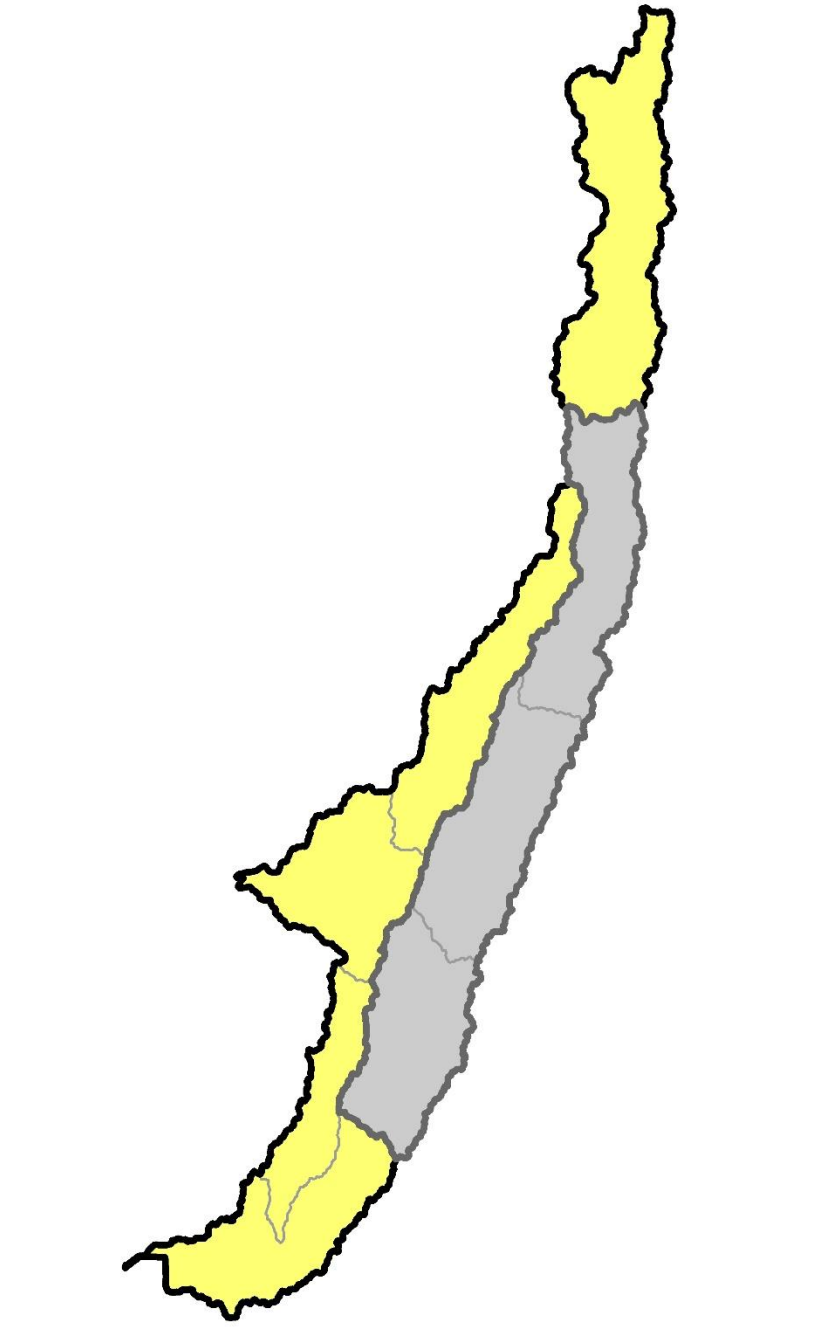
Watershed Diffusion Strategy

for Walnut Creek and Indian Creek



Current Watershed Project Watershed Diffusion Area

Iowa Soybean Association
Environmental Programs & Services

IOWA SOYBEAN Association

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Watershed Diffusion

Watershed diffusion is a conceptual model for expansion and scaling of watershed projects. The concept is essentially a place-based application of the theory of diffusion of innovations in the context of the watershed approach.

In Iowa there is presently a large gap in scale between current water quality improvement efforts and that needed as articulated in the Iowa Nutrient Reduction Strategy. Closing the gap and getting to scale will require continued, increased, and sustained innovations from policy makers, institutions, funders, technical conservation specialists, and farmers and landowners.

Along with other support, the concept of watershed diffusion is intended help to advance Iowa towards the ambitious goals of statewide water quality improvement and nutrient loss reduction. Currently, the State of Iowa is funding watershed projects through the Water Quality Initiative and other programs. A successful watershed project with a track record of conservation practice implementation can be thought of as a "hub" from which local knowledge, expertise, and experience can be "diffused" into nearby sub-watersheds by watershed project coordinators, farmers and landowners, and local partners.

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1. Overview

The Walnut Creek Water Quality Initiative (WQI) watershed project is piloting the concept of watershed diffusion hubs. This area was selected for this initiative given its track record of high levels of practice implementation. The implementation of the diffusion hub strategy aims to expand these proven conservation practices to HUC-12 watersheds in the surrounding area.

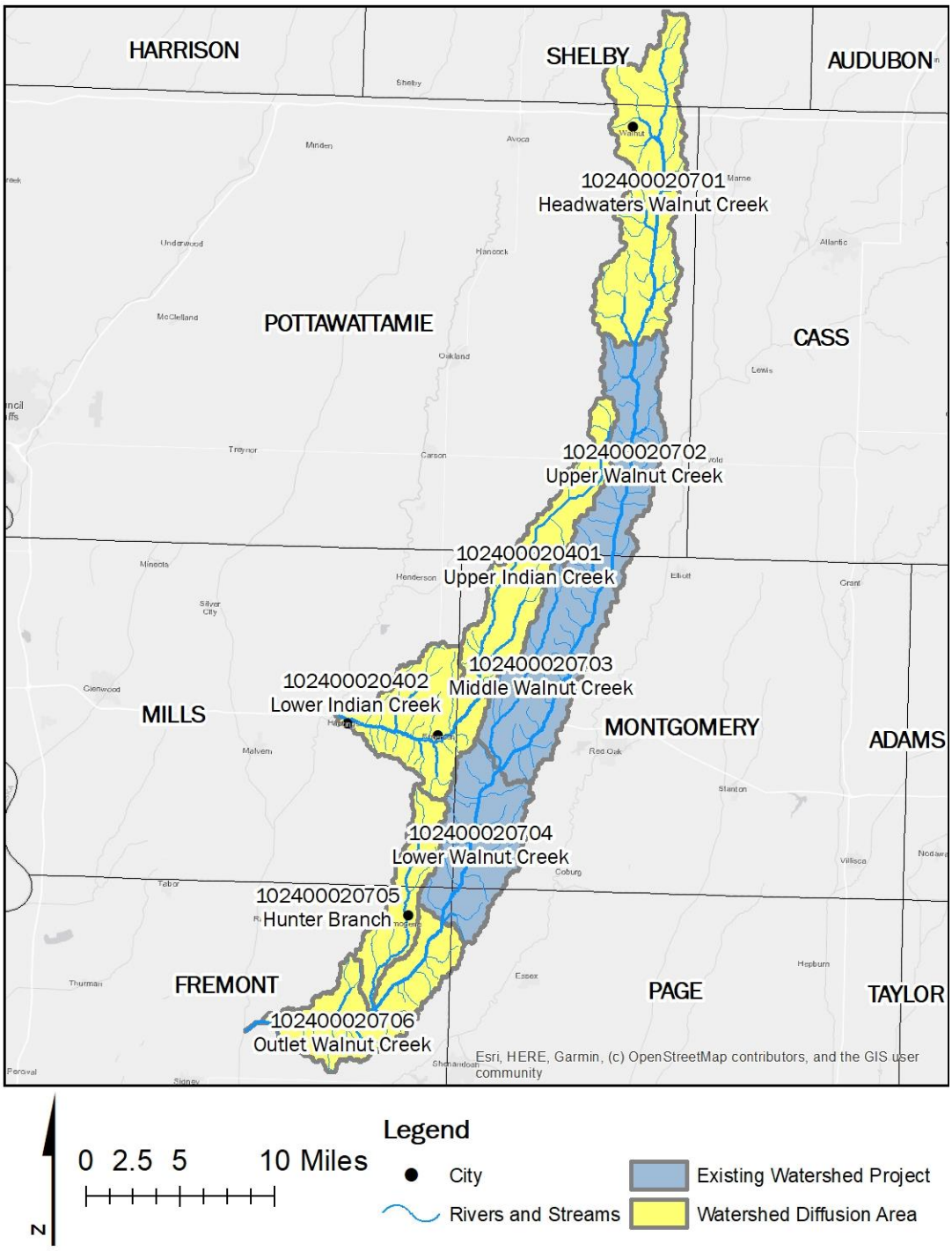

Figure 1. The Walnut Creek watershed project and diffusion area includes eight HUC-12 watersheds and encompasses 187,884 acres in the Walnut Creek and Indian Creek watersheds.

The Walnut Creek project encompasses three HUC-12 watersheds (Figure 1). The watershed project has been in progress since 2014. The project is funded by the Iowa Department of Agriculture and Land

Stewardship (IDALS) through the WQI, along with additional state and federal conservation programs. The project is incorporating in-field, edge-of-field, and land use practices to reduce nutrient loading from agriculture in an area that includes primarily Pottawattamie and Montgomery counties that totals 72,968 acres. The region is predominantly used for farming—with 82 percent of land use devoted to row crop agriculture. The watershed benefits from leadership from local stakeholders and has a successful track record of providing technical and financial assistance to support conservation.

The goals of the Iowa Nutrient Reduction Strategy (INRS) require that conservation practices are expanded across Iowa. Currently operating watershed projects could function as hubs of diffusion and expansion to meet these goals. In addition to the three HUC-12 watersheds in the current project area, five adjacent watersheds have been identified as a diffusion area for the project (Figure 1). Along with the current project area, the additional HUC-12 watersheds capture the entirety of the Walnut Creek watershed and the Indian Creek watershed within the West Nishnabotna River HUC-8 watershed. The diffusion area is 114,916 acres, and the total area of the current project and diffusion HUC-12 watersheds is 187,884 acres.

2. Implementation Roadmap

The INRS calls for 41 percent and 29 percent reductions in nitrogen and phosphorus loss, respectively, from agricultural sources. Many conservation practices were identified and incorporated into the nonpoint source science assessment within the INRS. The following practices have been identified by project staff as high priorities for Walnut Creek and Indian Creek:

- Cover crops
- Perennial cover, such as filter strips or riparian buffers
- Terraces, graded or level
- Ponds/water detention structures
- Constructed wetlands

Water quality models were utilized to develop a scenario with a combination of these conservation practices to meet INRS goals for the diffusion area. The water quality models are based on the INRS nonpoint source science assessment, and used inputs derived from the Iowa Environmental Mesonet and the Daily Erosion Project. In addition to the identified priority practices, soil health and nutrient management also are implicit and foundational goals for conservation and water quality improvement. One combination of the priority conservation practices that could meet INRS goals within the watershed project and diffusion area is shown below (Table 1). Implementation goals for each individual HUC-12 watershed are included in the appendix.

Table 1. Priority conservation practices and needed implementation levels to meet Iowa Nutrient Reduction Strategy goals. Phased implementation targets are cumulative, so practice retention is important. Implementation goals for each individual HUC-12 watershed are included in the appendix.

Practice	Unit	Total goal	Existing level	Additional implementation	Phase 1: Start-up 2020-2022	Phase 2: Speed-up 2023-2025	Phase 3: Scale-up 2026-2035
Nutrient management	acres/year	100,000	30,000	70,000	10,000	20,000	40,000
No-till/Strip-till	acres/year	120,000	120,000	-	-	-	-
Cover crops	acres/year	100,000	5,000	95,000	10,000	25,000	60,000
Perennial cover (filter strips, riparian buffers)	acres	5,450	4,950	500	100	100	300
Terraces (graded)	feet	8,660,460	8,280,460	380,000	60,000	90,000	230,000
Terraces (level)	feet	8,059,265	7,794,265	265,000	40,000	60,000	165,000
Ponds/Water detention	structures	188	188	-	-	-	-
Constructed wetlands	sites	12	-	12	1	2	9

During the initial phase, it will be essential to support farmer learning related to in-field management practices like nutrient management, no-till, and cover crops. Therefore, on-farm demonstrations, research, and peer-to-peer knowledge transfer should be implemented. Conservation practice adoption goals and progress should be regularly evaluated and adjusted as needed. At a minimum, reevaluation should be conducted between phases.

The Agricultural Conservation Planning Framework (ACPF) can be used to facilitate the selection and implementation of conservation practices in watersheds with predominately agricultural land use. The ACPF outlines an approach for conservation-oriented watershed management and also includes a GIS toolset to analyze watershed information and determine potential locations for conservation practices. Primary ACPF outputs include these potential locations. ACPF data for the diffusion area were provided by University of Iowa-IIHR and subsequently updated using version 3 of the GIS toolset. These locations were used to inform the implementation scenario for the diffusion area (Figure 2).

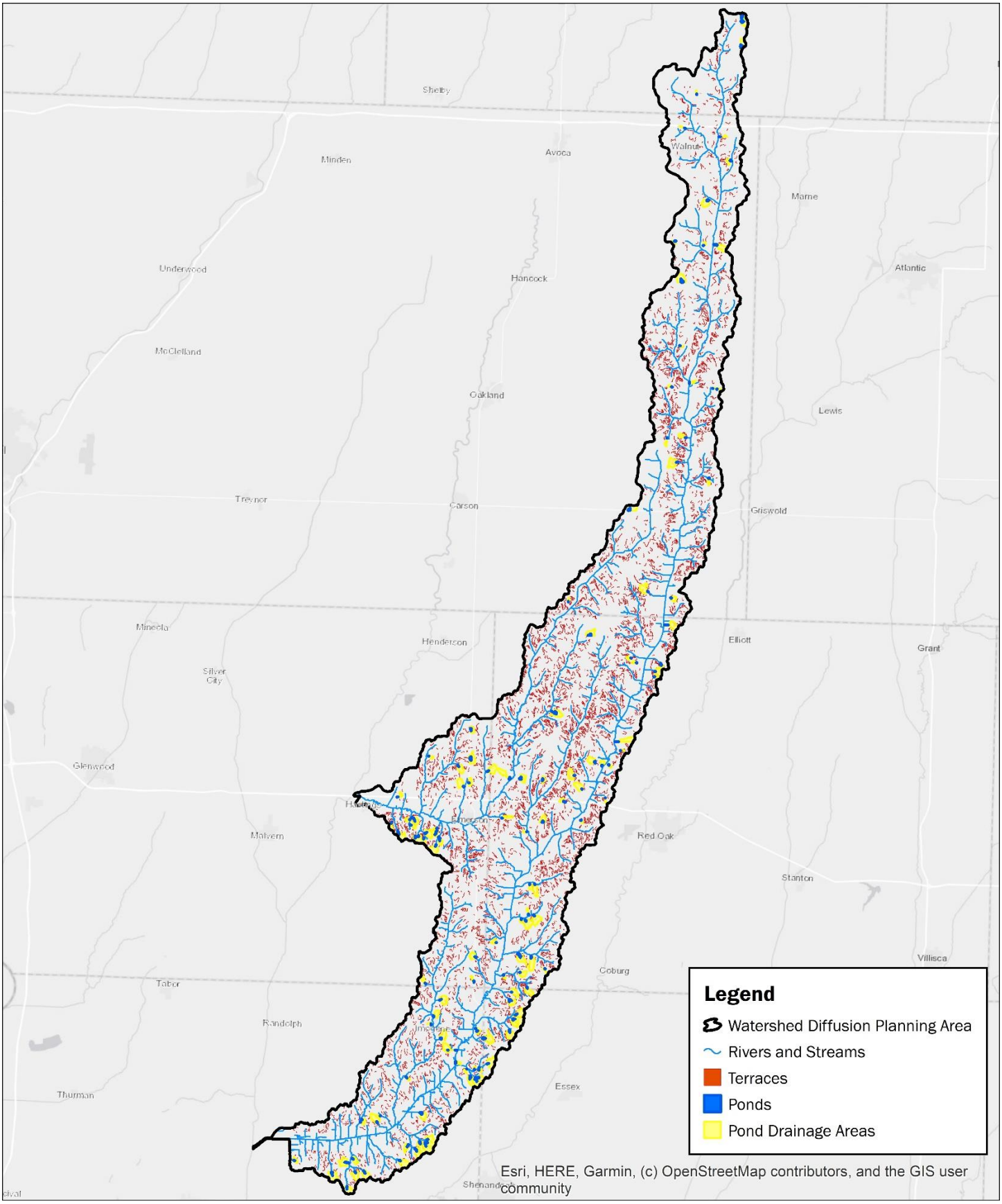

Figure 2. Potential locations for conservation practice adoption derived using the Agricultural Conservation Planning Framework GIS toolset.

Key inputs and results of the watershed modeling are shown below (Table 2).

Table 2. Primary inputs and outputs from watershed nutrient models for phosphorus (P) and nitrate-N (N). Anticipated reductions are based on the full implementation plan (Table 1).

Parameter	Value	Unit
Row crop agriculture	154,170	acres
Sheet and rill erosion rate	7.69	tons/acre/year
Ephemeral gully erosion	420,212	tons/year
Sediment delivery ratio	66%	
Baseline P load	1,202,686	pounds/year
Anticipated P load reduction	76%	
N (nitrate-N) yield	23.5	pounds/acre/year
Baseline N load	1,756,023	pounds/year
Anticipated N load reduction	41%	

3. Engagement Plan

3.1. Watershed Advisory Team

Implementing this diffusion strategy will require a cooperative approach amongst governmental, non-profit, and local business entities. However, participation in the diffusion and planning process should extend to local farmers and community members to develop a plan that can feasibly meet the needs of everyone. A survey of 25 watershed coordinators across Iowa indicated that in addition to a watershed plan, leadership and stakeholder awareness are key to a successful watershed project.

To satisfy these criteria, a watershed advisory team should be developed and regularly convened in order to provide a clear vision for the Walnut Creek and Indian Creek watershed diffusion area. Potential members of the advisory committee will be identified from local stakeholders and invited to participate. Input from the advisory group, other local stakeholders, and conservation experts can be used to guide ongoing implementation of priority conservation practices.

3.2. Facilitated Community Events

Public involvement is an essential component of the watershed approach. Watershed managers and project partners should encourage public participation. One way to deepen engagement in public events is through facilitated dialogue. Facilitation methods can be utilized in community meetings in order to focus on the exchange of information and ideas, rather than simply the presentation of such. This can create a platform for collective intelligence within a group—in this case, stakeholders of the watershed project and diffusion area—to come forth and allow for innovative local solutions to the complex challenge of implementing the INRS at full scale.

3.3. Cooperative Learning

Despite the institutional, partnership, and programmatic support available, farmers and landowners will bear primary responsibility for fully implementing the INRS. There is substantial opportunity for farmers to learn from each other, particularly for in-field conservation practices such as nutrient management, minimum or zero tillage, and cover crops. A local network of farmers participating in on-farm research should be developed and supported in order to facilitate the exchange of information on best management practices along with farm financial considerations.

4. Financing Strategy

4.1. Resources Needed

To achieve the goals of this watershed diffusion strategy, significant financial resources will be needed. An estimate of resource needs is crucial to gain support from potential funding sources. Based on the conservation practice target levels identified above (Table 1), an estimated $3,496,875 is needed for one-time practice construction plus an estimated $1,442,935 per year to support annual management practices along with operations and maintenance in the watershed project and diffusion area (Table 3). Estimated implementation costs for each phase are included in the appendix. Both prioritization of available funds and innovative approaches to securing additional funds will be needed to maximize the benefits of investing in water quality improvement in the Walnut Creek and Indian Creek watershed diffusion area.

Table 3. Cost estimates for priority conservation practices. Negative costs denote anticipated cost savings by the farmer. Implementation costs for each phase are included in the appendix.

Practice	Unit	Goal	Unit cost	Total cost
Nutrient management	acres/year	100,000	-$5.00	-$500,000.00
No-till/Strip-till	acres/year	120,000	-$10.00	-$1,200,000.00
Cover crops	acres/year	100,000	$30.00	$3,000,000.00
Perennial cover (filter strips, riparian buffers)	acres	500	$4,528.05	$2,264,025.00
Terraces (graded)	feet	380,000	$4.25	$1,615,000.00
Terraces (level)	feet	265,000	$2.50	$662,500.00
Constructed wetlands	sites	12	$100,000.00	$1,200,000.00

4.2. Cost Prioritization

One approach to prioritizing practices could be to consider the economic efficiency (i.e., cost-benefit ratio) of nutrient load reduction (Table 4). These benefits and costs should be aligned with the needs and goals of individual farmers and landowners that will implement each practice.

Table 4. Anticipated phosphorus (P) and nitrate-N (N) annual load reductions along with cost efficiency (dollars per pound of nutrient). Cost efficiencies were calculated using equal annualized cost to allow for comparison of annual management practices and long-term infrastructure.

Practice	Unit	Goal	P reduction (lb/yr)	P cost ($/lb/yr)	N reduction (lb/yr)	N cost ($/lb/yr)
Cover crops	acres/year	100,000	147,187	$27.18	466,240	$15.37
Perennial cover (filter strips, riparian buffers)	acres	500	19,033	$113.22	99,875	$21.58
Terraces (graded)	feet	380,000	106,320	$1.88		
Terraces (level)	feet	265,000	73,884	$1.10		
Constructed wetlands	sites	12	10,859	$4.67	29,328	$1.73

4.3. Conservation Finance

Conservation finance is the practice of raising and managing capital to support land, water, and natural resource conservation. At the core of conservation finance is the underlying belief that it is possible to align environmental, social, and economic returns: the so-called triple bottom line. New strategies that rely on market-based mechanisms to stimulate positive environmental and social outcomes, as well as financial returns have emerged (Conservation Finance Network).

Current funding mechanisms provided by local, state and federal units of government will not be adequate to address all goals outlined in this plan, so additional creative and sustainable approaches will be needed. To develop and deploy new approaches, project staff should work to account for the many benefits on-farm conservation can provide. Once the benefits are understood, beneficiaries should be identified. Beneficiaries could include downstream communities, supply chain companies, foundations, and others. Linking beneficiaries with outcomes may generate capital to support implementation of conservation. This approach could create new or additional revenue for farmers and landowners, while at the same time producing environmental outcomes.

Examples of linking beneficiaries with upstream conservation include the State Revolving Fund Sponsored Project program which allows municipalities to receive a lower interest rate on infrastructure loans in exchange for investing in nonpoint source water quality practices in the watershed. Another example is a supply chain company paying a portion of the cost for cover crop establishment. In all cases, the beneficiary (e.g., cities or supply chain companies) will need to value the benefits generated by the conservation practice being implemented. Understanding the value will require a shift in thinking from cost-share payments and incentives to outcome-based payments.

The implementation of conservation practices on farms also can be profitable for farmers. When managed effectively, conservation practices can enhance soil and water resources and lower operating or input costs, ultimately leading to a higher net farm revenue. Operation-scale farm accounting and adequate records management will help farmers to realize the tangible financial benefits of incorporating conservation into their standard practices.

Appendix

HUC-12 Implementation Goals and Costs

The following pages contain implementation goals and estimated costs for the priority conservation practices for each of the eight HUC-12 sub-watersheds in the Walnut Creek and Indian Creek watershed diffusion area.

HUC-12 number	HUC-12 name	Total acres	Row crop acres
102400020401	Upper Indian Creek	23,176	20,626
102400020402	Lower Indian Creek	21,160	16,773
102400020701	Headwaters Walnut Creek	35,012	30,604
102400020702	Upper Walnut Creek	23,952	19,385
102400020703	Middle Walnut Creek	26,277	22,046
102400020704	Lower Walnut Creek	22,740	17,346
102400020705	Hunter Branch	12,894	9,834
102400020706	Outlet Walnut Creek	22,675	17,556

In the following tables, baseline unit costs are in 2019 dollars. Cost estimates by phase assume an annual average inflation rate of 2.5%. Negative costs reflect anticipated cost savings for nutrient management and no-till/strip-till. The anticipated years for each implementation phase are 2020-2022 Phase 1, 2023-2025 Phase 2 and 2026-2035 Phase 3.

Upper Indian Creek

102400020401

Total area: 23,176 acres
Cropland: 20,626 acres
Sheet and rill erosion: 9.29 tons/acre/year
Gully erosion: 74,647 tons/year

Priority conservation practices		Implementation goals and costs			
Practice	**Unit (Unit cost)**	**Phase 1 (3-year cost)**	**Phase 2 (3-year cost)**	**Phase 3 (10-year cost)**	**Cumulative goal**
Nutrient management	acres/year (-$5.00)	5,200	7,800	13,000	13,000
No-till/Strip-till	acres/year (-$10.00)	15,600	15,600	13,000	15,600
Cover crops	acres/year ($30.00)	2,000 ($193,840.31)	5,200 ($542,736.52)	13,000 ($5,789,571.92)	13,000
Perennial cover (filter strips, riparian buffers)	acres ($4,528.05)	15 ($16,248.18)	15 ($17,497.51)	40 ($159,487.56)	65
Terraces (graded)	feet ($4.25)	11,950 ($54,692.58)	19,950 ($98,327.51)	47,900 ($302,208.23)	79,800
Terraces (level)	feet ($2.50)	-	-	-	-
Constructed wetlands	sites ($100,000.00)	-	1 ($115,969.34)	1 ($148,450.56)	2

Outcomes of full implementation are anticipated to include reductions of **95,593** pounds per year of nitrogen loss and **122,982** pounds per year of phosphorus loss from cropland in the watershed.

Lower Indian Creek

102400020402

Total area: 21,160 acres
Cropland: 16,773 acres
Sheet and rill erosion: 7.08 tons/acre/year
Gully erosion: 47,169 tons/year

Priority conservation practices		Implementation goals and costs			
Practice	**Unit (Unit cost)**	**Phase 1 (3-year cost)**	**Phase 2 (3-year cost)**	**Phase 3 (10-year cost)**	**Cumulative goal**
Nutrient management	acres/year (-$5.00)	4,400	6,600	11,000	11,000
No-till/Strip-till	acres/year (-$10.00)	13,200	13,200	11,000	13,200
Cover crops	acres/year ($30.00)	1,700 ($164,764.27)	4,400 ($459,238.59)	11,000 ($4,898,868.55)	11,000
Perennial cover (filter strips, riparian buffers)	acres ($4,528.05)	10 ($10,832.12)	10 ($11,665.01)	35 ($139,551.62)	55
Terraces (graded)	feet ($4.25)	-	-	-	-
Terraces (level)	feet ($2.50)	10,750 ($28,941.44)	17,900 ($51,896.28)	42,950 ($159,398.79)	71,550
Constructed wetlands	sites ($100,000.00)	-	-	1 ($148,450.56)	1

Outcomes of full implementation are anticipated to include reductions of **77,737** pounds per year of nitrogen loss and **100,009** pounds per year of phosphorus loss from cropland in the watershed.

Headwaters Walnut Creek

102400020701

Total area: 35,012 acres
Cropland: 30,604 acres
Sheet and rill erosion: 5.44 tons/acre/year
Gully erosion: 94,656 tons/year

Priority conservation practices		Implementation goals and costs			
Practice	**Unit (Unit cost)**	**Phase 1 (3-year cost)**	**Phase 2 (3-year cost)**	**Phase 3 (10-year cost)**	**Cumulative goal**
Nutrient management	acres/year (-$5.00)	8,000	12,000	20,000	20,000
No-till/Strip-till	acres/year (-$10.00)	24,000	24,000	20,000	24,000
Cover crops	acres/year ($30.00)	3,000 ($290,760.47)	8,000 ($834,979.26)	20,000 ($8,907,033.72)	20,000
Perennial cover (filter strips, riparian buffers)	acres ($4,528.05)	20 ($21,664.24)	20 ($23,330.02)	60 ($239,231.35)	100
Terraces (graded)	feet ($4.25)	-	-	-	-
Terraces (level)	feet ($2.50)	10,750 ($28,941.44)	17,900 ($51,896.28)	42,950 ($159,398.79)	71,550
Constructed wetlands	sites ($100,000.00)	1 ($107,689.06)	-	4 ($593,802.25)	5

Outcomes of full implementation are anticipated to include reductions of **141,836** pounds per year of nitrogen loss and **182,474** pounds per year of phosphorus loss from cropland in the watershed.

Upper Walnut Creek

102400020702

Total area: 23,952 acres
Cropland: 19,385 acres
Sheet and rill erosion: 12.56 tons/acre/year
Gully erosion: 59,522 tons/year

Priority conservation practices		Implementation goals and costs			
Practice	**Unit (Unit cost)**	**Phase 1 (3-year cost)**	**Phase 2 (3-year cost)**	**Phase 3 (10-year cost)**	**Cumulative goal**
Nutrient management	acres/year (-$5.00)	5,200	7,800	13,000	13,000
No-till/Strip-till	acres/year (-$10.00)	15,600	15,600	13,000	15,600
Cover crops	acres/year ($30.00)	2,000 ($193,840.31)	5,200 ($542,736.52)	13,000 ($5,789,571.92)	13,000
Perennial cover (filter strips, riparian buffers)	acres ($4,528.05)	15 ($16,248.18)	15 ($17,497.51)	40 ($159,487.56)	65
Terraces (graded)	feet ($4.25)	13,100 ($59,955.89)	21,850 ($107,692.03)	52,450 ($330,914.86)	87,400
Terraces (level)	feet ($2.50)	-	-	-	-
Constructed wetlands	sites ($100,000.00)	-	1 ($115,969.34)	1 ($148,450.56)	2

Outcomes of full implementation are anticipated to include reductions of **89,839** pounds per year of nitrogen loss and **115,579** pounds per year of phosphorus loss from cropland in the watershed.

Middle Walnut Creek

102400020703

Total area: 26,277 acres
Cropland: 22,046 acres
Sheet and rill erosion: 7.94 tons/acre/year
Gully erosion: 50,903 tons/year

Priority conservation practices		Implementation goals and costs			
Practice	**Unit (Unit cost)**	**Phase 1 (3-year cost)**	**Phase 2 (3-year cost)**	**Phase 3 (10-year cost)**	**Cumulative goal**
Nutrient management	acres/year (-$5.00)	5,600	8,400	14,000	14,000
No-till/Strip-till	acres/year (-$10.00)	16,800	16,800	14,000	16,800
Cover crops	acres/year ($30.00)	2,100 ($203,532.33)	5,600 ($584,485.48)	14,000 ($6,234,923.61)	14,000
Perennial cover (filter strips, riparian buffers)	acres ($4,528.05)	15 ($16,248.18)	15 ($17,497.51)	40 ($159,487.56)	70
Terraces (graded)	feet ($4.25)	19,400 ($88,789.63)	32,300 ($159,196.91)	77,500 ($488,959.04)	129,200
Terraces (level)	feet ($2.50)	-	-	-	-
Constructed wetlands	sites ($100,000.00)	-	-	1 ($148,450.56)	1

Outcomes of full implementation are anticipated to include reductions of **102,172** pounds per year of nitrogen loss and **131,446** pounds per year of phosphorus loss from cropland in the watershed.

Lower Walnut Creek

102400020704

Total area: 22,740 acres
Cropland: 17,346 acres
Sheet and rill erosion: 8.92 tons/acre/year
Gully erosion: 42,224 tons/year

Priority conservation practices		Implementation goals and costs			
Practice	**Unit (Unit cost)**	**Phase 1 (3-year cost)**	**Phase 2 (3-year cost)**	**Phase 3 (10-year cost)**	**Cumulative goal**
Nutrient management	acres/year (-$5.00)	4,400	6,600	11,000	11,000
No-till/Strip-till	acres/year (-$10.00)	13,200	13,200	11,000	13,200
Cover crops	acres/year ($30.00)	1,700 ($164,764.27)	4,400 ($459,238.59)	11,000 ($4,898,868.55)	11,000
Perennial cover (filter strips, riparian buffers)	acres ($4,528.05)	10 ($10,832.12)	10 ($11,665.01)	35 ($139,551.62)	55
Terraces (graded)	feet ($4.25)	12,550 ($57,438.65)	20,900 ($103,009.77)	50,150 ($316,403.82)	83,600
Terraces (level)	feet ($2.50)	-	-	-	-
Constructed wetlands	sites ($100,000.00)	-	-	1 ($148,450.56)	1

Outcomes of full implementation are anticipated to include reductions of **80,392** pounds per year of nitrogen loss and **103,425** pounds per year of phosphorus loss from cropland in the watershed.

Hunter Branch

102400020705

Total area: 12,894 acres
Cropland: 9,834 acres
Sheet and rill erosion: 7.27 tons/acre/year
Gully erosion: 21,644 tons/year

Priority conservation practices		Implementation goals and costs			
Practice	**Unit (Unit cost)**	**Phase 1 (3-year cost)**	**Phase 2 (3-year cost)**	**Phase 3 (10-year cost)**	**Cumulative goal**
Nutrient management	acres/year (-$5.00)	2,800	4,200	7,000	7,000
No-till/Strip-till	acres/year (-$10.00)	8,400	8,400	7,000	8,400
Cover crops	acres/year ($30.00)	1,100 ($106,612.17)	2,800 ($292,242.74)	7,000 ($3,117,461.80)	7,000
Perennial cover (filter strips, riparian buffers)	acres ($4,528.05)	5 ($5,416.06)	5 ($5,832.50)	20 ($79,743.78)	35
Terraces (graded)	feet ($4.25)	-	-	-	-
Terraces (level)	feet ($2.50)	7,550 ($20,326.31)	12,600 ($36,530.34)	30,200 ($112,080.17)	50,350
Constructed wetlands	sites ($100,000.00)	-	-	-	-

Outcomes of full implementation are anticipated to include reductions of **45,576** pounds per year of nitrogen loss and **58,634** pounds per year of phosphorus loss from cropland in the watershed.

Outlet Walnut Creek

102400020706

Total area: 22,675 acres
Cropland: 17,556 acres
Sheet and rill erosion: 3.66 tons/acre/year
Gully erosion: 29,446 tons/year

Priority conservation practices		Implementation goals and costs			
Practice	**Unit (Unit cost)**	**Phase 1 (3-year cost)**	**Phase 2 (3-year cost)**	**Phase 3 (10-year cost)**	**Cumulative goal**
Nutrient management	acres/year (-$5.00)	4,400	6,600	11,000	11,000
No-till/Strip-till	acres/year (-$10.00)	13,200	13,200	11,000	13,200
Cover crops	acres/year ($30.00)	1,700 ($164,764.27)	4,400 ($459,238.59)	11,000 ($4,898,868.55)	11,000
Perennial cover (filter strips, riparian buffers)	acres ($4,528.05)	10 ($10,832.12)	10 ($11,665.01)	35 ($139,551.62)	55
Terraces (graded)	feet ($4.25)	-	-	-	-
Terraces (level)	feet ($2.50)	10,750 ($28,941.44)	17,900 ($51,896.28)	42,950 ($159,398.79)	71,550
Constructed wetlands	sites ($100,000.00)	-	-	-	-

Outcomes of full implementation are anticipated to include reductions of **81,363** pounds per year of nitrogen loss and **104,674** pounds per year of phosphorus loss from cropland in the watershed.