Iron King / Humboldt Smelter Superfund Site

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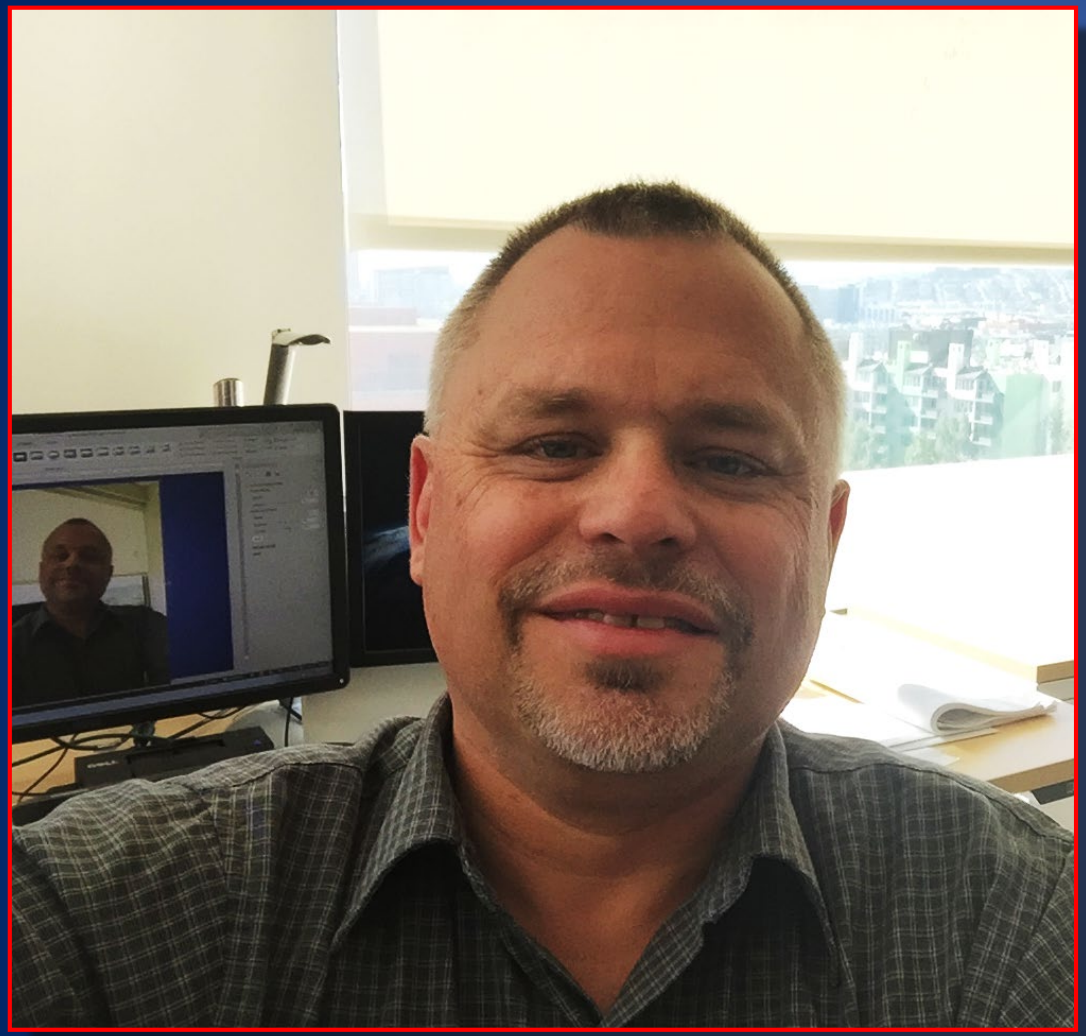

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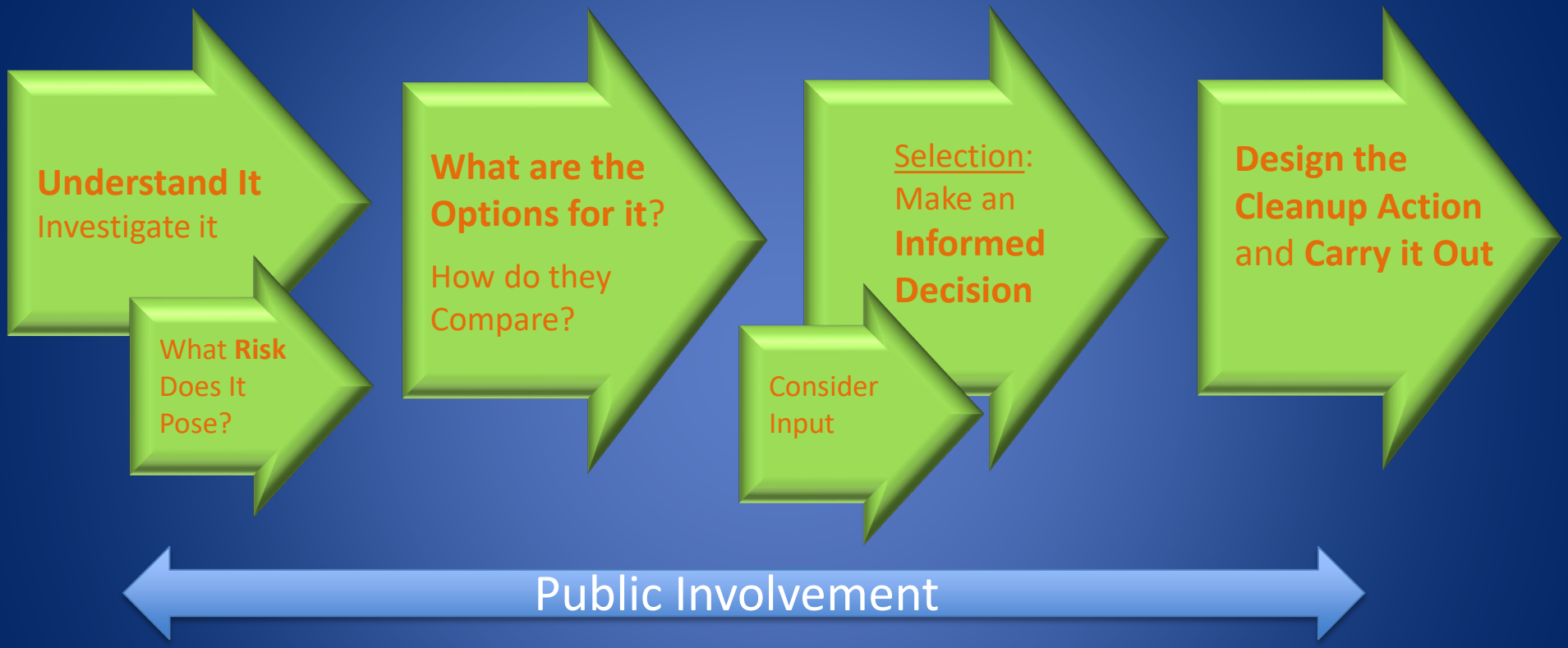
Iron King / Humboldt Smelter and Vicinity

The heavily-studied IKHS Site is based on contamination from a former mine and former smelter operating independently starting more than 100 years ago. The natural drainage lying between them is heavily contaminated with arsenic and lead. Heavy rains flowing to the river continue to be able to move this contamination downstream. EPA sampled almost 600 residential yards for contamination in the wider town, too. Most were unaffected or did not need cleanup. EPA has completed soil cleanups at the 50 yards that *were* contaminated.

The Superfund Process at the Simplest Level



In simple and everyday terms, the Superfund process looks like this. Superfund is a law that covers cleanup of uncontrolled releases of hazardous substances that threaten human health or the environment. A specific process is required to decide on and then carry out a cleanup. The law says which parties are responsible to pay for or perform cleanup. EPA can order those parties to clean up, or sometimes EPA performs cleanup itself. It often takes significant time to investigate a complex site and select a cleanup. It can also take significant additional time to negotiate with responsible parties and take legal actions necessary, or to obtain needed government funding in cases where the U.S. Government must perform the cleanup..

Superfund Process… and How We Broke It Into Two Parts Here

This shows the more *specific* terms we use to refer to the parts of the Superfund process. Note that at IKHS, we have finished the extensive "Remedial Investigation." We followed a faster process called "removal" to clean up the simpler soil in residential yards. Addressing the contamination still at the mine and smelter, the tailings pile, in the drainage gulch, and at the dam is much more complicated and requires the usual "remedial" process shown at bottom. We are currently doing the FEASIBILITY STUDY.

Less Time Need

More Urgent

Less Complex

REMOVAL PROCESS

Process for simpler, more urgent residential soils cleanup

Decide

Action Memo

EPA decides on and authorizes a cleanup.

Do the Cleanup

Removal Action

EPA carries out the cleanup.

REMEDIAL PROCESS

Investigate

Remedial Investigation & Risk Assessment

EPA investigates the contamination, where it is, and the risks is poses.

Study the Options

Feasibility Study

EPA studies and compares Cleanup options.

Proposed Plan

Public Comment

Decide

Record of Decision

EPA obtains public input, then selects a cleanup option.

Do the Cleanup

Remedial Design and Remedial Action

EPA designs and carries out the cleanup.

Process for complex parts of site such as the mine pile, tailings & dam

The remedial investigation report fills three five-inch binders when printed out. It represents years and millions of dollars of effort to determine the nature and extent of contamination everywhere at the site so we can understand the problem fully and choose meaningful cleanup options.

With residential soils cleanup done, The focus is now turning to…handling the wastes

LOTS of WATER

Former Iron King Mine Property

Former Humboldt Smelter

WHAT WAS LEFT BEHIND?

- **Mine Tailings**
- Waste Rock
- Dross
- Slag
- Mixed up Tailings, Sediments & Soils

WHY ARE TAILNGS A PROBLEM?

- They are **TOXIC :** High levels of arsenic and lead
- They can **MOVE**: Easily in Air, Water, Soil
- They can **REACT** Once in the Environment

The mine and smelter left behind many kinds of wastes in the environment. The worst of these are the toxic and fine TAILINGS left over after ore is ground up and saleable metals are extracted. Tailings can move easily to new locations, and can generate toxic acid waste under the right conditions.

We Need Cleanup Solutions For Each of These Areas

This shows the many different areas, or parts, of the IKHS Site that contain mine wastes of some type. Our cleanup needs to determine an appropriate cleanup action for every one of these many areas. These actions will be interrelated. Do we permanently cover certain wastes? How? Is there enough cover material available? Do we remove wastes? If so, where to we put them? Will there be enough room? How do we keep water from washing them away again in the future? Can land be reused? If so, how?

Both the mine and smelter had tailings impoundments in different time periods. Tailings from the mine over many years entered the Chaparral Gulch through two pathways that merged in Middle Chaparral Gulch. Downstream, tailings from the mine mixed with tailings from the smelter in the tailings flood plain. Tailings are held back by a dam, about ¼ mile above the Agua Fria River. The Smelter sits on a high plateau above the dam and it is heavily contaminated with a variety of wastes such as dross and slag.

…From the Operating Days - 45 to as much as 120 years ago

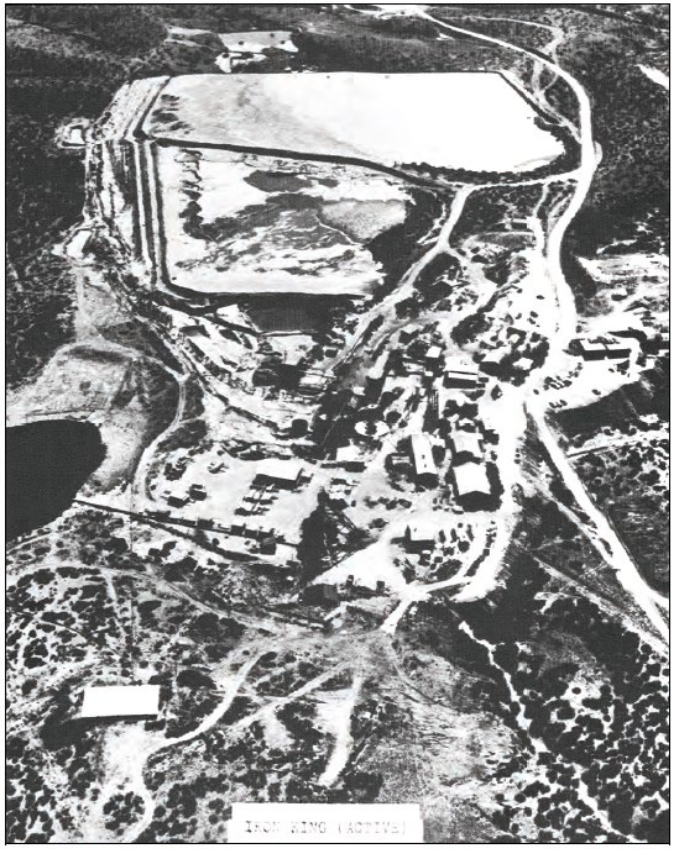


Figure 11. 1955 Aerial View of Iron King Mine, Looking East (photograph courtesy of Sharlot Hall Museum).

Iron King Mine in 1955, looking east, with mineworks and tailings pond in background. Highway did not yet exist. Operated by Shattuck Dunn, Corp.

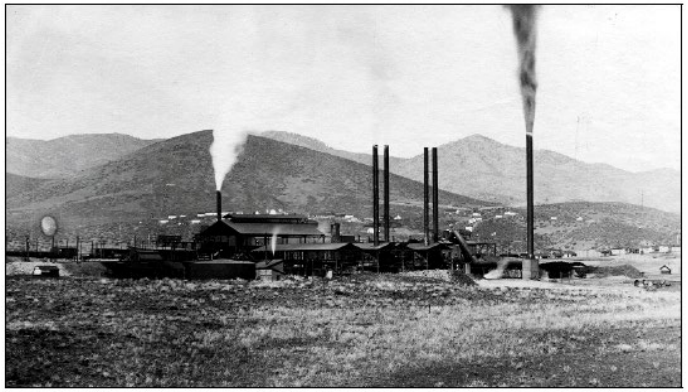


Figure 20. Ca. 1910 Image of Humboldt Smelter (photograph courtesy of Sharlot Hall Museum).

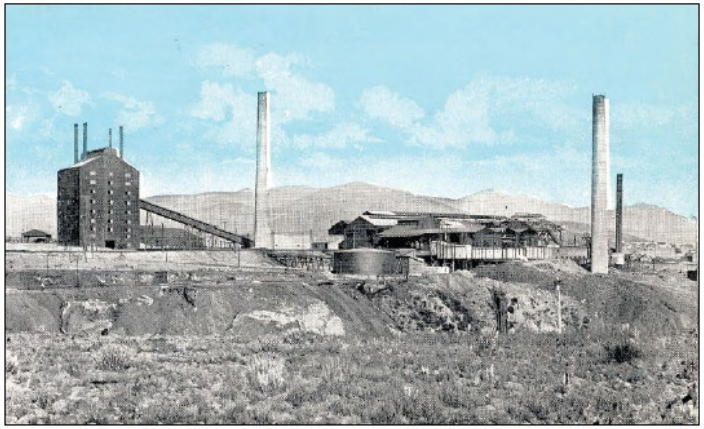
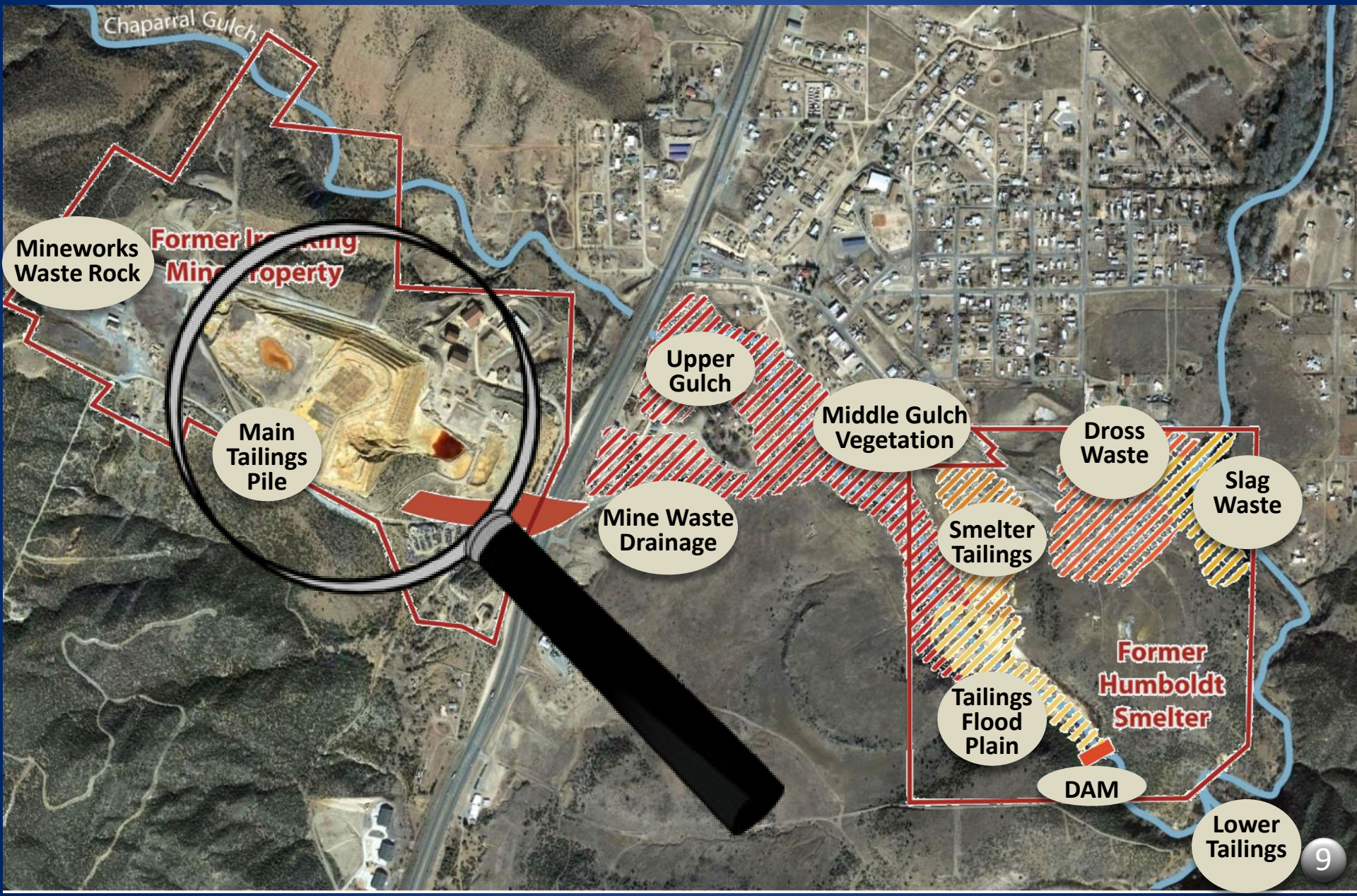


Figure 21. Ca. 1918 Tinted Postcard of Smelter and Sample Mill, Humboldt (image courtesy of Sharlot Hall Museum).

Humboldt Smelter in the era 1910-1918. Operated by Arizona Consolidated Metals Co.

Exploring the Iron King Mine Main Tailings Pile – Area by Area



Exploring the Main Tailings Pile

The Iron King Mine Main Tailings Pile contains 3.5 million cubic yards of tailings. It is a former tailings waste pond that has slowly dried out. The slopes are too steep to be stable. The top is well-encrusted. Here you see the top the way it appeared in a dry year about 7 years ago, and before EPA placed yard soils cover on top. Note that nothing grew on it because the tailings are too toxic for most plants. See next page for how different it is now.

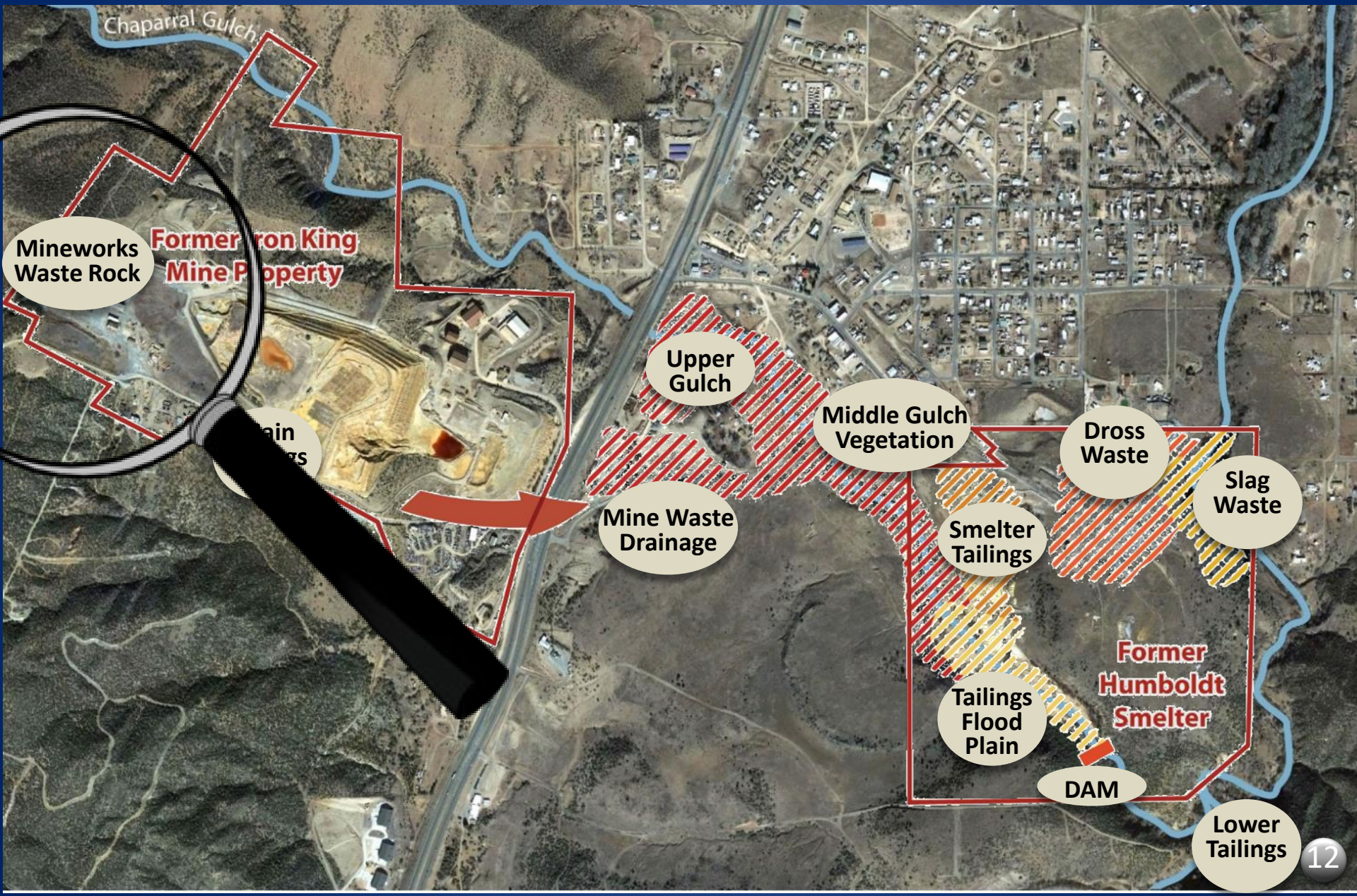
Exploring the Main Tailings Pile



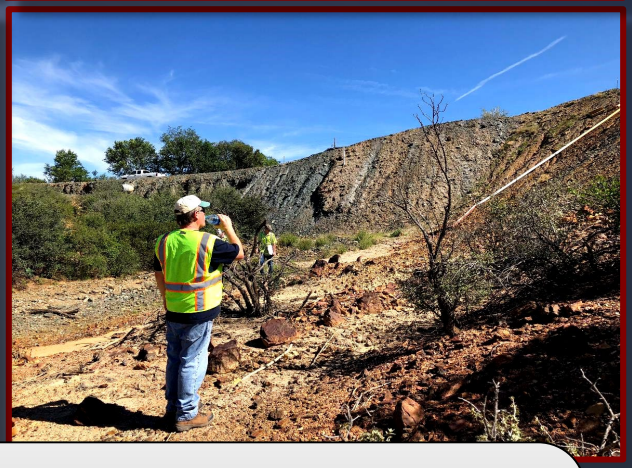



Upper row left and center photos (from 2018) show a very wet year where water is ponding on top of the pile. Almost all of this water eventually evaporates. Because EPA placed removed yard soils on top of the pile, one can see that much more of the tailings are covered and plants are now growing. This is not a permanent fix, but it helps. The ponds shown are rainwater collection ponds to control drainage on the pile. The red color on lower right is in one pond is due to very high levels of iron oxides in the water. The tailings are very high in arsenic, lead, iron and sulfides.

Exploring the Iron King Mine Waste Rock and Galena Gulch

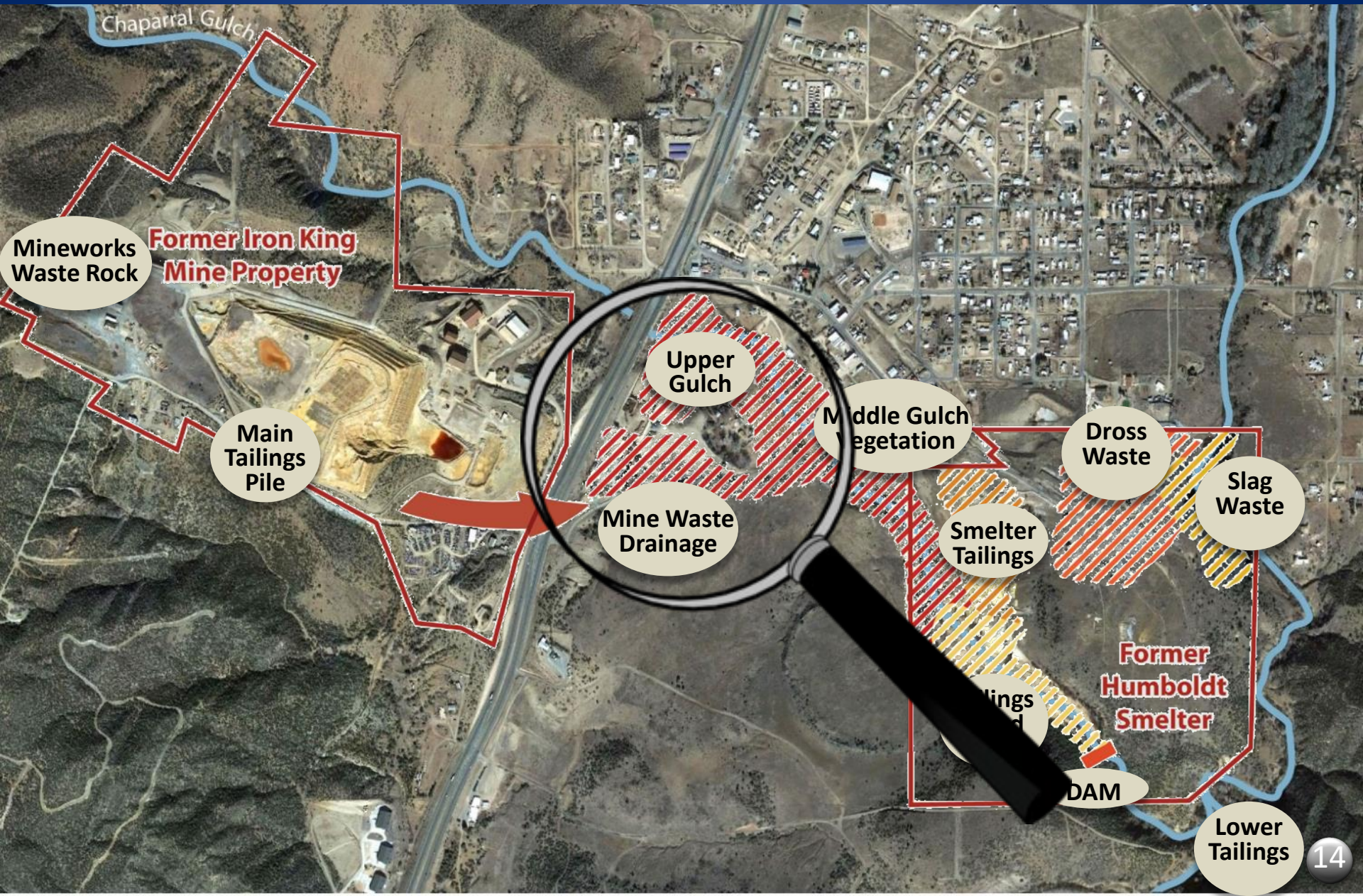


Exploring the Waste Rock Pile and Galena Gulch

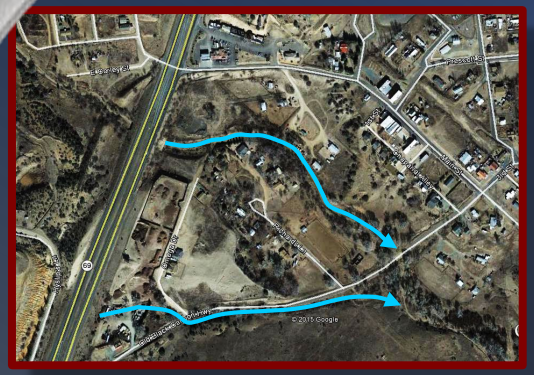


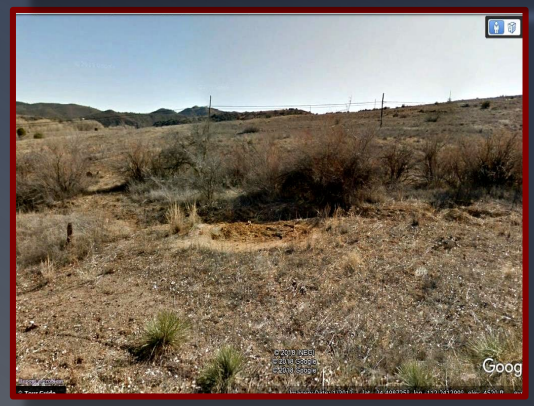
Waste rock is what is removed from a shaft during mining on the way to down to the target ore. It is usually dumped to the side. Like tailings, it can contain high levels of toxic metals that can leach into water bodies. Here huge piles of Iron King Mine waste rock sit above the Galena Gulch, a natural tributary. An adit is like a cave that goes in horizontally to meet a mine shaft. Shown lower left is the only known adit at IKHS.

Exploring the Upper Gulch and Mine Waste Drainage



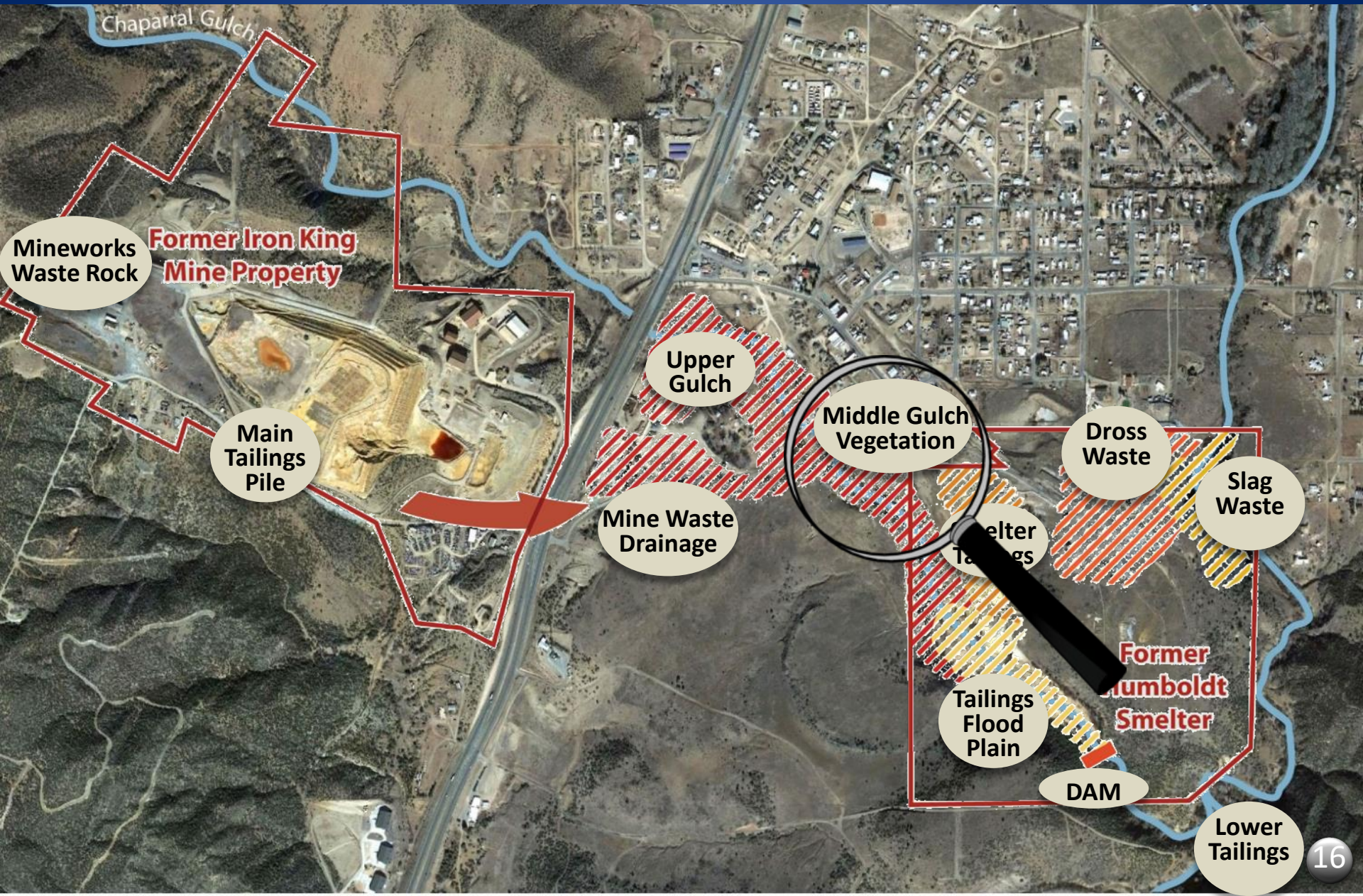
Exploring the Upper Gulch





In the past, Iron King mine wastes flowed into drainages along two pathways in Upper Gulch (upper left). Mineshaft dewatering and processing water took the path on the north. The Iron King Mine tailings ponds had outfalls that discharged tailings into the path on the south. No have been observed in the north path but the sediments are contaminated in spots (lower right). In contrast, in the south path there are deposits of partially covered tailings. You can see some of these from the side of 3rd Street (photos). Some of the deposits are several feet deep, as can be seen in the lower middle picture.

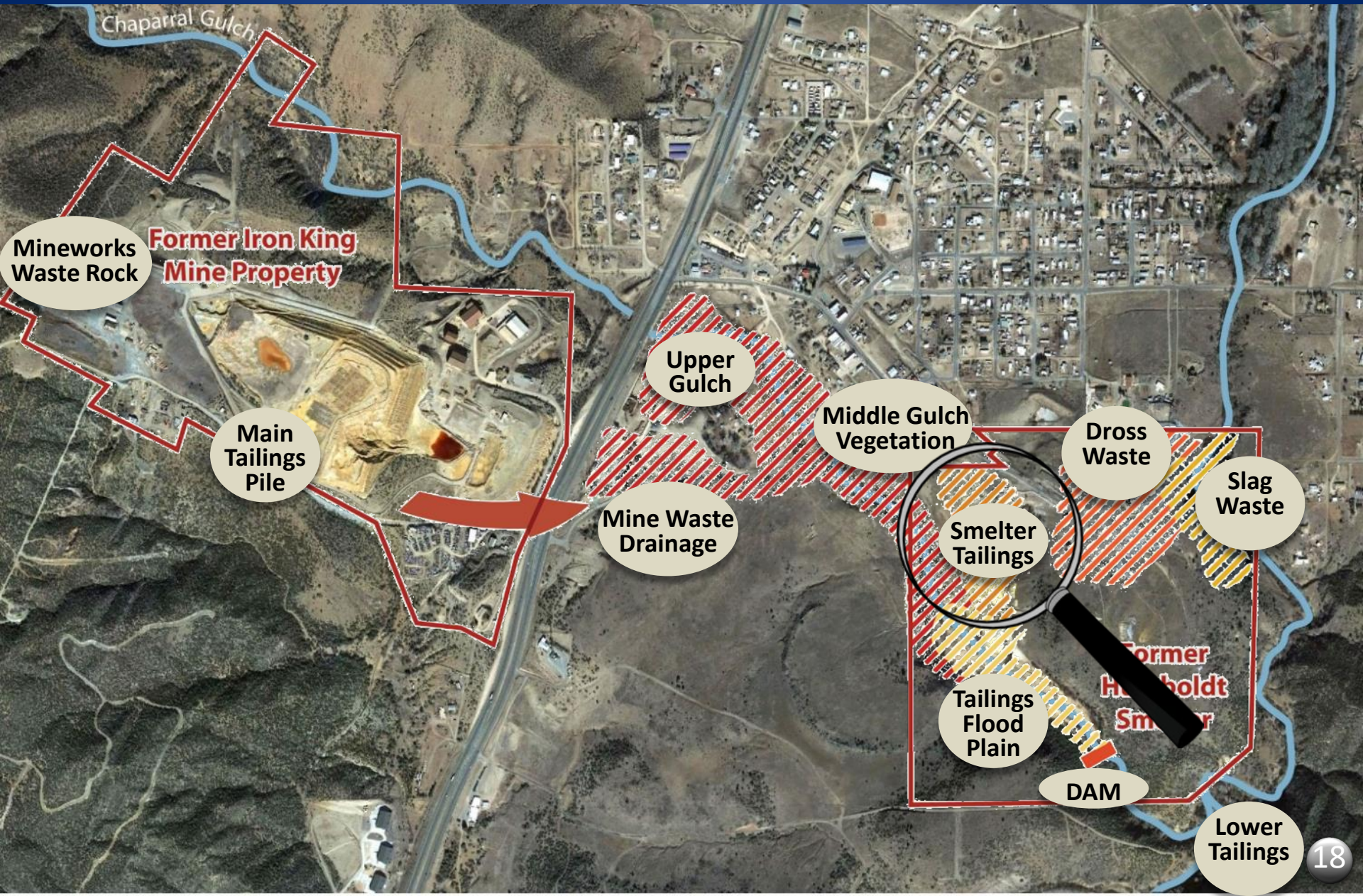
Exploring the Middle Gulch



Exploring the Middle Gulch

The Middle Gulch has riparian habitat – mature trees, shrubs and grasses along a waterway. See first 2 photos. In the mining days, the Gulch was not so well-vegetated or lush because toxic tailings were near the surface. Over time, the tailings in the Middle Gulch have become mostly, but not completely, covered up by cleaner sediments that wash down from the mountains. Upper right, you can see partially exposed buried tailings peeking out along the path. Bottom left picture was in 2008, while bottom right in 2018. These show how much sediment has flowed in from the mountains in storms over the last 10 years. But some storms also "cut in" to the sediments and cause tailings to get exposed again.

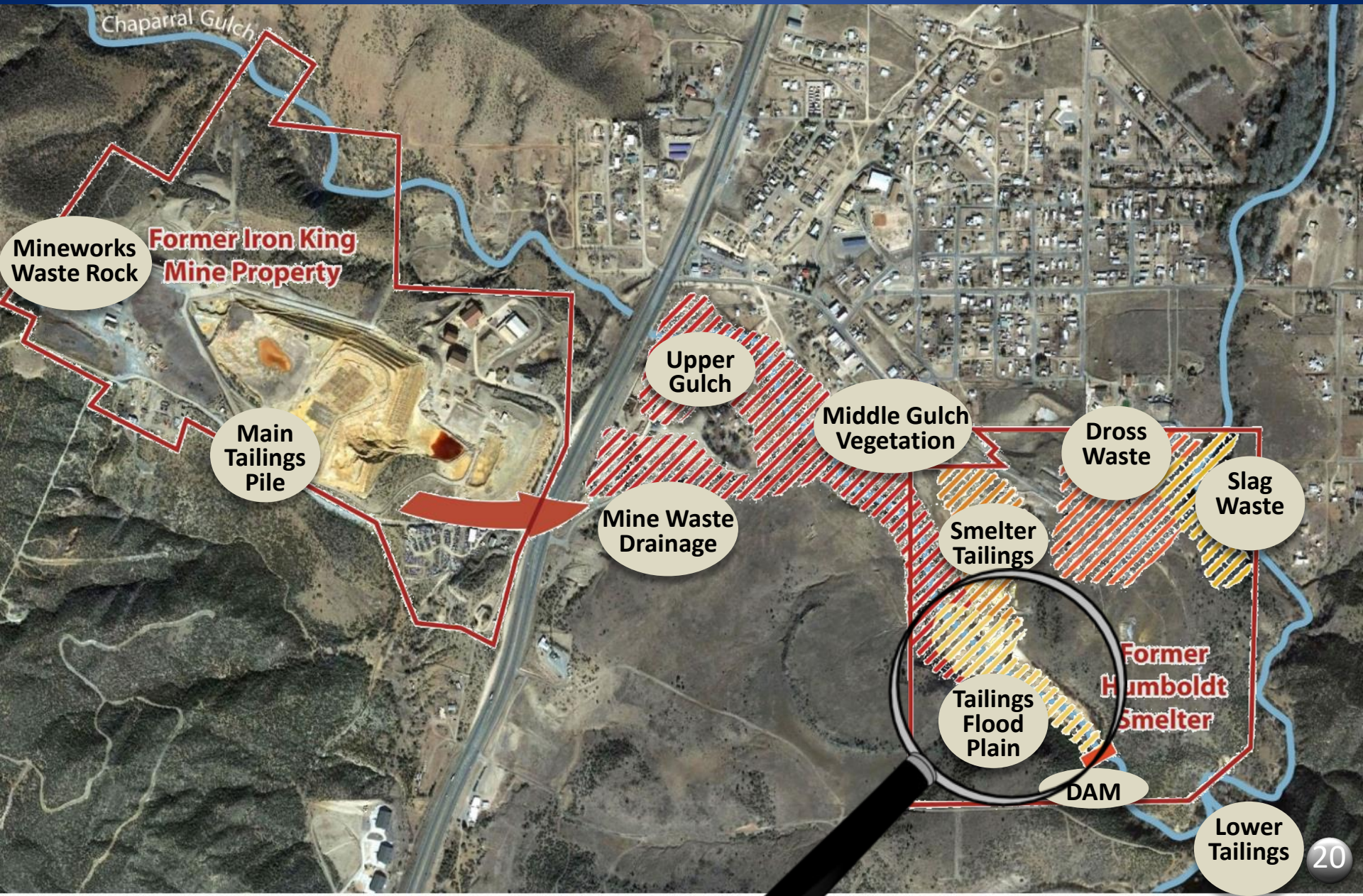
Exploring the Smelter Tailings Swale



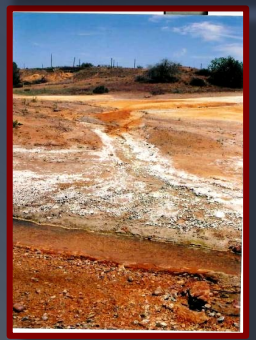
Exploring the Smelter Tailings Swale

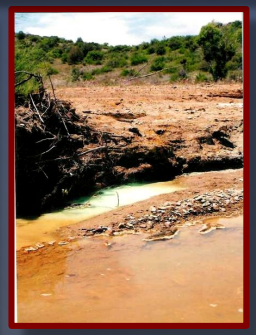
Smelters generally melt ores in furnaces, separate non-metal materials, and then form pure metal ingots for sale. The Humboldt smelter did this but also did a little grinding/milling of ores on the side, just like the Iron King Mine did. This second process creates tailings as wastes. The Smelter had a small tailings pond in a bowl-shaped valley, or swale, to hold these tailings. After the smelter stopped operating in 1937, in the 1940s another fly-by-night operator imported ores to the property and did milling/grinding near the swale. These tailings added to the Humboldt Smelter tailings already there. Drainage water has powerfully etched these tailings into 15-foot high formations. At some point, the berm holding back the tailings pond broke, spilling tailings out into the flood plain. These tailings and those from the Iron King Mine have mixed in the flood plain below the swale.

Exploring the Great Tailings Flood Plain



Exploring the Great Tailings Flood Plain





Tailings from the Iron King Mine upstream, and the Humboldt Smelter property, have mixed in the Tailings Flood Plain. The plain is about the size of 9 football fields. Water flowing out of Middle Gulch spreads out here and allows sediment and tailings to drop out in layers. In some spots, there are tailings at the surface with no plants. In other areas, there is a foot or two of cleaner sediment washed from the mountains sitting on top of deeper tailings. There, grasses grow on top. Big storms push water powerfully through this area, and this washes tailings downstream. Tailings caught deep behind the dam are soaked in water and look muddy and green; while tailings at the surface are bright orange. It is generally not good for toxic mine tailings to remain in a flood plain above a River.

Exploring the Dam and Lower Gulch

Exploring the Dam and the Lower Gulch

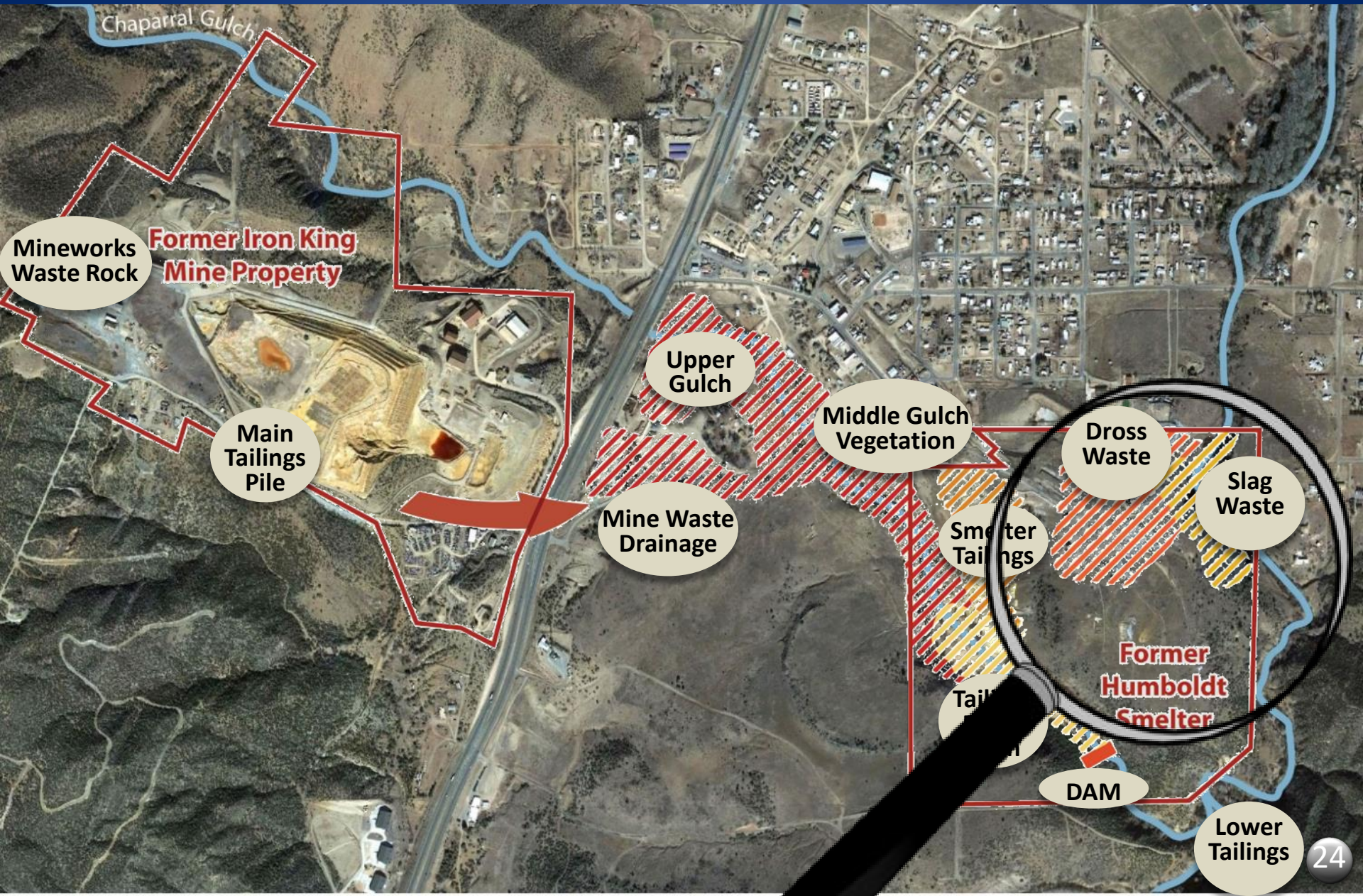







The dam is made of concrete and stands about 25 feet high. Tailings are filled to the top behind the dam, so when there are heavy rains, the dam acts kind of like a waterfall. The dam is fairly stable, but very old. Some water leaks out from behind and under it. This water caries dissolved iron and mine wastes. When these make contact with air downstream of the dam, they undergo a chemical reaction to form red- or orangish to yellowish particles, which settle out of the water (photos). Below the dam, Chaparral Gulch plunges into a narrow, steep canyon. Tall plants grow in wet times, and not in dry times. Raging waters flow over the dam and mow down the plants at times (photo - 2018). At the bottom of the Lower Gulch is a very old tailings deposit that has very high levels of lead. (photo).

Exploring the Smelter, the Dross, the Slag



Exploring the Smelter, the Dross, the Slag


Aerial View


Stack, converter flue, dross

Figure B 38. Overview of AZ N:8:71(ASM) Locus 5 CASC flue and smokestack (F4) facing southeast.

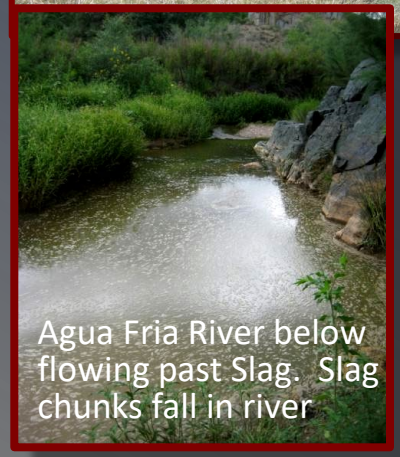

Stack in poor condition


Dross Waste


Monolithic slag over river

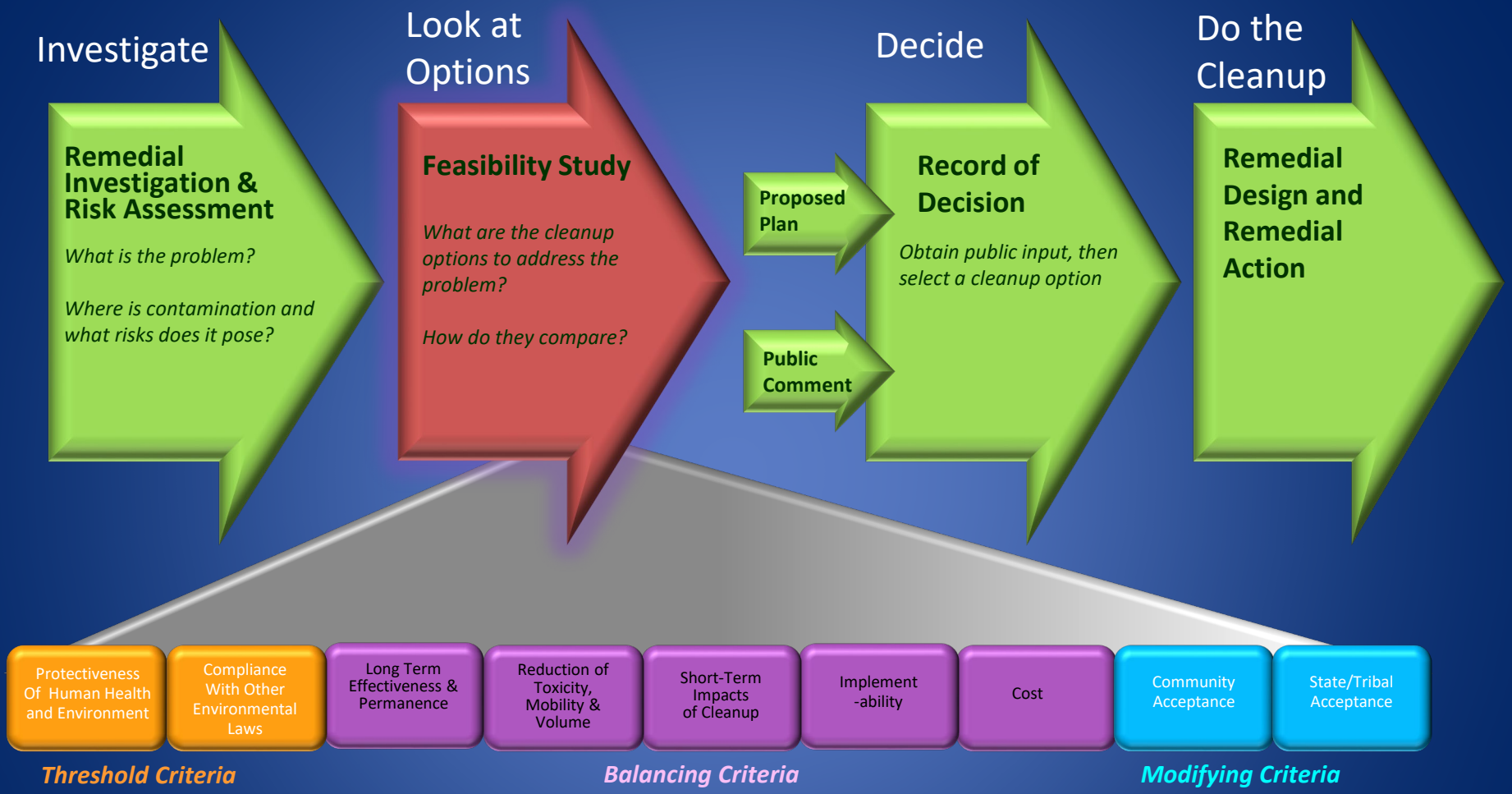
Slag Crevasses


Loose Slag Piles


Agua Fria River below flowing past Slag. Slag chunks fall in river

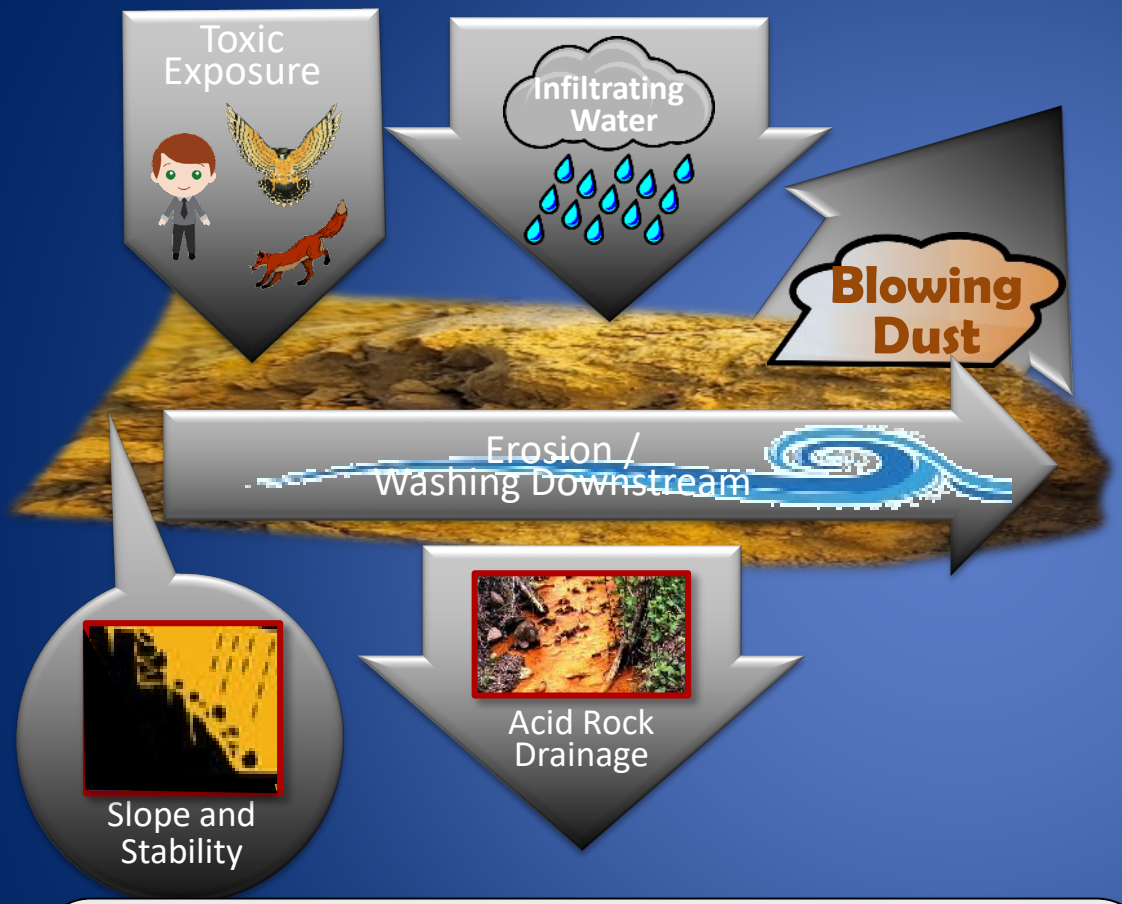
The smelter property sits on a high plateau above the town and well above the Gulch. In the north portion, ore was melted in blast furnaces, and a waste called slag was removed. Pure copper was then purified and sold. The only iconic structures left from the 1906-1937 operations are a brick stack and a flue converter. These are in crumbling/unsound condition. In the 1950s and 1960s, a fly-by-night operator brought in aluminum dross (a waste like slag) from dye casting plants to try to process out the aluminum, but the business failed. Piles and fields of this gray dross waste remain in the north and under the stack. Dross is contaminated. Molten slag, like lava, was poured over the cliff over the Agua Fria River, where it hardened into a mass against the cliff wall. Chunks have broken off into the river and there are crevasses. Elsewhere there are piles of broken up (loose) slag scraped out of the furnaces. Soils in the south are also contaminated with elevated levels of metals. .

Criteria for Comparing Cleanup Alternatives



The Superfund law requires that EPA follow a process leading to the selection of a cleanup alternative from among many alternatives. This decision is documented in what is called a RECORD OF DECISION, or ROD. Usually, we must have a ROD *before* we can seek funding or enforce against a responsible party to carry out a cleanup. The FEASIBILITY STUDY is a VERY detailed evaluation of cleanup alternatives that informs the cleanup decision. Because there are so many different areas at the IKHS Site that need cleanup and they are interrelated, the alternatives in the FS will be complex. Shown are the nine criteria that the law requires us to use when we compare alternatives in the feasibility study and in the ROD.

Putting Together Cleanup Alternatives: Factors and Goals in Mine Tailings Cleanup



Goals

- PROTECT people and animals
- CREATE STABLE SLOPES
- CONTROL EROSION
- CHANNEL THE WATER
- STOP INFILTRATION of Rainwater Don't Make Acid Mine Drainage
- Future LAND USES?

Questions

- Move it or cover it where it is?
- What kinds of cover?
- Is there enough cover material?
- Where does the repository go?
- Is there enough repository space?
- Is existing environment preserved?
- What future land uses?
- How would it look?

This slide shows the many challenges we need to consider or control when addressing toxic mine tailings and wastes in varied environmental settings at this site. On the right, you can see some of the goals and questions that come up. We will design cleanup alternatives in the FS around these and other goals and questions. Among the questions, having enough material for high-tech permanent covers over waste; having enough space to put any wastes that are removed; and where to put those wastes; are paramount.

Redevelopment: What Superfund Does and Doesn't Do

Consider whether, how, and to what degree remedial alternatives can be compatible with reasonably desired future land reuse or redevelopment

Pay for, require, or make part of the cleanup the costs of restoration, development, or enhancements leading to redevelopment

The Superfund process does NOT select what the future land use will be of a property after cleanup. Also, *importantly,* EPA does not pay for, nor can we order parties to pay for, future redevelopment or reuse of the property after cleanup. However, we *DO* consider how various cleanup alternatives would leave the property and whether or to what degree they are compatible with reasonable or likely desired land uses. That is what we are trying to do now with the community and why we are doing it early in the FS process.

Ideas We Heard From You So Far for Smelter Property Reuse

- A recreational or public park (state or community)
- A place for public gatherings or events
- Open space
- A piece of history – echoing or highlighting the Town's past
- A place for tourists to stop enroute to Prescott, Sedona, or Grand Canyon
- A heritage museum
- A historical interpretive trail
- A playing field of some kind
- Solar energy array
- A place for town businesses

The Dilemma of the Structures

- Extremely poor condition
- May not be restorable to condition safe for occupancy
- Most contaminated area of the property
- Contamination piles and soils surround and underlie the structures
- Cleaning up around the structures may require their demolition

EPA Contacts

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