

BECK'S ENTERPRISES

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Project: IFB No. 10-038-150

Attention: Jeff Huggins
California Valley Water Board

Regarding: Safety and stabilization of the Walker Mine 700' Access Tunnel.

During the site work of repairing the ventilation system in the access tunnel at the 700' Level of the Walker Mine an inspection was completed by Jeff Huggins (Central Valley Water Board) and Beck's Enterprises (Elmer Brown and Jeremy Micallef). The results of this inspection are summarized in this letter report dated July 23, 2010. This inspection will also include a review of the repairs previously completed.

The west reach of the 700' level access tunnel at the Walker Mine from station 0+00 to station 3+50[±] has experienced an ancient major slide above the portal, causing partial tunnel collapses (possibly during construction of the access tunnel or while mining operations were on going), leaving loose displaced rock and ground above the tunnel in heights from 8' to 60'. The scarp on the hillside is 60'[±] High 150'[±] wide.

The first reach of the tunnel station 0+00 to station 0+15[±] is concrete lined approximately 15'[±] of the tunnel appears to be in good condition along with the portal.
Recommendation: no maintenance at this time.

The second reach of the tunnel station 0+15 to station 2+55 is galvanized steel corrugated pipe with 10'[±] cross section. This reach of the tunnel appears to be in good condition.
Recommendation: no maintenance at this time.

The third reach of the tunnel (station 2+55 to station 11+35) is Timbered Sets, Posts and Caps. There are signs of long term staining and deteriorating timbers with water seepage coming through the fractures and joints of the rocks. Areas could be seen where timbers sets had been replaced during previous repairs. Timber Posts and caps are placed skin to skin to support the heavy weight of loose ground and displaced rocks, extending approximately 350' into the tunnel from the west portal beneath the ancient slide. During the inspection July 23, 2010 it was noted 10% of the existing timber sets need to be replaced due to continuing deterioration (refer to Timber Pictures).



The fourth reach of the access tunnel (station 11+35 to station 26+00) was inspected and scaled down as recommended for the necessary maintenance repairs of the ventilation system. This reach of the tunnel was unlined and without any rock reinforcement. Elmer Brown found the tunnel to be horseshoe shaped with a current width of 8'± and a height of 9'±. The unlined reach was approximately 1,465'±. The rock masses appear to be generally blocky resulting from faults and joints in the rock. Very few rocks were seen in the invert that had previously fallen from air slacking. There are signs of long term staining water and mud seepage coming through fractures and joints; however there are few signs of instability. Some tight rear vertical joints in the roof were observed and have several discontinuities and joints that could lead to instability in the future. A few areas could be seen where spot rockbolting could be used to improve the long term stability of the tunnel.

Ventilation System

The 18" Jet Air 3 hp ventilation fan motor would not run on 3-phase 480 voltage as indicated on the fan motor plate, this problem required the services of a qualified electrician to inspect, test and diagnose. The electrician found that the fan motor had been rewired for 3 phase 208/240 voltage. The fan could potentially perform better if rewired for 3 phase 480 voltage, but probably it is too small (won't produce sufficient ventilation) for future construction activities. Ventilation fans are designed to run both in forward (exhaust) or reverse (blow). Beck's Enterprises performed tests on both directions and recommends that running the fan in the forward (exhaust) position in order to provide proper air flow.

It is recommended that the current 18" inch Jet Air 3 hp Ventilation System in the Walker Mine 700 Level Adit should be increased or changed to support any future construction activities. The air velocity in the Walker Mine varied through the different reaches in the Adit Tunnel. Due to the reduction in size of some reaches in the Adit Tunnel, and distance the ventilation fan had to maintain the positive pressure through out these reaches.

Example: The C.M.P. reach maintained a positive pressure of 30 LFM, due to it being larger a cross section. The Timber reach maintained a positive pressure of 60 LFM due to the reduction in size of the cross section of this reach. In the Bald Headed section the pressure varied from 45 LFM at St. 12+00 to at the Bulk Head where air flow had decreased to a level that was not measurable. Due to the increased size of the cross section of the Bald Headed reach the condition of the ground changes. The Ribs and Back of the Adit Tunnel are irregular which causes turbulence thus decreasing the air flow due to the length of the ventilation system as well as the turbulence created by the rough walls in this cross section of the Adit Tunnel.



As stated in the Title Eight Regulations Subchapter 20. Tunnel Safety Orders Article 12. Ventilation and Dust Control, 8437. Ventilation and Air Quality.

(a) Fresh air shall be provided in adequate quantities to all underground work areas. The supply shall at least be sufficient to prevent dangerous or harmful accumulations of dusts, fumes, vapors or gases, and shall not be less than 200 cubic feet per minute for each person underground and 100 cubic feet per minute per brake horse power on a diesel engines. The lineal velocity of the air flow in the tunnel bore shall not be less than 60 feet per minute in those tunnels where blasting or rock drilling is conducted or where there are other conditions that are likely to produce dusts, fumes, vapors or gases in harmful quantities.

(b) The main ventilation system shall be so arranged that the air flow can be reversed or shut off from the surface.

SUMMARY

The results of our site inspection indicated minor stability problems due to rotting timber, post & caps. Although it is unlikely that a large failure will occur, (which could block the tunnel), erosion of the weathered rock will continue without remedial measures.

Beck's Enterprises recommends, the Central Valley Water Board consider installing rockbolts as required. Conditions in unlined tunnels with highly jointed rock and fractures such as these can change rapidly.

Beck's enterprises recommends, the Central Valley Water Board consider replacing rotten timber sets, post and caps as outlined above in this report.

As with the timbered reach of the tunnel, it is critical that any ground that requires support be reinforced as quickly as possible. It is simpler, faster and less expensive to support ground that is still keyed together than after movement has occurred and may still be in progress. Ground that is open but still keyed, is to some extent self-supporting. This fact means that the total rock load does not need to be supported, as with the timbered reach of this tunnel where a previously partial or total tunnel collapse had occurred (station 0+00 to station 9+50[±] possibly during construction). Some of the unlined portion of the tunnel should have some maintenance however the tunnel condition are such that there is no clear dividing line regarding where to start or stop maintenance work.



Walker Mine 700 Level Adit Safety Evaluation

This Evaluation was created to inform and increase the awareness of the Potential Hazards, Proper Equipment and Safety Procedures for future visits or Construction Activities at the Walker Mine Site.

Prior to the entry and the onsite work completed at the Walker Mine 700 Level Adit Job Site. A series of Safety precautions and procedures were devised and implemented in order to safely complete the construction tasks required and to protect the safety of Beck's Enterprises Personnel and the Central Valley Water Board. The procedures included but were not limited to the creation of a site specific Emergency Action Plan, a JSSA (Job Specific Site Analysis) and the Safety Training and Orientation required by the Title Eight TSO and Division of Mining and Tunneling Cal OSHA Regulations.

Subchapter 20. Tunnel Safety Orders, Article 2. Definitions

Tunnel- An underground passageway, 30 inches in diameter or greater, excavated by employees working below the earth's surface, that provides a subterranean route along which employees, equipment or substances can move; other than passageways excavated by mine or quarry operators in connection with such operations. For the purpose of these safety orders, "tunnels" include shafts, raises, underground chambers and premises appurtenant thereto.

An initial mandatory job site inspection with the Mining and Tunnel Division of Cal OSHA representative Jerry Snapp included Beck's Enterprises personnel and the Central Valley Water Board Engineer, Jeff Huggins. The ATA (Atmosphere) was monitored with an Industrial Scientific 5 Gas I.T.X. Gas Detection Meter for any potential Toxic and or Explosive Gases during this inspection. Ventilation checks were made through out the inspection with a Davis Low Speed Anemometer and the air flow were evaluated to determine the limitations of Construction activities allowed during the Walker Mine 700 Level Adit Repairs. (see attached Gas Logs) The Air Quality through out the Walker Mine was sufficient with the O₂ varying from 20.9 to 20.7. No toxic gasses were recorded. The Air Movement throughout the Walker mine varied with different sections with readings from 10 LFM to 60LFM. At the Bulkhead the airflow was unreadable due to the low flow.

Walker mine has not been ventilated for a long time period, and the air has had very little movement, the gases that exist in the mine atmosphere can separate and stratify according the specific gravity (weight) of each gas in the mixture. Very light gases such as methane and carbon monoxide will rise to the overhead, and heavier gases such as carbon dioxide will descend to low lying areas. Other gases, including oxygen will stratify somewhere between the crown and the invert, but you can never know in advance just what level any gas will be in because you can never know what gases are present, or how much of any particular gas exists, until you test the atmosphere.



The air movement caused simply by walking through the stratified gases causes mixing of the stratified gas with the other gases, possibly even seemingly good air. The resulting mixture may be incapable of supporting respiration, and the person may not be able to evacuate the mine.

Stratification of gases can happen over short distances or long distances, so it is important to test for gases starting at the portal and test continuously for the duration of the mine exploration. When entering a mine, DO NOT BE IN A HURRY.

Walker Mine 700 Level Adit CMP (Corrugated Metal Pipe)

The CMP was found to be in good condition and provides safe access.

Walker Mine 700 Level Adit Timber Set Section-

Many of the timbers throughout the Timber Set reach of the Walker Mine 700 Level Adit that have once supported the rock above, have oxidized and rotted. Although they may remain in-place and appear to provide support, they could be totally ineffective. In order to provide future access and maintain safety for personnel for maintenance and inspection purposes some of the timber sets should be replaced.

Walker Mine 700 Level Adit Bald Headed Section-

During the inspection of the Bald Headed section, areas in the Walker Mine 700 Level Adit were noted and addressed as potential hazards, due to the excessive amount of mud that is seeping into the mine through fractures and seams located in the back and ribs of the mine. Unlike caves, mines are artificial, temporary openings designed to last as long as it takes to extract the ore. When a mine is abandoned, there is no longer a maintenance program to address deteriorating rock conditions and weakened ground supports. Naturally occurring caves are formed over thousands of years by relatively stable processes, whereas mines are created by blasting, which destabilizes the rock that is left in place. Soft, stratified rock types, such as shale, tend to collapse easily, but often in small pieces. Harder, more massive rock types such as granite, limestone, or sandstone collapse less frequently, but often more catastrophically in large blocks. Keep in mind that mines often follow fault zones, which are inherently unstable.



GUIDELINES FOR WALKER MINE ADIT LEVEL 700 FUTURE MAINTAINCE OR INSPECTION

1. Underground exploration teams must realize that the Walker Mine Adit Level 700 is an unnatural, unstable, and temporary openings with a unique set of potential hazards. Spelunking (natural cave exploration) experience is **not** a substitute for underground mine experience.

2. Underground teams should be comprised of at least two people. If three or more people are present, one person will remain at the mine entrance. The exploration crew will check in with this person at predetermined time intervals.

As stated in the Title Eight Regulations Subchapter 20. Tunnel Safety Orders Article 4. Safety Precautions, 8410. General Safety Precautions.

(d) At least one designated person shall be on duty outside of all tunnels whenever anyone is working underground. This person's duties shall not interfere with his/her ability to secure aid for those persons underground in case of emergency.

3. At least one person on the team will need to be trained and experienced in underground mine safety and hazard recognition. This individual will lead the underground team and instruct inexperienced team members on potential hazards, underground mine safety procedures, and the use of safety equipment.

4. Safety equipment for **each individual** will include, but not be limited to:

- **Hardhat**
- **Steel-toed Footwear**
- **Proper Lighting**, at least two reliable lights, plus additional batteries each person.
- **Eye Protection** - safety glasses are recommended; contact lenses are discouraged.

5. In addition to the above equipment, the **lead person** will be equipped with and use:

- **Scaling Bar**
- **Air Monitoring Equipment** - recommend using a multi-gas detector which continuously monitors for oxygen, carbon monoxide, hydrogen sulfide and explosive gasses. The meter should have a visual display of gas concentrations, with warning lights and audible alarms that illuminate and sound when a PEL level of any of these gases is detected.



WHERE TO TEST

Test gases

- overhead,
- at your head (breathing) level,
- chest level,
- waist level,
- knee level and
- at your foot level (floor).

MINIMUM GASES TO TEST FOR IN TUNNELS ARE:

- Oxygen (O₂)
- Carbon Monoxide (CO)
- Methane (CH₄)
- Carbon Dioxide (CO₂)
- Hydrogen Sulfide (H₂S)

The dangers associated with the mine gases is one reason why extreme caution, **proper instrumentation**, and approved procedures should be used when descending into a mine.

ALWAYS BE CAREFUL AND TEST YOUR GASES!

You must remember that a mine atmosphere is very small compared to the atmosphere outside, so dangerous gases can build up quickly.

MINE GASES

The composition of clean, dry air at sea level is 78.08% nitrogen, 20.95% oxygen, 0.93% argon, 0.03% carbon dioxide, and 0.01% other gases. Air composition can be altered in underground mines for a number of reasons. Some gases are poisonous, some gases are not poisonous, **but all gases that are not oxygen can kill you simply by displacing the oxygen and suffocating you.** So, always test continuously for the oxygen content in a mine atmosphere to be certain that you have enough oxygen to keep you safe and alive

6. Underground teams will maintain voice contact with each other at all times.



CHANGE: A Major Reason for Caution

The Walker Mine 700 Level Adit Site is dynamic. That means that the conditions in and around the mine can change over time, even a short period of time. Rock stability will deteriorate with time, so a portal or drift that may have been stable previously may now be a death trap. A heavy snow pack or a torrential spring storm may cause subsidence of a shallow mine feature, leaving a treacherous opening which may not have existed the last time a site was visited. Erosion may uncover new hazards such as abandoned explosives or openings that were not properly closed in the past.

Perhaps the most dynamic aspect of change at Walker Mine 700 Level Adit Site is airflow. Airflow can influence a mine's internal configuration due to **fluctuations in temperature, and changes in atmospheric pressure**.

Mines are often described as "breathing", in that airflow at a given opening may be **static, incast, or outcast** under different atmospheric conditions. Because of these air movements, a particular area may have good air on one site visit and bad air on the next visit. Air quality may even change in the course of an extended site visit. When conducting underground inspections, note the direction of airflow, especially at intersections where air from a different source may be encountered. Keep in mind that temperature and pressure changes may reverse airflow, bringing contaminated or oxygen-deficient air from different parts of a mine into an area that previously had good air.

In conclusion of the Walker Mine Level 700 Adit Repairs and Inspection and Safety Inspection the primary potential hazards that has been identified by Beck's Enterprises are the high levels of mud that is seeping through the fractures and seams weakening the integrity of these localized areas throughout bald headed section. Many areas throughout the timber section were identified as oxidized and rotted. In addition the current 18" Jet Air 3 hp Ventilation System in the Walker Mine 700 Level Adit should be replaced by a larger fan with higher pressures to support any future construction/maintenance activities. For the safety and integrity of the Walker Mine Level 700 Adit for future inspection and maintenance procedures these areas should be addressed.

If desired, we could provide assistance to the Central Valley Water Board in the design of the recommended repair measures and in the field during scaling, installation of rockbolts, and replacement of timber sets, post & caps.

**Thank you,
Project Manager
Elmer Brown**





Photo 1. Walker Mine Seam



Photo 4. Stalls under Rock.



Photo 2. Vertical Seam without Support.



Photo 5. Rotten Timber – 4 inch penetration.



Photo 3. Vertical Mud Seam.



Photo 6. Rotten Timber – 4 inch penetration Vertical Mud Seam.



Photo 7. Rotten Timber 4.



Photo 10. Rotten Timber 1.



Photo 8. Rotten Timber 3.



Photo 11. Rock Scaling and Sounding.



Photo 9. Rotten Timber 2.



Photo 12. Rock Fall and Mud.



Photo 13 Mud Seeping into Invert.



Photo 16. Loose Rock-Rotten Timber.



Photo 14. Mud Seam 2.



Photo 17. In & Out Board, Mine Phone, Safety etc.



Photo 15. Mud Seam.



Photo 18. Fractured Rock.



Photo 19. Flat back (mud forced through cracks, mud seeping).



Photo 22. Copper Contaminated Mud.



Photo 20. Discontinuous Seams and Wedges (Needs rock bolts).



Photo 23. Compressed Rotten Timber 2.



Photo 21. Deteriorating Timber.



Photo 24. Compressed Rotten Timber.



Photo 25. Broken Timber-Loose Rock-Weight 2.



Photo 014. Ancient Landslide (scarp at tree line).



Photo 26. Broken Timber-Loose Rock-Weight.



Photo ?. Walker Mine ventilation fan.



Photo 27. Broken Timber and Crown Bars.