Agricultural Drainage Management Coalition

Evaluating the Saturated Buffer Output within the Agricultural Conservation Planning Framework and the Use of the Model to Improve Practice Adoption Efficiency

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Introduction

The Agricultural Conservation Planning Framework is a powerful tool to help make state and regional level planning a reality by mapping out the potential for farm-level best management practice implementation. It can be utilized at the HUC-12 scale (10,000-40,000-acre watersheds) to help stakeholders identify solutions and prioritize practices to meet their local watershed goals. The ACPF framework emphasizes soil health as its base then builds layers of practices for water control within the field, water control below the field, and finally riparian zone management. Saturated buffers are a particularly effective nitrate removal practice identified within the riparian management feature of ACPF. The cost effectiveness of saturated buffers gives them the potential to play a significant role in the nutrient loss reduction strategies for many Midwest states.

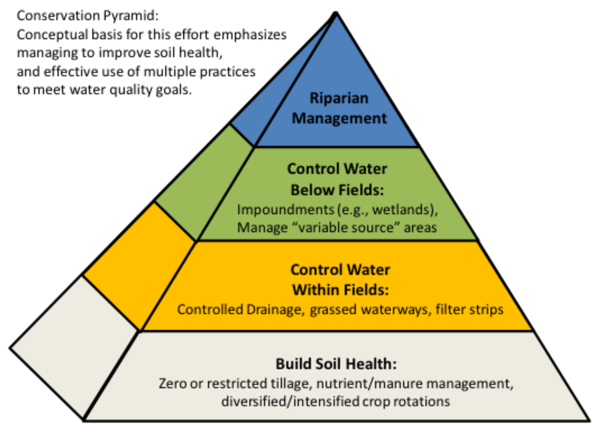

Figure 1 The ACPF Conservation Pyramid (accessed online at acpf4watersheds.org/about-acpf/#framework).

Even though ACPF has proven useful, it has been difficult to evaluate the rigor of the saturated buffer output tool due to the low number of saturated buffers implemented through 2020. The Central Iowa Water Quality Infrastructure Project, commonly referred to as the Polk County Saturated Buffer Project, had a high level of success of implementing saturated buffers within four Polk County Iowa watersheds. The level of success presented the opportunity to review the ACPF saturated buffer output for accuracy and to provide feedback on how to better utilize the tool for outreach. This report is intended to provide that feedback.

How ACPF Identifies Saturated Buffers

The Riparian Denitrifying Practices tool helps to identify which riparian catchments are suitable based off user defined soil, topography, and land use criteria. If all three of the criteria are met, the catchment is labelled "YES" for saturated buffers. The ACPF generated riparian catchments are generally 250 meters in length and 90 meters in width.

Soils

The following three criteria are evaluated to determine if the riparian catchment soils are suitable for a saturated buffer.

1. Minimum Organic Matter – default is 1.7% with a recommended range of 1.5-5.1%
2. Maximum % of Coarse Soils – default is 65% with a recommended range of 50-75%

3. Drainage Class must be “very poorly drained, poorly drained, somewhat poorly drained, or moderately well drained”; to ensure capacity of buffer to maintain discharged water near the surface.

The user can select the minimum % of soils within 20 meters of the stream that meet all three of the soil conditions as the threshold to meet the suitable soil criteria. The default minimum is 35% with a recommended range of 25-75%.

Topography

The riparian catchments must meet the following two criteria for the riparian denitrifying practices tool to deem the catchment suitable for a saturated buffer based on topography.

1. A minimum of 35% of the 90-meter riparian zone must have slopes between 2-8%. The user can adjust the threshold within a recommended range of 25 – 75%.
2. Estimated bank height must be less than the default of 12 feet or the user can adjust the range between 8 – 14 feet.

Land Use

Either cropland or pasture agricultural land use must exist within the 90-meter riparian zone to avoid forested riparian buffers.

Completed ACPF Outputs

An online database with completed ACPF runs has been compiled by Iowa State University showing the extent of the usage of the tool. To access the map, an online search for “ACPF in Action” will lead to the ESRI powered map, or it can be viewed at https://www.arcgis.com/apps/View/index.html?appid=1449ef6534e246cc8ef8995ba8573c07 . The database, although not comprehensive, is the most extensive collection of ACPF runs.

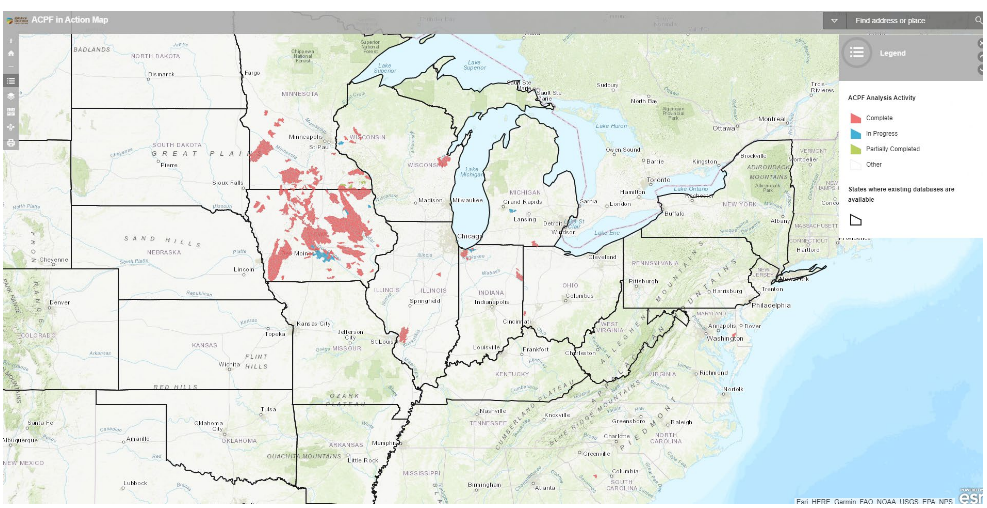

Figure 2 ACPF in Action map extent.

The ACPF outputs are not included on the map but has attributed data that includes contact information. Table 1 is an example of information available from the ACPF in Action map. The table includes information on the HUC 12, status of ACPF output, date of run, the analyst, a contact email, organization who completed the analysis, as well as information on if there has been an updated run of the output.

Table 1 ACPF in Action attribute data.

Attribute	Data
HUC_12	071000040908
Status	Complete
DskInSrc	Desktop visual inspection
Date	8/1/2018
Analyst (1)	Calvin Wolter
Contact (1)	iihr-iowafloodcenter@uiowa.edu
Organization (1)	University of Iowa – Flood Center
Comments (1)	Updated FB information using 2017 photography
Date (2)	
Analyst (2)	
Contact (2)	

States to focus future ACPF runs

The 2018 FSA funded ADMC report "Quantifying the Effectiveness of Saturated Buffers to Reduce Nutrient Loading from Tile Drainage Waters" worked with the University of Illinois, Urbana-Champaign to estimate the potential number of saturated buffer sites in the Midwest. Table 2 lists the number of estimated potential sites with Iowa, Illinois, and Ohio leading the way.

Table 2 Number of estimated saturated buffer sites according to 2018 ADMC report.

State	Estimated Potential Saturated Buffer Sites
Iowa	70,330 – 101,927
Illinois	69,485 – 100,703
Ohio	42,768 – 61,983
Minnesota	19,430 – 28,160
Indiana	15, 946 – 23,110
Missouri	13,200 – 19,130
Michigan	9,504 – 13,774
Nebraska	2,006 – 2,908
South Dakota	1,795 – 2,602
North Dakota	1,690 – 2,449
Wisconsin	792 – 1,148

It would make sense to prioritize future ACPF runs targeting saturated buffers in states that have a higher likelihood of sites. When thinking about implementation, states that have consistent state led funding for conservation practices are vital as state programs can match with federal dollars to help facilitate implementation. Iowa, Ohio, and Minnesota all have consistent state led funding and a high number of estimated potential sites making them strong candidates for focusing ACPF runs with the saturated buffer output. While Missouri does have consistent state led funding, it does not have a high occurrence of potential saturated buffer sites and would not need ACPF runs for the purpose of installing saturated buffers. Illinois does not have consistent funding, but it does have significant number of estimated potential sites and strong agricultural conservation partnerships with the Illinois Sustainable Ag Partnership. Illinois would benefit from an increased number of watersheds with the ACPF output that includes saturated buffers.

Accuracy of ACPF at identifying saturated buffers

The Central Iowa Water Quality Infrastructure Project utilized the ACPF Riparian Denitrifying Practices tool to select landowners to conduct outreach to in the Fourmile Creek, Walnut Creek, Mud/Camp Creek, and Spring Creek watersheds within Polk and Dallas County Iowa. The ACPF outputs were completed by the Iowa Soybean association in 2019. The ACPF output was an important consideration on selecting the watersheds to work in for the CIWQIP as the project partners wanted to ensure that there would be an adequate number of sites to recruit and select from. Table 3 displays the number of ACPF identified riparian buffer segments that were deemed suitable for saturated buffers.

Table 3 Frequency of ACPF identified saturated buffer riparian segments.

Polk County Watershed	ACPF Identified Saturated Buffer Segments
Camp Creek	142
Fourmile Creek	265
Spring Creek	84
Walnut Creek*	132

* The Dallas County portion of the watershed was included.

Why sites are missed by ACPF that were deemed appropriate after site investigations

The targeted outreach and project team efforts resulted in 41 saturated buffers to be installed in the summer of 2021 with an additional 10 bioreactors to be installed. It is estimated that an additional 50-75 sites will be installed in the summer of 2022. Of the 41 sites to be installed in the summer of 2021, only 13 saturated buffers were located within a riparian segment that ACPF identified as being suitable and 28 to be installed in areas deemed as not suitable according to the ACPF output. The success rate for ACPF identifying sites suitable for saturated buffers for the 2021 installed CIWQIP saturated buffers was 32%.

ADMC was able to obtain the saturated buffer output files for the Fourmile Creek ACPF run to evaluate the reason why sites that were identified by ACPF as being unsuitable but are going forward with a saturated buffer installation. In total there will be 32 saturated buffers installed in the Fourmile Creek watershed in the summer of 2021. 21 of the 32 sites will be in locations that ACPF did not identify as suitable sites, with 11 sites moving forward in areas in which ACPF identified as being suitable. Table 4 displays the reasons the sites were deemed unsuitable.

Table 4 Sites moving forward as saturated buffers despite being in an ACPF riparian segment deemed unsuitable.

Unsuitable Category	Reason	Count
Land Use	Road interrupted segment	1
Soils	% Max Course Above User Defined Threshold	9
Soils/Topography	% Max Course Above User Defined Threshold & %slope between 2-8% is below the 35% threshold	11

Eleven of the 32 sites were deemed unsuitable for due to both soils and topography, nine suites were unsuitable due to soils, and one site was unsuitable due to the land use. The site with "Land Use" flagged as the category making the riparian segment unsuitable was due a road intersecting the segment. All the nine sites that were flagged for soils met the drainage classification and the threshold for organic matter but fit within the range for % Max Course Solids that the user could define as unsuitable. Had the user used the default setting of the 65% threshold for the % Max Course Soils, all nine of the sites flagged for soils would have been identified as suitable as they all had soils with an identified 52.6% Max Course Soils (users are allowed to set the threshold as low as 50%). The final 11 sites are located on segment unsuitable for failing to meet both the soils and topography criteria. Once again, the sites were flagged for soils due to the % of Max Course Soils even though they were below the default setting of 65% but they were above the lowest end of the range the user could define of 50%. The 11 sites were also flagged for topography since they were lower than the default of 35% of the area having a slope between 2 – 8%. The user is allowed to lower the threshold to 25% of the area, and had this been done, the number of riparian segments flagged as unsuitable for topography would have been reduced to 8.

Twelve of the 21 Fourmile Creek saturated buffers being built in riparian segments that were deemed unsuitable for a saturated buffer fall within the ACPF recommended ranges which the user could have selected to be more inclusive. The % of Max Course soils setting was more restrictive than the default setting of 65% as sites with 52.6% Max Course soils were flagged. The default topography criteria of 35% of the area having a slope between 2 – 8% could be more inclusive by reducing the threshold to the lower end of the 25-75% recommended range. Even outside of this range, sites below 2% slope can be designed to meet NRCS standards, but the landowner should be made aware of potential impact zones behind the control structures and management required.

Table 5 Breakdown how ACPF identified the riparian segments in which a saturated buffer is being installed in the Fourmile Creek Watershed (Polk County, IA).

	Number correctly identified riparian segments with original ACPF output	**Accuracy**	**Potential number of correctly identified riparian segments by adjusting thresholds**	**Accuracy**
Yes	11	34%	23	72%
No	21	66%	9	28%

By adjusting the soil and topography thresholds within the recommend ranges to be more inclusive, the ACPF output could increase its accuracy of correctly identifying from 34% to 72% in the instance of the 2021 sites being installed in the Polk County Iowa Fourmile Creek Watershed.

Why ACPF identified sites are rejected after site investigation

Unfortunately, ADMC was not able to participate with the site investigations in 2020 due to COVID restrictions and were unable to quantify why sites that ACPF identified as suitable were rejected. ADMC did interview the site investigators and the predominate reason was due to lack of an outlet in the location of the segment. In some instances, there was the occurrence of surface intakes, especially in terraced fields. Otherwise, there were situations where the outlet was too large to be adequately treated by a saturated buffer.

Iowa watershed coordinator use of ACPF

ADMC sent a survey out to 28 watershed coordinators, who work on various Iowa Department of Agricultural and Land Stewardship (IDALS) Water Quality Initiative projects, to learn about their use of ACPF specifically for saturated buffers. Fifteen coordinators returned the 10-question survey. See Appendix A for specific questions and results.

Use of ACPF for Outreach

Thirteen of the respondents do have an ACPF output for their watershed. A majority (8 of 14) of the respondents have not used ACPF for outreach yet. Those that have used ACPF for outreach have generally done so in both group watershed meetings and in 1 on 1 settings with farmers/landowners. Most of the respondents (11) do have a saturated buffer installed in their watershed with 5 coordinators having 5+ saturated buffers either installed or in the planning process. Nine of the coordinators credit targeted one on one outreach as the reason as to why the landowner wanted a saturated buffer. Four of the coordinators did have a farmer/landowner ask about a saturated buffer themselves, and there were two coordinators who had interest from farmers who had a referral from another farmer.

Accuracy of ACPF Outputs

Coordinators were asked if they found ACPF to be accurate at identifying saturated buffers and 7 responded no while 4 responded yes with 4 stating that they have not had the chance to evaluate in the field. Nine coordinators have had saturated buffers installed in areas that were not identified by ACPF, while five are unsure if the saturated buffers installed in their watershed were identified by ACPF. Eleven of the coordinators responded that they have found ACPF identified segments to be unsuitable. The leading reasons provided that prevented the project from going forward were presence of surface intakes (7), no existing tile (5), or too small of a drainage area (4).

Conclusions

Thirty-two percent of the saturated buffers sites moving forward in the 2021 CIWQIP are located within segments identified by ACPF as being suitable. Meaning 68% of the sites that are going to be installed would have been missed had the project partners only looked at sites specifically identified by the ACPF output. Looking at the large subset of the CIWQIP sites that are located within the Fourmile Creek Watershed, changing the user defined suitability thresholds for soils and topography to be more inclusive, but still within the bounds of the ACPF manual, would have increased the accurate number of sites deemed suitable from 34% to 72%. Many of the Iowa watershed coordinators have also seen sites installed in sites that were not identified by ACPF suggesting that being more inclusive could be warranted. Sites that were identified by ACPF to be suitable only to be declared unsuitable upon a site investigation were unsuitable due to no existing tile (likely no outlet) and because of the presence of surface intakes. It would be beneficial if the ACPF tool would flag riparian segments with terraces within its drainage area as likely to have a surface intake.

States that ACPF could most help with saturated buffer outreach would be Ohio, Minnesota, and Illinois. All three have a high occurrence of estimated potential saturated buffer sites and Ohio and Minnesota has strong state dedicated funding for agricultural conservation practices. While Illinois does not have the state funding component, it does have a strong agricultural conservation partnership in ISAP which could help drive implementation.

References

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Porter, S.A., M.D. Tomer, D.E. James, and J.D. Van Horn. 2018. Agricultural Conservation Planning Framework ArcGIS® Toolbox User's Manual Version 3.0. Date of Release: 08/2018. National Laboratory for Agriculture and the Environment. USDA-ARS. Ames, IA.

Appendix A

Iowa Watershed Coordinator Survey

1. Do you have an ACPF output for your watershed? (Yes/No)
   Yes: 13
   No: 2
2. If yes, how have you utilized the ACPF output as an outreach tool? (Circle all that apply) (14 answered 1 skipped)
   a. At a group watershed meeting (4)
   b. With an individual field map in a 1 on 1 farmer/landowner meeting (5)
   c. It has not been used as outreach yet (8)
   d. Other, please describe (1) (To target landowners for edge of field practice outreach)
3. If no, have you utilized the Iowa Statewide ACPF Saturated Buffer Viewer? (Yes/No)
   Yes: (9)
   No: (5)
   a. https://www.nrrig.mwa.ars.usda.gov/st40_huc/satBuff.html
4. Have you used ACPF to conduct outreach specifically for a saturated buffer? (Yes/No/Haven't accessed ACPF)
   Yes: 9
   No: 6
5. How many saturated buffers are installed or in the planning process in your project area?
   a. 0 (4)
   b. 1 – 2 (4)
   c. 3 – 5 (2)
   d. 5+ (5)
6. If there are saturated buffers in your project area, how did the farmer/landowner come to want the saturated buffer? (Circle all that apply) (14 answered 1 skipped)
   a. Asked about it themselves (4)
   b. Became interested after a watershed meeting/field day (3)
   c. Referral from another farmer (2)
   d. Targeted one on one outreach (9)
   e. Other, please describe (1 topography is not ideal)
7. If you have utilized ACPF to promote saturated buffers, have you found ACPF to be accurate at identifying saturated buffers? (Yes/No/Have not had the opportunity to field evaluate an ACPF site)
   Yes: 4
   No: 7
   Have not had the opportunity to field evaluate an ACPF site 4
   - It will be a spring project
   - Generally we are approaching landowners we think are amenable to a project about checking potential sites, not the other way around
   - Have not used ACPF for buffers
   - I have found several sites, but still need to go and assess the sites to ensure that they are suitable

8. Have any saturated buffers been installed in areas that were not identified by ACPF in your project area? (Yes/No/Not sure)

   Yes: 9
   No: 1
   Not sure: 5
9. Have any of the ACPF saturated buffer segments been found to be unsuitable? (Yes/No)
   Yes: 11
   No: 1
   Unsure: 3
10. If so, what factors prevented the project from moving forward? (Circle all that apply) (13 answered, 2 skipped)
    a. No existing tile (5)
    b. Surface intakes present (7)
    c. Too small of a drainage area (4)
    d. Soils were too sandy (2)
    e. Not enough organic material (1)
    f. Impermeable layer too deep (1)
    g. Water table to high (2)
    h. Other, please explain (7)
        i. Soil too hydric, not enough room for distribution line
        ii. I have no input
        iii. No filter strip or a tile main is too close to creek
        iv. n/a
        v. No output from ACPF yet- been trying to work with it buy my ArcMap skills are pretty minimal!!
        vi. These are sites examined by previous coordinators
        vii. Banks were too steep