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The Agricultural Conservation Planning Framework
Experience from Minnesota ACPF Users

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The Agricultural Conservation Planning Framework (ACPF) is a set of desktop tools to help locate conservation practices within small watersheds. The University of Minnesota Water Resources Center (WRC) wanted to learn how the ACPF would work in our state. With funding from the McKnight Foundation, the WRC provided training to 39 GIS technicians across the state. Several months later, we interviewed several people who had used the ACPF to learn about their experience with the tool. This report summarizes what they told us.

What is the ACPF?

The Agricultural Conservation Planning Framework is a watershed approach to conservation planning facilitated by a set of technical tools semi-automated within ArcGIS software. Users can generate detailed maps showing where conservation practices are suitable and effective within sub-watersheds (e.g. HUC-12). The ACPF was developed by a team of researchers with the USDA-Agricultural Research Service in Ames, IA.

The ACPF begins with terrain analysis to identify critical source areas which contribute disproportionate amounts of nutrients, sediment, or runoff water to a water body. Then the toolset is used to analyze sites appropriate for specific practices such as grassed waterways, filter strips, terraces, controlled drainage, wetlands, detention basins, and buffers. Fields are prioritized for runoff risk, and riparian areas are analyzed to determine the appropriate types of buffers.

The ACPF takes advantage of high-resolution 3-meter digital elevation models (DEMs) of the landscape, which are available for all of Minnesota. Before these LiDAR-based DEMs can be used in the ACPF, they require hydro-modification, or hydroconditioning, to create an accurate representation of how water flows across the land. Since LiDAR detects only surface features, it does not show subsurface flow paths. Hydro-modification is a time-intensive process of locating all culverts or other subsurface water flow paths that were not part of the original LiDAR-based DEM.

The ACPF is designed for identifying opportunities and appropriate sites for specific conservation practices. It has limited capability for prioritizing specific projects, in part because prioritization depends on social and economic factors as well as estimated downstream benefits that are not considered. Although it doesn't prioritize practices, it does highlight high-priority sites.

The ACPF does not allow for direct estimates of pollution reduction impacts. Instead, the developers have described a method for estimating contributions of multiple practices towards meeting nutrient reduction goals (Tomer et al. 2015).

Example of ACPF output
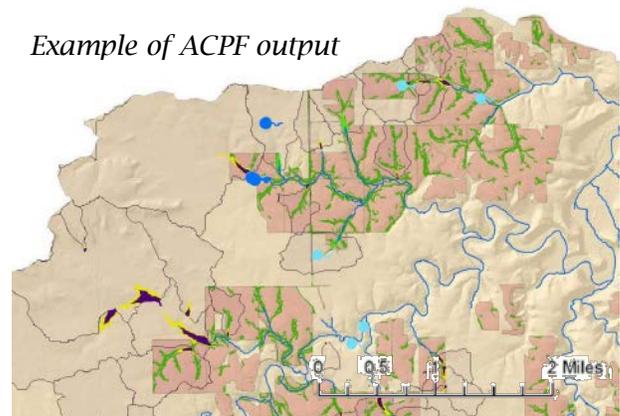
Who uses the ACPF?

The people interviewed for this project were GIS technicians for SWCDs, counties, or non-governmental organizations. Running the ACPF tools requires moderate proficiency in ArcGIS; knowledge of local topography, hydrology, and land use; and understanding of how conservation practices are implemented. Few people have all those skills, so typically a GIS technician will work in close consultation with one or more local field experts. For this reason, project participants emphasized the importance of running the ACPF locally.

What does "moderate proficiency in ArcGIS" mean? Users need intermediate knowledge of ArcMap Advanced 10.2 or higher, and should be comfortable with geodatabase naming and storage, editing procedures, geoprocessing tools, and multiple data formats. Users should have enough experience to do basic spatial troubleshooting.

Field technicians with knowledge of the local landscape and conservation practices are needed to: (1) check the hydro-modification linework and designation of perennial streams; (2) choose locally appropriate constraints for conservation practices; and (3) interpret the resulting map.

How much time does it take?

The ACPF is intended for analysis of subwatersheds of 10,000 to 30,000 acres – i.e., HUC-12 watersheds. Participants in this project took 2 to 10 days to generate ACPF output for a single watershed. Most of that time went towards hydro-modification of the DEM. The amount of time needed depended on the size of the watershed, the experience of the user, and most significantly, the complexity of the hydro-modification required to prepare the DEM and define stream networks. Hydro-modification will go faster if a database of culvert locations is available or a layer of "cut lines" has already been developed for other purposes. The process will go slower in flat landscapes where the flow networks are driven by low-relief

features such as roads and underground conduits.

Once the stream networks were defined, users were able to run the tools for siting practices in less than a day. Computer processing time is generally fairly rapid – several minutes for most tools, and an hour for the more complex tools on larger watersheds. This assumes use of 3m DEMs. Using 1m DEMs substantially increases processing time without improving the usefulness of the output.

What software is required?

One of the most significant barriers to use of the ACPF is the need for ArcGIS Advanced version 10.2 or higher, with a license for Spatial Analyst extension. The advanced license is far more expensive than the basic license that is common in local offices. This could be addressed if local offices negotiated a reduced cost for the advanced license. Asking technicians in regional or state offices to run the analysis is only a partial solution because of the need for local knowledge of the landscape, and because of the value of running alternate scenarios, as needed.

What did users like?

The participants in this project were generally happy with how easy it was to use the ACPF. Even experienced GIS technicians found it easier to do hydro-modification and define watershed boundaries with the ACPF tools than with other ArcGIS alternatives.

Participants appreciated that they could easily adjust the settings for the various conservation practices, giving them flexibility to meet unique local needs.

A local DEM is the only input users have to provide. All the other input databases (soils, field boundaries, and crop cover) are provided and ready to use for most agricultural regions of Minnesota. (For a map of coverage, see URL at the end.) Plans are underway to finish the databases for the Red River Valley.

The ACPF analyses are run on a farm-field basis – matching how conservationists do their work, and making it easy to combine with parcel data to identify landowners. A layer of farm-field boundaries is one of the provided input databases.

The erosion risk tool effectively highlights critical areas. Users said these maps were some of the most useful. They also said they would like even more help with prioritizing sites, e.g. by including the Stream Power Index (SPI).

What training is required?

Training is important to understand the logic behind the tools, and to choose appropriate options for local conditions. Participants in this project attended a 1½ day workshop. They identified several components of the training they wanted to emphasize to other users:

- Prevent excessive processing time by preparing input DEMs correctly; i.e., use 3m DEMs and convert the vertical (z) units from decimal meters to integer centimeters.
- Hydro-modification of the DEM and defining stream networks are time consuming, require local expertise, and have a substantial impact on the accuracy of the ACPF output. Use best practices such as avoiding over-editing the DEM, and be systematic (one user overlaid a fishnet on the area to guide his work through the watershed).
- Hierarchical naming conventions and file paths are important; pay attention to them.
- Plan ahead how to manage different versions and scenarios, and track what settings were selected for each practice.
- Keep in mind that the tools (e.g. for WASCOBs) are meant for general siting, not precise design.

- Consider adding other layers:
  o aerial images and stream network layers to help during hydro-modification;
  o local information on ditching and drainage to aid hydro-modification;
  o Minnesota's restorable wetlands map;
  o existing conservation practices, if the information is available; and
  o parcel data and feedlots to help with local prioritizing.
- Export output maps to KML files for easy display within Google Earth.

How do people use ACPF output?

The ACPF-generated maps may be used in the office by conservation staff, or in the field with landowners. They may be shared with individuals, or with groups of stakeholders. In any case, using the framework and its outputs promotes discussions of watershed-scale interactions of conservation activities.

Use the maps while working with individual landowners:

- Before a site visit, study ACPF output maps to identify potential opportunities and high risk areas.
- Have maps available to show the landowner conservation opportunities and show how their land relates to the rest of the watershed. However, one experienced user cautioned against overwhelming landowners with extensive maps that show all of the practice site options.
- For the MN Ag Water Quality Certification Program, use ACPF outputs to identify areas of concern across fields.

Use the maps in watershed planning to:

- Help target CREP funding with output from the water storage tool;
- Plan and justify grant proposals;
- Quantify the extent of opportunities for a practice;
- Provide information about conservation opportunities to groups of landowners;

- Help staff understand watershed scale needs and opportunities, and encourage outreach for high-impact sites.

How the ACPF fits in the planning process:

1. First, other tools are used for modeling and large-scale (HUC-8) watershed planning to identify priority watersheds and general implementation strategies.
2. When staff are ready to focus on smaller (HUC-12) watersheds, they would use the ACPF to identify specific sites suitable for specific practices. The maps would provide background information to help landowners and conservation staff to select appropriate and acceptable sites and practices.
3. Other tools would be used for final practice design at a site and to quantify expected benefits.

Landowners vary in their response to ACPF maps, depending on the landowner and depending how the maps are presented. Used in the wrong setting, landowners may feel threatened and that they are being targeted. Used in the right setting, landowners feel empowered by the information – by seeing opportunities and having control over selecting effective options. It is important that the maps be presented as a smorgasbord of options and not as a plan. Field checking the maps improves their quality and credibility.

The University of Minnesota WRC, in cooperation with the University of Wisconsin and Purdue University, is working to learn more and provide guidance about how local conservationists use ACPF output maps to effectively implement practices.

Where can I get the ACPF?

The ACPF is available at the North Central Region Water Network website. Click on Resources, and Tools, or go directly to http://northcentralwater.org/acpf/ . This site includes links to:

- Download the ACPF toolkit, including the User Manual,
- Download the land use and soils input databases for your watersheds. Follow this link to see a map of available watersheds.
- Sign up for an online group to discuss technical issues and receive update notices about the ACPF;
- See the map of watersheds where the ACPF analysis has been applied. This will help you identify colleagues with experience;
- An extended explanation of the ACPF and technical articles.

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