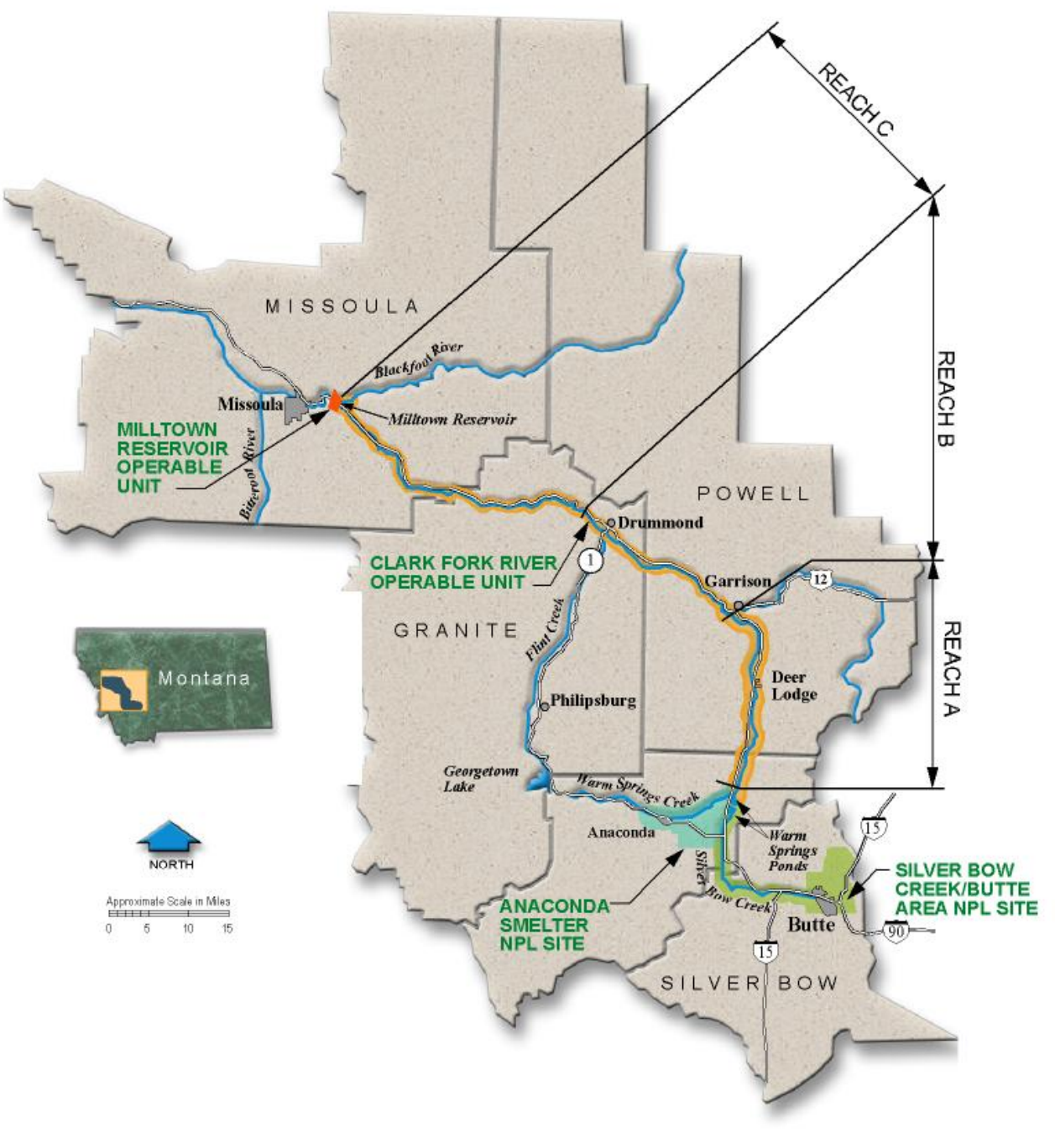
Clark Fork River Ecological Risk Assessment & Risk Management Decisions


REACH C
REACH B
REACH A
MISSOULA
Blackfoot River
Missoula
Milltown Reservoir
MILLTOWN RESERVOIR OPERABLE UNIT
Bitterroot River
POWELL
Drummond
CLARK FORK RIVER OPERABLE UNIT
1
Garrison
12
GRANITE
Flint Creek
Deer Lodge
Philipsburg
Montana
Georgetown Lake
Warm Springs Creek
Anaconda
Warm Springs Ponds
15
SILVER BOW CREEK/BUTTE AREA NPL SITE
Silver Bow Creek
ANACONDA SMELTER NPL SITE
Butte
90
15
SILVER BOW
NORTH
Approximate Scale in Miles
0 5 10 15

Clark Fork River Ecological Risk Assessment
Problem Formulation

- Assessment Endpoints for Terrestrial Receptors
  - Survival, growth, diversity and abundance of the riparian vegetation community under chronic exposure to contaminants and other chemical and physical stressors in the 100 year flood plain habitats of the Clark Fork River
  - Survival, growth, and reproduction of wildlife populations under chronic exposure to contaminants and other chemical and physical stressors in the 100 year flood plain habitats of the Clark Fork River

Clark Fork River Ecological Risk Assessment
Problem Formulation

- Assessment Endpoints for Aquatic Receptors
  - Survival of fish, aquatic invertebrates, and algal populations under acute exposure to contaminants of concern and other chemical and physical stressors in the Clark Fork River
  - Survival, growth and reproduction of fish, aquatic invertebrates, and algal populations under chronic exposure to contaminants of concern and other chemical and physical stressors in the Clark Fork River.
  - Species of Special Concern: Bull Trout
    - **Survival, growth and reproduction of Bull Trout under acute and chronic exposure to contaminants of concern and other chemical and physical stressors in the Clark Fork River.**

Problem formulation: Site Conceptual Model

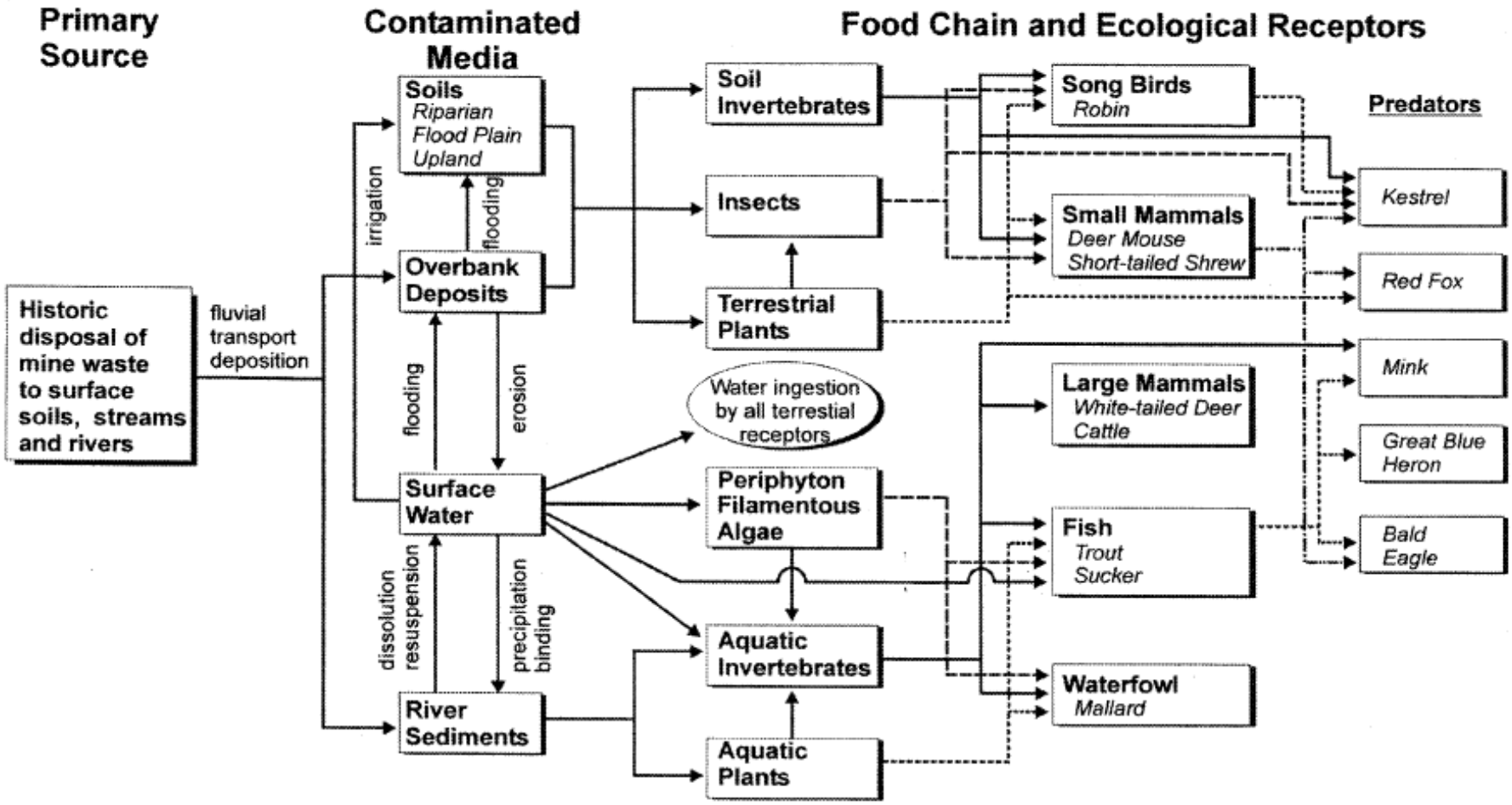
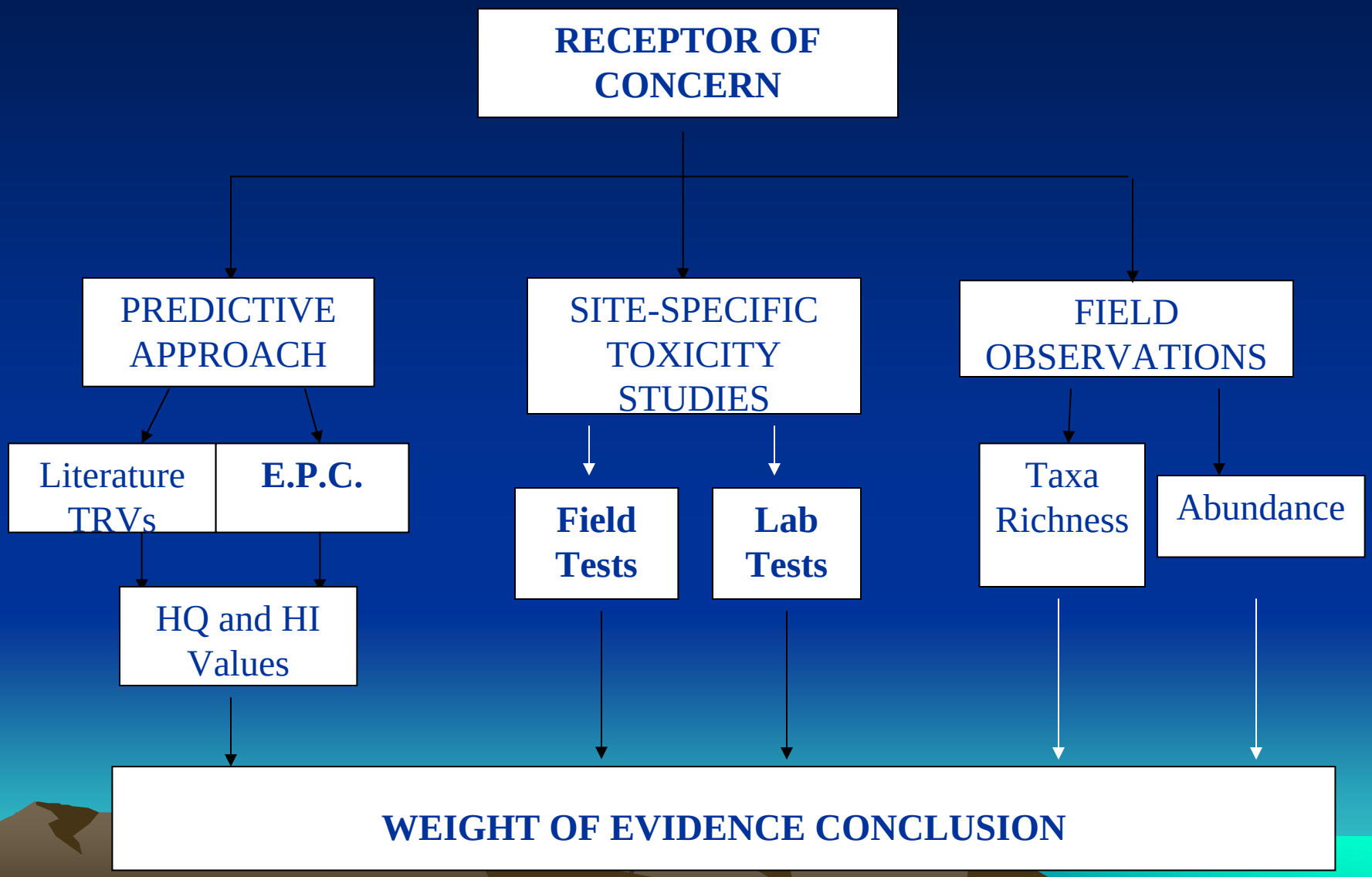


Figure 3-3: Conceptual Model for Ecological Exposures Clark Fork River Operable Unit

Risk Characterization Approach



Exposure & Risk Characterization

- Identified Exposure Point Concentrations and characterized risks in separate chapters for:
  - Aquatic Community as a whole
  - Fish
  - Macroinvertebrates
  - Algae
  - Terrestrial Plants
  - Terrestrial Vertebrates
  - Terrestrial Soil Organisms

Exposure & Risk Characterization

- For Each Receptor Category
  - Exposure Pathways identified
  - Predicted Hazard:
    - Hazard Quotient = [Surface Water] / AWQC
  - Site-specific Toxicity tests
    - Water effect Ratio toxicity testing with Rainbow trout, Ceriodaphnia, and fat head minnow
  - Site-specific receptor population and demographic data
    - Density of brown trout / 100 meters of stream
  - Weight of Evidence

Exposure & Risk Characterization

- Weight of Evidence Analysis
  - Evidence Category
    - Predictive, direct testing, population studies
  - Exposure Pathway: Eg. Direct contact, dietary
  - Observation: **Eg. caged fish show pattern of intermittent mortality**
  - Discussion
    - No correlation of mortality with average or peak copper levels; suspect pulsed are main cause
  - Score:
    - -2 = Strong evidence metals do not cause an adverse effect
    - -1 = Evidence is consistent with, but not proof, that metals do not cause an adverse effect
    - 0 = Evidence neither supports nor refutes occurrence of an adverse effect of metals
    - +1 = Evidence is consistent with, but not proof, that metals do cause an adverse effect
    - +2 = Strong evidence metals do cause an adverse effect

Exposure & Risk Characterization

Weight of Evidence Analysis—Acute Hazards to Fish From Typical (non-Pulse) conditions

Evidence Category	Exposure Pathway	Observation	Discussion	Score
Predictive	Gill	Only 2 of 232 routine Cu Conc. Have HQ > 1	Data represents 6 years and 5 stations	-1.5
Direct Testing	Gill	Caged fish show pattern of intermittent mortality	No correlation of mortality with average or peak Cu levels. Suspect Pulses are cause	0.5
Population Studies	All: gill and diet	Reduced fish populations at multiple locations in each of 2 years	Lethality from ambient concentrations coul result in decreased fish population	1.5

Conclusions

- Aquatic community
  - **Fish**: Data are consistent with the hypothesis that Cu is imposing an intermittent low-level chronic stress; lower populations more likely to be from acute pulses of high concentrations of Cu
  - **Macroinvertebrates**: Metals are likely altering composition of community, not overall abundance
    - Bed sediments mostly non-toxic
  - **Algae**: Dissolved metals cause low to minimal stress

Conclusions

- Terrestrial Community
  - **Riparian Vegetation**: The weight of evidence is strong that tailings materials present in the root zone of the riparian area soils are significantly phytotoxic to terrestrial Plants
  - **Wildlife Receptors**: Small vertebrate insectivores & herbivores at highest potential risk. Little site-specific data, these receptors had highest uncertainty

Risk Pathways Identified in Assessment

- Receptors At Risk
  - Fish
    - Direct Exposure to Acute Pulses
  - Riparian Vegetation
    - Direct Exposure to Mine waste
  - Wildlife Receptors
    - Dietary exposure from eating Invertebrates and plants in contaminated soils of riparian Area
- Media of Concern
  - Water: Overland flow during storm events on "Slickens Areas"
  - Mine Tailings
  - Contaminated Soils and mine tailings

Common Theme: Mine waste and contaminated soils in the floodplain and River Banks

CLARK FORK RIVER OPERABLE UNIT
RISK MANAGEMENT DECISION MAKING PROCESS

LIST OF ALTERNATIVES

- **No Further Action**
- **In-Place Reclamation of Exposed Tailings**
- **In-Place Reclamation of Exposed Tailings and Other Impacted Soils and Vegetation Areas**
- **In-Place Reclamation of Exposed Tailings and Other Impacted Soils and Vegetation Areas with Streambank Stabilization**
- **Removal of Exposed Tailings and Other Impacted Soils and Vegetation with Streambank Stabilization**
- **Total Removal Unless Overlain by Woody Vegetation**
- **Total Removal of all Exposed and Buried Tailings Areas, i.e., Essentially a Complete Reconstruction of the Entire Floodplain of the Clark Fork River**

ANTICIPATED OUTCOMES OF THE ALTERNATIVES:

None of the alternatives, if individually implemented, would completely achieve all of the Remedial Action Objectives (e.g., State of Montana's water quality standard for copper) because of continued copper loading from tributary, upstream, and residual contamination sources left onsite.

ANTICIPATED OUTCOMES OF THE ALTERNATIVES:

- **No Further Action: Impacted areas may improve over time, but many risks and impacts would remain for many years.**

- **Alternative 2: Buried tailings, impacted soils, and contaminated streambanks would continue to cause vegetation and aquatic impacts.**

ANTICIPATED OUTCOMES OF THE ALTERNATIVES:

- **<u>Alternative 3</u>: Areas of buried tailings would not be remediated. Also, streambank erosion would not be addressed. Ecological impacts would be expected to continue.**

- **<u>Alternative 4</u>: Buried tailings without impacted vegetation would be addressed only by BMPs and land use management techniques. Possibility of continued ecological impacts should be less than under Alternative 3.**

ANTICIPATED OUTCOMES OF THE ALTERNATIVES:

- **Alternative 5:** This alternative uses more aggressive clean up of slickens, a principle threat waste. The streambank component addresses the risk of erosional problems and inhibits (but does not eliminate) migration of wastes left in place into the river. Many of the existing land uses could be continued following construction of the remedy.

- **Alternative 6:** No in-situ reclamation is proposed under this alternative, remaining impacted soils would be subject to natural healing. However, construction costs and construction impacts would be significantly higher than Alternatives 2-5. EPA is not comfortable the construction impacts could be successfully managed.

ANTICIPATED OUTCOMES OF THE ALTERNATIVES:

- **Alternative 7: Because any buried tailings and metals-impacted soil areas underlying woody vegetation would remain in place, minor long-term ecological impacts may continue. The construction impacts would be substantial during this period of time and would be very difficult to manage.**

- **Alternative 8: The construction costs would be much higher than all of the previous alternatives. The construction effort would have substantial short-term and long-term impacts assuming these impacts could be successfully managed. This alternative would take approximately 25 years to implement (much longer than all of the other alternatives).**

RISK MANAGEMENT DECISION MAKING PROCESS
CONCLUSION

- **Balance between long-term and short-term effectiveness and permanence, reduction of mobility, toxicity, and volume of wastes, and concerns with implementability.**

- **Remedy calls for removal of most slickens, where uncertainty is greatest regarding the effectiveness of in-situ treatment, where it was most cost effective to dig up wastes, i.e., reduce volume of wastes, and from which potentially large-scale releases of toxic materials could occur into the river. The ecological risk assessment identified this type of contamination problem as an acute risk to aquatic life.**

RISK MANAGEMENT DECISION MAKING PROCESS
CONCLUSION

- Remedy proposes in-situ treatment where success of this technique was deemed likely to decrease mobility of wastes. Also, the remedy can be completed more quickly (and less costly), and with less impact to land uses without sacrificing a great deal in protectiveness of the remedy. The ecological risk assessment identified this type of contamination problem as a chronic risk to aquatic life.

- Remedy calls for streambank stabilization where appropriate to minimize erosion of contaminated materials into the river to reduce episodic large-scale releases of toxic materials that the ecological risk assessment identified as a chronic risk to aquatic like.

RISK MANAGEMENT DECISION MAKING PROCESS
CONCLUSION

- **Remedy proposes revegetation of slickens, other areas, as appropriate, and streambanks. This effort would address terrestrial risks identified in the ecological risk assessment.**

- **Remedy could be completed in a reasonable period of time (approximately 10 years), at a reasonable cost (approximately $100 million under most current federal-lead estimate), and at a reasonable impact to current use of land by the ranchers/farmers on whose property the remedy would be carried out.**