary one?*

Ty: I didn't have the input that I would have liked in terms of building that model. We now have an agreement that I'll be involved in this last phase of the model. I'm not so concerned that I didn't have as much direct input in building it because it's a fairly general model, the base upon which we will build different versions of the model. I should be careful here because within hydrogeologic modeling, there's a debate about what it means for models to be different. Do you have to use an entirely different package to have a different model? Do you have to have a different concept of how processes work to have a different model? Or can you simply have one model that has different packages or different ways of representing processes and different parameter values? I tend to fall on the side of an open definition which is if we have this base model, and we have the opportunity to look at parameter uncertainty and how that translates to uncertainties and predictions or if we had the opportunity to represent this process using this package, but we really think that another package may be more suitable to our question. If we had the chance to implement those, then I feel like that's allowing us to build a suite of models. The exception would be if there's something that the model with its different packages just can't deal with. And there's another model that can deal with it. Then that's the point at which I would say you need to advocate for a different model package or a different model platform. Does that make sense?

Marcelino: *Yes, that makes sense. Tomas, how come the professor wasn't included from the inception of the model?*

Tomas: *Some of this work began long before Ty entered into Panel work. Ty and I have had a number of conversations from the time that he became involved. Our pursuit of preparing this model and making sure that it meets the needs of the panel has been addressed. But it wasn't in terms of the technical details of the model. Like Ty was saying, I don't think that those technical details are constraining except in the sense that we can utilize this as a foundation. We can utilize new parameter values, looking at sensitivities and uncertainties to cover a range of possible outcomes.*

Marcelino: *If we go through this field of questions and answers and it comes down to we're not happy with the model itself and the professor recommends that we need to do another model, how receptive will you or the company be if we were to make a recommendation like that?*

Tomas: *I think it depends on the specific questions that we're trying to answer. This model doesn't do everything. There are going to be limitations. And if there are other interests that are outside of this model domain, or its capabilities, depending on specifics, it would depend on how we would make a revision or utilize a different model or say that's just not part of the scope of this project. But it really depends on very specific questions.*

Marcelino: *I just want to make sure if there's a little seismic shift with us that the professor is not going to do battle with you or the company. That there's going to be a welcoming format for his perceptions and advice to us. That it is going to be accepted by South32.*

Tomas: *We have a good relationship.*

Ty: Building models is expensive and takes a lot of time. If you are concerned about a specific process there may be a relatively simple model that from your perspective may be conservative, but it might predict worse outcomes than a more complicated model. It depends on what makes sense.

Carolyn: *First of all, it's been a wonderful two and a half years together and I'm impressed with everybody wanting to work on this and come up with the best way possible. I was beyond frustrated trying to take your assignment and go through the questions and*

rank them and do what you asked us to do. I don't work well with spreadsheets that you've got to go down and over on the screen. I've asked Catherine and Joanne to please come up with something that is printable and readable.

Ben: *For the sake of clarity, when you say package, you mean a routine within the platform of modules?*

Ty: When I say package, I mean that. You could say if you use MODFLOW[1] you have different decisions about how to treat a pumping well. Whether it's fully screened or partially screened, all sorts of things. There are different packages that you can use. If I was talking about modeling something entirely different I would refer to that as a different platform. Thank you for that clarification.

Damian: *I think last month you mentioned a very well developed, but localized model, versus a low level model. I'm looking for a little more background on that. Are they both USGS MODFLOW models?*

Ty: All MODFLOW models are developed, built and put out by USGS, which is one of the reasons that it's well accepted, because it has a third-party developer status. Not to say anything bad about other model developers. What I think of as the local model is the mine model. My understanding is that for legal reasons, and fiduciary reasons, we have to assume that we will never see that local model. I'm continuing to push for the idea that what they do with a local model could help to inform us in important ways about how we model the impacts. In that sense, it almost doesn't matter what platform you use for the local model. The way that you model a smaller area, is you make assumptions about what's happening on the boundary of that model. That's the way that it isolates what's happening within that domain from everything else. In general, for water movement, we can choose one of two things. We can either say we know what the water level is on that boundary, and then we can calculate the flow across it. Or we can say we know what the flow is across that boundary we can calculate the water level.

Ben: *Can't it also be a nested higher resolution?*

Ty: We could do it as a nested high resolution, but then the problem is that basically you have to define the boundary conditions on the larger domain. At some point, you have to isolate your domain from the rest of the universe.

Ben: *If we understand correctly, the onsite model, in other words, a smaller model, as opposed to a regional model, is proprietary, right?*

Ty: Absolutely. That's my understanding is that's proprietary.

Ben: *But we want to make sure it interacts correctly with the regional MODFLOW platform.*

Ty: What I think is reasonable to ask is, can we essentially take the predictions from the local model and use them and embed them within our model? Is there anything you're learning about what's happening on the edge of this property? Can we use that to inform the larger models so that we have the most up-to-date information? Is there a way that we can make sure that giving that information is not giving away proprietary information about what's inside? I think that's the tension.

Ben: *If we look at the outputs we should be okay, right? If we're not looking internally?*

Ty: My imperfect understanding is that that they need to make sure that they're not giving away information that would allow somebody to make an investment with insider information.

Linda: *I think it would also be safe to assume, though, that they're going to share whatever they can about that smaller model because they don't want catastrophic results outside that we can blame on that model. The purpose isn't to make it be the worst case, such as, Patagonia will be under 100 feet of water, and they're not going to tell us why.*

Ty: Similarly, the other side of the coin is I think it's in the mine's interest to share information so that, based on their predictions made for something else there aren't going to be problems.

Carolyn: *The counterbalance to flooding concern is drying them out.*

Tomas: *If I can assist in this conversation a bit. The primary result from the sub regional model and the mine site model is actually the pumping rates. Its purpose is to identify how much water is required to pump in order to maintain the watering for the operations of the mine. That is actually extracted directly from that and put into the regional model. The results of that model are included in the regional model. In terms of other aspects, Ty and I have talked about providing some additional information on those boundary conditions so that we can share some of the similarities or differences between the models. But let me be clear, the subregional model, in many ways has no relationship to the regional model, other than providing input to how much are you going to have to pump in order to evaluate larger impacts. That's what the end result is from the subregional model. The questions regarding other boundary conditions and how they're connected to the larger regional model, in many ways, are immaterial to the broader questions of this group.*

Ty: I think that's where it would be really helpful to

[1] MODFLOW is the USGS's modular hydrologic model and considered an international standard for simulating and predicting groundwater conditions and groundwater/surface-water interactions. MODFLOW 6 is presently the core MODFLOW version distributed by the USGS.

have this conversation with the modelers. To make an extreme example, if the subregional model was this size, and the grid cell for the regional model is the size of this desk, then it may not be sufficient to know what the total pumping rate is. Spreading that pumping over a very large area compared to that small model may not be ideal. Maybe they do something where they have a nesting. I do think there's room to have that conversation with the modelers.

Ben: *I think we're okay as long as the regional model gets the pumping rates and does represent the subregional model's geology in the regional model, that we're not having a gap inside of it.*

Ty: I don't think that you'd end up with a gap in a sense of a black box, but the rest of the domain of that regional model has geologic information that's publicly available and it may not be possible to take highly detailed geologic information from just this small part and be included even if it was available. I think the nature of your question is right on. We're not going to ignore that part, and we need to know at a minimum how much water is coming out. That's the stress on the system. I think we're all on the same page. It's an abundance of caution. The other thing that is possible is the small-scale model may also be used for scenario testing, if we needed pumping rate to be in a certain range. Small models can help us to understand what we think the impact might be.

Ben: *We're dealing with the fine line here of what's proprietary information that the company would not want to release and what's public information regarding the model. And so, regarding the questions, though, I'm a little bit perplexed as to why they're all being reviewed legally. I can understand policy questions, procedural questions, questions about the sub regional model. And of course, any proprietary information being legally reviewed by South32. But technical questions, scientific questions. and hydrologic questions about the area? I hope these were not legally vetted by South32.*

Ty: My responses are not influenced by legal vetting. Whether or not they look at the discussion and think that it can have an impact.

Ben: *Before you got the questions, I want to know if they have been filtered?*

Ty: To my knowledge nothing has been taken off or filtered.

Melanie: *The process that we've gone through is when South32 provides a company response it has been reviewed by our legal team.*

Ty: All right. I think we're all rowing in the same direction here. The key for me was to look at this list of questions that have been developed and make sure that we're being clear about some things that have nothing to do with the modeling. And others are related to the pumping rates. The model won't tell you the pumping rates, we need to know the pumping rates to run the model. But it is not easily answered by the model. So that I would say is a related question. There are some things that might be related. You might ask about something like riparian health. This model won't predict riparian health, but it will predict something that would be useful for interpreting that. The outputs from this model should be something that you talk to the Nature Conservancy about.

Ben: *Before you start, I would like to thank Fritz for all the work he has done. I don't take any credit for that.*

Ty: Fritz was super helpful in putting the questions into four general areas: 1) Impacts of regional dewatering and I think you mean the effects of the pumping on regionally dewatering; 2) Flooding in and around Patagonia; 3) Mounding in and around Patagonia; and 4) The dewatering model, and that really is one question about the next phase.

Ty: Let's start with the first group: Impacts of regional dewatering.

Question 8: How (or do) mining operations impact water availability around the area? This is absolutely what this model is doing.

Question 9: How far from the mining operations is groundwater model affected? And what do we know about the water brought to the surface (e.g., age, quality, etc.)? So there really are two parts there. Again, that distribution of dewatering is a primary output of the model. The model wouldn't be useful if it didn't do that. Beyond that what we want to see is from your perspective, it's not what is the most likely, but what is the range of plausible dewatering that we might see. In this next phase, we don't just want to use the calibrated model parameters. We want to say what's the range of those parameters and which of those parameters can still calibrate the model? And which ones give us the biggest cone of depression?

Fritz: *So, what's the next phase?*

Ty: The next phase of the modeling, that we've been moving towards, is prediction phase. It's about taking the base model and thinking about what the uncertainties of the parameters are and predicting those uncertainties and then are there some packages that you used in there that may not be ideal for answering these specific questions? And the question about what do we know about what are being brought to the surface in terms of age quality? That in my mind is not something that's going to be well answered by the model. You might see something about the pathways and maybe residence times of the model, but those questions are going to be answered as water sources come out. You can start doing those measurements.

Ruth Ann: *And what water studies are happening?*

Ty: If number nine is an important question to you

then, then you need to be thinking about what can be measured and where and how often to determine that.

Ben: *We know the age pretty much don't we? I mean, it's connate water.*

Ty: It depends on how distinctly you want to know the age. Do you want to an isotopic analysis of the water to see something about its actual age, or do you just want to say it's old water?

Ruth Ann: *Why is that question important?*

Ty: There's an article in the New York Times recently about mining groundwater. In a very simple sense, you can think of groundwater as either being part of the active recycling groundwater system, or it's been there a long time. Those waters aren't different except that water that's down there would not come up to the surface if it wasn't pumped up. But then if you pump up some of that water, then some of the new waters are going to replace it over time.

Ben: *Okay, I will try to answer your questions because the deeper you go for groundwater the older it is, the more likely it is to have more contaminants.*

Ty: And not just suddenly, it also has to do with the amount of time that has been in contact with the rocks or something in the rocks. Contaminants is a tricky word. A contaminant is basically anything we don't want to have in the water.

Carolyn: *Related to that, I want to mention Sean Schrag-Toso who did his graduate thesis[2] on the age of the water. And it is old water and one of my hydrology lessons was that indicates then recharge issues, which is one of the things that I want to be sure gets addressed. As you're dewatering it, what's the recharge rate that's happening? That's also something that needs to be modeled.*

Ty: The recharge rate is an input to the model. We're not going to determine that from the modeling. That's something that we'll put in as far as the distributed recharge rate. There is a difference in terms of some of the recharges that occurs within the model will occur through the stream. If you're changing the conditions beneath the stream, you might change that recharge rate. There's some information that will come out about recharge.

Carolyn: *When you're saying that though, in my understanding on Hydrology 101 is the underlying geology is different, so discharging as planned into the Harshaw is not necessarily going to recharge the area that's being dewatered.*

Ty: Absolutely true. If I take water out and it conveys here to recharge, then it's not going to recharge where it's being taken out. There is the bank account analogy. If you inherited a bunch of money and you make a bunch of money in a given year, that money that you spend doesn't really matter which one it is. But, if you spend down that inheritance, the way to build it back up is to take more money out of your annual salary. One concern that's been identified here is if you cause drawdown, then you're going to capture some water that's recharging that otherwise may have flowed through that system. So, you see you put this big divot in the water table that has to be replenished.

Marcelino: Professor, I'm just trying to think about when the point comes that I have to explain to the public the impact on the community of aging water. I've never heard the term aging water. How does it affect the realities of the people that live in Patagonia?

Ty: We mean ancient water. Usually, your domestic well is relatively shallow and it's probably capturing a fair amount of this active water, this recharge water. The only thing that I can really imagine that would cause somebody downgrading their well to get older water is if you're somehow capturing that new water upstream and older waters are being pulled up. I think that is something that we could take out of this moment. This would be good to put a pin in: do we have any reason to believe from the modeling that the perturbation has been caused by the pumping is going to change the flow paths towards people's wells that may lead to old water. It's a good question.

Marcelino: *Because I would have a heck of a time trying to explain it. What's this guy talking about ancient water and old water and aging water?*

Ty: You could just tell somebody, well, do you want to drink water that's been in your water tank for a year or 1000 years? If it sits there a long time it has a lot of time to react and its older water. It's not always dirty. It depends on the rocks.

Marcelino: *But we don't think that that water will get into the water table for the people of Patagonia and affect them adversely?*

Ty: My first estimation would be that it's unlikely but that is something that we can address with the model. We can ask is there a change in the flow path? You can imagine water that's arriving at this spot and in a model, you can run time backwards. If I started with water here, where was that water 100 years ago, or 1000 years ago, and you could do that with and without the pumping. You ask what are the capture zones of that well?

Ben: *I think the underlying concern with connate or ancient water is that it took thousands, if not, millions of years for the recharge to get there. And now within six years or something, they'll be gone. You can't*

[2] Schrag-Toso, S., *Isotopes, geochemistry, citizen science and local partnerships as tools to build upon a fractured understanding of the hydrology of the Patagonia Mountains,* 2020, University of Arizona, Department of Hydrology and Water Resources

expect it to be refilled overnight. That's where the recharge question comes in.

Ty: That is a good point. It will refill slowly, and it will be a long-term sink of water rate. That's why the term of water mining has been applied to it. Because it's essentially treating that water as nonrenewable.

Ben: *It has implications to surface waters, for example, a surface perennial flow in the Sonoita Creek. As we dewater the area sufficiently, we have a reversal. We have pirating of that stream.*

Ty: That is something that I think should definitely be examined with the model and would be something that the models should be able to show us. The amount of water that's coming out of the stream and going into the aquifer, it's as recharge. If you pump from beneath the stream, then you have a stronger attracting for that water to go underground. You can increase the rate that water leaves the stream to go underground, which is essentially this, and we call it capture.

Carolyn: *That doesn't feel like it's the situation here. They're all looking at the cone of depression. And I understand there's nine dewatering wells that are dewatering up here and dumping down here. That's my point of it's got to get recharged up here.*

Ty: Imagine the stream is flowing down this way and we have the ground water down here. We take water out of the aquifer and then we put it in the stream. It's so much easier for that water to flow over surface and ground that water that's pumped out is not going to recharge this. But at the same time, we have groundwater that's flowing through that system that previously, even though it's slow, was flowing all the way through that system. Now we've put this deficit there. Some of that water that would have continued to flow just gets caught there. It goes back into storage. That's how it refills. It's refilling either by groundwater flow into it, which is very slow, or if the stream exists above where the mine is, if the stream is flowing past the mine, then that's where you've increased the gradients. You may have more loss.

Ty: Question 13: How will South32's use of water effective groundwater? What is the regional footprint of impacts due to dewatering? I think it's absolutely fair to expect that the output from this regional model will be a projection of the change in the water level.

Question 14: How will dewatering impact residents? How will that impact groundwater and surface water? The impact on surface water is a place where we're going to have to be very careful about exactly which package is used and how it's represented. You can have different reasons to model surface water. You may want to model how are solutes moving in surface water or how is surface water interacting with groundwater, or how does the roughness of the stream affect streamflow. How they're going to model the surface water part is a place where it's going to be very question specific.

Ben: *Will the MODFLOW Prudic package for stream flow show groundwater interaction?*

Ty: The Prudic and Niswonger model was built for separated streams when you have flow through an unsaturated zone, and it's an interaction process and it's a kinematic wave. It's good for what it does, but in this case, it's not what they would apply because they don't have that separation.

Ben: *Let's compare MIKE SHE[3], for instance, where you have much shorter intervals of computation. Wouldn't that be better for capturing our short-lived events?*

Ty: It depends. The time step is a choice you can make no matter what the time. But if your primary interest is in modeling the movement of water on the surface, then a package that's developed to do that is going to be better. Whether that's MIKE SHE or GSFLOW[4], which is built to look at surface water flow, is where that decision comes in about using the strengths of each model and making sure that the model is efficient to do what you want. If you're interested in a big rainfall event and how far does that flood propagate, how high on the banks does it go? GSFLOW is great for that because over the time scale of that impulse the loss of groundwater isn't that important. Question 14 about how dewatering will impact residents? I would say the model will tell you the predicted changes. What that change means to the residents is something the residents have to decide.

Marcelino: *Professor, will the model tell us, if there's a heavy flooding event that has happened, and during that the pumps don't stop dewatering, they're continuously running, what that impact will have to the residents?*

Ty: Yes. This is a case where we could do a fully coupled model. Let's say we use MIKE SHE and this accounts for this infiltration and accounts for adding water to storage in the subsurface. What MIKE SHE is trying to capture is how much of that water is being put in either by a flood or by the discharge from the mine. How much of that goes to the subsurface and

[3] MIKE SHE is integrated hydrological modelling software for analyzing groundwater, surface water, recharge and evapotranspiration processes.

[4] GSFLOW is a coupled Groundwater Surface-water FLOW model based on the integration of the USGS Precipitation-Runoff Modeling System (PRMS-V) and the USGS Modular Groundwater Flow Model (MODFLOW-2005 and MODFLOW-NWT). GSFLOW was developed to simulate coupled groundwater/surface-water flow in one or more watersheds by simultaneously simulating flow across the land surface, within subsurface saturated and unsaturated materials, and within streams and lakes. Climate data consisting of measured or estimated precipitation, air temperature, and solar radiation, as well as groundwater stresses (such as withdrawals) and boundary conditions are the driving factors for a GSFLOW simulation.

then how much how much goes into the ground and how much continues on the stream? And if you think about it that way, any water that goes into the subsurface makes the surface water flooding less dramatic. It's taking some water out of the stream. My approach to looking at that from your point of view, I would say is conservative if you only use this surface water model and assume that no water is left in the stream, then that's going to give you a prediction of what's going to happen with flooding. That would be a place where I think you could address what you want by using a simpler model that's built to look at that process.

Marcelino: *I just got confused, when you say a simpler model does that mean a different model than the model that they've approved?*

Ty: That would be a model that's just built to consider you have a stream with a certain demography and if you add water, how high does the water have to rise to get that much flooding.

Marcelino: *I think that that's a very vital question that needs to be answered by this model so that we feel comfortable as we're explaining this to the people of the affected area of Patagonia.*

Ruth Ann: *My question is what are we going to do with those answers? What is the action? Is it going into the community agreement? Is it helping South32 do something different?*

Ty: The best use of models in my opinion is that you say we have a potential concern and is that concern viable or not? You can use the model to look at what we know and what we don't know. Based on all of the things that we know and assume we just don't see where that's going to be a problem. Then you can take it off the list. On the other hand, if you run these models and you see there is going to be a problem, then you know it goes to the top of your list. You then go to South32 and say this is going to be a problem, how do we rate it, or go to the community and say this is probably what's going to happen. So get ready for it.

Ruth Ann: *All of that action isn't going to happen until they actually start drilling and dewatering and all that actually starts.*

Ty: That's where the GNA is important because it allows you to identify a handful of things that we think are really important and that the modeling says are plausible. If we see this problem, what are you willing to do to help us so that you don't have to be reactive.

Ben: Regarding the question, Dr. Varona proposed, shutting down 10 cubic feet per second during a flood that lasts a few hours isn't going to make any difference. But 10 cubic feet per second 24/7 times 365 the cumulative impacts of groundwater water mounding might raise flooding levels and risks when it comes though.

Ty: In my interpretation the reason that subsurface matters is it removes storage. And the storage capacity is what allows when you have a flood so that water goes into the ground which means you don't have as much of a flooding event. It spreads it out over time. The ultimate extent of that is what if we have no storage capacity? What if we just filled up the ground entirely? That's a worst-case scenario. That's why I think doing a surface water model is essentially saying we have no room for any water to leave. I'm trying to picture ways that we can use it as a worst-case scenario model that's accessible.

Ben: *Especially, for example, in Sonoita Creek where it's already on the surface, a perennial flow, so we know where the water table is. It's not going to take much to rise that and then when the flood comes through how much a problem that is.*

Ty: This question is a really good point to how much of a problem it is right? For instance, I can say you're going to get five centimeters stage change, but how many of us really have a good picture of what that means? One thing that I think would be great for you guys to do, or do you want to talk to me about doing, is finding a place where you have access to train a camera on a stream with a strain gauge. If the model result is five centimeters of increasing stage, you will have an image of what the stream looks like with five centimeters of increasing stage. My understanding is that South32 can't necessarily do this, but I don't think there's any reason for you guys not to do that. Maybe some of you already have property that would give you access for a camera.

Ben: *I love that suggestion; we should find a spot where we have some control for cross section so we could do a rating curve at that crossing.*

Ty: That'd be ideal. You can think about doing that where you have real control like a conduit. Essentially what you're going to get is a better estimate of what the flow rate is, but it may not have as much impact for people as far as what that change is in stages. Maybe, if it's not that expensive, you want to do both. Maybe you want to have one where you can get a good flow. And then another one we can say you know, that place that you drive by every day, this is what that place looks like with one to five to 10 centimeters.

Ben: *When the rating curve is this high, you've got this much CFS [cubic feet per second] going through and when it's not that much more.*

Ty: My concern is that the general public, if you show them a picture of a conduit and they see what the water level is in that conduit, I don't know if that has the same meaning or impact as saying like, you know, where the water goes under that bridge that everybody drives over. This is what it looks like.

Ben: *The underpasses there in Tucson where they actually mark the water level. There's no question.*

Ty: Something like that. The problem with those is that they are coupled with bubblers that tell you the stage and record it. I think what you really want is to be able to provide people with an image that they can relate to. Rather than getting this model result, which is a cold bunch of numbers, they can look at that and say these three points in the graph, maybe 10 centimeters isn't that much isn't a big deal, but maybe two centimeters is a big deal.

Linda: *I am not sure that I'm following but is the image of what people would see is predicted?*

Ty: No. The idea is that if you had a camera sitting out there through a monsoon season, through time, and you have natural variation in the flow rate. Then you have your plot that says here's our prediction at this location: you might get as much as five centimeters of flow. Then you can go back through and say in July, we had five more centimeters in flow and this is what the street looked like. It's a way to illustrate what those changes would be by looking at what it was in the past.

Linda: *I live inside Red Rock, inside the intersection of Harshaw and Red Rock Creek. We have been flooded in for two and a half days in 2017 by just the water. But right now, the creeks are dry so I don't know that putting a camera there matters. I will volunteer Red Rock to be appointed a camera point if that matters.*

Damian: *I think, Linda, it's really something for the public to understand what these changes really are. It's a tool for understanding…*

Linda: *But the water doesn't run anywhere in Patagonia above ground all the time.*

Michael: *Yes, by Turner's property, Turner Loop*.

Tomas: *There's a challenge with that particular location. It's typically point one CFS through most of the year. This wide and about this deep.*

Ben: *It is where the water table is.*

Tomas: *Yes, it is running over rock at that point.*

Maureen: *Do you know, or can the studies answer, what the difference is between how the water is under surface and what the rainfall might need to bring those creeks running? Because in the old days, it used to run right under the bridge there in Patagonia. Not all four creeks would come down at the same time. They always predicted, if they did, Patagonia would be washed away because it would jump the bridge.*

Ty: The major difficulty is what's going to cause all four of those to flow at the same time is meteorological related to storms. The model is focused on the groundwater and its interaction with the surface water. The predictions of what will happen in the future. One of the big uncertainties, as you've mentioned, is climate change impacts. If you have much more frequent, much more intense storms, then the whole system is responding differently. That's a risk.

Carolyn: *A lot of unknowns these days, but weaving together a couple of the questions, I think this monitoring, and wherever we do and however we do it, is also going to become a part of the Community Protection and Benefits Agreement because the modeling will predict this might happen and that's happening. Then a request to South32 if they stopped dewatering for X amount of time that's going to require them to do plans because of the concerns about safety with any workers that might be in the tunnels, etc, etc. That's going to be the tradeoff we're all going to have to live with.*

Ty: This idea of monitoring, measuring your time and adapting, I think is really important and Thomas has agreed to this as well that this will be a living model. If the model is making predictions that aren't matching measurements that are made in the future, then the model has to be updated. But there's also a public engagement or public information part of it, that there are things that you can measure that may or may not be used for the model. Is plugging away within the model…

Michael: *Does the model reflect the current timeframe? I know you can't predict it because we don't know within the 15 wells that are going to be drilled how much water is going to be coming out of there. However, as a homeowner in that area, as time goes on, will this also affect flood zoning areas? Because water being put in has to go somewhere. Have you seen that in your practice anywhere as a hydrologist? Most of Patagonia is in the floodplain and if you buy a home and you mortgage it, it's mandatory that you have flood insurance.*

Ty: I honestly don't know because I don't know how flood risk maps are defined. I have a student now who's doing a US-wide project trying to replace FEMA maps with machine learning approaches. But I think the bigger question here is there something that's coming out of the model that that might inform a change in the way that FEMA defines flood risk. I would ask the question to what degree is your flood risk insurance tied to the water table depth? The FEMA flood map depends on average annual precipitation and the slope of the water. In that case, those things aren't going to change. So, I wouldn't expect that designation would change. But if the FEMA flood map, which I really don't think they are, but if they were sophisticated enough to say what's the subsurface storage capacity for water that's going to ameliorate flow in the flood then that's something that the model predictions, if you have the model predict that the water level was going to be higher, you would have less storage capacity, and so you may have more flooding.

Fritz: *I don't disagree with what you are saying, but*

my understanding is, once dewatering starts and it goes 24/7, everything down Patagonia way will be groundwater saturated. Everything is going to be saturated because you're predicting five quarters.

Tomas: *But that was during the flooding event and that was the increase in stage. Currently, FEMA uses the HEC-RAS[5] model that has been developed for evaluating the floodplain mapping typically as a 24-hour form event for a five-year, 10-year, 100-year, and 500-year storm event. HEC-RAS, as Dr. Ferre mentioned, assumes that water is flowing on the surface and there is no interaction with groundwater. That is the standard FEMA practice for evaluating floodplains. There is a current project underway by Santa Cruz County to reevaluate the topography to reevaluate the potential for flooding within Patagonia and within the region. They've done high-level LiDAR[6] studies to get better topography for that purpose to reevaluate and determine the updated higher resolution information and refine the floodplain moving into the future.*

Ty: I think the direct answer is whoever is doing that modeling if they are including the expected discharge from the mine, then that would be your clearest indication of whether or not the flood risk would change.

Fritz: *What I am trying to tell you is everything is going to be saturated downgrade. You're not going to have any impact from storm events going into your groundwater because it's already saturated. There's no place for it to go.*

Ty: I think the key point here is that the model being used now to assess flood risk assumes there's no infiltration because it's HEC-RES. If it already includes that based on the model it is overestimated flood risk.

Fritz: *What I am trying to tell you is there's not going to be any kind of surface water going into the ground because…*

Ty: …'probably' would be more accurate. Does that make sense?

Michael: *I can see where you're going and I can say we're probably screwed. I'm going to put it point blank because through time…*

Fritz: *…you're not screwed. We've talked about this. Are there ways that you can put some kind of dams, ribs, whatever, that is going to help store that shock you're going to get. Those are the questions you need to be asking.*

Carolyn: *They are the questions that need to be asked and the Flood and Flow committee is involved in working on the FEMA stuff. That's the group of people who have the expertise to be talking about what to do in terms of watershed restoration. The original proposal from the town was a big hole that would fill up some day and nobody in town wanted that. We want to do what we're seeing done by Borderlands Restoration Network, the Nature Conservancy, and Tucson Audubon, which is a much better method of slowing it down, to allow it to sink in. They need to be a part of the ultimate solution.*

Ty: The thing with gabions[7] is that they are most effective where you have ephemeral flow. The flow happens quickly and then there's a long dry period. In that setting, you can imagine that having a barrier that takes that pulse and lets it sit there and infiltrate longer is more effective than if you have continuous flow, then the gabion is just going fill up. I think it's good the Flood and Flow committee is also using models. It's just using a different model than we're talking about here.

Ben: *I agree with Fritz. What he's saying is, with time, the cumulative impact of 10 CFS going downstream will build up the water table. Especially reaches that are already perennial it's going to raise that water table therefore when the flood comes through it's going to raise the water surface elevation of that flood*.

Ty: I remember way back we were talking about the different predictions of the two models. It's really an apples and oranges thing that one of them focused on the big floods. In the big floods, that small amount of added flow really doesn't make a difference because it's such a small difference. In the small flow events, the added the added water is a significant fraction of how much is already flowing in the stream. I think that's where it might be really useful to have these images to say if you had this level of flow, it would take it to this level. So you can really see it.

Ben: *In this scale we know because 10 CFS is nothing compared to 1000s in the big events.*

Ty: It gets to a question of what are you defining as a flood? This can be any increase in flow over what would have been expected or it can be flow above some threshold that is expected to cause more damage.

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[5] HEC-RAS stands for Hydrologic Engineering Center River Analysis System. It's a software program developed by the United States Army Corps of Engineers (USACE). It is a one-dimensional steady flow hydraulic model designed to aid hydraulic engineers in channel flow analysis and floodplain determination. The results of the model can be applied in floodplain management and flood insurance studies.

[6] LiDAR (Light Detection and Ranging) is a remote sensing method that uses laser light to examine the Earth's surface. It works by sending laser light from a source (transmitter) and reflecting it from objects in the scene. The reflected light is detected by the system receiver and the time of flight (TOF) is used to develop a distance map of the objects in the scene.

[7] A cage, cylinder or box filled with rocks, concrete, or sometimes sand and soil for use in civil engineering, road building, military applications, and landscaping.

Ben: *My bottom line on this question is asking South32 to shut down at 10 CFS because we either having a flood or it's eminent makes no difference*.

Ty: I've said this many times. I think the optics are not going to be good. But it's not going to make a big difference.

Carolyn: *To tag onto your comment, Ben, the alternative to discharging into Harshaw is rerouting the water to a place that is actually recharging.*

Ben: *That's why I keep advocating for an alternative infrastructure.*

Marcelino: *That's a valid point that you bring up and it helps me in my understanding because we wouldn't have to demonstrate that to the people of Patagonian as we're going through this process because if they see that they're having a flood, and then they find out that they're also still pumping water down there and enhancing the flooding, which by your statement is not really going to enhance it. They just need to understand that before. Like the professor says the perception of the optic for South32 would be atrocious. I mean, if there was damage done to the town or something they would hold you responsible even though there's really not that impact. So just something in the future for us to look at with this model. So we can explain way ahead of time before anything goes wrong.*

Ben: *And to be clear, the impact would be from the cumulative CFS not from shutting it down at an incident when the floods come. One is an instantaneous peak flow that we're talking about on surface water. The other one is cumulative impacts over 60 years of continual pumping, that buildup of groundwater model raise the water surface elevations in your water table and then when the flood comes through then they would be right to save costs.*

Ty: The way that I think about this is you have this stream that's flowing. As it flows, if there's room underground for some water to go there, it will go there. Any water that goes into the ground is taken out of that storm event.

Ben: *In perennial regions there is no room left.*

Ty: That's also tricky because it can be perennial but disconnected. But sometimes I can take my professor hat off. But I think you guys have spent a lot of time thinking about water, and talking about water, so these concepts can resonate with you. But somebody that hasn't had that advantage is not going to know what that 10 CFS doesn't matter. I keep coming back to the more that you can do to really illustrate this will be most helpful.

Linda: *We have 45 minutes left. What's the most important of your four categories?*

Ty: I think the first one is. The second category is 'Flooding in and around Patagonia' and I think to a large degree, that's the Flood & Flow committee. I think that the impact of this model on the flooding or the increased load Patagonia has to do with exactly what you're talking about potentially filling up that storage, so you don't have that buffer. The third category, 'Mounding in and around Patagonia,' is something that that we'll come up with this model. If we have the aquifer and the stream exchanging water, then we will see that buildup in the model. And, that's another place where we want to be careful about the way that routing is considered in the model so that we allow for that mounding. The fourth category, 'Dewatering Model,' is about the next phase of the model, which I would call that a prediction phase. It has everything to do with how do we go from this base model to making sure that we have those answers that you can then use to make decisions about what we should push on, what should we think about trying to get earlier? And what can we just throw because it's not useful.

Marcelino: *But how do we do that?*

Ty: I think what's really important is that everything that you're thinking about going on the Good Neighbor Agreement has an associated question on this sheet.

Linda: *And vice versa. Every question on the sheet has a reference in the CPBA.*

Ty: Question 15: Can you explain the cone of depression created through dewatering? Will the removal of ground water cause dangerous geologic formations like sinking of land? The simplest way to think of a cone of depression is to imagine that we have this flat line with sandy area that's full of water. We put in a straw and then we start pulling water out. You're going to first pull water out from where that straw is and then slowly that water is going to come to respond to that reduction in the amount of water that's present in the straw. What that means is that right near the straw, you have this big drawdown or this big depressurization. And the farther and farther away you go, the less impact you see. So, the mathematical description of that is a cone in three dimensions. Through time if you think of that straw with this water table like this, you can imagine the water running down the water table, and it's running towards the well. When the well is taking water up and that's fine, it's just there and it's taking it up. When the well stops pumping, that water still flowing towards the well, it has nowhere to go so it starts to fill up with storage. Over time that cone of depression slowly fills up and eventually gets back to where it was.

Ben: *It also expands with time; the wings start to relax.*

Ty: The edges do because there is still a gradient, so water is still flowing so it's actually taking in water even after you stop pumping.

Ben: *But the land subsidence[8] part of this question I don't think applies up here in the area we're talking about. This is for big deep alluvial basins where you have land subsidence and then fissuring.*

Ty: There is a question, and this is not a question that will be answered this morning. Ask a geologist if you change the water pressure, could you activate faults? It's unlikely, but it's possible. You are taking a fair amount of water out and the most likely place for that to happen is right near where you're pumping. These guys have an interest in making sure that that's not going to happen.

Damian: *On that point, the cone is not uniform. So, there might be areas impacted that are much further away from the actual pumping.*

Ty: That's something that we would like to have some indication from the mine that on their small-scale model, is it reasonable from what they're seeing to treat it as if it's isotropic. As if to say we can put the well in the middle and draw water equally in all directions. Just so we know that if they're seeing all of this drawdown is pushed in one direction for some reason, that would be something useful to be able to incorporate.

Ben: *Which brings up a very basic question in my mind regarding the way the model was set up. One of the most important things is how that geologic basement is modeled. With your familiarity of the Cienega Creek groundwater basin, did you get a chance to examine that the geology matches the Cienega Creek groundwater basins geology, because we are in the Cienega Creek groundwater basin.*

Ty: I've reviewed their report, which would be their first report, and it seemed quite comprehensive to me. I can't say in particular how much detail of that was built into that second model. That's a good question. Let's put a pin on that question.

Ben: *The reason I asked that is because when I saw NewFields cone of depression, it didn't reflect the fact that there are two different groundwater basins there. The Cienega Creek groundwater basin, it stops right there before Patagonia Lake, Tellez Chapel, and Circle Z Ranch, and then there's the Santa Cruz AMA downstream from that but you look at that model, and the contours of the drawdown lines, and they were hard to see, but it didn't look like it was reflecting that geologic shunt there.*

Ty: That was the one figure that I was concerned about. Flow basically seemed to be moving across an impermeable boundary.

Tomas: *If we are talking about Red Mountain, there's a low permeability unit that's represented there. You see a shift in green and you still perceive flow moving northward generally. Even though its low permeability, it's not impermeable, there's nothing that's modeled that's impermeable, it's lower permeability so you see gradient changes.*

Ben: *So, talking about the area downstream from there just below Patagonia Lake where you see that Santa Cruz AMA is separated from Cienega Creek groundwater basin I don't see where the model picked this up.*

Ty: Do you still have access to that figure? Send it to me and then we can make sure we are talking about the same thing. I'll be happy to follow up.

Tomas: *An additional comment is, unlike a lot of alluvial basins which are simulated throughout the state where you have much larger pumping, where a lot of the cities are located in these alluvial valleys, we're talking about groundwater flow within a fractured bedrock environment. We're in the middle of the where all of the flows split. All of DWR's[9] models say that everything in the mountains is impermeable. So that's a general modeling condition. Actually, where we're modeling is where most people say that there's no water. There is conceptual difference from AMA models where they're separating out flows in different areas. We're flowing and pumping from an area that most of what a DWR looks says there's no water there.*

Ben: *The reason they're separated is not because of how much water is there, there's definite geologic shunting going on right there where the road is met by basic bedrock on both sides. We know from the geology underlying there are two different groundwater basins.*

Tomas: *I agree. What I'm saying is we're pumping from bedrock. All the rock units underneath Hermosa are bedrock. To say that there's no flow across bedrock that's what we're pumping from. There is water flowing through that region, but as a much smaller amount. I want to clarify that in most cases, people talk about bedrock as being no water. We're pumping from a supposed place where there's no water.*

Carolyn: *I hear what you're saying. As a long time local I've always heard the mountain described as fractured geology and that's why water flows everywhere. That's why Asarco shut down in the 60's because their tunnels at 400 feet were filling with that water because it flows throughout the mountain.*

Tomas: I agree. From a broader hydrologic simulation that's usually discounted by most hydrologists. They don't look at the mountains as being big contributors to flow.

Ty: I think we're all saying similar things. It's the contrast between the medium inside the basin and what we all think of as impermeable. The ability of

[8] Land subsidence is the gradual settling or sudden sinking of the Earth's surface due to changes that take place underground.

[9] Department of Water Resources

water to flow through one or the other is so different that for many applications, you can just ignore what's happening in the mountain. But, if you live there, or if you're trying to pump water out of it, then you have to represent that.

Question 19: Will springs dry up? This is something that is absolutely included in the model. We will need to be careful about the way that we define the boundary condition at the spring. Generally, we're not dealing with the spring necessarily as a defined feature. We're saying if the water table ducks below that spring elevation, then it is dried up, and if it goes above, it flows.

Ben: *It can also be reduced, if not totally eliminated.*

Ty: Question 23: We need to discuss where the water truly feeds into Patagonia – what impact does Mt Wrightson to Sonoita have as to the watershed in Patagonia? What I picture we'll get out of this model is each version of the model with each set of parameters is going to give us a map that shows how the water level will change. And what are the paths that water is taking through the system. In terms of saying what is the source of water to Patagonia, the way you do that is track back along those flow paths and say the water is starting here. If we see no significant change in those flow paths, then we would say there's no significant change in the source of water.

Question 29: Change in groundwater level in shallowest aquifers? Change in spring and stream flows? In the shallowest aquifers, one thing that we're going to have to be aware of is how the streambed sediments are handled in the versions of the model we used to identify. That's the key question we have. If you don't include the aquifer, then it's not going to predict what happens in that aquifer.

Question 30: How much of Harshaw Creek discharge (from mine and natural) will be captured by mine pumping? The idea of stream flow capture is an important one because a lot of our attention has been on what's put into the stream and going downstream from there. But another thing that we'll get out of the model is with predicted pumping and lowering of the water table, what would that do to exchange between this history and the groundwater upgrading from that.

Question 47: Will water be available for the area, and potable? It's a broad question, but what we will be able to say from the model is whether or not the water levels are predicted to drop and whether that would be too low to extract water using someone's existing well, for instance. In terms of potability, the clearest thing to say is whether or not our source of water has changed. Do I recall that you guys monitor water quality that's being put into the stream? For the most part, the water that's put into the stream is going to be the chemistry of the water that gets down to Patagonia.

Carolyn: *Well, I would raise my hand on that one. Because the water will travel through what are already known as areas that are contaminated from prior mining, like Queen Mine. Even though they test at the point of discharge it is then going to, in my personal opinion, change as it flows downstream and gets to Patagonia, both in terms of the quality of the water, but also the impact on the habitat in the area.*

Ty: No question. The water that's arriving now is already flowing through that. I don't expect that that added water, unless there's a chemical reaction between the added water and the sediments, that you'll see a real change.

Carolyn: *I think that it is going to move a lot faster and that could potentially be the change instead of the rate it's moving in now. When you dump in six and a half million gallons of water per day that's going to change it.*

Fritz*: Dilution.*

Carolyn*: One can only hope.*

Ty: We can think of this as a mixing project. We have a certain amount of water that they're testing that they know what the quality is and what the composition is. And you have the one that's already flowing through the system. We know what its composition is. My first guess would be that you can have volumetric averaging of those two water qualities. The only differences I could see is if you have a higher flow there could be times when you release more sediment, or you transport more sediment. Or it's possible that something in this added water might react differently with something that's in the system released. But pretty unlikely. I don't see why you're going to have huge surprises about what the chemistry is going to be.

Carolyn: *The Town of Patagonia is monitoring water for some things but not for all contaminants. You've looked at their list. What comes to my mind at this point in time is the manganese because that is incredibly toxic and airborne. I've pictured it airborne floating, landing in the water and that's going to change it.*

Ty: That won't be captured by this model. But if that's a concern, it's worth asking for air quality monitoring.

Tomas: It is a requirement for us to monitor air quality and will be made publicly available.

Ben: *Let me say that heavy metals, E. coli, bacteria, and viruses tend to bond themselves to sediments and lay on the floodplains. Now 10 CFS is not going to cause any flushing. It's not enough because we get several 1000 coming down there with any good rain event so they've already been flushed to that level. I wouldn't worry about 10 CFS flushing out heavy metals from the Harshaw Creek flood plain or E coli and anything like that.*

Ty: Question 52: The geology around Patagonia appears to be limiting for any large storage. I had asked if Patagonia Lake would fill and overflow downstream, and if Hermosa had evaluated storage in the area downstream of the Patagonia Lake (see the link below). I think it is important to understand the downstream storage, the area impacted and any effects whether positive or negative over the life of mine. Unfortunately, this information may be more beneficial to Nogales and/or Rio Rico but it is still part of puzzle. This question is basically asking about storage and whether or not Patagonia Lake would overflow. We used to do our Hydrology Field Camp downstream from Patagonia Lake and I think the regular outflow from the dam is higher than 10 CFS. If you have 10 CFS extra coming through the system I think you're going to be able to handle that with increased outflow beneath the dam.

Ben: *It's been said that dam leaks.*

Ty: We did all sorts of measurements down at the base.

Ben: *And there are springs below downstream of the dam.*

Ty: The creek below the dam has flow all the time. And, they have to check the release structure every year, so I think that dam is pretty buttoned down.

Carolyn: *I think as we're developing through this process and the questions and the answers, and where this group fits, the intention is also to reach out to the larger community. So, then you'd have people from the State Park involved and looking at what we've arrived at as our product, who could then give that individual information. I'm just using that as an example, but they will have it for outreach.*

Ty: Letting somebody from the park know that this is the expected discharge, assuming the hose came straight from South32 into the lake, and asking them, can you guys handle this?

Question 55: How many dewatering wells will be needed and what will be the maximum pumping capacities of each well? Will dewatering activities impact the public water wells in and around Patagonia by lowering or increasing the water table? My guess is that that's not necessarily a number that you would get, you might get something about total.

Tomas: *4500 gallons a minute is the maximum capacity for our water treatment. That will be the maximum that we would ever be able to produce. As has been mentioned previously, there are nine dewatering wells going into the site permanently. Those are all surface dewatering. They're going to have a various range of production values individually, but the maximum is 10 CFS.*

Carolyn: *How much water are you taking out?*

Tomas: *It's a much smaller quantity than the 4500 as a maximum. We actually have a very low water use projection associated with the mine. Our desire, that's been mentioned before, isn't to pump a bunch of water. If we can dewater and make the mine safe, then we'll pump much less water. We have to plan much like some of the conversations here for the worst-case scenarios. Not because that's what we're planning on but because we need to be able to make sure that we can handle some of those worst-case scenarios.*

Marcelino: *When you're ready to drill into the mountain or down the mountain, does the drill use water?*

Tomas: *The shaft sinking is a vertical shaft. They will use small scale blasting because it's going through the rocks. And then they'll muck that out. And then they'll put concrete levels and concrete up the sides. It will be a gradual process, but it's not really a drill, per se. The diameter of the shaft will be 25.'*

Ty: Question 59: What is the predicted aerial extent (radius) of the bottom of the expected cone of depression? This will be a direct outcome of the model. The entire map of that cone of depression.

Question 60: Are any dewatering or contamination impacts expected to affect the San Rafael Valley (East side of Patagonia Mountains divide)? Dewatering is something that you would definitely get out of the model. Do you recall how they represent that divide?

Tomas: *The extent of the model actually encompasses the San Rafael Valley all the way to the Huachuca Mountains and incorporates that full watershed.*

Ty: In terms of the dewatering contaminant, just like the water quality, you're going get any changes in expected water flow pattern. A little bit of background. Modeling the movement of water is the first thing we generally do. If we're concerned about the movement of contaminants, we put another model on top it. We need to know the water flow and include all the processes that affect the contaminant transport or solute transport. If you have a source of contamination here, and your well is there, and the water is going that way, then you don't have to worry about it. If you have that same thing, and any activities you do don't change the patterns of water flow significantly, then you can make the conclusion that it's not going to change the expected contaminant.

Ruth Ann: *Where would the monitoring be done on what's flowing into the San Rafael?*

Ty: It's really difficult to directly monitor water flow in the subsurface. What we do is monitor the energy level, the water level, and then from the water level, the pressure, we can tell which direction the water is moving. Specifically, we wouldn't really measure what's flowing into that basin or anywhere on the

model. But we would see is there any change in that energy distribution. Will there be any change in the expected flow? We can't measure the flow directly, so we infer the flow from the model.

Ben: *Will there be any monitors in the San Rafael site so we can get some more levels of changes?*

Tomas: *We have 73 sites that South32 monitors throughout the region. There are 84 different seeps and springs sites that we monitor around the entire Patagonia mountains that are listed on our website. The information we collect from community wells belongs to the well owner and they decide if they want to share it.*

Carolyn*: Is the private sector monitoring within a three-mile radius or a five- mile radius or?*

Tomas*: It is not a specific radius.*

Ben*: I may not be recalling correctly. But did Newfields image on the cone of depression, and the storage drawdown areas, extend into Mexico? I know the model did, but I can't recall if the actual impacts of drawdown extended Mexico and if so, do we have monitoring wells there to calibrate?*

Ty: Those were semi schematic drawdowns, and I don't think that those were predictive quantitative outcomes at that point. They will be when the model is done. Even if it extended into Mexico I don't I don't know the answers to what the monitoring would be there. But you don't necessarily have to have measurements in all parts of the cone in order to nail it down. So even if we only have measurements in the USA we can still calibrate.

Ben: *And there's gravity stations you can also use to detect groundwater level changes over time.*

Ty: Those are tricky. I've had a couple of PhD students work on gravity measurements and they're good, but they measure the change in mass of water. If you have something like a fractured aquifer, you can have a big change in water level without taking a lot of water out of the system. So that gravity becomes very insensitive. It has a little bit of variable sensitivity in terms of finding water level, but it does a really good job getting water mass.

Question 69: Can South32 provide updated 'impact simulation' (dewatering depth of 4,500 feet at a pump rate of 3,200 gpm)? You'd certainly be able to run the model with that. This gets to how that result is incorporated into the regional model. It depends on the size of the cells and whether or not the actual depth of that well is going to make that much difference with a big cell like that. We need to talk through the why. Is there a specific reason or concern to do that?

Question 70: What will be the depth of the de-watering wells on the mine site? That depends on the drilling. Some of these details may not make that much difference outside the model cell closest to the edge of the mine's detailed model.

Question 71: Based on the updated impact simulation, state and show what springs, seeps, wells, and monitoring wells are impacted by the dewatering activity and/or the release of treated waters into the creek? The primary output from this model, or these models, will be those drawdown predictions that will tell you about dewatering wells and affecting springs.

Question 72: As a point of clarity here, you're not taking any water for the mine from the town of Patagonia, not disturbing any of their wells or anything like that? My assumption is that you guys want to have as little water to deal with as possible not taking more water out of the ground than you need to. I wouldn't expect you to be taking water from the town.

Question 73: When you say if we dry up a neighboring well, we'll deepen it for them. How are you going to make sure they're still getting the same water quality? Because the deeper you go, the less the quality is, and the pumping cost increases. You got to pump it from farther down. So, are they fully compensated with a new deeper well, or well with good water quality? And, you know, some compensation for their increased electric bill? Or is it just well, we'll drill deeper for you? This is a great question for the CPBA. If you have a concern and if the modeling supports that concern as valid and worth spending your time on, then you want to ask exactly these questions in the agreement.

Question 75b: What is the projected change in hydraulic head along the groundwater divide? In a model boundary, you can choose one of two things that you know and you have to calculate the other one. You can say what the water level is, and then you calculate the flow rate. Or you can see what the flow rate is and you calculate the water level. On a groundwater divide you say that the water flow is zero because it is the divide, so we'll be able to calculate the head. This would be an output.

Question 75c: How is it expected to impact direction of flow and magnitude of flow? This is something that from the resulting model results will show us the change in water level and also the changing patterns from that. The magnitude of flow is affected by the hydraulic conductivity and the ease with which water can float to the subsurface. That's hard to measure in the laboratory on a small thing very accurately. There's always a bit of uncertainty in magnitude flow and velocity of flow. But in this case, what we're looking at is what is the change in something due to pumping? One thing that we'd be able to say is the model of calibration in an area, if the flow doesn't change because of the pumping, then no matter what the flow was, it'll still be that. So that's something more certain for us to be able to say.

Note: Unbeknownst to Catherine, the Panel, and Melanie, the Q&A document that Ty sent to Melanie to show on screen during the Panel meeting had been modified by Ty, which changed the numbering and the order of the questions. We've been careful to maintain the integrity of the numbering, even though some of the questions are similar and are in random order. Ty answered Question 91. This is the actual *Question 83: Will there be water for Patagonia after the life of the mine?* In consultation with Ty, he would prefer to answer the question in person to be sure the Panel has an opportunity for clarification.

Question 91: It is assumed the downstream aquifers from Outfall 002 will be charged and at full capacity or so. Correct? Once dewatering has slowed or terminated, what is the likelihood of the downstream aquifers draining back into the dewatering cone and being dewatered? Does the model address this? The model addresses this. The only stipulation is that we need to run the model long enough to address this question. Since this question is here, we'll make sure that the model runs beyond an expected end of pumping to see what the recovery period is.

Carolyn: *Is the Clark deposit going to require the same level of dewatering? I think there's a significant estimated mine life difference. My understanding for the Taylor deposit is 20 years and the Clark deposit is 60 years. So that's part of the reason I asked is dewatering going to be necessary over on the Clark deposit area like it is on the Taylor deposit area.*

Tomas: *Because the Taylor deposit is much deeper, much of what you would encounter in terms of need for dewatering in Clark is eliminated because you actually dewater Clark as a function of dewatering Taylor.*

Carolyn: *It's also got a longer projected timeline, 60 years versus 20 years.*

Tomas: *It does, but the number of tons is extended over a longer period of time for Clark. Right now, there's minimal demand from a market standpoint. We're projecting out a smaller amount of mining for a longer period of time, as opposed to Taylor, which has a more concentrated mining effort because there's demand for those minerals on the short term.*

Note: The next three questions Ty was supposed to answer were Questions 86, 87, and 88. He actually answered Questions 94, 95, and 96 on the Q&A document. For reference, here are questions that will be answered at the next meeting he attends:

- Question: 86: Mounding near and around Patagonia. If mounding has the potential to create issues, what will be the mitigation plan?
- Question 87: How will the discharge into Harshaw Creek impact downstream flooding or damage to infrastructure?
- Question 88: How difficult would it be to change the point of dewatering discharge from upper Harshaw Creek to a gravity flow pipe lay outlet discharge in upper Sonoita Creek which would mitigate the direct impacts of groundwater mounding flood risks in Patagonia, and would also help to slowly return some percentage of recharge to also mitigate the eventual long-term drying of the entire area, as shown in Newfield's "Area of influence"? Tomas agreed that was an "Excellent idea" but said that it would require more permitting. Fast 41 should enable faster permitting.

Ty: Question 94: Will the model show the approximate area along Harshaw Creek where the short-circuiting basically stops? Fritz, I'd like to follow up with you specifically about this in terms of short circuiting. I think you're talking about exchange between the surface and groundwater where it's a hyporheic[10] type exchange. The model, as set up now, would not be looking at this.

Fritz: *You've got this drawdown column, and we really don't know where it is, and what are the impacts and what it's going to be. Let's say it extends all the way into Patagonia for instance, how much that water is going to be drained back out of those pumping the aquifers.*

Ty: If you have a well, what really matters to you, in a sense, is whether or not I lower the water level. If we know the extent of the drawdown cone, then we can see where on the map is the gradient back towards the well. That'll come directly out of the model. We'll also see during recovery that the cone can continue to extend. At any point in the modeling time we can say, here's your well, what's the direction of water flow, and what's the projected water level.

Question 95: Does the model show the interaction between surface water and ground water? Yes, it depends on how we implement it in this last phase.

Question 96: Is the model capable of modeling stream flows or identifying spring discharge changes? It will say whether or not they will decrease or stop, but over the actual flow rate of the stream I'm not entirely sure how well the hydraulics of the stream are included in the model. We would be able to say that we don't expect to see change, or we expect a problem here.

[10] ***Hyporheic exchange*** occurs as stream water circulates into and out of the stream channel, bed, and banks, to mix with the adjacent groundwater system.

SOUTH32 HERMOSA

Project Update
September 2023

ONGOING PERMITTING & SITE ACTIVITIES

1. Flux Exploration Drilling Plan
   - Plaintiff's motion for preliminary injunction denied, moving forward (7 pads, ~1.8 acres)
2. Small Tracts Act (no update)
   - USFS Review
3. AZPDES Permit
   - Unable to provide an update due to pending litigation
4. APP Permit (no update)
   - Arizona State Superior Court denied PARA's motion to stay the WQAB decision during pendency of appeal
5. Site Exploration
   - Continuing shaft sinking activities, shaft depth planned for 2900ft.
6. Off Site Projects
   - CCC Construction
     > Finalizing phase 1 grading
     > Target project completion date is June 2024
   - 9001 Bridge
     > Resume construction October 2 – public detour planned
     > Target project completion date is March 2024

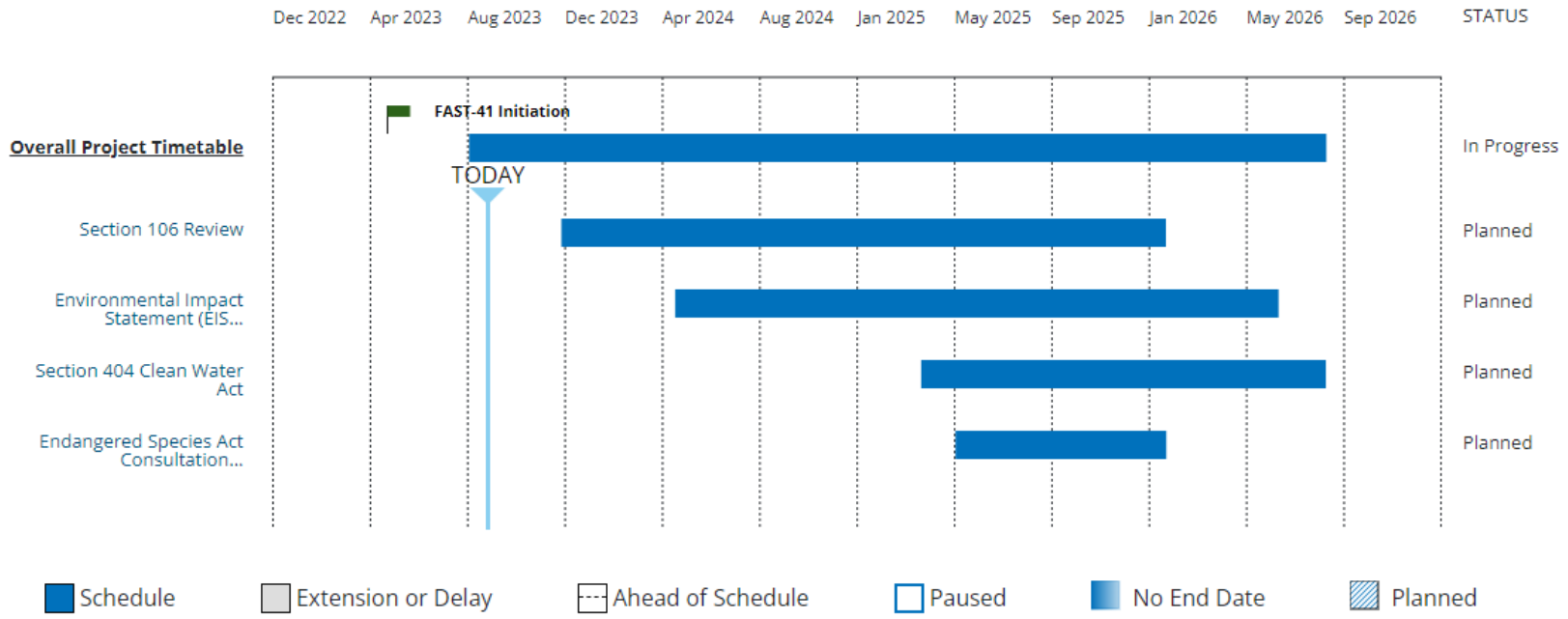
FAST-41: PERMITTING COUNCIL AND DASHBOARD

- South32 Hermosa Critical Minerals Project | Permitting Dashboard (performance.gov)
- Mine Plan of Operations (MPO) submitted to U.S. Forest Service in August.

Permitting Timetable

The permitting timetable below displays data as reported by agencies. Dates for Environmental Review and Permitting processes (Actions) that are in 'Paused' or 'Planned' status are subject to change and are not indicative of a project's final schedule.

- For information about extensions, select an Action from the timetable below and select 'View Action Details' at the bottom of the page.



Action Information

For additional information, please select an Action from the Permitting Timetable above.

MINE PLAN OF OPERATIONS

What is a Mine Plan of Operations?

- Focuses on lands located on or beneath National Forest Service land.
- Submitted to the lead agency (U.S. Forest Service) on August 17, 2023
- Built around the regulations and does not include all the technical information

What's happens next?

- U.S. Forest Services reviews for completeness (December 17, 2023 on FAST-41 schedule)
  - Everything presented today is subject to change until deemed complete
- Anticipate will be complete end of calendar year 2023

Then what?

- U.S. Forest Service prepares a report describing the environmental impacts of issuing a permit
  - Environmental Impact Statement (EIS)
- Timeline throughout this process can be tracked on FAST-41 dashboard

MINE PLAN OF OPERATIONS – WHAT'S IN IT?

Chapter 1 – Introduction

- Describes the location of the Plan Operations and Project, the operator, land status, and summarizes acreage disturbed or utilized by Plan Operations.

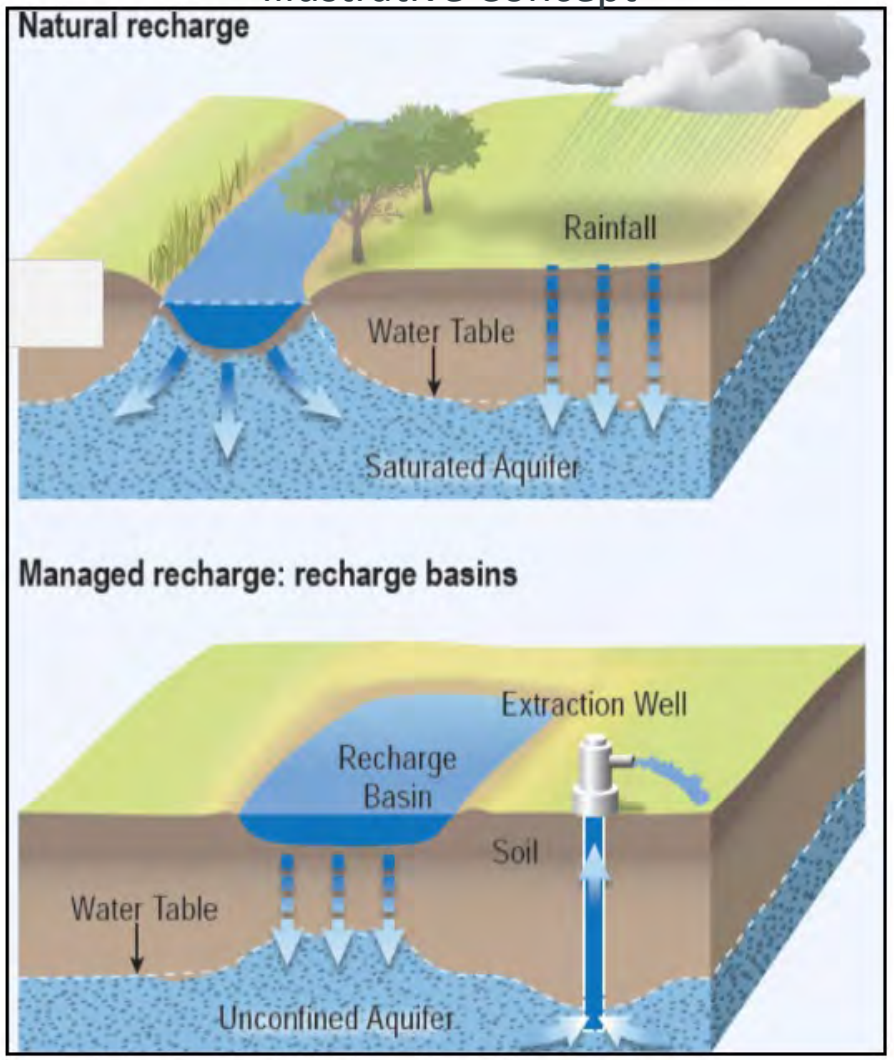
Chapter 2 – Project Description

- Describes the proposed uses of U.S. Forest Service land
  - Dry-stack tailings facility
  - Permanent access route (Gas-line route)
  - Exploration work (surface and underground exploration activities)
  - Water management (Rapid Infiltration Basins)

Chapter 3 – Environmental Protection Measures

- Describes the applicant proposed environmental protection measures to minimize potential environmental impacts to air quality, water quality, scenic values, fisheries and wildlife habitat, and cultural resources, as well as the management of solid waste and public safety.

Illustrative Concept



MINE PLAN OF OPERATIONS – WHAT'S IN IT?

Chapter 4 – Temporary Cessation of Operations

- Describes those measures that would be implemented in the event operations temporarily cease on NFS land

Chapter 5 – Reclamation and Closure

- Describes the proposed strategy that would be used to reclaim and close facilities on NFS land at the end of operations

Chapter 6 – Literature Cited

Appendices

- Appendix A – Roads Plan
- Appendix B – Stormwater Management
- Appendix C – Materials Management

HOW THE PANEL (& PUBLIC) SHAPED THE PLAN

Permanent Access Route (Gas-line route)

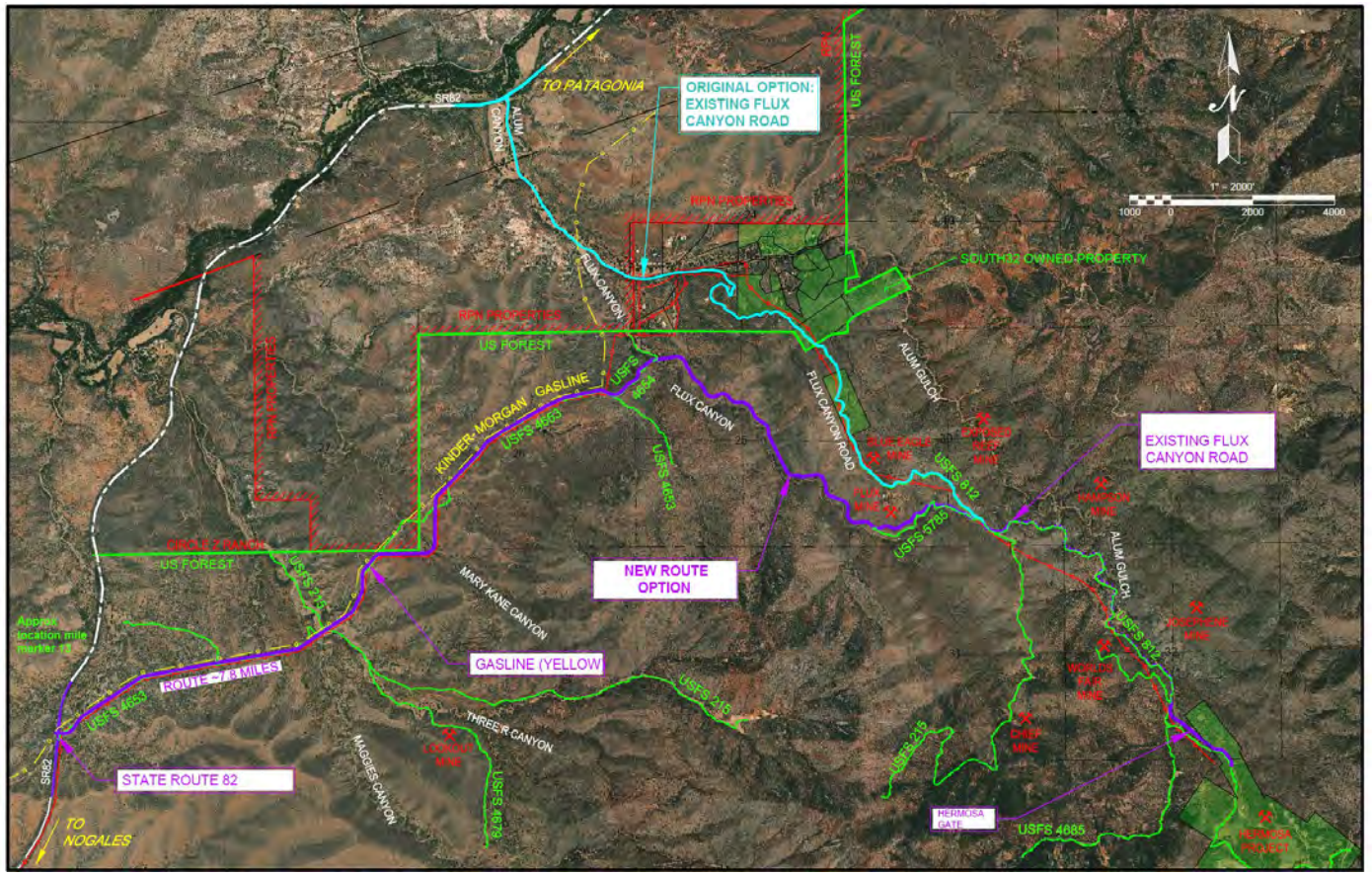
- Re-evaluation of Flux Canyon Road, preference for gas-line route
- Areas for continued hiking access
- Avoid SR-83 (not in MPO because not on USFS land)

Water Management

- Rapid Infiltration Basins
  - Preference for recharge

Community Investment (not in MPO)

  - Richardson Park improvements



PANEL WEBSITE

www.sccadvisorypanelonsouth32hermosa.com


SOUTH32

Town of Patagonia Flood & Flow Committee Update
for the Santa Cruz County Advisory Panel on Hermosa Project
Presented by Panelist Carolyn Shafer as a Flood & Flow Committee Member
September 20, 2023

The Town of Patagonia "Sonoita Creek Flood & Flow Committee" ("F&F") which conducts (currently via Zoom) monthly public meetings the second Thursday of each month at 10 a.m.

CURRENT PROJECTS

This is a summary report of Flood & Flow (F&F) Committee activity during August & September, 2023.

1. There were an updates about working with the Coronado National Forest to draft a Watershed Restoration Action Plan for the Harshaw Creek sub-watershed.

2. There were updates on the School Canyon failure of CCC structures; there were discussions with the Forest Service and with South32.

3. There was an update on the August 2 meeting on the Patagonia Regional Flood Control Project Feasibility Study.

4. Chris Kuzdas and Morgan Ross of the Environmental Defense Fund gave a presentation on the Water Leadership Institute. A follow-up planning session is scheduled for September 26.

5. The Committee voted to move the monthly meetings from the second to the third Thursday.

The next Committee meeting is scheduled for October 19, 2023.

INFORMATION for the Santa Cruz County Advisory Panel on Hermosa Project
Presented by Panelist Carolyn Shafer as a PARA Board Member
September 20, 2023

These are three sources for information relative to water issues in the Sonoita Creek Watershed that I recommend:

- The Town of Patagonia "Sonoita Creek Flood & Flow Committee" ("F&F") which conducts (currently via Zoom) monthly public meetings the third Thursday of each month at 10 a.m.
- Friends of Sonoita Creek ("FOSC")
- Patagonia Area Resource Alliance ("PARA")

UPDATES:

AQUIFER PROTECTION PERMIT - a legal action by PARA against a state agency for failure to follow state statutes that require a point of compliance:

- ADEQ filed its Answering Brief on Jan 23 and South32 filed its Answering Brief on Jan 26. PARA filed its Consolidated Response Brief to both Answering Briefs on February 13. The Court has said that during the week of September 18, it will issue a decision or a date for oral arguments.

ARIZONA POLLUTANT DISCHARGE ELIMINATION SYSTEM (AZPDES) PERMIT - a legal action by PARA against a state agency for failure to follow Clean Water Act regulations:

- On March 10, ADEQ released its Decision to Renew the permit. PARA filed its Appeal on April 7.

- Multiple legal documents have been filed. All parties are waiting for a hearing date before the Water Quality Appeals Board on procedural matters.

- PARA has notified the Environmental Protection Agency (EPA) that in PARA's experience the AZ Department of Environmental Quality has failed to protect the region's water supply and the health of our community and the environment. As the letter states "To this end, we write here to request that the EPA exercise its oversight authority of ADEQ to ensure that ADEQ fully complies with its obligations under the Clean Water Act." Specifically ". . . ADEQ has inaccurately concluded that the Hermosa Project is a continuation of an "existing mine" under the CWA. However, the Hermosa Project represents an entirely new industrial mine and South32's current and planned mining activities at the Hermosa Project meet the definition of "new source" or "new sources" [40 C.F.R. § 122.2 and 40 C.F.R. § 122.29(b)] under the Clean Water Act and as such, are subject to all new source performance standards and the requirement that ADEQ complete all Total Maximum Daily Load (TMDL) studies for Alum Gulch and Harshaw Creek, and perform the corresponding wasteload allocations for these impaired waters prior to issuing the AZPDES Permit to South32 (if at all)."

- On Sept 19, the Santa Cruz County Board of Supervisors will discuss and vote on sending a letter to the EPA to exercise its oversight authority of ADEQ to ensure that ADEQ fully complies with its obligations under the Clean Water Act.

- On Sept 27, the Town of Patagonia Council will discuss and vote on sending a letter to the EPA to exercise its oversight authority of ADEQ to ensure that ADEQ fully complies with its obligations under the Clean Water Act.

- The Water Quality Appeals Board has scheduled a September 26 hearing to discuss PARA's motion to review the Board's August 17 decision to dismiss PARA's motion.

FOREST SERVICE PERMITTING EXPLORATORY DRILLING AT SOUTH32 FLUX SITE ON PUBLIC LANDS - a legal action by PARA against a federal agency for failure to follow regulations:

- On June 20, PARA and seven other conservation organizations filed a federal lawsuit against the Forest Service for issuing the permits for exploratory drilling at the Barksdale Resources Sunnyside site and at the South32 Flux site. The lawsuit states that the Forest Service provided these permits without consideration of the cumulative impacts. The court denied the Plaintiff's Motion for Injunction. Plaintiffs have filed a Notice of Appeal and an Emergency Motion for Injunction with the U.S. Ninth District Court.

GNA Working Group (WG) Report

Santa Cruz County Advisory Panel on the Hermosa Project

September 6, 2023, 11:00 am – 12:00 pm AZ Time via Zoom

Meeting Agenda: Catherine formally opened the working group meeting at 11:02. There was one new attendee, Mayor Andrea Wood, representative for the Town of Patagonia. She will be actively participating in the monthly meeting.

Present:
Acorn International
- Ranay Guifarro
- Dr. Chris Anderson
- Dean Slocum

Working Group
- Gerry Isaac
- Ben Lomeli
- Damian Rawoot
- Caroline Shafer
- Linda Shore
- Andrea Wood

Interfuse Associates
- Catherine Tornbom
- Joanne Lamb

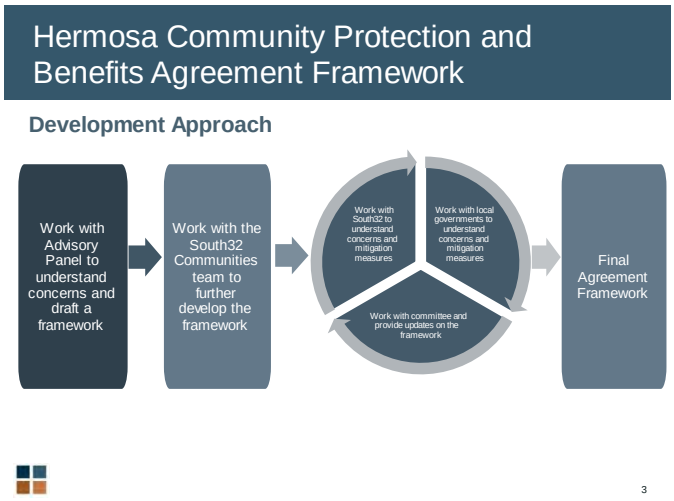
Not Present:

The first slide shows the CBPBA Framework Based on two previous meeting discussions:

1. Expected Signatories
2. Resource Protection
3. Monitoring, Reporting & Feedback
4. Benefits

Discussion:

A question was raised about item #4 – Benefits. This item is suggested by Acorn, International and was explained by Dr. Anderson, with most of these agreements the company or the project agrees to a certain amount of new money. It is given out usually based on the performance of the project or the operations that will go into and agreed to within this agreement. So, it's new money that's going to the foundation not existing money that hasn't been agreed to as to what that might be? It might be a certain percentage of the profit. These funds are over and above what's already been put there by South32.



Hermosa Community Protection and Benefits Agreement Framework: The slide on the right is Acorn's model for the framework (their approach) for the agreement. They've worked with the Panel to understand their concerns and then worked with South32 Communities team to further develop the framework. From there is this cycle that has a defined five steps until the agreement is complete. It's an ongoing arrangement they have with the communities. We first talk and listen to the Advisory panel, then we're going to talk and listen to the South32 communities

team and then become around cycle of talking with the communities, the signatories, we talked with the panel the committee's, and then we receive feedback. We go through that cycle of listening and understanding what the needs are, what understanding we need to be mitigating and what that framework is going to ultimately look like and out pops the final agreement framework.

Demographics- EJ Communities

- Wastewater Discharge Indicators (toxicity-weighted concentration/m distance)
- Demographic Index
- Supplemental Demographic Index
- People of Color Population
- Low-Income Population
- Unemployed
- Limited English Speaking Households
- Population with Less Than High School Education

Santa Cruz County, ARIZONA, EPA Region 9 (Population: 47,463)

Category	Selected Variables	Value	State Avg.	%ile in State	USA Avg.	%ile in USA
Environmental	Particulate Matter (PM 2.5 in ug/m3)	6.03	5.87	46	8.08	8
Environmental	Ozone (ppb)	57.9	66.1	1	61.6	23
Environmental	Diesel PM (ug/m3)	0.0443	0.278	7	0.261	<50th
Environmental	Air Toxics Cancer Risk (risk per MM)	19	25	1	25	<50th
Environmental	Air Toxics Respiratory Hazard Index	0.19	0.31	1	0.31	<50th
Environmental	Toxic Releases to Air	2	2800	11	4600	5
Environmental	Traffic Proximity and Volume (daily traffic count/distance to road)	36	190	23	210	33
Environmental	Lead Paint Indicator (% pre-1960s housing)	0.11	0.089	77	0.3	36
Environmental	Superfund Proximity (site count/km distance)	0.014	0.077	12	0.13	9
Environmental	RMP Proximity (facility count/km distance)	0.02	0.38	10	0.43	1
Environmental	Hazardous Waste Proximity (facility count/km distance)	0.022	0.71	5	1.9	2
Environmental	Underground Storage Tank Indicator	1.5	1.7	64	3.9	53
Environmental	Wastewater Discharge Indicators (toxicity weighted concentration/m distance)	1.1	5.8	83	22	**92**
Demographic	Demographic Index	68%	38%	87	35%	**88**
Demographic	Supplemental Demographic Index	24%	14%	86	14%	**88**
Demographic	People of Color Population	85%	44%	87	39%	**86**
Demographic	Low Income Population	50%	32%	77	31%	**80**
Demographic	Unemployed	10%	6%	81	6%	**81**
Demographic	Limited English Speaking Households	23%	4%	96	5%	**94**
Demographic	Population with Less Than High School Education	22%	12%	81	12%	**84**
Demographic	Population under Age 5	7%	5%	67	6%	67
Demographic	Population over Age 64	18%	20%	61	17%	60

4

Demographics – EJ Communities: The US government is kind of centered in what kind of community so what are those demographics? What are those environmental concerns that identify a community as potential environmental justice communities, wo we call it EJ Communities. When you look at Santa Cruz County, Arizona EPA Region 9, this is what pops up. The US government says anything that is at the 80th percentile or higher is identified as having indicators that look at an EJ Community. As you can see in the chart above, the things n Santa Cruz County that are identified as indicators in that Environmental Justice sphere is the Wastewater discharge at 92%, People of Color Population at 86%, low income population, at the 80%, Limited English Speaking Household at 94% and Population with less than a High School Education at 84%. The point of pulling this EJ up is that when we're creating a community agreement, it's important for s to understand what we can do in this agreement to assist those communities that are in Santa Cruz County to help them improve and help South32 to ultimately improve these numbers.

Draft Community Protection and Benefits Agreement:

Acorn International presented the working group a draft of an agreement. Members were tasked to review the document, make comments with their initials on the comments by the next meeting. This daft will not be revealed to anyone outside the working group.

Action Items:

Date	*Description*	*Who*
Completed	Working Group Dropbox Link to Acorn International	Catherine
Completed	Poll to WG with the two suggested names: CBA and CPBA	Catherine
Completed	Distribute copies of sample GNAs	Acorn International
Completed	Share initial list of topics, goals, and objectives for an agreement	Gerry
September 11	Prepare and Distribute WG summary (this document)	Catherine & Joanne
September 20	Report to Panel	Damian
ASAP	Share meeting recording or link to Jesus Valdez and Frank Dylan from Santa Cruz County	Catherine
October 4	Review agreement and provide comments in the document link.	WG members

Next meeting: October 4 at 11:00 am.to noon. Meetings are generally for one hour.

Link: https://tnc.zoom.us/j/8712196245?pwd=bTBousingieFp0M3h3UnFBaTl2NDd6ZnNnZz09