

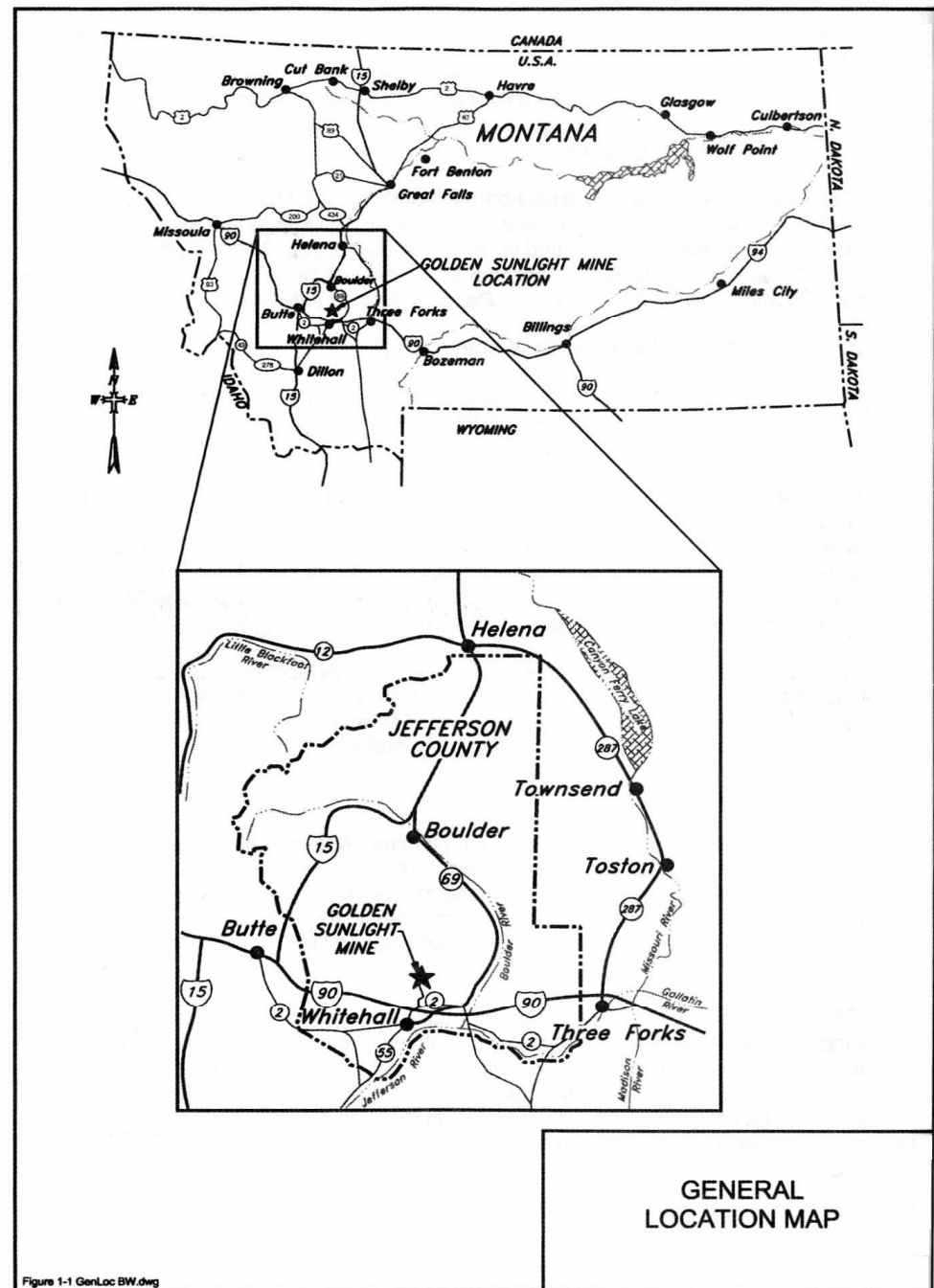
Pit Backfill: Yea or Nay

Golden Sunlight Mine Pit Backfill: The History and Science of the Pit Backfill Issue at the Golden Sunlight Mine

R. David Williams, Geologist, Bureau of Land Management,
106 North Parkmont, Butte, Montana, 59701 USA

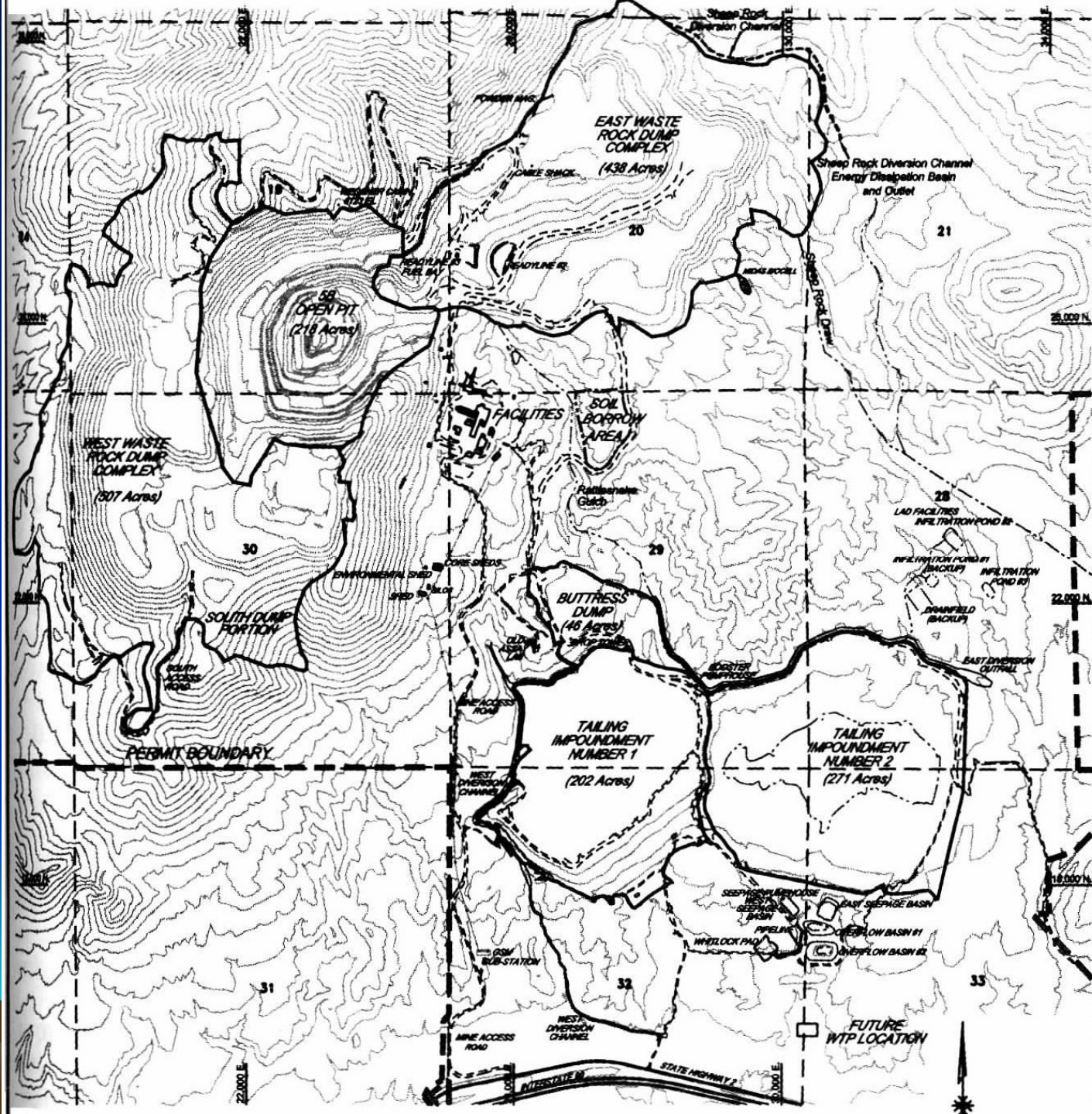
Presented at the 13th Annual BC Metal Leaching/Acid Rock Drainage Workshop
Vancouver, B.C. November 29th and 30th, 2006

General Location



Conventional Mine

- Truck/Shovel moving 30,000 mt/day, recent underground work left open stopes below pit. Additional underground work permitted this fall (2006).
- 250 m wide breccia pipe intruded into PreC Belt rocks, depth unknown
- Au bearing sulfides, mostly pyrite
- Highly acidic waste, but fairly low precipitation area: 30-40 cm/year
- Two tailing impoundments, one, unlined, is reclaimed, had leaks → pumpback wells
- West waste rock dump complex reclaimed, east dump complex active



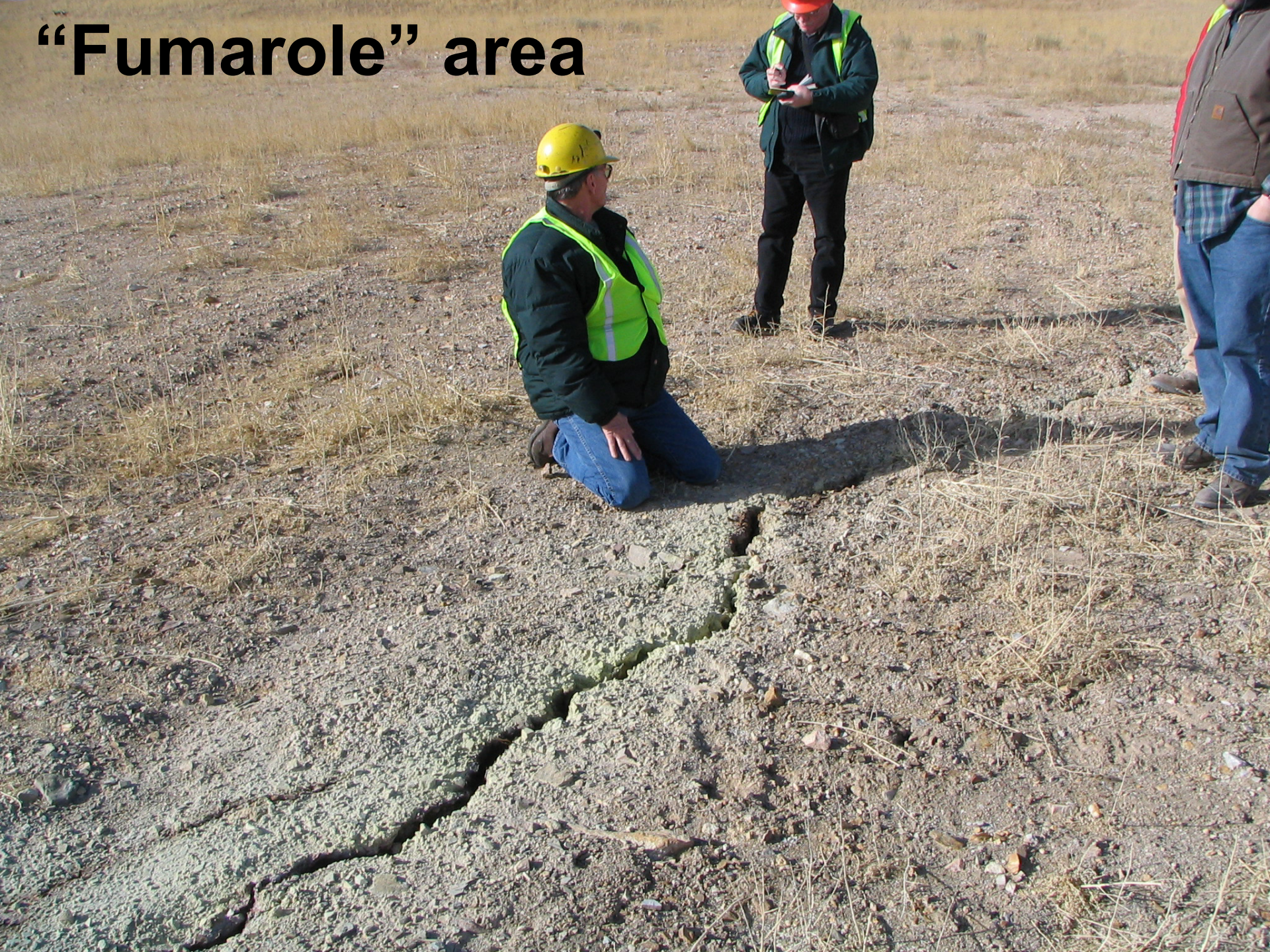
View into GSM pit from the Southeast



Overview of the top of the west and south waste rock dump complex



“Fumarole” area



Portion of reclaimed West waste rock dump complex

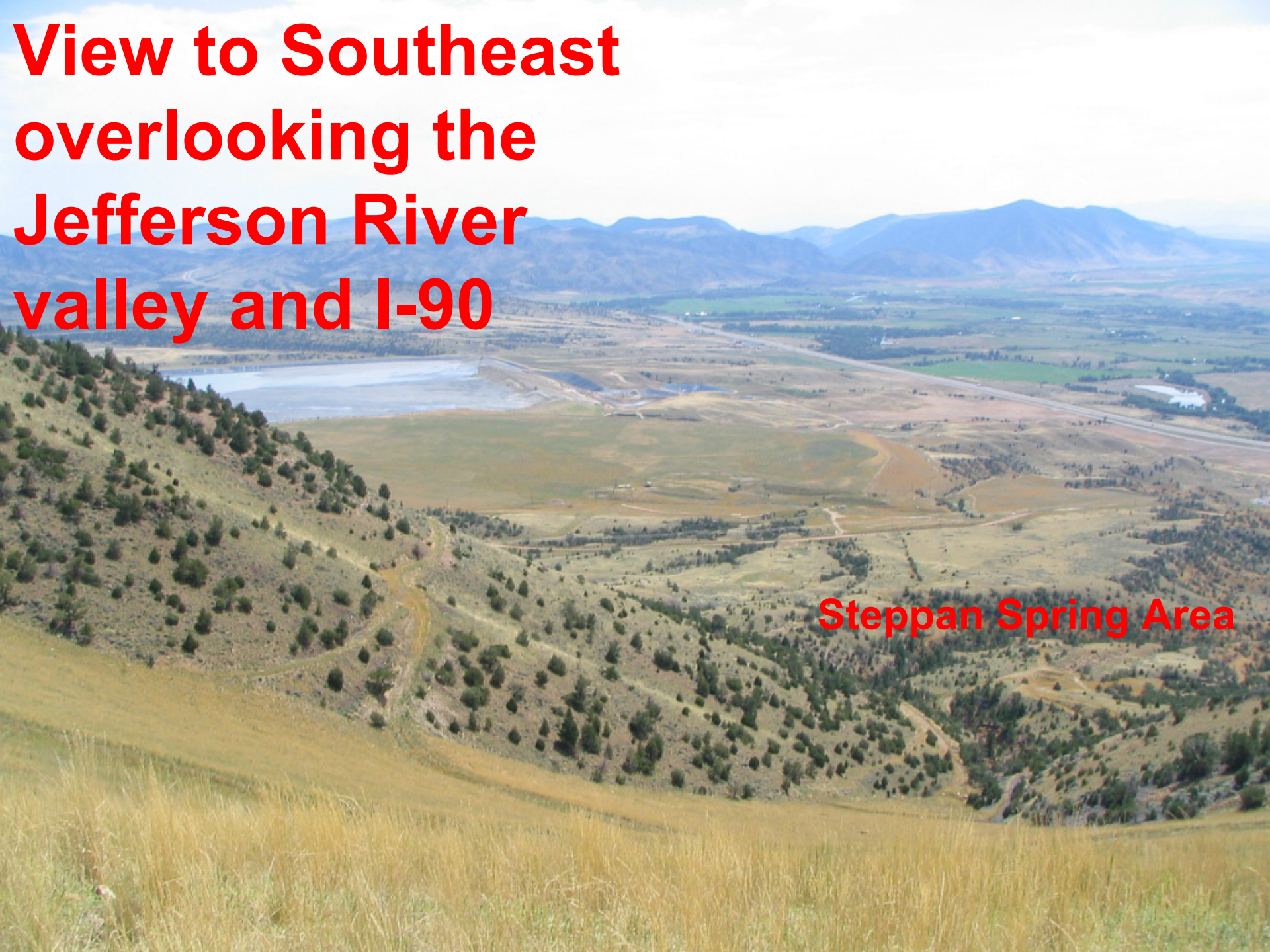


East waste rock dump complex



View to Southeast overlooking the Jefferson River valley and I-90

Steppan Spring Area



Steppan Spring Ferricrete



A Complex Legal History

- Permitting began in 1981 with an EIS
- 1990 Expansion permitted with an EA, subsequent court challenge based on failure to select pit backfill alternative.
- 1998 EIS selected No Pit Pond alternative, partly based on economics, partial pit backfill not analyzed in detail, not selected.
- 2000 District Court found DEQ should have selected partial pit backfill (EIS did not properly review environmental consequences)



More legal history...

- 2002 District Court orders GSM to submit Partial Pit Backfill plan
- December 2002 GSM submits plan:
- • Pit backfilled with 300 meters of acidic waste from East waste rock dump complex
- • 270 + meter dewatering wells in backfill

Multiple Accounts Analysis:

- Used to refine technical issues for the SEIS



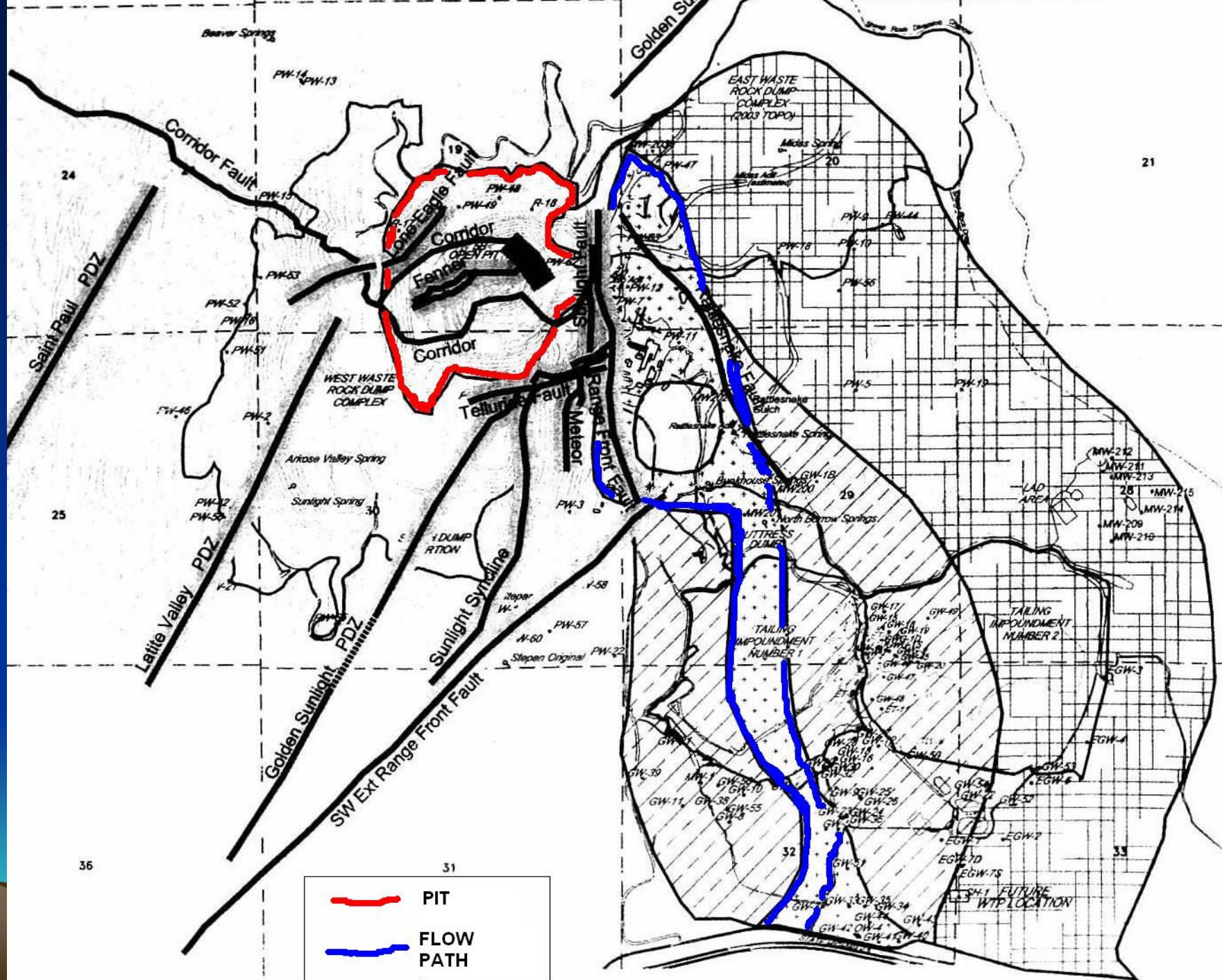
December 2004 Draft SEIS

- Analyzed three alternatives in detail:
 - GSM's proposal (partial pit backfill with dewatering wells)
 - Partial pit backfill with downgradient collection
 - Underground sump alternative (**NO** backfill)
- Alternatives not analyzed in detail: engineered backfill, amended backfill, no collection of water and pit lake.



Flow Path Critical Issue:

- Will groundwater below a backfilled pit be impacted by the poor water quality present in the backfilled pit, and if so to what extent and when?? Water around the pit already shows significant ARD indicators.
- **SEIS conclusion:** Pit backfill: Even adding in additional mitigating measures; upgradient and downgradient collection wells, water quality was protected only for the most favorable of modeling conditions, assuming all aspects of a complex, interdependent collection system was working at all times.



View NE overlooking notch at the eastern edge of the pit



Note structural complexity

Agencies Decision:

- **Agency technical staff unanimously recommended the Underground Sump Alternative as the alternative most protective of groundwater resources.**
- **Agency management are still evaluating the technical staff's recommendations prior to issuing a Record of Decision!**

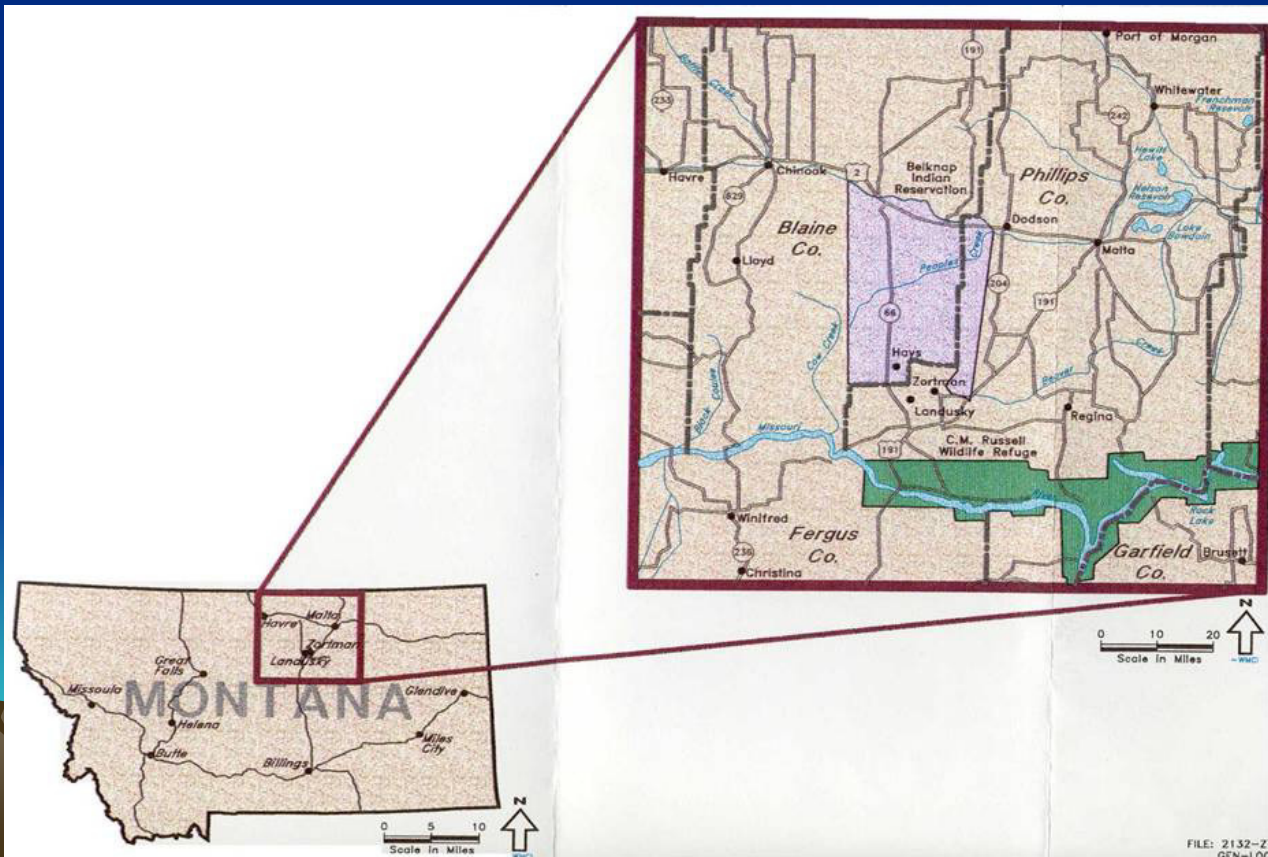


Conclusion:

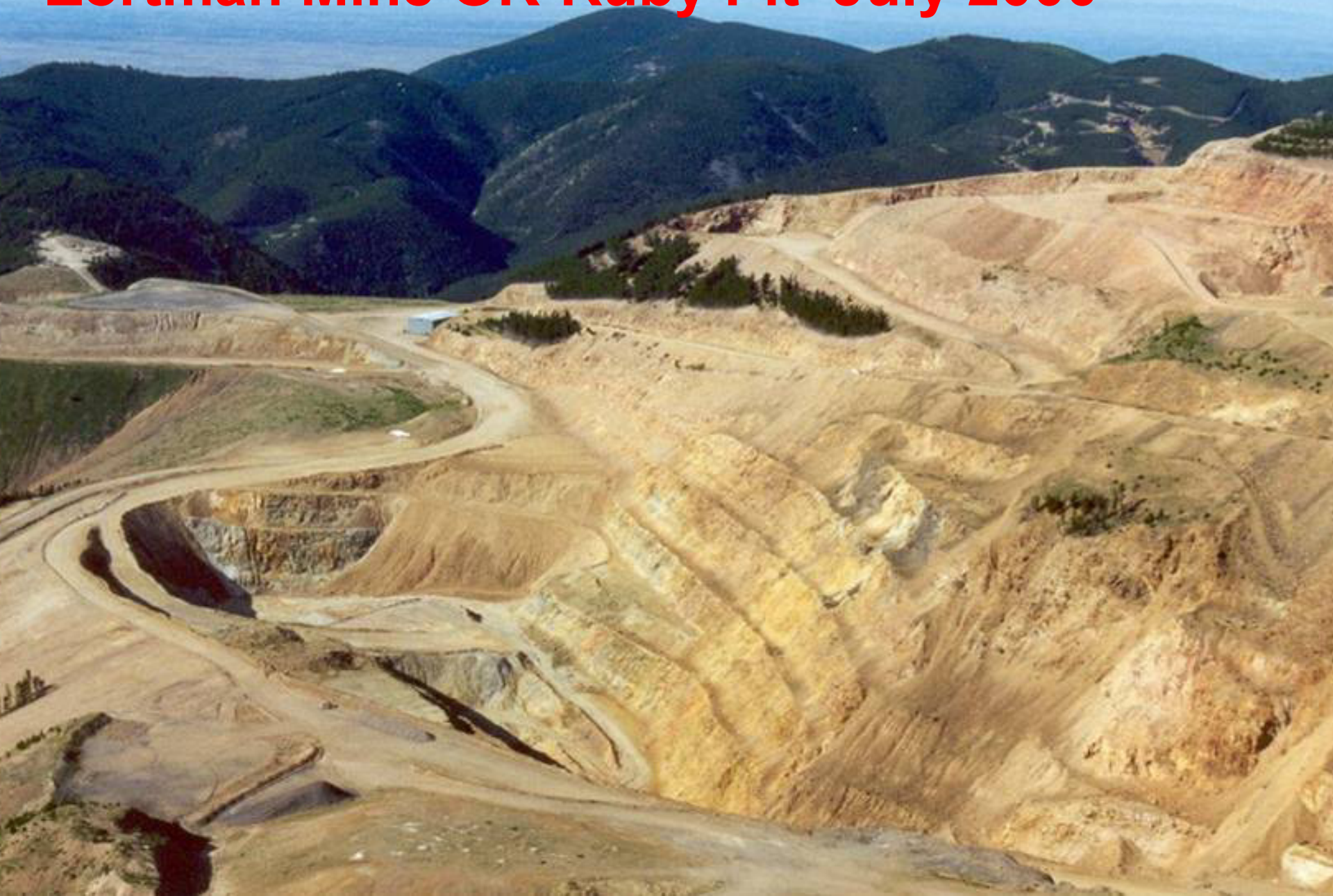
The permitting of environmentally contentious mine projects, particularly those that involve pit backfill and groundwater issues must focus on a transparent, science based process, fully open to public involvement, as exemplified here by the Multiple Accounts Analysis. Even if a process such as the Multiple Accounts Analysis is used, it does not assure consensus can be reached on the project. It should help identify all relevant technical and social issues which can then lead to an environmental review document better able to withstand any potential legal challenges.



BUT....



Zortman Mine OK-Ruby Pit July 2000



Zortman Mine OK-Ruby Pit July 2000



Zortman Mine OK-Ruby Pit July 2005

Backfilling was done to cover acid producing rock walls and pit floors and to limit infiltration. Pit seepage still reports to water treatment plant.

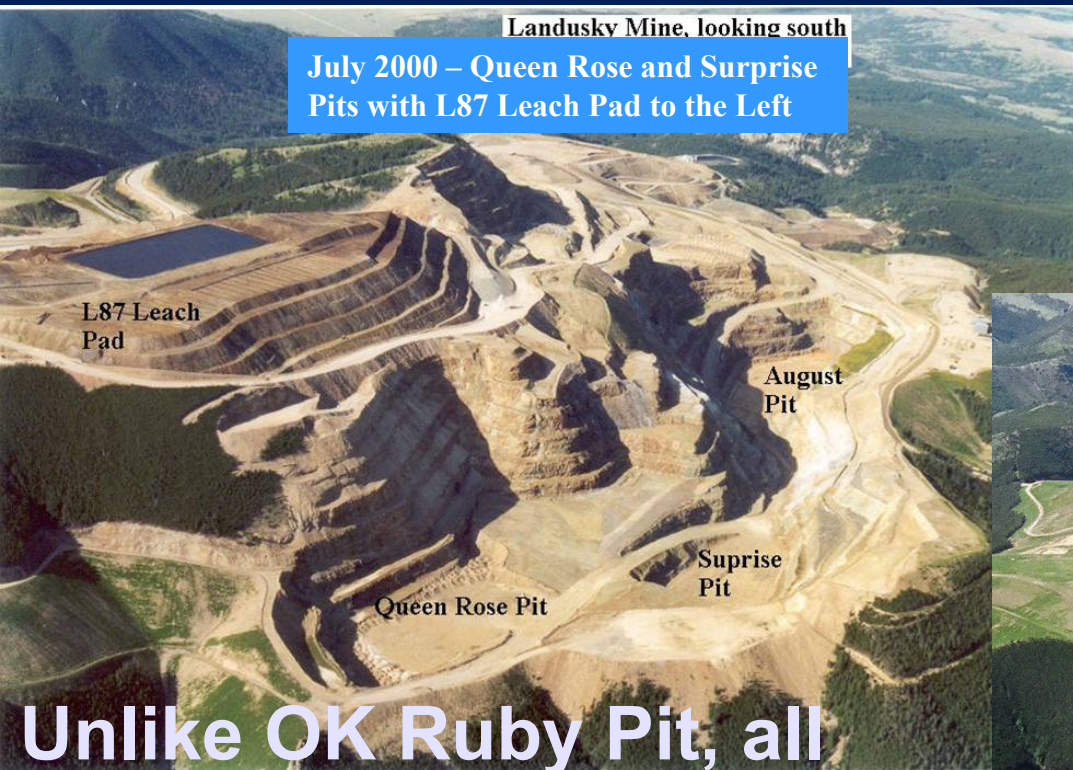
November 2001. Liner Placed North of the Groundwater Divide to Limit Groundwater recharge in above the Swift Gulch watershed (upper left). Portion of L87 leach pad visible in upper right.



June 2006. Revegetation in the pit area north of the groundwater divide above the Swift Gulch watershed (upper left). Portion of the reclaimed L87 leach pad visible in upper right.



Landusky Mine Reclamation Queen Rose/Surprise Pits 2000 to 2005



Unlike OK Ruby Pit, all the water here may not report to treatment as Swift Gulch has unresolved ARD issues.



June 2006 - Lined and Vegetated Pit Floor;
Graded and Vegetated L87 Leach Pad

Important Points:

- Backfill limited to non or low AGP waste rock
- Backfill used to achieve positive drainage, or to cover high AGP pit walls and floors
- High risk to tribal resources (water) from backfilling
- Benefits from restoration of landforms and drainage patterns minor compared with increased risk of contaminated water migrating north to Ft. Belknap tribal lands, even with best available pollution control technology

**That's All....any
questions?**

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