NTP
National Toxicology Program

Literature-Based Analysis of Mountaintop Removal Mining: Impacts on Health in the Surrounding Community

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NTP Board of Scientific Counselors
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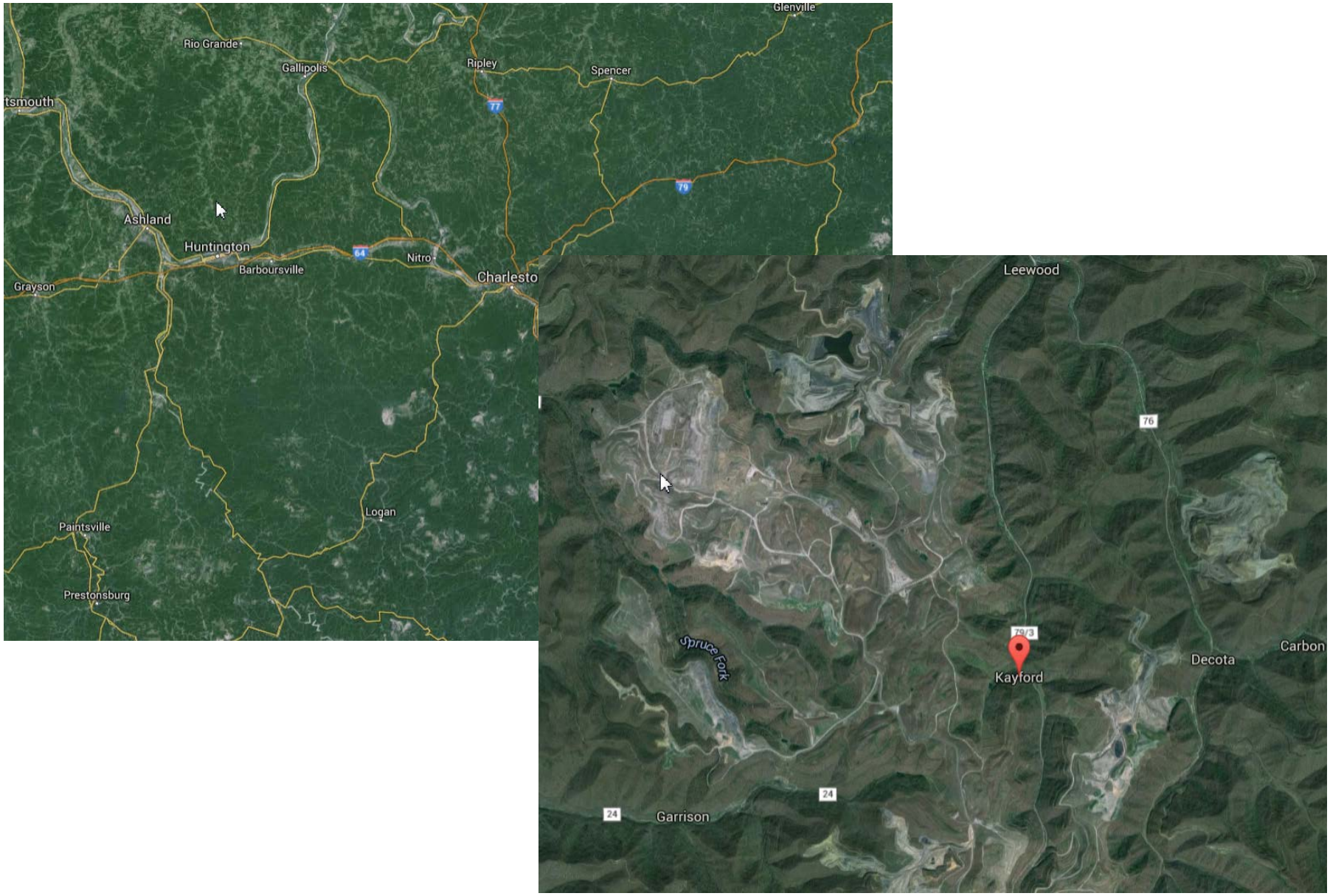
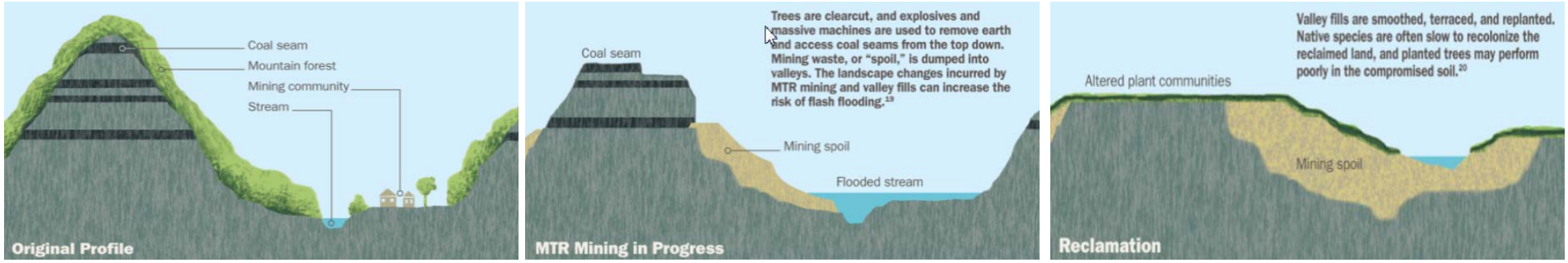
Kayford, West Virginia: Google Earth



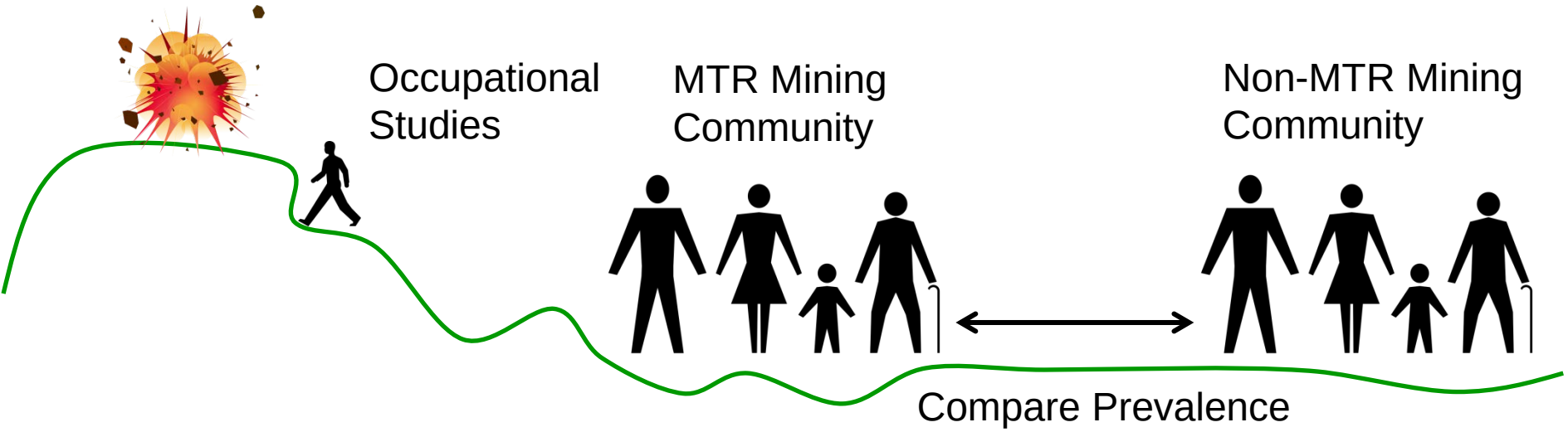
Mountaintop Removal (MTR) Mining



- Predominant form of coal mining in Central Appalachia
- Faster, cheaper, less labor intensive
- Compared to underground coal mining, improved occupational health and safety
- Air, water, and soil in the surrounding area are impacted
- Focus of this project is on humans not ecological impacts

Environ Health Perspect 119:a476-a483 (2011). http://dx.doi.org/10.1289/ehp.119-a476

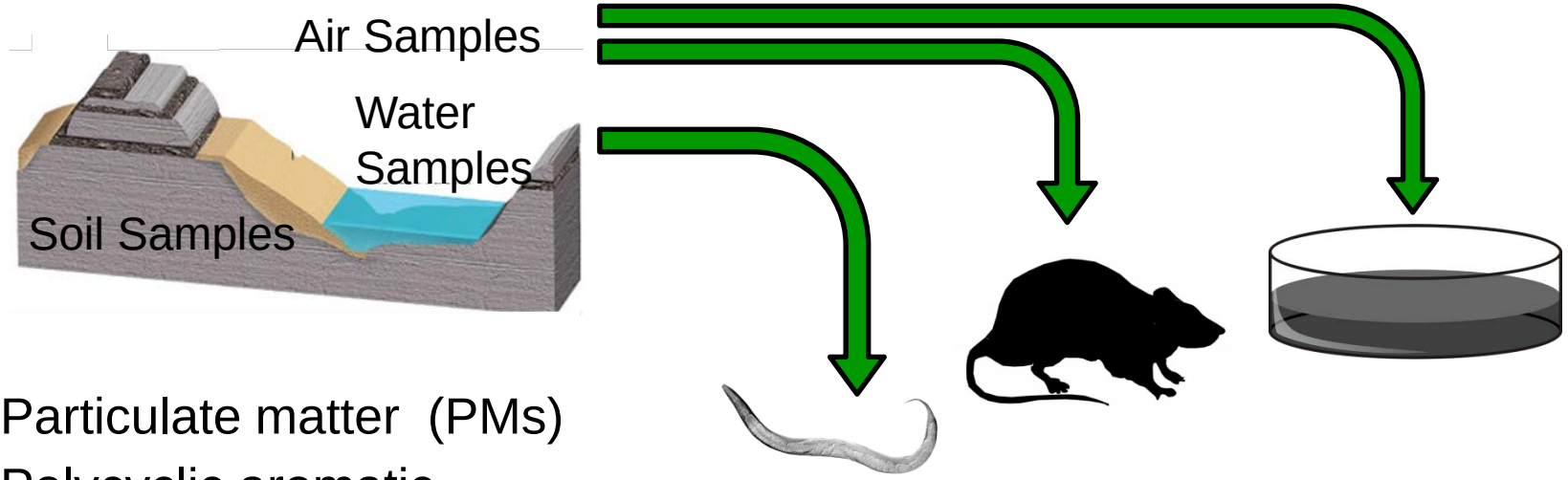
Existing Epidemiological Studies are Limited



- Some studies report higher rates of birth defects, cancer, cardiovascular disease, hospitalization, general quality of health, and mortality in MTR Mining communities.
- Cannot account for significant confounding factors: low SES, smoking, reduced access to health care, limited mobility

Complex Exposure Mixture

Experimental Studies of MTR Mining Mixtures



- Particulate matter (PMs)
- Polycyclic aromatic hydrocarbons (PAHs)
- Metals (Mn, Fe, Al)
- Hydrogen sulfide (H_2S)
- Nitrogen oxides (NO_x)
- Sulfate (SO_4)
- Selenium (Se)

- Inhibited growth of C. elegans
- Impaired microvascular function in rats
- Neoplastic transformation of human bronchial epithelial cells

Overall Objective

Literature-Based Analysis of Mountaintop Removal (MTR) Mining: Impacts on Health in the Surrounding Community

- To understand the human health impacts of MTR mining by conducting a systematic review of published studies of MTR mining and community health, occupational studies of MTR mining, and any available animal and in vitro experimental studies of exposures to MTR mining-related mixtures

Proposed Literature-based Analysis

Systematic review of community health effects of mountaintop removal (MTR) mining

1. Find relevant studies
   - Human observational and occupational
   - Experimental animal and in vitro model systems
2. Extract data from relevant studies
3. Assess the internal validity (risk of bias) of individual studies
4. Summarize the evidence
   - Identify data gaps
   - Required evidence

Proposed Literature-based Analysis

Depending on the extent of the available evidence…

5. Synthesize the evidence
   - Conduct meta-analyses, if appropriate
   - Consider sensitivity analyses: community/occupational, MTR/unspecified mining, and pre-1980/post-1990
6. Rate confidence in the body of evidence
7. Translate confidence ratings into level of evidence of health effects
8. Combine the level of evidence ratings for human and animal data and consider the degree of support from mechanistic data

A protocol for these steps will be developed based on the OHAT Approach and Handbook.

PECO Statement

PECO Element	Evidence
Population	• Humans without restriction based on age, sex, or lifestage • Experimental animal models of human health • in vitro models of human health
Exposure	Exposure to mountaintop removal mining activities including: • Residential proximity • Occupational exposure • Environmental measures (e.g., air, water levels) • Experimental exposure to a MTR mining-related mixture (not single components)
Comparators	• Observational: a comparison population exposed to lower levels (e.g. greater distance of residence from exposure or no exposure/exposure below detection levels) • Experimental: vehicle-only treatment controls
Outcomes	• Any health-related effect or change in physiological or cellular response

Proposed Search Strategy

- "Mountaintop Mining"
  - mountaintop OR mountain top

  AND
  - anthracite OR bituminous OR coal OR mine OR mines OR mining OR removal

OR

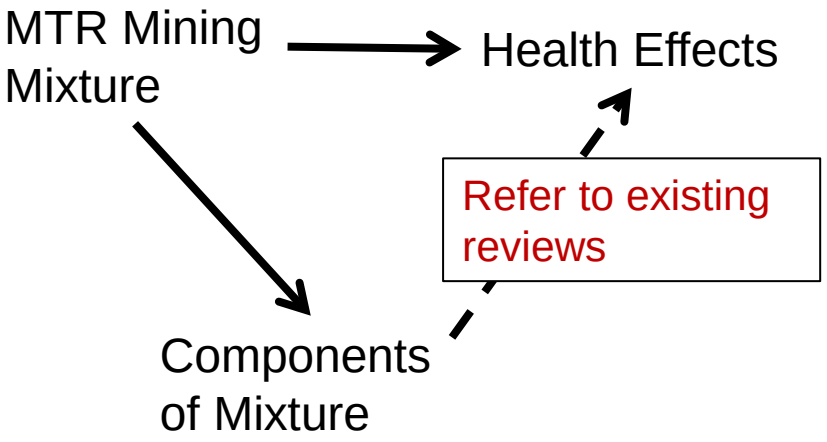
- "Appalachia Coal Mining"
  - Appalachian Region OR Appalachia* OR Kentucky OR Ohio OR Pennsylvania OR Tennessee OR Virginia OR West Virginia

  AND
  - anthracite OR bituminous OR coal

  AND
  - mine OR mines OR mining

Yield: 2983 References (Oct 2015)

Inclusion/Exclusion



"Excluded"

- Critical Background: Exposure characterization

Included: Meets PECO

- Observational studies
  - MTR Mining communities
  - Occupational
- Experimental Studies
  - Animal models of human health
  - In vitro studies of potential mechanisms

NO SR of specific chemical components and health outcomes

Challenges

- Limited size and scope in existing literature
- Complex mixture exposure scenarios
- Observational epidemiology studies may not adequately account for misclassification and confounding
- Experimental studies necessary to interpret the biological plausibility of human literature

Catalyst for Future Research

Why?

- Public and government interest
  - Request from the WV DHHS for federal expert input
- Utility of a systematic review
  - Comprehensive review of human, animal, and in vitro studies
  - Risk of bias assessment can strengthen future studies
  - Integrate evidence streams to prioritize future research
- Identify what information is required to reach conclusions

Acknowledgements

- Stephanie Holmgren
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- John Bucher
- Aubrey Miller
- Federal partners at ATSDR, NIOSH, and USGS

Technical Experts

- Michael McCawley, WVU
- Jerry Paulson, GWU

Review Questions

1. Please comment on the clarity and validity of the rationale for the proposed evaluation as articulated in the draft concept.

2. Please comment on the merit of the proposed evaluation relative to the goals of the NTP.
   The NTP's objectives are to: provide information on potentially hazardous substances; develop and validate improved test methods; strengthen the science base in toxicology; coordinate toxicology testing programs across DHHS.

3. Please comment on the proposed approach for the evaluation.

4. Please comment on the scope of the proposed evaluation and its appropriateness, relative to the public health importance of the issue.

5. What priority (low, moderate, or high) should NTP give the proposed evaluation given the rationale, merit, and scope?

6. Prove any other comments you feel staff should consider in developing this evaluation.