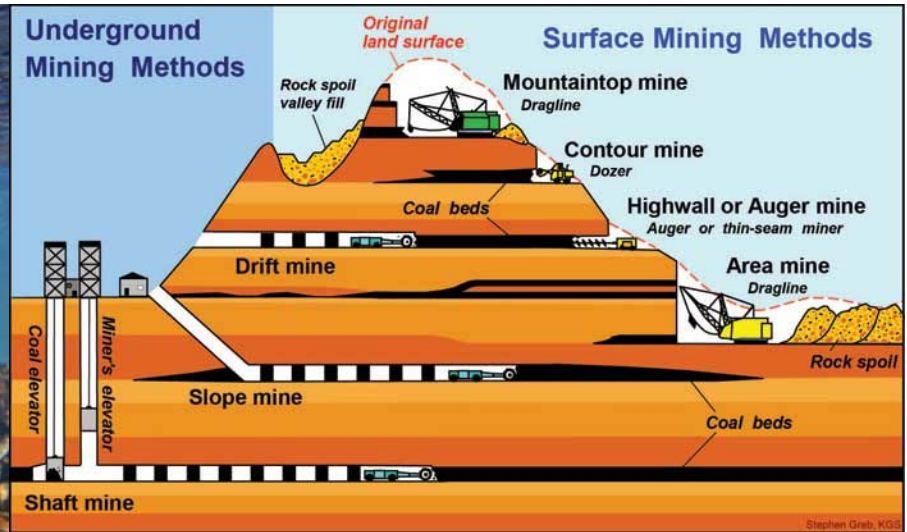




COLLEGE OF  
AGRICULTURE,  
FOOD SCIENCE, AND  
SUSTAINABLE SYSTEMS

# Survey of Mine Water Resources for Trout Aquaculture in Eastern Kentucky



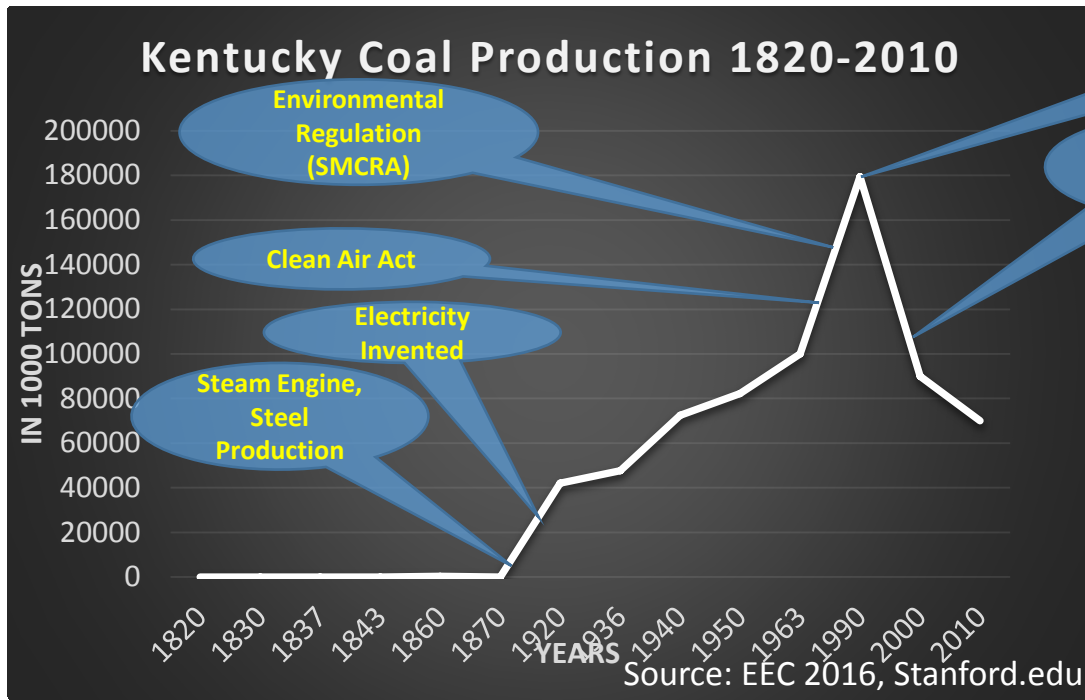
Oguz Sariyildiz, Buddhi Gyawali  
Kentucky State University  
USGS KASMC Meeting, Feb 2018



# Outline

- **What are historical coal production and current economical trends in eastern Kentucky?**
- **Is there a demand for seafood in US? Where is Kentucky in seafood production?**
- **How can we use mine water for trout farming?**
- **Where are the available underground mine water outflows and how many of them appropriate for trout farming?**

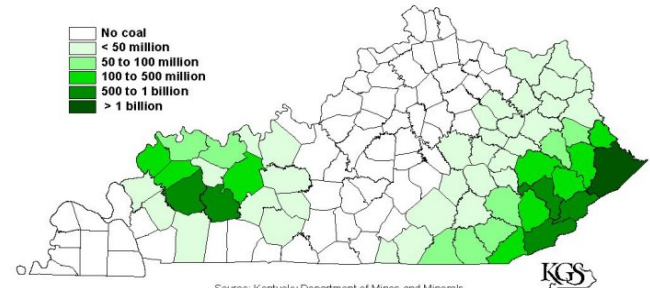
# Coal Production History in Kentucky and Major Events Effecting Coal Production



Advanced Fracking Methods

Gas cheaper than coal

### Cumulative Coal Production (tons) 1790-2001



# Human Livelihood In Eastern Kentucky

“The Times’ data-analysis venture The Upshot compiled six basic metrics to present a picture of the longevity and quality of life in each county in the U.S.

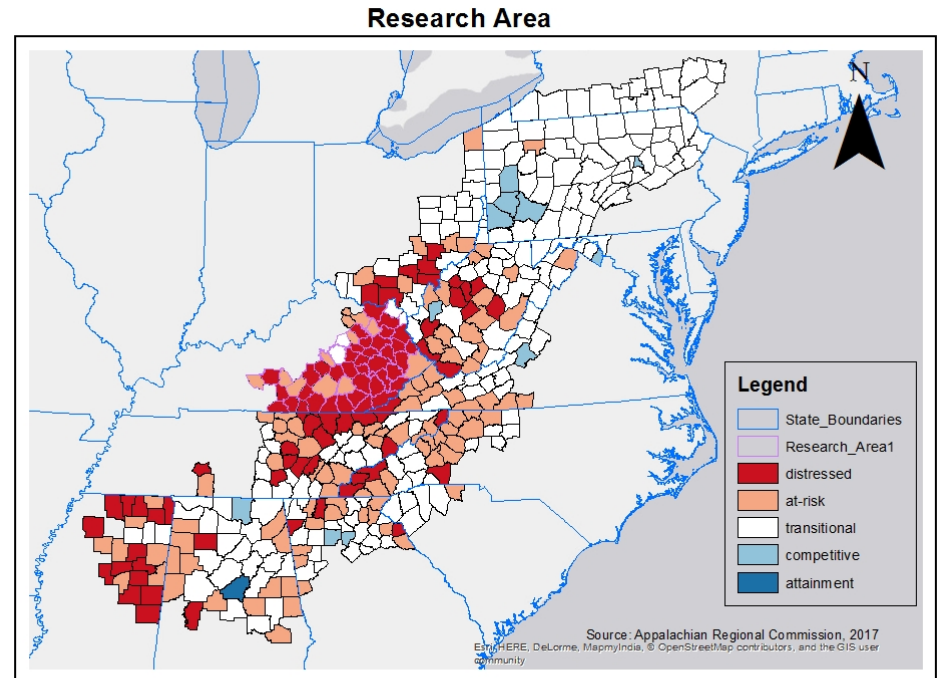
- education attainment,
- household income,
- jobless rate,
- disability rate,
- life expectancy and
- obesity rate.

The six counties in Kentucky’s coal country—Breathitt, Clay, Jackson, Lee, Leslie and Magoffin—are all among the bottom 10 for all of these.”

(*Insiderlouisville, 2014*)



Source: Olive Branch Minister, N.D., Rural



Author: Oguz Sariyildiz  
Date: 3/16/2017

# US Seafood Consumption vs Production

**“In 2012, consumers in the United States spent an estimated \$82.6 billion on seafood, making the U.S. one of the top three seafood markets worldwide. Yet the domestic farm gate value of aquaculture products only approaches \$1.3 billion annually. Thus, much of the U.S. demand is supplied by international imports.” (Office of Science and Technology Policy, 2014)**

# 2012 USDA Aquaculture Census Data

	Kentucky Farm Count	Top Producer Farm Count	Kentucky Revenue In \$1000	Top producer Revenue In \$1000
Catfish	27	275 Mississippi	645	179209
Trout	2	180 Pennsylvania	N/A	15139
Other Fish	10	143 Washington	4	59844
Baitfish	5	35 Minnesota	N/A	5666
Crustacean	9	496 Louisiana	33	33778

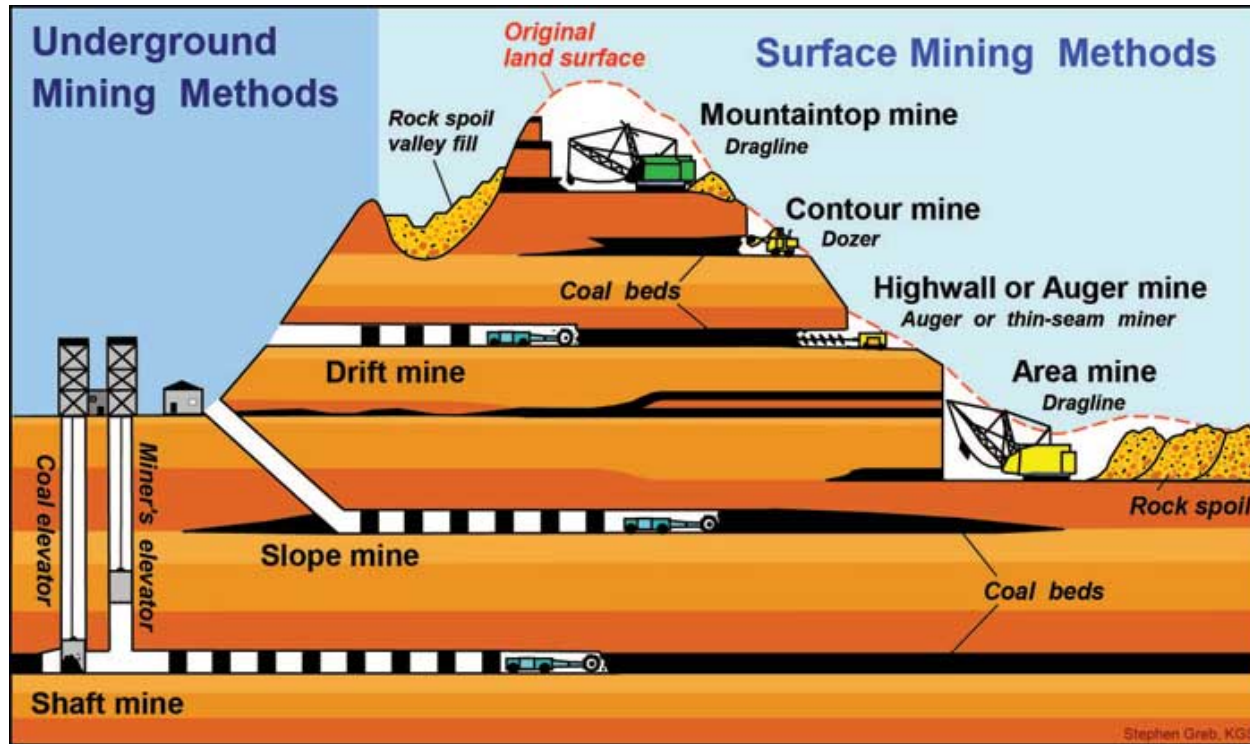
Source: USDA Census, 2012

# Kentucky Water Resources

Streams		Ponds	
<b>Counts Total</b>	<b>Counts &gt; 1 mile</b>	<b>Counts Total</b>	<b>Counts &gt; 1 acre</b>
<b>237,785</b>	<b>19,706</b>	<b>193,268</b>	<b>25,790</b>
<b>Length Total (mile)</b>		<b>Area Total (acre)</b>	
<b>94,201</b>		<b>450,720</b>	

Source: USGS

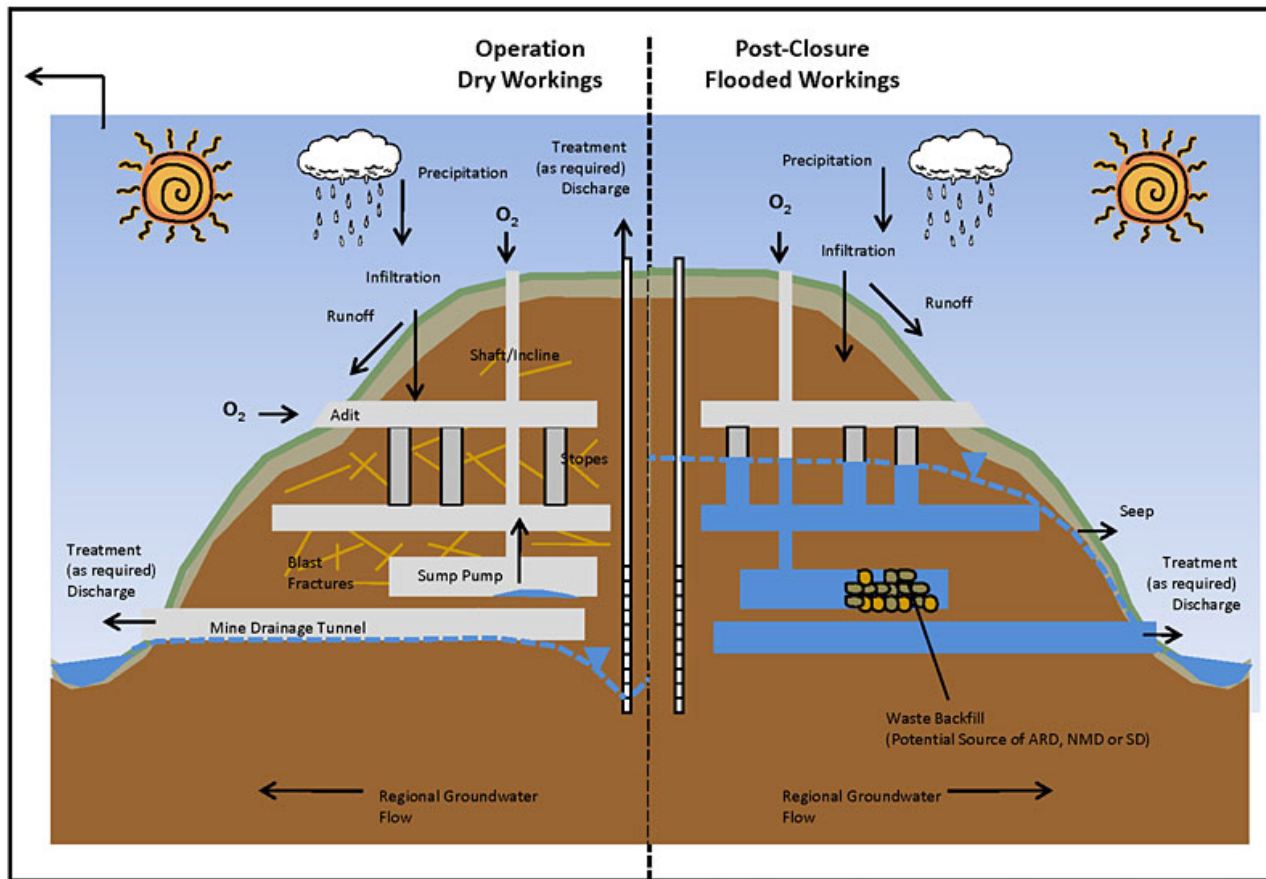
# How Coal Is Extracted?



Source: Kentucky Geological Survey(KGS)



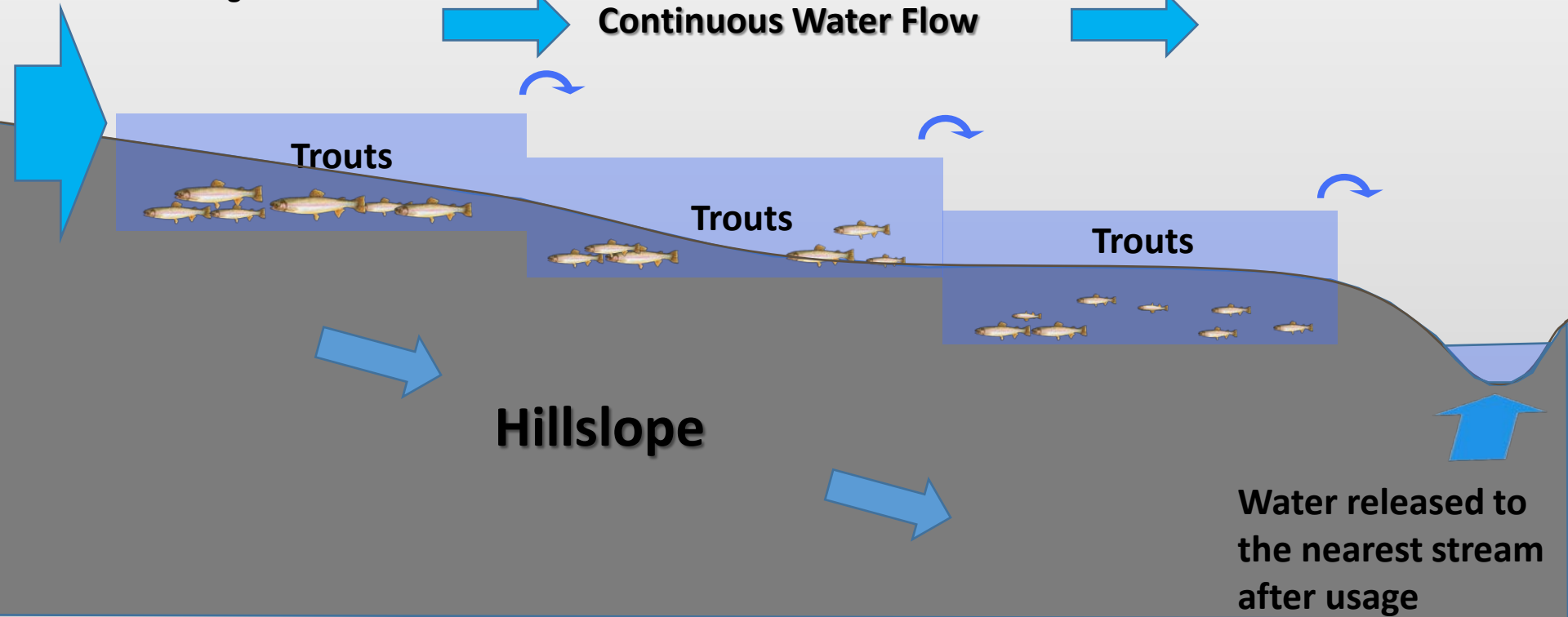
# What Happens After Mining Is Done?



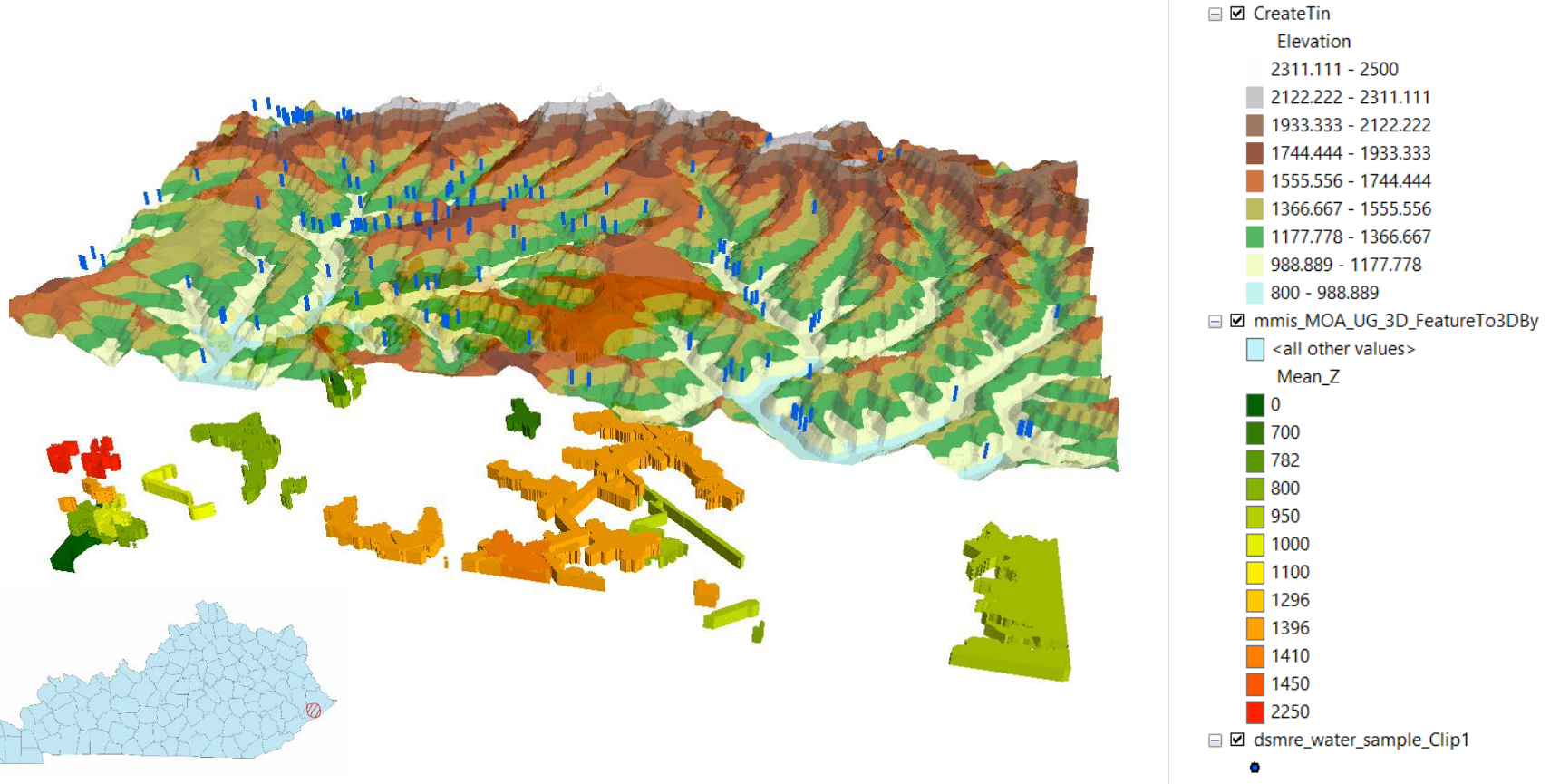
Source: International Network of Acid Drainage Prevention(INAP)

# How Can We Use Post-mining Water Outflow

Inflow to production area  
from mine discharge



# Groundwater Discharge Points 3D



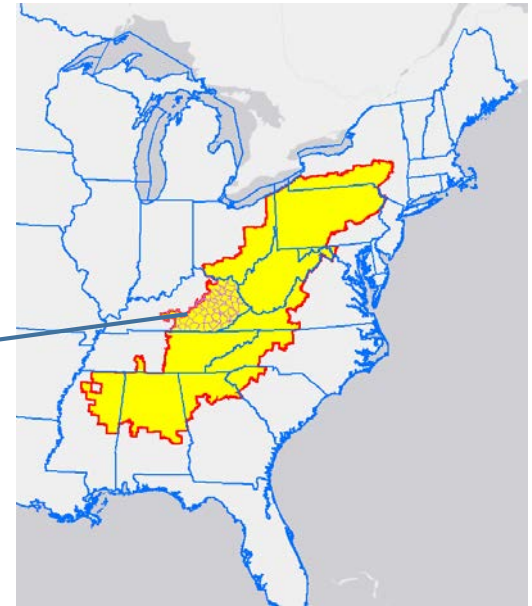
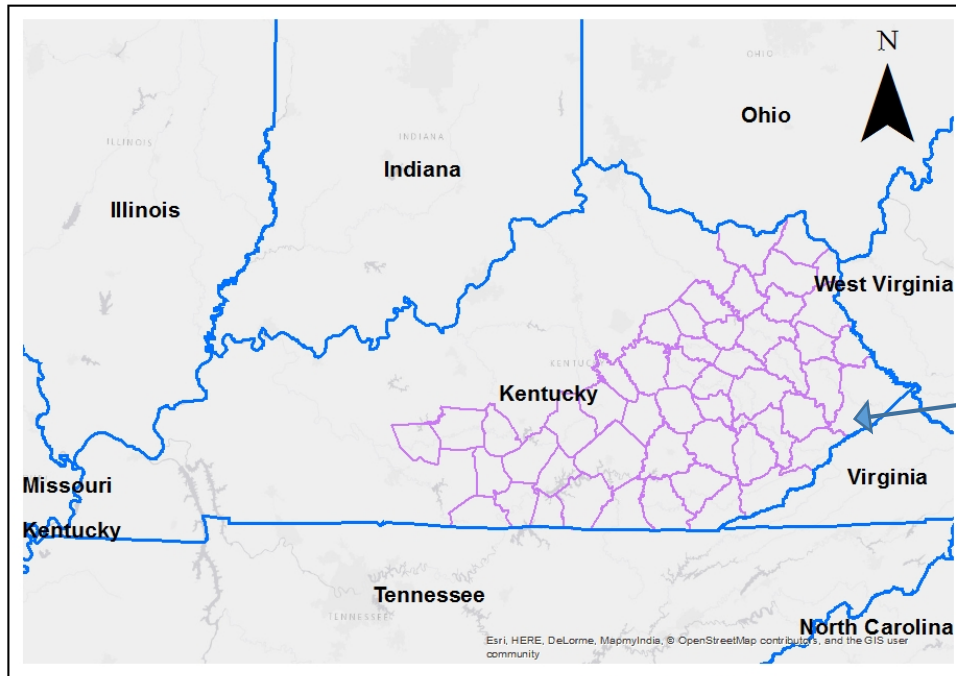
3D data displays groundwater discharge points from underground mine galleries in about 20,000 acres area in southern Pike County. Blue columns: Groundwater discharge points, Bottom features: Underground mine galleries, Top feature: Terrain

# Research Approach

- **Freshwater Institute concluded 118,000 gal/min was available in West Virginia for aquaculture improvements (Jenkins et al., 1995). Moreover, 53% of the water was usable for trout farming without additional treatment.**
- **Utilizing mine water in aquaculture made West Virginia net exporter of rainbow trout. A single location in Beckley, West Virginia produces 500,000 lb of rainbow trout (Semmens & Miller 2004).**
- **West Virginia has similar topography, geology and coal production with eastern Kentucky. Acidity is one of the common issues in West Virginia that is not the case in Kentucky (Semmens & Miller 2004).**

# Research Area

Research Area



Appalachian Regional Commission, 2017

Author: Oguz Sariyildiz  
Date: 3/16/2017

# What Water Qualities And How Much Flow Required For Trout Farming?

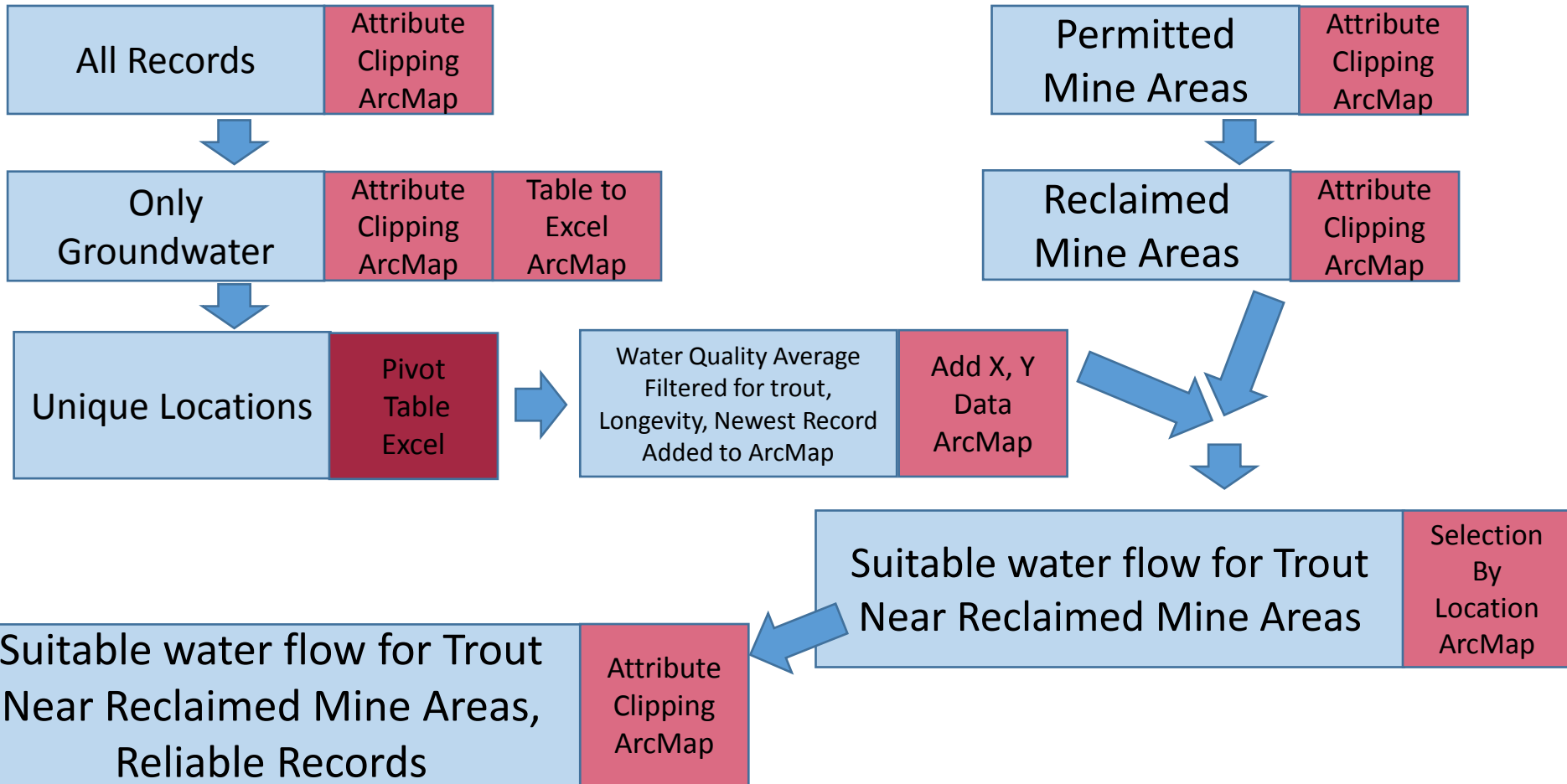
Parameter	Recommended
pH	6.5 to 8.5
Alkalinity (mg/l as CaCO <sub>3</sub> )	10 to 400
Sulfates (mg/l)	<850
Total Hardness (mg/l as CaCO <sub>3</sub> )	10 to 400
Fe (mg/l)	<0.1
Al (mg/l)	<0.087
Mn (mg/l)	<1.0
Discharge (gal/min)	500 (commercial level)
Temperature (°F)	40°-70°

Source: Heinen, 1996

# What Data Available?

- **Kentucky Division of Water (KDOW):** over 600,000 water quality records between 1980-2013, Measured Parameters: pH, Alkalinity, Sulfates, Dissolved Fe, Dissolved Mn, Flow, Temperature
- **Kentucky Division of Mine Safety (KDMS):** Permitted coal mine areas 1980-Present, Measured Parameters: Active or Inactive (Reclaimed)

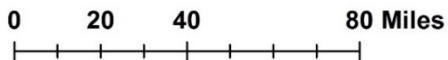
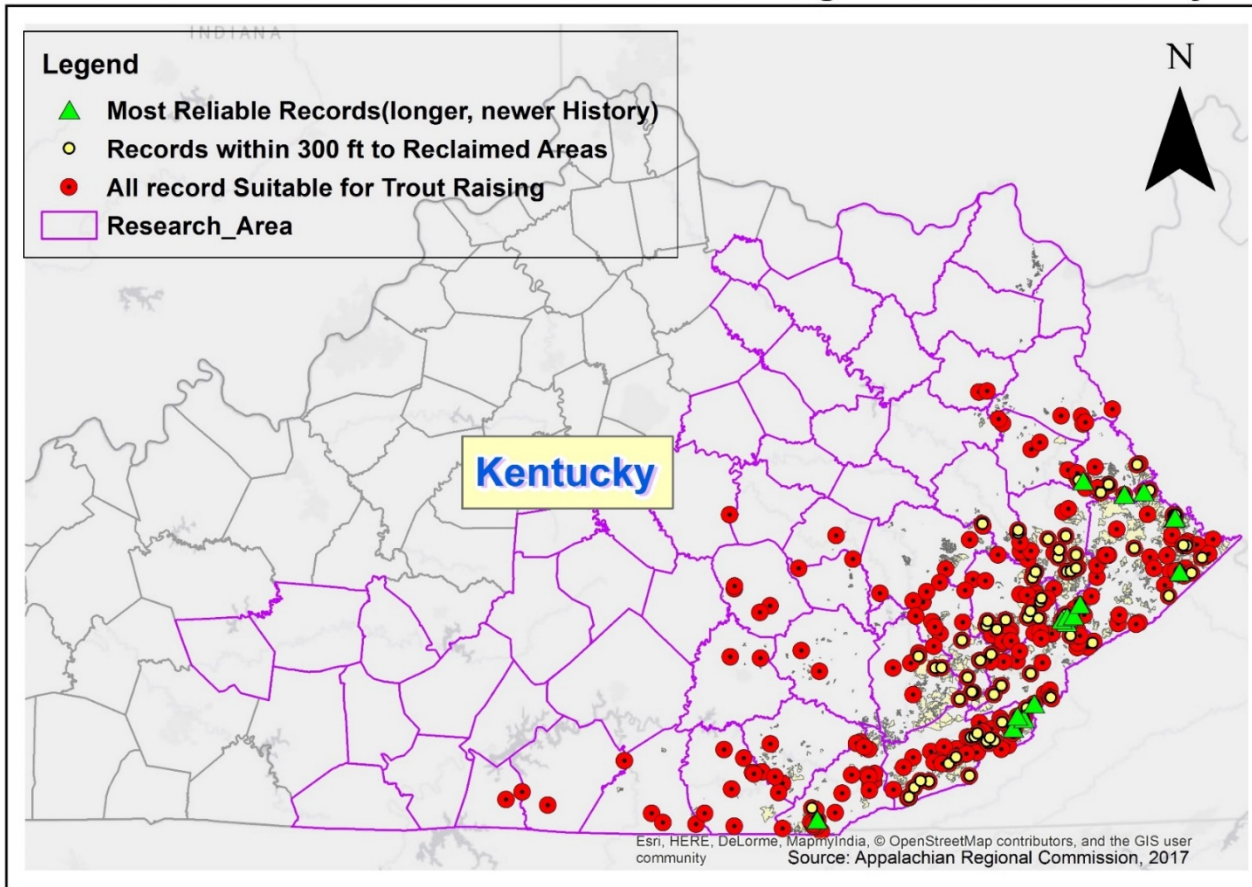
# Methods For Analyzing The Data





# Results

## Coal Mine Outflow Locations for Trout Farming in Eastern Kentucky



Coordinate System: NAD 1983 2011 StatePlane Kentucky FIPS 1600 FUS  
Projection: Lambert Conformal Conic  
Datum: NAD 1983 2011  
False Easting: 4,621,250.0000  
False Northing: 3,260,833.3333  
Central Meridian: -85.7500  
Standard Parallel 1: 37.0833  
Standard Parallel 2: 38.8667  
Latitude Of Origin: 36.3333  
Units: Foot US

Author: Oguz Sariyildiz  
Date: 3/19/2017

# Results

	<b>Filter Type</b>	<b>Total Discharge</b>	<b>Unique Points</b>
<b>Most reliable records</b>	<b>Newer, Longer periods</b>	<b>312</b>	<b>16</b>
<b>Within 300 ft reclaimed Mines</b>	<b>Spatial filtering</b>	<b>2,090</b>	<b>96</b>
<b>All records suitable for trout farming</b>	<b>Water quality filtering</b>	<b>6,385</b>	<b>320</b>
<b>All groundwater discharge</b>	<b>Water discharge type filtering</b>	<b>49,908</b>	<b>660</b>

# Discussion & Limitations

- **Even though the research was tailored for trout production, available mine water can be used for other purposes such as agriculture and agroforestry.**
- **Only secondary data used, ground truth needed for the accuracy.**
- **Data did not have the unit for flow amount.**
- **Water quality data was available between 1980-2012 in most cases, newer records could be added from EPA Discharge Monitoring Report tool.**
- **Surface mining activity may have effect on groundwater.**
- **The research is still in progress and has not been completed yet.**

# Acknowledgements

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**PI Dr. Buddhi Gyawali**

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Shresta**

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# Thank You!

## Questions & Comments

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