



# Delineation of the Cumulative Impact Area (CIA)

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~ 25 miles

Google

1984

# Wyoming Coal Mining, 1984-2011

# Outline

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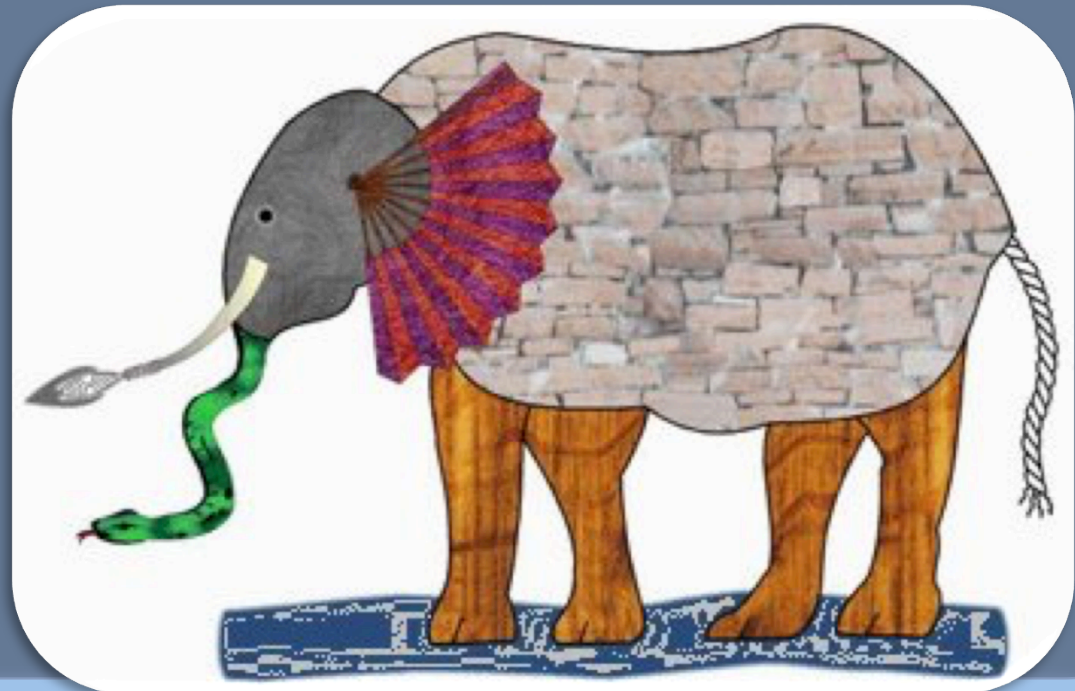
- CIA – Introduction / Background
- Steps in Delineating a CIA
- Hypothetical Example
- Approaches and Tools
- Tips for a Defensible CIA



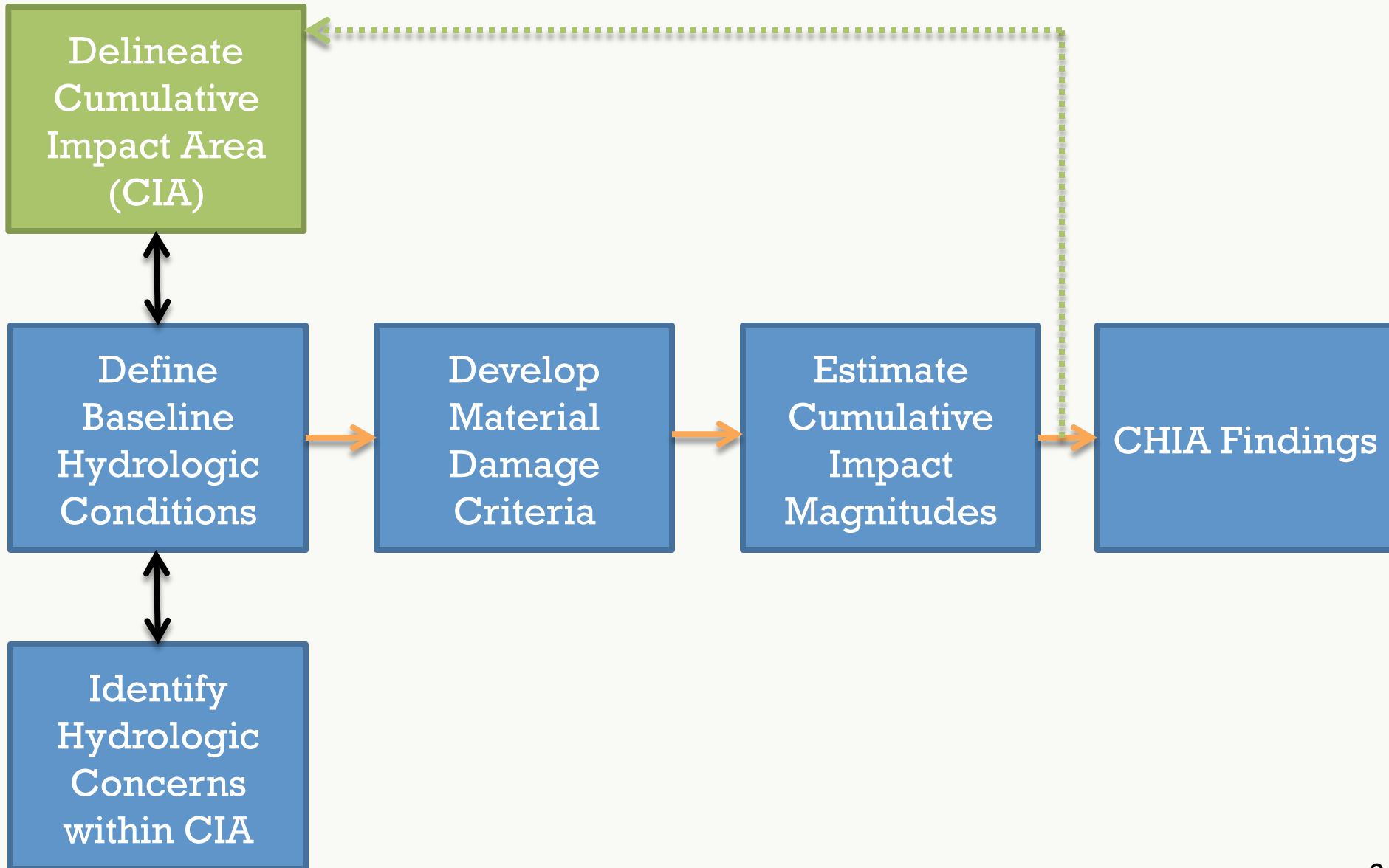


# CHIA - Technical Premise

- ◉ Keep an eye on the bigger picture
- ◉ Possible that the hydrologic system is more than a mere sum of parts



# CIA – Where does it fit in a CHIA ?





# CIA Definition

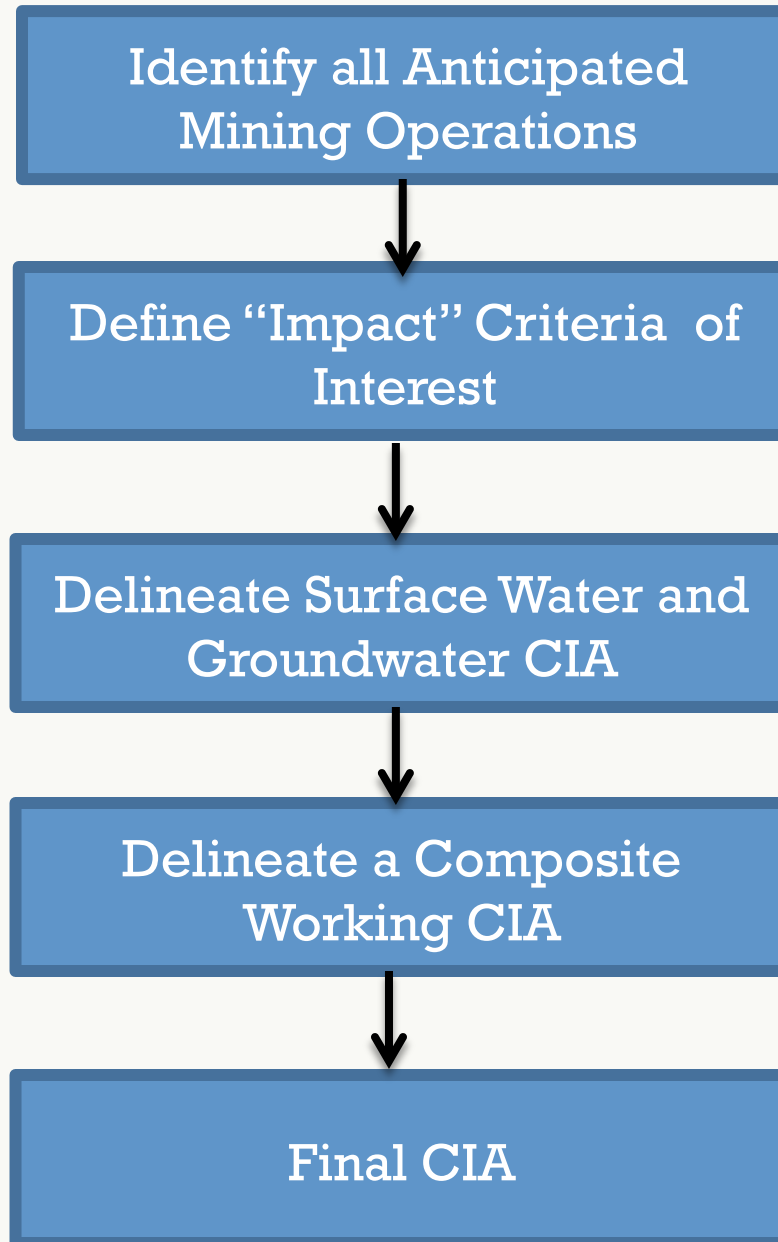
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## ● 30 CFR 701.5

- *Cumulative Impact Area (CIA)* means the area, including the permit area, within which **impacts resulting from the proposed operation may interact with the impacts of all anticipated mining** on surface- and ground-water systems

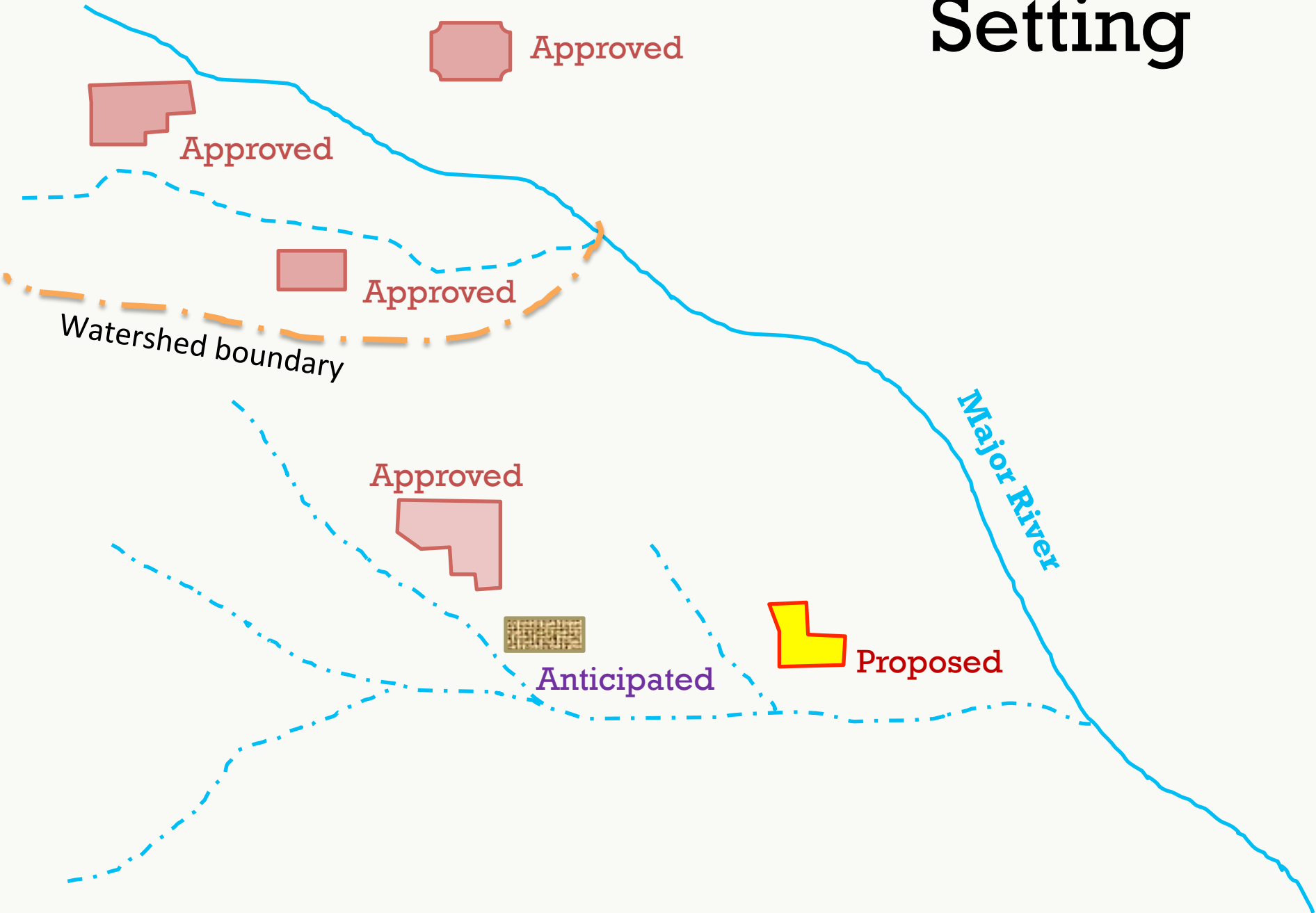
**Cumulative - Both spatial and temporal  
Impact - Measurable change**

# Delineating a CIA - Recommended Steps

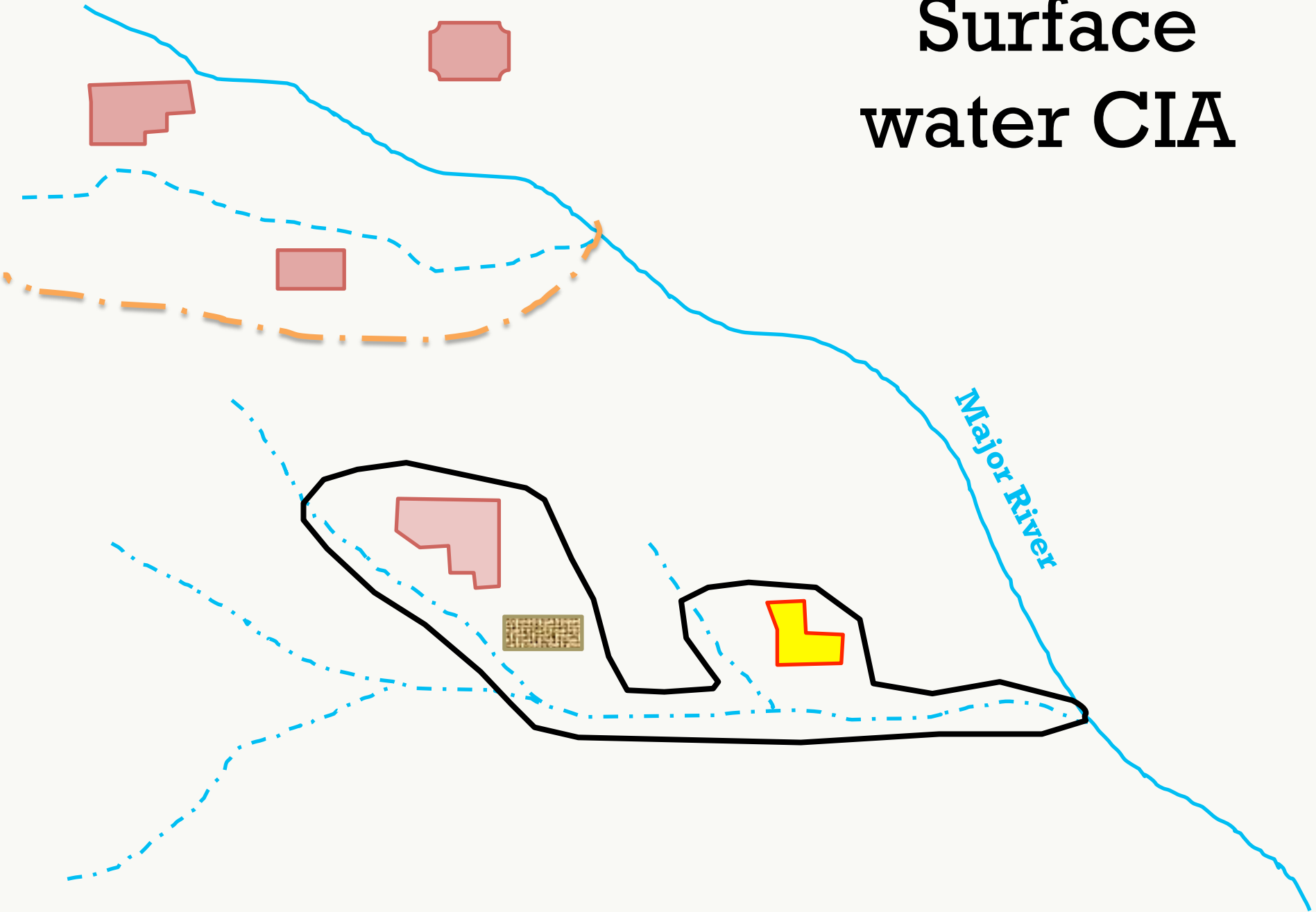




# Setting

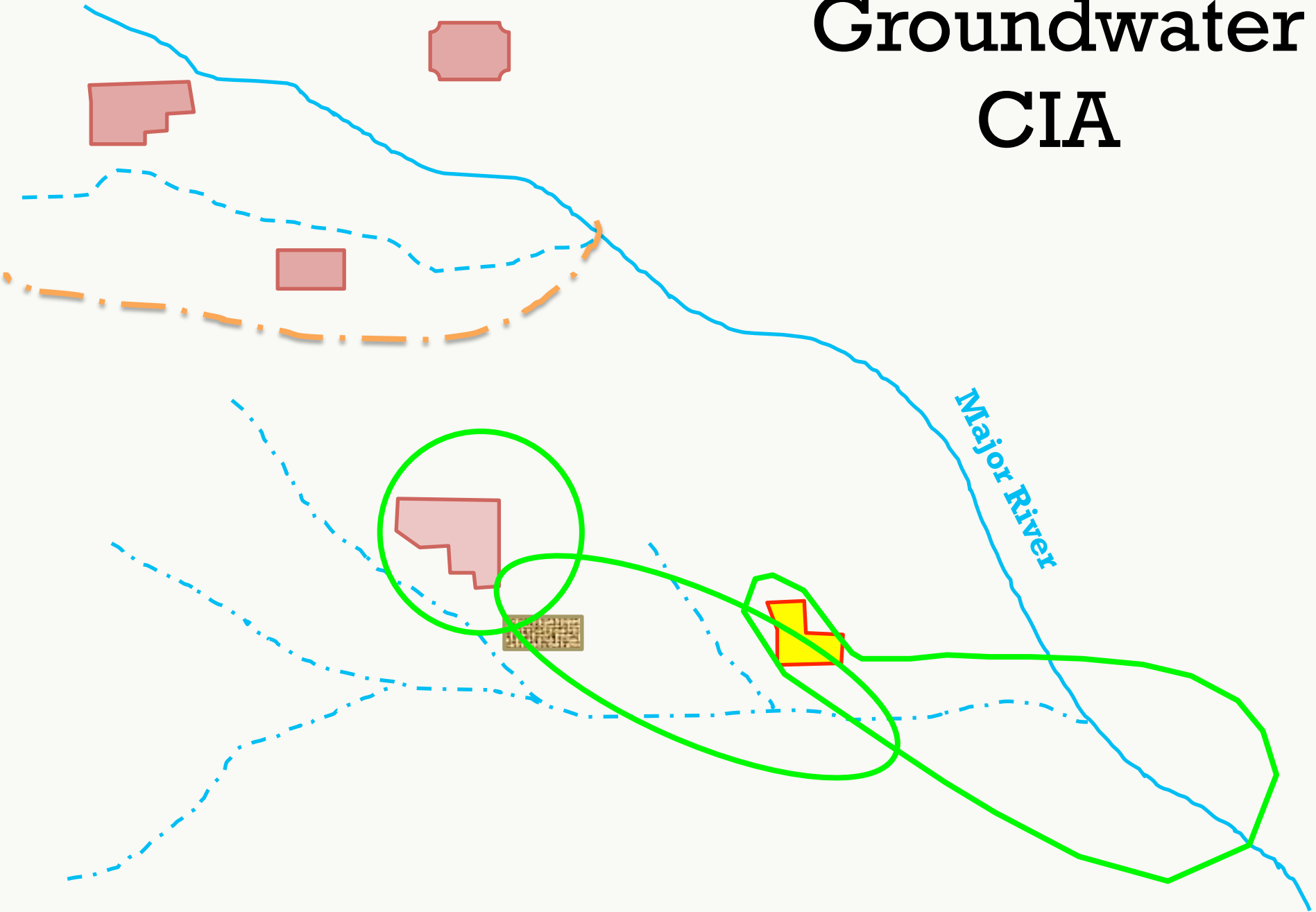


# Surface water CIA

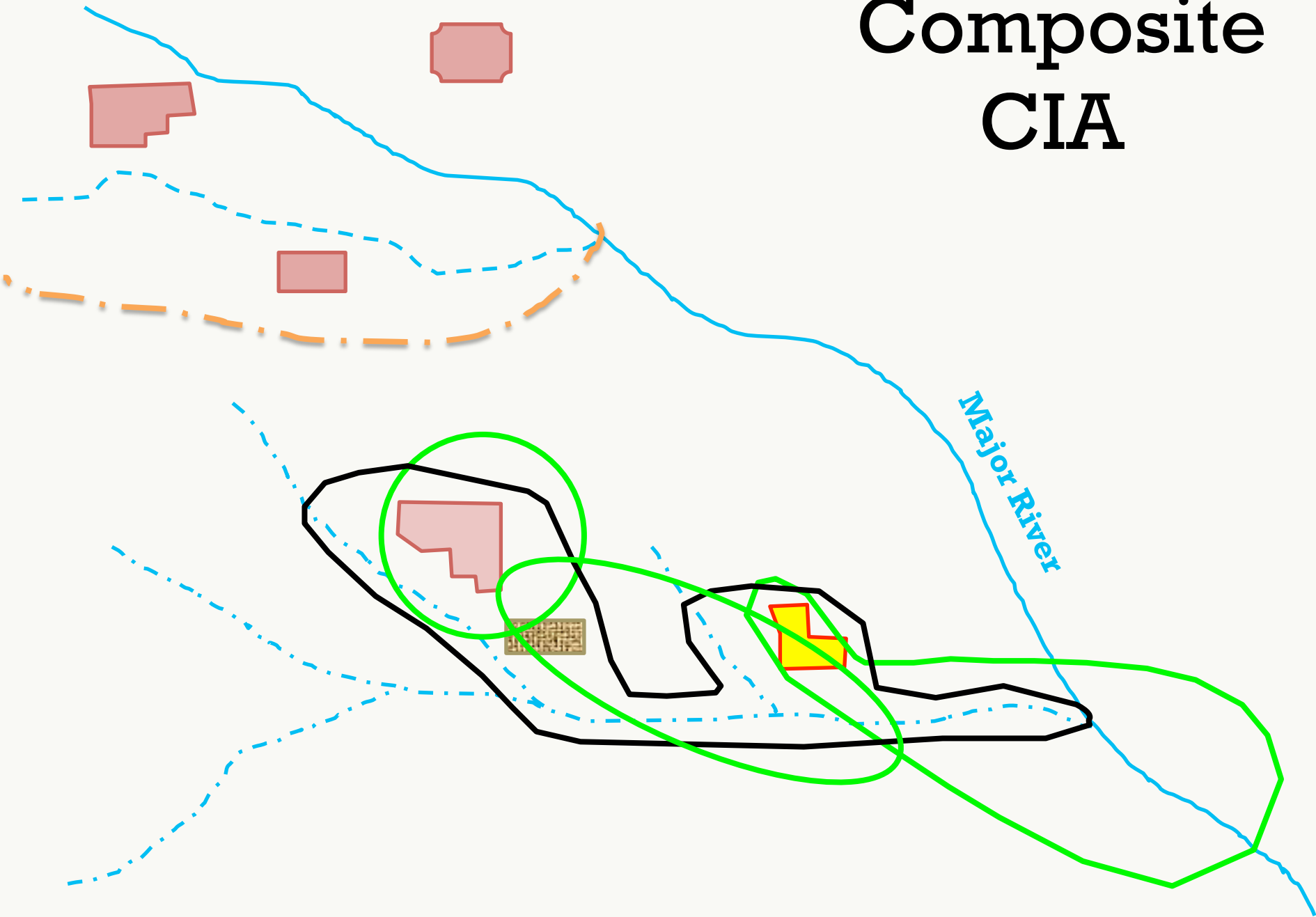




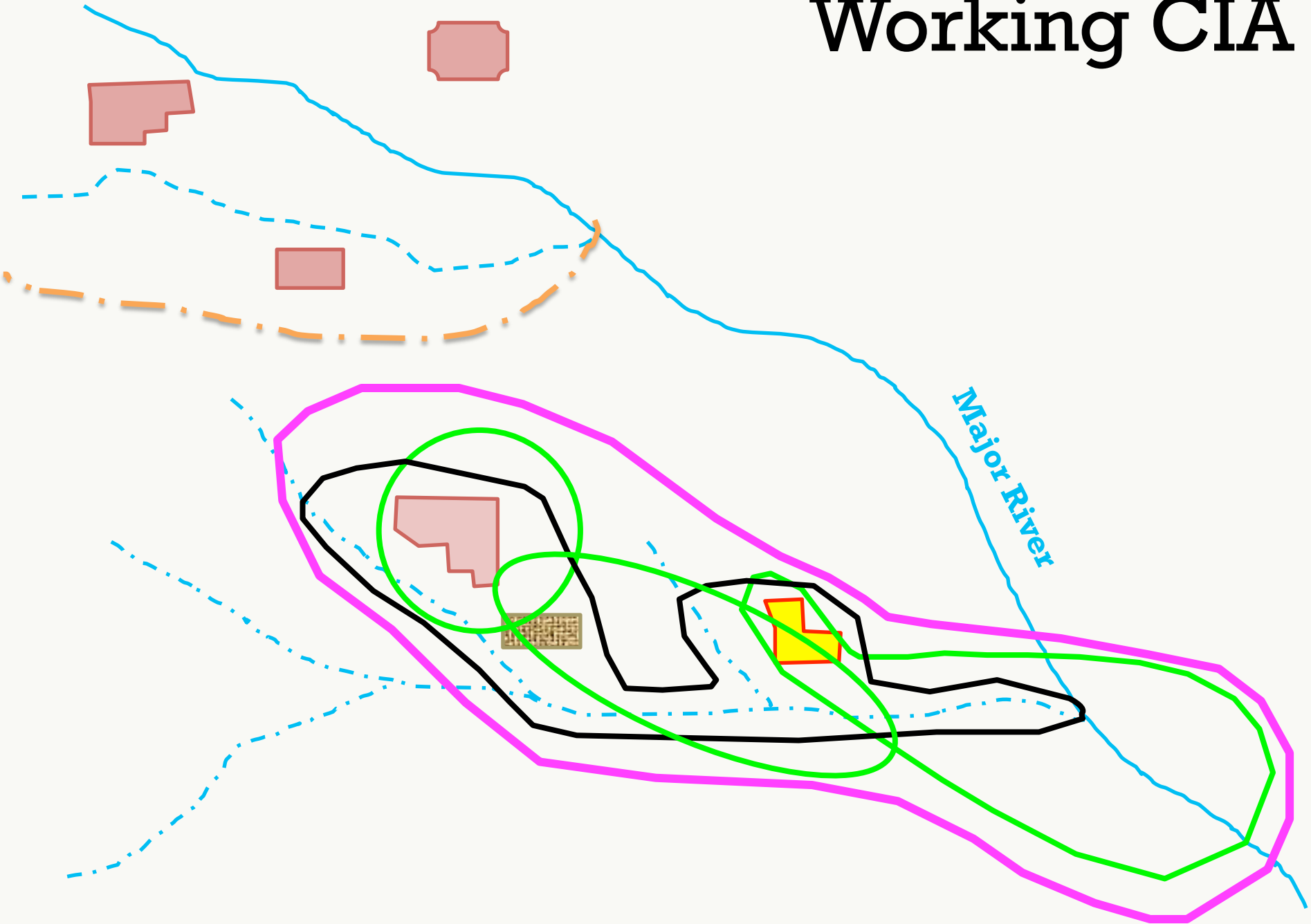
# Groundwater CIA



# Composite CIA



# Working CIA



# General Approaches

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## ◉ Combinational Approach

- Combine the predicted effects from individual mine PHCs

## ◉ Independent Approach

- Independent hydrologic analysis using raw data from the mine permits

# Tools Available – OSMRE TIPS

## Surface Water

ArcGIS – Watershed delineation

HEC RAS –Runoff

RUSLE 2 – Soil erosion

SEDCAD- Runoff /sediment

Aquachem – Water quality

Geochemist's Work Bench

## Groundwater

MODFLOW – Groundwater flow

MT3D – Contaminant transport

Aqtesolv – Aquifer testing



# Tips for a Defensible CIA

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- Multiple lines of evidence
  - Site monitoring and modeling
  - Effects of similar adjacent mines with monitoring data
  - Analytical equations and numerical modeling
- Be conservative
  - Account for uncertainty
  - Sensitivity analysis (Worst case vs. reasonably possible case)
  - Consider the transport of a conservative tracer constituent
- Honor hydrologic concerns
- Delineating a CIA can be iterative

# References

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- OSMRE, 1985, Draft Guidelines for Preparation of a Cumulative Hydrologic Impact Assessment (CHIA)
- OSMRE, 2002, Permitting Hydrology: A Technical Reference Document for Determination of Probable Hydrologic Consequences (PHC) and Cumulative Hydrologic Impact Assessments (CHIA)
- OSMRE, Mid Continent Technology Development and Transfer Team, 2007, Technical Reference for the Mid-Continent Region : Hydrologic Consideration for Permitting and Liability Release

# Thank You!



***In theory, theory and practice are the same.  
In practice they are not!***

***~ Einstein***