Use of GPS Treatment Data & ArcGIS tools: Evaluating Herbicide Treatment Effectiveness at a Reclaimed Coal Mine

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Background: Southwestern Mine

- Permitted Acres: 25,000
- Disturbed Acres: 12,500
- Mine Operated 60 years with contemporaneous reclamation
- Mine is in Final Reclamation Phase
- SMCRA Authority: Federal/Indian & State Agencies
Environment

- Elevation 6,300 to 8,000 Feet above MSL
- Annual Precipitation
  - Average 13 inches
  - Monsoon Rains - July through November
- Temperature: Typically varies 16°F to 87°F; rarely below 2°F or above 93°F
- Growing Season: Early May thru mid October
- Early Spring Bloom April 3rd
Environment

• Wind Speed—Significant seasonal variation
• Westerly Predominates
• Calmest Day - August 15\textsuperscript{th} avg 6.7 mph
• Windiest Day - April 11\textsuperscript{th} avg 12.1 mph
• Wind Speed: 10/90 percentiles – 4 & 22 mph
Noxious Weed Treatment

- 2010: Habitat Management began treatment operations.

- 2011: Extent of noxious weed infestations was recognized.

- 2012: A mine wide survey was conducted to map infestations to plan future treatments.
Treatment Methods

- Backpack Sprayers
- 4X4 UTV Mounted Low Profile Tank Spray Rigs
  - Spring Loaded Hose Reels/Spray Guns
  - Broadcasters
- Chainsaws
Noxious Weeds Treated

- Canada thistle
- Bull thistle
- Musk thistle
- Russian knapweed
- Whitetop
- Russian olive
- Tamarisk
Treatment Documentation

• Equipment used over duration of treatments
  1. Paper field maps & colored markers
  2. GPS units
  3. PDF Maps on tablets
  4. Dataloggers

• Treatments recorded by species, lat & long

• Daily herbicide use reports
Noxious Weed Treatment

- 2013 through 2015
- Weed treatment emphasized
- Treatment data collected using maps and sharpies, and various GPS equipment
- Rudimentary GIS database compiled
Noxious Weed Treatment

• 2016 and 2017
  • Increased emphasis on infestation characterization
  • More detailed, accurate mapping

• 2017
  • Treatment data 2012 to present compiled into a geodatabase
  • GIS treatment database was analyzed
  • Findings submitted in the annual report
GIS Treatment Database Analyses

• 2017 Client/regulatory agencies- Request herbicide treatment effectiveness evaluation
• 2016 and 2017 treatment locations compared
• Treatment density information used to evaluate effectiveness
GIS Quantitative Grid Pattern Analysis

- Established 10,000 SF fishnets covering extent of the permits.
- GPS point data was spatially joined to fishnets.
- Empty fishnets discarded.
GIS Quantitative Grid Pattern Analysis

- Number of treatments per grid was characterized

- ArcMap-Jenks Natural Breaks classification method used to create 3 grid density classes
  - Low
  - Medium
  - High
GIS Grid Pattern Analysis

2016 Treatment Density

2017 Treatment Density

Grid Pattern Densities
- Low
- Medium
- High

Scale: 1:50,000

Legend
- N
- East
- West
- North

Comparison of treatment density in 2016 and 2017 using GIS grid pattern analysis.
Herbicide Treatment Effectiveness

- Rain Gages: Year Around Collection
- Moisture Conditions Favored Increase in Cool Season Noxious Weed Populations
Herbicide Treatment Effectiveness

Treatment Category:
- Low Density = Significant Decrease
- Medium Density = Moderate Increase
- High Density = Slight Increase

Total Treatments by Area/Year & Treatment Density Type
Summary

- Efficient data collection technologies are available to document treatments.

- Treatment variability may skew effectiveness evaluation results.

- Using treatment data assumes weed density and distribution are reasonably represented.

- GPS mapping and GIS tools can be used to evaluate treatment effectiveness trends.
Summary

• Mapping illustrates trends in infestations.

• Effectiveness evaluations should take yearly environmental conditions into consideration.

• Infestation inventories can be performed periodically to document distributions.
Questions?