Introduction

Tom introduced me as a consultant and that is true today but in the interest of full disclosure, I was a full-time, direct employee of the mine for a little more than 15 years until very recently. I oversaw the groundwater program for most of that 15-year career with them. But I sure didn't do it alone – there was a lot of help from the on-site Tyrone environmental team and additionally we've had the services of the Daniel B. Stephens & Associates hydrology consulting firm out of Albuquerque for all that time and even prior to my arrival in 2006. They are the true hydrology experts and I've got John Ayarbe from their firm to co-present this segment with me today. I'll turn it over to him following the next few slides.

State the Problem

You neighbors with concerns about groundwater, I get it. If I was dependent on groundwater for a domestic well and I lived near a large industrial user of the groundwater, I'd want to understand how we're going to co-exist with enough water for me and my household! I might not even care about the industrial user, I'd feel my rights to the water ought to supersede theirs. But that's not how it works. Freeport has worked strategically for decades to secure the water rights needed for their operations, no differently from ranchers and other area land owners and water users. Our aim today is to explain how we can co-exist and if we're successful, help you realize the mine won't be a threat to either the quality or the quantity of your water supply. NEXT SLIDE

Slide 1 Generalized Hydrologic Cycle

So first of all, some general information on the nature of the hydrologic cycle in mountainous terrain. Rainfall is typically heavier at higher elevations as illustrated here. From those highlands, surface water in the form of streams and groundwater below the surface, flow downhill. Stream flows are of course the way we can best see for ourselves the direction of flow but groundwater flows are generally running parallel to the majority of stream flows because they are both moving from higher to lower elevations. In other words, both surface and subsurface flows of water follow the land surface topography, especially in terrain as steep as we have in the Emma vicinity. Throughout New Mexico, due to heavier rainfall at higher elevations, the highlands form high value, distinct recharge zones for groundwater that is then carried to surrounding lowlands supplying water to well owners and groundwater users, both domestic and industrial, as illustrated. We all count on this phenomenon of highland groundwater recharge zones for our water supply. NEXT SLIDE

Slide 2: Shaded Relief Top Map

So let's apply these general principles to the immediate vicinity of Emma. The highlands are the Burro mountains seen as the greenish color in this shaded relief topographic map in the lower left corner. Land surface elevations there peak at over 8,000 feet above seal level which is close to 2,000 feet higher than the 6,000 foot elevation of Emma and the neighboring subdivisions of Apache Mound and Loma Blanca, further to the south, seen here to all be roughly the same elevation. As local residents, we know the Burros receive much more precipitation than our 6,000-foot elevation because first, we can see the rainfall and snowfall but also because of how forested the mountain tops are in comparison to the lowlands. At higher elevations the mountains are thick with ponderosa pine and other species that you'll hardly find at 6,000 feet due in part, to much lower soil moisture.

In this graphic, we also see the blue lines showing the stream flows down from the burros. On the north slope of the Burros, flows are mostly toward the north and on the east slope, flows are mostly towards the east and although it's not shown, the same is true for the western and southern slopes of the burros. This is equally true for the generalized flow direction of groundwater. Groundwater comes off the Burro highlands in all directions. A particularly good source of information that confirms this can be found in a historic document produced by the New Mexico State Bureau of Mines & Mineral Resources. It's titled Water Resources and General Geology of Grant County, New Mexico, was published in 1972 and was written by a geologist named Trauger. The report did a thorough job of characterizing our local hydrology and everything I'm saying is consistent with that report. And even though the report is decades old, since we're talking about a hydrologic system that operates in Geologic time, it hasn't changed much, if at all, since the 1970's. NEXT SLIDE

Slide 3: Same map with drainage basins highlighted

This next figure has some additional overlays on top of the same shaded relief map. The colored zones show the surface watersheds or drainage basins. The blue arrows show the direction of surface water flows but in general, groundwater in such steep topography, is travelling pathways parallel to the surface water pathways, illustrated by these drainage basins down from the burros. The 2,000-foot drop I already mentioned between the top of the burros and Emma occurs over a distance of only 5 to 6 miles. That's approximately a 7 to 8 percent grade from top to bottom, and in such steep terrain, there's really no question about the direction of groundwater flow exiting the burro highlands. This is backed up by the 1972 Trauger report. These flow patterns deliver groundwater from the recharge zone high in the burros following parallel paths to the drainage basins highlighted here. Groundwater is delivered to Apache Mound and Loma Blanca subdivisions through the general flow pattern following the Cherry Creek water shed in an easterly direction from the primary recharge zone. And as you see, the Emma pit intercepts groundwater primarily flowing toward the northeast beneath the Oak Grove watershed. The small greenish basin is tributary to Oak Grove, joining the main channel just off the edge of the figure. Cherry Creek and underlying groundwater flow form a distinct pathway from the recharge zone at the top of the burros that will NOT be intercepted in any meaningful way by the Emma pit.

CONCLUSION

That concludes my portion of the presentation where I've explained how groundwater SHOULD flow directionally based on local topography and the historic account of the Trauger report. But in addition to this, we've collected site-specific data following our first two phases of installing monitoring wells at Emma. We conduct our drilling in phases so that we learn from the early stages informing us how to best conduct following stages. The first two drilling phases are by no means the end of our plans as we have in mind several additional wells to help us further characterize and monitor the surrounding aquifer. I'll now turn it over to John Ayarbe to go over what we've learned from the wells drilled so far and to show our future drilling plans.