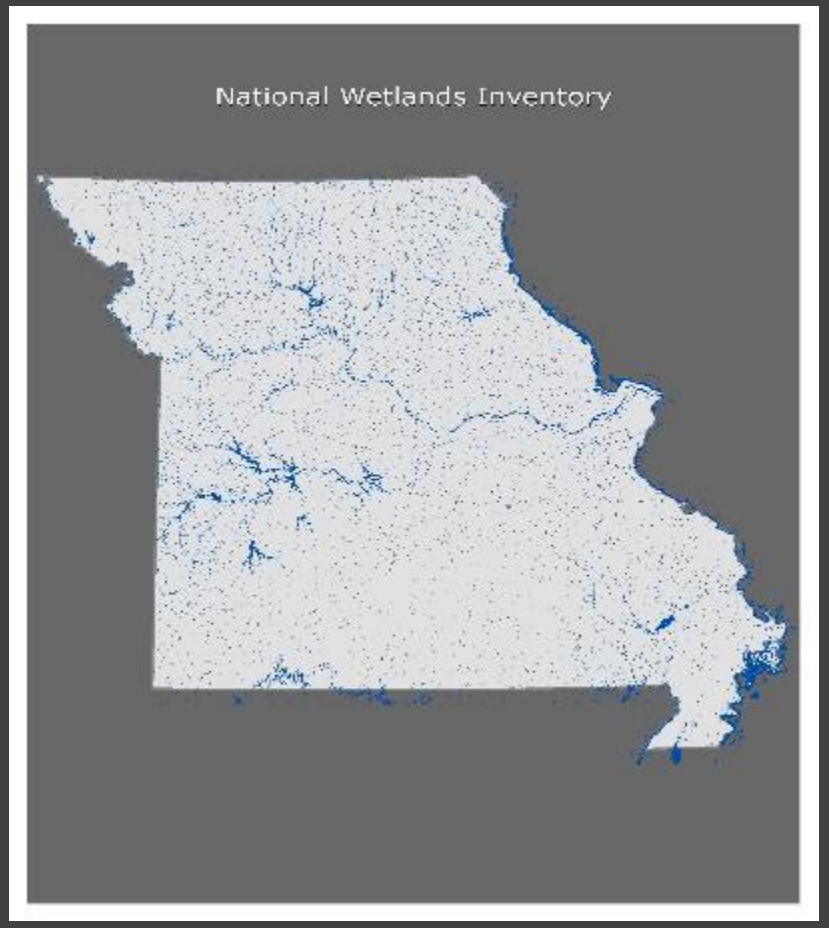
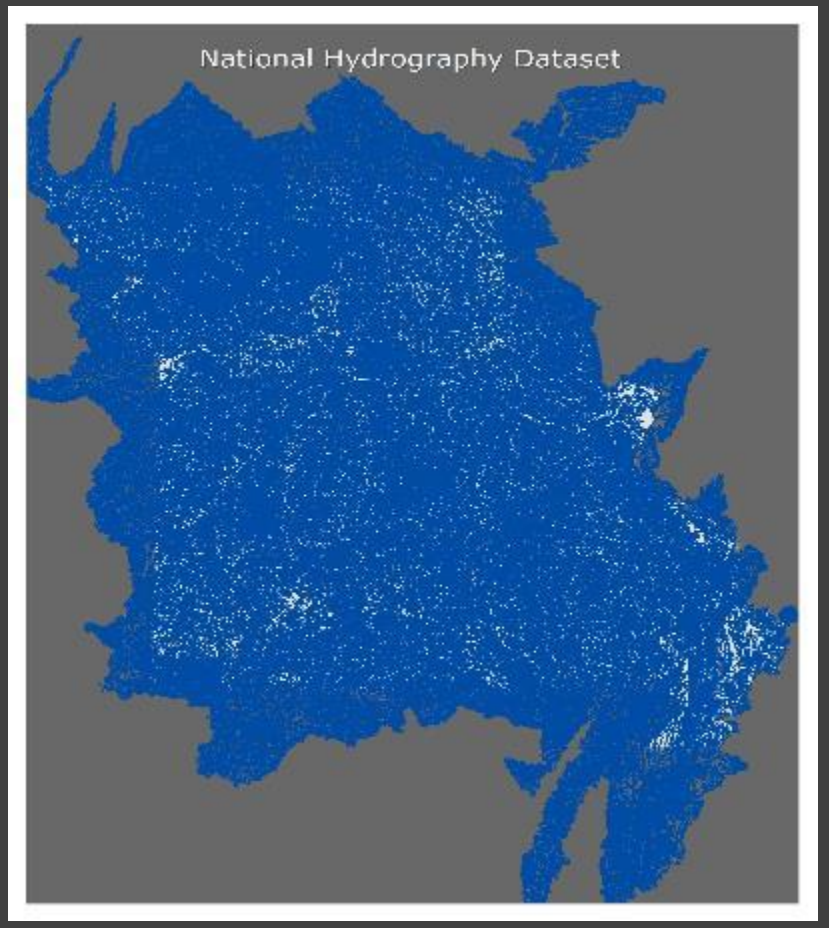
Missouri’s effort to form partnerships and secure funding to update the National Hydrography Dataset and National Wetland Inventory





Missouri Department of Conservation

State Agency – created in 1937 creating an apolitical, science-based conservation agency with exclusive authority over forests, fish, and wildlife.

Mission - To protect and manage the fish, forest, and wildlife resources of the state; to facilitate and provide opportunity for all citizens to use, enjoy, and learn about these resources.

Vision – A future with healthy fish, forests, and wildlife where all people appreciate nature

Manage 1,179 Conservation Areas throughout the State with 15 of those being intensively managed wetlands, we also work with private landowners to help them meet their habitat management goals.

Acknowledged the need to update the NWI & NHD and the need for partners.

- The Missouri NHD and NWI datasets were largely developed in the 1980s, with data sources as old as the 1960s. The age and inaccuracy of Missouri's GIS stream and wetland data is now hindering strategic conservation and infrastructure planning and the ability to develop measurable objectives related to watershed, stream, wetland, and riparian habitat quantity and quality.

- Extreme rain events are increasing, leading to more floods, and associated damages and rising costs. Without up-to-date GIS data products, Missouri risks remaining unaware of the current location, extent, and quality of our wetland and stream networks, which opens us up to continued damages, project delays, and liability (e.g. infrastructure development, flood risk).

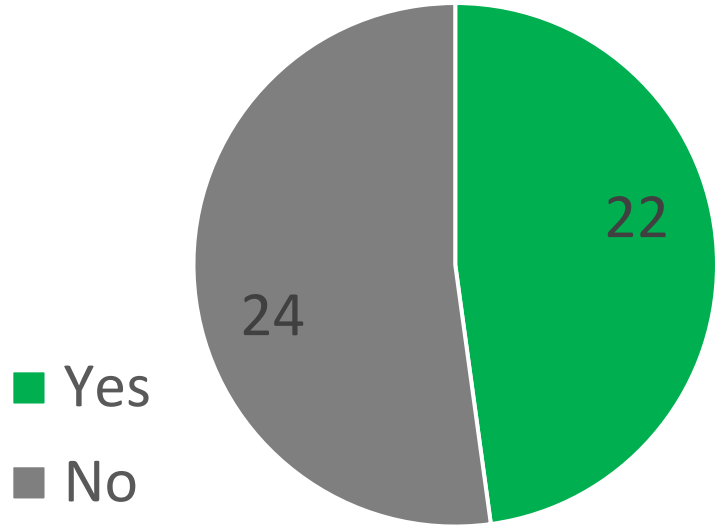
- Updating NHD/NWI will benefit many local, state, and federal governmental agencies, as well as many non-profit organization and private citizens.

Internal Strategy to Raise Awareness and Request Funding

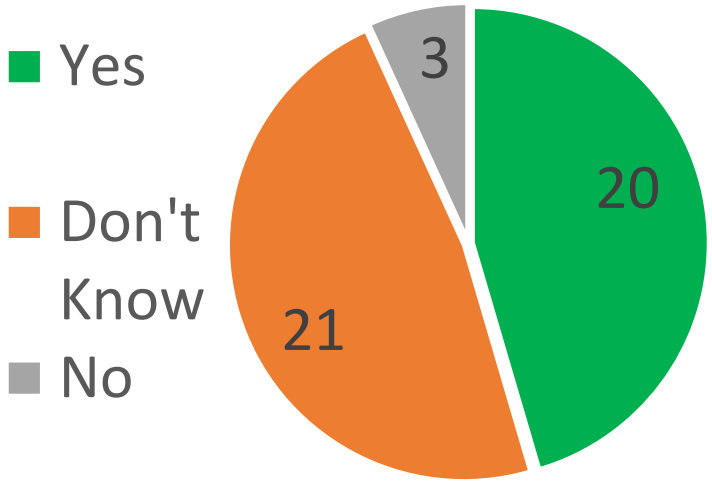
- In July 2020 we Surveyed 70 MDC staff that work on wetlands, streams/rivers, GIS, and some foresters. Received 51 responses
- Survey focus was on past use and potential future use of some of the statewide base GIS Datasets. (leaf on and off orthophotography, land use, NWI, NHD, Lidar.)
- We created briefing/scoping papers and had internal meetings to raise awareness of the need to not only update the NWI and NHD but the need to update leaf off imagery and lidar.
- With the results of those surveys, we were able to create a list of applications that could benefit from updated spatial datasets.
- These efforts helped us sell the need for financial and technological support internally, but it was acknowledged early on that external partners would be needed for the updates to be a success.

Use of GIS data: NHD and NHDPlus HR

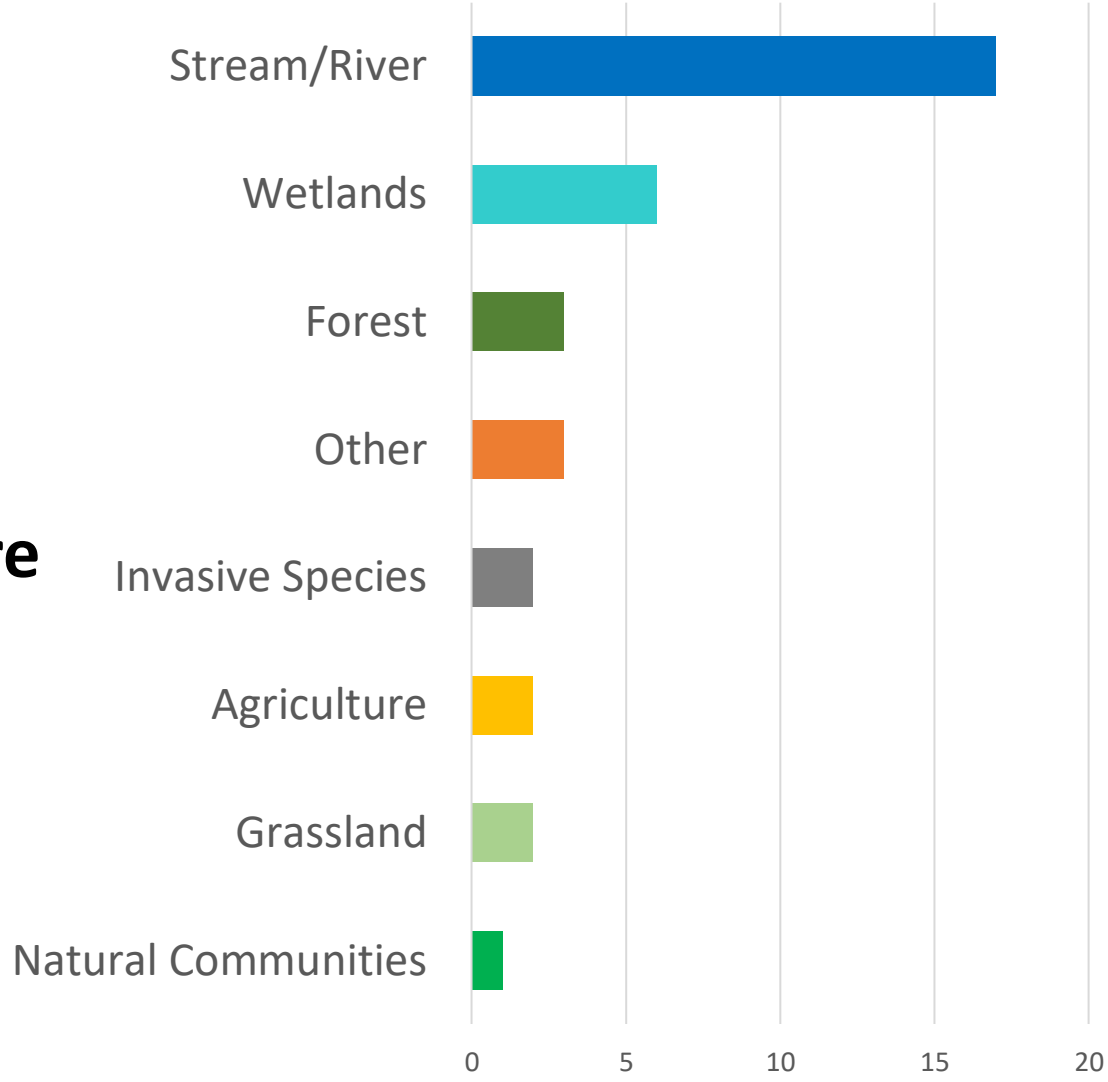
Used in the past



Would use in the future

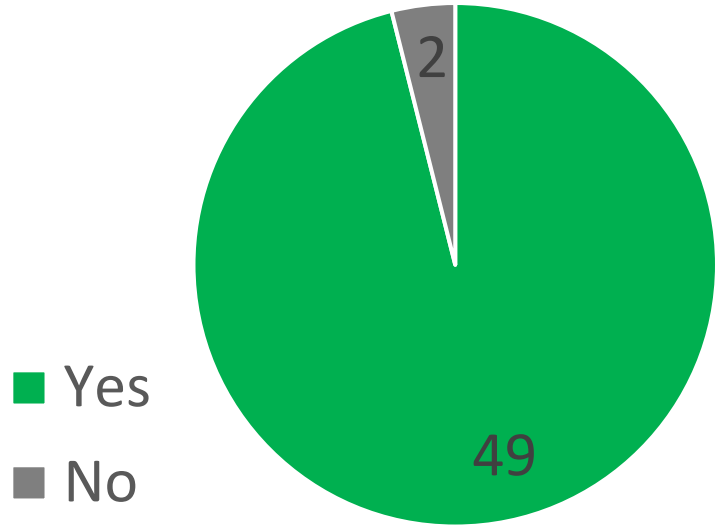


Most Common Uses for NHD

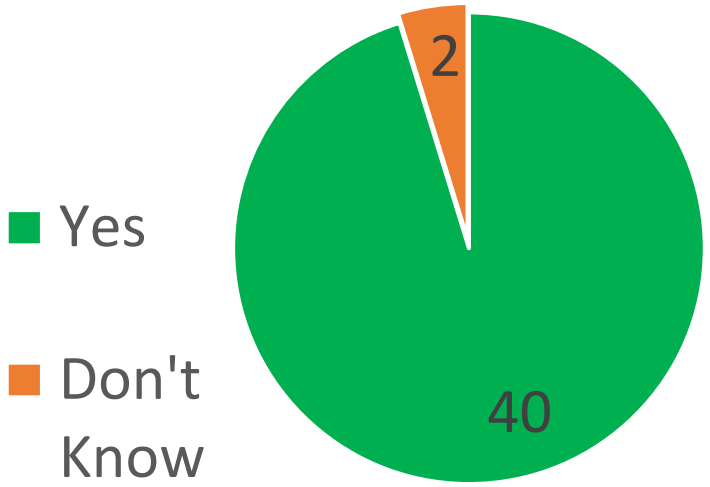


Use of GIS data : Leaf-Off Imagery

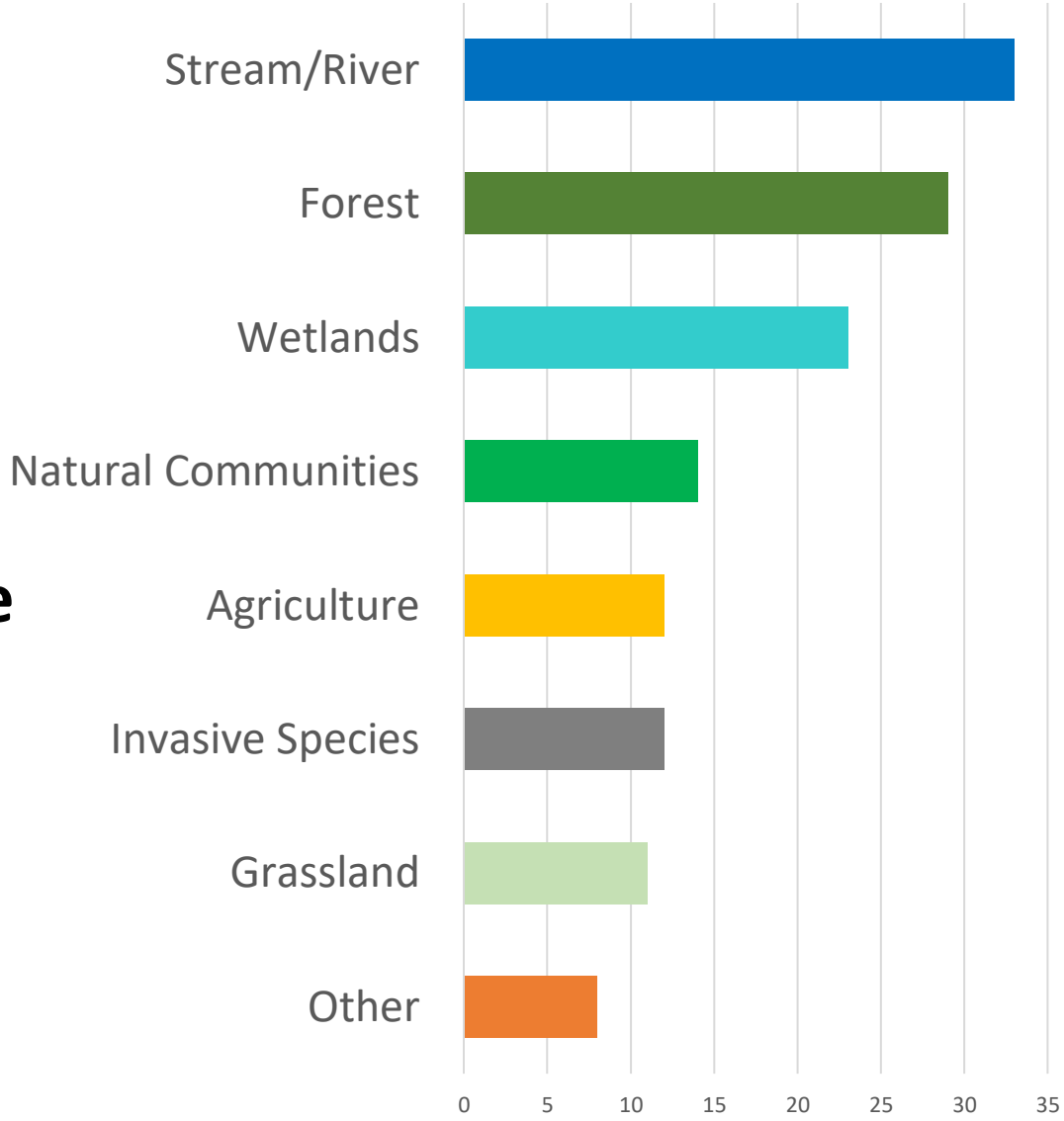
Used in the past



Would use in the future



Most Common Uses for Leaf-Off Imagery

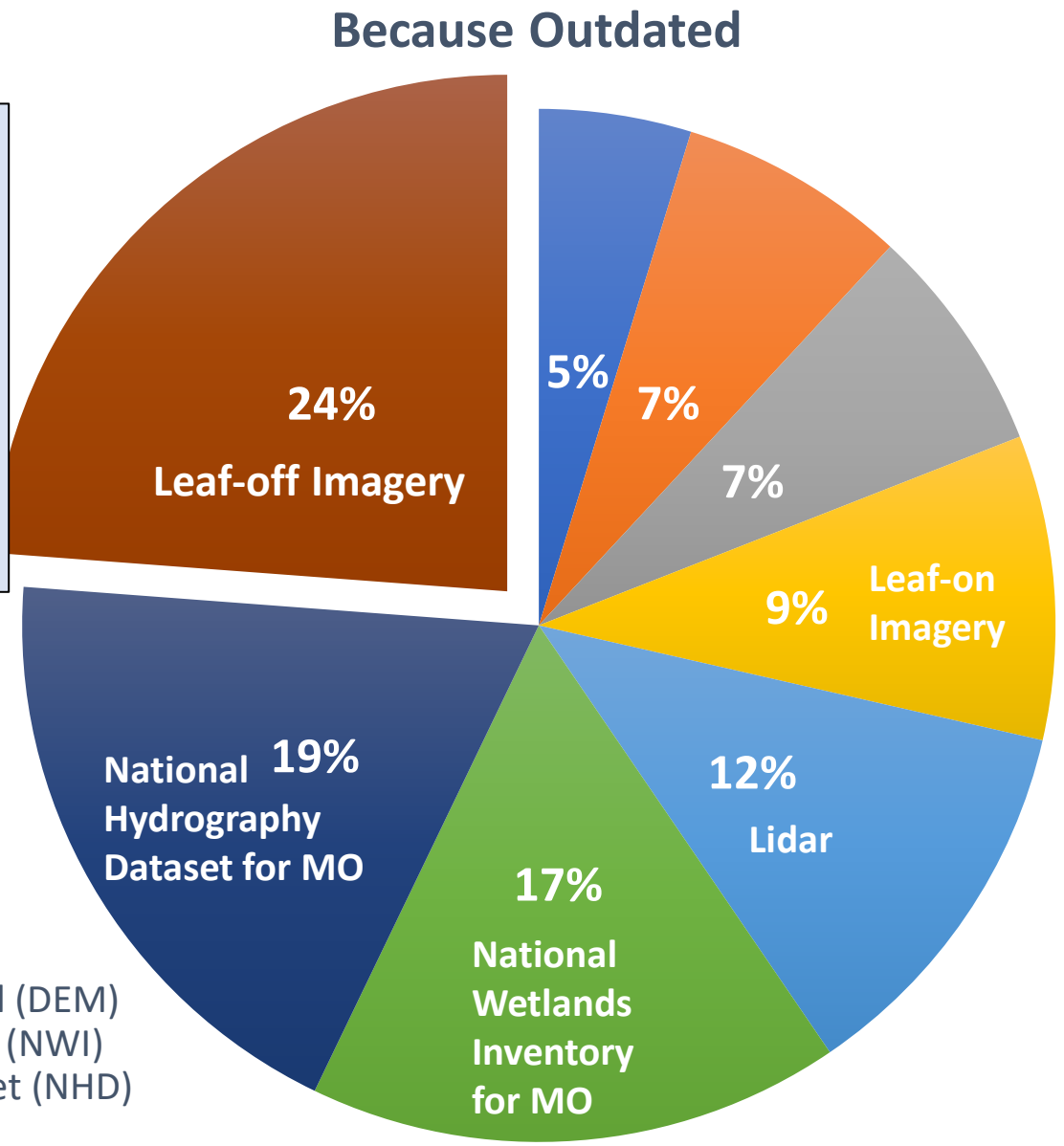


Limitations

Out of Date
Leaf-Off Imagery is old, 2015 NWI and NHD are archaic, late 1980's

Timely information = more accurate and greater use to professionals

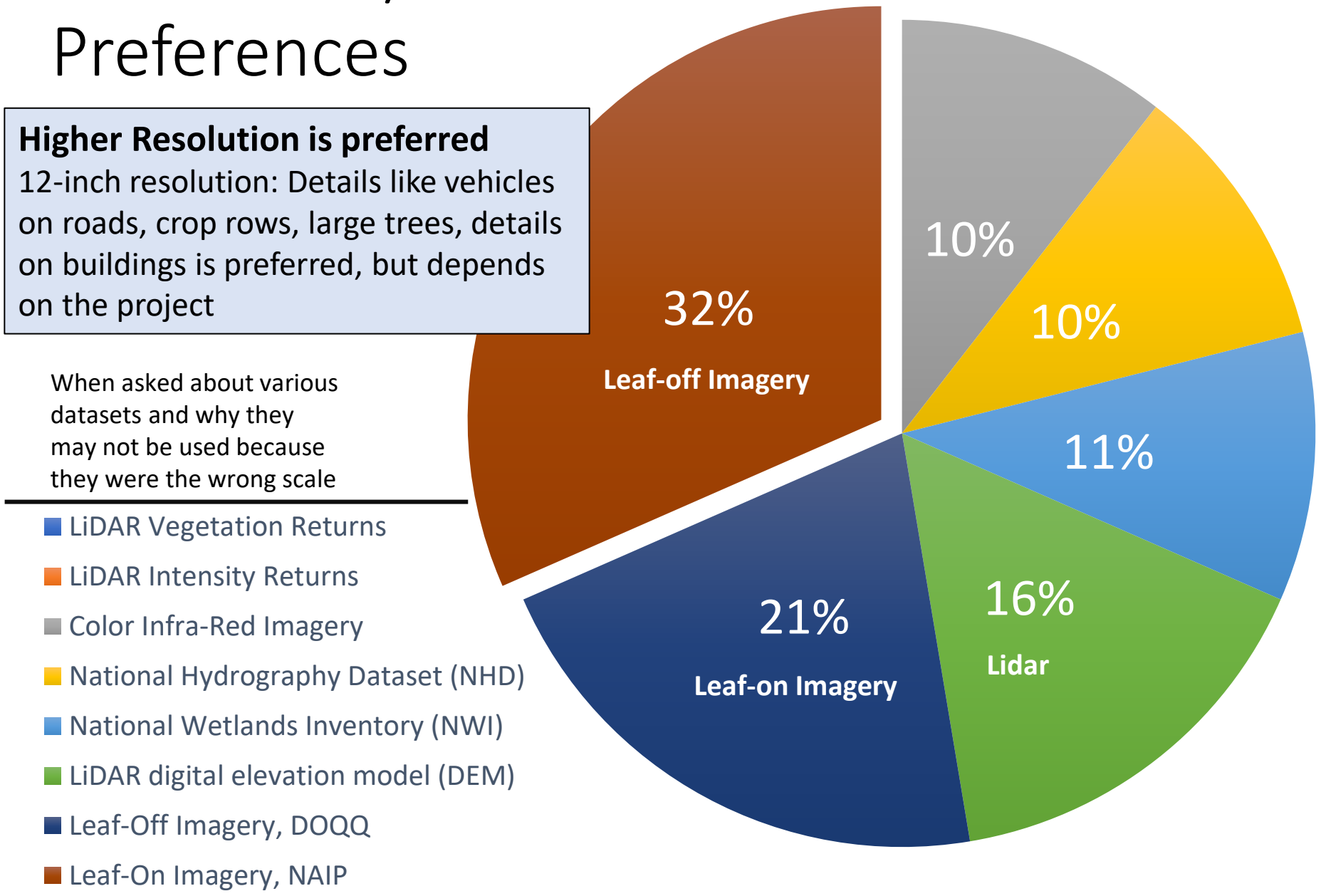
When asked about various datasets and why they may not be used because they were outdated



Limitations/ Preferences

Higher Resolution is preferred
12-inch resolution: Details like vehicles on roads, crop rows, large trees, details on buildings is preferred, but depends on the project

When asked about various datasets and why they may not be used because they were the wrong scale



Examples of Applications that can benefit from updated NHD and NWI

List of Applications for NHD

- **Streams/Rivers**
- Map base layer
  - Find streams and waterbodies
  - Show distribution of streams, rivers and ditches
- Stream classification and watershed network
- Drainage review
- Planning for Implementation of Watershed Best Management Practices
- Watershed Analysis
  - Use the networked stream segments to delineate locations up and downstream of a point.
  - Use the networked stream segments to select streams with watersheds, and catchments in those watersheds
  - Used to delineate watersheds and associated attributes
  - Attributes provide stream orders and upstream drainage area
  - More robust Hydrologic Analysis
  - Evaluate streambank stabilization projects and stream crossing replacements
- Fish Research
  - Identify fish community sampling locations
  - Measuring distances between tag and catch locations of tagged fish species.
- Fish kills
  - Used in the new online fish kill applications
  - Determine potential pollution sources
- **Wetlands**
- Wetland delineations
- Juxtaposition of adjacent streams and wetlands
  - Potential flood sources
- **Grasslands and Forests**
- Planning for Implementation of Best Management Practices
- Comparing stream lines to visual cues for headwaters
- **Agriculture**
- Quantify the extent of ditch networks developed to drain land for agricultural development
- Comparing stream lines to visual cues for headwaters
- **Invasive Species**
- Used to identify stream segments that could potentially have zebra mussels
- **Other Applications**
- Infrastructure and water body relationships/impacts
- Looking for streams in urban and suburban areas

List of Applications for NWI

- **Streams/Rivers**
- To confirm wetland delineation boundaries
- Environmental review
- Restoration planning
  - Check for historical or marked wetlands
- **Wetlands**
- Identify extent of known wetlands
  - Establish a baseline of the extent and type of wetlands
  - To search for potential fens (identified as PEMb)
  - To confirm wetland delineation boundaries
  - Temporal effects
- Research, monitoring, planning
- Wetland construction and management
- Wetland determinations
- Restoration
- **Forests and Grasslands**
- A review of delineations
- Historical wetlands for possible restorations
- **Agriculture**
- For ACEP- WRE program applications on farm land
- Looking for farmed wetlands or wetland conversions
- **Natural Communities**
- Identifying potential sites for SOCC surveys
- To search for sinkhole ponds, or to determine if they have been artificially dammed.
- Also to search for pond shrub swamps, seeps, riverine wetlands, etc.
- Identifying known fens

Examples of Applications that can benefit from updated leaf off imagery

- **Stream/Rivers**
- Examining streams
  - Stream location, width, delineation
  - Stream channel condition
  - Stream channel migration and evulsions before and after floods
  - Bank erosion, point bar development, riparian scour
  - Determining water, pools, depressions
  - Finding side channels
- Examining riparian corridors
  - Identify trees
  - Proximity to levee and riparian areas
  - Historical land use impacts to riparian/floodplain area to establish timeline of clean water violations.
  - Defining riparian buffers
  - Defining streamside management zones (SMZ)
  - Identify and display drainages
- Erosion status
- Finding drainage headcuts
- Identify road crossings
- Identify flooded locations in the winter
- Observation of connectivity
- Wetland adjacency determination
- Pump station construction
- Wetland decision making
- Information for habitat management
- Used for enforcement
- Use in burn plans
- Used in forest stand delineations
- **Wetlands**
- Enhancement and restoration potential
- Identifying water control structures and outlets
- Looking for appropriate places for species
  - Searching for federally endangered pondberry
- Wetland delineations and classification
  - Measuring extent of fens
- Examining wetland attributes
  - Identify ephemeral pools or inundation
  - Mapping sloughs, channel scars, lower elevations
  - Evaluate flooding impacts
  - Connectivity
  - Hydrologic indicators
  - Examine differences in water levels and exposed mud flats and shorelines
- Invasive Species
- Identify vegetation location and density
  - Forest stands with invasives
  - Wetlands with paspalum coverage
  - Honeysuckle invasions
  - Giant cut grass expansion
  - Reed canary grass infestation along creeks
- **Forests**
- Identify ephemeral pools, canopy openings, natural drains
- Habitat management on private and public land
  - Stand delineation
  - Woodland thinning and timber harvest
  - Differences in deciduous and evergreen veg
  - Pine density
  - Cedar encroachment and removal
  - Burn plan preparation and post management
- Locate structures, land features, and windthrow
- Topography
- Change detection
- Disturbance Assessment
- Locating forest roads and trails
- Identify streamside management zone and digitizing streams
- Identify slough signatures
- Identify drainage headcuts
- Used for enforcement
- Delineating field edges
- **Grasslands**
- Identify woody encroachment
- Identify remnant wetlands within grasslands
- Grassland classification
  - Distinguishing between warm and cool season grasses
  - Habitat management
- Burn plan preparation and post management
  - Delineating areas for measuring, fire lines, etc.
- Finding drainage headcuts
- Examining erosion on trails or cattle paths
- **Agriculture**
- Identify crop field boundaries and measurements
- Management plans
  - Habitat management
  - For permittee farmers
  - Past crop production
  - Soil mapping
- Examining erosion in gullies and ditches
- Proximity to wetlands
- Restoration potential
  - Historical flow channels or depressions
- **Natural Communities**
- Identify vegetation cover, pools, other natural features
  - Red cedar encroachment
  - Ephemeral stream boundaries
  - Depressions hidden by veg
  - Glades
  - Fens
  - Burn plan Preparation
  - Habitat Management Plans

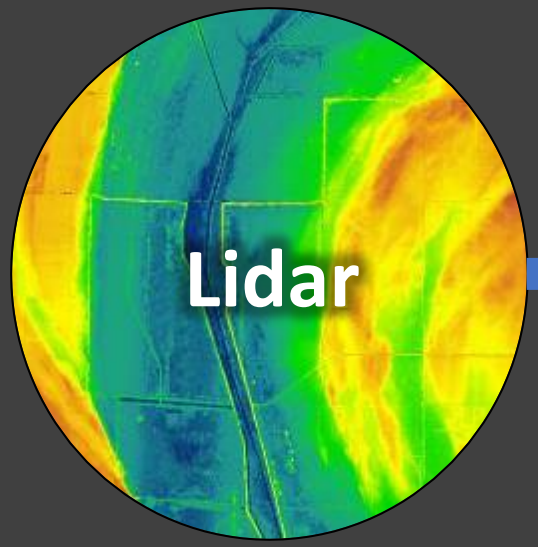
Examples of Applications that can benefit from updated lidar

- **Stream/Rivers**
- Identifying/monitoring erosion
  - Examine bank elevations to determine erosion rates
- Identify landscape alterations
- Identify landforms
  - Extracted elevations to develop 2-D hydraulic models
  - Examining topographic relief, floodplain elevations, and drainages
  - Determinizing stream order for streamside management zone placement
- Create more accurate stream lines and stream networks
- Create riparian buffers
- Habitat management Planning
- Restoration planning
- From LAS:
  - 1-m veg height raster
  - DEM generation
- **Wetlands**
- Examining
  - Wetlands
  - Levees
  - Forest slope
  - General relief
- Land classification
  - Identifying wetland types across landscape
- Measuring watersheds
- Wetland restoration design planning
- Habitat Management Planning
- Wetland Decision Support Tool
  - Planning water management based upon elevations
- **Forests**
- Modeling Site Attributes
- Land classification
- Habitat Management Planning
- Restoration Planning
- Examining topography and slope
- Locating drainage and depressions
- Delineation of habitat types in forest complexes
- Identify suitable elevation for different forest communities
- Developing burn plans
- **Grasslands**
- Land classification
- Pinpoint headcuts in drainages
- Developing burn plans
- Identifying drainage areas
- **Agriculture**
- Wetland Restoration Planning
  - Identifying remnant wetland features in crop fields for restoration potential
  - Locating depressions
- Examining drainage issues
  - Helping landowners understand drainage and water flow
- **Natural Communities**
- Assessing Landtype Associations and Ecological Site Description designations against the topographic DEM layer
- Delineation of natural community complexes prior to ground surveys
- Comparison of landforms for fen identification
- **Invasive Species**
- Identifying areas too wet for Reed Canary Grass control
- **Other Applications**
- DEMs have been used in conjunction with other spatial data sets to model habitat type
- Surveys, design, and infrastructure
- Cultural resources
- Assist with the development of the Ecological Classification System
- Monitor headcuts on Conservation Areas
- Use it to update NHDPlus HR and NWI+
- HCP retention guideline review
- Watershed management efforts

The need for partnerships

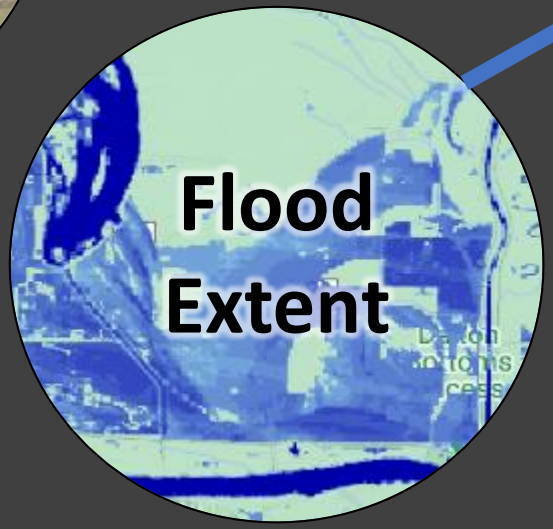
- External partner meetings to raise awareness, receive feedback, and develop plans. October 2020 – Led by Frank Nelson (MDC Wetland Manager)
- Missouri GIS Advisory Council – Frank gave NWI/NHD presentation, Oct 2021, the Council helped coordinate the Southern MO Leaf Off Imagery Flight.
- Missouri Department of Natural Resources – NHD Data Steward, Financial Contributor to Leaf off Southern MO imagery.
- Missouri Department of Transportation – Financial Contributor to Leaf Off Southern MO Imagery
- United States Environmental Protection Agency – Fully support the effort and has funding that can be used for wetland mapping.
- Upper Miss/Great Lakes JV - Very interested. Willing to help with technical questions/applications with GIS support and Python scripting.
- United States Fish and Wildlife Service – Open to staying informed and to be a technical resource.
- Ducks Unlimited – Updating NWI for the US is a priority for DU. They are a frequent contractor used by state partnerships for NWI updates, providing helpful background and context on the process.
- United States Geological Survey – Coordination of Lidar and NHD updates. Cost share dollars available.
- United States Department of Agriculture, NRCS – Interested in deriving stream networks from Lidar and DEMs. Providing funding and coordinating Lidar acquisition in Missouri.
- U.S. Army Corps of Engineers – Mostly focused on individual studies and projects. Collected Lidar in SE MO to assist with studies on the St. Francis River & the New Madrid Floodway.
- Saint Mary's University of Minnesota – Frequent contractor used by state partnerships for NWI updates, provided helpful background and context on the process.
- State University of New York, College of Environmental Science and Forestry – Wetland Classification Pilot using publicly available SAR data (Sentinel-1 C band and ALOS-PALSAR L-Band). Used SAR data and machine learning for Canadian Wetland Classification and looking to see it's application towards Cowardin Classification.
- Conservation Federation of Missouri – Passed a resolution to support the updating of the NHD and NWI.
- University of Missouri, Missouri Spatial Data Information Service (MSDIS) – Hosts imagery, lidar, and other spatial datasets. Missouri's Spatial Data Clearinghouse

Relationship of various GIS Inputs



Watershed Boundaries,
Stream Networks,
Channel Alignment

Current Bank-lines Under Riparian Canopy

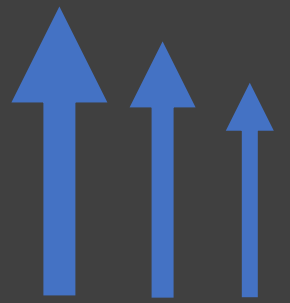


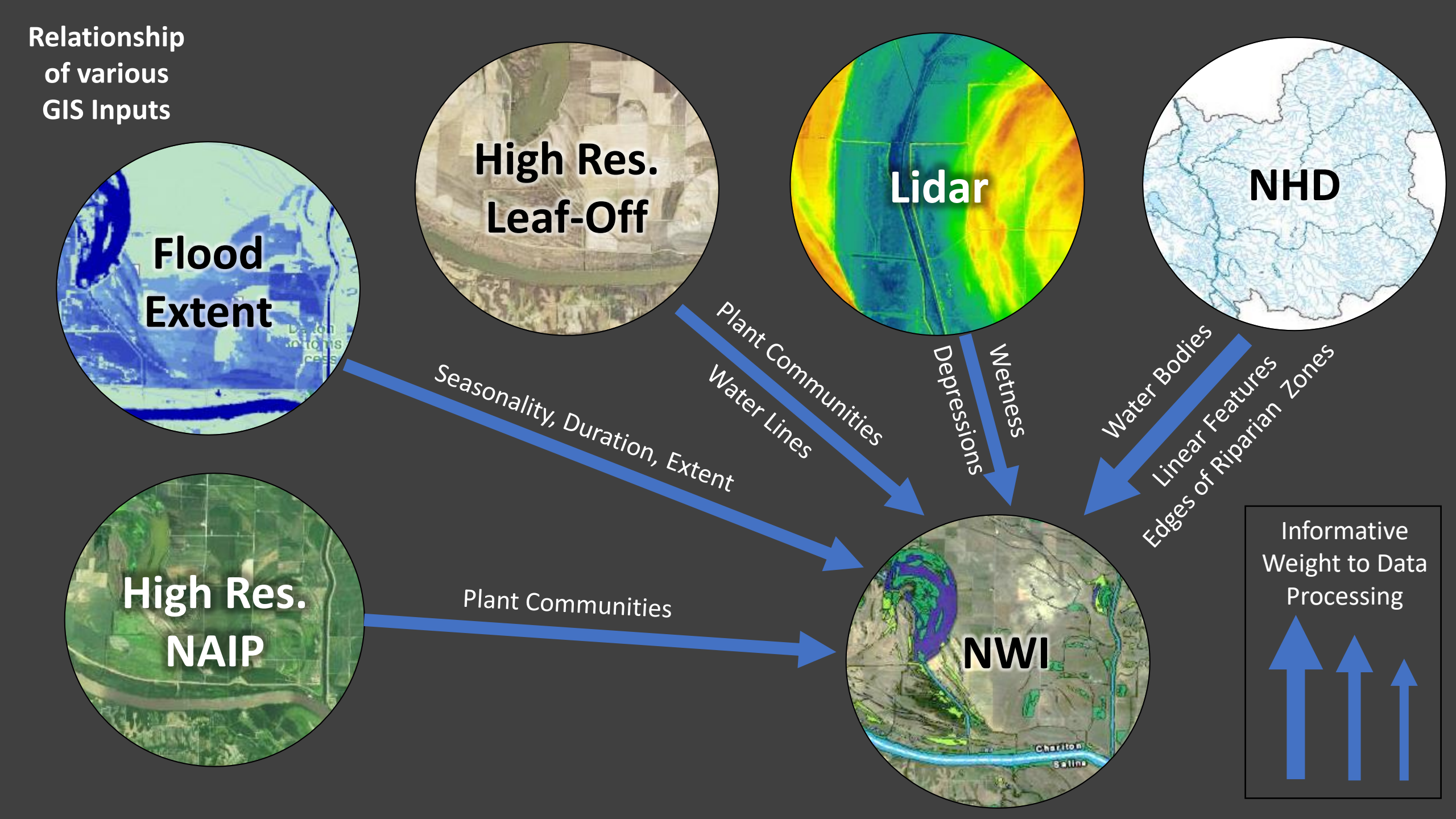
Water Bodies

Water Bodies

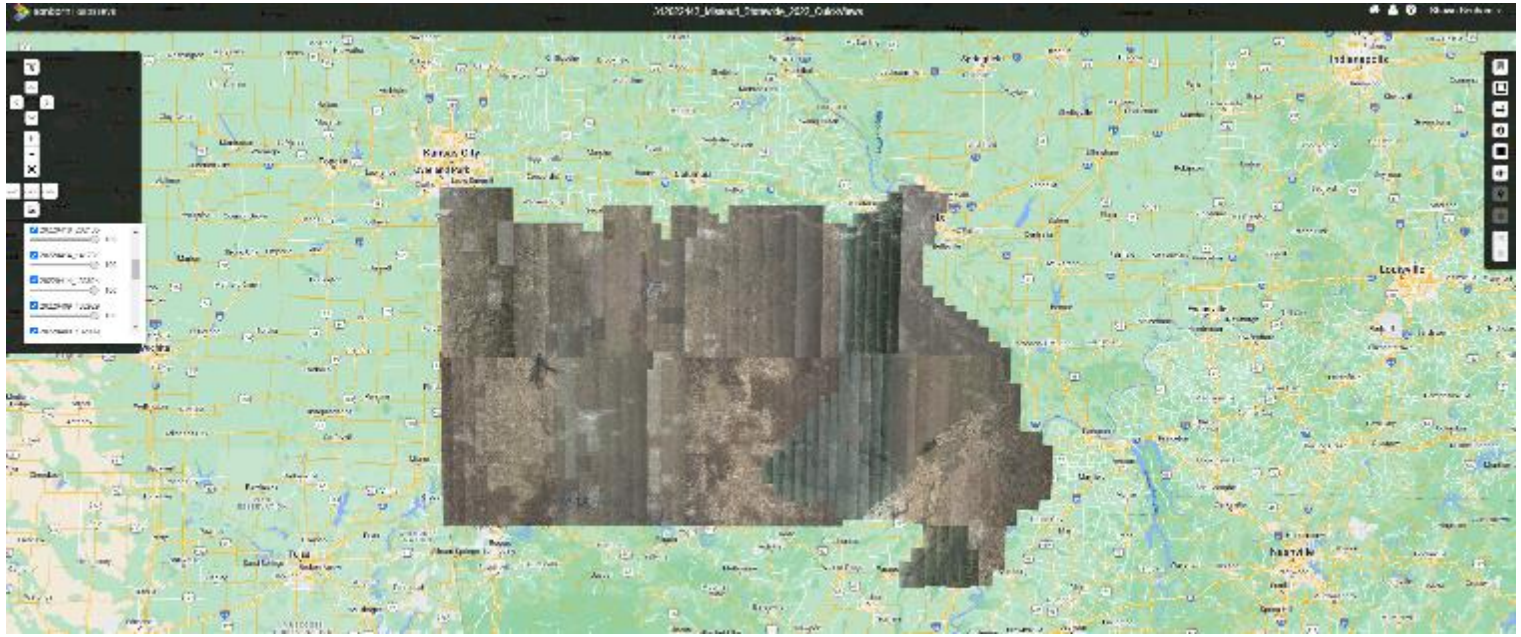
Current Stream Alignment

Informative Weight to Data Processing




Relationship of various GIS Inputs
Flood Extent
High Res. Leaf-Off
Lidar
NHD
High Res. NAIP
NWI
Seasonality, Duration, Extent
Plant Communities
Water Lines
Depressions
Wetness
Water Bodies
Linear Features
Edges of Riparian Zones
Plant Communities
Informative Weight to Data Processing

Where is the Missouri Effort at Now



- We successfully formed a partnership between the MDC, MoDNR, and MoDOT to fund the acquisition of leaf off 4 band imagery in Southern Missouri. Leaf off imagery was last acquired in 2015/2016. The Missouri GIS Advisory Committee (MGISAC) helped coordinate the effort and QC process. Winter 2022

Where is the Missouri Effort at Now

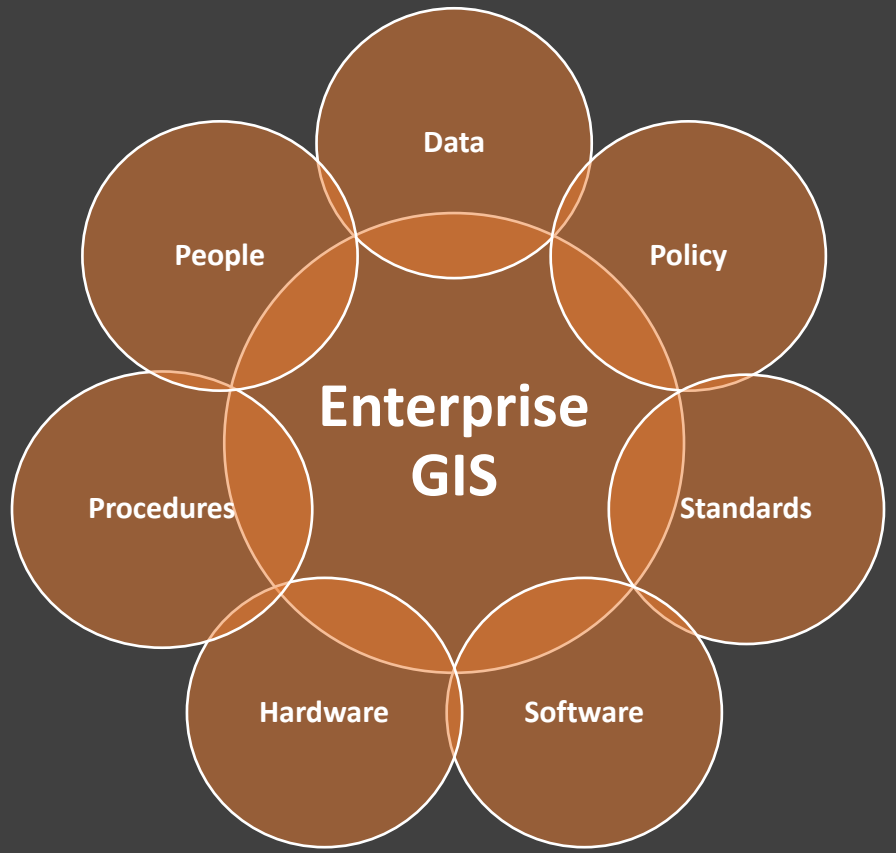
- We successfully formed a partnership between the MDC and the Mid-America Regional Council (MARC) to capture 11 counties of leaf off 4 band, 12-inch pixel imagery Winter 2022

What's next

- Form Partnership to fly leaf off photography for remaining Northern MO Counties – Winter 2023
- Flood Extent and Duration dataset creation and analysis. FY 23
- Start NHD work in SE MO FY 23
- Collect QL2 lidar in Missouri counties where data is getting old or does not exist. FY 23
- Pilot to see how multi-temporal SAR data could help tackle instances of inundation extent, seasonality, and duration in Missouri as a useful layer to inform the process of wetland classification. – FY 23
- Buy Up on NAIP Leaf On Photography – FY 24
- Continue NHD Work, Flood extent and duration work, and Start NWI work – FY 24
- Similar efforts through FY 27.

MGISAC

MISSOURI GEOGRAPHIC INFORMATION SYSTEMS ADVISORY COUNCIL



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