


Risk Assessment for Mercury Releases to the Kuskokwim River from the BLM Red Devil Mine

**Mike McCrum, BLM Alaska**  
**Doug Cox, Ph.D., BLM Nat'l Operations Center**



Red Devil Mine

1

**Organization of Presentation**

- Discussion of Site setting and the Kuskokwim River
  - History of mercury mining activities
- Initial investigations and RI study
  - Early response action - 2014
- Fish telemetry and tissue study
- Supplemental RI data collection
- Human health risk assessment
  - Multiple lines of evidence
- Consideration of findings
  - Risk management recommendations

2


**Introduction**

- Mercury and other site contaminants from Red Devil Mine have been detected in Kuskokwim River media
- The methylation of mercury and food chain biomagnification can impact upper food chain organisms, such as pike and burbot
  - leading to concerns about human health risk (esp. subsistence) from consumption of contaminated fish
- This presentation describes a **“Multiple Lines of Evidence”** approach developed to incorporate a number of site-specific findings into risk management decision making

3

**Kuskokwim River**

- Drains much of southwest AK
- Ninth largest river in North America
- Average discharge is 67,000 cfs



4

**Kuskokwim River at Red Devil, June 2015**




Linear shorelines  
 High Turbidity  
 Strong current  
 Few shoreline wetlands

5

**Important Site Issues Related to RDM and the Kuskokwim River**

- Numerous Mercury Deposits
- Elevated Background Mercury
- Fish are Important Local Source of Protein
- Elevated Mercury in Resident Fish



6



### Remedial Investigation Findings

RI conducted between 2009 – 2014, and concluded

- The RDM is a source of heavy metals contamination to site soils, groundwater, surface water, and sediments
- Contaminants are migrating offsite through groundwater and surface water transport
- Transport of contaminated sediments in Red Devil Creek has affected sediments in the Kuskokwim River
- Potential risks to human and ecological receptors were identified
  - Primary COCs are arsenic, antimony, and mercury

8

### Mercury in Kuskokwim River Sediment

**Mercury Concentration Range**

Total Mercury <0.0062 mg/kg to 310 mg/kg

Methylmercury <0.01 to 3.73 ng/g

Mouth of Red Devil Creek

- Sediment concentrations upstream are low
- Highest concentrations at the mouth
- Sediment concentrations generally decrease downstream

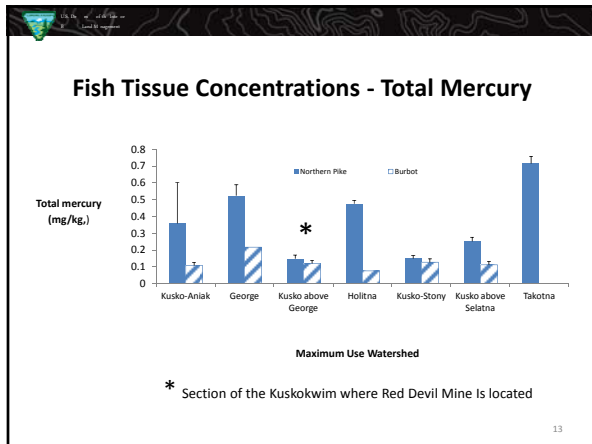
9



### BLM/US F&W Telemetry Study Area in Kusko Watershed

- Pike – Sedentary
- Burbot – Mobile
- Few fish near Red Devil Mine

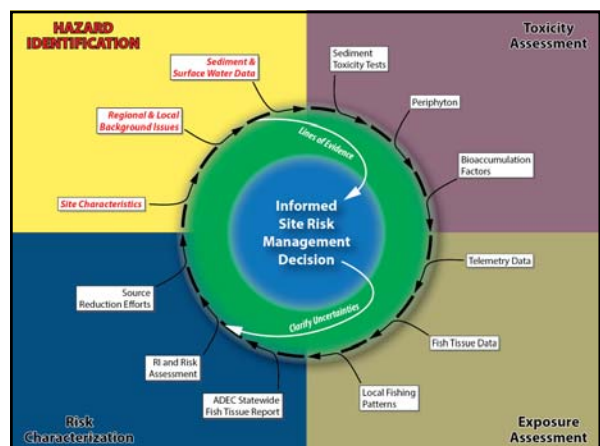
12



- ### Human Health Risk Questions for RDM and Kuskokwim River
- Is mercury from RDM being methylated and getting into the Kusko River food chain?
    - Is the issue site-specific or regional in nature?
  - Are local subsistence populations at risk from consuming MeHg in Kusko River fish?
  - Why is mercury the primary concern?
    - *Cinnabar ore* → Hg → MeHg → food chain bioaccumulation → human exposure → potential toxicity
    - Other COCs – arsenic (As), antimony (Sb)
      - Toxic but not bioaccumulative

- ### Multiple Lines of Evidence (MLOE)
- Reviews the evidence for a causal relationship between a project hypothesis and observed impacts for a number of endpoints
  - Supports decision making by *incorporating a wide range of data* to develop an *overall evidence-based conclusion*
  - Widely used approach to evaluate a large amount of data in support of environmental decision making
  - At Red Devil, will help distinguish between *regional* and *site-specific* issues

- ### Lines of Evidence Evaluated in the Risk Assessment
- Hazard Identification
    - Site characteristics, regional and local background, sediment data
  - Exposure Assessment
    - Telemetry data, fish tissue, local fishing patterns
  - Toxicity Assessment
    - Sediment toxicity tests, periphyton, site-specific bioaccumulation factors
  - Risk Characterization
    - RI and Supplemental RI, ADEC statewide fish monitoring report, source control efforts



### Hazard Identification: Site and Kuskokwim River Characteristics

- Red Devil Mine is located in a highly mineralized region of Alaska
  - Naturally occurring background levels important to project
- The flow volume from Red Devil Creek is a minor contributor to the Kusko
- The reach of the Kuskokwim near Red Devil is generally poor habitat for game fish of interest
  - Few wetlands, cobbled bottom, very turbid

19

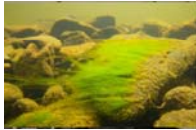
### Chemical and Biological Mercury Levels in the Kuskokwim River

- While there is a measurable and biologically significant elevation of mercury and arsenic in fish and insects in Red Devil Creek, similar levels are found near other abandoned mines in the middle Kuskokwim River watershed
- Percentage of readily bioavailable mercury in sediment samples is low, typically less than 1% of total mercury
  - However, the amount of Hg historically released into the river from Red Devil provides ample Hg for methylation even if overall rates are low

20

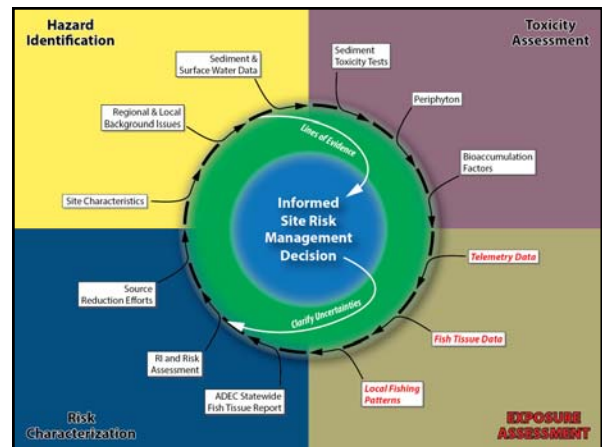
### Periphyton Mercury Tissue Data

Methylmercury was not detected in tissue samples collected from periphyton communities in vicinity of Red Devil Mine



Periphyton data suggest that mercury released from Red Devil Mine have not resulted in greater methylmercury levels in the base of the aquatic food web in the Kuskokwim River

21



### Exposure Assessment: Populations, Pathways, and Assumptions

Supplemental Risk Assessment will consider:

- Residents (adult and child)
- Recreational or Subsistence User (adult and child)
- Industrial/mine worker
- Dermal contact with sediments
- Incidental ingestion of sediments
- Fish ingestion (*pathway of primary interest*)

Based on approaches from 2014 RI report

- Combination of default and site-specific assumptions

23

### Kuskokwim Fishing Patterns - Pike



- Pike frequent tributaries with low energy habitat
- Kuskokwim habitat poor for pike

24

### Kuskokwim Fishing Patterns - Burbot

- Burbot migrate hundreds of miles each year
- Local fishermen catch burbot in Kuskokwim in winter



25

### Subsistence Fish Consumption Issues

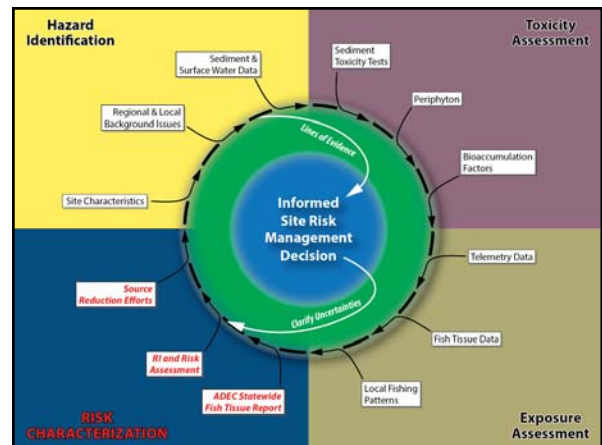
- Fish of Interest for Human Consumption
  - Pike, Burbot (most preferred species)
  - Sheefish, Arctic Grayling, other whitefish, salmonids
- Alaska Dept of Fish and Game (ADFG) did a survey of consumption rates and types of wild food used by Red Devil Village residents
- Multiyear telemetry and fish tissue MeHg study done for pike and burbot in the middle Kusko region

26

### ADEC Statewide Pike and Burbot Data and State Fish Consumption Advisories

- Total Hg tissue levels in pike and burbot from the middle Kusko are consistent with the median 2001-2016 statewide tissue levels reported by ADEC (<http://dec.alaska.gov/eh/docs/vet/Fish/TotalMercuryInAlaskanFish.pdf>)
- State of Alaska Epidemiology Department has issued fish consumption advisories for Hg across the state
  - For women of childbearing age and children in the Middle Kuskokwim area, it is recommended to eat more fish < 2 feet in length and less of longer fish
  - Advisories more restrictive in other river systems

27



### Risk Characterization: Regional vs Site-Specific Risk


- Fish consumption risk results will represent **regional** risks for middle Kusko River area
- Site-specific human health risks are difficult (impossible?) to quantify:
  - Impact area from site is small in relation to home range of species of impact
  - Habitat in Kusko near RDM unattractive to fish; villagers tend to fish elsewhere
  - COCs (esp Hg) are widespread in the watershed
  - BLM doing sediment – food chain modeling as part of uncertainty analysis

29

### Current Project Status

- The **Supplemental RI Human Health and Ecological Risk Assessment for the Kuskokwim River** is being developed by BLM with input from EPA and AK Dept of Environmental Conservation
- Based on:
  - Updated sediment and biota data
  - Telemetry and tissue concentration data
  - RI risk assessment approaches
  - ADFG fish consumption information
  - Fish contaminant uptake modeling

30




**Risk Management Options**  
**Pending Risk Assessment Results**

- No action
- Monitored natural attenuation
  - Sediments, biota
- Further study – specific endpoints
- Limited removal action in Kusko
  - delta area sediment
- Regional evaluation

31

Questions?



32